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Department of Natural Resources
Coastal Restoration Division

2007 Operations, Maintenance and Monitoring Report

for

CHANDELEUR ISLANDS MARSH RESTORATION

State Project Number PO-27
Priority Project List 9

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I. Introduction

The Chandeleur Islands are a 72-km-long barrier island chain located in easternmost St. Bernard and Plaquemines Parishes, Louisiana, about 70 miles (113 km) east of downtown New Orleans. The islands are bound by the Gulf of Mexico to the north, south, and east, and by Chandeleur and Breton Sounds to the west. Classified as a wilderness area, the islands are contained within the Breton National Wildlife Refuge and managed by the United States Fish and Wildlife Service (USFWS). The Chandeleur Islands Marsh Restoration (PO-27) project area encompasses Chandeleur Island, the northernmost island in the Chandeleur Island chain (Figure 1).

The islands, which comprise the largest and oldest transgressive barrier island arc in the northern Gulf of Mexico, are the remnant land mass of the St. Bernard delta complex, which was abandoned some 1,500 years ago (Debusschere et al. 1990; Suter et al. 1988). Delta abandonment initiates barrier island development through the erosion of abandoned headlands and the redistribution of eroded sediments as flanking barrier islands (Penland et al. 1985, Penland et al. 1988). Subsidence of the abandoned delta leads to the detachment of the barrier shoreline and the creation of a barrier island arc, such as the Chandeleur Islands, which migrates landward from its initial position. The final stage in barrier shoreline evolution occurs when erosional factors such as relative sea level rise and storm impacts begin to overcome the ability of the island arc to regenerate itself through washover deposits and flood tidal delta deposits. This eventually transforms the barrier arc to a submerged inner shelf shoal.

The Chandeleur Islands have been retreating west-northwest toward the mainland for the last 100 years at rates greater than 15 m yr^{-1} in the southern islands, and decreasing northward to less than 5 m yr^{-1} (Penland et al. 1985). The asymmetric morphology of the island arc is due to its almost parallel orientation to the dominant southeasterly wave approach, causing extensive northward longshore transport. The northern portion of the island arc is dominated by wide beaches with multiple bars and large washover fans separated by hummocky dune fields. The dune zone is vegetated by shrubs and grasses, and grades into a high salt marsh populated by black mangrove (*Avicennia germinans*) and smooth cordgrass (*Spartina alterniflora*) (Kahn and Roberts 1982). Other species which occur on the islands include inland saltgrass (*Distichlis spicata*), wiregrass (*Spartina patens*), gulf croton (*Croton punctatus*), beach morning-glory (*Ipomoea imperati*), wax myrtle (*Myrica cerifera*), and eastern baccharis (*Baccharis halimifolia*). The southern islands are narrower and lower in elevation, and eventually give way to small island fragments and shoals separated by tidal inlets toward the southern tip. The barrier beach generally consists of broken *Rangia* and oyster-shell litter mixed with well-sorted fine quartzose sand (Kahn and Roberts 1982).

The Chandeleur Islands experienced an average land loss rate of 0.08 km^2 yr^{-1} between 1869 and 1985 (Penland et al. 1985). According to Kahn and Roberts (1982), the long-term deterioration of the island arc is enhanced by 1) subsidence of the St. Bernard delta sediments,

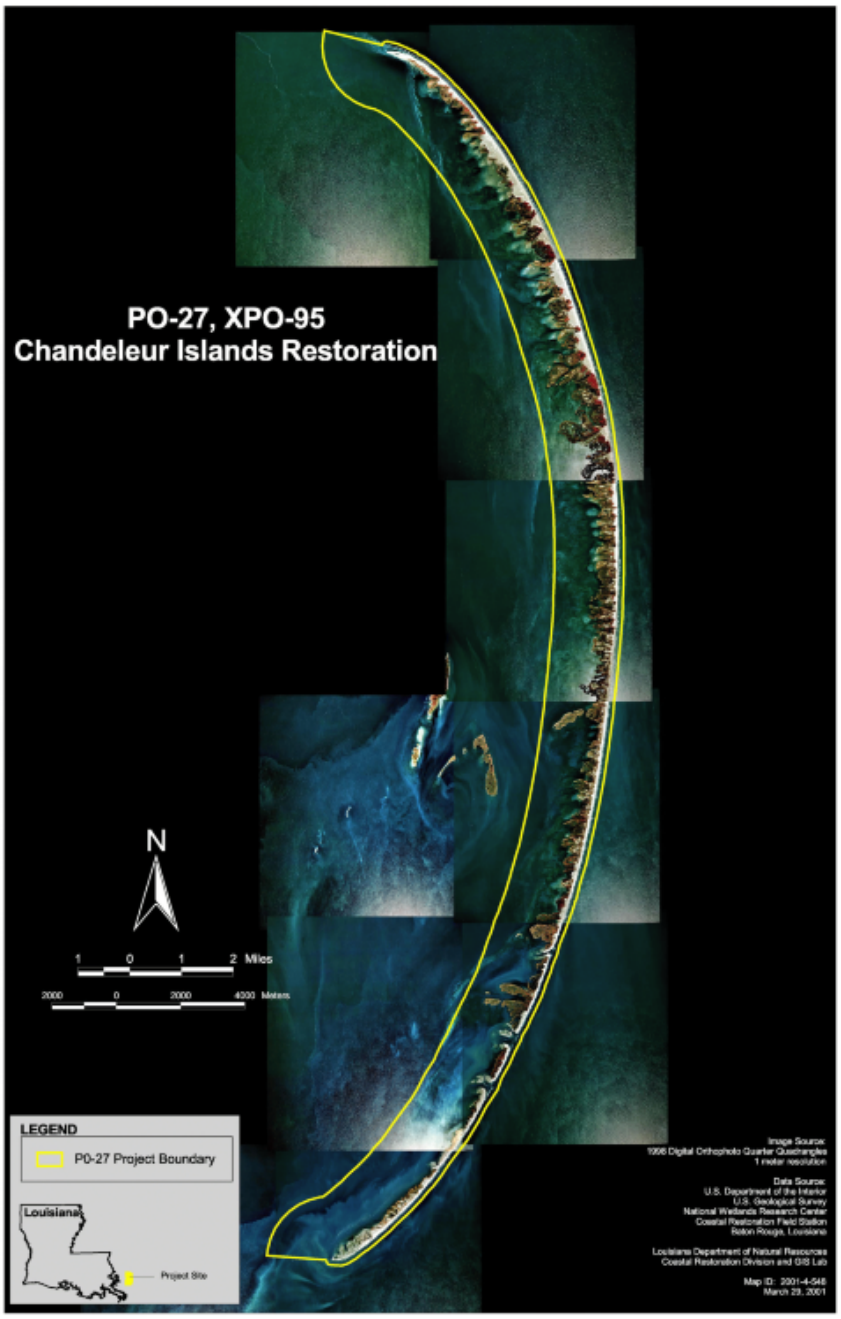


Figure 1. Chandeleur Islands Marsh Restoration (PO-27) project boundary based on 1998 mosaic.

2) absence of sediment supply, and 3) the frequent passage of destructive tropical cyclones. During storm events, sediment is eroded from the beach face and nearshore bars of barrier islands and is deposited seaward. The constructive period between storms is usually of insufficient length to allow the barrier island to completely regenerate. In many transgressive barrier island systems, such as the Chandeleurs, sediment is often deposited as overwash on the landward side of the island (or seaward side, depending on direction of storm surge flooding) due to overtopping or breaching of the barrier during storm events. Overwash deposits in the backbarrier marshes are often colonized by salt marsh vegetation and sea grasses, counteracting some beach erosion and promoting landward migration of the islands (Debusschere et al. 1990). Ritchie and Penland (1988) note the importance of vegetation in the establishment and stabilization of coastal dunes. If a washover area is not subjected to repeated disruption due to overwash events, plant colonization produces ground cover and encourages sand aggradation.

The Chandeleur Islands Marsh Restoration project, which involved the planting of *Spartina alterniflora* to stabilize hurricane washover areas, was developed in response to extensive overwash and breaching of the islands which occurred during the passage of Hurricane Georges in 1998. However, in the seven years following Hurricane Georges, the islands were repeatedly battered by several intense tropical storm events (Table 1), which devastated the islands and greatly affected the outcome of this project. The islands proved amazingly resilient through the comparatively weaker storms of the 2002-2003 seasons. However, in 2004 Hurricane Ivan passed within 60 miles to the east of the islands, causing damage similar to what was seen after Hurricane Georges, with the number of overwash channels increasing from less than 20 before the storm to over 100 after the storm. One year later, Hurricane Katrina passed to the west of the islands and washed away a significant portion of its landmass. Unfortunately, Hurricane Katrina struck at the end of a frequent storm period which had already placed the island in a fragile state of recovery. During Katrina, the Chandeleur Islands lost much of the critical sand reserves that are normally deposited on the backside of the island during storm events and are crucial to the islands' recovery.

Table 1. Major storm events affecting the Chandeleur Islands from 2002 to 2005.

Storm Event	**Date of U.S. Landfall**	**Approximate Landfall Location**	**Windspeed at Landfall**
Tropical Storm Isidore	September 26, 2002	Grand Isle, La.	55 knots
Hurricane Lili	October 3, 2002	Intracoastal City, La.	80 knots
Tropical Storm Bill	June 30, 2003	Cocodrie, La.	50 knots
Hurricane Ivan	September 16, 2004	Mobile Bay, Ala.	105 knots
Hurricane Cindy	July 6, 2005	Grand Isle, La.	60 knots
Hurricane Katrina	August 29, 2005	Buras, La.	110 knots
Hurricane Rita	September 24, 2005	Texas/Louisiana border	100 knots

The objective of the Chandeleur Islands Marsh Restoration project was to stabilize 364 acres (1.47 km^2) of unvegetated washover deposits on 22 overwash fan sites through the use of *Spartina alterniflora* plantings to trap and hold sediments. Stabilization of washover deposits was to allow for the accretion of back barrier marshes through sediment trapping, the re-colonization of submerged aquatic vegetation (SAV) beds due to stabilization of subtidal sand flats, and the protection of up to 30 acres (0.12 km^2) of main island habitat through wave reduction and sediment trapping. The specific goals of the project were to 1) increase percent cover of emergent vegetation in planting areas, and to 2) maintain or increase intertidal area, as indexed by elevation data, within and adjacent to the planting sites. Areas within the elevation range of mean low water and mean high water will be defined as "intertidal." Phase I of the project, which accounts for 40% of the total plantings, was completed in July 2001. A total of 80,730 plants were installed at 10 overwash sites (Figure 2). Each site was planted with two rows of plants below mean tide, plus additional rows to reach the mean high tide line at 1.06-ft NAVD88 (0.32-m). Rows were spaced 10 ft (3 m) apart. A total of 35,100 linear ft (10,698 m) of shoreline were planted. A site visit to the Chandeleur Islands on May 12-13, 2003, by Louisiana Department of Natural Resources (LDNR) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries staff revealed that there was not a significant number of planting sites that required further work, as defined by the criteria established during a test planting in 2000. This test planting determined the optimal planting elevation to be at mean water level. Therefore, it was decided that Phase II of the project, which included the remaining 60% of the proposed plantings, would not be installed. Other factors contributing to this decision were the uncertainty of future storm damage coupled with the high cost of construction. The total cost of the planting operation was $388,743 ($11.08 per linear ft of planted rows), which included cost to acquire, deliver, and install the plants.

II. Maintenance Activity

a. Project Feature Inspection Procedures

Maintenance activities and funds were not authorized for this project. Therefore, maintenance inspections or work has not been conducted.

III. Operation Activity

a. Operation Plan

There is no operations activity on this project, and therefore, there is not an operation plan.

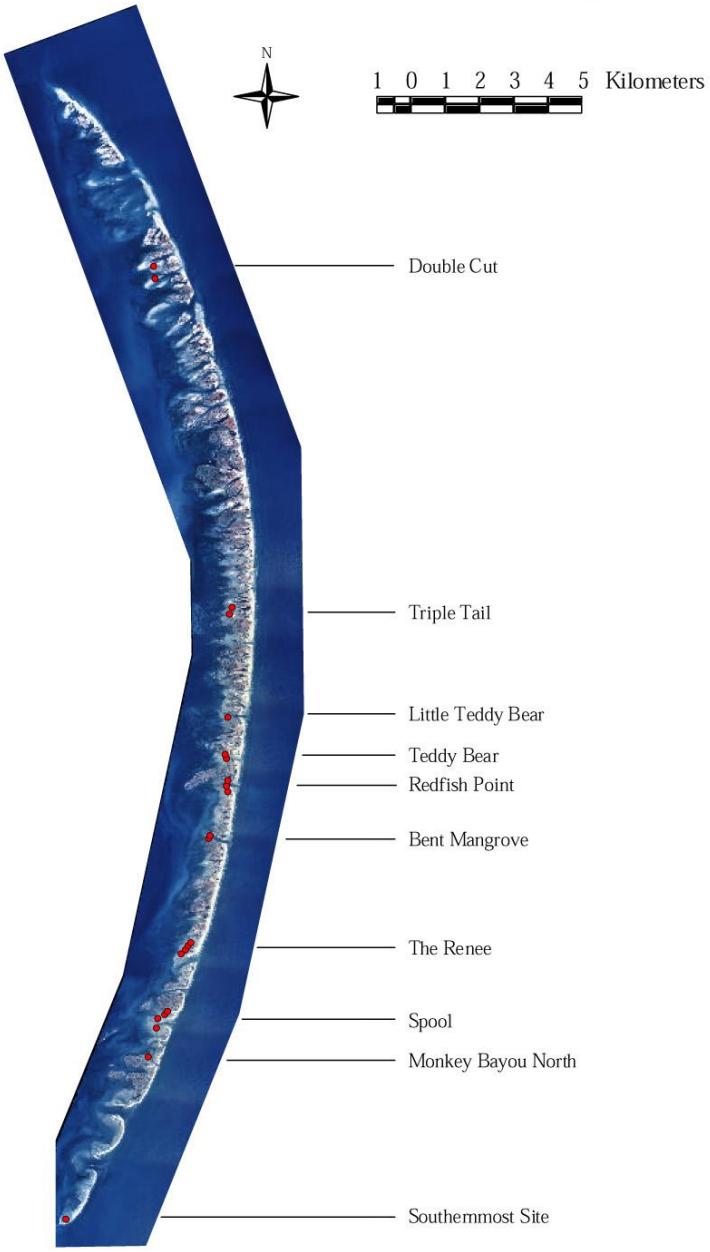


Figure 2. Chandeleur Islands Marsh Restoration (PO-27) Phase I planting site locations.

IV. Monitoring Activity

This is a comprehensive report and includes all data collected from the pre-construction period and the post-construction period through 2006.

a. Monitoring Goals

The objective of the Chandeleur Islands Marsh Restoration project was to stabilize overwash deposits resulting from Hurricane Georges in 1998 through the use of vegetation plantings to trap and hold sediments.

The specific monitoring goals which will be used to evaluate the above objective are to 1) determine if percent cover of emergent vegetation increased within planting areas, and to 2) determine if the intertidal area increased or was maintained, as indexed by elevation data, within and adjacent to the planting sites.

b. Monitoring Elements

Aerial Photography

Color-infrared aerial photography (1:12,000 scale) was obtained and analyzed to determine land:water ratios. Each planting site was quantified separately. The land-water data for each site were classified under the following categories: water, irregularly exposed, regularly flooded, irregularly flooded, and land. All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluctuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of Wetlands and Deepwater Habitats of the United States" (Cowardin et al. 1979). Photography was obtained in November 2000 (pre-construction), November 2003, and November 2005.

Vegetation Surveys

Percent cover and species composition were determined at five of the planting sites. The Braun-Blanquet method was used to survey vegetation in 4-m^2 plots along randomly selected transects, which bisected the planting elevation contours. The number of transects and vegetation plots were determined by the relative size of each planting area; however, a minimum of three transects and twelve plots (four plots/transect) were established at each site. Surveys were conducted in spring of 2001 (as built) and in early fall in years 2001, 2002, 2003, and 2004. In December 2004, an additional vegetation survey was conducted following Hurricane Katrina to assess storm impacts. The 2005 survey was cancelled due to the effects of Hurricane Katrina, although each site was visited to assess storm impacts.

Elevation Surveys

Elevation surveys were conducted along the same transects established for vegetation monitoring. The temporary benchmark installed at each site was used for horizontal and vertical control. Elevations were recorded using a GTS 3020 Electronic Total Station at 20-ft (6.1-m) maximum intervals along each transect as well as at any significant changes in elevation within those intervals. The transects were carried out at least 60 ft (18.3 m) beyond the most seaward planted row. The transects were also carried across any interior unplanted area, in the case of an island planting. In addition, elevation was taken at the southeast corner of each vegetation plot. A permanent benchmark was established on the island to be used as a reference datum. Surveys were conducted in conjunction with vegetation surveys in the spring of 2001 (as built) and in 2003. Due to Hurricane Ivan, a post-storm elevation survey was conducted in December 2004 to assess storm impacts. The 2005 survey was cancelled due to the effects of Hurricane Katrina.

c. Preliminary Monitoring Results and Discussion

Aerial Photography

Land:water analyses of the 10 planting sites from years 2000, 2003, and 2005 can be found in Appendix 1, and a summary of the results can be found in Table 2. In 2000, a mean of 73% of the area within the sites was at or above mean low tide (irregularly exposed or higher). The effects of the 2002 storms, which are reflected in the 2003 data, indicate differences between the northern and southern sites. The four most northern sites all experienced a reduction in the area at or above mean low tide from a mean of 83% in 2000 to 53% in 2003. At the southern sites, with the exception of the Renee site, the area at or above mean low tide was either maintained or increased after the 2002 storms from 64% in 2000 to 70% in 2003. The explanation for this is based in the anatomy of the island with the southern sites being more susceptible to overwash due to the narrower island width and lower dune profile. As a result, these sites experienced greater storm deposition onto the planting sites during the 2002 storms. Although there was no net loss in landmass at these southern sites, the plantings did not necessarily fare well due to burial and scouring. The morphology of these high energy sites underwent many changes after each overwash event, which caused direct losses of the planting areas. On the other hand, the plantings at the northern sites were the most stable throughout the monitoring period, due to greater protection from overwash effects. The devastation of Hurricane Katrina at all of the sites is evident in the 2005 photography. The sediment supply had already been reduced during Hurricane Ivan in 2004 and the island was still in a recovery phase. During Hurricane Katrina, the entire island experienced severe overwash, and in this case, sediments were not deposited on the backside of the island but were instead washed offshore. Based on the 2005 photography, all of the planting sites were between 96 and 100% open water immediately after the storm.

Table 2. Results of land:water analyses of the 10 planting sites of the Chandeleur Islands Marsh Restoration (PO-27) project based on year 2000, 2003, and 2005 photography. The sites are listed in geographic order from north to south.

Study Site Name	Year	Water	Irregularly Exposed	Regularly Flooded	Irregularly Flooded	Land	Total
Double Cut	2000	31.3	40.3	38.9	1.7	5.3	117.5
	2003	83.1	18.5	3.2	1.2	11.5	
	2005	117	0.4	0.1	0	0	
Tripletail	2000	2.5	15.4	4.2	2.3	0.4	24.8
	2003	14.6	1.2	6.3	0	2.7	
	2005	23.9	0.3	0.6	0	0	
Little Teddy Bear	2000	3.1	14.2	5	0	0.1	22.4
	2003	8.7	3.2	7.9	1.3	1.3	
	2005	22.1	0.1	0.1	0	0.2	
Teddy Bear	2000	1.6	4	3.1	0.3	1.1	10.1
	2003	1.8	2.1	3	0.9	2.3	
	2005	9.9	0	0.1	0	0.1	
Redfish Point	2000	8.6	37.8	8.8	4.4	0.9	60.5
	2003	7.3	22.2	21.5	7	2.5	
	2005	58.6	0.7	0.2	0	1	
Bent Mangrove	2000	5.3	10.1	8.8	3.2	0.6	28
	2003	10	2.9	11.2	2.4	1.5	
	2005	27.6	0	0.3	0	0.1	
Renee	2000	23.7	55.2	6.6	2.8	2.3	90.6
	2003	10.6	68.7	9.2	0.8	1.3	
	2005	90.6	0	0	0	0	
Spool	2000	32.4	2.1	83.4	6.7	1.4	126
	2003	33.6	48.2	31	11	2.2	
	2005	122.4	1.1	1.5	1	0	
North Monkey Bayou	2000	15.2	0	16.1	0.9	1.6	33.8
	2003	15	6.3	9	1.9	1.6	
	2005	32.5	0.2	0.4	0.7	0	
Southernmost	2000	47.5	0	16.4	4.6	0.2	68.7
	2003	29.3	14.7	19.9	4.7	0.1	
	2005	68.7	0	0	0	0	

Vegetation Surveys

The planting sites selected for vegetation monitoring were (north to south) Tripletail, Little Teddy Bear, Redfish Point, Spool, and North Monkey Bayou. A total of 72 4-m^2 (2m X 2m) Braun- Blanquet plots were surveyed, with the number of plots at each site ranging from 12 to 20 (Table 3). A survey was not conducted following Hurricane Katrina because there was no *Spartina alterniflora* remaining within any of the monitored planting sites.

Table 3. The number of 4-m^2 vegetation plots established at each monitored planting site for the Chandeleur Islands Marsh Restoration (PO-27) project.

Site Name	# of Plots
Tripletail	12
Little Teddy Bear	12
Redfish Point	16
Spool	20
North Monkey Bayou	12
Overall	72

All five monitoring sites were overwashed during Hurricane Ivan, as evidenced by breaches in the beach face and significant sediment deposition and scour within the sites. Overall mean percent cover of *S. alterniflora* across all 72 vegetation plots was reduced by half in the wake of Hurricane Ivan (Figure 3). The mean percent cover of all five sites decreased from 30% just before the storm to 15% after the storm. This was the first time a decrease in the overall mean percent cover was observed since monitoring began on the project in 2001. It should be noted, however, that the post-storm survey was conducted in December when the plants were becoming dormant. While this may have contributed in part to the decrease in mean percent cover, it was clear that hurricane-related impacts were responsible for much of the plant loss, particularly at the Redfish Point and North Monkey Bayou sites.

The mean percent cover increased at each of the individual planting sites from 2003 to September 2004 (pre-Hurricane Ivan) and decreased at each of the sites after the storm (Figure 4). The effects of Hurricane Ivan on the individual planting sites were highly variable, with the two most northern sites, Tripletail and Little Teddy Bear, generally faring better than the three southern sites. Although the decrease in mean percent cover of *Spartina alterniflora* at the two northern sites was as high or higher than the decrease at the three

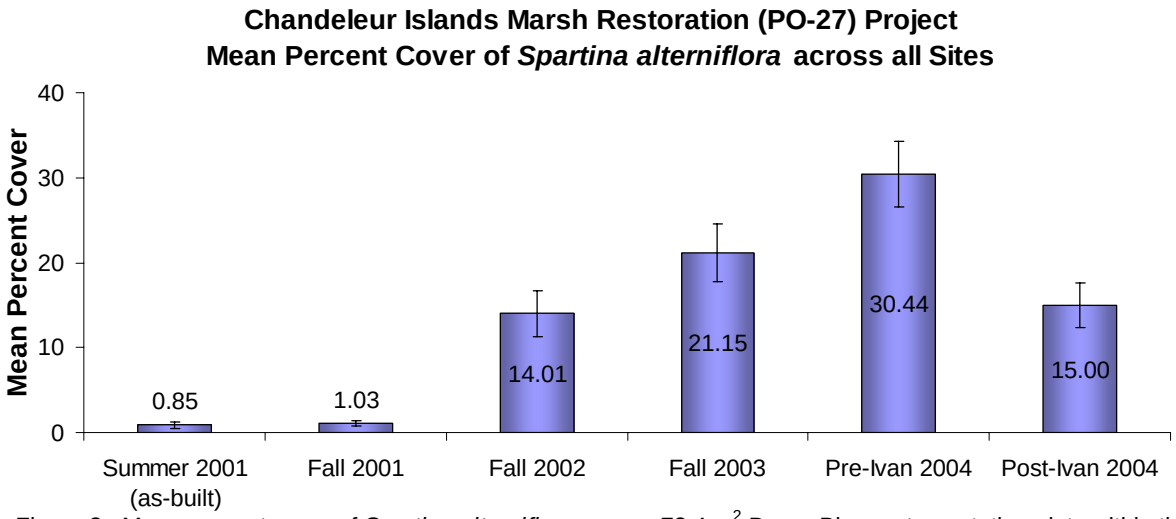


Figure 3. Mean percent cover of *Spartina alterniflora* across 72 4-m^2 Braun-Blanquet vegetation plots within the five selected plantings sites of the Chandeleur Islands Marsh Restoration (PO-27) Project from 2001 to 2004.

