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

2009 Operations, Maintenance, and Monitoring Report

for

Barataria Barrier Island Complex Project: Pelican Island and Pass La Mer to Chaland Pass Restoration

State Project Number BA-38
Priority Project List 11

July 2009
Plaquemines Parish

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2009 Operations, Maintenance, and Monitoring Report
For
Barataria Barrier Island Complex Project: Pelican Island and Pass La Mer to Chaland Pass Restoration (BA-38) Project

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Preface

The 2009 OM&M Report format is a streamlined approach which combines the Operations and Maintenance annual project inspection information with the Monitoring data and analyses on a project-specific basis. This reporting format for 2009 includes monitoring data collected through December 2008, and annual Maintenance Inspections through June 2009. Monitoring data collected in 2009 and maintenance inspections conducted between July 2009 and June 2010 will be presented in the next OM&M Report.

I. Introduction

The Barataria/Plaquemines barrier shoreline system is about 30 miles long, reaching from Grand Terre Island to Sandy Point, Louisiana. The project is located in two areas within this barrier shoreline system: Pelican Island [BA-38(1)] is located between Fontanelle Pass (Empire Waterway) and Scofield Pass; and the Chaland Headland [BA-38(2)] is located between Pass La Mer and Chaland Pass in Plaquemines Parish, Louisiana (Figure 1). The proposed project was developed as part of the comprehensive Barataria Shoreline Complex Project that was tasked with restoring the entire Barataria island chain.

The Barataria shoreline is an important coastal barrier in protecting the residential communities, infrastructure and interior marshes of Barataria bay. This barrier shoreline provides unique habitat for coastal fisheries and wildlife and helps protect natural and human resources from tidal inundation, storm surge and wave action. Due to repeated storm events, a diminishing sediment supply, and high rates of subsidence, Louisiana's barrier shorelines are the fastest eroding shorelines in the nation. In some locations, erosion of the Louisiana barrier islands exceeds 65 ft/yr (Penland and Boyd 1981).

The Louisiana deltaic plain is fronted by a series of headlands and barrier islands that were formed as a result of the Mississippi River deltaic cycle. Following deltaic abandonment marine processes, such as lateral sediment movement, rework and redistribute the seaward edges of the plain forming barrier beaches and headlands (Kindinger et al. 2001). Submergence of the abandoned delta separates the headland from the shoreline forming a barrier island arc. Models developed by Penland et al. (1988) illustrate that Louisiana's barrier islands gradually narrow, fragment and transgress through time eventually becoming subaqueous shoals. The Barataria chain of barrier islands, like all of Louisiana's barrier islands, are experiencing island narrowing and land loss as a consequence of a complex interaction among global sea level rise, compactual subsidence, wave and storm processes, inadequate sediment supply, and intense human disturbance (Penland et al. 1988; McBride et al. 1989).

The average shoreline loss rate for the Plaquemines barrier shoreline has been 5.5 m/yr (18 ft/yr) for the period 1884 to 1988 (McBride et al. 1992), with average retreat rates of 3.35 m/yr and 3 m/yr (11 ft/yr and 10 ft/yr) respectively, for the Chaland headland and Pelican island areas from 1988 - 2000 (CPE 2003).

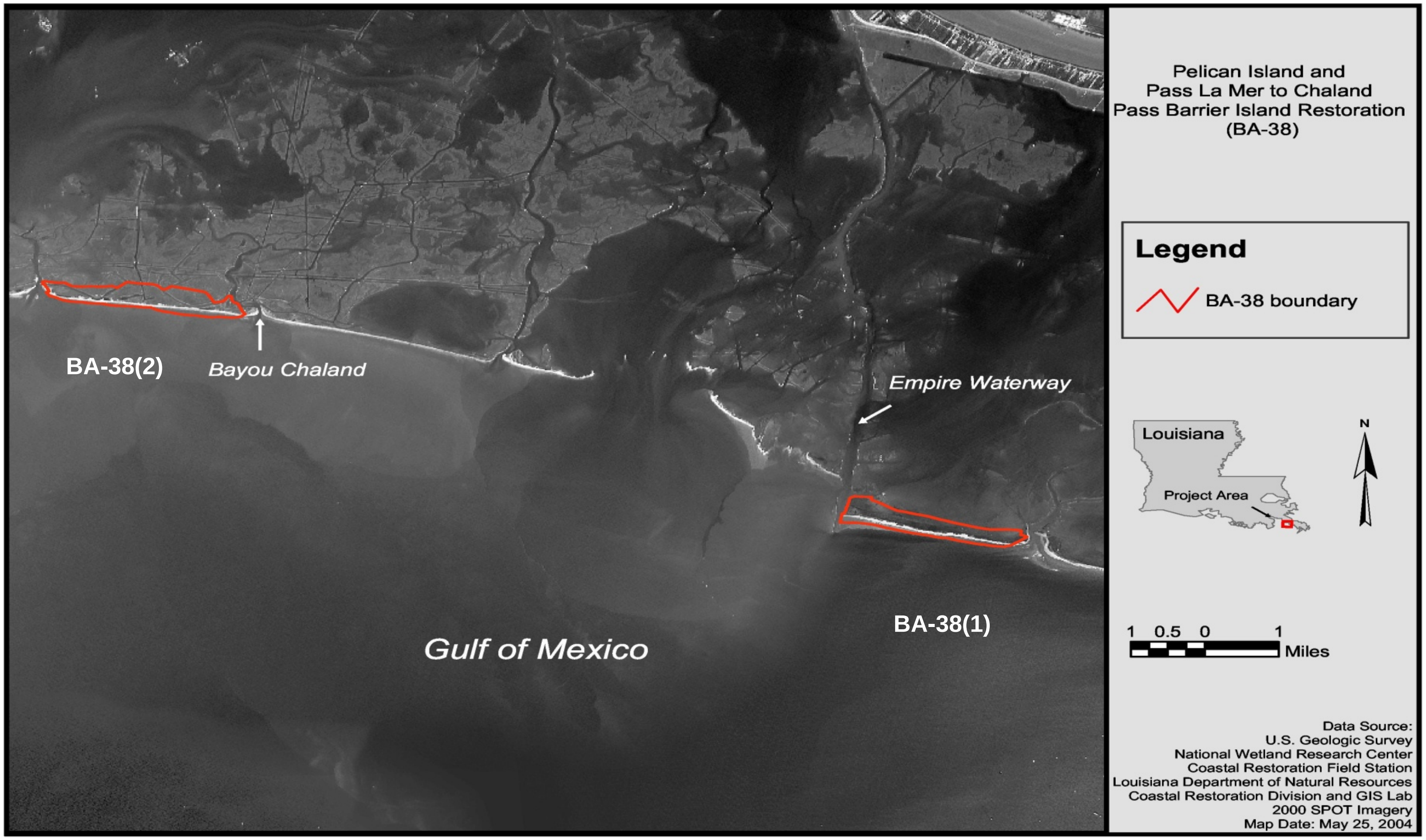


Figure 1. Location of the Pelican Island [BA-38(1)] and Pass La Mer to Chaland Pass [BA-38(2)] Barrier Island restoration project.

Barrier island restoration includes increasing beach/dune cross-sections and the improvement of the bayside marsh platform. The enhancement of the beach and dune will provide increased protection from storm-related surge and wave attack, through the prevention of island breaching or loss of major portions of the islands. Restoration of the marsh platform behind the barrier islands will reinforce the long-term stability of the island system and provide an opportunity to capture placed sediments displaced by storm events. Prevention of island breaching (inlet cutting) and limitations on overtopping (washover) during storms are the primary mechanisms by which the project will provide storm protection (CPE 2003).

Construction of the Pass La Mer to Chaland Pass Restoration Project [BA-38(2)] was completed in January, 2007. At this time construction has not begun on the Pelican Island Restoration Project [BA-38(1)].

The Chaland Headland Restoration [BA-38(2)] CWPPRA Project consisted of the placement of marsh fill, beach and dune fill, and primary dikes. The constructed beach and dune elevations on Chaland Headland are +4 and +6 feet NAVD respectively, and the marsh platform elevation is +2.5 feet NAVD. Table 2 shows predicted changes to the beach and marsh platform components of the island at target years. Dredging of an access channel and closure of an island breach and existing canals was included within the project construction plan. Approximately 29,000 ft of sand fencing was erected concurrent with construction in shore parallel rows with staggered gaps. Planting of the dune and marsh platforms was completed during construction and included the following species: Sea Oats (*Uniola paniculata*), Bitter Panicum (*Panicum amarum*), Marshhay Cordgrass (*Spartina patens*), and Smooth Cordgrass (*Spartina alterniflora*).

Table 2. Projected acreage, by elevation class, at target years for the Chaland Headland Restoration Project.

NAVD ft Elevation	Acres at elevation within project area at year...				
	1	**3**	**5**	**10**	**20**
>+ 5.0’	111	90	70	42	0
+2’ to +5’	276	90	89	90	82
Marsh	65	246	244	230	217

II. Maintenance Activity

a. Project Feature Inspection Procedures

An inspection of the Chaland Headland Project [BA-38(2)] was held on September 25, 2008, by representatives of the OCPR Barry Richard and Brady Carter, and Rachel Sweany representing National Marine Fisheries Service (NMFS). This inspection was prompted by the coastal Louisiana landfall of Hurricanes Gustav and Ike (Richard 2008).

b. Inspection Results

Sand Fence

All of the sand fencing was destroyed by the storms.

Containment Dike

The containment dike was not degraded upon demobilization from the construction site. Since demobilization the dike has been slowly degrading due to natural processes. In May 2008, members of the OCPR and NMFS hydraulically cut 4 gaps into the containment dike using a high pressure pump, restoring the back-barrier marsh's hydrologic connection with the surrounding area. At the time of the inspection these gaps were larger and allowing water to exchange between the back-barrier marsh of the project area and the outer marshes and canals.

Settlement Plates

One settlement plate was turned on its side during the storms. The other six were undamaged.

Vegetative Plantings

Approximately 90% of the vegetative plantings were damaged due to the storms.

