

COMPENSATORY RESTORATION OF MANGROVE HABITAT FOLLOWING THE TAMPA BAY OIL SPILL

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ABSTRACT: In 1993, an incident involving three vessels near the entrance to Tampa Bay, near St. Petersburg, Florida, resulted in a discharge approximately 300,000 gallons of No. 6. fuel oil into the waters off Egmont Key. The oil contacted the shores from Egmont Key to locations approximately 14 miles to the north. Oil also entered Boca Ciega Bay through John's Pass and impacted four small islands that supported mature overwash mangrove forest. A cooperative damage assessment process was developed between the Responsible Parties (RPs) and the trustees for the natural resources: the state of Florida, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Fish and Wildlife Service (USFWS). Through the cooperative process, several alternatives for primary and compensatory restoration were developed.

In considering alternatives to compensate for impacts to epibenthic communities, fish and bird habitats, wetlands, and mangrove communities, the trustees and the RPs considered purchase of shoreline habitat and restoration of mangrove forest at several sites. The RP developed a proposal to purchase and deed into public ownership in perpetuity, a 10.67-acre parcel of land on the west bank of Cross Bayou in Boca Ciega Bay that had been used as a disposal site for dredge spoil in the past. This site consisted of approximately 5.0 acres of uplands, 4.4 acres of mangrove forest, and 1.4 acres of nonmangrove intertidal and subtidal habitat. The objective of the project was to establish a typical Tampa Bay mangrove forest and a roadside buffer free of exotic plant species. The secondary goals were to establish a typical Tampa Bay salt marsh dominated by smooth cordgrass (*Spartina* spp.) as a successional precursor to mangrove recruitment by seeds and seedlings. Tidal exchange through the site was reestablished to improve water quality and increase export of mangrove detritus and import of high-quality tidal waters. The project was designed and constructed by the RPs with the approval and supervision of the trustees. The project was completed and title transferred to Pinellas County, Florida in summer 1999.

A monitoring program was developed and performance criteria established by trustee representatives and the RPs. The monitoring program currently is being conducted and has met performance criteria to date. This project demonstrates the positive result of trustees and the RPs working together to provide compensation to the environment.

The incident

On August 10, 1993, the tank barges *Ocean 255* and *B-155* collided with the freighter *Balsa 37* near the entrance to Tampa Bay, Florida (Figure 1). The *Ocean 255* was carrying approximately 7.9 million gallons of Jet A fuel and approximately 1.8 million gallons of gasoline. The *Ocean 255* caught fire, was grounded by the crew off Fort De Soto Park, and burned for approximately 18 hours. The fire consumed a significant portion of the barge's cargo, and a portion of its cargo was observed burning on the water.

The *B-155* was carrying approximately 5 million gallons of No. 6 fuel oil, of which an estimated 328,440 gallons were discharged into Tampa Bay from the No. 1 port tank. The *Balsa 37* was carrying a cargo of phosphate, and there was only a minor, if any, discharge of fuel from this ship and no loss of cargo. These incidents and discharges were collectively referred to as "the spill." The various interests in the *Balsa 37*, *Ocean 255*, and *B-155* collectively are referred to as the Responsible Parties (RPs). These interests include ownership, protection and indemnification (P&I) insurers and other interests.

Although some oil came ashore at Fort De Soto Park and Egmont Key, mild east winds carried the majority of the discharged oil into the Gulf of Mexico approximately 15 to 30 miles offshore. On August 14, onshore winds from the west pushed oil onto beaches in Pinellas County, and oil entered Boca Ciega Bay through Johns Pass, Pass-a-Grille and Blind Pass. As a result, mangroves, seagrass, saltmarsh, and shellfish (oyster and clam beds) within Boca Ciega and Lower Tampa Bays were exposed to oil, and suffered injuries and interim ecological service losses as a result. Oil also came in contact with sea turtles and their nests, birds, subtidal sediments, and the water column. The scope of this paper is limited to discussion of mangrove and marsh restoration actions performed by the RPs.

