Mississippi Trustee Implementation Group Draft Restoration Plan II and Environmental Assessment: Wetlands, Coastal, and Nearshore Habitats and Oysters

April 2020

Cover Photo Credits:

Top photo - oyster cultch (photo courtesy of Covington Civil and Environmental, LLC)

Bottom Left - Pineywoods steer (photo courtesy of Covington Civil and Environmental, LLC)

Bottom Center - Pine savannah (photo courtesy of Grand Bay National Wildlife Refuge)

Bottom Right - Wildflower (photo courtesy of Dr. Jonathon Pitchford, Grand Bay National Estuarine Research Reserve)

EXECUTIVE SUMMARY

Under the authority of the Oil Pollution Act of 1990 (OPA), and as a result of the April 20, 2010 *Deepwater Horizon* oil spill[1] (DWH oil spill), a council of federal and state DWH oil spill Trustees (the Trustees) was established on behalf of the public to assess natural resource injuries resulting from the incident, and to work to make the environment and public whole for those injuries. The following federal and state agencies are the designated Trustees under OPA for the DWH oil spill:

- U.S. Department of the Interior (DOI), represented by the U.S. Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Bureau of Land Management (BLM);
- National Oceanic and Atmospheric Administration (NOAA), on behalf of the U.S. Department of Commerce (DOC);
- U.S. Department of Agriculture (USDA);
- U.S. Department of Defense (DOD);
- U.S. Environmental Protection Agency (EPA);
- The State of Alabama's Department of Conservation and Natural Resources (ADCNR) and Geological Survey of Alabama (GSA);
- The State of Florida's Department of Environmental Protection (FDEP) and Fish and Wildlife Conservation Commission (FWC);
- The State of Louisiana's Coastal Protection and Restoration Authority (CPRA), Department of Natural Resources (LDNR); Department of Environmental Quality (LDEQ); Oil Spill Coordinator's Office (LOSCO); and Department of Wildlife and Fisheries (LDWF);
- The State of Mississippi's Department of Environmental Quality (MDEQ); and
- The State of Texas' Parks and Wildlife Department (TPWD), General Land Office (TGLO), and Commission on Environmental Quality (TCEQ).

Trustee Implementation Groups (TIGs) were established by the April 4, 2016 DWH Consent Decree with BP Exploration & Production, Inc. and are composed of specific Trustees for each of the respective Restoration Areas defined in the Consent Decree. Each TIG makes all restoration decisions for the funding allocated to its Restoration Area.

This "Mississippi Trustee Implementation Group Draft Restoration Plan II/Environmental Assessment: Wetlands, Coastal, and Nearshore Habitats and Oysters" (Draft RPII/EA) was prepared by the following federal and state natural resource trustees, which together comprise the Mississippi Trustee Implementation Group (MS TIG):

- MDEQ;
- DOI, represented by the USFWS, the NPS, and the BLM;

[1] The DWH oil spill as referred to in this Draft RPII/EA was defined in Chapter 2 Incident Overview of the Final PDARP/PEIS. https://www.fws.gov/doiddata/dwh-ar-documents/1138/Chapter-2_Incident-Overview_508.pdf

- NOAA, on behalf of DOC;
- USDA; and
- EPA.

The MS TIG is responsible for restoring the natural resources and services in Mississippi that were injured by the DWH oil spill. This Draft RPII/EA was prepared pursuant to OPA and its related NRDA regulations, as well as the National Environmental Policy Act of 1969 (NEPA), and is consistent with the findings in the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement* (PDARP/PEIS) (DWH Trustees 2016).

In accordance with the OPA regulations (15 C.F.R. § 990.53), the MS TIG developed a screening process to identify a reasonable range of alternatives that is evaluated in this Draft RPII/EA. This process included compiling project ideas and screening them against MS TIG developed criteria to identify a suite of projects intended to partially restore for the Wetlands, Coastal, and Nearshore Habitats (WCNH) and Oysters Restoration Types in Mississippi. The projects were then evaluated against the following:

- The Programmatic Trustee Goals outlined in the PDARP/PEIS for the WCNH and Oysters Restoration Types;
- The restoration approaches and restoration techniques for these Restoration Types; and
- The OPA criteria found in 15 C.F.R. § 990.54.

The MS TIG considered over 1,198 project submissions. Development of the reasonable range of alternatives is described in Chapter 2.0 of this document. The OPA analysis for the reasonable range of alternatives is described in Chapter 3.0 of this document. The NEPA analysis for the reasonable range of alternatives is described in Chapters 4.0 and 5.0 of this document.

The MS TIG evaluated a total of seven alternatives as the reasonable range of alternatives. Pursuant to NEPA, a No Action Alternative was also considered for each restoration type, WCNH and Oysters. This Draft RPII/EA proposes four preferred alternatives/projects for implementation (Proposed Action): Wolf River Coastal Preserve Habitat Management – Dupont and Bell's Ferry Tracts (WCNH); Hancock County Coastal Preserve Habitat Management – Wachovia Tract (WCNH); Oyster Spawning Reefs in Mississippi Project (Oysters) and the Mississippi Oyster Gardening Program (Oysters) (See Table ES-1 and Figure ES-1.) The terms alternatives and projects are used interchangeably in this document.

Table ES-1. The Proposed Action for this Draft RPII/EA

Proposed Action	PDARP/PEIS Restoration Goal: Restoration Type	Proposed Funding
Wolf River Coastal Preserve Habitat Management – Dupont and Bell's Ferry Tracts	Restore and Conserve Habitat: Wetlands, Coastal, and Nearshore Habitats	$3,127,500
Hancock County Coastal Preserve Habitat Management – Wachovia Tract	Restore and Conserve Habitat: Wetlands, Coastal, and Nearshore Habitats	$1,760,000
Oyster Spawning Reefs in Mississippi	Replenish and Protect Living Coastal and Marine Resources: Oysters	$10,000,000
Mississippi Oyster Gardening Program	Replenish and Protect Living Coastal and Marine Resources: Oysters	$500,000
Total		$15,387,500

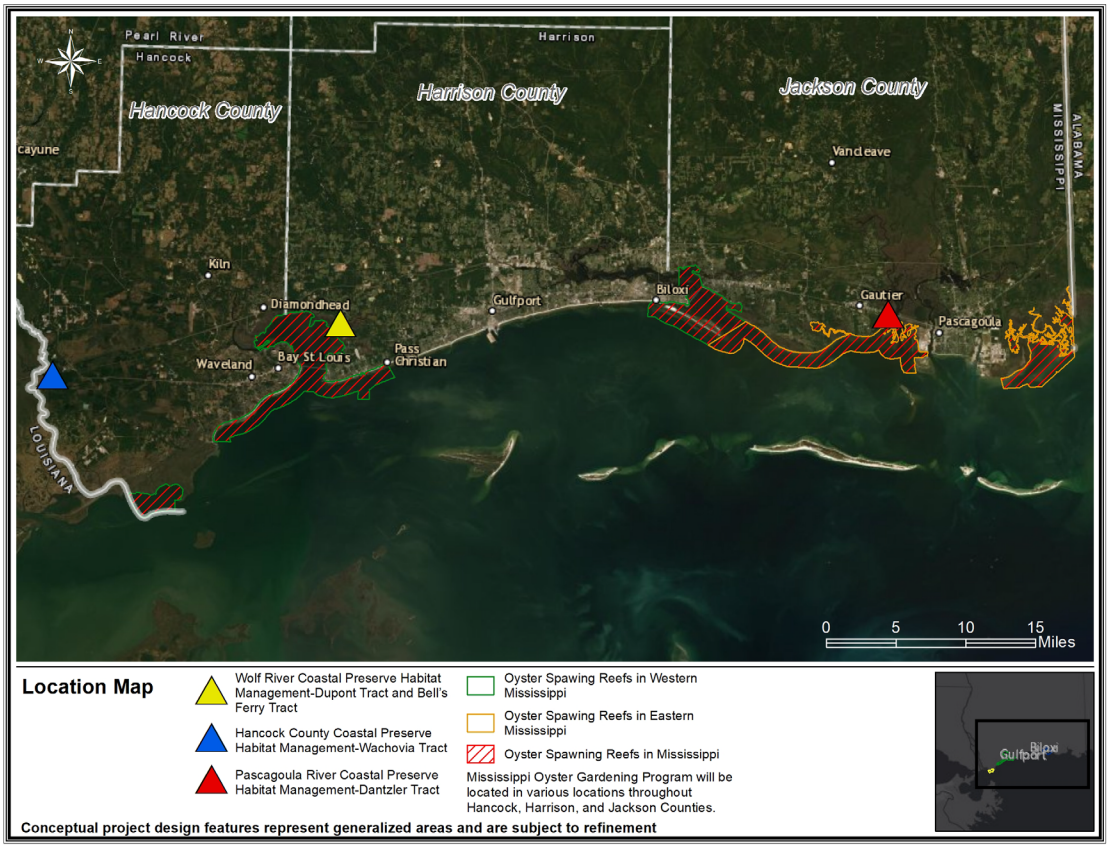


Figure ES-1. Locations of Proposed Alternatives

Pursuant to NEPA, an evaluation of environmental consequences is discussed in the PDARP/PEIS and incorporated by reference into this Draft RPII/EA and is also discussed in Chapters 4.0 and 5.0. Environmental consequences to the physical environment, the biological environment, and the socioeconomic environment are evaluated in this Draft RPII/EA for WCNH and Oysters alternatives. The findings are summarized below.

WCNH Alternatives - Environmental Consequences Summary.—Proposed habitat restoration measures and management activities for the WCNH alternatives include prescribed fire and invasive species management through chemical treatment and/or mechanical treatment, road repair and replacement, and prescribed grazing. Implementation of these restoration

measures and management activities would have short-term, minor to moderate, adverse impacts to hydrology and water quality, wetlands, habitats and wildlife from ground-disturbing activities associated with habitat restoration measures and management activities. For one alternative (Wolf River CP Habitat Management-Dupont and Bell's Ferry), the adverse impacts to substrates (soils) would also range from minor to moderate but could be long-term for impacts associated with road repair and replacement. For all of the alternatives, there would be short-term minor to moderate, adverse impacts to substrates (soils) for prescribed fire and invasive species management through chemical treatment and/or mechanical treatment, and prescribed grazing. There would be no impacts to protected species. The MS TIG has completed technical assistance with USFWS and NOAA National Marine Fisheries Service (NMFS) and ESA consultations have been initiated for the WCNH alternatives. There would be short-term, minor, adverse impacts to tourism and recreational use due to temporary closures of portions of the coastal preserve(s) in order to conduct invasive species management activities (e.g. prescribed fire). There would be short-term, minor to moderate adverse impacts to air quality and greenhouse gases resulting from emissions due to equipment use for invasive species management activities and from smoke associated with prescribed fires. There would be short-term, minor impacts to public health and safety due to the potential for the exposure to smoke from prescribed fire(s), and exposure to herbicides during chemical treatment. Restoration measures and management activities would be designed to avoid cultural resources to the extent practicable. The Implementing Trustee (MDEQ) would work with the Mississippi State Historic Preservation Officer and/or all appropriate Tribal Historic Preservation Officers to determine compliance measures if historic resources are likely in the area or encountered during implementation. There would be long-term benefits to geology and substrates (soil), hydrology, water quality, floodplains, wetlands, protected species, habitat and wildlife species (including birds), tourism and recreation, and public health and safety, due to the re-establishment of native plant communities, increased diversity in flora and fauna, implementation of existing resource management plans/initiatives, and the potential for increased visitor use.

Oysters Alternatives - Environmental Consequences Summary.—Proposed restoration activities for oysters include cultch deployment on existing oyster reefs, cultch deployment on suitable substrate (not colonized by oysters), cultch deployment on soft bottom substrate/buried hard substrate, and placement of oyster gardening baskets. In addition, oysters produced by the Mississippi Oyster Gardening Program would be placed on approximately three acres of reef during the lifespan of the project. Implementation of cultch deployment restoration activities would have long-term minor adverse impacts to substrates, and short-term minor adverse impacts to hydrology and water quality, fisheries and aquaculture as a result of equipment movement, mooring, disturbance from the placement of cultch, and the resulting temporary turbidity in the water column. There could be short-term minor adverse impacts to wildlife species, land and marine management, and aesthetics and visual resources, due to temporary displacement of wildlife, short-term variances from standard management and harvesting practices during the monitoring period, and from placement of signage in the vicinity of cultch deployments. There could be short to long-term minor impacts to benthic habitats and marine and estuarine fauna from the placement of cultch. There could be short-term minor to impacts to protected species from construction activities for oyster alternatives; there would be no long-term impacts to protected species. The MS TIG has completed technical assistance with USFWS and NOAA National Marine Fisheries Service (NMFS) and ESA consultations have been initiated for the oyster alternatives. Cultch deployments and oyster gardening restoration activities would

be designed to avoid cultural resources to the extent practicable. MDEQ would work with the Mississippi State Historic Preservation Officer and/or all appropriate Tribal Historic Preservation Officers to determine compliance measures if historic resources are likely in the area or encountered during implementation. Cultch deployment and Oyster Gardening Program restoration activities would result in long-term beneficial impacts to substrates, water quality, habitats, wildlife, protected species, marine and estuarine fauna, land and marine management, and fisheries and aquaculture.

Next Steps.—Following the public comment period, the MS TIG will receive and review public comments and finalize the RPII/EA. A decision will then be made whether a Finding of No Significant Impact (FONSI) is appropriate.

TABLE OF CONTENTS

Appendix D: Monitoring and Adaptive Management Plan for Deepwater Horizon NRDA Project: Mississippi Oyster Gardening Program

LIST OF TABLES:

LIST OF FIGURES:

1.0 INTRODUCTION

This "Mississippi Trustee Implementation Group Draft Restoration Plan II/Environmental Assessment: Wetlands, Coastal, and Nearshore Habitats and Oysters" (Draft RPII/EA) was prepared by the federal and state natural resource trustees of the Mississippi Trustee Implementation Group (MS TIG), which is responsible for restoring the natural resources and services in the Mississippi Restoration Area that were injured by the April 20, 2010, *Deepwater Horizon* oil spill and associated spill response efforts (DWH oil spill).

The MS TIG includes the following agencies: the Mississippi Department of Environmental Quality (MDEQ); the United States Department of Commerce, represented by the National Oceanic and Atmospheric Administration (NOAA); the United States Department of the Interior (DOI), represented by the United States Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Bureau of Land Management (BLM); the United States Department of Agriculture (USDA); and the United States Environmental Protection Agency (EPA).

The MS TIG prepared this Draft RPII/EA to (1) inform the public about its DWH natural resource damage assessment (NRDA) restoration planning efforts, (2) analyze the potential restoration benefits and environmental consequences of projects/alternatives proposed for implementation to help restore the target Restoration Types, and (3) seek public comment on the restoration alternatives considered in this document (See Section 1.6.1 for details).

The purpose of restoration, as discussed in this document and detailed more fully in the *Deepwater Horizon Oil Spill*: Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement (PDARP/PEIS) is to make the environment and the public whole for injuries resulting from the incident by implementing restoration actions that return injured natural resources and services to baseline conditions and compensate for interim losses, in accordance with the Oil Pollution Act of 1990 (OPA) and associated Natural Resource Damage Assessment (NRDA) regulations. The PDARP/PEIS and record of decision can be found online at https://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan (DWH Trustees 2016).

1.1 DEEPWATER HORIZON TRUSTEES, TRUSTEE COUNCIL AND TRUSTEE IMPLEMENTATION GROUPS

Under the authority of OPA, and as a result of the April 10, 2010, DWH oil spill, a council of federal and state DWH Trustees (the Trustees) was established on behalf of the public to assess natural resource injuries resulting from the incident, and work to make the environment and public whole for those injuries. Trustee Implementation Groups (TIGs) were established by the April 4, 2016, DWH Consent Decree with BP Exploration & Production, Inc. and are composed of specific Trustees for each of the respective Restoration Areas defined in the Consent Decree. Each TIG makes all restoration decisions for the funding allocated to its Restoration Area.

This "Mississippi Trustee Implementation Group Draft Restoration Plan II/Environmental Assessment" (Draft RPII/EA) was prepared by the federal and state natural resource trustees, which together comprise the Mississippi Trustee Implementation Group (MS TIG). The MS TIG

is responsible for restoring the natural resources and services in the Mississippi Restoration Area that were injured by the DWH oil spill.

1.2 OPA AND NEPA COMPLIANCE

As an oil pollution incident, the DWH oil spill is subject to the provisions of OPA, 33 U.S.C. § 2701 *et seq*. A primary goal of OPA is to make the environment and public whole for injuries to natural resources and services resulting from an incident involving an oil discharge or substantial threat of an oil discharge. Federal trustees must also comply with NEPA, 42 U.S.C § 4321et seq., its regulations, 40 Code of Federal Regulations (CFR) § 1500 eq seq., and agency-specific NEPA regulations when planning restoration projects.

USDA is the lead federal trustee for preparing this Draft RPII/EA. Three federal agencies (DOI, NOAA and EPA) and MDEQ act as cooperating agencies for the purposes of NEPA in the development of this Draft RPII/EA. Each federal cooperating agency on the MS TIG will review the final RPII/EA for adequacy in meeting the standards set forth in its own NEPA implementing procedures and decide whether to adopt the NEPA analysis herein. Adoption of the final RPII/EA would be completed via signature on the relevant NEPA decision document.

1.3 PURPOSE AND NEED

The MS TIG has undertaken this restoration planning effort to meet the purpose of contributing to the restoration of natural resources and services injured in the Mississippi Restoration Area as a result of the DWH oil spill which identifies extensive and complex injuries to natural resources and resource services across the Gulf of Mexico, as well as a need and plan for comprehensive restoration consistent with OPA. This Draft RPII/EA falls within the scope of the purpose and need identified in Section 5.3.2 of the PDARP/PEIS. The five DWH Programmatic Trustee Goals work independently and together to benefit injured resources and services. The proposed alternatives in this Draft RPII/EA would focus on the following two DWH programmatic restoration goals:

1) Restore and Conserve Habitat; and
2) Replenish and Protect Living Coastal and Marine Resources

This Draft RPII/EA addresses two Restoration Types: Wetlands, Coastal, and Nearshore Habitats (WCNH) and Oysters. Consistent with the DWH Programmatic Trustee Goals for restoration, the DWH Trustees also developed specific goals to guide restoration planning and project selection for each Restoration Type (See PDARP/PEIS Sections 5.5.2.1 and 5.5.9.1 for WCNH and Oysters, respectively).

1.4 PROPOSED ACTION: DRAFT MS TIG RPII/EA

In order to identify the reasonable range of alternatives for this Draft RPII/EA, the MS TIG reviewed PDARP/PEIS Programmatic Trustee Goals for restoration and developed additional specific MS TIG Draft RPII/EA Goals and Objectives. The MS TIG identified two Restoration Types - WCNH and Oysters - that it considered appropriate for this Draft RPII/EA. The MS TIG then screened project submittals against OPA appropriateness criteria identified in the

PDARP/PEIS and other criteria. Further detail on the screening process can be found in Section 2.4.

The MS TIG is evaluating a total of seven alternatives as the reasonable range of alternatives for this RPII/EA. Pursuant to NEPA, a no action alternative is also considered for each restoration type, WCNH and Oysters. Project locations for all alternatives are shown in Figure ES-1. The Proposed Action for the plan is the selection of four alternatives preferred for implementation; they are summarized in Table 1-1. All alternatives are independent of each other and may be selected independently for implementation in this and/or future restoration plans by the MS TIG. Alternatives not implemented may be considered for future restoration by the Mississippi TIG or may be considered by other TIGs (e.g. Regionwide, Open Ocean). Section 3.3 provides a discussion of the preferred and non-preferred alternatives considered in this plan.

Table 1-1. The Proposed Action in this Draft RPII/EA

Proposed Action	PDARP/PEIS Restoration Goal: Restoration Type	Proposed Funding
Wolf River Coastal Preserve Habitat Management – Dupont and Bell's Ferry Tracts	Restore and Conserve Habitat: Wetlands, Coastal, and Nearshore Habitats	$3,127,500
Hancock County Coastal Preserve Habitat Management – Wachovia Tract	Restore and Conserve Habitat: Wetlands, Coastal, and Nearshore Habitats	$1,760,000
Oyster Spawning Reefs in Mississippi	Replenish and Protect Living Coastal and Marine Resources: Oysters	$10,000,000
Mississippi Oyster Gardening Program	Replenish and Protect Living Coastal and Marine Resources: Oysters	$500,000
Total		$15,387,500

1.5 PUBLIC INVOLVEMENT

Public input is an integral part of NEPA, OPA, and the DWH oil spill restoration planning effort. The Trustees conducted an extensive public outreach process as part of the PDARP/PEIS; that process is described more fully in Chapter 8 of the PDARP/PEIS. The MS TIG published a Notice of Solicitation calling for project ideas on June 11, 2018[2] (hereafter, June 11, 2018 Notice). Project ideas requested included the following restoration types: WCNH; Nutrient Reduction; Oysters; Sea Turtles; and Marine Mammals. The MS TIG notified the public that they would consider new, revised, and previously submitted project ideas received by August 10, 2018. On October 10, 2018 the MS TIG published a Notice of Initiation of Restoration Planning in Mississippi[3]. During the planning process the MS TIG decided to focus only on WCNH and Oyster Restoration Types in RPII.

[2] https://www.gulfspillrestoration.noaa.gov/2018/06/mississippi-trustee-implementation-group-welcomes-publics-project-ideas

[3] https://www.gulfspillrestoration.noaa.gov/2018/10/notice-initiation-restoration-planning-mississippi

In developing this Draft RPII/EA, the MS TIG considered projects previously submitted to the MDEQ Restoration Project Idea portal[4] and the Trustee Council Project Submission Portal[5], as well as those proposed in response to the June 11, 2018 Notice[6].

The Draft RPII/EA is made available for public review and comment for thirty (30) days following its release, as specified in the public notice published in the Federal Register, the restore.ms website, and the DWH Trustee Council website.

Comments on the Draft RPII/EA can be submitted during the comment period by one of the following methods:

- Via the Web: *https://www.gulfspillrestoration.noaa.gov/restoration-areas/mississippi*
- Via U.S. Mail:
  U.S. Fish and Wildlife Service
  P.O. Box 29649
  Atlanta, Georgia 30345

The MS TIG will host a public webinar. A webinar date and time is provided in the Federal Register, on the restore.ms website, and the DWH Trustee Council website. After registering, participants will receive a confirmation email with instructions for joining the webinar.

Submissions must be postmarked no later than 30 days after the publication of the Notice of Availability for the Draft RPII/EA in the Federal Register.

After the close of the public comment period, the MS TIG will consider the comments received and revise the Draft RPII/EA as needed. A summary of comments received and the MS TIG's responses (where applicable) will be included in the Final RPII/EA.

1.5.1 Decisions to be Made

This Draft RPII/EA is intended to inform decision-makers and provide the public with information and analysis needed to enable meaningful review and comment on the alternatives presented in this document. Ultimately, this Draft RPII/EA and the corresponding opportunity for the public to review and comment on the document are intended to guide the MS TIG's selection and implementation of one or more of the alternatives analyzed in this Draft RPII/EA.

[4] http://www.restore.ms/submit-project-idea/
[5] http://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/suggest-a-restoration-project/
[6] https://www.gulfspillrestoration.noaa.gov/2018/10/notice-initiation-restoration-planning-mississippi

1.5.2 Administrative Record

Pursuant to 15 C.F.R. § 990.45, the Trustees opened a publicly available Administrative Record for the DWH oil spill NRDA, including restoration planning activities, concurrently with the publication of the 2010 Notice of Intent to Conduct Restoration Planning (75 Fed. Reg. 60800). DOI is the lead federal Trustee for maintaining the Administrative Record, which can be found at http://www.doi.gov/deepwaterhorizon/adminrecord. Information about MS TIG restoration project implementation is being provided to the public through the Mississippi Department of Environmental Quality Website[7], the Administrative Record, the Gulf Spill Restoration website[8], NOAA's Data Integration Visualization and Exploration data warehouse (DIVER)[9] and other outreach efforts.

1.6 DOCUMENT ORGANIZATION

This Draft RPII/EA is divided into the following Chapters:

- **Chapter 1 (Introduction).**—Introductory information and context for this Draft RP II/EA, background on the NRDA restoration planning process, the purpose and need for action, and public process for engagement, and document organization;
- **Chapter 2 (Restoration Planning Process: Screening and Alternatives).**—Summary of injuries of resources resulting from the DWH oil spill addressed in this Draft RPII/EA, and screening of alternatives to address those injuries, and proposal of a reasonable range of alternatives;
- **Chapter 3 (OPA Evaluation of Restoration Alternatives).**—Evaluation of the reasonable range of alternatives for NRDA restoration against criteria set forth in the OPA NRDA regulations;
- **Chapters 4 and 5 (NEPA Affected Environment and Environmental Consequences).**—Description of the affected environment and the environmental consequences for each of the alternatives for WCNH (Chapter 4) and Oysters (Chapter 5) evaluated in this Draft RPII/EA and a description of the cumulative impacts of the alternatives when added to other past, present, and reasonably foreseeable future actions;
- **Chapter 6 (Compliance with Other Laws and Regulations).**—Identification and description of other federal and state laws, in addition to the requirements of OPA and NEPA, that may apply to the alternatives in this Draft RPII/EA;
- **Chapter 7 (Monitoring and Adaptive Management).**—Discussion of monitoring and adaptive management requirements for DWH oil spill NRDA restoration projects;
- **Chapter 8 (List of Preparers and Reviewers).**—Identification of individuals who substantively contributed to the development of this document; and

[7] https://www.mdeq.ms.gov/restoration/
[8] https://www.gulfspillrestoration.noaa.gov/2018/10/notice-initiation-restoration-planning-mississippi
[9] https://www.diver.orr.noaa.gov/web/guest/diver-explorer?siteid=9&sqid=643&subtitle=DWH%20Restoration%20Projects

- **Chapter 9 (Literature Cited).**—A list of references used to write and support the analysis in this Draft RPII/EA.

2.0 RESTORATION PLANNING PROCESS: SCREENING AND ALTERNATIVES

NRDA restoration under OPA is a process that includes evaluating injuries to natural resources and natural resource services to determine the types and extent of restoration needed to address the injuries. The OPA NRDA regulations (15 C.F.R. § 990.54) provide factors for Trustees to consider when evaluating projects designed to compensate the public for injuries caused by oil spills.

Applying the OPA NRDA regulations (15 CFR 990.53), the MS TIG developed a screening process to identify a reasonable range of alternatives to be further evaluated in this Draft RPII/EA. The MS TIG utilized the Mississippi Gulf Coast Restoration Plan (MGCRP; MDEQ and NFWF, 2017), numerous other regional restoration and ecosystem management planning documents, project ideas submitted through the MDEQ Restoration Project Idea portal and the Trustee Council Project Submission Portal, coordination with resource agencies, and MS TIG Trustees' expertise in order to develop a reasonable range of alternatives for this Draft RPII/EA.

This chapter describes the screening process that the MS TIG used to identify a reasonable range of alternatives to include in this Draft RPII/EA under both OPA and NEPA. The reasonable range of alternatives identified is consistent with the DWH Trustees' selected programmatic alternative and the goals identified in the PDARP/PEIS. Consequently, this chapter also summarizes the restoration decisions stated in the PDARP/PEIS and ROD, the relationship of the PDARP/PEIS to this document, injuries addressed by this restoration plan, and the projects considered in the reasonable range of alternatives. The restoration planning process was also conducted in accordance with the Consent Decree, the DWH Trustee Council Standard Operating Procedures, OPA NRDA regulations, and NEPA regulations.

2.1 PDARP/PEIS AND RECORD OF DECISION

Given the potential magnitude and breadth of restoration for injuries resulting from the DWH oil spill, the Trustees prepared a PDARP/PEIS under OPA and NEPA to analyze alternative approaches to implementing restoration and to consistently guide restoration decisions.

This Draft RPII/EA is consistent with and tiers from the PDARP/PEIS, a programmatic document developed by the Trustees to provide high-level guidance for identifying, evaluating, and selecting DWH restoration projects. The reasonable range of alternatives identified is consistent with the DWH Trustees' selected programmatic alternative and the goals identified in the PDARP/PEIS.

2.2 RELATIONSHIP OF THIS DRAFT RPII/EA TO THE PDARP/PEIS

As a programmatic restoration plan, the PDARP/PEIS provides direction and guidance for identifying, evaluating, and selecting restoration projects to be carried out by the TIGs (PDARP/PEIS Section 5.10.4 and Chapter 7). The Trustees elected to prepare a PEIS to support analysis of the environmental consequences of the selected Restoration Types and Restoration Approaches, to consider the multiple related actions that may occur because of restoration planning efforts, and to allow for a better analysis of cumulative impacts of potential actions. For the PDARP/PEIS, the Trustees developed a set of Restoration Types for inclusion in programmatic alternatives, consistent with the desire to seek a diverse set of projects providing benefits to a broad array of injured resources and services they provide. Ultimately, this process resulted in the inclusion of thirteen (13) Restoration Types for restoration, including:

1) Wetlands, Coastal, and Nearshore Habitats (WCNH)
2) Habitat Projects on Federally Managed Lands
3) Nutrient Reduction (Nonpoint Source)
4) Water Quality (e.g., Stormwater Treatments, Hydrologic Restoration, Reduction of Sedimentation)
5) Fish and Water Column Invertebrates
6) Sturgeon
7) Submerged Aquatic Vegetation
8) Oysters
9) Sea Turtles
10) Marine Mammals
11) Birds
12) Mesophotic and Deep Benthic Communities
13) Provide and Enhance Recreational Opportunities

A summary of the funding allocated to these restoration types in Mississippi is available at https://www.gulfspillrestoration.noaa.gov/restoration-areas/mississippi.

2.3 SUMMARY OF INJURIES ADDRESSED IN THIS DRAFT RPII/EA

Chapter 4 of the PDARP/PEIS describes the injury assessment which established the nature, degree, and extent of injuries from the DWH incident to both natural resources and the services they provide. Restoration projects proposed in this Draft RPII/EA and in future MS TIG restoration plans are designed to help address injuries in Mississippi resulting from the DWH oil spill. This section briefly summarizes injury caused by the DWH incident to Wetlands, Coastal, and Nearshore Habitats (PDARP/PEIS 4.6.4) and to Oysters (PDARP/PEIS Section 4.6.5).

2.3.1 Wetlands, Coastal, and Nearshore Habitats

The PDARP/PEIS summarizes studies in Mississippi demonstrating the presence of DWH oil in nearshore habitats and at wetland sites; reductions of live biomass in coastal wetlands; losses in

the numbers of nearshore oysters; increased shoreline erosion because of the loss of oysters; and other physical and biological injuries to beach, wetland, and nearshore habitats resulting from oiling and response activities in the state.

2.3.2 Oysters

The PDARP/PEIS indicates that the spill severely affected oyster reproduction in the Mississippi Sound. It concludes that the spill resulted in reduced larval production, spat settlement, and spat substrate availability that compromises the long-term sustainability of oyster reefs. In addition, losses of intertidal oysters occurred because of oiling and cleanup actions, resulting in the destruction of oyster cover.

2.4 SCREENING FOR THE REASONABLE RANGE OF ALTERNATIVES

In this Draft RPII/EA, the MS TIG is focusing on projects to benefit WCNH and Oysters. The MS TIG identified these Restoration Types for this Draft RPII/EA, considering the ecological benefits that would be realized with further investment of restoration funds in these Restoration Types, the amount of funding available for Draft RPII/EA and on-going restoration funded by NRDA, NFWF GEBF, RESTORE Act, and other funding. WCNH restoration in Mississippi has included land acquisition, habitat management, and living shoreline projects in early restoration and post-settlement restoration actions. Oyster restoration has included oyster cultch deployments and artificial reefs in early restoration. Projects, including those funded with NRDA, RESTORE and National Fish and Wildlife Gulf Environmental Benefit Funding (NFWF-GEBF) are summarized at: http://www.msrestoreteam.com/ProjectStoryMap/.

Restoration Type Screening Process Overview.—The MS TIG's screening process resulted in a set of restoration projects that provides a reasonable range of alternatives for WCNH and Oysters. The results of the screening represent those restoration projects with a reasonable likelihood of satisfying the OPA criteria and, from preliminary project development, have no obvious major adverse environmental impacts. The screening process included three primary steps for both WCNH and Oysters. This section provides an overview of the screening process. Section 2.4.2 and 2.4.3 provide a detailed review of decisions made in the screening process for each Restoration Type.

Step 1—Eligibility Screening

The MS TIG assembled a master database of 1,198 project ideas which was compiled from three sources:

- MDEQ Restoration Project Idea Portal[10], a DWH public comment portal which allows the public to submit projects ideas for DWH restoration;
- The Trustee Council Project Submission Portal,[11] a similar web-based public portal; and
- Projects developed by the MS TIG.

Next, the MS TIG conducted a basic eligibility screen to determine the objectives of each project idea in the master database, followed by coding of each project idea according to its Restoration Type(s). Projects were then sorted by Restoration Type. Criteria considered for eligibility screening included:

- Project addresses WCNH and oyster restoration concerns and meets the PDARP goals in Mississippi;
- Project would help restore natural resources injured by the DWH oil spill in Mississippi;
- Project is not already fully funded;
- Project is not duplicative of other projects on the portal project list(s);[12] and
- Project does not fund activities otherwise required by local, state or federal law, order, or permit (WCNH).

Step 2—Initial Project Screening Criteria

The Step 2 screening considered a variety of criteria developed by the MS TIG to determine whether a project idea would be an effective way of addressing injuries in Mississippi. Projects were screened using the same set of criteria for each project. Examples of representative questions addressed include:

- Does the project have a reasonable likelihood of success?
- Is the project more likely to be implemented more effectively by the MS TIG than by another TIG?
- Does the project have available information that is sufficient or can be made sufficient in a reasonable amount of time to permit screening of the project?
- Is the project idea or project component(s) consistent with MS TIG's goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses?
- Does the project focus on active measures to meet the PDARP goals as opposed to research, program management, planning or monitoring activities?

For WCNH, Step 2 also considered whether the project focus was on at least one of the two restoration approaches:

- Create, restore, and enhance coastal wetlands

[10] http://www.restore.ms/submit-project-idea/
[11] http://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/suggest-a-restoration-project/
[12] For WCNH and Oysters screening, where project ideas were duplicative, a single representative project idea was carried forward.

- Protect and conserve marine, coastal, estuarine and riparian habitats

And whether the project focuses on one or more of the following restoration techniques:

- Acquire lands for conservation
- Develop and implement management actions in conservation areas and/or restoration projects
- Restore hydrologic connections to enhance coastal habitats
- Create or enhance coastal wetlands through placement of dredged material

The following WCNH project ideas or components of projects with the following restoration techniques were screened out:

- Backfill canals
- Construct breakwaters
- Establish or expand protections for marine areas

For Oysters, Step 2 considered whether the project achieved one or more of the following:

- Makes direct contributions to solving long-term oyster survivorship problems in Mississippi coastal waters,
- Restores oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels,
- Restores resilience to oyster populations that are supported by productive larval source and sufficient substrate in larval sink areas to sustain reefs over time, or
- Restores a diversity of oyster reef habitat that provides ecological functions for estuarine -dependent fish species, nearshore benthic communities and other habitats.

And whether the project focuses on one or more of the following restoration techniques:

- Restore or create oyster reefs through placement of cultch in nearshore or subtidal areas;
- Enhance oyster reef productivity through spawning stock enhancement projects such as planting hatchery raised oysters, relocating wild oysters to restoration sites, oyster gardening programs, and other similar projects, and
- Develop a network of oyster reef spawning reserves.

The following Oysters project ideas or components of projects with the following restoration techniques were screened out:

- Construct breakwaters

Projects not meeting applicable Step 2 criteria were eliminated[13] from further consideration from this plan. The outcomes of the Step 2 screening process are discussed below for each of the

[13] For the purposes of this screening document, eliminated project ideas may continue to be considered for inclusion in future TIG restoration plans.

Restoration Types considered in Section 2.4. Appendix B contains the Screening Methodology which includes detailed screening criteria developed by the MS TIG for each Restoration Type.

Step 3—Project Specific Screening Considerations

For projects that reached Step 3 of the screening process, the MS TIG found it necessary in most cases to gather additional details about projects and conduct some project development and refinement. The MS TIG collected additional information from project proponents to better understand project design, cost, and/or potential ecological or data collection benefits of those projects remaining after Step 2. Although the criteria and associated questions varied by Restoration Type, the following questions are representative of the issues addressed during Step 3 of the screening:

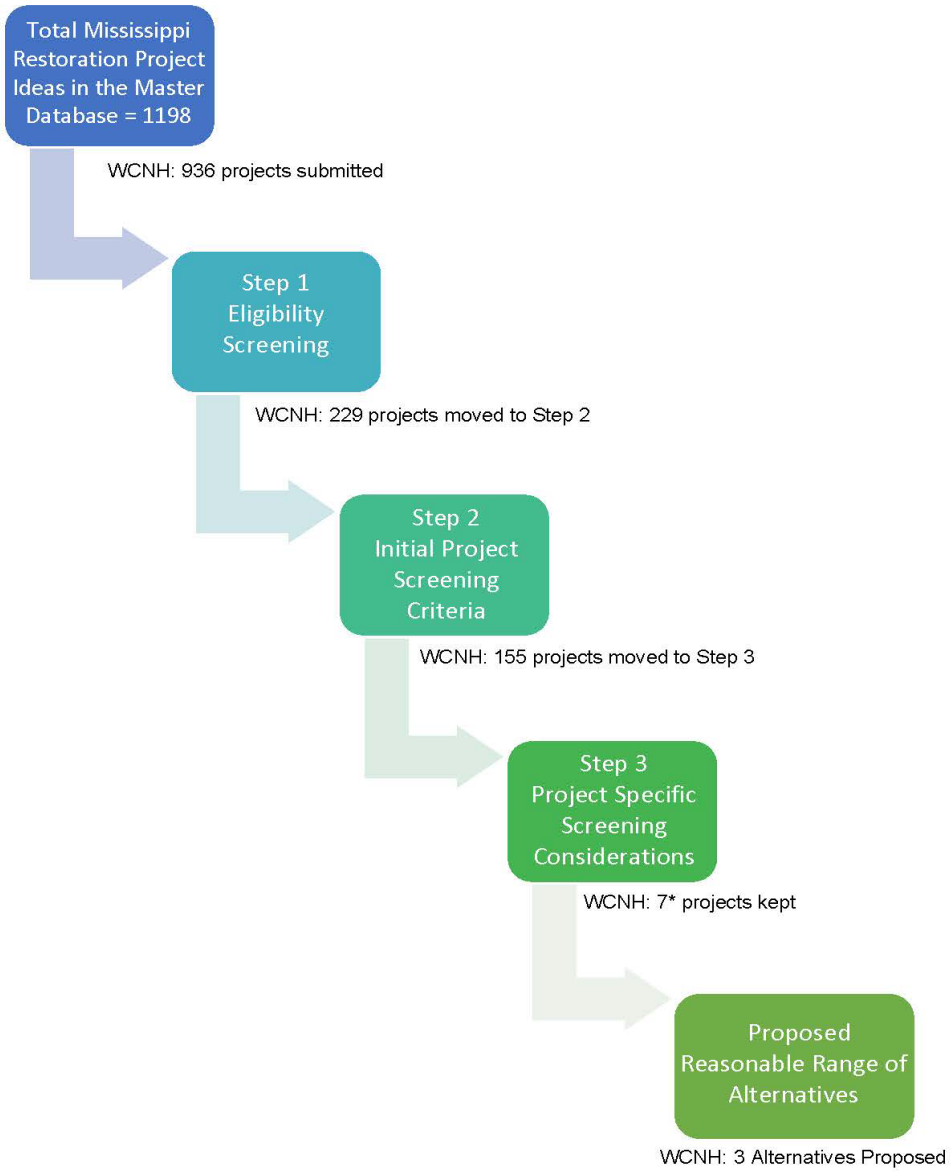
- Do the project techniques have a reasonable likelihood of being implemented successfully?
- Can the project be implemented within the budget available for this restoration plan or is there a source of other funds that can be leveraged in conjunction with NRDA funds available to allow implementation?
- Is the project likely to be cost-effective?
- Can the project be implemented in a reasonable time frame?
- Does the project have a significant potential to result in adverse environmental or human health impacts?
- Are there any other impediments to carrying the project forward as part of the reasonable range of alternatives designated for more detailed OPA and NEPA analysis (e.g., environmental compliance issues)?
- Is the project consistent with existing management and conservation plans, state programs, and/or other previous efforts completed by federal, state, local, NGO, or academic entities?
- To what extent does the project protect or restore a continuum of habits within the coastal ecosystem mosaic and would return injured resources and services to baseline conditions (WCNH)?
- Would the project contribute to habitat protection or restoration in the vicinity of other projects proposed for selection in this plan, thereby achieving a greater overall benefit to nearshore habits (WCNH)?
- Does the project build off of information developed by other projects currently being implemented (Oysters)?
- Is the project consistent with the DWH Trustees' Strategic Framework for Oyster Restoration Activities (Oysters)?

The MS TIG refined project scopes and/or budgets, and in some cases merged project ideas with similar scopes to take advantage of efficiencies. Decisions of the MS TIG to move project ideas from Step 3 to the reasonable range of alternatives were based on the balancing of the considerations outlined above within the context of the full suite of proposed restoration alternatives being advanced for evaluation in this Draft RPII/EA and projects being implemented or proposed with other DWH funding mechanisms (e.g., Resources and Ecosystems Sustainability (RESTORE) and National Fish and Wildlife Fund-Gulf Environmental Benefit Fund; NFWF-GEBF). As a result, a project idea considered in Steps 2 and 3 may have received a

generally favorable review but a decision was made not to move it to the reasonable range of alternatives for this Draft RPII/EA. In some cases, the MS TIG combined similar project ideas, further developed project ideas of similar or overlapping scope, used components of submitted ideas, utilized information in regional management plans, relied on resource expertise within the MS TIG, and consulted with relevant resource agencies in order to develop the reasonable range of alternatives. The reason (or reasons) a project was not carried forward at this time is documented below for each Restoration Type. The remainder of this section provides a more detailed discussion of the screening process, by Restoration Type, and rationale for the results for each of the Restoration Types considered in this Draft RPII/EA.

2.4.1 Wetlands, Coastal, and Nearshore Habitat Screening

This section describes the MS TIG's screening process for WCNH in this Draft RPII/EA. Figure 2-1 provides a summary of the results. Steps 1-3 are described here.



* A total of 7 project ideas were evaluated; three project ideas are proposed for the reasonable range of alternatives (See Section 2.5)

Figure 2-1. Summary of WCNH Screening Process for Draft RPII/EA

Step 1: Eligibility Screening for WCNH Project Ideas

MS TIG Decisions.—The MS TIG reviewed the master database which contained 1,198 project ideas and found a total of 936 project ideas that referenced benefits to WCNH. The MS TIG reviewed all project ideas to determine if they contained components that would contribute to

restoration of WCNH using PDARP restoration approaches and techniques[14]. A total of 936 project ideas were reviewed in Step 1.

The MS TIG eliminated 707 project ideas[15] that did not contribute to WCNH restoration in Mississippi, were duplicative, or had already been completed. The MS TIG kept 229 project ideas that would contribute to WCNH restoration or would be a potential component of a proposed WCNH project.

Step 2: Initial Project Screening Criteria for WCNH Project Ideas

MS TIG Decisions.—This step included screening of 229 project ideas. The MS TIG focused on the following WCNH Restoration Approaches:

1. Approach #1-Create, restore, and enhance Coastal Wetlands
2. Approach #2-Protect and conserve marine, coastal, estuarine, and riparian habitats.

The MS TIG eliminated the following restoration techniques from Approach #1 and #2: Backfill canals; construct breakwaters; and establish or expand protections for marine areas. The MS TIG also eliminated project ideas which included research, monitoring, planning, and oversight or financial management as their major focus because those projects did not include a restoration technique that would provide WCNH benefits.

The MS TIG eliminated 74 project ideas that did not include restoration techniques covered in Restoration Approaches #1 and #2. The MS TIG eliminated project ideas that were duplicates, that did not contain sufficient information to evaluate in this Step 2 or in Step 3, and that had received funding from other sources.

The MS TIG kept 155 project ideas that included the following techniques in Approach #1 and Approach #2:

- Create or enhance coastal wetlands through placement of dredge materials (beneficial use)
- Restore hydrologic connections to enhance coastal habitats (hydrologic connectivity)
- Acquire lands for conservation (acquisition)
- Develop and implement management actions in conservation areas and/or restoration projects (habitat restoration)

Step 3: Project Specific Screening Considerations for WCNH Project Ideas

MS TIG Decisions.—Members of the MS TIG coordinated with the Mississippi Department of Marine Resources Coastal Preserves Program (MDMR CPP) to determine if there were projects

---

[14] The WCNH approach "Restore Oyster Reef Habitat" was screened under the Oyster Restoration Type for Draft RPII/EA, so these project ideas were largely eliminated prior to WCNH screening or at least by Step 2 in the WCNH screening.

[15] For the purposes of this screening document, eliminated project ideas may continue to be considered for inclusion in future TIG restoration plans.

in the Coastal Preserves (CP) management plan(s) that met PDARP goals, provided habitat connectivity benefits to a continuum of habitats, and would develop and implement management actions in conservation areas and/or habitat restoration. The MS TIG decided to focus on projects that would (1) restore the CP using prescribed fire, chemical treatment, mechanical treatment, and (2) restore hydrologic connections to enhance coastal habitats. The MS TIG decided to eliminate project ideas which would create or enhance coastal wetlands through placement of dredge materials (beneficial use) and project ideas that would acquire lands for conservation (acquisition) as these types of project ideas are already currently being implemented with NRDA, RESTORE and NFWF GEBF funding. The MS TIG also eliminated some project ideas that would develop and implement management actions in conservation areas and/or restoration projects that did not include prioritized management activities (e.g. aquatic nuisance species control). These project ideas were eliminated for a variety of reasons including limited size, limited habitat connectivity benefits, and/or restoration activities that were not priorities for this RP.

Of the 155 projects screened in this step, 148 project ideas were eliminated.

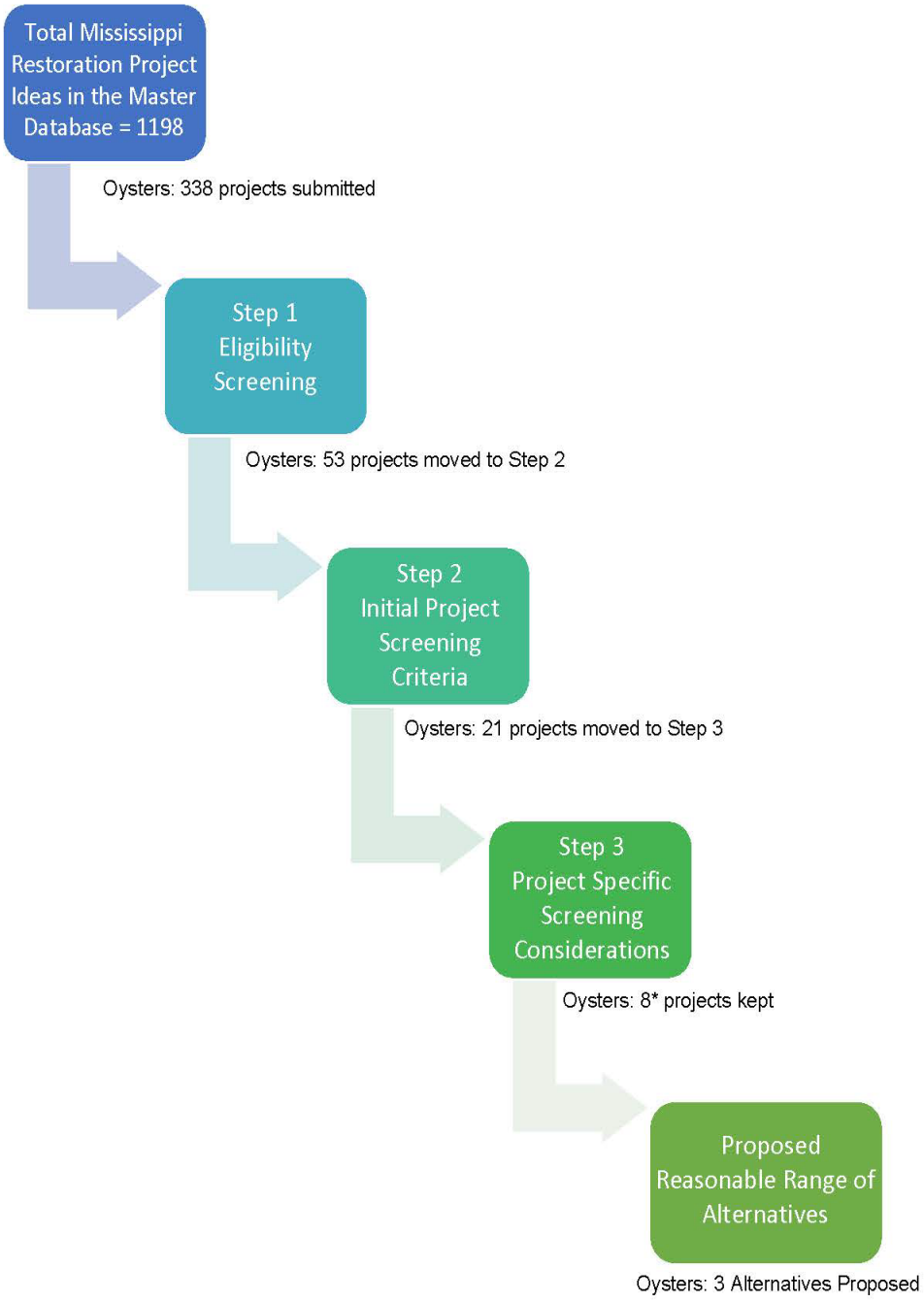
The MS TIG moved forward the following 7 project ideas that included those items and characteristics listed above:

Deer Island CP-Deer Island Restoration
Pascagoula River CP-Dantzler Restoration
Hancock County Marsh CP-Wachovia Restoration
Hancock County Marsh CP-Beckendorf Tract Restoration
Hancock County Marsh CP-Marsh and Forest Restoration at Ansley
Wolf River CP-Wolf River Preserve Restoration
Wolf River-Dupont Restoration

At the conclusion of the screening process described above, the MS TIG decided to keep four project ideas to develop three proposed alternatives in the CP: Wolf River CP-Wolf River Preserve Restoration/Dupont Restoration; Hancock County Marsh CP-Wachovia Tract Restoration; and Pascagoula River CP-Dantzler Restoration. For Draft RPII/EA, the MS TIG kept these four project ideas because they would develop and implement management actions in conservation areas and/or restoration projects within the CP with larger acreages of contiguous habitat relative to other tracts at this time, and would be managed using prescribed fire, chemical treatment, and mechanical treatment. Some of the projects that were eliminated had access issues that would make implementation more difficult. The reasonable range of alternatives for WCNH restoration are further described in Section 2.5, and Chapters 3, 4, and 5 of this Draft RPII/EA.

2.4.2 Oysters Screening

This section describes the MS TIG decisions in the screening process for Oysters in Draft RPII/EA. Figure 2-2 provides a summary of the results. Steps 1-3 are described here.



* A total of 8 project ideas were evaluated; three project ideas are proposed for the reasonable range of alternatives (See Section 2.5)

Figure 2-2. Summary of Oysters Screening Results for Draft RPII/EA

Step 1: Eligibility Screening for Oysters in Draft RPII/EA

MS TIG Decisions.—The MS TIG reviewed the master database of 1,198 project ideas and found a total of 338 project ideas that included references to benefits to Oysters that may contribute to restoration of Oysters. A total of 338 project ideas were reviewed in Step 1.

The MS TIG eliminated 285 project ideas that did not contribute to Oysters restoration in Mississippi, were duplicative or had already been completed. This left 53 projects ideas.

Step 2: Initial Project Screening Criteria for Oysters in Draft RPII/EA

MS TIG Decisions.— The MS TIG decided to focus on three restoration techniques:

1. Restoration Technique #1- Restore or create oyster reefs through placement of cultch in nearshore and subtidal areas;
2. Restoration Technique #2- Enhance oyster reef productivity through spawning stock enhancement projects such as planting hatchery raised oysters, relocating wild oysters to restoration sites, oyster gardening programs, and other similar projects; and
3. Restoration Technique #3- Develop a network of oyster reef spawning reserves.

The MS TIG decided to eliminate the construct living shorelines restoration technique since the TIG has made significant investments in that technique in Early Restoration Phases 3 & 4 and those projects are ongoing. MS TIG also decided to eliminate project ideas which include research, monitoring, planning, and oversight or financial management that did not include a restoration technique that would provide benefits to Oysters.

The MS TIG eliminated 32 project ideas that included constructing living shorelines; project ideas that were duplicates, project ideas that did not contain sufficient information to evaluate in Step 2, and some project ideas that had received funding from other sources. The MS TIG also eliminated project ideas which include research, monitoring, planning, and oversight or financial management that did not include a restoration technique that would provide benefits to oysters.

Step 3: Project Specific Screening Considerations for Oysters in Draft RPII/EA

MS TIG Decisions.— A total of 21 project ideas were evaluated in Step 3. The MS TIG retained project ideas that include the previously mentioned Restoration Techniques #1-3. Members of the MS TIG met with MDMR Fisheries staff to discuss oyster spawning reserve projects and siting of spawning reefs in areas that would be anticipated to provide sustainability and resiliency for oyster resources and that would be located in close proximity to the largest oyster resources in Mississippi waters. The MS TIG decided to eliminate planting hatchery-raised oysters and relocating wild oysters to restoration sites because there are current projects underway and planned that are funded by other sources. An oyster gardening program is currently funded, but project funding will expire soon; and, therefore, this project idea was retained for consideration.

The MS TIG eliminated 13 project ideas in this step. For Restoration Technique #1 and Restoration Technique #3, the MS TIG used project screening criteria and information from project development to eliminate individual reef sitings, reef siting areas approved for harvest by dredging, and reefs where specific locations were not identified. For Restoration Technique #2, the MS TIG eliminated projects that included oyster relay and planting hatchery-raised oysters.

The MS TIG kept eight restoration project ideas. For Restoration Technique #3, the MS TIG used information from project development to consider area wide project ideas to identify oyster spawning reserve projects and to consider siting of spawning reefs in areas that would be anticipated to provide sustainability and resiliency or oyster resources in close proximity to the largest oyster resource area in Mississippi. Area wide project ideas included:

- Mississippi Early Resource Restoration Using Artificial Reefs
- Hancock County Marsh Living Shoreline Protection/Oyster Cultch
- Subtidal Oyster Reef Restoration in Biloxi Bay, Mississippi
- Subtidal Oyster Reef Restoration Bay St. Louis, Mississippi
- Graveline Bayou Oyster Bed Restoration
- Restoration of Oyster Habitats in Point Aux Chenes Bay in Eastern Jackson County, MS within Grand Bay National Estuarine Research Reserve
- East Mississippi Artificial and Oyster Reef Expansion and Enhancement
- Ocean Springs High School Aquaculture Expansion (included an oyster gardening component)

Members of the MS TIG coordinated with MDMR and MS-AL Sea Grant Consortium to develop the reasonable range of alternatives from the eight remaining projects. During project development, components of the eight Mississippi area-wide project ideas were combined to develop the reasonable range of alternatives for oysters which includes two proposed spawning reef programs and an oyster gardening program. The alternatives are further described in Section 2.5, and Chapters 3, 4, and 5 of this Draft RPII/EA.

2.4.3 Screening Approach Summary

Application of the Mississippi TIG's screening methodology provides a rigorous and comprehensive approach to identifying a reasonable range of alternatives for this RPII/EA. Based on that process there are six proposed projects that comprise the reasonable range of alternatives. Section 2.5 of this chapter includes descriptions of these proposed alternatives organized by Restoration Type.

2.4.4 Natural Recovery Alternative

Pursuant to the OPA NRDA regulations, the PDARP/PEIS considered a "natural recovery alternative in which no human intervention would be taken to directly restore injured natural resources and services to baseline" (40 CFR 990.53[b][2]). Under this alternative, no additional restoration would be done by the MS TIG to accelerate the recovery of habitat on federally managed lands, water quality, or recreational losses in the Mississippi Restoration Area using DWH NRDA funding at this time. The MS TIG would allow natural recovery processes to occur, which could result in one of four outcomes for injured resources: (1) gradual recovery, (2) partial recovery, (3) no recovery, or (4) further deterioration. Although injured resources could presumably recover to or near baseline conditions under this scenario, recovery would take much longer compared to a scenario in which restoration actions were undertaken. Given that technically feasible restoration approaches are available to compensate for interim natural resource and service losses, the Trustees rejected this alternative from further OPA evaluation within the PDARP/PEIS. Based on this determination, tiering this Draft RPII/EA from the PDARP/PEIS, and incorporating that analysis by reference, the MS TIG did not find natural recovery to be a viable alternative under OPA. Natural recovery is not considered further in this Draft RPII/EA.

