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Department of Natural Resources
Coastal Restoration Division and
Coastal Engineering Division

2005 Operations, Maintenance, and Monitoring Report

for

EAST TIMBALIER SEDIMENT RESTORATION, PHASES 1 & 2

State Project Number TE-25 & TE-30
Priority Project List 3

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Terrebonne Parish

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2005 Operations, Maintenance, and Monitoring Report
for
East Timbalier Island Sediment Restoration, Phases 1 & 2 (TE-25 & 30)

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I. Introduction

The East Timbalier Sediment Restoration Project is located on East Timbalier Island in Lafourche)arish, Louisiana, at latitude 29° 04’ 00” N and longitude 90° 18’ 00” W, about 5.5 mi (9.1 km) east of Timbalier Island and about 5.8 mi (9.3 km) west of Port Fourchon (figure 1). East Timbalier Island is approximately one half mile (0.9 km) wide by four miles (6.5 km) long and located at the mouth of Timbalier Bay. The island was formerly located on the outer edge of the Mississippi River’s abandoned Lafourche delta lobe (Morgan 1979; Penland et al. 1988; McBride et al. 1991) and considered a part of the Bayou Lafourche headland. East Timbalier Island is bordered by Timbalier Bay directly to the north, the Gulf of Mexico to the south, Little Pass to the west, and Raccoon Pass/Penrod Slip to the east.

East Timbalier Island has experienced extreme shoreline erosion due to the decrease in sediment supply from the Caminada-Moreau headland from the recent extension of existing jetties at Belle Pass just east of the island (Mossa et al. 1985). The sediment supply was sufficient to maintain and, at times, even increase the surface area of East Timbalier from 9.25 mi (14.9 km) in 1887 to 11.25 mi (18.1 km) in 1956, despite initial placement of jetties at Belle Pass in 1935, repeated hurricane impacts, and substantial relative sea level rise due to compactional subsidence (Mossa et al. 1985; McBride et al. 1991). However, several modifications and extensions of the jetties in the 1960’s resulted in accelerated erosion downdrift of these structures (Mossa et al. 1985). The island is currently experiencing average shoreline retreat rates around 75 ft (23 m) per year (McBride et al. 1991; Penland et al. 2004).

The barrier islands along the Louisiana coast serve important structural functions imperative to the health of the coastal marshes and economy of southern Louisiana. East Timbalier acts as an important coastal barrier reducing the wave energy that marshes lining Timbalier Bay could potentially experience. Barrier islands protect these wetland areas from Gulf of Mexico waves, storm surges, and salt water intrusion (McBride et al. 1991). An analysis of wetland loss for the Timbalier basin over the two periods (1956 – 1978 and 1978 – 1990) showed that marsh losses cannot be attributed solely to increased salinity (van Heerden et al. 1993). The general decrease in length of the island over time, from 31,680 ft (9,662.4 m) in 1956 to 24,340 ft (7,423.7 m) in 1990, resulted in an increase in the width of the associated tidal passes. As a consequence, the tidal prism within the bay has increased by at least 70% since 1980 (van Heerden et al. 1993). This increase in tidal prism is now thought to be the dominant cause (~80%) of wetland loss in Terrebonne Bay (van Heerden et al. 1993). Van Heerden et al. (1993) also predict that if the barrier islands were restored to their 1880’s configuration, the tidal prism would be reduced by 69% and result in a net increase in wetlands. Likewise, it has been predicted that if all the barrier islands were lost, Terrebonne Basin would experience a wetland loss of at least 117,000 ac (4734.1 ha) (van Heerden et al. 1993) and the infrastructure around Port Fourchon, an important off-shore oil and gas port, would be undermined. In addition, a large number of oil and gas facilities exist in the shallow bays behind East Timbalier Island and would be vulnerable without the island’s protection. East Timbalier Island also supports an abundantly diverse and rich fishery and serves as a

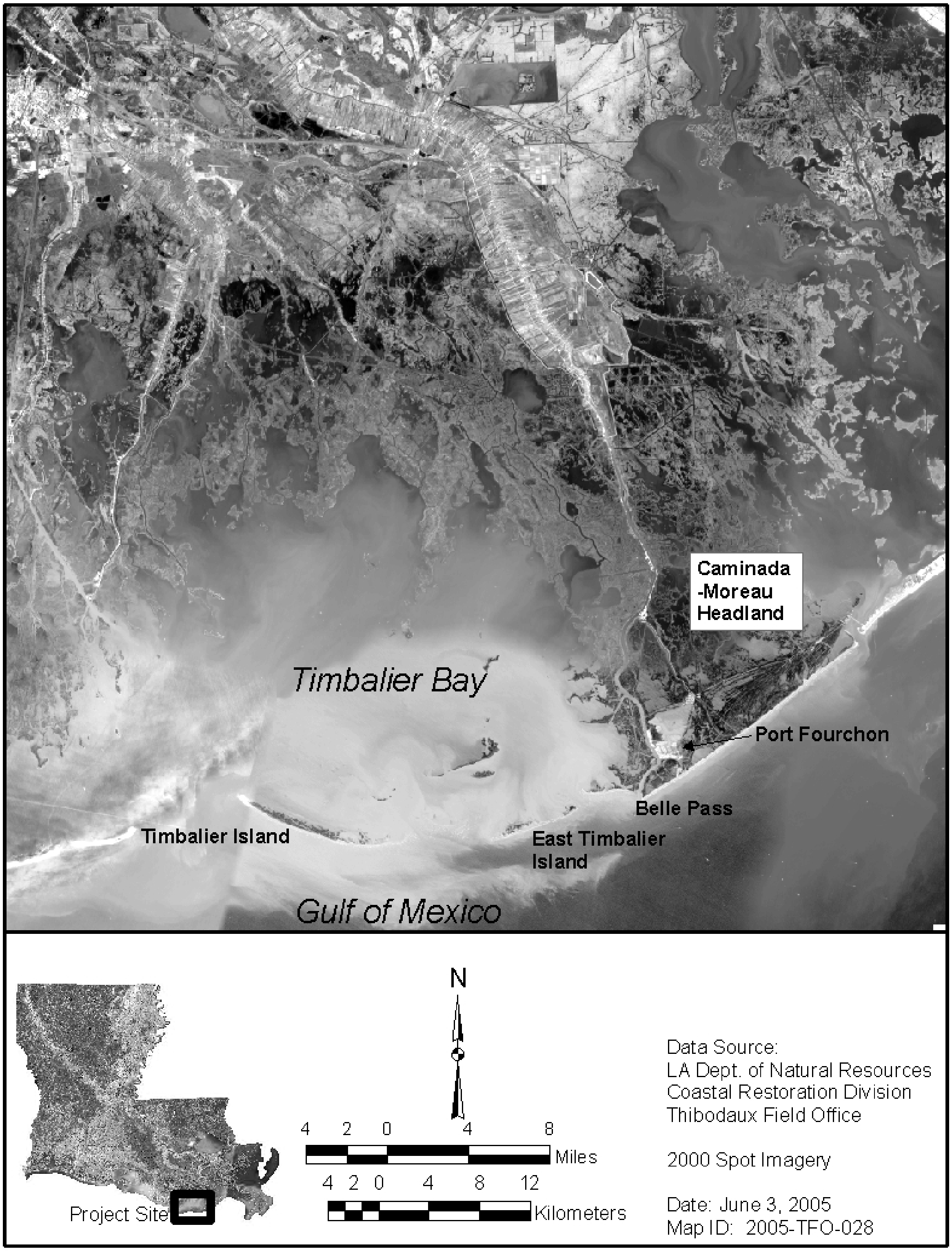

Figure 1. Location of East Timbalier Island in relation to Timbalier Island, Belle Pass, and Port Fourchon. The borrow site was located approximately 2.5 miles (~4 km) to the west of the eastern end of East Timbalier Island.

prime nesting habitat for many neotropical migrants and other birds. The important structure and function of East Timbalier Island to both the ecology and economy of the area underscores its need for restoration.

The habitat of East Timbalier Island consists of beach, low dunes, and back-barrier marsh. *Spartina alterniflora* Loisel. (smooth cordgrass) is the dominate species of the salt marsh communities with *Spartina patens* (Ait.) Muhl. (marshhay cordgrass) and *Distichlis spicata* (L.) Green (seashore saltgrass) also present. *Avicennia germinans* (L.) L. (black mangrove) is distributed across a large area of the island.

As-built features for East Timbalier Sediment Restoration projects required approximately 2.6 million cubic yards (1.99 million m^3) of fill material to create a 200-ft- (60.96-m-) wide dune to an elevation of +5.0 ft (+1.52 m) National Geodetic Vertical Datum 1929 (NGVD29) and a back-barrier marsh platform at +2.0 ft (+0.61 m) NGVD29. Other as-built features used to stabilize dune features included a shoreline rock revetment laid upon an earthen dike to help protect the newly-created area from erosion, the plantings of *S. patens* and *Panicum amarum* Ell. (bitter panicgrass), and the aerial-seeding of *Cynodon dactylon* (L.) Pers. (Bermuda grass) (figure 2). Lastly, sand fencing consisting of a shore-parallel fence with varying orientations of spur fencing was used to trap wind-blown sands and to aid in the development of dune habitat (figure 3). That is, some areas of the island included spur fences that either intersected or crossed the linear, shore-parallel fence at near-45° angles and resulted in fencing segments that resembled an “A” or “V” alignment.

The objective of this project was to strengthen and thus increase the life expectancy of the remaining portions of East Timbalier Island. Sediment dredging and subsequent fill were concluded in December 1999. Aerial seeding of *C. dactylon* was completed in the spring of 2000. The construction of approximately 13,000 linear feet (3,962 m) of sand fencing was in place by the end of September 2000. Lastly, vegetative plantings, 13,000 plugs of *P. amarum* and 6,500 plugs of *S. patens*, were finished by May 1, 2001. Approximately 109 acres (44.1 ha)of new land were created post-construction (Penland et al. 2003).

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the inspection of the East Timbalier Island Sediment Restoration (TE-25 & 30) projects is to evaluate the constructed project features in order to identify any deficiencies. The inspection results are used to prepare a report which details the condition of the project features and recommends any corrective actions considered necessary. Should it be determined that corrective actions are needed, Louisiana Department of Natural Resources (LDNR) shall provide in the report a detailed cost estimate for engineering, design, supervision, inspection, construction, contingencies, and an assessment of the urgency of such repairs. The inspection report also contains an estimated, projected budget for the upcoming three (3) years for

Figure 2. Location of the project boundaries, rock revetment, fill area, and aerial seeding for East Timbalier Island sediment restoration (TE-25/30). Approximately 2.6 million cubic yards (~1.99 million m^3) of fill were placed on East Timbalier Island.

Figure 3. Location and orientation of sand fencing and vegetative plantings on East Timbalier Island. Some of the orientations of spur fencing resemble an "A" or "V" alignment.

operation, maintenance, and rehabilitation. Photographs taken as part of the inspection are presented in Appendix A. The three-year projected operation and maintenance budget is shown in Appendix B.

The Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) budgets for these projects do not provide funding for any maintenance activities or inspections for assessing O&M needs. However, LDNR has decided to inspect the projects on a three-year cycle along with other barrier island projects.

The inspection of the East Timbalier Island Sediment Restoration (TE-25 & TE-30) projects was held on June 21, 2005. In attendance were Daniel Dearmond, Shane Triche, Jonathan West, and Darin Lee from LDNR and Cheryl Brodnax representing National Marine Fisheries Service (NMFS). The boat was launched at approximately 10:00 a.m. at the Port Fourchon public boat launch on LA Highway 3090. From the launch, we traveled through Pass Fourchon, Bayou Lafourche, Evans Canal, and Timbalier Bay to arrive at East Timbalier Island. The weather conditions included clear skies, temperatures in the mid to upper 80's °F, winds of approximately 10 knots from the east, and seas of approximately 1 to 2 ft (0.3-0.6 m). No tide gauge is available in the project area. The tide gauges along Bayou Lafourche could not be located. We anchored the boat along the marsh platform on the bayside of the island and proceeded on foot to the gulf shoreline at the east end of the island. Inspection of the project features began at approximately 11:10 a.m. at the east end of the island in the TE-30 project area. We continued the inspection westward along the current shoreline through the TE-25 project area to the west end. In order to return to the boat, we traveled east through the marsh platform. The inspection concluded at approximately 1:15 p.m.