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

The Chaland Headland Project area was damaged significantly during the 2008 hurricane season. The sand fencing will require replacement as well as the vegetative plantings because most of those were displaced. The remaining settlement plates will continue to be surveyed as scheduled while the damaged plate will be removed. A majority of the beach material is now located within the marsh template and some can be found farther north of the project area. The project will continue to be monitored for any changes and the required maintenance work should be performed in a timely manner.

ii. Programmatic/Routine Repairs

It is the recommendation of the OCPR/NOFO that the sand fencing and vegetative plantings be replaced as necessary.

III. Operation Activity

a. Operation Plan

This project has no structure to operate, thus no operation plan.

IV. Monitoring Activity

This is a comprehensive report and includes all data collected from the pre-construction period and the post-construction period through December 2008.

a. Monitoring Goals

1. Increase the elevation and width of the Chaland Headland using dredged sediments.
2. Reduce the loss of dredged sediments through the growth of vegetation and construction of sand fences.

b. Monitoring Elements

To more effectively identify the magnitude, rates, and processes of shoreline change a Barrier Island Comprehensive Monitoring program (BICM) has been developed by the Office of Coastal Protection and Restoration (OCPR) as a framework for a coast-wide monitoring effort (Troutman et al. 2003). A significant component of this effort includes documenting the historically dynamic morphology of the Louisiana nearshore, shoreline, and backshore zones. The advantage of BICM over current project-specific monitoring efforts is that it will provide long-term morphological datasets on all of Louisiana's barrier islands and shorelines, rather than just those islands and areas that are slated for coastal engineering projects or have had construction previously completed. BICM provides a larger proportion of unified, long-term datasets that will be available to monitor constructed projects, plan and design future barrier island projects, develop operation and maintenance activities, and assess the range of impacts created by past and future tropical storms.

Data for BICM tasks are collected and compiled for all of the barrier island systems and shorelines with similar approaches and methodologies. The project specific monitoring for the BA-38 project follows procedures used to collect the BICM data. BICM data along with project specific data will be used in conjunction to help determine project effectiveness.

Topographic/Bathymetric Survey

Topographic and bathymetric surveys were employed to document elevation and volume changes inside the Chaland Headland [BA-38(2)] project fill area. Preconstruction (09/2002 and 05/2006), as-built (12/2006), and year 1 post-construction (04/2009) elevation data were collected using traditional cross sectional survey methods. The post-construction survey utilized the same cross-shore profile lines as the pre-construction surveys, however, only every third line was surveyed during post-construction due to budget constraints. All survey data were referenced to the Louisiana Coastal Zone (LCZ) GPS Network using the North American Vertical Datum (NAVD) of 1988. This network of secondary monuments was created and is maintained by the OCPR.

Aerial Photography/Habitat Classification

Habitat mapping has been determined for Chaland Headland for 1998, 2002, 2004, and 2005 through the BICM program. The goal of BICM's habitat change analysis is to classify and compare the habitat types present along Louisiana's sandy shorelines for the four time periods.

The habitat mapping was completed by the University of New Orleans-Pontchartrain Institute for Environmental Sciences (UNO-PIES) under contract by OCPR.

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

Sediment Properties/Geotechnical

Grab samples were collected along 5 cross-shore transects at 7 locations: (1) back-barrier marsh, (2) dune, (3) berm, (4) mean low water, (5) depth approximately one third of depth of closure, (6) depth approximately two thirds of depth of closure, and (7) depth of closure. The long-shore spacing of sediment transects is 3,000 feet and matches the spacing of (every other) beach profile survey line. Samples were collected but analysis was delayed due to contract delays. The samples will be analyzed for sediment grain size, sorting, percent sand and fines, organic matter content and bulk density, and will be presented in the next report.

Vegetation

The vegetation planted on the Chaland Headland was completely destroyed by Hurricane's Gustav and Ike prior to the scheduled sampling in 2008. Due to the absence of planted vegetation on the island, sampling was postponed until it is reestablished.

To determine plant species composition and diversity in major habitats on the barrier islands, the line-intercept method (Canfield 1941) will be used to survey vegetation along cross-shore transects spaced 6,000 feet apart. Vegetation will be sampled during the period from September 1^{st} and November 1^{st}. The objective of vegetation sampling is to characterize vegetation communities on the islands as a whole as well as determine the impacts of plantings on community development over time. These data will compliment the larger-scale habitat analyses conducted through aerial photography, and the relationships between vegetation, elevation, and sediment data will be determined.

IV. Monitoring Activity (continued)

c. Preliminary Monitoring Results and Discussion

Topographic/Bathymetric Survey

The Chaland Headland [BA-38(2)] project has experienced reductions in volume and shoreline erosion since construction was completed in 2006. Volumetric changes for the BA-38-2 fill area are presented in Table 3. Elevation changes by profile line for September 2002, May 2006, December 2006, and April 2009 are provided in Appendix A. Approximately, 2,483,649 yd^3 of sediment were deposited during construction in 2006. The total sediment volume loss in the fill area from 2006 to 2009 was approximately 1,416,102 yd^3, a 57% reduction in volume.

Table 3. Volumetric changes calculated from beach survey profiles for the Chaland Headland project [BA-38(2)].

Station From	To	May-06 Dec-06	Dec-06 Apr-09
14+68	29+20	309,120	-242,271
29+20	43+72	387,141	-219,458
43+72	58+23	399,305	-166,150
58+23	72+75	349,065	-137,991
72+75	87+28	354,418	-111,948
87+28	101+80	332,709	-119,656
101+80	116+32	343,365	-182,543
116+32	130+84	186,390	-146,450
130+84	145+35	106,725	-89,634
		2,768,238	**-1,416,102**

Storm and longshore transport induced shoreline erosion appear to be major factors in producing this large volume change in the fill area. Hurricanes Gustav and Ike (September 2008) likely caused the majority of loss in the project area. Although the volume in the fill area has decreased considerably, portions of the sand and sediment resources were conserved outside the project fill area. The overwash on the western side of the island was captured in the shallow pond immediately north of the project area. The post-construction survey profile was extended on the three western most lines to document elevations on these overwash sands; with some extending the back barrier by 1000' or more (Appendix A). The western end shows the highest rate of annual volume change for the fill area (figure 2).

Shoreline position was determined from the surveys conducted pre-, during, and post-construction. The average shoreline change along the whole island during the post-construction period was -197 ft. However, the current shoreline position is still greater, i.e. further gulf-ward, than that of pre-construction conditions (Table 4). The pre-construction change (Sep 02 – May 06) is associated with the passing of Hurricanes Katrina and Rita; and although less (-182 ft) than that of the post-construction change, there was much less shoreline to erode before the project was built.

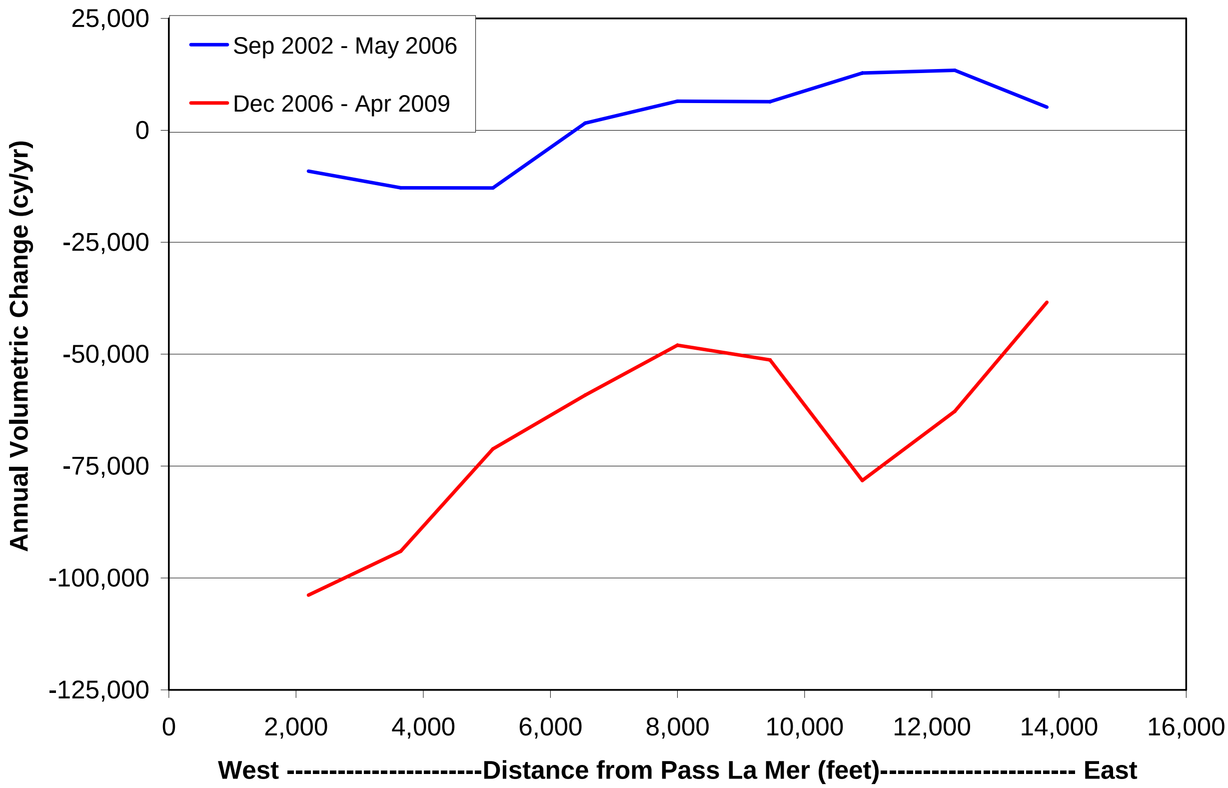


Figure 2. Average annual volumetric change determined from topographic/bathymetric surveys for the Chaland Headland project [BA-38(2)].

Table 4. Summary of shoreline change for Chaland Headland project [BA-38(2)] for 2002, 2006, and 2009.