2.5 REASONABLE RANGE OF ALTERNATIVES CONSIDERED

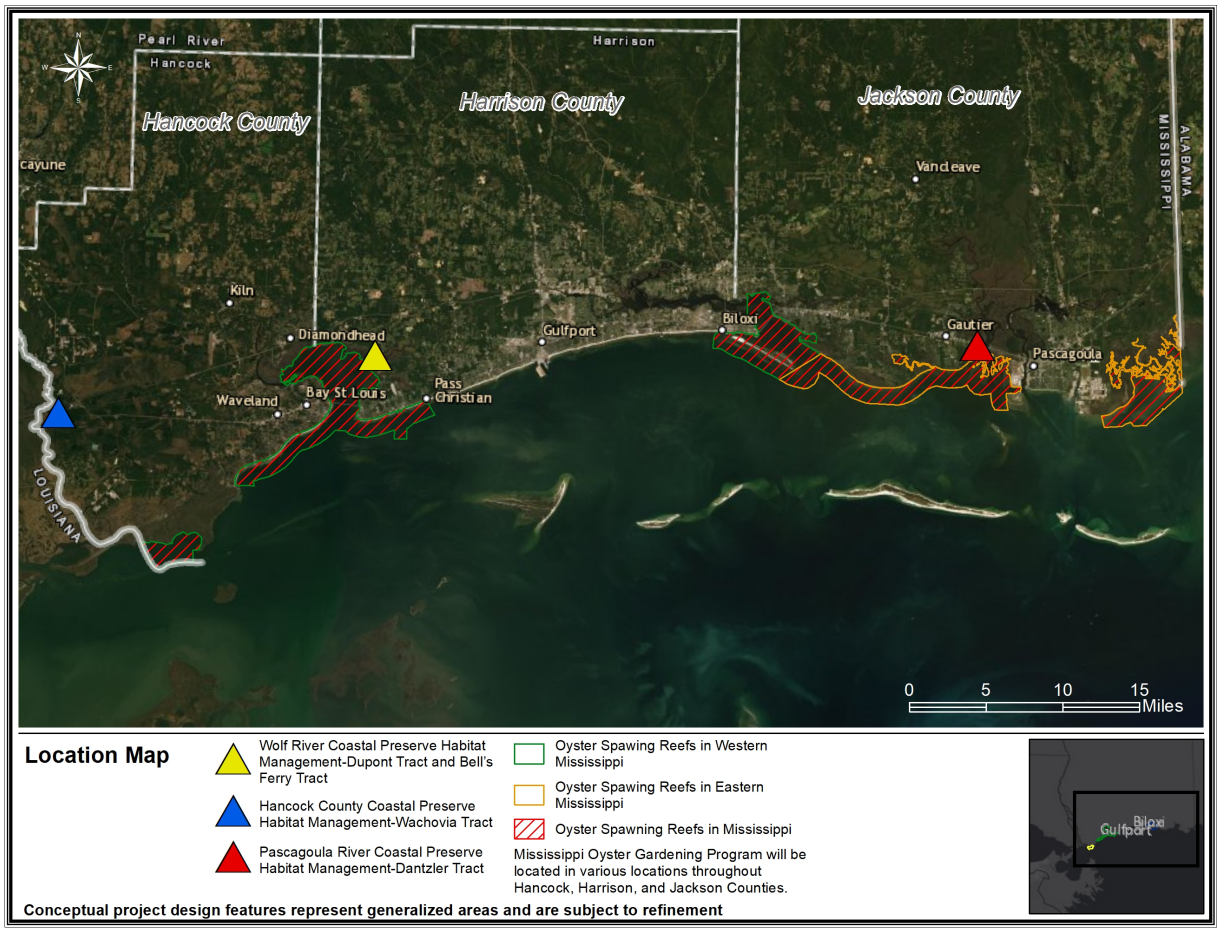


Figure 2-3. Location Map for Proposed Alternatives in Draft RPII/EA

The alternatives included in the reasonable range of alternatives are discussed in the following sections and are evaluated under OPA and NEPA in Chapters 3, 4, and 5, respectively, of this Draft RPII/EA. Figure 2-3 below shows the locations of each of the alternatives.

2.5.1 Wetlands, Coastal, and Nearshore Habitats

Project screening resulted in four alternatives for Wetlands, Coastal, and Nearshore Habitats.

Table 2-1. Reasonable Range of Alternatives for the Wetlands, Coastal, and Nearshore Habitats Restoration Type

Reasonable Range of Alternatives	Estimated Project Cost
Wolf River Coastal Preserve Habitat Management-Dupont Tract and Bell's Ferry Tract	$3,127,500
Hancock County Coastal Preserve Habitat Management-Wachovia Tract	$1,760,000
Pascagoula River Coastal Preserve Habitat Management-Dantzler Tract	$2,340,000

2.5.1.1 Wolf River Coastal Preserve Habitat Management-Dupont/Bell's Ferry Tract

The Wolf River Coastal Preserve is a 2,500-acre area located near the confluence of the Wolf River with St. Louis Bay which is managed by the Mississippi Department of Marine Resources Coastal Preserve Program (MDMR CPP). MDMR CPP has performed management activities on the Wolf River Preserve Dupont Tract under the Invasive Species Management on Coastal State Land Project which is funded by the National Fish and Wildlife Federation (NFWF) Gulf Environmental Benefit Fund (GEBF); the management activities are currently complete. Management activities have included chemical treatment and prescribed fire on the Dupont Tract (See Figure 2-4). The proposed project would continue the management activities that have been previously implemented on the Dupont Tract, and could initiate similar management activities on the Bell's Ferry Tract (Figure 2-4). The restoration approach is to protect and conserve marine, coastal, estuarine and riparian habitats. The proposed technique for restoration would be to restore hydrologic connections to enhance coastal habitats; and develop and implement management actions in conservation areas.

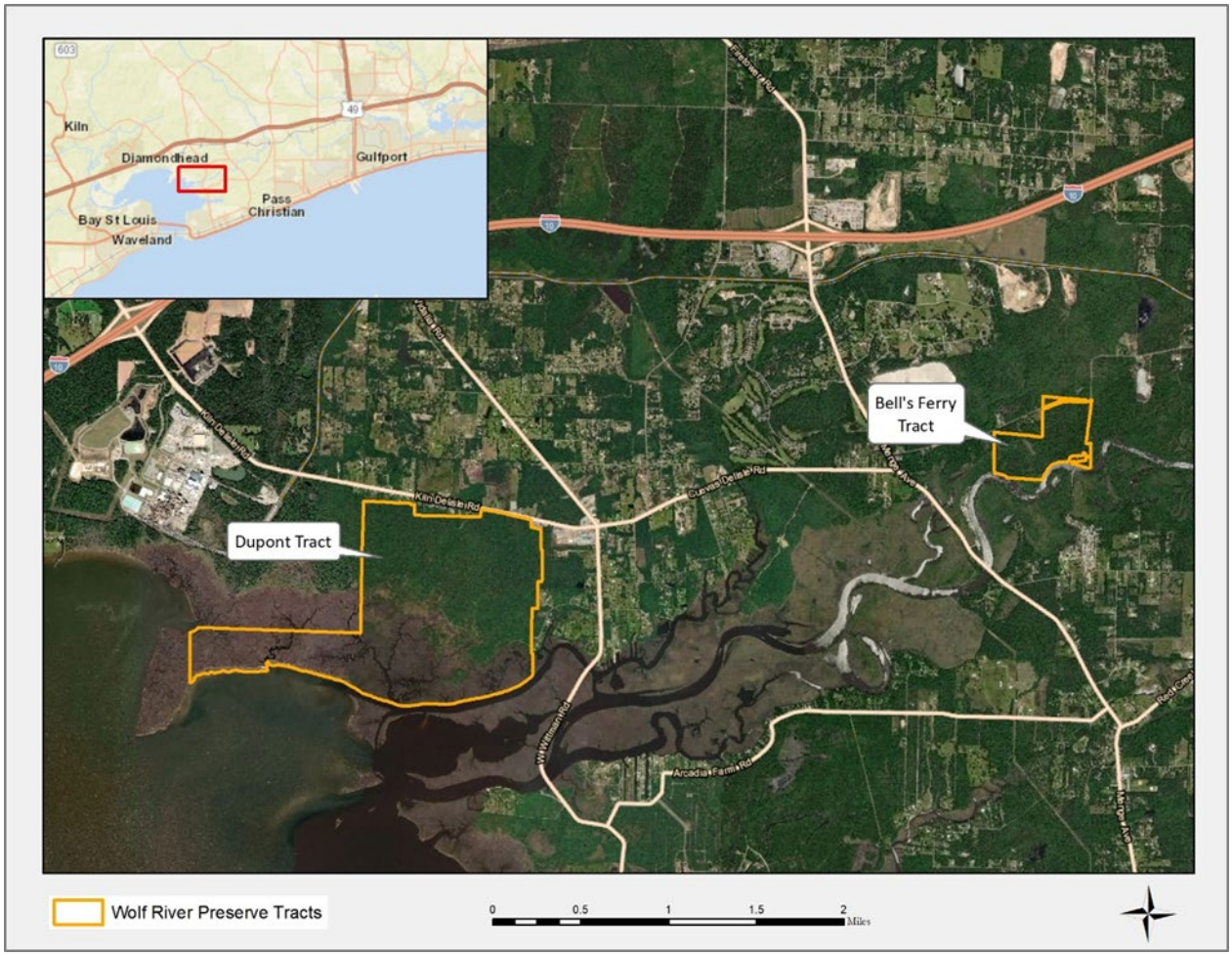


Figure 2-4. Wolf River Coastal Preserve Habitat Management-Dupont and Bell's Ferry Tracts

2.5.1.1.1 Dupont Tract

The Dupont Tract (650 acres) of the Wolf River Coastal Preserve is in public ownership and consists of three major habitat types. The first is the pine flatwood uplands on the northern third of the Tract. This pine flatwood very gently slopes to marshes that are a mixture of freshwater habitats and saltwater habitats located to the southeast, south and southwest of the pine woods. These marshes make up the remaining two thirds of the Tract and the other two habitat types. There are several tree islands embedded in this marsh area, with pines, hardwoods and shrubs. The target acreage for management is 232 acres consisting of three burn units of 154 acres, 58 acres and 20 acres, which are restricted to the pine flatwood portions of the Tract.

2.5.1.1.2 Bell's Ferry

The Bell's Ferry Tract is a 115-acre tract that is predominately pine flatwoods broken into two burn units of 39 acres and 9 acres. Fire infrastructure (e.g. fire lines) has not been established. The project would include the development of fire infrastructure on the Bell's Ferry Tract and initiation of a prescribed fire regime including the production of a fire management plan. The burn units of this plan are restricted to the pine flatwood portions of the Tract.

Management activities on the Dupont Tract would include prescribed fire, chemical treatment, mechanical treatment, hydrologic restoration, road repair, culvert replacement and installation of low water crossings. Management activities on the Bell's Ferry Tract would include prescribed fire, chemical treatment, mechanical treatment, and prescribed grazing, using a specific breed of cattle, Pineywoods cattle.

2.5.1.1.3 Project Implementation Methodology and Timing

MDEQ would be the Implementing Trustee. The project would be implemented over a 10-year timeframe. Restoration measures and management activities are described here.

Prescribed Fire (Dupont and Bell's Ferry Tracts).—The target area for prescribed fire includes established and planned burn units on the Dupont and Bell's Ferry Tracts. This management activity would occur on a regular two to three-year interval from years 1 to 10 of the project, with a preference for prescribed burns during the growing season (March-October). Environmental factors such as weather, access due to seasonal conditions, and other factors could affect the timing and frequency for prescribed fire.

Fire infrastructure has been established on the 232-acre Dupont Tract and a burn was completed in the spring of 2016. Prescribed fire would focus on pine flatwoods habitats which are composed of a mixture of southern pines (Slash, Longleaf, Loblolly), southern hardwoods, shrubs, and grass fuels.

The Bell's Ferry Tract is predominately pine flatwoods. The project would include the development of fire infrastructure (e.g. fire lines and staging areas) on the Bell's Ferry Tract and initiation of a prescribed fire regime as described above.

Chemical Treatment (Dupont and Bell's Ferry Tracts).—There are numerous invasive plants in the project area including : Chinese tallow (*Triadeca sebifera*), Wild Taro (*Colocascia esculenta*), camphor tree (*Cinnamomum camphor*), Chinese privet (*Ligustrum sinense*), cogon

grass (*Imperata cylindrical*), Japanese honeysuckle (*Lonicera japonica*), Japanese climbing fern (*Lygodium japonicum*), torpedo grass (*Panicum repens*), rattlebox (*Sesbania punicea*), wisteria (*Wisteria sinensis*) and Johnson grass (*Sorghum halepense*). Prescribed fire would help to kill some of these invasive plants as well as to open up the understory for direct non-native plant treatments. Chemical treatment would include application of herbicides for scattered populations of Chinese tallow and cogon grass control in the Dupont and Bell's Ferry Tract. In the Dupont Tract, the current program includes two treatments of approximately 157 acres in 5 subunits within a 650-acre treatment area. This project would include continued treatment in the Dupont Tract project area and would initiate treatment in the Bell's Ferry Tract. The treatment regime is anticipated to be completed approximately on an annual basis in years 1 to 10 of the project. Environmental factors such as weather, access due to seasonal conditions, and other factors could affect the timing and frequency for chemical treatment.

Mechanical Treatment (Dupont and Bell's Ferry Tracts).—Mechanical treatment would be initiated on the Dupont Tract and the Bell's Ferry Tract. These sites require smaller tracked equipment due to saturated conditions throughout much of the project area. Opportunities for mechanical treatment would likely be limited to a few months because of wet conditions. Mechanical treatment is anticipated to be completed in years 1 to 5 of the project. Environmental factors such as weather and access due to seasonal conditions, and other factors could affect the timing and frequency of mechanical treatment.

Hydrologic Restoration (Dupont Tract).—Efforts to improve hydrologic connectivity would be limited to work along a 2.2-mile road within the Dupont Tract. Restoration measures and management activities would include but may not be limited to the following: removal of culverts; installation of low water crossings; road removal; road repair; installation or construction of conveyance structures, swales or ditches; and other activities to facilitate the restoration of historical hydrologic connections. The current roadway infrastructure impedes direct connection to adjacent coastal waters.

Prescribed Grazing (Bell's Ferry Tract).—Pineywoods cattle are a heritage breed that are often used in conservation grazing. A pilot area is proposed on approximately 13 acres on the Bell's Ferry Tract outside of riparian areas. Descendants of the original Spanish stock left along the Atlantic and Gulf coasts by the Spanish explorers, these cattle evolved naturally in the brushy wooded terrain of the Gulf Coast and survived in thick woods and brush areas. They are small, rugged, heat and humidity tolerant, and disease and parasite resistant. They eat low-quality forage (leaf-litter, bark and woody undergrowth). Cattle would be released within the fenced area for a specified period of time and during specific times of the year. The fenced area would be monitored and compared to other forms of management (e.g., fire, mechanical treatment, chemical treatment). This pilot area would test the effectiveness of prescribed grazing as an alternative to prescribed fire in urban interface areas (of close proximity to housing, institutional or commercial developments).

2.5.1.1.4 Operations, Maintenance and Monitoring

Short and long-term maintenance includes regular maintenance of access, firelanes, and infrastructure needed to routinely implement management activities including prescribed fire, chemical treatment, mechanical treatment, and fence repair/replacement for prescribed grazing activities. Project monitoring is described in the Monitoring and Adaptive Management Plan

(Appendix A) and would include baseline vegetative monitoring and metrics to measure of changes in plant composition and structure as well as an annual count of acres of management activities.

2.5.1.1.5 Cost

The estimated costs are $3,127,500 and include planning, compliance, engineering, permitting, implementation, monitoring, maintenance, oversight, and contingency costs.

2.5.1.2 Hancock County Marsh Coastal Preserve Habitat Management-Wachovia Tract

The Wachovia Tract (Figure 2-5) is in the Hancock County Coastal Preserve, Hancock County, Mississippi. The restoration approach is to protect and conserve marine, coastal, estuarine and riparian habitats. The proposed restoration technique would be to develop and implement management actions in conservation areas.

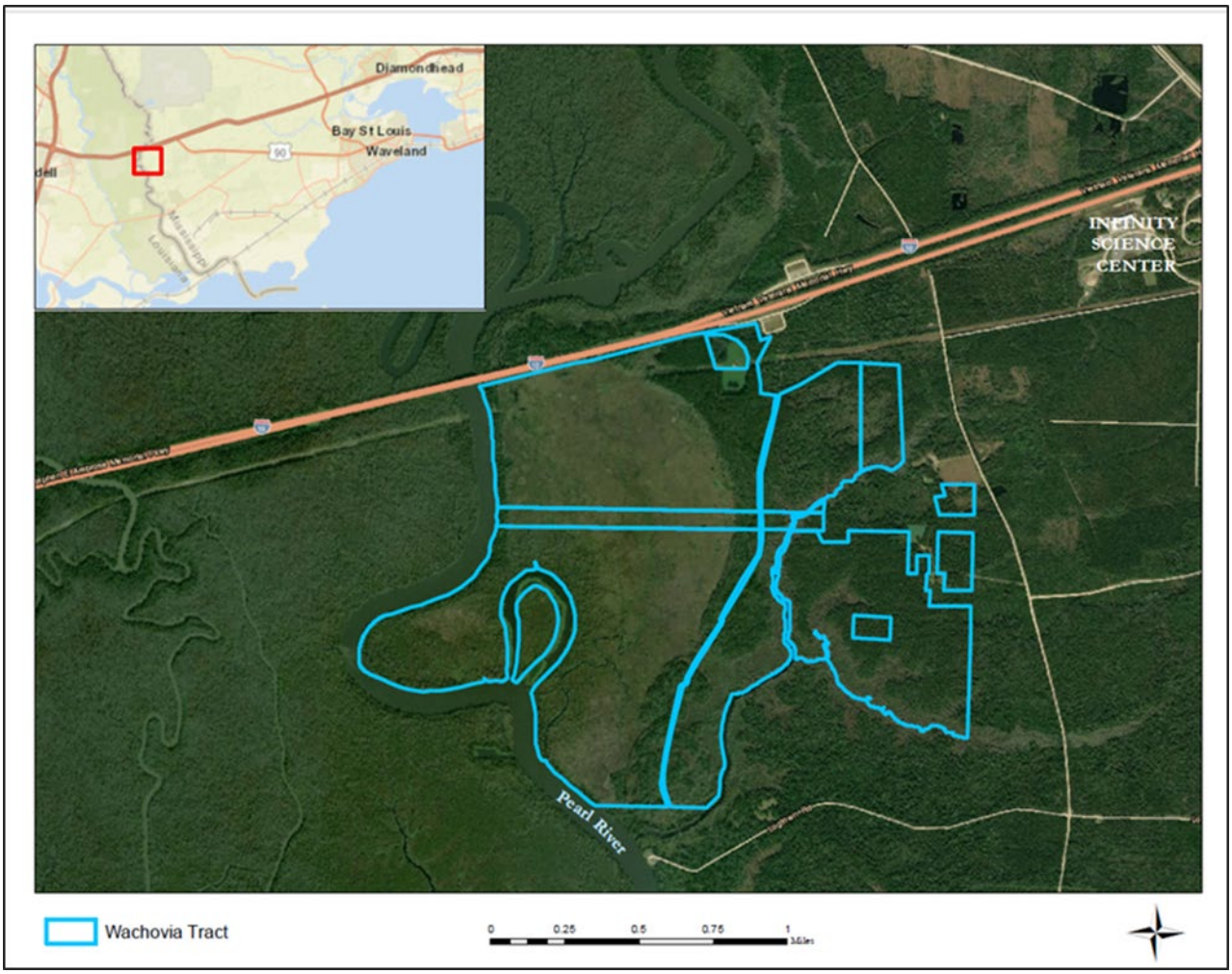


Figure 2-5. Hancock County Marsh Coastal Preserve Habitat Management-Wachovia Tract

The Hancock County Coastal Preserve-Wachovia Tract is a 1,203-acre area located south of I-10, east of the Pearl River and west of the Possum Walk Trail which is managed by the MDMR CPP. MDMR CPP has initiated management activities on the Hancock County Coastal Preserve-Wachovia Tract Component under the Invasive Species Management on Coastal State Land Project, which is funded by the NFWF GEBF. Management activities have included chemical treatment, prescribed fire and mechanical treatment. The proposed project would fund continued management activities on the Wachovia Tract.

The Wachovia Tract is in state ownership and consists of two major habitat types. The first is the pine flatwood uplands on the center and eastern two thirds of the Tract. This pine flatwood very gently slopes to marshes that are a mixture of freshwater and brackish habitats located to the west and southwest of the pine flatwoods. Marshes make up the remaining one third of the Tract. There are several tree islands embedded in this marsh area, with pines, hardwoods and shrubs. The target acreage for management is broken into three burn units of 74 acres, 144 acres and 159 acres. The ignition units of this plan are restricted to the pine flatwood portions of the Tract. Management activities would include prescribed fire, chemical treatment and mechanical treatment.

2.5.1.2.1 Project Implementation Methodology and Timing

MDEQ would be the Implementing Trustee. The project would be implemented over a 10-year timeframe. Restoration measures and management activities are described here.

Prescribed Fire.—This management activity would occur on a regular two to three-year interval, with a preference for prescribed burns during the growing season (March-October). Fire infrastructure has been established on the Wachovia Tract and completed a "first entry" burn in the spring of 2016. Burn Units are approximately 377 acres in size including pine flatwoods. Prescribed fire for this project would focus on prescribed fire in pine flatwoods which are composed of a mixture of southern pines (Slash, Longleaf, Loblolly), southern hardwoods, shrubs, and grass fuels. This management activity is anticipated to occur every 2 to 3 years from years 1 to 10 of the project. Environmental factors such as weather, access due to seasonal conditions and other factors, may affect the timing and frequency of prescribed fires.

Chemical Treatment.—There are numerous invasive plants in the project area including Chinese tallow, cogongrass, Cherokee Rose, alligator weed (*Alternanthera philoxeroides*), torpedo grass, water hyacinth (*Eichhornia crassipes*), common duckweed (*Lemna minor*), Chinese privet, Japanese honeysuckle, Japanese climbing fern, common reed (*Phragmites australis*), rattlebox (*Sesbania punicea*), tung tree (*Vernicia fordii*), and Japanese wisteria (*Wisteria floribunda*).

Prescribed fire is intended to topkill some of these invasive plants as well as to open up the understory for direct non-native plant treatments. Chemical treatment would include application of herbicides for scattered populations of Chinese tallow and cogon grass control in the Wachovia Tract. In the Wachovia Tract, the current program includes 2 treatments of approximately 455 acres in 15 subunits. Chemical treatment would continue on approximately 455 acres and is anticipated to occur annually in years 1 to 10 of the project. Environmental factors such as weather, access due to seasonal conditions, and other factors, could affect the timing and frequency for chemical treatment.

Mechanical Treatment.—Mechanical treatment would be initiated on the Wachovia Tract under this proposal. Mechanical treatment on this site requires smaller tracked equipment due to saturated conditions throughout much of the project area. Opportunities for mechanical treatment would likely be limited to a few months per year because of wet conditions. Approximately 377 acres of mechanical treatment is anticipated to occur in years 0 to 3 of the project. Environmental factors such as weather, access due to seasonal conditions, and other factors could affect the timing and frequency of mechanical treatment.

2.5.1.2.2 Operations, Maintenance and Monitoring

Short and long-term maintenance includes regular maintenance of access and fire lines needed to routinely implement management activities including prescribed fire, chemical treatment, and mechanical treatment activities. Project monitoring is described in the Monitoring and Adaptive Management Plan (Appendix B) and would include baseline vegetative monitoring and metrics to measure of changes in plant composition and structure as well as annual counts of managed acres.

2.5.1.2.3 Cost

The estimated costs are $1,760,000 and include planning, compliance, implementation, monitoring, maintenance, oversight, and contingency costs.

2.5.1.3 Pascagoula River Marsh Coastal Preserve-Dantzler Tract

The Dantzler Tract (Figure 2-6) is in the Pascagoula River Coastal Preserve, Jackson County, Mississippi, and is managed by the MDMR CPP. The restoration approaches to this proposed alternative project are to create, restore and enhance coastal wetlands; and protect and conserve marine, coastal, estuarine and riparian habitats. The proposed technique for restoration would be to restore hydrologic connections to enhance coastal habitats; and develop and implement management actions in conservation areas and/or restoration projects.

Figure 2-6. Pascagoula River Coastal Preserve Habitat Management-Dantzler Tract

The Pascagoula River Coastal Preserve-Dantzler Tract consists of approximately 426 acres of brackish marsh and pine savanna/flatwoods. This proposed project includes restoration of 328 acres of severely degraded wet pine savannah to the west of the large Pascagoula River Marsh. Measures required to restore hydrology and natural vegetative habitat to the Dantzler site include removal of existing hurricane debris and sedimentation, filling drainage ditches, road removal, control of non-native species, and controlled burning. MDMR CPP has initiated management activities on the Dantzler Tract under the Invasive Species Management on Coastal State Land Project which was funded by the NFWF GEBF; the management activities are currently complete. Management activities have included chemical treatment and mechanical clearing. The proposed project would fund extended management activities on the Dantzler Tract.

The Dantzler Tract is in state ownership and consists of two major habitat types wet pine savanna and estuarine marsh[16]. Wet pine savanna includes uplands which are a mixture of southern pines (Slash, Longleaf, and Loblolly) and southern hardwoods and shrubs. The estuarine marshes to the south are primarily Sawgrass (*Cladium sp.*) and Needle Rush (*Juncus* sp.). The project area is bounded to the north by a developed residential subdivision, to the west by commercial and residential lands adjacent to the Gautier Vancleave Road and to the south and east by primarily state-owned marshes bordering the Pascagoula River. Across the river to the southwest and south it is mostly commercial, residential and campus development. To the northeast, directly adjacent to the Tract is the privately-owned Indian Point RV Resort. The target acreage for management activities includes 326 acres broken down by burn unit: Unit 1 (77 acres), Unit 2 (39 acres), Unit 3 (120 acres), and Unit 4 (92 acres). The burn units of this plan are restricted to the pine savanna portions of the Tract. Management Activities include prescribed fire, chemical treatment and mechanical treatment.

2.5.1.3.1 Project Construction Methodology and Timing

The Implementing Trustee would be MDEQ and it would be completed over a 10-year timeframe. Restoration measures and management activities are described below.

Prescribed Fire.— This management activity would occur on a regular two to three-year interval, with a preference for prescribed burns during the growing season (March-October). Growing season burns would continue the process of thinning pine and reducing the presence of hardwood trees, reducing shrub cover and encouraging more sunlight to assist in the recovery of forbs, grasses, sedges and other herbaceous ground cover. Prescribed fire is anticipated to occur approximately every 2 to 3 years from years 1 to 10 of the proposed project. Environmental factors such as weather, access due to seasonal conditions, and other factors could affect the timing and frequency for prescribed fire.

Chemical Treatment.—There are numerous invasive plants in the project area including : Chinese tallow, cogongrass, mimosa (*Albizia julibrissin*), camphor tree, pampas grass (*Cortaderia selloania*), Chinese privet, Japanese honeysuckle, Japanese climbing fern, torpedo grass, Cherokee rose, common salvinia (*Salvinia minima*), rattlebox (*Sesbania punicea*), and wisteria (*Wisteria sinensis*). Prescribed fire is intended to topkill some of these invasive plants as well as to open up the understory for direct non-native plant treatments. Chemical treatment would include application of herbicides for scattered populations of Chinese tallow and cogongrass control in the Dantzler Tract. The chemical treatment regime is anticipated to be completed approximately on an annual basis in years 1 to 10 of the project. Environmental factors such as weather, access due to seasonal conditions, and other factors could affect the timing and frequency for chemical treatment.

Mechanical Treatment.—MDMR CPP would initiate mechanical treatment on the Dantzler Tract under this project. A timber sale is contemplated as a management measure and a precursor to mechanical treatment. Mechanical treatment on this site could be used as a replacement for

[16] Mississippi Department of Wildlife, Fisheries and Parks (MDWF) 2015. Mississippi State Wildlife Action Plan.

fire in areas that are in close proximity to the urban interface. Mechanical treatment is anticipated to be completed in years 1 to 5 of the project. Environmental factors such as weather and access due to seasonal conditions, and other factors could affect the timing and frequency of mechanical treatment.

Hydrologic Restoration.—Road removal, culvert replacement and installation of low water crossings: Efforts to improve hydrologic connectivity would include but may not be limited to road removal; filling drainage ditches; and other activities to facilitate the restoration of historical hydrologic connections.

2.5.1.3.2 Operations, Maintenance and Monitoring

Short and long-term maintenance includes regular maintenance of access, firelanes, and infrastructure needed to routinely implement management activities including prescribed fire, chemical treatment, and mechanical treatment activities. A Monitoring and Adaptive Management Plan is not included for this alternative since it not proposed as a preferred alternative at this time.

2.5.1.3.3 Cost

The estimated costs are $2,340,000 and include planning, compliance, permitting, implementation, monitoring, maintenance, oversight, and contingency costs.

2.5.2 Oysters

Project screening resulted in four alternatives for oysters.

Table 2-2. Reasonable Range of Alternatives for the Oysters Restoration Type

Reasonable Range of Alternatives	Estimated Project Cost
Oyster Spawning Reefs in Western Mississippi	$10,000,000
Oyster Spawning Reefs in Eastern Mississippi	$10,000,000
Oyster Spawning Reefs in Mississippi	$10,000,000
Mississippi Oyster Gardening Program	$500,000

2.5.2.1 Oyster Spawning Reefs in Western Mississippi

The proposed project would include the restoration or creation of a minimum of 100 acres and a maximum of 400 + acres of high-relief cultch placements in up to three locations in the Mississippi Sound and areas including St. Louis Bay, Heron Bay, and Back Bay/Biloxi Bay in Hancock and Harrison Counties (Figures 2-7; Table 2-3). This project includes the possibility of placement of more than 400 acres where it is feasible, depending on engineering and design, costs, and other considerations. It is estimated that, historically[17], greater than 6,400 acres of

[17] As defined in MDMR Permit (SAM-2015-00644-MJF) Mississippi Department of Marine Resources, Mississippi Sound Oyster Reef Restoration Project, Hancock, Harrison and Jackson Counties, MS. Permitting of reefs would be worked out in the project implementation phase of the project in consultation with MDMR.

oyster reefs occurred in the locations that encompass the Oyster Spawning Reefs in Western Mississippi project area. Table 2-3 lists the acreage of the potential cultch placement areas.

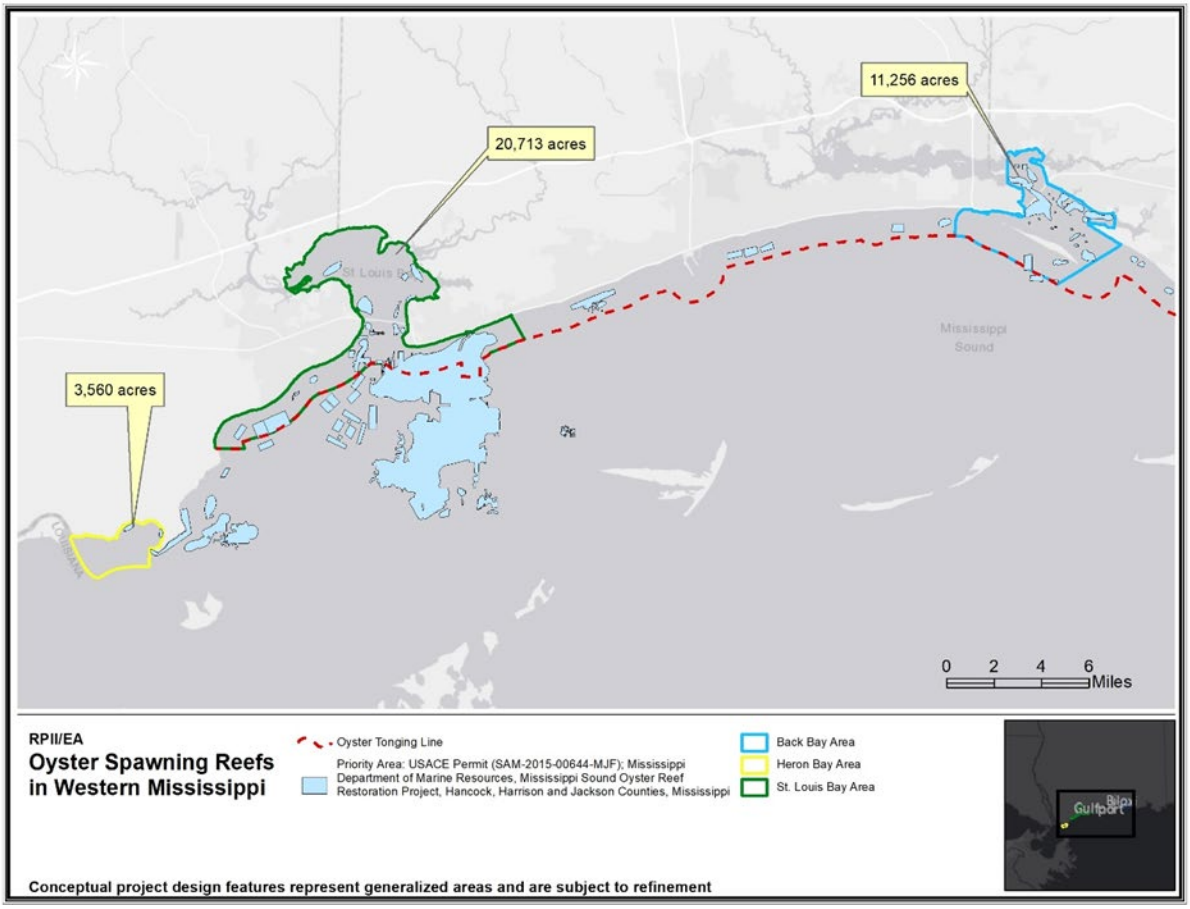


Figure 2-7. Oyster Spawning Reefs in Western Mississippi

Table 2-3. Project Locations and Acreages for Oyster Spawning Reefs in Western Mississippi

Location	Total Acreage of Potential Cultch Placement Areas	Harvestable (tonging only) Acres	Non-Harvestable (Restricted/ Prohibited) Acres
St. Louis Bay and the adjacent Mississippi Sound	20,713	5,234	15,479
Heron Bay and the adjacent Mississippi Sound	3,560	0	3,560
Biloxi Back Bay and the adjacent Mississippi Sound	11,256	5,927	5,328
Total Acreage	35,529	11,161	24,367

Siting.—Cultch placement would be prioritized to areas determined to be the most suitable to maximize restoration benefits within the potential cultch placement areas listed in Table 2-3. The siting of reefs would consider substrate suitability, on-going and planned management activities, and other environmental factors that could affect restoration efforts. No more than 35% of cultch would be placed in harvestable (tonging only zones) with the remaining cultch placement in non-harvestable zones (Restricted and Prohibited Areas).

Harvest Moratorium.—The Implementing Trustee (MDEQ) would request a harvest moratorium in both harvestable (tonging only) and restricted waters (relay only, no direct harvest) from the Mississippi Commission on Marine Resources for the duration of the monitoring and adaptive management period. For cultch placed in harvestable waters, the harvest moratorium would be a minimum of 3 years and a maximum of 5 years. After this time, oysters could be harvested following existing protocols and limits established by MDMR. For cultch placed in restricted waters, the moratorium would be a minimum of 5 years and a maximum of 7 years. After this time, relay could occur based on appropriate management techniques outlined by MDMR. In the event of an imminent catastrophic event that could cause significant oyster mortality, reefs in both harvestable and restricted areas could be harvested/relayed even under an existing moratorium, based on mutual agreement between MDMR and MDEQ.

2.5.2.1.1 Project Implementation Methodology and Timing

MDEQ would be the Implementing Trustee. While target areas have been identified, final identification of specific cultch placement locations may be anywhere inside the evaluated project areas (listed in Table 2-3, Potential Cultch Placement Areas) in consultation with MDMR and would be based on factors including but not limited to substrate suitability (e.g. geotechnical probing, multi-beam sonar), salinity, bathymetry, and other environmental and management considerations. The subtidal reefs would be constructed using appropriate cultch material (limestone, crushed concrete, oyster shells, fossilized oyster shells, and other suitable cultch material or a combination thereof) to be determined during each project's design process. The cultch materials would be stockpiled at an upland staging area. The cultch materials would be inspected to ensure the materials are clean and free of all debris, including but not limited to, trash, steel reinforcement, and asphalt. Mechanical equipment would be utilized to load the materials onto shallow draft barges or shallow draft self-powered marine vessels. The material would be deployed using a high-pressure water jet or using a clam-shell bucket mounted on a crane or a long-armed track hoe located on a separate equipment barge. The cultch material

would be deployed generally in water depths ranging from 0 to -10 MLLW. The cultch material thickness would range from <1 foot to up to several feet, depending on site conditions.

2.5.2.1.2 Operations, Maintenance and Monitoring

Maintenance of the subtidal reefs, including the deployment of additional cultch material, may be needed in the event of a disaster such as a hurricane or tropical storm, or for other reasons. A Monitoring and Adaptive Management Plan would be developed if the project was selected for implementation. Implementation of adaptive management measures would typically be based on monitoring results.

2.5.2.1.3 Cost

The estimated costs are $10,000,000 and include planning, compliance, engineering, permitting, implementation, monitoring, maintenance, oversight, and contingency costs.

2.5.2.2 Oyster Spawning Reefs in Eastern Mississippi

The proposed project would include the restoration or creation of a minimum of 100 acres and a maximum of 400 + acres of high-relief cultch placements in up to six locations in the Mississippi Sound and areas including Graveline Bay, Pascagoula Bay, and Grand Bay in Harrison, and Jackson Counties (Figure 2-8; Table 2-4). This project includes the possibility of placement of more than 400 acres where it is feasible, depending on engineering and design, costs, and other considerations. It is estimated that, historically[18], greater than 1,500 acres of oyster reefs occurred in the locations that encompass the Oyster Spawning Reefs in Eastern Mississippi project area. Table 2-4 lists the acreage of the potential cultch placement areas.

[18] As defined in MDMR Permit (SAM-2015-00644-MJF) Mississippi Department of Marine Resources, Mississippi Sound Oyster Reef Restoration Project, Hancock, Harrison and Jackson Counties, MS. Permitting of reefs would be worked out in the project implementation phase of the project in consultation with MDMR.

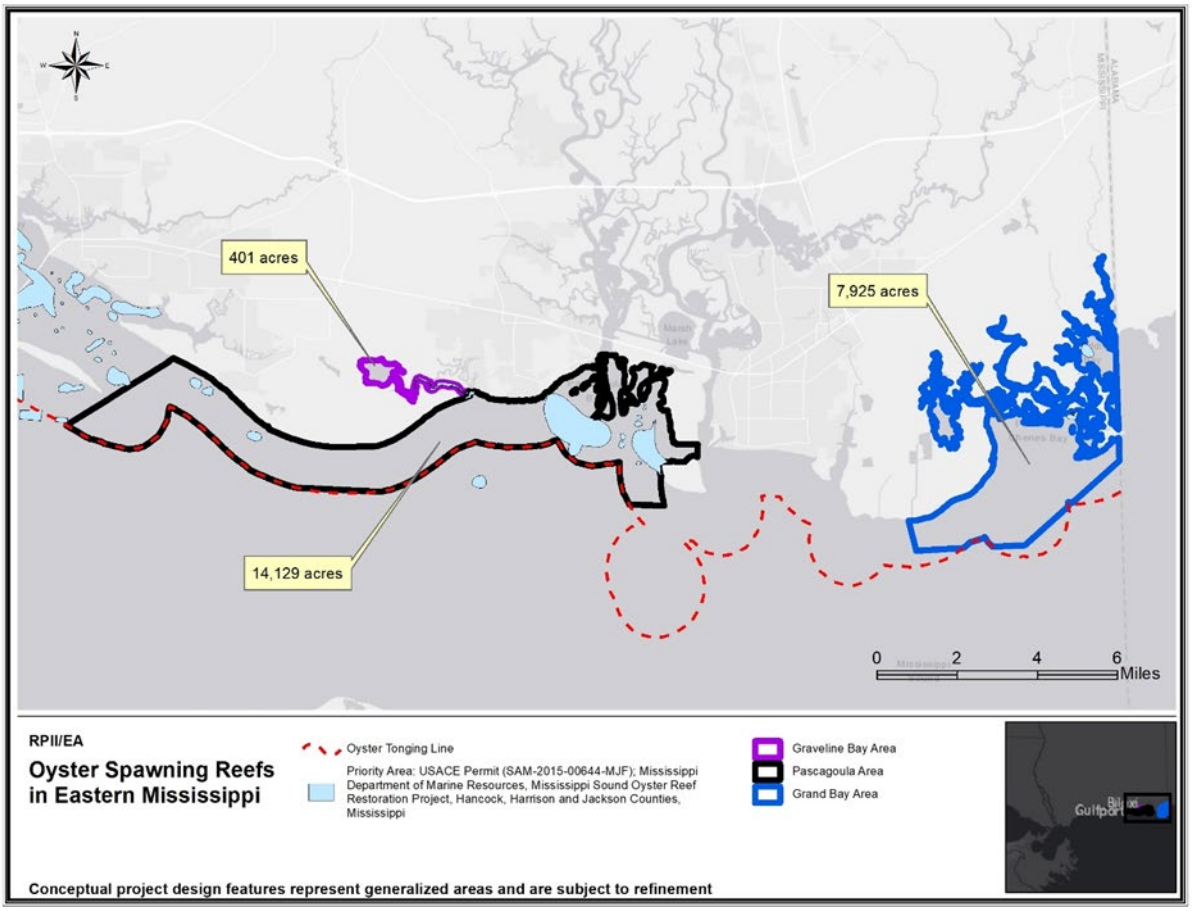


Figure 2-8. Oyster Spawning Reefs in Eastern Mississippi

Table 2-4. Project Locations and Acreages for Oyster Spawning Reefs in Eastern Mississippi

Location	Total Acreage	Harvestable (tonging only) Acres	Non-Harvestable (Restricted/ Prohibited) Acres
Pascagoula Bay and the adjacent Mississippi Sound	14,129	1,401	13,374
Graveline Bay	401	0	401
Grand Bay and the adjacent Mississippi Sound	7,925	0	7,925
Total Acreage	22,455	1,401	21,700

Siting, harvest moratorium, project implementation, methodology, timing, operations, maintenance, monitoring and costs would be the same as Oyster Spawning Reefs in Western Mississippi.

2.5.2.3 Oyster Spawning Reefs in Mississippi

The proposed project would include the restoration or creation of a minimum of 100 acres and a maximum of 400 + acres of high-relief cultch placements in up to six locations in the Mississippi Sound and areas including St. Louis Bay, Heron Bay, Back Bay/Biloxi Bay, Graveline Bay, Pascagoula Bay, and Grand Bay in Hancock, Harrison, and Jackson Counties (Figure 2-9; Table 2-5). This project includes the possibility of placement of more than 400 acres where it is feasible, depending on engineering and design, costs, and other considerations. It is estimated that, historically[19], greater than 7,000 acres of oyster reefs occurred in the locations that encompass the Oyster Spawning Reefs in Mississippi project area. Table 2-5 lists the acreage of the potential cultch placement areas.

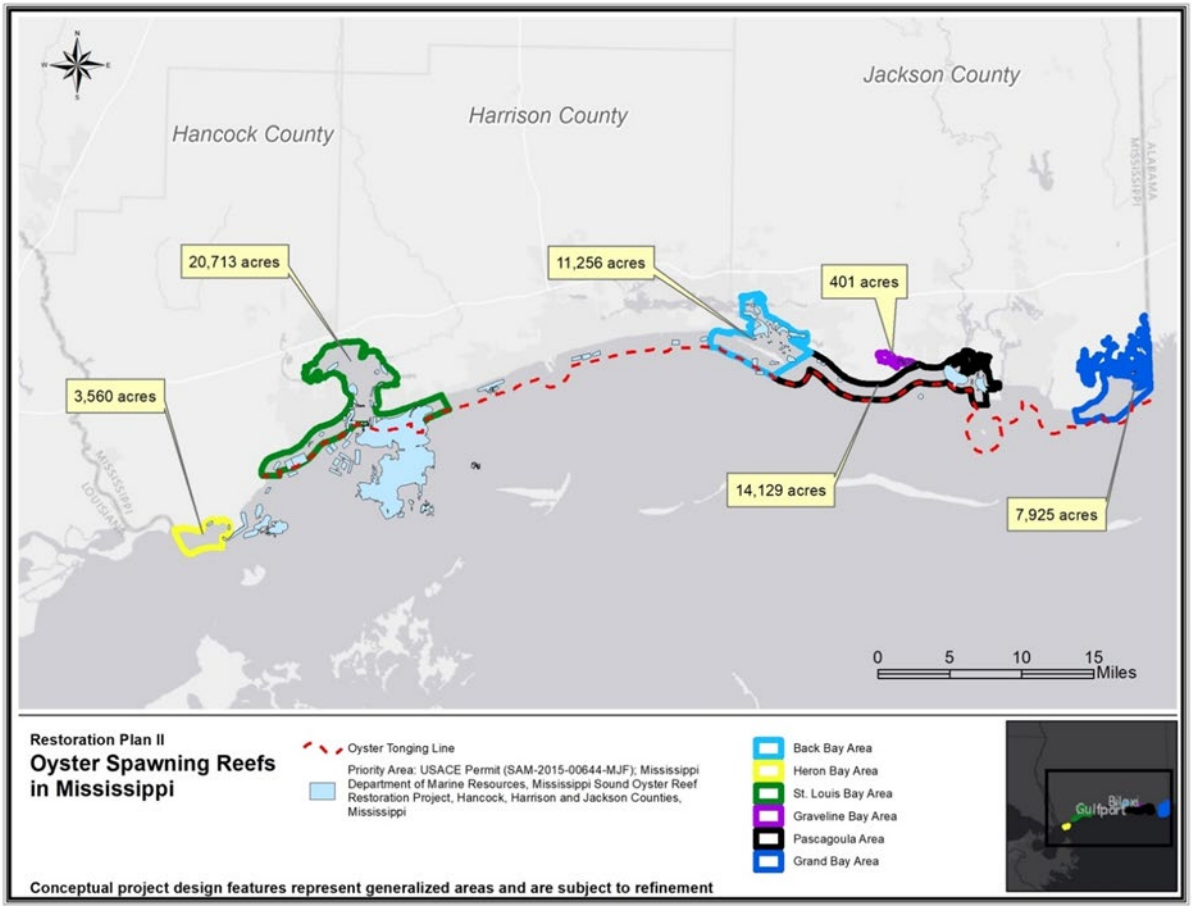


Figure 2-9. Oyster Spawning Reefs in Mississippi

[19] As defined in MDMR Permit (SAM-2015-00644-MJF) Mississippi Department of Marine Resources, Mississippi Sound Oyster Reef Restoration Project, Hancock, Harrison and Jackson Counties, MS. Permitting of reefs would be worked out in the project implementation phase of the project in consultation with MDMR.

Table 2-5. Project Locations and Acreages for Oyster Spawning Reefs in Mississippi

Location	Total Acreage	Harvestable (tonging only) Acres	Non-Harvestable (Restricted/ Prohibited) Acres
St. Louis Bay and the adjacent Mississippi Sound	20,713	5,234	15,479
Heron Bay and the adjacent Mississippi Sound	3,560	0	3,560
Biloxi Back Bay and the adjacent Mississippi Sound	11,256	5,927	5,328
Pascagoula Bay and the adjacent Mississippi Sound	14,129	1,401	13,374
Graveline Bay	401	0	401
Grand Bay and the adjacent Mississippi Sound	7,925	0	7,925
Total Acreage	57,984	12,562	46,067

Siting, harvest moratorium, project implementation, methodology, timing, operations, maintenance, monitoring and costs would be the same as Oyster Spawning Reefs in Western Mississippi. A draft Monitoring and Adaptive Management Plan for Oyster Spawning Reefs in Mississippi is included in Appendix C of this Draft RPII/EA.

2.5.2.4 Mississippi Oyster Gardening Program

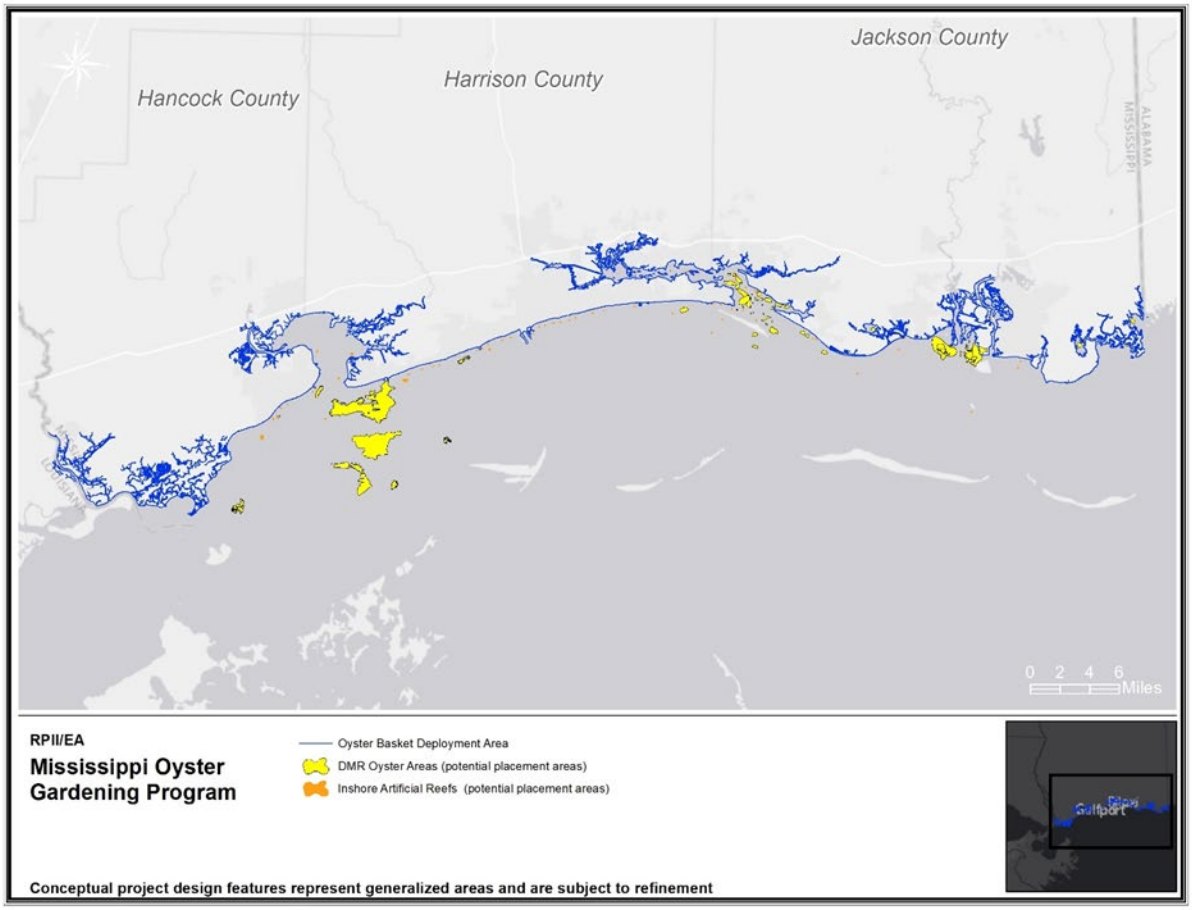


Figure 2-10. Mississippi Oyster Gardening Areas

This proposed Mississippi Oyster Gardening Program (MSOGP) would be implemented over a five-year period utilizing volunteers along the Mississippi Gulf Coast (Figure 2-10). This program would be a continuation of the current NFWF-GEBF funded project. The Program would grow sub-adult oysters from spat in gardens on shell stock that hang from waterfront piers/wharves and docks located in coastal waters anywhere along the Mississippi Gulf Coast (Hancock, Harrison and Jackson Counties) as depicted in Figure 2-10. The DWH Oil Spill caused injuries to Mississippi's nearshore marine ecosystem, including interrelated and biologically diverse habitats such as estuarine coastal wetland complexes, beaches and dunes, barrier islands, submerged aquatic vegetation (SAV), oyster reefs, and shallow unvegetated areas (see PDARP/PEIS Section 4.6.1.1 Ecological Description, p. 4-292). Injuries were detected over a range of species, communities, and habitats, affecting a wide variety of ecosystem components (PDARP/PEIS Section 4.6.9). The restoration approach is to restore oyster reef habitat. The proposed technique is to enhance oyster reef productivity through spawning stock enhancement projects such as planting hatchery raised oysters, relocating wild oysters to restoration sites, establishing oyster gardening programs, and other similar projects. Objectives outlined in this proposed project include the development of a community, volunteer-based oyster gardening program that would grow sub-adult oyster from spat on shell stock that would then be transferred to designated areas in coastal MS waters that are not open to oyster harvesting. The proposed MSOGP would be managed by MDEQ with the assistance of two partners: Mississippi Department of Marine Resources (MDMR) and Mississippi-Alabama Sea Grant Consortium (MASGC).

The proposed funding for the MSOGP would cover program operations to coordinate with volunteers, distribute basket materials, and collect oysters, and other activities associated with the following project objectives:

1. Retain approximately fifty volunteer oyster gardeners for the duration of the program (existing, NFWF-GEBF funded program ramped up from zero to thirty volunteers in year one, to about fifty in years 2 to 5).
2. Produce approximately 1,000 sub-adult oysters per site per year.
3. Produce approximately 210,000 sub-adult oysters (based on estimates) over the five-year life of the proposed project, enough for a 20 oyster per square meter density across approximately 3 acres.

2.5.2.4.1 Project Methodology and Timing

MDEQ would be the Implementing Trustee. The project would be implemented over a 5-year timeframe. Short and long-term maintenance would include regular maintenance of hanging gardens (fabricated cages) by the volunteer gardeners. Volunteer gardeners would clean the gardens every seven to ten days by pulling them out of the water and rinsing off mud, algae and any other fouling material. After visually inspecting the gardens and removing predators, such as blue crabs, stone crabs and oyster drills, the gardeners would return the gardens to the water.

2.5.2.4.2 Project Monitoring

Project monitoring is described in the Monitoring and Adaptive Management Plan for the Mississippi Oyster Gardening Program (Appendix D).

2.5.2.4.3 Cost

The estimated costs are $500,000 and include planning, compliance, engineering, permitting, implementation, monitoring, maintenance, and oversight.

3.0 OPA EVALUATION OF RESTORATION ALTERNATIVES

The MS TIG has identified a reasonable range of alternatives consistent with the OPA NRDA regulations (15 C.F.R. § 990.53(a) (2)). The OPA NRDA regulations (15 C.F.R. § 990.54) provide criteria the MS TIG used to evaluate the reasonable range of alternatives. This chapter includes the MS TIG's evaluation of the reasonable range of alternatives in accordance with the OPA NRDA regulations, which include:

- **Trustees' goals and objectives.**—The MS TIG evaluates the extent to which each alternative is expected to meet the MS TIG's goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses. This encompasses the PDARP/PEIS goals and approaches for each resource type considered in this restoration plan as well as restoration goals tailored to Mississippi by the MS TIG and, where available, information provided by the MS TIG. Under this criterion, the focus is on each restoration alternative's nexus to the relevant injuries as described in the PDARP/PEIS, and the nature, magnitude, and impact of the ecological and other natural resource benefits that the alternative is expected to provide the public.
- **Cost to carry out the alternative**.—The MS TIG considered whether the full costs of the alternative over the life of the project (including restoration, training, associated studies, staffing, E&D, construction, management, monitoring, maintenance, and contingency) are clearly specified and described. In addition, the analysis determines whether the costs of the alternative are reasonable, appropriate, and comparable to other equivalent restoration alternatives.
- **Likelihood of success of each alternative**.—The MS TIG considered factors bearing on an alternative's likelihood of success as part of their decision about whether to recommend an alternative for implementation.
- **Prevents future injury and avoids collateral injury**.—Consistent with OPA NRDA regulations, the MS TIG evaluated the extent to which each alternative would prevent future injury as a result of the incident and/or avoid collateral injury as a result of implementing the alternative.
- **Benefits more than one natural resource and/or service.—**The MS TIG evaluated whether proposed alternatives convey multiple ecosystem service benefits.
- **Effects on public health and safety.**—The MS TIG considered whether any aspects of the alternative could affect public health and safety.

3.1 WETLANDS, COASTAL, AND NEARSHORE HABITATS

3.1.1 Overview of Restoration Goals and Approaches

For WCNH restoration, the MS TIG developed a reasonable range of alternatives based on the following goals and objectives derived from the PDARP/PEIS (Section 5.5.2) and MS TIG-specific considerations:

- Restore a variety of interspersed and ecologically connected coastal habitats in each of the five Gulf states to maintain ecosystem diversity, with particular focus on maximizing ecological functions for the range of resources injured by the spill, such as oysters, estuarine-dependent fish species, birds, marine mammals, and nearshore benthic communities.
- Restore for injuries to habitats in the geographic areas where the injuries occurred, while considering approaches that provide resiliency and sustainability.
- While acknowledging the existing distribution of habitats throughout the Gulf of Mexico, restore habitats in appropriate combinations for any given geographic area. Consider design factors, such as connectivity, size, and distance between projects, to address injuries to the associated living coastal and marine resources and restore the ecological functions provided by those habitats.

The WCNH alternatives include the following restoration approaches and techniques identified in the PDARP/PEIS.