The field inspection included a complete visual inspection of the entire project site. Photographs were taken (Appendix A), and Field Inspection Notes were completed in the field to record the project feature conditions and any deficiencies (Appendix C). The location of photographs are provided in Appendix A, figure A-1.

b. Inspection Results

Dune

Along most of the project length, the Gulf of Mexico shoreline is currently located near the back of the as-built location of the 200-ft- (60.9-m-) wide dune platform (Appendix A, Photos 14-16, 21, 23, 25). In the case of the east end of the TE-30 project, the as-built dune location is now open water (Appendix A, Photo 28). The placement of rock revetments onto the island prior to construction has had profound effects on the dynamics of the sediment movement. The rocks are believed to have been originally placed to protect island infrastructure. The rocks trapped dune sediment in some areas holding sediment and protecting the back barrier marsh from washover. However, gaps in the revetment have promoted scouring of dune sediment and washover into the marsh. In some areas of the island, much of the dune sediment appears to have been washed over onto the marsh platform. On the east end, sediment continues to move to the bayside of the island. In fact, dredging by the oil company along the back of the island has been ongoing in order to maintain an access channel for the oil and gas infrastructure. Much of this material is probably sediment from the project that has moved to the back of the island. The dredged material has been stacked on the bayside of the island alongside the access channel (Appendix A, Photos 29-30).

Rubble mound revetment

According to the as-built plans, the revetment consisted of Class 440 lb riprap constructed along the gulf-side face of the front containment dike. The rock revetment associated with the project could not be seen other than the tops of a few rocks when the gulf waves would break. Presently, only open water or sloping beach face exists behind the rock revetment. At the western portion of TE-25 it appears from aerial photographs that the revetment located along the western end and the southwest corner are no longer visible (Station -4+00 to 1+00). This also appears to be the case in the southeast corner of this area. The storms of late 2002 removed sediment in these areas (Station 6+00 to 9+00). The rocks were apparently scattered by the storms or leveled to an elevation below the tide. Also, the revetment along the shoreline that could be seen at the west end appears to be a much smaller class of rock. It is not clear if this revetment is from the project, rock placed by the oil company, or a combination of both (Appendix A, Photo 1). Generally, it appears that as the dune fill continues to erode or overwash onto the marsh platform and as the island experiences rollover, the rock revetment will remain isolated in front of the island as the island continues to retreat.

Sand fence

No sand fencing was found completely intact during the inspection. Some fence posts remained on the TE-25 project (Appendix A, Photos 15, 20-21). The late 2002 storms appeared to have removed the sand fencing from the project area.

Marsh platform

In general, the marsh platform section of the constructed template appeared to be flourishing. Of course the east end of the TE-30 project (Station 96+00 to 114+00) has been completely eroded as described previously. While much of the marsh platform had been overwashed with sediment from the dune fill (Appendix A, Photos 6-10, 22, 24), other areas within the marsh platform had been shielded from the dune fill by the existing rock or bulkheads on the island (Appendix A, Photos 17-19). Vegetative cover was much greater in the areas not affected by the overwash events.

c. Maintenance Recommendations

i. Immediate / Emergency Repairs

None

ii. Programmatic / Routine Repairs

None

III. Operation Activity

a. Operation Plan

None of the project features require operations.

b. Actual Operations

None of the project features require operations.

IV. Monitoring Activity

a. Monitoring Goals

The objective is to increase the life expectancy of East Timbalier Island by placing dredged material along its shoreline. The following goals would contribute to the evaluation of the above objective:

1. Increase the elevation and width of East Timbalier Island using dredged sediments;
2. Reduce loss of sediments through the growth of aerially seeded and natural vegetation.

b. Monitoring Elements

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

Aerial Photography

Near vertical, color-infrared aerial photography (1:12,000 scale), flown in December 1997, was acquired from the U.S. Geological Survey (USGS) as the pre-construction standard for future changes in the island's dimension. The photography was geo-rectified using GIS by UNO according to standard operating procedures (Steyer et al. 1995, revised 2000). We also used 1998 Digital Orthophoto Quarter Quadrangles (DOQQs) in Multi-resolution Seamless Image Database (MrSID) format as another pre-construction standard. The USGS Biological Resources Division National Wetlands Research Center (NWRC) provided 2001 aerial photo of East Timbalier Island for post-construction or as-built comparisons. The University of New Orleans, Pontchartrain Institute for Environmental Sciences (UNO/PIES) conducted habitat statistical analysis of island area from color infrared aerial photography before and after the 2002 hurricane season. Lastly, we used 2004 DOQQs to assess project effectiveness 5 years post-construction.

Vegetation

Hand-planted, naturally colonizing, and aerially-seeded vegetation, if present, was monitored along the shore-parallel sand fencing. Nine areas were selected randomly and divided into three treatments of various fence alignments: A-configuration, V-configuration, and Linear fencing (no spur fence) known heretofore as treatments A, V, and L (figure 4). Each alignment (treatment) consisted of three transects. Two transects were laid in a north-south direction from the intersection of a shore-parallel and spur fence and one transect was laid in a north-south direction equidistant between the spur fences (figure 5). In dunes with no spur fences, transects were laid in a north-south direction at 150- ft (45.7-m) intervals. Species composition and percent cover of vegetation were determined using the Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974; Steyer et al. 1995, revised 2000) in four 6.56-ft x 6.56-ft (2-m x 2-m) plots randomly placed along each transect. Two of the plots were randomly placed on the transect gulf-side of the shore-parallel fence and two plots bayside. A 2-in x 2-in (5-cm x 5-cm) wooden stake was driven into the ground to mark the southeast corner of the plot. All plots were oriented in a north-south orientation. Every species in the plot was recorded, and visual estimates of percent cover for the total plot and each individual species were made. Percent cover was measured by estimating the percentage of the ground area within each plot covered by each species identified. Cover

Figure 4. Location and orientation of the vegetation stations, sediment fences, vegetative plantings along East Timbalier Island. Vegetation stations are placed in differing sand fencing orientation such that they fall into three treatments: A-configurations (A) , V-configurations (V), and linear (L) shore-parallel fencing (i.e., no spur fencing).

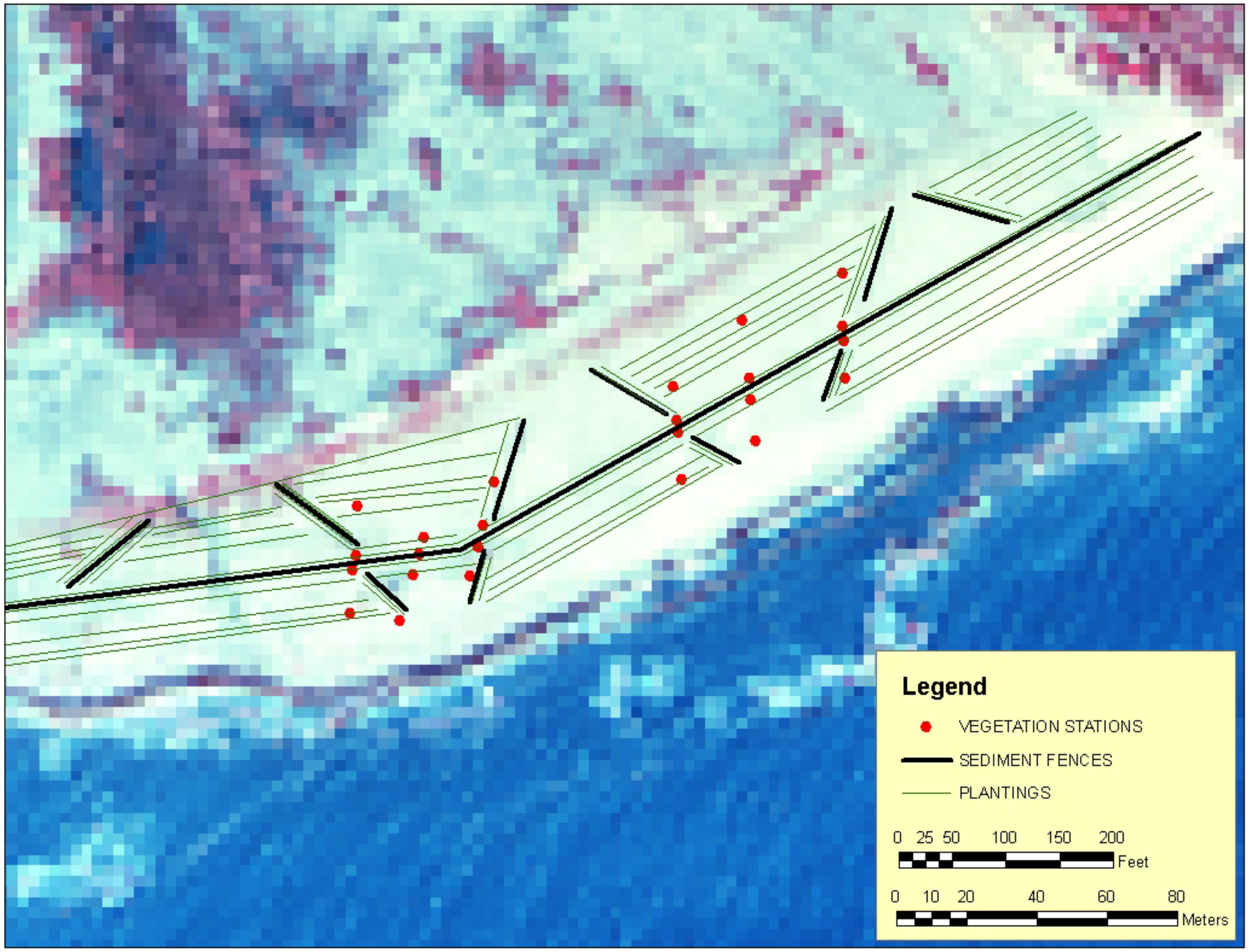

Figure 5. Example of a typical vegetation station layout, East Timbalier Island.

classes used were: solitary, <1%, 1-5%, 6-25%, 26-50%, 51-75%, and 76-100%.

Survivability data for planted vegetation were collected for each row along a transect. Random numbers identified a plant that became the first individual plant and the next four plants were determined to be alive or dead (five total plants). Random numbers originated from east to west. All plants were counted and survivability was determined in rows along spur fences. Vegetation data were collected in August 2001 and September 2002.

We used Tukey's post hoc comparisons in the generalized linear model (GLM) procedure in SAS to analyze survival data of planted vegetation within each fencing treatment (i.e., A, V, and L configurations) and between planted vegetation growing north and south of the shore-parallel fence (SAS 1999). Differences were considered significant if $p < 0.05$.

Elevation

To document both spatial and vertical change along the constructed area of East Timbalier Island, transect lines were established at 200-ft (60.9-m) intervals by professional surveyors before construction. Elevation was determined every 100 ft (30.5 m) across the island along each transect. Pre-construction surveys were conducted in May and June 1999 and post-construction (as-built) surveys were conducted in December 1999 – January 2000. Beginning in fall 2000, airborne light detection and ranging (LiDAR) surveys replaced conventional on-the-ground surveys. Airborne LiDAR surveys collect data along lines the entire length of the island versus the traditional transects used in conventional surveys. LiDAR surveys were conducted in October 2000 by Morris P. Hebert, and again in 2001 and 2002 by USGS. LiDAR surveys will be repeated in 2007 and 2016. Data collected were used to develop elevational triangulation-based (TIN) surface generation models and subsequent Grid models in ArcView®. Difference grids were created by subtracting earlier grids from succeeding grids. Volume change for these difference grids as well as volume for each of the 2000, 2001, and 2002 LiDAR grids were calculated with the cut/fill calculator in the LiDAR data handler extension of ArcView®. The 2000 LiDAR survey has ± 10 cm accuracy (John Chance Land Surveys, Inc. 2000) while surveys performed in 2001 and 2002 have ± 15 cm accuracy (Sallenger et al. 2003). LiDAR grids were not filtered for vegetation.

c. Preliminary Monitoring Results and Discussion

Aerial Photography

Pre-construction aerial photos showed that East Timbalier Island was in considerably poor condition prior to the outset of construction (figure 6). It was interlaced with a network of canals, scours, and cuts, and the integrity of the island was deeply compromised. Between 1996 and 1998, several rows of rocks were emplaced along the middle portion of the island. We do not know who placed these rocks but we assume that the rocks were put in place to protect what was left of the island and the oil facilities behind the island. Additionally, canals to the north of the island were dredged and spoil banks were created that are evident in the 1998 DOQQs (figure 6).

