Appendix H

Environmental

Section 404(b)(1) Evaluation

SECTION 404(b)(1) EVALUATION
HOUMA NAVIGATION CANAL DEEPENING REEVALUATION STUDY
TERREBONNE PARISH, LOUISIANA

I. PROJECT DESCRIPTION

a. Location.

The Houma Navigation Canal (HNC) is a Federally maintained waterway that connects the Gulf Intracoastal Waterway (GIWW) in Houma with the Gulf of Mexico (Figures 1 and 2). The HNC is located in south-central Terrebonne Parish, approximately 50 miles southwest of New Orleans. The project area is within the Barataria-Terrebonne National Estuary, one of the most expansive and productive estuaries in the U.S.

b. General Description.

The Louisiana Department of Transportation and Development (LADOTD) has prepared an Integrated Feasibility Report/Environmental Impact Statement (IFR/EIS) for the Houma Navigation Canal (HNC) Deepening Project. Houma, Louisiana, is a large center for shipyard work for the offshore marine sector for the construction of new vessels and for regular repairs of licensed vessels. A deeper waterway is needed to reduce future waterborne transportation costs and allow the efficient passage of large oil and gas sector barges, new vessels built at the Houma shipyards, and vessels working in the Gulf of Mexico (Gulf). The IFR/EIS investigates the alternative plans that could provide economic benefits through deepening of the HNC, along with other structural measures. The analysis of deepening alternatives has been limited to a maximum channel elevation of −20 feet NAVD88.

The Tentatively Selected Plan proposes the deepening of the channel from -15 NAVD88 to -20 feet NAVD88 from Mile 36.3 to Mile -3.7. Dredged material would be beneficially used to restore marsh habitat within adjacent disposal areas along the inland and bay reaches. Dredged material would be disposed of through single point discharges a minimum of 1,000 feet from the channel centerline, within the offshore reach in unconfined areas of open water adjacent to marsh and/or barrier islands. Approximately 16,270,500 cubic yards of material would be dredged and disposed within inland disposal areas for deepening and maintenance of the channel within the inland and bay reaches over a 50-year project life.

Approximately 14.7 miles of rock retention dikes and/or foreshore protection would be constructed or refurbished for bank protection. Approximately 13.1 miles of foreshore protection would be constructed or refurbished along the Inland Reach (6 miles along the west bank and 7.1 miles along the east bank). In addition to the foreshore protection, approximately 1.6 miles of rock retention dikes would be constructed on the Inland Reach. Locations and quantities associated with the bank protection measures are presented in Figure 3 and Table 3.

A flotation channel may be required if the channel is too far away from the bank line. The flotation channel for dike construction should not be dredged any closer than 50 feet to the centerline of the dike. The flotation channel may be dredged up to 8.0 feet below the water surface.

c. Authority and Purpose.

The LADOTD has developed this Section 203 study to determine the feasibility of deepening the existing Houma Navigation Canal Federal project and to identify the National Economic Development (NED) plan. At present, the depth of the channel causes marine interests to use less efficient methods to service the offshore oil and gas facilities located in the Gulf of Mexico. These inefficiencies manifest themselves as light loading and/or use of more remote harbors with deeper channels. Deepening the channel would eliminate these inefficiencies.

By letter to the Assistant Secretary of the Army for Civil Works (ASA(CW)), dated January 10, 2012, the LADOTD recommended initiating this IFR/EIS under the authority granted by Section 203 of the 1986 WRDA (PL 99-662).

d. General Description of Dredged or Fill Material

(1) General Characteristics of Material. (grain size, soil type)

The bed material of the HNC varies with proximity to the Gulf of Mexico. Material near the Gulf Intracoastal Waterway is approximately 48% silt, 30% clay, and 2% sand. The material in Terrebonne Bay is approximately 35% silt, 15% clay, and 50% sand.

(2) Quantity of Material. (cubic yards)

Approximately 55,012,500 cubic yards of material would be dredged and disposed via single point discharges for deepening and maintenance of the channel within the offshore reach over a 50-year project life. Approximately 16,270,500 cubic yards of material would be dredged and disposed within inland disposal areas. This would be a total of 71,283,000 cubic yards of material dredged and placed over 50 years.

(3) Source of Material.

The material to be dredged would consist of the bed sediments of the Houma Navigation Canal (HNC) from the intersection with the Gulf Intracoastal Waterway (GIWW) to Terrebonne Bay at the Gulf of Mexico.

e. Description of the Proposed Discharge Site(s)

(1) Location. (map)

See Figures 1 and 2

(2) Size. (acres)

See Table 1

(3) Type of Site. (confined, unconfined, open water)

See Table 1

(4) Type(s) of Habitat.

See Table 1

(5) Timing and Duration of Discharge.

See Table 2

f. Description of Disposal Method. (hydraulic, drag line, etc)

The navigation canal improvements would require the use of a hydraulic cutterhead dredge to deepen the channel. The proposed authorized channel depth is -20 feet NAVD88. The hydraulically dredged material is assumed to be pumped in a pipeline to the designated disposal areas.

(1) River Mile 36.3 to 34.0

It is assumed that a 27-inch hydraulic cutterhead dredge crew would be used. All dredged material from this reach would be pumped to confined upland Site 1 or confined upland Site 3.

(2) River Mile 34.0 to 32.0

A 27-inch hydraulic cutterhead dredge crew is assumed to be used in this reach. Material dredged in this location would be disposed of in semi-confined Wetland Site 7E on the east side of the channel. A 34-acre pipeline access corridor would be utilized to make way for the dredge pipelines. Pipeline access will be placed within existing canals and waterways to the maximum extent practicable to limit habitat disturbance. Dikes would also be constructed in order to contain the dredged material.

(3) River Mile 32.0 to 29.5

A 27-inch hydraulic cutterhead dredge crew is assumed to be used in this reach. Material dredged in this location would be disposed of in semi-confined Wetland Site 7E on the east side of the channel. A 34-acre pipeline access corridor would be utilized to make way for the dredge pipelines. Pipeline access will be placed within existing canals and waterways to the maximum extent practicable to limit habitat disturbance. Dikes would also be constructed in order to contain the dredged material.

(4) River Mile 29.5 to 28.0

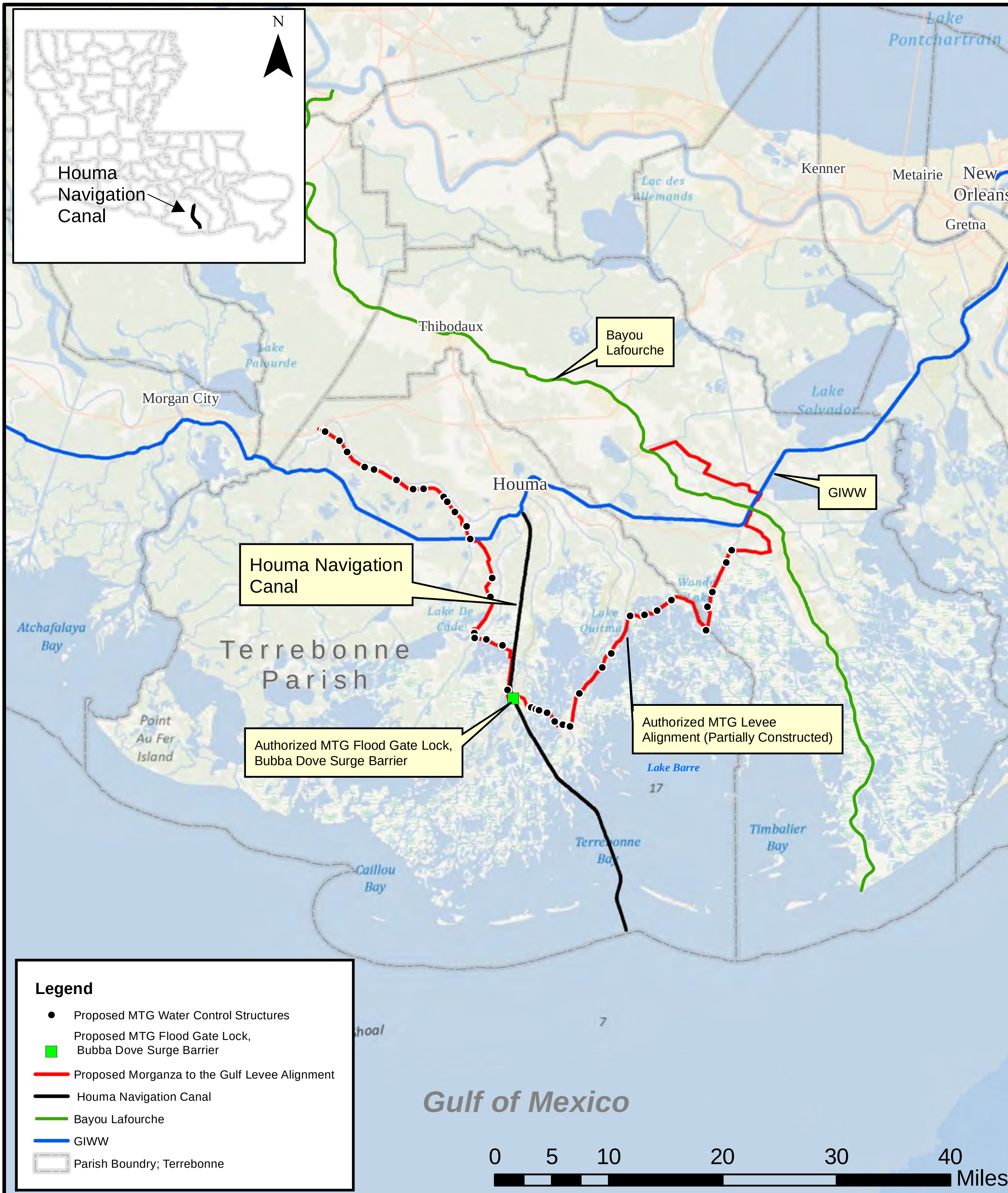
Assumes a 27-inch hydraulic cutterhead dredge crew would be used. The dredged material in this reach would be pumped east to Wetland Sites 12B and 12 and placed unconfined. A 1-acre pipeline access corridor would be utilized to make way for the dredge pipelines. Pipeline access will be placed within existing canals and waterways to the maximum extent practicable to limit habitat disturbance. Dikes would also be constructed in order to contain the dredged material.

(5) River Mile 28.0 to 26.0

A 27-inch hydraulic cutterhead dredge crew is assumed to be used in this reach. Material dredged in this location would be disposed of unconfined in Wetland Site A-07-A on the west side of the channel. A 1.1-acre pipeline access corridor would be utilized to make way for the dredge pipelines. Pipeline access will be placed within existing canals and waterways to the maximum extent practicable to limit habitat disturbance. Dikes would also be constructed in order to contain the dredged material.

(6) River Mile 26.0 to 24.0

A 27-inch hydraulic cutterhead dredge crew is assumed to be used in this reach. Material dredged in this location would be disposed of unconfined in Wetland Sites A-07-A and 14A on the west side of the channel. A 1.1-acre pipeline access corridor would be utilized to make way for the dredge pipelines. Pipeline access will be placed within existing canals and waterways to the maximum extent practicable to limit habitat disturbance. Dikes would also be constructed in order to contain the dredged material.

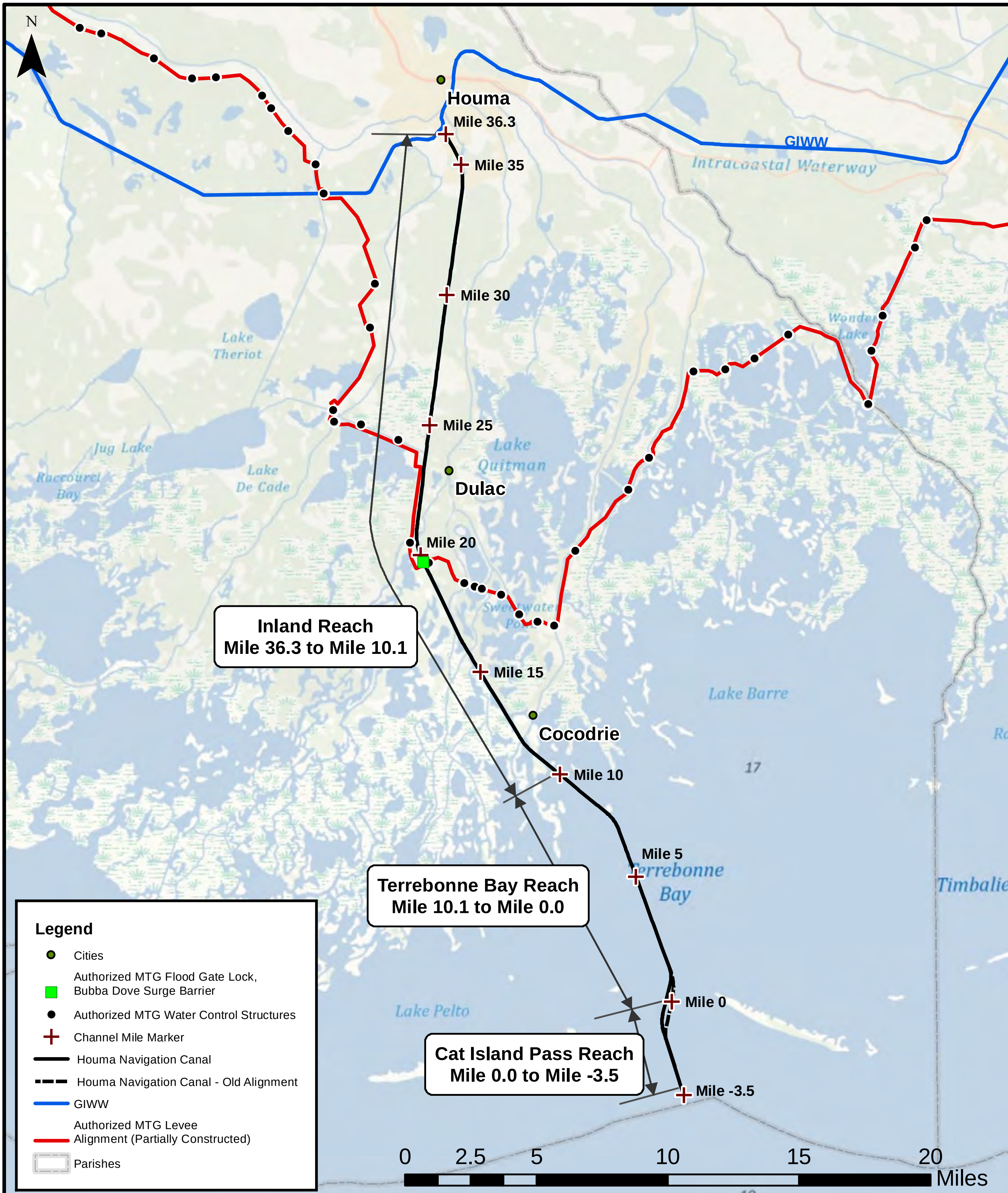


VICINITY MAP

Houma Navigation Canal Deepening

ERSI Ocean Map

Figure 1
Date: October 2012
Scale:1:750,000
Source: ESRI/GEC
Map ID: 278500218-3026



HNC REACHES

Houma Navigation Canal Deepening

ERSI Ocean Map

GEC

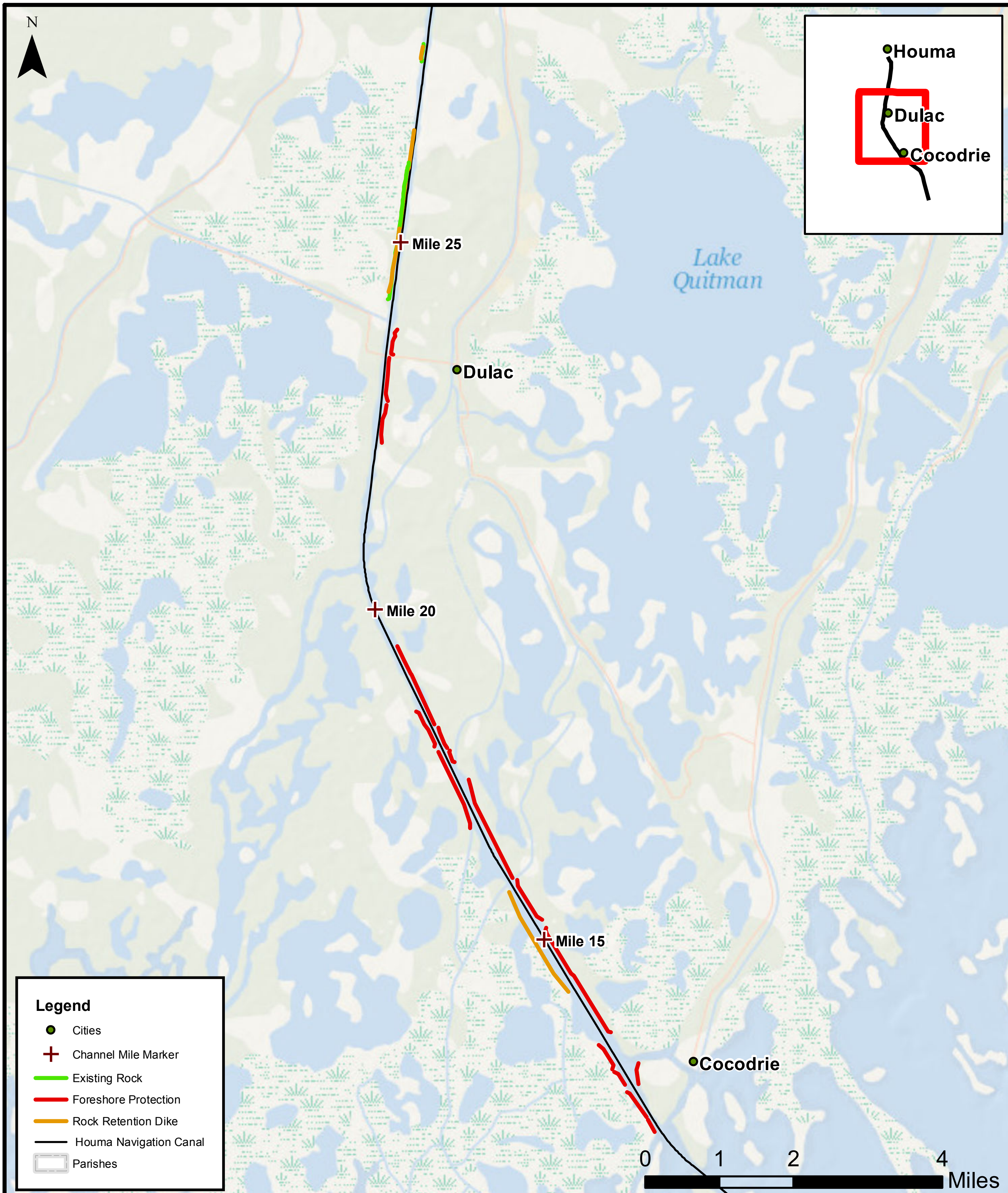
Figure 2

Date: September 2012

Scale:1:325,000

Source: ESRI/GEC

Map ID: 278500218-3026



FORSHORE PROTECTION AND ROCK RETENTION DIKES

(INLAND REACH)

Houma Navigation Canal Deepening

ERSI Ocean Map

GEC

Figure 3
Date: October 2012
Scale:1:115,000
Source: ESRI/GEC
Map ID: 278500218-3026

Table 1. Disposal Site Descriptions					
Reach (Mile)	**Construction Disposal Site**	**Maintenance Disposal Site(s)**	**Acres Disposaed**	**Type of Disposal Site**	**Habitat Type**
36.3 to 34.0	1	1	44.9	Upland - Confined	Bottomland Hardwood
36.3 to 34.0		3	101.9	Upland - Confined	Bottomland Hardwood
34.0 to 32.0	7E	7E	175.3	Semi-Confined	Brackish Marsh
32.0 to 29.5	7E	7E	143.8	Semi-Confined	Brackish Marsh
29.5 to 28.0	12B	12B	48.3	Unconfined	Intermediate Marsh
29.5 to 28.0		12	91.3	Unconfined	Intermediate Marsh
28.0 to 26.0	A-07-A	A-07-A	151.9	Unconfined	Intermediate Marsh
26.0 to 24.0	A-07-A	A-07-A	33.8	Unconfined	Intermediate Marsh
26.0 to 24.0		14A	136.1	Unconfined	Intermediate Marsh
24.0 to 22.0	15	15	146.5	Semi-Confined	Brackish Marsh
24.0 to 22.0		15A	27.2	Unconfined	Brackish Marsh
22.0 to 20.0	16	16	116.7	Unconfined	Brackish Marsh
22.0 to 20.0		15A	67.9	Unconfined	Brackish Marsh
20.0 to 18.0	19C	19C	65.9	Unconfined	Brackish Marsh
20.0 to 18.0		19D	81.7	Unconfined	Brackish Marsh
18.0 to 16.0	20C	20C	130.0	Unconfined	Brackish Marsh
18.0 to 16.0		21	34.0	Semi-Confined	Salt Marsh
16.0 to 13.0	21	21	305.6	Semi-Confined	Salt Marsh
13.0 to 11.0	24		53.9	Semi-Confined	Salt Marsh
13.0 to 11.0		21	157.7	Semi-Confined	Salt Marsh
11.5 to 10.0	SPD Mile 8.8		N/A	Single Point Discharge	Open Water
11.0 to 8.0		SPD Mile 8.8	N/A	Single Point Discharge	Open Water
10.0 to 8.0	SPD Mile 8.8		N/A	Single Point Discharge	Open Water
8.0 to 6.0	SPD Mile 7	SPD Mile 7	N/A	Single Point Discharge	Open Water
6.0 to 4.0	SPD Mile 5	SPD Mile 5	N/A	Single Point Discharge	Open Water
4.0 to 2.0	SPD Mile 3	SPD Mile 3	N/A	Single Point Discharge	Open Water
2.0 to 0.0	SPD Mile 1	SPD Mile 1	N/A	Single Point Discharge	Open Water
0.0 to −3.7	Mile −1.7	Mile −1.7	N/A	Single Point Discharge	Open Water
0.0 to −3.7	and Mile −2.5	and Mile −2.5	N/A	Single Point Discharge	Open Water
TOTAL			**2,114.4**		

Implementation Schedule

(blue)	Construction Work
(green)	O&M Work

20 Foot Adjacent

Year No.	Year	Contract	River Mile 36.3 to 34.0	River Mile 34.0 to 32.0	River Mile 32.0 to 29.5	River Mile 29.5 to 28.0	River Mile 28.0 to 26.0	River Mile 26.0 to 24.0	River Mile 24.0 to 22.0	River Mile 23.7 to 22.4 (East Bank)	River Mile 22.2 to 22.1 (East Bank)	River Mile 22.0 to 20.0	River Mile 20.0 to 18.0	River Mile 19.2 to 17.5 (East Bank)	River Mile 19.1 to 17.8 (West Bank)	River Mile 18.0 to 16.0	River Mile 17.7 to 16.7 (West Bank)	River Mile 16.9 to 13.3 (East Bank)	River Mile 16.0 to 13.0	River Mile 13.1 to 11.9 (West Bank)	River Mile 13.0 to 11.0	River Mile 12.6 to 12.3 (East Bank)	River Mile 11.0 to 8.0	River Mile 8.0 to 6.0	River Mile 6.0 to 4.0	River Mile 4.0 to 2.0	River Mile 2.0 to 0.0	River Mile 0.0 to -3.7
00	2022	Const. 1	1	7E	7E	12B	A-07-A	A-07-A	15	Stone Placement	Stone Placement																	
01	2023	Const. 2										16	19C	Stone Placement	Stone Placement	20C	Stone Placement	Stone Placement	21	Stone Placement	24	Stone Placement						
02	2024	Const. 3																					SPD	SPD				
03	2025	Const. 4																							SPD	SPD	SPD	
04	2026	Const. 5																										SPD
05	2027	OM01	1						15			16											SPD	SPD	SPD	SPD	SPD	
06	2028	OM02																										SPD
07	2029	OM03																					SPD	SPD	SPD	SPD	SPD	
08	2030	OM04																										SPD
09	2031	OM05																					SPD	SPD	SPD	SPD	SPD	
10	2032	OM06	3	7E	7E	12B	A-07-A	14A	15	Stone Placement	Stone Placement	16																SPD
11	2033	OM07											19C	Stone Placement	Stone Placement	20C	Stone Placement	Stone Placement	21	Stone Placement	24	Stone Placement	SPD	SPD	SPD	SPD	SPD	
12	2034	OM08																										SPD
13	2035	OM09																					SPD	SPD	SPD	SPD	SPD	
14	2036	OM10																										SPD
15	2037	OM11	3						15			16											SPD	SPD	SPD	SPD	SPD	
16	2038	OM12																										SPD
17	2039	OM13																					SPD	SPD	SPD	SPD	SPD	
18	2040	OM14																										SPD
19	2041	OM15																					SPD	SPD	SPD	SPD	SPD	
20	2042	OM16	3	7E	7E	12	A-07-A	14A	15	Stone Placement	Stone Placement	16																SPD
21	2043	OM17											19C	Stone Placement	Stone Placement	20C	Stone Placement	Stone Placement	21	Stone Placement	21	Stone Placement	SPD	SPD	SPD	SPD	SPD	
22	2044	OM18																										SPD
23	2045	OM19																					SPD	SPD	SPD	SPD	SPD	
24	2046	OM20																										SPD
25	2047	OM21	3						15			16											SPD	SPD	SPD	SPD	SPD	
26	2048	OM22																										SPD
27	2049	OM23																					SPD	SPD	SPD	SPD	SPD	
28	2050	OM24																										SPD
29	2051	OM25																					SPD	SPD	SPD	SPD	SPD	
30	2052	OM26	3	7E	7E	12	A-07-A	14A	15	Stone Placement	Stone Placement	15A																SPD
31	2053	OM27											19D	Stone Placement	Stone Placement	20C	Stone Placement	Stone Placement	21	Stone Placement	21	Stone Placement	SPD	SPD	SPD	SPD	SPD	
32	2054	OM28																										SPD
33	2055	OM29																					SPD	SPD	SPD	SPD	SPD	
34	2056	OM30																										SPD
35	2057	OM31	3						15			15A											SPD	SPD	SPD	SPD	SPD	
36	2058	OM32																										SPD
37	2059	OM33																					SPD	SPD	SPD	SPD	SPD	
38	2060	OM34																										SPD
39	2061	OM35																					SPD	SPD	SPD	SPD	SPD	
40	2062	OM36	3	7E	7E	12	A-07-A	14A	15	Stone Placement	Stone Placement	15A																SPD
41	2063	OM37											19D	Stone Placement	Stone Placement	20C	Stone Placement	Stone Placement	21	Stone Placement	21	Stone Placement	SPD	SPD	SPD	SPD	SPD	
42	2064	OM38																										SPD
43	2065	OM39																					SPD	SPD	SPD	SPD	SPD	
44	2066	OM40																										SPD
45	2067	OM41	3						15A			15A											SPD	SPD	SPD	SPD	SPD	
46	2068	OM42																										SPD
47	2069	OM43																					SPD	SPD	SPD	SPD	SPD	
48	2070	OM44																										SPD
49	2071	OM45																					SPD	SPD	SPD	SPD	SPD	
50	2072	OM46	3	7E	7E	12	A-07-A	14A	15A	Stone Placement	Stone Placement	15A																SPD
51	2073	OM47											19D	Stone Placement	Stone Placement	21	Stone Placement	Stone Placement	21	Stone Placement	21	Stone Placement	SPD	SPD	SPD	SPD	SPD	
52	2074	OM48																										SPD
53	2075	OM49																					SPD	SPD	SPD	SPD	SPD	
54	2076	OM50																										SPD

Table 3. Rock Quantities

Reach (miles)	West	East	Total
Rock Retention			
15.6 - 14.0	1.6		1.6
Total	**1.6**		**1.6**
Foreshore Protection			
27.6 - 27.4	0.2		0.2
26.4 - 25.9	0.5		0.5
25.9 - 24.1	1.8		1.8
23.7 - 22.4		1.3	1.3
22.2 - 22.1		0.1	0.1
19.2 - 17.5		1.7	1.7
19.1 - 18.4	0.7		
18.3 - 17.8	0.5		
17.7 - 16.7	1.0		1
16.9 - 13.3		3.6	3.6
13.2 - 11.9	1.3		1.3
12.7 - 12.3		0.4	0.4
Total	**6**	**7.1**	**13.1**

(7) River Mile 24.0 to 22.0

A 27-inch hydraulic cutterhead dredge crew is assumed to be used in this reach. Material dredged in this location would be disposed of semi-confined in Wetland Site 15 and unconfined in Wetland Site 15A on the west side of the channel. A 0.5-acre pipeline access corridor would be utilized to make way for the dredge pipelines. Pipeline access will be placed within existing canals and waterways to the maximum extent practicable to limit habitat disturbance. Dikes would also be constructed in order to contain the dredged material.

(8) River Mile 22.0 to 20.0

Assumes a 27-inch hydraulic cutterhead dredge crew would be used. The dredged material in this reach would be pumped west to Wetland Sites 16 and 15A and placed unconfined. A 0.5-acre and 0.3-acre pipeline access corridor would be utilized to make way for the dredge pipelines. Pipeline access will be placed within existing canals and waterways to the maximum extent practicable to limit habitat disturbance. Dikes would be constructed in order to contain the dredged material within Wetland Site 15A.

(9) River Mile 20.0 to 18.0

A 27-inch hydraulic cutterhead dredge crew is assumed to be used in this reach. Material dredged in this location would be disposed of unconfined in Wetland Sites 19C and 19D on the east and west side of the channel, respectively. A 0.4-acre pipeline access corridor would be utilized to make way for the dredge pipelines. Pipeline access will be placed within existing canals and waterways to the maximum extent practicable to limit habitat disturbance. Dikes would also be constructed in order to contain the dredged material in Site 19D.

(10) River Mile 18.0 to 16.0

A 27-inch hydraulic cutterhead dredge crew is assumed to be used in this reach. Material dredged in this location would be disposed of unconfined in Wetland Site 20C and semi-confined in Wetland Site 21 on the west side of the channel. A 0.1-acre pipeline access corridor would be utilized to make way for the dredge pipelines. Pipeline access will be placed within existing canals and waterways to the maximum extent practicable to limit habitat disturbance. Dikes would also be constructed in order to contain the dredged material in Site 21.

(11) River Mile 16.0 to 13.0

Assumes a 27-inch hydraulic cutterhead dredge crew would be used. The dredged material in this reach would be pumped west to Wetland Site 21 and placed semi-confined. Dikes would be constructed in order to contain the dredged material.

(12) River Mile 13.0 to 11.5

A 27-inch hydraulic cutterhead dredge crew is assumed to be used in this reach. Material dredged in this location would be disposed of semi-confined in Wetland Sites 24 and 21 on the west side of the channel. A 0.3-acre pipeline access corridor would be utilized to make way for the dredge pipelines. Pipeline access will be placed within existing canals and waterways to the maximum extent practicable to limit habitat disturbance. Dikes would also be constructed in order to contain the dredged material.

(13) River Mile 11.5 to 5.0

Assumes a 27-inch hydraulic cutterhead dredge crew would be used. The dredged material would be placed as single point discharges a minimum of 1,000 feet from the channel centerline at Miles 8.8, 7.0, and 5.0.

(14) River Mile 5.0 to 0.0

Assumes a 27-inch hydraulic cutterhead dredge crew would be used. The dredged material would be placed as single point discharges a minimum of 1,000 feet from the channel centerline at Miles 3.0 and 1.0.

(15) River Mile 0.0 to -3.5

Assumes a 30-inch hydraulic cutterhead dredge crew would be used. The dredged material would be placed as single point discharges a minimum of 1,000 feet from the channel centerline at Miles -1.7 and -2.5.

1. Location. For the Inland and Bay Reaches, fill material would be placed within the 15 disposal sites shown in Figures 4 and 5. For the Offshore Reach material would be disposed of unconfined as single point discharges in seven locations, a minimum of 1,000 feet from the center line of the channel.

2. Size. Disposal of dredged material would occupy approximately 2,114 acres within the Inland and Bay Disposal Sites. To deepen the HNC, 102 acres of waterbottom would be required to increase the top width of the channel (73 acres Inland Reach, 24 acres Terrebonne Bay Reach, and 5 acres Cat Island Pass Reach).

3. Types of Sites. The area to be filled with dredged material near the Gulf Intracoastal Waterway is approximately 48% silt, 30% clay, and 2% sand. The adjacent disposal in Terrebonne Bay is approximately 35% silt, 15% clay, and 50% sand. The Inland and Bay sites consist of confined and semi-confined open water within existing marsh habitat. Single point discharges are within open water.

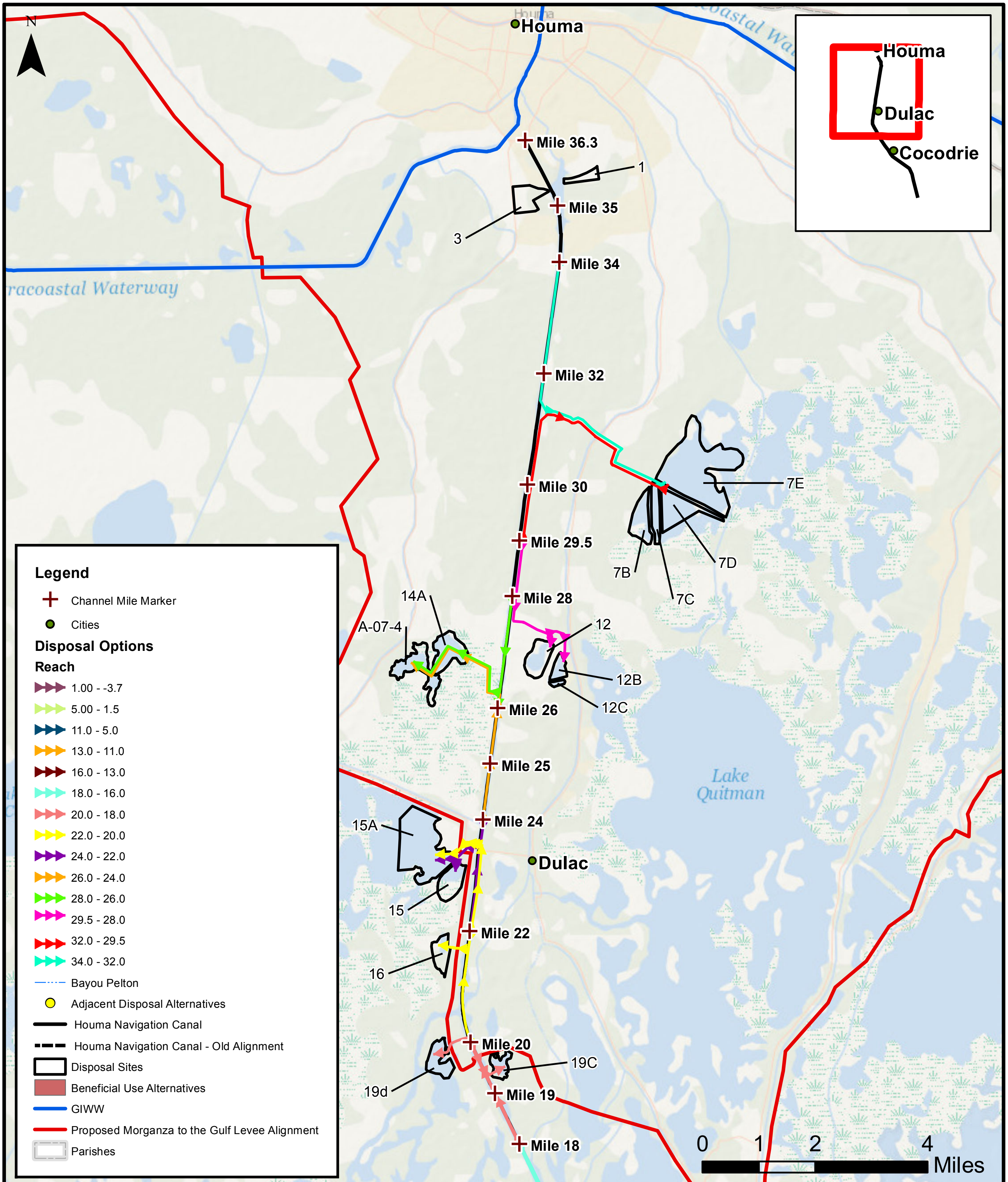
4. Types of Habitat. Bottomland hardwood, swamp, brackish, intermediate, and salt marsh, and open water habitat would be impacted by placement of the fill material.

5. Timing and Duration of Discharge. Construction of the deepened channel is not anticipated to occur until after the Houma Lock is in place by approximately the year 2022. Construction of the deepened channel and the required dredging and disposal would take a total of five years. In year one the channel would be deepened from Mile 36.3 through Mile 22.0. In year two Miles 22.0 through 11.0 would be depended. Deepening would occur via single point discharges within the offshore reaches to Mile -3.7 over the next three years. Once deepening of the channel is completed for all reaches, maintenance dredging of the channel would occur over the next 50-year period.

II. FACTUAL DETERMINATIONS

a. Physical Substrate Determinations

(1) The existing bottom of the channel sits at elevation -15 NAVD88 and would be dredged and maintained to -20.



