The Louisiana Regional Restoration Planning Program

Draft
Regional Restoration Plan
Region 2

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Louisiana Department of Environmental Quality
Louisiana Department of Natural Resources
Louisiana Department of Wildlife and Fisheries
Louisiana Oil Spill Coordinator's Office, Office of the Governor
National Oceanic and Atmospheric Administration
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CHAPTER 1
INTRODUCTION

Federal and Louisiana natural resource trustees have developed a statewide Louisiana Regional Restoration Planning Program to assist the natural resource trustees in carrying out their Natural Resource Damage Assessment (NRDA)[1] responsibilities for discharges or substantial threats of discharges of oil (referred to herein as “incident(s)”). The goals of this statewide program are to: 1) expedite and reduce the cost of the NRDA process; 2) provide for consistency and predictability by describing in detail the NRDA process, thereby increasing understanding of the process by the public and industry; and 3) increase restoration of lost natural resources and services. Attainment of these goals will serve to make the NRDA process as a whole more efficient in Louisiana.

The Oil Pollution Act of 1990 (OPA), 33 USC 2701 *et seq*., and the Louisiana Oil Spill Prevention and Response Act of 1991 (OSPRA), La. Rev. Stat. 30:2451 *et seq*. are the principal Federal and State statutes, respectively, which authorize Federal and State agencies and tribal officials to act as natural resource trustees for the recovery of natural resource damages resulting from incidents in Louisiana. The Louisiana Regional Restoration Planning Program is established to address incidents in accordance with OPA and OSPRA. A complete description of the program is provided in the Louisiana Regional Restoration Planning Program Draft Programmatic Environmental Impact Statement (PEIS) (National Oceanic and Atmospheric Administration [NOAA] *et al.* 2003) which can be found at www.darp.noaa.gov.

This document is a draft Region 2 Regional Restoration Plan (RRP) and is the first of the nine regional plans being developed under the Louisiana Regional Restoration Planning Program (Figure 1). For each incident, as appropriate, the trustees will use the analyses from the PEIS and the relevant information from the RRPs to produce incident-specific Damage Assessment and Restoration Plan/Environmental Assessment.

[1] Natural resource damage assessment is the mechanism by which the trustees pursue damages from responsible parties to compensate the public for any injuries to natural resources.

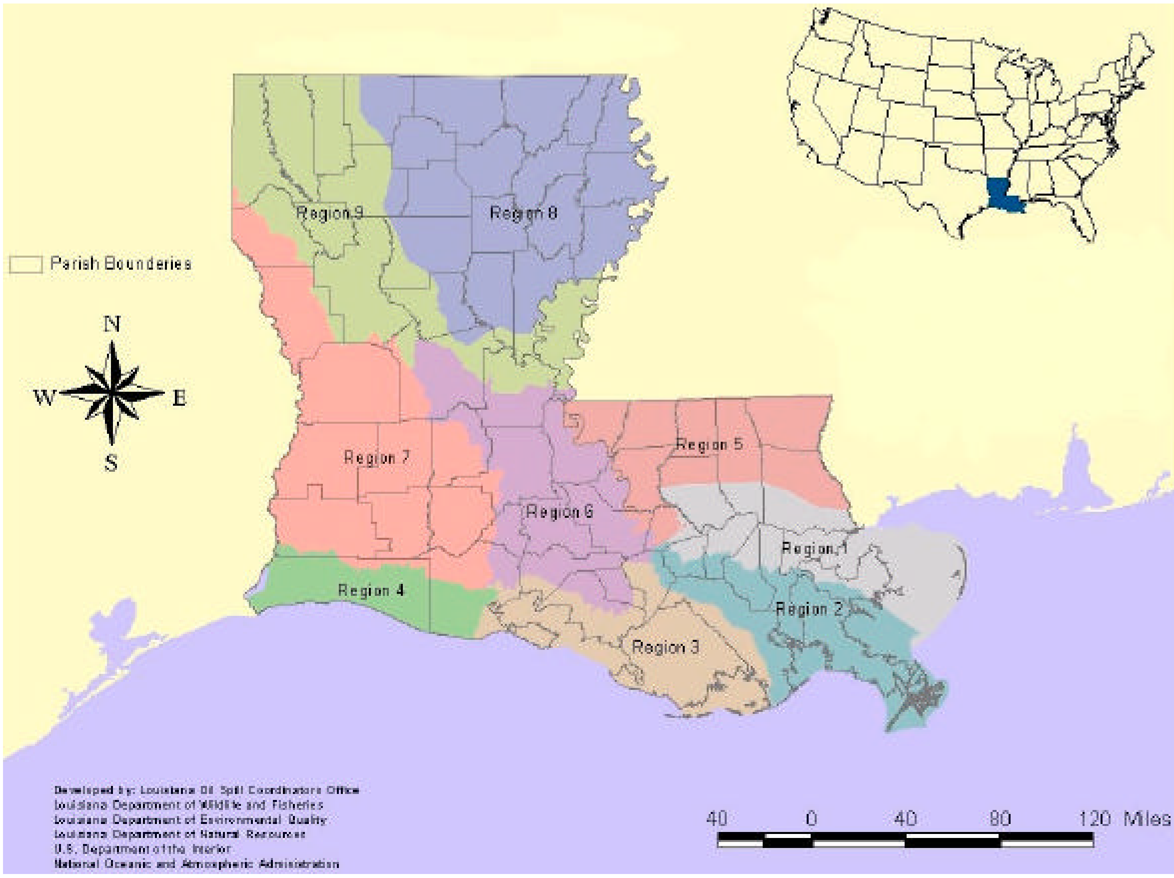

Figure 1: RRP Regions

This chapter provides summary background information on the Louisiana Regional Restoration Planning Program, including its goals, objectives, components, and benefits. Chapter 2 describes the boundaries of Region 2 and the affected environment. Chapter 3 describes the draft Region 2 RRP, including the natural resources/services that are likely to be injured by an incident, the appropriate restoration types for each of the potentially injured resources/services, and the available restoration projects which have been identified in Region 2. The appendices contain information about the biological resources and associated habitat types in Region 2 (Appendix A), the project solicitation form (Appendix B), the list of available Region 2 restoration projects according to restoration type (Appendix C), and technical papers providing the basis for the Region 2 unit costs for the Non-Project-Specific Cash Out Settlement (Appendix D).

<u>Louisiana Regional Restoration Planning Program Summary</u>

The Louisiana Regional Restoration Planning Program (NOAA *et al.* 2003) identifies the statewide program structure, decision-making process, and criteria that will be used to select the restoration project(s) that may be implemented to restore the natural resources injured by a given incident. Specifically, the Louisiana Regional Restoration Planning Program defines, expands, and/or refines the following important components of the existing NRDA process:

- Potentially injured resources/services;
- Restoration types (including nexus analysis[2], and environmental consequences analysis of implementation);
- Settlement alternatives;
- Screening criteria; and
- Regional boundaries of the RRPs.

Potentially Injured Resources/Services

The Louisiana Regional Restoration Planning Program PEIS defines those natural resources and services in Louisiana that are likely to be injured (*i.e.*, at risk) by oil spills as potentially injured resources/services. Identification of these potentially injured resources/services will facilitate the expedient development of restoration alternatives during the restoration planning phase. The potentially injured resources/services are listed under three broad categories: coastal, inland, and statewide.

Restoration Types

The Louisiana Regional Restoration Planning Program PEIS identifies restoration types that are appropriate for the restoration of injuries for each of the identified potentially injured resources/services in the Louisiana Regional Restoration Planning Program. These restoration type categories are:

- Creation/Enhancement
- Physical Protection of Habitat
- Acquisition/Legal Protection
- Stocking of Fauna
- Physical Protection of Fauna
- Restoration of Recreation Resource Services
- Restoration of Cultural Resource Services

The Louisiana Regional Restoration Planning Program PEIS describes the specific restoration type(s) in each restoration type category that is appropriate for the restoration of injuries to each of the identified potentially injured resources/services in the Louisiana Regional Restoration Planning Program. This determination of the range of appropriate restoration types was based on a nexus analysis. The trustees also conducted an environmental consequences analysis on the restoration types by

[2] According to the NRDA regulations at 15 CFR §990, trustees must consider compensatory restoration actions that provide services of the same type and quantity, and of comparable values as those lost. Restoration types are evaluated to determine how well the restoration would address the injuries to potentially injured resource/services affected by the incident.

evaluating impacts of implementing various restoration techniques. Both analyses will result in technical, process, and NEPA compliance efficiencies at the case level during the restoration planning phase. The trustees will be able to use relevant analysis and information from the Louisiana Regional Restoration Planning Program PEIS to produce the incident(s)-specific Damage Assessment and Restoration Plans (DARPs) and environmental assessment(s).

The trustees have also developed restoration type selection criteria that will assist in determining which of the various restoration types identified will be most appropriate to restore the resources/services injured during a given incident. It is anticipated that the criteria will also provide a level of predictability to the public and affected parties regarding restoration project selection. Furthermore, projects in each RRP will be classified by restoration type to facilitate the selection of specific restoration projects based on the type of resource(s) injured. This approach will streamline the process of evaluating and selecting preferred restoration project(s) for review by the public.

Settlement Alternatives

The Louisiana Regional Restoration Planning Program PEIS describes a number of additional case settlement alternatives that will assist the trustees and Responsible Parties in negotiations to resolve Responsible Party liabilities for incidents. These settlement alternatives generally represent different ways of resolving liability from an incident under one or the other (or both) of the two options: Responsible Party implemented restoration, or Responsible Party cash settlement and trustee implemented restoration. These settlement alternatives also may provide opportunities for implementing restoration projects more quickly and cost-effectively; *e.g.*, ;pooling settlements to implement larger projects than could otherwise be accomplished by using individual settlements, and potentially facilitating implementation of more ecologically significant projects.

Screening Criteria

In order to improve the consistency, predictability, and accountability of the NRDA decision-making process, the trustees identified and defined project selection and other screening criteria to be used in implementing the Louisiana Regional Restoration Planning Program, including:

- Selection of restoration projects to be incorporated into each RRP;
- Selection of most appropriate restoration type(s) to restore the injured resources/services in a case (discussed above);
- Selection of projects for implementation under the Non-Project-Specific Cash Out alternative; and
- Project selection/screening of specific restoration actions required for a case.

Regional Boundaries of the RRPs

The Louisiana Regional Restoration Planning Program identifies nine regions for which regional plans will be developed. Identifying regions within the Louisiana Regional Restoration Planning Program will facilitate tracking of cases, settlement accounting, and oversight of assessment and restoration-related activities. The boundaries of the four coastal regions are based on the Coast 2050 Plan regions(Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998), and the boundaries of the five inland regions are based on the Louisiana Department of Environmental Quality (LDEQ) defined (Louisiana Department of Environmental Quality 2000) watersheds. A separate RRP will be developed for each of these regions which will identify the resources and/or services that could potentially be affected by an incident and a list of restoration projects that are available for implementation within that region. The Region 2 RRP is the first of those plans to be developed.

Summary of Program Benefits

The Louisiana Regional Restoration Planning Program, including the region-specific RRPs, is intended to benefit the public, industry, and natural resource trustees by:

- Providing greater opportunities to restore injuries to trust resources/services;
- Expediting restoration of injured resources/services from incidents;
- Reducing the cost of restoration planning and implementation;
- Pooling of individual case recoveries to provide for implementation of larger, more ecologically significant restoration projects;
- Providing for more consistency and predictability by describing in detail the NRDA process, thereby increasing understanding of the process by the public and industry;
- Improving coordination between restoration activities under the NRDA mandates and other restoration efforts in the State of Louisiana (State);
- Enhancing the capability for trustees to restore resources/services injured by incidents for which there is no viable Responsible Party;
- Maximizing opportunities for partnering among Responsible Parties, trustees, and other public and private restoration efforts; and
- Increasing opportunity for public participation in the NRDA process through pre-incident planning.

CHAPTER 2
REGION 2 - DESCRIPTION

This chapter describes the geographic boundaries, environment, and resources in Region 2.

Region 2 Boundaries

Region 2 encompasses the Breton Sound and Barataria hydrologic basins and the lower Mississippi River basin, delta plain, and modern Balize (Birdsfoot) delta, including State waters in the Gulf of Mexico. Bordered to the north by the headwaters of Bayou Lafourche and the Mississippi River, Region 2 extends south to the Caminada-Moreau Headland, Plaquemines barrier system, and Birdsfoot delta, and from Bayou Lafourche along its western border to the Mississippi River and Mississippi River Gulf Outlet along its eastern border. The following parishes are located either partly or completely within Region 2: Ascension, Assumption, Jefferson, Lafourche, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, and St. John the Baptist.

Affected Environment and Biological Resources

A summary description of the environment and resources that may be impacted by the implementation of the Louisiana Regional Restoration Planning Program in Region 2 is provided below.

Physical Environment

Coastal Louisiana, which includes Region 2, has been formed over the last 7,500 years and is the result of delta formations. The modern deltaic coastal plain is experiencing land loss on the order of 25 to 30 square miles of marsh each year due to the combined effects of levee construction, subsidence, and associated hydrologic changes (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998). Region 2 is comprised primarily of Alluvial soils and Gulf Coast marsh soils, as described by Johnson and Yodis (1998). The Mississippi River runs through or adjacent to Ascension, St. Bernard, St. James, St. John the Baptist, St. Charles, Jefferson, Orleans, and Plaquemines parishes.

Region 2 ground water is primarily contained within the Chicot Equivalent Aquifer System (Stuart *et al.* 1994). Region 2 encompasses the Breton Sound and Barataria hydrologic basins and the lower Mississippi River basin, delta plain, and modern Balize (Birdsfoot) delta. The surface waters in Region 2 range from fresh to saline.

Biological Resources

As Figure 2 illustrates, Region 2 habitats are dominated by coastal herbaceous wetlands (*i.e.*, fresh, intermediate, brackish, and salt marsh) and open waters in the seaward areas, while forested wetlands with some agricultural cropland/grassland and upland vegetated habitat occur in the interior portions of the Region. The following habitat types are present in Region 2 (Detailed descriptions of each are provided in the PEIS, Appendix B):

- Marsh (Salt, Brackish/Intermediate, Fresh)
- Wetland Forest (Evergreen, Deciduous, and Mixed)
- Wetland Shrub/Scrub (Evergreen, Deciduous, and Mixed)
- Agriculture-Cropland-Grassland
- Wetland Barren
- Open Water
- Marine/Estuarine Shore
- Freshwater Shore
- Marine/Estuarine and Freshwater Benthic (soft-sedimentary)
- Marine/Estuarine Encrusting Community (natural/artificial substrates)
- Living Reefs
- Marine/Estuarine Submerged Aquatic Vegetation (SAV)
- Mangrove Swamp
- Batture
- Upland Vegetation (Upland Forest, Upland Scrub/Shrub)

Common biota associated with these habitat types are summarized in Appendix A (Vegetation, A-1; Mammals, A-2; Reptiles and Amphibians, A-3; Birds, A-4 through A-9; Fish and Shellfish, A-10). Detailed descriptions of wildlife species associated with these habitat types are also described in the PEIS, Appendix B.

The Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority, as part of their Coast 2050 plan (1998), identified 21 wildlife species and species groups that rely on the habitats in Region 2 for all or part of the year. These include wading birds, seabirds and shorebirds, raptors, woodland residents including various birds and mammals, and the American alligator.

As of April 2003, the published list of Threatened and Endangered Species for the State of Louisiana includes 31 animal and three plant species (U.S. Department of the Interior, Fish and Wildlife Service 2003). The following 12 threatened and endangered animal species are found in Region 2 (Appendix A; Table A-11): inflated heelsplitter (*Potamilus inflatus*); bald eagle (*Haliaeetus leucocephalus*); brown pelican (*Pelecanus occidentalis*); piping plover (*Charadrius melodus*); green sea turtle (*Chelonia mydas*); hawksbill sea turtle (*Eretmochelys imbricata*); Kemp's Ridley sea turtle (*Lepidochelys kempii*); leatherback sea turtle (*Dermochelys coriacea*); loggerhead sea turtle (*Caretta caretta*); gulf sturgeon (*Acipenser* *oxyrinchus desotoi*); and pallid sturgeon (*Scaphirhynchus albus*); and West Indian manatee (*Trichechus manatus*). Critical habitat has been designated for the piping plover and gulf sturgeon. There are no endangered plants identified in Region 2.

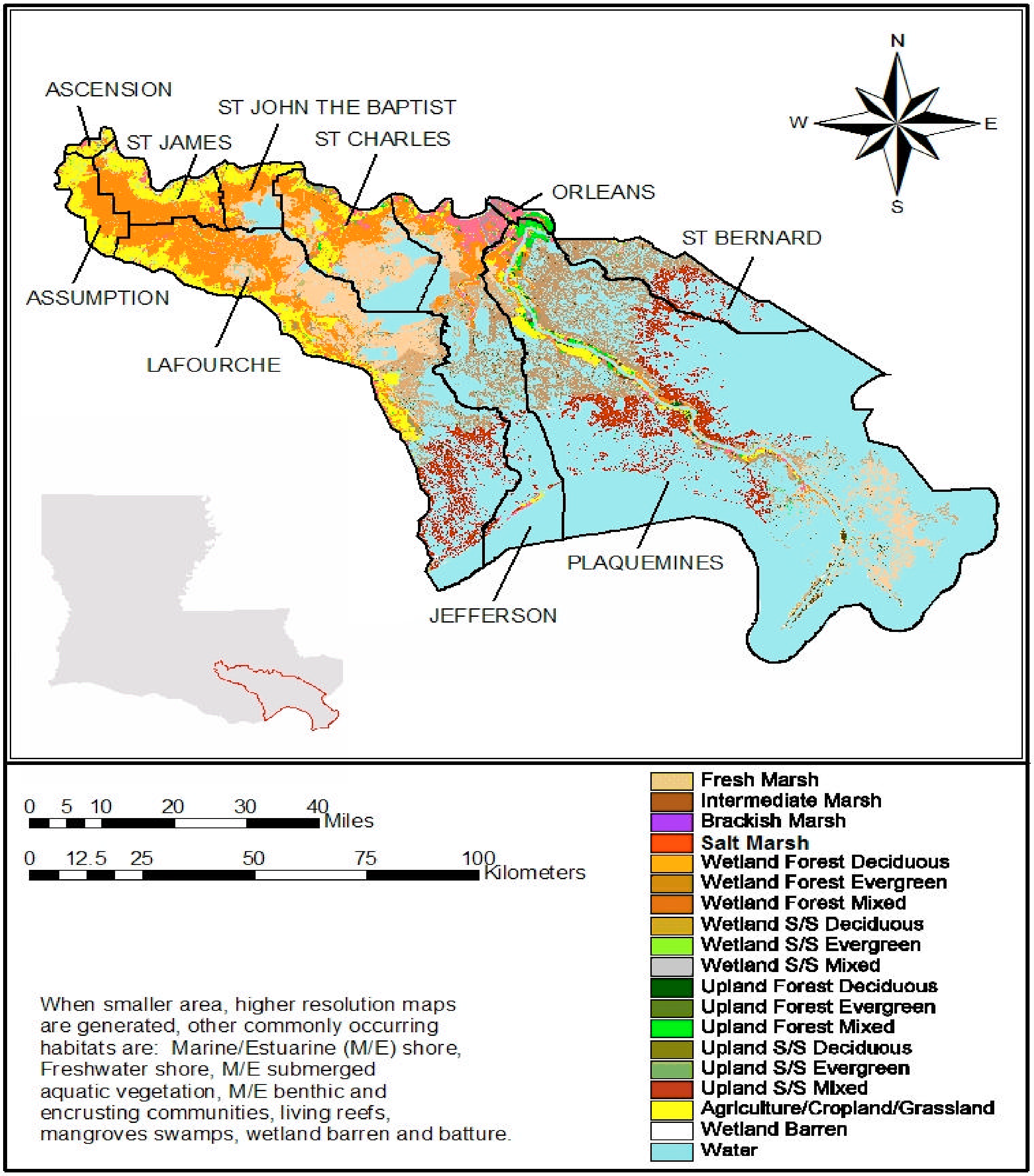

Figure 2: Region 2 Boundary, Parishes, and Associated Habitat Types (adapted from Hartley *et al.* 2000)

Socio-Economic Resources

Infrastructure within Region 2 includes 13 highways (that pass through or border the region), 77 miles of primary roads, 322 miles of secondary roads, 2,631 miles of tertiary roads, and approximately 218 miles of railroads (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998). Major bridges within or adjacent to Region 2 include the Sunshine Bridge, the bridge at I-310, the Huey P. Long Bridge, and the Crescent City Connection. In addition, smaller crossings over Bayou Lafourche include, but are not limited to, bridges at Rita, Raceland, Thibodaux, Freetown, and Plattenville. There are numerous private helipads in Region 2, and the nearest public heliport is located just north of Region 2 at the Louis Armstrong New Orleans International Airport. In addition, there are numerous sea planes available in the Region to rent from private companies. Commercial and recreational ports located either within or adjacent (when noted) to Region 2 include:

- Port Fourchon
- New Orleans (adjacent)
- Braithwaite
- LaPlace (adjacent)
- Grand Isle
- Metarie (adjacent)
- Empire-Venice port
- Delacroix port
- Grand Isle port
- Lafitte port

The Gulf Intracoastal Waterway, a critical shallow-draft transportation link, traverses Region 2. In addition, the Bayou Segnette Waterway, South Pass Channel, U.S. Army Corps of Engineers maintained Barataria Bay Waterway, and the waterway from Empire to the Gulf of Mexico traverse Region 2. The Mississippi River main stem levee system, comprised of levees, floodwalls, and various control structures, traverses Region 2.

