Coastal Protection and Restoration Authority of Louisiana

Coastal Protection and Restoration Authority of Louisiana
Office of Coastal Protection and Restoration

2008 Operations, Maintenance, and Monitoring Report

for

Isles Dernieres Restoration, Phase 0, Trinity Island

State Project Number TE-24
Priority Project List 3

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Terrebonne Parish

Prepared by:

Laurie Bourke Rodrigue,
Glen P. Curole, Darin M. Lee &
Daniel A. Dearmond

CPRA/Office of Coastal Protection and Restoration
Thibodaux Field Office
1440 Tiger Drive, Suite B
Thibodaux, LA 70301

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2008 Operations, Maintenance, and Monitoring Report
For
Isles Dernieres Restoration, Phase 0, Trinity Island (TE-24)

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I. Introduction

Trinity Island is part of the Isles Dernieres barrier island chain and is located along the southern Louisiana coast in Terrebonne Parish at 29^{o} 02' 46" N and 90^{o} 43' 48" W (figure 1). The Isle Dernieres, which separate Terrebonne Bay, Lake Pelto, and Caillou Bay from the Gulf of Mexico, is a 20 mile (32 km) long island arc segmented into four islands: Raccoon Island, Whiskey Island, Trinity Island, and East Island (McBride et al. 1989). Like all of Louisiana's barrier islands, Trinity Island is experiencing island narrowing and land loss as a consequence of a complex interaction among global sea level rise, compactual subsidence, wave and storm processes, inadequate sediment supply, and significant anthropogenic disturbances (Penland et al. 1988, McBride et al. 1989, Penland and Ramsey 1990, List et al. 1997).

The Louisiana deltaic plain is fronted by a series of headlands and barrier islands that were formed as a result of the Mississippi River deltaic cycle. The Isles Dernieres is a barrier island arc transformed from the abandonment of the Caillou headland (part of the Lafourche delta complex), which occurred approximately 500 years B.P. (Frazier 1967, Penland and Boyd 1985). Following deltaic abandonment, headland sand deposits were reworked and deposited longshore forming flanking barriers (Penland et al. 1988). Submergence of the abandoned delta separated the headland from the shoreline forming a barrier island arc. The transgressive island arc cannot keep pace with the high rate of relative sea level rise and will eventually become an inner-shelf shoal (Penland et al. 1988).

Currently, the Isles Dernieres arc is exhibiting some of the highest rates of erosion of any coastal region in the world (Khalil and Lee 2006). Erosional models have estimated that the Isles Dernieres would gradually narrow, fragment, and transgress through time eventually becoming subaqueous sand shoals between 2007 (McBride et al. 1991) and 2019 (Penland et al. 1988) unless restoration efforts are made. Between 1887 and 1988 the average annual rate of land loss was 69.6 ac yr^{-1} (28.2 ha yr^{-1}) while the average rate of shoreline retreat has been estimated between 36.4 – 60.4 ft yr^{-1} (11.1 – 18.4 m yr^{-1}; McBride et al. 1989, McBride et al. 1991). Between 1978 and 1988, shoreline erosion was even as high as 116.6 ft yr^{-1} (35.5 m yr^{-1}; McBride et al. 1989). Trinity Island has decreased in area from 1,317.1 acres (533 ha) in 1978 to 901.9 acres (365 ha) in 1988. These conditions have led to the rapid landward migration, termed barrier island rollover, and disintegration of the Isles Dernieres as well as a decrease in the ability of the island chain to protect the adjacent mainland marshes and wetlands from the effects of storm surge, saltwater intrusion, an increased tidal prism, and energetic storm waves (McBride and Byrnes 1997).

TE-24 (Trinity Island) is considered Phase 0 of the Isles Dernieres Restoration Plan. This plan was designed to restore this barrier island in the Isles Dernieres chain in Terrebonne Parish, Louisiana by increasing the elevation and width of the island, closing existing breaches, and restoring back barrier marshes. The Trinity Island Restoration project created

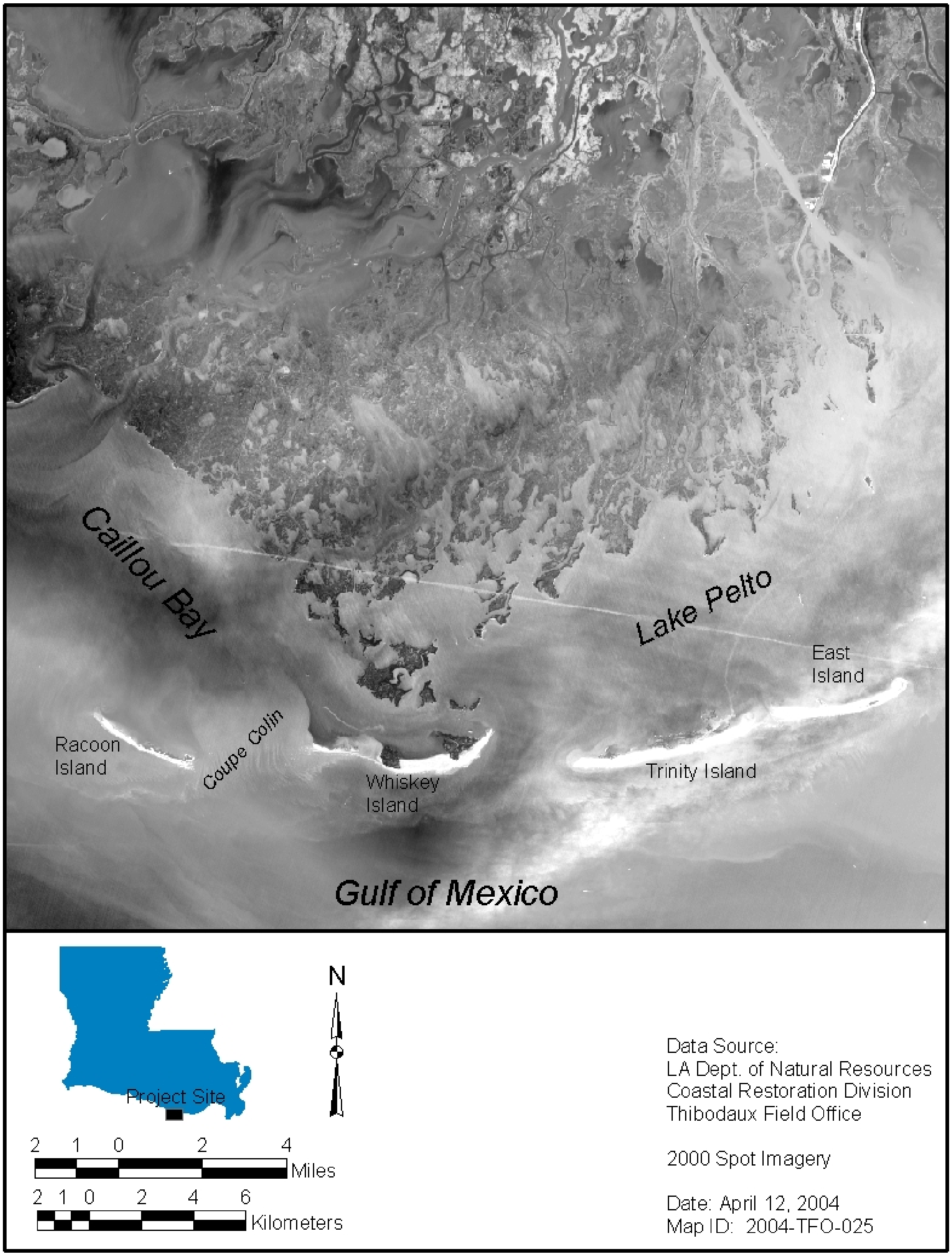

Figure 1. Isles Dernieres islands, Terrebonne Parish, Louisiana.

approximately 353 acres (143 hectares) of dunes and wetland including supratidal (beach, dune, barrier flat) and intertidal (beach, marsh) habitat using sediments dredged from Whiskey Pass and Lake Pelto (figure 2). Sand fencing was constructed on the gulf side of the dune to trap blowing sand and to minimize wind-driven export of sediment (figure 2). The sediment transferal phase of the construction of the Trinity Island Restoration project commenced January 1998 and was completed May 1999. The first phase of construction included hydraulic dredging of sediments using a 30" Cutter Head Suction Dredge (7,200 hp) and Booster Pump Barge and was completed in October 1998. Approximately 4.8 million cubic yards (3.7 million m^3) of borrow sediment were used to construct dune/berm, dune, and marsh platform features. The dune/berm, dune, and marsh platform extended the entire length of the island approximately 23,000 feet. Target elevations ranged from +2 ft (0.6 m) to +8 ft (2.4 m) North American Vertical Datum of 1988 (NAVD 88). Immediately post-dredging, aerial seeding with *Cynodon dactylon* (Bermuda grass) was conducted (figure 2).

During the second phase of construction, vegetation was planted between May 12 and 26, 1999 to stabilize the emplaced sediment on the newly created dune area, in the back-bay area, and on spurs from the dune area across the island to the back-bay area. Hand-planted vegetation included *Spartina patens* (marshhay cordgrass), *Spartina alterniflora* (smooth cordgrass), and *Panicum amarum* (bitter panicum). In total, 8,348 *S. alterniflora*, 10,579 *S. patens*, and 10,579 *P. amarum* were planted. The first vegetation sampling was conducted August 26 and 31, 1999 and additional vegetation sampling occurred September 19, 2001, September 16, 2003 and October 8-11, 2007.

II. Maintenance Activity

Over the past decade, numerous barrier island and headlands projects have been or are being restored by the state and their federal partners through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) and other funding sources (Lindquist and Martin 2007). Unfortunately, scheduled maintenance of these projects has not been incorporated into their design or funding (Lindquist and Martin 2007). To account for the programmatic maintenance needs of the barrier islands and headlands, the state has implemented the Barrier Island Maintenance Program (BIMP) through House Bill 429, Act No. 407, outlining the process by which the Office of Coastal Protection and Restoration (OCPR) would annually develop a priority list of projects to be submitted to the House and Senate Committee on Natural Resources (Lindquist and Martin 2007). These projects would be funded by the Barrier Island Stabilization and Preservation Fund established to provide appropriations, donations, grants and other monies for the program. BIMP was created to coordinate and fund restoration barrier shorelines in Louisiana and formulate a much needed component of maintenance planning for existing projects without funding (Lindquist and Martin 2007). With the implementation of the BIMP, the state has also begun performing annual inspections of barrier island projects constructed under the CWPPRA program.

The most recent annual inspection conducted on Trinity Island was completed on September 11, 2007. This inspection included the visual observations of the entire island features and

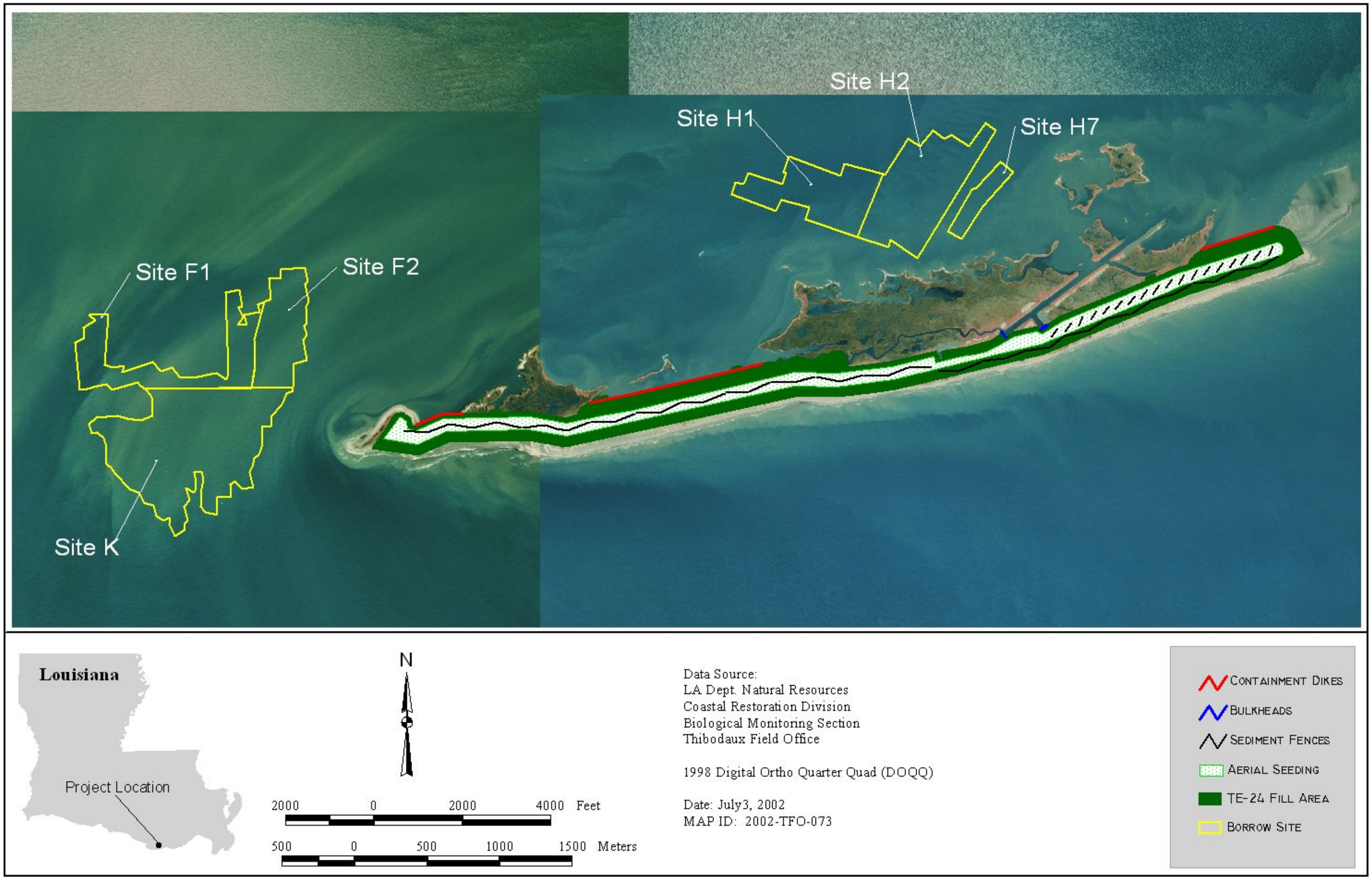

Figure 2. Isles Dernieres Restoration, Phase 0, Trinity Island (TE-24). Project features, including borrow sites, sediment fencing installation area and aerial seeding area.

collection of GPS points along established stations from the existing shoreline to the back barrier marsh. While finalizing the 2008 Operation, Maintenance and Monitoring (OM&M) report, Hurricanes Gustav and Ike severely impacted southern Louisiana, including the barrier island chain in Terrebonne Parish. As a result of the 2008 hurricanes, CWPPRA authorized the Storm Recovery Contingency Fund to perform post-storm inspections of all constructed CWPPRA projects. The post-storm inspection of Isle Dernieres - Trinity Island project was performed on October 29, 2008 and was attended by OCPR and Louisiana Department of Wildlife and Fisheries (LDWF) representatives. With the completion of the damage assessments and reports, recent up-to-date information such as general observations, photos, deficiencies, recommendations and estimated costs for repairs were obtained that will assist in estimating shoreline erosion and calculating volume changes along the island over the past year and pre- and post-storm. Committed to providing the most recent data in the OM&M reports, we have incorporated the data and subsequent analysis obtained from the 2007 annual inspection and 2008 damage assessment report into this OM&M report.

On October 29, 2008 a damage assessment was conducted by representatives of the OCPR and the LDWF. Participants included Darin Lee, Daniel Dearmond, and Laurie Rodrigue with the OCPR and Michael Carloss with LDWF. The assessment began at approximately 10:00 am and proceeded from the western tip of the island easterly to the New Cut project (TE-37). Location of the shoreline was established with global position system (GPS) equipment during the 2007 inspection at several locations. These locations were revisited during this assessment and new positions obtained at approximately the same stations along the shoreline. This information will allow us to determine the shoreline change over the past year and with the Barrier Island Comprehensive Monitoring (BICM) Program shoreline change data determine any impacts from the hurricanes. Below are general observations made during the damage assessment, recommendations, and costs for possible corrective actions. Photos taken during the assessment are found in Appendix A.

