State of Louisiana
Department of Natural Resources
Coastal Restoration Division

Monitoring Plan

for

Oaks/Avery Canal Hydrologic Restoration, Increment 1

State Project Number TV-13a
Priority Project List 6

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Iberia and Vermilion Parishes

Prepared by:

Troy Barrilleaux, Monitoring Section (CRD)
LDNR/Coastal Restoration and Management

MONITORING PLAN

PROJECT NO. TV-13A
OAKS/AVERY CANAL HYDROLOGIC RESTORATION

ORIGINAL DATE: March 19, 1999
REVISED DATE: August 14, 2003;
January 15, 2014

Preface

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System (CRMS-*Wetlands*) for CWPPRA, updates were made to this Monitoring Plan to merge it with CRMS to provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act. The implementation plan included review of monitoring efforts on currently constructed projects for opportunities to 1) determine if current monitoring stations could be replaced by CRMS stations, 2) determine if monitoring could be reduced to evaluate only the primary objectives of each project and 3) determine whether monitoring should be reduced or stopped because project success had been demonstrated or unresolved issues compromised our ability to actually evaluate project effectiveness. As a the result of a joint meeting with DNR, USGS, and the federal sponsor, the recommendations for this Monitoring Plan were to reduce the annual water-level sampling to only one event post-construction, eliminate the 2011 and 2017 aerial photography, eliminate the SAV and bathymetry in Tigre Lagoon, and since the planted vegetation is indistinguishable, eliminate future vegetation sampling. Vegetation habitat data will be supplemented with data from approximately 6 Chabreck and Linscombe points and 2 CRMS stations (CRMS532 and CRMS528) that fall within the project area. These recommendations have been incorporated into this revised Monitoring Plan and are described in the Monitoring Elements section.

Project Description

The project area encompasses 2,876 acres (1,164 ha) located in the extreme eastern portion of Vermilion Parish and southwestern portion of Iberia Parish, north of Vermilion Bay (United States Geological Survey 1998)(figure 1). The Vermilion Bay shoreline makes up most of the southern boundary of the project area. The major tributaries and waterways within the project area are Oaks Canal to the west, Avery Canal on the east, and the Gulf Intracoastal Waterway (GIWW) traversing the project area east to west. Union Oil Canal makes up the eastern boundary of the hydrologic unit of the project north of the GIWW. Most soils in this area are classified as Lafitte Muck, which are very poorly drained, very fluid, organic soils in brackish marshes (Natural Resources Conservation Service [NRCS] 1978, 1996). The area is composed of approximately 1,936 acres (783 ha) of brackish marsh and 791 acres (320 ha) of open water, 4.8% of which is dominated by submerged aquatic vegetation (SAV), with the remainder made up of nonmarsh habitats (USGS 1998). The dominant SAV species is *Myriophyllum spicatum* (Eurasian milfoil)(Castellanos 1998). The vegetation in the area has historically been classified as brackish and intermediate marsh (O'Neil 1949, Chabreck and Linscombe 1968, 1978, 1988). Land loss rates in the

