Louisiana Trustee Implementation Group
Final Phase II Restoration Plan and Environmental Assessment #3.3

LARGE-SCALE BARATARIA MARSH CREATION: UPPER BARATARIA COMPONENT (BA-207)

July 2020

Aerial photograph of project area.

Credit: Patrick Quigley.

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LIST OF ABBREVIATIONS AND ACRONYMS

BA	Biological Assessment
BMP	Best Management Practice
BO/CO	Biological Opinion/Conference Opinion
BP	British Petroleum Exploration and Production, Inc.
CAA	Clean Air Act
CEI	Coastal Environments, Inc.
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMP	Coastal Master Plan
CPRA	Coastal Protection and Restoration Authority
CRMS	Coastwide Reference Monitoring System
CWA	Clean Water Act
CWPPRA	Coastal Wetlands Planning, Protection, and Restoration Act
CZMA	Coastal Zone Management Act
CZM Program	Coastal Zone Management Program
DO	Dissolved Oxygen
DOI	U. S. Department of the Interior
DWH	Deepwater Horizon
ECD	Earthen Containment Dike
E&D	Engineering and Design
EA	Environmental Assessment
EIS	Environmental Impact Statement
EFH	Essential Fish Habitat
ERP/PEIS	Early Restoration Plan and Programmatic Environmental Impact Statement
ESA	Endangered Species Act
EO	Executive Order
Final PDARP/PEIS	Deepwater Horizon Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement
FMP	Fishery Management Plan

FONSI	Finding of No Significant Impact
GEBF	Gulf Environmental Benefit Fund
HAPC	Habitat Areas of Particular Concern
LAC	Louisiana Administrative Code
LCA	Louisiana Coastal Area
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LDSP	Long Distance Sediment Pipeline
LDWF	Louisiana Department of Wildlife and Fisheries
LMFERSC	Louisiana Marine Fisheries Enhancement, Research, and Science Center
LPDES	Louisiana Pollutant Discharge Elimination System
LRS	Louisiana Revised Statute
LSBMC-UBC	Large-Scale Barataria Marsh Creation: Upper Barataria Component
MBSD	Mid-Barataria Sediment Diversion
MAM	Monitoring and Adaptive Management
MCA	Marsh Creation Area
MCY	Million Cubic Yards
MMPA	Marine Mammal Protection Act of 1972
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOGC	New Orleans and Gulf Coast
NOI	Notice of Intent
NPS	National Park Service
NRDA	Natural Resource Damage Assessment
NTU	Nephelometric Turbidity Unit
OPA	Oil Pollution Act of 1990

PPT	parts per thousand
RESTORE Act	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
RM	River Miles
ROD	Record of Decision
RP/EA	Restoration Plan and Environmental Assessment
SAV	Submerged Aquatic Vegetation
SED	Supplementary Environmental Document
SHPO	State Historic Preservation Officer
SWAMP	System Wide Assessment and Monitoring Program
TIG	Trustee Implementation Group
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

On April 20, 2010, the *Deepwater Horizon (DWH)* mobile drilling unit exploded, resulting in loss of life and the release of approximately 3.19 million barrels (134 million gallons) of oil from the BP Exploration and Production Inc. (BP) Macondo well. Oil was discharged from the deep ocean and dispersed to the surface and nearshore environment from Texas to Florida, resulting in extensive injury to natural resources. Response actions, including cleanup activities and actions to prevent the oil from reaching sensitive resources, were undertaken; however, many of these actions had collateral impacts on the environment and natural resources. As part of a 2016 settlement, BP agreed to pay a total of $8.1 billion in natural resource damages (inclusive of Early Restoration funding) over a 15-year period, and up to an additional $700 million for adaptive management or to address injuries to natural resources that are presently unknown but may come to light in the future. The settlement specified funding amounts for restoration for each Restoration Area and Restoration Type.

The Louisiana Trustee Implementation Group[1] (TIG) has undertaken this restoration planning effort to contribute to the restoration of wetland, coastal, and nearshore habitat resources and services injured by the *DWH* oil spill, specifically in Barataria Basin, Louisiana. The purpose of restoration, as discussed in this document and detailed more fully in the Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement[2] (Final PDARP/PEIS) (*DWH* Trustees, 2016), is to make the environment and the public whole for injuries resulting from the oil spill 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 Final PDARP/PEIS provides for TIGs to propose phasing restoration projects across multiple restoration plans. The Louisiana TIG previously prepared the *Strategic Restoration Plan and Environmental Assessment #3: Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin* (Final Phase I SRP/EA #3) as a first phase plan, selecting project alternatives to undergo engineering and design (E&D) until which time during the E&D process enough information was developed to undergo further Oil Pollution Act of 1990 (OPA) and National Environmental Policy Act of 1969 (NEPA) analyses in a second phase plan. One of the projects selected for E&D in the Final Phase I SRP/EA #3 was the Large-Scale Barataria Marsh Creation – Upper Barataria Component (LSBMC-UBC).

This Final *Phase II Restoration Plan and Environmental Assessment #3.3, Large-Scale Marsh Creation: Upper Barataria Component* (Final RP/EA #3.3) presents OPA and NEPA evaluations of design alternatives for the LSBMC-UBC, considers input from the public, and selects an alternative for project

[1] The LA TIG includes four federal Trustee agencies: U.S. Department of Commerce (DOC), represented by the National Oceanic and Atmospheric Administration (NOAA); 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); U.S. Department of Agriculture (USDA); and U.S. Environmental Protection Agency (USEPA).

[2] The Final PDARP/PEIS and Record of Decision (ROD) can be found at: https://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/

implementation. This Final RP/EA #3.3 tiers from, and is based on, the Final Phase I SRP/EA #3 and is consistent with the Final PDARP/PEIS and Record of Decision (ROD), OPA, and NEPA.

In this Final RP/EA #3.3, the Louisiana TIG identifies and evaluates three design alternatives to create and restore marshes in Barataria Basin and a No Action Alternative. The alternatives are consistent with the restoration approaches described in the Final PDARP/PEIS (*DWH* Trustees, 2016) for the Restoration of Wetlands, Coastal, and Nearshore Habitats Restoration Type for the Louisiana Project Area. All three marsh creation design alternatives would meet the Louisiana TIG's restoration goals and objectives, reduce and prevent future injury to estuarine-dependent resources, and benefit multiple resources by restoring a range of ecological functions and services. Marsh creation under all three design alternatives would result in collateral injury due to construction activities such as dredging and/or placement of fill over benthic habitat and corresponding disturbance of other habitats. Alternative 2 would result in the creation of less marsh than either Alternative 1 or Alternative 3. Alternative 3, because it requires more sediment, would also require two construction phases (compared with one for Alternatives 1 and 2) and would have greater collateral injury, as well as potential construction delays, when compared with the other alternatives. The No Action Alternative would result in ongoing and increased coastal land loss in this portion of the Barataria Basin and subsequent loss of "another fifth of the basin's wetlands … by 2045" (LCWCTRF, 1993).

After evaluation of the three design alternatives and the No Action Alternative, the Louisiana TIG has identified one alternative (Alternative 1) as preferred for implementation, at a total estimated cost of $176 million. The Preferred Alternative would create approximately 1,163 acres of intertidal marshes during approximately 26 months by filling diked marsh creation areas with approximately 10.5 million cubic yards of sediment dredged from renewable Mississippi River borrow sources.

The Louisiana TIG published a Notice of Availability of the Draft RP/EA #3.3 in the Federal Register on March 20, 2020. The public was invited to submit comments regarding the alternatives evaluated in the Draft RP/EA #3.3 either online or by mail through April 20, 2020. Additionally, the Louisiana TIG hosted a public webinar on April 2, 2020 to facilitate the public review and comment process for the Draft RP/EA #3.3. During the public comment period, the Louisiana TIG received 116 individual submissions from private citizens and non-governmental organizations. These comments were received during the public webinar, submitted via a web-based application, and sent via email. All commenters expressed support for the TIG's preferred alternative, noting that the project would provide critical habitat for important bird species and other wildlife and would provide a buffer from storm surge for communities and industry along the Louisiana coast. Commenters also appreciated that the preferred alternative is consistent with Louisiana's 2017 Coastal Master Plan and the effort to address the Barataria Basin Land Bridge in a cost-effective manner. They noted the potential for synergy with the proposed Mid-Barataria Sediment Diversion project and the importance of implementing a monitoring and adaptive management plan. The Louisiana TIG considered all comments received and revised this Final RP/EA #3.3 as appropriate. A summary of comments received and the Louisiana TIG's responses are included in Section 6 of this Final RP/EA #3.3.

Overall, this Final RP/EA #3.3 considers the OPA screening criteria, NEPA evaluations, and input from the public to guide the Louisiana TIG's selection of an alternative for implementation that best meets the purpose and need of the Proposed Project, as summarized above and described in more detail in subsequent sections of this document. A Finding of No Significant Impact (FONSI) is provided in Appendix E.

1. INTRODUCTION

The Louisiana Trustee Implementation Group[3] (TIG) prepared this Final Phase II Restoration Plan and Environmental Assessment #3.3 (Final RP/EA #3.3) in accordance with the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS) and Record of Decision (ROD), Oil Pollution Act of 1990 (OPA), and the National Environmental Policy Act of 1969 (NEPA) (*DWH* Trustees, 2016). A Finding of No Significant Impact (FONSI) is included in Appendix E. This Final RP/EA #3.3 tiers from the *Louisiana TIG Strategic Restoration Plan #3: Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin* (Final Phase I SRP/EA #3) and describes the Deepwater Horizon (*DWH*) oil spill restoration planning process, considers design alternatives for the proposed Large-Scale Barataria Marsh Creation: Upper Barataria Component (LSBMC-UBC) project, and selects Alternative 1 to compensate the public for injuries to marshes in the Barataria Basin caused by the *DWH* oil spill in the Louisiana Restoration Area (Louisiana TIG, 2018b). The LSBMC-UBC (FIGURE 1-1) restoration project was selected for engineering and design (E&D) in the Final Phase I SRP/EA #3 (Louisiana TIG, 2018b).

The Louisiana TIG subsequently prepared this Final RP/EA #3.3 for the restoration and creation of intertidal marshes in the Barataria Basin. This Final RP/EA #3.3 would contribute to restoration of ecosystem-level injuries in the Gulf of Mexico that resulted from the *DWH* oil spill, specifically in the Barataria Basin, which had the heaviest and most persistent shoreline oiling and response activities along the Louisiana coast (Michel et al., 2013; Zengel & Michel, 2013). In this Final RP/EA #3.3, the Louisiana TIG analyzes alternatives for final design and construction of created marshes in the upper Barataria Basin.

Land loss in the Barataria Basin between 1932 and 2016 totaled approximately 432 square miles (a 29 percent reduction), accounting for the second greatest land loss among Louisiana's ten coastal basins (Couvillion et al., 2017). Coastal wetlands loss has been attributed to several factors, including sea-level rise, land subsidence, storm damage, sediment deprivation, oil and gas extraction and infrastructure, navigation infrastructure, saltwater intrusion, altered hydrology, and others (Penland et al., 2001). Recent hurricanes and the *DWH* oil spill have exacerbated land loss in the Barataria Basin (Beland et al., 2017; McClenachan et al., 2013; Rangoonwala et al., 2016; Silliman et al., 2016; Turner et al., 2016; Zengel et al., 2015). The consequences of the spill include adverse impacts to marsh vegetation and intertidal biota (for example, fiddler crabs) and shoreline erosion (Zengel et al., 2015). Further loss of benthic resources and coastal fish and shellfish populations is anticipated with additional loss of habitats critical to their growth and survival (Beck et al., 2011; Browder et al., 1989; Chesney et al., 2000). The Barataria Basin Land Bridge, which historically acted as a hydrologic separation between the freshwater wetlands in the upper basin and more saline marshes in the lower basin (FIGURE 1-2), has also

[3] The LA TIG includes five Louisiana state trustee agencies and four federal trustee agencies: Coastal Protection and Restoration Authority (CPRA), Louisiana Department of Natural Resources (LDNR), Louisiana Department of Environmental Quality (LDEQ), Louisiana Oil Spill Coordinator's Office, Louisiana Department of Wildlife and Fisheries (LDWF), National Oceanic and Atmospheric Administration (NOAA), U. S. Department of the Interior (DOI), U. S. Department of Agriculture (USDA), and U. S. Environmental Protection Agency (USEPA).

deteriorated, resulting in further saltwater intrusion and marsh degradation (Hymel, 2017; Lindquist, 2007). The historic Land Bridge is the site of several restoration projects that focus on stabilizing the Land Bridge and reducing the impacts of erosion and saltwater on marshes in the upper Barataria Basin.

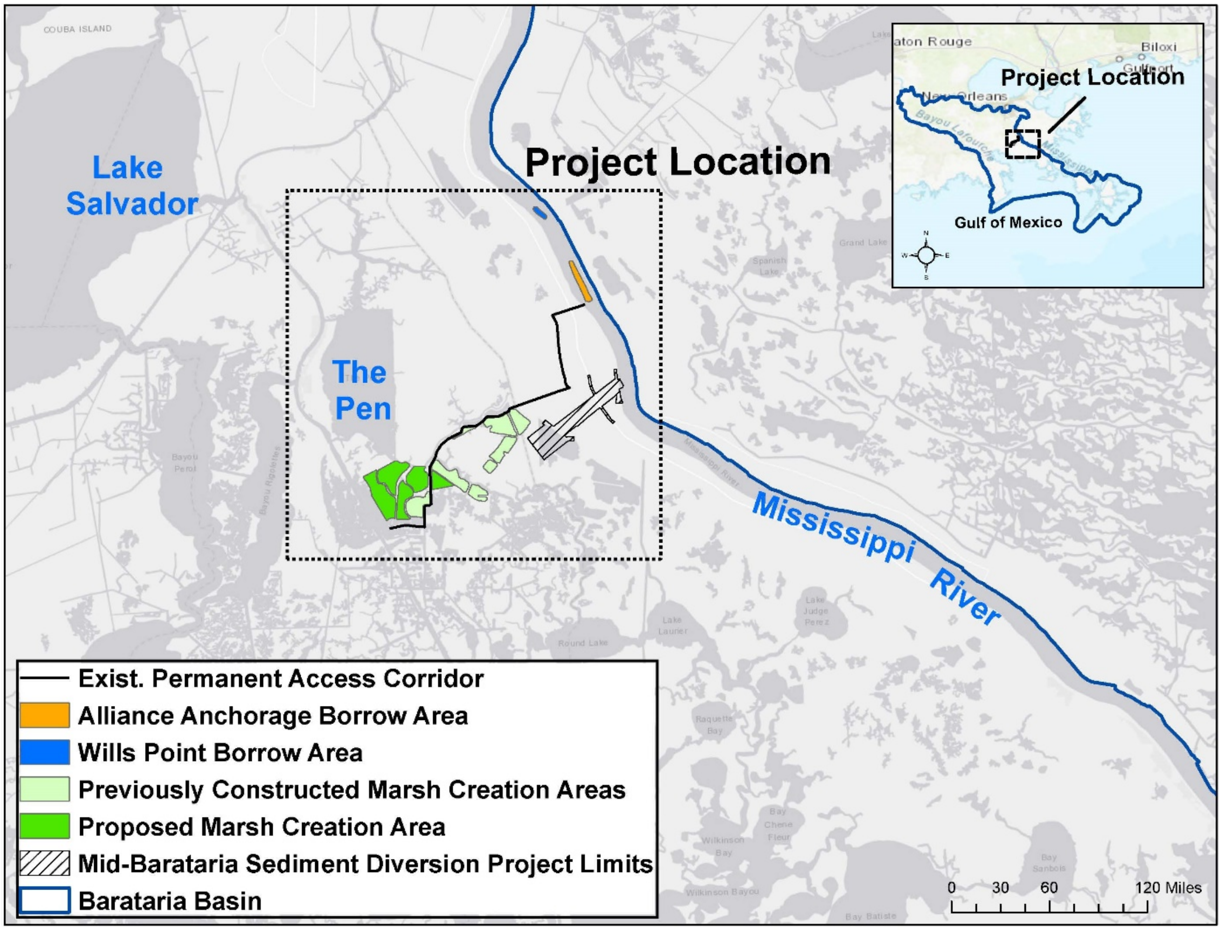

FIGURE 1-1. Location of the LSBMC-UBC project in the Barataria Basin.

1.1. Background

On April 20, 2010, the *DWH* mobile drilling unit exploded, resulting in a massive release of oil from the BP Exploration and Production Inc. (BP) Macondo well, causing loss of life and extensive natural resource injuries. Oil spread from the deep ocean to the surface and nearshore environment from Texas to Florida. Extensive response actions were undertaken to try to reduce harm to people and the environment. However, many of these response actions had collateral impacts on the environment and on natural resource services.

On February 19, 2016, the *DWH* Trustee Council issued the Final PDARP/PEIS detailing a specific proposed plan to fund restoration projects over the next 15 years (*DWH* Trustees, 2016). In March 2016, the Trustees published a Notice of Availability (NOA) of a ROD for the Final PDARP/PEIS (*DWH* Trustees, 2016). Based on the *DWH* Trustees' injury determination established in the Final PDARP/PEIS, the ROD set forth the basis for the *DWH* Trustees' decision to select Alternative A: Comprehensive Integrated Ecosystem Alternative (*DWH* Trustees, 2016). On April 4, 2016, the U.S. District Court for the Eastern District of Louisiana entered a Consent Decree resolving civil claims by the *DWH* oil spill Trustees against BP arising from the *DWH* oil spill. United States v. BPXP et al., Civ. No. 10-4536, centralized in MDL 2179, In re: Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico, on April 20, 2010 (E.D. La.). This historic settlement resolved the Trustees' claims against BP for natural resource damages under OPA.

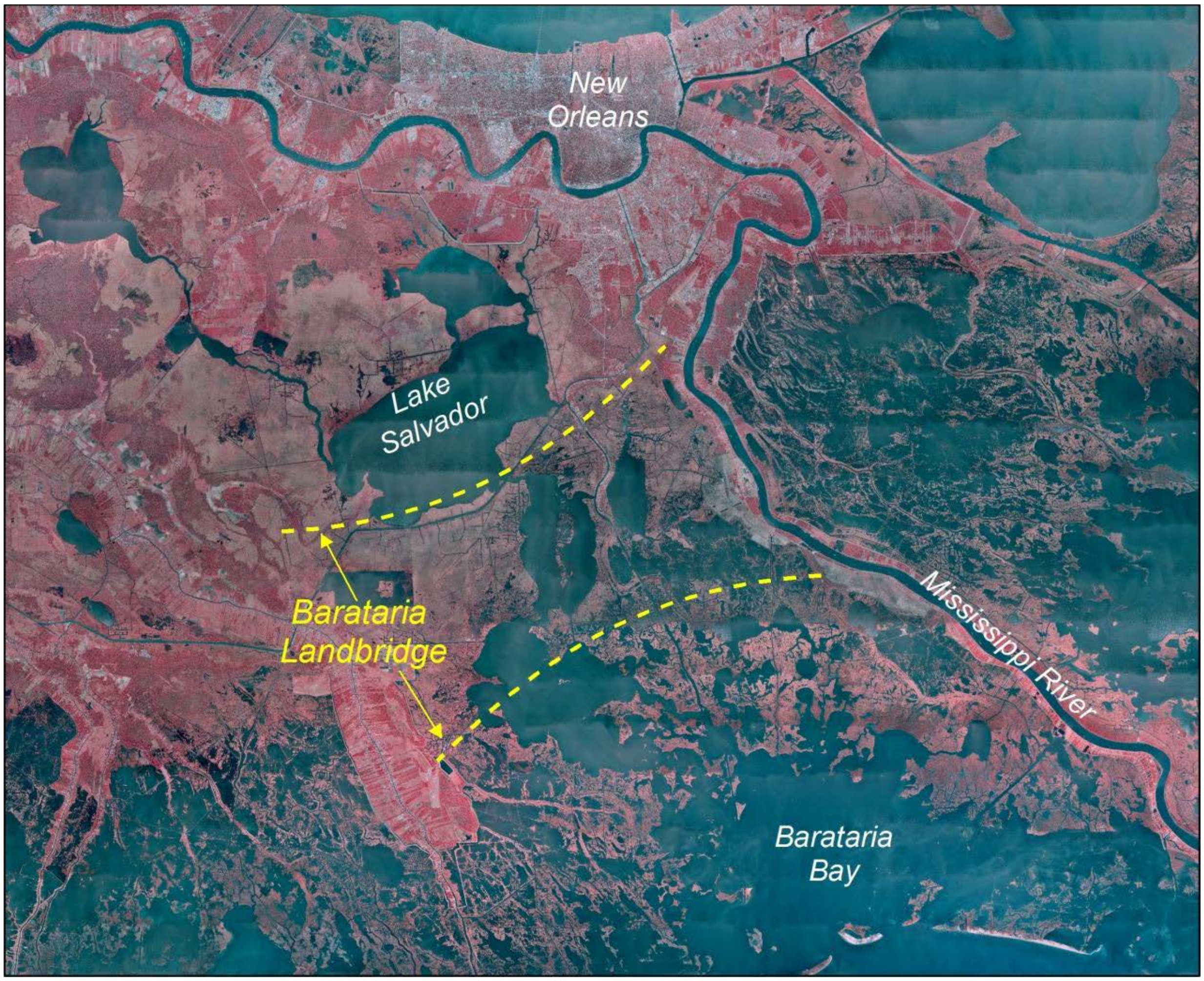

FIGURE 1-2. General location of the Barataria Land Bridge (after Hymel, 2017).

Under the Consent Decree, BP agreed to pay (over a 15-year period) a total of $8.1 billion in natural resource damages (which includes $1 billion BP previously committed to pay for early restoration projects), and up to an additional $700 million (some of which is in the form of accrued interest) for adaptive management or to address injuries to natural resources that are presently unknown but may come to light in the future. Each restoration area has a specific monetary allocation to each of the 13 Restoration Types specified in the Consent Decree. The *DWH* settlement allocation for the Louisiana TIG by Restoration Type is described in Section 5.10.2 of the Final PDARP/PEIS and presented below in TABLE 1-1 (*DWH* Trustees, 2016).

More details on the background of the *DWH* oil spill, the impact of the spill on the Gulf of Mexico ecosystem, and additional context for the settlement and allocation of funds can be found in Chapter 2 of the Final PDARP/PEIS (*DWH* Trustees, 2016).

TABLE 1-1. Restoration funding in dollars for the Louisiana Restoration Area (not including allocations for Early Restoration work).

Major Restoration Categories and Restoration Types	Louisiana Restoration Area Funding Allocation ($)
1. Restore and Conserve Habitat	
Wetlands, Coastal, and Nearshore Habitats	4,009,062,700
Habitat Projects on Federally Managed Lands	50,000,000
2. Restore Water Quality	
Nutrient Reduction (Nonpoint Source)	20,000,000
3. Replenish and Protect Living Coastal and Marine Resources	
Sea Turtles	10,000,000
Submerged Aquatic Vegetation (SAV)	22,000,000
Marine Mammals	50,000,000
Birds	148,500,000
Oysters	26,000,000
4. Provide and Enhance Recreational Opportunities	
Provide and Enhance Recreational Opportunities	38,000,000
5. Monitoring, Adaptive Management, and Administrative Oversight	
Monitoring and Adaptive Management	225,000,000
Administrative Oversight and Comprehensive Planning	33,000,000

This Final RP/EA #3.3 is based on the Louisiana TIG project selections for E&D funding as described and analyzed in the Final Phase I SRP/EA #3, pursuant to OPA, and is consistent with the Final PDARP/PEIS (*DWH* Trustees, 2016; Louisiana TIG, 2018b). These documents are herein incorporated by reference. Links to online versions of these documents are included with their respective citations in Section 7.

The Louisiana TIG prepared the Final Phase I SRP/EA #3 as a first-phase plan, selecting project alternatives[4] to undergo a second phase of planning for E&D, including the LSBMC-UBC, for E&D funding (Louisiana TIG, 2018b). In selecting projects for the Final Phase I SRP/EA #3, the Louisiana TIG considered:

- OPA screening criteria;
- Restoration goals and other criteria identified by the Trustees in the Final PDARP/PEIS (*DWH* Trustees, 2016);

[4] Project alternatives are independent restoration projects that could be selected and implemented to address injuries as a result of the DWH oil spill. The word "project" and "project alternative" may be used interchangeably in this document. Alternatives are different configurations of potential designs for a given project alternative that are analyzed and evaluated. After analysis, a "preferred alternative" is selected from the alternatives and carried forward with a "non-preferred alternative" for OPA and NEPA analysis.

- Contents of Louisiana's Comprehensive Master Plan for a Sustainable Coast from 2017 (CPRA, 2017);
- The need to provide restoration benefits across the many Louisiana basins impacted by the *DWH* oil spill;
- Input from the public; and
- Current and future availability of funds under the *DWH* oil spill Natural Resource Damage Assessment (NRDA) settlement payment schedule (Louisiana TIG, 2018b).

The Final Phase I SRP/EA #3 describes the *DWH* NRDA restoration planning process, identifies a reasonable range of restoration project alternatives to continue to address injuries to resources and habitats caused by the *DWH* oil spill, and selects from those alternatives a suite of restoration alternatives on which the Louisiana TIG will conduct E&D (Louisiana TIG, 2018b).

1.2. Restoration by the Louisiana TIG to Date

The *DWH* Trustees began planning for and implementing Early Restoration projects with funding from BP before the oil spill's injury assessment was complete and before the entry of the Consent Decree because of the magnitude of the *DWH* oil spill. Early Restoration occurred in five separate phases, during which Early Restoration plans were prepared, and associated NEPA compliance and analyses were completed (Phases II and III included restoration projects in Louisiana). These actions were a subset of the continuing effort to address complete restoration of injuries to natural resources resulting from the *DWH* oil spill. Restoration plans completed by the Louisiana TIG to date are listed below. All final restoration plans with environmental assessments include FONSIs. Status updates for the individual DWH restoration projects under can be accessed at https://www.diver.orr.noaa.gov/.

- **Louisiana TIG Final Restoration Plan #1**: *Restoration of Wetlands, Coastal, and Nearshore Habitats; Habitat Projects on Federally Managed Lands; and Birds*, which selects six restoration alternatives for engineering and design: two bird island projects (Queen Bess and Rabbit Island Restoration), three coastal wetlands projects (Terrebonne Basin Ridge and Marsh Creation Project: Bayou Terrebonne Increment; Barataria Basin Ridge and Marsh Creation Project: Spanish Pass Increment; and Lake Borgne Marsh Creation Project: Increment One), and one habitat project on federally managed lands (Shoreline Protection and Jean Lafitte National Park and Preserve; Louisiana TIG, 2017a).
    - **Louisiana TIG Final Phase 2 Restoration Plan and Environmental Assessment #1.1:** *Queen Bess Island Restoration*, which evaluates design alternatives for restoration of bird habitat (Louisiana TIG, 2019a).
    - **Louisiana TIG Draft Phase 2 Restoration Plan and Environmental Assessment #1.2:** *Spanish Pass Ridge and Marsh Creation Project and Lake Borgne Marsh Creation Project*, which proposes construction activities for the restoration of wetlands, coastal, and nearshore habitats (Louisiana TIG, 2019b).
    - **Louisiana TIG Final Restoration Plan and Environmental Assessment #1.3:** *Rabbit Island Restoration & Shoreline Protection at Jean Lafitte Historical National Park and Preserve*, which evaluates design alternatives for construction activities to help restore injured

resources under the "birds" and "habitat projects on federally managed lands" restoration types (Louisiana TIG, 2020a).

- **Louisiana TIG Final Restoration Plan and Environmental Assessment #2:** *Provide and Enhance Recreational Opportunities,* which proposes to reallocate the Early Restoration funds earmarked for the Louisiana Marine Fisheries Enhancement, Research, and Science Center to four projects intended to provide and enhance recreational use (Louisiana TIG, 2017b).
    - **Louisiana TIG Final Supplemental Restoration Plan and Environmental Assessment for the Lake Charles Science Center and Educational Complex Project Modification** assesses the environmental impacts resulting from modifications to the scope and design of the Lake Charles Science Center and Educational Complex project (Louisiana TIG, 2019c).
    - **Louisiana TIG Draft Supplemental Restoration Plan and Environmental Assessment for the Elmer's Island Access Project Modification** assesses the environmental impacts resulting from modifications to the scope and design of the Elmer's Island Access project (Louisiana TIG, 2018a).
- **Louisiana TIG Final Strategic Restoration Plan and Environmental Assessment #3:** *Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin, Louisiana* was prepared to identify a restoration strategy that will help prioritize future decisions regarding project selection and funding in Barataria Basin, Louisiana (Louisiana TIG, 2018b).
- **Louisiana TIG Final Restoration Plan and Environmental Assessment #4:** *Nutrient Reduction (Nonpoint Source) and Recreational Use* was prepared to address both nutrient reduction (nonpoint source) within Louisiana's coastal watersheds and lost recreational use opportunities in the state of Louisiana resulting from the DWH oil spill (Louisiana TIG, 2018c).
    - **Louisiana TIG Draft Supplemental Environmental Assessment for the Point-Aux-Chenes Wildlife Management Area (PACWMA) Recreational Use Enhancement Project** proposes modifications to the design of the PACWMA Recreational Use Enhancement project (Louisiana TIG, 2020b).
    - **Louisiana TIG Draft Supplemental Environmental Assessment for the Wetlands Center Project Modification** assesses the environmental impacts resulting from modifications to the scope and design of the Wetlands Center project (Louisiana TIG, 2019d).
    - **Louisiana TIG Final Supplemental Restoration Plan and Environmental Assessment: Cypremort Point State Park Improvements Project Modification** assesses environmental impacts from modifications to the scope and design of the Cypremort Point State Park Improvements project (Louisiana TIG, 2020c).
- **Louisiana TIG Draft Restoration Plan and Environmental Assessment #5**: *Living Coastal and Marine Resources – Marine Mammals and Oysters* evaluates six restoration alternatives and identifies four as preferred for implementation to help restore marine mammal and oyster populations (Louisiana TIG, 2020d).
- **Louisiana TIG Draft Restoration Plan and Environmental Assessment #6:** *Wetlands, Coastal, and Nearshore Habitats* proposes three restoration projects for the Wetlands, Coastal, and Nearshore Habitats restoration type (Louisiana TIG, 2019e).

1.3. 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 incidents involving an oil discharge or substantial threat of an oil discharge.

Federal trustees must comply with NEPA, 42 U.S.C. § 4321 et seq., its regulations, 40 Code of Federal Regulations (CFR) § 1500 et seq., and agency specific NEPA regulations when planning restoration projects. Given the massive scale of the *DWH* oil spill and needed restoration, the *DWH* Trustees established a tiered restoration planning and NEPA compliance process. The Final PDARP/PEIS considered on a broad programmatic level alternative means of restoring injured natural resources and selected an ecosystem- based approach to be implemented through a suite of restoration types and techniques (*DWH* Trustees, 2016). The Final PDARP/PEIS allows for strategic restoration planning (*DWH* Trustees, 2016). In this document, the Louisiana TIG has incorporated selected restoration approaches and techniques described and evaluated in the Final PDARP/PEIS and selected particular projects for further restoration planning and environmental review (*DWH* Trustees, 2016).

In tiering this Final RP/EA #3.3 from the Final PDARP/PEIS and Final Phase I SRP/EA #3, the Louisiana TIG finds that: (1) the Final PDARP/PEIS includes a thorough evaluation of the potential range of environmental effects that could result from the various restoration approaches and techniques analyzed in the Final PDARP/PEIS; (2) the analysis of the environmental consequences of those approaches and techniques in the Final PDARP/PEIS remains valid; (3) the effects of the restoration approaches and techniques are within the range of impacts evaluated in the Final PDARP/PEIS; and (4) any new information regarding the environmental consequences of the restoration approaches and techniques are within the range of and consistent with the environmental impacts identified and analyzed within the Final PDARP/PEIS (*DWH* Trustees, 2016; Louisiana TIG, 2018b). The Louisiana TIG's independent review of the environmental consequences of the restoration alternatives considered, as well as comments submitted by the public, revealed neither substantial changes in the action evaluated in the Final PDARP/PEIS nor new information indicating significant environmental issues or circumstances presented by application of the restoration techniques and approaches in the Barataria Basin (*DWH* Trustees, 2016).

1.4. Lead, Cooperating Agencies, and Intent to Adopt

The Louisiana TIG designated NOAA as the lead federal trustee for preparing this Final RP/EA #3.3 pursuant to NEPA. In accordance with 40 CFR 1506.3(a), each of the federal cooperating agencies participating on the Louisiana TIG reviewed this Final RP/EA #3.3 for adequacy in meeting the standards set forth in its own NEPA implementing procedures. Each agency is adopting the analysis to inform its own federal decision-making and fulfill its responsibilities under NEPA. More information about OPA and NEPA, as well as their application to *DWH* oil spill restoration planning, can be found in Chapters 5 and 6 of the Final PDARP/PEIS (*DWH* Trustees, 2016).

1.5. Purpose and Need

The Louisiana TIG has undertaken this restoration planning effort to meet the purpose of contributing to the restoration of ecosystem-level injuries in the Gulf of Mexico through restoration of critical wetlands, coastal, and nearshore habitat resources and services in the Barataria Basin. The proposed project described in this RP/EA #3.3 (i.e., the LSBMC-UBC restoration project) is intended to implement a restoration strategy that prioritizes restoration approaches and techniques for further restoration in the Barataria Basin. This Final RP/EA #3.3 is intended to ensure that the Trustees carry out their statutory and regulatory duties on behalf of the public to restore injured natural resources in the Barataria Basin in a manner consistent with OPA and its implementing regulations as well as the goals and objectives of the Final PDARP/PEIS (*DWH* Trustees, 2016).

This Final RP/EA #3.3 is consistent with and tiers from the Final PDARP/PEIS, which identifies extensive and complex injuries to natural resources and services across the Gulf of Mexico, including in Louisiana, as well as a need to plan for comprehensive restoration consistent with OPA (*DWH* Trustees, 2016). Additional information about the overall Purpose and Need for *DWH* NRDA restoration can be found in Section 5.3.2 of the Final PDARP/PEIS (*DWH* Trustees, 2016).

The Final PDARP/PEIS identifies goals for each Restoration Type (Sections 5.5.2 through 5.5.14) (*DWH* Trustees, 2016). These Restoration Type-specific goals help to guide restoration planning and project selection. In addition, the Final PDARP/PEIS identifies restoration approaches that describe options for implementation and, in some cases, techniques and methods (*DWH* Trustees, 2016). This Final RP/EA #3.3 addresses the *Wetlands, Coastal, and Nearshore Habitats* restoration type. The goals of this Restoration Type, outlined in Section 5.5.2.1 of the Final PDARP/PEIS (*DWH* Trustees, 2016) are to:

- 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.

1.6. Proposed Action

To address the purpose and need for action, the Louisiana TIG proposes to undertake the final design and implementation of the TIG's preferred alternative for the LSBMC-UBC restoration project using funds made available through the *DWH* Consent Decree.

Alternative 1 (also referred to as preferred alternative) would meet the goal of restoring and conserving wetland, coastal, and nearshore habitats by creating and nourishing marsh habitat that has deteriorated due to the *DWH* oil spill as well as sea-level rise, high subsidence rates, diminished sediment supply, and extreme storm events. The objective of the preferred alternative is the creation of approximately 1,163 acres intertidal marshes that would restore interspersed and ecologically connected coastal habitats in the upper Barataria Basin, where the greatest amount of oiling occurred.

Marsh creation projects directly restore wetland habitat and are typically carried out in areas that historically supported marsh habitat which has been lost due to natural and human induced causes. The proposed intertidal marshes would be created by constructing approximately 40,779 linear feet of earthen containment dike (ECD) and filling the resulting marsh creation areas (MCAs) with approximately 10.5 million cubic yards (MCY) of borrow material from the Mississippi River. Flow ways would be constructed through dikes and between sections of constructed, diked MCAs to ensure tidal exchange and connectivity between and among MCAs and the larger Barataria Basin. The estimated cost of the preferred alternative is approximately $176 million for construction, construction oversight, operations, maintenance, monitoring, adaptive management, and any future E&D costs. Further details on the design components of Alternative 1 are presented in Section 3.1.1.

1.6.1 Additional Alternatives Analyzed in this Final RP/EA #3.3

In this Final RP/EA #3.3 the Louisiana TIG analyzes in detail a reasonable range of design alternatives. In addition to the preferred alternative (Alternative 1) the following alternatives are evaluated in detail:

- Alternative 2 would create fewer acres of marsh platform than the preferred alternative (creating approximately 862 acres) using approximately 8.4 MCY of available borrow material from the Mississippi River and needing one construction mobilization and has an estimated total cost of $150 million. Further details are presented in Section 3.1.2.
- Alternative 3 would create approximately 1,476 acres) using 13.8 MCY of material. This would require two mobilizations to dredge 8.4 MCY available sediment volume from the borrow areas during a first phase and an additional 5.4 MCY of sediment that would become available once it accumulated in the borrow areas. A minimum of two years (between mobilizations) and additional construction time over two phases would be required. Alternative 3 has an estimated total cost of $278 million. Project details are provided in Section 3.1.3.
- Pursuant to NEPA, no action is addressed and serves as a benchmark against which to compare the effects of the action alternatives. Under no action, the Louisiana TIG would not undertake the LSBMC-UBC restoration project at this time. Conditions would continue to deteriorate in the

area and the benefits derived from implementation of the action alternatives would not occur. The effects of the No Action Alternative are described in detail in Section 3.1.4.

1.7. Coordination with Other Gulf Restoration Programs

The *DWH* Trustees are committed to coordination with other Gulf of Mexico restoration programs to maximize the overall ecosystem impact of *DWH* NRDA restoration efforts, as described in Section 1.5.6 of the Final PDARP/PEIS (*DWH* Trustees, 2016). During the course of the restoration planning process, the Louisiana TIG has coordinated and will continue to coordinate with other *DWH* oil spill and Gulf of Mexico restoration programs, including the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act) as implemented by the Gulf Coast Ecosystem Restoration Council; the Gulf Environmental Benefit Fund (GEBF) managed by the National Fish and Wildlife Foundation; and other state and federal funding sources.

For example, provisions within the plea agreements direct a total of $2.544 billion to the GEBF over a five-year period to be used to support natural resource benefit projects in the Gulf states. In Louisiana, the GEBF funding was directed specifically to large-scale sediment diversion projects and to barrier islands. In the Barataria Basin, GEBF funding has been used to:

- Accelerate planning of river diversions in the Barataria Basin. This effort led to the prioritization of the proposed Mid-Barataria Sediment Diversion (MBSD) over the Lower-Barataria Sediment Diversion for near-term implementation and helped quantify project benefits and potential effects on fisheries species. It also included an Independent Technical Review of the planning effort and a Diversion Advisory Panel.
- Engineer and design the proposed MBSD at a cost of approximately $118 million, which is currently underway.
- Engineer and design, construct, and monitor Increment II of the Caminada Headland Restoration Project (Biological Assessment (BA)-143) at a cost of approximately $146 million. To date, this is the largest restoration project ever undertaken by CPRA. Construction was completed in early 2017 but monitoring of the project is ongoing.
- Improve adaptive management of river diversions and barrier islands in the Barataria Basin through the implementation of the System Wide Assessment and Monitoring Program (SWAMP) and Barrier Island Comprehensive Monitoring program.

In the Barataria Basin, funds from the RESTORE Act have been used to:

- Engineer and design the West Grand Terre Beach Nourishment and Stabilization Project ($7.3 million). These barrier islands were heavily impacted by the April 2010 *DWH* oil spill. The West Grand Terre Beach Nourishment and Stabilization project, once fully implemented, will restore and enhance dune and back-barrier marsh habitat on the key barrier island of West Grand Terre to provide storm surge and wave attenuation, thereby addressing Gulf shoreline erosion, diminished storm surge protection, and the subsidence of back-barrier marshes.
- Develop a large-scale program to build the technical knowledge base needed to develop a plan that moves the nation towards a more holistic management scheme for the Lowermost

Mississippi River, which seeks to both enhance the great economic value of the River while also elevating the importance of ecological maintenance and restoration of the landscape through which it flows ($9.3 million). This planning effort will advance the science developed under the Louisiana Coastal Area (LCA) Mississippi River Hydrodynamic and Delta Management Study to form the foundation for any future river management analysis by creating an integrated science-based management strategy for the Lower Mississippi River to improve navigation, reduce flood risk, and provide for a more sustainable deltaic ecosystem.