In natural resource damage assessments (NRDAs), the preferred measure of damages is based on appropriate or necessary restoration actions. For this paper "restoration" is defined as "restoration, rehabilitation, replacement, or the acquisition of similar services" as per the Oil Pollution Act of 1990 (OPA 90). The characterization of injuries and the associated damages to natural resources are based on observations and scientific studies conducted during or following

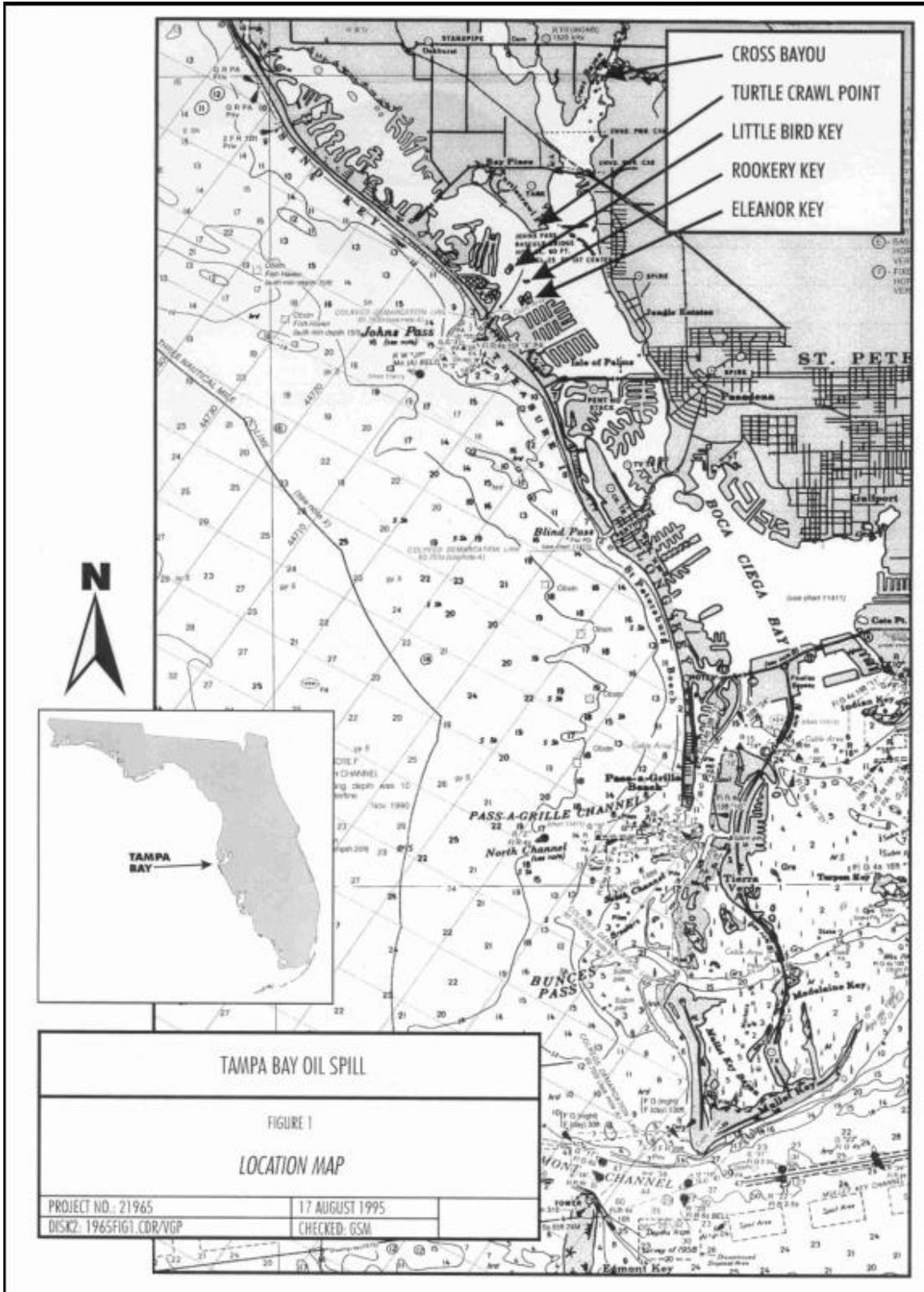


Figure 1. Location map.

the oil spill incident. In this case, the restoration actions for some components of the injured resources are being conducted directly by the RP.