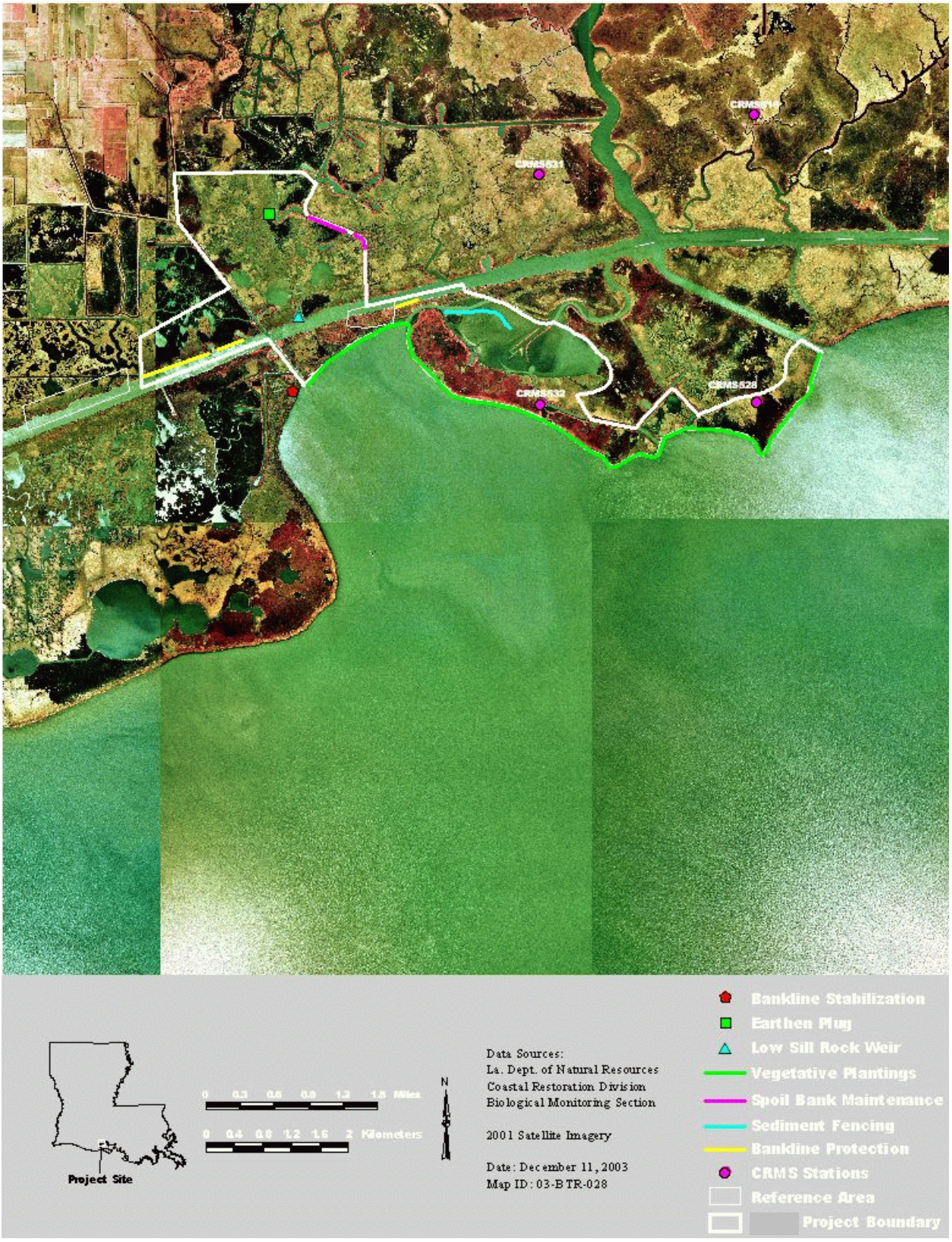

Figure 1 Oaks/Avery Canal Hydrologic Restoration (TV-13a) Project boundary and features and reference areas.

project area averaged 8 ac/yr from 1956-1978 (USGS 1998). Current erosion rate estimates for the Vermilion Bay shoreline and the GIWW bank in the project area are 13 ft/yr (4 m/yr) and 5 - 10 ft/yr (1.5 - 3 m/yr) respectively (NRCS and Louisiana Department of Natural Resources [LDNR] 1996). Results from the Boston Canal / Vermilion Bay Shoreline Protection Project (TV-09) reference area, which is along the same shoreline as this project, reported an average erosion rate of 5.17 ft/yr (1.58 m/yr) for the period November 1995 to March 1998 (Thibodeaux 1998).

This project consists of the following unrelated restorative components designed to address different land loss problems within the project area: protection of Vermilion Bay shoreline with vegetative plantings; protection of GIWW bankline with rock dikes; stabilization of water level variability north of the GIWW and east of Oaks Canal; and reestablishment of Bayou Petite Anse through Tigre Lagoon. Each problem and the project feature designed to address it are described in the following paragraphs.