DISPOSAL AREAS
North End
Houma Navigation Canal Deepening

ERSI Ocean Map

GEC

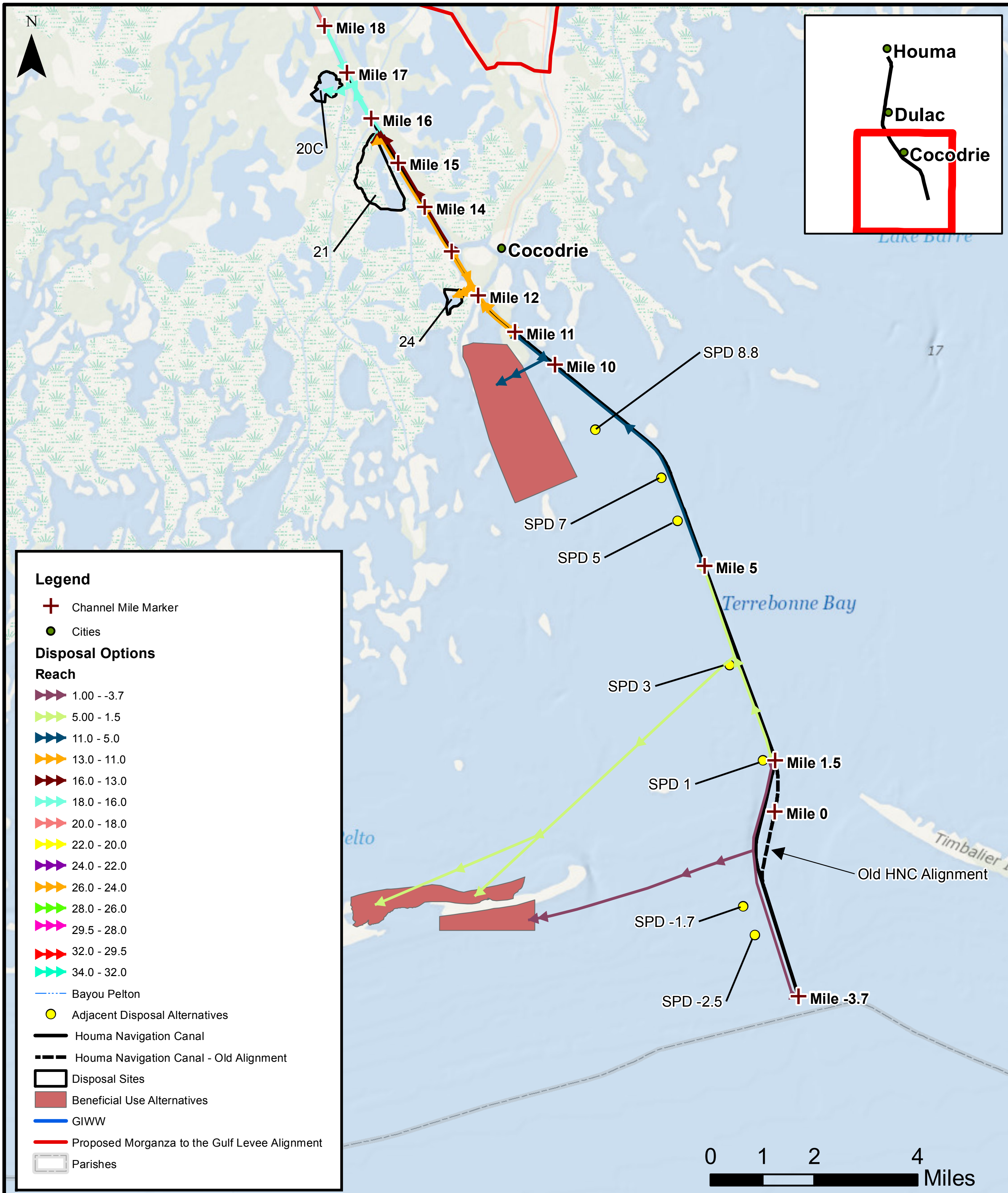
Figure 4

Date: December 2014

Scale:1:150,000

Source: ESRI/GEC

Map ID: 278500218-3026



DISPOSAL AREAS
South End
Houma Navigation Canal Deepening

ERSI Ocean Map

GEC

Figure 5
Date: December 2014
Scale:1:165,000
Source: ESRI/GEC
Map ID: 278500218-3026

(2) Sediment Type. The material to be dredged would consist of the bed sediments of the Houma Navigation Canal (HNC) from the intersection with the Gulf Intracoastal Waterway (GIWW) to Terrebonne Bay at the Gulf of Mexico. Material from portions of the banks of the HNC would be excavated for refurbishing and placement of rock foreshore protection and rock retention structures at designated bank segments. Material would also be excavated for access to proposed disposal sites not directly adjacent to the HNC.

The bed material of the HNC varies with proximity to the Gulf of Mexico. Material near the Gulf Intracoastal Waterway is approximately 48% silt, 30% clay, and 2% sand. The material in Terrebonne Bay is approximately 35% silt, 15% clay, and 50% sand.

The HNC and the marsh creation sites are in the same geographic area; therefore, the sediments would be expected to be similar. The excavated sediment/soil along the banks of the HNC would also be expected to be similar to the disposal areas due to their proximity.

The material in the existing confined disposal facilities (CDFs), sites 1 and 3, consist of previously dredged sediments from the HNC. It would be expected that the materials are similar.

(3) Dredged/Fill Material Movement. The dredge material placed in the existing CDFs would not be expected to transport outside of the dikes except for minimal release over the weir. However, the CDF is designed to allow for settling of most of the sediment prior to the effluent discharge, which would flow into the HNC. The water body subsegment that receives the effluent is already listed as impaired due to turbidity; therefore, the minimal suspended sediment in the effluent would not adversely impact the HNC. Aside from the minimal release over the weir, after the material is pumped into the CDF it would dry and become compacted, therefore, no movement beyond the dikes.

The dredge material placed in the semi-confined marsh creation sites could transport beyond the proposed receiving areas. The material would not transport back into the HNC. Most of the disposal areas are open waters that were once marsh and are bordered by existing marsh that has not eroded or been destroyed by man-made and/or natural causes. Minimal movement beyond the proposed receiving areas is expected. Dredged material migrating within the semi-confined sites would benefit the marsh habitat by providing nourishment and reversing the effects of subsidence. Any addition of sediment within the surrounding marsh platform would not be expected to be in a high enough quantity to rise above marsh elevation.

The dredge material placed in the unconfined marsh creation sites could also transport beyond the proposed receiving areas. Again, for similar reasons stated above for the semi-confined sites minimal movement beyond the proposed receiving areas is expected.

(4) Physical Effects on Benthos. (burial, changes in sediment types, etc) The benthic and/or terrestrial communities in the approximately 147 acres of the CDFs would be smothered by the dredged material. The increased elevation in the CDFs would probably lead to drier conditions with either another benthic community or a terrestrial community establishing depending upon final settled elevation.

The benthos in the approximately 1,970 acres of the marsh creation sites would be buried beneath the material placed into the open waters of the site. Benthic communities suited to marsh conditions versus open water would establish once the placement of material has ceased.

(5) Other Effects. No other effects are expected.

(6) Actions Taken to Minimize Impacts. Impacts would be minimized with the use of 2 disposal sites that have been used previously for dredged material discharge, specifically sites 1 and 3. Impacts would also be minimized with the similarity of the disposal material to the substrate at the disposal site.

b. Water Circulation, Fluctuation, and Salinity Determinations

(1) Water

(a) Salinity. The deepening of the channel would cause an increase in salinity intrusion within the HNC; however, this would be mitigated by the operation of the HNC lock for marsh located north of Mile 20. The lock complex, which is estimated to be completed by 2022, would be located south of Dulac and would consist of a 110-foot by 800-foot lock, an adjacent 250 foot-wide sector gate, and a dam closure tying into adjacent earthen levees to reduce the risk of storm surge traveling up the HNC. Deepening of the channel is not to begin until construction of the lock complex is completed.

To compute the effects of the HNC deepening on salinity at the proposed HNC lock location, a one-dimensional analysis was done using a simplified form of the Advection-Diffusion equation. The results of this analysis indicated that salinities would increase an average of 0.0054 ppt or 4.81 percent. To offset this impact, operation of the lock and gate would be carried out an average of approximately 48 days per year. Controlling for the median salinity increase projected by the model, at 3.84 percent, would require closure of the structure for 37 days per year. The rate of marsh loss due salt water intrusion could decrease if the HNC lock and floodgate is operated to reduce salinity intrusion.

The salinity gradient of the unconfined and semi-confined marsh creation sites would not be altered since the sites would still be connected to the adjacent tidal water bodies. The CDFs could experience slightly elevated salinity levels during the pumping operation; however, when the pumping has ceased and the material settles, salinities would return to pre-pumping conditions in wet areas. It should be noted that the dredging would take place during high water, during which the water near the CDFs would be less saline than during low water when salinity levels are higher.

(b) Water Chemistry. (PH etc) Water chemistry data for the study area is provided in Table 3. Ambient pH values of water body subsegment LA120509 ranged from 5.64 to 8.00 with an average of 7.60; LA120508 ranged from 5.42 to 8.00 with an average of 7.10; LA 120705 and LA 120802 ranged from 7.20 to 8.50 with averages of 7.80 and 8.00, respectively. DEQ's numerical criteria for these water body subsegments are 6.00 to 8.50, 6.50 to 9.00, 6.50 to 9.00, and 6.50 to 9.00, respectively. Factors typically associated with dredging activities could cause pH in receiving waters to shift toward more acidic conditions. These factors include increased turbidity, organic enrichment, chemical leaching, reduced dissolved oxygen, and elevated carbon dioxide levels among others. Therefore, a temporary reduction in pH in the surrounding waters of the marsh creation sites would be expected.

Metals and cyanide were detected and exceeded water quality criteria in some of the elutriate analyses of the HNC samples. Lead, mercury, copper, and cyanide were already exceeding the water quality standards in the ambient water analyses at some of the sample sites. Refer to Table 4 for this information. The metals bound to the sediments prior to dredging could remain bound resulting in potential increases in metal concentrations of the sediments downstream of the disposal area. According to Su et al, metals have a, "high affinity for organic particulates; only that fraction that is freely dissolved is available for bioaccumulation into tissue via the water column" (Su 2002). Su et al also state that metals do not generally demonstrate significant food-chain bioaccumulation and the concentrations in the Houma Navigation Canal are not relatively high with respect to the reference sites. Therefore, there does not appear to be cause for concern. The dissolved metals concentrations seen in the elutriate analyses potentially could migrate into the adjacent water bodies causing bioaccumulation in aquatic life within the water column. However, S. C. Edwards et al. found that, "Hg and Cu concentrations increased by up to 7-fold after dredging, but declined to background concentrations within 48 h" (Edwards 1995). Therefore, the exposure to the aquatic life in the water column would probably be limited.

(c) Clarity. The highest turbidity effects of the proposed project would occur in the semi-confined and unconfined marsh creation sites. The elevated levels would probably return to background conditions in a relatively short amount of time. Su et al reported during their studies, "in general, turbidity levels returned to baseline conditions within 24-48 hour of cessation" of sediment disturbing activities such as barge removal, which is compared to dredging activities (Su 2002).

The construction of rock foreshore protection, and rock retention structures would have direct and indirect surface water runoff impacts to the adjacent water bodies (Figure 6). Specifically, the construction activities would probably introduce storm water pollutants such as suspended sediments increasing turbidity during the construction activity.

(d) Color. During the proposed construction activities, temporary changes in color would occur at the disposal sites. The changes would be associated with the disturbance and introduction of organic soils at the disposal sites as a result of dredging and disposal as well as other construction activities. The water color would return to background conditions after completion of disposal activities at each site, and no significant long-term changes in water color would occur.

(e) Odor. No effect.

(f) Taste. Water body subsegment LA 120509 is designated as a drinking water supply source. The proposed dredging activity is approximately 2500 feet downstream of the Houma Drinking Water Plant intake. The dredge material would be placed in one of the CDFs adjacent to this dredging reach. Therefore, no effects to taste are expected since the material would not be directly discharged into the HNC. Rather, the CDF effluent would discharge into the HNC, and the effluent would meet DEQ mixing zone requirements.

(g) Dissolved Gas Levels. See discussion in Section II (c) (2) (b).

(h) Nutrients. The marsh creation sites would likely experience increased levels of nutrients in the surface waters in and around the disposal areas due to the proposed dredge disposal. Sampling within the HNC water body subsegments do not show the presence of high nutrient levels, but the turbulence associated with the dredge disposal could resuspend any limited levels of nutrients such as nitrogen, phosphorus, and carbon that may be present in the substrate. No long-term effects would occur due to the proposed activity as these nutrients are not thought to exist in high levels.

(i) Eutrophication. Increased nutrient levels occurring during construction, dredging and disposal activities would not be substantial to cause an increase in eutrophic conditions. After project activities have ceased, background conditions would return.

(j) Others as Appropriate. N/A

(2) Current Patterns and Circulation

(a) Current Patterns and Flow. Flow in and around the unconfined and semi-confined marsh creation sites would be minimally impacted. Existing sheetflow patterns within existing marsh and open water areas would be disrupted by placement of containment systems for dredge material. However, more natural hydrology for healthy marsh habitat would be established once confinement systems are breached and settlement of dredge material has occurred.

Current patterns and flow in the CDFs would not be altered, as they are existing sites and are disconnected from the adjacent water bodies. Therefore, there is no effect.

(b) Velocity. No effect.

(c) Stratification. No effect.

(d) Hydrologic Regime. The hydrologic regime in and around the unconfined and semi-confined marsh creation sites would be disrupted by placement of containment systems for dredge material. However, more natural hydrology for healthy marsh habitat would be established once confinement systems are breached and settlement of dredge material has occurred.

The hydrologic regime in the CDFs would not be impacted since they are existing sites and are disconnected from the adjacent water bodies. Therefore, there would be no effect.

(3) Normal Water Level Fluctuations. The normal water level fluctuations in the semi-confined and unconfined marsh creation sites would be minimally impacted due to the new elevations in the deposition areas.

The normal water level fluctuations in the CDFs would not be impacted since they are disconnected from the adjacent water bodies. Therefore, there is no effect on adjacent water bodies.

(4) Salinity Gradients. The deepening of the channel would cause an increase in

salinity intrusion within the HNC; however, this would be mitigated by the operation of the HNC lock for marsh located north of Mile 20. The lock complex, which is estimated to be completed by 2022, would be located south of Dulac and would consist of a 110-foot by 800-foot lock, an adjacent 250 foot-wide sector gate, and a dam closure tying into adjacent earthen levees to reduce the risk of storm surge traveling up the HNC. Deepening of the channel is not to begin until construction of the lock complex is completed.

The salinity gradient of the unconfined and semi-confined marsh creation sites would not be altered since the sites would still be connected to the adjacent tidal water bodies. A temporary alteration could occur during the dredge disposal operation, but would return to background conditions.

The CDFs could experience slightly elevated salinity levels during the pumping operation; however, when the pumping has ceased and the material settles, salinities would return to pre-pumping conditions in wet areas. It should be noted that the dredging would take place during high water, during which the water near the CDFs would be less saline than during low water when salinity levels are higher.

(5) Actions That Would Be Taken to Minimize Impacts. Storm Water Pollution Prevention Plans (SWPPPs) shall be prepared in accordance with good engineering practices emphasizing storm water Best Management Practices (BMPs) and complying with Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT). The SWPPP shall identify potential sources of pollution, which may reasonably be expected to affect storm water discharges associated with the construction activity. In addition, the SWPPP shall describe and ensure the implementation of practices which are to be used to reduce pollutants in storm water discharges associated with the construction activity and to assure compliance with the terms and conditions of this permit.

Through coordination with the Houma Drinking Water Plant, NOD would dredge the northern water quality subsegment, LA120509, during high water flows to avoid potential contaminant migration (arsenic) toward the drinking water intake, therefore, causing the plant to potentially fail regulated contaminant levels in the drinking water.

No other actions would be warranted.

c. <u>Suspended Particulate/Turbidity Determinations</u>

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site. The highest suspended particulate and turbidity effects of the proposed project would occur in the semi-confined and unconfined marsh creation

sites. The elevated levels would probably return to background conditions in a relatively short amount of time. Su et al reported during their studies, “in general, turbidity levels returned to baseline conditions within 24-48 hour of cessation” of sediment disturbing activities such as barge removal, which is compared to dredging activities (Su 2002).

The suspended particulates and turbidity levels in the CDFs would not be impacted since they are existing sites and are disconnected from the adjacent water bodies. Therefore, there would be no effect on adjacent waterbodies.

The construction of rock dikes, earthen dikes, rock foreshore protection, and rock retention structures would have direct and indirect surface water runoff impacts to the adjacent water bodies. Specifically, the construction activities would probably introduce storm water pollutants such as suspended sediments increasing turbidity during the construction activity. Again, the elevated levels would return to background conditions in a relatively short amount of time.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light penetration. Decreased light penetration would be associated with water-column turbidity and suspended material generated during construction, dredging, and disposal activities.

Light penetration in and around the unconfined and semi-confined marsh creation sites would remain elevated until conditions return to background levels after disposal has ceased. As mentioned in II (c) (1), Su et al reported during their studies, “in general, turbidity levels returned to baseline conditions within 24-48 hour of cessation” of sediment disturbing activities such as barge removal, which is compared to dredging activities (Su 2002).

There would be no effect at the existing CDFs.

The construction of rock dikes, earthen dikes, rock foreshore protection, and rock retention structures would decrease light penetration due to increased turbidity during the construction activities. This effect would be localized and temporary and would return to background levels within approximately 48 hours of cessation of construction.

(b) Dissolved oxygen. Ambient dissolved oxygen (DO) levels recorded on a sampling field trip in November 2002 in the HNC ranged from 6.05 ppm to 7.15 ppm. No ambient DO data were collected in the disposal areas.

DO levels in the marsh creation sites could decrease temporarily due to oxidation of organic matter in the sediments. This would subside rapidly as the suspended material would settle quickly. Oxygen demand due to the soluble organics from the disturbed sediments could continue after the suspended material has settled out; however, this would probably not burden the DO levels in the disposal areas and would decrease as the organics are absorbed by microorganisms. Elevated turbidity levels in the disposal areas could also decrease the DO levels by reducing light penetration and consequently photosynthesis. Also, the suspended material could absorb solar energy potentially resulting in elevated water temperatures. This along with increased dissolved solids concentrations due to turbulence would temporarily reduce the equilibrium concentration of oxygen in the waters of the disposal areas. However, turbidity levels would probably return to background conditions within 24-48 hours of cessation of the dredging and disposal activity; therefore, DO levels would return to background conditions soon after. There would be no effect at the existing CDFs.

(c) Toxic metals and organics. See discussion in Section II (d).

(d) Pathogens. No effect.

(e) Aesthetics. Area aesthetics would be temporarily degraded during the construction and maintenance phases of the proposed project; however, any visual impacts resulting from the presence of pipeline and equipment during disposal, would be temporary.

(3) Effects on Biota.

(a) Primary production, photosynthesis. Existing and proposed channel depths, along with channel flow, do not promote biota production and photosynthesis. Therefore, deepening the channel is not anticipated to impact either of these functions within the channel. Biota within the proposed disposal sites would not be impacted because those sites are mostly open water areas with little to no submerged aquatic vegetation.

(b) Suspension/filter feeders. Larval and juvenile forms of suspension and filter feeding organisms would be adversely affected on a localized and temporary basis, as the feeding structures could be damaged or the individuals could be smothered.

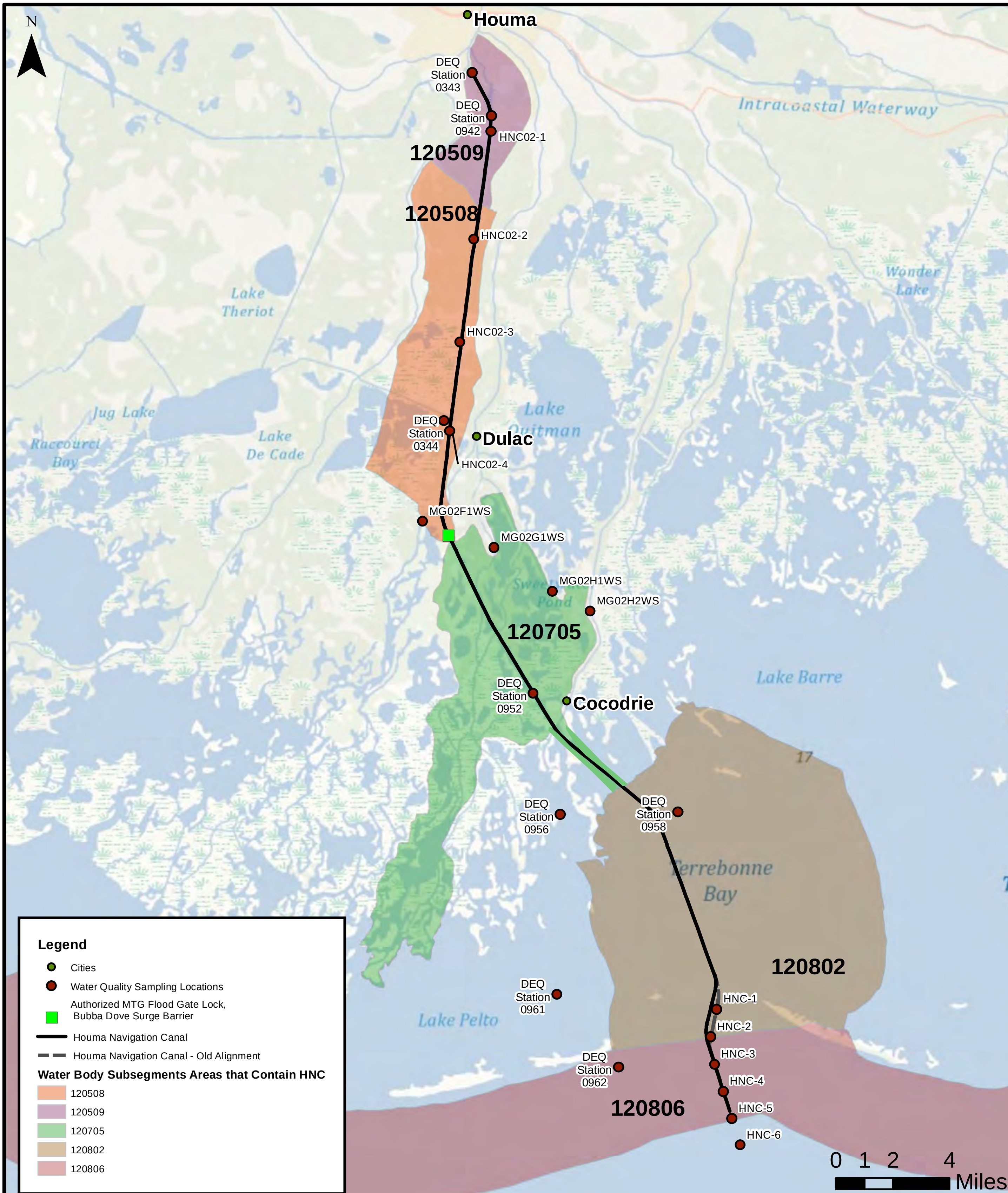
(c) Sight feeders. No significant effects. These organisms are generally highly mobile and would avoid or escape areas of high turbidity during fill placement in unconfined disposal areas, although some incidental mortality could occur in both the unconfined and semi-confined disposal areas. Turbidity adjacent to disposal sites is expected to return to pre-fill conditions in a reasonably short time, so sight feeders will only be temporarily displaced and/or impacted.

(4) Actions Taken To Minimize Impacts. Best Management Practices will be implemented according to the Storm Water Pollution and Prevention Plan developed prior to construction and maintenance of the deepened channel. These could include the use of silt fencing, turbidity control, and containment berms.

d. Contaminant Determinations The limits of the proposed project include three water body subsegments of the Houma Navigation Canal from Houma, Louisiana to Terrebonne Bay. The water body subsegment for Terrebonne Bay is also included in the project limits, which is a total of 8 water body subsegments directly impacted by the proposed project. The water body subsegments are listed in Table 3 with a description of the boundaries of the subsegments. Figure 5 shows the limits of each subsegment.

TABLE 4
WATER BODY SUBSEGMENTS OF PROPOSED PROJECT

Water Body Subsegment Number	Water Body Name	Water Body Type
LA 120509	Houma to Bayou Pelton	River
LA 120507	Houma to Lake Boudreaux	River
LA 120508	Bayou Pelton to One Mile South of Bayou Grand Caillou	River
LA 120502	Bayou Pelton to Houma Navigation Canal	River
LA 120701	Houma Navigation Canal to Caillou Bay	River
LA 120705	One Mile South of Bayou Grand Caillou to Terrebonne Bay	River
LA 120802	Terrebonne Bay	Estuary
LA 120806	Cat Island Pass	Offshore



WATER QUALITY SAMPLING LOCATIONS AND WATER BODY SUBSEGMENTS

Houma Navigation Canal Deepening

ERSI Ocean Map

GEC

Figure 6

Date: August 2012

Scale:1:301,000

Source: ESRI/GEC

Map ID: 278500218-3026

Data from eighteen sampling locations were analyzed and compared to the water quality standards and criteria and the sediment quality benchmarks. Based on DEQ's descriptions, one subsegment of the Houma Navigation Canal within the project limits is a fresh water body. The other subsegments are marine water bodies. Therefore, fresh water criteria were only used in the analysis of LA120509. Marine water criteria were used in the analyses of the other subsegments. Results of the analyses for the subsegments are discussed in the following paragraphs and presented in Table 4. Only parameters that were detected are discussed below. In some samples, it should be noted that there is a slight gap between the level of sensitivity of our tests and the LDEQ standards. For subsegments LA120509, LA120508, and LA120705, reference sediment for the Bayou Segnette project was used in the analysis. For LA120802, reference sediment collected by the contractor of the operation and maintenance study was used in the analysis.

LA120509: The chemical analyses of the elutriate revealed the presence of eleven metals at station HNC02-1. Antimony, arsenic, barium, beryllium, cadmium, total chromium, copper, lead, manganese, nickel, and zinc were detected. Arsenic, copper, cadmium, and lead were exceeding the applicable DEQ criteria/standard. Lead was already exceeding the DEQ chronic fresh water criterion in the ambient water analysis. However, copper and cadmium were not exceeding the fresh water criteria in the ambient water analysis and arsenic was not exceeding the drinking water supply criterion for human health protection. DEQ does not have WQS for antimony, barium, beryllium, or manganese. As a point of reference, EPA regulates barium to 2 ppm through the National Primary Drinking Water Regulations (NPDWRs), which are legally enforceable standards that apply to public water systems. EPA recommends a manganese standard of 50 ppb through the National Secondary Drinking Water Standards (NSDWRs), which are non-enforceable guidelines regulating contaminants that may cause cosmetic or aesthetic effects in drinking water. The lab analyses resulted in 419 ppb for barium, which does not exceed the NPDWR. The manganese concentration was 2,290 ppb, which exceeds the NSDWR of 50 ppb. Manganese was already exceeding the NSDWR in the ambient water analysis. EPA regulates antimony and beryllium to concentrations of 6 ppb and 4 ppb, respectively, through the NPDWRs. The lab analyses of HNC02-1 resulted in concentrations of 5.62 ppb for antimony, which is below the NPDWR, and 4.36 ppb for beryllium, which exceeds the NPDWR. Beryllium was not exceeding the NPDWR in the ambient water sample.

The chemical analyses of the sediment revealed the presence of ten metals at station HNC02-1. None of the results were exceeding the sediment quality benchmarks established by NOAA. The detected metals include arsenic, barium, total chromium, copper, lead, manganese, nickel, selenium, thallium, and zinc. The results for most detected compounds show that test sediment concentrations were generally not noticeably different from the reference sediment concentrations, recognizing that the determined concentrations of duplicate sediment samples often differ by a factor of 3 to 5. However, at HNC02-1, zinc, total organic carbon, and ammonia differed by factors greater than or equal to 5.

Table 4 shows which parameters exceeded the applicable state criteria/standard and the lab analysis result.

LA120508: The ambient water sample collected at HNC02-1 was used to represent HNC02-2 and was also used in the standard elutriate chemical analysis for HNC02-2. HNC02-2 is located in a different water quality subsegment than HNC02-1, and they are classified differently; i.e. HNC02-1 is fresh and HNC02-2 is estuarine. Therefore, freshwater criteria were applied to HNC02-1, and marine criteria were applied to HNC02-2 even though the sample was collected in the same place for both.

The chemical analyses of the elutriate revealed the presence of eleven metals at stations HNC02-2, -3 and -4. Antimony, arsenic, barium, beryllium, cadmium, total chromium, copper, lead, manganese, nickel, and zinc were detected. Arsenic and zinc were exceeding the DEQ acute and chronic marine water criteria at HNC02-2. They were not exceeding the criteria for the ambient water analysis of this station. Arsenic, copper, lead, nickel, and zinc were exceeding the acute and chronic marine water criteria at HNC02-3. Copper was the only parameter exceeding the criteria for the ambient water analysis of this station. Copper was exceeding the acute and chronic marine water criteria at HNC02-4, which also occurred in the ambient water analysis for this station.

The chemical analyses of the sediment revealed the presence of 10 metals at stations HNC02-2, 3, and 4. Arsenic, barium, total chromium, copper, lead, manganese, nickel, selenium, thallium, and zinc were detected at all three stations. None of the results were exceeding the sediment quality benchmarks at stations HNC02-3 or 4. Zinc exceeded the ER-L at station HNC02-2. The results for most detected compounds show that that test sediment concentrations were generally not noticeably different from the reference sediment concentrations, recognizing that the determined concentrations of duplicate sediment samples often differ by a factor of 3 to 5. However, at HNC02-2, 3, and 4, zinc and total organic carbon differed by factors greater than 5. Ammonia concentrations at HNC02-4 also differed by a factor greater than 5.

Table 4 shows which parameters exceeded the applicable state criteria/standard and the lab analysis result.

120705: The chemical analyses of the elutriate revealed the presence of four metals and cyanide at station HNC-Lock, which represents data collected at the site of a proposed lock for the Houma Navigation Canal. Arsenic, copper, nickel, selenium, and cyanide were detected. Of the detected parameters, copper and cyanide were exceeding the DEQ acute and chronic marine water criteria and the acute marine criterion, respectively, which also occurred in the ambient water sample analysis.

The chemical analyses of the sediment revealed the presence of eleven metals at station HNC-Lock. None of the results were exceeding the sediment quality benchmarks. The detected metals include arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc. The results for most detected compounds show that test sediment concentrations were generally not noticeably different from the reference sediment concentrations. However, at HNC-Lock, zinc differed by a factor 5 to 6.

Table 4 shows which parameters exceeded the applicable state criteria/standard and the lab analysis result. Also, listed in Table 4 are four stations that were collected for the Morganza to the Gulf of Mexico Project. These stations are not located in the Houma Navigation Canal, but they are located adjacent to the canal along water quality subsegment 120705. The data for these stations provide information on the water and sediment quality conditions in the adjacent water bodies and marshes. Refer to Table 4 for the parameters that exceed applicable criteria/standards and the results.

LA120802: The NOD collected data in 1994 in this subsegment, specifically near Wine Island Pass for operation and maintenance efforts. Chemical analyses were conducted on water, elutriate, and sediment samples at six stations (HNC-1 through -6) in the Houma Navigation Canal, and solid phase bioassays were conducted on sediment from three stations (HNC-2, -4, and -6). The results of all detected compounds show that test sediment concentrations were not noticeably different than reference sediment concentration and no trends were apparent.

Results of the chemical analyses on the samples indicated no cause for concern. Barium and TOC were the only detected compounds in the water and elutriate samples. Detected compounds in the sediment were not noticeably different from the reference samples and no trends were apparent. With the exception of TOC, no organics were detected in any sediment sample.

Survival of organisms exposed to test sediments in the solid phase bioassays was not significantly different from survival of organisms exposed to the solid phase of the reference control.

The NOD report stated that the results provided reasonable assurance that dredging and discharge of the material from the test sites would not cause unacceptable impacts to the water column or to benthic organisms found in disposal areas in the Gulf of Mexico. It should be noted that the proposed project in the Houma Navigation Canal does not propose ocean dumping of dredged material.

e. Aquatic Ecosystem and Organism Determinations

(1) Effects on Plankton. Any existing plankton in the immediate area of the placement of temporary fill operation would be adversely impacted due to elevated turbidity levels. The impacts would be localized and short-term.

(2) Effects on Benthos. Benthic impacts are discussed in item II.A.4.

(3) Effects on Nekton. The placement of dredged material within areas of open water could cause displacement of species that use the microhabitats found in these areas.

(4) Effects on the Aquatic Food Web. The loss of benthic species due to placement of dredged material would reduce food abundance for fish and other species in the disposal areas, but food is readily available within adjacent open water areas.

(5) Effects on Special Aquatic Sites.

(a) No State Wildlife Refuges are located within the project area.

(b) Wetlands. Due to the impacts of placing dredged material in confined disposal areas, a total of 20.4 acres (10.43 AAHUs) of Swamp and Bottomland Hardwood mitigation would be required for the project.

(c) Mud Flats. Placement of dredged material within open water areas would temporarily increase the amount of mud flats within the disposal areas. Eventually, vegetation would reestablish and those areas would revert back to marsh habitat.

(d) Vegetated Shallows. Dredged material is being placed in degraded marsh habitat or open water areas that once was marsh. Therefore, no vegetated shallows would be impacted.

(e) Coral Reefs. Not applicable.

(f) Riffle and Pool Complexes. Not Applicable.

(6) Threatened and Endangered Species. No effects as none are known to exist within the footprint of the fill placement, and no critical habitat exists within the fill placement area.

(7) Other Wildlife. No wildlife aside from the aquatic species discussed in earlier sections would be directly impacted by fill placement.

(8) The footprint of the dredged material placement has been minimized to the maximum extent practicable.

f. <u>Proposed Disposal Site Determinations</u>

(1) Mixing Zone Determination. The placement of dredge material into the five

upland CDFs including Sites 1 and 3 would result in the discharge of effluent into the Houma Navigation Canal except for Site 1 which will discharge into Short Cut Canal. The quality of the effluent was modeled to ensure compliance with state WQS since it is regulated as a discharge under Section 404 of the CWA. DEQ requires the evaluation of the mixing zone, which is the portion of the water body where effluent waters are dispersed into receiving waters. Mixing must be accomplished as quickly as possible to ensure that the effluent is mixed in the smallest practicable area (DEQ 2002). The zone of initial dilution (ZID) is restricted to the immediate point of discharge and must not exceed 10 percent of the size of the mixing zone. WQS do not apply in the ZID. Numeric acute aquatic life criteria apply beginning at the edge of the ZID; chronic aquatic life criteria for toxic substances apply beginning at the edge of the mixing zone; and human health criteria are to be met below the point of discharge after complete mixing. Appendix C of the ITM (Inland Testing Manual) provides guidance for evaluating the size of mixing zones for dredged material discharges including CDFs. The size of a mixing zone depends on a number of factors including the contaminant or dredged material concentrations in the discharges, concentrations in the receiving water, the applicable WQS, discharge density and flow rate, receiving water flow rate and turbulence, and the geometry of the outlet structure and the receiving water boundaries. The Dilution Volume Method for CDF Effluent Discharges was used for the evaluation of the five CDFs of the proposed project. This is a simplified approach that is applicable in both riverine and estuarine conditions where a discrete discharge source such as a weir is utilized. Refer to Appendix C6.0 of the ITM for the equations and variables involved. Refer to Tables 5, 6, and 7 in this document for the model assumptions and the model output as well as the calculated mixing zone required by DEQ. Table 5 illustrates the dilution factors used in the mixing calculations. For CDFs 1and 3, a dilution factor of 12.77 for Copper was calculated from the sample collected at HNC02-1, which represents the sediment to be placed in these CDFs. This was the highest dilution factor for this sample; therefore, it was used in the mixing zone evaluation per Appendix B of the ITM. For CDF 7a, a dilution factor of 20.70 for Nickel was calculated from the sample for HNC02-2 and used in the mixing zone evaluation. Table 2a in Title LAC 33:IX.1115.C from DEQ provides guidance on water body categorization for the determination of the appropriate dilution and mixing zone application. The Houma Navigation Canal was classified as a Category 3, tidal channel with flows greater than 100 cfs. Therefore, the ZID should not exceed 1/30th of the flow and the mixing zone should not exceed 1/3rd of the flow where the flow equals 1/3rd of the average or typical flow averaged over one tidal cycle irrespective of flow direction. With the available flow and velocity data on hand, the mixing zone requirements would be met for all CDFs with appropriately sized weirs. For CDFs 1, 2, 3 and 5, an initial plume width of a minimum of 30 feet would be required to meet applicable WQS. For CDF 7a, an initial plume width of a minimum of 50 feet would be required. The weirs for each CDF would be designed to meet these minimum requirements. The weirs would be placed to ensure no overlapping of the mixing zones as also required by DEQ.

(2) Determination of Compliance with Applicable Water Quality Standards. See discussion in Section II (f) (1) for determination of compliance of CDF disposal sites.

The placement of dredge material for the beneficial use of marsh creation in Sites 7E, 12, 12B, A-07-A, 14A, 15, 15A, 16, 19C, 19D, 20C, 21 and 24 would not result in point source discharges into the Houma Navigation Canal. Rather, the dredge material would discharge into the site; and the suspended material would settle out in the receiving area with probable runoff of the supernatant into adjoining water bodies and marsh/wetland areas. The proposed marsh creation sites would be semi-confined or unconfined. The metals bound to the sediments prior to dredging could remain bound resulting in potential increases in metal concentrations of the sediments downstream of the disposal area. As discussed earlier, bound metals do not generally demonstrate significant food-chain bioaccumulation and the concentrations in the Houma Navigation Canal are not relatively high with respect to the reference sites. Therefore, there does not appear to be cause for concern. The dissolved metals concentrations seen in the elutriate analyses potentially could migrate into the adjacent water bodies causing bioaccumulation in aquatic life within the water column. However, S. C. Edwards et al. state that, “Hg and Cu concentrations increased by up to 7-fold after dredging, but declined to background concentrations within 48 h” (Edwards 1995). Therefore, the exposure to the aquatic life in the water column would probably be limited. It should be noted that copper concentrations exceeded the WQS in the ambient water sample for the Morganza to the Gulf sites in the area adjacent to the Houma Navigation Canal (See Table 4). Also, arsenic exceeded the ER-L in the Morganza to the Gulf sites sediment samples. Therefore, the aquatic life in these areas, which correspond to the marsh creation sites, are already exposed to elevated levels of some metals.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and private water supply. The elutriate sample from sample site HNC02-1 revealed elevated levels of arsenic and other metals that exceeded the water quality criteria. Specifically, the results exceeded the DEQ human health protection criteria for a drinking water supply water body for arsenic as well as NPDWR and NSDWR for other contaminants; LA120509 has a designation of drinking water supply. The result of 61.7 ppb for arsenic exceeds the current standard of 50 ppb. This standard has been reviewed and amended by the EPA, and a new standard of 10 ppb was put into effect in 2006. The Houma Drinking Water Plant would potentially be affected and is involved and aware of the proposed project and the concentrations of contaminants in the sediment. Through coordination with the facility, NOD would dredge the northern water quality subsegment, LA120509, during high water flows to avoid potential contaminant migration toward the drinking water intake, therefore, causing the plant to potentially fail regulated contaminant levels in the drinking water.

(b) Recreational and commercial fisheries. The placement of dredged material would result in the filling of open water areas that could hold recreational and commercial fisheries. However, the impact to aquatic species due to fill placement is not expected to have a significant impact on the abundance of fish within the project area. Three commercial oyster leases impacted due to fill placement within Wetland Site 21 will be compensated.

(c) Water-related recreation. Aside from the impact to recreational fishing, no other water related recreational impacts would be caused by the placement of fill.

(d) Aesthetics. Area aesthetics would be temporarily degraded during the construction phase of the proposed project; however, the construction would occur within the industrial setting of the HNC.

