MONITORING PLAN

PROJECT NO. C/S-19
WEST HACKBERRY PLANTINGS & SEDIMENT ENHANCEMENT

ORIGINAL DATE: May 24, 1994
UPDATE: July 05, 1995
REVISED DATE: July 23, 1998

Preface

The original Task Force approved monitoring plan was developed for a 20 year monitoring period and was updated to reflect a 10 year monitoring period, which is consistent with the project design life of this demonstration project. The update modifications were a reduction in the frequency of elevational profile and shoreline surveys from annual to every three years and a 50% reduction in aerial photography. Subsequent field investigations found that there was no hay in the haybale structures; therefore, all elevation and shoreline surveys were halted.

Pursuant to a CWPPRA Task Force decision on April 14, 1998, the updated monitoring plan was reduced in scope due to budgetary constraints. The project was redefined as a 5 year demonstration project to be consistent with other demonstration projects. Specifically, emergent and submersed aquatic vegetation sampling and soil sample analysis scheduled for 2004 was eliminated.

Project Description

The West Hackberry Plantings & Sediment Enhancement (C/S-19) project area is located approximately 7 km west-southwest of the town of Hackberry in Cameron Parish, Louisiana (figure 1). Centered at Latitude 29E26' N and Longitude 93E27' E, the project area is comprised of approximately 300 ac (120 ha) of impounded, intermediate to brackish interior wetlands (about 120 ac [48 ha] of emergent marsh and 180 ac [72 ha] of shallow open water about two ft [0.6 m] deep). The project area is bounded by emergent marsh to the west, Black Lake and the Amoco/Shell Western Management Area to the north, Sabine National Wildlife Refuge to the south, and the Brown Lake complex to the east.

In the 1940's, O'Neil (1949) characterized the project area wetlands as fresh to intermediate marshes dominated by *Cladium jamaicense* (Jamaica sawgrass). Between 1952 and 1974, the Black Lake area experienced an 81% reduction in the acreage of emergent wetlands (figure 2, from Adams et al. 1978), and by 1972 was characterized as brackish marsh (Chabreck 1972). A number of factors influenced this outcome. Valentine (n.d.) hypothesized that these marshes were destroyed as a result of the combined effects of Hurricane Audrey in 1957 and subsequent drought periods extending into the mid-1960's. The dredging of the Calcasieu Ship Channel has led to increased salinities in Black Lake, which is connected to the ship channel via Black Lake Bayou. Spoil banks along the Gulf Intracoastal Waterway, Alkali Ditch, Calcasieu Ship Channel, and North Stark's Canal, combined with natural ridges in the area, have left Black Lake Bayou as one of the only drainage sites for the Black Lake marshes, impeding the drainage of high salinity water associated with hurricane/storm surges. Dredging of Rycade Canal and deterioration of the spoil banks along North Stark's Canal has led to increased tidal action, the circulation of high salinity water from the ship channel into the