The inland waters, coastal marshes, and offshore waters of Region 2 support commercial fishing and aquaculture industries. There is little forest industry in Region 2. Sugarcane, citrus, and commercial fruits and vegetables are important agricultural products. Animal furs and alligator skins are also important commodities in Region 2.

Oil and gas production is important in the region. There are more than 1,500 miles of oil and gas pipelines and more than 15,000 oil and gas wells located within Region 2 (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998). The Louisiana Offshore Oil Port (LOOP), which provides deepwater tanker offloading and temporary storage of crude oil, has a pipeline that delivers product onshore through

Barataria Bay to Clovelly Farms. LOOP receives approximately 13 percent of the United States' imported crude oil. Onshore salt domes located near Galliano have a 40 million barrel capacity to receive oil from the LOOP terminal (LA 1 Coalition 2003).

Region 2 has both State and National Parks that provide for the recreational use and/or preservation of natural and cultural resources. Bayou Segnette and Grand Isle State Parks are both located in Jefferson Parish. Jean Lafitte National Historic Park and Preserve, operated by the National Park Service, is located in Orleans Parish. In addition, residents of and visitors to Region 2 take advantage of the numerous habitat types and wildlife and fisheries resources, which provide opportunities for wildlife viewing, hunting, fishing, boating, swimming, hiking, biking, camping, and picnicking. Tourism in Orleans and Jefferson Parishes alone is a $4+ billion dollar industry (Louisiana Department of Culture, Recreation, and Tourism [LCRT] 2001). Within Region 2, the Louisiana Department of Wildlife and Fisheries (LDWF) manages the four Wildlife Management Areas (WMAs) of Salvador/Timken, Wisner, Maurepas, and Pass-a-Loutre. The U.S. Fish and Wildlife Service (USFWS) manages the Delta and Breton National Wildlife Refuges. Bayou Des Allemands borders Lafourche and St. Charles Parishes and is a State-designated scenic river.

CHAPTER 3
REGIONAL RESTORATION PLAN

The Region 2 RRP is made up of the following components: 1) an identification of potentially injured resources/services; 2) an identification of one or more restoration types appropriate for each of the potentially injured resources/services in Region 2; 3) restoration projects in Region 2 that have been identified for this RRP[3]; 4) the criteria for selecting restoration types and restoration projects during a NRDA for a given incident; and, 5) the basis for settlement of a damage assessment claim. These components are described below with references to the PEIS and appendices as appropriate.

Potentially Injured Natural Resources and Services

As described in the PEIS, the Louisiana Regional Restoration Planning Program defines those natural resources and services in Louisiana that are likely to be injured (*i.e.*, at risk) by incidents as potentially injured resources/services. Pre-identification of at-risk resources will assist in the coordination of response activities by informing agency personnel who are participating in the incident response (*i.e.*, cleanup) of resources that may be of greatest concern to the trustees. The potentially injured resources/services in Region 2 are defined under three broad categories: coastal, inland, and regionwide.

The following describes the potentially injured resources/services found in Region 2[4].

Coastal

Herbaceous Wetlands
Herbaceous wetlands are primarily salt, brackish/intermediate, and fresh marshes located in or near the coastal zone and alluvial basin. The marshes of the Mississippi River delta complex and other similar areas in Louisiana support a mix of freshwater, estuarine, and marine species. These wetlands are vital habitat for various fish, mammals, and resident and migratory birds. As considered here, this category includes marsh plants and the invertebrates, bacteria, algae and sediments associated with the vegetation that contribute to marsh habitat functions.

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[3] Trustees are not strictly limited to the selection of projects contained in this RRP, but may consider other restoration projects as appropriate.
[4] The list under the Biological Resources section of Chapter 2 identifies habitat types in Region 2. The list provided in this section and in the header of Figures 3 and 4 is potentially injured natural resources and services (which includes, but is not limited to, habitat).

Forested Wetlands
Forested wetlands are wetland areas dominated by woody vegetation. They usually consist of an overstory of large trees, an understory of young trees or shrubs, and an herbaceous layer. As considered here, this category includes the trees, understory vegetation, soils, closely associated invertebrates, and the services that this habitat provides to other resources.

Beaches/Shorelines/Streambeds
Unvegetated beaches and shorelines in coastal waters include the perimeters of headlands, barrier islands, estuaries and bays, tidal mudflats and river deltas. This zone begins at the lowest part of the intertidal zone (*i.e.*, mean lower low water) and extends into the supratidal zone. As considered here, this injury category includes the invertebrates that burrow and/or live in this habitat. It encompasses all ecological functions performed by this habitat, including, among others, primary production by benthic diatoms in the intertidal zone and secondary production by grazers, but does not include human recreational services.

Streambeds include all water channels, which are defined by Langbein and Iseri (1960) as natural or artificial open conduits that periodically or continuously contain moving water, or that form a connecting link between two bodies of standing water. Streambeds containing flowing water include seasonally flooded, temporarily flooded, intermittently flooded, irregularly exposed, regularly flooded, irregularly flooded, seasonal-tidal, or temporary-tidal water regimes. As considered here, this injury category includes the substrate (soils/sediments and hard surfaces) and closely associated invertebrates, and includes all ecological functions performed by this habitat (Cowardin *et al.* 1979).

Oyster and Other Reefs
This category considers living reefs in marine and estuarine waters. As considered here, living reefs encompass oysters, mussels, and/or other benthic organisms that contribute to the reef structure, and the fauna and flora that attach to or are closely associated with these reefs. It also includes all ecological services this habitat provides to other natural resources.

Water Column Organisms
As considered here, this category consists of planktonic (*i.e.*, drifting) (including larval fish) and nektonic (*i.e.*, swimming) organisms in marine and estuarine waters, and the ecological services these organisms provide to other resources. It also includes large mobile crustaceans, such as crabs and shrimp, and demersal fishes which live on or near the seafloor.

<u>Inland</u>

Herbaceous Wetlands
Inland herbaceous wetlands are generally those environments that experience periodic flooding and are comprised of emergent vegetation having little or no woody

tissue. This definition refers specifically to the inland geographic areas where freshwater flow regimes prevail throughout the year and salt water does not typically penetrate from the coast. These wetlands support a diverse group of fish, invertebrates, reptiles, amphibians, birds and mammals. As considered here, this category includes marsh plants, invertebrates, bacteria, algae closely associated with the plants, and sediments, as well as all marsh habitat functions.

Forested Wetlands

Forested wetlands are characterized by woody vegetation that is at least 18.5 feet tall. They occur in freshwater systems and normally possess an overstory of tall/mature trees, an understory of young trees or shrubs, and an herbaceous layer. Specific examples of this habitat in Louisiana are wetland forest (evergreen, deciduous, and mixed) and swamp. As considered here, this category includes the trees, understory vegetation, soils, closely associated invertebrates, and the services that this habitat provides to other resources.

Beaches/Shorelines/Streambeds

Unvegetated beaches and shorelines in fresh waters include, but are not limited to, lakefronts, pond shores, mudflats, and riverbanks. As considered here, this injury category includes the invertebrates that burrow and/or live in this habitat. It encompasses all ecological functions performed by this habitat, including, among others, primary production by benthic algae and secondary production by grazers, but does not include human recreational services.

Streambeds include all wetlands contained within the intermittent subsystem of the riverine system. Water regimes are restricted to irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, and intermittently flooded. As considered here, this injury category includes the substrate (soils/sediments and rocks) and closely associated invertebrates, and includes all ecological functions performed by this habitat.

Upland Vegetation

This category includes vegetated urban, agricultural-cropland-grassland, upland shrub/scrub (deciduous, evergreen, and mixed), and upland forest (deciduous, evergreen, and mixed). It encompasses trees as well as understory vegetation, soils, and invertebrates in the soil or associated with plants, and the services this habitat provides to other resources.

Water Column Organisms

As considered here, this category consists of both planktonic (including larval fish) and nektonic organisms, such as fish that live in fresh waters streams, ponds, swamps, and lakes. It also includes the ecological services these organisms provide to other resources.

Regionwide (Coastal/Inland)

Birds
Common resident and migratory birds that are found in coastal and inland areas of Region 2, and tables describing habitat use by season are listed in Appendix A, Tables A-4 through A-9.

Wildlife
Common mammals, reptiles, and amphibians from all habitats in Region 2 habitats are listed in Appendix A, Tables A-2 and A-3 and are included in this category. This injury category can also include the ecological services these organisms provide to other resources.

Recreational Resource Services
Human recreational services are provided by habitats and/or areas throughout Region 2. Indirect activities (*i.e.*, hiking, biking, picnicking, or jogging) and direct activities (*i.e.*, bird and wildlife viewing, hunting, fishing, boating, or swimming) all take place in Region 2 and therefore are included in this category. This category does not, however, include the resources themselves that are involved in the activity.

Cultural Resource Services
Cultural resource services is a broad term that includes prehistoric, historic, architectural, and traditional cultural services that flow from natural resources that have cultural attributes. Such attributes in Louisiana include lands, travel routes, burial sites, ceremonial sites, battle grounds, Indian mounds, middens, etc., generally in excess of 50 years of age, that represent the history and culture of the region as perceived by the public or cultural scientists. While all State and local historic preservation groups may contribute to the list of State cultural resource sites or attributes, the Louisiana State Preservation Office, State Indian Tribes, and Department of the Interior are primarily responsible for designating Louisiana's cultural resource sites and attributes. Biological resources can have cultural significance and values under specific conditions. As an example, a bald eagle may have spiritual/religious importance to native tribes. Its loss or injury would constitute not only natural resource injury but a loss of cultural resource services as well. Therefore this category includes all cultural resource services that natural resources in the State may provide.

Restoration Types

In accordance with OPA and OSPRA, trustees must design a restoration program that restores, replaces or acquires the equivalent of the injured resource or lost services. To ensure that the Louisiana Regional Restoration Planning Program addresses this mandate, the trustees: 1) conducted a nexus analysis to identify one or more appropriate restoration types for each of the potentially injured resources/services in the region; 2) developed restoration type screening criteria to assist in the selection of the most appropriate restoration type(s) to restore resources/services injured during a given incident; and 3) developed screening criteria to aid in selecting the most appropriate restoration project(s) for a given incident.

Detailed results and descriptions of the nexus analyses are presented in Section 3.2.4 of the PEIS, and are summarized in Figures 3 and 4, excerpted from the PEIS. As shown in Figures 3 and 4 below, the restoration types identified for Region 2 include the following seven broad categories (See Section 3.2.3 of the PEIS for a detailed description):

- Creation or enhancement of a habitat;
- Physical protection of a habitat;
- Acquisition or legal protection of a resource;
- Stocking of fauna;
- Physical protection of fauna;
- Restoration of recreational resource services; and
- Restoration of cultural resource services.

COASTAL			POTENTIALLY INJURED RESOURCES/SERVICES								
			Herbaceous Wetlands	Forested Wetlands	Beaches/Shorelines/ Streambeds	Oyster Reefs (& other)	Water Column Org.	Birds	Wildlife	Recreational	Cultural
RESTORATION TYPES	Creation/ Enhancement	Coastal Herbaceous Wetlands	v	v		v	v	v	v	v	
		Coastal Forested Wetlands	v	v			v	v	v	v	
		Coastal Beaches/Shorelines/Streambeds			v		v	v	v	v	
		Coastal Oyster Reefs (& other)				v	v	v	v	v	
		Coastal Artificial Reefs				v	v	v	v	v	
		Coastal SAV	v			v	v	v	v	v	
	Physical Protection of Habitat	Coastal Herbaceous Wetlands	v	v		v	v	v	v	v	
		Coastal Forested Wetlands	v	v			v	v	v	v	
		Coastal Beaches/Shorelines/Streambeds			v		v	v	v	v	
	Acquisition/ Legal Protection	Coastal Herbaceous Wetlands	v	v		v	v	v	v	v	
		Coastal Forested Wetlands	v	v			v	v	v	v	
		Coastal Beaches/Shorelines/Streambeds			v		v	v	v	v	
		Coastal Oyster Reefs (& other)				v	v	v	v	v	
		Coastal SAV	v				v	v	v	v	
	Stocking of Fauna	Coastal Water Column Org.					v			v	
		Coastal Oyster Reefs (& other)				v	v			v	
		Birds						v		v	
		Wildlife							v	v	
	Physical Protection of Fauna	Birds						v		v	
		Wildlife							v	v	
	Recreational Services									v	
	Cultural Services										v

Figure 3: Coastal Restoration Types by Resource/Service Category (NOAA *et al.* 2003)

INLAND			POTENTIALLY INJURED RESOURCES/SERVICES								
			Herbaceous Wetlands	Forested Wetlands	Beaches/Shorelines/ Streambeds	Upland Vegetation	Water Column Org.	Birds	Wildlife	Recreational	Cultural
RESTORATION TYPES	Creation/ Enhancement	Inland Herbaceous Wetlands	v				v	v	v	v	
		Inland Forested Wetlands		v			v	v	v	v	
		Inland Beaches/Shorelines/Streambeds			v		v	v	v	v	
		Inland Upland Vegetation				v	v	v	v	v	
	Physical Protection of Habitat	Inland Herbaceous Wetlands	v				v	v	v	v	
		Inland Forested Wetlands		v			v	v	v	v	
		Inland Beaches/Shorelines/Streambeds			v		v	v	v	v	
		Inland Upland Vegetation				v	v	v	v	v	
	Acquisition/ Legal Protection	Inland Herbaceous Wetlands	v				v	v	v	v	
		Inland Forested Wetlands		v			v	v	v	v	
		Inland Beaches/Shorelines/Streambeds			v		v	v	v	v	
		Inland Upland Vegetation				v	v	v	v	v	
	Stocking of Fauna	Inland Water Column Org.					v			v	
		Birds						v		v	
		Wildlife							v	v	
	Physical Protection of Fauna	Birds						v		v	
		Wildlife							v	v	
	Recreational Services									v	
	Cultural Services										v

Figure 4: Inland Restoration Types by Resource/Service Category (NOAA *et al.* 2003)

Restoration Type Screening Criteria

As described in Section 3.2.4.1.5 of the PEIS, the trustees have developed restoration type selection criteria to assist in determining which of the various restoration types (Figures 3 and 4) will be most appropriate to restore the resources/services injured during a given incident.

These restoration type selection criteria are based in part on the OPA regulations (Sections 990.54(a)(1-6)) and include (see Section 3.2.4.1.5 in PEIS for definitions):

- Strength of Nexus to the Injury;
- Scalability;
- Degree to Which Restoration Type Addresses Multiple Injuries;
- Availability of Projects for this Restoration Type in RRP; and
- Other Case Specific Parameters.

Project Selection Screening Criteria

The trustees will select the appropriate restoration types, conduct initial scaling and select a set of potential project alternatives (including a preferred alternative), and provide the draft restoration plan to the public for review under OPA, NEPA, and other applicable statutes and regulations. In order to provide consistency, predictability, and accountability in this phase of the NRDA decision-making process, the trustees established project selection/screening criteria to assist in selecting the preferred restoration project(s).These project selection screening criteria are based in part on the OPA regulations (Section 990.54(a)(1-6)) as described in Section 3.2.4.2 of the Louisiana Regional Restoration Planning Program PEIS. These include:

- Project Cost-Effectiveness (including ability to partner);
- Proximity to Affected Area;
- Scalability;
- Extent of Benefit to Injured Resources/Services;
- Technical Feasibility and Likelihood of Success;
- Avoidance of Future Additional Injury Resulting from Project;
- Degree to Which Project Addresses Multiple Injuries;
- Public Health and Safety;
- Ability to Implement Project with Minimal Delay;
- Degree to Which Project Supports Existing Strategies/Plans; and
- Project Urgency.

A final restoration plan will be issued for public comment prior to implementing the selected restoration project(s).

Special Circumstances

If an incident occurs that affects resources and services in more than one RRP region, the trustees may select a restoration project(s) in any of the affected regions. In other cases, the trustees may find that in applying the restoration type and/or project selection criteria, the most appropriate restoration project(s) for an incident in one region is located outside that region. In both cases, in accordance with the law, regulation and criteria above, the trustees will select the restoration project(s) that will provide the closest nexus between the injuries and restoration in the most cost-effective manner.

Restoration Projects in Plan

Each region-specific RRP includes a list of restoration projects identified in that region. These project lists are not intended to be final, and will be periodically updated as appropriate projects are identified for inclusion. Further, trustees are not strictly limited to selecting projects contained in the lists, but rather can refer to the project lists as tools for expediting settlements. The projects were identified through a two-step process: 1) projects were solicited from the public, government agencies, and industry; and 2) the restoration projects that were submitted were reviewed relative to the criteria for incorporation into the RRP as defined in the Section 3.2.1 of the PEIS.

RRP Project Solicitation

Solicitation of projects for inclusion in the RRP regional plans began during the informal scoping meetings conducted in October 2000 through Spring 2001. Project solicitation will continue as an ongoing process, and the projects lists will be updated as additional projects are identified.

In June 2001, the “Louisiana’s Proposed Louisiana Regional Restoration Planning Program, Public Review Document (PRD)” was finalized and the formal scoping of the Louisiana Regional Restoration Planning Program and project solicitation began. Over 1000 copies of the PRD were distributed to the public and affected parties on or before July 2, 2001. Each PRD disseminated included a Project Information Sheet (see Appendix B) and directions for public and private groups to submit projects to be considered for implementation. Six public meeting were held throughout the State of Louisiana in July 2001 (see Section 8.3 of the Louisiana Regional Restoration Planning Program PEIS).

In addition to the six public meetings, 16 additional project solicitation meetings were conducted (see Table 1).

Table 1: Project Solicitation Meetings for Region 2 RRP

Organization	Event	Date
Louisiana Department of Natural Resources/Coastal Management Division - Coastal Zone Management	Quarterly Parish Meeting	05/22/2002
Lafourche Parish	CZM Advisory Committee	07/16/2002
St. James Parish	CZM Advisory Committee	07/31/2002
Barataria-Terrebonne National Estuary Program	Informal Meeting	08/13/2002
St. Charles Parish	Informal Meeting	08/23/2002
Ascension Parish	Informal Meeting	08/26/2002
Inter-Tribal Council	Informal Meeting	08/27/2002
Ducks Unlimited	Informal Meeting	08/28/2002
Jefferson Parish	Informal Meeting	08/29/2002
U.S. Department of Agriculture - Natural Resources Conservation Service	Informal Meeting	09/16/2002
Plaquemines Parish	CZM Advisory Committee	09/17/2002
Lafourche Basin Levee District	Board of Commissioners	10/08/2002
Lafourche Basin Levee District	Board of Commissioners	11/27/2002
LA Department of Wildlife and Fisheries	Informal Meeting	02/25/2003
Louisiana Department of Natural Resources/Small Dredge Program	Informal Meeting	04/30/2003
Louisiana Department of Natural Resources/Coastal Restoration Division	Informal Meeting	06/10/2003

Region 2 RRP Restoration Project Selection

As of June 30,2003, 124[5] projects were received for the Region 2 RRP. A group of State and Federal trustees reviewed each submitted project relative to the criteria for incorporation into the RRP as defined in the PEIS in Section 3.2.1. If a project did not meet all of the criteria, it was not included in the Region 2 RRP. Table C-1 lists the projects that have met the screening criteria for inclusion in the Region 2 RRP. Table C-2 lists projects that have not met the screening criteria.

