



**State of Louisiana  
Department of Natural Resources  
Coastal Restoration Division and  
Coastal Engineering Division**

**2005 Operations, Maintenance,  
and Monitoring Report**

for

**Sabine Structure Replacement**

State Project Number CS-23  
Priority Project List 3

June 2005  
Cameron Parish

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for  
Sabine Structure Replacement (CS-23)

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## Preface

The Operations, Maintenance, and Monitoring (OM&M) Report format is a streamlined approach which combines the Operations and Maintenance annual project inspection information with the Monitoring data and analyses on a project-specific basis. This report includes monitoring data collected through December 2004, and annual Maintenance Inspections through June 2005.

The 2005 report is the second in a series of reports. For additional information on lessons learned, recommendations, and project effectiveness, please refer to the 2004 Operations, Maintenance, and Monitoring Report on the Louisiana Department of Natural Resources (LDNR) web site at [dnr.louisiana.gov](http://dnr.louisiana.gov) (Miller and Billodeau 2007).



## I. Introduction

The Sabine Structure Replacement (CS-23) project area, which includes the Hog Island Gully, West Cove Canal, and Headquarters Canal structures, is located within the Sabine National Wildlife Refuge, approximately 9 mi (14.5 km) south of the town of Hackberry in Cameron Parish, Louisiana (figure 1). Established on December 6, 1937, the Sabine Refuge is bound on the east by Calcasieu Lake, on the west by Sabine Lake, on the north by broken marsh, and on the south by pasture land and coastal ridges.

O'Neil (1949) characterized the project area wetlands as fresh to intermediate marshes dominated by *Cladium mariscus* (Jamaica sawgrass). The Black Lake area, located north of the project, experienced an 81% reduction in the acreage of emergent wetlands between 1952 and 1974 (Adams et al. 1978). By 1972, the Black Lake area was characterized as brackish marsh (Chabreck and Linscombe 1978). A number of factors—such as salinity stress, erosion, subsidence, burning, and hydrologic modification—influenced this habitat change.

Since there are primarily three avenues for water passage in the area (Hog Island Gully, West Cove Canal, and Headquarters Canal), water management by weirs was initiated in the 1970's. By the 1990's, these structures had corroded with the continuous exposure to saline water to the extent that they were inoperable or almost inoperable.

Due to the detrimental impacts of excessive salinity on brackish and intermediate marshes, the ability to occasionally reduce or halt the inflow of saline water is critical. This level of control was not available with the original structures. The inability to manipulate gate structures jeopardized the integrity of thousands of acres of interior brackish and intermediate marshes which are lower in elevation and often occur in highly organic semifloating soils. The estimated subsidence rate in the project marshes ranges between 0.12 in/yr and 0.16 in/yr (0.32 and 0.42 cm/yr) (Penland et al. 1989).

Because of the restricted cross-sectional area of the pre-existing structures and culverts, the lower-elevation interior marshes experienced longer periods of vegetative water logging stress than the marshes located east of Highway 27. The pre-existing structures afforded the primary avenues for drainage and were inadequate to provide sufficient discharge to evacuate excess water. Due to the project area not being fully enclosed, secondary drainage for the area could occur to the west through Sabine Lake via Northline, Central, and Southline canals.

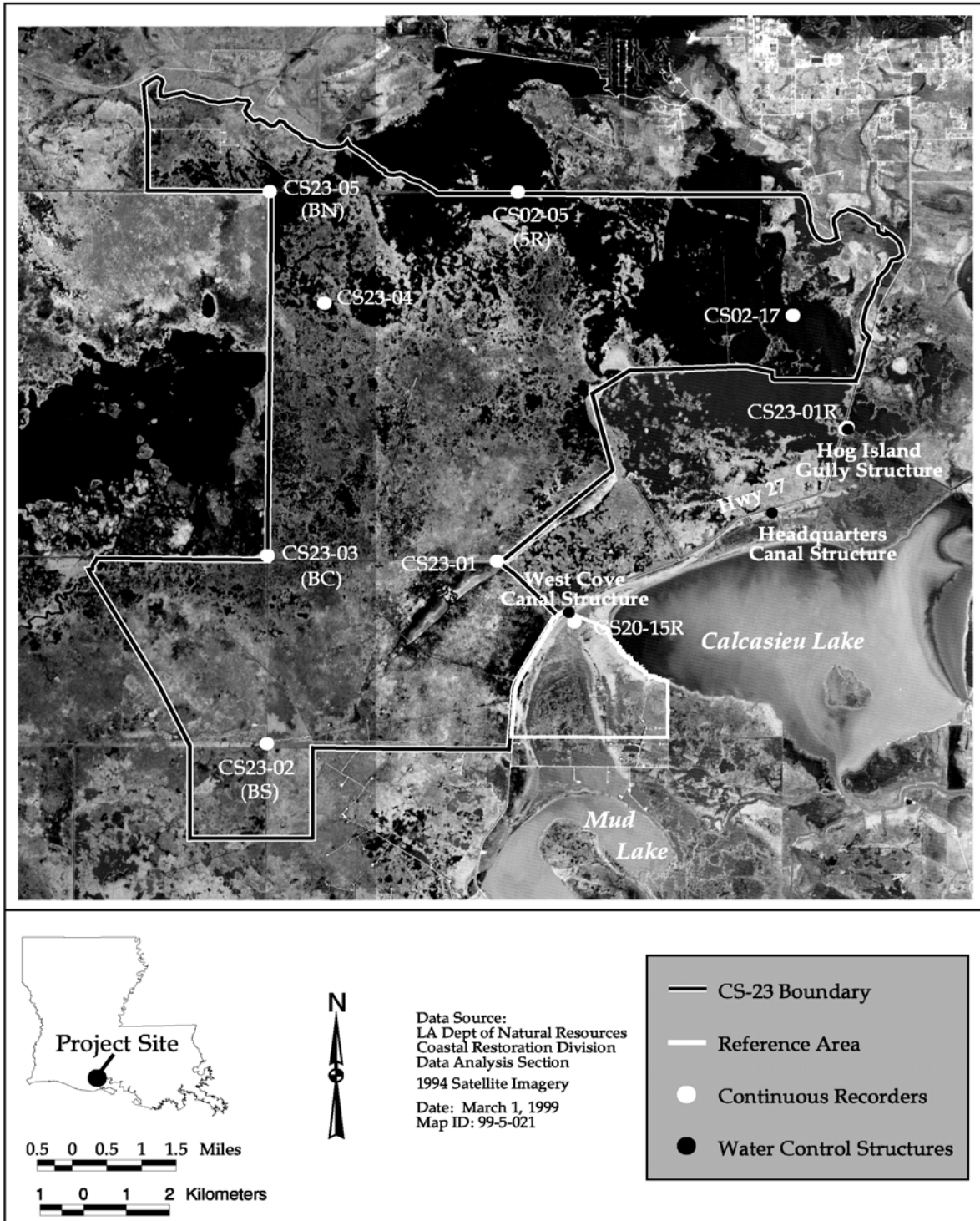
In May 1999, the U.S. Fish and Wildlife Service (USFWS) completed the environmental assessment (EA) plan (USFWS 1999) addressing the Sabine Structure Replacement Project (CS-23), which directs the replacement of water control structures at Hog Island Gully, West Cove Canal, and Headquarters Canal. The plan called for the complete removal of the Hog Island Gully Structure, West Cove Canal Structure, and Headquarters Canal Structure, and their replacement

with additional structures and culverts to provide larger cross sections for water removal and to minimize saltwater intrusion.

The replacement structures are operated to more effectively discharge excess water, increase cross-sectional area for ingress and egress of estuarine-dependent species, and more effectively curtail saltwater intrusion into the interior marshes. Since completion of the new structures, high saline waters can be precisely controlled, water discharge capacities have been increased, and vegetative stress through water logging has been minimized, thus enhancing emergent and submergent vegetative growth.

Construction began in November 1999 and was completed on the Hog Island Gully, West Cove, and Headquarters Canal structures in August 2000, June 2001, and February 2000, respectively. However, the Hog Island Gully and West Cove structures are not fully operational due to an electrical service problem.





**Figure 1.** Sabine Structure Replacement (CS-23) project features, project area boundaries, and reference area boundaries, specifically featuring the Hog Island Gully, West Cove Canal, and Headquarters Canal structures.



## **II. Maintenance Activity**

### **a. Project Feature Inspection Procedures**

The purpose of the annual inspection of the Sabine Structure Replacement Project (CS-23) is to evaluate the constructed project features to identify any deficiencies, and prepare a report detailing the condition of project features and recommended corrective actions needed. Should it be determined that corrective actions are needed, LDNR shall provide, in the report, a detailed cost estimate for engineering, design, supervision, inspection, and construction contingencies, and an assessment of the urgency of such repairs.

An inspection team consisting of two representatives of LDNR and one representative of USFWS performs annual visual inspections. If damage is apparent, LDNR and USFWS assign a team to perform a detailed inspection and report on the findings. The team documents the condition of the project features and may employ a survey party to make detailed measurements. As noted in Appendices A, B, and C, initial project goals included documenting inspections with photographs, creating a three-year budget projection, and taking field inspection notes.

### **b. Inspection Results**

No inspection was conducted in calendar year 2005 since this project is currently under a maintenance event.

### **c. Maintenance Recommendations**

#### **i. Immediate/ Emergency Repairs**

1. Install operating nut in gate 6A, Hog Island Gully.
2. Free gate 6b that is jammed, Hog Island Gully.
3. Replace operation nut in gate 3A, West Cove.
4. Replace batteries in all Rotork Actuators.

#### **ii. Programmatic/ Routine Repairs**

None





**d. Maintenance History**

**June 2005 – F. Miller & Sons, Inc.** A maintenance event was performed to correct the following:

1. Install operating nut in gate 6A, Hog Island Gully.
2. Free gate 6b that is jammed, Hog Island Gully.
3. Replace operation nut in gate 3A, West Cove.
4. Replace batteries in all Rotork Actuators and re-calibrate.

Construction (Item Nos. 1, 2 & 3):                 \$ 7,800.00

Construction (Item No. 4):                             \$ 5,416.45

**TOTAL CONSTRUCTION COST:                         \$13,216.45**

**III. Operation Activity**

**a. Operation Plan**

**i. Structure Descriptions**

**Structure A-Hog Island Gully Canal**

This structure has four 7.5-ft-wide (2.3-m-wide) gates (HG1, HG2, HG5, and HG6) and two 3.0-ft-wide (0.9-m-wide) gates (HG3 and HG 4) [306 ft<sup>2</sup> (28.4 m<sup>2</sup>) total area]. Each gate is 8 ft (2.4 m) deep, assuming that water level is at marsh elevation (1.0 ft NGVD). Each gate is equipped with stop logs on slide gates that may be used to preclude all water flow. Of the four 7.5-ft-wide gates, three have exterior flap gates (HG1, HG2, and HG6).

**Structure B-Headquarters Canal**

This structure has three 5-ft-wide (1.5-m-wide) diameter culverts (HQ1, HQ2, and HQ3) [59 ft<sup>2</sup> (5.5 m<sup>2</sup>) total area]. The top of each culvert is at marsh level (1.0 ft NGVD). Each gate is equipped with an exterior flap gate that may be raised and locked closed to serve as an adjustable sluice gate.