Observations of structure features which sustained damage:

1. Overall, the island showed shoreline erosion as the only damage. No breaches were observed and the dune feature did roll back in most instances where marshes were in place to capture the sediment. The western end was the only area that showed severe overwash with almost 1,200 ft (365.8 m) of complete template removal from station 13+00 to station 25+00. Also, vegetation was salt burned, but these features are natural and should recover with rains and time.
2. The most severe shoreline erosion occurred in the central portion of the area from station 100+00 to 170+00, with less erosion on both the eastern and western ends of the project (figure 3). The average erosion measured since the 2007 inspection was approximately -131.8 ft (-40.2 m). BICM data shows an average erosion rate of -40.8 ft (-12.4 m) for this portion of the coast in the last decade (1990’s to 2005) and -95.4 ft (-29.1 m) of erosion between 2004 and 2005 (Hurricanes Katrina and Rita). Removing the short-term erosion rate from that measured gives us an erosion rate of -91.0 ft (-27.7 m). This is conservative since the BICM short-term erosion rate includes the

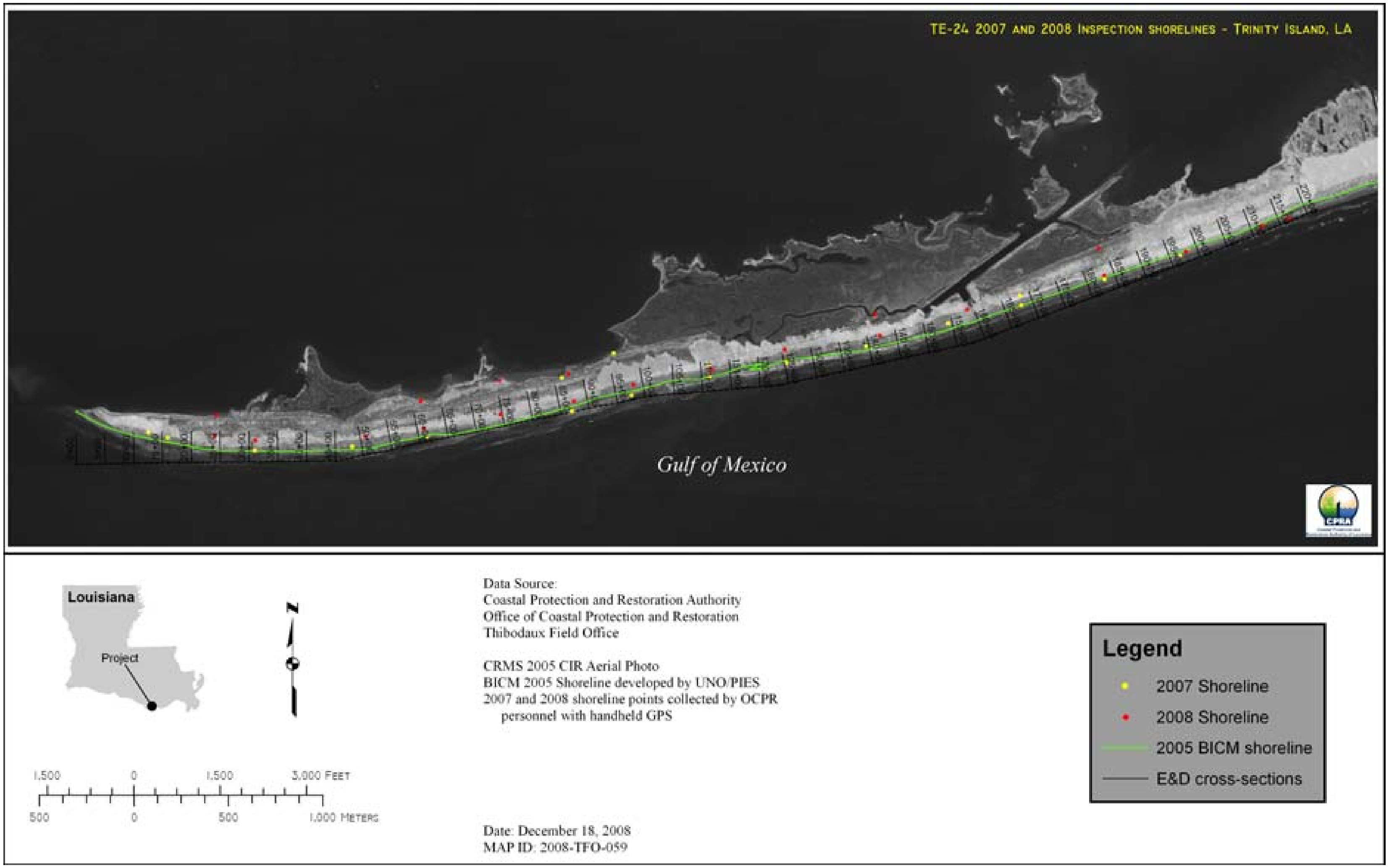

Figure 3. 2008 Shoreline positions obtained during the post-Ike assessment along with the 2007 inspection data and the BICM 2005 shoreline at the Isle Dernier – Trinity Island CWPRRA Project (TE-24).

2005 hurricanes within it, which increases the average significantly. However, this also confirms that these storms caused erosion that approached or exceeded Hurricanes Katrina and Rita in 2005.

3. Repairs of hurricane impacts to the dune and beach features of the CWPPRA project would be completed through hydraulic dredging of appropriate sediment to replace that lost through shoreline erosion. With approximately 372 ft^2 (34.6 m^2) of sediment removed from 19,000 ft (5,791 m) of beach, we would need to replace 262,000 yd^3 (200,313 m^3) of sediment.

Estimated Project Budget:

Construction:		
Mobilization and Demobilization: Lump Sum	$3,000,000	
Hydraulic Dredging (262,000 cu yd) @ $9.00/cu. Yd:	$2,358,000	
Sand Fencing: (9,000 linear ft.) $15.00/ft	$ 135,000	
Surveying: (Lump Sum)	$ 100,000	
Construction Costs:	$5,593,000	
Contingency (25%):	$1,398,250	
Total Construction plus Contingency:		$6,991,250
Professional Services:		
Engineering and Design:	$ 420,600	
Surveying:	$ 100,000	
Construction Admin:	$ 30,000	
Inspection:	$ 117,000	
Total professions Services:		$ 667,600
Total Estimated Project Budget:		**$7,658,850**

III. Operation Activity

This project has no operations and maintenance budget and no operations are required.

IV. Monitoring Activity

a. Monitoring Goals

The objectives for the Isles Dernieres Restoration Phase 0 (Trinity Island) project were to restore the coastal dunes of Trinity Island, reduce loss of sediment, and enhance the physical stability of Trinity Island utilizing hand planted vegetation.

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

1. Increase the height and width of Trinity Island and close breaches using dredged sediments.
2. Reduce loss of sediment through vegetative plantings, therefore increasing the stability of the island.

b. Monitoring Elements

Due to the morphological changes since the last sampling event in 2003 and the inception of the BICM, data collection procedures deviated from the July 23, 1998 monitoring plan. The following monitoring elements provide the methods used to gather the vegetation data in 2007 and the information obtained from the BICM program which was used to evaluate the specific goals of the project listed above.

Elevation

Topographic and bathymetric surveys were employed to document elevation and volume changes inside the Isles Dernieres Restoration Trinity Island (TE-24) project fill area. Pre-construction (1997) and as-built (1998) elevation data were collected using traditional cross sectional survey methods. Subsequent post-construction topographic surveys were conducted using Light Detection and Ranging (LiDAR) procedures (Brock et al. 2002). These post-construction surveys were performed in 2000 (John Chance Land Surveys, LTD), 2001 (USGS), 2002 (USGS), and 2006 (USGS). The latter survey and a separate bathymetric survey were funded through the BICM program in 2006 (Troutman et al. 2003). The bathymetric survey (USGS) recorded subaqueous elevations in the shoreface, inlet, and bay regions surrounding Trinity Island. The 2006 LiDAR and bathymetric surveys were joined to form a single continuous elevation contour of this barrier island. All survey data were established using or adjusted to tie in with the Louisiana Coastal Zone (LCZ) GPS Network. The 2001 and 2002 LiDAR data were not applied to the following analysis because these surveys were not filtered for vegetation; however, results from these two years are found in West and Dearmond (2004). 2000 and 2006 LiDAR data were filtered for vegetation and present a more accurate illustration of island topography.

The 1997, 1998, 2000, and 2006 survey data were re-projected horizontally to the Universal Transverse Mercator (UTM) North American Datum (NAD) of 1983 coordinate system and vertically to the North American Vertical Datum of 1988 (NAVD88) 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 TE-24 fill area polygon to estimate elevation and volume changes within the fill area.
Elevation changes from 1997-1998, 1998-2000, 2000-2006, and 1998-2006 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 TE-24 fill area were mapped in half meter elevation classes. Lastly, volume changes in the fill area 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.

Shoreline Change

Average shoreline change for the Isles Dernieres was derived from BICM program documents by combining the average shoreline change in feet per year of the 4 islands in the chain, Raccoon Island, Whiskey Island, Trinity Island and East Island and then dividing by four (4).

Vegetation

<u>1999-2003 Sampling</u>
Species composition and percent cover of vegetation were determined in 1999, 2001 and 2003 using the Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974; Folse & West 2005). The purpose of the initial vegetation sampling scheme was to sample the planted and unplanted areas monitor planting success. The vegetation sampling method and results for the time interval between 1999 and 2003 are described in the 2004 Operations, Maintenance and Monitoring Report for Trinity Island (West and Dearmond 2004).

<u>2007 Sampling</u>
In October of 2007, emergent vegetation was sampled using the Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974; Folse & West 2005). Previously sampled stations were superimposed on the 2005 Digital Orthophoto Quarter Quadrangle (DOQQ) photography and it was determined that many plots established gulfside had been consumed by erosion (figure 4). This observation was confirmed during the operations and maintenance inspection trip for barrier islands which took place on September 10, 2007. Because previously established stations were no longer accessible, a new sampling scheme was developed which would allow for future sampling, if necessary. The new sampling scheme catalogued the species found on the island, but did not sample to monitor planting success. Using the existing BICM bathymetric survey lines and ESRI® ArcMap™ software, lines (transects) were extended across the island. These transects were spaced 1500 feet apart (figure 5). It was decided to stop at transect 15 because of the influence of the New Cut (TE-37) project. Sediment from the TE-37 project was deposited gulfward of the eastern end of the TE-24 project boundary. Coordinates were generated every two (2) meters along each transect and assigned a numerical value to facilitate the random selection

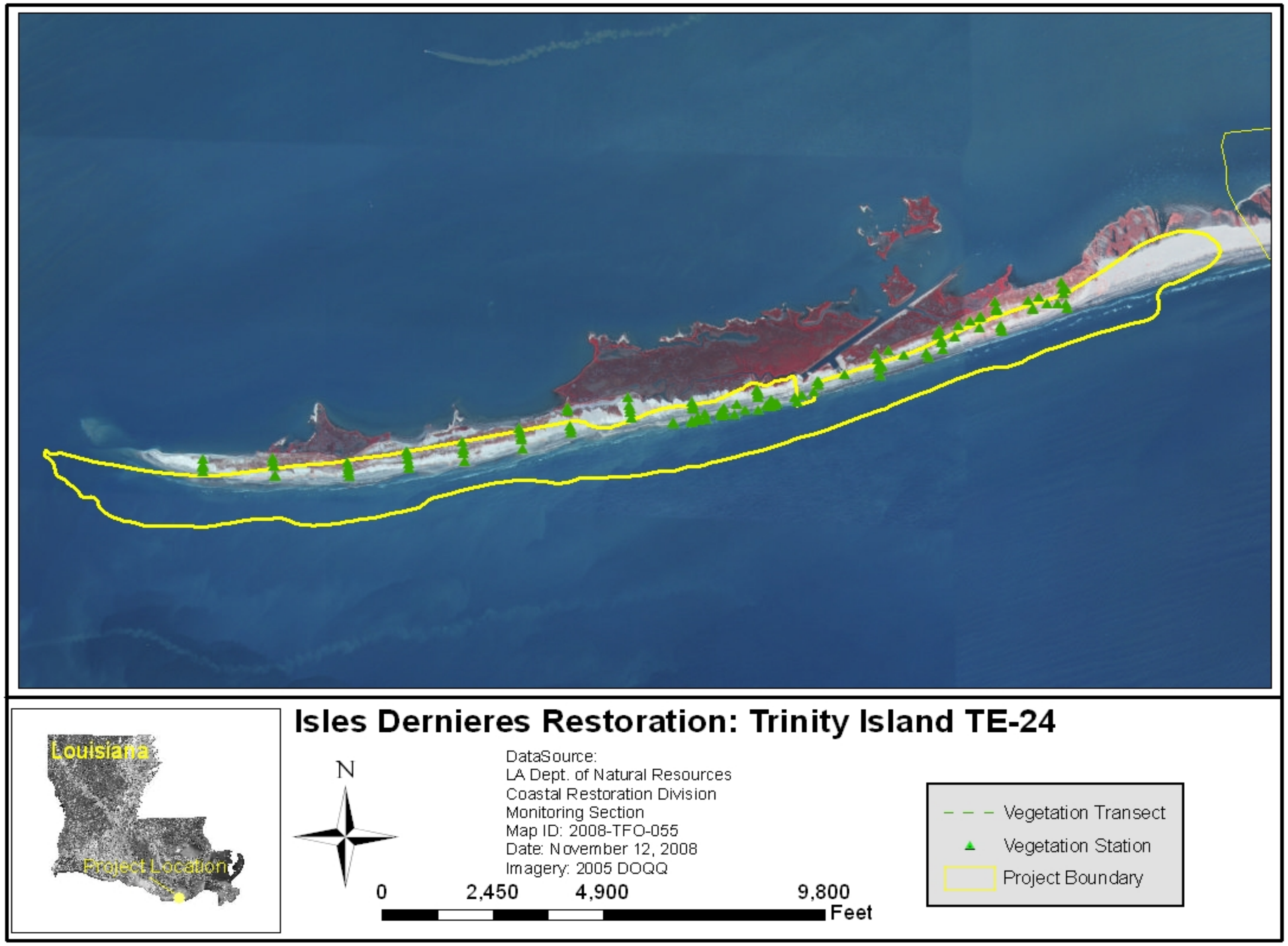

Figure 4. Vegetation sampling stations established prior to 2007 consumed by erosion at Isles Dernieres Restoration, Phase 0, Trinity Island (TE-24).

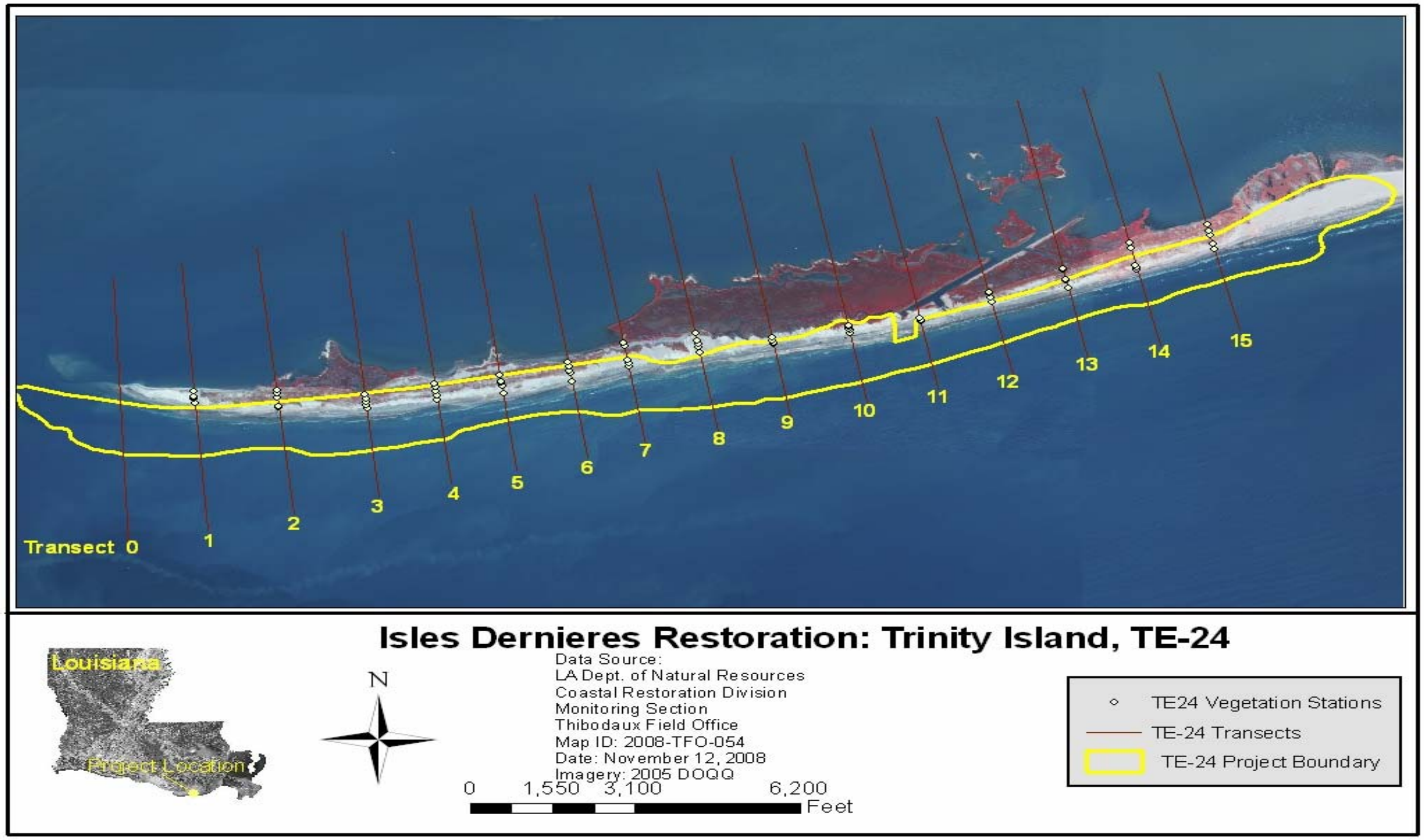

Figure 5. Vegetation transects and plots for the 2007 sampling scheme at Isles Dernieres Restoration, Phase 0, Trinity Island (TE-24).

process when establishing stations in the field. Files generated in ArcMap™ were then transferred to a DGPS with sub meter accuracy.