(e) No National Wildlife Refuges (NWR) or Management Areas are located within the study area. The project area is located approximately three miles east of Mandalay NWR, two miles west of Lake Boudreaux, and nine miles west of Point-Au-Chien Wildlife Management Area (WMA). None of these NWRs are impacted by the project.

g. Determination of Cumulative Effects on the Aquatic Ecosystem

1. The impacts caused by the placement of dredged material would be in addition to any impacts to the aquatic ecosystem that has been caused by the construction of the HNC, relative sea level rise, and the resulting degradation of surrounding marsh habitat. Therefore, the cumulative impact of the placement of fill would not be expected to be greater than those discussed in earlier sections of this evaluation and the FR/EIS.

h. Determination of Secondary Effects on the Aquatic Ecosystem

1. No secondary effects are anticipated aside from the indirect impacts to the aquatic food web discussed in Section III.E.4.

III. FINDINGS OF COMPLIANCE OR NON-COMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

a. No significant adaptations of the Section 404(b)(1) guidelines were made relative to this evaluation.

b. The footprint of the dredged material placement has been minimized to the maximum extent practicable.

c. The planned deposition of dredged material would not violate applicable State Water Quality Standards (Louisiana Administrative Code (LAC) Title 3, Part IX, Chapter 11, Water Quality Standards for Louisiana).

d. The planned fill action would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

e. No endangered species or their critical habitat will be adversely impacted by the planned action, as none are known to exist within the footprint of the fill placement.

f. The planned action would not violate the Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection, Research, and Sanctuaries Act of 1972

g. The proposed deposition of fill material would not result in unacceptable adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. Further, as detailed in the SDEIS, the proposed discharges would not result in unacceptable adverse effects on the life stages of aquatic or semiaquatic organisms, the aquatic ecosystem, diversity, productivity, stability, recreation and esthetic resources, and economic values.

h. Appropriate steps to minimize potential adverse impacts of the fill action on aquatic systems include the use of BMPs and avoidance of discharges into open water where possible.

i. On the basis of the Section 404(b)(1) guidelines, the proposed sites for the deposition of fill material are specified as complying with the requirements of these guidelines.

IV. EVALUATION RESPONSIBILITY

a. Water Quality Input Prepared by: Jonathan Puls, PE

b. Project Description and Biological Input Prepared by: Jonathan Puls, PE

________________________ ________________________________

Date

David. F. Carney
Chief, Environmental Planning
and Compliance Branch

REFERENCES

Edwards, S.C., *et al*. 1995. "The Success of Elutriate Tests in Extended Prediction of Water Quality after a Dredging Operation Under Freshwater and Saline Conditions." Environmental Monitoring and Assessment 36: 105-122.

Louisiana. Louisiana Department of Environmental Quality. 2002. Title 33, Part IX, Chapter 11: Surface Water Quality Standards. http://deq.state.la.us/

NOAA. 1999. Sediment Quality Guidelines Developed for the National Status and Trends Program. Prepared by the Office of Response and Restoration. http://response.restoration.noaa.gov/cpr/sediment/sediment.html.

Su, Steave H., *et al*. 2002. "Potential Long-Term Ecological Impacts Caused by Disturbance of Contaminated Sediments: A Case Study." Environmental Management 29 (February): 234-249.

USEPA/USACE. 1998. Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.-Testing Manual. EPA-823-B-98-004, Washington, D.C.

USEPA. 1996. Title 40, Chapter 1, Part 141—National Primary Drinking Water Regulations. www.epa.gov.

USEPA. 1992. National Secondary Drinking Water Regulations. www.epa.gov.

TABLE 5
PARAMETERS EXCEEDING LOUISIANA WATER QUALITY CRITERIA & NOAA[3] SEDIMENT BENCHMARKS

Water Quality Subsegment	Station	Sample Type	Parameters	Criteria/Standard	Results, ppb[4]
120509	HNC02-1	Water (Fresh)	Lead	Fresh – Chronic	1.53
		Elutriate	Arsenic	Drinking Water Supply	61.7
			Copper	Fresh-Acute & Chronic	30.5
			Cadmium	Fresh-Chronic	1.19
			Lead	Fresh-Chronic	9.09
		Sediment	None		
	DEQ 58010343	Water (Fresh)	Mercury	Fresh-Chronic	0.05
			Turbidity	Water body subsegment criteria	78.00 (NTU)[5]
			Total Chlroide	Water body subsegment criteria	10733 (ppm)[6]
			Total Sulfate	Water body subsegment criteria	1466 (ppm)
120508	[1]HNC02-2	Water (Marine)	Copper	Marine-Acute & Chronic	1.53
		Elutriate	Arsenic	Marine-Acute & Chronic	104
			Zinc	Marine-Acute & Chronic	829
		Sediment	Zinc	ER-L	154
	HNC02-3	Water (Marine)	Copper	Marine-Acute & Chronic	6.53
		Elutriate	Arsenic	Marine-Acute & Chronic	81.9
			Copper	Marine-Acute & Chronic	48.3
			Lead	Marine-Chronic	11.2
			Nickel	Marine-Acute & Chronic	81.6
			Zinc	Marine-Acute & Chronic	259
		Sediment	None		
	HNC02-4	Water (Marine)	Copper	Marine-Acute & Chronic	6.53
		Elutriate	Copper	Marine-Acute & Chronic	7.26
		Sediment	None		
	DEQ 58010344	Water (Marine)	Mercury	Marine-Chronic	0.07
			Turbidity	Water body subsegment criteria	60.00 (NTU)
120705	HNC-Lock	Water (Marine)	Copper	Marine-Acute & Chronic	4.0
			Cyanide	Marine-Acute	9.0
		Elutriate	Copper	Marine-Acute & Chronic	4.0

Water Quality Subsegment	Station	Sample Type	Parameters	Criteria/Standard	Results, ppb[4]
			Cyanide	Marine-Acute	7.0
		Sediment	None		
	DEQ 58010037	Water (Marine)	Mercury	Marine-Chronic	0.20
			Copper	Marine-Acute & Chronic	6.80
			Fecal Coliform	Water body subsegment criteria (oyster propagation)	1100 (MPN)[7]
120802	NOD Report	Water	None		
		Elutriate	None		
		Sediment	None		
[2]N/A	MG02F1WS	Water (Marine)	None		
		Elutriate	Mercury	Marine-Chronic	0.55
		Sediment	Arsenic	ER-L	10.0
	MG02G1WS	Water (Marine)	Copper	Marine-Acute & Chronic	33.9
		Elutriate	None		
		Sediment	Arsenic	ER-L	9.24
	MG02H1WS	Water (Marine)	None		
		Elutriate	None		
		Sediment	None		
	MG02H2WS	Water (Marine)	None		
		Elutriate	None		
		Sediment	None		

[1]Ambient water sample collected at HNC02-1 and HNC02-4 used to represent HNC02-2 and HNC02-3, respectively, and also used in standard elutriate analyses. HNC02-2 is located in a different water quality subsegment than HNC02-1, and they are classified differently; i.e. HNC02-1 is fresh and HNC02-2 is estuarine. Therefore, freshwater criteria applied to HNC02-1 and marine criteria applied to HNC02-2 even though same water sample.

[2]The Morganza to the Gulf of New Mexico Project's sampling locations are not located in the Houma Navigation Canal. However, they are located adjacent to the canal along water quality subsegment 120705 and provide a perspective on the water and sediment quality conditions in the adjacent water bodies and marshes.

[3]NOAA-National Oceanic and Atmospheric Administration

[4]ppb=parts per billion

[5]NTU=Nephelometric Turbidity Units

[6]ppm=parts per million

[7]MPN=most probably number

TABLE 6
DILUTION FACTORS

Testing for Evaluation of Effluent Water Quality

(orange) exceeds WQS
(blue) exceeds WQS
(yellow) positive dilution factor

$D = (C_{ee} - C_{wq})/(C_{wq} - C_{ds})$

where:

D = dilution required to meet the water quality standards

C_{ee} = concentration of the dissolved contaminant in the effluent elutriate (µg/L)

C_{wq} = water quality standard (µg/L)

C_{ds} = background concentration of the contaminant at the disposal site (µg/L)

(** Criteria comes from EPA. No state WQS.)

Site Location	**Parameter**	C_{ee}	C_{wq}	C_{ds}	**D**
HNC02-1	Antimony**	5.62	5.6	2.9	0.007407
	Arsenic	61.7	50	2.35	0.24554
	Cadmium	1.19	0.62	0.9	-2.03571
	Chromium, Total	5.79	363	1.61	-0.98843
	Copper	30.5	7	5.16	12.77174
	Lead	9.09	1.2	1.53	-23.9091
	Mercury	0.19	0.012	0.19	-1
	Nickel	41.5	88	1.06	-0.53485
	Selenium**	1.9	4.61	1.99	-1.03435
	Silver**	0.9	3.2	0.99	-1.04072
	Thallium**	0.9	1.7	0.99	-1.12676
	Zinc	335	58	7.34	5.467825
	Cyanide	19.9	5.4	19.9	-1
HNC02-2	Antimony**	4.56	5.6	2.9	-0.38519
	Arsenic	104	36	2.35	2.020802
	Cadmium	4.78	10	0.9	-0.57363
	Chromium, Total	16.1	103	1.61	-0.85709
	Copper	29.5	3.63	5.16	-16.9085
	Lead	4.49	8.08	1.53	-0.54809
	Mercury	0.19	0.025	0.19	-1
	Nickel	156	8.2	1.06	20.70028
	Selenium**	1.99	71	1.99	-1
	Silver**	0.99	1.9	0.99	-1
	Thallium**	0.99	1.7	0.99	-1
	Zinc	829	81	7.34	10.15477
	Cyanide	19.9	1	19.9	-1

TABLE 7
MIXING ZONE CALCULATIONS FOR CDFs 1 and 3 USING MARCH 2003 DATA

Assumptions/Given:

Volume of effluent discharge per unit time, V_p	=	82cfs
Turbulent dissipation parameter, λ	=	0.001
Water column depth, d	=	18ft
Water velocity, V_w	=	1.4ft/sec
Initial width of plume, 2r	=	30ft
Dilution factor, D	=	12.771739(from Dilution Sheet)

Calculations:

Required volume per unit time, V_a	=	1047.28cfs
Required width of the mixing zone, L	=	41.56ft
Required time to achieve lateral spread, t	=	221.56sec
Length of the mixing zone, x	=	310.19ft
Surface area of mixing zone, A	=	11098.40ft^2

Mixing Zone Application for Aquatic Life (per DEQ):

		Fraction of Flow or Radial Distance (feet)		
Category	**Description**	**Flow**	**ZID**	**MZ**
3	Tidal Channel with flows > than 100 cfs	1854.50	61.82	618.17

*Note: ZID shall not exceed 10% of the MZ.

Flows Recorded March 13, 2003		
Time	**Discharge (cfs)**	**Max V (ft/sec)**
730	6580	1.702
1500	4547	1.4

TABLE 8
MIXING ZONE CALCULATIONS FOR CDFs 1 and 3 USING JUNE 2003 DATA

Assumptions/Given:

Volume of effluent discharge per unit time, V_p	=	82cfs
Turbulent dissipation parameter, λ	=	0.001
Water column depth, d	=	18ft
Water velocity, V_w	=	1.573ft/sec
Initial width of plume, 2r	=	30ft
Dilution factor, D	=	12.771739(from Dilution Sheet)

Calculations:

Required volume per unit time, V_a	=	1047.28cfs
Required width of the mixing zone, L	=	36.99ft
Required time to achieve lateral spread, t	=	137.28sec
Length of the mixing zone, x	=	215.94ft
Surface area of mixing zone, A	=	7232.61ft^2

Mixing Zone Application for Aquatic Life (per DEQ):

Category	**Description**	**Fraction of Flow or Radial Distance (feet)** Flow	ZID	MZ
3	Tidal Channel with flows > than 100 cfs	1083.33	36.11	361.11

*Note: ZID shall not exceed 10% of the MZ.

Flows Recorded June 13, 2003	
Time	**Discharge (cfs)**
NA	4000
NA	2500

Biological Assessment

APPENDIX H

SECTION 1

BIOLOGICAL ASSESSMENT

HOUMA NAVIGATION CANAL DEEPENING PROJECT, TERREBONNE PARISH, LOUISIANA

1.0 PURPOSE

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended, requires that, *"Each Federal agency shall, in consultation with and with the assistance of the secretary, insure that any action authorized, funded, or carried, out by such agency…. Is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species…."*

This Biological Assessment provides the information required pursuant to the ESA and implementing regulation (50 CFR 402.14), to comply with the ESA. Additional jurisprudence includes the National Environmental Policy Act (NEPA) of 1969, 42 U.S.C. section 4321, *et seq.;* the Fish and Wildlife Conservation Act of 1958 (PL 85-624; 16 U.S.C. 661 *et seq*.); the Marine Mammal Protection Act of 1972; and the Bald Eagle Protection Act of 1940.

This Biological Assessment (BA) evaluates the potential impacts of the Tentatively Recommended Plan (TRP) described in the Integrated Feasibility Report and Environmental Impact Statement for the Houma Navigation Canal Deepening project on Federally-listed threatened and endangered species, and their critical habitat. This evaluation is presented to the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) to achieve compliance with the requirements of Section 7 of the ESA for consultation with USFWS and NMFS.

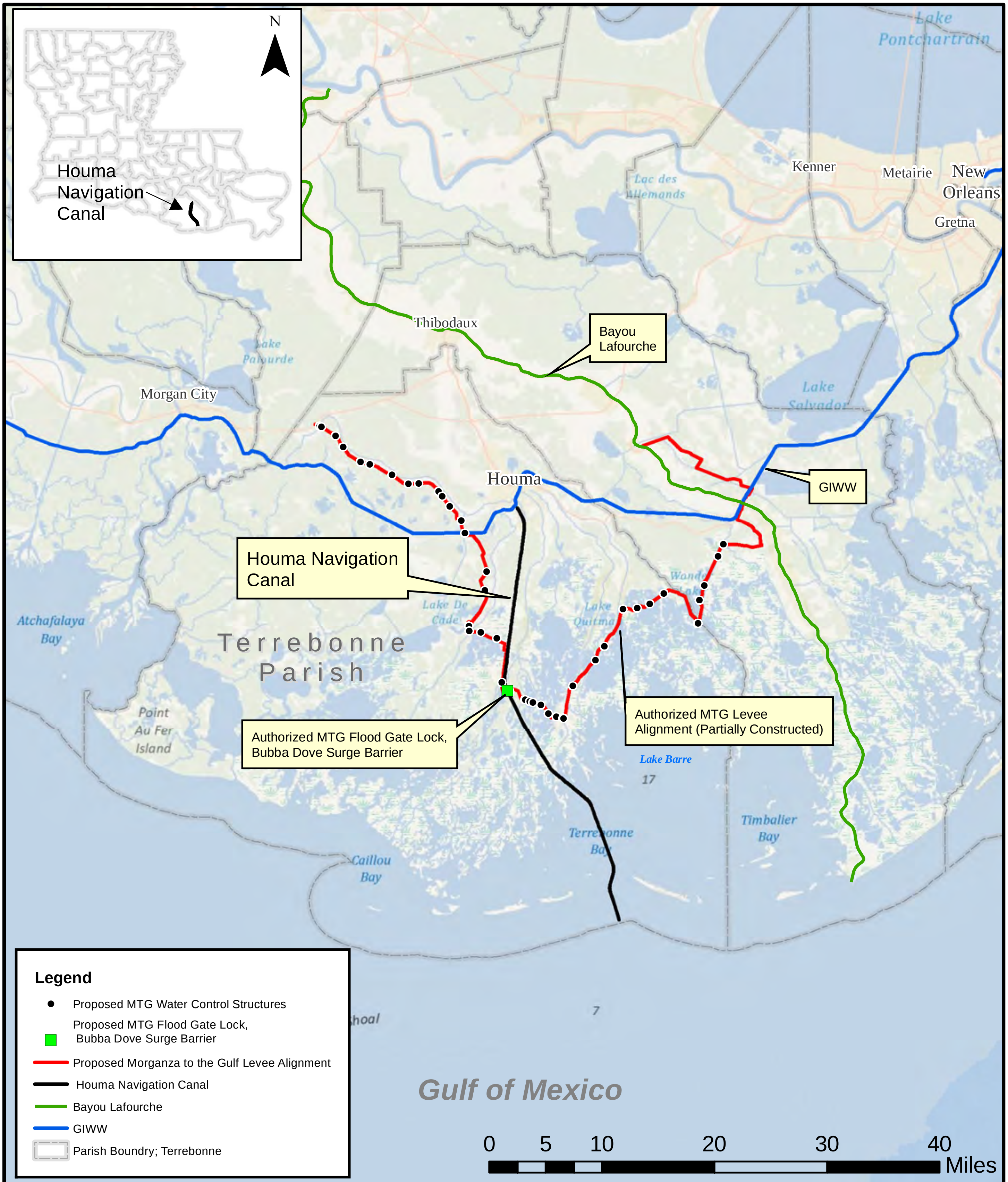
The BA provides an assessment of the effects of the project on the protected species in the vicinity of the project. Because this project will not be constructed in the next year, an updated T&E review will have to occur no more than a year before construction begins and be coordinated with USFWS and NMFS. Coordination with USFWS and NMFS is ongoing.

2.0 LOCATION AND GENERAL DESCRIPTION OF THE STUDY AREA

The Houma Navigation Canal is a Federally maintained waterway that connects the Gulf Intracoastal Waterway (GIWW) in Houma with the Gulf of Mexico (Figures 1 and 2). The HNC is located in south-central Terrebonne Parish, approximately 50 miles southwest of New Orleans. The project area is within the Barataria-Terrebonne National Estuary, one of the most expansive and productive estuaries in the U.S. and is located in the following sections:

- T17S R17E, Sections 11, 12
- T18S R18E, Section 73, 74, 75, 78, 80, and 81
- T19S R17E, Sections 1, 23, 43-51, 66, 75, 78, 87, 88,
- T20S R17E, Sections 4,5,8,9, 16, 17, 20, 21, 33, 34, 37
- T21S R17E, Sections 2,3,10,11
- T21S R18E, Sections 59-78
- T22S R18E, Sections 3, 4, 8, 9, 10
- T23S R18E, Sections 7,8

For planning purposes, the study area has been divided into three reaches (Figure 2). Each reach was identified based on hydrologic differences and boundaries.



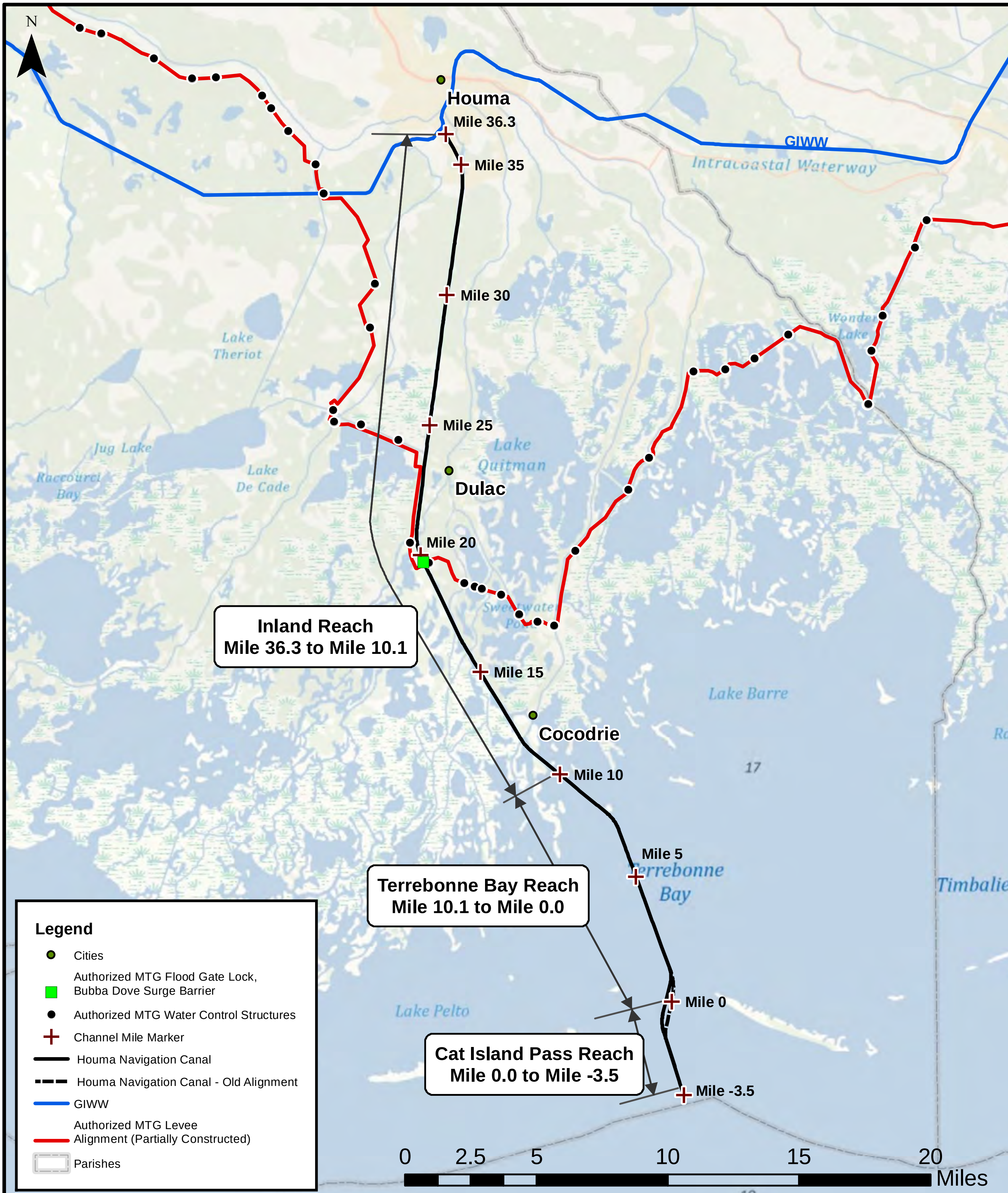
VICINITY MAP

Houma Navigation Canal Deepening

ERSI Ocean Map

GEC

Figure 1
Date: October 2012
Scale:1:750,000
Source: ESRI/GEC
Map ID: 278500218-3026



HNC REACHES

Houma Navigation Canal Deepening

ERSI Ocean Map

GEC

Figure 2
Date: September 2012
Scale:1:325,000
Source: ESRI/GEC
Map ID: 278500218-3026

3.0 PROPOSED ACTION

Alternative 2A of the HNC Deepening Study, Integrated Feasibility Report and Environmental Impact Statement (FR/EIS) is the Tentatively Selected Plan (TSP). Features of the TRP include:

- Deepening the channel to an elevation of -20 feet NAVD88.
- Construction of rock foreshore protection and retention dikes for channel bank erosion control and for retention of dredged material.
- Placement of dredged material in disposal sites that have been selected based on opportunities for habitat creation for ecosystem restoration (Figures 3 and 4).

3.1 Channel Deepening

The primary feature of the recommended plan consists of deepening the HNC from the present maintained elevation of −15 feet MLG to an elevation of −20 feet NAVD88. The design width would remain the same as that of the currently authorized project (150 feet between Miles 36.3 and 0.0; and 300 feet between Miles 0.0 and −3.7). The side slopes of the channel would be 1V on 3H for the entire length of the HNC. Typical cross sections for the existing channel and the design profile with advance maintenance for the channel deepening are shown in Figure 5.

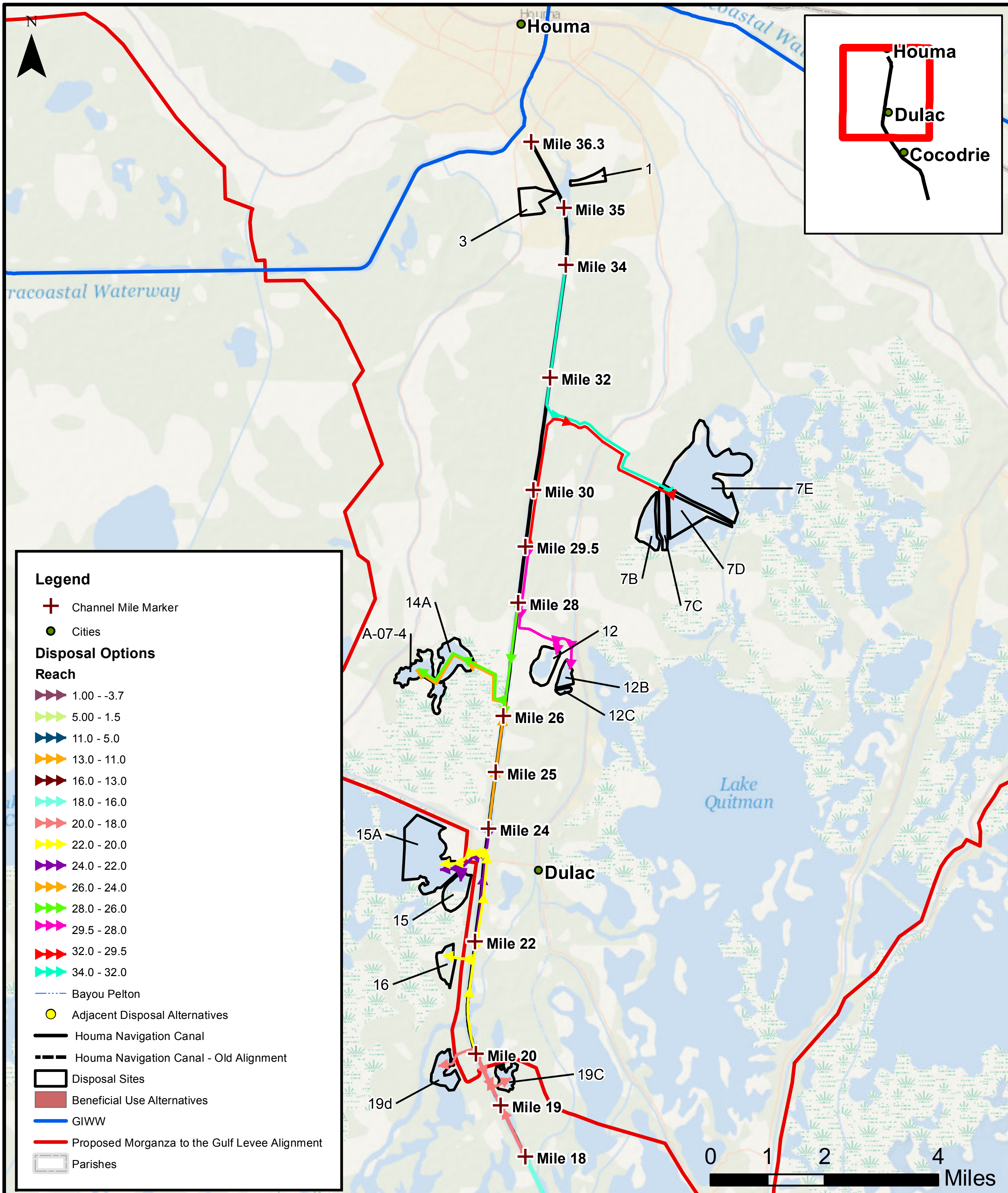
3.2 Disposal Sites

Disposal plans were developed for three reaches of the channel: the Inland Reach (Mile 11.0 to the GIWW at Mile 36.3), the Bay Reach (Mile 0 to Mile 11.0), and the Cat Island Pass Reach (Mile –3.7 to Mile 0). Disposal locations are described below and are listed in Figures 3 and 4. Cross sections for the proposed rock retention, foreshore protection, and interior earthen berms to be used within the disposal sites are shown in Figures 6 and 7.

3.2.1 Inland Reach (Mile 11.0 to the GIWW at Mile 36.3)

The inland portion of the channel has numerous locations available for disposal, these include locations already identified for current maintenance of the channel and also new sites that provide for beneficial placement of the dredged material for ecosystem restoration, consistent with the State of Louisiana’s Master Plan for the Coastal Zone and the consistency requirements of the Louisiana Coastal Zone Management Program. In addition, because these sites are located adjacent to, or within close proximity of, the channel alignment, they represent the least cost disposal option for the inland reach of the channel. As a result of the HET screening process, 15 disposal sites were designated for disposal of dredged material generated from the Inland Reach. These sites are shown in the Figure 3. Details on the sites are presented in Annex V of the Engineering Appendix.

Two sites were previously designated as disposal sites under the current maintenance dredging and have been used for upland disposal of material. Site 1 was previously permitted and mitigation has been provided for upland disposal impacts at this site. Site 3 has developed into bottomland hardwood habitat, and continued use of this site for disposal will require mitigation for impacts to this habitat type. The mitigation requirements for the Tentatively Selected Plan are

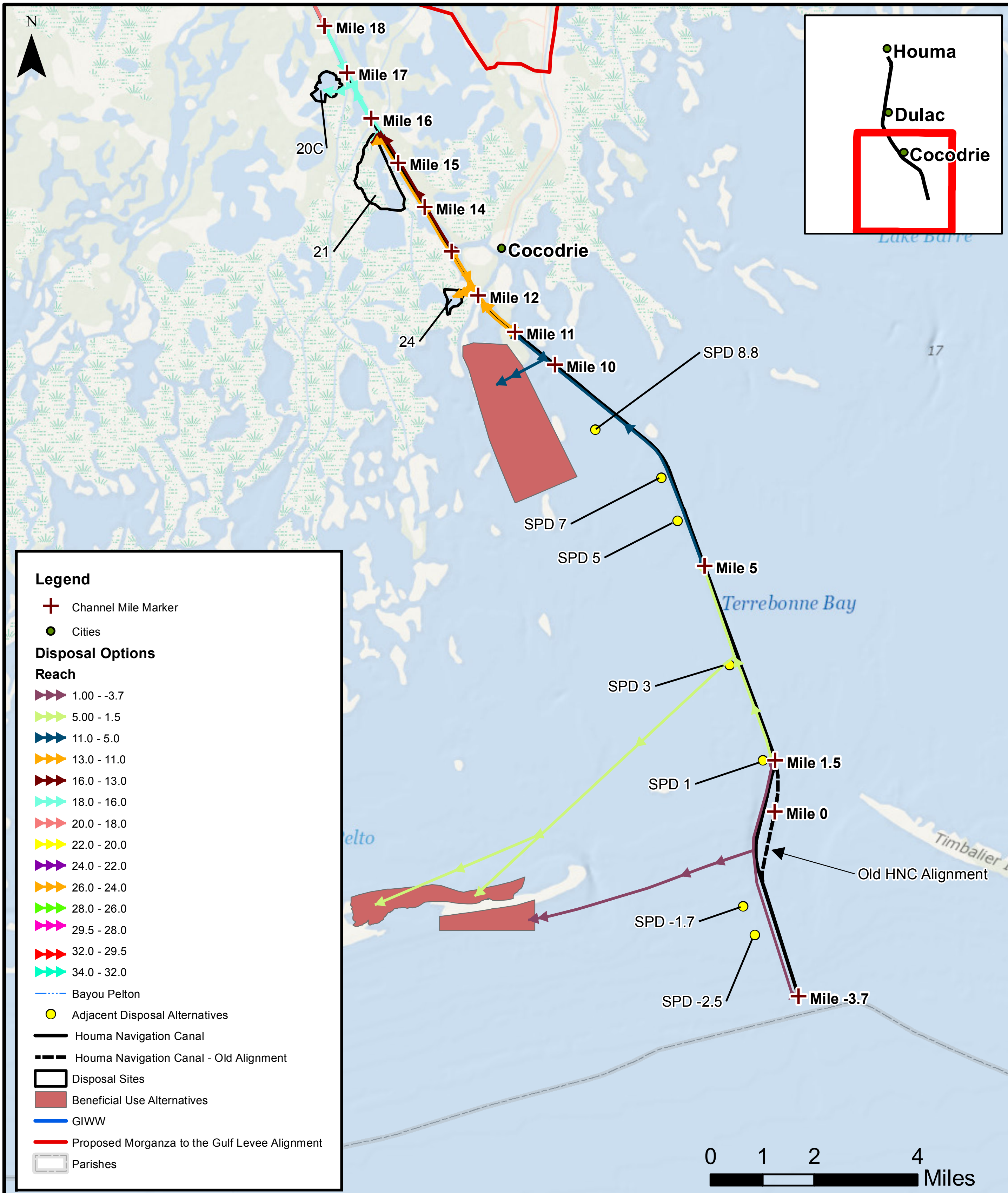


DISPOSAL AREAS
North End
Houma Navigation Canal Deepening

ERSI Ocean Map

GEC

Figure 3
Date: December 2014
Scale:1:150,000
Source: ESRI/GEC
Map ID: 278500218-3026



DISPOSAL AREAS
South End
Houma Navigation Canal Deepening

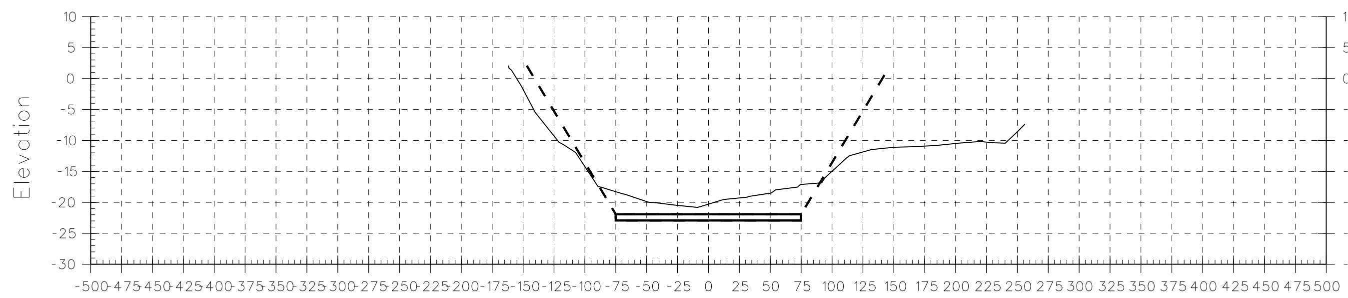
ERSI Ocean Map

GEC

Figure 4	
Date: December 2014	
Scale:1:165,000	
Source: ESRI/GEC	
Map ID: 278500218-3026	

5 | 4 | 3 | 2 | 1

EAST BANK WEST BANK



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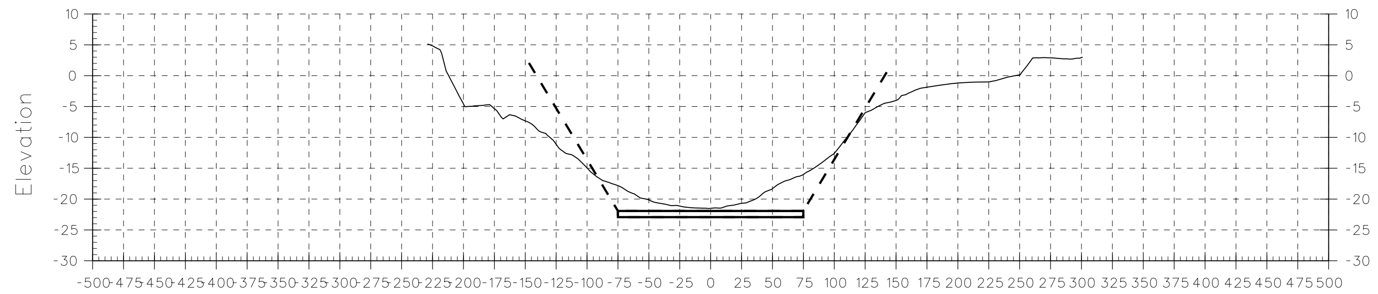

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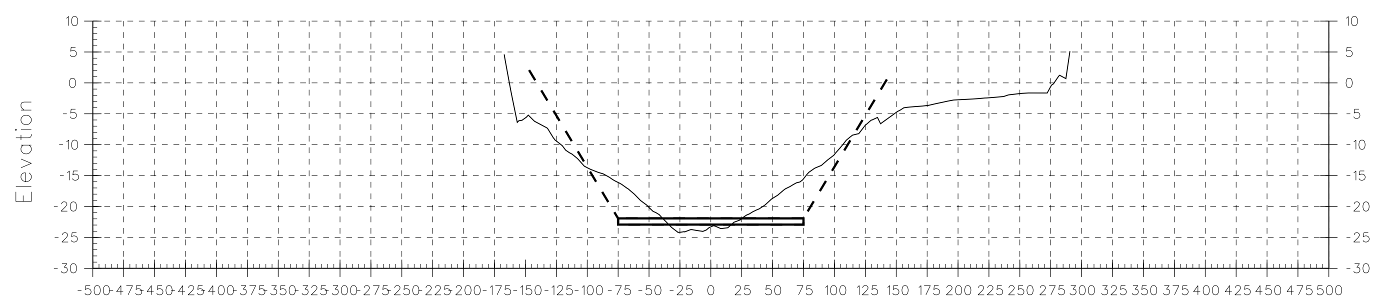

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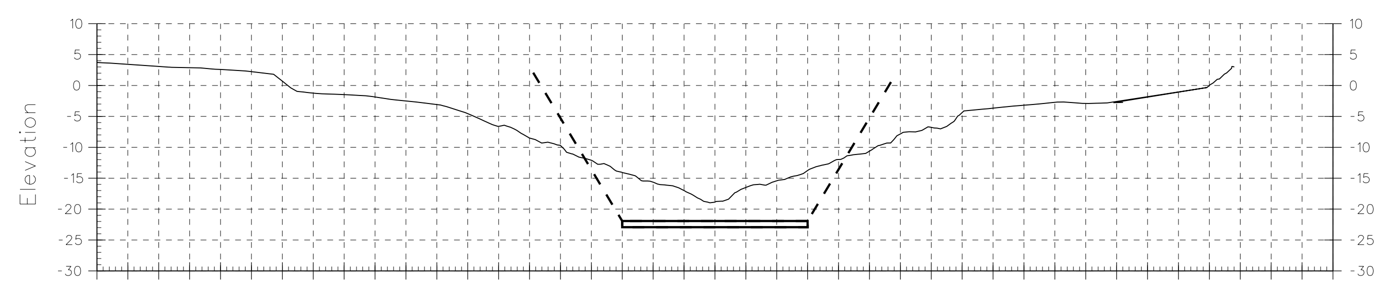

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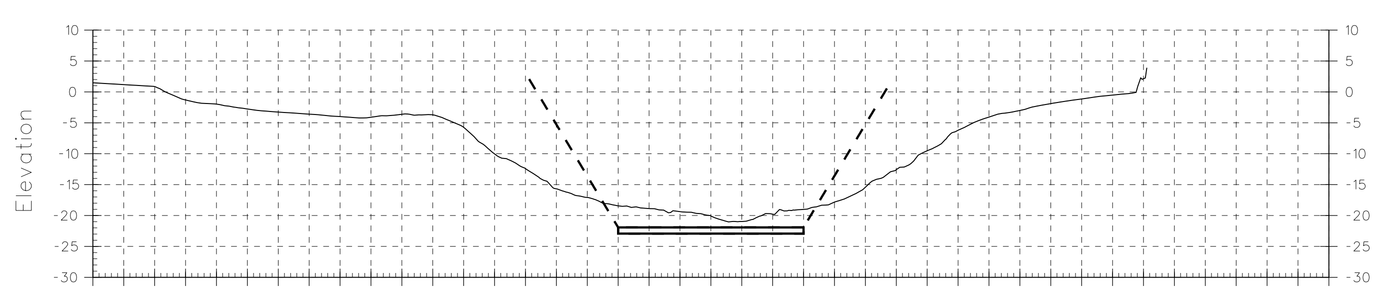

