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Coastal Protection and Restoration Authority of Louisiana

Office of Coastal Protection and Restoration

2010 Operations, Maintenance, and Monitoring Report

for

Big Island Mining (AT-03)

State Project Number AT-03
Priority Project List 2

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St. Mary Parish

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Operations, Maintenance, and Monitoring Report
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Big Island Mining
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Table of Contents

I. Introduction

The Big Island Mining (AT-03) project is a sediment diversion and marsh creation restoration project located inside the Atchafalaya Delta. The project lies within the Louisiana Department of Wildlife and Fisheries (LDWF) administered Atchafalaya Delta Wildlife Management Area (WMA) and is positioned approximately 26 km (16 mi) south of Morgan City in St. Mary Parish, Louisiana (figure 1). The AT-03 project is situated directly across the Atchafalaya River from the Atchafalaya Sediment Delivery (AT-02) project (figures 1 and 2) and was placed between Big and Shell Islands (figure 3). The project was federally sponsored by the National Marine Fisheries Service (NMFS) and locally sponsored by the Louisiana Office of Coastal Protection and Restoration (OCPR) under the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA, Public Law 101-646, Title III). The AT-03 project area consists of 1,119 ha (2,765 acres) of fresh marsh, scrub-shrub, wetland forested, beach/bar/flat, submerged aquatics, and open water habitats and has a 427 ha (1,054 acre) reference area (figure 3).

Atchafalaya Delta growth was originated in 1952 with the deposition of prodelta clay sediments into Atchafalaya Bay. The aggradation of prodelta clay continued until 1962 when distal bar sediments (interlaminated thin sands, silts, and clays) began to accumulate on the bay bottom and form an embryonic subaqueous delta. By the early 1970’s, sand rich distributary mouth bar sediments began to aggrade the Atchafalaya River-Atchafalaya Bay interface and establish subaerial mid-channel bar and levee facies (Majersky et al. 1997; Roberts and van Heerden 1992; Roberts 1998; van Heerden and Roberts 1980; van Heerden and Roberts 1988; van Heerden et al. 1991). The substantial floods of 1973, 1974, and 1975 hastened the emergence of the sudaerial delta through the frictional deposition of larger grained sediments. These deposits were formed into a bifurcating network of mid-channel bars and secondary and tertiary distributary channels. During this time, seaward channel elongation and bifurcation were the geological mechanisms governing delta growth (Roberts and van Heerden 1992; Roberts 1998; van Heerden and Roberts 1980; van Heerden and Roberts 1988; van Heerden et al. 1991). In this period of rapid delta development (1973 to 1976), the land in the Atchafalaya Delta expanded at a rate of 525 ha/yr (1297 acres/yr) (van Heerden et al. 1991). After 1976, channel abandonment and lobe fusion became the dominant geological processes forcing delta growth. These processes are initiated when subaqueous bars form across tertiary channels leading to deposition of fine grained sediments, channel narrowing, and lobe fusion (Roberts and van Heerden 1992; Roberts 1998; van Heerden and Roberts 1980; van Heerden and Roberts 1988; van Heerden et al. 1991). van Heerden et al. (1991) reported that the rate of land creation in the delta slowed to 193 ha/yr (477 acres/yr) from 1977 to 1991, a period dominated by channel abandonment and lobe fusion. Since this early period of subaerial delta growth, spring floods have arisen along the Atchafalaya River in 1979, 1983, 1984, 1993, 1997 (Trotter et al. 1998), 2001, and 2008. Moreover, sediment deposition and subaerial lobe creation in the Atchafalaya Delta generally occur during the late winter and spring when river stages and discharges are highest. The overlying distributary mouth bar facies in the Atchafalaya River Delta consists of approximately 60% sand and have been estimated to be 3.0 m (9.8 ft) thick (Majersky et al. 1997; Roberts 1998).

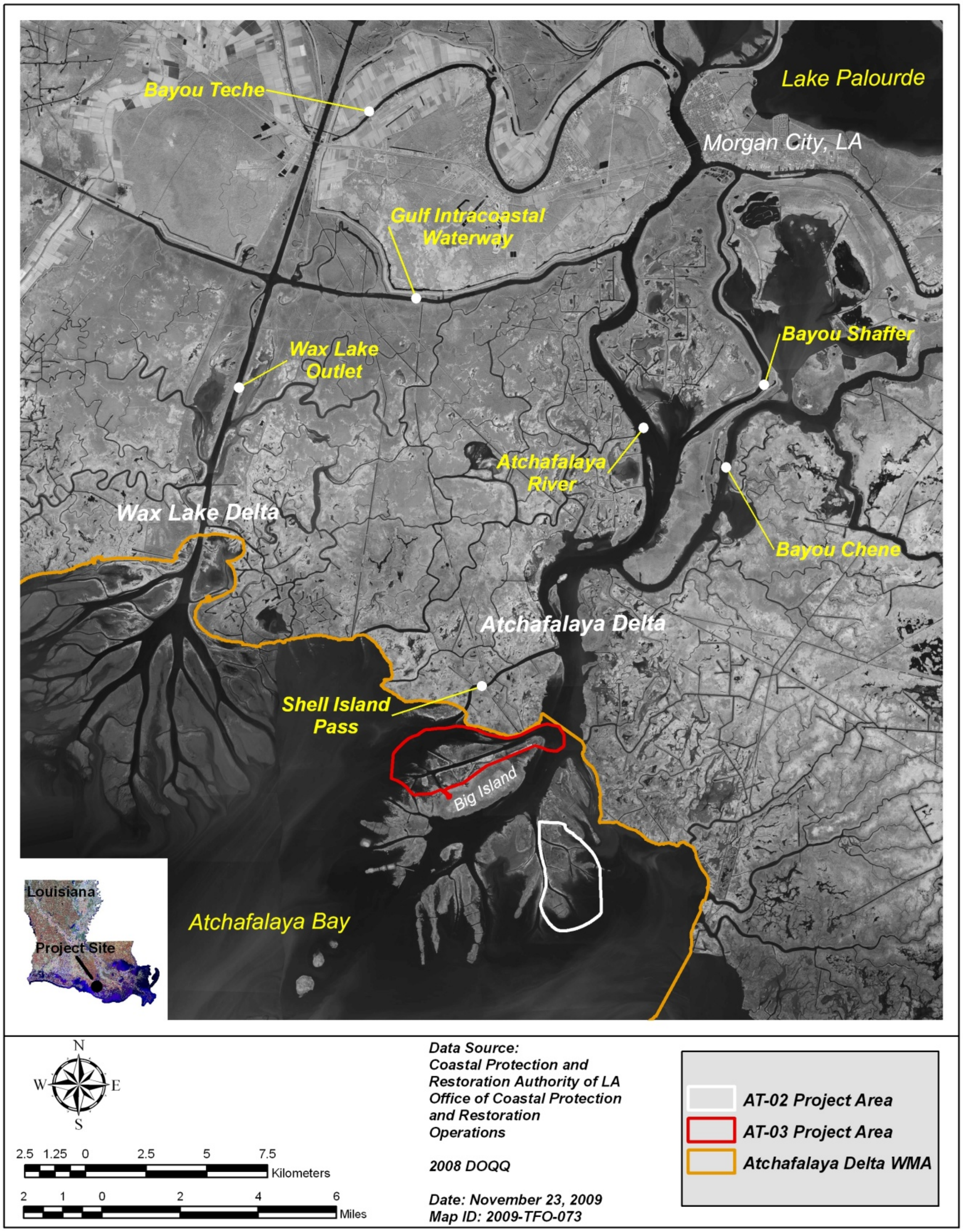


Figure 1. Location and vicinity of the Big Island Mining (AT-03) project.

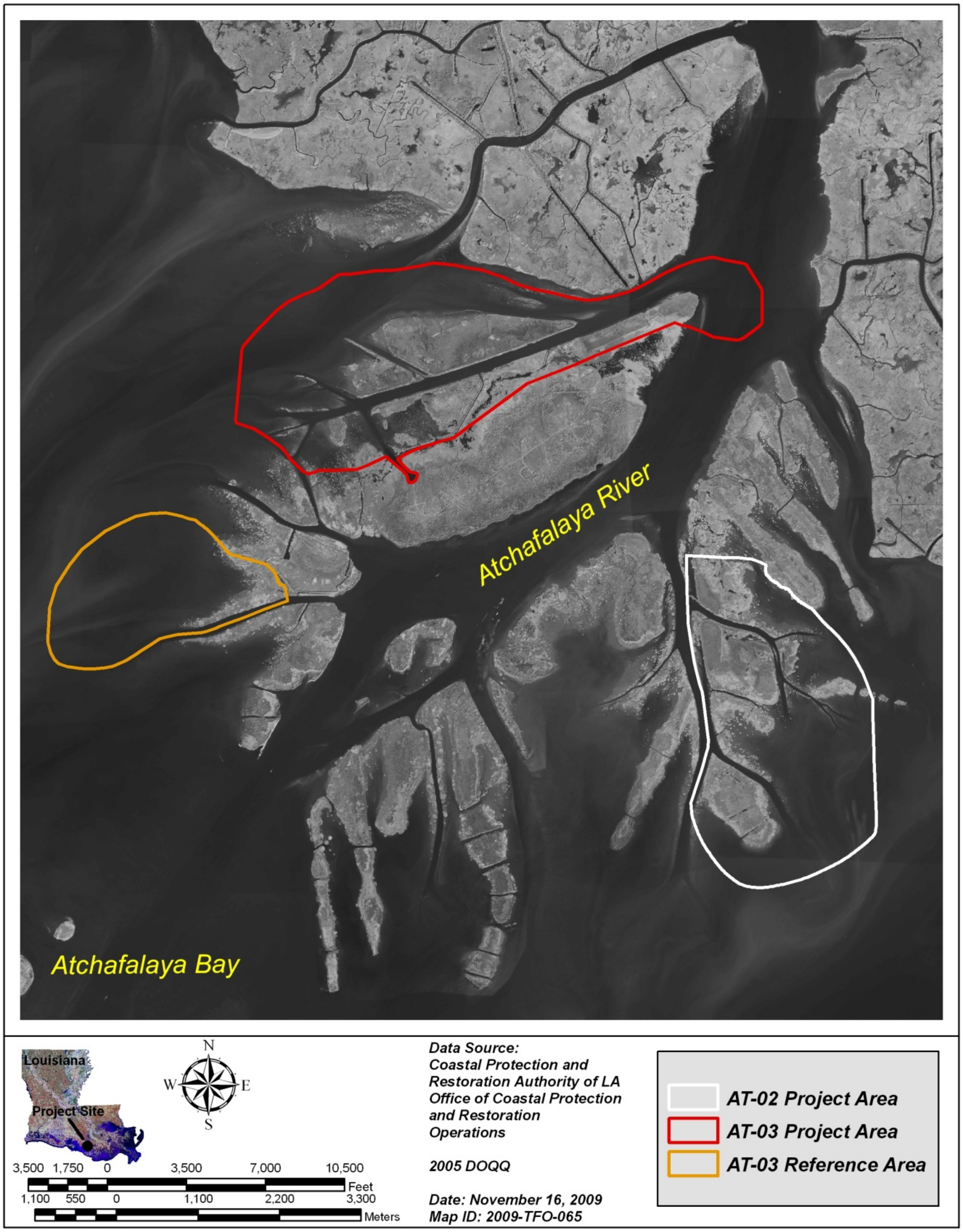


Figure 2. Location of the Atchafalaya Sediment Delivery (AT-02) project across the Atchafalaya River from the Big Island Mining (AT-03) project.

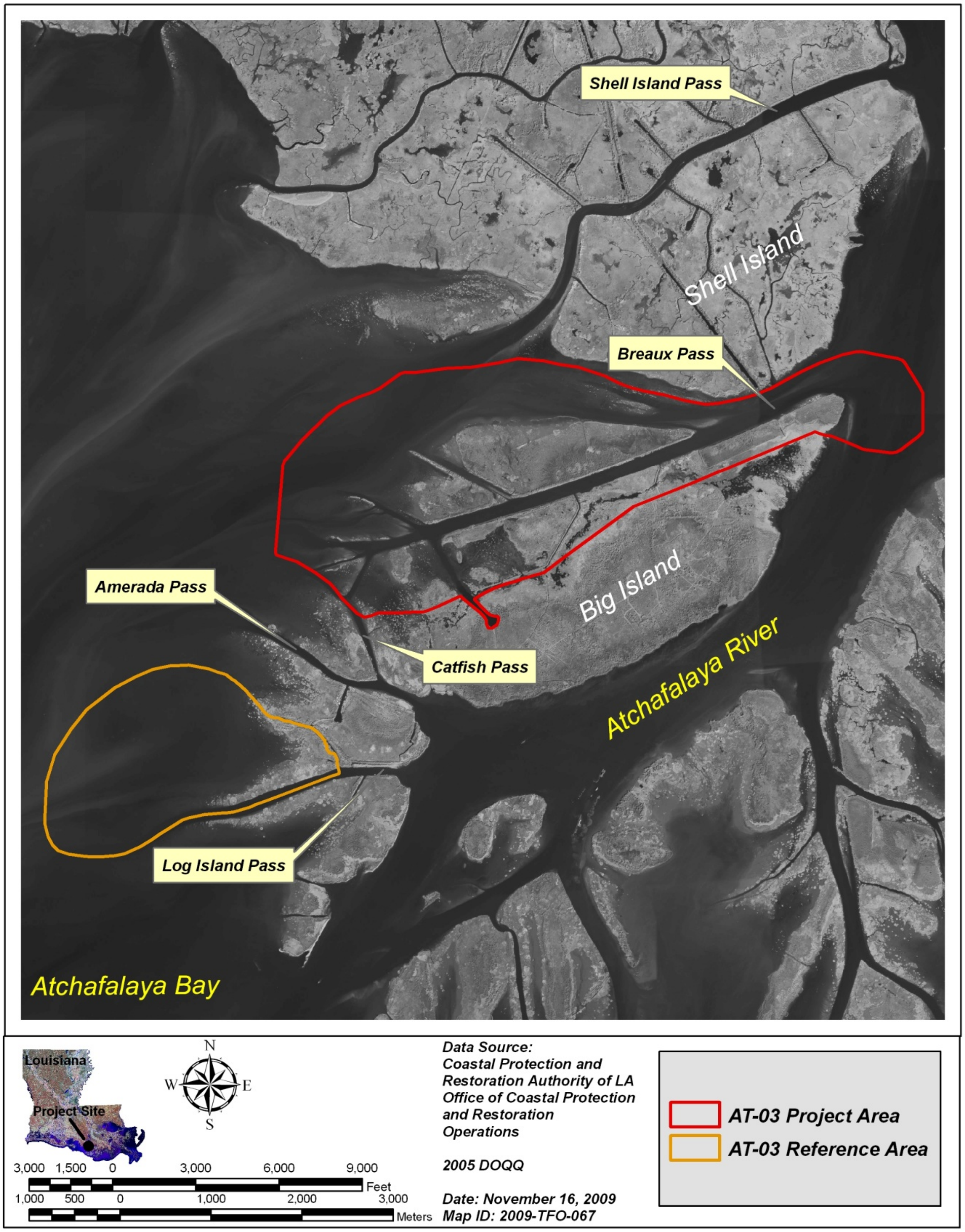


Figure 3. Location of the Big Island Mining (AT-03) project and reference areas.

The construction and maintenance of the Lower Atchafalaya River Bay and Bar navigation channel, which extends the entire length of the Lower Atchafalaya River and AtchafalayaBay into the Gulf of Mexico, is slowing sediment deposition and subaerial lobe creation in the Lower Atchafalaya River Delta and providing a path for sediment transport into the Gulf of Mexico (van Beek 1979; Roberts 1998). The Lower Atchafalaya River Bay and Bar navigation channel was initially constructed in 1939 to a depth of 3 m (10 ft) and a width of 30 m (100 ft). This navigation channel was expanded to its present dimensions [6 m (20 ft) deep by 122 m (400 ft) wide] in 1974 and has been sustained through annual maintenance dredging (Penland et al. 1996; Penland et al. 1997). Approximately, 12,232,880 m^3/yr (16,000,000 yd^3/yr) of sediments are dredged annually from the Lower Atchafalaya River to maintain the Lower Atchafalaya River Bay and Bar navigation channel (Mashriqui et al. 1997). To dispose of this large volume of sediments, dredged materials have been used to construct islands along the edges of the navigation channel. These artificially built islands have been placed at considerably higher elevations than the naturally created deltaic lobes (Penland et al. 1996; Penland et al. 1997; Sasser and Fuller 1988; van Beek 1979). Creation of dredged material islands in the Atchafalaya River Delta began in 1974 with the expansion of the Lower Atchafalaya River Bay and Bar navigation channel. During the period from 1974 to 1987, the vast majority of dredged materials were placed on the western banks of the Lower Atchafalaya River Delta. Big Island was constructed during this period (figure 3). This island extends for 3.2 km (2 mi) along the western delta and is the largest dredged material spoil area constructed in the Atchafalaya Delta. However since 1987, large amounts of dredged materials have also been deposited along the eastern banks of the Atchafalaya River Delta (Penland et al. 1996; Penland et al. 1997). As of 1996, 72% of the total area of the Atchafalaya River Delta was created by deposition of dredged materials while only 28% of the total area was created through natural processes (Penland et al. 1997).

The naturally created deltaic lobe islands of the Lower Atchafalaya River are generally composed of fresh marsh and mudflat habitats (Penland et al. 1996; Penland et al. 1997). Johnson et al. (1985) documented the initial colonization and spatial distribution of the naturally created Lower Atchafalaya River deltaic lobe islands as consisting of a *Salix nigra Marsh.* (black willow) association on the higher elevated upstream end of the lobe islands, a *Typha latifloia L.* (broadleaf cattail) association at intermediate elevations, and a *Sagittaria latifloia Willd.* (broadleaf arrowhead) association at intermediate and lower elevations. Later vegetation surveys showed increases in species diversity and reductions in vegetative cover in the plant community on these deltaic lobes (Sasser and Fuller 1988; Shaffer et al. 1992). In contrast, the vegetative communities on many of the constructed islands differ greatly from the naturally created islands due to placement of dredged material at higher elevations than the deltaic lobe islands. The vegetative communities on these dredged material islands are mainly composed wetland scrub-shrub, wetland forested, and bare ground habitats (Penland et al. 1996; Penland et al. 1997).

Big Island impedes fluvial discharge to the western Atchafalaya Delta because of its large size, high elevation, and critical placement in the northwestern reaches of the delta. Since Big Island lowers river discharge, sediment transport is reduced and delta growth is minimized westward (van Heerden 1983). Therefore, the planform geometry and the geomorphology of the western delta have been altered by construction of this large spoil area. The rate of subaerial land growth inside the AT-03 project area has been estimated to be 2 ha/yr (4 acres/yr) from 1956 to 1978 and 1 ha/yr (3 acres/yr) from 1978 to 1990 (Barras et al. 1994). The Big Island Mining (AT-03) project will attempt to enhance sediment transport and delta growth in the northwestern delta by construction of a distributary network of channels and dredged material islands. One secondary [Channel A (CA)] (aka Breaux Pass) and five tertiary channels [Channel B (CB), Channel C (CC), Channel D (CD), Channel E (CE), and Channel F (CF)] were constructed for the AT-03 project (figure 4). The channels were dredged to a depth of -3 m (-10 ft) NGVD 29 and the corresponding lengths CA 6,400 m (21,000 ft), CB 1,676 m (5,500 ft), CC 610 m (2,000 ft), CD 1,219 m (4,000 ft), CE 1,280 m (4,200 ft), and CF 670 m (2,200 ft). The materials dredged from these channels were placed into Disposal Area 1 (DA1), Disposal Area 5 (DA5), Disposal Area 6 (DA6), Disposal Area 8 (DA8), and Disposal Area 9 (DA9) (figure 4). The 5 disposal areas were built to elevations ranging from 0.6 to 1.2 m (2 to 4 ft) NGVD 29. Earthen containment dikes were constructed for all disposal areas at a 0.9 m (3 ft) NGVD 29 elevation. After construction, the containment dikes were gapped in several locations. In 2006 additional gaps were added to the containment dikes for fisheries research (Thompson and Peterson 2006). Construction of the AT-03 project began on January 25, 1998 and was completed by October 8, 1998. The Atchafalaya Sediment Delivery (AT-02) project is a similar sediment diversion and marsh creation project in the Atchafalaya Delta that was constructed simultaneously with the AT-03 project in 1998.