On sampling day, transects were located by a team of two field personnel using the Trimble GeoXT unit. Five (5) stations per transect were randomly chosen in the three (3) different regions of the transect. During the September 2007 trip, it was determined that the project had 3 different geomorphic regions: upslope, platform (barrier flat), and marsh. On Trinity Island, the upslope region consisted of the area closest to the Gulf of Mexico, where the sand/water interface begins, rising upward in elevation until the constructed platform region begins. The platform reaches the highest elevation in the center of the island. The marsh region begins as the platform decreases in elevation as it nears the bay side of the island. The overwash region is where sand from the upslope and platform was pushed by high water from the gulf into the marsh. Each region has a unique composition of emergent vegetation. When a transect was located, the team identified the first point at the edge of the vegetation in the upslope region, then walked through the upslope region until it transitioned into the platform region, where an additional point was collected. The team continued until the transition from platform to the marsh region.

When an overwash region was present it was included in the random selection process. All four regions did not exist along all transects. The team then decided how to divide the number of stations per region and then randomly selected the stations in each. Stations were then marked for the sampling teams with a PVC pole. Two additional teams sampled alternating plots along transects for efficiency. Plots were oriented in a North-South direction. Species in 4 m^2 plots were recorded, and visual estimates of percent cover for the total plot and individual species were made. Cover classes used were: solitary, <1%, 1-5%, 6-25%, 26-50%, 51-75%, and 76-100%. Vegetation outside of each plot but within 15 feet were also identified and recorded.

Based on time and budget constraints, it was determined that five (5) stations per transect would be the maximum sample size possible. The 5 stations per transect except transect 11 were divided amongst the regions based on the length of the region. Table 1 provides the number of stations for transects 1-15. A total of 73 stations were sampled.

The 2007 data were grouped by region and by transect to determine the relative mean percent cover for each species. Bare ground was included as a separate species. This analysis was calculated using SAS.

Table 1. Number of stations per region for each sampled transect.

Transect	Number of Upslope Stations	Number of Platform Stations	Number of Marsh Stations	Number of Overwash Stations
1	0	4	1	0
2	2	2	1	0
3	1	3	1	0
4	1	2	2	0
5	1	3	1	0
6	1	3	1	0
7	1	2	2	0
8	1	4	0	0
9	1	3	0	1
10	1	2	0	2
11	3	0	0	0
12	1	2	2	0
13	1	3	1	0
14	1	4	0	0
15	1	2	2	0
Total	17	39	14	3

Habitat Mapping

Habitat mapping has been determined for Trinity Island for 1996, 2002, 2004 and 2005 through the BICM program. The goal of BICM's habitat change analysis is to classify and compare the habitat types present along Louisiana's sandy shorelines for the four time periods. The habitat mapping was completed by the University of New Orleans Ponchartrain Institute for Environmental Sciences (UNO/PIES).

Habitat mapping consists of six steps to acquire the final product. Briefly, these steps include: (1) Mosaicking, which creates a complete image of the shoreline / island to be classified, (2) Clipping, a process that removes the surrounding water from the image, (3) Creating Signatures, which defines the spectral values of each habitat class, (4) Supervised Classification, which is the classification of the mosaic based on collected signature or Unsupervised Classification partitions the mosaic into a user defined number of spectral classes, (5) Manual Cleaning, which is the final differentiation between habitat classes, and (6) Final Classified Image. These steps utilize Erdas Imagine version 9.1 software and ArcGIS version 9.2 software. More detailed methods are found in Fearnley et al (2009).

c. Preliminary Monitoring Results and Discussion

Elevation

The Isles Dernieres Restoration Trinity Island (TE-24) project fill area experienced volume reductions and some shoreline transgressions since construction was completed in 1998. Elevation change and volume distributions for the TE-24 fill area are shown in figure 6 (1998-2006). Elevation change and volume distributions for 1997-1998, 1998-2000, and 2000-2006 are provided in Appendix B. Approximately, 3,421,533 yd^3 (2,615,950 m^3) of sediment were deposited during construction in 1998. In the post-construction period, sediment volume in the fill area decreased by 15% from 1998 to 2000 and 43% from 2000 to 2006. The total sediment volume loss in the fill area from 1998 to 2006 was approximately 1,765,714 yd^3 (1,349,985 m^3), a 51% reduction in volume.

The TE-24 project was considerably more successful in resisting shoreline erosion and retaining sediment volume than the Isles Dernieres Restoration East Island (TE-20) and the Whiskey Island Restoration (TE-27) projects (Rodrigue et al. 2008a; Rodrigue et al. 2008b). Several factors have enhanced the sustainability of the TE-24 project. One factor is the eastern border of Trinity Island is partially buffered from storm and geomorphic impacts by East Island. This factor is important because East Island (Rodrigue et al. 2008a; Barras 2006), Whiskey Island (Rodrigue et al. 2008b), and Timbalier Island (Barras 2006) all lost sizeable acreages on their eastern border since 2000 while Trinity Island did not. A second factor is the westward drifting longshore transport (Stone and Zhang 2001; Georgiou et al. 2005; Peyronnin 1962) on Isles Dernieres, which nourish Trinity Island with sediments removed from East Island. Although considerable quantities of the downdrift sediments from East Island were diverted into the New Cut Inlet, the closure of this inlet by the New Cut Dune/Marsh Restoration (TE-37) project in 2007 will enhance the sediment transport from East Island to Trinity Island and provide an additional sediment source. A third factor is the fairly large expanse of back barrier marshes limiting the effect of winter storms (Dingler and Reiss 1990; Boyd and Penland 1981; Georgiou et al. 2005) on the TE-24 fill area. However, exposed portions of the bay shoreline have been subjected to volume reductions (Appendix B). Though TE-24 retained a greater percentage of sediments than TE-20 and TE-27, the fill area was condensed to half its volume through geomorphic and storm processes.

Elevation grid models for the 1997, 1998, 2000, and 2006 surveys are provided in Appendix C. The pre-construction (1997) elevation grid model shows a minimum elevation of -5.6 ft (1.70 m) and a maximum elevation of 6.3 ft (1.92 m). The as-built (1998) model shows a minimum elevation of -0.03 ft (-0.01 m) and a maximum elevation of 9.0 ft (2.75 m). The 2000 elevation grid model shows a minimum elevation of -3.5 ft (-1.08 m) and a maximum elevation of 21.1 ft (6.44 m). The 2006 elevation grid model shows a minimum elevation of -7.6 ft (-2.328 m) and a maximum elevation of 12.7 ft (3.87 m).

Shoreline transgressions and volume losses are particularly evident along the central portion of the gulf shoreline and the western edge of the TE-24 fill area was reshaped during the 2005 hurricane season (Barras 2006).

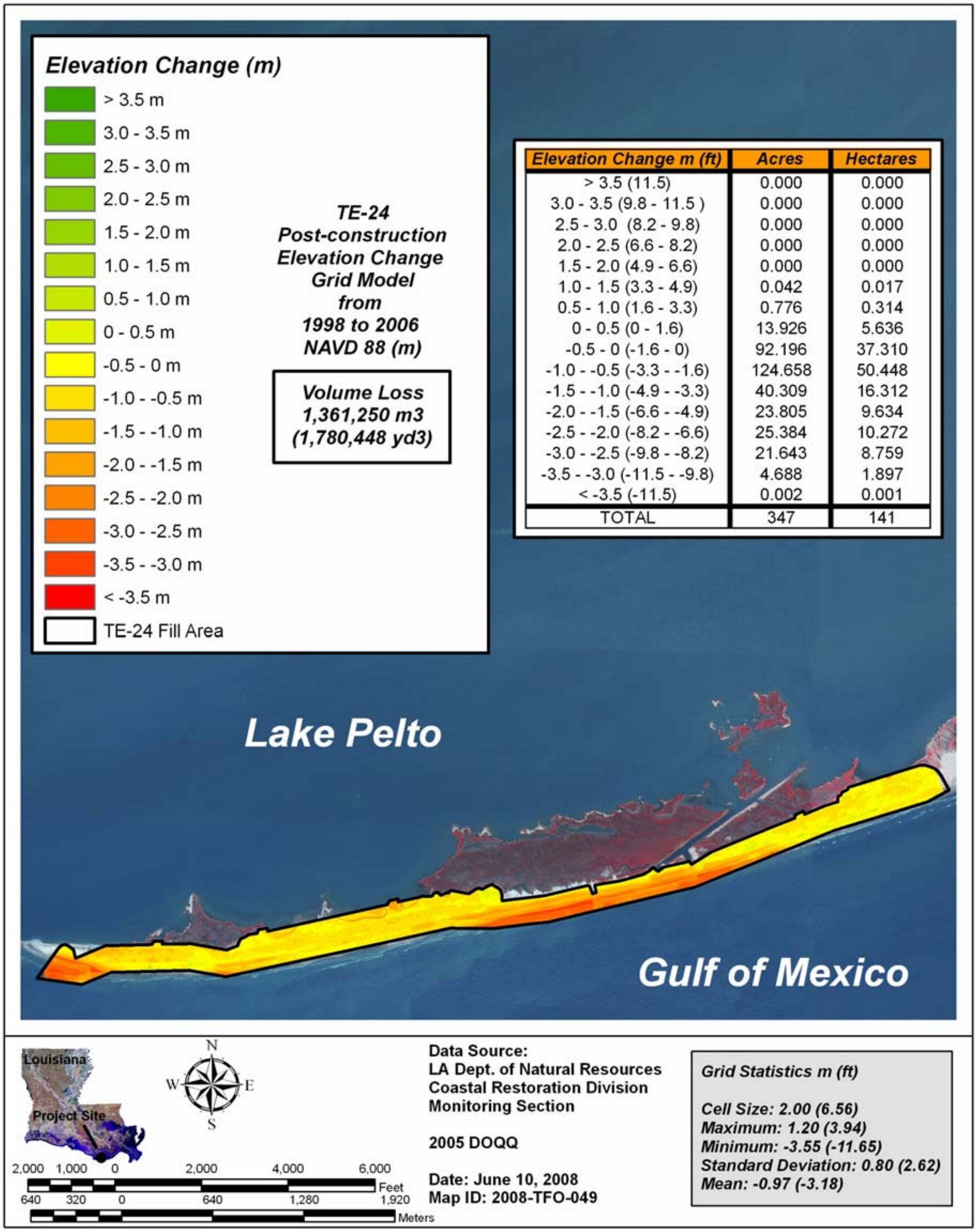

Figure 6. Isles Dernieres Restoration, Phase 0, Trinity Island (TE-24) post-construction (1998-2006) elevation and volume change map.

Shoreline Change

As a part of the BICM program, shoreline change analysis was performed along Trinity Island as well as the entire Louisiana coastal shoreline. Documents show the rate of shoreline change on Trinity Island in average feet per year for four (4) different time periods. The 2004-2005 rate is associated with the passing of Hurricanes Katrina and Rita. Shoreline change rates for Trinity Island are greater than those of the Isles Dernieres combined from the 1800's-2005, 1920's-2005 and 1990's-2005, but less in 2004-2005. The rate of erosion has increased over the last century. Data is shown in table 2.

Table 2. Shoreline change rate (feet per year) comparison for different period ranges between Trinity Island and the Isles Dernieres island chain.

	1800's-2005	1920-2005	1990's-2005	2004-2005
Trinity Island	-37.2	-36.7	-40.8	-95.4
Isles Dernieres	-34.1	-34	-32.9	-124.3

Vegetation

On Trinity Island, the upslope region contained 16 different plant species, including bare ground (figure 7). Bare ground was treated as an individual species and assigned a cover value. The platform region contained 23 total species and the marsh region showed the most diversity with 27 total species, all regions including bare ground. The relative mean percent cover of bare ground was 67.7 on the upslope, 39.1 on the platform, 25.97 on the overwash and 20.7 percent on the marsh region.

As vegetation becomes established on barrier islands, distinct vegetative regions may form (Hester et al. 2005). The vegetation in the upslope or dune region assists sand collection and dune formation, which in turn allows the swale (the platform region of TE-24) to form. The swale region, or platform in this project, is a less stressful habitat for vegetation than the upslope or dune habitat, therefore more diverse in species content (Hester et al. 2005) not seen on the constructed platform region of Trinity Island. Back barrier marshes may have two (2) zones of vegetation, high and low marsh, in which environmental stressors can further limit vegetative diversity in an already specialized plant community. On Trinity Island, the marsh region contained the greatest number of species.

The relative mean percent cover of *Spartina patens* in the upslope region was 13.6, 10.3 on the platform, 38.9 on the overwash and 13.4 in the marsh. The relative mean percent cover of *Panicum amarum* was 0.3 on the upslope, 5.95 on the platform and 0.3 on the overwash. No *Panicum amarum* was found in plots in the marsh region. Other species frequently found included *Croton punctatus, Phyla nodiflora, Solidago*

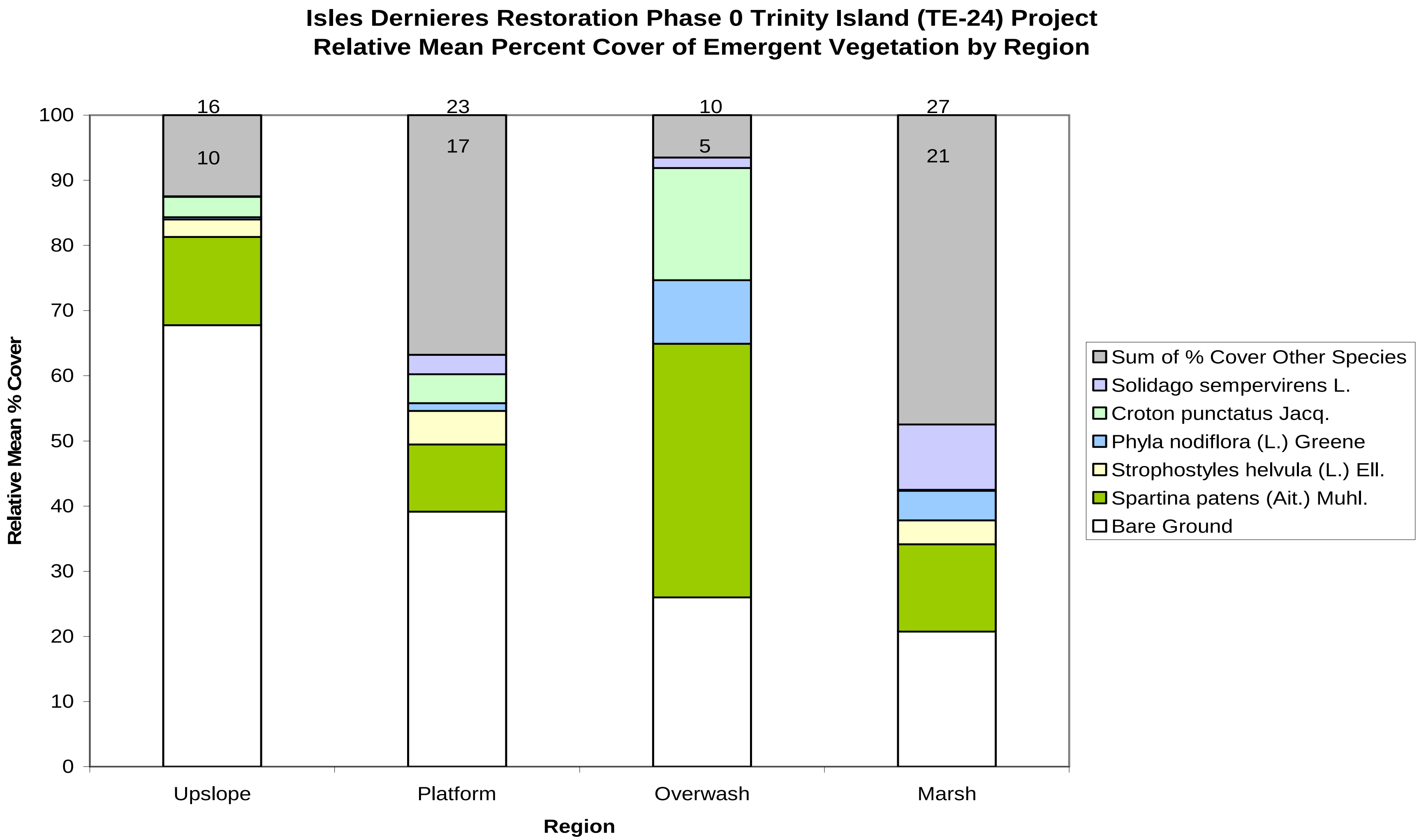

Figure 7. Relative mean percent cover of emergent vegetation by region.

sempervirens and *Strophostyles helvula* (figure 7).