Cooperative damage assessment

Immediately following the August 10, 1993 incident, technical and legal representatives of the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of the Interior (DOI), and Florida Department of Environmental Protection (FDEP), (the trustees) and the RPs began working together to assess injury, identify restoration alternatives, and implement restoration. Technical representatives of the trustees and RPs participated within a coordinating technical forum referred to as the Technical Working Group (TWG). The TWG coordinated the exchange of technical information regarding injury to, and restoration of, natural resources during many meetings and field surveys in this period. Concepts of potential restoration actions were discussed. A Restoration and Compensation Proposal was prepared and submitted by the RPs following over 24 months of communication among the technical representatives. Among other elements, this document contained the conceptual site proposal described in this paper. The trustees and RPs worked together to assess alternative restoration options and ultimately to refine the details of the Cross Bayou Restoration Project.

A draft Damage Assessment and Restoration Plan (DARP I) for this spill was prepared by the designated natural resource trustees under applicable federal and state laws. The draft DARP I includes a description of the oil spill incident, a description of the natural resources found in the Tampa Bay area, the injured ecological and physical injury categories, a description of the assessment process, a preliminary assessment of natural resource injuries and losses, restoration alternatives, and the preferred restoration actions. The DARP I also contained final details of the project as agreed by the trustees and RPs (Table 1).

Table 1. Chronology of events.

Date	Incident
August 10, 1993	Spill occurred
February 23, 1995	Property optioned to purchase by RPs
March 25, 1995	Phase I environmental site assessment completed
April 20, 1995	Compensation plan proposed
May 24, 1995	Property purchased by RPs
July 17, 1995	Construction commences
June 1997	Draft DARPI identifies injury
March 25, 1998	All permits secured
April 16, 1998	Consent decree signed
August 21, 1998	Trustees issue draft restoration and compensation plan for biological and physical injuries
January 1999	Construction bids advertised
July 2, 1999	Earthwork complete
August 9, 1999	Monitoring plan approved
August 1999	Planting complete
August 20, 1999	Title transfer to Pinellas County
September 3, 1999	Project acceptance certificate
September 4, 1999	Time zero monitoring

Injury and compensation

Identified categories of natural resource injury (general).

The categories of natural resources affected by this incident are mangroves, water column, birds, turtles, salt marshes, seagrasses, shellfish beds, subtidal sediments, and beach sand. The estimates for injury and the associated compensation for these categories were subject to public review of the draft DARP I.

Mangrove. Mangroves were oiled in several locations in Tampa Bay and Boca Ciega Bay as a result of the spill. The most heavily oiled mangroves were located on a group of islands immediately inside John's Pass. These islands are referred to as Little Bird, Rookery, Elnor Front, and Elnor Back Islands or Keys. Surveys conducted by a professional land surveyor contracted by the state indicate that 5.5 acres of mangrove forest were exposed to moderate to heavy oiling, with additional areas receiving lighter oiling.

Estimates of the amount of mangrove injury are based on preliminary findings of field studies conducted on behalf of the Trustees and aerial infrared photography, in addition to first hand field evaluations by TWG personnel. To calculate the amount of injury, the DARP I applied a habitat equivalency analysis (HEA) to the available data. The HEA is used to estimate the amount of ecological services lost as a result of the spill, and calculates the amount, in acres, of mangrove habitat to be created, as compensation for that loss. The HEA provides a method to consider factors such as the amount of mortality, sublethal stress, time to full recovery of the injured resource, the date of initiation of the restoration project and its rate, and time to maturity, as well as its relative ecological value when mature. The results of trustee studies indicated that the majority of mangrove losses were to juvenile and seedling plants. Fewer mature trees were lost than originally expected. This is assumed to be the result of very careful cleanup treatments applied to the oiled forest areas, which maximized oil removal and minimized invasive disturbance of roots and pneumatophores.

Because the mortality data collected on mangroves (trees and juveniles) were limited to the most heavily oiled areas (1.72 acres), the original injury estimate represented a worst case estimate of mangrove mortality applied the entire 5.5 acres that were oiled. Using input parameters determined by the trustees and agreed to by the RPs, HEA calculations indicated that the creation of approximately 3.9 acres of new mangrove habitat was appropriate compensation for this injury.

Saltmarsh. Based on the state survey, the trustees determined that 0.75 acres of saltmarsh dominated by *Spartina alterniflora* were injured for about 1 year as a result of the discharge and RPs' response activities. The injured site is located at Turtle Crawl Point within War Veterans Memorial Park in Boca Ciega Bay. The RPs proposed to compensate for these injuries by using a 2:1 replacement ratio derived from the Tampa Bay Comprehensive Regional Plan proposed mitigation ratios. This approach would require 1.5 acres of salt marsh to be created as in-kind compensation.

