MONITORING PLAN

PROJECT NO. TE-29 RACCOON ISLAND BREAKWATERS DEMONSTRATION PROJECT

ORIGINAL DATE: April 2, 1997
REVISED DATE: July 23, 1998

Preface

Pursuant to a CWPPRA Task Force decision on April 14, 1998, the original monitoring plan was reviewed for potential reduction in scope. Specifically, there were no reductions in scope, only changes to the format of the document.

Project Description

The Louisiana deltaic plain is fronted by a series of headlands and barrier islands that were formed as a result of the Mississippi River deltaic cycle. Following deltaic abandonment, headland sand deposits are reworked and deposited longshore forming flanking barriers (Penland et al. 1988). Submergence of the abandoned delta separates the headland from the shoreline forming a barrier island arc. The transgressive island arc cannot keep pace with the high rate of relative sea level rise and eventually becomes an inner-shelf shoal (Penland et al. 1988).

The Isles Dernieres are a barrier island arc transformed from the abandonment of the Caillou headland (part of the Lafourche delta complex) which occurred approximately 500 years B.P. (Penland and Boyd 1985). The Isles Dernieres, which separate Terrebonne Bay, Lake Pelto and Caillou Bay from the Gulf of Mexico, are a 20 mi (32 km) long island arc and are segmented into four islands: Raccoon Island, Whiskey Island, Trinity Island and East Island (McBride et al. 1989). Raccoon Island is the western-most island of the Isles Dernieres (figure 1).

Raccoon Island is located in Terrebonne Parish, Louisiana at 29^o 04' 00" N and 90^o 56' 00" W, approximately 50 mi (80 km) south of Houma, LA (Williams et al. 1992). Raccoon Island, like all of Louisiana's barrier islands, is experiencing island narrowing and land loss as a consequence of a complex interaction among global sea level rise, compactual subsidence, wave and storm processes, inadequate sediment supply, and intense human disturbance (Penland et al. 1988; McBride et al. 1989; Williams et al. 1992). Models developed by Penland et al. (1988) illustrate that Louisiana's barrier islands gradually narrow, fragment and transgress through time eventually becoming subaqueous shoals.

The Isles Dernieres have experienced severe erosion. Between 1890 and 1988, the Isles Dernieres shoreline has eroded at an average rate of 60.4 ft yr^{-1} (18.4 m yr^{-1}) and the area of Isles Dernieres has lost an average of 116.6 ac yr^{-1} (47.2 ha yr^{-1}) between 1978 and 1988 (McBride et al. 1989). Raccoon Island has decreased in area from 368 ac (149 ha) in 1978 to 200 ac (81 ha) in 1988.

