

FINAL

DAMAGE ASSESSMENT/RESTORATION PLAN  
and  
ENVIRONMENTAL ASSESSMENT

**M/V WESTCHESTER  
CRUDE OIL DISCHARGE**

LOWER MISSISSIPPI RIVER, LOUISIANA  
NOVEMBER 28, 2000

Prepared by:

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This Damage Assessment and Restoration Plan/Environmental Assessment (DARP/EA) has been prepared by state and federal natural resource Trustees (listed in Section 2.2 of this document) to address the restoration of natural resources and resource services injured by the M/V Westchester oil spill of November 28, 2000 (the "incident") on the Mississippi River in Plaquemines Parish, Louisiana. This DARP/EA was developed after a Draft DARP/EA, informing the public of the results of natural resource injury studies/analyses and proposed restoration actions to address those injuries, was released for a 30-day public comment period. The DARP/EA also serves as an Environmental Assessment as defined under the National Environmental Policy Act (NEPA) (42 U.S.C. § 4321, et seq.). The integrated EA addresses the potential impact of proposed restoration actions on the quality of the physical, biological, and cultural environment.

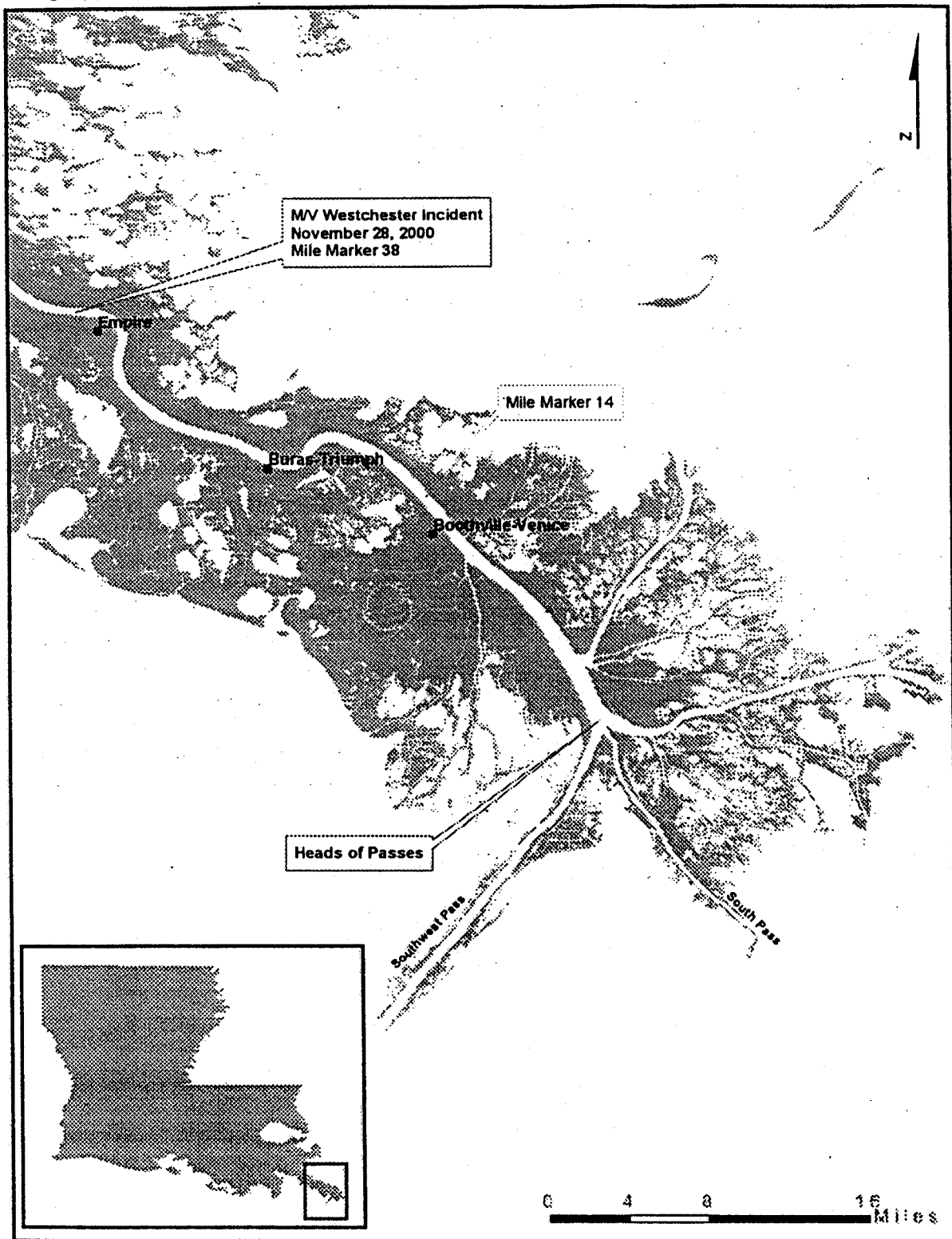
The Trustees and the Responsible Parties (RPs) for the Westchester incident considered the injuries resulting from this incident, evaluated potential restoration alternatives suggested by the public, local scientists, and other interested parties, ranked the alternatives according to established criteria, and identified preferred restoration alternatives to address these injuries. These preferred restoration alternatives were identified in the Draft DARP/EA, released for a 30-day public comment period on September 27, 2001. No comments were received during the public comment period; therefore, the restoration alternatives identified as preferred in the Draft DARP/EA were selected for implementation in this DARP/EA to address these injuries in accordance with the Oil Pollution Act of 1990 (OPA) (33 U.S.C. § 2701, et seq.) and the OPA regulations for natural resource damage assessments (15 C.F.R. Part 990). Furthermore, the Trustees determined that the restoration projects are not likely to have significant adverse impacts on the environment, and the NEPA process will conclude with the issuance of a Finding of No Significant Impact (FONSI).

## **1.1 OVERVIEW OF THE INCIDENT**

At approximately 6:20 PM CST on November 28, 2000, the U.S. Coast Guard (USCG) Marine Safety Office in New Orleans was notified that the M/V Westchester lost steerage because of a crankcase explosion while transiting the Mississippi River at Mile Marker (MM) 38 (measured from the Head of Passes). The vessel grounded, holing the #1 starboard cargo tank, and subsequently leaked approximately 550,000 gallons of Nigerian crude oil into the river. Response efforts were quickly mounted, including placing booms at key bayous and cuts, and deploying skimmers to collect oil from the water surface. Much of the oil became trapped in the rip-rap on the west bank of the river, which facilitated the recovery of oil, resulting in a more efficient recovery than is typical for oil spills. The location of the incident is shown in Figure 1.

State and federal agency personnel along with the RPs responded to the spill, as part of the unified command, and observed potential indications of biological injury and effects on recreational activities due to the incident. As a result of this incident, several thousand acres, including Mississippi River surface waters and shoreline habitats, coastal surface waters, adjacent marsh and other habitats, and the fauna inhabiting these areas, were exposed to crude oil (black oil, emulsified oil, or sheen). Vessel traffic on the Mississippi River between MM 38 and MM 9 was halted on the

**FIGURE 1.** Site of Westchester Incident (MM 38). Black oil went as far south as MM 14, with sheens going beyond that point and into marshes located south of Venice.



morning of November 29, 2000, affecting both commercial and recreational use of the river itself, and also use of down river recreational sites largely dependent on use of the river for access. The river was opened to in-bound traffic at around 4:00 PM CST on November 30, 2000; the river was opened to both up river and down river traffic on December 1, 2000. Pursuant to Section 1006 of OPA (33 U.S.C. § 2706), designated natural resource Trustees have conducted a damage assessment to evaluate potential injuries to natural resources and services, and to determine the need for and scale of restoration actions required. During the period of active response, representatives of the RPs met with Trustee representatives to establish a cooperative assessment process for the natural resource damage assessment (NRDA) conducted for this incident.

## 1.2 NATURAL RESOURCE INJURIES

The Trustees reviewed the information gathered as a result of response activities as well as information collected specifically for injury assessment. Based on this work, the Trustees believe that the incident caused injuries to habitats and biota in the Mississippi River and shoreline environments, including a variety of birds.

Using a modeling approach (as described in Section 4.4.1.2), the Trustees estimate that approximately 19,396 kilograms of finfish and shellfish biomass (direct kill and production foregone) were lost as a result of the incident. A modeling approach was also used to estimate direct mortality to birds and wildlife (see Section 4.4.2.2). The model estimates that approximately 582 birds were killed from exposure to oil, and predicts that no mammals, amphibians, or reptiles were killed. These faunal injuries were translated into marsh biomass equivalents, as described in Section 5.4.1.2.3.1.

A number of different habitats were affected as a result of the incident. These habitats (as categorized by the Trustees for the purpose of this assessment) include freshwater river vegetative habitat, delta marsh habitat, rip-rap habitat, and sandflat habitat. The Trustees used experience gained from injury analysis for similar habitats impacted in previous spills and the opinions of local agency personnel to derive estimates for service losses caused by the oiling and the recovery time to baseline<sup>1</sup> service flows. A phased approach was used in this assessment, with the Trustees first applying conservative assumptions<sup>2</sup> to determine upper-end habitat injury estimates in order to inform them about how to prioritize efforts to refine the injury estimates. However, as described in Chapter 5, the Trustees and RPs found an extremely cost-effect restoration alternative to address habitat injuries. Therefore the Trustees did not seek to further refine these injury estimates, nor did the RPs request refinements, because the cost of doing the additional injury work would increase

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<sup>1</sup> Baseline is defined as the condition that would have existed, but for the incident.