**Structure C-West Cove Canal**

This structure has three 7.5-ft-wide (2.3-m-wide) gates (WC1, WC3, and WC5) and two 3.0-ft-wide (0.9-m-wide) gates (WC2 and WC4) [242 ft<sup>2</sup> (22.5 m<sup>2</sup>)total area]. Each gate is 8 ft (2.4 m) deep, assuming that water level is at marsh elevation (1.0 ft NGVD). Each is equipped with stop logs in slide gates that may be used to preclude all water flow. Two of the four 7.5-ft gates have exterior flap gates (WC1 and WC5).



## ii. Normal Operation

Water exchange will be provided through open bays having approximately the same cross-sectional area as that provided by the old structures' fully open gates [182 ft<sup>2</sup> (16.9 m<sup>2</sup>) total area]. The slide/slucice gates of the flap-gated bays may be adjusted by the refuge manager at his/her discretion, except for the middle Headquarters Canal Structure culvert (HQ2), which will remain 50 % open. All flap gates will remain down in the operating position, except for at HQ2, where the flap gate will be locked closed to serve as the sluice gate.

**Hog Island Gully Canal – Structure A:** Normal management of this structure would provide a cross-sectional area of 112 ft<sup>2</sup> (10.4 m<sup>2</sup>) compared with 93.5 ft<sup>2</sup> (8.7 m<sup>2</sup>) of gated opening in the old structure.

HG1	HG1	HG2	HG2	HG3	HG3	HG4	HG4	HG5	HG5	HG6	HG6
Stop Logs	Flap Gate	Stop Logs	Flap Gate	Stop Logs	Flap Gate	Stop Logs	Flap Gate	Stop Logs	Flap Gate	Stop Logs	Flap Gate
MD	Down	MD	Down	-7'	None	-7'	None	-7'	None	MD	Down

MD=Manager's discretion

**Headquarters Canal – Structure B.** Normal management provides a cross-sectional area of approximately 10 ft<sup>2</sup> (0.9 m<sup>2</sup>) compared with 0 to 12.6 ft<sup>2</sup> (1.2 m<sup>2</sup>) of gated opening maintained through operation of the old structure.

HQ1 Sluice	HQ2 Sluice	HQ3 Sluice
Sluice Open	Sluice ½ Open	Sluice Open

**West Cove Canal - Structure C.** Normal management provides a cross-sectional area of 60 ft<sup>2</sup> (5.6 m<sup>2</sup>) compared to 59.5 ft<sup>2</sup> (5.5 m<sup>2</sup>) of gated opening in the old structure.

WC1	WC1	WC2	WC2	WC3	WC3	WC4	WC4	WC5	WC5
Stop Logs	Flap Gate	Stop Logs	Flap Gate	Stop Logs	Flap Gate	Stop Logs	Flap Gate	Stop Logs	Flap Gate
MD	Down	+2'	None	-7'	None	+2'	None	MD	Down

Deviations from normal operation will be short-term and conducted for the reason identified below.



### iii. Increased Exchange Operation

Additional gates may be temporarily opened to the degree necessary as determined by the refuge manager for any of the following reasons.

- 1) To discharge excess water
- 2) To facilitate inflow of freshwater, or water of lower salinity
- 3) To enhance ingress and egress of estuarine-dependent fishes and shellfishes
- 4) To discharge anoxic waters

**iv. High Water Provisions:** When water levels in interior marshes exceed four inches above average marsh level for four days or more, the discharge capacity of structures A, B, and/or C will be increased with flap gates or by opening stop logs or sluice gates to permit outflows. Normal operation will be restored when the water conditions have receded.

**v. Storm Provisions:** Prior to a storm's approach, flap-gated bays may be readied in advance for later discharge of excess water by raising and thereby opening the sluice gates of those bays equipped with flap gates. Prior to a storm's approach, refuge personnel may restrict or close non-flap-gated bays to reduce exposure or interior marshes to saltwater tidal surges. Following a storm, normal or restricted water exchange operations shall be resumed on non-flap-gated bays in accordance with the established salinity and water level provisions and criteria. In an attempt to reduce the exposure of interior marshes to saltwater because of tropical depression tidal surges, the gates will be closed precluding any surges. Following the inundation of high tides and rainfall, the gates will be opened to alleviate interior marsh flooding.

### b. Actual Operations

Due to electrical and mechanical malfunctions (described above), the electric motors on the Hog Island Gully and West Cove Canal structures have not been operational. Due to the inability to operate the structures correctly, salinity and water level spikes have occurred, although less frequently than pre-construction.

Once the Hog Island Gully and West Cove Canal structures become fully operational, their ability to halt saltwater inflows and reduce water level fluctuations within the project area and surrounding areas will be evaluated.

## IV. Monitoring Activity

Pursuant to a Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Task Force decision on August 14, 2003, to adopt the Coastwide Reference Monitoring System-*Wetlands* (CRMS-*Wetlands*) for CWPPRA, updates were made to the CS-23 Monitoring Plan to merge it



with CRMS-*Wetlands* and provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act.

### **a. Monitoring Goals**

The objective of the Sabine Structure Replacement Project (CS-23) is to increase the cross-sectional area of the project features—Hog Island Gully, West Cove Canal, and Headquarters Canal—to improve hydrologic conditions that control high saline waters, increase water discharge capacities, and maintain emergent vegetation.

The following goals will contribute to the evaluation of the above objectives:

1. Reduce the occurrence of salinities that exceed target levels during the growing and non-growing seasons at stations CS23-02 (BS), CS23-03 (BC), CS23-05 (BN), and CS02-05 (5R). Target levels range from 2 – 8 ppt during the growing season and 3 – 10 ppt during the non-growing season (table 1).
2. Minimize frequency and duration of marsh flooding events.
3. Maintain existing intermediate and brackish vegetation communities.
4. Increase occurrence of submerged aquatic vegetation (SAV).

### **b. Monitoring Elements**

#### **Aerial Photography**

Near-vertical color-infrared aerial photography (1:24,000 scale) was used to measure land to water ratios for the project and reference areas (figure 2). The photography was obtained in November 2000 prior to project construction and post-construction in 2004. The original photography was checked for flight accuracy, color correctness, and clarity, and was subsequently archived. Aerial photography was scanned, mosaicked, and georectified by U.S. Geological Survey/National Wetlands Research Center (USGS/NWRC) personnel according to standard operating procedures (Steyer et al. 1995, revised 2000), (figure 3). The photography will be obtained after construction in 2009, and 2018.

#### **Salinity**

Salinities were monitored hourly utilizing eight continuous recorders (figure 4). Six are located in the project area, one in the reference area, and one outside of the project area within Hog Island Gully Canal. Five recorders are associated with this project, two associated with Rycade Canal (CS02-05, CS02-17) and one from East Mud Lake (CS20-15R). Discrete salinities are collected bi-weekly at 15 stations in the project and reference areas by the U.S. Fish and Wildlife Service (USFWS) and data are provided to LDNR each month. The USFWS has also been collecting salinity, water temperature, dissolved oxygen, pH, and specific conductivity parameters at area stations approximately every two weeks for over 15 years and will continue to do so after project completion. Both discrete and continuous data will be used to characterize



frequency and duration of average annual salinities throughout the project and reference area. Salinity data will also be used to identify occurrences of salinities that exceed target levels at stations CS23-03 (BC), CS23-05 (BN), CS02-05 (5R), and CS02-17 (17). Salinity was monitored in 1998-1999 (pre-construction) and January 1-November 26, 2004 (post-construction) at stations CS23-03, CS23-05, CS02-05, CS02-17, and CS23-01R. Due to the impending installation of Coastwide Reference Monitoring Stations (CRMS), data collection at two of the continuous recorder monitoring stations (CS23-01 and CS23-02) was discontinued in May 2004. The remaining four continuous recorder monitoring stations (CS23-03, CS23-05, CS23-01R, CS02-05) will continue data collection and will be operated by the USFWS. There are 10 CRMS-*Wetlands* stations in the project area.

### **Water Level**

Water levels are monitored hourly utilizing eight continuous recorders (figure 4). Six are located in the project area, one in the reference area, and one outside of the project area within Hog Island Gully Canal. Five recorders are associated with this project, two associated with Rycade Canal (CS02-05, CS02-17) and one from East Mud Lake (CS20-15R). To document annual duration and frequency of flooding, water levels were analyzed at four of the continuous recorder stations, which were referenced to marsh elevations. A staff gauge has been surveyed adjacent to each continuous recorder to correlate water levels to a known datum. Marsh elevations have been established at stations CS23-03, CS23-05, CS02-05, and CS02-17, and will be used to analyze duration and frequency of flooding events. Water levels were monitored in 1998-1999 (pre-construction) and January 1-November 26, 2004 (post-construction) at stations CS23-03, CS23-05, CS02-05, CS02-17, and CS23-01R. Due to the impending installation of Coastwide Reference Monitoring Stations (CRMS), data collection at two of the continuous recorder monitoring stations (CS23-01 and CS23-02) was discontinued in May 2004. The remaining four continuous recorder monitoring stations (CS23-03, CS23-05, CS23-01R, CS02-05) will continue data collection and will be operated by the USFWS. There are 10 CRMS-*Wetlands* stations in the project area.

### **Vegetation**

Species composition, richness, and relative abundance will be evaluated in the project and reference areas using the Braun-Blanquet method as described in Steyer et al. (1995, revised 2000). Fifty 4-m<sup>2</sup> sample areas (replicate 2-m x 2-m plots) are used to monitor percent cover, species composition, and height of dominant plants. Forty plots are located in the project area and 10 existing plots are in the reference area. The plots were established along a north/south transect line and are marked by GPS points and PVC poles to allow revisiting over time. Vegetation was monitored in 1999 (pre-construction) and 2004 (post-construction). Future vegetation data will be collected at the 10 CRMS-*Wetlands* stations that fall within the project and surrounding area stations.

### **Submerged Aquatic Vegetation**

To determine the occurrence of SAV within the project and reference area, eight ponds are randomly sampled for presence or absence of SAV using the modified rake method (Nyman and Chabreck 1996). Five ponds are located in the project area and three in the reference area. Transect lines are set up within each pond and a minimum of 25 samples are taken along each transect line, not to exceed 100 samples per line. Depending on pond configuration and wind



direction, the number of transect lines within each pond varies. SAV was monitored in 1999 (pre-construction). The 2004 SAV data was not collected due to weather conditions, airboat failures, and time constraints. SAV data will be collected in 2005 and every five years.

**c. Preliminary Monitoring Results and Discussion**

**Aerial Photography**

Aerial photography was acquired in November 2000 for a land:water analysis (figure 2). Results indicate that the project area had a ratio of 67.5% land to 32.5% water, while the reference area consisted of 57.9% land to 42.1% water. Post-construction photography was collected in 2004 and is currently being processed.

**Salinity**

Salinity data were collected hourly at seven stations (figure 4) associated within the CS-23 project and reference areas (figures 5 to 11).

<b>Station</b>	<b>Data collection period</b>
CS23-01	3/18/98 – 5/19/04
CS23-02	3/18/98 – 5/19/04
CS23-03	3/18/98 - present
CS23-04*	3/18/98 – 8/25/99
CS23-05	3/18/98 - present
CS23-01R	3/17/98 - present
CS02-05**	7/14/94 - present
CS02-17**	6/14/94 – 7/29/04

\*The continuous recorder at CS23-04 was removed due to low water conditions and station-to-station analysis, which concluded that no significant differences ( $P < .005$ ) were found when compared to station CS23-05.

\*\*Vented water level data were not collected at stations CS02-05 and CS02-17 from 6/14/94 until 4/8/97.