Station	Shoreline Location Sep-02	May-06	Dec-06	Apr-09	Total Shoreline Change (ft) Sep-02 May-06	May-06 Dec-06	Dec-06 Apr-09
14+68	135	-351	455	62	-486	805	-393
29+20	249	-23	361	131	-271	383	-230
43+72	263		332	173			-158
58+23	227	-2	331	173	-229	333	-157
72+75	223	108	289	245	-115	180	-44
87+28	239	109	332	230	-130	223	-102
101+80	248	133	446	309	-115	313	-137
116+32	283	140	693	283	-143	553	-409
130+84	309	232	669	318	-77	437	-351
145+35	420	350	413	420	-70	63	7
				Average	**-182**	**366**	**-197**

Aerial Photography/Habitat Classification

The BICM program funded habitat classification and change analysis for four (4) years of photography (1998, 2000, 2004, and 2005). This analysis was for the Chaland Headland, not specific to the BA-38-2 project boundary. The boundary used for the BICM analyses starts at Four Bayou Pass and goes east to the western edge of Bay Joe Wise; the Northern boundary extends approximately 1 mile inland, see Appendix B. The habitat classes used for classification included: water, intertidal flat, marsh, barrier vegetation, bare land, beach, rip rap, and structure. Table 5 summarizes the acres of each habitat class for each time period.

Table 5. BICM Habitat Change Analysis: Chaland Headland Classification in acres – 1998, 2002, 2004, 2005.

Habitat Classes	1998	2002	2004	2005
Water	4800	4526	5197	4883
Intertidal Flat	394	761	72	370
Marsh	1616	1498	1561	1499
Barrier Vegetation	21	32	10	39
Bare Land	12	21	1	6
Beach	110	96	84	138
Rip Rap	0	0	0	0
Structure	0	1	2	0

Figures illustrating the habitat change classification for 1998 to 2002, 2002 to 2004, 2004 to 2005, and 1998 to 2005 are presented in Appendix B. Data from these figures were combined and are presented in table format within Appendix B. Project construction was completed in December of 2006 and therefore the affects of the restoration are not apparent in these analyses. Habitat mapping has not been conducted on any photography after 2005; consequently, there are no supporting data sets for the impacts of the 2008 hurricanes.

V. Conclusions

a. Project Effectiveness

One goal of the project was to increase the elevation and width of the Chaland Headland using dredged sediments. This goal was accomplished when project construction was completed in late 2006. Since construction, the island has experienced two major tropical systems which have accelerated erosion of the sediment. The total sediment volume loss in the project area in the 2 years since construction was approximately 1,416,102 yd^3, a 57% reduction in volume. Although the volume of the fill area has decreased considerably, portions of the sand resources were conserved outside the fill area. The back barrier marsh captured some of the overwash sand with the areas containing natural vegetation capturing the most. A shallow pond on the western end bordering the project also captured overwash sands creating subaerial land adjacent to the project. Although the entire island was overwashed, no breaches were observed.

The second goal of the project was to reduce the loss of dredged sediments through the growth of vegetation and construction of sand fences. All constructed sand fences and the majority of planted vegetation were removed by Hurricanes Gustav and Ike. Field observations prior to the hurricanes showed accumulation of sand around the fences and some of the vegetation. However, the storms destroyed these project features before the scheduled monitoring was to be completed.

b. Recommended Improvements

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

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

c. Lessons Learned

Barrier islands are often exposed to storm events resulting in substantial over-wash and breaching. It is important that a continuous dune of sufficient height and width is maintained on these islands to combat these processes. Sediment fencing has proven to be an effective technique in rebuilding dunes by capturing wind blown sediment and is less costly than periodically replenishing sediment by hydraulic dredge. We have learned from past projects that orienting the sediment fencing parallel to the shore face and perpendicular to the predominant wind direction has maximized the potential for maintaining a viable dune section. However, strong storms can completely remove sand fencing if they have not had a chance to become well established. This is also true of vegetative plantings, which work well when sufficiently established but are vulnerable prior to significant vegetative coverage on the dune. A sufficient back-barrier marsh platform plays an important role in capturing and retaining sediment once fencing and beach plantings are compromised during storms. Shallow bays located adjacent to the back-barrier marsh can perform similar sediment retaining functions; as was seen on the western end of the island where sub-aerial land was formed from sand displaced from the beach and dune.

VI. Literature Cited

Canfield, R. 1941. Application of the line interception method in sampling range vegetation. Journal of Forestry. 39:388-394.

Coastal Planning and Engineering Incorporated. 2003. Barataria/Plaquemines Barrier Shoreline Restoration Project Geotechnical Investigation and Analysis. State/Federal Project No. BA-38. 52 pp. plus appendices.

Fearnley, S., l. Brien, L. Martinez, M. Miner, M. Kulp, S. Penland. 2009. Louisiana Barrier Island Comprehensive Monitoring Program (BICM) Vol 5: Chenier Plain, South Central Louisiana, and Chandeleur Islands, Habitat Mapping and Change Analysis 1996 to 2005 Part 2: Habitat, Habitat Change, Land Loss, and Mosaic Maps – part 2 of 4. Prepared for the LA Dept. Natural Resources, Coastal Restoration Div. by the Univ. of New Orleans – PIES, New Orleans, LA. 296 pp.

Kindinger, J., J. Flocks, M. Kulp, S. Penland, and L. Britsch. 2001. Sand Resources, Regional Geology, and Coastal Processes for the Restoration of the Barataria Barrier Shoreline. Report to the U.S. Army Corps of Engineers, New Orleans District, September 2001. *US Geological Survey Open File Report 01-384.*

McBride, R.A., S. Penland, B.E. Jaffe, S.J. Williams, A.H. Sallenger, and K.A. Westphal. 1989. Erosion and deterioration of the Isles Dernieres barrier island arc-Louisiana, U.S.A: 1853-1988. Transactions of the Gulf Coast Association of Geological Societies 39: 431-444.

McBride, R.A., S. Penland, M.W. Hiland, S.J. Williams, K.A. Westphal, B.E. Jaffe, and A.H. Sallenger, Jr. 1992. Analysis of barrier island shoreline change in Louisiana from 1853 to 1989. In: Williams, S.J., S. Penland, and A.H. Sallenger, Jr. (eds), Atlas of shoreline changes in Louisiana from 1853 to 1989. U.S. Geological Survey Miscellaneous Investigations Series I-2150-A.

Penland, S. and R. Boyd. 1981. Shoreline Changes on the Louisiana Barrier Coast. *Proceedings of an International Symposium, Oceans '81*, New York, IEEE, p.210.

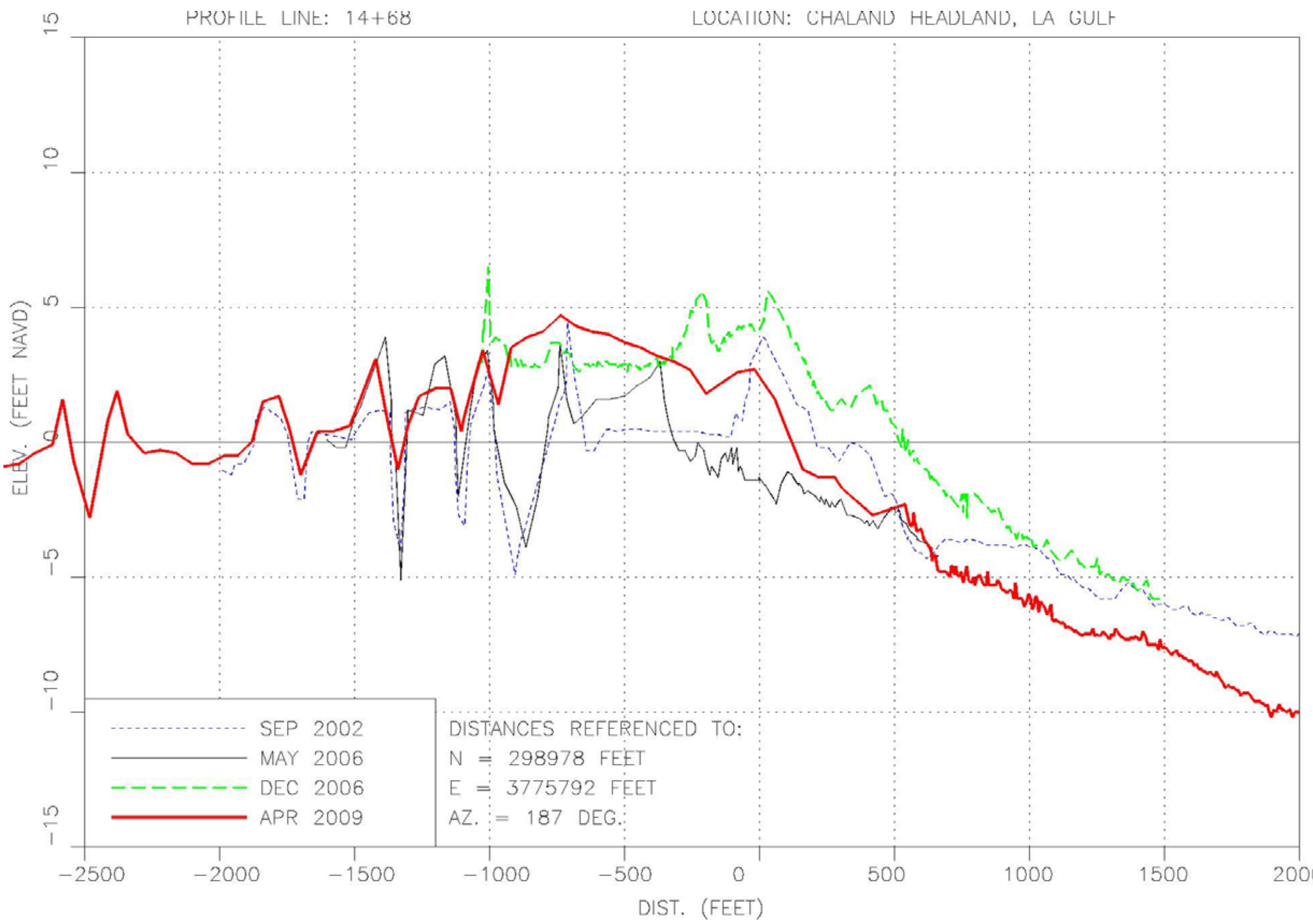
Penland, S., R. Boyd, and J.R. Suter. 1988. A transgressive depositional systems of the Mississippi River delta plain: A model for barrier island shoreline and shelf sand development. Journal of Sedimentary Petrology 58:932-949.