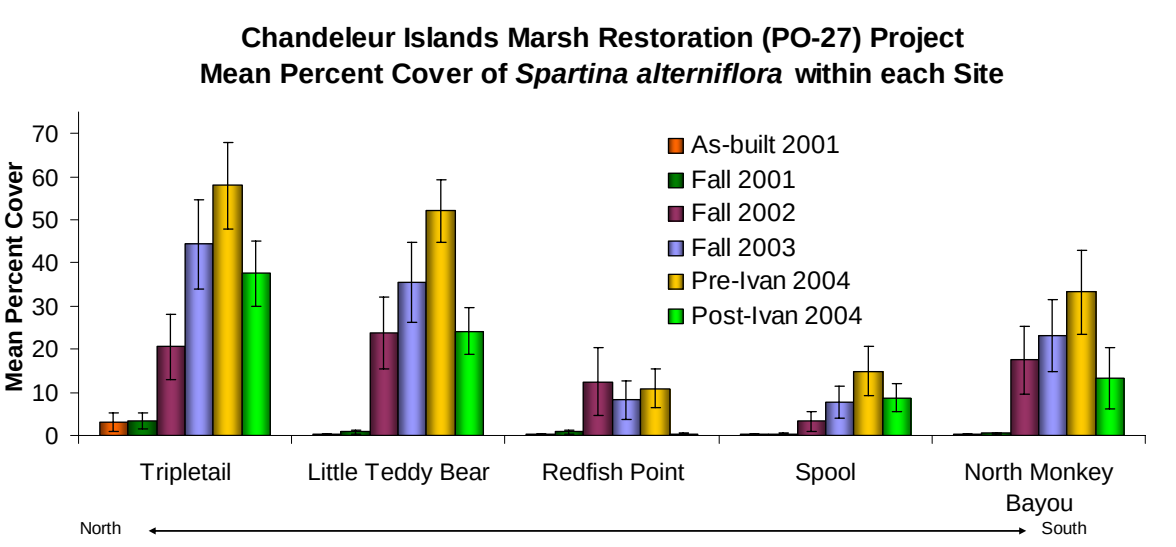


Figure 4. Mean percent cover of *Spartina alterniflora* across all 4-m^2 vegetation plots within each of the five selected plantings sites of the Chandeleur Islands Marsh Restoration (PO-27) Project from 2001 to 2004.

southern sites, the two northern sites had the highest percent cover of vegetation before and after the storm. Despite the large decrease in mean percent cover at the northern two sites, they continued to be the healthiest planting sites with regard to the percentage of plots vegetated as well as with having a greater coverage of plants within the sites. The southern three sites are located on a narrower part of the island and therefore were less protected from overwash events. The washover breaches at these three sites resulting from Hurricane Ivan appeared to be much more severe than at the two northern sites. The higher beach profile at the northern sites, combined with the protective effect of higher plant coverage, were the main factors in reducing the effects of Hurricane Ivan at these planting sites.

Since 2002, the percentage of plots containing no *S. alterniflora* had been decreasing at all sites except for Redfish Point, indicating that the plants "spread" by seed or underground shoots from nearby stands into those previously empty plots (Figure 5). However, after the storm the percentage of plots containing no *S. alterniflora* increased at all five planting sites. More than half of the plots at the three southern sites contained no *S. alterniflora* after the storm. The most southern site, North Monkey Bayou, experienced the greatest increase in unvegetated plots with more than half of its previously vegetated plots becoming unvegetated after the storm. More than half of the plots at the Redfish Point and Spool sites were already unvegetated before the storm passed.

In 2003, we began to see colonization of species other than *S. alterniflora* occurring within the planting areas. In 2004, the number of species observed inside or within 5 m of the 72 vegetation plots dropped from 14 before the storm to 7 after the storm (Table 4). The loss in diversity is attributable not only to the hurricane, but also to the time of year in which the sampling took place. For example, *Salicornia bigelovii* (dwarf saltwort) is an annual species which had died out naturally by the time of the post-Ivan survey. However, several of the species observed during the pre-Ivan survey were single specimens which were located in plots that became overwashed by the storm. The most diverse site was Redfish Point, which also happened to be one of the most severely impacted by the storm. The two species found at all five sites before and after the storm were *Avicennia germinans* (black mangrove) and *Spartina alterniflora*.

Summary of Individual Planting Sites

Note: Mean percent cover for the sites was calculated both by including and excluding empty plots. This is because at some sites, although there may be an overall low percent coverage due to a high number of empty plots, there may be a high percent coverage within the vegetated plots only. For example, at the North Monkey Bayou site, the mean percent cover across all plots is low, but the mean coverage calculated only within vegetated plots is high due to the high density of the undisturbed plants.

Tripletail, the northernmost monitoring site, was the most successful planting site in terms of total percent coverage of *S. alterniflora* and total number of plots that were vegetated (Figures 4 and 5). The mean percent cover of *S. alterniflora* within vegetated plots decreased from 63.2 to 45.1% after Hurricane Ivan and the mean percent cover across all plots decreased from

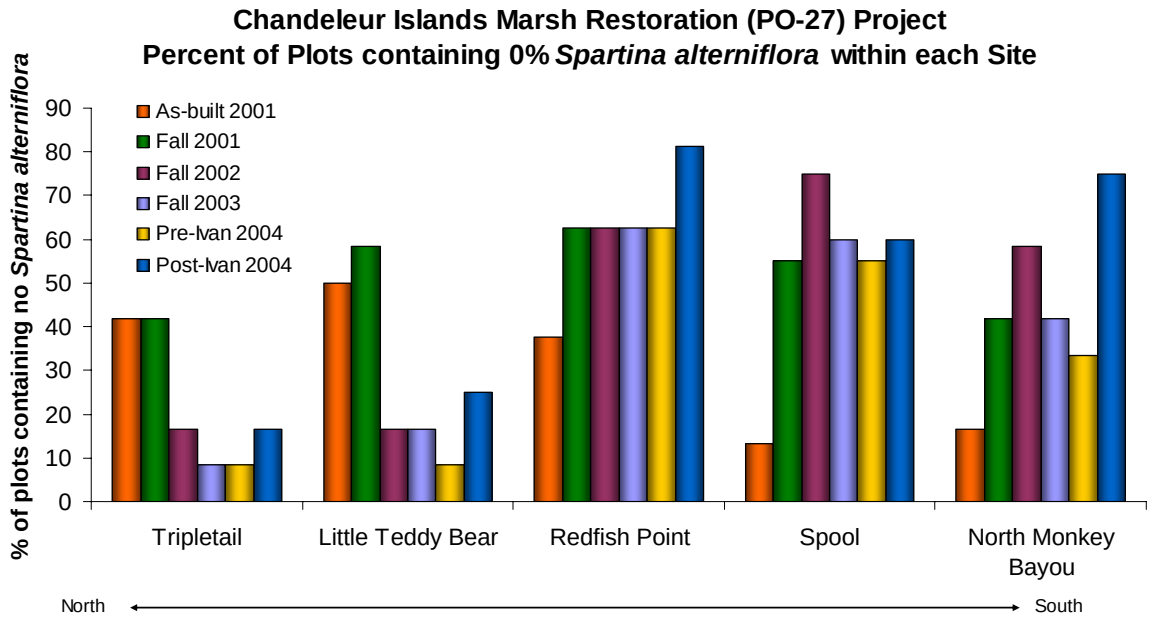


Figure 5. Percent of vegetation plots containing no *Spartina alterniflora* at each monitored planting site of the Chandeleur Islands Marsh Restoration (PO-27) Project from 2001 to 2004.

Table 4. Species observed inside or within 5 meters of the 72, 4-m^2 vegetation plots at the five monitored planting sites of the Chandeleur Islands Marsh Restoration (PO-27) project in September 2004 (pre-Hurricane Ivan) and December 2004 (post-Hurricane Ivan).

X - Observed Pre-Ivan only, XX - Observed Pre and Post-Ivan, O – Observed Post-Ivan only					
Species List	**Tripletail**	**Little Teddy Bear**	**Redfish Point**	**Spool**	**North Monkey Bayou**
Avicennia germinans black mangrove	XX	XX	XX	XX	XX
Baccharis halimifolia eastern baccharis			XX		
Batis maritima Saltwort			XX	XX	
Borrichia frutescens bushy seaoxeye			X		
Distichlis spicata inland saltgrass			XX		
Fimbristylis castanea saltmarsh fimbristylis			X		
Iva frutescens Jesuit's bark			X		
Iva imbricata seacoast marshelder			X		
Limonium carolinianum Carolina sealavender			X		
Salicornia bigelovii* dwarf saltwort	X	X	X	X	X
Salicornia virginica Virginia glasswort		X	XX	XX	
Sesuvium portulacastrum shoreline seapurslane			XX	O	
Spartina alterniflora smooth cordgrass	XX	XX	XX	XX	XX
Spartina patens marshhay cordgrass			X		
Suaeda linearis annual seepweed		X	X		
*The lack of *S. bigelovii* in the post-Ivan survey is a result of the annual nature of the plant. Many dead *S. bigelovii* were observed during the post-Ivan survey, but were not counted.					

57.9 to 37.6%. Only 2 out of the 12 plots contained no *S. alterniflora*. This site was consistently the most stable planting site due to its location behind a relatively high dune profile. Immediately after Hurricane Ivan on September 30, 2004, we observed that damage was mostly limited to scour of the outer edges of the plantings, partial burial of some plants, and large swaths of dead plant matter lying on top of formerly living plants. Plant burial at that time was approximately 40 cm in some areas. By the time of the December 2004 trip the plants at the Tripletail site, which are generally thick and healthy, were thinning and dying back. The loss of percent coverage observed in December was mainly attributed to scour of edge plots and thinning of the vegetation within the interior plots. Deposition of sand and organic material within these interior plots during the storm may have contributed to this loss; however, it is possible that some of it was due to natural seasonal dieback.

The Little Teddy Bear site had a decrease in mean percent cover of 28% after Hurricane Ivan, which was the highest decrease of all the sites. However, this site still had the second highest total plant coverage out of all the sites. The mean percent cover within vegetated plots decreased from 56.8 to 32.2% after the storm and the mean percent cover across all plots decreased from 52.1 to 24.2%. Three plots were unvegetated, compared to only one before the storm. At this site, we observed significant scour along the edges of the vegetated areas, but the plants seemed to have survived fairly well despite a large overwash breach in the island. Like the Tripletail site, the decrease in percent coverage was caused by a combination of scour at the edges of the planting lobe and dieback of the plants within the lobe interior. It is unclear whether the storm accelerated the browning and thinning of the plants associated with seasonal dieback. The percent cover of vegetation plot PO27020104, which is located on the southern edge of the planting lobe, was reduced from 30% cover before the storm to 0% cover after the storm due to a cut which formed along the southern edge of the plantings. There were indications in some areas that the plants were effective in retaining sand and reducing scour. The area surrounding plot PO27020203 consisted of thick, scattered clumps of *S. alterniflora* the week before the storm. Although this area experienced heavy scour of surface sand during the storm, many of these clumps remained intact. Storm overwash deposits resulted in the formation of a new bare sand lobe near the original planting area.

The Redfish Point site had been highly modified by overwash events since the installation of the plants even before the passage of Hurricane Ivan. The low beach profile and the narrow width of the island at this site make it particularly vulnerable to repeated overwash events. With the passage of Hurricane Ivan, we observed further deterioration of the plantings at this site. Overwash impacts were much more evident within the planting areas than they were at the two northern sites. Isolated patches of vegetation were all that remained of the original *S. alterniflora* plantings. Several new overwash lobes were formed at this site, while some formerly vegetated areas were washed away due to the formation of new cuts. The mean percent cover within vegetated plots decreased from 29.2% to 2% and the mean percent cover across all plots decreased from 10.9% to 0.4% after the storm. The week before Ivan passed, 6 of the original 16 vegetation plots contained *S. alterniflora*. After Hurricane Ivan, only three plots were vegetated. Two plots, both of which contained 45% cover before the storm, contained 0% cover and were located in newly formed cuts after the storm. The main

channel, which had formerly migrated northward, effectively destroying most of the plantings on the northern lobe by 2002, had migrated southward again. Some of the vegetation plots along this lobe that had been located in the deep cut were now located on a new sand flat and could potentially revegetate. There was very little beach left after Hurricane Ivan to protect this site from future overwash events.

Like Redfish Point, the Spool site had been affected by overwash events even before the passage of Hurricane Ivan. Overwash impacts from Hurricane Ivan were evident at the Spool site, but were not as severe as those observed at the Redfish Point site. The week before the storm, only 9 of the 20 plots contained *S. alterniflora*. Fortunately, eight plots were still vegetated after the storm. The mean percent cover within vegetated plots decreased from 33.2% to 21.6% and the mean percent cover across all plots decreased from 14.9% to 8.7% after the storm. Some burial of the plants was observed immediately after the storm along with significant scour within the planting sites. Some plots which were formerly on unvegetated sand flats were now located in newly formed cuts. One cut formed almost directly in the center of the main planting lobe through the area where plots 40302 and 40306 are located. Very little of the beach remained at this site following Hurricane Ivan and new overwash lobes had formed on the backside of the island near the plantings. As seen at the other sites, the vegetation that remained was generally brown and less dense than during the September survey.

The North Monkey Bayou site was severely impacted by Hurricane Ivan. The week before the storm, 8 out of the 12 plots contained *S. alterniflora* compared to only 3 after the storm. The beach at this site had almost completely disappeared and much of the outer edges of the planting lobe had washed away. The original planted lobe has been cut into two pieces consisting of one larger lobe that was roughly at the center of the original lobe and a separate smaller lobe to the south. The loss of plants at this site was mostly due to direct damage from Hurricane Ivan through overwash scour. Despite the loss of vegetated plots at this site, the mean percent cover within the remaining vegetated plots was the highest out of all the sites. The mean percent cover within vegetated plots actually increased from 49.8% to 53.3% after the storm. Where the plants remained, they were still generally more dense and in better condition than at the other sites. The mean percent cover across all plots, however, decreased from 33.2% to 13.3% due to the loss of vegetated plots. Although the remaining plants continued to thrive at this site, much of the remaining area would have been too far below mean tide to revegetate.

In summary, the first specific goal of the project, which was to "increase the percent cover of vegetation within the planting areas," was achieved up until the devastation of Hurricane Katrina. The percent cover of *S. alterniflora* increased steadily at each site, with the exception of Redfish Point, up until the passage of Hurricane Ivan. Although Hurricane Ivan reduced the percent coverage at all of the sites, the coverage was still greater at all of the sites than at the time of the initial planting. The plantings at all of the sites were expected to recover to some degree from the impacts of Hurricane Ivan, had it not been for the passage of Hurricane Katrina. During a trip in June 2007, *S. alterniflora* was not found growing within

any of the former planting sites. Only a few higher elevation species were found growing at the Spool site, which experienced a great deal of sand deposition due to the westward movement of the beach.

Elevation Surveys

Elevation surveys were conducted in 2001 (as built), 2003, and 2004 (post-Hurricane Ivan). All five of the monitored sites experienced some increase in mean elevation between the 2001 and 2003 surveys except at the Little Teddy Bear site (Figure 6). ANOVA results showed a significant increase in the overall mean elevation from 2001 to 2003 at the five sites from 0.22±0.01 m NAVD88 (0.72±0.03 ft) to 0.30±0.01 m NAVD88 (0.95±0.03 ft) (p<0.0001). However, the mean elevation of the sites decreased significantly from 2003 to 2004 at 0.09±0.01 m NAVD88 (0.30±0.03 ft) (p<0.0001) after Hurricane Ivan. The actual impacts of Hurricane Ivan varied widely between the sites depending on the vulnerability of the site to be overwashed during storm events. Elevations at the individual sites ranged from -0.09 m (-0.28 ft) to 0.30 m (0.98 ft) in 2004 (Figure 6). At the Little Teddy Bear planting site, two of the survey transects were extended to bisect nearby unvegetated intertidal sand flats, which were to be used as informal reference sites. However, these were lower elevation areas that had already become subtidal by 2003 and were not included in the analysis (Figure 6).

Changes in topography within the individual sites from 2001 to 2004 varied widely depending upon how the sites were impacted during the storms. The Tripletail site remained the most stable site throughout the monitoring period (Figure 7). This was the only site to show an increase in mean elevation during the post-Hurricane Ivan survey. Sediment movement and elevation changes from 2001 to 2003 were minimal, with no part of the planting area experiencing significant scour or sediment deposition. However, a breach did occur in the beach face during Hurricane Ivan, causing sediment to be deposited on top of the original planting lobes. As a result, much of the planted area was actually above mean high tide and above the ideal elevation for *S. alterniflora*.

The Little Teddy Bear site showed significant changes in topography between each survey event. The site experienced an overall decrease in elevation from 2001 to 2003 due to sediment loss in the central and southern areas of the planting lobe, but gained elevation eastward toward the beach. During Hurricane Ivan, the area east of the site, which had gained elevation after the 2003 storms, was significantly eroded (Figure 8). However, the central area of the original lobe received new sediment deposits and was restored almost to 2001 levels. The instability of the area due to overwash between 2001 and 2003 and reactivation of the breach during Hurricane Ivan caused alternate erosion and burial of much of the planted areas. The vegetation near the crest of the lobe, as well as to the north and west of the crest, was the least impacted.

The Redfish Point site also showed extreme changes in topography from 2001 to 2003 and again from 2003 to 2004 (Figure 9). In 2001, all of the plantings at this site were in the intertidal range, mostly at or slightly above mean tide, and the entire site was between the mean low and mean high tide elevations. The site experienced significant sand deposition

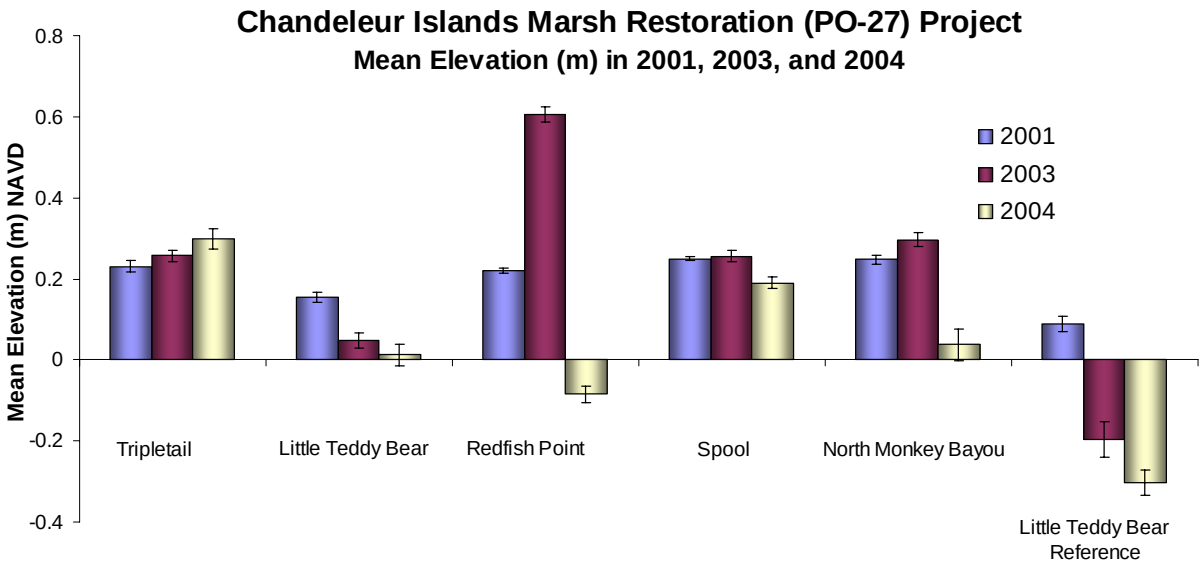


Figure 6. Mean elevation (m) at five planting sites and one unplanted reference area of the Chandeleur Islands Marsh Restoration (PO-27) Project in July 2001, September 2003, and December 2004. Elevation readings were taken along three to five transects per planting site.

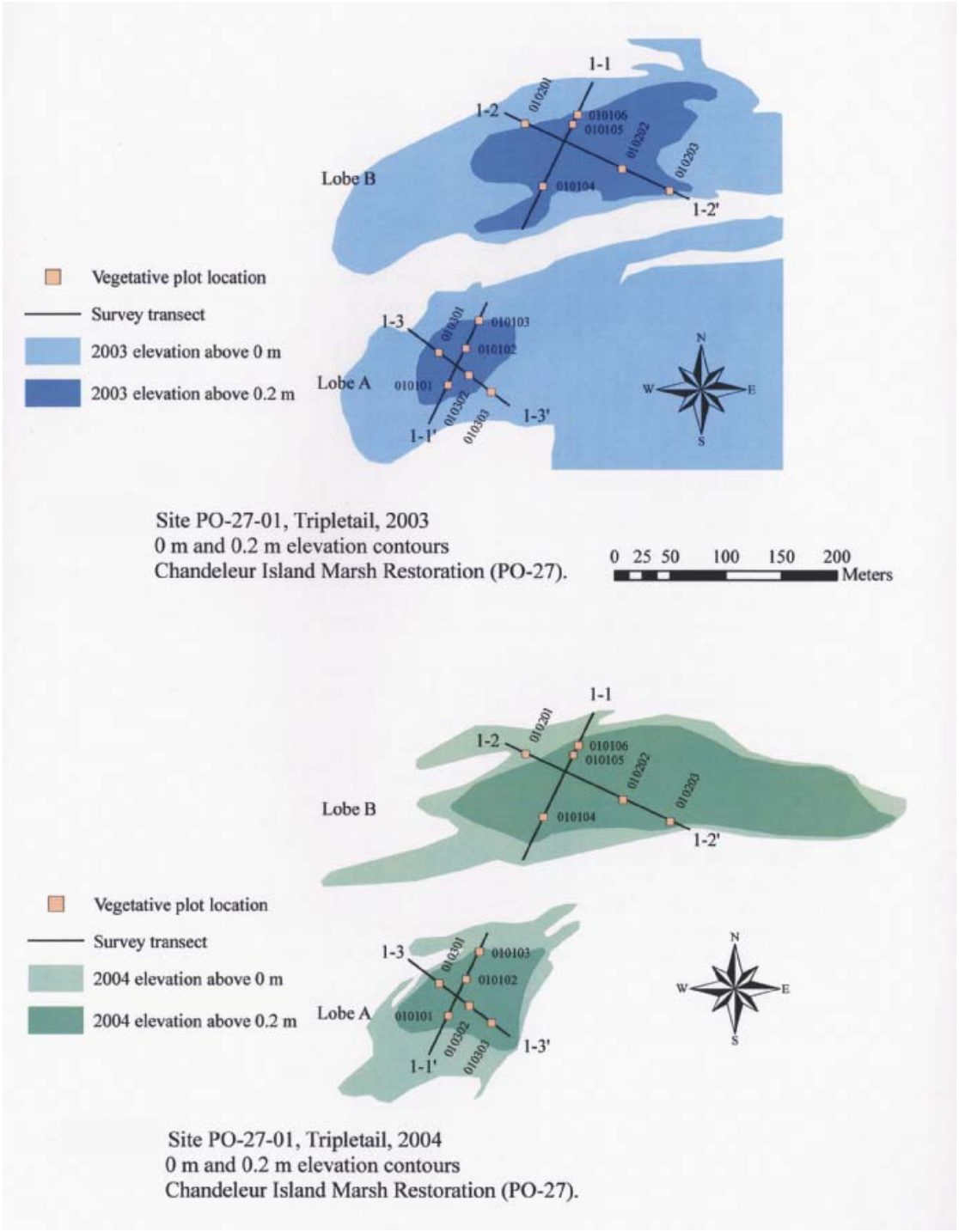


Figure 7. Elevation contour maps of the Tripletail planting site based on surveys conducted in 2003 and 2004 of the Chandeleur Islands Marsh Restoration (PO-27) project.