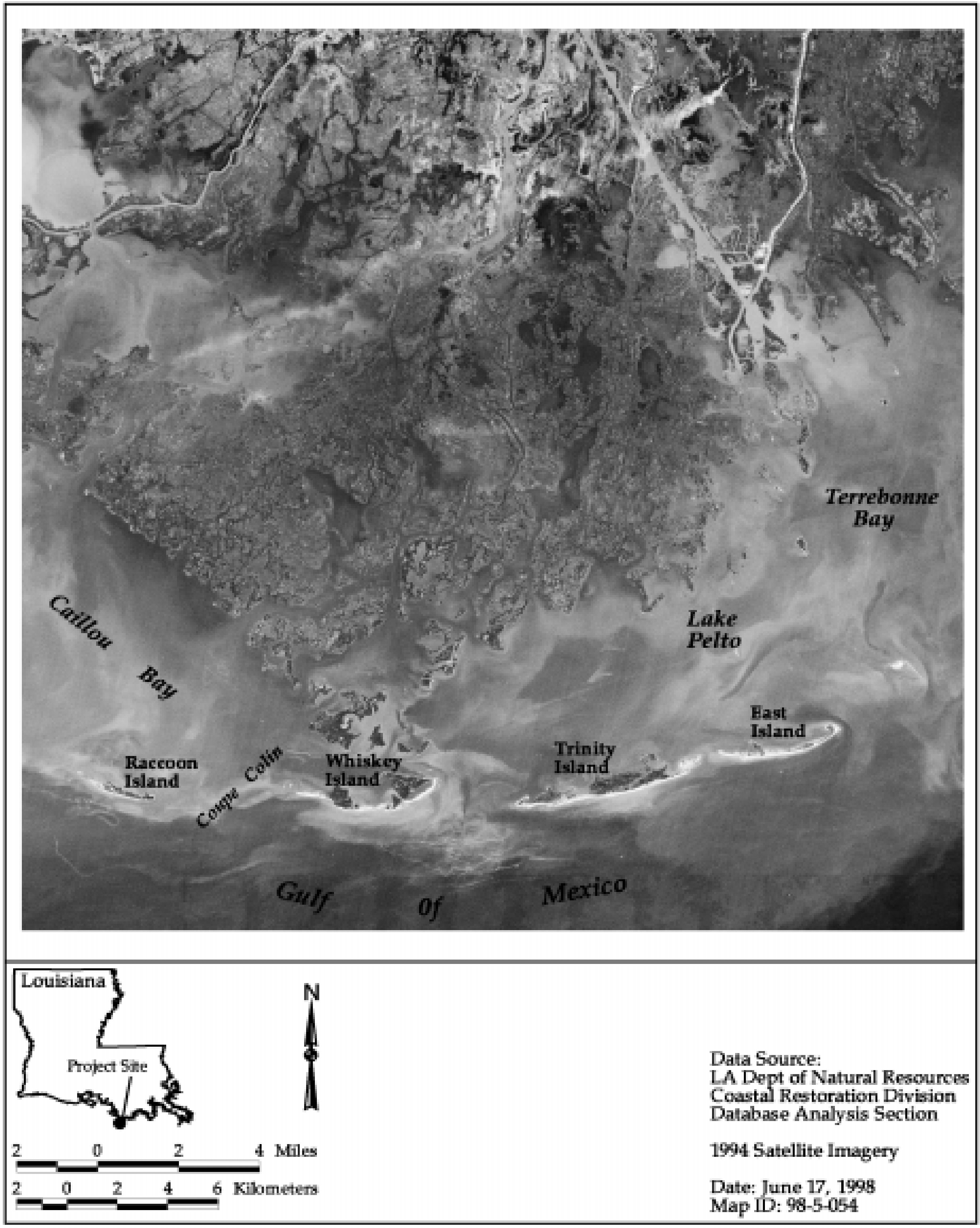

Figure 1. Isles Dernieres Islands, Terrebonne Parish, Louisiana.

Without any restoration efforts, Raccoon Island is estimated to become subaqueous by the year 2000 (McBride et al. 1989).

Segmented breakwaters have been used at Holly Beach to protect 7.3 mi (11.7 km) of coast in the Louisiana chenier plain. At Holly Beach, 85 segmented breakwaters averaging 150 ft (46 m) in length with 300 ft (91 m) gaps were constructed in water depths of 4-6 ft (1.2-1.8 m). Short-term beach profiles conducted between 1990 and 1994 indicate extensive sediment aggradation, especially in the updrift zone. However, beach profile analysis conducted after the summer and winter of 1995 indicates that over half of the accumulated sediment was removed due to Tropical Storms Dean and Opal (Byrnes and McBride 1995).

Over the years, the concept of barrier islands as protectors of mainland marshes has changed. As late as 1993, barrier islands were shown to provide tidal protection for the mainland (van Heerden et al. 1993). The same model, the computer model of tidal prism, run with more recent, accurate elevation data indicated that the barrier islands presence did little to change the hydrologic influence on the mainland marshes including storm surges (Clark 1997). This current information, along with the facts that Raccoon Island is one of the smallest in the Isle Denieres chain and is more than 5 mi (8 km) from the mainland marshes of the coast at its closest point, would seem to signify reduced influence of this island and this project on the mainland marshes.

The Raccoon Island Breakwaters Demonstration project will involve the construction of seven segmented breakwaters on the eastern end of Raccoon Island (figure 2). The breakwaters are 300 ft (91 m) long, 10 ft (3 m) wide and 10 ft (3 m) high with 3:1 side slopes (figure 3). The breakwaters will be placed at a water depth of 4-6 ft (1.2-1.8 m) with 300 ft 91 m() centers and 300 ft (91 m) gaps between them.

Project Objective

1. To protect the beaches, back barrier marshes, and wetlands of Raccoon Island through the use of segmented breakwaters.

