BENEFICIAL USE OF DREDGED MATERIAL MONITORING PROGRAM 1998 ANNUAL REPORT

Part 2: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana - Southwest Pass

Base Year 1985 thru Fiscal Year 1997

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Beneficial Use of Dredged Material Monitoring Program (BUMP)

The U.S. Army Corps of Engineers New Orleans District (USACE-NOD) maintains eleven major navigation projects in Louisiana that require regular maintenance dredging (Figure 1). More than 90 million cubic yards of sediment is dredged annually and the USACE-NOD coordinates with state and federal natural resource agencies to determine the most appropriate methods for the disposal of dredged material and, where possible, to beneficially use this material to create or enhance wetlands and other habitats. The USACE-NOD has developed long-term disposal plans incorporating beneficial use for each of these navigation channels. In 1994, the USACE-NOD, working in cooperation with Louisiana State University - Center for Coastal, Energy and Environmental Resources (LSU), implemented a large-scale monitoring program to quantify the amount of new habitat created and to improve dredge disposal placement techniques to maximize beneficial use. A contract was awarded to the University of New Orleans in 1998 to continue the monitoring program which is known as the USACE-NOD Beneficial Use of dredged material Monitoring Program (BUMP).

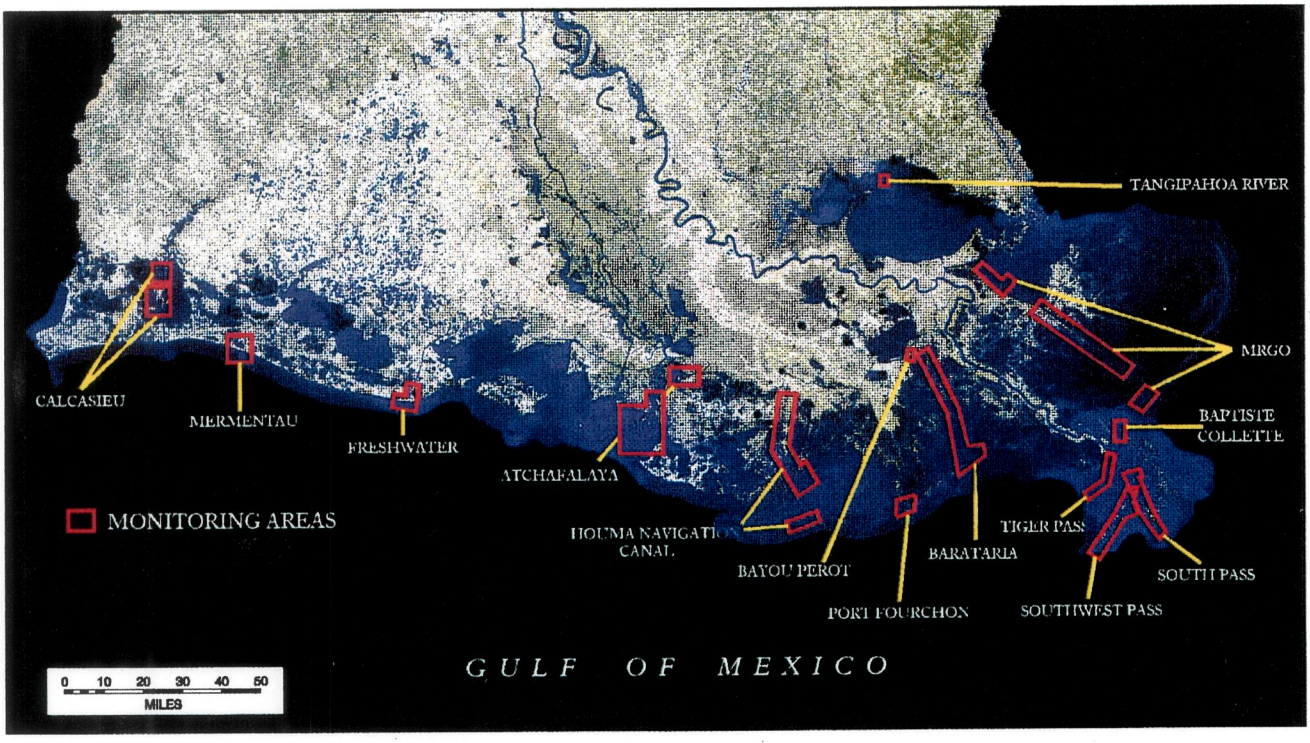


Figure 1. Locations of the beneficial use of dredged material monitoring areas.

Each year, vertical photography is acquired and digital mosaics are produced for each of the study sites listed on Figure 1. GIS habitat analysis and field surveys are conducted on only those sites specified by the USACE-NOD. The work products for the sites selected for full monitoring include dredging history maps, habitat maps for the base year, habitat maps for the selected monitoring years, and habitat change maps. From this analysis, coastal change data quantifies the creation of new coastal lands and other habitats at selected navigation channel locations. The field program includes ground truthing operations to verify and update the habitat maps and field surveys to collect information about vegetation, disposal elevations, and placement practices which maximize beneficial use.

This is the second part of the two part Beneficial Use of dredged material Monitoring Program (BUMP), 1998 Final Report. The two parts are:

Part 1: Results of Monitoring the Beneficial Use of Dredged Material at the Barataria Bay Waterway - Barataria Bay and Bar Channel Reaches (Mile 0 - 15)

Part 2: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana - Southwest Pass

BUMP at Southwest Pass and Pass a Loutre

Southwest Pass is the main distributary of the Mississippi River which currently carries the majority of the river's flow and is used for national and international shipping traffic (Figure 2). The Mississippi River drains 1.25 million square miles of the North American continent and flows over 3,900 miles from its headwaters to the Gulf of Mexico. Its sediment load of 300,000,000 tons annually has fashioned much of the state of Louisiana, adding some 15,000 square miles of land in the last 6000 years. The Mississippi River deltaic plain is the third largest in the world. The early appearance of the delta with only three major channels prior to extensive crevasse sedimentation led investigators to refer to the modern river mouth as the *birdfoot* delta (Morgan 1977). The major passes of the modern delta used for navigation include Tiger Pass, Southwest Pass, South Pass, Southeast Pass, Northeast Pass, Pass a Loutre, North Pass, Main Pass, and Baptiste Collette Bayou.

Characteristically only a few channels within a delta system will carry the majority of the flow at any one time. These channels advance slowly seaward, while the remainder of the delta system subsides and deteriorates. Subsidence of the natural levees and interlevee basins by compaction of underlying unconsolidated prodelta clays results in rapid enlargement of ponds and lakes within the subdeltas. Crevasses, or breaks in the levees, divert sediment and can result in extensive land building over varying time periods, forming small splays or large subdeltas.

Artificial modifications of the Mississippi River and its delta have contributed to lower rates of land formation and higher rates of deltaic deterioration in recent years. Artificial levees and revetments have reduced the occurrence of natural crevasses and their associated land-building processes. Lower rates of land progradation at the mouth of major distributaries is the result of

channelization and sediment deposition in deeper waters. Artificially created crevasses and the beneficial use of dredged materials by the U.S. Army Corps of Engineers has imitated the role of natural crevasses in diverting sediment from the channels into shallow water for marsh and other habitat creation.

In this report, UNO/LSU presents the results of the continuation of monitoring along the Southwest Pass navigation channel (Figure 3a) through the USACE-NOD Fiscal Year (FY) 1997 maintenance event, and the first results of the BUMP analysis at the Southwest Pass - Pass a Loutre disposal area (Figure 3b) through the USACE-NOD FY98 maintenance event.

The natural and man-made habitats in the study area were classified using aerial photography. Photography acquired December 1985 and October 1997 was used for Southwest Pass and December 1985 and January 1999 was used for Pass a Loutre. Through GIS analysis, these areas were measured and changes calculated. Field surveys were conducted in November 1998 on the beneficial use areas created through FY97 at Southwest Pass, and in September 1999 at areas created in FY98 at Pass a Loutre. Habitats were ground truthed and survey transects established to document vegetation species and stacking elevations, and as a base for measuring compaction.

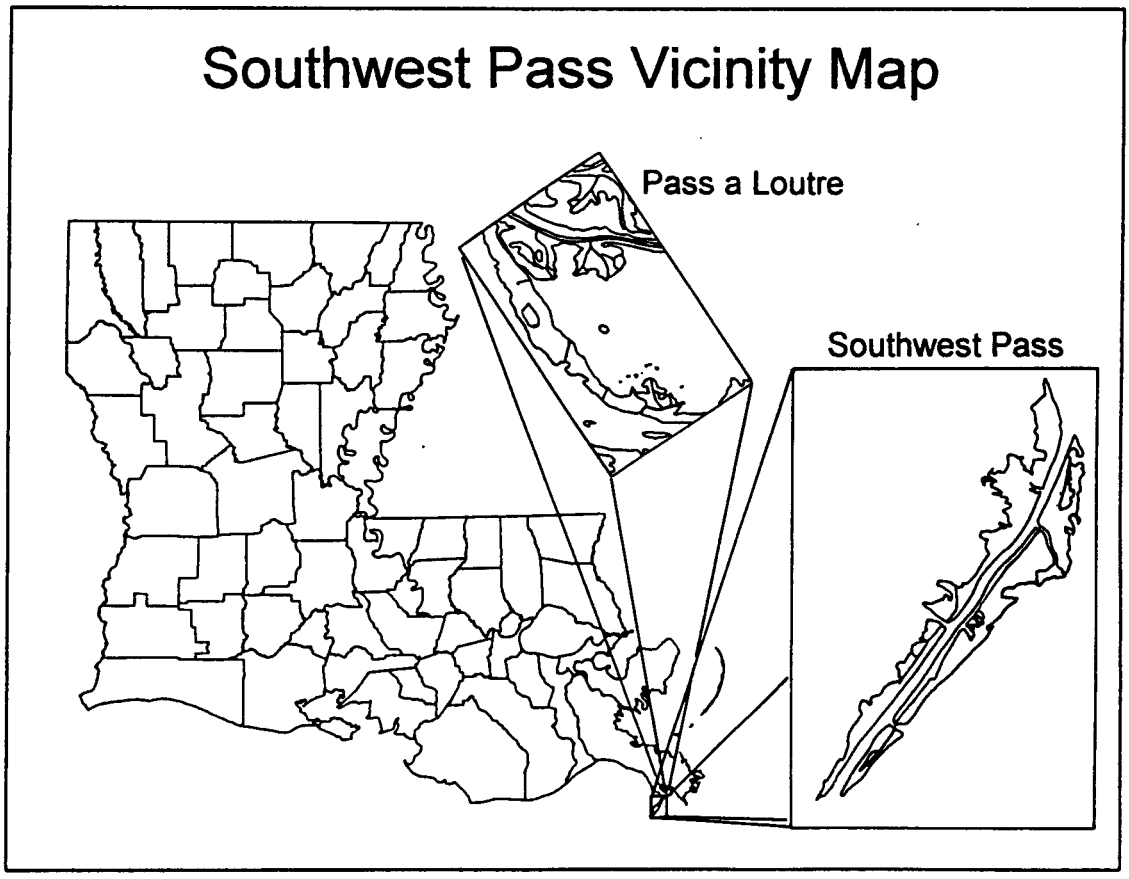


Figure 2. Location map of Southwest Pass and Pass a Loutre BUMP study areas.

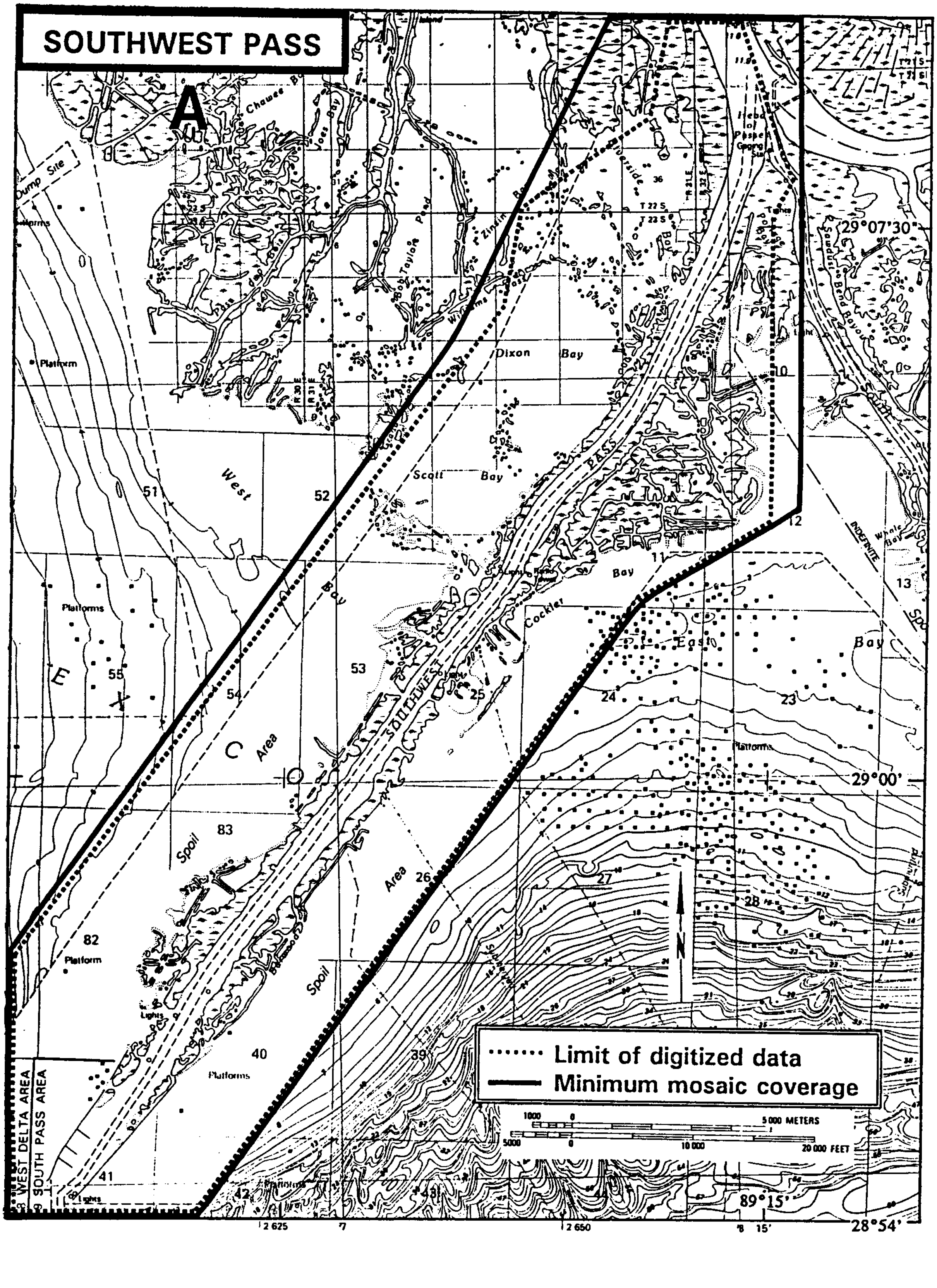


Figure 3a. The Mississippi River - Southwest Pass BUMP study area showing the minimum coverage of the aerial photo-mosaic and the limits of the area digitized.

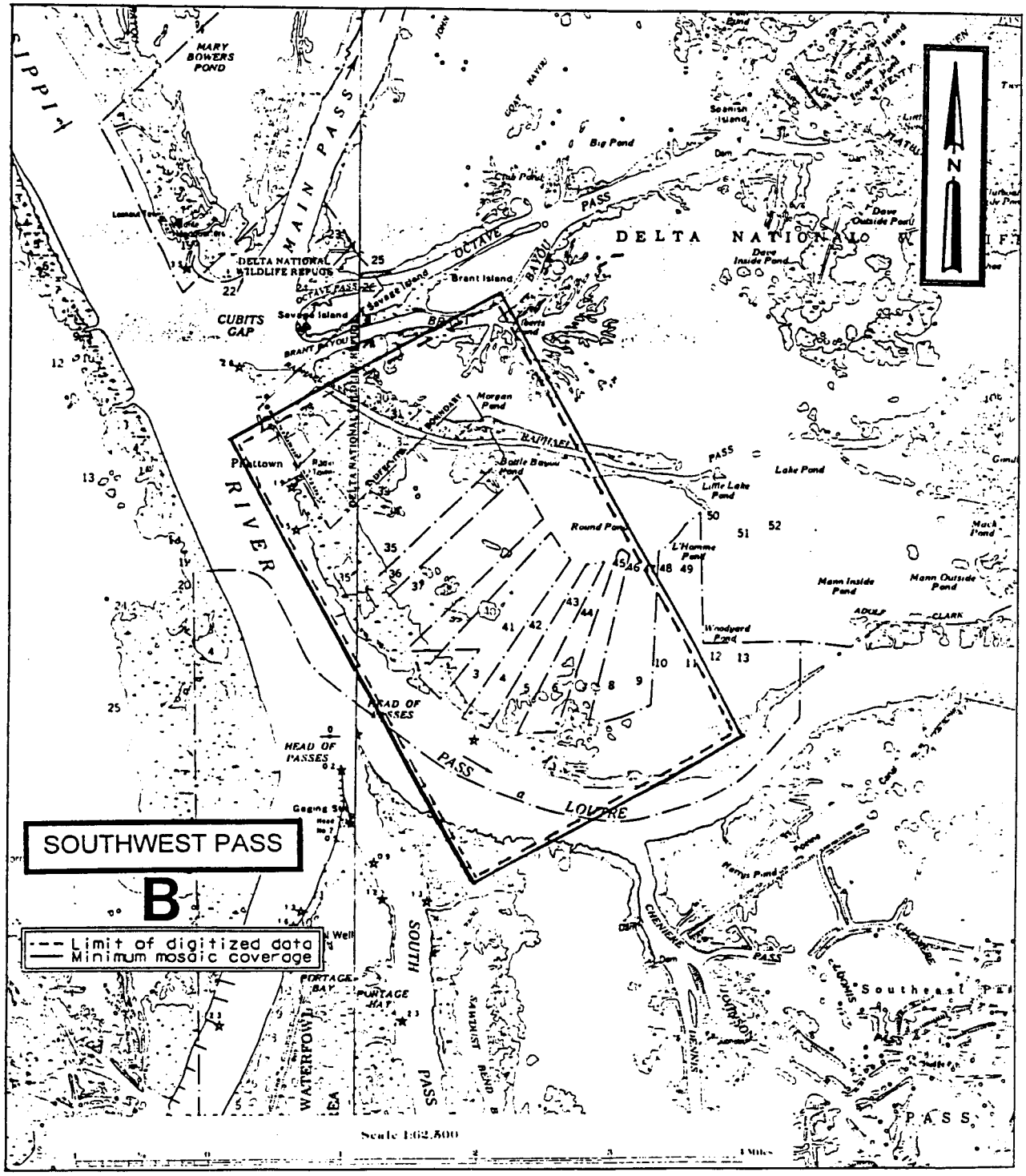


Figure 3b. The Mississippi River - Pass a Loutre BUMP study area showing the minimum coverage of the aerial photo-mosaic and the limits of the area digitized.

NAVIGATION AND DREDGING HISTORY OF THE LOWER MISSISSIPPI RIVER

The natural distributaries of the Mississippi River have been used as navigation channels by Europeans since 1682 when La Salle explored the mouth of the river. The site of New Orleans was selected in the early 1700s, and levee construction began as early as 1717 at New Orleans to control flooding. By 1726 a levee 5400 feet long, 18 feet wide and 3 feet high had been constructed. By 1735, levees extended on both sides of the river from 30 miles above New Orleans to 12 miles below, and by 1858 extended to the Ohio River. The effect of the levee system was largely to contain floodwaters within the river channel. Although the levees decreased the number of crevasses that occurred during flood stage of the river, it increased the intensity of the crevasses which did occur, and the modern delta experienced an overall growth in area between 1890s to the mid 1920s.

In 1720, only South Pass of the Mississippi River was utilized for navigation. However, since most commerce came from an easterly direction, a pilot station known as *Balize* was established on an island off of Balize Bayou which was a distributary of Northeast Pass. The Balize settlement was destroyed before 1767 by a flood and the pilot station was moved to the north shore of Northeast Pass. By the late 1700s, Northeast Pass was being surpassed by Pass a Loutre as a main navigation channel, and South Pass had shoaled considerably. Southwest Pass had the greatest water depth over the distributary mouth bar, and by 1813, had become the major channel. Between 1852 and 1869, attempts to increase the depth of the channel at Southwest Pass and Pass a Loutre included jettying, dredging the channel mouth bar, blasting mudlumps, agitation of the bottom with steam-driven propellers, and dragging iron harrows across the bar. None of these techniques were successful and bar deposits soon reformed when attempts ceased. The building of jetties at Southwest Pass commenced in 1902 and was largely completed in 1908, although work on the project continued for nearly another decade, including damming of upstream subsidiary channels (Morgan 1977).

During the first half of the 1900's, the Mississippi River's Southwest Pass (SWP) navigation channel was maintained to a 35-foot depth. The Rivers & Harbors Act of 1945 authorized a 40-foot deep by 800-foot wide navigation channel, and in 1961 the SWP navigation channel was enlarged to achieve a 40-foot depth. The Rivers & Harbors Act of 1985 authorized a 55-foot deep channel. The SWP navigation channel is currently maintained by the USACE-NOD at a 45-foot depth and 750-foot width between mile 4.0 Above Head of Passes (AHP) to mile 17.5 Below Head of Passes (BHP). Between mile 17.5 BHP and mile 22.0 BHP the navigation channel is maintained to a 45-foot depth and 600-foot width. Construction to enlarge the channel dimensions to the current 45-foot maintained depth began in 1987. The 45-foot channel was completed from SWP to Mile 181 in 1988. Construction of the 45-foot channel from Mile 181 to Baton Rouge (Mile 232.4) was initiated in 1994 and completed in the same year.

Although dredging records prior to 1956 are sketchy, records indicate that SWP has been dredged annually in discontinuous reaches since at least 1945. Currently, SWP is dredged annually in discontinuous reaches from Mile 4.0 AHP to Mile 22.0 BHP. Both hopper and hydraulic cutterhead dredges are used to maintain the upper Mile 4.0 AHP to Mile 18.8 BHP reach, and hopper dredges are used to maintain the lower Mile 18.8 BHP to Mile 22.0 BHP reach. Hopper-

dredged material from the lower part of the reach including the lower jetty and bar channel reach of the river is either agitation dredged or deposited in a designated ocean dredged material disposal site. Hopper-dredged material from the upper part of the reach is deposited in an open water disposal area, the Hopper Dredge Disposal Area (HDDA), at the entrances to Pass a Loutre and South Pass. Historically, this disposal area has been dispersive and shoal material has been scoured from the site during high river flows. Hydraulically-dredged Southwest Pass shoal material historically has been placed into one of three different categories of disposal areas: 1) unconfined into the open waters located on either side of Southwest Pass (including East Bay and West Bay), 2) behind existing foreshore dikes for bank stabilization purposes, and 3) shallow open water areas for wetland creation.

Since 1975, material hydraulically dredged from Southwest Pass has been utilized to create marsh. The 1976 Mississippi River, Baton Rouge to the Gulf of Mexico Final Environmental Impact Statement (FEIS) Supplement, and the 1982 Deep-Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana FEIS, both outlined placement of dredged material in open water habitats for marsh creation purposes. In 1975, a marsh creation experiment was conducted at East Bay. In coordination with the Louisiana Department of Wildlife and Fisheries, the NOD developed a plan in which approximately 4,000,000 cubic yards (CY) of dredged material was placed into the open water of East Bay to create marsh.

The 1985 Mississippi River, Baton Rouge to the Gulf of Mexico FEIS Supplement 2 discussed the utilization of material dredged from Mile 11.6 AHP to Mile 20.1 BHP for bank nourishment and marsh creation. Placement of dredged material behind foreshore dikes for bank nourishment between Mile 11.6 AHP to Mile 0.0 would be to a maximum initial height of +8.3 feet Mean Low Gulf (MLG) (+7.5 feet National Geodetic Vertical Datum (NGVD)) to achieve a maximum final height of +5.3 feet MLG (+4.5 feet NGVD). Between Mile 0.0 and Mile 20.1 BHP, dredged material placed for bank nourishment would be discharged to a maximum initial height of 7.8 feet MLG (+7.0 feet NGVD) to achieve a final height of +4.8 feet MLG (+4.0 feet NGVD). This maximum initial height restriction of dredged material was changed to +6.0 feet MLG (+5.2 feet NGVD) in 1987. Material excavated during maintenance dredging that was not used for bank nourishment would be discharged unconfined into open water habitats for marsh creation.

Since 1975, and probably earlier, open water placement of dredged material into East Bay was restricted to a maximum initial discharge height of +10.0 feet MLG (+9.2 feet NGVD) to offset the erosive effects of the high energy wave environments. Placement of dredged material into other open water habitats was restricted to a maximum initial height of +6.0 feet MLG (+5.2 feet NGVD). Subsequent consultation with the U.S. Fish and Wildlife Service led to the determination that dredged material placed at these heights did not result in the formation of intertidal marshland. In 1988, the maximum height restriction was changed to +6.0 feet MLG (+5.2 feet NGVD) for East Bay disposal and to +4.5 feet MLG (+3.7 feet NGVD) with an expected final height of +3.0 feet MLG (+2.2 feet NGVD) for other open water disposal areas to facilitate intertidal marsh formation. Further consultation with various State and Federal resource agencies resulted in another modification of the initial height restriction for material placed in these other open water areas to +4.0 feet MLG (+3.2 feet NGVD) in 1996.