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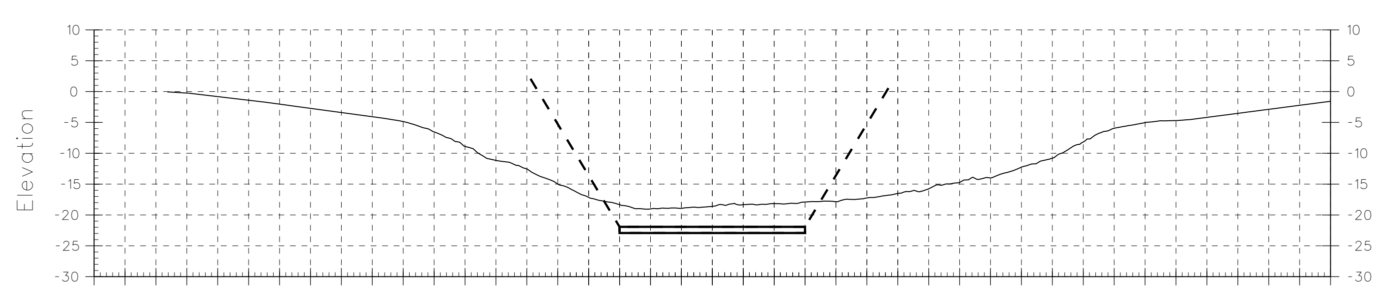

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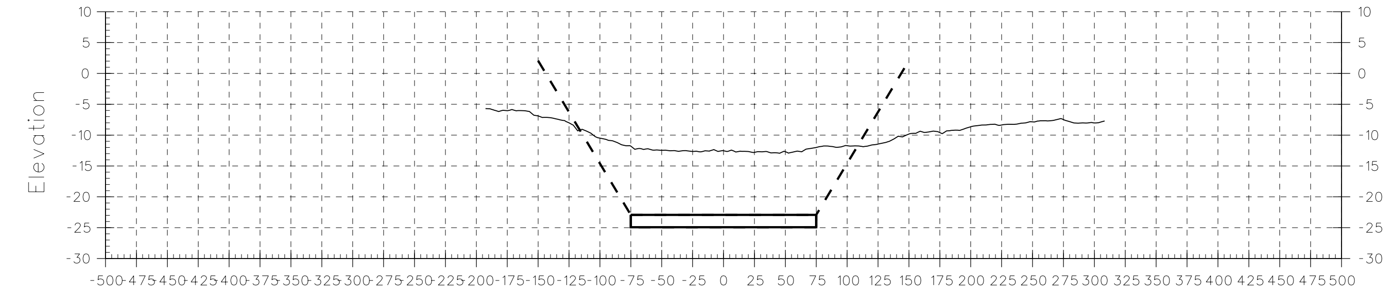
EAST BANK WEST BANK



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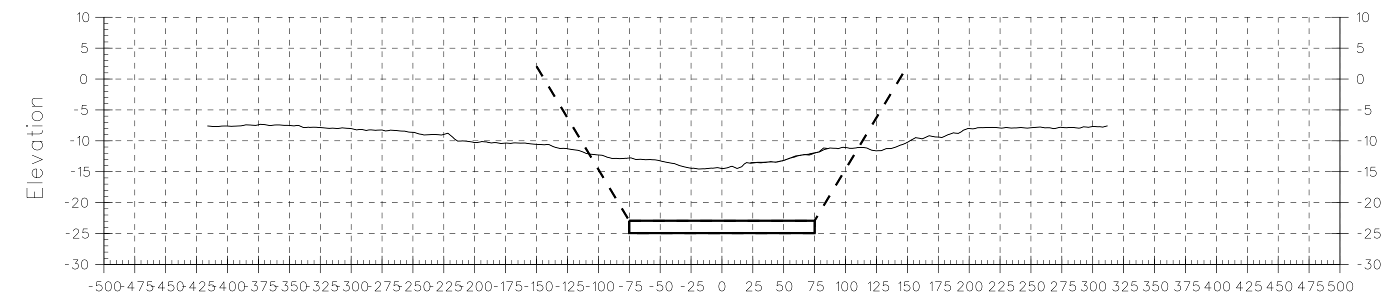

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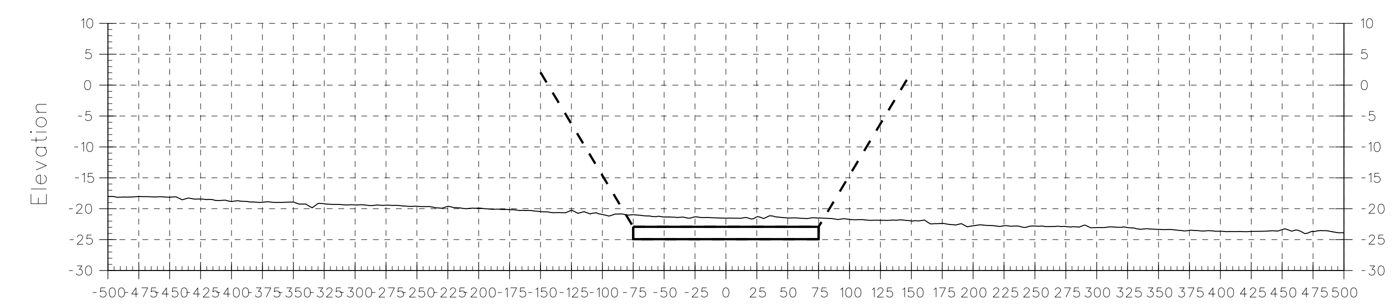

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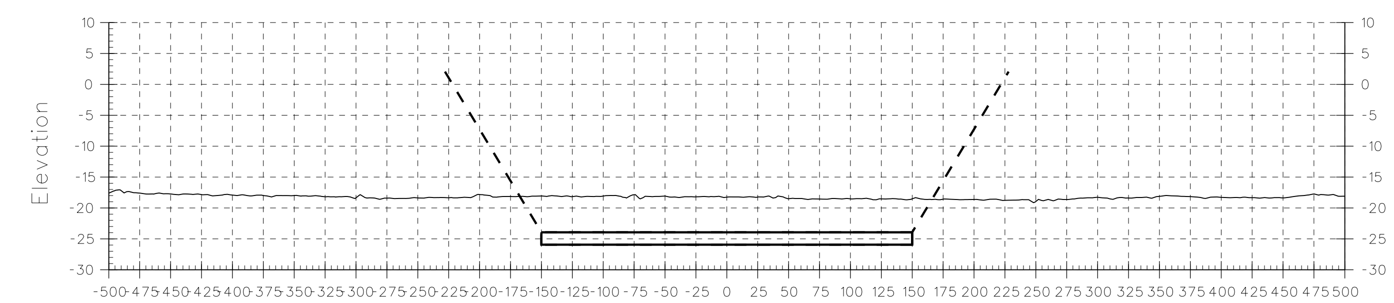

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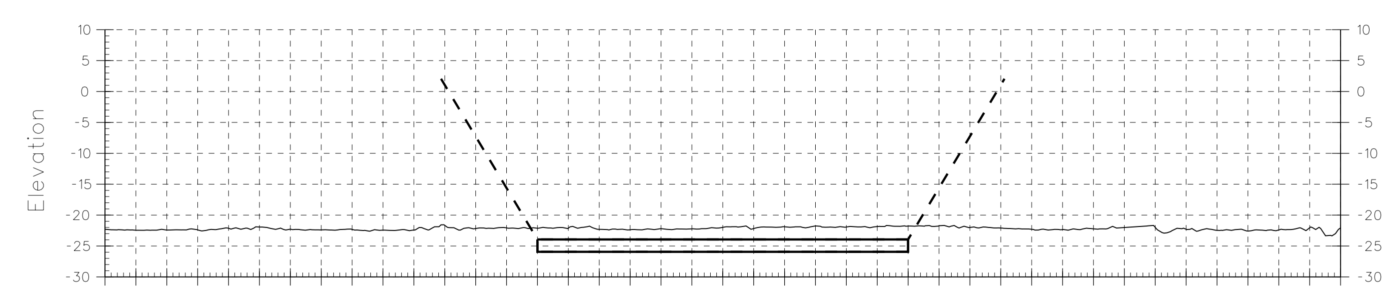


2150+00

NOTES:

1. ELEVATIONS SHOWN REFLECT NAVD88 DATUM.
2. THEORETICAL CHANNEL SIDE SLOPES ARE 1V ON 3H.
3. SIDE SLOPES ARE INCLUDED IN THEORETICAL SECTION WHICH INCLUDES ADVANCE MAINTENENCE.
4. OVERDEPTH IS INDICATED BY THE BOTTOM BOX CUT SECTION.

Figure 5

HOUMA NAVIGATION CANAL
HOUMA NAVIGATION DEEPENING - GENERAL REEVALUATION REPORT
MILE 36.0 TO MILE (-)15.0
TERREBONNE PARISH, LOUISIANA

TYPICAL SECTIONS -20' NAVD88 PROJECT

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DESIGNED BY: T.DORCEY DRAWN BY: TD/RB CHECKED BY: R.BROUSSARD	PLOT SCALE: 500:1	PLOT DATE: MAR 10	CADD FILE: H020083.DGN FILE NO.
	DATE: MAR 10		

5 | 4 | 3 | 2 | 1

PLATE C16

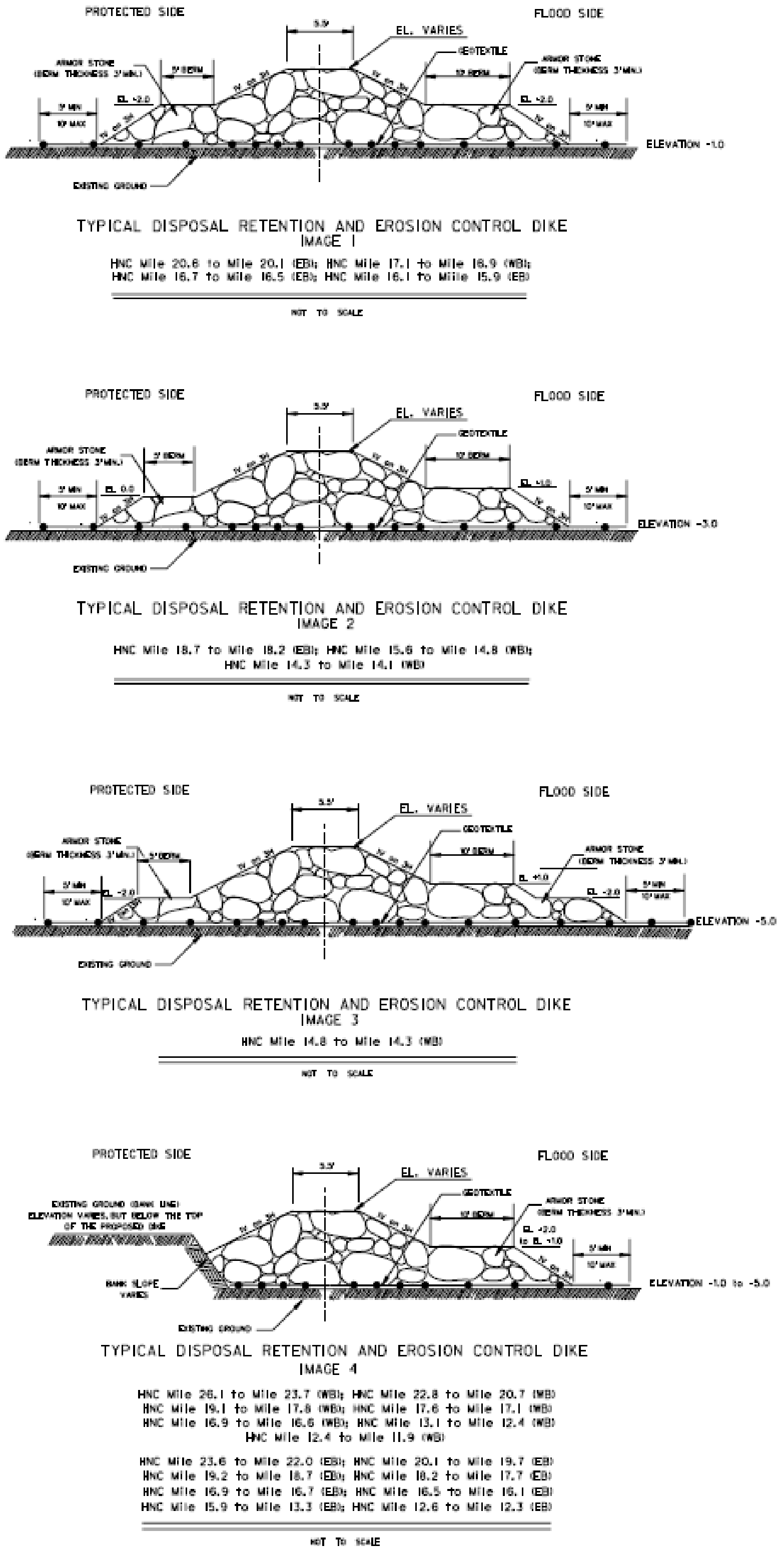


Figure 6. Typical Rock Retention and Foreshore Protection Dike Cross Sections

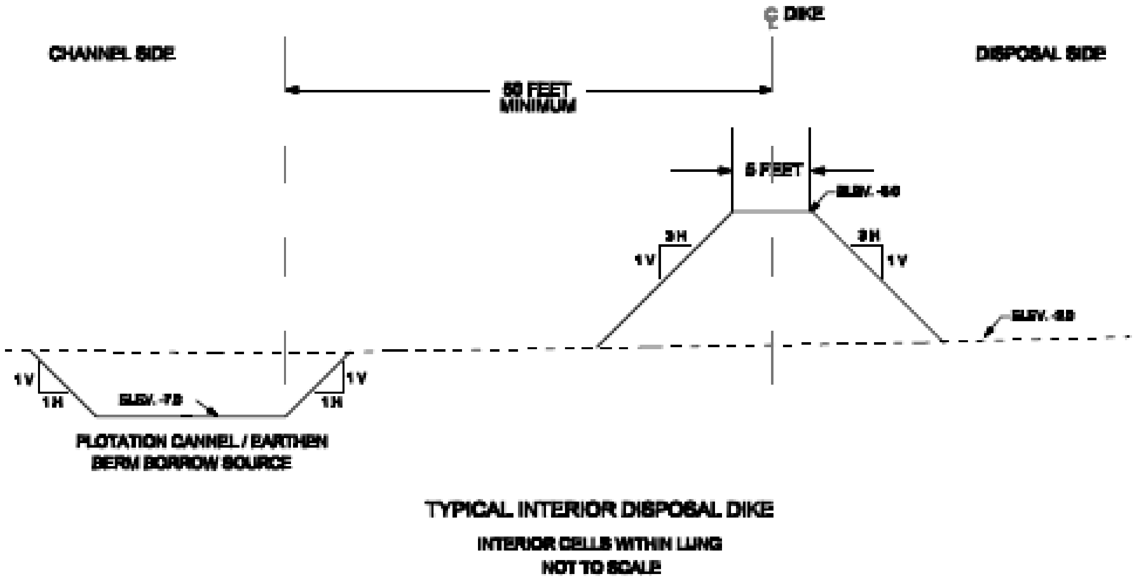


Figure 7. Typical Interior Disposal Dike Cross Sections

provided in Section 4.5.6 of the FR/EIS. The other placement sites are primarily open water and would be used to create marsh.

3.2.2 Terrebonne Bay Reach (Mile 0.0 to 11.0)

A number of disposal options were considered for disposal of material in the Terrebonne Bay reach. Five disposal sites were identified for material dredged to deepen and maintain the Houma navigation channel in this reach. All five disposal locations would place material unconfined, a minimum of 1,000 feet west of the channel. The single point discharge locations would be at Mile 8.8, 7, 5, 3, and 1 (Figure 4). The unconfined disposal utilized in Terrebonne Bay would follow the same procedures currently used for maintenance dredging in the HNC.

3.2.3 Cat Island Pass Reach (Mile –3.7 to Mile 0)

The same disposal approach would be used to place the material from the Cat Island Pass (Mile 0.0 to -3.7), with disposal occurring at Miles -1.7 and -2.5. Disposal would occur a minimum of 1,000 feet to the west of the HNC and would utilize unconfined disposal of material at SPD -1.7 and SPD -2.5 (Figure 4). Material from Cat Island Pass is approximately 70 percent sand, percent shell, and 25 percent silt.

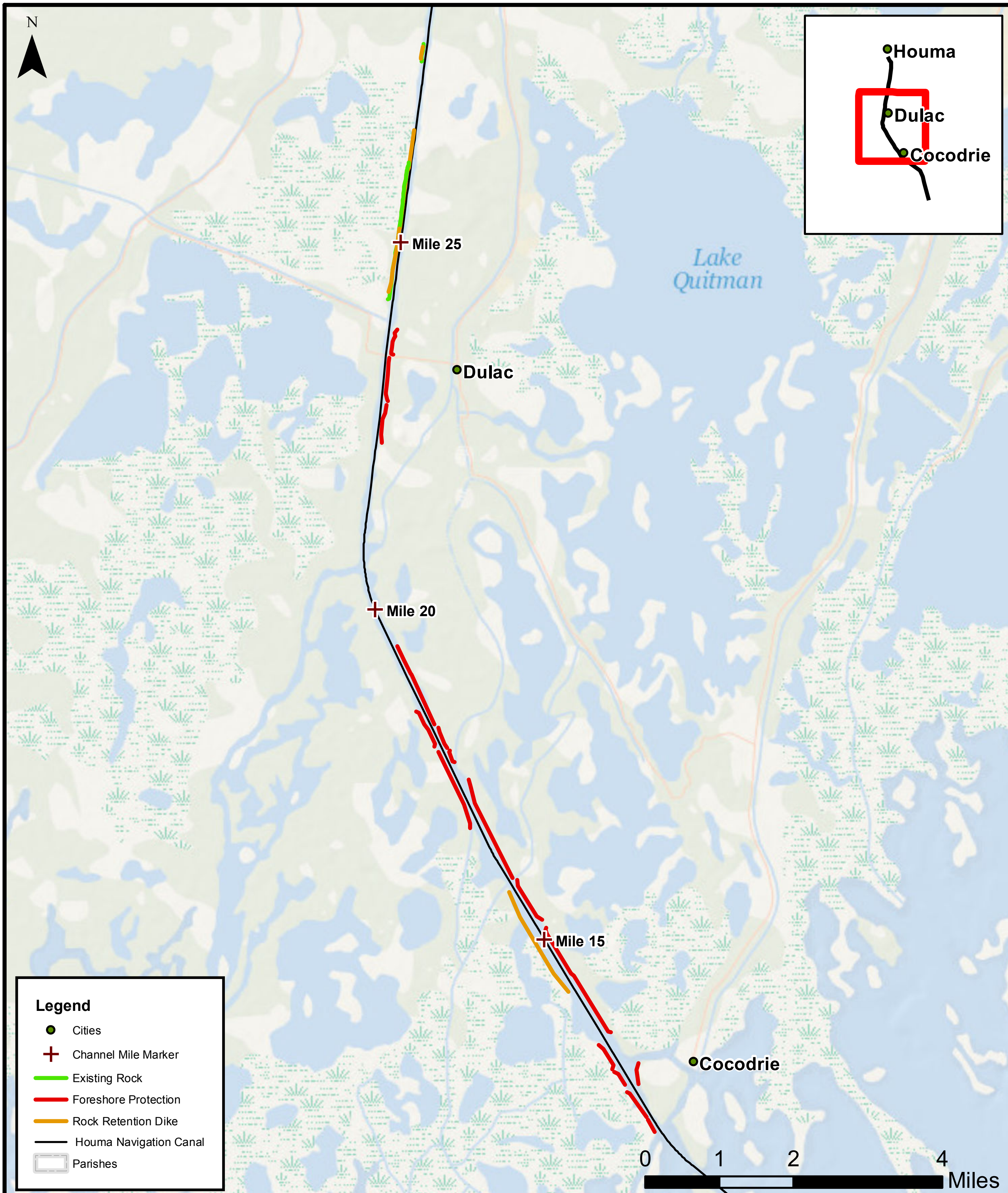
3.3 Rock Dikes for Retention and Foreshore Protection

Approximately 14.7 miles of rock retention dikes and/or foreshore protection would be constructed or refurbished for bank protection. Approximately 13.1 miles of foreshore protection would be constructed or refurbished along the Inland Reach (6 miles along the west bank and 7.1 miles along the east bank). In addition to the foreshore protection, approximately 1.6 miles of rock retention dikes would be constructed on the Inland Reach. Locations of the bank protection measures are presented in Figure 8. A typical cross section for the four types of rock dikes for foreshore protection and rock retention are shown in Figure 6.

The foreshore dikes are proposed for the southern reaches to slow down land loss adjacent to the channel. The foreshore rock dikes would require a geotextile fabric to be placed under the dikes. These dikes would be built to an elevation of +6 feet NAVD88.

Retention dikes are proposed at strategic locations to retain material dredged from the channel. They would also require a geotextile fabric to be placed under the dikes. The retention dikes would be built to an elevation of +5 feet NAVD88.

For both the foreshore protection and retention rock dikes, the toe elevations of the channel side wave berm must be at or below elevation −1.0 feet and the berm top must be at least at elevation +1.0 foot, while maintaining a minimum 3-foot thickness. Protected side stability berms would be required, with a minimum width of 5 feet and thickness of 3 feet. The protected side berm may be eliminated if the dike is located against an earthen bank of +3.5 feet or higher. A flotation channel may be required if the channel is too far away from the bank line. The flotation channel for dike construction should not be dredged any closer than 50 feet to the centerline of the dike. The flotation channel may be dredged up to 8.0 feet below the water surface.



FORSHORE PROTECTION AND ROCK RETENTION DIKES

(INLAND REACH)

Houma Navigation Canal Deepening

ERSI Ocean Map

GEC
Figure 8
Date: October 2012
Scale:1:115,000
Source: ESRI/GEC
Map ID: 278500218-3026

4.0 SPECIES DESCRIPTIONS

Seventeen threatened or endangered species have been identified as potentially occurring within the boundaries of the study area. The species listed in Table 1 may be present in the area and may be affected by the project. There are no known threatened and endangered floral species in the vicinity of the study area.

Table 1. Threatened and Endangered Species in Vicinity of Study Area

Species	Scientific Name	Federal Status
FISHES		
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	**T**
Smalltooth sawfish	*Pristis pectinata*	**E**
SEA TURTLES		
Green turtle	*Chelonia mydas*	**T**
Hawksbill	*Eretmochelys imbricate*	**E**
Kemp's ridley	*Lepidochelys kempii*	**E**
Leatherback	*Dermochelys coriacea*	**E**
Loggerhead	*Caretta caretta*	**T**
MARINE MAMMALS		
West Indian manatee	*Trichechus manatus*	**E**
Sperm whale	*Physeter macrocephalus*	**E**
Sei whale	*Balaenoptera borealis*	**E**
Humpback whale	*Megaptera novaeangliae*	**E**
Fin (Finback) whale	*Balaenoptera physalus*	**E**
Blue whale	*Balaenoptera musculus*	**E**
Northern right whale	*Eubalaena glacialis*	**E**
BIRDS		
Piping plover	*Charadrius melodus*	**TC**
Red knot	*Calidris canutus rufa*	**PT/C**

T=Threatened; E=Endangered; C=Critical habitat
Source: USFWS, April 2014 (http://www.fws.gov/endangered/)

In response to a Corps' March 19, 1996 request, the National Marine Fisheries Service (NMFS) listed the threatened Gulf sturgeon, smalltooth sawfish, and five species of endangered or threatened sea turtles [green (threatened), Kemp's ridley (endangered), hawksbill (endangered), leatherback (endangered), and loggerhead{threatened)] that occur in the northern Gulf near the study area. Five species of baleen whales (northern right, sei, finback, blue, and humpback), one species of toothed whale (sperm whale), and the West Indian Manatee are also listed by NMFS as possibly in the Gulf of Mexico near the study area. All are currently listed as endangered. There is no proposed or designated critical habitat for these species in Louisiana. The Fish and Wildlife Service (FWS) noted black bear (threatened), piping plover (threatened), red knot (threatened), and Kemp's ridley sea turtle (endangered) as possibly being in or near the study area and under their responsibility. On July 10, 2001, FWS designated critical habitat for the red knot within portions of the study area and piping plover within the extreme southern portions of the study area. No other critical habitat has been designated in the project area by FWS or NMFS.

The American alligator is listed as threatened due to similarity of appearance. This species is found in waterbodies throughout the fresh to brackish portions of the study area. Louisiana has implemented a commercial harvest season for alligator as its population has risen well above a level of concern. None of the action alternatives would have adverse impacts to the alligator population. Therefore, alligator will not be discussed further in this Biological Assessment.

All the whale species are uncommon to rare in the Gulf of Mexico except for the sperm whale (Burkard! 1996; DOI 1994), which is found in deeper waters and are not likely to be affected, even indirectly, by any of the alternatives studied in detail.

The assessment on sea turtles relies heavily on information from the 1995 Biological Assessment: Impacts of Navigation Channel Hopper Dredging on Threatened and Endangered Species in Louisiana (Baird 1995). Information on sea turtles along coastal Louisiana is generally sparse. Historical and recent occurrences of the Kemp's ridley, loggerhead, green, leatherback, and hawksbill turtles in the vicinity of the three coastal Louisiana channels are summarized, and the potential impacts are discussed.

The two endangered species, Gulf sturgeon, and West Indian manatee, could potentially be found in the project area. Nevertheless, the features of the proposed action would not adversely impact either species' critical habitat, which is not present within the study area. Manatees are rare transient foragers in the study area.

4.1 GULF STURGEON (*ACIPENSER OXYRHYNCHUS DESOTOI*)

The Gulf sturgeon has been a recognized subspecies of the Atlantic sturgeon since 1985 and inhabits the Atlantic and Pacific oceans and certain freshwaters of the United States. According to Barkuloo (1988) this fish is found in most major river systems from the Mississippi River to the Suwannee River that connect to the Gulf of Mexico and in the central and eastern Gulf of Mexico. They are found mostly in the eastern rivers of the Gulf of Mexico near Florida. Particularly important are the Apalachicola and Suwannee Rivers in Florida.

Gulf sturgeon is an anadromous species, laying eggs in freshwater, moving to the Gulf of Mexico at 3-4 years of age during the fall and winter, and returning to freshwater each spring as river temperatures rise to 16 to 23 C. Wooley and Crateau (1985) found Gulf sturgeon in the Apalachicola River downstream from Jim Woodruff Lock and Dam (river km 171) from May through September. They seemed to concentrate in a large scour hole below the lock, moving very little from the area. The area consisted of sand and gravel substrate, with water depths of 6.0 to 12.0 meters and velocities of 0.6 to 0.9 meters/second. The fish begin to migrate back to estuaries when river temperatures dip below 23°C Wooley and Crateau (1985).

Food of the Gulf sturgeon consists primarily of crab, amphipods, annelids, lancelets, and, brachiopods (Mason and Clugston 1993). However, they do not eat once they enter the rivers in the spring. It remains unclear why most subadult and adult Gulf sturgeon feed in the marine environment for a relatively short time and enter freshwater where they do not feed (USFWS and Gulf States Marine Fisheries Commission 1995).

The Gulf sturgeon can easily attain over 2 meters in length and live nearly 30 years. Huff (1975) found that mature females ranged in age from 8 to 17 years and that mature males ranged from 7 to 21 years. Chapman found that mature Gulf sturgeon produce an average of 403,000 eggs. Eggs are demersal and adhesive. Timing, location, and habitat requirements for Gulf sturgeon spawning are not well documented.

The Gulf sturgeon was virtually extirpated throughout its range at the turn of the 20th century. Overexploitation, damming of rivers and other forms of habitat destruction, incidental catch, and water quality deterioration are listed as some of the causes of their decline (Huff 1975; Barkuloo 1988; McDowall 1988; and Birstein 1993).

4.2 SMALLTOOTH SAWFISH (*PRISTIS PECTINATA*)

The U.S. population of smalltooth sawfish *(Pristis pectinata)* was listed as endangered under the ESA on April 1, 2003 (68 FR 15674). Presently, smalltooth sawfish critical habitat has not been designated within the TRP project area. Historically, smalltooth sawfish commonly occurred in the shallow waters of the Gulf of Mexico and along the eastern seaboard as far north as North Carolina. The current distribution is believed to be centered near the extreme southern portion of peninsular Florida (i.e., Everglades National Park including Florida Bay). Recent sawfish records are limited to Georgia (n=1), Florida, and Texas. Notably, the Texas sighting was not verified and may have been either the endangered smalltooth sawfish or the similar largetooth sawfish (*P. perotteti*); records of both are rare throughout the western Gulf of Mexico. There are no known sawfish breeding or juvenile habitats adjacent to, or associated with, the project area. Based upon consultation with an experienced hopper dredge industry observer provider (C. Slay, Coastwise Consulting, pers. comm. August 18, 2003), and a review of the available scientific literature, NMFS has determined that there has never been a reported take of a smalltooth sawfish by a hopper dredge, and such take is unlikely to occur because of smalltooth sawfishes' affinity for shallow, estuarine systems. Therefore, NMFS believes smalltooth sawfish are rare in the action area, the likelihood of their entrainment is very low, and the chances of the proposed action affecting them are discountable. This species will not be discussed further in this opinion.

4.3 SEA TURTLES IN THE GULF OF MEXICO

Inshore areas of the Gulf of Mexico appear to be important habitats for the Kemp's ridley. Members of this genus are characteristically found in waters of low salinity, high turbidity, high organic content, and where shrimp are abundant (Zwinenberg 1977, Hughes 1972). Adults tagged at Rancho Nuevo were recaptured off coastal Louisiana and in Vermilion Bay, and animals have been reported from Vermilion Parish to Terrebonne Parish (Pritchard and Marquez 1973; Chavez 1969; Keiser 1976; Zwinenberg 1977; Dobie *et al.* 1961). Ridleys are commonly captured by shrimpers off the Texas coast and in heavily trawled areas of the Louisiana and Alabama coast (Pritchard and Marquez 1973; Carr 1980).

Kemp's ridley has been labeled the "Louisiana turtle" by Hildebrand (1981) and is thought to be the most abundant turtle off the Louisiana coast (Viosca 1961; Gunter 1981). The highly productive white shrimp-portunid crab beds of Louisiana from Marsh Island to the Mississippi Delta, south of the study area are thought to be the major feeding grounds for subadult and adult ridley (Hildebrand 1981). The current patterns in the Gulf of Mexico could aid in transport of individuals, where small turtles would enter the major clockwise loop current of the western Gulf of Mexico, carrying individuals north and east along Texas, Louisiana, and other northern Gulf areas (Pritchard and Marquez 1973; Hildebrand 1981).

Beginning in April 1994, unprecedented numbers of Dead Sea turtles beached along the coasts of Louisiana and Texas. During 1994, a total of 174 turtles, including 134 Kemp's ridleys, stranded in Louisiana. An additional 488 turtles stranded on offshore Texas beaches during 1994, including almost 243 Kemp's ridley turtles and 190 loggerheads. The apparent cause of most of the strandings was the simultaneous occurrence of an intensive pulse of shrimping in an area of high Kemp's ridley abundance during 1994. Information regarding whether the abundance of sea turtles in the northern Gulf was a seasonal anomaly, or represents the current status of sea turtles in nearshore waters, is not available. The Louisiana Sea Turtle Stranding and Salvage Network (LA-STSSN) registered 373 sea turtles stranded on Louisiana beaches from 1990 through 1994. Of these, 268 were Kemp's ridleys, and 41 were unidentified (Koike 1995).

Stomach content analyses on sea turtles stranded in Texas suggest that, in all years, most mortalities occur in nearshore waters. Stomach contents of Kemp's ridleys along the lower Texas coast also showed a predominance of nearshore crabs and mollusks, as well as fish, shrimp and other foods considered to be shrimp fishery discards (Shaver 1991). Over 150 Kemp's ridleys have been intentionally live-captured by research gillnets in 1993 and 1994 at Sabine Pass by Texas A&M University scientists conducting research for the Corps of Engineers. This illustrates the availability of ridleys to human interactions in north Texas waters.

Findings of ongoing research conducted by NMFS scientists support the likelihood that the nearshore waters of Texas and Louisiana provide important developmental habitat for young loggerheads and Kemp's ridley sea turtles. Ogren (1988) suggests that the Gulf Coast from Port Aransas, Texas, through Cedar Key, Florida, represents the primary habitat for subadult ridleys in the northern Gulf of Mexico. One hundred and thirty turtles have been tracked by NMFS Galveston Lab staff since 1980, including 91 ridleys tracked since September 1988 with Corps support. Preliminary analysis of data collected suggests that subadult Kemp's ridleys occupy shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida Coast (Renaud, pers. comm.) Juvenile ridleys are usually found in waters of 9 meters or less, and all ridleys are generally found in water depths less than 18 meters (Renaud, draft in- house report transmitted December 8, 1994).

In addition to the NMFS studies, satellite transmitters have been applied to approximately 50 adult female Kemp's ridleys over the last decade to identify the movements of the females after leaving the nesting beach in Rancho Nuevo, Mexico (Byles, unpublished data). While most female ridleys head south towards the Bay of Campeche after leaving the beach, two out of eight turtles headed into nearshore Texas waters during one year's study. In 1994, of four turtles that were tagged, three went south and one went as far north as the vicinity of the mouth of the Mississippi River (Byles, pers. comm.) Clearly, reproductively active Kemp's ridleys, which are directly required for the recovery of the population, are found within the U.S. Gulf of Mexico, and are as vulnerable to human impacts as sub-adults.

Loggerhead turtle strandings have been reported in Louisiana from Cameron (Fuller 1986) as well as Holly Beach in August, and Isles Dernieres in July (SEAN 1980). A tagged loggerhead was recaptured near Grand Isle at Belle Pass (Lund 1974). More recently, LA-STSSN registered 45 loggerheads stranded on Louisiana beaches from 1990 through 1994. This represented 12 percent of the sea turtles stranded, second only to the Kemp's ridley.

Studies conducted on loggerheads stranded on the lower Texas coast (south of Matagorda Island) have indicated that stranded individuals were feeding in nearshore waters shortly before their death (Plotkin *et al.* 1993). Recent capture and telemetry studies of sea turtle movements along the northern Gulf of Mexico showed usage of the nearshore areas near jetties and channels. Kemp's ridleys were captured most frequently, and loggerheads were the second most frequently captured in Texas and Louisiana waters.

Historical sightings of green turtles by fishermen in Louisiana occurred gulfward of Isles Dernieres and Timbalier Islands in spring, summer, and fall. Recent sightings have been reported from the northwest areas of Terrebonne Bay in summer and off Belle Pass in fall (Fuller 1986). A green turtle also has been reported from the Chandeleur Islands (Viesca 1961). A green turtle was found in June on Grand Terre near Fort Livingston (SEAN 1980). No green turtles were observed during an aerial survey in Louisiana or Texas in 1979, possibly due to low abundance as well as identification problems. Green turtle stranding records, and turtle fishing records from Louisiana and Texas combined, are one-third that reported from Florida (Fritts *et al.* 1983). LA-STSSN registered 10 green turtles stranded on Louisiana beaches from 1990 through 1994. This represented 2.7 percent of the sea turtles stranded.

Historical sightings of leatherback turtles have been reported in Louisiana from Terrebonne Bay and Timbalier Bay. Sightings were noted by helicopter pilots in National Marine Fisheries Service statistical zones 12, 14 and 17 in January, March, and April (Fuller 1986). These zones include the area off Isles Dernieres and Timbalier Islands (Area 14) and off Cameron (Area 17). Leatherback turtles have been reported in aerial surveys off Marsh Island in April. They were observed in waters of a depth of 20 meters and 330 meters, approximately 55 and 190 kilometers from shore, respectively (Fritts *et al.* 1983). Low numbers of leatherback turtles reported by fishermen in coastal Louisiana may reflect low numbers in the area, or lack of fishing in areas where the species would occur (Fuller 1986). Only eight leatherbacks were stranded on Louisiana beaches from 1990 through 1994.

While there have been no sightings of hawksbill turtles in the proposed area of work, one was reported from a gillnet catch in Cameron Parish, Louisiana, in the 1986 survey of Louisiana coastal waters by the National Marine Fisheries Survey (Fuller *et al.* 1987). This supports the general belief that hawksbills are scarce in Louisiana waters. The stranding network data from 1990 through 1994 reported only one hawksbill stranding in Louisiana.

The LA-STSSN data (1990-1994) shows that of the reported 373 turtles stranded in Louisiana, approximately 60 percent were in Cameron Parish and 26 percent were in Jefferson Parish. Strandings in Lafourche Parish were somewhat frequent (eight percent), but the number of strandings in Terrebonne Parish was low (one percent). It should be noted that because of differences in beach access and coastline irregularities, reports are likely to reflect these influences.

4.3.1 GREEN SEA TURTLE (*CHELONIA MYDAS*)

The green turtle has worldwide distribution, concentrated primarily between 35° North and 35° South latitude. Green turtles tend to occur in waters that remain warmer than 20 C; however, there is evidence that they may be buried under mud in a torpid state in waters to 10 C (Ehrhart 1977; Carr *et al.* 1979). This species migrates between feeding and nesting areas, often over long distances (Carr and Hirth 1962). It is a large sea turtle with carapace length in adults commonly reaching one meter (NMFS and USFWS 1991).

In the United States' Atlantic waters, green turtles nest in small numbers in the U.S. Virgin Islands and Puerto Rico, and in larger numbers along the east coast of Florida. Estimates of age at sexual maturity range from 20 to 50 years (Balazs 1982; Frazer and Ehrhart 1985) and they may live over 100 years Zug *et al.* (1986).