Specific Goals

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

1. Slow beach erosion by reducing wave energy and enhancing net sediment deposition.

2. Protect the acreage of the back barrier marshes.

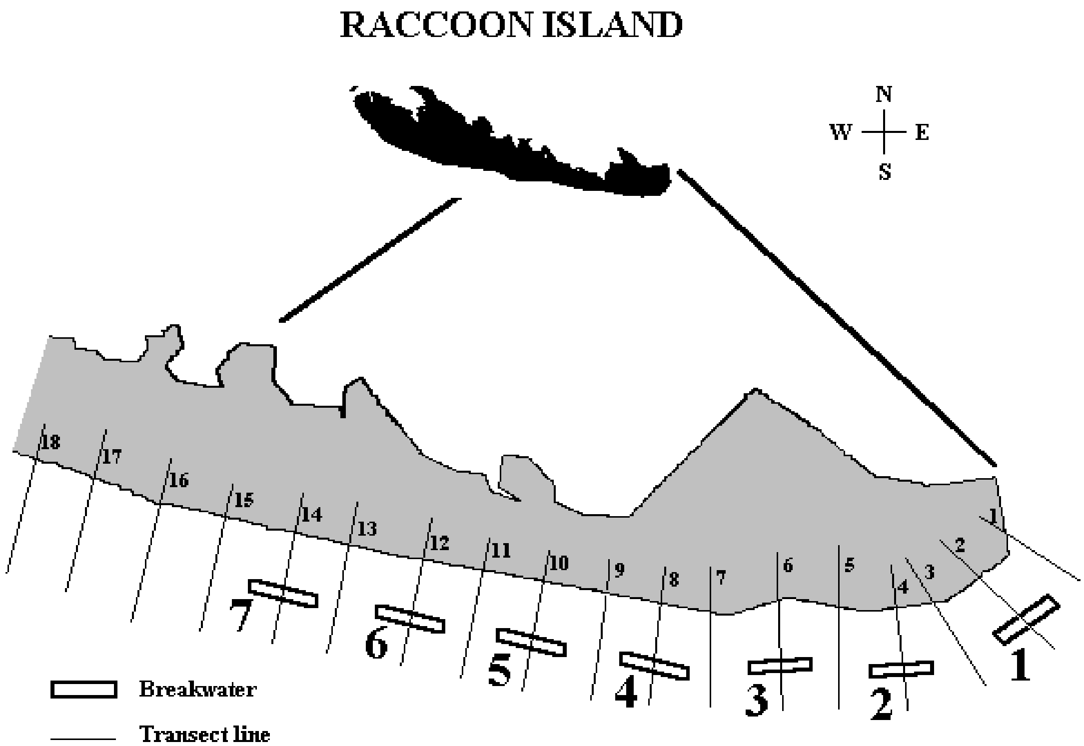

Figure 2. Location of breakwaters and transect lines.