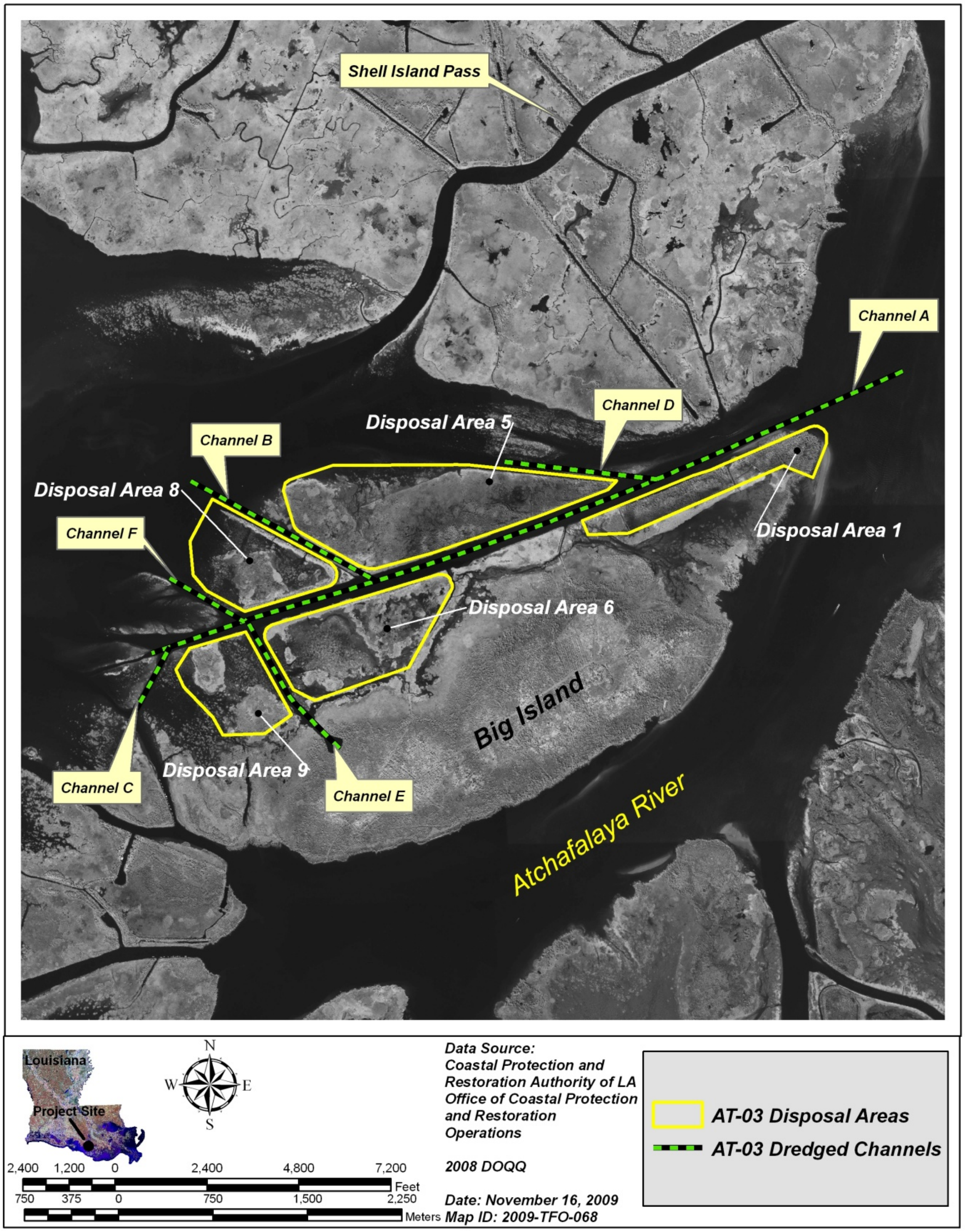


Figure 4. Location of the Big Island Mining (AT-03) project features.

II. Inspection and Maintenance Activities

a. Inspection Purpose and Procedures

The purpose of the annual inspection of the Big Island Mining (AT-03) Project is to evaluate the constructed project features, identify any deficiencies and prepare a report detailing the condition of such features, and to recommend corrective actions needed, if any. Should it be determined that corrective actions are needed, OCPR shall provide, in report form, a detailed cost estimate for engineering, design, supervision, inspection, construction contingencies, and an assessment of the urgency of such repairs. The annual inspection report also contains a summary of maintenance projects undertaken since the constructed features were completed and an estimated budget for the upcoming three (3) years for operation, maintenance and rehabilitation. The three (3) year projected operation and maintenance budget is show in Appendix C and the summary of completed maintenance projects are outlined in Section II.b of this report.

An inspection of the Big Island Mining (AT-03) Project was held on April 6, 2010 under partly cloudy skies and mild temperatures. In attendance were Brian Babin, and Glen Curole of OCPR, Dr. John Foret of the National Marine Fisheries Service (NMFS) and Edmond Mouton with the Louisiana Department of Wildlife and Fisheries (LDWF). The attendees met at the Berwick Public Boat Launch in St. Mary Parish. The inspection began at approximately 9:00 a.m. and ended at 1:00 p.m.

The field trip included a visual inspection and limited soundings of Breaux’s Pass or Channel “CA”, Channel “CB”, Channel “CC”, Channel “CD”, Channel “CE” and Channel “CF”. No attempt was made to measure the geometry of the channels other than periodic depth measurements recorded using a hand-held fathometer. The primary source of information and data used in analyzing project deficiencies and determining the need for maintenance or corrective actions in this report are the 2008 Topographic and Bathymetric Surveys performed by Morris P. Hebert, Inc. and the 2009 Operations, Maintenance, and Monitoring Report prepared by Mr. Glen Curole of OCPR.

b. Summary of Past Operation and Maintenance Projects

Since the completion of the Big Island Mining (AT-03) Project in March 1998, no maintenance dredging or marsh creation efforts have been undertaken. As recommended in the 2005 Annual Inspection Report, a complete survey of all dredged channels and marsh fill areas was completed in the spring of 2008 by Morris P. Hebert, Inc., survey consultant contracted by the Office of Coastal Protection and Restoration (OCPR).

c. Inspection Results

Prior to presenting the inspection results for the 2010 annual inspection, a brief summary of previous inspections will be discussed to outline the findings and theories of the inspection team in 2003, 2005 and 2008. Also included in the 2010 inspection results is a review of the 2008 topographic and bathymetric survey data for each channel section. As part of the monitoring plan for the project, a topographic and bathymetric survey was conducted in 2008 on all dredged channels and disposal areas to determine the extent of shoaling in the channels and evaluate settlement of the constructed disposal areas. This survey data is the primary information used in this report for describing the current conditions of the dredge channels and for formulating recommendations and potential corrective actions.

Channel "CA", better known as Breaux's Pass, is a secondary channel approximately 20,600 ft. long beginning at Sta. -2+89 near the Atchafalaya River and ending at Sta. 206+00 near the Atchafalaya Bay (Appendix B - Photos 1, 2, 9, 10, 13, 14, 17 & 18). The 2010 inspection of the Big Island Mining (AT-03) project began at the head of Channel "CA", near the beginning of the reach near Sta. 20+00 and proceeded southwesterly to the Atchafalaya Bay to Sta. 206+00, the end of the dredged section. In 2003, the inspection team found that Channel "CA" was in good condition with adequate depths for sediment accumulation and transport. They also noted that the channel had scoured for several hundred feet in a southwesterly direction beyond the point where dredging ceased at Sta. 206+00. In 2005, the condition of Channel "CA" had not changed much in two years. No additional shoaling was discovered. To get a better understanding sediment deposit and channel depths, the OCPR contracted a local survey firm to perform a topographic and bathymetric survey in 2008. The survey of channel "CA" began near Sta. -2+89 in the center of the Atchafalaya River and ended at Sta. 206+00 northwest of Channel "CC" near the Atchafalaya Bay. A review of the 2008 survey data revealed no significant shoaling at the head of the channel until a better defined channel was encountered near Sta. 25+00, where the channel bottom slopped upwards from -5.0 ft NAVD 88. The original constructed channel section at this location was approximately 600 ft wide with a -10.0 ft NAVD 88 elevation. From the 2008 survey data, it was determined that substantial sediment deposition had occurred on the north side of the channel, creating a smaller, narrower channel on the south side. The smaller channel was approximately 300 ft wide, 10 ft deep and stretched from Sta. 30+00 to 70+00, near the head of Channel "CD". From Sta. 70+00 westward along Channel "CA", the channel opened up to its original constructed section of 500 ft with slightly shallower depths ranging from -5.0 ft to -7.0 ft NAVD 88. The channel width and depth remained constant to the end of the 500 ft section near Sta. 200+00. The 2010 inspection revealed additional shoaling at the head of Channel "A" resulting in a shallow channel bottom across the entire section between Sta. 10+00 to 30+00. During the inspection, it was difficult to navigate this stretch of the channel without the channel markers marking a narrow passage with adequate depths for boats access. The channel west of Sta. 30+00 appear to have remained open with no visual shoaling beyond what has been outlined in the 2008 survey report.

Channel “CD” is approximately 2,400 ft long and is the first tertiary channel along the north bank of Breaux’s Pass which extends in a northwest direction from Channel “CA” to Shell Island Pass (Appendix B – Photos 3 & 4). In 2003, there was approximately 4 ft of water in the initial reach at the head of the Channel “CD” and 5 ft of water depths as the channel proceeds downstream towards Shell Island Pass. In 2005, as a result of obvious sediment deposition in the Channel “CD”, the depths decreased from 2 to 3 ft at the head of the channel with slightly deeper depths downstream near Shell Island Pass. Since that time, the channel has continued to encounter severe shoaling as confirmed by the 2008 survey transects which indicate that the average bottom elevation of the channel between Sta. 10+00 and Sta. 25+00 was 0.0 ft NAVD 88. Traveling downstream from Sta. 25+00 to Sta. 50+89, the end of the channel, water depths averaged -4.0 ft to -5.0 ft NAVD 88. This data would seem to suggest that the upper reach of Channel “CD” had completely shoaled in and that very little flow was occurring in the lower reach where deltaic development was anticipated. Based on Channel “CD’s” position on the upstream end of Disposal Area 5, the extensive shoaling of the channel, and the formation of a large subaqueous and subaerial bar on the northeastern bank of this channel, it is unlikely that maintenance dredging of Channel “CD” would produce substantial benefits and the channel would most likely continue to shoal due to hydraulic inefficiencies.

Channel “CB” is approximately 5,500 ft long and the second tertiary channel on north side of Channel “CA” which extends in a northwesterly direction towards Shell Island Pass (Appendix B – Photos 5 & 6). Sounding taken during the 2003 inspection revealed that the water depths in the upper reach of Channel “CB” were approximately 4.0 ft deep and 8.0 ft to 9.0 ft in the lower reach near Shell Island Pass (Juneau, 2003 Inspection Report). Over the next five years (5 years), the entire reach between Sta. 5+00 and 40+00 along Channel “CB” had completely shoaled in with channel bottoms between 0.0 ft NAVD 88 and -1.0 ft NAVD 88 as evident in the 2008 topographic and bathymetric surveys. Downstream from Sta. 40+00, as the channel begins to get closer to Shell Island Pass, the depths begin to increase from -2.0 to -5.0 ft NAVD 88. We suspect that Channel “CB”, like Channel “CD”, is not hydraulically efficient and supports a low discharge causing suspended sediment to fall out at the head of the channel rather than forcing delta growth near downstream lobes as designed. Observations during the 2010 annual inspection revealed similar conditions with a large vegetated sediment deposits in the center and across the channel indicating significant flow restrictions through the channel. In light of these observations, we believe that dredging Channel “CB” to its original design section would not produce long term project benefits. Therefore, we are not recommending maintenance dredging of Channel “CB”.

Channel “CE” is approximately 4,150 ft long and is the first channel extending in a southeasterly direction from the south bank of Breaux’s Pass to a cul-da-sac on the interior of Big Island (Appendix B – Photos 11 & 12). The primary function of this channel is for access to the island and not for the transport of sediments for the enhancement of the deltaic island processes. In 2003, controlling depths of 2 ft over a hump approximately 150 ft in length downstream from the mouth was reported (Juneau, 2003 Inspection Report). Thereafter, the water depths increased to 5 ft and gradually sloped down to the cul-da-sac where the depths were approximately 10 ft deep (Juneau, 2003 Inspection Report). It was apparent from field observations over the years and the 2008 survey data that Channel "CE" was receiving significant sediments from Channel "CA" which were settling out at the mouth of the channel from a lack of hydraulic gradient in the channel along with inadequate velocities required to transport river sediment (Juneau, 2003 Inspection Report). To provide the needed access to public hunting grounds and biological collection stations on the downstream end of Channel "CE", the LDWF dredged a smaller channel section through the shoal deposits at the head of the channel which was completed in early spring of 2010. Since Channel "CE" is primarily an access channel and is unlikely to contribute to the deltaic development on Big Island in the future, we are not recommending channel improvements or maintenance dredging of Channel "CE". It shall be the responsibility of the LDWF to maintain access by periodically dredging the head of Channel "CE" that will provide adequate depths for marine traffic.

Channel "CC" is approximately 2,400 linear ft in length and is a small tertiary channel at the end of Breaux's Pass along the south bank (Appendix B – Photos 15 & 16). This channel extends in a southwesterly direction from Breaux's Pass to Catfish Pass. In 2003, depth measurements indicated approximately 5 ft of water at the head of the channel near Breaux's Pass and 6 ft to 7 ft deep downstream near Catfish Pass. In 2005, a field inspection revealed a large build-up of sediment overgrown with vegetation in the center of the channel (Babin, 2005 Biennual Inspection Report). The 2008 survey data confirms previous observations of shoaling in the center of the channel. It appears that the sediment deposition is concentrated in the center of the channel and along the left descending bank causing the channel to migrate to the west of the original dredge sections. Elevations ranged between 0.0 ft and -2.0 ft NAVD 88 in the center and along the east bank where shoaling has developed, and -6.0 ft NAVD 88 along the newly created channel section east of center (Babin, 2008 Biennual Inspection Report). The 2010 inspection revealed additional shoaling at the head of the channel with very shallow depths across the entire section. Subsequent to the 2010 inspection, the LDWF had dredged the head of Channel "CC to open the channel to access as well as flow into Catfish Pass. The LDWF dredged approximately 500 linear feet beginning from the head of the channel near Breaux's Pass southwestward for access. Of all the tertiary channels along Breaux's Pass, Channel "CC" has shown the most potential of nourishing existing marshes and providing sediment rich water southwest of Big Island. It is the intent of the inspection team to maintain the necessary flow from Channel "CA" through Channel "CC" by periodically dredging the shoals at the head of the channel.

Channel "CF" is approximately 2,400 linear ft and extends in a northwesterly direction towards Shell Island Pass (Appendix B – Photos 7 & 8). In 2003, Channel "CF" had approximately 4 ft of controlling depth at the head of the channel near Breaux's Pass for several hundred feet. Further downstream, closer to Shell Island Pass, a consistent depth of 6 ft was found (Juneau, 2003 Inspection Report). In 2005, a visual inspection revealed no serious siltation or shoaling in Channel "CF" with estimated depths of 7 ft in the center of the channel (Babin, 2005 Inspection Report). However, the 2008 survey data indicated that more shoaling had occurred than previously thought. Large portions of the original section has shoaled in, leaving a much smaller channel along the south bank which was approximately 50 ft wide with elevations ranging from -7.0 ft to -10.0 ft NAVD 88. As in the case of Channels "CD" and "CB", we believe that Channel "CF" is not hydraulically efficient and supports a lower discharge causing sediments to aggrade in the channel rather than creating downstream deltaic features. However, unlike Channels "CD" and "CB", Channel "CF" had not completely shoaled at the head of the channel and maintained remnants of a smaller channel that directs flow from Breaux's Pass towards the Atchafalaya Bay. Without updated survey data, we are unable to definitively determine if the smaller channel remained open or if further siltation has occurred.

III. Operation Activity

No operation activities are required for the AT-03 project.

IV. Monitoring Activity

a. Monitoring Goals

The specific measurable goals established to evaluate the effectiveness of the project are:

1. To increase the project areas delta-building potential through the establishment of effective distributary channels.

2. Create approximately 340 ha (850 acres) of delta lobe islands through the beneficial use of dredged material at elevations suitable for emergent marsh vegetation.

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

b. Monitoring Elements

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

Elevation

Topographic surveys were employed to document elevation and volume changes inside the Big Island Mining (AT-03) project disposal areas. Pre-construction (July 1998) and as-built (November 1998) elevation data were collected using cross sectional survey methods (500 ft intervals) with a centerline profile. Five disposal areas (DA) were surveyed during the pre-construction and as-built periods (DA1, DA5, DA6, DA8, and DA9). Subsequent post-construction topographic surveys were conducted without a centerline profile and DA6, DA8, and DA9 were not surveyed. In addition, the DA1 post-construction surveys were condensed from 13 to 6 transects. These post-construction surveys were performed in April 2001 and May 2008. The surveys were reduced in scope due to budgetary constraints. All survey data were established using or adjusted to tie in with the Louisiana Coastal Zone (LCZ) GPS Network. The April 2001 topographic data were not applied to the following analysis because these surveys were not consistent with elevation data collected for the other time intervals. November 1998 and May 2008 data present a more accurate illustration of disposal area topography.

The July 1998, November 1998, and May 2008 survey data were re-projected horizontally and vertically to the UTM NAD83 coordinate system and the NAVD 88 vertical datum in meters using Corpscon® software. The re-projected data were imported into ArcView® GIS software for surface interpolation. Triangulated irregular network models (TIN) were produced from the point data sets. Next, the TIN models were converted to grid models (2.0 m^2 cell size), and the spatial distribution of elevations were mapped. The grid models were clipped to the AT-03 disposal area polygons to estimate elevation and volume changes within the fill area.

Elevation changes from July 1998-November 1998 and November 1998-May 2008 were calculated by subtracting the corresponding grid models using the LIDAR Data Handler extension of ArcView® GIS. After the elevation change grid models were generated, the spatial distribution of elevation changes in the AT-03 disposal areas were mapped in half meter elevation classes. Lastly, volume changes in the disposal areas were calculated in cubic meters (m^3) using the Cut/Fill Calculator function of the LIDAR Data Handler extension of ArcView® GIS. Note, these elevation and volume calculations are valid only for the extent of the survey area.

Bathymetry

Bathymetric surveys were employed to document sedimentation patterns in the Big Island Mining (AT-03) dredged secondary and tertiary channels. Pre-construction (July 1998) and as-built (November 1998) elevation data were collected using cross sections spaced 100 ft apart and centerline profiles. One secondary (CA) and five tertiary (CB, CC, CD, CE, and CF) channels were surveyed during the pre-construction and as-built periods. Subsequent post-construction bathymetric surveys were conducted using 500 ft intervals and centerline profiles. These post-construction surveys were performed in April 2001 and May 2008. The surveys were reduced in scope due to budgetary constraints. All survey data were established using or adjusted to tie in with the Louisiana Coastal Zone (LCZ) GPS Network. The April 2001 bathymetric data were not applied to the following analysis because the areal extents of these surveys were limited. November 1998 and May 2008 data present a more accurate illustration of the dredged channel contours.

The July 1998, November 1998, and May 2008 survey data were re-projected horizontally and vertically to the UTM NAD83 coordinate system and the NAVD 88 vertical datum in meters using Corpscon® software. The re-projected data were imported into ArcView® GIS software for surface interpolation. Triangulated irregular network models (TIN) were produced from the point data sets. Next, the TIN models were converted to grid models (2.0 m^2 cell size), and the spatial distribution of elevations were mapped. The grid models were clipped to the AT-03 dredged channel polygons to estimate elevation and volume changes within each channel.
Elevation changes from July 1998-November 1998 and November 1998-May 2008 were calculated by subtracting the corresponding grid models using the LIDAR Data Handler extension of ArcView® GIS. After the elevation change grid models were generated, the spatial distribution of elevation changes in the AT-03 dredged channels were mapped in half meter elevation classes. Lastly, volume changes in the dredged channels were calculated in cubic meters (m^3) using the Cut/Fill Calculator function of the LIDAR Data Handler extension of ArcView® GIS. Note, these elevation and volume calculations are valid only for the extent of the survey area.

Vegetation

Vegetation stations were established in the Big Island Mining (AT-03) project area to document species composition and percent cover over time. Plots were placed on DA1 and DA5 (figure 5). Vegetation data were collected in October 1999 (1 year post-construction), October 2002 (4 years post-construction), and October 2007 (9 years post-construction) via the semi-quantitative Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974; Sawyer and Keeler-Wolf 1995; Barbour et al. 1999). Plant species inside each 4m^2 plot were identified, and cover values were ocularly estimated using Braun-Blanquet units (Mueller-Dombois and Ellenberg 1974) as described in Steyer et al. (1995). The cover classes used were: solitary, <1%, 1-5%, 6-25%, 26-50%, 51-75%, and 76-100%. After sampling the plot, the residuals within a 5 m (16 ft) radius were inventoried. Thirty-six (36) stations were sampled in 1999, 35 stations were sampled in 2002, and 36 stations were sampled in 2007.

No reference area was established to compare vegetation communities on the naturally occurring delta islands and the AT-03 disposal areas. However, historical data from Log and Hawk Islands (1979-1998) were obtained from Louisiana State University/Coastal Ecology Institute (LSU/CEI) (figure 5). This vegetation data were used to establish community colonization and succession trends on a prograding delta island. The LSU/CEI data were also collected with the Braun-Blanquet method

(Mueller-Dombois and Ellenberg 1974) and had a 1m^2 plot size. LSU/CEI sampled 48 vegetation stations in 1979, 58 stations in 1980, 58 stations in 1982, and 66 stations in 1998.

Relative cover and importance value (IV) were calculated to summarize vegetation data. Both these parameters were grouped by disposal area and year in the project area while the reference area was grouped by year. Relative cover represents the cover of each species as a percentage of total cover (Barbour et al. 1999). An IV is calculated using a minimum of two relative measures. The following IV formula was applied to this analysis: IV = (relative cover + relative frequency)/2. IV represents each species relative contribution to the vegetative community (Barbour et al. 1999). Since relative cover and IV are relative measures, each species earns a value ranging from 0 to 100.

