State of Louisiana
Department of Natural Resources
Coastal Restoration Division

Monitoring Plan

for

West Bay Sediment Diversion

State Project Number MR-03
Priority Project List 1

August 2003
Plaquemines Parish

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MONITORING PLAN

PROJECT NO. MR-03 WEST BAY SEDIMENT DIVERSION

Date: August 20, 2003

Project Description

The West Bay Sediment Diversion project, which was approved on the 1st priority list of the Coastal Wetlands Planning, Protection, and Restoration Act (CWPRRA), is located on the west bank of the Mississippi River in Plaquemines Parish, Louisiana (figure 1). For this project, a crevasse will be constructed on the right descending bank of the main Mississippi River channel, at river mile 4.7 above Head of Passes. The project outfall area is a large, shallow, open-ended inter-distributary basin, situated between the main river channel on the east, Grand Pass on the west, and Zinzin Bay on the south. The project area is composed of 12% freshwater marsh and tidal flats and 88% percent open water, totaling 12,294 ac (4,975 ha).

The major process that forms subaerial land in the lower Mississippi River Delta (MRD) is the formation of sub-deltas and crevasse-splays. Subdeltas are “scaled down” versions of the major deltaic cycle, both in size and time (Coleman and Gagliano 1964, Wells and Coleman 1987). Subdeltas consist of relatively large receiving bays that have areal extents of 115 - 154 sq mi. (300 - 400 sq km) and depths of 32 - 49 ft (10 - 15 m) (Coleman and Gagliano 1964). Crevasse splays are a smaller sub-unit that are smaller in size, frequency, and expected life spans and generally have a receiving bay extent of approximately 0.234 sq mi. (0.59 sq km) (Boyer 1996).

Subdeltas go through two stages, constructional and destructional, during their typical life span (Scruton 1960) of 115 to 175 years (Wells and Coleman 1987). The constructional stage begins with the formation of a crevasse along a distributary’s levee. Once a crevasse occurs, a “splay” develops within the receiving bay as sediments accrete near the mouth of the crevasse (Boyer et al. 1997). After major channels have formed, rapid subaerial growth ensues. This newly formed land provides substrate for the rapid colonization of emergent vegetation, which stabilizes sediment and increases the rate of accretion (White 1993). As more channels develop by bifurcation, the rate of progradation decreases. Near the end of the constructional stage, the older parts of the subdelta enter the destructional stage (Scruton 1960). As interdistributary areas become cut off from sedimentation by natural levees and infilling of the main channel, subsidence due to compaction from dewatering causes ponding (Scruton 1960, Coleman and Gagliano 1964, Morgan 1973). Thus, the subdelta subsides from the inside out.

The West Bay Sediment Diversion project area is located on the abandoned West Bay Complex subdelta of the MRD. Subsidence (estimated to be as high as 0.45 in/yr ;Day and Templet 1989) and sediment deprivation are natural characteristics of abandoned deltas (Neill and Deegan 1986, Coleman and Gagliano 1964, Kolb and Van Lopik 1966, Coleman 1988, Wells and Coleman 1987,

