

U.S. Army Corps of Engineers - New Orleans District  
Louisiana State University - Coastal Studies Institute

# **BENEFICIAL USE OF DREDGED MATERIAL MONITORING PROGRAM 1996 ANNUAL REPORT**

**Part 2: Results of Monitoring the Beneficial Use of Dredged Material at  
the Mississippi River Gulf Outlet, Louisiana - Mile 47-59**

**Base Year 1990 through Fiscal Year 1996**



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## INTRODUCTION

The Mississippi River Gulf Outlet (MRGO) navigation channel - Mile 47-59 BUMP study area is located 10 miles southeast of New Orleans between MRGO Mile 47 and Mile 59 (Figure 1). The U.S. Army Corps of Engineers - New Orleans District (USACE-NOD) maintains this navigation channel through the abandoned St. Bernard delta complex. Because the St. Bernard delta complex is abandoned, it is experiencing rapid coastal erosion and wetland loss.

The Beneficial Use of dredged material Monitoring Program (BUMP) at Louisiana State University - Coastal Studies Institute (LSU-CSI) is documenting the beneficial use of dredged material using aerial photography, geographical information system (GIS) analysis, and field surveys through the sponsorship of the USACE-NOD. BUMP results are provided in map series, annual reports, and scientific literature.

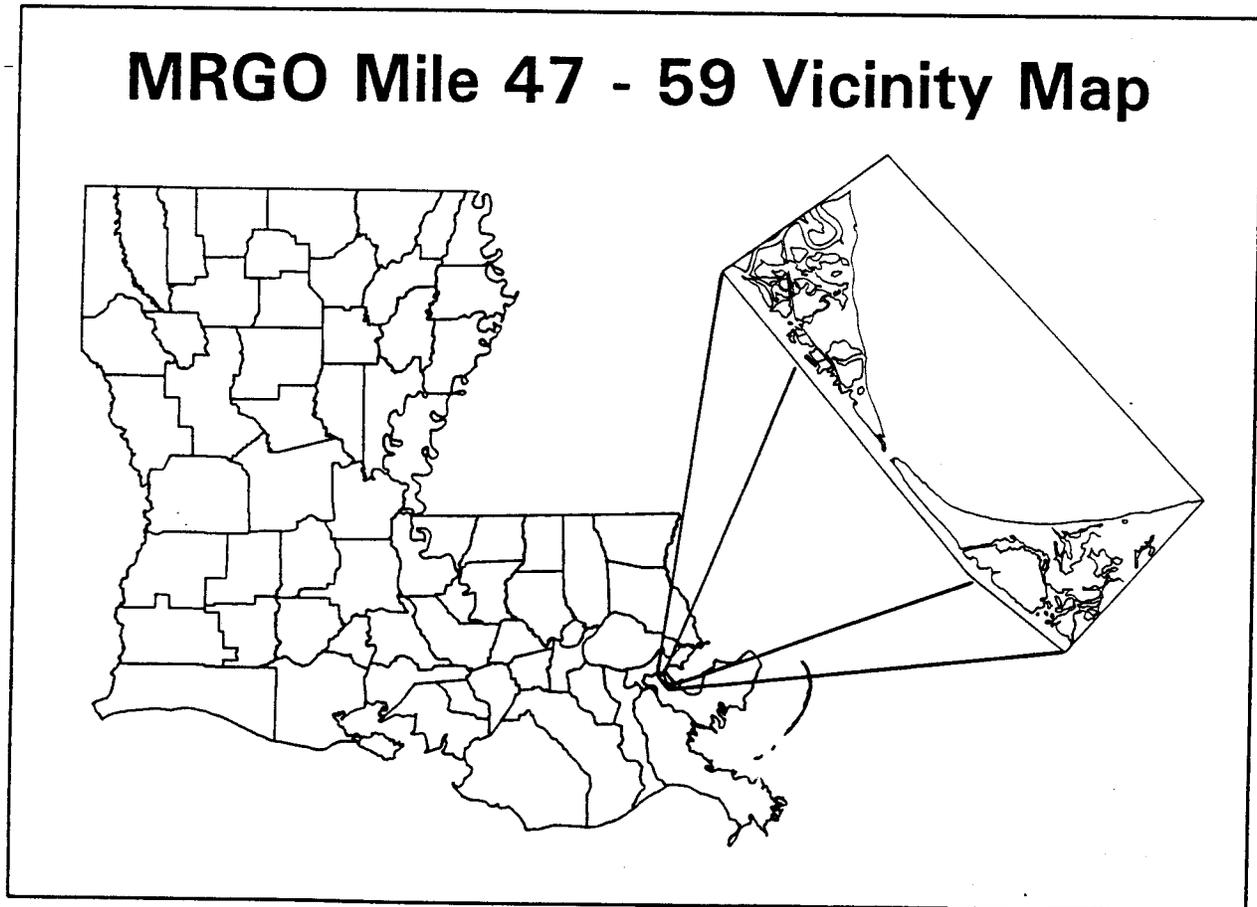


Figure 1. The location of the Mississippi River Gulf Outlet navigation channel - Mile 47-59 BUMP study area in Louisiana.

In this report, LSU presents the first results of the BUMP analysis at the Mississippi River Gulf Outlet navigation channel - Mile 47-59 study area, which represents monitoring results through the USACE-NOD 1996 Fiscal Year. This is the second part of the nine part Beneficial Use of dredged material Monitoring Program (BUMP), 1996 Final Report. The nine parts are:

- Part 1: Introduction and Methodology
- Part 2: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Gulf Outlet, Louisiana - Mile 47-59
- Part 3: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Gulf Outlet, Louisiana - Jetties
- Part 4: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Gulf Outlet, Louisiana - Breton Island
- Part 5: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Outlet, Venice, Louisiana - Baptiste Collette Bayou
- Part 6: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River, Baton Rouge to the Gulf of Mexico, Louisiana - Southwest Pass
- Part 7: Results of Monitoring the Beneficial Use of Dredged Material at the Houma Navigation Channel, Louisiana - Bay Chaland
- Part 8: Results of Monitoring the Beneficial Use of Dredged Material at the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Lower Atchafalaya River Horseshoe
- Part 9: Results of Monitoring the Beneficial Use of Dredged Material at the Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana - Atchafalaya Bay/Delta and Bar Channel

Using aerial photography LSU classified the natural and man-made habitats in the study area for December 1990, November 1995, and November 1996, including habitat created during the USACE-NOD FY1996 maintenance event. Previous maintenance events occurred in 1988, 1993 and 1995/96. There was no maintenance dredging between Mile 47 and 59 during FY94. Through the GIS analysis, these areas were calculated and changes were documented between 1990, 1995 and 1996. Field surveys were conducted on the beneficial use area created during the Fiscal Year 1993 and FY1996 maintenance events. Habitats were ground truthed and survey transects established to document vegetation species, stacking elevations, and subsidence. Figure 2 shows the areas of minimum air photo mosaic coverage and the limit of the digitized area.

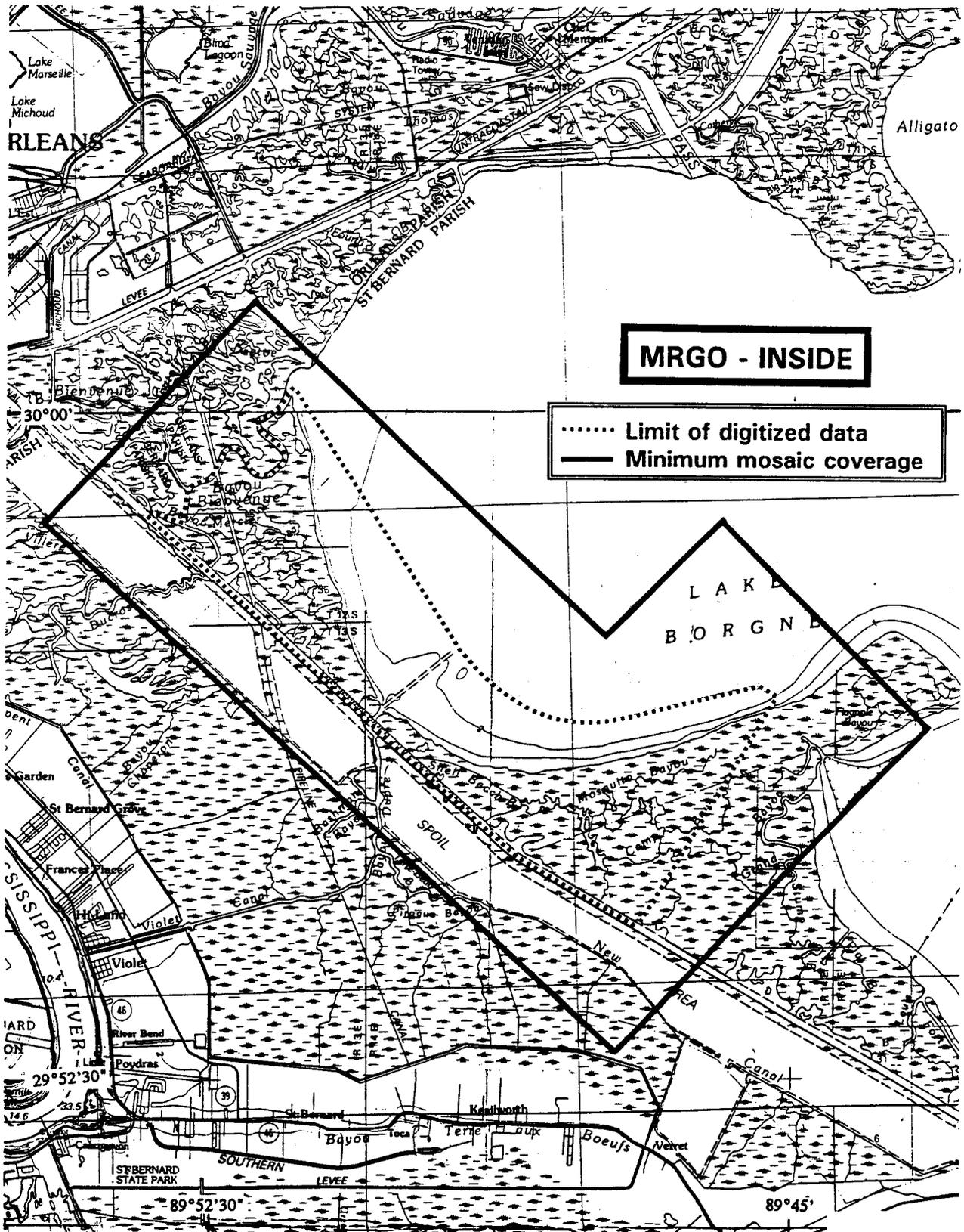


Figure 2. Location of the Mississippi River Gulf Outlet - Mile 47-59 BUMP study area showing the minimum coverage of the aerial photo-mosaic and the limits of the area digitized.