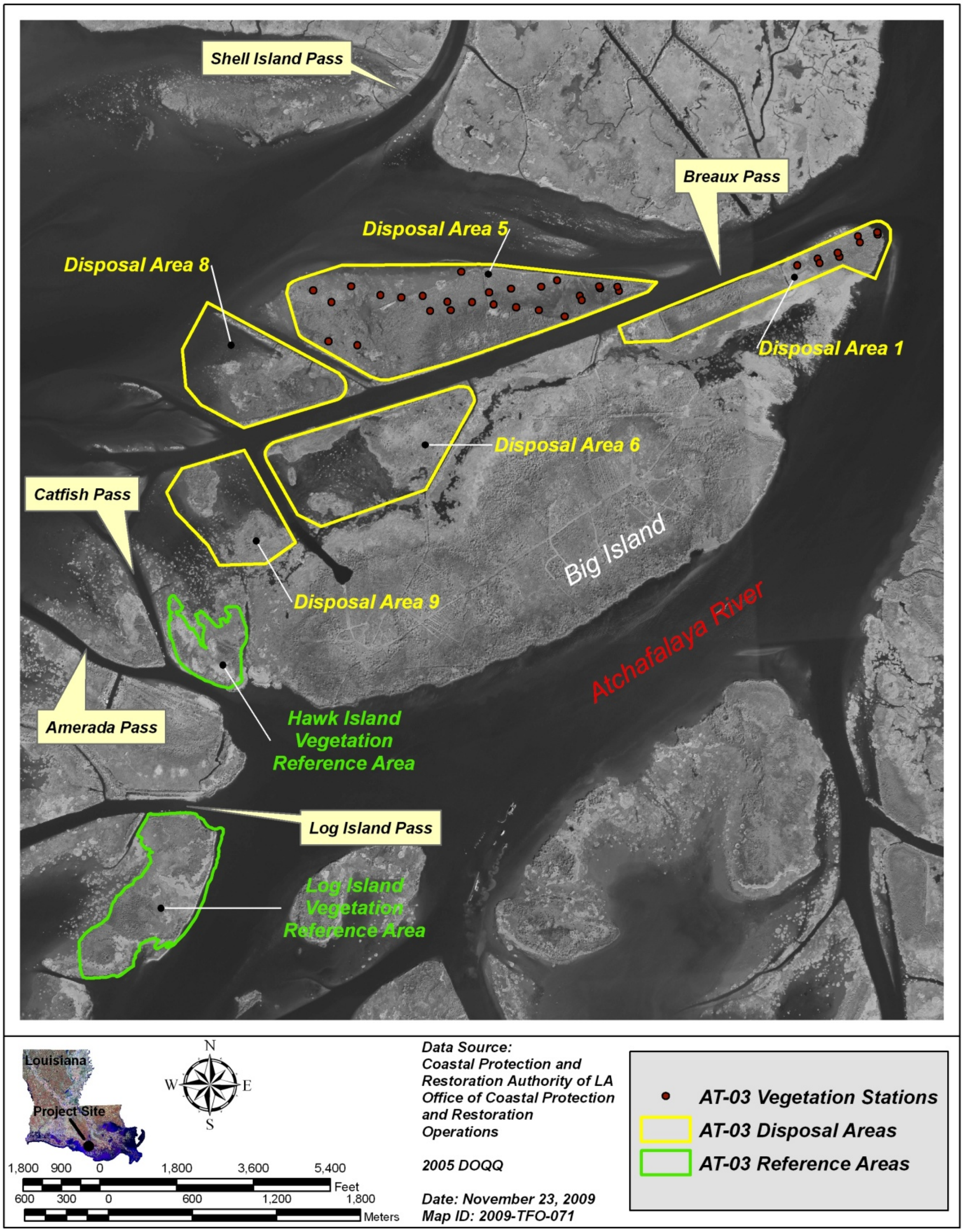


Figure 5. Location of the Big Island Mining (AT-03) vegetation stations and LSU/CEI's Log and Hawk Islands vegetation reference areas.

Habitat Mapping

The U.S. Geological Survey's National Wetlands Research Center (USGS/NWRC) obtained 1:12,000 and 1:40,000 scale color infrared (CIR) aerial photography to delineate habitats over time. These aerial images were classified and photo-interpreted to perform habitat analysis of the Big Island Mining (AT-03) project [1,119 ha (2,765 acres)] and reference [427 ha (1,054 acres)] areas. Pre-construction aerial photographs were acquired on December 19, 1994 and November 24, 1997 at a 1:12,000 scale while post-construction photographs were acquired on November 3, 1998 (1:40,000 scale), November 15, 2000 (1:12,000 scale), and October 29, 2007 (1:12,000 scale) (figure 6). The 1998 image was obtained from LDWF at the larger scale, and habitats were not classified in the reference area in 1994. Aerial photographs were scanned at 300 pixels per inch and georectified using ground control data collected with a global positioning system (GPS) and digital ortho quarter quads. These individually georectified frames were assembled to produce a mosaic of the project and reference areas.

Using the National Wetlands Inventory (NWI) classification system, the 1994, 1997, 1998, 2000 and 2007 photography were photointerpreted by USGS/NWRC personnel and classified to the subclass level (Cowardin et al. 1979). The habitat delineations were transferred to 1:6,000 scale mylar base maps and digitized. After being checked for quality and accuracy, the resulting digital data were analyzed using geographic information systems (GIS) to determine habitat change over time in the project and reference areas. The habitat types were aggregated into nine habitat classes for the purpose of mapping change. Habitat changes inside the project area were calculated for the following intervals 1994-1997, 1994-1998, 1998-2000, and 1998-2007 while the reference area habitat changes were evaluated from 1997-1998, 1998-2000, and 1998-2007.

Habitat classes were combined further to assess land to water changes in the project and reference areas. Habitats were condensed to a land or water classification in the project (1994, 1997, 1998, 2000, and 2007) and reference (1997, 1998, 2000, and 2007) areas using the Steyer et al. (1995) protocol. Land was considered to be a combination of agriculture range, fresh marsh, upland barren, upland scrub-shrub, wetland forested, and wetland scrub-shrub. The beach/bar/flat, open water-fresh and submerged aquatics habitat classes were considered water. Once grouped into these two classes, the percentage of land and water for each time period was calculated, the land to water ratio for each time period was calculated, and the annual rate of land expansion in the project and reference areas from 1997 to 2007 was calculated. The pre-construction annual rate was calculated from 1994 to 1997.

Subaerial and subaqueous growth in the project area was qualitatively delineated by comparing the 1998 and 2007 NWI habitat assessments. Areas showing growth were classified as either subaerial growth, subaqueous to subaerial growth, or subaqueous growth. Subaerial growth occurred when the open water-fresh habitat was converted

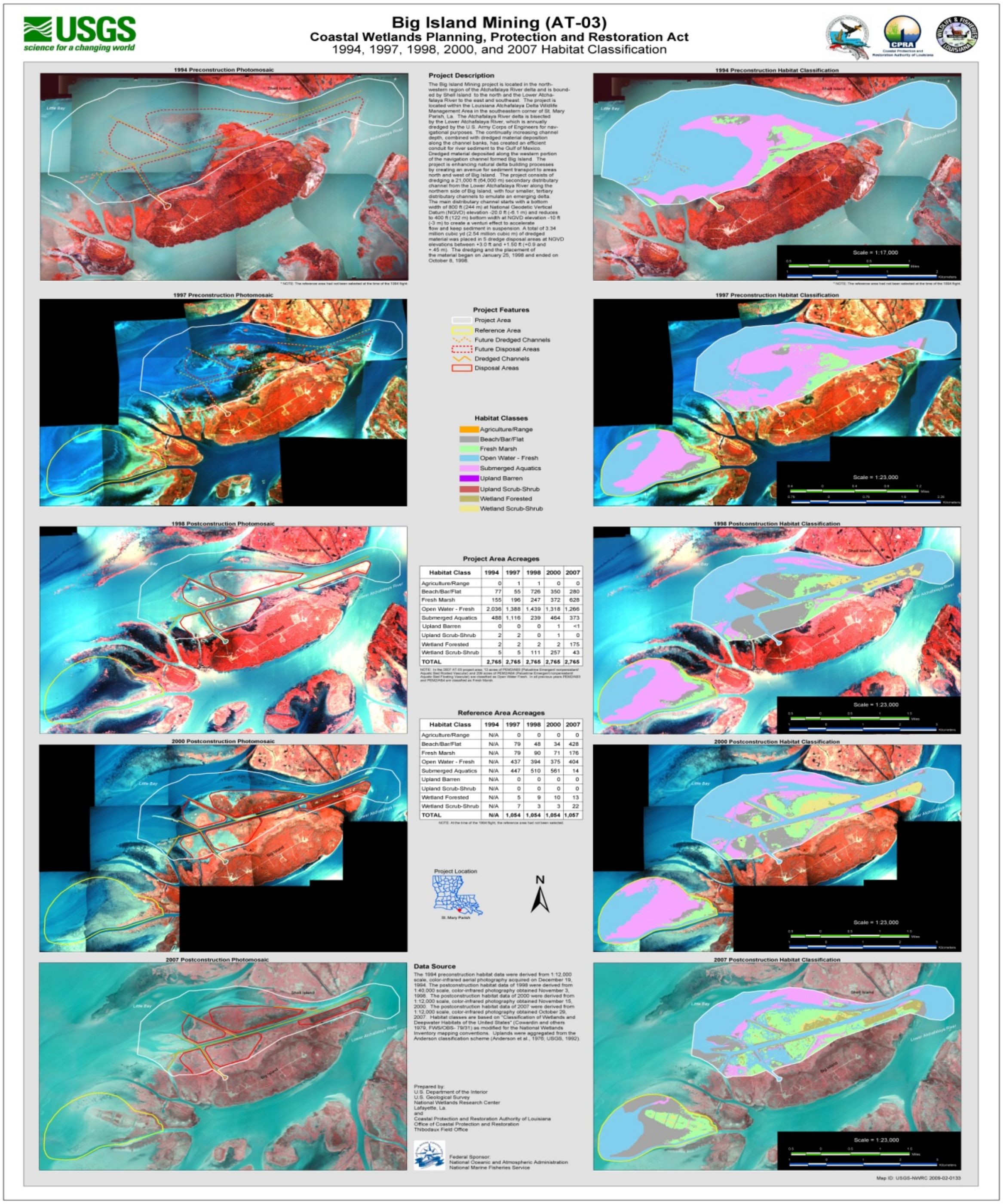


Figure 6. **Pre-construction (1994 and 1997), as-built (1998), and post-construction (2000 and 2007) photomosaics and habitat analysis of the Big Island Mining (AT-03) project and reference areas.**

to subaerial land (agriculture range, fresh marsh, upland barren, upland scrub-shrub, wetland forested, or wetland scrub-shrub habitats). Subaqueous to subaerial growth arose when beach/bar/flat or submerged aquatics habitats were transformed to subaerial land. Subaqueous growth transpired when the open water-fresh habitat was changed to beach/bar/flat or submerged aquatics habitats. Once classified, these areas were outlined using ESRI shapefiles (polygon) to illustrate spatial growth in the project area from 1998 to 2007.

c. Preliminary Monitoring Results and Discussion

Elevation

The Big Island Mining (AT-03) project disposal areas experienced differential volume reductions since construction was completed in 1998. Elevation change and volume distributions for the AT-03 disposal areas are shown in figure 7 (July 1998-November 1998) and figure 8 (November 1998-May2008). Elevation grid models for the July 1998 (figure 9), November 1998 (figure 10), and May 2008 (figure 11) surveys are also provided. Approximately, 744,201 m^3 (973,378 yd^3) of sediment were deposited during construction in DA1 and DA5 (figures 7 and 10). In the post-construction period, sediment volume decreased by 57% in DA1 and 8% in DA5 (figures 8 and 11). The total sediment volume loss in the disposal areas from 1998 to 2008 was approximately 136,885 m^3 (179,039 yd^3), an 18% reduction in volume. The volume loss in DA1 correlates favorably with Atchafalaya Sediment Delivery (AT-02) disposal area 1 (DA1) and disposal area 4 (DA4), which were condensed by 51% and 58% from 1998 to 2008 (Curole and Babin 2009). While DA1 consolidated to less than half its fill volume, DA5 retained over 90% of its fill volume. Figure 8 shows areas where volume increased or decreased from 1998 to 2008. Comparing this figure to the earlier elevation change grid model (figure 7) reveals that the parts of DA5 that gained volume in 2008 were filled to the lowest elevation in 1998. The as-built (figure 10) and post-construction (figure 11) elevation grid models and habitat maps reaffirm this point. Habitats in the northwestern part of DA5 were converted from open water–fresh, submerged aquatics, and beach/bar/flat habitats in 2000 to fresh marsh in 2007 (figure 6). Although no accretion plots were established in DA5, topographic data suggest that sediments were deposited in the post-construction period. Therefore, it is plausible to infer that the areas of low relief in DA5 probably accreted mitigating volume losses in this disposal area. The movement of sediments into the northwestern part of DA5 was aided by the erosion of the containment dike. Approximately, 914 m (3,000 ft) of this earthen structure eroded and/or subsided either during or immediately after construction in 1998. By 2000, 1,433 m (4,700 ft) of the dike had degraded. The close proximity of Shell Island Pass and the Atchafalaya River and the low relief probably induced sedimentation in this section of DA5.

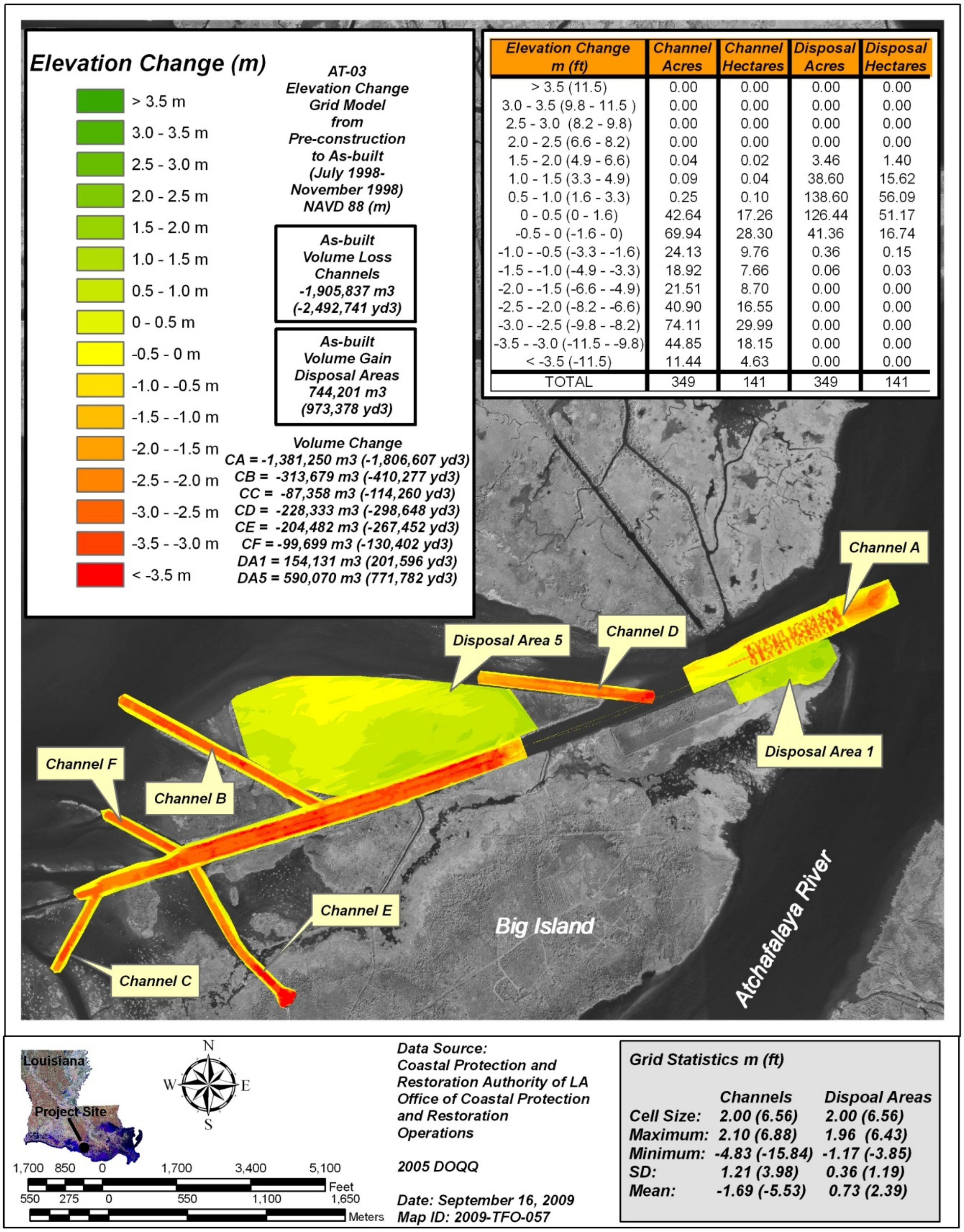


Figure 7. **Elevation and volume change grid model from pre-construction (1998) to post-construction (1998) at the Big Island Mining (AT-03) project.**

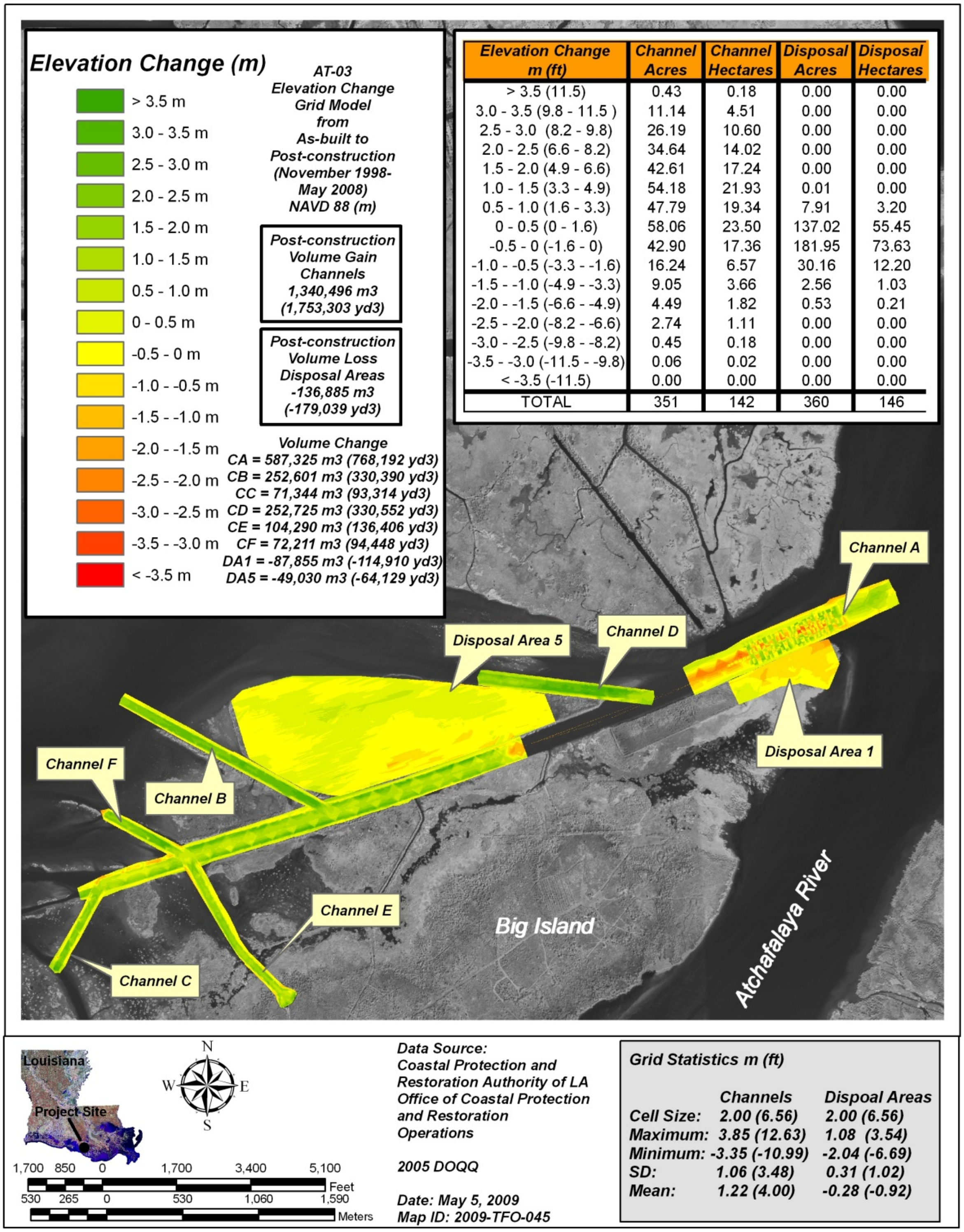


Figure 8. **Elevation and volume change grid model from as-built (1998) to post-construction (2008) at the Big Island Mining (AT-03) project.**

