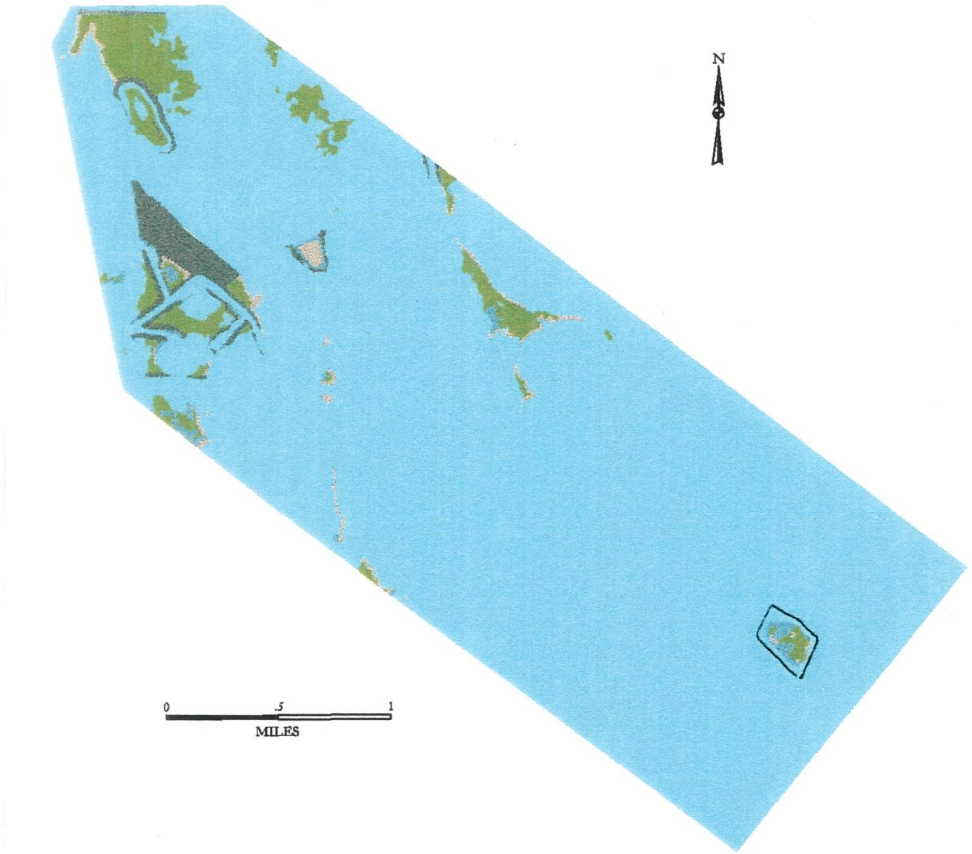
U.S. Army Corps of Engineers - New Orleans District
Louisiana State University - Coastal Studies Institute

BENEFICIAL USE OF DREDGED MATERIAL MONITORING PROGRAM 1996 ANNUAL REPORT

Part 7: Results of Monitoring the Beneficial Use of Dredged Material at the Houma Navigation Canal, Louisiana - Terrebonne Bay Reach

Base Year 1990 through Fiscal Year 1996



Shea Penland, Karen A. Westphal, Qiang Tao, Chris Zganjar, and Paul Connor
Louisiana State University - Coastal Studies Institute
Baton Rouge, LA 70803

and

Linda Mathies, Beth Nord, Ed Creef, and Robert Gunn
Operations Division - Technical Support Branch (CELMN-OD-T)
U.S. Army Corps of Engineers - New Orleans District
New Orleans, LA 70160-0267

Baton Rouge, Louisiana
1997

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The Houma Navigation Canal, Louisiana - Terrebonne Bay Reach BUMP study area is located in Terrebonne Parish in south-central Louisiana (Figure 1). The navigation channel runs north to south and extends approximately 36 miles from Houma into Lake Pelto and then between Wine Island and Timbalier Island through Cat Island Pass into the Gulf of Mexico. Maintenance by the USACE-NOD of discontinuous reaches of the channel has been accomplished on an as-needed basis. The dredged material is used in semi-confined and unconfined beneficial use area for wetland development.

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. This report includes data for the USACE-NOD Fiscal Year (FY)1990 through FY 1996 maintenance events. BUMP results are provided in map series, annual reports, and scientific literature.

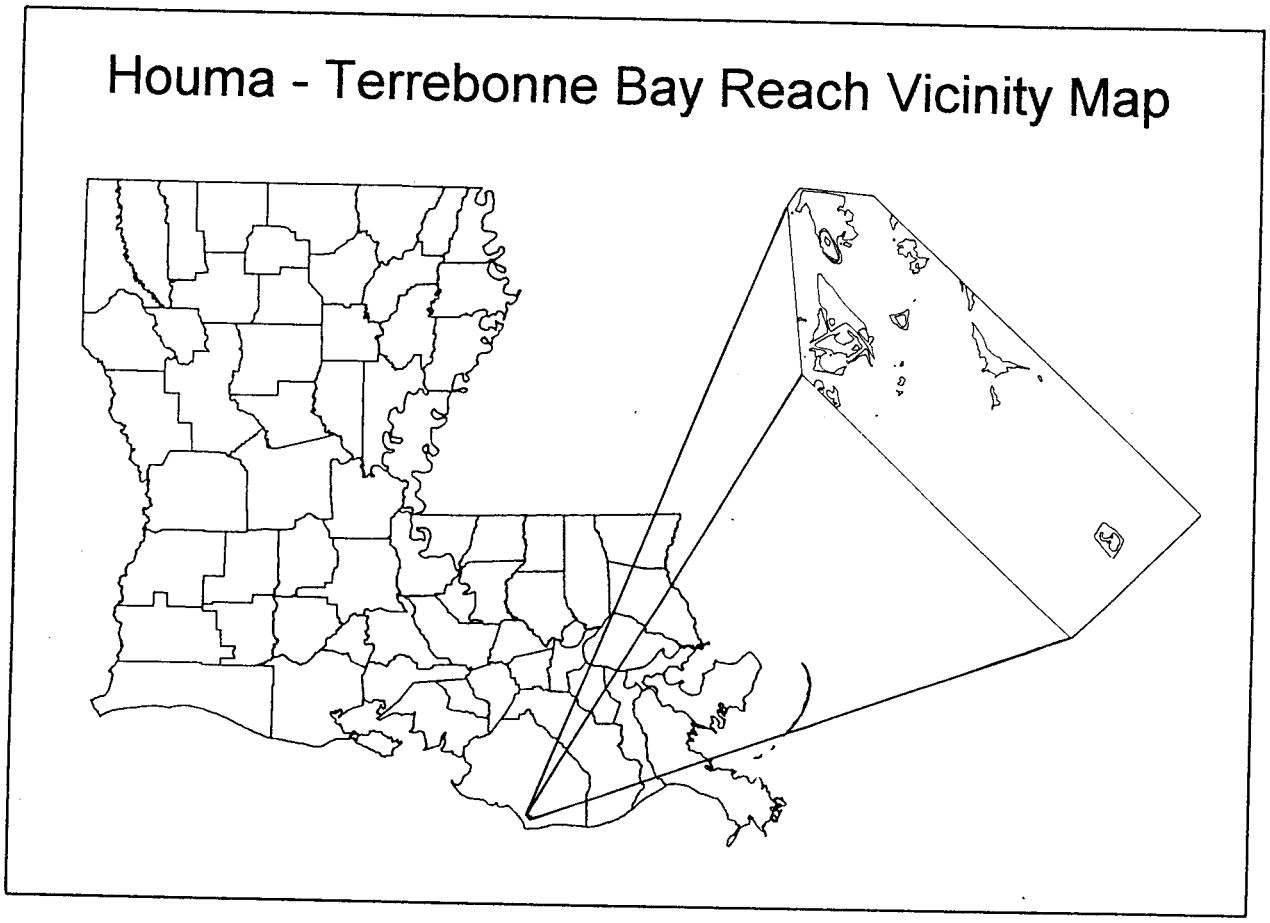


Figure 1. The location of the Houma Navigation Canal, Louisiana - Terrebonne Bay Reach BUMP study site in Louisiana.

This is the seventh part of the nine part Beneficial Use of dredged material Monitoring Program (BUMP), Final Report, representing monitoring results through the USACE-NOD Fiscal Year 1996. 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 - Inland Reach Vicinity Mile 60-50
Part 3: Results of Monitoring the Beneficial Use of Dredged Material at the Mississippi River Gulf Outlet, Louisiana - Jetties Reach
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 - Terrebonne Bay Reach
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, February/April 1995, November 1995, and November 1996. Through GIS analysis, these areas were calculated and changes documented. Field surveys were conducted in September 1996 on the beneficial use areas created in 1993 and 1995. Habitats were ground truthed and survey transects established to document vegetation species, stacking elevations, and as a base for measuring compaction. Figure 2 shows the area of minimum aerial photo-mosaic coverage and the limit of the digitized area.

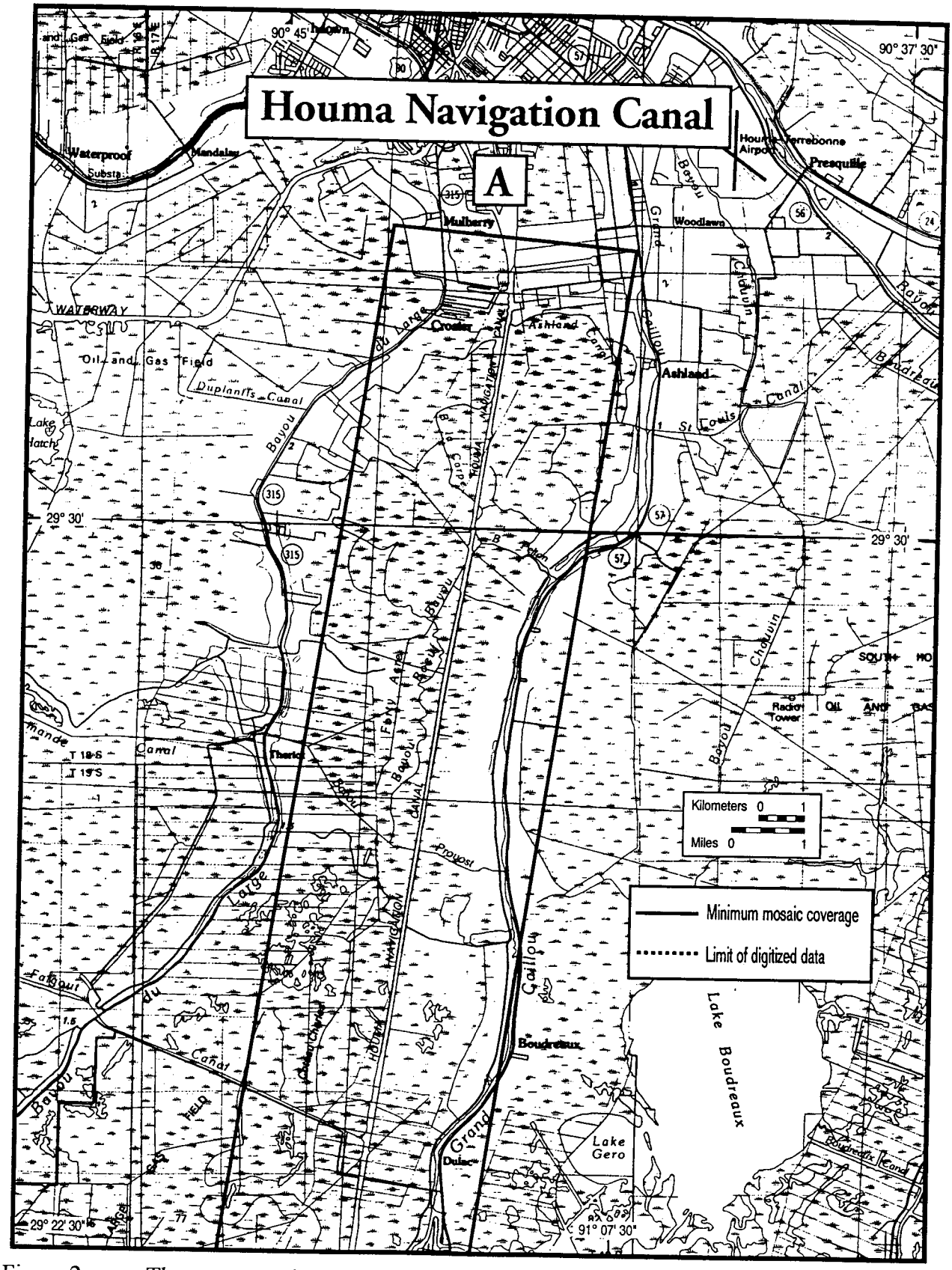


Figure 2a. The upper reach of the Houma Navigation Canal - Inland Reach BUMP study area showing the minimum coverage of the aerial photo-mosaic.