During their first year of life, green sea turtles are thought to feed mainly on invertebrates, with adults preferring an herbivorous diet and frequenting shallow water flats for feeding (Fritts *et al.* 1983). The adult turtle feeds primarily on seagrasses (i.e., *Thalassia testudinum* and turtle grass), which have a high fiber content and low forage quality (Bjorndal 1981a) and algae (Bjorndal 1985). The Caribbean green turtle is considered by Bjorndal (1981b) to be nutrient-limited, resulting in low growth rate, delayed sexual maturity, and low annual reproductive effort. This low reproductive effort makes recovery of the species slow once the adult population numbers have been severely reduced (Bjorndal 1981). In the Gulf of Mexico, principal "feeding pastures" are located in the upper west coast of Florida (Hirth 1971). Nocturnal resting sites may be a considerable distance from feeding areas, and distribution of the species is generally correlated with grassbed distribution, location of resting beaches, and possibly ocean currents (Hirth 1971).

Immediately after hatching, green turtles swim past the surf and other shoreline obstructions, primarily at depths of 20 centimeters or less below the water surface, and are dispersed both by vigorous swimming and surface currents (Frick 1976; Balzas 1980). The whereabouts of hatchlings to juvenile size (35 centimeters) is uncertain. In the Hawaiian Archipelago, juveniles greater than 35 centimeters in length, as well as subadults, feed and rest in shallower coastal areas than adults. Hawaiian adult and immature turtles come inshore at certain undisturbed sites to bask or rest (Balzas 1980). Green turtles tracked in Texas waters spent more time on the surface, with less submergence at night than during the day, and a very small percentage of the time was spent in the Federally maintained navigation channels. The tracked turtles tended to utilize jetties, particularly outside of them, for foraging habitat (Renaud *et al.* 1993).

Most green turtle populations have been depleted or endangered because of direct exploitation or incidental drowning in trawl nets (King 1981). Defunct green turtle fisheries in Louisiana and

Texas indicate it was more common in areas where it is now rare (Rebel 1974, in Fritts *et al.* 1983). In Texas in the 1800's, the green turtle fishery was the first to appear and disappear. Animals were captured from April to November, primarily when they were returning to diurnal feeding areas from nocturnal resting places in deeper waters of bays (Hildebrand 1981). Green turtles in Texas still inhabit the same seagrass meadows as at the turn of the century, although in reduced numbers (Hildebrand 1981). In Florida, the nesting population was nearly extirpated within 100 years of the initiation of commercial exploitation (King 1981).

4.3.2 HAWKSBILL SEA TURTLE (*ERETMOCHELYS IMBRICATE*)

The hawksbill turtle is the second smallest sea turtle being somewhat larger than the Kemp's ridley. Nesting females average about 87 centimeters in curved carapace length (Eckert 1992). The adults are easily recognized by their thick carapace scutes, usually with radiating brown and black streaks on an amber background, and a jagged posterior margin on the carapace. The name of the turtle is derived from the tapered beak and narrow head.

These turtles generally live most of their life in tropical waters such as the warmer parts of the Atlantic Ocean, Gulf of Mexico and the Caribbean Sea (Carr 1952 and Witzell 1983). Florida and Texas are the only states where hawksbills are sighted with any regularity (NMFS and USFWS 1993). They are extremely rare in Louisiana waters.

Hawksbills nest throughout their range, but most of the nesting occurs on restricted beaches, to which they return each time they nest. The hawksbill breeds and nests in a diffuse rather than colonial nesting pattern in warm waters between 25° North and 25° South latitude (Rebel 1974). These turtles are some of the most solitary nesters of all the sea turtles. Depending on location, nesting may occur from April through November (Fuller *et al.* 1987).These turtles prefer to nest on clean beaches with greater oceanic exposure than those preferred by green sea turtles, although they are often found together on the same beach. The nesting sites are usually on beaches with a fine gravel texture. Hawksbills have been found in a variety of beach habitats ranging from pocket beaches only several yards wide formed between rock crevices to a low-energy sand beach with woody vegetation near the waterline. These turtles tend to use nesting sites where vegetation is close to the water’s edge. They do not nest in Louisiana.

Mating takes place offshore near the nesting sites. Males rarely come ashore. Mature females come to shore at night to prepare nests at the upper part of the beach. Females nest several times a season and have up to 200 eggs per clutch (NMFS and USFWS 1993). Each female may not reproduce every year. Young turtles dig out of nests and go to sea in search of food. Large numbers of young are normally lost to predation. Since the juvenile mortality rate is high, rapid growth and adult longevity tend to make most turtle populations consist of mainly larger turtles.

Juvenile hawksbills are normally found in waters less than 15 meters in depth. Areas around coral reefs, shoals, lagoons, lagoon channels and bays with marine vegetation that provides both protection and plant and animal food. The hawksbill can tolerate muddy bottoms with sparse vegetation unlike the green turtles.

The hawksbill was once thought to be a generalist or opportunistic feeder but studies now indicate that the primary food source is comprised of sponges and other encrusting organisms. Other organisms found in the diet are now believed to be incidental organisms living in association with the sponges which are being used for food (Meylan 1988). Adults forage around reefs up to 100 meters in depth and are not usually in shallow waters less than 20 meters in depth. Juveniles forage in shallow waters near the shallowest coral reefs. Offshore behavior of the turtles is not well understood. Both single and mated pairs of adult turtles and juveniles as well have been observed in all seasons in the Caribbean. It is thought they are foraging on the live bottom sponges in the area.

The hawksbill is probably a diurnal species and only feeds in daylight in captivity. These turtles go through a pelagic feeding phase as hatchlings and are normally associated with seaweed mats. During this phase the juveniles feed on the shallow reefs until they reach a length of 15-25 centimeters. As the turtles mature, they move from pelagic feeders to benthic feeders. With this change in feeding habits the foraging territory is moved further and further from shore to the deeper waters as the turtle improves its capability for deep dives.

4.3.3 KEMP'S RIDLEY SEA TURTLE (*LEPIDOCHELYS KEMPII*)

Almost all Kemp's ridley nesting occurs on a single beach at Rancho Nuevo, Mexico, about 30 kilometers south of the Rio Grande. There is some sporadic nesting along the Texas coast. Females arrive in small aggregations known as arribadas from mid-April through August (Rabalais and Rabalais 1980). Based on returns of females tagged on the nesting beach, most adult ridleys move to major foraging grounds to the south in the Campeche-Tabasco region and some move to the northern Gulf of Mexico (Chavez 1969). Members of this genus are usually found in water with low salinity, high turbidity, high organic content, and where shrimp are abundant (Zwinenberg 1977). Such conditions occur where major rivers enter the Gulf.

Stomach analysis of specimens collected in shrimp trawls off Louisiana includes crabs (*Callinectes*), gastropods *(Nassarius)*, and clams *(Nuculana, Corbula*, and probably *Mulinia)*, as well as mud balls, indicating feeding near a mud bottom in an estuarine or bay area (Dobie *et al*. 1961). Although considered primarily carnivorous benthic feeders (Ernst and Barbour 1972), jellyfish have also been reported as part of their diet (Fritts *et al.* 1983). Presence of fish such as croaker and spotted seatrout in the gut of stranded individuals in Texas may suggest that turtles feed on the bycatch of shrimp trawlers (Landry 1986).

Precise data regarding the total number of Kemp's ridleys occurring in the Gulf of Mexico are not available. Trends in turtle populations are identified through monitoring of their most accessible life stages on the nesting beaches, where hatchling production and the status of adult females can be directly measured. Population declines of the ridley have been attributed to egg stealing on the localized nesting beach, capture of diurnal nesting females, and fishing and accidental capture in shrimp trawls (Fuller 1978; Pritchard and Marquez 1973).

Film taken in 1947 documented over 40,000 nesting females in a single day during an arribada at Rancho Nuevo (Carr 1963). Bi-national protection and monitoring by Mexico and the United States has occurred on the nesting beach since 1978. Arribadas of up to 200 females have rarely been observed since the beginning of monitoring (U.S. Fish and Wildlife Service [USFWS) and NMFS 1992). Nest production plummeted to only 702 nests in 1985, but has been steadily increasing since that time (Byles, pers. comm.). Over 1,500 nests were observed during the 1994-nesting season, representing the highest nesting year since monitoring was initiated. While these data need to be interpreted cautiously due to expanded monitoring efforts since 1990, an estimated 107,687 hatchlings were released from Rancho Nuevo in 1994, compared to 45,000 to 80,000 from 1987 through 1991 (Byles, pers. comm.). In 1998, there were over 3,700 nests and 183,000 hatchlings; the number of nest declined slightly in 1999 with only 3,600, but hatchlings set a new record with over 225,000 (LSUCES 1999; LSUCES 2000).

Documented evidence and anecdotal accounts suggest a recent upward trend in the Kemp's ridley population. However, the Recovery Plan for the Kemp's ridley sea turtle *(Lepidochelys kemp1)* (USFWS and NMFS, 1992) has identified a recovery criteria of 10,000 nesting females in one season as a prerequisite for a determination that Kemp's ridleys can be down listed to a threatened status. Considering 58 percent of all adult females appear to nest in any one year, and each female lays an estimated 2.7 nests, 1,500 nests documented in 1994 represents less than 1,000 adult female Kemp's ridleys in the entire population. This is less than 2.5 percent of nesting females observed in one day in 1947, and only 5 percent of the down listing criterion identified in the Recovery Plan.

4.3.4 LEATHERBACK SEA TURTLE (*DERMOCHELYS CORIACEA*)

The leatherback is the largest sea turtle and is highly migratory, is the most pelagic of all sea turtles (NMFS and USFWS 1992), and is commonly occurring in continental shelf waters (Pritchard 1971; Hirth 1980; Fritts *et al.* 1983). It is a temperate zone form with a tropical nesting range (Ross 1981). Distribution of this species has been linked to thermal preference and seasonal fluctuations in the Gulf Stream and other warm water features (Fritts *et al.* 1983). General decline of this species is attributed to exploitation of eggs (Ross 1981).

Nesting of leatherback turtles is nocturnal with nesting in the United States in the Gulf of Mexico (Florida) from April to late July (Pritchard 1971; Fuller 1978; Fritts *et al.* 1983). The Pacific coast of Mexico supports the world’s largest known concentration of nesting leatherbacks. There is very little nesting in the United States and no nesting has been reported from Louisiana (Gunter 1981). A small number nest on the west coast of Florida from April to late July (Pritchard 1971; Fulller 1978; Fritts 1983).

Leatherback turtles feed primarily on jellyfish and other coelenterates. They will also ingest plastic bags and other plastic debris, which is commonly generated by oil drilling rigs and production platforms in coastal Louisiana (Fritts *et al.* 1983).

4.3.5 LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*)

The loggerhead is found in temperate and subtropical waters worldwide. The principal nesting range of the loggerhead is from Cape Lookout, North Carolina, to Mexico. The majority (90 percent) of the reproductive effort in the coastal United States occurs along the south-central east coast of Florida (Hildebrand 1981). Nesting in the northern Gulf outside of Florida occurs primarily on the Chandeleur Islands and to a lesser extent on adjacent Ship, Horn, and Petit Bois Islands in Mississippi and Alabama (Ogren 1977). Loggerhead eggs were collected from Grand Isle, Louisiana, 50 years ago (Hildebrand 1981). Ogren (1977) reported a historical reproductive assemblage of sea turtles, which nested seasonally on remote barrier beaches of eastern Louisiana, Mississippi, and Alabama. This included Bird, Breton, and Chandeleur Islands in Louisiana.

Loss or degradation of suitable nesting habitat may be the most important factor affecting the nesting population in Louisiana (Ogren 1977). Overall loss of nesting beaches, hatchling disorientation from artificial light, drowning in fishing and shrimping trawls, marine pollution, and plastics and Styrofoam have led to the decline of loggerheads.

Loggerhead turtles are considered turtles of shallow water, less than 50 meters deep (Rabalais and Rabalais 1980). Juvenile loggerheads are thought to utilize bays and estuaries for feeding, while adults prefer waters less than 50 meters deep (Nelson 1986). During aerial surveys of the Gulf of Mexico, the majority (97 percent) of loggerheads were seen off the east and west coasts of Florida (Fritts 1983). Most were observed around mid-day near the surface, possibly related to surface basking behavior (Nelson 1986). Although loggerheads were seen off the coast of Louisiana and Texas, they were 50 times more abundant in Florida than in the western Gulf. The majority of the sightings were in the summer (Fritts *et al.* 1983). Loggerheads migrate west along with shallow coastal waters, as indicated by telemetry data from an individual tagged in the Mississippi Delta moving to Corpus Christi (Solt 1981).

Loggerheads are frequently observed near offshore oil platforms, natural rock reefs, and rock jetties in Texas. Large numbers of stranded turtles were observed inshore of such areas (Rabalais and Rabalais 1980). Oyster fishermen have reported large turtles near oyster reefs in Louisiana. In a recent tracking study, loggerheads spent more than 90 percent of the time underwater, tended to avoid colder water, and spent much of the time in the vicinity of oil and gas structures (Renaud and Carpenter, in preparation).

Food of loggerheads consists of mollusks, crabs, shrimp, sea urchins, sponges, squid, basket stars, jellyfish, and even mangrove leaves in the shallows (Caldwell *et al.* 1955; Hendrickson 1980; Nelson 1986). Presence of fish species such as croaker in stomachs of stranded individuals may indicate feeding on the by-catch of shrimp trawling (Landry 1986). They appear to be well adapted for feeding on mollusks with a heavy jaw and head (Hendrickson 1980). Caldwell *et al.* (1955) suggest that the willingness of the loggerhead to consume any type of invertebrate food permits its range to be limited only by the presence of cold water. In shallow Florida lagoons, loggerheads were found during the morning and evening, leaving the area during mid-day when temperatures reached 31°C. At dusk, turtles moved to a sleeping site and remained there until morning, possibly in response to changes in light or water temperature (Nelson 1986).

4.4 WEST INDIAN MANATEE (*TRICHECHUS MANATUS*)

The West Indian manatee was listed as endangered throughout its range for both the Florida and Antillean subspecies in 1967, and received Federal protection with the passage of the ESA in

1973. Critical habitat was designated in 1976, 1994, 1998, 2002, and 2003 for the Florida subspecies.

The West Indian manatee is a large gray or brown aquatic mammal. Adults average approximately 10 feet (3 meters) in length and weigh up to 2,200 pounds (999 kilograms). They have no hind limbs, and their forelimbs are modified as flippers. Manatee tails are flattened horizontally and rounded. Their body is covered with sparse hairs and their muzzles with stiff whiskers (USFWS, 2001c). The nostrils, located on the upper snout, open and close by means of muscular valves as the animal surfaces and dives (Husar, 1977; Hartman, 1979). Manatees will consume any aquatic vegetation (i.e., submerged, floating, and emergent) available to them and sometimes even shoreline vegetation. Although primarily herbivorous, they occasionally feed on fish. Manatees may spend about five hours a day feeding, and may consume four to nine percent of their body weight per day.

Observations of mating herds indicate that females mate with a number of males during their 2- to 4-week estrus period; pregnancy is estimated to last 12 to 14 months (O'Shea *et al.* 1992). Births occur year-round with a slight drop during winter months. Manatee cows usually bear a single calf, but 1.5 percent of births are twins. Calves reach sexual maturity at three to six years of age. Mature females may give birth every two to five years (USFWS, 2001c).

Manatees inhabit both salt and fresh water of sufficient depth (5 feet [1.5 meters] to usually less than 20 feet [6.1 meters]) throughout their range. Shallow grassbeds with ready access to deep channels are preferred feeding areas in coastal and riverine habitats (USFWS, 2001c). They may also be encountered in canals, rivers, estuarine habitats, saltwater bays, and have been observed as much as 3.7 miles (6.0 kilometers) off the Florida Gulf Coast. Between October and April, Florida manatees concentrate in areas of warmer water. Severe cold fronts have been known to kill manatees when the animals did not have access to warm water refuges. During warmer months, they appear to choose areas based on an adequate food supply, water depth, and proximity to fresh water. Manatees may not need fresh water, but they are frequently observed drinking water from hoses, sewage outfalls, and culverts.

During winter months, the United States' manatee population is confined to the coastal waters of the southern half of peninsular Florida and to springs and warm water outfalls as far north as southeast Georgia. Power plant and paper mill outfalls create most of the artificial warm water refuges utilized by manatees. During summer months, they migrate as far north as coastal Virginia on the east coast and the Louisiana coast in the Gulf of Mexico.

During summer months, manatees disperse from winter aggregation areas, and are commonly found almost anywhere in Florida where water depths and access channels are greater than 3.3 to 6.6 feet (1.0 to 2.0 meters) (O'Shea, 1988). In the warmer months, manatees usually occur alone or in pairs, although interacting groups of five to ten animals are not unusual (USFWS 2001c).

In the early 1980s, scientists tried to develop procedures for estimating the overall manatee population in the southeastern United States (USFWS, 2001c). The best estimate throughout the State of Florida was 1,200 manatees (Reynolds and Wilcox, 1987). In the early 1990s, the

State of Florida initiated a statewide aerial survey in potential winter habitats during periods of severe cold weather (Ackerman, 1995), and the highest count of 3,276 manatees was recorded in January 2001.

The most significant problem faced by manatees in Florida is death or injury from boat strikes (USFWS, 2001c). Minimum flows and levels for warm water refuges need to be established to ensure their long-term availability for manatees. Their survival will depend on maintaining the ecosystems and habitat sufficient to support a viable manatee population (USFWS, 2001c). The focus of recovery is on implementing, monitoring, and addressing the effectiveness of conservation measures to reduce or remove threats that will lead to a healthy and self-sustaining population (USFWS, 2001c).

The West Indian manatee is also protected under the Marine Mammal Protection Act (MMPA) of 1972. The MMPA establishes a national policy for the maintenance of health and stability of marine ecosystems and for obtaining and maintaining optimum sustainable populations of marine mammals. It includes a moratorium on the taking of marine mammals. The recovery planning under the ESA includes conservation planning under the MMPA (USFWS, 2001c).

4.5 SPERM WHALE (*PHYSETER MACROCEPHALUS*)

Sperm whales were once quite numerous in the Gulf of Mexico, enough so to justify full-scale commercial whaling operations (Lowery 1974). Although no longer common in the Gulf of Mexico, the species has been observed on several occasions in recent years off the mouth of the Mississippi River by fishermen and personnel on exploratory research vessels of the NMFS (Lowerey 1974). Sperm whales were observed 229 miles off the coast of Louisiana in 1980 by Fritts *et al.* 1983a.

Three strandings along the coast of Louisiana have been reported. An individual stranded near Sabine Pass in 1910, another stranded in 1960 at the mouth of the Mississippi River near Pass a Loutre, and a third stranded on the central coast of Louisiana in Terrebonne Parish in 1977 (Schmidly 1981).

4.6 SEI WHALE (*BALAENOPTERA BOREALIS*)

Sei whales occur in all oceans, but are rare in tropical and polar seas. They are widely distributed in nearshore and offshore waters of the western north Atlantic from the Gulf of Mexico and the Caribbean Sea to Nova Scotia and Newfoundland (Leatherwood *et al.* 1976).

Records from the Gulf of Mexico are limited to strandings near Campeched, Mexico and the coasts of Louisiana and Mississippi. The record from Louisiana is of an individual that stranded near Fort Bayou on the western edge of Breton Sound in 1956. The record from Mississippi is of the specimen originally reported as a finback whale. This whale entered Mississippi Sound in 1967 and subsequently died near the entrance to the harbor at Gulfport, Mississippi (Gunter and Christmas 1973). The authors believed this occurrence would not have been possible except for the deep navigation channel leading into Gulfport.

4.7 HUMPBACK WHALE (*MEGAPTERA NOVAEANGLIAE*)

Humpback whales occur in all oceans. They are a coastal species and feed primarily on krill and fish. The western north Atlantic stock is migratory. Their summer range is from Cape Cod to Iceland, and their winter calving grounds are in the Caribbean Sea (Schmidldy 1981).

The only recent record for the Gulf of Mexico is of an individual sighted in 1962 at the mouth of Tampa Bay (Layne 1965).

4.8 FINBACK WHALE (*BALAENOPTERA PHYSALUS*)

The finback whale is the second largest baleen whale. It feeds primarily on krill and small schooling fish. In the western north Atlantic they occur from Greenland south to the Gulf of Mexico and the Caribbean Sea (Leatherwood *et al.* 1976). They may occur year-round in the Gulf of Mexico; however, no finbacks were sighted during aerial surveys conducted in 1980-1981 (Fritts *et al.* 1983a).

Finbacks have stranded in the Gulf of Mexico along the coasts of Florida, Louisiana, and Texas. Standing records for Louisiana include Isles Dernieres off Terrebonne Parish in 1915, Pelican Island on the western edge of Breton Sound in 1917, near Sabine Pass in 1924, the Chandeleur Islands in 1928, and in the marsh west of Venice in 1968 (Lowery 1974). A whale that stranded in Mississippi Sound in 1967 was originally reported as a finback but was later determined to be a sei whale.

4.9 BLUE WHALE (*BALAENOPTERA MUSCULUS*)

Blue whales are found in all oceans and are separated into populations by ocean basin in the North Atlantic, North Pacific, and Southern Hemisphere. They migrate seasonally between summer and winter, but some evidence suggests that individuals remain in certain areas year-round. Information about distribution and movement varies with location, and migratory routes are not well known. In general, distribution is driven largely by food requirements--they occur in waters where krill is concentrated. In addition, some evidence suggests that blue whales occur infrequently in the Gulf of Mexico and the Caribbean. The blue whale is listed as endangered throughout its range under the ESA, and, thus, is listed as depleted throughout its range under the MMPA. Internationally, blue whales received complete legal protection from commercial whaling in 1966 under the International Convention for the Regulation of Whaling. The NMFS believes blue whales are rare in the action area and the likelihood of their entrainment is very low, and the chances of the proposed action affecting them are discountable. This species will not be discussed further in this opinion.

4.10 NORTHERN RIGHT WHALE (*EUBALAENA GLACIALIS*)

Right whales occur in the temperate waters of the north Atlantic, the north Pacific, and the southern hemisphere. In the western north Atlantic, right whales are distributed from Iceland to Florida and the Gulf of Mexico (Leatherwood 1976).

They have been recorded only twice from the Gulf of Mexico and their status is questionable. Two right whales were reported off New Pass, Florida in 1963, and in 1972 one washed ashore near Freeport, Texas (Schmidly 1981).

4.11 PIPING PLOVER (*CHARADRIUS MELODUS*)

Piping plovers breed in northern latitudes in three geographic regions and winter along the south Atlantic and Gulf coasts, including coastal Louisiana. Overwintering populations in Louisiana occur on beaches, sandflats, and dunes in Cameron Parish in the west and Jefferson Parish (Grand Terre Island and Grand Isle) in the east in 1987 (USFWS 1988). Numbers are highly variable, based on recent census data provided by Steve Shively of the Louisiana Department of Wildlife and Fisheries. They do occur on the Isle Dernieres barrier island chain in Terrebonne Parish. Historically, piping plovers also have been reported from Calcasieu, Vermilion, East Baton Rouge, and Orleans parishes. Not much is known about their nonbreeding habitat.

Piping plovers begin arriving at the northern United States and southern Canada breeding grounds in mid-April (Prindiville 1986).They are known to nest with least tern, arctic terns, and common terns (USFWS 1985; Cairns 1977). They breed in open, sparsely vegetated habitats that are slightly raised in elevation. Egg laying occurs in May with clutch size equaling four and 1-2 chicks fledging at about four weeks old (Haig and Oring 1985). The adults leave nesting grounds in late July-early August, with the juveniles following a few weeks later (Wiens 1986). Birds normally return to the same breeding area (Haig 1987), but occasionally they go to other areas (Haig and Oring 1988).

Primary prey for wintering plover includes polychaete marine worm, various crustaceans, insects, and occasionally bivalve mollusks. Chicks feed on smaller sizes of these same foods shortly after they hatch.

There were just over 2,000 breeding pairs in 1986-1987. This number is not comparable to historical numbers because data is lacking. Piping plovers can apparently live five years or somewhat longer (Wilcox 1957). In 1990 there were an estimated 1,840 breeding pairs (FWS 1991).

Critical habitat has been designated for piping plovers in both their breeding and wintering grounds. Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering, and the physical features necessary for maintaining the natural processes that support these habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide) and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent un-vegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers.

4.12 RED KNOT (*CALIDRIS CANTUS RUFA*)

The red knot is a medium-sized shorebird about 9 to 11 inches (23 to 28 centimeters) in length with a proportionately small head, small eyes, short neck, and short legs. The black bill tapers steadily from a relatively thick base to a relatively fine tip; bill length is not much longer than head length. Legs are typically dark gray to black, but sometimes greenish in juveniles or older birds in non-breeding plumage. Non-breeding plumage is dusky gray above and whitish below. The red knot breeds in the central Canadian arctic but is found in Louisiana during spring and fall migrations and the winter months (generally September through March). During migration and on their wintering grounds, red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks. Observations along the Texas coast indicate that red knots forage on beaches, oyster reefs, and exposed bay bottoms, and roost on high sand flats, reefs, and other sites protected from high tides. In wintering and migration habitats, red knots commonly forage on bivalves, gastropods, and crustaceans. Coquina clams *(Donax variabilis)*, a frequent and often important food resource for red knots, are common along many gulf beaches. Piping plover and red knot share similar habitats and winter and migration patterns in Louisiana. Major threats to this species along the Gulf of Mexico include the loss and degradation of habitat due to erosion, shoreline stabilization, and development; disturbance by humans and pets; and predation.

The red knot was listed as threatened in 2014. As required by the ESA, USFWS is reviewing the U.S. range of the red knot to identify critical habitat.

5.0 DETERMINATION OF EFFECTS OF THE PROPOSED ACTION

The potential exists that the protected species in the study area may be present during proposed construction activities. However, while individuals may be affected, whole populations would not be adversely affected by implementation of the proposed action.

5.1 GULF STURGEON

The proposed action would involve activities outside the critical habitat of the Gulf sturgeon. Potential project-induced impacts, however unlikely, may result from incidental interaction with the Gulf sturgeon during the excavation for the construction of gaps in the dredged material banks of the ARDC. The scope of activities constitutes a “Not Likely to Adversely Affect” determination for the species and its critical habitat.

5.2 SEA TURTLES

Recent research has shown that sea turtles are virtually absent from the nearshore waters of the northern Gulf from December through March (Renaud *et al.* 1995) and would not ever be present far enough inland to be directly impacted by any of the alternatives. This leaves only the possibility of indirect and/or cumulative impacts to sea turtles. Hawksbill and leatherback sea turtles are very unlikely to occur near the study area. Green and loggerhead sea turtles are unlikely to occur, but Kemp's ridley sea turtles may be found in coastal waters near the study area during the summer. Sea turtles (Kemp's ridley) are known to occur in the nearshore environment of the Gulf of Mexico some 15 kilometers (9 miles) south of the closest possible work areas along Highway 57. Therefore, dredging and other construction activities would not be expected to impact areas occupied by Kemp's ridley sea turtle.

5.3 WEST INDIAN MANTATEE

Sightings of the West Indian manatee in Louisiana have occurred in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, Mississippi River Gulf Outlet (MRGO), and in canals within the adjacent coastal marshes of Louisiana. However, there is no known population thriving in the State. On July 9, 2001, a manatee was observed passing safely through the Inner Harbor Navigation Canal (IHNC) Lock and into the Mississippi River. Should any manatees be encountered during the proposed activities, an on-board observer would notify the proper personnel, and harmful activities (e.g., dredging) would be temporarily suspended until the animal(s) moves out of the area of operations. Any disturbance to the manatee would only be temporary during construction activities, and would result in temporary displacement. The manatees would likely move and relocate to other nearby areas for foraging or resting purposes. The scope of activities constitutes a “Not Likely to Adversely Affect” determination for the species and its critical habitat.

Because the West Indian manatee may occur in the project vicinity, the Contractor shall instruct all personnel associated with the project of the potential presence of manatees in the area, and the need to avoid collisions with these animals. All construction personnel shall be advised that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. The Contractor shall be held responsible for any manatee harmed, harassed, or killed as a result of construction activities not conducted in accordance with these specifications.

a. Special Operating Conditions If Manatees Are Present in the Project Area

(1) If a manatee(s) is sighted within 100 yards (91 meters) of the project area, all appropriate precautions shall be implemented by the Contractor to ensure protection of the manatee. These precautions shall include the operation of all moving equipment no closer than 50 feet (15.2 meters) of a manatee. If a manatee is closer than 50 feet (15.2 meters) to moving equipment or the project area, the equipment will be shut down and all construction activities will cease to ensure protection of the manatee.

Construction activities will not resume until the manatee has departed and the 50-foot (15.2 m) buffer has been re-established.

(2) If a manatee(s) is sighted in the project area, all vessels associated with the project shall operate at "no wake/idle" speeds at all times while in waters where the draft of the vessel provides less than a four-foot (1.2 meters) clearance from the bottom, and vessels will follow routes of deep water whenever possible. Boats used to transport personnel shall be shallow-draft vessels, preferably of the light-displacement category, where navigational safety permits.

(3) If siltation barriers are used, they will be made of material in which manatees cannot become entangled, are properly secured, and are regularly monitored to avoid manatee entrapment.

(4) Manatee Signs. Prior to commencement of construction, each vessel involved in construction activities shall display at the vessel control station or in a prominent location, visible to all employees operating the vessel, a temporary sign at least 8-1/2 inches x 11 inches (21.6 x 27.9 centimeters) reading, "CAUTION: MANATEE HABITAT/IDLE SPEED IS REQUIRED IN CONSTRUCTION AREA." In the absence of a vessel, a temporary 3 foot x 4 foot (0.9 x 1.2 meters) sign reading "CAUTION: MANATEE AREA" will be posted adjacent to the issued construction permit. A second temporary sign measuring 8-1/2 inches x 11 inches (21.6 x 27.9 centimeters) reading "CAUTION: MANATEE HABITAT. EQUIPMENT MUST BE SHUT DOWN IMMEDIATELY IF A MANATEE COMES WITHIN 50 FEET OF OPERATION" will be posted at the dredge operator control station and at a location prominently adjacent to the issued construction permit. The Contractor shall remove the signs upon completion of construction.

b. Manatee Sighting Reports

Any sightings of manatees, or collisions with a manatee, will be reported immediately to the Corps of Engineers. The point of contact within the USACE will be Edward Creef, (504) 862-2521, FAX (504) 862-2317.

Whales are extremely unlikely to be found anywhere near the study area. No adverse impacts would be expected to whales with any of the alternatives.

5.4 WHALES

Sperm whales (*Physeter macrocephalus*) are found year-round in the Gulf of Mexico but rarely occur within inshore waters. Other endangered whales, including the blue whale (*Balaenoptera musculus*), sei whale (*B. borealis*), fin whale (*B. physalus*), humpback whale (*Megaptera novaeangliae*), and the northern right whale (*Eubalaena glacialis*) have been observed occasionally in the Gulf of Mexico. It is believed individuals observed have likely been inexperienced juveniles straying from the normal range of these stocks, or occasional transients (in April 2004, a right whale mother and calf were spotted several miles off of Panama City Beach, Florida). NMFS believes there are no resident stocks of right or humpback whales in the Gulf of Mexico. Blue, fin, and sei whales are deepwater species found offshore which are unlikely to be found near hopper dredging sites. There has never been a report of a whale taken by a hopper dredge. Therefore, based on the improbability of their presence, feeding habits, and very low likelihood of hopper dredge interaction, the above-mentioned cetaceans will not be discussed further in this opinion. There is no designated critical habitat for any protected species in or near the action area; therefore, effects to critical habitat are not evaluated in this opinion.

5.5 PIPING PLOVER

Piping plover do overwinter in southern most portions of the study area but not within the actual impact area of the recommended plan so they would not be adversely impacted. During construction activities associated with the project any piping plover within the area will be temporarily displaced. The proposed action will create 2,114 acres of marsh in areas that are currently open water which will provide temporary foraging habitat for the Piping Plover until the mud flats become vegetated. The placement of this material will expose marine worms, mollusks, crustaceans and other small marine animals within the area allowing for easy foraging access to plovers in the area. As the marsh becomes vegetated there is potential for an increase in the number of mudflats within these areas that are presently open water. It is expected that the TRP is not likely to adversely affect the species.

5.6 RED KNOT

Red Knot and piping plover share similar habitats and winter and migration patterns in Louisiana. Major threats to this species along the Gulf of Mexico include the loss and degradation of habitat due to erosion, shoreline stabilization, and development; disturbance by humans and pets; and predation. In some localized areas, red knots will use artificial habitats that mimic natural conditions, such as nourished beaches, dredged spoil sites, elevated road causeways, or impoundments; however, there is limited information regarding the frequency, regularity, timing, or significance of red knots' use of such artificial habitats. During construction activities associated with the project, any red knot within the area will be temporarily displaced. The proposed action will create 2,114 acres of marsh in areas that are currently open water which will provide temporary foraging habitat for the red knot until the mud flats become vegetated. The placement of this material will expose marine worms, mollusks, crustaceans and other small marine animals within the area allowing for easy foraging access to red knots in the area. As the marsh becomes vegetated there is potential for an increase in the number of mudflats within these areas that are presently open water. It is expected that the TSP is not likely to adversely affect the species.

6.0 CONCLUSIONS

The TSP would not have adverse impacts upon threatened and endangered species, provided that work areas do not expand to the south of the study area and that the precautions noted above are followed.

7.0 LITERATURE CITED

Ackerman, B.B. 1995. Aerial surveys of manatees: a summary and progress report. Pp. 13-33 *in* T.J. O'Shea, B.B. Ackerman, and H.F. Percival (eds.). Population Biology of the Florida Manatee. National Biological Service, Information and Technology Report No. 1. Washington, D.C.

Boschung, H (ed.). 1976. Endangered and threatened plants and animals of Alabama. Bull. AL Mus.Nat. Hist. No. 2. Univ.of AL, Tuscaloosa, AL. Pp. 57.

Clugston, J.P., A.M. Foster, and S.H. Carr. 1995. Gulf sturgeon, *Acipenser oxyrhynchus desotoi*, in the Suwannee River, Florida, USA. Proc. of International Symposium on Sturgeons. Moscow, Russia. Editors: A.D. Gershanovich and T.I.J. Smith. Sept. 6-11, 1993. 370 pp.

Foster, A.M. 1993. Movement of Gulf sturgeon, *Acipenser oxyrhynchus desotoi*, in the Suwannee River, Florida. Master Thesis, Univ. of FL, Gainesville, FL. 131 pp.

Fox, D. A.; Hightower, J. E.; Parauka, F. M. 2000. Gulf sturgeon spawning migration and habitat in the Choctawhatchee River system, Alabama-Florida. Trans. Amer. Fish. Soc. 129: 811-826.

Fox, D., Hightower, J. and F. Parauka. 2002. Estuarine and nearshore marine habitat use by gulf sturgeon from the Choctawhatchee River System, Florida. Amer. Fish. Society Symposium 28, 111-126.

Hartman, D.S. 1979. Ecology and behavior of the manatee (*Trichechus manatus*) in Florida. Amer. Soc. Mammalogists Spl. Publ. No. 5. 153 pp.

Huff, J.A. 1975. Life history of the Gulf of Mexico sturgeon, *Acipenser oxyrhynchus desotoi*, in Suwannee River, FL. Mar. Res. Publ. No. 16. 32 pp.

Husar, S.L. 1977. The West Indian manatee (*Trichechus manatus*). U.S. Fish and Wildlife Service. Wildl. Res. Rpt. No. 7: 1-22.

Mason, W.T. Jr., and J.P. Clugston. 1993. Foods of the Gulf sturgeon in the Suwannee River, Florida. Trans. Amer. Fish. Soc. 122: 378-385.

McDowall, R.M. 1988. Diadromy in fish migrations between freshwater and marine environments. Truder Press and Croom Helm. 308 pp.

Morrow, J.V. Jr. J.P. Kirk, and K.J. Killgore. 1998. Status and Recovery Potential of Gulf Sturgeon in the Pearl River System, Louisiana–Mississippi. No. Amer. J. Fish. Mg .1998; 18: 798-808

Odenkirk, J.S. 1989. Movements of Gulf of Mexico sturgeon in the Apalachicola River, Florida. Proc. Ann. Conf., Southeastern Assoc. Fish & Wildl. Agencies 43: 230-238.

O'Shea, T.J., B.B. Ackerman, and H.F. Percival (eds.). 1992. Interim report of the technical workshop on manatee population biology. Manatee Population Res. Rpt. No. 10. FL Coop. Fish & Wildl. Res. Unit. Gainesville, FL. 83 pp.

Parauka, F.M., W.J. Troxel, F.A. Chapman, and L.G. McBay. 1991. Hormone-induced ovulation and artificial spawning of Gulf of Mexico sturgeon, *Acipenser oxyrhynchus desotoi*. Prog. Fish-Culturist 53(2): 113-117.

Reynolds, J.E. III and J.R. Wilcox. 1987. People, power plants, and manatees. Sea Frontiers 33(4):263-269.

Rogillio, H.E., R.T. Ruth, E.H. Behrens, C.N. Doolittle, W.J. Granger, and J.P. Kirk. 2007. Gulf sturgeon movements in the Pearl River drainage and the Mississippi Sound. No. Amer. J. Fish. Mgt. 27:89-95.

U.S. Army Corps of Engineers. 2006. Draft Biological Assessment: Impacts of USACE Navigational Projects on the Gulf Sturgeon in Louisiana. New Orleans, LA. 43 pp.

U.S. Fish and Wildlife Service. 2001c. Florida manatee recovery plan. Southeast Region, U.S. Fish and Wildlife Service, Atlanta, GA. 144 pp. + App.

U.S. Fish and Wildlife Service. 2007. National Bald Eagle Management Guidelines. U.S. Fish and Wildlife Service. 23 pp.

Vladykov, V.D., and J.R. Greely. 1963. Oder Acipenseroidei. In fishes of the western North Atlantic. Mem. Sears Found. Mar. Res. 1(3): 24-58.

Wooley, C.M., and E.J. Crateau. 1985. Movement, microhabitat, exploitation and management of Gulf of Mexico sturgeon, Apalachicola River, Florida. N. Amer. J. Fish. Mgt. Pp. 590-605.

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Coastal Zone Consistency Determination

LOUISIANA COASTAL RESOURCES PROGRAM
CONSISTENCY DETERMINATION

Louisiana Coastal Use Guidelines

Houma Navigation Canal Deepening Project
Terrebonne Parish, Louisiana

INTRODUCTION

Section 307 of the Coastal Zone Management Act of 1972, 16 U.S.C. 1451 et. seq. requires that "each Federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs." In accordance with Section 307, the Louisiana Department of Transportation and Development (LADOTD) has prepared a Consistency Determination for the Houma Navigation Canal Deepening project. Coastal Use Guidelines were written in order to implement the policies and goals of the Louisiana Coastal Resources Program, and serve as a set of performance standards for evaluating projects. Compliance with the Louisiana Coastal Resources Program, and therefore, Section 307, requires compliance with applicable Coastal Use Guidelines.