- Implementation of the Jean Lafitte Canal Backfilling project ($8.7 million). Canals constructed to access well sites and install pipelines within Jean Lafitte National Historical Park and Preserve resulted in wetland loss, ground and surface water alteration, saltwater intrusion, and soil compaction, and contributed to the introduction and spread of invasive species. The National Park Service (NPS) will work on these remnant canals (16.5 miles) to restore to freshwater wetland and shallow water habitat by leveling spoil banks into canal ways.

The *DWH* Trustees have planned and implemented several projects in the Barataria Basin beginning in 2014 through the Early Restoration process (listed below).

1.7.1. Early Restoration

- Louisiana Oyster Cultch Project. This project involves: (1) the placement of oyster cultch onto public oyster seed grounds throughout coastal Louisiana, and, specific to the Barataria Basin, along public oyster seed grounds in Hackberry Bay; and (2) the construction of an oyster hatchery facility in Grand Isle. The Trustees received approximately $14.8 million for the implementation of this project.
- Lake Hermitage Marsh Creation Project. This project creates approximately 104 acres of new brackish marsh in the Barataria Basin using hydraulically dredged sediment from a borrow area in the Mississippi River. The 104-acre fill area was also planted with native marsh vegetation to accelerate the benefits of the project. The Trustees received approximately $13.2 million for the implementation of this project.
- Louisiana Outer Coast Project. This project involves the restoration of beach, dune, and back-barrier marsh habitats, as well as brown pelicans, terns, skimmers, and gulls at four barrier island locations in Louisiana. Specific to the Barataria Basin, this project includes the restoration of Chenier Ronquille and Shell Island. [The project also includes the restoration of North Breton Island (in the Breton Sound Basin) and Caillou Lake Headlands (in the Terrebonne Basin)]. The Trustees received approximately $318.4 million for the implementation of this entire project.

1.7.2. Post-settlement Restoration

- Barataria Basin Ridge and Marsh Creation - Spanish Pass Increment. This ridge restoration and marsh creation project would be located in Plaquemines Parish. Spanish Pass is a natural historic tributary of the Mississippi River located west of Venice, Louisiana. If implemented, this project will restore approximately 120 acres of earthen ridge and approximately 1,134 acres of marsh. This project was approved for engineering and design in a 2017 restoration plan entitled Louisiana Trustee Implementation Group Final Restoration Plan #1: Restoration of Wetlands, Coastal, and Nearshore Habitats; Habitat Projects on Federally Managed Lands; and Birds (Phase 1 RP #1). The Trustees have allocated $4.5 million for these restoration activities.

- Shoreline Protection at Jean Lafitte National Historical Park and Preserve. This project is located in the Jean Lafitte National Historical Park and Preserve. This project was approved in February 2020 and will restore SAV habitat by constructing breakwaters along the shorelines of Lake Cataouatche, Lake Salvador, and/or Bayou Bardeaux and add material where needed to raise the elevation of the existing features to match the elevation of the new construction. Marsh creation features and SAV planting activities may be integrated into the project. The Trustees have selected this project through the E&D phase and allocated $2.3 million for these restoration activities.
- Queen Bess Island Restoration Project. The Barataria Basin is home to a limited number of bird rookeries. Queen Bess Island, located in Jefferson Parish, is one of the largest and most productive rookeries for numerous colonial nesting bird species, including brown pelicans. This project restores suitable colonial water bird nesting and brood rearing habitat on the island from less than five acres to approximately 36 acres. The Trustees selected this project through the E&D phase and allocated $2.5 million for these restoration activities. Prior to the restoration, only five of the available 36 acres on the island were available for brown pelican nesting. The project successfully restored 30 aces of brown pelican nesting habitat and was completed in time for the arrival of nesting brown pelicans in April.

1.8. Public Involvement

Public input is an integral part of NEPA, OPA, and the *DWH* oil spill restoration planning effort. The purpose of public review is to facilitate public discussion regarding the restoration alternatives, allow the Trustees to solicit and consider public comment, and ensure that final plans consider relevant issues.

1.8.1. Public Involvement in the Final PDARP/PEIS and Louisiana Coastal Master Plan

The *DWH* Trustees conducted public outreach as part of the Final PDARP/PEIS; the process is described in Chapter 8 of the Final PDARP/PEIS (*DWH* Trustees, 2016). More detail on public outreach and involvement can also be found in plans for previous phases of *DWH* NRDA restoration, including in the Early Restoration Plans available at: http://www.gulfspillrestoration.noaa.gov/restoration/early-restoration.

Similarly, during the development of the 2017 Louisiana Coastal Master Plan (CMP), CPRA combined opportunities to hear from coastal communities in person and online. Its outreach and engagement efforts initially began in 2014 and continued until the publication of the 2017 CMP. These public involvement efforts included a series of community meetings across coastal Louisiana. These community conversations, combined with the development of tools and materials to help communities understand available resiliency measures, gave coastal citizens and leaders active ownership in their future adaptation decisions. CPRA also hosted community meetings in partnership with local community organizations that facilitated discussions to obtain feedback on draft lists of potential restoration projects. Throughout the planning process, CPRA hosted in-person meetings and webinars with the technical community to provide updates on different analytical aspects of the 2017 CMP. The feedback helped refine the technical analysis and approach. After the draft CMP was released, CPRA hosted four official public hearings to receive feedback and comments. Over 800 people attended these meetings, and CPRA used Facebook Live to broadcast the presentation, which reached more than 11,000 additional citizens.

In addition to the public hearings, CPRA traveled across coastal Louisiana and participated in approximately 50 meetings, briefings, and presentations, meeting with thousands of stakeholders during the public comment period. In all, over 1,300 comments were received on the 2017 CMP.

1.8.2. Public Involvement in the Development of the Barataria Basin Final Phase I SRP/EA #3

In late March 2017, the Louisiana TIG published a Notice of Solicitation for Project Ideas, which requested the public's input regarding natural resource restoration opportunities in Louisiana, focused on the restoration type that restores and conserves wetlands, coastal, and nearshore habitats in the Barataria Basin (specifically restoration approaches identified in the Final PDARP/PEIS that can sustainably create, restore, and enhance coastal wetlands and restore and/or preserve Mississippi River processes) (*DWH* Trustees, 2016).[5]

On April 28, 2017, the Louisiana TIG published a Notice of Intent (NOI) to prepare the Final Phase I SRP/EA #3 for the Barataria Basin in Louisiana, pursuant to the *DWH* Final PDARP/PEIS (82 Federal Register 19659) (*DWH* Trustees, 2016; Louisiana TIG, 2018b). The NOI explained that the Louisiana TIG would consider whether a combination of the Barataria Basin habitat restoration projects in the Draft 2017 CMP constitutes a preferred alternative, among other feasible alternatives, for fulfilling OPA and the Final PDARP/PEIS intent for the Trustees to address ecosystem-level injuries and to restore, rehabilitate, replace or acquire the equivalent of the injured wetlands, coastal, and nearshore habitat resources and services and compensate for interim losses of those resources from the *DWH* oil spill (*DWH* Trustees, 2016).

On December 20, 2017, the Louisiana TIG released the Draft Phase I SRP/EA #3. It was made available for public review and comment for 45 days as specified in the public notice published December 20, 2017 in the Federal and Louisiana Registers. A public meeting was held January 24, 2018 in New Orleans to present the Draft Phase I SRP/EA #3 and hear public comments on the plan. The public comment period closed on February 5, 2018.

The Final Phase I SRP/EA #3 was completed in March 2018 after review, consideration, and response to public comments (Louisiana TIG, 2018b). Section 7 of the Final Phase I SRP/EA #3 provides a description of the comment analysis process, a summary of the public comments, and the Louisiana TIG's responses to these comments (Louisiana TIG, 2018b).

[5] For more information, see http://www.gulfspillrestoration.noaa.gov/2017/03/request-restoration-project-ideas-louisiana and http://la-dwh.com/2016_2017Restoration.aspx.

1.8.3. Public Involvement in the Development of the Phase II RP/EA #3.3 for the LSBMC-UBC (BA-207)

On March 20, 2020, the Louisiana TIG posted a NOA in the Federal Register, encouraging the public to review and comment on the Draft RP/EA #3.3 that was made available for public review and comment for 30 days following its release. Additionally, the Louisiana TIG hosted a public webinar on April 2, 2020 to facilitate the public review and comment process for the Draft RP/EA #3.3. During the public comment period, the Louisiana TIG received 116 individual submissions from private citizens and non-governmental organizations. These comments were received during the public webinar, submitted via a web-based application, and sent via email. After the comment period closed on April 20, 2020, the Louisiana TIG considered all comments received and revised this Final RP/EA #3.3 as appropriate. A summary of comments received and the Louisiana TIG's responses are included in Section 6 of this Final RP/EA #3.3.

1.8.4 Administrative Record

The *DWH* Trustees opened a publicly available Administrative Record for the NRDA of the *DWH* oil spill, including restoration planning activities, concurrently with publication of the 2010 NOI (pursuant to 15 CFR § 990.45). DOI is the lead federal Trustee for maintaining the Administrative Record, which can be found at http://www.doi.gov/deepwaterhorizon/adminrecord. This administrative record site is also used by the Louisiana TIG for *DWH* restoration planning. Information about restoration project implementation is being provided to the public through the Administrative Record and other outreach efforts, including at http://www.gulfspillrestoration.noaa.gov.

1.9. Key Changes Made in this Final RP/EA #3.3

After considering the public comments received, the Louisiana TIG revised the Draft RP/EA #3.3 and made minor revisions to address issues identified through internal review. None of these revisions affected the conclusions made in the Draft RP/EA #3.3. Key changes made between the Draft RP/EA #3.3 and Final RP/EA #3.3 are listed below.

1. Addition of *Chapter 6 – Response to Public Comment*, which summarizes the public comments received on the Draft RP/EA #3.3 and the Louisiana TIG's responses.
2. Addition of *Appendix E*, which summarizes the Louisiana TIG's finding of no significant impact.
3. Minor technical and editorial changes including:
    a. updates to project cost and design numbers;
    b. federal compliance status updates for the preferred alternative; and
    c. revisions to the MAM plan to clarify methods and timing of monitoring parameters.

1.10. Decision to be Made

This RP/EA is intended to provide the public and decision makers with information and analyses on the alternatives presented in this RP/EA #3.3. This RP/EA considers OPA and NEPA analyses and input from the public to help guide the Louisiana TIG's selection of Alternative 1 as the preferred alternative for implementation. Upon finalizing this RP/EA #3.3, the LA TIG has determined that a Finding of No

Significant Impact (FONSI) is appropriate.

1.11. Document Organization

This Final RP/EA #3.3 is organized into the sections listed below.

- *Section 1 Introduction* provides the background and context for this document, purpose and need for the proposed project, the decision to be made, and a descripton of public involvement for the proposed project.
- *Section 2 Restoration Planning Process* presents the NRDA restoration planning process, a summary of the injuries addressed by the restoration, the OPA evaluation of the design alternatives, and a brief description of the alternatives.
- *Section 3 Reasonable Range of Alternatives* details the design alternatives, an analysis of the alternatives, and the preferred alternative.
- *Section 4 Environmental Consequences* provides a description of the affected environment and an analysis of the environmental consequences of the design alternatives for the LSBMC-UBC Project.
- *Section 5 Compliance with Other Laws and Regulations* presents additional federal laws, regulations, and Executive Orders (EOs) that may be applicable to the proposed project.
- *Section 6 Response to Public Comments* describes the public comments received on the Draft RP/EA #3.3 during the public comment period and the Louisiana TIG's responses.
- *Section 7 Literature Cited* lists the literature referenced in this document.

2. RESTORATION PLANNING PROCESS

2.1. Restoration Planning Process

Immediately following the *DWH* oil spill, the Trustees initiated an injury assessment pursuant to OPA, which established the nature, degree, and extent of injuries from the *DWH* oil spill to both natural resources and the services they provide. The Trustees then used the results of the injury assessment to inform restoration planning so that restoration can address the nature, degree, and extent of the injuries caused by the *DWH* oil spill.

2.1.1. Summary of Injuries Addressed

The Louisiana TIG focused the Final Phase I SRP/EA #3 on restoring wetlands, coastal, and nearshore habitat in the Barataria Basin, both because these habitats are critical components of the broader Gulf of Mexico ecosystem and because these resources suffered the greatest degree of oiling in Louisiana from the *DWH* oil spill (Louisiana TIG, 2018b). This focus is consistent with the overall investment of NRDA restoration funding laid out in the Final PDARP/PEIS, described as follows: "This investment of funds particularly focuses on restoring Louisiana coastal marshes as an essential element of the preferred alternative. Given both the extensive impacts to Louisiana marsh habitats and species and the critical role that these habitats play across the Gulf of Mexico for many injured resources and for the overall productivity of the Gulf, coastal and nearshore habitat restoration is the most appropriate and practicable mechanism for restoring the ecosystem-level linkages disrupted by this spill" (Final PDARP/PEIS, Section 5.1) (*DWH* Trustees, 2016; Gosselink & Pendleton, 1984). Injuries to be addressed by the LSBMC-UBC are consistent with those presented in the Final Phase I SRP/EA #3 and the Final PDARP/PEIS (*DWH* Trustees, 2016; Louisiana TIG, 2018b).

Chapter 4 of the Final PDARP/PEIS summarizes the injury assessment, which documented the nature, degree, and extent of injuries from the *DWH* oil spill to both natural resources and the services they provide (*DWH* Trustees, 2016). The paragraphs below summarize key relevant injury information from the Final PDARP/PEIS and subsequent studies that establish the nexus for restoration planning for resources in the Barataria Basin (*DWH* Trustees, 2016). As summarized in the Final PDARP/PEIS, the *DWH* spill created over 1,100 kilometers of wetland oiling Gulf-wide, and approximately 95 percent of this marsh oiling occurred in coastal Louisiana (e.g., Final PDARP/PEIS, Table 4.6.2) (*DWH* Trustees, 2016; Nixon et al., 2016). Within Louisiana, the majority of the "heavier" and "heavier persistent" oiling was in the Barataria Basin. This heavy oiling was primarily in marshes dominated by *Spartina alterniflora* and *Juncus roemerianus* (Lin & Mendelssohn, 2012; Silliman et al., 2012; Visser et al., 2017). These marshes provide critical habitat for estuarine dependent species throughout the Gulf of Mexico.

Within the Barataria Basin, relatively "weathered" emulsions of crude oil coated the productive marsh edge, resulting in extensive mortality of coastal vegetation in these environments (Hester et al., 2016; Lin & Mendelssohn, 2012; Lin et al., 2016; Silliman et al., 2012; Zengel et al., 2014; Zengel et al., 2015). The impacts of this oiling were documented across multiple trophic levels within the Barataria Basin. For example, growth rates of juvenile brown and white shrimp along this oiled marsh edge were reduced by up to 50 percent compared to those collected near shorelines that did not experience oiling (e.g., Rozas et al., 2014; van der Ham & de Mutsert, 2014). Growth rates of red drum along heavily oiled marsh shorelines were also reduced by approximately 50 percent in 2010 relative to un-oiled shorelines, and these reduced growth rates persisted through at least 2013 (e.g., Powers & Scyphers, 2016). The Final PDARP/PEIS estimated that 35 percent of bottlenose dolphins in Barataria Bay were killed as a result of the oil spill, and 46 percent of female dolphins suffered from reproductive failure (*DWH* Trustees, 2016). Numerous other examples of impacts to specific species and resources, as described in the Final PDARP/PEIS, demonstrate that the *DWH* oil spill created an ecosystem-level injury to the Gulf of Mexico that necessitates an ecosystem-level restoration strategy (e.g., Final PDARP/PEIS, Chapter 4) (*DWH* Trustees, 2016).

In addition to providing habitat for estuarine-dependent species, the marsh grasses *Spartina alterniflora* and *Juncus roemerianus* also help to maintain this habitat by protecting the marsh edge from wave-induced erosion: the aboveground plant stems slow tidal and wave energy, while the belowground root biomass increases soil shear strength and resistance of the soil to erosion along the marsh edge (Angelini et al., 2011; Graham & Mendelssohn, 2014; Kirwan & Megonigal, 2013; Leonardi et al., 2016; Li & Yang, 2009; Marion et al., 2009; Sasser et al., 20142). Because these marsh plants are critical to maintaining the resilience of coastal marshes, the extensive oiling and death of marsh vegetation in the Barataria Basin created an acceleration of land loss following the spill (McClenachan et al., 2013; Silliman et al., 2012; Silliman et al., 2016; Turner et al., 2016; Zengel et al., 2015). Although moderately-oiled marshes have shown vegetation recovery since the spill, many of the more heavily-oiled shorelines have either recovered slowly or were completely lost to subsequent erosion (Lin & Mendelssohn, 2012; Lin et al., 2016; McClenachan et al., 2013; Michel & Rutherford, 2014; Silliman et al., 2012; Silliman et al., 2016; Zengel & Michel, 2013). Accelerated erosion due to the spill resulted in a permanent loss of coastal wetlands over large portions of the Barataria Basin that can only be addressed through restoration.

2.1.2. Final Phase I SRP/EA #3: Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin, LA

The Louisiana TIG Final Phase I SRP/EA #3: *Restoration of Wetlands, Coastal, and Nearshore Habitats* in the Barataria Basin, Louisiana, identified a restoration strategy to help assign priority to future decisions regarding project selection and funding in the Barataria Basin (Louisiana TIG, 2018b). The Final Phase I SRP/EA #3 complies with NEPA due its incorporation of information included in the Final PDARP/PEIS, where appropriate, to evaluate and compare environmental impacts of considered alternatives (*DWH* Trustees, 2016; Louisiana TIG, 2018b).

To restore for the ecosystem injuries identified in the PDARP/PEIS, the Louisiana TIG focused on two approaches: creating, restoring and enhancing coastal wetlands; and restoring and preserving Mississippi-Atchafalaya River processes. These approaches provide the most direct link to restoring, creating, and maintaining coastal wetland habitat in the Barataria Basin. To develop alternatives, the Trustees followed this approach:

- Step one: The Louisiana TIG identified which restoration approaches and techniques are most compatible with restoring wetlands, coastal, and nearshore habitat in the Barataria Basin.
- Step two: The Louisiana TIG compiled a list of potential projects submitted in response to the March 2017 NOS to the federal and state project portals. The Louisiana TIG also did an initial prescreening of projects from the Final 2017 Louisiana CMP (see http://coastal.la.gov/ourplan/2017-coastal-master-plan/planning-process/projects/) to identify CMP projects of potential geographic and ecological relevance to the Final Phase I SRP/EA #3 (e.g., screening out nonstructural risk reduction projects). The combined list of projects submitted in response to the NOS plus projects pre-screened from the CMP were then carried forward to step three.
- Step three: The Louisiana TIG screened the list of projects from step two using a set of screening criteria focused on applicability to the Final Phase I SRP/EA #3.
- Step four: The Louisiana TIG developed appropriate strategic restoration alternatives that logically combine restoration approaches and techniques exemplified by the projects that passed through the screening of step three.

The Louisiana TIG is responsible for identifying a reasonable range of restoration project alternatives to carry forward for further analysis pursuant to OPA and NEPA. After reviewing the restoration project examples and the restoration approaches and techniques that these projects represent, the Louisiana TIG identified four strategic alternatives that combine these approaches and techniques in a logical manner. With the exception of the natural recovery/No Action Alternative, each of these alternatives, listed below, meets the purpose and need of the Final Phase I SRP/EA #3 to “restore ecosystem-level injuries in the Gulf of Mexico through restoration of critical wetlands, coastal, and nearshore habitat resources and services in the Barataria Basin” (Louisiana TIG, 2018b).

Alternative 1: Marsh creation and ridge restoration plus large-scale sediment diversion

Alternative 2: Marsh creation and ridge restoration plus shoreline protection

Alternative 3: Marsh creation and ridge restoration

Alternative 4: Natural recovery/No-Action Alternative

Section 2.3 of the Final Phase I SRP/EA #3 describes the screening and evaluation process used to select projects for inclusion in Phase II restoration plans (Louisiana TIG, 2018b). The OPA evaluation for the four alternatives is presented in the Final Phase I SRP/EA #3, Section 3.2 (Louisiana TIG, 2018b).

The Louisiana TIG selected Alternative 1 as the preferred strategic alternative for wetlands, coastal, and nearshore habitat restoration in the Barataria Basin to be carried forward to E&D during which alternatives were further developed. Screening of the project alternatives adheres to project selection criteria consistent with OPA NRDA regulations (15 CFR § 990.54), the Final PDARP/PEIS, and additional evaluation criteria established by the Louisiana TIG (Final Phase I SRP/EA #3, Section 3.2) (*DWH* Trustees, 2016; Louisiana TIG, 2018b). The OPA evaluation is herein incorporated by reference and can be found in Section 3.2.1 of the Final Phase I SRP/EA #3 (Louisiana TIG, 2018b).

The preferred strategic alternative relies on a suite of restoration approaches and techniques in the Barataria Basin, including large-scale sediment diversions to restore deltaic processes, marsh creation, and ridge restoration (Louisiana TIG, 2018b). The Louisiana TIG selected the proposed MBSD and two marsh creation increments within Large Scale Marsh Creation - Component E in northern Barataria Bay for advancement and further evaluation under both OPA and NEPA in Phase II restoration plans: Large Scale Marsh Creation and Lower Barataria Marsh Creation. The Barataria Basin was selected as the geographic scope for the Final Phase I SRP/EA #3 because, in addition to the high rates of erosion in the Barataria Basin, wetlands in the Barataria Basin experienced some of the heaviest and most persistent oiling and associated response activities from the *DWH* oil spill, as described previously, and the wetlands in this estuary support very high primary and secondary production that contribute to the overall function of the northern Gulf of Mexico ecosystem (Louisiana TIG, 2018b; Michel et al., 2013; Zengel & Michel, 2013). The Large-Scale Marsh Creation in the upper Barataria Marsh was subsequently named the Large-Scale Barataria Marsh Creation – Upper Barataria Component (LSBMC – UBC), as referenced previously.

2.1.3. Final Phase II RP/EA #3.3 LSBMC-UBC (BA-207)

The LSBMC-UBC project is at a stage in the E&D process sufficient for meaningful OPA and NEPA analysis on the reasonable range of design alternatives. Therefore, the Louisiana TIG initiated preparation of this Final RP/EA #3.3. As other selected projects progress through E&D, additional Phase II restoration plans are expected to be initiated for those projects.

2.2. OPA Evaluation of Alternatives

During conceptual and preliminary design, design alternatives were developed and evaluated for the LSBMC-UBC project and are presented in the *Large-Scale Barataria Marsh Creation: Upper Barataria Component (BA-207): Draft 95 Percent Design Submittal* (Moffat & Nichol, 2020). The information contained in the report is incorporated herein by reference. Oversight, operation and maintenance, adaptive management, and monitoring were added to cost estimates from the Draft 95 Percent Design Report for this Final RP/EA #3.3. During the design and planning processes, the Trustees elected to place a priority on maximizing the potential use of borrow from the defined Mississippi River borrow areas. The preferred alternative maximizes use of potential borrow and therefore results in a slightly larger project area with higher costs than those anticipated in the SRP/EA #3. Final E&D costs among design alternatives were anticipated to be similar due to similar design, construction activities, and project footprint. Therefore, when comparing costs between alternatives, only construction costs, oversight operation and maintenance, adaptive management, and monitoring were included in the project costs. The Louisiana TIG applied each of the six OPA NRDA regulation evaluation standards (15 CFR § 990.54) to the range of alternatives with respect to the OPA NRDA evaluation criteria (listed below).

1. The cost to carry out the alternative;

2. The extent to which each alternative is expected to meet the Louisiana TIG's goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses;
3. The likelihood of success of each alternative;
4. The extent to which each alternative would prevent future injury as a result of the incident and avoid collateral injury as a result of implementing the alternative;
5. The extent to which each alternative benefits more than one natural resource and/or service; and
6. The effect of each alternative on public health and safety.

Three alternatives were subsequently carried forward for consideration and evaluation. Brief descriptions of the three alternatives considered are presented below. Detailed descriptions are provided in the *Large-Scale Barataria Marsh Creation: Upper Barataria Component (BA-207): Draft 95 Percent Design Submittal* (Moffat & Nichol, 2020). Following the descriptions, OPA screening of the alternatives is summarized in TABLE 2-1.

2.2.1. LSBMC-UBC Design Alternatives

Alternatives and design elements have been developed and refined over multiple phases of design. Each of the alternatives consists of a MCA or marsh fill area footprint, ECD footprint, flow ways between the MCAs and the larger Barataria Basin, and borrow areas (FIGURE 2-1). Using combinations of MCAs, ECDs and borrow areas, an initial evaluation was performed to uniformly and objectively assess these alternatives. This evaluation included environmental, cultural resource and geotechnical data collection; development of design criteria; and assessment of potential borrow areas, access corridors and marsh fill area footprints. Additional analysis may result in further refinement of these acres and sediment volumes.

- **Alternative 1 (Preferred) – 1,163-acre marsh with a single construction phase**. This alternative proposes the creation of approximately 1,163 acres of intertidal marsh by filling MCAs 1A, 1B, 2A, 2B, and 3A, using approximately 10.5 MCY of sediment material from two borrow sites in the Mississippi River. A total of 8.4 MCY of fill is currently available from the borrow areas and the additional 2.1 MCY would accumulate at the borrow areas during construction so that a single construction mobilization would be needed. ECDs would be constructed to contain the sediments but would have gaps to connect the created marshes and provide for tidal exchange and movement of fisheries and other fauna in and out of the marshes. Alternative 1 would have a single construction phase that would occur over an estimated 26 months. The cost of the project is an estimated $176 million.
- **Alternative 2 – 862-acre marsh with a single construction phase**. This alternative proposes the creation of approximately 862 acres of intertidal marsh by filling MCAs 1A, 1B, and 2B, using approximately 8.4 MCY of borrow material from the Mississippi River. This alternative includes 301 fewer acres of marsh platform and the connectivity feature (i.e., marshes interspersed

among connecting waterways) described for Alternative 1. Alternative 2 does not require fill from the borrow areas in excess of what is currently available and, like Alternative 1, would require a single construction mobilization that would occur over a period of approximately 24 months.

- **Alternative 3 – 1,476-acre marsh with two construction phases**. This alternative proposes the creation of approximately 1,476 acres of intertidal marsh by filling MCAs 1A, 1B, 2A, 2B, 3A, and 3B using approximately 13.8 MCY of borrow material from the Mississippi River. Alternative 3 includes the connectivity feature described for the other alternatives. This alternative requires 5.42 MCY of sediment in addition to the 8.4 presently available from the borrow areas. As a result, construction would occur in two phases, with two mobilizations, and require 26 to 36 months to complete.

TABLE 2-1. OPA evaluation summary for alternatives.

Design Alternatives	OPA Screening
Alternative 1: 1,163-acre marsh with a single construction phase, 10.5 MCY of fill **Alternative 2:** 862-acre marsh with a single construction phase, 8.4 MCY of fill **Alternative 3:** 1,476-acre marsh with two construction phases, 13.8 MCY of fill	*Cost-effectiveness*: Alternative 1 is more cost-effective because it would achieve a greater level of benefit at a lower cost. The estimated cost for Alternative 1 is $176 million ($151,333/acre), compared with $150 million ($174,014/acre) for Alternative 2 and $278 million ($188,347/acre) for Alternative 3. We recognize the cost per acre for these marsh creation alternatives are greater than those in other areas of the Basin; however, the strategic location of these marsh cell components justifies the additional cost associated with this project as its distance to the borrow source demands additional pipe and booster pumps. *Goals and objectives*: Alternatives 1, 2, and 3 would meet the Louisiana TIG's goals and objectives by restoring interspersed and ecologically connected coastal habitats, restore for injuries to habitats in the Barataria Basin where significant oiling from the *DWH* oil spill occurred, and restore habitats appropriate to the area, by creating intertidal marshes. *Likelihood of success*: Alternatives 1, 2, and 3 are likely to succeed because they rely on previously proven approaches and techniques and the success of numerous, previously created marshes. Alternatives 1 and 2 minimize risk to a greater extent than Alternative 3 due to reduced construction time, reduced number of construction mobilizations, and reduced need for fill. Alternative 1 would result in the creation of a greater number of marsh acres and therefore would be more resilient to future sea-level rise and subsidence than Alternatives 2. *Avoid collateral injury*: All three alternatives would help prevent future erosion injuries to marsh vegetation and soils in areas that had increased erosion as a result of the *DWH* oil spill. Created marshes would help prevent and reduce future injury to estuarine-dependent resources, such as fish, crustaceans, birds, and other wildlife affected by loss of habitat due to the oil spill and through subsequent increased erosion. Marsh creation under all three alternatives would result in collateral injury due construction activities such as dredging and/or placement of fill over benthic habitats, shifts in habitat types due to higher elevations and reduced salinities, and opportunities for establishment of

Design Alternatives	OPA Screening
	invasive species that can affect habitat value for native species. Alternative 3, because it requires two mobilization phases, would be expected to result in greater collateral injury than the other alternatives. *Benefits to natural resources*: All three alternatives would benefit multiple resources because coastal wetlands provide a range of ecological functions and services, including providing important habitat for fish and wildlife species, improving water quality, stabilizing shorelines, reducing storm-surge risk, capturing and storing carbon in organic soils, and increasing recreational opportunities for people. Alternative 3 results in more marsh creation than the other alternatives but has a prolonged construction period that may delay benefits to natural resources. *Health and safety*: Benefits to health and safety under any of the alternatives would likely include increased storm protection due to the creation of marshes and subsequent protection from wave energy (and erosion), storm surge, and flooding. Adverse impacts to public health and safety are not anticipated as a result of any of the alternatives. The proposed project area is uninhabited and remote, the access corridor is already permitted, and the borrow areas are regularly excavated for sediment. During construction, all applicable laws and regulations pertaining to worker safety would be followed.

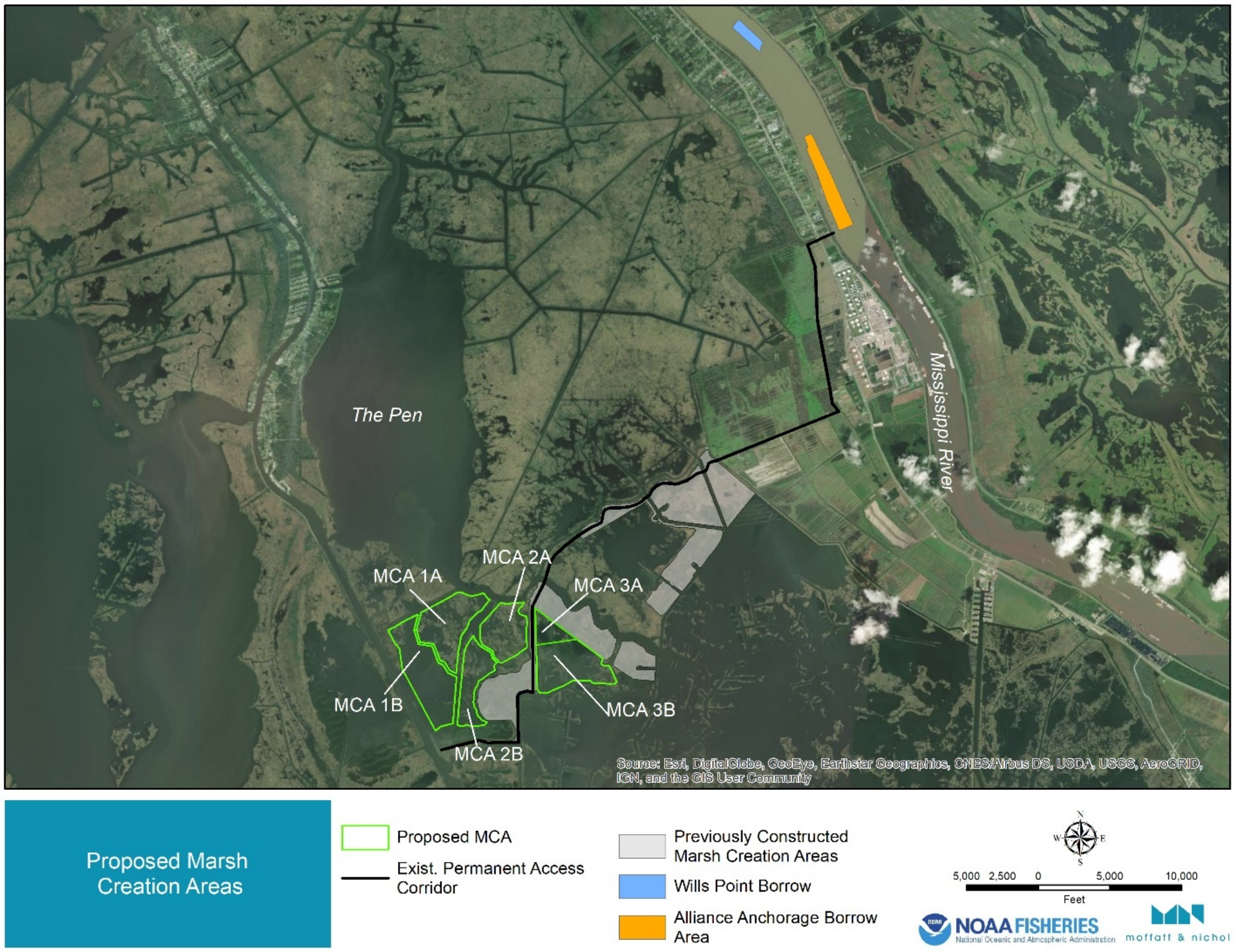

FIGURE 2-1. Proposed project area with potential MCAs, LDSP conveyance corridor, and Alliance Anchorage and Wills Point borrow areas.

2.2.2. Natural Recovery

Pursuant to the OPA NRDA regulations, the Final 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)) (*DWH* Trustees, 2016). Under a natural recovery alternative, the ongoing coastal land loss in this portion of the Barataria Basin is expected to continue. Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) reports that without actions to correct problems associated with land loss, "another fifth of the basin's wetlands would be lost to open water by 2045" (LCWCRTF, 1993). In the absence of intervention such as the proposed project, coastal land loss in the Barataria Basin, which totaled approximately 432 square miles for the period 1932-2016 and is the second greatest among the ten Louisiana coastal basins, would continue and/or increase (Couvillion et al., 2017). Given that technically feasible restoration approaches are available to compensate for interim natural resource and service losses, the *DWH* Trustees rejected this alternative from further OPA evaluation within the Final PDARP/PEIS (*DWH* Trustees, 2016). Based on this determination and incorporating that analysis by reference, the Louisiana TIG did not evaluate natural recovery as a viable alternative under OPA.

2.2.3. Conclusion

The Louisiana TIG has completed its screening of the alternatives under an initial application of the OPA NRDA regulations restoration evaluation criteria to develop a reasonable range of alternatives. The Louisiana TIG has determined that Alternative 1 should be carried forward due to cost-effectiveness and likelihood of success. This alternative would meet the Louisiana TIG's goals and objectives for the project, have a high likelihood of success, would produce the same level of benefits by creating 1,163 acres of habitat, and would not impact public health and safety.

These findings are consistent with those of the Final Phase I SRP/EA #3, in which the OPA analysis concluded that marsh creation projects through the placement of dredged materials can be implemented quickly, can be targeted to specific locations with currently degraded habitat, and have a track record of success within Louisiana. These projects directly compensate for injuries to wetland habitat resources and services in Barataria Basin, as well as providing habitat for other injured resources that benefit from these marsh habitats. Additionally, the proposed Marsh Creation and Ridge Restoration Plus Large-Scale Sediment Diversion project alternative would provide the greatest level of benefits to injured Wetlands, Coastal, and Nearshore habitats and to the large suite of injured resources that depend in their lifecycle on productive and sustainable wetland habitats in the Barataria Basin. Design alternative 1 for the LSBMC-UBC project meets the Louisiana TIG goals and objectives, has a high likelihood of success, and would reduce some sources of future injury (particularly erosion).

3. REASONABLE RANGE OF ALTERNATIVES

Under the OPA NRDA regulations, Trustees identified a reasonable range of restoration alternatives (15 CFR § 990.53(a)(2)) that are then evaluated according to the OPA NRDA regulation evaluation standards (15 CFR § 990.54). As described in Section 2.2, the three design alternatives for the LSBMC-UBC were screened under an initial application of the OPA NRDA regulations evaluation criteria in 15 CFR § 990.54 to develop a reasonable range of alternatives per the OPA NRDA regulations in 15 CFR § 990.53.

For the LSBMC-UBC, all three design alternatives were carried forward in the conceptual 30 percent design report because construction features and benefits were similar (Moffatt & Nichol, 2019). During the preliminary design, agency input from NOAA led to design changes that would avoid and minimize impacts to Essential Fish Habitat (EFH). Alternative 1 had the greatest amount of created marsh habitat with only a single construction mobilization due to the availability of adequate sediment from the borrow areas during the construction of the project. Alternative 1 is carried forward as the preferred alternative for this Final RP/EA #3.3 (See Section 3.3 for details). Alternative 2 would create fewer acres of habitat and Alternative 3 would require two mobilizations for additional sediment volumes. These three alternatives meet the purpose and need for marsh restoration in the Louisiana Restoration Area and comprise the Louisiana TIG's reasonable range of alternatives to undergo further analysis, including NEPA analysis.

This reasonable range of alternatives is described in greater detail (Section 3.1) and evaluated under the OPA NRDA regulatory criteria (Section 3.2) in the following sections. The Louisiana TIG applied each of the OPA NRDA regulatory criteria to the reasonable range of alternatives in this section to review the questions and analysis raised under each of the OPA NRDA criteria and provide a narrative summary of each evaluation with respect to those criteria.

3.1. LSBMC-UBC Project

The proposed project area is in the upper Barataria Basin, 15 miles south of New Orleans, in Jefferson and Plaquemines Parishes, Louisiana. The western limit of the proposed project area is approximately 5.4 miles west of the Mississippi River. The eastern limit of the proposed project area extends along the Mississippi River between river miles (RM) 64 and 67. The Barataria Waterway flows along the western boundary, and The Pen lies at the northern boundary of the proposed project area (FIGURE 3-1). Approximately 1,700 acres of previously created or nourished marsh, including three Bayou Dupont projects (BA-39, BA-164, BA-48), and the Mississippi River Long Distance Sediment Pipeline (LDSP) (BA-43-EB) using Mississippi River borrow areas (FIGURE 2-1) are located along the south boundary of the proposed project area. The proposed project area is north of the outfall of the proposed MBSD (BA-153), which would divert sediment from the Mississippi River into the Barataria Basin to restore sediment input to marshes. The three alternatives comprising the reasonable range of alternatives for the LSBMC-UBC project and the No Action Alternative (pursuant to NEPA) are listed below and evaluated in subsequent sections.