The relative mean percent cover per transect refers to the percent cover of an individual species, measured in five plots, across an entire transect, through the 4 different regions of Trinity Island. At the time of sampling, transect 15 was the most diverse, with 18 species identified. A total of forty-two (42) species were identified in or within 15 feet of the vegetation sampling plots on Trinity Island. No remarkable trends were observed with regard to species cover by transect (figure 8).

Table 3 illustrates the number of species found in, or both inside and within 15 feet of vegetation plots for all years sampled. This table also shows the total number of species found on Trinity Island each year vegetation was sampled. The total number of species is the number found in the plots, both in the plots and within 15 feet of a plot and species found outside, but within 15 feet of a plot. A total of forty-two (42) species were identified in or within 15 feet of the vegetation sampling plots on Trinity Island.

Table 3. Number of plant species found inside all stations and the total number of plant species found including outside the stations sampled by year.

	1999	2001	2003	2007
In	9	18	27	37
Total	24	25	31	42

Habitat Mapping

The BICM program funded habitat classification and change analysis for four (4) years of photography (1996, 2000, 2004, and 2005). This analysis was for Trinity Island, not specific to the TE-24 project boundary. The habitat classes used for classification included: water, intertidal flat, marsh, barrier vegetation, bare land, beach, rip rap, and structure. This particular island had no rip rap or structures classified in any of the 4 time periods. Table 4 summarizes the acres of each habitat class for each time period.

Table 4. BICM Habitat Change Analysis: Trinity Island Habitat Classification – 1996, 2002, 2004, and 2005.

Habitat Classes	1996	2002	2004	2005
Water	2868.50	2749.62	2877.75	2764.46
Intertidal Flat	143.09	214.90	96.49	279.77
Marsh	408.21	235.81	234.65	225.17
Barrier Vegetation	6.45	46.82	165.07	10.87
Bare Land	14.42	323.40	233.93	83.13
Beach	188.26	56.60	17.35	261.87
Rip Rap	0.00	0.00	0.00	0.00
Structure	0.00	0.00	0.00	0.00

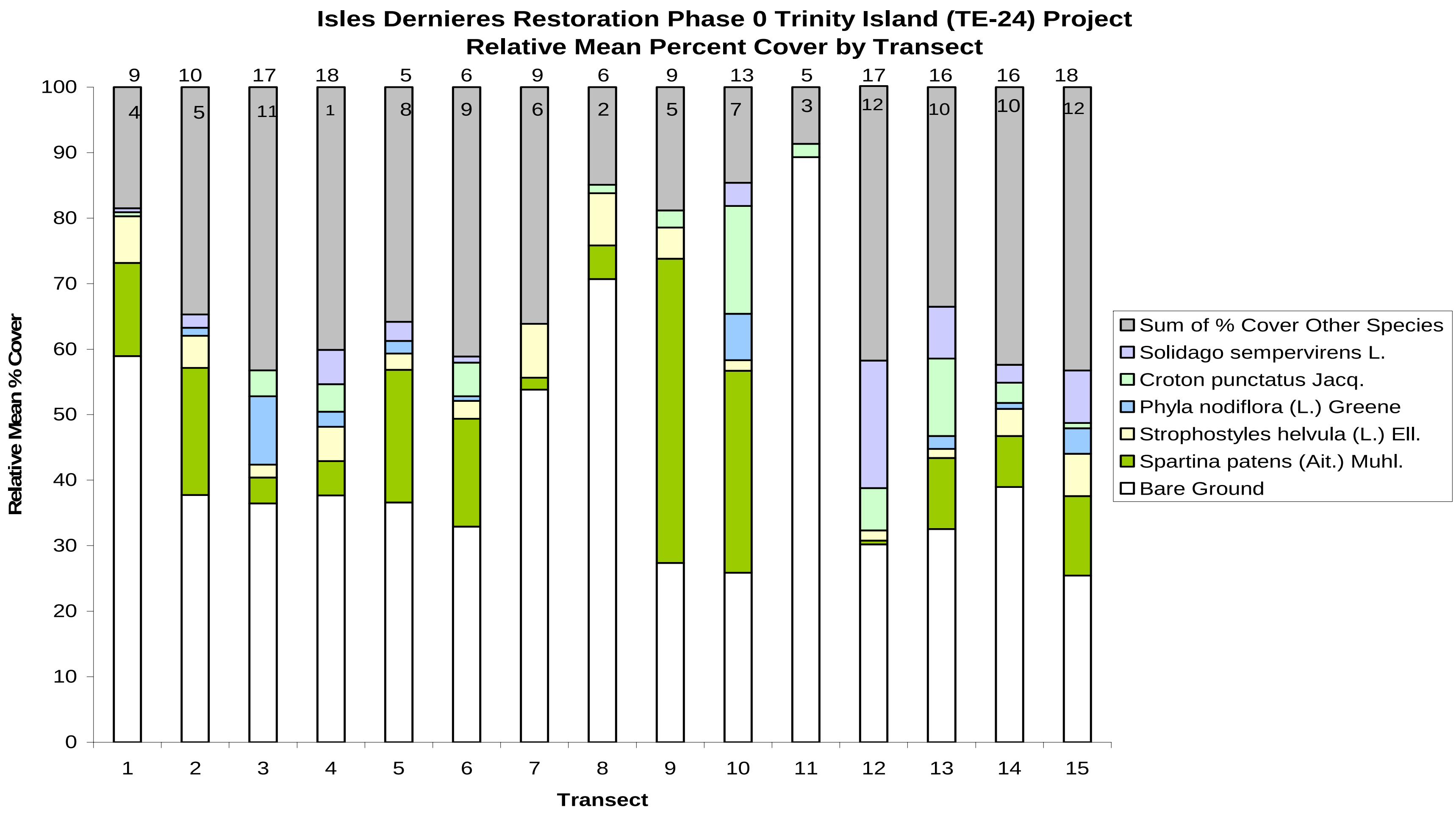

Figure 8. Relative mean percent cover of emergent vegetation by transect.

Figures for each time period showing the habitat classes are in Appendix D. When comparing the 1996 and 2002 figures, the TE-24 project area is very distinctive. It is represented by a majority of bare land with some barrier vegetation classification and beach along the gulf side. Both the gulf side and bay side show some intertidal marsh areas. Although vegetative composition and cover was not collected in the same year as the photography of 2002, vegetative composition and cover was collected in 2001 and 2003. Results from those sampling periods provided bare land between 60 and 95 percent depending on the region sampled (West and Dearmond 2004). These two sampling efforts support the classification of the project area for 2002. Unfortunately, there was no other vegetative data collection between 2003 and 2005 to compare / support the habitat classification efforts.

Figures illustrating the habitat change classification for 1996 to 2002, 2002 to 2004, 2004 to 2005, and 1996 to 2005 are presented in Appendix E. Data from those figures are presented in table 5 for all time periods. The most dramatic transformation in the project area between the 2004 and 2005 periods includes the areas that were classified as bare land and barrier vegetation in 2004 have been mostly converted to beach and bare land habitat as a result of the 2005 hurricanes. Habitat mapping has not been conducted on any photography after 2005; consequently, there are not supporting data sets for the impacts of the 2008 hurricanes.

V. Conclusions

a. Project Effectiveness

One of the goals of the project was to increase the height and width of Trinity Island and close breaches using dredged material. Data collection efforts post-construction show the elevation of the project area increased an average of 6.1 ft (1.86 m). Eight years post-construction, the mean elevation was 2.92 ft (0.89 m) higher than pre-construction mean elevations. The project area has been narrowing as a result of gulfside and bayside erosion where there were no existing marshes. Where the island is experiencing erosion, the elevation in those areas is lower than pre-construction elevations. However, overall the project area has remained for the most part above the pre-construction elevations. As recorded by the hurricane damage assessment of 2008, no breaches have formed thus far in the project area.

The second goal of the project was to reduce the loss of sediment through vegetative plantings, therefore increasing the stability of the island. This report does not dispute the project effectiveness as stated in the 2004 OM&M report (West and Dearmond 2007) as it relates to the vegetative component of the project goal. Since that report was composed, the island has experienced several more tropical systems, notably hurricanes Katrina and Rita in 2005 and hurricanes Gustav and Ike in 2008. In 2007,

Table 5. BICM Habitat Change Classification Analysis: Trinity Island Habitat Classification – 1996 to 2002, 2002 to 2004, and 2004 to 2005.

Habitat Change Class (From - To)	1996 - 2002 Acreages	2002 - 2004 Acreages	2004 - 2005 Acreages
water - water	2586.46	2724.95	2731.23
intertidal flat - water	45.15	107.48	11.07
marsh - water	15.51	19.63	10.65
barrier vegetation - water	2.66	3.12	1.69
bare land - water	2.07	8.92	8.32
beach - water	96.56	13.57	1.48
water - intertidal flat	112.92	12.95	108.85
intertidal flat - intertidal flat	34.89	63.71	47.55
marsh - intertidal flat	28.40	6.13	47.18
barrier vegetation - intertidal flat	1.29	0.18	30.44
bare land - intertidal flat	1.53	2.46	34.70
beach - intertidal flat	35.86	11.03	11.05
water - marsh	10.79	0.70	20.45
intertidal flat - marsh	14.89	11.66	10.90
marsh - marsh	204.94	201.85	166.41
barrier vegetation - marsh	0.83	15.20	20.96
bare land - marsh	2.22	3.93	6.26
beach - marsh	2.14	1.30	0.19
water - barrier vegetation	8.64	1.25	0.05
intertidal flat - barrier vegetation	3.74	7.29	0.03
marsh - barrier vegetation	25.54	6.73	0.54
barrier vegetation - barrier vegetation	0.63	22.53	7.26
bare land - barrier vegetation	4.10	118.37	2.99
beach - barrier vegetation	4.18	8.90	0.00
water - bare land	134.24	7.28	0.37
intertidal flat - bare land	34.65	22.54	0.07
marsh - bare land	119.05	1.46	2.81
barrier vegetation - bare land	0.79	5.68	35.61
bare land - bare land	3.86	185.32	44.27
beach - bare land	30.81	11.65	0.00
water - beach	12.51	0.45	16.80
intertidal flat - beach	9.69	2.22	26.88
marsh - beach	14.74	0.01	7.07
barrier vegetation - beach	0.32	0.11	69.11
bare land - beach	0.63	4.40	137.38
beach - beach	18.71	10.15	4.63

prior to the 2008 hurricanes, forty-two (42) plant species were documented; the highest number of species recorded during project sampling. Although the sampling scheme was different in 2007, forty-two (42) species constitutes high diversity for a barrier island.

b. Recommended Improvements

The O&M plan should define critical limits for the project area. Once these critical limits are reached, discussions within the CWPPRA and restoration community should commence on how to replenish the sediment that migrated from the project area.

Allocation of funding for maintenance of barrier island restoration projects was not considered due to the expense involved with replenishment of dredged material over the life expectancy of the project. Claims for FEMA assistance resulting from extensive or catastrophic damage to barrier islands from tropical storms and hurricanes are ineligible because there is no scheduled maintenance. Based on monitoring activity of the Isles Dernieres, it has been documented that these barrier islands are experiencing significant land loss due to barrier island rollover and island narrowing resulting from tropical and winter storm events. Therefore, it is recommended that maintenance funds be provided for the implementation of an inspection and maintenance program for assessment and replacement of dredged sediment and sand fencing necessary to maintain the integrity of these islands. The implementation of a maintenance program for barrier island projects would enable these projects to qualify for assistance under the Federal Emergency Management Program.

New projects should include a marsh component along with the gulfside restoration efforts. It has been noted that as the project area and other island's project areas get overwashed, the marsh platform on the bayside captures the sand from the gulfside. This helps to keep the dredged material on the island and conserves elevation for the next event that occurs. Also, the marsh component keeps the dredged material in the barrier island system much longer.

Monitoring should include the entire island system, not just the project area as outlined during the project planning stages. Construction may not directly affect regions outside of the project area. However, through time and natural processes, the dredged materials migrate outside of the project area. Monitoring only the project area causes difficulty in analyzing how much material or benefit the entire island has received.

c. Lessons Learned

Barrier islands are often exposed to storm events resulting in substantial over-wash and breaching. It is important that a continuous dune of sufficient height and width is maintained on these islands to combat these processes. Sediment fencing has proven to be an effective technique in rebuilding dunes by capturing wind blown sediment and is less costly than periodically replenishing sediment by hydraulic dredge. We have learned from past projects that orienting the sediment fencing parallel to the shore face and perpendicular to the predominant wind direction has maximized the potential for maintaining a viable dune section.

The combined use of dredged sediment, sand fencing, and vegetative plantings are plausible ways to create quasi-stabilization and prolong the lives of barrier islands. The construction of sand fencing as well as vegetative planting should occur as soon as possible after the placement of dredged sediment to minimize loss. A different vegetative planting design must be determined to allow vegetative colonization quickly in order to maximize sediment stabilization.

The original vegetation sampling set up was such that plots were established along original plantings. This pattern placed most plots near the gulfside or bayside of Trinity Island. Most original plots are now open water, due to the migration of the island. The original set up was not conducive to a 20 year monitoring period, because of the ephemeral nature of barrier islands. In future situations, it may be more feasible to establish plots along transects as was done in the 2007 vegetation sampling season. The coordinates of the transects will not change, and the transects could be extended as the island migrates. Individual plots along transects may have to be reestablished to compensate for island migration or erosion, but with the 2007 method statistical comparisons will be possible throughout the life of the project.

Lessons learned from the initial percent survival sampling include a need for flexibility in sampling method in case the actual plantings do not match the intended plantings (cf. Townson et al. *Unpublished*). This need for flexibility can include resizing plots or increasing the number of the plots established.

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Appendix A

Photos from Damage Assessment Field Trip

BICM oblique aerial photos of California Canal Dock in 2005 (post-Katrina and Rita) and 2007. Note that landowner placed some material from canal back onto beach. (Photos courtesy of UNO/PIES)

OCPR oblique aerial photos of California Canal Dock on September 24, 2008 (post-Ike).

BICM oblique aerial photos of Trinity Bayou camps in 2005 (post-Katrina and Rita) and 2007. (Photos courtesy of UNO/PIES)

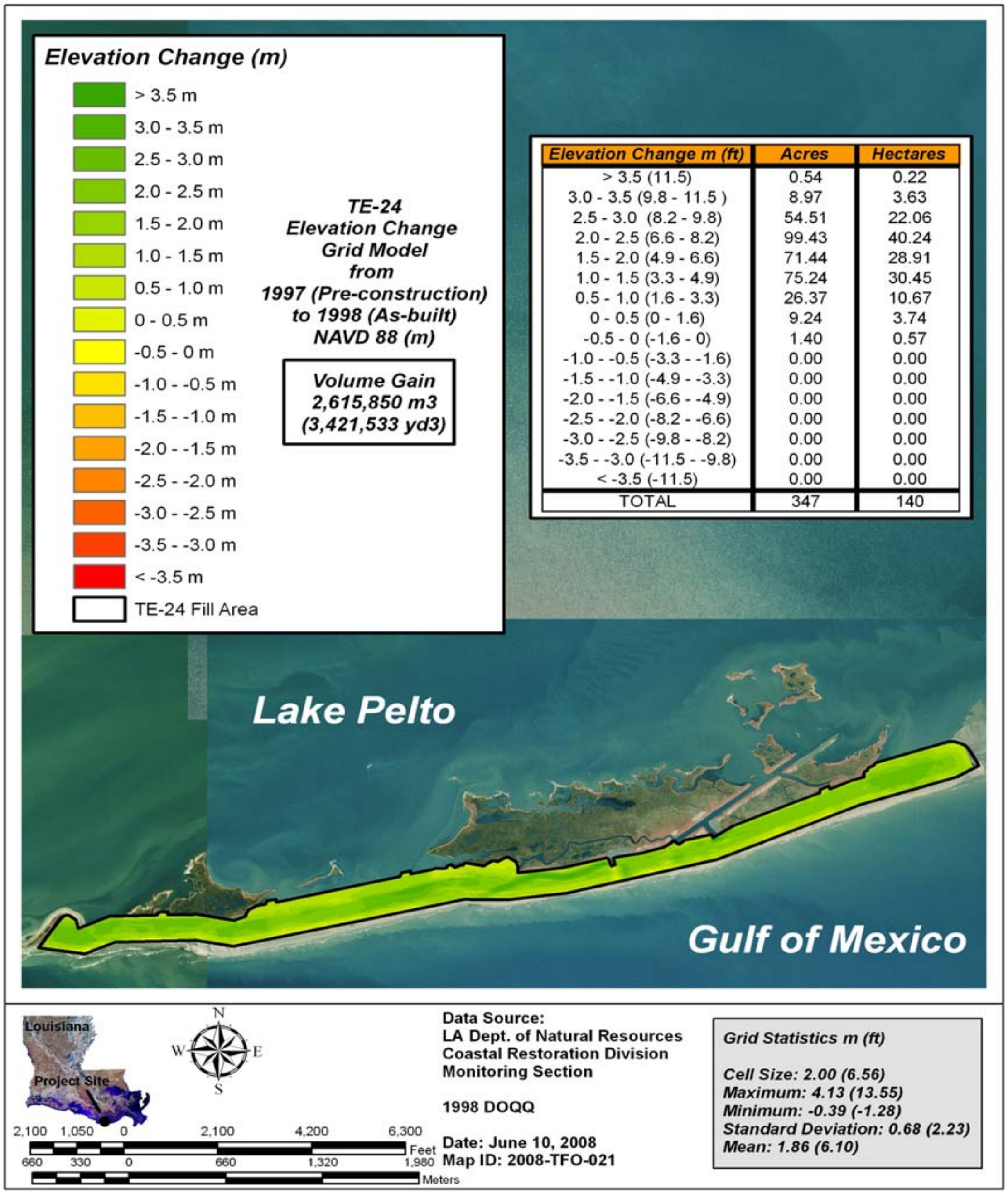
OCPR oblique aerial photos of trinity Bayou camps on September 24, 2008 (post-Ike).