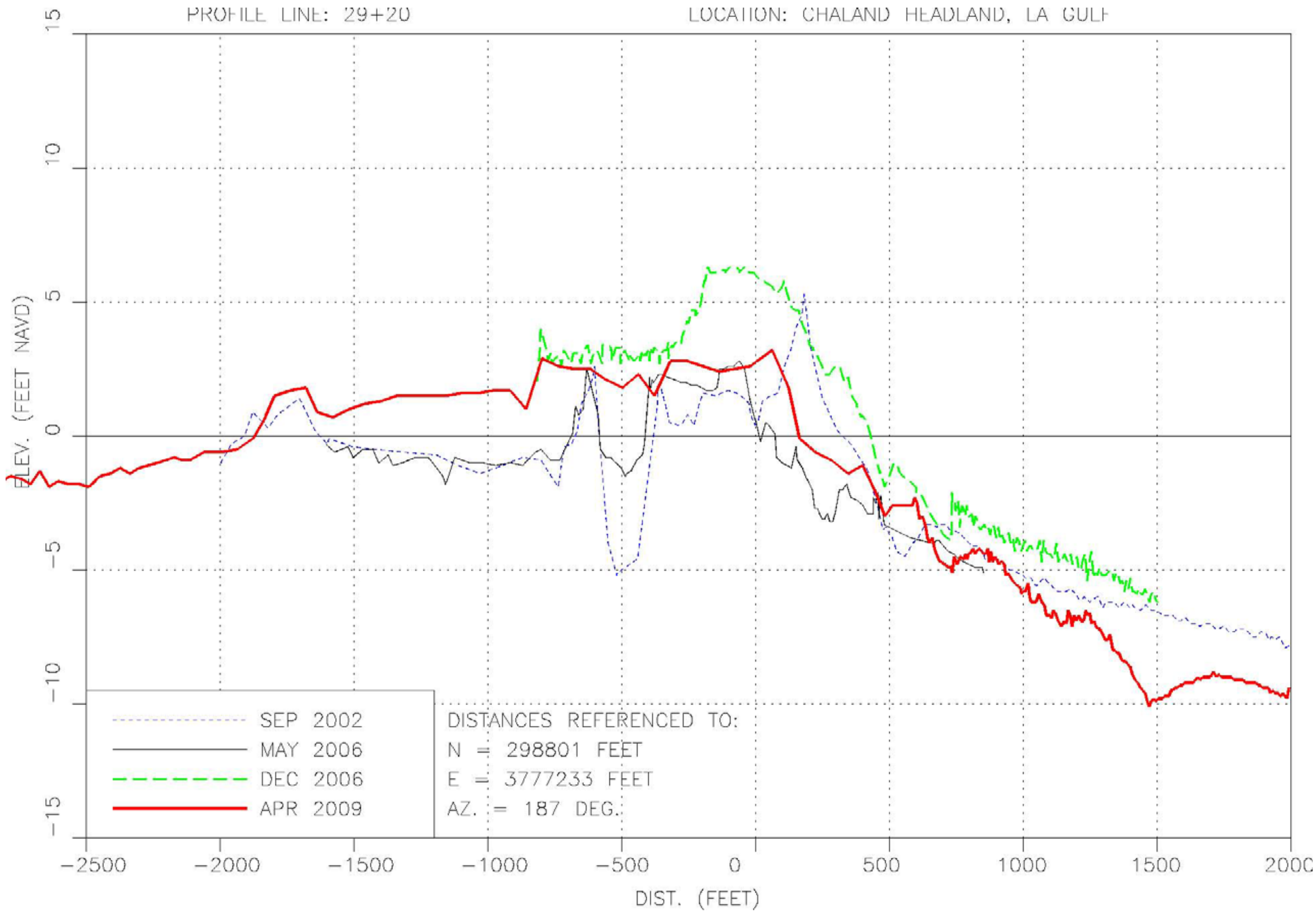
Richard, B. 2009. 2008 Annual Inspection Report for Barataria Barrier Island Complex Project: Pelican Island and Pass La Mer to Chaland Pass Restoration. Coastal Protection and Restoration Authority of Louisiana, Office of Coastal Protection and Restoration. 19pp.

Troutman, J.P., D.M. Lee, S. Khalil, B.S. Carter, K.S. Gray, and L.A. Reynolds. 2003. Draft Barrier Island Comprehensive Monitoring Program. Louisiana Department of Natural Resources Coastal Restoration Division Biological Monitoring Section.

Appendix A

Survey Profiles
(Starting on western end)


PROFILE LINE: 14+68
LOCATION: CHALAND HEADLAND, LA GULF
ELEV. (FEET NAVD)
DIST. (FEET)
SEP 2002
MAY 2006
DEC 2006
APR 2009
DISTANCES REFERENCED TO:
N = 298978 FEET
E = 3775792 FEET
AZ. = 187 DEG.



PROFILE LINE: 29+20
LOCATION: CHALAND HEADLAND, LA GULF
ELEV. (FEET NAVD)
15
10
5
0
−5
−10
−15
−2500
−2000
−1500
−1000
−500
0
500
1000
1500
2000
DIST. (FEET)
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MAY 2006
DEC 2006
APR 2009
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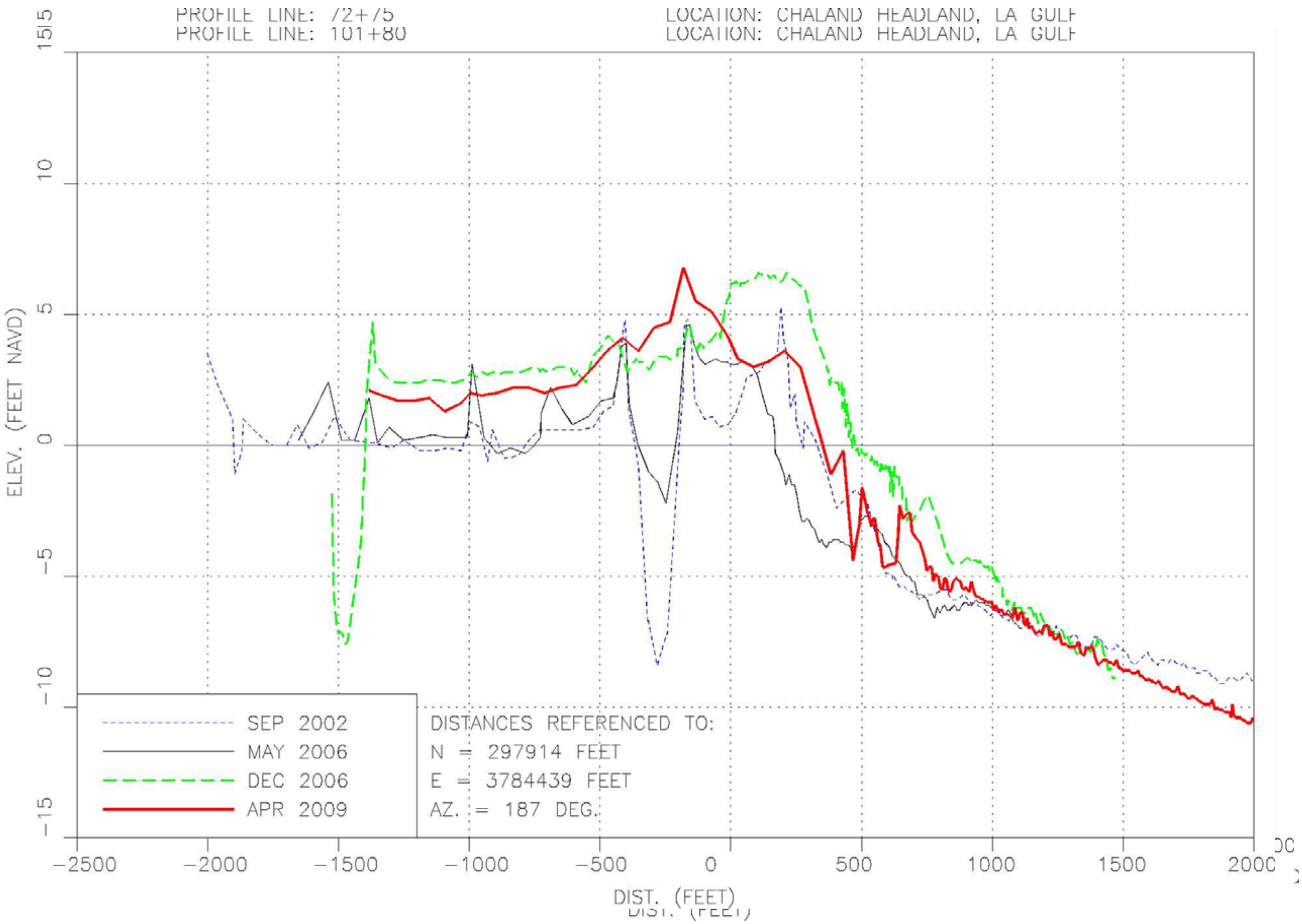
AZ. = 187 DEG.