Open water disposal areas dedicated to wetland creation were established in 1992 at specific locations in the West Bay (West Bay Mandatory Disposal Area (WBMDA) at Mile 14.5 BHP) and in the East Bay (East Bay Mandatory Disposal Area (EBMDA) at Mile 9.5 BHP) of Southwest Pass. Initial plans for the WBMDA called for a crescent-shaped design to extend into West Bay in order to help retain dredged material from subsequent placements. Prior to 1996, a maximum discharge height for dredged material placed at the West Bay site was +6.0 feet MLG (+5.2 feet NGVD) with an expectation that, following dewatering and compaction, a final height of +3.0 feet MLG (+2.2 feet NGVD) would be achieved. This maximum elevation height restriction was chosen to offset the erosive effects of the high energy wave environment present in West Bay. The WBMDA design plan was altered in 1996 to create a continuous spit to be angled away from the existing shoreline. The maximum initial height of dredged material placed at this site was also changed to +4.5 feet MLG (+3.7 feet NGVD) with an expected final height of +3.0 feet MLG (+2.2 feet NGVD). Approximately 2,017,000 cy of dredged material have been placed at the WBMDA since 1992, including 436,635 cy in FY 96 and 120,630 cy in FY 97.

The EBMDA was authorized under Section 150 of the Water Resources Development Act of 1976. Prior to 1996, material placed at the EBMDA was not to exceed a maximum initial height of +4.5 feet MLG (+3.7 feet NGVD). This maximum height restriction was changed to +4.0 feet MLG (+3.2 feet NGVD) in 1996. Approximately 827,000 cy of dredged material have been placed at this site since 1992. Once this site had been filled to capacity, plans called for placing material into the open water of East Bay. The EBMDA was determined to be filled to capacity in 1996.

Figure 4 illustrates the dredged material disposal history for the Southwest Pass study area in detail between FY 1985 and FY 1995. Figure 5 illustrates the more recent dredged material disposal history up to FY 1997, showing FY 1996 and FY 1997 disposal in detail.

Approximately 7,000,000 cubic yards of material are discharged annually into the HDDA at the Head of Pass a Loutre and South Pass. The disposal material in the HDDA usually is scoured from the site during high river flows. However, on occasion, extensive shoaling in Southwest Pass results in the rapid temporary filling of this disposal area. In FY 1998, the New Orleans District implemented a management plan for the HDDA in order to insure continuous availability of the site for hopper dredge disposal. The management plan included dredging within the existing HDDA and placement of the dredged material into a 298-acre, shallow, open water area, the Pass a Loutre Disposal Area (PALDA), on the east side of the Mississippi River north of Pass a Loutre within the Delta National Wildlife Refuge in a manner conducive to wetlands development.

In FY 1998 (November 21, 1997 - February 21, 1998), approximately 1,051,661 CY of material were hydraulically dredged from the HDDA and placed unconfined in shallow open water in the northern one-third of the designated PALDA (Figure 6). The specified maximum initial height of the dredged material was +3.0 feet MLG (+2.2 NGVD); however, during construction, the material was stacked too high and had to be washed down. At the project's completion, the elevation of most of the dredged material placed in the PALDA was +3.0 feet MLG (+2.2 feet NGVD) or less. Following compaction and de-watering, final elevations of +1.0 to +0.5 feet MLG (+0.2 feet NGVD) are expected.

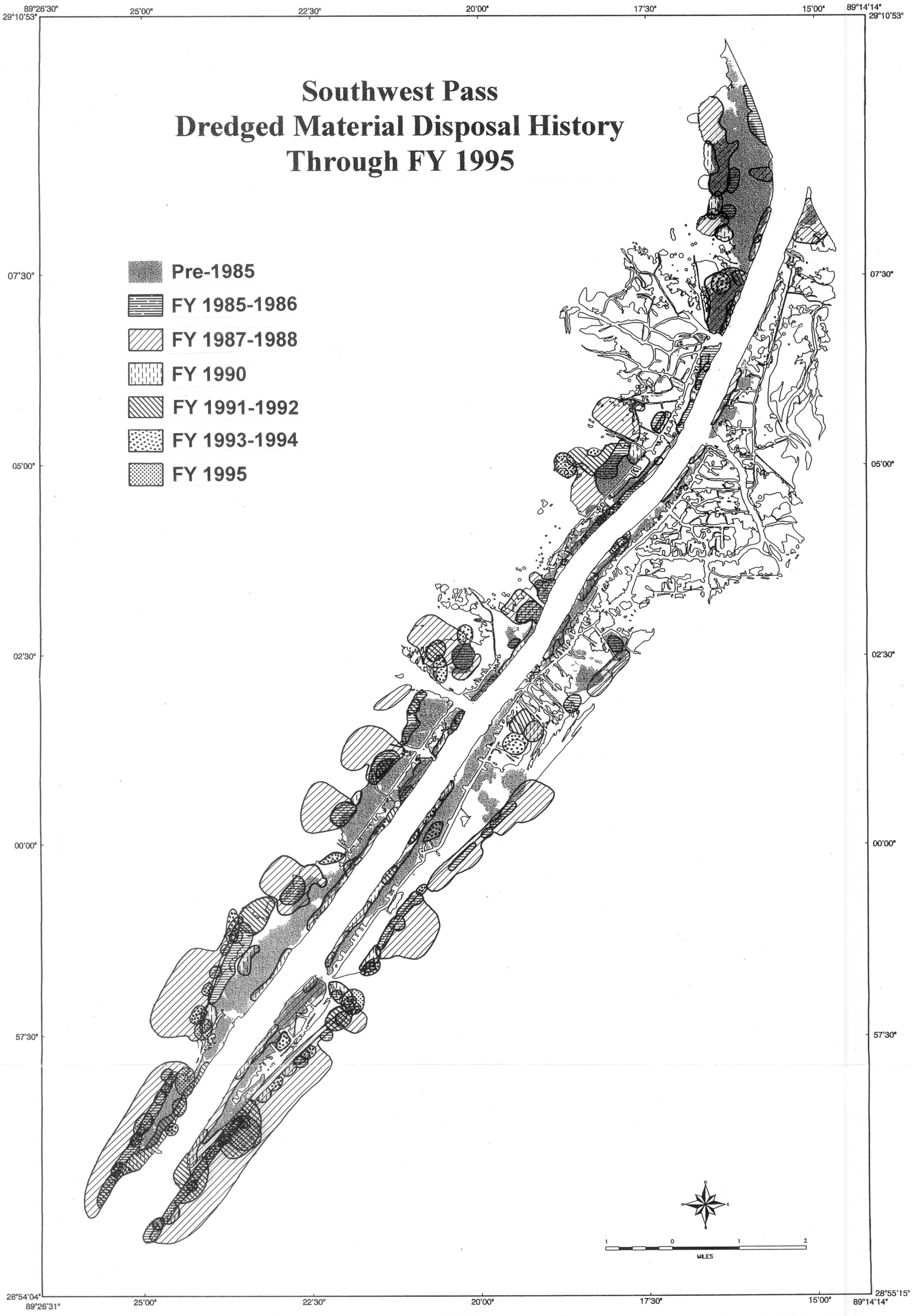


Figure 4. The dredged material disposal history for the Mississippi River - Southwest Pass BUMP study area, showing FY85 through FY95 disposal in detail.

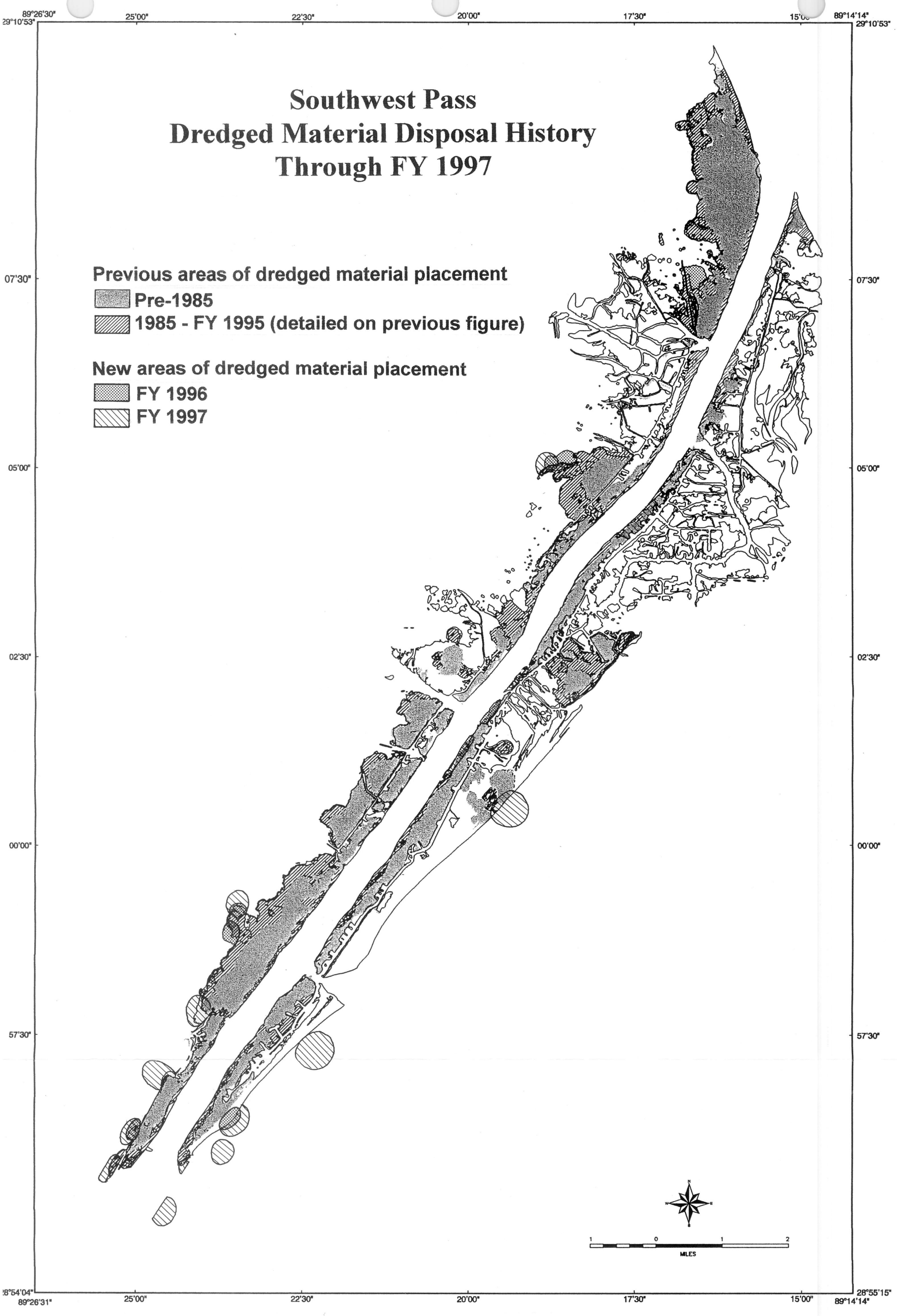


Figure 5. The dredged material disposal history for the Mississippi River - Southwest Pass BUMP study area, showing the FY96 through FY97 disposal in detail.

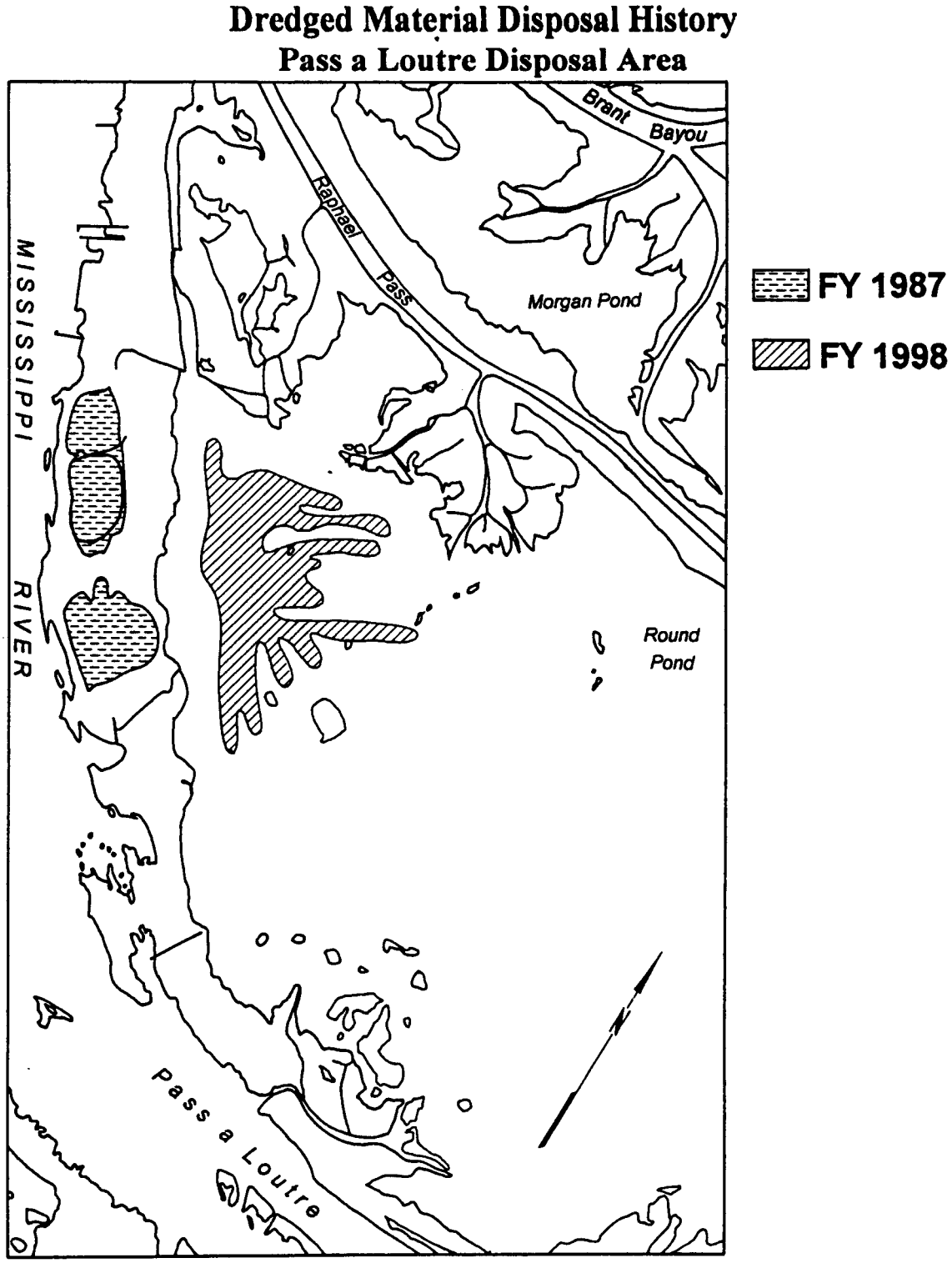


Figure 6. The dredged material disposal history for the Pass a Loutre BUMP study area, showing disposal through FY98.

BASIC METHODOLOGY

Aerial Photographic Analysis and Habitat Determination

The aerial photographic analysis was the basis for all statistics and analyses. For each monitoring site, a base year was selected against which the assessment of changes are made. The base year for the Southwest Pass navigation channel and for Pass a Loutre was 1985 and the historical 1985 aerial photography was acquired from the U.S. Geological Survey Earth Resources Observation Systems (EROS) Data Center. Photography was acquired by UNO's air photo contractor during October 1997 at Southwest Pass and during January 1999 at Pass a Loutre. Color infrared photography was acquired at a scale of 1:24,000. There was a 60 percent forward overlap of the photography which allowed the use of stereo plotting techniques for better accuracy. Color infrared photography was used for mapping and photo-interpretation because it provided a better definition of vegetation types, habitats, and the land/water interface. A copy of the color infrared photography was archived at UNO/LSU. A second set of color infrared photography was provided to the USACE-NOD.

The study areas were interpreted and mapped from the base year photography and the color infrared aerial photography using a Bausch and Lomb zoom transfer cope. USGS quadrangle maps were used for the initial ground control to set the interpretations in the state plane coordinate system. The absolute accuracy is $\pm 50'$ and the relative accuracy is $\pm 10'$. The shoreline was interpreted according to the location of the wet/dry beach contact visible on aerial photographs, the outer edge of well-established marsh, or the outer edge of organic beaches. An accurate shoreline was important to area calculations and assessments of trends in erosion, accretion, or effects of dredged material disposal.

The interpretations of habitat type were verified by taking the photography or interpreted map into the field to check specific areas against the actual landscape for positive habitat identification and vegetative community composition. Corrections were made where necessary to the map, and the revised map was then submitted for GIS digitization and final analysis.

Habitat types were important to understanding the result of disposal practices. The Appendix of this report lists the species documented during the field visits, including scientific names, common names, type of vegetation and habitat it prefers. This information verifies the habitat interpretations, helps to further characterize the habitat type, and can give further insight to the type of habitats created by the placement of dredged material. The habitats were broken into simple classes and sub-classes based on the types of vegetation present: water, wetlands (marsh and forested wetlands), and land (beach, bare, dune, upland, shrub/scrub, and forest). These very general characterizations necessarily incorporate many other habitats and transition areas.

The habitat categories used are in quotes below and were delineated using the definitions and criteria defined below.

Water (not included in statistics)

"***Open water***" is water not completely encircled by land, including some intertidal areas.

"***Intertidal***" is an indistinct, shallow area that indicates natural sediment deposits or dredge material deposits below normal high tide that does not support emergent vegetation. Some of these areas do support submerged aquatic vegetation or can become colonized by marsh vegetation.

Wetlands

"***Marsh***" for our purpose, is any unforested, vegetated area normally subject to inundation or tidal action at any time, sufficient to support wetland-dependant, emergent vegetation. *High marsh*, an area above normal high tides but inundated frequently by spring and storm tides or seasonally heavy rainfall, can occur in conjunction with any type of marsh, but is associated most commonly along the coast with saline marshes and is dominated there by *Spartina patens* and *Distichlis spicata*. High marsh associated with fresh or brackish marsh is often represented by grasslands and considered "upland".

"***Forested Wetlands***" is any forested area normally subject to inundation through part of the growing season, or with permanent or near-permanent standing water. This includes swamps, batture communities, bottomland forest, and riparian forest.

Land

"***Beach***" is an unvegetated area adjacent to open water that is subject to direct wave action at some time during the daily tidal cycle or during average storm surges. This can be sand, shell, organic, or a mixture of sediment types. This area is unlikely to permanently support vegetation because of frequent reworking by wave action. Most colonization occurs on the upper beach area less frequently affected by waves.

"***Dune***" is an area above the high water line formed by aeolian deposition of sand into ridges or hummocks.

"***Bare land***" encompasses the areas that are unvegetated and not normally subject to direct wave action. It may be adjacent to open water but in a more sheltered orientation not subject to active wave reworking. Usually it indicates areas of freshly deposited dredged material or recent natural sediment deposition. It may include areas of sparse plant colonizations that may become either upland or marsh.

"***Upland***" is a natural area or dredged material deposition area that is elevated and not subject to tidal action or inundation under normal circumstances so that upland species (non-marsh species) thrive. For this study, it includes barrier island

habitats as well as inland habitats, does not include significant shrub or tree coverage, and usually denotes a grassland, meadow, natural levee or elevated area within a marsh, or some types of agricultural or artificially altered land. Natural succession may lead to shrub/scrub in some areas.

"Shrub/scrub" is an area dominated by shrubs or small trees under 20 feet tall. This may be within an upland area or within a marsh area. Within a marsh, shrubs usually occupy elevated areas, marking natural levees or areas artificially elevated. Natural succession may eventually lead to forest or forested swamp in some areas.

"Forest" is any area dominated by trees, that is not normally subject to inundation during the growing season or is only periodically influenced by flooding. For this study it includes bottomland hardwood areas as well as oak or pine woods.

Field Program

The field program supported the air photo-interpretation and GIS analysis tasks. The field program was comprised of two work efforts. The first field effort, ground-truthing, verified the interpretation of habitat type based on the density and types of vegetation present, and verified surface morphology from the aerial photographic analysis. The initial ground-truthing for both Pass a Loutre and Southwest Pass BUMP study sites was done by floatplane on November 19, 1999. The second field effort, field monitoring, recorded changes in elevation, vegetative species and cover, geomorphic character, and surface texture at selected beneficial use sites in order to assess the best disposal practices. Field monitoring for Southwest Pass was conducted on December 15, 1998 and February 24, 1999. Field monitoring for Pass a Loutre was conducted on September 23, 1999.

The objective of the field monitoring is to clarify the habitat types by identifying dominant vegetative communities, and to determine the best disposal elevation and placement configuration in order to produce the maximum habitat benefits. Monitoring changes in elevation, habitat type and surface morphology at a disposal site will identify the important processes that control change. Understanding the relationships between change and process and habitat and elevation will facilitate better predictions of the potential habitat benefits associated with different placement elevations and configurations.

Geographic Information System (GIS) Analysis

Once the photography was acquired and interpreted for each site, the digital files were imported into the GIS, ground truthed, and referenced to its true geographic position. The line work was checked for gaps, overshoots and other digitizer errors and edited accordingly. A project schema was created to organize data attributes: area, habitat type, and perimeter. After corrected digital data sets were generated for each USACE-NOD beneficial placement site, two primary forms of GIS analysis were used to quantify and characterize wetland conditions at selected sites. The first form of analysis was the extraction of area measures for each habitat type. Values were generated

per type for each year and location. The second form of GIS analysis was the creation of change detection maps and tables for interim periods. These illustrated primary trends in geomorphic change by comparing shoreline configurations and total areas of habitat for the different time periods.

World Wide Web Site

To facilitate the transfer of information to the natural resource trustees and other interested parties, UNO has a World Wide Web site for the dissemination of the beneficial use of dredged material monitoring data. A home page allows the user to click (hyperlink) through data on the beneficial use of dredged material, including scanned aerial photographic mosaics, habitat maps, habitat change maps, habitat data spread sheets, and the results of field investigations. The web site is updated periodically after data has been checked and approved by the USACE-NOD. The site can be found at:

http://beach.geol.uno.edu/bump/

SOUTHWEST PASS NAVIGATION CHANNEL

Southwest Pass (SWP) is the main distributary of the Mississippi River. It carries the majority of the river's flow and is used for national and international shipping traffic. The Southwest Pass BUMP study area encompasses both sides of the navigation channel, approximately Mile 2 Above Head of Passes (AHP) to Mile 18.5 Below Head of Passes (BHP) (Figure 3b). Head of Passes is the location where the lower Mississippi River abruptly divides into several major distributaries. Most of the SWP landscape has been created or altered by the placement of dredged material.

FIELD SURVEY RESULTS

Methodology

The collection of elevation and vegetation profile surveys was conducted in two phases. Phase-I involved assessing the characteristics of various beneficial use disposal areas to determine the most appropriate sites to document the beneficial use of dredged material and habitat development. This was accomplished by discussion with the USACE-NOD, reviewing vertical aerial photography, and reviewing dredging schedules and history. Based on these factors, four areas were selected: three on the west side of the channel and one on the east. Gaining access to the selected sites proved to be somewhat difficult. On November 19, 1998, access was not possible because the floatplane could not land in shallow waters with unknown obstacles. An airboat could not traverse the expanse of open water on the west side of the sites, and crossing the foreshore rock dikes from the riverside was too dangerous with the probability of high wakes from passing ships. On December 15, 1998, one transect line was successfully positioned on the west-central site utilizing a boat for access, and on February 24, 1999, one transect line was positioned on each of the other sites utilizing a helicopter for access (Figure 7). Two stakes were placed to define each transect line, recording secondary features such as towers, navigation markers, or cattle enclosures to assist in relocating the transects should the vegetation become taller or thicker, or should erosion or other action remove the stakes. Permanent 1-inch diameter by 6-foot galvanized stakes were buried approximately 1-foot in the sediment and secured with concrete. Temporary white, ten-foot PVC poles with flagging and neon orange paint were slipped over the galvanized stakes to make profile siting and re-location easier.

Phase-II involved the actual collection of profile data. On December 15, 1998 and February 24, 1999, profile surveys were conducted along the transects defined by the stakes during phase-I. One transect profile was collected from each of the sites. Survey data were collected using a Topcon GTS-300_{DPG} Total-Station, tri-prism, and TDS48 Data Collection System. Horizontal accuracy of the GTS-300 is 0.25 ft $\pm$ 0.0125 ft., with a vertical accuracy of 0.45 ft $\pm$ 0.0125 ft. The maximum horizontal range with tri-prism is 3,525 ft. A Pathfinder Professional MC-5 global positioning system (GPS) device was used to record the horizontal positions of each stake, instrument location, and the position and exact orientation of each transect line. The transect data collected were processed, referenced to the local tide gage, and entered into a graphic software program to produce topographic profiles.