BICM oblique aerial photos of western end of Trinity Island in 2005 (post-Katrina and Rita) and 2007. (Photos courtesy of UNO/PIES)

OCPR oblique aerial photos of western end of Trinity Island on September 24, 2008 (post-Ike).

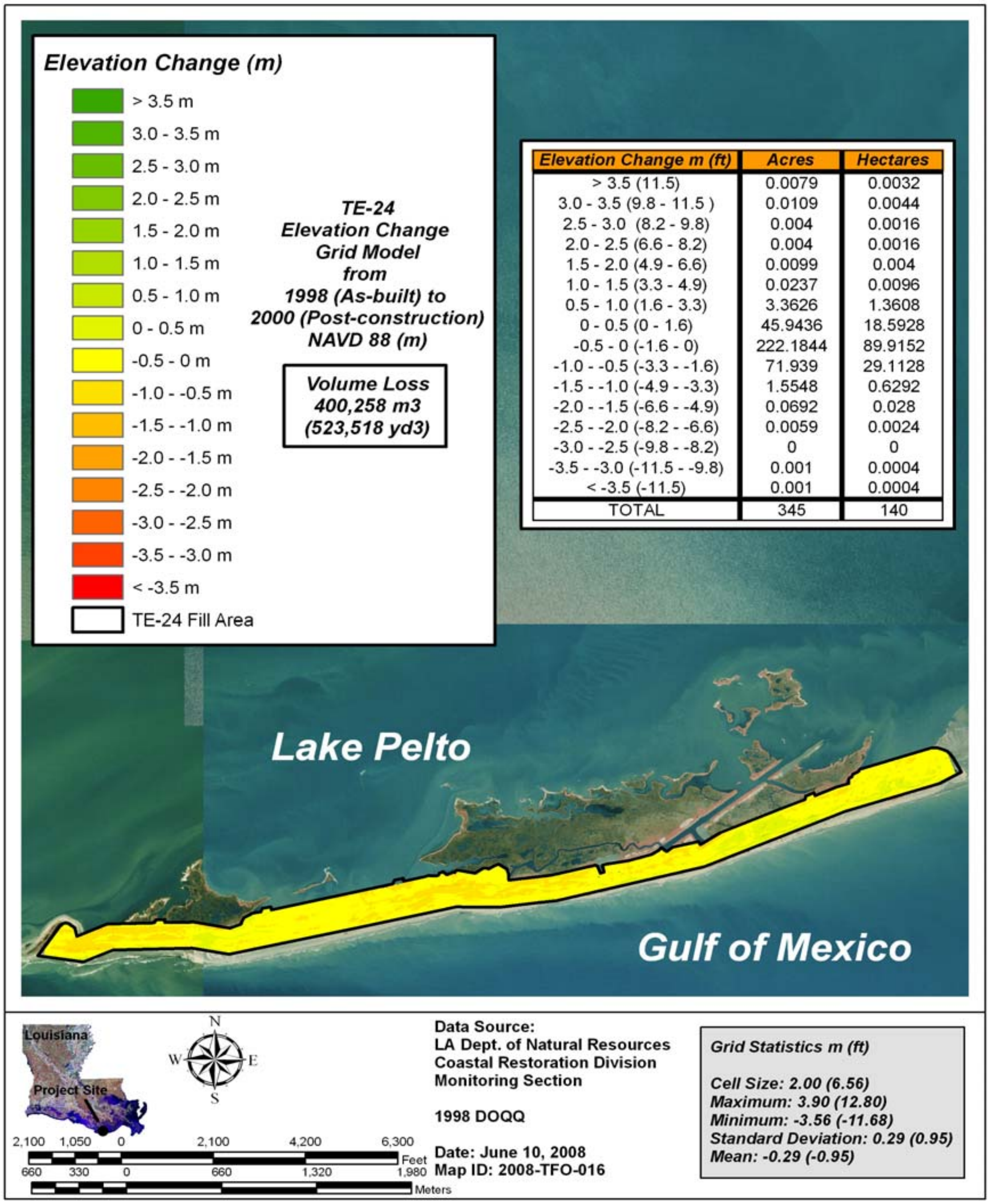
Appendix B

Elevation Change Models

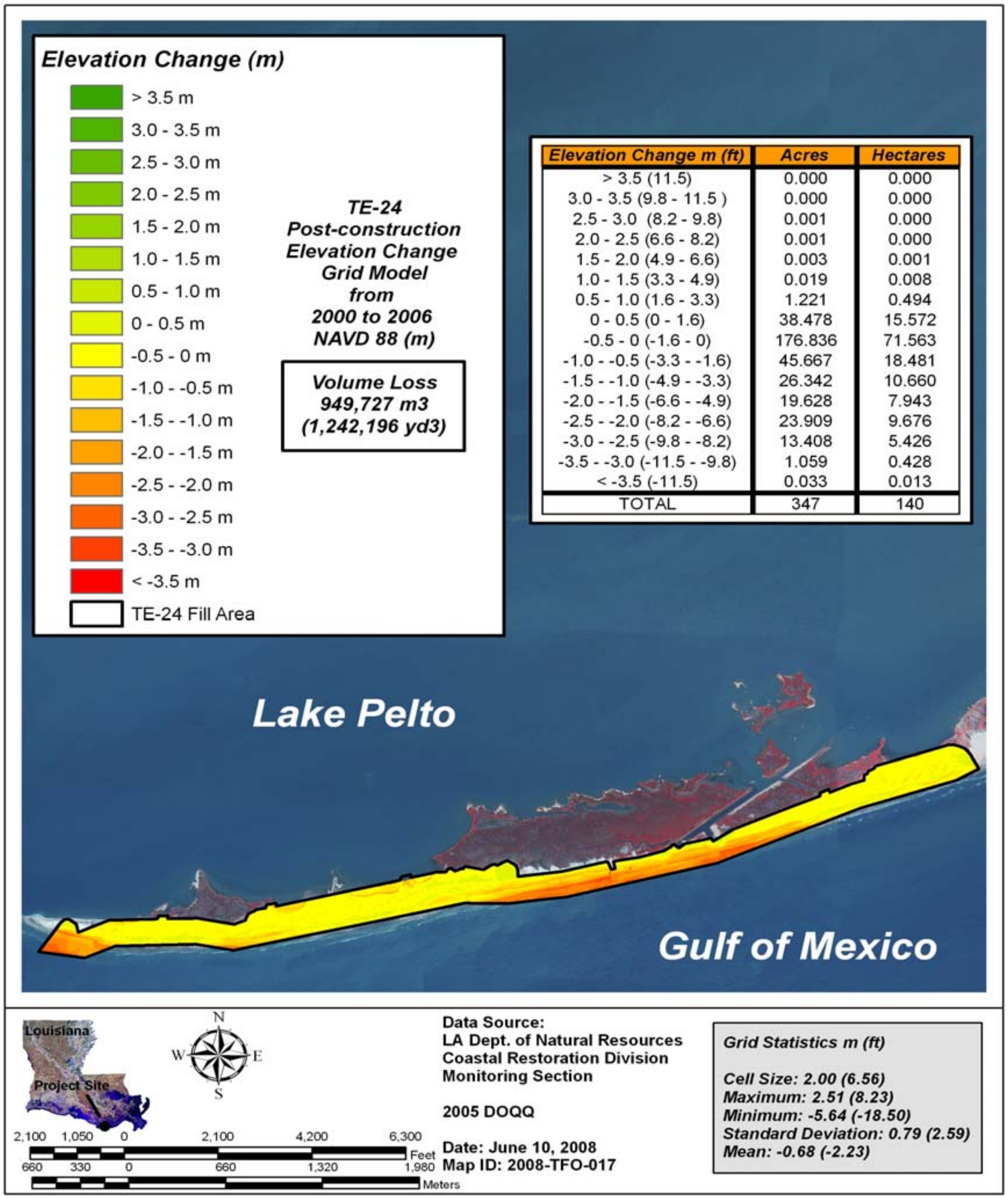


Elevation Change m (ft)	Acres	Hectares
> 3.5 (11.5)	0.54	0.22
3.0 - 3.5 (9.8 - 11.5)	8.97	3.63
2.5 - 3.0 (8.2 - 9.8)	54.51	22.06
2.0 - 2.5 (6.6 - 8.2)	99.43	40.24
1.5 - 2.0 (4.9 - 6.6)	71.44	28.91
1.0 - 1.5 (3.3 - 4.9)	75.24	30.45
0.5 - 1.0 (1.6 - 3.3)	26.37	10.67
0 - 0.5 (0 - 1.6)	9.24	3.74
-0.5 - 0 (-1.6 - 0)	1.40	0.57
-1.0 - -0.5 (-3.3 - -1.6)	0.00	0.00
-1.5 - -1.0 (-4.9 - -3.3)	0.00	0.00
-2.0 - -1.5 (-6.6 - -4.9)	0.00	0.00
-2.5 - -2.0 (-8.2 - -6.6)	0.00	0.00
-3.0 - -2.5 (-9.8 - -8.2)	0.00	0.00
-3.5 - -3.0 (-11.5 - -9.8)	0.00	0.00
< -3.5 (-11.5)	0.00	0.00
TOTAL	347	140

Elevation and volume change grid model from pre-construction (1997) to as-built (1998) at the Isles Dernieres Restoration, Phase 0, Trinity Island (TE-24) project.



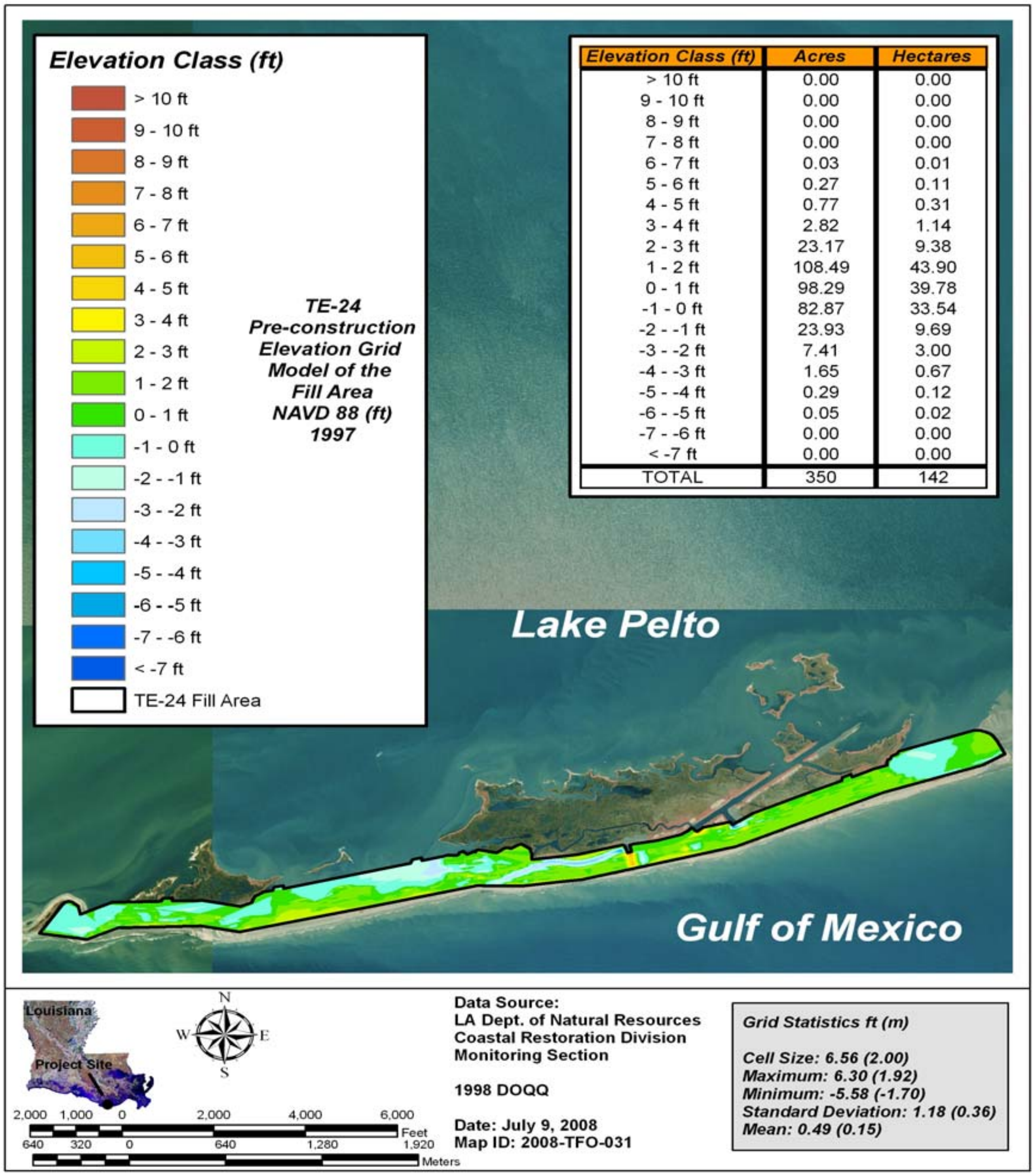
Elevation and volume change grid model from as-built (1998) to post-construction (2000) at the Isles Dernieres Restoration, Phase 0, Trinity Island (TE-24) project.



Post-construction elevation and volume change grid model from 2000 to 2006 at the Isles Dernieres Restoration, Phase 0, Trinity Island (TE-24) project.