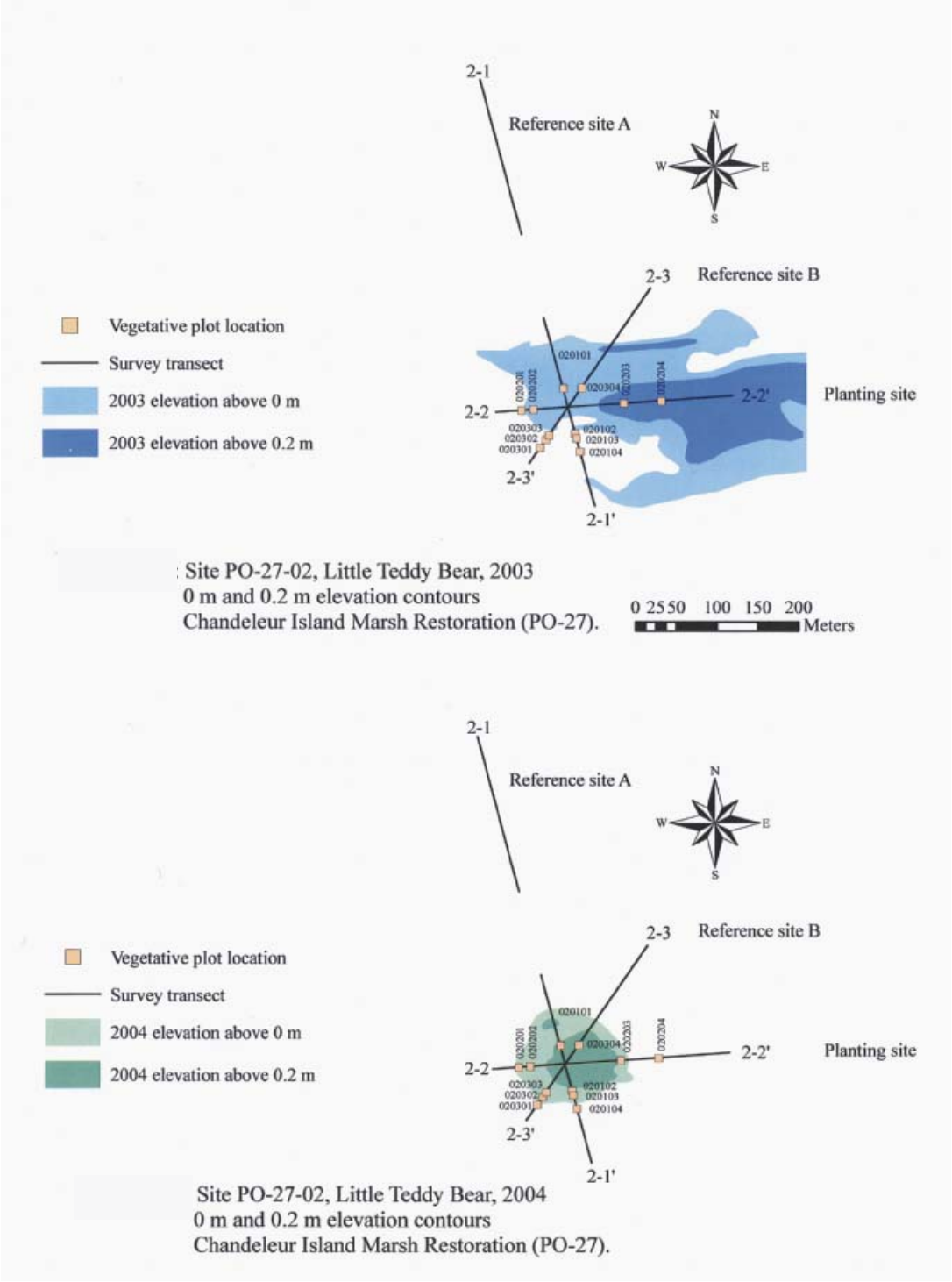


Figure 8. Elevation contour maps of the Little Teddy Bear planting site based on surveys conducted in 2003 and 2004 of the Chandeleur Islands Marsh Restoration (PO-27) project.

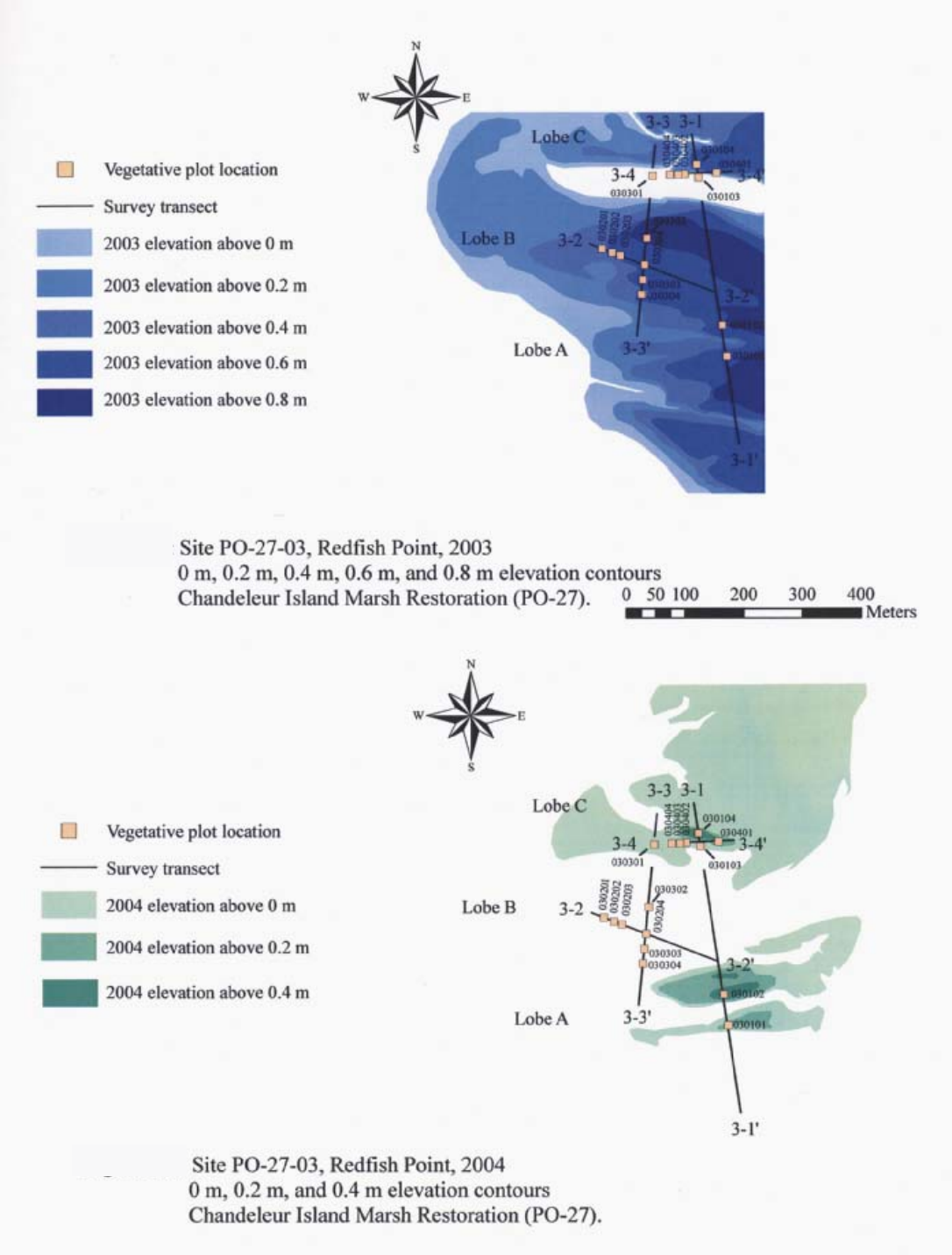


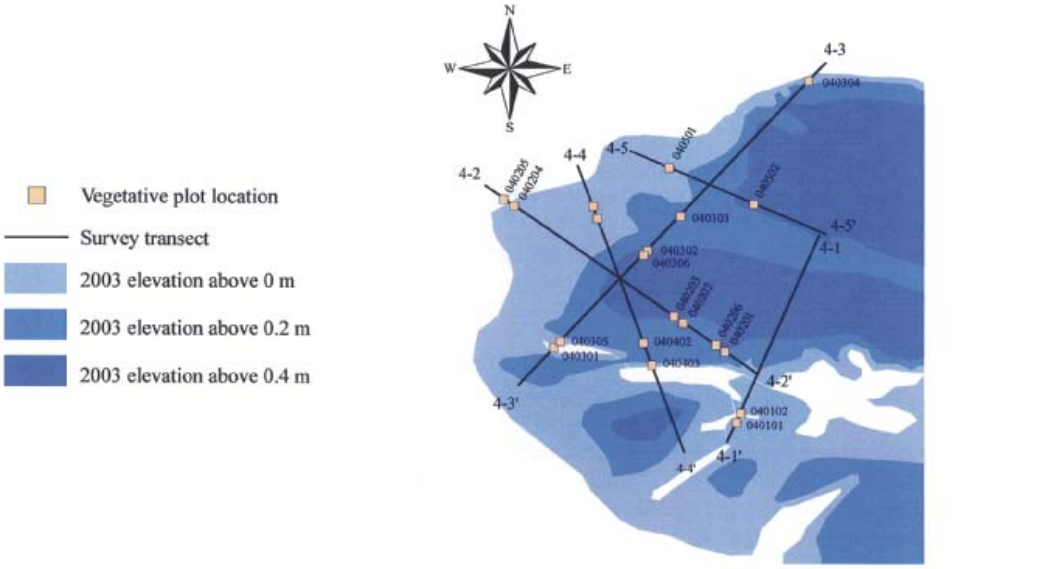
Figure 9. Elevation contour maps of the Redfish Point planting site based on surveys conducted in 2003 and 2004 of the Chandeleur Islands Marsh Restoration (PO-27) project.

during the 2002 storms. The maximum elevation surveyed in 2003 was above the high tide elevation due to the deposition of about 0.4 m of overwash deposits in some areas. Other areas of the site, however, experienced a loss of sediment due to scour. The main channel bisecting this site migrated northward during the 2002 storms, effectively eroding away the majority of the plantings on the northern lobe of the site. Following Hurricane Ivan, the main channel migrated again back to the south resurrecting the original northern lobe. However, much of the main lobe had washed away and was now below 0 m NAVD88. Through the three years of sediment redistribution, heavy overwash deposition, and channel migration, almost all of the 2001 plantings had been damaged or removed.

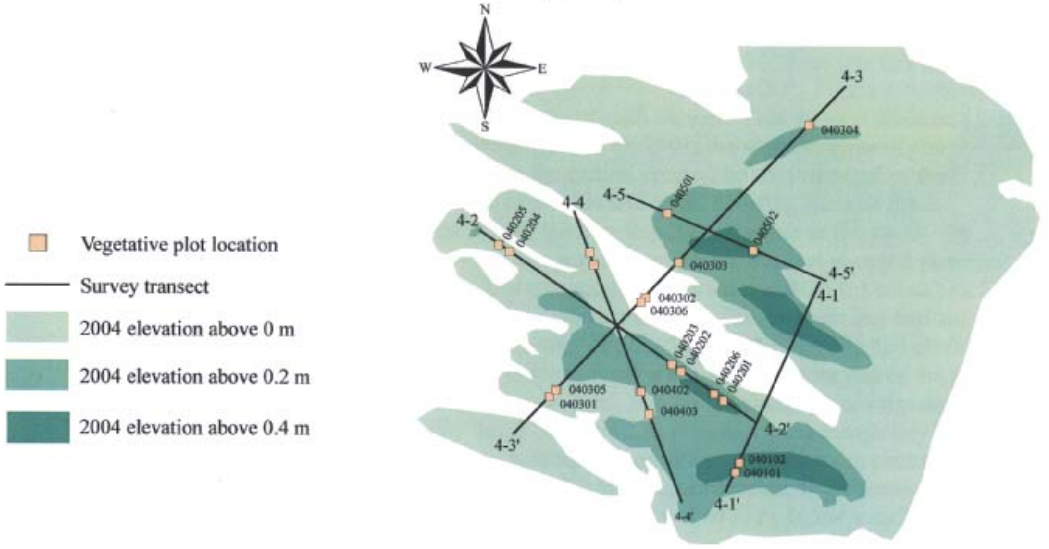
The Spool site was the largest planting site, which consisted of multiple lobes of sediment deposited behind a major cut just south of Dago Hole. Although the Spool site experienced major changes in topography between 2001 and 2003 due to sediment deposition and erosion, the overall net change in elevation at this site was minimal (Figure 6). During the 2002 storms, this site experienced severe erosion in some areas and deposition of about 2 ft of overwash sediment in other areas. During Hurricane Ivan, the main overwash channel migrated northward cutting through part of the main planting lobe (Figure 10). There was significant sand deposition on each side of the channel to the north and south. Although there was significant direct damage to the plantings at this site due to burial and scouring, the extent of the damage was not as extreme as seen at Redfish Point.

In 2001, the North Monkey Bayou site consisted of a single lobe of sediment deposited behind a hurricane scour just north of Monkey Bayou. This site also showed areas of erosion and sediment deposition after the 2002 storms, although the impacts were not as severe as at the Redfish Point and Spool sites. However, this site experienced severe overwash during Hurricane Ivan (Figure 11). The beach environment to the east was largely removed and a large channel was formed through the center of the site. High ridges of sand were deposited along each side of this new channel. This caused the direct loss of a significant area of the plantings through burial or scouring.

One of the specific goals of the project was to maintain or increase intertidal area, which was determined to be the elevation for optimum growth of *S. alterniflora*, within and adjacent to the planting sites. Areas within the elevation range of mean low water and mean high water were to be defined as the 'intertidal' range, which was determined during a pre-construction survey of the planting sites to be between 0 m NAVD88 (mean low tide line) and 0.37 m NAVD88 (mean high tide line). Intertidal area was calculated for each site using Arcmap. Polygons were created for each monitoring site for each of the elevation survey years. One set of polygons was developed for the areas at the site above mean low tide, and another for the areas above mean high tide. The areas of these polygons were calculated in Arcmap, and the difference between the two areas is displayed in Figure 12 as the intertidal area (m^2). By 2004, all of the monitored sites except for North Monkey Bayou showed a decrease in intertidal area from the initial 2001 survey. The Little Teddy Bear site was the only site to show an increase in intertidal area after the 2002 storms, but then decreased to below 2001



Site PO-27-04, Spool, 2003
0 m, 0.2 m, and 0.4 m elevation contours
Chandeleur Island Marsh Restoration (PO-27).



Site PO-27-04, Spool, 2004
0 m, 0.2 m, and 0.4 m elevation contours
Chandeleur Island Marsh Restoration (PO-27).

Figure 10. Elevation contour maps of the Spool planting site based on surveys conducted in 2003 and 2004 of the Chandeleur Islands Marsh Restoration (PO-27) project.

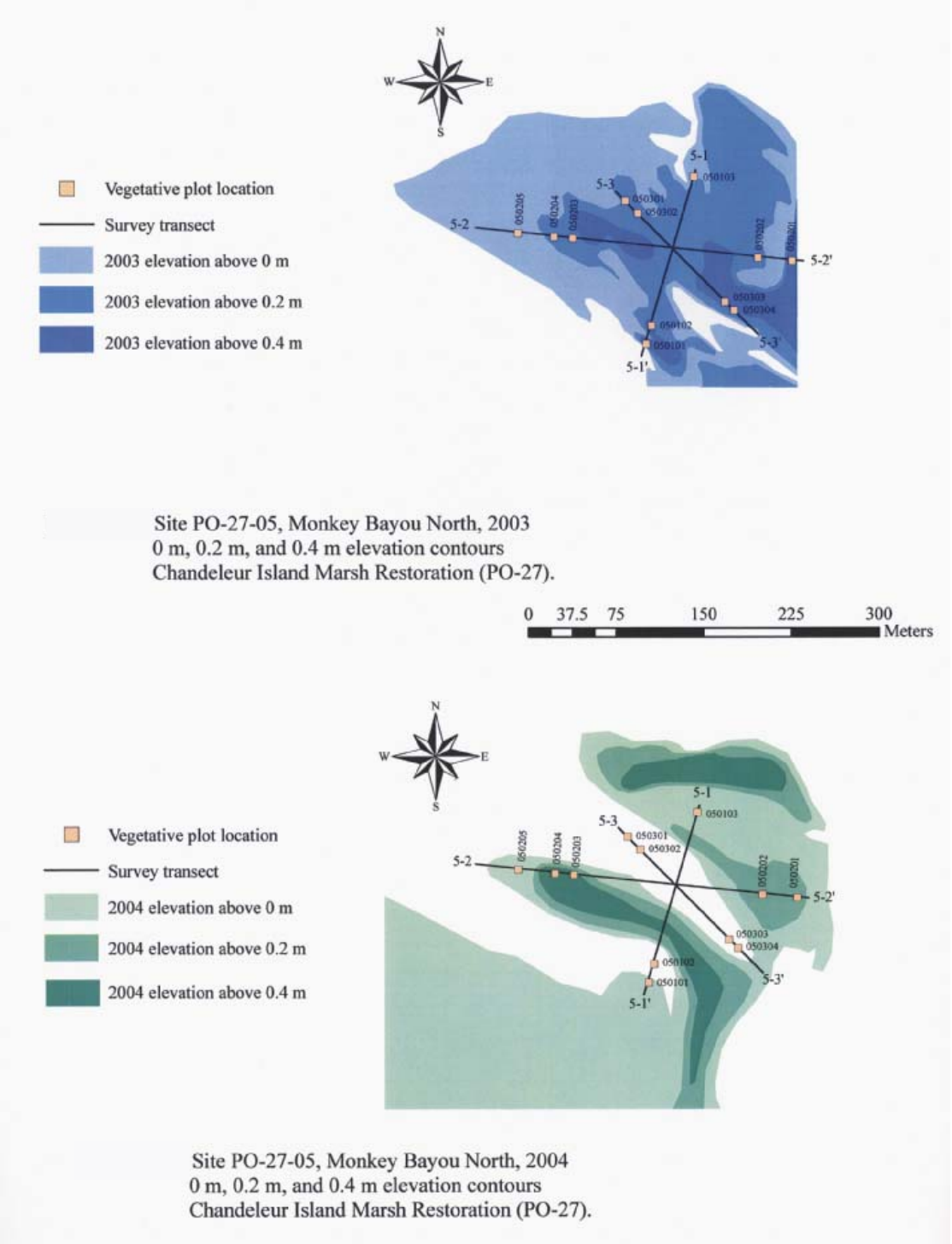


Figure 11. Elevation contour maps of the North Monkey Bayou planting site based on surveys conducted in 2003 and 2004 of the Chandeleur Islands Marsh Restoration (PO-27) project.

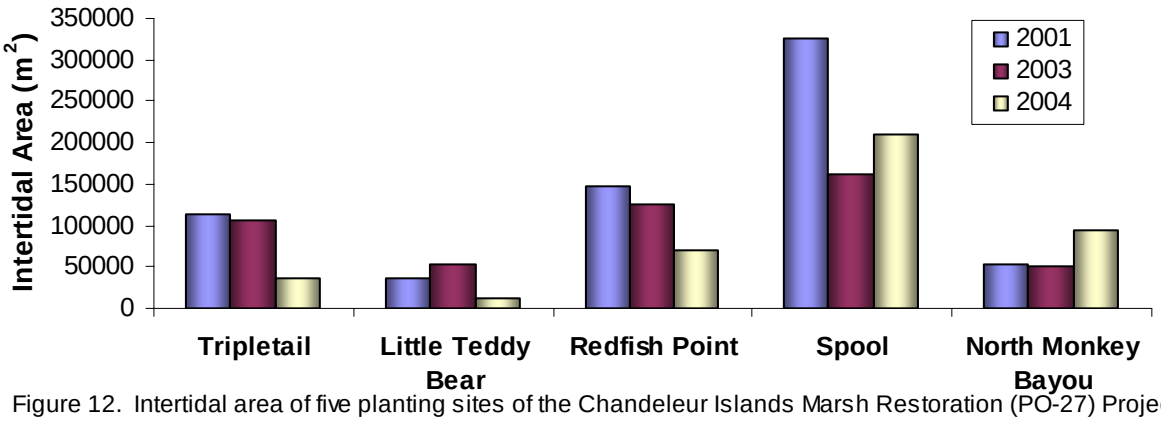


Figure 12. Intertidal area of five planting sites of the Chandeleur Islands Marsh Restoration (PO-27) Project in July 2001, September 2003, and December 2004 (post-Hurricane Ivan). The intertidal range was determined to be between 0 m NAVD 88 (mean low tide line) and 0.37 m NAVD 88 (mean high tide line).

levels following Hurricane Ivan. The Spool site showed a gain in intertidal area between the 2003 and 2004 surveys, but this was still below 2001 levels.

Based on these data, it can be concluded that the goal of increasing or maintaining intertidal area was generally not being met at most of the sites before Hurricane Katrina. However, some of the areas that were no longer within intertidal range actually increased in elevation, which is obviously preferable to becoming subtidal or open water. The four sites which experienced a decrease in intertidal area between the 2001 and 2003 surveys actually increased in mean elevation during this period. A loss in intertidal area did not necessarily indicate a net loss in land area. While these higher elevation areas were no longer within the optimum growth range for *S. alterniflora*, they became intermittently flooded sand flats capable of supporting other higher elevation species. It is also important to note that the baseline elevation of the planting sites in 2001 was almost completely intertidal because the layout of the sites followed the mean tide line contour surveyed just before construction. This 2001 as-built layout in effect represented the "best case scenario" elevation for survival of *S. alterniflora*. It may have been an ambitious goal to expect that the intertidal area of these sites would be maintained or even improved in a high energy environment such as the Chandeleur Islands.

While it was hoped that the presence of the plantings would actually drive an increase in intertidal area through sediment trapping and stabilization, it was clear that the storm events were the main driving factors in changes to the intertidal area. The magnitude of topographical changes at Redfish Point, for example, was clearly storm driven and would have occurred regardless of the presence of the plants. However, it was clear that the plantings did buffer the storm effects to some extent during the 2002 and 2004 storms. The plantings appeared to reduce the scouring of sediment within and along the edges of the sites. In some areas where the vegetation was particularly dense, it also appeared to encourage the accumulation of sediment. Due to the devastation of Hurricane Katrina, it is difficult to determine what effect the plantings had on buffering the effects of the storm. However, it is likely that the loss of sediment at the sites may have been even worse had the sites been unvegetated.

V. Conclusions

a. Project Effectiveness

The specific goals of the project were to 1) increase percent cover of emergent vegetation in the planting areas, and to 2) maintain or increase intertidal area, as indexed by elevation data, within and adjacent to the planting sites. The first goal was achieved at most of the monitored sites until the devastation of Hurricane Katrina. The percent cover of *S. alterniflora* had increased steadily at each site except for Redfish Point until the passage of Hurricane Ivan. Although Hurricane Ivan reduced the percent coverage at all of the sites, the coverage was still greater at all of the sites than at the time of the initial planting. The second goal of

maintaining or increasing intertidal area, however, was generally not being met at most of the sites before Hurricane Katrina, indicating a loss of optimum *S. alterniflora* habitat. Storm events were determined to be the driving factor for elevation changes in the planting areas during the study period. Island breaching and overwashing of some of the planting sites during the 2002 storm season destroyed some of the planted areas before the plants were able to become fully established. Although the planting sites showed excellent signs of recovery from the 2002 storms, the sites were more severely impacted during Hurricane Ivan in 2004, and eventually destroyed by Hurricane Katrina in 2005.

b. Recommended Improvements

There are no recommended improvements for this project.

c. Lessons Learned

Due to the dynamic nature of the barrier island environment, the success of the plantings before Hurricane Katrina proved to be "hit or miss." The plants were planted in unstable overwash areas, and therefore were highly susceptible to repeated overwash events. However, the plantings at the more protected sites did continue to thrive until the passage of Hurricane Katrina. Although the plantings were compromised by repeated storm events which occurred over a relatively short period of time, the more protected sites proved resilient to these events and would have continued to recover had Hurricane Katrina not occurred. The key to the success of these sites compared to the other sites was a relatively higher, wider, and more continuous beach face. Although there is a risk of severe storms such as Hurricane Katrina in any given year, the probability of the Chandeleur Islands experiencing intense hurricane force winds (≥115 mph) each season is only 0.3% (Gray and Klotzbach, www.e-transit.org/hurricane/map.asp). The uncertainty of damage from storm events coupled with the high cost of construction created considerable risk for the Chandeleur Islands Marsh Restoration project.

In future Chandeleur planting projects, planners may want to evaluate the condition of the beach face when choosing prospective overwash planting locations. In the current project, 22 potential overwash sites were identified, but only 10 of the sites proved to be optimum for planting based on the elevation of the sites. Several of these sites might also have been rejected if the condition of the beach face had been considered. It is likely that a combination of restoration techniques may have increased the chances of project success at all of the sites. Restoration techniques designed to maintain the beach and dune system, such as sand fencing or dune plantings, may have provided some protection to the plantings by weakening the storm overwash.

The *S. alterniflora* cultivar that was planted on the project was the "Vermillion" cultivar released by the Natural Resources Conservation Service (NRCS)-Plant Material Center. We

believe that this ecotype may not be best suited for the growing conditions of the Chandeleur Islands. The "Vermillion" cultivar's robust form is inherently at a disadvantage in the harsh environment of the island. We feel that a "barrier island ecotype" has a morphology that is more suited to the growing conditions that exist on the Chandeleur Islands. The individuals in the native stands of *S. alterniflora* have the physiology and morphology that are required to survive and thrive on the island.