Hourly data were combined at each station to derive yearly mean values. Analysis of Variance (ANOVA) was conducted on yearly salinity means for 2004. Stations had significantly different salinities for 2004 ( $F_{3,3} = 159.4814$ ;  $P = 4.0001$ ). Post-ANOVA contrasts of each project station compared against the reference station revealed that all stations were significantly different from the reference station at the  $P < 0.05$  level ( $p < 0.0001$ ) (figure 12).

Salinity relative to target levels, which were set forth in the Environmental Assessment (EA) for the Replacement of Water Control Structures at the Hog Island Gully, West Cove Canal, and Headquarters Canal project (XCS/CS-23; 1999), were calculated using hourly salinity (ppt) data from January 1 to November 26, 2004. Salinity values were calculated at stations CS02-05, CS23-



02, CS23-03, and CS23-05, which had salinity target levels for the growing (March – August) and non-growing (September – February) seasons (table 1). The percentages of total time for which target levels were maintained during the growing season at stations CS02-05, CS23-02, CS23-03, and CS23-05 were 88.0, 92.3, 93.9, and 92.1 %, respectively. The percentages of total time for which target levels were maintained during the non-growing season was 79.0, 100.0, 87.0, and 79.0 %, respectively (table 2).

### **Water Level**

Water levels relative to marsh elevation (ft, NAVD 88) were collected hourly at four stations associated within the CS-23 project and reference areas. Water circulation patterns relative to incoming tidal flows are depicted in figure 13. Hourly data were combined at each station to derive yearly mean values. ANOVA was conducted on yearly means of adjusted water level to marsh (ft) for 2004. Stations were significantly different from each other ( $F_{2,2} = 30.8$ ;  $P < 0.0001$ ). Post-ANOVA contrasts revealed that both stations CS23-03 (-0.096) and CS23-05 (-0.199) were significantly different from the reference CS23-01R (-0.341) station. However, water levels relative to marsh remained below the average marsh elevation of 1.41 ft (0.43 m) for the January 1–November 26, 2004, period (figure 14).

### **Vegetation**

Vegetation surveys were conducted in June 2004 (N = 49 plots) during the post-construction period (figure 15). During this sampling period, the area was dominated by *Spartina patens*, which had the highest cover value of 57.1 %. The five co-dominant emergent vegetation species were *Paspalum vaginatum*, *Schoenoplectus californicus*, *Schoenoplectus robustus*, *Schoenoplectus americanus*, and *Typha latifolia*, with percent covers of 36.1 %, 32.2 %, 27.6 %, 20.4 %, and 14.1 % respectively (table 3).

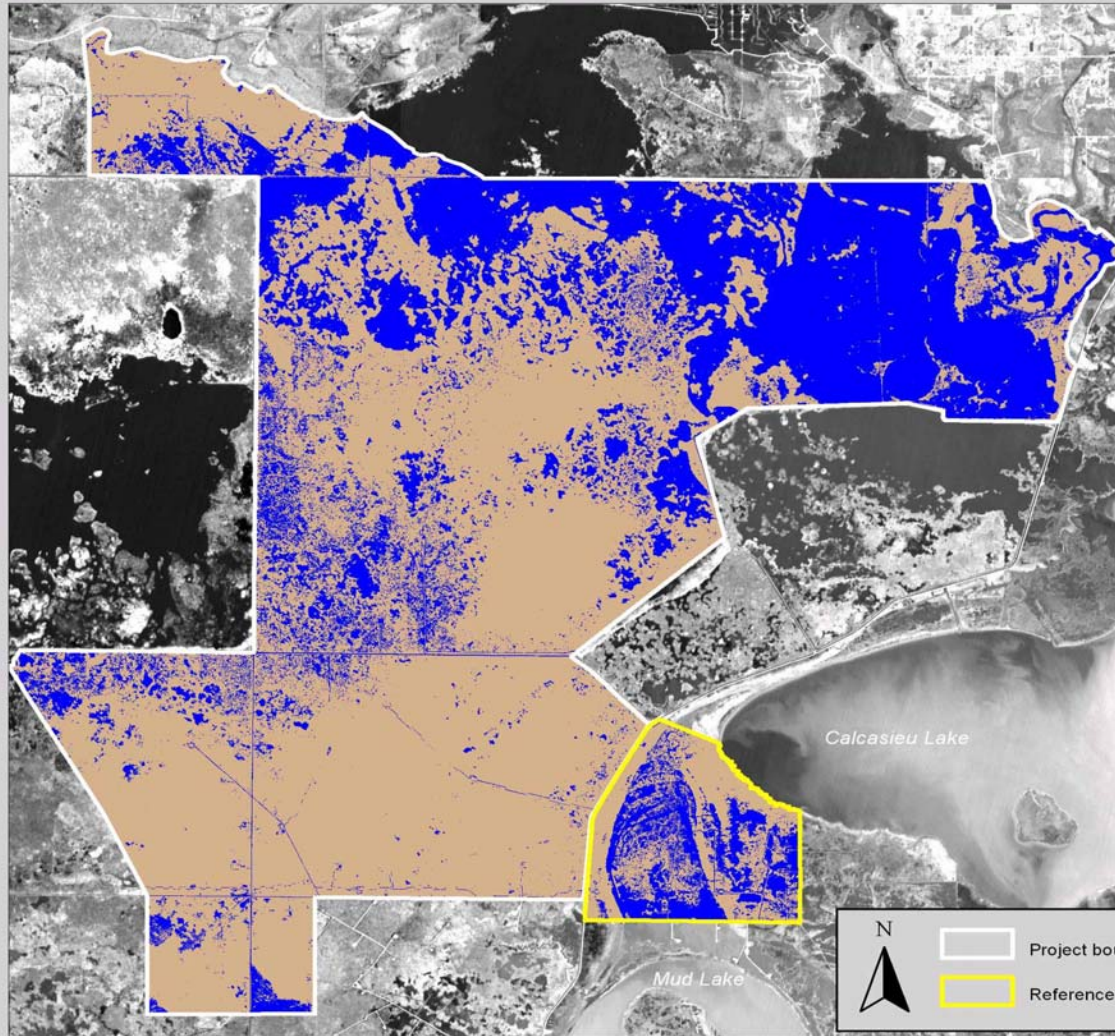
### **Submerged Aquatic Vegetation**

SAV surveys were not conducted in 2004 during the post-construction period due to weather conditions, airboat failures, and time constraints.





**Replace Sabine Refuge Water Control Structures at Headquarters Canal, West Cove Canal, and Hog Island Gully (CS-23)**  
 Coastal Wetlands Planning, Protection and Restoration Act  
 2000 Land-Water Analysis



Class	Project Acres	Reference Acres
Land	28146.8	1695.5
Water	13572.1	1233.5
<b>Total</b>	<b>41718.9</b>	<b>2929.0</b>

Source:  
 The land-water data were acquired from 1:24,000 color infrared photography shown here at 1:120,000 scale. The photography was obtained on November 27, 2000. The data were overlaid on a 1998 Digital Ortho Quarter Quadrangle.



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Federal Sponsor:

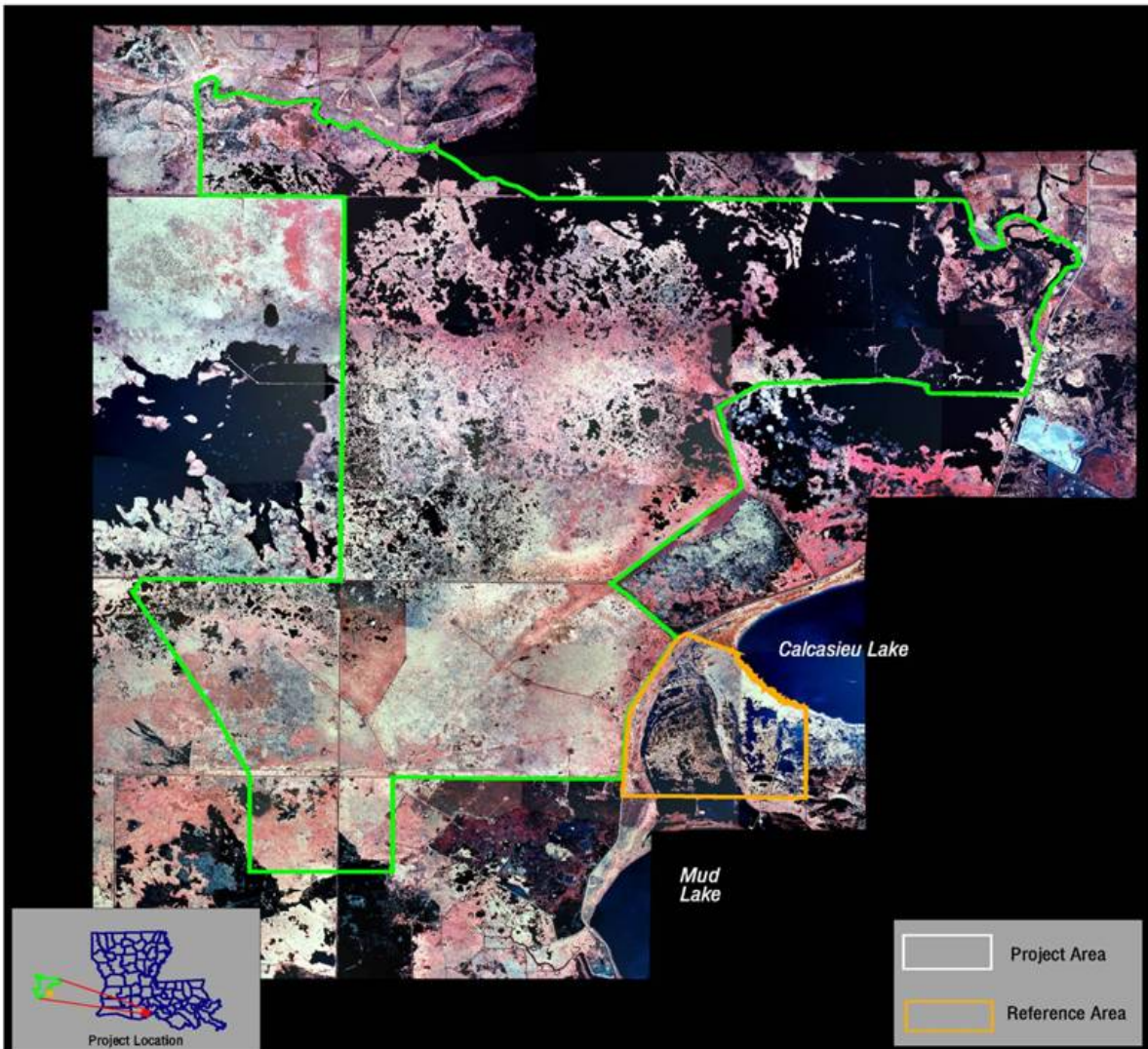


Map ID: USGS-NWRC 2003-02-0331

**Figure 2.** Land/water analysis of the Sabine Structure Replacement (CS-23) project for the project and reference areas from photography obtained November 27, 2000.