Seagrass. The discharge and subsequent cleanup activities resulted in exposure of seagrasses to oil. Seagrass beds near Mullet Key, Egmont Key, and in Boca Ciega Bay near John's Pass were all known to have been exposed to oil. This exposure was from direct contact with heavy oil to light oil or possibly from sheen present on the surface of the water overlying the seagrass. Most of the heavy to moderate oiling of seagrass seems

to have occurred in Boca Ciega Bay in the area near John's Pass and southward. The oil formed localized mats and globs of submerged oil in some seagrass beds in Boca Ciega Bay. There were considerable efforts by the RPs' cleanup response crews to remove the sunken oil. However, the submerged oil was difficult to locate, and removal technology for submerged heavy oil is not well established, resulting in limited cleanup success. The TWG evaluated the extent of remaining submerged oil in seagrasses in early January 1994 by transect survey methods. While traces of oil were noted, no areas of gross contamination were detected. However, the continued presence of some oil in the seagrasses was noted during other field activity in the vicinity of the oiled mangrove island.

Aerial photography and ground surveys by the state of Florida estimated that 2.5 acres of seagrasses were apparently injured because of oiling and response activities. Another 255 acres are estimated from trajectory mapping to have been briefly "exposed to" the surface oil slick as it passed over the sea floor. Follow-up state aerial photography documented that the injured 2.5 acres had grown back by fall 1994. Also, the 255 potentially exposed acres showed no observable vegetation loss. A HEA estimate with this new information indicates a maximum of 0.8 acres would be required to fully compensate for the interim ecological services loss to seagrasses from this spill. This injury will be compensated for by fringe plantings of *Spartina* on the mangrove islands in an attempt to protect the integrity of the mangrove islands and adjacent seagrass beds.

Cross Bayou Restoration Project

Site description. The RPs purchased and deeded into public ownership in perpetuity, a 10.76-acre parcel of land on the west bank of Cross Bayou in Boca Ciega Bay (Figure 1). The parcel of land is located in the southwest quadrant of the intersection of Park Street and Cross Bayou in Pinellas County, Florida. For several years prior, the site had been used as campsites by itinerants and had accumulated substantial amounts of trash, garbage, and makeshift building supplies.

The 10.76-acre parcel is located adjacent to two existing habitat restoration projects. Northeast of the proposed site is the Joe's Creek restoration project being conducted by Pinellas County. That project encompasses over 40 acres and has been underway for several years. To the southeast, on the other side of Cross Bayou is a parcel of land of just less than 7 acres that is the site of a restoration project managed by the South West Florida Water Management District (SWFWMD). The 10.76-acre parcel of land contains supratidal, intertidal, and subtidal habitats. As per the request of the RPs, the parcel was surveyed on February 26, 1995. The site consisted of approximately 5.0 acres of uplands, 4.4 acres of mangrove forest, and 1.4 acres of intertidal and subtidal habitat.

The preexisting mangrove forest was comprised predominately of black mangroves (*Avicennia germinans*) and white mangroves (*Laguncularia racemosa*). The forest is less than 10% red mangroves (*Rhizophora mangle*). The mangrove trees ranged from 5 to 7 meters in height. The large black mangroves on the site were estimated to be between 50 to 75 years old. It is surmised that the entire site was formerly a mangrove forest and that dredge spoils were disposed of in the center of the forest. Approximately 50% of the existing mangroves were isolated from tidal flow that would normally provide for estuarine fish rearing, detrital transport and other physical and biological communication with Boca Ciega Bay. It was estimated that the ecological productivity of the existing mangrove forest was depressed by up to 70%.

The 1.4 acres of intertidal and subtidal land did not contain emergent vegetation. The 5.0-acre upland area supported vegetation that was consistent with a disturbed habitat. Invasive vegetation on the uplands consists of brush, grasses, Brazilian pepper, live oak, slash pine, wax myrtle, and southern red cedars. The 10.76-acre parcel was zoned "Aquatic Lands" by Pinellas County. Real estate professionals consulted on the issue believed that it might have been possible that 2 to 3 acres of the parcel could potentially be described as "high ground." Although they believe it unlikely, it is possible that this portion of the parcel might be rezoned Residential Estate (RE).

Results of Phase I site investigation. The RPs commissioned a Phase I environmental site assessment (ESA) on the site. The March 22, 1995 report and associated May 25, 1995 addendum concluded (FGS Inc., 1995a, b), "No environmental concerns were identified for the subject site." Thus concerns of both the trustees and the RPs regarding potential hazardous materials on site were alleviated.