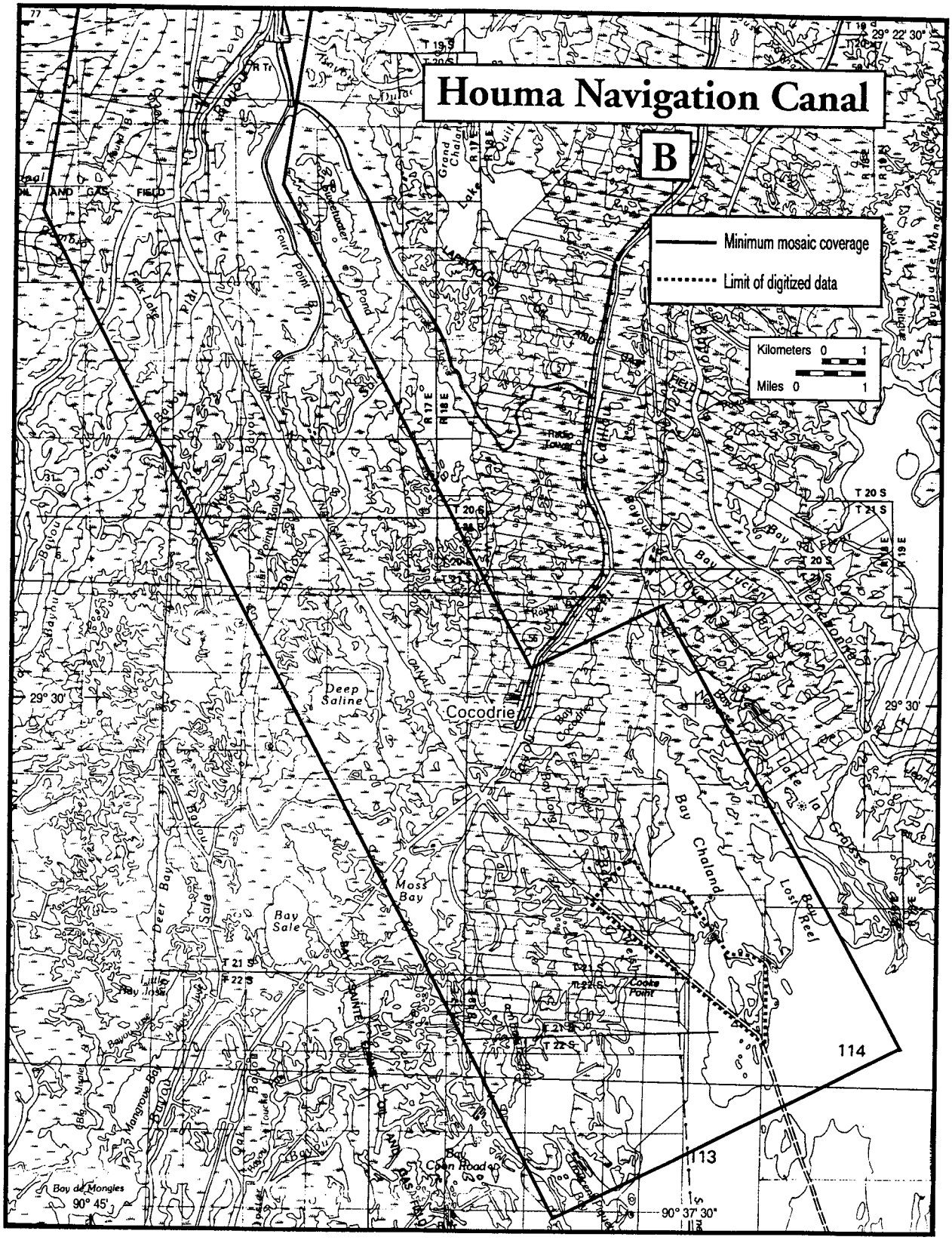


Figure 2b. The lower reach of the Houma Navigation Canal - Inland and Terrebonne Bay Reaches BUMP study area showing the minimum coverage of the aerial photo-mosaic and the limits of the area digitized.

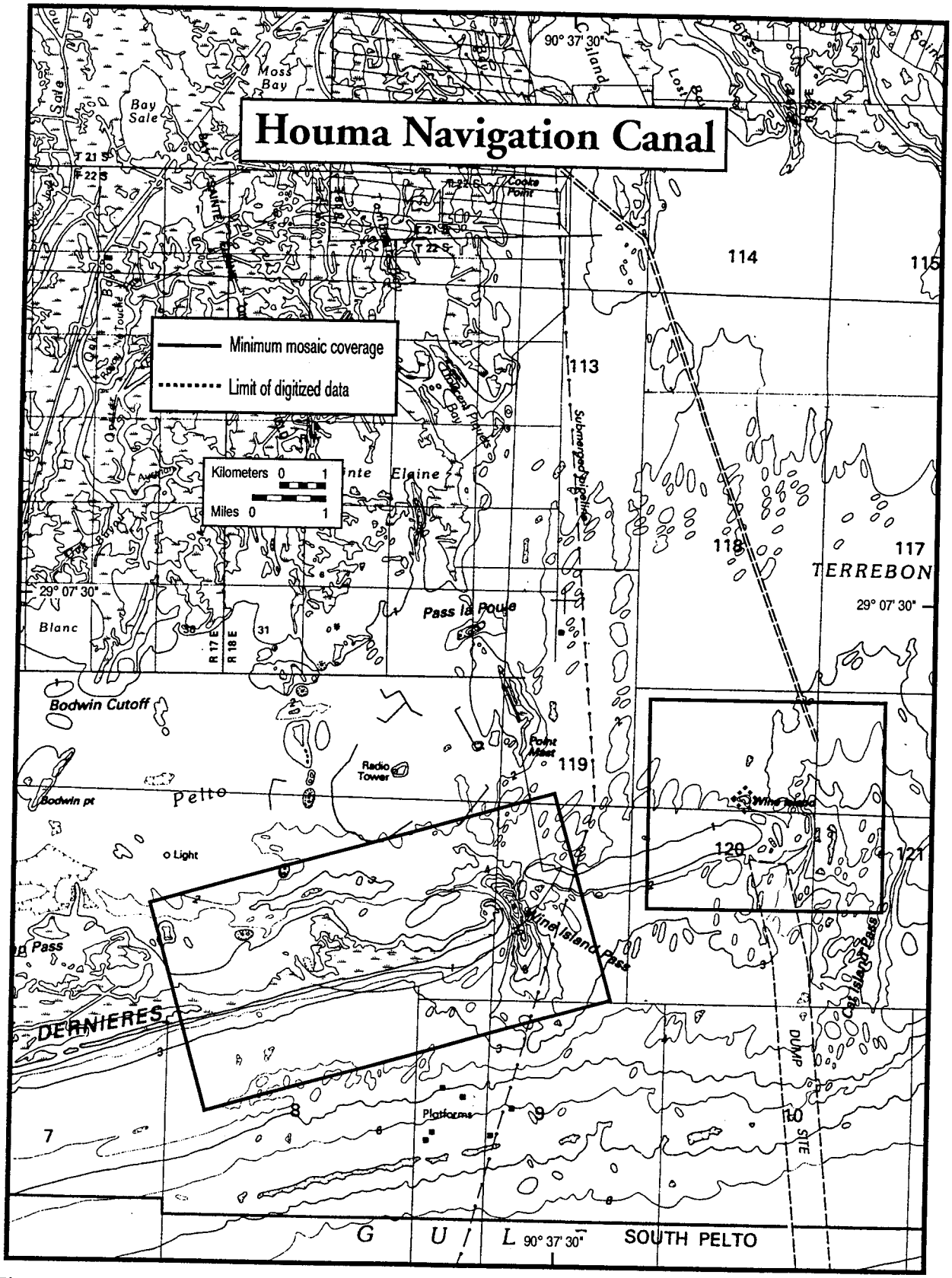


Figure 2c. The lower reach of the Houma Navigation Canal - Bar Channel Reach BUMP study area showing the minimum coverage of the aerial photo-mosaic and the limits of the area digitized.

DREDGED MATERIAL DISPOSAL HISTORY

The Rivers and Harbors Act of 1962 provided for the maintenance of a 15-foot-deep by 150-foot-wide channel from Houma, Louisiana, through Terrebonne Bay, and a 18-foot-deep by 300-foot-wide bar channel to the minus 18-foot contour constructed by local interests. Construction of the 150-foot channel was completed in 1962, and the bar channel was enlarged to 300-foot width in 1974. Maintenance of discontinuous reaches of the channel have been accomplished on an as-needed basis since the Corps of Engineers assumed project maintenance in 1962.

Historically, material dredged from the Houma Navigation Canal during maintenance was deposited confined in upland confined disposal areas, along the bankline, and in open water.

Project maintenance is divided into three reaches: 1) inland reach Mile 36 to Mile 12 (Figure 2a), 2) Terrebonne Bay reach Mile 12 to Mile 0 (Figure 2b), and 3) bar channel /Cat Island Pass, Mile 0 to Mile -5 (Figure 2c). Only the Terrebonne Bay reach is included as the study area for this report. However, discussion of project maintenance of all three reaches is reviewed below.

Inland Reach (Mile 36-12)

Prior to FY 1991, material dredged from the inland reach has been deposited confined in upland disposal areas located on the east and west bank of the Houma Navigation Canal. During FY 1991 dredged material from the inland reach was placed confined into three marsh creation disposal sites as well as into upland confined areas. The maximum elevation of dredged material placement in the marsh creation disposal sites was +4 feet mean low gulf (MLG).

No maintenance was conducted in this reach of the Houma Navigation canal in FY 1992, FY 1993, or FY 1994.