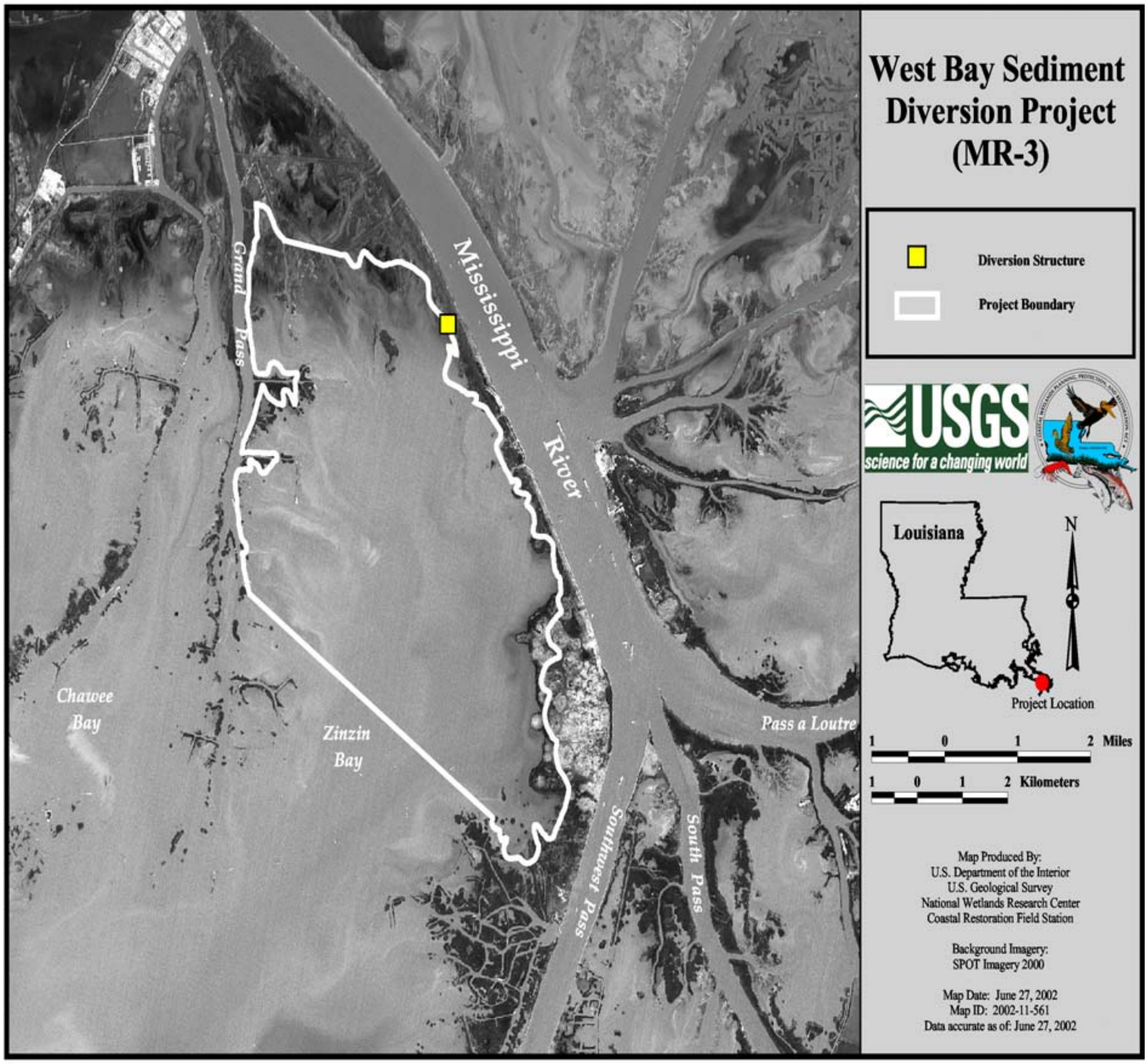

Figure 1. Location of the West Bay Sediment Diversion (MR-03) project.

Penland et al. 1990) and are the main factors influencing land loss in the MRD. During his study of an artificial crevasse on the eastern MRD, Marin (1996) noted that approximately one quarter of the pond bottom elevation gained from sediment accretion is lost because of shallow subsidence. Anthropogenic causes of land loss, such as leveeing, canal dredging, gas and oil exploration and withdrawl, as well as natural processes such as eustatic sea level rise, saltwater intrusion, and erosion, have contributed to wetland deterioration.

The benefits of creating artificial crevasses on the MRD became evident in the 1980's as both a cost effective and highly successful mean of creating new wetlands. The Louisiana Department of Natural Resources (LDNR) constructed three crevasses in 1986 (on Pass-a-Loutre, South Pass, and Loomis Pass) that produced over 657 ac (266 ha) of emergent marsh from 1986 to 1991, and four crevasses in 1990 (two each on South Pass and Pass-a-Loutre) that produced over 400 ac (162 ha) of emergent marsh from 1990 to 1993 (LDNR 1993; Trepagnier 1994). Thirteen crevasses included in the LDNR Small Sediment Diversions (MR-01) project cumulatively produced 313 ac (127 ha) of emergent marsh between 1986 and 1993; land growth rates ranged from 28 to 103 ac (11.3 to 41.7 ha) per crevasse for the older crevasses (4 to 10 years old) and 0.5 to 12 ac (0.2 to 4.9 ha) for the younger crevasses (0 to 2 years old) (Kelley 1996). All of these constructed crevasses had a mean monthly discharge rate of less than 4,000 cubic feet per second (cfs).