- **Alternative 1 (Preferred – 1,163-acre marsh with a single construction phase)**. This alternative proposes the creation of approximately 1,163 acres of intertidal marsh by filling MCAs 1A, 1B, 2A, 2B, and 3A, using approximately 10.5 MCY of sediment material from two borrow sites in the Mississippi River. A total of 8.4 MCY of fill is currently available from the borrow areas and the additional 2.1 MCY would accumulate at the borrow areas during construction so that a single construction mobilization would be needed. ECDs would be constructed to contain the sediments but would have gaps to connect the created marshes and provide for tidal exchange and movement of fisheries and other fauna in and out of the marshes. Alternative 1 would have a single construction phase that would occur over an estimated 26 months.
- **Alternative 2 (862-acre marsh with a single construction phase).** This alternative proposes the creation of approximately 862 acres of intertidal marsh by filling MCAs 1A, 1B, and 2B, using approximately 8.4 MCY of borrow material from the Mississippi River. This alternative includes 301 fewer acres of marsh platform and the connectivity feature described for Alternative 1. Alternative 2 does not require fill from the borrow areas in excess of what is currently available and, also like Alternative 1, would require a single construction mobilization and would occur over a period of approximately 24 months.
- **Alternative 3 (1,476-acre marsh with two construction phases).** This alternative proposes the creation of approximately 1,476 acres of intertidal marsh by filling MCAs 1A, 1B, 2A, 2B, 3A, and 3B using approximately 13.8 MCY of borrow material from the Mississippi River. Alternative 3 includes the connectivity feature described for the other alternatives. This alternative requires 5.42 MCY of sediment in addition to the 8.4 presently available from the borrow areas. As a result, construction would occur in two phases, with two mobilizations, and require 26 to 36 months to complete.
- **No Action Alternative**. Under this alternative, the proposed project would not be constructed with the current funding.

3.1.1. Detailed Description of Alternative 1 (Preferred) – 1,163-Acre Marsh with a Single Construction Phase

The preferred alternative would include adding fill to MCAs 1A, 1B, 2A, 2B, and 3A (FIGURE 3-2) to satisfy budget and borrow material constraints, create marshes in areas that would receive sediment inputs from the proposed MBSD, and create marshes in areas strategic to restoration of the Barataria Land Bridge. The construction would occur over a period of approximately 26 months. Marshes created by the preferred alternative are expected to persist for the 20-year project life, accounting for sea-level rise and subsidence, based on modeling completed by Meselhe et al. (2016). Past projects have demonstrated successful creation using renewable sediment sources dredged from Mississippi River borrow areas. For example, the Mississippi River Sediment Delivery System at Bayou Dupont (BA-39), completed in 2010, created 471 acres of marsh in the Barataria Basin; The Lake Hermitage Marsh Creation (BA-42), completed in 2015, created 1,600 acres of marsh in the Barataria Basin. The Dedicated Dredging on the Barataria Basin Land Bridge (BA-36) project (Bayou Rigolettes and Bayou Perot located just west of The Pen) created 731 acres of land, compared with a 29-acre loss in a control marsh (without restoration) three years post-construction (Hymel, 2017). The preferred alternative has the following three primary components:

- Excavation of approximately 10.5 MCY of sediment from the Alliance Anchorage and Willis Point borrow areas in the Mississippi River, pipeline construction, and transport of the material along the 13.3-mile LDSP access corridor;
- Construction of approximately 40,779 linear feet of ECDs using onsite (in-situ) borrow material to contain the created marsh platform; and
- Discharge of borrow material into MCAs to create approximately 1,163 acres of intertidal marsh in the project area.

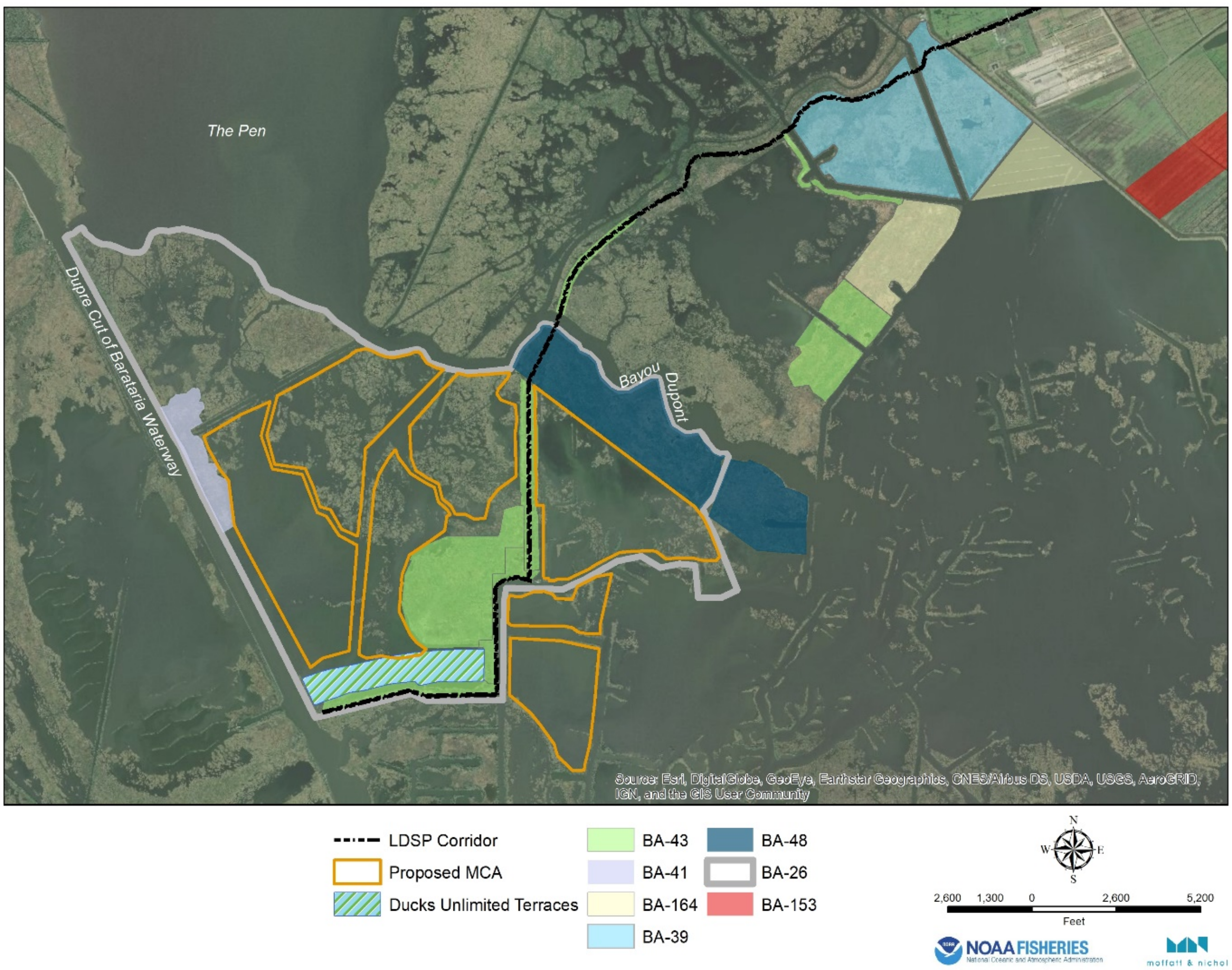

FIGURE 3-1. Proposed project area (below The Pen) and previously constructed Barataria marsh restoration projects in the area.

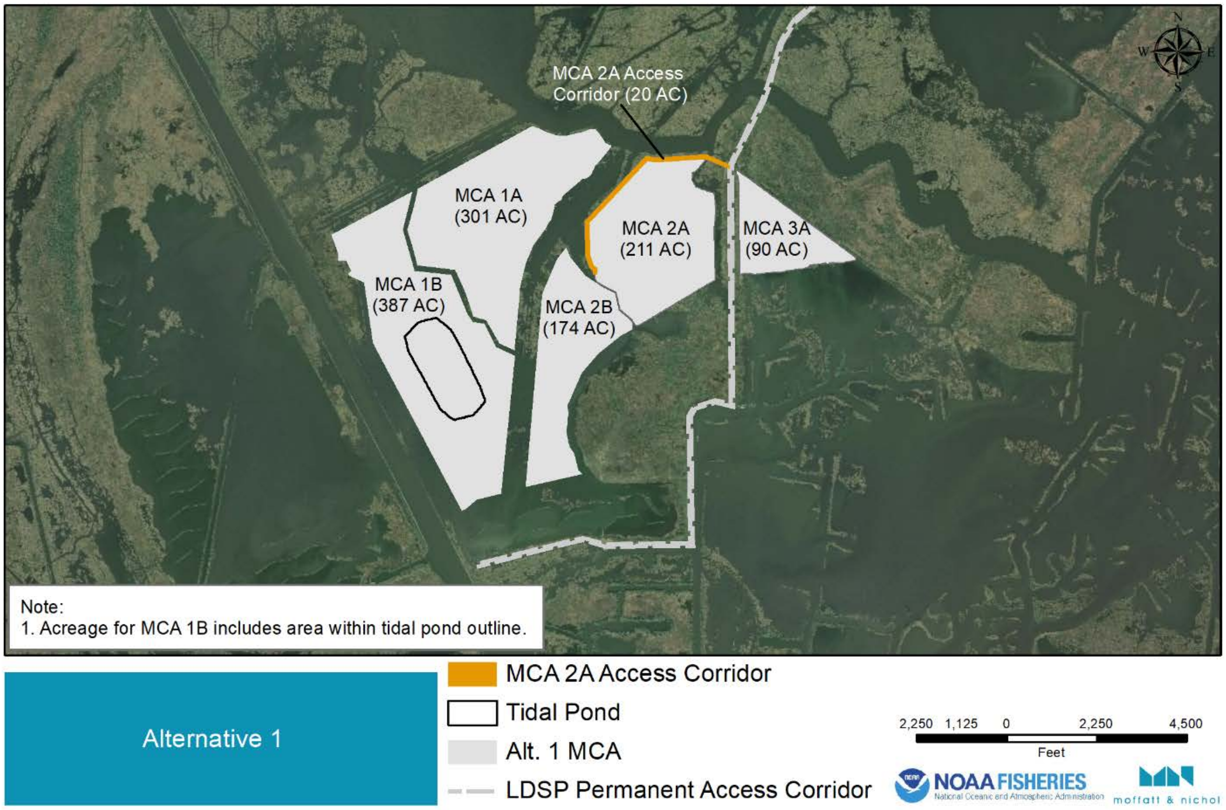

FIGURE 3-2. Alternative 1: includes MCAs 1A, 1B, 2A, 2B, and 3A and a single construction phase. MCAs include a minimum 100 feet of setback from verified pipelines and flow ways to ensure hydrologic connections.

3.1.1.1. Borrow Material

Sediment would be excavated from borrow areas using a hydraulic cutter suction dredge and then transported to MCAs via a sediment pipeline along the 13.3-mile LDSP conveyance corridor and discharged into the MCAs. The borrow areas selected for the preferred alternative are within 15 miles of the proposed MCAs and have been permitted and used to construct several similar projects. CPRA's Investigation of Potential Mississippi River Borrow Areas: Final Report (CPRA, 2012) provides detailed geotechnical descriptions of the borrow areas. The two borrow sources identified for the preferred alternative (FIGURE 3-3) are considered renewable due to an estimated nine to 15 MCY of material available for capture from the Mississippi River on an annual basis (Allison et al., 2012). However, this volume of sediment is not always available due to variability in renewal rate due to river stage (see Section 3.1.3) and the use of sediments for other restoration projects such as other marsh creation and barrier island restoration. Alliance Anchorage borrow area is located on a large point bar at RM 64 and has captured large volumes of new sediment following extraction and use of borrow material for previous projects or project segments. It has an estimated available sediment volume of 6.6 MCY.

- Wills Point borrow area is at RM 67 and has an estimated 1.8 MCY available sediment volume. The Wills Point borrow area requires a submerged Mississippi River pipeline crossing, which decreases dredging efficiency.
- A total of 10.5 MCY of sediment would be dredged from the two borrow areas for the preferred alternative. A total of about 2.2 MCY is expected to infill at the both borrow sites based on historical data and sediment modeling. The volume to be excavated is greater than the estimated sediment needed to fill the MCAs to account for loss of sediments during excavation and construction activities. The total available at Anchorage Alliance has been adjusted to 6.7 MCY to ensure adequate sediment available for the saltwater sill at the borrow site.

FIGURE 3-3. Alliance Anchorage and Wills Point borrow area locations in Mississippi River and associated data collection and model calibration points.

3.1.1.2. ECD Construction

An estimated 40,779 linear feet of ECDs would be constructed (FIGURE 3-4) to contain sediments for dewatering after being discharged into the MCAs. Approximately 5,350 linear feet of ECDs would be constructed as the sediment pipeline is installed along the LDSP conveyance corridor. The ECDs would be constructed by excavating adjacent material and piling it to top (crest) elevations of four feet (all elevations are in NAVD88) and crest widths of five feet. Based on slope stability analyses, a side slope of either 4H:1V (mudline elevations shallower than -3 feet) or 5H:1V (mudline elevations deeper than -3 feet) has been assigned for 95 percent design of the ECDs. A typical cross section of the ECD is illustrated in FIGURE 3-5. The ECD alignment is offset at least 100 feet from construction activities to all pipelines and other structures to avoid impacts to the structures and pipelines. An offset of 50 feet was established along the south side of the ECD to ensure the stability of the dike with respect to Bayou Dupont, which flows along the north ECDs of MCAs 1A and 2A.

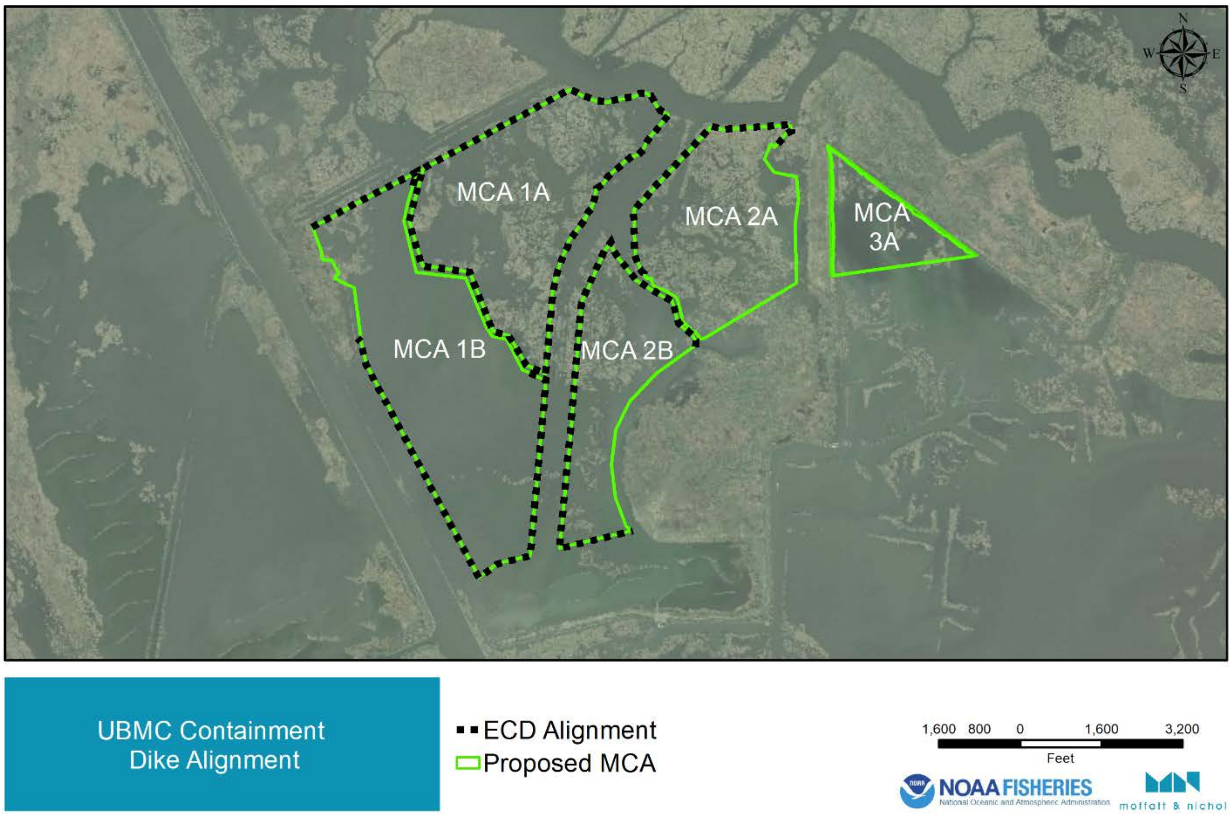

FIGURE 3-4. Earthen containment dikes (ECDs) around MCAs.

3.1.1.3. Marsh Creation

A total of 10.5 MCY of sediment would be dredged and then pumped into five MCAs (1A, 1B, 2A, 2B, and 3A; FIGURE 3-2), creating approximately 1,163 acres of intertidal marsh platform after the material settles and consolidates. Marsh vegetation is expected to colonize and become established on the constructed platform. For example, marsh vegetation nourished with six to 12 inches of borrow material from the river has been shown to respond favorably and revegetate quickly and no vegetation planting is planned (Howard et al., 2019; Mendelssohn & Kuhn, 2003; Trahan, 2016). The MCA locations are distant enough from the proposed MBSD that they would not overlap with the proposed MBSD diversion outfall and close enough to receive sediment inputs to compensate for sea-level rise and soil subsidence. The marsh target elevation is 3 feet NAVD88 with a tolerance of -0.5 feet (FIGURE 3-5) and is designed so the marsh platform is dry during low water and flooded during high water. The elevation tolerance allows only a decrease in the target elevation to -0.5 feet to ensure flooding of the created marsh platform. Crest elevations average approximately - 4.1 feet along ECDs. Hydrologic connections will be made by opening (dredging) gaps in the ECD to create flow pathways between MCAs 1A and 1B, 2A and 2B, and west from 1A and 1B (FIGURE 3-6), along with Bayou Dupont and existing canals, are included in the MCA design to support the exchange of water, sediments, and nutrients and to provide access to marshes for fish and wildlife.

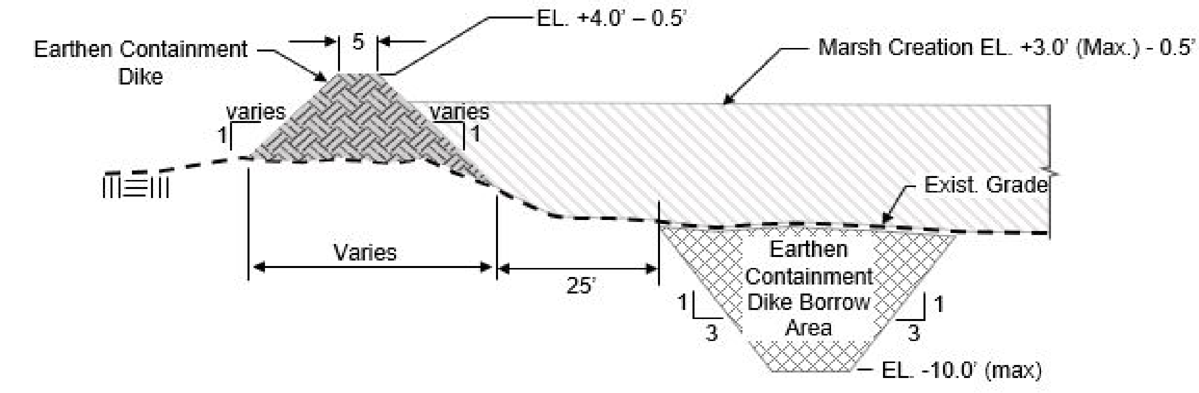

FIGURE 3-5. Typical ECD and in-situ borrow area design features and geometry.

As many as three booster pumps may be necessary to ensure sediments reach the MCAs from the borrow areas. MCA locations avoid five existing crude oil or gas pipelines. The sediment pipeline would cross a canal between MCA-1A and MCA-2A along Bayou Dupont, containing two oil pipelines located 5 to 10 feet below the channel. Pontoons on each side of the channel would support the sediment delivery pipeline across the channel during construction to avoid any potential disturbance to the oil pipelines. Transport of construction materials between MCAs would be accomplished via barge. An access corridor would be constructed using fill to allow equipment access to MCA-1A. If MCA-2A is constructed prior to MCA-1A, construction equipment would be transported by barge from either The Pen or Bayou Dupont. In addition to avoiding existing pipelines, the updated MCA-1 and MCA-2 has been delineated to retain hydrologic connectivity between areas of open water proximate to the Ducks Unlimited Terraces (FIGURE 3-1) and Bayou Dupont.

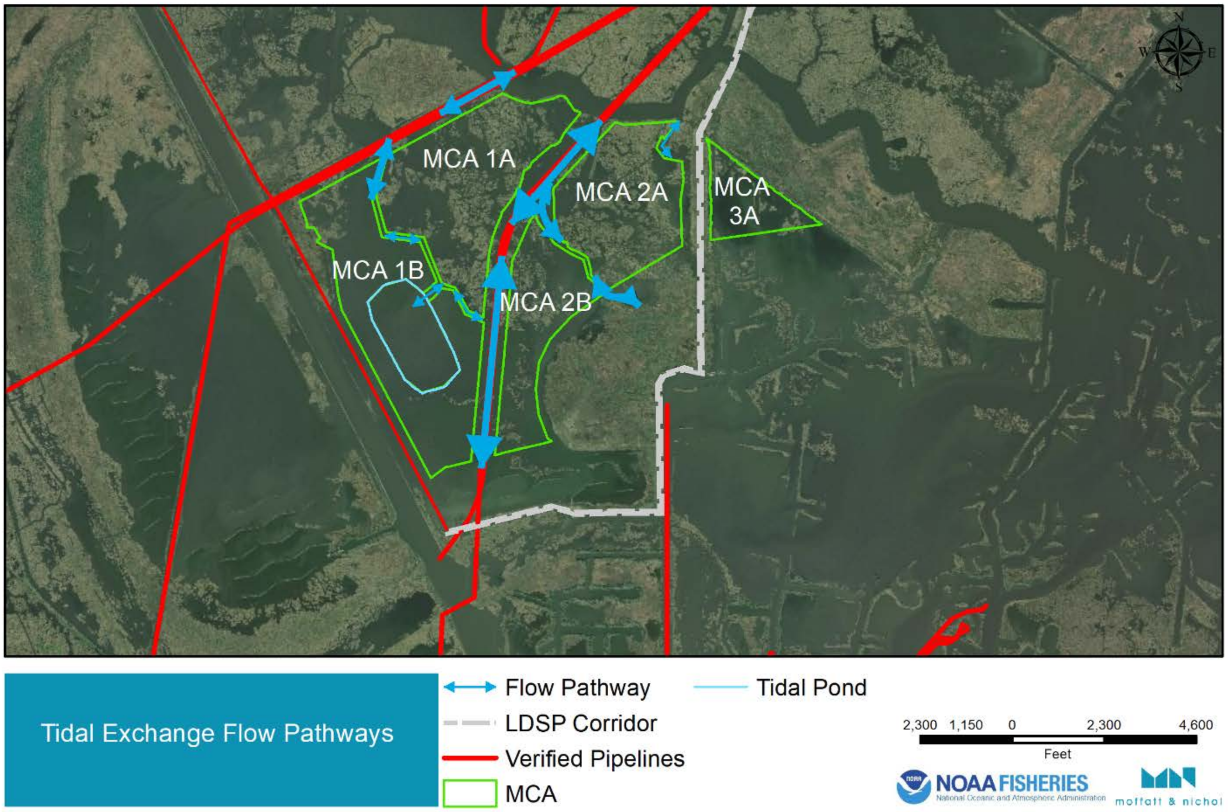

FIGURE 3-6. Flow pathways between and among MCAs.

Elevations in some portions of the proposed project area are lower than -3 feet and would require fill greater than 6 feet. Filling these areas becomes prohibitive due to the settlement of the sediments over the 20-year project life and construction costs would increase by an additional $12,000 to $14,000 per acre. An 85-acre tidal pond is included in MCA-1B to alleviate the need for an additional 7.1 MCY of fill (FIGURE 3-7). The tidal pond would have uncontained fill edges with anticipated 1V:50H side slopes (based on previously constructed projects) towards the interior of the pond. Sediment volumes, acres, target elevations, and other measures are summarized for proposed project components in TABLE 3-1. Some uncertainties associated with the proposed project may be resolved as more data become available; for example, final elevation surveys will confirm the target elevations for the created marsh. Potential uncertainties associated with the proposed project include:

- Elevations. Pre-construction elevation surveys will be performed prior to construction to ensure design elevations are accurate.
- Accumulation of sediments at borrow sites during construction. Rates of infill in the borrow areas may change with river conditions.
- Time required for consolidation of soils and dewatering of MCAs. The final geotechnical analysis estimated the time required for dewatering and consolidation.
- Changes in sea-level rise and submergence. These factors may change. Increases in sea-level rise and submergence rates would reduce the life of the proposed project.

Hurricanes and/or storm events may erode the newly created marshes or increase the salinity beyond the tolerance of the vegetation, and impacts may be temporary or permanent.

TABLE 3-1. Summary of measures associated with project features for the Alternative 1 (Preferred).

Project Feature	Acres*	Volume (MCY)	Target Elevation (NAVD88)	ECD Length (linear feet)
LDSP/MCA 2A Access Corridor (13.3 miles long)	20	0.2	NA	5,856
Borrow Areas (total)	189.5	10.5	-90 feet	NA
Additional Material**	NA	2.1	NA	NA
Alliance Anchorage	144.3	6.6	-90 feet	NA
Wills Point	45.2	1.8	-90 feet	NA
ECDs	NA	NA	4.0 - 0.5 feet	40,779
ECD Borrow Area	NA	NA	TBD	NA
MCAs (total)	1,163	6.8	3.0 - 0.5 feet	40,779
MCA-1A	301	1.6	Water depths from -1.2 to -1.7 feet for MCAs 1A, 2A, and 3A; average depths -2.7 feet for MCA-1B*.	17,185
MCA-1B	387	2.7		13,073
MCA-2A	211	0.84		0
MCA-2B	174	1.1		10,521
MCA-3A	90	0.54		0
*Includes 85-acre tidal pond. **Additional 2.1 MCY accumulated during and after first mobilization.				

3.1.1.4. Project Cost

Cost estimates were prepared for the preferred alternative and includes implementation of MCAs 1A, 1B, 2A, 2B, and 3A, using sediment from the Alliance Anchorage and Wills Point borrow areas, and using in-situ material for the ECDs. Cost estimates include considerations for similar projects developed for the same purpose. The preferred alternative cost is approximately $176 million and includes the following construction activities:

- Mobilization/demobilization of pipeline, booster pumps, and dredge plant;
- Pipeline installation from the Mississippi River levee to the Plaquemines Parish levee along the pipeline corridor (this includes railroad and highway crossings through existing casing pipes);
- Additional pipeline placement along the pipeline corridor from the Plaquemines Parish levee to the proposed MCAs;
- Placement of a pontoon crossing between MCA-1A and MCA-2A at Bayou Dupont;
- Dredging/placement costs;
- ECDs;
- Surveys (pre-construction, pay, and post-construction); and
- Settlement plates (for monitoring sediment settlement).

A comparison of the acres of marsh creation and other relevant features among the alternatives is provided in TABLE 3-2.

TABLE 3-2. Comparison of Alternatives.

Construction Alternative	MCAs Filled						Acres	Volume (MCY) Phase*		Approximate Time Frame	Estimated Construction Cost (millions)
	1A	1B	2A	2B	3A	3B		1	2		
Alternative 1: Preferred							1,163	10.5	None	26 months	$176
Alternative 2:							862	8.4	None	24 months	$150
Alternative 3:							1,476	8.4	5.4	26 to 36 months	$278
*Additional construction phase and mobilization effort required if available sediment is inadequate for proposed project.											

3.1.2. Detailed Description of Alternative 2 - 862-Acre Marsh with a Single Construction Phase

This alternative includes excavation and transport of borrow material, ECD construction, and marsh platform creation as described for the preferred alternative. However, Alternative 2 creates less marsh and, therefore, corresponding differences in sediment volumes and other features. A summary of Alternative 2 features is provided in TABLE 3-3. A summary comparison of the features and costs of Alternative 2 among the Preferred, Non-Preferred, and No Action Alternatives is presented in TABLE 3-2. Differences in Alternative 2 when compared with the preferred alternative are summarized below.

- Requires a total of 8.4 MCY of material excavated from borrow areas and transported to the MCAs;
- Requires a single mobilization since 8.4 MCY are currently available from the borrow areas;
- Creates 301 fewer acres (total approximately 862 acres) of tidal marsh in MCAs 1A, 1B, and 2B by excluding MCA-2A (refer to FIGURE 3-2);
- Requires construction of 40,779 linear feet of ECD and 5,856 linear feet of containment along the MCA-2A access corridor (refer to FIGURE 3-4); and
- Has a slightly decreased total cost of $150 million as a result of reduced borrow volume and smaller area of marsh creation, compared with Alternative 1.

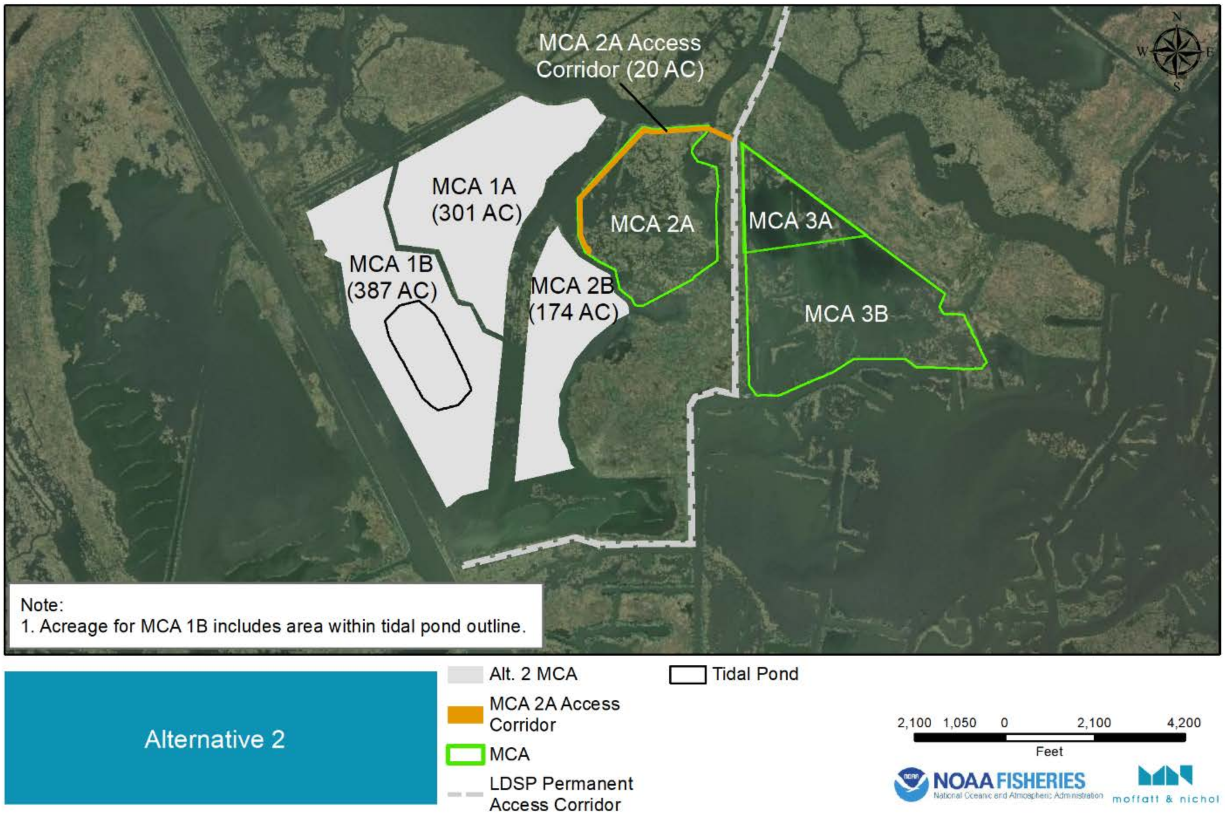

FIGURE 3-7. Alternative 2: includes MCAs 1A, 1B, and 2B in one construction phase. MCAs include a minimum 100 feet of setback from verified pipelines and flow ways to ensure hydrologic connectivity.

TABLE 3-3. Summary of measures associated with project features for Alternative 2.

Project Feature	Acres*	Volume (MCY)	Target Elevation (NAVD88)	ECD Length (linear feet)
LDSP/MCA 2A Access Corridor (13.3 miles long)	20	0.2	NA	5,856
Borrow Areas (total)	189.5	8.4	-90 feet	NA
Additional Material	NA	None	NA	NA
Alliance Anchorage	144.3	6.6	-90 feet	NA
Wills Point	45.2	1.8	-90 feet	NA
ECDs	NA	NA	4.0 - 0.5 feet	39,780
ECD Borrow Area	NA	NA	TBD	NA
MCAs (total)	862	5.4	3.0 - 0.5 feet	40,779
MCA-1A	301	1.6	Water bottom ranges from -1.2 to -1.7 feet for MCAs 1A and 2B; average -2.7 feet for MCA-1B*.	17,185
MCA-1B	387	2.7		13,073
MCA-2B	174	1.1		10,521
*Includes 85-acre pond.				

3.1.3. Detailed Description of Alternative 3 – 1,476 Acre Marsh with Two Construction Phases

This alternative includes excavation and transport of borrow material, ECD construction, and marsh platform creation just as described for the preferred alternative. However, Alternative 3 includes more created marsh and, therefore, corresponding differences in sediment volumes and other features. For this alternative, MCAs 3A and 3B were combined. A summary of Alternative 3 features is provided in TABLE 3-4. A summary comparison of the features and costs of Alternative 3 between the Preferred, Non-Preferred, and No Action Alternatives is provided in TABLE 3-2. Differences in Alternative 3 when compared with the preferred alternative are summarized below.

- Requires 13.8 MCY of material excavated from borrow areas and transported to the MCAs;
- Requires two mobilizations to dredge 8.4 MCY available sediment volume from the borrow areas during the first phase and an additional 5.4 MCY of sediment that would become available once it accumulated in the borrow areas;
- Creates 313 more acres (for a total of approximately 1,476 acres) of tidal marsh due to addition of MCA-3B (FIGURE 3-8);
- Requires construction of approximately 40,779 linear feet of ECD and 5,856 linear feet of ECD along the MCA 2A access corridor (same as preferred alternative) for sediment containment (FIGURE 3-8);
- Occurs over a minimum of two years (between mobilizations) and additional construction time for a total of 26 to 36 months in two phases due to wait time for accumulation of additional 5.4 MCY in borrow areas; and
- Has an increased total cost of $278 million as a result of increased borrow volume and larger area of marsh creation due to the addition of MCA-3B, and two mobilizations, compared with Alternative 1.

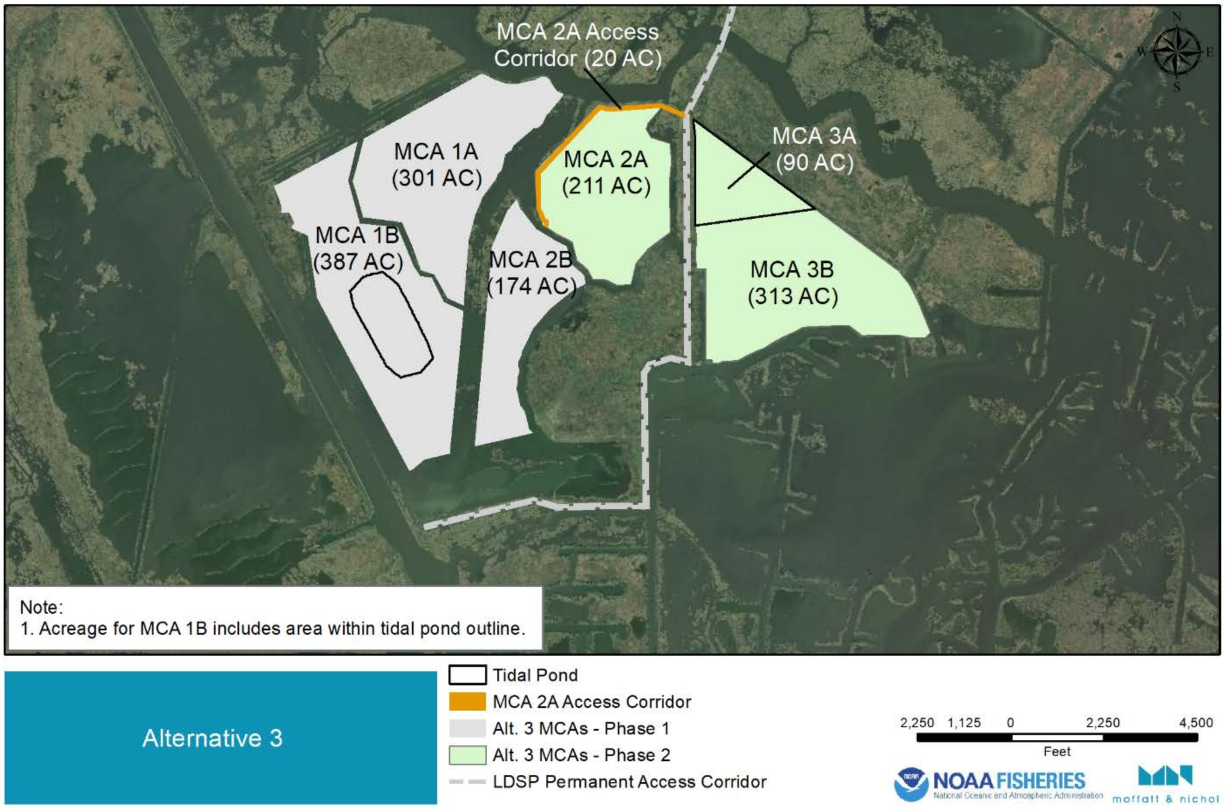

FIGURE 3-8. Alternative 3: includes MCAs 1A, 1B, 2A, 2B, 3A, and 3B constructed in two phases. MCAs include a minimum 100 feet of setback from verified pipelines and flow ways to ensure hydrologic connectivity.

TABLE 3-4. Summary of measures associated with project features for Alternative 3.

Project Feature	Acres*	Volume (MCY)	Target Elevation (NAVD88)	ECD Length (linear feet)
LDSP/MCA 2A Access Corridor (13.3 miles long)	20	0.2	NA	5,856
Borrow Areas (total)	189.5	13.8	-90 feet	NA
Additional Material**	NA	5.4	NA	NA
Alliance Anchorage	144.3	6.6	-90 feet	NA
Wills Point	45.2	1.8	NA	NA
ECDs	NA	NA	4.0 - 0.5 feet	40,779
ECD Borrow Area	NA	NA	TBD	NA
MCAs (total)	1,476	8.7	3.0 - 0.5 feet	40,779
MCA-1A	301	1.6	Water depths from -1.2 to -1.7 feet for MCAs 1A, 2A, and 3A; average depths -2.7 feet for MCA-1B*.	17,185
MCA-1B	387	2.7		13,073
MCA-2A	211	0.84		0
MCA-2B	174	1.1		10,521
MCA-3A	90	0.549		0
MCA-3B	313	2.1		0

*Includes 85-acre pond.
**Additional 5.4 MCY accumulated in borrow areas during construction period.

3.1.4. Detailed Description of the No Action Alternative

Under the No Action Alternative, the proposed project would not be constructed under any of the design alternatives. In the absence of the proposed construction activities, sediments would continue to accumulate in the Alliance Anchorage and Wills Point borrow areas and would be available for other projects. Areas proposed as MCAs would not be disturbed or converted from open water to marsh and would therefore continue to provide temporary habitat for aquatic vegetation, fish, and wildlife due to the continued land loss and saltwater intrusion in the Barataria Basin. Existing projects and operations in and around the project area would be expected to continue, and other future projects would also be expected to occur.