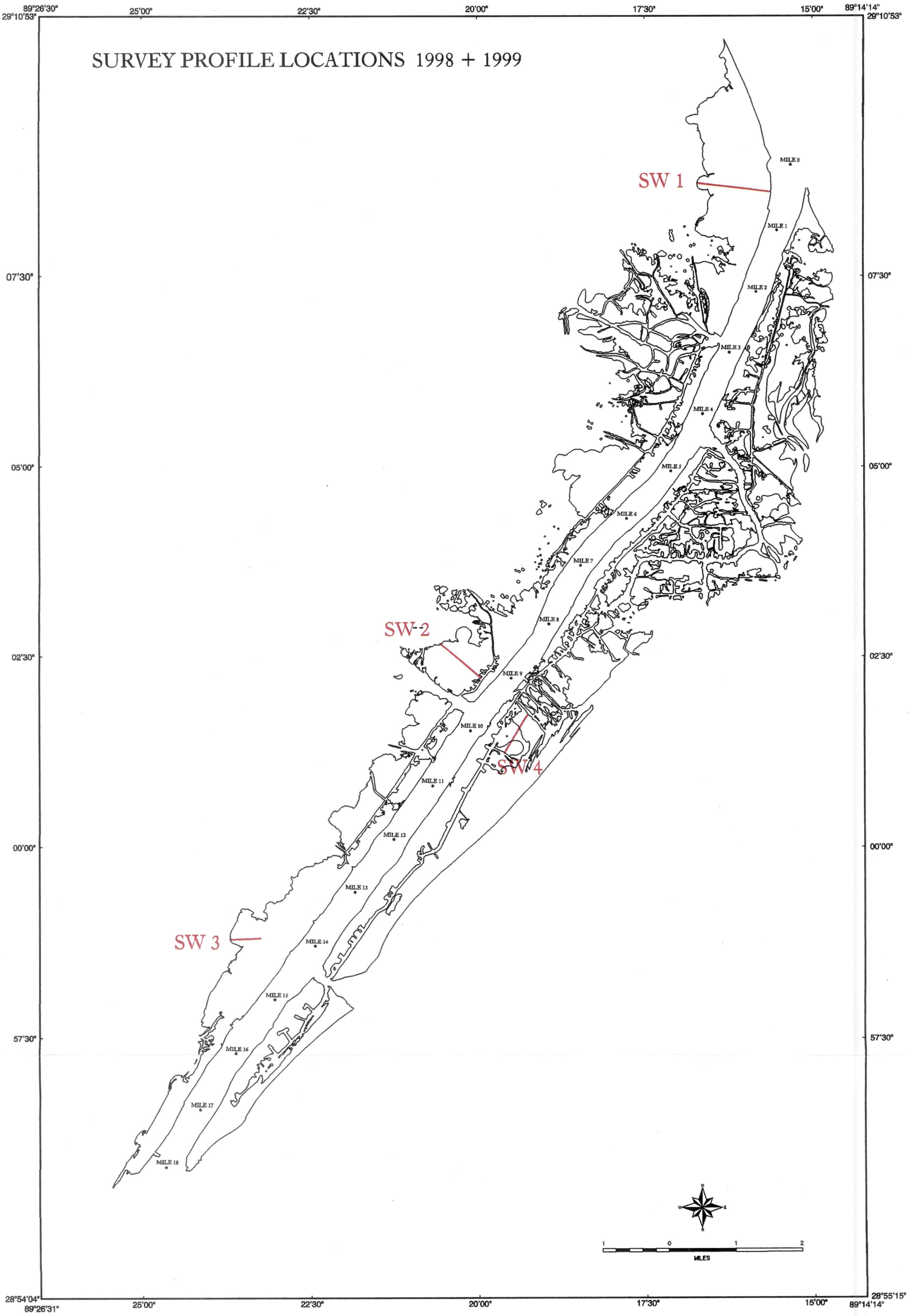


Figure 7. Location of the four elevation and vegetation transects at the Southwest Pass - BUMP study area.

The topographic profiles for the study area were constructed in reference to Micronautics Tide Table - Southwest Pass Mississippi River station #4593, Louisiana (28°56' N / 89° 26' W). The mean diurnal tidal range for the Southwest Pass study area is published as 1.3 ft.

Field monitoring for vegetative species composition and habitat verification was done on December 15, 1998 and February 24, 1999. Species composition was determined within a six-foot swath along each profile, and major divisions between vegetative communities were entered as points on the elevation profile. No submerged aquatic species were considered for this report. Plants were identified in the field with only representative specimens taken for confirmation by taxonomic keys and/or verification by the LSU Department of Plant Biology. The better specimens and uncommon specimens were entered into the LSU herbarium collection; all others were archived by the contractor. The percent composition of each species was visually estimated in order to determine the relative abundance and dominance of species for habitat determinations. These percentages were not intended to provide scientific ratios or statistics. The species list included in the Appendix of this report is not complete; it reflects only those species that were readily observed during the profiling period. Some plants can only be identified during a short flowering period which may not have coincided with the ground truthing or the profile data collection, and therefore can not be included in the list other than by a broad classification.

Profiles at Southwest Pass

The 1998 profiles were established with two metal poles (stakes) partially buried and anchored with concrete, and extending 2-3 feet from the sediment surface.

Southwest Pass - Head of Passes

The Southwest Pass - Head of Passes site is located on the west side of the channel just south of the Head of Passes near Mile 0.6 BHP (Figure 7). This area along the channel has been used for disposal during maintenance dredging for many years prior to 1985. The last disposal within this area was along the outer shoreline in FY90 (Figures 4 & 5).

The elevation and vegetation data were acquired February 24, 1999. Access to the area was by helicopter. The transect SW1 was oriented to cross recent disposal in the area and crossed the entire width of land between the river bank behind the foreshore rock dike and West Bay (Figure 8). The transect was delineated by 1 stake north of a cattle enclosure between two isolated trees, and a second stake set 270 ft away across a fence toward the west (Figure 9). The landscape was dominated by upland habitats and included elevated ponds and marshes (Figure 10). The area is currently used for the grazing of cattle which encourages the stability and development of extensive grasslands (Figure 11). The disposal material was made up of fine silty sand.

The profile was over a mile long and had a length of 5792.8 ft (Figure 12). The maximum relief along the axis was 14.3 ft MLG (13.5 NGVD), at the location of stake 1, with an average relief of 6.3 ft MLG (5.5 NGVD). The published tidal range for Southwest Pass is 1.3 ft.

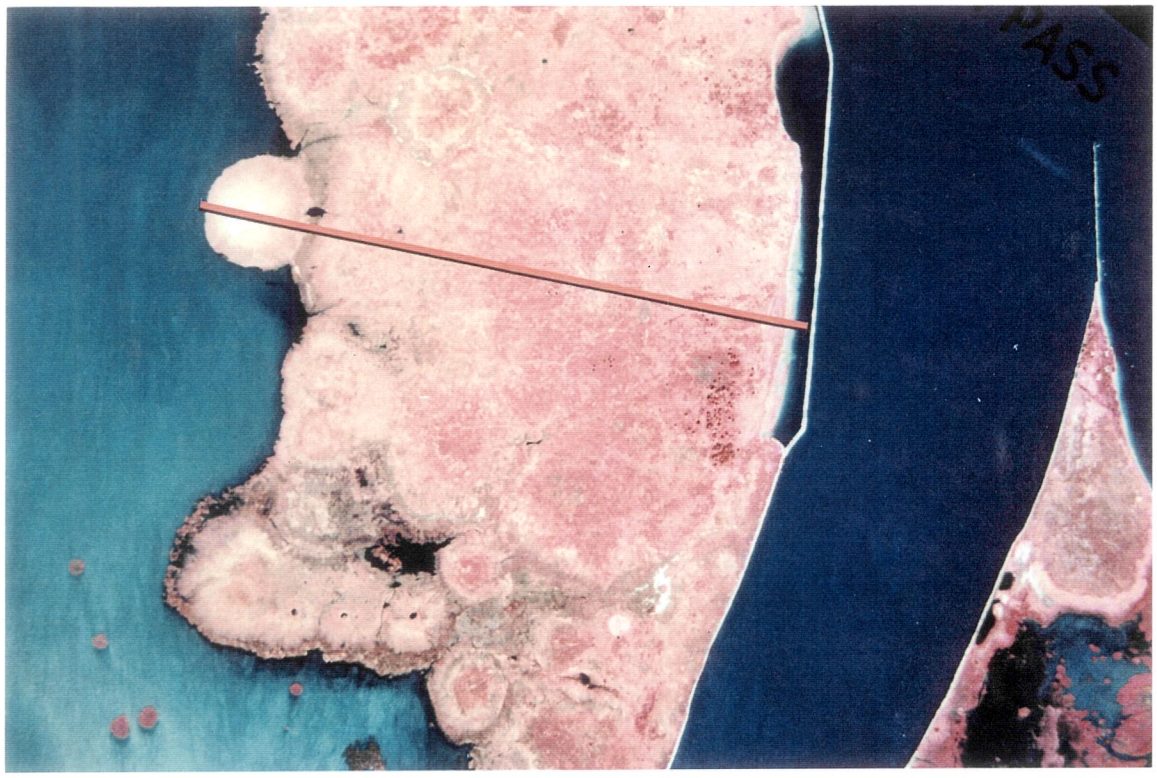


Figure 8. Infrared vertical aerial photography taken on October 16, 1997 of the Head of Passes area at Southwest Pass, showing the approximate location of the transect SW1.

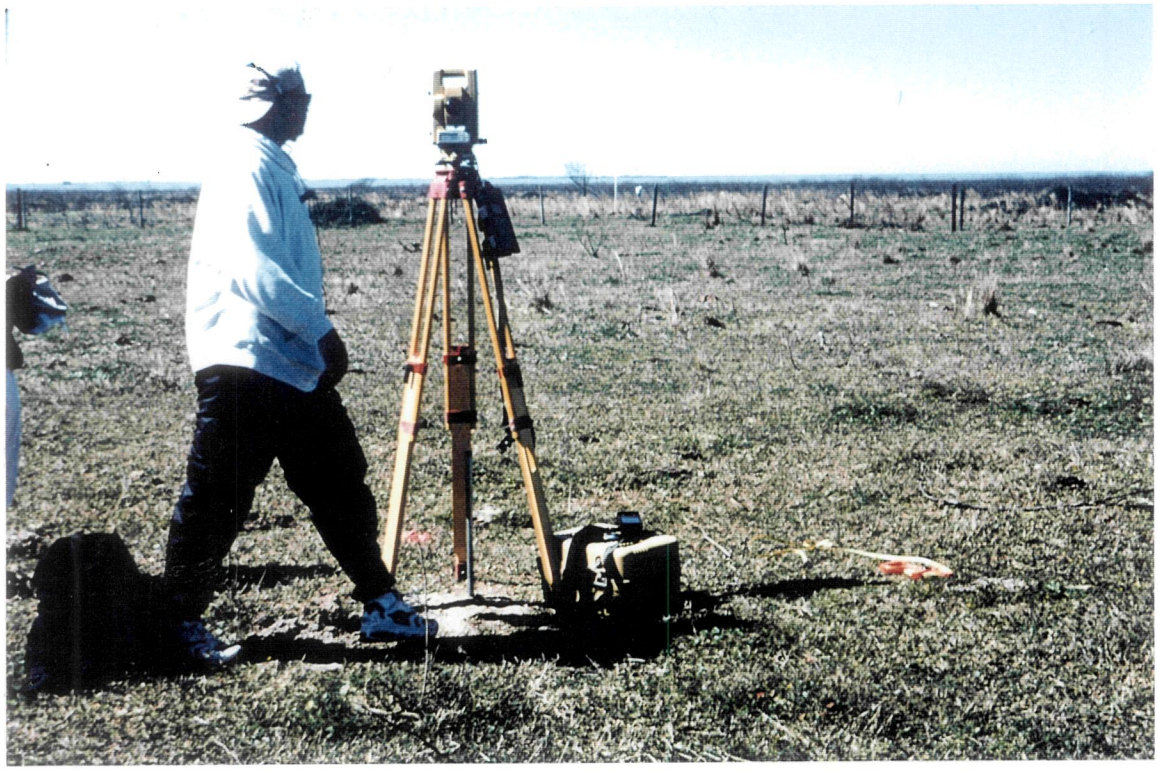


Figure 9. Photograph taken on February 24, 1999 along transect SW1 at the Southwest Pass - Head of Passes BUMP study site.

Figure 10. Photograph taken on February 24, 1999 along transect SW1 at the Southwest Pass - Head of Passes BUMP study site, showing impounded fresh marsh and pond.

Figure 11. Photograph taken on February 24, 1999 along transect SW1 at the Southwest Pass - Head of Passes BUMP study site showing extensive grasslands used for grazing cattle.

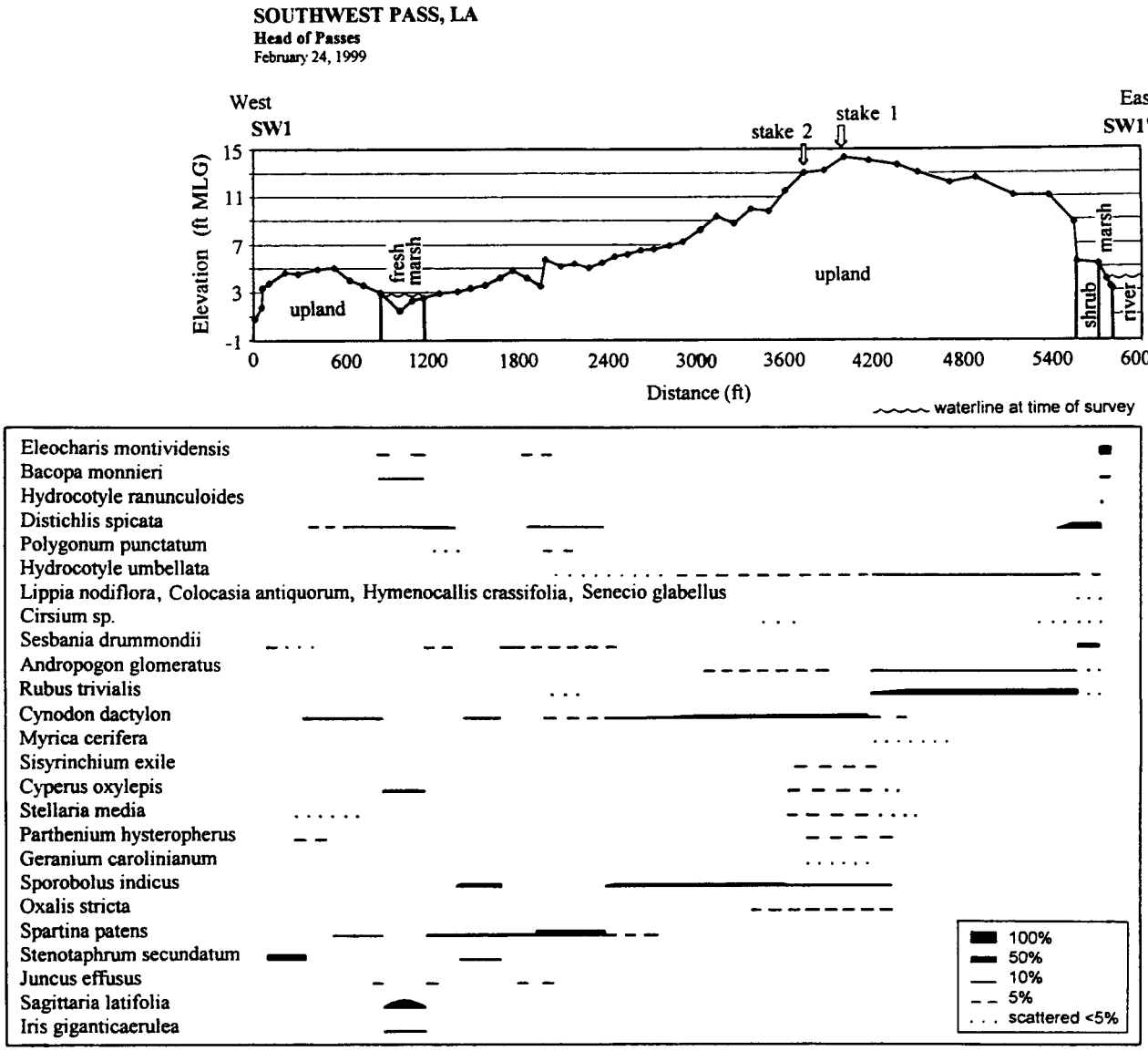


Figure 12. Elevation profile SW1 at the of the Southwest Pass - Head of Passes BUMP study site with vegetation data illustrated.

Southwest Pass - Central West Bay

The site at Central West Bay is located along the west side of the Southwest Pass channel near Mile 9.5 (Figure 7). It was accessed by boat through a navigation break in the foreshore rock dike along the river and by the access canals to an oil facility (Figure 13). The last disposal within this area was along the outer shoreline in FY93-4 (Figures 4 & 5).

The elevation and vegetation data was acquired December 15, 1998. The transect SW2 was delineated by two stakes and crossed the width of land between the access canal and the West Bay shoreline. The transect was oriented to cross recent disposal in the area. The first stake was placed near a cattle loading enclosure on the top of an eroding ridge that was created by maintenance of the access canal. The second stake was placed 406 ft away on the other side of a fenced cattle run (Figure 14).

The landscape was dominated by upland habitats and included elevated ponds and marshes (Figure 15). The area is currently used for the grazing of cattle which encourages the stability and development of extensive grasslands (Figure 16). Shrub thickets bordered the edges of the newer disposal areas (Figure 17). The disposal material was made up of fine silty sand.

The profile here had a length of 3571.8 ft (Figure 18). The maximum relief along the axis was 14.3 ft MLG (13.5 ft NGVD), at the edge of the ridge next to the navigation channel, with an average relief of 4.2 ft MLG (3.4 ft NGVD). The published tidal range for Southwest Pass is 1.3 ft.

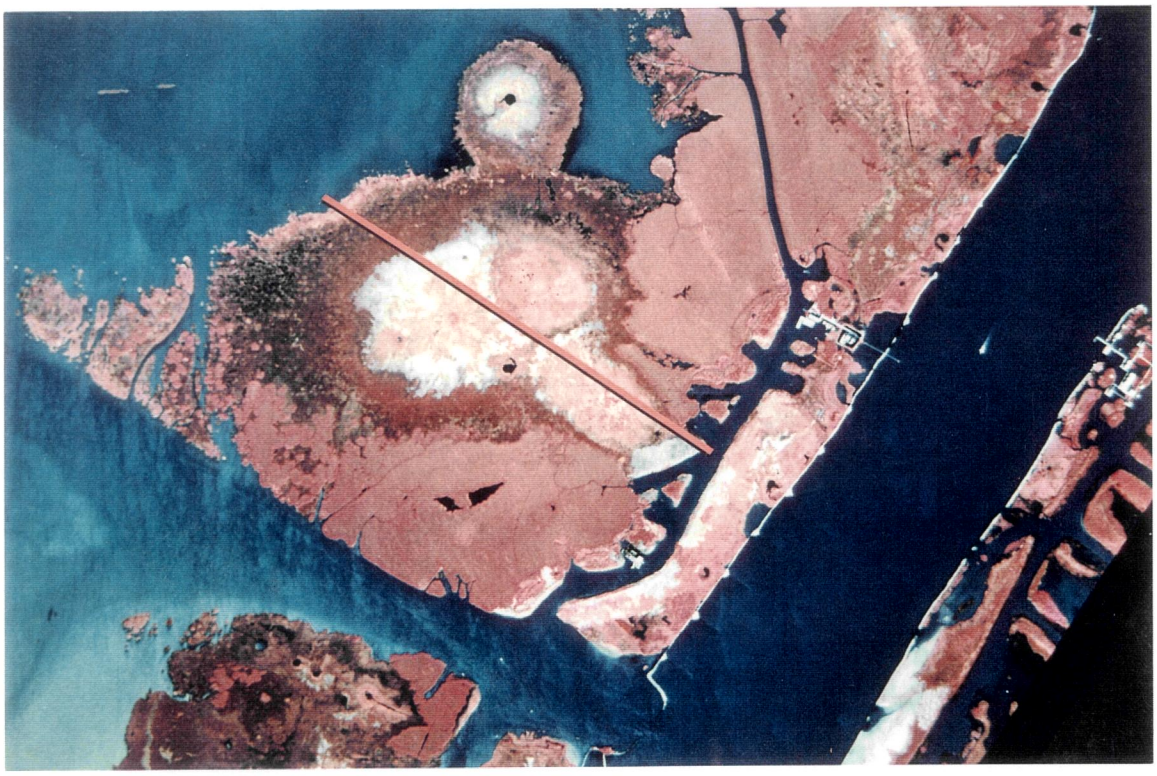


Figure 13. Vertical aerial photograph of the transect SW2 at the Southwest Pass - Central West Bay BUMP study site on October 15, 1997.

Figure 14. Photograph taken on February 24, 1999 along transect SW2 - Central West Bay. This view is in line with the transect, looking past stake 2 (where the man is digging) to the instrument placed over stake 1 on the ridge next to the access canal (arrow).

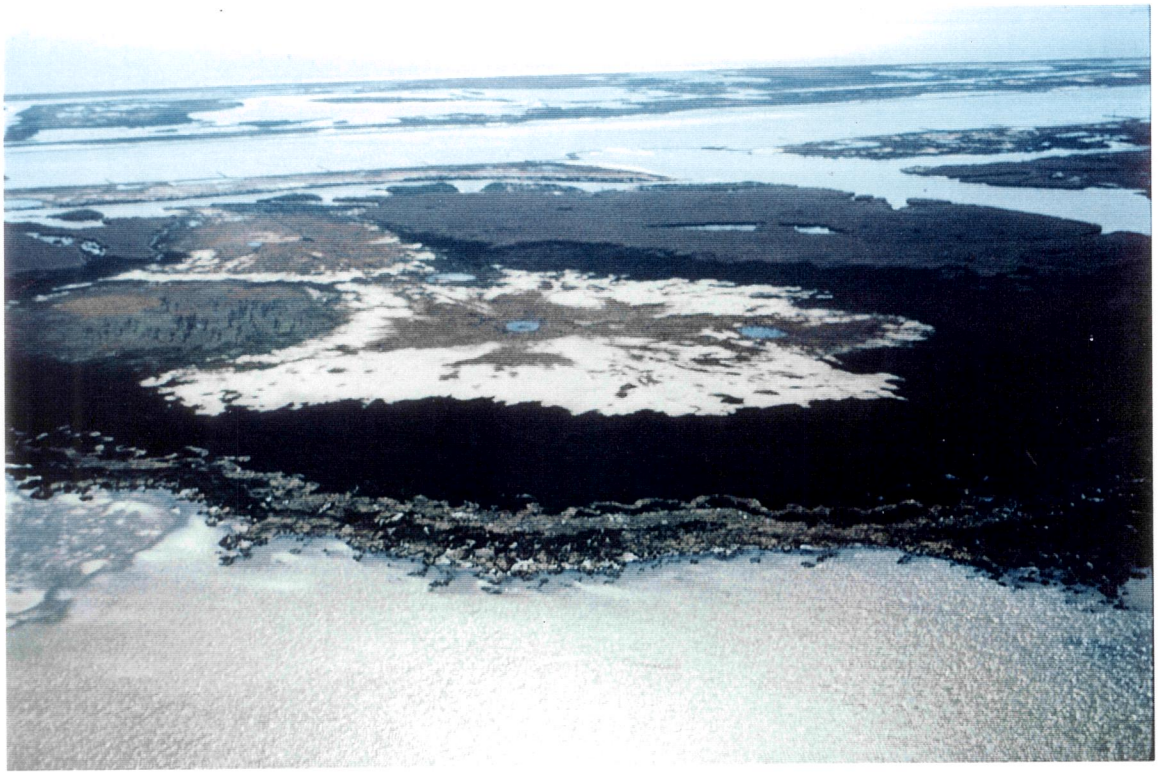


Figure 15. Oblique aerial photograph taken February 6, 1996 of the Central West Bay area, showing the varied habitats of the transect.

Figure 16. Photograph taken February 24, 1999 along transect SW2 - Central West Bay, showing the extensive grassland and scattered willow trees of this area.

Figure 17. Photograph taken February 24, 1999 along transect SW2 - Central West Bay, showing the shrub thicket bordering the edge of newer deposits.