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Federal Sponsor:



Map ID: 01-2-107

**Figure 3.** Photo-mosaic of the Sabine Structure Replacement project area from photography obtained November 27, 2000.

**Table 1.** Salinity criteria for restricting and halting saltwater inflows, which were set forth in the *Draft Environmental Assessment (EA) for the Replacement of Water Control Structures at the Hog Island Gully, West Cove and Headquarters Canal project* (XCS/CS-23; USFWS, Sabine National Wildlife Refuge 1999)

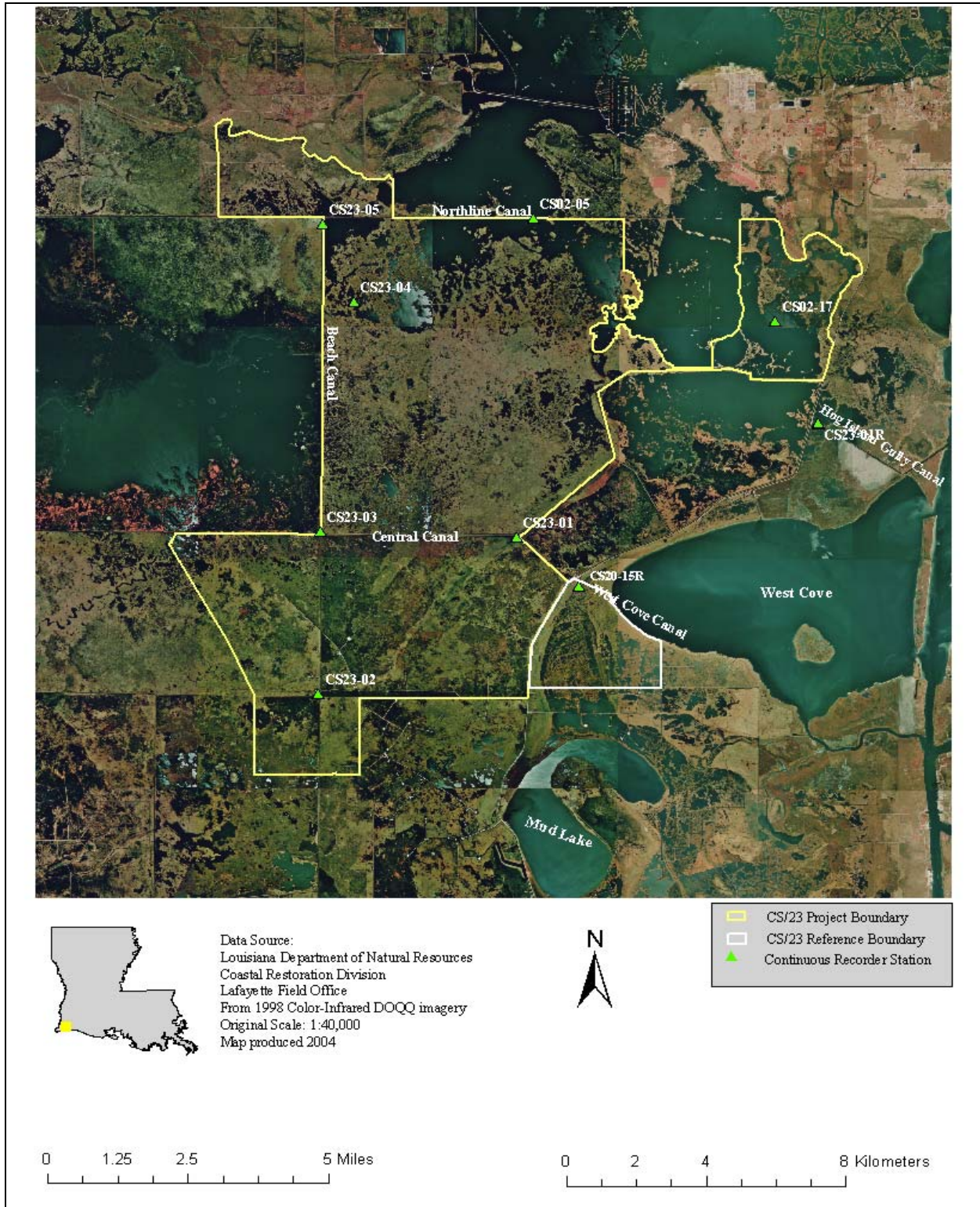
		<b>Monitoring Station</b>			
<b>Season</b>	<b>Months</b>	<b>CS23-03</b>	<b>CS23-02</b>	<b>CS02-05</b>	<b>CS23-05</b>
Growing	Mar - Aug	4	4	5	2
Non-Growing	Sept - Feb	8	8	7	4

Salinity criteria (ppt) for restricting saltwater inflows.

		<b>Monitoring Station</b>			
<b>Season</b>	<b>Months</b>	<b>CS23-03</b>	<b>CS23-02</b>	<b>CS02-05</b>	<b>CS23-05</b>
Growing	Mar - Aug	6	6	-	3
Non-Growing	Sept - Feb	10	10	-	5

Salinity criteria (ppt) for halting all saltwater inflows.

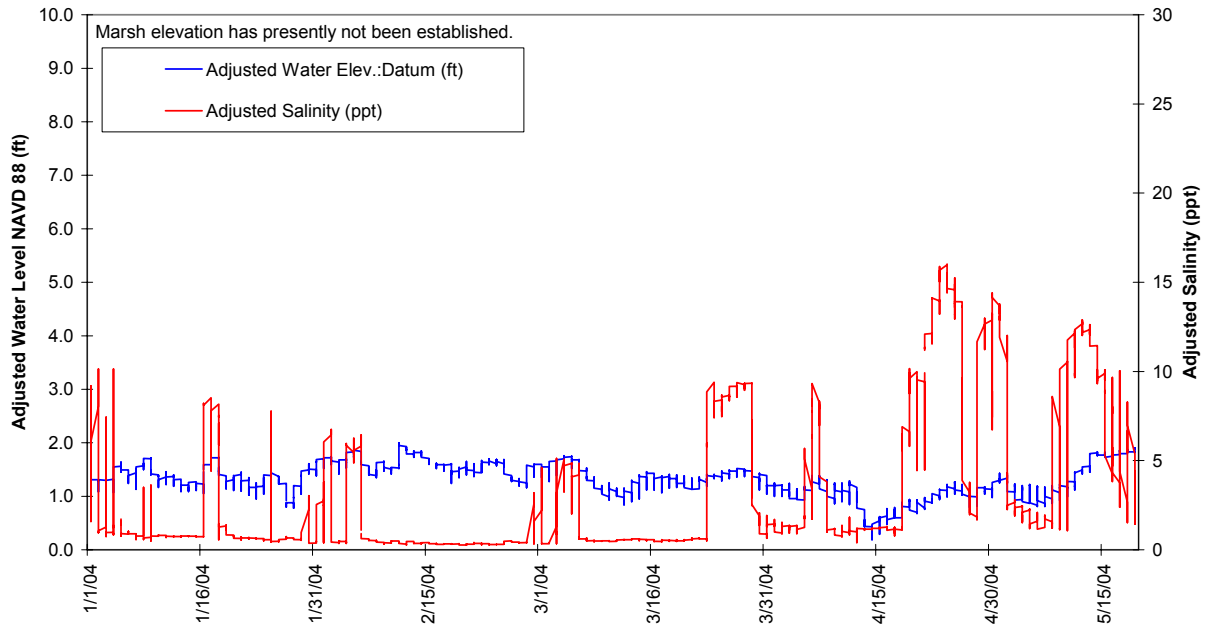




**Figure 4.** 1998 DOQQ imagery of continuous recorder monitoring stations in the Sabine Structure Replacement project and reference areas.



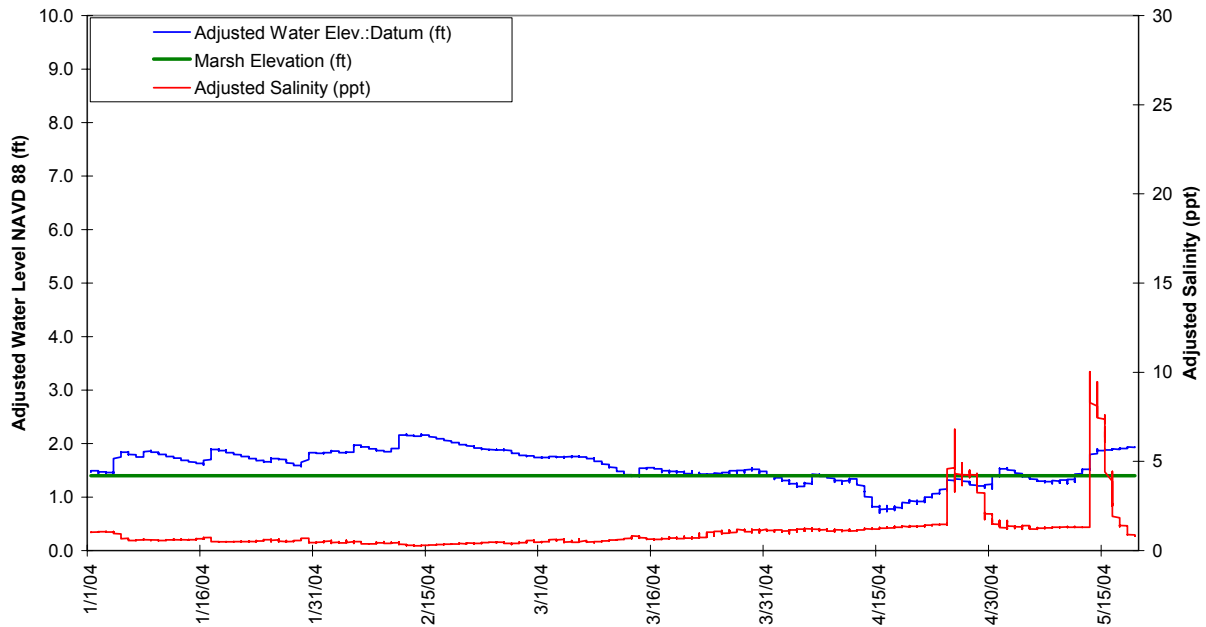
**Station CS23-01 (1/1/04 – 05/19/04)**  
**Salinity and Water Level Data**



**Figure 5.** Hourly salinity and water level at station CS23-01 in the Sabine Structure Replacement (CS-23) project area. No marsh elevation was established due to the close proximity of a ridge and shell road.



