Appendix A

SHOALING

US Army Corps
of Engineers
New Orleans District

TECHNICAL REPORTS
CALCASIEU RIVER AND PASS, LOUISIANA
DREDGED MATERIAL MANAGEMENT PLAN
PHASE II

January 2009

TECHNICAL REPORTS
SHOALING STUDY

CALCASIEU RIVER AND PASS, LOUISIANA
DREDGED MATERIAL MANAGEMENT PLAN
PHASE II

Contract No. DACW27-03-D-0005
Delivery Order No. CZ03
GEC Project No. 27321CZ03

PREPARED FOR:

U.S. Army Corps of Engineers
New Orleans District
New Orleans, Louisiana

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1 INTRODUCTION

1.1 Project Location

The Project is located on the Calcasieu River from channel mile 5.0 to mile 36.0 in Calcasieu and Cameron Parishes and within Calcasieu Lake.

1.2 Purpose

The United States Army Corps of Engineers (USACE), Mississippi Valley Division, New Orleans District (MVN) is preparing a Dredged Material Management Plan (DMMP) and the corresponding Environmental Impact Statement (EIS) for the disposal of dredged material from the continued maintenance of the Calcasieu River and Pass, Louisiana project. The DMMP study investigates alternatives for managing dredged material for the next 20 years, including confined, aquatic (open water or ocean), within banks, beach nourishment, and other beneficial-use placement areas. As part of the development of the DMMP and EIS, technical and environmental studies to support the design, construction, and operation of dredged material disposal areas, or beneficial-use sites, are being conducted. The purpose of this technical memorandum is to provide the estimated amount of dredged materials for the next 20 years from mile 5 to mile 36 and programmatically identify sites that can be expanded or added to meet the needs of the DMMP.

1.3 Scope of Work

Historical dredging records and aerial photos were used to support statistical analysis by channel reach of the historical dredging and placement of materials from channel mile 5 to 36. This report, nor its developed scope, is intended to be an engineering design-level document. This evaluation was conducted to support preliminary planning of Placement Areas (PAs).

2 BACKGROUND

2.1 Channel Configurations

The Calcasieu Ship Channel was authorized under the River and Harbor Act of 24 July 1946. Subsequent additions and modernizations occurred under the River and Harbor Act of 14 July 1960, and 23 October 1962, among others to bring the channel to its current configuration. The Calcasieu Ship Channel consists of three main configurations:

- A -42-foot-deep and 800-foot-wide approach channel from the Gulf of Mexico to the Jetties.
- A -40-foot-deep and 400-foot-wide ship channel extending from the jetties to channel mile marker 34.1.
- A -35-foot-deep and 250-foot-wide ship channel from channel mile marker 34.1 to 36 in Lake Charles.
- Mile 0.0 is approximately where the channel makes landfall at the jetties.

Additionally, the authorized channel has the following improvements:

- A mooring basin at channel mile marker 3.
- A -40-foot-deep turning basin at mile 29.6.
- A 1,200 by 1,400-foot turning basin and -40-foot-deep by 400-foot- wide channel at Devil's Elbow.
- A -40-foot by 200-foot channel with a 1,000-foot turning basin at Coon Island.

2.2 Historical Dredging Projections by USACE MVN and ERDC

Dredged materials from ship channel mile marker 5 to 36 are dredged with a cutterhead suction dredge and placed in upland confined or semi-confined placement areas. Some materials have been beneficially used in Black Lake, Brown Lake, and the Sabine National Wildlife Refuge. Dredged material placement areas are discussed further in Section 4.

Review of the several previous reports prepared by USACE MVN and the USACE Engineer Research and Development Center (ERDC) indicate differing quantities for dredging from mile marker 5 to 36 between 1984 and 1994. The USACE MVN "Dredged Material Management Plan Preliminary Assessment", 2 October 1995, divides this study area into 2 reaches. The first reach ranges from mile 5 to 22 and is dredged on an average of once every 5 years with an average of 2,152,000 CY/year. The second reach, from mile 22 to 36, is also dredged every 5 years. A small portion, near Devil's Elbow, is dredged every 2.5 years. An average of 1,262,000 CY/year is removed from this reach. The ten-year projection for each reach is 21,520,000 CY and 12,620,000 CY for the lower and upper reaches respectively. The ten-year total is 34,140,000 CY with a 20-year projection of 68,280,000 CY.

The USACE ERDC, "Calcasieu River and Pass Dredged Material Sedimentation Study Phase 2 Study", August 2005 divides the study area into three reaches: the lower reach from mile 5 to 14, the middle reach from mile 14 to 24, and the upper reach from mile 24 to 36. The ERDC conceptual 20-year plan consists of approximately 4,000,000 CY of material to be dredged every other year in the lower reach, 4,500,000 every other year in the middle reach; and 6,500,000 CY every 5 years for the upper reach. The total dredging for 20 years in the lower reach is estimated at 44,000,000 CY, 49,500,000 in the middle reach, and 32,500,000 in the upper reach for a grand total of 126,000,000 CY of material. The ERDC projected volume is almost double the USACE MVN projected volume taken from actual dredging over 5 years. Review of the ERDC report indicates that the volumes used were taken from the "Calcasieu River Sediment Removal Study", August 1994, by Roy Wade. Review of the Wade Report does not indicate how the volumes were projected but lists assumptions made to illustrate how to use the information in the study for conceptual design of Confined Disposal Facilities (CDFs) and are <u>not</u> actual dredging records for the area. Volumes projected in the ERDC Report were not based on actual site specific dredging data. The historic dredging projections were not evaluated for the entrance and bar channel reaches of the ship channel.

3 SHOALING AND DREDGING EVALUATION

The currents and shoaling evaluation has primarily utilized historic dredging records to determine shoaling rates. The sources of sediment shoaling have not been identified as part of this particular study. A limited Hydrodynamic and Sediment Modeling Study has been completed that indicates the circulation patterns and high energy areas within the project and is included as Appendix C of the overall DMMP. Sources of material consist of riverine deposits, lake and bay bottom erosion, and possible recycling of materials from eroding CDFs or PAs and minimal site management during dredging operations. Figures 1-10 show the reaches of channel

dredged and the corresponding disposal areas. The projected rates of shoaling and required dredging are discussed in the following subsections.

3.1 Data Collection

In order to develop the projected 20-year dredging quantity, historical data from USACE MVN dredging contracts from 1994 to 2005 were reviewed and dredging contractors were interviewed. Dredging contract records were provided by USACE MVN and the USACE Lafayette Area Office. The dredging quantities by contract number and mile are shown in **Table 1**.

3.2 20-Year Dredging Forecast

Using the 11 years of dredging data compiled in Table 1, the projected gross dredging volumes for the next 20 years within the Federal Channel are outlined below.

Channel Reach (by mile)	20-Year Dredging Quantity (CY)
5-12	22,470,000
12-22	34,655,000
22-36	39,590,000
Total	**96,715,000**

The dredging forecast does not account for bulking during dredging or shrinkage during consolidation. Issues relating to bulking and shrinkage will be addressed in the geotechnical report and future conceptual designs under separate cover. However, a 70% bulking factor was added for the purposes of preliminary planning of disposal sites for each dredging event as discussed in Section 4 of this report**.** Table 2 outlines the 10 and 20-year dredging need with bulking factors by dredging cycle. Dredged materials from these reaches are placed in various confined, semi-confined, and beneficial-use sites in the project area.

The gross dredging volume is defined as the total material removed, as a result of the dredging process, to meet the required contract lines and grades or dredging template. The gross dredging volume is calculated as the area between the before and after dredging hydrographic survey lines.

3.2.1 Historic Dredging Analysis

The historic dredging completion reports from 1994 to 2005 were reviewed and compiled as shown in Table 1**.** Due to limited Operation and Maintenance funds available for dredging and PA capacity limitations, the 2003 to present dredging contracts reduced the overall channel width dimensions from 400-feet-wide to 350-feet-wide from approximate mile marker 11 to 22, and to 300-feet-wide around mile marker 15. During initial review of the 20-year dredging need quantities for the project DMMP, the Project Design Team (PDT) recommended that the quantities in this segment be changed to reflect the quantities that would have been dredged and placed, without capacity limitations.

Three methods were discussed by the team to forecast the quantities: 1) Use the before dredge (BD) survey from the last contract and compare that to the required grade template if the channel was dredged to full dimension; 2). Use the after dredge (AD) survey from the last contract that fully maintained the channel width and depth and compare that to the most recent contract before

dredge (BD) survey; and 3) evaluate the statistics for the most recent dredging event for overdepth and width by applying them to the wider template or compiling a theoretical template based on the AD survey for that contract, by repeating centerline data in the middle of the channel to simulate an AD survey for a wider required dredging template and compare that to the BD survey.

The PDT did not recommend utilizing the BD surveys to the restricted AD template as it would not reflect the actual amount of material dredged in a box cut to meet grade. They recommended using the AD survey for the last full template contract and comparing it to the BD surveys for the most recent restricted contract in order to estimate the amount of dredging needed.

The AD survey for the last full template contract was available in paper form. However, the electronic xyz data set could not be found by USACE MVN. The AD surveys for the most recent dredging event were available. Therefore, the AD surveys for the narrowed cuts were compiled and reviewed from approximately mile 11 to mile 22. The AD survey data was modified by cutting the data set at the channel centerline, then adding 25 feet of data on either side of the centerline. The data added on either side of the channel centerline was a repeat of the trend of three to four soundings either side of the centerline. The resultant sections are shown in Appendix B.

The analysis method simulated the “box” cuts typical of the industry and for the dredge used in the various contracts. A direct comparison of the BD and AD surveys was conducted to determine the amount of material dredged (or would have been dredged) using the current dredging practices in the area irrespective of the template. Using visual and statistical analysis of the entire segment from mile 11 to 22, it was determined that the contractor has typically swung approximately 235 feet from the centerline on each side on average for the entire segment to get his "box" cut. The average accounts for the extremes in width and narrowness along the entire mile segment analyzed.