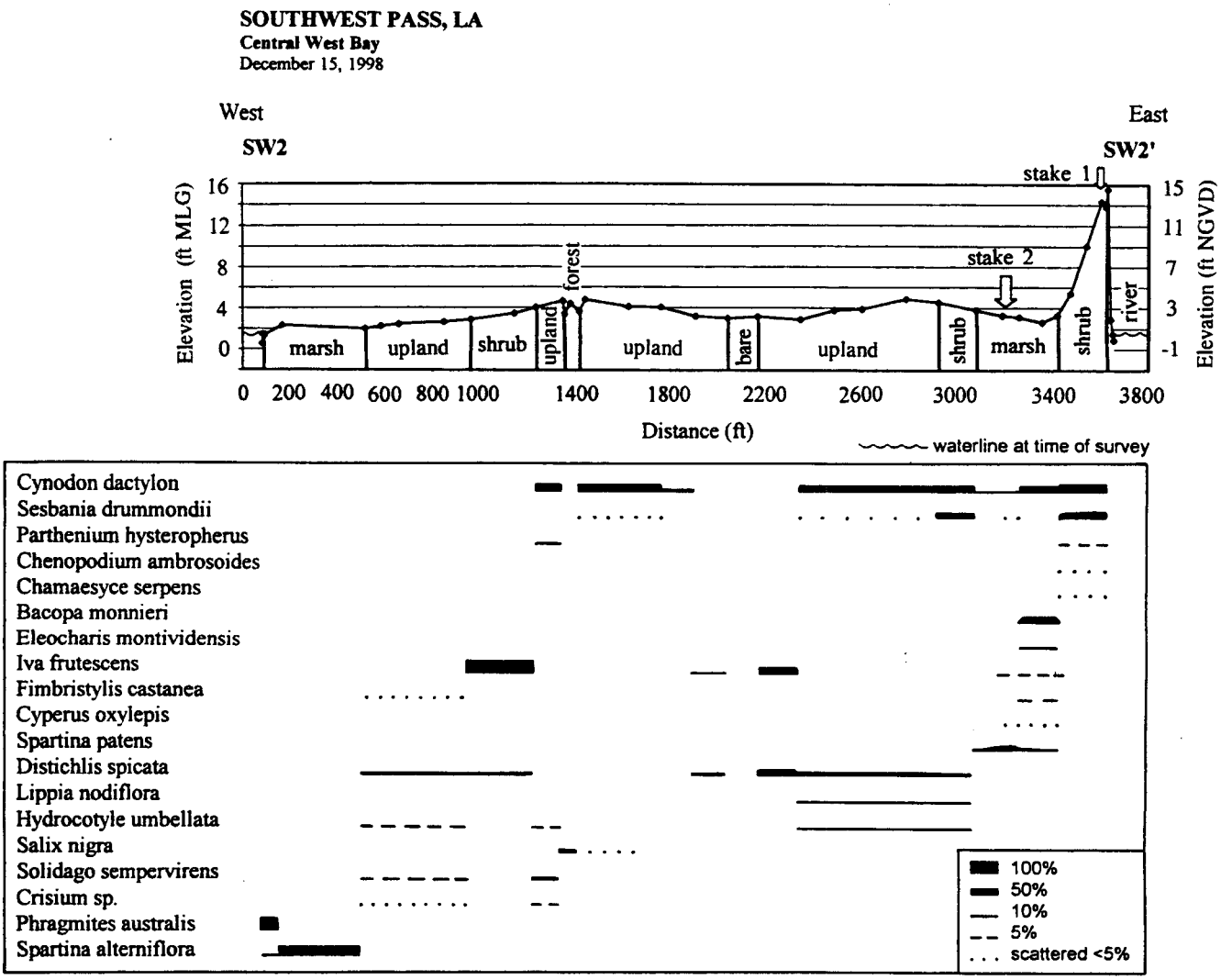


Figure 18. Elevation profile SW2 of the Southwest Pass - Central West Bay BUMP study site with vegetation data illustrated.

Southwest Pass - Southern West Bay

The Southwest Pass - Southern West Bay site is located on the west side of the channel adjacent to the old lighthouse near Mile 14.5 BHP (Figure 7). This area along the channel has been used for disposal during maintenance dredging for many years prior to 1985. The last disposal within this area was along the outer shoreline in FY97 (Figures 4 & 5).

The elevation and vegetation data was acquired February 24, 1999. Access to the area was by helicopter. The transect SW3 was oriented to cross the most recent disposal in the area. The transect crossed the width of land between the lighthouse and West Bay (Figure 19). The transect was delineated by 1 stake north of the old lighthouse, and a second stake set 149 ft away toward the west (Figure 20). The eastern end of the transect was in a well established *Spartina alterniflora* saltmarsh (Figure 21). The remainder of the transect crossed bare to sparsely vegetated, low relief mudflats dominated by saltgrass *(Distichlis spicata)* in the lower areas and Bermuda grass in the higher areas (Figures 22 & 23). The area is frequented by cattle which encourages the development of grasslands.

The profile had a length of 2154.1 ft (Figure 25). The maximum relief along the axis was 3.9 ft MLG (3.1 ft NGVD), at the dune along the outer shore, with an average relief of 2.8 ft MLG (2.0 ft NGVD). The published tidal range for Southwest Pass is 1.3 ft.

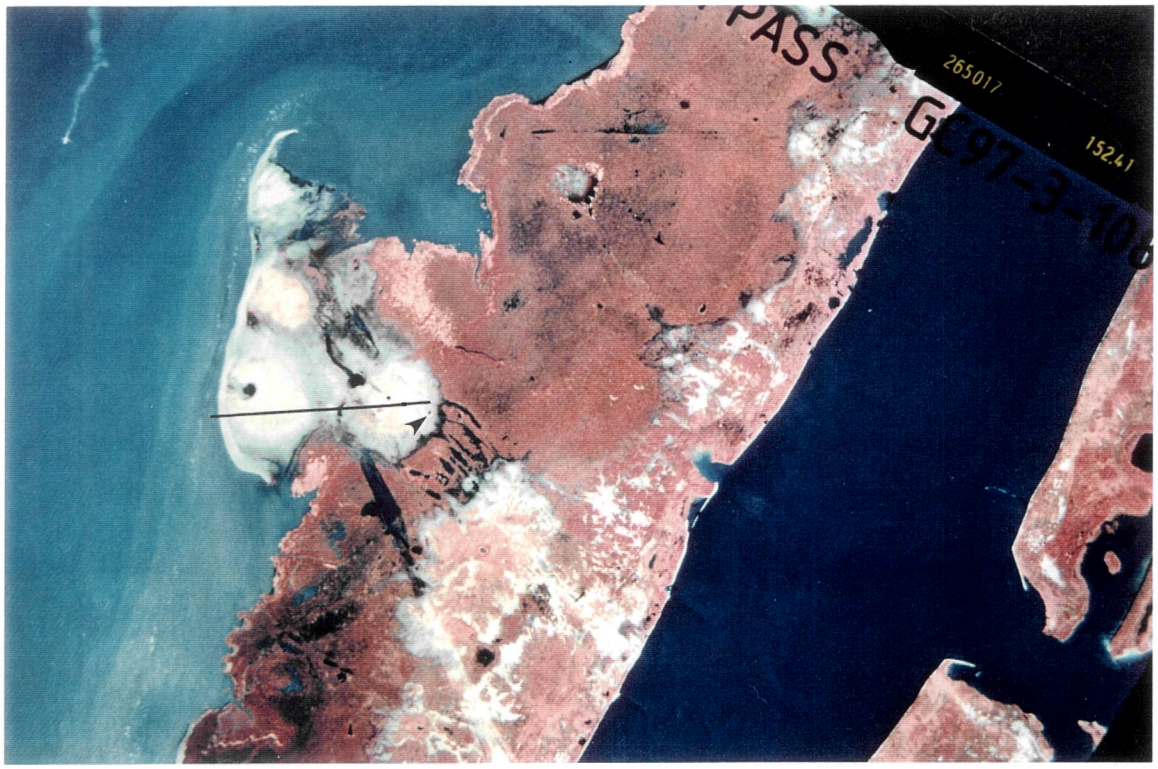


Figure 19. Vertical aerial photograph taken on October 16, 1997 of the area containing the SW3 transect (black line) at the Southwest Pass - Southern West Bay BUMP study site. The old lighthouse can be seen as a dot indicated by the arrow.

Figure 20. Photograph of transect SW3 at the Southwest Pass - Southern West Bay BUMP study site on February 24, 1999. Stake 1 was placed near the old lighthouse.

Figure 21. Photograph of transect SW3 at the Southwest Pass - Southern West Bay BUMP study site on February 24, 1999. The transect began in the well established salt marsh east of the lighthouse.

Figure 22. Photograph taken on February 24, 1999 along transect SW3 at the Southwest Pass - Southern West Bay BUMP study site. The newer deposits were only sparsely vegetated.

Figure 23. Photograph taken on February 24, 1999 along transect SW3 at the Southwest Pass - Southern West Bay BUMP study site. Ponds created by the disposal process collected freshwater and were frequented by cattle and wildlife.

Figure 24. Oblique aerial photograph taken February 6, 1996 of the SW3 area at the Southwest Pass - Southern West Bay BUMP study site, showing the overall low relief of the area.

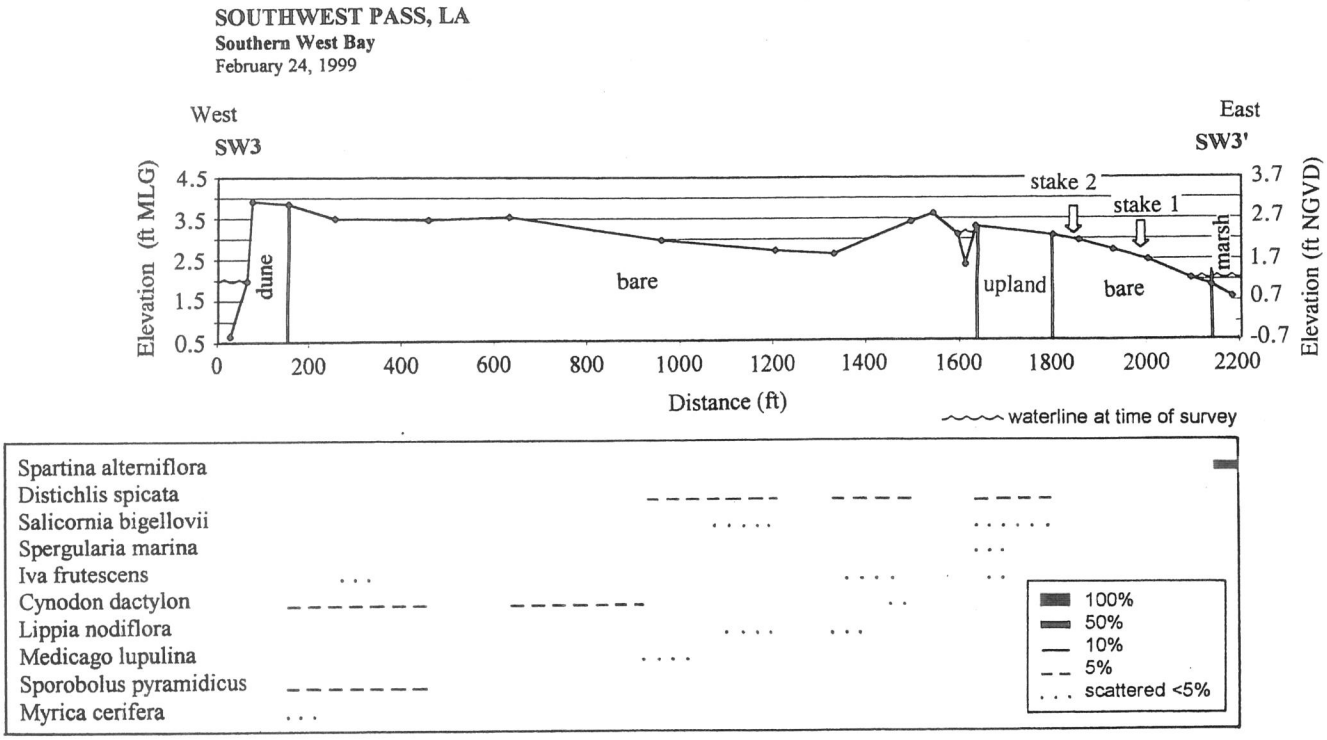


Figure 25. Elevation profile SW3 - South West Bay of the Southwest Pass BUMP study site with vegetation data illustrated. This site received dredged material in FY96 and FY97 and was only sparsely vegetated.

Southwest Pass - East Bay

The Southwest Pass - East Bay site is located on the east side of the channel approximately near Mile 14 BHP (Figure 7). This area is designated a wetland creation site and occupies an open area bordered by artificial ridges created during the dredging and maintenance of the surrounding oil and gas access canals (Figure 26). Disposal within this area is designed to result in a substrate conducive to the creation of wetland habitats. The last dredged material disposal within this area was in FY90 and FY93-94 (see Figures 4 & 5) and resulted in the formation of two lobes of land.

The elevation and vegetation data was acquired February 24, 1999. Access to the area was by helicopter. The transect SW4 was delineated by 1 stake set on each lobe of land approximately 2547 ft apart. The southern lobe was of lower relief and was dominated by a mixed marsh and shrubs (Figure 27 & 28). The two lobes were separated by a wide area of shallow water (Figure 29). The northern lobe supported marsh and grassland upland (Figure 30).

The profile had a length of 3122.4 ft (Figure 31). The maximum relief along the axis is 2.5 ft MLG (1.7 ft NGVD) on the older, more northern lobe of land, and had an average relief of 1.0 ft MLG (0.2 ft NGVD). The water between the two measured parts of the transect was of an unknown depth. The published tidal range for Southwest Pass is 1.3 ft.

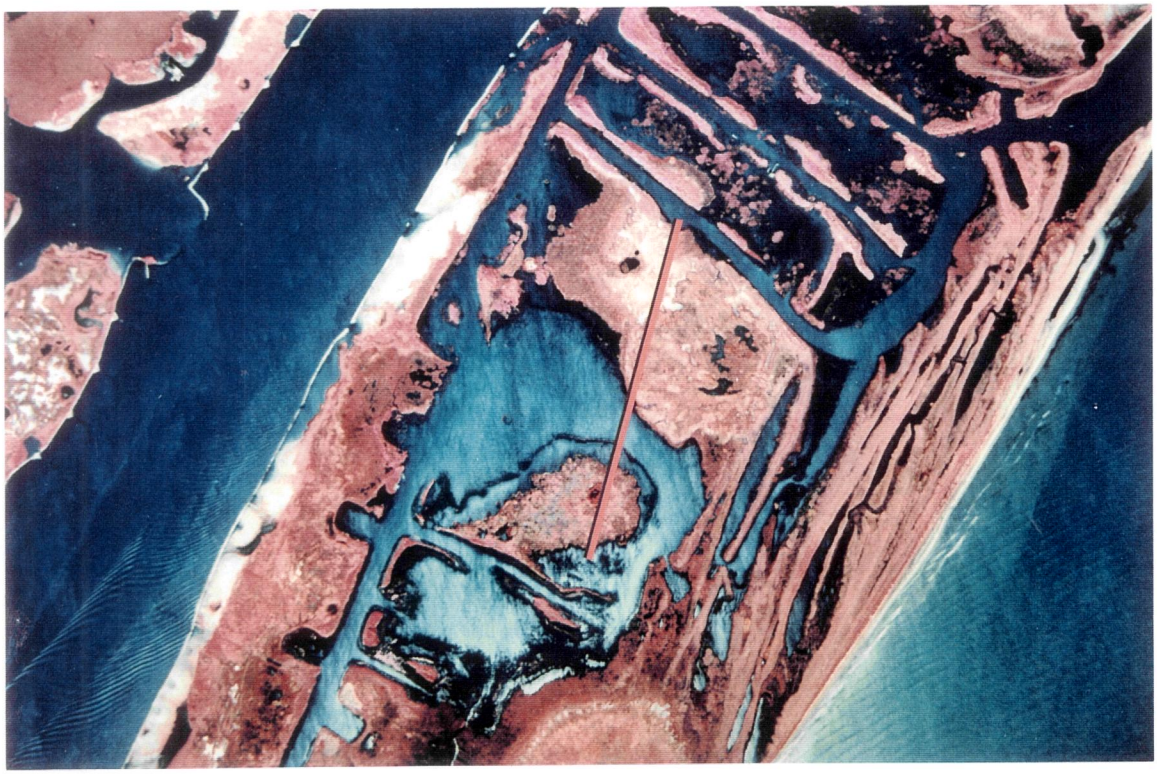


Figure 26. Vertical aerial photograph taken October 16, 1997 containing the transect SW4 of the Southwest Pass - East Bay BUMP study site. The orange line illustrates the approximate location of transect SW4.

Figure 27. Photograph taken February 24, 1999 along transect SW4 - East Bay at the Southwest Pass BUMP study site. This view is of the well-established mixed marsh on the southern side of the south lobe.

Figure 28. Photograph of transect SW4 - East Bay at Southwest Pass BUMP study site on February 24, 1999. This view is of the stake placement within a shrub/scrub habitat on the southern lobe of the transect.

Figure 29. Photograph of transect SW4 - East Bay at Southwest Pass BUMP study site on February 24, 1999, showing the water that separates the two lobes of the transect.

Figure 30. Photograph taken on February 24, 1999 along transect SW4 - East Bay at the Southwest Pass BUMP study site. This view is of fresh marsh approaching the instrument and other stake on the northern lobe of the transect.

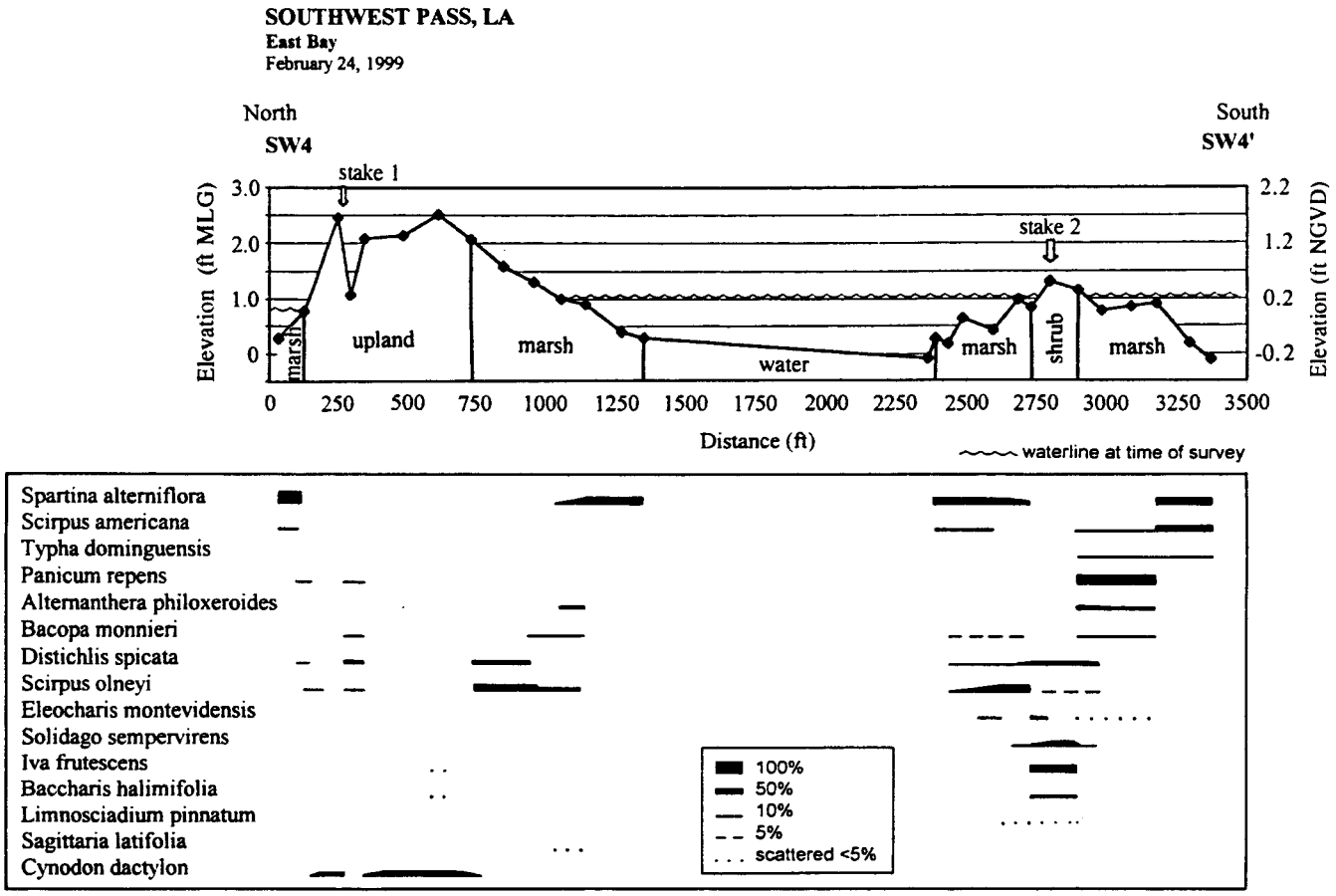


Figure 31. Elevation profile SW4 - East Bay of the Southwest Pass BUMP study site with vegetation data illustrated.

Vegetative Character of Southwest Pass

General Description

Most of the Southwest Pass topography has been created by disposal of dredged material over many years of channel maintenance or has been altered by oil and gas access canals. The older areas were created by multiple disposal events that created elevated areas supporting upland habitats such as grasslands, scattered forest, and shrub/scrub thickets. Uneven placement of the material has led to perched fresh marshes and multiple ponds. Narrow beaches of fine sand or organics occur along the outer shorelines of the Southwest Pass area.

Beneficial use along Southwest Pass navigation channel consisted of placing dredged material along the outer shorelines of existing land, between the foreshore rock dike and the land along the river channel, or in sheltered open water areas for wetland creation.

Southwest Pass is a riverine dominated system that is acted upon by the salt waters of the Gulf of Mexico. There is a great interaction between the seasonal levels of fresh water of the river and the tidal forces of the Gulf of Mexico. The marshes tend to be fresh adjacent to the river channel and toward the upriver reaches of the channel because of the high freshwater flow of the Mississippi River. Saline marshes predominate toward the southern reaches of the channel and toward the outer shorelines more affected by the Gulf. Mixed marshes occur frequently because of the rapidly changing salinity regimes. Erosion of the shoreline is primarily from ship wakes and high flood waters along the channel margins, and primarily from wave action and storms along the outer shores.

Vegetative community types

The overall marsh type for this area ranges between fresh marsh typified by Roseau Cane (*Phragmites communis*), elephantsear (*Colocasia antiquorum*), and bull-tongue (*Sagitarria sp.)*, and salt marsh typified by Oyster grass (*Spartina alterniflora*) and salt grass (*Distichlis spicata*). There is much mixed marsh marked by a mixture of the two where the conditions change too rapidly to preclude either.

Cattle are run on the somewhat isolated islands created by the topography of the channel. The cattle take advantage of the grasslands that have formed on the elevated areas and also create them by the constant removal of young shrubs and saplings during grazing. The grasslands are mostly vegetated by Bermuda grass on the elevated areas and saltgrass and rushes on the lower, wetter areas, with a multitude of other grass species present (see Appendix). A multitude of upland composites are also present.

The forested wetlands are represented by willow trees (*Salix nigra)* along the transects and cypress trees (*Taxodium disticum)* further upriver along the channel. Shrub/scrub habitats are represented by the yellow rattlebox (*Sesbania drummondii*) and marsh elder (*Iva frutescens*).

GIS ANALYSIS RESULTS FOR THE SOUTHWEST PASS NAVIGATION CHANNEL

Shoreline Changes of Southwest Pass: 1985-1997

Figure 32 graphs the spatial history of the Mississippi River - Southwest Pass BUMP study area between December 1985 and October 1997. Table 1 documents the changes and Figure 33 illustrates the changes that took place at Southwest Pass between 1985 and 1997.

In December 1985, the Southwest Pass study area was measured at 9389.5 acres. The study area in October 1997 measured 13,250.2 acres. This is a cumulative area increase of +3860.7 acres at a rate of +326.3 acres per year for this 11.83 year period. The total area of the Southwest Pass BUMP study site increased by 41 percent between 1985 and 1997. There was an overall increase in the area of Southwest Pass of +784.2 acres in the natural areas. The contribution of BUMP related and other man-made areas accelerated the rate of growth by +3076.5 acres. BUMP-made land totaled +7596.8 acres in 1997, with +2536.1 acres of increase between 1985 and 1997. Other man-made land totaled +1541.7 acres, with +540.4 having been created between 1985 and 1997. The BUMP-made habitats accounted for 66 percent of the increase in area of the Southwest Pass Study area between 1985 and 1997.

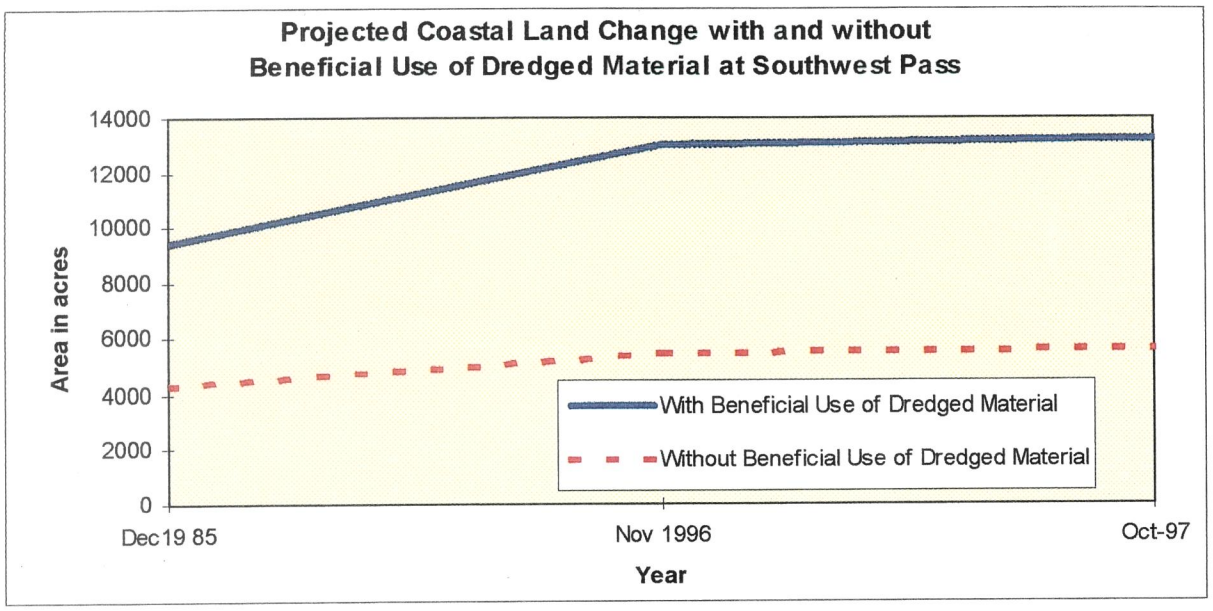


Figure 32. Graph of the area of the Mississippi River - Southwest Pass BUMP study area over time, showing the contribution of the beneficial use of dredged material.