During FY 1995, maintenance was conducted in the inland reach near Mile 36 and dredged material was deposited in an upland confined disposal area.

Terrebonne Bay Reach (Mile 12-0)

Prior to FY 1991, dredged material removed from this reach was placed either into confined disposal areas or into open water. In FY 1991, dredged material from the Terrebonne Bay reach was placed confined into upland disposal areas located opposite Mile 11.3 and Mile 10.3. Dredged material from the Terrebonne Bay reach also was placed confined for wetlands development at the Bay Chaland disposal site at mile 7.1-8.0. Dredged material was placed to an elevation of no higher than+3.5 feet MLG. Dredged material from the Terrebonne Bay reach also was placed unconfined in open water approximately 1000 feet west of the Houma Navigation Canal.

No maintenance was conducted in this reach of the Houma Navigation Canal during FY 1992.

In FY 1993, dredged material from this reach was placed to an elevation of no higher than +5 feet MLG in the confined disposal areas located opposite Mile 11.3 and Mile 10.3. Material was placed for wetlands development at the Bay Chaland disposal area at Mile 7.1-8.0 to a maximum

disposal elevation of +3.5 feet MLG. Dredged material also was placed in open water approximately 1000 feet west of the Houma Navigation Canal centerline.

No maintenance was conducted in this reach during FY 1994.

In FY 1995, dredged material from this reach was placed confined in the disposal area located opposite Mile 10.3. Dredged material from this reach also was placed for wetlands development at the Bay Chaland disposal area. Prior to placing dredged material at Bay Chaland, retention dikes were constructed at the disposal area and capped with limestone. Dredged material was placed no higher than +3.5 feet MLG. Dredged material from this reach also was placed in open water approximately 1000 feet west of the Houma Navigation Canal centerline.

Figure 3 illustrates the dredged material disposal history for the study areas within the Houma Navigation Canal Terrebonne Bay reach since 1990.

Bar Channel/ Cat Island Pass (Mile 0- -5)

In the bar channel/Cat Island Pass reach, dredged material removed during routine maintenance between FY 1976 and FY 1990 was placed in the ocean dredged material disposal site (ODMDS) located on the east side of the channel.

During FY 1991, the New Orleans District obtained special funding and authority pursuant to Section 1135 of the Water Resources Development Act of 1986 to place dredged material from Cat Island Pass on Wine Island Shoal. The State of Louisiana and Terrebonne Parish jointly funded the construction of a retention dike encircling a 23-acre area at Wine Island Shoal.

No maintenance was conducted on this reach during FY 1992.

During 1992, Hurricane Andrew made landfall on the Louisiana coast causing significant property damage. State and Terrebonne Parish Governments supplied Federal Emergency Management Act funds to pay the costs of pumping dredged material to Wine Island Shoal. During FY 1993, these funds were utilized to place dredged material from this reach at Wine Island Shoal. Dredged material from this reach also was placed in the ODMDS during 1993.

No maintenance was conducted on this reach during FY 1994.

Prior to FY 1995, the New Orleans District designated two shoals for placement of dredged material. The two shoals are located within the ODMDS. The purpose of placing dredged material on the two shoals was twofold: 1) to concentrate material on the shoals; and 2) to monitor the natural transport of the material. If monitoring indicates dredged material placed on the shoals is transported or feeds sediments to barrier islands to the west of the canal, the New Orleans District would modify disposal operations to continue concentrating material at the shoals. To date, the results of monitoring neither support nor reject the hypothesis that the dredged material placed on the shoals would be transported to the barrier islands.

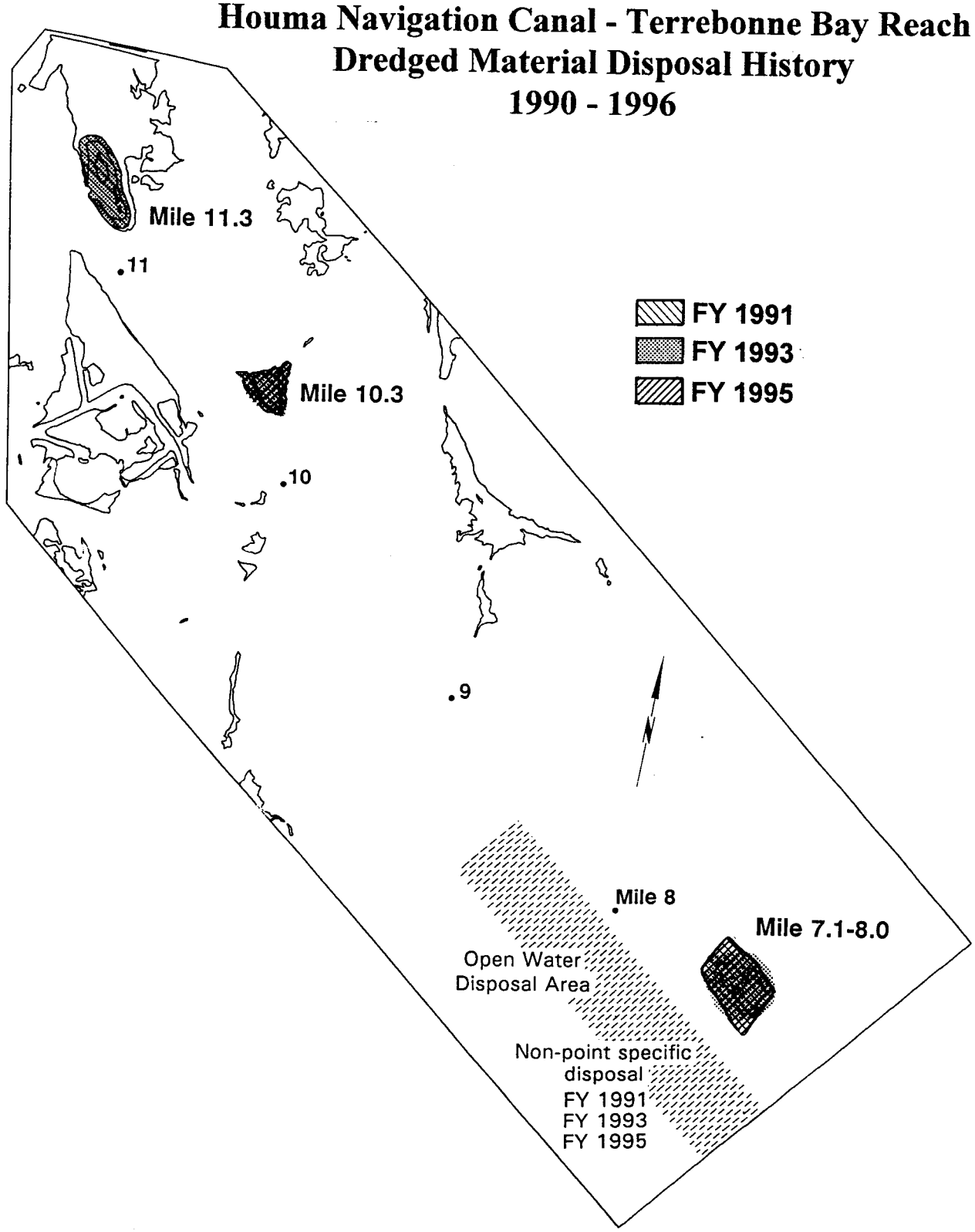


Figure 3. The dredged material disposal history for the Houma Navigation Canal-Terrebonne Bay Reach study area since 1990.

FIELD SURVEY RESULTS

Methodology

Elevation Profile Surveys

The BUMP study area is located where the Houma Navigation Canal passes through Terrebonne Bay Reach south of Cocodrie, Louisiana (Figure 2). 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 applicable sites to document the beneficial use of dredged materials 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, two areas were selected: the site at Mile 11.3 to the north and Mile 7.1-8.0 to the south. One transect line was positioned on each site along the lateral axes (Figure 4). One stake was placed along the rock dike at the channel side of each site to define the transect line, recording secondary features such as towers or navigation markers to assist in relocating the transects should the vegetation become taller or thicker. Permanent 1-inch diameter by 6-foot galvanized stakes were buried approximately 1 feet in the rock dike and secured with more rocks. 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 datum. In September 1996, profile surveys were conducted along the transects defined by the stakes during phase-I. One transect profile was collected from each site. Survey datum 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 datum collected were processed, referenced to local tide gage, and entered into a graphic software program to produce topographic profiles.

The topographic profiles for the study area were constructed in reference to Micronautics Tide Table - Wine Island, Terrebonne Bay, Louisiana (29°5'N / 90° 37'W) (Figure 4). The mean diurnal tidal range for the Houma Navigation Canal study area is published as 1.3 ft. Profiles ranged in length from 937.2 to 1335.8 feet. Maximum relief along the profiles was 4.21 feet (MSL) along the dike at the Mile 11.3 site.

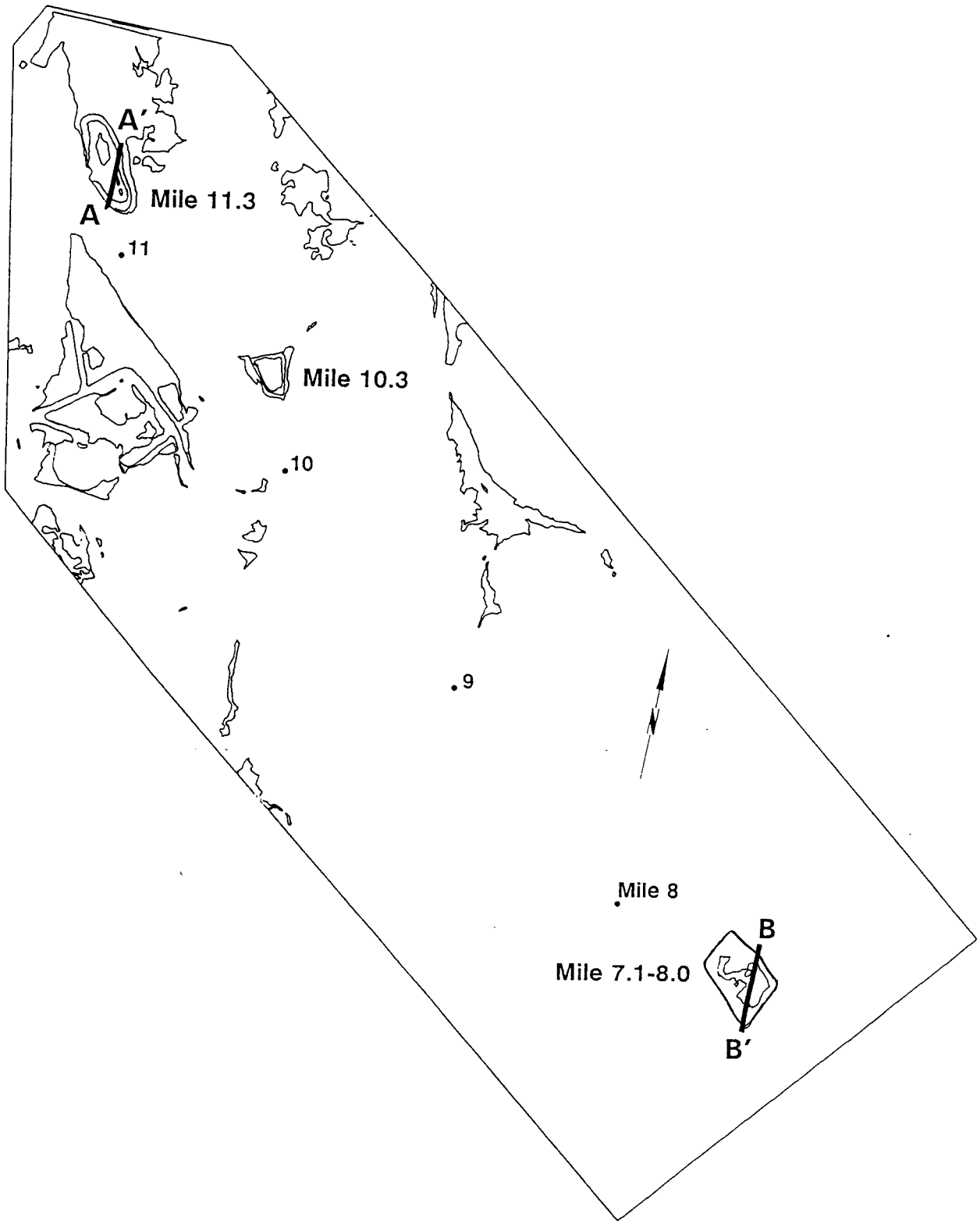


Figure 4. Location of the Houma Navigation Canal - Terrebonne Bay Reach BUMP study area transects.