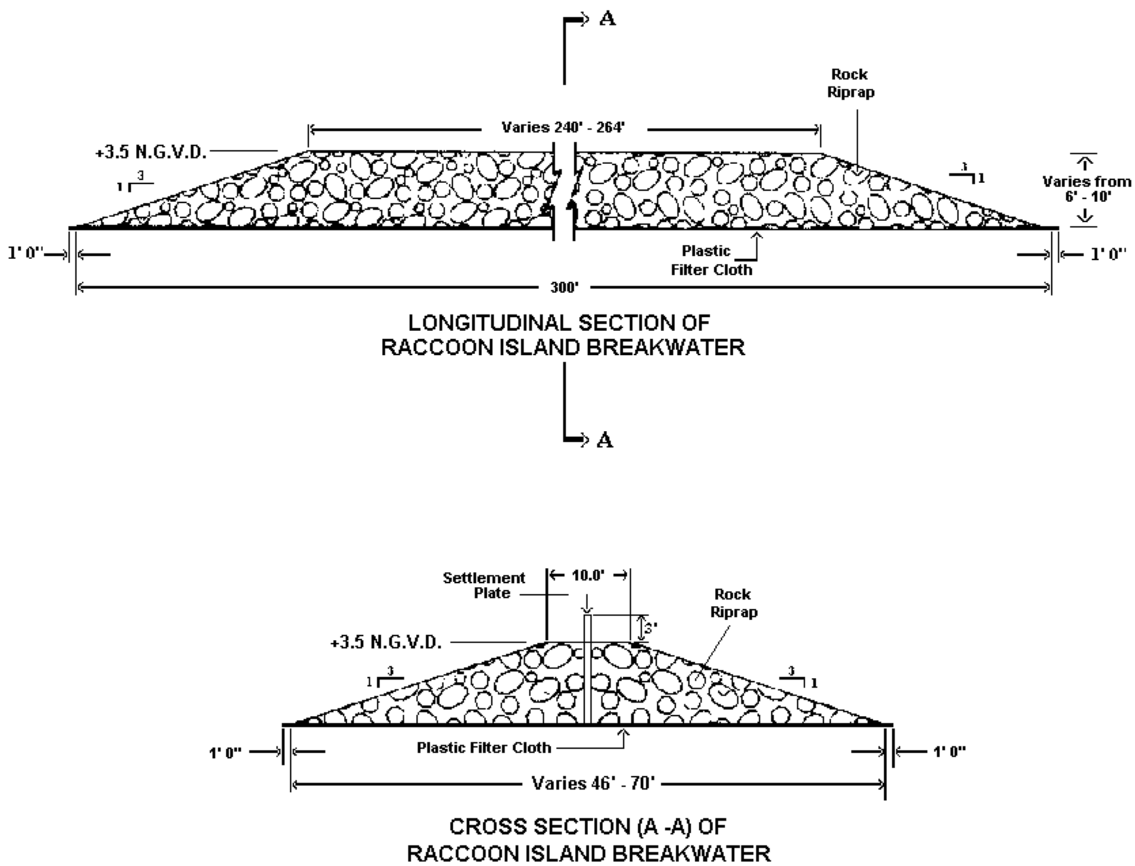

Figure 3. Longitudinal and cross sectional view of a breakwater.

Reference Area

No appropriate reference area could be found for this project. The exclusion of a reference area is based on several factors. First, there is no island area within the Isle Dernieres chain with the same orientation that will not be impacted by planned restoration projects. Second, the area westward of this project will be affected by the breakwaters and therefore, cannot be used as a control. Third, this project involves a study of effects over time, not space. For these reasons, no reference area will be established for the project.

Monitoring Elements

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

1. Aerial Photography — To measure land and water areas and to document long term island morphological changes, color-infrared aerial photography (1:6000 scale, with ground control markers) will be acquired by the National Wetlands Research Center (NWRC). The photography will be georectified by NWRC personnel using NWRC standard operating procedures (Steyer et al. 1995). The photography will be obtained in 1996 (pre-construction) and in 2001 post-construction. Additional photography may be obtained in response to storm events.

2. Bathymetry/ Topography — To document both horizontal and vertical change along Raccoon Island, transect lines used to measure elevation will be established by professional surveyors before construction. From the baseline established by National Resources Conservation Service (NRCS) along the shoreline, eighteen (18) perpendicular topographic and bathymetric lines will be established in connection with the breakwaters and the mid-points between breakwaters (figure 2). The first will be a line 150 ft (46 m) updrift of the first breakwater. The last four will be downdrift of the last breakwater with line 15 being 150 ft (46 m) downdrift of the end of breakwater number 7 and lines 16, 17, and 18 at 300 ft (91 m) intervals past line 15. Transect lines perpendicular to each breakwater will begin 200 ft (61 m) bayward of the beach vegetation line on the island and extend through the center point of the breakwater and continue 200 ft (61 m) beyond into the Gulf. Between each breakwater, a survey line will be established from a point 200 ft (61 m) bayward of the beach vegetation line on the island through the mid-point between two breakwaters to a point approximately 200 ft (61 m) past the edge of the adjoining breakwaters into the Gulf. Data will be collected at 100 ft (30 m)

intervals except where significant changes in elevation occur with a "significant change" being defined as 0.5 ft (0.15 m) or greater. The lines will be surveyed in to control points or benchmarks on the island. These transect lines will be re-surveyed at post-construction years 1998, 2000, and 2001. Surveys will be run twice a year, during the winter (January - February) and, during the fall (September - October), as allowed by the arrival and departure of the pelican population.

3. Wave Energy — To determine the effectiveness of the segmented breakwaters in reducing wave energy, wave height will be measured using continuous water level recorders capable of measuring water depth four times per second. Three separate instruments will be used for each of the measurement periods at a given structure. Measurements will be made with two instruments in a line through the structure and the third off to the side. The first instrument will be deployed offshore of the structure, midway along the length, to measure incoming waves. The second instrument will be deployed behind the structure to measure the effect of the structure on the incoming waves. The third instrument would be deployed near the beach in the same depth of water as the instrument behind the breakwater, past the end of the structures to measure the effect of the undisturbed waves on the beach. Wave height will be collected by measuring water level every 0.25 seconds for a period of 6- 8 hours. This data will be obtained once every three months for a one year period during post-construction years 1997/1998 and 2001.

<u>Anticipated Statistical Tests and Hypotheses</u>

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 post-project implementation to assess changes in island loss/gain rates over time and to assess whether the post-project loss rate deviates from the expected future without project condition of 26-30 ft yr^{-1} (8-9 m yr^{-1}) (Stone 1997).