[5] The Coastwide Nutria Control Program and the Small Dredge Program submitted project information sheets containing information about the respective programs. However, project-specific information was not provided and these submittals could not be evaluated to include as projects in the Region 2 RRP. Projects submitted by these and other programs will be considered for inclusion in the Region 2 RRP.

Settlement Calculation

The Louisiana Regional Restoration Planning Program offers a number of settlement alternatives to assist the trustees and Responsible Parties in resolving the Responsible Partys' natural resource damage liability for incidents. As a requirement of settlement, the Responsible Party(s) or the trustees will be implementing a restoration project(s) to compensate for the injured resources and services lost as a result of an incident. These settlement alternatives are described in detail in Sections 3.2.6 of the PEIS.

Regardless of the specific settlement alternatives selected to restore the injured resources/services lost from a given incident, the financial responsibilities of the Responsible Party include: the costs associated with injury assessment, project planning (site selection, feasibility analyses, engineering and design, permitting, conservation easements, etc.), project implementation, monitoring, operations and maintenance, trustee oversight and administrative costs, corrective actions, contingencies, and any other project-related costs that may foreseeably arise throughout the life of the project.

RP Implemented Restoration Project

If a Responsible Party chooses to implement a restoration project itself or through a contracted third party, the settlement calculation will consist primarily of the cost associated with the trustees' costs to conduct the injury assessment and restoration planning, and the required trustee oversight and administrative costs for the life of the project. Costs associated with the implementation of the project, monitoring, operations and maintenance, potential corrective actions, and contingencies would remain the responsibility of the Responsible Party(s) as part of the settlement. In the case of multiple Responsible Parties or the implementation of a RRP restoration project with a partnering program or organization, the settlement calculation would take into account what portion of the cost each contributing Responsible Party or program is responsible for. Partnering will not decrease a Responsible Party's liability, but may allow them to take advantage of economies of scale in implementing a larger project, thereby lowering the cost of their specific liabilities.

Cash Settlement - Project-Specific Cash Out

If the Responsible Party(s) provides the trustees with the money to implement a specific restoration project (which was selected by the trustees with input from the Responsible Party(s) and the public (by applying the Louisiana Regional Restoration Planning Program project selection criteria), the settlement calculation would include the trustees' assessment costs plus the sum of all costs to conduct the project planning and design, permitting, implementation, monitoring, operation and maintenance, oversight and administration, and contingencies for a specific project that compensates for the direct and interim losses of natural resources and services (expressed as discounted service acre years (DSAY). If the Responsible Party's liability is less than the full amount of the project, the Responsible Party can pay the trustees based on the percentage of the selected restoration project (*e.g.,* RP Fund/CO-OP Settlement Alternative).

Cash Settlement - Non-Project-Specific Cash Out

If the Non-Project-Specific Cash Out settlement alternative is selected as the basis for resolving a Responsible Party's liability, the settlement amount is calculated using the magnitude of the loss expressed as Discounted Service Acre Years (DSAY) or Discounted Kilogram Biomass Years (DKBY) and the cost per unit of restoration expressed in these same terms. For example, if 10 DSAYS of coastal herbaceous wetland were lost as a result of a spill, and the cost of restoring one DSAY of coastal herbaceous wetland were $28,464, then the settlement amount would be $284,640 for this component of the damages.

The trustees have determined that the predominant habitat types in Region 2 are coastal herbaceous wetlands, coastal forested wetlands, and oyster reefs. Unit restoration costs were determined for these habitats (Appendices D - F) because they are the most likely to be used in restoration projects in the region. The unit cost/DSAY or DKBY by definition includes all costs to conduct the project planning, engineering and design, land rights, permitting, implementation, monitoring, operations and maintenance, contingencies, and trustee oversight. In order to keep the costs as accurate as possible, cost/DSAY and cost/DKBY estimates will be periodically reviewed and updated as new data become available. Any changes made to the estimates will be made available for public review and comment. The trustees will use these types of cash settlements to implement a restoration project in the RRP based on project selection criteria as discussed in Section 3.2.6.2.3.1 in the Louisiana Regional Restoration Planning Program PEIS.

Determination of Cost for a Non-Project Specific Cash Out
Unit costs for each of the three restoration types for the Non-Project Specific Cash Out were developed by determining a relationship between average restoration project costs and project function. The following sections describe how the unit costs for the three restoration types in Region 2 were derived. Costs were determined for three broad categories: 1) project implementation, which includes engineering and design, land rights, construction, and operation and maintenance; 2) monitoring and oversight; and 3) contingencies for unexpected cost overruns or corrective actions. Given the trustees' expected average time period of five years to pool money for case settlements, it is assumed that the project is implemented in 2009 to account for delay in restoration implementation.

Herbaceous Wetlands - Restoration implementation costs were collected from past or planned Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) projects, brown marsh projects, and small dredge projects. The monitoring and oversight costs were assigned as a percentage of the implementation costs. With respect to monitoring costs, the assignment of values was based on hypothetical monitoring costs for salt marsh restoration of different sizes in Louisiana, while the assignment of values for oversight costs was based on data collected from completed NRDA projects nationwide. The contingency cost for each project was assigned as a fraction of total cost.

Project function[6] was determined for three types of projects: shoreline protection, marsh creation, and vegetation planting. Functions provided by herbaceous wetlands include habitat, above and below ground primary productivity, nutrient cycling, and fish and shellfish production. For each project type, parameters were developed to determine project function including functional life of the project, time to full service flow of the project, value of restored services relative to injured services, and shape of project functional maturity curve. Trustees estimated cost/DSAY (an acre year is the flow of services from one acre of habitat for one year, discounted into the future). The average cost/DSAY for coastal herbaceous wetlands was estimated at $28,464/DSAY. For a detailed analysis of cost/DSAY determination, see Appendix D.

Forested Wetlands - Forested wetland costs were estimated using the steps described by Allen *et al.* (2001) and were based largely on data from various sized projects obtained from various State and private groups, and public and published information. Estimated costs for land acquisition and land rights, site characterization, permitting, engineering and design, site preparation, and vegetation planting were also generated. The monitoring and oversight costs were assigned as a percentage of the implementation costs. For monitoring costs, the assignment was based on estimated monitoring costs for forested wetland restorations of different sizes in Louisiana, while the oversight costs were based on historical data gathered during the course of NRDA project implementation nationwide. The contingency cost was assigned as a fraction of the total cost.

A literature search was conducted to identify functions provided by forested wetlands, and to assess when loss of those functions may be adequately restored through the creation/enhancement of the ecosystem. They include water quality, flood storage, nutrient cycling, sediment trapping, above- and below-ground primary productivity, and habitat. The function information along with estimates of the projected longevity of the project was used to determine the DSAY benefit of restoration. The cost/DSAY for forested wetlands restoration was determined by combining the cost and function information and resulted in an estimate of $1768/DSAY. For detailed analysis of cost/DSAY analysis, see Appendix E.

Oyster Reefs - Oyster reef construction costs were collected from historical data on prior LDWF projects. Estimated costs for permitting, engineering and design, and acquisition of land rights (in the event the water bottom is leased from a private entity) were also considered. The monitoring and oversight costs were assigned as a percentage of the implementation costs. For monitoring costs, the assignment was based on hypothetical monitoring costs for oyster reef projects of different sizes

[6] Project function refers to the level of resource and service flows provided over time.

in Louisiana. Oversight costs were based on data collected from similar, previously implemented projects nationwide. The contingency cost for each project was assigned as a fraction of the total cost.

Functions provided by oyster reefs include secondary and primary productivity, water quality, carbon sequestration, and habitat for epibenthic invertebrates and fish. Parameters used to estimate function include functional life of the project, and time until full service flow of the project. The average cost/DKBY is $19.60. For a detailed analysis of cost/DKBY determination, see Appendix F.

RRP Revisions

The Region 2 RRP will be updated through periodic project solicitations and will be revised accordingly (see Appendix B for the “Project Solicitation Form”). A public review and comment period on revisions to the Region 2 RRP will be provided as needed.

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United States Department of the Interior (USDOI)
United States Fish and Wildlife Service (USFWS)

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APPENDIX A - COMMON BIOTA AND ASSOCIATED HABITAT TYPES IN REGION 2

Table A- 1: Common Vegetation in Region 2 and their Associated Habitats

Scientific Name	Common Name	Habitats (see Table A-12 for key)
Spartina alterniflora	smooth cordgrass	SM, B/IM
Distichlis spicata	saltgrass	SM, B/IM
Salicornia spp.	glasswort	SM
Juncus roemerianus	black rush	SM
Batis maritime	saltwort	SM
Iva frutescens	shrubby marsh alder	SM, B/IM
Spartina patens	marshhay cordgrass	SM, B/IM
Solidago sempervirens	seaside goldenrod	SM, B/IM
Schoenoplectus spp.	bulrushes, three squares, three corner grass	B/IM, FM
Phragmites spp.	roseau cane	B/IM, FM
Baccharis halimifolia	eastern baccharis	B/IM, FM
Cladium jamaicense	saw grass	B/IM, FM
Hydrocotyle spp.	pennywort	B/IM, FM
Typha spp.	cattail	FM
Zizaniopsis miliacea	giant cutgrass	FM
Panicum hemitomon	maidencane	FM
Juncus effusus	soft-stem rush	FM
Eleocharis spp.	spike-rush	FM
Pontederia cordata	pickerelweed	FM
Sagittaria spp.	arrowhead	FM
Salix nigra	black willow	FM, WF, BT
Quercus spp.	oak	WF, UF
Liquidambar styraciflua	sweet gum	WF, UF
Sassafras albidum	sassafras	WF, UF
Cornus spp.	dogwood	WF, UF
Fraxinus spp.	ash	WF, UF
Acer rubrum	red maple	WF, UF
Nyssa aquatica	tupelo gum	WF
Nyssa biflora	swamp tulelo	WF
Saururus cernuus	lizards tail	WF
Taxodium distichum	bald cypress	WF
Ulmus americana	american elm	WF
Ilex spp.	holly	WF
Platanus occidentalis	sycamore	WF
Cephalanthus occidentalis	buttonbush	WF
Pinus echinata	shortleaf pine	UF
Pinus taeda	loblolly pine	UF
Carya spp.	hickory	UF
Avicennia germinans	black mangrove	MS
Potamogeton spp.	pondweed	M/ESAV, FSAV
Zostera marina	eel grass	M/ESAV
Vallisneria Americana	American eelgrass	M/ESAV
Thalassia testudinum	turtlegrass	M/ESAV
Ceratophyllum demersum	coontail	FSAV
Utricularia sp.	bladder wort	FSAV
Eichhornia crassipes	water hyacinth	FSAV
Alternanthera philoxeroides	alligatorweed	FSAV
Limnobium spongia	American frog-bit	FSAV
Pistia stratiotes	water lettuce	FSAV
Nymphaea odorata	white water lily	FSAV
Hydrilla verticillata	hydrilla	FSAV

Table A- 2: Common Mammals in Region 2 and their Associated Habitats

Scientific Name	Common Name	Habitats (see Table A-12 for key)
Odocoileus virginianus	whitetail deer	B/IM, FM, WF, BT, WS/S, UF, A/C/G, US/S, FS, U
Sylvilagus spp.	swamp rabbit, eastern cottontail	B/IM, FM, WF, BT, WS/S, UF, A/C/G, US/S, U
Myocastor coypus	nutria	B/IM, FM, WF, BT, WS/S, FS
Ondatra zibethica	muskrat	B/IM, FM, WF, BT, WS/S, FS
Procyon lotor	racoon	B/IM, FM, WF, BT, WS/S, UF, US/S, FS, M/ES, A/C/G, U
Sus scrofa	wild boar	FM, WF, BT, UF, WS/S, US/S
Reithrodontomys fulvescens	fulvous harvest mouse	SM, B/IM, FM, WF, BT, UF, MS, UF, A/C/G, WS/S, US/S, FS, M/ES
Dasypus novemcinctus	armadillo	WF, BT, UF, A/C/G, WS/S, US/S
Canis latrans	coyote	UF, A/C/G, WF, BT, WS/S, US/S
Lynx rufus	bobcat	WF, BT, UF, US/S
Didelphis virginiana	Virginia opossum	WF, BT, UF, US/S
Lasiurus borealis	eastern red bat	WF, UF
Sciurus carolinensis	eastern grey squirrel	UF, US/S
Mustela vison	mink	B/IM, FM, FS, M/ES, OW
Lutra canadensis	river otter	B/IM, FM, WF, BT, WS/S, FS

Table A- 3: Common Reptiles and Amphibians in Region 2 and their Associated Habitats

Scientific Name	Common Name	Habitats (see Table A-12 for key)
Alligator mississippiensis	American alligator	SM, B/IM, FM, WF, BT, MS, M/ESAV, FSAV, M/EBS, FB
Chelydra serpentina	snapping turtle	B/IM, FM, M/ES, FS, WF, BT, M/ESAV, FSAV, M/EBS, FB
Sternotherus spp.	musk turtles	FM, FS, WF, BT, FSAV, FB
Kinosternon spp.	mud turtles	B/IM, M/ES, FM, FS, WF, BT, FSAV, M/ESAV, M/EBS, FB
Graptemys kohnii	Mississippi map turtle	FM, FS, WF, BT, FSAV, FB
Malaclemys terrapin	diamondback terrapin	SM, B/IM, M/ES, M/ESAV, M/EBS
Deirochelys reticularia	chicken turtle	FM, FS, WF, BT, FSAV, FB
Chrysemys picta	painted turtle	FM, FS, WF, BT, FSAV, FB
Pseudemys concinna	river cooter (turtle)	FM, FS, WF, BT, FSAV, FB
Trachemys scripta	slider (turtle)	FM, FS, WF, BT, FSAV, FB
Terrapene spp.	box turtles	WF, BT, UF, A/C/G, WS/S, US/S, FS,
Apalone spp.	softshell turtles	FM, FS, WF, BT, FSAV, FB
Nerodia spp.	water snakes	SM, B/IM, M/ES, M/ESAV, FM, FS, WF, BT, FSAV
Regina spp.	crawfish snakes	FM, FS, WF, BT, FSAV, A/C/G, WS/S
Thamnophis spp.	garter, ribbon snakes	FM, FS, WF, BT, FSAV, UF, A/C/G, US/S, WS/S
Storeria spp.	redbelly, brown snakes	FM, FS, FSAV, WF, BT, UF, A/C/G, US/S, WS/S
Virginia spp.	earth snakes	FM, FS, FSAV, WF, BT, UF, A/C/G, US/S, WS/S
Diadophis punctatus	ringneck snake	WF, BT, UF, A/C/G, US/S, WS/S, FS
Heterodon platirhinos	eastern hognose snake	WF, BT, UF, A/C/G, US/S, WS/S, FS
Opheodrys aestivus	rough green snake	WF, BT, UF, A/C/G, US/S, WS/S, FS, FM
Farancia abacura	mud snake	SM, B/IM, M/ES, M/ESAV, FM, FS, WF, BT, FSAV
Coluber constrictor	racer (snake)	WF, BT, FM, FS, WS/S
Elaphe spp.	rat snakes	UF, A/C/G, WF, BT, US/S, WS/S
Lampropeltis spp.	milk snake, kingsnake	B/IM, M/ES, FM, FS, WF, BT, UF, A/C/G, WS/S, US/S
Agkistrodon piscivorus	cottonmouth (snake)	B/IM, M/ES, FM, FS, WF, BT, WS/S

Scientific Name	Common Name	Habitats (see Table A-12 for key)
Agkistrodon contortrix	copperhead (snake)	FS, WF, BT, US/S, WS/S, A/C/G, UF
Sistrurus miliarius	pigmy rattlesnake	FS, WF, BT, WS/S, US/S, A/C/G, UF
Crotalus horridus	timber rattlesnake	FS, WF, BT, WS/S, US/S, A/C/G, UF
Scincella lateralis	ground skink	WF, WS/S, UF, BT, A/C/G, FS, M/ES, U, US/S, UB
Hyla ssp.	tree frogs	B/IM, M/ES, M/ESAV, FM, FS, FSAV, WF, BT, WS/S
Pseudacris ssp.	chorus frogs	B/IM, M/ES, M/ESAV, FM, FS, FSAV, WF, BT, WS/S, A/C/G
Acris ssp.	cricket frogs	B/IM, M/ES, M/ESAV, FM, FS, FSAV, WF, BT, WS/S, A/C/G
Rana ssp.	true frogs	B/IM, M/ES, M/ESAV, FM, FS, FSAV, WF, BT, WS/S, US/S, A/C/G, UF

Table A- 4: Common Birds in Region 2 and their Associated Habitats – Waterfowl and Waterbirds

Scientific Name	Common Name	Season	Habitats (see Table A-12 for key)
Gavia immer	common loon	W	M/ES, FS, M/ESAV, FSAV, OW
Podiceps spp.	grebes	W	M/ES, M/ESAV, OW
Phalacrocorax auritus	double-crested cormorant	W	M/ES, M/ESAV, FS, FSAV, OW
Anhinga anhinga	American anhinga	YR	WF, BT, A/C/G, FS, WS/S, OW
Chen caerulescens	snow goose	W	M/ES, FS, B/IM, FM, A/C/G, OW
Anas fulvigula	mottled duck	YR	B/IM, M/ES, FM, FS, M/ESAV, FSAV, OW
Anas strepera	gadwall	W	B/IM, M/ES, FM, FS, M/ESAV, FSAV, OW
Anas platyphynchos	mallard	W	B/IM, M/ES, FM, FS, M/ESAV, FSAV, WF, BT, WS/S, OW
Anus acuta	common pintail	W	SM, B/IM, M/ES, FM, FS, M/ESAV, FSAV, OW
Americana	American wigeon	W	B/IM, M/ES, FM, FS, M/ESAV, FSAV, A/C/G, OW
Aix sponsa	wood duck	YR	WF, WS/S, FS, BT, OW
Anas clypeata	northern shoveler	W	FM, FS, FSAV, SM, B/IM, M/ES, M/ESAV, OW
Anas discors	blue winged teal	YR	FM, FS, FSAV, OW
Anas crecca	green-winged teal	W	M/ES, B/IM, FM, FS, FSAV, OW
Aythya valisineria	canvasback	W	SM, B/IM, FM, M/ES, FS, M/ESAV, FSAV, OW
Aythya collaris	ring-necked duck	W	WF, WS/S, FS, BT, OW
Aythya affinis	lesser scaup	W	FS, FSAV, M/ES, OW
Bucephala clangula	common goldeneye	W	WF, WS/S, FS, OW, BT, M/ES
Bucephala albeola	bufflehead	W	FS, FSAV, M/ES, M/ESAV, OW
Oxyura jamaicensis	ruddy duck	W	FS, FM, FSAV, M/ES, OW
Mergus serrator	red-breasted merganser	W	FS, M/ES, FSAV, OW
Gelochelidon nilotica	gull-billed tern	YR	SM, M/ES, WB, A/C/G, OW, B/IM
Lophodytes cucullatus	hooded merganser	W, BR	WF, WS/S, BT, FS, OW
Fulica americana	American coot	W	OW, FM, B/IM, FS, B/IS, A/C/G, M/ESAV, FSAV
Gallinula chloropus	common gallinule	YR	OW, FM, FS, FSAV
Porphyrula martinica	purple gallinule	BR	OW, FM, FS, WF, BT, FSAV
BR = present during breeding season (generally spring and/or summer) W = present in winter YR = present year round			

Table A- 5: Common Birds in Region 2 and their Associated Habitats – Colonial Nesting Wading Birds