PROFILE LINE: 72+75
PROFILE LINE: 101+80
LOCATION: CHALAND HEADLAND, LA GULF
LOCATION: CHALAND HEADLAND, LA GULF
ELEV. (FEET NAVD)
DIST. (FEET)
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MAY 2006
DEC 2006
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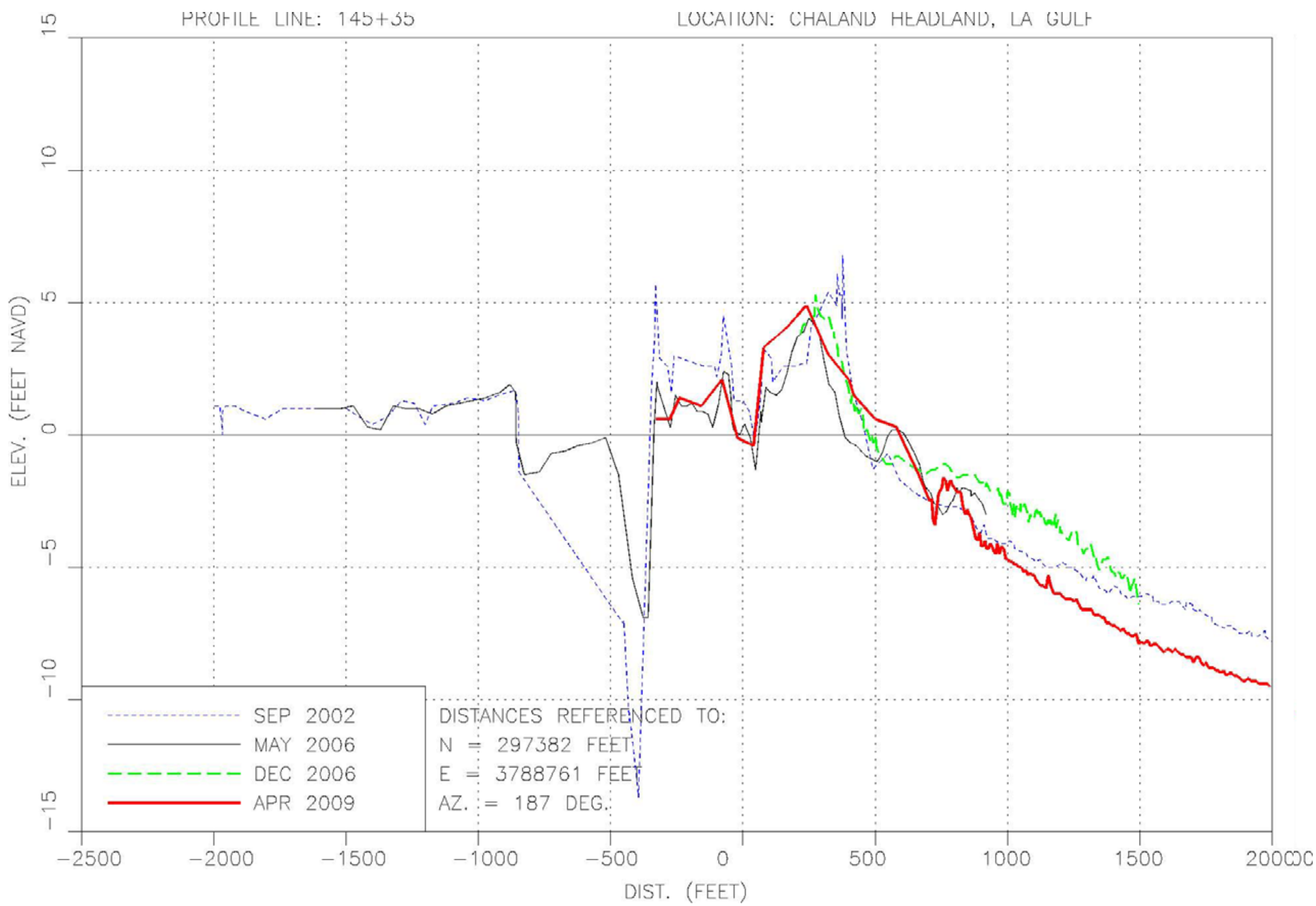

PROFILE LINE: 145+35
LOCATION: CHALAND HEADLAND, LA GULF
ELEV. (FEET NAVD)
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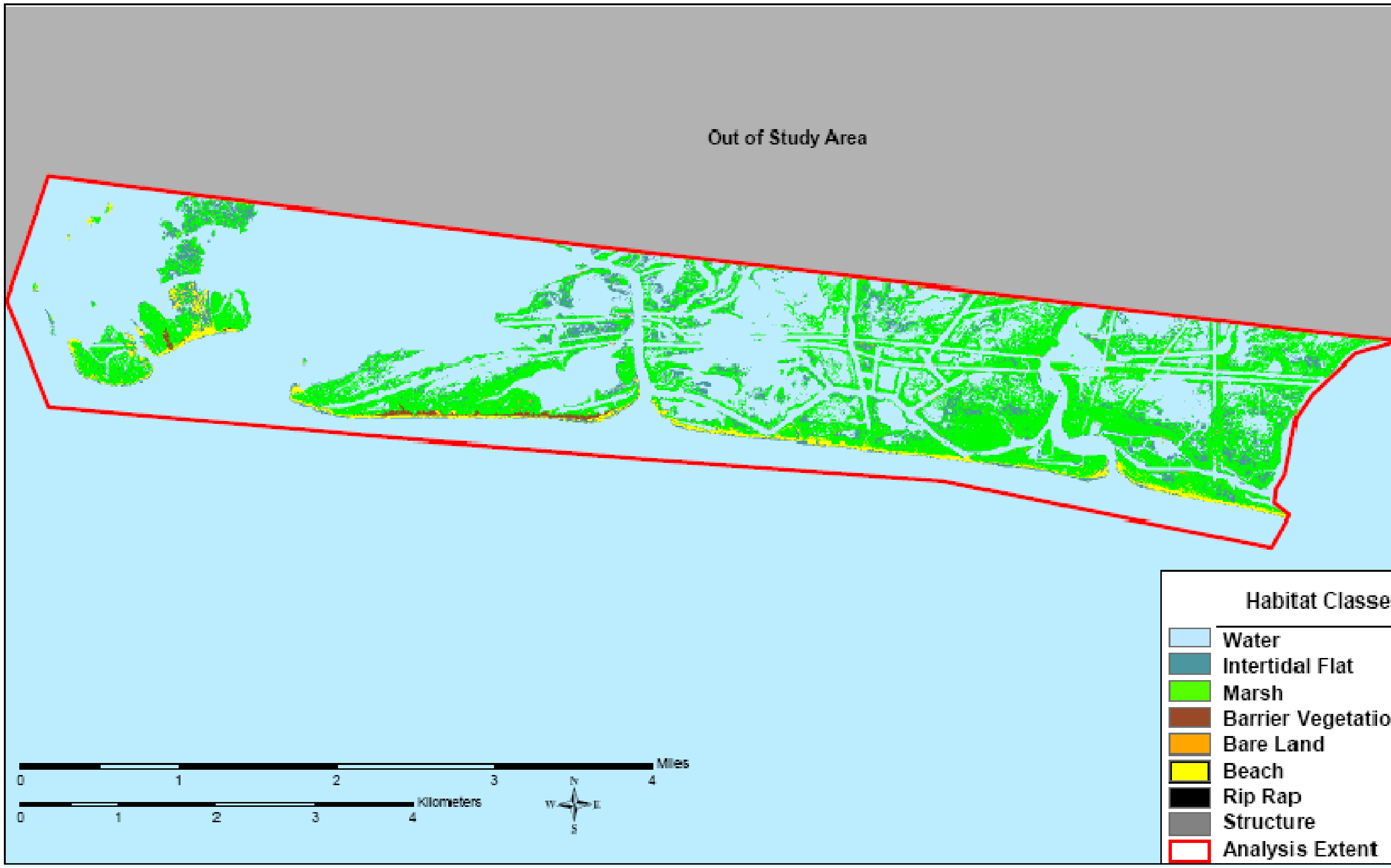
10
5
0
-5
-10
-15
SEP 2002
MAY 2006
DEC 2006
APR 2009
DISTANCES REFERENCED TO:
N = 297382 FEET
E = 3788761 FEET
AZ. = 187 DEG.
-2500
-2000
-1500
-1000
-500
0
500
1000
1500
2000
DIST. (FEET)