It is the recommendation of the LDNR staff that the state of Louisiana pursue the addition of sand to nourish the Chandeleur Islands as it recovers from the devastation of Hurricane Katrina. The Chandeleur Islands protect unique habitat of a protected shallow bay behind the island which supports beds of manatee grass, shoal grass, turtle grass, and widgeon grass.

VI. References

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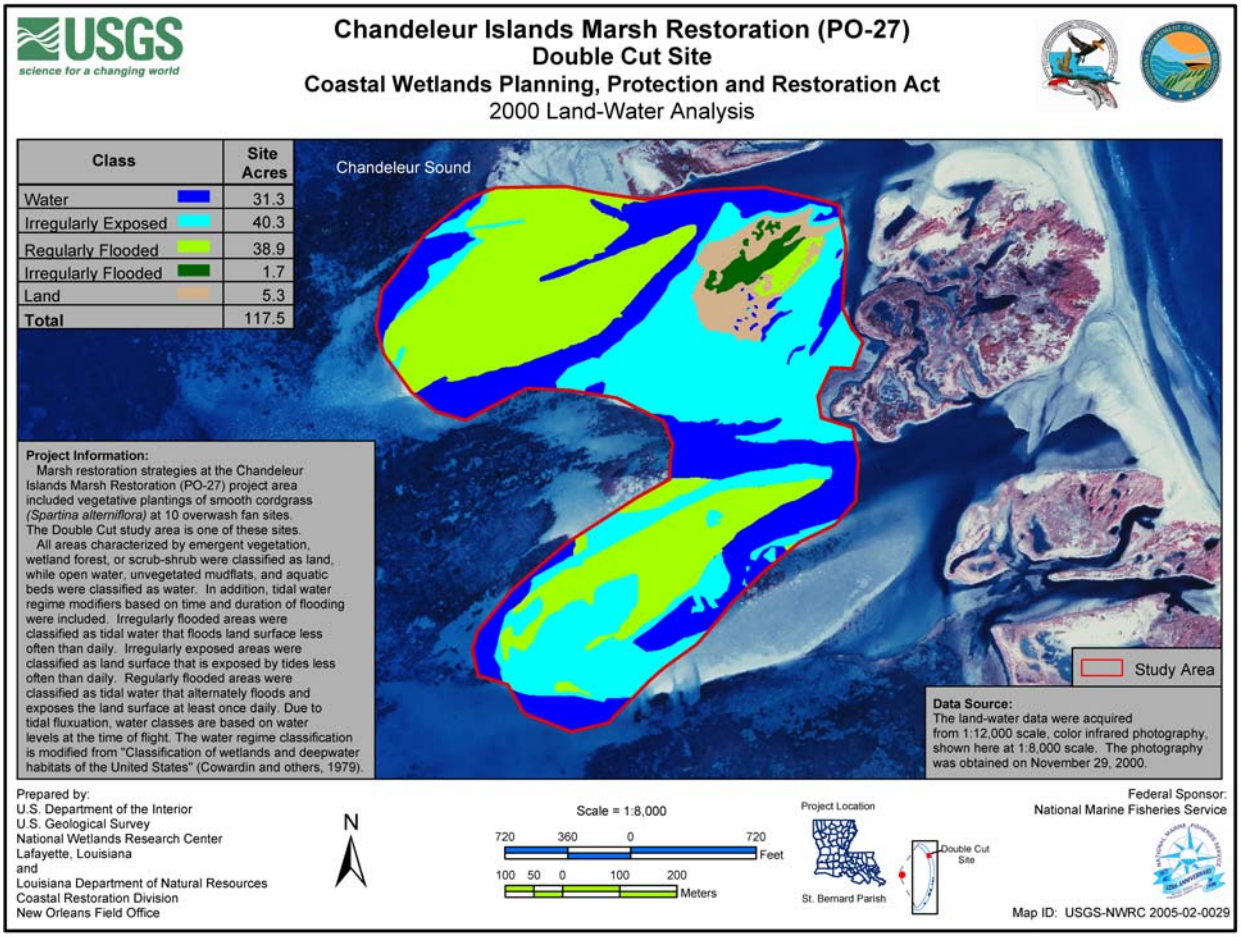
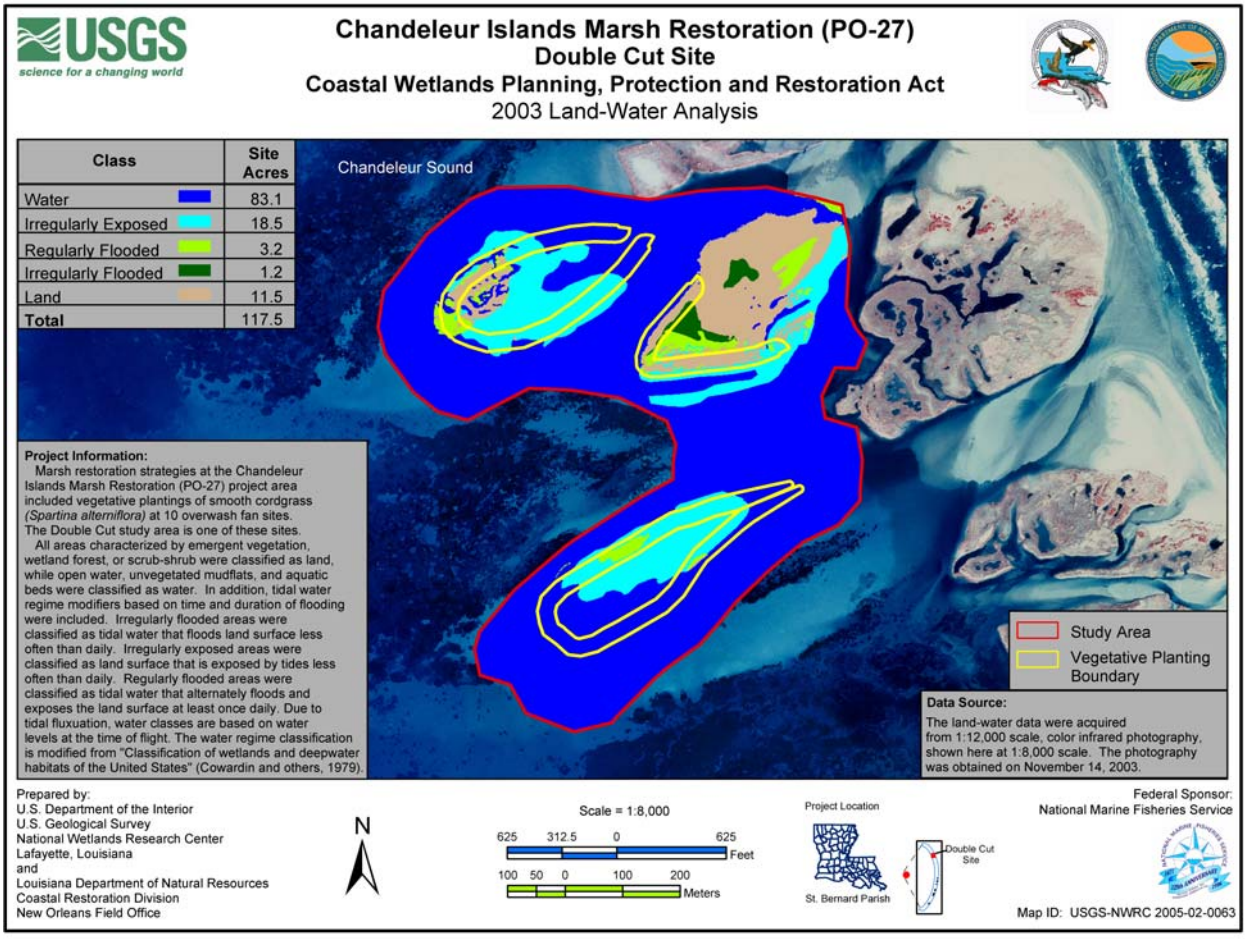
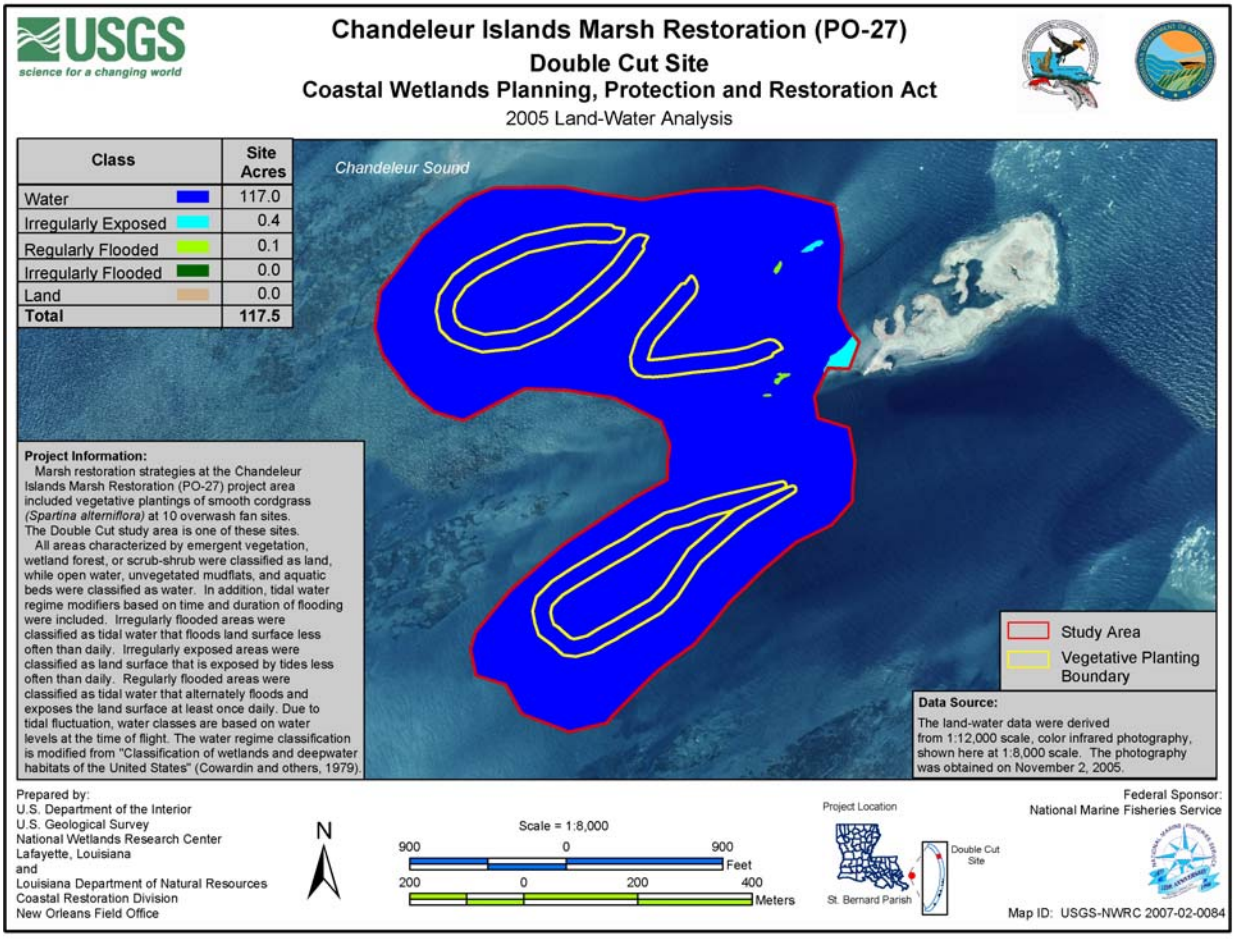
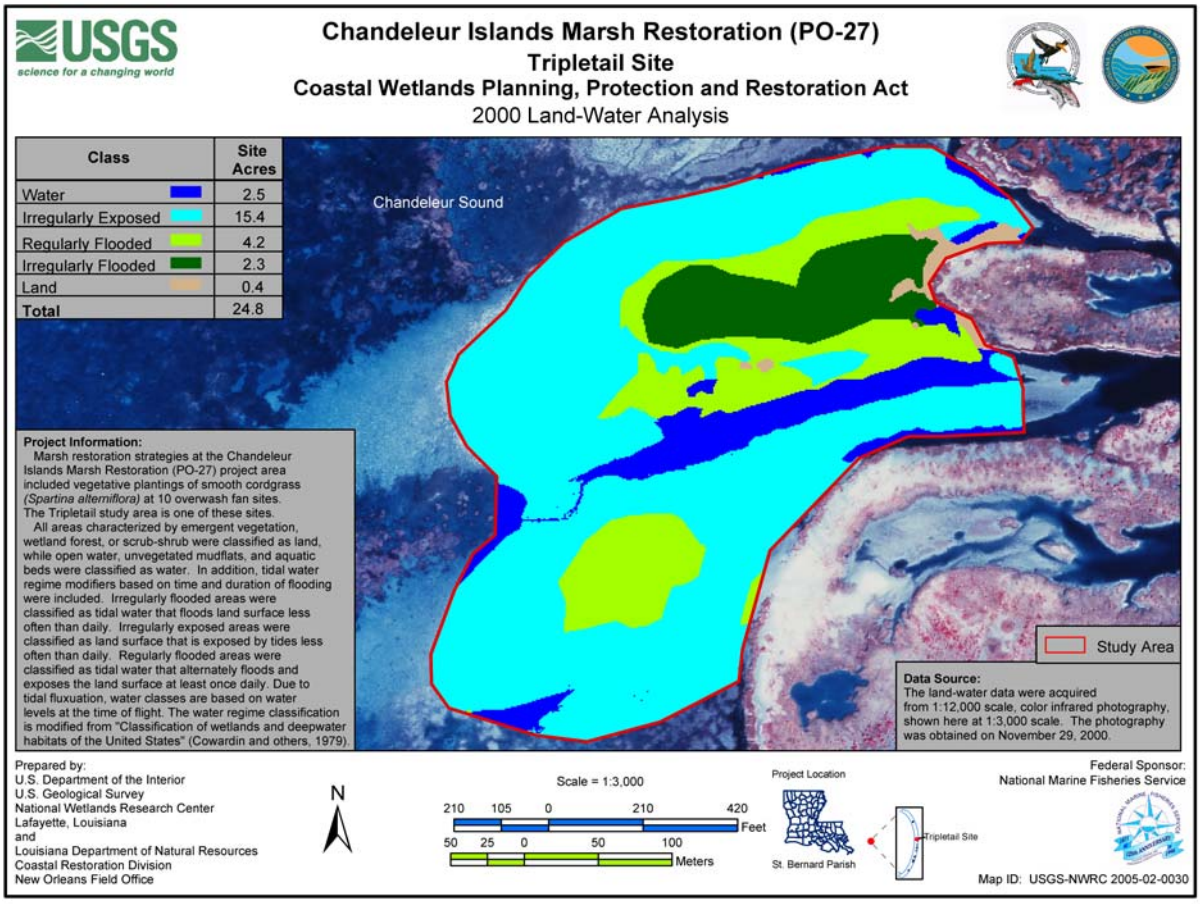
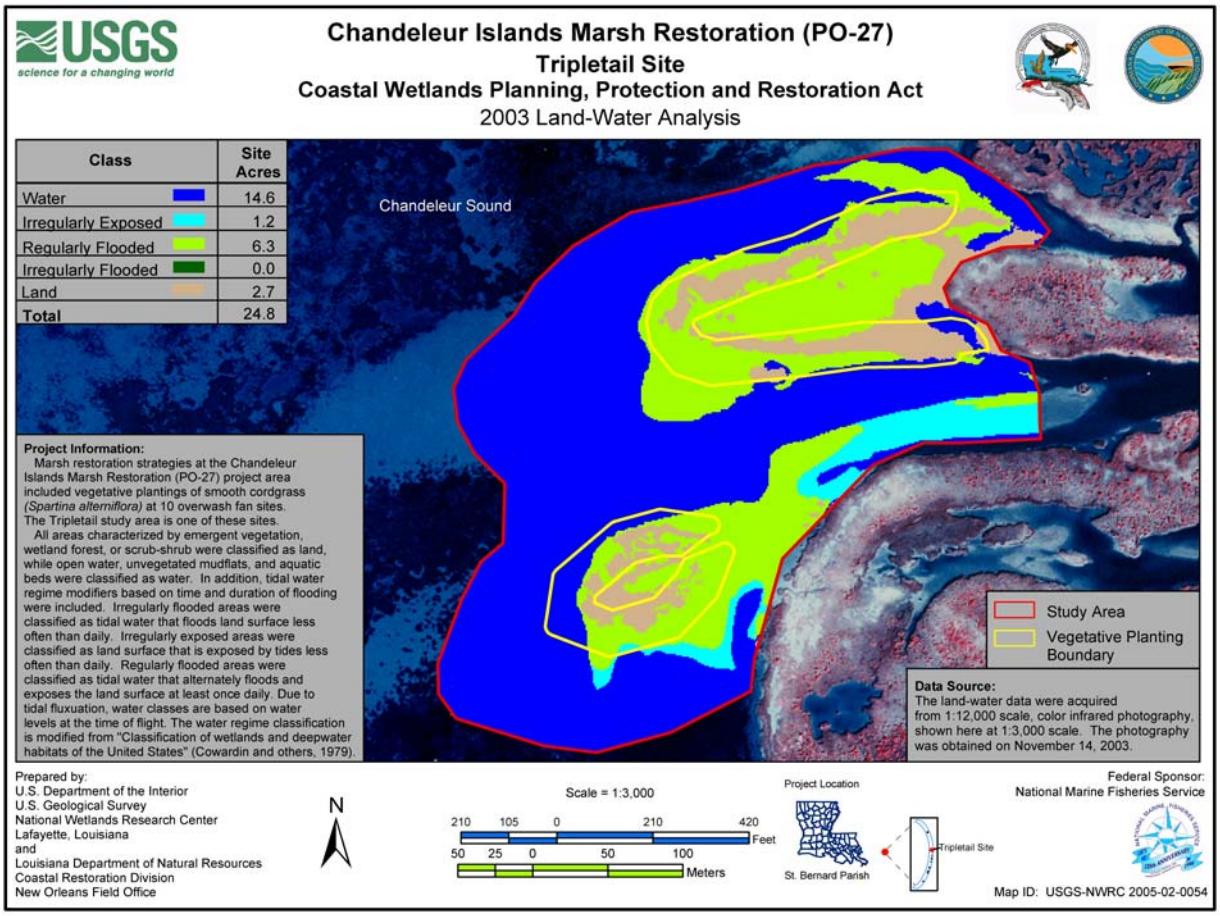
VII. Appendix 1: 2000, 2003, and 2005 land:water analyses of the Chandeleur Islands Marsh Restoration (PO-27) planting sites.

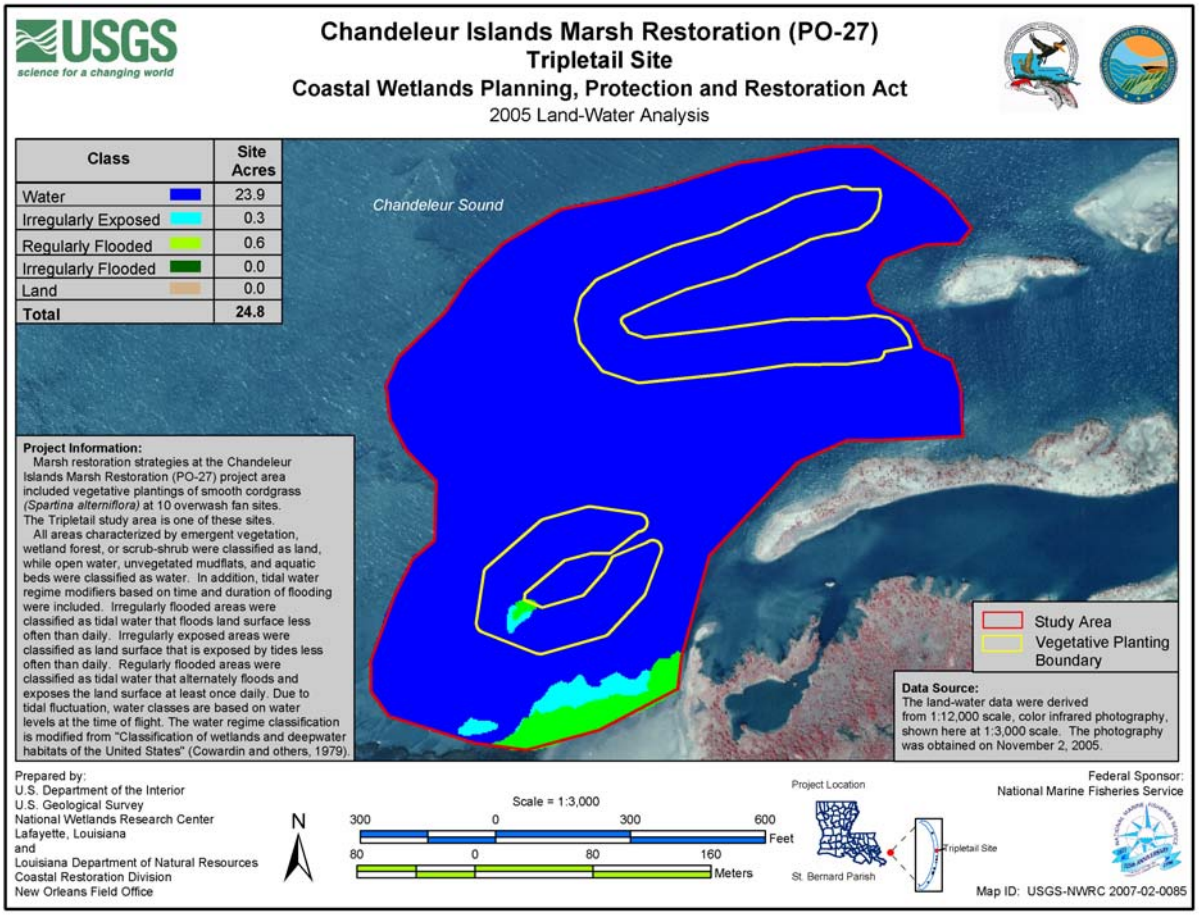


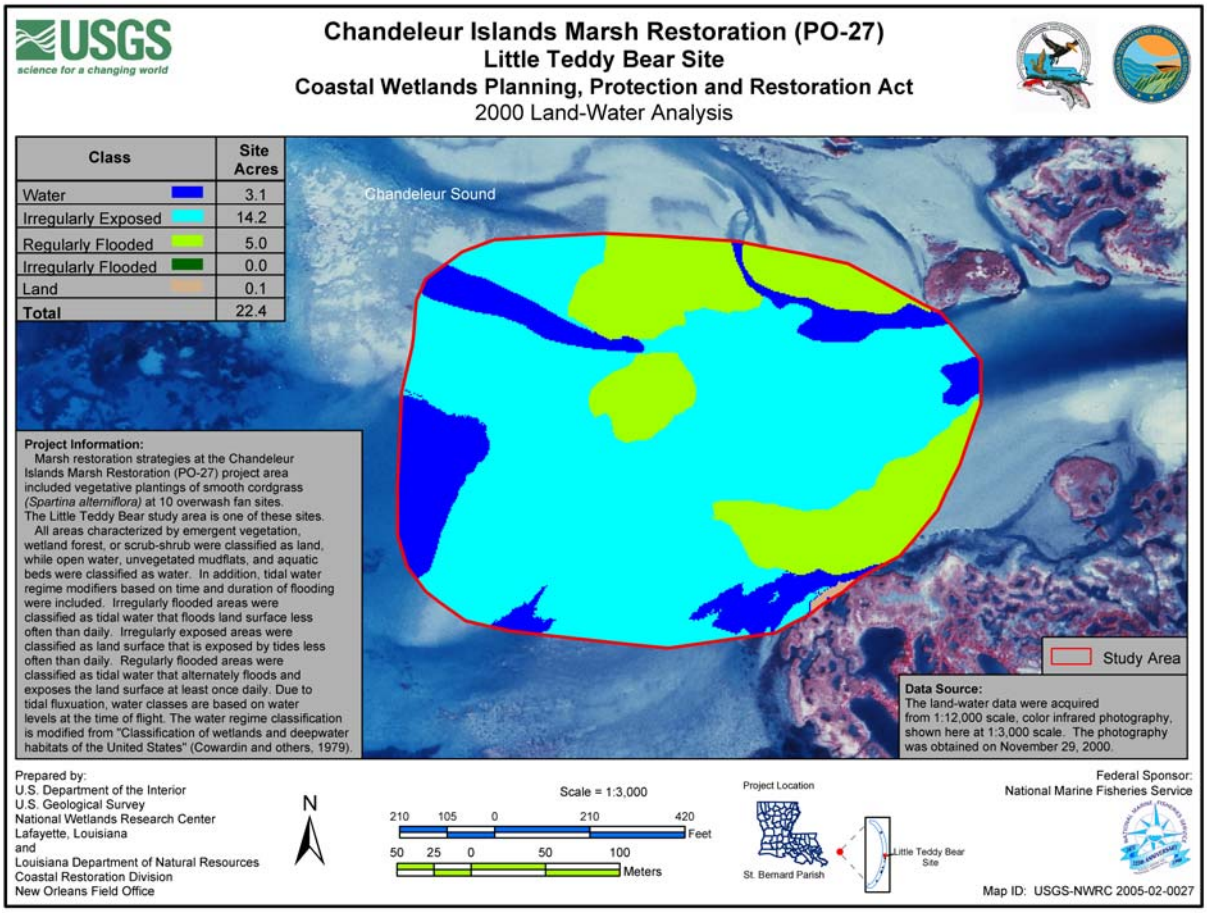

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Double Cut Site
Coastal Wetlands Planning, Protection and Restoration Act
2003 Land-Water Analysis
Class
Site Acres
Water
83.1
Irregularly Exposed
18.5
Regularly Flooded
3.2
Irregularly Flooded
1.2
Land
11.5
Total
117.5
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Double Cut study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:8,000 scale. The photography was obtained on November 14, 2003.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:8,000
625 312.5 0 625 Feet
100 50 0 100 200 Meters
Project Location
St. Bernard Parish
Double Cut Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0063