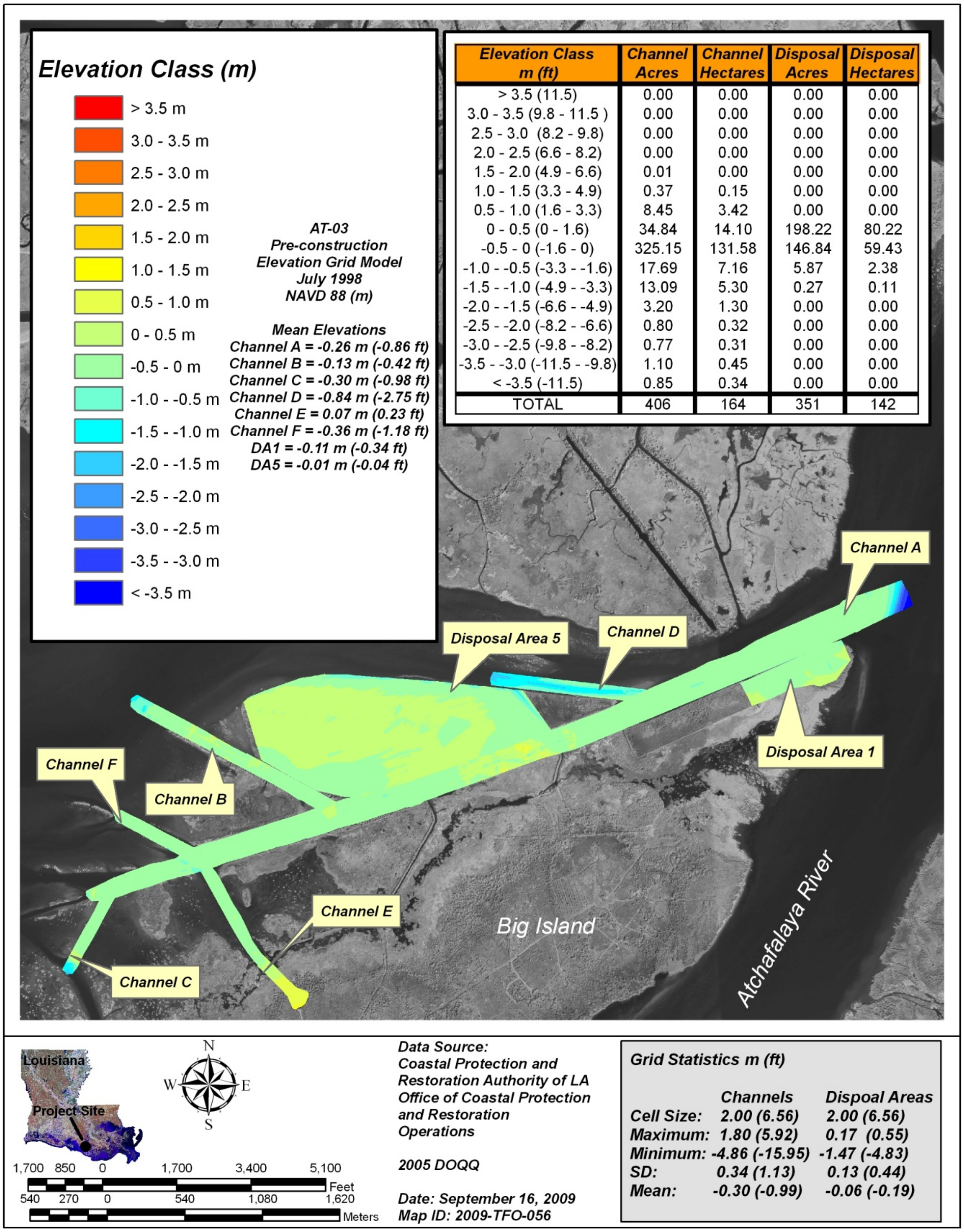
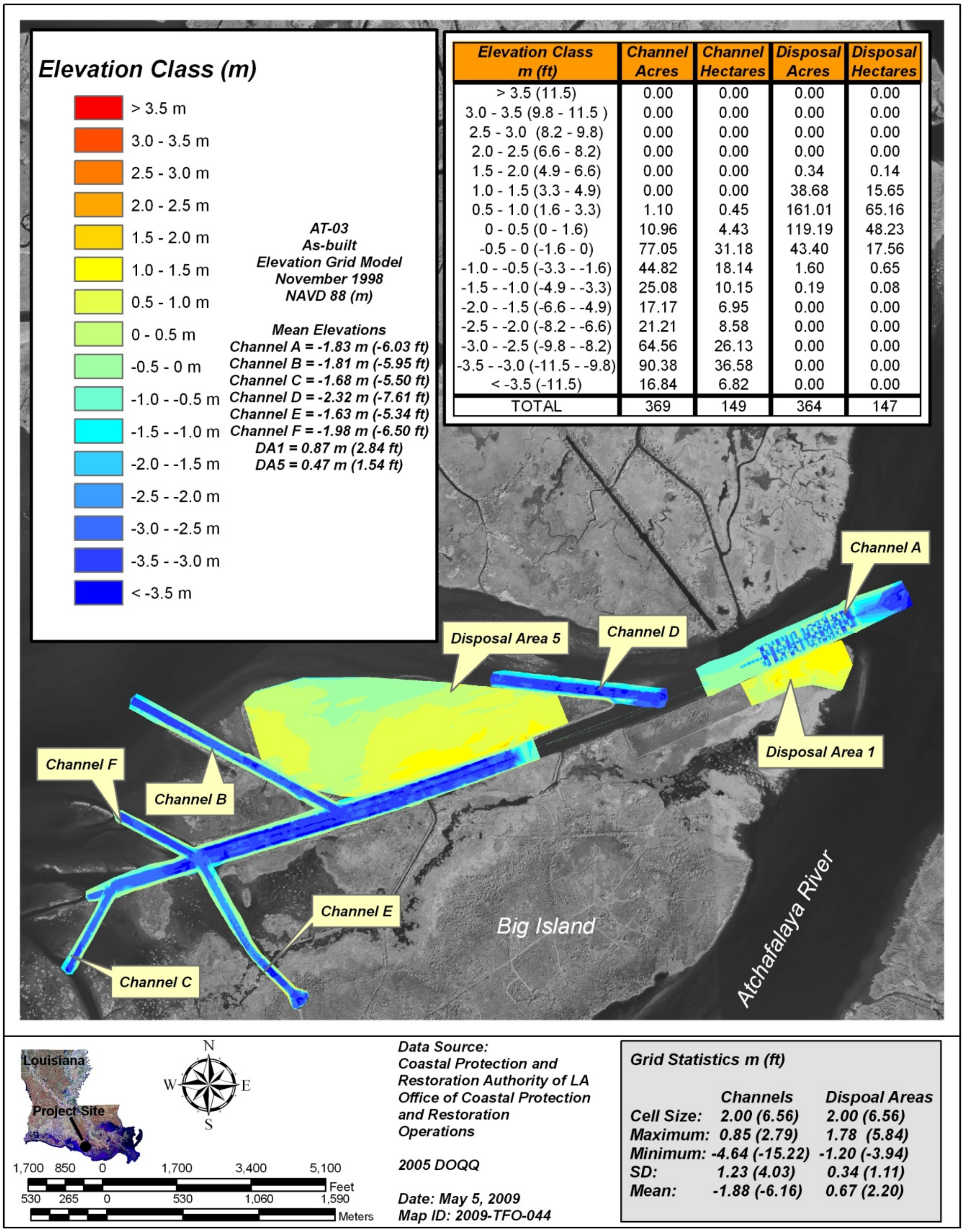
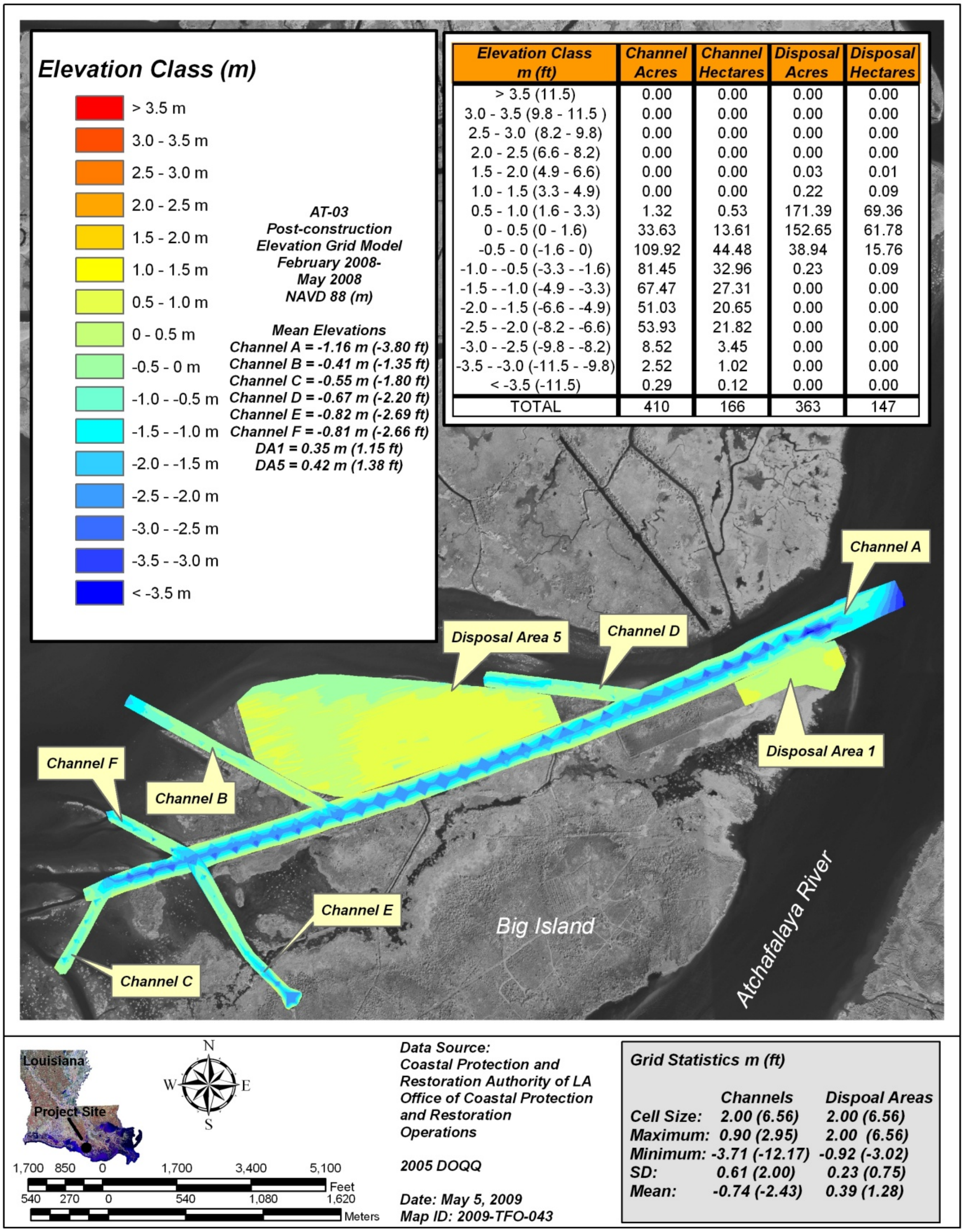


Figure 9. **Pre-construction (1998) elevation grid model at the Big Island Mining (AT-03) project.**



Elevation Class m (ft)	Channel Acres	Channel Hectares	Disposal Acres	Disposal Hectares
> 3.5 (11.5)	0.00	0.00	0.00	0.00
3.0 - 3.5 (9.8 - 11.5)	0.00	0.00	0.00	0.00
2.5 - 3.0 (8.2 - 9.8)	0.00	0.00	0.00	0.00
2.0 - 2.5 (6.6 - 8.2)	0.00	0.00	0.00	0.00
1.5 - 2.0 (4.9 - 6.6)	0.00	0.00	0.34	0.14
1.0 - 1.5 (3.3 - 4.9)	0.00	0.00	38.68	15.65
0.5 - 1.0 (1.6 - 3.3)	1.10	0.45	161.01	65.16
0 - 0.5 (0 - 1.6)	10.96	4.43	119.19	48.23
-0.5 - 0 (-1.6 - 0)	77.05	31.18	43.40	17.56
-1.0 - -0.5 (-3.3 - -1.6)	44.82	18.14	1.60	0.65
-1.5 - -1.0 (-4.9 - -3.3)	25.08	10.15	0.19	0.08
-2.0 - -1.5 (-6.6 - -4.9)	17.17	6.95	0.00	0.00
-2.5 - -2.0 (-8.2 - -6.6)	21.21	8.58	0.00	0.00
-3.0 - -2.5 (-9.8 - -8.2)	64.56	26.13	0.00	0.00
-3.5 - -3.0 (-11.5 - -9.8)	90.38	36.58	0.00	0.00
< -3.5 (-11.5)	16.84	6.82	0.00	0.00
TOTAL	369	149	364	147

Figure 10. **As-built (1998) elevation grid model at the Big Island Mining (AT-03) project.**



Elevation Class m (ft)	Channel Acres	Channel Hectares	Disposal Acres	Disposal Hectares
> 3.5 (11.5)	0.00	0.00	0.00	0.00
3.0 - 3.5 (9.8 - 11.5)	0.00	0.00	0.00	0.00
2.5 - 3.0 (8.2 - 9.8)	0.00	0.00	0.00	0.00
2.0 - 2.5 (6.6 - 8.2)	0.00	0.00	0.00	0.00
1.5 - 2.0 (4.9 - 6.6)	0.00	0.00	0.03	0.01
1.0 - 1.5 (3.3 - 4.9)	0.00	0.00	0.22	0.09
0.5 - 1.0 (1.6 - 3.3)	1.32	0.53	171.39	69.36
0 - 0.5 (0 - 1.6)	33.63	13.61	152.65	61.78
-0.5 - 0 (-1.6 - 0)	109.92	44.48	38.94	15.76
-1.0 - -0.5 (-3.3 - -1.6)	81.45	32.96	0.23	0.09
-1.5 - -1.0 (-4.9 - -3.3)	67.47	27.31	0.00	0.00
-2.0 - -1.5 (-6.6 - -4.9)	51.03	20.65	0.00	0.00
-2.5 - -2.0 (-8.2 - -6.6)	53.93	21.82	0.00	0.00
-3.0 - -2.5 (-9.8 - -8.2)	8.52	3.45	0.00	0.00
-3.5 - -3.0 (-11.5 - -9.8)	2.52	1.02	0.00	0.00
< -3.5 (-11.5)	0.29	0.12	0.00	0.00
TOTAL	410	166	363	147

Figure 11. **Post-construction (2008) elevation grid model at the Big Island Mining (AT-03) project.**

Bathymetry

Massive quantities of sediment have aggraded the Big Island Mining (AT-03) dredged channels since construction was completed in 1998. This sedimentation has raised channel contours and volumes. Elevation change and volume distributions for the AT-03 channels are shown in figure 7 (July 1998-November 1998) and figure 8 (November 1998-May 2008). Elevation grid models for the July 1998 (figure 9), November 1998 (figure 10), and May 2008 (figure 11) surveys are also provided. Approximately, 1,905,837 m^3 (2,492,741 yd^3) of sediment were removed from the secondary and tertiary channels during construction in 1998 (figures 7 and 10). In the post-construction period, sediment volume increased by 43% in CA, 81% in CB, 82% in CC, 111% in CD, 51% in CE, and 72% in CF from 1998 to 2008 (figures 8 and 11). The total sediment volume gain in the dredged channels from 1998 to 2008 was approximately 1,340,496 m^3 (1,753,303 yd^3), a 70% expansion in volume. It appears that the secondary channel (CA) experienced less shoaling than the tertiary channels (CB, CC, CD, CE, and CF). Although CA added 587,325 m^3 (768,192 yd^3) of sediment to its bedload, the 2008 average channel contour, -1.16 m (-3.80 ft) NAVD 88, was considerably deeper than the tertiary channels, -0.65 m (-2.14 ft) NAVD 88 (figures 8 and 11). Furthermore, CA aggraded by 0.68 m (2.23 ft) while the tertiary channels aggraded by 1.23 m (4.04 ft) during the ten year period after construction (figures 8 and 11). Among the tertiary channels, CB [1.40 m (4.60 ft)] and CD [1.65 m (5.41 ft)] exhibited the densest deposits of sediment while CE [0.81 m (2.65 ft)] exhibited the thinnest deposits. Shoaling of CB led to the formation of a subaerial bar at the intersection of CB and CA restricting flow into the tertiary channel. CB seems to be experiencing the fluvial process of channel abandonment and partial lobe fusion (Roberts and van Heerden 1992; Roberts 1998; van Heerden and Roberts 1980; van Heerden and Roberts 1988; van Heerden et al. 1991). CD was the deepest channel dredged (figure 7), and its position on the upstream end of DA5 probably aided in sediment deposition. Surprisingly, CD was the deepest channel pre-construction (figure 9). CE is a cul-de-sac channel that bisects a large pond and does not have defined banks along most of its watercourse. As a result, these attributes probably contributed to lower sedimentation in the southern end of this channel (figure 11). The extensive shoaling occurring in the secondary and tertiary channels signifies that the dredged channels are not hydraulically efficient. Moreover, the discharge flowing (flow energy) through these distributaries could not maintain the channel morphology (DuMars 2002; Letter et al. 2008) and cross sectional area (Roberts and van Heerden 1992; Mashriqui 2003). In addition, constructing tertiary channels at acute angles does not fit the river mouth bar model of delta growth (Edmonds and Slingerland 2007; Edmonds and Slingerland 2008; Roberts and van Heerden 1992; Roberts 1998; van Heerden and Roberts 1980; van Heerden and Roberts 1988; van Heerden et al. 1991; DuMars 2002; Letter et al. 2008; Mashriqui 2003), which is the dominant mechanism forcing delta expansion (Edmonds and Slingerland 2007). The construction and annual maintenance of the Lower Atchafalaya River Bay and Bar navigation channel (DuMars 2002; Mashriqui 2003; Roberts 1998), the construction of the AT-03 project on a concave bendway (Letter et al. 2008), and the low contours surrounding the dredged channels during the pre and post construction periods probably influenced a reduced discharge into the AT-03 channels. In closing, the secondary and tertiary channels experienced considerable aggradation since construction diminishing the delta-building potential of this created sub-delta. Therefore, the goal to establish an effective network of distributary channels has not been attained to date.

Vegetation

The Big Island Mining (AT-03) vegetation data show that different vegetation communities inhabit the disposal areas and the historical reference areas. Moreover, the disparities in these communities appear to be related to elevation differences. The results of the relative cover and importance value (IV) analysis are graphically illustrated in figure 12 and figure 13 for disposal area habitats. The LSU/CEI vegetation data are delineated in figures 14 (relative cover) and 15 (IV). Note the differences between relative cover and IV is correlated with the frequency that a species populates vegetation plots. For example if a species is found in only a few plots with a high cover value, the species is likely to have a high relative cover value but probably will not have a high IV. The dominant species found in DA1 was *Salix nigra Marsh.* (black willow) while this species remains dominant over time the understory species have changed from 1999 to 2007. The changes in the DA1 community are probably a result of elevation differences incurred between 1999 and 2007 (figure 8). The dominant species found in DA5 in 1999 was *Sagittaria latifloia Willd.* (broadleaf arrowhead). By 2007, *Zizaniopsis miliacea (Michx.) Doell & Aschers.* (giant cutgrass) and *Alternanthera philoxeroides (Mart.) Griseb.* (alligatorweed) became the dominant species. Subsidence and accretion in DA5 (figure 8) probably was a factor influencing change in this disposal area. Figure 12 and figure 13 show the differences in DA1 and DA5 vegetation communities from 1999 to 2007. Although there are many differences, there are also some similar trends in the DA1 and DA5 vegetation communities. Both disposal areas experienced increases in species diversity and mean cover since 1999. In addition, both disposal have undergone primary succession and continue to change over time. The LSU/CEI historical reference areas have different vegetation community structures than the AT-03 disposal areas. One of the fundamental differences between the project and historical data sets is the naturally created deltaic lobe islands were established at low relief (Sasser and Fuller 1988; Shaffer et al. 1992; Johnson et al. 1985; Penland et al. 1996; Penland et al. 1997). However, the 1998 Hawk and Log Island data the 2007 DA5 data demonstrate similarities between these vegetation communities (figures 12, 13, 14, and 15). Future vegetation samplings events will determine if these communities converge. In conclusion, vegetation data show that different vegetation communities inhabit the disposal areas and the historical reference areas.

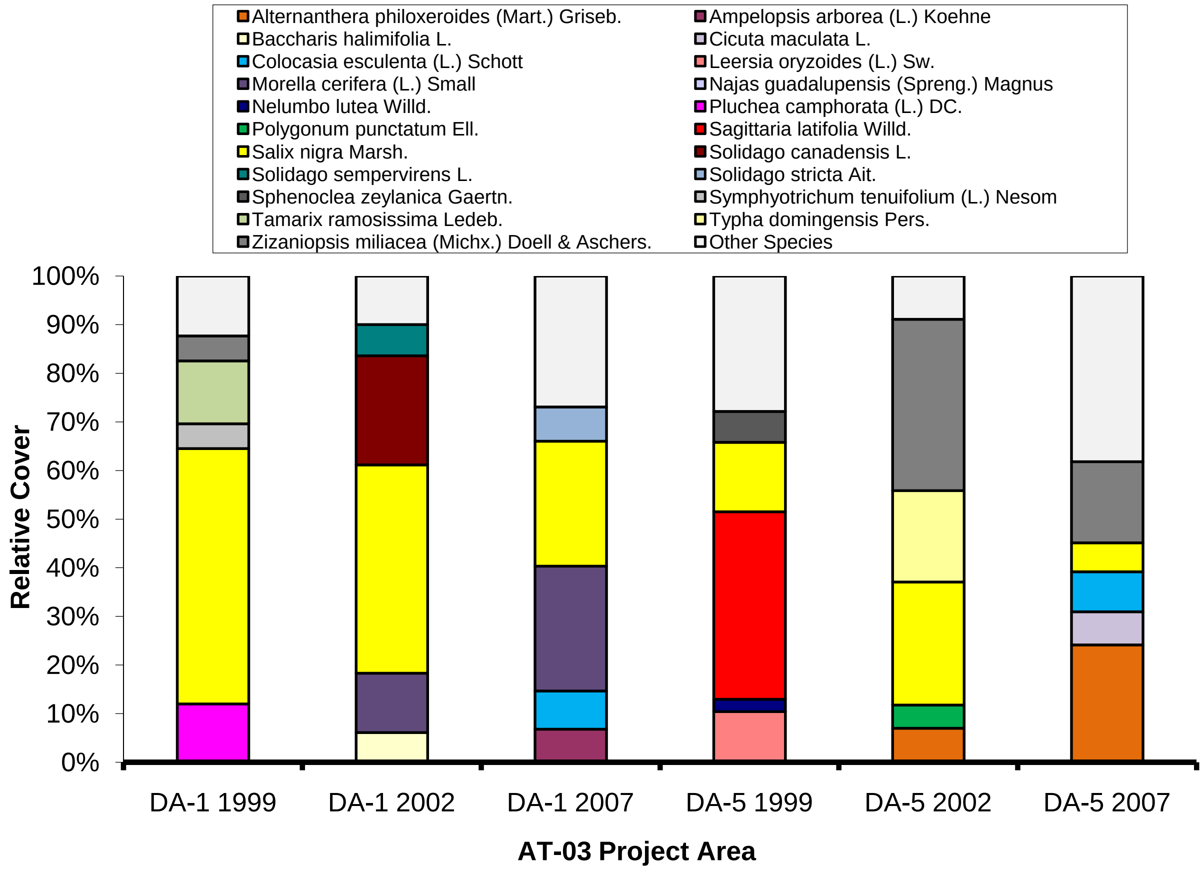


Figure 12. **Relative cover of the top five vegetation species populating the Big Island Mining (AT-03) disposal areas from 1999 to 2007. Ocular vegetation data were grouped by disposal area and year.**

Habitat Mapping

The Big Island Mining (AT-03) project area experienced habitat colonization, succession, and disturbance since construction was completed in 1998. The initial post-construction (as-built) habitat change analysis of the project area (1994-1998) show increases in beach/bar/flat (843%), wetland scrub-shrub (2,120%) and fresh marsh (59%) habitats and decreases in submerged aquatics (-51%) and open water-fresh (-29%) habitats (table 1 and figure 6). Combined mosaics and habitat maps for all sampling intervals (1994, 1997, 1998, 2000, and 2007) are chronologically arranged in figure 6. Individual mosaics and habitat maps for each interval are located in appendix A for clarity and will not be referred to again in this text. By 1998, the project area consisted of 52% open water-fresh, 26% beach/bar/flat, 9% fresh marsh, 9% submerged aquatics, 4% wetland scrub-shrub, and 0.1% wetland forested habitats (figure 6). The large expanse of beach/bar/flat habitat in 1998 is probably due to the short duration between project completion (October 1998) and the as-built aerial photography (November 1998). Moreover, the considerable enlargement of the wetland scrub-shrub habitat signify higher elevated wetlands while the declines in

