State of Louisiana
Department of Natural Resources
Coastal Restoration Division

Monitoring Plan

for

Atchafalaya Sediment Delivery

State Project Number AT-02
Priority Project List 2

August 2003
St. Mary Parish

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MONITORING PLAN

PROJECT NO. AT-02 ATCHAFALAYA SEDIMENT DELIVERY

ORIGINAL DATE: June 26, 1996
REVISED DATES: July 23, 1998; August 14, 2003

Preface

Pursuant to a CWPPRA Task Force decision on April 14, 1998, the original plan was modified. Specifically, one additional pre-construction photography was obtained due to delays in construction timetables and submerged aquatic vegetation sampling was added in 1998, 2000, 2007, and 2016.

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System (CRMS-*Wetlands*) for CWPPRA, updates were made to this Monitoring Plan to merge it with CRMS to provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act. The implementation plan included review of monitoring efforts on currently constructed projects for opportunities to 1) determine if current monitoring stations could be replaced by CRMS stations, 2) determine if monitoring could be reduced to evaluate only the primary objectives of each project and 3) determine whether monitoring should be reduced or stopped because project success had been demonstrated or unresolved issues compromised our ability to actually evaluate project effectiveness. The recommendations for modifying this Monitoring Plan are the result of a joint meeting with DNR, USGS, and the federal sponsor. The recommendations have been incorporated into this revised Monitoring Plan and are described in the Monitoring Elements section. Specifically, SAV sampling in 2007 and 2016 was eliminated.

Project Description

The project area is located in the northwestern region of the Atchafalaya delta and is bounded by East Pass to the northwest, Atchafalaya Bay to the south and southeast, and Mile Island to the northeast. The project is located within the Atchafalaya Delta Wildlife Management Area in the southeast corner of St. Mary Parish, LA. (figure 1). The Atchafalaya delta is a part of the Atchafalaya Bay delta complex, which also includes the Wax Lake delta located in western Atchafalaya Bay. The Atchafalaya delta and the Wax Lake delta formed in the shallow Atchafalaya Bay between the mouth of the Atchafalaya River navigation channel and the Point Au Fer shell reef. The Atchafalaya River has been a distributary of the Mississippi River since the 1500s and is typical of diversion or capture of mainstream flow by a distributary (van Heerden and Roberts 1980). In 1963 the Old River control structure was completed by the U.S. Army Corps of Engineers (USACE) and has since maintained the flow of the Atchafalaya River at the historical rate of 30% of the combined flow of the Mississippi and Red Rivers (Louisiana Coastal Wetlands Conservation and Restoration Task Force 1993).