Objectives. Primary: (1) Establish a typical Tampa Bay mangrove forest composed of red mangroves, black mangroves, and white mangroves throughout the project site. (2) Establish buttonwood (*Conocarpus erecta*) and other typical transition zone species in the roadside buffer and easement areas, free of exotic plant species such as Brazilian pepper.

Secondary: (1) Establish a typical Tampa Bay saltmarsh dominated by smooth cordgrass (*Spartina alterniflora*) as a successional precursor to mangrove recruitment by seeds and seedlings (with assisted recruitment if deemed necessary), retaining narrow fringe marsh in front of mangroves at lower tidal elevations. (2) Increase tidal exchange through the site by attempting to reestablish the estimated historical tidal exchange within the existing mangrove forest and connecting to Cross Bayou with self-sustaining tidal channels to locally improve water quality and increase export of mangrove detritus and import of high quality tidal waters. (3) Provide opportunities for oyster, epibenthic invertebrate, and fish recruitment and growth within the constructed channels and on marsh and mangrove surfaces. (4) Create foraging habitat for wading birds. (5) Improve water quality entering Boca Ciega Bay via Cross Bayou.

Cross Bayou restoration plan. The site was placed under purchase option by the RPs on May 24, 1995. Existing squatters were removed, and the property secured by a fence. Topographic surveys of the site and adjacent well-flushed mangroves were conducted prior to completion of design drawings. The target elevations for restored marsh planting areas were contingent upon those found within the adjacent mangroves to ensure that the site had appropriate hydrology and was not excavated too high or too low.

Once the site was secured, the perimeter of the existing mangroves to be preserved was identified by placing marked stakes in the ground for entry to the existing conditions survey. At the same time, all exotic plants were treated with an EPA-approved systemic herbicide and physically removed to prevent seed production and subsequent recolonization after site excavation. A large amount of trash on the site including bottles, cans, and plastic were removed.

Using the existing conditions survey, a preliminary restoration plan was prepared. This plan was provided to permitting agency personnel for review and comment. Estimates of cubic yardage of fill to be removed and numbers of plants needed for planting were generated from this plan. After receipt of comments, the plan was finalized and used to prepare the wetland resource permit. The permit applications were filed as soon as possible after the site was secured and surveys were finished. Draft detailed design drawings and construction plans were prepared while permits were being processed.

After all environmental permits were secured, the final construction drawings and bid specifications for the work were prepared, reviewed by a professional civil engineer, and reviewed and approved by the trustees. The actual construction work was performed by land-based equipment with the excavated fill removed to an approved offsite location. The material was first offered to local governments for possible use as backfill for borrow pits or other areas where it could be beneficially used. Otherwise it was disposed of in an approved landfill. Construction permits were secured prior to actual construction. The elevations were reconfigured as per the plan as shown in Figure 2. Post-clearing condition is shown in Figure 3.

Installed plant materials consisted of nursery grown, smooth cordgrass bare root units that were ordered far enough in advance of actual construction to insure availability for installation as soon as site preparation was completed, and an as-built survey confirmed that slopes and elevations were correct. Final site elevations ranged between -3.0 and -1.0 ft NGVD within the constructed channels and between $+0.5$ and $+2.0$ ft NGVD in the planting areas. Plants were installed on 3-foot centers to achieve a density of no less than 4,840 units per acre. Planting occurred during the spring and summer months to achieve maximum cover prior to hurricane season and winter dieback of plants. Had this window not been achieved, the entire construction and planting phase would have been delayed 1 year.

Permitting. The RPs fulfilled all applicable permitting requirements as set forth in the Florida ERP Manual, in addition to meeting the outlined success criteria as set forth by the trustees. A joint FDEP/U.S. Army Corps of Engineers Water Resources Permit Application was prepared and signed by a professional civil engineer. An Environmental Resources Permit Application was utilized to include the SWFWMD in the permitting process. Copies were also provided to the USFWS, National Marine Fisheries Service, and Florida Game and Freshwater Fish Commission to expedite reviewing agency comments.

Performance verification. Postconstruction (preacceptance) monitoring. The monitoring measures ensured that all success criteria are met, and allowed for the identification of all mid-course corrections in a timely manner. The monitoring intervals will remain as specified in the trustees' response to the RPs' proposal, until acceptance of the project

Performance criteria. Restoration shall be considered successful at the project site when all of the success criteria have been met and maintained continuously for a period of at least one growing season without intervention including, but not limited to any form of irrigation, dewatering, removal of undesirable vegetation, or replanting of desired vegetation.