## **DREDGED MATERIAL DISPOSAL HISTORY**

The Rivers and Harbors Act of 1956 authorized the USACE-NOD to construct and maintain a deep draft navigation channel 36 feet deep by 500 feet wide from the Inner Harbor Navigation Canal in New Orleans to the Chandeleur Islands (Mile 66.0 to Mile 0) and a channel 38 feet deep by 600 feet wide from the islands to the 38 foot contour in the Gulf of Mexico (Mile 0 to Mile -9.0). Construction of the Mississippi River - Gulf Outlet (MRGO), Louisiana, navigation channel was initiated in 1958 and enlargement to full project dimensions was completed in 1968. Maintenance of discontinuous reaches of the channel has been accomplished on an annual basis since construction was completed.

Prior to and including the USACE-NOD 1988 Fiscal Year maintenance event, dredged material removed from the Mile 50 to Mile 60 reach of the channel was placed into an existing confined disposal facility located on the south bank of the navigation channel. For the 1993 and 1996 maintenance events, dredged material from the Mile 50 to Mile 60 reach of the channel was placed within confined areas to nourish or restore wetlands adjacent to existing marsh between Lake Borgne and the MRGO navigation channel. The initial height of the dredged material placed for wetland creation adjacent to the south jetty was not to exceed +3.0 feet Mean Low Gulf (MLG) (+2.2 National Geodetic Vertical Datum (NGVD)).

There was no maintenance dredging in the Mile 50 to Mile 60 reach of the navigation channel during FY 1994, during which time dike repairs and construction were completed. Figure 3 illustrates the dredged material disposal history for the MRGO-Mile 47-59 BUMP study area prior to November 1996.

MISSISSIPPI RIVER GULF OUTLET DREDGING HISTORY

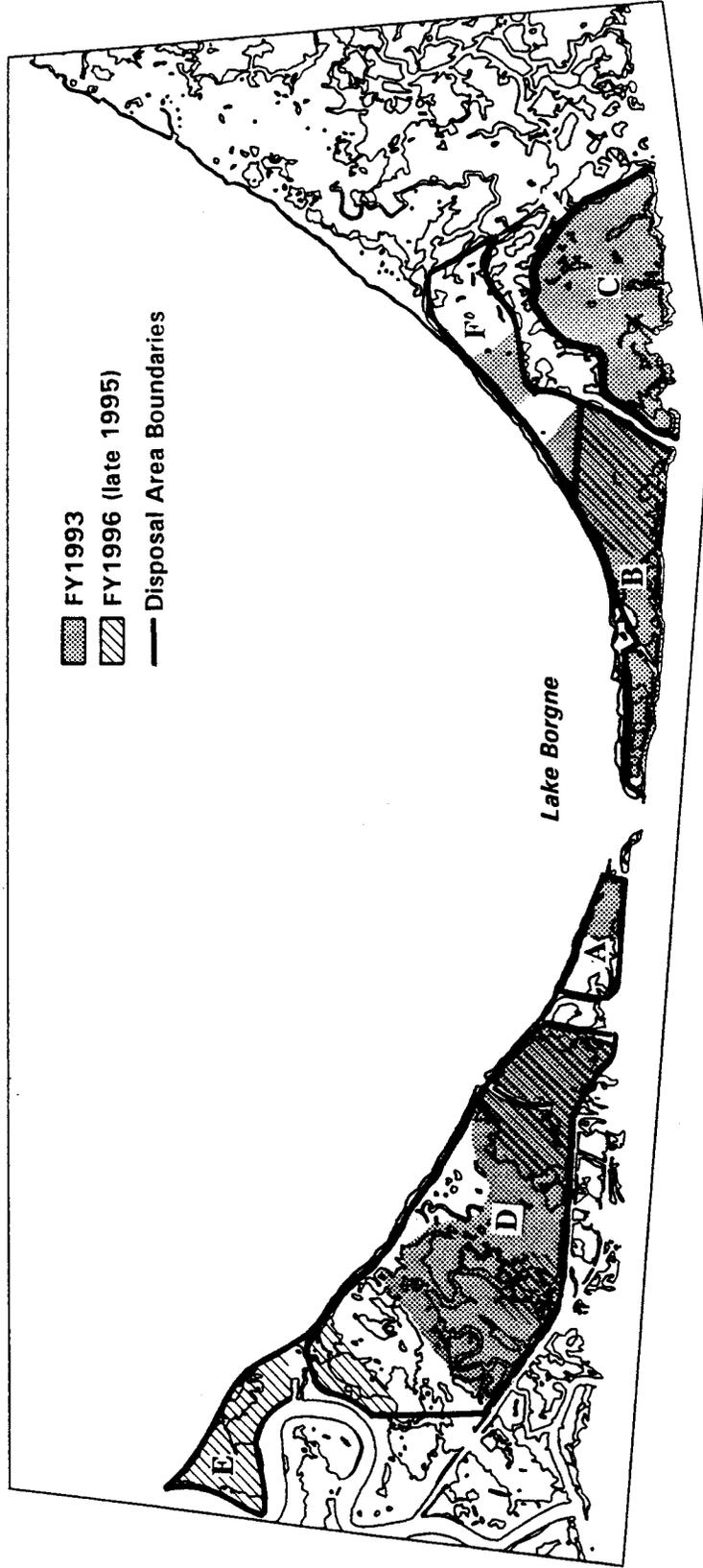


Figure 3. The dredged material disposal history for the Mississippi River Gulf Outlet - Mile 47-59 BUMP study area before November 1996, and the USACE-NOD designated disposal areas.

## FIELD SURVEY RESULTS

### Methodology

#### **Elevation Profile Surveys**

The MRGO - Mile 47-59 study area is located between Lake Borgne and the MRGO navigation channel 10 miles southeast of New Orleans (Figure 2).

The collection of survey profiles was made in two phases. Phase-I involved assessing the characteristics of the study site to determine the most applicable position to setup a long-term monitoring program. This was accomplished using vertical aerial photography, reviewing dredging schedules and history, ground truthing the study area, defining varying vegetation and morphology, and assessing access possibilities. Based on these factors, one transect line was positioned at each of two widely spaced sites; one near Bayou Bienvenue to the northeast and one within an area designated by the USACE-NOD as "Area B" (Figure 4). An attempt was made to establish a third site, but access was denied to the methods we had at hand. Two stakes were permanently placed to represent the two profile transects. Permanent 1-inch diameter by 6-foot galvanized stakes were driven approximately 3.5 feet into the ground and secured with concrete. 8 ft. white, PVC pipes painted bright orange were placed over the stakes to help make relocation easier and to prevent damage from other transportation through the area. The position of the stakes was determined using a Global Positioning System (GPS).

Phase-II involved the actual collection of profile datum. In November 1996, profile surveys were conducted along the transects defined by the stakes during phase-I. One profile transect was collected from each site selected in the MRGO- Mile 47-59 area. Survey datum and profiles were collected using a Topcon GTS-300<sub>DPG</sub> 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, the position and exact orientation of each transect line, and the location of vegetation encountered along the transect lines. The transect datum collected were processed, referenced to local tide gages, and entered into a graphic software program to produce topographic profiles.

The topographic profiles for MRGO - Mile 47-59 BUMP study area were constructed in reference to the tide gage at Shell Beach, Lake Borgne, Louisiana (29°52' N / 89°41' W). The mean diurnal tidal range for the MRGO - Mile 47-59 BUMP study area is published as 1.4 ft. Profiles here were 950 and 1200 feet in length. Maximum relief along profile A-A' at the Bayou Bienvenue site was 2.76 feet, with an average relief of 1.04 feet. Profile B-B' at the Area B site exhibited a maximum relief of 4.77 feet, with an average relief of 1.48 feet. The area was characteristically defined as a low relief salt marsh throughout. The surficial sedimentology of the peninsula is composed of tidalite type sediments (silty clays, with very fine quartz sand).

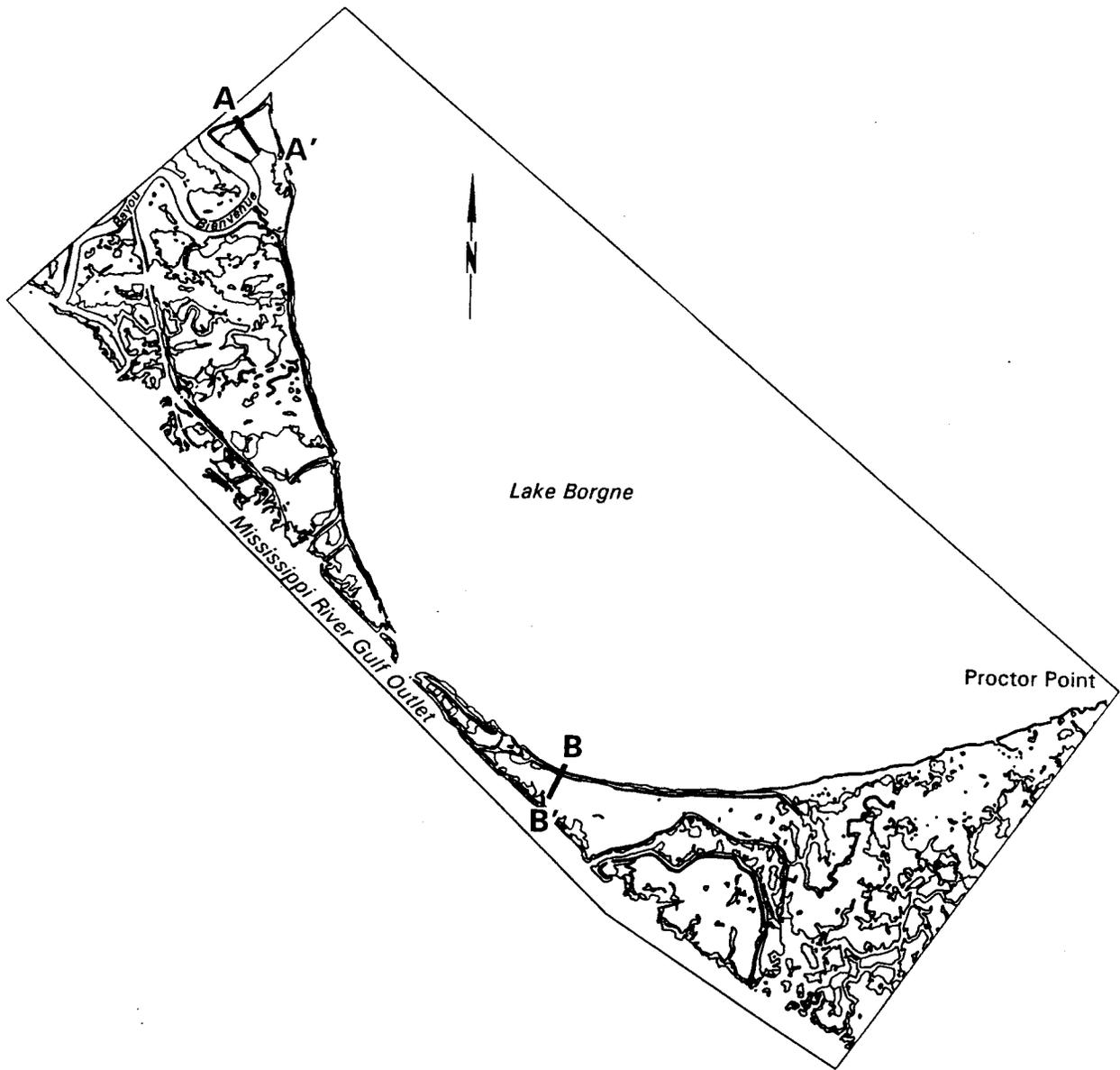


Figure 4. Location of the MRGO - Mile 47-59 BUMP study area profile transects.