Vegetation Surveys

Ground truthing for vegetative species composition and habitat verification was done in September 1996. 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 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 the Appendix 7A 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

The 1996 profiles were established with metal poles (stakes) buried in the rock retaining dike and extending 2-3 feet from the sediment surface. One stake was placed at each site to define each profile.

Terrebonne Bay Reach Mile 11.3

The Terrebonne Bay Reach site at Mile 11.3 is located just south of the LUMCON facility at Cocodrie along the northeast side of Houma Navigation (Figure 4). It consists of an encircling dike that is open to tidal action at the southwest side, an adjacent encircling, shallow to intertidal lagoon, and central colonizing salmarsh (Figure 5).

The transect was delineated by 1 stake set in the southwest rock dike of the site, in line with a water tower visible on the horizon to the north. The material within the encircling dike was extremely fine, soft mud, well colonized by saltmarsh. The encircling lagoon was too shallow to float the usual two-person survey crew in a pirogue, and the substrate was too soft to traverse on foot.

The profile here had a length of 937.2 ft. The maximum relief along the axis is 4.21 ft MSL, with an average relief of 1.29 ft MSL. The profile indicates that the island is typically characterized as a mud flat colonized by saltmarsh.

Figure 5. Photograph of the Houma Navigation Canal - Terrebonne Bay Reach Mile 11.3 BUMP study site in September 1996. This view is from the channel side dike, looking across the shallow lagoon to the semi-confined saltmarsh.

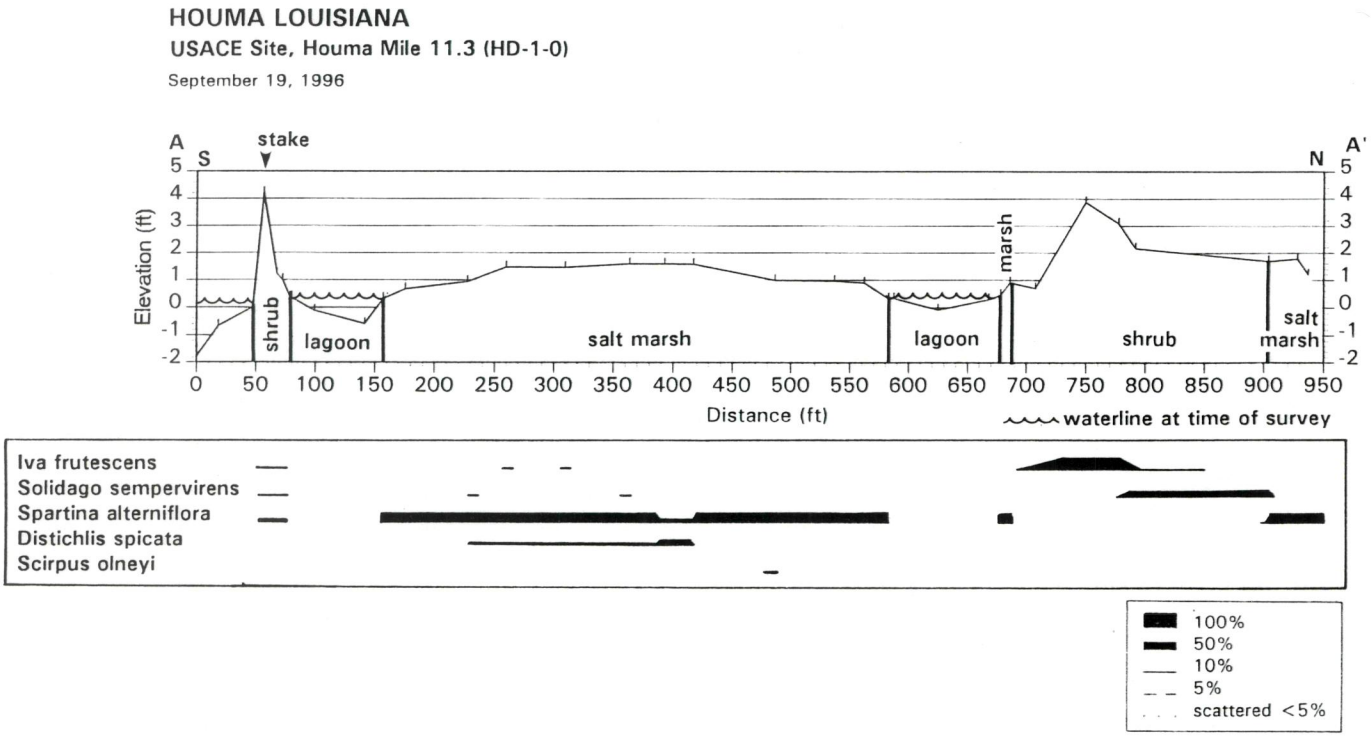


Figure 6. Elevation profile of the Houma Navigation Canal - Terrebonne Bay Reach Mile 11.3 BUMP study site with vegetation data illustrated.

Bay Chaland Mile 7.1 - 8.0

The site at Mile 7.1-8.0 is located along the northeast side of the Houma Navigation Canal as it passes through Bay Welsh near Lake Pelto (Figure 5). A dike was constructed around existing saltmarsh (Figure 7) and material was filled in around the marsh during the FY1993 and FY1995 maintenance events. However, the dike is incomplete in at least two places allowing tidal flow and wave action to remove much of the placed material.

The transect was delineated by one stake set in the rock levee on the northeast side of the site, and was aligned due south along the series of survey stakes placed within the existing marsh by the dredging survey crews (Figure 8).

The profile here was 1335.8 ft. The maximum relief was 2.5 ft MSL, with an average relief of .88 ft MSL. The profiles indicate that the island is typically characterized as a low relief saltmarsh (Figure 8). The encircling lagoon between the existing marsh and the rock dike is deeper than that of the Terrebonne Bay Reach site, and appears to have considerably more tidal action. No new marsh colonization was observed during the time of the transect.

Figure 7. Photograph of the Bay Chaland Mile 7.1-8.0 BUMP study site taken in September 1996, showing the rock dike that partially encloses the existing natural marsh.

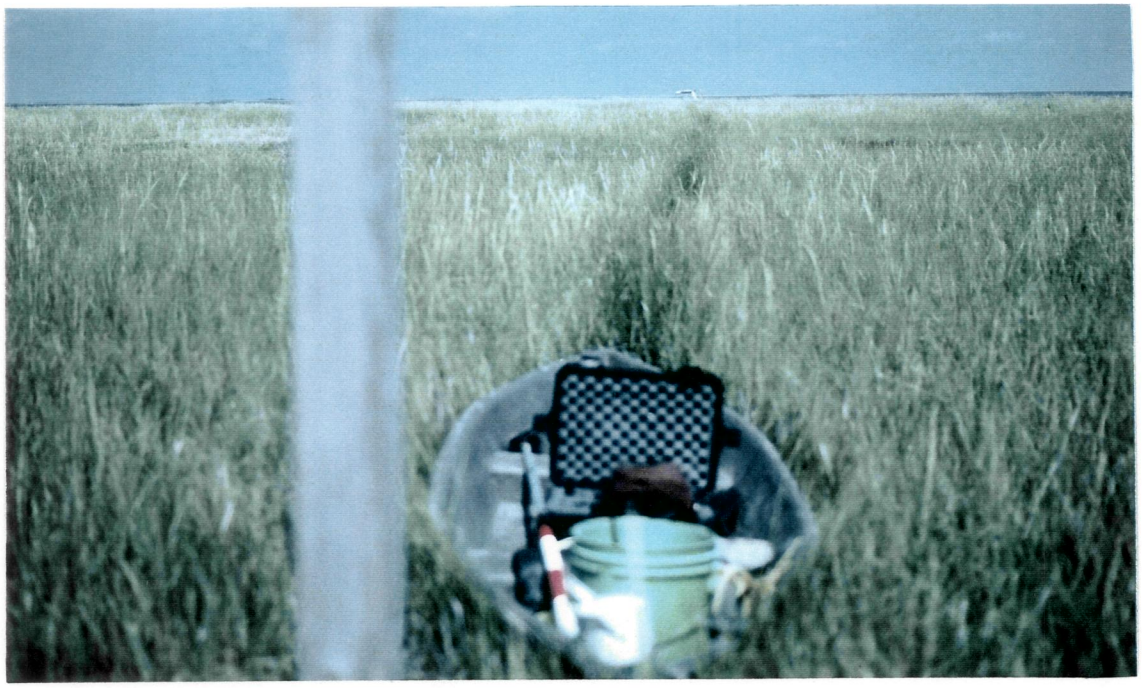


Figure 8. Photograph of the Bay Chaland Mile 7.1-8.0 BUMP study site taken in September 1996, showing the transect line that is in line with survey markers left by a previous crew.