Using the above analyses, the cubic yard quantities by mile were modified to reflect a theoretical 400 foot wide channel cut for contracts that had been dredged to a reduced dimension. On average, the difference between the 300 to 350-foot-wide restricted-width channel dredged and the theoretical 400 foot wide dredged channel increased the anticipated volume of 21% to 31% in quantity over the reach. The additional yards were distributed based on a more detailed analysis of each mile from approximately mile 11 to 22, with minor changes at the extremes. The contracts modified were:

1. 2003-C-0044
2. 2004-C-0048
3. 2005-C-0045

3.2.2 Private Dredging Needs

The Port of Lake Charles Harbor and Terminal District (PLCHTD), Trunkline LNG, Sempra LNG Cheniere LNG, Citgo, and Conoco are the only private dredging needs identified during this study.

3.2.2.1 Port of Lake Charles Harbor and Terminal District (PLCHD)

The PLCHTD owns and operates 4 terminals. The City Docks are comprised of several terminals, approximately 8,000 linear feet of berthing space. The dredging need varies from 65,000 to 95,000 CY every 7 to 10 years as provided by PLCHD. The last maintenance dredging cycle was in 2006, approximately 170,000 CY. The material may have been deposited as a result of poor operations by the terminal operator who processes sand and gravel as it was granular and contained gravel. No records exist for the previous dredging event.

Bulk Terminal 4 is located at approximately mile 35. A 1,500 foot berthing area requires maintenance dredging every 5 to 7 years, 8,000-18,000 CY per cycle. The last cycle was in 2006, removing 10,000 CY. Again, no records exist for previous dredging contract events.

Bulk Terminal 1 is permitted to be built south of I-210, but has not been constructed. An anticipated 900,000 cubic yards of dredged material will come from the new work construction. This would be new work material and could be used for levee building materials to either increase levee heights at an existing CDF or to create new levees at the Olin Tailing Ponds Facility currently being evaluated. Therefore, this quantity was not added to the dredging amount needed for disposal capacity. However, geotechnical properties of this material have not been evaluated for levee construction. If not suitable for direct levee pumping, the material could be stockpiled or strategically placed along levee borrow areas necessary for levee expansion at one of the disposal areas. Anticipated shoaling is 12,000 CY per 7-year dredging cycle.

3.2.2.2 Other Private Dredging Needs

Citgo, Conoco, and Trunkline LNG were contacted numerous times by this contractor and the PLCHTD to determine their dredging need. Only Citgo has responded to the requests.

Citgo will require the approximately 30,000 CY of annual dredging at heir Clifton Ridge Facility for a total of 600,000 CY near Channel Mile 27.5. The Citgo Refinery Docks will require approximately 20,000 CY annually for a total of 400,000 CY near Channel Mile 28. They will also attempt to deepen their Refinery Dock with a projected 45,000 CY sometime in the 20 year DMMP.

The Trunkline LNG Terminal is located on Devils Elbow. Dredging to their facility is accounted for in the overall shoaling study. Cheniere is currently constructing their facility around mile 4. Their dredged materials will be placed in their own disposal facility. No other private users were identified during this study period.

Sempra and Cheniere LNG have established their own dredging disposal areas.

3.2.3 Anticipated Future Dredging Needs

As the result of the Calcasieu River and Pass Navigation, Louisiana Reconnaissance Report, May 2006, four alternative plans for the development of anchorages and passing lanes to improve safety on the Calcasieu Ship Channel were developed. The four alternatives include:

- Plan 1 – Anchorage Area at Mile 15
- Plan 2 – Anchorage Area at Mile 5.1
- Plan 3 – Passing Lane at Mile 24
- Plan 4 – Passing Lane at Mile 5

These four alternatives will be further evaluated in an ongoing Feasibility Study. Long-term maintenance dredging needs and quantities are not known at this time. However, it should be noted that any new work dredging conducted to construct the anchorages or passing lanes could be stockpiled and utilized as much needed construction material to rehabilitate or raise existing CDF levees and/or create new levees as necessary at PAs M, 12A, 12B, or 13, or could be placed beneficially in Lake Calcasieu or other site identified in the Feasibility Study. Estimates of the new work materials range from 760,000 to 1,250,000 CY. Geotechnical properties of the materials will be determined during the ongoing feasibility study. New work dredging from the anchorages or passing lanes would not deplete existing or future disposal area capacities. Construction of these alternatives is not expected before the next 3 to 5 years and maintenance would not be expected before the next 8 to 10 years.

3.3 Shoreline Loss

Aerial photography of sufficient quality to determine erosion and deposition rates on an annual basis in the area was not available during this study. However, the ERDC report estimates that 5% of the dredging quantities could be caused by recycling of materials. The method for determining the rate of recycling was not provided.

Visual examination of all existing CDFs in July 2006 indicated significant active dike erosion, particularly in the Calcasieu Lake Region from mile 7 to 21 on both the ship channel and lake sides of the CDFs. Photographs documenting some of the erosion are included in Appendix A**.** Although the amount of material recycled due to erosion could not be easily quantified, it is reasonable to assume the recycling rate is greater than 5%. Recycling of materials could be reduced through shoreline and dike protection measures. A riprap foreshore dike has been designed and constructed on the east side of the ship channel between mile 11.2 and 15.7. The installation of the foreshore dike should help to reduce some of the recycling. However, as shown in the photographs from the site visits, extensive erosion of the CDFs is occurring on the western side of the ship channel and along the lakeside of the CDFs as well.

3.3.1 Limited Shoreline Loss Analysis

A limited historical shoreline change analysis was developed in the Bay Reach along PA 17 to PA E based on historical aerial photographs of the Calcasieu Shorelines dated 1998 and 2008 as provided by the USACE New Orleans District.

In each aerial the shoreline position was digitized based on the vegetation line. The resulting shape file of the shoreline from the 1998 aerial was overlaid on top of the 2008 aerial and

compared. Results can be seen in Figures 11-14**.** Two methods were used to determine the rate-of-change for the selected shoreline. The sections below describe the statistical methods used to calculate the loss of shoreline in area and the resulting deposition of materials into the system in cubic yards (CY).

3.3.1.1 Shoreline Change - Difference of Areas Method

The difference of areas method involves the evaluation of the change in area between the two georeferenced shape files that represent the vegetated shorelines between the 1998 and the 2008 aerials and an assumed elevation to determine the volume of materials lost. Limited survey or LIDAR data exists over the entire area. The average elevation of the top of the dikes is approximately +10 MLG. It was assumed that the erosion was limited to a -2 MLG elevation. Therefore the total height lost would be 12 feet. It is difficult with this method to identify areas of accretion or erosion and what the magnitude of the net rate-of-change would be along a specified section of shoreline. Table 3 below shows the calculated loss of area and CY of materials from 1998 to 2008.

Table 3 – Shoreline Change – Difference in Areas Method

	1998 Area	2008 Area	Change in Area (SqFt)	Average Elevation	CY Loss	Per Year
17-20	17,267,118	14,449,449	-2,817,669	12	-1,252,297	-125,230
22-23	27,715,825	23,651,693	-4,064,133	12	-1,806,281	-180,628
D	19,001,995	13,913,844	-5,088,150	12	-2,261,400	-226,140
E	11,205,259	8,428,548	-2,776,711	12	-1,234,094	-123,409
Totals					**-6,554,073**	**-655,407**

3.3.1.2 Shoreline Change - Average End Point Rate Method

The end point rate method also evaluated the changes in vegetated shoreline between the two georeferenced shape files but was calculated by dividing the distance of shoreline movement by the time elapsed between the oldest and the most recent shorelines. The shorelines were divided into 500 foot sections, and measurements for the loss in area were taken and recorded as positive for shoreline accretion and negative for shoreline erosion. The end point rate allows for independent analysis of the channel shoreline and bay shoreline. The calculation for volume change can be performed based on the determination of the slope of the shoreline and utilization of the average end area method. See Figure 15 below.

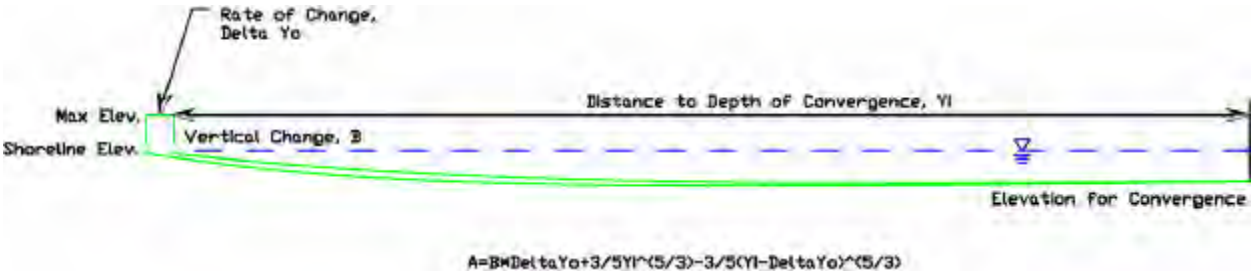

Figure 15
Formula to calculate the change in area using the End Point Rate.

The distance to the depth of convergence was based on visual examination in the field and review of aerial photographs. The depth of convergence was determined based on wave type impacting the ship channel and Bay side shorelines. The shorelines on the ship channel are predominantly impacted by ship waves (surge waves); where as the Bayside shorelines are impacted by the wind, wave environment. The depth of convergence was based on conclusions in the technical report "Hydrodynamic and Sediment Transport Study", prepared by Applied Coastal Research and Engineering, Inc. The study indicated that significant ship wave-induced transport along the ship channel side of the PAs occurred when the surge wave flow velocities reached or exceeded 1.5 ft/sec, creating a critical shear stress eroding the bay bottom promoting sediment transport. This typically occurred between the -2 and -4 MLG contour. The same methodology of critical shear stress was used to evaluate the depth of convergence for the bayside shoreline.