The purpose of the West Bay Sediment Diversion (MR-03) project is to promote the formation of emergent marsh through construction of a crevasse and the placement of dredge material. Trepagnier (1994) suggested the idea that "the most successful crevasse would probably be one that discharges from a large pass into a large, open-ended receiving basin that allows the water to flow efficiently through the system". Open systems allow for rapid subaerial creation, thus making them mature more quickly and allow for colonization of native vegetation. The location of the West Bay Sediment Diversion (MR-03) project receiving basin, along with the shallow depth and open-ended configuration, will maximize the potential for emergent marsh creation.

Project Goals and Strategies/Coast 2050 Strategies Addressed

CWPPRA projects are reviewed prior to authorization of construction funds for compatibility of project goals with those in Coast 2050 [Louisiana Coastal Wetlands Conservation and Restoration Task Force and Wetlands Conservation and Restoration Authority (LCWCRTF and WRCA) 1998], and for the probability that proposed restoration strategies will accomplish those goals. Project goals and strategies are provided to the LDNR by the sponsoring federal agency through the Environmental Assessment (EA) and/or Wetland Value Assessment (WVA) for the project. The following goals and strategies for the West Bay Sediment Diversion project were provided by the U. S. Army Corp of Engineers (USACE).

Project Goal:

1) Create, nourish, and maintain 9,831 acres of emergent marsh within the project area over the 20 year project life by enhancing the natural process of delta growth and through the beneficial placement of dredged material.

Project Strategies:

1) Reintroduce alluvial sediment through the creation of a large, uncontrolled diversion channel.

2) Beneficially place dredged material from channel construction, maintenance dredging, and relocation of a 10 in. gas pipeline.

This project goal and these project strategies are consistent with the Coast 2050 Region 2 ecosystem strategy to restore and sustain marshes by building and maintaining delta splays (LCWCRTF and WCRA 1998). The introduction of sediment through the use of the constructed crevasse should "assure vertical accumulation to achieve sustainability", which is one of the strategic goals of Coast 2050. The introduction of freshwater through the artificial crevasse will also enhance the estuarine gradient in the project area, which is another important strategic goal of the Coast 2050 plan.

Project Features

The West Bay Sediment Diversion project includes a conveyance channel for a large uncontrolled diversion of water and sediment from the Mississippi River. The diversion has been designed to be sediment rich; the angle, depth, and site location of the diversion have been designed to increase the concentration of bed material per unit volume of water diverted. Prior to construction of the diversion channel, a 10 in. pipeline located in the outfall channel pathway will be relocated for safety reasons. The sediment diversion channel will be constructed at a 120-degree angle from the downstream direction, in two phases: 1) construction of an interim diversion channel to accommodate a discharge of 20,000 cfs at the 50 percent duration stage of the Mississippi River, and 2) modification of the interim diversion channel design to accommodate full-scale diversion of 50,000 cfs at the 50 percent duration stage of the Mississippi River. This enlargement will be implemented upon completion of intensive monitoring of diversion characteristics by the USACE Operations Division.

The USACE will collect discharge data with an Acoustic Doppler Current Profiler (ADCP) upstream, downstream, and within the diversion channel (including bifurcations when formed) approximately 12 - 16 times per year for the first five years, and six times per year for the remainder of the project. As part of the channel patrol surveys performed by the Corps to monitor the navigation channel in the MRD, the USACE will extend the monitoring to mile 8 AHP to provide information on channel response due to the West Bay Diversion. Cross sections in the vicinity of the diversion will be extended on the right descending bank to provide information on the area outside the navigation channnel. Cross sections will also be extended into the diversion channel.