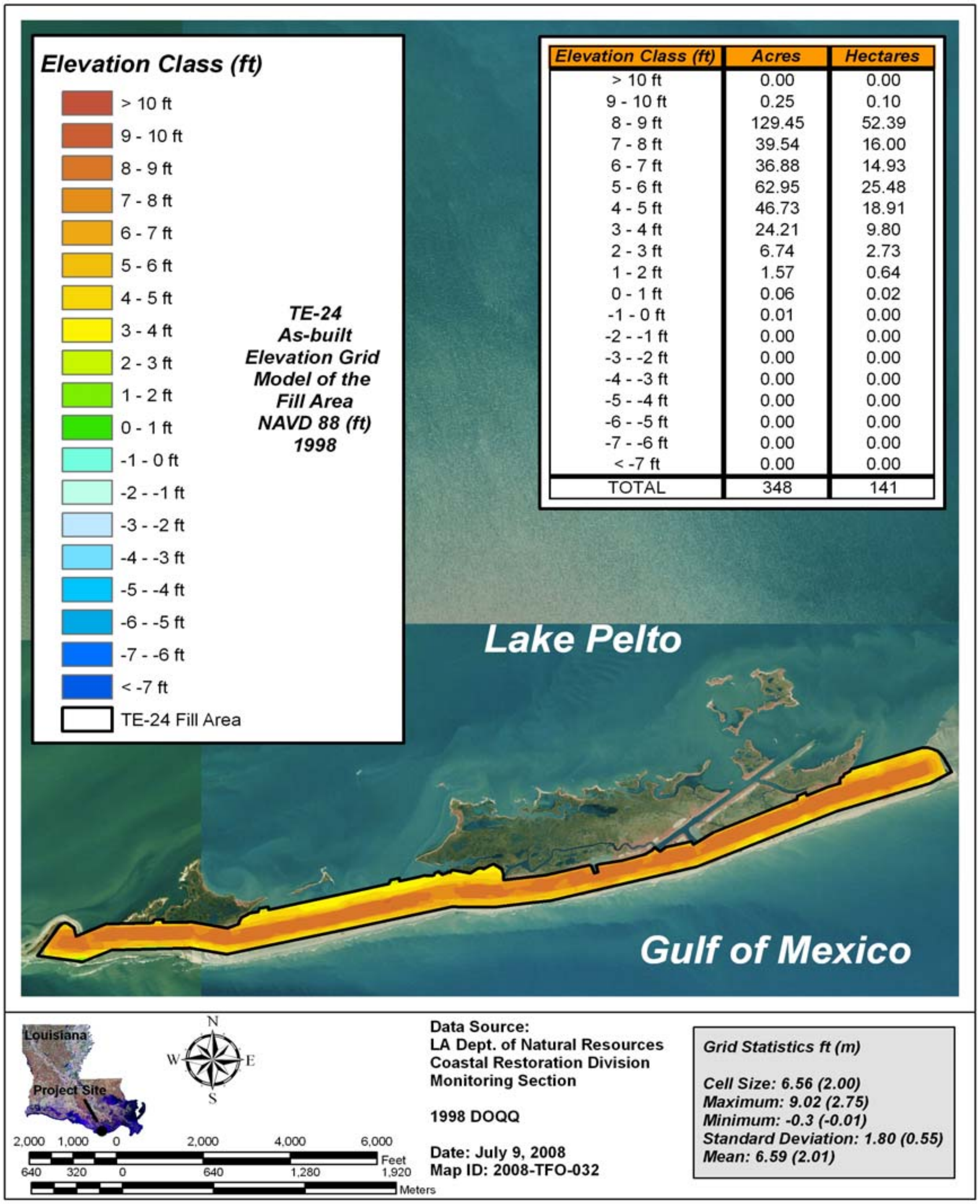
Appendix C

Elevation Grid Models

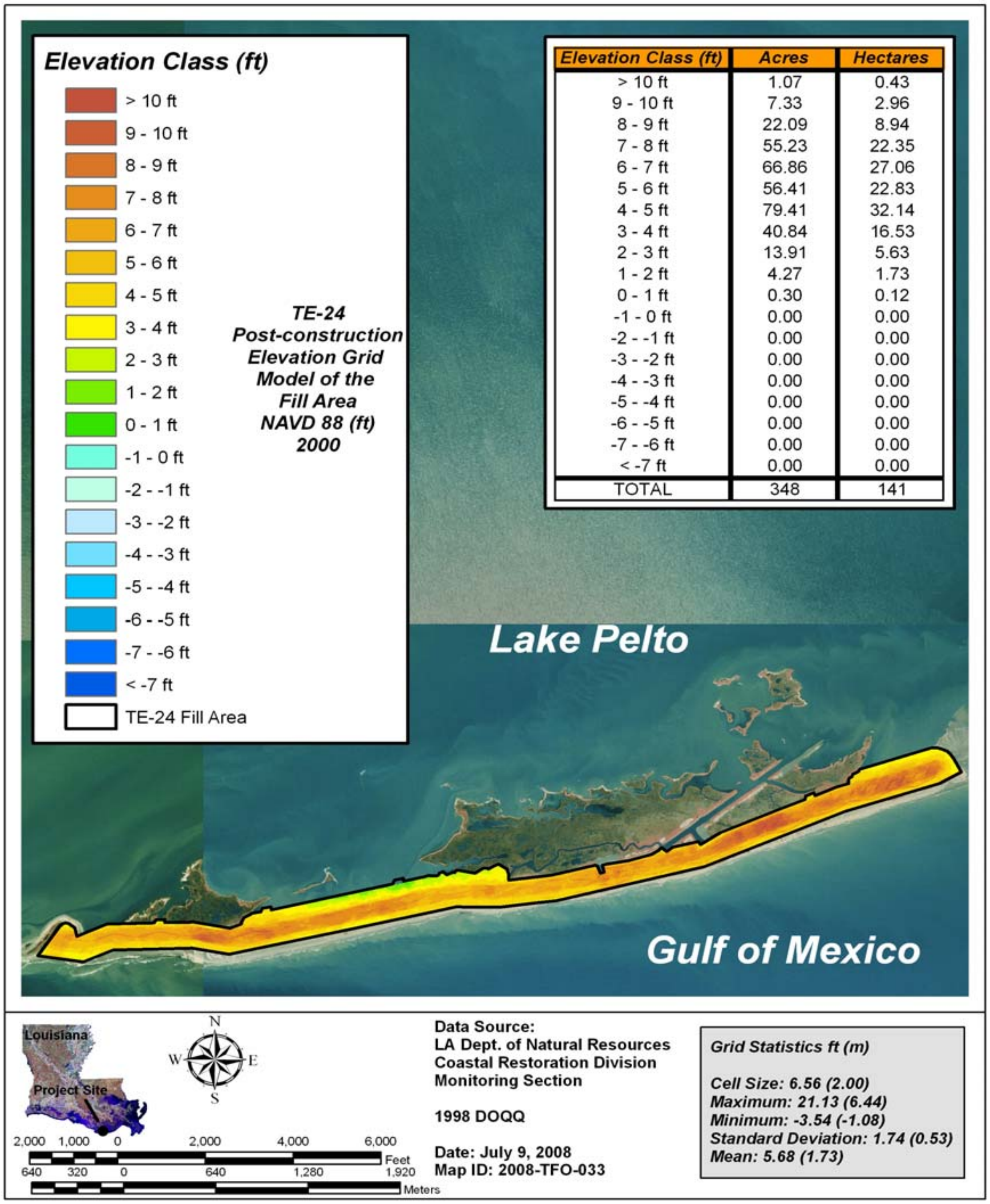


Elevation Class (ft)	Acres	Hectares
> 10 ft	0.00	0.00
9 - 10 ft	0.00	0.00
8 - 9 ft	0.00	0.00
7 - 8 ft	0.00	0.00
6 - 7 ft	0.03	0.01
5 - 6 ft	0.27	0.11
4 - 5 ft	0.77	0.31
3 - 4 ft	2.82	1.14
2 - 3 ft	23.17	9.38
1 - 2 ft	108.49	43.90
0 - 1 ft	98.29	39.78
-1 - 0 ft	82.87	33.54
-2 - -1 ft	23.93	9.69
-3 - -2 ft	7.41	3.00
-4 - -3 ft	1.65	0.67
-5 - -4 ft	0.29	0.12
-6 - -5 ft	0.05	0.02
-7 - -6 ft	0.00	0.00
< -7 ft	0.00	0.00
TOTAL	350	142

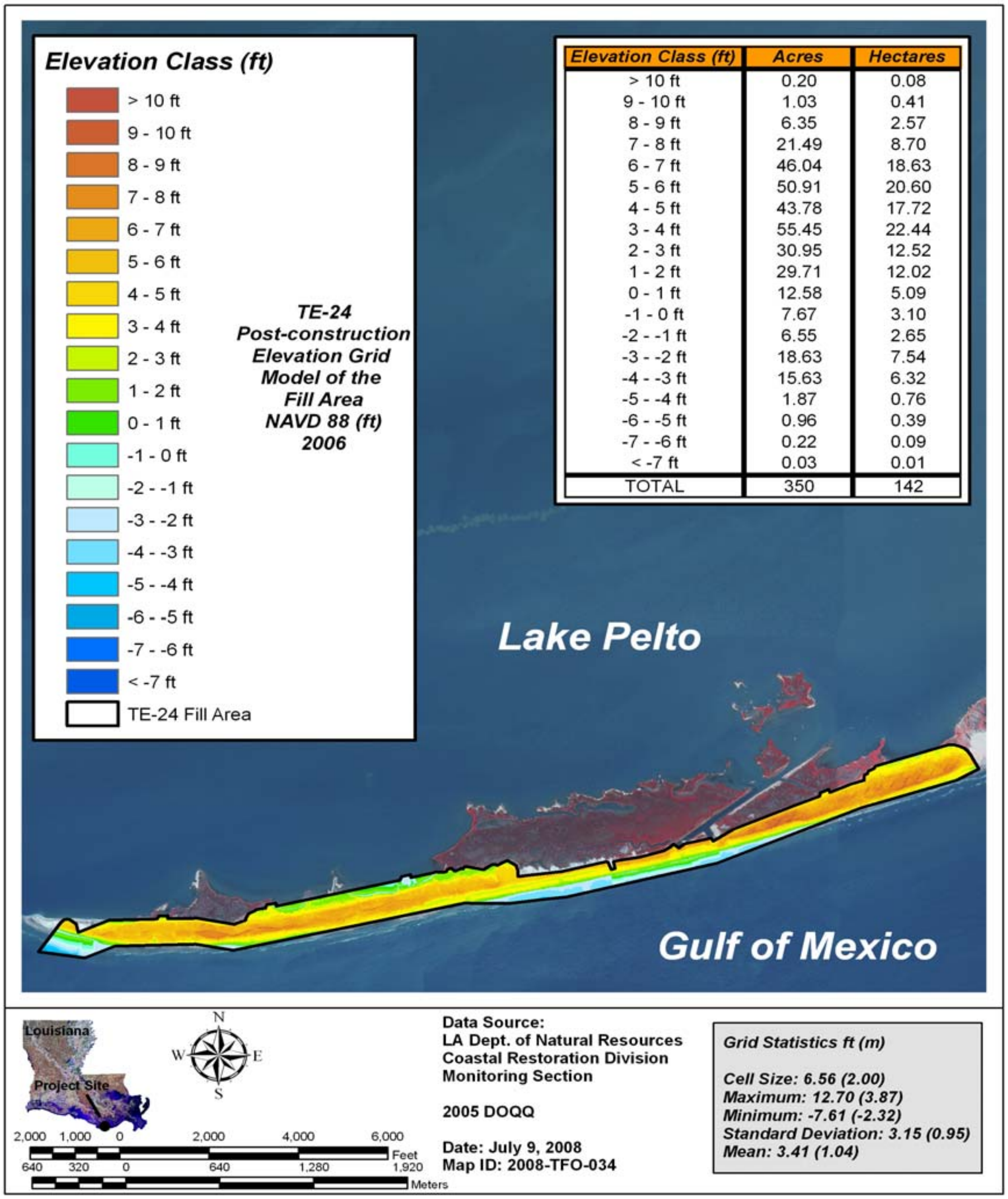
Pre-construction (1997) elevation grid model at the Isles Dernieres Restoration, Phase 0, Trinity Island (TE-24) project.



As-built (1998) elevation grid model at the Isles Dernieres Restoration, Phase 0, Trinity Island (TE-24) project.



Post-construction (2000) elevation grid model at the Isles Dernieres Restoration , Phase 0,Trinity Island (TE-24) project.

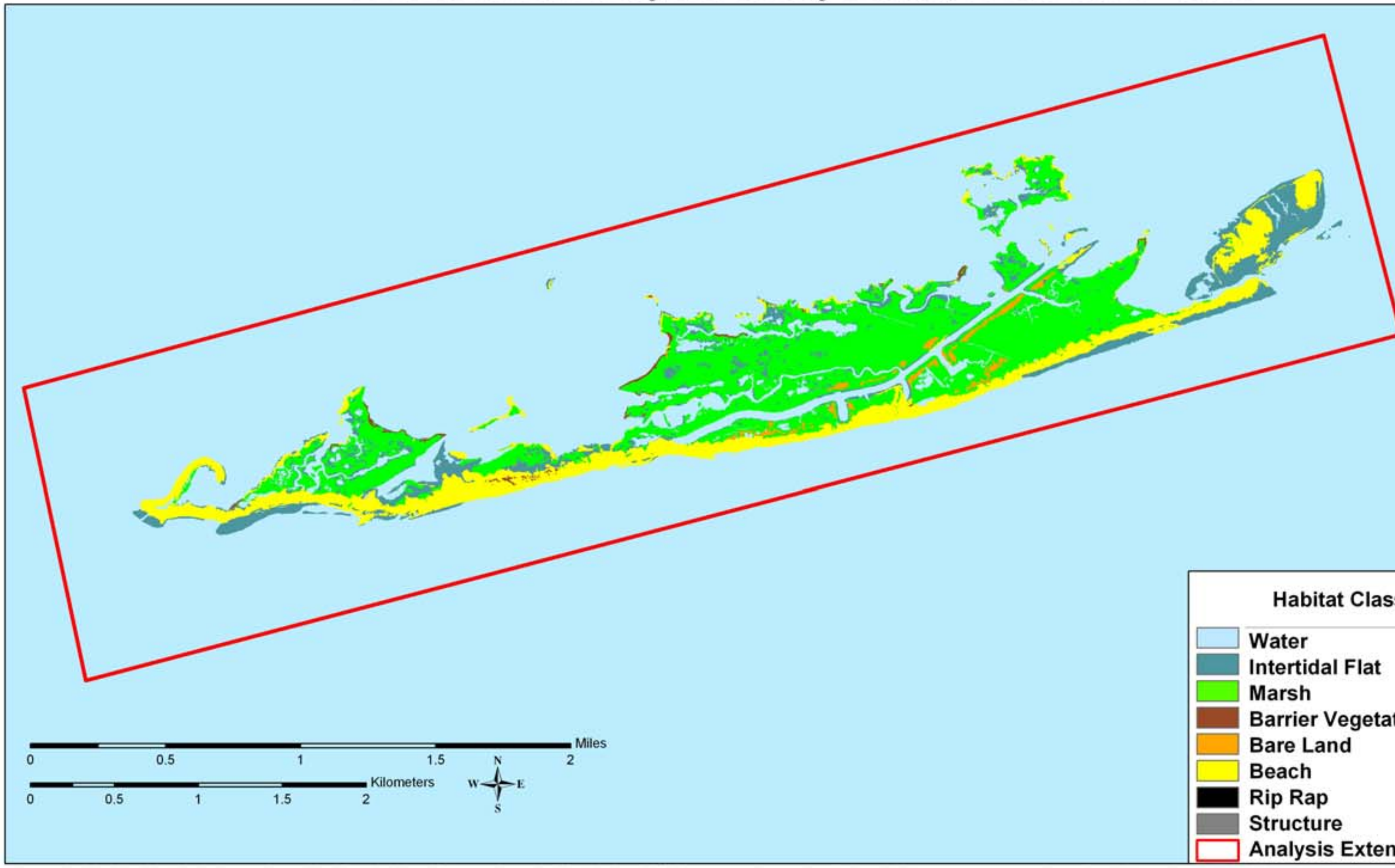


Post-construction (2006) elevation grid model at the Isles Dernieres Restoration , Phase 0, Trinity Island (TE-24) project.