Using the above information, it was assumed that the vertical elevation of erosion for the channel sides are +12 MLG and the distance to the depth of conversion was approximately 40 feet. However, on the Bay side there is a long fetch of wind and wave action that causes bay bottom scouring as it approaches the area. The vertical elevation for the Bay side was assumed at +3 MLG but the distance to the depth of convergence was assumed at 200 feet. Table 4 below summarizes the calculated loss of CY of materials from 1998 to 2008 using the End Point Rate Method.

Table 4 – Shoreline Change – End Point Rate Method

Area	Channel (CY)	Bay (CY)	Total (CY)	Per Year
17-20	-1,091,761	-1,169,643	-2,261,404	-226,140
22-23	-579,471	468,860	-110,611	-11,061
D	-234,758	-1,721,486	-1,956,244	-195,624
E	-505,544	-1,327,519	-1,833,063	-183,306
Totals	**-2,411,535**	**-3,749,787**	**-6,161,322**	**-616,132**

It is assumed that a majority of eroded materials from these areas remain suspended in the water column and ultimately circulate and fall out into the ship channel. The difference in methods are fairly similar in magnitude and indicate that it is possible that an additional six million CY of

material may fall into the ship channel over the ten-year period of review or approximately an additional twelve million CY over the 20 year life of the DMMP. The shoaling rates described in this report indicate that gross quantities dredged over the study period and would include the natural processes occurring here. By placing rock armor along the confined disposal areas in the lake reaches of the ship channel studied in this limited shoreline change analysis from Mile 12 to 20 the amount of dredging necessary could be reduced by approximately twelve million CY.

Initial cost estimates indicate that the CY cost of placing materials in a CDF is approximately $3.27/CY and $5.27/CY to beneficial use sites. The total cost of dredging the "recycled materials" over the 20-year life of the DMMP would be approximately $39,240,000 for placement within a CDF and $63,240,000 for placement in a beneficial use site. The estimated costs to place rock armoring around the channel and Bay sides of PAs 17, 19, 20, 22, 23 and the backside of D and E was estimated at approximately $27 Million by the New Orleans District. This estimate assumes that rock would be placed from a +8 MLG elevation to a -2 MLG elevation on a 3:1 slope.

Additional concerns have been raised regarding the shoreline on the West side of the ship channel from mile 16.5 to 18.7. A shoreline rate change analysis was not conducted along this shoreline but active erosion is present. The cost of placing rock armor along this section of channel is estimated at approximately $3.5 Million.

4 PRELIMINARY PLACEMENT AREA PLANNING

4.1 Existing Placement Area Capacities

Review of existing LIDAR survey data of the study area and visual examination of all of the existing PAs within the current federal standard conducted in July 2006 indicates that the majority of the PAs are at or near capacity. A combination of visual examination and LIDAR data was used to estimate the remaining disposal capacities of the PAs in their present condition as shown in Table 5**.** The remaining total capacity of all of the current PAs is estimated at approximately 5 MCY. Figures 1-10 show the location of the existing PAs. Expanding existing PA capacity, alternative disposal, and beneficial-use alternatives have been analyzed and are quantified in the DMMP in Section 2 for each of the alternatives evaluated. PA expansion, alternative disposal, and beneficial use of dredged materials will be necessary to make up for the existing disposal area capacity shortfalls. Implementation of the selected alternative to include existing PA vertical and horizontal expansions, beneficial use of dredged materials, dredged material disposal management, and site management are discussed in Section 5.

5 CONCLUSIONS

- *The 20-year dredging forecast indicates a dredged material capacity need of approximately 97 million cubic yards.*
- *The existing CDFs do not provide sufficient capacity for the 20-year dredging forecast. A combination of site rehabilitation, dike construction, active CDF site management, contractor quality control, and a combination of beneficial-use placement will be needed to meet the dredged material disposal capacity need.*

- *The dredged material disposal capacity need can be met from mile 21 to 36 with dike rehabilitation, dike raising, and active site management. In addition to these measures, innovative placement and beneficial-use of dredged materials at the Sabine National Wildlife Refuge, Browns Lake, Black Lake, the Cameron Wildlife Refuge, and in the Calcasieu Lake will be needed to meet the dredging needs between mile 6 and 21.*
- *There is a minimal private dredging need.*
- *Placing rock armoring along the eroding PAs 17, 19, 20, 22, 23 and the backside of D and E could reduce the dredging need by approximately 12 Million CY over the life of the DMMP and provide a cost savings from 36 to 12 Million dollars depending on the disposal method used.*

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"Calcasieu River and Pass Dredged Material Sedimentation Study Phase 2 Study", USACE Environmental Processes and Engineering Division, August 2005.

"Calcasieu River and Pass Dredged Material Sedimentation Study", USACE Environmental Processes and Engineering Division, May 2004.

"Calcasieu River Sediment Removal Study", Roy Wade, USACE Waterways Experiment Station, August 1994.

"Calcasieu River and Pass Environmental Impact Statement" USACE, 1976

Personal Interviews:

Mike McMahan – Mike Hooks
Charles Harris – formerly with TL James Dredging and Weeks Marine
Herbert Juneau – former Area Engineer, Lafayette Area Office

Contract Completion Reports for Maintenance Dredging for Calcasieu River and Pass, Louisiana, USACE MVN, 1994-2005.

Table 1 – 10 Year Historical Dredging Quantities by Contract

Contract #	Contract Date	Contract Complete	Dredged Dimensions	Devil's Elbow	Clooney Isl. Loop	Turning Basin	Nav Gap ~ Mile 8.5	Mile 5-5.7	Mile 5.7-6.6	Mile 6.6-7.6	Mile 7.6-8.5	Mile 8.5-9.5	Mile 9.5-10.4	Mile 10.4-11.4	Mile 11.4-12.3	Mile 12.3-13.3	Subtotal
05-C-0045	**12-Jul-05**	**8-Mar-06**	**400**'X-42.0**	1,056,407													1,056,407
04-C-0048	**12-Aug-04**	**23-Feb-05**	**400**'X-42.0**										109,057	360,000	750,000	700,000	1,919,057
04-C-0041	**30-Jun-04**	**29-Sep-04**	**400**'X-42.0**						36,366	94,312	289,570	76,407	119,826		-	-	616,481
03-C-0058	**11-Sep-03**	**25-Jan-04**	**400'X-42.0**	1,081,670													1,081,670
03-C-0044	**19-Jun-03**	**29-Nov-03**	**400**'X-42.0**														0
01-C-0038	**4-Apr-01**	**20-Jan-02**	**400'X-42.0**				32,629	15,003	133,581	321,391	706,743	266,417	199,853	304,044	316,993	314,378	2,611,032
00-C-0092	**13-Sep-00**	**14-Aug-01**	**400'X-42.0**	**1,063,161**	**207832**												1,270,993
99-C-0050	**16-Jul-99**	**12-Nov-99**	**400'X-42.0**						265,759	336,549	826,221	539,385	560,608	796,694	563,684	528,611	4,417,511
98-C-0065	**18-Aug-98**	**8-Jul-99**	**400'X-42.0**	999,220													999,220
96-C-0039	**10-Apr-96**	**26-Oct-96**	**400'X-42.0**	954,781				7,521	117,439	328,241	610,432	422,557			550,125	370,956	3,362,052
94-C-0099	**12-Sep-94**	**30-May-95**	**400'X-42.0**	1,395,780	347,925	326,765											2,070,470
			SUMMATION BY MILE	**6,551,019**	**555,757**	**326,765**	**32,629**	**22,524**	**553,145**	**1,080,493**	**2,432,966**	**1,304,766**	**989,344**	**1,460,738**	**2,180,802**	**1,913,945**	**19,404,893**

Contract #	Contract Date	Contract Complete	Dredged Dimensions	Mile 13.3-14.2	Mile 14.2-15.2	Mile 15.2-16.1	Mile 16.1-17.1	Mile 17.1-18.0	Mile 18.0-18.9	Mile 18.9-19.90	Mile 19.90-20.8	Mile 20.8-21.8	Mile 21.8-22.7	Mile 22.7-23.7	Mile 23.7-24.6	Mile 24.6-25.6	Subtotal
05-C-0045	**12-Jul-05**	**8-Mar-06**	**400**'X-42.0**					342,000	287,000	384,000	145,000	145,000	760,000	421,000		119,000	2,603,000
04-C-0048	**12-Aug-04**	**23-Feb-05**	**400**'X-42.0**	723,000	663,000	788,000	750,000									109,225	3,033,225
04-C-0041	**30-Jun-04**	**29-Sep-04**	**400**'X-42.0**	-	-	-	-										0
03-C-0058	**11-Sep-03**	**25-Jan-04**	**400'X-42.0**										308,577	440,072	420,560		1,169,209
03-C-0044	**19-Jun-03**	**29-Nov-03**	**400**'X-42.0**	52,000	439,000	501,000	437,000	347,000	236,000	234,000	334,000	438,000	100,000				3,118,000
01-C-0038	**4-Apr-01**	**20-Jan-02**	**400'X-42.0**	250,465	-	-	-										250,465
00-C-0092	**13-Sep-00**	**14-Aug-01**	**400'X-42.0**		430,164	662,016	513,258	281,406	182,679	182,679	469,934	421,877	421,877	500,000	357,733	357,733	4,781,356
99-C-0050	**16-Jul-99**	**12-Nov-99**	**400'X-42.0**	569,731													569,731
98-C-0065	**18-Aug-98**	**8-Jul-99**	**400'X-42.0**		505,665	606,400	444,500	456,700	302,400	426,900	502,650	578,900	663,800	512,200	455,785	163,300	5,619,200
96-C-0039	**10-Apr-96**	**26-Oct-96**	**400'X-42.0**	547,604	564,739	520,722	578,232	606,790	495,592	460,245	542,776	645,644	242,343				5,204,687
94-C-0099	**12-Sep-94**	**30-May-95**	**400'X-42.0**										233,295	486,705	355,585	157,740	1,233,325
			SUMMATION BY MILE	**2,142,800**	**2,602,568**	**3,078,138**	**2,722,990**	**2,033,896**	**1,503,671**	**1,687,824**	**1,994,360**	**2,229,421**	**2,729,892**	**2,359,977**	**1,589,663**	**906,998**	**27,582,198**