Scientific Name	Common Name	Season	Habitats (see Table A-12 for key)
Ardea herodias	great blue heron	YR	FM, B/IM, SM, WB, FS, M/ES, WF, MS, BT, WS/S, OW
Egretta caerulea	little blue heron	YR	FM, B/IM, SM, WB, WF, MS, BT, WS/S, A/C/G, OW, FS, ME/S
Egretta tricolor	Louisiana tricolored heron	YR	FM, B/IM, SM, WB, WF, MS, BT, WS/S, OW, FS, ME/S
Casmerodius albus	great egret	YR	FM, B/IM, SM, WB, WF, OW, FS, ME/S, WF, FS, M/ES
Egretta thula	snowy egret	YR	FM, B/IM, SM, WB, WF, MS, BT, WS/S, OW, FS, M/ES
Bubulcus ibis	cattle egret	YR	FM, WB, OW, A/C/G, N/VU, FS
Nycticorax nycticorax	black-crowned night heron	YR	FM, B/IM, SM, WB, WF, MS, BT, WS/S, OW, FS, M/ES
Nyctanassa violacea	yellow-crowned night heron	BR	FM, B/IM, SM, WB, WF, MS, BT, WS/S, OW, FS, M/ES
Butorides striatus	green heron	YR	FM, B/IM, SM, WB, WF, MS, BT, WS/S, OW, FS, M/ES
Ixobrychus exilis	least bittern	BR	FM, FS, OW
Botaurus lentiginosus	American bittern	W	FM, FS, OW
Plegadis spp.	dark ibis	YR	FM, B/IM, SM, WB, WF, MS, BT, WS/S, OW, FS, M/ES, A/C/G
Eudocimus albus	white ibis	YR	FM, B/IM, SM, WB, WF, MS, BT, WS/S, OW, FS, M/ES, A/C/G
Rallus spp.	rails	W, BR	FM, B/IM, SM, WB, WF, MS, BT, WS/S, OW, FS, M/ES
Himantopus mexicanus	black-necked stilt	YR	FM, FS, OW, WB
Recurvirostra americana	American avocet	W	M/ES, FS, OW
Pluvialis squatarola	black-bellied plover	W	FS, WB, ME/S, OW
Arenaria interpres	ruddy turnstone	W	FS, WB, ME/S, OW, WS/S
Charadrius semipalmatus	semipalmated plover	W	ME/S
Charadrius wilsonia	Wilson's plover	BR	ME/S
Charadrius vociferous	killdeer	YR	A/C/G, FS, WS/S, OW
Philohelo minor	American woodcock	W	WS/S, WF, BT
Capella gallinago	common snipe	W	WB, FM, B/IM, A/C/G
Limnodromus griseus	short-billed dowitcher	W	WB, FM, B/IM, FS
Calidris canutus	red knot	W	M/ES, FS
Catoptrophorus semipalmatus	willet	YR	FM, B/IM, SM, M/ES, WB
Tringa melanoleuca	greater yellowlegs	W	FM, WB, FS, OW, BT, WF, WS/S
Tringa flavipes	lesser yellowlegs	W	FM, WB, FS, OW, WF, WS/S, M/ES, B/IM, SM
Calidris alba	sanderling	W	FS, M/ES
Calidris alpine	dunlin	W	WB, M/ES, FS
Actitus macularia	spotted sandpiper	W	WS/S, FS
Calidris minutilla	least sandpiper	W	WB, FM, OW, FS
Calidris mauri	western sandpiper	W	WB, M/ES, FS
BR = present during breeding season (generally spring and/or summer) W = present in winter YR = present year round			

Table A- 6: Common Birds in Region 2 and their Associated Habitats – Raptors

Scientific Name	Common Name	Season	Habitats (see Table A-12 for key)
Ictinia mississippiensis	Mississippi kite	BR	WF, BT, WS/S
Accipiter striatus	sharp-shinned hawk	W	WF, UF, BT, WS/S, US/S
Accipiter cooperii	Cooper's hawk	YR	WF, UF, BT, WS/S, US/S
Circus cyanus	northern harrier	W	FM, B/IM, A/C/G
Buteo jamaicensis	red-tailed hawk	YR	A/C/G, WF, BT, UF, FM, WS/S
Buteo lineatus	red-shouldered hawk	YR	A/C/G, WF, BT, UF, FM, WS/S
Buteo platypterus	broad-winged hawk	BR	WF, UF, BT
Haliaeetus leucocephalus	bald eagle	BR	WF, UF
Pandion haliaetus	osprey	YR	WF, FS, M/ES
Cathartes aura	turkey vulture	YR	U, WF, UF
Coragyps atratus	black vulture	YR	U, WF, UF
Falco sparverius	American kestrel	W	A/C/G, U, WF, UF
Falco columbarius	merlin	W	UF, WF, FM, A/C/G
Falco peregrinus	peregrine falcon	W	A/C/G, U
Otus asio	common screech owl	YR	WF, UF, A/C/G, US/S, WS/S, BT
Bubo virginianus	great horned owl	YR	WF, UF, WS/S, US/S, A/C/G
BR = present during breeding season (generally spring and/or summer) W = present in winter YR = present year round			

Table A- 7: Common Birds in Region 2 and their Associated Habitats – Non-Passerine Land Birds

Scientific Name	Common Name	Season	Habitats (see Table A-12 for key)
Zenaida macroura	mourning dove	YR	A/C/G, U, UF, US/S
Coccyzus americanus	yellow-billed cuckoo	BR	UF, US/S, A/C/G
Chordeiles minor	common nighthawk	BR	A/C/G, UF, U
Archilochus colubris	ruby-throated hummingbird	BR	U, A/C/G, UF
Megaceryle alcyon	belted kingfisher	W	FS, M/ES, W, FM, B/IM, SM
Melanerpes erythrocephalus	red-headed woodpecker	YR	A/C/G, U, UF, US/S
Dryocopus pileatus	pileated woodpecker	YR	UF, WF
Colaptes auratus	common flicker	YR	UF, WF, U, A/C/G
Melanerpes carolinus	red-bellied woodpecker	YR	WF, UF, U, A/C/G
Sphyrapicus varius	yellow-bellied sapsucker	W	WF, UF,
Picoides pubescens	downy woodpecker	YR	WF, UF, BT, WS/S, US/S
Picoides villosus	hairy woodpecker	YR	WF, UF, BT, WS/S, US/S
BR = present during breeding season (generally spring and/or summer) W = present in winter YR = present year round			

Table A- 8: Common Birds in Region 2 and their Associated Habitats – Seabirds and Gulls

Scientific Name	Common Name	Season	Habitats (see Table A-12 for key)
Pelecanus erythrorhynchos	white pelican	W	OW, FS, M/ES, FM, B/IM
Pelecanus occidentalis	brown pelican	YR, BR	SM, B/IM, FM, FS, M/ES, OW
Fregata magnificens	magnificent frigatebird	NBR	SM, M/ES
Morus bassanus	northern gannet	W	M/ES
Larus spp.	gulls	W	SM, B/IM, FM, M/ES, FS, OW, U, A/C/G
Sterna spp.	terns	W, BR	SM, B/IM, FM, WB, OW, M/ES, FS
Rynchops niger	black skimmer	YR	SM, B/IM, WB, OW, M/ES

BR = present during breeding season (generally spring and/or summer)
NBR = not a breeder, but present during the breeding season (spring and/or summer)
W = present in winter
YR = present year round

Table A- 9: Common Birds in Region 2 and their Associated Habitats – Passerine Birds

Scientific Name	Common Name	Season	Habitats (see Table A-12 for key)
Tyrannus tyrannus	eastern kingbird	BR	UF, WF, WS/S, A/C/G, U
Myiarchus crinitus	great crested flycatcher	BR	UF, WF
Empidonax virescens	acadian flycatcher	BR	UF, WF, BT
Anthus spinoletta	water pipit	W	FS, M/ES, A/C/G
Progne subis	purple martin	BR	FS, A/C/G, U
Hirundo rustica	barn swallow	BR	A/C/G, FM, FS, OW, U
Iridoprocne bicolor	tree swallow	W	A/C/G, FS, WB, FM, WF, U
Stelgidopteryx ruficollis	rough-winged swallow	BR	FS, WS/S, FM
Corvus ossifragus	fish crow	YR	FS, A/C/G, M/ES
Corvus brachyrhynchos	American crow	YR	UF, WF, A/C/G, WS/S, FS
Cyanocitta cristata	blue jay	YR	UF, A/C/G, U
Parus carolinensis	Carolina chickadee	YR	UF, A/C/G, U
Parus bicolor	tufted titmouse	YR	WF, UF, U, A/C/G
Certhia familiaris	brown creeper	W	WF, UF, WS/S, US/S, U
Troglodytes aedon	house wren	W	A/C/G, U, US/S, UF
Thryothorus ludovicianus	Carolina wren	YR	U, A/C/G, US/S
Cistothorus platensis	sedge wren	W	A/C/G, FM
Regulus satrapa	golden-crowned kinglet	W	UF, WF
Regulus calendula	ruby-crowned kinglet	W	UF, WF
Polioptila caerulea	blue-gray gnatcatcher	YR, BR	UF, WF, US/S, WS/S
Toxostoma rufum	brown thrasher	YR	US/S, WS/S
Dumetella carolinensis	gray catbird	W, YR	US/S, WS/S, A/C/G, U
Mimus polyglottos	northern mockingbird	YR	US/S, UF, A/C/G, U
Sialia sialis	eastern bluebird	YR	A/C/G, US/S, WS/S, U
Turdus migratorius	American robin	W	U, A/C/G, UF
Bombycilla cedrorum	cedar waxwing	W	UF, WF, US/S, A/C/G
Vireo spp.	vireos	BR, W, YR	UF, US/S, U, UB
Protonotaria citrea	prothonotary warbler	BR	WF, BT, WS/S
Parula americana	northern parula warbler	BR	WF, BT
Dendroica coronata	yellow-rumped warbler	W	UF, WF, US/S, WS/S
Dendroica palmarum	palm warbler	W	A/C/G, UF, U, US/S
Wilsonia pusilla	Wilson’s warbler	W	WS/S, BT

Scientific Name	Common Name	Season	Habitats (see Table A-12 for key)
Wilsonia citrine	hooded warbler	BR	WF, BT, WS/S
Geothlypis trichas	common yellowthroat	YR	FW, BT, FM, WS/S
Icteria virens	yellow-breasted chat	BR	WS/S, US/S
Agelaius phoeniceus	red-winged blackbird	YR	FM, WF, BT, A/C/G, FS, WS/S
Molothrus ater	brown-headed cowbird	YR	A/C/G, WS/S, WF, US/S, UF
Euphagus carolinus	rusty blackbird	W	WS/S, WF, BT
Euphagus cyanocephalus	Brewer's blackbird	W	A/C/G, U
Quiscalus quiscula	common grackle	YR	A/C/G, U, WS/S
Quiscalus major	boat-tailed grackle	YR	SM, M/ES
Sturnella magna	eastern meadowlark	YR	A/C/G
Sturnus vulgaris	European starling	YR	U, A/C/G
Icterus spurious	orchard oriole	BR	A/C/G, UF, US/S
Passer domesticus	house sparrow	YR	A/C/G, U
Cardinalis cardinalis	northern cardinal	YR	U, A/C/G, UF, US/S
Carduelis tristis	American goldfinch	W, BR	US/S, A/C/G, U, UF
Passerina cyanea	indigo bunting	BR	A/C/G, US/S
Passerina ciris	painted bunting	BR	US/S, UF, U, A/C/G
Zonotrichia spp.	sparrows	W	UF, WF, US/S, WS/S, U, A/C/G, FM, B/IM, SM
Catharus guttatus	hermit thrush	W	UF, WF, US/S, WS/S, A/C/G
Lanius ludovicianus	loggerhead shrike	YR	A/C/G
BR = present during breeding season (generally spring and/or summer) W = present in winter YR = present year round			

Table A- 10: Common Fish and Shellfish Species in Region 2 and their Associated Habitats

Scientific Name	Common Name	Habitat
Dasyatis sabina	Atlantic stingray	SW
Acipenser oxyrinchus desotoi	Gulf sturgeon	FW, BW, SW
Scaphirhynchus platorynchus	shovelnose sturgeon	FW
Polyodon spathula	paddlefish	FW
Lepisosteus oculatus	spotted gar	FW
Lepisosteus platostomus	shortnose gar	FW
Lepisosteus spatula	alligator gar	FW, BW
Amia calva	bowfin	FW
Elops saurus	ladyfish	BW, SW
Megalops atlanticus	tarpon	SW
Anguilla rostrata	American eel	FW, BW, SW
Myrophis punctatus	speckled worm eel	BW, SW
Brevoortia patronus	Gulf menhaden	BW, SW
Dorosoma cepedianum	gizzard shad	FW, BW
Dorosoma petenense	threadfin shad	FW, BW
Anchoa mitchilli	bay anchovy	BW, SW
Cyprinus carpio	common carp	FW
Hybognathus hayi	cypress minnow	FW
Hybognathus nuchalis	Mississippi silvery minnow	FW
Notemigonus crysoleucas	golden shiner	FW
Notropis spp.	shiners	FW
Phenacobius mirabilis	suckermouth minnow	FW
Pimephales vigilax	bullhead minnow	FW
Carpiodes carpio	river carpsucker	FW
Ictiobus bubalus	smallmouth buffalo	FW
Ictiobus cyprinellus	bigmouth buffalo	FW
Ictiobus niger	black buffalo	FW
Ictalurus furcatus	blue catfish	FW, BW
Ictalurus natalis	yellow bullhead	FW

Scientific Name	Common Name	Habitat
Ictalurus punctatus	channel catfish	FW
Noturus spp	madtoms	FW
Pylodictis olivaris	flathead catfish	FW
Mugil cephalus	striped mullet	FW, BW, SW
Fundulus notatus	blackstripe topminnow	FW
Fundulus notti	bayou topminnow	FW
Morone chrysops	white bass	FW
Morone mississippiensis	yellow bass	FW
Morone saxatilis	striped bass	FW, BW, SW
Centrarchus macropterus	flier	FW
Lepomis spp.	hybrid sunfish	FW
Lepomis gulosus	warmouth	FW
Lepomis humilis	orangespotted sunfish	FW
Lepomis macrochirus	bluegill	FW
Lepomis megalotis	longear sunfish	FW
Lepomis microlophus	redear sunfish	FW
Lepomis punctatus	spotted sunfish	FW
Lepomis symmetricus	bantam sunfish	FW
Micropterus salmoides	largemouth bass	FW
Pomoxis annularis	white crappie	FW
Pomoxis nigromaculatus	black crappie	FW
Caranx hippos	crevalle jack	SW
Trachinotus carolinus	Florida pompano	SW
Lutjanus griseus	gray snapper	SW
Archosargus probatocephalus	sheepshead	BW, SW
Aplodinotus grunniens	freshwater drum	FW
Bairdiella chrysoura	silver perch	BW, SW
Cynoscion arenarius	sand seatrout	BW, SW
Cynoscion nebulosus	spotted seatrout	BW, SW
Leiostomus xanthurus	spot	BW, SW
Micropogonias undulatus	Atlantic croaker	BW, SW
Menticirrhus americanus	southern kingfish	BW, SW
Pogonias cromis	black drum	BW, SW
Sciaenops ocellatus	red drum	BW, SW
Scomberomorus maculatus	Spanish mackerel	SW
Prionotus spp.	searobins	BW, SW
Citharichthys spilopterus	bay whiff	BW, SW
Etropus crossotus	fringed flounder	BW, SW
Paralichthys lethostigma	southern flounder	BW, SW
Trinectes maculatus	hogchoker	BW, SW
Macrobrachium ohione	river shrimp	FW
Palaemonetes spp.	grass shrimp	FW
Penaeus aztecus	brown shrimp	BW, SW
Penaeus duorarum	pink shrimp	BW, SW
Penaeus setiferus	white shrimp	BW, SW
Xiphopenaeus kroyeri	sea bob	SW
Callinectes sapidus	blue crab	FW, BW, SW
Loliginidae	squid	BW, SW
Crassostrea virginica	eastern oyster	BW, SW
Stramonita haemostoma	southern oyster drill	SW
Mercenaria spp.	clam	FW, SW, BW

FW = Fresh Water
BW = Brackish Water
SW = Salt Water

Table A- 11: Threatened and Endangered species in Region 2 and their Associated Habitats

Scientific Name	Common Name	Habitats (see Table A-12 for key)
Potamilus inflatus	inflated heelsplitter	FS, OW
Haliaeetus leucocephalus	bald eagle	WF
Pelecanus occidentalis	brown pelican	M/ES, OW, MS, WS/S
Charadrius melodus	piping plover*	ME/S, WB
Chelonia mydas	green sea turtle	OW, M/ESAV, ME/S
Eretmochelys imbricata	hawksbill sea turtle	OW, M/ESAV, ME/S
Lepidochelys kempii	Kemp's ridley sea turtle	OW, M/ESAV, ME/S
Dermochelys coriacea	leatherback sea turtle	OW, ME/S
Caretta caretta	loggerhead sea turtle	OW, ME/S, M/ESAV, SM
Acipenser oxyrinchus desotoi	gulf sturgeon*	OW
Scaphirhynchus albus	pallid sturgeon	OW
Trichechus manatus	West Indian manatee	OW
* Note: critical habitat has been designated for these species.		

Table A- 12: Key for Habitat Type Abbreviations. All habitat types are found in Region 2 except for upland forest, vegetated/non-vegetated urban, upland scrub/shrub habitats.

Habitat Type	Abbreviation
Salt Marsh	SM
Brackish/Intermediate Marsh	B/IM
Fresh Marsh	FM
Wetland Forest	WF
Wetland Scrub-Shrub	WS/S
Mangrove Swamp	MS
Upland Forest	UF
Marine/Estuarine SAV	M/ESAV
Freshwater SAV	FSAV
Batture	BT
Agriculture-Cropland-Grassland	A/C/G
Freshwater Shore	FS
Marine/Estuarine Shore	M/ES
Vegetated/Non-Vegetated Urban	U
Upland Scrub/Shrub	US/S
Wetland Barren	WB
Open Water	OW
Marine/Estuarine Benthic	M/EB
Freshwater Benthic	FB
Marine/Estuarine Encrusting Communities	M/EEC
Living Reefs	LR

APPENDIX B - PROJECT SOLICITATION FORM

(This document is pending OMB approval).

(This document is pending OMB approval).