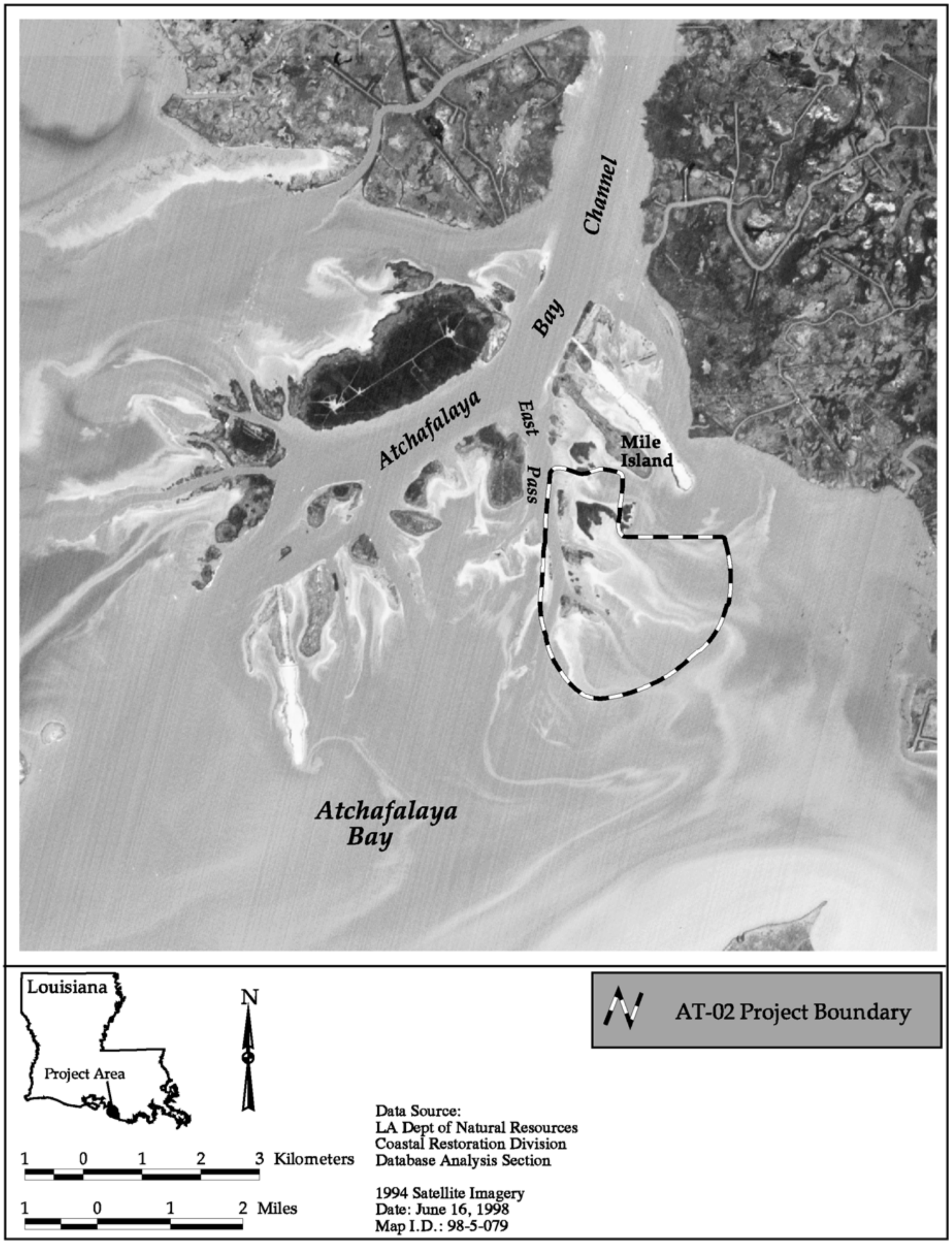

Figure 1. Atchafalaya Sediment Delivery (AT-02) project area.

A subaqueous delta began to form at the mouth of the Atchafalaya River between 1952 and 1962 with the introduction of silts and fine sands to the bay. Prior to 1952, the lakes and bays within the Atchafalaya Basin floodway system, north of the Atchafalaya Delta, filled with sediment. Only prodelta clay deposition was occurring in the Atchafalaya Bay due to contact with higher salinity water (Louisiana Coastal Wetlands Conservation and Restoration Task Force 1993). From 1962 to 1972 coarser materials began to be deposited into the Atchafalaya Bay and a period of distal bar and subaqueous bar accretion occurred (van Heerden and Roberts 1980). The spring flood of 1973 produced the first subaerial growth of the Atchafalaya Delta on both sides of the navigation channel with a total area of 1.95 mi^2 (5.1 km^2). During the progradational phase of delta growth, which occurred between 1973 and 1976, deposition of coarse sediment accounted for growth of new land at an average rate of 2.05 mi^2 yr^{-1} (5.3 km^2 yr^{-1}). From 1977 to 1990 (a period of channel abandonment and lobe fusion) growth occurred at an average of 0.75 mi^2 yr^{-1} (1.9 km^2 yr^{-1}) to form its present subaerial expression of 11.31 mi^2 (29.4 km^2)(van Heerden et al. 1991).

The general pattern of vegetation in the area is affected by delta formation, seasonal changes, and elevation. Three vegetation associations occupy 93% of the vegetated area of natural islands within the Atchafalaya delta (Johnson et al. 1985). Woody vegetation, mostly *Salix nigra* (black willow), covers 19% of the vegetated areas and generally occurs on the upstream end of delta lobes and along the leading edge where elevation is highest and sand content is greatest. The *Typha* association covers 10% of the vegetated areas and occurs at intermediate elevations and includes species such as *Typha latifolia* (broadleaf cattail), *Cyperus difformis* (cyperus), *Eleocharis* spp.(spikerush), *Scirpus americanus* (three-cornered grass), *Scirpus validus* (softstem bullrush), and *Ammannia coccinea* (ammannia). The *Sagittaria* association includes species such as *Sagittaria latifolia* (duckpotato), *S. platyphylla* (delta duckpotato) and *Scirpus americanus*. This association is most extensive covering 64% of the vegetated areas of natural delta islands and occurs at the lowest intertidal elevations. Submerged aquatics form a secondary association that occurs at the downstream ends of islands with the lowest elevations (Louisiana Coastal Wetlands Conservation and Restoration Task Force 1993). Herbivory by nutria (*Myocastor coypus*) and muskrat (*Ondatra zibethicus*) has been reported for islands in the Atchafalaya Delta (Fuller et al. 1985, Shaffer et al. 1992). Biomass of *S. platyphylla* and *A. coccinea* was higher within mammal exclosures than outside of the exclosures and plant species composition within the Atchafalaya delta has been shown to be affected by herbivory (Fuller et al. 1985).