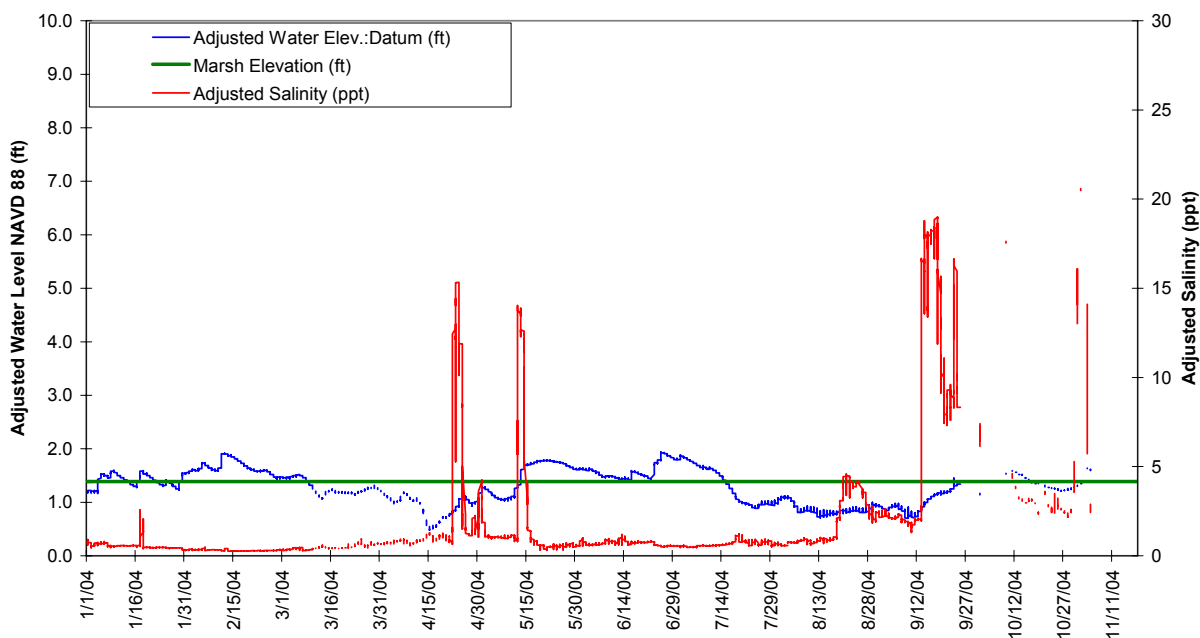
**Station CS23-02 (01/01/04 – 05/19/04)  
Salinity and Water Level Data**



**Figure 6.** Hourly salinity and water level at station CS23-02 in the Sabine Structure Replacement (CS-23) project area. A water level reading above marsh elevation indicates that the marsh is flooded.



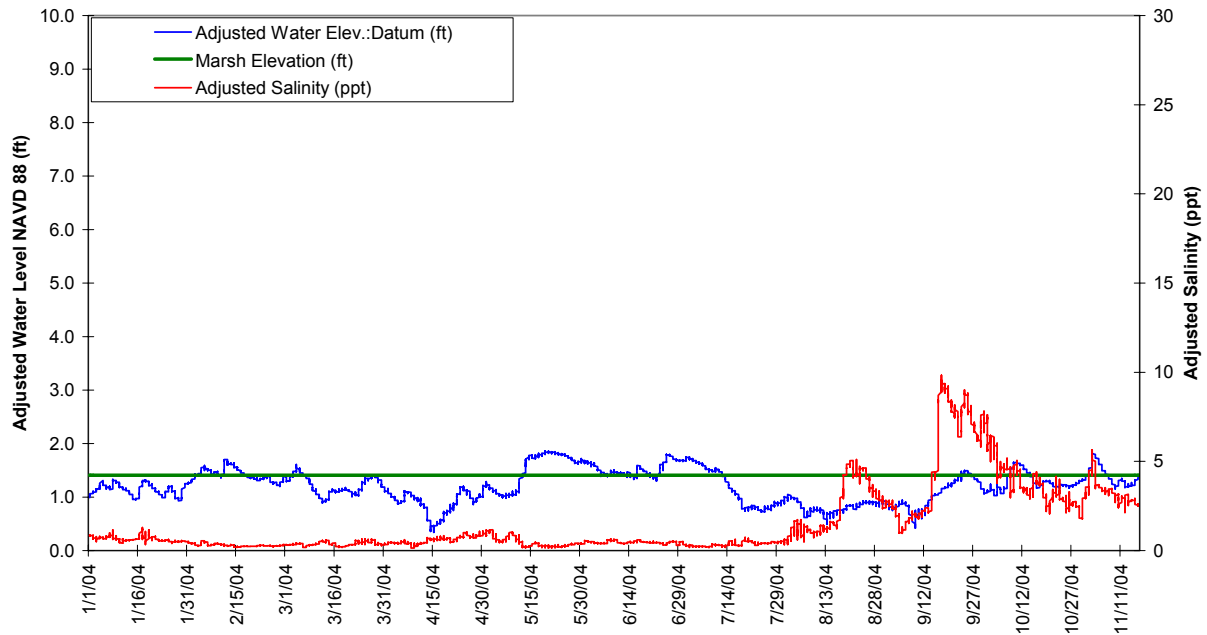
### Station CS23-03 (1/1/04 – 11/18/04) Salinity and Water Level Data



**Figure 7.** Hourly salinity and water level at station CS23-03 in the Sabine Structure Replacement (CS-23) project area. A water level reading above marsh elevation indicates that the marsh is flooded.



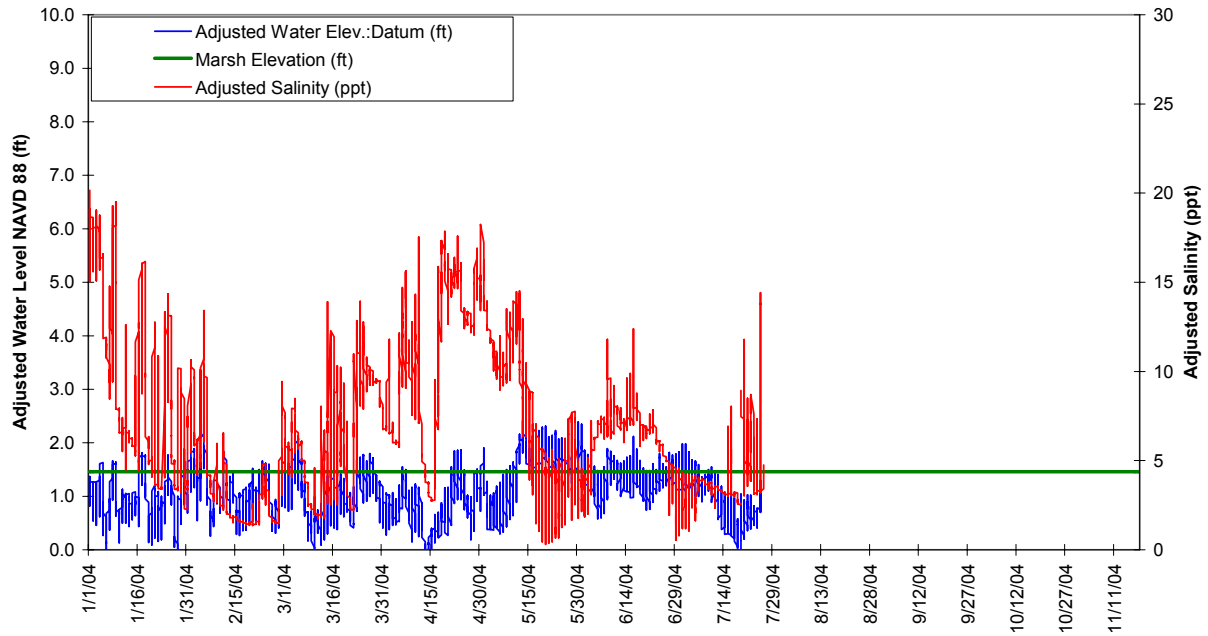
# Station CS23-05 (01/01/04 – 11/16/04) Salinity and Water Level Data



**Figure 8.** Hourly salinity and water level at station CS23-05 in the Sabine Structure Replacement (CS-23) project area. A water level reading above marsh elevation indicates that the marsh is flooded.



**Station CS23-01R (01/01/04 – 11/18/04)  
Salinity and Water Level Data**

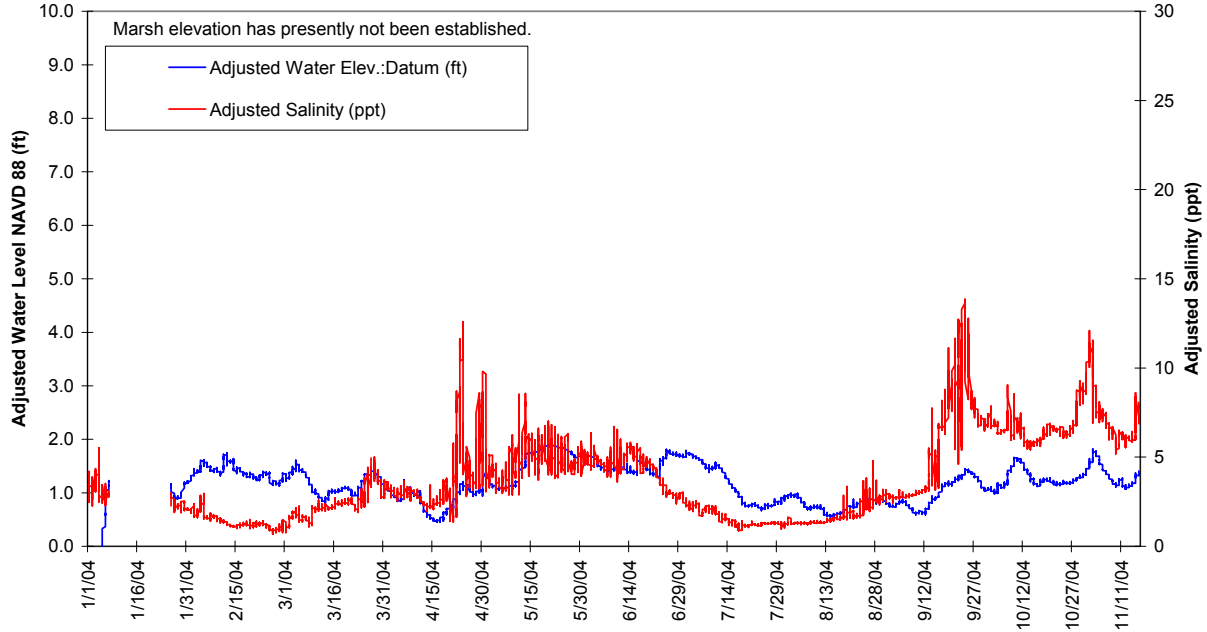


**Figure 9.** Hourly salinity and water level at station CS23-01R in the Sabine Structure Replacement (CS-23) project area. A water level reading above marsh elevation indicates that the marsh is flooded.





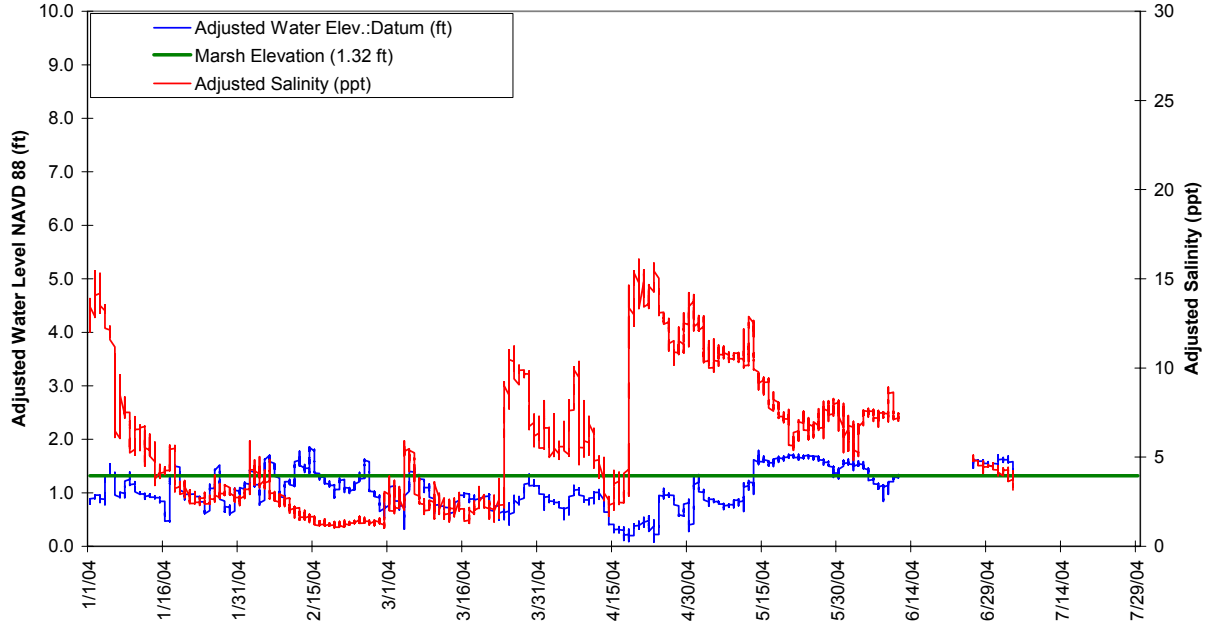
### Station CS02-05 (01/01/04 – 11/16/04) Salinity and Water Level Data



**Figure 10.** Hourly salinity and water level at station CS02-17 in the Sabine Structure Replacement (CS-23) project area. A water level reading above marsh elevation indicates that the marsh is flooded.