Cont. Table 1 – 10 Year Historical Dredging Quantities by Contract

Contract #	Contract Date	Contract Complete	Dredged Dimensions	Mile 25.6-26.5	Mile 26.5-27.5	Mile 27.5-28.4	Mile 28.4-29.4	Mile 29.4-30.3	Mile 30.3-31.3	Mile 31.3-32.2	Mile 32.2-33.1	Mile 33.1-34.1	Mile 34.1-35.0	Mile 35.0-36.0	Subtotal	Total Contact
05-C-0045	**12-Jul-05**	**8-Mar-06**	**400**'X-42.0**	265,000	200,000	202,000	193,000	79,000							939,000	4,598,407
04-C-0048	**12-Aug-04**	**23-Feb-05**	**400**'X-42.0**	169,675									51,237	51,237	272,149	5,224,431
04-C-0041	**30-Jun-04**	**29-Sep-04**	**400**'X-42.0**												0	616,481
03-C-0058	**11-Sep-03**	**25-Jan-04**	**400'X-42.0**												0	2,250,879
03-C-0044	**19-Jun-03**	**29-Nov-03**	**400**'X-42.0**												0	3,118,000
01-C-0038	**4-Apr-01**	**20-Jan-02**	**400'X-42.0**												0	2,861,497
00-C-0092	**13-Sep-00**	**14-Aug-01**	**400'X-42.0**	465,536		474,320	538,267	351,851							1,829,974	7,882,323
99-C-0050	**16-Jul-99**	**12-Nov-99**	**400'X-42.0**												0	4,987,242
98-C-0065	**18-Aug-98**	**8-Jul-99**	**400'X-42.0**												0	6,618,420
96-C-0039	**10-Apr-96**	**26-Oct-96**	**400'X-42.0**												0	8,566,739
94-C-0099	**12-Sep-94**	**30-May-95**	**400'X-42.0**	151,785	56,735	170,625	138,310	105,620	172,840	117,100	95,005	77,400	106,885	213,015	1,405,320	4,709,115
			SUMMATION BY MILE	**1,051,996**	**256,735**	**846,945**	**869,577**	**536,471**	**172,840**	**117,100**	**95,005**	**77,400**	**158,122**	**264,252**	**4,446,443**	**51,433,534**

** Modified by analysis to include quantities for full dimensions Modified CellData modified to reflect 400 foot cut

	Modified	Unmodified	Delta
Total 94-05	**51,433,534**	**47,483,959**	**3,949,575**
Sum of 95 to 05	**46,724,419**	**42,774,844**	**3,949,575**
Sum of 94 to 04	**46,562,978**	**42,939,139**	**3,623,839**

Table 2 – 20-year Dredging Forecast

Mile	10-YR Gross Quantity (CY)	Est. 20-Year Required Capacity	Quantity Per Year	Dredging Cycle (yrs)	Quantity Per Cycle	70% Bulking Capacity/Cycle
34 to 36	422,374	844,748	42,237	10	422,374	718,036
Port	176,000	352,000	17,600	5	88,000	149,600
Turning Basin	326,765	653,530	32,677	10	326,765	555,501
Clooney Is. Loop	555,757	1,111,514	55,576	5	277,879	472,393
30 to 34	462,345	924,690	46,235	10	462,345	785,987
26 to 30	2,938,649	5,877,298	293,865	6	1,763,189	2,997,422
22 to 26	6,353,205	12,706,410	635,321	2	1,270,641	2,160,090
21 to 22	2,229,421	4,458,842	222,942	2	445,884	758,003
Devil's Elbow	5,155,239	10,310,479	515,524	2	1,031,048	1,752,781
16 to 21	9,942,741	19,885,482	994,274	2.5	2,485,685	4,225,665
12 to 16	9,737,451	19,474,902	973,745	2.5	2,434,363	4,138,417
9.5 to 12	4,630,884	9,261,768	463,088	3	1,389,265	2,361,751
5 to 9.5	5,426,523	10,853,046	542,652	3	1,627,957	2,767,527
Total:	**48,357,354**	**96,714,709**	**4,835,735**			

Notes:
*Quantities used were from the 95 to 05 contracts for all reaches except miles 30 to 36, the Turning Basin and Clooney Island Loop.
*The 94 to 04 contract summation was used to capture the mile 30 to 36 reach, the Turning Basin and Clooney Island Loop quantities.

Table5 – Existing CDF Capacities

Placement Area	Acres	Vertical Capacity (CY/FT)	Remaining Freeboard (FT)	Existing Capacity (CY)	Perimeter Levees (FT)
1	50	80,600	4	80,600	6,300
2	44	71,000	4	71,000	5,400
3	113	182,300	5	364,600	11,000
7	257	414,600	4	414,600	13,000
8	192	309,700	2	0	14,000
9	170	274,200	2/3	0	12,500
10	135	217,800	2/3	0	10,000
11	135	217,800	4	217,800	10,000
12A	160	258,100	3	0	12,000
12B	433	698,500	6	2,095,500	24,000
13	710	1,145,400	2/3	0	25,000
15	181	292,000	4/5	584,000	12,000
16N	168	271,000	2/3	0	11,000
17	192	309,700	3/4	309,700	18,000
22	133	214,500	3/4	214,500	12,000
23	116	187,100	4/5	374,200	15,000
D	247	398,500	3/4	398,500	25,000
E	155	250,000	2/3	0	16,000
H	142	229,000	4/5	458,000	13,000
M	392	632,400	2/3	0	18,000
N	219	353,300	2/3	0	16,000
				5,583,000	

**All confined areas are estimated with 2 feet of freeboard and 1 foot for ponding or full capacity at 3 feet of total freeboard on levees.

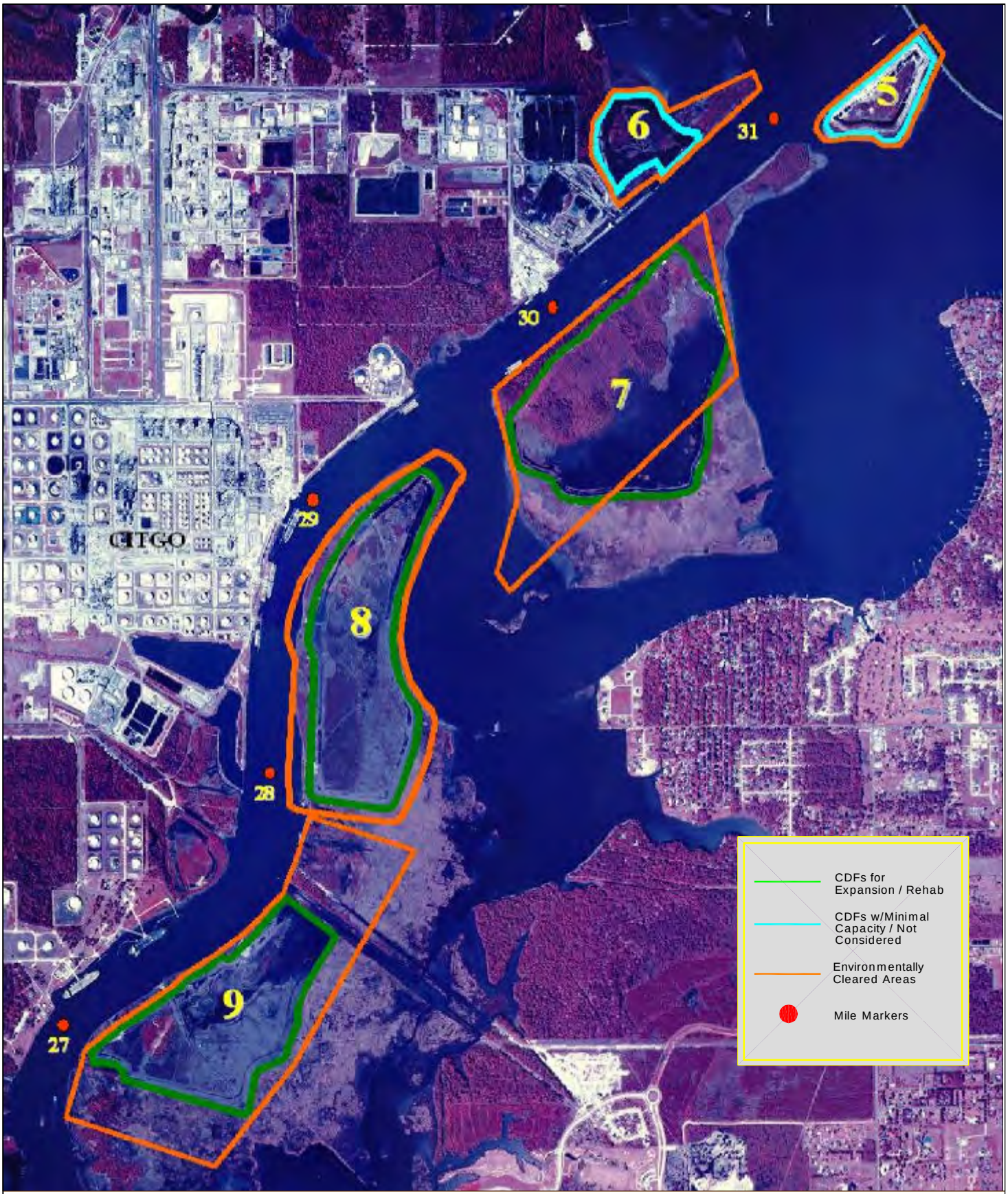
**Sites A, B, C, F, G, J, K, 4, 5, 6, 14, 16S, 16C, 19, 20, 21 were not included due to limited capacity, land loss, cost effectiveness for expansion/future use, and/or removal of easements.