Appendix B

Habitat Analysis Maps

BICM Habitat Analysis: Chaland Headland, Modern delta - 1998

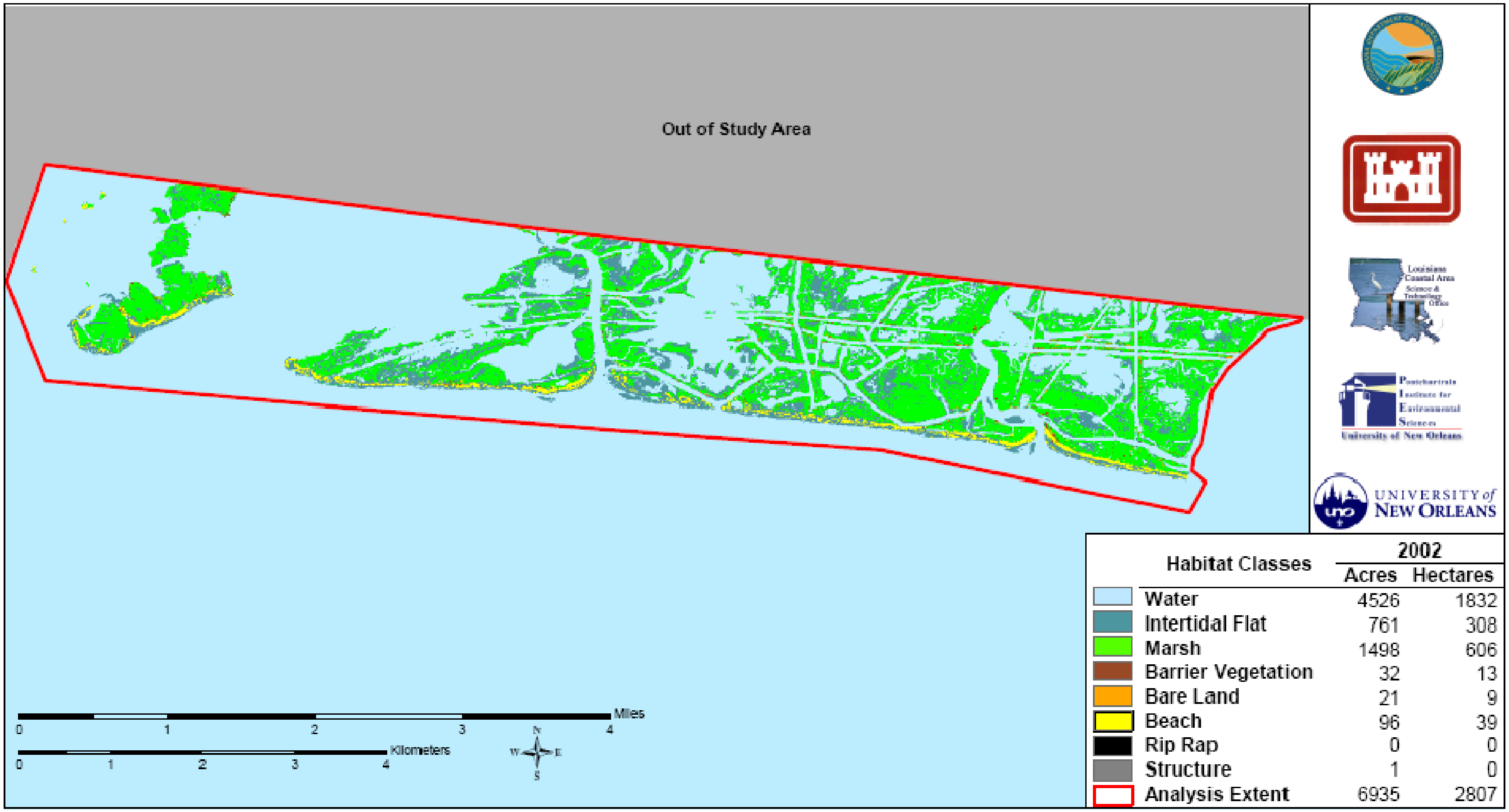


Habitat Classes	1998 Acres	1998 Hectares
Water	4800	1942
Intertidal Flat	394	159
Marsh	1616	654
Barrier Vegetation	21	9
Bare Land	12	5
Beach	110	44
Rip Rap	0	0
Structure	0	0
Analysis Extent	6953	2814

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

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

BICM Habitat Analysis: Chaland Headland, Modern delta - 2002



Habitat Classes	2002 Acres	2002 Hectares
Water	4526	1832
Intertidal Flat	761	308
Marsh	1498	606
Barrier Vegetation	32	13
Bare Land	21	9
Beach	96	39
Rip Rap	0	0
Structure	1	0
Analysis Extent	6935	2807

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

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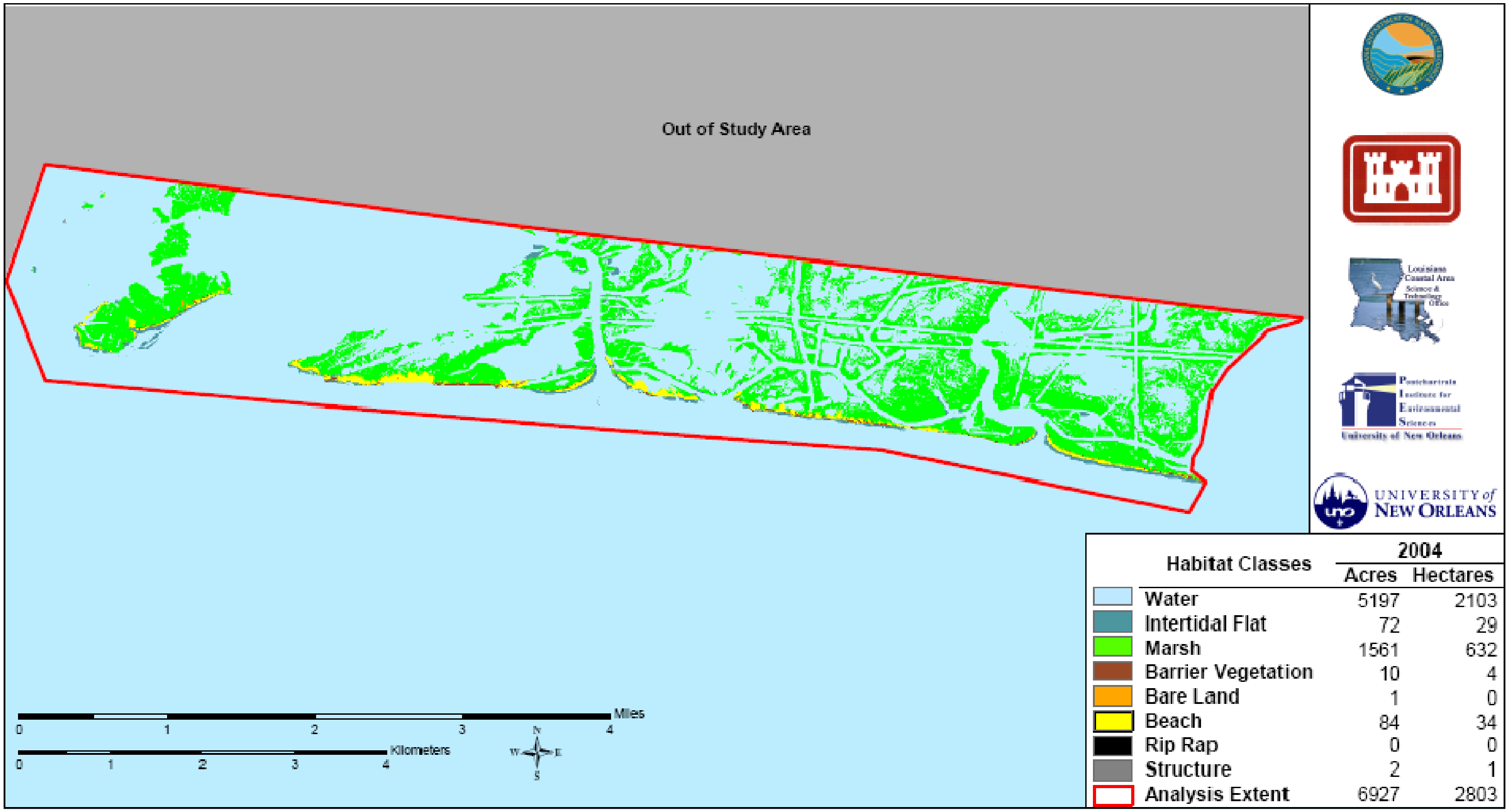
BICM Habitat Analysis: Chaland Headland, Modern delta - 2004



Habitat Classes	2004 Acres	2004 Hectares
Water	5197	2103
Intertidal Flat	72	29
Marsh	1561	632
Barrier Vegetation	10	4
Bare Land	1	0
Beach	84	34
Rip Rap	0	0
Structure	2	1
Analysis Extent	6927	2803

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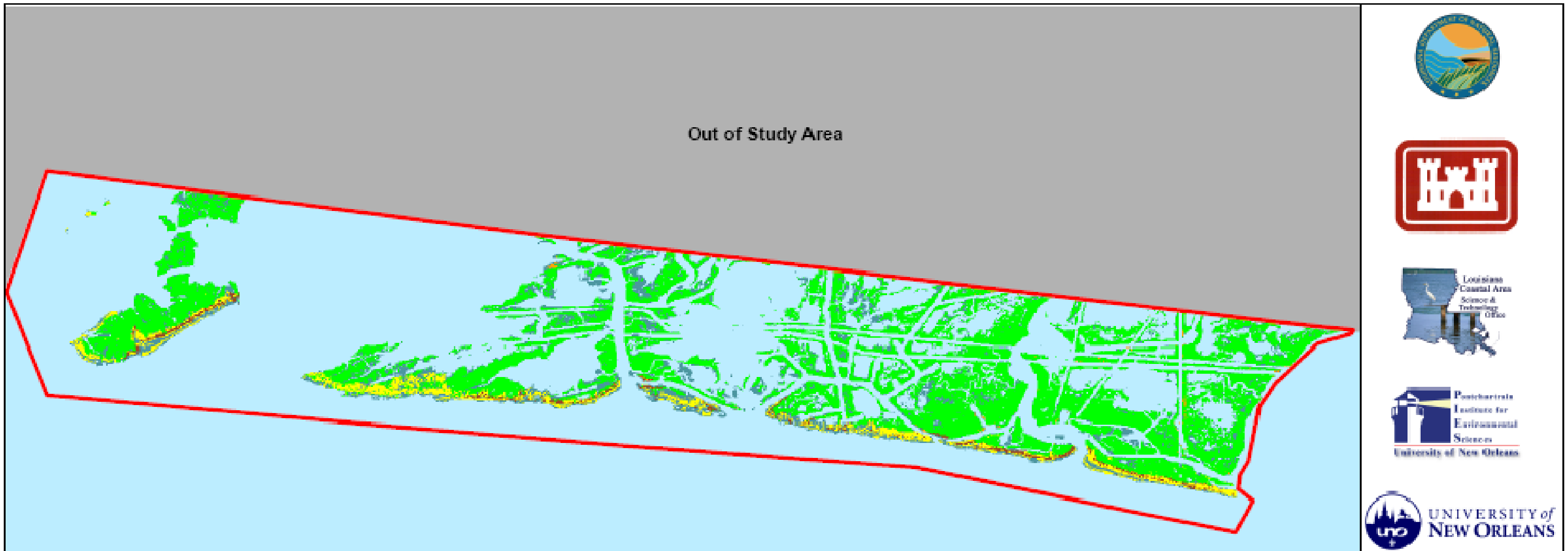

Habitat Classes	2005 Acres	2005 Hectares
Water	4883	1976
Intertidal Flat	370	150
Marsh	1499	606
Barrier Vegetation	39	16
Bare Land	6	2
Beach	138	56
Rip Rap	0	0
Structure	0	0
Analysis Extent	6934	2806