## **Vegetation Surveys**

Ground truthing for vegetative species composition and habitat verification was done in November 1996. Species composition was determined within an approximate six-foot swath along each transect. 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 author. 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 Appendix 2A 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 time of the profile collection or ground truthing, and therefore can not be included in the list other than by a broad classification.

## **Profiles**

The 1996 profiles were established with permanent 1-inch diameter by 6-foot galvanized stakes that were driven approximately 3.5 feet into the ground and secured with concrete. One stake was placed at each site to define each profile.

### **Bayou Bienvenue transect**

The Bayou Bienvenue transect is located within the USACE-NOD Disposal Area "E" of the MRGO - Mile 47-59 BUMP study site, to the east of where the bayou empties into Lake Borgne, and is generally defined by the shorelines of these waterbodies (Figure 4). The construction of this site was initiated during the USACE-NOD FY1993 maintenance event and consisted of an earthen dike encircling deteriorating saltmarsh. The dike is broken in several places and the enclosed area is open to tidal action. This site included a vast amount of shallow, open water. The material within the encircling dike was extremely fine, soft mud, sparsely colonized by widely spaced clumps of saltmarsh (Figure 5).

The transect was delineated by 1 permanent stake set in the west, shell and earth retaining dike along the east bank of Bayou Bienvenue, and one temporary stake set in the soft substrate of the old marsh at the east side of the site. It traversed the old deteriorating marsh, the shallow open water, and new colonizing marsh next to the retaining dike (Figure 6).

The profile here had a length of 1200 feet. The maximum relief along the axis is 2.76 feet, with an average relief of 1.04 feet. The profile indicates that the island is typically characterized as a mud flat colonized by saltmarsh (Figure 7).



Figure 5. Photograph of the MRGO - Mile 47-59 Bayou Bienvenue BUMP study site taken on November 7, 1996 showing the shallow open water, sparsely colonized by widely spaced clumps of *Spartina alterniflora*. The view is from the back stake along the transect to the front stake that is just to the left of the marsh clump.



Figure 6. Photograph of the MRGO - Mile 47-59 Bayou Bienvenue BUMP study site taken on November 7, 1996 showing the existing saltmarsh protected by the earthen dike. View is from front stake toward the back stake which is placed in old marsh in the background.

**BAYOU BIENVENUE, LOUISIANA**  
**USACE Site, Bayou Bienvenue (BB-1-1)**  
 November 6, 1996

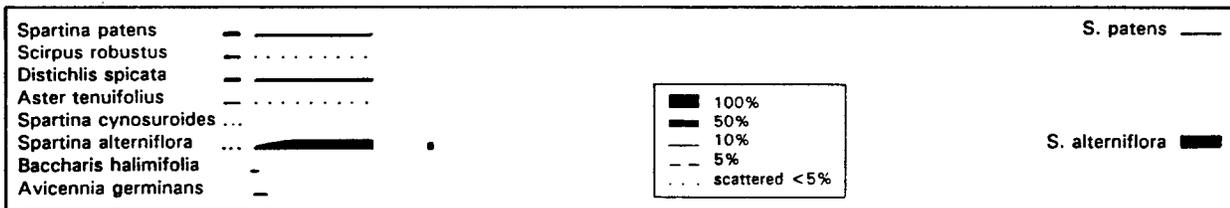
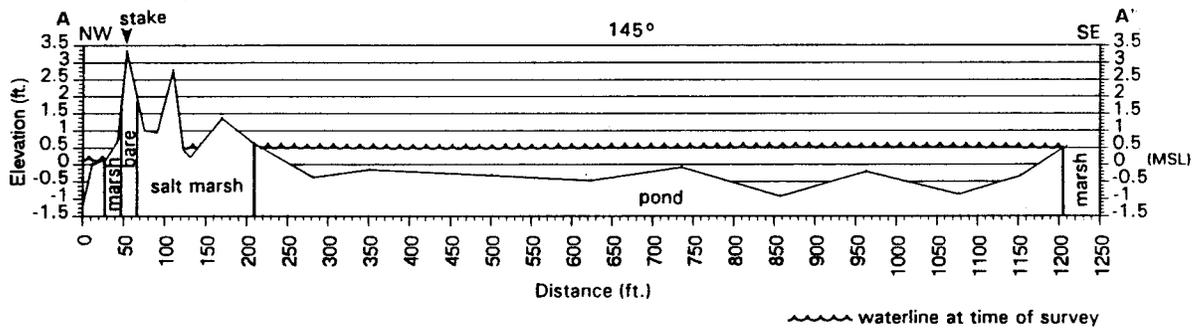


Figure 7. Elevation profile of the MRGO Bayou Bienvenue BUMP study site with vegetation data illustrated.

### **Bayou Dupre transect**

The Bayou Dupre transect is located within the USACE-NOD Disposal Area "B" (Figure 3) to the east side of the MRGO - Mile 47-59 BUMP study area (Figure 4). An earthen levee was constructed around existing saltmarsh and material was filled in around the marsh during the 1993 and 1996 maintenance events (Figure 8). A shallow, water-filled borrow canal runs parallel to the levee on the inland side. The substrate was solid, compacted clay and silt and was well colonized by salt marsh (Figure 9). The nearshore was steep and of a sandy substrate.

The transect was delineated by one stake set in the top of the earthen levee on the north side of the site, near the shoreline of Lake Borgne and near the west end of the borrow canal east of the trees. The transect was set perpendicular to the Lake Borgne shoreline.

The profile here was 950 feet in length. The maximum relief was 4.77 feet, with an average relief of 1.48 feet. The profiles indicate that the area is typically characterized as a low relief saltmarsh (Figure 10).



Figure 8. Photograph of the MRGO - Mile 47-59 Bayou Dupre (Area B) BUMP study site taken on November 7, 1996 of material added to the marsh as evidenced by mud cracks and the clumping appearance of the vegetation.



Figure 9. Photograph of the MRGO - Mile 47-59 Bayou Dupre BUMP study site taken on November 7, 1996 showing the thick growth of *Spartina alterniflora* saltmarsh in the interior of Disposal Area "B".

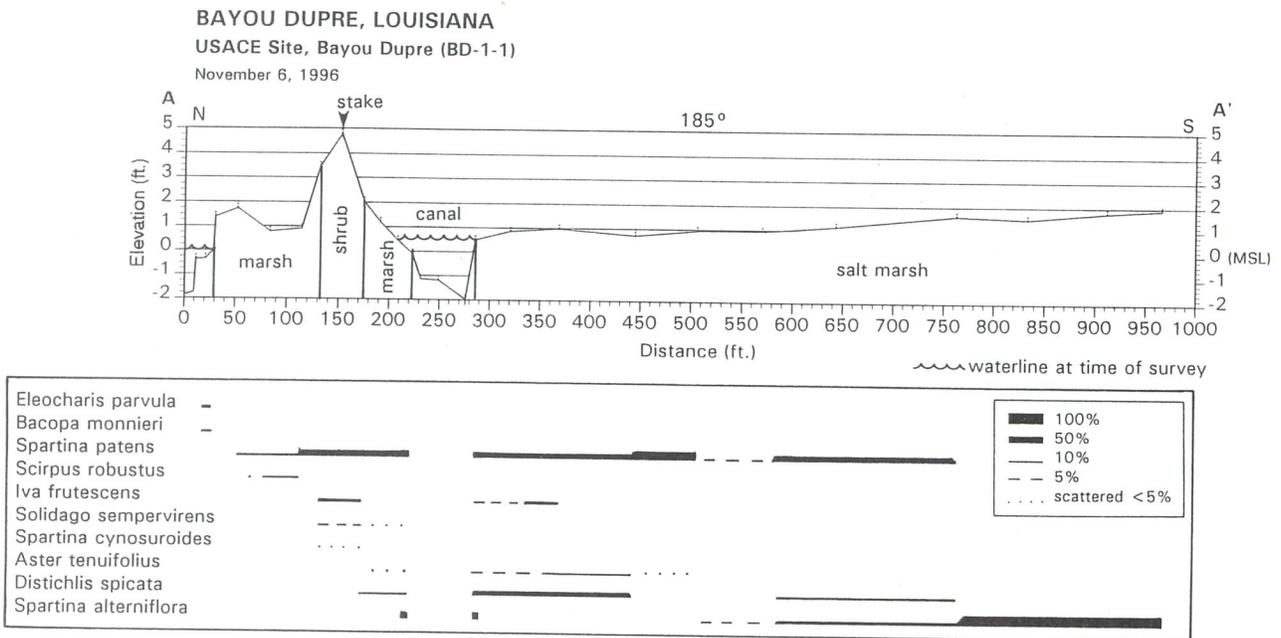


Figure 10. Elevation profile of the MRGO - Mile 47-59 Bayou Dupre (Area B) BUMP study site with vegetation data illustrated.

## Vegetative Character

### General Description

The overall marsh type for this area would be classified as salt marsh. The only other vegetative habitat found at this site was a narrow shrub/scrub zone occupying the ridge created to act as a retaining dike that generally paralleled the shoreline. The substrate was very soft, fine-grained silt and mud.

### Vegetative Community Types

The salt marsh in the study area was represented by *Spartina alterniflora* and *Distichlis spicata*, with a variety of other species noticeable, such as *Aster tenuifolius*, *Spartina patens*, and *Scirpus sp.* growing thickly in older deposits and just beginning to colonize throughout the newly deposited mud flat.

Shrub communities usually indicate older, more stable, elevated areas. The narrow shrub zone occupying the earthen dike was primarily 5-6 foot *Iva frutescens* with some *Baccharis halimifolia* and an understory of *Spartina patens*, *Distichlis spicata*, and *Solidago sempervirens*.