As-built aerial photos taken in 2001 and prior to the hurricane season in 2002 show that most of the canals were filled in and the rocks placed between 1996 and 1998 were covered by the emplaced fill in some areas but not in others, especially in the back barrier marsh platform (figure 7). There is some barrier island rollover occurring between these photos as evident by the slight retreat seen along the front of the dune platform. This project did not have a fronting beach to serve as protection for the dune platform. A large cut developed on the eastern portion of the island which may have been a remnant of an earlier cut prior to construction. That is, canals or cuts that have been filled during project construction may have tendency to reappear after construction due to condition of the underlying sediment or wave training in the sub-aerial portion gulfward of the remnant cuts.

The compounding effects of Tropical Storm Isidore and Hurricane Lili caused considerably erosion and rollover to East Timbalier Island, especially on the eastern portion of the island where the remnant cut had began in 2001 (figure 8). We also saw other cuts or scours in the project features where previous cuts were located prior to project construction (see figure 6 and 8). The dune platform appears to be pushed back onto the back barrier marsh platform in some places and several washover events are evident in both photos. In 2004, the further buildup of a spoil bank to the north side of the island is apparent and this sediment may have originated previously as dune platform material washed into oil canals during the 2002 hurricane season. Rocks placed between 1996 and 1998 appear to have stopped washover events in some areas of the islands (Appendix A) but have also focused wave action and scour in other portions (Appendix A).

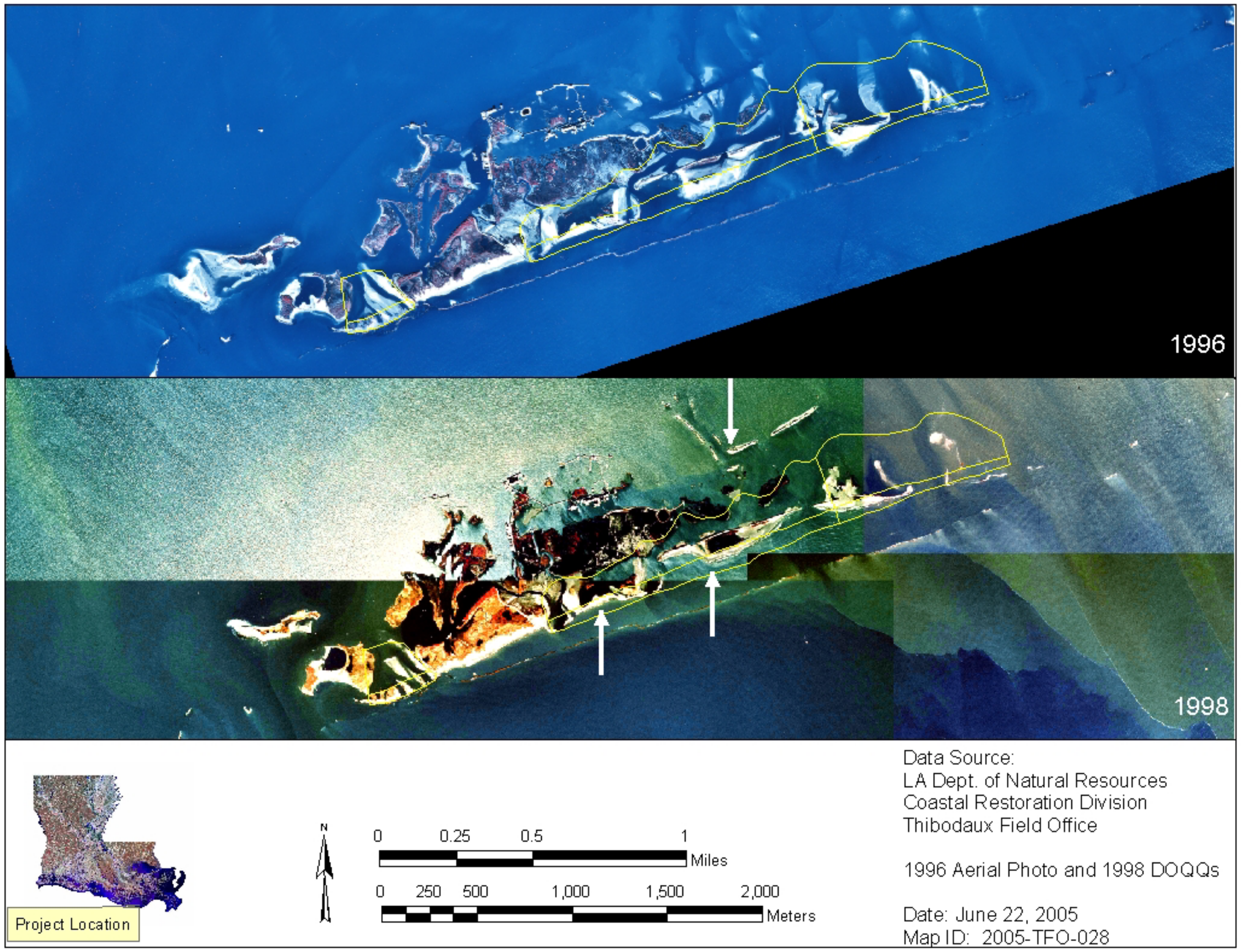

Figure 6. 1996 Aerial photo and 1998 DOQQs of East Timbalier Island shown with the as-built dune and marsh platforms superimposed. Arrows point to rock walls and spoil banks constructed between 1996 and 1998.

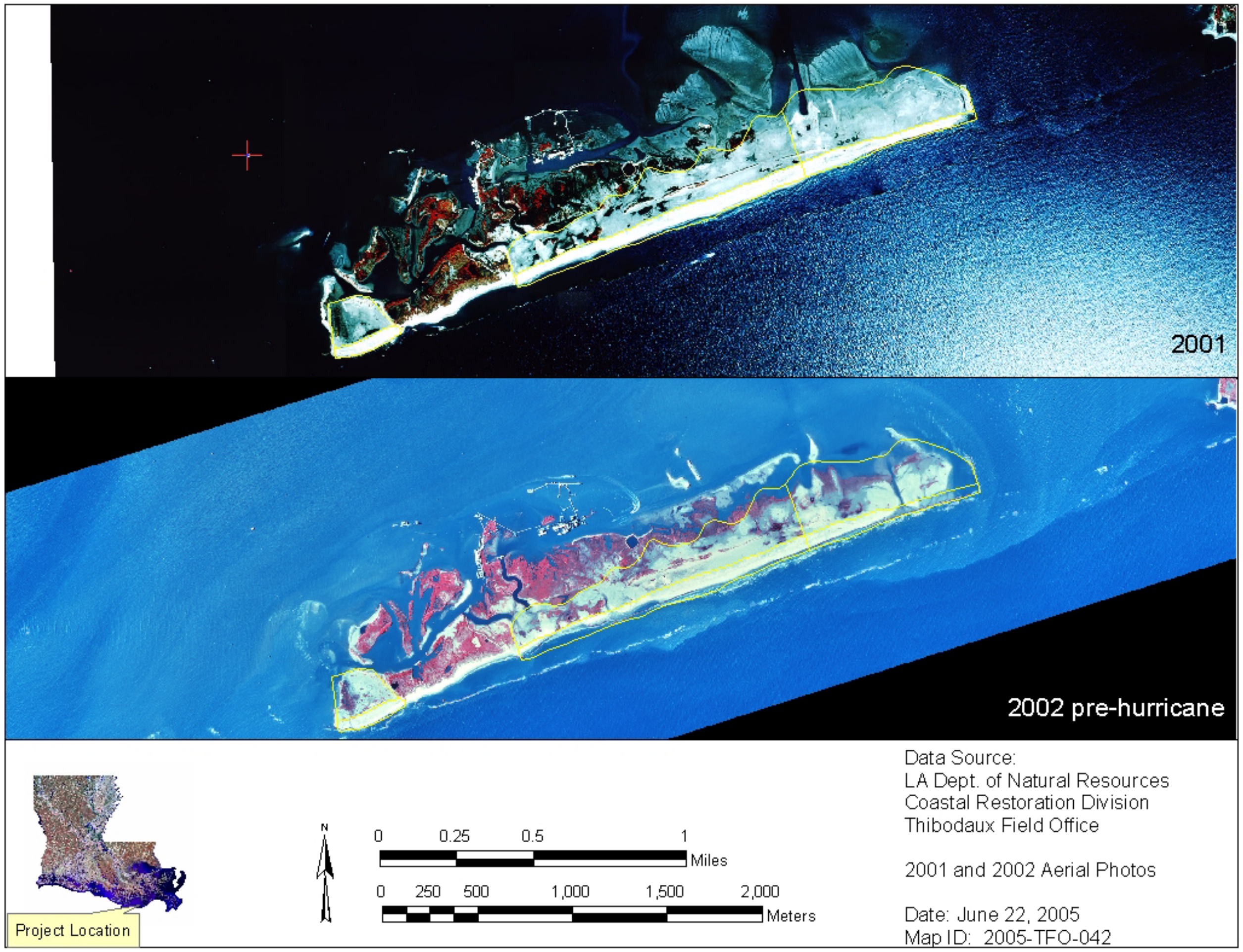

Figure 7. 2001 and 2002 pre-hurricane season aerial photos of East Timbalier Island shown with the as-built dune and marsh platforms superimposed.

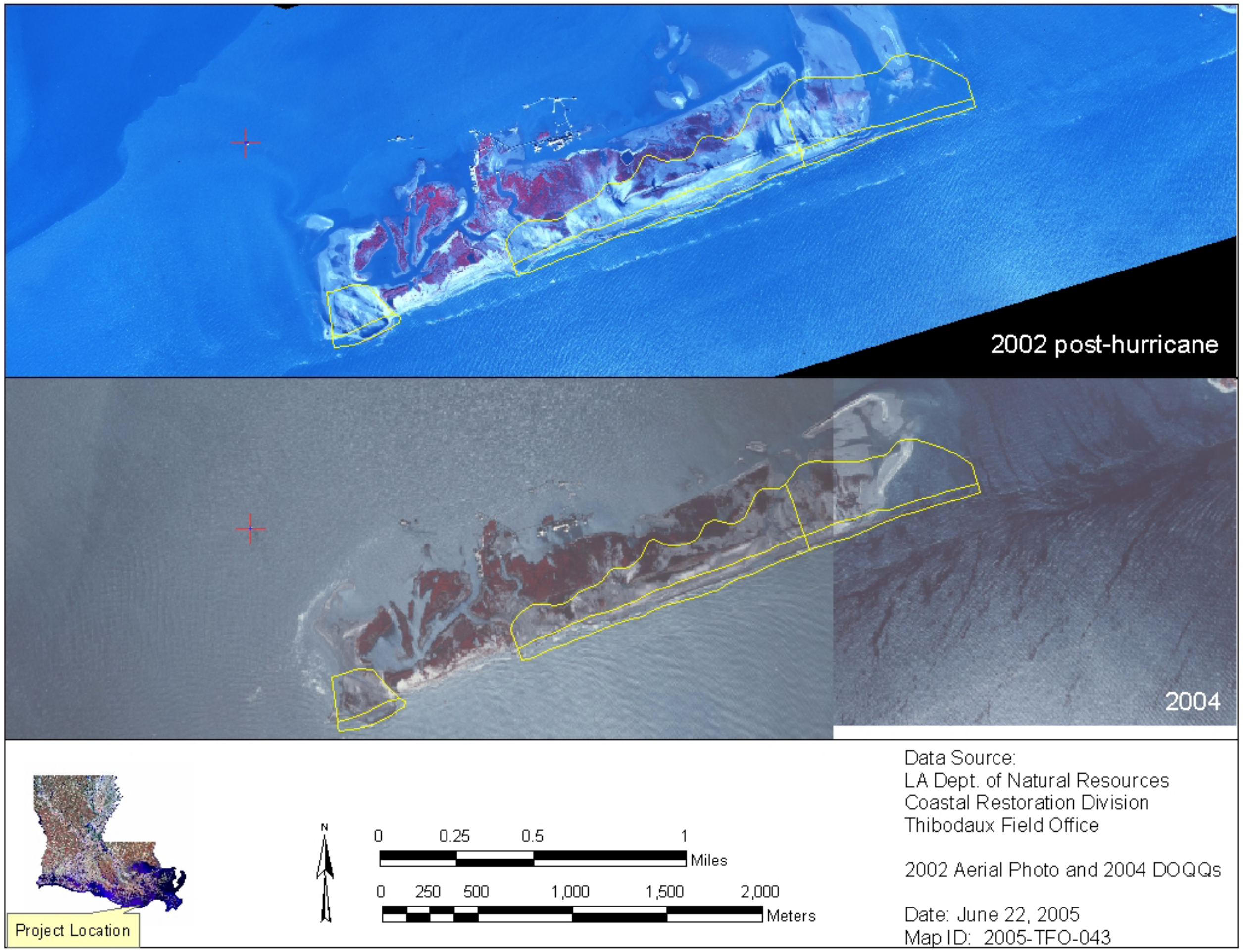

Figure 8. 2002 post-hurricane season aerial photo and 2004 DOQQs of East Timbalier Island shown with the as-built dune and marsh platforms superimposed.