A real time automatic stage recorder will be deployed inside the receiving area, and one will be placed outside the diversion channel in the river.

The USACE has developed multiple action strategies to address the trigger points that will be monitored. Primary trigger conditions included scour hole depth limits of -40 ft within 3,000 ft of the navigation channel centerline, enlargement of the diversion channel to convey more than 30% of the river flow at the point of diversion, and/or the deposition of more than 50,000 cubic yards of induced shoal material per day in the navigation channel below the diversion. If any of these trigger conditions develop, the Corps will employ a two-step process to respond and alleviate the problems. First, a dredging operation will be mobilized to mine material from the anchorage area and the material would be pumped into the diversion channel. This effort would help maintain control of the diversion channel and would help keep the navigation channel open and safe to navigation by encouraging material to fall out in the anchorage area instead of the channel. Second, following the passage of high water a rock sill would be installed in the diversion mouth from bank to bank to permanently fix the dimensions of the channel and prevent future threats to safe navigation in the river.

Dredged material from the relocation of the gas pipeline, crevasse construction, and maintenance of the Pilottown anchorage area will be used beneficially to create new marsh in the project area. Also, considerable amounts of dredge material, estimated to be 0.5 to 1 mcy every 1-2 years, may be placed within the project area in conjunction with the proposed CWPPRA project, Sediment Trap South of Venice (MR-12).

Monitoring Goals

Priorities:

LDNR monitoring efforts for the West Bay Sediment Diversion project will focus on evaluating project effects on land/water ratios, bathymetry/topography, and emergent vegetation. Analysis of land/water ratios in the project and reference areas will be used to determine the effects of the constructed crevasse and beneficial use of dredge material on the acreage of subaerial land. Periodic elevation surveys of the receiving bay will be performed to monitor project effects on the vertical elevation of the marsh. Surveys of emergent vegetation within the crevasse receiving bay will determine if the project is effectively creating marsh substrate for colonizing vegetation. Water discharge data collected by the USACE will be used to relate land gain to river discharge.

Specific Monitoring Goals:

1) Determine the effects of the project on land/water ratios in the project area.
2) Determine the changes in the mean elevation within the crevasse receiving bay.
3) Determine the effects of the project on emergent vegetation within the crevasse receiving bay.

Reference Area:

Two reference areas were selected in order to compare project-induced changes in land and water areas within the crevasse receiving bay with natural changes in areas of similar hydrologic influence. Vegetation and elevation surveys will not be conducted in the reference areas. The first reference area (Ref 1), Brant Bayou, is due east of the project area just inside Cubit's Gap (figure 2). This natural crevasse was formed in 1978 and will be used as a "with project" target reference area for making comparisons. The second reference area (Ref 2) will be used as a "without" project reference area, and is located due North of the project area (figure 2). It is situated between the Mississippi River on the east, Grand Pass on the west and a pipeline canal on the south, but does not receive direct riverine input. Since these reference areas will also be used to evaluate other similar projects in the Mississippi River Delta area, funding for aerial photography acquisition and analysis for these reference areas will come from the monitoring budgets of other Mississippi River Delta projects.

It was difficult to find reference areas with identical characteristics and influences as the project area. The reference areas chosen have the following limitations: 1) where as dredge material will be placed in the project area, none will be placed in either reference area 2) neither reference area is subjected to the open Gulf of Mexico or its wave energies 3) smaller in size 4) Brant pass has a smaller parent pass.

<u>Monitoring Strategies</u>

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

1. Aerial Photography — To evaluate land/water ratios in the receiving bay, near-vertical, color-infrared aerial photography (1:24,000 scale) will be obtained prior to construction in 2002, and in post-construction years 2008, 2013, 2018 and 2023. The photography will be georectified using standard operating procedures described in Steyer et al. (1995, revised 2000), and land/water ratios will be determined.