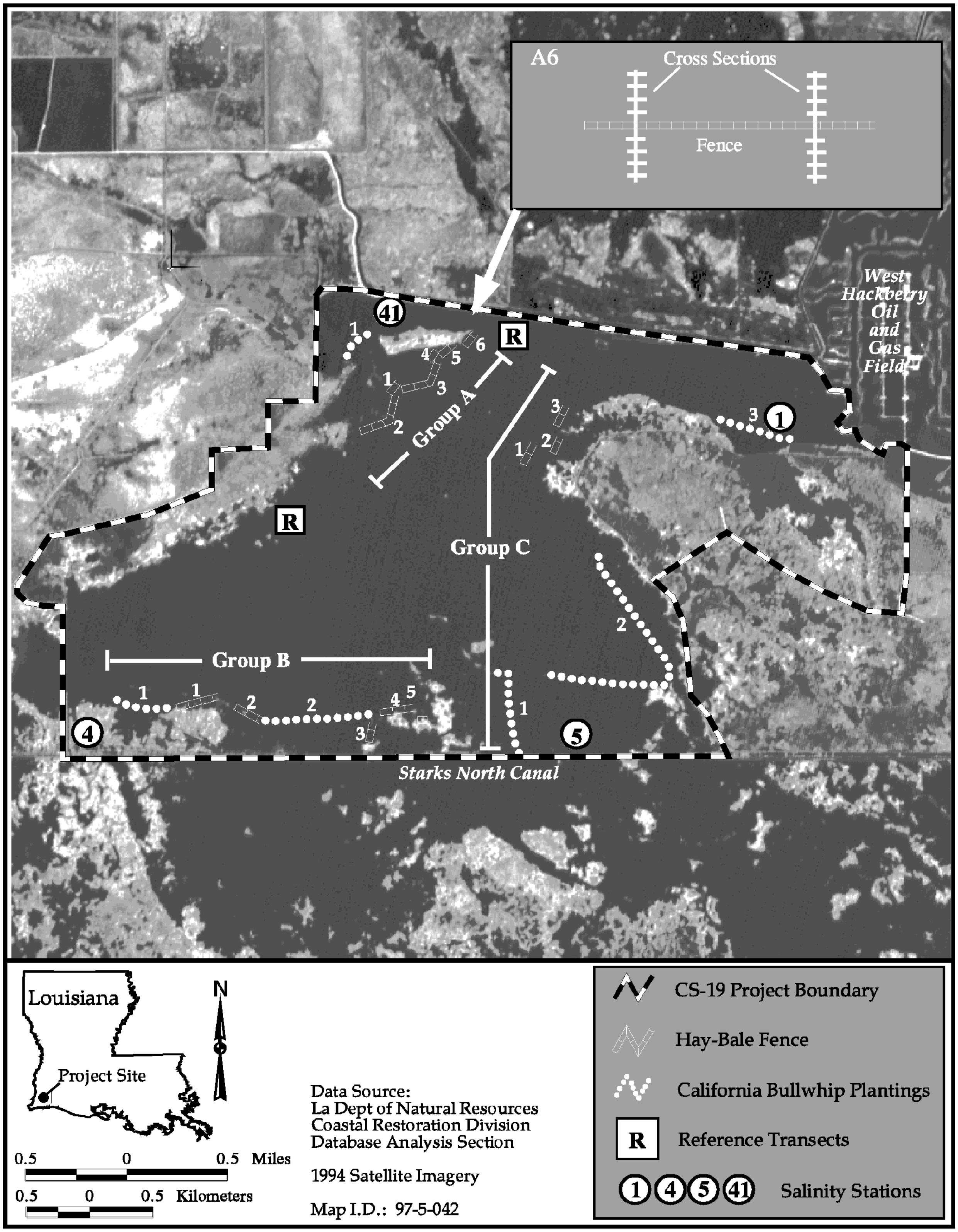

Figure 1. West Hackberry Plantings and Sediment Enhancement (C/S-19) project area showing locations of restoration features and a typical cross-section elevation survey within Group A