Under the No Action Alternative, the ongoing coastal land loss in the Barataria Basin would continue. CWPPRA reports that without actions to correct problems associated with land loss, “another fifth of the basin's wetlands would be lost to open water by 2045” (LCWCRTF, 1993). In the absence of intervention such as the proposed project, coastal land loss in the Barataria Basin, which totaled approximately 432 square miles for the period 1932-2016 and is the second greatest among the ten Louisiana coastal basins, would continue and/or increase (Couvillion et al., 2017). Wetland loss in the Barataria Basin and along the Louisiana coast in general is attributed to several factors, including sea-level rise, land subsidence, storm damage, sediment deprivation, oil and gas extraction and infrastructure, navigation infrastructure, saltwater intrusion, altered hydrology, and others (Penland et al., 2001). Recent hurricanes and the *DWH* oil spill have exacerbated land loss impacts in the Barataria Basin (Beland et al., 2017; McClenachan et al., 2013; Rangoonwala et al., 2016; Turner et al., 2016; Zengel et al., 2015). The consequences of the *DWH* oil spill included adverse impacts to marsh vegetation and intertidal biota (for example, fiddler crabs) and shoreline erosion (Zengel et al., 2015). Without restoration of marshes, further loss of benthic resources and coastal fish and shellfish populations is anticipated with additional loss of habitats that are critical to their growth and survival (Browder et al., 1989; Chesney et al., 2000).

Under the No Action Alternative, continued loss of coastal marshes would result in corresponding loss of habitat for fish and wildlife, increases in saltwater intrusion into the historically freshwater upper basin due to further loss of the Land Bridge, and increased erosion and flooding due to storm events (Lindquist, 2007; Peterson & Turner, 1994).

3.2. Evaluation of Alternatives 1, 2, and 3

The Louisiana TIG evaluated Alternatives 1, 2, and 3 under the OPA NRDA regulations restoration evaluation criteria (15 CFR 990.54(a)) as described below:

- **Cost-effectiveness**. The estimated cost for Alternative 1 is $176 million, which is $26 million (17 percent) more than Alternative 2 ($150 million) and $102 million (37 percent) less than Alternative 3 ($278 million). Alternative 1 is $148,774/acre, compared with $158,898/acre for Alternative 2 and $180,052/acre for Alternative 3. Therefore, Alternative 1 is more cost-effective than Alternatives 2 and 3 because it would achieve a greater level of benefit at a lower cost.
- **Goals and objectives**. Alternatives 1, 2, and 3 would meet the Louisiana TIG’s goals and objectives by creating approximately 862 (Alternative 2) to 1,476 (Alternative 3) acres of

intertidal marsh that would restore interspersed and ecologically connected coastal habitats, restore marsh habitat impacted by the *DWH* oil spill specific to the Barataria Basin, increase plant and nekton productivity, and restore marsh habitat in the Barataria Bay to provide the greatest benefits within geographic ranges consistent with the Final PDARP/PEIS (*DWH* Trustees, 2016).

- **Likelihood of success**. Alternatives 1, 2, and 3 are likely to succeed because they are technically feasible and use proven and established restoration methods, which have been implemented successfully on other projects in the region (i.e., CWPPRA projects).
- **Avoid collateral injury**. Created marshes under Alternatives 1, 2, and 3 would settle to an intertidal elevation soon after construction and gaps in containment dikes would allow tidal and nutrient exchange and enhance faunal (e.g., crabs and fish) access to coastal habitats and avoid collateral injury to resources.
- **Benefits to natural resources**. All three alternatives would serve as incremental components of the larger, regional Barataria Basin restoration efforts and would contribute to the synergy of multiple efforts focused on restoring the Barataria Land Bridge. Alternatives 1 and 3 provide greater levels of benefits to natural resources when compared with Alternative 2 due to greater number of acres of marsh platform created. The level of benefits is greater and the duration of potential adverse impacts shorter for Alternative 1 when compared with Alternative 3 because of differences in fill need and the duration of construction activities. Alternative 1 requires less fill for MCAs and, therefore, only a single construction mobilization and a shorter construction period (26 months) when compared with Alternative 3, which requires two mobilizations and 26 to 36 months for construction.
- **Health and Safety**. The Louisiana TIG does not anticipate impacts to public health and safety from implementing any of the alternatives. The proposed MCAs are uninhabited and remote, and the borrow areas are regularly excavated for sediment. During construction, all applicable laws and regulations pertaining to worker safety would be followed.

3.3. Rationale for Selection of Alternative 1 as the Preferred Alternative

The Louisiana TIG prefers Alternative 1 for implementation over Alternatives 2 and 3 because it is more cost effective than both Alternative 2 and 3, creates more habitat than Alternative 2 thereby resulting in greater benefits to natural resources, and has a reduced construction period and corresponding reduction in potential adverse impacts to resources when compared with Alternative 3, as summarized below.

- Alternative 1 would result in approximately 301 additional acres of marsh habitat when compared with Alternative 2.
- Alternative 1 would cost $151,333/acre, compared with $174,014/acre for Alternative 2 and $188,347/acre for Alternative 3. Therefore, Alternative 1 is more cost effective than the other alternatives because it would achieve a greater level of benefit at a lower cost.
- Alternative 1 would require as single construction mobilization phases because the total sediment volumes needed for this alternative would be available during that time. The sediment

volume needed for Alternative 3 would not be available until at least the second year, depending on river conditions, and would require a second construction mobilization once adequate sediment volumes became available.

- Alternative 1 would be constructed over a shorter construction period, which would reduce the duration over which construction-related adverse impacts to resources would occur.

Therefore, Alternative 1 is preferred for implementation because it is more cost effective than Alternatives 2 and 3; would benefit wetland, coastal, and nearshore habitat; and would have the shortest duration of construction-related adverse impacts to soils and sediments (when compared with Alternative 3), hydrology, water quality, habitats, estuarine and marine fauna, EFH, and aquaculture in the project area and surrounding areas.

4. ENVIRONMENTAL CONSEQUENCES

4.1. Introduction

This section includes a description of the affected environment and an analysis of the environmental consequences of the reasonable range of alternatives for the LSBMC-UBC project. The No Action Alternative is included pursuant to NEPA and provides a benchmark against which to analyze impacts from the action alternatives.

The alternatives addressed in this section are proposed under OPA NRDA regulations and meet the level of federal agency involvement to require NEPA review. 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- or long-term impacts). Intensity refers to the severity of an impact and could include the timing of the action (e.g., more intense impacts would occur during critical periods of high visitation or wildlife breeding/rearing). Intensity is also described in terms of whether the impact would be beneficial or adverse. For purposes of this document, adverse impacts are characterized as minor, moderate, or major, and temporary or long-term. Impacts were assessed in accordance with the guidelines in the Final PDARP/PEIS, TABLE 6.3-2 (NOAA, 2016)**.**

Analysis of beneficial impacts focuses on the duration (short- or long-term) without attempting to specify the intensity of the benefit as is consistent with that used in the Final PDARP/PEIS (*DWH* Trustees, 2016). "Adverse" is used in this section only to describe the federal trustees' evaluation under NEPA. That term is defined and applied differently in consultations conducted pursuant to the ESA and other protected resource statutes. The results of any completed protected resources consultations are included in the Administrative Record.

The area for which the affected environment is described encompasses all physical environmental conditions, including natural resources, and cultural heritage or built resources and the relationship of people with the environment. The description of the affected environment facilitates an analysis of the effects of the alternatives under consideration in a manner adequate for the reader to understand the effects of the alternatives. The project area includes a portion of the Mississippi River and is located on the west side of the Mississippi River, south of The Pen, and bounded to the west by the Barataria Waterway and to the east by Bayou Dupont (FIGURE 3-1). Several marsh creation and restoration projects have been completed directly adjacent to the project area and east of the project area to the Mississippi River (FIGURE 3-1). Portions of the Barataria Basin within and around the following project components are included in the project area:

- The Anchorage Alliance and Willis Point borrow areas in the Mississippi River;
- A previously permitted 13.3-mile access corridor from the borrow areas to the MCAs; and
- MCAs and ECDs that make up the project construction footprint, located just south of The Pen and proximate to previously completed marsh restoration projects such as Bayou Dupont.

4.2. Activities Addressed in Previous NEPA Assessments and Incorporated by Reference

NOAA's NEPA Companion Manual states, "Decision makers may use existing NOAA environmental analyses (EAs and EISs) to analyze effects associated with a proposed action, when doing so would build on work that has already been done, avoid redundancy, and provide a coherent and logical record of the analytical and decision-making process" (NOAA, 2017). In cases where the impacts of an activity were evaluated in a previous NEPA document and determined to have no significant adverse impact on a resource addressed in the present analysis, the impact is briefly described, and the relevant document is referenced. A number of EAs have been prepared for other marsh creation projects along the Barataria Land Bridge and/or in the Barataria Basin using similar sediment excavation and fill activities, are summarized below, and are used throughout this Final RP/EA #3.3 to support the analysis of similar impacts for the alternatives.

- The *DWH* Final PDARP/PEIS presents a programmatic analysis of proposed restoration approaches for wetlands, coastal, and nearshore habitats, among other restoration types (*DWH* Trustees, 2016). All the activities and resources analyzed for this Final RP/EA #3.3 were previously analyzed at a programmatic level as part of the Final PDARP/PEIS. The ROD (2016) concluded that all practicable means to avoid, minimize, or compensate for environmental harm from the action had been considered programmatically, and that project-specific measures would be adopted during subsequent restoration planning efforts.
- The *Louisiana TIG Final I SRP/EA #3* analyzed strategic restoration alternatives associated with the restoration of wetlands, coastal, and nearshore habitat resources and services in the Barataria Basin at a more specific level than the Final PDARP/PEIS (Louisiana TIG, 2018b). The Final Phase I SRP/EA #3 considered the resources of the Barataria Basin, and a comprehensive suite of restoration techniques and approaches to address ecosystem level injuries in the Barataria Basin. Large-scale diversions, marsh creation, and ridge restoration techniques and approaches were evaluated to help prioritize future decision making for restoration in the Barataria Basin. Three projects, including the project evaluated in this RP/EA were selected to move forward for further evaluation and planning (MBSD; Large-Scale Marsh Creation: Component E; and Spanish Pass Increment of the Barataria Basin Ridge and Marsh Creation project. The FONSI for the SRP/EA was issued 3/08/2018.
- The *Louisiana TIG Phase II Restoration Plan/Environmental Assessment #1.1: Queen Bess Island Restoration* (Queen Bess RP/EA) addresses three Final PDARP/PEIS restoration types: Restoration of Wetlands, Coastal, and Nearshore Habitats; Habitat Projects on Federally Managed Lands; and Birds (Louisiana TIG, 2019a). The Queen Bess RP/EA is incorporated here by reference because it includes NEPA analysis of similar restoration techniques (e.g., marsh creation via placement of dredged sediments), and similar resources potentially impacted by the proposed project. The final RP/EA is available at https://la-dwh.com/restoration-plans/. The FONSI was issued 3/21/2019.
- The *Louisiana TIG Draft Phase II Restoration Plan/ EA #1.2: Spanish Pass Ridge and Marsh Creation Project and Lake Borgne Marsh Creation Project* (Spanish Pass RP/EA) evaluated design alternatives for two projects to restore wetlands, coastal, and nearshore habitats in Spanish

Pass and Lake Borgne. Both projects involve a marsh creation component in Barataria Bay and sediment delivered from borrow areas in the Mississippi River, using the same construction techniques as proposed in this RP/EA, hence that related evaluation from RP/EA #1.2 is incorporated by reference. The Final Spanish Pass RP/EA is pending approval and will be available at https://la-dwh.com/restoration-plans/.

- The *Supplementary Environmental Document (SED) for the Mississippi River Long Distance Sediment Pipeline (LDSP)* (LDSP SED) (CH2MHILL, 2011). The purpose of the LDSP was to obtain sustainable and renewable sediment sources, provide an adequate access corridor that supports equipment mobilization for long distance sediment conveyance, and restore intertidal wetlands along the Barataria Land Bridge in central Barataria Basin). The LDSP analysis is incorporated by reference because of its similarities to the LSBMC-UBC, including: it is located immediately adjacent to the LSBMC-UBC project; it includes sediment delivery from the same borrow sources, it uses the same construction techniques, and; it evaluates impacts of these activities on the same and/or similar resources.
- The *Final RP/EA and FONSI for the Bayou Grande Chenier Marsh and Ridge Restoration (BA-173) in Plaquemines Parish, LA* (Bayou Grande RP/EA) (USFWS, 2017). The purpose of the project was to create approximately 302 acres of wetlands in response to a "tremendous loss of emergent wetlands" by hydraulically dredging sediments from the Mississippi River and depositing that material in shallow open-water areas to restore portions of Bayou Grande Chenier, resulting in the creation of 302 acres of brackish marsh. The Bayou Grand RP/EA is incorporated by reference due the same or similar construction techniques, sediment sources, and resources potentially impacted.
- The *Final EA for the Bayou Dupont Sediment Delivery Marsh Creation #3 and Terracing CWPPRA Project (BA-164) in Plaquemines and Jefferson Parishes, LA* (Bayou Dupont #3 RP/EA) (USEPA, 2015). The project used sediment hydraulically dredged from the Mississippi River to create a 252-acre marsh platform in an area that lies within a rapidly eroding and subsiding section of the Barataria Land Bridge (FONSI issued 2011). The Bayou Dupont #3 RP/EA is incorporated by reference due the same or similar location, construction techniques, sediment sources, and resources potentially impacted, when compared with the LBMC-UBC project alternatives. The project was completed in 2017.
- The *RP/EA for Bayou Dupont Marsh and Ridge Creation CWPPRA Project (BA-48) in Jefferson and Plaquemines Parishes, LA* (Bayou Dupont RP/EA) (NOAA, 2011). The project re-defined a natural ridge along Bayou Dupont and re-establish adjacent marsh using renewable sediment from the Mississippi River and created and nourished approximately 331 acres of marsh using similar restoration techniques in the Barataria Basin. The FONSI for this project was issued in 2011. This Bayou Dupont marsh creation project is located immediately adjacent to the LSBMC-UBC project and was completed in 2015.
- The *Draft 95 Percent design report for the Large-Scale Barataria Marsh Creation – Upper Barataria Component* (Moffatt & Nichol, 2020). The design report provides an analysis of alternatives for the LSBMC-UBC project, including borrow sediment and MCA fill volume estimates, and containment dike locations, under the four alternatives.

The analyses and conclusions presented in the documents summarized above provide the basis of much of the analysis presented here for the LSBMC-UBC design alternatives. This is because the same or similar affected resources and activities are proposed and analyzed in this Final RP/EA #3.3, and similar outcomes are expected. For example, RP/EAs for the Bayou Dupont restoration projects described above were developed for similar marsh creation projects in immediately adjacent areas using the same source of borrow materials (NOAA, 2011; USEPA, 2015). Analyses presented here for the LSBMC-UBC project are consistent with findings of minor to moderate, primarily short term (due to construction activities) adverse impacts to resources as a result of the proposed restoration projects. Long-term benefits to resources were anticipated as a result of the proposed restoration projects.

4.3. Resources Not Analyzed in Further Detail in this RP/EA

NEPA and the Council on Environmental Quality (CEQ) regulations direct agencies preparing an EIS to "avoid useless bulk . . . and concentrate effort and attention on important issues" (40 CFR 1502.15) and to "identify and eliminate from detailed study the issues which are not significant, or which have been covered by prior environmental review" (40 CFR 1506.3). These resources would either not be affected or would have minimal, short-term impacts that are common to all alternatives. This allows for a focused impact analysis by eliminating (from detailed analysis) resources with little or no potential for adverse impacts.

Potential impacts to resources relevant to the LSBMC-UBC alternatives have been included in previous NEPA analyses for other marsh restoration projects in the Barataria Basin, including the Spanish Pass Ridge EA, Bayou Grande RP/EA, Bayou Dupont #3 RP/EA, the Bayou Dupont RP/EA, and LDSP SED (CH2MHILL, 2011; Louisiana TIG, 2019b; NOAA, 2011; USEPA, 2015; USFWS, 2017). Documents other than these are cited individually as needed in the following sections. Each of these analyses concluded that resources would not be significantly adversely impacted by marsh creation activities that are similar to or the same as those proposed for the LSBMC-UBC project (e.g., excavation of borrow material, transport of the borrow along the access corridor, construction of containment dikes from in-situ materials, and filling open water areas with sediment to create marshes). These resources were subsequently identified as being minimally impacted by the proposed project and are described briefly below, with the rationale for their elimination from further analysis. In addition, the LSBMC-UBC alternatives are not anticipated to contribute substantially to cumulative impacts and this resource is not analyzed in further detail in the cumulative impacts section.

4.3.1. Air Quality

The Clean Air Act (CAA) requires the USEPA to establish National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. USEPA has established NAAQS for six criteria pollutants: sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter, carbon monoxide (CO), ozone (O_3), and lead (Pb). Primary NAAQS are intended to protect public health, while secondary NAAQS are intended to protect the environment (crops, wildlife, and buildings). Individual states may establish more stringent standards. Exhaust from ships, boats, cars, and other modes of transportation; agricultural and construction equipment; manufacturing; pollutants from forest and other fires; and Saharan dust that travels across the north Atlantic Ocean to the Gulf of Mexico, including coastal Louisiana, are all sources of air pollution in the project area.

Air emissions would be generated over the short term as a result of construction activities, but not to levels significantly higher than what presently occur under the No Action Alternative, and emissions would not be outside the normal range of emissions from other activities in and around the project area. An increase in vegetation could potentially provide a long-term benefit to air quality for the area. Therefore, impacts from restoration activities would be negligible. No differences in impacts to ambient air quality between alternatives are anticipated. Plaquemines and Jefferson Parishes are both in attainment of the NAAQS (https://www3.epa.gov/airquality/greenbook/ancl.html) and therefore exempt from analysis under the general conformity requirements of the Clean Air Act, Section l 76(c)(4) (USEPA, 2019).

4.3.2. Noise

Noise would be generated during restoration activities from sources including motor vessel and mechanical equipment operation (e.g., pumps, compressors, heavy equipment). The proposed activities are of short duration and the types of noise generated are not unusual to everyday activities and, therefore, not anticipated to impact resources in the watershed. Minor noise impacts to wildlife, such as colonial waterbirds would be expected. The effects of noise would be short-term, minor to negligible, adverse impacts to resources would be limited to effects of construction activities.

4.3.3. Socioeconomic and Environmental Justice

Federal, state, and local regulations would ensure that human health and safety are not impacted as part of any proposed restoration activities. EO 12898 states that, to the greatest extent practicable, federal agencies must “identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.” This order requires lead agencies to identify and address, as appropriate, disproportionately high and adverse environmental effects on minority and low-income populations from projects or programs that are proposed, funded, or licensed by federal agencies.

A desktop analysis utilizing USEPA’s Environmental Justice View tool indicated approximately 372 persons and a population density of 19 people per square mile along the 13.3-mile access corridor and in the vicinity of the MCAs and borrow areas for the period 2013-2017 (USEPA, 2019). Eighty-three percent (309 people) in the area are considered black and 15 percent are considered white, with the remaining approximately two percent identified as “other.” The per capita income is $19,179 and more than a quarter (26 percent) of the population makes less than $15,000/year. The Environmental Justice View Tool Demographic Index uses the two demographic indicators explicitly named in EO 12898 (low-income and minority). The Index is 70 percent, compared with the state average of 40 percent and the U.S. average of 36 percent, indicating the proportion of susceptible individuals in the group analyzed, compared with the U.S. average.

The LSBMC-UBC would result in short-term increases in the demand for employment. Construction activities involving construction equipment and commuting workers would increase traffic and may lead to temporary road closures in localized areas. However, these impacts would be minor and short-term in nature. None of the alternatives for these projects would create a disproportionately high and adverse effect on minority or low-income populations. Improvements in marsh habitat could provide benefits to commercial and recreation fishing industries through benefits to fish populations.

EO 13045, "Protection of Children from Environmental Health Risks and Safety Risks" (62 FR 19885), specifically addresses children because they may be more vulnerable or disproportionately impacted when compared to an adult exposed to the same event. No children would be adversely impacted by any of the activities that may occur under the proposed activities.

4.3.4. Cultural Resources

Cultural resources are evidence of past human activity and may include pioneer homes, buildings, or old roads; structures with unique architecture; prehistoric village sites; historical or prehistoric artifacts or objects; rock inscriptions; human burial sites; or earthworks, such as battlefield entrenchments, prehistoric canals, or mounds.

As stated in the Final PDARP/PEIS, all projects implemented under subsequent restoration plans and tiered NEPA analyses consistent with the Final PDARP/PEIS would secure all necessary state and federal permits, authorizations, consultations, or other regulatory processes and ensure the project is in accordance with all applicable laws and regulations concerning the protection of cultural and historical resources. If any culturally or historically important resources were identified during project preparations or predevelopment surveys, the appropriate state and/or federal agencies would be notified and further work in that area would be avoided until additional guidance is provided.

A Phase I Cultural Resources Investigation was conducted for the project by Coastal Environments, Inc. (CEI) (CEI, 2019). Approximately 2,275 acres of marsh and open water, including MCAs 1A, 1B, 2A and 2B, MCA 3A and 3B, and additional MCAs 4 and 5, were surveyed as part of the investigation. Visual and probe/auger test surveys yielded no archaeological sites or deposits indicative of prehistoric or historic activity of any antiquity. The debris from an apparent late twentieth century fishing camp (post-1969) was noted within the MCA 3B but lacked the antiquity necessary to record as a site. No historic standing structures were found. CEI concluded no further cultural resources work is necessary and recommended that the marsh creation project be allowed to proceed as planned. In a letter dated July 11, 2019, the State Historic Preservation Officer (SHPO) concurred with the assessment that no properties listed in or eligible for listing in the National Register of Historical Places would be affected by the project. The Final Cultural Resources Report (CEI 2019b) was reviewed and accepted by the SHPO on August 3, 2019 (Report # 22-6275). The LDSP pipeline conveyance corridor and borrow areas were assessed for previously constructed projects and the SHPO concurred that no historic properties would be affected by the using the pipeline corridor.

4.3.5. Land and Marine Management

The proposed project area is unsuitable for most development since it is primarily wetlands or open water. Populated upland areas are confined to the perimeter of the Barataria Basin, accounting for 22.7 percent of the total basin area, of which 10 percent is urbanized and 90 percent is in various forms of agriculture, mostly sugarcane farming (43.7 percent) (Lane & DeLaune, 2015). The only developed lands such as residential, commercial, or industrial, in the vicinity of the project area is the Conoco Phillips Alliance Refinery adjacent to the proposed borrow areas and sediment pipeline corridor. A clay mine is also adjacent to the pipeline corridor. Oil and natural gas activities occur throughout Barataria Bay and along the Mississippi River, which is the main source of shipping navigation for much of the nation. The Conoco-Philips Alliance Refinery is the nearest major infrastructure to the proposed project; the borrow area boundaries are north of the refinery to avoid impacting navigation. A 24” Gulf pipeline, 20” and 24” Plains pipelines are located downriver of the proposed borrow areas and the marsh creation areas are adjacent to other pipelines. The basin supports many commercial activities ranging from sugarcane production and aquaculture to commercial fishing, trapping, logging, and oil and gas production.

The Coastal Zone Management Act (CZMA) is a federal act that encourages states to develop coastal management programs for preserving statewide coastal resources. Under this act, once a state develops a federally approved coastal management program, “federal consistency” requires that any federal actions affecting coastal land or water resources (the coastal zone) must be consistent with the state’s program. In Louisiana, the LDNR Office of Coastal Management oversees the state’s Coastal Zone Management Program (CZM Program). The proposed project is located within the Louisiana Coastal Zone established by the State and Local Coastal Resources Management Act of 1978 and modified in 2012.

Both Jefferson and Plaquemines Parishes have state and federally approved Parish Local CZM Programs. The LSBMC-UBC project would support the goals outlined in the parish Coastal Zone Management programs and would result in long-term, benefits to land and marine management due to coastal wetland restoration. CZM consistency certification has been requested. For all federal compliance status updates, please see TABLE 5-1 in Section 5 of this Final RP/EA #3.3.

4.3.6. Tourism and Recreational Use

All of the design alternatives would serve to enhance recreational opportunities and experiences. The proposed project location is primarily private lands and minor, adverse impacts to recreation use may occur if construction activities adversely impacted local traffic. However, the proposed project would result in long-term benefits to local recreational use and more regional tourism due to increased habitat value for wildlife populations and wildlife viewing opportunities.

Recreational activities in the Barataria Basin include fishing, hunting, bird watching, swimming, and boating (Kravitz et al., 2005). Fishing is an important recreational activity in the Barataria Basin that also generates significant annual revenue (CH2MHILL, 2011). Plaquemines Parish has 15 park sites totaling approximately 400 acres, providing athletic fields, community centers, and playgrounds; the parish is nationally known for its waterfowl hunting (Plaquemines Parish Department of Coastal Zone

Management, 2013). Similarly, Jefferson Parish has multiple public parks, mostly located in the northern third of the parish; the closest facility to the LDSP Corridor is the Rose Thorne Playground located in Lafitte. The closest major recreation area is the Barataria Preserve unit of the Jean Lafitte National Park and Preserve, located 5 to 7 miles northwest of the proposed alignment and operated by the NPS. The Preserve includes bayous, swamps, marshes, forests, and wildlife which can be accessed by boardwalks, dirt trails, and canoe.

The LSBMC-UBC project area, including its surroundings, are popular destinations for boating, birdwatching, fishing, camping and other recreational activities. There are no public hunting sites within this project area; however, waterfowl and other hunting is permitted in the area to those granted access to private lands. The MCAs are privately leased and would therefore not affect public recreation, tourism, or access.

Construction and removal of the sediment pipeline would result in short-term minor impacts to traffic on local roads. Construction-related traffic would include trucks delivering equipment and workers driving personal vehicles. The pipeline corridor would pass under LA 23 and West Ravenna Road. Those roads would be temporarily closed during construction. Traffic control procedures, including use of flaggers, would minimize impacts to traffic flow.

Short-term construction-related traffic delays would occur due to construction and would require manual traffic control to direct traffic around construction areas to minimize disruption and inconvenience during pipeline borings. Construction and removal of the sediment pipeline would require boring and placement of pipeline under the New Orleans and Gulf Coast (NOGC) rail line and would result in temporary disruptions to railroad activities until the work is complete and has been inspected. Work would be coordinated with the railroad to prevent or minimize impacts to NOGC customers and employees. Marine transportation is addressed in Section 4.3.9.

4.3.7. Aesthetics and Visual Resources

Visual resources include natural and man-made components of the environment perceived by human receptors. “Aesthetics” refers to beauty in both form and appearance. Perceptions and aesthetic values may vary among individuals depending upon personal preferences. Areas of aesthetic and visual value within the proposed project area include the Mississippi River and undeveloped/natural portions of the Barataria Basin.

Activities currently occurring in these areas both interrupt and act as part of their visual appeal. For example, dredging and shipping operations are frequent on the Mississippi River. These activities interrupt the view of a natural river but enhance the river by adding interest and activity to the view. The proposed project is located within the Mississippi River industrial corridor. Oil and gas exploration, recreational boating, and recreational fishing occur in the Barataria Basin. Commercial boating, fishing, and shipping also occur on the Barataria Waterway and fishing and boating occurs in The Pen and Bayou Dupont.

During the proposed project, dredging activity would increase on the Mississippi River. However, this activity would be similar to other activities, including other dredging projects that already occur. No visual or aesthetic impacts would occur.

Construction and operation of the pipeline would result in minor long-term visual impacts to the Barataria Basin. The pipeline would be constructed at marsh elevation, which would limit the visual impact to those located in the immediate vicinity. Upon completion of the proposed project, the pipeline would be removed, and the route would be allowed to return to pre-construction conditions.

The marsh restoration would provide a long-term beneficial visual benefit. Natural marsh area would be created, improving the aesthetics within the area of restoration.

4.3.8. Public Health and Safety

The proposed project would create emergent marshes that reduce flooding, wave action, saltwater intrusion, storm surge, and tidal current. Therefore, the proposed project would result in long-term, beneficial effects to public health and safety through the maintenance and enhancement of the coastal marsh. Alternatives would comply with EO 13045, “Protection of Children from Environmental Health Risks and Safety Risks” and do not represent disproportionately high and adverse environmental health or safety risks to children in the U.S. Implementation of this project would not increase shoreline erosion or create other health and safety concerns. There would be a potential for construction accidents and construction worker exposure. Health and safety plans would be developed and implemented for the proposed project. Personal protective equipment would be used by construction personnel where appropriate.

4.3.9. Marine Transportation

The Mississippi River is one of the largest water navigation routes in the U.S., connecting the Gulf of Mexico to ports in the central and southern U.S. The Port of New Orleans generates $100 million in revenue annually through four lines of business — cargo, rail, industrial real estate, and cruises (Port of New Orleans, 2019). The USACE conducts regular surveys and navigation maintenance activities to support shipping on the Mississippi River (USACE, 2011).

Dredging activities in borrow areas in the Mississippi River and construction and removal of the pipeline in the river, could result in temporary disruption to commercial and recreational boat traffic. The pipeline would be submerged in the river and properly marked to minimize disruptions. In addition, work would be coordinated with the USACE, U.S. Coast Guard, Crescent River Port Pilots Association, and Conoco Phillips Alliance refinery to reduce potential impacts to commercial activities.

Construction and operation of the pipeline for transport of dredged sediments would result in long-term disruptions to boat traffic in the immediate area around the pipeline route in the Barataria Basin. Although the project would include a floatation access channel, the corridor would block access to adjacent wetlands and open water areas, including oil and gas canals. The pipeline would be submerged at Bayou Dupont to maintain navigation along that waterway. Upon completion of the proposed project, the pipeline would be removed.

The MCAs are privately owned and leased, and land-owner agreements will be obtained prior to construction. Consequently, no loss of access for transportation would occur. The access corridor is already permitted and no changes in use are anticipated. The transportation infrastructure near the proposed project area is adequate to accommodate the increased use during construction, operation, and removal of the pipeline and pipeline crossings for vehicles will be constructed. Impacts would be short-term and restricted to the immediate area. Construction activities would be conducted to avoid any unreasonable interference with navigation of marine transportation. Temporary disruptions in recreation and commercial boat traffic on the Mississippi River near the proposed borrow sites would be expected. Long-term disruptions to small boats would occur along the proposed route within Barataria Basin. Boat access in restoration areas would be eliminated. Use of the Wills Point borrow area may temporarily impact marine navigation when the submerged pipeline is installed across the bottom of the river. The pipeline would cross existing canals over bridges and would be submerged to allow navigation on Bayou Dupont.

The transportation infrastructure near the project area is adequate to accommodate the increased use during construction, operation, and removal of the pipeline. Impacts would be short-term and restricted to the immediate area. The proposed project would not result in impacts to marine transportation because none of the design alternatives would unreasonably interfere with or create obstructions to navigation on the surrounding waterways. Therefore, no long-term adverse impacts to transportation would be expected.

4.4. Resources Analyzed in Detail

The differences among the alternatives are a matter of scale (acreage of marsh created, volume of sediment excavated from borrow areas, linear feet of containment dike constructed, volume of sediment excavated to construct the containment dikes) and the timeframe for project construction (ranging from 24 months to 36 months). Consequently, impacts across alternatives are similar except for the extent of the marsh creation, extent of containment dike and sediment dredged, the volume needed and the availability of borrow area sediment, and the duration of construction activities. Alternative 3 requires more sediment than is currently available from the borrow areas. Differences in construction duration (and subsequent mobilizations) are dependent on the availability of material from the borrow areas. Although the Mississippi River borrow areas are renewable, i.e., they continue to accumulate sediments under sufficient water level conditions), the total material available from both proposed borrow areas for a single mobilization effort is 8.4 MCY. If more sediment is needed, the construction activities must stop and then re-mobilize when more sediment is available, which increases the duration of construction activities and the number and extent of physical disturbance. If river flow conditions are insufficient, adequate sediment may not be available for project completion as planned and further delays would be expected. ECDs will be constructed using material borrowed from the MCAs prior to sediment placement from the Mississippi River borrow areas. A comparison of the alternatives is provided in TABLE 3-2.

The following analyses rely on sources described earlier that are not cited for each resource/alternative combination to avoid redundancy (CH2MHill, 2011; Louisiana TIG, 2018b; Louisiana TIG, 2019a;

Louisiana TIG, 2019b; Moffatt & Nichol, 2020; NOAA, 2011; USEPA, 2015; USFWS, 2017). Other than these, relevant sources are individually cited.

4.4.1. Physical Environment

The physical resources described here are geology and substrates, hydrology, and water quality.

4.4.1.1. Geology and Substrates - Affected Environment

Coastal marshes, such as those present in the proposed project area, act as a buffer to reduce the effects of wave action, saltwater intrusion, storm surge, and tidal currents on associated estuaries and wetlands. The geologic features within the project area are characterized by Holocene-era gray to black clay of very high organic content, including some peat (Louisiana Geological Survey, 1984). Geologic features are not expected to be altered by any of the design alternatives.

Soil and sediment erosion and sediment deprivation in the Barataria Basin are due to a combination of naturally and human-induced processes and has resulted in dramatic land loss. Sediments that were previously carried with high river flows into the marshes were diverted away from the marshes by the levee system constructed along the Mississippi River, the closure of Bayou Lafourche at the Mississippi River, and the creation of the Barataria Bay Waterway and Harvey Cut (Lindquist, 2007). From 1932 to 2016, the Barataria Basin lost approximately 432 square miles of land, which represents nearly 30 percent of the total 1932 landmass (Couvillion et al., 2017).

The soils in the proposed project area are a Lafitte-Clovelly association (NRCS & USDA, 2019). Soils of these series are typical of brackish marshes that are flooded or ponded most of the time and are described as level, very poorly drained saline, semi-fluid organic soils. They have a thick or moderately thick mucky surface layer and clayey underlying material. Soils are described in greater detail in the 95 Percent Design Report for the LSBMC-UBC (Moffatt & Nichol, 2020). Lafitte soils characterize the broad basins between natural streams and are characterized by semi-fluid, saline muck, saline clay and silty clay loam. Clovelly soils occur on submerged ridges along natural streams and have a moderately thick surface layer of semi-fluid, saline muck and underlying material of semi-fluid, saline clay. Greater detail on these soils is provided in the 95 Percent Design Report for the LSBMC-UBC project (Moffatt & Nichol, 2020).

Organic matter and mineral content of these wetland soils are crucial to soil development and are often used to describe the roles of organic accumulation and mineral sediment deposition (Neubauer, 2008; Nyman et al., 2006). Both processes vary with plant communities and other aspects of wetland dynamics, including soil inundation, drainage, redox potential, and other biogeochemical processes (Reddy et al., 2000). Marsh creation provides soils on which these processes occur. The anoxic conditions in wetlands are a natural environment for sequestration and storage of carbon from the atmosphere and nutrients from the water column (Mitsch et al., 2012).

The Mississippi River borrow area sediments range from poorly graded sand and poorly graded sand with silt over cohesive materials (GEC, 2009). The existing pipeline corridor is approximately 13.3 miles long and about 60 feet wide and was established in 2015 (Moffatt & Nichol, 2020). The borrow areas are considered renewable due to an estimated 9 to 15 MCY of material available for capture from the Mississippi River on an annual basis (Allison et al., 2012).

4.4.1.2. Geology and Substrates - Environmental Consequences

Alternative 1 (Preferred). The preferred alternative is expected to result in long-term benefits to sediments and soils in the project area due to the addition of soils and reduced erosion and subsidence associated with higher elevation marsh platforms. Soils and sediments would eventually be inundated again due to sea level rise (and other factors) but this is not anticipated within the 20-year project life.

Alternative 1 includes fill material excavated from the Mississippi River and then conveyed and discharged into the MCAs and the subsequent creation of approximately 1,163 acres of intertidal marsh (TABLE 3-1). ECDs would be constructed from in-situ dredged material prior to the conveyance and discharge of material from the Mississippi River borrow areas into the MCAs. Alternative 1 would require excavation of 10.5 MCY of sediment from the two Mississippi River borrow areas. This alternative requires a single mobilization effort for excavation of sediments and filling MCAs. After fill placement, marsh vegetation would be allowed to recolonize naturally. Marsh vegetation would help stabilize soils and reduce soil loss due to erosion in the long term. Soils and sediments in restoration areas would be permanently covered with riverine sediments excavated from the Mississippi River. Thomas et al. (2019) found that placing sand amendments onto the marsh platform to support marsh restoration drastically modified the bacterial communities (decreasing richness and diversity) but suggest the bacterial community structure can equilibrate if the inundation regime is maintained within the optimal range for *Spartina alterniflora*.

These sediments would replace soils lost to erosion and would restore the elevation of the marsh at the restoration location based on the alternative implemented. At MCA-1B, a 5,500-foot-long containment dike will be created from in-situ materials about 400 feet from the Barataria Waterway to prevent the discharge of hydraulic fill from dredging operations into the waterway. Toxicity testing of Mississippi River borrow sediments found concentrations of fluorene and total PAHs in borrow sediment samples that exceeded NOAA Screening Quick Reference Tables concentrations, although results of the biological analysis found no significant difference between mortality to organisms exposed to the borrow and fill area sediments and those exposed to the reference sediment (Buchman, 2008; GEC, 2009). Therefore, the dredged material is not predicted to be acutely toxic to benthic organisms in the soils. Impacts to benthic organisms due to burial is addressed under habitats (Section 4.4.2).

Short-term, minor, adverse impacts to terrestrial substrates, such as localized soil disturbances and/or compaction, may result from use of heavy equipment during site preparation and restoration activities at both the Mississippi River and MCA dredging sites. Dredging would permanently remove material from borrow areas and subsequently permanently bury terrestrial substrates along ECDs and in the MCA marsh platforms. Soils in the access corridor would have minor long-term adverse impacts from construction and operation disturbances along the permanent pipeline access corridor, consistent with its permitted use. The existing pipeline corridor has been in place since 2015 and was used to provide sediment for previous projects. Earthwork would be required for site preparation, and there would be a minor increased potential for erosion during construction and demolition activities. Installing the pipeline on the corridor will also require use of heavy equipment. Disturbed areas would be minimized to complete the work. Sedimentation and erosion controls would be implemented during clearing/grubbing and pipeline placement to minimize erosion of surrounding soils due to soil/ground disturbance and stormwater runoff. Site-specific measures would minimize the transport of soils. Appropriate Best Management Practices (BMPs) would be selected based on site-specific conditions.

Minor temporary impacts to sediments would occur at the two borrow areas in the Mississippi River due to sediment removal. However, the borrow areas area are renewable and would fill back in during subsequent seasonal flooding over a period of 26 to 36 months (Moffatt & Nichol, 2020).

Overall, the preferred alternative would result in short- to long- term, minor, adverse impacts and long-term, benefits to soils and substrates. No impacts to other geological resources are anticipated.

Alternatives 2 and 3. Activities would be the same for Alternatives 2 and 3 as they are for Alternative 1. Potential impacts would be similar but would vary in scale due to the volume of fill excavated from the borrow areas, the length of the ECDs, and the area of MCAs to be filled. Compared with Alternative 1, Alternative 2 would result in approximately 301 acres less of created marsh platform, while Alternative 3 would result in the creation of approximately 313 acres more of created marsh platform, resulting in correspondingly fewer or greater acres of potential benefits (TABLE 3-2).

Both alternatives would result in short- to long- term, minor, adverse impacts to wetland soils in the access corridor, such as disturbance, compaction, and erosion, would be greater under Alternative 3 due to the delay required for accrual of additional sediments at the borrow areas as well as the second construction mobilization required to complete construction. Similarly, dredging for ECDs and subsequent construction of ECDs with the dredged material, would permanently remove (from MCA) or bury (along the ECDs). Additional excavation from the borrow areas would further reduce the sediment available for other projects. No impacts to other projects are anticipated as a result of ECD construction activities.

Alternative 3 requires more sediment than is currently available from the borrow areas. The borrow areas are renewable, i.e., they continue to accumulate sediments under sufficient water level conditions in the Mississippi River, but if flow conditions are not adequate, adequate sediment may not be available for project completion as planned and further delays would be expected. Additional delays may result in erosional loss of sediments from MCAs and ECDs during construction down time, longer time periods for potential adverse impacts to occur, and greater opportunities for storm events to occur that may damage MCA containment. The period of construction ranges from 26 to 36 months for Alternative 3, compared with approximately 26 months for Alternative 1. Geology in the project area is not expected to be affected.