<sup>2</sup> Here and throughout this document, the term "conservative assumption" indicates that the value of the parameter in question would tend to favor the resource and the public's interests when used in the analysis. The assumed value therefore leads to an upper-end estimate of how much injury occurred or how much restoration is required. Often these assumptions are used in initial analyses to guide Trustees in determining the appropriate level of effort to apply in obtaining more refined estimates. Sometimes, as is the case for most of these kinds of assumptions used in this NRDA, the cost of developing refined estimates for parameters would exceed the potential reduction in the cost of restoration. In these instances, the use of conservative assumptions in the final analysis, rather than developing more precise point estimates, results in an overall cost savings to the RPs while still protecting the public's interest in obtaining sufficient restoration for the injuries.

overall costs compared to simply scaling restoration needs based on the preliminary injury estimates.

Recreational fishing was a human-use activity that was affected during the incident by the closure of the Mississippi River and, after the closure ended, by restrictions on access points for launching boats. Additionally, the spill occurred during the waterfowl hunting season in Louisiana, and access to the Delta National Wildlife Refuge (DWR) and the Pass-a-Loutre State Wildlife Management Area (PAL), two prime hunting sites, was restricted due to the incident. The Trustees contacted federal and state officials with knowledge on recreational use of the Mississippi River, PAL, and DWR, and estimated that 655 angler days and 804 hunter days may have been affected as a result of the incident. The recreational injury analysis is described in Section 4.4.2.

### 1.3 SELECTED RESTORATION ALTERNATIVES

Restoration actions under OPA are termed primary or compensatory. Primary restoration is any action taken to accelerate the return of injured natural resources and services to their baseline condition. Trustees may elect to rely on natural recovery rather than primary restoration actions in situations where feasible or cost-effective primary restoration actions are not available, or the injured resources will recover relatively quickly without human intervention.

Compensatory restoration is any action taken to compensate for interim losses of natural resources and services pending recovery. The scale of the required compensatory restoration will depend both on the magnitude of initial resource injury and how quickly each resource and associated service returns to baseline. Primary restoration actions that speed resource recovery reduce the requirement for compensatory restoration.

Based on observations made during the injury assessment studies, the Trustees determined that no active primary restoration actions were required to return injured natural resources and services to baseline, including human use services (see Section 5.3.1). Therefore the natural recovery (no action) alternative was chosen for primary restoration. The Trustees evaluated many compensatory restoration alternatives with the potential to provide additional resources to compensate for the

<b>Injured Resource/ Service</b>	<b>Primary Restoration</b>	<b>Compensatory Restoration</b>
Water Column Fauna	Natural recovery/No action	Marsh creation
Birds	Natural recovery/No action	Marsh creation
Freshwater Vegetation Habitat Services	Natural recovery/No action	Marsh creation
Rip-rap Habitat Services		
Sandflat Habitat Services		
Delta Marsh Habitat Services		
Recreational Human Use	Natural recovery/No action	Projects to increase recreational access to resources



ecological losses pending environmental recovery. As indicated in Table 1-1, the Trustees selected a compensatory restoration action directed at habitat services, aquatic fauna, and birds. The Trustees also selected a restoration action to compensate for lost public use (i.e., recreational fishing and hunting) resulting from the Westchester incident.

#### 1.4 ORGANIZATION OF THIS DOCUMENT

The remainder of this document presents further information about the natural resource injury studies and selected restoration actions for the Westchester oil spill incident.

Chapter 2 briefly summarizes the incident, the legal authority and regulatory requirements of the Trustees, and the respective roles of the RPs and the public in the damage assessment process.

Chapter 3 provides a brief description of the physical and ecological environments affected by the spill, as required by NEPA (42 U.S.C. § 4321, et seq.), and of the cultural and economic importance of Mississippi River delta natural resources.

Chapter 4 describes and quantifies the injuries caused by the spill, including an overview of Preassessment activities, a description of assessment strategies employed by the Trustees, and a presentation of assessment results.

Chapter 5 provides a discussion of restoration options considered during the Restoration Planning Phase, and determines the appropriate scale of the selected restoration actions, based on the nature and extent of injury presented in Chapter 4.

Appendix A provides a list of the documents submitted to the Administrative Record as of December 20, 2001.

Appendix B presents a list of applicable environmental laws that have been considered by the Trustees in conducting the assessment and planning restoration for this incident.

This chapter explains the NRDA process and describes the legal authority under which Trustees act on behalf of the public. It explains the requirement for the Trustees to seek involvement of the RPs and the opportunities for public participation in the NRDA process.

## **2.1 THE WESTCHESTER OIL SPILL: SUMMARY OF INCIDENT**

At around 6:20 PM CST on November 28, 2000, the USCG Marine Safety Office in New Orleans was notified that the M/V Westchester lost steerage because of a crankcase explosion while transiting the Mississippi River at MM 38 in Plaquemines Parish, Louisiana. The vessel ran aground and leaked approximately 550,000 gallons or more of sweet Nigerian crude oil into the river from the holed #1 starboard cargo tank. A dive survey identified six fractures over a 40-foot section in the forward section of this tank ranging from 2-6 inches wide and 2-6 feet long. The Mississippi River was closed between MM 38 and MM 9 on November 29, 2000. The river was opened to in-bound traffic on November 30, 2000; it was opened to two-way traffic on December 1, 2000. The locks at Empire and Ostrica were also closed on November 29, 2000, and opened on December 1, 2000. Similarly, booms located at Baptiste Collette Bayou, The Jump, and Cubits Gap were moved on December 1, 2000, to allow sportsmen access (Research Planning, Inc., 2001).

By 9 AM CST on November 30, 2000, heavy black oil had accumulated along the West Bank from MM 29 to MM 16, especially in rip-rap areas and sloughs. Most of the black oil remained trapped along the West Bank, although sheens were observed in marsh tidal creeks and bayous such as Grand Pass. Sheens also passed through cuts in the river levee into open water and marshes below Venice. Response efforts were quickly mounted, including placing booms at key bayous and cuts and deploying skimmers to collect oil from the water surface. Oil was washed off of rip-rap with high pressure flushing, contained with boom, and skimmed. Shoreline cleanup included manual removal of oil from sand and mudflats, low pressure flushing of oil from vegetation, and cutting of oiled vegetation. By February 20, 2001, the last shoreline segment was signed off on as meeting agreed-upon cleanup endpoints. For more information on this incident, see the Preassessment Data Report (Research Planning, Inc., 2001)

## **2.2 AUTHORITY AND LEGAL REQUIREMENTS**

This DARP/EA has been prepared jointly by the Louisiana Oil Spill Coordinator's Office (LOSCO), the Louisiana Department of Wildlife and Fisheries (LDWF), the Louisiana Department of Natural Resources (LDNR), the Louisiana Department of Environmental Quality (LDEQ), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Department of the Interior (DOI) which is represented by the United States Fish and Wildlife Service (USFWS) (collectively, "the Trustees"). Each of these agencies is a designated natural resource Trustee under Section 1006(b) of OPA, 33 U.S.C. § 2706(b), and the National Contingency Plan, 40 C.F.R. §§ 300.600-300.615, for natural resources injured by the Westchester incident. As a designated Trustee, each agency is authorized to act on behalf of the public under state and/or federal law to assess and recover natural resource damages, and to plan and implement actions to restore natural

resources and resource services injured or lost as the result of incidents involving the discharge, or significant threat of discharge, of oil.

### 2.2.1 Overview of OPA Requirements

NRDA is described under Section 1006(c) of OPA (33 U.S.C. § 2706(c)). Under the OPA NRDA regulations at 15 C.F.R. Part 990, the NRDA process consists of three phases: 1) Preassessment; 2) Restoration Planning; and 3) Restoration Implementation.

During the Preassessment Phase, the Trustees determine whether they have jurisdiction to pursue a NRDA for the incident. In order for the Trustees to proceed with a NRDA, the following conditions must be met under 15 C.F.R. § 990.41:

1. an incident must have occurred as defined at 15 C.F.R. § 990.33;
2. the incident must not be permitted under a permit issued under federal, state, or local law;
3. the incident must not involve a public vessel; and
4. the incident must not be from an onshore facility subject to the Trans-Alaska Pipeline Authority Act (43 U.S.C. § 1651, et seq.).

The Trustees determined that an incident occurred and that all of the above conditions were met for the Westchester oil spill. In addition, based on early available information collected during the Preassessment Phase, Trustees must make a preliminary determination whether natural resources or services have been injured and/or are threatened by ongoing injury. Injury is defined as "an observable or measurable adverse change in a natural resource or impairment of a natural resource service" (15 C.F.R. § 990.33). Through coordination with response agencies (e.g., the USCG), Trustees next determine whether response actions will eliminate injury or the threat of ongoing injury. If injuries are expected to continue, and feasible restoration alternatives exist to address such injuries, Trustees may proceed with the Restoration Planning Phase. Restoration planning also may be necessary if injuries are not expected to continue but are suspected to have resulted in interim losses of natural resources and services from the date of the incident until the date of recovery.

The purpose of the Restoration Planning Phase is to evaluate potential injuries to natural resources and services, and use that information to determine the need for, and scale of, restoration actions. Natural resources are defined as "land, fish, wildlife, biota, air, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any state or local government or Indian tribe" (15 C.F.R. § 990.30). This phase provides the link between injury and restoration and has two basic components: injury assessment and restoration selection.

The goal of injury assessment is to determine the nature and extent of injuries to natural resources and services, thus providing a factual basis for evaluating the need for, type of, and scale of restoration actions. As the injury assessment is being completed, the Trustees develop a plan for restoring the injured natural resources and services. The Trustees must identify a reasonable range of restoration alternatives, evaluate and select the preferred alternative(s), develop a Draft

Restoration Plan presenting the alternative(s) to the public, solicit public comment on the Plan, and consider these comments when developing a Final Restoration Plan.