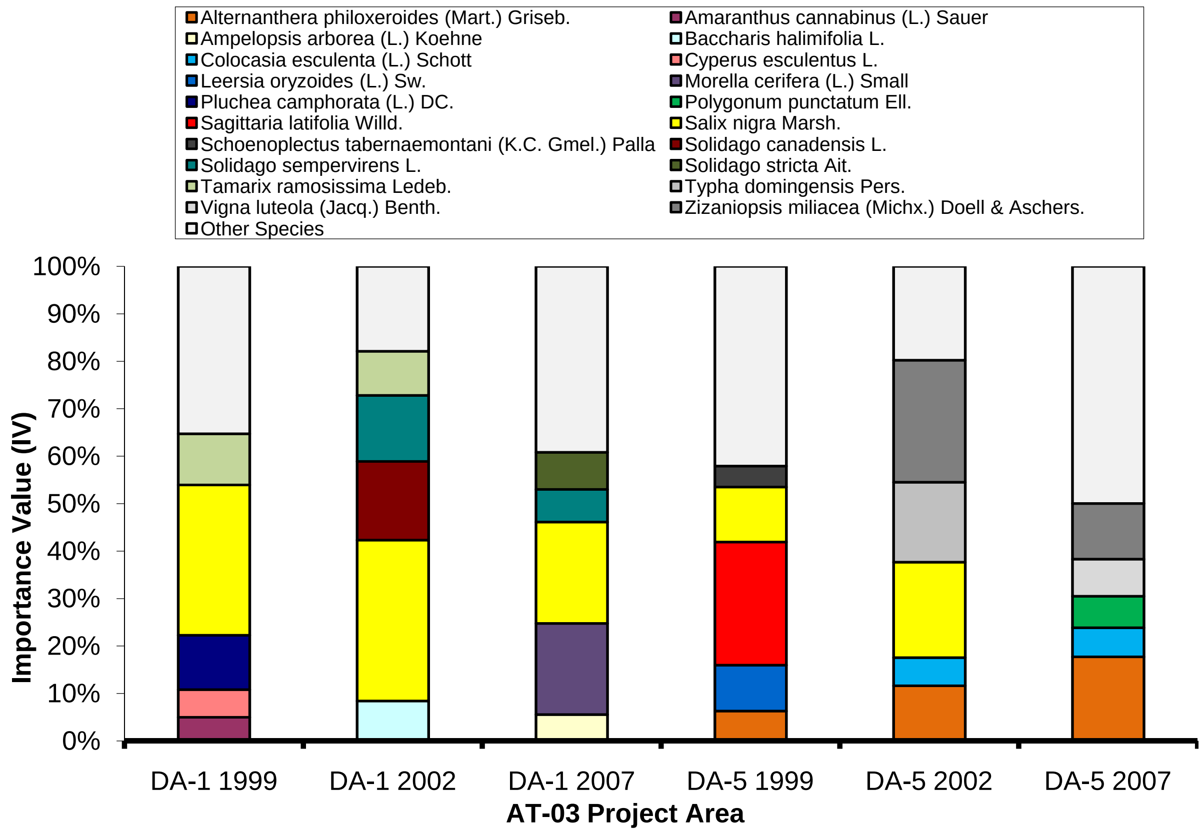


Figure 13. **Importance value (IV) of the top five vegetation species populating the Big Island Mining (AT-03) disposal areas from 1999 to 2007. Ocular vegetation data were grouped by disposal area and year.**

submerged aquatics habitat are probably related to the creation of the disposal areas and channel dredging in areas once inhabited by submerged aquatics. Subsequent (1998-2000 and 1998-2007) post-construction habitat change analysis reveals fresh marsh gains in 2000 (51%) and 2007 (154%), wetland forested gains in 2007 (8,650%), submerged aquatics gains in 2000 (94%) and 2007 (56%), wetland scrub-shrub gains in 2000 (132%) and losses in 2007 (-61%), beach/bar/flat losses in 2000 (-52%) and 2007 (-61%), and open water-fresh losses in 2000 (-8%) and 2007 (-12%) (table 1 and figure 6). By 2007, the project area consisted of 48% open water-fresh, 23% fresh marsh, 17% submerged aquatics, 10% beach/bar/flat, 6% wetland forested, and 2% wetland scrub-shrub habitats (figure 6). Since construction, considerable acreage of beach/bar/flat and submerged aquatic habitats were converted to either fresh marsh or open water-fresh habitats, and a large part of the wetland scrub-shrub habitat underwent succession to form wetland forested and fresh marsh habitats. Over time fresh marsh species continued to expand their range through colonization of beach/bar/flat habitat and areas displaying elevation change (figures 6, 8, and 11). In fact, accretionary processes occurring in the north-western quadrant of DA5 aided in the conversion of open water–fresh, submerged aquatics, and beach/bar/flat habitats in

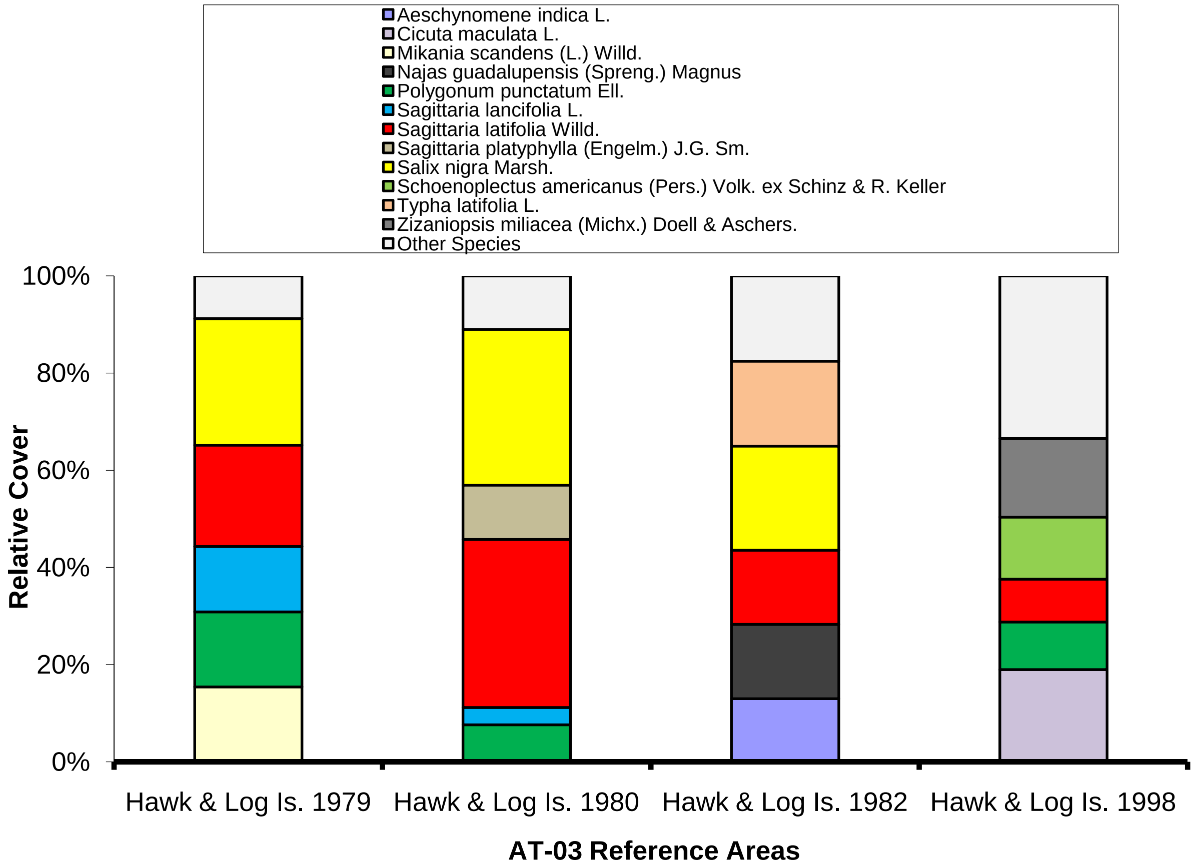


Figure 14. Relative cover of the top five vegetation species populating the Big Island Mining (AT-03) historical reference area from 1979 to 1998. Ocular vegetation data were grouped by year. Vegetation data provided courtesy of Louisiana State University/Coastal Ecology Institute (LSU/CEI).

2000 to fresh marsh in 2007 (figures 6, 8, and 11). The sizeable reduction in wetland scrub-shrub habitat from 2000 to 2007 (-83%) is attributable to forest maturation in DA1 and DA5 (figure 6) and elevation declines in DA5 (figures 8 and 11). Furthermore, a -42% decrease in woody vegetation occurred between 2000 and 2007 primarily due to subsidence in the higher elevated portions of DA5 (figure 11). Alteration of scrub-shrub to marsh habitat has been found to be initiated by sediment consolidation on other marsh creation projects (Boshart 2003). In closing, the project area has been altered since construction through succession and disturbance (sediment additions and subsidence).

The Big Island Mining (AT-03) project area experienced considerable subaqueous growth and modest subaerial growth before construction. Pre-construction habitat change analysis of the project area (1994-1997) show increases in submerged aquatics (129%) and fresh marsh (26%) habitats and decreases in and open water-fresh (-32%) and beach/bar/flat (-29%) habitats while wetland scrub-shrub and wetland forested habitats remain unchanged (table 1 and figure 6). In 1994 and 1997,

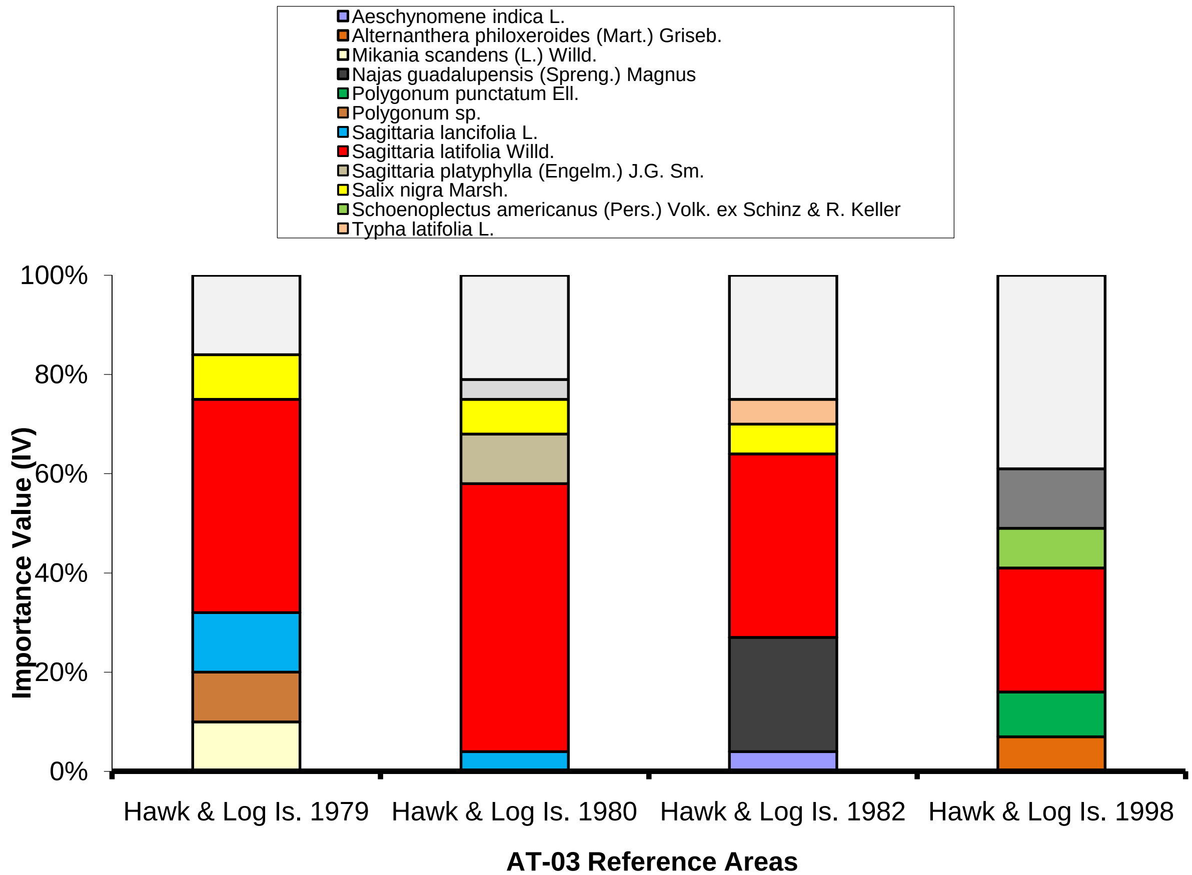


Figure 15. **Importance value (IV) of the top five vegetation species populating the Big Island Mining (AT-03) historical reference area from 1979 to 1998. Ocular vegetation data were grouped by year. Vegetation data provided courtesy of Louisiana State University/Coastal Ecology Institute (LSU/CEI).**

the project area consisted of 74% (1994) and 50% (1997) open water-fresh, 18% (1994) and 40% (1997) submerged aquatics, 6% (1994) and 7% (1997) fresh marsh, 3% (1994) and 2% (1997) beach/bar/flat, 0.2% (1994) and 0.2% (1997) wetland scrub-shrub, and 0.1% (1994) and 0.1% (1997) wetland forested habitats (figure 6). During this 3 year pre-construction interval, extensive conversion of open water-fresh to submerged aquatics habitat transpired and small acreages of naturally created beach/bar/flat and submerged aquatics habitat were colonized by fresh marsh vegetation. The distribution and abundance submerged aquatic habitats can be ephemeral because these environments are very susceptible to changes in light penetration. Increases or decreases in light penetration alternatively regulate the growth or declines in this habitat (Cho and Poirrier 2005; Koch 2001). Although submerged aquatics environments are very dynamic, habitat expansion at a rate of 87 ha/yr (214 acres/yr) is noteworthy (table 1 and figure 6). Fresh marsh habitat enlarged its areal extent by 17 ha (41 acres) or 6 ha/yr (14 acres/yr) in the pre-construction period (table 1 and figure 6). The substantial spring flood of 1997 probably induced

Table 1. **National Wetlands Inventory habitat classes, acreages, and changes photo-interpreted from 1994, 1997, 1998, 2000, and 2007 aerial photography for the Big Island Mining (AT-03) project area.**

Habitat Class Project Area	*1994 Acres*	*1997 Acres*	*1998 Acres*	*2000 Acres*	*2007 Acres*	*94-97 Change*	*94-98 Change*	*98-00 Change*	*98-07 Change*
Agriculture/Range	0	1	1	0	0	1	1	-1	-1
Beach/Bar/Flat	77	55	726	350	280	-22	649	-376	-446
Fresh Marsh	155	196	247	372	628	41	92	125	381
Open Water-Fresh	2,036	1,388	1,439	1,318	1,266	-648	-597	-121	-173
Submerged Aquatics	488	1,116	239	464	373	628	-249	225	134
Upland Barren	0	0	0	1	<1	0	0	1	0
Upland Scrub-Shrub	2	2	0	1	0	0	-2	1	0
Wetland Forested	2	2	2	2	175	0	0	0	173
Wetland Scrub-Shrub	5	5	111	257	43	0	106	146	-68
TOTAL	2,765	2,765	2,765	2,765	2,765	0	0	0	0

these increases in submerged aquatics and fresh marsh habitats (Trotter et al. 1998). While the rate of fresh marsh development was appreciably higher following construction, the pre-construction data illustrates that subaerial growth was occurring in the project area before construction.

The Big Island Mining (AT-03) reference area experienced minor habitat modifications before being impacted by sediment additions. The habitat change analysis of the reference area before dredge disposal (1997-1998 and 1998-2000) exhibited wetland forested gains in 1998 (80%) and 2000 (11%), submerged aquatics gains in 1998 (14%) and 2000 (10%), fresh marsh gains in 1998 (14%) and losses in 2000 (-21%), wetland scrub-shrub losses in 1998 (-57%), beach/bar/flat losses in 1998 (-39%) and 2000 (-29%), and open water-fresh losses in 1998 (-10%) and 2000 (-5%) (table 2 and figure 6). In 1997 and 2000, the reference area consisted of 42% (1997) and 53% (2000) submerged aquatics, 41% (1997) and 36% (2000) open water-fresh, 7% (1997) and 7% (2000) fresh marsh, 7% (1997) and 3% (2000) beach/bar/flat, 0.7% (1997) and 0.3% (2000) wetland scrub-shrub, and 0.5% (1997) and 1% (2000) wetland forested habitats (figure 6). During this 3 year period (1997-2000), small acreages of fresh marsh and beach/bar/flat habitats were displaced by submerged aquatics and wetland forested habitat increased slightly due to forest maturation. Sometime between 2006 and 2007 the USACE placed dredged material inside the AT-03 reference area significantly impacting habitats. Approximately, 53 ha (130 acres) of the Willow Island reference area were geomorphically altered by this disposal event (figure 16). The ensuing (1998-2007) habitat change analysis illustrates gains in beach/bar/flat (792%), wetland scrub-shrub (633%), fresh marsh (96%), wetland forested (44%), and open water-fresh (3%) habitats and decreases in submerged aquatics (-97%) habitat (table 2 and figure 6). By 2007, the reference area consisted of 40% beach/bar/flat, 38% open water-fresh, 17% fresh marsh, 2% wetland scrub-shrub, 1% submerged aquatics, and 1% wetland forested habitats (figure 6). The reference area habitat structure in 2007 is very similar to the project area habitat structure immediately after construction (1998) because both areas display large gains in beach/bar/flat, fresh marsh, and wetland scrub-shrub habitats and substantial declines

Table 2. **National Wetlands Inventory habitat classes, acreages, and changes photo-interpreted from 1994, 1997, 1998, 2000, and 2007 aerial photography for the Big Island Mining (AT-03) reference area.**

Habitat Class Reference Area	*1994 Acres*	*1997 Acres*	*1998 Acres*	*2000 Acres*	*2007 Acres*	*97-98 Change*	*98-00 Change*	*98-07 Change*
Agriculture/Range	N/A	0	0	0	0	0	0	0
Beach/Bar/Flat	N/A	79	48	34	428	-31	-14	380
Fresh Marsh	N/A	79	90	71	176	11	-19	86
Open Water-Fresh	N/A	437	394	375	404	-43	-19	10
Submerged Aquatics	N/A	447	510	561	14	63	51	-496
Upland Barren	N/A	0	0	0	0	0	0	0
Upland Scrub-Shrub	N/A	0	0	0	0	0	0	0
Wetland Forested	N/A	5	9	10	13	4	1	4
Wetland Scrub-Shrub	N/A	7	3	3	22	-4	0	19
TOTAL	N/A	1,054	1,054	1,054	1,057	0	0	3

in submerged aquatics habitat. As a result, the reference can no longer be classified as a naturally created environment.