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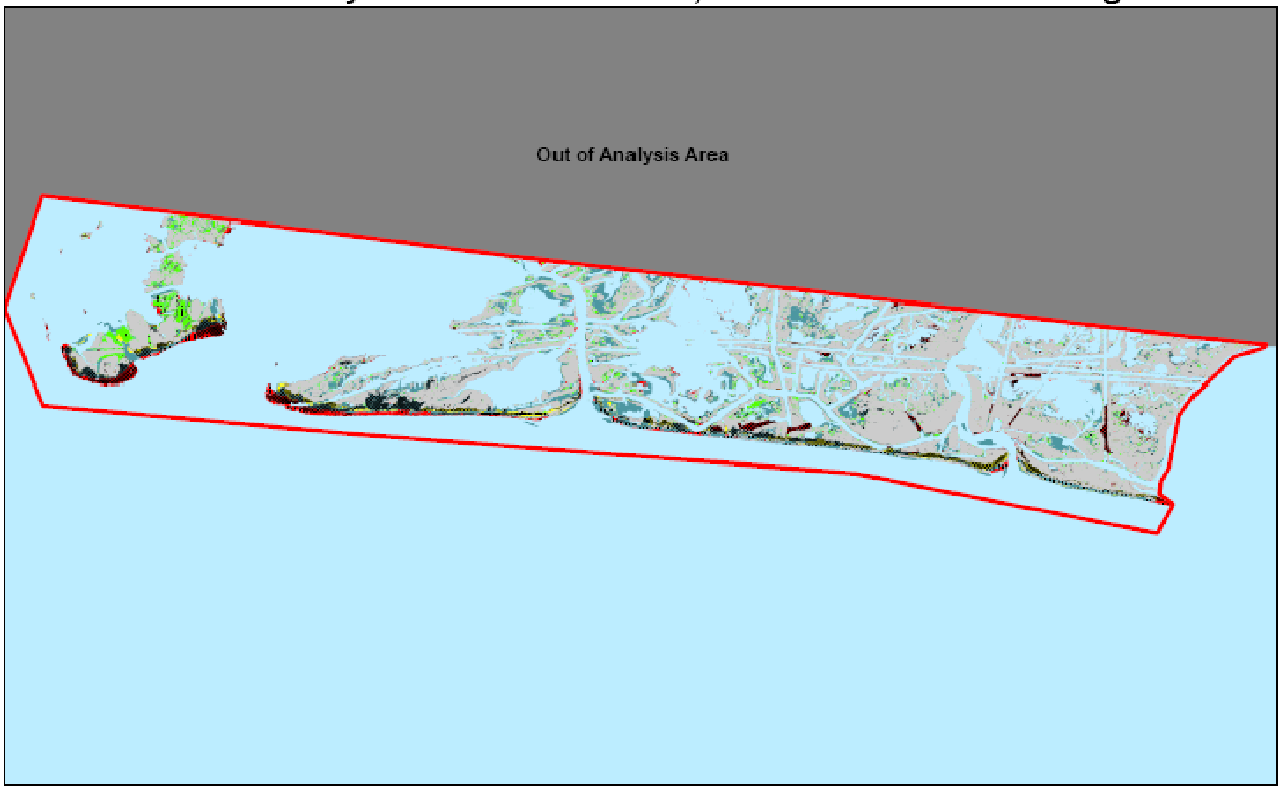
BICM Habitat Analysis: Chaland Headland, Modern delta Habitat Change Classification - 2002 from 1998



Legend (2002 from 1998)	Acreages	Hectares
water from water	4322	1749
unchanged land	1398	566
intertidal flat from water	353	143
marsh from water	100	41
barrier vegetation from water	1	0
bare land from water	1	0
beach from water	10	4
water from intertidal flat	58	23
water from marsh	108	44
water from barrier vegetation	4	2
water from bare land	1	0
water from beach	32	13
water from structure	0	0
intertidal flat from marsh	195	79
intertidal flat from barrier vegetation	8	3
intertidal flat from bare land	3	1
intertidal flat from beach	41	16
marsh from intertidal flat	164	66
marsh from barrier vegetation	2	1
marsh from bare land	6	3
marsh from beach	14	6
barrier vegetation from intertidal flat	1	0
barrier vegetation from marsh	28	11
barrier vegetation from bare land	1	0
barrier vegetation from beach	1	0
bare land from intertidal flat	1	0
bare land from marsh	18	7
bare land from barrier vegetation	0	0
bare land from beach	0	0
beach from intertidal flat	6	3
beach from marsh	51	21
beach from barrier vegetation	7	3
beach from bare land	0	0
rip rap to rip rap	0	0
structure to structure	0	0
anlaysis extent	6934	2806

Miles: 0, 0.5, 1, 1.5, 2
Kilometers: 0, 0.5, 1, 1.5, 2

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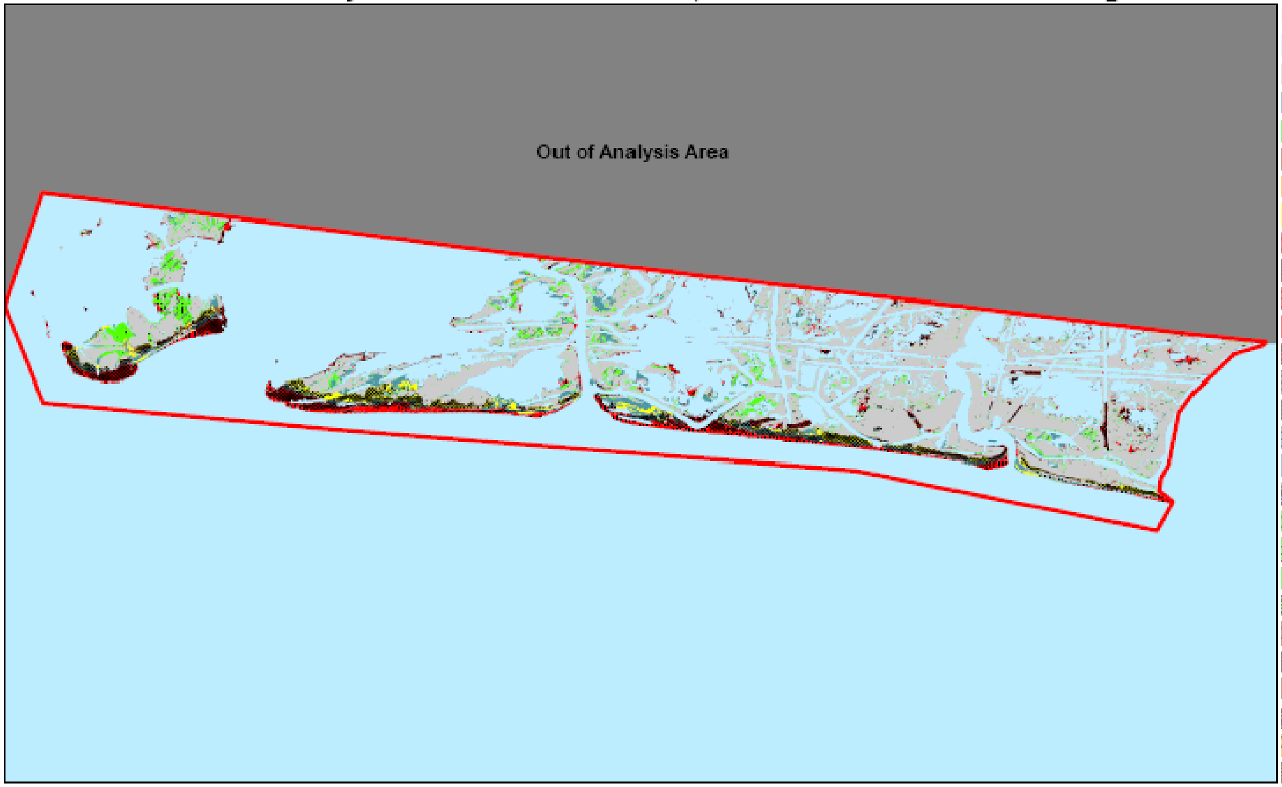
BICM Habitat Analysis: Chaland Headland, Modern delta Habitat Change Classification - 2005 from 1998



Legend (2005 from 1998)	Acreages	Hectares
water from water	4472	1810
unchanged land	1278	517
intertidal flat from water	160	65
marsh from water	121	49
barrier vegetation from water	3	1
bare land from water	1	1
beach from water	30	12
water from intertidal flat	119	48
water from marsh	211	85
water from barrier vegetation	12	5
water from bare land	2	1
water from beach	66	27
water from structure	16	7
intertidal flat from marsh	109	44
intertidal flat from barrier vegetation	3	1
intertidal flat from bare land	2	1
intertidal flat from beach	13	5
marsh from intertidal flat	177	72
marsh from barrier vegetation	2	1
marsh from bare land	8	3
marsh from beach	14	6
barrier vegetation from intertidal flat	2	1
barrier vegetation from marsh	30	12
barrier vegetation from bare land	0	0
barrier vegetation from beach	3	1
bare land from intertidal flat	0	0
bare land from marsh	3	1
bare land from barrier vegetation	0	0
bare land from beach	0	0
beach from intertidal flat	9	4
beach from marsh	81	33
beach from barrier vegetation	3	1
beach from bare land	1	0
rip rap to rip rap	0	0
structure to structure	0	0
anlaysis extent	6950	2813