Under the regulations, the Final Restoration Plan is presented to the RPs at the start of the Restoration Implementation Phase, to implement or to fund the Trustees' costs of implementing the plan, thus providing the opportunity for settlement of damage claims without litigation. Should the RPs decline to settle a claim, OPA authorizes Trustees to bring a civil action against the RPs for damages; or to seek disbursement from the USCG's Oil Spill Liability Trust Fund equal to the value of the damages. Components of damages include the cost of implementing the selected restoration action or actions, including monitoring and necessary corrective actions, and the cost of the damage assessment itself (33 U.S.C. §§ 2701(5) and 2702(b)). For this incident, however, the Trustees and RPs worked cooperatively throughout the Restoration Planning Phase in identifying potential restoration actions. The RPs agreed to implement the selected restoration actions identified in this Final DARP/EA.

### 2.2.2 NEPA Compliance

Any restoration of natural resources under OPA must comply with NEPA (42 U.S.C. § 4321, et seq.) and the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 C.F.R. § 1500, et seq.). In compliance with NEPA and the CEQ regulations, the Draft DARP/EA summarized the environmental setting, described the purpose and need for action, identified alternative actions, assessed their applicability and environmental consequences, and summarized opportunities for public participation in the decision-making process. This information was used in making a threshold determination as to whether preparation of an Environmental Impact Statement (EIS) is required prior to the selection of the final restoration actions (i.e., are any of the proposed actions a major federal action that may significantly affect the quality of the human environment?). Based on the draft EA integrated in the Draft Restoration Plan, it was determined that the proposed restoration actions do not meet the threshold requiring an EIS. The Trustees received no public comments on the Draft DARP/EA affecting this judgment; and therefore, a Finding of No Significant Impact (FONSI) will be issued.

### 2.3 **COORDINATION WITH THE RESPONSIBLE PARTY**

The OPA regulations require the Trustees to invite RPs to participate in the damage assessment process. Although the RPs may contribute to the process in many ways, final authority to make determinations regarding injury and restoration rests solely with the Trustees.

Accordingly, the Trustees engaged in several informal discussions with representatives for the RPs concerning a cooperative assessment and more formal discussions during a meeting on November 30, 2000, and also during a joint site visit by Trustees and RP representatives on December 11, 2000. Further coordination continued throughout the restoration planning process, including site visits to investigate potential restoration options in May, June, and October, 2001, with local agency and RP representatives. Coordination between the Trustees and RPs helped reduce duplication of studies, increase the cost-effectiveness of the assessment process, increase sharing of information and experts, and is expected to decrease the likelihood of litigation. Input from the RPs was sought and considered throughout the damage assessment process.

**PUBLIC PARTICIPATION**

Public review of the Draft DARP/EA was an integral component of the restoration planning process. Through the public review process, the Trustees sought public comment on the analyses used to define and quantify natural resource injuries and the methods being proposed to restore injured natural resources or replace lost resource services. The Draft DARP/EA provided the public with information about the nature and extent of the natural resource injuries identified and restoration alternatives evaluated.

Following issuance of a public notice, the Draft DARP/EA was made available to the public for a 30-day comment period beginning on September 27, 2001. Public review of the Draft DARP/EA is consistent with all state and federal laws and regulations that apply to the natural resource damage assessment process, including Section 1006 of OPA (33 U.S.C. § 2706), the OPA regulations for NRDA's (15 C.F.R. Part 990), NEPA (42 U.S.C. § 4321, et seq.) and the regulations implementing NEPA (40 C.F.R. §1500, et seq.). No comments were received during the public comment period, which ended on October 27, 2001.

## 2.4.1

**Administrative Record**

The Trustees developed records documenting the information considered by the Trustees as they planned and implemented assessment activities and addressed restoration and compensation issues and decisions. These records have been compiled into an administrative record, which is available for public review at the address given below. The administrative record facilitated public participation in the assessment process and will be available for use in future administrative or judicial review of Trustee actions to the extent provided by federal or state law. A list of those documents submitted to the administrative record through December 20, 2001 is attached as Appendix A to this document.

Documents within the administrative record can be viewed at:

Louisiana Oil Spill Coordinator's Office  
625 N. Fourth Street, Suite 800  
Baton Rouge, LA 70802

Arrangements should be made in advance to review the record, or to obtain copies of documents in the record, by contacting Warren Lorentz at the listed address, by calling him at (225) 219-5810, or by emailing him ([wlorentz@losco.state.la.us](mailto:wlorentz@losco.state.la.us)).

This chapter presents a brief description of the physical and biological environment affected by the Westchester incident, as required by NEPA. The physical environment includes the waters of the Mississippi River and associated shoreline and bature habitats, including sand and mudflats, sloughs and fresh marsh. It also includes delta habitats that were exposed to sheen. The affected environments provide habitat for a wide variety of fish, birds, mammals, and other organisms. Commercial fishing, aquaculture, recreational fishing, hunting, and wildlife viewing in the lower Mississippi River delta contribute to the economy of Plaquemines Parish. The affected environment- cultural, economic, environmental, and recreational- is described in detail in the Draft Heritage Study and Environmental Assessment (National Park Service, 2001) and so will be only briefly discussed below. More information is available at: <http://www.cr.nps.gov/delta/home.htm>.

### **3.1 PHYSICAL ENVIRONMENT**

The state of Louisiana is located along the north-central coast of the Gulf of Mexico. Over time the Mississippi River has created a number of deltaic lobes, the most recent of which is the area below New Orleans at the present mouth of the river, where the channel forks into many passages. This area is also referred to as the "bird's foot." This lobe was created over the last 5,000 years, but is now being gradually lost due to subsidence and erosion primarily resulting from man-made alterations in the river. There are several types of shoreline habitats along the river itself, including mud and sandflats, rip-rap, fringe vegetation along the river and vegetated edges of sloughs.

### **3.2 BIOLOGICAL ENVIRONMENT**

The lower Mississippi River and delta area ecosystem supports an incredible variety of species. Bird species found in the area include: snowy egrets, double-crested cormorants, various species of gulls, brown and white pelicans, ospreys and various hawks, kingfishers, great blue herons, and many more. It serves as an extremely important wintering area for waterfowl, with the DWR alone supporting up to 200,000 ducks and 50,000 geese. Other wildlife in the area includes alligators, muskrats, and river otters. This area supports both fresh and marine aquatic species. Fish such as redfish, flounder, trout, catfish, buffalo, and gar, among many other species, are found in the waters of the Mississippi River and deltaic marshes. In the outer portions of the delta, shellfish such as crabs and shrimp can be abundant.

### **3.3 ENDANGERED AND THREATENED SPECIES**

The Endangered Species Act of 1973 (16 U.S.C. § 1531, et seq.) instructs federal agencies to carry out programs for the conservation of endangered and threatened species and to conserve the ecosystems upon which these species depend. LDWF's Natural Heritage Program also lists species that are of special concern to the state. Table 3.1 provides a list of federal and state recognized endangered or threatened species reported to reside in or migrate through south coastal Louisiana ecosystems.

Table 3.1

**FEDERAL AND STATE ENDANGERED OR THREATENED SPECIES  
IN PLAQUEMINES PARISH, LOUISIANA**

Common Name	Scientific Name	Status
<b>MAMMALS</b>		
Florida Panther*	<i>Felis Concolor corvi</i>	Endangered
Louisiana Black Bear	<i>Ursus americanus luteolus</i>	Threatened
West Indian Manatee	<i>Trichechus manatus</i>	Endangered
<b>REPTILES</b>		
Kemp's Ridley Sea Turtle	<i>Lepidochelys kempii</i>	Endangered
Hawksbill Sea Turtle	<i>Eretmochelys imbricata</i>	Endangered
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	Endangered
Loggerhead Sea Turtle	<i>Caretta caretta</i>	Threatened
Green Sea Turtle	<i>Chelonia mydas</i>	Threatened
<b>BIRDS</b>		
Brown Pelican	<i>Pelecanus occidentalis</i>	Endangered
Piping Plover	<i>Charadrius melodus</i>	Threatened
Eskimo Curlew*	<i>Numenius borealis</i>	Endangered
Bachman's Warbler*	<i>Vermivora bachmanii</i>	Endangered
Ivory-Billed Woodpecker*	<i>Campephilus principalis</i>	Endangered
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Threatened
<b>FISH</b>		
Gulf Sturgeon	<i>Acipenser oxyrinchus desotoi</i>	Threatened
Pallid Sturgeon	<i>Scaphirhynchus albus</i>	Endangered

\* These species may no longer be present in Louisiana, but remain officially listed.

## 3.4

**CULTURAL ENVIRONMENT AND HUMAN USE**

Ever since the early 1600s when the explorer Robert Cavalier, Sieur de La Salle, successfully reached the mouth of the Mississippi River claiming the region for France, the delta has become widely known as an area with an abundance of fish and wildlife resources. A variety of cultures have existed in this region, including Native American, Spanish, French, British, Acadian (Cajun), Creole, and African. This area is directly used for commercial and recreational crabbing, trapping, hunting, and fishing, and is also used for wildlife viewing. Ecotourism (primarily bird and wildlife viewing and hunting and fishing) is increasingly important to the area. Oil and gas exploration and production also occur in this area.

Two National Historical Monuments are located in the area affected by the incident. Fort Jackson is located on the right descending bank near MM 20 and Fort St. Philip is located slightly downriver on the left descending bank. They served as the Confederate Army's primary defensive positions protecting New Orleans during the Civil War. The Union Navy managed to move upriver of these fortifications in April 1862, leading to the surrender of New Orleans. Access to Fort St. Philip is limited, and it is in a lesser state of preservation than Fort Jackson, which is a well-maintained and popular point of interest for tourists. Fort Jackson also serves as the location of Plaquemines Parish's annual Parish Fair and Orange Festival each December.

This chapter describes and quantifies the injuries caused by the Westchester incident. The chapter begins with an overview of data collected during the Preassessment Phase of the NRDA process. The following section describes the Trustees' assessment strategy, including the approaches used to identify, determine, and quantify potential injuries. The remainder of the chapter presents the results of Trustee injury assessments for the specific resources affected by the Westchester incident. Chapter 5 addresses the identification, selection, and scaling of restoration options to restore injured resources and services.