Approach: Create, Restore, and Enhance Coastal Wetlands

Technique: Restore hydrologic connections to enhance coastal habitats

Approach: Protect and Conserve Marine, Coastal, Estuarine, and Riparian Habitats

Technique: Develop and implement management actions in conservation areas and/or restoration projects

The remainder of this section provides OPA analysis for the three individual WCNH projects included in the reasonable range of alternatives, with specific reference to each evaluation criterion.

3.1.2 Wolf River Coastal Preserve Habitat Management-Dupont Tract and Bell's Ferry Tract

3.1.2.1 Project Summary

The Wolf River Coastal Preserve is a 2,500-acre area located near the confluence of the Wolf River with St. Louis Bay which is managed by the MDMR CPP. Management activities would include prescribed fire, chemical treatment, mechanical treatment, hydrologic restoration, road repair, culvert replacement, and prescribed grazing (Bell's Ferry Tract only). The full project description is included in Chapter 2.0.

3.1.2.2 The extent to which each alternative is expected to meet the MS TIG's goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses

Implementation of the alternative would support the MS TIG's WCNH goal of restoring ecologically connected coastal habitats with a focus on maximizing ecological function because this site is directly adjacent to St. Louis Bay and contains a habitat continuum that grades from salt marshes to coastal freshwater wetlands and upland buffer communities. Objectives outlined in this alternative include restoring priority habitats through actions including implementation of management plans/invasive species management and enhancement of hydrologic connectivity. Habitat management plans provide guidance on ways to improve the overall condition of a receiving water body (i.e. St. Louis Bay/Mississippi Sound) by restoring land cover and enhancing hydrologic connectivity. Management activities are expected to improve the form and function of habitats at the project site, which is expected to contribute to the PDARP goals.

3.1.2.3 Cost to carry out the alternative

The estimated cost is reasonable and is comparable to previous restoration efforts. Costs were based on recent restoration measures and management activities on Mississippi CP including prescribed fire, mechanical treatment, and chemical treatment. Costs for road repair and culvert replacement (fire infrastructure/ hydrologic connectivity) are based on preliminary conceptual designs which would be refined during engineering and design. A prescribed grazing pilot area component would include fencing of several acres; estimates were based on construction estimates per linear foot. Further, since the State of Mississippi already owns the lands, there are no costs associated with acquisition to accomplish the management activities.

3.1.2.4 Likelihood of success

The MS TIG anticipates this alternative would have a high likelihood of success. Restoration measures and management activities have been successfully implemented on similar habitats within the Mississippi CP, such as the Grand Bay National Estuarine Research Reserve/National Wildlife Refuge (NERR/NWR), the Sandhill Crane NWR, and other locations in coastal counties in Mississippi. Prescribed grazing using Pineywoods cattle would be conducted as a pilot area component. Prescribed grazing could provide benefits similar to other restoration measures and has been used successfully in similar environmental settings. Studies have shown an increase in species richness and a decrease in leaf-litter cover when sites were introduced to prescribed grazing.[20]

3.1.2.5 Prevents future injury and avoids collateral injury

The MS TIG does not anticipate collateral natural resource injuries to result from implementing the alternative. Restoration measures and management activities would restore land cover, enhance hydrologic connectivity, control invasive species, increase floral and faunal species

[20] Albin, L. Tyler, "Restoring the Longleaf Pine (Pinus palustris) Forests Using Pineywoods Cattle Grazing in Conjunction with Prescribed Burning (2014). Honors Theses. 257. http://aquila.usm.edu/honors_theses/257

diversity, enhance provisions for wildlife/birds, and enhance habitat for potential marsh migration providing for greater habitat resiliency in the event of a future spill. To minimize impacts to soil, prescribed grazing would be monitored and the intensity, frequency, timing and duration of grazing would be adjusted to meet the objectives for the plant communities and the associated resources, including the grazing animal.[21] Best management practices would be implemented to avoid collateral injury.

3.1.2.6 Benefits more than one natural resource/service

This alternative would provide multiple resource benefits to the Wolf River Coastal Preserve, and improve the overall condition of the tract and the receiving water body (St. Louis Bay) by providing a wide array of WCNH benefits including restoring land cover, enhancing hydrologic connectivity, controlling invasive species, increasing floral and faunal species diversity, enhancing provisions for wildlife/birds, and enhancing habitat for potential marsh migration, which would continue to support the myriad benefits that marsh provides as forage habitat, protective cover, and spawning habitat for a variety of marine and terrestrial species.

3.1.2.7 Effects on public health and safety

The alternative is not expected to negatively affect public health and safety. Public health and safety risks that could arise from prescribed fire, mechanical treatment, and chemical treatment would be mitigated by using standard safety procedures during the execution of these restoration measures and management activities (e.g. burn plans, public notification). Road repair and culvert replacement would provide increased public safety during recreational access to the tract. Pineywoods cattle used for prescribed grazing would be fenced to protect public health and safety. Further evaluation is included in Section 4.4.5.

3.1.3 Hancock County Marsh Coastal Preserve Habitat Management-Wachovia Tract

3.1.3.1 Project Summary

The Hancock County Coastal Preserve-Wachovia Tract is a 1,203-acre area located south of I-10, east of the Pearl River, and west of the Possum Walk Trail which is managed by the MDMR CPP. MDMR CPP has initiated management activities on the Hancock County Coastal Preserve-Wachovia Tract under the Invasive Species Management on Coastal State Land Project, which was funded by the NFWF GEBF. The alternative would continue the funding for extended management activities on the Wachovia Tract after NFWF GEBF funds run out, including chemical treatment, prescribed fire, and mechanical clearing. The full project description is included in Chapter 2.0.

[21] 2017. USDA Natural Resources Conservation Service. Conservation Practice Standard Prescribed Grazing Code 528 (Ac) https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1255132.pdf

3.1.3.2 The extent to which each alternative is expected to meet the MS TIG's goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses

Implementation of the alternative would accomplish the MS TIG's goal of restoring ecologically connected coastal habitats with a focus on maximizing ecological function. Objectives for this alternative include restoring priority habitats through actions including implementation of management plans and invasive species management.

3.1.3.3 Cost to carry out the alternative

The estimated cost is reasonable and is comparable to previous restoration efforts. Estimated costs were based on recent restoration measures and management activities on Mississippi CP and include prescribed fire, mechanical treatment, and chemical treatment.

3.1.3.4 Likelihood of success

The MS TIG anticipates this alternative would have a high likelihood of success. Restoration measures and management activities (prescribed fire, mechanical treatment, and chemical treatment) have been routinely implemented and monitored on similar habitats within the Mississippi CP, at the Grand Bay NERR/NWR, on the Sandhill Crane NWR, and at other locations in coastal counties in Mississippi. The Wachovia Tract is adjacent to the south of I-10. Risk that could arise from prescribed fire would be mitigated by using standard safety procedures during the execution of these restoration measures and management activities (e.g. prescribed fire plans, public notification).

3.1.3.5 Prevents future injury and avoids collateral injury

The MS TIG does not anticipate collateral natural resource injuries to result from implementing the alternative. Restoration measures and management activities would restore land cover, enhance hydrologic connectivity, control invasive species, increase floral and faunal species diversity, enhance provisions for wildlife/birds, and enhance habitat for potential marsh migration providing for greater habitat resiliency in the event of a future spill. Best management practices would be implemented to avoid collateral injuries (see Chapter 4).

3.1.3.6 Benefits more than one natural resource/service

This alternative would provide a wide array of WCNH benefits including restoring land cover, enhancing hydrologic connectivity, controlling invasive species, increasing floral and faunal species diversity, enhancing provisions for wildlife/birds, and enhancement of habitat for potential marsh migration, which would continue to support the myriad of benefits that marsh provides as forage habitat, protective cover, and spawning habitat for a variety of marine and terrestrial species.

3.1.3.7 Effects on public health and safety

Implementation of the alternative is not expected to negatively affect public health and safety. Public health and safety risks that could arise from prescribed fire, mechanical treatment, and chemical treatment would be mitigated by using standard safety procedures during the execution

of these restoration measures and management activities (e.g. prescribed fire plans, public notification). Further evaluation is included in Section 4.4.5.

3.1.4 Pascagoula River Coastal Preserve-Dantzler Tract

3.1.4.1 Project Summary

The Pascagoula River Coastal Preserve-Dantzler Tract consists of approximately 426 acres of brackish marsh and pine savanna/flatwoods. This alternative includes restoration of 328 acres of severely degraded wet pine savannah to the west of the large Pascagoula River Marsh. Measures required to restore hydrology and natural vegetative habitat to the Dantzler site include removal of existing hurricane debris and sedimentation, filling drainage ditches, road removal, control of non-native species, and controlled burning. The full project description is included in Chapter 2.0.

3.1.4.2 The extent to which each alternative is expected to meet the MS TIG's goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses

Implementation of the alternative would accomplish the MS TIG's WCNH goal of restoring ecologically connected coastal habitats with a focus on maximizing ecological function. Objectives outlined in this alternative include restoring priority habitats through actions including implementation of management plans and invasive species management. Habitat management plans provide guidance on ways to improve the overall condition of a receiving water body (i.e. Pascagoula River/Mississippi Sound).

3.1.4.3 Cost to carry out the alternative

The estimated cost is reasonable and is comparable to previous restoration efforts. Estimated costs were based on recent restoration measures and management activities on Mississippi CP including prescribed fire, mechanical treatment, and chemical treatment.

3.1.4.4 Likelihood of success

Restoration measures and management activities (prescribed fire, mechanical treatment, and chemical treatment) have been routinely implemented and monitored on similar habitats within the Mississippi CP, such as the Grand Bay NERR/NWR, the Sandhill Crane NWR, and other locations in coastal counties in Mississippi. The MS TIG anticipates successful restoration at the Dantzler Tract. There are currently two logistical impediments that could affect implementation of the alternative 1) tree density in the primary management units and the need to harvest timber before restoration components are implemented and 2) the proximity of the tract to urban development near this CP, which could affect implementation of prescribed fire activities. Implementation of the alternative would restore appropriate WCNH using similar restoration techniques described in other alternatives.

3.1.4.5 Prevents future injury and avoids collateral injury

The MS TIG does not anticipate collateral natural resource injuries to result from implementing the alternative. Restoration measures and management activities would restore land cover, enhance hydrologic connectivity, control invasive species, increase floral and faunal species diversity, enhance provisions for wildlife/birds, and enhance habitat for potential marsh migration providing for greater habitat resiliency in the event of a future spill. Best management practices would be implemented to avoid collateral injuries.

3.1.4.6 Benefits more than one natural resource/service

This alternative would provide multiple resource benefits to the Pascagoula River Coastal Preserve and improve the overall condition of the tract and the receiving water body (Pascagoula Bay and the Mississippi Sound) including a wide array of WCNH benefits such as restoring land cover, enhancing hydrologic connectivity, controlling invasive species, increasing floral and faunal species diversity, enhancing provisions for wildlife/birds, and enhancing habitat for potential marsh migration, which would continue to support the myriad of benefits that marsh provides as forage habitat, protective cover, and spawning habitat for a variety of marine and terrestrial species.

3.1.4.7 Effects on public health and safety

Implementation of the alternative is not expected to negatively affect public health and safety. Public health and safety risks that could arise from prescribed fire, mechanical treatment, and chemical treatment would be mitigated by using standard safety procedures during the execution of these restoration measures and management activities (e.g. prescribed fire plans, public notification). Further evaluation is included in Section 4.4.5.

3.2 OYSTERS

3.2.1 Overview of Restoration Goals and Approaches

For Oysters restoration, the MS TIG developed a reasonable range of alternatives based on the following goals and objectives derived from the PDARP/PEIS (Section 5.5.9) and MS TIG-specific considerations:

- Restore oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs;
- Restore resilience to oyster populations that are supported by productive larval source reefs and sufficient substrate in larval sink areas to sustain reefs over time; and
- Restore a diversity of oyster reef habitats that provide ecological functions for estuarine-dependent fish species, vegetated shoreline and marsh habitat, and nearshore benthic communities.

The reasonable range of alternatives supports the following restoration approach and techniques identified in the PDARP/PEIS.

Approach: Restore Oyster Reef Habitat

Technique: Restore or create oyster reefs through placement of cultch in nearshore and subtidal areas

Technique: Develop a network of oyster reef spawning reserves

Technique: Enhance oyster reef productivity through spawning stock enhancement projects such as planting hatchery-raised oysters, relocating wild oysters to restoration sites, oyster gardening programs, and other similar projects

The remainder of this section provides OPA analysis for Oyster restoration alternatives advanced to the reasonable range of alternatives, with specific reference to each evaluation criterion.

3.2.2 Oyster Spawning Reefs in Western Mississippi

3.2.2.1 Project Summary

The proposed project would include the restoration or creation of a minimum of 100 acres and a maximum of 400 + acres of high-relief cultch placements in up to three locations in the Mississippi Sound and areas including St. Louis Bay, Heron Bay, and Back Bay/Biloxi Bay in Hancock and Harrison Counties. This project includes the possibility of placement of more than 400 acres where it is feasible, depending on engineering and design, costs, and other considerations. It is estimated that, historically, greater than 6,400 acres of oyster reefs occurred in the locations that encompass the Oyster Spawning Reefs in Western Mississippi project area. A full description of the proposed project is included in Chapter 2.0.

3.2.2.2 The extent to which each alternative is expected to meet the MS TIG's goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses

This alternative meets the MS TIG's Goals for Oysters by restoring oyster abundance and spawning stock to support a regional oyster larval pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs and enhancing survivorship. The alternative would restore up to 400 acres of high-relief reef in the vicinity of the largest existing and historic reefs. A high proportion of these 400 acres would be in non-harvestable zones and sited to have the most benefit, via larval transport, to reefs in the vicinity.

3.2.2.3 Cost to carry out the alternative

The costs, including cultch placement, were estimated based on prior experience with similar types of projects. The MS TIG reviewed these estimated costs and found them to be reasonable and comparable to previous restoration efforts that planned for higher relief (1ft. and greater), targeted cultch placement in nearshore areas.

3.2.2.4 Likelihood of success

This alternative would have a reasonable likelihood of successfully developing productive oyster spawning reefs and meeting the MS TIG goals and objectives related to oyster restoration. Strategic siting of reefs based on recently collected water quality, hydrodynamic, and oyster larval dispersal models along with substrate suitability data, would guide site selection to

increase the likelihood of success. In addition, monitoring data from previous restoration projects would be used in the planning, siting, and engineering of cultch placements.

3.2.2.5 Prevents future injury and avoids collateral injury

The MS TIG does not anticipate collateral injuries to result from implementation of the alternative. The construction of spawning reefs would increase the resilience of the oyster resource in the event of a future injury. Best management practices would be implemented to prevent collateral injuries.

3.2.2.6 Benefits more than one natural resource/service

Oysters are an ecological keystone species. Restoration of oyster reefs through cultch placement provides multiple resource benefits. Cultch placement has the potential to benefit the health of Mississippi's coastal and estuarine ecosystems, provides habitat for a diversity of marine organisms, provides structural integrity to reduce shoreline erosion, and also improves water quality. In addition, oysters and their associated habitat provide an ecosystem service delivery in estuarine systems in Mississippi. Benefits include enhancing estuarine biodiversity as a hard substratum for epi-biotic invertebrates; increasing areal production of fish and invertebrates; and, as mentioned previously, improving water quality by removing suspended sediments and microalgae, and thus, stimulating denitrification (MDEQ-NFWF, 2016).

3.2.2.7 Effects on public health and safety

Implementation of the alternative is not expected to negatively affect public health and safety. As described in Chapter 5, actions are not expected to result in any impacts to public health and safety described in PDARP/PEIS Table 6.3-2. Public health and safety risks that could arise from deployment of cultch would be mitigated by using standard safety procedures including notification to MDMR Marine Patrol, notification to mariners, installation of temporary buoys and lighting, and observing oyster reef work safety practices. The alternative would involve creation of high-relief reefs in areas that are currently used for recreational and commercial boating. However, installation of navigational markers and mapping of reefs on Coast Guard Navigational Maps would be a post-installation practice where applicable.

3.2.3 Oyster Spawning Reefs in Eastern Mississippi

3.2.3.1 Project Summary

The proposed project would include the restoration or creation of a minimum of 100 acres and a maximum of 400 + acres of high-relief cultch placements in up to six locations in the Mississippi Sound and areas including St. Louis Bay, Heron Bay, Back Bay/Biloxi Bay, Graveline Bay, Pascagoula Bay, and Grand Bay in Harrison, and Jackson Counties. This project includes the possibility of placement of more than 400 acres where it is feasible, depending on engineering and design, costs, and other considerations. It is estimated that, historically, greater than 1,500 acres of oyster reefs occurred in the locations that encompass the Oyster Spawning Reefs in Mississippi project area. A full description of the proposed project is included in Chapter 2.0.

3.2.3.2 The extent to which each alternative is expected to meet the MS TIG's goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses

This alternative meets the MS TIG's Oysters restoration goals by restoring oyster abundance and spawning stock to support a regional oyster larval pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs and enhancing survivorship. Implementation of the alternative would restore resilience to oyster populations which are supported by productive larval source reefs. The alternative would provide substrate in larval sink areas to sustain reefs over time. The alternative would restore up to 400 acres of high-relief reef in the vicinity of existing and historic reefs.

3.2.3.3 Cost to carry out the alternative

The estimated costs were estimated based on prior oyster restoration experience of the MS TIG which included cultch placement. The proposed project is intended to provide funding for siting reefs in the most suitable substrates, in priority locations, using construction methods that would allow for the greatest probability of oyster survival. The MS TIG reviewed these estimated costs and found them to be reasonable and comparable to previous restoration efforts.

3.2.3.4 Likelihood of success

The MS TIG anticipates a reasonable likelihood of success for this alternative. Strategic siting of reefs based on recently collected water quality, hydrodynamic, and oyster larval dispersal models, as available and substrate suitability data, would guide site selection to increase the likelihood of success. In addition, monitoring data from previous projects would be used in the planning, siting, and engineering of cultch placements. The reefs would be designed to take into account the key factors that are known to affect the success of settlement and growth of oysters. While this alternative is located adjacent to existing and historic reefs, it is estimated that historically 1,510 acres of current and historic oyster reef footprint occur in Oyster Spawning Reefs in Eastern Mississippi project area as compared to 5,552 acres in the Oyster Spawning Reefs in Western Mississippi project area.

3.2.3.5 Prevents future injury and avoids collateral injury

The MS TIG does not anticipate collateral natural resource injuries to result from implementation of the alternative. The construction of spawning reefs would increase the resilience of the oyster resource in the event of a future injury. Best management practices would be implemented to avoid collateral injuries.

3.2.3.6 Benefits more than one natural resource/service

Oysters are an ecological keystone species and successful restoration of oyster reefs through improved survivorship would provide habitat for a diversity of marine organisms, provide structural integrity to reduce shoreline erosion, and improve water quality. Cultch placement for the development of oyster spawning reefs provide multiple resource benefits and have the potential to benefit the health of Mississippi's coastal and estuarine ecosystems, providing habitat for a diversity of marine organisms, structural integrity to reduce shoreline erosion, and

improving water quality. In addition, oysters and their associated habitat provide an ecosystem service delivery in estuarine systems in Mississippi. Benefits include enhancing estuarine biodiversity as a hard substratum for epi-biotic invertebrates; increasing areal production of fish and invertebrates; and, as mentioned previously, improving water quality by removing suspended sediments and microalgae, and thus, stimulating denitrification (MDEQ-NFWF, 2016).

3.2.3.7 Effects on public health and safety

Implementation of the alternative is not expected to negatively affect public health and safety. As described in Chapter 5, actions are not expected to result in any impacts to public health and safety described in PDARP/PEIS Table 6.3-2. Public health and safety risks that could arise from deployment of cultch would be mitigated by using standard safety procedures including notification to MDMR Marine Patrol, notification to and mariners, temporary buoys, lighting, and observance of oyster reef work safety practices. The alternative would involve creation of high-relief reefs in areas that are currently used for recreational and commercial boating. However, installation of navigational markers and mapping of reefs on Coast Guard Navigational Maps would be a post-installation practice where applicable.

3.2.4 Oyster Spawning Reefs in Mississippi

3.2.4.1 Project Summary

The proposed project would include the restoration or creation of a minimum of 100 acres and a maximum of 400 + acres of high-relief cultch placements in up to six locations in the Mississippi Sound and areas including St. Louis Bay, Heron Bay, Back Bay/Biloxi Bay, Graveline Bay, Pascagoula Bay, and Grand Bay in Hancock, Harrison, and Jackson Counties. This project includes the possibility of placement of more than 400 acres where it is feasible, depending on engineering and design, costs, and other considerations. It is estimated that, historically, greater than 7,000 acres of oyster reefs occurred in the locations that encompass the Oyster Spawning Reefs in Mississippi project area. A full description of the proposed project is included in Chapter 2.0.

3.2.4.2 OPA Evaluation for Oyster Spawning Reefs in Mississippi

The OPA evaluation for Oyster Spawning Reefs in Mississippi the same as the OPA evaluations described in Sections 3.2.2 and 3.2.3, except that this larger project area would provide more potential to restore oyster productivity/spawning habitat across a broader geographic range than the Oyster Spawning Reefs in Western Mississippi or Oyster Spawning Reefs in Eastern Mississippi.

3.2.5 Mississippi Oyster Gardening Program

3.2.5.1 Project Summary

This Mississippi Oyster Gardening Program (MSOGP) would be a continuation of the NFWF-GEBF funded project and continued over a five-year period utilizing volunteers along the Mississippi Gulf Coast to grow sub-adult oysters in gardens from spat on shell stock that hang

from waterfront piers/wharves and docks, which would then be transferred to designated areas in coastal MS waters. The MSOGP would be managed by MDEQ with the assistance of two partners: MDMR and Mississippi-Alabama Sea Grant Consortium (MASGC). The full project description is provided in Chapter 2.0.

3.2.5.2 The extent to which each alternative is expected to meet the MS TIG's goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses

This alternative meets the MS TIG's goals for oyster restoration by restoring oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs and enhanced survivorship.

3.2.5.3 Cost to carry out the alternative

These estimated costs were developed based on prior restoration experience of the MS TIG through the current Mississippi Oyster Gardening Program funded by NFWF GEBF. The MS TIG reviewed these estimated costs and found that them to be reasonable and comparable to previous restoration efforts.

3.2.5.4 Likelihood of success

The MS TIG anticipates a reasonable likelihood of success for this alternative. The current NFWF GEBF oyster gardening project, of which this effort would be an extension, exhibited high participation rates, which is an indicator of success. Currently, estuarine waters in Mississippi are open to oyster gardening activities; therefore, there are no existing barriers that would limit the continued expansion of this program throughout Coastal Mississippi. The high participation rate is not anticipated to change. Additionally, the program has seen successful cultivation of oysters at numerous sites.

3.2.5.5 Prevents future injury and avoids collateral injury

The MS TIG does not anticipate collateral natural resource injuries to result from implementing the alternative and anticipates minimal environmental impacts. Oyster gardening would increase the resilience of the oyster resource in the event of a future injury.

3.2.5.6 Benefits more than one natural resource/service

Oysters are an ecological keystone species and success through improved survivorship would provide habitat for a diversity of marine organisms and improve water quality, even at the scale of a gardening program. The educational and community engagement benefits provide both short-term and long-term value by providing an increased understanding of the ecological and cultural importance of oyster resources in Mississippi.

3.2.5.7 Effects on public health and safety

Implementation is not expected to negatively affect public health and safety. As described in Chapter 5, actions are not expected to result in any impacts to public health and safety described

in PDARP/PEIS Table 6.3-2. Oyster gardening would occur on piers and docks and not propose risks to recreational boaters.

3.3 PREFERRED AND NON-PREFERRED ALTERNATIVES

In Table 1-2, the MS TIG identifies the proposed action, which is implementation of the preferred restoration alternatives, i.e., those alternatives that are proposed to be selected for Restoration Type funding in this Draft RPII/EA (Table 1-2). Table 3-1 identifies the alternatives which have been identified as preferred and the alternatives which have been identified as non-preferred. Non-preferred alternatives in this Draft RPII/EA may be considered in future restoration planning.

Table 3-1. Preferred and Non-Preferred Alternatives

Alternative	Preferred/Non-Preferred	Rationale if not Preferred	Project Cost[22]
Wetlands, Coastal, and Nearshore Habitats			
Wolf River Coastal Preserve Habitat Management-Dupont Tract and Bell's Ferry Tract	Preferred		$3,127,500
Hancock County Coastal Preserve Habitat Management-Wachovia Tract	Preferred		$1,760,000
Pascagoula River Coastal Preserve Habitat Management-Dantzler Tract	Non-Preferred	Project would restore appropriate WCNH using similar restoration techniques as proposed preferred alternatives. However, MDMR is attempting to complete timber sales prior to implementation of restoration management actions.	$1,190,000
No Action/Natural Recovery	Non-Preferred	Recovery would take much longer compared to restoration actions, and the interim losses of natural resources would not be compensated under a "no-action" alternative. Technically feasible restoration approaches are available to compensate for interim natural resource and service losses.[23]	$0
Oysters			
Oyster Spawning Reefs in Mississippi	Preferred		$10,000,000
Oyster Spawning Reefs in Western Mississippi	Non-Preferred	Project would restore oysters using similar restoration techniques as the proposed preferred alternative; however, limiting the project area to the Western Mississippi Sound does not provide full potential to restore oyster productivity/spawning habitat across a broader geographic range.	$10,000,000
Oyster Spawning Reefs in Eastern Mississippi	Non-Preferred	Project would restore oysters using similar restoration techniques as proposed preferred alternative; however, limiting the project area to the Eastern Mississippi Sound does not provide full potential to restore oyster productivity/spawning habitat across a broader geographic range.	$10,000,000
Mississippi Oyster Gardening Program	Preferred		$500,000
No Action/Natural Recovery	Non-Preferred	Recovery would take much longer compared to restoration actions, and the interim losses of natural resources would not be compensated under a "no-action" alternative. Technically feasible restoration approaches are available to compensate for interim natural resource and service losses.[24]	$0

[22] Costs for non-preferred alternatives were based on limited project development and may need refinement in future plans if the alternative is selected for implementation.
[23] PDARP/PEIS Section 5.8.2
[24] PDARP/PEIS Section 5.8.2

4.0 NEPA AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES FOR WCNH ALTERNATIVES

4.1 INTRODUCTION

This chapter describes the affected environment and anticipated environmental impacts for all WCNH alternatives for this Draft RPII/EA. The proposed action (the selection of two alternatives for implementation) is summarized in Section 1.4. The MS TIG's preferred projects are Wolf River CP Habitat Management - Dupont and Bell's Ferry Tracts and Hancock County Marshes CP Habitat Management – Wachovia Tract. Section 3.3 provides the rationale based on the OPA evaluation for preferred versus non-preferred alternatives. The analysis of the No Action Alternative is summarized at the end of this chapter for WCNH. Cumulative Impacts for WCNH and Oysters restoration alternatives are summarized in Section 5.8.

4.1.1 Tiering From the PDARP/PEIS

Agencies are encouraged to tier their environmental impact statements to eliminate repetitive discussions on the same issues and to focus on the actual issues ripe for decision at each level of environmental review. Whenever a broad environmental impact statement has been prepared and a subsequent statement or environmental assessment is then prepared on an action included within the entire program or policy, the subsequent statement or environmental assessment need only summarize the issues discussed in the broader statement and incorporate discussions from the broader statement by reference (40 C.F.R 1502.20). The NEPA analysis presented in this chapter is consistent with the PDARP/PEIS and tiers where applicable.

Impacts were assessed in accordance with the impact definitions in the PDARP/PEIS; Table 6.3-2, Appendix A. To determine whether an action has the potential to result in significant impacts, the context and intensity of the action must be considered. Context refers to the area of impacts (e.g., local, statewide) and their duration (e.g., whether they are short- term or long-term impacts). Intensity refers to the severity of an impact and could include the timing of the action. Intensity is also described in terms of whether the impact would be beneficial or adverse. "Adverse" is used in this chapter and Chapter 5 only to describe the federal Trustees' evaluation under NEPA. This term is defined and applied differently in consultations conducted pursuant to the Endangered Species Act (ESA) and other protected resource statutes. For purposes of this document, impacts are characterized as adverse or beneficial; minor, moderate, or major and short-term or long-term. Consistent with the PDARP/PEIS, beneficial impacts are not quantified and are characterized as short and long-term. For resource areas where there is no expected effect from project activities, a "no-impact" conclusion is made.

The MS TIG would consider best practices referenced in Section 6.15 and Appendix 6A of the PDARP/PEIS. Additional best practices may be recommended for site-specific restoration measures and management activities. The MS TIG has completed technical assistance with USFWS and NOAA National Marine Fisheries Service (NMFS) and ESA consultations have

been initiated for the WCNH alternatives. If a project is selected, MDEQ would implement BMPs agreed to during the technical assistance/consultation process.

Incorporation by Reference of Previous NEPA Analyses.—Agencies shall incorporate material by reference when the effect will be to cut down on bulk without impeding agency and public review of the action (40 C.F.R. 1502.21). Incorporation by reference of relevant information from existing NEPA analyses is used in this analysis to avoid redundancy and reduce the bulk of the document. All source documents relied upon for the NEPA analyses are available to the public and links are provided in the discussion of the environmental consequences where applicable. For WCNH projects, this Draft RPII/EA incorporates by reference portions of the Affected Environment and Environmental Consequences from the following documents:

- DWH Trustees. 2017. Mississippi Trustee Implementation Group 2016-2017 Restoration Plan/Environmental Assessment. https://www.fws.gov/doiddata/dwh-ar-documents/1272/DWH-ARZ000488.pdf.
- DWH Trustees. 2014. Deepwater Horizon Oil Spill Final Phase III Early Restoration Plan and Early Restoration Programmatic Environmental Impact Statement. https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/ERP-PEIS-Part-3-Chapter-10-through-Chapter-11.pdf.
- DWH Trustees 2016. Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement (PDARP/PEIS). https://www.fws.gov/doiddata/dwh-ar-documents/1138/Front-Matter-and-Chapter-1_Introduction-and-Executive-Summary_508.pdf.
- DWH Trustees 2016. Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement (PDARP/PEIS). https://www.fws.gov/doiddata/dwh-ar-documents/1138/Chapter-6_Environmental-Consequences_508.pdf.

The MS TIG reviewed incorporated material and finds it to remain relevant and applicable to the current NEPA analysis. Summary of this incorporated material is provided in Section 4.2 Physical Resources, Section 4.3 Biological Resources, Section 4.4 Socioeconomic and Environmental Justice, and Section 4.5 No Action. Adverse impacts from the proposed WCNH projects are expected to fall within the range of impacts identified in the previous NEPA analyses that are incorporated by reference in this RPII/EA. Impacts previously analyzed range from short-term minor to long-term moderate, and no major impacts were concluded, as defined in Table 6.3-2 of the PDARP/PEIS. If any activity proposed in this Draft RPII/EA has not been previously analyzed (e.g. prescribed grazing) or is determined to fall outside of the range of impacts described in the incorporated material, more detailed NEPA analysis is provided.

4.1.2 Resources Not Analyzed in Detail in this Plan For WCNH Alternatives

As appropriate in a tiered analysis, the evaluation of each alternative focuses on site-specific resources with a potential to be affected by the project. To avoid redundant or unnecessary information, resources that are expected to be minimally affected are not evaluated in detail in this Draft RPII/EA. For WCNH projects in this Draft RPII/EA, these resources include noise,

marine and estuarine fauna, infrastructure, fisheries and aquaculture, marine transportation, and aesthetics and visual resources. This Draft RPII/EA incorporates by reference Sections 3.3.1.2, 3.3.1.3, and 3.3.1.4 of the MS TIG RPI/EA which provides the rationale for determining why the resource would be minimally affected. Brief summaries are provided below.

Noise: RPI Section 3.3.1.2 states that "There would be short-term, minor, adverse noise impacts from equipment and operations associated with mechanical treatment, establishment of fire breaks, prescribed fire operations, and road repair/removal and culvert placement."

Marine and estuarine fauna: RPI Section 3.3.1.3 states that "There would be no in-water work. Estuarine marsh would be acquired and preserved, but there are no management activities planned in this habitat in the proposed alternative project area."

Infrastructure: RPI Section 3.3.1.4 states that "There could be short-term, minor impacts from activities associated with mechanical treatment and prescribed fire. Care would be taken to identify infrastructure as part of project planning and prior to implementation or restoration measures. The impacts resulting from road repair/replacement and culvert placement are covered in the site-specific analysis for physical and biological resources, but the proposed activities would not affect public infrastructure."

Fisheries and Aquaculture: RPI Section 3.3.1.4 states that "There would be no activities in open water or estuarine marsh", which is also the case for WCNH projects in this Draft RPII.

Marine Transportation: RPI Section 3.3.1.4 states that "There would be no restoration activity that would occur in open water; the proposed alternative would not have an impact on marine transportation."

Aesthetics and Visual Resources: RPI Section 3.3.1.4 states that "Prescribed fire would result in a change in viewshed. There may be temporary short-term, minor impacts as a result due to presence of smoke. The land may look scorched after a prescribed fire but burn units can revegetate ("green up") within days to weeks, resulting in a viewshed of natural vegetation with increased diversity of flowering plants and fauna. Removal of unmaintained roads and debris would enhance the aesthetic character of the land for the public that utilizes the area."

For more details, see Sections 3.3.1.2, 3.3.1.3, and 3.3.1.4 of the MS TIG RPI/EA.

4.1.3 WCNH Restoration Measures and Management Activities Included in this Analysis

Chemical treatment, mechanical treatment, prescribed fire, road repair and replacement, and prescribed grazing are summarized in Table 4-1. Table 4-1 also includes the frequency, duration and area of impact for restoration measures and management activities and will be referred to throughout the environmental consequences discussion in this chapter. Applicable methodologies for prescribed fire, mechanical, and chemical treatment are described in the Mississippi Trustee Implementation Group 2016-2017 Restoration Plan/Environmental Assessment Section 3.3 and 3.4.

Table 4-1. Restoration Measures and Management Activities for WCNH in this Draft RPII/EA

Restoration Measures and Management Activities	General Description/Nature of Activities	Duration	Area of Impact		
			Wolf River CP HM-Dupont and Bell's Ferry Tracts	Hancock County Marshes CP HM-Wachovia Tract	Pascagoula River Marsh CP HM-Dantzler Tract
Chemical Treatment	Application of herbicides, use of trucks for access, light equipment and access on foot, spraying and hand application of herbicides.	Annually; years 1–10	650 acres	455 acres	326 acres
Mechanical Treatment	Mechanized land clearing to remove non-native material using soft track and/or wide track equipment use in wet areas.	Annually; Years 1–5	460 acres	377 acres	326 acres
Prescribed Fire	Mechanical treatment impacts described above to clear fire lines. Ignition of prescribed fires in 10 to several hundred-acre increments.	every 2–3 years; years 1–10	460 acres	377 acres	326 acres
Prescribed Grazing	Installation of fence posts/fencing; release/removal of cattle in fenced areas. Early growing season grazing (March to May) for 30 – 90 days in years 1 – 5. Herd size would be determined by a professional at the appropriate stocking rate.	Years 1–10	1 – 3 acres	N/A	N/A
Road Repair and Replacement	Appropriate material would be used to bring the roadway to an elevation that would limit flooding. Small track mounted excavators, tandem trucks and small wide track dozers would be used to improve the roadway. Culverts and low water crossing would be installed at waterways and depressions. Clean fill material and geosynthetic materials would be used for roadbed stabilization and reinforcement.	One-time event, of 12–16 months in duration	12,500 ft. (2.4 mi); 10–15 ft in width	N/A	N/A
N/A=Not Applicable					

The affected environment and environmental consequences for the WCNH alternatives are discussed in the following sections as follows:

Section 4.2 Physical Resources
Section 4.3 Biological Resources
Section 4.4 Socioeconomic and Environmental Justice
Section 4.5 No Action
Section 4.6 Comparison of Impacts of the Alternatives for WCNH

The Cumulative impacts for the WCNH and Oysters alternatives are discussed at the end of Chapter 5.0.

4.2 PHYSICAL RESOURCES

Section 6.4.1.5.1 of the PDARP/PEIS describes the impacts to Physical Resources for the relevant restoration approaches and are incorporated by reference and briefly described here.

PDARP/PEIS environmental consequences related to physical resources summarized here.—Specific restoration measures and management activities identified as part of land management plans could result in short-term, minor to moderate adverse impacts on geology, substrates, and water resources. Land management activities may have short-term adverse impacts on soils, substrates, and air quality. Activities could result in short-term, minor to moderate adverse impacts through increased soil compaction, rutting, or erosion caused by human presence and activity within the conservation area.

For WCNH alternatives in this Draft RPII/EA, environmental consequences are within the general range of impacts as described in the PDARP/PEIS (summarized above) with some variances related to specific actions. An exception would be prescribed grazing (Bell's Ferry tract only) which was not evaluated in the PDARP/PEIS and is fully evaluated in this Draft RPII/EA as part of the Wolf River CP Habitat Management – Dupont and Bell's Ferry Tracts project. Table 4-2 is a summary of impacts to the physical environment that would result from the WCNH alternatives.

Table 4-2. Impacts to the Physical Environment from Project Restoration Measures and Management Activities

Resource	Beneficial Impacts	Chemical Treatment	Mechanical Treatment	Prescribed Fire	Prescribed Grazing	Road Repair and Replacement
Geology and Substrates	Long-Term	Short-Term, Minor	Short-Term, Minor to Moderate	Short-Term, Moderate	Short-Term, Minor	Short-Term to Long-Term, Moderate
Hydrology and Water Quality						
Hydrology	Long-Term	Short-Term, Minor	Short-Term, Minor to Moderate	Short-Term, Minor to Moderate	Short-Term, Minor	Short-Term, Moderate
Water Quality	Long-Term	Short-Term, Minor	Short-Term, Minor to Moderate	Short-Term, Minor	Short-Term, Minor	Short-Term, Moderate
Floodplains	Long-Term	No Impact	No Impact	No Impact	No Impact	No Impact
Wetlands	Long-Term	Short-Term, Minor	Short-Term, Minor to Moderate	Short-Term, Minor to Moderate	No Impact	Short-Term, Minor to Moderate
Air Quality and GHG Emissions	N/A	Short-Term, Minor	Short-Term, Minor	Short-Term, Minor to Moderate	No Impact	Short-Term, Minor
N/A=Not Applicable						

4.2.1 Geology and Substrates

4.2.1.1 Affected Environment

Section 3.3.3 of the PDARP/PEIS discusses the geomorphological zones of the northern Gulf of Mexico. The project areas for the alternatives are located within the Gulf Coastal Plain and the

Mississippi Alluvial Plain physiographic regions. Landforms and substrates are generally comprised of Holocene sediments and are similar to geology and substrates described in the Phase III FERP/PEIS for the Restoration Initiatives at INFINITY Science Center Project (Section 10. 5. 6.2) and in the MS TIG RP I/EA for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.2.1) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.2.1).

4.2.1.1.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Surficial soils in the project area consist of Holocene age coastal deposits of loam, sand, gravel, and clay (Schmid and Otvos, 2005). The USDA Natural Resource Conservation Service (NRCS) Web Soil Survey (NRCS, 2019) identifies 14 soil-mapping units within the footprint of the project. These soils include sandy loams, mucky silt loams, and muck ranging from 0 to 8 percent slopes with hydrology regimes ranging from well drained in high relief areas to frequently flooded in low relief areas in estuarine marsh, depressions, and along drainageways.

4.2.1.1.2 Hancock County Marshes CP Habitat Management-Wachovia Tract

Data from the Mississippi State Geological Survey generally indicate that surface soils in the project area consist of Holocene age coastal deposits of loam, sand, gravel, and clay. The USDA NRCS Web Soil Survey (NRCS, 2019) identifies 12 soil-mapping units within the footprint of the project. These soils include sandy loams, silt, silt loams, and mucky silt loams ranging from 0 to 5 percent slopes with hydrology regimes ranging from well drained in high relief areas to frequently flooded in low relief areas in brackish marsh, depressions, and along drainageways.

4.2.1.1.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

Data from the Mississippi State Geological Survey generally indicate that surface soils in the project area consist of Holocene age coastal deposits of loam, sand, gravel, and clay. The USDA NRCS Web Soil Survey (NRCS, 2019) identifies 8 soil-mapping units within the footprint of the project. These soils include loamy sands, sandy loams, silt loams, mucky loams, and muck ranging from 0 to 8 percent slopes with hydrology regimes ranging from well drained in high relief areas to frequently flooded in low relief areas in estuarine marsh, depressions, and along drainageways.

4.2.1.2 Environmental Consequences

Environmental consequences to geology and substrates resulting from the restoration measures and management activities described in Table 4-1 are summarized in this section. MS TIG RPI/EA environmental consequences described for geology and substrates for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.2.1) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.2.1) are incorporated by reference and included in the summary analysis below.

4.2.1.2.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Chemical Treatment, Mechanical Treatment, and Prescribed Fire.—These restoration measures and management activity impacts to geology and substrates would range from short-

term minor to short-term moderate from use of equipment to apply chemicals and to conduct mechanical clearing/prescribed fire operations, particularly in wetter soils. To minimize these impacts, care would be taken in the selection of equipment used and timing of operations, particularly in wetter conditions.

Prescribed Grazing.—Environmental consequences to geology and to substrates for this management activity could include soil compaction and disturbance from the installation of fencing and from the grazing of cattle on the Bell's Ferry tract. Over-grazing could expose the soil surface to erosion. The use of cattle for habitat management would result in a short-term, minor adverse impacts to soils, however it is anticipated that grazing livestock impacts on soil would be generally shallow and transient. To minimize impacts to soil, cattle grazing would be monitored, and the number of cattle and the duration of time cattle are present on site would be adjusted if necessary.

Road Repair and Replacement.—The existing fire infrastructure at the Dupont tract is insufficient for successful habitat management and requires the reestablishment of a suitable "roadway" which would facilitate equipment mobilization. The use of this equipment as described in Table 4-1, would have short-term to long-term moderate impacts to soils from compaction removal and replacement of the topsoil layer. The use of fill material and geosynthetic materials for stabilization and reinforcement would bury native soils in the footprint of the roadway which are already compacted from current vehicle traffic. This would result in a long-term, moderate impact to geology and substrates, but also facilitates long-term beneficial impacts to hydrology and habitats as discussed in other sections. To minimize impacts to soil, project activities would be limited to the existing roadway footprint and staging areas.

4.2.1.2.2 Hancock County Marshes CP Habitat Management-Wachovia Tract

Chemical Treatment, Mechanical Treatment, and Prescribed Fire.—The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.2.1.2.1 for chemical treatment, mechanical treatment, and prescribed fire, ranging from short-term minor to moderate. This alternative does not include prescribed grazing or road repair and replacement.

4.2.1.2.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

Chemical Treatment, Mechanical Treatment, and Prescribed Fire.—The environmental consequences for these restoration measures and management activities (Table 4-1) are similar to those described in Section 4.2.1.2.1 for chemical treatment, mechanical treatment, and prescribed fire, ranging from short-term minor to moderate. This alternative does not include prescribed grazing or road repair and replacement.

4.2.1.2.4 Best Practices

Potential BMPs would be similar to those listed in MS TIG RPI/EA for the Graveline Land Acquisition and Management Project and the Grand Bay Land Acquisition and Habitat Management Project which were described in Section 3.3.1.2.1 and 3.4.1.2.1, respectively, of MS TIG RP I/EA, and are described below:

- Allow revegetation of fire breaks or actively revegetate with native species or annual grasses, if prolonged period of greening up is anticipated.
- Develop and implement spill prevention and response plan, including conducting daily inspections during chemical treatment, mechanical treatment and prescribed fire operations to ensure there are no leaks of antifreeze, hydraulic fluid, pesticides or other substances.
- To the extent practicable, for equipment use in wet areas, soft tracked or wide tracked equipment should be used to distribute the equipment weight and minimize impacts to soils. Alternatively, crews may remove vegetative material with chainsaws.
- Minimize concentrated livestock areas, trailing, and trampling to reduce soil compaction, excess runoff and erosion.[25]
- Plan intensity, frequency, timing and duration of grazing and/or browsing to provide adequate ground cover, litter and canopy to maintain or improve infiltration and soil condition.[26]

4.2.2 Hydrology and Water Quality

4.2.2.1 Affected Environment

Section 3.3.2 of the PDARP/PEIS addresses river flows on the Northern Gulf geography and water quality. Section 6.14.2 discusses future sea level rise, storm surge, and storm intensity projections and is incorporated by reference here. For the alternatives, the affected hydrological resources consist of coastal stream drainageways, estuarine waterbodies, and freshwater and estuarine wetlands. Hydrological and water quality characteristics for Draft RPII/EA alternatives are similar to those described in the Phase III FERP/PEIS for the Restoration Initiatives at INFINITY Science Center Project (Section 10.5.6.3) and in the MS TIG RP I/EA for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.2.2) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.2.2).

4.2.2.1.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Hydrology and Water Quality.—This alternative is in the Mississippi Coastal Streams watershed (HUC 8 – 03170009) (Figure 4-1), which includes portions of Jackson, Hancock, Harrison, Lamar, Pearl River, and Stone counties; however, the project area for this alternative is exclusively in Harrison County. Major waterbodies that flow through or share boundaries with the project area include DeLisle Bayou, Cedar Bayou, Wolf River, and St. Louis Bay. None of these waterbodies are included in the 2018 Mississippi Section 303(d) List of Impaired Water Bodies.

[25] 2017. USDA Natural Resources Conservation Service. Conservation Practice Standard Prescribed Grazing Code 528 (Ac) https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1255132.pdf
[26] 2017. USDA Natural Resources Conservation Service. Conservation Practice Standard Prescribed Grazing Code 528 (Ac) https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1255132.pdf

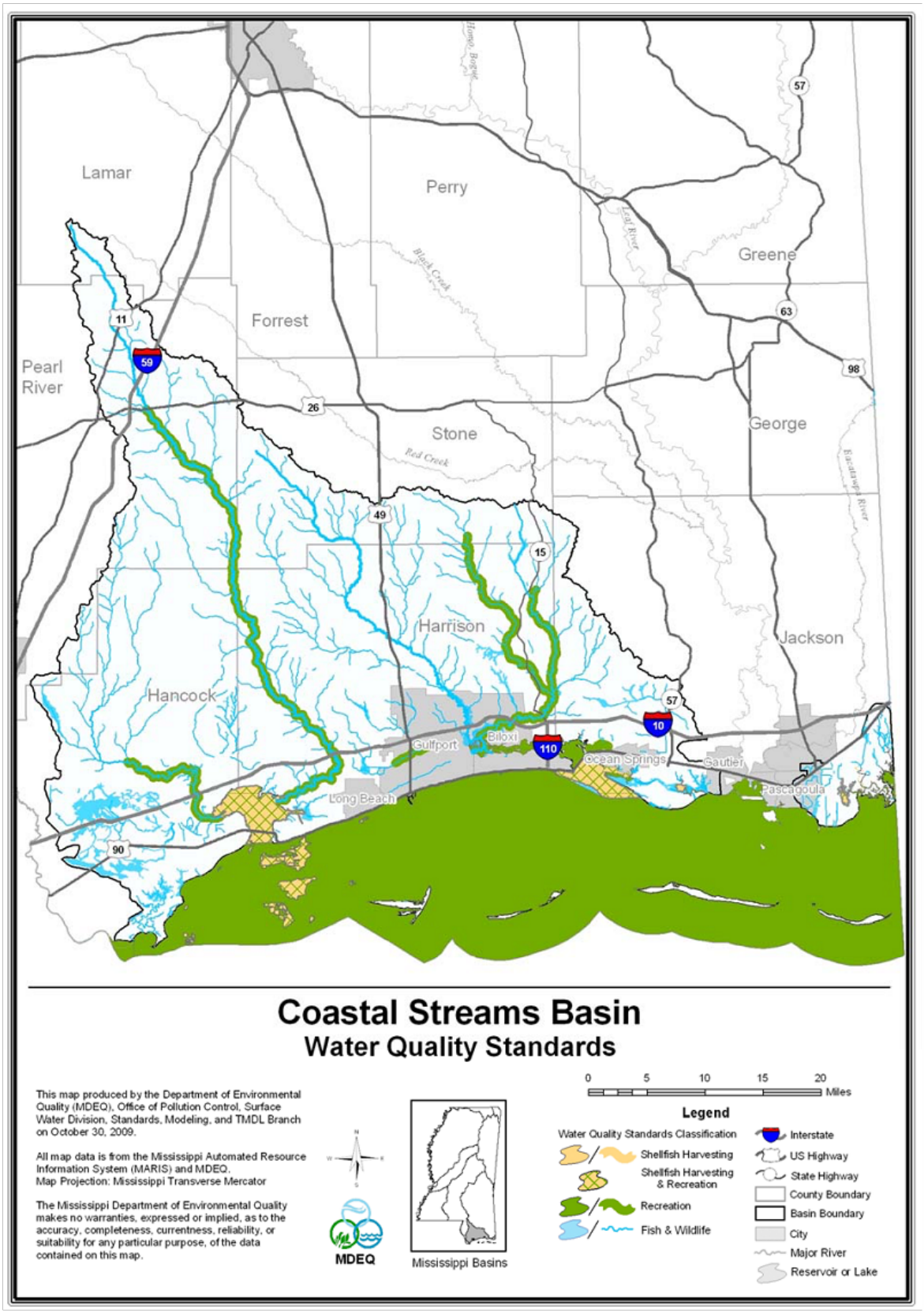


Figure 4-1. Coastal Streams HUC 8 Watersheds and Water Quality Standard Classifications

Floodplains.—A large portion of the project area is mapped as Zone VE (Figure 4-2). Zone VE is defined as Coastal flood zone with velocity hazard. The upper central portion of the project area is in Zone AE, which is defined as "Base Flood Elevations Determined". The northern portion in project area is Zone X. Zone X are defined as "Areas of 0.2% annual change flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood".

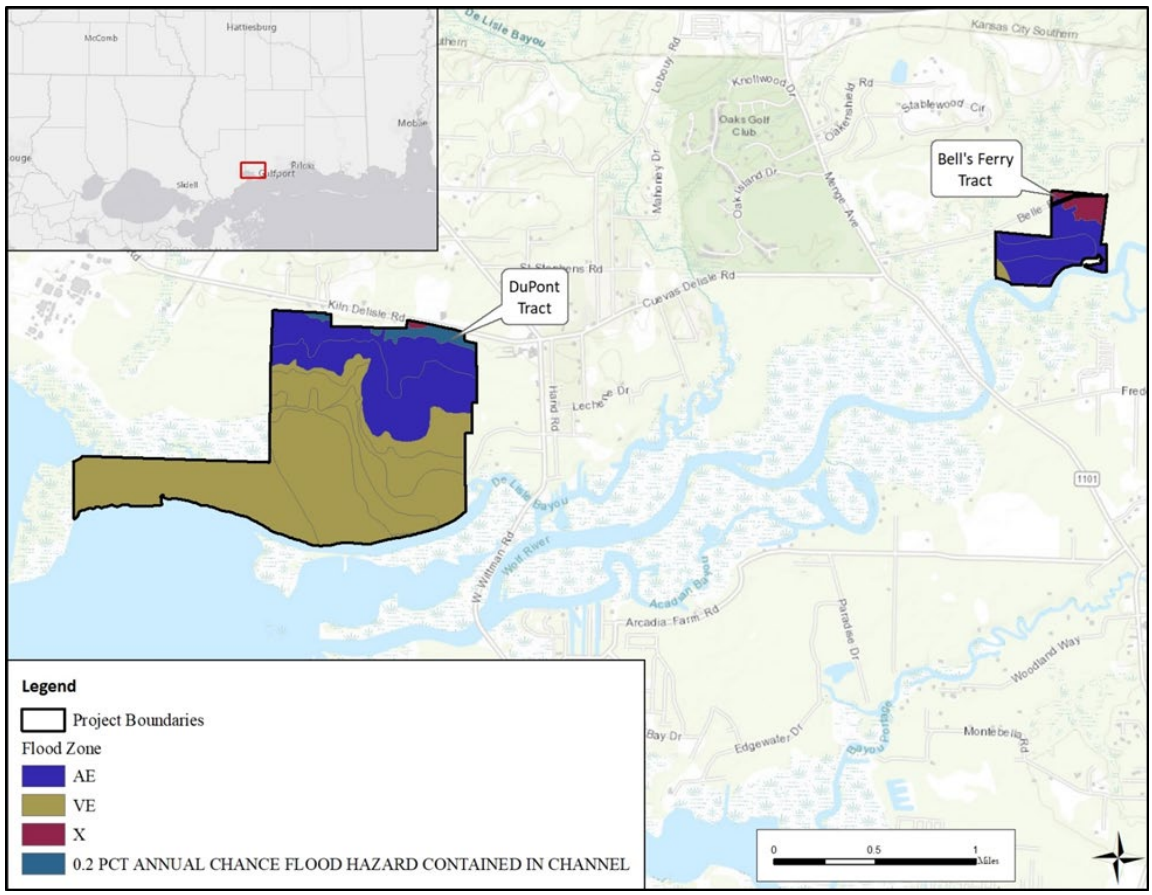


Figure 4-2. Wolf River Coastal Preserve Habitat Management-DuPont and Bell's Ferry Tracts flood zones

Wetlands.—The project area is a mosaic of wetlands and uplands extending from the open water at St. Louis Bay to estuarine marsh and to pine flatwood/savanna and coastal stream drainages (hydric drains) (See Habitats in Section 4.3.1).

4.2.2.1.2 Hancock County Marshes CP Habitat Management-Wachovia Tract

Hydrology and Water Quality.—This alternative is in the Lower Pearl watershed (HUC 8 – 03180004) (Figure 4-3) which includes portions of Hancock, Lamar, Marion, and Pearl River Stone counties; however, the project area for the alternative is exclusively in Hancock County. Major waterbodies that flow or share boundaries with the project area include the Pearl River. Bogue Homa Creek, a small tributary of the Pearl River, runs through the tract. The Pearl River terminates at the western Mississippi Sound approximately twelve miles downstream from the tract. No waterbodies that intersect or are adjacent to the project area are listed on the 2018 Mississippi Section 303(d) List of Impaired Water Bodies.

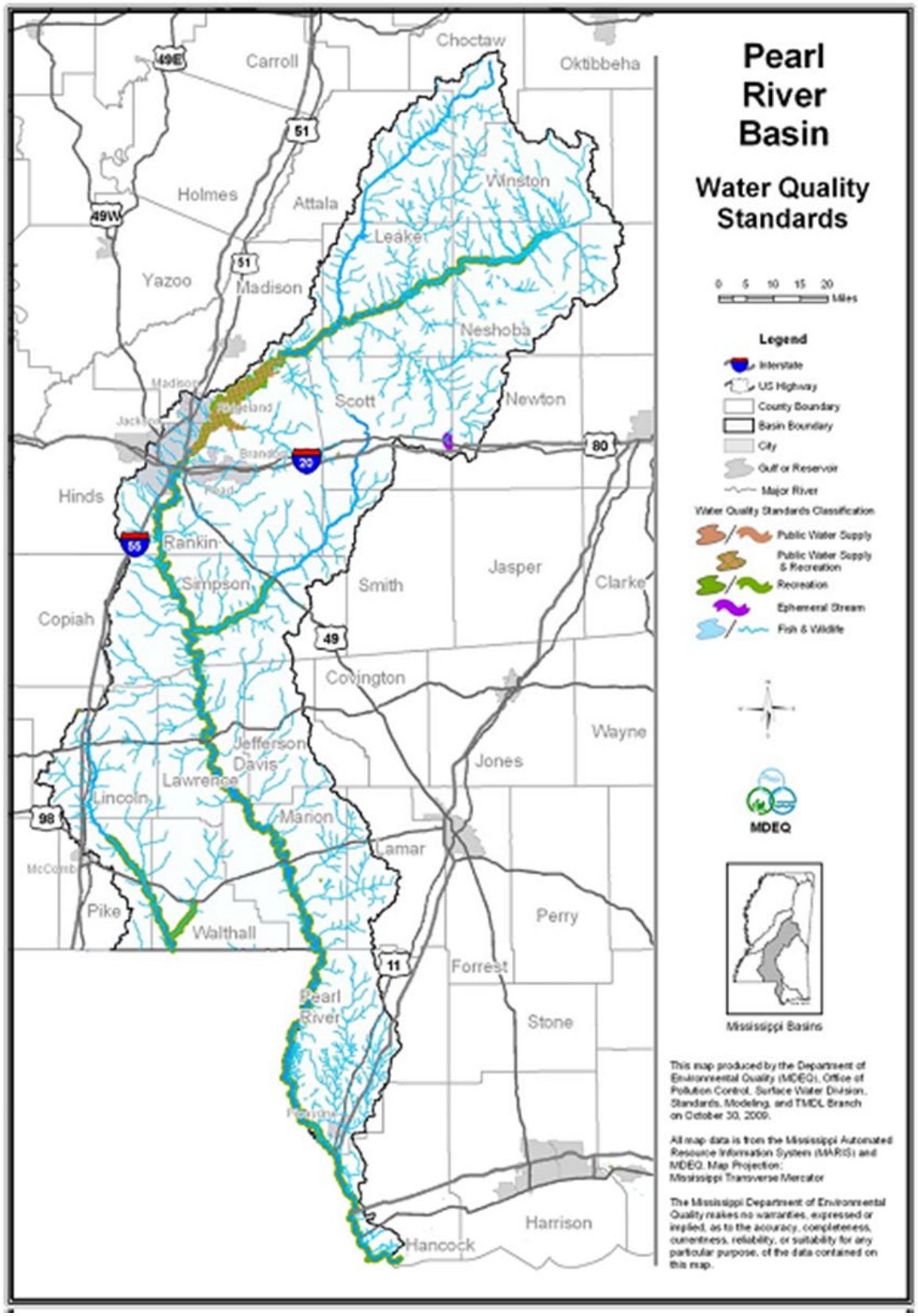


Figure 4-3. Pearl River Basin HUC 8 Watersheds and Water Quality Standard Classifications

Floodplains.—A large portion of the project area is mapped as Zone VE (Figure 4-4). Zone VE is defined as Coastal flood zone with velocity hazard. This is primarily open water and estuarine marsh. The eastern portion in project area is Zone X. Zone X are defined as "Areas of 0.2% annual change flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood". These are primarily ecotonal zones and hardwood and pine flatwood wetlands.