APPENDIX C - REGION 2 RRP RESTORATION PROJECTS

Table C- 1: Region 2 RRP Accepted Restoration Projects

Region	RRP Track Code	Project Name	Sponsor Organization(*)	State Project Number	Federal Project Number	Basin	Parish	RRP Restoration Type (**)
2	R2-5CWP-2001-001	Northeast Extension of Barataria Land Bridge Shoreline Protection	NRCS	BA-27d	BA-24-4	Barataria	Jefferson	PP CHW
2	R2-5CWP-2001-002	Grand Bayou to Pass Chaland Island Restoration	NMFS	BA-35	BA-21-2	Barataria	Plaquemines	C/E CHW
2	R2-5CWP-2001-003	Little Lake Shoreline Protection/Dedicated Dredging near Round Lake	NMFS	BA-37	BA-24-1	Barataria	Lafourche	C/E CHW
2	R2-5CWP-2001-004	Dedicated Dredging in Connection with Existing Barataria Basin Land Bridge	USFWS	BA-36	BA-CW-3	Barataria	Jefferson	C/E CHW
2	R2-5CWP-2001-013	Bayou Lafourche Diversion	USEPA	BA-25b				C/E CHW
2	R2-5CWP-2001-014	Pelican Island & Pass La Mer to Chaland Pass	NMFS	BA-38		Barataria	Plaquemines	C/E CHW; C/E CBSS
2	R2-5CWP-2001-015	Lake Lery Dedicated Dredging	USACE		BS-CW-1	Breton Sound	St. Bernard	C/E CHW; C/E CBSS
2	R2-5CWP-2001-016	South Shore of the Pen Protection/Dedicated Dredging	USACE		BA-24-3A;B	Barataria	Jefferson	C/E CHW; PP CHW
2	R2-5CWP-2000-025	Delta Management at Fort St. Phillip	USFWS	BS-11		Breton Sound	Plaquemines	C/E CHW
2	R2-5CWP-2000-027	Delta-Building Diversion North of Fort St. Phillip	USACE	BS-10		Breton Sound	Plaquemines	C/E CHW
2	R2-5CWP-2000-029	Delta-Building Diversion at Benny's Bay 50000 cfs with Outfall Management	USACE	MR-13		Mississippi River Delta	Plaquemines	C/E CHW
2	R2-5CWP-2000-033	Small Freshwater Diversion to the Northwestern Barataria Basin	USEPA	BA-34		Barataria	St. James/ Lafourche	C/E CFW
2	R2-5CWP-2000-034	Delta-Building Diversion at Myrtle Grove	USACE	BA-33		Barataria	Plaquemines/ Jefferson/ Lafourche	C/E CHW
2	R2-5CWP-2000-037	Delta-Building Diversion at Benny's Bay 20000 cfs with Outfall Management	USACE			Mississippi River Delta	Plaquemines	C/E CHW
2	R2-5CWP-2000-038	South Lake Salvador Shoreline Protection and Marsh Creation	NMFS			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-5CWP-1999-046	Barataria Basin Landbridge Shoreline Protection Phase III	NRCS	BA-27c	XBA-63iii	Barataria	Lafourche/ Jefferson	PP CHW
2	R2-5CWP-1999-050	LA Highway 1 Marsh Creation (S. of Leeville)	USEPA	BA-29	BA-32a	Barataria	Lafourche	C/E CHW; C/E COR

Region	RRP Track Code	Project Name	Sponsor Organization(*)	State Project Number	Federal Project Number	Basin	Parish	RRP Restoration Type (**)
2	R2-5CWP-1999-054	East/West Grand Terre Restoration Project	NMFS	BA-30	XBA-1a/b	Barataria	Jefferson	C/E CHW; C/E CBSS
2	R2-5CWP-1999-058	River Diversion (15000 cfs) Between Triumph and Venice	USACE	BA-31		Barataria	Plaquemines	C/E CHW; C/E CSAV
2	R2-5CWP-1999-059	Sediment Trap South of Venice	USACE	MR-12		Mississippi River Delta	Plaquemines	C/E CHW
2	R2-5CWP-1999-065	Amoretta (City Price) Freshwater Diversion	NRCS			Mississippi River Delta	Plaquemines	C/E CHW
2	R2-5CWP-1999-066	East Golden Meadow Terracing Project	USACE			Barataria	Lafourche	C/E CHW
2	R2-5CWP-1999-067	Grand Pierre Island Restoration	USEPA			Barataria	Plaquemines	C/E CBSS; PP CHW; PP CBSS
2	R2-3JEF-082301-075	Wave Absorbers/Reef Zones in Barataria Bay	JEF			Barataria	Jefferson	C/E COR; PP CHW
2	R2-2TNC-012402-084	Des Allemands (Portfolio Site_Nature Conservancy)	Nature Conservancy			Barataria	St. John/ St. Charles/ Lafourche	AcLp CHW; AcLp CFW; AcLp CBSS
2	R2-2TNC-012402-086	Fort Jackson Woods (Action Site_N.C.)	Nature Conservancy			Barataria	Plaquemines	AcLp CFW
2	R2-2TNC-012402-087	Lake Boeuf (Action Site_N.C.)	Nature Conservancy			Barataria	Lafourche	AcLp CHW; AcLp CFW
2	R2-2TNC-012402-089	Grand Isle/Barataria Bay Complex (Portfolio Site_N.C.)	Nature Conservancy			Barataria	Lafourche/ Jefferson/ Plaquemines	AcLp CHW; AcLp CFW; AcLp CBSS
2	R2-2TNC-012402-090	River Aux Chenes Forest (Portfolio Site_N.C.)	Nature Conservancy			Breton Sound	Plaquemines	AcLp CHW; AcLp CFW
2	R2-2TNC-012402-091	Abandoned Channel of Bayou Barataria (Portfolio Site_N.C.)	Nature Conservancy			Barataria	Jefferson	AcLp CHW; AcLp CFW
2	R2-2TNC-012402-093	Jean Lafitte NP (Portfolio Site_N.C.)	Nature Conservancy			Barataria	Jefferson	AcLp CHW; AcLp CFW
2	R2-2TNC-012402-094	Caernarvon Marshes (Portfolio Site_N.C.)	Nature Conservancy			Breton Sound	Plaquemines	AcLp CHW
2	R2-2TNC-012402-095	Des Allemands Marsh (Portfolio Site_N.C.)	Nature Conservancy			Barataria	St. John/ Lafourche/ St. Charles	AcLp CHW; AcLp CFW
2	R2-2TNC-012402-096	Delta Farms Marshes (Portfolio Site_N.C.)	Nature Conservancy			Barataria	Lafourche	AcLp CHW
2	R2-2TNC-012402-098	Lake Salvador (Portfolio Site_N.C.)	Nature Conservancy			Barataria	St. Charles/ Jefferson/ Lafourche	AcLp CHW; AcLp CFW

Region	RRP Track Code	Project Name	Sponsor Organization(*)	State Project Number	Federal Project Number	Basin	Parish	RRP Restoration Type (**)
2	R2-5CWP-2002-102	Bayou Dupont Sediment Delivery System	USEPA			Barataria	Plaquemines/ Jefferson	C/E CHW
2	R2-5CWP-2002-103	Shell Island Barrier Headland Restoration	NRCS			Barataria	Plaquemines	C/E CHW; C/E CBSS; PP CHW
2	R2-5CWP-2002-104	East Fourchon Marsh Creation and Terracing	NMFS			Barataria	Lafourche	C/E CHW
2	R2-2DU-082802-116	Pass A Loutre WMA Crevasse Splays	DU			Mississippi River	Plaquemines	C/E CHW
2	R2-3JEF-010303-125	Grand Pierre Island Restoration (BS-1)	JEF		XBA-1c	Barataria	Plaquemines	C/E CHW; C/E CBSS; PP CHW
2	R2-3JEF-010303-126	Elmer's Island and West Grande Terre Oak Ridge Restoration (BI-4)	JEF			Barataria	Lafourche/ Jefferson	C/E CHW; C/E CFW
2	R2-3JEF-010303-127	Caminada Chenier Restoration (FN-1)	JEF			Barataria	Lafourche	C/E CFW
2	R2-3JEF-010303-128	Grand Isle Plan (BI-6)	JEF			Barataria	Jefferson	C/E CHW; PP CHW
2	R2-3JEF-010303-129	Naomi Siphon Sediment Enrichment (NA-1)	JEF			Barataria	Plaquemines	C/E CHW
2	R2-3JEF-010303-130	Hero Canal Diversion (NA-7)	JEF		BA-13	Barataria	Plaquemines	C/E CHW; C/E CFW
2	R2-3JEF-010303-131	Bayou Dupont Sediment Delivery Expansion (NA-9)	JEF			Barataria	Plaquemines/ Jefferson	C/E CHW
2	R2-3JEF-010303-133	Myrtle Grove Natural Ridge Restoration (MG-1)	JEF			Barataria	Jefferson	C/E CFW
2	R2-3JEF-010303-134	Bayou Segnette Shoreline Restoration at Yankee Pond (CS-5)	JEF			Barataria	Jefferson	PP CHW; PP CFW
2	R2-3JEF-010303-135	North of Yankee Pond Restoration (CS-6)	JEF			Barataria	Jefferson	C/E CHW; PP CHW
2	R2-3JEF-010303-136	Southeast Lake Salvador near Bayou Villars Shoreline Protection/Stabilization (CS-9)	JEF			Barataria	Jefferson	C/E CHW; PP CHW
2	R2-3JEF-010303-137	Northeast Lake Salvador Chenier Restoration (CS-10)	JEF			Barataria	Jefferson	C/E CFW; PP CHW; PP CFW
2	R2-3JEF-010303-138	North Cuba Island Shoreline Protection	JEF			Barataria	St. Charles	PP CHW
2	R2-3JEF-010303-139	Tenneco Canal Restoration-National Park Service (CS-18)	JEF			Barataria	Jefferson	C/E CHW

Region	RRP Track Code	Project Name	Sponsor Organization(*)	State Project Number	Federal Project Number	Basin	Parish	RRP Restoration Type (**)
2	R2-3JEF-010303-140	Goose Bayou to Cypress Bayou Shoreline Protection (NA-3)	JEF			Barataria	Jefferson	C/E CFW; PP CHW; PP CFW
2	R2-3JEF-010303-141	South Shore of the Pen Shoreline Protection/Stabilization (MG-5)	JEF			Barataria	Jefferson	C/E CHW; PP CHW
2	R2-3JEF-010303-142	Land Bridge Shoreline Protection Extension and Wetland Protection (PR-7)	JEF			Barataria	Jefferson	C/E CHW; PP CHW
2	R2-3JEF-010303-143	Bayou Perot/Bayou Rigolettes Peninsula Restoration (PR-11)	JEF			Barataria	Jefferson	C/E CHW; PP CHW
2	R2-3JEF-010303-144	Bay Dos Gris Vicinity Wetlands Restoration	JEF			Barataria	Jefferson	C/E CHW
2	R2-3JEF-010303-145	Mud Lake Vicinity Wetland Restoration (LL-5)	JEF			Barataria	Jefferson	C/E CHW; PP CHW
2	R2-3JEF-010303-146	BBWW from Bayou Normand to Bayou St. Denis Shoreline Restoration (LL-6)	JEF			Barataria	Jefferson	PP CHW
2	R2-3JEF-010303-147	North Barataria Bay Shoreline Wave Breaks	JEF			Barataria	Jefferson	PP CHW
2	R2-3JEF-010303-148	Whiskey Canal Wetland Enhancement (CS-19)	JEF			Barataria	Jefferson	C/E CHW
2	R2-3JEF-010303-149	Dupre Cut Project 9 (BA-26) Wetlands Restoration (MG-3)	JEF			Barataria	Jefferson	C/E CHW
2	R2-3JEF-010303-150	Lafitte Oil and Gas Field (East) Restoration (MG-2)	JEF			Barataria	Jefferson	C/E CHW
2	R2-3JEF-010303-151	Manila Oil and Gas Restoration (MG-4)	JEF			Barataria	Jefferson	C/E CHW
2	R2-3JEF-010303-152	Little Lake Hunting Club Wetland Restoration (PR-3)	JEF			Barataria	Jefferson	C/E CHW; PP CHW
2	R2-3JEF-010303-153	Delta Farms Oil and Gas Field Restoration (PR-6)	JEF			Barataria	Jefferson	C/E CHW; PP CHW
2	R2-3JEF-010303-154	Bayou Rigolettes Bayou Perot and Harvey Cut Channel Management (PR-1)	JEF			Barataria	Jefferson	C/E CHW
2	R2-3JEF-010303-155	Dupre Cut/Barataria Bay Waterway Channel Management (PR-2)	JEF			Barataria	Jefferson	C/E CHW
2	R2-3JEF-010303-156	Bayou St. Denis Channel Management (LL-1)	JEF			Barataria	Jefferson	C/E CHW
2	R2-3JEF-010303-158	Wetland Harbor Activities Recreational Facility (WHARF) (CS-4)	JEF			Barataria	Jefferson	R

Region	RRP Track Code	Project Name	Sponsor Organization(*)	State Project Number	Federal Project Number	Basin	Parish	RRP Restoration Type (**)
2	R2-3JEF-010303-159	Elmer's Island Acquisition and Preservation (BI-3)	JEF			Barataria	Jefferson	Ac/LP CHW; Ac/LP CFW; Ac/LP CBSS; R
2	R2-3JEF-010303-162	North Bayou Segnette Water Quality Improvement Project (CS-1)	JEF			Barataria	Jefferson	C/E CBSS
2	R2-3JEF-010303-163	Bayou Segnette Wetlands Sewage Effluent Diversion (CS-3)	JEF			Barataria	Jefferson	C/E CHW; C/E CFW
2	R2-3JEF-010303-164	Rosethorne Wetlands Sewage Effluent Diversion (NA-6)	JEF			Barataria	Jefferson	C/E CHW C/E CFW
2	R2-3JEF-010303-166	Barataria Basin Barrier Levee (BW-1)	JEF			Barataria	Jefferson	C/E CHW
2	R2-3JEF-010303-169	Jones Point Shipyard Wetland Restoration-National Park Service (CS-17)	JEF			Barataria	Jefferson	C/E CFW
2	R2-3JEF-010303-171	Grand Isle Oil and Gas Pipeline Corridor Shoreline Protection (BI-5)	JEF			Barataria	Jefferson	PP CBSS
2	R2-3LBLD-010603-172	South of Clovelly Farms Levee Stabilization (C1)	LBLD			Barataria	Lafourche	C/E CHW
2	R2-3LBLD-010603-173	East of Clovelly Farms Levee Stabilization (C2)	LBLD			Barataria	Lafourche	C/E CHW
2	R2-3LBLD-010603-174	North of Clovelly Farms Levee Stabilization (C2)	LBLD			Barataria	Lafourche	C/E CHW
2	R2-3LBLD-010603-175	Delta Farms Levee Stabilization (C4)	LBLD			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-3LBLD-010603-176	GIWW Bank Stabilization Phase 1 (C5)	LBLD			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-3LBLD-010603-177	GIWW Bank Stabilization Phase 2 (C6)	LBLD			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-3LBLD-010603-178	GIWW Bank Stabilization Phase 3 (C7)	LBLD			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-3LBLD-010603-179	Bayou Perot Shoreline Protection (C8)	LBLD			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-3LBLD-010603-180	West of Bayou Perot Marsh Creation (C9)	LBLD			Barataria	Lafourche	C/E CHW
2	R2-3LBLD-010603-181	North of Little Lake Phase 1 Marsh Creation (C10)	LBLD			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-3LBLD-010603-182	North of Little Lake Phase 2 Marsh Creation (C11)	LBLD			Barataria	Lafourche	C/E CHW
2	R2-3LBLD-010603-183	South of Yankee Canal Freshwater Diversion (LE1)	LBLD			Barataria	Lafourche	C/E CHW

Region	RRP Track Code	Project Name	Sponsor Organization(*)	State Project Number	Federal Project Number	Basin	Parish	RRP Restoration Type (**)
2	R2-3LBLD-010603-184	Pointe Fourchon LA Highway 1 Ridge Protection (CB1)	LBLD			Barataria	Lafourche	C/E CHW
2	R2-3LBLD-010603-185	Lake Laurier LA Highway 1 Ridge Protection (CB2)	LBLD			Barataria	Lafourche	C/E CHW
2	R2-3LBLD-010603-186	Bay Jaque Hydrologic Restoration (CB3)	LBLD			Barataria	Lafourche	C/E CHW
2	R2-3LBLD-010603-187	Tidewater Canal Hydrologic Restoration (CB4)	LBLD			Barataria	Lafourche	C/E CHW
2	R2-3LBLD-010603-188	Golden Meadow Farms Hydrologic Restoration (CB5)	LBLD			Barataria	Lafourche	C/E CHW
2	R2-3LBLD-010603-189	Hydrologic Restoration South of Bayou L'ours Ridge (LL1)	LBLD			Barataria	Lafourche	C/E CHW
2	R2-3LBLD-010603-190	Marsh Rim Establishment on the South Shore of Little Lake (LBLD1)	LBLD			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-3LBLD-010603-191	East Snail Bay Shoreline Protection (LBLD2)	LBLD			Barataria	Lafourche	PP CHW
2	R2-3LBLD-010603-192	West of Snail Bay Shoreline Protection and Marsh Creation (LBLD3)	LBLD			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-3LBLD-010603-193	Live Oak Bay Shoreline Protection (LBLD4)	LBLD			Barataria	Lafourche	PP CHW
2	R2-3LBLD-010603-194	Hackberry Bay North Island Restoration (LBLD5)	LBLD			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-3LBLD-010603-195	West Champagne Bay Marsh Creation (LBLD6)	LBLD			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-3LBLD-010603-196	Caminada Bay Breakwaters (LBLD7)	LBLD			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-3LBLD-010603-197	Lake Palourde Tidal Restriction (LBLD8)	LBLD			Barataria	Lafourche	C/E CHW
2	R2-3LBLD-010603-198	Caminada Bay Marsh Creation (LBLD9)	LBLD			Barataria	Lafourche	C/E CHW; PP CHW
2	R2-4LDWF-061103-204	Cultch Placement for Oyster Enhancement - Hackberry Bay	LDWF			Barataria	Jefferson/ Lafourche	C/E COR
2	R2-4LDWF-061103-205	Cultch Placement for Oyster Enhancement - Barataria Bay	LDWF			Barataria	Jefferson	C/E COR
2	R2-5CWP-2003-216	Caernarvon Diversion Outfall Management (East) BS-5-2	USACE		BS-5-2	Breton Sound	St. Bernard/ Plaquemines	C/E CHW

Region	RRP Track Code	Project Name	Sponsor Organization(*)	State Project Number	Federal Project Number	Basin	Parish	RRP Restoration Type (**)
2	R2-5CWP-2003-218	Spanish Pass Diversion	USACE			Mississippi River	Plaquemines	C/E CHW
2	R2-1MPH-061903-225	Edward Wisner Marsh Creation	Edward Wisner Foundation			Barataria	Lafourche	C/E CHW
2	R2-3SJA-062703-226	Hydrologic Restoration / South Vacherie	Bayou Chevreuil Land Company			Barataria	St. James	C/E CHW; C/E CFW
2	R2-3SJA-062703-228	Levee Gapping / West Bank St. James Parish	St. James Parish CZM			Barataria	St. James	C/E CHW; C/E CFW
2	R2-5CWP-2003-231	Lake Lery Shoreline Protection	LDNR/CRD			Breton Sound	St. Bernard	PP CHW
2	R2-5CWP-2003-232	Shell Island Barrier Protection (2-4)	NRCS			Barataria	Plaquemines	PP CHW; PP BSS
2	R2-3SJA-062703-233	Wetland Creation-Parishwide / West Bank	St. James Parish CZM			Barataria	St. James	C/E CHW; C/E CFW
Coastwide	CW-5CWP-2000-043	Deep Hole Breakwaters	USACE			Barataria	Plaquemines	C/E CBSS
Coastwide	CW-5CWP-2000-044	Enhancing Salt Marsh Creation by Coupling Bay Bottom Terracing with Innovative SAV Plantings	NMFS			Coastwide	Coastwide	C/E CHW; C/E CSAV
Coastwide	CW-5CWP-2000-045	Fiber Mat Demo for Erosion Control and SAV and Marsh Creation	USEPA			Terrebonne	Terrebonne	C/E CHW; C/E CBSS; C/E CSAV; PP CHW; PP CBSS
Coastwide	CW-5CWP-1999-048	Periodic Introduction of Sediment and Nutrients at Selected Diversion Sites	USACE	MR-11	MR-DEMO	Mississippi River Delta	No location Identified	C/E CHW

Table C- 2: Region 2 RRP Restoration Projects Not Included

Region	RRP Track Code	Project Name	Sponsor Organization (*)	State Project Number	Federal Project Number	Basin	Parish	Reason for Exclusion
2	R2-3JEF-010303-132	Freshwater Introduction through Abandoned O&G Pipelines (BW-2)	JEF			Barataria	Basinwide	Not one of the Restoration types
2	R2-3JEF-010303-157	Grande Terre Channel Management (BI-1)	JEF			Barataria	Jefferson	Insufficient information provided
2	R2-3JEF-010303-165	Goose Bayou to Lafitte Levee (NA-8)	JEF			Barataria	Jefferson	No nexus to potentially injured resource
2	R2-3JEF-010303-168	Peters and Engineers Road Extension and Widening (JW-1)	JEF			Barataria	Jefferson	No nexus to potentially injured resource
2	R2-3JEF-010303-170	Shoreline Stabilization at North Bank of Bayou Rigolette near Bayou Barataria (PR-5)	JEF			Barataria	Jefferson	Insufficient information provided

(*)	NRCS	Natural Resource Conservation Service
	NMFS	National Marine Fisheries Service
	USEPA	U.S. Environmental Protection Agency
	USACE	U.S. Army, Army Corps of Engineers
	USFWS	U.S. Fish and Wildlife Service
	DU	Ducks Unlimited
	JEF	Jefferson Parish
	LBLD	Lafourche Basin Levee District
(**)	C/E CHW	Creation/Enhancement of Coastal Herbaceous Wetlands
	C/E CFW	Creation/Enhancement of Coastal Forested Wetlands
	C/E CBSS	Creation/Enhancement of Coastal Beach/Shoreline/Streambeds
	C/E COR	Creation/Enhancement of Coastal Oyster Reefs
	C/E CSAV	Creation/Enhancement of Coastal Submerged Aquatic Vegetation
	PP CHW	Physical Protection of Coastal Herbaceous Wetlands
	PP CFW	Physical Protection of Coastal Forested Wetlands
	PP CBSS	Physical Protection of Coastal Beach/Shoreline/Streambeds
	AcLp CHW	Acquisition/Legal Protection of Coastal Herbaceous Wetlands
	AcLp CFW	Acquisition/Legal Protection of Coastal Forested Wetlands
	AcLp CBSS	Acquisition/Legal Protection of Coastal Beach/Shoreline/Streambeds
	R	Recreational Resources Restoration

Appendix D – Non-Project Specific Cash Out Cost analyses for Coastal Herbaceous Wetlands in Region 2

Introduction

The U.S. Environmental Protection Agency (USEPA) estimates the state of Louisiana to contain 5,882,070 acres of fresh and tidal wetlands which is greater than 50% of the total wetland area in the continental United States. Petroleum products are equally as abundant within the in- and off-shore regions of the state. Louisiana ranks second in the nation in total energy produced, second in natural gas produced, and first in crude oil production (Louisiana Mid-Continent Oil and Gas Association 2002).