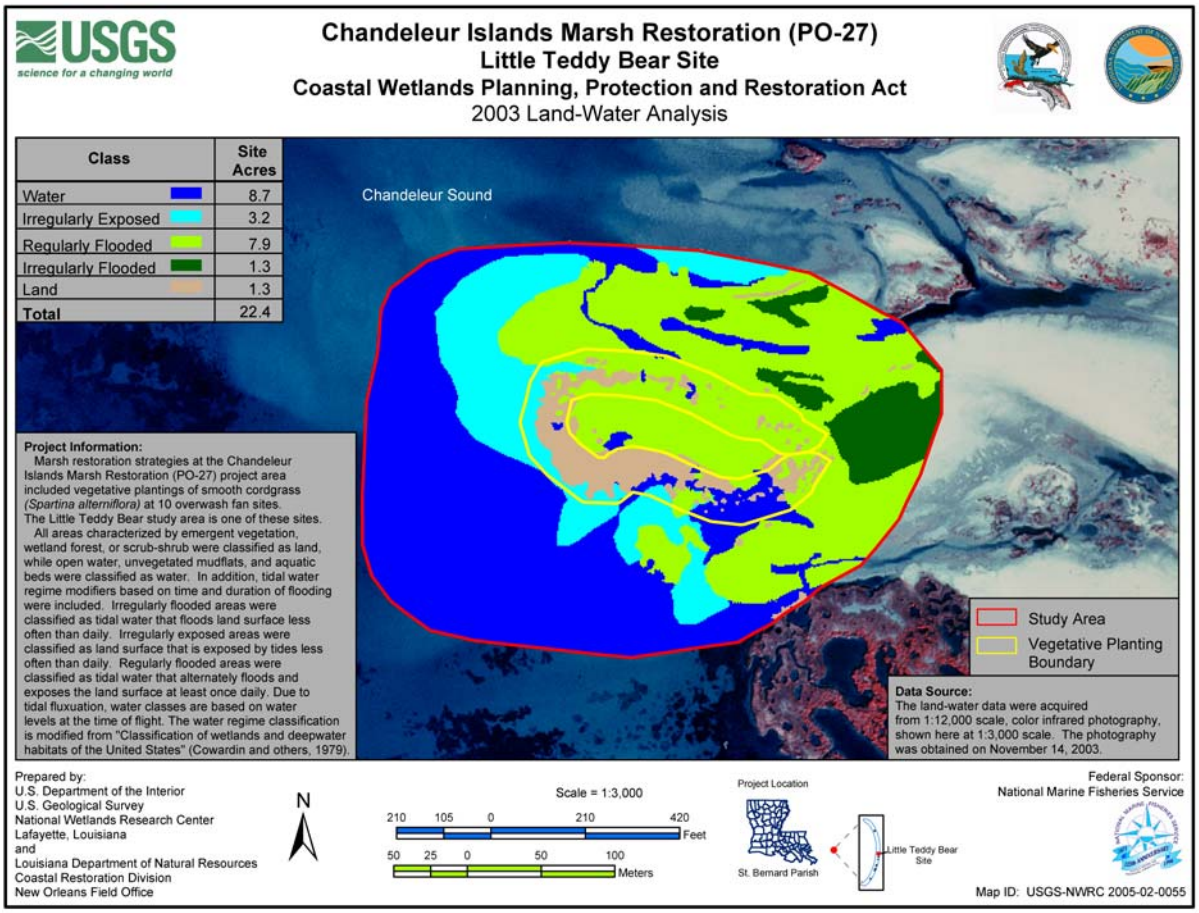

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Double Cut Site
Coastal Wetlands Planning, Protection and Restoration Act
2005 Land-Water Analysis
Class
Site Acres
Water 117.0
Irregularly Exposed 0.4
Regularly Flooded 0.1
Irregularly Flooded 0.0
Land 0.0
Total 117.5
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Double Cut study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluctuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were derived from 1:12,000 scale, color infrared photography, shown here at 1:8,000 scale. The photography was obtained on November 2, 2005.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:8,000
900 0 900 Feet
200 0 200 400 Meters
Project Location
St. Bernard Parish
Double Cut Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2007-02-0084

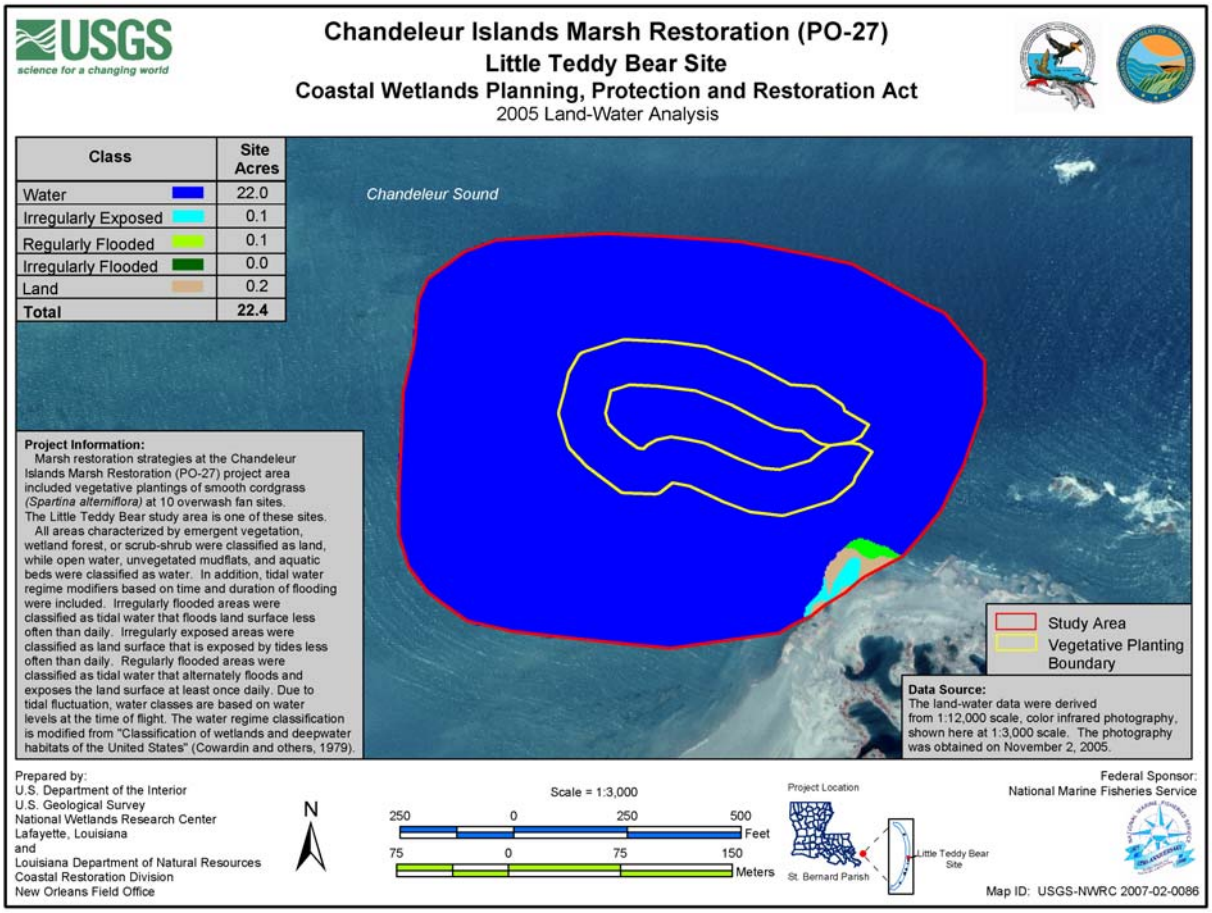

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Tripletail Site
Coastal Wetlands Planning, Protection and Restoration Act
2000 Land-Water Analysis
Class
Site Acres
Water
2.5
Irregularly Exposed
15.4
Regularly Flooded
4.2
Irregularly Flooded
2.3
Land
0.4
Total
24.8
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Tripletail study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:3,000 scale. The photography was obtained on November 29, 2000.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:3,000
210 105 0 210 420 Feet
50 25 0 50 100 Meters
Project Location
St. Bernard Parish
Tripletail Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0030

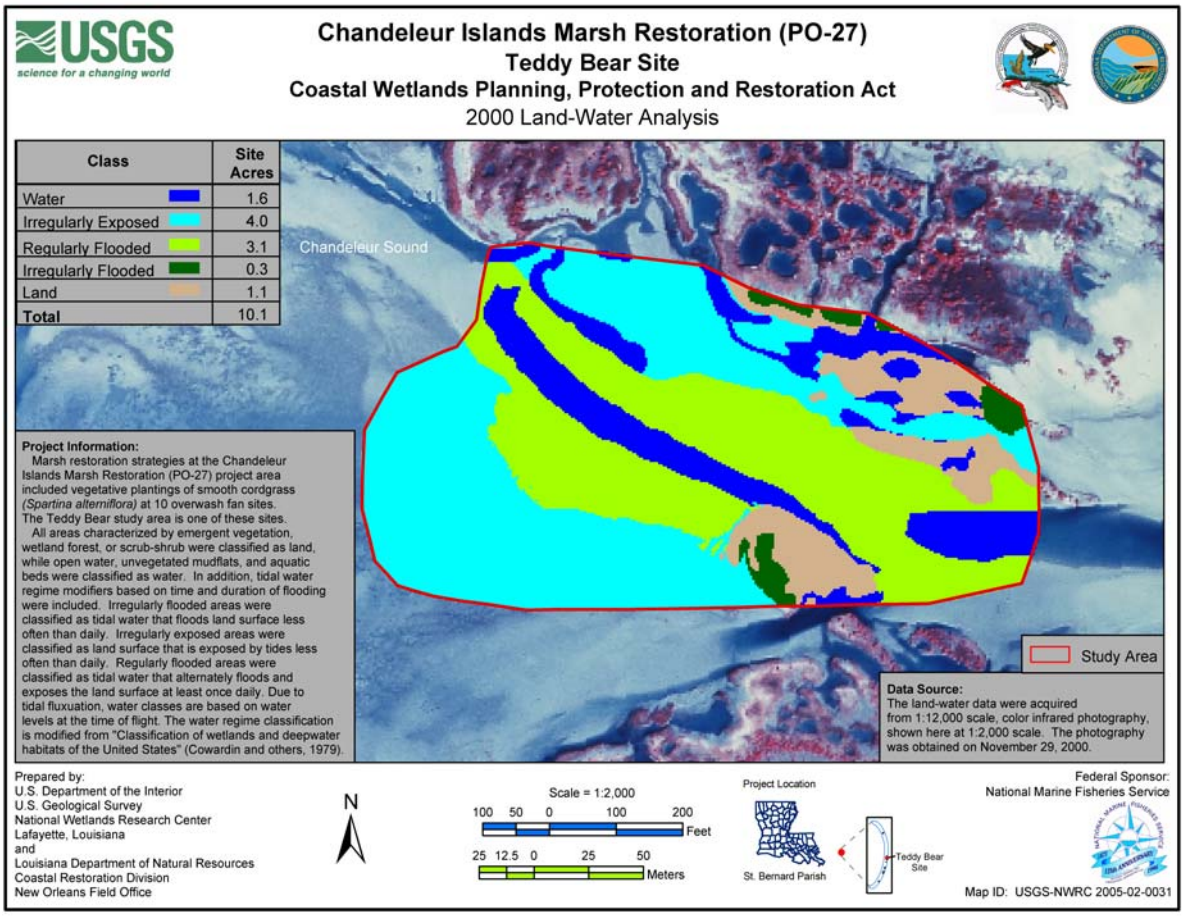

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Tripletail Site
Coastal Wetlands Planning, Protection and Restoration Act
2003 Land-Water Analysis
Class
Site Acres
Water 14.6
Irregularly Exposed 1.2
Regularly Flooded 6.3
Irregularly Flooded 0.0
Land 2.7
Total 24.8
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Tripletail study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:3,000 scale. The photography was obtained on November 14, 2003.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:3,000
210 105 0 210 420 Feet
50 25 0 50 100 Meters
Project Location
St. Bernard Parish
Tripletail Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0054

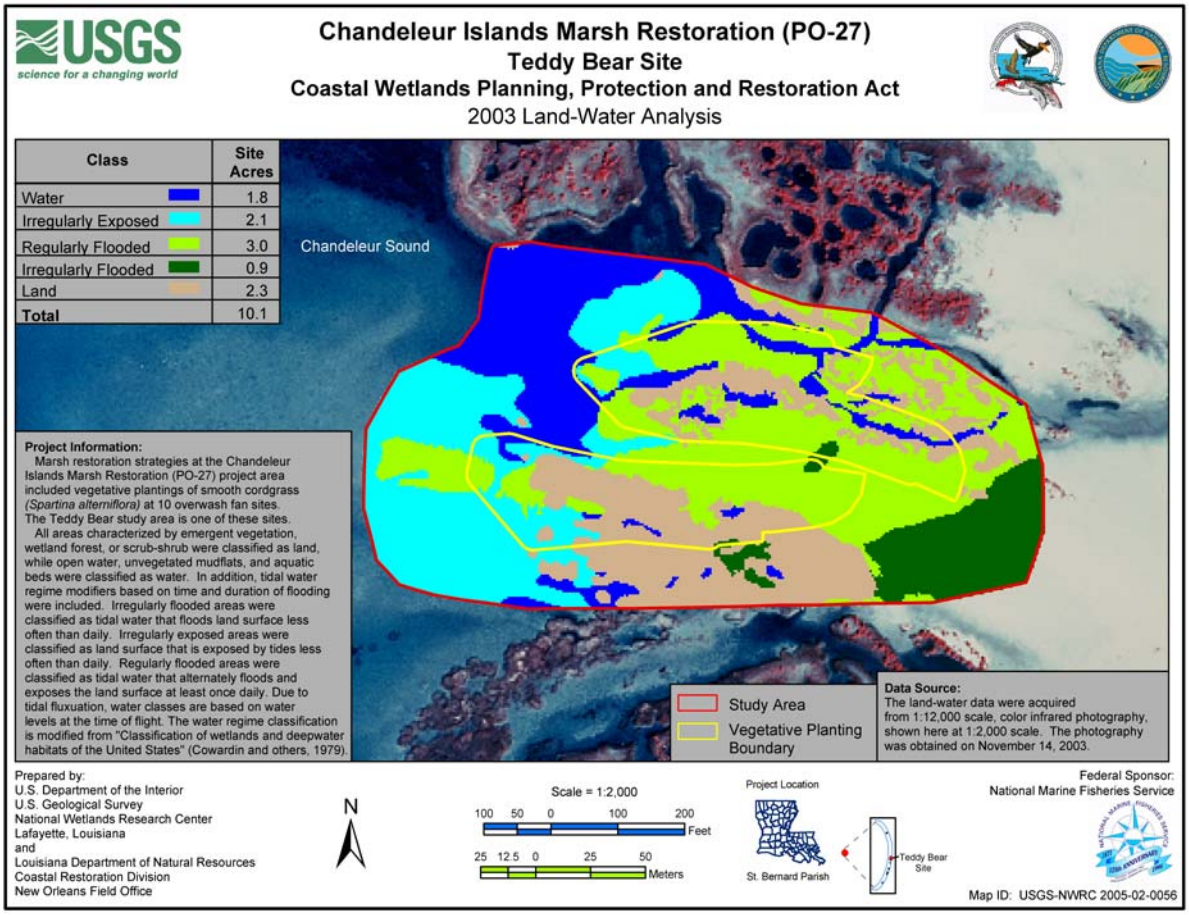

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Tripletail Site
Coastal Wetlands Planning, Protection and Restoration Act
2005 Land-Water Analysis
Class
Site Acres
Water
23.9
Irregularly Exposed
0.3
Regularly Flooded
0.6
Irregularly Flooded
0.0
Land
0.0
Total
24.8
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Tripletail study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluctuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were derived from 1:12,000 scale, color infrared photography, shown here at 1:3,000 scale. The photography was obtained on November 2, 2005.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:3,000
300 0 300 600 Feet
80 0 80 160 Meters
Project Location
St. Bernard Parish
Tripletail Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2007-02-0085

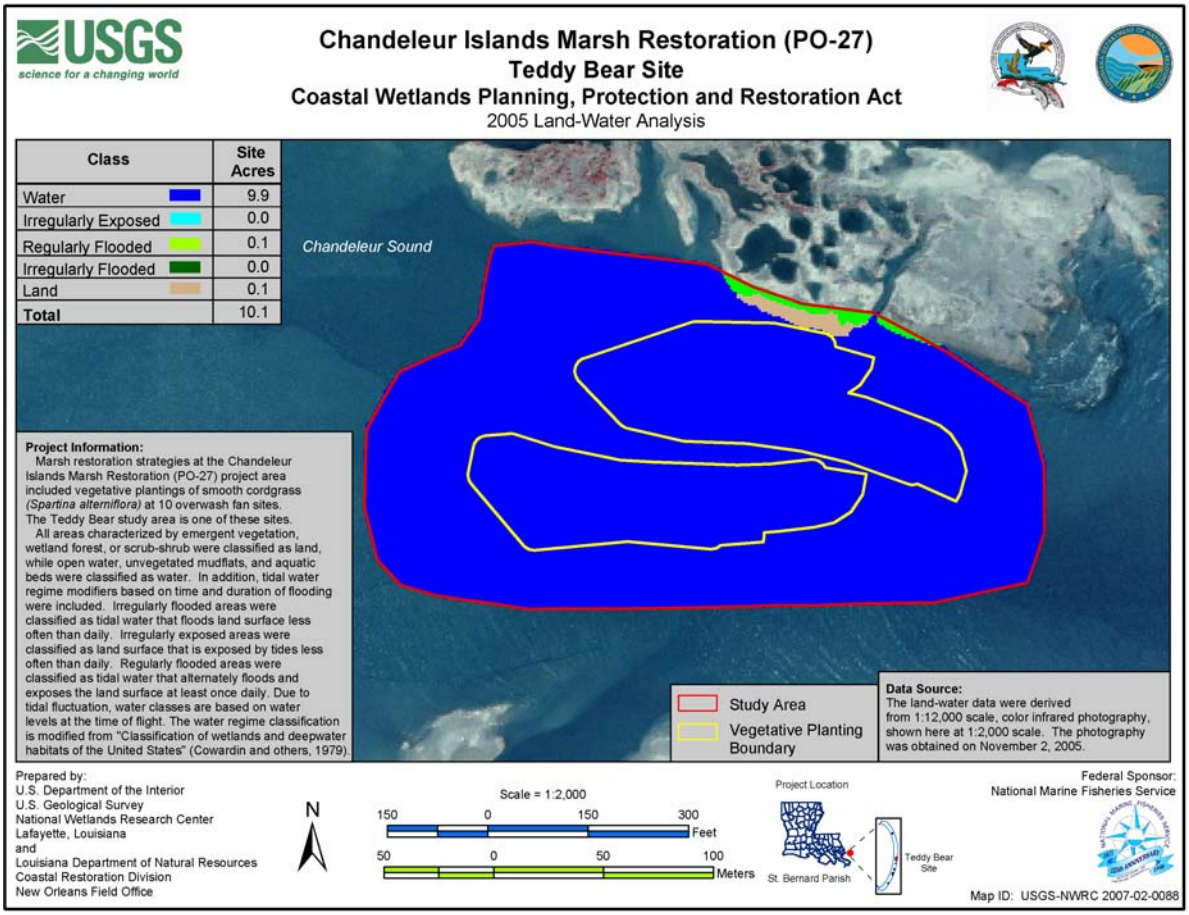

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Little Teddy Bear Site
Coastal Wetlands Planning, Protection and Restoration Act
2000 Land-Water Analysis
Class
Site Acres
Water 3.1
Irregularly Exposed 14.2
Regularly Flooded 5.0
Irregularly Flooded 0.0
Land 0.1
Total 22.4
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Little Teddy Bear study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:3,000 scale. The photography was obtained on November 29, 2000.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:3,000
210 105 0 210 420 Feet
50 25 0 50 100 Meters
Project Location
St. Bernard Parish
Little Teddy Bear Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0027

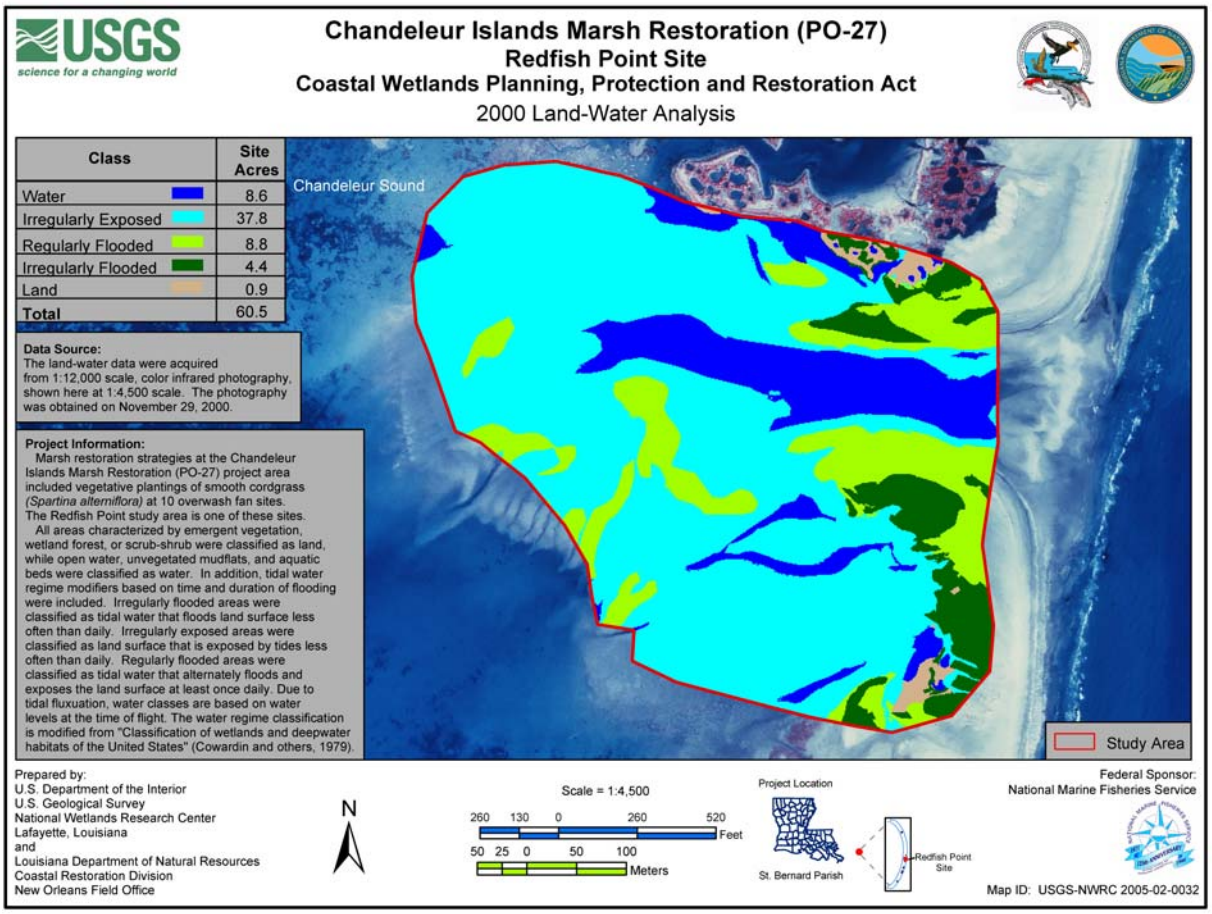

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Little Teddy Bear Site
Coastal Wetlands Planning, Protection and Restoration Act
2003 Land-Water Analysis
Class
Site Acres
Water 8.7
Irregularly Exposed 3.2
Regularly Flooded 7.9
Irregularly Flooded 1.3
Land 1.3
Total 22.4
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Little Teddy Bear study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:3,000 scale. The photography was obtained on November 14, 2003.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:3,000
210 105 0 210 420 Feet
50 25 0 50 100 Meters
Project Location
St. Bernard Parish
Little Teddy Bear Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0055


USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Little Teddy Bear Site
Coastal Wetlands Planning, Protection and Restoration Act
2005 Land-Water Analysis
Class
Site Acres
Water 22.0
Irregularly Exposed 0.1
Regularly Flooded 0.1
Irregularly Flooded 0.0
Land 0.2
Total 22.4
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Little Teddy Bear study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluctuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were derived from 1:12,000 scale, color infrared photography, shown here at 1:3,000 scale. The photography was obtained on November 2, 2005.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:3,000
250 0 250 500 Feet
75 0 75 150 Meters
Project Location
St. Bernard Parish
Little Teddy Bear Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2007-02-0086


USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Teddy Bear Site
Coastal Wetlands Planning, Protection and Restoration Act
2000 Land-Water Analysis
Class
Site Acres
Water 1.6
Irregularly Exposed 4.0
Regularly Flooded 3.1
Irregularly Flooded 0.3
Land 1.1
Total 10.1
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Teddy Bear study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:2,000 scale. The photography was obtained on November 29, 2000.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:2,000
100 50 0 100 200 Feet
25 12.5 0 25 50 Meters
Project Location
St. Bernard Parish
Teddy Bear Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0031


USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Teddy Bear Site
Coastal Wetlands Planning, Protection and Restoration Act
2003 Land-Water Analysis
Class
Site Acres
Water 1.8
Irregularly Exposed 2.1
Regularly Flooded 3.0
Irregularly Flooded 0.9
Land 2.3
Total 10.1
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Teddy Bear study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:2,000 scale. The photography was obtained on November 14, 2003.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:2,000
100 50 0 100 200 Feet
25 12.5 0 25 50 Meters
Project Location
St. Bernard Parish
Teddy Bear Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0056


USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Teddy Bear Site
Coastal Wetlands Planning, Protection and Restoration Act
2005 Land-Water Analysis
Class
Site Acres
Water 9.9
Irregularly Exposed 0.0
Regularly Flooded 0.1
Irregularly Flooded 0.0
Land 0.1
Total 10.1
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Teddy Bear study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluctuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were derived from 1:12,000 scale, color infrared photography, shown here at 1:2,000 scale. The photography was obtained on November 2, 2005.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:2,000
150 0 150 300 Feet
50 0 50 100 Meters
Project Location
St. Bernard Parish
Teddy Bear Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2007-02-0088


USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Redfish Point Site
Coastal Wetlands Planning, Protection and Restoration Act
2000 Land-Water Analysis
Class
Site Acres
Water 8.6
Irregularly Exposed 37.8
Regularly Flooded 8.8
Irregularly Flooded 4.4
Land 0.9
Total 60.5
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:4,500 scale. The photography was obtained on November 29, 2000.
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Redfish Point study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Chandeleur Sound
Study Area
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:4,500
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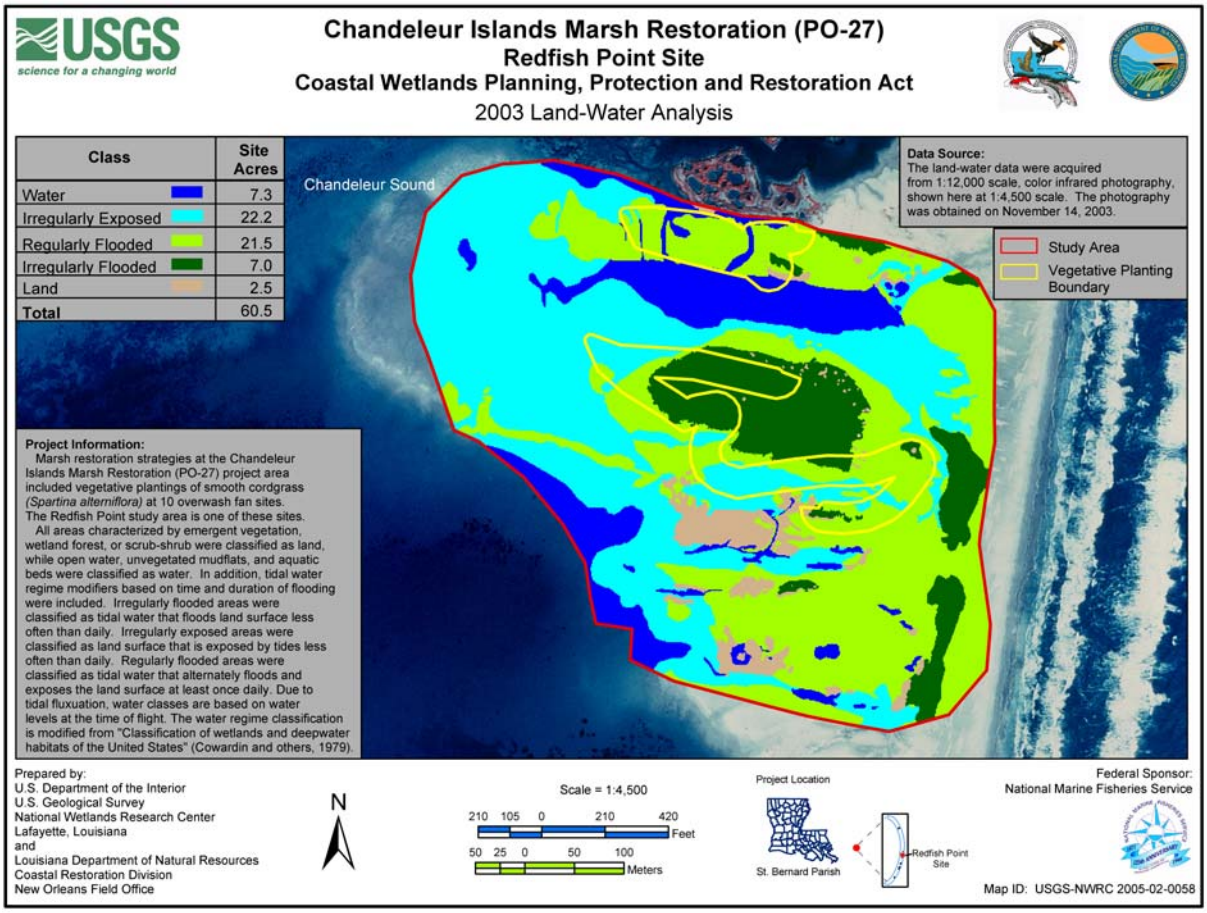
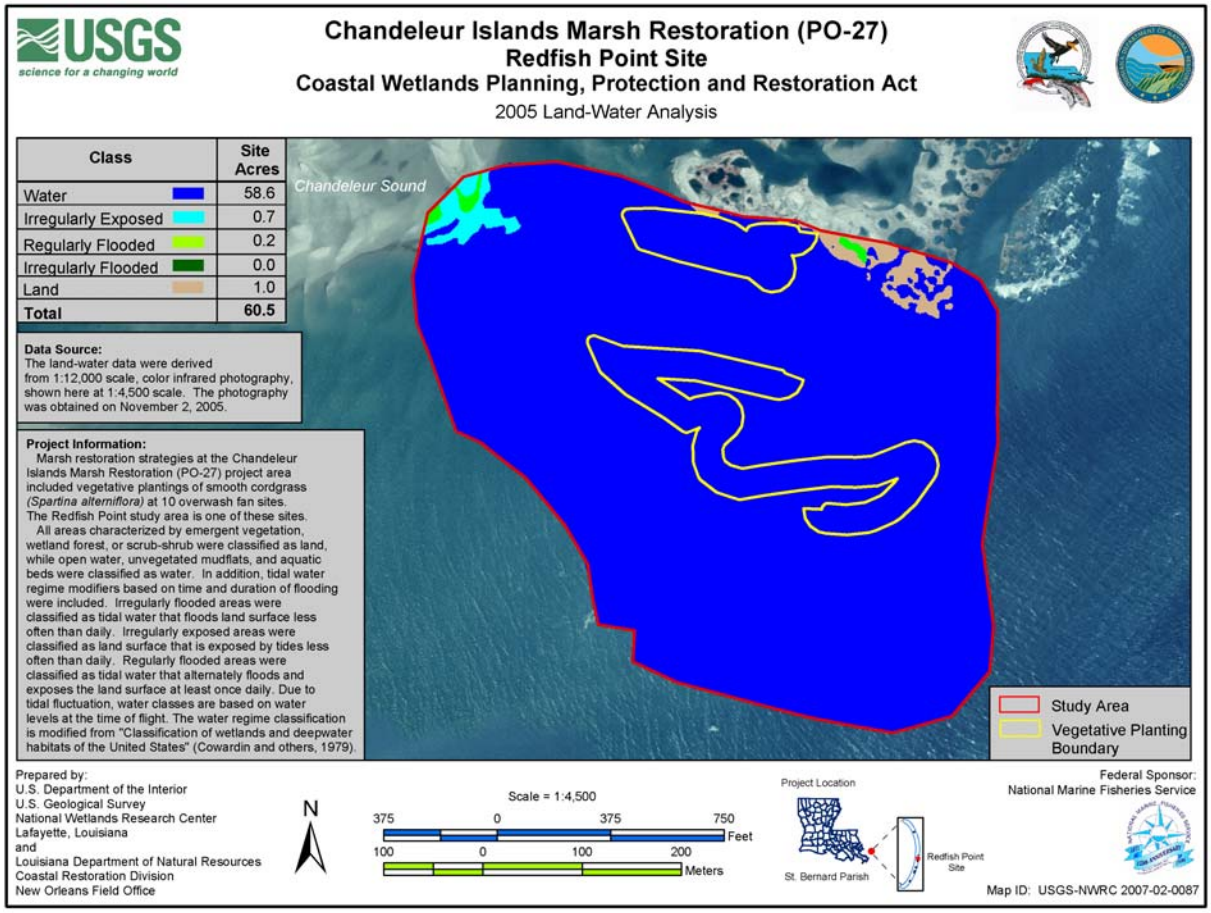
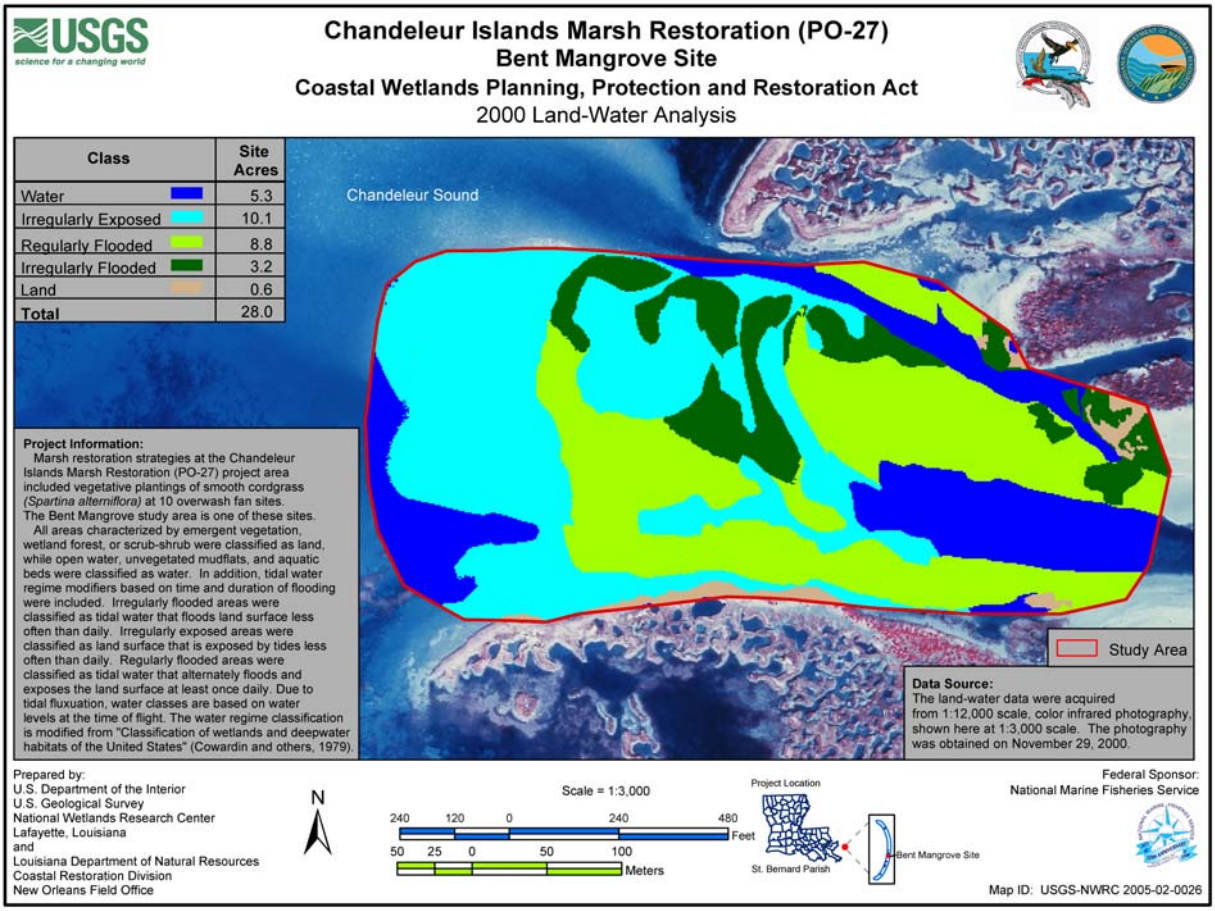
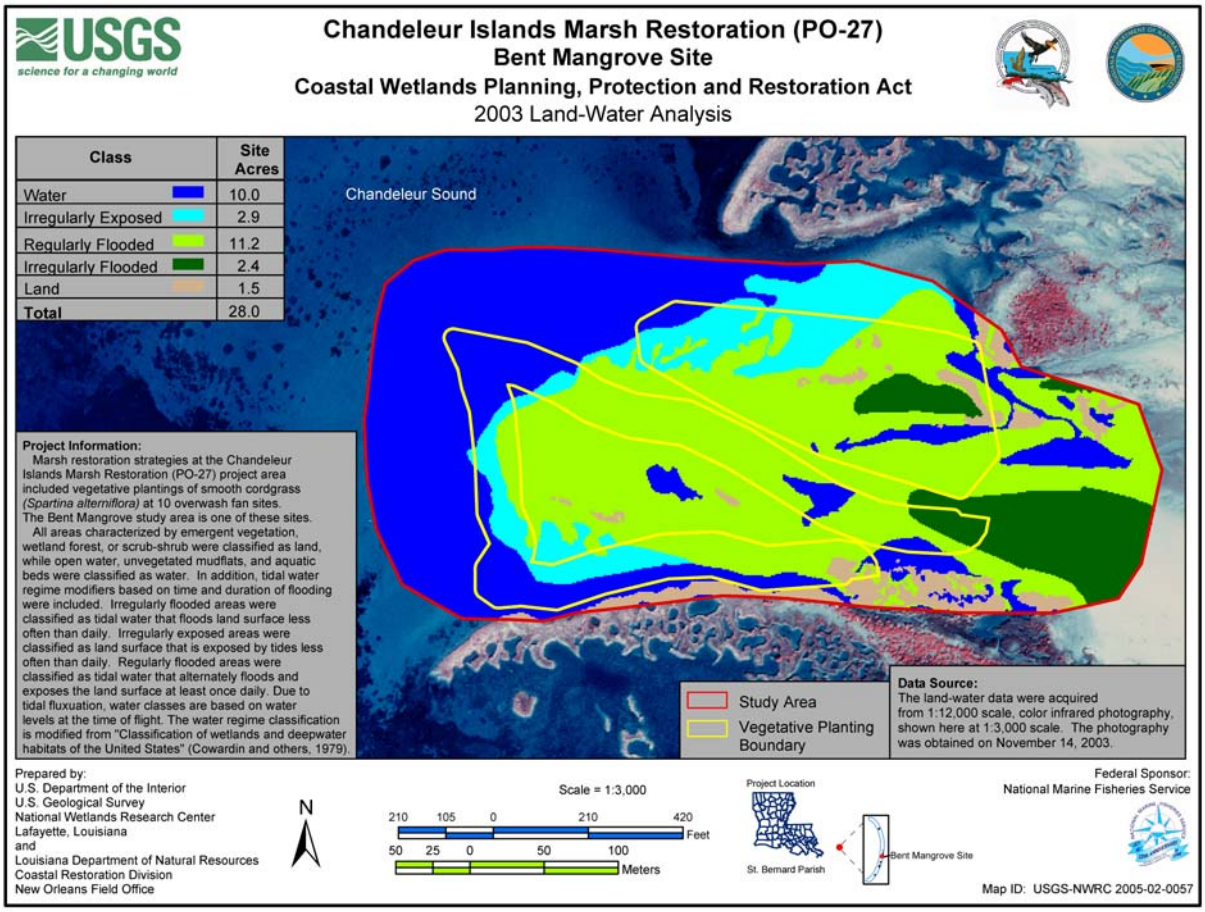
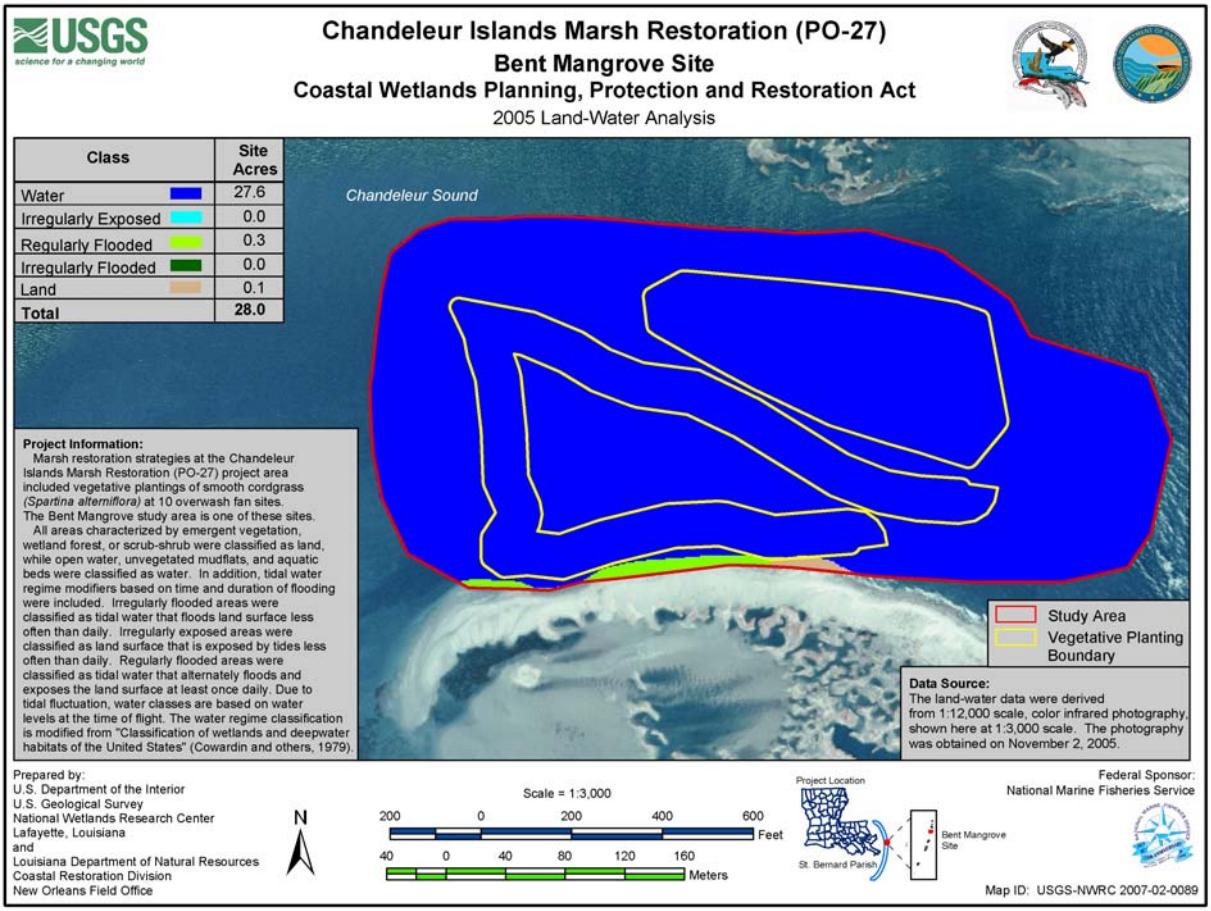
Project Location
St. Bernard Parish
Redfish Point Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0032

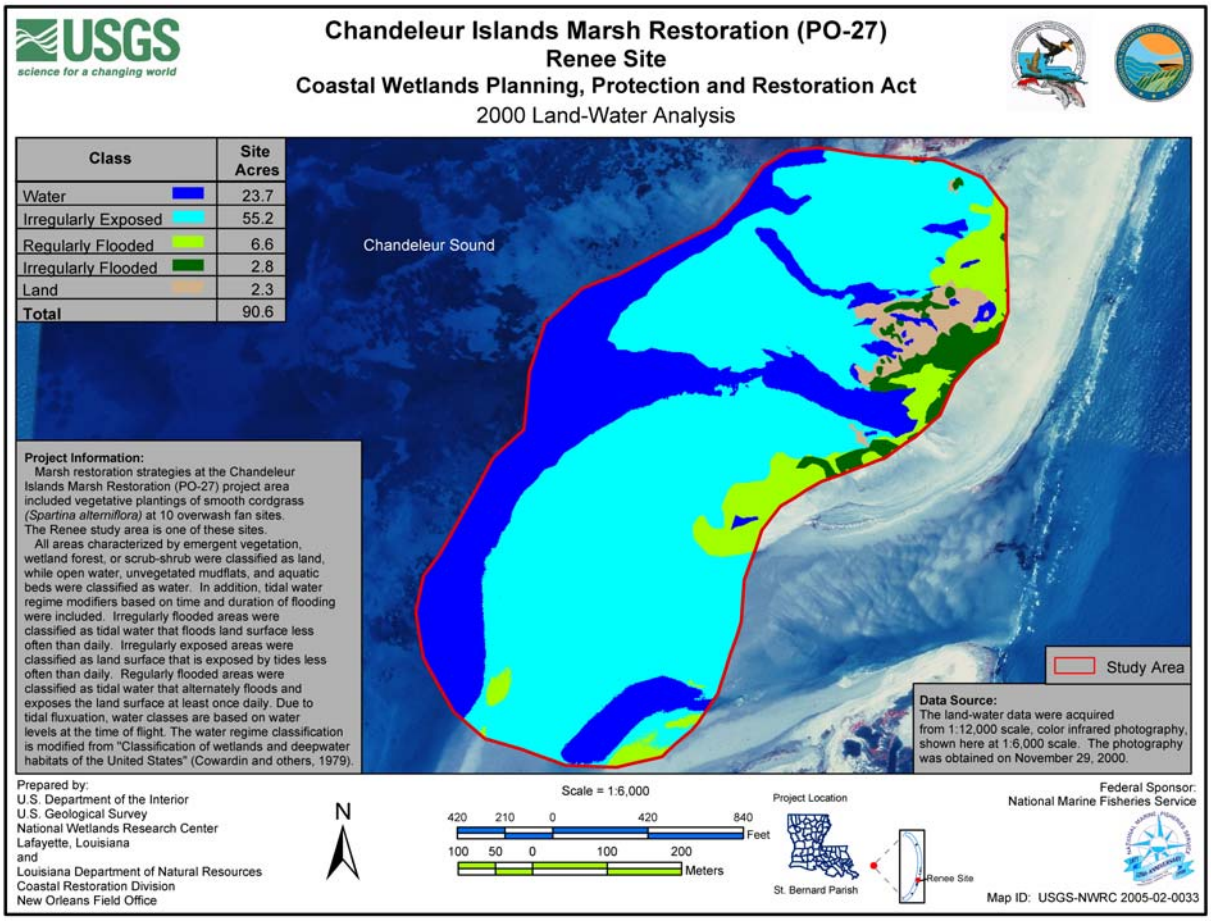

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Redfish Point Site
Coastal Wetlands Planning, Protection and Restoration Act
2003 Land-Water Analysis
Class
Site Acres
Water 7.3
Irregularly Exposed 22.2
Regularly Flooded 21.5
Irregularly Flooded 7.0
Land 2.5
Total 60.5
Chandeleur Sound
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:4,500 scale. The photography was obtained on November 14, 2003.
Study Area
Vegetative Planting Boundary
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Redfish Point study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:4,500
210 105 0 210 420
Feet
50 25 0 50 100
Meters
Project Location
St. Bernard Parish
Redfish Point Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0058