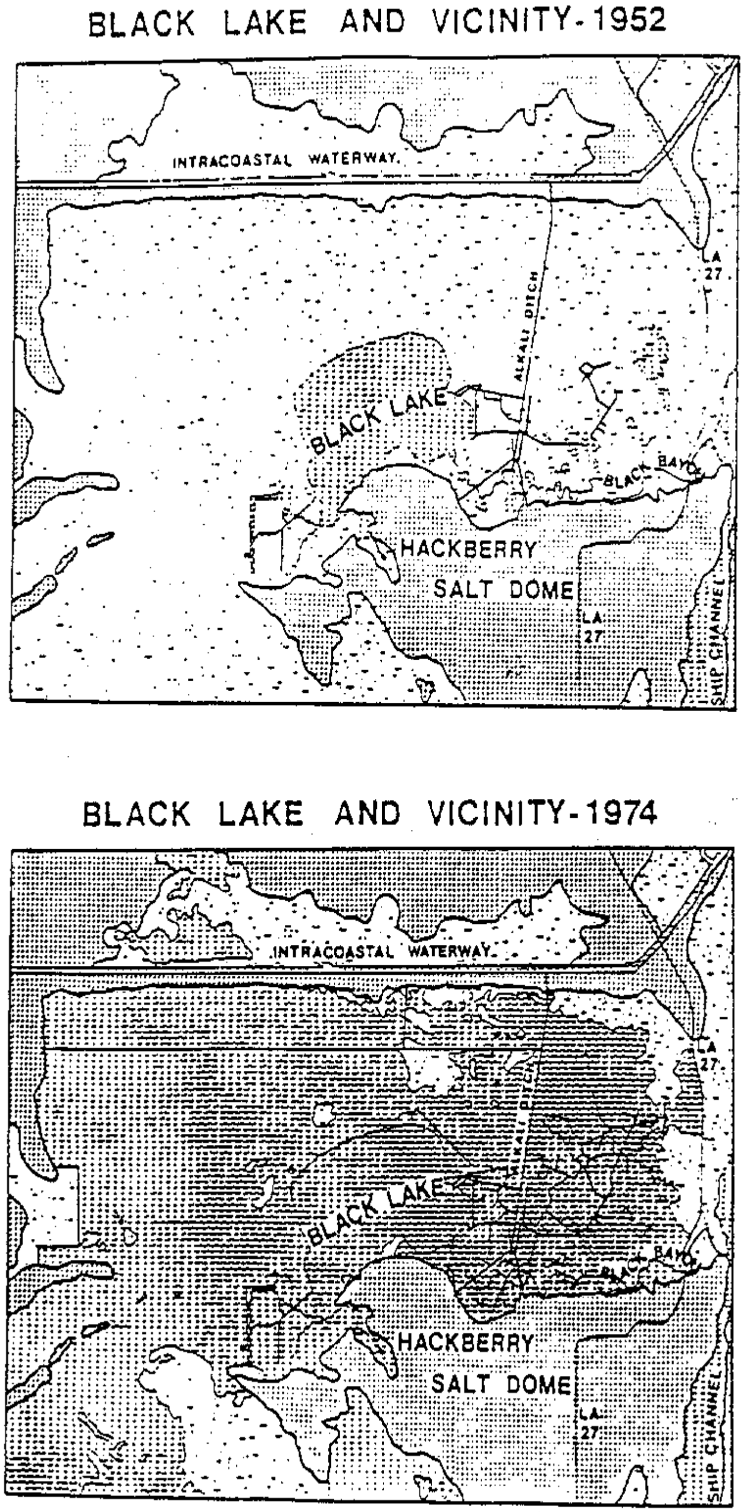

Figure 2. Changes in land to open water in the Black Lake area, 1952 to 1974.

project area via Black Lake Bayou to the north and Hog Island Gully to the south, and a concomitant loss of inorganic and organic sediments through tidal scour. In addition, the actual extraction of oil and gas in the area may have induced subsidence, as documented in east Texas (Weaver and Sheets 1962). Bench marks in the vicinity of Black Lake have subsided an average of 0.6 m since the early 1950's, according to unpublished records of the Louisiana Department of Public Works.

In Louisiana's subsiding coastal environments, the maintenance of emergent marsh is dependent on vertical accretion of inorganic and organic sediments. Vertical accretion counteracts subsidence and helps to maintain marsh elevations within a tidal range that is suitable for the growth of vegetation characteristic of each marsh type. Unfortunately, tide gauge data from Calcasieu Pass and sedimentation studies at East Cove Marsh of Sabine National Wildlife Refuge indicate that apparent sea level has been rising in the project area at twice the rate of marsh aggradation over the past 25 years (Baumann and DeLuane, 1982).