The Big Island Mining (AT-03) project showed gains in subaerial land during the post-construction period, the pre-construction period, and in the reference area. Since construction (1998), the land acreage in the project area has continually expanded. The percentage of subaerial land in the project area was 13% in 1998, 23% in 2000, and 31% in 2007 (figure 17). These percentages correspond to land to open water ratios of 1.0:6.7 (1998), 1.0:3.4 (2000), and 1.0:2.3 (2007). Approximately, 640 acres (259 ha) of subaerial land habitats were created for the ten year period from 1997 (pre-construction) to 2007 (post-construction). Moreover, 196 ha (485 acres) of the subaerial land habitats were established after construction from 1998 (as-built) to 2007 (post-construction). The subaerial land gain was composed of fresh marsh [175 ha (432 acres)] and woody habitats [85 ha (211 acres)]. The rate of this subaerial land expansion was 26 ha/yr (64 acres/yr) from 1997 to 2007 (table 1 and figure 6). The creation of 259 ha (640 acres) of subaerial land habitats approaches but does not attain the projected goal to create 344 ha (850 acres) of delta lobe islands in the project area. However, additional subaerial land will probably be created in the project area before the end of the project life, and the 344 ha (850 acre) goal could still be realized. Pre-construction data (1994-1997) show small gains in subaerial land inside the project area. The percentage of subaerial land in the project area was 6% in 1994 and 7% in 1997 (figure 17). These percentages correspond to land to open water ratios of 1.0:15.9 (1994) and 1.0:12.4 (1997). Approximately, 17 ha (42 acres) of subaerial land habitats were created for the 3 year pre-construction period from 1994 to 1997. The pre-construction subaerial land gain was primarily comprised of fresh marsh [17 ha (41 acres)]. The rate of this subaerial land expansion was 6 ha/yr (14 acres/yr) from 1994 to 1997 (table 1 and figure 6). The pre-construction data illustrates that modest subaerial land growth was occurring in the project area before construction. The growth of subaerial land in the reference area increased considerably after additions of dredged material by the USACE. Before this dredge disposal event, the reference area

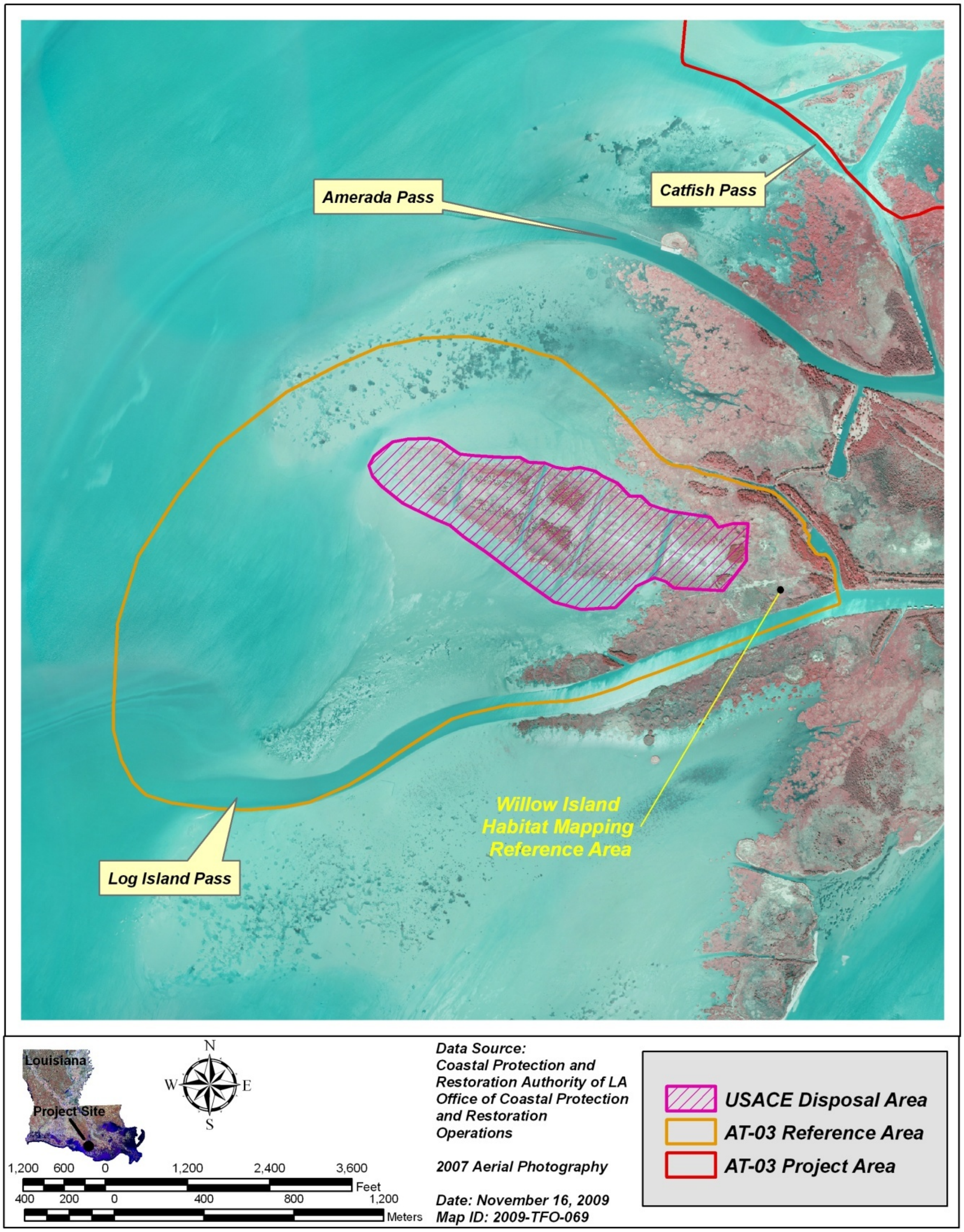


Figure 16. Location of USACE dredge disposal area inside the Big Island Mining (AT-03) reference area.

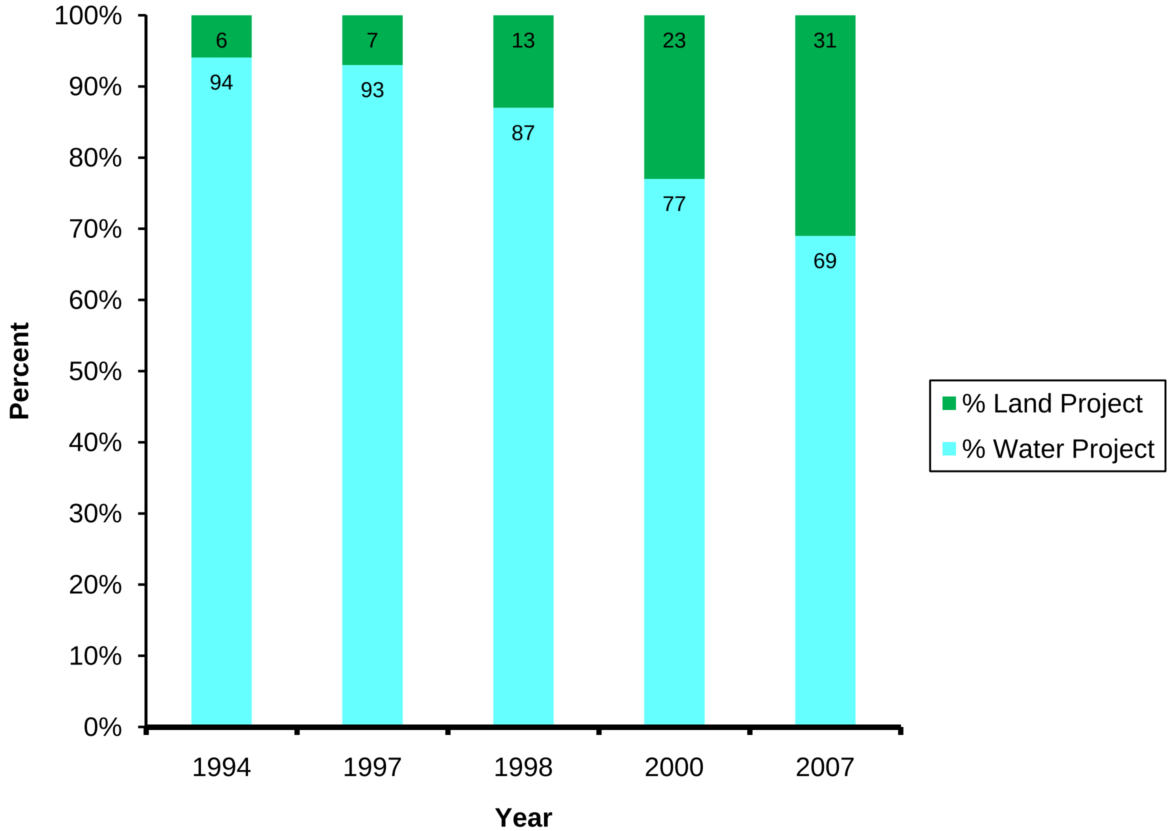


Figure 17. **Percentage of land and water inside the Big Island Mining (AT-03) project area in 1994 (pre-construction), 1997 (pre-construction), 1998 (as-built), 2000 (post-construction), and 2007 (post-construction).**

alternately gained and loss small acreages of subaerial land. The percentage of subaerial land in the reference area was 9% in 1997, 10% in 1998, 8% in 2000, and 20% in 2007 (figure 18). These percentages correspond to land to open water ratios of 1.0:10.6 (1997), 1.0:9.3 (1998), 1.0:11.5 (2000), and 1.0:4.0 (2007). Approximately, 49 ha (120 acres) of subaerial land habitats were created for the ten year period from 1997 to 2007. However prior to 2007, the reference area had small gains from 1997 to 1998 [4 ha (11 acres)] and losses from 1998 to 2000 [-7 ha (-18 acres)] in subaerial land habitat. The subaerial land gain was composed of fresh marsh [39 ha (97 acres)] and woody habitats [9 ha (23 acres)]. The rate of this subaerial land expansion was ha/yr (12 acres/yr 5) from 1997 to 2007 (table 2 and figure 6). As a result, the subaerial lands gains in the reference area are almost entirely derived from disposal of dredged materials.

The Big Island Mining (AT-03) project area experienced subaerial growth, subaqueous to subaerial conversion, and subaqueous growth since construction. Figure 19 delineates the growth in the project area from 1998 to 2007. Large acreages [18 ha/yr

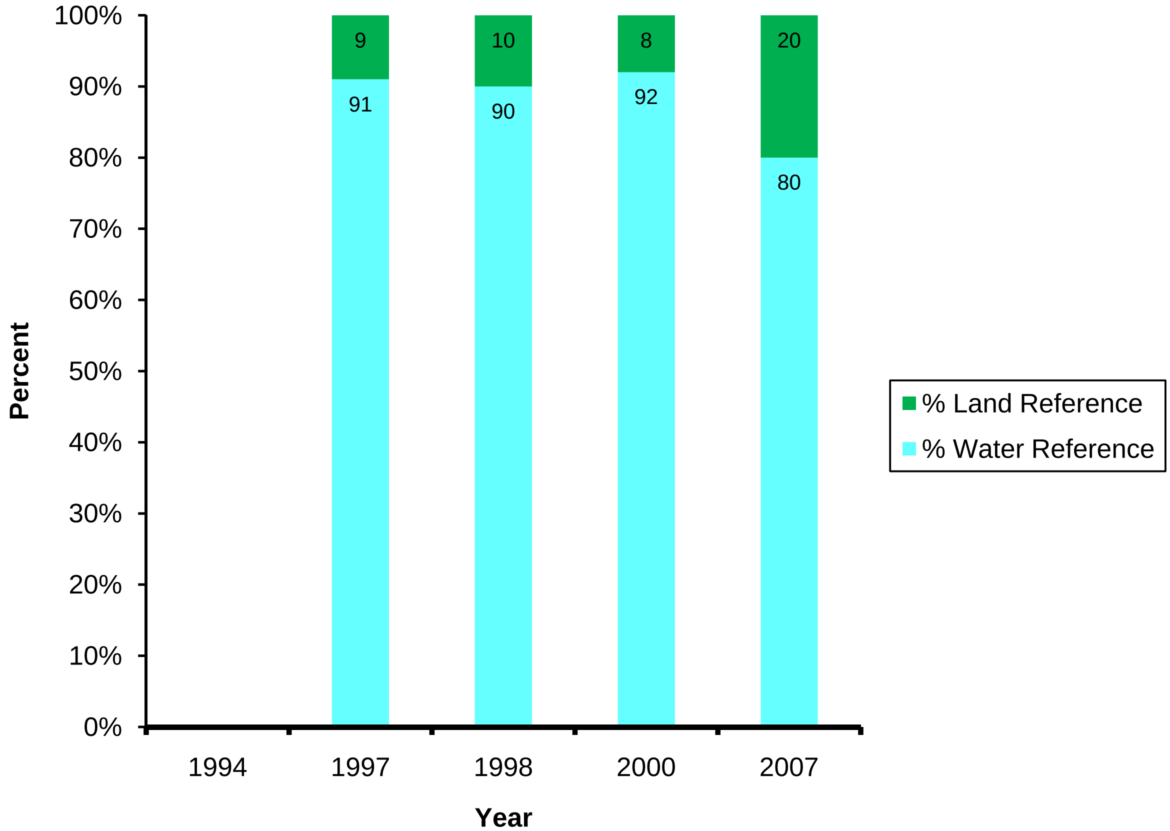


Figure 18. Percentage of land and water inside the Big Island Mining (AT-03) reference area in 1997 (pre-construction), 1998 (as-built), 2000 (post-construction), and 2007 (post-construction).

(45 acres/yr)] of subaqueous habitats were converted to subaerial habitats (subaqueous to subaerial) inside the AT-03 disposal areas from 1998 to 2007. This occurred primarily through the colonization of beach/bar/flat habitat by fresh marsh vegetation. It is important to note that the 1998 habitats were derived from aerial images captured less than 1 month after construction was completed. Therefore, the disposal areas were not given time to vegetate before the habitats were classified in 1998 and a large expanse of barren habitats remained (figure 6). By 2000, vegetated wetlands enlarged their areal extent in the disposal areas. The subaqueous to subaerial conversion in the AT-03 disposal areas continued to develop after 2000 principally in DA5, DA8, and DA9 (figure 6). Very little subaerial [0.4 ha/yr (1 acres/yr)] (open water-fresh to subaerial habitat) or subaqueous [0.8 ha/yr (2 acres/yr)] (open water-fresh to beach/bar/flat or submerged aquatics habitat) growth arose in the disposal areas. The largest part of this subaerial and/or subaqueous growth occurred along the edges of the disposal areas (figure 19). Outside the disposal areas subaerial growth [1 ha/yr (3 acres/yr)] emerged in very small acreages at a few locations within the project area. The majority of subaerial growth transpired along channel banks on the

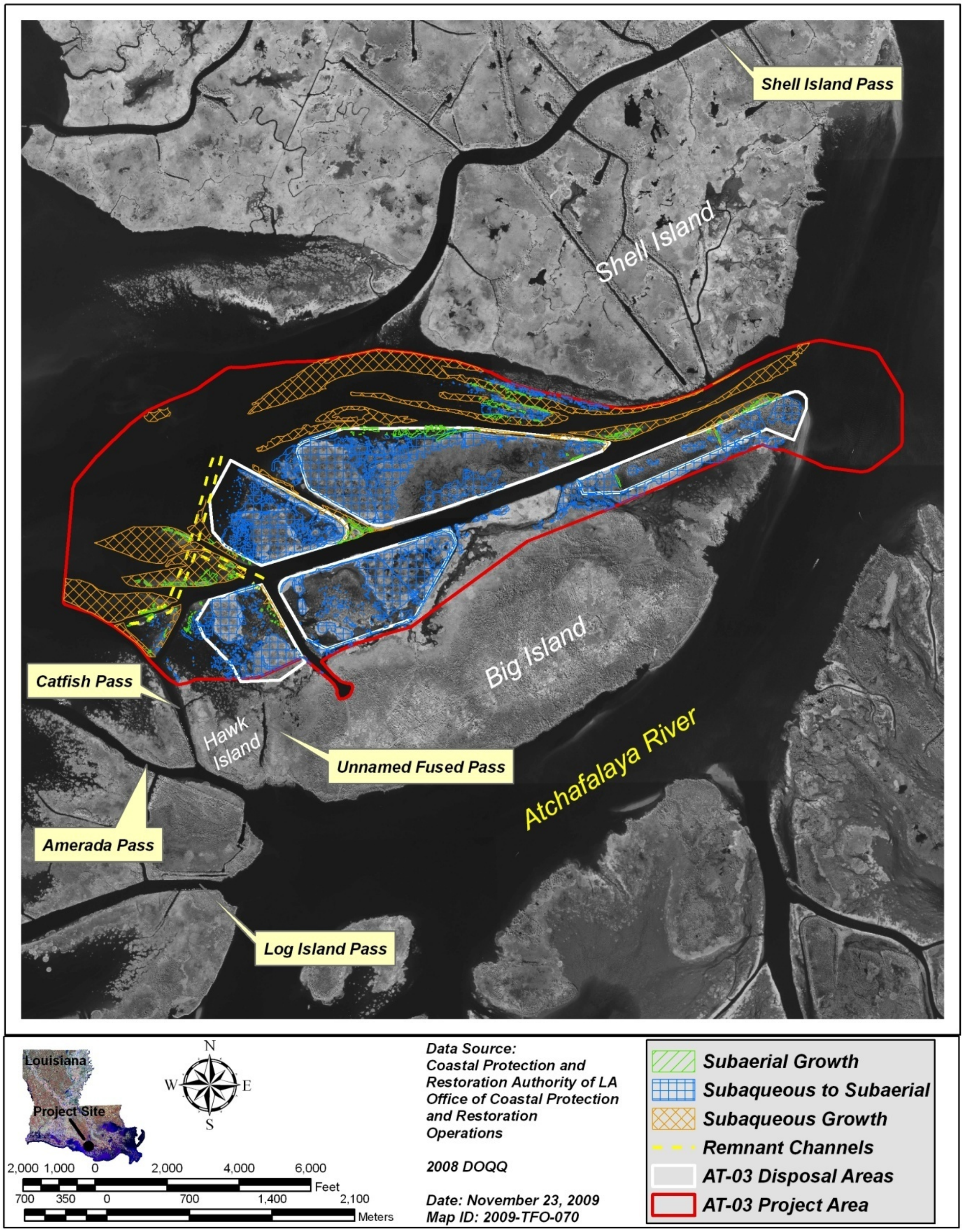


Figure 19. **Location of areas experiencing subaerial growth, subaqueous to subaerial conversion, and subaqueous growth inside the Big Island Mining (AT-03) project area.**

edge the disposal areas, on the remains of subsided spoil banks (remnant channels), and the area between DA5 and Shell Island (figure 19). The formation of a subaerial bar on the upstream end of CB has restricted flow and the distributary potential of this channel. Likewise the formation of a subaerial and subaqueous bar on the upstream end of CD narrowed the channel reducing the distributary potential of this channel. Interestingly, a large part of the subaerial growth at the mouth of CA materialized along the remains of degraded spoil banks (remnant channels) (figure 19), and the subaerial growth between DA5 and Shell Island took place adjacent to submerged aquatic beds. Subaqueous to subaerial conversions outside the disposal areas [4 ha/yr (9 acres/yr)] surfaced on the landward border of the some disposal areas, at the northern junction of DA5 and CB, and the area between DA5 and Shell Island (figure 19). The conversions of beach/bar/flat and submerged aquatics habitats to fresh marsh on the disposal area borders were the result of vegetation colonization and perhaps vertical accretion while the conversions at the DA5-CB junction appear to be facilitated by vegetation colonization of excess dredge material. In addition, the area between DA5 and Shell Island experienced small amounts of submerged aquatics to fresh marsh conversion. Several noteworthy subaqueous features [16 ha/yr (39 acres/yr)] were created in the project area from 1998 to 2007 (figure 19). The first of these features is a predominantly subaqueous bar that extends from the Atchafalaya River to CD. This bar forms a partial barrier to fluvial discharge and narrows the entrance to the secondary channel (CA). The second feature is the expanding submerged aquatic beds between DA5 and Shell Island. These beds have been increasing their areal extent since 1997 (figure 6), and a subaqueous bar and subaerial fresh marsh habitats have formed on their eastern edge. The third feature is the formation of subaqueous bars at the mouth of CA (figures 6 and 19). These bars are predominantly subaqueous (beach/bar/flat) with subaerial fresh marsh found on the outer perimeter of several banks. It appears that these geomorphic features formed in the low contour mouth of the secondary channel (CA). Nearly all the subaerial portions of these bars overlie degraded spoil banks of remnant channels (figure 19). These spoil banks seem to have facilitated sedimentation and bar formation at this location. The southern bar began aggrading around 1997 (figure 6) receiving sediments from Catfish Pass (figure 19). This bar expanded between 2000 and 2007 aggregating discharge from CA and Catfish Pass. Likewise the northern bar probably collected discharge from CA, Shell Island Pass, and the small channel between DA5 and Shell Island (figures 6 and 19). The creation of these bars infers that some bedload transport is occurring within the project area (Edmonds and Slingerland 2007). Outside the project area, Catfish Pass is aggrading and narrowing and Hawk Island is fusing with Big Island (figures 6 and 19). Therefore, channels in the immediate vicinity of the project area are also shoaling and contracting, like the AT-03 tertiary channels (DuMars 2002; Letter et al. 2008; Roberts and van Heerden 1992; Mashriqui 2003). Moreover, Catfish Pass and the unnamed Hawk Island Pass are undergoing channel abandonment and lobe fusion (Roberts and van Heerden 1992; Roberts 1998; van Heerden and Roberts 1980; van Heerden and Roberts 1988; van Heerden et al. 1991). While the formation of these bars and other features is impressive, only a small fraction of the naturally created features are subaerial. In conclsion, the goal to increase the rate of subaerial growth in the project area was achieved because the subaerial growth rate of 5 ha/yr (12 acres/yr) (subaqueous to subaerial conversion and subaerial growth) exceeded the pre-construction growth rates estimates of 2 ha/yr (4 acres/yr) from 1956 to 1978 and 1 ha/yr (3 acres/yr) from 1978 to 1990 (Barras et al. 2004).

V. Conclusions

a. Project Effectiveness

The results of the Big Island Mining (AT-03) project reveal that two of the project goals have not been achieved to date while the third goal was attained. The first goal to increase the project areas delta-building potential through the establishment of effective distributary channels has not been achieved to date because large scale aggradation transpired in the secondary and tertiary channels during the post-construction period. The constructed channels are also experiencing channel narrowing and modifications to their channel morphology. Moreover, this extensive shoaling and narrowing occurring in the secondary and tertiary channels indicates that the dredged channels are not hydraulically efficient. Therefore, these channels are transporting a reduced discharge and have a lowered delta-building potential. The second goal to create approximately 340 ha (850 acres) of delta lobe islands through the beneficial use of dredged material at elevations suitable for emergent marsh vegetation has not been accomplished to date because only 259 ha (640 acres) were created. While colonization of the disposal areas continued to expanded over time, the project fell 85 ha (210 acres) short of its goal. However, additional subaerial land will probably be created in the project area before the end of the project life, and the 344 ha (850 acre) goal could still be realized. The third goal to increase the rate of subaerial growth in the project area was achieved because the subaerial growth rate of 5 ha/yr (12 acres/yr) (subaqueous to subaerial conversion and subaerial growth) exceeded the pre-construction growth rates estimates of 2 ha/yr (4 acres/yr) from 1956 to 1978 and 1 ha/yr (3 acres/yr) from 1978 to 1990 (Barras et al. 2004). Therefore, the creation of the dredged channels and disposal areas seems to have improved the subaerial growth rate. In conclusion, the AT-03 project has not been successful in establishing an effective distributary channel network and creating 340 ha (850 acres) of delta lobe islands, but the AT-03 project was successful in increasing the subaerial growth rate during the first 10 year period after construction.

b. Recommended Improvements

As reported in previous reports, substantial shoaling was evident throughout the distributary and tertiary channels of the Big Island Mining (AT-03) project, most notable in Channels “CD”, “CB”, “CE” and “CF”, where the head of these channels were completely shoaled across the channel section. It is our opinion that the tertiary channels are not hydraulically efficient limiting the effective transport of sediment and delta growth. We believe that the hydraulic inefficiencies of the tertiary channels are promoting a reduced discharge resulting in the severe shoaling of Channels “CD”, “CB” and “CF”. Based on these observations, maintenance dredging of these channels would not likely provide the desired benefits and would continue to shoal several years after dredging. Therefore, we are not recommending maintenance dredging of these channels (“CD”, “CB” and “CF”). Severe shoaling has also been reported near the head of Channel “CE” which is primarily an access channel to the interior of Big Island and does not serve as an effective tertiary channel that would enhance the deltaic lobe building process. Since Channel “CE” provides little deltaic formation benefits, we are not recommending maintenance dredging. Although shoaling has been an obvious problem for tertiary channels of the Big Island (AT-03) project, we are beginning to see positive visual signs of small delta land formations at the end of Breaux Pass. With the limited maintenance funds available for the project, we are recommending maintenance dredging of Channel “CA” and Channel “CC” to increase the volume of water and sediment reaching these newly developing land formations. Due to the astronomical costs associated with hydraulic dredging, we are also recommending that maintenance dredging be performed by mechanical means. The spoil material obtained from excavation operations would be broadcast along the berm of the existing channel. This work will require a permit modification which would be obtained prior to construction. OCPR has entered into preliminary discussions with the Louisiana Department of Wildlife and Fisheries (LDWF), the landowner, to perform the dredging work in-house with their barge and excavation equipment. We are currently working out the details with LDWF for implementation of this work.