The Atchafalaya delta is bisected by the Lower Atchafalaya River navigation channel, which is maintained by the USACE for navigational purposes. Dredged material on the channel banks and increased channel depth have created unnatural conditions forming an efficient conduit for river sediment to the Gulf of Mexico depriving the adjacent delta environments of sediment critical to the delta-building process. Also, distributary channels in the eastern portion of the Atchafalaya delta have undergone large reductions in cross-sectional area and flow efficiency, further reducing sediment delivery to the delta lobes (van Heerden and Roberts 1980). A comparison can be made between the Atchafalaya delta and the Wax Lake delta to the west. Dredging ceased on the Wax Lake Outlet in 1980 and this delta has been building naturally since that time.

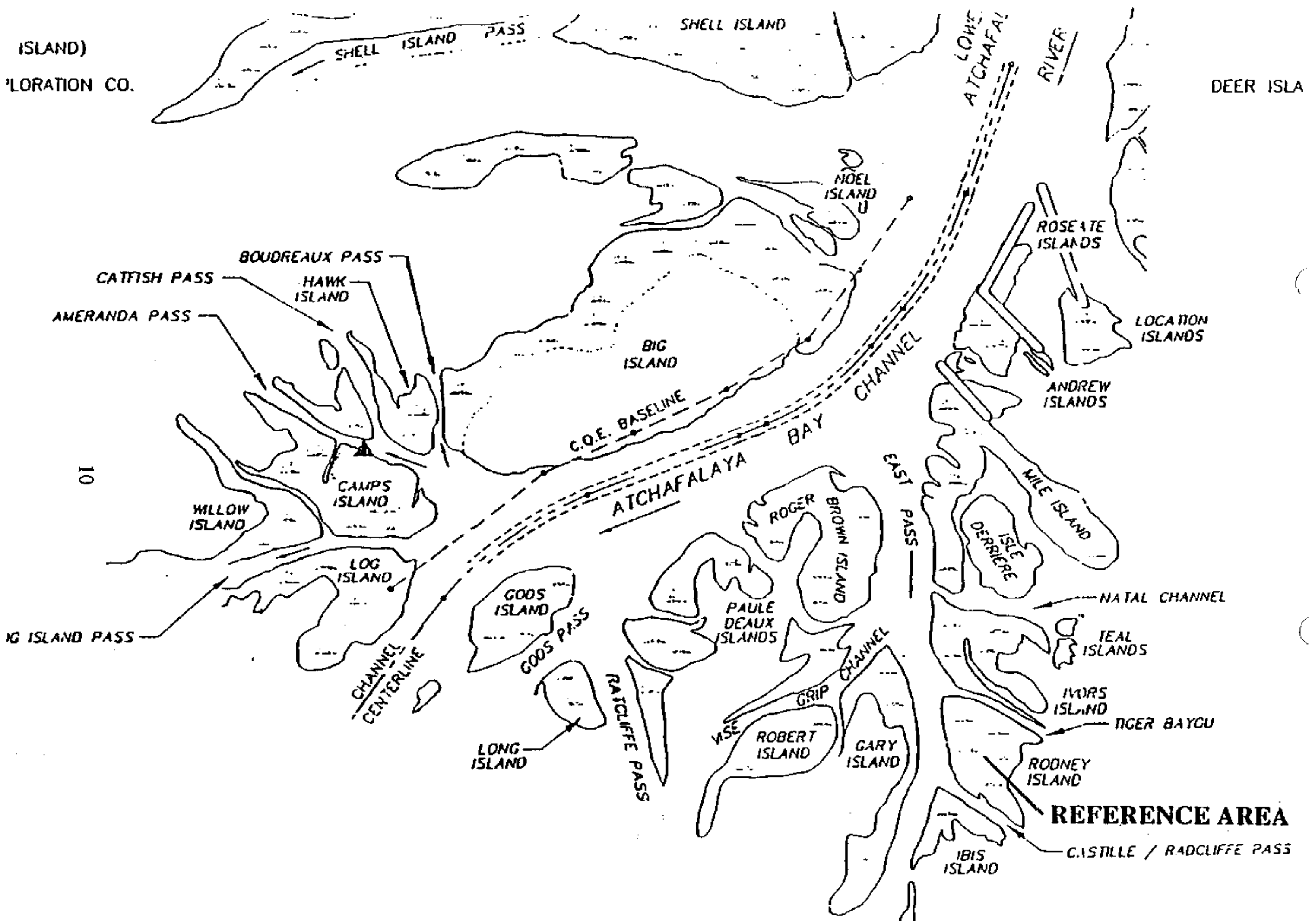

Figure 2 Islands of the Atchafalaya Delta.