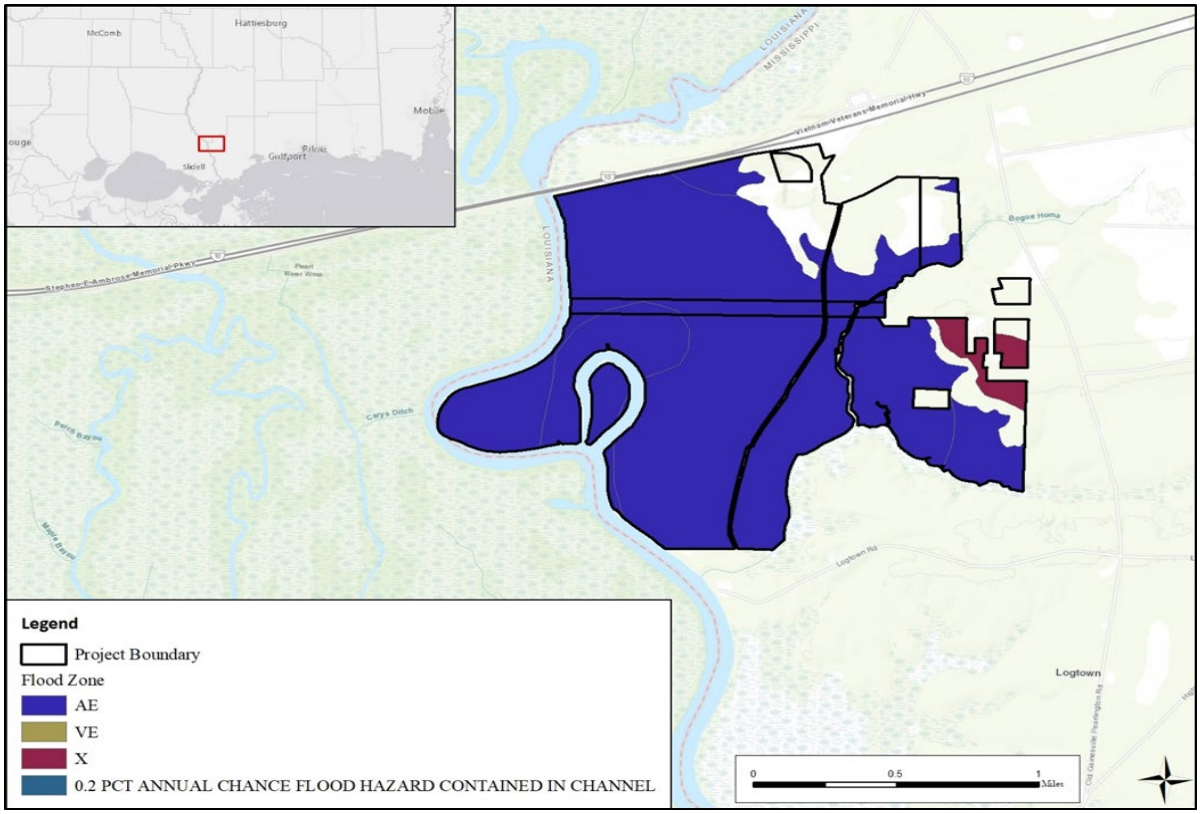


Figure 4-4. Hancock County Coastal Preserve Habitat Management-Wachovia tract flood zones

Wetlands.—The project area is a mosaic of wetlands and uplands extending from the open water of the Pearl River. Brackish and freshwater marshes start on the east side of the Pearl River. Across the marshes, as the land gently rises in elevation to the east, there are bayheads and hardwood swamp in freshwater strands. Farther to the east is the pine flatwood/savanna forested uplands in the center and eastern portions of the tract (See Habitats in Section 4.3.1).

4.2.2.1.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

Hydrology and Water Quality.—This alternative is in the Pascagoula watershed (HUC 8 – 03170006) (Figure 4-5), which includes portions of Jackson, George, and Perry counties; however, the project area is exclusively in Jackson County. Major waterbodies that flow or share boundaries with the project area include May Walker Bayou, and the West Pascagoula River. Lang Bayou, a small tributary bayou of Mary Walker Bayou runs through the tract. The Pascagoula River terminates at the eastern Mississippi Sound approximately 1.5 miles downstream from the tract. The West Pascagoula River is included in the 2018 Mississippi Section 305(b) List of Impaired Water Bodies for not attaining the designated use of fish consumption. The assessment and TMDL were completed for this waterbody in 2010.

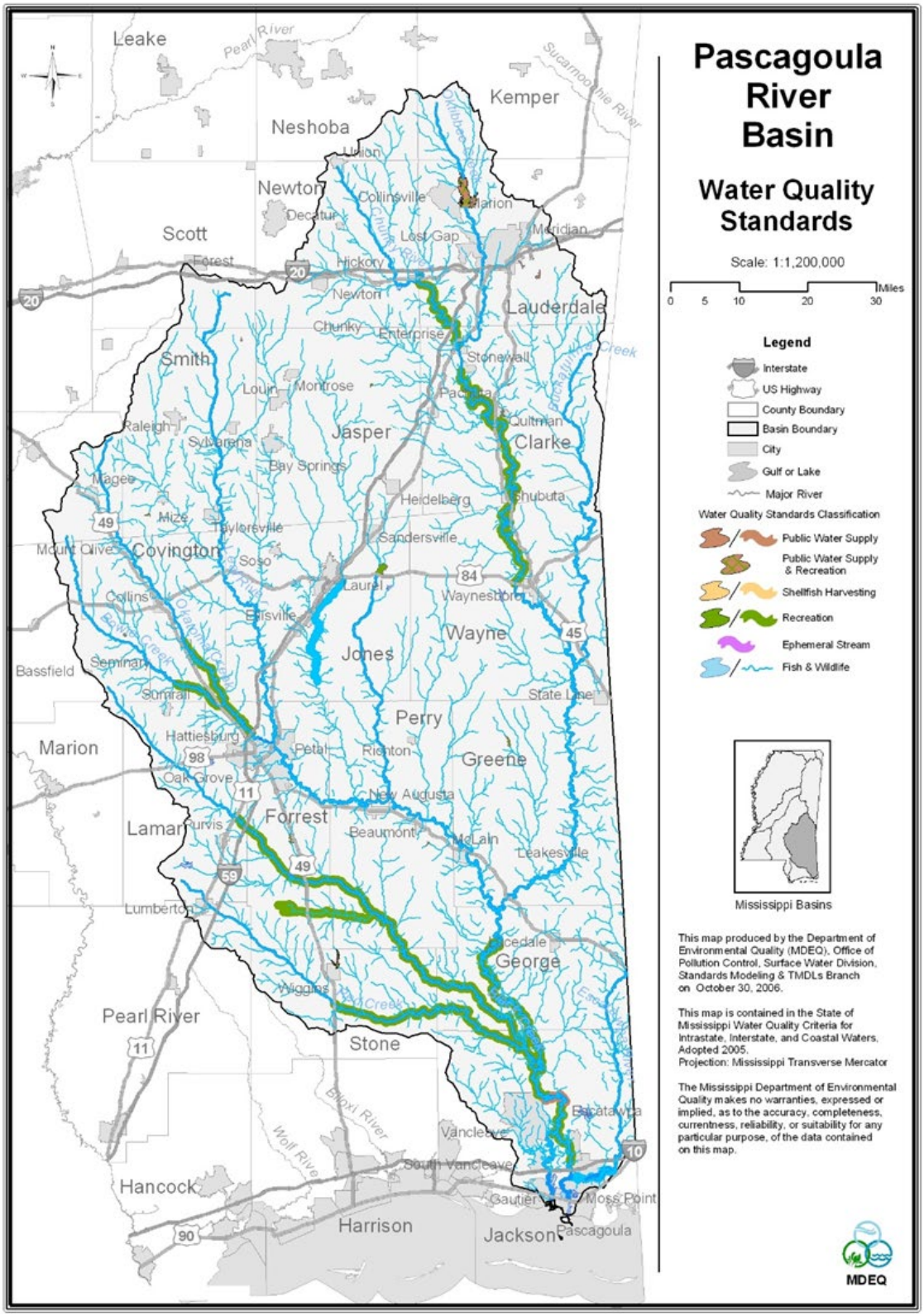


Figure 4-5. Pascagoula River HUC 8 Watershed with MDEQ Water Quality Standard Classifications

Floodplains.—A large portion of the project area is mapped as Zone AE (Figure 4-6). Zone AE is defined as "Areas subject to inundation by the 1-percent-annual-chance flood event determined Base Flood Elevations (BFEs)". The AE zone in the tract is primarily ecotonal and pine flatwood habitats. The eastern portion in project area is Zone X, which is defined as "Areas of 0.2% annual change flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood". The eastern portion of the tract near the West Pascagoula River is on Zone VE and is defined as Coastal flood zone with velocity hazard. This is primarily open water and estuarine marsh. Zone X is in the northern portion of the project area and is mostly comprised of pine flatwood habitat. Zone X are defined as "Areas of 0.2% annual change flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood".

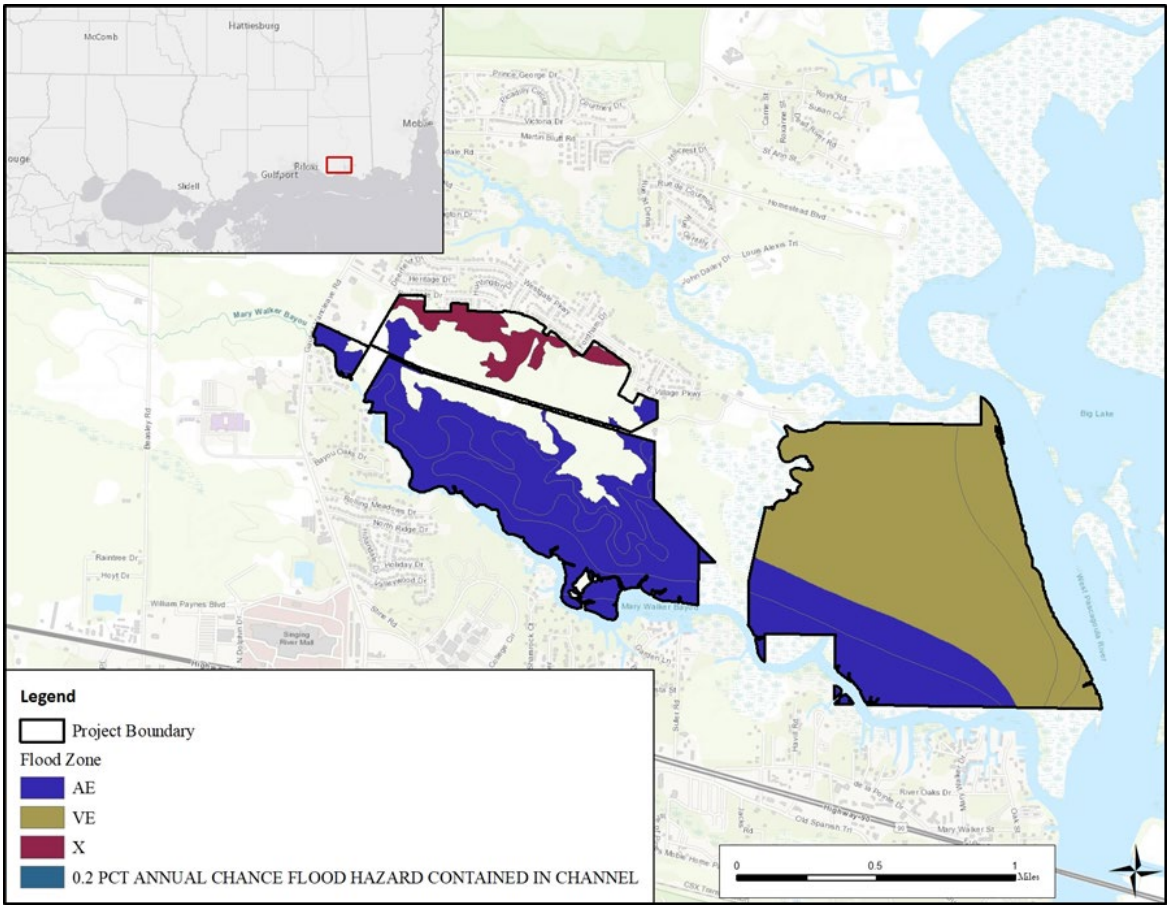


Figure 4-6. Pascagoula River Coastal Preserve-Dantzler tract flood zones

Wetlands.—The project area for the alternative is a mosaic of wetlands and uplands extending from the open water of the West Pascagoula River and graduating toward the west from estuarine marsh to pine flatwood/savanna uplands. (See Habitats in Section 4.3.1).

4.2.2.2 Environmental Consequences

Environmental consequences to hydrology and water quality resulting from the restoration measures and management activities described in Table 4-1 are summarized in this section. MS

RPI/EA environmental consequences described for hydrology and water quality in the MS TIG RP I/EA for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.2.2) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.2.2) are incorporated by reference where appropriate.

4.2.2.2.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Chemical Treatment, Mechanical Treatment, and Prescribed Fire.—These restoration measures and management activity impacts to hydrology, water quality, and wetlands would range from short-term minor to short-term moderate from use of equipment to apply chemicals and to conduct mechanical clearing/prescribed fire operations. There would be no impact to floodplains in the area. Impacts are similar to those described in sections 3.3.1.2.2 and 3.4.1.2.2 of the MS TIG RPI/EA.

Prescribed Grazing.—Prescribed grazing, as described in Table 4-1, would result in a short-term, minor adverse impacts to hydrology and to water quality and no impacts to wetlands or floodplains on the Bell's Ferry tract. Over-grazing could expose the soil surface and cause water run-off and low amounts of localized sedimentation. Pineywoods cattle have evolved to avoid predators by spending only a minimum of time at their water hole. This makes them very low impact cattle, as they do not contribute to bank erosion and fouling of streams like most domestic stock.[27] Nonetheless, the cattle would graze on a small, fenced approximately 13-acre area on the Bell's Ferry tract outside of riparian areas and wetlands, to minimize impacts to hydrology and water quality.

Road Repair and Replacement.—The current fire infrastructure at the Dupont tract is insufficient for habitat management efforts and requires the reestablishment of a suitable "roadway" for use by equipment used for fire management activities. As summarized in Table 4-1, the use of this equipment would have short-term, minor moderate impacts on hydrology, water quality, and wetlands and no impact on floodplains in the project area. Road repairs activities would be designed to avoid impoundment of water and would not disrupt natural hydrology. Impacts are similar to those described in sections 3.3.1.2.2 of the MS TIG RPI/EA.

4.2.2.2.2 Hancock County Marshes CP Habitat Management-Wachovia Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.2.2.2.1 for chemical treatment, mechanical treatment, and prescribed fire, ranging from short-term minor to moderate. This project does not include prescribed grazing or road repair and replacement.

4.2.2.2.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.2.2.2.1 for chemical treatment, mechanical treatment,

---

[27] http://www.pcrba.org/

and prescribed fire, ranging from short-term minor to moderate. This project does not include prescribed grazing or road repair and replacement.

4.2.2.2.4 Best Practices

Potential BMPs would be similar to those listed in MS TIG RP I/EA for the Graveline Land Acquisition and Management Project and the Grand Bay Land Acquisition and Habitat Management Project which were described in Section 3.3.1.2.2 and 3.4.1.2.2 of the MS TIG RPI/EA. For prescribed grazing, the cattle would graze on various plots which would be in a small, fenced, approximately 13-acre area on the Bell's Ferry tract outside of riparian areas and wetlands, to minimize impacts to hydrology and water quality.

4.2.3 Air Quality and Greenhouse Gases

4.2.3.1 Affected Environment

The following section is a discussion of air quality for the three WCNH alternatives. EPA has set national ambient air quality standards (NAAQS) for six principal air pollutants (also called criteria pollutants): Ground-Level Ozone (O3), Particulate Matter (PM), Nitrogen Dioxide (NO2), Sulfur Dioxide (SO2), Carbon Monoxide (CO), and Lead (Pb). MDEQ is the state agency responsible for development and maintenance of state specific air emission standards for Mississippi and monitors these pollutants with the exception of lead as MDEQ ceased lead monitoring on June 30, 2016. In Mississippi's three coastal counties, the following parameters are monitored: O3, PM, NO2, and SO2. According to MDEQ 2018 Air Quality Data Summary[28] the entire state of Mississippi, including the coastal counties, is meeting all of the NAAQS. Air quality conditions for Draft RPII/EA alternatives are the same as those described in the Phase III FERP/PEIS for the Restoration Initiatives at INFINITY Science Center Project (Section 10.5.6.4) and in the MS TIG RP I/EA for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.2.3) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.2.3).

4.2.3.2 Environmental Consequences

Environmental consequences to air quality and greenhouse gases resulting from the restoration measures and management activities described in Table 4-1 are summarized in this section. MS TIG RPI/EA environmental consequences described for air quality and greenhouse gases for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.2.3) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.2.3) are incorporated by reference and included in the summary analysis below.

4.2.3.2.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Chemical Treatment, Mechanical Treatment, and Prescribed Fire.—As described in Table 4-1, these restoration measures and management activities would result in a short-term, minor-

[28] https://www.mdeq.ms.gov/wp-content/uploads/2019/03/2018-Air-Quality-Data-Summary.pdf

moderate adverse impact to air quality and GHG emissions from use of equipment to apply chemicals, access sites for management, and to complete mechanical clearing/prescribed fire operations. Environmental consequences resulting from equipment operation/best practices and environmental consequences resulting from prescribed fire/best practices are similar to those described in sections 3.3.1.2.3 and 3.4.1.2.3 of the MS TIG RPI/EA.

Prescribed Grazing.—The MS TIG does not anticipate any adverse impacts to air quality or GHG emissions associated with this management activity.

Road repair and Replacement.—As summarized in Table 4-1, these restoration measures and management activities would result in a short-term, minor adverse impact to air quality and GHG emissions. Environmental consequences resulting from equipment operation/best practices are similar to those described in sections 3.3.1.2.3 and 3.4.1.2.3 of the MS TIG RPI/EA.

4.2.3.2.2 Hancock County Marshes CP Habitat Management-Wachovia Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those short-term, minor-moderate adverse impacts described in Section 4.2.3.2.1 for chemical treatment, mechanical treatment, and prescribed fire. This project does not include prescribed grazing or road repair and replacement.

4.2.3.2.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those short-term, minor-moderate adverse impacts described in Section 4.2.3.2.1 for chemical treatment, mechanical treatment, and prescribed fire. This project does not include prescribed grazing or road repair and replacement.

4.2.3.2.4 Best Practices

Potential BMP's for environmental consequences from equipment operation and prescribed fire would be similar to those listed for the Graveline Land Acquisition and Management Project and the Grand Bay Land Acquisition and Habitat Management Project which were described in sections 3.3.1.2.3 and 3.4.1.2.3, respectively, of MS TIG RP I/EA.

4.3 BIOLOGICAL RESOURCES

Section 6.4.1.5.2 of the PDARP/PEIS describes the impacts to Biological Resources for the relevant restoration approaches and are incorporated by reference and briefly described here.

PDARP/PEIS environmental consequences related to biological resources analyzed here.—DARP/PEIS consequences related to biological resources are similar to those documented in sections 3.3.1.3 and 3.4.1.3 of the MS TIG RPI/EA.

For WCNH alternatives in this Draft RPII/EA, environmental consequences are within the general range of impacts as described in the PDARP/PEIS (summarized above). Table 4-3 is a summary of impacts to biological resources that would result from WCNH alternatives.

Table 4-3. Impacts to Biological Resources from Project Restoration Measures and Management Activities in this Draft RPII/EA

Resource	Beneficial Impacts	Chemical Treatment	Mechanical Treatment	Prescribed Fire	Prescribed Grazing	Road repair and Replacement
Habitats	Long-Term	Short-Term Minor	Short-Term Minor to Moderate	Short-Term Minor to Moderate	Short-Term Minor	Short-Term Minor to Moderate
Wildlife Species (including Birds)	Long-Term	Short-Term Minor	Short-Term, Minor to Moderate	Short-Term Minor to Moderate	Short-Term Minor	Short-Term Minor
Protected Species	N/A	No impact	No Impact	No Impact	No Impact	No Impact
N/A=Not Applicable						

4.3.1 Habitats

4.3.1.1 Affected Environment

Section 3.5 of the PDARP/PEIS provides a discussion of habitats of the northern Gulf of Mexico. This section covers habitats that are the focus for management activities in the project areas. Habitats in the affected environment for Draft RPII/EA alternatives are similar to those described in the Phase III FERP/PEIS for the Restoration Initiatives at INFINITY Science Center Project (Section 10.5.6.6) and in the MS TIG RP I/EA for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.3.1) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.3.1).

4.3.1.1.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

The Dupont tract is comprised of the following habitat types: estuarine marsh, hydric drains including bay head drain/wet cypress strand vegetation communities, and upland/wetland pine flatwood/savanna. The hydric drains slope southwards across the pine flatwoods/savanna to a black needlerush (*Juncus roemerianus)* dominated salt marsh. The property has extensive heavy woody shrub cover that typically results from decades of fire exclusion in the Mississippi coastal plain. There are still substantial areas containing fire dependent flatwood/savanna species in the north to central portions of the tract. These include pitcher plants, (*Saracenia spp.*), Candyroot (*Polygala spp.*), etc. The Bell's Ferry tract is similar to the habitats found at the Dupont tract, but includes a higher percentage of uplands. Burn management plans for both tracts include detailed information about vegetative fuels and target areas for ignition.

4.3.1.1.2 Hancock County Marshes CP Habitat Management-Wachovia Tract

The tract is comprised of the following habitat types: freshwater and brackish marsh, bottomland hardwood forest, hydric drains including bayhead habitats; and upland pine flatwood/savanna. The target areas for restoration measures and management activities (Table 4-1) are the upland pine flatwood/savanna habitats. Even though this habitat is subject to seasonally high-water tables, soils are typically moderately well drained. Overstory vegetation is characterized by slash pine (*Pinus elliottii*) with scattered loblolly pine (*Pinus taeda*). The property exhibits some heavy

woody shrub cover that typically results from decades of fire exclusion in the Mississippi coastal plain; although, there are areas containing fire dependent species.

4.3.1.1.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

The tract is comprised of the following habitat types: estuarine marsh, hydric drains, and upland upland/wetland mosaic of pine/savanna/flatwood forest. The emergent wetlands marshes are comprised primarily of sawgrass (*Cladium jamaicense*) and black needlerush (*Juncus roemerianus*), reflective of a brackish, estuarine marsh. The target area for restoration measures and management activities (Table 4-1) is the upland/wetland mosaic of pine savanna/flatwood forest. Approximately 60% of the upland contains a stand of longleaf pine of varying densities mixed with slash and loblolly pines and encroaching hardwoods. The remainder is slash pine with encroaching hardwoods. Except for the wettest sites, a heavy understory of brush characterizes the entire upland. The marsh portion of the tract contains four islands of uplands totaling 11 acres, predominantly slash pine, ranging in size from less than an acre to about nine acres.

4.3.1.2 Environmental Consequences

Environmental consequences are discussed below only for habitats where restoration measures and management activities (Table 4-1) would occur, which includes pine flatwood/savanna habitats, both wetland and upland forms. MS RPI/EA environmental consequences described for habitats for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.3.1) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.3.1) are incorporated by reference and included in the summary analysis below.

4.3.1.2.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Chemical Treatment, Mechanical Treatment, and Prescribed Fire.—These restoration measures and management activity impacts to habitats would range from short-term minor to short-term minor to moderate from use of equipment to apply chemicals, and to complete mechanical clearing/prescribed fire operations. Environmental consequences resulting from equipment operation/best practices and environmental consequences resulting from prescribed fire/best practices are similar to those described in sections 3.3.1.3.1 and 3.4.1.3.1 of the MS TIG RPI/EA. Management activities would restore flatwood/savanna vegetation composition and structure over time and provide long-term benefits to the ecosystem.

Prescribed Grazing.—Prescribed grazing could result in a short-term, minor adverse impact to existing habitats. If allowed, over-grazing could impact native vegetation composition and structure. To minimize impacts, the number of cattle/length of grazing would be adjusted if necessary to provide grazed plants sufficient recovery time to meet planned objectives. Prescribed grazing would improve or maintain desired species composition, structure and/or

vigor of plant communities, increase species richness, and improve or maintain the quantity, quality, or connectivity of food and/or cover available for wildlife.[29]

Road Repair and Replacement.—Road repair and replacement would result in a short-term, moderate adverse impact to existing habitats from the use of equipment to regrade and to improve the roadway and replacement of new roadway materials. Environmental consequences resulting from road removal/repair and culvert replacement are similar to those described in sections 3.3.1.3.1 of the MS TIG RPI/EA.

4.3.1.2.2 Hancock County Marshes CP Habitat Management-Wachovia Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.3.1.2.1 for chemical treatment, mechanical treatment, and prescribed fire, ranging from short-term minor to moderate. This project does not include prescribed grazing or road repair and replacement.

4.3.1.2.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.3.1.2.1 for chemical treatment, mechanical treatment, and prescribed fire, ranging from short-term minor to moderate. This project does not include prescribed grazing or road repair and replacement.

4.3.1.2.4 Best Practices

Potential BMPs would be similar to those listed in MS TIG RP I/EA for the Graveline Land Acquisition and Management Project and the Grand Bay Land Acquisition and Habitat Management Project which were described in Section 3.3.1.3.1 and 3.4.1.3.1 of MS TIG RP I/EA.

4.3.2 Wildlife Species (Including Birds)

4.3.2.1 Affected Environment

Section 3.6 of the PDARP/PEIS discusses the biota of the northern Gulf of Mexico. Wildlife includes all native and naturalized vertebrate and invertebrate species of animals. For the three RPII/EA WCNH project areas, faunal species include those associated with habitats that are the focus of management activities (Table 4-1). These include various species of mammals, birds, fish, reptiles, infauna, epifauna, and other aquatic invertebrates which were previously described in Phase III FERP/PEIS for the Restoration Initiatives at INFINITY Science Center Project (Section 10.5.6.6) and in the MS TIG RP I/EA for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.3.4) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.3.4).

---

[29] 2017. USDA Natural Resources Conservation Service. Conservation Practice Standard Prescribed Grazing Code 528 (Ac) https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1255132.pdf

4.3.2.2 Environmental Consequences

4.3.2.2.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Chemical Treatment, Mechanical Treatment, and Prescribed Fire.—These restoration measures and management activity impacts to wildlife would range from short-term minor to short-term minor to moderate from use of equipment to apply chemicals and to conduct mechanical clearing/prescribed fire operations. Environmental consequences resulting from equipment operation/best practices and environmental consequences resulting from prescribed fire/best practices are similar to those described for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.3.4) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.3.4) of the MS TIG RPI/EA. Management activities would restore flatwood/savanna and bay head drain/wet cypress strand habitats over time and provide long-term benefits to wildlife.

Prescribed Grazing.—As described in Table 4-1, this management activity would result in a short-term, minor adverse impact to wildlife. The presence of cattle may modify the behavior of native species and fencing could inhibit wildlife movement for some species. To minimize impacts, cattle grazing would be monitored, and number of cattle adjusted if necessary. Additionally, the type of fencing would allow for wildlife movement (e.g. height of fence, clear space at the bottom of fencing). Prescribed grazing would improve or maintain desired species composition and vigor of plant communities and improve or maintain the quantity of food and/or cover available for wildlife, because the cattle consume low-quality forage (leaf-litter, pine needles, bark and woody undergrowth).

Road Repair and Replacement.—As summarized in Table 4-1, these restoration measures and management activities would result in a short-term, minor adverse impact to wildlife from the use of equipment to regrade and to improve the roadway and replacement of new roadway materials. Environmental consequences resulting from road removal/repair and culvert replacement are similar to those described for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.3.4) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.3.4) of the MS TIG RPI/EA.

4.3.2.2.2 Hancock County Marshes CP Habitat Management-Wachovia Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.3.2.2.1 for chemical treatment, mechanical treatment, and prescribed fire, ranging from short-term minor to moderate. This alternative does not include prescribed grazing or road repair and replacement.

4.3.2.2.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.3.2.2.1 for chemical treatment, mechanical treatment, and prescribed fire, ranging from short-term minor to moderate. This alternative does not include prescribed grazing or road repair and replacement.

4.3.2.2.4 Best Practices

Potential BMP's for the restoration measures and management activities are similar to those described in sections 3.3.1.3.2, 3.3.1.3.3, 3.4.1.3.2, and 3.4.1.3.3 of the MS TIG RPI/EA. For prescribed grazing, best practices would include planning the intensity, frequency, timing, and duration of grazing and/or browsing to provide for the development and maintenance of the plant structure, density, and diversity needed for the desired wildlife species of concern.[30]

4.3.3 Protected Species

The U.S. Fish and Wildlife Service (USFWS) lists species as threatened or endangered when they meet criteria detailed under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. §1531 et seq.). Additionally, Mississippi Department of Wildlife Fisheries and Parks (MDWFP) and NOAA National Marine Fisheries Service (NMFS) identify and list protected species. Section 7(a) (2) of the ESA requires that each federal agency ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of those species. When the action of a federal agency may affect a protected species or its critical habitat, that agency is required to consult with either the NMFS or the USFWS, depending upon the protected species that may be affected. There is no critical habitat for any protected species in the WCNH project areas.

The 1996 Magnuson-Stevens Fishery and Conservation Act requires cooperation among NOAA Fisheries, anglers, and federal and state agencies to protect, conserve, and enhance Essential Fish Habitat (EFH). EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. Restoration measures and management activities described in Table 4-1 would not be conducted in estuarine marshes or open water areas; the WCNH alternatives would not affect federally managed fish species protected under the Magnuson-Stevens Fishery and Conservation Act.

4.3.3.1 Affected Environment

Section 3.3.2 of the PDARP/PEIS discusses Living Coastal and Marine Resources in the northern Gulf of Mexico. This section focuses on the species that are most likely to occur in or around the project areas. These include protected species which were previously described in Phase III FERP/PEIS for the Restoration Initiatives at INFINITY Science Center Project (Section 10.5.6.6) and in the MS TIG RP I/EA for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.3.2) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.3.2). Protected species lists for each alternative were determined by downloading information from the USFWS Information for Planning and Conservation system, reviewing scientific literature, and using professional judgment. None of the restoration measures or management activities for the WCNH alternatives would be completed in open water. Thus, there would be no impact to in-water species (and associated

[30] 2017. USDA Natural Resources Conservation Service. Conservation Practice Standard Prescribed Grazing Code 528 (Ac) https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1255132.pdf

critical habitat), including Gulf sturgeon, West Indian manatee, and sea turtles; for this reason, they are not included in the affected environment discussion. Protected species that are known to occur or that may potentially occur within the project area include six bird species, three reptile species, one amphibian species, and one plant species. Table 4-4 provides species habitats and identifies the project areas where the species are known to occur or have the potential to occur.

Table 4-4. Protected Species That Are Known to Occur or Have the Potential to Occur in the WCNH Project Areas

Common Name	Scientific Name	Federal Status	Habitat	Project Area Occurrence
Birds				
Piping Plover	*Charadrius melodus*	Threatened	Beaches and mudflats in southeastern coastal areas.	WR; PR
Red Knot	*Calidris canutus rufa*	Threatened	Marine intertidal habitats including inlets, estuaries, and bays feeding in mud and sand flats on beaches and barrier islands.	WR; PR
Wood Stork	*Mycteria americana*	Threatened	Wood Storks breed in fresh and brackish forested wetlands. They forage in wetlands, swamps, ponds, and marshes, especially those with an open canopy.	WR; HC; PR
Eastern Black Rail	*Laterallus jamaicensis ssp. jamaicensis*	Proposed Threatened	High portions of salt marshes, shallow freshwater marshes, wet meadows, and flooded grassy vegetation.	WR; HC; PR
Red-cockaded Woodpecker	*Picoides borealis*	Endangered	Open-understory pine forests, particularly in longleaf pine. This species excavates nesting and roosting cavities in living pine trees. Older, mature trees are selected for cavity excavation. The birds are often found in mature loblolly and slash pine.	HC
Mississippi Sandhill Crane	*Grus canadensis pulla*	Endangered	Open savannas, swamp edges, young pine plantations, and wetlands along edges of pine forests; associated trees and shrubs include longleaf pine, slash pine, bald cypress, gallberry, wax myrtle, black gum, sweet bay, and yaupon.	PR
Reptiles				
Alabama Red-bellied Turtle	*Pseudemys alabamensis*	Endangered	Uplands with well-drained sandy soils in areas of longleaf pine and hardwood tree species.	PR
Black Pinesnake	*Pituophis melanoleucus lodingi*	Threatened	Uplands with well-drained sandy soils in areas of longleaf pine and hardwood tree species.	WR
Gopher Tortoise	*Gopherus polyphemus*	Threatened	Well-drained, sandy soils, which allow easy burrowing; an abundance of diverse herbaceous ground cover; and an open canopy and sparse shrub cover, which allows sunlight to reach the ground floor.	WR; HC; PR
Amphibians				
Dusky Gopher Frog	*Rana sevosa*	Endangered	Upland, sandy areas covered with open longleaf pine forest with abundant ground cover; and isolated, ephemeral, wetland breeding sites within the forested landscape.	WR; HC; PR
Plants				
Louisiana Quillwort	*Isoetes louisianensis*	Endangered	Mineral soil, usually light gray in color, in bottomlands that are periodically washed free of leaves and debris. Streams along which quillworts grow may have flow year around.	WR
WR: Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts; HC: Hancock County Marshes CP Habitat Management-Wachovia Tract; PR=Pascagoula River CP Habitat Management- Dantzler Tract				

4.3.3.2 Environmental Consequences

Potential impacts to threatened or endangered species and their critical habitat are presented in Table 4-5. None of the restoration activities for the alternatives would be completed in open water. There would be no impact as a result of any restoration activity to in-water species (and associated critical habitat), including Gulf sturgeon, West Indian manatee, and sea turtles; for this reason, they are not included in the environmental consequences discussion. Technical assistance with NOAA NMFS and USFWS is complete and consultations have been initiated.

Table 4-5. Protected Species - Potential Impacts

Species/Critical Habitat	Applicable Habitats	Activity	Potential Impacts to Species/ Critical Habitat	Project Area Occurrence
Birds				
Piping Plover (*Charadrius melodus)*	Estuarine marsh	None	Since no restoration activities would take place in this habitat type, no impacts to the species are anticipated.	WR; PR
Red-cockaded Woodpecker *(Picoides borealis)*	Open-understory pine forests, particularly in longleaf pine.	PF, MC, CT, PG, RR	It is not likely that suitable habitat exists in the alternative area because much of the habitat is characterized by dense canopy cover. As such, no impacts to the species are anticipated.	HC
Red Knot (*Calidris canutus rufa)*	Estuarine marsh	None	Since no restoration activities would take place in this habitat type, no impacts to the species are anticipated.	WR; PR
Wood Stork (*Mycteria Americana)*	Hydric drains	PF, MC, CT, PG, RR	It is not likely that suitable habitat exists in the alternative area because much of the habitat is characterized by dense canopy cover. As such, the project is not likely to adversely affect the species.	WR; HC; PR
Eastern Black Rail (*Laterallus jamaicensis ssp. Jamaicensis)*	High marsh; ecotones	PF	Prescribed fire may reach ecotonal boundaries, however, fire lines are in place to avoid the spread of fire. As such, the project is not likely to adversely affect the species.	WR; HC; PR
Mississippi Sandhill Crane (*Grus canadensis pulla)*	Pine flatwood/savanna	PF, MC, CT	Restoration measures and management activities could affect the species. If disturbed, this species can temporarily leave the area during the implementation of restoration measures and management activities. As such, no impacts to the species are anticipated.	PR
Reptiles				
Black Pinesnake (*Pituophis melanoleucus lodingi*)	Pine flatwood/savanna	PF, MC, CT, PG, RR	It is not likely that this habitat exists in the proposed alternative area because much of the habitat is characterized by dense canopy cover or existing disturbance. Surveys would be conducted in areas where the species is likely to occur. Survey results would be considered in the design of management activities and restoration measures to either avoid or to minimize impacts to the species. As such, the project is not likely to adversely affect the species.	WR
Gopher Tortoise (*Gopherus Polyphemus)*	Pine flatwood/savanna	PF, MC, CT, PG, RR	Restoration measures and management activities could affect species habitat. Areas that are likely to contain the species would be surveyed; if burrows are identified, conservation measures would be implemented to avoid or minimize impacts. As such, the project is not likely to adversely affect the species.	WR; HC; PR
Alabama Red-bellied Turtle	Estuarine marsh; adjacent uplands	PF, MC, CT	Restoration measures and management activities could affect species habitat. If there is potential habitat for the Alabama red-bellied turtle, surveys would be	PR

Species/Critical Habitat	Applicable Habitats	Activity	Potential Impacts to Species/ Critical Habitat	Project Area Occurrence
(*Pseudemys alabamensis)*			conducted in potential habitat. Survey results would be considered in the design of the restoration measures and management activities to either avoid or minimize impacts to the species. As such, no impacts to the species are anticipated.	
Amphibians				
Dusky Gopher Frog (*Rana sevosa*)	Pine flatwood/savanna	PF, MC, CT, PG, RR	Suitable habitat features required by this species for survival do not exist in the project area. As such, the project is not likely to adversely affect the species.	WR; HC; PR
Plants				
Louisiana Quillwort (*Isoetes louisianensis*)	Hydric drains	PF, MC, RR	Restoration measures and management activities could affect the species. If mechanical treatment, road removal/repair, or replacement were to be conducted within 165 feet of Louisiana quillwort suitable habitat (ephemeral, intermittent, 1st and 2nd order perennial freshwater streams), then a qualified biologist would conduct a survey for Louisiana quillwort. If the species is found, then protective measures outlined in the best practices would be implemented. As such, the project is not likely to adversely affect the species.	WR
PF=Prescribed Fire; MC=Mechanical Clearing; CC=Chemical Treatment; PG=Prescribed Grazing; RR=Road removal/repair and replacement				
WR: Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts; HC: Hancock County Marshes CP Habitat Management-Wachovia Tract; PR=Pascagoula River CP Habitat Management- Dantzler Tract				

4.3.3.2.1 Best Practices

The MS TIG would continue to consult with the appropriate regulatory agency to further avoid or minimize impacts to these species in the planning of site-specific restoration measures and management activities. Potential BMPs would be similar to those listed in MS TIG RP I/EA for the Graveline Land Acquisition and Management Project and the Grand Bay Land Acquisition and Habitat Management Project which were described in Section 3.3.1.3.2 and 3.4.1.3.2 of MS TIG RP I/EA. For prescribed grazing, best practices would include planning the intensity, frequency, timing and duration of grazing and/or browsing to provide for the development and maintenance of the plant structure, density, and diversity needed for the desired wildlife species of concern.[31]

4.4 SOCIOECONOMIC RESOURCES

Section 6.4.1.5.3 of the PDARP/PEIS describes the impacts to Socioeconomic Resources for the restoration approaches and are incorporated by reference and briefly described here.

PDARP/PEIS consequences related to socioeconomic resources analyzed here.— DARP/PEIS consequences related to socioeconomic resources are similar to those documented in sections 3.3.1.4 and 3.4.1.4 of the MS TIG RPI/EA.

For WCNH alternatives in this Draft RPII/EA, environmental consequences are within the general range of impacts as described in the PDARP/PEIS (summarized above) with some variances related to specific actions. Table 4-6 is a summary of impacts to socioeconomic resources that would result from WCNH alternatives.

[31] 2017. USDA Natural Resources Conservation Service. Conservation Practice Standard Prescribed Grazing Code 528 (Ac) https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1255132.pdf

Table 4-6. Impacts to Socioeconomic Resources from Project Restoration Measures and Management Activities

Resource	Beneficial Impacts	Chemical Treatment	Mechanical Treatment	Prescribed Fire	Prescribed Grazing	Road repair and Replacement
Socioeconomics and Environmental Justice	N/A	No Impact	No Impact	No Impact	No Impact	No Impact
Cultural Resources	N/A	No adverse impacts anticipated*	No adverse impacts anticipated*	No adverse impacts anticipated*	No adverse impacts anticipated*	No adverse impacts anticipated*
Tourism and Recreational Use	Long-Term	Short-Term, Minor	Short-Term, Minor	Short-Term, Minor	Short-Term, Minor	Short-Term, Minor
Land and Marine Management	N/A	No Impact	No Impact	No Impact	No Impact	No Impact
Public Health and Safety	Long-Term	Short-Term, Minor	Short-Term, Minor	Short-Term, Minor	No Impact	Short-Term, Minor

N/A=Not Applicable
* Restoration measures and management activities would be designed to avoid cultural resources to the extent practicable. MDEQ would work with the Mississippi State Historic Preservation Officer and/or all appropriate Tribal Historic Preservation Officers to determine compliance measures if historic resources are likely in the area or encountered during implementation.

4.4.1 Socioeconomics and Environmental Justice

4.4.1.1 Affected Environment

PDARP/PEIS Section 3.2 discusses human and economic activities in the northern Gulf of Mexico region and is incorporated by reference here.

4.4.1.1.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

The affected environment for the alternative includes the population of Census Tract 003102. According to the American Community Survey 2013-2017, the population of Harrison County was 200,491 and accounted for 6.7% of the state's total population, while Census Tract 003102 (population 6,954) accounted for 3.5% of the county population. Median household income in Harrison County was $44,684, which was 6.4% higher than the median household income in the State of Mississippi ($42,009). Median household income of Census Tract 003102 was $44,772, which is 0.2% higher than that of the county and 6.2% higher than the median household income of the state. Race demographics for Census Tract 003102 include Non-Hispanic White: 5,520; Hispanic or Latino: 114; Black or African American: 1,094; Asian: 122; and American Indian and Alaska Native: 17. Minorities comprise 19.6% of the population in this census tract. By comparison, minorities comprise 33.7% of the Harrison County population and 42% at the state level.

4.4.1.1.2 Hancock County Marshes CP Habitat Management-Wachovia Tract

The affected environment for the alternative includes the population of Census Tract 030400. According to the American Community Survey 2013-2017, the population of Hancock County was 46,277 and accounted for 1.5% of the state's total population, while Census Tract 030400

(population 2,222) accounted for 4.8% of the county population. Median household income in Hancock County was $44,684, which was 10.6% higher than the median household income in the State of Mississippi ($42,009). Median household income of Census Tract 030400 was $40,417, which is 17.5% lower than that of the county and 5% lower than the median household income of the state. Race demographics for Census Tract 030400 include Non-Hispanic White: 1,798; Hispanic or Latino: 27; Black or African American: 323; Asian: 0; and American Indian and Alaska Native: 0. Minorities comprise 15.8% of the population in this census tract. By comparison, minorities comprise 13.2% of the Hancock County population and 42% at the state level.

4.4.1.1.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

The affected environment for the alternative includes the population of Census Tract 041000. According to the American Community Survey 2013-2017, the population of Jackson County was 141,314 and accounted for 4.7% of the state's total population, while Census Tract 041000 (population 4,680) accounted for 3.3% of the county population. Median household income in Jackson County was $44,684, which was 6.4% higher than the median household income in the State of Mississippi ($42,009). Median household income of Census Tract 041000 was $51,896, which is 2% higher than that of the county and 17.7% higher than the median household income of the state. Race demographics for Census Tract 041000 include Non-Hispanic White: 2,979; Hispanic or Latino: 154; Black or African American: 1,467; Asian: 80; and American Indian and Alaska Native: 0. Minorities comprise 36% of the population in this census tract. By comparison, minorities comprise 30.6% of the Jackson County population and 42% at the state level.

4.4.1.2 Environmental Consequences

Restoration measures and management activities described in Table 4-1 from use of equipment to apply chemicals, to access sites for management, for cattle grazing management (Bell's Ferry Tracts only), to complete mechanical clearing/prescribed fire operations, and for road repair and replacement (Dupont and Bell's Ferry Tracts only) would take place within state-owned boundaries and have no disproportionate impacts on minority, low-income, or underserved populations from the implementation of WCNH projects proposed in this Draft RPII/EA.

4.4.2 Cultural Resources

The alternatives would be reviewed under Section 106 of the NHPA to identify any historic properties located within the project areas and to evaluate whether the project alternatives would impact any historic properties. See sections 3.3.1.4.3 and 3.4.1.4.3 of the MS TIG RPI/EA for descriptions of the affected environment and environmental consequences related to cultural resources.

Cultural resources include historic properties listed in, or eligible for listing in the National Register of Historic Places (36 C.F.R. §60[a-d]). The National Historic Preservation Act of 1966 (NHPA), as amended and recodified (54 U.S.C. § 300308), defines an historic property as "any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on the National Register [of Historic Places]." Under the statute and implementing regulations, historic properties include significant traditional religious and cultural properties important to Indian tribes. Historic properties include built resources (bridges, buildings, piers,

etc.), archaeological sites, and Traditional Cultural Properties, which are significant for their association with practices or beliefs of a living community that are both fundamental to that community's history and a piece of the community's cultural identity. Although often associated with Native American traditions, such properties also may be important for their significance to ethnic groups or communities. Historic properties also include submerged resources.

4.4.2.1 Affected Environment

The three Draft RPII/EA WCNH project areas would be reviewed under Section 106 of the NHPA to identify any historic properties located within the project area and to evaluate whether the alternative would affect any historic properties. Previously recorded archaeological sites, shipwrecks, historical standing structures, National Register of Historic Places properties, National Register Districts, and National Historic Landmarks are being reviewed.

4.4.2.2 Environmental Consequences

The National Historic Preservation Act of 1966 (NHPA) charges the federal government with protecting the cultural heritage and resources of the nation. The WCNH projects would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources. Cultural and historic resources would be considered when preparing site-specific restoration measures and management actions. Where there is a likelihood to disturb cultural resources, CP resource managers would conduct appropriate surveys to inform the methods and location of restoration and management actions. Restoration measures/management actions would be designed to avoid cultural resources to the extent practicable. MDEQ would work with the Mississippi State Historic Preservation Officer and/or all appropriate Tribal Historic Preservation Officers to determine compliance measures if historic resources are likely in the area or encountered during implementation. Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

For restoration measures and management activities (Table 4-1) that include the use of equipment to apply chemicals, to access sites for management, for cattle grazing management, for road repair and replacement, and to complete mechanical clearing/prescribed fire operations, The Implementing Trustee would follow requirements under Section 106 of the National Historic Preservation Act and 36 CFR Part 800 to determine if these activities have the potential to impact cultural resources.

4.4.2.2.1 Hancock County Marshes Hancock County Marshes CP Habitat Management-Wachovia Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.3.2.2.1 for chemical treatment, mechanical treatment, and prescribed fire. This project does not include prescribed grazing or road repair and replacement.

4.4.2.2.2 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.3.2.2.1 for chemical treatment, mechanical treatment, and prescribed fire. This project does not include prescribed grazing or road repair and replacement.

4.4.2.2.3 Best Practices

Restoration measures and management activities would be designed to avoid cultural resources to the extent practicable. MDEQ would work with the Mississippi State Historic Preservation Officer and/or all appropriate Tribal Historic Preservation Officers to determine compliance measures if historic resources are likely in the area or encountered during implementation.

4.4.3 Tourism and Recreational Use

4.4.3.1 Affected Environment

The project areas are owned and maintained by the MDMR CP. These areas are all open to the public for hiking, hunting, fishing, kayaking, and other outdoor activities. Information regarding visitor use of the properties as well as trail maps is provided online by the MDMR CP[32].

4.4.3.1.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

The public has access to the DuPont and Bell's Ferry tracts in the Wolf River CP for recreational activities similar to those listed in section 4.4.3.1. Additionally, boaters and anglers use the area on occasional and seasonal basis for fishing and sparingly for waterfowl hunting.

4.4.3.1.2 Hancock County Marshes Hancock County Marshes CP Habitat Management-Wachovia Tract

The public has access to the Wachovia tract in the Hancock County Marshes CP for recreational activities similar to those listed in section 4.4.3.1. Additionally, boaters and anglers use the area on occasional and seasonal basis for waterfowl hunting and for fishing.

4.4.3.1.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

The public has access to the Dantzler tract in the Hancock County Marshes CP for recreational activities similar to those listed in section 4.4.3.1. Additionally, boaters and anglers use the area on occasional and seasonal basis for waterfowl hunting and for fishing.

4.4.3.2 Environmental Consequences

4.4.3.2.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Chemical Treatment, Mechanical Treatment, and Prescribed Fire.—MS TIG RP I/EA environmental consequences described for tourism and recreational use for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.4.2) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.4.3) are incorporated by reference where appropriate. Chemical treatment, mechanical treatment, and prescribed fire would result in a short-term, minor adverse impact to tourism and recreational use due to the presence and operation of equipment to apply chemicals, to access sites for management, and to complete

[32] http://www.dmr.ms.gov/index.php/wildlife-a-plants/coastal-preserves

mechanical clearing/prescribed fire operations on the project site. There would be short-term restriction of public access in some areas where the work is being performed; the public would be notified of any closures or restrictions by communication methods used by MDMR. The investment of funds to restore habitats would provide a long-term benefit to tourist or to recreational users that visit the Wolf River CP.

Prescribed Grazing.—Prescribed grazing would result in a short-term, minor adverse impact to tourism and to recreational use. Fencing for cattle grazing could alter access during and after installation of fencing. Any trails that are cut off from the grazing area would be detoured so that the public can access remaining parts of the trail system; the grazing area would be approximately13acres so it is not anticipated that this would significantly detract from the public use of the trails.

Road Repair and Replacement.— MS TIG RP I/EA environmental consequences described for tourism and recreational use for the Graveline Bay Land Acquisition and Management Project (Section 3.3.1.4.2) and the Grand Bay Land Acquisition and Habitat Management Project (Section 3.4.1.4.2) are incorporated by reference where appropriate. Road repair and replacement activities would result in a short-term, minor adverse impact to tourism and recreational use due to the presence and operation of equipment to regrade and to improve the roadway and replacement of new roadway materials. Adverse impacts resulting from road repair would include limited public access during construction; the public would be notified of any closures or restrictions by communication methods used by MDMR. It is anticipated that the road repair would have long-term benefits for public access.

4.4.3.2.2 Hancock County Marshes Hancock County Marshes CP Habitat Management-Wachovia Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those short-term, minor adverse impacts described in Section 4.4.3.2.1 for chemical treatment, mechanical treatment, and prescribed fire. This project does not include prescribed grazing or road repair and replacement.

4.4.3.2.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those short-term, minor adverse impacts described in Section 4.4.3.2.1 for chemical treatment, mechanical treatment, and prescribed fire. This project does not include prescribed grazing or road repair and replacement.

4.4.3.2.4 Best Practices

For restoration measures and management activities (Table 4-1), efforts would be made to provide public notices before activities are implemented to reduce conflict for public access.

4.4.4 Land and Marine Management

Land and marine resources are managed through various local, regional, state, and federal entities across coastal Mississippi. The federal Coastal Zone Management Act (CZMA) of 1972

is implemented through the Mississippi Coastal Program (MCP). The MCP is the primary responsibility of the Office of Coastal Resources, Coastal Resources Management division, at the MDMR and was legislatively mandated in Section 57-15-6 of the Mississippi Code of 1972. The CZMA defines coastal zones wherein development must be managed to protect areas of natural resources unique to coastal regions and requires federal agency activities to be fully consistent with a state's approved coastal management program. In addition to coastal management responsibilities, the Coastal Resources Management division at MDMR also administers the CP Program. All of the project areas are owned and maintained by the MDMR CP. The restoration measures and management activities are consistent with the CP management plans and would require no local zoning change or amendments.

4.4.4.1 Affected Environment

4.4.4.1.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

The DuPont and Bell's Ferry tracts are part of the Wolf River CP in the Mississippi CP Program. The combined acreage of these tracts is approximately 931 acres.

Implementation of the project would not disrupt existing land management; therefore, no impact to land and marine management is expected.

4.4.4.1.2 Hancock County Marshes CP Habitat Management-Wachovia Tract

The 1,203-acre Wachovia tract is part of the Hancock County Marshes Preserve in the Mississippi CP Program. It is bounded by the Pearl River to the west. MDMR manages the area as a CP for conservation purposes to protect the ecological integrity of the habitats and its wildlife.

4.4.4.1.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

The 1.099-acre Dantzler tract is part of the Pascagoula River Marsh Preserve in the Mississippi CP Program. It is bounded by the West Pascagoula River to the east. MDMR manages the area as a CP for conservation purposes to protect the ecological integrity of the habitats and its wildlife.

4.4.4.2 Environmental Consequences

4.4.4.2.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

The environmental consequences for restoration measures and management activities (Table 4-1) for this project (with the exception of cattle grazing) are consistent with the current Wolf River CP management plan. Implementation of the project would not disrupt existing land management; therefore, no impact to land and marine management is expected.

4.4.4.2.2 Hancock County Marshes Hancock County Marshes CP Habitat Management-Wachovia Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.4.4.2.1 for chemical treatment, mechanical treatment, and prescribed fire. This project does not include prescribed grazing or road repair and replacement.

4.4.4.2.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.4.4.2.1 for chemical treatment, mechanical treatment, and prescribed fire. This project does not include prescribed grazing or road repair and replacement.

4.4.5 Public Health and Safety Including Flood and Shoreline Protection

4.4.5.1 Affected Environment

4.4.5.1.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Section 4.2.2.1.1 describes the project area's flood zones. The parking area for public access is located in Zone X which is outside of the 500-year floodplain. The majority of the public access road is in Zone AE and Zone X. There is a substantial marsh buffer between the public access areas and the shoreline of St. Louis Bay. It is anticipated that the conservation and management of the tract would facilitate habitat migration due to the sea-level rise in the future and hence, provide long-term benefit to the public by abating storm surge.

4.4.5.1.2 Hancock County Marshes CP Habitat Management-Wachovia Tract

Section 4.2.2.1.2 describes the project area's flood zones. The parking area and roadway for public access is outside of any flood zone. Majority of the hiking trails are outside of any flood zone and are in Zone AE but elevated using boardwalks and previously created earthen surfaces. There is a significant marsh buffer between the public access areas and the shoreline of the Pearl River. It is anticipated that the conservation and management of the tract would facilitate habitat migration due to the sea-level rise in the future and hence, provide long-term benefit to the public by abating storm surge.

4.4.5.1.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

Section 4.2.2.1.3 describes the project area's flood zones. The parking area and roadway for public access is outside of any flood zone. The majority of the hiking trails are in Zone AE and outside of any flood zone. There is a substantial marsh buffer between the public access areas and the shoreline of the West Pascagoula River. It is anticipated that the conservation and management of the tract would facilitate habitat migration due to the sea-level rise in the future and hence, provide long-term benefit to the public by abating storm surge.

4.4.5.2 Environmental Consequences

4.4.5.2.1 Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Chemical Treatment, Mechanical Treatment, and Prescribed Fire.—Public access would be restricted during the implementation of any restoration measures and management activities described in Table 4-1 which have the potential for adverse impacts to public health and safety (i.e., chemical treatment or prescribed fire). There would be short-term, minor adverse impacts to public health and safety. Exposure to smoke during prescribed fires would adversely impact public health, but these impacts are expected to be minor since prescribed fires are typical in this regions and short term. Chemical treatment would require use of herbicides, but most of the applications would be in remote areas where there is limited public access. Environmental consequences resulting from equipment operation/best practices and environmental consequences resulting from prescribed fire/best practices are similar to those described in sections 3.3.1.4.5 and 3.4.1.4.5 of the MS TIG RPI/EA.

Prescribed Grazing.—Prescribed grazing would not have an adverse impact to public health and safety, because cattle used for habitat management would be appropriately fenced from public access.

Road Repair and Replacement.—Restoration measures and management activities described in Table 4-1 would result in a short-term, minor adverse impact to public health and safety from the use of equipment to regrade and improve the roadway and replacement of new roadway materials. Environmental consequences resulting from road repair would include the use of heavy equipment during construction which would restrict public access for recreation. The public would be notified, and access restriction would be short in duration relative to the overall project. There could be long-term benefits to public health and safety resulting from the road repair and replacement once completed. Environmental consequences resulting from equipment operation/best practices and environmental consequences resulting from road repair and replacement are similar to those described in sections 3.3.1.4.5 and 3.4.1.4.5 of the MS TIG RPI/EA.