The Vermilion Bay shoreline is subject to high energy wind driven waves due to the large fetch of Vermilion Bay. Most of the shoreline within the project area is "scalloped", with sloped banks separated by more seaward points of land with cutbanks. Vegetative plantings provide protection for erosion impacted areas by stabilizing sediment with live root mass and dissipating wave energy with above-ground plant structure (Knutson 1977). The lead federal agency for the project, NRCS, determined that vegetation plantings, similar to those used for the effective TV-09 project (Thibodeaux 1998), are the preferred alternative to protect this shoreline (NRCS 1998). The plantings of this project, along with those of the adjacent TV-09 project will provide approximately 19 miles (30.6 km) of nearly continuous protection for the Vermilion Bay shoreline from Mud Point eastward to Avery Canal.

The banks of the GIWW within the project boundary are subject to erosion from boat wakes from heavy commercial traffic (Good et al. 1995). The emergent marsh and SAV behind the bank will be subject to the erosive action of boat wakes if the banks are not protected. Wake protection from marine traffic will be provided along sections of the GIWW by freestanding dike sections of rip-rap material placed approximately 25–30 ft (7.6 - 9.1 m) from the existing "cut" bank. Approximately 1,200 ft (365.8 m) of bankline will be protected on the south embankment in the area where Bayou Petite Anse exits Tigre Lagoon and enters Vermilion Bay (figure 1). The narrow strip of land that currently separates Bayou Petite Anse from the GIWW continues to reduce in size due to the eroding banks of the GIWW. The remaining 4,800 ft (1,463 m) of bankline stabilization is planned for the north bank of the GIWW immediately west of Oaks Canal (figure 1). The absence of spoil bank material in this section of the GIWW exposes fragile marsh soils to the erosive wake action of passing marine vessels.

The section of the project area north of the GIWW and east of Oaks Canal is currently subject to increased effects of tidal action and frontal storm passage, and from water surges created by daily barge traffic in the GIWW. The scour erosion from rapid water movement through channels in the area may physically damage vegetation and cause excess water turbidity, which has been found to be an important factor limiting SAV growth (Korschgen et al. 1997). A low sill rock weir will be set 2 ft below marsh level, approximately 150 ft (45.7 m) north of the opening of this area to the GIWW, to stabilize water levels and lessen the impact of the approximately 500 acres (202 ha) of this section of the project area that will be the hydrologic unit (figure 1). An existing spoilbank

(from the weir, south to the Intracoastal Canal) will be refurbished to prevent the possibility of water flow bypassing the structure. To ensure the integrity of the hydrologic unit, a breach between the hydrologic unit and outside waterways will be plugged with earthen fill. Additionally, existing substandard sections of the hydrologic unit embankment south of the earthen plug will be refurbished (figure 1).

Low sill structures being built at the outfall of Oaks and Avery Canals for the TV-13b state project are expected to redirect more water flow through the part of Bayou Petite Anse south of the GIWW. In Tigre Lagoon, along the remnants of the Bayou Petite Anse channel, segmented structures will be installed on the historical south bank of the channel. The segmented structures will reduce surface flows currently entering Tigre Lagoon, encouraging the reestablishment of the Bayou Petite Anse channel and allowing an efficient flow of the expected increased volume of water.

The purpose of the project is to protect existing wetlands, stabilize hydrologic conditions, reestablish Bayou Petite Anse channel through Tigre Lagoon, and encourage the growth of emergent and submergent vegetation. Project features include:

1. Bankline stabilization along the outfall of Oaks Canal

2. Approximately 6,000 ft (1,829 m) of bankline stabilization along the north and south banks of the GIWW

3. A fixed crest rock weir in an artificial channel 1,900 ft (579 m) east of Oaks Canal and 900 ft (274 m) north of the GIWW

4. An earthen plug in an opening through the north embankment of an oilfield canal along the Union Oil Canal in the northeast section of the project area, north of the GIWW