#### 4.1 OVERVIEW OF THE PREASSESSMENT PHASE

The following three requirements identified in the OPA regulations, at 15 C.F.R. § 990.42, must be met before Restoration Planning can proceed:

- injuries have resulted, or are likely to result, from the incident;
- response actions have not adequately addressed, or are not expected to address, the injuries resulting from the incident; and
- feasible primary and/or compensatory restoration actions exist to address the potential injuries.

Information collected during the Preassessment Phase of the incident is contained in the Preassessment Data Report (Research Planning, Inc., 2001). This information meets the first two criteria listed above. A number of potential restoration actions exist that can provide the same or equivalent services and resources to those affected by the incident, thereby meeting the third criterion. Because these three criteria are met, the Trustees determined that there was a need for restoration planning to address impacts resulting from the incident and proceeded to the Restoration Planning Phase.

##### 4.1.1 Aquatic Faunal Impacts

The release resulted in concentrations of polycyclic aromatic hydrocarbons (PAHs) that were detected in some locations at concentrations known to be toxic to aquatic organisms in laboratory tests. Although there were no reports of large numbers of fish or shellfish mortalities observed as a result of the incident (dead fish that were observed during the cleanup operations are believed to be shrimp boat by-catch and not spill-related), the Trustees' modeling effort suggests that some mortality did occur. The model estimates that approximately 19,400 kg of aquatic fauna were lost either from direct mortality or from future growth foregone (French-McCay and Galagan, 2001).

##### 4.1.2 Bird Impacts

The Trustees conducted field surveys during the response phase of the spill. On November 30, 2000, a total of 1,680 birds were observed between MM 12 and MM 25. Of these, nine birds had visible oil on their plumage. Tri-State Bird Rescue personnel observed 117 oiled birds that they



could not capture. Fourteen oiled birds were brought into the rehabilitation center, of which ten died. Another five dead oiled birds were collected, for a total of 15 known bird deaths believed to have been spill-related. This is likely only a fraction of the total birds killed; the Trustees' model run predicts that approximately 582 birds may have been killed as a result of this incident (French-McCay and Galagan, 2001).

#### 4.1.3 Habitat Impacts

A number of different shoreline habitats were affected by oil released during the incident (see descriptions in Research Planning, Inc., 2001). Oiled habitats include approximately eleven acres of rip-rap, less than one acre each of fresh marsh and freshwater edge of slough, slightly more than seven acres of sandflats, and just over 15 acres of mudflats. Although the areal extent was not precisely quantified, the Trustees observed that marshes west of the river below Venice, Louisiana, were exposed to sheen. Based on observations made during the response, the Trustees believe that the acreage of delta marsh vegetation affected was 100 acres or less (not inclusive of the open water areas between portions of marsh).

#### 4.1.4 Human Recreational Use Impacts

The incident affected human use services in the Mississippi River delta. Under OPA, the Trustees are responsible for evaluating and obtaining compensation for public (but not private) lost human use of natural resources (33 U.S.C. § 2706(d)(1)). The closure of the river to vessel traffic affected recreational activities that depend on river access, including hunting and fishing in PAL and DWR. The Trustees contacted federal and state officials with knowledge on recreational use of the Mississippi River, PAL, and DWR, and estimated that 655 angler days and 804 hunter days may have been affected as a result of the incident (Galvin, 2001a).

#### 4.1.5 Other Potential Impacts

Assessment of some resources that had the potential to be injured was not carried forward into the Restoration Planning Phase following the Preassessment Phase because the evidence of injury was not sufficient to justify further evaluation. An example of such a resource is mammals. Although two dead nutria were found, possibly spill-related, the Trustees recognized that nutria are an introduced species that is considered a nuisance, and are not seeking compensation for this loss. The model used to quantify bird and aquatic faunal injury also evaluated potential injury to mammals, and did not predict any mortalities to mammalian species. The Trustees examined evidence of injury to mammals and other resources, and have determined that none of those potential injuries merited further assessment efforts. The Trustees are reassured by the fact that the selected ecological restoration project (see Section 5.4.1.2) will benefit a number of resources, thereby helping to ensure that the public and environment are made whole in the event that some injury was missed in the assessment.

### 4.2 ASSESSMENT STRATEGY

The goal of injury assessment under OPA is to determine the nature and extent of injuries to natural resources and services, thus providing a technical basis for evaluating the need for, type of, and

scale of restoration actions. The assessment process occurs in two stages: injury determination and injury quantification.

Injury determination begins with the identification and selection of potential injuries to investigate. The OPA regulations allow the Trustees to consider several factors when making this determination, including, but not limited to:

- the natural resources and services of concern;
- the evidence indicating exposure, pathway and injury;
- the mechanism by which injury occurred;
- the type, degree, spatial and temporal extent of injury;
- the adverse change or impairment that constitutes injury;
- available assessment procedures and their time and cost requirements;
- the potential natural recovery period; and
- the kinds of restoration actions that are feasible.

The Trustees considered all of the above-listed factors when making injury determinations for this incident. A list of the injury categories carried forward into the Restoration Planning Phase for the Westchester incident is provided in the first column of Table 4-1. As indicated in the table, the Trustees assessed possible injuries to four categories of ecological resources and recreational fishing and hunting losses. These categories were selected based on input from preassessment activities; local, state and federal government officials; the RPs; and others knowledgeable about the affected environment.

For each potential injury, the Trustees determine whether an injury has occurred, identify the nature of the injury and identify a pathway linking the injury to the incident. Injury is defined by the OPA regulations as "an observable or measurable adverse change in a natural resource or impairment of a natural resource service. Injury may occur directly or indirectly to a natural resource and/or service" (15 C.F.R. § 990.30). The assessment methods used for the incident are described in the second column of Table 4-1. Where feasible, the Trustees use simplified, cost-effective procedures and methods to document resource injuries.

Aquatic Fauna	Injury estimate developed by Trustees using a site-specific modeling approach.
Birds	Injury estimate developed by Trustees using a site-specific modeling approach.
Habitat Services	Injury estimates developed by Trustees using information gathered during the response and Trustee site visits, together with Trustees' experience from previous spills and knowledge of local agency experts and other experts.
Recreational Human Use	Recreational loss estimate developed using a benefits transfer approach with consumer surplus estimates from literature and normal recreational use estimates from local agency experts.

The Trustees considered the following factors in selecting appropriate assessment procedures:

- the range of procedures available under the OPA regulations at 15 C.F.R. § 990.27(b);
- the time and cost necessary to implement the procedures;
- the potential nature, degree, and spatial and temporal extent of the injury;
- the potential restoration actions for the injury; and
- the relevance and adequacy of information generated by the procedures to meet information requirements of restoration planning.

Accordingly, depending on the injury category, the Trustees rely on information and methodologies from relevant scientific literature, literature-based calculations, and models and/or focused injury determination and quantification studies in assessing injury. Best professional judgement of local experts, Trustees familiar with effects of oil in similar environments, and others is also utilized, when appropriate.

If the Trustees determine that a resource has been injured, the injury may be quantified as the next step in the assessment. The injury quantification process determines the degree and spatial and temporal extent of injury relative to baseline, and therefore forms the basis for scaling restoration actions. Baseline refers to the condition that the resource would have maintained but for the effects of the incident.

#### 4.3 SUMMARY OF ASSESSMENT METHODS

Injury quantification for aquatic fauna and bird resources begins with developing an estimate of the number of animals killed. Possible sublethal injuries to populations also are considered, if the Trustees have evidence that such effects might be important. Quantification of injury to habitats begins with an estimate of the amount of acreage affected, and the amount of habitat service flow reduction.

Once the magnitude of injury is established, Trustees estimate the recovery time required for the resource to return to baseline condition. The actual biological processes that determine recovery from an oil spill are complex. Both the magnitude of injury and recovery time must be considered when scaling compensatory restoration actions. For resources such as fish, under the specific circumstances of this incident, it is helpful for scaling purposes to express the injury in terms of biomass lost. To include recovery time as part of the lost biomass estimate the Trustees calculate the growth foregone for animals killed by the incident during the recovery period. Growth foregone in each year after the incident is discounted at three percent per year, summed, and added to the injury in the year of the incident to generate an estimate of total injury. The discounting calculation accounts for differences in timing between the initial kill and later years when growth is foregone. After discounting, the total injury is expressed in present terms as of the date of the initial kill<sup>3</sup>. The discount rate of three percent approximates society's rate of time preference. Discounting reflects the greater value that people assign to goods and services now, compared to in

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<sup>3</sup> The year 2000 was used as the "present year" for the purpose of discounting.

the future. For additional discussion concerning discounting, please refer to the NOAA technical document on discounting (NOAA, 1999) which is available at the following website:

<http://www.darp.noaa.gov/darporg/publicat.htm>

For habitat injury, the injury is quantified as acre-years of lost habitat services, and is discounted in a similar fashion as faunal injuries. An acre-year of habitat services is the flow of benefits that one acre of habitat provides to the entire ecosystem over the time period of one year. For example, an acre-year of marsh services is the totality of services provided by one acre of marsh over the period of one year.

Diminution in recreational use of natural resources constitutes an injury as defined by the OPA regulations, in that use by the public constitutes a service provided by natural resources (15 C.F.R. § 990.30). Recreational injury analysis starts with estimating the number of affected user-trips for each activity. Affected trips can be trips that are totally forgone, trips to alternate, less-preferred sites, or trips to the affected area where the value of the trip is diminished because of the injuries and response activities. Economists often use the average consumer surplus as the measure of the net economic value for a recreation trip. Consumer surplus is the measure of an individual's value of a good, in this case recreational hunting and fishing, above and beyond any payments that are necessary to obtain that good.