PURPOSE AND NEED FOR THE PROPOSED ACTION

The LADOTD has developed this Section 203 study to determine the feasibility of deepening the existing Houma Navigation Canal Federal project and to identify the National Economic Development (NED) plan. The NED plan has the greatest net economic benefits consistent with protection of the Nation's environment. This feasibility study has been developed together with an EIS as required by the National Environmental Policy Act of 1969 (NEPA).

An updated report, *Economic Benefits of Houma Navigation Canal Deepening* (Appendix D), reanalyzes the NED benefits of deepening the HNC. This analysis was originally conducted in 2006 and updated in 2016. The 2016 update incorporates the prior reports, including the results of a time series of market interviews and assessments conducted in relation to traditional NED benefits analyses of waterway improvements and fabrication benefits related to the deepwater oil and gas sector. The report complies with guidance provided by Section 6009 of the Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Tsunami Relief, 2005 (PL 109-13) dated May 11, 2005, which states:

> *SEC. 6009. OFFSHORE OIL AND GAS FABRICATION PORTS.*
> *In determining the economic justification for navigation projects involving offshore oil and gas fabrication ports, the Secretary of the Army, acting through the Chief of Engineers, is directed to measure and include in the National Economic Development calculation the value of future energy exploration and production fabrication contracts and transportation cost savings that would result from larger navigation channels.*

The analysis of deepening alternatives has been limited to a maximum channel elevation of −20 feet NAVD88. The non-Federal project cost share increases from 20 to 35 percent for Federal navigation projects deeper than −20 feet elevation. In accordance with ER 1105-2-100, dated April 22, 2000, if the non-Federal sponsor identifies a constraint to maximum physical project size or a financial constraint due to limited resources, and if net benefits are increasing as the constraint is reached, the requirement to formulate larger scale plans in an effort to identify the NED plan is suspended. However, the constrained plan may be recommended.

LOCATION AND GENERAL DESCRIPTION OF THE STUDY AREA

The Houma Navigation Canal is a Federally maintained waterway that connects the Gulf Intracoastal Waterway (GIWW) in Houma with the Gulf of Mexico (Figures 1 and 2). The HNC is located in south-central Terrebonne Parish, approximately 50 miles southwest of New Orleans. The project area is within the Barataria-Terrebonne National Estuary, one of the most expansive and productive estuaries in the U.S. and is located in the following sections:

- T17S R17E, Sections 11, 12
- T18S R18E, Section 73, 74, 75, 78, 80, and 81
- T19S R17E, Sections 1, 23, 43-51, 66, 75, 78, 87, 88,
- T20S R17E, Sections 4,5,8,9, 16, 17, 20, 21, 33, 34, 37
- T21S R17E, Sections 2,3,10,11
- T21S R18E, Sections 59-78
- T22S R18E, Sections 3, 4, 8, 9, 10
- T23S R18E, Sections 7,8

For planning purposes, the study area has been divided into three reaches (Figure 2). Each reach was identified based on hydrologic differences and boundaries.

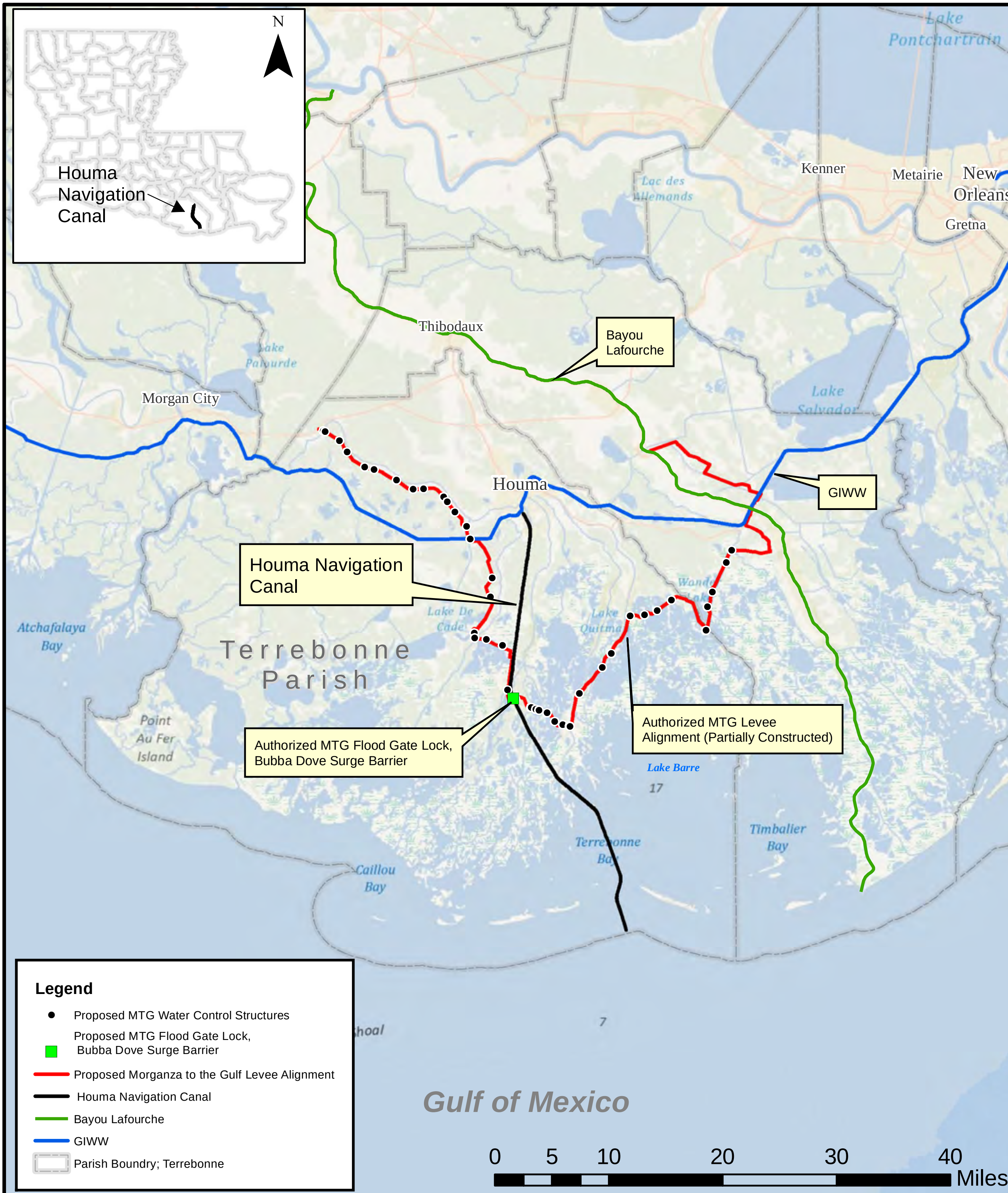
DESCRIPTION OF THE PROPOSED ACTION

Alternative 2A of the HNC Deepening Study, Integrated Feasibility Report and Environmental Impact Statement (FR/EIS) is the Tentatively Selected Plan (TSP). Features of the TSP include:

- Deepening the channel to an elevation of -20 feet NAVD88.
- Construction of rock foreshore protection and retention dikes for channel bank erosion control and for retention of dredged material.
- Placement of dredged material in disposal sites that have been selected based on opportunities for habitat creation for ecosystem restoration (Figures 3 and 4).

Channel Deepening

The primary feature of the recommended plan consists of deepening the HNC from the present maintained elevation of −15 feet MLG to an elevation of −20 feet NAVD88. The design width would remain the same as that of the currently authorized project (150 feet between Miles 36.3 and 0.0; and 300 feet between Miles 0.0 and −3.7). The side slopes of the channel would be 1V on 3H for the entire length of the HNC.



VICINITY MAP

Houma Navigation Canal Deepening

ERSI Ocean Map

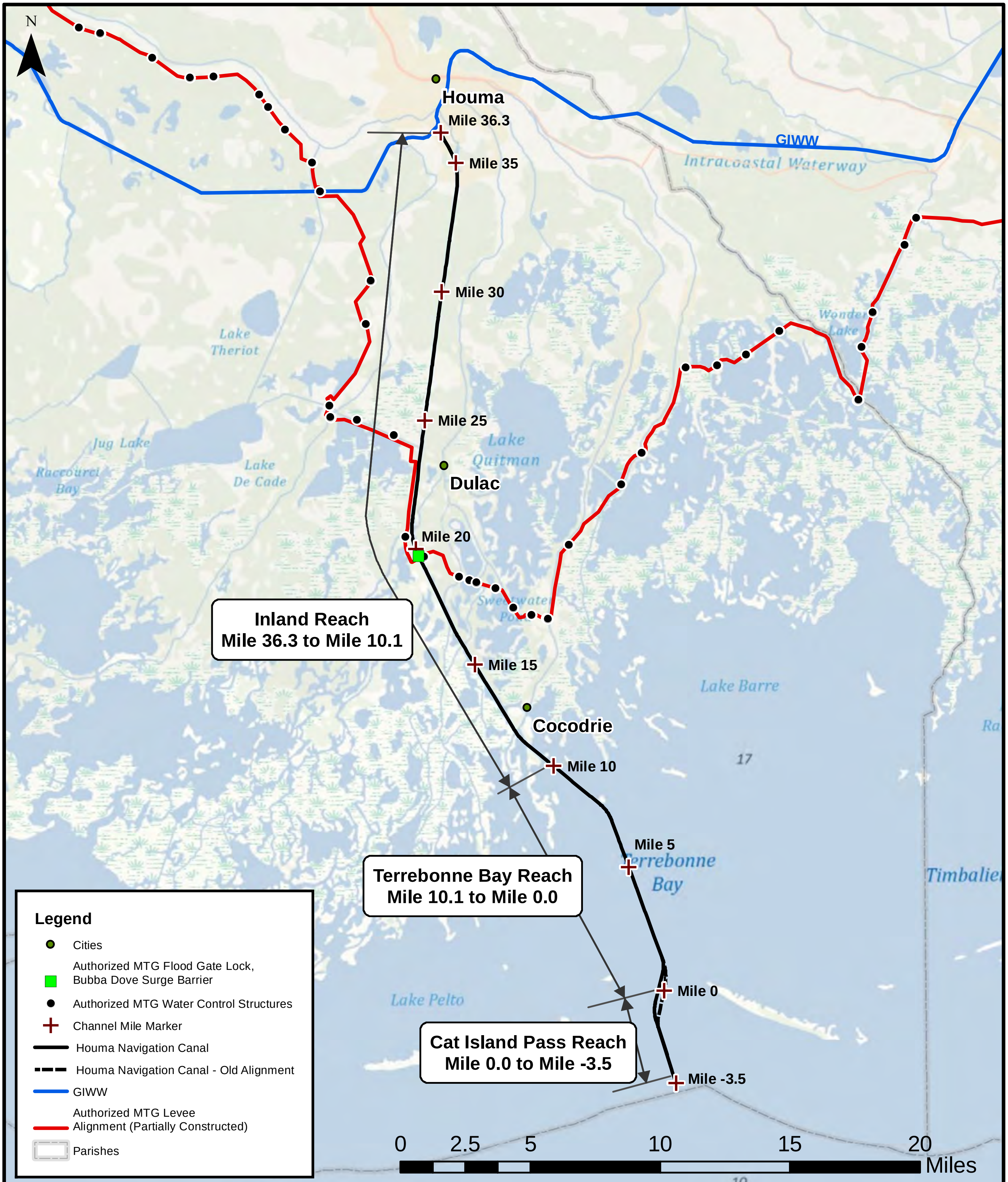
GEC

Date: October 2012

Scale:1:750,000

Source: ESRI/GEC

Map ID: 278500218-3026



HNC REACHES

Houma Navigation Canal Deepening

ERSI Ocean Map

GEC

Date: September 2012
Scale:1:325,000
Source: ESRI/GEC
Map ID: 278500218-3026

Disposal Sites

Disposal plans were developed for three reaches of the channel: the Inland Reach (Mile 11.0 to the GIWW at Mile 36.3), the Bay Reach (Mile 0 to Mile 11.0), and the Cat Island Pass Reach (Mile –3.7 to Mile 0). Disposal locations are described below and are listed in Figures 3 and 4.

Inland Reach (Mile 11.0 to the GIWW at Mile 36.3)

The inland portion of the channel has numerous locations available for disposal, these include locations already identified for current maintenance of the channel and also new sites that provide for beneficial placement of the dredged material for ecosystem restoration, consistent with the State of Louisiana's Master Plan for the Coastal Zone and the consistency requirements of the Louisiana Coastal Zone Management Program. In addition, because these sites are located adjacent to, or within close proximity of, the channel alignment, they represent the least cost disposal option for the inland reach of the channel. As a result of the HET screening process, 15 disposal sites were designated for disposal of dredged material generated from the Inland Reach. These sites are described in Figures 3 and 4. Details on the sites are presented in Annex V of the Engineering Appendix (Appendix A).

Two sites were previously designated as disposal sites under the current maintenance dredging and have been used for upland disposal of material. Site 1 was previously permitted and mitigation has been provided for upland disposal impacts at this site. Site 3 has developed into bottomland hardwood habitat, and continued use of this site for disposal will require mitigation for impacts to this habitat type. The mitigation requirements for the Tentatively Selected Plan are provided in Section 4.55.6 of the FR/EIS. The other placement sites are primarily open water and would be used to create marsh.

Terrebonne Bay Reach (Mile 0.0 to 11.0)

A number of disposal options were considered for disposal of material in the Terrebonne Bay reach. Five disposal sites were identified for material dredged to deepen and maintain the Houma navigation channel in this reach. All five disposal locations would place material unconfined, a minimum of 1,000 feet west of the channel. The single point discharge locations would be at Mile 8.8, 7, 5, 3, and 1. The unconfined disposal utilized in Terrebonne Bay would follow the same procedures currently used for maintenance dredging in the HNC.

Cat Island Pass Reach (Mile –3.7 to Mile 0)

The same disposal approach would be used to place the material from the Cat Island Pass (Mile 0.0 to -3.7), with disposal occurring at Miles -1.7 and -2.5. Disposal would occur a minimum of 1,000 feet to the west of the HNC and would utilize unconfined disposal of material at SPD -1.7 and SPD -2.5 (Figure 4). Material from Cat Island Pass is approximately 70 percent sand, percent shell, and 25 percent silt.

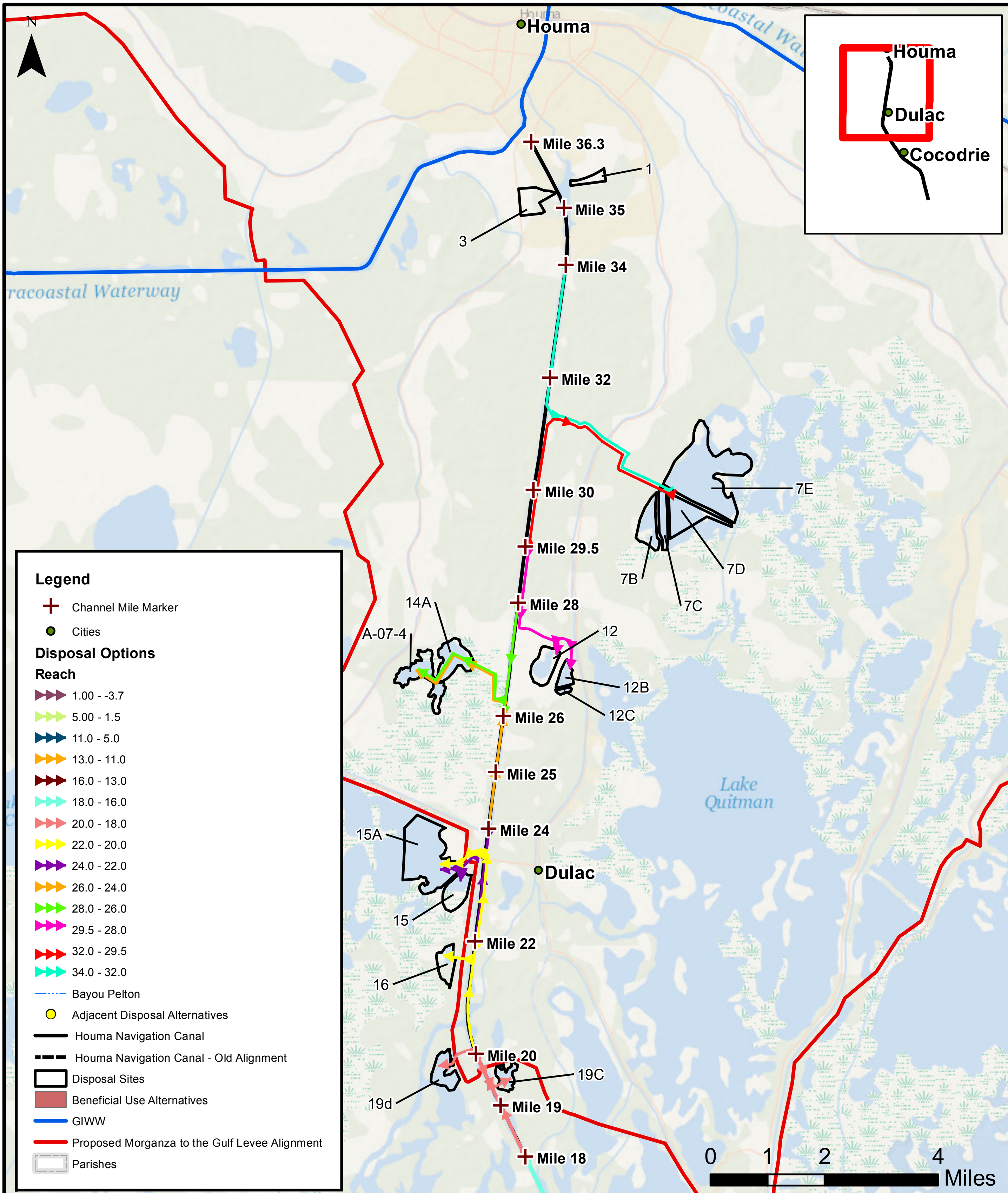
Rock Dikes for Retention and Foreshore Protection

Approximately 14.7 miles of rock retention dikes and/or foreshore protection would be constructed or refurbished for bank protection. Approximately 13.1 miles of foreshore protection would be constructed or refurbished along the Inland Reach (6 miles along the west bank and 7.1 miles along the east bank). In addition to the foreshore protection, approximately 1.6 miles of rock retention dikes would be constructed on the Inland Reach. Locations of the bank protection measures are presented in Figure 5.

The foreshore dikes are proposed for the southern reaches to slow down land loss adjacent to the channel. The foreshore rock dikes would require a geotextile fabric to be placed under the dikes. These dikes would be built to an elevation of +6 feet NAVD88.

Retention dikes are proposed at strategic locations to retain material dredged from the channel. They would also require a geotextile fabric to be placed under the dikes. The retention dikes would be built to an elevation of +5 feet NAVD88.

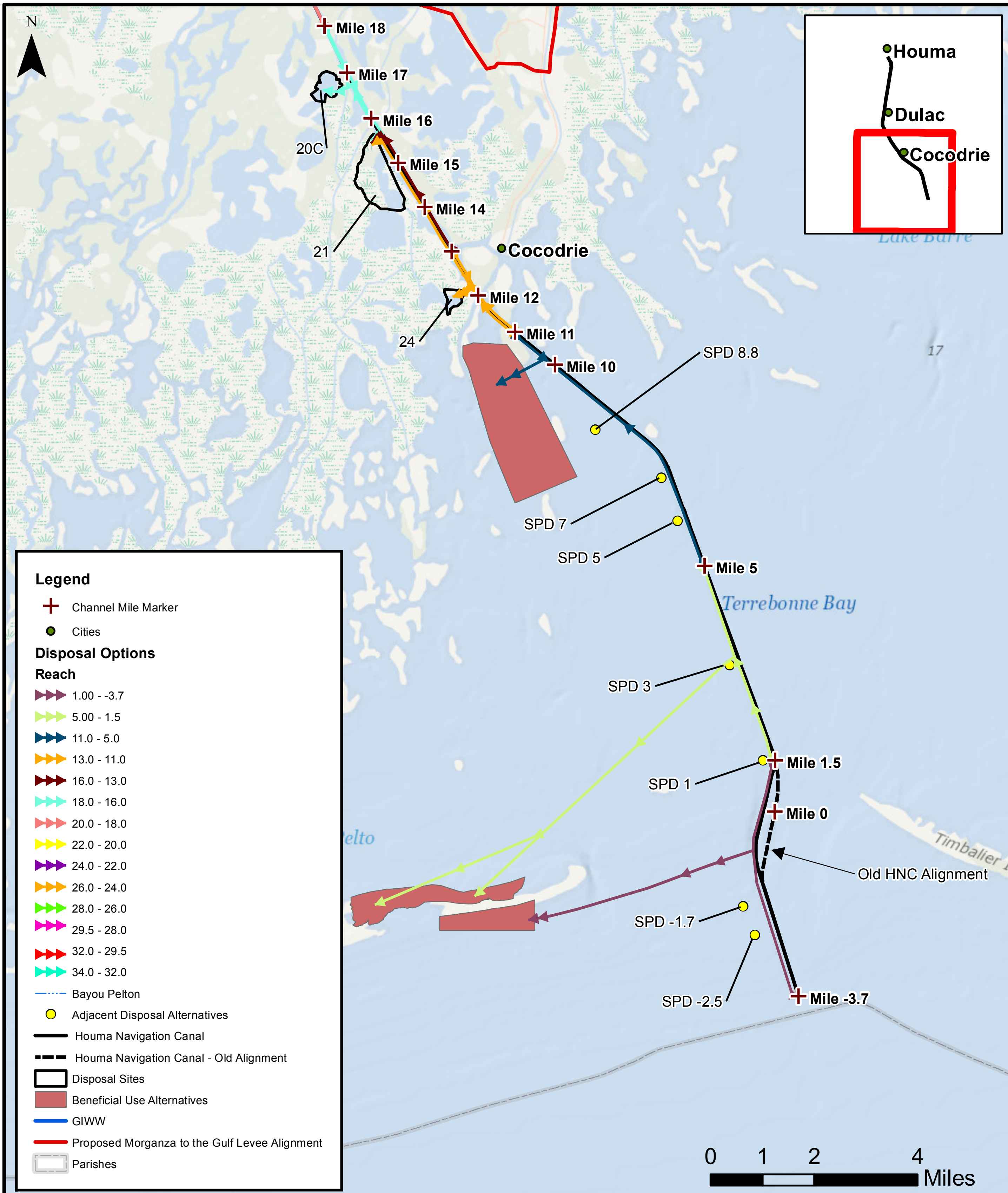
For both the foreshore protection and retention rock dikes, the toe elevations of the channel side wave berm must be at or below elevation −1.0 feet and the berm top must be at least at elevation +1.0 foot, while maintaining a minimum 3-foot thickness. Protected side stability berms would be required, with a minimum width of 5 feet and thickness of 3 feet. The protected side berm may be eliminated if the dike is located against an earthen bank of +3.5 feet or higher. A flotation channel may be required if the channel is too far away from the bank line. The flotation channel for dike construction should not be dredged any closer than 50 feet to the centerline of the dike. The flotation channel may be dredged up to 8.0 feet below the water surface.



DISPOSAL AREAS
North End
Houma Navigation Canal Deepening

ERSI Ocean Map

Date: December 2014
Scale:1:150,000
Source: ESRI/GEC
Map ID: 278500218-3026



DISPOSAL AREAS
South End
Houma Navigation Canal Deepening

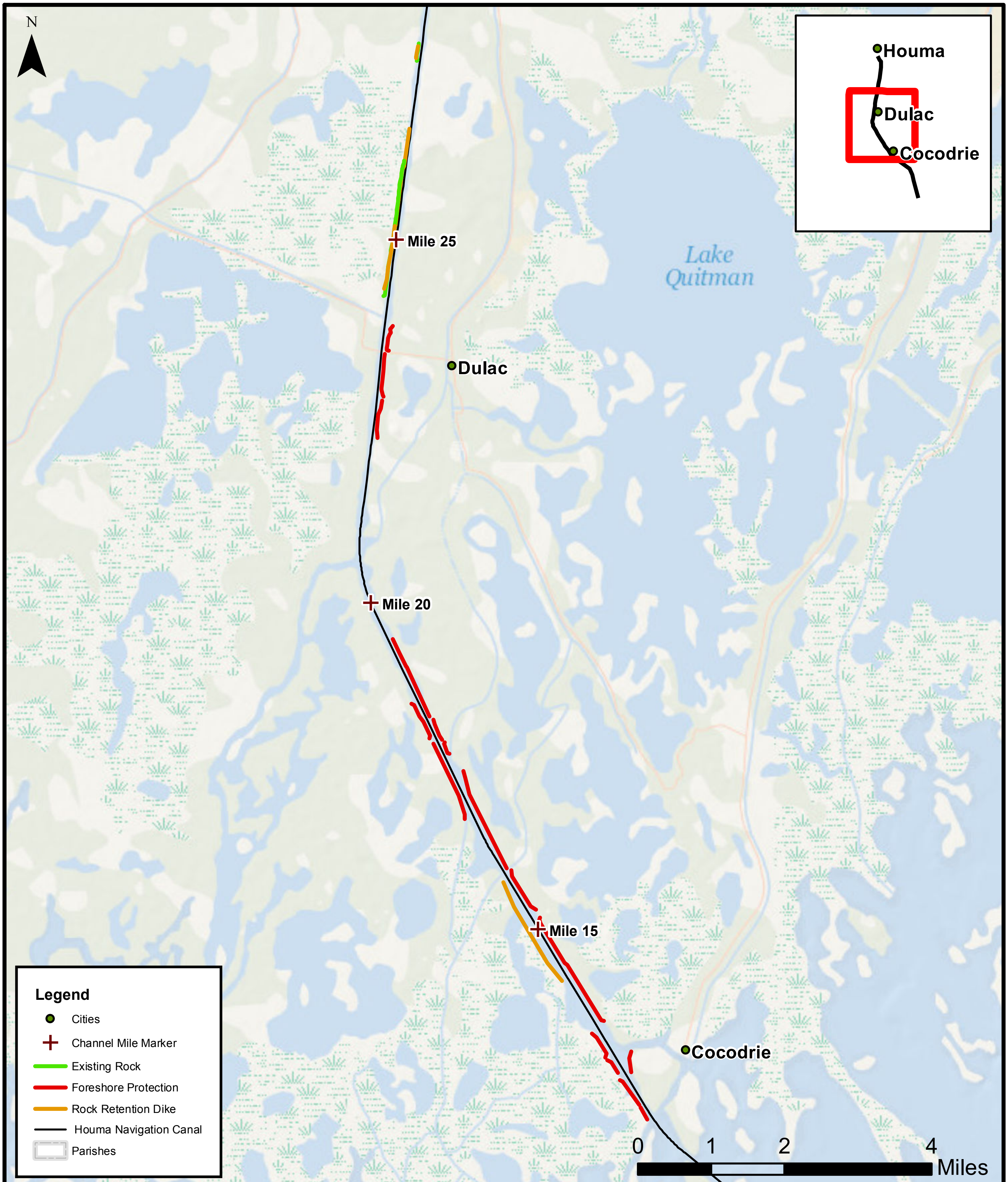
ERSI Ocean Map

Date: December 2014

Scale:1:165,000

Source: ESRI/GEC

Map ID: 278500218-3026



FORSHORE PROTECTION AND ROCK RETENTION DIKES

(INLAND REACH)

Houma Navigation Canal Deepening

ERSI Ocean Map

GEC

Date: October 2012	
Scale:1:115,000	
Source: ESRI/GEC	
Map ID: 278500218-3026	

GUIDELINES APPLICABLE TO ALL USES

"These guidelines are acknowledged and have been addressed through the preparation of responses to the guidelines contained within the specific use categories."

Guideline 1.1: The guidelines must be read in their entirety. Any proposed use may be subject to the requirements of more than one guideline or section of guidelines and all applicable guidelines must be complied with.

Response: Acknowledged.

Guideline 1.2: Conformance with applicable water and air quality laws, standards and regulations, and with those other laws, standards and regulations which have been incorporated into the coastal resources program shall be deemed in conformance with the program except to the extent that these guidelines would impose additional requirements.

Response: Acknowledged.

Guideline 1.3: The guidelines include both general provisions applicable to all uses and specific provisions applicable only to certain types of uses. The general guidelines apply in all situations. The specific guidelines apply only to the situations they address. Specific and general guidelines should be interpreted to be consistent with each other. In the event there is an inconsistency, the specific should prevail.

Response: Acknowledged.

Guideline 1.4: These guidelines are not intended to nor shall they be interpreted so as to result in an involuntary acquisition or taking of property.

Response: Acknowledged. No involuntary acquisition would be required for the proposed action. Oyster leases that are anticipated to be impacted would be acquired through the Louisiana Department of Natural Resources oyster lease acquisition program.

Guideline 1.5: No use or activity shall be carried out or conducted in such a manner as to constitute a violation of the terms of a grant or donation of any lands or water-bottoms to the State or any subdivision thereof. Revocations of such grants and donations shall be avoided.

Response: Acknowledged. No violations or revocations of such grants or donations are expected.

Guideline 1.6: Information regarding the following general factors shall be utilized by the permitting authority in evaluating whether the proposed use is in compliance with the guidelines.

a) Type, nature and location of use.

b) Elevation, soil and water conditions and flood and storm hazard characteristics of site.

c) Techniques and materials used in construction, operations and maintenance of use.

d) Existing drainage patterns and water regimes of surrounding area including flow, circulation, quality, quantity and salinity; and impacts on them.

e) Availability of feasible alternative sites or methods – for implementing the use.

f) Designation of the area for certain uses as part of a local program.

g) Economic need for use and extent of impacts of use on economy of locality.

h) Extent of resulting public and private benefits.

i) Extent of coastal water dependency of the use.

j) Existence of necessary infrastructure to support the use and public costs resulting from use.

k) Extent of impacts on existing and traditional uses of the area and on future uses for which the area is suited.

l) Proximity to, and extent of impacts on important natural features such as beaches, barrier islands, tidal passes, wildlife and aquatic habitats, and forest lands.

m) The extent to which regional, state and national interests are served including the national interest in resources and the siting of facilities in the coastal zones as identified in the coastal resources program.

n) Proximity to, and extent of impacts on, special areas, particular areas, or other areas of particular concern of the state program or local programs.

o) Likelihood of, and extent of impacts of, resulting secondary impacts and cumulative impacts.

p) Proximity to and extent of impacts on public lands or works, or historic, recreational or cultural resources.

q) Extent of impacts on navigation, fishing, public access, and recreational opportunities.

r) Extent of compatibility with natural and cultural setting.

s) Extent of long term benefits or adverse impacts.

Response: Acknowledged. The action is being proposed under Section 425 of the Water Resourced Development Act of 1996 (PL 104-303) which required the USACE to develop a study of the HNC lock as an independent feature of the Morganza to the Gulf of Mexico Hurricane and Storm Damage Risk Reduction Project.

Guideline 1.7: It is the policy of the coastal resources program to avoid the following adverse impacts. To this end, all uses and activities shall be planned, sited, designed, constructed, operated and maintained to avoid to the maximum extent practicable significant:

a) Reductions in the natural supply of sediment and nutrients to the coastal system by alterations of freshwater flow.

Response: Acknowledged. The proposed deepening of the HNC would not hinder the flow of freshwater or sediments within the channel. Operation of the Houma Lock will serve to mitigate potential salinity increases within the channel. The beneficial use of dredged sediments resulting from the deepening of the channel would result in increased marsh habitat and shoreline protection to reduce interior marsh loss by reducing wave-induced shoreline erosion.

b) Adverse economic impacts on the locality of the use and affected governmental bodies.

Response: Acknowledged. The proposed action is not expected to have any adverse economic impacts on the locality of the use or on nearby governmental bodies. No industries, jobs, or other economic activities would be adversely impacted by the proposed action. It is anticipated that the proposed action would benefit the local governments and economy.

c) Detrimental discharges of inorganic nutrient compounds into coastal waters.

Response: Acknowledged. No detrimental discharges of inorganic nutrient compounds would occur.

d) Alterations in the natural concentration of oxygen in coastal waters.

Response: Acknowledged. There may be a temporary decrease in the dissolved oxygen concentrations during actual construction operations, as well as for a short time thereafter. Any effects are expected to be minor and would occur only during actual dredging activities. Dissolved oxygen levels would return to ambient levels following construction operations.

e) Destruction or adverse alterations of streams, wetland, tidal passes, inshore waters and water bottoms, beaches, dunes, barrier islands, and other natural biologically valuable areas or protective coastal features.

Response: Acknowledged. No adverse alterations of water bodies would result from the proposed action. Instead, it is expected that the beneficial use of dredged material would result in net gains in marsh habitat quality within the project area.

f) Adverse disruption of existing social patterns.

Response: Acknowledged. Any disruptions of social patterns would be associated with construction activities, and would be of a short-term nature.

g) Alterations of the natural temperature regime of coastal waters.

Response: Acknowledged. No alterations of the natural temperature regime are expected to occur.

h) Detrimental changes in existing salinity regimes.

Response: Acknowledged. Deepening of the HNC could increase salinity levels for areas north of the project area, but this issue would be mitigated because it has been stipulated by the local sponsors that construction would not take place until after the HNC floodgate and lock complex has been constructed and the lock is operational. Construction and operation of the Lock is not within the scope of this study, but rather the Morganza to the Gulf Project. The EIS for this project is referenced in the HNC Deepening study. The following excerpts are taken from the referenced document:

The HNC lock complex would consist of a 110-foot by 800-foot lock, an adjacent 250 foot-wide sector gate, and a dam closure that ties into adjacent earthen levees to reduce the risk of storm surge traveling up the HNC (Figure 6). Vessel traffic would pass through the sector gate portion of the structure for the majority of conditions. However, when the sector gates are closed, the lock would be used. The HNC Lock Complex will be deepened to -23 feet NAVD88 to accommodate the deepening of the HNC. The HNC lock/floodgate complex will have a salinity trigger which is described in the table below. The environmental control structures would be used for drainage of isolated areas within a certain timeframe and maximum inundation of the marsh areas. The lock operation plan has two triggers based on the two purposes. First, maintaining a safe water elevation in the channel for storm control and navigation, and second, controlling chloride levels at the Houma Treatment Plant and controlling salinity to protect environmental habits upstream of the structure.

The HNC lock and floodgate would be closed for salinity control only if:

1. Flows in the Atchafalaya River are below 100,000 cfs as measured on the Simmesport gage (USGS 07381490 Atchafalaya River at Simmesport, LA) or

2. If a gage on the outside of the HNC Lock complex exceeds a salinity value that has been correlated with preventing exceedance of the maximum allowable chloride level of 250 ppm as defined in EPA’s secondary drinking water standard at the Houma Treatment Plant. The structure should be closed for at least 12 hrs and fluctuations in chloride levels should be monitored and recorded hourly. This to be determined salinity value at the new gage should correlate with the value of 7.5 ppt measured at the HNC at Dulac monitoring station. The 7.5 ppt trigger would be used to perform the indirect impact analysis in this document. Once the new trigger is established the impact analysis would
be redone to verify the assumptions made.

The HNC lock complex may be opened when all of the following additional criteria have been met (The lock may be used for navigation, as soon as the hurricane and small craft warning no longer apply to the project area, and the channel has been cleared of obstructions. This may occur before the next two criteria are met)**:**

1. The differential between the interior water level and exterior water level is equal to or less than the +1.0 feet as measured on the upstream and downstream staff gage respectively.

2. After monitoring chloride levels over the 12 hour period at the new gage on the outside of the HNC Lock complex drops below the salinity closure trigger described above. For the analysis of indirect impacts a salinity level of 13 ppt as measured near Cocodrie (LUMCON Station) would be used. The LUMCON station replaces the Bayou Grand Caillou USACE 76305 from the 2002 feasibility report because it has a more robust dataset. If the USACE re-evaluates the salinity trigger at the LUMCON station and comes up with a trigger different than 13ppt, this trigger may change. Once the new trigger is established the impact analysis would be redone to verify the assumptions made. In order to operate the HNC lock according to the criteria laid out in this plan, a monitoring program must be included in the O&M manual and in place.

Table 4-3: Morganza to the Gulf of Mexico, Louisiana Water Control Structure Operations Plan - Flood Closure Criteria

The following group of structures…	…cannot be closed until the following conditions are met:	…and can only be re-opened if the following conditions are met:
<u>Group 1:</u> Bayou Grand Caillou HNC lock and floodgate	1. A NHC watch is issued for the area, <u>AND</u> The stage measured at the gate location reaches +2.5 ft NAVD88.	1. The NHC watch has been discontinued for the area, <u>AND</u> 2. Stages on the outside of the structures drop below +2.5 ft NAVD88, <u>AND</u> The NHC small craft advisory no longer applies to the area and the channel has been cleared of obstructions so that navigation can safely resume.

Note: The following operation plans are preliminary for the purpose of assessing potential adverse indirect impacts of the proposed Federal project. Operation plans would be further refined during Preconstruction Engineering and Design and in future NEPA documents.

Group 1 contains the constructible features; all other groups contain programmatic features.

No structure can be closed or re-opened when the pressure head differential exceeds the structure design capability. No structure can be re-opened until storm force winds have dropped to a level safe for personnel to access the area and operate the machinery.

[1] An announcement that tropical-storm conditions are possible within the specified area (includes tropical depressions). Because outside preparedness activities become difficult once winds reach tropical storm force, watches are issued 48 hours in advance of the anticipated onset of tropical-storm-force winds.

NHC = National Hurricane Center. ECS = Environmental Control Structure

Under future conditions, closure frequency could increase if the closure trigger is not adjusted to account for sea level rise. For example, under existing conditions, HNC floodgate closure (based on a 2.5-ft closure stage only, not the salinity triggers) would occur approximately 1.5 days per year. If the trigger remained the same through 2085, low RSLR would require closure 5 days per year by 2035 and 168 days per year by 2085. Intermediate RSLR would require closure for 15 days per year by 2035 and 354 days per year by 2085. High RSLR would require closure for 24 days per year in 2035 and 365 days per year in 2085. To prevent frequent structure closings, operation plans would need to be re-evaluated periodically and closure trigger elevations may need to be increased if significant sea level rise occurs. Under future conditions, closure frequency could increase if the closure trigger is not adjusted to account for sea level rise. For example, under existing conditions, HNC floodgate closure (based on a 2.5-ft closure stage only, not the salinity triggers) would occur approximately 1.5 days per year. If the trigger remained the same through 2085, low RSLR would require closure 5 days per year by 2035 and 168 days per year by 2085. Intermediate RSLR would require closure for 15 days per year by 2035 and 354 days per year by 2085. High RSLR would require closure for 24 days per year in 2035 and 365 days per year in 2085. To prevent frequent structure closings, operation plans would need to be re-evaluated periodically and closure trigger elevations may need to be increased if significant sea level rise occurs.