5. Maintenance of approximately 1,000 ft (305 m) of incremental sections of spoil embankment on the western side of the Union Oil Canal

6. Approximately 4,300 ft (1,311 m) of structures along the historic southern channel edge of Bayou Petite Anse inside Tigre Lagoon

7. Approximately 27,000 ft (8,230 m) of vegetative plantings (*Spartina alterniflora* [saltmarsh cordgrass]) along the northern shoreline of Vermilion Bay between Oaks Canal and Avery Canal

Project Objectives

1. Protect the Vermilion Bay shoreline through the planting of *S. alterniflora*
2. Protect sections of the GIWW bank from erosion through use of rock dikes
3. Reestablish Bayou Petite Anse in Tigre Lagoon
4. Stabilize water levels in the hydrologic unit

Specific Goals

The following measurable goals were established to evaluate project effectiveness:

1. Reduce erosion rate on the northern shoreline of Vermilion Bay
2. Reduce erosion rate of specific high-risk portions of the GIWW bank
3. Reestablish the Bayou Petite Anse channel in Tigre Lagoon
4. Attenuate rapid water level fluctuations in hydrologic unit
5. Increase occurrence of SAV north of the GIWW in the project area
6. Reduce marsh loss rates of emergent vegetated marsh area in the hydrologic unit

Reference Area

To assist in evaluating project effectiveness over time, reference areas will be monitored concurrently with the project area. The main criteria for selecting a reference area are similarities in vegetative community, marsh soil type, hydrology, and proximity to the project area. Based on these criteria, reference area one (R1) was selected as a reference for the hydrologic unit for the water level and aerial photography monitoring elements. Two reference areas (R2 and R3) for GIWW shoreline change monitoring element will be established along the bank of the GIWW adjacent to the bank sections protected by the rock breakwater. The bank types of R2 and R3 most closely match those of the respective project areas on the north and south banks of the GIWW (figure 1). An appropriate reference area for the Vermilion shoreline protection was not available. To the west of the project area, the shoreline has been planted as part of the TV-09 project. To the east, the shoreline has already been planted, and it has a different orientation to Vermilion Bay than that of the project area shoreline.

CRMS will provide a pool of reference sites within the same basin and across the coast to evaluate project effects. At a minimum, every project will benefit from basin-level satellite imagery and land:water analysis every 3 years, and supplemental vegetation data collected through the periodic Chabreck and Linscombe surveys. Other CRMS parameters which may serve as reference include Surface Elevation Table (SET) data, accretion (measured with feldspar), hourly water level and salinity, and vegetation sampling. A number of CRMS stations are available for each habitat type within each hydrologic basin to supplement project-specific reference area limitations.

Monitoring Elements

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

1. Aerial Photography

To document land and water acreage and land loss rates in the hydrologic unit, reference area, and whole project area, color infrared aerial photography (1:12,000 scale with ground controls) of the project and reference areas will be obtained. The photography will be georectified by National Wetlands Research Center (NWRC) personnel following procedures described in Steyer et al. (1995, revised 2000), but detailed photo interpretation, mapping, and GIS is not planned. The photography will be obtained in 2000 (preconstruction) and in years 2002, 2006, and 2014.

Based on the CRMS review, aerial photography originally scheduled for 2001 and 2017 was eliminated. Land:water analyses will be supplemented by land:water classifications from basin-scale satellite imagery collected through CRMS.

2. Vegetation Plantings

The general condition of *S. alterniflora* plantings along Vermilion Bay will be documented by monitoring twenty-five 40-ft long vegetation sampling plots (3% of entire planted area). Each plot will consist of 16 plantings with the sampling location determined by a random numbers table based on distance and marked with a pole. Species composition, and % cover for the 16 plant plot will be documented using the Braun-Blanquet procedure. Survival will be determined as a percentage of the number of live plants to the number planted (within the plot) (Mendelssohn et al. 1991). These criteria will be documented at years 2000, 2002, 2004, and a later year to be determined, or until original plants become indistinguishable from each other.