For incidents such as the Westchester oil spill, in which the number of affected trips was relatively small, use of literature values to estimate the reduction in benefits, rather than site-specific studies, is a reasonable approach. This method of estimating the value (consumer surplus) of an affected hunting or fishing trip by the public is known as benefits transfer. Benefits transfer utilizes value estimates previously generated for other similar activities through extensive survey-based analyses to estimate a value for the specific activities in question. This method applies the per day consumer surplus estimates as reported in the existing literature for fishing and hunting in Louisiana (when available) and in comparable areas of the United States to the estimated number of hunters and anglers impacted by the Westchester spill. All literature estimates must be adjusted for inflation, based on the Consumer Price Index. Once the loss (reduction in value) associated with each affected trip is then estimated, the loss per trip estimate is multiplied by the estimate of the number of affected trips in order to determine the total loss.

#### 4.4

#### INJURIES TO SPECIFIC RESOURCES AND SERVICES

The following sections of this chapter describe the results of the Trustees' injury determination and quantification efforts for the incident that were conducted subsequent to the Preassessment Phase. For some of the injuries, preliminary scoping injury analyses, using conservative assumptions that would tend to produce an upper-end injury estimate, indicated that the amount of potential injury was relatively low. For those injuries, the Trustees chose not to further refine the injury estimates. Although additional analysis would likely reduce the estimated injury for some affected resources and services, such work and expense was judged to be unnecessary given the kinds of cost-effective restoration alternatives available to redress those injuries. The cost of refining the injury estimates would be greater than the potential reduction in the cost of implementing restoration with scaling

based upon the preliminary estimates. The Trustees provided the RPs with documents that formed the basis for the injury estimates, and discussed the assessment strategy used with them. However, as discussed in the following chapter, the RPs recognized that there were very cost-effective restoration alternatives available and agreed with the Trustees that further work to refine the injury estimates would not be reasonable given the availability of these alternatives. Thus, the agreement to move forward to find and scale appropriate restoration alternatives without further refining the injury estimates does not necessarily indicate that the RPs agree with all of the approaches used by the Trustees or the results obtained. Potential injuries that were assessed in the Restoration Planning Phase are organized into four categories: aquatic fauna, birds, habitats, and human use (recreation).

#### 4.4.1 Aquatic Fauna

The lower Mississippi River and delta area is heavily used by aquatic fauna, including blue crabs, shrimp, and other invertebrates, and numerous species of fish.

##### 4.4.1.1 Determination of Injury

Water samples collected by the Trustees on December 1-2, 2000, indicate that polycyclic aromatic hydrocarbons (PAHs) were present in the water column at levels which likely resulted in some mortality to aquatic organisms, especially in the early portion of the incident (see appendix F in French and Galagan, 2001). Although some dead fish were observed along the shoreline, the fish species observed tended to be offshore species and were probably shrimp fishery by-catch, rather than spill-related mortality.

##### 4.4.1.2 Injury Quantification Strategy

The Trustees determined that the cost of conducting a large field study to investigate aquatic faunal injuries was not warranted, given the specific circumstances of this incident. A field effort designed to quantify injuries to fish, shellfish, and other aquatic organisms would be very expensive, and the natural variability that exists in the aquatic fauna in this region would have made it difficult to detect the magnitude of injuries that the Trustees believed were present. Although some aquatic mortalities were observed, as noted above, there were not any dramatic fish kills or strandings of large numbers of organisms as sometimes occur following releases of petroleum products (e.g., North Cape oil spill, and others). Given the visual evidence suggesting that the magnitude of injury to aquatic organisms was relatively small, the Trustees decided to use a modeling approach to quantify injury to aquatic fauna.

The Trustees decided to develop a site-specific modeling approach, using some algorithms from the Natural Resource Damage Assessment Model for Coastal and Marine Habitats (Version 2.4, April 1996), modified to account for the specific circumstances of the incident. The resultant injury estimate includes the direct predicted mortality as well as an estimate of the lost somatic growth that would have been expected had these organisms not been killed. The model estimates that approximately 19,400 kg of aquatic fauna was lost as a result of this incident.

This injury category, as evaluated by the model approach utilized by the Trustees, estimates the aquatic injury that resulted from death due to exposure to predicted concentrations of low molecular weight PAHs in the water column in the early days following the incident. The model also estimates the resulting loss in growth of the aquatic fauna predicted to have died from exposure to PAHs<sup>4</sup>. It does not account for a reduction in aquatic faunal production that resulted from reductions in habitat service flows supporting aquatic fauna. Losses due to a reduction in habitat services supporting aquatic organisms are accounted for in the assessment of injury to these habitats:

The Trustees and the Westchester RPs agreed to move forward with identifying an appropriate restoration alternative to compensate for these losses. The selected restoration option and the scaling approach are discussed in Chapter 5.

#### 4.4.2 Birds

The lower Mississippi River and delta area is used by a variety of bird species, including mottled ducks, snowy egrets, great egrets, Louisiana herons, sandpipers, rails, gulls, and terns. Individuals of several species of birds, including white and brown pelicans, great blue herons, and double-crested cormorants were reported as oiled.

##### 4.4.2.1 Determination of Injury

Although only fifteen dead birds were documented, the Trustees believe that additional birds were killed as a result of direct exposure to the oil in the first few days following the incident. Oil from the release was documented to cover hundreds of acres of surface waters and shoreline habitats where numerous birds were seen.

##### 4.4.2.2 Injury Quantification Strategy

The large size of the affected area and the complexity of the extensive marsh and shoreline vegetation and bature habitats in which dead birds would be difficult to find, were practical obstacles in determining bird injury. Additionally, many birds may have been carried down river away from the incident site or drawn underwater by river currents during the first evening and not observed. Rather than try to conduct an extensive field survey whose results (and restoration needs based on those results) would likely not be proportionate to the amount of time and expense required for such a survey, the Trustees decided to use a site-specific modeling approach. This approach used many algorithms from the Natural Resource Damage Assessment Model for Coastal and Marine Habitats (Version 2.4, April 1996), along with new algorithms to account for the specific circumstances of the incident, and updated habitat data. Bird species composition and abundance data used in the model were taken from the survey conducted by Trustee representatives on November 30, 2000. The Trustees' model estimates that approximately 582 birds were lost as a result of the incident from impacts due to oil released from the vessel (French-McCay and Galagan,

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<sup>4</sup> The model also includes the effects of the direct kill of lower trophic levels (e.g., plankton, forage fish not individually tabulated as injured, and others) on higher trophic levels (such as fish and birds), as a component in the injury estimate for higher trophic level organisms. The estimated injury associated with food web losses is a very small component of the total aquatic fauna or bird injuries (French and Galagan, 2001).

2001). Of this total, approximately 75 percent of the estimated avian mortalities are cormorants, 19 percent are gulls, and five percent are terns.

In this model, all birds that are "oiled" by contact with the slick are assumed to have been killed. This is a conservative assumption in that it is possible that some of the oiled birds did not die. The Trustees believe, however, that a significant proportion of the birds that were exposed to oil likely died. It is not unexpected that only a small proportion of expected bird mortalities were found, because dead birds can be subject to predation, sinking, or could have been hidden in the thick marsh vegetation. This approach does not address possible sub-lethal impacts on birds, including potential reduction in growth or reproduction (but see footnote 4).

This injury category, as evaluated by the Trustees' modeling approach, estimates the bird injury that resulted from death due to exposure to surface slicks that were present in the early days following the incident. It does not estimate the potential reduction in bird production that resulted from reductions in habitat service flows supporting birds. Losses due to a reduction in habitat services supporting birds are accounted for in the assessment of injury to the affected habitats.

The Trustees and the Westchester RPs agreed to move forward with identifying an appropriate restoration alternative to compensate for these losses. The selected restoration alternative and the scaling approach are discussed in Chapter 5.

#### 4.4.3 Habitats

A number of different types of habitats are present in the area affected by oil from this incident. Both vegetated (freshwater river shoreline vegetation and delta marsh) and unvegetated (rip-rap and sandflat) habitats provide ecological services to the Mississippi River delta ecosystem that were impacted due to this release.

##### 4.4.3.1 Determination of Injury

The trajectory of the oil and the extent of oiling were documented frequently during the initial response using overflights, on-water surveys, and Shoreline Cleanup Assessment Teams. Trustees participated in many of these activities throughout the early portion of the response, and additionally made a joint site visit with RP representatives on December 11, 2000. A number of habitats were exposed to oil. These habitats include rip-rap, fresh marsh and freshwater edge of slough, sandflats, mudflats, and delta marshes.

##### 4.4.3.2 Injury Quantification Strategy

Based on observations made by Trustees and response personnel, the Trustees developed conservative assumptions to use in a preliminary Habitat Equivalency Analysis (HEA)<sup>5</sup>. This HEA

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<sup>5</sup> HEA is an approach that has been used successfully for scaling restoration actions at a number of locations in Louisiana, and around the country. In brief, HEA is a technique that balances "debits" (habitat or other injuries) that have occurred as a result of an incident against compensatory "credits" (resources and services provided by habitat restoration projects). It uses a discount factor to account for the difference in time between when the injuries were

was intended to give the maximum likely amount of injury (ecological service loss) that could have occurred as a result of this incident in order to guide in the development of an injury assessment approach. However, even with the conservative assumptions employed in this preliminary effort, the HEA results suggest that the level of injury to the affected habitats was relatively small. Given this result, and the fact that very cost-effective restoration alternatives exist to compensate for these injuries (discussed in Chapter 5), the Trustees did not seek to refine the injury estimate further at this point. The Trustees, without disagreement from the RPs, decided to use the preliminary results when exploring the type and scale of an ecological restoration project. This was judged a more cost-effective approach than generating additional assessment costs to refine the injury estimate. This judgment was ultimately borne out. Although further refinement would likely reduce the estimate of injury, it would not lower the cost of the implementing the selected restoration project, for reasons described in Section 5.4.1.2.3.2. For more information on HEA, see the technical document (NOAA, 2000) on this scaling approach also available at the web site cited above.