The 2002 hurricane season that included Tropical Storm Isidore and Hurricane Lili contributed to 99.86 acres (40.41 ha) lost and a 29.85% decrease in East Timbalier Island's total area (from UNO/PIES; table 1). All habitat classifications displayed an aerial decrease with barrier vegetation showing the greatest loss at an 80.26% decrease with 13.38 acres (5.41 ha) of the original 16.67 acres (6.75 ha) pre-hurricane season. The greatest total acreage lost was a 45.76 acres (18.52 ha) loss in bare habitat (a 56.91% decrease).

Vegetation

C. dactylon, *P. amarum*, and *Suaeda linearis* (Ell.) Moq. (sea-blite) were the most prevalent plants observed during the August 2001 vegetation sampling trip (table 2; figure 9). These species were observed in over 36% of the plots, with *C. dactylon* having the greatest mean cover in each of the three treatments and appearing to have filled in most vacant areas between plantings. Several over-wash areas were noticed during the sampling trip; planted rows were either dead or missing, and several planted rows closest to the Gulf of Mexico were washed away in several places. Many of the plantings of *S. patens* were reported to be dead or barely alive by field personnel. Furthermore, personnel reported that those still alive appeared to be stressed and no tillers were observed. In contrast, most plantings of *P. amarum* were alive except where washed away. *P. amarum* appeared to the field personnel to be tall and healthy although no tillers were observed. However, no significant differences for percent survival among fence treatments (figure 10) and north/south of the fence (figure 11) were apparent in sampled areas.

P. amarum and *S. linearis* were still fairly prevalent in 2002 (table 3; figure 12). *C. dactylon* displayed a decrease in cover and prevalence in 2002. Vegetative cover had increased over bare ground in treatments A and V but decreased in L. During the September 2002 sampling trip, field personnel noticed that segments on the eastern end of the island were destroyed and most of the area was intertidal. However, some plant segments north of the sand fencing were still intact at the eastern end of the island. Percent survival was significantly higher ($p < 0.001$) in treatment V as this fencing configuration buffered vegetation to the inside of the V-configuration from over-wash, wave action, or scour (figure 13). In contrast, treatment A appeared to be focusing or funneling over-wash into the fencing configuration and causing scour. Percent survival of planted vegetation was greater to the north of the sand fencing (figure 14). The GLM was significant ($p < 0.05$). However, pairwise contrasts yielded no significant comparisons between species or north/south of the dune fence. That is, we may be seeing an overall effect in the location of planted vegetation, but we lack the statistical power to determine any significant differences between any two treatments/species (i.e., inadequate sample size).

Table 1. Habitat statistic analysis from May 2002 to November 2002 showing the effect of Tropical Storm Isidore and Hurricane Lili on various habitats of East Timbalier Island (from UNO/PIES).

East Timbalier:

Classification	5-14-02 (acres)	5-14-02 Percent	11-07-2002 (acres)	11-07-02 Percent	Change (acres)	Change Percent
beach	83.61	24.99	64.14	27.33	(19.47)	(23.29)
bare	80.41	24.04	34.65	14.76	(45.76)	(56.91)
marsh	153.86	45.99	132.61	56.50	(21.25)	(13.81)
barrier vegetation	16.67	4.98	3.29	1.40	(13.38)	(80.26)
rip rap	14.72	4.40	9.24	3.94	(5.48)	(37.23)
oil/gas structure	7.78	2.33	6.93	2.95	(0.85)	(10.93)
intertidal	50.05	14.96	230.77	98.33	180.72	361.08
total land only	***334.55***	*100.00*	***234.69***	*100.00*	***(99.86)***	***(29.85)***

Table 2. Estimated mean percent cover for all species occurring during the August 2001 sampling of 2x2 m Braun-Blaunqet vegetation plots at East Timbalier Island (TE-25/30) project dredge material fill area.

	A		V		L	
Species	**% Stations**	**Mean Cover**	**% Stations**	**Mean Cover**	**% Stations**	**Mean Cover**
Bare ground	100.0	90.9	100.0	84.8	100.0	85.6
Amaranthus greggii S. Wats.	2.8	5.0	5.6	0.8		
Cynodon dactylon (L.) Pers.	47.2	9.0	86.1	14.0	66.7	18.2
Heliotropium curassavicum L.	8.3	0.5	22.2	4.8	2.8	5.0
Iva frutescens L.			2.8	0.5		
Panicum amarum Ell.	52.8	3.1	58.3	0.8	44.4	1.4
Panicum virgatum L.			5.6	0.1		
Sesuvium portulacastrum (L.) L.	13.9	2.3	13.9	9.2	13.9	6.1
Solidago sempervirens (L.)	2.8	0.5				
Spartina patens (Ait) Muhl.	8.3	0.1	25.0	1.6	25.0	0.6
Suaeda linearis (Ell.) Moq.	66.7	4.5	36.1	2.2	47.2	0.7

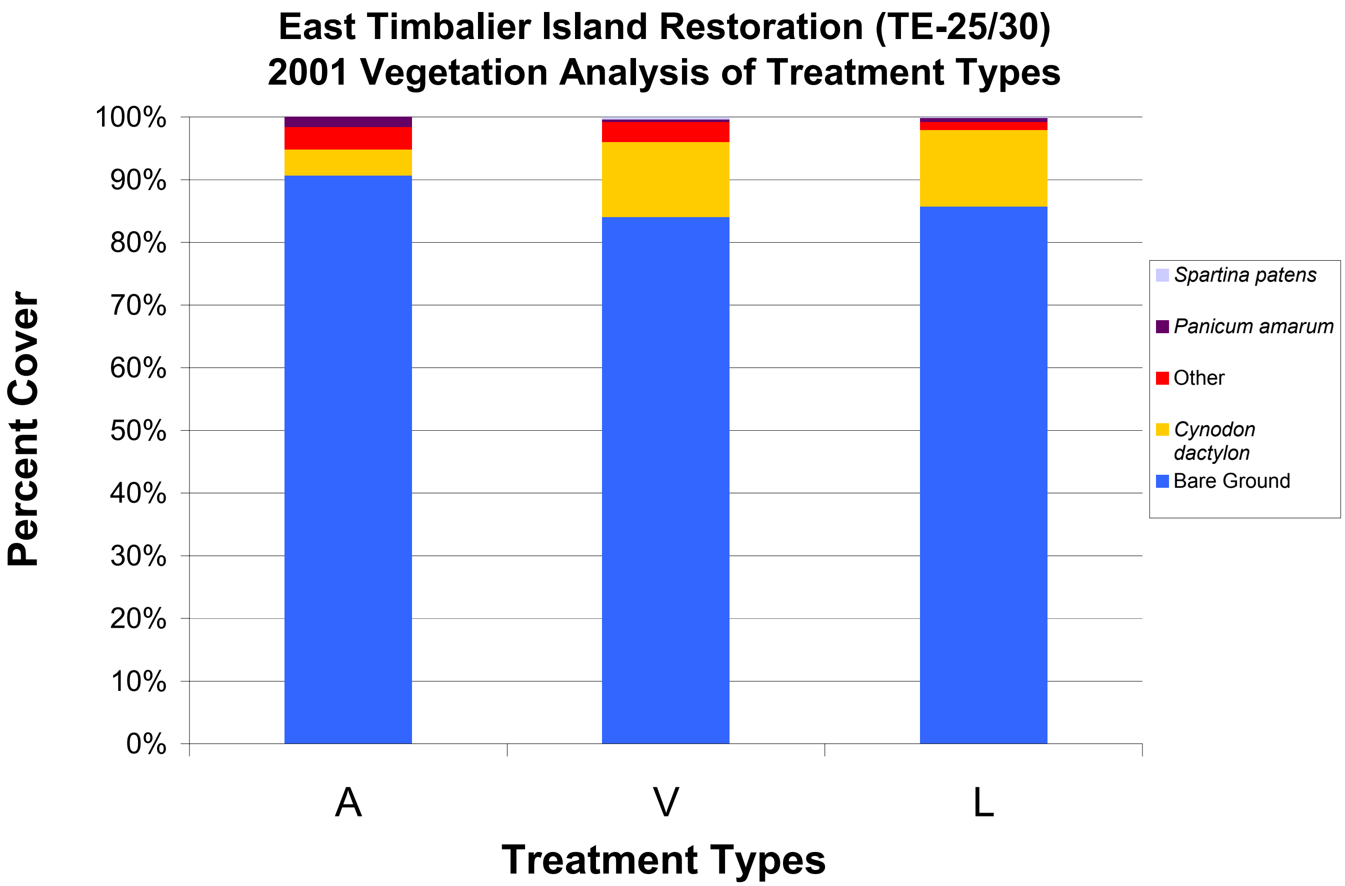

Figure 9. East Timbalier Island Restoration Phases I and II (TE-25/30) mean cover of selected species by treatments A, V, and L collected in August 2001 (6 months post-planting).