2. Elevation — To document changes in the mean sediment elevation within the receiving bay related to the creation of subaerial land, elevational transect lines will be established across the crevasse receiving bay. Approximately 17 cross-sectional transects will be run in a northwest to southeast direction across the receiving bay. The lines will be spaced 1,000 ft (304.9 m) apart for the first 5,000 ft (1524.4 m) from the mouth of the diversion, then at 1,500 ft (457.3 m) intervals to the southern project boundary. The southernmost survey line will be taken along this southern boundary alignment. Elevation data will be

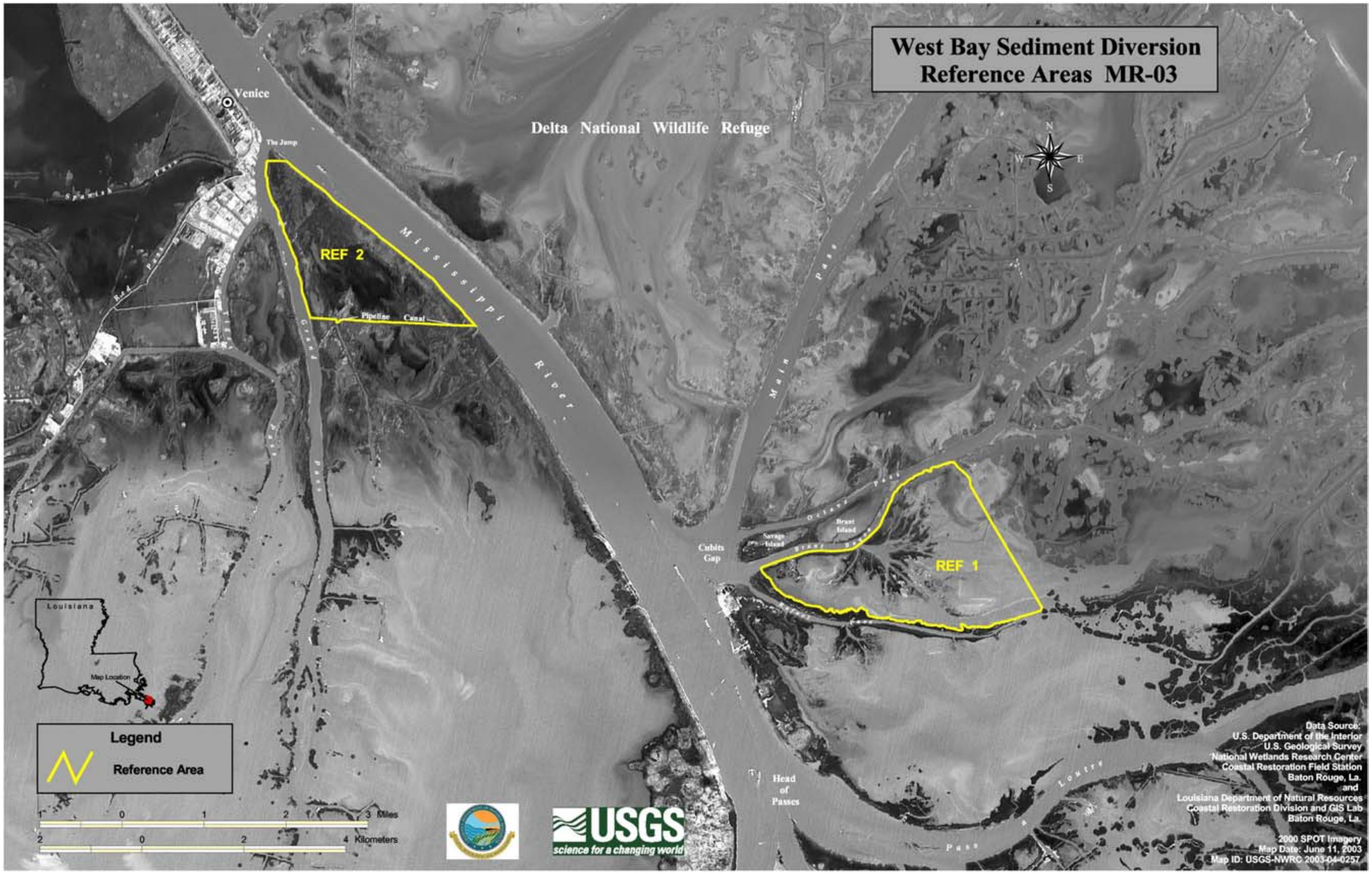

Figure 2. Location of the reference areas for the West Bay Sediment Diversion (MR-03) project.