TABLE 1
Mississippi River - Southwest Pass Area: 1985-1997

Area in acres	Dec 1985	Nov 1996	Oct 1997	Area Change 1985-1996	Area Change 1985-1997
Natural Areas	3327.5	4084.4	4111.7	+756.9	+784.2
Other Man-made Areas	1001.3	1390.2	1541.7	+388.9	+540.4
BUMP-made Areas	5060.7	7552.3	7596.8	+2491.6	+2536.1
Total	9389.5	13,026.9	13,250.2	+3637.4	+3860.7

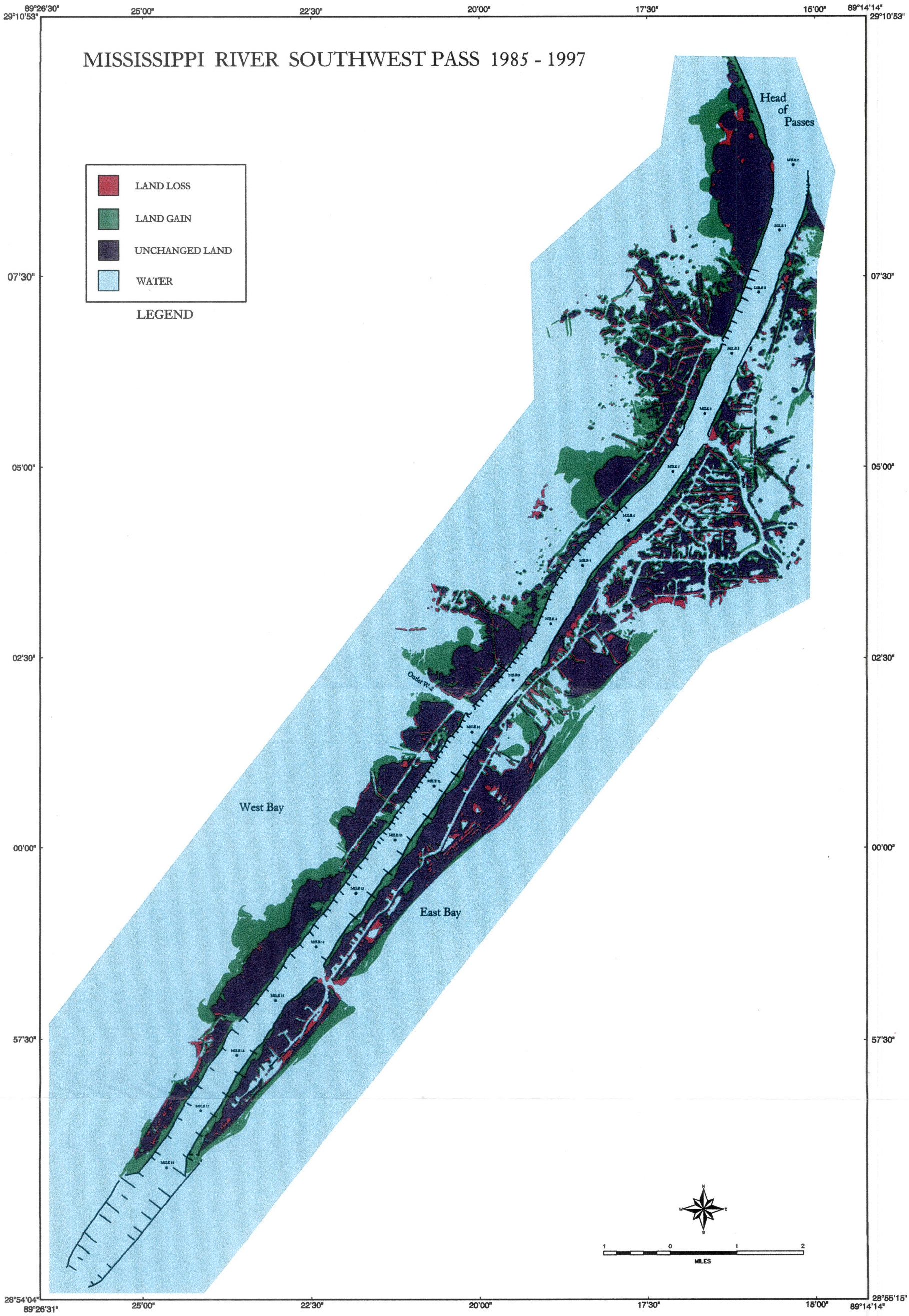


Figure 33. Shoreline changes of the Mississippi River - Southwest Pass BUMP study area between December 1985 and October 1997.

Habitat Inventory

The aerial photographic interpretation combined with field surveys identified six major habitat types in the Mississippi River - Southwest Pass BUMP study area. These habitats are further classified as natural and man-made. The natural class identifies natural deltaic processes as responsible for habitat creation. The BUMP man-made (BUMP-made) class identifies the habitats created by the beneficial-placement of dredged material. The non-BUMP man-made class (Other-made) separates areas created that were not related to the beneficial use of dredged material such as areas created in association with the oil industry access and pipeline canals. Disposal material reworked by natural processes are most often classified as "natural" unless specifically identified by the USACE-NOD as "BUMP-created." On the habitat maps presented in this report, an intertidal class is included to indicate nearshore topography. Because the seaward extent of these areas is not clearly defined, the area of this class is not calculated or included in the inventory.

Table 2 lists the areas of the six habitat types found in the Mississippi River - Southwest Pass BUMP study area in December 1985. The location and arrangement of these habitats is presented in figure 34. The total area of the Southwest Pass study site was 9,389.5 acres. Of this total, 3,327.5 acres were natural and 6,062.0 acres were man-made including 5,060.7 acres of BUMP-made and 1,001.3 acres of other-made. Habitats within the BUMP study site were 35.4 percent natural, 53.9 percent BUMP-made and 10.7 percent other-made.

In order of decreasing size and importance, the largest habitats found were natural marsh (2,964.2 acres) and BUMP-made marsh (2,049.7 acres), followed by BUMP-made upland (1,636.6 acres), BUMP-made bare land (1,250.5 acres), other-made marsh (417.0 acres), and other-made shrub/scrub (326.6 acres).

In terms of habitat totals, marsh (5,430.9 acres or 57.8%) dominated the Mississippi River - Southwest Pass landscape.

TABLE 2
December 1985 Habitat Inventory of the
Mississippi River - Southwest Pass BUMP Study Area

HABITAT	TOTAL	NATURAL	OTHER-MADE	BUMP-MADE
Marsh	5430.9	2964.2	417.0	2049.7
Upland	1762.8	68.5	57.7	1636.6
Shrub/Scrub	422.0	3.7	326.6	91.7
Forest	139.8	36.6	78.7	24.5
Bare Land	1388.6	16.8	121.3	1250.5
Beach	245.4	237.7	0.0	7.7
Habitat Total	9389.5	3327.5	1001.3	5060.7

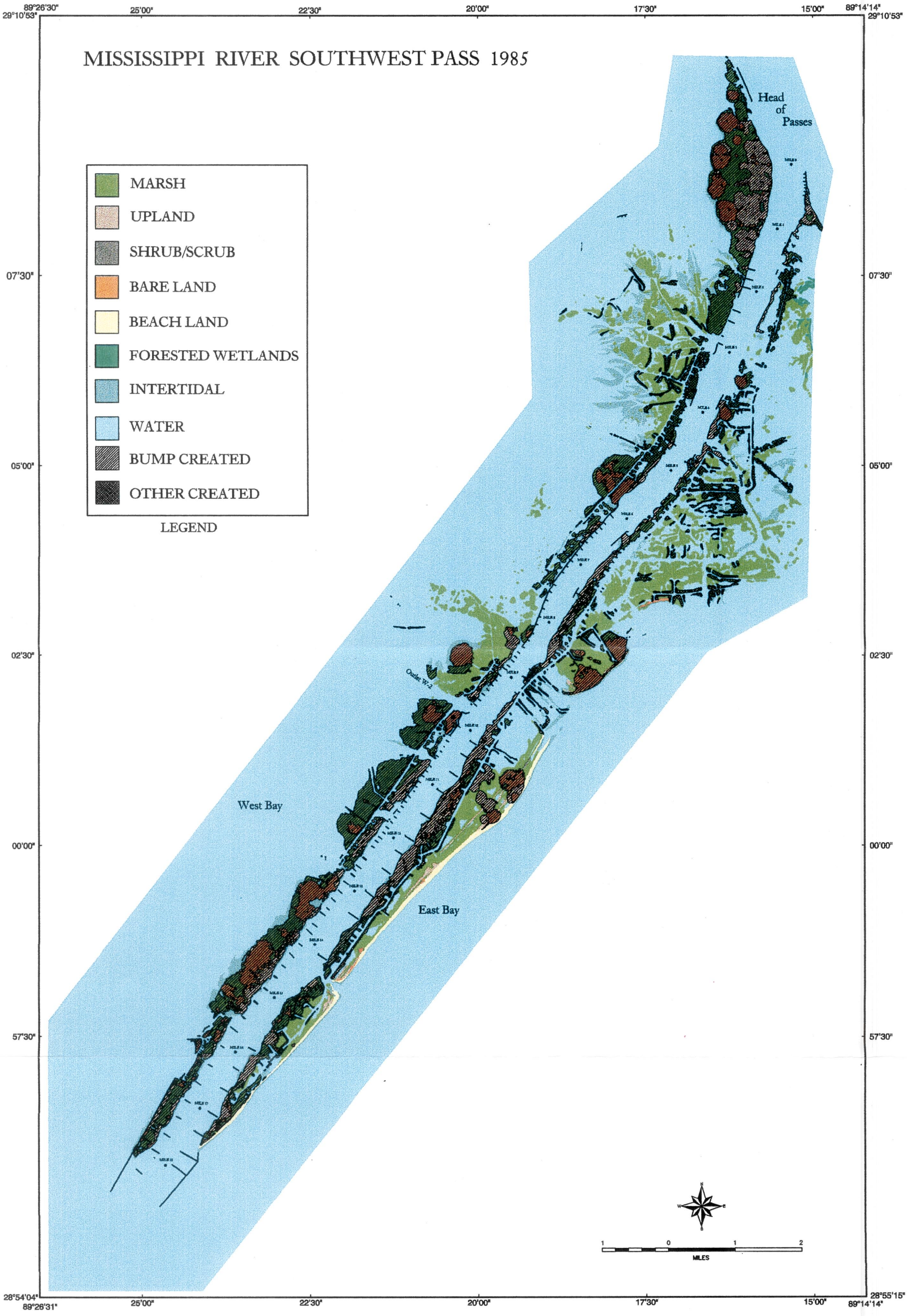


Figure 34. Habitat inventory map of the Mississippi River - Southwest Pass BUMP study area in December 1985.

Table 3 lists the areas of the six habitats found in the Mississippi River - Southwest Pass BUMP study area in October 1997. The location and arrangement of these habitats is presented in figure 35. In 1997, the total area of the Mississippi River - Southwest Pass BUMP study area was calculated at 13,250.2 acres. Of this total, 4,111.7 acres were natural and 9,138.5 acres were man-made including 7,596.8 acres BUMP-made and 1,541.7 acres other-made. Habitats were 31.1 percent natural, 57.3 percent BUMP-made and 11.6 percent other-made.

In order of decreasing size and importance, the largest habitats found were BUMP-made marsh (3756.4 acres) followed by natural marsh (3640.4 acres), BUMP-made upland (1830.1 acres), and BUMP-made shrub/scrub (1241.3 acres).

In terms of total area, marsh (7900.7 acres or 59.6%) dominated the landscape of the Mississippi River - Southwest Pass BUMP study area.

TABLE 3
October 1997 Habitat Inventory of the
Mississippi River - Southwest Pass BUMP Study Area

HABITAT	TOTAL	NATURAL	OTHER-MADE	BUMP-MADE
Marsh	7900.7	3640.4	503.9	3756.4
Upland	2181.2	203.8	147.3	1830.1
Shrub/Scrub	1747.1	23.5	482.3	1241.3
Forest	413.4	58.7	315.8	38.9
Bare Land	803.2	2.6	90.8	709.8
Beach	204.6	182.7	1.6	20.3
Habitat Total	13250.2	4111.7	1541.7	7596.8

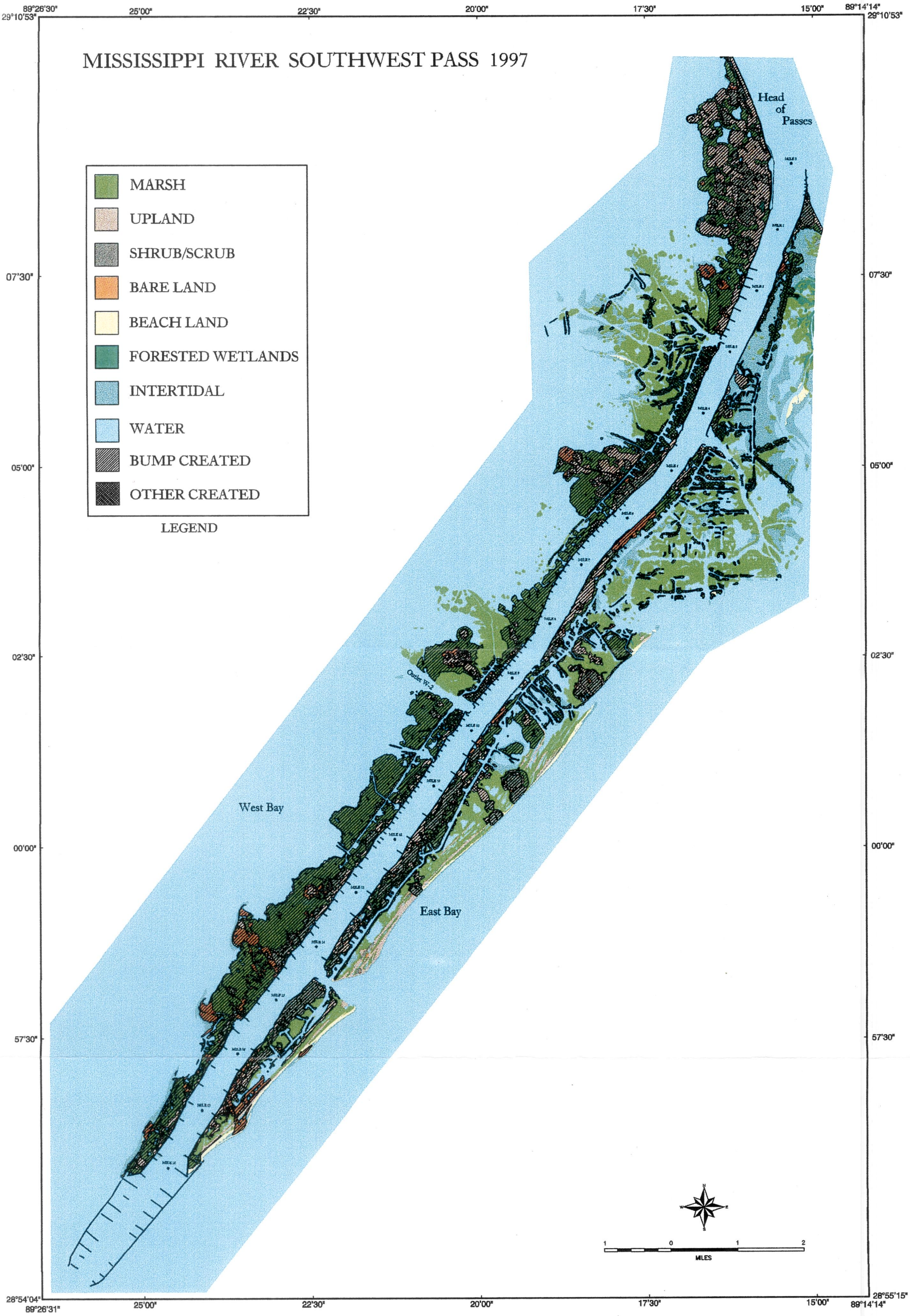


Figure 35. Habitat inventory map of the Mississippi River Southwest Pass BUMP study area in October 1997.

Habitat Change

Figure 36 shows changes over time of the major habitat categories: natural, other-made and BUMP-made. Figure 37 shows the creation of new habitat, both natural and man-made, along the Mississippi River - Southwest Pass BUMP study area by comparing December 1985 and October 1997. Land gain due to beneficial use of dredged materials dominates the processes of this area. The total area increased by +3860.7 acres which represents a +41 percent increase in area between 1985 and 1997. There was an overall increase of +784.2 acres of the natural habitats, an increase of +540.49 acres in other-made habitats, and an increase of +2536.1 acres of BUMP-made habitats. Table 4 lists the major habitat changes during the period between December 1985 and October 1997.

The greatest cumulative habitat changes between 1985 and 1997 were the increases of BUMP-made marsh (+1706.78 acres) and BUMP-made shrub/scrub (+1149.6 acres). For the natural areas, there was a gain of +676.2 acres of marsh and +135.3 acres of upland. The overall change in natural and man-made habitats was an increase of +3860.7 acres.

Figure 38 shows a time series of habitat changes along the Mississippi River - Southwest Pass BUMP study area. Figure 38A graphs the natural habitat changes over time. Natural land building and erosion dominates the processes effecting the natural habitat class. Figure 38B graphs the other-made habitat changes over time. Marsh and shrub/scrub creation by beneficial use of dredged material dominates the man-made class. Figure 38C graphs the BUMP-made changes over time.

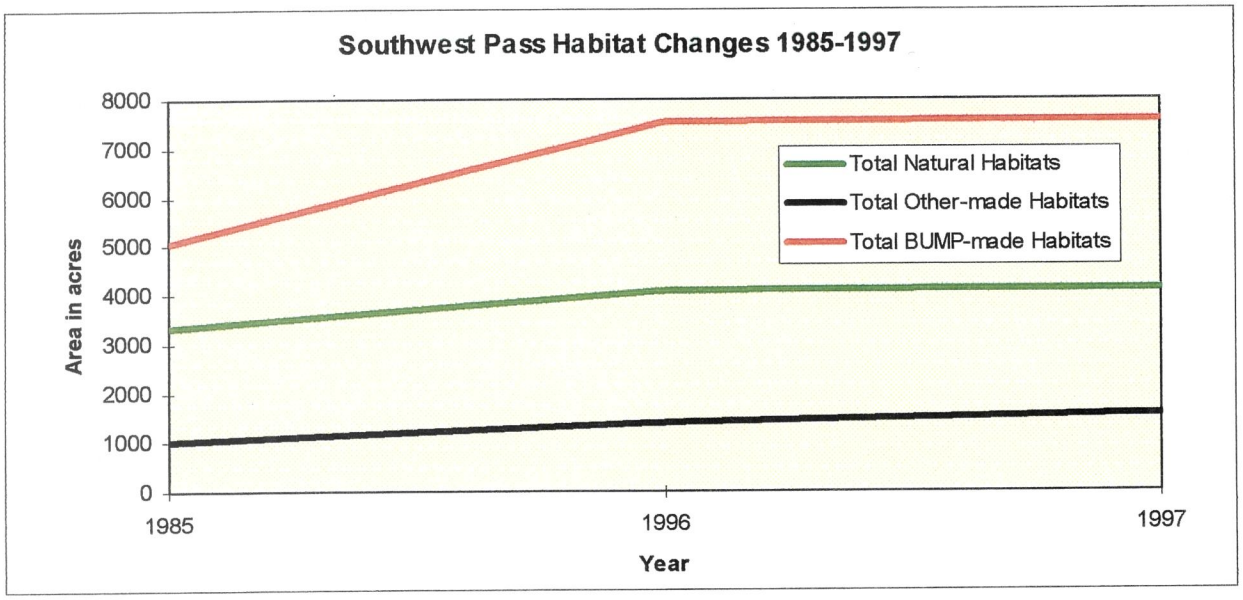


Figure 36. Graph showing the relative change in total area of the major habitat categories: natural, other-made, and BUMP-made, between 1985 and 1997.

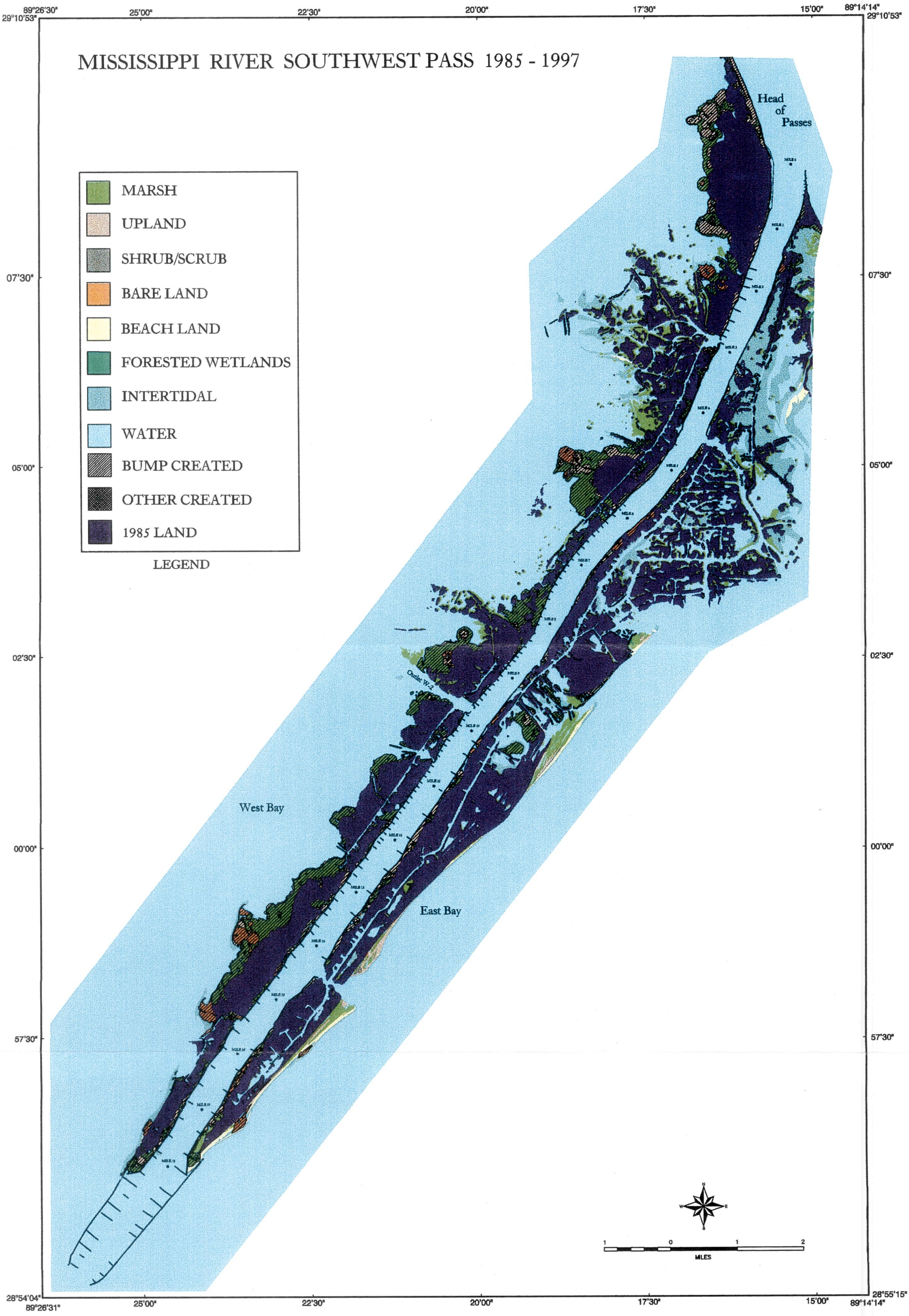
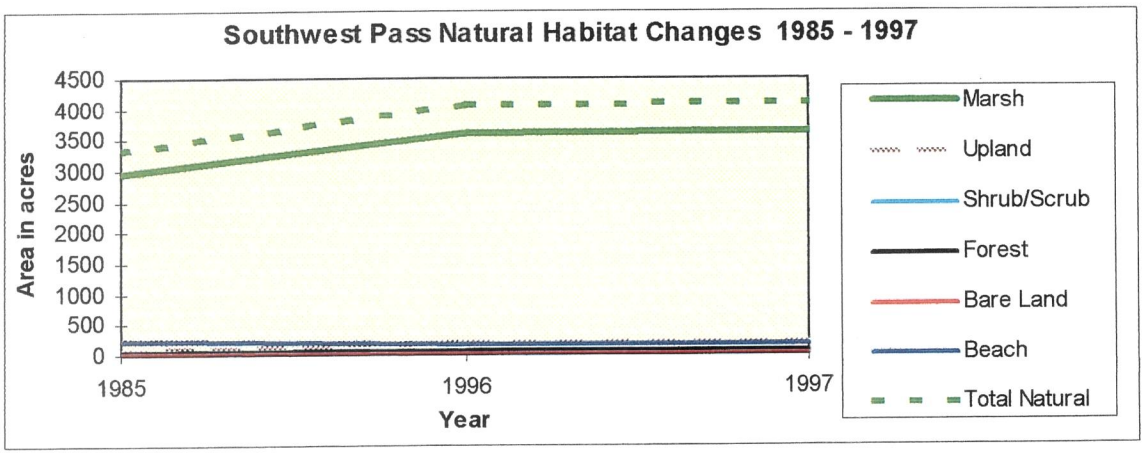


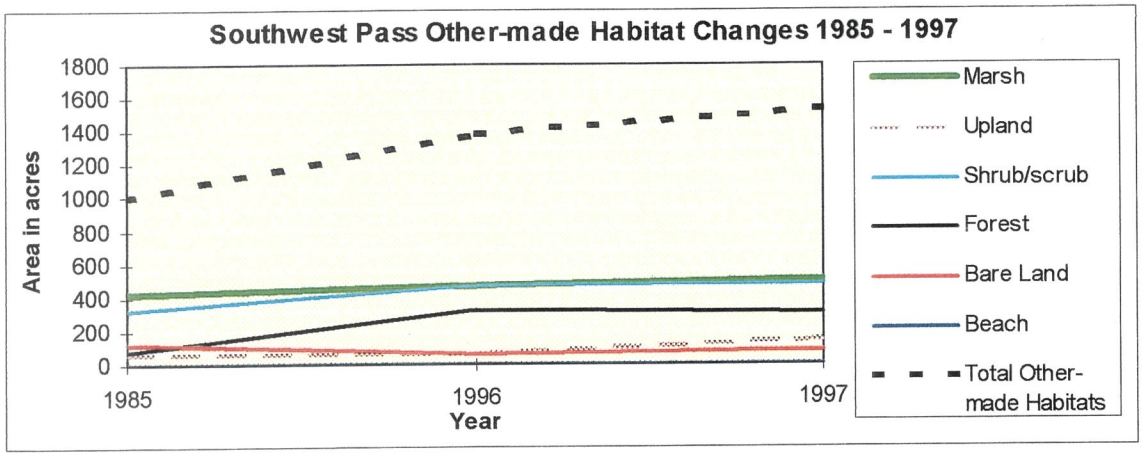
Figure 37. Map of the Mississippi River - Southwest Pass BUMP study area showing the new habitats created by beneficial use of dredged material or formed by natural processes between December 1985 and October 1997.