Overall, these alternatives would also result in short- to long- term, minor, adverse impacts and long-term, benefits to the resource, similar to the preferred alternative. However, the smaller marsh area under Alternative 2 would result in fewer benefits and the additional construction phase under Alternative 3 would extend the time over which adverse impacts would occur, when compared with the preferred alternative.

No Action Alternative. Under the No Action Alternative, none of the proposed construction activities would occur. In the short term, geology and substrate conditions would remain the same as described above. However, due to local subsidence and sea level rise, long-term, moderate to major adverse impacts would occur from inundation and erosion. Therefore, under the No Action Alternative, impacts to substrates would be adverse, major, and long-term.

4.4.1.3. Hydrology - Affected Environment

Freshwater and brackish wetlands and salt marshes, as well as freshwater ponds and lakes, natural and man-made canals, and brackish and saline bays and passes characterize the Barataria Basin. Hydrology and water quality are important as drinking water sources to communities, recreation, and fish and wildlife habitat. Hydrology integrates the basin components, allows the exchange of sediments and nutrients, and provides access to estuarine nursery habitats for many aquatic organisms. Hydrology is presented in more detail in the LDSP SED (CH2MHILL, 2011).

Hydrology in the basin is primarily a function of wind velocity, wind direction, and tides. Strong southerly wind pushes water north from Barataria Bay into The Pen and into adjacent canals and bayous and winds from the north push the water south. Tides have an average diurnal range of 1.05 feet, and non-flood tides are negligible north of The Pen (McGraw, 2005). The Barataria Waterway and other artificial canals contribute to increased saltwater intrusion and water levels. Freshwater inputs are minimal and the freshwater aquifer present in much of Louisiana is absent in the project area.

Shallow, interconnected bayous, lakes, and bays in the basin are typically less than 6.5 feet deep and have an elevation at or just above sea level. The 75-acre constructed pond planned for MCA-1 would be approximately 5 feet deep and consistent with naturally occurring, similar features. Constructed canals, generally associated with oil and gas exploration activities, are deeper and straighter than the natural bayous of the area. Low spoil banks or levees are often associated with the canals and bayous and are also often slightly higher in elevation than the surrounding land surface. These levees and banks disrupt the hydrology of the marsh by interrupting the natural exchange and sheet flow of water and tidal action in the basin.

The Barataria Basin has undergone significant natural and anthropogenically induced hydrological changes (Holcomb et al., 2015). Historically, the Mississippi River was the source of fresh water, nutrients, and sediment for the basin. The construction of levees and the closure of Bayou Lafourche eliminated freshwater and sediment inputs. Navigation canals like the Barataria Waterway, Wilkinson Canal, the GIWW and the hundreds of miles of oil field canals combined with natural processes such as subsidence and sea level rise have increased saltwater intrusion and shoreline erosion. The engineering modifications of the Mississippi River for flood control and navigation have altered freshwater flows and sediment transportation downriver of those controls, including within the Barataria Basin. A number of structures have been constructed, or are proposed, to address this issue within the Barataria Basin, including Davis Pond located 22 miles upriver (USACE, 2011). The proposed Mid-Barataria sediment diversion structure would be located on the Mississippi River, east of the proposed project area and would divert fresh water and sediments into the Barataria Basin, inclusive of the project area. The Naomi Siphons were constructed to bring fresh water from the Mississippi River into the area near the project; however, these siphons are rarely operated. The Bayou Dupont rock weir was constructed to reduce flows from the Barataria Waterway into The Pen.

4.4.1.4. Hydrology - Environmental Consequences

Alternative 1 (Preferred). Alternative 1 includes filling MCAs and reducing the area of surface water in the proposed project area by replacing open water with a marsh platform. However, flow ways would be constructed between and among MCAs and existing canals and the ECDs would include gaps to create hydrologic connections. Containment dikes would alter hydrology; however, pipeline corridors and fish passage corridors (flow pathways) have been added to allow hydrologic connectivity to the created marsh areas (Moffatt & Nichol, 2020). Gaps in ECDs would be created after construction to increase connectivity into the MCAs.

These flow ways would restore tidal, salinity, and nutrient exchange in the marshes and, in turn, re-establish intertidal habitat for fish and wildlife. Construction and operation of Alternative 1 would result in long-term benefits to local hydrology within the Barataria Basin. Short-term moderate to major adverse impacts to hydrology would result from the temporary partial removal of the Bayou Dupont rock weir and access dredging The Pen and Bayou Dupont. The weir would be rebuilt, and the access dredging areas would be filled back in at the end of construction.

Changes to marsh hydrology would be permanent. Short-term moderate to major adverse impacts are expected during construction activities due to fill placement and ECD construction. However, these changes are consistent with the goals and objectives of the restoration efforts and would support the development of marsh habitat. Sediment would be contained in MCAs by ECDs to reduce the potential for runoff from the project area. The proposed fill substrates would have a high sand content, resulting in greater permeability and water holding capacity. The natural establishment of vegetation would stabilize soils and reduce soil loss. Overall benefits to hydrology are anticipated due to re-establishment of marsh connectivity by constructing flow pathways, gapping the containment dikes and constructing and reconnecting the 85-acre tidal pond to support the exchange of sediments and nutrients and improve habitat for fish and wildlife in the project area. However, hydrology may not be stabilized due to settlement until well after construction has been completed (NAS, 1992).

No impacts to hydrology in the Mississippi River as a result of activities in the borrow areas are anticipated.

Alternatives 2 and 3. The effects of these alternatives on hydrology are similar to those for Alternative 1 but would create less (Alternative 2) or more (Alternative 3) marsh platform and containment dikes (TABLE 3-2). Alternative 2 would result in less marsh creation and therefore fewer adverse impacts to hydrology in the project area. The longer time required for construction under Alternative 3 would delay implementation of the marsh creation and additional delays may result if an adequate sediment volume does not become available in the time anticipated. Further delays would impact the availability of sediment for this and other marsh creation projects in the basin, such as the proposed MBSD project.

No Action Alternative. Under the No Action Alternative, the proposed placement of fill material would not occur, and the hydrology of the proposed project area would remain the same or shift to more open water. There would be no short-term adverse impacts compared to the Alternatives 1 through 3 because no restoration and construction activities with potential for water quality impacts (fill placement, breakwater installation, and use of equipment) would occur. However, under the No Action Alternative, local subsidence and sea level rise would continue, which would result in continued long-term, adverse impacts to hydrology in the proposed project area and in the adjacent waters unless other restoration projects were undertaken. Under the No Action Alternative, there would be long-term adverse impacts to water current patterns and water levels due to loss of marsh habitat and connectivity to Bayou Dupont would remain through shallow openings.

4.4.1.5. Water Quality - Affected Environment

Water quality in Louisiana surface waters is regulated by the LDEQ through Clean Water Act (CWA) authority (40 CFR) delegated by USEPA. Louisiana surface waters are classified based on their potential uses and minimum water quality standards have been established by LDEQ for each designated use. The seven designated uses in Louisiana include agriculture, drinking water supply, fish and wildlife propagation, outstanding natural resource waters, oyster propagation, primary contact recreation, and secondary contact recreation. The Mississippi River is designated for primary recreation, secondary recreation, fish and wildlife propagation, and drinking water supply. The proposed project area is in the Bayou Barataria and Barataria Waterway (estuarine) subsegment (Number 020802) of Louisiana. This subsegment is designated for the following uses: primary contact recreation, secondary contact recreation, and fish and wildlife propagation (TABLE 4-1). Water quality in the Mississippi River, Barataria Basin, and Barataria Waterway within and adjacent to the project area is considered good and water quality standards are being met (LDEQ, 2013; USEPA, 2018). The Barataria Basin has seasonal occurrences of low dissolved oxygen (DO) due to natural conditions (LDEQ, 2013).

TABLE 4-1. Water quality in the project area (LDEQ, 2019).

Water Body Subsegment	Water Body Name	Primary Contact Recreation	Secondary Contact Recreation	Fish and Wildlife Propagation
LA020802	Bayou Barataria and Barataria Waterway (estuarine)	Fully supporting	Fully supporting	Fully supporting

Louisiana's Water Quality Regulations (LAC 33: Chapter IX) require permits for the discharge of pollutants from any point source into waters of the State, which is administered under the Louisiana Pollutant Discharge Elimination System (LPDES) program. The LPDES program regulates stormwater discharges from construction sites greater than five acres in size (LDEQ, 2019). The nearest permitted discharges are from the Conoco-Phillips Alliance refinery at Belle Chasse., which discharges stormwater, treated process water, treated effluent, and cooling water (USEPA, 2018). Stormwater runoff from sugarcane farm fields is a major source of sediment and nutrient pollution in the upper Barataria Basin and stormwater drainage of farm fields surrounding the perimeter of the basin result in downstream sediment and nutrient pollution (Lane & DeLaune, 2015).

Water quality is an important attribute of estuaries that encompasses water characteristics including salinity, turbidity, dissolved oxygen (DO), chlorophyll a, and nutrients (total nitrogen, total phosphorus and silicate). These parameters inform understanding of the ecosystem status of pelagic and benthic communities, estuarine and marine wildlife, and soil properties of adjacent wetlands (Hijuelos & Hemmerling, 2015).

Salinity varies seasonally and decreases landward from the coast and is highest from October through November and lowest in February and March. Coastwide Reference Monitoring System (CRMS) (water quality data for the Barataria Basin (https://lacoast.gov/chart/Charting.aspx?laf=crms&tab=2) indicate salinities ranged from 0.12 to 8.70 parts per thousand (ppt) (fresh water) and from 0.17 to 26.3 ppt (brackish water) from 2008-2019 (TABLE 4-2). CRMS0248 is hydrologically connected to the MCAs.

TABLE 4-2. Salinity data from monitoring stations proximate to the proposed project area.

Station	Salinities (ppt) from CRMS Viewer (CPRA, 2019)		
	Range (2008-2019)	Long term Mean	2018 Growing Season Mean
CRMS4103	0.12 – 8.70	1.73	1.60
CRMS0248	0.17-26.30	3.63	3.44

A study of the effects of the Naomi Siphon in and near the proposed project area referenced salinities in the 0.5 – 2.5 ppt) range (Moffatt & Nichol 2019). The higher salinities occurred during periods of no discharge from the siphon, while salinities on the lower end of the range tended to occur during discharge. Deeper waterways such as Bayou Dupont had higher salinities and are conduits for saltwater into and out of the basin in general. Turbidity typically ranged from 14 to 20 Nephelometric Turbidity Units (NTU), with higher turbidities during rising tides and rainfall events (McGraw, 2005). Water quality in the Barataria Basin and for the borrow areas were reported in greater detail in the LDSP SED and the Bayou Dupont Sediment Report (CH2MHILL, 2011; GEC, 2009).

4.4.1.6. Water Quality - Environmental Consequences

Alternative 1 (Preferred). Long-term benefits to water quality are anticipated as a result of Alternative 1. The creation of large areas of marsh would result in corresponding large areas of sediments on which physical, chemical, and biological processes for improving water quality would occur, while the exchange of water in and out of the marshes influences water quality via nutrient exchange (Carter, 1986; Gosselink & Turner, 1978). Larger wetlands have a greater capacity to assimilate water quality constituents; however, the greater edge provided by the interconnectivity of flow ways in the marshes is more important to water quality than area of the marsh (NAS, 2001). Alternative 1 would improve hydrologic connectivity between the created marshes and the larger basin, which is important for salinity, nutrient, and sediment exchange, as well as determining the extent of chemical and physical interactions (Gelwick et al., 2001).

Short-term, minor, adverse impacts to water quality in and near the proposed project area are expected during construction and restoration activities. Minor changes in DO, nutrients, salinity, turbidity, and suspended solids levels could occur due to mixing and the release of sediments into the water column during dredging and during placement for marsh restoration and ECD construction. Decreases in salinity would occur as a result of the introduction of fresh water during placement for restoration. Any impacts would be expected to be restricted to the immediate vicinity of dredging activities. Local erosion and sediment runoff are expected during fill material placement in the MCAs and ECDs, sediment transport activities along the access corridor, and during sediment excavation at the borrow areas. Dredging activities in the Mississippi River, the placement of dredged material in the MCAs, and the construction of containment dikes (from in-situ material) would increase turbidity as bottom sediments are disturbed. However, the increased turbidity would be limited to periods of active dredging and is expected to dissipate rapidly upon completion of construction. Turbidities may increase after rainfall events as water runs off the unvegetated marsh platform, especially immediately after dredged material deposition. Temperature profiles would be affected as a result of water column mixing during dredging but would return to previous conditions following completion of dredging. For example, increased water depth (i.e., flood flow) due to hydrologic connection can decrease water temperature and waters with cooler temperature may have higher dissolved oxygen concentrations (Alvarez-Borrego & Alvarez-Borrego, 1982; Kang & King, 2013). However, in a study of connected and not connected ponds in coastal marshes of Louisiana, no temperature differences were found (Kang & King, 2013).

Increased marsh elevation, combined with freshwater inflows and rainfall, will decrease marsh salinities in the created marshes, while tidal channels will maintain the exchange of nutrients and sediments throughout the marshes. Concentrations of nutrients could increase locally for short periods following marsh restoration. However, nutrients would be taken up by biota and dispersed by the water. Any impacts would be temporary and minor. The use of barges, other vehicles, and equipment during implementation and monitoring could also result in short-term, minor, adverse impacts to water quality due to potential fuel leaks or vehicle fluid leaks.

Water quality samples from borrow areas indicated freshwater conditions with corresponding low conductivity values (TABLE 4-3). Salinity, temperature, pH, and conductivity at the borrow areas were similar to a reference fill site near the proposed MCAs.

TABLE 4-3. Field observations and in situ water quality data from borrow areas (2008) (GEC, 2009).

Site	Temperature °C	Salinity (ppt)	Dissolved Oxygen (mg/L)	pH	NTU	Conductivity (µs/cm)	Depth (feet)
Borrow area Center	25.9	0.001	4.36	7.43	55	0.293	44
Reference	25.9	0.001	7.09	7.48	107	0.295	42
Fill 1	28.5	0.056	9.78	7.98	126	10.4	2.5
Fill 2	28.2	0.085	7.89	7.68	88.9	14.7	3.4

All requirements of the USACE 404 permit and LDEQ's 401 Water Quality certification for the proposed project would be followed to protect water quality. An LPDES stormwater general permit would be obtained and a stormwater pollution prevention plan would be developed for the project. The construction BMPs, in addition to other avoidance and mitigation measures as required by state and federal regulatory agencies, would minimize water quality and hydrology impacts.

BMPs would be adhered to during construction and restoration activities to minimize water quality impacts. Clearing and grubbing along existing pipeline access corridor would result in temporary increases in stormwater runoff. Runoff from unvegetated upland portions of the corridor would result in increased turbidity and suspended solids in adjacent water bodies. BMPs and standards would be followed to prevent or limit potential impacts. These include the implementation of erosion and turbidity controls. BMPs used could include:

- Temporary sediment barriers;
- Entrance/exit controls;
- Silt fencing;
- Berms;
- Stabilization techniques such as mulching;
- Timing activities to coincide with dry weather; and/or
- Use of good housekeeping practices.

Alternatives 2 and 3. Long-term benefits to water quality are anticipated for all three alternatives as a result of the created marsh and subsequent increase in substrate over which water-soil interactions that improve water quality may occur. Greater marsh area and connectivity would increase tidal exchange, while higher marsh elevations are expected to result in lower salinities, resulting in long-term benefits to freshwater and intermediate marshes, and result in greater capacity overall for nutrient uptake. Adverse impacts to water quality under these alternatives would be limited to construction activities and vary due to the scale of the marsh area being created and the timeframe over which construction occurs, as described earlier (Section 4.3). Because the construction period duration is longer and there is a second construction mobilization, Alternative 3 would result in disturbance of soils and water over a longer period of time and would therefore result in a longer period of short-term, minor, adverse impacts when compared with Alternative 1 and Alternative 2. Alternatives 1 and 2 would have similar adverse impacts (i.e., short-term, minor, and temporary primarily due to sediment disturbance, burial, and displacement). Benefits to resources from created marsh area would differ between Alternatives 1 and 2 due to small differences in the area of marsh created.

No Action Alternative. Under the No Action Alternative, the proposed placement of fill material would not occur, and the water quality of the project area would continue to shift towards a higher salinity system as marsh elevations continue to decline and marshes continue to deteriorate. There would be no short-term adverse impacts compared to Alternatives 1 through 3 because no restoration and construction activities with potential for water quality impacts (dredging, fill placement, ECD construction, and use of equipment) would occur. However, under the No Action Alternative, local subsidence and sea level rise would continue, which would result in continued long-term, adverse impacts to water quality due to increased salinities and reduced sediment available for sediment-nutrient interactions. Under the No Action Alternative, long-term adverse impacts to water quality would continue due to continued loss of marsh habitat.

4.4.2. Biological Environment

Resources addressed in this section are habitats, wildlife, protected species, marine and estuarine aquatic fauna, EFH, and managed fish species.

4.4.2.1. Habitats – Affected Environment

Habitats in the proposed project area are part of the larger Barataria Basin wetland system, characterized by bottomland hardwood forests, freshwater swamps, and coastal marshes (Conner & Day, 1987; Couvillion, 2011; Nelson et al., 2002). As described in the Final PDARP/PEIS, these wetlands provide habitat for the largest concentration of over-wintering waterfowl in the U.S. as well as habitat for wildlife, finfish, shellfish, and other aquatic organisms, including threatened or endangered species and support the largest commercial fishery in the contiguous U.S., by volume (NOAA, 2017). Wetlands improve water quality by removing organic and inorganic toxic materials, suspended sediments, and nutrients via soil processes and assimilation by plants. Primary productivity, decomposition, and other chemical processes contribute to the removal of certain chemicals from the water (Mitsch & Gosselink, 2000). Wetlands provide a level of flood control via attenuation of waves and storm surges by vegetation, and communities sheltered by wetlands may sustain less damage from storm surges (Day et al., 2007).

The proposed project area is characterized by open water, a small amount of SAV, low elevation emergent marshes, ponds, and navigation channels. The emergent marshes are generally near sea level, with maximum ground elevations rarely exceeding 2 feet above sea level. These emergent marshes are classified as intermediate and brackish marshes (Sasser et al., 2014). The CRMS vegetation monitoring station just south of, and closest to, the project area is characterized by both intermediate and brackish marsh species and reflects the range of salinities in the project area described previously (TABLE 4-2). The intermediate marshes in the Barataria Basin in general are diverse plant communities and have an irregular tidal regime and variable salinity conditions (Holcomb et al., 2015). Dominant vegetation in intermediate marshes typically consists of narrow-leaved, persistent species that can tolerate salinity fluctuations in particular, *Spartina patens* and *Sp. Alterniflora* (Lester et al., 2005). The brackish marshes are more saline and undergo regular tidal flooding and are dominated by salt-tolerant grasses. Plant diversity and soil organic matter content are relatively low in saline marshes when compared with freshwater and intermediate marshes (Holcomb et al., 2015).

Intermediate and brackish tidal marshes provide important nesting, brood-rearing, and foraging habitat for various bird species, including migratory birds and colonial nesting birds. Emergent marshes are also important nursery habitats for larval fish, crustaceans, and aquatic invertebrates. Benthic and epiphytic algae are also important producers in emergent marsh habitats (Holcomb et al., 2015; Lester et al., 2005). Open water habitats also occur within the proposed project area. Water depths in these systems are generally less than 3 feet, with maximum depths of around 10 feet in some channels (CPRA, 2018).

Intermediate marsh occurs in areas where salinity ranges from 0.5 to 5 ppt, between brackish marsh and freshwater marsh (LDWF, 2009; Steyer et al., 2010). Intermediate marsh occurs in areas where salinity ranges from 0.5 to 5 ppt, between brackish marsh and freshwater marsh (LDWF, 2009; Steyer et al., 2010). Intermediate marsh undergoes an irregular tidal regime and small pools and ponds are interspersed across the landscape. Historically, intermediate marsh in eastern Louisiana was dominated by narrow-leaved, persistent species. Intermediate marsh vegetation is a diverse assemblage of species, including species that occur in brackish marshes and species that occur in fresh marshes. Dominant vegetation frequently consists of marshhay cordgrass (*Spartina patens*). Other common species include Roseau cane (*Phragmites australis*), bulltongue (*Sagittaria lancifolia*), coastal water hyssop (*Bacopa monnieri*), spikesedges (*Eleocharis spp.*), three-cornered grass (*Scirpus olneyi*), giant bulrush (*Scirpus californicus*), common threesquare (*Scirpus americanus*), deer pea (*Vigna luteola*), seashore paspalum (*Paspalum vaginatum*), switch grass (*Panicum virgatum*), bearded sprangletop (*Leptochloa fascicularis*), camphor-weed (*Pluchea camphorata*), water millet (*Echinochloa walteri*), fragrant flatsedge (*Cyperus odoratus*), alligator weed (*Alternanthera philoxeroides*), southern naiad (*Najas guadalupensis*), big cordgrass (*Spartina cynosuroides*), and gulf cordgrass (*Spartina spartinae*) (LDWF, 2009).

Brackish marsh occurs in mesohaline areas where salinity ranges from 5 to 15 ppt. Brackish marsh typically is located between intermediate marsh and salt marsh (LDWF, 2009; Steyer et al., 2010). Brackish marsh is irregularly flooded by tides and is dominated by salt-tolerant grasses and grass-like plants. Small pools or ponds are interspersed across the landscape. Plant diversity is typically lower than in intermediate marsh and is typically dominated by marshhay cordgrass and salt grass (*Distichlis spicata*). Other common plant species include camphor-weed, three-cornered grass, salt marsh bulrush (*Scirpus robustus*), dwarf spikesedge (*Eleocharis parvula*), widgeon grass (*Ruppia maritima*), seashore paspalum, black rush (*Juncus roemerianus*), coastal water hyssop, smooth cordgrass (*Spartina alterniflora*), and big cordgrass (LDWF, 2009). Percent cover of marsh species occurring at CRMS0248 monitoring station (2017 and 2018 data averaged) is graphed in and reflects brackish conditions described here (FIGURE 4-1).

Several events have impacted the Barataria Basin since the late 1990s and affected vegetation species and distributions. There was an extreme drought in 1999 and 2000, Hurricanes Rita and Katrina in 2005, another drought from late 2005 through 2006, and hurricanes Nate and Barry in 2017 and 2019, respectively (Steyer et al., 2010). Disturbance events such as these, combined with sea level rise, subsidence, and other factors, contribute to the decline of low salinity intermediate marshes and the expansion of more saline brackish marshes. In eastern Louisiana, substantial amounts of intermediate marsh have converted to open water following the disturbance of Hurricane Katrina (Steyer et al., 2010). In other parts of eastern Louisiana, freshwater marsh is expanding onto areas previously occupied by intermediate marsh. This change likely is a result of multiple factors, including natural community change and the influence of the Caernarvon Freshwater Diversion Project (Steyer et al., 2010).

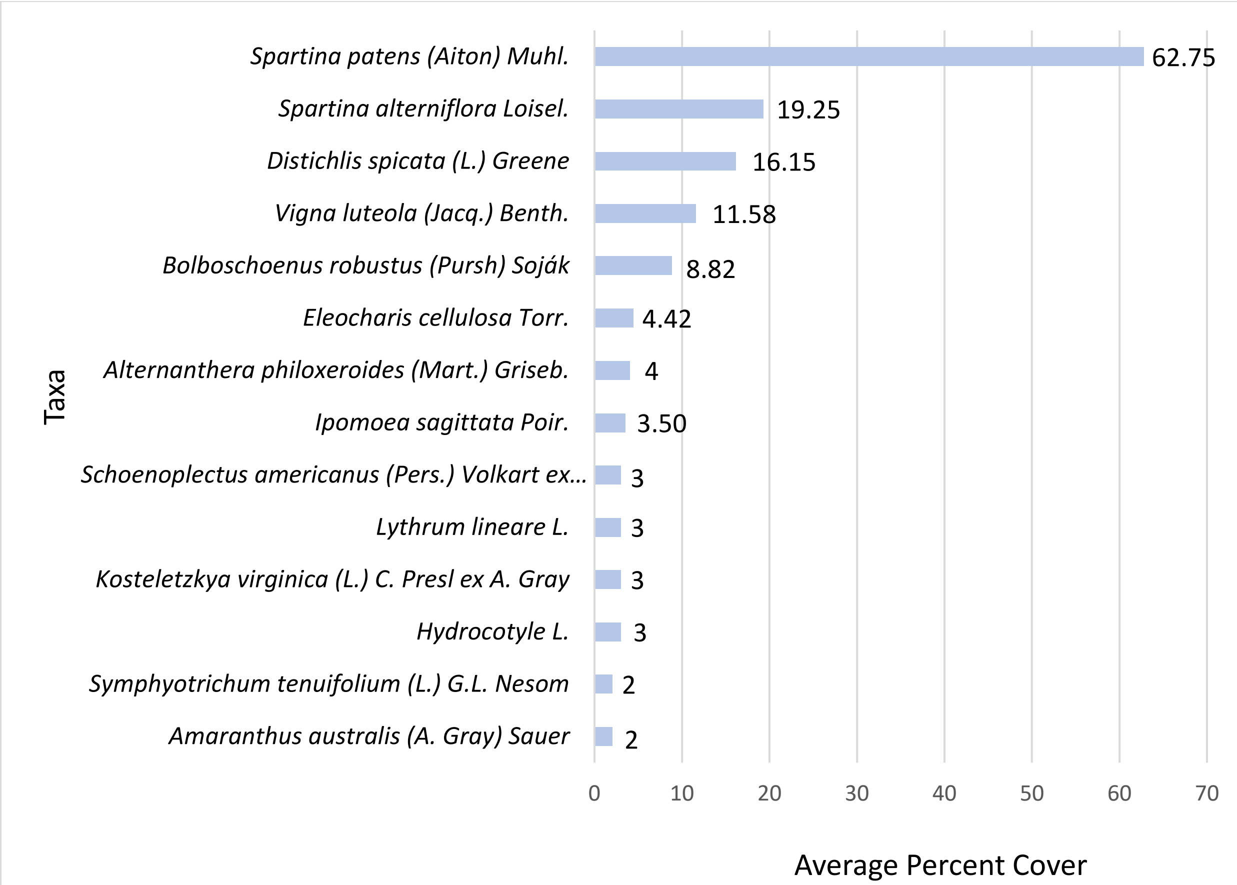

FIGURE 4-1. Average percent cover of all plant species at CRMS0248 sampling station (2017 and 2018 averaged).

Habitat associated with the borrow areas is limited due to the regular excavation that occur in the borrow areas. The Alliance Anchorage and Wills Point borrow areas have not been associated with habitats important to any protected species, as reported in previous BAs (CH2MHILL, 2011; NOAA, 2011; USEPA, 2015).

Water and salinity patterns, nutrients, and sediments influence the quality of available habitat, biological diversity, as well as the establishment and expansion of invasive and exotic species in native habitats (Sklar & Browder, 1998). Aquatic habitats in coastal Louisiana, including the Barataria Basin, are adversely impacted by numerous invasive species and the State of Louisiana has developed a State Management Plan for Aquatic Invasive Species to address this issue (Kravitz et al., 2005). Invasive species such as water hyacinth (*Eichhornia crassipes*), alligator weed (*Alternanthera philoxeroides*), and hydrilla (*Hydrilla verticillata*) are common invasive plants in the project area. Waterferns (common salvinia [*Salvinia minima*] and giant salvinia [*S. molesta*]) and variable-leaf milfoil (*Myriophyllum heterophyllum*) have also become invasive in the region. These species would likely decline as open water is replaced by emergent marsh. Subsequently exposed, unvegetated areas would be colonized by both native and nonnative and invasive species. Invasive emergent species can be a problem because they can outcompete native species and degrade habitat for fish and wildlife that depend on native species. Roseau cane (*Phragmites australis*) is considered a problem throughout most of the Gulf and Atlantic coast of the U.S. and can cause reductions in species biodiversity by replacing many native species, with corresponding reductions in insect, avian and other animal assemblages (Chambers et al., 1999). In coastal Louisiana however, Roseau cane provides ecosystem services such as substrate stabilization and water quality and although invasive, Roseau cane provides critical ecosystem services (Chambers et al., 1999; Howard et al., 2008). The Eurasian subspecies of Roseau cane was found to expand at the expense of the native Roseau cane in a study in the Barataria Basin and appears to be less affected by the nonnative scale insect that appears to be related to the die-off of Roseau cane in coastal Louisiana (Howard et al., 2008; Howard et al., 2019; Knight et al., 2018). However, the value of Roseau cane in marsh stabilization is an important consideration if recolonization by native species is limited or precluded due to high subsidence and relative SLR (Howard et al., 2008). Further, increased dominance by native plants may be desirable as local patches, but widespread loss of Phragmites, even if replaced by native species, could result in additional increases in coastal erosion and wetland loss (Zengel et al., 2018).

Aquatic invasive animals in the Barataria Basin include mollusks (e.g., zebra mussel, Asian clam, apple snail), at least one crustacean species (Asian tiger shrimp), and numerous invasive fish species (e.g., several species of carp) (Holcomb et al., 2015). The State Management Plan for Aquatic Invasive Species in Louisiana identifies several established finfish that may spread via aquatic pathways. Established finfish in the region include Rio Grande cichlid (*Cichlasoma cyanoguttatum*), common carp (*Cyprinus carpio*), grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*), and bighead carp (*Hypophthalmichthys nobilis*). Nutria and feral hogs are the only mammals identified as invasive in Louisiana. Feral hogs are established sporadically throughout the state. Feral hogs also provide some social and economic benefit for local hunters and trappers. The problems caused by feral hogs in Louisiana, however, are small compared with those caused by nutria. Although the fur industry for nutria has declined since the 1980s, the LDWF offers a $6 bounty on each nutria tail. The LDWF Coastwide Nutria Control Program, established in 2002 and funded by CWPPRA, reported 241 active participants turned in 223,155 nutria tails worth $1.1 million for the 2018-2019 season.

4.4.2.2. Habitats – Environmental Consequences

Alternative 1 (Preferred). The proposed project would result in long-term benefits to local and nearby habitats by increasing the quantity and quality of emergent marsh in the proposed project area that has deteriorated dramatically since the 1930s and subsequently replaced by open water and SAV (Couvillion et al., 2017). Under Alternative 1, a marsh platform with suitable elevations would be created and hydrologic connectivity would be restored, resulting in lower salinity, emergent marshes such as those present historically. Recent studies support the expectation that marshes will have vegetation cover consistent with reference sites within 2 to 5 years of the proposed restoration activities. For example, a recent experimental study in Bayou Dupont, immediately a following restoration, found that vegetation cover at not-planted sites was equivalent to that at reference sites after two years (Howard et al. 2019). In addition, two recent analyses of marsh recovery data along the northern Gulf of Mexico quantified recovery of restored marshes with respect to reference marshes (Fricano et al. 2020; Ebbets et al. 2019).

Both indicate that different marsh components (e.g., aboveground biomass, belowground biomass) often have different recovery rates. With respect to a case study of restoration in the Barataria Basin, Fricano et al. (2020) found that the response of vegetation cover was relatively rapid following restoration, reaching equivalence with reference site conditions at around 5 years post restoration completion. Aboveground biomass recovered almost immediately and remained relatively steady for the life of the project, while belowground biomass did not reach equivalence with reference marshes until 17 years post-restoration. A meta-analysis of marsh recovery data by Ebbets et al. (2019) found aboveground biomass at restoration areas was equal to reference marsh values for the first 17 years post-restoration and then declined by year 20. Belowground biomass increased to reference values in years 18-20, while total live cover increased to the same as the reference values in years 5 and 6, followed by a decline through year 20.

Permanent adverse impacts to present open water, SAV, and low elevation emergent marsh would occur due to fill placement over these habitats and replacement by higher elevation marsh habitat. Habitat benefits include connectivity for tidal and nutrient exchange, increased availability of marsh nursery habitat by fisheries, increased availability of marsh substrate for macroinvertebrates such as crabs and snails, reduced erosion of marsh habitats farther up in the basin, and subsequent reductions in long-term susceptibility of habitats to subsidence and sea level rise.

There would also be short-term, minor, adverse impacts to existing marsh, SAV, and open water habitats in the MCAs due to construction activities during fill material placement. The use of boats, construction machinery, and other heavy equipment within and around marshes may result in short-term, minor, adverse impacts to marsh habitats due to localized soil and sediment disturbances and contamination from possible vehicle fuel and fluid leaks. However, these potential adverse impacts would be minimized by vehicle maintenance and spill -plans Short-term, minor, adverse impacts may also result during site preparation and material staging. Some of the tidal areas that are currently shallow tidal waters would be filled with dredged material to create higher elevation marsh habitat. Filling the tidal habitats would constitute a short-term, minor to moderate, adverse impact to those affected tidal habitats.

The primary adverse effects would be the direct and immediate impacts from construction-related sediment excavation and deposition on habitats where non-mobile benthic organisms occur in and around MCAs. Dredging associated with ECD construction would have adverse impacts on habitats within and adjacent to the borrow areas. Short-term, minor, adverse impacts would occur in the aquatic habitats above the benthic zone as there would be temporary local disturbances from dredging equipment and increased vehicle traffic along the access routes. Short-term, moderate, adverse impacts would occur in benthic habitats that are actively dredged or in which conveyance pipelines are installed. BMPs would be implemented to minimize impacts during construction.

The disturbances associated with construction activities and newly constructed (unvegetated) marsh platforms create opportunities for invasive plant species to become established and spread. Invasive species are typically better able to exploit resources than many native species and disturbed areas, e.g., unvegetated marsh platforms, provide opportunities for their establishment (see previous discussion in Section 4.2.2.1 regarding potential adverse impacts and benefits of invasive species). The newly created habitat may be unsuitable for native fish and wildlife species and invasive species may outcompete native species due to the stress imposed by disturbances to sediment, hydrology, and water quality disturbances (McCormick et al., 2010). Native freshwater bivalves are especially vulnerable to disturbance and competition from nonnative species (Williams & Brown, 2014). Exotic species such zebra mussels could become established in the project area and preclude native mussels, but also potentially improving water quality by filtering nutrients. Giant apple snails would reduce aquatic plant cover and subsequent reductions in available habitat for native fish.

Overall, impacts to native habitats due to construction and subsequent increase in invasive plant species are anticipated to be minor to moderate, adverse, and temporary, although permanent changes in species dominance may occur in the project area.

Alternatives 2 and 3. Activities would be the same for Alternatives 2 and 3 as they are for Alternative 1 and the potential impacts would be similar but would vary in scale due to the volume of fill excavated from the borrow areas, the length of the ECDs, and the area of MCAs to be filled (TABLE 3-2). There would be short-term, minor, adverse impacts to existing marsh, SAV, and open water habitats in the MCAs due to construction activities during fill material placement under both alternatives. However, adverse impacts to habitats would be greater for Alternative 3 due to the wait-time for additional sediment volume needed (Section 4.3). The additional sediment requirements also mean a second phase of mobilization and construction, which prolongs the period of construction, compared with 26 and 24 months, respectively for Alternatives 1 and 2.

There would be short-term, minor, adverse impacts associated with construction in and around the restoration areas during fill placement, but these impacts would be greater when compared with Alternatives 1 and 2. There would be permanent loss of aquatic habitats that are filled with dredged material. In the borrow areas, there would be short-term, minor, adverse impacts to aquatic habitats due to vehicle traffic and construction disturbances. There would be short-term, moderate, adverse impacts on benthic habitats in the ECD borrow areas due to dredging. Impacts of invasive species on native habitats would be the same as those described for Alternative 1.

No Action Alternative. Under the No Action Alternative, long term adverse impacts to freshwater and intermediate marsh habitats in the basin are anticipated. The rate of land loss would be expected to continue at approximately 10 square miles/year in the Barataria Basin, with the rate declining as the amount of land decreases (Couvillion et al., 2017). In the absence of a large-scale river sediment diversion and/or other marsh creation projects, the upper basin would also shift from freshwater and intermediate marshes to more saline conditions characterized by brackish and saltmarsh habitats. As sea level rise and subsidence continue, open water would become more prevalent.

Under the No Action Alternative, expansion of invasive species would continue at the present rate without intervention and removal (e.g., herbicide controls). Louisiana's Wildlife Action Plan indicates that "…the rate at which invasive species spread is frequently faster than the rate at which these removal techniques can be implemented" (Holcomb et al., 2015). Under the No Action Alternative, the adverse impacts to existing marsh and aquatic habitats associated with dredging and fill placement would not occur. However, there would be no long-term benefits to the habitats in the proposed project area.

4.4.2.3. Wildlife – Affected Environment

Approximately 735 species of birds, finfish, shellfish, reptiles, amphibians, and mammals spend all or part of their life cycle in the Barataria-Terrebonne estuary complex, in which the proposed project area is located (USACE, 2004b). Although emergent wetlands in the proposed project area and surrounding areas have declined dramatically since the 1930s, open water and SAV habitat remain important to a number of species of wildlife, including waterfowl. Both intermediate and brackish marshes in the proposed project area provide important nesting, brood-rearing, and foraging habitat for various bird species, including migratory birds and colonial nesting birds. Emergent marshes are also important nursery habitats for larval fish, crustaceans, and aquatic invertebrates. Benthic and epiphytic algae are also important producers in emergent marsh habitats (Holcomb et al., 2015; Lester et al., 2005).

The coastal marshes of Louisiana provide winter habitat for more than 50 percent of the duck population of the Mississippi Flyway. Large populations of migratory waterfowl, including gadwall (*Anas strepera*), blue-winged teal (*Anas discours*), green-winged teal (*Anas cercea*), American wigeon (*Anas americana*), lesser scaup (*Aythia affinis*), northern shoveler (*Anas clypeata*), pintail (*Anas acuta*), and mallard (*Anas platyrhynchos*), occur during winter in the region. Mottled duck (*Anas fulvigula*) occur year-round. In addition to their ecological importance, these waterfowl are of economic importance for hunting. Dabbling duck and diving duck numbers have been shown to increase near freshwater diversions, such as in the Caernarvon Diversion (Sibley, 2003; USACE & CPRA, 2010). American coot (*Fulica americana*), common gallinule (*Gallinula chloropus*), rails (*Rallus* spp.), mourning dove (*Zenaida macroura*), and snipe (*Capella gallinag*o) also are important game species.

Shallow open water areas in the proposed project area provide wintering habitat for migratory puddle ducks including gadwall, blue-winged teal, green-winged teal, American widgeon, and northern shoveler. The larger and deep open water areas that have formed due to marsh loss are used by diving ducks such as lesser scaup and ring-necked ducks. Common wading bird species which utilize the project area include the great blue heron, green heron, tricolored heron, great egret, snowy egret, yellow-crowned night-heron, black-crowned night-heron, and white ibis. Mudflats and shallow-water areas provide habitat for numerous species of shorebirds and seabirds. Shorebirds include the American avocet, willet, black-necked stilt, dowitchers, and various species of sandpipers. Seabirds include the white pelican, herring gull, laughing gull, and several species of terns.

The Barataria-Terrebonne estuary complex, which includes the proposed project area, is important for a wide range of resident and migratory birds. An estimated 353 species of birds have occurred in the region, 185 of which are annual migrants (USACE, 2004a). Non-game bird species in the region include anhinga (*Anhinga anhi*nga), egrets and herons (*Ardea* spp. and *Egretta* spp.), ibises (*Eudocimus albus* and *Plegadis* spp.), sandpipers (*Bartramia longicauda* and *Calidris* spp.), willet (*Catoptophorus semipalmatus*), black-necked stilt (*Himantopus mexicana*), gulls (*Laru*s spp.), terns (*Sterna* spp.), black skimmer (*Rhynchops niger*), grebes (*Podiceps* spp.), common loon (*Gavia immer*), double-crested cormorant (*Phalacrocorax auritus*), and white and brown pelicans (*Pelicanus erythrorhynchos* and *P. occidentalis*). Various raptors such as barred owl (*Strix varia*), red-shouldered hawk (*Buteo lineatus*), northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), and red-tailed hawk (*Buteo jamaicensis*) occur in southern Louisiana. Many of these birds occur in the region only during spring and fall migrations (USACE & CPRA, 2010). Migratory and resident non-game birds, such as the boat-tailed grackle, red-winged blackbird, seaside sparrow, northern harrier, osprey, belted kingfisher, and marsh wrens, also utilize the project area. Important gamebirds found in the area include the clapper rail, sora rail, Virginia rail, American coot, common moorhen, and common snipe in addition to resident and migratory waterfowl.