Due to the extent of coastal herbaceous wetlands in Louisiana and the magnitude of the oil and gas produced both in- and off-shore, most natural resource damage assessments (NRDAs) in Louisiana have been conducted in or adjacent to marsh and the injuries have been compensated for by creating coastal herbaceous wetlands. Therefore, the likelihood of pursuing future NRDA's in the coastal zone of Louisiana was our impetus to develop the cost per discounted service acre year metric for use in the non-project specific cash out settlement alternative of the Louisiana Regional Restoration Planning Program. The following details how we obtained and used cost and function information used to generate this metric.

Project Costs

We divided marsh restoration costs into three categories: implementation, which include engineering and design, land rights, construction, and operation and maintenance; monitoring and oversight; and contingencies for unexpected cost overruns.

We collected marsh restoration implementation costs from past or planned CWPPRA projects, brown marsh projects, and small dredge projects. There are 35 CWPPRA projects in our data set (Appendix D- 1). This is subset of past or planned CWPPRA projects because a number of them were excluded for one or more of the following reasons: 1) a high probability that the project design would change during construction (planned barrier island projects especially); 2) the area benefited could not be determined (freshwater diversions); 3) the project was a three to five year demonstration project that utilized experimental techniques; 4) infrastructure data were unavailable to aid in the determination of functional benefits; 5) the project was de-authorized due to a lack in benefit, exorbitant maintenance cost, or structural failure; or 6) project features were not consistent with the designated restoration type (e.g., fixed-crest weirs as the major component of a shoreline protection project). We did not consider CWPPRA projects that had not surpassed the phase 1 planning stage, i.e., the early development stage.

We have brown marsh dredging bids from seven different contractors. To complete the cost of brown marsh restoration implementation, we added estimated costs for engineering and design, permitting, and vegetation planting (Appendix D- 2). These added costs were based on Robin Lewis' estimate of wetlands restoration effort that was developed for the Mulberry Phosphates damage assessment (Table D- 1). Hourly rates of three engineering contractors were averaged and applied to the effort estimates to obtain Louisiana specific costs. The average cost per unit of vegetation (Table D- 2) was provided by Kenneth Bahlinger (Pers. Comm. 2002) – Louisiana DNR's point of contact for all vegetation planting conducted on CWPPRA projects.

Table D- 1 Adapted from Robin Lewis' estimate of man-hour effort for a 4-acre wetland creation. This estimate was prepared for the Mulberry Phosphates damage assessment.

Pre-construction		
	Review maps and existing aerials for potential sites, shortlist sites, order aerials, visit sites with aerials and surveyors to determine existing ground elevations and potential for restoration to marsh such as proximity to tidal waters and access.	
Site identification		
	Baseline aerials (3)	
	24 hrs.	Principal ecologist
	8 hrs.	Clerical
Plans and Specifications		
	Prepare drawings and plans to scale for review, modify per review comments, transfer to permit application form size, calculate cubic yardage and square footage of quantities and potential impact areas.	
	24 hrs.	Principal ecologist
	12 hrs.	Professional engineer
	30 hrs.	Ecologist
	16 hrs.	CAD tech
	20 hrs.	EI
	18 hrs.	Clerical
	1 day	Boat rental
	Misc. expenses	Mileage, copying, etc.

Jurisdictional and Permitting		
	Submit permit applications, meet with agencies for field inspections, determine agency jurisdictional boundaries with agency personnel, answer oral questions, answer questions over the phone and in writing. Modify permit application as needed.	
	10 hrs.	Principal ecologist
	16 hrs.	Professional engineer
	52 hrs.	Ecologist
	8 hrs.	Reg. land surveyor
	26 hrs.	CAD tech
	8 hrs.	EI
	8 hrs.	Draftsmen
	16 hrs.	3-man survey crew
	21 hrs.	Clerical
	Misc. expenses	

Construction		
	Construction includes the hiring of the construction personnel, usually through advertising the availability of construction drawings, requesting bids, and selecting the most responsive and experienced bidder, sometimes limited by law to the lowest bidder. Staking of the site to define cut and fill locations is usually done in conjunction with a surveyor. The contractor is supervised by the owner's representative, and work is approved and paid for over a scheduled period of time. Penalties may be imposed for delays in construction, or additional funds paid for unforeseen delays due to events beyond the control of the contractor like hurricanes. Final approval of the construction using an as-built survey and supervision of plant materials usually finishes the job.	
	Construction supervision	Construction supv.
	Ecological supervision	Ecologist
	Mobilization/De-mobilization	$ varies
	Dredging	$ varies
	As-built survey	3-man survey crew
	Planting	4840 per acre

Table D- 2. Average cost per plant (*Spartina alterniflora, Spartina patens, Panicum amarum,* and *Avicennia germinans*) including mobilization/demobilization, planting crews, fertilizer, and pre-planting site visit in regions 1 through 4.

Plant size	Average cost per unit ($)
Plug	4
4-inch potted	7
Gallon	8

Louisiana DNR provided dredging costs for two groups of small dredge projects in Lake Salvador and Bayou Dupont. Here we also added costs for the other project components, but instead of using estimates derived from Robin Lewis' work, we acquired DNR's man-hour report for those personnel who charged time to the dedicated dredging program, used hourly rates of engineering contractors in south Louisiana, and computed costs accordingly (Appendix D- 3).

We investigated other sources of project implementation costs, but none of them were useful. There have been a handful of marsh restoration projects in Louisiana to resolve NRDA liability, however, those projects were RP implemented and we do not have reliable cost information. There is only a limited community-based restoration program in Louisiana and there have not been any marsh restoration projects. Attempts were made to acquire cost information for restoration projects undertaken in Southern Louisiana by Ducks Unlimited and The Nature Conservancy (TNC). Ducks Unlimited was unreachable and TNC was unable to contribute because their focus has been on land acquisition of imperiled areas. A literature search uncovered no other sources of marsh restoration project information.

The monitoring and oversight costs were assigned as a percentage of the implementation costs. For monitoring costs, the assignment was based on hypothetical monitoring costs (Table D- 3) for marsh restorations of different sizes in Louisiana, while the oversight costs were based on national NRDA past project data (Table D- 4). We found that monitoring and oversight costs are approximately 27 and 13 percent of the implementation costs, respectively (see below).

Table D- 3. Estimated monitoring costs for projects of various sizes in southern Louisiana reported as the percent of implementation costs.

Project size	Cost		
	Monitoring	Implementation	% of Implementation
4-acre creation	$189,214	$407,021	46.49%
10-acre creation	$226,722	$848,030	26.74%
20-acre creation	$334,473	$1,475,639	22.67%
40-acre creation	$382,996	$2,807,194	13.64%
Average			27.4%

Table D- 4. Cost of Trustee oversight for Trustee implemented projects nationwide reported as the percent of implementation.

Project	Cost		
	Oversight	Implementation	% of Implementation
Berman	$206,583	$9,329,506	2.21%
Chalk Point (marsh)	$117,588	$397,212	29.60%
CB (Port)	$1,800,000	$10,200,000	17.65%
CB (S/C)	$75,000	$500,000	15.00%
CB (City)	$1,250,000	$6,161,747	20.29%
Great Lakes	$31,394	$356,445	8.81%
M. Beholden	$47,500	$1,623,837	2.93%
Mulberry	$278,155	$3,371,845	8.25%
Mystery Spill	$307,610	$1,198,790	25.66%
N. Cape (non-lobster)	$400,000	$6,800,000	5.88%
Salvors	$17,650	$128,348	13.75%
Average without high and low (Chalk Pt., Berman)			13.13%

The contingency cost for each project was assigned as a fraction of total cost per Army Corps of Engineer guidance. The Corps recommends a 25 percent contingency at the planning stage of project development. So, 25 percent was added to the sum of implementation, monitoring, and oversight costs to estimate total project cost. We inflated all project costs to June 2003 dollars.

Project Function

The marsh restoration projects for which we have cost information are different types of projects that have different functions. We identified three types of projects: shoreline protection, marsh creation, and vegetation planting. For each project type we identified one set of parameters that determine project function. The longevity for every project was assumed to be fifteen years starting in 2009 to account for delay in restoration implementation. The remaining parameters and resulting function for each project type follow.

Shoreline Protection projects are designed to halt shoreline erosion, thereby, saving or providing for the continued services of natural marsh. We assigned this restoration type a 100% value of restored service relative to the injury, fifteen years of full service flow, and a linear maturity curve. The latter two parameters imply preventing loss at a constant rate, which is how erosion rates are usually reported. For each project, individual shoreline erosion rates were determined using Barras *et al.* (1994) analysis of land loss rates from 1956 to 1990. This rate of erosion prevention, or the continuation of services provided by the protected area, was calculated to last fifteen years. Using these parameters as Habitat Equivalency Analysis (HEA; NOAA 2000) inputs, a shoreline protection project (with a lifetime cumulative benefit of one acre) generates 5.115 DSAYs per acre (Appendix D- 4).

Marsh Creation projects create substrate at elevations suitable for the emergence and dominance of vascular plants through a dredge and fill scenario. Typically, in salt and brackish marsh, the fill material is planted with native vegetation following dewatering and compaction of the sediments. The habitat equivalency analysis parameters used for past NRDA projects in Louisiana are 50% value of restored services relative to the injury, five years to full service flow, and a linear maturity curve. This level of service provided by a created coastal herbaceous marsh at year five is based on the levels of functional equivalency through a projects life for primary productivity, soil development, nutrient cycling, food chain support, and fish and shellfish production as reported by Broome 1990; Broome and Craft 1999; Broome *et al.* 1983; Broome *et al.* 1986; Cammen 1975; Craft *et al.* 1988; Craft *et al.* 1999; Currin and Paerl 1998; Currin *et al.* 1996; Langis *et al.* 1991; LaSalle *et al.* 1991; Levin *et al.* 1996; Lindau and Hossner 1981; Minello 1997; Minello and Webb 1997; Minello and Zimmerman 1992; Moy and Levin 1991; Peck *et al.* 1994; Piehler *et al.* 1998; Sacco *et al.* 1994; Sacco *et al.* 1987; Scatolini and Zedler 1996; Seneca *et al.* 1976; Seneca *et al.* 1985; Thompson *et al.* 1995; Thompson *et al.* 1995. Using the above mentioned parameters for past NRDA projects in Louisiana as HEA (NOAA 2000) inputs, a one acre marsh creation project generates 4.335 DSAYs per acre (Appendix D- 5).

Vegetation Planting – these projects entail planting to promote plant growth and marsh function by supplementing species richness, contributing to nutrient cycling, and water quality to name a few. The result is 2.37 DSAYs per acre (Penn and Tomasi 2002).

We considered freshwater diversion projects as a marsh restoration type because the projects are designed to enhance existing marsh areas by altering an estuaries isohaline lines. Reports on the CWPPRA projects indicate that each of the projects benefits thousands of acres of marsh, which drives the cost/DSAY for this type of project very low. However, the diversions rarely function at their capacity benefiting the maximum number of acres. Because the areas of benefit are not definitive, we excluded this restoration type from our analysis. Furthermore, this type of project is not likely to be implemented under the RRP Program. Freshwater diversions are costly and projects do not function at full capacity due in part to socioeconomic and political pressure.

We also considered crevasse construction projects for inclusion in the data set. This project type has been widely implemented in the Mississippi River Delta; however cost information was only available for two projects: Delta-wide crevasses and Channel Armor Gap. Data on the former project were excluded because construction widened or re-opened existing areas and no sub-aerial expressions existed three years after project implementation (Troutman, Pers. Comm. 2003). With only one data point for crevasse construction costs, the trustees eliminated this as a potential marsh restoration type.

Cost/DSAY

Figures 1 and 2 present the cost/DSAY data, calculated using cost and function information, by restoration implementation method. The mean cost/DSAY for each restoration type is: shoreline protection - $29,804 (n=18), marsh creation - $32,822 (n=16) and vegetative planting - $20,665 (n=2). We also computed weighted average marsh restoration costs/DSAY based on different weighting schemes. To implement the non-project specific cash out settlement, we calculated a mean cost/DSAY using all of the data points (n=37) using weighted averages based on the frequency of past NRDA project implementation. The resulting cost per DSAY is $28,464. This cost is in June 2003 dollars. To apply this statistic, the amount should be updated at the time of use to account for inflation. The consumer price index (see http://www.bls.gov/cpi/home.htm) is published monthly and is an appropriate index.

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Appendix D- 1: Implementation costs for CWPPRA projects constructed in regions 1 through 4 from 1993 to present.

Project	DNR code	Total Implementation	Land created and features built	Notes for benefit quantification
Vegetative Plantings	CS-19	$164,721.00	4750 gallon size pots of Scirpus californicus, created 1.2 acres of emergent wetlands.	Marsh creation, 1.2 acres
Compost Demo	CS-26	$349,785.00	Create approximately 10.3 acres of marsh through the use of a dredge slurry mixture.	Marsh creation, 10.3 acres
Isles Dernieres (Phase 1)	TE-20	$8,233,680.33	Design specified 1287207 cubic yards to be dredged and placed, 45000 foot containment dike, sand fencing of unknown length, and *Spartina alterniflora* plantings across the island, aerial seeding of 110 acres.	Marsh creation, 107 acres
Isles Dernieres (Phase 2)	TE-24	$10,627,902.03	3 containment dikes of unknown length, aerial seeding of approx 150 acres, 2 creosote timber plugs, approx 5.1 million cubic yards of dredge material.	Marsh creation, 150 acres
East Timbalier Island	TE-25	$3,898,092.00	949300 cubic yards (approx. 17.5 acres created and/or increased in elevation).	Marsh creation, 17.5 acres
Lake Chapeau Marsh	TE-26	$4,896,210.00	182 acres filled with dredge material. A total of 721,931 cubic yards of dredge material.	Marsh creation, 182 acres
Little Vermilion Bay	TV-12	$750,134.25	19.28 ac total - of that, 12 was suitable for marsh.	Marsh creation, 19.28 acres
New Cut Dune/Marsh	TE-37	$10,339,520.00	239 acres to be built.	Marsh creation, 239 acres
Bayou Labranche	PO-17	$3,391,495.00	Earthen berm and 2.7 million cubic yards of dredge material. Aerial seeding of Japanese millet following dredging.	Marsh creation, 250 acres
Plowed Terraces	CS-25	$ 280,486.00	Approximately 4.2 acres of emergent marsh to be created if terraces are built and settle to the correct height.	Marsh creation, 4.2 acres

Project	DNR code	Total Implementation	Land created and features built	Notes for benefit quantification
Whiskey Island	TE-27	$ 7,581,873.00	Containment dikes of an unknown length, 1 dock, approx 3.2 million cubic yards of dredge material, approx 83 acres of aerial seeding, and an unknown amount of *Spartina alterniflora* and *Panicum amarum* plantings.	Marsh creation, 83 acres
Barataria Bay	BA-19	$ 1,096,969.00	Goal was 9, but none remain. Shell dike too high.	Marsh creation, 9 acres
Atchafalaya Sediment	AT-02	$ 2,346,273.00	A hydraulic dredge was used to create 5 disposal areas. A total of 95 acres were created - of which only 14.4 were marsh.	Marsh creation, 95 acres
East Timbalier Island	TE-30	$ 13,619,974.00	1677816 cubic yards (approx. 98 acres created and/or increased in elevation)	Marsh creation, 98 acres
Point Au Fer Canal	TE-22	$ 2,796,830.34	5 creosote timber plugs, 2 shell plugs, 1 concrete plug, 1000 ft of articulated concrete mat, and 7262 feet of 250 lb class rock armor.	Shoreline protection, 10 acres
Cheniere au Tigre	TV-16	$ 540,628.00	(9) 200 ft rock breakwaters.	Shoreline protection, 10.65 acres
Barataria Bay	BA-26	$ 6,900,369.00	(2) 415 and 200 ft wide fixed crest weirs and 17600 ft of rock armor.	Shoreline protection, 105 acres
Clear Marais Bank	CS-22	$ 3,610,225.00	35,000 ft (10,668 m) rock dike along the north shore of the GIWW	Shoreline protection, 160 acres
Sweet Lake/Willow	CS-11b	$ 4,849,513.00	18,200 ft of rock armor, 24,300 ft of *Scirpus californicus* plantings, 25,500 ft of earthen terraces with two rows of *S. californicus* planted on each side.	Shoreline protection, 20 acres, 145 acres; 3 acres of Shoreline creation
Cameron Prairie	ME-09	$ 1,125,946.44	13,200 ft (4,023 m) rock breakwater was constructed	Shoreline protection, 22.8 acres

Project	DNR code	Total Implementation	Land created and features built	Notes for benefit quantification
Raccoon Island	TE-29	$1,595,800.00	8 rock breakwaters constructed	Shoreline protection, 23 acres
Vegetative Plantings	TE-17	$141,985.00	Protect approx 3 acres behind the structures that protects an open water area from saltwater intrusion. Open water area is approx 30 acres.	Shoreline protection, 3 acres
Sabine Refuge Bank	CS-18	$1,505,230.63	5.5 linear mi of free-standing, continuous rock dike, levee gaps restored using dredge material from an adjacent canal.	Shoreline protection, 3.7 acres
Bayou Chevee	PO-22	$2,555,022.00	5690 feet of rock armor.	Shoreline protection, 39 acres
Marsh Island	TV-14	$4,390,216.00	5 earthen closures of canals, 2 breach repairs using limestone, 1 sheetpile and rock plug, 1 rock plug, 3000 feet of rock armor, unknown length of rock armor for shoreline protection.	Shoreline protection, 46 acres
Lake Salvador Shore	BA-15	$2,454,289.00	Grating Apex (5) 100 ft sections at $390.00/ft, geo-textile tubing (3) 250 ft sections at $340.00/ft, angle timbered fence (3) 167 ft sections at 252.00/ft, vinyl sheet piling (6) 100ft sections at $200.00/ft, 8000 ft of rock armor at $150/ft and a 6 ft deep flotation channel dredged yielding 191,000 cubic yards of dredge. Approx. 20 acres protected.	Shoreline protection, 48 acres
Vermilion River Cutoff	TV-03	$1,955,174.00	8900 ft of rock breakwater.	Shoreline protection, 54 acres
Perry Ridge Bank	CS-24	$2,510,909.00	Approximately 12,000 linear ft (3.7 km) of free-standing rock dike.	Shoreline protection, 55 acres
Freshwater Bayou	ME-13	$2,486,719.00	Approximately 23,193 linear ft (7,069 m) of free-standing rock dike.	Shoreline protection, 63 acres

Project	DNR code	Total Implementation	Land created and features built	Notes for benefit quantification
Jonathan Davis	BA-20	$11,662,842.00	5 low sill rock weirs, 1 earthen plug, 7 rock armored earthen plugs, 6 breaches armored with rock, 34000 feet of rock armor along shoreline.	Shoreline protection, 633 acres
Black Bayou	CS-27	$5,543,577.00	Approximately 20,000 linear ft. of rock foreshore dikes, weir with a barge bay, 100 ft. wide plug with a 15 ft. boat bay at - 4 ft. bottom elevation, 150 ft. wide plug with at least 4-48" culverts fitted with flapgates and screw gates, 100 ft. wide plug in Black Bayou, replace two collapsed culverts under the shell road, rock weir with a 15 ft. boat bay at - 3 ft. bottom elevation, estimated 53,200 plants (*Scirpus californicus*).	Shoreline protection, 92 acres
Cote Blanche	TV-04	$5,243,043.00	7 low-level weirs and approx 10,000 feet of shoreline protection.	Shoreline protection, 92 acres
Grand Terre	BA-28	$673,658.00	35000 plugs of Spartina alterniflora, 600 gallon pots of Avicennia germinans, and 3100 4 inch containers each of Spartina patens, Panicum amarum, and Spartina spartinae.	Vegetation planting, 28 acres
Vegetative Plantings	TE-18	$363,185.00	17250 plantings each of Spartina patens and Panicum amarum, 7390 ft of sand fencing - designed to revegetate 3.2 acres of land	Vegetation planting, 3.2 acres
Chandeleur Islands	PO-27	$1,554,554.00	66000 plugs and 15000 4 inch pots of Spartina alterniflora to stabilize 15 hurricane overwash areas	Vegetation planting, 45 acres

Appendix D- 2. Estimated brown marsh costs calculated using the average per cubic yard bid of dredge material bids from seven contractors. Three areas will receive dredge material for a total area of 12.3 acres.