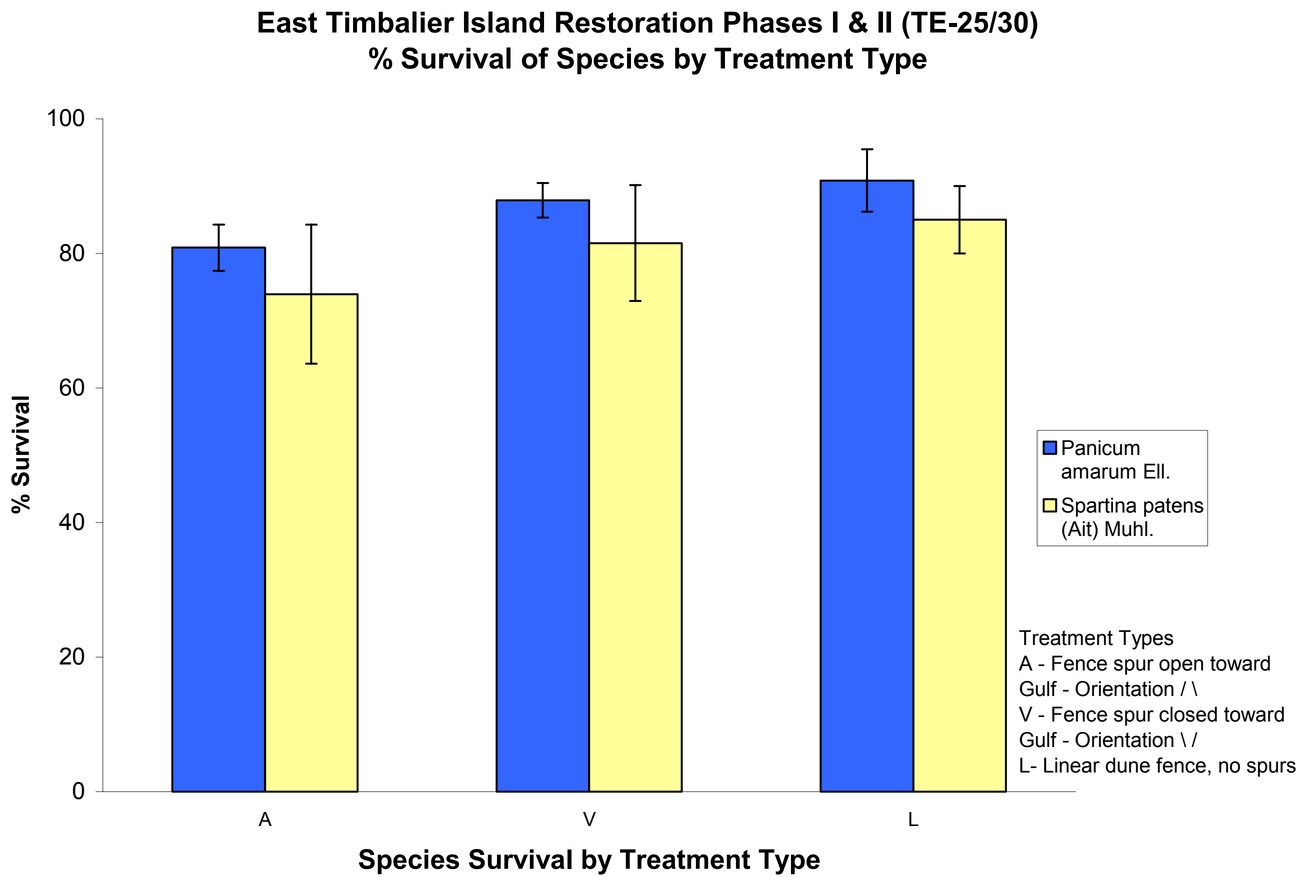

Figure 10. East Timbalier Island Restoration Phases 1 and 2 (TE-25/30) percent survival of planted species within the A, V, and L treatments collected August 2001 (6 months post-planting). There were no significant differences in plant survival among treatments.

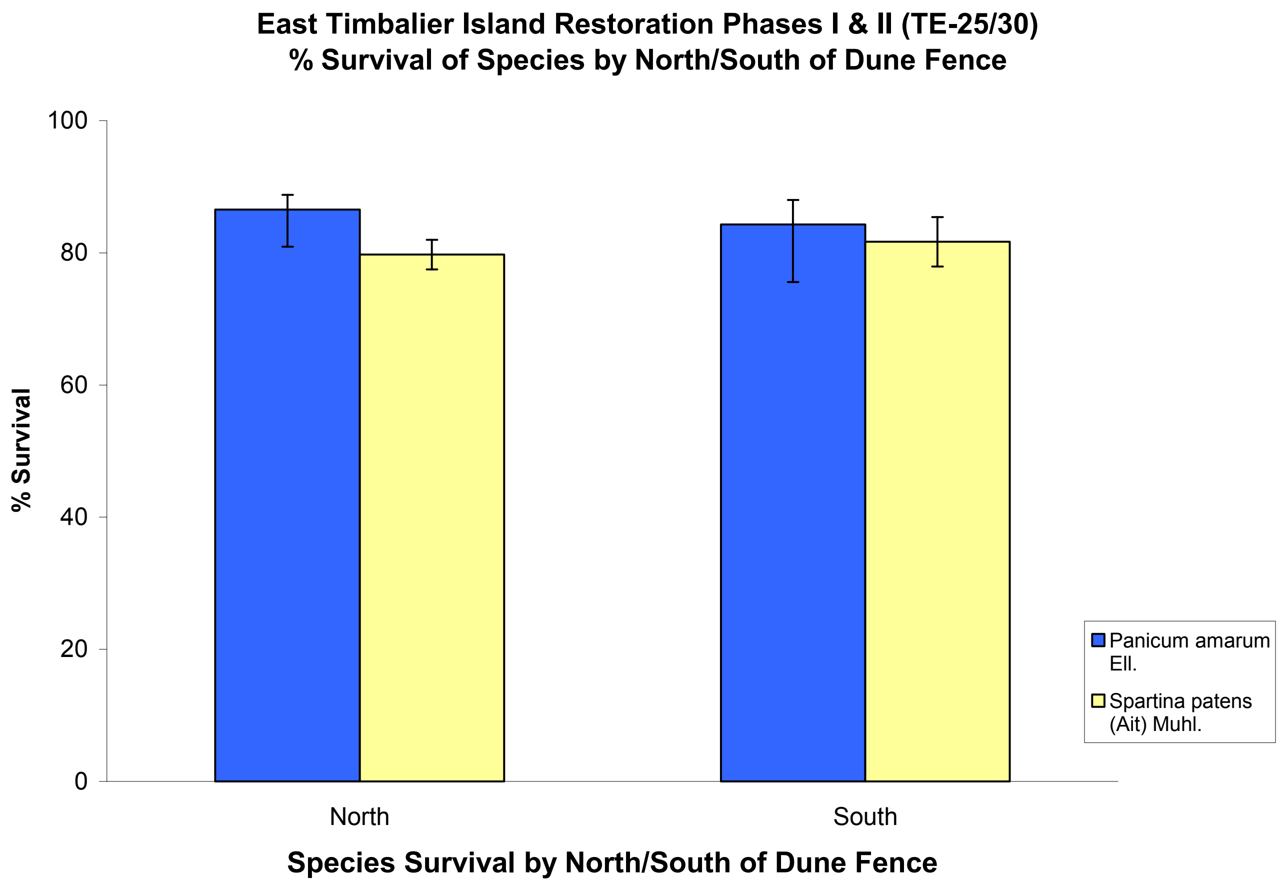

Figure 11. East Timbalier Island Restoration Phases 1 and 2 (TE-25/30) percent survival of planted north or south of shore-parallel dune fence collected August 2001 (6 months post-planting). There were no significant differences in plant survival.

Table 3. Estimated mean percent cover for all species occurring during the September 2002 sampling of 2x2 m Braun-Blaunqet vegetation plots at East Timbalier Island (TE-25/30) project dredge material fill area.

			V		L	
Species	**%**	**Mean Cover**	**%**	**Mean Cover**	**%**	**Mean Cover**
Bare ground	100.0	82.4	100.0	72.2	100.0	92.6
Baccharis halimifolia L.	5.9	3.5	5.6	0.1		
Cynodon dactylon (L.) Pers.	17.6	7.2	77.8	13.3	19.4	10.3
Eustoma exaltatum (L.) Salisb. ex G. Don	2.9	1.0				
Heliotropium curassavicum L.	8.8	0.4	8.3	1.5		
Ipomoea pes-caprae (L.) R. Br.						
Panicum amarum Ell.	44.1	29.7	77.8	16.1	35.5	21.8
Sesuvium portulacastrum (L.) L.	5.9	0.6				
Solidago sempervirens L.	2.9	10.0				
Spartina patens (Ait.) Muhl.	11.8	18.8	27.8	7.7	9.7	5.0
Strophostyles helvula (L.) Ell.			2.8	5.0		
Suaeda linearis (Ell.) Moq.	26.5	9.0	36.1	10.0		

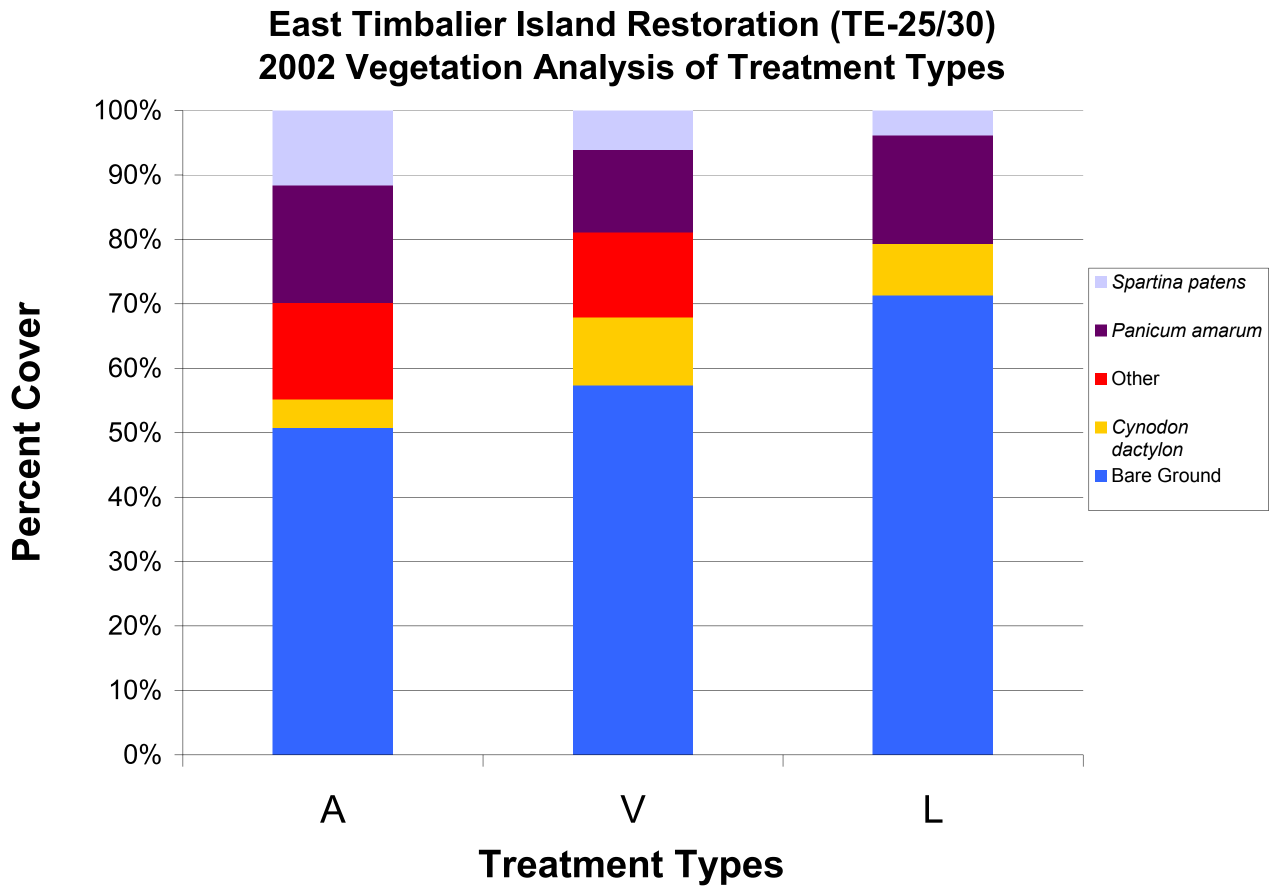

Figure 12. East Timbalier Island Restoration Phases I and II (TE-25/30) mean cover of selected species by treatments A, V, and L collected in September 2002 (18 months post-planting).