Although relatively little is known about the hydraulic and sedimentary properties of the West Hackberry marshes, its primary sources of sediment are *in-situ* biomass production within the project area and adjacent wetlands, and suspended and reworked materials from the surrounding areas, much of which has been removed through tidal scour. At West Hackberry, the transport and resuspension of sediment (i.e., sediment flux), is generally influenced more by winds than by the tides, especially now with the Rycade Canal project structures operating to stop the circular pattern of water flow through the project area wetlands. The use of hay bale fences and vegetative plantings to break up fetch, reduce wind driven wave erosion, and trap sediments will be demonstrated as cost-effective techniques for protecting and restoring emergent marsh in shallow open water areas in coastal marshes.

Since 1991, several conceptual plans have appeared for restoring the West Hackberry wetlands have been developed (LCWCRTF 1991, LDNR 1992, 1993; and SCS 1991, 1992). As presently planned, in this five year demonstration project, the project features include the installation of 6,600 linear ft (2,012 m) of hay bale fencing, and 4,768 plantings of *Scirpus californicus* (California bullwhip) in shallow open water in the project area (figure 1). The project is expected to benefit 96 ac (39 ha) of vegetated wetlands.

Twelve wooden enclosures of varying lengths will be constructed and installed along and parallel to existing shorelines in three groupings (A-C) within the project area, at different distances from and orientations to existing shorelines. The enclosures will then be filled with standard hay bales, stacked two bales high.

Approximately 4,768 "trade gallon" size plantings of California bullwhip will be planted in two parallel rows on 5 ft (1.5 m) centers in the three groupings (A-C) in the project area. The plantings will be installed between existing bullwhip plantings and the proposed sediment fences, such that a nearly continuous line of sediment fences and bullwhip plantings will be formed along the periphery of the large, shallow, open water area that constitutes most of the project area.

The sediment fences and vegetative plantings will be monitored to determine their effectiveness as restoration techniques. The project may provide insight into the mechanisms of sedimentation and vertical accretion operative in the project area wetlands. The general methodology for monitoring CWPPRA projects is described by Steyer et al. (1995). The specific items that comprise this monitoring plan are presented below.

Project Objectives

1. Restore, protect and enhance approximately 300 ac (120 ha) of inland wetlands through planning, designing and implementing vegetative projects.

2. Minimize wetland erosion and provide restoration through the use of vegetative plantings.

3. To encourage the deposition of sediments through the use of hay bale enclosures.

Specific Goals

The following measurable goals were established to evaluate project effectiveness:

1. Reduce wind induced wave erosion along shorelines of a large, shallow interior lake using vegetative plantings of *Scirpus californicus* (California bulrush).

2. Increase sediment deposition adjacent to hay bale enclosures.

3. Increase the amount of emergent and submerged aquatic vegetation.

Additional Monitoring Needs

1. Salinities will be taken at least monthly at 7 existing stations throughout the project area (in conjunction with the Rycade Canal (C/S-2) project).

Reference Areas

To assist in evaluating the degree of success of the hay bale fences in abating shoreline erosion and increasing sediment accretion, reference areas of shoreline and water bottom located within the project area but away from the influence of the fences will be selected for monitoring concurrently with areas influenced by these features.

Data collected in the reference areas will be used to make statistically valid comparisons of shoreline erosion rates and sediment accretion with and without the influence of hay bale fences.

Reference areas were not selected for comparison with the vegetative planting areas. Planting success will be determined by evaluating planting survival in random sampling plots and comparison of pre- and post-project habitat mapping.

Monitoring Elements

The following monitoring elements will provide the information necessary to evaluate the specific goals listed above:

1. Habitat Mapping — To measure vegetated and non-vegetated areas and to document shoreline movement in the project area, near vertical, color infrared aerial photography (1:12,000 scale, with ground controls) will be obtained once pre-construction (1993) and once post-construction (1997). Historical information on changes in marsh/open water ratio were obtained from 1934 and 1982 USGS Quadrangle Maps.