Mammals found in the proposed project area include nutria, muskrat, mink, river otter, and raccoon, all of which are commercially important furbearers. Reptiles and amphibians are fairly common in the low-salinity brackish and intermediate marshes that occur in the project area. Reptiles include the American alligator, western cottonmouth, water snakes, speckled kingsnake, rat snake, and eastern mud turtle. Amphibians expected to occur in the area include the bullfrog, southern leopard frog, and Gulf coast toad. Marsh habitats also provide refuge for state and federally designated at-risk species such as the diamondback terrapin, black rail, reddish egret, brown pelican and the Louisiana eyed silkmoth.

Species of Conservation Concern. Habitats within the Barataria Basin support many species of conservation concern in Louisiana. The brackish marsh community is known to support 36 species of conservation concern, including 30 bird species, five butterfly species, and one reptile species (Lester et al., 2005). The intermediate marsh community is known to support 31 species of conservation concern, including 26 bird species and five butterfly species (Lester et al., 2005). Agricultural land within the MRAP ecoregion is known to support 30 species of conservation concern, including 24 bird species, one butterfly species, one amphibian species, and four mammal species (Lester et al., 2005).

4.4.2.4. Wildlife – Environmental Consequences

Alternative 1 (Preferred). Long term benefits to wildlife in the proposed project area and surrounding areas are anticipated as a result of Alternative 1 due to increases in acres of emergent marsh habitat (TABLE 3-1). Alternative A would result in long-term benefits to bird species in the proposed project area and the Louisiana Restoration Area. These benefits would result from the restoration of approximately 1,163 acres of emergent marsh habitat important for the feeding, nesting, and roosting needs of migratory and nonmigratory bird species. The created marsh habitat would also benefit mammals, reptiles, and amphibians that rely on wetlands for all or part of their life cycle.

While SAV and open water habitat in the proposed project area will decrease, these habitats will remain and/or expand in the basin due to the previous loss of emergent marshes. An 85-acre tidal pond is included in MCA-1 (to reduce the need for additional fill) and would continue to provide open water habitat for ducks and other birds that use open water. Activities under Alternative 1 would temporarily displace birds and other wildlife during construction. Birds would need to find other areas to forage, loaf, and breed during this time. However, these impacts would be short-term, and suitable habitats are available outside the proposed project area. Following the restoration, birds are expected to return. Impacts to nesting, foraging, and overwintering habitats resulting from construction would be short-term, moderate, and adverse. BMPs would be implemented to minimize impacts to wildlife. Long term benefits would include increased emergent marsh and corresponding wildlife habitat that has been dramatically reduced over the past decades as a result of both natural and anthropogenic causes.

Alternatives 2 and 3. Benefits and adverse impacts under these alternatives would be similar to Alternative 1 but would vary in scale, ranging from approximately 301 fewer acres of emergent marsh created under Alternative 2, to more marsh created under Alternative 3 (approximately 313 acres) (TABLE 3-2). Impacts to nesting, foraging, and overwintering habitats resulting from construction would be short-term, moderate, and adverse for both alternatives. However, as described previously in Section 4.3.2.2 (Habitats - Environmental Consequences), construction activities would be prolonged under Alternative 3, resulting in greater duration of adverse impacts under Alternative 3.

No Action Alternative. Under the No Action Alternative, there would be no direct impacts to wildlife. There would be long-term, adverse impacts to wildlife populations as marsh habitats continue to deteriorate throughout the project area and eventually are replaced by open water, which would no longer support marsh-dependent wildlife.

4.4.2.5. Protected Species – Affected Environment

Endangered Species Act. Section 7 of the ESA requires that activities authorized by federal agencies consider potential impacts to threatened or endangered species and their critical habitat. To comply with the ESA, consultation with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) is required. A list of federally threatened and endangered species and other protected species with the potential to occur within the project areas was developed based on information from the USFWS and the NMFS.

Protected species with potential to occur in the proposed project areas include West Indian manatee (*Trichechus manatus*), pallid sturgeon (*Scaphirhynchus albus*), Kemp's ridley sea turtle (*Lepidochelys kempii*), loggerhead sea turtle (*Caretta caretta*), and bottlenose dolphin (*Tursiops truncatus*).

The USFWS Biological Opinion/Conference Opinion (BO/CO) evaluated effects of actions taken under the Final PDARP/PEIS to 115 listed, proposed, or candidate species, and on 39 designated or proposed critical habitats. The BO/CO concluded that "Although these actions may result in short-term adverse effects to the resources, long-term direct and indirect benefits to species and habitats are anticipated" (USFWS, 2016). The BO/CO provides descriptions and potential impacts of the 115 evaluated species, including the West Indian manatee and pallid sturgeon (summarized below). NMFS also prepared a Framework Programmatic BO (NMFS, 2016) for species under their jurisdiction such as sea turtles, to address potential impacts of restoration activities proposed under the Final PDARP/PEIS Information presented in this section is consistent with the findings presented in these previously approved BOs.

- **West Indian Manatee.** The West Indian manatee is a large aquatic mammal occurring from Florida, throughout the nearshore Gulf of Mexico, and in the Caribbean Sea. The West Indian manatee is herbivorous and consumes native aquatic plants such as eelgrasses (*Zostera* spp. and *Vallisneria* spp.) and non-native species, such as water hyacinth and hydrilla. The West Indian manatee inhabits a variety of warm marine, brackish, and freshwater environments but prefers large, slow-moving rivers, river mouths, and shallow coastal areas such as coves and bays. The greatest threats to manatee survival are collisions with boats and loss of warm water habitats (USFWS, 2008). In Louisiana, manatees are known to occur in Plaquemines, Jefferson, and Lafourche Parishes, and could reach the proposed project area.

- **Pallid Sturgeon.** The pallid sturgeon is one of the largest fish in the Mississippi and Missouri River drainages (USEPA, 2007). The largest individuals, which reached a maximum weight of 86 pounds, were historically collected in the upper Missouri River. Mississippi River fish typically have maximum weights of 46 pounds. The pallid sturgeon is carnivorous, typically consuming aquatic insects and fish. The pallid sturgeon requires a large, turbid, riverine habitat and prefers the main channel areas of the Mississippi River. Anthropogenic modifications to the riverine system, including channelization and impoundments, are the primary threat to the pallid sturgeon. In Louisiana, the sturgeon is known or believed to occur in Plaquemines, Jefferson, and Lafourche Parishes and could occur in the proposed project area.
- **Sea Turtles**. Loggerhead, Kemp's ridley, and green sea turtles occur in Louisiana. Green sea turtles may be in the borrow area while migrating between their nesting and foraging sites in Florida and Texas. Major threats to sea turtles in the U.S. include destruction and alteration of nesting and foraging habitats; incidental capture in commercial and recreational fisheries; marine debris; and vessel strikes. They feed on phytoplankton, zooplankton, SAV, and small fish. Kemp's ridley nest in Mexico and immature individuals are believed to stay in shallow, warm, nearshore waters in the northern Gulf of Mexico. They forage for crabs, mollusks, shrimp, and small fish. Loggerhead sea turtles occur in coastal and marine areas along the margins of the Atlantic, Pacific, and Indian Oceans. Their major threats are direct take, incidental capture in fisheries, and loss of habitat. The loggerhead turtle is the most abundant species of U.S. sea turtles and have a complex life history that is highly migratory. No sea turtle nesting is known to occur in the vicinity of the proposed project area.

Marine Mammal Protection Act. All marine mammals are protected under the MMPA of 1972. The MMPA established a national policy to prevent marine mammal species and population stocks from declining beyond the point where they ceased to be significant functioning elements of the ecosystems of which they are a part. Threats to marine mammals include fisheries interactions, anthropogenic noise, vessel interactions, contaminants and pollutants, disease, marine debris, research, predation and natural mortality, competition for resources, loss of prey base, climate change, ecosystem change, and activities associated with oil and gas exploration and extraction. Both bottlenose dolphins and manatees protected under the MMPA may be in the proposed project area.

Bottlenose dolphins are the most common dolphin species along the Atlantic and Gulf coasts in the U.S. and comprise a population distinguishable from others in the Gulf of Mexico. They eat fish and the soft parts of shellfish such as shrimp, squid, mollusks, and cuttlefish. Bottlenose dolphins are vulnerable to stressors such as disease, biotoxin, pollution, habitat alteration, vessel collisions, human harassment, interactions with commercial and recreational fishing, energy exploration and oil spills, and other types of human disturbance (such as underwater noise). An estimated 35 percent of bottlenose dolphins in Barataria Bay were killed as a result of the oil spill, and 46 percent of female dolphins suffered from reproductive failure (DWH Trustees, 2016). Current evidence suggests that the Deepwater Horizon oil spill is a contributor to the largest and longest lasting dolphin die-off on record in the Gulf of Mexico (Baran et al., 2014).

Manatees are described above in the ESA section, since they are protected under both the ESA and MMPA. Bottlenose dolphins are only protected under the MMPA.

4.4.2.6. Protected Species – Environmental Consequences

Alternative 1 (Preferred). If West Indian manatees, bottlenose dolphins, sturgeon, or sea turtles are present, best management practices (BMPs) would be implemented to avoid potential direct impacts. The marsh habitat is not suitable for bald eagle nesting. Potential adverse impacts to the West Indian manatee and pallid sturgeon were evaluated for similar activities for the SED LDSP and Bayou Dupont and found “likely to affect, but not likely to adversely affect” (CH_2MHILL, 2011; USEPA, 2015). Permit conditions relevant to these two species are provided in Department of the Army Permit No. 2009-1353-EFF. Any impacts associated with displacement of the West Indian manatee during project construction would be minimal due to the extent of similar habitat outside the project area. Displaced West Indian manatee would likely move to other areas with more suitable habitat.

In accordance with the ESA, the NOAA Restoration Center, on behalf of the Louisiana TIG, requested concurrence from NMFS with the determination of “not likely to adversely affect” for sea turtles. For any in-water work, the alternatives would implement measures from the NMFS’s *Measures for Reducing Entrapment Risk to Protected Species* (2012), *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008), and USACE’s *Standard Manatee Conditions for In-water Work* (2011).

In accordance with the ESA, the Department of Interior, on behalf of the Louisiana TIG, requested concurrence from USFWS with the determination of “not likely to adversely affect” for manatees and pallid sturgeon. Construction BMPs and other avoidance and mitigation measures, as required by state and federal regulatory agencies, would minimize water quality impacts that could affect the aquatic habitat. To ensure no adverse effects, construction guidelines including manatee and pallid sturgeon protection measures will be placed within the project plans and specifications.

Potential effects to manatees and bottlenose dolphins under the MMPA were also reviewed by NMFS and USFWS. Under the MMPA, management of manatees is the responsibility of the USFWS, while NMFS is responsible for the management of bottlenose dolphins. The protection measures listed above (i.e., NMFS’s *Measures for Reducing Entrapment Risk to Protected Species* (2012), *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008), and USACE’s *Standard Manatee Conditions for In-water Work* (2011)) for in-water work would also minimize the potential for impacts to bottlenose dolphins and no adverse effects are anticipated. Sea turtles and sturgeon are under NMFS jurisdiction in the marine environment but do not occur in the proposed project area.

Any avoidance or conservation measures recommended would be evaluated and incorporated into the final design. Technical assistance with agencies has been completed for the preferred alternative. Any required consultations will be completed prior to project implementation. For federal compliance status updates, please see TABLE 5-1 in Section 5 of this Final RP/EA #3.3.

Alternatives 2 and 3. Benefits and adverse impacts under these alternatives would be similar to Alternative 1 but would vary in scale, ranging from fewer acres of emergent marsh created under Alternative 2, to more marsh created under Alternative 3 (TABLE 3-2). However, as described previously in Section 4.3.2.2 (Habitats - Environmental Consequences), construction activities would be prolonged under Alternative 3, resulting in greater duration of any potential adverse impacts under Alternative 3.

No Action Alternative. Under the No Action Alternative, there would be no direct impacts to listed species. There would be long-term, adverse impacts to these species as marsh habitats continue to deteriorate throughout the proposed project area and eventually are replaced by open water, which would no longer provide habitat for some species and would no longer support habitat for prey items for others.

4.4.2.7. Marine and Estuarine Aquatic Fauna, EFH, and Managed Fish Species – Affected Environment

Fauna described here include key shellfish populations (shrimp, crabs, and oysters) and fish in the Barataria Basin, although some of these species also can inhabit inland freshwater lakes and bayous or the nearby coastal and shelf waters of the northern Gulf of Mexico at different times during the year. Freshwater, estuarine, and marine waters and vegetation are used during different life stages by these species, making impacts to any of these habitats relevant to the species.

Fauna of the Barataria Basin are important for two main reasons: (1) they support valuable fisheries; and (2) they serve important ecological roles in the estuarine food web by transferring primary production up the estuarine food web and to coastal fish predators, marine mammals, sea turtles, and seabirds in the northern Gulf of Mexico. Estuarine fishery species consist of resident fishes that inhabit the estuary through their entire life cycle and transient fishes that utilize the estuary for only a portion of their life cycle. Killifishes (*Fundulus* spp.) are common resident species, and the gulf menhaden (*Brevoortia patronus*) is a common transient species in the Barataria-Terrebonne estuary complex. Several marine species typically inhabit the lower edge of the estuary where salinity levels are high, and prey is abundant.

Common marine species in the lower estuary include the speckled trout (*Cynoscion nebulosus*), red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), sheepshead (*Archosargus probatocephalus*), sand seatrout (*Cynoscion arenarius*), Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurusc*), southern flounder (*Paralichthys lethostigma*), and gulf menhaden. Spotted seatrout, red drum, black drum, and southern flounder are economically important species for both commercial harvest and recreational harvest (USACE & CPRA, 2010). Many of these species are important prey for other federally managed species such as mackerels, groupers, snappers, billfishes, and sharks. Consequently, the productivity of the estuarine ecosystem helps to support commercially and ecologically important offshore food webs.

The proposed project area is identified as EFH by the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The 1996 amendments to the MSA set forth a new mandate for NOAA's NMFS, regional fishery management councils, and other federal agencies to identify and protect important marine and anadromous fish habitat. The MSA of 1978 promotes the protection, conservation, and enhancement of EFH. The EFH designation aids in the development of sustainable fisheries by protecting marine fish habitats. The MSA defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity." Detailed information on federally managed fisheries and their EFH is provided in the 1999 generic amendment of the Fishery Management Plans (FMPs) for the Gulf of Mexico prepared by the Gulf of Mexico fishery management council. NMFS administers EFH regulations.

The proposed project area includes EFH for shrimp and red drum fisheries, reef fish, and coastal migratory pelagic species, but occurs along the edges of EFH for these species. Federally managed species with EFH in the proposed project area include juvenile white shrimp; post-larval and juvenile brown shrimp; and larval, post-larval, juvenile, and adult red drum (TABLE 4-4).

TABLE 4-4. EFH for managed species in or proximate to the proposed project area.

Species	Life Stage	Habitat	EFH
Brown Shrimp	Juvenile	Estuarine	<18 m; planktonic, sand/shell/soft bottom, SAV, emergent marsh, oyster reef
White Shrimp	Juvenile	Estuarine	<30 m; SAV, soft bottom, emergent marsh
Red Drum	Larvae/post-larvae	Estuarine	All estuaries planktonic, SAV, sand/shell/soft bottom, emergent marsh
	Juvenile	Estuarine/Marine	GOM <5m west from Mobile Bay; all estuaries SAV, sand/shell/soft/hard bottom, emergent marsh
	Adults	Marine/Estuarine	GOM 1-46 m west from Mobile Bay; all estuaries SAV, pelagic, sand/shell/soft/hard bottom, emergent marsh

No Habitat Areas of Particular Concern (HAPC) or EFH Areas Protected from Fishing (EFHA) were identified in the proposed project area. The proposed project area is also in Eco-Region 4 and includes a variety of estuarine habitat types designated as EFH including: open water, emergent saline and brackish marsh, submerged aquatic grass beds, oyster reef, sand/shell bottom, and mud/soft bottom. Primary categories of EFH in the proposed project area are summarized below. Emergent wetlands are included here, based on the proposed project to restore these marshes.

- **Estuarine Soft Bottom.** Soft bottom habitats support a diverse assemblage of organisms living within or on the sediment, including crustaceans, gastropods, bivalves, and worms, as well as many larger animals such as fish and crabs (Minerals Management Service, 2006). Lower densities of fishes and invertebrates occur in soft bottom communities compared to areas with hard bottom substrates. Soft bottom communities are characterized by burrows and mounds from active infauna. White and brown shrimp larvae and juveniles typically inhabit terrigenous muds, feeding on infauna and detrital food sources. Red drum are demersal species in their larval, juvenile, and adult life stages and can be found in estuarine soft bottom habitats, feeding on a variety of prey species, including white and brown shrimp.

- **Estuarine/Water column.** Estuarine water column consists of the shallow open water column habitat and is also found extensively within the proposed project area. Estuarine water column supports photosynthesizing organisms such as phytoplankton (small, single-celled organisms that live in the water) (Miller, 2004). Currents and tides are important driving factors for movement of organisms, organic matter, and nutrients within this habitat zone. Fish eggs and larvae are transported from the open ocean to these protected areas where young fish can hide from predators and grow (Day et al., 2012; O'Connell et al., 2005). These estuarine environments are especially important to larval, juvenile and subadult red drum. Estuaries are also important nursery grounds for shrimp.
- **Submerged Aquatic Vegetation.** SAV habitat is limited in the proposed project area. *Ruppia maritima* (widgeon grass) and *Vallisneria americana* (wild celery) are the most common SAV found in Louisiana's estuaries (LDWF, 2009). SAV observed in and around the proposed project area includes filamentous algae within the project area and coontail *(Ceratophyllum demersum)* in Bayou Dupont (NOAA, 2011). The distribution and composition of SAV habitat is influenced by several factors; among the most important factors are light, salinity, nutrient levels, and wave action. SAV habitats are important nursery areas for a variety of fish, providing food and protection from predators. For these reasons SAV provides optimal habitat for red drum and shrimp.
- **Estuarine Emergent Wetlands.** This EFH type is being created in the proposed project area and is described as deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the ocean, with ocean-derived water at least occasionally diluted by freshwater runoff from the land. The upstream and landward limit is where ocean-derived salts measure less than 0.5 ppt during the period of average annual low flow. Estuarine wetlands are important nursery grounds for many fish, shellfish, and other invertebrate species. In addition to providing shelter and food wetlands also serve as erosion deterrents.

Coastal wetlands also provide nursery and foraging habitat that supports economically important marine fishery species such as spotted seatrout, sand seatrout, southern flounder, Atlantic croaker, spot, gulf menhaden, striped mullet, white mullet, killifish, kingfish, pompano, anchovies, and blue crab. Some of these species serve as prey for other managed fish species (e.g., mackerels, snappers, and groupers) and highly migratory species managed by NMFS (e.g., billfishes and sharks).

A wide variety of estuarine-dependent fishery species are found in the Barataria Basin in general (LCWCRTF & WCRA, 1999). Commercially fished species include brown shrimp, white shrimp, blue crab (*Callinectes sapidus)*, gulf menhaden, Atlantic croaker (*Micropogonias undulatus)*, gafftopsail catfish (*Bagre marinus),* and oysters *(Crassostrea virginica)*. These resources are species of national economic importance in accordance with Section 906(e)(l) of PL 99-602, the Water Resources Development Act of 1986.

Sport fishes sought after include sand seatrout (*Cynoscion arenarius)*, spotted seatrout (*C. nebulosus)*, spot*,* black drum *(Pogonius cromis),* red drum, and southern flounder *(Paralichthys lethostigma).* Nearly all these species vary in abundance from season to season due to their migratory life cycle, habitat preferences according to life stage, and the variation in salinity (Herke, 1992; LCWCRTF & WCRA, 1999; Rogers et al., 1993). Most of these species spawn offshore in the open Gulf of Mexico and enter the marsh area as post-larvae or young juveniles to use the marshes as a nursery. Most species return to the open gulf as subadults or adults.

Fisheries resources in Barataria Basin are monitored as part of the long-term plan of the Davis Pond Freshwater Diversion Project. Project reports includes catch data of freshwater catfish, bluegill, and bass; and saltwater shrimp, crab, redfish, trout, and oyster species from 1998 to 2004 (LDNR, 2005). Those data are incorporated by reference and considered in analysis of the preferred and non-preferred alternatives. The aquatic habitats of the Mississippi River borrow areas are relatively low in primary productivity because of the high turbidity. Poor benthic productivity in the Mississippi River results from the high current velocities and shifting substrates. The deep river channel and surrounding sandbars and mudflats provide habitat for species such as: bigmouth buffalo (*Ictiobus cyanellus*); blue catfish (*Ictalurus furcatus*); carp (*Cyprinus carpio*); channel catfish (*Ictalurus punctatus*); flathead catfish (*Pylodictis olivaris*); freshwater drum (*Aplodinotus grunniens*); largemouth bass (*Micropterus salmoides*); long nose gar *(Lepisosteus osseus*); smallmouth buffalo (*Ictiobus bubalus*); spotted gar (*Lepisosteus oculatus*); striped bass (*Morone saxatilis*); white bass (*Morone chrysops*); and white crappie (*Pomoxis annularis*).

4.4.2.8. Marine and Estuarine Aquatic Fauna, EFH, and Managed Fish Species – Environmental Consequences

Alternative 1 (Preferred). Marsh restoration would increase the quantity and quality of emergent marsh habitat (a designated EFH) in the proposed project area, replacing SAV habitat and estuarine soft bottom habitat (designated EFH). Soft bottom habitat is not limited in the proposed project area and increasing the amount of emergent marsh habitat is consistent with the goals of the proposed project. As described previously, open water, SAV, and low elevation marshes would be converted to approximately 1,163 acres of emergent marsh, which would permanently replace previous habitats. Impacts to these areas may affect aquatic fauna, fisheries, and EFH and would alter present habitats. Therefore, Alternative 1 would have short- and long-term, minor, adverse impacts associated with placement of fill in the MCAs and long-term, moderate, adverse impacts associated with ridge creation. Disturbed and displaced aquatic fauna in these areas would likely find refuge in nearby suitable habitats. Conversely, for those species that depend on emergent marsh habitats, Alternative 1 would result in increases in the quantity and quality of emergent marsh habitat, providing long term benefits to marine and estuarine aquatic fauna, managed fish species, and EFH.

Dredging activities for ECDs may impact EFH, disrupt prey sources, and disturb spawning and feeding habitats due to turbidity and siltation. Placement of sediments would result in permanent burial of benthic sediments and organisms. However, neither the total volume of material to be dredged nor the estimated area of dredging associated with ECD construction is considered significant (Moffatt & Nichol, 2020). ECD dredging areas would be rapidly colonized by opportunistic infauna. Later stages of colonization would be more gradual and would depend on environmental conditions after cessation of dredging. Fish and invertebrates are expected to recover as turbidity returns to pre-construction levels. Persistent low dissolved oxygen conditions that would impact fisheries and aquatic biota in the borrow and placement areas are not anticipated, given the disturbance and turnover of the borrow areas from recent use and the shallow nature of placement areas, respectively. Impacts from dredging and transport of material are expected to be minimized due to the established access corridor and implementation of BMPs. Therefore, impacts resulting from dredging sediments in the project area would cause short-term, minor, adverse impacts to aquatic fauna, fisheries, and EFH.

The quality of fish habitat would increase over the 20-year life of the proposed project. The creation of healthy marsh habitat would provide a greater diversity of foraging, breeding, spawning, and cover habitat for a greater variety of adult and juvenile fish and shellfish species. The marsh would contribute nutrients and detritus would be added to the existing food web, providing a positive benefit to local area fisheries. The marsh habitat would provide nursery habitat for estuarine-dependent fisheries accessible via ECD gaps and maintained eater channels.

Potential impacts to estuarine and aquatic fauna, managed fish species, and EFH would be considered and avoided or minimized to the extent practicable during construction. When impacts cannot be avoided, BMPs would be implemented to minimize the potential magnitude and duration of impacts to aquatic fauna, managed fisheries, and EFH. BMPs during construction would help to avoid and minimize impacts when protected and managed species are expected to be present or when most vulnerable. They would also likely include standard erosion and sediment control measures to protect water quality and aquatic habitats from impacts resulting from construction and sediment runoff. EFH consultation guidance documents on the NMFS webpage accessible at the URL via the following link: (https://www.fisheries.noaa.gov/) provide additional best practices to avoid or limit project impacts to EFH. Specific BMPs for the protection of EFH would be identified and selected based on project elements and selected construction methods during the final engineering design. Technical assistance with agencies is in progress or has been completed for the preferred alternative. Any required consultations will be completed prior to project implementation. For federal compliance status updates, please see TABLE 5-1 in Section 5 of this Final RP/EA #3.3.

Overall, short- and long-term, minor to moderate, adverse impacts to marine and estuarine aquatic fauna, EFH, and other aquatic organisms are anticipated due to construction activities and habitat replacement. However, long term benefits for most species and EFH are anticipated due to the creation of marsh habitats that have historically deteriorated. No loss of water column habitat is anticipated, and loss of soft bottom habitat is negligible due to the extent of the habitat type proximate to the proposed project area and throughout the basin. Loss of any EFH habitat would be offset by higher quality and higher quantities of EFH following marsh enhancement.

Under Alternative 1, potential impacts to estuarine and aquatic fauna, managed fisheries, and EFH would be considered and avoided or minimized to the extent practicable during design and construction. BMPs during construction would help to avoid and minimize impacts when protected and managed species are expected to be present or when most vulnerable. Specific BMPs for the protection of EFH would be identified and selected based on project elements and chosen construction methods during the final engineering design.

Alternatives 2 and 3. All three of these alternatives would increase the quality and quantity of estuarine emergent marsh habitat in the proposed project area and result in long-term benefits to this resource. Alternative 3 would result in greater increases in emergent marsh habitat and greater benefits to fish species dependent on emergent marsh habitats when compared with Alternatives 1 and 2.

Adverse impacts to the resources from Alternatives 2 and 3 would also be similar to those described for Alternative 1. Therefore, impacts resulting from dredging the borrow source areas would cause short-term, minor, adverse impacts to aquatic fauna, fisheries, and EFH. However, the prolonged construction period and second mobilization activities under Alternative 3 due to the time required to accumulate the needed volumes of sediment from the borrow areas are expected to result in greater adverse impacts to habitats and species when compared with Alternatives 1 or 2. A longer construction duration would also result in greater adverse impacts to benthic habitats and organisms.

No Action Alternative. Under the No Action Alternative, no additional adverse impacts or benefits to aquatic fauna, EFH, or managed fisheries would be expected in the short term. The conditions in the proposed project area would remain the same unless other projects are implemented. Because of continued degradation of aquatic habitats from erosive forces, subsidence, and sea level rise, there would be long-term, minor to moderate, adverse impacts to aquatic fauna, EFH, and managed fisheries compared to Alternatives 1, 2, and 3.

4.4.3. Socioeconomic Environment

A single resource, Fisheries, was retained for further analysis under the Socioeconomic Environment. This section addresses potential impacts to the industry of fishing in communities in the proposed project (potential impacts to the fisheries resources such as federally managed fish species and EFH were addressed in Section 4.9).

4.4.3.1. Fisheries– Affected Environment

Fisheries include recreational and commercial fishing of fish and shellfish. Aquaculture operations in the two parishes that include the proposed project area are summarized in TABLE 4-5 (USDA, 2012). Oysters, finfish, crabs, and shrimp are the primary harvested fishery resources in the project area (Plaquemines Parish Department of Coastal Zone Management, 2013). No oyster leases are present within the proposed project area. In addition, while Louisiana supports an important aquaculture industry and aquaculture, there is no aquaculture in the proposed project area. Finfish aquaculture farms have not reported revenues in parishes within the proposed project area.

TABLE 4-5. Aquaculture in Jefferson and Plaquemines parishes (after USDA, 2012).

Parish	Crustacean and Mollusks	Other Aquaculture Products and Food Fish Farms	Value of Sales (thousands of dollars)
Jefferson	7	4	$873
Plaquemines	22	2	$7,329

The commercial fishing industry represents a major source of jobs and income in Louisiana and include large volumes of finfish, shrimp, oysters, and crabs. Approximately 890.6 million pounds, of seafood, on average, behind only Alaska, is landed in Louisiana each year for commercial sale, with an estimated dockside value of $354.3 million (NMFS, 2018). Louisiana is the largest producer of shrimp in the U.S. in landings by weight and value, and shrimping is the largest commercial fishery in the Project area by value and volume as well (Bourgeois et al., 2015). NMFS' Fishing Engagement and Reliance Indices are indicators of the importance of commercial fishing at the level of coastal communities (Jepson & Colburn, 2013). The level of reliance on commercial fishing in the Barataria Basin is 1.13, which is more than a standard deviation above the average, indicating relatively high reliance on commercial fishing and, therefore, relatively higher vulnerability of the communities with respect to adverse impacts to commercial fisheries (NMFS, 2018).

Marshes are nursery, foraging, and spawning habitat for numerous commercially and recreationally important marine and estuarine species. The wetlands of the Barataria-Terrebonne estuary complex in which the proposed project area is located are estimated to support approximately 20 percent of the U.S. fisheries that are dependent on estuarine habitat. The Barataria-Terrebonne estuary complex supports a commercial harvest of over 600 million pounds of fish and shellfish each year (BTNEP, 2019).

Understanding changes in the Barataria is especially important because an estimated 97 percent of all commercially valuable Louisiana Gulf of Mexico fisheries species depend, for some or part of their life cycle, on the productivity of the Barataria and adjacent coastal estuarine basins (Nelson et al., 2002). This estimate is approximately 20 percent of the U.S. commercial seafood harvest, approximately 600 million pounds of fish and shellfish per year. Historically, shrimp have generated the largest share of income followed by oysters, menhaden (*Brevoortia patronus*), blue crab (*Callinectes sapidus*), and striped mullet (*Mugil cephalus*) (LCWCRTF & WCRA, 1998). The Barataria-Terrebonne estuary system supports a large blue crab fishery and has accounted for more than 70 percent of the statewide commercial harvest (USACE & CPRA, 2010).

4.4.3.2. Fisheries – Environmental Consequences

Alternative 1 (Preferred). Under this alternative, short-term, local, minor adverse impacts to fisheries are anticipated during the construction phase of the proposed project. Access to fisheries in the MCAs would be eliminated due to conversion from open water to emergent marsh. Immediate effects of dredging are the removal of sediment along with the organisms living in the sediment, which may impact feeding opportunities. Mobile aquatic animals would be expected to move away from the proposed project area during construction and return after construction is complete. Invertebrates and fish that do not move out of the area would likely be injured as suspended particulates clog gills. Short-term adverse impacts to fish eggs and larvae in the immediate area may also occur due to increased turbidity or direct burial. Dredging would change substrate topography, causing a temporary redistribution of organisms in the immediate vicinity.

These impacts would be minimized by implementation of BMPs, and all stipulations and procedures outlined in the applicable permits would be followed accordingly. Long term benefits to fisheries would be expected due to improvements in marsh habitat and fisheries populations.

Benefits to fisheries are anticipated under Alternative 1. The quality of fish habitat would increase over the 20-year life of the proposed project. The creation of healthy marsh habitat would provide a greater diversity of foraging, breeding, spawning, and cover habitat for a greater variety of adult and juvenile fish and shellfish species. The marsh would contribute nutrients and detritus would be added to the existing food web, providing a positive benefit to local area fisheries. The marsh habitat would provide nursery habitat for estuarine-dependent fisheries. Access to the marsh habitat would still be possible through maintained water channels and gaps in the containment dikes.

Alternatives 2 and 3. Increased estuarine emergent marsh habitat would result in long-term benefits to fisheries and as a result of increased marsh habitat for numerous adult and juvenile fish and shellfish species. All three of these alternatives would increase the quality and quantity of estuarine emergent marsh habitat for fisheries in the proposed project area and result in long-term benefits to this resource. Alternative 3 would result in greater increases in emergent marsh habitat and greater long-term benefits to fisheries when compared with Alternatives 1 and 2.

Adverse impacts to the resources from Alternatives 2 and 3 would be similar to those described for Alternative 1. Therefore, impacts resulting from dredging the borrow source areas would cause short-term, minor, adverse impacts to fisheries. However, the prolonged construction period and second mobilization activities under Alternative 3 due to the time required to accumulate the needed volumes of sediment from the borrow areas are expected to result in greater adverse impacts to habitats and species when compared with Alternatives 1 or 2. A longer construction duration would also result in greater adverse impacts to fisheries.

No Action Alternative. Under the No Action Alternative, the project area would continue to provide nursery habitat and associated food resource for small resident fishes. However, continued land loss will lead to increasing water depth and the value of the area as a food source and nursery will decline. As a marsh complex exceeds 70 percent unvegetated open water, shrimp, and blue crab populations may decline (Minello & Rozas, 2002).

4.4.4. Summary of Environmental Consequences

Potential adverse impacts to resources due to the alternatives are typically short term, temporary, minor to moderate, and a result of construction activities. Benefits are long term and a result of creating and restoring marshes that have been historically been replaced by open water habitat due to anthropogenic and natural factors. A summary of these impacts is presented in TABLE 4-6.

TABLE 4-6. Summary of environmental consequences of Proposed Design alternatives.

		Alternatives			
	Resources	**Alternative 1 (Preferred)** 1,163 acres created 10.5 MCY to be dredged	**Alternative 2** 862 acres created 8.4 MCY to be dredged	**Alternative 3** 1,476 acres created 13.8 MCY to be dredged	**No Action**
Physical Environment	Geology and Substrates	**Adverse Impacts**. Short-term, minor impacts to terrestrial substrates due to compaction, erosion, and sedimentation during construction. Sediment placed in MCAs would permanently cover/ compact existing substrates; sediments dredged in-situ to create ECDs would also bury existing substrates. **Benefits.** Long-term due to the addition of sediment and increased marsh and marsh elevation and subsequent reductions in erosion and marsh loss caused by SLR, diverted river sediments, and subsidence, for example.	**Adverse Impacts.** Same as Alternative 1 with less fill material placed on existing substrates. **Benefits.** Same as Alternative 1 but with fewer acres of marsh platform created in a shorter construction period.	**Adverse Impacts.** Same as Alternative 1 but with additional impacts due to second construction phase required to meet additional sediment needs. **Benefits.** Same as Alternative 1 but with more acres of marsh created to restore for previous losses.	**Adverse Impacts**. Long-term, major impacts due to ongoing erosion, substrate deterioration, land loss, and shift to larger areas of open water as a result of continued sediment diversions and SLR. **Benefits.** No construction related impacts.
	Hydrology	**Adverse Impacts.** Short term, minor impacts due to fill placement and ECD construction that would reduce the amount of open water in the project area. **Benefits.** Long-term benefits due to re-establishment of marsh connectivity that supports hydrologic exchange and corresponding exchange of sediments and nutrients, restore sheet flow of fresh water across marshes, and restore tidal inundation regime in marshes.	**Adverse Impacts.** Same as Alternative 1 but fewer acres of marsh, fewer tidal channels for hydrologic exchange and connectivity. **Benefits.** Same as Alternative 1 but fewer acres of restored hydrologic connectivity.	**Adverse Impacts.** Same as Alternative 1 but with additional impacts due to second construction phase required to meet additional sediment needs. **Benefits.** Same as Alternative 1 but with more acres of marsh created.	**Adverse Impacts**. Long-term, major impacts due to the continued shift to more open water area, reduced sheet flow across marshes, and ongoing marsh loss. **Benefits.** No construction related impacts.
	Water Quality	**Adverse Impacts.** Short term, minor impacts due to transport of sediments/other pollutants from construction activities into the water column. Introduction of freshwater sediments from borrow areas into intermediate/ brackish MCAs would cause changes to DO, nutrients, salinity, and turbidity. **Benefits.** Long-term benefits due to the creation of large areas of marsh over which nutrient uptake from surface waters would occur, resulting in improved water quality.	**Adverse Impacts.** Same as Alternative 1 but with fewer acres of marsh created and, therefore, lower capacity for nutrient uptake. **Benefits.** Same as Alternative 1 with shorter construction period and less potential for construction-related water quality impairment.	**Adverse Impacts.** Same as Alternative 1 but with additional impacts due to second construction phase required to meet additional sediment needs. **Benefits.** Same as Alternative 1 but with more acres of marsh created and greater potential nutrient uptake.	**Adverse Impacts**. Long-term, major impacts due to ongoing increases in salt- water intrusion as marsh elevations decline, and continued marsh degradation in absence of restoration activities. **Benefits.** No construction related impacts.

	Resources	Alternatives			
		Alternative 1 (Preferred) 1,163 acres created 10.5 MCY to be dredged	**Alternative 2** 862 acres created 8.4 MCY to be dredged	**Alternative 3** 1,476 acres created 13.8 MCY to be dredged	**No Action**
Biological Environment	Habitats	**Adverse Impacts.** Short term, minor to moderate impacts to habitats due to replacement of existing habitats with higher elevation marsh platform. Increased risk of invasive species establishment due to construction disturbances. Replacement of open water benthic habitat with emergent marsh habitat. Local habitat disturbance and contamination possible due to increased boat and construction equipment use. **Benefits.** Long-term benefits due to restoration of former emergent marshes that would increase habitat connectivity and support for nursery habitat for fisheries, emergent habitat for macroinvertebrates, and reduce long-term susceptibility of habitats to subsidence and sea level rise.	**Adverse Impacts.** Same as Alternative 1 but with fewer acres of open water habitat replaced with emergent marsh. **Benefits.** Same as Alternative 1 but with fewer acres of emergent marsh habitat created.	**Adverse Impacts.** Same as Alternative 1 but with additional impacts due to second construction phase required to meet additional sediment needs. **Benefits.** Same as Alternative 1 but with more acres of habitat created.	**Adverse Impacts**. Long-term, major impacts due to continued shift from emergent marsh to open water and to higher salinity marsh, decreased emergent habitat for fisheries, declines in macroinvertebrate habitat, and increased opportunity for invasive species associated with open water habitat. **Benefits.** No construction related impacts to habitats.
	Wildlife	**Adverse Impacts.** Short term, minor to moderate impacts due to temporary displacement during construction activities, impacts to nesting, foraging, and overwintering bird species, and loss of open water habitat suitable for waterfowl, other bird species. **Benefits.** Long-term benefits to wildlife due to increased amount of marsh habitat important for feeding, nesting, and roosting needs of migratory and nonmigratory bird species. Created marsh would also benefit mammals, reptiles, and amphibians that rely on marsh habitat for all or part of their life cycle.	**Adverse Impacts.** Same as Alternative 1 but with fewer acres of open water habitat replaced with marsh habitat. **Benefits.** Same as Alternative 1 but with shorter construction period that could potentially benefit wildlife.	**Adverse Impacts.** Same as Alternative 1 but with additional impacts due to second construction phase required to meet additional sediment needs. **Benefits.** Same as Alternative 1 but with more acres of habitat created for wildlife.	**Adverse Impacts**. Long-term, major impacts due to shift from emergent marsh to open water brackish and saltmarsh that does not support marsh-dependent wildlife. **Benefits.** No construction related impacts to wildlife would occur.