4.4.5.2.2 Hancock County Marshes Hancock County Marshes CP Habitat Management-Wachovia Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.4.5.2.1 for chemical treatment, mechanical treatment, and prescribed fire. This project does not include prescribed grazing or road repair and replacement.

4.4.5.2.3 Pascagoula River Marsh CP Habitat Management-Dantzler Tract

The environmental consequences for restoration measures and management activities (Table 4-1) are similar to those described in Section 4.4.5.2.1 for chemical treatment, mechanical treatment, and prescribed fire. This project does not include prescribed grazing or road repair and replacement.

4.4.5.2.4 Best Practices

Best practices for equipment operation and prescribed fire would be similar to those described in sections 3.3.1.4.5 and 3.4.1.4.5 of the MS TIG RPI/EA.

4.5 NO ACTION

According to the Final PDARP/PEIS, a No Action Alternative is considered a "… natural recovery alternative in which no human intervention would be taken to directly restore injured natural resources and services to baseline" (15 CFR 990.53(b)(2)).

Under the No Action Alternative, the MS TIG would not select and implement the restoration alternatives in this RP/EA to compensate for lost natural resources or their services resulting from the DWH oil spill. Therefore, the No Action Alternative would not meet the purpose and need for implementing alternatives that address lost natural resources for the WCNH restoration type and their services as described in Section 5.3.2 of the Final PDARP/PEIS and in Section 2.2 of this plan. The impacts from the No Action Alternative are summarized in Table 4-7. The impacts analysis for the No Action Alternative uses the same structure for environmental consequences as the other project alternatives in this Draft RPII/EA. There are no beneficial or short-term, adverse impacts for the No Action Alternative, therefore these will not be discussed in detail further in the document. Pursuant to NEPA, no action is included in the analysis as a benchmark against which to compare the environmental consequences of the action alternatives.

Table 4-7. Summary of Impacts from the No Action Alternative

Affected Environment Category	Adverse Short-Term Impact	Adverse Long-Term Impact	Beneficial Impact
Physical Resources			
Geology and Substrates	No Impact	No Impact	No Impact
Hydrology and Water Quality	No Impact	Minor	No Impact
Air Quality and GHG Emissions	No Impact	No Impact	No Impact
Biological Resources			
Habitats	No Impact	Moderate	No Impact
Wildlife	No Impact	Moderate	No Impact
Protected Species	No Impact	No Impact	No Impact
Socioeconomic Resources			
Socioeconomic and Environmental Justice	No Impact	No Impact	No Impact
Cultural Resources	No Impact	No Impact	No Impact
Land and Marine Management	No Impact	Minor-Moderate	No Impact
Public Health and Safety, Including Flood and Shoreline Protection	No Impact	Minor	No Impact

4.5.1 Environmental Consequences

Under the No Action Alternative, the MS TIG would not implement any projects for the WCNH restoration type at this time. This alternative would not contribute to long-term benefits to the affected environment over the course of the project life in the project areas.

4.5.1.1 Physical Environment

4.5.1.1.1 Geology and Substrates

The No Action Alternative would have no impact on geology and substrates because no restoration actions would occur that could result in soil compaction or erosion.

4.5.1.1.2 Hydrology and Water Quality

Under the No Action Alternative, none of the WCHN project alternatives would be implemented and restoration would not improve hydrological connectivity between the uplands, wetlands, and the receiving water body (St. Louis Bay) and overall enhancements to hydrology and water quality in the area.

4.5.1.1.3 Air Quality and GHG Emissions

The No Action Alternative would have no impact on air quality and GHG emissions because no restoration actions would occur that could result in degraded air quality from equipment use or prescribed fire activities.

4.5.1.2 Biological Resources

4.5.1.2.1 Habitats

Under the No Action Alternative, none of the WCNH project alternatives would be implemented and restoration would not contribute to the enhancement of habitats that are currently degraded and subjected to a lack of natural fire/prescribed grazing and invasive species proliferation. Allowing the natural recovery of habitats would cause moderate, long-term adverse impacts due to the continued spread of invasive species and inability to implement prescribed burns in the project areas.

4.5.1.2.2 Wildlife

Under the No Action Alternative, none of the WCNH project alternatives would be implemented and restoration would not contribute to the enhancement of habitats that directly benefits wildlife, including birds. Habitat provisions that wildlife depends on are currently degraded and subjected to a lack of natural fire and invasive species proliferation. Allowing the natural recovery of habitats would cause moderate, long-term adverse impacts due to the continued degradation of habitats that wildlife needs to survive and reproduce. This includes habitats with natural vegetation communities and pine savanna vegetation structure.

4.5.1.2.3 Protected Species

The No Action Alternative would have no impact on protected species because no restoration actions would occur that could result in impacts to threatened and endangered species in the project areas.

4.5.1.3 Socioeconomic Resources

4.5.1.3.1 Socioeconomic and Environmental Justice

Under the No Action Alternative, none of the WCNH project alternatives would be implemented. There would be no impacts on socioeconomics and environmental justice. The lack of restoration action implementation on state-owned lands does not have the potential to adversely impact or disproportionally affect minority or low-income populations economically, socially, or environmentally (i.e. health effects) per Executive Order 12898.

4.5.1.3.2 Cultural Resources

The No Action Alternative would have no impact on cultural resource because no restoration actions would occur that could result in adverse impacts to historic properties or archaeological sites.

4.5.1.3.3 Land and Marine Management

Under the No Action Alternative, none of the WCNH project alternatives would be implemented and restoration would not contribute to the enhancement of habitats that is the goal of the CP Program. No Action would hinder the CP program's current land use management activities to attain improved ecological integrity and therefore contribute to a long-term, minor-moderate adverse impact to land and marine management in the project areas.

4.5.1.3.4 Public Health and Safety, Including Flood and Shoreline Protection

Under the No Action Alternative, none of the WCNH project alternatives would be implemented and restoration would not contribute to the management of habitat to improve ecological integrity. Benefit to marsh migration and aid in storm surge reductions which could help protect public infrastructure and improve flood control and coastal resiliency would not be realized under the No Action Alternative, resulting in a minor long-term adverse impact.

4.5.2 Conclusion of the No Action Alternative

The No Action Alternative for this plan does not meet the MS TIG's goals and does not provide the significant environmental benefits to injured natural resources and services that would occur through active restoration. Additionally, the benefits to resources intended as a result of implementing the alternatives in this plan would not occur at this time.

4.6 COMPARISON OF IMPACTS OF THE ALTERNATIVES FOR WCNH

Table 4-8. Summary of Environmental Consequences for WCNH Projects in this Draft RPII/EANEPA

Tracts	Geology and Substrates	Hydrology and Water Quality	Air Quality and GHG	Habitats	Wildlife Species	Protected Species	Socioeconomic and Environmental Justice	Cultural Resources	Land and Marine Management	Tourism and Recreational Use	Public Health and Safety
Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts	Short-term to long-term-minor to moderate adverse impacts, Long-term benefit	Short-term minor to moderate adverse impacts, Long-term benefit	Short-term minor to moderate adverse impacts	Short-term minor to moderate adverse impacts, Long-term benefit	Short-term minor to moderate adverse impacts, Long-term benefit	No Impact	No Impact	No adverse impacts anticipated*	No Impact	Short-term minor adverse impact, Long-term benefit	No adverse Impact, Long-term benefit
Hancock County Marshes CP Habitat Management-Wachovia Tract	Short-term minor to moderate adverse impacts Long-term benefit	Short-term minor to moderate adverse impacts, Long-term benefit	Short-term minor to moderate adverse impacts	Short-term minor to moderate adverse impacts, Long-term benefit	Short-term minor to moderate adverse impacts, Long-term benefit	No Impact	No Impact	No adverse impacts anticipated*	No Impact	Same as described above for the Wolf River CP project	Same as described above for the Wolf River CP project
Pascagoula River Marsh CP Habitat Management-Dantzler Tract	Same as described above for the Hancock County Marshes CP Project	Short-term minor to moderate adverse impacts, Long-term benefit	Short-term minor to moderate adverse impacts	Short-term minor to moderate adverse impacts, Long-term benefit	Short-term minor to moderate adverse impacts, Long-term benefit	No Impact	No Impact	No adverse impacts anticipated*	No Impact	Same as described above for the Wolf River CP project	Same as described above for the Wolf River CP project
No Action***	No Impact	Long-term, minor	No Impact	Long-term, moderate	Long-term, moderate	No Impact	No Impact	No Impact	Long-term, minor to moderate	Long-term, minor	Long-term, minor

5.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES FOR OYSTERS ALTERNATIVES

5.1 INTRODUCTION

This chapter describes the affected environment and anticipated environmental impacts for all Oysters alternatives for this Draft RPII/EA. The proposed action (the selection of three alternatives for implementation) is summarized in Section 1.4. Section 3.3 provides the rationale for preferred versus non-preferred alternatives. The analysis of the No Action Alternative for oysters is summarized in Section 5.5. Cumulative impacts for Oyster and WCNH restoration alternatives are summarized in Section 5.7.

5.1.1 Tiering from the PDARP/PEIS

The discussion in Section 4.1.1 for WCNH alternatives is applicable to Oysters alternatives regarding tiering of the PDARP/PEIS where applicable and the use of PDARP/PEIS context and intensity and impacts (minor, moderate, major) definitions. The MS TIG would consider best practices referenced in Section 6.15 and Appendix 6A of the PDARP/PEIS. Additional best practices may be recommended for site-specific restoration measures and management activities. The MS TIG has completed technical assistance with USFWS and NOAA National Marine Fisheries Service (NMFS) and ESA consultations have been initiated for the WCNH alternatives. If a project is selected, MDEQ would implement BMPs agreed to during the technical assistance/consultation process.

5.1.2 Incorporation by Reference of Previous NEPA Analyses

The discussion in Section 4.1.2 for WCNH alternatives is applicable to Oysters alternatives regarding incorporation of relevant information from existing NEPA analyses. For Oysters projects, this Draft RPII/EA incorporates by reference appropriate portions of the Affected Environment and Environmental Consequences from the following restoration plans:

- DWH Trustees. 2014. Deepwater Horizon Oil Spill Final Phase III Early Restoration Plan and Early Restoration Programmatic Environmental Impact Statement. https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/ERP-PEIS-Part-3-Chapter-10-through-Chapter-11.pdf.
- DWH Trustees DWH Trustees. 2015. Deepwater Horizon Oil Spill Final Phase IV Early Restoration Plan and Environmental Assessments https://www.fws.gov/doiddata/dwh-ar-documents/1126/DWH-AR0294749.pdf https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/Final-Phase-IV-ERP-EA.pdf
- DWH Trustees 2016. Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement (PDARP/PEIS). https://www.fws.gov/doiddata/dwh-ar-documents/1138/Front-Matter-and-Chapter-1_Introduction-and-Executive-Summary_508.pdf

- DWH Trustees 2016. Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement (PDARP/PEIS). https://www.fws.gov/doiddata/dwh-ar-documents/1138/Chapter-6_Environmental-Consequences_508.pdf

5.1.3 Resources Not Analyzed in Detail in this Plan for Oysters Alternatives

As appropriate in a tiered analysis, the evaluation of each alternative focuses on the specific resources with a potential to be affected by the project. To avoid redundant or unnecessary information, resources that are expected to be minimally affected based on previous analyses conducted in the above-mentioned documents, and are not expected to differ substantially in impacts for any of the alternatives, are not evaluated further in this Draft RPII/EA. For Oysters projects these resources include air quality and greenhouse gases, noise, socioeconomic and environmental justice, infrastructure, and tourism and recreational use, and are briefly summarized below. This Draft RPII/EA incorporates by reference Section 6.2.7 of the Phase IV FERP/EA which provides the rationale for determining why each of these resources would only be minimally affected. Review of the baseline affected environments and environmental consequences identified in the incorporated NEPA analyses concludes the information is current and relevant to the alternatives considered in this Draft RPII/EA. The MS TIG finds no new relevant environmental concerns with the Oysters alternatives that would change the following outcomes.

- Air quality and greenhouse gases: Phase IV FERP/EA Section 6.2.7 states that "Jackson, Harrison and Hancock counties are classified as in attainment, meaning criteria air pollutants do not exceed National Ambient Air Quality Standards (NAAQS).… the project would have no long-term impacts on air quality or to emissions of greenhouse gases."
- Noise: Phase IV FERP/EA Section 6.2.7 states that "noise impacts would be restricted to a brief construction window and would be short-term minor impacts with little or no long-term impact to ambient noise conditions. In addition, the construction activities are primarily in-water work and would not be directly adjacent to residential and commercial development."
- Socioeconomic and environmental justice: Phase IV FERP/EA Section 6.2.7 states that "Socioeconomic impacts would be beneficial and short-term. The relatively small and remote construction activities are not expected to create a disproportionately high and adverse effect on minority or low-income populations."
- Infrastructure: Phase IV FERP/EA Section 6.2.7 states that "There would be limited storage and movement of land-based material storing and therefore limited, short-term impacts to infrastructure, if any."
- Tourism and recreational use: Phase IV FERP/EA Section 6.2.7 states that "Construction would result in short-term adverse impacts to recreational activities, primarily fishing and boating."

Other Resources Not Analyzed in Detail in This Plan.—The MS TIG also eliminates the detailed analysis of effects to the following resources in this Draft RPII/EA: marine

transportation, and public health and safety because no adverse impacts are anticipated. Brief summaries of the rationale are provided below.

Marine Transportation.—No impacts on marine transportation are anticipated. There could be negligible increases in local daily marine traffic volumes during cultch deployment resulting in perceived inconvenience to operators but no actual disruptions to transportation. These are subtidal reefs and clearance to navigation would be incorporated during design. Oyster gardening would occur on piers and would have no effect on marine transportation.

Public Health and Safety.—Actions are not expected to result in any impacts to public health and safety described in PDARP/PEIS Table 6.3-2. Safety risks would be mitigated by using standard safety procedures including signage, notification to MDMR Marine Patrol, notification to mariners, installation of temporary buoys and lighting, and observing oyster reef work safety practices. Installation of navigational markers and mapping of reefs on Coast Guard Navigational Maps would be a post-installation practice where applicable.

5.1.4 Oyster Restoration Activities Included in this Analysis

Oyster restoration activities for cultch deployment and oyster gardening are summarized in Table 5-1. Table 5-1 also includes the frequency and the duration of impact for restoration activities associated with cultch deployments and oyster gardening activities and will be referred to throughout the environmental consequence discussion in this chapter.

Table 5-1. Restoration Activities for Oysters in this Draft RPII/EA

Anticipated Oyster Restoration Activities*	General Description of Restoration Activity	Duration	Oyster Spawning Reefs Alternatives	MS Oyster Gardening Program
Cultch Deployment on existing oyster reefs (defined as areas with evidence of live oysters or previously existing live oysters	Approximately 1 inch up to several feet of cultch deployed by clamshell bucket or high-pressure water jet in selected areas ranging in depth from 0 to -10 feet MLLW. Distribution of cultch in undulating mound and inter-mound areas or as an evenly distributed reef bed.	one to several weeks for each deployment, depending on size of deployment	X	N/A
Cultch Deployment on suitable substrate-not colonized (Defined as firm mud, existing oyster reefs, or other hard bottom substrates that are required to support oysters)	Approximately 1 inch up to several feet of cultch deployed in selected areas ranging in depth from 0 to 10 feet MLLW. Siting would depend on bathymetry, salinity, substrate suitability and other factors. Deployment by clamshell bucket or high-pressure water jet. Distribution of cultch in undulating mound and intermound areas or as an evenly distributed reef bed.	one to several weeks for each deployment, depending on size of deployment	X	N/A
Cultch Deployment on soft bottom substrate/buried hard substrate (defined as suitable hard substrates which may now have a thin veneer of soft sediments); this is not the preferable or intended substrate for cultch placement and would make up less than 10% of the total placement areas.	Approximately 6 inches to several feet of cultch deployment in selected areas ranging in depth from 0 to-10 feet MLLW. Siting would depend on depth to suitable substrate, bathymetry, salinity, and other factors. Deployment by clamshell bucket or high-pressure water jet. Distribution of cultch in undulating mound and inter-mound areas or as an evenly distributed reef bed.	one to several weeks for each deployment, depending on size of deployment	X	N/A
Deployment of Spat Inoculated Cultch on hard substrate	Technique to enhance oyster colonization on a new cultch deployment, an existing reef, or a developing reef. Deployment density and thickness varies by type of material and application. Deployment methods would vary depending on materials; placement by hand or using methods for discrete placement of inoculated materials, by clam shell bucket or similar device, or other methods.	one to several weeks for each deployment, depending on size of deployment	X	N/A
Oyster Gardening Basket Placement	Each oyster gardening site would consist of approximately 2 – 4 baskets that would hang from waterfront piers/wharves and docks. Baskets would be suspended approximately 12 inches off the water bottom. Each gardening site would receive one bag of spat set on whole shell (10 shells) to be divided among the baskets to grow sub-adult oysters. Every 7-10 days, baskets would be pulled from the water and shaken at the water surface to remove mud and other loose fouling agents. Baskets would be hosed off to remove algal growth and each basket would be opened and any predators (drill, crab, etc.) removed. As the season progresses, gardeners would place baskets in the shade to allow desiccation to destroy any early barnacle set and further control algal growth.	Years 1-5	N/A	X
Placement of sub-adult oysters from oyster gardens on existing oyster reefs	Oysters produced by the program would be enough to create approximately 3 acres of reef across the lifespan of the project, which would be placed at suitable reef locations in the Mississippi Sound.	Years 1 -5	N/A	X
* These are the oyster restoration activities currently anticipated for Draft RPII/EA. X indicates that the restoration activity would occur in the project area. N/A=Not Applicable				

Project activities could be refined during engineering and design phases and if so, MDEQ would determine whether or not additional environmental review would be required and coordinate with the MS TIG as necessary. Federal and state permits that would be required for oyster cultch deployment activities also include environmental review.

The affected environment and environmental consequences for the Oysters alternatives are discussed in the following sections as follows:

Section 5.2 Physical Resources
Section 5.3 Biological Resources
Section 5.4 Socioeconomic Resources
Section 5.5 Comparison of Impacts of the Alternatives for Oysters
Section 5.6 No Action
Section 5.7 Cumulative Impacts for RPII/EA

5.2 PHYSICAL RESOURCES

Sections 6.4.12.1.1 of the PDARP/PEIS describe the impacts to Physical Resources for the relevant restoration approaches and are incorporated by reference and briefly described here.

PDARP/PEIS environmental consequences related to physical resources.—Short-term, minor adverse impacts on physical resources would be anticipated as a result of cultch deployment. Short-term, minor adverse impacts on geology, substrates, and water quality could result from activities such as anchoring marker buoys and signs for reserve areas, including increased turbidity and reduced water clarity. Long-term benefits to substrates would be anticipated as a result of the placement of oyster shell or another suitable substrate for oyster recruitment. Placement of reefs may reduce wave energy reaching shorelines, which may reduce erosion of shorelines and stabilize substrates. Long-term benefits to water quality could also occur due to increased filter feeding by oysters.

For Oysters alternatives in this Draft RPII/EA, environmental consequences are within the general range of impacts as described in the PDARP/PEIS (summarized above) with some variances related to specific actions. Table 5-2 summarizes the adverse and beneficial impacts to physical resources as a result of the Oyster Spawning Reefs in Western Mississippi, the Oyster Spawning Reefs in Eastern Mississippi, and the Oyster Spawning Reefs in Mississippi Alternatives.

Table 5-2. Oyster Spawning Reef Alternatives Impact Summary for Physical Resources

Resource	Short-Term Impacts from Project Activities	Long-Term Impacts from Project Activities	Beneficial Impacts from Project Activities
Geology and Substrates	Minor	Minor	Long-Term
Hydrology and Water Quality			
Hydrology	No Impact	No Impact	No Impact
Water Quality	Minor	No Impact	Long-Term

Table 5-3 summarizes the adverse and beneficial impacts to physical resources as a result of the Mississippi Oyster Gardening Alternative.

Table 5-3. Mississippi Oyster Gardening Program Alternative Impact Summary for Physical Resources

Resource	Short-Term Impacts from Project Activities	Long-Term Impacts from Project Activities	Beneficial Impacts from Project Activities
Geology and Substrates	No Impact	No Impact	Long-Term
Hydrology and Water Quality			
Hydrology	No Impact	No Impact	No Impact
Water Quality	Minor	No Impact	Long-Term

5.2.1 Geology and Substrates

Section 3.3.3 of the PDARP/PEIS discusses the geomorphological zones of the northern Gulf of Mexico. The project area for all alternatives is located within the Gulf Coastal Plain and the Mississippi Alluvial Plain physiographic regions. Landforms and substrates are generally comprised of Holocene sediments and are similar to geology and substrates described in the Phase III FERP/PEIS for the Hancock County Marsh Living Shoreline Project (Section 10.3.6.3) and the Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project (6.2.7.1.1).

5.2.1.1 Affected Environment

5.2.1.1.1 Oyster Spawning Reefs in Western Mississippi

The project area is located within the Gulf Coastal Plain and the Mississippi Alluvial Plain physiographic regions. Specifically, sites are located in the St. Louis Bay, Heron Bay, Biloxi Bay, Back Bay, and the Mississippi Sound adjacent to those bays. Substrates are generally comprised of Holocene sediments. These sediments are composed of sand, silt, and clay with comparatively high organic matter content. The coastal estuaries of Mississippi are composed of mostly sandy fine-grained sediment, silt, and clays (Schmid 2015). The project would be constructed in estuarine shallow water and shallow open water. The habitats can be divided into two classes - intertidal and subtidal. Intertidal zones (typical tidal range of 0.5 ft.) near the project areas are generally composed of mud flats and small areas of natural sand beach. In general, the nearshore subtidal habitat is composed mostly of unconsolidated bottom types including sand, muddy sand, and mud bottom. It is anticipated that the project activities would be completed in subtidal areas.

Seismic activity in the project area is low. Since the late 1800s, about ten earthquakes large enough to be detected have occurred in the Gulf of Mexico. These earthquakes were mostly small-magnitude events (magnitudes of 3 to 4 on the Richter scale).

5.2.1.1.2 Oyster Spawning Reefs in Eastern Mississippi

The project area is located within the Gulf Coastal Plain and the Mississippi Alluvial Plain physiographic regions. Specifically, sites are located in the Pascagoula Bay, Graveline Bay, and Grand Bay, and the adjacent Mississippi Sound to those bays. Geology and substrates of these areas are similar to those described in Section 5.2.1.1.1.

5.2.1.1.3 Oyster Spawning Reefs in Mississippi

The project area is located within the Gulf Coastal Plain and the Mississippi Alluvial Plain physiographic regions. Specifically, sites are located in the St. Louis Bay, Heron Bay, Biloxi Bay, Back Bay, Pascagoula Bay, Graveline Bay, and Grand Bay, and the adjacent Mississippi Sound to those bays. Geology and substrates of these areas are similar to those described in Section 5.2.1.1.1.

5.2.1.1.4 Mississippi Oyster Gardening Program

The project area consists of waterfront piers/docks along the Mississippi coastline and suitable reefs in the Mississippi Sound. Oysters produced by the program would be enough to create approximately 3 acres of reef over the lifespan of the program, which would be placed at suitable locations in the Mississippi Sound. Geology and substrates of these areas are similar to those described in Section 5.2.1.1.1.

5.2.1.2 Environmental Consequences

Environmental consequences to geology and substrates resulting from the restoration activities and management activities described in Table 5-2 and Table 5-3 are summarized in this section. Phase IV FERP/EA environmental consequences described for geology and substrates in Section 6.2.7.1.1 are incorporated by reference and included in the summary analysis below.

5.2.1.2.1 Oyster Spawning Reefs in Western Mississippi

Cultch deployment on suitable substrate that is not colonized by oysters and cultch deployments on soft bottom substrate/buried hard substrate: These cultch deployment restoration activities (Table 5-1) would have a long-term, minor adverse effect on substrates which would be converted, over time, to viable oyster reef. After the cultch has been colonized, the reef would provide hard substrate, and long-term benefit to substrates. If spawning reefs are placed near the shore, cultch deployment and resulting oyster reef development could reduce wave energy, which could provide a long-term beneficial effect by reducing shoreline erosion and stabilizing sediments in the vicinity of the cultch deployment areas.

Cultch deployment on existing oyster reefs and deployment of spat inoculated cultch on hard substrate.—These cultch plants (Table 5-1) would have no impact to geology and substrates as the deployments would occur on existing reefs or cultch. There would be a long-term beneficial impact on substrate in the project area through the increase in hard bottom and reef elevation as a result of the placement of cultch on reefs or spat-inoculated cultch on hard substrate.

5.2.1.2.2 Oyster Spawning Reefs in Eastern Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.2.1.2.1 and are summarized in Table 5-2.

5.2.1.2.3 Oyster Spawning Reefs in Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.2.1.2.1 and are summarized in Table 5-2.

5.2.1.2.4 Mississippi Oyster Gardening Program

Restoration activities for oyster gardening summarized in Table 5-3 would result in no impacts to geology and substrates as the baskets would be suspended from piers. The project-produced oysters placed on reefs would have a beneficial effect on geology and substrates, enhancing approximately three acres of reef across the lifespan in suitable locations within the Mississippi Sound.

5.2.2 Hydrology and Water Quality

Section 3.3.2 of the PDARP/PEIS addresses river flows on the Northern Gulf geography and water quality. Section 6.14.2 discusses future sea level rise, storm surge, and storm intensity projections and is incorporated by reference here. For the alternatives, the affected hydrological resources consist of open water in the Mississippi Sound, as well as shallow water habitats such as tidal creeks, bayous, and bays. Since the projects would not be conducted in wetlands or floodplain areas, impacts to wetlands and floodplains are not anticipated and are not discussed in this section. Hydrological characteristics are similar to those described in Phase III FERP/PEIS for the Hancock County Marsh Living Shoreline Project (Section 10.3.6.4) and Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project (Section 6.2.7.1.2).

5.2.2.1 Affected Environment

5.2.2.1.1 Oyster Spawning Reefs in Western Mississippi

Hydrology and Water Quality for the Oyster Spawning Reefs in Western Mississippi project are described in this section.

Hydrology.—The affected resources consist of shallow water habitats such as tidal creeks, lagoons, bayous, and bays in the western Mississippi Sound including St. Louis Bay, Heron Bay, Back Bay of Biloxi, and the adjacent inshore areas. These areas are influenced by freshwater flow from coastal rivers and streams as well as by tidal action from the marine system.

The project area is in the Lower Pearl River watershed (HUC 8 – 03180004) and the Mississippi Coastal Streams watershed (HUC 8 – 0317009) (Figure 5-1). The Lower Pearl River watershed has a drainage area of approximately 8,760 square miles and includes portions of St. Tammany and Washington parishes in Louisiana and Hancock, Lamar, Marion, and Pearl River counties in Mississippi. Major tributaries within the Lower Pearl watershed include the Pearl River, Yockanookany River, Lobutcha Creek, Strong River, and the Bogue Chitto River.

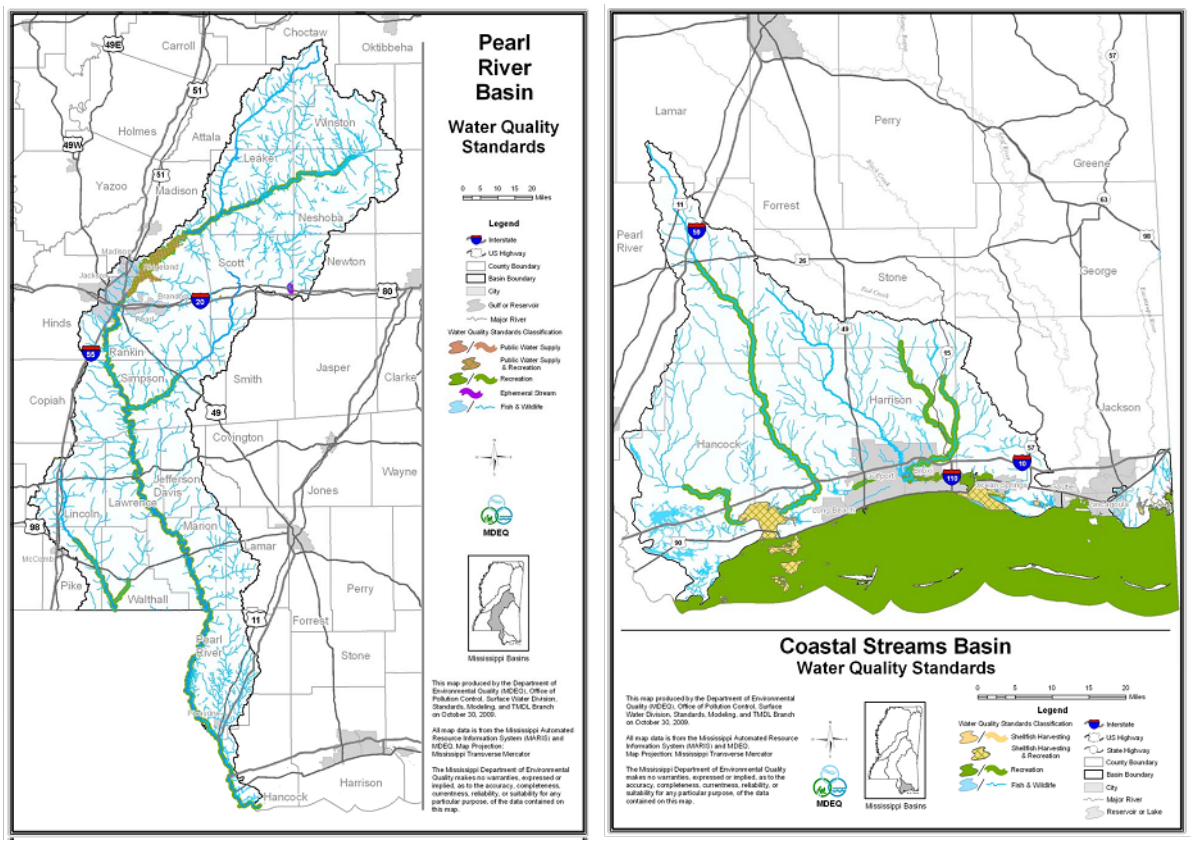


Figure 5-1. Pearl River Basin and Coastal Streams Basin Water Quality Standards Classifications

The Mississippi Coastal Streams watershed drainage area is approximately 1,550 square miles (MDEQ 2012) and includes portions of Lamar, Hancock, Pearl River, Stone, Harrison, and Jackson counties (Figure 5-1). Major tributaries within the Mississippi Coastal Streams watershed include Bayou Casotte, Wolf River, Rotten Bayou, DeLisle Bayou, Bayou La Croix, Bayou Bacon/Jourdan River, Turkey Creek/Bernard Bayou, Biloxi River, and Tuxachanie Creek.

Water Quality.—There are numerous freshwater inputs into Mississippi's bays, estuaries, and the Mississippi Sound, including inputs from urban systems, that result in alterations to water quality. Pollution from agriculture, improperly treated sewage, roadways, accidental spills, industry discharges, and other sources also affect the water quality health of the Mississippi Sound. This change in water quality is often associated with changes in water column conditions (i.e., hypoxia, eutrophication, and bacterial loads), and can also lead to the body of water not meeting its intended use (i.e., recreation or fishery).

A large driver in oyster reef ecology is the balance of fresh and marine water to create the appropriate salinity range for oyster growth. Marine water inputs enter the Mississippi Sound primarily through the barrier island passes which form the boundary between estuarine conditions and open ocean Gulf waters. Major rivers such as the Pearl River contribute substantial amounts of freshwater into the western Mississippi Sound that helps create the estuarine environment conducive for oyster growth. Additionally, freshwater drainage from smaller rivers contribute to the mixing zone in bays and bayou (e.g. Wolf River to St. Louis Bay). The western portion of the Sound is also influenced by freshwater contribution from Lake

Pontchartrain and is prone to large influxes of fresh water from the management of the Bonnet Carre Spillway on the Mississippi River above New Orleans. The spillway has operated since the 1930's and has been opened at different times and capacities. Freshwater inputs from the spillway have been documented to have adverse and detrimental impacts to resources including oysters in the western Mississippi Sound (MGCRP; MDEQ and NFWF, 2017).

Salinity values in the project areas vary intra-annually and are primarily influenced by changes in freshwater inputs from river systems. The area's salinity regime can generally be partitioned into two seasons, high and low, with transitional increasing and decreasing regimes in between. The regime depicted during the high salinity season is typically the time of year with the lowest freshwater inflow to estuaries. In coastal Mississippi, the high season occurs during the winter months. Conversely, the low salinity season, typically the time of year with the highest freshwater inflow to estuaries, occurs during the summer months. Transitional increasing and decreasing regimes occur during spring and fall months (Nelson, 2015). The following salinity categories are used to bin salinity values: Oligohaline (0.5-5 ppt), Mesohaline (5-15 ppt), and Polyhaline (15-25 ppt). As discussed above, typical salinity regimes can be altered by anthropogenic forcing as evidenced by the opening of the Bonnet Carre Spillway and can result in habitat degradation and modifications.

Typical salinity regimes in the project area are oligohaline year-round in Heron Bay and the adjacent unconsolidated bottom areas. This is due primarily to the freshwater inflow influence from the Pearl River. St. Louis Bay and Back Bay of Biloxi estuarine embayments exhibit oligohaline in the low season to mesohaline and polyhaline in the high season. In the adjacent unconsolidated bottom areas of the Mississippi Sound, salinity ranges from mesohaline in the low season to polyhaline in the high season.

The following sections discuss water quality in the context of Mississippi's water quality standards and state shellfish growing areas that are directly linked to water quality conditions in the project area.

Water Quality Standards.—The project area is represented by three classifications as designated by the state. These include "recreational", "shellfish harvesting", "shellfish harvesting and recreation", and "fish and wildlife" as shown in Figure 5-2. All state waters are in the fish and wildlife classification and are intended for fishing, and for propagation of fish, aquatic life, and wildlife. Coastal waters also in the recreational classification are to be suitable for recreational purposes, including water contact activities such as swimming and water skiing. Waters also in the shellfish harvesting classification are for propagation and harvesting shellfish for sale or use as a food product. Total Maximum Daily Load (TMDLs) document the acceptable amount of a specific pollutant a waterbody can receive and attain water quality standards in the future if implemented. The waterbodies that flow into or are a direct part of the project area that are listed for impairment in the Mississippi 2018 Section 303(d) List of Impaired Water Bodies (MDMR 2018) are listed in Table 5-4.

Table 5-4. List of Impaired Water Bodies in the Oyster Spawning Reefs in Western Mississippi Project Area

Waterbody	Pathogens
St. Louis Bay	Pathogens
Canal # 3	Total Nitrogen, Total Phosphorus
Mallini Bayou	Pathogens, Total Nitrogen, Total Phosphorus
Wolf River	Pathogens
Bayou DeLisle	Pathogens
Cutoff Bayou	Pathogens, Total Nitrogen, Total Phosphorus
Jourdan River	Pathogens
Joe's Bayou	Pathogens
Bayou Caddy	Sediment, Total Toxics Acute, Total Toxics Chronic, Turbidity
Pearl River	Sediment, Total Nitrogen, Total Phosphorus
Back Bay of Biloxi	Pathogens
Big Lake	Pathogens
Biloxi Bay	Pathogens
Old Fort Bayou	Pathogens

MDMR regulates the harvesting of oysters in the Mississippi Sound and has classified state waters into five state shellfish growing areas (MDMR 2013) (Figures 5-2 and 5-3) that are linked to water quality sanitary surveys. State shellfish growing areas in the project area include Approved, Conditionally Approved, Restricted, and Prohibited.

Definitions are provided here:

- An APPROVED AREA is the classification of a state shellfish growing area, which has been approved by the State Shellfish Control Authority (SSCA) for growing or harvesting shellfish for direct marketing. The classification of an approved area is determined through a sanitary survey conducted by the SSCA. An approved shellfish growing area may be temporarily closed when a public health emergency such as a hurricane or flooding is declared.
- A CONDITIONALLY APPROVED AREA is the classification of a state shellfish growing area determined by the SSCA to meet approved area criteria for a predictable period. The period is conditional upon established performance standards specified in a management plan. A conditionally approved shellfish growing area is closed by the SSCA when it does not meet the approved growing area criteria.
- RESTRICTED AREAS are state waters that have been classified by the SSCA as an area from which shellfish may be harvested only by permit from the SSCA and are subjected to suitable and effective treatment through relaying.
- PROHIBITED AREAS are growing waters where there is no current sanitary survey or where the sanitary survey or other monitoring program data indicate that fecal material, pathogenic microorganisms, deleterious substances, marine toxins, or radionuclides may reach this area in excessive concentrations. The taking of shellfish for any human food purposes from such areas is prohibited.

- UNCLASSIFIED AREAS are waters that are presently unclassified and from which the harvest of shellfish is prohibited pending classification based on a sanitary survey of the area.

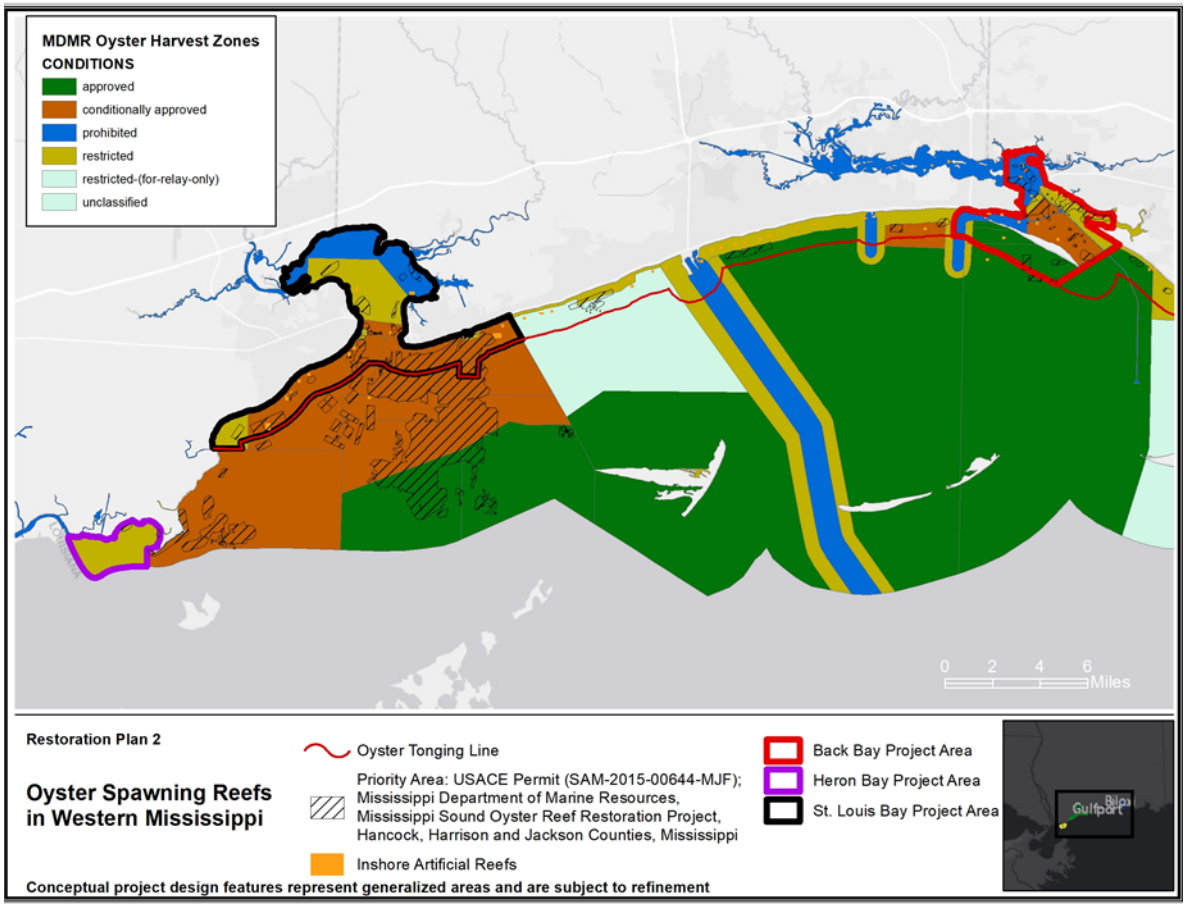


Figure 5-2. Oyster Spawning Reefs in Western Mississippi-State Shellfish Growing Areas

5.2.2.1.2 Oyster Spawning Reefs in Eastern Mississippi

Hydrology and Water Quality for the Oyster Spawning Reefs in Eastern Mississippi project are described in this section.

Hydrology.—The affected resources consist of shallow water habitats such as tidal creeks, bayous, and bays in the eastern Mississippi Sound including Pascagoula Bay, Graveline Bay, Grand Bay, and the adjacent nearshore areas. These areas are influenced by freshwater flow from coastal rivers and streams as well as by tidal action from the marine system.

The project is located in the Mississippi Coastal Streams watershed as described in Section 5.2.2.1.1 of this plan.

Water Quality.—Water quality characteristics are similar as described in Section 5.2.2.1.1. Major rivers include the Pascagoula River, which contributes much of the freshwater flow and sediment loads into the eastern Mississippi Sound. Freshwater drainage from smaller streams contribute to the mixing zone in bays and bayous. The eastern Mississippi Sound also receives water inputs from Alabama through longshore current transport from the southwestern side of Mobile Bay (Cedar Point). Thus, there is nutrient and pollutant transport from the large river systems in the Mobile Delta to the eastern Mississippi Sound. The eastern Sound can be impacted from flows coming out of the Bonnet Carre spillway; although, it is less prominent in terms of freshwater inflow and alterations to the salinity regime. The 2019 spillway openings have had impacts in the eastern Sound including harmful algal blooms as far east as the Grand Bay NERR.

Typical salinity regimes in the project area include oligohaline in the estuarine embayments to mesohaline and polyhaline in the unconsolidated bottom areas of the Mississippi Sound. As described in Section 5.3.2.1.1, salinity ranges are seasonal with lower values in the summer months.

Water Quality Standards.—The project area is represented by three classifications as designated by the state. These include "recreational", "shellfish harvesting", "shellfish harvesting and recreation", and "fish and wildlife use" as shown in Figure 5-1 and described in Section 5.2.2.1.1. The waterbodies that flow into or are a direct part of the project area that are listed for impairment in the Mississippi 2018 Section 303(d) List of Impaired Water Bodies (MDMR 2018) are summarized in Table 5-5.

Table 5-5. List of Impaired Water Bodies in the Oyster Spawning Reefs in Eastern Mississippi Project Area

Waterbody	Pollutant
Biloxi Bay	Pathogens
Graveline Bayou	Fecal Coliform
West Pascagoula River	Mercury
East Pascagoula River	Mercury
Lake Yazoo	Hydrocarbons, Phenols, Total Toxics Acute, Total Toxics Chronic
Bangs Lake	Pathogens

State Shellfish Growing Areas.—Figure 5-3 shows the state shellfish growing areas for the Oyster Spawning Reefs in Eastern Mississippi project area(s).

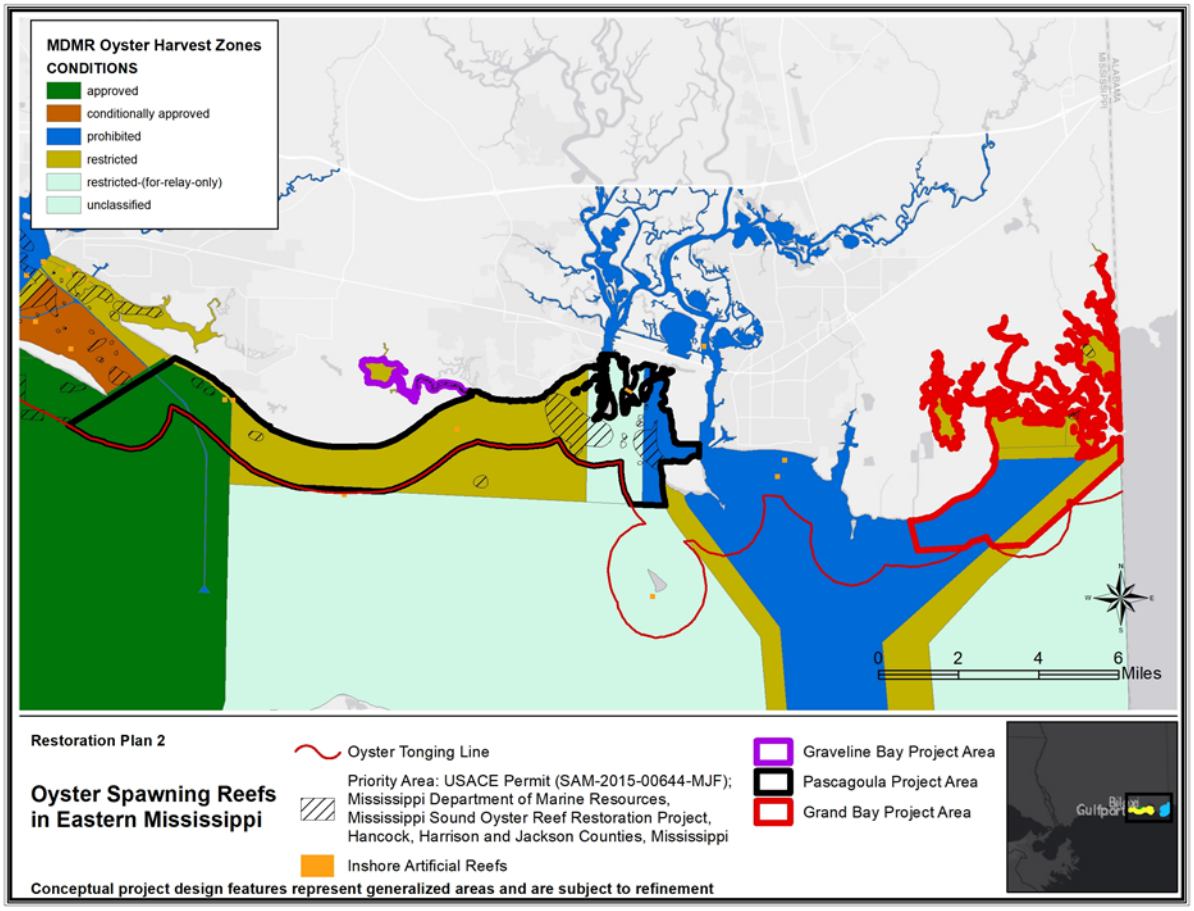


Figure 5-3. Oyster Spawning Reefs in Eastern Mississippi-State Shellfish Growing Areas

5.2.2.1.3 Oyster Spawning Reefs in Mississippi

This alternative combines the Oyster Spawning Reefs in Western Mississippi and the Oyster Spawning Reefs in Eastern Mississippi, so the affected environment for hydrology and water quality would be the combination of the descriptions above in 5.2.2.1.1 and 5.2.2.1.2 (Figure 5-4).

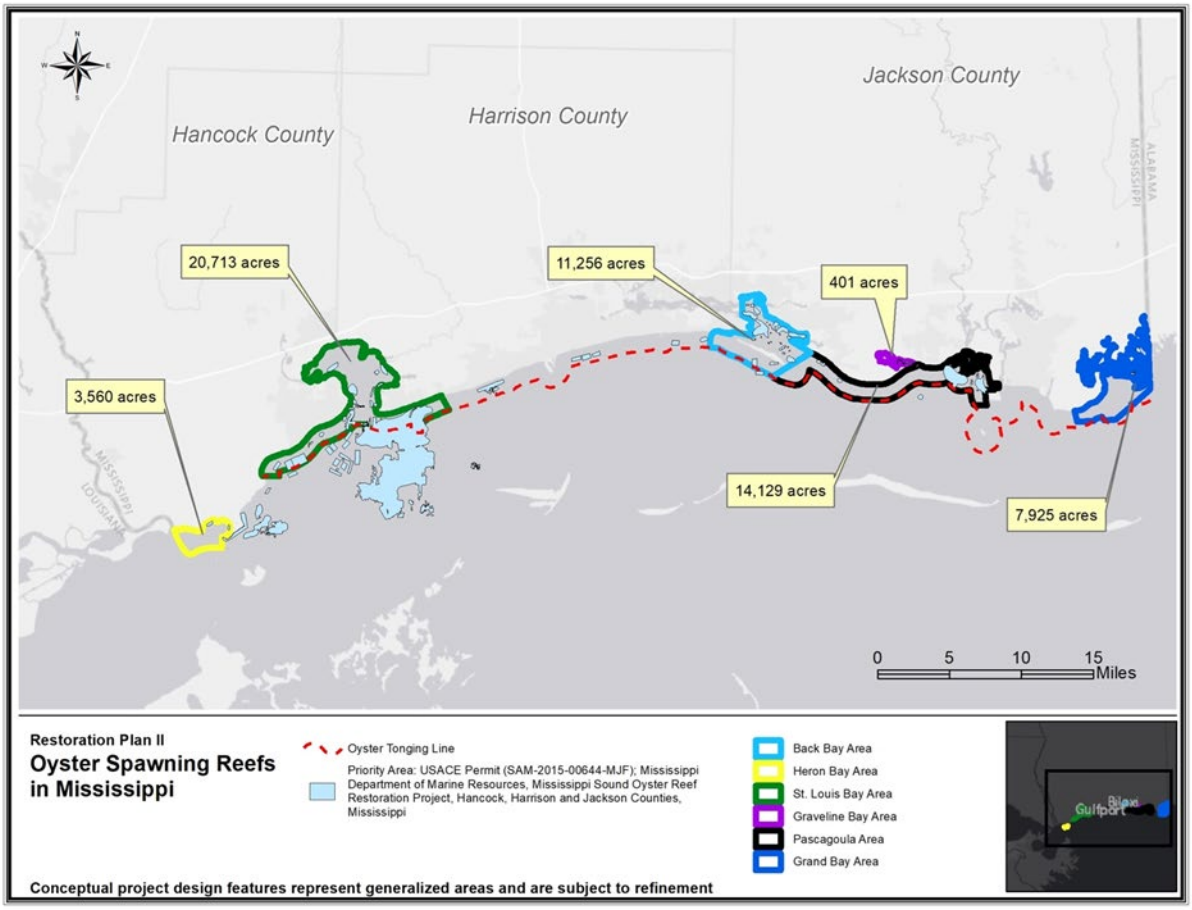


Figure 5-4. Oyster Spawning Reefs in Mississippi Project Area

5.2.2.1.4 Mississippi Oyster Gardening Program

The project area consists of waterfront piers/wharves and docks along the Mississippi coastline (oyster gardening) and suitable oyster reefs in the Mississippi Sound (placement). Oysters produced by the program would be enough to create approximately three acres of reef which would be placed at a suitable location in the Mississippi Sound (Figure 5-5). The affected environment for hydrology and water quality for this project would be similar to that described in Sections 5.2.2.1.1 and 5.2.2.1.2.

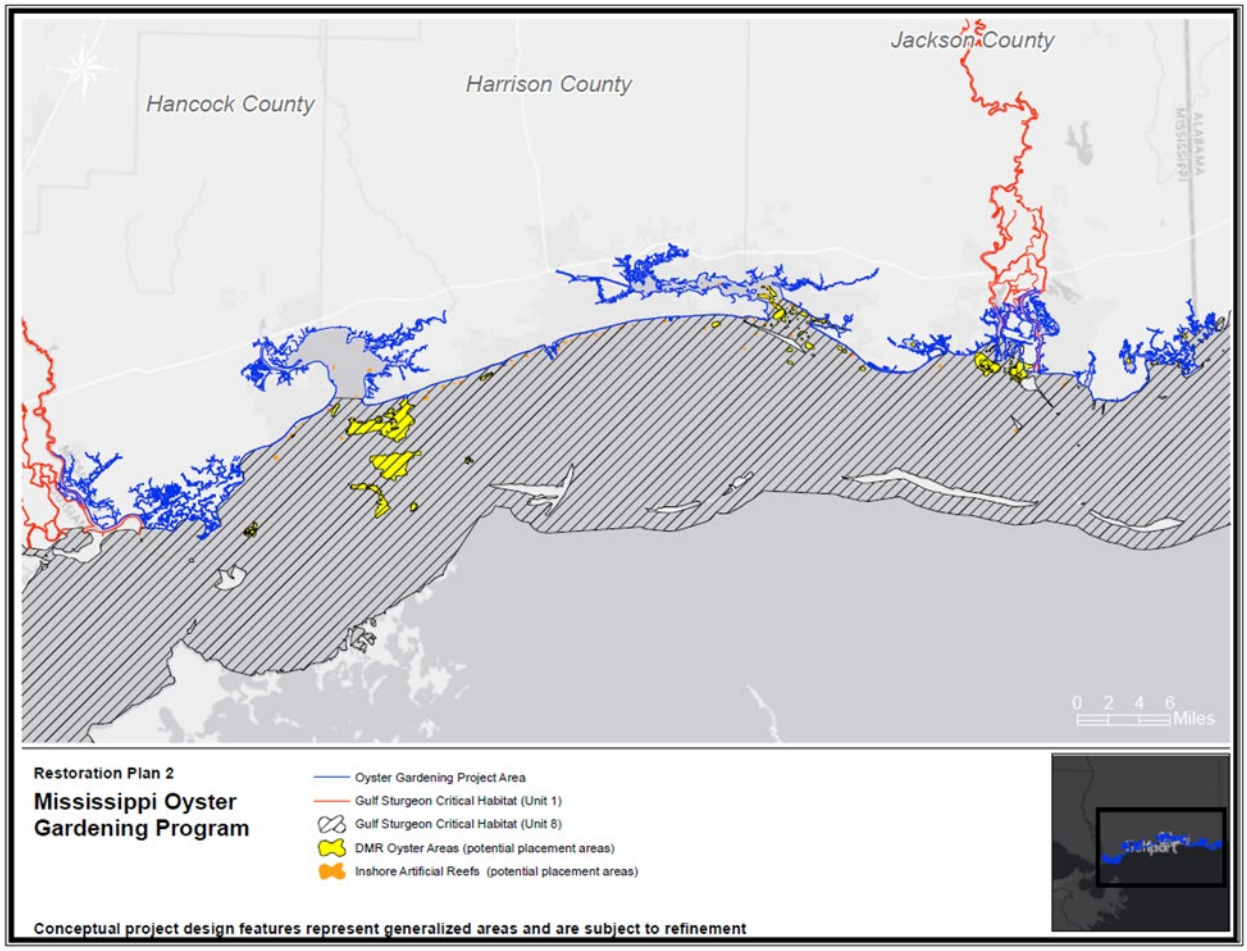


Figure 5-5. Mississippi Oyster Gardening Program-Project Area

5.2.2.2 Environmental Consequences

Environmental consequences to hydrology and water quality resulting from the restoration activities described in Table 5-2 and Table 5-3 are summarized in this section. Phase IV FERP/EA environmental consequences described for hydrology and water quality in Section 6.2.7.1.2 are incorporated by reference where appropriate and included in the summary analysis below.

5.2.2.2.1 Oyster Spawning Reefs in Western Mississippi

There would be no impacts to hydrology as a result of implementing cultch deployment restoration activities described in Table 5-1. The following environmental consequences are for water quality impacts only.

Cultch deployment on suitable substrate that is not colonized by oysters and cultch deployment on soft bottom substrate/buried hard substrate: These cultch deployments could result in minor, short-term adverse impacts to water quality, primarily from increases in turbidity from cultch deployment construction activities. Cultch material would be off-loaded from barges or other vessels to the surface of the water. There would be some mixing of cultch residue in the water

column during deployment. In addition, the cultch material would settle on the water bottom/substrate causing short-term mixing of the substrate sediments in the water column. It is anticipated that the sediments would return to the water bottom a short time after disturbance. Additionally, short-term, minor adverse impacts to water quality could result from activities such as anchoring marker buoys and installing signs to mark cultch deployment areas.

Cultch deployment on existing oyster reefs and deployment of spat inoculated cultch on hard substrates.—These deployments would have minor, short-term impacts to water quality. Although there would some mixing of cultch residue in the water column during deployment, the materials would settle on existing reef/cultch and there would no mixing of cultch with soft sediments.

Long-term benefits to water quality could also occur due to increased filter feeding by oysters after the cultch is colonized.

5.2.2.2.2 Oyster Spawning Reefs in Eastern Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.2.2.2.1 and are summarized in Table 5-2.

5.2.2.2.3 Oyster Spawning Reefs in Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.2.2.2.1 and are summarized in Table 5-2.

5.2.2.2.4 Mississippi Oyster Gardening Program

Growing of the oysters would result in no adverse impacts to hydrology. There would be minor, short-term impacts to water quality resulting from maintenance activities to remove mud and loose fouling agents which could mix in the water column for short periods and then settle into the substrate. Placement of oysters on reefs would have similar adverse and beneficial impacts described in Section 5.2.2.2.1 for cultch deployment on existing oyster reefs and deployment of spat inoculated material deployment on hard substrate. Environmental consequences for this project and are summarized in Table 5-3.

5.2.2.2.5 Best Practices

Potential BMPs similar to those listed in Phase III FERP/PEIS for the Hancock County Marsh Living Shoreline Project (Section 10.3.7) and Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project (Section 6.7.3.5) would also be considered.

5.3 BIOLOGICAL RESOURCES

Section 6.4.12.1.1 of the PDARP/PEIS describes the impacts to Biological Resources for the relevant restoration approaches and are incorporated by reference and briefly described here.