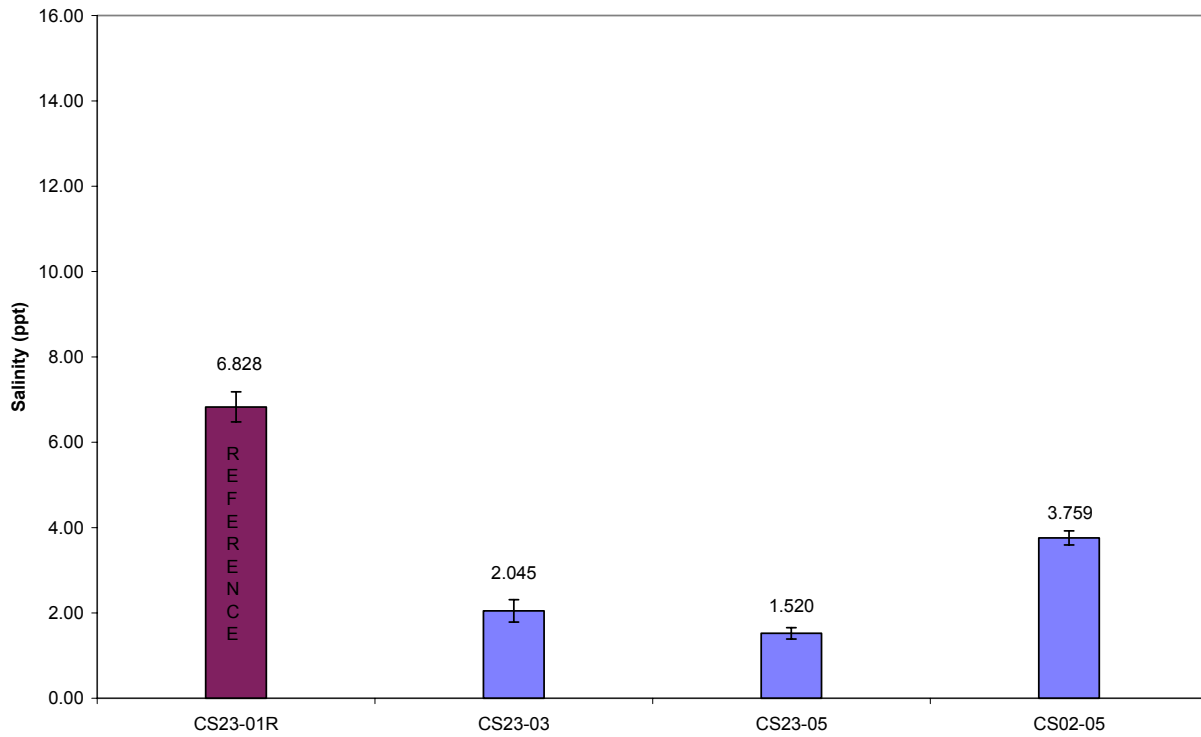
**Station CS02-17 (01/01/04 – 07/30/04)**  
**Salinity and Water Level Data**



**Figure 11.** Hourly salinity and water level at station CS02-17 in the Sabine Structure Replacement (CS-23) project area. A water level reading above marsh elevation indicates that the marsh is flooded.



Project vs. Reference (47 weeks)



**Figure 12.** Yearly means derived from weekly means of salinity (ppt) at four continuous recorder stations located in the Sabine Structure Replacement (CS-23) project and reference areas for the period 01/01/04 – 11/16/04.



**Table 2.** Frequency distribution of salinities during the growing and non-growing seasons in the project and reference areas from 1/1/04 to 11/16/04.

\*Red indicates target levels during the growing season.

\*\*Blue indicates target levels during the non-growing season.

**(CS02-05) Sabine Structure Replacement**  
**Frequency Distribution of salinities (ppt) (01/01/04 -11/16/04)**

Salinity (ppt)	"Growing"		"Non-Growing"	
	Duration of Salinity events (hours)	Percent of Total Time	Duration of Salinity events (hours)	Percent of Total Time
>20.0 ppt	0	0.00	0	0.00
10.0 - 20.0 ppt	17	0.39	110	3.90
7.0 - 10.0 ppt	57	1.30	474	16.81
5.0 - 7.0 ppt	445	10.15	953	33.81
2.0 - 5.0 ppt	2538	57.88	624	22.14
0.0 - 2.0 ppt	1328	30.29	658	23.34
<b>total hours</b>	<b>4385</b>	<b>100</b>	<b>2819</b>	<b>100</b>
<b>Days n= 300.2</b>	<b>182.7</b>		<b>117.5</b>	

**(CS23-02) Sabine Structure Replacement**  
**Frequency Distribution of salinities (ppt) (01/01/04 - 05/19/04)**

Salinity (ppt)	"Growing"		"Non-Growing"	
	Duration of Salinity events (hours)	Percent of Total Time	Duration of Salinity events (hours)	Percent of Total Time
>20.0 ppt	0	0.00	0	0.00
8.0 - 20.0 ppt	24	1.26	0	0.00
6.0 - 8.0 ppt	47	2.46	0	0.00
4.0 - 6.0 ppt	75	3.93	0	0.00
2.0 - 4.0 ppt	75	3.93	0	0.00
0.0 - 2.0 ppt	1686	88.41	1440	100.00
<b>total hours</b>	<b>1907</b>	<b>100</b>	<b>1440</b>	<b>100</b>
<b>Days n= 139.5</b>	<b>79.5</b>		<b>60</b>	

**(CS23-03) Sabine Structure Replacement**  
**Frequency Distribution of salinities (ppt) (01/01/04 -11/18/04)**

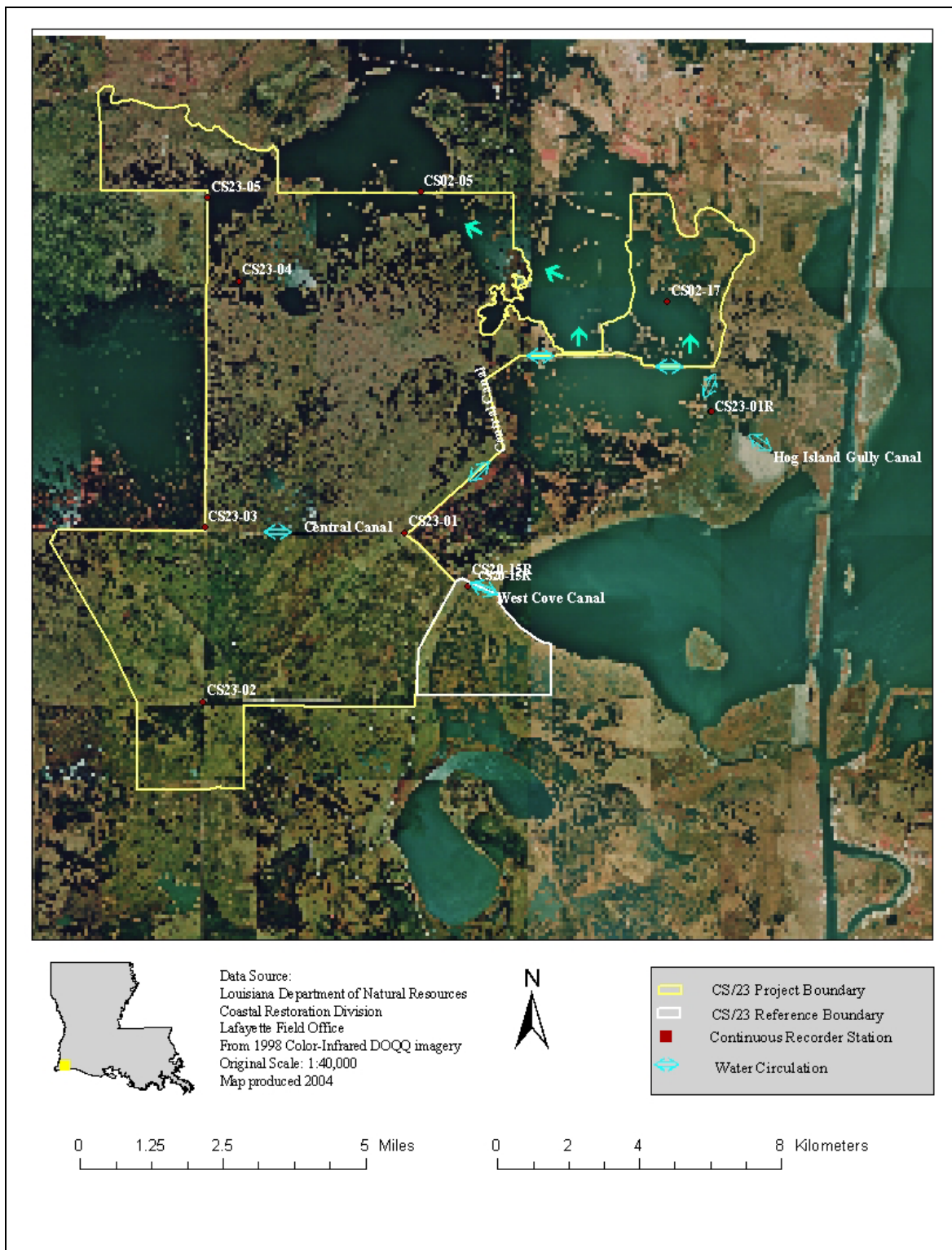
Salinity (ppt)	"Growing"		"Non-Growing"	
	Duration of Salinity events (hours)	Percent of Total Time	Duration of Salinity events (hours)	Percent of Total Time
>20.0 ppt	0	0.00	3	0.14
8.0 - 20.0 ppt	118	3.03	274	12.67
6.0 - 8.0 ppt	2	0.05	28	1.30
4.0 - 6.0 ppt	114	2.93	8	0.37
2.0 - 4.0 ppt	260	6.68	311	14.38
0.0 - 2.0 ppt	3399	87.31	1538	71.14
<b>total hours</b>	<b>3893</b>	<b>100</b>	<b>2162</b>	<b>100</b>
<b>Days n= 252.3</b>	<b>162.2</b>		<b>90.1</b>	