Resources		Alternatives			
		Alternative 1 (Preferred) 1,163 acres created 10.5 MCY to be dredged	**Alternative 2** 862 acres created 8.4 MCY to be dredged	**Alternative 3** 1,476 acres created 13.8 MCY to be dredged	**No Action**
	Protected Species	**Adverse Impacts.** Short term, minor impacts to species such as the West Indian manatee, pallid sturgeon and sea turtles due increased vessel traffic, dredging activities (i.e. dredging with a cutterhead), and increased turbidity. However, USFWS concurred the project is "likely to affect, but not likely to adversely affect" these species. Concurrence from NMFS is likely; however the consultation is still in progress. No adverse impacts to species or critical habitats under NMFS jurisdiction were identified. No adverse effects requiring further review under the MMPA were identified. **Benefits.** Long-term benefits due to increased marsh area that would improve water quality, increase nutrient uptake, and increase hydrologic connectivity, thereby improving habitat for these and other protected species.	**Adverse Impacts.** Same as Alternative 1 but with slightly less dredging activity and vessel traffic due to shorter construction period. **Benefits.** Same as Alternative 1 but with fewer acres of marsh created.	**Adverse Impacts.** Same as Alternative 1 but with additional impacts due to second construction phase required to meet additional sediment needs. **Benefits.** Same as Alternative 1 but with a greater number of acres of marsh created.	**Adverse Impacts**. Long-term, major impacts due to continued shift from marsh habitats to open water. No direct impacts to wildlife would occur under the no action alternative. **Benefits.** No construction related impacts.
	Marine and Estuarine Aquatic Fauna, EFH, and Managed Fish Species	**Adverse Impacts.** Short to long-term, minor to moderate impacts due to construction activities and replacement of open water EFH with marsh habitat and EFH. Localized habitat disturbance and possible contamination possible due to increased boat and construction equipment use. Construction of marsh platform and ECDs would displace and/or bury aquatic fauna. **Benefits.** Long-term benefits due to restoration of marsh habitat that was previously, and continues to be, replaced by open water habitat as a result of anthropogenic and natural changes.	**Adverse Impacts.** Same as Alternative 1 with fewer acres of disturbed or replaced aquatic habitat. **Benefits.** Same as Alternative 1 with fewer acres of marsh created and a corresponding shorter construction period.	**Adverse Impacts.** Same as Alternative 1 but with additional impacts due to second construction phase required to meet additional sediment needs. **Benefits.** Same as Alternative 1 but with more acres of marsh EFH created.	**Adverse Impacts**. Long-term, major impacts due to the continued degradation of habitat and EFH associated with estuarine aquatic fauna and several managed fish species due to ongoing subsidence, SLR, and land loss. **Benefits.** No construction related impacts.

Resources		Alternatives			
		Alternative 1 (Preferred) 1,163 acres created 10.5 MCY to be dredged	**Alternative 2** 862 acres created 8.4 MCY to be dredged	**Alternative 3** 1,476 acres created 13.8 MCY to be dredged	**No Action**
Socioeconomic Environment	Fisheries and Aquaculture	**Adverse Impacts.** Short term, local, minor impacts due to increased turbidity and water quality changes during construction activities. Replacement of open water with marsh platform would disturb and/or bury some fisheries habitat. No impacts to fishery leases are anticipated. **Benefits.** Long-term benefits to fisheries and aquaculture due to restoration of marsh habitat that was previously, and continues to be, replaced by open water habitat due to anthropogenic and natural changes.	**Adverse Impacts.** Same as Alternative 1 but with fewer acres of open water habitat replaced by marsh habitat. **Benefits.** Same as Alternative 1 but with fewer acres of marsh creation and a shorter construction period.	**Adverse Impacts.** Same as Alternative 1 but with additional impacts due to second construction phase required to meet additional sediment needs. **Benefits.** Same as Alternative 1 but with more acres of habitat creation.	**Adverse Impacts**. Long-term, major impacts due to continued increases in open water habitat and salt water intrusion, at the expense of emergent habitat. **Benefits.** No construction related impacts.

4.5. Cumulative Impacts

4.5.1. Potential Cumulative Impacts

Cumulative impacts are defined 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 undertake such other actions" (40 CFR § 1508.7). Per the CEQ handbook, *Considering Cumulative Effects Under the National Environmental Policy Act*, 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 (CEQ, 1997).

Therefore, in accordance with NEPA and to the extent reasonable and practical, this Final RP/EA #3.3 considers the combined effects of each of the alternatives (Alternative 1, Alternative 2, and Alternative 3) with other past, present, and reasonably foreseeable actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over time. Cumulative impacts are an important consideration because of the potential for additive effects from individual projects that may result in a cumulative effect to a resource in the proposed project area.

4.5.2. Method for Assessing Cumulative Impacts

The scope of the cumulative impact analysis for the LBMC-UBC alternatives involves both the geographic extent of the effects and the timeframe in which the effects could be expected to occur, as well as the resources potentially cumulatively affected. The approach used for evaluating cumulative impacts and the subsequent analysis of the LBMC-UBC design alternatives are presented here. Consistent with the Final PDARP/PEIS, cumulative impacts were evaluated according to the following steps:

- Step 1: Identify resources affected;
- Step 2: Establish boundaries. Appropriate spatial and temporal boundaries may vary for each resource.
- Step 3: Identify a cumulative action scenario; and
- Step 4: Analyze cumulative impacts.

4.5.2.1. Resources Affected

Resources retained for analysis are considered here. The key factor to cumulative assessment is identifying any potential temporal or spatial overlap or successive effects that may significantly affect resources occurring in the analysis areas (CEQ, 1997; USEPA, 1999). A list of past, existing, and future projects was compiled for each project using state, USACE, USEPA, USFWS, USDA, and NOAA databases and internet searches, as needed, for more detail. Several resources were earlier identified (Section 4.3) as minimally (adversely) affected by the design alternatives and were therefore also eliminated from this cumulative impact analysis. Resources included in this analysis are listed in TABLE 4-7.

TABLE 4-7. Resources addressed in Cumulative Impacts Analysis.

Resources excluded from this Analysis	Resources analyzed for Potential Consequences
• Air quality • Noise • Socioeconomic and Environmental Justice • Cultural Resources • Land and Marine Management • Tourism and Recreation Use • Aesthetics and visual Resources • Public Health and Safety • Marine Transportation	• Geology and Substrates • Hydrology • Water Quality • Habitats • Wildlife • Protected Species • Marine and Estuarine Aquatic Fauna • EFH, and Managed Species • Fisheries

4.5.2.2. Spatial and Temporal Boundaries of Analysis

The spatial boundaries for evaluating cumulative impacts encompass those areas where alternatives would occur, including the borrow areas in the Mississippi River, the access corridor along which sediment would be transported to the MCAs, the MCAs themselves, and surrounding areas.

Project construction is anticipated to occur over 2 to 3 years of the 20-year project life. The duration of project implementation and useful project life contribute to an assessment of cumulative impacts. Present actions are those that are currently occurring and result in impacts to the same resources within the same spatial boundary that the alternatives affect. Reasonably foreseeable future actions are those actions that are likely to occur and affect the same resources as the proposed project. These include projects that are likely to be started prior to finalization of the Draft RP/EA #3.3 and actions that are likely to occur after finalization of this Final RP/EA #3.3. Determining how far into the future to consider actions is based on the impact of the alternatives being considered. Once the impacts of the alternatives are no longer experienced by the affected resource, future actions beyond that need not be considered.

4.5.3. Cumulative Action Scenario: Past, Present, and Reasonably Foreseeable Actions

Past, present, and reasonably foreseeable future actions near the proposed project area were identified to effectively consider the potential cumulative impacts. A list of past, existing, and future projects was compiled for each project using Louisiana state, USACE, USEPA, USFWS, USDA, and NOAA databases and internet searches for more detail as needed. The proposed project area is coastal, and regulations pertaining to coastal permits were considered appropriate for developing a list of past and reasonably foreseeable future activities that may affect the resources. Based on information obtained from permitting databases, past and potential future activities near the proposed project area include beach nourishment, road maintenance, additional recreational improvements, and pipeline installation.

Actions or groups of actions within the established geographic and timeframe boundaries were considered. The *CEQ Memorandum Guidance on Consideration of Past Actions in Cumulative Effects Analysis* states that consideration of past actions is only necessary insofar as it informs agency decision-making and that “[a]gencies are not required to list or analyze the effects of individual past actions unless such information is necessary to describe the cumulative effect of all past actions" (CEQ, 2005). Agencies may aggregate the effects of past actions without delving into the historical details of individual past actions.

- **Land development.** Louisiana coastal areas had a population of approximately 2.3 million in 2010 (NOAA OCM & U.S. Census Bureau, 2013). Coastal landscapes will continue to be altered by development for tourism-related, residential, commercial, industrial, recreational, agricultural, and forestry purposes in response to this growing population. Loss and/or degradation of natural areas may adversely impact the affected area and specific project sites and resources during implementation of a proposed project or after restoration. Habitat restoration would reduce the adverse impacts of these activities.

Based on the assessment summarized in TABLE 4-6, the resource areas with potential for cumulative impacts are geology and substrates; hydrology and water quality; habitats; wildlife species; protected species; marine and estuarine fauna, EFH, and managed fish species; land and marine management; and fisheries and aquaculture. The alternatives would result in long-term benefits to these resources along with some short-term adverse impacts. The anticipated short-term impacts to habitats, wildlife, and protected species from construction could be minimized with the development and implementation of BMPs. The preferred alternative would result in short-term, adverse impacts but would also have long-term benefits to the resources. The cumulative effects from the preferred alternative and the identified actions are expected to result in cumulative benefits to geology and substrates; hydrology and water quality; habitats; wildlife species; marine and estuarine fauna, EFH, and managed fish species; protected species; land and marine management; and fisheries and aquaculture. Therefore, cumulative impacts of the preferred alternative are expected to be beneficial.

Past, present, and reasonably foreseeable projects included in this analysis are listed in TABLE 4-8. Project types (e.g., marsh creation projects) are mapped in FIGURE 4-2.

TABLE 4-8. Description of other past and present actions in Upper Barataria Bay considered in the Cumulative Impact Analysis.

Louisiana Project Number	Project Name	Year Completed (or other)
LA-01-B	Dedicated Dredging Program – Bayou Dupont	1999
BA-01	Davis Pond Freshwater Diversion	2001
BA-02	GIWW to Clovelly Hydrologic Restoration	2000
BA-03	Naomi Siphon Diversion	1993
BA-03c	Naomi Outfall Management	2002
BA-04	West Pointe a la Hache Siphon Diversion	1992
BA-05	Queen Bess	1990
BA-15	Lake Salvador Shore Protection Demonstration	1998
BA-15 15x1	Lake Salvador Shoreline Protection Extension	2005
N/A	Baie de Chactas Shoreline Protection	1990
BA-16	Bayou Signette Wetland Protection	1994/1998
BA-19	Barataria Bay Waterway Wetland Restoration	1999

Louisiana Project Number	Project Name	Year Completed (or other)
BA-20	Jonathan Davis Wetland Protection	1999
BA-23	Barataria Bay Waterway West Side Shoreline Protection	2000
BA-25	Bayou Lafourche Siphon (Phase I)	2000
BA-26	Barataria Bay Waterway East Side Shoreline Protection	2001
BA-27	Barataria Basin Land Bridge Shoreline Protection, Phases 1 and 2	2001
BA-27c	Barataria Basin Land Bridge Shoreline Protection, Phase 3	2009
BA-30	East Grand Terre Islands Restoration	2011
BA-28	Vegetation of a Dredged Material Disposal Site on Grand Terre Island	2001
BA-35	Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration	2009
BA-36	Dedicated Dredging on the Barataria Basin Land Bridge	2010
BA-37	Little Lake Shoreline Protection/Dedicated Dredging Near Round Lake	2007
BA-38	Barataria Barrier Island Complex Project: Pelican Island and Pass La Mer to Chaland Pass	2007
BA-39	Mississippi River Sediment Delivery System - Bayou Dupont	2015
BA-40	Riverine Sand Mining/Scofield Island Restoration	2014
BA-41	South Shore of The Pen Shoreline Protection and Marsh Creation	2012
BA-42	Lake Hermitage Marsh Creation	2014
BA-43 (EB)	Mississippi River Long Distance Sediment Pipeline	2015
BA-45 (EB)	Caminada Headlands Beach and Dune Restoration	2017
BA-48	Bayou Dupont Marsh and Ridge Creation	2015
BA-68	Grand Liard Marsh and Ridge Restoration	2015
BA-76 (BA-0142)	Chenier Ronquille Barrier Island Restoration	2018
BA-110	Shell Island East Barrier Island Restoration	2013
BA-111	Shell Island West NRDA Restoration Project	2014
BA-141	NRDA Lake Hermitage Marsh Creation Increment 2	2014
BA-143	Caminada Headlands Beach and Dune Restoration Increment 2	2017
BA-153	Mid-Barataria Sediment Diversion	E&D
BA-164	Bayou Dupont Sediment Delivery – Marsh Creation #3 and Terracing	2016
BA-168	Fifi Island Breakwaters	2015
N/A	Nutria Harvest and Control – multiple projects	Ongoing
BA-171	Caminada Back Barrier Marsh Creation	E&D
BA-193	Caminada Back Barrier Marsh Creation Increment 2	E&D
BA-197	West Grand Terre Beach Nourishment and Stabilization	In Construction
BA-202	Queen Bess Island Restoration	2020
BA-0210	Grand Isle and Vicinity Breakwater	In Construction
BA-0233	Grand Isle Bayside Breakwater	In Construction

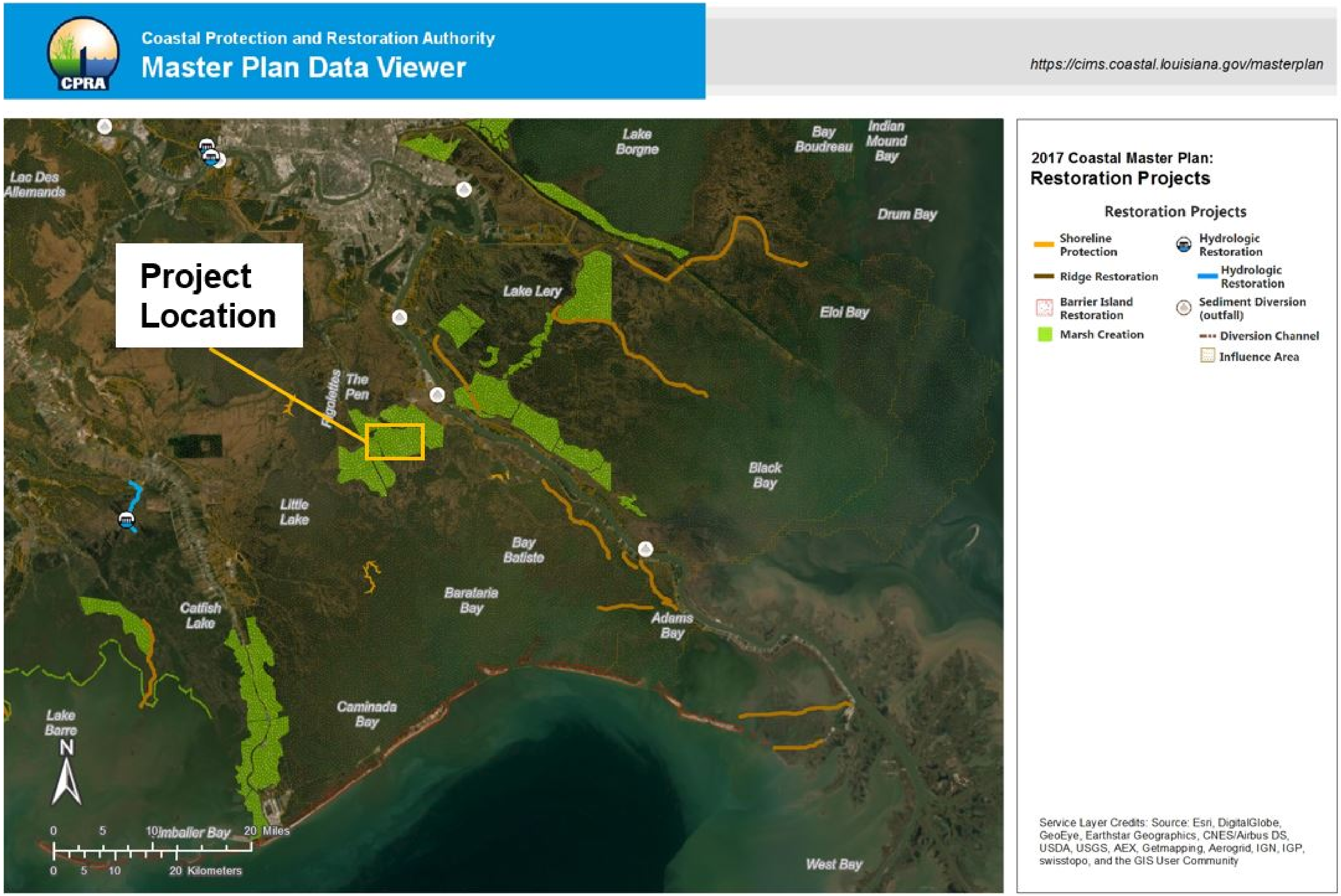

FIGURE 4-2. Project types in the Barataria Basin and the surrounding areas.

4.5.4. Cumulative Impacts Analysis

Overall, the adverse impacts from the proposed project would be short-term and minor to moderate due to construction activities under the three action alternatives: Alternative 1 (preferred), Alternative 2, and Alternative 3. Impacts from present and reasonably foreseeable actions in the proposed project area would be similar since many are also marsh restoration projects. However, long-term cumulative benefits are anticipated as a result of project implementation, regardless of the action alternative selected. Any successful restoration project should lead to longer-term minor, moderate, or major benefits to physical, biological, and built resources. Because project implementation periods (and the associated adverse effects from construction activities) are relatively short-term and temporary (directly related to construction impacts) and the benefits from a project are long-term, the cumulative impact of the project activities are predicted to result in a net benefit to physical, biological, and socioeconomic resources. In contrast, the No Action Alternative is anticipated to contribute to continued increases in erosion, subsidence, land loss, flooding from storm surge, and subsequent impacts to physical, biological, and socioeconomic resources, as discussed previously (Section 4.3) and therefore contribute to cumulative adverse impacts to resources. The life of the project is 20 years, at which point, in the absence of further intervention, created projects would be subjected to ongoing subsidence and SLR impacts. The proposed project would restore natural habitat structure and function.

Importantly, the LBMC-UBC project is similar to other Barataria Basin restoration projects (e.g., Bayou Dupont projects) and would result in the addition of over 900 to nearly 1,600 acres of marsh platform in the basin, depending on the design alternative. A larger platform would be more stable both physically and ecologically and would persist longer as a result of reduced erosion and greater stability due to vegetation. In addition, the proposed Mid Barataria Sediment Diversion project would be located directly east of the LBMC-UBC project and if constructed, could provide sediment inputs to this and other marsh creation projects, resulting in further development and persistence of the lower Barataria Basin marshes. Finally, BMPs would be implemented to avoid as much adverse impact as possible, further reducing the potential for adverse cumulative impacts.

These restoration approaches could help re-establish native plant communities, stabilize substrates and shorelines, support sediment deposition, increase nutrient uptake and productivity, and reduce erosion. In the long term, these activities would support the restoration and recovery of marshes in the Barataria Basin and potentially ameliorate the adverse impacts of other past, present, and reasonably foreseeable actions. Based on information available for this analysis, the preferred alternative and the other design alternatives are not expected to contribute substantially to short-term or long-term cumulative adverse impacts to biological resources when analyzed in combination with other past, present, and reasonably foreseeable future actions.

Public health and safety, tourism, and socioeconomics can be complicated by large storm events such as tropical storms and hurricanes (and associated storm surges, winds, and battering waves) that may damage the shoreline and infrastructure such as roadways, bridges, and buildings. In addition, construction activities and increased human uses of resources can also pose risks to public health and safety. The No Action Alternative would result in continued adverse impacts to resources due to such events. Based on information available for this analysis, the No Action and Alternative 2 are not expected to contribute substantially to short-term or long-term cumulative adverse impacts to socioeconomics when analyzed in combination with other past, present, and reasonably foreseeable future actions. Anticipated cumulative benefits that may result from this project and others could include direct and indirect, long-term, minor to moderate benefits, both within and adjacent to the project site. Overall, however, these cumulative impacts would not be significant at a regional or larger scale.

4.5.4.1. No Action Alternative

Cumulative impacts under the No Action Alternative would reflect a continuation of adverse impacts from past and ongoing anthropogenic activities such as oil and gas exploration and the DWH oil spill, as well as climate effects such as sea level rise. Adverse impacts of these ongoing activities and climate effects include land subsidence, release of toxins, opportunities for invasive species, nutrient and pollutant runoff, loss of habitat, and subsequent adverse impacts to fish and wildlife. Continued sea level rise and greater numbers and intensity of storms will continue to result in increases in erosion, saltwater intrusions, land loss, flooding, and subsequent adverse impacts to fish and wildlife as well as human communities. No cumulative benefits are anticipated under the No Action Alternative. Potential cumulative impacts under the No Action Alternative are summarized in TABLE 4-9.

4.5.4.2. Alternative 1 (Preferred)

Adverse cumulative impacts of past activities would be reduced under the preferred alternative, resulting in long-term cumulative benefits to resources in the Barataria Basin. For example, the incremental loss of marshes in the basin would be reduced by the creation of marshes and the proposed Mid Barataria Sediment Diversion inputs, combined with several other marsh creation projects in the basin (FIGURE 4-2). The impacts of sea level rise and climate change (described above) would be reduced due to the creation of more marshes that would buffer the shorelines from storms, increase nutrient uptake and productivity, and provide habitat for fish and wildlife. Under this alternative, the sediment volume required would be dredged from the borrow area during a single mobilization, ensuring the availability of sediment for the project as well as for the proposed Mid Barataria Sediment Diversion project. Potential cumulative impacts under the three design alternatives are summarized in TABLE 4-9.

4.5.4.3. Alternative 2

Under Alternative 2, long-term cumulative benefits would be very similar to those described for the preferred alternative. The difference under Alternative 2 would be approximately 301 fewer acres of marsh created, resulting in fewer benefits. Borrow material would be available under a single construction mobilization, similar to the preferred alternative.

4.5.4.4. Alternative 3

Under Alternative 3, long-term cumulative benefits would be very similar to those described for the preferred alternative. The difference under Alternative 3 would be an additional approximately 313 acres of marsh created, which would result in corresponding greater benefits to resources, as described above. However, the greater marsh area would require an additional 3.2 MCY of borrow material compared to the preferred alternative. The additional borrow material would require an additional construction phase and mobilization because of the wait time needed for additional sediment to accrue in the borrow areas, which would depend on river flow conditions. Consequently, this alternative would occur over a longer timeframe and use more sediment and may compromise the availability of sediment for other projects, including the proposed Mid Barataria Sediment Diversion project. Long-term benefits, however, would not begin to accrue until after a second mobilization under this alternative, unlike the preferred alternative and Alternative 2, which require only a single construction mobilization.

TABLE 4-9. Potential cumulative impacts to resources.

Resource		Cumulative Impacts of No Action Alternative	Cumulative Impacts of Action Alternative
Physical Environment	**Geology and Substrates**	Cumulative degradation and loss of soil resources and loss of an estimated 328,000 acres anticipated over the next 50 years. Continued flow diversions away from marshes would continue to divert sediments away from marshes and degrade marshes, leading to further erosion and land loss. Cumulative adverse impacts related to natural and anthropogenic activities would continue.	Cumulative benefits to soils over the life of the proposed project are anticipated. Combined with other projects, would expand the timeframe over which degradation and loss of soils are expected to occur in the basin and support restoration of the Barataria Land Bridge. Proposed projects such as the Mid Barataria Sediment Diversion may restore sediment inputs to the basin, further benefiting soil structure and stabilization.
	Hydrology **Water Quality**	Continued freshwater flow diversion down the Mississippi River (and away from the marshes) will persist, resulting in continued reductions in freshwater influence and increased saltwater intrusion. Continued maintenance of navigation canals in MCAs will also facilitate saltwater intrusion into upper portion of the basin. Continued reductions in marsh area would result in corresponding reductions in water quality due to reduced nutrient assimilation.	Cumulative benefits to hydrology due to effects of the proposed project combined with other nearby restoration projects in the Basin. Freshwater flows from the Mississippi River remain constrained. Increased marsh area reduces amount of open water and saltwater intrusion, restores sheet-flow of water over land surfaces. Cumulative benefits anticipated due to improved water quality anticipated as a result of increased marsh area available for nutrient assimilation.
Biological Environment	**Habitats** **Wildlife Species** **Marine and Estuarine Fauna, EFH, and Managed Fish Species**	Cumulative adverse impacts to habitats, wildlife, marine and estuarine fauna, EFH, and managed fish species would continue. Adverse impacts include continued loss of freshwater and intermediate marsh habitat for fish and wildlife, EFH, marine and estuarine fauna, and managed fish species due to direct habitat loss, habitat degradation, and invasive species. The No Action Alternative would not further contribute to cumulative adverse impacts due to oil and gas infrastructure and sea level rise, for example. No benefits to these resources are anticipated as a result of the No Action Alternative.	Cumulative benefits to these resources are anticipated under the proposed project. Although loss of habitat and other resources would persist due to natural processes (e.g., sea level rise) and human (e.g., oil exploration) that directly or indirectly degrade or eliminate habitat, the proposed project would result in additional (from 862 to 1,476 acres) marsh area. Combined with other restoration projects, these would benefit habitat and other biological resources by restoring intermediate marshes over the life of the project. The proposed project would increase the area of suitable wildlife habitat and fisheries nursery habitats.
Socioeconomic Environment	**Fisheries and Aquaculture**	Cumulative adverse impacts to recreational and commercial fisheries and aquaculture are not anticipated under the No Action Alternative. As salinities and area of open water increase in the basin due to natural and anthropogenic activities, fisheries and aquaculture activities may benefit in terms of areas able to support these activities.	Cumulative adverse impacts to recreational and commercial fisheries and aquaculture are not anticipated. No oyster leases are in the area, and therefore none would be impacted. Reduced open water would reduce open water fishing but increase the habitat available to fish for other species. Combined with similar projects, cumulative benefits to fisheries would be anticipated due to more nursery areas for many species.

5. Compliance with Other Laws and Regulations

Sections 3 and 4 of this Final RP/EA #3.3 provide detailed information and OPA and NEPA analyses for each design alternative and are consistent with the Final PDARP/PEIS. In addition, coordination and reviews to ensure compliance with a variety of other legal authorities potentially applicable to the selected alternative have been completed or are in progress (TABLE 5-1). The Louisiana TIG will ensure compliance with all applicable state and local laws, as well as applicable federal laws and regulations applicable to the selected design alternative. All compliance will be completed prior to implementation of on the ground activities.

Documentation of regulatory compliance is available in the Administrative Record that can be found at the DOI's Online *DWH* Administrative Record.[6] Existing consultations or permits have been reviewed to determine if they are applicable to the actions described in this Final RP/EA #3.3. Implementing Trustees are required to implement alternative-specific mitigation measures (including BMPs) identified in the biological evaluation form, this Final RP/EA #3.3, and completed consultations/permits.

TABLE 5-1. Current status of compliance with federal laws.

Endangered Species Act - Marine Species (NMFS)*	Endangered Species Act - Terrestrial Species (USFWS)*	Magnuson-Stevens Fishery Conservation and Management Act (NMFS)	Coastal Zone Management Act (LA DNR)	Marine Mammal Protection Act (NMFS)	Marine Mammal Protection Act (USFWS)	Bald and Golden Eagle Protection Act (USFWS)	National Historic Preservation Act (AHC)
In Progress – Not Likely to Adversely Affect	Complete	Complete	Complete	Complete	In Progress	Complete	In Progress

5.1. Compliance with Federal Laws

Additional federal laws may apply to the preferred alternative considered in this Final RP/EA #3.3. Legal authorities applicable to the development of the preferred design alternative were fully described in the context of the *DWH* NRDA restoration planning in the Final PDARP/PEIS, Section 6.9, Compliance with Other Applicable Authorities, and Appendix 6D, Other Laws and Executive Orders. That material is incorporated by reference here. Examples of applicable laws or executive orders include but are not necessarily limited to those listed below. Additional detail on each of these laws or executive orders can be found in Chapter 6 of the Final PDARP/PEIS.

- Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, reauthorized by the National Invasive Species Act in 1996, 16 U.S.C. § 4701 et seq.

[6] The DOI's Online *DWH* Administrative Record is available at: https://www.doi.gov/deepwaterhorizon/adminrecord

- Bald and Golden Eagle Protection Act, 16 U.S.C. §§ 668 et seq.
- CWA, 33 U.S.C. § 1251 et seq.
- CZMA, 16 U.S.C. § 1451 et seq.
- ESA, 16 U.S.C. § 1531 et seq.
- Estuary Protection Act, 16 U.S.C. § 1221 et seq.
- EO 11990, Protection of Wetlands.
- EO 11988, Floodplain Management.
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.
- EO 12962: Recreational Fisheries.
- EO 13112, Invasive Species.
- EO 13175: Consultation and Coordination with Indian Tribal Governments.
- EO 13186, Migratory Birds.
- EO 13653, Preparing the United States for the Impacts of Climate Change.
- EO 13693: Planning for Federal Sustainability in the Next Decade.
- Farmland Protection Policy Act.
- Fish and Wildlife Coordination Act, as amended in 1964, 15 U.S.C. § 661 et seq.
- MSA, 16 U.S.C. § 1801 et seq., Reauthorized by the Sustainable Fisheries Act of 1996.
- MMPA, 16 U.S.C. § 1361 et seq.
- Marine Protection, Research and Sanctuaries Act.
- Migratory Bird Treaty Act of 1918, 16 U.S.C. § 703 et seq
- National Historic Preservation Act of 1966, 16 U.S.C. § 470 et seq.
- National Marine Sanctuaries Act (NMSA), 16 U.S.C. § 1431 et seq.
- Rivers and Harbors Act of 1899, 33 U.S.C. § 407.

5.2. Compliance with State and Local Laws

The Louisiana TIG will ensure compliance with all applicable state, local, and federal laws and regulations relevant to the State of Louisiana. Additional laws and regulations are listed below.

- Archaeological Finds on State Lands (Louisiana Revised Statute (LRS) 41:1605)
- Coastal Wetlands Conservation and Restoration Authority (LRS 49:213.1)
- Coastal Wetlands Conservation and Restoration Plan (LRS 49:213.6)
- Louisiana State and Local Coastal Resources Management Act (LRS 49:214.21 – 214.42)
- Louisiana Oil Spill Prevention and Response Act (LRS 30:2451 et seq.)
- Management of State Lands (LRS 41:1701.1 et seq.)
- Louisiana Coastal Resources Program (LAC 43:700 et seq.)
- Louisiana Surface Water Quality Standards (LAC 33.IX, Chapter 11)
- Management of Archaeological and Historic Sites (LRS 41:1605)
- Oyster Lease Relocation Program (LAC 43:I, 850-859, Subchapter B)

6. Response to Public Comment

The public comment period for the Draft RP/EA #3.3 opened on March 20, 2020 and closed on April 20, 2020. During the public review period, the Louisiana TIG hosted one public meeting via webinar, on April 2, 2020.

During the public comment period, the Louisiana TIG received 116 individual submissions from private citizens and non-governmental organizations. The Louisiana TIG accepted and documented written comments submitted during the public webinar, hosted a web-based comment submission site, and provided a mailing and email address for the public to provide comments in the Federal Register. As a result, the Louisiana TIG received comments during the webinar and through additional web-based submissions, and emailed submissions. All comments received were reviewed and considered by the Louisiana TIG prior to finalizing this RP/EA.

6.1. Comment Analysis Process

Comment analysis is a process used to compile similar public comments into a format that can be addressed efficiently. Comments were sorted into categories by topics and issues, consistent with the range of topics applicable to the Draft RP/EA #3.3. The process was designed to capture and condense all comments received rather than to restrict or exclude any comments. The comment analysis process allows the Louisiana TIG to provide an organized and comprehensive response to public comments, consistent with OPA and NEPA NRDA regulations. The DOI's Planning, Environment and Public Comment (PEPC) database was used to manage public comments. The database stores the full text of all submissions and allows each comment to be grouped by topic and issue. All comments submitted are represented in the summary comment descriptions listed in this chapter, and all public comments, whether written or oral, are retained in the administrative record.

6.2. Comment Summary

Comments received by the Louisiana TIG during the public comment period and the Louisiana TIG's responses are summarized below.

6.2.1. PEPC Comments

1. All commenters expressed their support for the TIG's preferred alternative, and many commenters stated their appreciation for the opportunity to demonstrate support. Some commenters also stated that the project would provide critical nesting or foraging habitat for many of the National Audubon Society's conservation priority species, such as clapper rail, seaside sparrow, little blue heron, western sandpiper, and mottled duck and expressed additional support for activities "critical to the future of the Barataria Basin and the people, wildlife, and industries that depend on it." A few commenters stated that because the location of the marsh creation is strategic with respect to other projects in the basin, they will provide

long-term benefits to habitat. Some commenters also noted support for the Louisiana TIG's efforts in restoring the Gulf of Mexico ecosystem.

Response: The Louisiana TIG acknowledges the public support for the preferred alternative.

2. The majority of commenters stated that enhancing coastal wetlands in tandem with planned sediment diversions will safeguard critical habitat for important bird species and other wildlife into the future and will result in higher biodiversity and productivity. Some commenters also noted that new and sustained wetlands will provide a buffer from storm surge for communities and industry along the Louisiana coast.

   Response: The Louisiana TIG acknowledges and appreciates this support.

3. The majority of commenters expressed support for the preferred alternative and referenced its consistency with Louisiana's 2017 Coastal Master Plan and the effort to address a critical landscape feature, the Barataria Basin Land Bridge, which separates the saltwater and brackish habitat in the lower basin from the freshwater swamps and marshes in the upper basin and provides critical habitat for wildlife and fish. Some commenters also referenced the cost-effectiveness of the preferred alternative that results from maximizing the acres of marsh built during a single construction phase, using material from two renewable borrow sites.

   Response: The Louisiana TIG acknowledges and appreciates this support.

4. Many commenters noted the importance of leveraging restoration projects across Louisiana restoration programs and the potential for synergy of the preferred alternative with the proposed MBSD project. Many commenters recognized the importance of monitoring and adaptive management plans to evaluate project success and identify corrective actions, supported the learning goals identified for adaptive management, and recognized the relationship to the TIG's "Louisiana Adaptive Management Status and Improvement Report: Vision and Recommendations." Many commenters reiterated their belief that the preferred alternative is the most cost-effective alternative.

   Response: The Louisiana TIG acknowledges and appreciates this support.

5. Many commenters expressed support for the project as part of the large-scale restoration projects in the Mississippi River in general and commended the Louisiana TIG for the plan to restore the critical Barataria Land Bridge, implement a MAM plan, and implement the most cost-effective alternative for restoring the Barataria Land Bridge.

   Response: The Louisiana TIG acknowledges and appreciates this support.

6.2.2. Public Webinar Comments

1. One commenter asked about the availability of a monitoring and adaptive management plan for the project.

Response: The MAM plan is included in RP/EA #3.3 as Appendix D.

2. One commenter requested that the webinar slides and transcript be made available.

   Response: The webinar slides and transcript are available at the Gulf Spill Restoration website: https://www.gulfspillrestoration.noaa.gov/2020/03/draft-plan-design-barataria-marsh-creation-project-open-comment.

3. One commenter asked which agency would be responsible for bidding the project and construction management.

   Response: NOAA is the Implementing Trustee for the project.

4. One commenter asked about the availability of the current project footprint on the Gulf Spill Restoration website.

   Response: The project footprint is mapped in Figures 3-2, 3-4, and 3-6 in RP/EA #3.3, which is available at the Gulf Spill Restoration website: https://www.gulfspillrestoration.noaa.gov/2020/03/draft-plan-design-barataria-marsh-creation-project-open-comment.

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APPENDICES

Appendix A – List of Repositories

State	Repository	Address	City	Zip Code
LA	St. Tammany Parish Library	310 W. 21st Avenue	Covington	70433
LA	Terrebonne Parish Library	151 Library Drive	Houma	70360
LA	New Orleans Public Library, Louisiana Division	219 Loyola Avenue	New Orleans	70112
LA	East Baton Rouge Parish Library	7711 Goodwood Boulevard	Baton Rouge	70806
LA	Jefferson Parish Library East Bank Regional Library	4747 W. Napoleon Avenue	Metairie	70001
LA	Jefferson Parish Library West Bank Regional Library	2751 Manhattan Boulevard	Harvey	70058
LA	Plaquemines Parish Library	8442 Highway 23	Belle Chase	70037
LA	St. Bernard Parish Library	1125 E. St. Bernard Highway	Chalmette	70043
LA	St. Martin Parish Library	201 Porter Street	Martinville	70582
LA	Alex P. Allain Library	206 Iberia Street	Franklin	70538
LA	Vermillion Parish Library	405 E. St. Victor Street	Abbeville	70510
LA	Martha Sowell Utley Memorial Library	314 St. Mary Street	Thibodaux	70301
LA	South Lafourche Public Library	16241 E. Main Street	Cut Off	70345
LA	Calcasieu Parish Public Library Central Branch	301 W. Claude Street	Lake Charles	70605
LA	Iberia Parish Library	445 E. Main Street	New Iberia	70560
LA	Mark Shirley, Louisiana State University AgCenter	1105 West Port Street	Abbeville	70510

Appendix B – List of Preparers, Reviewers, and Persons Consulted

Agency/Firm	Name	Position
National Oceanic and Atmospheric Administration		
NOAA Restoration Center	Mel Landry	Marine Habitat Resource Specialist
NOAA Restoration Center	Jason Manthey	General Engineer
NOAA Office of the General Counsel, Natural Resources Section	Jared Piaggione	Attorney Advisor
NOAA Restoration Center/ Earth Resources Technology, Inc.	Barrett Ristroph	Marine Habitat Restoration Specialist
NOAA Restoration Center	Donna Rogers	Marine Habitat Resource Specialist
NOAA Restoration Center	Ramona Schreiber	*DWH* NEPA Coordinator
NOAA Restoration Center/ Earth Resources Technology, Inc.	Courtney Schupp	Marine Habitat Resource Specialist
NOAA Office of Habitat Conservation	Jeff Shenot	NEPA Coordinator
NOAA Restoration Center	Eric Weissberger	Marine Habitat Resource Specialist
United States Department of Agriculture		
Gulf Coast Ecosystem Restoration Team	Mark Defley	Biologist
United States Environmental Protection Agency		
EPA Region 6	Douglas Jacobson	Environmental Protection Specialist, Louisiana Team Leader
EPA Region 6	Patty Taylor	Environmental Engineer
State of Louisiana		
Coastal Protection and Restoration Authority	David Peterson	Deputy General Counsel
Contractor Team		
Industrial Economics, Inc. (IEc)	Gail Fricano	Principal
Industrial Economics, Inc. (IEc)	Niamh Micklewhite	Research Analyst
Industrial Economics, Inc. (IEc)	Michaela Murray	Research Analyst
Research Planning, Inc. (RPI)	Pam Latham	Senior Scientist

Appendix C – NEPA Impact Thresholds

Resource	Impact Duration	Minor Intensity	Moderate Intensity	Major Intensity
Physical Resources				
Geology and Substrates	Short-term: During construction period. Long-term: Over the life of the project or longer.	Disturbance to geologic features or soils could be detectable but could be small and localized. There could be no changes to local geologic features or soil characteristics. Erosion and/or compaction could occur in localized areas.	Disturbance could occur over local and immediately adjacent areas. Impacts to geology or soils could be readily apparent and result in changes to the soil character or local geologic characteristics. Erosion and compaction impacts could occur over local and immediately adjacent areas.	Disturbance could occur over a widespread area. Impacts to geology or soils could be readily apparent and could result in changes to the character of the geology or soils over a widespread area. Erosion and compaction could occur over a widespread area. Disruptions to substrates or soils may be permanent.
Hydrology and Water Quality	Short-term: During construction period. Long-term: Over the life of the project or longer.	*Hydrology*: The effect on hydrology could be measurable, but it could be small and localized. The effect could only temporarily alter the area's hydrology, including surface and ground water flows. *Water quality*: Impacts could result in a detectable change to water quality, but the change could be expected to be small and localized. Impacts could quickly become undetectable. State water quality standards as required by the CWA could not be exceeded. *Floodplains*: Impacts may result in a detectable change to natural and beneficial floodplain values, but the change could be expected to be small, and localized. There could be no appreciable increased risk of flood loss including impacts on human safety,	*Hydrology*: The effect on hydrology could be measurable, but small and limited to local and adjacent areas. The effect could permanently alter the area's hydrology, including surface and ground water flows. *Water quality*: Effects to water quality could be observable over a relatively large area. Impacts could result in a change to water quality that could be readily detectable and limited to local and adjacent areas. Change in water quality could persist; however, it could likely not exceed state water quality standards as required by the CWA. *Floodplains*: Impacts could result in a change to natural and beneficial floodplain values and could be readily detectable, but limited to local and adjacent areas. Location of operations	*Hydrology*: The effect on hydrology could be measurable and widespread. The effect could permanently alter hydrologic patterns including surface and ground water flows. *Water quality*: Impacts could likely result in a change to water quality that could be readily detectable and widespread. Impacts could likely result in exceedance of state water quality standards and/or could impair designated uses of a water body. *Floodplains*: Impacts could result in a change to natural and beneficial floodplain values that could have substantial consequences over a widespread area. Location of operations could increase risk of flood loss, including impacts on human safety, health, and welfare.