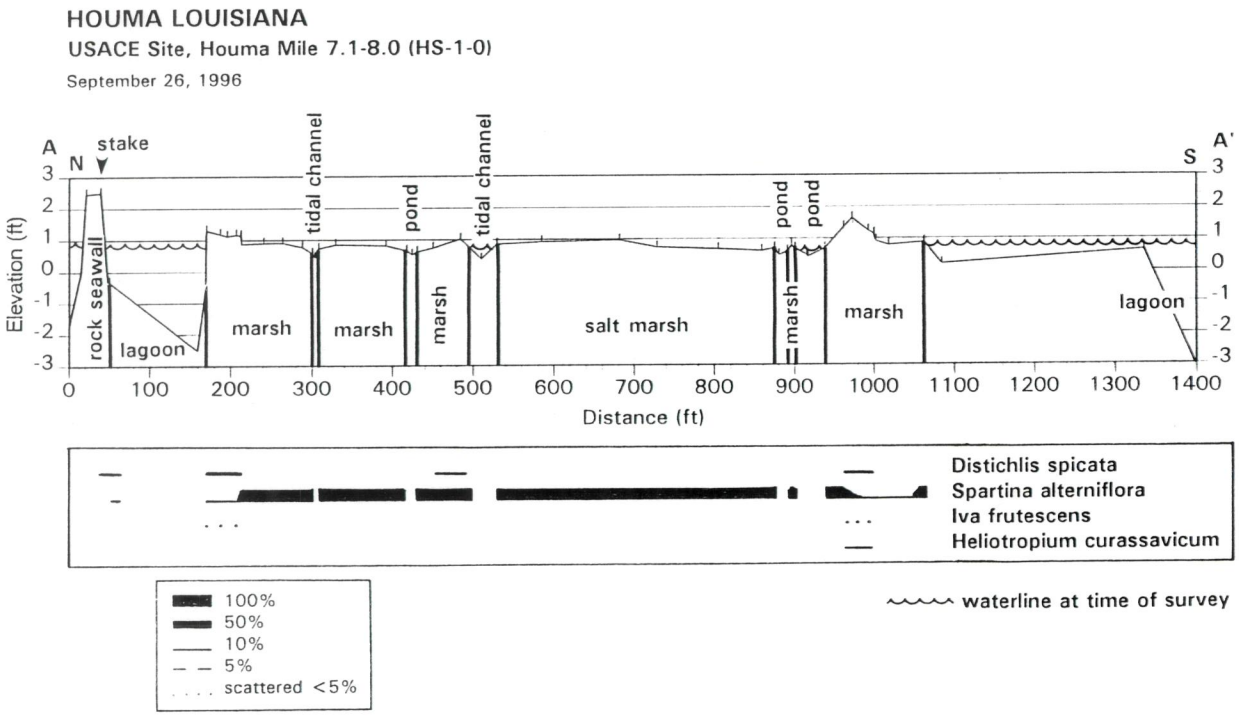


Figure 9. Elevation profile of the Bay Chaland Mile 7.1-8.0 BUMP study site with vegetation data illustrated.

Vegetative Character

General Description

The beneficial use sites consisted of placing dredged material adjacent to deteriorating marsh within a retaining dike. Wave and tidal action eroded the earthen dikes and rearranged the rock dikes in some places to restore tidal action to the enclosed marsh. The overall marsh type for this area is classified as salt marsh. During the time of the field survey, Oyster grass (*Spartina alterniflora*) and salt grass (*Distichlis spicata*) dominated the vegetative community.

The material deposited in the Terrebonne Bay Reach Mile 11.3 site appeared to have been successful in inducing saltmarsh colonization. However, the material deposited within the Bay Chaland Mile 7.1-8.0 site appears to have been reworked or removed by the constant tidal action and had not induced any additional colonization at the time of the elevation transect. The most recent disposal at this site was conducted during FY 1995.

Vegetative community types

The low salt marsh in the study area is inundated by daily tides and is dominated by Oyster grass (*Spartina alterniflora*) and salt grass (*Distichlis spicata*).

The older levee around the Terrebonne Bay Reach site provided an upland habitat for vegetative growth and supported a dense shrub/scrub community consisting mainly of *Iva frutescens* and *Solidago sempervirens*.

GIS ANALYSIS RESULTS

Shoreline Changes: 1990-1996

Figure 10 graphs the spatial history of the Houma Navigation Canal - Terrebonne Bay Reach (HNC) BUMP study area between 1990 and 1996, depicted in Table 1 and illustrated in Figure 11. In December 1990, the HNC study area was measured at 423.0 acres. The study area in November 1996 was measured at 349.2 acres. This is a cumulative area decrease of -73.8 acres or a decrease in area of 17.4 percent for the 5.9 year period at an overall rate of change of -12.5 acres per year. There was an overall loss of -76.1 acres of natural habitats and a loss of -2.2 acres of other man-made habitats, offset by the creation of +4.5 acres due to the beneficial use of dredged materials. Without the contribution of new habitats due to the beneficial placement of dredged material, the total coastal land loss in the study area would have exceeded -78 acres at a rate of -13.2 acres per year, which is equivalent to a 3 percent loss of the area per year.

Between December 1990 and February 1995, the total area of HNC decreased by -57.3 acres at a rate of 13.6 acres per year for this 4.2 year period. The primary areas of progradation took place along the eastern margin of the HNC navigation channel. Land loss was associated with HNC channel widening and erosion along the island edges of the study area.

Between February 1995 and October 1995, the area of HNC study area for this 0.7 year time period decreased by -4.9 acres at a rate of -7.0 acres per year. Land gain occurred primarily in the beneficial use disposal areas. Land loss occurred sporadically in the southern portion of the study area as edge erosion.

Between October 1995 and November 1996, the HNC study area decreased by -11.6 acres at a rate of -12.9 acres per year for this 0.9 year period. Land gain occurred primarily in the beneficial use areas. Land loss took the form of edge erosion along the channel margins and the margins of the islands.

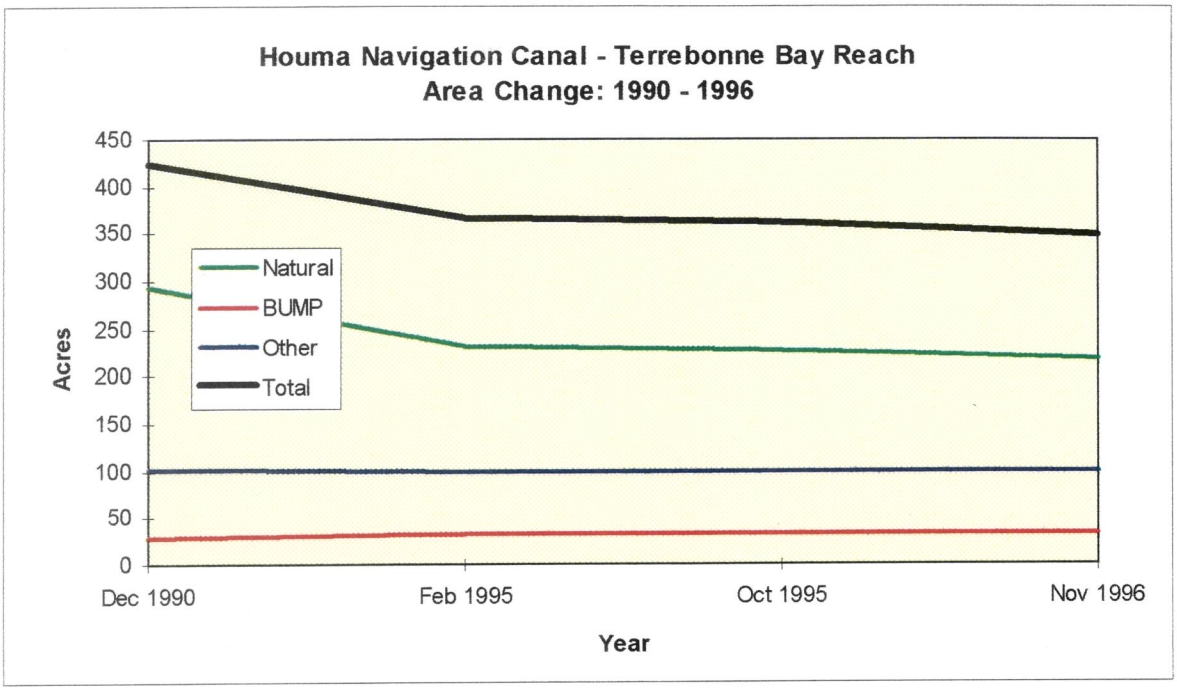


Figure 10. Graph of the area of the Houma Navigation Canal - Terrebonne Bay Reach BUMP study area over time. The green line graphs the total natural area excluding areas created by beneficial use of dredged materials and other man-made areas.

TABLE 1
Houma Navigation Canal - Terrebonne Bay Reach Area: 1990-1996

Area in Acres	Dec 1990	Feb 1995	Oct 1995	Nov 1996
Natural Areas	293.5	232.7	227.2	217.4
BUMP Man-made Areas	27.7	33.9	33.4	32.2
Non-BUMP Man-made Areas	101.8	99.1	100.2	99.6
Total	423.0	365.7	360.8	349.2

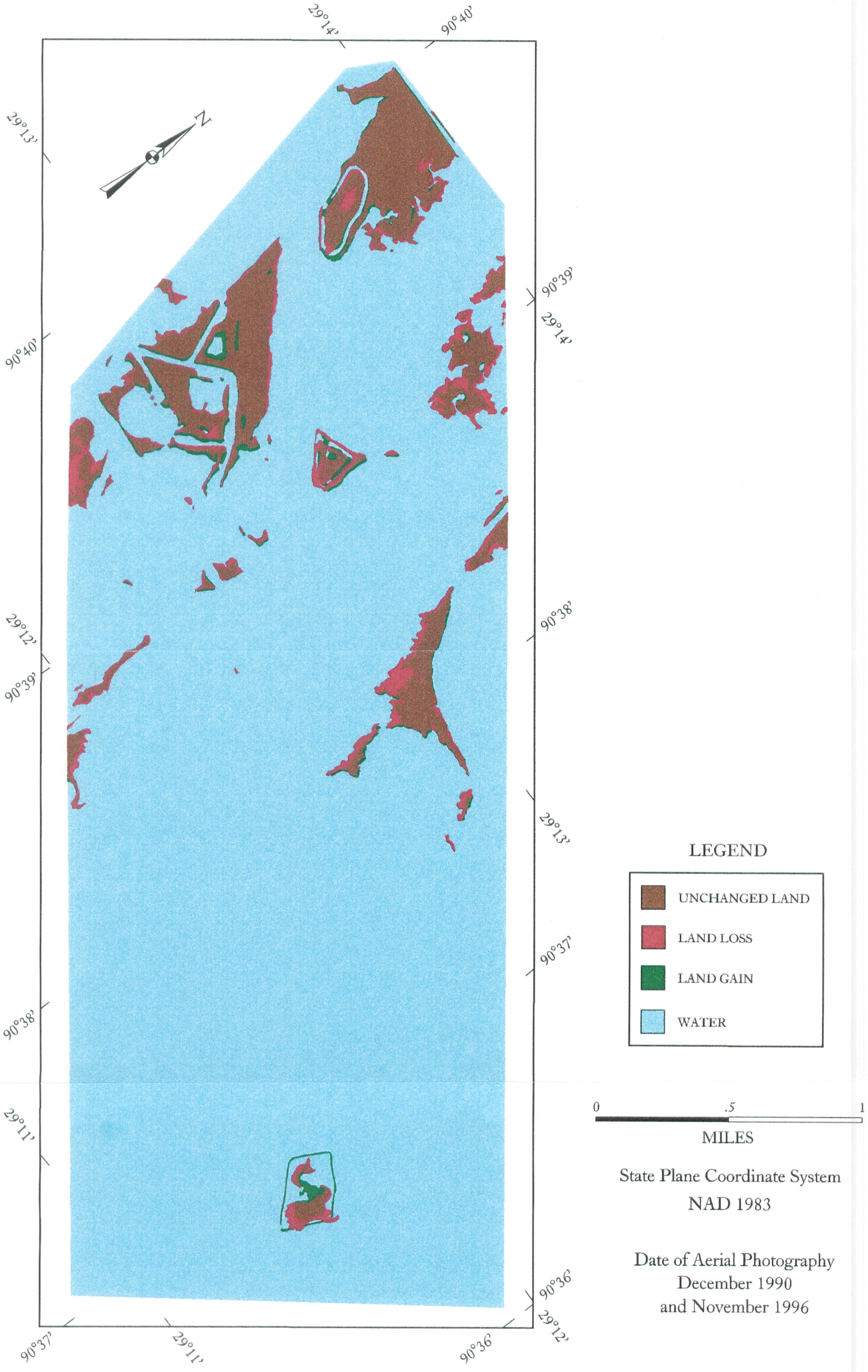


Figure 11. Shoreline change history for the Houma Navigation Canal - Terrebonne Bay Reach BUMP study area between December 1990 and November 1996.