2. The primary method of analysis for elevation/bathymetry will be to determine differences in mean elevation and width as evaluated by a repeated measures ANOVA that will consider both spatial and temporal variation and interaction. This basic model will determine if there is a detectable impact (for example, increase in beach elevation) in the project area after construction. All original data will be analyzed and transformed (if necessary) to meet the assumptions of ANOVA (e.g. normality).

Goal: Enhance net sediment deposition.

Hypothesis A_1:

H_0: Volume of beach sediment along the transect line after project implementation at time point i, will not be significantly greater than the sediment volume before project implementation.

H_a: Volume of beach sediment along the transect line after project implementation at time point i, will be significantly greater than the sediment volume before project implementation.

Hypothesis A_2:

H_0: Width of the beach after project implementation at time point i, will not be significantly greater than the width before project implementation.

H_a: Width of the beach after project implementation at time point i, will be significantly greater than the width before project implementation.

3. The primary method of analysis for evaluating the structure effectiveness as a wave dampening device will be to determine and make comparisons among the mean wave height in front of and behind the breakwater and to the east of the project area, a control point, in a water depth equal to the placement of the recorder behind the breakwater as evaluated by an analysis of variance (ANOVA) that will consider both spatial and temporal variation and interaction. All original data will be analyzed and transformed (if necessary) to meet the assumption of ANOVA (e.g. normality, equality of variances).

Goal: Slow beach erosion by reducing wave energy.

Hypothesis B_1:

H_0: Mean wave height behind the structure at time point i, will not be significantly lower than the mean wave height in front of the structure.

H_a: Mean wave height behind the structure at time point i, will be significantly lower than the mean wave height in front of the structure.

Hypothesis B_2:

H_0: Mean wave height behind the structure at time point i, will not be significantly lower than the mean wave height at the control site.

H_a: Mean wave height behind the structure at time point i, will be significantly lower than the mean wave height at the control site.

NOTE: Available ecological data, both descriptive and quantitative, will be evaluated in concert with all of the above data and with statistical analyses to aid in determination of the overall project effectiveness.

<u>Notes</u>

1.	Implementation:	Start Construction:	April 24, 1997
		End Construction:	June 15, 1997
2.	NRCS Point of Contact:	Cindy Steyer	(504) 389-0334
3	DNR Project Manager:	Scott Van Zant	(504) 342-7305
	DNR Monitoring Manager:	Chris Borron	(504) 447-0996
	DNR DAS Assistant:	Chris Cretini	(504) 342-0277

4. The twenty year monitoring plan development and implementation budget for this project is $192,384. A progress report will be available in June 1998, and a comprehensive report will be available in June 2002. These reports will describe the status and effectiveness of the project.

5. Monitoring elements may be reduced (number of surveys, final aerial photography) in number or eliminated (wave energy measurements) if the current level of funding does not increase.

6. Settlement plates will be placed on the breakwaters as part of construction. Data collected from the settlement plates by the engineering staff will be utilized in conjunction with the monitoring data.

7. References:

Byrnes, M. R., and R. A. McBride 1995. Preliminary Assessment of Beach response to a segmented breakwater system: Constance Beach and vicinity, 1990-1994: Final Report to Louisiana Department of Natural Resources, Coastal Restoration Division, Baton Rouge, LA. 102 p.

McBride, R. A., S. Penland, B. E. Jaffe, S. J. Williams, A. H. Sallenger, and K. A. Westphal 1989. Erosion and deterioration of the Isles Dernieres barrier island arc-Louisiana, U. S. A.: 1853-1988: Transactions of the Gulf Coast Association of Geological Societies 39:431-444.

Penland, S., and R. Boyd 1985. Transgressive depositional environments of the Mississippi River delta plain: A guide to the barrier islands, beaches and shoals of Louisiana: Louisiana Geological Survey Guidebook Series No. 3, 233p.

Penland, S., J. R. Suter, and R. Boyd 1988. The transgressive depositional systems of the Mississippi River delta plain: A model for barrier shoreline and shelf sand development. Journal of Sedimentary Petrology 58:932-949.

Steyer, G. D., R. C. Raynie, D. L. Steller, D. Fuller and E. Swenson 1995. 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.

Stone, G. 1997. Personal communication. Baton Rouge: Louisiana State University.

Williams, J. S., S. Penland, and A. H. Sallenger, eds. 1992. Atlas of Shoreline Changes in Louisiana from 1853 to 1989. Prepared by the U.S. Geological Survey in cooperation with the Louisiana Geological Survey. Reston, VA. 103 pp.

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