Vegetation plantings were indistinguishable after 2002. Consequently, subsequent vegetation sampling was eliminated.

3. Shoreline Change — The shoreline position will be monitored along Vermilion Bay, along sections of the GIWW bank where rock dikes will be constructed, and along the reference area bankline in R2 and R3. A differential Global Positioning System (GPS) will be used to map the Vermilion Bay shoreline in 2000 (immediately following planting of vegetation) and in years 2003, 2007, 2010, 2012, 2015, and 2018. The shoreline along the GIWW in the project and reference areas will be mapped in 2003 (immediately following construction of te rock dike). Future surveys will follow the schedule listed above. The difference between shoreline change in the reference areas and the project will be used to estimate the area of wetlands protected by the rock dikes. Because of the lack of a suitable reference area for the Vermilion Bay shoreline, the benefits of the plantings cannot be directly determined, but they can be inferred from the survival of the plantings.

4. Water Level — To monitor hydrologic conditions (water depth, salinity) and document water levels within the hydrologic unit, one hourly data recorder will be placed inside the unit and three recorders will be placed in R1 at three locations along a semi-natural waterway at increasing distances from the GIWW. Water level data will be used to document the water level variability in the project area relative to R1. Water level data will be collected at the shortest interval possible with the recorders (every 30 seconds) for 10 days each month during a 6 month period for the years 1999 (preconstruction) and 2003 (post-construction).

   Based on the CRMS review, the high-intensity water level sampling was reduced to only one post-construction period, instead of annually for 10 years. Water level sampling in 2011, 2017, and 2017 was also eliminated.

Anticipated Statistical Analyses and Hypotheses

The following paragraphs describe the analyses that will be conducted on data collected for the monitoring element listed to evaluate the accomplishment of the project goals. The numbers to the left correspond to the monitoring elements described above. These are followed by statements of the project goals, and the hypotheses that will be used in the evaluation.

1. Aerial Photography:

   Descriptive and summary statistics on historical data and data from color-infrared aerial photography collected before and after construction will be used, along with GIS interpretations of these data sets, to evaluate marsh to open water ratios and changes in the rate of marsh loss/gain in the project area.

Goal: Reduce marsh loss rates of emergent vegetated marsh area in the hydrologic unit

2. Vegetation Plantings:

The change in percent cover, species composition, and percent survival over time will be analyzed using appropriate parametric and/or nonparametric statistics, descriptive statistics, and life tables. The condition of the plantings will be used to infer the protection afforded to the Vermilion Bay shoreline.

3. Shoreline Change:

Appropriate parametric and/or nonparametric statistics will be used to test the following hypothesis.

Goal: Reduce erosion rate on the northern shoreline of Vermilion Bay

Hypothesis:

H_o: Mean erosion rate of the northern shoreline of Vermilion Bay postconstruction will not decrease significantly from the erosion rate preconstruction.

H_a: Mean erosion rate of the northern shoreline of Vermilion Bay postconstruction will be significantly lower than the erosion rate preconstruction.

Goal: Reduce erosion rate of specific high-risk portions of the GIWW bank

Hypothesis:

H_o: Mean erosion rate of specific high-risk portions of the GIWW bank will not decrease relative to the reference area (project vs reference) or decrease over time as compared to pre-construction erosion rates (pre- vs postconstruction).

H_a: Mean erosion rate of specific high-risk portions of the GIWW bank will decrease relative to the reference area (project vs reference) or decrease over time as compared to pre-construction erosion rates (pre- vs postconstruction).

5. Water Level:

Appropriate parametric and/or nonparametric statistics will be used to test the following hypotheses.

Goal: Attenuate rapid water level fluctuations in hydrologic unit

Hypothesis:

H_o: Water level variability (measured in terms of standard deviation of water level) in the hydrologic unit will not decrease relative to the reference area (project vs reference) or decrease over time as compared to pre-construction water level variability (pre- vs postconstruction).

H_a: Water level variability (measured in terms of standard deviation of water level) in the hydrologic unit will decrease relative to the reference area (project vs reference) or decrease over time as compared to pre-construction water level variability (pre- vs postconstruction).