Habitat Inventory

The aerial photographic interpretation combined with field surveys identified six major habitat types in the Houma Navigation Canal - Terrebonne Bay Reach BUMP (HNC) 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 use of dredged material. The non-BUMP man-made (other-made) class identifies areas created as a result of activities other than BUMP, such as areas associated 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 five habitat types found in the HNC study area in December 1990. The location and arrangement of these habitats is presented in figure 12. The total area of the HNC study area in December 1990 was 423.0 acres. Of this total, 293.5 acres were natural and 129.5 acres were man-made including 27.7 acres BUMP-made and 101.8 acres of other-made or 69.3 percent were natural, 5.0 percent were BUMP-made and 24.1 percent was other-made. In order of decreasing size and importance, the largest habitat found was natural marsh (277.0 acres) followed by other-made upland (66.5 acres), other-made shrub/scrub (28.4 acres), BUMP-made bare land (19.9 acres), natural upland (11.5 acres), BUMP-made upland (7.8 acres), other-made marsh (6.9 acres), natural beach (4.2 acres) and natural shrub (0.8 acres).

In terms of habitat totals, marsh (283.9 acres or 67.1%) dominated the Houma - Terrebonne Bay Reach landscape.

TABLE 2
December 1990 Habitat Inventory of the Houma - Terrebonne Bay Reach BUMP Study Area

HABITAT	TOTAL	NATURAL	OTHER-MADE	BUMP-MADE
Marsh	283.9	277.0	6.9	0
Upland	85.8	11.5	66.5	7.8
Shrub/Scrub	29.2	0.8	28.4	0
Beach	4.2	4.2	0	0
Bare Land	19.9	0	0	19.9
Habitat Total	423.0	293.5	101.8	27.7

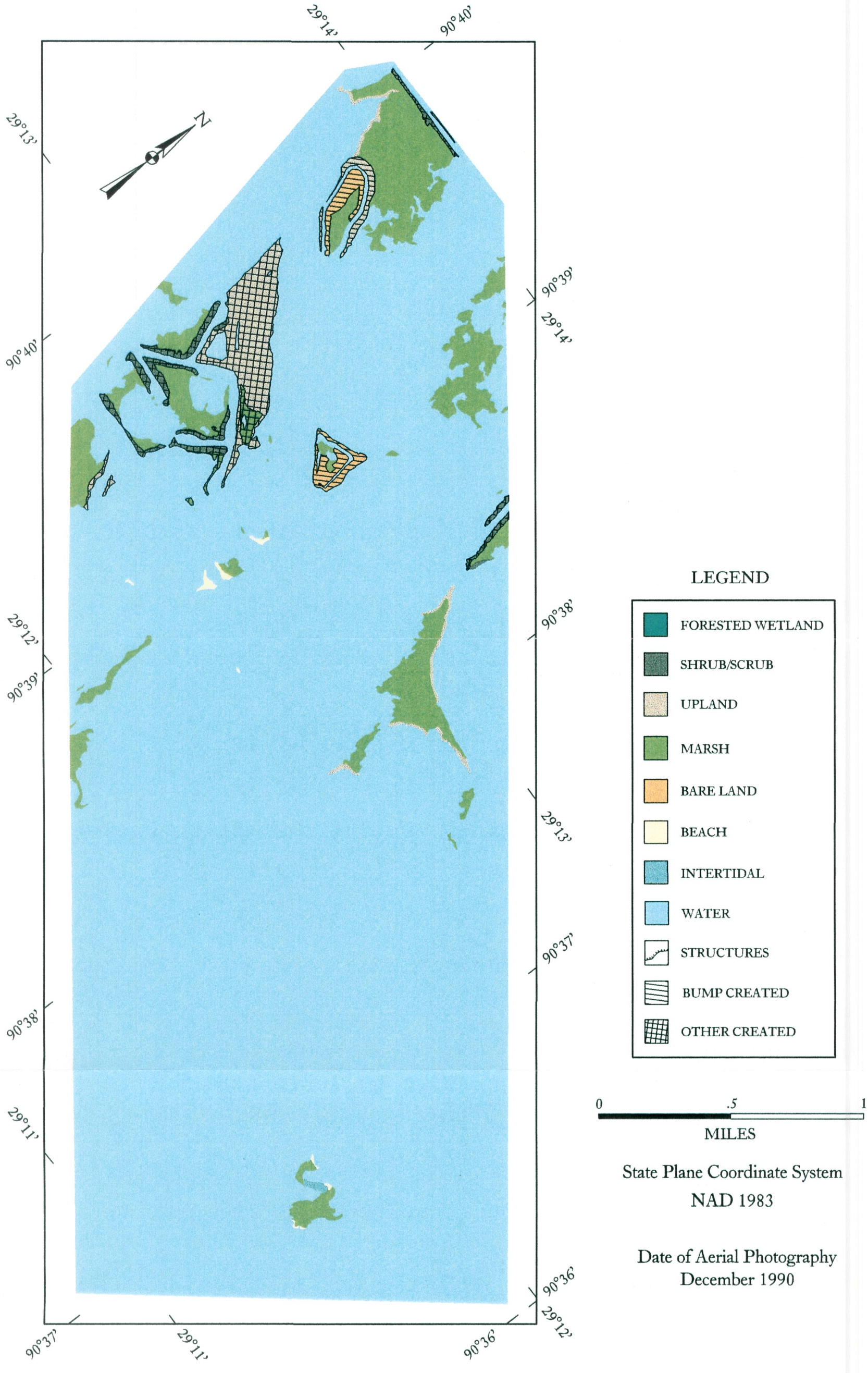


Figure 12. Habitat inventory map of the Houma Navigation Canal - Terrebonne Bay Reach BUMP study area in December 1990.

Table 3 lists the areas of the five habitat types found in the HNC study area in February 1995. The location and arrangement of these habitats is presented in Figure 13. The total area of the HNC study site was measured at 365.7 acres. Of this total, 232.7 acres were natural and 133.0 acres were man-made including 99.1 acres other-made and 33.9 acres of BUMP-made, or 63.6 percent were natural, 27.1 percent was other-made, and 9.3 percent were BUMP-made. In order of decreasing size and importance, the largest habitat found was natural marsh (212.2 acres) followed by other-made shrub/scrub (90.2 acres), natural upland (19.7 acres), BUMP-made upland (11.5 acres), BUMP-made shrub/scrub (10.4 acres), BUMP-made marsh (9.0 acres), other-made marsh (8.0 acres), BUMP-made bare land (3.0 acres), other-made upland (0.9 acres), natural shrub/scrub (0.6 acres), and natural beach (0.2 acres).

In terms of habitat totals, marsh (229.2 acres or 62.7%) dominated the Houma - Terrebonne Bay Reach landscape.

TABLE 3
February 1995 Habitat Inventory of the Houma - Terrebonne Bay Reach Study Area

HABITAT	TOTAL	NATURAL	OTHER-MADE	BUMP-MADE
Marsh	229.2	212.2	8.0	9.0
Upland	32.1	19.7	0.9	11.5
Shrub/Scrub	101.2	0.6	90.2	10.4
Beach	0.2	0.2	0.0	0.0
Bare Land	3.0	0.0	0.0	3.0
Habitat Total	365.7	232.7	99.1	33.9

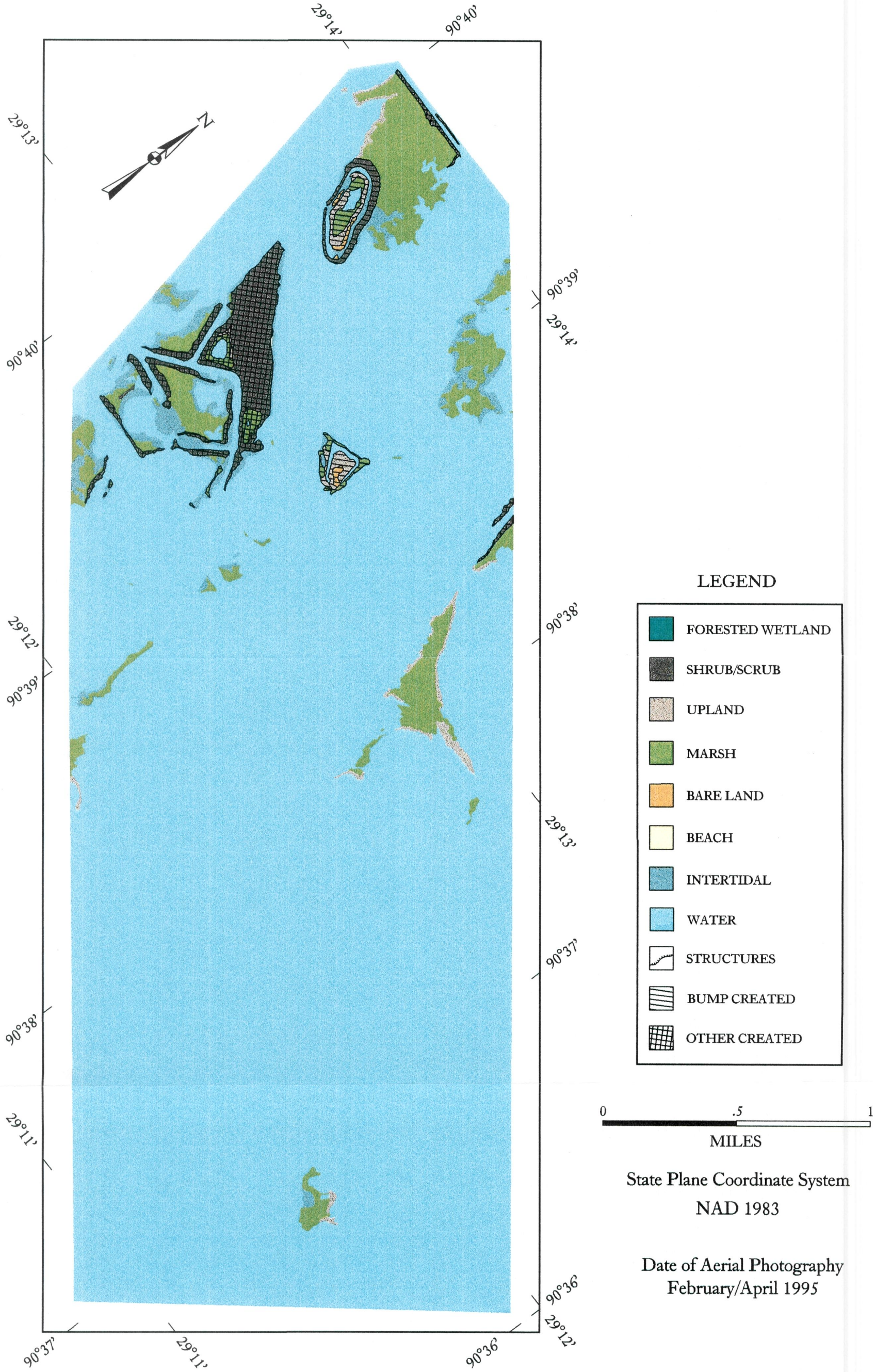


Figure 13. Habitat inventory map of the Houma Navigation Canal - Terrebonne Bay Reach BUMP study area in February 1995.