Saltmarsh vegetative cover:

- 80% in 2 years

Mangrove coverage:

- Natural recruitment and/or planting results in one mangrove seedling/4 sq meter over 50% of the area within 2 years
- Vegetative cover of 80%, with mangrove cover accounting for at least 30% of the planted area
- Constructed tidal streams open and free flowing with connections to Cross Bayou without sill formation or indications of closure
- Invasive exotic species Brazilian pepper, Australian pine (*Casuarina spp*), melaleuca (*Melaleuca quinquenervia*) not present within any planting zone, less than 5% cover in any buffer zone through time zero plus, 60 months
- Observed and reported presence of wading birds, oyster spat, epibenthic invertebrates, and fish using site (qualitative observation)



Figure 2. Elevations reconfigured.

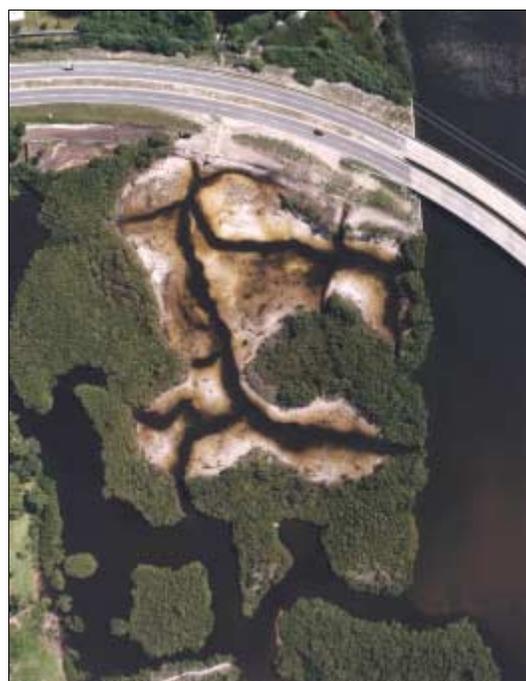


Figure 3. Postclearing.

Monitoring. Frequency:

- Time zero (within 60 days of completion of construction and planting) including as-built survey
- Time zero plus 3, 6, 9, 12, 18, 24, 36, 48, and 60 months

Measures:

- Five fixed photographic reference points (color prints) plus two panoramics
- Percent vegetation coverage by species in five 1 m x 2 m stratified random quadrats

- Height of first ten mangroves encountered in each stratified random quadrat
- Presence/absence/location of all exotic vegetative species on-site
- Actions taken to remove exotics
- Tidal stream depths relative to surface of planting area and conditions of main channel connections
- Salinity and temperature of water
- Presence/absence/location of oysters on-site
- Epibenthic invertebrates, wading bird and fish observed during routine monitoring

Monitoring contractor. The RPs contracted with a monitoring contractor who supplied all communications and reports to both the RPs and the trustees. The monitoring contract provided that the trustees are third party beneficiaries of the contract.

Contingencies. A contract approved by the trustees was executed between the construction contractor and the RPs specifying contractor performance criteria. At any time that the submittal of a monitoring report indicates that a criterion is not being met or is in immediate risk of not being met within the next monitoring period, the monitoring contractor will arrange a meeting with the lead regulatory permitting agencies and the RPs to discuss corrective actions. It is required of the RPs to maintain the entire site for a period of 3 years postacceptance by removing trash and maintaining exotic vegetation below the specified 5% level. An annual report certifying achievement of the success criteria will be forwarded to the trustees.

If, during the preacceptance phase of the project, there was evidence to suggest that the project was not achieving the stated goals and trends, it may necessitate midcourse corrections to replant or reconfigure elements of the project that are hindering development. An alternative restoration plan must be submitted if 2 years after completion of initial construction, the restoration site is not clearly trending toward attaining success criteria. The new plan must include a new implementation schedule and will restart the project clock with respect to all monitoring requirements if the site is substantially (>30%) recontoured or requires greater than 30% of the area to be replanted. If, however, the midcourse corrections require less than 30% recontouring of the entire site or less than 30% replanting, then the entire monitoring schedule will remain on track with no change except that 1 additional year of postconstruction monitoring will be required.