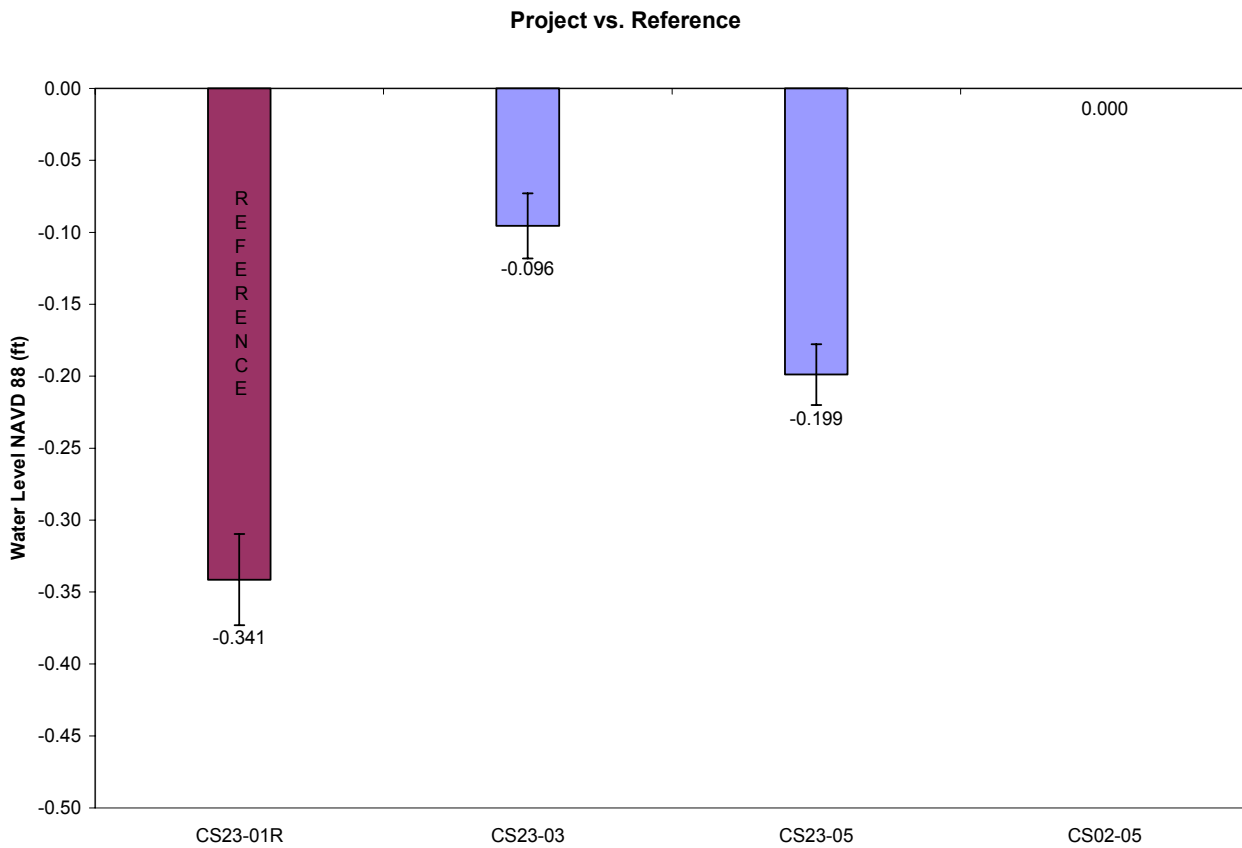
**(CS23-05) Sabine Structure Replacement  
Frequency Distribution of salinities (ppt) (01/01/04 -11/16/04)**

Salinity (ppt)	"Growing"		"Non-Growing"	
	Duration of Salinity events (hours)	Percent of Total Time	Duration of Salinity events (hours)	Percent of Total Time
>20.0 ppt	0	0.00	0	0.00
10.0 - 20.0 ppt	0	0.00	0	0.00
6.0 - 10.0 ppt	0	0.00	380	11.59
4.0 - 6.0 ppt	180	4.08	309	9.42
2.0 - 4.0 ppt	167	3.78	978	29.83
0.0 - 2.0 ppt	4067	92.14	1612	49.16
<b>total hours</b>	<b>4414</b>	<b>100</b>	<b>3279</b>	<b>100.00</b>
<b>Days n= 320.5</b>	<b>183.9</b>		<b>136.6</b>	



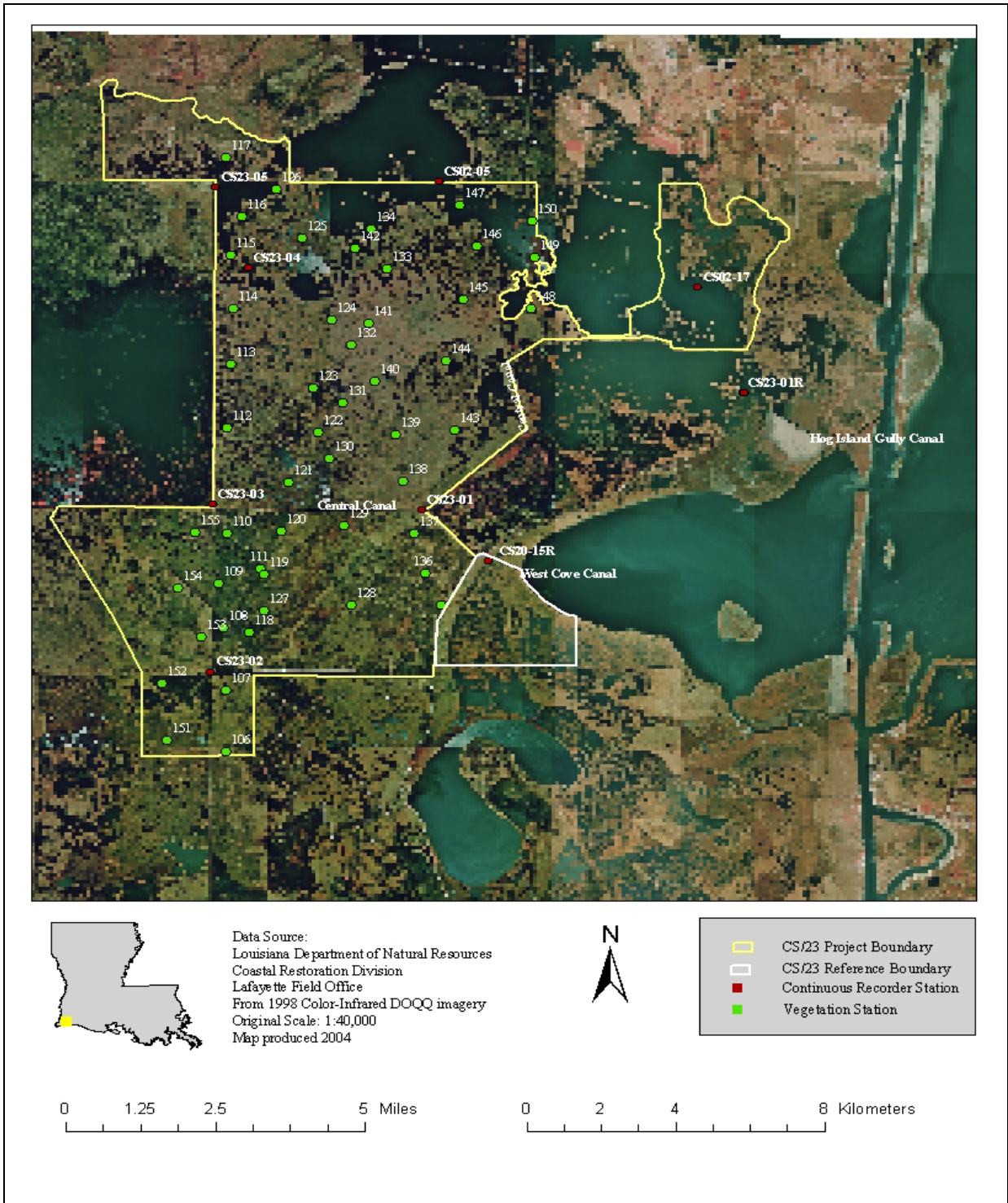


**Figure 13.** 1998 DOQQ imagery of continuous recorder monitoring stations and water circulation patterns in the Sabine Structure Replacement project and reference areas.



**Figure 14.** Yearly means derived from weekly means of water levels relative to marsh elevation (ft, NAVD 88) at four continuous recorder stations located in the Sabine Structure Replacement (CS-23) project and reference areas for the period 1/1/04 – 11/18/04.





**Figure 15.** Location of vegetation stations within the Sabine Structure Replacement project area.



**Table 3.** Mean percent cover and number of occurrences of highest ranking emergent vegetation species in the Hog Island Gully site of the Sabine Structure Replacement (CS-23) project area as recorded in June 2004.

Species	Common Name	Mean % Cover	# Occurrences
<i>Spartina patens</i> (Ait.) Muhl.	Marshhay Cordgrass	57.17	92
<i>Paspalum vaginatum</i> Sw.	Seashore Paspalum	36.14	14
<i>Schoenoplectus californicus</i> (C.A. Mey.) Palla	California Bulrush	32.26	23
<i>Schoenoplectus robustus</i> (Pursh) M.T. Strong	Sturdy Bulrush	27.61	18
<i>Schoenoplectus americanus</i> (Pers.) Volk. ex Schinz & R. Keck	Slender Bulrush	20.48	26
<i>Typha</i> sp. L.	Cattail	14.15	55



## **V. Conclusions**

### **a. Project Effectiveness**

Electrical problems caused the electric motors to overheat on the Hog Island Gully and West Cove structures after the initial installation, and the structures are not fully operational at this time. Due to the inability to operate the structures correctly, salinity and water level spikes have occurred, although less frequently than during pre-construction. Yearly mean salinities derived from the weekly means were also lower within the project area when compared to the reference area (figure 12).

Water levels remained below the average marsh elevation of 1.41 ft (0.43 m) for the January 1-November 18, 2004 period (figure 14).

Once the Hog Island Gully and West Cove Canal structures become fully operational, their ability to halt saltwater inflows and reduce water level fluctuations within the project area and surrounding areas will become evident. Data collection using 10 CRMS *Wetlands* stations will begin in fall of 2005.

### **b. Recommended Improvements**

When a problem arises with the stem or operating nut, the stem and nut should be removed and brought to a machine shop. The lead of the threads should be checked and corrected if needed. The nut should be repaired or replaced. Both flanges on the pedestal should be machined to ensure that they are square with the pipe. When reassembling, the pedestal should be shimmed level and in a position to line up the stem in the center of the gate attachment bracket. Cost per gate is estimated to be \$12,000.00, time to complete, one week per gate.

### **c. Lessons Learned**

Installation instructions should be written for the installation of the pedestal, stem, and actuator, which state the tolerances to be used.



## VI. REFERENCES

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- O'Neil, T. 1949. Map of the southwestern part of Louisiana showing vegetation types of the Louisiana marshes. New Orleans: Louisiana Department of Wildlife & Fisheries.
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- Steyer, G. D., R. C. Raynie, D. L. Steller, D. Fuller, and E. Swensen 1995, revised 2000. Quality management plan for Coastal Wetlands Planning, Protection, and Restoration Act monitoring program. Open-file series no. 95-01. Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division.
- United States Fish and Wildlife Service (USFWS), Sabine National Wildlife Refuge 1999. Draft Environmental Assessment. Replacement of water control structures at Hog Island Gully, West Cove Canal, and Headquarters Canal. Hackberry, Louisiana: Sabine National Wildlife Refuge.



## **Appendix A (Inspection Photographs)**

No inspection was conducted in calendar year 2005 because this project is currently under a maintenance event, therefore no photographs were available.