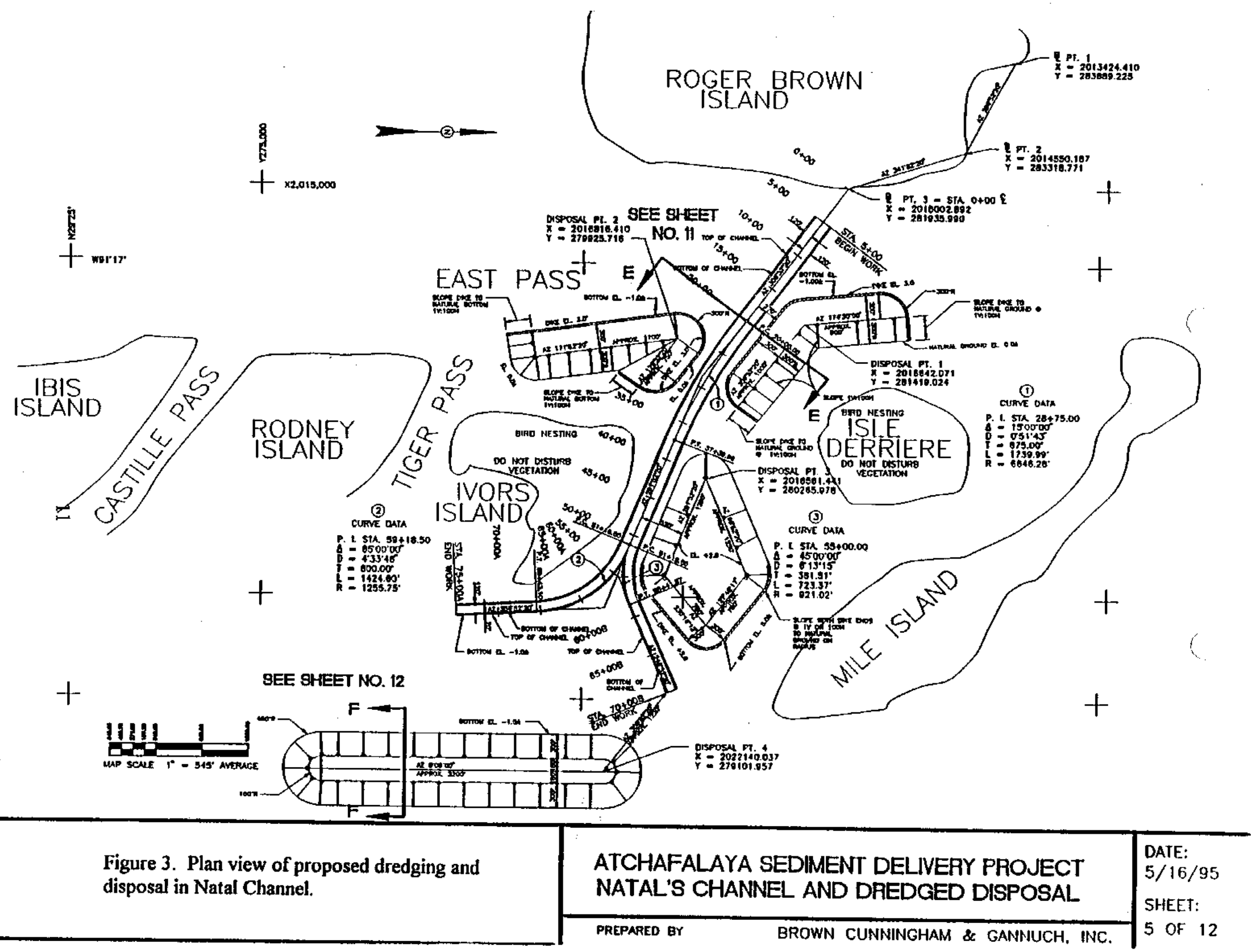

Figure 3. Plan view of proposed dredging and disposal in Natal Channel.