2. Shoreline Change — To document shoreline movement on a fine scale, PVC marker poles will be placed on the marsh edge along shorelines west of Group A fences 5 and 6 at a maximum of 100 ft (30.5 m) intervals. The pre-construction position of the shoreline will be measured in 1994 by surveying the locations of the marker poles and the major shifts between the marker poles. One subsequent survey will be conducted during 1997 to document shoreline position relative to the original shoreline position at the marker poles. In addition, shoreline movement will be documented by direct measurement from the marker poles to the marsh edge. For comparison, a reference area located along the shoreline between and west of the Group A and B plantings will be delineated and similarly monitored with surveys and direct measurement. Because of the ineffectiveness of the haybale structures, all shoreline monitoring was stopped in 1997.

3. Vegetation — The general condition of the vegetative plantings will be documented by monitoring a 5% sample of the plantings from each of the three planting groups, using sampling plots. Each sampling plot will consist of 16 plantings, eight on each of two rows (2 x 8 plant plots) with a labelled PVC marker pole beside one of the four corner plants to mark the location of the plot. Survival will be determined as a percentage of the number of live plants to the number planted (% survival = no. plants/no. planted x 100), after Mendelssohn et al. (1991). In addition, a 1 m^2 plot centered around the corner plant with the marker pole for each plot will be sampled for species composition, as % cover by species. To document the establishment of the vegetation, these criteria will be documented in August 1994, February and August 1995, and in August of 1997 and 1999.

The occurrence of submersed aquatic vegetation around the fences will be monitored along 16 transects surveyed perpendicular to the fences, and running 100 ft (30.5 m) on either side of the fences, and parallel to the elevational profile transects described below. Species composition, as % cover of submerged aquatic plants by species, will be determined by ocular estimates within 1 m^2 plots established along the transect lines at 3 ft (0.9 m) intervals for the first 30 ft (9.1 m), and then every 10 ft (3 m) for the remaining 70 ft (21 m) along the transect lines on each side of the sediment fences. In addition, two reference areas located in open water away from the influence of the sediment fences will be utilized. One will be located north of hay bale fence A_6 (reference A), and one will be located between the Group A and B structures (reference B). Ocular estimates of submerged aquatic plant cover will be conducted along all 18 transects once pre-construction, and in 1997 and 1999.

4. Elevational Profiles

Sediment deposition along the sediment fences will be monitored using transects surveyed perpendicular to the sediment trapping fences, and running 100 ft (30.5 m) on either side of the fences. Elevation of the water bottom sediments will be measured at 3' (0.9 m) intervals for the first 30 ft (9.1 m) along the transects, and at 10 ft (3 m) intervals for the remaining 70 ft (21 m). Because the budget does not allow all fences to be sampled, a subsample of six fences, two from each of the three groups (A-C) will be utilized. A total of 18 transects will be monitored, allowing for two transects per fence on those 500 ft (152 m) and under (i.e., fences A_6, B_4, C_2, and C_3), and four transects per fence on those over 500 ft long (i.e., fences A_2, and B_3). In addition, the two reference areas described above under "Vegetation" (i. e., references A and B) will also be utilized as reference areas for comparing sedimentation with and without the influence of hay bale fences. Elevational profile surveys will be conducted in 1994 pre-construction, and in 1997 post-construction. Because of the ineffectiveness of the haybale structures, all elevation surveys ended in 1997.

Anticipated Statistical Tests & Hypotheses

The following hypotheses correspond with the monitoring elements and will be used to evaluate the accomplishment of the project goals.

1. Descriptive and summary statistics will be used on both historical data and data collected during post-project implementation to assess changes in marsh loss/gain rates over time, and to assess whether or not the post-project marsh loss rate deviates from the expected "future without condition." If sufficient historical information is available, regression analyses will be done to examine changes in slope between pre- and post-project conditions.

Goal: Increase emergent wetland vegetation to water ratios.

Hypothesis:

H_0 Emergent wetland vegetation: open water ratio after project implementation will not be significantly higher than the emergent wetland vegetation area: open water ratio before project implementation.

H_a: Emergent wetland vegetation: open water ratio after project implementation will be significantly higher than the emergent wetland vegetation: open water ratio before project implementation.