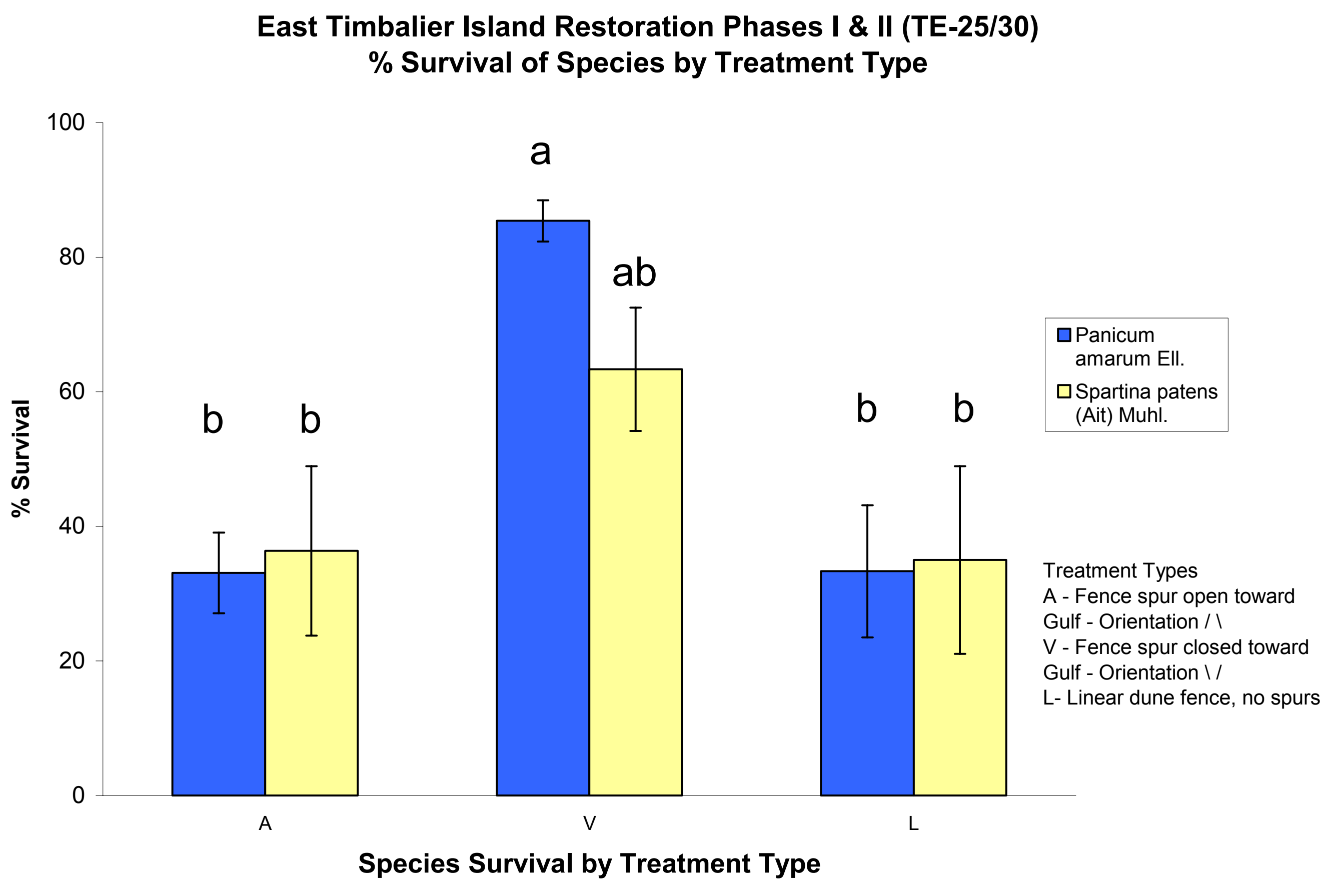

Figure 13. East Timbalier Island Restoration Phases 1 and 2 (TE-25/30) percent survival of planted species within the A, V, and L treatments collected September (18 months post-planting). *Panicum amarum* in treatment V showed a significantly higher percentage of survival ($p < 0.001$) 18 months after planting probably due to the wave and washover protection provided by the V fence configuration.

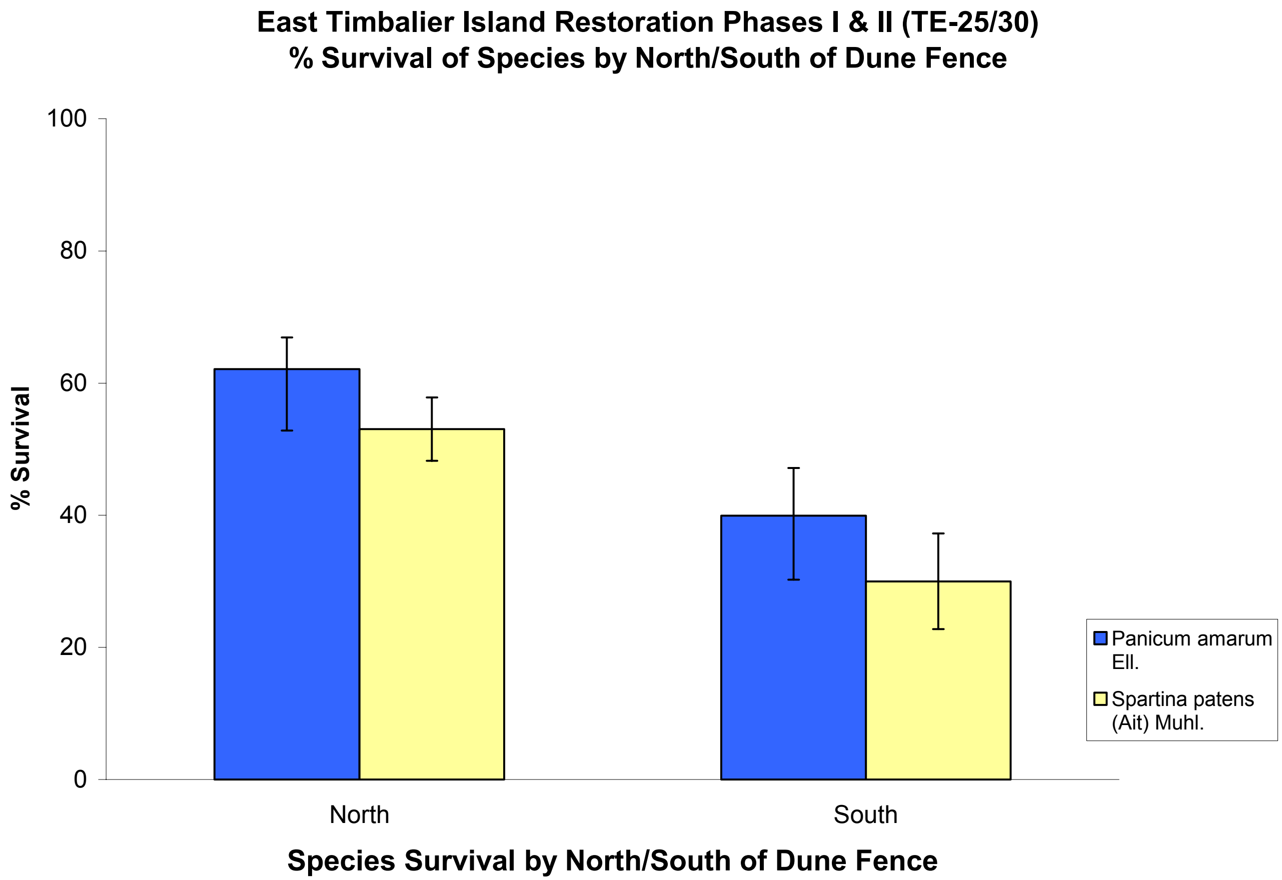

Figure 14. East Timbalier Island Restoration Phases 1 and 2 (TE-25/30) percent survival of planted north or south of shore-parallel dune fence collected September 2002 (18 months post-planting). There were no significant differences in plant survival.

Elevation

Currently, we are still in the process of converting pre-construction and as-built survey data collected via conventional survey methods to the Louisiana Department of Natural Resources-Louisiana Coastal Zone (LCZ) GPS network datum. LiDAR surveys show a total increase of nearly 230,000 cubic yards (175,801 m^3) and a percent increase of 12.6% between 2000 and 2001 (figure 15). We saw a similar increase between 2000 and 2001 with the Isles Dernieres (West and Babin 2007a, b, c) and attribute this increase to a change of data collection instruments or datum units as field investigations could not confirm any volume increase or sand buildup. Tropical Storm Isidore (September 2002) and Hurricane Lili (October 2002) contributed to a decrease in volume of the island to more than 359,000 cubic yards (274,581 m^3), or a 17.4% decrease, between LiDAR surveys conducted in 2001 and 2002.

V. Conclusions

a. Project Effectiveness

This project initially suffered from the selection of poor fill material (D. Burkholder, *pers. comm.*). Fill sediments had a percentage of fine materials that was too high and unsuitable as beach material. Initially the sand fences on the western end of the island were building dunes on either side of the fence. However, the central and western portions of the island were not building dunes, suggesting a net movement of sand to the west. Furthermore, several washovers were noticeable within two years post-construction (see figure 7). The lack of a fronting beach and unfavorable fill material may have contributed to the overwash events. Some of the vegetative plantings looked healthy upon inspection 6 months post-planting in some areas. However, some plantings on the south side of the sand fencing and within the A-orientation of spur fencing appeared stressed or were missing due to sand scours.

b. Recommended Improvements

Funding for the maintenance of barrier island restoration projects was not considered due to the expense involved with replenishment of dredge material over the life expectancy of the project. In forgoing the funding of a barrier island maintenance program to replenish sediment lost to normal storm events, claims for Federal Emergency Management Agency (FEMA) assistance resulting from extensive or catastrophic storm damage to barrier islands from unexpected storms events such as tropical storms and hurricanes are considered ineligible. Based on monitoring activity of these islands, it has been documented that these barrier island are experiencing significant land loss due to barrier island rollover and island narrowing resulting from such unexpected

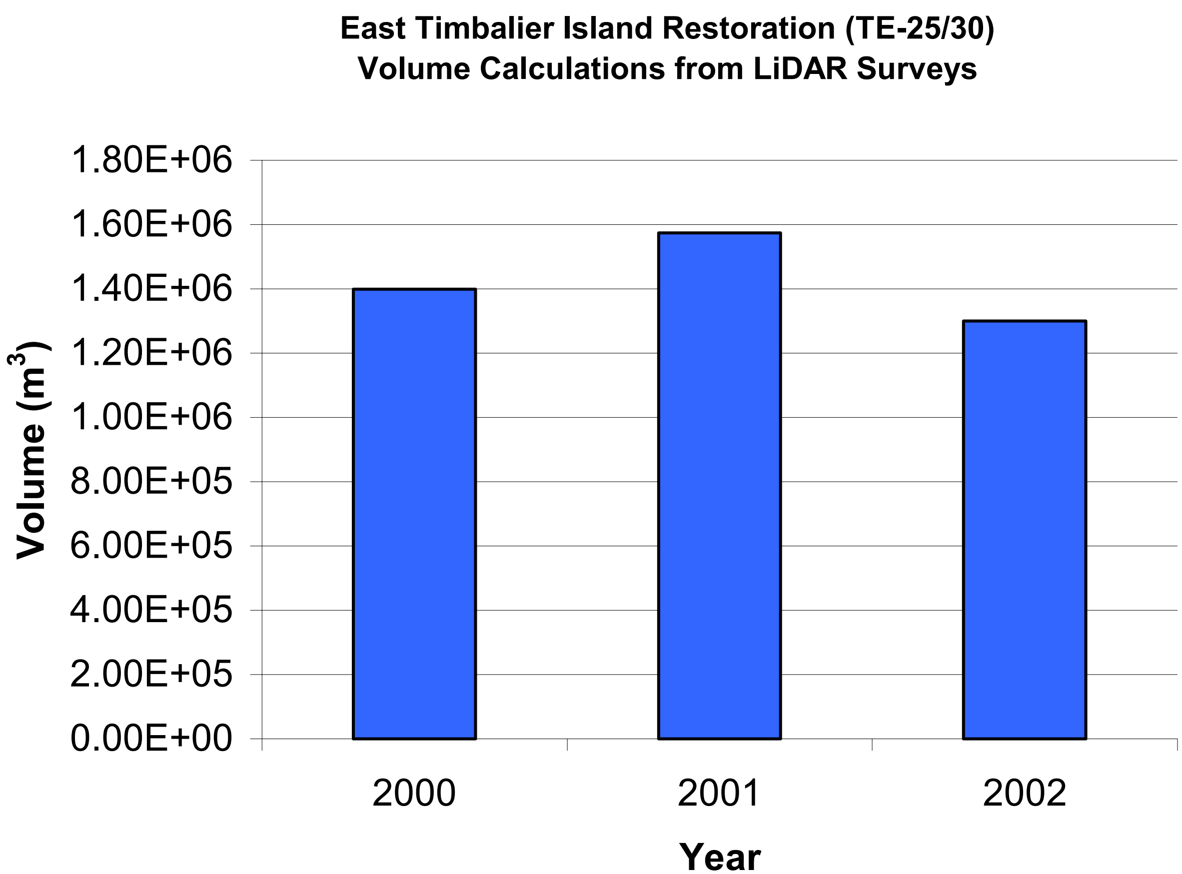

Figure 15. Volume calculations of the East Timbalier Island calculated from LiDAR surveys in 2000, 2001, 2002.