## GIS ANALYSIS RESULTS

### Shoreline Changes: 1990-1996

Figure 11 graphs the spatial history of the MRGO - Mile 47-59 BUMP study area between December 1990 and November 1996 from the data in Table 1. In December 1990, the MRGO - Mile 47-59 BUMP study area was measured at 3618.0 acres. The study area in November 1996 was measured at 3463.0 acres. This is a cumulative area decrease of -155.0 acres or a decrease in area of -4 percent for the 5.9 year period at an overall rate of 26.3 acres per year. There was an overall loss of 645.9 acres of natural habitats, offset by the creation of +417.5 acres due to the beneficial use of dredged materials. Without the contribution of the new habitats due to the beneficial placement of dredged material, the total coastal land loss in the study area would have exceeded -572.5 acres at a rate of -97.0 acres per year. Figure 12 illustrates the pattern of land loss and gain in the MRGO - Mile 47-59 study area.

Figure 13 depicts the coastal land loss history for the MRGO - Mile 47-59 BUMP study area between December 1990 and November 1995. The total area of the MRGO - Mile 47-59 decreased by -173.3 acres at a rate of -35.4 acres per year for this 4.9 year period. The primary area of land loss took place within the interior marsh as a result of subsidence and natural marsh degradation. This was offset by an increase in BUMP-made area of +394.8 acres as marsh colonization within USACE-NOD disposal areas.

Figure 14 depicts the coastal land loss history for the MRGO - Mile 47-59 BUMP study area between November 1995 and November 1996. The total area of the MRGO - Mile 47-59 increased by +18.3 acres at a rate of +18.3 acres per year for this one year period. The primary areas of land loss took place in the natural habitats as a result of shoreline erosion and interior pond development. This was enhanced further by an increase in BUMP-made area of +22.7 acres as marsh colonization within USACE-NOD disposal areas.

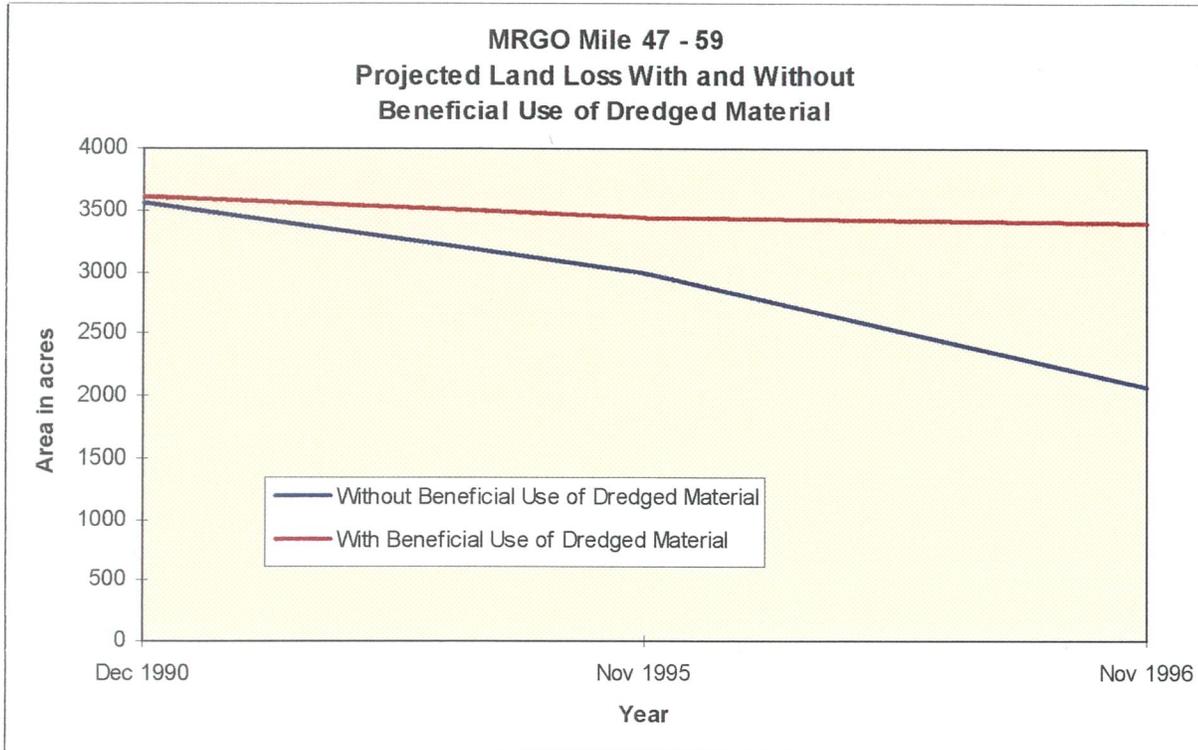


Figure 11. Graph of the area of the Mississippi River Gulf Outlet -Mile 47-59 BUMP study area over time, with and without the placement of dredged material.

**TABLE 1**  
**MRGO -Mile 47-59 Area: 1990-1996**

| Area in acres           | Dec 1990      | Nov 1995      | Nov 1996      |
|-------------------------|---------------|---------------|---------------|
| Natural Areas           | 3548.7        | 2920.1        | 2902.8        |
| Non-BUMP Man-made Areas | 10.4          | 70.8          | 83.8          |
| BUMP Man-made Areas     | 58.9          | 453.7         | 476.4         |
| <b>Total</b>            | <b>3618.0</b> | <b>3444.7</b> | <b>3463.0</b> |

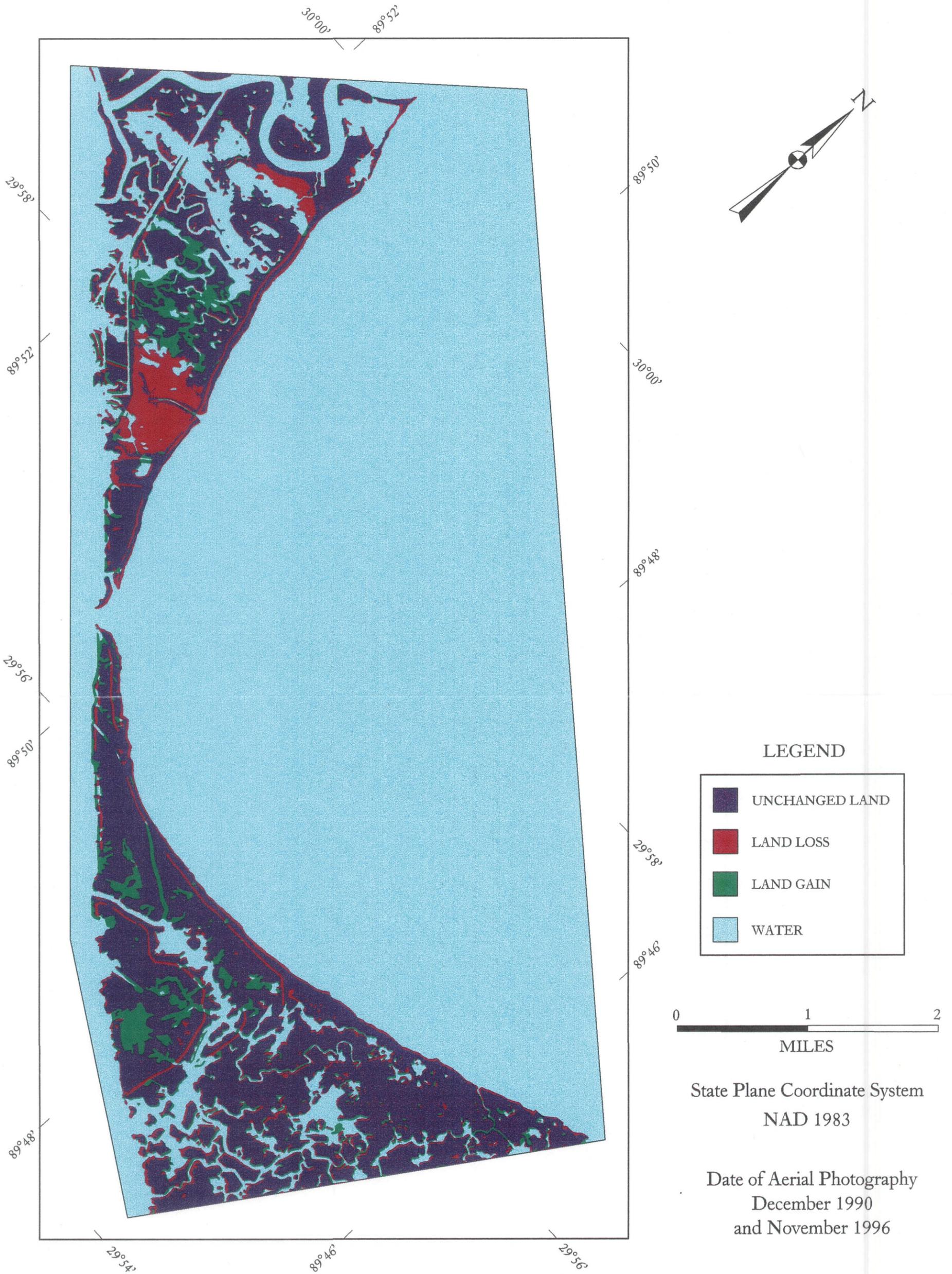


Figure 12. Land loss/land gain map of the Mississippi River Gulf Outlet - Mile 47-59 BUMP study area comparing December 1990 and November 1996.