TABLE 4
Cumulative Change in Total Area of each Habitat in the Southwest Pass Study Area between 1985 and 1997[1]

HABITAT	Dec 1985	Oct 1997	AREA CHANGE
Natural Marsh	2964.2	3640.4	+676.2
Natural Upland	68.5	203.8	+135.3
Natural Shrub/Scrub	3.7	23.5	+19.8
Natural Forest	36.6	58.7	+22.1
Natural Bare Land	16.8	2.6	-14.2
Natural Beach	237.7	182.7	-55.0
Total Natural Habitats	3327.5	4111.7	+784.2
Other-made Marsh	417.0	503.9	+86.9
Other-made Upland	57.7	147.3	+89.6
Other-made Shrub/Scrub	326.6	482.3	+155.7
Other-made Forest	78.7	315.8	+237.1
Other-made Bare Land	121.3	90.8	-30.5
Other-made Beach	0	1.6	+1.6
Total Other-made Habitats	1001.3	1541.7	+540.4
BUMP-made Marsh	2049.7	3756.4	+1706.7
BUMP-made Upland	1636.6	1830.1	+193.5
BUMP-made Shrub/scrub	91.7	1241.3	+1149.6
BUMP-made Forest	24.5	38.9	+14.4
BUMP-made Bare Land	1250.5	709.8	-540.7
BUMP-made Beach	7.7	20.3	+12.6
Total BUMP-made Habitats	5060.7	7596.8	+2536.1
HABITAT TOTAL	9389.5	13250.2	+3860.7

[1] in acres





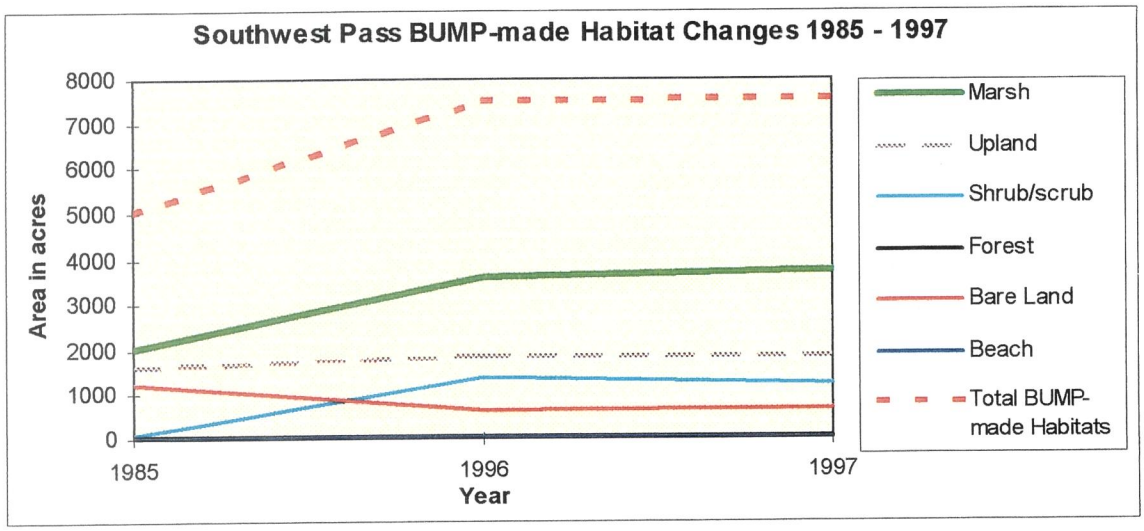


Figure 38. Time series showing the changes in total area of each habitat in the Mississippi River - Southwest Pass BUMP study area between December 1985 and October 1997. A) natural habitat changes. B) Other-made habitat changes. C) BUMP-made habitat changes.

PASS A LOUTRE

The Pass a Loutre BUMP study site (PAL) is located on the east side of the Mississippi River navigation channel, north of the Pass a Loutre channel, upriver of Southwest Pass, within the Delta Wildlife Refuge. Most of what remains of the Pass a Loutre topography was created by natural deposition by the Mississippi River. The part that borders the navigation channel has been augmented by the disposal of dredged material during channel maintenance and supports a small community named Pilottown. The remaining area is undergoing rapid landloss due to high rates of subsidence in this geologically young area of the Mississippi River Delta, resulting in large open water areas. Breaks through the northern border of this area created crevasse splays to bring sediment into the area. In 1998 this area was designated a beneficial use disposal area for the creation of wetlands. In FY98, the USACE-NOD placed approximately 1,051,661 CY of dredged material into the area (Figure 6).

FIELD SURVEY RESULTS

Methodology

The collection of elevation and vegetation profile surveys was conducted in two phases. Phase-I involved assessing the characteristics of various beneficial use disposal areas to determine the most appropriate sites to document the beneficial use of dredged material and habitat development. This was accomplished by discussion with the USACE-NOD, reviewing vertical aerial photography, and reviewing dredging schedules and history.

Phase-II involved the actual collection of profile data. Gaining access to the selected sites proved to be somewhat difficult. On November 19, 1998, access was not possible because the floatplane did not have enough room to land. It was also determined that the area was too large and open to try access by pirogue. On February 24, 1999, the site was determined to be too unstable for the helicopter to land. Several attempts were made by airboat, but were aborted because of conditions at the Mississippi River that would have been dangerous to a small vessel attempting to cross. On September 23, 1999 two transect lines were successfully positioned across the recently placed dredged material utilizing an airboat for access (Figure 39). Both transects were surveyed from a navigation marker platform because of high water conditions, and one stake was placed at a distance to define each transect line. Permanent 1-inch diameter by 6-foot galvanized stakes were buried approximately 1-foot in the sediment and secured with concrete. Temporary white, ten-foot PVC poles with flagging and neon orange paint were slipped over the galvanized stakes to make profile siting and re-location easier.

Survey data were collected using a Topcon GTS-300_{DPG} Total-Station, tri-prism, and TDS48 Data Collection System. Horizontal accuracy of the GTS-300 is 0.25 ft $\pm$ 0.0125 ft., with a vertical accuracy of 0.45 ft $\pm$ 0.0125 ft. The maximum horizontal range with tri-prism is 3,525 ft. A Pathfinder Professional MC-5 global positioning system (GPS) device was used to record the horizontal positions of each stake, instrument location, and the position and exact orientation of each transect line. The transect data collected were processed, referenced to the local tide gage, and entered into a graphic software program to produce topographic profiles.

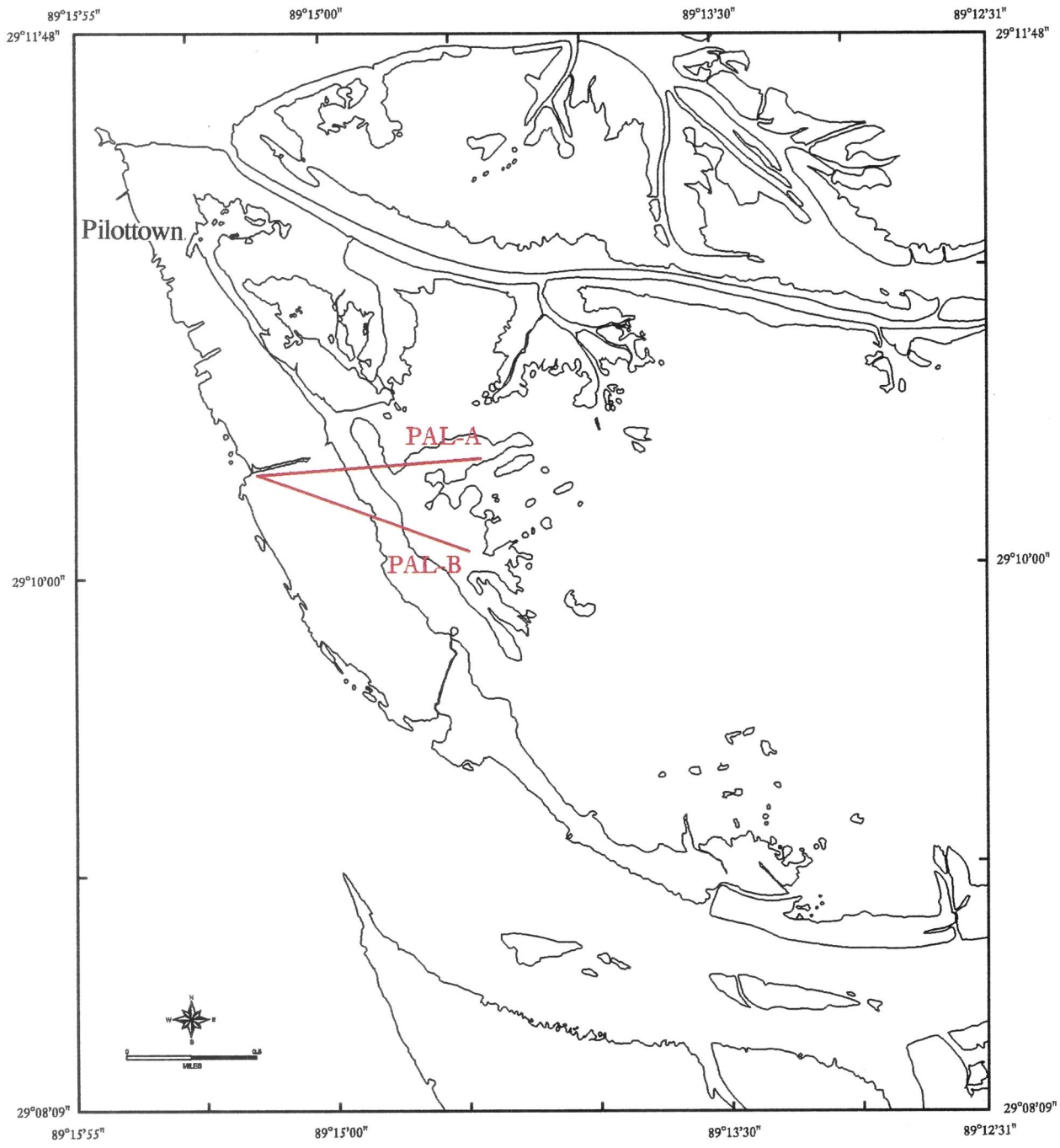


Figure 39. Location of the two elevation and vegetation transects at the Pass a Loutre - BUMP study area.

The topographic profiles for the study area were constructed in reference to Micronautics Tide Table - Southwest Pass Mississippi River station #4593, Louisiana (28°56' N / 89° 26' W). The mean diurnal tidal range for the Southwest Pass study area is published as 1.3 ft.

Initial ground truthing for habitat verification was done on November 19, 1998 by an overflight in a small plane and showed bare land of low elevation and little relief (Figure 40). This landscape correlates with the aerial photography taken on January 11, 1999 that was used for all statistical analyses. Field monitoring for vegetative species composition and habitat verification was done on September 23, 1999, after a full season of vegetative growth. Species composition was determined within a six-foot swath along each profile, and major divisions between vegetative communities were entered as points on the elevation profile. No submerged aquatic species were considered for this report. Plants were identified in the field. The percent composition of each species was visually estimated to determine the relative coverage and dominance of species for habitat clarification. These percentages were not intended to provide scientific ratios or statistics. The species list included in the Appendix of this report is not complete; it reflects only those species that were readily observed during the profiling period. Some plants can only be identified during a short flowering period which may not have coincided with the ground truthing or the profile data collection, and therefore can not be included in the list other than by a broad classification.

Figure 40. Oblique aerial photography taken on November 19, 1998 of the Pass a Loutre BUMP study site showing the low relief of the newly placed bare land.

Profiles at Pass a Loutre

The 1999 profiles were established with one metal pole (stake) partially buried and anchored with concrete, and extending 2-3 feet from the sediment surface. The two transects converged at the site of the survey instrument which was placed on a navigation marker platform near the Mississippi River navigation channel at mile 1.4 AHP, just south-east of Pilottown (Figure 41). The platform provided the best vantage-point for the disposal area and was the only dry and stable area along either transect. The area along the navigation channel has been used for disposal during maintenance dredging for many years prior to 1985. The last disposal within the Pass a Loutre disposal area was in FY98 (Figure 6). Access to the area was by airboat.

The elevation and vegetation data were acquired September 23, 1999. The Pass a Loutre transect A-A' is oriented east-west to cross the recently placed dredged material (Figure 39). One stake defines the transect and was placed 3727 feet from the survey platform, on the highest point of land, still 2-3 inches below the water level. The Pass a Loutre transect B-B' is oriented southeast-northwest to cross the recently placed dredged material. One stake defines the transect and was placed 4082 feet from the survey platform, on the highest point of land, still 3 inches below the water level. The western end of both transects terminate at the navigation platform. The navigation platform is located on the Mississippi River natural levee that has been augmented with channel maintenance dredged material for many years and is elevated and well vegetated. The eastern end of each transect terminates with the last bit of marsh into the open water of the bay (Figure 42). The entire area was flooded by high water at the time of the survey, and many plants escaped detection and documentation. The transects crossed multiple lobes of well vegetated marsh separated by water channels and drainage features (Figure 43).

The new material was being colonized by a fresh marsh consisting primarily of bulrush (*Scirpus americanus*) (Figure 44). Other species present include bull-tongue (*Sagittaria* sp.), black rush (*Juncus roemerianus*) and roseau cane (*Phragmites communis*). Willow tree seedlings (*Salix nigra*) were colonizing the more elevated new areas near the bay. Elephantsear (*Colocasia antiquorum*) outlined the margin of the former shoreline and yellow rattlebox (*Sesbania drummondii*) was found on elevated areas. The disposal material was consisted of silty sand.

Profile A - A' had a length of 4273.7 ft (Figure 45). The maximum relief along the axis was 3.7 ft MLG (2.9 ft NGVD) at the location of survey instrument along the navigation channel, with an average relief of 1.8 ft MLG (1.0 ft NGVD). Profile B - B' had a length of 4537.4 ft (Figure 46). The maximum relief along the axis was 3.7 ft MLG (2.9 ft NGVD) at the location of survey instrument along the navigation channel, with an average relief of 2.1 ft MLG (1.3 ft NGVD). The published tidal range for the Southwest Pass area that includes Pass a Loutre is 1.3 ft.

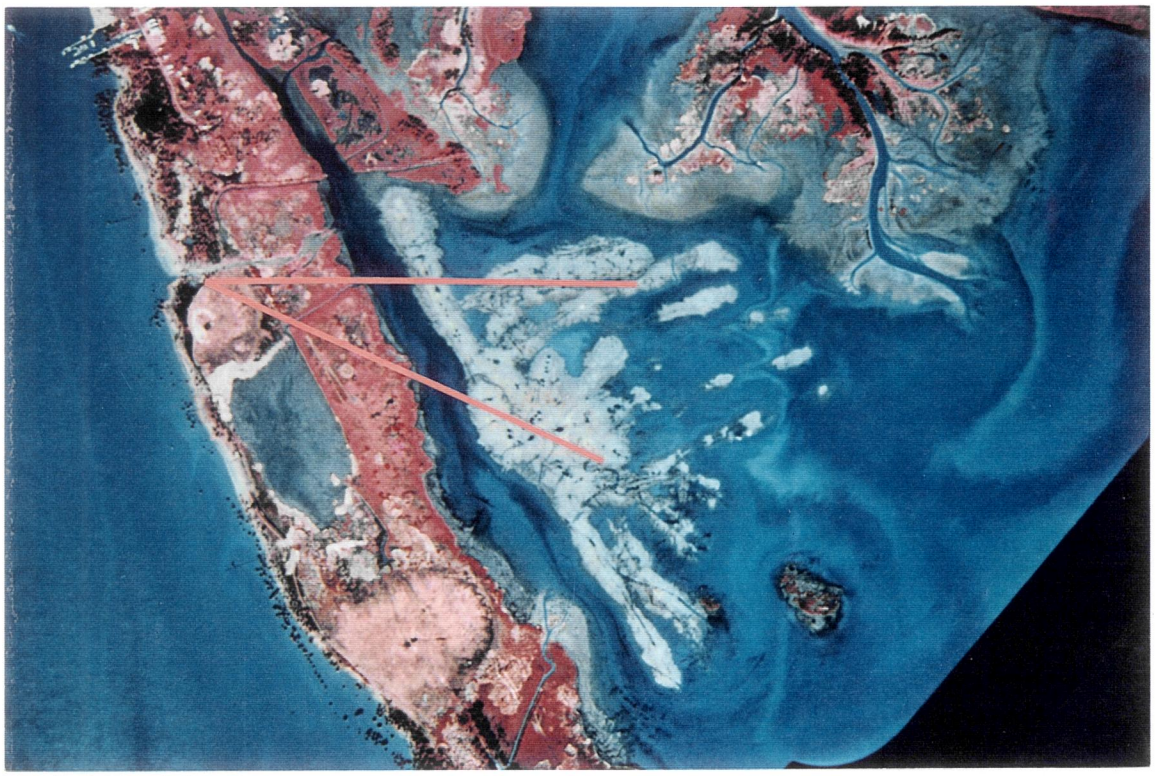


Figure 41. Infrared, vertical aerial photography taken on January 11, 1999 of the Pass a Loutre BUMP study site. The approximate locations of the transects are represented by the orange lines.

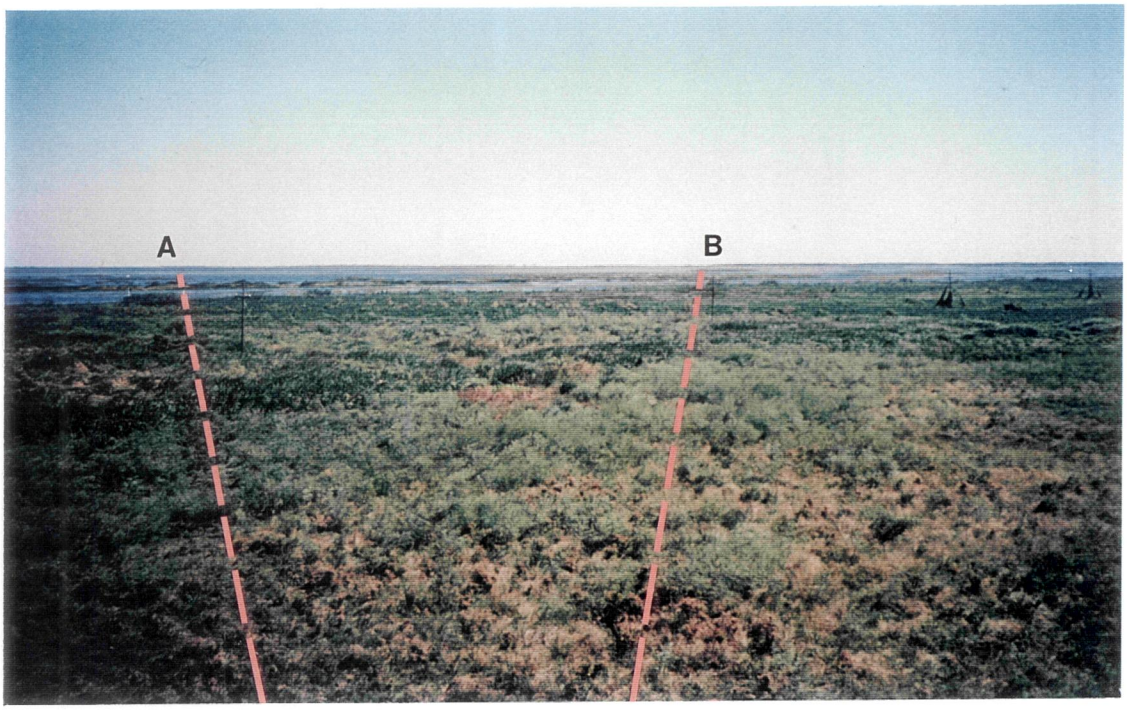


Figure 42. Photograph taken on September 23, 1999 from the navigation marker platform showing both transects, A-A' and B-B', at the Pass a Loutre BUMP study site.

Figure 43. Photograph taken on September 23, 1999 along transect A-A' at the Pass a Loutre BUMP study site showing the colonizing fresh marsh separated by channels of water.

Figure 44. Photograph taken on September 23, 1999 along transect A-A' at the Pass a Loutre BUMP study site, showing colonizing fresh marsh.

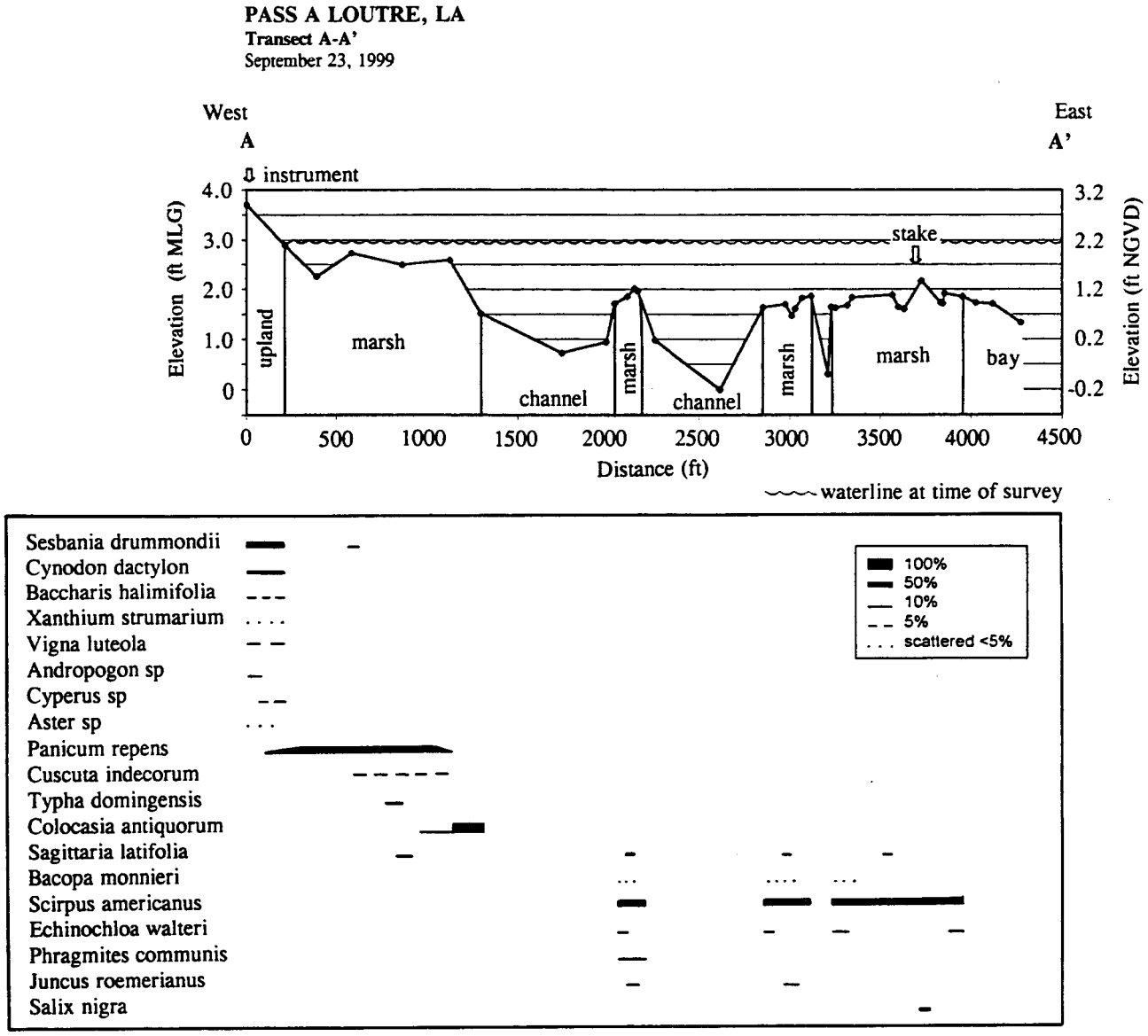


Figure 45. Elevation profile A-A' at the of the Pass a Loutre BUMP study site with vegetation data illustrated.