Preconstruction

Site Identification	*Hours or # needed*	*Total cost*
Aerial photography	4	12,000.00
Principal Ecologist	40	2,960.00
Clerical	12	336.00
Landrights		2,000.00
Plans and Specifications		
Principal Ecologist	40	4,000.00
Professional Engineer	24	1,776.00
Ecologist	56	4,144.00
CAD Tech	30	1,800.00
GIS tech	30	1,545.00
Clerical	32	896.00
2 man survey crew	40	4,120.00
22' Work boat	8 days	3,400.00
RTK GPS	4 days	1,880.00
Geotech	20	30,000.00
Misc expenses (gas, copying)		1,500.00
Jurisdictional and Permitting		
Principal Ecologist	20	2,400.00
Professional Engineer	30	2,220.00
Ecologist	80	5,920.00
Registered Land Surveyor	8	592.00
CAD tech	48	2,880.00
Engineer Intern	48	2,472.00
Draftsmen	30	1,500.00
3 man survey crew	30	3,090.00
Clerical	36	1,008.00

Construction

Dredging	$4.37/cubic yard	421,158.75
Planting	4850 S. alterniflora/acre	436,257.50
Construction supervisor	8 man-weeks	17,200.00
Ecologist	3 man-weeks	9,000.00
Mobilization/Demobilization		82,362.19
Containment		26,600.00

Appendix D- 2. Continued

Post-construction	
Monitoring	297,299.27
Oversight	142,399.28
Contingency	381,843.50
Project Total	$1,908,559.49

Appendix D- 3. Estimated small dredge program project costs using actual construction costs (save plantings) and the LDNR man hour report for hours. All other cost categories were estimated following Robin Lewis' cost report.

Preconstruction		
Site Identification	*Hours or # needed*	*Total cost*
Aerial photography	6	18,000.00
Principal Ecologist	100	7,400.00
Clerical	40	1,120.00
Landrights		12,375.00
Plans and Specifications		
Principal Ecologist	80	8,000.00
Professional Engineer	400	29,600.00
Ecologist	80	5,920.00
CAD Tech	60	3,600.00
GIS tech	60	3,090.00
Clerical	40	1,120.00
2 man survey crew	8days	8,240.00
22' Work boat	32 days	13,600.00
RTK GPS	16 days	7,520.00
Geotech	40	60,000.00
Misc expenses (gas, copying)		5,000.00
Jurisdictional and Permitting		
Principal Ecologist	60	6,000.00
Professional Engineer	60	4,440.00
Ecologist	120	8,880.00
Registered Land Surveyor	12	888.00
CAD tech	72	4,320.00
Engineer Intern	48	2,472.00
Draftsmen	40	2,060.00
3 man survey crew	60	6,180.00
Clerical	60	1,680.00
Construction (Lake Salvador)		
Contracting	190	9,500.00
Dredging 4422 cy/ac	25.8 ac	296,631.40
Planting	4850/acre	875,910.00
Construction supervisor	12 man-weeks	25,800.00
Ecologist	6 man-weeks	18,000.00
Mobilization/Demobilization		32,600.00
Containment	3919 feet	27,433.00
State employee supervision	200	9,000.00

Appendix D- 3. (Continued)

Construction (Bayou Dupont)		
Dredging 448725 c.f. @ $2.34/c.f.		1,050,016.50
Mobilization/Demobilization		30,000.00
Planting	4850/acre	1,972,495.00
Construction supervisor	10 man-weeks	21,500.00
Ecologist	6 man-weeks	18,000.00
State employee supervision	275	12,375.00
Post-construction		
Monitoring		1,263,779.47
Trustee oversight		605,320.33
Contingency		1,622,466.43
Project total		$ 8,112,332.13

Appendix D- 4. Habitat Equivalency Analysis output for a shoreline protection project that benefits one acre of coastal herbaceous wetlands.

Shoreline Protection

HEA Parameters - Restoration	
Year in which restoration is completed	2009
Years to full service flow	15 linear
Relative value of restored services	100%
Acres of habitat restored	1.00
Lifespan of project (years)	15
Discount rate	3%
Base year	2003

Year	Percent Service Flow: End of Period	Raw Acre Years of Wetland Services	Discounted Acre Years of Services
2002	0.00%	0.000	0.000
2003	0.00%	0.000	0.000
2004	0.00%	0.000	0.000
2005	0.00%	0.000	0.000
2006	0.00%	0.000	0.000
2007	0.00%	0.000	0.000
2008	0.00%	0.000	0.000
2009	6.67%	0.067	0.056
2010	13.33%	0.133	0.108
2011	20.00%	0.200	0.158
2012	26.67%	0.267	0.204
2013	33.33%	0.333	0.248
2014	40.00%	0.400	0.289
2015	46.67%	0.467	0.327
2016	53.33%	0.533	0.363
2017	60.00%	0.600	0.397
2018	66.67%	0.667	0.428
2019	73.33%	0.733	0.457
2020	80.00%	0.800	0.484
2021	86.67%	0.867	0.509
2022	93.33%	0.933	0.532
2023	100.00%	1.000	0.554
2024	0.00%	0.000	0.000
2025	0.00%	0.000	0.000
2026	0.00%	0.000	0.000
Total discounted acre years of services provided per acre			**5.115**

Appendix D- 5. Habitat Equivalency Analysis output for a marsh creation project that benefits one acre of coastal herbaceous wetlands.

Herbaceous Wetlands Creation

HEA Parameters - Restoration	
Year in which restoration is completed	2009
Years to full service flow	5 linear
Relative value of restored services	50%
Acres of habitat restored	1.00
Lifespan of project (years)	15
Discount rate	3%
Base year	2003

Year	Percent Service Flow: End of Period	Raw Acre Years of Wetland Services	Discounted Acre Years of Services
2002	0.00%	0.000	0.000
2003	0.00%	0.000	0.000
2004	0.00%	0.000	0.000
2005	0.00%	0.000	0.000
2006	0.00%	0.000	0.000
2007	0.00%	0.000	0.000
2008	0.00%	0.000	0.000
2009	20.00%	0.100	0.084
2010	40.00%	0.200	0.163
2011	60.00%	0.300	0.237
2012	80.00%	0.400	0.307
2013	100.00%	0.500	0.372
2014	100.00%	0.500	0.361
2015	100.00%	0.500	0.351
2016	100.00%	0.500	0.340
2017	100.00%	0.500	0.331
2018	100.00%	0.500	0.321
2019	100.00%	0.500	0.312
2020	100.00%	0.500	0.303
2021	100.00%	0.500	0.294
2022	100.00%	0.500	0.285
2023	100.00%	0.500	0.277
2024	0.00%	0.000	0.000
2025	0.00%	0.000	0.000
2026	0.00%	0.000	0.000
Total discounted acre years of services provided per acre			**4.335**

APPENDIX E – NON-PROJECT SPECIFIC CASH OUT COST ANALYSES FOR FORESTED WETLANDS IN REGION 2

Introduction

Forested wetlands are the most common type of wetlands in the conterminous United States (Dahl and Johnson 1991), however, since the turn of the century there has been a reduction in their area. The USDA Forest Service (1988) reports that the area of bottomland hardwood forests in the South is predicted to decrease from 30.15 million acres (12.2 million ha) in 1990 to 26.2 million acres (10.6 million ha) in 2030. Much of the decrease in area can be attributed to the conversion of bottomland hardwood forests, primarily to agricultural lands, by clearing the trees and ditching the land to improve drainage (Abernathy and Turner 1987, Brinson *et al.* 1981, Mitsch and Gosselink 1993, Turner *et al.* 1980).

Because there are expanses of agricultural land where forested wetlands were formerly present (in the transitional zone between terrestrial and aquatic systems), restoration scientists are presented with numerous opportunities to convert agricultural land back to forested wetlands using their pre-existing substrate, correcting hydrology, and planting native vegetation. This is the basic principal behind the Louisiana Regional Restoration Planning Program's effort to develop costs per discounted service acre year (DSAY) for the creation/enhancement of wetland forests under the non-project specific cash-out settlement. The following describes where we obtained project cost and function information and the resulting cost/DSAY metric.

Project Costs

We divided forested wetland costs into three categories: implementation, which includes land rights and acquisition, site characterization, permitting, engineering and design, and construction; monitoring and oversight; and contingencies for unexpected cost overruns. Though we pursued cost data from various state and private groups (LA Department of Natural Resources, engineering and biological contractors, seedlings nurseries, etc.), our search never yielded figures for complete projects. Therefore, to develop this cash out settlement, we estimated costs for various sized projects (10, 20, 30, and 40 acres) using phone quotes and published information and applied them to the steps described by Allen *et al.* (2000) in *A Guide to Bottomland Hardwood Restoration*.

To complete the cost for creation/enhancement of forested wetland implementation, we added estimated costs for land acquisition and land rights, site characterization, permitting, engineering and design, site preparation, and vegetation planting. These added costs were based on multiple sources (Table E- 1) that include Robin Lewis' estimate of wetlands restoration effort that was developed for the Mulberry Phosphates damage assessment (Table E- 2), hourly labor rates for contractual services provided by numerous firms in south Louisiana, and plant specific costs obtained from state agencies and private nurseries.

Table E- 1. Sources of information used to develop estimates of total project costs.

Data type	Source of cost information
Land acquisition	FarmProspector.com Farm & Ranch Real Estate Marketplace Iberville Parish Sugar Cane Farmer
Site characterization	Remote Data Systems, Inc. Louisiana State University Agricultural Extension Center
Permitting, Engineering & Design	Lewis Environmental Services, Inc. Numerous contractors in south Louisiana
Site Preparation and Seedling Planting	Louisiana Office of Forestry Mississippi State University Extension Service Hardwood Seedlings, LLC. International Paper Company North Carolina State University Hardwood Research Cooperative MS Means Heavy Construction data
Monitoring	Louisiana Department of Natural Resources – Coastal Restoration Division North Carolina State University – Restoration Ecology Program
Oversight	National average from Natural Resource Damage Assessment cases
Contingency	United State Army Corps of Engineers

Table E- 2. Estimated man-hour effort and equipment needs for a 10-acre forested wetland restoration.

Pre-construction

Land acquisition and land rights		
	Determine ownership of tracts Purchase agricultural land	

Site characterization		
	Review maps for potential reference sites, choose sites and determine area hydrology, vegetation type, and soil characteristics.	
	240 hrs.	Ecologist
	20 hrs.	Clerical
	10 wells	Water level recorders
	100 samples	Soil sampling
	2 days	3-man survey crew

Plans and Specifications		
	Prepare drawings and plans to scale for review, modify per review comments, transfer to permit application form size, determine types of land manipulation and potential impact areas.	
	36 hrs.	Principal ecologist
	18 hrs.	Professional engineer
	48 hrs.	Ecologist
	24 hrs.	CAD tech
	30 hrs.	Engineer intern
	27 hrs.	Clerical
	3 days	Differential GPS
	Misc. expenses	Mileage, copying, etc.

Jurisdictional and Permitting		
	Submit permit applications, meet with agencies for field inspections, provide transportation to site, answer oral questions, and answer questions over the phone and in writing. Modify permit application as needed.	
	15 hrs.	Principal ecologist
	70 hrs.	Ecologist

	8 hrs.	Reg. land surveyor
	40 hrs.	CAD tech
	24 hrs.	Engineer intern
	3 days	3-man survey crew
	30 hrs.	Clerical
	Misc. expenses	
Construction		
	Construction includes staking of the site in the field, performing earthwork, planting trees, placing tree shelters, and applying herbicide and fertilizer. Penalties may be imposed for delays in construction, or additional funds paid for unforeseen delays due to events beyond the control of the contractor like hurricanes. Final approval of the construction using an as-built survey usually finishes the job.	
	Site preparation/earthwork	
	Construction supervision	Construction supervisor
	Ecological supervision	Ecologist
	Tree planting	
	Tree shelters	
	Herbicide treatment	
	As-built survey	3-man survey crew

The monitoring and oversight costs were assigned as a percentage of the implementation costs. For monitoring costs, the assignment was based on estimated monitoring costs for forested wetland restorations of different sizes in Louisiana (Table E- 3), while the oversight costs were based on national NRDA past project data (Table E- 4). We found that monitoring costs are approximately 85.8 percent of implementation costs and oversight costs are 13 percent.

Table E- 3. Estimated monitoring and implementation costs for hypothetical forested wetland creation projects in southern Louisiana. Each project's monitoring costs are presented as the percent of implementation. Monitoring protocols were established for a period of 5-years post-construction and consist of monitoring vegetative structure and composition, soil chemical and physical properties, and hydro-period.

Project size	Cost		
	Monitoring	Implementation	% of Implementation
10 acre creation	$126,759	$141,266	89.7%
20 acre creation	$207,060	$221,199	93.6%
30 acre creation	$251,621	$301,348	83.5%
40 acre creation	$291,519	$382,066	76.3%
Average			85.8%

Table E- 4. Oversight costs for Trustee implemented projects nationwide presented as the percent of implementation.

Project	Costs		
	Oversight	Implementation	% of Implementation
Berman	$206,583	$9,329,506	2.21%
Chalk Point (marsh)	$117,588	$397,212	29.60%
Commencement Bay (Port)	$1,800,000	$10,200,000	17.65%
Commencement Bay (S/C)	$75,000	$500,000	15.00%
Commencement Bay (City)	$1,250,000	$6,161,747	20.29%
Great Lakes	$31,394	$356,445	8.81%
M. Beholden	$47,500	$1,623,837	2.93%
Mulberry	$278,155	$3,371,845	8.25%
Mystery Spill	$307,610	$1,198,790	25.66%
N. Cape (non-lobster)	$400,000	$6,800,000	5.88%
Salvors	$17,650	$128,348	13.75%
			13.64%
Average without high and low (Chalk Pt., Berman)			13.13%

The contingency cost for each project was assigned as a fraction of total cost per Army Corps of Engineer guidance. The Corps recommends a 25 percent contingency at the planning stage of project development. So, 25 percent was added to the sum of implementation, monitoring, and oversight costs to estimate total project cost. We inflated all project costs to June 2003 dollars.

Therefore, the equation used to develop the cost of forested wetland creation projects is:

$$((I + M + O) * C)) + (I + M + O)$$

where I = implementation costs, M = monitoring costs (as a % of implementation), O = trustee oversight costs (as a % of implementation), and C = 25% contingency for cost overruns.

Project Function

We conducted a literature search to identify various functions provided by forested wetlands to assess when those functions may be met following the creation/enhancement of this ecosystem by the LA Regional Restoration Planning Program. At present, five major categories of wetland ecosystem function are recognized: hydrology, water quality, nutrient cycling/food chain support, habitat, and socioeconomic (The Conservation Foundation 1988, Greeson *et al.* 1979, Mitsch and Gosselink 1993, Sather and Smith 1984).

Water quality. The more commonly cited improvements of water quality due to wetlands include the removal of nitrogen, phosphorous, and sediment from floodwaters and all are related to hydrology, soils, and vegetation of a particular wetland (Brinson *et al.* 1981, Cooper *et al.* 1987, Elder 1985, Gilliam and Skaggs 1987, Kadlec and Kadlec 1979). Nutrients, sediments, and pollutants move into and out of the wetland with the water and they are subject to plant uptake, soil-plant cycling, hydrologic dilution, soil chemical alteration or sorption, or deposition (Adamus and Stockwell 1983, van der Valk *et al.* 1979). These types of transformations emphasize the critical role between upland terrestrial and aquatic ecosystems (Waring and Schlesinger 1985). Flood storage, nutrient cycling, and sediment trapping are typically significantly different from mature forests following plantings and/or natural regeneration. Numerous studies have been conducted in forested wetlands comparing functions between mature and newly regenerated forests (Aust 1989, Aust *et al.* 1990, Freese 1994, Lockaby *et al.* 1994, Lockaby *et al.* 1997, Messina *et al*. 1997, Perison *et al.* 1997, Trettin 1994) and each indicates that the systems ability to improve water quality through nutrient cycling and sediment trapping is slow at first and that these functions are often not provided after 3-5 growing seasons. Rapp *et al.* (2001) investigated the long term recovery of a cypress-tupelo swamp in South Carolina and found that the water quality and sediment trapping capabilities gradually increased to 90-100% to that of a mature forest between growing seasons eight through twelve.

Nutrient cycling/Food chain support. Wetland vegetation is significant to the functions of erosion control, sedimentation, nutrient cycling and transformations, food chain support, habitat provision, and recreation (Niering 1988, Sather and Smith 1984, Waring and Schlesinger 1985). In general, wetland vegetation rapidly consumes available forms of nutrients brought by floodwaters and incorporates it into primary productivity. This same source of vegetation serves as the principal source of organic detritus which can be cycled or exported in particulate organic forms supporting secondary production of downstream biota (Brinson *et al.* 1981, *Brinson et al.* 1984, de la Cruz 1979, Elder 1985, Mitsch *et al.* 1979, Reddy and Patrick 1975). Therefore, soil organic matter is an integral component of the substrate and its rate of decomposition has been the subject of study for decades. In short- and long-term studies of forested, organic matter decomposition is higher in newly regenerated forests (Aust 1989, Perison 1997, Rapp 1999, Rapp *et al.* 2001).

The accumulation of organic matter in forested wetlands is directly dependent upon productivity, nutrient input, and hydrologic input. Periodic inundation subsidizes the forested wetland with nutrients and sediments that stimulate plant growth (Gosselink *et al.* 1981). Aboveground biomass and primary productivity values for cypress/ tupelo forests are among the highest reported for forest ecosystems, due largely to the effects of fluctuating water levels and nutrient inflows (Brinson *et al.* 1981, Brown 1981, Conner and Day 1982). Forest productivity will be low immediately following planting or natural regeneration, but will begin its exponential increase between 10-25 years (Faulkner *et al.* 1985, Conner 1988, Conner and Flynn 1989). This increase will outpace that of the then 100 - 110 year old cypress trees in the adjacent forest and at that time the forest could be considered as meeting its productivity function (Figure E- 1).

The function information along with longevity of the project determines the discounted service acre year (DSAY) benefit of restoration. For purposes of the DSAY quantification, we assume the restored forested wetland achieves the function of a natural forested wetland after 25 years and that its longevity is 60 years. We also assume that the project is implemented in 2009 to account for delay in restoration implementation. The DSAYs generated per acre under this scenario total 15.748 (Appendix E- 1).

Cost/DSAY

The cost/DSAY for forested wetlands restoration is determined by combining the cost and function information. The resulting statistic is $1,768/DSAY, which implies a forested wetland restoration cost of $27,840 per acre. This cost is in June 2003 dollars. To apply this statistic, the amount should be updated at the time of use to account for inflation. The consumer price index (see http://www.bls.gov/cpi/home.htm) is published monthly and is an appropriate index.

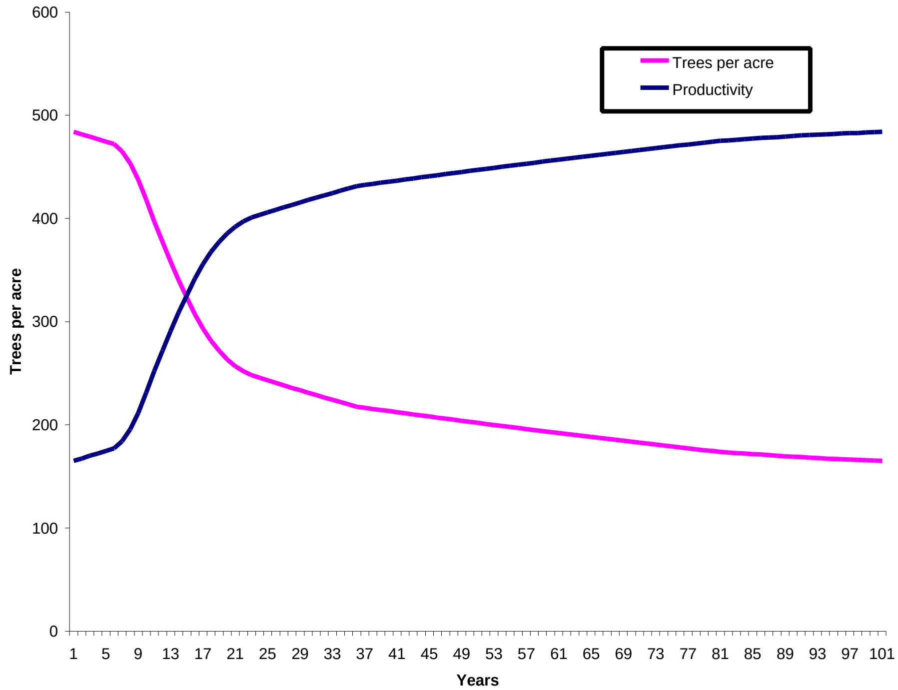

Figure E- 1. Typical mortality curve due to naturally induced thinning following canopy closure of an even-aged forest. Hypothetical productivity of the same even-aged forest is displayed, but no units are applied.