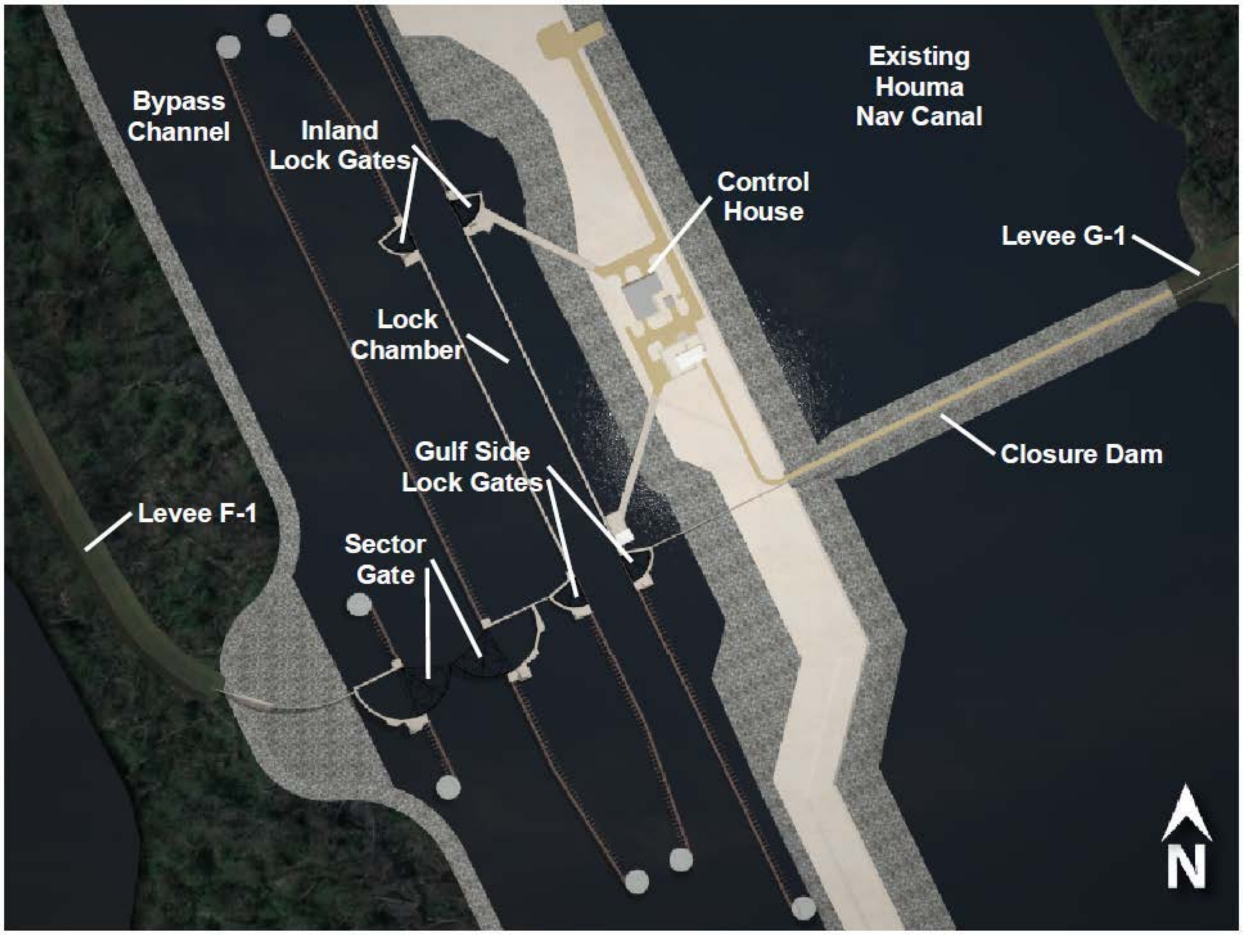


Figure 6. Houma Lock Complex

i) Detrimental changes in littoral and sediment transport processes.

Response: Acknowledged. Sediment buildup within the channel would be reduced within the channel with the construction of rock retention and foreshore protection. However, the deepening and widening of the channel would result in overall increased shoaling rates. Degradation of the channel slopes would also be reduced due to the stability provided by the rock structures.

j) Adverse effects of cumulative impacts.

Response: Acknowledged. Cumulative impacts represent the effects of this proposed action in association with other past, present, and reasonably foreseeable future projects. This proposed

action provides beneficial economic and environmental effects and would not contribute to adverse effects of cumulative impacts.

k) Detrimental discharges of suspended solids into coastal waters, including turbidity resulting from dredging.

Response: Acknowledged. There would be a temporary increase in turbidity and suspended solids during construction (dredging and placement) of project features. However, any effects would be temporary and conditions would return to ambient following completion of construction activities.

l) Reductions or blockage of water flow or natural circulation patterns within or into an estuarine system or a wetland forest.

Response: Acknowledged. No existing openings between the HNC and adjacent waterbodies will be blocked during deepening of the channel. All hydrologic connections would be maintained.

m) Discharges of pathogens or toxic substances into coastal waters.

Response: Acknowledged. There are no known toxic or pathogenic substance levels that are expected to significantly increase due to implementing the proposed action.

n) Adverse alteration or destruction of archaeological, historical, or other cultural resources.

Response: Acknowledged. Adverse alteration or destruction of cultural resources is not expected to occur.

o) Fostering of detrimental secondary impacts in undisturbed or biologically highly productive wetland areas.

Response: Acknowledged. Adverse impacts to wetlands would not result. As demonstrated through Wetland Value Assessments, the proposed action would improve the quality of wetlands. There would be an overall net gain of 235 AAHUs (-9.7 Bottomland Hardwood; -0.7 Swamp; 39 Intermediate Marsh; 103 Brackish Marsh; 103 Salt Marsh). This would result from an overall net gain of 474 acres of habitat (-101.9 Bottomland hardwood; 147 Intermediate Marsh; 256 Brackish Marsh; 173 Salt Marsh).

p) Adverse alteration or destruction of unique or valuable habitats, critical habitat for endangered species, important wildlife or fishery breeding or nursery areas, designated wildlife management or sanctuary areas, or forestlands.

Response: Acknowledged. No unique or valuable habitats would be adversely affected; the intermediate, brackish, and salt marshes of the area would be improved by the proposed action. All upland habitat impacted by the project would be mitigated. The project area does not contain critical habitat for endangered species. The improvement in marsh habitat would enhance the area for fish and wildlife habitats, including breeding areas.

q) Adverse alteration or destruction of public parks, shoreline access points, public works, designated recreation areas, scenic rivers, or other areas of public use and concern.

Response: Acknowledged. No public parks, shoreline access points, public works, or designated recreation areas would be adversely altered by the proposed action.

r) Adverse disruptions of coastal wildlife and fishery migratory patterns.

Response: Acknowledged. The proposed action would not disrupt coastal wildlife or fishery migratory patterns. Rather, the deepening of the HNC may improve the ingress and egress of aquatic organisms between the swamps and surrounding water bodies.

s) Land loss, erosion and subsidence.

Response: Acknowledged. The proposed action would not adversely affect land loss, erosion, or subsidence. By improving the quality of marsh habitats through beneficial use of dredged materials it is anticipated that improved subsurface growth of root masses would elevate ground levels. Additionally, the stabilization of the channel through the addition and/or refurbishment of rock structures would reduce habitat loss from bank erosion caused by ship traffic.

t) Increases in the potential for flood, hurricane or other storm damage, or increases in the likelihood that damage will occur from such hazards.

Response: Acknowledged. The proposed action is not expected to increase the potential for flood, hurricane, or other storm damage, or increase the likelihood of damage from such hazards.

u) Reductions in the long-term biological productivity of the coastal ecosystem.

Response: Acknowledged. As demonstrated through Wetland Value Assessment determinations, the proposed action would improve the quality of the ecosystem in the project area. There would be an overall net gain of 235 AAHUs (-9.7 Bottomland Hardwood; -0.7 Swamp; 39 Intermediate Marsh; 103 Brackish Marsh; 103 Salt Marsh). This would result from an overall net gain of 474 acres of habitat (-101.9 Bottomland hardwood; 147 Intermediate Marsh; 256 Brackish Marsh; 173 Salt Marsh).

<u>Guideline 1.8</u>: In those guidelines in which the modifier "maximum extent practicable" is used, the proposed use is in compliance with the guideline if the standard modified by the term is complied with. If the modified standard is not complied with, the use will be in compliance with the guideline if the permitting authority finds, after a systematic consideration of all pertinent information regarding the use, the site and the impacts of the use as set forth in guideline 1.6, and a balancing of their relative significance, that the benefits resulting from the proposed use would clearly outweigh the adverse impacts resulting from non compliance with the modified standard and there are no feasible and practical alternative locations, methods and practices for the use

that are in compliance with the modified standard and: a) significant public benefits will result from the use, or; b) the use would serve important regional, state or national interests, including the national interest in resources and the siting of facilities in the coastal zone identified in the coastal resources program, or; the use is coastal water dependent. The systematic consideration process shall also result in a determination of those conditions necessary for the use to be in compliance with the guideline. Those conditions shall assure that the use is carried out utilizing those locations, methods and practices which maximize conformance to the modified standard; are technically, economically, environmentally, socially and legally feasible and practical and minimize or offset those adverse impacts listed in guideline 1.7 and in the guideline at issue.

Response: Acknowledged.

Guideline 1.9 Uses shall to the maximum extent practicable be designed and carried out to permit multiple concurrent uses which are appropriate for the location and to avoid unnecessary conflicts with other uses of the vicinity.

Response: Acknowledged. Generally, the project area would only be unavailable for use during construction activities. The project area would again be available for multiple uses following actual construction operations. Natural waterways would not be closed.

Guideline 1.10 These guidelines are not intended to be, nor shall they be, interpreted to allow expansion of governmental authority beyond that established by La. R.S. 49:213.1 through 213.21, as amended; nor shall these guidelines be interpreted so as to require permits for specific uses legally commenced or established prior to the effective date of the coastal use permit program nor to normal maintenance or repair of such uses.

Response: Acknowledged.

2. GUIDELINES FOR LEVEES

These guidelines are not applicable as the actions taken do not include any levee work

3. GUIDELINES FOR LINEAR FACILITIES

Guideline 3.1: Linear use alignments shall be planned to avoid adverse impacts on areas of high biological productivity or irreplaceable resource areas.

Response: Acknowledged. Flotation channels would be dredged in wetlands to allow for the disposal of dredged material within predetermined disposal areas. While this would convert a portion of the marsh habitat to open water, the overall effect would be to improve the net quality of the wetland habitat in the project area.

Guideline 3.2: Linear facilities involving the use of dredging or filling shall be avoided in wetland and estuarine areas to the maximum extent practicable.

Response: Acknowledged. Flotation channels would be dredged in wetlands to allow for the disposal of dredged material within predetermined disposal areas. While this would convert a portion of the marsh habitat to open water, the overall effect would be to improve the net quality of the wetland habitat in the project area.

Guideline 3.3: Linear facilities involving dredging shall be of the minimum practical size and length.

Response: Acknowledged.

Guideline 3.4: To the maximum extent practicable, pipelines shall be installed through the "push ditch" method and the ditch backfilled.

Response: Acknowledged.

Guideline 3.5: Existing corridors, rights of way, canals, and streams shall be utilized to the maximum extent practicable for linear facilities.

Response: Acknowledged.

Guideline 3.6: Linear facilities and alignments shall be, to the maximum extent practicable, designed and constructed to permit multiple uses consistent with the nature of the facility.

Response: Acknowledged. While disruption to multiple uses of the project area may occur during construction, multiple uses of the area would be restored following construction.

Guideline 3.7: Linear facilities involving dredging shall not traverse or adversely affect any barrier island.

Response: Acknowledged. The proposed action does not occur on or near any barrier islands.

Guideline 3.8: Linear facilities involving dredging shall not traverse beaches, tidal passes, protective reefs or other natural gulf shoreline unless no other alternative exists. If a beach, tidal pass, reef or other natural gulf shoreline must be traversed for a non navigation canal, they shall be restored at least to their natural condition immediately upon completion of construction. Tidal passes shall not be permanently widened or deepened except when necessary to conduct the use. The best available restoration techniques which improve the traversed area's ability to serve as a shoreline shall be used.

Response: Acknowledged. The proposed action would include dredging of the existing channel and flotation channels along the HNC only. Tidal passes, beaches, and natural shorelines will be maintained during construction of this project.

Guideline 3.9: Linear facilities shall be planned, designed, located and built using the best practical techniques to minimize disruption of natural hydrologic and sediment transport patterns, sheet flow, and water quality, and to minimize adverse impacts on wetlands.

Response: Acknowledged.
Guideline 3.10: Linear facilities shall be planned, designed, and built using the best practical techniques to prevent bank slumping and erosion, saltwater intrusion, and to minimize the potential for inland movement of storm generated surges. Consideration shall be given to the use of locks in navigation canals and channels which connect more saline areas with fresher areas.

Response: Acknowledged. The proposed action is to be constructed after the Houma Navigation Canal floodgate and lock complex is constructed as part of the Morganza to the Gulf Hurricane Protection Project and the lock is operational.

Guideline 3.11: All non-navigation canals, channels and ditches which connect more saline areas with fresher areas shall be plugged at all waterway crossings and at intervals between crossings in order to compartmentalize them. The plugs shall be properly maintained.

Response: Concur. The proposed action would not construct any channels or canals that would adversely affect salinity patterns.

Guideline 3.12: The multiple use of existing canals, directional drilling and other practical techniques shall be utilized to the maximum extent practicable to minimize the number and size of access canals, to minimize changes of natural systems and to minimize adverse impacts on natural areas and wildlife and fisheries habitat.

Response: Acknowledged. While the proposed action would involve the construction flotation channels, the channels would serve to enhance the quality of the wetlands and improve fish and wildlife habitats.

Guideline 3.13: All pipelines shall be constructed in accordance with parts 191, 192, and 195 of Title 49 of the Code of Federal Regulations, as amended, and in conformance with the Commissioner of Conservation's Pipeline Safety Rules and Regulations and those safety requirements established by La. R. S. 45:408, whichever would require higher standards.

Response: Acknowledged.

Guideline 3.14: Areas dredged for linear facilities shall be backfilled or otherwise restored to the pre existing conditions upon cessation of use for navigation purposes to the maximum extent practicable.

Response: Acknowledged.

Guideline 3.15: The best practical techniques for site restoration and re-vegetation shall be utilized for all linear facilities.

Response: Acknowledged.

Guideline 3.16: Confined and dead end canals shall be avoided to the maximum extent practicable. Approved canals must be designed and constructed using the best practical techniques to avoid water stagnation and eutrophication.
Response: Acknowledged. While the proposed action would involve the construction of flotation channels, the channels would serve to enhance the quality of the wetlands, and improve fish and wildlife habitats.

4. GUIDELINES FOR DREDGED MATERIAL DEPOSITION

Guideline 4.1: Spoil shall be deposited utilizing the best practical techniques to avoid disruption of water movement, flow, circulation and quality.

Response: Concur. The placement of material dredged in association with the proposed action would not disrupt the movement, flow, circulation, or quality of water.

Guideline 4.2: Spoil shall be used beneficially to the maximum extent practicable to improve productivity or create new habitat, reduce or compensate for environmental damage done by dredging activities, or prevent environmental damage. Otherwise, existing spoil disposal areas or upland disposal shall be utilized to the maximum extent practicable rather than creating new disposal areas.

Response: Concur. Material excavated from construction activities associated with the deepening of the HNC would be placed in adjacent open water areas to create and/or expand existing brackish, intermediate, and salt marsh habitat. Wetland Value Assessment models show that placement of this material would result in a net gain of 235 AAHUs (-9.7 Bottomland Hardwood; -0.7 Swamp; 39 Intermediate Marsh; 103 Brackish Marsh; 103 Salt Marsh). This would result from an overall net gain of 474 acres of habitat (-101.9 Bottomland hardwood; 147 Intermediate Marsh; 256 Brackish Marsh; 173 Salt Marsh).

Guideline 4.3: Spoil shall not be disposed of in a manner which could result in the impounding or draining of wetlands or the creation of development sites unless the spoil deposition is part of an approved levee or land surface alteration project.

Response: Concur. The proposed action would not impound wetlands but would improve existing marsh habitats located within the project area.

Guideline 4.4: Spoil shall not be disposed of on marsh, known oyster or clam reefs or in areas of submersed vegetation to the maximum extent practicable.

Response: Acknowledged. The proposed action would not involve the placement of spoil on a marsh or areas of submerged vegetation. Any oyster reef impacted by the placement of dredged material would be compensated through mitigation.

Guideline 4.5: Spoil shall not be disposed of in such a manner as to create a hindrance to navigation or fishing, or hinder timber growth.

Response: Concur. The material dredged from the HNC would be placed in an open water site for the purposes of restoration. Material placed within the marsh will be placed to build up existing marsh in the area as well as restore open area waters to former conditions and allowed to vegetate naturally.

Guideline 4.6: Spoil disposal areas shall be designed and constructed and maintained using the best practical techniques to retain the spoil at the site, reduce turbidity, and reduce shoreline erosion when appropriate.

Response: Best management practices would be employed to retain dredged material and minimize turbidity resulting from dredging activities. This would include the use of retention dikes to contain disposed material.

Guideline 4.7: The alienation of state owned property shall not result from spoil deposition activities without the consent of the Department of Natural Resources.

Response: Acknowledged. The proposed action would not result in the alienation of state owned property.

GUIDELINES FOR SHORELINE MODIFICATION

These guidelines are not applicable as the actions taken did not occur along shorelines therefore do not include shoreline alteration.

GUIDELINES FOR SURFACE ALTERATIONS

Guideline 6.1: Industrial, commercial, urban, residential, and recreational uses are necessary to provide adequate economic growth and development. To this end, such uses will be encouraged in those areas of the coastal zone that are suitable for development. Those uses shall be consistent with the other guidelines and shall, to the maximum extent practicable, take place only:

a) On lands five feet or more above sea level or within fast lands; or

b) On lands which have foundation conditions sufficiently stable to support the use, and where flood and storm hazards are minimal or where protection from these hazards can be reasonably well achieved, and where the public safety would not be unreasonably endangered; and

    1) The land is already in high intensity of development use, or

    2) There is adequate supporting infrastructure, or

    3) The vicinity has a tradition of use for similar habitation or development

Response: The project area already serves as an industrialized area for shipping and fishing activities and has served in this manner for years. The project would increase NED benefits for these industries.

Guideline 6.2: Public and private works projects such as levees, drainage improvements, roads, airports, ports, and public utilities are necessary to protect and support needed development and shall be encouraged. Such projects shall, to the maximum extent practicable, take place only when:

a) They protect or serve those areas suitable for development pursuant to Guideline 6.1; and

b) They are consistent with the other guidelines; and

c) They are consistent with all relevant adopted state, local and regional plans.

Response: Not applicable.

Guideline 6.3: BLANK (Deleted by Louisiana Department of Natural Resources)

Guideline 6.4: To the maximum extent practicable wetland areas shall not be drained or filled. Any approved drain or fill project shall be designed and constructed using best practical techniques to minimize present and future property damage and adverse environmental impacts.

Response: No wetlands would be filled for development purposes as a result of the proposed action. Only areas of open water that converted from marsh habitat would be used for dredged material placement, thereby resulting in habitat improvements for the disposal area.

Guideline 6.5: Coastal water dependent uses shall be given special consideration in permitting because of their reduced choice of alternatives.

Response: Not applicable.

Guideline 6.6: Areas modified by surface alteration activities shall, to the maximum extent practicable, be re-vegetated, refilled, cleaned and restored to their predevelopment condition upon termination of the use.

Response: Acknowledged.

Guideline 6.7: Site clearing shall to the maximum extent practicable be limited to those areas immediately required for physical development.

Response: Acknowledged.

Guideline 6.8: Surface alterations shall, to the maximum extent practicable, be located away from critical wildlife areas and vegetation areas. Alterations in wildlife preserves and management areas shall be conducted in strict accord with the requirements of the wildlife management body.

Response: Acknowledged.

Guideline 6.9: Surface alterations which have high adverse impacts on natural functions shall not occur, to the maximum extent practicable, on barrier islands and beaches, isolated cheniers, isolated natural ridges or levees,' or in wildlife and aquatic species breeding or spawning areas, or in important migratory routes.
Response: The proposed action would not alter barrier islands, beaches, isolated cheniers, isolated natural ridges or levees. The proposed action is anticipated to improve the quality of wildlife and aquatic species breeding/spawning areas through improvement of the quality of wetland habitats.

Guideline 6.10: The creation of low dissolved oxygen conditions in the water or traps for heavy metals shall be avoided to the maximum extent practicable.

Response: No traps for heavy metals are anticipated to occur. The proposed action may temporarily create low dissolved oxygen conditions due to increased turbidity associated in the immediate vicinity of construction activities. However, any such conditions would be of short duration and would return to ambient conditions after construction activities were completed.

Guideline 6.11: Surface mining and shell dredging shall be carried out utilizing the best practical techniques to minimize adverse environmental impacts.

Response: Not applicable.

Guideline 6.12: The creation of underwater obstructions which adversely affect fishing or navigation shall be avoided to the maximum extent practicable.

Response: No underwater obstructions would result from the proposed action.

Guideline 6.13: Surface alteration sites and facilities shall be designed, constructed, and operated using the best practical techniques to prevent the release of pollutants or toxic substances into the environment and minimize other adverse impacts.

Response: Acknowledged.

Guideline 6.14: To the maximum extent practicable only material that is free of contaminants and compatible with the environmental setting shall be used as fill.

Response: Fill would be native material from adjacent areas. No contaminants are anticipated to be present.

GUIDELINES FOR HYDROLOGIC AND SEDIMENT TRANSPORT MODIFICATIONS

Guideline 7.1: The controlled diversion of sediment laden waters to initiate new cycles of marsh building and sediment nourishment shall be encouraged and utilized whenever such diversion will enhance the viability and productivity of the outfall area. Such diversions shall incorporate a plan for monitoring and reduction and/or amelioration of the effects of pollutants present in the freshwater source.

Response: Acknowledged. The proposed action does not include the controlled diversion of sediment-laden water.

Guideline 7.2: Sediment deposition systems may be used to offset land loss, to create or restore wetland areas or enhance building characteristics of a development site. Such systems shall only be utilized as part of an approved plan. Sediment from these systems shall only be discharged in the area that the proposed use is to be accomplished.

Response: Concur. Material excavated from construction activities associated with the deepening of the HNC would be placed in adjacent open water areas to increase and improve existing marsh habitat.

Guideline 7.3: Undesirable deposition of sediments in sensitive habitat or navigation areas shall be avoided through the use of the best preventive techniques.

Response: Acknowledged.

Guideline 7.4: The diversion of freshwater through siphons and controlled conduits and channels, and overland flow to offset saltwater intrusion and to introduce nutrients into wetlands shall be encouraged and utilized whenever such diversion will enhance the viability and productivity of the outfall area. Such diversions shall incorporate a plan for monitoring and reduction and/or amelioration of the effects of pollutants present in the freshwater source.

Response: Acknowledged. The proposed action does not include such diversions.

Guideline 7.5 Water or marsh management plans shall result in an overall benefit to the productivity of the area.

Response: Acknowledged.

Guideline 7.6: Water control structures shall be assessed separately based on their individual merits and impacts and in relation to their overall water or marsh management plan of which they are a part.

Response: Acknowledged. The proposed action would utilize some temporary water control structures for dewatering of dredged material placed in wetland cells.

Guideline 7.7: Weirs and similar water control structures shall be designed and built using the best practical techniques to prevent "cut arounds," permit tidal exchange in tidal areas, and minimize obstruction of the migration of aquatic organisms.

Water Quality Certification

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT

(33 CFR 325)

OMB APPROVAL NO. 0710-003
Expires October 1996

Public reporting burden for this collection of information is estimated to average 5 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Service Directorate of Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003), Washington, DC 20503. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authority: 33 USC 401, Section 10; 1413, Section 404. Principal Purpose: These laws require permits authorizing activities in, or affecting, navigable waters of the United States, the discharge of dredged of fill material into waters of the United States, and the transportation of dredged material for the purpose of dumping it into ocean waters. Routine Uses: Information provided on this form will be used in evaluating the application or a permit. Disclosure: Disclosure of requested information is voluntary. If information is not provided, however, the permit application cannot be processed nor can a permit be issued.

One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	***2. FIELD OFFICE CODE***	***3. DATE RECEIVED***	***4. DATE APPLICATION COMPLETED***

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME
Louisiana Department of Transportation and Development

8. AUTHORIZED AGENT'S NAME AND TITLE (an agent is not required)
Same as Applicant

6. APPLICANT'S ADDRESS
LADOTD
Marine and Rail Division
P.O. BOX 94245
BATON ROUGE, LA 70804

9. AGENT'S ADDRESS
Same as Applicant

7. APPLICANT'S PHONE NOS. W/AREA CODE

a. Residence

b. Business 225-379-3035

10. AGENT'S PHONE NOS. W/AREA CODE

a. Residence

b. Business Same as Applicant

11. STATEMENT OF AUTHORIZATION

____

APPLICANT'S SIGNATURE *DATE*

NAME, LOCATION AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)

Houma Navigation Canal Deepening Project

13. NAME OF WATERBODY, IF KNOWN (if applicable)

Houma Navigation Canal

14. PROJECT STREET ADDRESS (if applicable)

15. LOCATION OF PROJECT

______Terrebonne_________ _Louisiana
COUNTY *STATE*

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN, (see instructions)
The project area includes the Houma Navigation Canal and adjacent disposal areas located approximately from Channel Mile 36.3 near Houma, LA. To Channel Mile -3.7 in Cat Island Pass.

17. DIRECTIONS TO THE SITE

From Baton Rouge, head south on I-10 towards New Orleans for 60 Miles. Turn right onto 310 South for 11 Miles. Turn right onto LA 90 West for 17 miles. Merge right onto LA 304 West for 0.5 miles. Turn left onto Hwy 3198 South for 11.6 miles. Turn right onto LA 24 West for 1.2 miles. Turn left onto Howard Ave. (South) for 0.5 miles. Keep straight onto South Van Ave (LA 661) South for 1.9 Miles.

18. Nature of Activity (Description of project, include all features.)

The Houma Navigation Canal would be deepened from an authorized depth of -15 MLG to -20 MLG. The deepening would be from HNC Mile 36.3 south of Houma, LA. through Mile -3.7 within Cat Island Pass. A total of 14.7 miles of foreshore protection and rock retention structures would be constructed or refurbished along the channel at various locations. Material would be hydraulically dredged and disposed of to 15 inland disposal sites and 7 bay/offshore single point discharge locations.

19. Project Purpose (Describe the reason or purpose of the project, (see instruction.)

The LADOTD has developed this Section 203 study to determine the feasibility of deepening the existing Houma Navigation Canal Federal project and to identify the National Economic Development (NED) plan. The NED plan has the greatest net economic benefits consistent with protection of the Nation's environment.

USE BLOCKS 20-22 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

Dredged material will be discharged into nearby disposal areas to accommodate the deepening of the channel from -15 feet to a depth -20 feet (NAVD88) and for maintenance dredging to keep the channel at the authorized depth over a fifty-year period.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Years.

The material to be dredged would consist of the bed sediments of the Houma Navigation Canal (HNC) from the intersection with the Gulf Intracoastal Waterway (GIWW) to Terrebonne Bay at the Gulf of Mexico. The bed material of the HNC varies with proximity to the Gulf of Mexico. Material near the Gulf Intracoastal Waterway is approximately 48% silt, 30% clay, and 2% sand. The material in Terrebonne Bay is approximately 35% silt, 15% clay, and 50% sand. Approximately 16,270,500 cubic yards of material would be dredged and disposed within confined disposal areas for deepening and maintenance of the channel within the inland and bay reaches over a 50-year project life. Approximately 39,412,000 cubic yards of material would be dredged and disposed single point discharges for deepening and maintenance of the channel within the offshore reach over a 50-year project life. This would be a total of 55,682,500 cubic yards of material dredged and placed over 50 years.

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Within the inland and bay reaches, approximately 2,114 acres of open water would be filled with dredged material from the channel, over a 50-year period. This accounts for both deepening and maintenance of the channel.

23. Is Any Portion of the Work Already Complete? Yes _____ No __X__ IF YES, DESCRIBE THE COMPLETED WORK

24. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (If more than can be entered here, please attach a supplemental list.

25. List of Other Certifications or Approvals/Denials Received from other Federal, State or Local Agencies for Work Described in This Application.

AGENCY	***TYPE APPROVAL***	***IDENTIFICATION NO.***	***DATE APPLIED***	***DATE APPROVED***	***DATE DENIED***
LDEQ	Water Quality Certification		TBD		

To the best of my knowledge the proposed activity described in my permit application complies with and will be conducted in a manner that is consistent with the LA Coastal management Program.

**Would include but is not restricted to zoning, building and flood plain permits.*

26. Application is hereby made for a permit or permits to authorize the work described in this application. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

_________________________________ ____________________ ____ ____________________

SIGNATURE OF APPLICANT *DATE* *SIGNATURE OF AGENT* *DATE*

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency The United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both.

Wetland Value Assessment

Wetland Value Assessment Project Information Sheet
November 2016

Project Name: Houma Navigation Canal Deepening Project

Project Type(s): Navigation; National Economic Development (NED)

Sponsoring Agency: Louisiana Department of Transportation and Development

Preparer of Wetland Value Assessment (WVA) information sheet: Jonathan Puls
Information found in this project information sheet was obtained primarily from information provided by Ronnie Paille of the United States fish and Wildlife Service.

Project Area: The Houma Navigation Canal is a Federally maintained waterway that connects the Gulf Intracoastal Waterway (GIWW) in Houma with the Gulf of Mexico (Figures 1-1 and 1-2). The HNC is located in south-central Terrebonne Parish, approximately 50 miles southwest of New Orleans. The project area is within the Barataria-Terrebonne National Estuary, one of the most expansive and productive estuaries in the U.S.

Problem: At present, the depth of the channel causes marine interests to use less efficient methods to service the offshore oil and gas facilities located in the Gulf of Mexico. These inefficiencies manifest themselves as light loading and/or use of more remote harbors with deeper channels. Deepening the channel would eliminate these inefficiencies.

Many and varied businesses are located along the approximately 41 miles of the HNC south of Hwy 661. The navigation needs of many of these firms are not being fully met by the existing dimensions of the channel. Most of the current traffic on the canal is composed of motorized boats used for support of the offshore oil and gas industry, including support vessels, tug/tow boats, as well as local area commercial fishing vessels. Almost all of the remaining tonnage on the HNC is composed of petroleum barges and barges carrying gravel. Over a 3-year period of 1996 through 1998, vessel traffic declined an average of 7.5 percent annually. However, offshore oil and gas activity grew during this same period. This trend implies that activity on the HNC will stabilize and remain there well into the future if no changes are made to the channel because inefficiencies in navigation manifest themselves as light loading and/or use of more remote harbors with deeper channels.

The following problem statements describe these inefficiencies:

- The current Federal channel depth is insufficient and there are opportunities to improve navigation in the channel;
- The insufficient channel depth results in waterway users light-loading larger vessels, using smaller vessels, rerouting larger vessels to deeper ports, and

detouring along longer routes to avoid the HNC, and there are opportunities to reduce transportation costs;

- Bank erosion occurs along the Inland Reach of the channel and there are opportunities to reduce shoaling and reduce maintenance dredging in the Federal channel; and
- Bank erosion and wetland loss occurs in the area and there are opportunities to reduce erosion and create wetlands in the area.

Goal: The goal of the Houma Navigation Canal Deepening Project is to formulate alternative plans that would maximize the benefits to industry and the community while seeking ways to preserve and enhance the environment.

Objectives:

1) Provide increased efficiency for navigation on the HNC;
2) Preserve and enhance opportunities to maintain the fabrication industry in the study area;
3) Reduce economic and environmental losses caused by bank erosion; and
4) Preserve, restore, and enhance ecosystem wetland resources.

Project Features:

1. Channel Deepening – The primary feature of the recommended plan consists of deepening the HNC from the present maintained elevation of −15 feet MLG to an elevation of −20 feet NAVD88. The design width would remain the same as that of the currently authorized project (150 feet between Miles 36.3 and 0.0; and 300 feet between Miles 0.0 and −3.7). The side slopes of the channel would be 1V on 3H for the entire length of the HNC.

2. Disposal Sites - Dredged material quantities required to construct and maintain the channel for the TRP over the 50-year period of analysis would be disposed of in 22 locations along the channel. Disposal plans were developed for the three reaches of the channel: the Inland Reach (Mile 11.0 to the GIWW at Mile 36.3), the Bay Reach (Mile 0 to Mile 11.0), and the Cat Island Pass Reach (Mile –3.7 to Mile 0). Fifteen disposal areas were identified for the Inland and Bay Reaches. Disposal within these sites would be placed in open water areas and placed within earthen confinement, when necessary. Seven disposal areas were identified for the Cat Island or Offshore Reach. These disposal areas consist of single point discharges, or unconfined disposal of the dredged material a minimum of 1,000 feet from the channel center line.

3. Foreshore Protection and Rock Retention Structures – Approximately 14.7 miles of rock retention dikes and/or foreshore protection would be constructed or refurbished for bank protection. Approximately 13.1 miles of foreshore protection would be constructed or refurbished along the Inland Reach (6 miles along the west bank and 7.1 miles along the east bank). In addition to the foreshore protection, approximately 1.6 miles of rock retention dikes would be constructed on the Inland Reach. The foreshore dikes are proposed for the southern reaches to

slow down land loss adjacent to the channel. The foreshore rock dikes would require a geotextile fabric to be placed under the dikes. These dikes would be built to an elevation of +6 feet NAVD88.

Evaluation Methodology and Assumptions: Project-related impacts on fish and wildlife resources were evaluated using the Wetland Value Assessment (WVA) methodology, which was developed to quantify benefits of proposed CWPPRA projects. The WVA is similar to the Service's Habitat Evaluation Procedures (HEP), in that habitat quality and quantity (acreage) are measured for baseline conditions, and predicted for future without-project and future with-project conditions. Instead of the species-based approach of HEP, each WVA model utilizes an assemblage of variables considered important to the suitability of that habitat type for an array of fish and wildlife species. As with HEP, the community based WVA provides a quantitative estimate of project-related impacts to fish and wildlife resources; however, the WVA is based on separate models for bottomland hardwoods, fresh/intermediate marsh, brackish marsh, and saline marsh. Although the WVA may not include every environmental or behavioral variable that could affect fish and wildlife populations, it is widely acknowledged to provide a cost-effective means of assessing restoration measures in Louisiana's coastal wetland communities.

The WVA models operate under the assumption that optimal conditions for fish and wildlife habitat within a given wetland type can be characterized, and that existing or predicted conditions can be compared to that optimum to provide an index of habitat quality. Habitat quality is estimated and expressed through the use of a mathematical model developed specifically for each wetland type. Each model consists of: 1) a list of variables that are considered important in characterizing community-level fish and wildlife habitat values; 2) a Suitability Index graph for each variable, which defines the assumed relationship between habitat quality (Suitability Index) and different variable values; and, 3) a mathematical formula that combines the Suitability Indices for each variable into a single value for wetland habitat quality, termed the Habitat Suitability Index (HSI).

Field data are typically used to compute baseline HSI values and to predict HSIs for each target year (TY). Target years are established when future significant changes in habitat quality or quantity were expected under future with-project and future without-project conditions. Records of the WVA inputs and projected habitat changes are on file in the Service's Lafayette, Louisiana, Field Office.

The product of an HSI value and the acreage of available habitat for a given target year is the Habitat Unit (HU), which is the basic unit for measuring project effects on fish and wildlife habitat. HUs are annualized over the project life to determine the Average Annual Habitat Units (AAHUs) available for each habitat type.

The change (i.e., increase or decrease) in AAHUs for each future with-project scenario, compared to future without-project conditions, provides a measure of anticipated impacts.

A net gain in AAHUs indicates that the project is beneficial to the fish and wildlife community within that habitat type; a net loss of AAHUs indicates that the project would adversely impact fish and wildlife resources. In determining future with-project conditions, project-related direct (construction) impacts were assumed to occur in TY1 (2022) for the upper HNC. The last disposal event would occur in year 2072. Because the project life includes 2022 and 2072, the project life is 51 years. For the middle and lower portions of the inland reach, TY1 occurs in 2023, and the last disposal event is in 2073 (51 year project life). For Bay and Cat Island Pass reaches, construction would begin in 2024 and 2025, respectively, and end in 2075 for both.

The WVA models for fresh/intermediate, brackish, and saline marsh consist of six variables: 1) percent of wetland covered by emergent vegetation; 2) percent open water dominated by submerged aquatic vegetation (SAV); 3) degree of marsh edge and interspersion; 4) percent of open water less than or equal to 1.5 feet deep; 5) salinity; and, 6) aquatic organism access. Variable 1, percent marsh was determined by applying loss rates from a regional wetland loss assessment to marshes and DAs adjacent to the HNC.

Because the marsh WVAs incorporate variables for SAV and shallow open water into the models, impacts to those habitat components are combined with impacts to emergent marshes. However, SAV and percent shallow open water variables, receive roportionally less weight that the marsh variables, when variable scores are combined into a single AAHU value which measures the combined quantity and quality of the marsh/water matrix. The bottomland hardwood forest and swamp models do not include SAV or shallow open-water variables; hence, impacts to those habitats are not included in the WVA analysis for those habitat types.

Rather than using current field measurements, equations were used to estimate values for variables 2, 3, and 4 over the target years ranging from 2022 through 2072. For V2 (percent SAV coverage), baseline coverage was estimated via field knowledge. Subsequent V2 values were assumed to increase incrementally as V1 values (percent marsh) exceeded 30%, 50%, and 70%. Those relationships varied with each DA based on field knowledge (information is available upon request from the FWS). The Marsh Interspersion variable (V3) was also estimated based on V1 values, such that if V1 was 90% or greater, V3 was assumed to be 100% Class 1. If V1 was 10% or less, V3 was assumed to be 100% Class 5. When V1 was between 10 and 90%, that V1 value was assumed to equal the V3 Class 2 percentage, and the V3 Class 4 value was equal to 100% minus the Class 2 percentage. For the Percent Shallow Open Water variable (V4), the baseline value was established based on field experience in the area. Values for subsequent years were computed as follows:

Target Years 1-19: Baseline value + (V1 value x 0.1)
Target Years 20-39: (Baseline value x 0.8) + (V1 value x 0.1)
Target Years 40-50: (Baseline value x 0.6) + (V1 value x 0.1)

Current salinity data, obtained from the Coastal Reference Monitoring System (CRMS) website, was assumed to represent baseline conditions. Where a DA was located between two CRMS stations, the V5 value was estimated by extrapolating between those CRMS station salinities. Additionally, salinities for sites south of the lock were assumed to increase over time whereas little or no future increases were estimated for sites north of the lock. The magnitude of salinity increases was greatest for the high SLR scenario, and moderate for the intermediate SLR scenario.