FIGURES

Mile Marker
34 to 36

Figure 1
Calcasieu Ship Channel
Disposal Locations

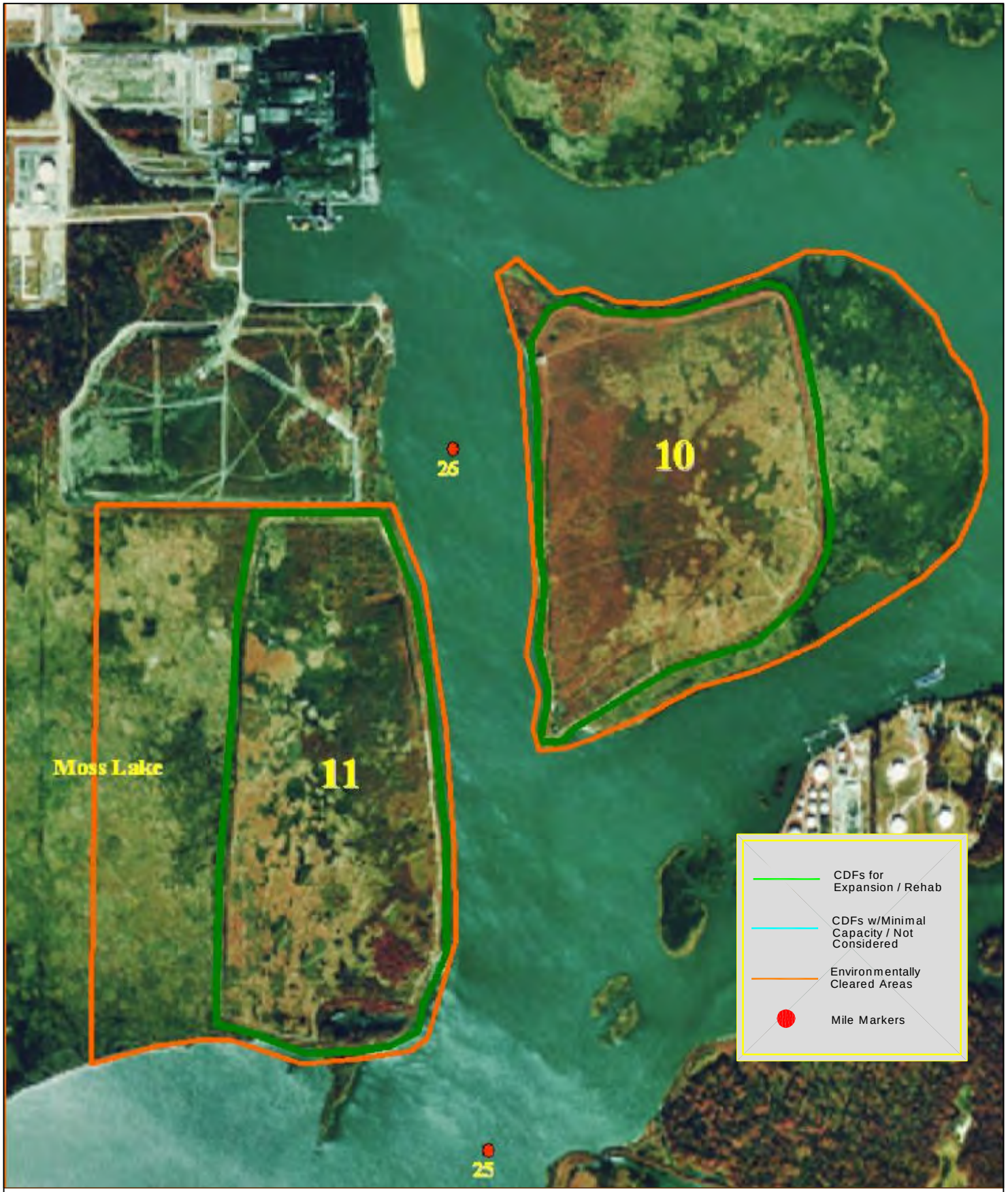
Drawing Date:	October 31, 2006
Drawn By:	Danny J. Broudy
Checked By:	Dana L. Cheney
Drawing Name:	Figure 1 Disposal Areas.dwg
Drawing Scale:	NTS



Mile Marker
27 to 31

Figure 2
Calcasieu Ship Channel
Disposal Locations

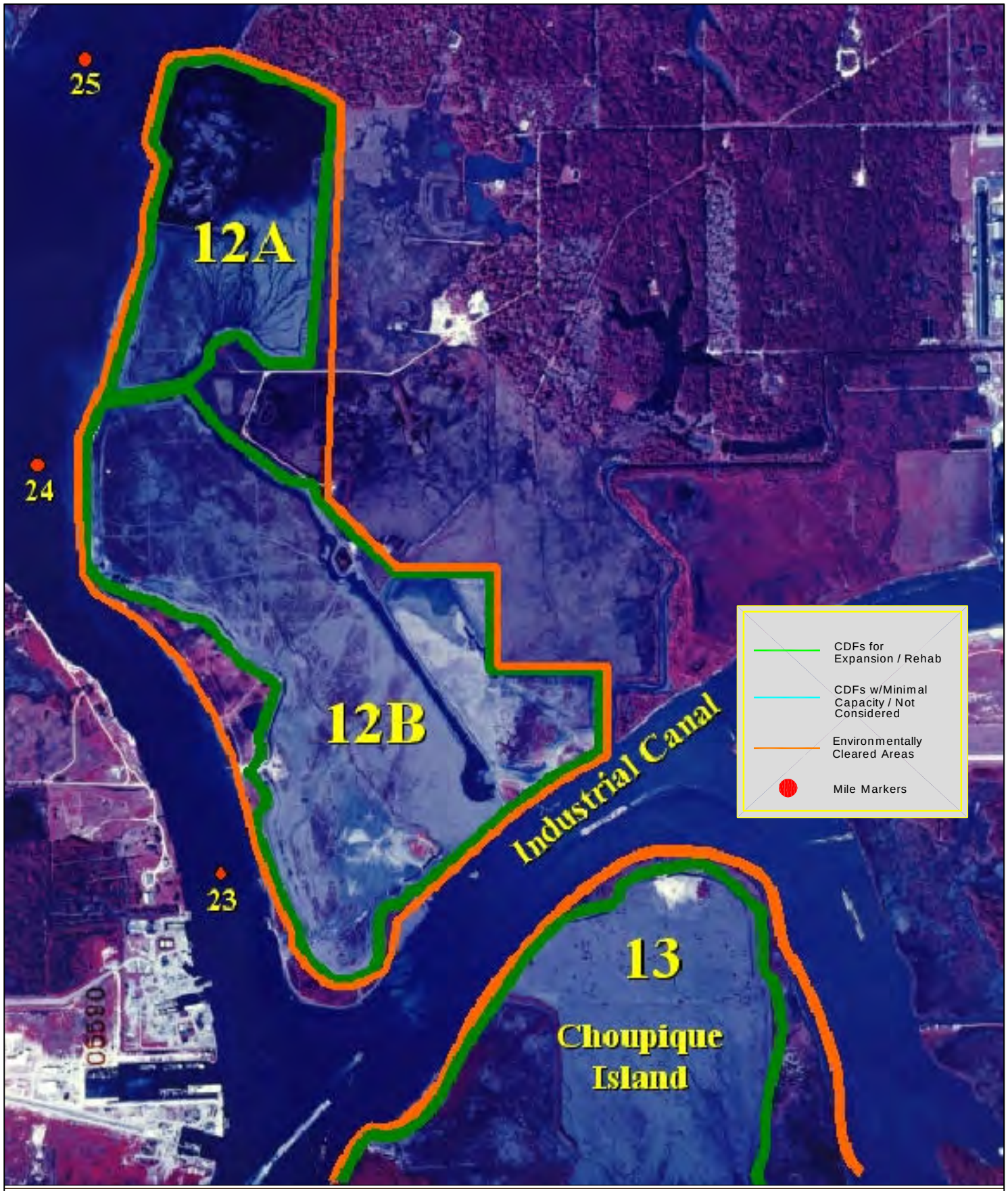
Drawing Date:	October 31, 2006
Drawn By:	Danny J. Broudy
Checked By:	Dana L. Cheney
Drawing Name:	Figure 2 Disposal Areas.dwg
Drawing Scale:	NTS