East Pass is a secondary distributary channel located on the eastern side of the Atchafalaya delta. Natal Channel and Castille Pass are tertiary channels on the east side of East Pass (figure 2). Natal Channel is currently at elevation of 0.0 ft NGVD at its juncture with East Pass, and has a bottom elevation of -1.0 ft (-0.3 m) NGVD near the Teal Islands. Castille Pass has a subaqueous bar at its head, restricting flow. The remainder of Castille Pass has a fully defined channel averaging 6.0 ft (1.8 m) deep and 200 ft (61 m) wide. These restrictions have resulted in the deprivation of sediment to wetland areas and the formation of a shallow delta platform in the eastern portion of the Atchafalaya Bay. Reopening these channels will supply fresh water and suspended sediment to 2,000 ac (800 ha) of delta environments (Woodward-Clyde 1992a). The project features include dredging Natal Channel and Castille Pass and placing the dredged material at an elevation suitable for emergent marsh vegetation.

Natal Channel will be dredged from its head at East Pass and extend 5,100 ft (1,554 m) with a bottom width of 200 ft (61 m) at an elevation of -10.0 ft (-3 m) NGVD (figure 3). At the Teal Islands, the channel will split into two smaller, curved channels (Channels A and B) designed to emulate a natural delta bifurcation. Channel A will be directed south between Ivor's Island and the Teal Islands and will be approximately 2,400 ft (732 m) in length with a bottom width of 100 ft (30.5 m) at an elevation of -10.0 ft (-3 m) NGVD. Channel B will be directed north along the north side of the Teal Islands and will be approximately 1,900 ft (579 m) in length with a bottom width of 100 ft (30.5 m) at an elevation of -10.0 ft (-3 m) NGVD. A total of 565,856 cu yd (419,153 m^3) of dredged material will be placed at 4 disposal sites totaling 184.6 ac (73.8 ha) at +3.0 ft to +2.0 ft (+0.9- 0.6 m) NGVD. The created delta lobes will settle to an elevation suitable for emergent marsh vegetation through dewatering and compaction.

Dredging in Castille Pass will extend 2,002 ft (610.2 m) from its head at East Pass with a bottom width of 200 ft (61 m) at elevation -10.0 ft (-3 m) NGVD (figure 4). A total of 145,346 cu yd (107,664 m^3) of dredged material will be placed at one 45.5 ac (18.2 ha) disposal site at elevation +3.0 ft (0.9 m) NGVD.

Project Objectives

1. Restore Natal Channel and Castille Pass to functioning tertiary distributary channels thereby enhancing the system's natural delta-building potential.

2. Utilize dredged material from the dredging of Natal Channel and Castille Pass to create delta lobe islands suitable for establishment of emergent marsh.

Specific Goals

The following goals will contribute to the evaluation of the above objectives:

1. To increase the distributary potential of Natal Channel and Castille Pass by increasing their cross-sectional area and length.