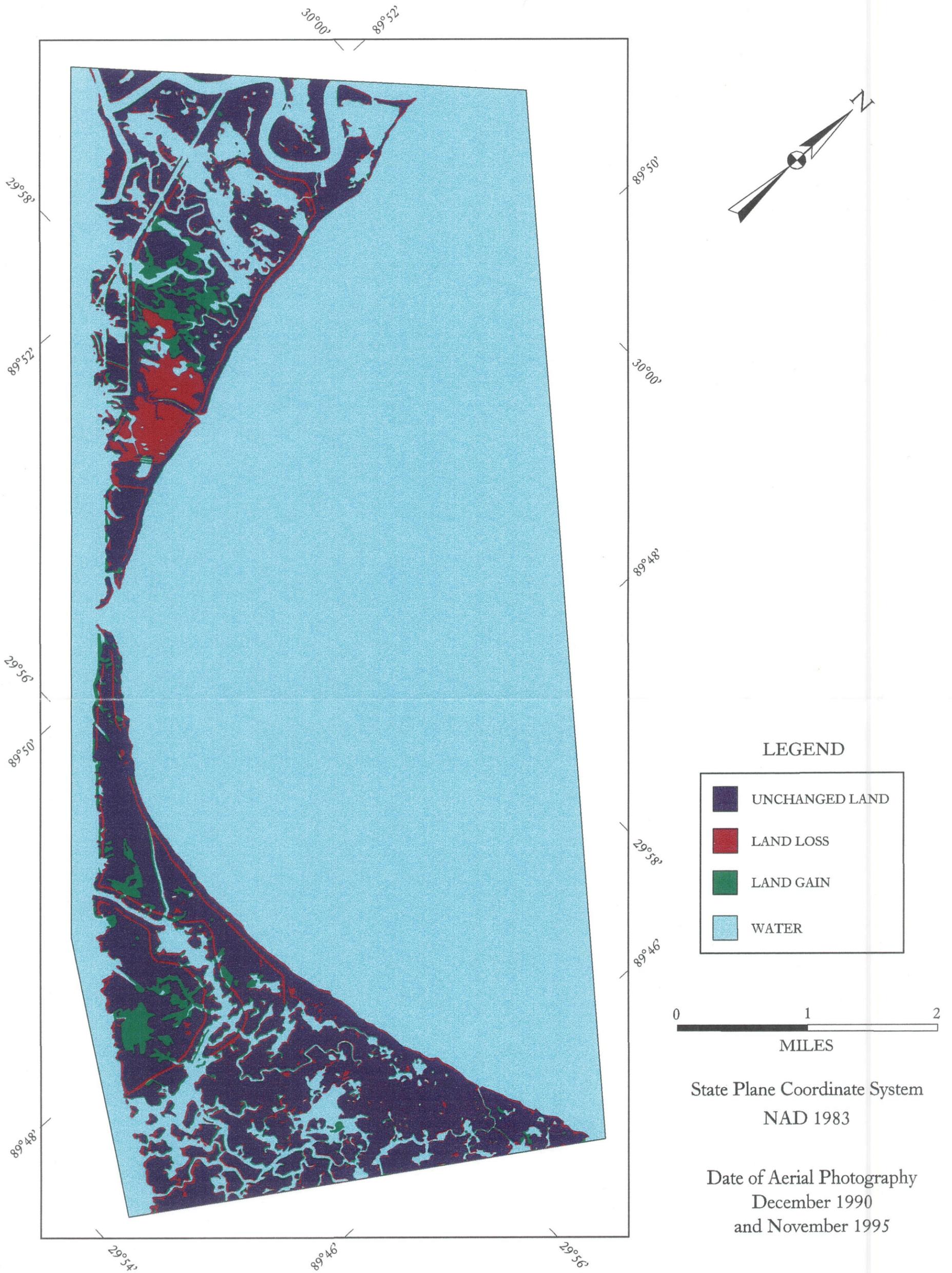


Figure 13. Land loss/land gain map of the Mississippi River Gulf Outlet - Mile 47-59 BUMP study area comparing December 1990 and November 1995.

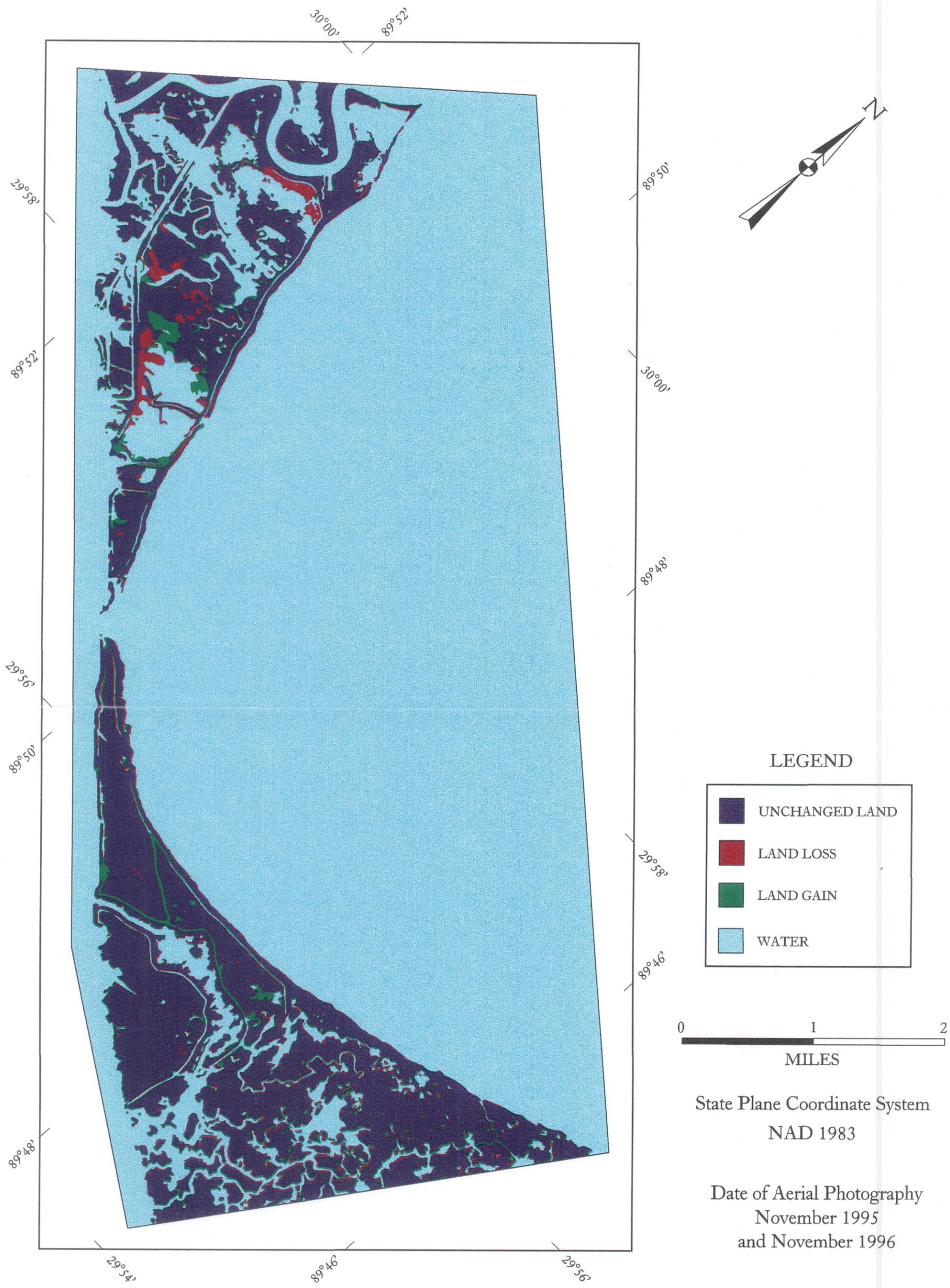


Figure 14. Land loss/land gain map of the Mississippi River Gulf Outlet - Mile 47-59 BUMP study area comparing November 1995 and November 1996.

## **Habitat Inventory**

The aerial photographic interpretation combined with field surveys identified six major habitat types in the MRGO - Mile 47-59 BUMP study area. These habitats are further classified as natural, BUMP man-made, and non-BUMP 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 materials by the USACE-NOD. The non-BUMP man-made class (other-made) separates areas created that were not part of the BUMP effort, such as areas created in association with the oil industry access and pipeline canals. 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 MRGO - Mile 47-59 BUMP study area in December 1990. The location and arrangement of these habitats is presented in figure 15. The total area of the MRGO - Mile 47-59 site was 3618.0 acres. Of this total, 3548.7 acres were natural and 69.3 acres were man-made including 10.4 acres of other man-made and 58.9 acres of BUMP-made habitats, or 98.1 percent were natural, 0.3 percent were man-made, and 1.7 percent were BUMP-made. In order of decreasing size and importance, the largest habitat found was natural marsh (3063.7 acres) followed by natural bare land (237.7 acres), natural upland (113.5 acres), natural shrub/scrub (68.9 acres), natural beach (64.9 acres), BUMP-made upland (28.8 acres), BUMP-made shrub/scrub (23.3 acres), other-made shrub/scrub (5.2 acres), BUMP-made bare land (4.1 acres), other-made upland (2.8 acres), BUMP-made marsh (2.7 acres) and other-made trees (1.1 acres).

In terms of habitat totals, marsh (3067.7 acres or 85%) dominated the landscape.

**TABLE 2**  
**December 1990 Habitat Inventory of the MRGO-Mile 47-59 BUMP Study Area**

| HABITAT       | TOTAL  | NATURAL | OTHER<br>MAN-MADE | BUMP-MADE |
|---------------|--------|---------|-------------------|-----------|
| Marsh         | 3067.7 | 3063.7  | 1.3               | 2.7       |
| Upland        | 145.1  | 113.5   | 2.8               | 28.8      |
| Shrub/Scrub   | 97.4   | 68.9    | 5.2               | 23.3      |
| Trees         | 1.1    | 0       | 1.1               | 0         |
| Bare Land     | 241.8  | 237.7   | 0                 | 4.1       |
| Beach         | 64.9   | 64.9    | 0                 | 0         |
| Habitat Total | 3618.1 | 3548.7  | 10.4              | 58.9      |