When marsh creation projects are assessed using the WVA, typically the fill site is not assumed to be functioning vegetated marsh until 3 to 5 years after spoil placement. To avoid the need to create additional target years to capture vegetation coverage of fill material, a simplifying assumption was made whereby all marsh creation sites were assumed to be fully functioning marsh with full fish access in year 1.

The WVA model for bottomland hardwoods consists of seven variables: 1) tree species association; 2) stand maturity; 3) percent understory and midstory coverage; 4) hydrology; 5) size of contiguous forested area; 6) surrounding land use; and, 7) disturbance type and disturbance distance. The WVA model for swamp incorporates 4 variables: 1) stand structure; 2) stand maturity; 3) water regime; and 4) salinity. Field data collected in 2009 was used in these WVAs.

18-Foot Channel Alternatives

Marsh Creation Disposal Area	Habitat Type	18 ft Channel w Earthen Dikes AAHUs Low SLR	Med SLR	High SLR
3	BLH	-1.56	-1.56	-1.56
12	INT Marsh	0.78	0.19	0.05
12B	INT Marsh	7.75	7.06	5.54
A-07-A	INT Marsh	10.36	9.10	7.13
14A	INT Marsh	3.54	3.42	3.07
	Subtotal	22.43	19.78	15.79
7E	BR Marsh	7.77	7.37	5.50
15	BR Marsh	10.23	9.42	7.51
15A	BR Marsh	0.29	0.29	0.27
16	BR Marsh	7.54	7.03	4.59
19C	BR Marsh	-8.30	-8.08	-7.46
19D	BR Marsh	6.51	6.07	5.40
20C	BR Marsh	3.57	2.83	2.03
	Subtotal	27.62	24.93	17.84
21	SAL Marsh	12.29	10.39	8.79
24	SAL Marsh	9.41	8.62	6.99
LUNG-E	SAL Marsh	360.10	337.20	271.35
BSEI-E	SAL Marsh	256.44	242.86	200.30
	Subtotal	638.24	599.08	487.43
Marsh Creation Subtotal		688.29	643.79	521.05

Marsh Creation Disposal Area	Habitat Type	18 ft Channel w Rock Dikes AAHUs Low SLR	Med SLR	High SLR
3	BLH	-1.56	-1.56	-1.56
12	INT Marsh	0.78	0.19	0.05
12B	INT Marsh	7.75	7.06	5.54
A-07-A	INT Marsh	10.36	9.10	7.13
14A	INT Marsh	3.54	3.42	3.07
	Subtotal	22.43	19.78	15.79
7E	BR Marsh	7.77	7.37	5.50
15	BR Marsh	10.23	9.42	7.51
15A	BR Marsh	0.29	0.29	0.27
16	BR Marsh	7.54	7.03	4.59
19C	BR Marsh	-8.30	-8.08	-7.46
19D	BR Marsh	6.51	6.07	5.40
20C	BR Marsh	3.57	2.83	2.03
	Subtotal	27.62	24.93	17.84
21	SAL Marsh	12.29	10.39	8.79
24	SAL Marsh	9.41	8.62	6.99
LUNG-R	SAL Marsh	410.00	386.90	313.50
BSEI-R	SAL Marsh	266.05	249.85	204.35
	Subtotal	697.75	655.76	533.64
Marsh Creation Subtotal		747.80	700.47	567.27

Marsh Creation Disposal Area	Habitat Type	18 ft Channel w Adj Disposal AAHUs Low SLR	Med SLR	High SLR
3	BLH	-1.56	-1.56	-1.56
12	INT Marsh	0.78	0.19	0.05
12B	INT Marsh	7.75	7.06	5.54
A-07-A	INT Marsh	10.36	9.10	7.13
14A	INT Marsh	3.54	3.42	3.07
	Subtotal	22.43	19.78	15.79
7E	BR Marsh	7.77	7.37	5.50
15	BR Marsh	10.23	9.42	7.51
15A	BR Marsh	0.29	0.29	0.27
16	BR Marsh	7.54	7.03	4.59
19C	BR Marsh	-8.30	-8.08	-7.46
19D	BR Marsh	6.51	6.07	5.40
20C	BR Marsh	3.57	2.83	2.03
	Subtotal	27.62	24.93	17.84
21	SAL Marsh	12.29	10.39	8.79
24	SAL Marsh	9.41	8.62	6.99
LUNG-R	SAL Marsh	0.00	0.00	0.00
BSEI-R	SAL Marsh	0.00	0.00	0.00
	Subtotal	21.70	19.01	15.78
Marsh Creation Subtotal		71.75	63.73	49.41

Upper Channel Bank Erosion	Habitat Type	18 ft Channel w Earthen Dikes AAHUs Low SLR	Med SLR	High SLR
Erosion	BLH	-2.39	-2.39	-2.39
Erosion	Swamp	-0.72	-0.72	-0.72
Erosion	INT Marsh	-0.70	-0.70	-0.70
Erosion	BR Marsh	23.91	23.91	23.91
Erosion	SAL Marsh	61.15	61.15	61.15

Upper Channel Bank Erosion	Habitat Type	18 ft Channel w Rock Dikes AAHUs Low SLR	Med SLR	High SLR
Erosion	BLH	-2.39	-2.39	-2.39
Erosion	Swamp	-0.72	-0.72	-0.72
Erosion	INT Marsh	-0.70	-0.70	-0.70
Erosion	BR Marsh	23.91	23.91	23.91
Erosion	SAL Marsh	61.15	61.15	61.15

Upper Channel Bank Erosion	Habitat Type	18 ft Channel w Rock Dikes AAHUs Low SLR	Med SLR	High SLR
Erosion	BLH	-2.39	-2.39	-2.39
Erosion	Swamp	-0.72	-0.72	-0.72
Erosion	INT Marsh	-0.70	-0.70	-0.70
Erosion	BR Marsh	23.91	23.91	23.91
Erosion	SAL Marsh	61.15	61.15	61.15

TOTALS Habitat Type	18 ft Channel w Earthen Dikes AAHUs Low SLR	Med SLR	High SLR
BLH	-3.95	-3.95	-3.95
Swamp	-0.72	-0.72	-0.72
INT Marsh	21.73	19.08	15.09
BR Marsh	51.52	48.84	41.75
SAL Marsh	699.38	660.22	548.57

TOTALS Habitat Type	18 ft Channel w Rock Dikes AAHUs Low SLR	Med SLR	High SLR
BLH	-3.95	-3.95	-3.95
Swamp	-0.72	-0.72	-0.72
INT Marsh	21.73	19.08	15.09
BR Marsh	51.52	48.84	41.75
SAL Marsh	758.89	716.91	594.78

TOTALS Habitat Type	18 ft Channel w Rock Dikes AAHUs Low SLR	Med SLR	High SLR
BLH	-3.95	-3.95	-3.95
Swamp	-0.72	-0.72	-0.72
INT Marsh	21.73	19.08	15.09
BR Marsh	51.52	48.84	41.75
SAL Marsh	82.85	80.16	76.93

20-Foot Deep Channel Alternatives

Marsh Creation Disposal Area	Habitat Type	20 ft Channel w Earthen Dikes AAHUs Low SLR	Med SLR	High SLR
3	BLH	-7.32	-7.32	-7.32
12	INT Marsh	10.31	8.72	7.32
12B	INT Marsh	5.37	4.72	3.08
A-07-A	INT Marsh	6.62	6.17	4.13
14A	INT Marsh	21.24	20.39	17.03
	Subtotal	43.54	39.99	31.57
7E	BR Marsh	22.39	20.86	16.25
15	BR Marsh	20.05	18.50	14.91
15A	BR Marsh	6.70	6.62	6.02
16	BR Marsh	13.82	13.01	8.89
19C	BR Marsh	-0.60	-0.95	-1.65
19D	BR Marsh	7.74	7.53	6.53
20C	BR Marsh	14.55	13.53	9.91
	Subtotal	84.64	79.11	60.87
21	SAL Marsh	44.93	41.66	33.87
24	SAL Marsh	0.66	0.23	-0.53
LUNG-E	SAL Marsh	401.80	375.97	299.99
BSEI-E	SAL Marsh	299.24	277.69	228.98
	Subtotal	746.63	695.56	562.32
Marsh Creation Subtotal		874.81	814.65	654.76

Marsh Creation Disposal Area	Habitat Type	20 ft Channel w Rock Dikes AAHUs Low SLR	Med SLR	High SLR
3	BLH	-7.32	-7.32	-7.32
12	INT Marsh	10.31	8.72	7.32
12B	INT Marsh	5.37	4.72	3.08
A-07-A	INT Marsh	6.62	6.17	4.13
14A	INT Marsh	21.24	20.39	17.03
	Subtotal	43.54	39.99	31.57
7E	BR Marsh	22.39	20.86	16.25
15	BR Marsh	20.05	18.50	14.91
15A	BR Marsh	6.70	6.62	6.02
16	BR Marsh	13.82	13.01	8.89
19C	BR Marsh	-0.60	-0.95	-1.65
19D	BR Marsh	7.74	7.53	6.53
20C	BR Marsh	14.55	13.53	9.91
	Subtotal	84.64	79.11	60.87
21	SAL Marsh	44.93	41.66	33.87
24	SAL Marsh	0.66	0.23	-0.53
LUNG-R	SAL Marsh	459.26	434.91	353.22
BSEI-R	SAL Marsh	304.24	287.45	233.60
	Subtotal	809.08	764.26	620.17
Marsh Creation Subtotal		937.26	883.36	712.61

Marsh Creation Disposal Area	Habitat Type	20 ft Channel w Adj Disposal AAHUs Low SLR	Med SLR	High SLR
3	BLH	-7.32	-7.32	-7.32
12	INT Marsh	10.31	8.72	7.32
12B	INT Marsh	5.37	4.72	3.08
A-07-A	INT Marsh	6.62	6.17	4.13
14A	INT Marsh	21.24	20.39	17.03
	Subtotal	43.54	39.99	31.57
7E	BR Marsh	22.39	20.86	16.25
15	BR Marsh	20.05	18.50	14.91
15A	BR Marsh	6.70	6.62	6.02
16	BR Marsh	13.82	13.01	8.89
19C	BR Marsh	-0.60	-0.95	-1.65
19D	BR Marsh	7.74	7.53	6.53
20C	BR Marsh	14.55	13.53	9.91
	Subtotal	84.64	79.11	60.87
21	SAL Marsh	44.93	41.66	33.87
24	SAL Marsh	0.66	0.23	-0.53
LUNG-R	SAL Marsh	0.00	0.00	0.00
BSEI-R	SAL Marsh	0.00	0.00	0.00
	Subtotal	45.58	41.89	33.35
Marsh Creation Subtotal		173.76	160.99	125.79

Bank Erosion	Habitat Type	20 ft Channel w Earthen Dikes AAHUs Low SLR	Med SLR	High SLR
Erosion	BLH	-2.39	-2.39	-2.39
Erosion	Swamp	-0.72	-0.72	-0.72
Erosion	INT Marsh	-0.70	-0.70	-0.70
Erosion	BR Marsh	23.91	23.91	23.91
Erosion	SAL Marsh	61.15	61.15	61.15

Bank Erosion	Habitat Type	20 ft Channel w Rock Dikes AAHUs Low SLR	Med SLR	High SLR
Erosion	BLH	-2.39	-2.39	-2.39
Erosion	Swamp	-0.72	-0.72	-0.72
Erosion	INT Marsh	-0.70	-0.70	-0.70
Erosion	BR Marsh	23.91	23.91	23.91
Erosion	SAL Marsh	61.15	61.15	61.15

Bank Erosion	Habitat Type	20 ft Channel w Adj Disposal AAHUs Low SLR	Med SLR	High SLR
Erosion	BLH	-2.39	-2.39	-2.39
Erosion	Swamp	-0.72	-0.72	-0.72
Erosion	INT Marsh	-0.70	-0.70	-0.70
Erosion	BR Marsh	23.91	23.91	23.91
Erosion	SAL Marsh	61.15	61.15	61.15

TOTALS Habitat Type	20 ft Channel w Earthen Dikes AAHUs Low SLR	Med SLR	High SLR
BLH	-9.71	-9.71	-9.71
Swamp	-0.72	-0.72	-0.72
INT Marsh	42.84	39.29	30.87
BR Marsh	108.55	103.02	84.78
SAL Marsh	807.77	756.70	623.46

TOTALS Habitat Type	20 ft Channel w Rock Dikes AAHUs Low SLR	Med SLR	High SLR
BLH	-9.71	-9.71	-9.71
Swamp	-0.72	-0.72	-0.72
INT Marsh	42.84	39.29	30.87
BR Marsh	108.55	103.02	84.78
SAL Marsh	870.23	825.41	681.32

TOTALS Habitat Type	20 ft Channel w Adj Disposal AAHUs Low SLR	Med SLR	High SLR
BLH	-9.71	-9.71	-9.71
Swamp	-0.72	-0.72	-0.72
INT Marsh	42.84	39.29	30.87
BR Marsh	108.55	103.02	84.78
SAL Marsh	106.73	103.04	94.49

TSP Net Acres

Marsh Creation Disposal Area	Habitat Type	20 ft Channel (TSP) TY50 net acres Low SLR	Med SLR	High SLR
3	BLH	-40	-40	-40
12	INT Marsh	30.78	29.64	21.66
12B	INT Marsh	1.10	-0.55	-4.40
A-07-A	INT Marsh	0.00	0.00	-7.72
14A	INT Marsh	104.72	99.28	80.24
	Subtotal	136.60	128.37	89.78
7E	BR Marsh	25.52	22.33	12.76
15	BR Marsh	17.64	13.23	1.47
15A	BR Marsh	77.90	76.00	71.25
16	BR Marsh	-23.56	-27.28	-39.68
19C	BR Marsh	-9.62	-10.36	-11.10
19D	BR Marsh	31.98	30.34	25.42
20C	BR Marsh	1.30	-2.60	-11.70
	Subtotal	121.16	101.66	48.42
21	SAL Marsh	129.22	124.25	94.43
24	SAL Marsh	-6.30	-7.00	-8.40
LUNG-E	SAL Marsh	0.00	0.00	0.00
BSEI-E	SAL Marsh	0.00	0.00	0.00
	Subtotal	122.92	117.25	86.03
Marsh Creation Subtotal		380.68	347.28	224.23

Initially Constructed MC Acres - not Net Acres at TY50!

with confined disposal bay and pass reach

Habitat Type	Marsh Creation Disposal Area	FWOP Acres Created	FWP- 18 ft Channel Acres Created	FWP-20 ft Channel Acres Created	FWP 20' Net Acres
BLH	3	-61.80	-73.47	-101.90	-40.10
INT Marsh	12	59.17	63.51	114.19	55.01
INT Marsh	12B	39.45	54.46	25.48	-13.97
INT Marsh	A-07-A	192.31	193.07	185.73	-6.58
INT Marsh	14A	23.50	75.72	136.12	112.61
Subtotal		314.43	386.77	461.51	147.08
BR Marsh	7E	229.20	269.90	319.15	89.94
BR Marsh	15	117.40	147.15	146.50	29.11
BR Marsh	15A	0.00	37.79	95.11	95.11
BR Marsh	16	117.40	116.06	116.65	-0.74
BR Marsh	19C	70.51	53.08	65.85	-4.66
BR Marsh	19D	47.01	75.72	81.67	34.66
BR Marsh	20C	117.52	110.53	129.97	12.45
Subtotal		699.04	810.23	954.90	255.86
SAL Marsh	21	323.93	403.06	497.36	173.43
SAL Marsh	24	54.50	70.33	53.86	-0.63
SAL Marsh	LUNG	0.00	2085.74	2209.14	2209.14
SAL Marsh	BSEI	0.00	1234.25	1316.89	1316.89
Subtotal		378.42	3793.39	4077.25	3698.83

Initially Constructed MC Acres - not Net Acres at TY50!

un-confined disposal bay and pass reach

Habitat Type	Marsh Creation Disposal Area	FWOP Acres Created	FWP- 18 ft Channel Acres Created	FWP-20 ft Channel Acres Created	TSP Net Acres
BLH	3	-61.80	-73.47	-101.90	-40.101
INT Marsh	12	59.17	63.51	114.19	55.01
INT Marsh	12B	39.45	54.46	25.48	-13.97
INT Marsh	A-07-A	192.31	193.07	185.73	-6.58
INT Marsh	14A	23.50	75.72	136.12	112.61
Subtotal		314.43	386.77	461.51	147.08
BR Marsh	7E	229.20	269.90	319.15	89.94
BR Marsh	15	117.40	147.15	146.50	29.11
BR Marsh	15A	0.00	37.79	95.11	95.11
BR Marsh	16	117.40	116.06	116.65	-0.74
BR Marsh	19C	70.51	53.08	65.85	-4.66
BR Marsh	19D	47.01	75.72	81.67	34.66
BR Marsh	20C	117.52	110.53	129.97	12.45
Subtotal		699.04	810.23	954.90	255.86
SAL Marsh	21	323.93	403.06	497.36	173.43
SAL Marsh	24	54.50	70.33	53.86	-0.63
SAL Marsh	LUNG	0.00	0.00	0.00	0.00
SAL Marsh	BSEI	0.00	0.00	0.00	0.00
Subtotal		378.42	473.40	551.22	172.80

Habitat Type	FWOP	FWP 18-ft Channel		FWP 20-ft Channel	
	Confined Disposal Acres Created	Confined Disposal Acres Created	Adjacent Disposal Acres Created	Confined Disposal Acres Created	Adjacent Disposal Acres Created
BLH	-61.80	-73.47	-73.47	-101.90	-101.90
INT marsh	314.43	386.77	386.77	461.51	147.08
BR marsh	699.04	810.23	810.23	954.90	255.86
SAL marsh	378.42	3793.39	473.40	4077.25	172.80
					Net

Habitat	Bank	20 ft Channel (TSP) TY50 net acres Low SLR	Med SLR	High SLR
BLH	Erosion	6.38	6.38	6.38
Swamp	Erosion	1.81	1.81	1.81
INT Marsh	Erosion	-1.97	-1.97	-1.97
BR Marsh	Erosion	62.83	62.83	62.83
SAL Marsh	Erosion	160.81	160.81	160.81

Bank Erosion Summary

TOTALS Habitat	20 ft Channel (TSP) TY50 net acres Low SLR	Med SLR	High SLR
BLH	-33.72	-33.72	-33.72
Swamp	1.81	1.81	1.81
INT Marsh	134.63	126.40	87.81
BR Marsh	183.99	164.49	111.25
SAL Marsh	283.73	278.06	246.84

Habitat Type	FWOP Acres	FWP- 18 ft Channel Acres Lost	FWP-20 ft Channel Acres Lost
BLH	155	162	162
Swamp	36	38	38
INT Marsh	46	48	48
BR Marsh	238	175	175
SAL Marsh	248	87	87

TOTALS	18 ft Channel w Earthen Dikes		
	AAHUs		
Habitat Typ	Low SLR	Med SLR	High SLR
BLH	-3.95	-3.95	-3.95
Swamp	-0.72	-0.72	-0.72
INT Marsh	21.73	19.08	15.09
BR Marsh	51.52	48.84	41.75
SAL Marsh	699.38	660.22	548.57

TOTALS	18 ft Channel w Earthen Dikes				
	Acres Required				
Habitat Typ	Low SLR	Med SLR	High SLR		
BLH	7.45	7.45	7.45		
Swamp	2.07	2.07	2.07	9.52	$428,000
INT Marsh	0.00	0.00	0.00		
BR Marsh	0.00	0.00	0.00		
SAL Marsh	0.00	0.00	0.00		

TOTALS	18 ft Channel w Rock Dikes		
	AAHUs		
Habitat Typ	Low SLR	Med SLR	High SLR
BLH	-3.95	-3.95	-3.95
Swamp	-0.72	-0.72	-0.72
INT Marsh	21.73	19.08	15.09
BR Marsh	51.52	48.84	41.75
SAL Marsh	758.89	716.91	594.78

TOTALS	18 ft Channel w Rock Dikes				
	Acres Required				
Habitat Typ	Low SLR	Med SLR	High SLR		
BLH	7.45	7.45	7.45		
Swamp	2.07	2.07	2.07	9.52	$428,000
INT Marsh	0.00	0.00	0.00		
BR Marsh	0.00	0.00	0.00		
SAL Marsh	0.00	0.00	0.00		

TOTALS	18 ft Channel w Rock Dikes		
	AAHUs		
Habitat Typ	Low SLR	Med SLR	High SLR
BLH	-3.95	-3.95	-3.95
Swamp	-0.72	-0.72	-0.72
INT Marsh	21.73	19.08	15.09
BR Marsh	51.52	48.84	41.75
SAL Marsh	82.85	80.16	76.93

TOTALS	18 ft Channel w Rock Dikes				
	Acres Required				
Habitat Typ	Low SLR	Med SLR	High SLR		
BLH	7.45	7.45	7.45		
Swamp	2.07	2.07	2.07	9.52	$428,000
INT Marsh	0.00	0.00	0.00		
BR Marsh	0.00	0.00	0.00		
SAL Marsh	0.00	0.00	0.00		

TOTALS	20 ft Channel w Earthen Dikes		
	AAHUs		
Habitat Typ	Low SLR	Med SLR	High SLR
BLH	-9.71	-9.71	-9.71
Swamp	-0.72	-0.72	-0.72
INT Marsh	42.84	39.29	30.87
BR Marsh	108.55	103.02	84.78
SAL Marsh	807.77	756.70	623.46

TOTALS	20 ft Channel w Earthen Dikes				
	Acres Required				
Habitat Typ	Low SLR	Med SLR	High SLR		
BLH	18.32	18.32	18.32		
Swamp	2.07	2.07	2.07	20.38	$917,000
INT Marsh	0.00	0.00	0.00		
BR Marsh	0.00	0.00	0.00		
SAL Marsh	0.00	0.00	0.00		

TOTALS	20 ft Channel w Rock Dikes		
	AAHUs		
Habitat Typ	Low SLR	Med SLR	High SLR
BLH	-9.71	-9.71	-9.71
Swamp	-0.72	-0.72	-0.72
INT Marsh	42.84	39.29	30.87
BR Marsh	108.55	103.02	84.78
SAL Marsh	870.23	825.41	681.32

TOTALS	20 ft Channel w Rock Dikes				
	Acres Required				
Habitat Typ	Low SLR	Med SLR	High SLR		
BLH	18.32	18.32	18.32		
Swamp	2.07	2.07	2.07	20.38	$917,000
INT Marsh	0.00	0.00	0.00		
BR Marsh	0.00	0.00	0.00		
SAL Marsh	0.00	0.00	0.00		

TOTALS	20 ft Channel w Adj Disposal		
	AAHUs		
Habitat Typ	Low SLR	Med SLR	High SLR
BLH	-9.71	-9.71	-9.71
Swamp	-0.72	-0.72	-0.72
INT Marsh	42.84	39.29	30.87
BR Marsh	108.55	103.02	84.78
SAL Marsh	106.73	103.04	94.49

TOTALS	20 ft Channel w Adj Disposal				
	Acres Required				
Habitat Typ	Low SLR	Med SLR	High SLR		
BLH	18.32	18.32	18.32		
Swamp	2.07	2.07	2.07	20.38	$917,000
INT Marsh	0.00	0.00	0.00		
BR Marsh	0.00	0.00	0.00		
SAL Marsh	0.00	0.00	0.00		

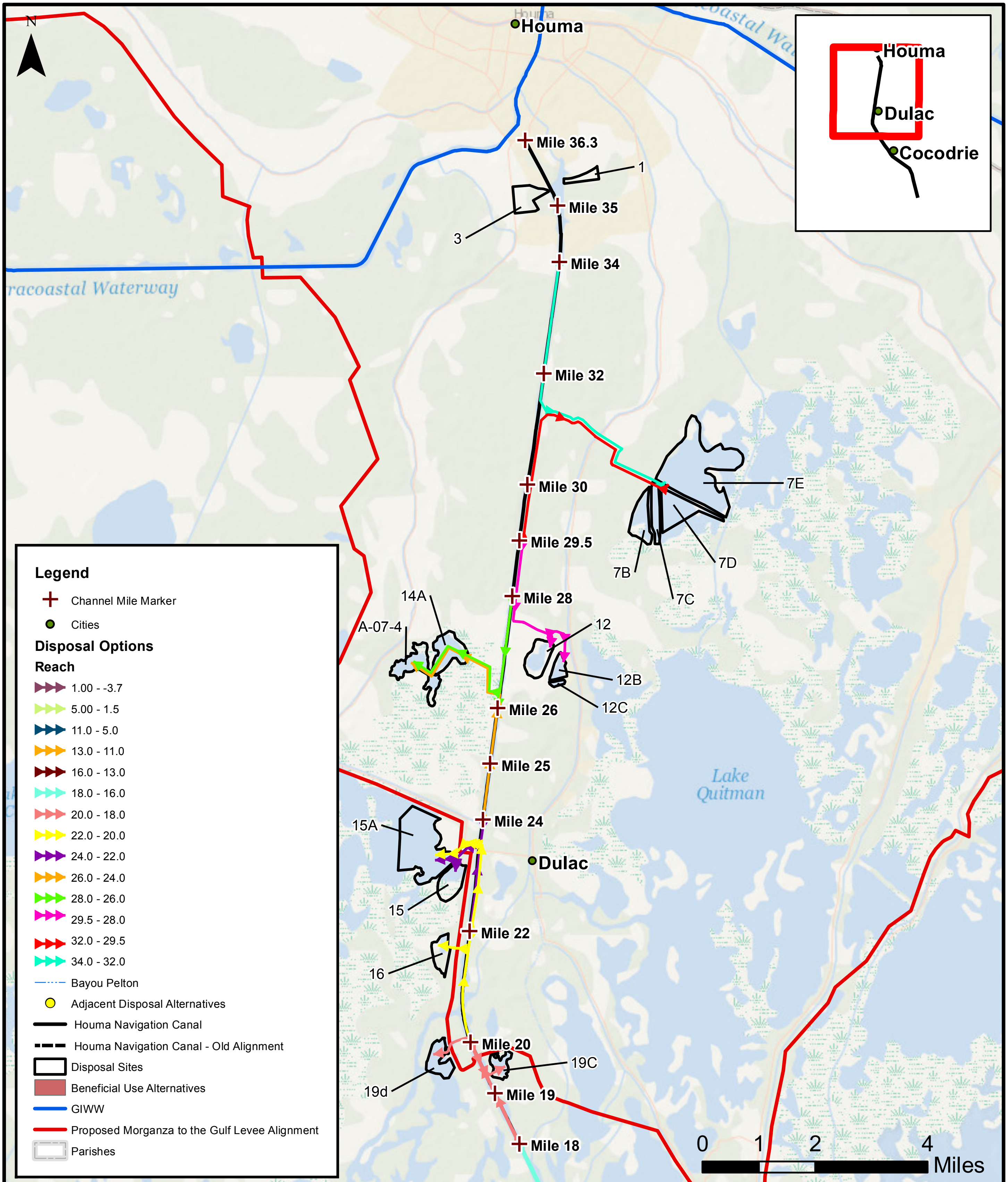
WVA Data

Figure 1 depicts the disposal areas for the Inland and Bay Reaches. Figure 2 depicts the disposal areas for the Offshore or Cat Island Pass Reach.

Table 1 shows the results of the WVA model in terms of habitat type in AAHUs.

Table 2 shows the results of the WVA model in terms of habitat type in acres.

Table 3 shows the mitigation requirements of the project in terms of AAHUs and acres.

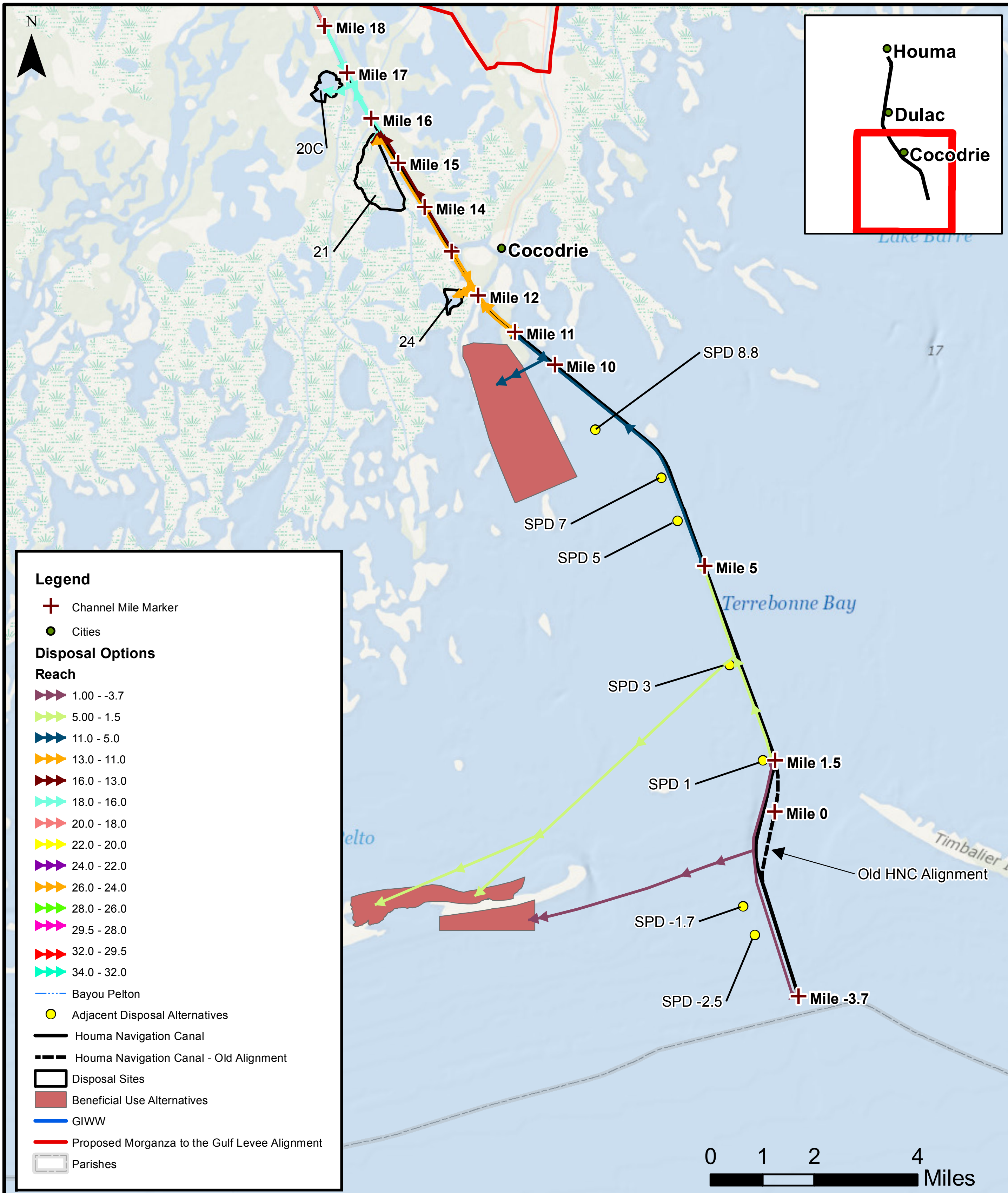


DISPOSAL AREAS
North End
Houma Navigation Canal Deepening

ERSI Ocean Map

GEC

Figure 1
Date: December 2014
Scale:1:150,000
Source: ESRI/GEC
Map ID: 278500218-3026



DISPOSAL AREAS
South End
Houma Navigation Canal Deepening

ERSI Ocean Map

GEC

Figure 2	
Date: December 2014	
Scale:1:165,000	
Source: ESRI/GEC	
Map ID: 278500218-3026	

Table 1. Construction and Maintenance Quantities per Disposal Area (Acres)

Disposal Site	Year 0 (ac)	Year 1 (ac)	Year 5 (ac)	Year 10 (ac)	Year 11 (ac)	Year 15 (ac)	Year 20 (ac)	Year 21 (ac)	Year 25 (ac)	Year30 (ac)	Year31 (ac)	Year 35 (ac)	Year 40 (ac)	Year 41 (ac)	Year 45 (ac)	Year 50 (ac)	Year 51 (ac)	Total Quantity
1	33.6		11.3															44.9
3				11.3		11.3	11.3		11.3	11.3		11.3	11.3		11.3	11.3		101.9
7E	53.7			53.1			53.1			53.1			53.1			53.1		319.1
12B	25.5			22.8														48.3
12							22.8			22.8			22.8			22.8		91.3
A-07-A	62.0			24.7			24.7			24.7			24.7			24.7		185.7
14A				27.2			27.2			27.2			27.2			27.2		136.1
15	37.8		13.6	13.6		13.6	13.6		13.6	13.6		13.6	13.6					146.5
15-A										13.6		13.6	13.6		27.2	27.2		95.1
16		48.7	13.6	13.6		13.6	13.6		13.6									116.7
19-C		11.4			27.2			27.2										65.9
19-D											27.2			27.2			27.2	81.7
20-C		21.1			27.2			27.2			27.2			27.2				130.0
21		48.8			51.4			90.8			90.8			90.8			124.8	497.4
24		22.3			31.5													53.9

Table 2. Construction and Maintenance Quantities per Disposal Area (Cubic Yards)

Disposal Site	Year 2 (ac)	Year 3 (ac)	Year 5 (ac)	Year 7 (ac)	Year 9 (ac)	Year 11 (ac)	Year 13 (ac)	Year 15 (ac)	Year 17 (ac)	Year 19 (ac)	Year 21 (ac)	Year 23 (ac)	Year 25 (ac)	Year 27 (ac)	Year 29 (ac)	Year 31 (ac)	Year 33 (ac)	Year 35 (ac)
LUNG	231.9	0.0	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1
Bay Side East Island	0.0	108.5	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3

Disposal Site	Year 37 (ac)	Year 39 (ac)	Year 41 (ac)	Year 43 (ac)	Year 45 (ac)	Year 47 (ac)	Year 49 (ac)	Year 51 (ac)	Year 53 (ac)	Total Quantity
LUNG	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	79.1	1,497
Bay Side East Island	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	882

TOTALS	18 ft Channel w Earthen Dikes		
	AAHUs		
Habitat Typ	Low SLR	Med SLR	High SLR
BLH	-3.95	-3.95	-3.95
Swamp	-0.72	-0.72	-0.72
INT Marsh	21.73	19.08	15.09
BR Marsh	51.52	48.84	41.75
SAL Marsh	699.38	660.22	548.57

TOTALS	18 ft Channel w Earthen Dikes				
	Acres Required				
Habitat Typ	Low SLR	Med SLR	High SLR		
BLH	7.45	7.45	7.45		
Swamp	2.07	2.07	2.07	9.52	$428,000
INT Marsh	0.00	0.00	0.00		
BR Marsh	0.00	0.00	0.00		
SAL Marsh	0.00	0.00	0.00		

TOTALS	18 ft Channel w Rock Dikes		
	AAHUs		
Habitat Typ	Low SLR	Med SLR	High SLR
BLH	-3.95	-3.95	-3.95
Swamp	-0.72	-0.72	-0.72
INT Marsh	21.73	19.08	15.09
BR Marsh	51.52	48.84	41.75
SAL Marsh	758.89	716.91	594.78

TOTALS	18 ft Channel w Rock Dikes				
	Acres Required				
Habitat Typ	Low SLR	Med SLR	High SLR		
BLH	7.45	7.45	7.45		
Swamp	2.07	2.07	2.07	9.52	$428,000
INT Marsh	0.00	0.00	0.00		
BR Marsh	0.00	0.00	0.00		
SAL Marsh	0.00	0.00	0.00		

TOTALS	18 ft Channel w Rock Dikes		
	AAHUs		
Habitat Typ	Low SLR	Med SLR	High SLR
BLH	-3.95	-3.95	-3.95
Swamp	-0.72	-0.72	-0.72
INT Marsh	21.73	19.08	15.09
BR Marsh	51.52	48.84	41.75
SAL Marsh	82.85	80.16	76.93

TOTALS	18 ft Channel w Rock Dikes				
	Acres Required				
Habitat Typ	Low SLR	Med SLR	High SLR		
BLH	7.45	7.45	7.45		
Swamp	2.07	2.07	2.07	9.52	$428,000
INT Marsh	0.00	0.00	0.00		
BR Marsh	0.00	0.00	0.00		
SAL Marsh	0.00	0.00	0.00		

TOTALS	20 ft Channel w Earthen Dikes		
	AAHUs		
Habitat Typ	Low SLR	Med SLR	High SLR
BLH	-9.71	-9.71	-9.71
Swamp	-0.72	-0.72	-0.72
INT Marsh	42.84	39.29	30.87
BR Marsh	108.55	103.02	84.78
SAL Marsh	807.77	756.70	623.46

TOTALS	20 ft Channel w Earthen Dikes				
	Acres Required				
Habitat Typ	Low SLR	Med SLR	High SLR		
BLH	18.32	18.32	18.32		
Swamp	2.07	2.07	2.07	20.38	$917,000
INT Marsh	0.00	0.00	0.00		
BR Marsh	0.00	0.00	0.00		
SAL Marsh	0.00	0.00	0.00		

TOTALS	20 ft Channel w Rock Dikes		
	AAHUs		
Habitat Typ	Low SLR	Med SLR	High SLR
BLH	-9.71	-9.71	-9.71
Swamp	-0.72	-0.72	-0.72
INT Marsh	42.84	39.29	30.87
BR Marsh	108.55	103.02	84.78
SAL Marsh	870.23	825.41	681.32

TOTALS	20 ft Channel w Rock Dikes				
	Acres Required				
Habitat Typ	Low SLR	Med SLR	High SLR		
BLH	18.32	18.32	18.32		
Swamp	2.07	2.07	2.07	20.38	$917,000
INT Marsh	0.00	0.00	0.00		
BR Marsh	0.00	0.00	0.00		
SAL Marsh	0.00	0.00	0.00		

TOTALS	20 ft Channel w Adj Disposal		
	AAHUs		
Habitat Typ	Low SLR	Med SLR	High SLR
BLH	-9.71	-9.71	-9.71
Swamp	-0.72	-0.72	-0.72
INT Marsh	42.84	39.29	30.87
BR Marsh	108.55	103.02	84.78
SAL Marsh	106.73	103.04	94.49

TOTALS	20 ft Channel w Adj Disposal				
	Acres Required				
Habitat Typ	Low SLR	Med SLR	High SLR		
BLH	18.32	18.32	18.32		
Swamp	2.07	2.07	2.07	20.38	$917,000
INT Marsh	0.00	0.00	0.00		
BR Marsh	0.00	0.00	0.00		
SAL Marsh	0.00	0.00	0.00		