Appendix D

Habitat Classification Maps

BICM Habitat Analysis: Trinity Island, Teche delta - 1996

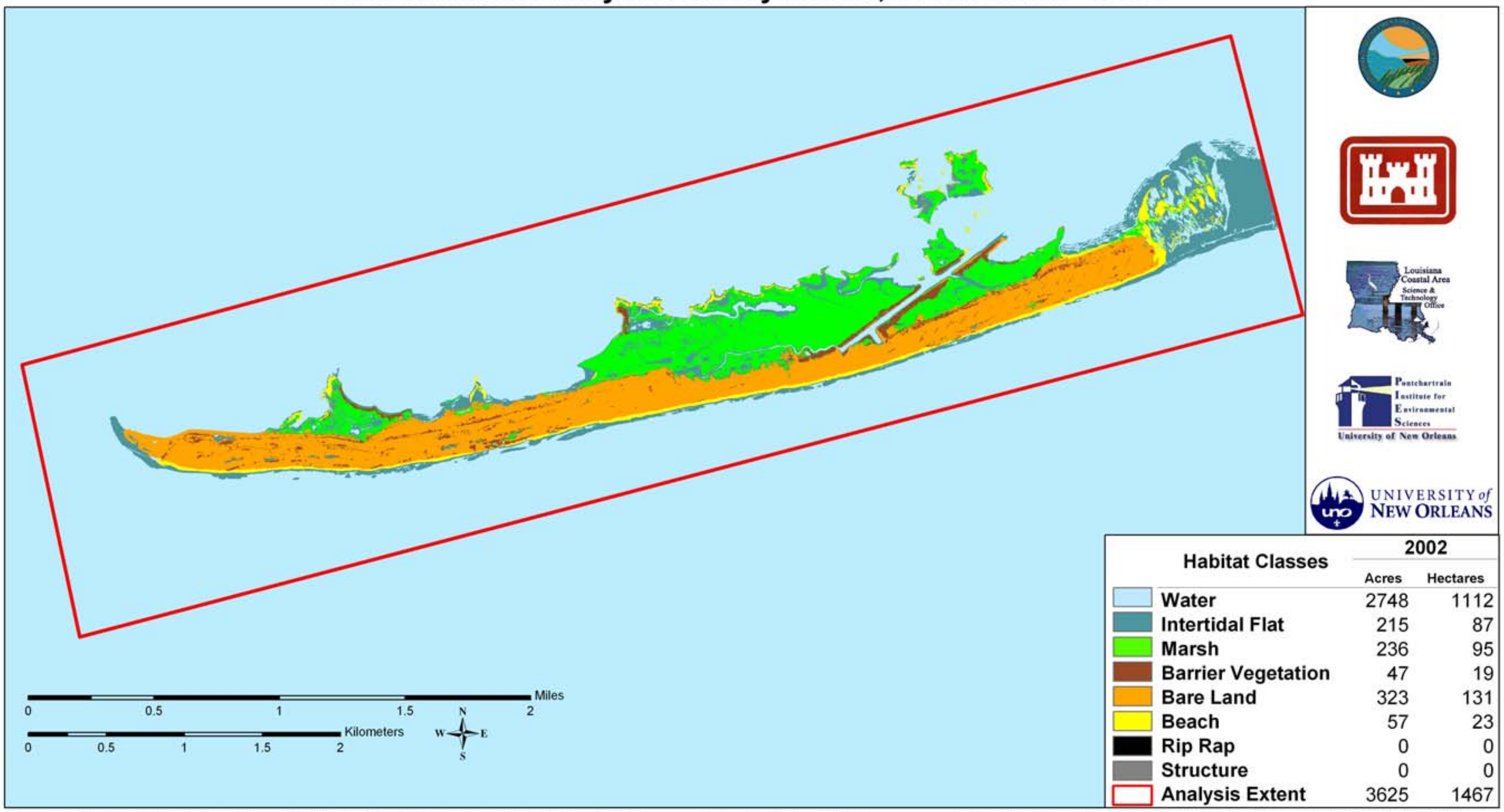


Habitat Classes	1996 Acres	1996 Hectares
Water	2866	1160
Intertidal Flat	143	58
Marsh	408	165
Barrier Vegetation	6	3
Bare Land	14	6
Beach	188	76
Rip Rap	0	0
Structure	0	0
Analysis Extent	3626	1467

The goal of the Habitat Analysis portion of the Barrier Island Comprehensive Monitoring (BICM) program is to classify the habitat types present along five delta regions in Louisiana for the time periods 1996/98, 2001/02, 2004, and 2005 and make comparisons between each time period. From west to east, the western Chenier Plain extends from Sabine Pass to the Lower Mud Lake Entrance in western Louisiana; the Teche delta extends from Raccoon Point to Wine Island Pass; the Lafourche delta extends from Cat Island Pass to Quatre Bayou Pass; the Modern delta extends from Quatre Bayou Pass to Sandy Point; and the Chandeleur Islands extend from Breton Island in the south to Hewes Point in the north.

Funding for this project was provided by the LCA Science and Technology Program, a partnership between the Louisiana Department of Natural Resources (LDNR) and the US Army Corps of Engineers (USACE), through LDNR Interagency Agreement No. 2512-06-06. All work was completed by staff at the University of New Orleans - Pontchartrain Institute for Environmental Sciences.

BICM Habitat Analysis: Trinity Island, Teche delta - 2002



Habitat Classes	2002 Acres	2002 Hectares
Water	2748	1112
Intertidal Flat	215	87
Marsh	236	95
Barrier Vegetation	47	19
Bare Land	323	131
Beach	57	23
Rip Rap	0	0
Structure	0	0
Analysis Extent	3625	1467

The goal of the Habitat Analysis portion of the Barrier Island Comprehensive Monitoring (BICM) program is to classify the habitat types present along five delta regions in Louisiana for the time periods 1996/98, 2001/02, 2004, and 2005 and make comparisons between each time period. From west to east, the western Chenier Plain extends from Sabine Pass to the Lower Mud Lake Entrance in western Louisiana; the Teche delta extends from Raccoon Point to Wine Island Pass; the Lafourche delta extends from Cat Island Pass to Quatre Bayou Pass; the Modern delta extends from Quatre Bayou Pass to Sandy Point; and the Chandeleur Islands extend from Breton Island in the south to Hewes Point in the north.

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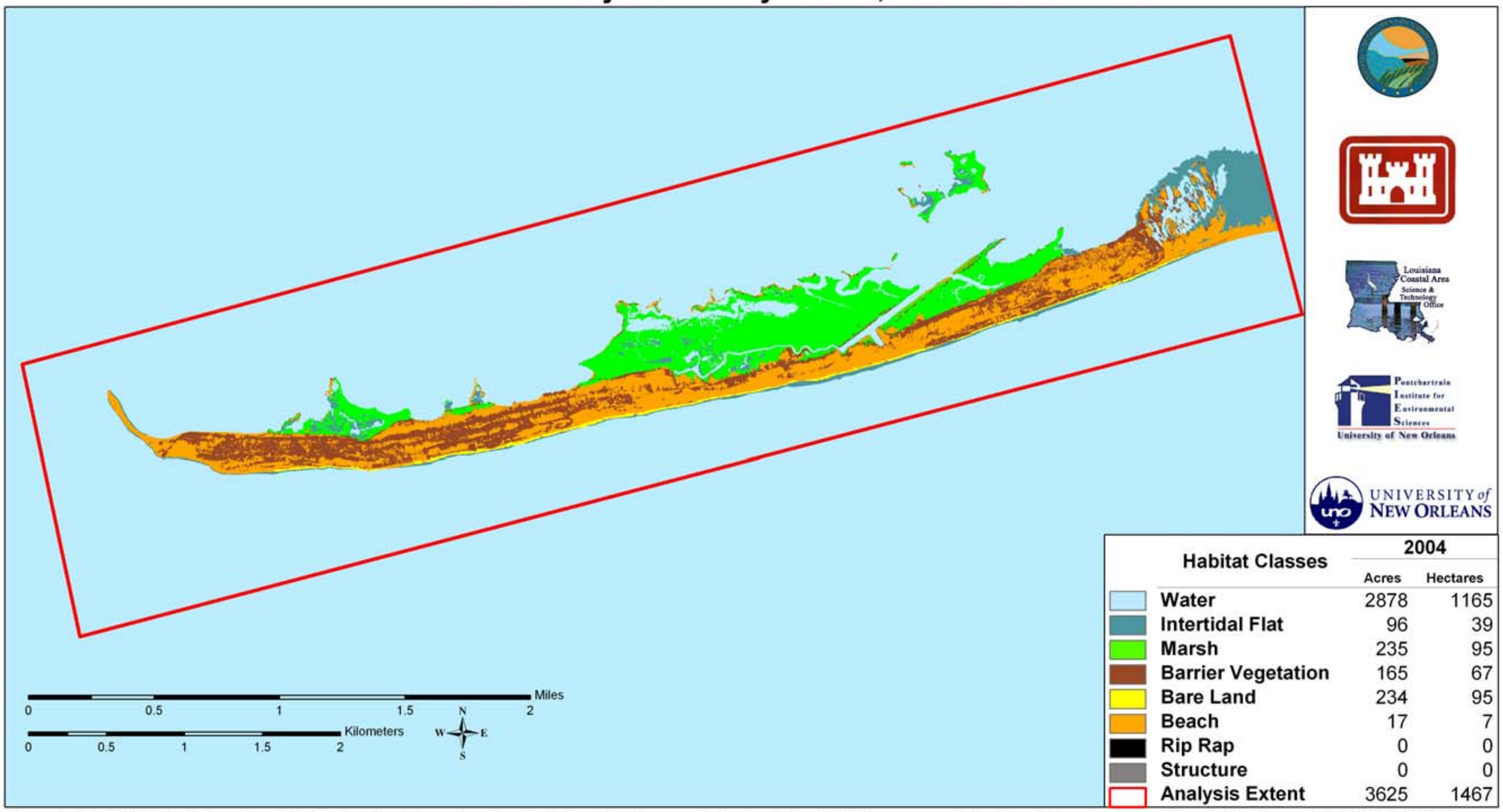
BICM Habitat Analysis: Trinity Island, Teche delta - 2004



Habitat Classes	2004 Acres	2004 Hectares
Water	2878	1165
Intertidal Flat	96	39
Marsh	235	95
Barrier Vegetation	165	67
Bare Land	234	95
Beach	17	7
Rip Rap	0	0
Structure	0	0
Analysis Extent	3625	1467

The goal of the Habitat Analysis portion of the Barrier Island Comprehensive Monitoring (BICM) program is to classify the habitat types present along five delta regions in Louisiana for the time periods 1996/98, 2001/02, 2004, and 2005 and make comparisons between each time period. The western Chenier Plain extends extend from Sabine Pass to the Lower Mud Lake Entrance in western Louisiana; the Teche delta extends from Raccoon Point to Wine Island Pass; the Lafourche delta extends from Cat Island Pass to Quatre Bayou Pass; the Modern delta extends from Quatre Bayou Pass to Sandy Point; and the Chandeleur Islands extend from Breton Island to Hewes Point.

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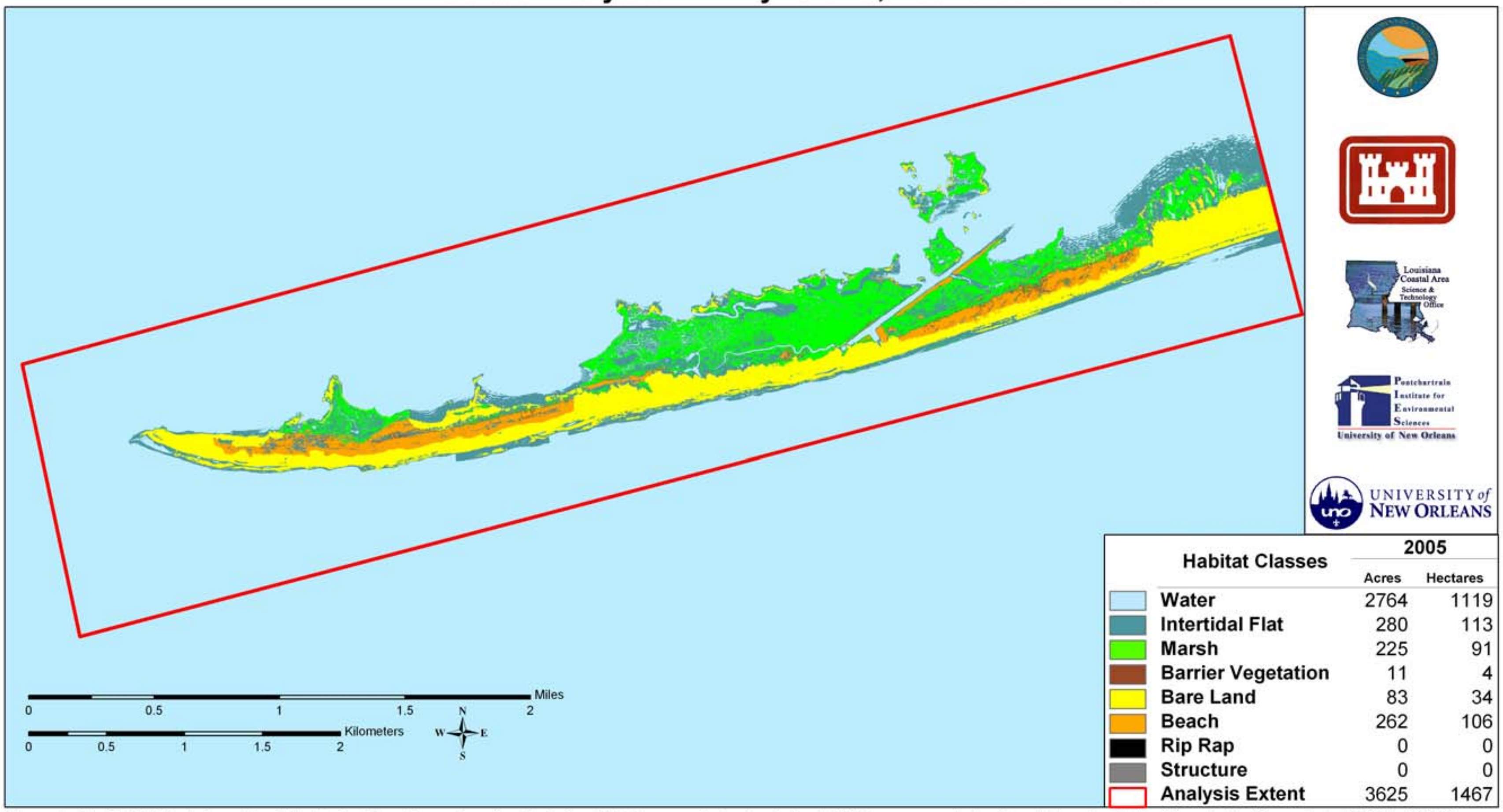
BICM Habitat Analysis: Trinity Island, Teche delta - 2005



Habitat Classes	2005 Acres	2005 Hectares
Water	2764	1119
Intertidal Flat	280	113
Marsh	225	91
Barrier Vegetation	11	4
Bare Land	83	34
Beach	262	106
Rip Rap	0	0
Structure	0	0
Analysis Extent	3625	1467

The goal of the Habitat Analysis portion of the Barrier Island Comprehensive Monitoring (BICM) program is to classify the habitat types present along five delta regions in Louisiana for the time periods 1996/98, 2001/02, 2004, and 2005 and make comparisons between each time period. The western Chenier Plain extends extend from Sabine Pass to the Lower Mud Lake Entrance in western Louisiana; the Teche delta extends from Raccoon Point to Wine Island Pass; the Lafourche delta extends from Cat Island Pass to Quatre Bayou Pass; the Modern delta extends from Quatre Bayou Pass to Sandy Point; and the Chandeleur Islands extend from Breton Island to Hewes Point.

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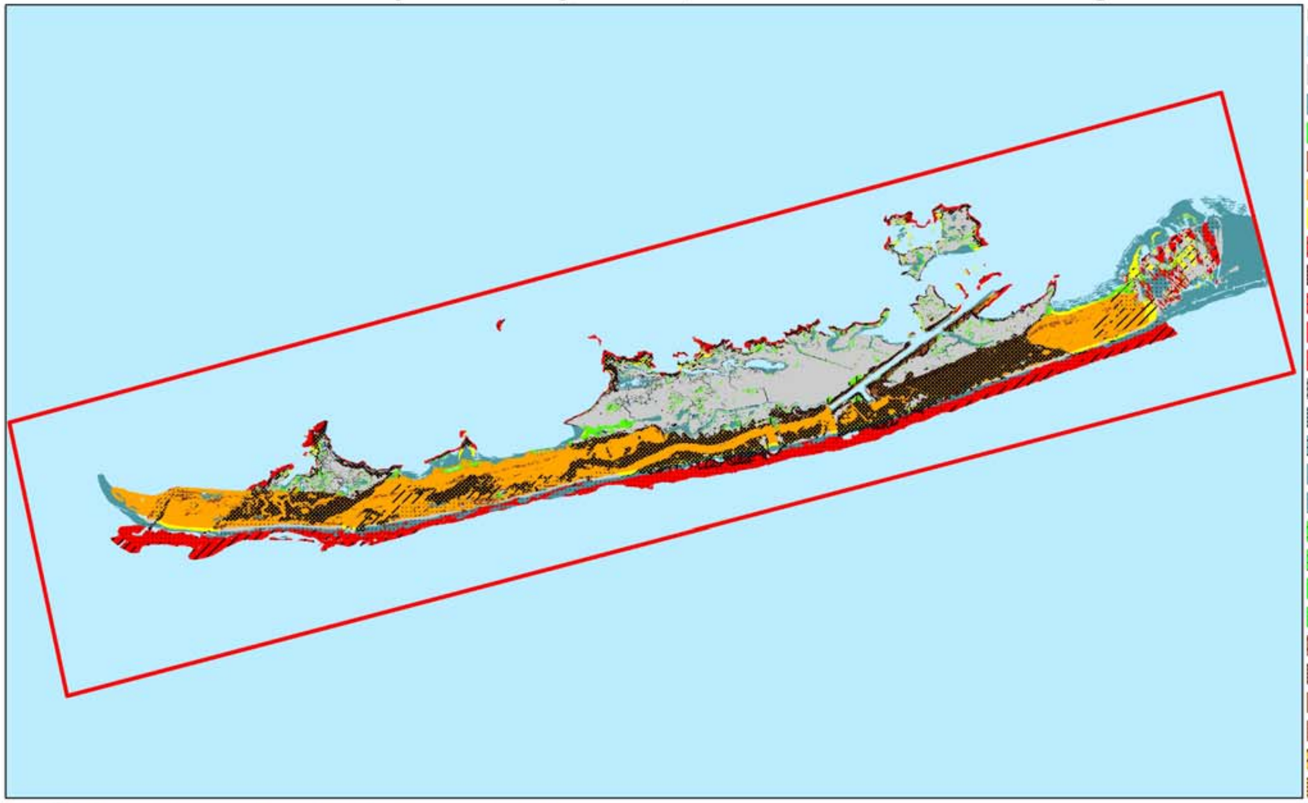
Appendix E

Habitat Change Maps

BICM Habitat Analysis: Trinity Island, Teche delta Habitat Change Classification - 2002 from 1996



Legend (2002 from 1996)	Acreages	Hectares
water from water	2586	1047
unchanged land	263	106
intertidal flat from water	113	46
marsh from water	11	4
barrier vegetation from water	9	3
bare land from water	134	54
beach from water	13	5
water from intertidal flat	45	18
water from marsh	16	6
water from barrier vegetation	3	1
water from bare land	2	1
water from beach	97	39
water from structure	0	0
intertidal flat from marsh	28	11
intertidal flat from barrier vegetation	1	1
intertidal flat from bare land	2	1
intertidal flat from beach	36	15
marsh from intertidal flat	15	6
marsh from barrier vegetation	1	0
marsh from bare land	2	1
marsh from beach	2	1
barrier vegetation from intertidal flat	4	2
barrier vegetation from marsh	26	10
barrier vegetation from bare land	4	2
barrier vegetation from beach	4	2
bare land from intertidal flat	35	14
bare land from marsh	119	48
bare land from barrier vegetation	1	0
bare land from beach	31	12
beach from intertidal flat	10	4
beach from marsh	15	6
beach from barrier vegetation	0	0
beach from bare land	1	0
rip rap to rip rap	0	0
structure to structure	0	0
anlaysis extent	3626	1467

Louisiana Coastal Area Science & Technology Office

Pontchartrain Institute for Environmental Sciences, University of New Orleans

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The goal of the Habitat Analysis portion of the Barrier Island Comprehensive Monitoring (BICM) program is to classify the habitat types present along five delta regions in Louisiana for the time periods 1996/98, 2001/02, 2004, and 2005 and make comparisons between each time period. The western Cheneir Plain extends from Sabine Pass to the Lower Mud Lake Entrance in western Louisiana; the Teche delta extends from Raccoon Point to Wine Island Pass; the Lafourche delta extends from Cat Island Pass to Quatre Bayou Pass; the Modern delta extends from Quatre Bayou Pass to Sandy Point; and the Chandeleur Islands extend from Breton Island to Hewes Point.