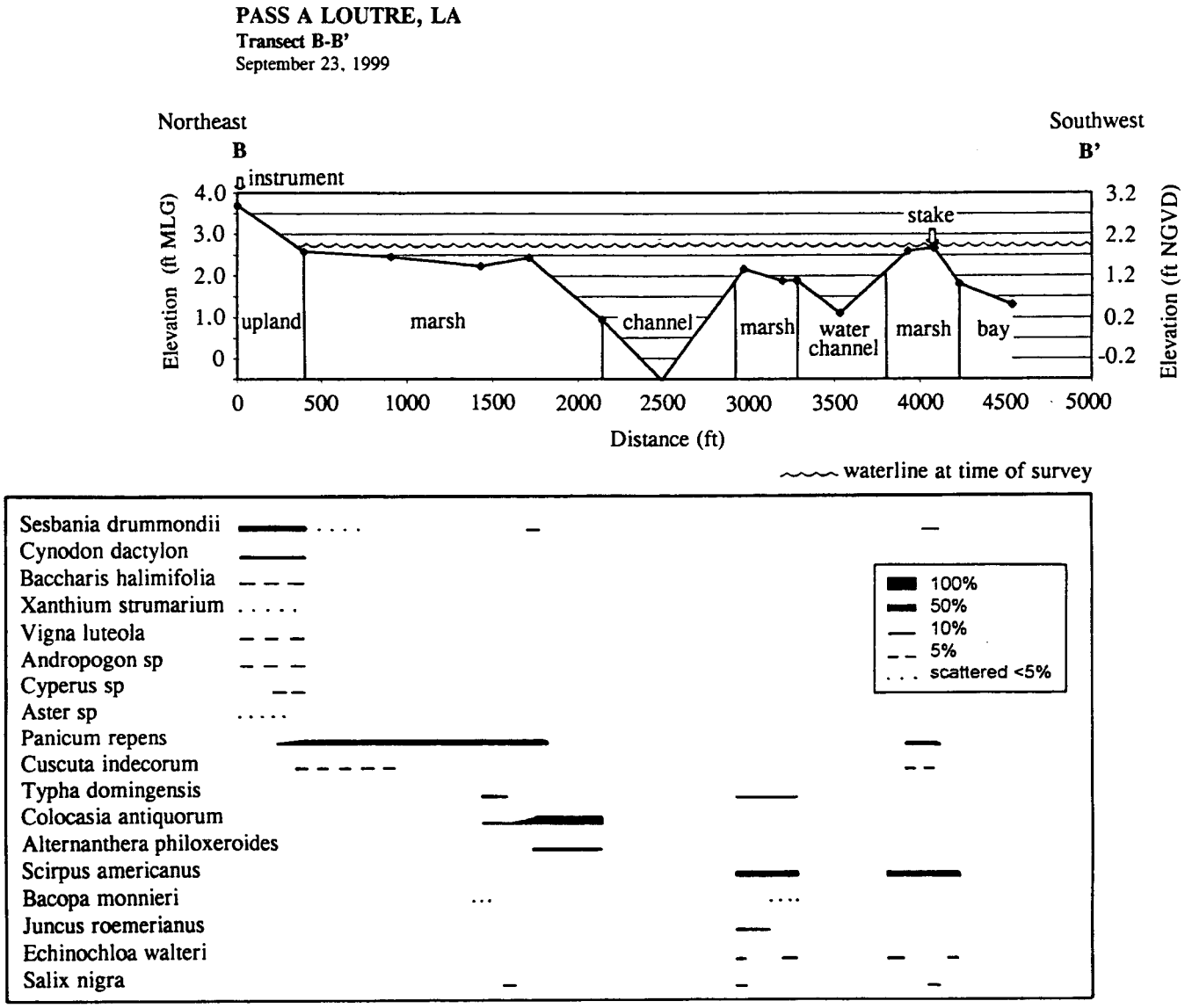


Figure 46. Elevation profile B-B' at the of the Pass a Loutre BUMP study site with vegetation data illustrated.

Vegetative Character of the Pass a Loutre BUMP study area

General Description

The Pass a Loutre BUMP study area is a riverine dominated system that is subjected to flood and tidal forces. There is a great interaction between the seasonal levels of fresh water of the river and the tidal forces of the Gulf of Mexico. The marshes tend to be fresh.

Vegetative community types

The overall marsh type for this area ranges between fresh marsh typified by roseau cane (*Phragmites communis*), elephantsear (*Colocasia antiquorum*), bulrush (*Scirpus americanus*), black rush (*Juncus roemerianus*), cat-tail (*Typha* sp.) and bull-tongue (*Sagittaria sp.*). Salt marsh typified by Oyster grass (*Spartina alterniflora*) and salt grass (*Distichlis spicata*) occur occasionally along the navigation channel.

The upland represented by grassland are mostly vegetated by Bermuda grass, with a multitude of other grass species present (see Appendix). A multitude of upland composites are also present.

The forested wetland are represented by cypress trees (*Taxodium distichum*) along the channel and willow trees (*Salix nigra*) along the newer river or crevasse splay deposits. Shrub/scrub habitats are represented by the yellow rattlebox (*Sesbania drummondii*), groundsel bush (*Baccharis halimifolia*), Elderberry (*Sambucus canadensis*), Wax-myrtle (*Myrica cerifera*), and marsh elder (*Iva frutescens*).

The newly created BUMP-made land was bare land and of low relief at the time of ground-truthing and GIS datum, but well colonized by marsh species by the time of the elevation profiles nine months later.

GIS ANALYSIS RESULTS FOR THE PASS A LOUTRE BUMP STUDY AREA

Shoreline Changes of Pass a Loutre: 1985-1999

Figure 47 graphs the spatial history of the Pass a Loutre (PAL) BUMP study area between December 1985 and January 1999. Table 5 documents the changes and Figure 48 illustrates the changes that took place at PAL between 1985 and 1999.

In December 1985, the PAL BUMP study area was measured at 1735.9 acres. The study area in January 1999 measured 1976.1 acres. This is a cumulative area increase of +240.2 acres at a rate of +18.4 acres per year for this 13.08 year period. The total area of the PAL BUMP study site increased by +13.8 percent between 1985 and 1999. There was an overall increase in the area of PAL of +51.1 acres in the natural areas. The contribution of BUMP related and other man-made areas accelerated the rate of growth by +189.1 acres. BUMP-made land totaled 197.3 acres in 1999 and other man-made land totaled 66.6 acres. The BUMP-made habitats accounted for +82.1 percent of the increase in area of the PAL BUMP study area between 1985 and 1999.

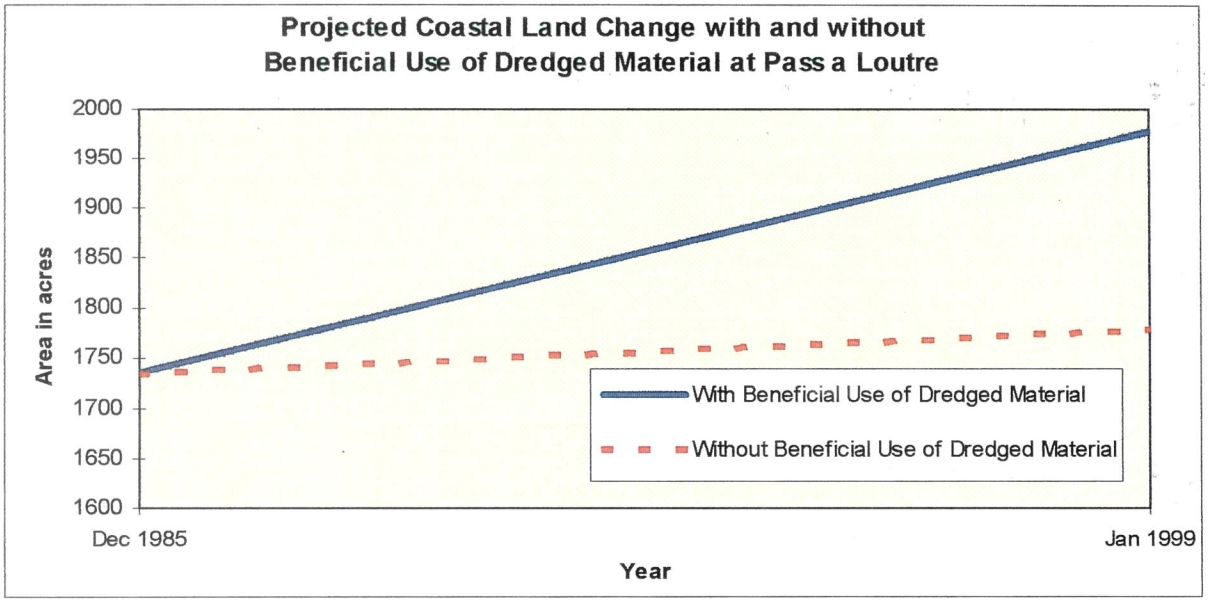


Figure 47. Graph of the area of the Pass a Loutre BUMP study area over time, showing the contribution of the beneficial use of dredged material.

TABLE 5
Mississippi River - Pass a Loutre Area: 1985-1999

Area in acres	Dec 1985	Jan 1999	Area Change
Natural Areas	1661.7	1712.8	+51.1
Other Man-made Areas	74.2	66.0	-8.2
BUMP-made Areas	0	197.3	+197.3
Total	1735.9	1976.1	+240.2

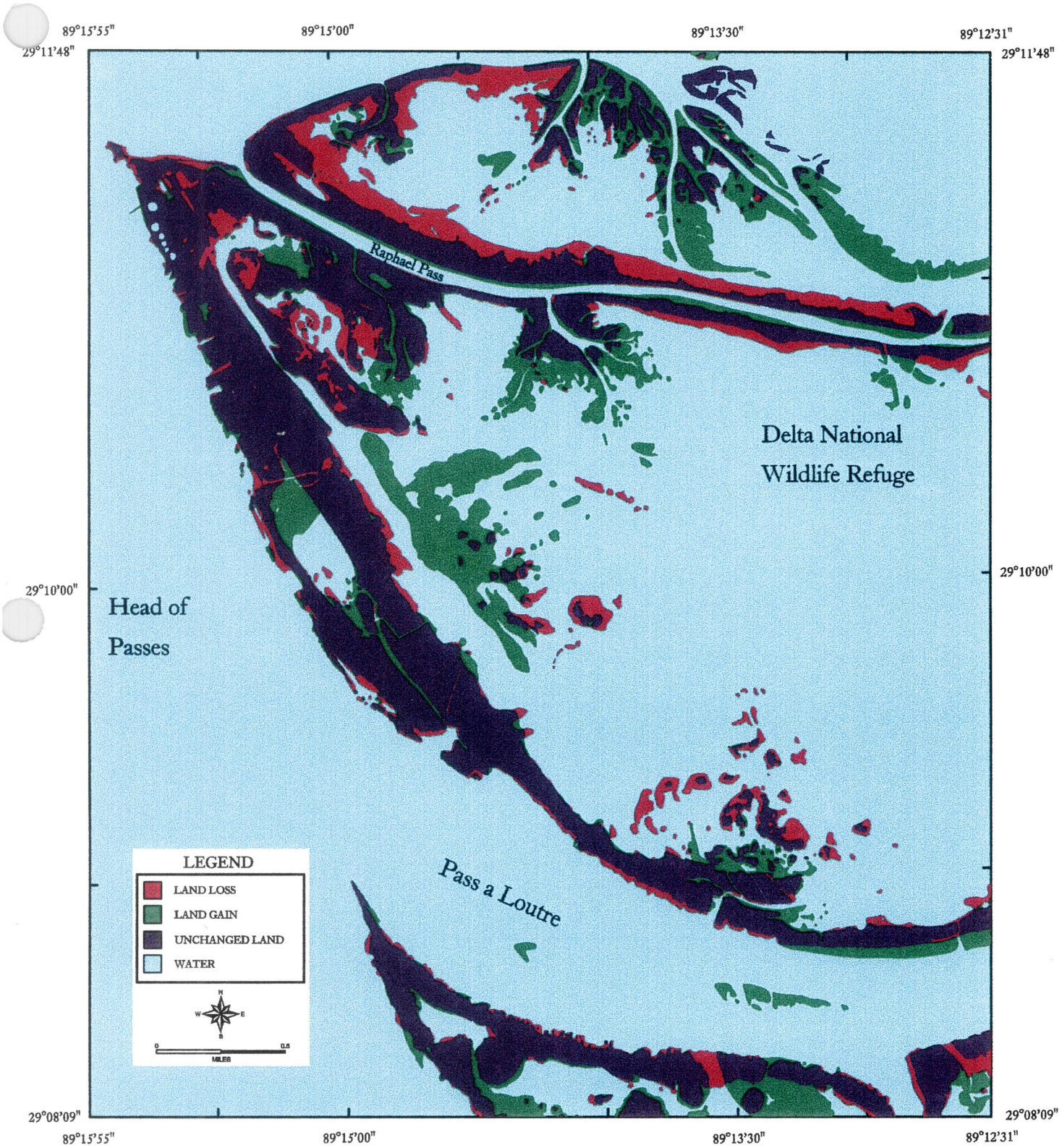


Figure 48. Shoreline changes of the Pass a Loutre BUMP study area between December 1985 and January 1999.

Habitat Inventory

The aerial photographic interpretation combined with field surveys identified six major habitat types in the Pass a Loutre (PAL) BUMP study area. These habitats are further classified as natural and man-made. The natural class identifies natural deltaic processes as responsible for habitat creation. The BUMP man-made (BUMP-made) class identifies the habitats created by the beneficial-placement of dredged material. The non-BUMP man-made class (other-made) identifies areas created as a result of activities other than BUMP, such as areas associated with the oil industry access and pipeline canals, or general channel maintenance. Disposal material reworked by natural processes are most often classified as "natural" unless specifically identified by the USACE-NOD as "BUMP-created." On the habitat maps presented in this report, an intertidal class is included to indicate nearshore topography. Because the seaward extent of these areas is not clearly defined, the area of this class is not calculated or included in the inventory.

Table 6 lists the areas of the six habitat types found in the PAL BUMP study area in December 1985. The location and arrangement of these habitats is presented in figure 49. The total area of the PAL BUMP study site was 1735.9 acres. Of this total, 1661.7 acres were natural and 74.2 acres were man-made with 0 acres of BUMP-made; or 95.7 percent were natural, 0 percent were BUMP-made and 4.3 percent were other-made.

In order of decreasing size and importance, the largest habitats found were natural marsh (1208.7 acres), natural forested wetland (453.0 acres), other-made upland (67.8 acres), and other-made shrub/scrub (6.4 acres).

In terms of habitat totals, marsh (1208.7 acres or 69.6%) dominated the Pass a Loutre 1985 landscape.

TABLE 6
December 1985 Habitat Inventory of the
Pass a Loutre BUMP Study Area

HABITAT	TOTAL	NATURAL	OTHER-MADE	BUMP-MADE
Marsh	1208.7	1208.7	0	0
Upland	67.8	0	67.8	0
Shrub/Scrub	6.4	0	6.4	0
Forested Wetland	453.0	453.0	0	0
Bare Land	0	0	0	0
Beach	0	0	0	0
Habitat Total	1735.9	1661.7	74.2	0

PASS A LOUTRE: 1985

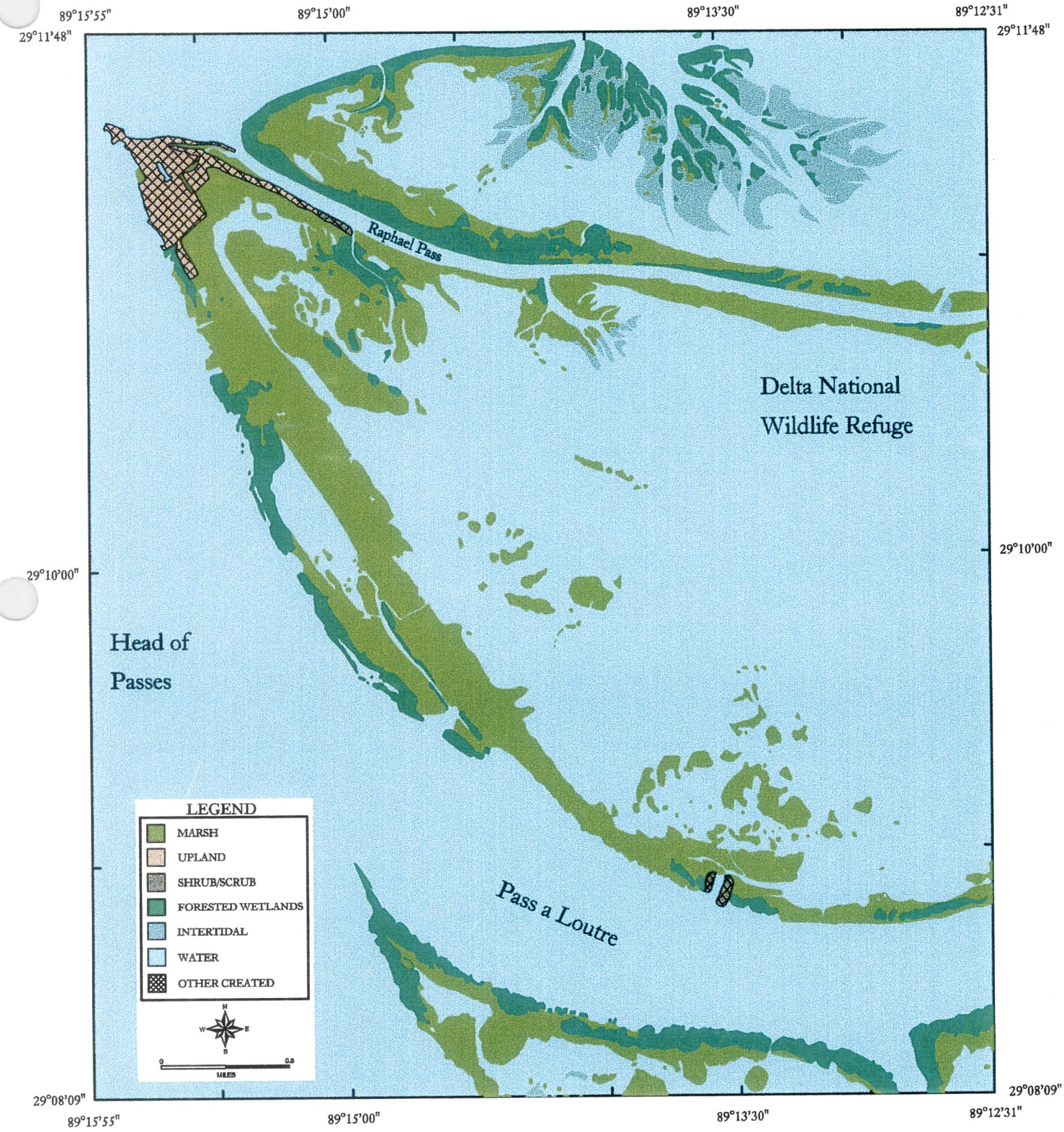


Figure 49. Habitat inventory map of the Pass a Loutre BUMP study area in December 1985.

Table 7 lists the areas of the six habitats found in the PAL BUMP study area in January 1999. The location and arrangement of these habitats is presented in figure 50. In 1999, the total area of the PAL BUMP study area was calculated as 1976.1 acres. Of this total, 1712.8 acres were natural and 263.3 acres were man-made including 197.3 acres BUMP-made and 66.0 acres other-made, or 86.7 percent was natural, 10.0 percent was BUMP-made and 3.3 percent was other-made.

In order of decreasing size and importance, the largest habitats found were natural marsh (1143.2 acres), natural forested wetland (483.4 acres), BUMP-made bare land (140.3 acres), other-made upland (62.1 acres), natural upland (61.1 acres), BUMP-made upland (57.0 acres), natural bare land (18.2 acres), natural shrub/scrub (4.4 acres), other-made shrub/scrub (2.8 acres), natural beach (2.5 acres), and other-made bare land (1.1 acres).

In terms of total area, marsh (1143.2 acres or 57.9%) dominated the landscape of the Pass a loutre BUMP study area.

TABLE 7
January 11, 1999 Habitat Inventory of the
Pass a Loutre BUMP Study Area

HABITAT	TOTAL	NATURAL	OTHER-MADE	BUMP-MADE
Marsh	1143.2	1143.2	0	0
Upland	180.2	61.1	62.1	57.0
Shrub/Scrub	7.2	4.4	2.8	0
Forested Wetland	483.4	483.4	0	0
Bare Land	159.6	18.2	1.1	140.3
Beach	2.5	2.5	0	0
Habitat Total	1976.1	1712.8	66.0	197.3

PASS A LOUTRE: 1999

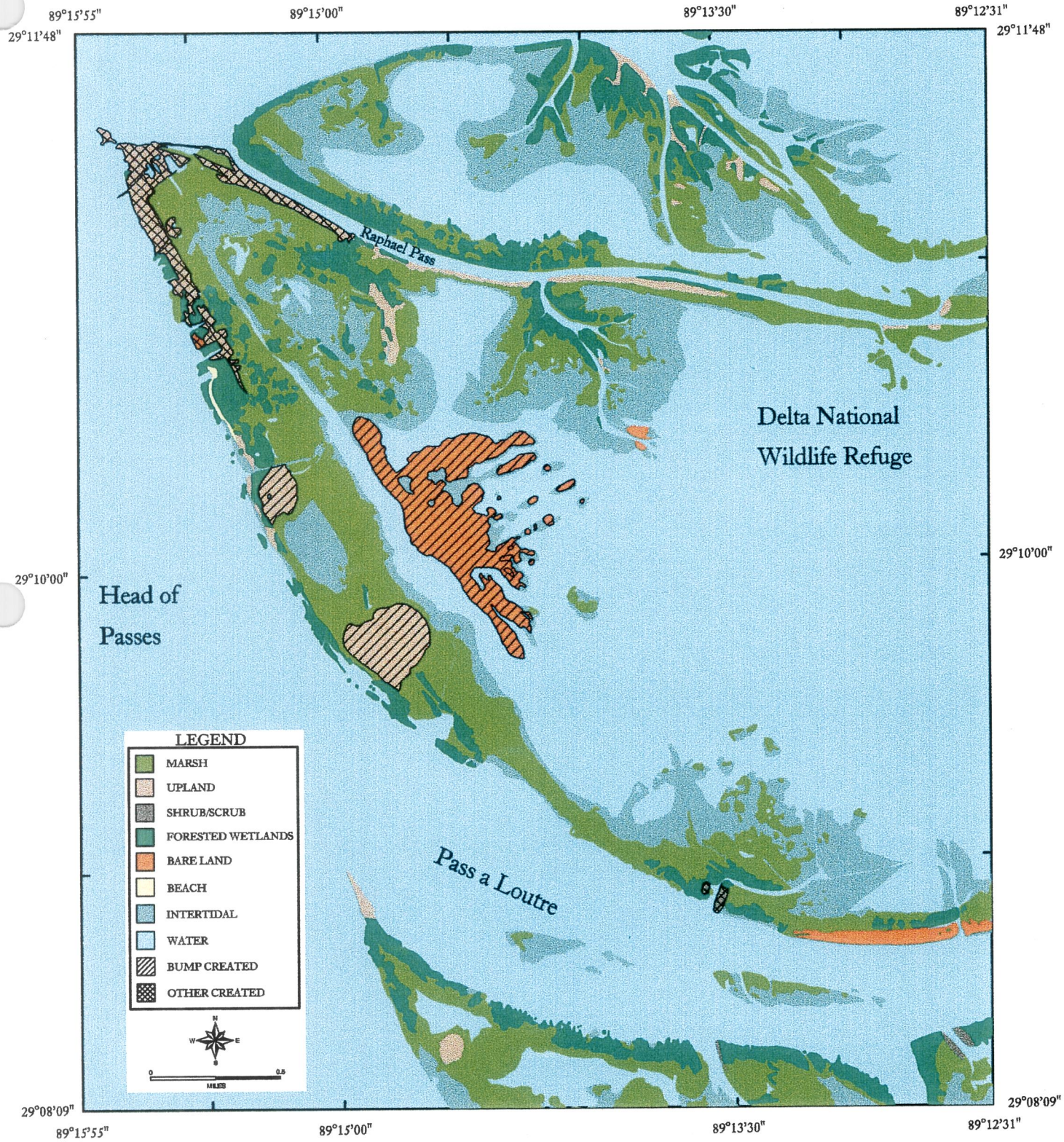


Figure 50. Habitat inventory map of the Pass a Loutre BUMP study area in January 1999.

Habitat Change

Figure 51 shows changes over time at the PAL BUMP study area of the major habitat categories: natural, other-made and BUMP-made. It clearly shows the dominance of the natural habitats. Figure 52 shows the creation of new habitat, both natural and man-made, along the PAL BUMP study area by comparing December 1985 and January 1999. Land gain due to beneficial use of dredged materials dominates the land-change processes of this area. The total area increased by +240.2 acres which represents a 13.8 percent increase in area between 1985 and 1999. There was an overall increase of 51.1 acres of the natural habitats, a decrease of -8.2 acres in other-made habitats, and an increase of +197.3 acres of BUMP-made habitats. Table 8 lists the major habitat changes during the period between December 1985 and January 1999.

The greatest cumulative habitat change between 1985 and 1999 was the increase of BUMP-made bare land (+140.3 acres). The only other habitat change due to BUMP was the increase of +57.0 acres of BUMP-made upland. There was a loss of -5.7 acres of other-made upland, -3.6 acres of other-made shrub/scrub, and +1.1 acres of other-made bare land. For the natural areas, there was a loss of -65.5 acres of marsh and increases of +61.1 acres of upland, +30.4 acres of forested wetlands, +18.2 acres of bare land, +4.4 acres of shrub/scrub, and +2.5 acres of beach. The overall change in natural and man-made habitats was an increase of +240.2 acres.