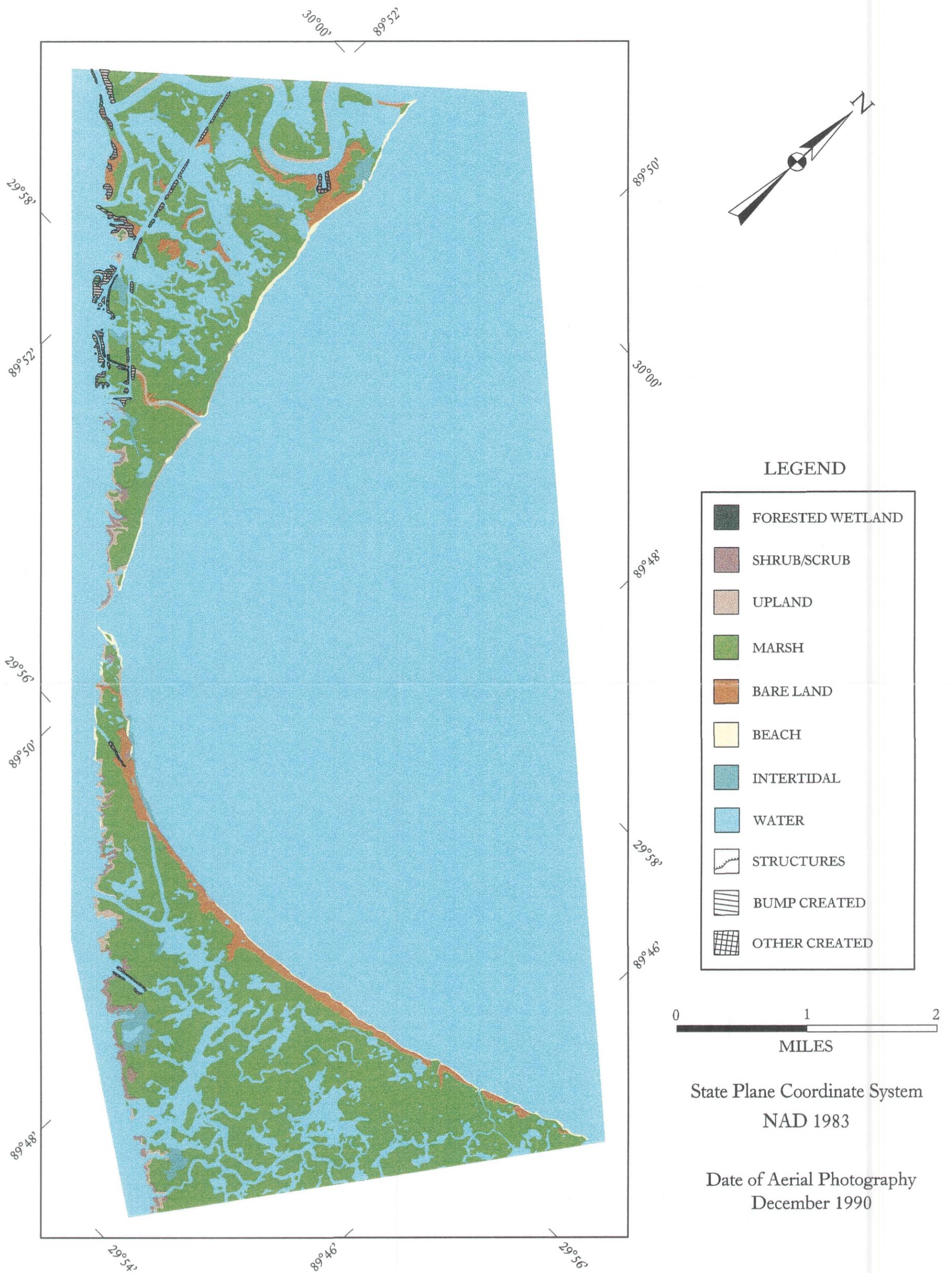


Figure 15. Habitat inventory map of the Mississippi River Gulf Outlet - Mile 47-59 BUMP study area in December 1990.

Table 3 lists the areas of the six habitats found in the Mississippi River Gulf Outlet - Mile 47-59 BUMP study area in November 1995. The location and arrangement of these habitats is presented in figure 16. In 1995, the total area of the MRGO - Mile 47-59 BUMP study area was calculated at 3444.7 acres. Of this total, 2920.1 acres were natural and 524.5 acres were man-made including 70.8 acres of other-made and 453.7 acres of BUMP-made, or 84.8 percent was natural, 2.1 percent was other-made, and 13.2 percent was BUMP-made. In order of decreasing size and importance, the largest habitat found is natural marsh (2715.2 acres) followed by BUMP-made marsh (221.5 acres), BUMP-made upland (187.4 acres), natural upland (64.6 acres), natural bare land (55.2 acres), natural beach (43.1 acres), natural shrub/scrub (42.0 acres), other-made shrub/scrub (38.0 acres), BUMP-made bare land (33.3 acres), other-made trees (19.1 acres), other-made upland (11.6 acres), BUMP-made shrub/scrub (11.5 acres), other-made marsh (1.2 acres), and other-made bare land (0.9 acres). The 1995 habitat inventory did not identify any natural trees, other-made beach or BUMP-made beach.

In terms of total area, marsh (2937.9 acres or 85.3%) dominated the landscape of the MRGO - Mile 47-59 BUMP study area.

**TABLE 3**  
**November 1995 Habitat Inventory of the MRGO-Mile 47-59 BUMP Study Area**

| HABITAT              | TOTAL         | NATURAL       | OTHER<br>MAN-MADE | BUMP-<br>MADE |
|----------------------|---------------|---------------|-------------------|---------------|
| Marsh                | 2937.9        | 2715.2        | 1.2               | 221.5         |
| Upland               | 263.6         | 64.6          | 11.6              | 187.4         |
| Shrub/Scrub          | 91.6          | 42.0          | 38.0              | 11.5          |
| Trees                | 19.1          | 0.0           | 17.2              | 0.0           |
| Bare Land            | 89.4          | 55.2          | 0.9               | 33.3          |
| Beach                | 43.1          | 43.1          | 0.0               | 0.0           |
| <b>Habitat Total</b> | <b>3444.7</b> | <b>2920.1</b> | <b>70.8</b>       | <b>453.7</b>  |

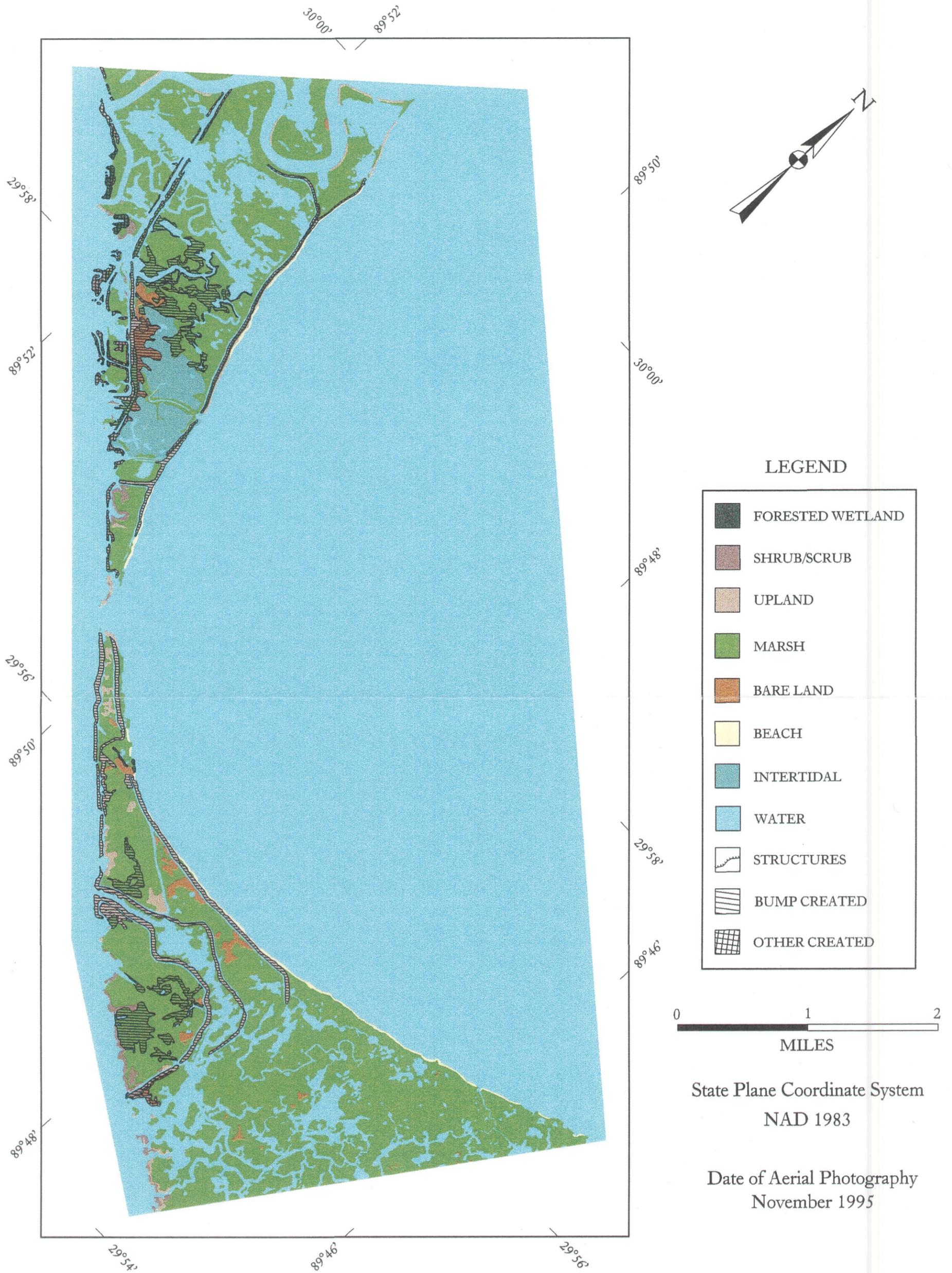


Figure 16. Habitat inventory map of the Mississippi River Gulf Outlet - Mile 47-59 BUMP study area in November 1995.

Table 4 lists the areas of the five habitats found in the Mississippi River Gulf Outlet - Mile 47-59 BUMP study area in November 1996. The location and arrangement of these habitats is presented in figure 17. In 1996, the total area of the MRGO - Mile 47-59 BUMP study area was calculated at 3463.0 acres. Of this total, 2902.8 acres were natural and 560.2 acres were man-made including 83.8 acres other-made and 476.4 BUMP-made, or 83.8 percent was natural, 2.4 percent was other-made and 13.8 percent was BUMP-made. In order of decreasing size and importance, the largest habitat found is natural marsh (2707.0 acres) followed by BUMP-made marsh (279.6 acres), other-made upland (133.8 acres), natural shrub/scrub (67.7 acres), natural beach (63.9 acres), BUMP-made shrub/scrub (48.5 acres), natural upland (47.0 acres), other-made shrub/scrub (41.8 acres), other-made upland (28.2 acres), natural bare land (17.2 acres), BUMP-made bare land (14.5 acres), other-made trees (6.6 acres), other-made bare land (5.2 acres), and other-made marsh (2.0 acres). The 1996 habitat inventory did not identify any natural or BUMP trees, other-made beach or BUMP-made beach.

In terms of total area, marsh (2988.6 acres or 86.3%) dominated the landscape of the MRGO - Mile 47-59 BUMP study area.