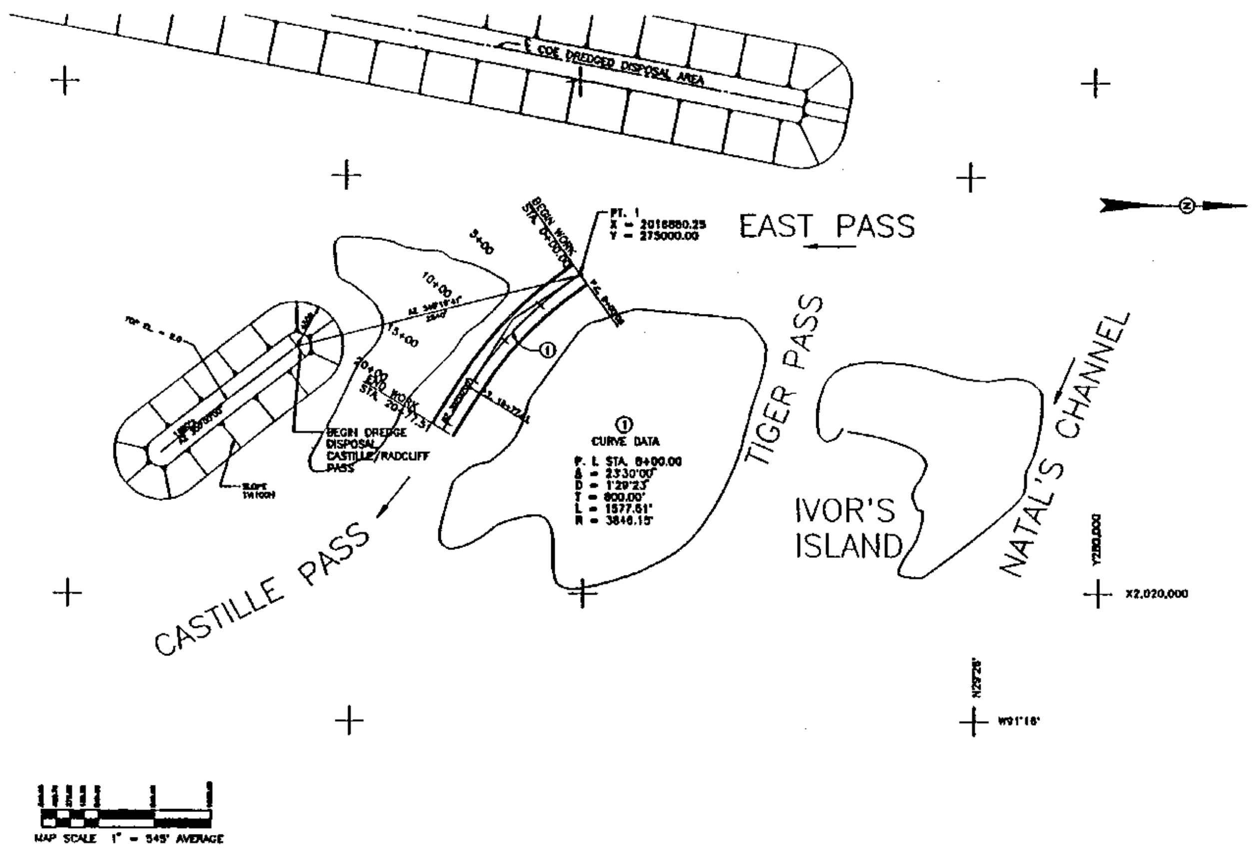

Figure 4. Plan view of proposed dredging and disposal in Castille Pass.	PLAN VIEW OF EAST PASS CHANNEL AND DEPOSIT AREAS	DATE: 5/16/95
	PREPARED BY BROWN CUNNINGHAM & GANNUCH, INC.	SHEET: 6 OF 12

2. Create approximately 230 ac (92 ha) of delta lobe islands through the beneficial use of dredged material at elevations suitable for emergent marsh vegetation.

3. Increase the rate of subaerial delta growth in the project area to that measured from historical photographs since 1956.

4. Increase frequency of occurrence of submerged aquatic vegetation.

Reference Area

A reference area was chosen to compare vegetative communities and elevation between the newly created lobe islands and a naturally formed lobe island. The evaluation of possible reference areas was based on aerial photography and site investigations. Areas were ranked on the basis of their proximity to the project, elevation, plant communities, and the possible future use as a dredged material disposal area. Ibis Island, Rodney Island, Ivor's Island, Roger Brown Island, Isle Derriere, Log Island, Willow Island, and islands in the Wax Lake delta were considered as potential reference areas. Many of these will likely be impacted by the project or through future dredging activities in the navigation channel. Rodney Island (figure 2) was chosen as the reference area for the following reasons: (1) it is not designated as a dredged material disposal area, (2) it is at an elevation which is close to that of the newly created lobe islands, (3) it appears it will experience the least impact due to the project, and (4) it will be exposed to the same tidal influences and similar flow regimes as the project area. Additionally, vegetative communities on the island are typical of lobe islands within the Atchafalaya delta. However, we recognize that in this dynamic environment interpretation of reference data may be limited or confounded by natural physical processes.

CRMS will provide a pool of reference sites within the same basin and across the coast to evaluate project effects. At a minimum, every project will benefit from basin-level satellite imagery and land:water analysis every 3 years, and supplemental vegetation data collected through the periodic Chabreck and Linscombe surveys. Other CRMS parameters which may serve as reference include Surface Elevation Table (SET) data, accretion (measured with feldspar), hourly water level and salinity, and vegetation sampling. A number of CRMS stations are available for each habitat type within each hydrologic basin to supplement project-specific reference area limitations.

Monitoring Elements

The following monitoring elements will provide the information necessary to evaluate the specific goals listed above:

1. Habitat Mapping — To document vegetated and nonvegetated areas, color-infrared aerial photography (1:12,000 scale with ground control markers) will be obtained. The photography will be georectified, photointerpreted, mapped, and analyzed with GIS by National Wetlands Research

Center (NWRC), following procedures outlined in Steyer et al. (1995). Photography will be obtained twice prior to construction in 1994 and 1997, and two times following construction in 2000 and 2007 in lieu of photography available from other sources.