The Big Island Mining (AT-03) project would have been more sustainable if the following improvements would have been incorporated into the design of the project. The first step in the design process should have been to conduct a geomorphic assessment of the area surrounding the diversion location. The process would help select a diversion location that is conducive to sediment transport. Secondly, a conceptual model should been created. This type of model estimates the hydrodynamics and sediment transport capacity of the overall system (the river and the receiving basin). Thirdly, a hydrodynamic and sediment transport model should have been created. These models quantify water and sediment discharge and forecast morphological changes to channels and landscapes. If these three steps would have been undertaken, the future outcome of the diversion could have been predicted, and the AT-03 channels would not have aggraded so rapidly.

The monitoring regime of the Big Island Mining (AT-03) project should have been expanded to estimate the geomorphic processes affecting the project area. The current data collection scheme is very reactionary (passive). The data collected from these methods only confirm what already happened. The data show where the channel has shoaled or where new landforms are visible. This data leads to speculation as to why the channel shoaled or why the new landforms were created. A more dynamic sampling protocol is needed to determine the mechanisms forcing geomorphic change in the project area. This protocol should include quantitative estimates of discharge (Q) during flood and non-flood conditions. The discharge measurements should consist of water velocity and volume, suspended sediment concentrations, and channel stratigraphy. The suspended sediment and channel stratigraphy data should be qualitative and quantitative to estimate the probability of geomorphic change in the project area. In addition, the habitat mapping, bathymetry, and topography procedures should be continued to locate change within the project area over time. Moreover, the data collected from this type of sampling regime could be used to not only foresee changes in the project area but also could be used to design more sustainable sediment diversion projects.

c. Lessons Learned

Several channel morphology and sediment transport lessons were learned from the Big Island Mining (AT-03) project. The first lesson is that constructing tertiary channels at acute angles did not increase the delta-building potential or the rate of subaerial growth because these channels aggraded so rapidly. Although delta channels typically are formed at acute angles, these channels are forced into this shape by concentrated discharge and bedload transport. The channel locations are not predetermined. Deltas extend seaward through channel elongation and bifurcation or avulsion. Channel elongation and bifurcation is the dominant mechanism expanding deltas seaward. Therefore, it would have probably been more conducive to dredge a secondary channel and let the discharge determine the location of the tertiary channels. Secondly, the project was constructed in an area with low contours and the dredged channels discharged into shallow basins. Therefore during low discharge events, the channels probably aggraded quickly. Thirdly, the sediment diversion seems to be built on the wrong side of a concave bendway. This lowers discharge and causes aggradation in the dredged channels.

One disposal area lesson was learned from the Big Island Mining (AT-03) project. Containment dikes in high sediment environments should be degraded or have wider and more frequent gaps because only the portion of DA5 adjacent to a degraded dike accreted. Other portions of DA1 and DA5 experienced volume losses. Therefore, degrading or expanded gapping of containment dikes should be considered after constructing marsh creations projects in high sediment environments.

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Appendix A

AT-03 Photomosaic and Habitat Analysis Maps

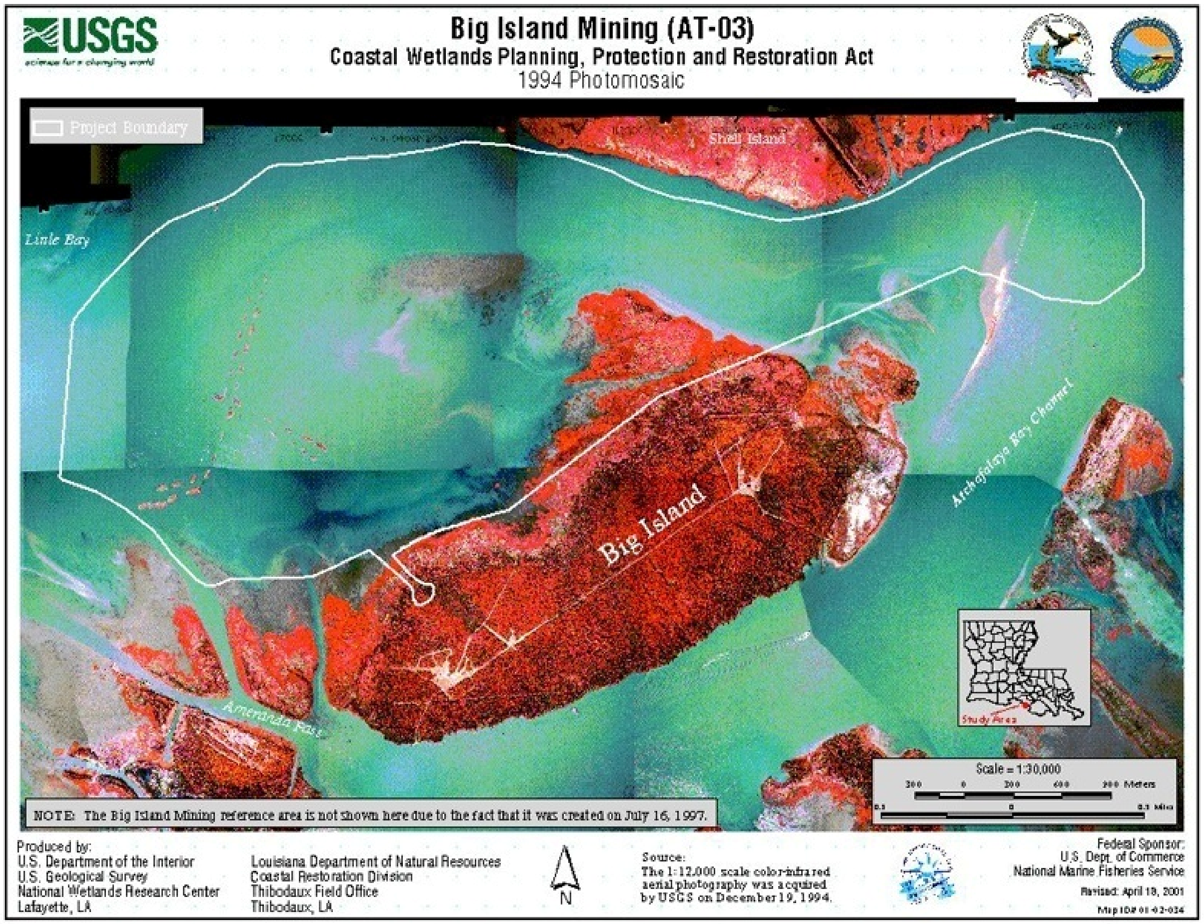

Figure. **Pre-construction (1994) photomosaic of the Big Island Mining (AT-03) project area.**

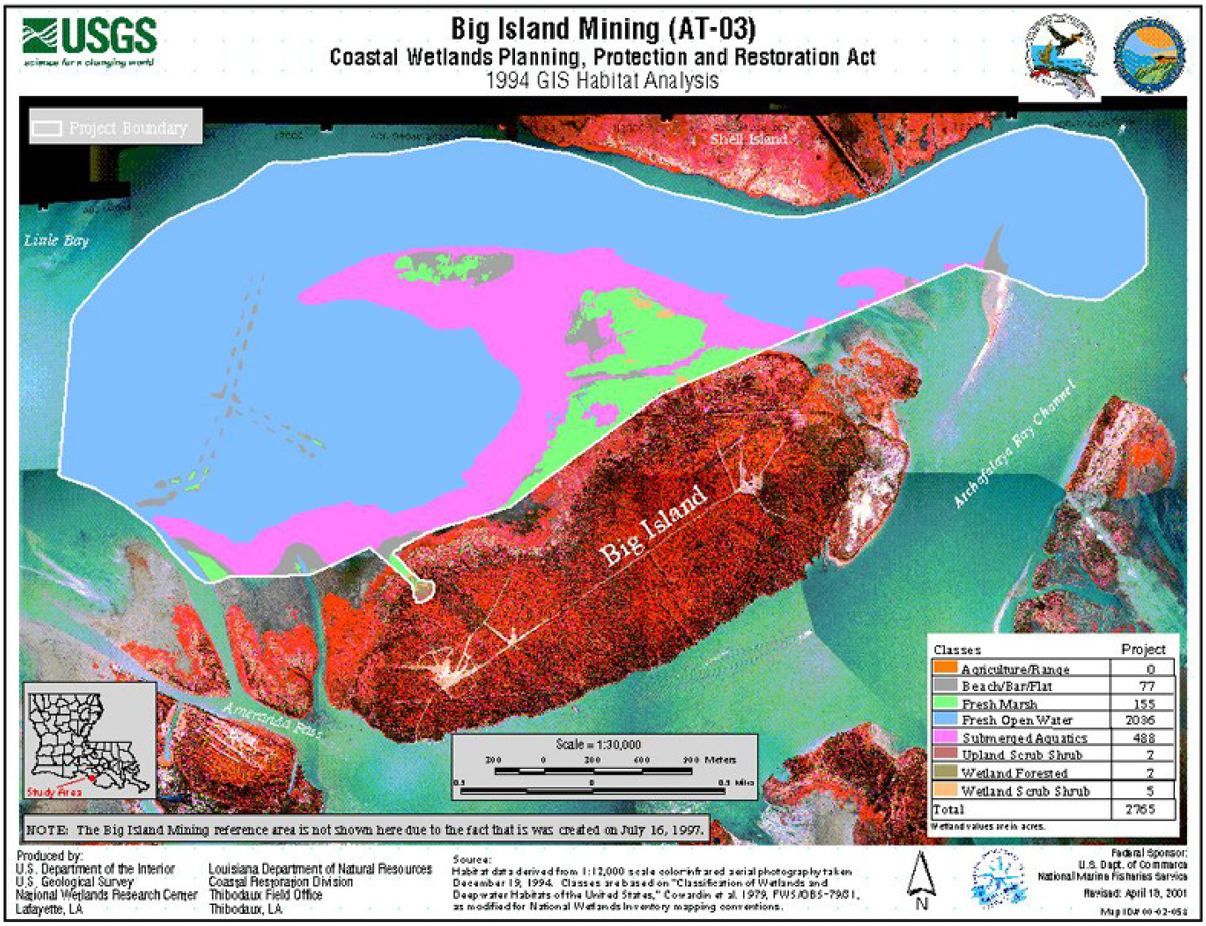

Figure. **Pre-construction (1994) habitat analysis of the Big Island Mining (AT-03) project area.**

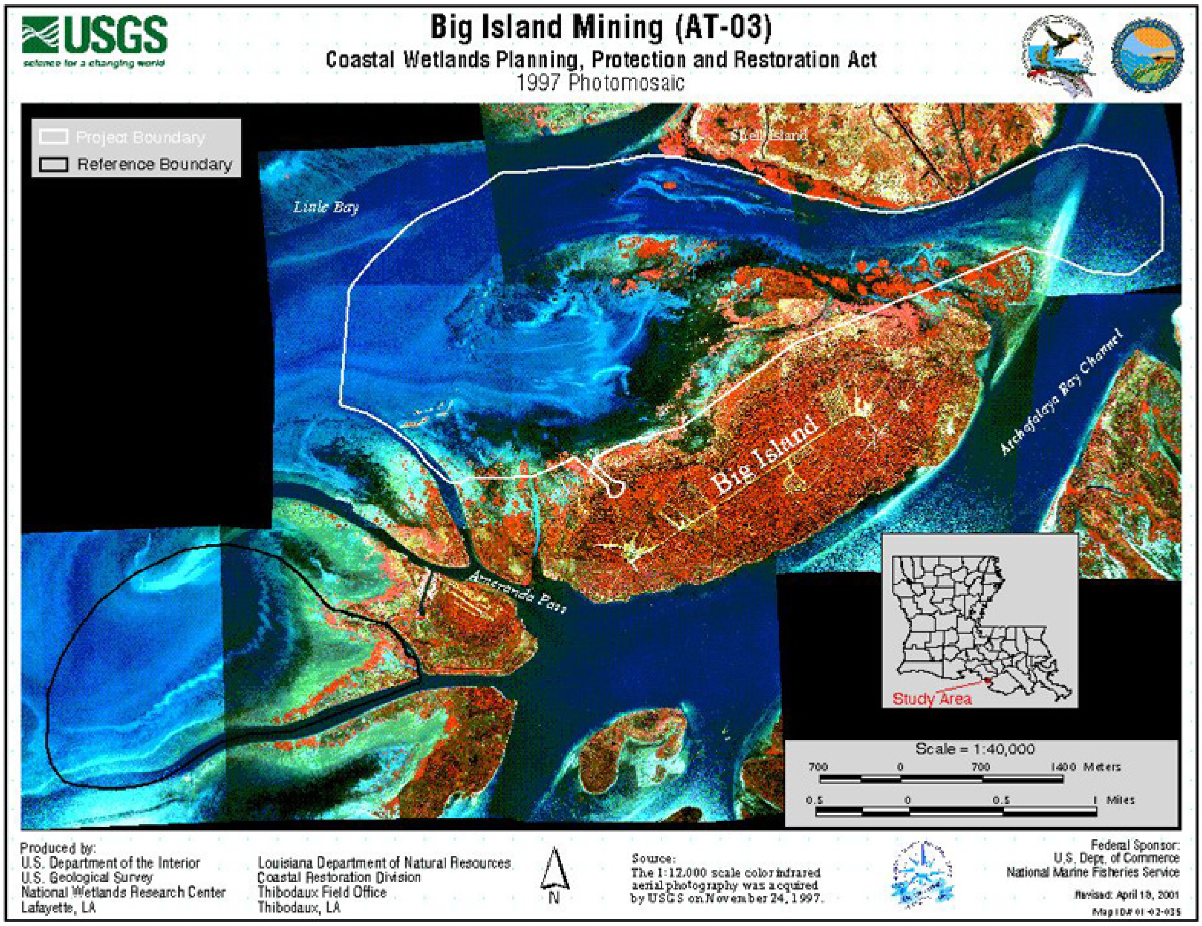

Figure. **Pre-construction (1997) photomosaic of the Big Island Mining (AT-03) project and reference areas.**

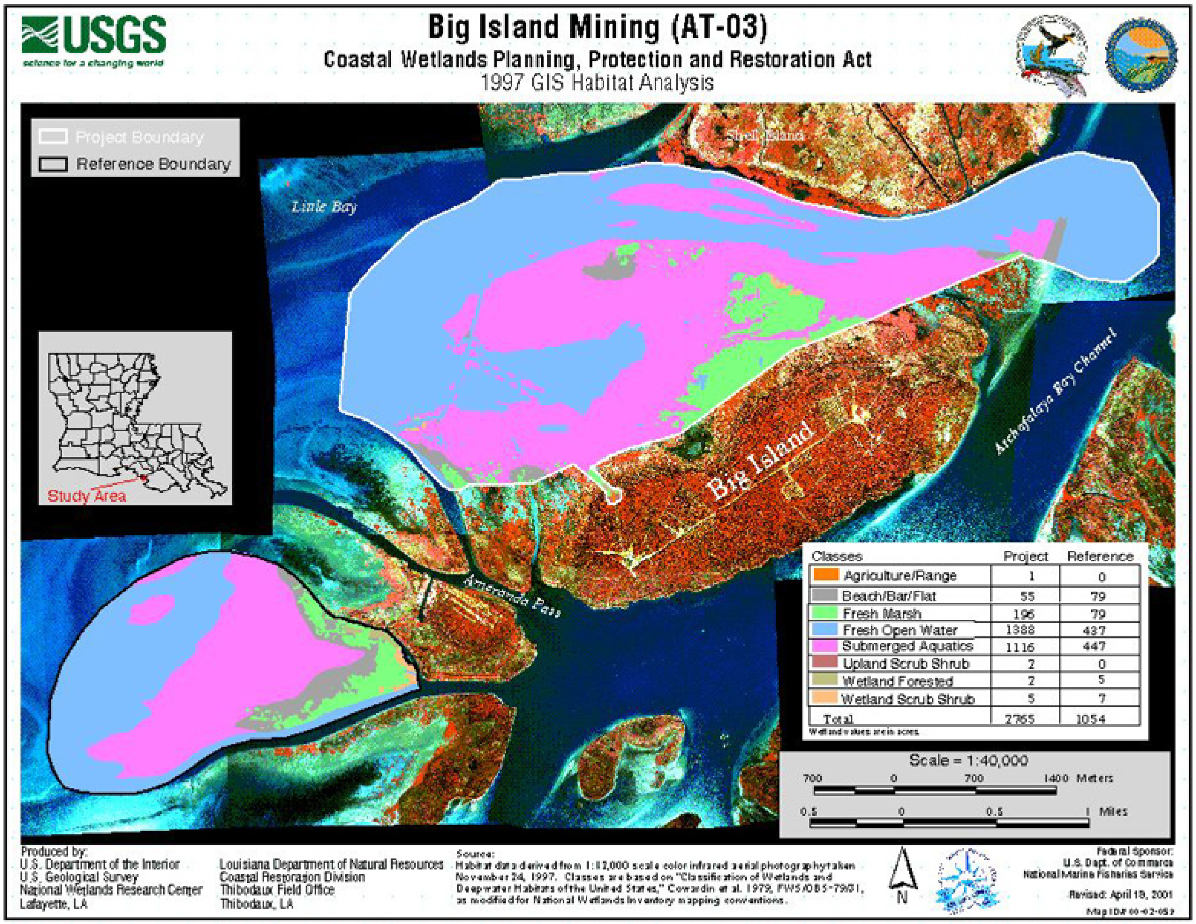

Figure. **Pre-construction (1997) habitat analysis of the Big Island Mining (AT-03) project and reference areas.**

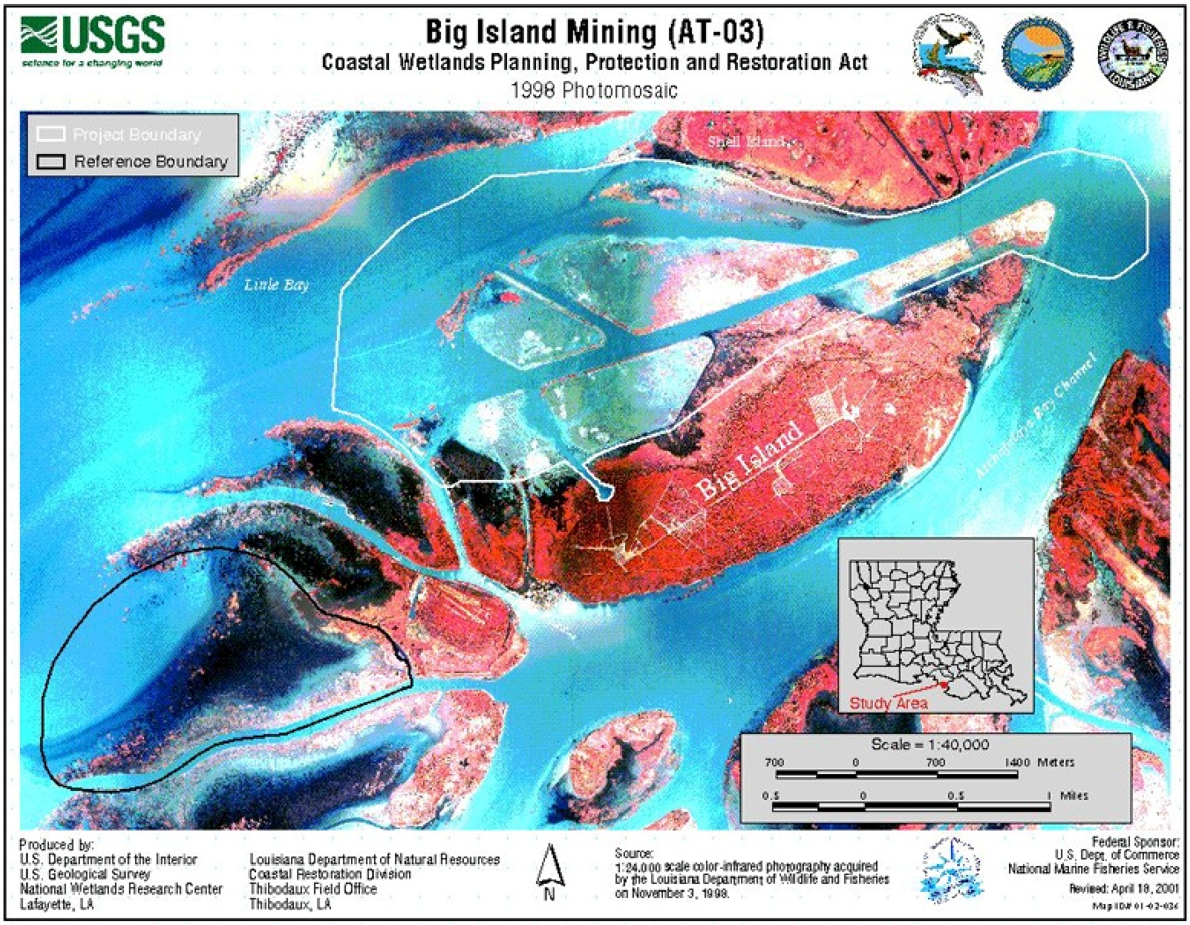

Figure. **As-built (1998) photomosaic of the Big Island Mining (AT-03) project and reference areas.**