3. The success of the vegetative plantings will be determined by analyses of the various monitoring elements described above. These elements will be examined utilizing ANOVA's and paired t-tests to monitor the success or failure of the plantings.

Goal: Increase occurrence of wetland vegetation.

Hypothesis:

H_0: Vegetative cover along the shoreline after project implementation will not be more than vegetative cover before project implementation.

H_a: Vegetative cover along the shoreline after project implementation will be more than vegetative cover before project implementation.

1, 3. If analyses fail to reject a null hypothesis, negative effects will be investigated.

NOTE: Available ecological data, including both descriptive and quantitative data, will be evaluated in concert with the statistical analyses to aid in determination of overall project success. This includes ancillary data collected in this monitoring project but not used directly in statistical analyses, as well as data available from other sources (USACE, USFWS, DNR, LSU, etc.).

<u>Notes</u>

1. Implementation:

Hay bale fence construction:	December 1993 - April 1994
Supplement 1 fence construction:	November 9 - December 14, 1994
California bullwhip planting:	June 14 - 28, 1994

2.	NRCS Point of Contact:	Cindy Steyer	(504) 389-0334
3.	DNR Project Manager:	Stan Aucoin	(318) 893-8536
	DNR Monitoring Manager:	Mike Miller	(318) 893-1256
	DNR DAS Assistant:	Mary Horton	(504) 342-4122

4. The five year monitoring plan development and implementation budget for this project is $68,630. Progress reports will be available in August 1995, June 1996, December 1996, and June 1997, and comprehensive reports will be available in December 1997 and December 2000. These reports will describe the status and effectiveness of the project.

5. The hay bale fences will need restocking periodically.

6. References, miscellaneous reports, and /or data available for this project area:

Adams, R. D., et al. 1978. Shoreline erosion on coastal Louisiana: inventory and assessment. Baton Rouge: Louisiana Department of Transportation and Development, Coastal Resources Program. 139 pp.

Baumann, R. H., and R. D. DeLuane 1982. Sedimentation and apparent sea-level rise as factors affecting land loss in coastal Louisiana. Proceedings of the conference on coastal erosion and wetland modification in Louisiana: causes, consequences, and options. U.S. Fish & Wildlife Service, Biological Program. FWS/OBS-82/59. pp. 2-13.

Chabreck, R. H. 1972. Vegetation, water and soil characteristics of the Louisiana coastal region. Bulletin No. 664. Baton Rouge: Louisiana State University, Agricultural Experiment Station.

Louisiana Coastal Wetlands Conservation and Restoration Task Force (LCWCRTF) 1991. Coastal Wetlands Planning, Protection, and Restoration Act, first priority project list report. Baton Rouge: LCWCRTF. Appendix E, tab G.

Louisiana Department of Natural Resources 1992. Coastal Wetlands Conservation and Restoration Plan for fiscal year 1992-1993. Baton Rouge: Coastal Restoration Division. pp. B72-B73.

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Mendelssohn, I. A., M. W. Hester, F. J. Monteferrante, and F. Talbot 1991. Experimental dune building and vegetative stabilization in a sand-deficient barrier island setting on the Louisiana coast, USA. Journal of Coastal Research 7(1): 137-149.

O'Neil, T. 1949. Map of the southern part of Louisiana showing vegetation types of the Louisiana marshes. New Orleans, La.: Louisiana Department of Wildlife & Fisheries.

Steyer, G. D, R. C. Raynie, D. L. Steller, D. Fuller, and E. Swenson 1995. Quality management plan for Coastal Wetlands Planning, Protection, & Restoration Act monitoring program. Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division.

U. S. Department of Agriculture Soil Conservation Service 1991. Vegetative plantings: chenier plain, deltaic plain, and barrier island. Candidate project information sheet for wetland value assessment. Alexandria, La.: Water Resources Office. 10 pp.

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Weaver, P., and M. M. Sheets 1962. Active faults, subsidence, and foundation problems in the Houston, Texas area. In *Geology of the Gulf Coast and Central Texas*. Houston, Tx.: Houston Geological Society. pp. 254-265.

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