Figure 53 shows a time series of habitat changes along the Pass a Loutre BUMP study area. Figure 53A graphs the natural habitat changes over time. Natural land building and erosion dominates the processes effecting the natural habitat class. Figure 53B graphs the other-made habitat changes over time. Figure 53C graphs the BUMP-made changes over time. Marsh and shrub/scrub creation by beneficial use of dredged material dominates the man-made class.

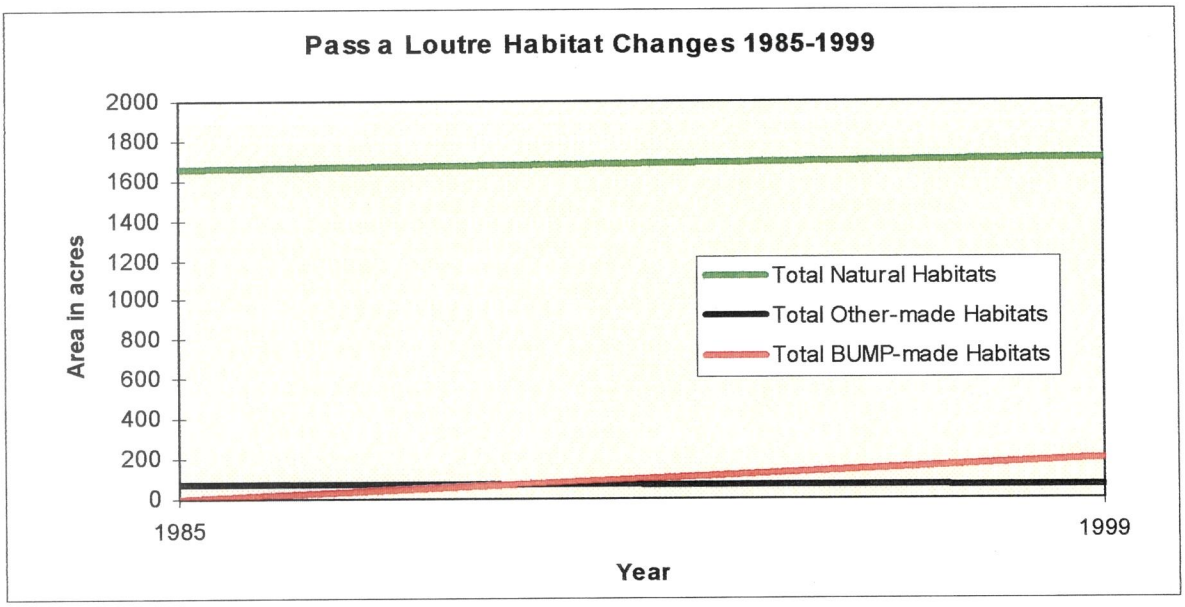


Figure 51. Graph showing the relative change in total area of the major habitat categories: natural, other-made, and BUMP-made, between 1985 and 1999.

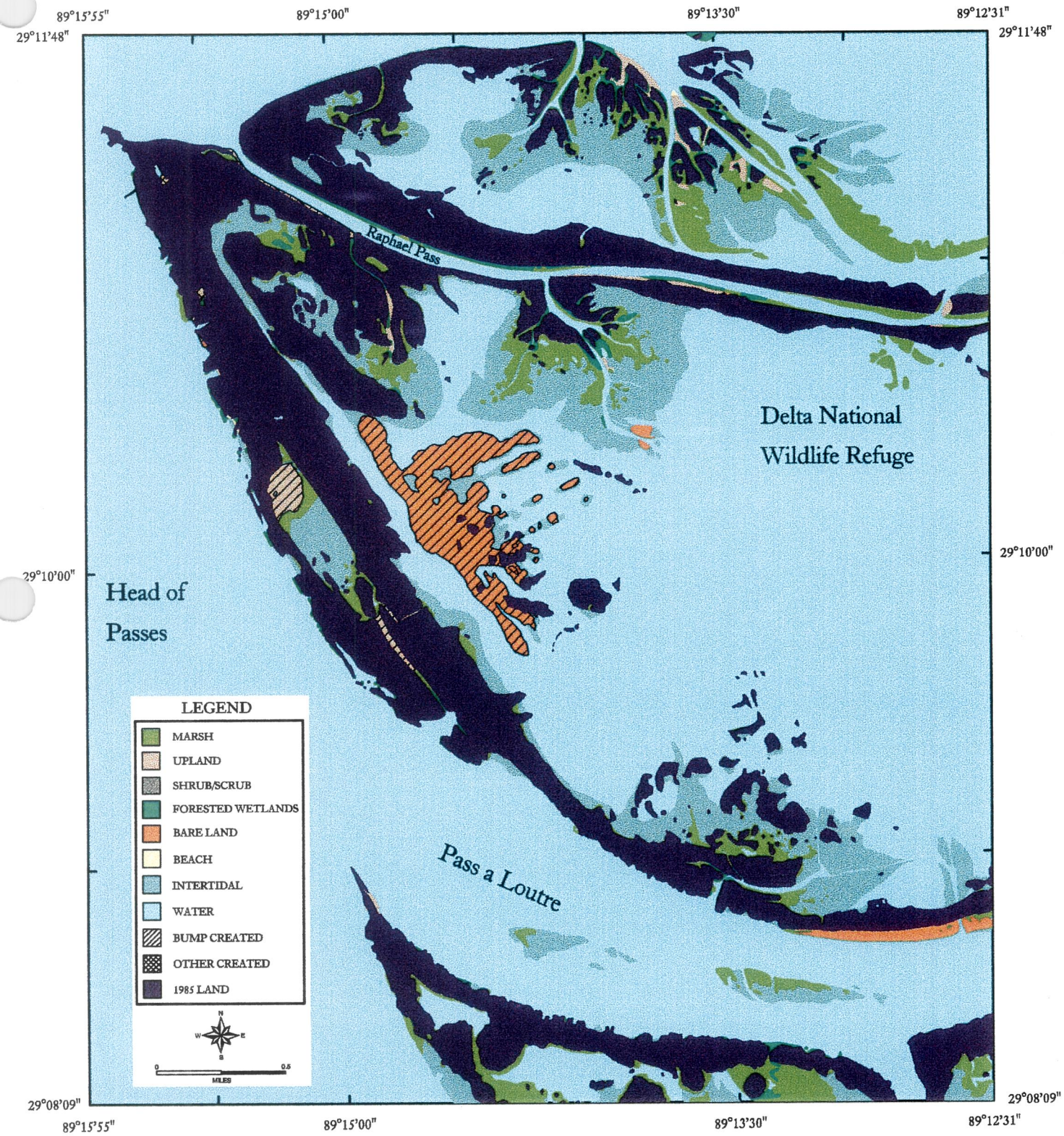
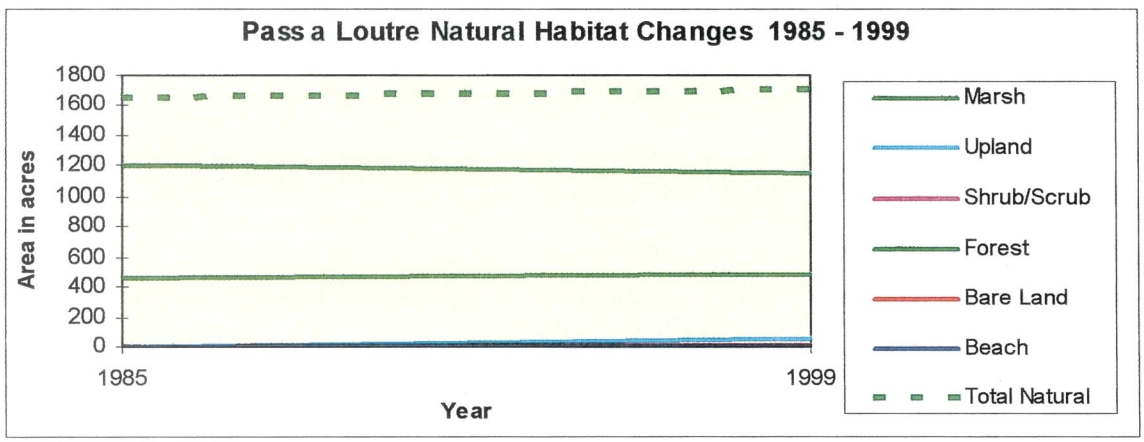


Figure 52. Map of the Pass a Loutre BUMP study area showing the new habitats created by beneficial use of dredged material or formed by natural processes between December 1985 and January 1999.

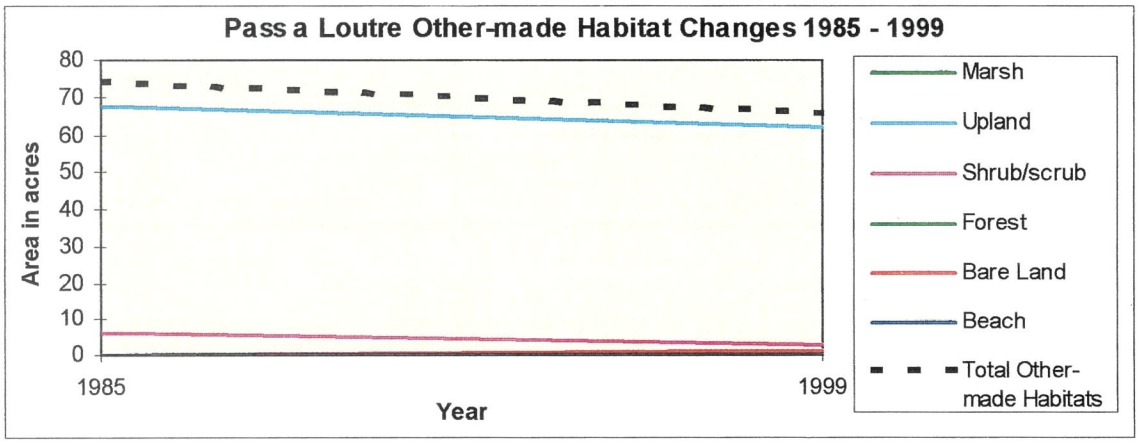
TABLE 8
Cumulative Change in Total Area of each Habitat in the Pass a Loutre Study Area between 1985 and 1999[1]

HABITAT	Dec 1985	Jan 1999	AREA CHANGE	RATE OF CHANGE (acres/yr)
Natural Marsh	1208.7	1143.2	-65.5	-5.0
Natural Upland	0	61.1	+61.1	+4.7
Natural Shrub/Scrub	0	4.4	+4.4	+0.3
Natural Forested Wetland	453.0	483.4	+30.4	+2.3
Natural Bare Land	0	18.2	+18.2	+1.4
Natural Beach	0	2.5	+2.5	+0.2
Total Natural Habitats	1661.7	1712.8	+51.1	+3.9
Other-made Marsh	0	0	-	-
Other-made Upland	67.8	62.1	-5.7	-0.4
Other-made Shrub/Scrub	6.4	2.8	-3.6	-0.3
Other-made Forested Wetland	0	0	-	-
Other-made Bare Land	0	1.1	+1.1	+0.1
Other-made Beach	0	0	-	-
Total Other-made Habitats	74.2	66.0	-8.2	-0.6
BUMP-made Marsh	0	0	-	-
BUMP-made Upland	0	57.0	+57.0	+4.4
BUMP-made Shrub/scrub	0	0	-	-
BUMP-made Forested Wetland	0	0	-	-
BUMP-made Bare Land	0	140.3	+140.3	+10.7
BUMP-made Beach	0	0	-	-
Total BUMP-made Habitats	0	197.3	+197.3	+15.1
HABITAT TOTAL	1735.9	1976.1	+240.2	+18.4

[1] in acres



A



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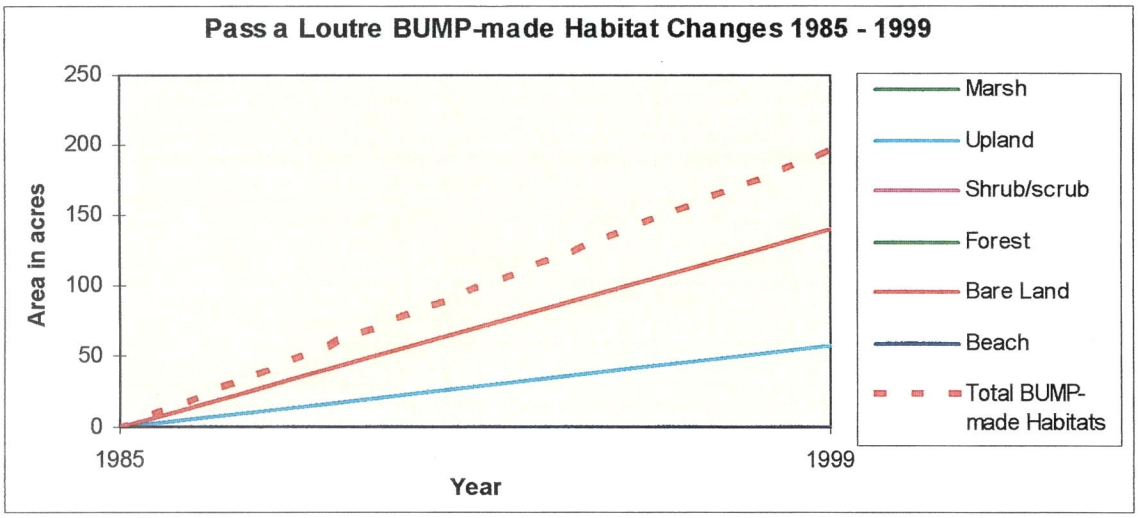

C

Figure 53. Time series showing the changes in total area of each habitat in the Pass a Loutre BUMP study area between December 1985 and January 1999. A) natural habitat changes. B) Other-made habitat changes. C) BUMP-made habitat changes.

CONCLUSIONS

1. The habitat inventory documented that the study area is primarily dominated by man-made habitats along Southwest Pass and natural habitats at Pass a Loutre.

2. Area change:
   A) At Southwest Pass in 1985, the study area contained 9389.5 acres of which 35% were natural and 65% were man-made. In 1997, the study area contained 13250.2 acres of which 31% remained natural and 69% were man-made.
   B) At Pass a Loutre in 1985, the study area contained 1735.9 acres of which 95.7% was natural and 4.3% was man-made. In 1999, the study area contained 1976.1 acres of which 86.7% remained natural and 13.3% remained man-made.

3. Habitat change analysis:
   A) At Southwest Pass, +7596.8 acres of habitat was created by 1997 through the beneficial use of dredged material, with +2536.1 of those acres created since 1985. Significant habitat increases between 1985 and 1997 include +1706.7 acres of BUMP-made marsh, +1149.6 acres of BUMP-made shrub/scrub, +676.2 acres of natural marsh, +237.1 acres of other-made forest, and +193.5 acres of BUMP-made upland.
   B) At Pass a Loutre, +140.3 acres of bare land was created between 1985 and 1999 through the beneficial use of dredged material. Other significant habitat increases include +61.1 acres of natural upland, +57.0 acres of BUMP-made upland, and +30.4 acres of natural forested wetlands where willows colonized new deltaic areas.

4. The beneficial use of dredged material at the Pass a Loutre and Southwest Pass disposal areas has been successful in creating new habitats.

5. The rapid increase in area of Southwest Pass is a result of natural processes accelerated by wetland and other habitat creation as a result of the beneficial use of dredged material.

6. The increase in area of Pass a Loutre is a direct result of the beneficial placement of dredged material offsetting the natural land loss processes of the area.

REFERENCES

Morgan, Joel David, 1977. The Mississippi River Delta - Legal-Geomorphic evaluation of historic shoreline changes in *Geoscience and Man*, Vol. 15, School of Geoscience, Louisiana State University, Baton Rouge, Louisiana.

APPENDIX 2A
LIST OF VEGETATIVE SPECIES
OF THE MISSISSIPPI RIVER - SOUTHWEST PASS
AND PASS A LOUTRE
BUMP STUDY AREAS

LIST OF VEGETATIVE SPECIES
IN THE SOUTHWEST PASS AND PASS A LOUTRE BUMP STUDY AREAS

An alphabetical list of observed and collected plant species follows. This list is not complete, but is meant to establish vegetative character and indicate dominant species observed. The list includes the species name, alternate scientific names, common names, and general habitat description for each plant. The habitat information was taken from the Manual of the Vascular Flora of the Carolinas, The Smithsonian Guide to Seaside Plants of the Gulf and Atlantic Coasts, or Common Vascular Plants of the Louisiana Marsh.

Alternanthera philoxeroides (Mart.) Griseb. . . . . alligator weed
perennial; fresh or intermediate aquatic or very wet habitats

Amaranthus sp. . . . . . amaranth, pigweed
annual herb; fields, waste places

Ambrosia psilostachya DC . . . . . naked-spike ragweed
rhizomatous perennial; sandy woods, meadows and along railroads

Andropogon glomeratus (Walter) BSP . . . . . bushy bluestem, broomsedge
tufted perennials ; fields, roadsides, open woods, savannahs and bogs

Aster sp. . . . . . purple aster
perennial; marshes, sand-mud flats

Atriplex arenaria Nuttall. . . . . Seabeach orach
annual herb; seashores, active dunes, overwash areas, edge of brackish or saline marshes

Baccharis halimifolia L. . . . . Groundselbush
shrub; elevated sites in fresh to saline marshes

Bacopa monnieri (L.) Pennell. . . . . coastal water-hyssop
Succulent, creeping, perennial herb; sandy margins of fresh or brackish marshes, streams and ponds

Chamaesyce serpens . . . . . matted broom-spurge
prostrate annual, poisonous ; sandy barrens, fields, pastures, roadsides

Chenopodium ambrosoides L . . . . . Mexican-tea, American wormseed
erect annual herb; common weed of cultivated fields, pastures and waste ground

Cirsium sp. . . . . . thistle
spiny biennial; roadsides, old fields, waste places, meadows

Colocasia antiquorum (L.) Schot . . . . . elephantsear
large leaf perennial; along shorelines of bayous and lakes in fresh marshes

Cuscuta indecora . . . . . dodder, love-vine
rootless, leafless, parasitic annual; yellow filiform stems; on woody marsh hosts

Cynanchum palustre (Pursh) Heller . . . . . milkweed vine
perennial twining vine; saltmarshes and coastal hammocks

Cynodon dactylon (L.) Persoon. . . . . Bermuda grass
rhizomatous repent perennial grass; fields, roadsides, waste places; valuable as forage

Cyperus oxylepis . . . . . sharp-scale flatsedge
annual; marshes and ditches

Digitaria ciliaris (Retz.) Koel. . . . . crab grass
annual; sandy fields, roadsides, waste places

Distichlis spicata (L.) Greene . . . . . seashore salt grass
rhizomatous perennial; brackish marshes and flats

Echinochloa crusgalli (L.) Beauv. . . . . barnyard grass
coarse annual; low fields, marshes and waste places

Echinochloa walteri (Pursh) Heller . . . . . Walter's millet
coarse annual; marshes and low waste places

Eleocharis montevidensis Kunth. . . . . sand spike-rush
rhizomatous perennial; wet sands

Fimbristylis castanea (Michaux) . . . . . marsh fimbry, sandrush
rhizomatous perennial; brackish marshes, savannahs, meadows

Geranium carolinianum L . . . . . wild geranium
winter annual; disturbed habitats, gardens, fields, pastures, roadsides

Hydrocotyle ranunculoides L.f. . . . . water penny
fleshy aquatic or semi-aquatic perennial; seepage areas, pools, stream margins and swamps

Hydrocotyle umbellata L. . . . . marsh pennywort
low perennial with rounded terminal leaves; low or moist areas - pond shores, swales, slough edges, ditches, freshwater marshes

Hydrocotyle bonariensis Comm. ex Lam. . . . . sea-side pennywort
low perennial; among beach dunes and in moist, open sandy areas - swales, sandy marshes, swamps, sand flats,

Hymenocallis crassifolia Herbert. . . . . spider lily
perennial bulb; brackish marshes, low woods and swamp forest borders

Iris giganticaerulea . . . . . giant blue flag
rhizomatous perennial; fresh marshes, swamps, and stream margins

Iva frutescens L. . . . . marsh elder
shrub; brackish marshes, upper zones of salt marsh

Juncus effusus L. . . . . soft rush
perennial; moist soil, edges of swamps and ponds, low pastures

Juncus roemerianus Scheele. . . . . black rush, needlerush
perennial; upper portions of salt and brackish marshes, often in solid stands

Limnosciadium pinnatum . . . . . tansy dog-shade
herb;

Lippia nodiflora (L.) Michaux. **[Phyla nodiflora]** . . . . . frogfruit
decumbent perennial herb; sandy, open habitats, usually moist

Medicago lupulina L. . . . . black medic
annual legume; fields, roadsides and waste places

Myrica cerifera L. . . . . wax myrtle
shrub or small tree; sand flats, pinelands and marshes

Oxalis stricta L . . . . . yellow wood-sorrel
rhizomatous perennial; stable dunes and interdunes, thin woods, fields, waste places

Panicum repens L. . . . . dogtooth grass, torpedo grass
creeping, rhizomatous perennial grass; fresh and intermediate marshes on slightly elevated sites; provides forage for rabbits, nutria and cattle

Parthenium hysteropherus . . . . . a wild quinine
perennial with tuberous thickened roots; woodlands, thickets, and old fields

Phragmites communis Trinius . . . . . roseau cane
tall, rhizomatous, perennial reed; fresh marshes, elevated areas in brackish or salt marshes

Phyla nodiflora (L.) Michaux. . . . . common frogfruit
prostrate, perennial herb; sandy, open habitats, usually moist

Physalis pubescens L. . . . . Low hairy ground-cherry
annual herb; fields, woodlands. Roadsides, waste places, disturbed areas

Phytolacca americana L. . . . . pokeweed, pigeonberry
robust perennial herb 1-3m tall; waste ground, pastures, disturbed habitats

Polygonum punctatum Ell. . . . . dotted smartweed
rhizomatous perennial with erect stems; alluvial woods, swamp forests or fresh marshes

Rubus trivialis Michaux . . . . . southern dewberry
trailing or arching, thorny shrub; roadsides, old fields and along railroads

Sagittaria latifolia Willd. . . . . wapato, duck potato
emersed monoecious perennial; fresh marshes, low meadow and stream and pond margins

Salicornia bigelovii Torrey. . . . . glasswort
annual succulent; brackish marshes, salt flats, low sand flats

Salix nigra Marshall. . . . . black willow
tree; stream banks and low, moist areas

Sambucus canadensis L. . . . . elderberry
stoloniferous shrub; swamp forests, alluvial woods and pastures

Scirpus americanus Persoon. . . . . bulrush, swordgrass
coarse rhizomatous perennial; fresh or brackish marshes, swales, shallow brackish water

Scirpus olneyi Gray. . . . . Olney's bulrush
coarse rhizomatous perennial; fresh or brackish marshes and ditches

Senecio glabellus Poir. . . . . butterweed
annual; alluvial woods, swamp forests and wet pastures

Sesbania drummondii (Rydb.) Cory. . . . . Rattlebox
shrub; elevated areas in fresh to brackish marshes, backdunes, waste places

Sisyrinchium atlanticum Bickn. . . . . blue-eyed grass
small perennial; moist to wet areas in the open, ditches, freshwater marshes, meadows, pond shores

Sisyrinchium exile Bickn . . . . . yellow-eyed grass
annual; moist to wet places - roadsides, lawns, meadows, old fields,

Solidago sempervirens L. . . . . seaside goldenrod
perennial; brackish marsh or saline sand

Spartina alterniflora Loisel. . . . . oyster grass
rhizomatous perennial; salt and brackish marshes

Spartina patens (Aiton) Muhl. . . . . marshhay cordgrass
tufted rhizomatous perennial; brackish marshes, low dunes and sand flats

Spergularia marina (L.) Grisebach. . . . . saltmarsh sand spurrey
tufted annual; salt marshes and tidal flats

Spiranthes vernalis Engelm. & Gray . . . . . spring ladies' tresses
stout or delicate, erect spiral orchid; moist roadsides, thin pinelands, fresh and brackish marshes, swales, low energy beaches, prairies and low meadows

Sporobolus indicus (L.) R.Br. . . . . smut grass
tufted perennial grass; meadow between dunes, swales, thin maritime or live oak woods, thin pinelands, lawns, pathways, roadsides

Sporobolus virginicus (L.) Kunth. . . . . coastal dropseed
Extensively creeping rhizomatous perennial grass; brackish marshes, low sandy areas, low dunes

Sporobolus pyramidatus . . . . . whorled dropseed
perennial grass;

Stellaria media (L.) Cyrillo. . . . . chickweed
prostrate or decumbent annual; waste places and fields

Stenotaphrum secundatum (Walter) Kuntze. . . . . St. Augustine grass
stoloniferous, mat-forming perennial; brackish marshes, lawns

Taxodium distichum (L.) Richard. . . . . bald cypress, swamp cypress
large, deciduous tree; swamps

Typha domingensis Persoon. . . . . southern cat-tail
2-3 m tall, rhizomatous perennial; brackish and freshwater habitats

Vigna luteola (Jacquin) Bentham. . . . . deer pea, beach pea
perennial herbaceous vine; waste places, borders of marshes and low fields

Xanthium strumarium L. var. **strumarium** . . . . . Cocklebur
annual coarse herb; sandy beaches and waste places

Zeuxine strateumatica . . . . . lawn orchid
perennial herb, orchid; lawns and waste places, wet fields, hummock edges, roadside ditches