0 0.5 1 1.5 2 Miles

0 0.5 1 1.5 2 Kilometers

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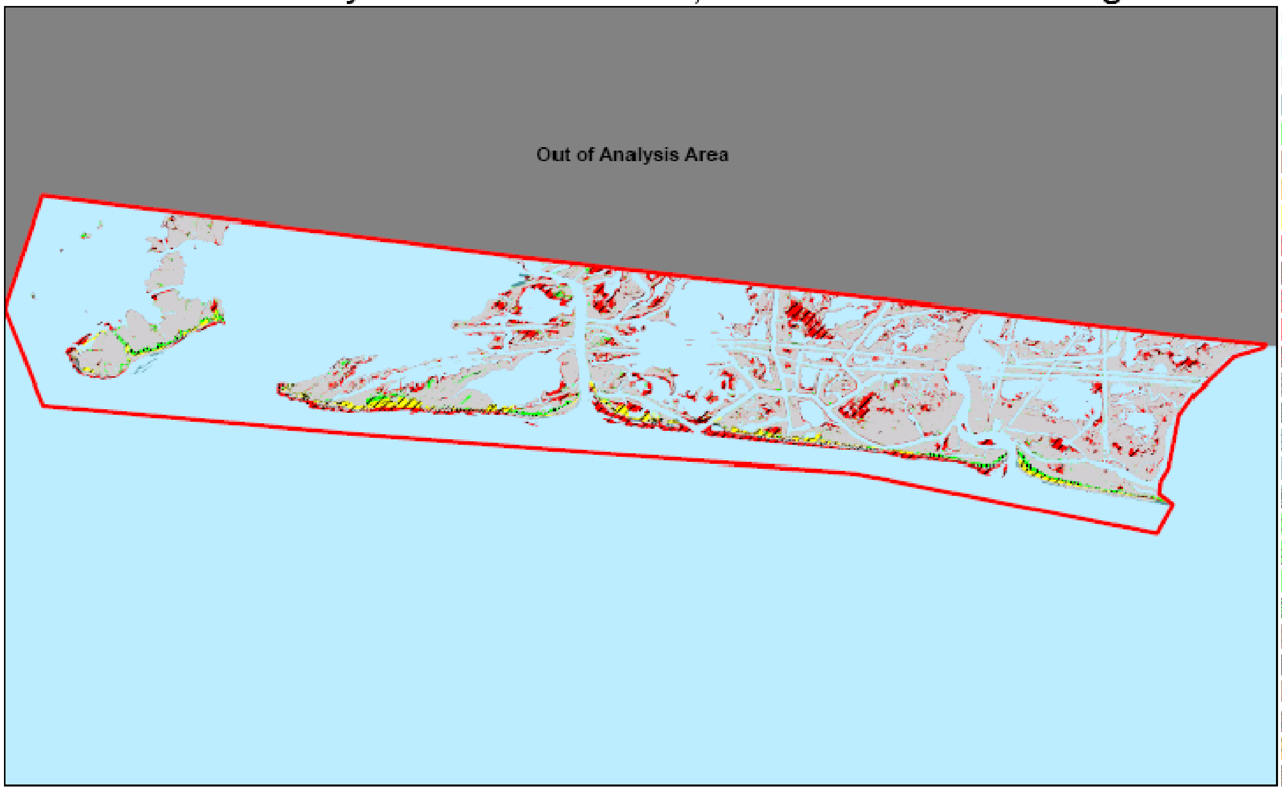
BICM Habitat Analysis: Chaland Headland, Modern delta Habitat Change Classification - 2004 from 2002



Legend (2004 from 2002)	Acreages	Hectares
water from water	4490	1817
unchanged land	1388	562
intertidal flat from water	15	6
marsh from water	11	5
barrier vegetation from water	0	0
bare land from water	0	0
beach from water	8	3
water from intertidal flat	533	216
water from marsh	147	60
water from barrier vegetation	1	1
water from bare land	3	1
water from beach	22	9
water from structure	0	0
intertidal flat from marsh	3	1
intertidal flat from barrier vegetation	0	0
intertidal flat from bare land	0	0
intertidal flat from beach	16	7
marsh from intertidal flat	136	55
marsh from barrier vegetation	29	12
marsh from bare land	18	7
marsh from beach	33	13
barrier vegetation from intertidal flat	5	2
barrier vegetation from marsh	2	1
barrier vegetation from bare land	0	0
barrier vegetation from beach	10	4
bare land from intertidal flat	1	0
bare land from marsh	0	0
bare land from barrier vegetation	0	0
bare land from beach	0	0
beach from intertidal flat	48	19
beach from marsh	12	5
beach from barrier vegetation	0	0
beach from bare land	0	0
rip rap to rip rap	0	0
structure to structure	1	0
anlaysis extent	6934	2806

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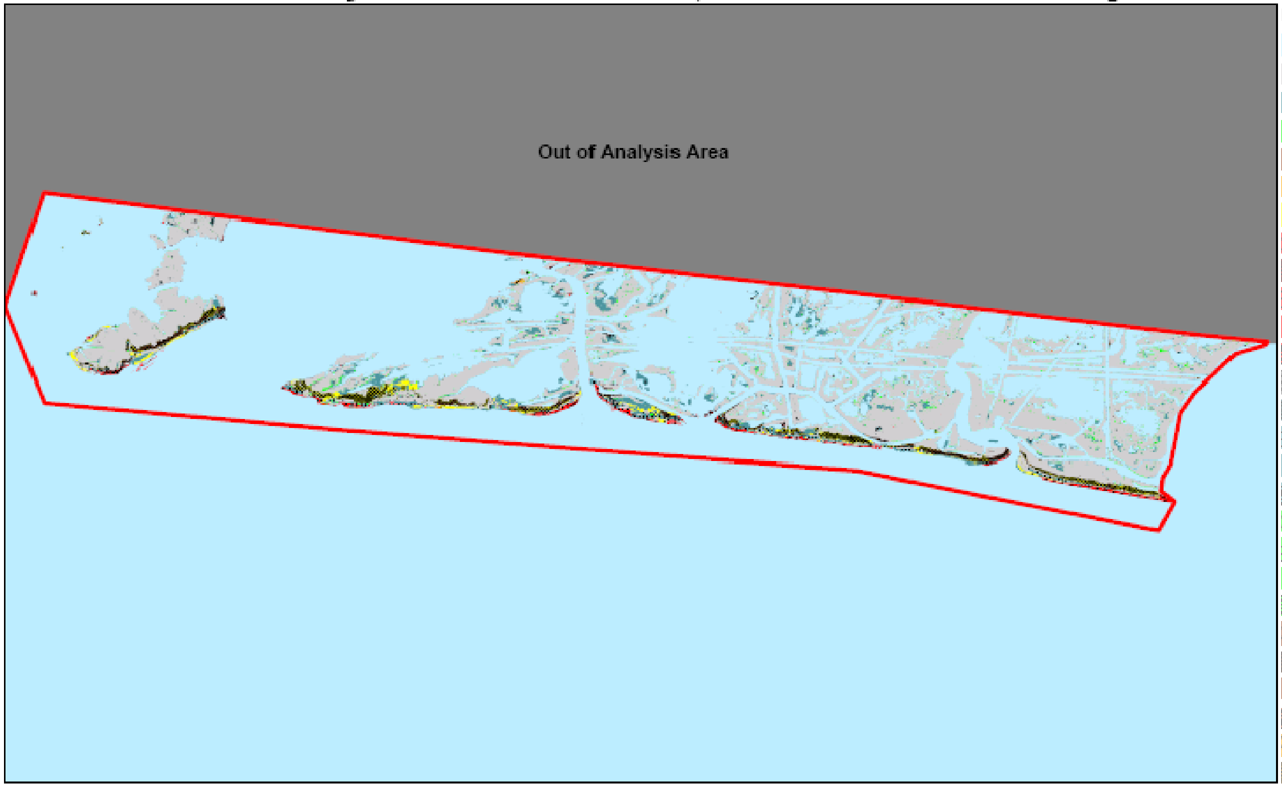
BICM Habitat Analysis: Chaland Headland, Modern delta Habitat Change Classification - 2005 from 2004



Legend (2005 from 2004)	Acreages	Hectares
water from water	4805	1944
unchanged land	1404	568
intertidal flat from water	223	90
marsh from water	143	58
barrier vegetation from water	0	0
bare land from water	0	0
beach from water	25	10
water from intertidal flat	36	14
water from marsh	27	11
water from barrier vegetation	2	1
water from bare land	0	0
water from beach	13	5
water from structure	1	0
intertidal flat from marsh	81	33
intertidal flat from barrier vegetation	6	3
intertidal flat from bare land	0	0
intertidal flat from beach	36	15
marsh from intertidal flat	3	1
marsh from barrier vegetation	1	0
marsh from bare land	0	0
marsh from beach	3	1
barrier vegetation from intertidal flat	0	0
barrier vegetation from marsh	34	14
barrier vegetation from bare land	0	0
barrier vegetation from beach	2	1
bare land from intertidal flat	1	1
bare land from marsh	3	1
bare land from barrier vegetation	0	0
bare land from beach	0	0
beach from intertidal flat	9	4
beach from marsh	66	27
beach from barrier vegetation	7	3
beach from bare land	1	0
rip rap to rip rap	0	0
structure to structure	2	1
anlaysis extent	6935	2806

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

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BICM Habitat Change Classification Analysis: Chaland Headland for the time periods of 1998 to 2002, 2002 to 2004, and 2004 to 2005.

Habitat Change Class (To – From)	1998–2002 Acreages	2002–2004 Acreages	2004–2005 Acreages	1998–2005 Acreages
water - water	4322	4490	4805	4472
unchanged land	1398	1388	1404	1278
intertidal flat – water	353	15	223	160
marsh – water	100	11	143	121
barrier vegetation – water	1	0	0	3
bare land – water	1	0	0	1
beach – water	10	8	25	30
water – intertidal flat	58	533	36	119
water – marsh	108	147	27	211
water – barrier vegetation	4	1	2	12
water – bare land	1	3	0	2
water – beach	32	22	13	66
water – structure	0	0	1	16
intertidal flat – marsh	195	3	81	109
intertidal flat - barrier vegetation	8	0	6	3
intertidal flat – bare land	3	0	0	2
intertidal flat - beach	41	16	36	13
marsh - intertidal flat	164	136	3	177
marsh - barrier vegetation	2	29	1	2
marsh - bare land	6	18	0	8
marsh - beach	14	33	3	14
barrier vegetation - intertidal flat	1	5	0	2
barrier vegetation -	28	2	34	30
barrier vegetation - bare land	1	0	0	0
barrier vegetation - beach	1	10	2	3
bare land – intertidal flat	1	1	1	0
bare land – marsh	18	0	3	3
bare land – barrier vegetation	0	0	0	0
bare land – beach	0	0	0	0
beach - intertidal flat	6	48	9	9
beach – marsh	51	12	66	81
beach – barrier vegetation	7	0	7	3
beach - bare land	0	0	1	1
structure - structure	0	1	2	0