**TABLE 4**  
**November 1996 Habitat Inventory of the MRGO-Mile 47-59 BUMP Study Area**

| HABITAT              | TOTAL         | NATURAL       | OTHER<br>MAN-MADE | BUMP-<br>MADE |
|----------------------|---------------|---------------|-------------------|---------------|
| Marsh                | 2988.6        | 2707.0        | 2.0               | 279.6         |
| Upland               | 209.0         | 47.0          | 28.2              | 133.8         |
| Shrub/Scrub          | 158.0         | 67.7          | 41.8              | 48.5          |
| Trees                | 6.6           | 0.0           | 6.6               | 0.0           |
| Bare Land            | 36.9          | 17.2          | 5.2               | 14.5          |
| Beach                | 63.3          | 63.9          | 0.0               | 0.0           |
| <b>Habitat Total</b> | <b>3463.0</b> | <b>2902.8</b> | <b>83.8</b>       | <b>476.4</b>  |

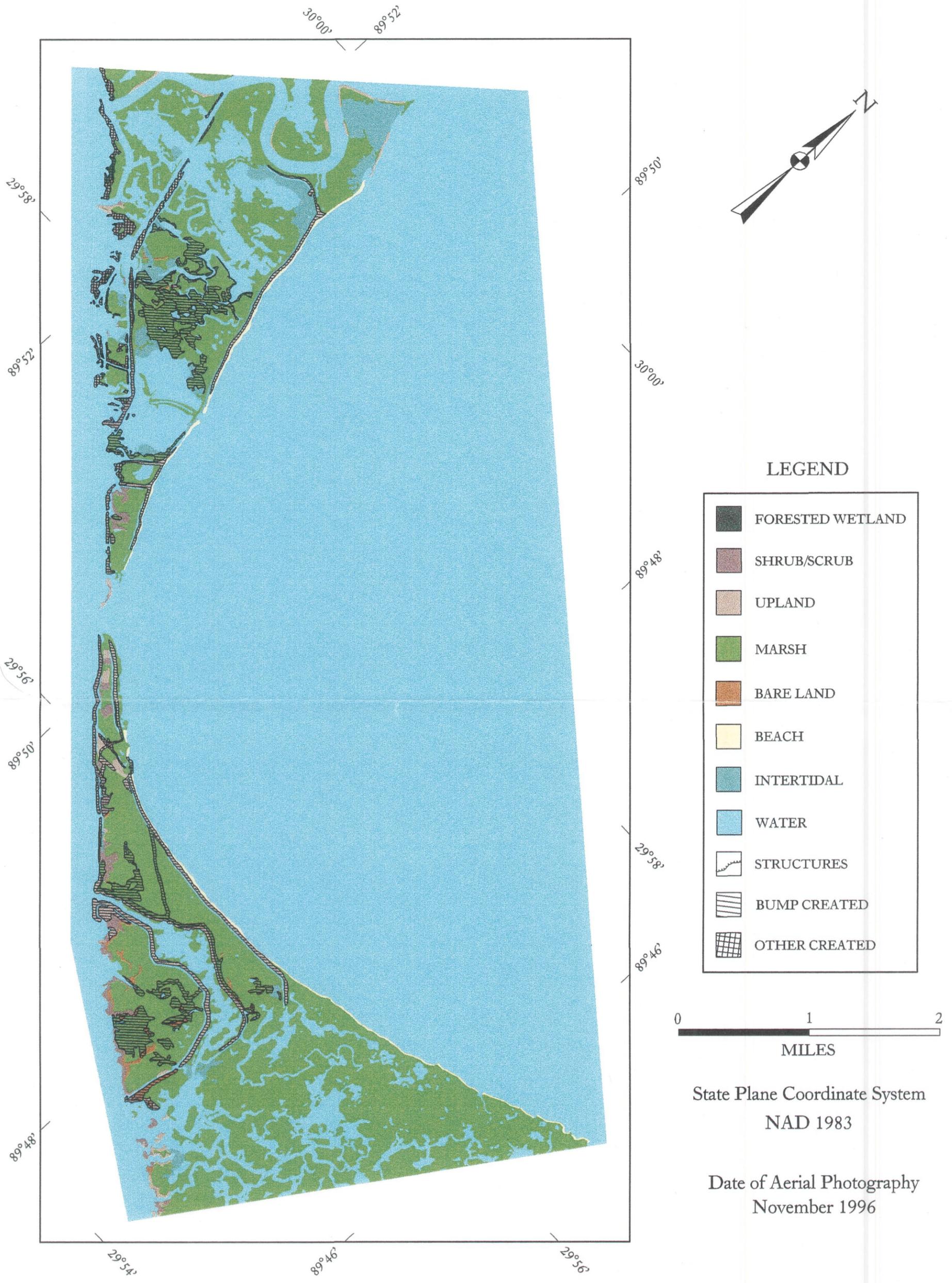


Figure 17. Habitat inventory map of the Mississippi River Gulf Outlet - Mile 47-59 BUMP study area in November 1996.

## **Habitat Change**

Land loss dominates the natural processes of this area. The total area decreased by -155.1 acres which represents a 4 percent decrease in area between 1990 and 1996. There was an overall decrease of -645.9 acres of the natural habitats, offset by an overall 490.9 acres of increase in man-made habitats largely due to the placement of dredged materials. Table 5 lists the major habitat changes.

The greatest habitat change was the decrease by natural processes of natural marsh (-356.7 acres). Other large changes occurred in the BUMP-made marsh (+276.9 acres), natural bare land (-220.5 acres), BUMP-made upland (+105.0 acres), natural upland (-66.5 acres), and other-made shrub/scrub (+36.6 acres). In terms of the beneficial use process, the greatest areas of new habitat creation include BUMP-made marsh (+276.9 acres), and BUMP-made shrub/scrub (+105.0 acres). Figure 18 graphs the natural habitat changes over time. Natural marsh degradation and erosion dominates the natural habitat class.

Figure 18 shows a time series of habitat changes in the MRGO Mile 47-59 BUMP study area. Figure 18A graphs the natural habitat changes over time. Figure 18B graphs the man-made habitat changes. Figure 19 documents the creation of habitats at the MRGO-Mile 47-59 BUMP study area from December 1990 and November 1996.

**TABLE 5**  
**Change in Total Acres of each Habitat**  
**in the MRGO-Mile 47-59 BUMP Study Area between 1990 and 1996**

| HABITAT                              | 1990-1995 <sup>1</sup> | 1995-1996 <sup>1</sup> | 1990-1996 <sup>1</sup> |
|--------------------------------------|------------------------|------------------------|------------------------|
| Natural Marsh                        | -348.5                 | -8.2                   | -356.7                 |
| Natural Upland                       | -48.9                  | -17.6                  | -66.5                  |
| Natural Shrub/Scrub                  | -26.9                  | +25.7                  | -1.2                   |
| Natural Trees                        | 0.0                    | 0.0                    | 0.0                    |
| Natural Bare Land                    | -182.5                 | +38.0                  | -220.5                 |
| Natural Beach                        | -21.8                  | +20.8                  | -1.0                   |
| <b>Total Natural Habitats</b>        | <b>-628.6</b>          | <b>-17.3</b>           | <b>-645.9</b>          |
| BUMP Man-made Marsh                  | +218.8                 | +58.1                  | +276.9                 |
| BUMP Man-made Upland                 | +158.6                 | -53.6                  | +105.0                 |
| BUMP Man-made Shrub/Scrub            | -11.8                  | +37.0                  | +25.2                  |
| BUMP Man-made Trees                  | 0.0                    | 0.0                    | 0.0                    |
| BUMP Man-made Bare Land              | +29.2                  | -18.8                  | +10.4                  |
| BUMP Man-made Beach                  | 0.0                    | 0.0                    | 0.0                    |
| <b>Total BUMP Man-made Habitats</b>  | <b>+394.8</b>          | <b>+22.7</b>           | <b>+417.5</b>          |
| Other Man-made Marsh                 | -0.1                   | +0.8                   | +0.7                   |
| Other Man-made Upland                | +8.8                   | +16.6                  | +25.4                  |
| Other Man-made Shrub/Scrub           | +32.8                  | +3.8                   | +36.6                  |
| Other Trees                          | +18.0                  | -12.5                  | +5.5                   |
| Other Man-made Bare Land             | +0.9                   | +4.3                   | +5.3                   |
| Other Man-made Beach                 | 0.0                    | 0.0                    | 0.0                    |
| <b>Total Other Man-made Habitats</b> | <b>+60.4</b>           | <b>+13.0</b>           | <b>+73.4</b>           |
| <b>HABITAT TOTAL</b>                 | <b>-173.4</b>          | <b>+18.4</b>           | <b>-155.1</b>          |

<sup>1</sup> in acres

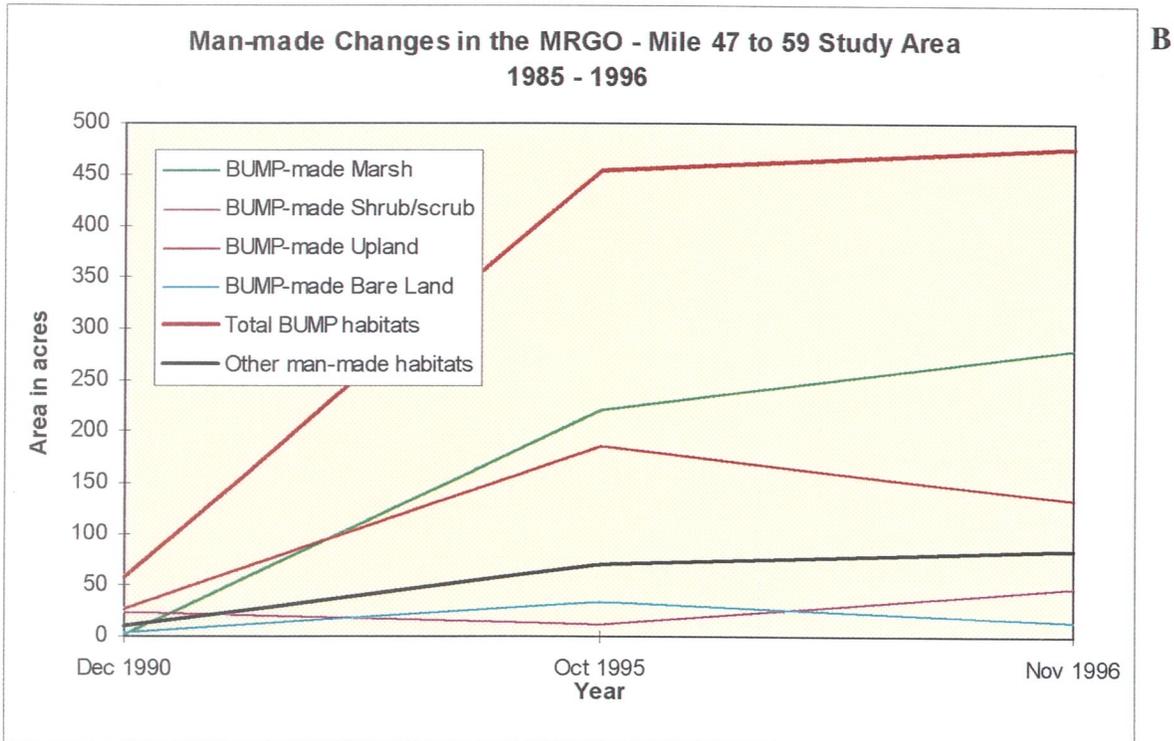
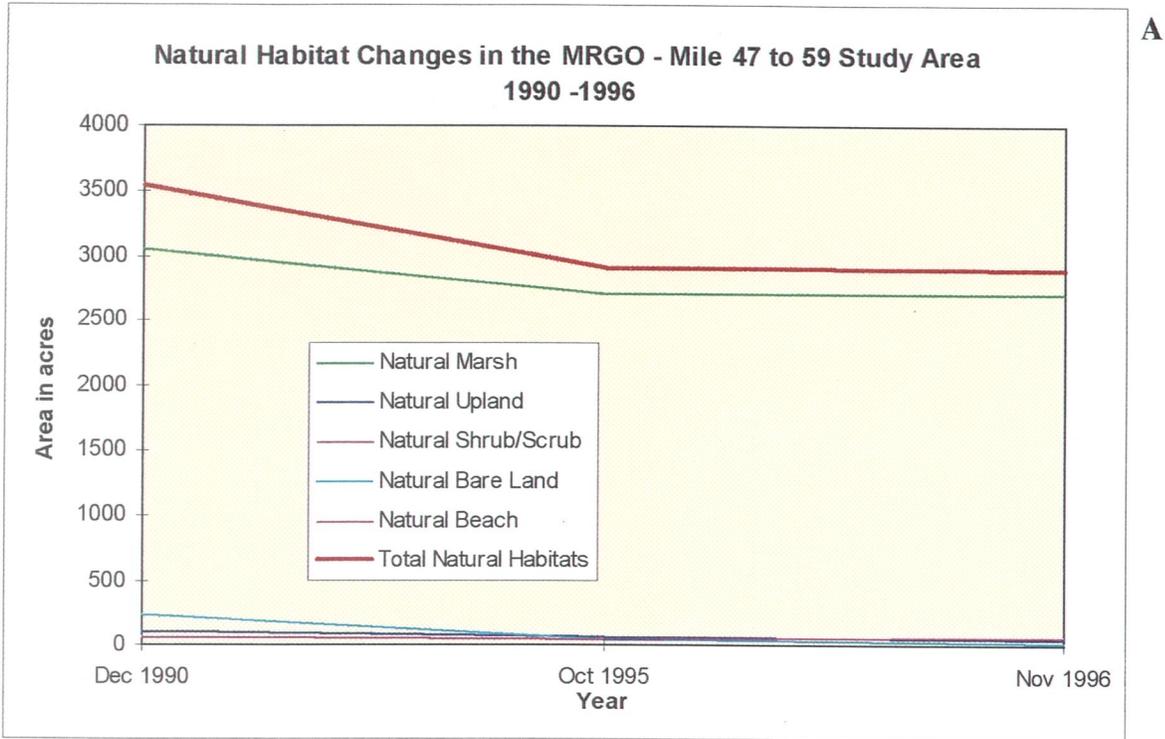