Mile Marker
25 to 26

Figure 3
Calcasieu Ship Channel
Disposal Locations

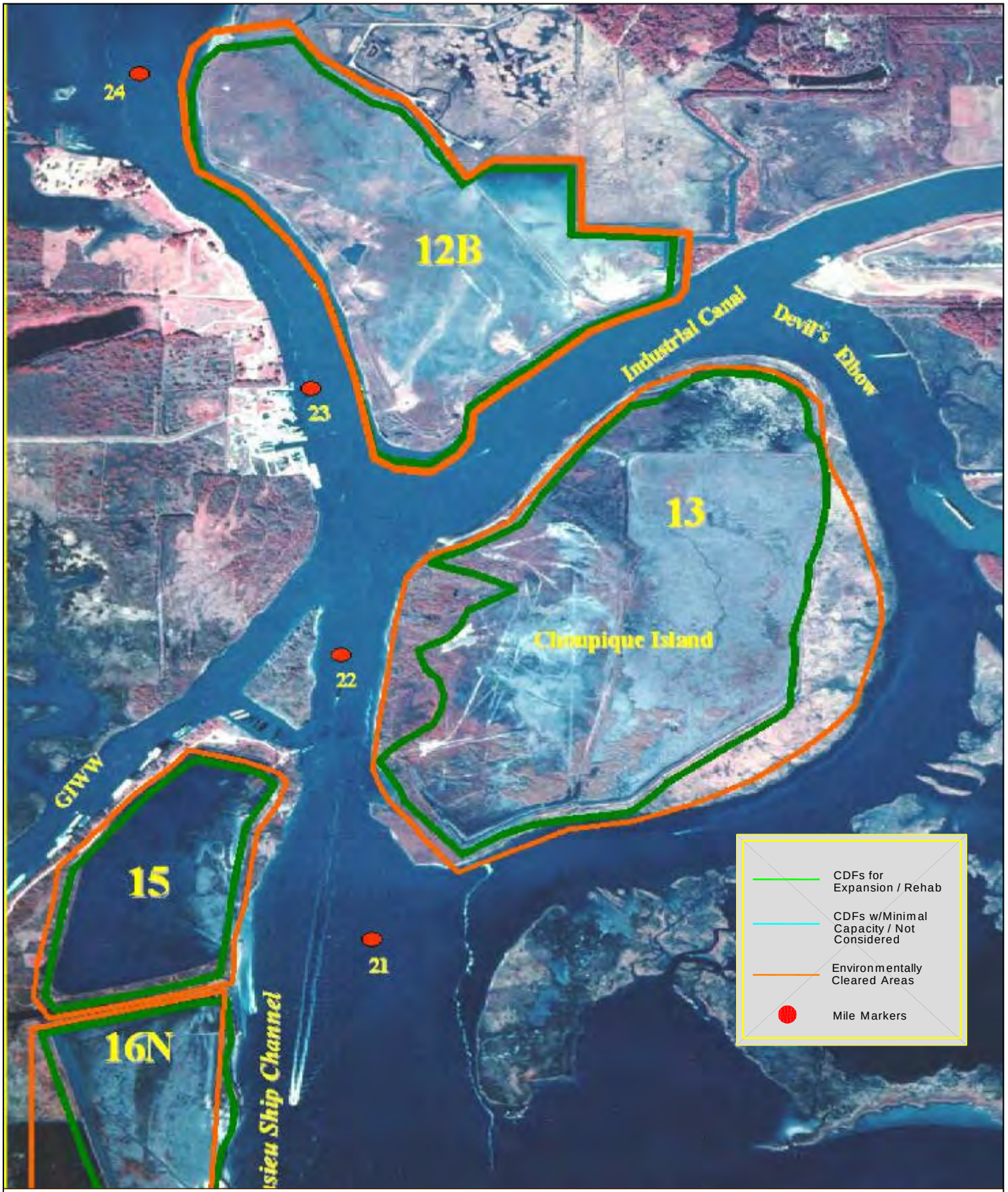
Drawing Date:	October 31, 2006
Drawn By:	Danny J. Broudy
Checked By:	Dana L. Cheney
Drawing Name:	Figure 3 Disposal Areas.dwg
Drawing Scale:	NTS



Mile Marker
23 to 25

Figure 4
Calcasieu Ship Channel
Disposal Locations

Drawing Date:	October 31, 2006
Drawn By:	Danny J. Broudy
Checked By:	Dana L. Cheney
Drawing Name:	Figure 4 Disposal Areas.dwg
Drawing Scale:	NTS



Mile Marker
21 to 24
Devil's Elbow

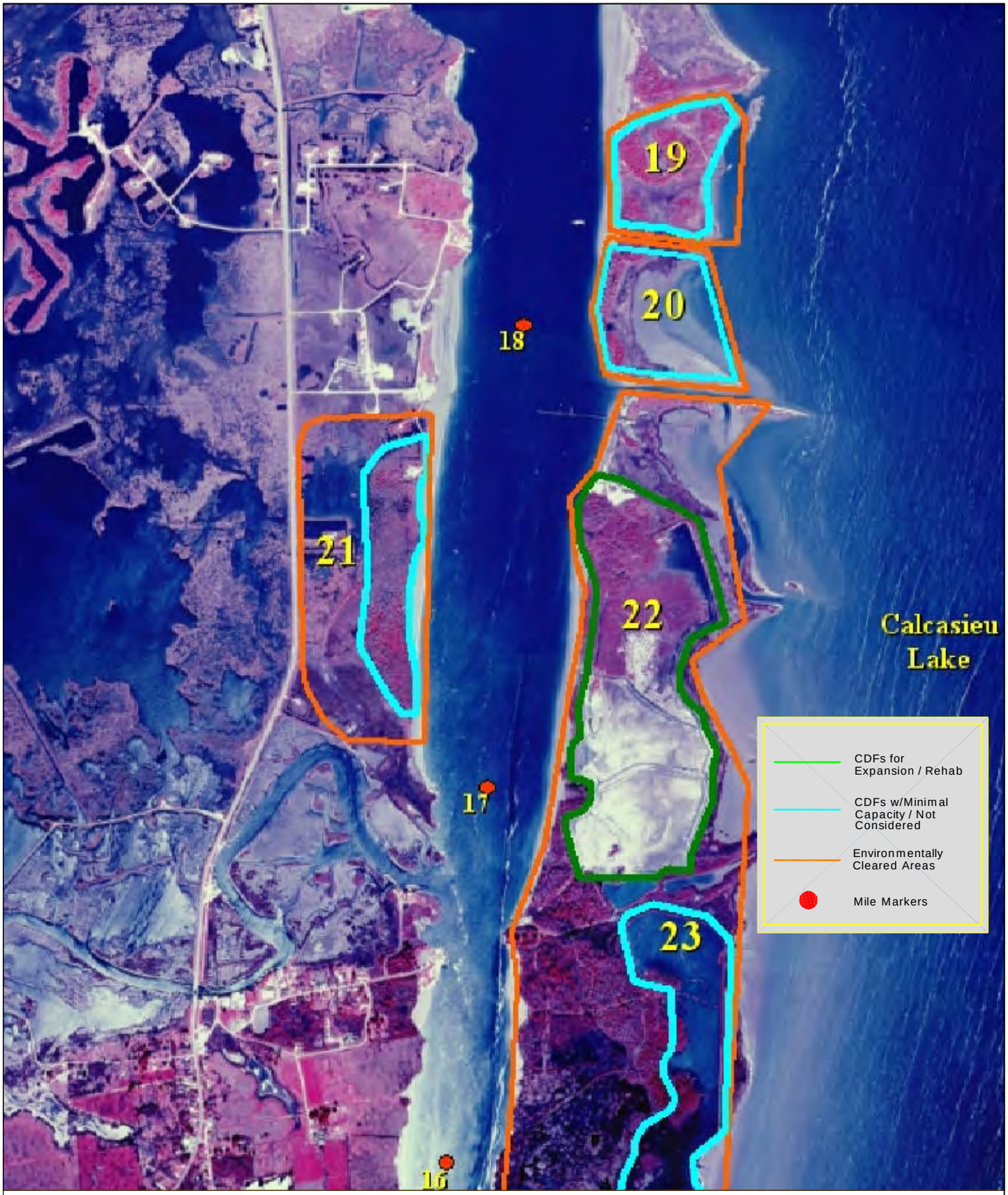
Figure 5
Calcasieu Ship Channel
Disposal Locations

Drawing Date:	October 31, 2006
Drawn By:	Danny J. Broudy
Checked By:	Dana L. Cheney
Drawing Name:	Figure 5a Disposal Areas.dwg
Drawing Scale:	NTS

Mile Marker
19 to 21

Figure 6
Calcasieu Ship Channel Disposal Locations

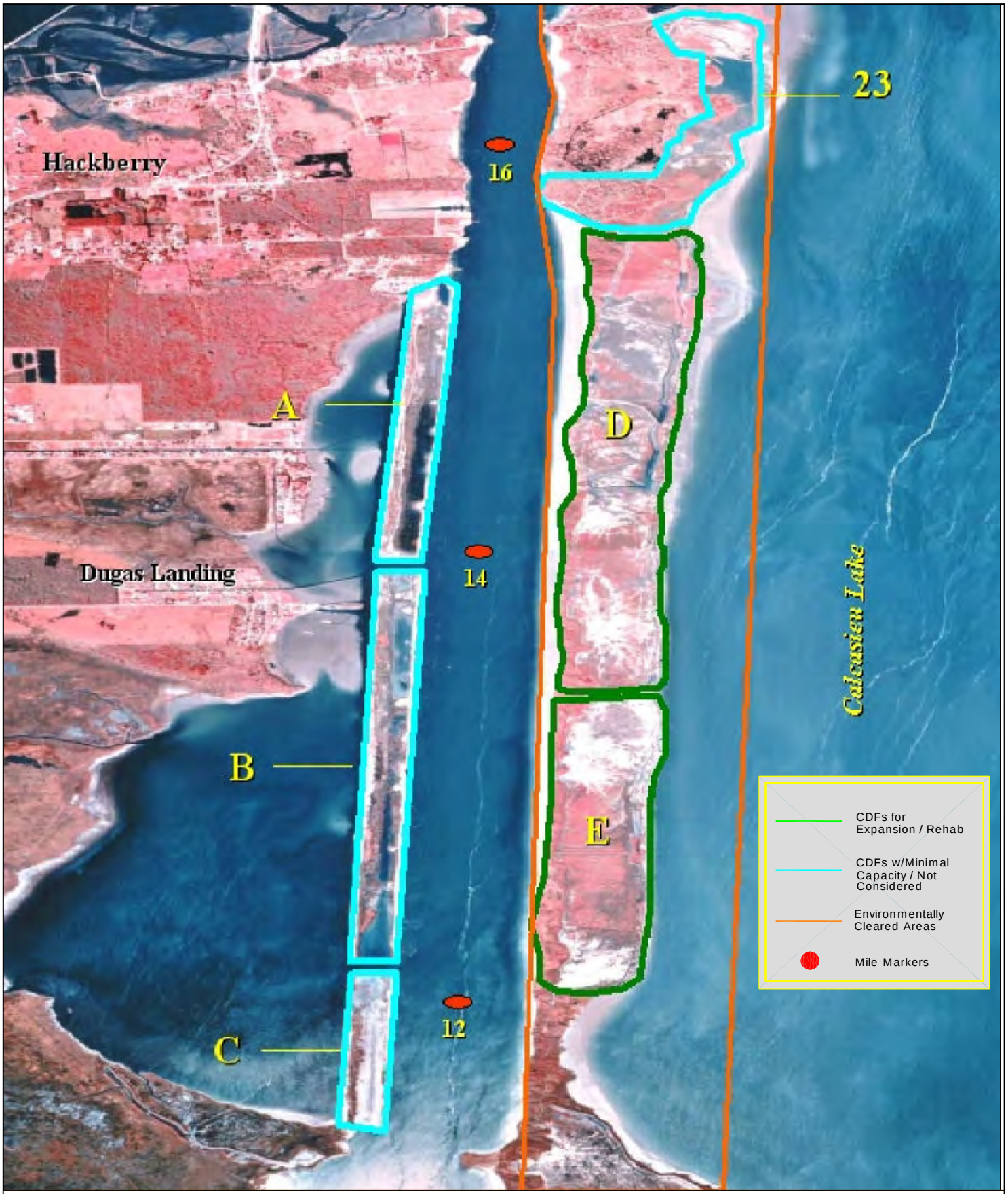
Drawing Date:	October 31, 2006
Drawn By:	Danny J. Broudy
Checked By:	Dana L. Cheney
Drawing Name:	Figure 5a Disposal Areas.dwg
Drawing Scale:	NTS