PDARP/PEIS environmental consequences related to biological resources.—For applicable restoration activities described in Table 5-1 of this Draft RPII/EA, short-term minor to moderate adverse impacts to biological resources are anticipated. Adverse impacts could include: an

increase in turbidity, reducing water quality (and photosynthetically available light), increasing crab predator abundance and subsequent predation on oyster spat, and burial of existing benthic communities. Anchors installed for buoys or signs would result in long-term, minor loss of habitat.

Habitats, wildlife species, marine and estuary fauna (fish, shellfish, benthic organisms), and protected species will be discussed in this section. For Oysters Alternatives in this Draft RPII/EA, environmental consequences are within the general range of impacts as described in the PDARP/PEIS (summarized above). Table 5-6 summarizes the adverse and beneficial impacts to biological resources as a result of the Oyster Spawning Reefs in Western Mississippi, the Oyster Spawning Reefs in Eastern Mississippi, and the Oyster Spawning Reefs in Mississippi Alternatives.

Table 5-6. Oyster Spawning Reef Alternatives Impact Summary for Biological Resources

Resource	Short-Term Adverse Impacts from Project Activities	Long-Term Adverse Impacts from Project Activities	Beneficial Impacts from Project Activities
Habitats	Minor	Minor	Long-Term
Wildlife Species (Including Birds)	Minor	No Impact	Long-Term
Protected Species	Minor	No impact	Long-Term
Marine and Estuarine Fauna (Fish, Shellfish, Benthic Organisms)	Minor	Minor	Long-Term

Table 5-7 summarizes the adverse and beneficial impacts to biological resources as a result of the Mississippi Oyster Gardening Alternative.

Table 5-7. Mississippi Oyster Gardening Program Alternative Impact Summary for Biological Resources

Resource	Short-Term Adverse Impacts from Project Activities	Long-Term Adverse Impacts from Project Activities	Beneficial Impacts from Project Activities
Habitats	Minor	No Impact	Long-Term
Wildlife Species (Including Birds)	No Impact	No Impact	Long-Term
Protected Species	Minor	No Impact	Long-Term
Marine and Estuarine Fauna (Fish, Shellfish, Benthic Organisms)	No Impact	No Impact	Long-Term

5.3.1 Habitats

Section 3.5 of the PDARP/PEIS discusses habitats in the Northern Gulf of Mexico. The northern Gulf of Mexico supports a variety of habitats and communities in the nearshore, water column, and marine benthic ecosystems. Organisms and nutrients move among and between these local ecosystem zones, supporting the overall connectivity of the larger northern Gulf of Mexico regional ecosystem. The Mississippi Sound is a marine system composed of an array of habitat types that support a large number of species and many different life stages. The diverse habitats include the estuarine intertidal zone, submerged aquatic vegetation (SAV), mollusk reefs, estuarine embayments, tidal creeks, Mississippi Sound unconsolidated bottom substrate (sand,

soft mud, and mixes), artificial reefs, and barrier island passes. Habitats for the alternatives discussed here are similar to those described in Phase III FERP/PEIS for the Hancock County Marsh Living Shoreline Project (Section 10.3.6.8) and Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project (6.2.7.2.1).

5.3.1.1 Affected Environment

5.3.1.1.1 Oyster Spawning Reefs in Western Mississippi

The project would be located in St. Louis Bay, Biloxi Back Bay, Heron Bay, and the adjacent nearshore areas of the Mississippi Sound. The project areas are all in subtidal environments; however, differences in environmental variables (salinity, water depth, and substrate) exist across the project areas. In general, the areas where cultch would be placed for the projects include the following habitats: estuarine embayment, Mississippi Sound unconsolidated bottom substrate (sand, mud, and mixes), and mollusk reefs (including artificial reefs).

Estuarine Embayments.—St. Louis Bay, Back Bay of Biloxi, and Heron Bay are examples of estuarine embayment habitats. These areas are characterized by protected, low-energy, subtidal and intertidal zones enclosed on three sides by land. Substrates are mud or muddy sand bottoms that contain more than 50% silt and clay mud, although there are some areas of concentrated sand including near river mouths. Salinity ranges from oligohaline in the low season to mesohaline in the high season (see Section 5.2.2.1.1).

Mississippi Sound Unconsolidated Bottom Substrate.—This habitat type is represented, geographically, as the nearshore environment adjacent to the estuarine embayment. These are more exposed to winds and wave energy and the waters are well flushed from the barrier island passes. Substrates are a mosaic of mud, sandy mud, muddy sand, and sand. Areas near the artificial beaches and Deer Island exhibit more sand in the substrates. Salinity ranges from mesohaline in the low season to polyhaline in the high season.

Mollusk Reefs.—Mollusk reefs in the project area are characterized by an undulating topography created from the build-up of shells on the water bottom. Prioritized cultch deployment within these locations is discussed below. It is estimated that historically ~5,552 acres of oyster reefs occurred in the locations that encompass the Oyster Spawning Reefs in western Mississippi Sound project area. The thickness and patchiness of the reefs varies greatly across the project area. Reef growth and survival is directly tied to water salinity, substrate type, turbidity, food availability, and other factors including oyster harvesting and natural/human-made disasters. Reefs exist in both the estuarine embayment and unconsolidated bottom habitats, the larger of them being located in the nearshore environment adjacent to the embayment. In some areas, reef thickness is more than three feet. Salinity ranges from oligohaline in the estuarine embayment and areas near the Pearl River in the low season to mesohaline and polyhaline in the high season in the Mississippi Sound Unconsolidated Bottom habitats.

5.3.1.1.2 Oyster Spawning Reefs in Eastern Mississippi

The project would be located in Grand Bay, Graveline Bay, Pascagoula Bay, and the adjacent nearshore areas of the Mississippi Sound. The biological setting for Grand Bay and Graveline Bay were described in Section 6.2.7.2 of the Phase IV FERP/EA for the Restoring Living

Shorelines and Reefs in Mississippi Estuaries Project. Habitats are similar to those described in Section 5.3.1.1.1; however, there are differences in environmental variables between eastern Mississippi Sound and the western Mississippi Sound.

Estuarine Embayment.—Pascagoula Bay, Point aux Chenes Bay, Middle Bay, and Graveline Bay are examples of this habitat type in the project area. Substrates are a mix of mud, sandy mud, muddy sand, and sand bottoms across the project area with most of the sand substrates near the mouth of the Pascagoula River and at the shorelines of Point aux Chenes Bay. Graveline Bay and Middle Bay are largely mud and sandy mud bottoms. Salinity ranges from oligohaline throughout the year in Graveline Bay, mesohaline to polyhaline in Pascagoula Bay (low season to high season), and polyhaline throughout the year in Point aux Chenes Bay and Middle Bay.

Mississippi Sound Unconsolidated Bottom Substrate.—This habitat type is represented, geographically, as the nearshore environment adjacent to the estuarine embayment. These are more exposed to winds and wave energy and the waters are well flushed from the barrier island passes. Substrates are a mosaic of mud, sandy mud, muddy sand, and sand. Areas near the Grand Battures headlands exhibit more sand in the substrates. Salinity ranges from mesohaline in the low season to polyhaline in the high season.

Mollusk Reefs.—Mollusk reefs in the project area include subtidal reefs in Pascagoula Bay as well as small, isolated subtidal reefs in some areas of Graveline Bay, Point aux Chenes Bay, and Middle Bay. It is estimated that historically ~1,510 acres of oyster reefs occurred in the locations that encompass the Oyster Spawning Reefs in eastern Mississippi Sound project area. Other reefs are in the form of patchy, intertidal oyster habitats that flank expansive reaches of coastal marsh in the Grand Bay complex, Graveline marsh, and Pascagoula River marsh. Salinity ranges from oligohaline in Graveline Bay to mesohaline and polyhaline in the Mississippi Sound Unconsolidated Bottom habitats.

5.3.1.1.3 Oyster Spawning Reefs in Mississippi

This alternative combines the Oyster Spawning Reefs in Western Mississippi and the Oyster Spawning Reefs in Eastern Mississippi, so the affected environment for hydrology and water quality would be the combination of the descriptions above in 5.3.2.1.1 and 5.3.2.1.2.

5.3.1.1.4 Mississippi Oyster Gardening Program

The affected environment for habitat for this project would be similar to that described in Sections 5.3.1.1.1 and 5. 3.1.1.2. Oyster gardening would take place across the Mississippi coast utilizing piers and docks as platforms to hang oyster baskets, and oyster placement would occur in suitable locations in the Mississippi Sound. Similar habitat characteristics would occur at these locations.

5.3.1.2 Environmental Consequences

Environmental consequences to habitat resulting from the restoration described in Table 5-2 and Table 5-3 are summarized in this section. The impacts anticipated from the alternatives discussed below are consistent with the range of impacts described in sections 10.3.6.7 and 10.3.6.8 of the Final Phase III ERP/PEIS and Section 6.2.7.2.1 of Phase IV FERP/EA and are incorporated by reference where appropriate and included in the summary analysis below.

5.3.1.2.1 Oyster Spawning Reefs in Western Mississippi

Cultch deployment on existing oyster reefs and deployment of spat inoculated cultch on hard substrate.—Restoration activities described in Table 5-1 could result in minor short-term adverse impacts to existing oyster reef habitat as a result of construction activities. Cultch materials deployed on top of existing resources could cover live mollusks which form reef habitats and inhibit some organisms from functioning.

Cultch deployment on suitable substrate that is not colonized by oysters and deployments on soft bottom substrate/buried hard substrate: Restoration activities described in Table 5-1 could result in minor short-term adverse impacts to mud and sand water bottoms as a result of construction activities, causing adverse impacts that could include changes in water quality from turbidity and substrate disturbance from in-water work and impacts to unconsolidated bottom biotic communities. Deployed cultch material could result in minor long-term adverse impacts to benthic communities in mud and sandy substrates by altering the biotic community assemblages through the replacement of substrate with cultch materials. However, unconsolidated bottom habitats represent the largest habitat type in the Mississippi Sound at over 400,000 acres (Clough et al., 2017) and it is expected that oyster restoration in unconsolidated substrate habitats would account for only a small fraction of the overall habitat in the Mississippi Sound.

The project is anticipated to have long-term beneficial impacts because the placement of cultch would generate more viable reefs that would improve water quality and provide additional habitat structure for an array of marine life including fish, invertebrates, crustaceans, and sea turtles. In addition, oyster reefs provide several ecosystem services including nutrient uptake and filtration, reduced sediment suspension, and shoreline protection from wave abatement.

5.3.1.2.2 Oyster Spawning Reefs in Eastern Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.3.1.2.1.

5.3.1.2.3 Oyster Spawning Reefs in Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.3.1.2.1.

5.3.1.2.4 Mississippi Oyster Gardening Program

Growing of the oysters would result in no adverse impacts to habitats. The placement of project-produced oysters would be the same as the consequences described in Section 5.3.1.2.1, short-term minor adverse impacts, but on a much smaller scale. Placement of project-produced oysters on existing reefs would have long-term beneficial impacts to by providing additional habitat structure.

5.3.2 Wildlife Species (Including Birds)

Section 3.6 of the PDARP/PEIS discusses the biota in the northern Gulf of Mexico. The northern Gulf of Mexico supports complex food webs composed of a wide range of aquatic and terrestrial biota, from bacteria and microscopic plankton to dolphins and whales. The following section

discusses marine mammals and birds. Marine mammals and birds that would occur in the project areas are similar to those described in Phase III FERP/PEIS for the Hancock County Marsh Living Shoreline Project (Section 10.3.6.8) and Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project (6.2.7.1.1) and Section 6.2.7.2.1 of Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project.

5.3.2.1 Affected Environment

Table 5-8 provides a summary of marine mammals and birds that could occur in the Oyster Spawning Reefs (Western Mississippi, Eastern Mississippi, and Mississippi) and the Mississippi Oyster Gardening projects for this Draft RPII/EA.

Table 5-8. Wildlife that could occur in the Oyster Spawning Reefs (Western Mississippi, Eastern Mississippi, and Mississippi) and Oyster Gardening Alternatives for Draft RPII/EA

SPECIES	ACTIVITIES	LIFE HISTORY PATTERNS
Marine Mammals		
Dolphins Bottlenose Dolphin *(Tursiops truncates)* Atlantic Spotted Dolphin (*Stenella frontalis)*	Feeding, reproduction	Both species feed primarily on fish, squid, and crustaceans. *S. frontalis* spends the majority of its life offshore; *T. truncatus* often travels into coastal bays and inlets for feeding and reproduction.
Birds		
Wading birds (herons, egrets, ibises)	Foraging, feeding, resting	Wading birds primarily forage and feed at the water's edge. These birds primarily nest and roost in trees or shrubs (e.g., pines, *Baccharis*), which occur outside the project area.
Seabirds (terns, gulls, skimmers, double-crested cormorant, American white pelican, brown pelican)	Foraging, feeding, resting	Seabirds forage, feed, and rest in the project area. Nesting and roosting habitat does not exist in the project area; therefore, it is not anticipated to impact nesting.
Waterfowl (ducks, loons, and grebes)	Foraging, feeding, resting,	Waterfowl forage, feed, and rest in the project area. As such, they may be impacted locally and temporarily by the project. These birds primarily roost and nest in low vegetation, which is not directly inside the project area; therefore, it is not anticipated to impact nesting.
Raptors (osprey, hawks, eagles, owls)	Foraging, feeding,	Raptors could feed and forage in the project area. As such, they may be impacted locally and temporarily by the project. It is expected that they would be able to move to another nearby location to continue foraging, feeding, and resting. Most raptors are aerial foragers and soar long distances in search of food. Locations where these birds roost and nest are not within the project area.

5.3.2.2 Environmental Consequences

Environmental consequences to wildlife species resulting from the restoration activities described in Table 5-1 are summarized in this section. Environmental consequences to wildlife species are described for Phase III FERP/EIS for the Hancock County Marsh Living Shoreline Project (Section 10.3.6.8) and the Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project (6.2.7.2.1) and are incorporated by reference where appropriate and included in the summary analysis below.

5.3.2.2.1 Oyster Spawning Reefs in Western Mississippi

Marine Mammals.—All cultch deployment restoration activities listed in Table 5-1 are expected to result in short-term minor adverse impacts to wildlife (including birds) as a result of restoration construction activities. Noise, temporary changes in water quality, and other activity associated with construction of the alternatives could temporarily disturb certain dolphin species if they are in the vicinity of the project area. However, the mobility of these species reduces the risk of injury due to construction activity. Based on the mobility of these species, the short duration of construction activities and the proposed construction methodology, and implementation of BMPs, adverse effects on dolphin species are not anticipated. Boat operators would follow NOAA NMFS Southeast Region's 'Vessel Strike Avoidance Measures and Reporting for Mariners'. The Trustees do not anticipate any take, incidental or otherwise, under the Marine Mammal Protection Act (MMPA) due to the implementation of the project.

Birds.—Short-term minor displacement of local birds could occur during construction but would be expected to move away to forage in other readily available foraging habitat during this activity.

The project would result in long-term benefits to wildlife. Cultch plants would create or restore habitat, reduce erosion, and improve water quality

5.3.2.2.2 Oyster Spawning Reefs in Eastern Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.3.2.2.1 of this Draft RPII/EA.

5.3.2.2.3 Oyster Spawning Reefs in Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.3.2.2.1 of this Draft RPII/EA.

5.3.2.2.4 Mississippi Oyster Gardening Program

There are no anticipated impacts to wildlife species that would result from restoration activities associated with the Mississippi Oyster Gardening Program. The existing residential piers which would support the oyster garden cages are within 200 feet of the coastal shorelines, so the water depth may vary but would typically be less than 10 feet. Thick taut rope would be used to suspend each 1-inch mesh coated wire cage approximately 12 inches off the bottom. The rope used to suspend the cage would be thick, taut and non-looping so that it would not present an entanglement risk.

5.3.2.2.5 Best Practices

Potential BMPs similar to those listed in Phase III FERP/PEIS for the Hancock County Marsh Living Shoreline Project (Section 10.3.7) and Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project (Section 6.7.3.5) would also be considered.

5.3.3 Protected Species

The U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) list species as threatened or endangered when they meet criteria detailed under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. §1531 et seq.). Additionally, Mississippi Wildlife Fisheries and Parks (MWFP) identify and list protected species. Section 7(a) (2) of the ESA requires that each federal agency ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of those species. When the action of a federal agency may affect a protected species or its critical habitat, that agency is required to consult with either the NMFS or the USFWS, depending upon the protected species that may be affected.

5.3.3.1 Affected Environment

This section focuses on the species that are could occur in or around the project areas. Protected species lists for each alternative were determined by downloading information from the USFWS Information for Planning and Conservation (IPAC) system, reviewing scientific literature, and using professional judgment. Federally protected species that are known to occur or could occur in Hancock County, Harrison County, or Jackson County are listed in Table 5-9.

Table 5-9. Federally threatened, endangered, and proposed species that could occur in the project area of Draft RPII/EA Alternatives

Common Name	Scientific Name	Federal Status	County	Habitat
Birds				
Piping Plover	*Charadrius melodus*	Threatened	Jackson, Harrison	Beaches and mudflats in southeastern coastal areas
Red Knot	*Calidris canutus rufa*	Threatened	Jackson, Harrison	Marine intertidal habitats including inlets, estuaries, and bays feeding in mud and sand flats on beaches and barrier islands
Fishes				
Gulf Sturgeon[33]	*Acipenser oxyrinchus desotoi*	Threatened	Jackson, Harrison, Hancock	Migrates from large freshwater coastal rivers to brackish and marine coastal bays and estuaries. Critical Habitat is located throughout the Mississippi Sound
Mammals				
West Indian Manatee	*Trichechus manatus*	Endangered	Jackson, Harrison, Hancock	Fresh and salt water in large coastal rivers, bays, bayous, and estuaries
Reptiles				
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	Jackson, Harrison, Hancock	Coral reefs, open ocean, bays, estuaries
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	Jackson, Harrison, Hancock	Open ocean, coastal waters
Kemp's ridley Sea Turtle	*Lepidochelys kempii*	Endangered	Jackson, Harrison, Hancock	Nearshore and inshore coastal waters, often in salt marshes; neritic zones with muddy or sandy substrate
Green Sea Turtle	*Chelonia mydas*	Threatened	Jackson, Harrison, Hancock	Shallow coastal waters with SAVs and algae, nests on open beaches
Loggerhead Sea Turtle	*Caretta caretta*	Threatened	Jackson, Harrison, Hancock	Open ocean, inshore areas, bays, salt marshes, ship channels, and mouths of large rivers

5.3.3.2 Environmental Consequences

Potential impacts to threatened or endangered species and their critical habitat are presented in Table 5-10. Technical assistance with NOAA NMFS and USFWS is complete and consultations have been initiated. Species background information is described in Section 10.3.6.9 of the Phase III RP/PEIS for the Hancock County Marsh Living Shoreline Project and Section 6.2.7.2.1 of the Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project. Since all work would be in open water environments, critical habitat for piping plover would not be impacted.

[33] Critical habitat was designated in 2003 by the National Marine Fisheries Service (NMFS) and was based on seven primary constituent elements (PCEs) essential for its conservation. The project contains four PCEs. The PCEs include abundance of prey items, water quality, sediment quality, and safe and unobstructed migratory pathways.

Table 5-10. Protected Species Impacts

Species	Potential Project Impacts	Project Area
Birds		
Piping plover (Charadrius melodus) and red knot (Calidris canutus rufa)	Piping plover and red knot are not known to use the action area, as such the project will have no effect on the species.	Not present
Fish		
Gulf sturgeon (Acipenser oxyrhynchus desotoi) (Designated Critical Habitat)	If individuals enter construction areas, short-term, minor impacts could be the result. However, sturgeon are mobile marine species and would avoid project activities such that transitory routes would not be impeded. Some of the potential project area is in gulf sturgeon critical habitat, but less than 10% of the soft bottom substrate/buried hard substrate in gulf sturgeon critical habitat would be affected. As such, the project is expected to have short-term minor impacts on designated critical habitat.	Oyster Spawning Reefs and Oyster Gardening
Mammals		
West Indian manatee *(Trichechus manatus)*	Short-term minor impacts could occur if manatees come in to contact with construction activities. However, manatees are a mobile marine species and project activities would not impede transitory routes. If individuals are within 50 feet of construction areas, construction would be halted until the individual leaves the area of its own volition. As such, the project is not likely to adversely affect the species.	Oyster Spawning Reefs and Oyster Gardening
Reptiles		
Green sea turtle *(Chelonia mydas)*	Sea turtles are a mobile marine species and project activities would not impede transitory routes. There is no nesting habitat in the project area. There is no designated or proposed critical habitat for sea turtles within the action area. If individuals enter construction areas, construction would be halted. As such, the project would have no impacts to the Green sea turtle, the Loggerhead sea turtle, and the Kemp's ridley sea turtle. Due to their range, the project will have no impacts on Hawksbill sea turtle and the Leatherback sea turtle.	Oyster Spawning Reefs and Oyster Gardening
Hawksbill sea turtle (Eretmochelys imbricata)		
Kemp's ridley sea turtle *(Lepidochelys kempii)*		
Leatherback sea turtle *(Dermochelys coriacea)*		
Loggerhead sea turtle *(Caretta caretta)*		

5.3.3.2.1 Best Practices

The following BMPS would also be considered:

- The following project design criteria would be implemented to minimize any possible adverse impacts from the project on Gulf Sturgeon critical habitat:
    - Fresh shell would be been properly aged or quarantined before being deployed;
    - Spat and other project material would be transported and placed in a manner to minimize disturbance of sediment;
    - Methods would be employed to avoid turbidity; and
    - A spill prevention and response plan would be developed.

5.3.4 Federally Managed Fish Species

The 1996 Magnuson-Stevens Fishery and Conservation Act requires cooperation among NOAA Fisheries, anglers, and federal and state agencies to protect, conserve, and enhance Essential Fish Habitat (EFH). EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. The designation and conservation of EFH seek to minimize adverse effects on habitat caused by fishing and non-fishing activities. NOAA's

Estuarine Living Marine Resources Program developed a database on the distribution, relative abundance, and life history characteristics of ecologically and economically important fishes and invertebrates in the nation's estuaries.

Section 6.4.1.2.2 of the PDARP/PEIS provides a discussion of the effect of restoration on Essential Fish Habitat. Phase III FERP/PEIS for the Hancock County Marsh Living Shoreline Project (Section 10.3.6.10) and the Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project (6.2.7.2.1) provide a review of relevant fishery management plans (FMP) for species that were affected and is incorporated by reference here.

5.3.4.1 Affected Environment

NOAA has designated EFH for more than 30 estuaries in the northern Gulf of Mexico for a number of species of finfish and shellfish. The MS TIG is working with NMFS to complete an evaluation of EFH in the project area. Table 5-11 lists project species, their EFH and substrates, life stages relative to the selected action, and summary impact analysis (GMFMC 2004 and 2005). A brief discussion of species Fisheries Management Plans is provided here.

Table 5-11. Oysters Alternatives- Species, Their Habitats and Life Stages in the Project Area

FMP Species	Habitats Utilized	Life stages within the Area of Selected Action
Red Drum (Scianops ocellatus)	SAVs, soft bottom, hard bottom, sand/shell, emergent marsh	Larvae, post larvae, juvenile, adult, spawning adults
Mutton Snapper (*Lutjanus analis*)	SAVs	Juvenile, adult
Cubera Snapper (Lutjanues cyanopterus)	SAVs, emergent marsh	Juvenile
Gray Snapper (Lutjanus griseus)	SAVs, soft bottom, sand/shell, emergent marsh	Post larvae, juvenile, adult,
Lane Snapper (Lutjanus synagris)	SAVs, soft bottom, sand/shell	Post larvae, juvenile
Yellowtail Snapper (*Ocyurus chrysurus*)	SAVs, soft bottom	Juvenile
Goliath Grouper (Epinephelus itajara)	SAVs, hard bottom	Juvenile
Red Grouper (Epinephelus morio)	SAVs, hard bottom	Juvenile
Black Grouper (Mycteroperca bonaci)	SAVs	Juvenile
Spanish Mackerel (Scomberomorus maculatus)	Pelagic	Juvenile, adult
Brown Shrimp (*Penaeus aztecus*)	SAVs, soft bottom, sand/shell, emergent marsh, oyster reef	Post larvae, juvenile
White Shrimp (Penaeus setiferus	Emergent marsh, soft bottom	Post larvae, juvenile

5.3.4.2 Environmental Consequences

Environmental consequences to federally managed fish species resulting from the restoration activities described in Table 5-1 are summarized in this section. Environmental consequences to federally managed species are described in Phase III FERP/PEIS for the Hancock County Marsh Living Shoreline Project (Section 10.3.6.10) and Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project (6.2.7.2.1) and are incorporated by reference here where appropriate and included in the summary analysis below.

5.3.4.2.1 Oyster Spawning Reefs in Western Mississippi

Cultch deployment on existing oyster reefs and deployment of spat inoculated cultch on hard substrate, cultch deployment on suitable substrate that is not colonized by oysters, and

deployments on soft bottom substrate/buried hard substrate: Restoration activities described in Table 5-1 could result in short-term minor adverse impacts to federally managed fish species as a result of construction activities. Adverse impacts could include changes in water quality from turbidity and substrate disturbance from in-water work, and the reduction of the availability of invertebrate prey in oyster deployment areas for a short time period. These impacts are expected to be short-term and minor because the fish species are mobile and would move out of the construction area during deployment. Furthermore, the deployment areas are small in comparison to the overall habitat in the Mississippi Sound. Unconsolidated bottom habitats represent the largest habitat type in the Mississippi Sound at over 400,000 acres (Clough et al., 2017). It is expected that oyster restoration in unconsolidated substrate habitats would account for only a small fraction of the overall habitat in the Mississippi Sound. Due to the mobility of the species and the amount of habitat, no long-term adverse impacts are anticipated.

Gulf Coast fish species would largely experience long-term beneficial impacts through improved health, stability and resiliency of habitats, and improved water quality as a result of cultch deployment.

5.3.4.2.2 Oyster Spawning Reefs in Eastern Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.3.4.2.1.

5.3.4.2.3 Oyster Spawning Reefs in Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.3.4.2.1.

5.3.4.2.4 Mississippi Oyster Gardening Program

Growing of the oysters would result in no adverse impacts because the baskets would be suspended in the water column from existing piers. The placement of oysters would be the same as the consequences described in Section 5.3.4.2.1.

5.3.5 Marine and Estuarine Fauna (Fish, Shellfish, and Benthic Organisms)

Section 3.6 of the PDARP/PEIS discusses the biota in the northern Gulf of Mexico. The northern Gulf of Mexico supports complex food webs composed of a wide range of aquatic and terrestrial biota, from bacteria and microscopic plankton to dolphins and whales. The following section discusses oysters, benthic infauna, and epifauna. These include various species of fish, infauna, epifauna, and other aquatic invertebrates, which were previously described in Section 10.3.6.8 of the Phase III ERP/PEIS for the Hancock County Marsh Living Shoreline Project and Section 6.2.7.2.1 of the Phase IV FERP/EA Restoring Living Shorelines and Reefs in Mississippi Estuaries.

5.3.5.1 Affected Environment

Fish.—Federally managed finfish species are discussed in Section 5.3.4. Other commercial, recreational and other important finfish species in the project area include southern flounder (*Paralichthys lethostigma*), mullet (*Mugil cephalus*), southern kingfish (*Menticirrhus americanus),* Atlantic croaker (*Micropogonias undulates*), spot (*Leiostomus xanthurus*), weakfish (*Cynoscion regalis*), speckled seatrout (*Cynoscion nebulosus*), black drum (*Pogonias cromis),* sheepshead (*Archosargus probatocephalus*), sea bream (*Pagrus pagrus*), pinfish, (*Lagodon rhomboids*) Gulf toadfish (*Opsanus beta*), blennies, and gobies (Neogobius melanostomus).

Shellfish and Benthic Organisms.—Oysters are important as both organisms and habitat with an integral role in the functioning of the ecosystem by creating hard substrate that provides habitat for multiple benthic organisms and fish, increasing biodiversity in estuaries. Oysters are an ecological keystone species in most estuaries along the Atlantic and Gulf coasts, and oyster populations contribute to the integrity and functionality of estuarine ecosystems. Nearshore benthic communities in the Gulf perform important ecological functions in the nearshore food web and are largely composed of macroinvertebrate groups such as mollusks, sponges, polychaetes, corals, and crustaceans. These groups are diverse and are found in Gulf habitats spanning from the intertidal zone to the soft sediments on the continental shelf.

5.3.5.2 Environmental Consequences

Environmental consequences to marine and estuarine fauna resulting from the restoration and management activities are summarized in this section. Environmental consequences to living coastal and marine resources were previously described in Sections 10.3.6.7 and 10.3.6.8 of the Phase III ERP/PEIS for the Hancock County Marsh Living Shoreline Project and Section 6.2.7.2.1 of the Phase IV FERP/EA Restoring Living Shorelines and Reefs in Mississippi Estuaries and are incorporated by reference where appropriate and included in the summary analysis below.

5.3.5.2.1 Oyster Spawning Reefs in Western Mississippi

Cultch deployment on existing oyster reefs and deployment of spat-inoculated cultch on hard substrate.—The cultch deployment described in Table 5-1 could result in minor short-term adverse impacts to existing oyster reefs as a result of construction activities. Cultch materials deployed on top of existing resources could cover live mollusks, which form reef habitats. Oyster populations and other benthic organisms could be impacted from increased turbidity and siltation, which may increase mortality and inhibit spawning activities; however, effects from turbidity and siltation are likely to minimal and temporary. Fish present in the work area could be temporarily displaced, or eggs and larvae could be killed due to smothering or crushing by construction activity or sediment placement. Fish could also be subject to a temporary increase in sound pressure levels and experience a temporary decrease in water quality; however, oyster reef and hard bottom habitat is relatively common in the MS Sound and therefore impacts from cultch deployment to individual reefs would be relatively minor in comparison to the available habitat for these species.

Cultch deployment on suitable substrate that is not colonized by oysters and deployments on soft bottom substrate/buried hard substrate: Implementation of these deployments would have minor short-term and long-term adverse impacts to existing benthic communities as a result of construction activities. Cultch deployment would permanently bury soft mud/sandy bottom areas and replace it with hard substrate for reef development. Benthic communities in the sediment would be permanently impacted.

The project would result in long-term benefits to marine and estuarine fauna. The project would create and/or restore habitat, reduce erosion, and improve water quality which would have long-term benefits for a variety of benthic and epifaunal species as well as provide foraging habitat and cover for fish species. Effort would be made during construction and during placement of materials to avoid existing environmentally sensitive areas such as viable productive oyster reefs, emergent vegetation, SAVs, and other live-bottom communities.

5.3.5.2.2 Oyster Spawning Reefs in Eastern Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.3.5.2.1.

5.3.5.2.3 Mississippi Oyster Gardening Program

Growing of the oysters would result in no adverse impacts. The placement of project-produced oysters would be the same as described for deployment of spat-inoculated cultch in Section 5.3.5.2.1 but on a much smaller scale. Due to the small scale no impacts are anticipated. Placement of project-produced oysters on existing reefs would have long-term beneficial impacts to marine and estuarine fauna.

5.3.5.2.4 Best Practices

Potential BMPs similar to those listed in the Phase III FERP/PEIS for the Hancock County Marsh Living Shoreline Project (Section 10.3.7) and the Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project (Section 6.7.3.5) would also be considered. Where practicable, shell obtained from commercial vendors that did not or would not impact the aquatic environments would be utilized for reef construction.

5.4 SOCIOECONOMIC RESOURCES

Section 6.4.12.1.3 of the PDARP/PEIS describes the impacts to Socioeconomic Resources for the relevant restoration approaches and are incorporated by reference and briefly described here.

PDARP/PEIS consequences related to socioeconomic resources analyzed here.—Long-term beneficial socioeconomic impacts would be expected from implementation by increasing recreational and commercial shellfish harvest opportunities after a harvest moratorium period. Restoration could increase the natural productivity of the shallow water area, thereby improving the quality of habitat and increasing oyster recruitment to both the restored reefs and those in the vicinity, potentially leading to increased revenue from commercial and recreational activities. Impacts to infrastructure and cultural resources resulting from the implementation of this

restoration approach are dependent on site-specific conditions associated with a project proposed for implementation.

Cultural resources, land use and management, fisheries and aquaculture, and aesthetics and visual resources will be discussed in this section. For Oysters alternatives in this Draft RPII/EA, environmental consequences are within the general range of impacts as described in the PDARP/PEIS (summarized above) with some variances related to specific actions. Table 5-12 summarizes the adverse and beneficial impacts to socioeconomic resources as a result of the Oyster Spawning Reefs in Western Mississippi, the Oyster Spawning Reefs in Eastern Mississippi, and the Oyster Spawning Reefs in Mississippi Alternatives.

Table 5-12. Oyster Spawning Reef Alternatives Impact Summary for Socioeconomic Resources

Resource	Adverse Short-Term Impacts from Project Activities	Adverse Long-Term Impacts from Project Activities	Beneficial Impacts from Project Activities
Cultural Resources	No adverse impacts anticipated*	No adverse impacts anticipated*	No Impact
Land and Marine Management	Minor	No Impact	Long-Term
Fisheries and Aquaculture	Minor	No Impact	Long-Term
Aesthetics and Visual Resources	Minor to Moderate	Minor	No Impact
* Restoration measures would be designed to avoid cultural resources to the extent practicable. Cultural resource sites and avoidance measures would be identified through the use of all currently available information, information that would be gathered through side-scan sonar surveys, and information resulting from the NHPA Section 106 consultation process. MDEQ would work with the Mississippi State Historic Preservation Officer and/or all appropriate Tribal Historic Preservation Officers to determine compliance measures if historic resources are likely in the area or encountered during implementation.			

Table 5-13 summarizes the adverse and beneficial impacts to Socioeconomic Resources as a result of the Mississippi Oyster Gardening Alternative.

Table 5-13. Mississippi Oyster Gardening Program Impact Summary for Socioeconomic Resources

Resource	Adverse Short-Term Impacts from Project Activities	Adverse Long-Term Impacts from Project Activities	Beneficial Impacts from Project Activities
Cultural Resources	No adverse impacts anticipated*	No adverse impacts anticipated*	No adverse impacts anticipated*
Land and Marine Management	No Impact	No Impact	No Impact
Fisheries and Aquaculture	No Impact	No Impact	Long-Term
Aesthetics and Visual Resources	Minor to Moderate	Minor	No Impact
*Restoration measures would be designed to avoid cultural resources to the extent practicable. MDEQ would work with the Mississippi State Historic Preservation Officer and/or all appropriate Tribal Historic Preservation Officers to determine compliance measures if historic resources are likely in the area or encountered during implementation.			

5.4.1 Cultural Resources

The alternatives would be reviewed under Section 106 of the NHPA to identify any cultural resources located within the project areas and to evaluate whether the project alternatives would impact any cultural resources. Cultural resources are discussed in the Phase III FERP/PEIS for

the Hancock County Marsh Living Shoreline Project (Section 10.3.6.12) and the Phase IV FERP/EA for the Restoring Living Shorelines and Reefs in Mississippi Estuaries Project (6.2.7.3.1) and are incorporated by reference where appropriate.

Cultural resources include historic properties listed in, or eligible for listing in the National Register of Historic Places (36 C.F.R. §60[a-d]). The National Historic Preservation Act of 1966 (NHPA), as amended and recodified (54 U.S.C. § 300308), defines an historic property as "any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on the National Register [of Historic Places]." Under the statute and implementing regulations, historic properties include significant traditional religious and cultural properties important to Indian tribes. Historic properties include built resources (bridges, buildings, piers, etc.), archaeological sites, and Traditional Cultural Properties, which are significant for their association with practices or beliefs of a living community that are both fundamental to that community's history and a piece of the community's cultural identity. Although often associated with Native American traditions, such properties also may be important for their significance to ethnic groups or communities. Historic properties also include submerged resources.

5.4.1.1 Affected Environment

The RPII/EA Oyster project alternative areas would be reviewed under Section 106 of the NHPA to identify any cultural resources located within the project areas and to evaluate whether the proposed alternative would affect any cultural resources. Previously recorded archaeological sites, shipwrecks, historical standing structures, National Register of Historic Places properties, National Register Districts, and National Historic Landmarks are being reviewed.

5.4.1.2 Environmental Consequences

The National Historic Preservation Act of 1966 (NHPA) charges the federal government with protecting the cultural heritage and resources of the nation. The oyster projects would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources. Cultural and historic resources would be considered when preparing site-specific restoration activities and management actions; where there is a likelihood disturbance of cultural resources, resource managers would conduct appropriate surveys to inform the methods and location of restoration and management actions. Restoration activities/management actions would be designed to avoid cultural resources to the extent practicable. Resource managers would work with the Mississippi State Historic Preservation Office to determine compliance measures if resources are likely in the area or encountered during implementation.

A complete review of the oyster projects under Section 106 of the NHPA would be completed prior to any project activities that would restrict consideration of measures to avoid, minimize, or mitigate any adverse effects on historic properties located within the project area. The projects would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources. A study plan would be developed which could include marine magnetometer surveys, side scan sonar surveys, and field studies to document resources and develop avoidance procedures for the project.

5.4.1.2.1 Best Practices

Restoration and management activities would be designed to avoid cultural resources to the extent practicable. The MS TIG would work with the Mississippi State Historic Preservation Office to determine compliance measures if resources are likely in the area or encountered during implementation. This project would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.

5.4.2 Land and Marine Management

Marine resources in Mississippi state waters are managed by the MDMR. More specifically for oysters, the Shellfish Bureau of MDMR is responsible for the management of Mississippi's marine shellfish resources. Oysters may be harvested only from approved areas that are delineated by the MDMR. Mississippi oyster harvesting locations are identified by sections and harvesting conditions. Harvestable oyster reefs are divided into two sections: tonging grounds and dredging grounds. Tonging grounds are intended for taking oysters by tong harvesting methods only. Dredgers are prohibited from dredging on tonging grounds. However, dredging grounds may be harvested by both tonging and dredging. Harvestable oyster locations are further divided into the following five harvesting conditions: approved, conditionally approved, restricted, prohibited, and unclassified. See Section 5.2.2.1.1 for state shellfish growing area definitions. Following heavy rainfall, oyster reefs may be temporarily closed to harvesting when poor water quality exists. The water bottoms on the Mississippi coast are considered state-owned. MDEQ would coordinate with MDMR on any required temporary amendments or modifications to the management practices for oysters.

5.4.2.1 Affected Environment

5.4.2.1.1 Oyster Spawning Reefs in Western Mississippi

State shellfish growing areas in the project area include conditionally approved, restricted, and prohibited inside the tonging line. The specific cultch deployment areas associated within the project area would be developed for up to 35% of cultch in conditionally approved areas. Prioritized cultch deployment within these locations is discussed in Section 2.5.2 of this plan.

5.4.2.1.2 Oyster Spawning Reefs in Eastern Mississippi

State shellfish growing areas in the project area include conditionally approved, prohibited, and restricted inside the tonging line. Specific cultch deployment parameters are similar to that discussed in Section 5.4.2.1.1.

5.4.2.1.3 Oyster Spawning Reefs in Mississippi

State shellfish growing areas in the project area include conditionally approved, prohibited, and restricted inside the tonging line. Specific cultch deployment parameters are similar to that discussed in Section 5.4.2.1.1.

5.4.2.1.4 Mississippi Oyster Gardening Program

Marine management in this project area is similar to those described in Section 5.4.2.1.1 of this report. Oyster baskets would be suspended from private piers and docks. Oysters produced by the program would be enough to create approximately 3 acres of reef across the lifespan of the project, which would be placed at suitable locations in the Mississippi Sound.

5.4.2.2 Environmental Consequences

5.4.2.2.1 Oyster Spawning Reefs in Western Mississippi

Restoration activities described in Table 5-1 could result in minor short-term impacts to marine management for the percentage of restoration that would take place in harvestable areas (up to 35%). The project would need to be monitored for a set period of time after implementation to track project performance and success. Harvesting restrictions would be established to prohibit harvesting during the monitoring period. Implementation of the project would require a temporary restriction[34] to the management practices for a period commensurate with the monitoring period; this would result in a short-term minor impact to land and marine management. There would be a long-term benefit to land and marine management by the creation of 100 to 400 acres of oysters as a result of the implementation of this project.

5.4.2.2.2 Oyster Spawning Reefs in Eastern Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.4.2.2.1 of this plan.

5.4.2.2.3 Oyster Spawning Reefs in Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.4.2.2.1 of this plan.

5.4.2.2.4 Mississippi Oyster Gardening Program

Growing of oysters for this alternative would result in no adverse impacts. Oysters would be placed on existing reefs providing a marine management benefit. There would be no impact to land and marine management. Oysters produced by the program would be enough to create

---

[34] **Harvest Moratorium**: MDEQ would request a harvest moratorium in both harvestable (tonging only) and restricted waters (relay only, no direct harvest) from the Mississippi Commission on Marine Resources for the duration of the monitoring and adaptive management period. For cultch placed in harvestable waters, the harvest moratorium would be a minimum of 3 years and a maximum of 5 years. After this time, oysters could be harvested following existing protocols and limits established by MDMR. For cultch placed in restricted waters, the moratorium would be a minimum of 5 years and a maximum of 7 years. After this time, relay could occur based on appropriate management techniques outlined by MDMR. In the event of an imminent catastrophic event that could cause significant oyster mortality, reefs in both harvestable and restricted areas could be harvested/relayed even under an existing moratorium, based on mutual agreement between MDMR and MDEQ and the MS TIG would be notified.

approximately three acres of reef across the lifespan of the project, which would be placed at suitable locations in the Mississippi Sound.

5.4.3 Fisheries and Aquaculture

Fisheries and aquaculture in Mississippi state waters is managed by MDMR. The oyster industry along the Mississippi Sound has traditionally been limited to harvestable reefs; however, the number of oysters available for harvest has decreased in the past decade, which has limited the number of oystermen and fishermen engaged in this economic sector. An Off-Bottom Oyster Aquaculture Pilot Program has been initiated by MDMR south of Deer Island and several oyster farmers have successfully graduated and are operating off-bottom oyster aquaculture businesses.

5.4.3.1 Affected Environment

Commercial and recreational fishing occurs on oyster reef areas in the project area. After the harvest moratorium terminates, oystermen, fishermen, and other boaters may use some restoration areas (up to 35% harvestable) for recreational or commercial harvesting of oysters (conditionally approved areas).

5.4.3.2 Environmental Consequences

5.4.3.2.1 Oyster Spawning Reefs in Western Mississippi

Restoration activities described in Table 5-1 could result in minor short-term adverse impacts to a few commercial oystermen, where cultch is placed in harvestable areas and restricted from harvest. In restricted or prohibited areas where cultch is planted, there could be an increase in oyster recruitment. This could benefit nearby harvestable reefs due to larval transport. Long-term beneficial impacts to fisheries and aquaculture would be expected from implementation of this restoration action by ultimately increasing recreational and commercial shellfish harvest opportunities.

5.4.3.2.2 Oyster Spawning Reefs in Eastern Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.4.3.2.1 of this plan.

5.4.3.2.3 Oyster Spawning Reefs in Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.4.3.2.1 of this plan.

5.4.3.2.4 Mississippi Oyster Gardening Program

Growing of oysters for the project would result in no adverse impacts. Placement of adult oysters produced by the program would have similar beneficial impacts described in Section 5.4.3.2.1 of this plan.

5.4.4 Aesthetics and Visual Resources

5.4.4.1 Affected Environment

The affected environment consists of open, shallow water in the Mississippi Sound and associated bays. The area is characterized by a mosaic of open water, coastline, and barrier islands. There are no designated protected viewsheds in the vicinity of the project areas. Equipment and construction activities related to oyster reef restoration would be visible from shore and those persons present on boats in the waterbodies.

5.4.4.2 Environmental Consequences

5.4.4.2.1 Oyster Spawning Reefs in Western Mississippi

Restoration activities described in Table 5-1 could result in minor short-term adverse impacts during construction due to the temporary presence of construction equipment, vessels, personnel, and barriers which would be readily apparent but would not dominate the view. These construction-related projects are not expected to result in the long-term placement of structures or signage; therefore, no long-term impacts are anticipated.

5.4.4.2.2 Oyster Spawning Reefs in Eastern Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.4.4.2.1 of this plan.

5.4.4.2.3 Oyster Spawning Reefs in Mississippi

The environmental consequences of this alternative would be the same as the consequences described in Section 5.4.4.2.1 of this plan.

5.4.4.2.4 Mississippi Oyster Gardening Program

Growing of oysters and placement of adult oysters produced by the program would have no adverse impacts to aesthetic and visual resources.

5.5 NO ACTION

Under the No Action Alternative, the MS TIG would not select and implement the restoration alternatives in this Draft RP/EA at this time to compensate for lost natural resources or their services resulting from the DWH oil spill. Therefore, the No Action Alternative would not meet the purpose and need for implementing alternatives that address lost natural resources for Oyster restoration type and their services as described in Section 5.3.2 of the Final PDARP/PEIS and in Section 2.2 of this plan. The impacts from the No Action Alternative are summarized in Table 5-14. The impacts analysis for the No Action Alternative uses the same structure for environmental consequences as the other project alternatives in this Draft RP/EA. There are no beneficial or short-term, adverse impacts for the No Action Alternative; therefore, these will not be discussed in detail further in the documents.

Table 5-14. Summary of Beneficial Impacts as well as Short-Term and Long-Term Adverse Impacts from the No Action Alternative

Affected Environment Category	Adverse Short-Term Impact	Adverse Long-Term Impact	Beneficial Impact
Physical Resources			
Geology and Substrates	No Impact	No Impact	No Impact
Hydrology and Water Quality	No Impact	Minor	No Impact
Biological Resources			
Habitats	No Impact	Minor	No Impact
Wildlife	No Impact	No Impact	No Impact
Protected Species	No Impact	No Impact	No Impact
Federally Managed Species	No Impact	No Impact	No Impact
Marine and Estuarine Fauna	No Impact	Minor	No Impact
Socioeconomic Resources			
Cultural Resources	No Impacts	No Impacts	No Impacts
Land and Marine Management	No Impacts	No Impacts	No Impacts
Fisheries and Aquaculture	No Impacts	Minor	No Impacts
Aesthetics and Visual Resources	No Impacts	No Impacts	No Impacts

5.5.1 Environmental Consequences

Under the No Action Alternative, the MS TIG would not implement any projects for the Oyster restoration type and would instead allow natural recovery processes to occur. This alternative would not contribute to long-term benefits to the affected environment and would contribute to the degradation of resources in the project areas.

5.5.1.1 Physical Resources

5.5.1.1.1 Geology and Substrates

Under the No Action Alternative, the oyster restoration projects would not be implemented at this time and there would be no long-term benefit to geology and substrates by creation of hard substrate. There would be no impact on geology and substrates from cultch deployment, because no restoration actions would occur that could result in displacement of soft or hard bottom substrates.

5.5.1.1.2 Hydrology and Water Quality

Under the No Action Alternative, the oyster restoration projects would not be implemented at this time and would not contribute to water quality improvements provided by oyster filtration in the 100 to 400-acre project area, resulting in a long-term adverse impact to water quality.

5.5.1.2 Biological Resources

5.5.1.2.1 Habitats

Under the No Action Alternative, oyster projects would not be implemented at this time, and restoration would not contribute to the oyster reef habitat in the 100 to 400-acre project area.

This alternative would cause minor, long-term adverse impacts in the 100 to 400-acre project area because oyster reefs would continue to be degraded.

5.5.1.2.2 Wildlife

The No Action Alternative would have no impact on wildlife because no restoration actions would occur at this time. Potential impacts to marine mammals and birds associated with project construction, including noise and degraded water quality, would not occur.

5.5.1.2.3 Protected Species

The No Action Alternative would have no impact on protected species because no restoration actions that could result in impacts to threatened and endangered species in the project areas, including sturgeon and sea turtles would occur, at this time.

5.5.1.2.4 Federally Managed Species

The No Action Alternative would have no impact on federally managed species because no restoration actions that could result in impacts to federally managed species in the project area would occur at this time.

5.5.1.2.5 Marine and Estuarine Fauna

Under this alternative, oyster restoration projects would not be implemented at this time and would not contribute to marine and estuarine faunal productivity in the 100 to 400-acre project area that depends on oyster reef habitats for survival and reproduction. Currently, these reef habitats are in decline in the project area, and the decline would be expected to continue, causing minor long-term adverse impacts to marine and estuarine fauna.

5.5.1.3 Socioeconomic Resources

5.5.1.3.1 Cultural Resources

The No Action Alternative would have no impact on cultural resource because no restoration actions would occur, at this time, that could result in adverse impacts to historic properties or archaeological sites, including ship wrecks or other submerged resources.

5.5.1.3.2 Land and Marine Management

Under the No Action Alternative, oyster restoration projects would not occur at this time. The No Action Alternative would have no impact on marine management because no restoration actions would occur in state shellfish growing areas at this time.

5.5.1.3.3 Fisheries and Aquaculture

For the No Action Alternative, oyster restoration projects would not occur at this time. The No Action Alternative would have no effect on commercially important species or EFH because no construction or other in-water work would occur in the 100 to 400-acre project area. Minor, long-term adverse impacts would occur because the restoration and enhancement of oyster reef

habitat, which provides important nursery habitat for many commercially important species and their prey, would not occur at this time.

5.5.1.3.4 Aesthetics and Visual Resources

The No Action Alternative would have no impact on aesthetics and visual resources because no restoration actions would occur in the 100 - 400-acre project area at this time. The presence of readily apparent construction equipment, vessels, personnel, and barriers which would contrast with and detract from the natural view shed, would not occur and therefore not cause any impacts to this resource.

5.5.2 Conclusion of the No Action Alternative

The No Action Alternative for this plan does not meet the MS TIG's goals and does not provide the significant environmental benefits to injured natural resources and services that would occur through active restoration. Additionally, the benefits to resources intended as a result of implementing the alternatives in this plan would not occur at this time.

5.6 Comparison of Impacts of the Alternatives for Oysters

Table 5-15. Comparison of Impacts of the Alternatives for Oysters

Alternative	Geology and Substrates	Hydrology and Water Quality	Habitats	Wildlife Species	Protected Species	Federally Managed Species	Marine and Estuarine Fauna	Cultural Resources	Land and Marine Management	Fisheries and Aquaculture	Aesthetics and Visual Resources
Oyster Spawning Reefs in Western Mississippi	Long-term minor adverse impacts to substrates, Long-term benefit to substrates	Short-term minor adverse impacts to water quality, Long-term benefit to water quality	Short-term to long-term minor adverse impacts, Long-term benefit	Short-term minor adverse impacts, Long-term benefit	No adverse impacts, Long-term benefit	Short-term, minor adverse; Long-term benefit	Short-term to long term minor adverse impacts, Long-term benefit	No adverse impacts anticipated*	Short-term minor adverse impacts, Long-term benefit	Short-term minor adverse impacts, Long-term benefit	Short-term minor adverse impacts
Oyster Spawning Reefs in Eastern Mississippi	Long-term, minor adverse impacts to substrates, Long-term benefit to substrates	Short-term minor adverse impacts to water quality, Long-term benefit to water quality	Short-term to long-term minor adverse impacts, Long-term benefit	Short-term, minor adverse impacts, Long-term benefit	No adverse impacts, Long-term benefit	Short-term, minor adverse; Long-term benefit	Short-term to long term minor adverse impacts, Long-term benefit	No adverse impacts anticipated*	Short-term, minor adverse impacts, Long-term benefit	Short-term, minor adverse impacts, Long-term benefit	Short-term, minor adverse impacts
Oyster Spawning Reefs in Mississippi	Long-term minor adverse impacts to substrates, Long-term benefit to substrates	Short-term minor adverse impacts to water quality, Long-term benefit to water quality	Short-term, to long-term minor adverse impacts, Long-term benefit	Short-term, minor adverse impacts, Long-term benefit	No adverse impacts, Long-term benefit	Short-term, minor; Long-term benefit	Short-term to long term minor adverse impacts, Long-term benefit	No adverse impacts anticipated*	Short-term, minor adverse impacts, Long-term benefit	Short-term, minor adverse impacts, Long-term benefit	Short-term, minor adverse impacts
Mississippi Oyster Gardening	No adverse impacts, Long-term benefit	No adverse impacts, Long-term benefit	Short-term, minor adverse impacts, Long-term benefit	No adverse impacts, Long-term benefit	No adverse impacts, Long-term benefit	No impact	No adverse impacts, Long-term benefit	No adverse impacts anticipated*	No adverse impacts, Long-term benefit	No adverse impacts, Long-term benefit	No adverse impacts
No Action	No adverse impacts	Long-term minor, adverse impacts	Long-term minor, adverse impacts	No adverse impacts	No impact	No impact	Long-term minor, adverse impacts	No adverse impacts	No adverse impacts	Long-term minor, adverse impacts	No adverse impacts

*Restoration measures would be designed to avoid cultural resources to the extent practicable. Cultural resource sites and avoidance measures would be identified through the use of all currently available information, information that would be gathered through side-scan sonar surveys, and information resulting from the NHPA Section 106 consultation process. MDEQ would work with the Mississippi State Historic Preservation Officer and/or all appropriate Tribal Historic Preservation Officers to determine compliance measures if historic resources are likely in the area or encountered during implementation.

5.7 Cumulative Impacts

The CEQ defines cumulative impacts as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR §1508.7). As stated in the CEQ handbook, *Considering Cumulative Effects* (CEQ 1997), cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on effects that are truly meaningful. Cumulative impacts should be considered for all alternatives, including No Action.

Tiering.—The PDARP/PEIS, Section 6.17.2 states that consideration of cumulative impacts of proposed projects in EAs tiered from programmatic analyses should focus on site-specific issues. This is consistent with 2014 CEQ guidance regarding effective use of programmatic NEPA analysis:

An analysis of the cumulative impacts for each resource would be provided in each level of review, either by relying upon the analysis in the programmatic NEPA review or adding to that analysis in the tiered NEPA review, either approach facilitated by incorporating by reference the cumulative impact analysis provided in the programmatic NEPA review (CEQ 2014).

The MS TIG determined that the conditions and environmental effects described in the PEIS are still valid and relied upon the cumulative impacts analysis in the PDARP/PEIS for the projects analyzed in this RPII/EA, where applicable, and added to the tiered NEPA review where necessary. Considering context and intensity, the MS TIG considers negligible to minor direct/indirect effects described in the RPII/EA as sufficiently analyzed cumulatively in the PDARP/PEIS. Moderate impacts, particularly those that are long-term in duration, are considered in more detail. No major impacts were concluded.

Section 6.6.2 of the PDARP/PEIS describes the cumulative impacts analysis methodology of the following:

1. Identify the Resources Affected
2. Establish the Boundaries of Analysis
3. Identify the Cumulative Impacts Scenario
4. Conduct Cumulative Impacts Analysis

Identify the Resources Affected.—The CEQ handbook states the analyst must determine the realistic potential for the resource to sustain itself in the future and whether the proposed action will affect this potential; therefore, the baseline condition of the resource of concern should include a description of how conditions have changed over time and how they are likely to change in the future without the proposed action. The baseline condition should also include other present (ongoing) actions, as discussed in Section 6.6.4 of the PDARP/PEIS. As stated above, the MS TIG focused additional analysis for resources moderately impacted, with an impact duration beyond the construction period (e.g. long term), by the alternatives considered in the RPII/EA. For WCNH alternatives the resource affected is geology and substrates.

Establish the Boundaries of Analysis.—The CEQ handbook states evaluating resource impact zones and the life cycle of effects rather than projects properly bounds the cumulative effects

analysis, focusing on important cumulative issues. The alternatives analyzed in this plan would have adverse impacts locally, mostly in the short-term, during their implementation stages, i.e. the life cycle of effects is temporary. Therefore, the MS TIG considered these short-term adverse impacts in concert with other present actions (i.e. projects whose effects would overlap with the implementation stage of the alternatives), thus limiting the temporal boundary of the analysis to the construction/implementation phases. In determining the spatial boundary, the MS TIG considered the programmatic analysis of cumulative impacts in the PDARP/PEIS, which analyzed impacts on a regional, ecosystem scale. The spatial boundary of the cumulative effects analysis in this RPII/EA is a local scale. The analysis boundaries for this plan include:

- WCNH Projects:
    - Affected-resource-specific spatial boundaries for WCNH
        - Hancock and Harrison Counties
    - Affected-resource-specific temporal boundaries for WCNH
        - Projects with similar impacts that have been implemented during the past three years
        - Within the next 10 years (approximate Project Lifespan)

Identify the Cumulative Impacts Scenario.—The PDARP/PEIS describes and discusses at the ecosystem level the affected environment and evaluates the effects of restoration and habitat improvement programs as well as programmatic development activities. The PDARP/PEIS considered cumulative impacts from implementation of DWH early restoration in the programmatic analysis. The MS 2016-2017 RP/EA cumulative impacts analysis of WCNH projects builds on previous analyses and is incorporated by reference[35], where applicable.

No significant cumulative impacts were concluded. Where applicable, each subsequent restoration plan's cumulative impacts analysis should build on previous plans, incorporating only effects not considered in previous analyses. The scenario includes:

Past Actions - Past projects/activities/programs that have contributed to the current condition of the resources are described and analyzed in Chapter 6 of the PDARP/PEIS, and the MS TIG 2016-2017 RP/EA and are not repeated in this analysis. Applicable to the WCNH and oyster restoration types, these include USACE maintenance dredging, shoreline armoring, oyster restoration, land acquisition, commercial and residential development, marsh restoration, beach nourishment actions, and habitat restoration actions. Where these actions are ongoing, they may apply as past, present, and reasonably foreseeable future actions.