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.

c. Lessons Learned

This project used the first implementation of a back barrier marsh platform. The marsh platform provided a stable foundation for barrier island rollover and may have decreased fill sediment loss into Timbalier Bay. Therefore, we advocate the construction of a marsh platform behind dunes on any upcoming barrier island construction template. This project did not have a fronting beach to protect the dune platform. The absence of this feature may have contributed to the increased loss and rollover that the dune platform underwent. We recommend that any upcoming barrier island design utilize a fronting beach to dampen wave strength and buffer the impact of waves to the dune platform.

The use of rocks on barrier islands may not be a feasible approach. Although the rocks placed between 1996 and 1998 initially protected the back barrier marsh in some places and held some of the dune sediment nearer to the gulf side of the island, they also may have facilitated scouring and washover fans where gaps in the rocks were located. As the island naturally experiences rollover, the rocks stay in place diffracting and refracting waves into abnormal patterns upsetting the natural processes of longshore transport and sediment erosion/deposition (cf. Davis and Fitzgerald 2004).

The use of dredged sediment, sand fencing, and vegetative plantings are plausible ways to create quasi-stabilization and further prolong the lives of barrier islands. These three techniques should be used in conjunction and the construction of sand fencing as well as vegetative planting should occur as soon as possible after the placement of dredged sediment to minimize soil loss. Furthermore, a different vegetative planting design must be determined to allow vegetative colonization in a sufficient time frame as to maximize sediment stabilization.

Barrier islands are often exposed to storm events resulting in substantial over-wash and breaching. To combat these processes, it is important that a continuous dune of sufficient height and width is maintained on these islands. Other than periodically replenishing sediment by hydraulic dredge, sand fencing has proven to be an effective technique in rebuilding dunes by capturing wind blown sediment. We have learned from past projects that orienting the sand fencing parallel to the shore face and perpendicular to the predominant wind direction has maximized the potential for maintaining a viable dune section. The use of spur fencing does not aid in dune accumulation and in the case of East Timbalier Island, some of the spur orientations actually promoted scouring.

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Appendix A

Inspection Photographs

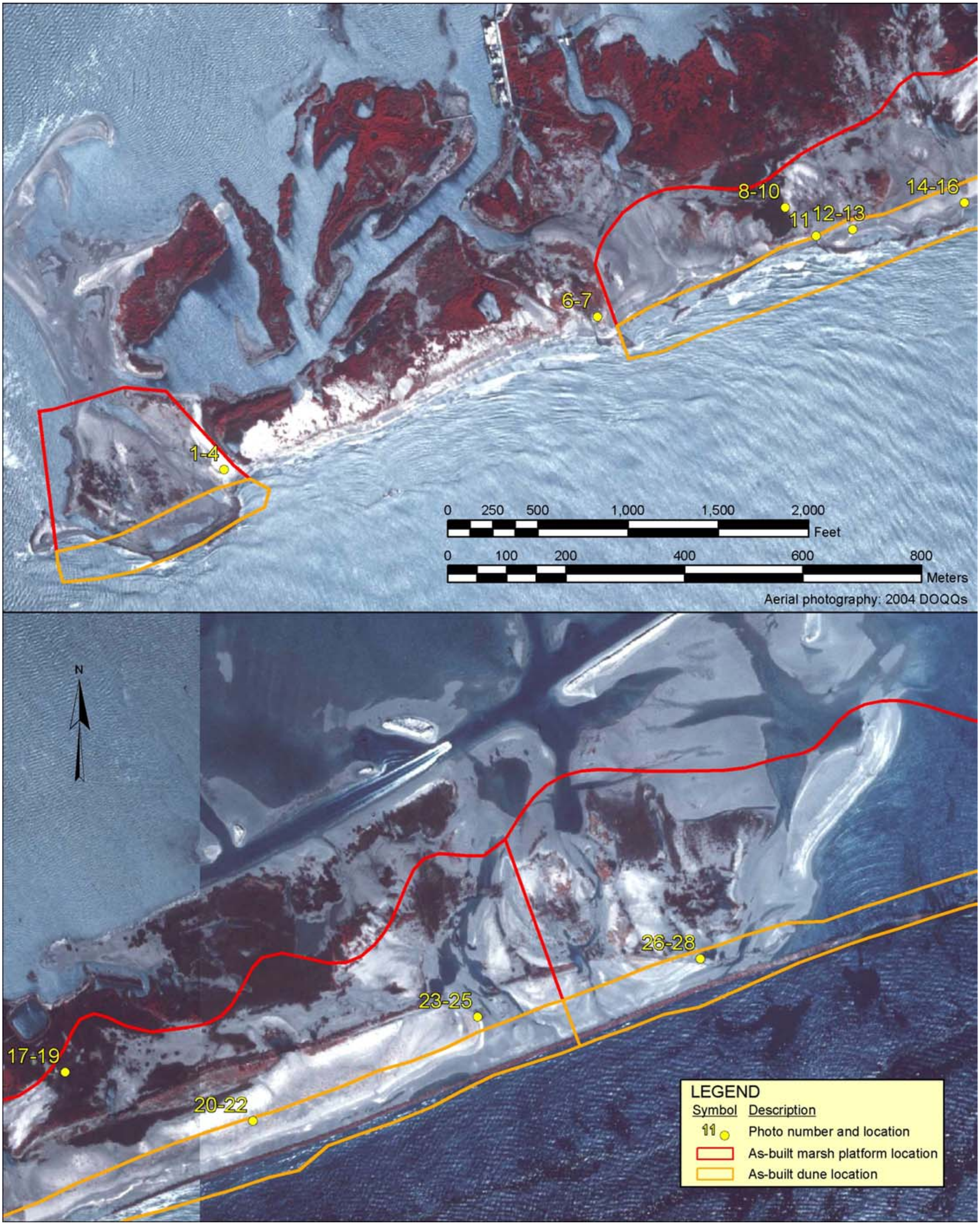


Figure A-1. Photo reference map from 6/21/2005 inspection of East Timbalier Island Sediment Restoration (TE-25 & TE-30).

Photo 1. *Sta. 6+50, View of western portion of TE-25 looking southwest (100_0444.jpg).*

Photo 2. *Sta. 6+50, View of western portion of TE-25 looking west (100_0445.jpg).*

Photo 3. *Sta. 6+50, View of western portion of TE-25 looking northwest (100_0446.jpg).*

Photo 4. *Sta. 6+50, View of western portion of TE-25 looking north (100_0447.jpg).*

Photo 5. *Sta. 28+50, View of marsh platform sand overwash looking east (100_0448.jpg). Note scoured dune area of lower elevation in background.*

Photo 6. *Sta. 29+00, View of marsh platform sand overwash looking east (100_0449.jpg).*

Photo 7. *Sta. 29+00, View of marsh platform sand overwash looking northeast (100_0450.jpg).*

Photo 8. *Sta. 41+00, View of marsh platform sand overwash looking east (100_0451.jpg).*

Photo 9. *Sta. 41+00, View of marsh platform sand overwash looking northeast (100_0452.jpg).*

Photo 10. *Sta. 41+00, View of marsh platform sand overwash looking west (100_0453.jpg).*

Photo 11. *Sta. 44+00, View of rubble mound revetment tie-in at "old" rocks looking southeast (100_0443.jpg).*

Photo 12. *Sta. 44+50, View of rubble mound revetment tie-in at "old" rocks looking west (100_0441.jpg).*

Photo 13. *Sta. 44+50, View of rubble mound revetment tie-in at "old" rocks looking southwest (100_0442.jpg).*

Photo 14. *Sta. 50+50, View of rubble mound revetment looking west (100_0438.jpg).*

Photo 15. *Sta. 50+50, View of dune fill looking west (100_0440.jpg).*

Photo 16. *Sta. 50+50, View of dune fill looking east (100_0439.jpg).*

Photo 17. *Sta. 56+00, View of marsh platform looking west (100_0456.jpg).*

Photo 18. *Sta. 56+00, View of marsh platform looking south (100_0455.jpg).*

Photo 19. *Sta. 56+00, View of marsh platform looking east (100_0454.jpg).*

Photo 20. *Sta. 64+50, View of sand fencing posts looking southwest (100_0437.jpg).*

Photo 21. *Sta. 64+50, View of sand fencing posts and dune fill looking west (100_0435.jpg).*

Photo 22. *Sta. 64+50, View of marsh platform and sand overwash looking north (100_0436.jpg). Note dune formation on top of marsh platform as island overwashes.*

Photo 23. *Sta. 78+50, View of remaining dune fill and marsh platform with sand overwash looking west (100_0434.jpg).*

Photo 24. *Sta. 78+50, View of marsh platform with sand overwash looking north (100_0433.jpg).*

Photo 25. *Sta. 78+50, View of remaining dune fill and marsh platform with sand overwash looking east (100_0432.jpg).*

Photo 26. *Sta. 91+00, View of remaining dune fill and marsh platform of TE-30 project looking west (100_0430.jpg).*

Photo 27. *Sta. 91+00, View of remaining marsh platform of TE-30 project looking north (100_0429.jpg).*

Photo 28. *Sta. 91+00, View of remaining dune fill of TE-30 project looking east (100_0428.jpg).*

Photo 29. *Sta. 89+00, View of remaining marsh platform of TE-30 project and maintenance dredging spoil material (background) looking north (100_0426.jpg).*

Photo 30. *View of maintenance dredging spoil material from access canal north of TE-30 project looking south (100_0423.jpg).*

Appendix B

Three-Year Budget Projects

EAST TIMBALIER ISLAND SEDIMENT RESTORATION / TE25 & TE30 / PPL3 & 4

Three-Year Operations & Maintenance Budgets 07/01/2005 - 06/30/2008

Project Manager	O & M Manager	Federal Sponsor	Prepared By
	Dearmond	NMFS	Dearmond

	2005/2006	2006/2007	2007/2008
Maintenance Inspection	$ -	$ -	$ 5,540.00
Structure Operation	$ -	$ -	$ -
Administration	$ -	$ -	$ -

Maintenance/Rehabilitation

05/06 Description:

	2005/2006
E&D	$ -
Construction	$ -
Construction Oversight	$ -
Sub Total - Maint. And Rehab.	$ -

06/07 Description

	2006/2007
E&D	$ -
Construction	$ -
Construction Oversight	$ -
Sub Total - Maint. And Rehab.	$ -