Figure 18. Time series showing the changes in total area of each habitat in the MRGO - Mile 47-59 BUMP study area between December 1990 and November 1996. A) natural habitat changes. B) man-made habitat changes.

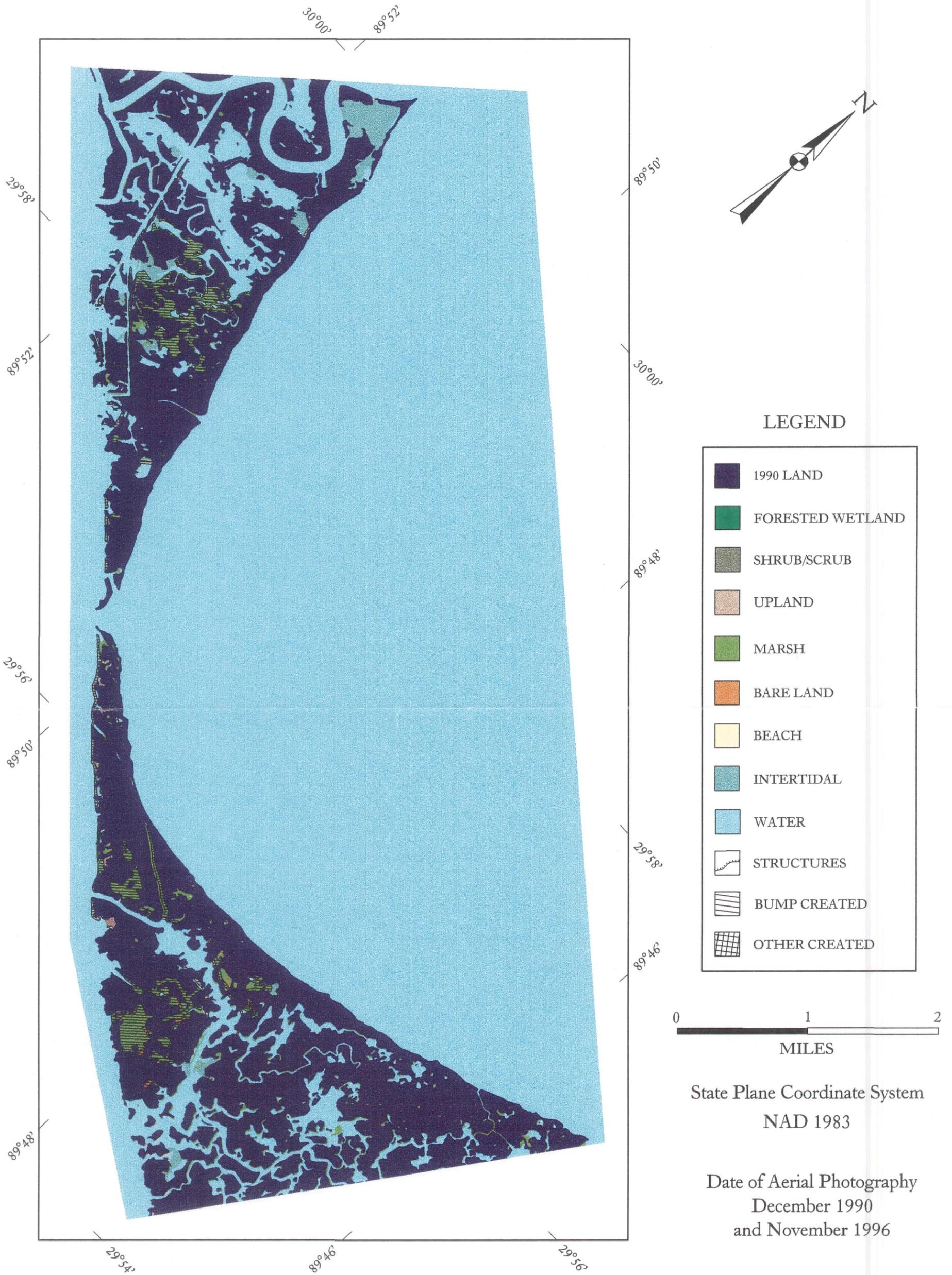


Figure 19. Map of the MRGO-Mile 47-59 BUMP study area showing the new habitats that developed between December 1990 and November 1996.

## CONCLUSIONS

1. A) The total area of the MRGO - Mile 47-59 BUMP study area in December 1990 was 3618.0 acres. Natural processes accounted for 3548.7 acres or 98 percent of the total area. Man-made processes related to beneficial use of dredged material accounted for 58.9 acres or 1.6 percent of the total area.  
B) The total area of the MRGO - Mile 47-59 BUMP study area in November 1995 was 3444.7 acres. Natural processes accounted for 2920.1 acres or 85 percent of the total area. Man-made processes related to the beneficial use of dredged material accounted for 453.7 acres or 13 percent of the total area.  
C) The total area of the MRGO - Mile 47-59 BUMP study area in November 1996 was 3463.0 acres. Natural processes accounted for 2902.8 acres or 84 percent of the total area. Man-made processes related to the beneficial use of dredged material accounted for 476.4 acres or 14 percent of the total area.
2. A) The MRGO - Mile 47-59 BUMP study area decreased by 173.4 acres between December 1990 and November 1995. Natural processes were responsible for -628.6 acres of decrease and the beneficial use of dredged material was responsible for +394.8 acres of increase.  
B) The MRGO - Mile 47-59 BUMP study area increased by +18.4 acres between November 1995 and November 1996. Natural processes were responsible for 17.3 acres of decrease and the beneficial use of dredged material was responsible for +22.7 acres of increase.  
C) The MRGO - Mile 47-59 BUMP study area decreased by -155.1 acres between December 1990 and November 1996. Natural processes were responsible for -645.9 acres of decrease and the beneficial use of dredged material was responsible for +417.9 acres of increase.
3. Natural processes are responsible for eroding the marsh at a rate of -59.5 acres per year. Beneficial use of dredged material appears to be effective in nourishing and restoring marsh habitats.
4. The field surveys indicate the correct stacking heights are optimal for creating marsh and to a lesser extent shrub/scrub. The optimal elevation for marsh creation appears to be less than +2 feet MSL (+2.78 feet MLG). Initial stacking heights were reported to be +3.5 MLG from "As-builts" which resulted in appropriate height presently for healthy marsh growth.
5. At the MRGO - Mile 47-59 BUMP study area, the beneficial use of dredged material created +417.5 acres of new habitat between December 1990 and November 1996. This total includes: +276.9 acres of marsh, +105.0 acres of upland, 25.2 acres of shrub/scrub, and +10.4 acres of bare land.
6. Within the MRGO - Mile 47-59 BUMP study area, the beneficial use of dredged material reduced the amount of coastal land loss by 65 percent.
7. Retaining dikes need to be maintained in place until material within them has consolidated enough to withstand tidal movement.

**APPENDIX 2A**

**LIST OF VEGETATIVE SPECIES  
IN THE MISSISSIPPI RIVER GULF OUTLET - MILE 47-59**

**LIST OF VEGETATIVE SPECIES  
IN THE MISSISSIPPI RIVER GULF OUTLET - MILE 47-59**

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 or The Smithsonian Guide to Seaside Plants of the Gulf and Atlantic Coasts.

- Aster tenuifolius** L. . . . . Salt marsh aster  
Herbaceous perennial; brackish marshes
- Avicennia germinans** L. . . . . Black mangrove  
evergreen shrub; sandy and silty shores in salt and brackish water, upper tidal zone of saline marshes
- Baccharis halimifolia** L. . . . . Groundselbush  
shrub; elevated sites in fresh to saline marshes
- Bacopa monnieri** (L.) Pennell. . . . . Smooth Water-hyssop  
Succulent, creeping herb; sandy margins of fresh or brackish marshes, streams and ponds
- Borrchia frutescens** (L.) . . . . . sea ox-eye  
rhizomatous shrub; brackish marsh or upper zones of salt marsh
- Distichlis spicata** (L.) Greene . . . . . salt grass  
rhizomatous perennial; brackish marshes and flats
- Eleocharis parvula** L. . . . . Spikerush  
small dense, rhizomatous perennial; brackish marshes, rarely fresh-water marshes
- Iva frutescens** L. . . . . marsh elder  
shrub; brackish marshes, upper zones of salt marsh
- Scirpus robustus** L. . . . . Saltmarsh Bulrush  
coarse perennial; brackish marshes and ditches, higher parts of salt or brackish marshes
- Spartina alterniflora** Loisel. . . . . oyster grass  
rhizomatous perennial; salt and brackish marshes
- Spartina cynosuroides** (L.) Roth . . . . . Big cordgrass  
coarse perennial; Brackish or freshwater tidal marshes, brackish sloughs
- Spartina patens** L. . . . . Marshhaycordgrass  
rhizomatous perennial; brackish marshes, low dunes and backbarrier sand flats
- Solidago sempervirens** L. . . . . Seaside Goldenrod  
Herbaceous perennial; elevated sites in brackish or saline marshes, bay shores, swales, overwash areas, mini-dunes