2. Vegetation

Species composition and relative abundance will be evaluated at each station utilizing the Braun-Blanquet method (Mueller-Dombois and Ellenbert 1974) as described in Steyer et. al. (1995). Transects will be delineated at disposal area 3 (figure 3) and at the reference area (figure 2) such that each habitat type will be included. Vegetation transects will be sampled post-construction in 1998, 2000, 2007, and 2016.

3. Elevation

Elevations will be surveyed to existing benchmarks according to Steyer et al. (1995) along transects on disposal area 3 and the reference area. The elevation transects will coincide with vegetational transects in each area. Elevations will be recorded in 1998 (as-built), and in 2000, 2002, 2007, and 2016.

4. Bathymetry

Benchmarks will be installed at the time of construction and tied to NAVD at three stations (head, midway, mouth) along each dredged distributary channel. Bathymetry will The equipment will be calibrated before use following the manufacturer's guidelines. Positioning will be recorded in x-y coordinates, and depth will be recorded in feet. Shallow-water bodies (inaccessible by boat) will be surveyed using topographic land surveying techniques. Water levels at each site will be related to a fixed datum and all bathymetric surveys will be referenced to the same water level datum. Bathymetric profiles will be recorded as-built, and in 2000, 2002, 2007, and 2016 post-construction.

5. SAV

To determine the frequency of occurrence of SAV between the project area and a reference area, two open water areas will be sampled for presence or absence of SAV at 25 random points using the rake method (Chabreck and Hoffpauir 1962). Species composition and frequency of occurrence will be determined in the late spring for each pond from the number of points at which SAV occurred and the total number of points sampled. SAV will be monitored post-construction in 1998 and 2000. Based on the 2003 recommendations, the SAV sampling in 2007 and 2016 was eliminated due to the low frequency of sampling and the lack of preconstruction, baseline data.

Anticipated Statistical Analyses and Hypotheses

The following hypotheses correspond with the monitoring elements and will be used to evaluate the accomplishment of the project goals.

1. Descriptive and summary statistics as well as t-tests on historical data and data from aerial photography and GIS interpretation collected during post-project implementation will be used to evaluate marsh loss/gain rates within the project and reference areas. Also, historical values for the area as well as data available from other surveys (USACE, USFWS, LDNR, LSU) will be gathered to document and allow for statistical analysis of long term marsh loss/gain rates in the project area.

   Goal: Create delta lobe islands.

   Hypothesis:

   H_0: Land gain in the project area will not be significantly greater than land gain in the reference area at time i.

   H_a: Land gain in the project area will be significantly greater than land gain in the reference area at time i.

2. The primary method of analysis will be to determine differences in relative abundance of vegetation as evaluated by an analysis of variance (ANOVA) that will consider both spatial and temporal variation and interaction. The ANOVA approach may include terms in the model to adjust for station/transect locations, proximity to the distributary channels, and seasonal fluctuations. Ancillary data (i.e., herbivory, historical) will be included as covariables when available. This additional information may be evaluated through analysis such as: correlation, trend, multiple comparisons, and interval estimates.

   Goal: Create delta lobe islands in which the relative abundance of vegetation is similar to that of natural lobe islands.

   Hypothesis:

   H_0: Mean relative abundance of vegetation within the project area will not be significantly different than the mean relative abundance of vegetation within the reference area at time i.

   H_a: Mean relative abundance of vegetation within the project area will be significantly different than the mean relative abundance of vegetation within the reference area at time i.

   If we reject the null hypothesis, any possible negative effects will be investigated.

3. Descriptive and summary statistics and t-tests will be used to evaluate elevation and elevational changes of the created and natural delta lobe islands.

   Goal: Create delta lobe islands in which the elevations will be similar to that of naturally occurring delta lobe islands (reference area).

   Hypothesis:

   H_0: Elevation of the created delta lobe islands will not be significantly different than the elevation of the reference area at time i.

   H_a: Elevation of the created delta lobe islands will be significantly different than the elevation of the reference area at time i.

   If we reject the null hypothesis, any possible negative effects will be investigated.

4. Descriptive and summary statistics will be used on bathymetric data collected during postproject implementation to determine how and/or if the cross-sectional area of dredged distributary channels within the project area are changing over time.

   Goal: Create functioning tertiary distributary channels

5. Over all sample dates, Repeated Measures Analyses will be used to compare the frequency of SAV between the project area and the reference area (Steele and Torrie 1980:377-437). These data will likely require transformation because percentage data with ranges between 0 and 20 or 80 and 100 often follow the Poisson distribution (Steele and Torrie 1980:3234-238). The square root plus 0.5 and the arcsin transformations are the most likely to correct heterogeneity of error associated with percentage data.