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

Notes

1.	Planned Implementation:	Start construction:	June 25, 2002
		End construction:	October 14, 2002
2.	NRCS Project Manager	Loland Broussard	(318) 291-3069
3.	DNR Project Manager:	Herb Juneau	(337) 482-0684
	DNR Monitoring Manager:	Maggie Hawkins	(337) 482-0657

4. The twenty year monitoring plan development and implementation budget for this project is $673,747. Pursuant to the CRMS review, it was authorized by the Task Force to maintain $542,043 with the project, and utilize $131,657 to support CRMS. Periodic comprehensive reports on coastal restoration efforts in the Teche-Vermilion hydrologic basin will describe the status and effectiveness of the project as well as cumulative effects of restoration projects in the basin.

References:

Castellanos, D. L., 1998. Personal observation on July 30. Abbeville Office: Louisiana Department of Natural Resources, Coastal Restoration Division, Geoscience Specialist.

Chabreck, R. H., and G. Linscombe 1968. Vegetative type map of the Louisiana coastal marshes. New Orleans: Louisiana Department of Wildlife and Fisheries. Scale 1:62,500.

_____. 1978. Vegetative type map of the Louisiana coastal marshes. New Orleans: Louisiana Department of Wildlife and Fisheries. Scale 1:62,500.

_____. 1988. Vegetative type map of the Louisiana coastal marshes. New Orleans: Louisiana Department of Wildlife and Fisheries. Scale 1:62,500.

Good, B., J. Buchtel, D. Meffert, J. Radford, K. Rhinehart, and R. Wilson, eds. 1995. Louisiana's major coastal navigation channels. Unpublished report. Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division. 57 pp.

Korschgen C. E., W. L. Green, and K. P. Kenow 1997. Effects of irradiance on growth and winter bud production by *Vallisneria americana* and consequences to its abundance and distribution. Aquatic Botany 58: 1-9.

Knutson, P. L. 1977. Designing for bank erosion control with vegetation. Reprinted for the U. S. Army, Coastal Engineering Research Center 716-733.

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.

Nyman, J. A., and R. H. Chabreck 1996. Some effects of 30 years of weir management on coastal marsh aquatic vegetation and implications to waterfowl management. Gulf of Mexico Science 14: 16-25.

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

Steyer, G. D., and R. E. Stewart, Jr. 1992. Monitoring program for coastal wetlands planning, protection, and restoration acts projects. Open-file report no. 93-01. Lafayette, LA.: U.S. Geological Service, National Wetlands Center. 85 pp.

Natural Resources Conservation Service 1998. Environmental Assessment, Oaks/Avery Canal Hydrologic Restoration Project, Vegetative Plantings. U. S. Department of Agriculture, Natural Resources Conservation Service, Iberia Parish, Louisiana. 5 pp.

Natural Resources Conservation Service and Louisiana Department of Natural Resources 1996. Oaks/Avery Canal Hydrologic Restoration Project (TV-13a) Candidate Project Information Sheet for WVA Analysis. U. S. Department of Agriculture, Natural Resources Conservation Service 6 pp.

Soil Conservation Service 1996. Soil Survey of Vermilion Parish, Louisiana. U.S. Department of Agriculture, Soil Conservation Service. 183 pp.

Soil Conservation Service 1978. Soil Survey of Iberia Parish, Louisiana. U. S. Department of Agriculture, Soil Conservation Service.

Thibodeaux, C. 1998. Boston Canal / Vermilion Bay Shoreline Protection (TV-09) Three-year comprehensive monitoring report. Open file monitoring series TV-09-MSTY-0998-1. Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division. 18pp.

U. S. Geological Survey 1998. Oaks/Avery Canal (TV-13a) Project Habitat Trend Data 1988/1990 and 1993. U. S. G. S. National Wetlands Research Center Coastal Restoration Project Office, Louisiana Deparatment of Natural Resources Coastal Restoration Division and GIS Lab.

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