Mile Marker
16 to 18

Figure 7
Calcasieu Ship Channel
Disposal Locations

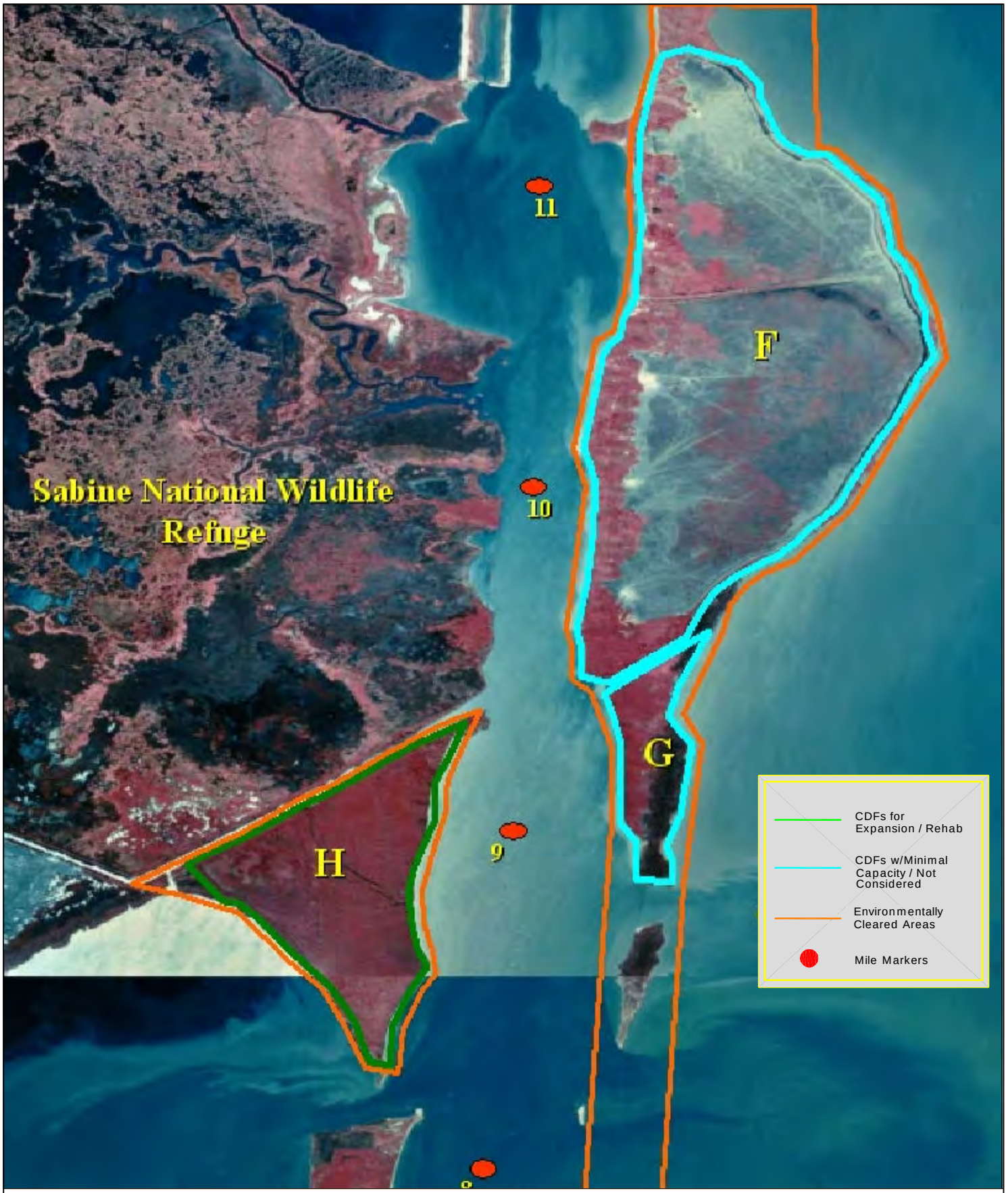
Drawing Date:	October 31, 2006
Drawn By:	Danny J. Broudy
Checked By:	Dana L. Cheney
Drawing Name:	Figure 5a Disposal Areas.dwg
Drawing Scale:	NTS



Mile Marker
12 to 16

Figure 8
Calcasieu Ship Channel
Disposal Locations

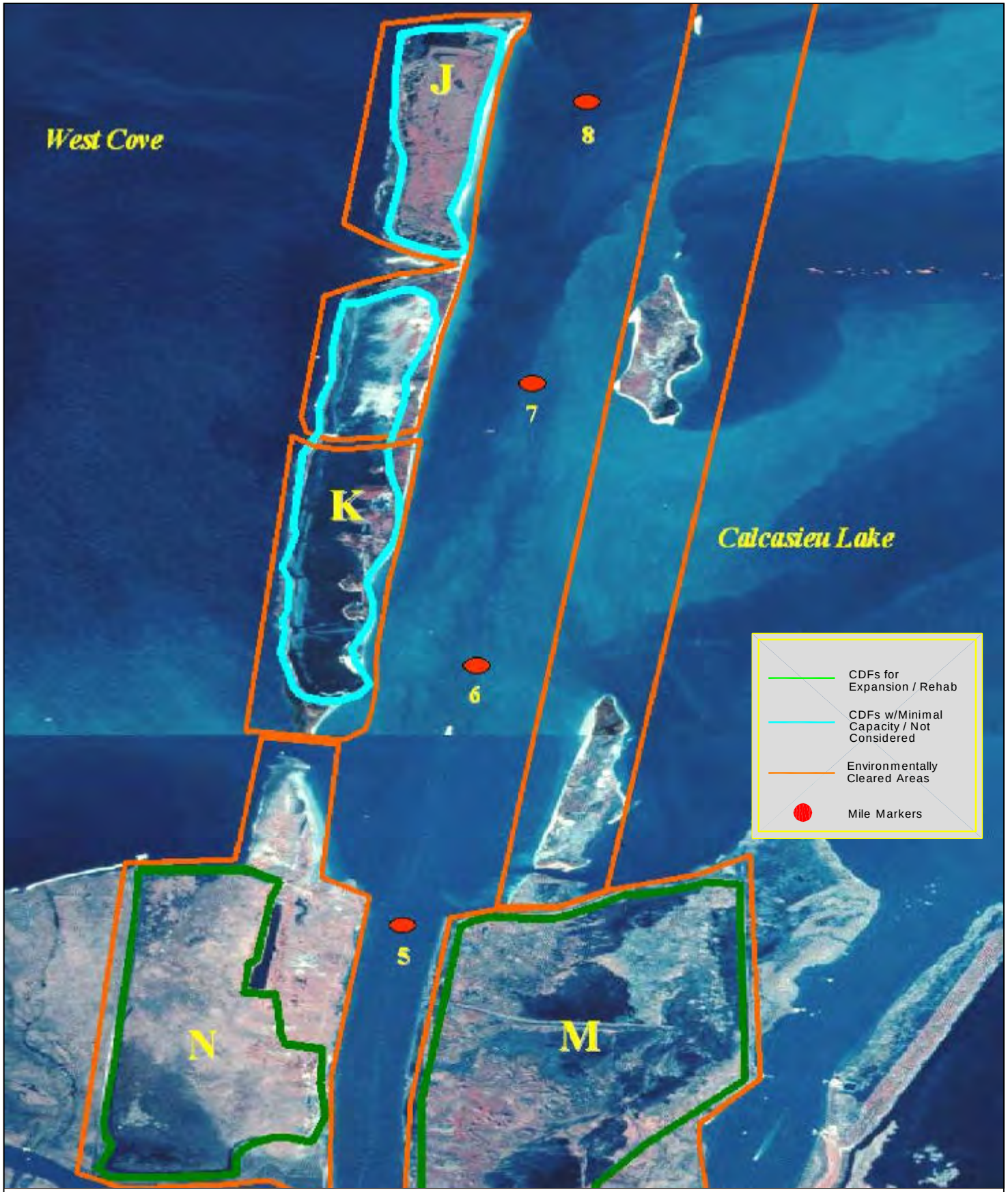
Drawing Date:	October 31, 2006
Drawn By:	Danny J. Broudy
Checked By:	Dana L. Cheney
Drawing Name:	Figure 7 Disposal Areas.dwg
Drawing Scale:	NTS



Mile Marker
8 to 11

Figure 9
Calcasieu Ship Channel
Disposal Locations

Drawing Date:	October 31, 2006
Drawn By:	Danny J. Broudy
Checked By:	Dana L. Cheney
Drawing Name:	Figure 7 Disposal Areas.dwg
Drawing Scale:	NTS