Present and Reasonably Foreseeable Future Actions - The MS TIG identified relevant present and reasonably foreseeable future actions not analyzed in the previous documents and considered their potential impacts in the analysis (Table 5-16). Similar to the past actions, projects applicable to the WCNH include USACE maintenance dredging, shoreline armoring, land

[35] This plan can be found at: https://www.gulfspillrestoration.noaa.gov/sites/default/files/MSTIG%20RP%20EA%202016-2017%20FINAL%20Combined%20508.pdf

acquisition, commercial and residential development, marsh restoration, beach nourishment actions, and habitat restoration actions.

Table 5-16. Description of Past, Present, and Reasonably Foreseeable Future Actions Considered in the Cumulative Impacts Analysis

Actions	Action Description	Key Resource Areas with Potential for Adverse Cumulative Impacts
Related to DWH Oil Spill		
DWH funded habitat restoration in Mississippi (including RESTORE, NRDA and NFWF GEBF)	These programs seek to restore habitat, water quality, and marine and estuarine fauna. Projects currently funded would improve living coastal and marine resources (oysters, birds, sea turtles, and marine mammals), marsh habitat, and coastal resilience through shoreline protection, habitat protection, and acquisition. Projects that are recently completed, planned, or are in process are listed here. NRDA Grand Bay Land Acquisition and Habitat Management NRDA Graveline Bay Land Acquisition and Management NRDA Hancock County Marsh Living Shoreline NFWF GEBF Invasive Species Management on Coastal State Lands NFWF GEBF Habitat Restoration: Federal Lands Program – Phase I Invasive Species Management on Coastal State Land Habitat Restoration: Federal Land Program- Phase I Habitat Restoration and Conservation in Turkey Creek Mississippi Coastal Connectivity Pascagoula River Corridor Acquisitions Strategic Land Protection, Conservation, and Enhancement of Priority Gulf Coast Landscapes	Geology and substrates
Resource Stewardship Activities		
Marsh restoration	Marsh restoration occurs and will continue throughout the Mississippi coast. Marshes help protect infrastructure during storms, provide valuable habitat for wildlife species, and improve water quality by filtering nutrients, and help recharge groundwater.	Geology and substrates
Land acquisition	Land Acquisition on the Mississippi coast by NGOs and federal and state agencies for the purpose of restoration and preservation has occurred and is likely to continue.	Geology and substrates
Restoration Programs administered through Other State Agencies	The Coastal Impact Assistance Program (CIAP) authorizes funds to be distributed to Outer Continental Shelf oil and gas producing states for the conservation, protection, and preservation of coastal areas, including wetlands. The Gulf of Mexico Security Act (GOMESA) covers OCS oil and gas leasing activities and revenue sharing in the Gulf of Mexico. GOMESA funds are to be used for coastal conservation, restoration, and hurricane protection. The Mississippi Department of Marine Resources (MDMR) is the designated lead agency for CIAP and GOMESA, and also administer the Coastal Preserves Program, using Tideland funding to acquire, preserve and protect coastal areas.	Geology and substrates
Restoration Programs administered through the USACE	The Mississippi Coastal Improvement Program was established by USACE after Hurricane Katrina. The program is comprehensive, consisting of structural, nonstructural, and environmental improvement projects for coastal Mississippi.	Geology and substrates

Actions	Action Description	Key Resource Areas with Potential for Adverse Cumulative Impacts
Dredged Material Disposal		
USACE maintenance dredging and other dredging	Ship channels leading to Mississippi ports as well as the GIWW are routinely dredged to maintain designated depths in order to facilitate waterborne cargo transportation. Harbors, marinas, and other publicly used water bottoms are dredged as needed to maintain navigability. Dredged materials are either beneficially used as part of another project or deposited in a designated disposal location.	Geology and substrates
Coastal Development and Land Use		
Commercial and residential development	The Mississippi coastal area has experienced an increase in developed space over time and it is likely that this trend will continue. Known projects associated with development include the Mississippi Aquarium, the Hyatt Place at the Markham in Gulfport, the District on Howard in Biloxi, and subdivision development on the outskirts of urban areas.	Geology and substrates
Beach nourishment	Most of Mississippi's sand beaches are man-made and maintained by the counties. Beach re-nourishment is performed as needed by placing sand from offshore borrow sites via dredge and pipe or by importing sand from inland areas.	Geology and substrates
Shoreline armoring	Armoring of the waterways (e.g., Gulf Intracoastal Waterway (GIWW) and other shorelines to protect marine transportation and/or decrease shoreline erosion. Example activities include armoring the GIWW to prevent erosion. Activities have occurred and will continue to occur throughout the Mississippi coast. Armoring may be used to protect infrastructure or as part of a habitat restoration and protection project.	Geology and substrates

Conduct Cumulative Impacts Analysis.— The MS TIG analyzed whether the direct/indirect moderate, long-term adverse impacts from implementation of the WCNH and Oysters alternatives would contribute substantially to adverse cumulative impacts when added to present or reasonably foreseeable future actions. Only geology and substrates were carried forward for WCNH alternatives. There were no direct/indirect moderate, long-term adverse impacts for Oysters alternatives.

Restoration Type: WCNH

Implementation of one of the three WCNH alternatives (Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts) could cause long-term, moderate impacts to geology and substrates from road repair/replacement). Impacts to geology and substrates from this restoration measure could have potential to overlap with impacts from other planned projects. These include but are not limited to (See Table 5-16 for complete project list):

- Invasive Species Management on Coastal State Land: This project manages invasive species on MDMR Coastal Preserve properties. Activities include chemical treatment, mechanical removal of invasive plants, and prescribed burning.
- NRDA Grand Bay Land Acquisition and Habitat Management: his project plans to acquire lands for the MDMR Coastal Preserve Program in the Grand Bay NERR and

NWR. Acquired parcels would be managed for habitat enhancements including invasive species management and prescribed fire.

- NRDA Graveline Bay Land Acquisition and Management: This project plans to acquire lands for the MDMR Coastal Preserve Program in the Graveline Bay area. Acquired parcels would be managed for habitat enhancements including invasive species management and prescribed fire.

Cumulative Impacts Determination for WCNH Alternatives in RPII/EA.—Past, present and reasonably foreseeable actions for WCNH that focus on similar restoration and management activities, residential and commercial land development, transportation infrastructure and other similar projects could contribute to incremental impacts that may result in a cumulative impact from the implementation of the project alternative. These impacts are related to the modification of soils (geology and substrates).

The area of impact for the project alternatives is small. The impacted area for the two projects is approximately 1,050 acres which represents about 3% of the habitats preserved or in target for preservation and management by MDMR Coastal Preserves (35,000 acres) and a far smaller percentage when considering the total acreage of habitats in coastal Mississippi that could benefit from the restoration techniques that would be implemented by the projects. When combined with current and future projects, the acreage of WCNH under similar management could increase to approximately 2,000 acres. Combined they still represent a small fraction of the overall impact to geology and substrates across coastal Mississippi.

In summary, the contribution of adverse effects from the proposed implementation of the WCNH alternatives falls within the range of cumulative impacts described in the PDARP/PEIS Section 6.6, and upon further review are not expected to contribute substantially to short-term or long-term cumulative adverse impacts to physical, biological or socioeconomic resources.

Restoration Type: Oysters

Cumulative Impacts Determination for Oysters Alternatives in Draft RPII/EA.—There are no long-term, moderate impacts contemplated for implementation of the Oyster Spawning Reefs in Western Mississippi Sound, Oyster Spawning Reefs in Eastern Mississippi Sound, Oyster Spawning Reefs in Mississippi and the Mississippi Oyster Gardening Program. Therefore, there would be no cumulative impacts resulting from the implementation of Oysters alternatives. The spatial extent of the area of impacts is small (100 to 400 acres) in comparison to resource availability (400,000 acres), even in combination with other present and reasonably foreseeable future actions.

In summary, the contribution of adverse effects from the proposed implementation of the Oysters alternatives falls within the range of cumulative impacts described in the PDARP/PEIS Section 6.6, and upon further review are not expected to contribute substantially to short-term or long-term cumulative adverse impacts to physical, biological or socioeconomic resources.

No Action Alternative (summarized from PDARP/PEIS Section 6.6).—Under No Action, restoration alternatives considered in the Draft RPII/EA would not occur. Short and long-term adverse impacts would be the result of continued degradation and from the lack of benefits provided by the implementation, in the project areas for the project lifespan. These impacts

would not contribute to the effects of past, present, and reasonably foreseeable future actions, which include soil compaction and removal, reduced soil stability, soil contamination, rutting, removal of substrates, and erosion. Activities including energy and mining, coastal development and land use, military activities, and marine transportation would result in short- and long-term adverse impacts to habitats, including habitat degradation through reduced quality (e.g., reduced water quality or introduction of invasive species), habitat fragmentation, and habitat loss. Construction activities from habitat restoration and conservation and recovery efforts associated with other environmental stewardship and restoration activities would also contribute to short-term adverse impacts.

Habitat restoration, conservation and recovery efforts associated with other environmental stewardship and restoration activities in the Gulf of Mexico would continue to provide benefits. These actions would likely create restored habitats, protect habitats from fragmentation, and preserve unaffected quality habitats, especially sensitive habitats. Under the No Action Alternative, however, the alternatives considered in this Draft RPII/EA would not contribute to the benefits provided by other restoration efforts.

6.0 Compliance with Other Laws and Regulations

Environmental compliance responsibilities and procedures would follow the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the Deepwater Horizon (DWH) Oil Spill, which are laid out in Section 9.4.6 of that document. Following these standard operating procedures, the Implementing Trustee for each project will ensure that the status of environmental compliance (e.g., completed versus in progress) is tracked through the Restoration Portal. Implementing Trustees will keep a record of compliance documents (e.g., ESA biological opinions, USACE permits) and ensure that they are submitted for inclusion to the Administrative Record.

Technical assistance with NOAA and DOI is completed and necessary consultations and reviews have been requested. MDEQ would ensure compliance with all applicable laws and regulations is completed prior to implementing projects and all requirements are executed during and after implementation. Further status updates to Table 6-1 below will be provided in the Final RP/EA.

Table 6-1. Current Status of Federal Regulatory Compliance Reviews and Approvals of Preferred Alternatives in this MS TIG Draft RPII/EA

Alternative	Coastal Zone Management Act	Endangered Species Act Terrestrial Species (USFWS)*	Endangered Species Act Marine Species (NMFS)*	Magnuson Stevens Fishery Conservation and Management Act (NMFS)	Marine Mammal Protection Act (NMFS)	Marine Mammal Protection Act (USFWS)	National Historic Preservation Act (NHPA)
Wolf River Coastal Preserve Habitat Management – Dupont and Bell's Ferry Tracts	In Progress	In Progress - NLAA	Complete - NE	Complete	Complete	In Progress	In Progress
Hancock County Coastal Preserve Habitat Management – Wachovia Tract	In Progress	In Progress - NLAA	Complete - NE	Complete	Complete	In Progress	In Progress
Oyster Spawning Reefs in Mississippi	In Progress	In Progress - NLAA	In Progress - NLAA	Complete	Complete	In Progress	In Progress
Mississippi Oyster Gardening Program	In Progress	In Progress - NLAA	In Progress - NLAA	Complete	Complete	In Progress	In Progress
*For ESA effect determinations: NE = no effect, NLAA = may affect, not likely to adversely affect, LAA = may affect, likely to adversely affect							

6.1 Additional Laws

Additional federal and state laws may apply to the alternatives considered in this Draft RPII/EA. Legal authority applicable to restoration project development were fully described in the context of the *DWH* restoration planning in the PDARP/PEIS, Section 6.9 Compliance with Other Applicable Authorities and Appendix 6.D, Other Laws and Executive Orders. That material is incorporated by reference here. Examples of federal and state laws, regulations, and executive orders that may be applicable include but are not limited to:

- Magnuson-Stevens Fishery Conservation and Management Ac
- Marine Mammal Protection Act
- Coastal Zone Management Act
- Coastal Barrier Resources Act
- Clean Air Act
- Clean Water Act
- Rivers and Harbors Act
- Marine Protection, Research and Sanctuaries Act Estuary Protection Act
- Archaeological Resource Protection Act
- National Marine Sanctuaries Act
- Farmland Protection Policy Act
- Private Aids to Navigation
- Federal Water Pollution Control Act
- Additional Executive Orders
    - EO 11988: Floodplain Management
    - EO 11990: Protection of Wetlands
    - EO 12898: Environmental Justice
    - EO 12962: Recreational Fisheries, as amended by Executive Order 13474
    - EO 13112: Invasive Species, as amended by Executive Orders 13286 and 13751
    - EO 13175: Consultation and Coordination with Indian Tribal Governments
    - EO 13186: Responsibilities of Federal Agencies to Protect Migratory Birds
    - EO 13807: Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure Projects
- Public Trust Tidelands, Miss. Code Ann. §29-1-1 *et seq*.
- Antiquities Law of Mississippi, Miss. Code Ann. §39-7-1 *et seq*.
- Mississippi Air and Water Pollution Control Law, Miss Code Ann. § 49-17-1 *et seq*.
- Coastal Wetlands Protection Act, Miss. Code Ann. § 49-27-1 *et seq*.
- Marine Resources, Miss. Code Ann. §57-15-1 *et seq.*

7.0 Monitoring and Adaptive Management

Monitoring, Adaptive Management, and Administrative Oversight was identified as one of the Programmatic Trustee Goals for restoration in the PDARP/PEIS. As described in Chapter 5, Appendix 5.E of the PDARP/PEIS, the Trustee Council has committed to a Monitoring and Adaptive Management (MAM) Framework to support restoration activities by incorporating best available science into project planning and design, identifying and reducing key uncertainties, tracking and evaluating progress toward restoration goals, determining the need for corrective actions, and supporting compliance monitoring. The Monitoring and Adaptive Management Procedures and Guidelines Manual (DWH, 2017a) provides TIGs with recommendations and guidance on development of MAM plans. MAM Plans include:

- Identification of Project-Level Restoration Objectives
- Identification of Monitoring Parameters for Project-Level Performance
- A discussion of example project drivers and potential uncertainties
- An approach to Adaptive Management
- A discussion on MAM Plan Administration

MAM Plans are living documents and are updated as needed to reflect changing conditions and/or to incorporate new information. For example, the MAM plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design is inadequate, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Full monitoring plans for each project would be posted on the Mississippi Restoration Area web page (https://www.gulfspillrestoration.noaa.gov/restoration-areas/mississippi). Data collected and any future revisions to these documents once Quality Assurance and Quality Control have been completed would be made publicly available at this site.

The MAM plans for the project alternatives proposed for implementation in this Draft RPII/EA (Proposed Action) are attached as Appendices:

Appendix A: Wolf River Coastal Preserve Habitat Management-Dupont/Bell's Ferry Tracts

Appendix B: Hancock County Marsh Coastal Preserve Habitat Management-Wachovia Tract

Appendix C: Oyster Spawning Reefs in Mississippi

8.0 List of Preparers and Reviewers

Table 8-1. List of Preparers and Reviewers

AGENCY/FIRM	NAME	POSITION
MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY		
MDEQ	Valerie Alley	NRDA Coordinator
MDEQ	Tabatha Baum	Attorney
MDEQ	Tina Nations	Environmental Administrator
Balch & Bingham LLP	Bradley A. Ennis	Attorney
Covington Civil & Environmental, LLC	Stephen Parker	Senior Scientist
Covington Civil & Environmental, LLC	Alane C. Young	Senior Geologist
Covington Civil & Environmental, LLC	Thomas Strange	Senior Scientist
Covington Civil & Environmental, LLC	Christopher Thomas	Project Scientist
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION		
National Oceanic and Atmospheric Administration	Grant Blumberg	Attorney
National Oceanic and Atmospheric Administration	Dan Van Nostrand	Marine Habitat Resource Specialist
National Oceanic and Atmospheric Administration / Earth Resources Technology, Inc.	Stella Wilson	Marine Habitat Restoration Specialist
National Oceanic and Atmospheric Administration	Ramona Schreiber	DWH NEPA Coordinator
U.S. DEPARTMENT OF AGRICULTURE		
Natural Resources Conservation Service, Gulf Coast Ecosystem Restoration Team	Ronald Howard	Senior Technical Advisor
Natural Resources Conservation Service	Ben Battle	Gulf of Mexico Forest Restoration Program Manager
Natural Resources Conservation Service	Mark Defley	Biologist
U.S. ENVIRONMENTAL PROTECTION AGENCY		
Gulf of Mexico Division	Troy Pierce	Chief Scientist
Gulf of Mexico Division	Calista Mills	Physical Scientist
Region 4, NEPA Program	Daniel Holliman	Environmental Scientist
Region 4, Water Division	Darryl Williams	Environmental Engineer
Office of Water	Tim Landers	Environmental Protection Specialist
U.S. DEPARTMENT OF THE INTERIOR		
U.S. Department of the Interior	Benjamin Frater	Assistant Restoration Manager
U.S. Department of the Interior	Ashley Mills	Restoration Biologist
U.S. Department of the Interior	Robin Renn	DWH NEPA Coordinator
U.S. Department of the Interior	John Rudolph	Attorney-Advisor

9.0 Literature Cited

Clough, J. S., Blancher II, E. C., Park, R. A., Milroy, S. P., Graham, W. M., Rakocinski, C. F., ... & Leaf, R. (2017). Establishing nearshore marine injuries for the Deepwater Horizon natural resource damage assessment using AQUATOX. Ecological modelling, 359, 258-268.

Council on Environmental Quality (CEQ). 1997. Considering Cumulative Effects Under the National Environmental Policy Act. Available: https://www.energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-ConsidCumulEffects.pdf.

DWH Trustees (Deepwater Horizon Natural Resource Damage Assessment Trustees). (2012a). *Deepwater Horizon oil spill Phase I early restoration plan and environmental assessment*. Retrieved from http://www.gulfspillrestoration.noaa.gov/wp-content/uploads/Final-ERP-EA-041812.pdf.

DWH Trustees. 2014. Deepwater Horizon Oil Spill Final Phase III Early Restoration Plan and Early Restoration Programmatic Environmental Impact Statement. https://www.fws.gov/doiddata/dwh-ar-documents/1102/DWH-AR0212235.pdf.

DWH Trustees. 2015. Deepwater Horizon Oil Spill Final Phase IV Early Restoration Plan and Environmental Assessments. https://www.fws.gov/doiddata/dwh-ar-documents/1126/DWH-AR0294749.pdf.

DWH Trustees. 2016. Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement (PDARP/PEIS). https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/Front-Matter-and-Chapter-1_Introduction-and-Executive-Summary_508.pdf.

DWH Trustees. 2017. Mississippi Trustee Implementation Group 2016-2017 Restoration Plan/Environmental Assessment. https://www.fws.gov/doiddata/dwh-ar-documents/1272/DWH-ARZ000488.pdf.

DWH Trustees. 2017a. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill. December. Available: http://www.gulfspillrestoration.noaa.gov/.

GMFMC. 2004. Final Environmental Impact Statement for the Generic Amendment to the following fishery management plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, Red Drum Fishery of the Gulf of Mexico, Reef Fish Fishery of the Gulf of Mexico, Stone Crab Fishery of the Gulf of Mexico, Coral and Coral Reef Fishery of the Gulf of Mexico, Spiny Lobster Fishery of the Gulf of Mexico and South Atlantic; Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic. The Commons at Rivergate, Tampa, Florida. Volume 1. March.

GMFMC. 2005. Generic Amendment Number 3 for Addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and Adverse Effects of Fishing in the

following Fishery Management Plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, Red Drum Fishery of the Gulf of Mexico, Reef Fish Fishery of the Gulf of Mexico, Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic, Stone Crab Fishery of the Gulf of Mexico, Spiny Lobster Fishery of the Gulf of Mexico and South Atlantic, Coral and Coral Reef Fishery of the Gulf of Mexico. March.

MDEQ. 2018. Mississippi 2018 Section 303(D) list of Impaired Water Bodies. Surface Water Division of the Office of Pollution Control. March.

MDMR, 2013. Oystermen's Guide to Mississippi Gulf Coast Oyster Reefs. Oyster Stewardship Program. August.

MDEQ and NFWF, 2016. 2016 Addendum. The Mississippi Gulf Coast Restoration Plan, A Path Toward Sustainable Ecosystem Restoration. Available from: https://www.mdeq.ms.gov/wp-content/uploads/2017/09/2016-Addendum-FINAL-10.31.2016.pdf.

MGCRP; MDEQ and NFWF, 2017. The Mississippi Gulf Coast Restoration Plan, A Path Toward Sustainable Ecosystem Restoration. Available from: http://msrestoreteam.com/NFWFPlan2018/#p=1.

Nelson, D. 2015. Estuarine Salinity Zones In Gulf of Mexico Atlas [Internet]. Stennis Space Center (MS): National Centers for Environmental Information; 2015. [3 screens]. Available from: https://gulfatlas.noaa.gov/.

NMFS. 2006. Sea Turtle and Smalltooth Sawfish Construction Conditions. Southeast Regional Office. St. Petersburg, Florida. Revised March 23.

NMFS. 2012. Reducing Entrapment Risk to Protected Species. Southeast Regional Office. St. Petersburg, Florida. Revised May 22.

Natural Resources Conservation Service (NRCS). 2019. United States Department of Agriculture. Web Soil Survey. Available at http://websoilsurvey.nrcs.usda.gov/.August.

Pearl River Basin Development District (PRBDD). 2013. Topography and History. Accessed on August 19 at: http://www.pearlriverbasin.com/topography_and_history.php.

Schmid, K., and E. Otvos. 2005. Geology and Geomorphology of the Coastal Counties in Mississippi – Alabama. Informational Report. Mississippi Department of Environmental Quality. Office of Geology.

Schmid, K. 2015. Geology and Geomorphology of the Coastal Counties in Mississippi-Alabama: Available at: Need website.

USFWS. 2011. Standard Manatee Conditions for In-water Work. Available at: http://www.dep.state.fl.us/water/wetlands/forms/spgp/SPGP_IV_Attachment_3-ManateeConstructionConditions.pdf.

Appendix A

DRAFT Monitoring and Adaptive Management Plan for Deepwater Horizon NRDA Project:

Wolf River Coastal Preserve Habitat Management – Dupont and Bell's Ferry Tracts

TABLE OF CONTENTS

1.0 Introduction

This project MAM plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support any necessary adaptive management of the restoration project. It identifies potential sources of uncertainty, incorporates monitoring data and decision points that address these uncertainties, and establishes a decision-making process for making adjustments where needed. This MAM Plan is a living document and may be updated as needed to reflect changing conditions and/or new information. For example, the plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design is inadequate, or if uncertainties are identified during project implementation and monitoring. Any significant future revisions to this document will be made publicly available through the Restoration Portal.

1.1 Project Overview

The Dupont Tract and Bell's Ferry Tract (Figure 1-1) are in the Wolf River Coastal Preserve (CP), Hancock County, Mississippi. This project is being implemented to partially restore injuries to natural resources and their services injured by DWH Oil Spill. As outlined within the PDARP/PEIS, this restoration project falls under the following programmatic goal, restoration type, restoration approach, restoration technique, TIG, and restoration plan:

Programmatic goal: Restore and Conserve Habitat

Restoration type: Wetlands, Coastal, and Nearshore Habitats

Restoration approaches: Create, restore, and enhance coastal wetlands; Protect and conserve marine, coastal, estuarine and riparian habitats

Restoration techniques: Develop and implement management actions in conservation areas and/or restoration projects; Restore hydrologic connections to enhance coastal habitats

TIG: Mississippi

Restoration plan: Mississippi Trustee Implementation Group Restoration Plan II/Environmental Assessment (RPII/EA)

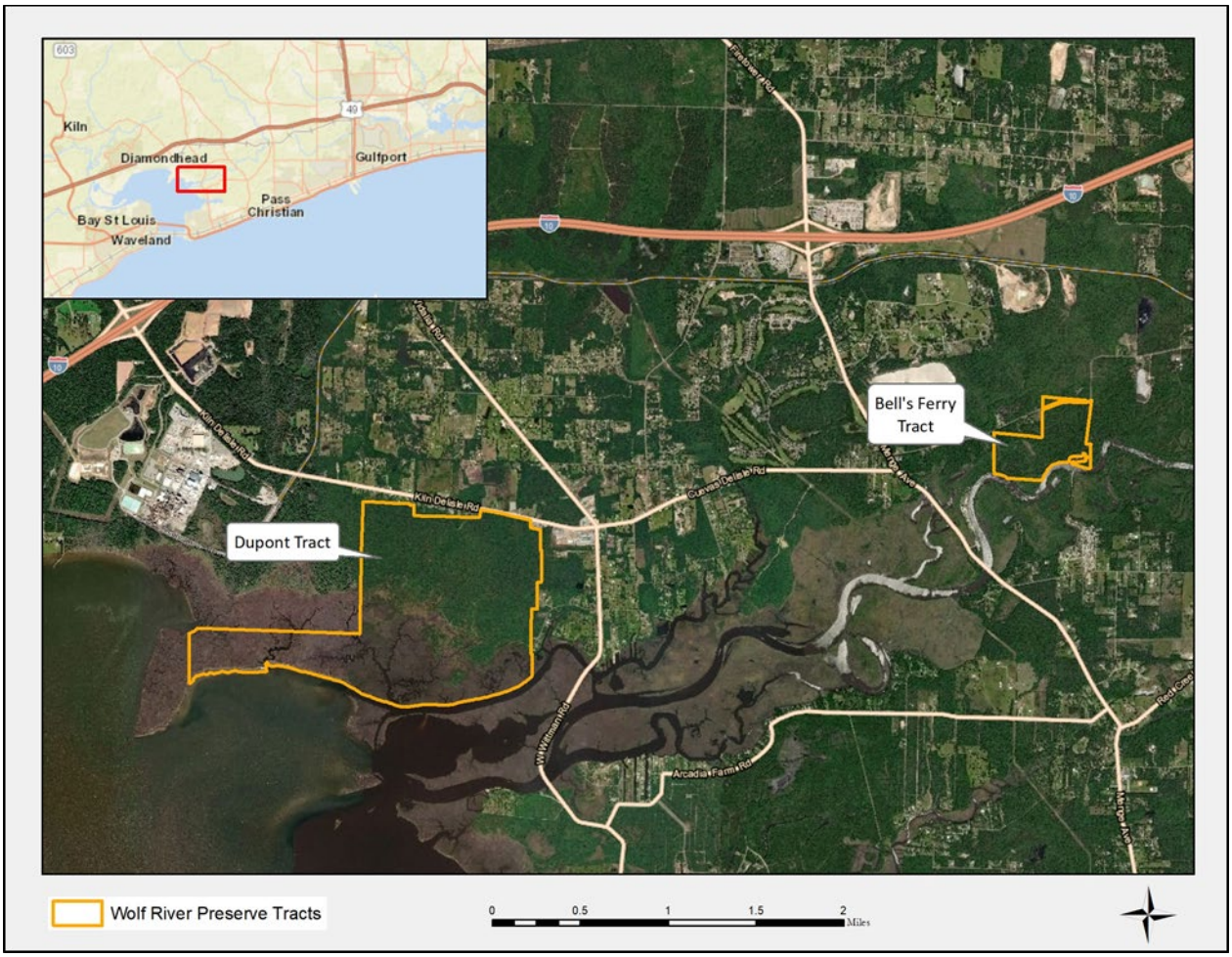


Figure 1-1. Wolf River CP Habitat Management - Dupont and Bell's Ferry Tracts

This restoration project is being implemented in the Wolf River CP; a 2,500-acre area located near the confluence of the Wolf River with St. Louis Bay which is managed by the Mississippi Department of Marine Resources Coastal Preserve Program. Management activities will include one or a combination of the following: chemical treatment, mechanical treatment, prescribed fire, prescribed grazing and road repair and replacement. Management activity specifics are described in section 2.5.1.1 of the Draft RPII/EA.

The Mississippi Department of Environmental Quality (MDEQ) will be the Implementing Trustee. The project will be implemented over a 10-year timeframe. The Mississippi Department of Marine Resources (MDMR) will be a project partner.

1.2 Project Goals and Restoration Objectives

Under the Restore and Conserve Habitat Programmatic Goal, the MS TIG will focus on the Wetlands, Coastal, and Nearshore Habitats Restoration Type. Specific goals of the restoration type include:

1) Restore a variety of interspersed and ecologically connected coastal habitats in each of the five Gulf states to maintain ecosystem diversity, with particular focus on maximizing ecological functions for the range of resources injured by the spill, such as oysters, estuarine-dependent fish species, birds, marine mammals, and nearshore benthic communities;
2) Restore for injuries to habitats in the geographic areas where the injuries occurred, while considering approaches that provide resiliency and sustainability; and
3) While acknowledging the existing distribution of habitats throughout the Gulf of Mexico, restore habitats in appropriate combinations for any given geographic area. Consider design factors, such as connectivity, size, and distance between projects, to address injuries to the associated living coastal and marine resources and restore the ecological functions provided by those habitats.

The specific restoration objectives for this project under the Wetlands, Coastal, and Nearshore Restoration Type are:

1) Increase and maintain native vegetation species composition and structure in restored habitats within the Wolf River CP; and
2) Restore hydrological connectivity within the Wolf River CP.

Performance criteria will be used to determine restoration success or the need for corrective action in accordance with (15 CFR 990.55(b)(1)(vii)) and are outlined for each objective in Section 2.

1.3 Conceptual Setting

Managing land prevents disturbances in priority habitats that buffer protected coastal wetlands, but then allows for the restoration and enhancement of native vegetation assemblages and structure that support life cycle needs of numerous injured resources. The habitats in the project area include estuarine marsh, pine savannas/flatwoods, hydric drains, and open water. Restoration of these habitats will protect downstream natural resources by slowing and filtering nutrient laden runoff, maintain resiliency of dynamic habitats by allowing for free movement in response to changing climate conditions, and provide diverse habitat to serve as refuge for wildlife in the densely populated coastal region. Habitat enhancement of conserved lands through various restoration measures of invasive species removal, restoring hydrological functions, and returning fire to the ecosystem increases natural ecosystem functioning of habitats resulting in a more resilient and sustainable habitat and increased heterogeneity of habitat patches.

Table 1-1. Conceptual Setting and Anticipated Outcomes for the Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Activity	Output	Short-term outcome	Long-term outcome
• Implement management actions on coastal preserve	• Management actions implemented on coastal preserve	• Increase in native vegetation species composition and desired vegetation structure	• Enhancement of ecosystem services of Gulf coast habitats and living resources
• Restore hydrologic connections	• Hydrological connections restored within the project area	• Enhanced hydrological flow across the project area	• Enhancement of ecosystem services of Gulf coast habitats and living resources

1.4 Sources of Potential Uncertainty

Sources of potential uncertainty and the degree of uncertainty among projects will vary. Monitoring to resolve potential uncertainties affecting these decisions can allow for more effective expenditure of resources (e.g., optimized project selection) into the future as learning takes place. Further, the learning that takes place through monitoring allows any necessary corrective actions to be taken in an effort to improve project outcomes. If unresolved, the potential uncertainty may delay the time it takes to achieve the restoration objectives and hinder an implemented project's ability to fully achieve restoration objectives. In this case, the MS TIG is proposing a project that is feasible and has a high likelihood of success. However, potential uncertainties for the project were nonetheless identified and evaluated. These are shown in Table 1-2.

Table 1-2. Potential uncertainties that may affect success of the Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Uncertainty	Summary of Strategy to Resolve
Native vegetation communities do not regenerate after implementation of restoration/management activities.	Conduct targeted monitoring on metrics related to native plant composition and structure specific to each habitat type (i.e., pine flatwoods) and for each restoration/management action (chemical treatment, prescribed fire, prescribed grazing, mechanical treatment). Monitoring data would be used to refine future management actions.
Hydrological connectivity between habitats is not restored	Conduct targeted monitoring on metrics related to hydrological connectivity. Monitoring data would be used to inform corrective actions and/or refine future management actions.
Storm Damage	Conduct an assessment of storm damage to habitats (e.g. forest stand structure) and roadways/culverts. Mechanical clearing of debris may be necessary to ensure hydrological connectivity is functional. Monitoring data would be used to assess potential invasive species encroachment post-storm.

Project Monitoring.—The proposed monitoring for this restoration project was developed to evaluate project performance. The monitoring parameters, outlined below, are organized by project objective, with one or more monitoring parameters for each objective. Information is

provided on the monitoring methods, timing and frequency, duration, sample size, and sites. In addition, example performance criteria for each parameter are identified (if applicable), including example corrective actions that could be taken if the performance criteria are not met. These parameters will be monitored at the restoration project location. The parameters listed below may or may not be tied to performance criteria and/or corrective actions. Project monitoring will be applied to the following objectives:

Objective 1: Increase and maintain native vegetation species composition and structure in restored habitats within the Wolf River CP.

Objective 2: Restore hydrological connectivity within the Wolf River CP.

Objective 1 Parameters:

Parameter #1: Vegetation Structure

a) Rationale: Evaluate progress toward meeting Objective 1.
b) Methods: The project will adopt the methodologies described in the Rapid Assessment Metrics to Enhance Wildlife Habitat and Biodiversity within Southern Open Pine Ecosystems (Nordman et al. 2016) and Field Manual for Rapid Assessment Metrics for Wildlife and Biodiversity in Southern Open Pine Ecosystems (White and Nordman, 2016) for the habitat "Wet Longleaf & Slash Pine Flatwoods & Savannas". Assessments will consist of documenting site characteristics (see Attachment 1) in 30-meter radial plots at multiple sites within a manage tract to capture habitat diversity across the project area. Then, metric assessment scores will be derived to calculate a score for the canopy, ground layer, and invasive species, and an overall score applied using the worksheet provided in Attachment 2.
c) Timing, Frequency, and Duration: Monitoring will take place twice per year (growing season and non-growing season) for the first year after treatment and once per year for subsequently in the growing season for the life of the project. Inter-annual sampling times may differ based on the timing of restoration actions. The data will be analyzed annually, and the appropriate corrective actions will be implemented to address the performance criteria.
d) Sample Size: Vegetation structure sampling design will be determined at a later date when a more detailed assessment of the habitat unit can take place.
e) Sites: N/A
f) Performance Criteria:
    1. Vegetation structure for fire-suppressed pine savanna (by year 5)
        i. 20-65% canopy cover of longleaf or slash pine
        ii. 40 to 100% herbaceous cover
        iii. Invasive nonnative plant species in any stratum present but sporadic (1-5 % cover)
g) Corrective Action: Based on the adaptive management plan, adjust management techniques as necessary to reach performance criteria goals. This may include increasing or decreasing the prescribed fire frequency, increasing amount of mechanical removal of canopy species, or an increase in herbicidal treatment for invasive species.

Parameter #2: Vegetation Composition

a) Rationale: Evaluate progress toward meeting Objective 1
b) Methods: In conjunction with the methods outlined for vegetation structure, vegetation composition information will be collected to document all plant species present within a 1-meter plot. The 1-meter plot will be the centroid of the 30-meter radial plot used for vegetation structure surveys. These plots will be located at multiple sites within a managed tract to capture habitat diversity across the project area.
c) Timing, Frequency, and Duration: Monitoring will take place twice per year (growing season and non-growing season) for the first year after treatment and once per year for the next four years in the growing season. Inter-annual sampling times may differ based on the timing of restoration actions. The data will be analyzed annually, and the appropriate corrective actions will be implemented to address the performance criteria.
d) Sample Size: Vegetation composition sampling design will be determined at a later date when a more detailed assessment of the habitat unit can take place.
e) Sites: N/A
f) Performance Criteria: 95% native flora[36]
g) Corrective Action: Based on the adaptive management plan, adjust management techniques as necessary to reach performance criteria goals. This may include increasing or decreasing the prescribed fire frequency, increasing amount of mechanical removal of canopy species, or an increase in herbicidal treatment for invasive species.

Parameter #3: Area of Improved Habitat

a) Rationale: Evaluate progress toward meeting Objective 1
b) Methods: Information will be collected to document the area of treated habitats across the project area in which management activities are implemented. This will be done by mapping the acreage of habitats that have undergone management.
c) Timing, Frequency, and Duration: 1 per year for the life of the project
d) Sample Size: One acreage calculation per treatment per habitat unit
e) Sites: N/A
f) Performance Criteria: Dupont: 200 acres; Bell's Ferry: 40 acres
g) Corrective Action: Based on the adaptive management plan, adjust management techniques as necessary to reach performance criteria goals. This may include increasing or decreasing the prescribed fire frequency, increasing amount of mechanical removal of canopy species, or an increase in herbicidal treatment for invasive species.

Objective 2 Parameters:

Parameter #4: Channel Dimensions

a) Rationale: Evaluate progress toward meeting Objective 2
b) Methods: Survey grade assessments of channel dimensions

[36] The performance criteria documented here represents a desired condition for the vegetation for a restored site that is well-managed through time. These conditions will be variable across the project area given uncertainties in the timing of management implementation, weather, and other factors.

c) Timing, Frequency, and Duration: Monitoring will take place before and after construction takes place and in year 3. After the five-year period, the data will be analyzed, and the appropriate corrective actions will be implemented to address the performance criteria.
d) Sample Size: Number of sample locations will be determined after surveying and engineering and design have occurred and identified areas in need of restoration activities
e) Sites: N/A
f) Performance Criteria: Channel dimensions will be restored to support the natural hydrological flow of the waterway channels. The appropriate dimensions will be documented after engineering and design have occurred. This will include the x, y, and z dimensions of a waterway.
g) Corrective Action: Based on the adaptive management plan, adjust management techniques as necessary to reach performance criteria goals. This may include increasing or decreasing the width and/or depth of the channel or the size of culverts.

Parameter #5: Structural integrity and function of constructed features

a) Rationale: Evaluate progress toward meeting Objective 2
b) Methods: Visual inspection and assessment of functionality of conveyance and other engineered structures
c) Timing, Frequency, and Duration: Monitoring will initiate after construction takes place and in year 3. After the five-year period, the data will be analyzed, and the appropriate corrective actions will be implemented to address the performance criteria.
d) Sample Size: Number of sample locations will be determined after surveying and engineering and design have occurred.
e) Sites: N/A
f) Performance Criteria: Structural integrity and function of construction features will be monitored to asses that the natural hydrological flow of the waterway channel is occurring. The appropriate criteria will be listed after engineering and design plans have been developed.
g) Corrective Action: Based on the adaptive management plan, adjust management techniques as necessary to reach performance criteria goals. Post-construction inspections will be conducted for structures including assessment of grade control and culvert/low water crossing sedimentation. Maintenance needs will be assessed and implemented to prevent future failures and to secure proper function.

2.0 Rationale for Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000).

Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project by project basis. For example, higher uncertainty may be associated with novel approaches, larger restoration scales (e.g., number and area of projects), limited scientific understanding of target resources, increasing influence of socioeconomic factors, and longer time scales of restoration implementation (LoSchiavo et al. 2013; Simenstad et al. 2006; Steyer & Llewellyn 2000; Williams & Brown 2012; see PDARP/PEIS for more information). The OPA NRDA regulations require that all restoration projects clearly identify performance criteria that will be used to determine project success or the need for corrective action. Projects with more uncertainty may require a more active approach to adaptive management.

3.0 Evaluation

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding and determine whether corrective actions are needed. Section 2.4.6 of the Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0 provides guidance on evaluation of monitoring data[37]. The analysis methods will be applied to all monitoring parameters as described below:

Vegetation structure.—Recorded metrics will be compared on an annual basis using descriptive summaries to track performance across time by analyzing individual metric scores and final scores for each sampling effort. Comparisons will include canopy cover, ground layer cover, basal area, and invasive species cover (Attachment 2).

Vegetation Composition.—All data will be analyzed using software capable of calculating general descriptive statistical analyses. Common analyses include:

- Descriptive summaries of cover for grass, forbs, and shrubs. Cover is calculated by dividing the number of intervals at which a life form was measured by the total number of intervals measured.
- Descriptive summaries of mean grass height, mean forb height, mean shrub height, pre- and post-treatment. The mean height of a life form is calculated by dividing the sum of the heights by the total number of interception points at which the life form occurred.

Channel Dimension & Structural integrity and function of constructed features.— Descriptive summaries of waterway characteristics and construction features will be generated using survey data as well as visual inspections/assessments and analyzed in tabular format.

[37] Deepwater Horizon (DWH) Natural Resource Damage Assessment Trustees. 2017. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill.

4.0 Project-Level Decisions, Including Corrective Actions

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria will be used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation of monitoring data may also determine the need for corrective actions. Table 5-1 provides the interim performance criteria for helping determine whether adjustments to the project are needed to better ensure the project meets the final performance criteria used to determine project success, as well as the potential adaptive management actions (e.g., mid-course corrections or corrective actions) that may be considered for individual parameters. This table does not include all possible options; rather, it includes a list of potential adaptive management actions for each individual parameter to be considered. The decision to implement a corrective action should holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Table 4-1. Corrective actions for the Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Monitoring Parameter	Final Performance Criteria used to determine Project Success (Year 10)	Interim Performance Criteria	Potential corrective actions or mid-course corrections
Vegetation Structure	1) 20-65% canopy cover of longleaf or slash pine 2) 40 to 100% herbaceous cover 3) Invasive nonnative plant species in any stratum present but sporadic (1-5 % cover)	Performance criteria not met by year 5	1) Change burn frequency 2) Modify mechanical removal strategy 3) Alter herbicide treatments 4) Continue to monitor
Vegetation Composition	1) 95% native flora	Performance criteria not met for year 5	1) Change burn frequency 2) Modify mechanical removal strategy 3) Alter herbicide treatments 4) Continue to monitor
Area of Improved Habitat	1) Dupont: 200 acres, Bell's Ferry: 40acres	Performance criteria not met for year 5	1) Change burn frequency 2) Modify mechanical removal strategy 3) Alter herbicide treatments 4) Continue to monitor
Channel Dimensions	1) TBD	Performance criteria not met for year 5	1) Widen channel or change culvert size 2) Adjust slope 3) Continue to monitor
Structural Integrity of Construction Features	1) TBD	Performance criteria not met for year 5	1) Assessment of grade control and culvert/low water crossing sedimentation 2) Continue to monitor

5.0 Monitoring Schedule

The schedule for the project monitoring is shown in Table 6-1, separated by monitoring activity. Execution of monitoring occurs when the project has been fully executed as planned (Year 0) and will represent baseline conditions. Performance monitoring will occur in the years following initial project execution after management has taken place in Years 1-5 and in alternate years 7 and 9, if funding is available (Table 6-1). The length of time a parameter is monitored is contingent on when the restoration action is executed within the project timeline. Thus, parameters may receive monitoring for 1-5 years. The monitoring schedule will be updated as project details are finalized, and management actions implemented.

Table 5-1. Monitoring Schedule for the Wolf River CP Habitat Management-Dupont and Bell's Ferry Tracts

Monitoring Parameters	Monitoring Timeframe							
	Execution Monitoring (initial)	Post-Execution Monitoring (years related to those following treatment)						
	As-built (Year 0)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 7	Year 9
Parameter 1: Vegetation Structure	x	x	x	x	x	x	x	x
Parameter 2: Vegetation Composition	x	x	x	x	x	x	x	x
Parameter 3: Area of Improved Habitat	-	x	x	x	x	x	x	x
Parameter 4: Channel Dimensions	x	x	-	-	x	-	-	-
Parameter 5: Structural Integrity of Construction Features	x	x	-	-	x	-	-	-

6.0 Data Management

To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets will be drafted prior to conducting any project monitoring activities. Electronic data files should be named with the date on which the file was created and should include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy will be made and the original preserved. MDEQ will verify and validate monitoring data and information and will ensure that all data is entered or converted into agreed upon/commonly used digital format labeled with metadata.

6.1 Data Review and Clearance

Once data is entered electronically it is reviewed and verified for completeness. A quality check is made by verbally comparing the electronic data entered to the original hard copy data sheet. Data are validated and any corrections needed are made. Upon validation, data are approved for analysis, reporting and archiving.

After any and all identified errors are addressed, data are considered to be QA/QC'd. MDEQ will give the other TIG members time to review the data before making such information publicly available. Before submitting the monitoring data and information package, Implementing Trustees shall confirm with one another that the package is approved for submission. No data release can occur if it is contrary to federal or state laws.

6.2 Data Storage and Accessibility

Once all data has been verified by quality assurance/quality control procedures, it will be stored on the Restoration Project Database that is maintained by MDEQ.

6.3 Data Sharing

Data will be made publicly available, in accordance with the Open Data Policy, through the DIVER Explorer Interface.

7.0 Reporting

All reporting will occur after field reconnaissance is complete for each assessment effort. This report will summarize the findings for the sampling period including all worksheets transferred into digital format and presented in tabular and graphical formats. The data should be summarized in such a way that it is meaningful to the reader. Additionally, an annual report will be completed that includes:

- Summary data –synthesized data for all efforts during the year;
- Graphs – vegetation characteristics, acres managed, etc.;
- Interpretation of graphical data;
- Discussion of comparison of data if pretreatment and post treatment data are available;
- Explanation of results;
- Uncertainties with management actions;
- Potential data collection issues;
- Issues to be resolved;
- Issues to improve data collection or cooperation in getting quality data; and
- Issues associated with data loss or inability to collect data for a time period.

8.0 Roles and Responsibilities

The MS TIG is responsible for addressing MAM objectives that pertain to their restoration activities and for communicating information to the public through DIVER. The Implementing Trustee for the project will be MDEQ. MDMR will be a project partner. MDEQ's roles include coordination with MDMR and the MS TIG to track project progress, program management and oversight, monitoring oversight, and partnering with MDMR for management operations.

9.0 References

LoSchiavo, A., Best, R., Burns, R., Gray, S., Harwell, M., Hines, E., ... & Vearil, J. (2013). Lessons learned from the first decade of adaptive management in comprehensive Everglades restoration. Ecology and Society, 18(4).

Nordman, Carl, Rickie White, Randy Wilson, Clay Ware, Catherine Rideout, Milo Pyne, and Chuck Hunter. 2016. Rapid Assessment Metrics to Enhance Wildlife Habitat and Biodiversity within Southern Open Pine Ecosystems, Version 1.0. U.S. Fish and Wildlife Service and NatureServe, for the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative.

National Research Council. 2004. Adaptive Management for Water Resources Project Planning. National Academies Press, Washington, DC. 138pp.

Pastorok, R. A., MacDonald, A., Sampson, J. R., Wilber, P., Yozzo, D. J., & Titre, J. P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9(1), 89-107.

Simenstad, C., Reed, D., & Ford, M. 2006. When is restoration not?: Incorporating landscape-scale processes to restore self-sustaining ecosystems in coastal wetland restoration. Ecological Engineering, 26(1), 27-39.

Steyer, G. D., & Llewellyn, D. W. 2000. Coastal Wetlands Planning, Protection, and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 15(3), 385-395.

Williams, B. K. 2011. Adaptive management of natural resources—framework and issues. Journal of Environmental Management, 92(5), 1346-1353.

Williams, B. K., & Brown, E. D. 2012. Adaptive management: the US Department of the Interior applications guide. US Department of the Interior, Adaptive Management Working Group. 136pp.

White and Nordman. 2016. Field Manual for Rapid Assessment Metrics for Wildlife and Biodiversity in Southern Open Pine Ecosystems. https://lccnetwork.org/resource/field-manual-rapid-assessment-metrics-wildlife-and-biodiversity-southern-open-pine

Attachment 1

Field Form for Rapid Assessment Metrics for Wildlife and Biodiversity in Southern Open Pine Ecosystems

Date: **Project:** **Site ID:**

Field Crew Team Members:
Leader: _____
Assistants:_____
Photographer: _____ **Photos of Site:** __*AA Centrum out:* _N _E_ S _W ; __*Buffer in*: _N _E _S _W; Add'l: Y / N
Photo filenames:
_____
_
Assessment Area Shape: Circle, Rectangle, Square, Polygon **Bearing:** _____
Assessment Area Dimensions: radius 18m, 40m, _____ m/ft. or rectangle _____ m/ft wide x _____m/ft long (fill in values, units)
State:_____County:_____ Twp:____Range:____Section:____USGS 7.5'
Quad:_____
Landowner/Managed Area Name:_____ **Contact Person**:
_____
Stand Name: _____ Permit Required? ___ Locked Gate? ___ Access Difficulties?

GENERAL DRAWING (Optional): Provide a drawing of the assessment area, including its boundaries, either aerial view or transect view.

LOCATION: Assessment Area CENTRUM (check one) ___ ORIGINAL ___ MOVED (why? how far?)				
GPS Unit:	**GPS Filename:**		**Projection:**	
UTM Zone:	**Datum:** NAD83 WGS84	**GPS Accuracy:** ___ m/ ft	**PDOP:**	**# of Sat's:**
UTM X Easting: __ __ __ __ __ __	**LAT:** decimal degree	*Original (GRTS):*	Field:	Post-processed:
UTM Y Northing: __ __ __ __ __ __ __	**LONG:** decimal degree			

Classification (use to select appropriate Southern Open Pine Metrics Datasheet for page 2 of field form)
Southern Open Pine Grouping:
_____
Other Community Classification Reference: _____ **Name:**
_____
USNVC Association (Optional):
Classification Comments:
Notes:

Attachment 2

Wet Longleaf & Slash Pine Flatwoods & Savannas Metrics Data Sheet					**Recorded Measured Value of Metric**	**Recorded Metric Score (1.0-4.0)**
Canopy Metrics						
	Excellent = 4.0	**Good = 3.0**	**Fair = 2.0**	**Poor = 1.0**		
Canopy Southern Yellow Pine Basal Area	20-80 ft^2/acre basal area of longleaf or slash pine	10 to <20 or >80 to <90 ft^2/acre basal area of longleaf or slash pine	5 to <10 or 90 to <100 ft^2/acre basal area of longleaf or slash pine	<5 or ≥100 ft^2/acre basal area of longleaf or slash pine	**ft^2/acre BA**	**x0.25**
Southern Yellow Pine Canopy Cover	20-65% canopy cover of longleaf or slash pine	15 to <20% canopy cover or >65-75% canopy cover of longleaf or slash pine	10 to <15% canopy cover or >75-85% canopy cover of longleaf or slash pine	<10% cover or >85% cover of longleaf or slash pine	**% cover**	**x0.25**
Southern Yellow Pine Stand Age Structure	BA ≥20 ft^2/acre of flat-top longleaf or slash pine of any diameter and/or longleaf or slash pine trees ≥14" DBH class	BA ≥10 ft^2/acre of longleaf or slash pine trees ≥14" DBH class	Longleaf or slash pine trees ≥14" DBH class present, but at <10 ft^2/acre BA	No longleaf or slash pine trees ≥14" DBH or with flat-top slash or longleaf pine	**ft^2/acre BA**	**x0.25**
Ground Layer Metrics						
	Excellent = 4.0	**Good = 3.0**	**Fair = 2.0**	**Poor = 1.0**		
Overall Native Herbaceous Ground Cover	40-100% herbaceous cover	30 to <40% herbaceous cover	20 to <30% herbaceous cover	<20% herbaceous cover	**% cover**	**x0.25**
Invasive Plant Presence / Distribution	Invasive nonnative plant species absent or cover is very low (≤1% cover)	Invasive nonnative plant species in any stratum present but sporadic (1-5% cover)	Invasive nonnative plant species in any stratum uncommon (5-10% cover)	Invasive nonnative plant species in any stratum common (>10% cover)	**% cover**	**x0.25**
Final Score is : **Canopy Score _____x0.33 + Midstory Score_____x0.33 + Ground Layer Score_____x0.33 =** **Evaluation Scale: 4.0 to 3.5 = Excellent, 3.5 to 2.5 = Good, 2.5 to 1.5 = Fair, 1.5 to 1.0 = Poor**					**Ground Layer Score =**	

Appendix B

DRAFT Monitoring and Adaptive Management Plan for Deepwater Horizon NRDA Project:

Hancock County Coastal Preserve Habitat Management – Wachovia Tract

TABLE OF CONTENTS

1.0 Introduction

This project MAM plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support any necessary adaptive management of the restoration project. It identifies potential sources of uncertainty, incorporates monitoring data and decision points that address these uncertainties, and establishes a decision-making process for making adjustments where needed. This MAM Plan is a living document and will be updated as needed to reflect changing conditions and/or new information. For example, the plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design is inadequate, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any significant future revisions to this document will be made publicly available through the Restoration Portal.

1.1 Project Overview

The Wachovia Tract (Figure 1-1) is in the Hancock County Coastal Preserve, Hancock County, Mississippi. This project is being implemented to partially restore injuries to natural resources and their services injured by *DWH* Oil Spill. As outlined within the PDARP/PEIS, this restoration project falls under the following programmatic goal, restoration type, restoration approach, restoration technique, TIG, and restoration plan:

Programmatic goal: Restore and Conserve Habitat

Restoration type: Wetlands, Coastal, and Nearshore Habitats

Restoration approaches: Create, restore, and enhance coastal wetlands; Protect and conserve marine, coastal, estuarine and riparian habitats

Restoration techniques: Develop and implement management actions in conservation areas and/or restoration projects

TIG: Mississippi

Restoration plan: Mississippi Trustee Implementation Group Restoration Plan II/Environmental Assessment (RPII/EA)

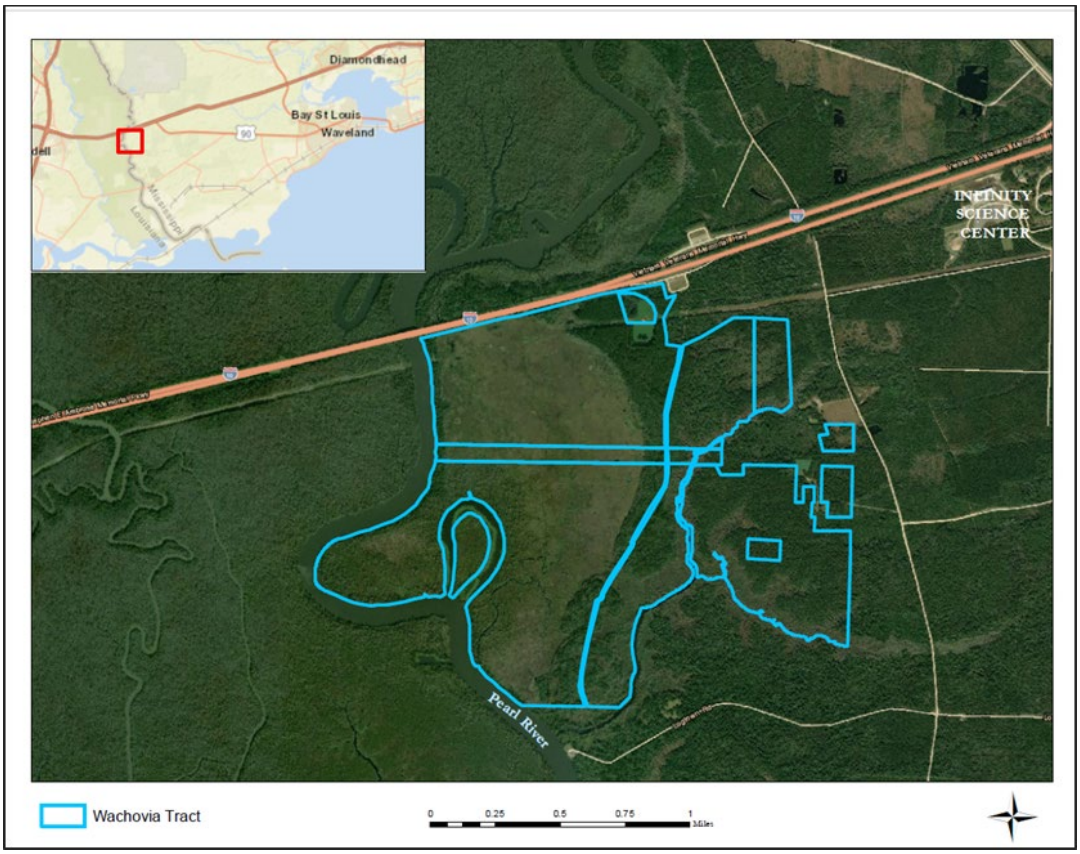


Figure 1-1. Hancock County CP Habitat Management - Wachovia Tract

This restoration project is being implemented in the Hancock County Coastal Preserve-Wachovia Tract Component, a 1,203-acre area located south of I-10 and east of the Pearl River and is managed by the Mississippi Department of Marine Resources Coastal Preserve Program (MDMR CPP). Management activities will include one or a combination of the following: chemical treatment, mechanical treatment, and prescribed fire. Management activity specifics are described in section 2.5.1.2 of the Draft RPII/EA. The Mississippi Department of Environmental Quality (MDEQ) will be the Implementing Trustee. The project will be implemented over a 10-year timeframe. The Mississippi Department of Marine Resources (MDMR) will be a project partner.

1.2 Project Goals and Restoration Objectives

Under the Restore and Conserve Habitat Programmatic Goal, the MS TIG will focus on the Wetlands, Coastal, and Nearshore Habitats Restoration Type. Specific goals of the restoration type include:

1) Restore a variety of interspersed and ecologically connected coastal habitats in each of the five Gulf states to maintain ecosystem diversity, with particular focus on maximizing ecological functions for the range of resources injured by the spill, such as oysters, estuarine-dependent fish species, birds, marine mammals, and nearshore benthic communities;

2) Restore for injuries to habitats in the geographic areas where the injuries occurred, while considering approaches that provide resiliency and sustainability; and
3) While acknowledging the existing distribution of habitats throughout the Gulf of Mexico, restore habitats in appropriate combinations for any given geographic area. Consider design factors, such as connectivity, size, and distance between projects, to address injuries to the associated living coastal and marine resources and restore the ecological functions provided by those habitats.