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Appendix E- 1: Habitat Equivalency Analysis output for a one acre forested wetland creation.

Forested Wetlands Creation

HEA Parameters - Restoration	
Year in which restoration is completed	2009
Years to full service flow	25 linear
Relative value of restored services	100%
Acres of habitat restored	1.00
Lifespan of project (years)	60
Discount rate	3%
Base year	2003

Year	Percent Service Flow: End of Period	Raw Acre Years of Wetland Services	Discounted Acre Years of Services
2002	0.00%	0.000	0.000
2003	0.00%	0.000	0.000
2004	0.00%	0.000	0.000
2005	0.00%	0.000	0.000
2006	0.00%	0.000	0.000
2007	0.00%	0.000	0.000
2008	0.00%	0.000	0.000
2009	4.00%	0.040	0.033
2010	8.00%	0.080	0.065
2011	12.00%	0.120	0.095
2012	16.00%	0.160	0.123
2013	20.00%	0.200	0.149
2014	24.00%	0.240	0.173
2015	28.00%	0.280	0.196
2016	32.00%	0.320	0.218
2017	36.00%	0.360	0.238
2018	40.00%	0.400	0.257
2019	44.00%	0.440	0.274
2020	48.00%	0.480	0.290
2021	52.00%	0.520	0.305
2022	56.00%	0.560	0.319
2023	60.00%	0.600	0.332
2024	64.00%	0.640	0.344
2025	68.00%	0.680	0.355
2026	72.00%	0.720	0.365
2027	76.00%	0.760	0.374

2028	80.00%	0.800	0.382
2029	84.00%	0.840	0.390
2030	88.00%	0.880	0.396
2031	92.00%	0.920	0.402
2032	96.00%	0.960	0.407
2033	100.00%	1.000	0.412
2034	100.00%	1.000	0.400
2035	100.00%	1.000	0.388
2036	100.00%	1.000	0.377
2037	100.00%	1.000	0.366
2038	100.00%	1.000	0.355
2039	100.00%	1.000	0.345
2040	100.00%	1.000	0.335
2041	100.00%	1.000	0.325
2042	100.00%	1.000	0.316
2043	100.00%	1.000	0.307
2044	100.00%	1.000	0.298
2045	100.00%	1.000	0.289
2046	100.00%	1.000	0.281
2047	100.00%	1.000	0.272
2048	100.00%	1.000	0.264
2049	100.00%	1.000	0.257
2050	100.00%	1.000	0.249
2051	100.00%	1.000	0.242
2052	100.00%	1.000	0.235
2053	100.00%	1.000	0.228
2054	100.00%	1.000	0.221
2055	100.00%	1.000	0.215
2056	100.00%	1.000	0.209
2057	100.00%	1.000	0.203
2058	100.00%	1.000	0.197
2059	100.00%	1.000	0.191
2060	100.00%	1.000	0.185
2061	100.00%	1.000	0.180
2062	100.00%	1.000	0.175
2063	100.00%	1.000	0.170
2064	100.00%	1.000	0.165
2065	100.00%	1.000	0.160
2066	100.00%	1.000	0.155
2067	100.00%	1.000	0.151
2068	100.00%	1.000	0.146
2069	0.00%	0.000	0.000
2070	0.00%	0.000	0.000
2071	0.00%	0.000	0.000
2072	0.00%	0.000	0.000
2073	0.00%	0.000	0.000
2074	0.00%	0.000	0.000
Total discounted acre years of services provided per acre			**15.748**

Appendix F – Non-Project Specific Cash Out Cost analyses for Oyster Reefs in Region 2

Introduction

Along the northern shore of the Gulf of Mexico, oyster shell bottoms are predominantly flat, subtidal and cultched, lacking the vertical relief and spatial heterogeneity provided by natural reefs (J. Plunkett, pers. comm. 2003). However, recent research suggests that oyster reefs, if created properly, provide unique three-dimensional hard bottom habitat for many fish species. Breitburg (1999) defined three groups of finfish associated with a three-dimensional subtidal oyster reef in Chesapeake Bay, (1) reef residents, which use the reef as their primary habitat; (2) facultative residents that are generally associated with structured habitats; and (3) transient species that may forage on or near the reef, but are wide-ranging. Plunkett (*unpublished data*) compared finfish and macroinvertebrate assemblages at a subtidal oyster shell reef and mud bottom in Barataria Bay, Louisiana, and found that finfish diversity and abundances were significantly greater over the reef than over mud bottom. Additionally, using substrate trays, Plunkett (*unpublished data*) collected significantly greater numbers of benthic fishes and decapod crustaceans on the reef than on the mud bottom. Lenihan *et al.* (2001) sampled fishes on natural and restored reefs in Pamlico Sound, North Carolina, to compare fish utilization of these different habitats and reported that all fish found on natural reefs were also found on restored reefs. Bahr and Lanier (1981) examined the community profile of reefs along the Atlantic coast and reported abundant populations of fishes and benthic invertebrates. MacKenzie *et al.* (1997a, 1997b) issued a comprehensive two-volume technical report on the state of molluscan fisheries in North and Central America as well as Europe and reported that wild shellfish stocks along the Atlantic, Gulf, and Pacific coasts of the United States support numerous valuable fisheries. These studies and others have led scientists, resource managers and the public to frequently consider shellfish restoration to be synonymous with fisheries stock enhancement (Coen and Luckenbach 2000). Therefore, efforts to sustain these fisheries by supplementing hard substrata on the water bottom are underway in most coastal states in the USA (Coen and Luckenbach 2000).

The literature supports the long held assumption that shellfish restoration influences fish utilization and production, and that ecologically important assemblages of fishes are dependent on a healthy oyster populations (Breitburg 1999). This is the theoretical basis for the development of a non-project specific cash-out settlement for the Louisiana Regional Restoration Planning (RRP) Program based on oyster reef creation. To exercise this alternative, we developed an estimate of cost per unit of fish biomass lost/provided (discounted kilogram biomass year), which relies on cost and productivity information. The metric was constructed this way assuming that oyster reef creation will be considered as restoration for fish biomass losses (commonly estimated with the Type A/SIMAP model) which are now commonly based upon the lost production of higher trophic levels, such as fish and large mobile crustaceans.[7] The following is an overview of the cost and productivity information and the results of our analysis.

Created Reefs in Louisiana: two- versus three-dimensional

For nearly a century, the Louisiana Department of Wildlife and Fisheries (LDWF) has embarked upon an extensive and successful effort to “seed” public oyster grounds in the subtidal waters of Louisiana. To date, the area of public seed grounds totals more than two million acres (P. Banks, pers. comm. 2003). The goal of this effort is to periodically spread thin veneers of substrate (150 cubic yards per acre), usually limestone, suitable for larval settlement over estuarine bottoms (Bartol and Mann 1999). This activity is undertaken with the intent of growing and retrieving juvenile “seed” oysters for use, both as substrate and a source of spat, on leased commercial and recreational water bottoms. The end product of this approach is a two-dimensional subtidal carpet of shell and live oysters that may or may not bare resemblance to an intricate three-dimensional reef after two or more years.

Just as LDWF has provided for vast acreage of public seed grounds, they have also worked with private and non-profit groups, whose mission is to create, maintain, or enhance sportfishing opportunities, to identify sites for the construction of three-dimensional reefs. The 10 reefs constructed to date (Table F- 1) are within the inshore boundary of Louisiana and are best characterized as low profile shell pads that increase the substrate elevation by 1.5 – 2 feet (utilizing approximately 3500 cubic yards per acre). Contrary to public seed grounds, the constructed reefs are “red lined” by the state to prohibit both the commercial harvest of oysters and the acceptance of water bottom lease applications over the site for the production of oysters, thereby, facilitating the continued vertical integrity of the three-dimensional reef.

Though both two- and three-dimensional reefs encourage oyster growth and recruitment, the three-dimensional reef has been documented to provide a more suitable and immediate habitat for fishes and benthic invertebrates (Breitburg 1999, Lenihan *et al.* 2001, Plunkett *unpublished data*, and others). Therefore, the cost per discounted kilogram biomass year (DKBY) metric for the Louisiana RRP Program will be developed with the intent to build low relief (approximately 2000 cubic yards per acre to settle at 1 foot above the mud bottom) three-dimensional reefs.

[7] We were not aware of cases where oil impacted oyster reef habitat, thus the focus on oyster reef as restoration for fish and shellfish injuries.

Table F- 1. Location, date, and name of the 10 inshore reefs constructed by LDWF and its partners to create sustainable habitat for fishes.

Bay	Date	Name	Donor	Water depth (ft)
Lake Pelto	08/22/2002	Bird Island	CCA	15
Lake Pontchartrain	02/18/2001		Lake Pontchartrain Basin Foundation	15
Pt. Au Chein	08/08/1997	Bully Camp 1	LDWF	12
Pt. Au Chein	08/08/1997	Bully Camp 2	LDWF	12
Cote Blanche	06/11/1997	Nickel Reef	LDWF	12
Cote Blanche	06/11/1997	Rabbit Island 1	LDWF	12
Cote Blanche	06/11/1997	Rabbit Island 2	LDWF	12
Terrebonne	06/06/1992	Pt. Mast	LDWF	12
Vermillion	09/24/1991	Cypremont Pt.	LDWF	12
Vermillion	09/22/1991	Redfish Pt.	LDWF	12

Project Costs

We divided oyster reef creation costs into three categories: implementation, which includes permitting, engineering and design, land rights, and construction; monitoring and oversight; and contingencies for unexpected cost overruns. We attempted to collect oyster reef implementation costs from past LDWF projects (Table F- 1), but the only costs available were those from the LDWF/Coastal Conservation Association partnership for the reef constructed near Lake Pelto in August, 2002. The Lake Pelto data point will be used to develop the implicit average cost of oyster reef implementation. In addition to the Lake Pelto data point, we calculated implementation costs for different sized reefs for the development of costs/DKBY. The estimated costs were developed using the following guidelines:

1) Each reef will be built in 10 feet or less of water and occupy equal to or less than 10% of the water column. By occupying 10% or less of the water column, we avoid a more extensive permitting process and navigation charts do not need to be changed;

2) As with gravel, limestone comes in various sizes, therefore, our cost estimates are based on the purchase of limestone (#57), a material averaging approximately 1.5 inches in diameter;

3) Due to our goal of low relief, we will use an average of 2,000 cubic yards (3,000 tons) of limestone (#57) per acre at an average cost of $40 per cubic yard (includes mobilization/demobilization).

To complete the implementation cost of creating an oyster reef, we added estimated costs for permitting, engineering and design, and land rights (in the event the water bottom is leased from a private entity). These added costs were based on Robin Lewis' (Lewis *unpublished data*) estimate of oyster reef creation effort that was developed for the Mulberry Phosphates damage assessment near Tampa Bay, Florida (Table F- 2). Hourly rates of three engineering contractors in south Louisiana were averaged and applied to the effort estimates to obtain Louisiana specific costs.

Table F- 2. An adaptation of the man-hour effort estimate prepared for the Mulberry Phosphates damage assessment by Robin Lewis for a 4-acre oyster reef creation project.

Pre-construction		
Site identification		
	Review maps and existing aerials for potential sites, shortlist sites, order aerials, visit sites with aerials and surveyors to determine suitable water depths and salinities.	
	Baseline aerials (3)	
	24 hrs.	Principal ecologist
	24 hrs.	Ecologist
	3 days	24' Work boat rental
	2 days	Side-scan sonar
Plans and Specifications		
	Prepare drawings and plans to scale for review, modify per review comments, transfer to permit application form size, calculate cubic yardage and square footage of quantities and potential impact areas.	
	24 hrs.	Principal ecologist
	12 hrs.	Professional engineer
	30 hrs.	Ecologist
	16 hrs.	CAD tech
	20 hrs.	Engineer intern
	18 hrs.	Clerical
	1 day	Boat rental
	Misc. expenses	Mileage, copying, etc.

Jurisdictional and Permitting		
	Submit permit applications, meet with agencies for field inspections, provide transportation to site, answer oral questions, and answer questions over the phone and in writing. Modify permit application as needed.	
	24 hrs.	Principal ecologist
	16 hrs.	Professional engineer
	100 hrs.	Ecologist
	8 hrs.	Reg. land surveyor
	26 hrs.	CAD tech
	8 hrs.	Engineer intern
	8 hrs.	Draftsmen
	21 hrs.	Clerical
	5 days	Boat rental
	Misc. expenses	
Construction		
	Construction includes staking of the site in the field, placement of turbidity control screens, supervision of the delivery of shell, inspection of the material before loading on the barge, supervision of the final placement of the material to ensure meeting the elevation criteria, as-built survey and final removal of turbidity screens and site cleanup. Penalties may be imposed for delays in construction, or additional funds paid for unforeseen delays due to events beyond the control of the contractor like hurricanes. Final approval of the construction using an as-built survey usually finishes the job.	
	Site prep./turbidity curtain placement and staking and maintenance	
	Construction supervision	Construction supervisor
	Ecological supervision	Ecologist
	Shell placement	
	As-built survey	3-man survey crew

The monitoring and oversight costs were assigned as a percentage of the implementation costs. For monitoring costs, the assignment was based on costs of hypothetical monitoring protocols (designed to measure reef elevation and structure at year 3 and 5 and oyster survivability, recruitment, growth, and spat set bi-monthly for 6 months each year) for 1, 2, 3, and 5-acre oyster reef creation projects in Louisiana (Table F- 3), while the oversight costs were based on national NRDA past project data (Table F- 4). We found that monitoring and trustee oversight costs are approximately 51.2 and 13 percent of implementation costs, respectively.

Table F- 3. Estimated monitoring and implementation costs for hypothetical oyster reef creation projects in southern Louisiana. Each projects monitoring costs are presented as the percent of implementation. Monitoring protocols were established for a period of 5-years post-construction and consist of monitoring reef structure and sustainability.

Area	**Costs**		
	Monitoring	Implementation	% of implementation
Lake Pelto 1-acre reef**		$77,993	
1-acre creation	$76,489	$93,841	81.51
2-acre creation	$102,668	$181,432	56.59
3-acre creation	$110,500	$270,899	40.79
5-acre creation	$116,186	$449,832	25.83
Average/acre		$89,500	51.18%

** This reef was constructed using 3,500 cubic yards of limestone (#57), so the implementation cost is pro-rated for 2000 cubic yards of limestone. Additionally, estimated costs for site identification, engineering & design, and land rights were added.

The contingency cost for each project was assigned as a fraction of total cost per U.S. Army Corps of Engineer (USACE) guidance. USACE recommends a 25 percent contingency at the planning stage of project development. So, 25 percent was added to the sum of implementation, monitoring, and oversight costs to estimate total project cost. We inflated all project costs to June 2003 dollars.

Therefore, the equation used to develop the cost of a 1-acre oyster reef creation projects is:

$$((I + M + O) * C)) + (I + M + O)$$

where I = implementation costs, M = monitoring costs (as a % of implementation), O = trustee oversight costs (as a % of implementation), and C = 25% contingency for cost overruns.

Table F- 4. Oversight costs for Trustee implemented projects nationwide presented as the percent of implementation.

Project	Costs: Trustee oversight	Implementation	% of implementation
Berman	$206,583	$9,329,506	2.21%
Chalk Point (marsh)	$117,588	$397,212	29.60%
Commencement Bay (Port)	$1,800,000	$10,200,000	17.65%
Commencement Bay (S/C)	$75,000	$500,000	15.00%
Commencement Bay (City)	$1,250,000	$6,161,747	20.29%
Great Lakes	$31,394	$356,445	8.81%
M. Beholden	$47,500	$1,623,837	2.93%
Mulberry	$278,155	$3,371,845	8.25%
Mystery Spill	$307,610	$1,198,790	25.66%
N. Cape (non-lobster)	$400,000	$6,800,000	5.88%
Salvors	$17,650	$128,348	13.75%
Average			13.64%
Average without high and low (Chalk Pt., Berman)			13.13%

Project Function

Though oyster reefs are known to provide numerous functions including filtration activities that improve water quality (Dame 1996, Laihonen *et al.* 1997, Jackson *et al.* 2001), carbon sequestration (Hargis and Haven 1999), and habitat for benthic invertebrates (Wells 1961, Zimmerman *et al.* 1989), we identified secondary productivity of an oyster reef (grams/square meter/year) as our target project function. For the Mulberry Phosphates damage assessment near Tampa Bay, Florida, Peterson *et al*. (in review) compiled six studies on the fish utilization of oyster reefs in the southeast (Zimmerman *et al.* 1989, Wenner *et al.* 1996, Meyer *et al.* 1996, Grabowski 2002, Lenihan and Peterson 1998, Lenihan *et al.* 2001) and developed an estimate of 257 grams/square meter/year of secondary production attributed to the presence of an oyster reef. For oyster reefs created as a result of the Louisiana RRP Program's non-project specific cash-out alternative, it was assumed that Peterson *et al.* (in review) productivity estimate will be reached after two-years. The two-year delay in productivity accounts for the time needed for oyster recruitment and continued development of the reefs three-dimensional structure. We also assume that the project is implemented in 2009 to account for delay in restoration implementation. In addition to the time to maturity and implementation date, we determined the duration of benefit. The longevity of the projects we implement under the Louisiana RRP Program is assumed to be twenty years with linearly declining function after eight years. Full functionality from year two until year eight, and declining thereafter, reflects the average period between sedimentation events and the affects of subsidence without replenishing the hard substrate through corrective actions. Using these parameters as Habitat Equivalency Analysis (HEA; NOAA 2000) inputs, a one acre oyster reef project generates 9,577.97 discounted kilogram biomass years (Figure F- 1).

Cost per Discounted Kilogram Biomass Year (cost/DKBY)

Putting the implicit average cost ($187,700 per acre calculated using the projects in Table 1) and function (9,577.97 DKBY; Appendix A) information together, we calculated the cost/DKBY for the creation of oyster reefs as $17.60/DKBY. This cost is in June 2003 dollars. To apply this statistic, the amount should be updated at the time of use to account for inflation. The consumer price index (see http://www.bls.gov/cpi/home.htm) is published monthly and is an appropriate index.

Consider an example of how this number could be applied. For the Lake Barre case we estimated that 7,465 kilograms of fish and shellfish were lost due to the spill. Using the cost/DKBY above, the cash out value for this injury would be $146,314 and contribute to the creation of approximately 0.652 acres of oyster reef.

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Appendix F- 1 Input parameters and output (discounted kilogram biomass/acre over 20 years) for a 1-acre oyster reef creation.

Reef Restoration for Fish Injury

HEA Parameters - Restoration	
Year of restoration	2009
Biomass (kg) produced/acre/year	1040.079
Lifespan of project (years)	20
Time to maturity (years)	2
Discount rate	3%
Base year	2003

	Fisheries Biomass/ Acre: End of Period	Discounted Fisheries Biomass/ Acre
Year		
2009	520.04	435.525
2010	1040.08	845.680
2011	1040.08	821.049
2012	1040.08	797.135
2013	1040.08	773.917
2014	1040.08	751.376
2015	1040.08	729.491
2016	1040.08	708.244
2017	960.07	634.722
2018	880.07	564.882
2019	800.06	498.572
2020	720.06	435.645
2021	640.05	375.961
2022	560.04	319.385
2023	480.04	265.785
2024	400.03	215.036
2025	320.02	167.018
2026	240.02	121.615
2027	160.01	78.715
2028	80.01	38.211
2029	0.00	0.000
Total discounted biomass (kg)/acre		**9,577.966**

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