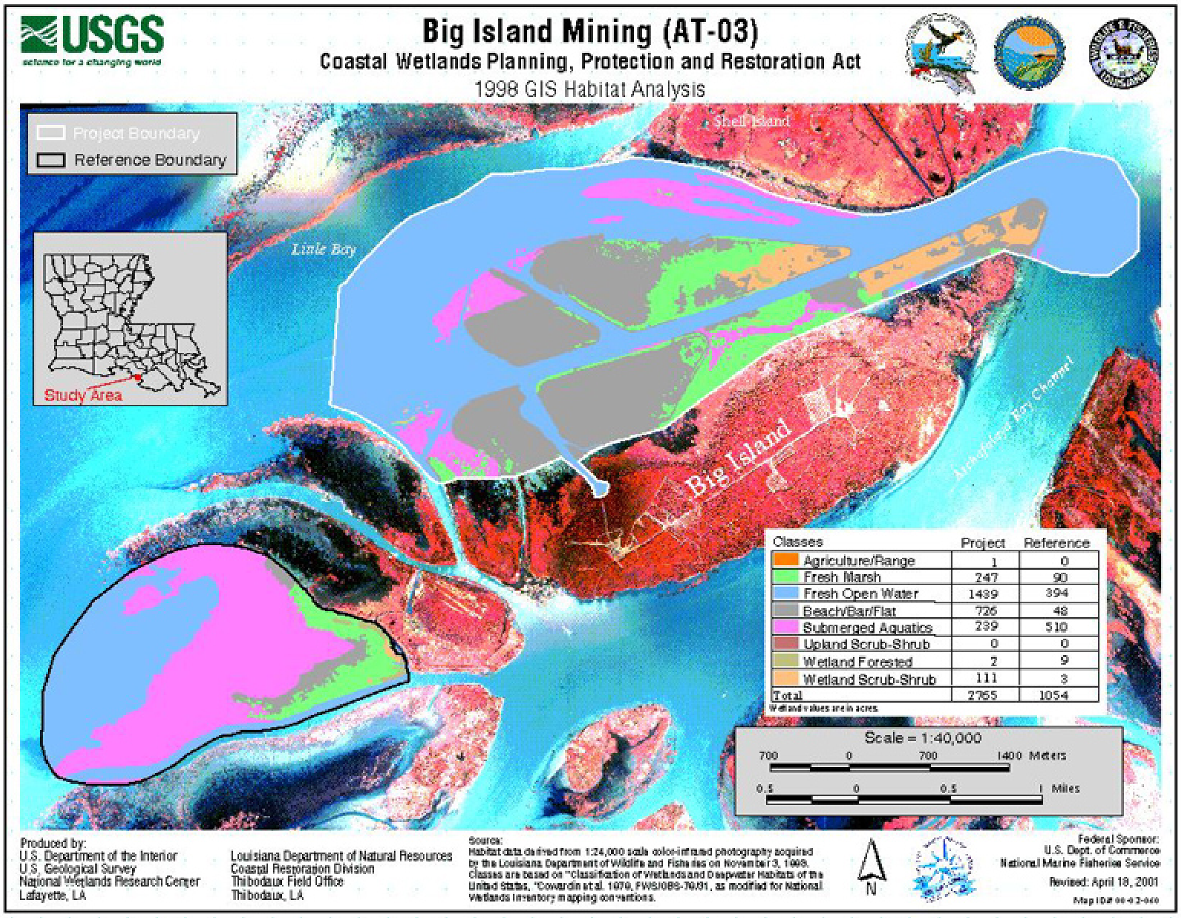

Figure. **As-built (1998) habitat analysis of the Big Island Mining (AT-03) project and reference areas.**

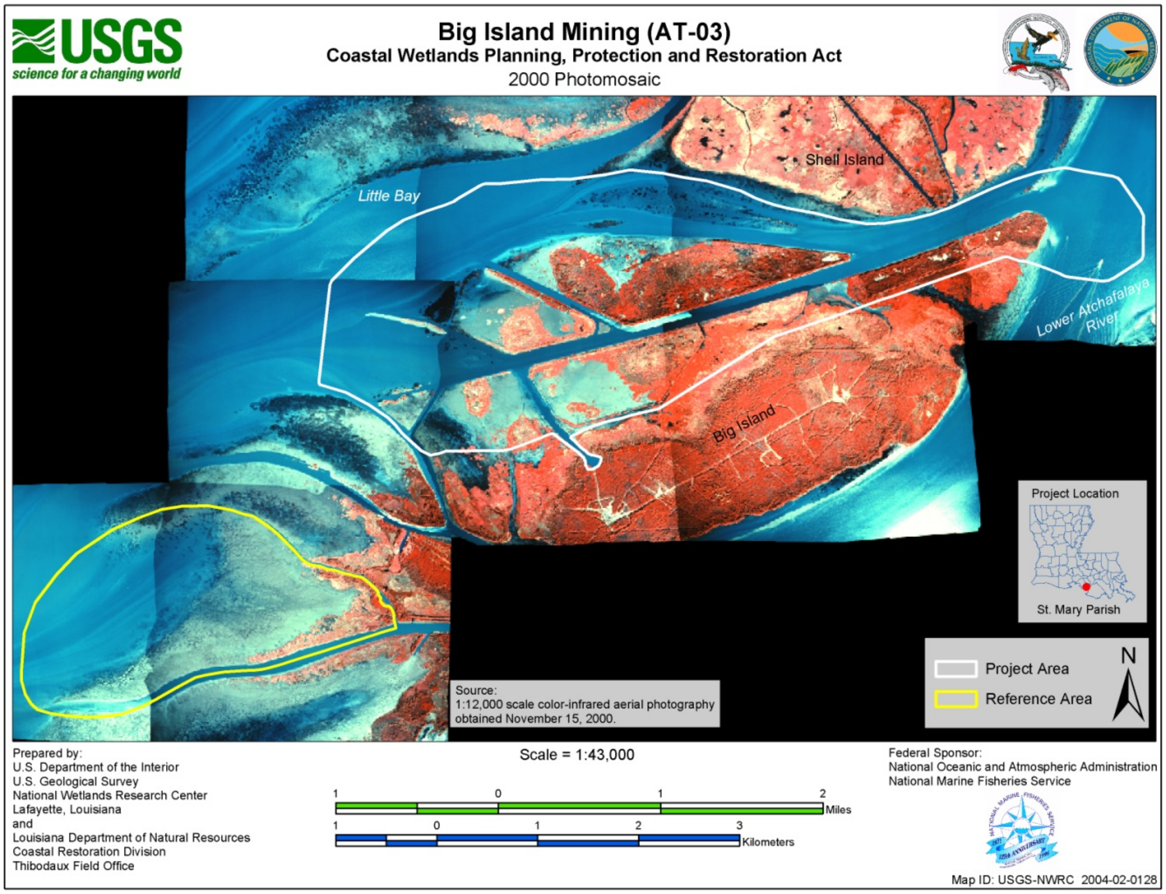

Figure. **Post-construction (2000) photomosaic of the Big Island Mining (AT-03) project and reference areas.**

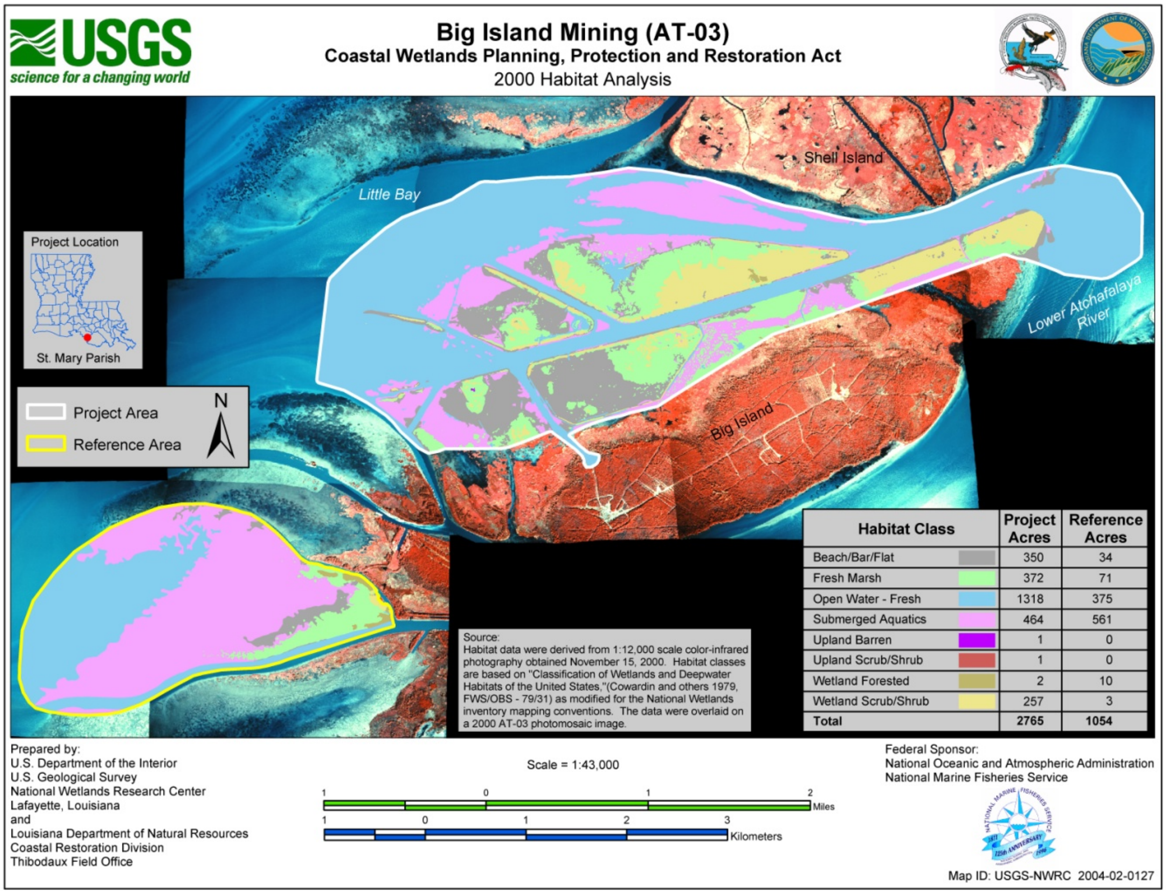

Figure. **Post-construction (2000) habitat analysis of the Big Island Mining (AT-03) project and reference areas.**

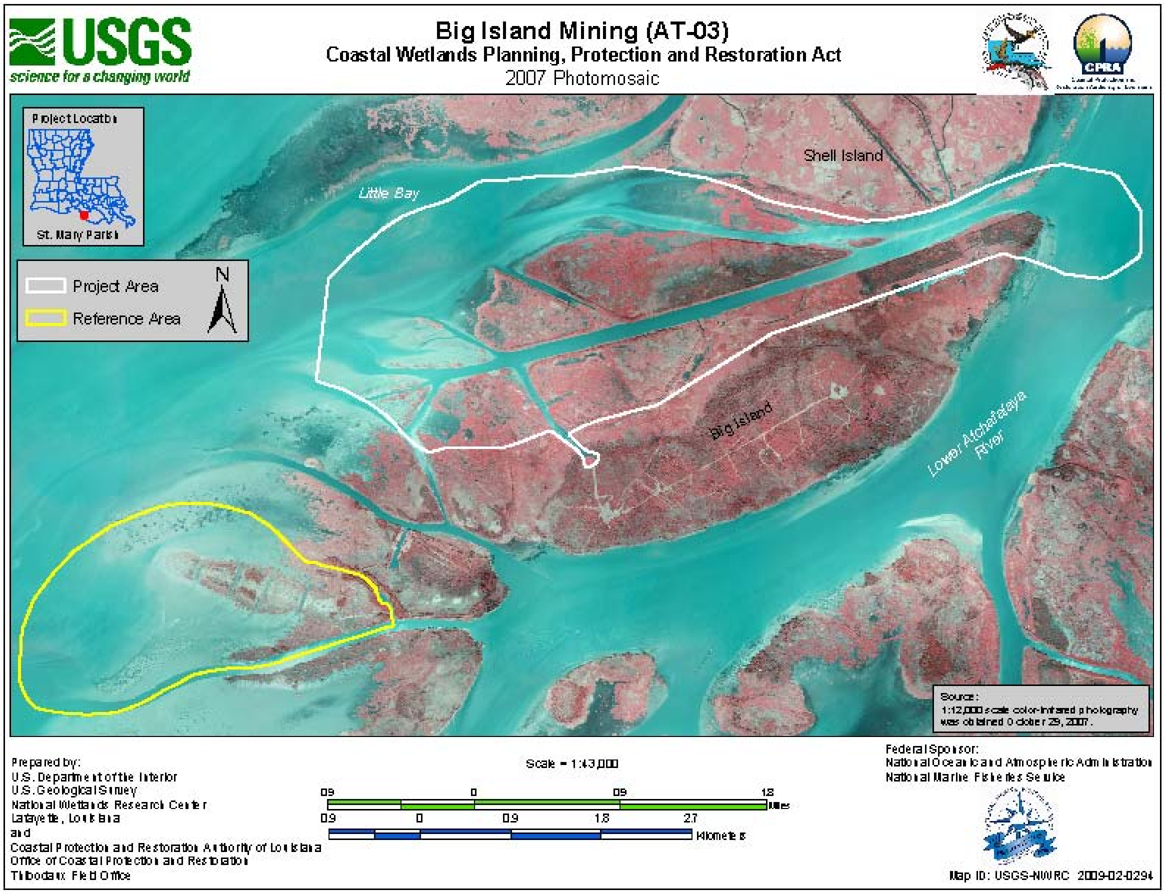

Figure. **Post-construction (2007) photomosaic of the Big Island Mining (AT-03) project and reference areas.**

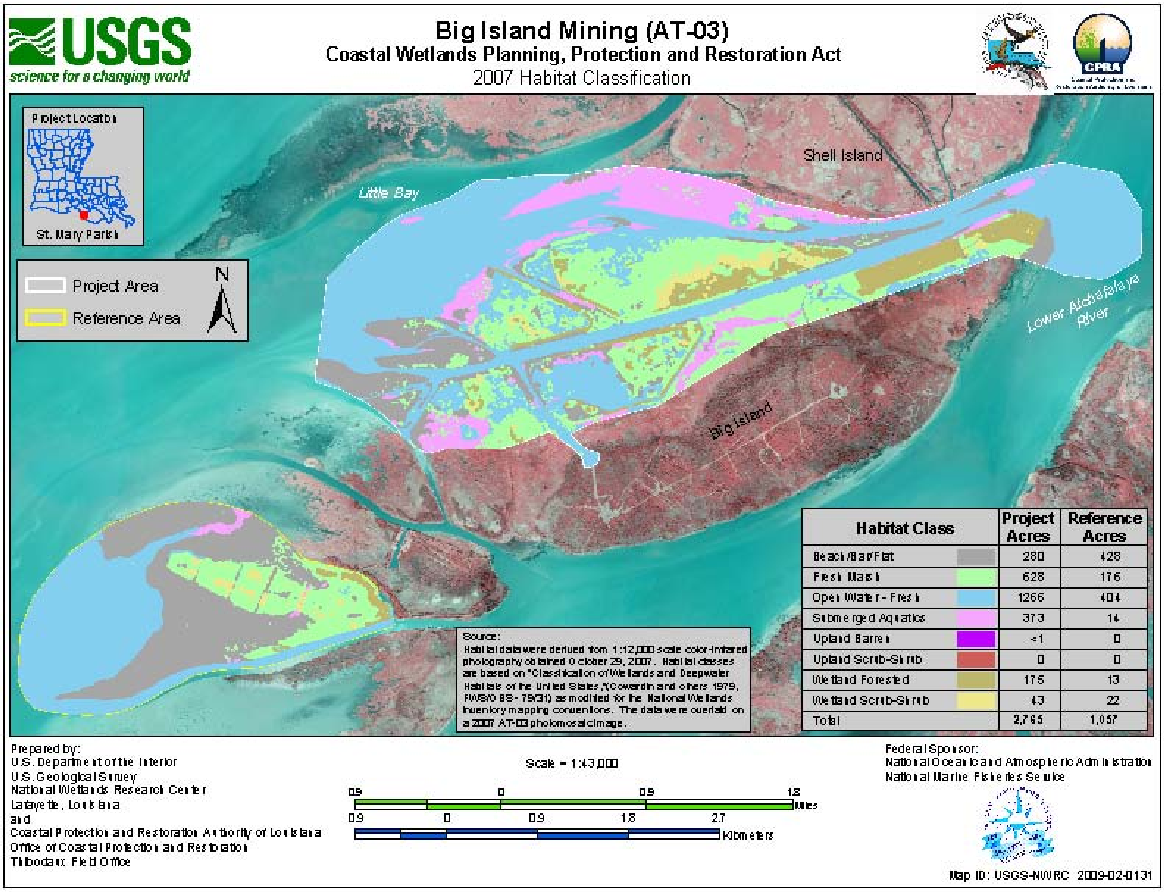

Figure. **Post-construction (2007) habitat analysis of the Big Island Mining (AT-03) project and reference areas.**

Appendix B

AT-03 Inspection Photos

Photo No.1 – View of Breaux's Pass (Channel "CA") near Sta. 60+00 looking southwest.

Photo No.2 – View of Breaux's Pass (Channel "CA") near Sta. 60+00 looking northeast.

Photo No. 3 - View of open water and marsh parallel to and on the north side of Channel “CD” looking northwest.

Photo No. 4 - View of Channel “CD” near Sta. 0+00 looking northwest. Entire channel silted in and not passable by boat.

Photo No. 5 - View of Channel “CB” near Sta. 0+00 looking northwest.

Photo No. 6 – View of Channel “CB” near Sta. 0+00 looking northwest.

Photo No. 7 - View of Channel "CF" near Sta. 0+00 looking northwest towards the Atchafalaya Bay.

Photo No. 8 - View of a bar that formed at the mouth of Channel "CF" looking northwest.

Photo No. 9 – View of a channel that has formed between two bars at the mouth of Channel "CA" looking west.

Photo No. 10 – View of a channel that has formed between two (2) bars at the mouth of Channel "CA" looking west.

Photo No. 11 – View of cul-da-sac section of Channel “CE” near Sta. 41+00.

Photo No. 12 - View of Channel “CE” from the head looking southeast.

Photo No. 13 – View of the marsh at the end of Breaux's Pass looking towards the Atchafalaya Bay.

Photo No. 14 – View of marsh near at the end of Breaux's Pass looking towards the Atchafalaya Bay.

Photo No. 15 - View of the mouth of Channel “CA” heading southwest towards Channel “CC”

Photo No. 16 – View from the mouth of Channel “CC” looking southwest toward Amerada Pass.

Photo No. 17 - View of open water and marsh at the end of Breaux's Pass looking northeast towards the mouth of Channel "CF".

Photo No. 18 – View of open water and marsh at the end of Breaux's Pass looking northeast towards the mouth of Channel "CF".

Appendix C

AT-03 Three Year Budget and Worksheets

BIG ISLAND MINING PROJECT (AT-03)

Three-Year Operations & Maintenance Budgets 07/01/2010 - 06/30/13

Project Manager	O & M Manager	Federal Sponsor	Prepared By
	Brian Babin	*NMFS*	*Brian Babin*

	2010/2011	2011/2012	2012/2013
Maintenance Inspection	$ 2,652.00	$ -	$ 2,813.00
Structure Operation	$ -	$ -	$ -
Administration		$ 6,000.00	$ -

Maintenance/Rehabilitation

10/11 Description:

	2010/2011
E&D	
Construction	$ -
Construction Oversight	$ -
Sub Total - Maint. And Rehab.	$ -

11/12 Description: Secondary Monument Maintenance. Maintenance Dredging of Channels "A" and "C".

	2011/2012
E&D	$ 5,000.00
Construction	$ 300,000.00
Construction Oversight	$ 20,000.00
Sub Total - Maint. And Rehab.	$ 325,000.00

12/13 Description:

	2012/2013
E&D	$ -
Construction	$ -
Construction Oversight	$ -
Sub Total - Maint. And Rehab.	$ -

	2010/2011	2011/2012	2012/2013
Total O&M Budgets	**$ 2,652.00**	**$ 331,000.00**	**$ 2,813.00**

Total O&M Budget 2008 through 2011	**$336,465**
Unexpended O&M Budget	**$360,963**
Remaining O&M Budget (Projected)	**$24,498**

OPERATIONS & MAINTENANCE BUDGET WORKSHEET

Project: Big Island Mining Project (AT-03)

FY 10/11 –

Administration		$ 0
O&M Inspection & Report		$ 2,652
Operation:		$ 0
Maintenance:		$ 0
E&D:	$	
Construction:	$	
Construction Oversight:	$	
General Maintenance:	$	

Operation and Maintenance Assumptions:
Biennial Inspection (2010/2011) – ($2,500 x 6% = $2,652)

FY 11/12 –

Administration		$ 6,000*
O&M Inspection & Report		$ 0
Operation:		$ 0
Maintenance:		$ 325,000
E&D:	$ 5,000**	
Construction:	$300,000	
Construction Oversight:	$ 20,000***	

Operation and Maintenance Assumptions:
Assume maintenance/ adjustment of secondary monuments at a lump sum cost of $5,000** and $1,000* for LDNR administration. Maintenance Dredging of Channels "A" and "C". Included in year 11/12 is a lump sum of $300,000 for planning, permitting and dredging of Channels "A" and "C" should the landowner agree to perform the work. OCPR administration costs for planning and construction oversight of maintenance dredging is estimated to e approximately $5,000* and $20,000***, respectively.

FY 12/13 –

Administration		$ 0
O&M Inspection & Report		$ 2,813
Operation:		$ 0
Maintenance:		$ 0
E&D:	$ 0	
Construction:	$ 0	
Construction Oversight:	$ 0	

Operation and Maintenance Assumptions:
Biennial Inspection (2012/2013) – ($2,652 x 6% = $2,813)

2010-2013 Accounting

Unexpended funds from Lana Report:	$ 366,082.21
FY08 Expenditures by LDNR:	$ -5,118.89
Estimated Unexpended Funds:	$ 360,963.32