Project Review Group. As per the condition of the Consent Decree (U.S. District Court for the Middle District of Florida Tampa Division. Civil Action No. 96-1556-CIV-T-17E, *Consent Decree*, April 16, 1998), NOAA, DOI, and FDEP established a Project Review Group (PRG) consisting of one representative from each agency to oversee the RPs' implementation of the project. In addition, the RPs shall designate one representative to serve as a nonvoting member of the PRG. The RPs' PRG representative acts as the point-of-contact between the agencies and the RPs for all matters relating to implementation of the restoration projects. The PRG:

- Reviewed and approved the plan(s), including monitoring plans, developed to implement the above projects (hereinafter, encompassed by "project plans")
- Oversaw implementation of approved project plan(s)
- Certified construction completion for each project
- Oversaw postconstruction project monitoring to evaluate project viability and allowed timely identification of problems or conditions that require corrective action
- Certify acceptance of the Cross Bayou Restoration Project when performance criteria are achieved
- Review and approve the plan(s) for proposed corrective actions, whenever such corrections were required or were otherwise proposed

Summary—Perspectives on this restoration project

Trustees' perspective. By focusing on the goal of restoring natural resources harmed by the spill, a common objective of both state and federal statutes, the trustees overcame many early challenges. The state/federal NRDA partnership had practical benefits as it brought the resources of multiple agencies to the planning and conduct of this multifaceted NRDA.

The trustees proposed an assessment process that would define injuries based on data and science, and used restoration as a basis for compensation. The process was based on technical consensus between the trustees and RPs. Tampa Bay has been the site of numerous restoration projects, and through its numerous governmental agencies, has identified and prioritized restoration actions, which would benefit the Tampa Bay area. This background gave a significant information base from which to identify and scale appropriate projects.

The HEA proved to be very useful in framing discussions on resource compensation and restoration scaling. Even when trustees and RPs did not agree on HEA input parameters, agreement could be reached on appropriate compensation (HEA outputs). While the trustees and RPs had not reached agreement on some of the mangrove HEA inputs, the question became a nonissue when the RPs located property suitable for use as a restoration site, which fit the trustees' restoration goals, and purchased it. Further, although the trustees felt that they could perform the restoration project proposed at Cross Bayou using existing state programs more cost effectively, the RPs disagreed and assumed all of the construction and monitoring responsibilities. This ultimately led to a more expeditious closure to the mangrove injury. Further it reinforced the point that the law and regulations relating to NRDA are not punitive in nature but are focused on the restoration of natural resources and resource services.

RPs' perspective. This incident occurred prior to the revisions of the NOAA guidelines recommending the use of cooperative damage assessments. Much has been subsequently written about cooperative procedures and models of interaction. The actuality of cooperation in this case served as an example of its benefits. The people involved in resolving the case are the critical elements. Professionalism, realism, technical capability, mutual respect and a focus on the goal of adequate and efficient restoration were valuable traits in this case of preguideline cooperation.

Expedient and efficient implementation of appropriately scaled restoration is in the best interest of the RPs. Accrual of interim lost use during extended periods of negotiation of injury, restoration scaling, and implementation is not in the best interest of the environment or the RPs. In this case, the RPs chose to purchase land and begin implementation of a compensatory restoration project prior to the approval of the trustees and prior to finalization of the official Consent Decree. While this sequencing is unusual the decision to proceed on this course was a product of three factors: (1) Interim lost use would accrue over additional time to resolve the case. The actual magnitude of this liability was perceived by the RPs to be modest. (2) The property was acquired by the RPs at a reasonable price when compared to alternatives identified by the trustees. (3) If negotiations had failed and litigation or other events precluded the utilization of this site as raw land or in a restored condition, it is likely that the RPs could have recouped their investment by selling the property for mitigation or development purposes unrelated to the spill.

The RPs in this case felt strongly that this project could be conducted most cost effectively by private industry. While an actual comparison of costs for this project will not be possible, the RPs remain secure in this belief.

Biography

Gary S. Mauseth is a Principal of Polaris Applied Sciences, Inc. with over 25 years of experience as a marine biologist dealing with marine and aquatic environmental problems. He has been a technical consultant involved in over 70 incidents including oil and chemical spills, coral reef groundings, and other cases worldwide. Mr. Mauseth has a B.A. in Biology from Whitman College and an M.S. Marine Science from the University of the Pacific, Pacific Marine Station.

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