Table 4 lists the areas of the four habitat types found in the Houma Navigation Canal -Terrebonne Bay Reach (HNC) BUMP study area in October 1995. The location and arrangement of these habitats are presented in figure 14. The total area of the HNC study site in October 1995 was 360.8 acres. Of this total, 227.2 acres were natural and 133.6 acres were man-made including 33.4 acres of BUMP-made and 100.2 acres of other-made, or 63.0 percent were natural, 9.3 percent were BUMP-made, and 27.7 percent were other-made. In order of decreasing size and importance, the largest habitat found was natural marsh (210.6 acres) followed by other-made shrub/scrub (90.9 acres), BUMP-made upland (20.4 acres), natural upland (15.9 acres), BUMP-made shrub/scrub (9.3 acres), other-made marsh (4.8 acres), other-made upland (4.5 acres), BUMP-made marsh (3.7 acres), natural shrub/scrub (0.6 acres), and natural beach (0.1 acres). There was no bare land measured during this time period.

In terms of habitat totals, marsh (219.2 acres or 60.8%) dominated the Houma - Terrebonne Bay Reach landscape.

TABLE 4

October 1995 Habitat Inventory of the Houma - Terrebonne Bay Reach BUMP Study Area

HABITAT	TOTAL	NATURAL	OTHER-MADE	BUMP-MADE
Marsh	219.2	210.6	4.8	3.7
Upland	40.8	15.9	4.5	20.4
Shrub/Scrub	100.7	0.6	90.9	9.3
Beach	0.1	0.1	0.0	0.0
Bare Land	0.0	0.0	0.0	0.0
Habitat Total	360.8	227.2	100.2	33.4

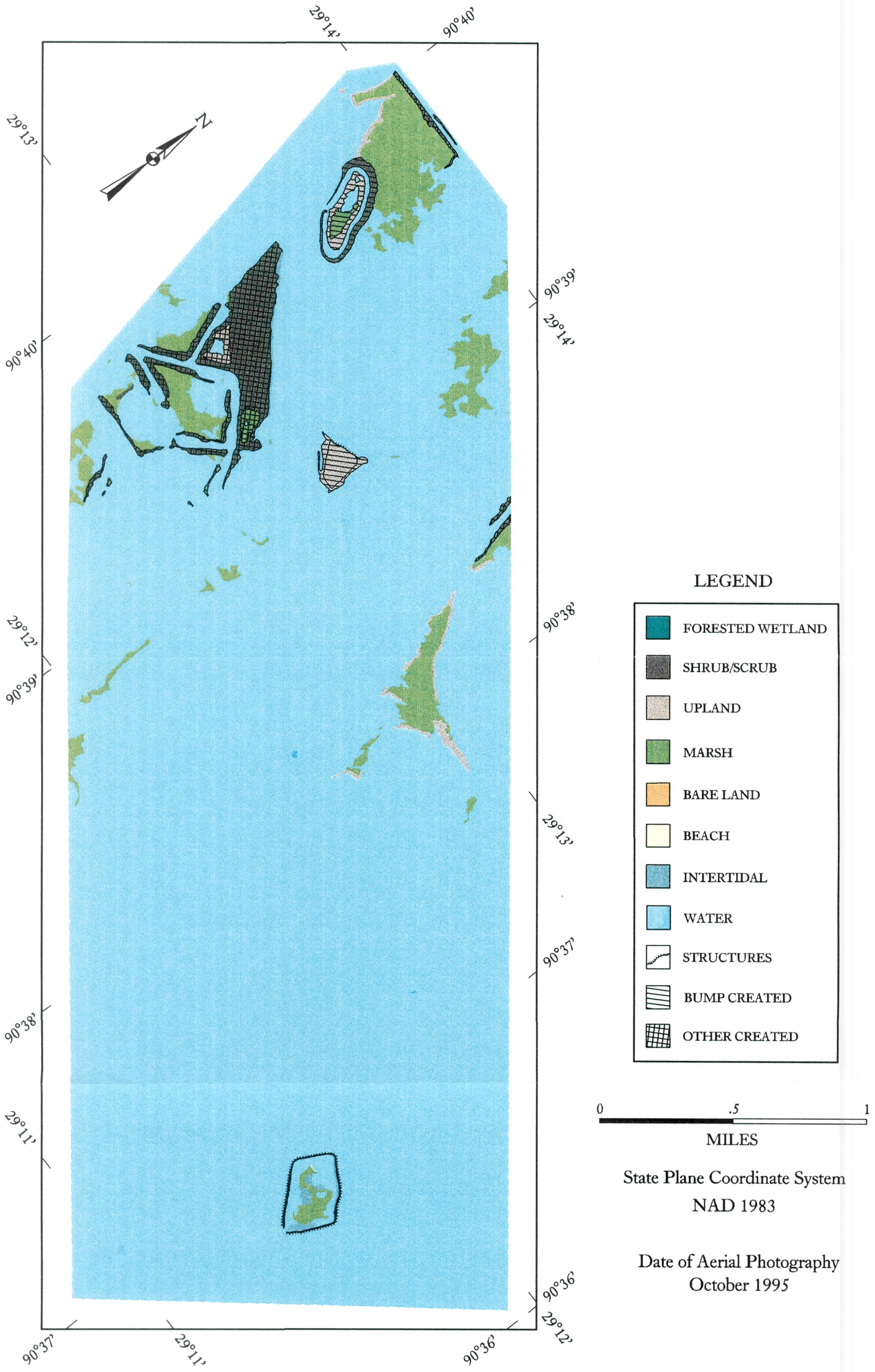


Figure 14. Habitat inventory map of the Houma Navigation Canal - Terrebonne Bay Reach BUMP study area in October 1995.

Table 5 lists the areas of the four habitat types found in the Houma Navigation Canal - Terrebonne Bay Reach BUMP (HNC) study area in November 1996. The location and arrangement of these habitats is presented in figure 15. The total area of the HNC study site in November 1996 was 349.2 acres. Of this total, 217.4 acres were natural and 131.8 acres were man-made including 32.2 acres BUMP-made and 99.6 acres other-made, or 62.3 percent were natural, 9.2 percent were BUMP-made, and 28.5 percent were other-made. In order of decreasing size and importance, the largest habitat found was natural marsh (190.8 acres) followed by other-made shrub/scrub (83.7 acres), natural upland (26.6 acres), BUMP-made marsh (13.4 acres), BUMP-made shrub/scrub (13.5 acres), other-made upland (8.3 acres), other-made marsh (7.3 acres), BUMP-made upland (5.3 acres), and other-made beach (0.3 acres). There was no bare land measured.

In terms of habitat totals, marsh (211.5 acres or 60.6%) dominated the Houma -Terrebonne Bay Reach landscape.

TABLE 5
November 1996 Habitat Inventory of the Houma - Terrebonne Bay Reach BUMP Study Area

HABITAT	TOTAL	NATURAL	OTHER-MADE	BUMP-MADE
Marsh	211.5	190.8	7.3	13.4
Upland	40.2	26.6	8.3	5.3
Shrub/Scrub	97.2	0.0	83.7	13.5
Beach	0.3	0.0	0.3	0.0
Bare Land	0.0	0.0	0.0	0.0
Habitat Total	349.2	217.4	99.6	32.2

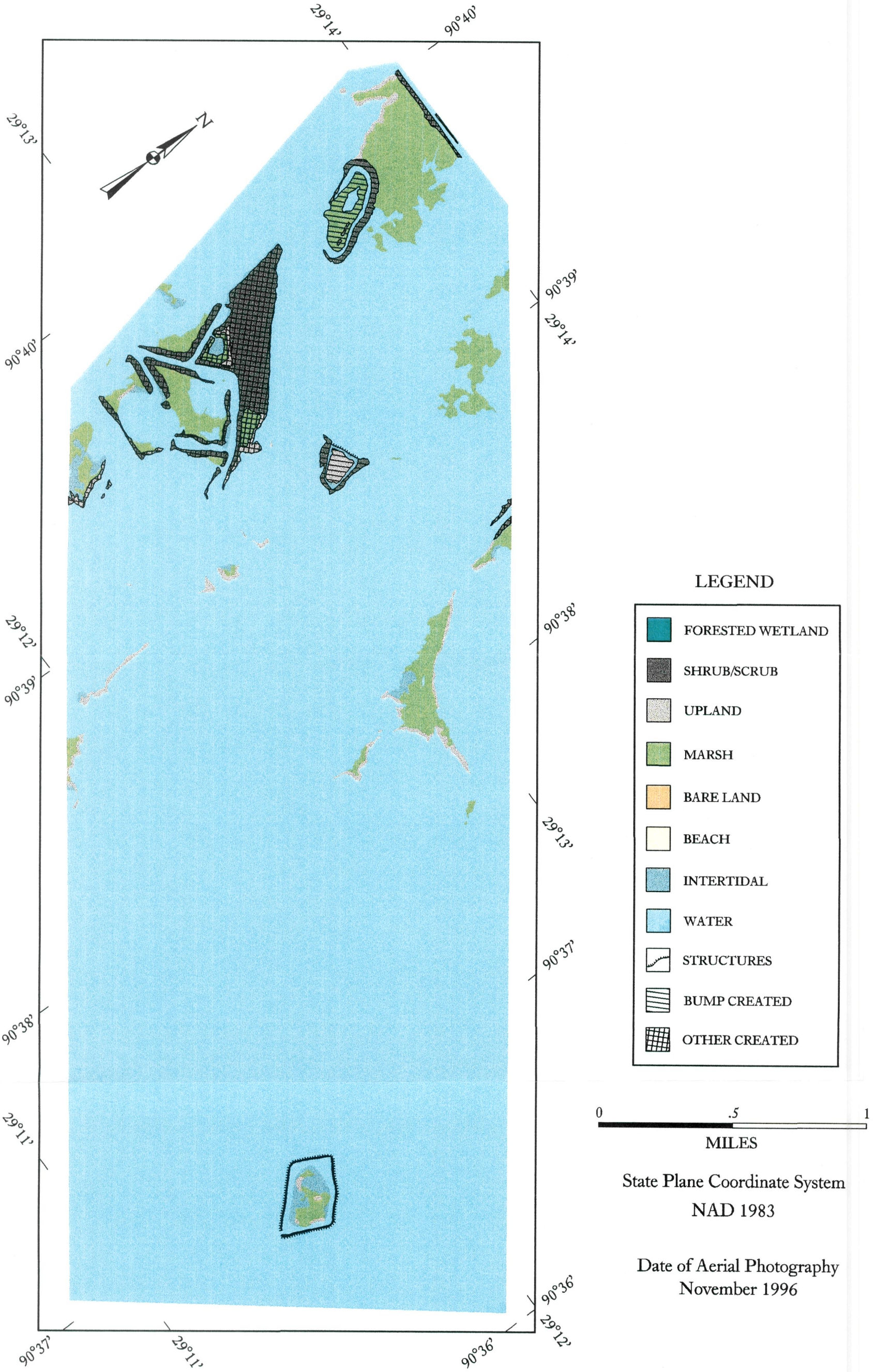


Figure 15. Habitat inventory map of the Houma Navigation Canal - Terrebonne Bay Reach BUMP study area in November 1996.