This injury quantification approach attempts to take into account reductions in the entire flow of habitat services. It is intended to account for a reduction in bird production that resulted from reductions in habitat service flows supporting birds. Likewise, it is intended to account for a reduction in aquatic faunal production from reductions in habitat service flows supporting fish, shrimp, crabs, and other aquatic fauna. It is also intended to capture the loss of other habitat services.

#### 4.4.3.2.1 Freshwater Vegetated Habitats

There are a number of different vegetated habitats along the river above the head of passes that have been lumped together in this analysis. The first of these is the partially vegetated mudflats that are primarily located in batture areas. The vegetation ranges from herbaceous grasses to small trees, which are located along the edges of the flats. A total of 15.4 acres of mudflat was moderately oiled. Although some of the mudflat is not vegetated, for the purpose of this analysis it is being treated as if entirely vegetated<sup>6</sup>. The second type is the vegetated banks of sloughs, of which approximately 0.5 acres were heavily oiled. The last type of vegetated habitat located along the river is fresh marsh. A total of approximately 0.9 acres of fresh marsh was oiled, with the vast majority being heavily oiled. In the preliminary analysis, the Trustees assumed that the entire 16.8 acres of these different vegetated habitats had an initial service loss of 50 percent, with full recovery of service flows occurring 12 months following the incident. This assumption of initial service loss is higher than that which would normally be expected from the nature of the oiling of these habitats, based upon the Trustees' experience from past spills. The recovery period is likely to be shorter than that assumed, due to the dynamic nature of the Mississippi River with substantial water

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suffered and when the restoration services are delivered. The final output of the HEA for this incident is a quantitative calculation of the number of acres of habitat to be created to fully compensate the public for the injuries resulting from the spill.

<sup>6</sup> The mapping of habitats was not of sufficient resolution to distinguish the vegetated from the non-vegetated portions of mudflats or, as described later, sandflats. To account for this, the Trustees treated the mudflats as being entirely vegetated and the sandflats as being entirely unvegetated. For the purpose of this preliminary analysis, such an approach is conservative, because there was likely to be less vegetated acreage than was assumed in the analysis. However, as discussed in Section 5.4.1.2.3.2, the amount of restoration required to compensate for all habitat injuries is very small compared to that required for faunal injuries; therefore, the assumption that all oiled mudflat is vegetated has little effect on the results.



level fluctuations and scouring/shoaling. This conservative analysis indicates that up to approximately 3.7 discounted service acre-years (DSAYs) of freshwater vegetated habitat services were lost.

#### 4.4.3.2.2 Rip-rap Habitat

This habitat is composed of cobble to boulder-sized pieces of rock that have been placed along the river edge for shoreline protection, but rip-rap also provides a substrate for the attachment of algae and refugia for some fish and invertebrates species (Curry, 2000) as well as other ecological services. A total of 11.14 acres of rip-rap were oiled as a result of this incident. Of this total, approximately 7.1 acres were heavily oiled, 2.5 acres were moderately oiled, and 1.6 acres were lightly oiled. In the preliminary analysis, the Trustees assumed that the entire 11.14 acres of rip-rap initially suffered a complete service loss, with a six-month recovery period to baseline service levels. The six-month recovery period is judged to be conservative because the approaching high-flow period would have removed residual oil, and recovery of habitat like rip-rap in the Mississippi River from disturbance is very rapid (Carl Way, Barry Vittor and Associates, pers. comm.). Using these conservative assumptions, the injury to rip-rap habitat is estimated at 2.3 DSAYs of rip-rap habitat services.

#### 4.4.3.2.2 Sandflat Habitat

This habitat type consisted of flats made up of fine-grained sand, exposed during low water. Although there is some vegetation along the edges of some of these flats, for the purposes of this analysis, sandflat habitat is treated as being entirely unvegetated. Treating this habitat as being totally unvegetated will serve to offset the unvegetated areas of mudflats that were treated as if they were entirely vegetated. A total of 7.23 acres of sandflat habitat was heavily oiled. In the preliminary analysis, the Trustees assumed an initial 100 percent loss of service due to the heavy coating of oil, recovering to a 25 percent loss of service after one month, with full recovery to baseline service flows assumed to occur one year following the incident. The Trustees believe that the effective removal of oil from the flats during the response, and the effects of the following high-flow period, resulted in a quicker recovery than was assumed in the preliminary analysis. The HEA analysis, using these conservative assumptions, indicates that 0.8 DSAYs of unvegetated sandflat services were lost.

#### 4.4.3.2.3 Delta Marsh Habitat

The marsh located west of the river below Venice, Louisiana, was exposed to only sheen, not black oil. No quantitative estimate of the acreage of this marsh that was exposed to sheen was made during the response, primarily because no cleanup activities took place in these areas due to the limited exposure. The Trustees have estimated that 100 acres or less of this marsh (vegetated area only, not including surface waters) were exposed to sheen and suffered an initial ten percent loss of service recovering to full service flows six months following the incident. The service flow reduction used in this analysis was similar to, but greater than, that used in the Lake Barre NRDA for similarly oiled marsh (Trustees, 1999). This conservative analysis suggests that 2.0 DSAYs of delta marsh services may have been lost.

#### 4.4.4 Human Recreational Use

Recreational hunters and anglers often visit the lower Mississippi River and delta area, and their use of the area was affected by the closure of the river to navigation. Restrictions on boat launching sites due to use by response personnel, the closure of locks at Empire and Ostrica, and placement of booms at Baptiste Collette Bayou, The Jump, and Cubit's Gap also potentially affected recreational use of the Mississippi River delta.

##### 4.4.4.1 Determination of Injury

The official closure of the river to navigation began on November 29, 2000. The river was opened to upriver traffic late in the afternoon on November 30, 2000, and to down river traffic on December 1, 2000. The incident occurred during the waterfowl-hunting season in Louisiana, and access to the DWR and the PAL, two prime hunting and fishing sites, was restricted due to the incident. Access to private hunting camps was also affected by this incident.

##### 4.4.4.2 Injury Quantification Strategy

The Trustees considered two major types of recreational injuries from this incident: losses of hunting and fishing access. Other recreational human uses may also have been affected, such as bird and wildlife viewing, but such uses were judged by the Trustees to be relatively minor uses during this time of year. Although the actual navigation closure on the river was partially lifted on November 30, 2000, and completely lifted on December 1, 2000, the Trustees assumed that full use of the area resumed on December 4, 2000. This assumption ignores any restrictions on use of access points to the river that may have existed due to on-going cleanup activities that continued into February 2001. The number of anglers expected on weekends and weekdays was estimated based on the Louisiana Marine Recreational Fishing Statistics Survey. An estimate of typical weekday and weekend hunting pressure for the DWR and PAL and private hunting camps was derived through interviews with DWR and PAL resource managers. Overall, it is estimated that 655 angler and 804 hunter trips were affected (Galvin, 2001a).

The Trustees conducted a literature review to derive consumer surplus estimates. The values found in the review for recreational hunting range from \$38.41 to \$62.30 per trip. The values obtained for recreational angling range from \$40.17 to \$109.88 per trip. For recreational lost use, using the estimated number of affected trips and the range in consumer surplus for both hunting and fishing activities, the total combined estimated loss ranges from \$57,193 to \$122,060. The Louisiana-specific studies in the literature for hunting and fishing consumer surplus were on the high-end of the spectrum, so the Trustees feel most comfortable with the high end of the estimated range of loss. However, given the relatively low value of even the upper-end of this range, the Trustees decided to forgo further refinement of the injury estimate. The cost of doing additional research to get a better estimate would be prohibitively costly given the small potential value of the loss. For more details on the assessment of the recreational injury, see Galvin (2001a).

#### 4.5 **INJURY SUMMARY**

After evaluating the potential natural resources and services (including human recreational use) that

could have been affected by the Westchester incident, the Trustees selected aquatic fauna, birds, habitats (freshwater vegetated habitat, rip-rap habitat, sandflat habitat, and delta marsh habitat), and recreational hunting and fishing as requiring assessment. The assessment results for these injury categories are presented in Table 4-2. The Trustees judged that the evidence for injury to other resources and services did not merit further assessment, and no restoration actions are required for them.

**Table 4-2  
TRUSTEES' ESTIMATES OF RESOURCE AND SERVICE INJURIES**

<b>Injury Category</b>	<b>Injury Estimate</b>
Aquatic Fauna	19,396 kilograms of finfish and shellfish biomass (direct kill and production foregone) were lost as a result of the incident
Birds	Approximately 582 birds were killed from exposure to oil
Habitat Services	3.7 DSAYs of freshwater vegetated habitat services
	2.3 DSAYs of rip-rap habitat services
	0.8 DSAYs of sandflat habitat services
	2.0 DSAYs of delta marsh services
Recreational Human Use	The combined recreational hunting and fishing loss estimate ranges from \$57,193 to \$122,060

The overall objective of the restoration planning process is to identify restoration alternatives that are appropriate to restore, rehabilitate, replace or acquire natural resources and their services equivalent to those injured or lost as a result of incidents involving the discharge or the significant threat of a discharge of oil. This chapter lays out the restoration screening and selection process undertaken by the Trustees to address restoration requirements for injuries resulting from the Westchester incident.

## 5.1 RESTORATION STRATEGY

The goal of restoration under OPA is to make the environment and public whole for injuries to natural resources and services resulting from incidents involving the discharge or threat of a discharge of oil. Restoration actions under OPA are termed primary or compensatory.

Primary restoration is any action taken to accelerate the return of injured natural resources and services to their baseline condition. Natural recovery, in which no human intervention is taken to directly restore the injured natural resources and/or services to baseline conditions (following all response actions) is always considered as a primary restoration alternative (and is equivalent to the NEPA No Action alternative). Natural recovery is the appropriate restoration alternative in situations where feasible or cost-effective primary restoration actions are not available, or where the injured resources will recover relatively quickly without human intervention. Active primary restoration actions (as opposed to natural recovery) are appropriate in situations where injured resources will not recover, or will recover slowly, without taking steps to bring about or speed recovery, and where feasible and cost-effective methods exist to assist recovery to baseline.