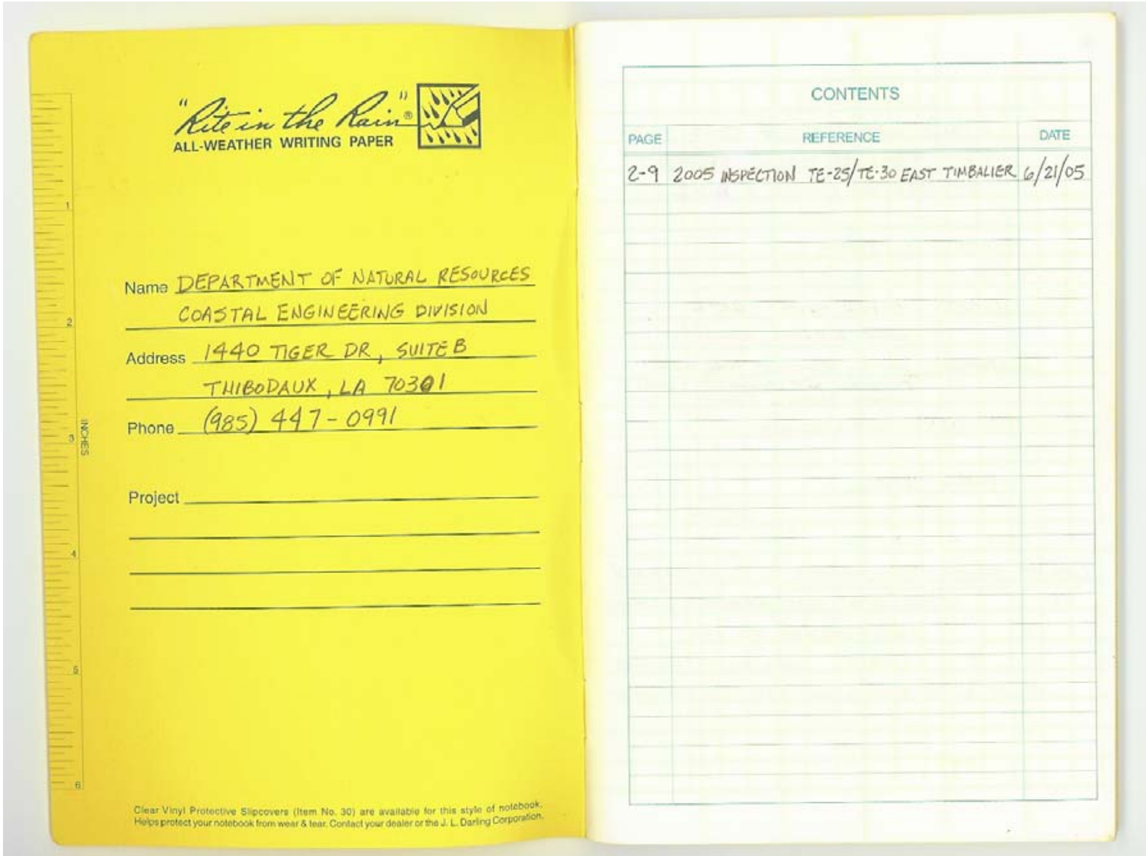
07/08 Description:

	2007/2008
E&D	$ -
Construction	$ -
Construction Oversight	$ -
Sub Total - Maint. And Rehab.	$ -

	2005/2006	2006/2007	2007/2008
Total O&M Budgets	**$ -**	**$ -**	**$ 5,540.00**

Appendix C

Field Inspection Notes



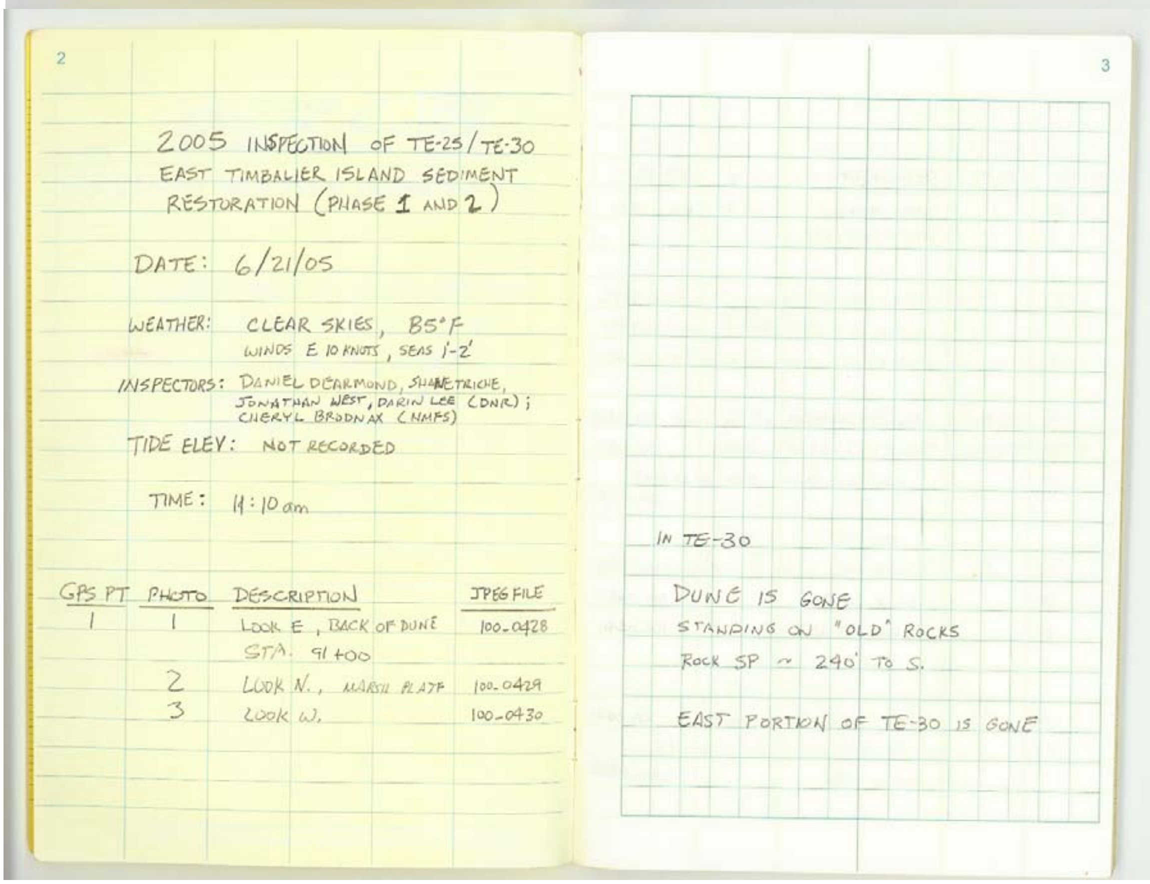
"Rite in the Rain" ALL-WEATHER WRITING PAPER

Name DEPARTMENT OF NATURAL RESOURCES
COASTAL ENGINEERING DIVISION
Address 1440 TIGER DR, SUITE B
THIBODAUX, LA 70301
Phone (985) 447-0991
Project

Clear Vinyl Protective Slipcovers (Item No. 30) are available for this style of notebook. Helps protect your notebook from wear & tear. Contact your dealer or the J. L. Darling Corporation.

CONTENTS

PAGE	REFERENCE	DATE
2-9	2005 INSPECTION TE-25/TE-30 EAST TIMBALIER	6/21/05



2

2005 INSPECTION OF TE-25/TE-30
EAST TIMBALIER ISLAND SEDIMENT
RESTORATION (PHASE 1 AND 2)

DATE: 6/21/05

WEATHER: CLEAR SKIES, 85°F
WINDS E 10 KNOTS, SEAS 1'-2'

INSPECTORS: DANIEL DEARMOND, SHANE TRICHE, JONATHAN WEST, DARIN LEE (DNR); CHERYL BRODNAX (NMFS)

TIDE ELEV: NOT RECORDED

TIME: 11:10 am

GPS PT	PHOTO	DESCRIPTION	JPEG FILE
1	1	LOOK E, BACK OF DUNE STA. 91+00	100-0428
	2	LOOK N., MARSH PLATF	100-0429
	3	LOOK W.	100-0430

3

IN TE-30

DUNE IS GONE
STANDING ON "OLD" ROCKS
ROCK SP ~ 240' TO S.

EAST PORTION OF TE-30 IS GONE

4

PHOTO	GPS PT	DESCRIPTION	JPEG FILE
4		STA. 82+00 SAND FENCE POST	100-0431
5	2	STA. 78+50 LOOK E	100-0432
6		LOOK N OVERWASH	100-0433
7		LOOK W. STAND ON MARSH PLAT.	100-0434
8	3	STA. 64+50 LOOK W SAND FENCE	100-0435
9		LOOK N MARSH PLATFORM	100-0436
10		LOOK SW STAND. BACK PART OF DUNE	100-0437
11	4	STA 50+50 LOOK W. ROCK	100-0438
12		LOOK E.	100-0439
13		LOOK W.	100-0440
14	5	STA. 44+50 LOOK W @	100-0441
15		SP TIE IN @ "OLD" ROCKS LOOK SW	100-0442

5

TE-25

EXIST. SHORELINE IS LOCATED APPX. @ LOCATION OF CONSTRUCTED BACK DUNE LINE.

TIME: 11:40 AM

6

PHOTO	GPS PT	DESCRIPTION	JPEG FILE
16	6	LOOK SE @ TIE-IN SP	100-0443
17	7	LOOK SW @ ROCK	100-0444
18		LOOK W	100-0445
19		LOOK NW	100-0446
20		LOOK N STA. 6+50	100-0447
21		LOOK E STA 28+50	100-0448
22	8	STA 29+00 LOOK E	100-0449
23		LOOK. NE @ WEST END OF EAST PORTION OF TE-25	100-0450
24	9	STA 41+00 LOOK E @ MARSH PLATF	100-0451
25		LOOK NE	100-0452
26		LOOK W	100-0453

7

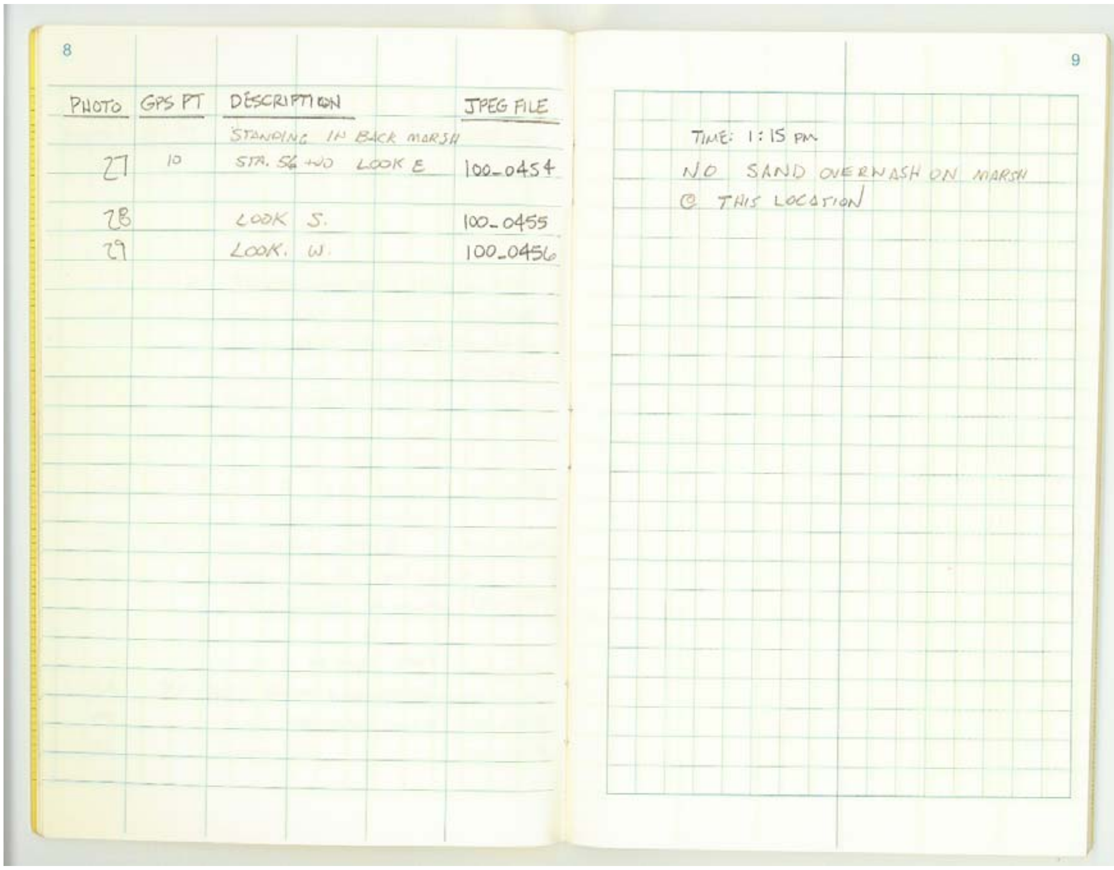
WEST PORTION OF TE-25

TIME: 12:20 PM

TIME: 12:45 PM

MARSH PLATFORM, TE-25

SAND OVERWASH


8
PHOTO GPS PT DESCRIPTION JPEG FILE
STANDING IN BACK MARSH
27 10 STA. 56+00 LOOK E 100_0454
28 LOOK S. 100_0455
29 LOOK. W. 100_0456
9
TIME: 1:15 PM
NO SAND OVERWASH ON MARSH
@ THIS LOCATION