Habitat Change

Erosion due to natural processes dominates the processes of this area. The total area decreased by -73.8 acres between 1990 and 1996 which represents a 17.4 percent decrease in area. There was an overall -76.1 acres of decrease of the natural habitats and a -2.2 acre decrease of other-made habitats, offset by an overall +4.5 acres of increase in BUMP-made habitats. Table 6 lists the major habitat changes.

In terms of changes in natural area, the marshes decreased by -86.2 acres, the beaches by -4.2 acres, and the shrub/scrub by -0.8 acres. The only area of land gain is in upland at +15.1 acres. The total decrease in natural habitats is -76.1 acres.

For the other-made habitats, in decreasing order, there was a gain of +55.3 acres of shrub/scrub, +0.4 acres of marsh, +0.3 acres of beach, and -58.2 acres of upland for a total loss of -2.2 acres. There was no other-made bare land measured.

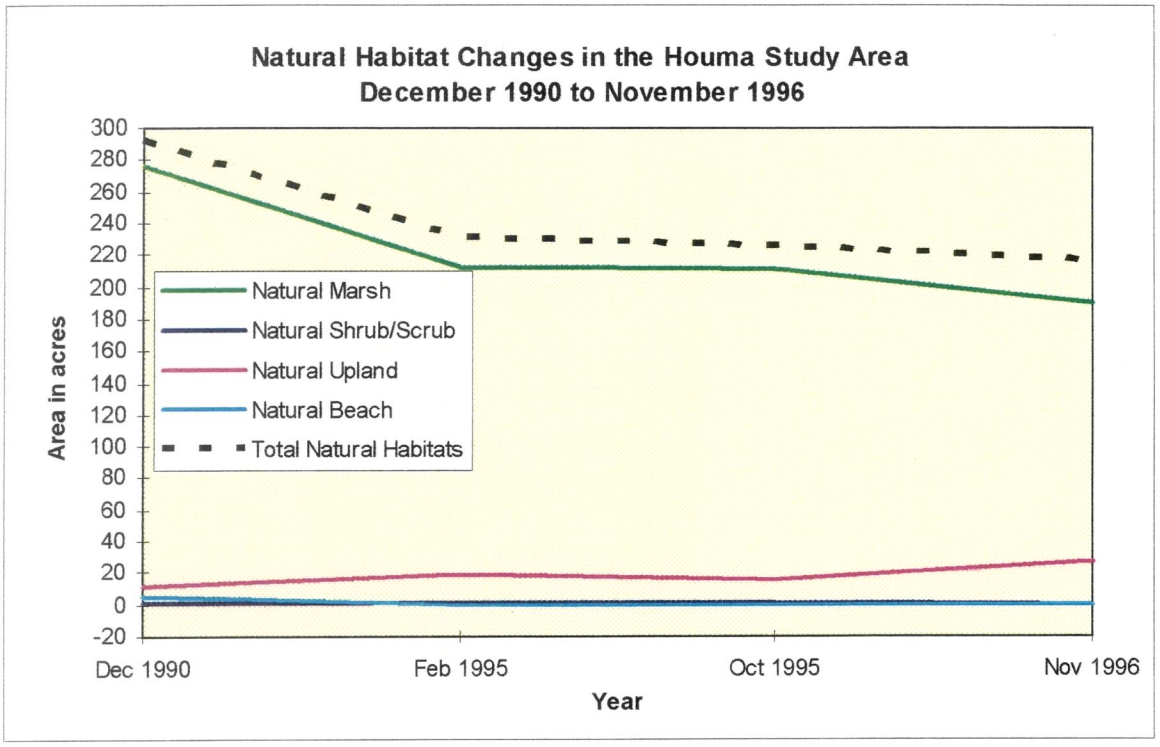
For the BUMP-made habitats, in decreasing order, there was a gain of +13.5 acres of shrub/scrub and +13.4 acres of marsh. In terms of loss, bare land decreased by -19.9 acres and upland by -2.5 acres. There was no BUMP-made beach measured. The overall change in BUMP-made habitats was an increase of +4.5 acres. The overall change in natural and man-made habitats was a decrease of -78.3 acres.

Figure 16 shows a time series of habitat changes along the Houma Navigation Canal - Terrebonne Bay Reach BUMP study area. Figure 16A graphs the natural habitat changes over time. Natural marsh degradation and erosion dominates the processes affecting the natural habitat class. Figure 16B graphs man-made habitats. In terms of the beneficial use process, the greatest areas of new habitat creation include shrub/scrub (+13.5 acres) and marsh (+13.4 acres) as indicated by the most recent inventory in November 1996 (Table 6).

TABLE 6
Houma Navigation Canal - Terrebonne Bay Reach
Cumulative Change in Total Acres of each Habitat
Between December 1990, February 1995, October 1995, and November 1996

HABITAT	Dec 1990-Feb 1995[1]	Feb 1995-Oct 1995[1]	Oct 1995-Nov 1996[1]	Dec 1990-Nov 1996[1]
Natural Marsh	-64.8	-1.6	-19.8	-86.2
Natural Upland	+8.2	-3.8	+10.7	+15.1
Natural Shrub/Scrub	-0.2	0.0	-0.6	-0.8
Natural Beach	-4.0	-0.1	-0.1	-4.2
Natural Bare Land	--	--	--	--
Total Natural Habitats	-60.8	-5.5	-9.8	-76.1
Other-made Marsh	+1.1	-3.2	+2.5	+0.4
Other-made Upland	-65.6	+3.6	+3.8	-58.2
Other-made Shrub/Scrub	+61.8	+0.7	-7.2	+55.3
Other-made Bare Land	--	--	--	--
Other-made Beach	--	--	+0.3	+0.3
Total Other-made	-2.7	+1.1	-0.6	-2.2
BUMP-made Marsh	+9.0	-5.3	+9.7	+13.4
BUMP-made Upland	+3.7	+8.9	-15.1	-2.5
BUMP-made Shrub/Scrub	+10.4	-1.1	+4.2	+13.5
BUMP-made Bare Land	-16.9	-3.0	--	-19.9
BUMP-made Beach	--	--	--	--
Total BUMP-made Habitats	+6.2	-0.5	-1.2	+4.5
HABITAT TOTAL	-57.3	-4.9	-11.6	-73.8

[1] in acres



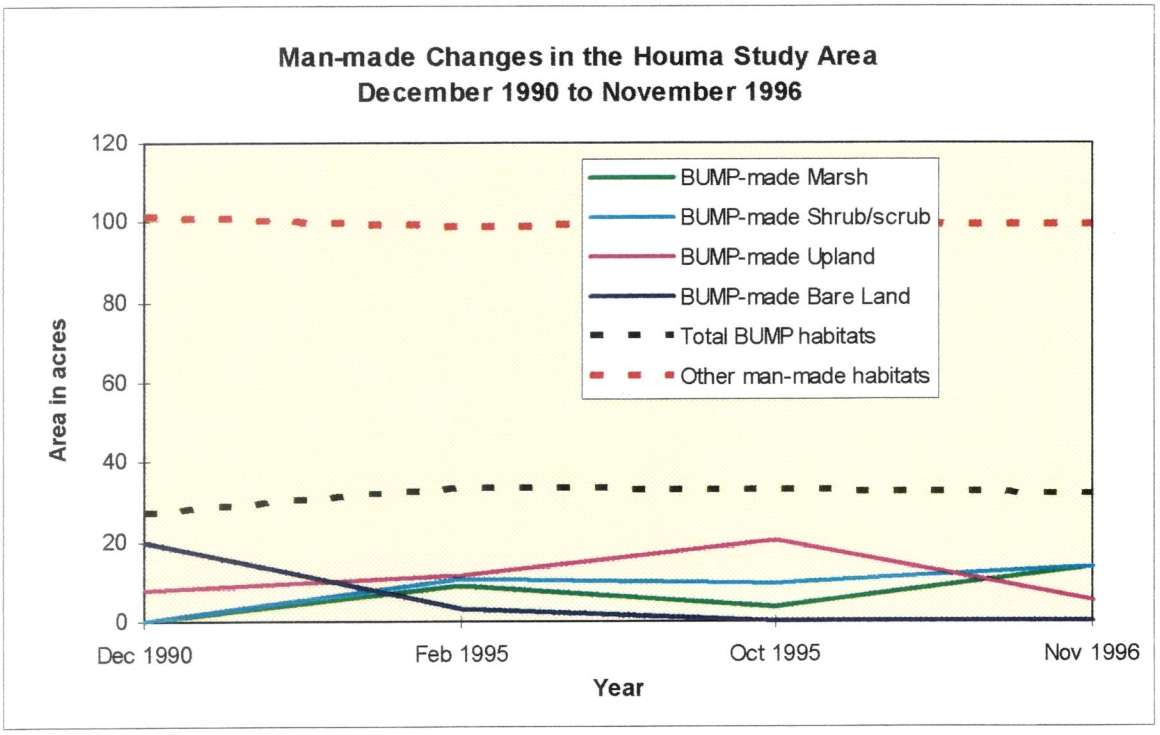


Figure 16. Time series showing the changes in total area of each habitat in the Houma Navigation Canal - Terrebonne Bay Reach BUMP study area between December 1990 and November 1996. A) natural habitat changes. B) Man-made habitat changes.

CONCLUSIONS

1. The beneficial use of dredged material at the HNC navigation channel has been successful in nourishing and sustaining the marsh habitat.

2. The beneficial use of dredged material has created +4.5 acres of man-made habitats between 1990 and 1996. In contrast, the natural habitats in the study area have decreased by -76.1 acres. The resultant total decrease in area of the HNC monitoring site is -73.8 acres. This decrease in area is a result of erosion and subsidence. Over +13.4 acres of marsh have been created since 1990, which accounts for 41.6% of the new habitats created by beneficial use.

3. The field surveys indicated that the marshes created consist of salt marsh species and should be classed as salt marshes. The field surveys also documented that the optimum elevation for marsh development is less than 3 feet msl (3.78 feet Mean Low Gulf).

4. The habitat inventory documented a study area primarily dominated by both natural habitats and man-made habitats. In 1990, the study area contained 423.0 acres of which 69% was natural and 31% was man-made. In 1996, the study area contained 349.3 acres of which 62% was natural and 38% was man-made.

5. The habitat change analysis indicated that +13.4 acres of man-made marsh was created through the beneficial use of dredged material. Other significant habitat changes due to beneficial use include the creation of +13.5 acres of shrub/scrub.

APPENDIX 7A
LIST OF VEGETATIVE SPECIES
OF THE HOUMA NAVIGATION CANAL - Terrebonne Bay Reach
STUDY AREA

LIST OF VEGETATIVE SPECIES
IN THE HOUMA NAVIGATION CANAL - Terrebonne Bay Reach STUDY AREA

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 year of observation, 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.

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

Borrichia 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

Heliotropium curassavicum L. ..... seaside heliotrope
annual succulent; seashores and borders of fresh to saline marsh

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

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

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