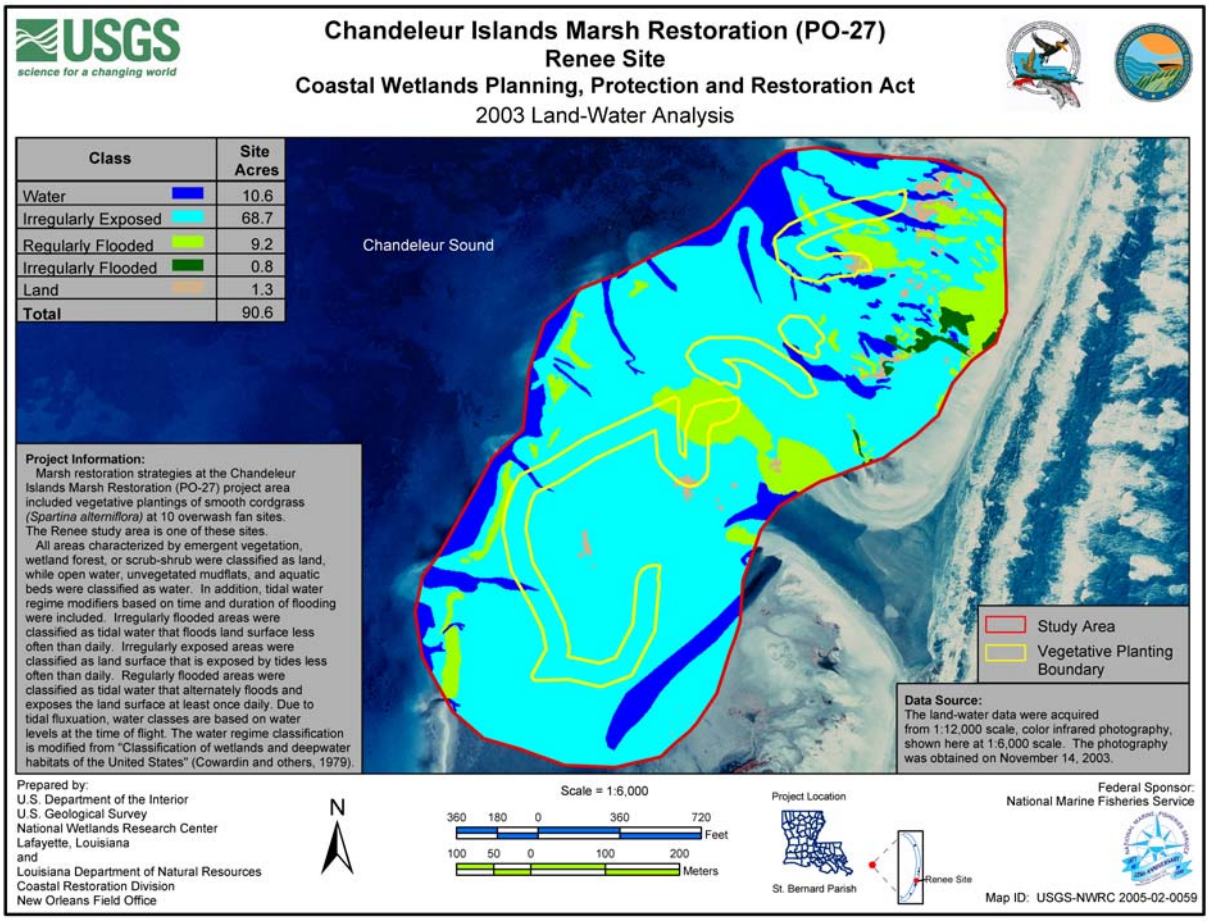

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Redfish Point Site
Coastal Wetlands Planning, Protection and Restoration Act
2005 Land-Water Analysis
Class
Site Acres
Water 58.6
Irregularly Exposed 0.7
Regularly Flooded 0.2
Irregularly Flooded 0.0
Land 1.0
Total 60.5
Chandeleur Sound
Data Source:
The land-water data were derived from 1:12,000 scale, color infrared photography, shown here at 1:4,500 scale. The photography was obtained on November 2, 2005.
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Redfish Point study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluctuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:4,500
375 0 375 750 Feet
100 0 100 200 Meters
Project Location
St. Bernard Parish
Redfish Point Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2007-02-0087

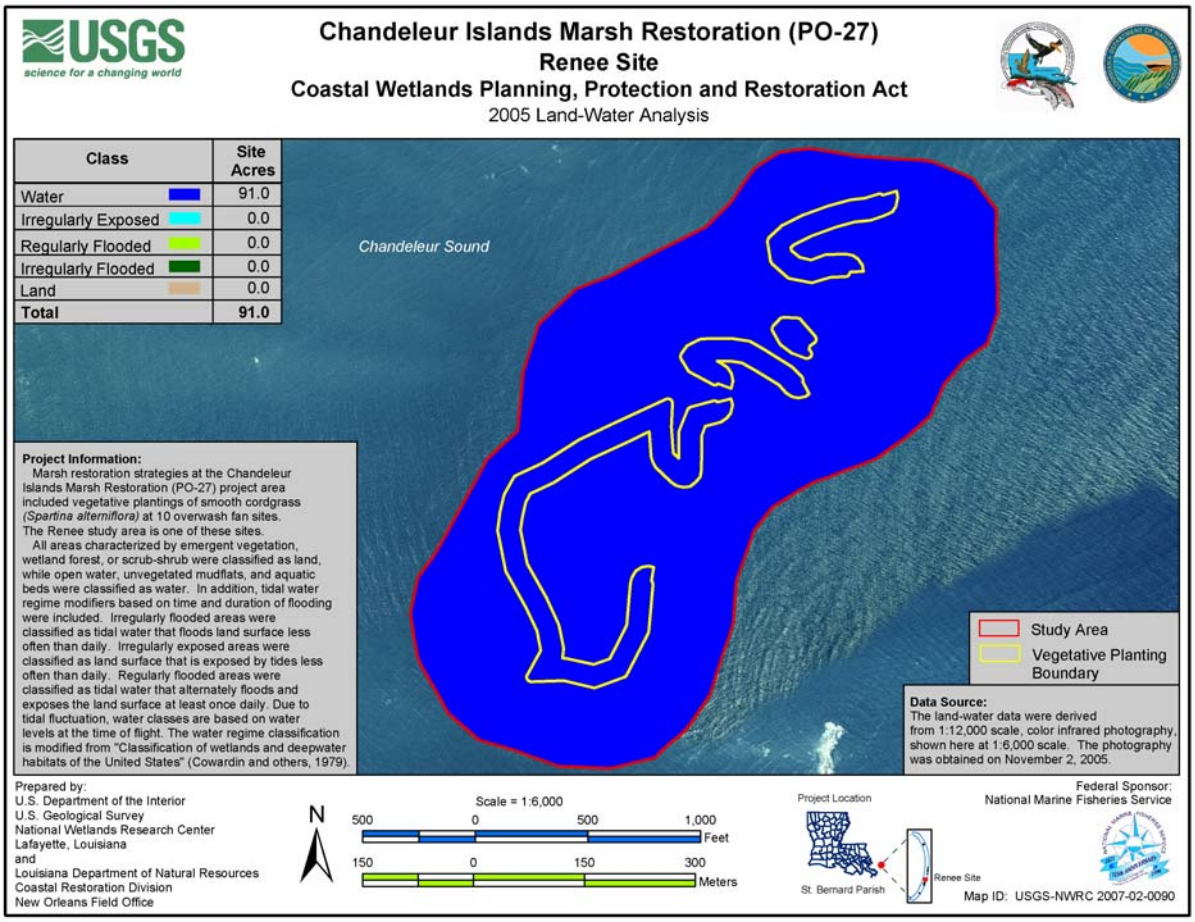

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Bent Mangrove Site
Coastal Wetlands Planning, Protection and Restoration Act
2000 Land-Water Analysis
Class
Site Acres
Water
5.3
Irregularly Exposed
10.1
Regularly Flooded
8.8
Irregularly Flooded
3.2
Land
0.6
Total
28.0
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Bent Mangrove study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:3,000 scale. The photography was obtained on November 29, 2000.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:3,000
240 120 0 240 480
Feet
50 25 0 50 100
Meters
Project Location
St. Bernard Parish
Bent Mangrove Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0026

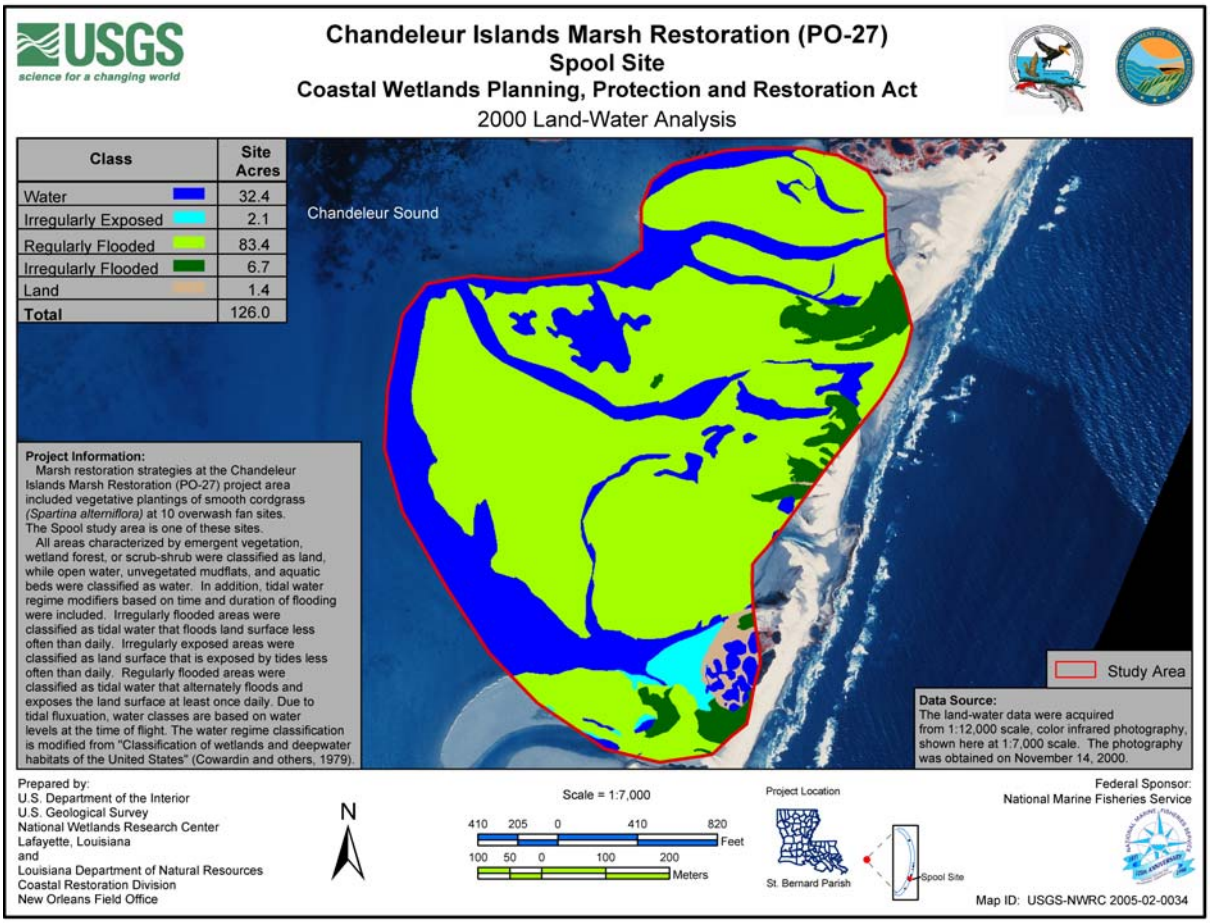

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Bent Mangrove Site
Coastal Wetlands Planning, Protection and Restoration Act
2003 Land-Water Analysis
Class
Site Acres
Water 10.0
Irregularly Exposed 2.9
Regularly Flooded 11.2
Irregularly Flooded 2.4
Land 1.5
Total 28.0
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Bent Mangrove study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:3,000 scale. The photography was obtained on November 14, 2003.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:3,000
210 105 0 210 420 Feet
50 25 0 50 100 Meters
Project Location
St. Bernard Parish
Bent Mangrove Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0057

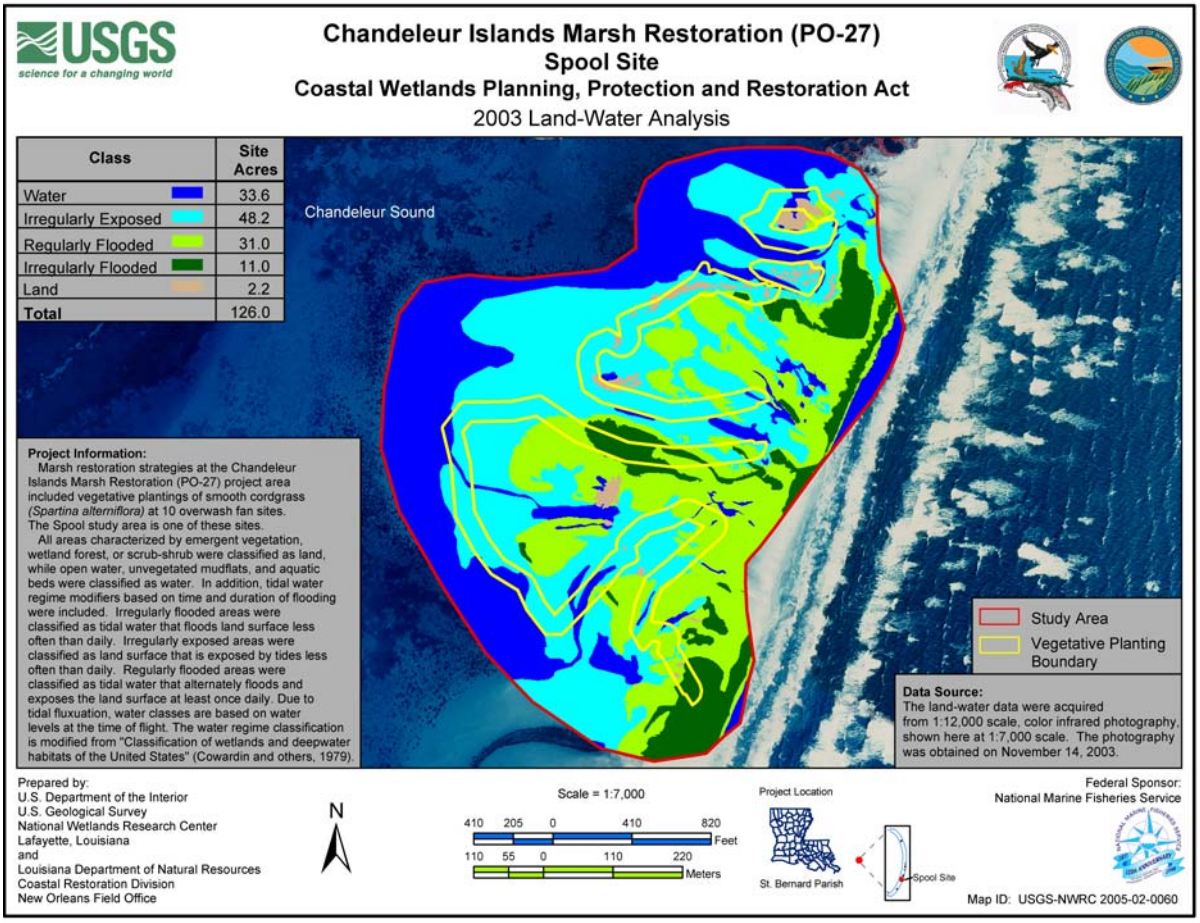

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Bent Mangrove Site
Coastal Wetlands Planning, Protection and Restoration Act
2005 Land-Water Analysis
Class
Site Acres
Water
27.6
Irregularly Exposed
0.0
Regularly Flooded
0.3
Irregularly Flooded
0.0
Land
0.1
Total
28.0
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Bent Mangrove study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluctuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were derived from 1:12,000 scale, color infrared photography, shown here at 1:3,000 scale. The photography was obtained on November 2, 2005.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:3,000
200 0 200 400 600 Feet
40 0 40 80 120 160 Meters
Project Location
St. Bernard Parish
Bent Mangrove Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2007-02-0089

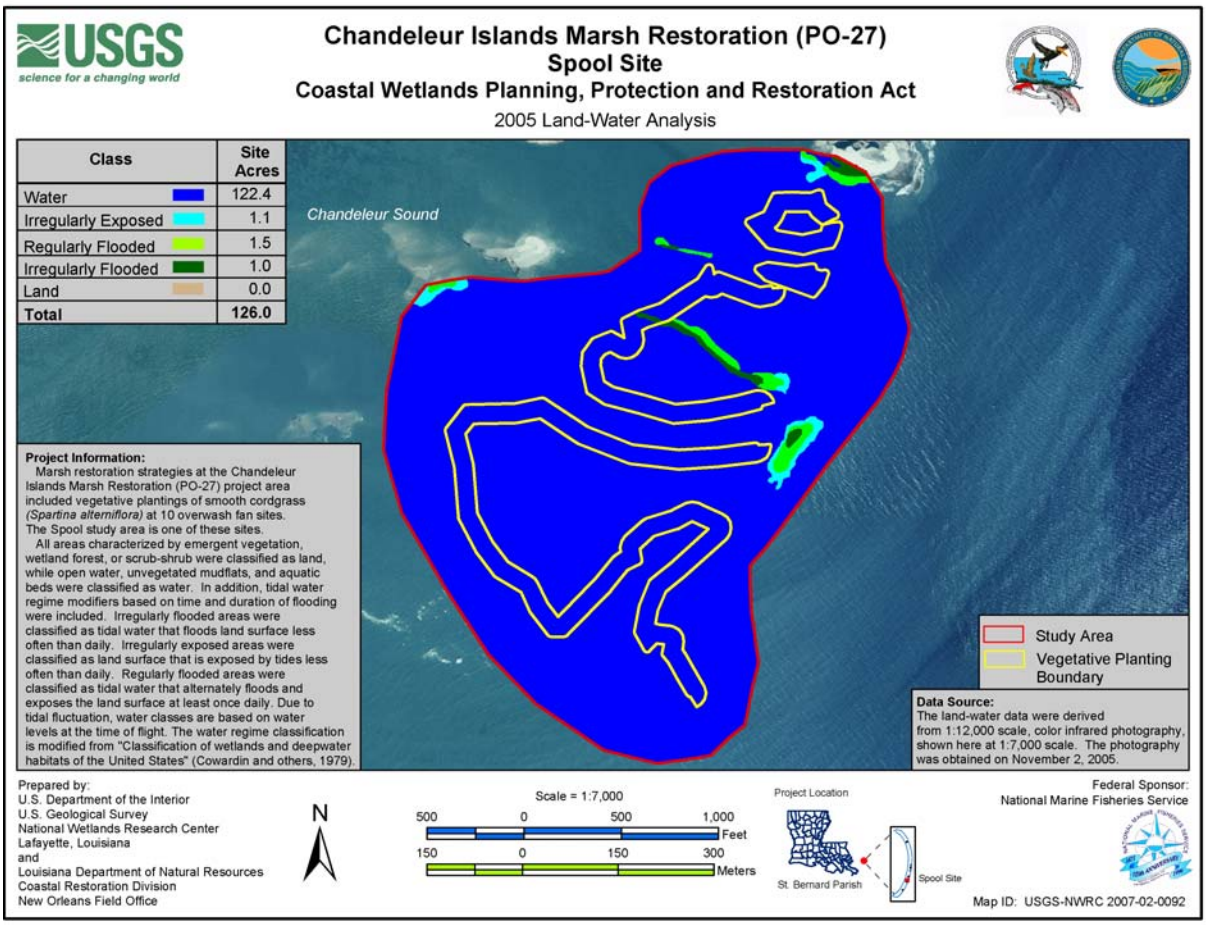

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Renee Site
Coastal Wetlands Planning, Protection and Restoration Act
2000 Land-Water Analysis
Class
Site Acres
Water
23.7
Irregularly Exposed
55.2
Regularly Flooded
6.6
Irregularly Flooded
2.8
Land
2.3
Total
90.6
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Renee study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:6,000 scale. The photography was obtained on November 29, 2000.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:6,000
420 210 0 420 840
Feet
100 50 0 100 200
Meters
Project Location
St. Bernard Parish
Renee Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0033

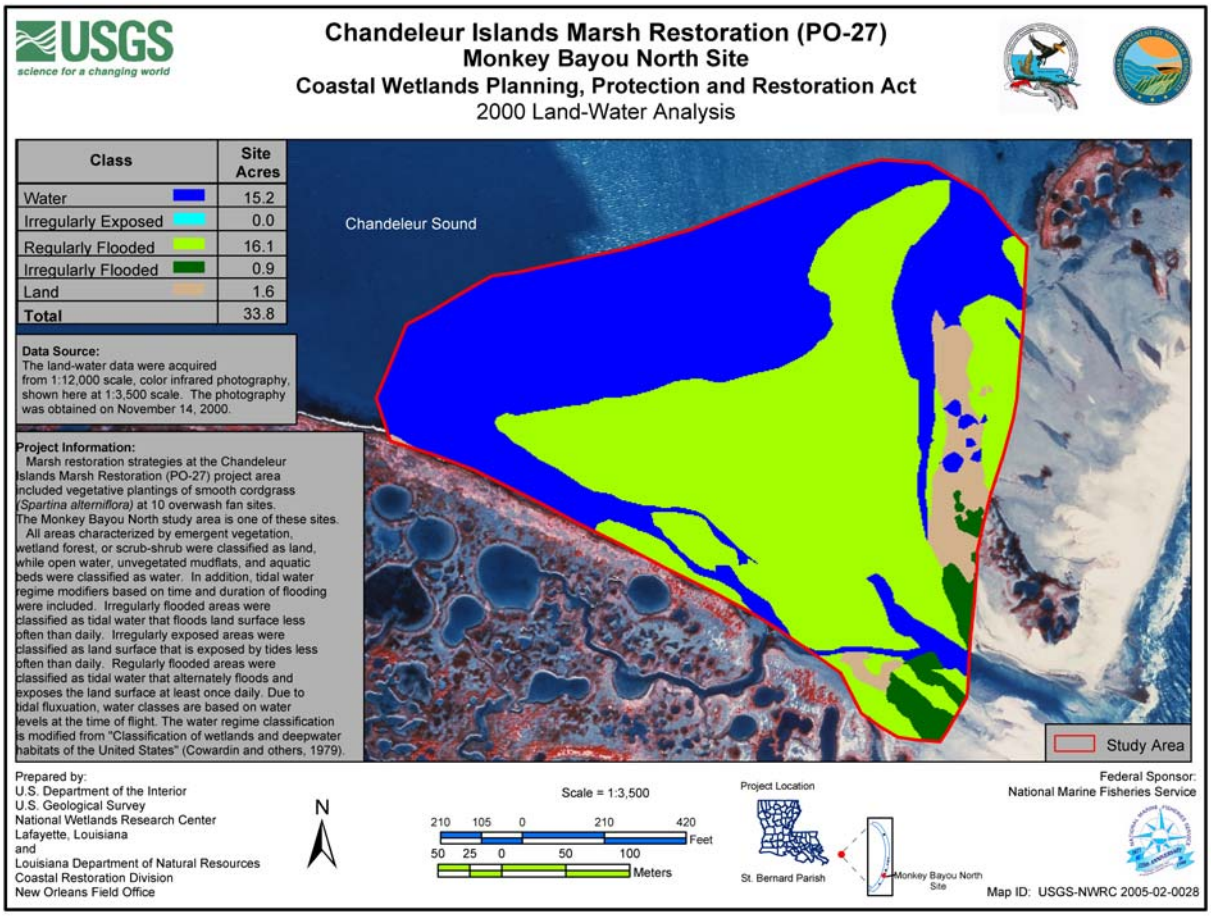

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Renee Site
Coastal Wetlands Planning, Protection and Restoration Act
2003 Land-Water Analysis
Class
Site Acres
Water
10.6
Irregularly Exposed
68.7
Regularly Flooded
9.2
Irregularly Flooded
0.8
Land
1.3
Total
90.6
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Renee study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:6,000 scale. The photography was obtained on November 14, 2003.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:6,000
360 180 0 360 720
Feet
100 50 0 100 200
Meters
Project Location
St. Bernard Parish
Renee Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0059