   Goal: Increase frequency of occurrence of SAV.

   Hypothesis:

   H_0: Frequency of SAV in the project area at any time point i is not significantly greater than the frequency of SAV in the reference area at any time point i.

   H_a: Frequency of SAV in the project area at any time point i is significantly greater than the frequency of SAV in the reference area at any time point i.

   If we reject the null hypothesis, any possible negative effects will be investigated.

NOTE: Available ecological data, both descriptive and quantitative, will be evaluated in concert with all of the above data and with statistical analyses to aid in determination of overall project success.

Notes

1. Implementation: Start Construction January 25, 1998
   End Construction March 21, 1998

2. NMFS Point of Contact: John Foret (337) 291-2107

3. DNR Project Manager: Van Cook (504) 342-6814
   DNR Monitoring Manager: Glen Curole (504) 447-0995

4. The twenty year monitoring plan development and implementation budget for this project is $212,750. Progress reports will be available in March 1999 and March 2003, and periodic comprehensive reports will describe the status and effectiveness of the project.

5. DNR/CRD has prints of near-vertical, aerial photography flown in 1985 (1:64,000), October 5, 1991 (1:12,000), and on December 17, 1994 (1:12,000). Additionally, NMFS has aerial photography from March 1998 and LDWF from October 1997. The Army Corps of Engineers proposes annual habitat mapping at the Lower Atchafalaya River Bay and Bar navigation channel.

6. Final estimates for wetland acreage created, destroyed, and enhanced through this project will be obtained from the Final Engineering and Design Report.

7. References:

Chabreck, R. H., and C. M. Hoffpauir 1962. The use of weirs in coastal marsh management in coastal Louisiana. Proceedings of the Annual Conference of the Southeastern Association of Game Fish Commissioners. 16:103-12. Columbia, South Carolina.

Fuller, D. A., C. E. Sasser, W. B. Johnson, and J. G. Gosselink 1985. The effects of herbivory on vegetation on islands in Atchafalaya Bay, Louisiana. Wetlands. 4. 105-114.

Johnson, W. B., C. E. Sasser, and J. G. Gosselink 1985. Succession of vegetation in an evolving river delta, Atchafalaya Bay, Louisiana. Journal of Ecology. 73. 973-986.

Louisiana Coastal Wetlands Conservation and Restoration Task Force 1993. Louisiana Coastal Wetlands Restoration Plan. Atchafalaya Basin Plan. Appendix F. 63 pp.

Mayer, E. J., Jr., A. L. Springston, and J. H. Shires 1995. Big Island mining and Atchafalaya sediment delivery. Unpublished preliminary report prepared for the Louisiana Department of Natural Resources. Baton Rouge: Brown, Cunningham and Gannuch, Inc. 23 pp. plus appendixes.

Mueller-Dombois, D., and H. Ellenberg 1974. Aims and Methods of Vegetation Ecology. New York: John Wiley and Sons. 547 pp.

Shaffer, G. P., C. E. Sasser, J. G. Gosselink, and M. Rejmanek 1992. Vegetation dynamics in the emerging Atchafalaya Delta, Louisiana, USA. Journal of Ecology. 80. 677-687.

Steele, R. G. D., and J. H. Torrie 1980. Principles and procedures of statistics: a biometrical approach. New York: McGraw-Hill, Inc. 633 pp.

Steyer, G. D., R. C. Raynie, D. L. Steller, D. Fuller, and E. Swenson 1995. Quality management plan for coastal wetlands planning, protection, and restoration act monitoring program. Open-file report no. 95-01. Baton Rouge, LA: Louisiana Department of Natural Resources Coastal Restoration Division. 97 pp. plus appendixes.

van Heerden, I. L., and H. H. Roberts 1980. The Atchafalaya Delta: Rapid progradation along a traditionally retreating coast (South-Central Louisiana). Z. Geomorph. N.F. Suppl.-Bd. 34. 188-201.

________________, H. H. Roberts, S. Penland, and R. H. Cunningham 1991. Subaerial delta development, eastern Atchafalaya Bay, Louisiana. Proceedings of GCS-SEPM 12th Annual Meeting. 13pp.

Woodward-Clyde Consultants 1992a. Re-establishment of natural sediment delivery systems, Atchafalaya Delta, Atchafalaya Basin. Unpublished technical proposal. Woodward-Clyde Consultants, Baton Rouge, LA. WCC file 92B022C. 13 pp.

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