Mile Marker
4 to 8

Figure 10
Calcasieu Ship Channel
Disposal Locations

Drawing Date:	October 31, 2006
Drawn By:	Danny J. Broudy
Checked By:	Dana L. Cheney
Drawing Name:	Figure 9 Disposal Areas.dwg
Drawing Scale:	NTS

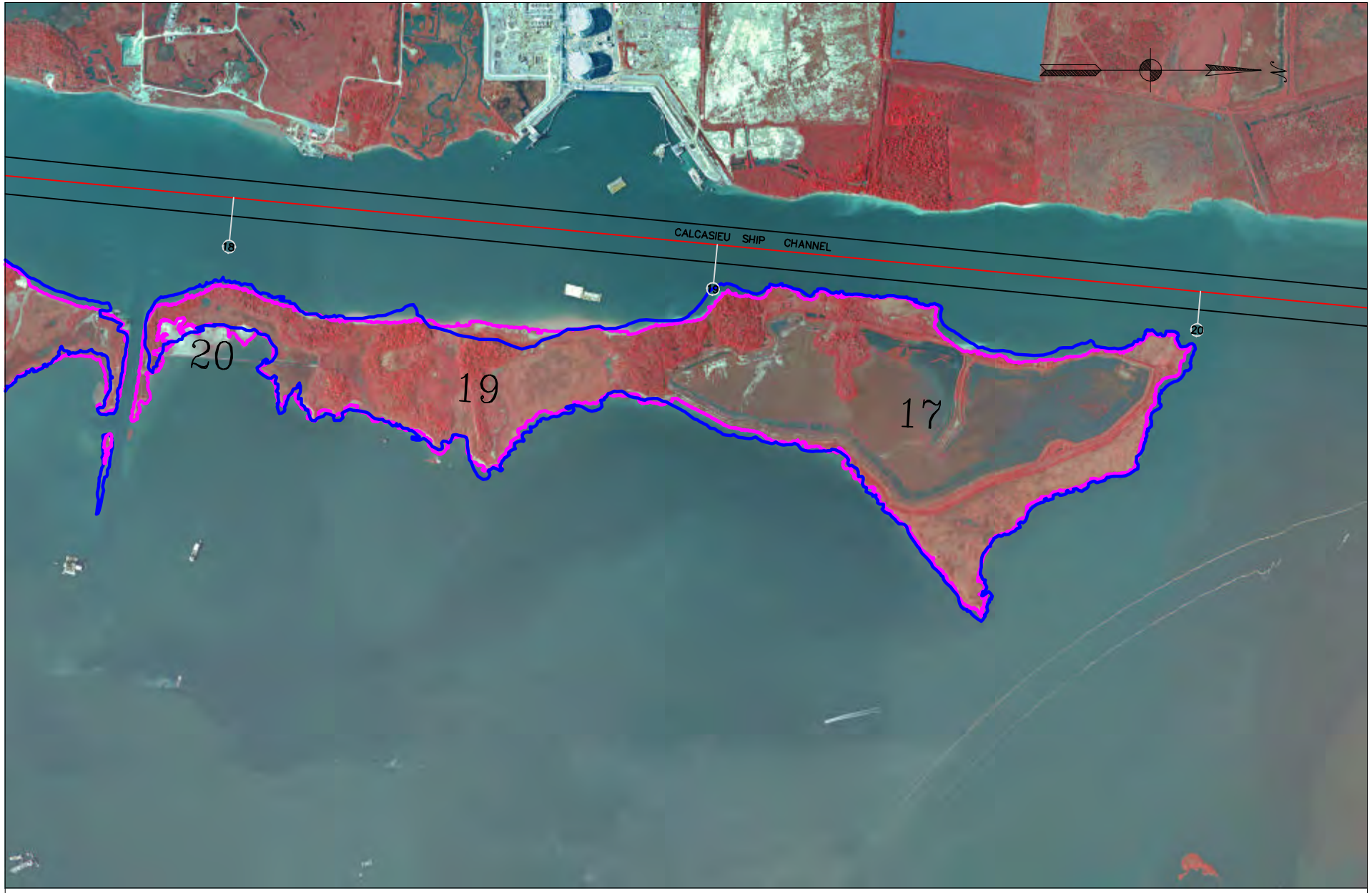


FIGURE 11

CALCASIEU RIVER SHORELINE STUDY
DISPOSAL AREA 17–20

Lake Charles, LA

*NOTE – AERIAL IMAGE PROVIDED BY USACE NEW ORLEANS DISTRICT 2008

LEGEND

1998 SHORELINE

2008 SHORELINE

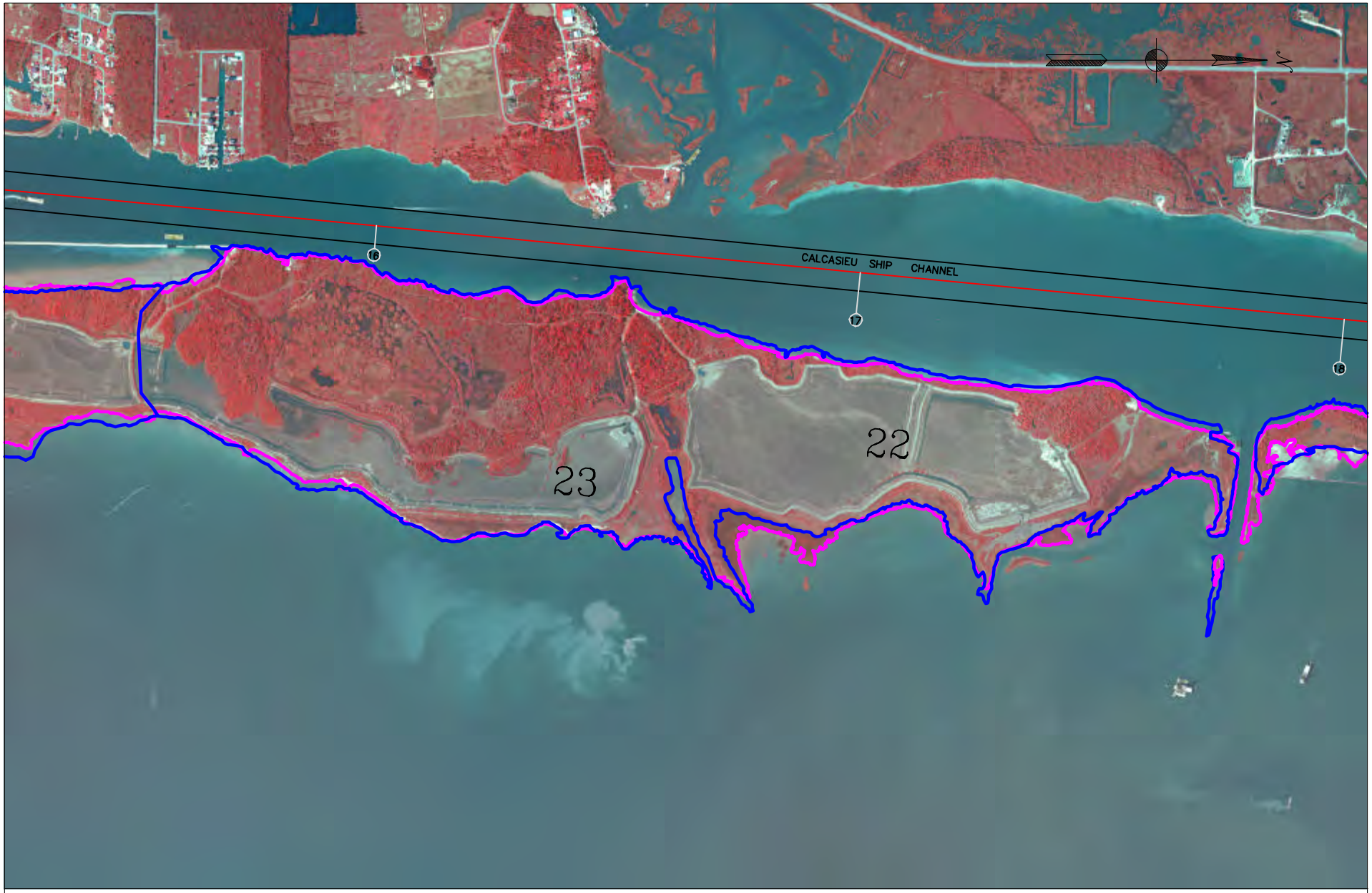


FIGURE 12

CALCASIEU RIVER SHORELINE STUDY
DISPOSAL AREA 22–23

Lake Charles, LA

*NOTE – AERIAL IMAGE PROVIDED BY USACE NEW ORLEANS DISTRICT 2008

LEGEND

1998 SHORELINE

2008 SHORELINE

FIGURE 13

CALCASIEU RIVER SHORELINE STUDY
DISPOSAL AREA D

Lake Charles, LA

*NOTE – AERIAL IMAGE PROVIDED BY USACE NEW ORLEANS DISTRICT 2008

LEGEND

1998 SHORELINE

2008 SHORELINE

FIGURE 14

CALCASIEU RIVER SHORELINE STUDY
DISPOSAL AREA E

Lake Charles, LA

*NOTE – AERIAL IMAGE PROVIDED BY USACE NEW ORLEANS DISTRICT 2008

LEGEND

1998 SHORELINE

2008 SHORELINE

APPENDIX A

Shoreline Erosion

Photograph 1 – Ship Channel Shoreline of PA 16N

Picture 2 – Ship Channel View of Levee at PA 16S.

Picture 3 – Ship Channel View of PA 17.

Picture 4 – North View of PA 17 along the Ship Channel.

Picture 5 – Ship Channel View of PA 22

Picture 6 – Lakeside View of PA 22

Picture 7 - PA D Levees

Picture 8 – Ship Channel View of PA D

Picture 9 – Lakeside View of PA E

Picture 10 – Lakeside View of PA E

APPENDIX B

Dredging Template

CALCASIEU CHANNEL TYPICAL SECTION