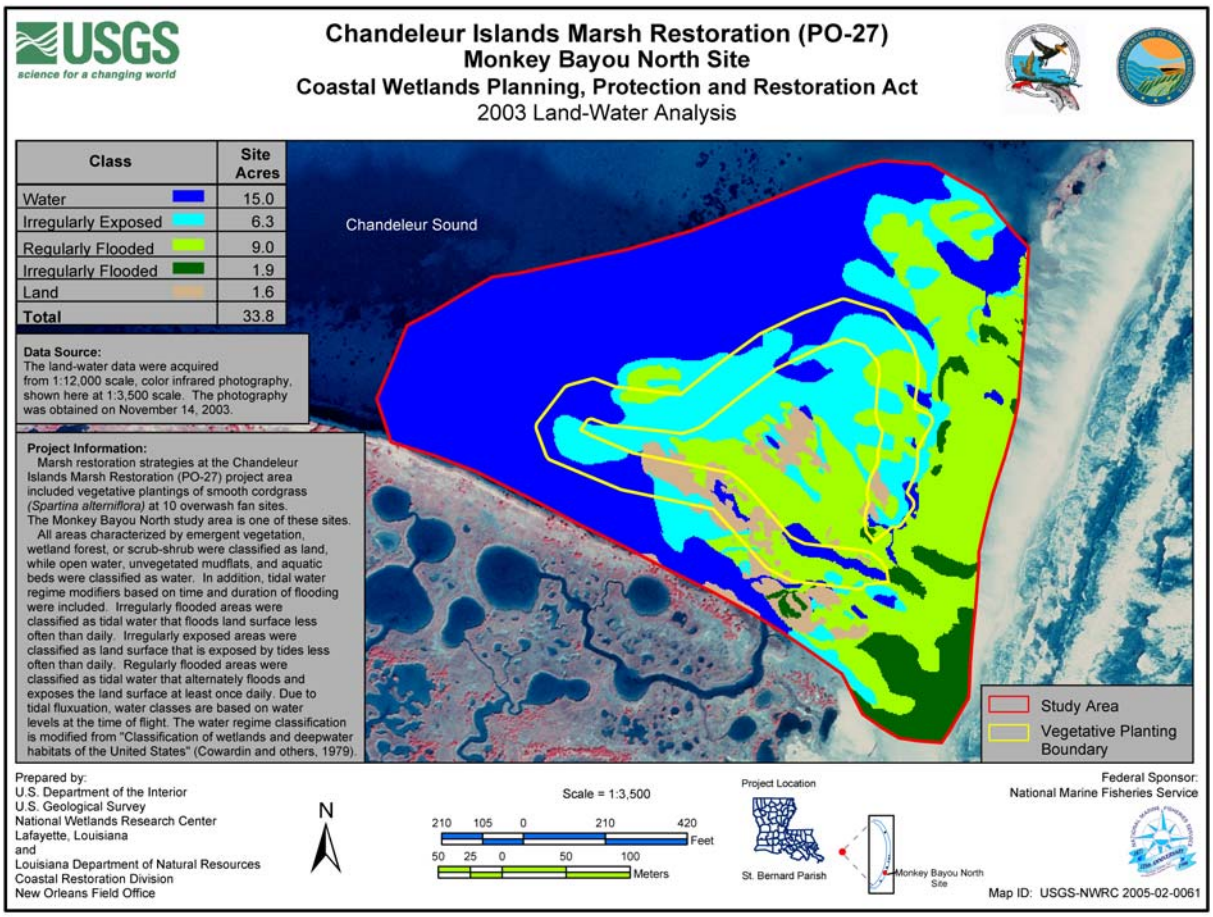

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Renee Site
Coastal Wetlands Planning, Protection and Restoration Act
2005 Land-Water Analysis
Class
Site Acres
Water 91.0
Irregularly Exposed 0.0
Regularly Flooded 0.0
Irregularly Flooded 0.0
Land 0.0
Total 91.0
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Renee study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluctuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were derived from 1:12,000 scale, color infrared photography, shown here at 1:6,000 scale. The photography was obtained on November 2, 2005.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:6,000
500 0 500 1,000 Feet
150 0 150 300 Meters
Project Location
St. Bernard Parish
Renee Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2007-02-0090

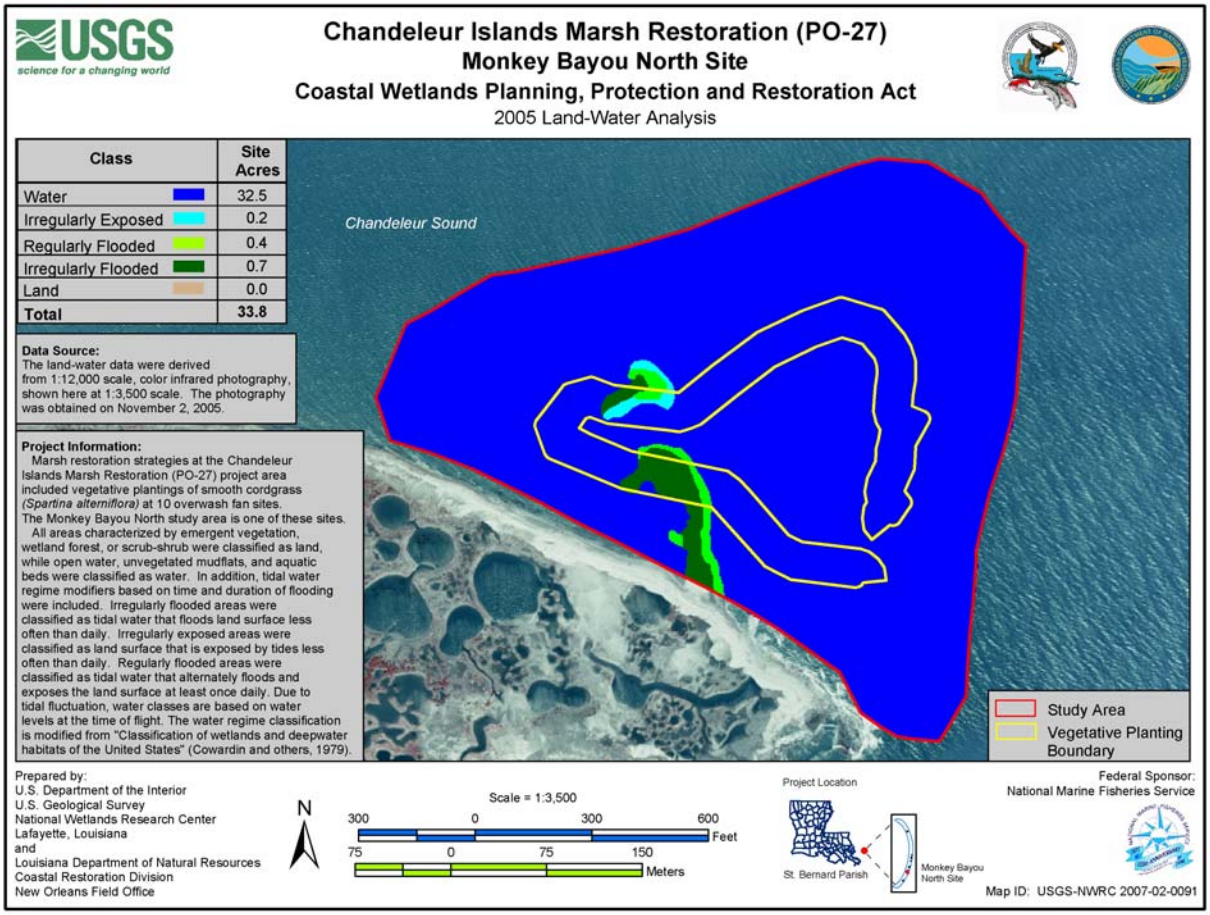

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Spool Site
Coastal Wetlands Planning, Protection and Restoration Act
2000 Land-Water Analysis
Class
Site Acres
Water
32.4
Irregularly Exposed
2.1
Regularly Flooded
83.4
Irregularly Flooded
6.7
Land
1.4
Total
126.0
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Spool study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:7,000 scale. The photography was obtained on November 14, 2000.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:7,000
410 205 0 410 820
Feet
100 50 0 100 200
Meters
Project Location
St. Bernard Parish
Spool Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0034

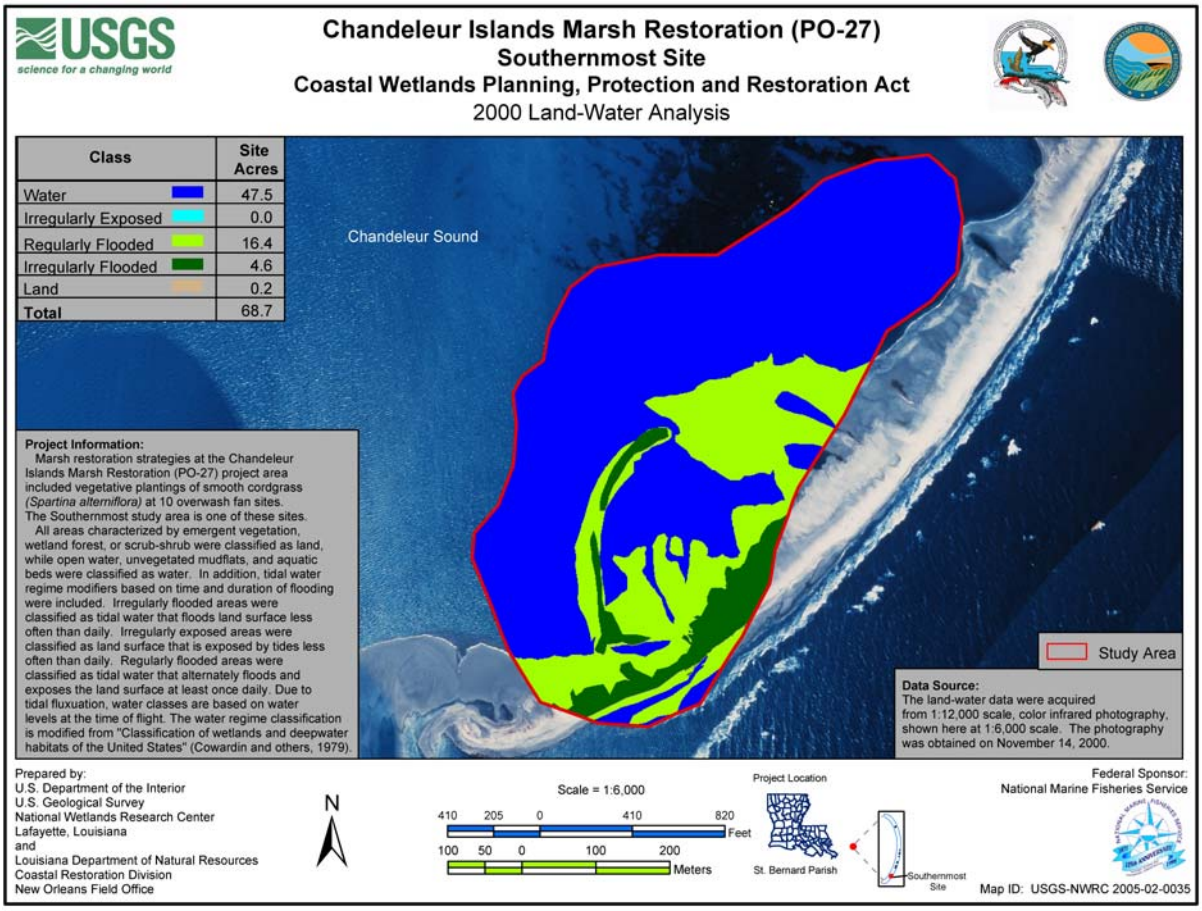

USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Spool Site
Coastal Wetlands Planning, Protection and Restoration Act
2003 Land-Water Analysis
Class
Site Acres
Water
33.6
Irregularly Exposed
48.2
Regularly Flooded
31.0
Irregularly Flooded
11.0
Land
2.2
Total
126.0
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Spool study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:7,000 scale. The photography was obtained on November 14, 2003.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:7,000
410 205 0 410 820 Feet
110 55 0 110 220 Meters
Project Location
St. Bernard Parish
Spool Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0060


USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Spool Site
Coastal Wetlands Planning, Protection and Restoration Act
2005 Land-Water Analysis
Class
Site Acres
Water
122.4
Irregularly Exposed
1.1
Regularly Flooded
1.5
Irregularly Flooded
1.0
Land
0.0
Total
126.0
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Spool study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluctuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were derived from 1:12,000 scale, color infrared photography, shown here at 1:7,000 scale. The photography was obtained on November 2, 2005.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:7,000
500 0 500 1,000 Feet
150 0 150 300 Meters
Project Location
St. Bernard Parish
Spool Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2007-02-0092


USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Monkey Bayou North Site
Coastal Wetlands Planning, Protection and Restoration Act
2000 Land-Water Analysis
Class
Site Acres
Water
15.2
Irregularly Exposed
0.0
Regularly Flooded
16.1
Irregularly Flooded
0.9
Land
1.6
Total
33.8
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:3,500 scale. The photography was obtained on November 14, 2000.
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Monkey Bayou North study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Chandeleur Sound
Study Area
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:3,500
210 105 0 210 420
Feet
50 25 0 50 100
Meters
Project Location
St. Bernard Parish
Monkey Bayou North Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0028


USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Monkey Bayou North Site
Coastal Wetlands Planning, Protection and Restoration Act
2003 Land-Water Analysis
Class
Site Acres
Water 15.0
Irregularly Exposed 6.3
Regularly Flooded 9.0
Irregularly Flooded 1.9
Land 1.6
Total 33.8
Chandeleur Sound
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:3,500 scale. The photography was obtained on November 14, 2003.
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Monkey Bayou North study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:3,500
210 105 0 210 420 Feet
50 25 0 50 100 Meters
Project Location
St. Bernard Parish
Monkey Bayou North Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0061


USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Monkey Bayou North Site
Coastal Wetlands Planning, Protection and Restoration Act
2005 Land-Water Analysis
Class
Site Acres
Water
32.5
Irregularly Exposed
0.2
Regularly Flooded
0.4
Irregularly Flooded
0.7
Land
0.0
Total
33.8
Data Source:
The land-water data were derived from 1:12,000 scale, color infrared photography, shown here at 1:3,500 scale. The photography was obtained on November 2, 2005.
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Monkey Bayou North study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluctuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Chandeleur Sound
Study Area
Vegetative Planting Boundary
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:3,500
300 0 300 600 Feet
75 0 75 150 Meters
Project Location
St. Bernard Parish
Monkey Bayou North Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2007-02-0091


USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Southernmost Site
Coastal Wetlands Planning, Protection and Restoration Act
2000 Land-Water Analysis
Class
Site Acres
Water
47.5
Irregularly Exposed
0.0
Regularly Flooded
16.4
Irregularly Flooded
4.6
Land
0.2
Total
68.7
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Southernmost study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:6,000 scale. The photography was obtained on November 14, 2000.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:6,000
410 205 0 410 820
Feet
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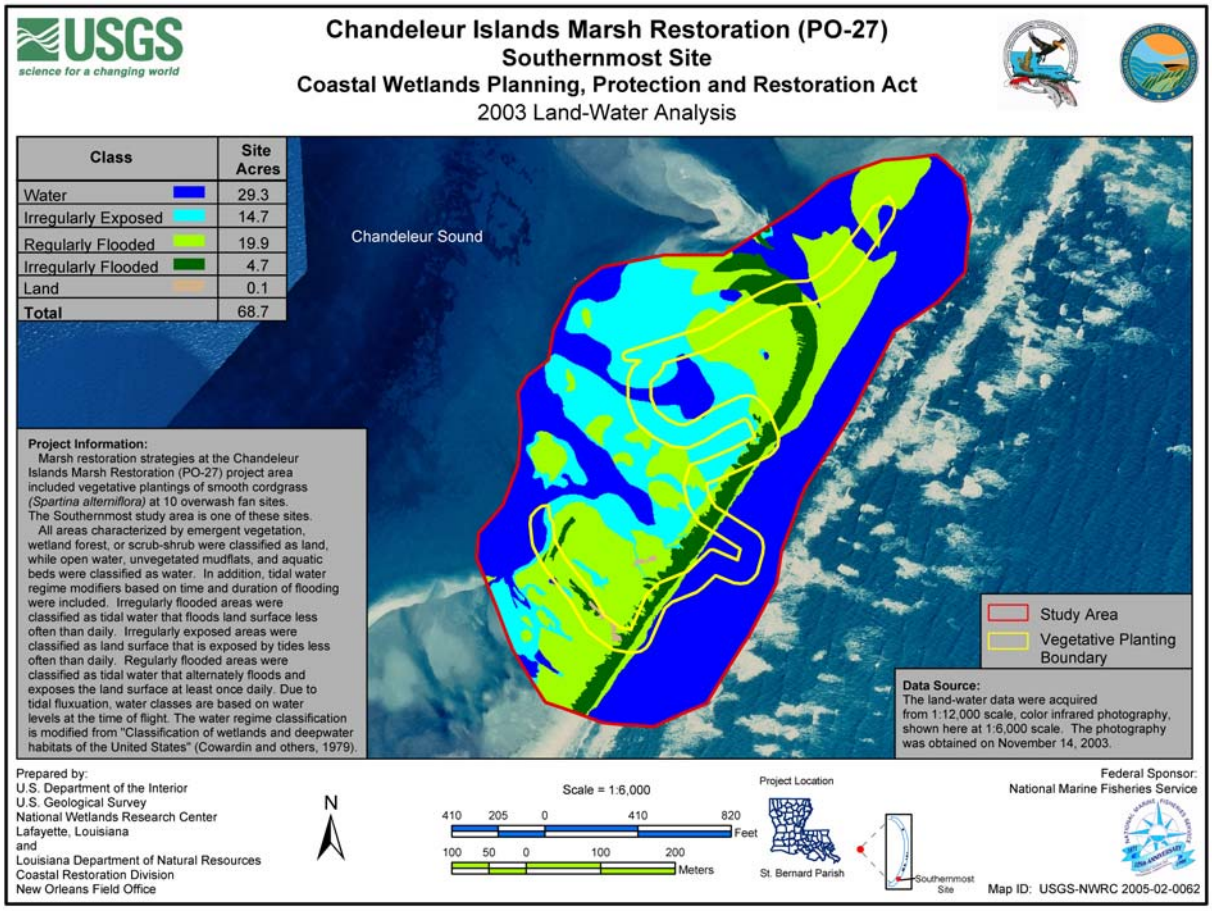
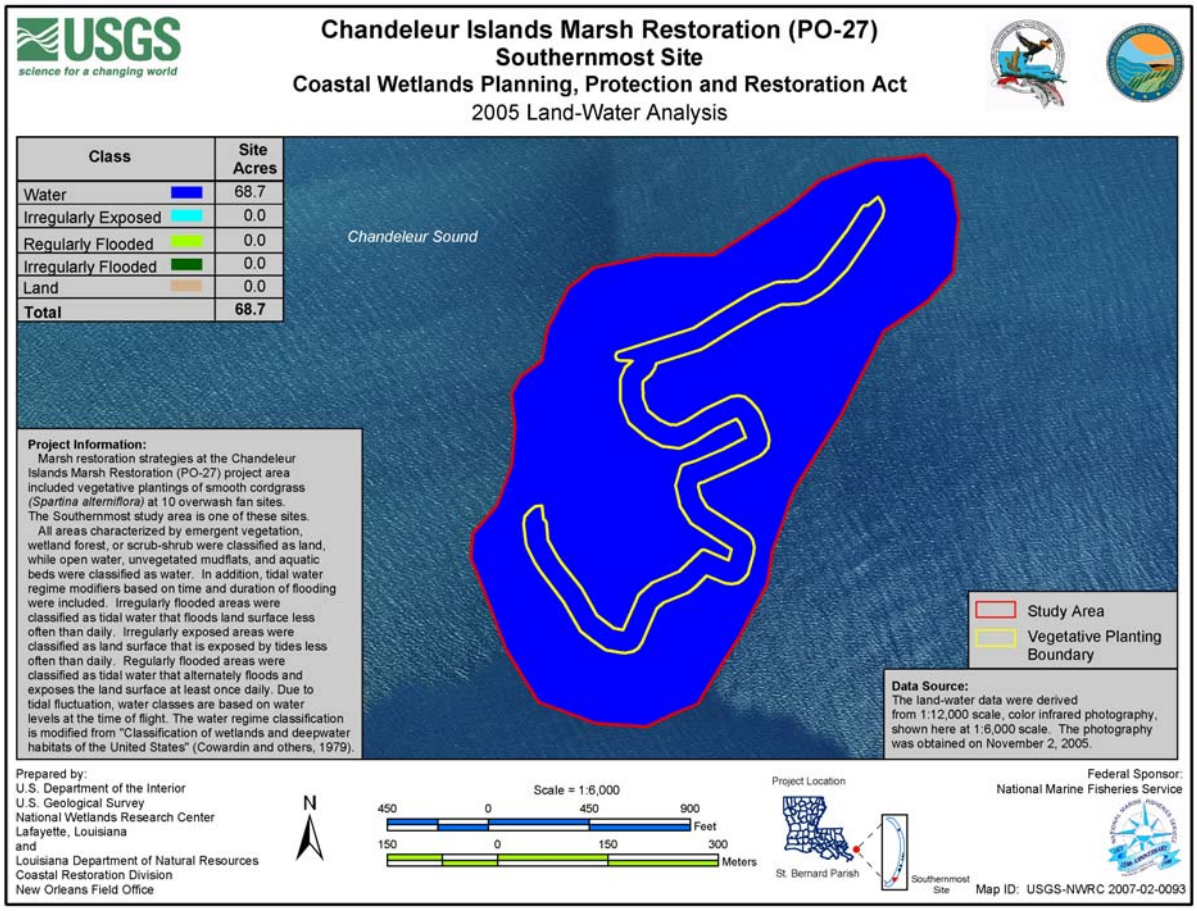
Meters
Project Location
St. Bernard Parish
Southernmost Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0035


USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Southernmost Site
Coastal Wetlands Planning, Protection and Restoration Act
2003 Land-Water Analysis
Class
Site Acres
Water
29.3
Irregularly Exposed
14.7
Regularly Flooded
19.9
Irregularly Flooded
4.7
Land
0.1
Total
68.7
Chandeleur Sound
Project Information:
Marsh restoration strategies at the Chandeleur Islands Marsh Restoration (PO-27) project area included vegetative plantings of smooth cordgrass (Spartina alterniflora) at 10 overwash fan sites. The Southernmost study area is one of these sites.
All areas characterized by emergent vegetation, wetland forest, or scrub-shrub were classified as land, while open water, unvegetated mudflats, and aquatic beds were classified as water. In addition, tidal water regime modifiers based on time and duration of flooding were included. Irregularly flooded areas were classified as tidal water that floods land surface less often than daily. Irregularly exposed areas were classified as land surface that is exposed by tides less often than daily. Regularly flooded areas were classified as tidal water that alternately floods and exposes the land surface at least once daily. Due to tidal fluxuation, water classes are based on water levels at the time of flight. The water regime classification is modified from "Classification of wetlands and deepwater habitats of the United States" (Cowardin and others, 1979).
Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were acquired from 1:12,000 scale, color infrared photography, shown here at 1:6,000 scale. The photography was obtained on November 14, 2003.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:6,000
410 205 0 410 820
Feet
100 50 0 100 200
Meters
Project Location
St. Bernard Parish
Southernmost Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2005-02-0062


USGS
science for a changing world
Chandeleur Islands Marsh Restoration (PO-27)
Southernmost Site
Coastal Wetlands Planning, Protection and Restoration Act
2005 Land-Water Analysis
Class
Site Acres
Water
68.7
Irregularly Exposed
0.0
Regularly Flooded
0.0
Irregularly Flooded
0.0
Land
0.0
Total
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Chandeleur Sound
Project Information:
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Study Area
Vegetative Planting Boundary
Data Source:
The land-water data were derived from 1:12,000 scale, color infrared photography, shown here at 1:6,000 scale. The photography was obtained on November 2, 2005.
Prepared by:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Lafayette, Louisiana
and
Louisiana Department of Natural Resources
Coastal Restoration Division
New Orleans Field Office
N
Scale = 1:6,000
450 0 450 900 Feet
150 0 150 300 Meters
Project Location
St. Bernard Parish
Southernmost Site
Federal Sponsor:
National Marine Fisheries Service
Map ID: USGS-NWRC 2007-02-0093