Compensatory restoration is any action taken to compensate for interim losses of natural resources and/or services pending recovery to baseline. The no compensatory restoration action alternative (NEPA's No Action alternative) is appropriate for a resource or service which was not injured or, if injured, for which appropriate restoration actions meeting the OPA criteria (see Section 5.3) are not possible. The scale of the required compensatory restoration is dependent on both the initial size of the injury and how quickly each resource and/or service returns to baseline. Primary restoration actions that speed recovery will reduce the requirement for compensatory restoration.

To plan restoration for injuries resulting from the Westchester incident, the Trustees first considered possible primary restoration actions for each injury and determined whether primary restoration can and should be implemented. The Trustees then considered the type and scale of compensatory restoration that can best compensate for lost resources and/or services during the recovery period.

Restoration alternatives must be scaled to ensure that their size appropriately reflects the magnitude of injuries resulting from the incident. Where feasible and otherwise appropriate, the Trustees employ a resource-to-resource scaling methodology. Under this approach, the Trustees determine the scale of restoration actions that will provide natural resources and/or services of the same type

and quality and of comparable value to those lost. Here, equivalency is obtained between the resources and/or services lost and those to be provided through restoration.

If a reasonable range of alternatives providing natural resources and/or services of the same type and quality and comparable value to those lost cannot be identified, other compensatory restoration actions may be considered. These other compensatory restoration actions must, in the judgment of the Trustees, provide services of comparable type and quality as those lost. When restoration provides resources or services not of comparable value as those injured, the Trustees must determine the appropriate trade-off between the injured resources and those provided by restoration.

The scaling calculations set forth in this chapter are based on straightforward methods combined with available data and the best professional judgment of the Trustees. More precise scaling calculations often are not possible due to one or more of the following factors: incomplete knowledge of the relevant physical and biological processes; uncertainties about important project-specific scaling parameters; or the high cost of obtaining additional site-specific data, relative to the likely gains associated with collecting this information. Where data are unavailable or prohibitively costly to collect, there is uncertainty in the true value for required inputs to the scaling calculations. In these instances, the Trustees used conservative assumptions that will ensure that the amount of restoration is sufficient to make the public and environment whole. More complex scaling calculations would be difficult and expensive to undertake and would not significantly improve the accuracy of the scaling results in this case. Moreover, the cost required to refine the scaling would be unjustified, given the availability of extremely cost-effective restoration alternatives. Specific scaling assumptions and calculations are described later in this chapter. The Trustees assume that restoration alternatives will be implemented in the year 2002. In the event that actual implementation occurs after this date, the Trustees will appropriately revise the scaling calculations.

The Trustees shared the scaling methods and results with the RPs as part of the cooperative NRDA process. However, both the RPs and Trustees agreed that, given the outcome of the search for appropriate and cost-effective restoration alternatives, as well as the outcome of the Trustees' scaling performed for the selected restoration alternatives, further refinement of the scaling analyses was not warranted. The acceptance of the outcome of the scaling by the RPs does not necessarily indicate agreement with all of the methods or assumptions used by the Trustees.

## 5.2 GENERAL RESTORATION ALTERNATIVES

In accordance with the OPA regulations, the Trustees, working cooperatively with the RPs, developed a reasonable range of restoration alternatives and chose preferred alternatives for each injury category which were presented for public comment in the Draft DARP/EA. For this incident, this was a two-step process. The Trustees first identified and evaluated general alternatives capable of serving as primary or compensatory restoration for the injured natural resources and/or services (the later evaluation of specific restoration alternatives is described beginning in Section 5.4). As part of the effort to develop general restoration alternatives, the Trustees and RPs sought input from a variety of local government officials and state and federal agency representatives knowledgeable about the Mississippi River delta ecosystem. These efforts

were important in identifying projects that have the potential to be feasible, have strong net environmental benefits, be acceptable to the local public, and meet restoration requirements to compensate for injuries resulting from the incident. The results of the restoration alternative identification and evaluation process are summarized in Table 5-1, located in Section 5.5.

The OPA regulations require the Trustees to preferentially seek to restore injured natural resources in-kind (e.g., create new marsh to compensate for lost marsh function) and in the geographical vicinity affected, while working to maximize ecosystem benefit, benefit to human uses of the environment (such as fisheries), and cost-effectiveness of restoration as a whole. However in-kind restoration is not always possible and, in those instances restoration of alternative resources that provide similar ecological benefits may be appropriate. Finally, increased benefits and improved cost-effectiveness may often be obtained by addressing several injured resources and/or services or classes of injury with a single restoration project. The logic for selecting alternatives that provide a different resource or service as compensation is described in detail in Section 5.3.

### 5.3 EVALUATION OF GENERAL RESTORATION ALTERNATIVES

Once a reasonable range of restoration alternatives is developed, the OPA regulations (15 C.F.R. § 990.54) require the Trustees to identify preferred restoration alternatives based on certain criteria. The following criteria, presented in the order given in the regulations, were used:

- the cost to carry out the alternative;
- the extent to which each alternative is expected to meet the Trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses;
- the likelihood of success of each alternative;
- the extent to which each alternative will prevent future injury as a result of the incident, and avoid collateral injury as a result of implementing the alternative;
- the extent to which each alternative benefits more than one natural resource and/or service; and
- the effect of each alternative on public health and safety.

The OPA regulations give the Trustees discretion to consider how to prioritize the criteria, and allow additional criteria to be used. The key criterion for the Trustees for the Westchester NRDA is the second in the list, because this criterion most clearly indicates whether the goal of making the public whole from losses resulting from the incident is met.

Based on a thorough evaluation of a number of factors, including the criteria listed above, the Trustees chose general preferred (now selected) restoration alternatives for primary and compensatory restoration of injured natural resources and/or services (highlighted in Table 5-1). Information relevant to the Trustees' selection of restoration alternatives is provided throughout the remainder of this chapter. In compliance with OPA and NEPA, the selection of restoration alternatives was finalized following public review and comment on the Draft DARP/EA.

#### 5.3.1 Primary Restoration

Based on observations made in the impacted area and on experience gained from recovery of

similar habitats from previous oil spill incidents, the Trustees determined that all affected habitats would recover to baseline condition within a reasonably short period of time. The dynamic nature of the Mississippi River was also a factor in this determination. All of the injured habitats are expected to recover to baseline conditions within one year of the incident. Therefore, the Natural Recovery (No Action) option was selected as the primary restoration alternative for injured habitats. In addition, based on the magnitude of the estimated injury and site conditions, the Trustees determined that no additional actions were necessary to aid in the recovery of aquatic fauna or birds. Therefore, the natural recovery (no action) option was selected as the primary restoration alternative for these resources. Additionally, human recreational use of the river and areas accessible via the river is believed to have returned to baseline conditions shortly after the reopening of the river to vessel traffic, eliminating the need to consider implementing any active primary restoration for this injury.

After determining the appropriate primary restoration alternative for each injury (in this case, natural recovery for all injuries), the Trustees can proceed to determine the type and size of compensatory restoration actions to make the environment and public whole for interim losses to injured resources and/or services (i.e., affected habitats, birds, aquatic fauna, and human use). The evaluation of compensatory restoration alternatives is addressed below.

### 5.3.2 Compensatory Restoration

Consideration of general compensatory restoration alternatives for the different injuries is described below.

#### 5.3.2.1 Habitats

Because interim losses of habitat services occurred during the period of recovery and technically feasible alternatives exist to compensate for these losses, the Trustees determined that compensatory restoration is required for injury to habitats, and the no compensation (no action) alternative was rejected. As discussed in Section 5.2, the preference under the OPA regulations is for in-kind restoration where possible and otherwise consistent with restoration selection criteria. Therefore in-kind restoration was first evaluated for each habitat type before considering other potential types of restoration. If in-kind restoration was not technically feasible, consistent with policies and regulations, cost-effective, or otherwise not appropriate, then other types of restoration that would provide similar services, were considered.

##### 5.3.2.1.1 Freshwater Vegetated and Delta Marsh Habitats

The ecological services provided by the impacted vegetated habitats along the river and out in the delta are similar in many respects, and were therefore treated as a single habitat category to simplify the Trustees' evaluation process. Marsh creation, a common restoration type for shoreline vegetation injuries, was considered as an in-kind restoration type for the injuries to freshwater vegetated and delta marsh habitats.

Marsh creation is an alternative that is consistent with the criteria used by the Trustees to evaluate restoration alternatives. Created marsh will provide an outflow of organic material that will

generally benefit the lower Mississippi River and delta ecosystem by providing a source of organic carbon (energy supply supporting deltaic aquatic and coastal foodwebs). Created marsh will provide services benefiting a wide range of resources, including benthic invertebrate species that inhabit marshes and the bird and fish species that feed on them. By providing critical nursery habitat for shrimp, fish, and other aquatic species, and nesting and foraging habitat for birds and other wildlife, created marsh will benefit recreational uses of the area by supporting increased populations of these species. Marshes located in the Mississippi River delta provide critical overwintering habitat for a large number of waterfowl. Therefore, this alternative would have clear overall benefits to the environment. Marsh would also benefit anglers by providing additional shoreline for enhanced fishing opportunities. Marsh creation projects typically have a high likelihood of success and tend to be very cost-effective to implement. Marsh creation is also consistent with state and federal government policies. Because in-kind restoration is feasible, cost-effective, and otherwise consistent with policies, marsh creation was chosen as the most appropriate restoration alternative for this injury.