recorded at 200 ft (61 m) intervals along the cross-sectional transects and at any notable elevation changes between theses intervals. Approximately 10 cross-sectional transects will also be run across the crevasse channel at 200 ft (61m) intervals with elevations being recorded at 10 ft (3 m) intervals. Elevation surveys will be conducted once pre-construction (2003, receiving bay only) and during years 2008, 2013, 2018, and 2023 (receiving bay and crevasse channel).

3. Vegetation — Plant species composition, percent cover, and relative abundance will be evaluated to document vegetation on newly created land in the receiving bay. Vegetation surveys will follow the Braun-Blanquet method as described in Steyer et al. (1995, revised 2000). Transects will be established once the splay islands become subaerial, and will match the transects laid out for the elevation surveys. Sample stations (duplicate 4-m^2 [2-m x 2-m] plots) along each transect will be established and will consist of a balanced number of replicates along the marsh creation gradient. Additional transects and sample stations may be established over time as new land is created. Vegetation surveys will be conducted during late summer (mid-July to mid-September) in years 2008, 2013, 2018 and 2023.

Anticipated Statistical Analyses and Hypotheses

The following describes hypotheses and associated statistical tests, if applicable, used to evaluate each of the specific goals and thus the effectiveness of the project. 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 from color-infrared aerial photography collected pre- and post-construction will be used to 1) document acreage of land created, 2) evaluate land/water ratios and changes in the rate of marsh loss/gain in the project area, 3) compare with selected reference areas in the region, and 4) locate and quantify dredge spoil areas.

   Goal: 1) Determine the effects of the project on land/water ratios in the project area.

2. Elevation: Elevation data will be evaluated through repeated measures analyses of variance (ANOVA). These tests will allow for the analysis and documentation of elevation changes within the receiving bay over time.

   Goal: 2) Determine the changes in the mean elevation within the crevasse receiving bay.

Hypothesis:

H_o: Mean elevation in the receiving bay at time *i* (time 0 = as-built) will not be significantly greater than mean elevation at time *i*-1.

H_a: Mean elevation in the receiving bay at time *i* (time 0 = as-built) will be significantly greater than mean elevation at time *i*-1.

3. Vegetation: Vegetation data from the crevasse splays will be evaluated through repeated measures ANOVA. These tests will allow for the analysis and documentation of spatial and temporal community changes within the receiving bay over time.

Goal: 3) Determine the effects of the project on emergent vegetation within thecrevasse receiving bay.

Hypothesis:

H_o: Mean % cover of emergent vegetation within the receiving bay at time *i* will not be significantly greater than vegetative cover at time *i*-1.

H_a: Mean % cover of emergent vegetation within the receiving bay at time *i* will be significantly greater than vegetative cover at time *i*-1.

<u>Notes</u>

1.	Proposed Implementation:	Start Construction:	September 2003
		End Construction:	November 2003
2.	USACE Point of Contact:	Greg Miller	(504) 862-2310
3.	LDNR Project Manager:	John Hodnett	(225) 342-7305
	LDNR Monitoring Manager:	Brady Carter	(504) 280-4069
	LDNR RTS Manager:	Kyle Balkum	(225) 342-9429

4. The twenty year monitoring plan development and implementation budget for this project is $1,196,946. Project effectiveness will be reported in the basin-level comprehensive reports in 2005, 2008, 2011, 2014, 2017, and 2020.

5. If the proposed Sediment Trap South of Venice (MR-12) project is constructed and the dredged material placed within the West Bay project area, quantifying the acreage of land created directly by the MR-03 project will be difficult. The actual project effectiveness may be biased.

6. All marsh creation locations within the project area over time will be identified and mapped by the USACE. The USACE will also provide dredging reports and maps showing discharge sampling locations. All discharge, stage, and bathymetric data, analyses, and reports will be provided to LDNR by the USACE.

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