**Appendix B**  
**(Three-Year Budget Projection)**  
**SABINE STRUCTURE REPLACEMENT / CS23 / PPL3**  
**Three-Year Operations & Maintenance Budgets 07/01/2005 - 06/30/08**

Project Manager                      O & M Manager                      Federal Sponsor                      Prepared By

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FWS

	2005/2006	2006/2007	2007/2008
<b>Maintenance Inspection</b>	\$ 4,955.00	\$ 5,119.00	\$ 5,288.00
<b>Structure Operation</b>		\$ -	\$ -
<b>Administration</b>	\$ 4,000.00	\$ 3,000.00	\$ 1,000.00

**Maintenance/Rehabilitation**

05/06 Description: General Structure Maintenance

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<i>E&amp;D</i>	\$	3,500.00
<i>Construction</i>	\$	40,000.00
<i>Construction Oversight</i>	\$	2,500.00
<i>Sub Total - Maint. And Rehab.</i>	\$	46,000.00

06/07 Description: General Structure Maintenance

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<i>E&amp;D</i>	\$	1,500.00
<i>Construction</i>	\$	20,000.00
<i>Construction Oversight</i>	\$	1,250.00
<i>Sub Total - Maint. And Rehab.</i>	\$	22,750.00

07/08 Description:

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<i>E&amp;D</i>	\$	-
<i>Construction</i>	\$	-
<i>Construction Oversight</i>	\$	-
<i>Sub Total - Maint. And Rehab.</i>	\$	-

	2005/2006	2006/2007	2007/2008
<b><u>Total O&amp;M Budgets</u></b>	<b>\$ 54,955.00</b>	<b>\$ 30,869.00</b>	<b>\$ 6,288.00</b>



**OPERATION AND MAINTENANCE BUDGET 07/01/2005 - 06/30/2006**  
**SABINE STRUCTURE REPLACEMENT / CS-23 / PPL NO.3**

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$4,955.00	<b>\$4,955.00</b>
General Structure Maintenance	LUMP	1	\$40,000.00	<b>\$40,000.00</b>
Engineering and Design	LUMP	1	\$3,500.00	<b>\$3,500.00</b>
Operations Contract	LUMP	1	\$0.00	<b>\$0.00</b>
Construction Oversight	LUMP	1	\$2,500.00	<b>\$2,500.00</b>

**ADMINISTRATION**

LDNR / CRD Admin.	LUMP	1	\$3,000.00	\$3,000.00
FEDERAL SPONSER Admin.	LUMP	1	\$1,000.00	\$1,000.00
SURVEY Admin.	LUMP	0	\$0.00	\$0.00
OTHER				\$0.00
<b>TOTAL ADMINISTRATION COSTS:</b>				<b>\$4,000.00</b>

**MAINTENANCE / CONSTRUCTION**

**SURVEY**

SURVEY DESCRIPTION:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Secondary Monument	EACH	0	\$0.00	\$0.00
	Staff Gauge / Recorders	EACH	0	\$0.00	\$0.00
	Marsh Elevation / Topography	LUMP	0	\$0.00	\$0.00
	TBM Installation	EACH	0	\$0.00	\$0.00
	OTHER				\$0.00
<b>TOTAL SURVEY COSTS:</b>					<b>\$0.00</b>

**GEOTECHNICAL**

GEOTECH DESCRIPTION:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Borings	EACH	0	\$0.00	\$0.00
	OTHER				\$0.00
<b>TOTAL GEOTECHNICAL COSTS:</b>					<b>\$0.00</b>

**CONSTRUCTION**

CONSTRUCTION DESCRIPTION:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Rip Rap	LIN FT	0	\$0.00	\$0.00
		TON / FT	0	\$0.00	\$0.00
		TONS	0	\$0.00	\$0.00
	Filter Cloth / Geogrid Fabric	SQ YD	0	\$0.00	\$0.00
	Navagation Aid	EACH	0	\$0.00	\$0.00
	Signage	EACH	0	\$0.00	\$0.00
	General Excavation / Fill	CU YD	0	\$0.00	\$0.00
	Dredging	CU YD	0	\$0.00	\$0.00
	Sheet Piles (Lin Ft or Sq Yds)		0	\$0.00	\$0.00
	Timber Piles (each or lump sum)		0	\$0.00	\$0.00
	Timber Members (each or lump sum)		0	\$0.00	\$0.00
	Hardware	LUMP	1	\$0.00	\$0.00
	Materials	LUMP	1	\$0.00	\$0.00
	Mob / Demob	LUMP	1	\$0.00	\$0.00
	Contingency	LUMP	1	\$0.00	\$0.00
	General Structure Maintenance	LUMP	1	\$0.00	\$0.00
	OTHER			\$0.00	\$0.00
	OTHER			\$0.00	\$0.00
	OTHER			\$0.00	\$0.00
<b>TOTAL CONSTRUCTION COSTS:</b>					<b>\$0.00</b>

**TOTAL OPERATIONS AND MAINTENANCE BUDGET:** **\$54,955.00**



**OPERATION AND MAINTENANCE BUDGET 07/01/2006 - 06/30/2007**  
**SABINE STRUCTURE REPLACEMENT / CS-23 / PPL NO. 3**

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$5,119.00	\$5,119.00
General Structure Maintenance	LUMP	1	\$20,000.00	\$20,000.00
Engineering and Design	LUMP	1	\$1,500.00	\$1,500.00
Operations Contract	LUMP	1	\$0.00	\$0.00
Construction Oversight	LUMP	1	\$1,250.00	\$1,250.00

**ADMINISTRATION**

LDNR / CRD Admin.	LUMP	1	\$2,000.00	\$2,000.00
FEDERAL SPONSER Admin.	LUMP	1	\$1,000.00	\$1,000.00
SURVEY Admin.	LUMP	0	\$0.00	\$0.00
OTHER				\$0.00
<b>TOTAL ADMINISTRATION COSTS:</b>				<b>\$3,000.00</b>

**MAINTENANCE / CONSTRUCTION**

**SURVEY**

SURVEY DESCRIPTION:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Secondary Monument	EACH	0	\$0.00	\$0.00
	Staff Gauge / Recorders	EACH	0	\$0.00	\$0.00
	Marsh Elevation / Topography	LUMP	0	\$0.00	\$0.00
	TBM Installation	EACH	0	\$0.00	\$0.00
	OTHER				\$0.00
<b>TOTAL SURVEY COSTS:</b>					<b>\$0.00</b>

**GEOTECHNICAL**

GEOTECH DESCRIPTION:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Borings	EACH	0	\$0.00	\$0.00
	OTHER				\$0.00
<b>TOTAL GEOTECHNICAL COSTS:</b>					<b>\$0.00</b>

**CONSTRUCTION**

CONSTRUCTION DESCRIPTION:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Rip Rap	LIN FT	0	\$0.00	\$0.00
		TON / FT	0	\$0.00	\$0.00
		TONS	0	\$0.00	\$0.00
	Filter Cloth / Geogrid Fabric	SQ YD	0	\$0.00	\$0.00
	Navagation Aid	EACH	0	\$0.00	\$0.00
	Signage	EACH	0	\$0.00	\$0.00
	General Excavation / Fill	CU YD	0	\$0.00	\$0.00
	Dredging	CU YD	0	\$0.00	\$0.00
	Sheet Piles (Lin Ft or Sq Yds)		0	\$0.00	\$0.00
	Timber Piles (each or lump sum)		0	\$0.00	\$0.00
	Timber Members (each or lump sum)		0	\$0.00	\$0.00
	Hardware	LUMP	1	\$0.00	\$0.00
	Materials	LUMP	1	\$0.00	\$0.00
	Mob / Demob	LUMP	1	\$0.00	\$0.00
	Contingency	LUMP	1	\$0.00	\$0.00
	General Structure Maintenance	LUMP	1	\$0.00	\$0.00
	OTHER			\$0.00	\$0.00
	OTHER			\$0.00	\$0.00
	OTHER			\$0.00	\$0.00
<b>TOTAL CONSTRUCTION COSTS:</b>					<b>\$0.00</b>

**TOTAL OPERATIONS AND MAINTENANCE BUDGET:** **\$30,869.00**



**OPERATION AND MAINTENANCE BUDGET 07/01/2007 - 06/30/2008**  
**SABINE STRUCTURE REPLACEMENT / CS-23 / PPL NO.3**

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$5,288.00	\$5,288.00
General Structure Maintenance	LUMP	1	\$0.00	\$0.00
Engineering and Design	LUMP	1	\$0.00	\$0.00
Operations Contract	LUMP	1	\$0.00	\$0.00
Construction Oversight	LUMP	1	\$0.00	\$0.00

**ADMINISTRATION**

LDNR / CRD Admin.	LUMP	1	\$500.00	\$500.00
FEDERAL SPONSER Admin.	LUMP	1	\$500.00	\$500.00
SURVEY Admin.	LUMP	0	\$0.00	\$0.00
OTHER				\$0.00
<b>TOTAL ADMINISTRATION COSTS:</b>				<b>\$1,000.00</b>

**MAINTENANCE / CONSTRUCTION**

**SURVEY**

SURVEY DESCRIPTION:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Secondary Monument	EACH	0	\$0.00	\$0.00
	Staff Gauge / Recorders	EACH	0	\$0.00	\$0.00
	Marsh Elevation / Topography	LUMP	0	\$0.00	\$0.00
	TBM Installation	EACH	0	\$0.00	\$0.00
	OTHER				\$0.00
<b>TOTAL SURVEY COSTS:</b>					<b>\$0.00</b>

**GEOTECHNICAL**

GEOTECH DESCRIPTION:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Borings	EACH	0	\$0.00	\$0.00
	OTHER				\$0.00
<b>TOTAL GEOTECHNICAL COSTS:</b>					<b>\$0.00</b>

**CONSTRUCTION**

CONSTRUCTION DESCRIPTION:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Rip Rap	LIN FT	0	\$0.00	\$0.00
		TON / FT	0.0	\$0.00	\$0.00
		TONS	0	\$0.00	\$0.00
			0	\$0.00	\$0.00
	Filter Cloth / Geogrid Fabric	SQ YD	0	\$0.00	\$0.00
	Navagation Aid	EACH	0	\$0.00	\$0.00
	Signage	EACH	0	\$0.00	\$0.00
	General Excavation / Fill	CU YD	0	\$0.00	\$0.00
	Dredging	CU YD	0	\$0.00	\$0.00
	Sheet Piles (Lin Ft or Sq Yds)		0	\$0.00	\$0.00
	Timber Piles (each or lump sum)		0	\$0.00	\$0.00
	Timber Members (each or lump sum)		0	\$0.00	\$0.00
	Hardware	LUMP	1	\$0.00	\$0.00
	Materials	LUMP	1	\$0.00	\$0.00
	Mob / Demob	LUMP	1	\$0.00	\$0.00
	Contingency	LUMP	1	\$0.00	\$0.00
	General Structure Maintenance	LUMP	1	\$0.00	\$0.00
	OTHER			\$0.00	\$0.00
	OTHER			\$0.00	\$0.00
	OTHER			\$0.00	\$0.00
<b>TOTAL CONSTRUCTION COSTS:</b>					<b>\$0.00</b>

**TOTAL OPERATIONS AND MAINTENANCE BUDGET:** **\$6,288.00**

**Appendix C**





**(Field Inspection Notes)**

No inspection was conducted in calendar year 2005 because this project is currently under a maintenance event, therefore no field inspection notes are available.