Acquisition or preservation of existing marsh is another potential in-kind restoration alternative. This option is feasible and can, under certain circumstances, be highly beneficial. Acquisition and protection of existing marshes would have little negative impact compared to either creation or enhancement of marsh. No increase in service flows would occur through acquisition or protection alone. However, if a particular marsh site had unique qualities, its location was especially valuable, and its destruction was imminent, benefits derived by exercising this option might increase substantially. Therefore, unless a particular marsh site has these three characteristics, marsh acquisition would not be the preferred general alternative. The Trustees were not aware of any marsh with the required three characteristics in the vicinity of this incident to justify acquisition or preservation of existing marsh as the preferred general alternative.

Some out-of-kind restoration alternatives could also provide some of the vegetated habitat services lost. Oyster reef creation could provide habitat services, increase secondary production services, and other services that would serve as compensation for those lost in vegetated habitat. Because the injury to vegetated habitats is relatively small, use of an out-of-kind restoration alternative might be reasonable provided that that alternative was selected to compensate for other injuries. As discussed below, this is not the case for other ecological injuries for the Westchester incident. Therefore out-of-kind restoration alternatives are not appropriate to compensate for injury to freshwater riverine vegetated and delta marsh habitats.

#### 5.3.2.1.2 Rip-Rap Habitat

Loss of rip-rap habitat services could be compensated by the placement of additional rock material to create new rip-rap structure. This restoration alternative would most closely replace lost services, has a very high likelihood of success, and would be relatively cost-effective. However, rip-rap habitat is not as productive as other potential habitats, such as marsh or oyster reef, which would provide more benefits to other natural resources than would rip-rap. Oyster reef restoration in this area is problematic, as discussed below in evaluation of injury to aquatic fauna, so marsh creation is a more feasible type of restoration for rip-rap injury resulting from this incident. Additionally, because marsh creation was selected as the preferred restoration approach for other habitat types, it is relatively cost-effective to create additional marsh as compensation for this injury. Created marsh



habitat will provide many of the same services as rip-rap habitat, including erosion protection, refugia for organisms, and as a site for primary and secondary production. Marsh creation is therefore chosen as the preferred (now selected) compensatory restoration alternative for rip-rap injury.

#### 5.3.2.1.3 Sandflat Habitat

Similarly to the analysis of rip-rap habitat injury, in-kind restoration for sandflat injury is possible, but this injury is more appropriately compensated for by creation of marsh under the circumstances of this case. Created marsh will provide some of the same services as sandflats including habitat for benthic infauna and a site for primary and secondary production. Marsh will also provide many additional services, benefiting a wide-range of resources, above and beyond that provided by sandflat habitat. Additionally, because marsh creation was selected as the preferred restoration approach for other habitat types, it is relatively cost-effective to create additional marsh as compensation for this injury. Marsh creation is therefore selected as the compensatory restoration alternative for sandflat habitat injury.

#### 5.3.2.2 Aquatic Fauna

The Trustees determined that technically feasible and cost-effective alternatives exist to compensate for interim losses to aquatic fauna. Thus, the Trustees determined that compensation was necessary for this injury, rejecting the no compensation (no action) alternative. The Trustees considered three types of restoration actions to compensate for injuries to aquatic fauna. The first of these was in-kind restoration (stocking). Because a variety of aquatic species would be expected to be killed as a result of a large oil spill on the lower Mississippi River (including both marine and freshwater species), targeted restocking of a particular species would not be appropriate to restore all of the affected species. Restocking several species would increase the cost of this type of alternative, compared to other alternatives. Furthermore, the carrying capacity for some species may be limited by habitat; and, therefore, simply placing additional animals in the area does not necessarily result in increased populations. Trustees have often used some form of habitat restoration to support increased populations of many aquatic species as a cost-effective method for addressing injury to a large number of different species simultaneously. If there had been a large injury to a particular species or a limited number of species, then stocking of the affected species would be more appropriate as a restoration alternative than it is for this incident.

Oyster reef creation can be an appropriate type of restoration for aquatic injuries under many circumstances. Oyster reef would support many marine and estuarine organisms, including many species of fish, provide an area for increased secondary productivity, while providing additional benefits such as a site for recreational fishing. Oyster reefs cannot be created in freshwater areas. Therefore, for an incident that affected many freshwater species, oyster reef creation is not as appropriate as it would be for an incident occurring in estuarine or marine waters. Furthermore, oyster reef restoration would not be expected to be successful within the general vicinity of the incident, due to the general low salinity regime in the vicinity of the incident and also the limited availability of waterbottoms suitable for oysters with appropriate salinity conditions that are not already leased. For these reasons creation of an oyster reef was not considered further as a restoration alternative for this injury.

Marshes are widely recognized as providing a suite of critical services for aquatic life. Marshes serve as spawning and nursery areas for many species of juvenile fish and shellfish, export detritus to surrounding waters, and can increase water quality by filtering sediments and other pollutants from the water column. In addition, marsh habitat provides many collateral benefits such as habitat for birds and mammals. As already discussed, marsh creation will benefit recreational use of the area by increasing production of important recreational species and their prey items. Marsh creation can be successfully and cost-effectively implemented. The rapid loss of coastal marshes in Louisiana due to subsidence and erosion is a serious threat to the ecology and economy of Louisiana. Efforts to offset the amount of marsh loss due to natural and man-caused processes, through marsh creation projects, are widely supported throughout the state. In addition, marsh creation is consistent with state and federal policies concerning wetlands and essential fish habitat.

#### 5.3.2.3 Birds

The Trustees feel that technically feasible and cost-effective alternatives exist to compensate for interim losses to birds. Thus, the Trustees determined that the no compensation (no action) alternative was not appropriate compensatory restoration for this injury and considered three other alternatives for compensatory restoration: in-kind restoration through actions to directly increase bird populations, oyster reef creation, and marsh creation.

On two previous incidents occurring in inshore waters of the eastern half of Louisiana, the Trustees considered several actions that would directly compensate for bird losses by creating, enhancing, or protecting bird nesting sites: fenced enclosures to reduce predation on eggs and young, shelters to reduce predation on chicks, and wooden rafts and platforms to provide additional nesting sites. The goal of these actions would be to increase the number of fledgling birds. In some cases, these types of actions have been successful in increasing survivorship and augmenting avian populations. However, in the studies considered by the Trustees in evaluating this restoration alternative, success was greatest when the actions were taken in response to known problems that were limiting the reproduction of a specific, targeted species. The Trustees carefully considered and discussed these options with state and federal bird experts, including managers of nearby LDWF and USFWS wildlife refuges, when considering this option for the two previous incidents. The Trustees were discouraged from implementing these types of projects for those incidents, and circumstances of the Westchester incident were sufficiently similar to also reject this type of bird restoration alternative for this spill.

Another option considered was implementing habitat modifications to benefit birds. Among the type of action considered was to build up supratidal land with dredged material and to plant trees on this land. This type of restoration action would benefit neotropical migratory bird species by providing them with convenient resting locations. Another potential habitat modification considered was to remove exotic plant species and to plant native plants in their place. Although these types of actions would be very beneficial ecologically, the Trustees recognized that the bird species that would benefit from this alternative would primarily be different bird species than were affected by this incident. Bird species that were injured by the incident would benefit little from the implementation of this alternative. This factor was sufficient to end consideration of this form of restoration as a compensatory restoration alternative for this incident, given better alternatives.

The Trustees also considered creation of an oyster reef as a restoration alternative to benefit birds. A created oyster reef would serve as a substrate for increased secondary productivity, would support fish, and therefore could provide feeding areas for some bird species. If constructed appropriately, it could provide an important resting area for birds during low tides. As discussed in Section 5.3.2.2, oyster reef creation would also have some very positive benefits to fish, other organisms, and recreational fishing. Although technically feasible, creation of an oyster reef in the Mississippi River delta area is not practical because there are few available waterbottoms with appropriate salinity and bottom strata characteristics not currently leased for oyster production. Therefore, this alternative was not deemed viable for compensation for bird injuries.

The Trustees decided that the preferred (now selected) compensatory restoration action for bird injury is marsh creation within the Mississippi River delta. As discussed in Section 5.3.2.1.1, marshes provide many services including nesting, cover, and foraging habitat for a variety of bird species, including many of those species found to be injured. In addition, marshes export detritus to the surrounding aquatic environment, which serves as a food source for bird prey organisms. Given the importance of marsh as habitat for birds, and because of the many other collateral benefits marsh provides, the Trustees determined that creation of marsh was the most beneficial compensatory restoration alternative for bird injuries resulting from the Westchester incident. This selection is also a very cost-effective alternative given that marsh creation was chosen as the preferred (now selected) restoration alternative for other ecological injuries caused by this incident.

#### 5.3.2.4 Scaling Marsh Creation Requirements for Habitat, Aquatic Fauna, and Bird Injuries

The size of marsh restoration was determined using Habitat Equivalency Analysis (HEA), a resource-to-resource scaling approach that is used to determine compensation for lost services based on the quantification of incident-related natural resource injuries. HEA considers several project-specific factors in scaling restoration, including elapsed time from onset of injury to restoration implementation, relative productivity of restored habitats (that is, the proportional equivalence of ecological services provided by the compensatory restoration project compared to the baseline condition of the relevant injury categories), the time required for created habitats to reach full-function (i.e., maturity), and project lifespan. Therefore, identification of a preferred (now chosen) restoration project, with its own unique characteristics, was necessary before HEA could be applied. Section 5.4.1.2 discusses selection of the marsh creation alternative and provides a detailed description of project scaling using HEA.

#### 5.3.2.5 Human Recreational Use

Human recreational use was primarily affected by the restrictions on use of the Mississippi River, either directly as a result of the closure of the river to navigation or indirectly through inability to access the river due to closure of locks, use of launch sites by response personnel, and other factors. The Trustees therefore treated actions that would serve to increase access to the natural resources of the Mississippi River delta as in-kind restoration. Numerous alternatives exist that would act to increase access for hunting and fishing and that are feasible, cost-effective, and otherwise consistent with the restoration selection criteria. Therefore, the Trustees chose increasing access to natural resources in the Mississippi River delta as the general restoration alternative to compensate