The specific restoration objective for this project under the Wetlands, Coastal, and Nearshore Restoration Type is:

1) Increase and maintain native vegetation species composition and structure in restored habitats within the Hancock County CP.

Performance criteria will be used to determine restoration success or the need for corrective action in accordance with (15 CFR 990.55(b)(1)(vii)) and are outlined for the objective in Section 2.

1.3 Conceptual Setting

Managing land prevents disturbances in priority habitats that buffer protected coastal wetlands, but then allows for the restoration and enhancement of native vegetation assemblages and structure that support life cycle needs of numerous injured resources. The tract is comprised of the following habitat types: freshwater and brackish marsh, bottomland hardwood forest, hydric drains including bayhead habitats; and upland pine flatwood/savanna. The target areas for restoration measures and management activities are the pine flatwood/savanna habitats. Restoration of these habitats will protect downstream natural resources by slowing and filtering nutrient laden runoff, maintain resiliency of dynamic habitats by allowing for free movement in response to changing climate conditions, and provide diverse habitat to serve as refuge for wildlife in the densely populated coastal region. Habitat enhancement of conserved lands through various restoration measures of invasive species removal, restoring hydrological functions, and returning fire to the ecosystem increases natural ecosystem functioning of habitats resulting in a more resilient and sustainable habitat and increased heterogeneity of habitat patches.

Table 1-1. Conceptual Setting and Anticipated Outcomes for Hancock County CP Habitat Management - Wachovia Tract

Activity	Output	Short-term outcome	Long-term outcome
• Implement management actions on coastal preserve	• Management actions implemented on coastal preserve	• Increase in native vegetation species composition and desired vegetation structure	• Enhancement of ecosystem services of Gulf coast habitats and living resources

1.4 Sources of Potential Uncertainty

Sources of potential uncertainty and the degree of uncertainty among projects will vary. Monitoring to resolve potential uncertainties affecting these decisions can allow for more effective expenditure of resources (e.g., optimized project selection) into the future as learning takes place. Further, the learning that takes place through monitoring allows any necessary corrective actions to be taken in an effort to improve project outcomes. If unresolved, the potential uncertainty may delay the time it takes to achieve the restoration objectives and hinder an implemented project's ability to fully achieve restoration objectives. In this case, the MS TIG is proposing a project that is feasible and has a high likelihood of success. However, potential uncertainties for the project were nonetheless identified and evaluated. These are shown in Table 1-2.

Table 1-2. Potential uncertainties that may affect success for Hancock County CP Habitat Management - Wachovia Tract

Uncertainty	Summary of Strategy to Resolve
Native vegetation communities do not regenerate after implementation of restoration/management activities.	Conduct targeted monitoring on metrics related to native plant composition and structure specific to each habitat type (i.e., pine flatwoods) and for each restoration/management action (chemical treatment, prescribed fire, mechanical treatment). Monitoring data will be used to refine future management actions.
Storm Damage	Conduct an assessment of storm damage to habitats (e.g. forest stand structure). Monitoring data would be used to assess potential invasive species encroachment post-storm.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance. The monitoring parameters, outlined below, are organized by project objective, with one or more monitoring parameters for each objective. Information is provided on the monitoring methods, timing and frequency, duration, sample size, and sites. In addition, example performance criteria for each parameter are identified (if applicable), including example corrective actions that could be taken if the performance criteria are not met. These parameters will be monitored at the restoration project location. The parameters listed below may or may not be tied to performance criteria and/or corrective actions. Project monitoring will be applied to the following objectives.

Objective 1: Increase and maintain native vegetation species composition and structure in restored habitats within the Hancock County CP.

Parameter #1: Vegetation Structure

a) Rationale: Evaluate progress toward meeting Objective 1
b) Methods: The project will adopt the methodologies described in the Rapid Assessment Metrics to Enhance Wildlife Habitat and Biodiversity within Southern Open Pine Ecosystems (Nordman et al. 2016) and Field Manual for Rapid Assessment Metrics for

Wildlife and Biodiversity in Southern Open Pine Ecosystems (White and Nordman, 2016) for the habitat "Wet Longleaf & Slash Pine Flatwoods & Savannas". Assessments will consist of documenting site characteristics (see Attachment 1) in 30-meter radial plots at multiple sites within a manage tract to capture habitat diversity across the project area. Then, metric assessment scores will be derived to calculate a score for the canopy, ground layer, and invasive species, and an overall score applied using the worksheet provided in Attachment 2.

c) Timing, Frequency, and Duration: Monitoring will take place twice per year (growing season and non-growing season) for the first year after treatment and once per year for subsequently in the growing season for the life of the project. Inter-annual sampling times may differ based on the timing of restoration actions. The data will be analyzed annually, and the appropriate corrective actions will be implemented to address the performance criteria.
d) Sample Size: Vegetation structure sampling design will be determined at a later date when a more detailed assessment of the habitat unit can take place.
e) Sites: N/A
f) Performance Criteria:
    1. Vegetation structure for fire-suppressed pine savanna (by year 5)
        i. 20-65% canopy cover of longleaf or slash pine
        ii. 40 to 100% herbaceous cover
        iii. Invasive nonnative plant species in any stratum present but sporadic (1-5 % cover)
g) Corrective Action: Based on the adaptive management plan, adjust management techniques as necessary to reach performance criteria goals. This may include increasing or decreasing the prescribed fire frequency, increasing amount of mechanical removal of canopy species, or an increase in herbicidal treatment for invasive species.

Parameter #2: Vegetation Composition

a) Rationale: Evaluate progress toward meeting Objective 1
b) Methods: In conjunction with the methods outlined for vegetation structure, vegetation composition information will be collected to document all plant species present within a 1-meter plot. The 1-meter plot will be the centroid of the 30-meter radial plot used for vegetation structure surveys. These plots will be located at multiple sites within a manage tract to capture habitat diversity across the project area.
c) Timing, Frequency, and Duration: Monitoring will take place twice per year (growing season and non-growing season) for the first year after treatment and once per year for the next four years in the growing season. Inter-annual sampling times may differ based on the timing of restoration actions. After the five-year period, the data will be analyzed, and the appropriate corrective actions will be implemented to address the performance criteria.
d) Sample Size: Vegetation composition sampling design will be determined at a later date when a more detailed assessment of the habitat unit can take place.
e) Sites: N/A

f) Performance Criteria: 95% native flora[38]
g) Corrective Action: Based on the adaptive management plan, adjust management techniques as necessary to reach performance criteria goals. This may include increasing or decreasing the prescribed fire frequency, increasing amount of mechanical removal of canopy species, or an increase in herbicidal treatment for invasive species.

Parameter #3: Area of Improved Habitat

a) Rationale: Evaluate progress toward meeting Objective 1
b) Methods: Information will be collected to document the area of treated habitats across the project area in which management activities are implemented. This will be done by mapping the acreage of habitats that have undergone management.
c) Timing, Frequency, and Duration: Monitoring for this parameter will take place after management activities are conducted. The frequency of collection is dependent on the number of treatments that would take place in a given year.
d) Sample Size: One acreage calculation per treatment per habitat unit
e) Sites: N/A
f) Performance Criteria: 377 acres
g) Corrective Action: Based on the adaptive management plan, adjust management techniques as necessary to reach performance criteria goals. This may include increasing or decreasing the prescribed fire frequency, increasing amount of mechanical removal of canopy species, or an increase in herbicidal treatment for invasive species.

3.0 Rationale for Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000).

Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project by project basis. For example, higher uncertainty may be associated with novel approaches, larger restoration scales (e.g., number and area of projects), limited scientific understanding of target resources, increasing influence of socioeconomic factors, and longer time scales of restoration implementation (LoSchiavo et al. 2013; Simenstad et al. 2006; Steyer & Llewellyn 2000; Williams & Brown 2012; see PDARP/PEIS for more information). The OPA NRDA regulations require that all restoration projects clearly identify performance criteria that will be used to determine project success or the

[38] The performance criteria documented here represents a desired condition for the vegetation for a restored site that is well-managed through time. These conditions will be variable across the project area given uncertainties in the timing of management implementation, weather, and other factors.

need for corrective action. Projects with more uncertainty may require a more active approach to adaptive management.

4.0 Evaluation

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding and determine whether corrective actions are needed. Section 2.4.6 of the Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0 provides guidance on evaluation of monitoring data[39]. The analysis methods will be applied to all monitoring parameters described below.

Vegetation structure

Recorded metrics will be compared an annual basis using descriptive summaries to track performance across time by analyzing individual metric scores and final scores for each sampling effort. Comparisons will include canopy cover, ground layer cover, basal area, and invasive species cover (Attachment 2).

Vegetation Composition

All data will be analyzed using software capable of calculating general descriptive statistical analyses. Common analyses include:

- Descriptive summaries of cover for grass, forbs, and shrubs. Cover is calculated by dividing the number of intervals at which a life form was measured by the total number of intervals measured.
- Descriptive summaries of mean grass height, mean forb height, mean shrub height, pre- and post-treatment. The mean height of a life form is calculated by dividing the sum of the heights by the total number of interception points at which the life form occurred.

5.0 Project-Level Decisions

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria will be used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation of monitoring data may also determine the need for corrective actions. Table 5-1 provides the interim performance criteria for helping determine whether adjustments to the project are needed to better ensure the project meets the final performance criteria used to determine project success, as well as the potential adaptive management actions (e.g., mid-course corrections or corrective actions) that may be considered for individual parameters. This table does not include all possible options;

[39] Deepwater Horizon (DWH) Natural Resource Damage Assessment Trustees. 2017. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill

rather, it includes a list of potential adaptive management actions for each individual parameter to be considered. The decision to implement a corrective action should holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Table 5-1. Corrective actions for Hancock County CP Habitat Management - Wachovia Tract

Monitoring Parameter	Final Performance Criteria used to determine Project Success (Year 10)	Interim Performance Criteria	Potential corrective actions or mid-course corrections
Vegetation Structure	1) 20-65% canopy cover of longleaf or slash pine. 2) 40 to 100% herbaceous cover 3) Invasive nonnative plant species in any stratum present but sporadic (1-5 % cover)	Performance criteria not met by year 5	1) Change burn frequency 2) Modify mechanical removal strategy 3) Alter herbicide treatments 4) Continue to monitor
Vegetation Composition	1) 95% native flora	Performance criteria not met for year 5	1) Change burn frequency 2) Modify mechanical removal strategy 3) Alter herbicide treatments 4) Continue to monitor
Area of Improved Habitat	1) 377 acres	Performance criteria not met for year 5	1) Change burn frequency 2) Modify mechanical removal strategy 3) Alter herbicide treatments 4) Continue to monitor

6.0 Monitoring Schedule

The schedule for the project monitoring is shown in Table 6-1, separated by monitoring activity. Execution of monitoring occurs when the project has been fully executed as planned (Year 0) and will represent baseline conditions. Performance monitoring will occur in the years following initial project execution after management has taken place in Years 1-5 and in alternate years 7 and 9, if funding is available (Table 6-1). The length of time a parameter is monitored is contingent on when the restoration action is executed within the project timeline. The monitoring schedule will be updated as project details are finalized, and management actions implemented.

Table 6-1. Monitoring Schedule for Hancock County CP Habitat Management - Wachovia Tract

Monitoring Parameters	**Monitoring Timeframe**							
	Execution Monitoring (initial)	Post-Execution Monitoring (years related to those following treatment)						
	As-built (Year 0)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 7	Year 9
Parameter 1: Vegetation Structure	-	x	x	x	x	x	x	x
Parameter 2: Vegetation Composition	-	x	x	x	x	x	x	x
Parameter 3: Area of Improved Habitat	-	x	x	x	x	x	x	x

7.0 Data Management

To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets will be drafted prior to conducting any project monitoring activities. Electronic data files should be named with the date on which the file was created and should include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy will be made and the original preserved. MDEQ will verify and validate monitoring data and information and will ensure that all data is entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

Once data is entered electronically it is reviewed and verified for completeness. A quality check is made by verbally comparing the electronic data entered to the original hard copy data sheet. Data are validated and any corrections needed are made. Upon validation, data are approved for analysis, reporting and archiving. All data are kept in one permanent electronic folder as a permanent record.

After any and all identified errors are addressed, data are considered to be QA/QC'd. MDEQ will give the other TIG members time to review the data before making such information publicly available. Before submitting the monitoring data and information package, co-Implementing Trustees shall confirm with one another that the package is approved for submission. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

Once all data has been verified by quality assurance/quality control procedures, it will be stored on the Restoration Project Database that is maintained by MDEQ.

7.3 Data Sharing

Data will be made publicly available, in accordance with the Open Data Policy, through the DIVER Explorer Interface.

8.0 Reporting

Data will be made publicly available, in accordance with the Open Data Policy, through the DIVER Explorer Interface:

- Summary data –synthesized data for all efforts during the year;
- Graphs – vegetation characteristics, acres managed, etc.;
- Interpretation of graphical data;
- Discussion of comparison of data if pretreatment and post treatment data are available;
- Explanation of results;
- Uncertainties with management actions;
- Potential data collection issues;
- Issues to be resolved;
- Issues to improve data collection or cooperation in getting quality data; and
- Issues associated with data loss or inability to collect data for a time period.

9.0 Roles and Responsibilities

The MS TIG is responsible for addressing MAM objectives that pertain to their restoration activities and for communicating information to the public through DIVER. The lead Implementing Trustee for the project will be MDEQ. MDMR will be a project partner. MDEQ's roles include coordination with MDMR and the MS TIG to track project progress, program management and oversight, monitoring oversight, and partnering with MDMR for management operations.

10.0 References

LoSchiavo, A., Best, R., Burns, R., Gray, S., Harwell, M., Hines, E., ... & Vearil, J. (2013). Lessons learned from the first decade of adaptive management in comprehensive Everglades restoration. Ecology and Society, 18(4).

Nordman, Carl, Rickie White, Randy Wilson, Clay Ware, Catherine Rideout, Milo Pyne, and Chuck Hunter. 2016. Rapid Assessment Metrics to Enhance Wildlife Habitat and Biodiversity within Southern Open Pine Ecosystems, Version 1.0. U.S. Fish and Wildlife Service and NatureServe, for the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative.

National Research Council. 2004. Adaptive Management for Water Resources Project Planning. National Academies Press, Washington, DC. 138pp.

Pastorok, R. A., MacDonald, A., Sampson, J. R., Wilber, P., Yozzo, D. J., & Titre, J. P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9(1), 89-107.

Simenstad, C., Reed, D., & Ford, M. 2006. When is restoration not?: Incorporating landscape-scale processes to restore self-sustaining ecosystems in coastal wetland restoration. Ecological Engineering, 26(1), 27-39.

Steyer, G. D., & Llewellyn, D. W. 2000. Coastal Wetlands Planning, Protection, and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 15(3), 385-395.

Williams, B. K. 2011. Adaptive management of natural resources—framework and issues. Journal of Environmental Management, 92(5), 1346-1353.

Williams, B. K., & Brown, E. D. 2012. Adaptive management: the US Department of the Interior applications guide. US Department of the Interior, Adaptive Management Working Group. 136pp.

White and Nordman. 2016. Field Manual for Rapid Assessment Metrics for Wildlife and Biodiversity in Southern Open Pine Ecosystems. https://lccnetwork.org/resource/field-manual-rapid-assessment-metrics-wildlife-and-biodiversity-southern-open-pine

Attachment 1

Field Form for Rapid Assessment Metrics for Wildlife and Biodiversity in Southern Open Pine Ecosystems

Date: **Project:** **Site ID:**

Field Crew Team Members:
Leader: _____
Assistants: _____
Photographer: _____ **Photos of Site:** __*AA Centrum out:* _N _E_ S _W ; __*Buffer in*: _N _E _S _W; Add'l: Y / N
Photo filenames:
_____
_
Assessment Area Shape: Circle, Rectangle, Square, Polygon **Bearing:** _____
Assessment Area Dimensions: radius 18m, 40m, _____ m/ft. or rectangle _____ m/ft wide x _____m/ft long (fill in values, units)
State:_____County:_____ Twp:____Range:____Section:____USGS 7.5'
Quad:_____
Landowner/Managed Area Name:_____ **Contact Person**:
_____
Stand Name: _____ Permit Required? ___ Locked Gate? ___ Access Difficulties? (describe)_____
SITE DESCRIPTION:

GENERAL DRAWING (Optional): Provide a drawing of the assessment area, including its boundaries, either aerial view or transect view.

LOCATION: Assessment Area CENTRUM (check one) ___ ORIGINAL ___ MOVED (why? how far?)				
GPS Unit:	**GPS Filename:**		**Projection:**	
UTM Zone:	**Datum:** NAD83 WGS84	**GPS Accuracy:** ___ m/ ft	**PDOP:**	**# of Sat's:**
UTM X Easting: __ __ __ __ __ __	**LAT:** decimal degree	*Original (GRTS):*	Field:	Post-processed:
UTM Y Northing: __ __ __ __ __ __ __	**LONG:** decimal degree			

Classification (use to select appropriate Southern Open Pine Metrics Datasheet for page 2 of field form)
Southern Open Pine Grouping:
_____
Other Community Classification Reference: _____ **Name:**
_____
USNVC Association (Optional):
Classification Comments:
Notes:

Attachment 2

Wet Longleaf & Slash Pine Flatwoods & Savannas Metrics Data Sheet					**Recorded Measured Value of Metric**	**Recorded Metric Score (1.0-4.0)**
Canopy Metrics						
	Excellent = 4.0	**Good = 3.0**	**Fair = 2.0**	**Poor = 1.0**		
Canopy Southern Yellow Pine Basal Area	20-80 ft^2/acre basal area of longleaf or slash pine	10 to <20 or >80 to <90 ft^2/acre basal area of longleaf or slash pine	5 to <10 or 90 to <100 ft^2/acre basal area of longleaf or slash pine	<5 or ≥100 ft^2/acre basal area of longleaf or slash pine	**ft^2/acre BA**	**x0.25**
Southern Yellow Pine Canopy Cover	20-65% canopy cover of longleaf or slash pine	15 to <20% canopy cover or >65-75% canopy cover of longleaf or slash pine	10 to <15% canopy cover or >75-85% canopy cover of longleaf or slash pine	<10% cover or >85% cover of longleaf or slash pine	**% cover**	**x0.25**
Southern Yellow Pine Stand Age Structure	BA ≥20 ft^2/acre of flat-top longleaf or slash pine of any diameter and/or longleaf or slash pine trees ≥14" DBH class	BA ≥10 ft^2/acre of longleaf or slash pine trees ≥14" DBH class	Longleaf or slash pine trees ≥14" DBH class present, but at <10 ft^2/acre BA	No longleaf or slash pine trees ≥14" DBH or with flat-top slash or longleaf pine	**ft^2/acre BA**	**x0.25**
Ground Layer Metrics						
	Excellent = 4.0	**Good = 3.0**	**Fair = 2.0**	**Poor = 1.0**		
Overall Native Herbaceous Ground Cover	40-100% herbaceous cover	30 to <40% herbaceous cover	20 to <30% herbaceous cover	<20% herbaceous cover	**% cover**	**x0.25**
Invasive Plant Presence / Distribution	Invasive nonnative plant species absent or cover is very low (≤1% cover)	Invasive nonnative plant species in any stratum present but sporadic (1-5% cover)	Invasive nonnative plant species in any stratum uncommon (5-10% cover)	Invasive nonnative plant species in any stratum common (>10% cover)	**% cover**	**x0.25**
Final Score is : **Canopy Score _____x0.33 + Midstory Score_____x0.33 + Ground Layer Score_____x0.33 =** **Evaluation Scale: 4.0 to 3.5 = Excellent, 3.5 to 2.5 = Good, 2.5 to 1.5 = Fair, 1.5 to 1.0 = Poor**					**Ground Layer Score =**	

Appendix C

DRAFT Monitoring and Adaptive Management Plan for Deepwater Horizon NRDA Project:

Oyster Spawning Reefs in Mississippi

Appendix C DRAFT MAM Plan - Oyster Spawning Reefs in Mississippi

TABLE OF CONTENTS

1.0 Introduction

This project MAM plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support any necessary adaptive management of the restoration project. It identifies potential sources of uncertainty, incorporates monitoring data and decision points that address these uncertainties, and establishes a decision-making process for making adjustments where needed. This MAM Plan is a living document and will be updated as needed to reflect changing conditions and/or new information. For example, the plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design is inadequate, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any significant future revisions to this document will be made publicly available through the Restoration Portal.

1.1 Project Overview

The project areas for the Oyster Spawning Reefs in Mississippi project are the Mississippi Sound and adjacent areas in St. Louis Bay, Heron Bay, Back Bay/Biloxi Bay, Graveline Bay, Pascagoula Bay, and Grand Bay in Hancock, Harrison, and Jackson Counties. This project is being implemented to partially restore injuries to natural resources and their services injured by DWH Oil Spill. As outlined within the PDARP/PEIS, this restoration project falls under the following programmatic goal, restoration type, restoration approach, restoration techniques, TIG, and restoration plan:

Programmatic goals: Replenish and Protect Living Coastal and Marine Resources

Restoration type: Oysters

Restoration approach: Restore Oyster Reef Habitat

Restoration techniques: Restore or create oyster reefs through placement of cultch in nearshore and subtidal areas; Develop a network of oyster reef spawning reserves

TIG: Mississippi

Restoration plan: Mississippi Trustee Implementation Group Restoration Plan II/Environmental Assessment (RPII/EA)

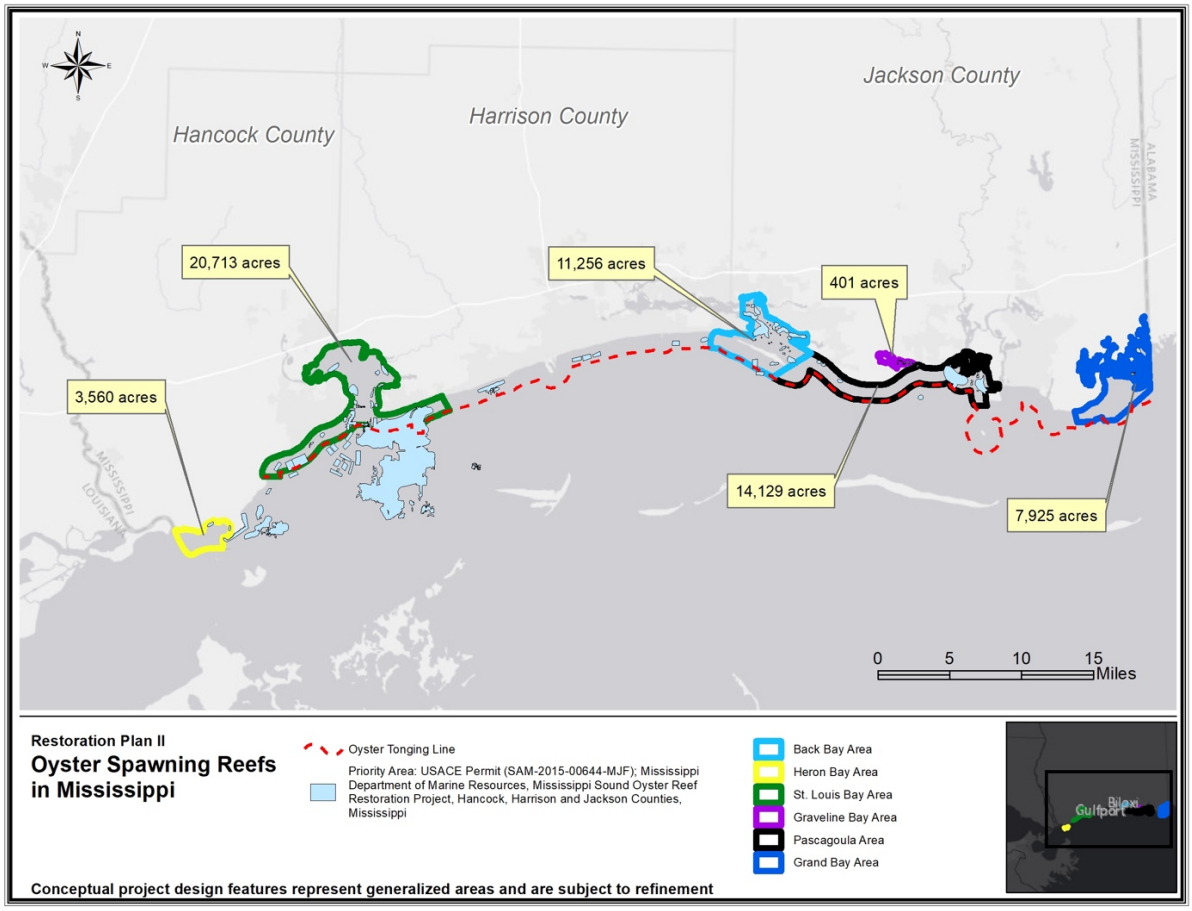


Figure 1-1. Oyster Spawning Reefs in Mississippi Project Area

The project would include the restoration or creation of a minimum of 100 acres and a maximum of 400 acres of high-relief cultch placements in the Mississippi Sound and adjacent bays (Figure 1-1). The proposed techniques for restoration are to restore or create oyster reefs through placement of cultch in nearshore and subtidal areas and develop a network of oyster reef spawning reserves. Management activity specifics are described in section 2.5.2.1 of the Draft RPII/EA.

The Mississippi Department of Environmental Quality (MDEQ) will be the Implementing Trustee. The project will be implemented over a 10-year timeframe. The Mississippi Department of Marine Resources (MDMR) will be a project partner.

1.2 Project Goals and Restoration Objectives

Under the Restore and Conserve Habitat Programmatic Goal, the MS TIG will focus on the Oysters Restoration Type. Specific goals of the restoration type include:

1) Restore oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs;

2) Restore resilience to oyster populations that are supported by productive larval source reefs and sufficient substrate in larval sink areas to sustain reefs over time; and
3) Restore a diversity of oyster reef habitats that provide ecological functions for estuarine dependent fish species, vegetated shoreline and marsh habitat, and nearshore benthic communities.

Specific objectives of the restoration type include:

1) Objective 1: Enhance survival, growth, and reproduction of oysters; and
2) Objective 2: Increase reef height and/or area through cultch placement.

Performance criteria will be used to determine restoration success or the need for corrective action in accordance with (15 CFR 990.55(b)(1)(vii)) and are outlined for each objective in Section 2.

1.3 Conceptual Setting

The Mississippi Sound is an estuarine system that supports a variety of habitats and communities in the nearshore, water column, and marine benthic ecosystems. Organisms and nutrients move among and between these local ecosystem zones, supporting the overall connectivity of the Mississippi Sound. The diverse habitats of this system include the estuarine intertidal zone, submerged aquatic vegetation (SAV), mollusk reefs, estuarine embayments, tidal creeks, Mississippi Sound unconsolidated bottom substrate (sand, soft mud, and mixes), artificial reefs, and barrier island passes. The project areas are all in subtidal environments; however, differences in environmental variables (salinity, water depth, and substrate) exist. In general, the areas where cultch would be placed for the projects includes the following habitats: estuarine embayments, Mississippi Sound unconsolidated bottom substrate (sand, mud, and mixes), and mollusk reefs (including artificial reefs).

Table 1-1. Conceptual Setting and Anticipated Outcomes for Oyster Spawning Reefs in Mississippi

Activity	Output	Short-term outcome	Long-term outcome
• Restore or create oyster reefs through placement of cultch in nearshore and subtidal areas	• Restored oyster reef	• Increase in oyster abundance and productivity	• Enhancement of ecosystem services of Gulf coast habitats and living resources

1.4 Sources of Potential Uncertainty

Sources of potential uncertainty and the degree of uncertainty among projects will vary. Monitoring to resolve potential uncertainties affecting these decisions can allow for more effective expenditure of resources (e.g., optimized project selection) into the future as learning takes place. Further, the learning that takes place through monitoring allows any necessary corrective actions to be taken in an effort to improve project outcomes. If unresolved, the potential uncertainty may delay the time it takes to achieve the restoration objectives and hinder an implemented project's ability to fully achieve restoration objectives. In this case, the MS TIG is proposing a project that is feasible and has a high likelihood of success. However, potential

uncertainties for the project were nonetheless identified and evaluated. These are shown in Table 1-2.

Table 1-2. Potential uncertainties that may affect success of Oyster Spawning Reefs in Mississippi

Uncertainty	Summary of Strategy to Resolve
Oysters do not survive after implementation of restoration activities	Conduct targeted monitoring on metrics related to physical reef characteristics (e.g. reef height) and oyster demographics including oyster density, spat abundance, and size distribution. Monitoring data will be used to refine future management actions.
Harvest of oyster resources	Cultch materials may be placed in harvestable areas. Monitoring will be used to determine potential loss of resources to inform future restoration actions.
Effects from local resource management, such as water or sediment diversions	Created or enhanced oyster reefs may be subjected to increased freshwater flows from the Bonnet Carré spillway or other freshwater diversions. Monitoring of oyster resources will document survival should a diversion event occur.
Effects from hypoxia events	Reefs will be designed to include enough vertical relief to be resilient to hypoxia events. Monitoring will be used to document oyster demographics over the life of project including the number of live oysters in the project areas.
Storm damage	Created or enhanced oyster reefs may be subjected to tropical storms. Monitoring of oyster resources will document survival should a storm event occur including biological monitoring and an assessment of reef structure (height/area).

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance. The monitoring parameters, outlined below, are organized by project objective, with one or more monitoring parameters for each objective. Information is provided on the monitoring methods, timing and frequency, duration, sample size, and sites. In addition, example performance criteria for each parameter are identified (if applicable), including example corrective actions that could be taken if the performance criteria are not met. These parameters will be monitored at the restoration project location. The parameters listed below may or may not be tied to performance criteria and/or corrective actions. The monitoring schedule may vary depending on the location of the cultch plant. For cultch placed in harvestable waters, the monitoring would be performed during the specified harvest moratorium which would be a minimum of 3 years and a maximum of 5 years. For cultch placed in restricted waters, the monitoring would be performed during the specified harvest moratorium which would be a minimum of 5 years and a maximum of 7 years.

Project monitoring will be applied to the following objectives:

Objective 1: Enhance survival, growth, and reproduction of oysters.

Objective 2: Increase reef height and/or area through cultch placement.

Objective 1 Parameters:

Parameter #1: Oyster Density

a) Rationale: Evaluate progress toward meeting Objective 1
b) Methods: Identify and count live and dead oysters within a sampling unit. Utilize methods that report density on a square meter basis (e.g., quadrat sampling). Determine live oyster density (oyster/m2) for standard oyster size classes and dead oyster density (oysters/m2) for standard oyster size classes. Potential method described by Baggett et al. (2014).
c) Timing, Frequency, and Duration: Monitoring will take place for the first year after deployment and once per year in the Summer or early Fall for the monitoring period/specified harvest moratorium. Inter-annual sampling times may differ based on the timing of restoration actions. After the monitoring period, the data will be analyzed, and the appropriate corrective actions will be implemented to address the performance criteria.
d) Sample Size: Sampling number and location will be derived using a stratified random sampling approach. Locations and number will be determined after the reefs have been mapped and areas specifying reef height have been quantified.
e) Performance Criteria: There are no performance criteria associated with this parameter. This data can provide valuable information about the oyster population on the reef and will be used to inform management.
f) Corrective Action: Not applicable

Parameter #2: Oyster Size-Frequency Distribution

a) Rationale: Evaluate progress toward meeting Objective 1
b) Sites: TBD
c) Methods: In conjunction with the methods outlined for oyster density, size-class information (shell height; mm) will be collected to document the size frequency of oysters within a 1-meter plot including spat. Methods would be comparable with those described in the MAM Manual.
d) Timing, Frequency, and Duration: Monitoring will take place for the first year after deployment and once per year in the Summer or early Fall for the monitoring period/specified harvest moratorium. Inter-annual sampling times may differ based on the timing of restoration actions. After the five-year period, the data will be analyzed, and the appropriate corrective actions will be implemented to address the performance criteria.
e) Sample Size: Sampling number and location will be derived using a stratified random sampling approach. Locations and number will be determined after the reefs have been mapped and areas specifying reef height have been quantified.
f) Performance Criteria: There are no performance criteria associated with the oyster size-frequency distribution parameters. This data can provide valuable information about the size (age) structure of the oyster population on the reef and growth.
g) Corrective Action: Not applicable

Parameter #3: Water Quality (Salinity; Dissolved Oxygen)

a) Rationale: Evaluate progress toward meeting Objective 1
b) Sites: TBD
c) Methods: In conjunction with the oyster demographic data collection, discrete water quality sampling would collect salinity and dissolved oxygen measurements using a

handheld water quality unit. Methods would be comparable with those described in the MAM Manual.

d) Timing, Frequency, and Duration: Monitoring will take place for the first year after deployment and once per year in the Summer or early Fall for the monitoring period/specified harvest moratorium. Inter-annual sampling times may differ based on the timing of restoration actions.
e) Sample Size: Sampling number and location will be derived using a stratified random sampling approach. Locations and number will be determined after the reefs have been mapped.
f) Performance Criteria: Not applicable
g) Corrective Action: Not applicable

Objective 2 Parameters:

Parameter #4: Reef Area

a) Rationale: Evaluate progress toward meeting Objective 2
b) Sites: TBD
c) Methods: Mapping of reefs using side scan sonar, multi-beam sounding, or similar technology with transects over the entire project footprint to derive data products that quantify oyster reef area. Reef area is the actual area (summed) of patches of living and non-living oyster shell (or reef substrate with and without live oysters) within the project footprint.
d) Timing, Frequency, and Duration: Monitoring will occur after cultch material has been deployed (as built) and in the final year of the monitoring period/specified harvest moratorium. After the monitoring period, the data will be analyzed, and the appropriate corrective actions will be implemented to address the performance criteria.
e) Sample Size: One dataset per reef and sampling event
f) Performance Criteria: The total submerged reef area should be equal to or greater than 100 acres.
g) Corrective Action: Based on the adaptive management plan, adjust management techniques as necessary to reach performance criteria goals. This may include increasing the height or area of a reef or constructing new reef structures.

Parameter #5: Reef Height

a) Rationale: Evaluate progress toward meeting Objective 2
b) Methods: Mapping of reefs using side scan sonar, multi-beam sounding, or similar technology with transects over the entire project footprint to derive data products that quantify oyster reef height. Reef height is a measure of the mean height of the reef above the surrounding substrate. In addition to average height, minimum and maximum values should be recorded within the project footprint.
c) Timing, Frequency, and Duration: Monitoring will occur after cultch material has been deployed (as built) and in the final year of the monitoring period/specified harvest moratorium. After the monitoring period, the data will be analyzed, and the appropriate corrective actions will be implemented to address the performance criteria.
d) Sample Size: One dataset per reef and sampling event

e) Performance Criteria: Positive or neutral change in reef height from original structure considering initial subsidence. Engineering and design would include estimates for subsidence based on geotechnical investigations. Documentation will include descriptive statistics (e.g. mean, max, min) for the height of a reef.
f) Corrective Action: Based on the adaptive management plan, adjust management techniques as necessary to reach performance criteria goals. This may include increasing the height or area of a reef or constructing new reef structures.

3.0 Rationale For Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000).

Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project by project basis. For example, higher uncertainty may be associated with novel approaches, larger restoration scales (e.g., number and area of projects), limited scientific understanding of target resources, increasing influence of socioeconomic factors, and longer time scales of restoration implementation (LoSchiavo et al. 2013; Simenstad et al. 2006; Steyer & Llewellyn 2000; Williams & Brown 2012; see PDARP/PEIS for more information). The OPA NRDA regulations require that all restoration projects clearly identify performance criteria that will be used to determine project success or the need for corrective action. Projects with more uncertainty may require a more active approach to adaptive management.

4.0 Evaluation

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding and determine whether corrective actions are needed. Section 2.4.6 of the Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0 provides guidance on evaluation of monitoring data[40].

The analysis methods will be applied to all monitoring parameters described below.

Oyster Demographics.—Recorded data will be analyzed on an annual basis using descriptive across time and location by analyzing sample plot data. Oyster demographic data will be

[40] Deepwater Horizon (DWH) Natural Resource Damage Assessment Trustees. 2017. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill.

interpreted to provide information concerning oyster growth, survivorship, and recruitment of oysters on constructed reefs.

Oyster Reef Dimensions.—All data will be analyzed using software capable of displaying and quantifying reef dimension characteristics (e.g. ArcGIS). Descriptive statistics data will be generated (mean, min, max) to interpret changes in the reef over time, such as the persistence of a reef after construction.

5.0 Project-Level Decisions

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria will be used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation of monitoring data may also determine the need for corrective actions. Table 5-1 provides the interim performance criteria for helping determine whether adjustments to the project are needed to better ensure the project meets the final performance criteria used to determine project success, as well as the potential adaptive management actions (e.g., mid-course corrections or corrective actions) that may be considered for individual parameters. This table does not include all possible options; rather, it includes a list of potential adaptive management actions for each individual parameter to be considered. The decision to implement a corrective action should holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Table 5-1. Corrective actions for Oyster Spawning Reefs in Mississippi

Monitoring Parameter	Final Performance Criteria used to determine Project Success (Year 5)	Interim Performance Criteria	Potential corrective actions or mid-course corrections
Oyster Density (live oysters)	Not applicable	Not applicable	Not applicable
Oyster Size-Frequency Distribution	Not applicable	Not applicable	Not applicable
Water Quality (salinity; dissolved oxygen)	Not applicable	Not applicable	Not applicable
Reef Area	≥ 100 acres	Performance criteria not met for monitoring period/harvest moratorium	Increase the area of a reef Construct new reef structures
Reef Height	Positive or neutral change in reef height from original structure	Performance criteria not met for monitoring period/harvest moratorium	Increase the height of a reef Construct new reef structures at suitable height

6.0 Monitoring Schedule

The schedule for the project monitoring is shown in Table 6-1, separated by monitoring activity. Execution of monitoring occurs when the project has been fully executed as planned (Year 0)

and will represent as-built conditions. The monitoring schedule will be updated as project details are finalized, and management actions implemented.

Table 6-1. Monitoring Schedule for Oyster Spawning Reefs in Mississippi

Monitoring Parameters	Monitoring Timeframe*					
	Execution Monitoring (initial)	Post-Execution Monitoring (years related to those following treatment)				
	As-built (Year 0)	Year 1	Year 2	Year 3	Year 4	Year 5
Parameter 1: Oyster Density	-	x	x	x	x	x
Parameter 2: Oyster Size-Frequency Distribution	-	x	x	x	x	x
Parameter 3: Water Quality	-	x	x	x	x	x
Parameter 4: Reef Area	x	-	-	x	-	-
Parameter 5: Reef Height	x	-	-	x	-	-
* The monitoring schedule may vary depending on the location of the cultch plant. For cultch placed in harvestable waters, the monitoring would be completed during the specified harvest moratorium which would be a minimum of 3 years and a maximum of 5 years. For cultch placed in restricted waters, the monitoring would be performed during the specified harvest moratorium which would be a minimum of 5 years and a maximum of 7 years.						

7.0 Data Management

To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Electronic data files should be named with the date on which the file was created and should include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy will be made and the original preserved. MDEQ will verify and validate monitoring data and information and will ensure that all data is entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

Once data is entered electronically it is reviewed and verified for completeness. A quality check is made by verbally comparing the electronic data entered to the original hard copy data sheet. Data are validated and any corrections needed are made. Upon validation, data are approved for analysis, reporting and archiving. All data are kept in one permanent electronic folder as a permanent record.

After any and all identified errors are addressed, data are considered to be QA/QC'd. MDEQ will give the other TIG members time to review the data before making such information publicly available. Before submitting the monitoring data and information package, co-Implementing

Trustees shall confirm with one another that the package is approved for submission. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

Once all data has been verified by quality assurance/quality control procedures, it will be stored on the Restoration Project Database that is maintained by MDEQ and also stored on DIVER.

7.3 Data Sharing

Data will be made publicly available, in accordance with the Open Data Policy, through the DIVER Explorer Interface.

8.0 Reporting

All reporting will occur after field reconnaissance is complete for each assessment effort. This report will summarize the findings for the sampling period including all worksheets transferred into digital format and presented in tabular and graphical formats. The data should be summarized in such a way that it is meaningful to the reader. Additionally, an annual report will be completed that includes:

- Summary data –synthesized data for all efforts during the year;
- Graphs – oyster demographics, oyster dimensions, etc.;
- Interpretation of graphical data;
- Discussion of comparison of data;
- Explanation of results;
- Uncertainties with management actions;
- Potential data collection issues;
- Issues to be resolved;
- Issues to improve data collection or cooperation in getting quality data; and
- Issues associated with data loss or inability to collect data for a time period.

9.0 Roles And Responsibilities

The MS TIG is responsible for addressing MAM objectives that pertain to their restoration activities and for communicating information to the public through DIVER. The Implementing Trustee for the project will be MDEQ. MDMR will be a project partner. MDEQ's roles include coordination with MDMR and the MS TIG to track project progress, program management and oversight, monitoring oversight, and partnering with MDMR for management operations.

10.0 References

Baggett, L.P., S.P. Powers, R. Brumbaugh, L.D. Coen, B. DeAngelis, J. Greene, B. Hancock, and S. Morlock,.2014. Oyster habitat restoration monitoring and assessment handbook. The Nature Conservancy, Arlington, VA, USA., 96pp.

LoSchiavo, A., Best, R., Burns, R., Gray, S., Harwell, M., Hines, E., ... & Vearil, J. (2013). Lessons learned from the first decade of adaptive management in comprehensive Everglades restoration. Ecology and Society, 18(4).

National Research Council. 2004. Adaptive Management for Water Resources Project Planning. National Academies Press, Washington, DC. 138pp.

Pastorok, R. A., MacDonald, A., Sampson, J. R., Wilber, P., Yozzo, D. J., & Titre, J. P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9(1), 89-107.

Simenstad, C., Reed, D., & Ford, M. 2006. When is restoration not?: Incorporating landscape-scale processes to restore self-sustaining ecosystems in coastal wetland restoration. Ecological Engineering, 26(1), 27-39.

Steyer, G. D., & Llewellyn, D. W. 2000. Coastal Wetlands Planning, Protection, and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 15(3), 385-395.

Williams, B. K. 2011. Adaptive management of natural resources—framework and issues. Journal of Environmental Management, 92(5), 1346-1353.

Williams, B. K., & Brown, E. D. 2012. Adaptive management: the US Department of the Interior applications guide. US Department of the Interior, Adaptive Management Working Group. 136pp.

Appendix D

DRAFT Monitoring and Adaptive Management Plan for Deepwater Horizon NRDA Project:

Mississippi Oyster Gardening Program

TABLE OF CONTENTS

1.0 Introduction

This project MAM plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support any necessary adaptive management of the restoration project. It identifies potential sources of uncertainty, incorporates monitoring data and decision points that address these uncertainties, and establishes a decision-making process for making adjustments where needed. This MAM Plan is a living document and will be updated as needed to reflect changing conditions and/or new information. For example, the plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design is inadequate, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any significant future revisions to this document will be made publicly available through the Restoration Portal.

1.1 Project Overview

The Mississippi Oyster Gardening Program (MSOGP) would be established over a five-year period utilizing volunteers along the Mississippi coast to grow subadult oysters in gardens from spat on shell stock that hang from waterfront piers and docks. This project would be implemented to partially restore injuries to natural resources and their services injured by DWH Oil Spill. As outlined within the PDARP/PEIS, this restoration project falls under the following programmatic goal, restoration type, restoration approach, restoration technique, TIG, and restoration plan:

Programmatic goal: Replenish and Protect Living Coastal and Marine Resources

Restoration type: Oysters

Restoration approach: Restore Oyster Reef Habitat

Restoration techniques: Enhance oyster reef productivity through spawning stock enhancement projects such as planting hatchery raised oysters, relocating wild oysters to restoration sites, oyster gardening programs, and other similar projects.

TIG: Mississippi

Restoration plan: Mississippi Trustee Implementation Group Restoration Plan II/Environmental Assessment (RPII/EA)

Objectives outlined in this proposed project include the continued development of a community volunteer-based oyster gardening program that would grow subadult oyster from spat on shell stock that would then be transferred to designated areas in coastal Mississippi. MDEQ will be the Implementing Trustee. The MSOGP will be managed by MDEQ with the assistance of two partners: Mississippi Department of Marine Resources (MDMR) and Mississippi-Alabama Sea Grant Consortium (MASGC). Management activity specifics are described in section 2.5.2.3 of the Draft RPII/EA. The project will be implemented over a 5-year timeframe.

Project Goals and Restoration Objectives.—Under the Restore and Conserve Habitat Programmatic Goal, the MS TIG will focus on the Oysters Restoration Type. Specific goals of the restoration type include:

1) Restore oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs;
2) Restore resilience to oyster populations that are supported by productive larval source reefs and sufficient substrate in larval sink areas to sustain reefs over time; and
3) Restore a diversity of oyster reef habitats that provide ecological functions for estuarine dependent fish species, vegetated shoreline and marsh habitat, and nearshore benthic communities.

Specific objectives of the restoration type include:

1) Objective 1: Enhance survival, growth, and reproduction of oysters; and
2) Objective 2: Maintain capacity of existing oyster gardening program to increase spawning stock.

Performance criteria will be used to determine restoration success or the need for corrective action in accordance with (15 CFR 990.55(b)(1)(vii)) and are outlined for each objective in Section 2.

1.2 Conceptual Setting

The Mississippi Sound is a marine system that supports a variety of habitats and communities in the nearshore, water column, and marine benthic ecosystems. Organisms and nutrients move among and between these local ecosystem zones, supporting the overall connectivity of the Mississippi Sound. The diverse habitats of this system include the estuarine intertidal zone, submerged aquatic vegetation (SAV), mollusk reefs, estuarine embayments, tidal creeks, Mississippi Sound unconsolidated bottom substrate (sand, soft mud, and mixes), artificial reefs, and barrier island passes. Oyster reefs are of particular significance to the diverse ecology of the marine environment and the state's fisheries economy. These habitats provide refuge and food source for numerous commercially and ecologically important species, as well as filter contaminants and sediments, and improve water quality. The project area includes the Mississippi Sound nearshore environment.

Table 1-1. Conceptual Setting and Anticipated Outcomes for the Mississippi Oyster Gardening Program

Activity	Output	Short-term outcome	Long-term outcome
• Enhance oyster reef productivity through an oyster gardening program	• Program maintained	• Oyster gardens growing oysters	• Oyster sanctuaries established from oysters grown in program to enhance population recruitment. • Improved oyster productivity and habitat quality

1.3 Sources of Potential Uncertainty

Sources of potential uncertainty and the degree of uncertainty among projects will vary. Monitoring to resolve potential uncertainties affecting these decisions can allow for more effective expenditure of resources (e.g., optimized project selection) into the future as learning

takes place. Further, the learning that takes place through monitoring allows any necessary corrective actions to be taken in an effort to improve project outcomes. If unresolved, the potential uncertainty may delay the time it takes to achieve the restoration objectives and hinder an implemented project's ability to fully achieve restoration objectives. In this case, the MS TIG is proposing a project that is feasible and has a high likelihood of success. However, potential uncertainties for the project were nonetheless identified and evaluated. These are shown in Table 1-2.

Table 1-2. Potential uncertainties that may affect success of the Mississippi Oyster Gardening Program

Uncertainty	Summary of Strategy to Resolve
Lack of participation	The MSOGP will rely on the well-established model that has been implemented over the last five years in Mississippi and from the established program in the neighboring state of Alabama. Early partnerships with regulatory agencies will minimize the primary uncertainty faced by new oyster gardening programs. In the case of MSOGP, these regulatory agencies are significant partners and supporters of the project.
Storm damage	While production numbers can decline during the weather events, MBOGP has never had a year where there was no production. The risk is directly correlated to the size and power of the storm, as storms are a real threat to the production of a season, the investment in the oysters for that year, the gear deployed and subjected to the storm, and the ability of the gardener to continue with the program in following years (pier loss).
Gardener care	While MBOGP has an average of 1,000 oysters produced per site (excluding weather events and DWHOS), gardener care ultimately dictates the overall success at each gardening site. There will be times when gardeners do not maintain their gardens well enough to warrant the investment in that site. In these cases, the program could be better served to recruit a replacement site.
Oysters do not grow	In some cases, oyster may not grow due to environmental conditions that are not conducive to oyster growth. If this occurs, another site could be selected that better supports oyster growth.

2.0 Project Monitoring

The proposed monitoring for this restoration project was developed to evaluate project performance. The monitoring parameters, outlined below, are organized by project objective, with one or more monitoring parameters for each objective. Information is provided on the monitoring methods, timing and frequency, duration, sample size, and sites. In addition, example performance criteria for each parameter are identified (if applicable), including example corrective actions that could be taken if the performance criteria are not met. These parameters will be monitored at the restoration project location. The parameters listed below may or may not be tied to performance criteria and/or corrective actions. Project monitoring will be applied to the following objectives:

Objective 1: Enhance survival, growth, and reproduction of oysters.

Objective 2: Maintain capacity of existing oyster gardening program to increase spawning stock.

Objective 1 Parameter:

Parameter #1: # of Subadult Oysters

a) Rationale: Evaluate progress toward meeting Objective 1
b) Methods: Each volunteer will receive four gardens (fabricated cages) for their site. Each garden will be suspended between pilings and approximately 12 inches off the bottom. Each site will receive one bag of spat set on whole shell. Each bag will contain 100 shells, which will ultimately be divided across the four gardens. At the conclusion of the growing season, oysters will be collected, counted, and stocked in areas identified by MSOGP partners.
c) Timing, Frequency, and Duration: The number of oysters per site will be quantified once every year of the project (total 5 years) at the end of each growing season.
d) Sample Size: The number of sites and baskets will be determined after volunteers and sites are selected for participation in the program.
e) Performance Criteria: 1,000 ± 200 subadult oysters per site per year
f) Corrective Action: Based on the adaptive management plan, adjust management techniques as necessary to reach performance criteria goals. This may include changing locations for sites that are not performing to the set criteria.

Objective 2 Parameter:

Parameter #2: # of Volunteers

a) Rationale: Evaluate progress toward meeting Objective 2
b) Methods: Count number of volunteers and sites participating in the program
c) Timing, Frequency, and Duration: Monitoring will take place after the first year's growing season and subsequently on an annual basis for the life of the project. After each year, the data will be analyzed, and the appropriate corrective actions will be implemented to address the performance criteria.
d) Sample Size: The number of volunteers will be determined after public engagement takes place.
e) Performance Criteria: 50 volunteers annually
f) Corrective Action: Based on the adaptive management plan, adjust management techniques as necessary to reach performance criteria goals. This could include increased public engagement and more targeted marketing.

3.0 Rationale For Adaptive Management

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000).

Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project by project basis. For example, higher uncertainty may be associated with novel approaches, larger restoration scales (e.g., number and

area of projects), limited scientific understanding of target resources, increasing influence of socioeconomic factors, and longer time scales of restoration implementation (LoSchiavo et al. 2013; Simenstad et al. 2006; Steyer & Llewellyn 2000; Williams & Brown 2012; see PDARP/PEIS for more information). The OPA NRDA regulations require that all restoration projects clearly identify performance criteria that will be used to determine project success or the need for corrective action. Projects with more uncertainty may require a more active approach to adaptive management.

4.0 Evaluation

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding and determine whether corrective actions are needed. Section 2.4.6 of the Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0 provides guidance on evaluation of monitoring data[41].

The analysis methods will be applied to all monitoring parameters described below.

# of Subadult Oysters.—Recorded data will be analyzed on an annual basis using summary statistics to track performance across time and location by analyzing oyster count information. Oyster data will be interpreted to provide information on the suitability of sites to successfully grow oysters.

# of Volunteers.—Recorded data will be analyzed on an annual basis using summary statistics to track performance across time and location by analyzing volunteer count information. This data will be interpreted to provide information on the appropriate number of program participants.

5.0 Project-Level Decisions

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria will be used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation of monitoring data may also determine the need for corrective actions. Table 5-1 provides the interim performance criteria for helping determine whether adjustments to the project are needed to better ensure the project meets the final performance criteria used to determine project success, as well as the potential adaptive management actions (e.g., mid-course corrections or corrective actions) that may be considered for individual parameters. This table does not include all possible options; rather, it includes a list of potential adaptive management actions for each individual parameter

[41] Deepwater Horizon (DWH) Natural Resource Damage Assessment Trustees. 2017. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill.

to be considered. The decision to implement a corrective action should holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Table 5-1. Corrective actions for the Mississippi Oyster Gardening Program

Monitoring Parameter	Final Performance Criteria used to determine Project Success (Year 5)	Interim Performance Criteria	Potential corrective actions or mid-course corrections
# of subadult oysters per site per year	1) 1,000 subadult oysters	Performance criteria not met by year 2	1) Change site to a more suitable location favorable to oyster growth
# volunteers	1) 50 volunteers/year	Performance criteria not met annually	1) Increased public engagement 2) Targeted marketing

6.0 Monitoring Schedule

The schedule for the project monitoring is shown in Table 6-1, separated by monitoring activity. Execution of monitoring occurs when the project has been fully executed as planned (Year 0) and will represent as-built conditions. The length of time a parameter is monitored is contingent on when the restoration action is executed within the project lifespan (5 years). Thus, parameters may receive monitoring for 1-5 years. The monitoring schedule will be updated as project details are finalized, and management actions implemented.

Table 6-1. Monitoring Schedule for the Mississippi Oyster Gardening Program

Monitoring Parameters	Monitoring Timeframe					
	Execution Monitoring (initial)	Post-Execution Monitoring (years related to those following treatment)				
	As-built (Year 0)	Year 1	Year 2	Year 3	Year 4	Year 5
Parameter 1: # of subadult oysters per site per year	-	x	x	x	x	x
Parameter 2: # volunteers	-	x	x	x	x	x

7.0 Data Management

To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets will be drafted prior to conducting any project monitoring activities. Electronic data files should be named with the date on which the file was created and should include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy will be made and the original preserved. MDEQ will verify and validate monitoring data and information and will ensure that all data is entered or converted into agreed upon/commonly used digital format labeled with metadata.

7.1 Data Review and Clearance

Once data is entered electronically it is reviewed and verified for completeness. A quality check is made by verbally comparing the electronic data entered to the original hard copy data sheet. Data are validated and any corrections needed are made. Upon validation, data are approved for analysis, reporting and archiving. All data are kept in one permanent electronic folder as a permanent record.

After any and all identified errors are addressed, data are considered to be QA/QC'd. MDEQ will give the other TIG members time to review the data before making such information publicly available. Before submitting the monitoring data and information package, co-Implementing Trustees shall confirm with one another that the package is approved for submission. No data release can occur if it is contrary to federal or state laws.

7.2 Data Storage and Accessibility

Once all data has been verified by quality assurance/quality control procedures, it will be stored on the Restoration Project Database that is maintained by MDEQ.

7.3 Data Sharing

Data will be made publicly available, in accordance with the Open Data Policy, through the DIVER Explorer Interface.

8.0 Reporting

All reporting will occur after field reconnaissance is complete for each assessment effort. This report will summarize the findings for the sampling period including all worksheets transferred into digital format and presented in tabular and graphical formats. The data should be summarized in such a way that it is meaningful to the reader. Additionally, an annual report will be completed that includes:

- Summary data –synthesized data for all efforts during the year;
- Graphs – oyster counts, volunteer counts, etc.;
- Interpretation of graphical data;
- Discussion of comparisons of data;
- Explanation of results;
- Uncertainties with management actions;
- Potential data collection issues;
- Issues to be resolved;
- Issues to improve data collection or cooperation in getting quality data; and
- Issues associated with data loss or inability to collect data for a time period.

9.0 Roles and Responsibilities

The MS TIG is responsible for addressing MAM objectives that pertain to their restoration activities and for communicating information to the public through DIVER. The Implementing Trustee for the project will be MDEQ. MDEQ's roles include coordination with project partners and the MS TIG to track project progress, program management and oversight, and monitoring oversight.

10.0 References

LoSchiavo, A., Best, R., Burns, R., Gray, S., Harwell, M., Hines, E., ... & Vearil, J. (2013). Lessons learned from the first decade of adaptive management in comprehensive Everglades restoration. Ecology and Society, 18(4).

National Research Council. 2004. Adaptive Management for Water Resources Project Planning. National Academies Press, Washington, DC. 138pp.

Pastorok, R. A., MacDonald, A., Sampson, J. R., Wilber, P., Yozzo, D. J., & Titre, J. P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9(1), 89-107.

Simenstad, C., Reed, D., & Ford, M. 2006. When is restoration not?: Incorporating landscape-scale processes to restore self-sustaining ecosystems in coastal wetland restoration. Ecological Engineering, 26(1), 27-39.

Steyer, G. D., & Llewellyn, D. W. 2000. Coastal Wetlands Planning, Protection, and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 15(3), 385-395.

Williams, B. K. 2011. Adaptive management of natural resources—framework and issues. Journal of Environmental Management, 92(5), 1346-1353.

Williams, B. K., & Brown, E. D. 2012. Adaptive management: the US Department of the Interior applications guide. US Department of the Interior, Adaptive Management Working Group. 136pp.