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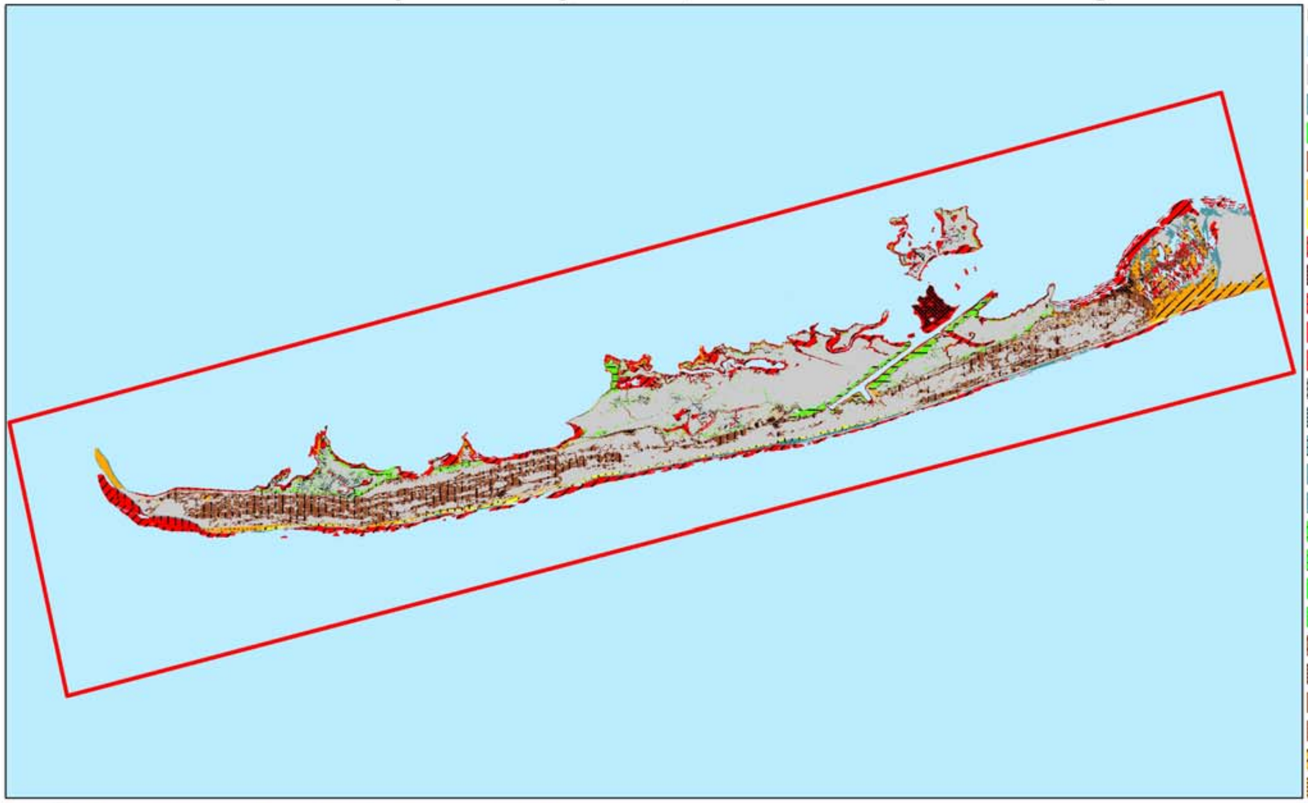
BICM Habitat Analysis: Trinity Island, Teche delta Habitat Change Classification - 2004 from 2002



Legend (2004 from 2002)	Acreages	Hectares
water from water	2725	1103
unchanged land	484	196
intertidal flat from water	13	5
marsh from water	1	0
barrier vegetation from water	1	1
bare land from water	7	3
beach from water	0	0
water from intertidal flat	107	43
water from marsh	20	8
water from barrier vegetation	3	1
water from bare land	9	4
water from beach	14	5
water from structure	0	0
intertidal flat from marsh	6	2
intertidal flat from barrier vegetation	0	0
intertidal flat from bare land	2	1
intertidal flat from beach	11	4
marsh from intertidal flat	12	5
marsh from barrier vegetation	15	6
marsh from bare land	4	2
marsh from beach	1	1
barrier vegetation from intertidal flat	7	3
barrier vegetation from marsh	7	3
barrier vegetation from bare land	118	48
barrier vegetation from beach	9	4
bare land from intertidal flat	23	9
bare land from marsh	1	1
bare land from barrier vegetation	6	2
bare land from beach	12	5
beach from intertidal flat	2	1
beach from marsh	0	0
beach from barrier vegetation	0	0
beach from bare land	4	2
rip rap to rip rap	0	0
structure to structure	0	0
anlaysis extent	3625	1467

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0 0.25 0.5 0.75 1 Miles

0 0.25 0.5 0.75 1 Kilometers

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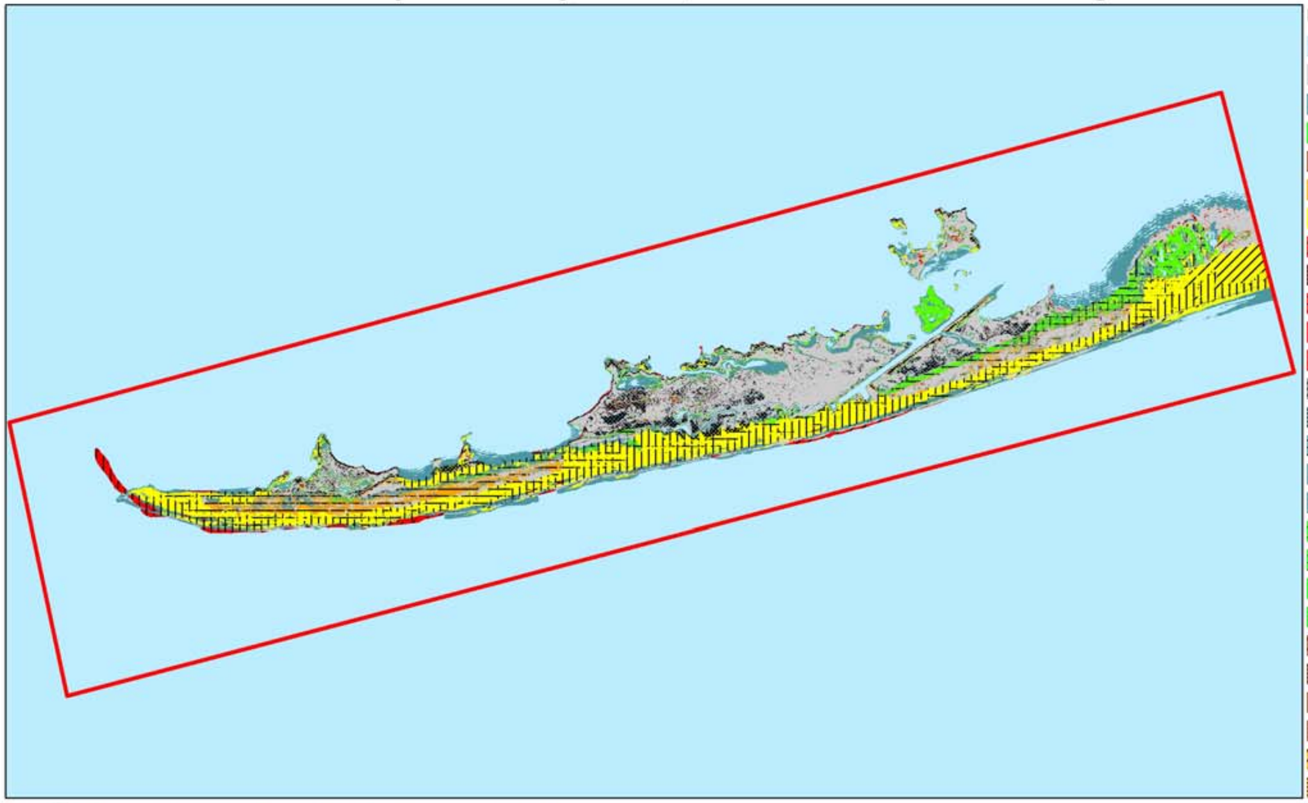
BICM Habitat Analysis: Trinity Island, Teche delta Habitat Change Classification - 2005 from 2004



Legend (2005 from 2004)	Acreages	Hectares
water from water	2731	1105
unchanged land	270	109
intertidal flat from water	109	44
marsh from water	20	8
barrier vegetation from water	0	0
bare land from water	0	0
beach from water	17	7
water from intertidal flat	11	4
water from marsh	11	4
water from barrier vegetation	2	1
water from bare land	8	3
water from beach	1	1
water from structure	0	0
intertidal flat from marsh	47	19
intertidal flat from barrier vegetation	30	12
intertidal flat from bare land	35	14
intertidal flat from beach	11	4
marsh from intertidal flat	11	4
marsh from barrier vegetation	21	8
marsh from bare land	6	3
marsh from beach	0	0
barrier vegetation from intertidal flat	0	0
barrier vegetation from marsh	1	0
barrier vegetation from bare land	3	1
barrier vegetation from beach	0	0
bare land from intertidal flat	0	0
bare land from marsh	3	1
bare land from barrier vegetation	36	14
bare land from beach	0	0
beach from intertidal flat	27	11
beach from marsh	7	3
beach from barrier vegetation	69	28
beach from bare land	137	56
rip rap to rip rap	0	0
structure to structure	0	0
anlaysis extent	3625	1467

Miles: 0 0.25 0.5 0.75 1
Kilometers: 0 0.25 0.5 0.75 1

The goal of the Habitat Analysis portion of the Barrier Island Comprehensive Monitoring (BICM) program is to classify the habitat types present along five delta regions in Louisiana for the time periods 1996/98, 2001/02, 2004, and 2005 and make comparisons between each time period. The western Cheneir Plain extends from Sabine Pass to the Lower Mud Lake Entrance in western Louisiana; the Teche delta extends from Raccoon Point to Wine Island Pass; the Lafourche delta extends from Cat Island Pass to Quatre Bayou Pass; the Modern delta extends from Quatre Bayou Pass to Sandy Point; and the Chandeleur Islands extend from Breton Island to Hewes Point.

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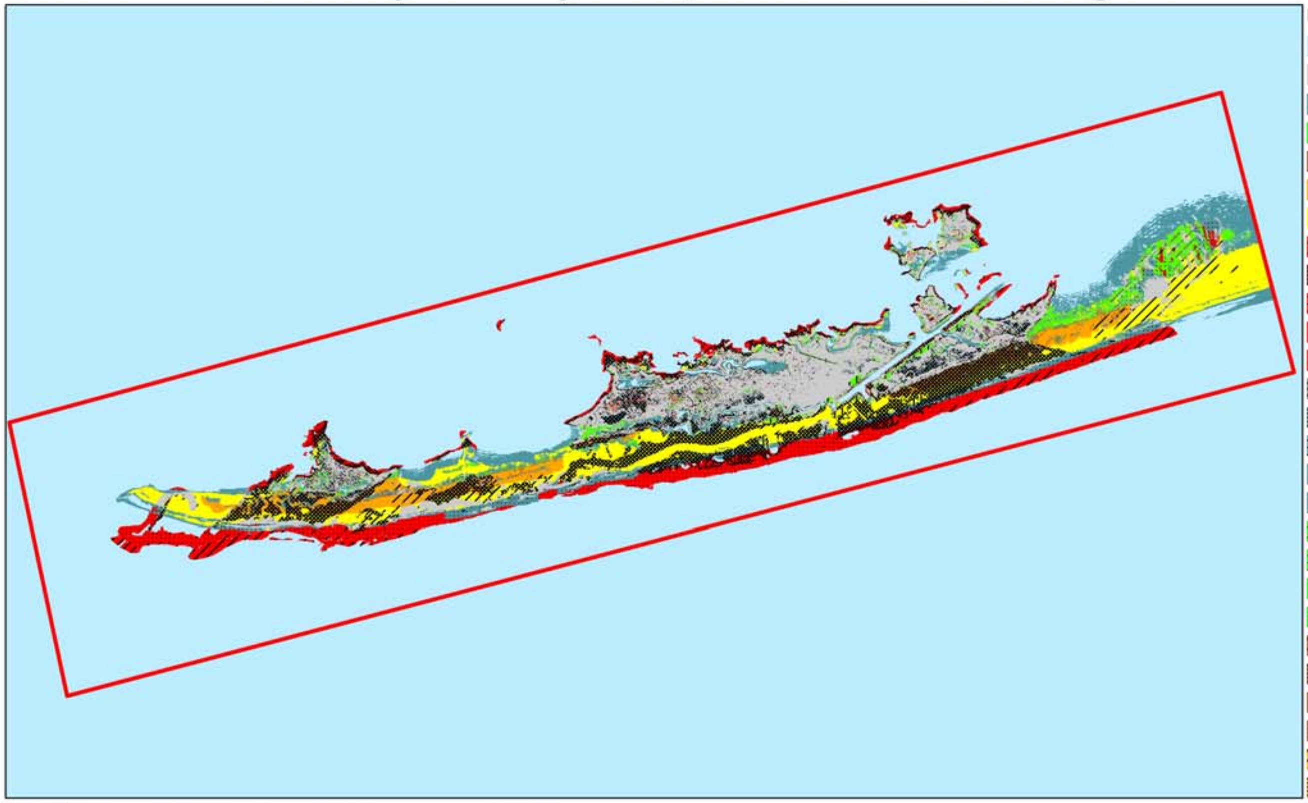
BICM Habitat Analysis: Trinity Island, Teche delta Habitat Change Classification - 2005 from 1996



Legend (2005 from 1996)	Acreages	Hectares
water from water	2569	1040
unchanged land	246	100
intertidal flat from water	131	53
marsh from water	19	8
barrier vegetation from water	4	2
bare land from water	30	12
beach from water	111	45
water from intertidal flat	44	18
water from marsh	39	16
water from barrier vegetation	4	2
water from bare land	3	1
water from beach	105	43
water from structure	0	0
intertidal flat from marsh	80	32
intertidal flat from barrier vegetation	1	0
intertidal flat from bare land	2	1
intertidal flat from beach	35	14
marsh from intertidal flat	19	8
marsh from barrier vegetation	1	0
marsh from bare land	4	2
marsh from beach	7	3
barrier vegetation from intertidal flat	1	0
barrier vegetation from marsh	5	2
barrier vegetation from bare land	0	0
barrier vegetation from beach	0	0
bare land from intertidal flat	11	4
bare land from marsh	38	15
bare land from barrier vegetation	0	0
bare land from beach	2	1
beach from intertidal flat	38	15
beach from marsh	71	29
beach from barrier vegetation	1	0
beach from bare land	3	1
rip rap to rip rap	0	0
structure to structure	0	0
anlaysis extent	3625	1467

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0 0.25 0.5 0.75 1 Miles

0 0.25 0.5 0.75 1 Kilometers

N W E S

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