Resource	Impact Duration	Minor Intensity	Moderate Intensity	Major Intensity
		health, and welfare. *Wetlands*: The effect on wetlands could be measurable but small in terms of area and the nature of the impact. A small impact on the size, integrity, or connectivity could occur; however, wetland function could not be affected, and natural restoration could occur if left alone.	in floodplains could increase risk of flood loss, including impacts on human safety, health, and welfare. *Wetlands*: The action could cause a measurable effect on wetlands indicators (size, integrity, or connectivity) or could result in a permanent loss of wetland acreage across local and adjacent areas. However, wetland functions could only be permanently altered in limited areas	*Wetlands*: The action could cause a permanent loss of wetlands across a widespread area. The character of the wetlands could be changed so that the functions typically provided by the wetland could be permanently lost.
Air Quality	Short-term: During construction period. Long-term: Over the life of the project or longer.	The impact on air quality may be measurable, but could be localized and temporary, such that the emissions do not exceed the USEPA's de minimis criteria for a general conformity determination under the CAA (40 CFR § 93.153).	The impact on air quality could be measurable and limited to local and adjacent areas. Emissions of criteria pollutants could be at USEPA's de minimis criteria levels for general conformity determination.	The impact on air quality could be measurable over a widespread area. Emissions are high, such that they could exceed USEPA's de minimis criteria for a general conformity determination.
Noise	Short-term: During construction period. Long-term: Over the life of the project or longer.	Disturbance to geologic features or soils could be detectable but could be small and localized. There could be no changes to local geologic features or soil characteristics. Erosion and/or compaction could occur in localized areas.	Disturbance could occur over local and immediately adjacent areas. Impacts to geology or soils could be readily apparent and result in changes to the soil character or local geologic characteristics. Erosion and compaction impacts could occur over local and immediately adjacent areas.	Disturbance could occur over a widespread area. Impacts to geology or soils could be readily apparent and could result in changes to the character of the geology or soils over a widespread area. Erosion and compaction could occur over a widespread area. Disruptions to substrates or soils may be permanent.

Resource	Impact Duration	Minor Intensity	Moderate Intensity	Major Intensity
Biological Resources				
Habitats	Short-term: Lasting less than two growing seasons. Long-term: Lasting longer than two growing seasons.	Impacts on native vegetation may be detectable but could not alter natural conditions and could be limited to localized areas. Infrequent disturbance to individual plants could be expected but would not affect local or range-wide population stability. Infrequent or insignificant one-time disturbance to locally suitable habitat could occur, but sufficient habitat could remain functional at both the local and regional scales to maintain the viability of the species. Opportunity for increased spread of non-native species could be detectable but temporary and localized and could not displace native species populations and distributions.	Impacts on native vegetation could be measurable but limited to local and adjacent areas. Occasional disturbance to individual plants could be expected. These disturbances could affect local populations negatively but could not be expected to affect regional population stability. Some impacts might occur in key habitats, but sufficient local habitat could retain function to maintain the viability of the species both locally and throughout its range. Opportunity for increased spread of non-native species could be detectable and limited to local and adjacent areas but could only result in temporary changes to native species population and distributions.	Impacts on native vegetation could be measurable and widespread. Frequent disturbances of individual plants could be expected, with negative impacts to both local and regional population levels. These disturbances could negatively affect range-wide population stability. Some impacts might occur in key habitats, and habitat impacts could negatively affect the viability of the species both locally and throughout its range. Actions could result in the widespread increase of non-native species, resulting in broad and permanent changes to native species populations and distributions
Terrestrial Wildlife	Short-term: Lasting up to two breeding seasons, depending on length of breeding season. Long-term: Lasting more than two breeding seasons.	Impacts to native species, their habitats, or the natural processes sustaining them could be detectable, but localized, and could not measurably alter natural conditions. Infrequent responses to disturbance by some individuals could be expected, but without interference to feeding, reproduction, resting, migrating, or other factors affecting population levels. Small changes to local population numbers, population structure, and other demographic factors could occur. Sufficient habitat	Impacts on native species, their habitats, or the natural processes sustaining them could be measurable but limited to local and adjacent areas. Occasional responses to disturbance by some individuals could be expected, with some negative impacts to feeding, reproduction, resting, migrating, or other factors affecting local population levels. Some impacts might occur in key habitats. However, sufficient population numbers or habitat could retain function to maintain the viability of	Impacts on native species, their habitats, or the natural processes sustaining them could be detectable and widespread. Frequent responses to disturbance by some individuals could be expected, with negative impacts to feeding, reproduction, migrating, or other factors resulting in a decrease in both local and range-wide population levels and habitat type. Impacts could occur during critical periods of reproduction or in key habitats and could result in direct mortality or loss of

Resource	Impact Duration	Minor Intensity	Moderate Intensity	Major Intensity
		could remain functional at both the local and range-wide scales to maintain the viability of the species. Opportunity for increased spread of non-native species could be detectable but temporary and localized, and these species could not displace native species populations and distributions.	the species both locally and throughout its range. Opportunity for increased spread of non-native species could be detectable and limited to local and adjacent areas but could only result in temporary changes to native species population and distributions.	habitat that might affect the viability of a species. Local population numbers, population structure, and other demographic factors might experience large changes or declines. Actions could result in the widespread increase of non-native species resulting in broad and permanent changes to native species populations and distributions.
Marine and Estuarine Fauna	Short-term: Lasting up to two spawning seasons, depending on length of season. Long-term: Lasting more than two spawning seasons.	Impacts could be detectable and localized but small. Disturbance of individual species could occur; however, there could be no change in the diversity or local populations of marine and estuarine species. Any disturbance could not interfere with key behaviors such as feeding and spawning. There could be no restriction of movements daily or seasonally. Opportunity for increased spread of non-native species could be detectable but temporary and localized and could not displace native species populations and distributions.	Impacts could be readily apparent and result in a change in marine and estuarine species populations in local and adjacent areas. Areas being disturbed may display a change in species diversity; however, overall populations could not be altered. Some key behaviors could be affected but not to the extent that species viability is affected. Some movements could be restricted seasonally. Opportunity for increased spread of non-native species could be detectable and limited to local and adjacent areas but could only result in temporary changes to native species population and distributions.	Impacts could be readily apparent and could substantially change marine and estuarine species populations over a wide-scale area, possibly river-basin-wide. Disturbances could result in a decrease in fish species diversity and populations. The viability of some species could be affected. Species movements could be seasonally constrained or eliminated. Actions could result in the widespread increase of non-native species resulting in broad and permanent changes to native species populations and distributions.
Protected Species	Short-term: Lasting up to one breeding/ growing season.	Impacts on protected species, their habitats, or the natural processes sustaining them could be detectable, but small and localized, and could not measurably alter natural conditions. Impacts could	Impacts on protected species, their habitats, or the natural processes sustaining them could be detectable and some alteration in the numbers of protected species or occasional responses to disturbance by some	Impacts on protected species, their habitats, or the natural processes sustaining them could be detectable, widespread, and permanent. Substantial impacts to the population numbers of protected species, or

Resource	Impact Duration	Minor Intensity	Moderate Intensity	Major Intensity
	Long-term: Lasting more than one breeding/growing season.	likely result in a "may affect, not likely to adversely affect" determination for at least one listed species.	individuals could be expected, with some negative impacts to feeding, reproduction, resting, migrating, or other factors affecting local and adjacent population levels. Impacts could occur in key habitats, but sufficient population numbers or habitat could remain functional to maintain the viability of the species both locally and throughout their range. Some disturbance to individuals or impacts to potential or designated critical habitat could occur. Impacts could likely result in a "may affect, likely to adversely affect" determination for at least one listed species. No adverse modification of critical habitat could be expected.	interference with their survival, growth, or reproduction could be expected. There could be impacts to key habitat, resulting in substantial reductions in species numbers. Results in an "is likely to jeopardize proposed or listed species/adversely modify proposed or designated critical habitat (impairment)" determination for at least one listed species.
Socioeconomic Resources				
Socioeconomics and Environmental Justice	Short-term: During construction period. Long-term: Over the life of the project or longer.	A few individuals, groups, businesses, properties, or institutions could be affected. Impacts could be small and localized. These impacts are not expected to substantively alter social and/or economic conditions. Actions could not disproportionately affect minority and low-income populations.	Many individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily apparent and detectable in local and adjacent areas and could have a noticeable effect on social and/or economic conditions. Actions could disproportionately affect minority and low-income populations. However, the impact could be temporary and localized.	A large number of individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily detectable and observed, extend over a widespread area, and have a substantial influence on social and/or economic conditions. Actions could disproportionately affect minority and low-income populations, and this impact could be permanent and widespread.
Cultural Resources	Short-term: During construction period.	The disturbance of a site(s), building, structure, or object could be confined to a small area with little, if any, loss	Disturbance of a site(s), building, structure, or object not expected to result in a substantial loss of important cultural information.	Disturbance of a site(s), building, structure, or object could be substantial and may result in the loss of most or all

Resource	Impact Duration	Minor Intensity	Moderate Intensity	Major Intensity
	Long-term: Over the life of the project or longer.	of important cultural information potential.		its potential to yield important cultural information.
Infrastructure and Transportation	Short-term: During construction period. Long-term: Over the life of the project or longer.	The action could affect public services or utilities, but the impact could be localized and within operational capacities. There could be negligible increases in local daily traffic volumes resulting in perceived inconvenience to drivers but no actual disruptions to traffic.	The action could affect public services or utilities in local and adjacent areas and the impact could require the acquisition of additional service providers or capacity. Detectable increase in daily traffic volumes (with slightly reduced speed of travel), resulting in slowed traffic and delays, but no change in level of service (LOS). Short service interruptions (temporary closure for a few hours) to roadway and railroad traffic could occur.	The action could affect public services or utilities over a widespread area resulting in the loss of certain services or necessary utilities. Extensive increase in daily traffic volumes (with reduced speed of travel) resulting in an adverse change in LOS to worsened conditions. Extensive service disruptions (temporary closure of one day or more) to roadways or railroad traffic could occur.
Land and Marine Management	Short-term: During construction period. Long-term: Over the life of the project or longer.	The action could require a variance or zoning change or an amendment to a land use, area comprehensive, or management plan, but could not affect overall use and management beyond the local area.	The action could require a variance or zoning change or an amendment to a land use, area comprehensive, or management plan, and could affect overall land use and management in local and adjacent areas.	The action could cause permanent changes to and conflict with land uses or management plans over a widespread area.
Tourism and Recreation	Short-term: During construction period. Long-term: Over the life of the project or longer.	There could be partial developed recreational site closures to protect public safety. The same site capacity and visitor experience could remain unchanged after construction. The impact could be detectable and/or could only affect some recreationists. Users could likely be aware of the action but changes in use could be slight. There could be partial closures to protect public safety. Impacts could be local. There could be a change in local recreational opportunities; however, it could affect relatively few	There could be complete site closures to protect public safety. However, the sites could be reopened after activities occur. There could be slightly reduced site capacity. The visitor experience could be slightly changed but still available. The impact could be readily apparent and/or could affect many recreationists locally and in adjacent areas. Users could be aware of the action. There could be complete closures to protect public safety. However, the areas could be reopened after activities occur. Some users	All developed site capacity could be eliminated because developed facilities could be closed and removed. Visitors could be displaced to facilities over a widespread area and visitor experiences could no longer be available in many locations. The impact could affect most recreationists over a widespread area. Users could be highly aware of the action. Users could choose to pursue activities in other available regional areas.

Resource	Impact Duration	Minor Intensity	Moderate Intensity	Major Intensity
		visitors or could not affect any related recreational activities.	could choose to pursue activities in other available local or regional areas.	
Fisheries and Aquaculture	Short-term: During construction period. Long-term: Over the life of the project or longer.	A few individuals, groups, businesses, properties, or institutions could be affected. Impacts could be small and localized. These impacts are not expected to substantively alter social and/or economic conditions.	Many individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily apparent and detectable in local and adjacent areas and could have a noticeable effect on social and/or economic conditions.	A large number of individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily detectable and observed, extend over a widespread area, and could have a substantial influence on social and/or economic conditions.
Marine Transportation	Short-term: During construction period. Long-term: Over the life of the project or longer.	The action could affect public services or utilities, but the impact could be localized and within operational capacities. There could be negligible increases in local daily marine traffic volumes, resulting in perceived inconvenience to operators but no actual disruptions to transportation.	The action could affect public services or utilities in local and adjacent areas, and the impact could require the acquisition of additional service providers or capacity. Detectable increase in daily marine traffic volumes could occur (with slightly reduced speed of travel), resulting in slowed traffic and delays. Short service interruptions	The action could affect public services utilities over a widespread area resulting in the loss of certain services or necessary utilities. Extensive increase in daily marine traffic volumes could occur (with reduced speed of travel), resulting in extensive service disruptions (temporary closure of one day or more).
Aesthetics and Visual Resources	Short-term: During construction period. Long-term: Over the life of the project or longer.	There could be a change in the view shed that was readily apparent but could not attract attention, dominate the view, or detract from current user activities or experiences.	There could be a change in the view shed that was readily apparent and attracts attention. Changes could not dominate the viewscape, although they could detract from the current user activities or experiences.	Changes to the characteristic views could dominate and detract from current user activities or experiences.
Public Health and Safety	Short-term: During construction period. Long-term: Over the life of the project or longer.	Actions could not result in (1) soil, ground water, and/or surface water contamination, (2) exposure of contaminated media to construction workers or transmission line operations personnel, and/or (3) mobilization and migration of contaminants currently in the soil,	Project construction and operation could result in (1) exposure, mobilization and/or migration of existing contaminated soil, ground water, or surface water to an extent that requires mitigation, and/or (2) could introduce detectable levels of contaminants to soil, ground water,	Actions could result in (1) soil, ground water, and/or surface water contamination at levels exceeding federal, state, or local hazardous waste criteria, including those established by 40 CFR § 261, (2) mobilization of contaminants currently in the soil, ground water, or surface water,

Resource	Impact Duration	Minor Intensity	Moderate Intensity	Major Intensity
		ground water, or surface water at levels that could harm the workers or general public. Increased risk of potential hazards (e.g., increased likelihood of storm surge) to visitors, residents, and workers from decreased shoreline integrity could be temporary and localized.	and/or surface water in localized areas within the project boundaries such that mitigation/remediation is required to restore the affected area to the preconstruction conditions. Increased risk of potential hazards to visitors, residents, and workers from decreased shoreline integrity could be sufficient to cause a permanent change in use patterns and area avoidance in local and adjacent areas.	resulting in exposure of humans or other sensitive receptors such as plants and wildlife to contaminant levels that could result in health effects, and (3) the presence of contaminated soil, ground water, or surface water within the project area, exposing workers and/or the public to contaminated or hazardous materials at levels exceeding those permitted by the federal Occupational Safety and Health Administration (OSHA) in 29 CFR § 1910. Increased risk of potential hazards to visitors, residents, and workers from decreased shoreline integrity could be substantial and could cause permanent changes in use patterns and area avoidance over a widespread area.

Appendix D – Monitoring and Adaptive Management (MAM) Plan

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

Large-Scale Marsh Creation –

Upper Barataria Component

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1 INTRODUCTION

The Deepwater Horizon (DWH) Louisiana Trustee Implementation Group (TIG)[7] developed this monitoring and adaptive management plan (MAM plan) for the Large-scale Marsh Creation – Upper Barataria Component (LSBMC-UBC) Project (the project), which represents one of three projects selected from within the broader *Strategic Restoration Plan and Environmental Assessment #3: Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin, Louisiana (SRP/EA)* in March 2018. The objective of the project is the creation of approximately 1,163 acres intertidal marshes that would restore interspersed and ecologically connected coastal habitats in the upper Barataria Basin. The purpose of this MAM plan is to identify monitoring activities that will be conducted to evaluate and document restoration effectiveness, including performance criteria for determining restoration success or need for interim corrective action (15 Code of Federal Regulations [CFR] 990.55(b)(1)(vii)). Where applicable, the MAM plan identifies key sources of uncertainty and incorporates monitoring data and decision points that address these uncertainties. It also establishes a decision-making process for incorporating adjustments where needed. There are three primary purposes for MAM plans:

1. Identify and document how restoration managers will measure and track progress toward achieving restoration goals and objectives
2. Before a project begins, increase the likelihood of successful implementation through identification of potential corrective actions that could be undertaken if the project does not proceed as expected
3. In a systematic way, ensure the capture of lessons learned or new information acquired that can be incorporated into future project selection, design, and implementation

The MAM plan is a living document and may be updated as needed to reflect changing conditions and/or new information. For example, the MAM plan may need to be revised should the project design change, if initial data analysis indicates that the sampling design requires adjustment, or if any existing uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any future revisions to the MAM plan will be made available through the Restoration Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the DWH Natural Resource Damage Assessment (NRDA) Trustees' website (http://www.restoration.noaa.gov/dwh/storymap/).

2 PROJECT OVERVIEW

This project is being implemented as restoration for the *DWH* oil spill Natural Resource Damage Assessment (NRDA), consistent with the PDARP/PEIS (DWH Trustees, 2016).

[7] The Louisiana TIG includes the following members: Louisiana State Trustees include the Louisiana Coastal Protection and Restoration Authority (CPRA); Louisiana Department of Environmental Quality (LDEQ); Louisiana Department of Wildlife and Fisheries (LDWF); and Louisiana Department of Natural Resources (LDNR); Louisiana Oil Spill Coordinator's Office. Federal Trustees include Department of the Interior (DOI), the National Oceanic and Atmospheric Administration (NOAA), U.S. Environmental Protection Agency (USEPA), and U.S. Department of Agriculture (USDA).

- Programmatic goal: Restore and Conserve Habitat
- Restoration type: Wetlands, Coastal, and Nearshore Habitats Restoration
- Restoration approach: Create, restore, and enhance coastal wetlands
- Restoration technique: Create or enhance coastal wetlands through placement of dredged material
- TIG: Louisiana TIG
- Restoration plan: Strategic Restoration Plan and Environmental Assessment (RP/EA) #3.3 Large-Scale Barataria Marsh Creation: Upper Barataria Component (BA-207)

This restoration project is being implemented within the Upper Barataria Basin (FIGURE 1). Restoration activities involve:

- Excavation of approximately 10.5 million cubic yards (MCY) of sediment from borrow areas in the Mississippi River, pipeline construction, and transport of the material along the 13.3-mile Long-Distance Sediment Pipeline (LDSP) access corridor;
- Construction of approximately 46,635 linear feet of earthen containment dikes using onsite (in-situ) borrow material to contain the created marsh platform; and
- Discharge of borrow material into Marsh Creation Areas (MCAs) to create approximately 1,163 acres of intertidal marsh in the Project Area.

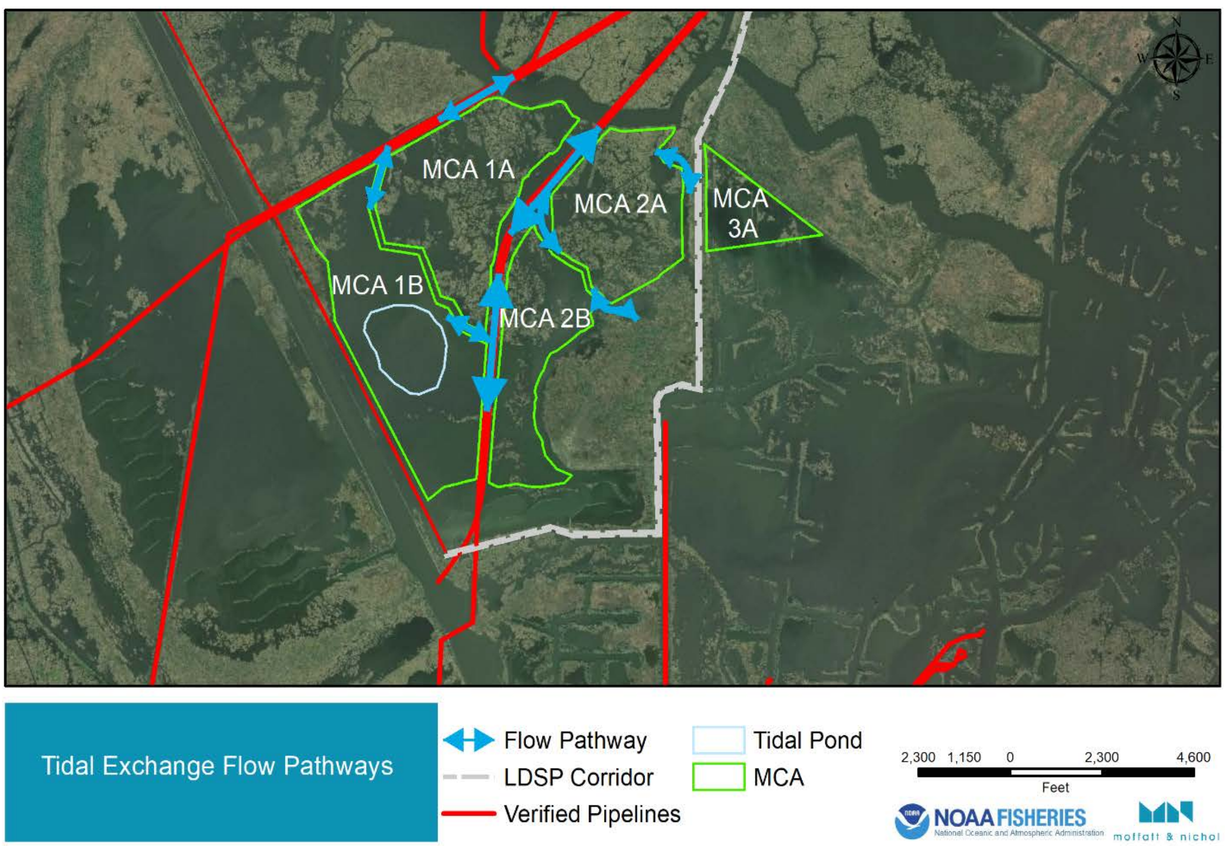

FIGURE 1. Project area.

This project is intended to restore for habitats and resources of the same type injured from the *Deepwater Horizon* oil spill, which included significant injuries to Louisiana's coastal marshes on which fish and wildlife species such as shrimp, fish, oysters, birds, sea turtles, and marine mammals in the Barataria Basin depend for one or more of their life stages (DWH Trustees, 2016). These injuries ranged from a threefold increase in coastal erosion in heavily oiled marshes to decreased growth rates and mortality in some species. Additional ecosystem services that may be provided by these marshes include protecting coastal areas from storm flooding and erosion, driving coastal food webs and fisheries, cycling nutrients, storing carbon and even self-maintenance of the marshes (Barbier et al., 2011; NAS, 2017).

The implementing agency for the project is the National Oceanic and Atmospheric Administration (NOAA).

2.1 Restoration Type Goals and Project Restoration Objectives

The primary goal of the project is the creation of approximately 1,163 acres intertidal marshes that would restore interspersed and ecologically connected coastal habitats in the upper Barataria Basin (refer to Section 3 of the Final RP/EA #3.3 for greater detail about the project).

Restoration Type Goals

The overall programmatic goal for this project is to Restore and Conserve Habitat. The Restoration Type is Wetlands, Coastal, and Nearshore Habitats Restoration. The goals of this Restoration Type, outlined in Section 5.5.2.1 of the PDARP/PEIS are to (DWH Trustees, 2016):

- 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.

Project Restoration Objectives

This project will create and/or restore approximately 1,163 acres of tidal intermediate and brackish marshes along the degraded Barataria Land Bridge. The Land Bridge formerly prevented saltwater intrusion into the Upper Barataria Basin from the Lower Barataria Basin, supported freshwater and intermediate tidal marsh habitat, and reduced the adverse impacts of coastal flooding and erosion. The project will create marsh that will compensate, in part, for marsh losses in the Barataria Basin that resulted from the DWH oil spill. Specific project restoration objectives are identified below:

Marsh creation: Create approximately 1,163 acres intertidal marshes in the upper Barataria Basin. The project would be located south of The Pen in Jefferson Parish, Louisiana and would remain for a 20-year Project life following construction. Using land loss rates and land:water ratios applied to the adjacent Bayou Dupont marsh creation project (BA-48), and assuming similar rates of ongoing subsidence and erosion over the project life, the created marsh under the preferred alternative would have a net gain of 826 acres after 20 years (Donna Rogers, pers.comm. 23 Jan 2020).

Basin Connectivity: Create and/or restore interspersed and ecologically connected marshes in the upper Barataria Basin by constructing gaps between MCAs that will ensure hydrologic and biologic connection among MCAs.

- Tidal channels, tidal pond, and marsh are hydrologically connected to the larger Barataria Basin ecosystem.
- The new marsh sub-habitats are utilized by the target nekton species.

Productivity: Increase vegetation and nekton productivity in the project area. Vegetation biomass will be used to provide a measure of primary productivity, while nekton biomass will provide a measure of secondary productivity in the system.

- Primary productivity is not significantly less in MCAs when compared to the reference marsh associated with CRMS0248.
- Nekton species abundance increases over Project life, as indicated by four representative species.

Learning Goals

In addition to goals and objectives, this project will also support learning goals related to whether ecosystem services are enhanced by hydrologic and biological connectivity and by marsh edge type (e.g., unconfined and diked marsh edges, both of which would be created as part of the MCA construction). Learning goals are discussed in Section 5.

2.2 Conceptual Setting

The purpose of the conceptual setting within the MAM plan is to identify, document, and communicate interactions and linkages among system components in the project area and to understand how the system works and may be affected by the proposed restoration (see MAM Manual). The primary action is the placement of dredged material into MCAs to target elevations that are adequate to support colonization and establishment of intermediate and brackish marsh vegetation (TABLE 1).

TABLE 1. Conceptual model for the project.

Restoration Action	As-built Design	Interim	Restoration Goal
Place hydraulically dredged sediments along existing subtidal areas to create a marsh platform	1,163 acres of marsh platform	• Fill sediments compact and dewater	Intermediate and brackish marsh habitat is restored and provides ecological services that contribute to making the environment and the

Restoration Action	As-built Design	Interim	Restoration Goal
		• Marsh vegetation community becomes established	public whole for spill-related injuries to these habitats

Interactions and linkages among system components in the project area are critical to the marsh creation goal. A study of marsh loss in Louisiana by Schoolmaster (2018) indicated that "vegetation cover in prior year was the best single predictor of subsequent loss … followed by changes in percent land and tidal amplitude." Other outside drivers of marshes, marsh processes, and stressors have been reviewed and described by numerous authors (e.g., Cahoon et al., 2009; Kneib et al., 2008; Schoolmaster et al., 2018) and include, but are not limited to, those listed below.

- Hydrologic regime
- Precipitation
- Subsidence
- Sea level rise
- Sediment accretion/erosion
- Invasive species
- Physical impacts (e.g., oil and gas infrastructure)
- Freshwater inflow
- Sediment input/load
- Nutrients
- Storms/wave energy
- Grazing/herbivory by nutria
- Adjacent land cover/ landforms
- Chemical impacts (e.g., oil spills)

Implementation of the project is designed to influence habitat, specifically marsh biodiversity, and productivity. Relationships between and among ecological components that are influenced by the project, and/or influence the outcomes of the project, make up the linkages between and among marsh physical and process components. Some of these linkages are listed below.

- Tides and freshwater flows at the terrestrial and aquatic interface
- Aquatic/terrestrial interface and nutrients, pollutants, and sediments
- Aquatic/terrestrial animals and marsh structure and processes, and nutrients, pollutants, and sediments
- Tides and water characteristics (e.g., salinity), inundation, nekton, and imported and exported productivity
- Nekton and nutrients, pollutants, and sediments, marsh structure and processes
- Marsh structure and processes and nutrients, pollutants, sediments, water characteristics, and productivity
- Erosion effects on production, decomposition, and accretion
- Accretion effects on compaction and subsidence, elevation, species biodiversity and productivity
- Compaction and subsidence effects on erosion and desiccation

- Production, biomass and decomposition effects on animal and emergent plant biodiversity and architecture.
- Marsh structure on water quality and characteristics, elevation, inundation, productivity, biodiversity

A simple diagrammatic conceptual model of drivers (white boxes), ecological factors or effects (tan boxes), and linkages (arrows) is provided in FIGURE 2. The most direct or strongest linkages are between ecosystem components, including those between ecosystem processes and the largely external environmental drivers, such as climatic, hydrogeomorphic, and anthropogenic drivers (TABLE 2). Condition of the overall system can be assessed by monitoring factors and functions that contribute to ecosystem services, such as water depth and duration, marsh morphology, and primary and secondary productivity.

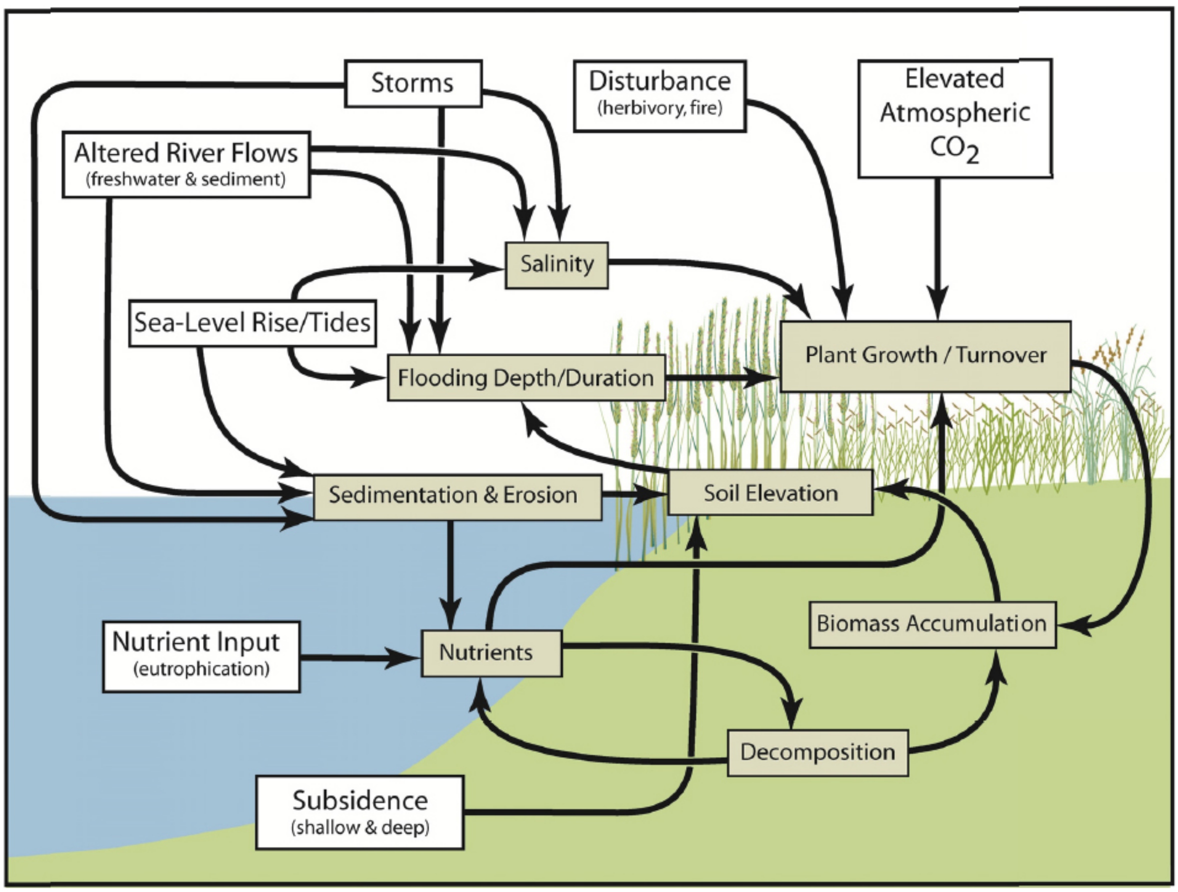

FIGURE 2. Conceptual model of a tidal marsh with substantial tidal inputs of sediment as influenced by environmental drivers (white boxes), factors (tan boxes) affecting accretion processes, and linkages (arrows) (directly from Cahoon et al., 2009).

TABLE 2. Conceptual ecological model (modified after Allen et al., 2018).

Environmental Drivers	**Climatic** Carbon dioxide, sea level rise (SLR), temperature, precipitation	**Hydrogeomorphic** Hydrology, current and wave energy, compaction, faulting, tidal inundation	**Anthropogenic** Land use, pollution, restoration and management, hydrologic modification
Major Ecological Factors	**Abiotic** Hydrology (flood depth, duration, frequency), water quality, soils	**Ecosystem Structure** Marsh morphology (land aggregation), plant and microbial community structure	**Ecosystem Function** Elevation change (submergent vulnerability), primary and secondary production, decomposition, biogeochemical cycling
Major Ecosystem Services	**Supporting** Habitat, sediment stability, marsh dispersion	**Regulating** Coastal protection (e.g., erosion), water quality, carbon sequestration	**Cultural** Aesthetic, recreation opportunities, commercial and subsistence fishing

2.3 Sources of Uncertainty

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). Potential uncertainties associated with the project are listed in TABLE 3. Monitoring activities can then be selected and implemented to inform these uncertainties and to select appropriate corrective actions in the event the project is not meeting its performance criteria.

TABLE 3. Sources of project uncertainty and potential impacts.

Uncertainty	Potential Impact
Sea-level rise (SLR)	SLR uncertainty can result in poor hydrologic predictions and site selection, which may then result in Project failure due to too much or too little inundation.
Storm events or other large disturbances	Storm events before or after the project is completed that are strong enough to breach ECDs can result in loss of sediment from MCAs, and ultimately project failure or reduced performance.
Mid-Barataria sediment diversion (MBSD)	Implementation of the proposed MBSD and the subsequent sediment, freshwater, and nutrient inputs into the MCAs will likely affect accretion and primary productivity of the project area.
Invasive species	Without vegetation plantings, MCAs will quickly be colonized by surrounding vegetation, including invasive species that may outcompete native species and reduce biodiversity and the value of the habitat for fish and wildlife. The value of the invasive Eurasian haplotype of *Phragmites (*which is expected to become dominant) as habitat and substrate stabilization would outweigh its adverse impacts.

Uncertainty	Potential Impact
Hydrology (e.g., depth, duration, flood frequency) for sustainable marsh	Hydrologic conditions will vary with rainfall, freshwater diversion operations, and storm events, and may be as unpredictable as storm events.
Vegetation colonization and establishment	Without planting, vegetation percent cover is expected to be the same as undisturbed marshes after about 2 years, although species diversity may be lower, based on recent nearby studies (Howard et al. 2019).
Land use changes and/or new barriers	Changes can alter hydrology, sediment inputs, and/or water quality.
Target elevations reached	Marsh platform will be low enough to receive tidal inundation and high enough to be exposed at low tide once sediments settle
Timely Project completion	Important for availability of borrow material in advance of potential MBSD operation

3 PROJECT MONITORING

Successful implementation of the project will be measured by assessing the performance of the restored intermediate and brackish marsh habitat. Performance will be evaluated using both qualitative and quantitative measures related to the Project goals and objectives. Prior to monitoring activities undertaken for this MAM plan, aerial photography of the pipeline corridor and MCAs will be included as part of the pre- and post- construction activity phases, as described in the construction contract for the project and detailed in the USGS Digital Orthoimagery Base Specification V1.0 (https://pubs.usgs.gov/tm/11/b5/pdf/tm11-B5.pdf).

Performance monitoring is organized by restoration objective, with each objective having one or more monitoring parameters. Each parameter provides information on the monitoring methods, timing and frequency, sample size, sampling sites, performance criteria, and potential corrective actions.

Louisiana's Coastal Protection and Restoration Authority (CPRA) currently maintains a monitoring program that provides ecological data and research to support the planning, design, construction, evaluation, and adaptive management of Louisiana's wetland restoration projects (Folse et al., 2020). This Coast-wide Reference Monitoring System – Wetlands (CRMS) (http://lacoast.gov/crms2/Home.aspx) was developed and implemented to improve the monitoring program's effectiveness in evaluating individual restoration projects, as well as the combined effects of multiple projects, by providing a network of reference sites where data are collected on a regular basis (Steyer et al., 2003). To the extent possible, the monitoring methods used for the project will be consistent with the methods described in Folse et al. (2020).

This MAM plan was developed to evaluate project performance, key uncertainties, and potential corrective actions, if needed. For each of the identified monitoring parameters, information is provided on the intended purpose (e.g., monitor progress toward meeting one or more of the restoration objectives, support adaptive management of the project, inform learning goals to improve future projects), monitoring methods, timing and frequency, duration, sample size, and sites. Further, these parameters will be monitored to demonstrate how the project is trending toward the performance criteria and to inform the need for corrective actions (see Section 6, Project-Level Decisions). Additional monitoring parameters may be implemented to more fully characterize the Project's effectiveness. Monitoring parameters for the Project are described below, listed under corresponding project objectives. Performance criteria and potential corrective actions are identified in Section 6 of this MAM plan.

3.1 Objective #1 Marsh Creation

Create and restore an estimated 1,163 acres of intermediate and brackish tidal marsh south of The Pen in Jefferson Parish, Louisiana, that experiences the same or lower rates of erosion as that experienced by other Barataria marshes during the 20-year designed project life.

Parameter #1 Spatial Extent (Acres) of Tidal Marsh Platform

This parameter will measure the acres of tidal marsh platform. As built topographic surveys and water level data will be used to measure the tidal inundation of the marsh platform. The extent of marsh will also inform marsh dispersion.

Methods:

1. Collect post-construction topographic survey data over the life of the project using RTK GPS (Real Time Kinematic Global Positioning System) methods and/or another equivalent method. Elevation data will indicate inundation level and frequency of the created marsh area. Protocols will follow those in Folse et al. (2020).
2. Acquire pre- and post- construction high-resolution, near vertical, orthorectified aerial imagery, over the life of the project. The data will assist in the quantification of spatial extent and fragmentation of the created marsh area. Protocols will follow those of USGS (https://pubs.usgs.gov/tm/11/b5/pdf/tm11-B5.pdf) and rely on the coastwide aerials flown every three years.
3. Collect settlement plate elevation data post-construction, including as-builts, to record/document the magnitude and rate of settlement under the fill material.

Timing and Frequency:

1. Four topographic surveys will be acquired: shortly after fill placement is completed (as-builts), three years after construction, and two more times over the project life (see monitoring schedule, Section 7) during the same year as aerial imagery if possible.
2. Aerial imagery (every three years). Aerial imagery will be acquired before and after fill placement is completed as part of the construction, and at three-year intervals after that as part of the coastwide aerial photo collection in the fall/winter every three years. Additional aerial imagery may need to be collected following major events such as tropical storms, or changes to the CWPPRA program collection of coastwide imagery.

3. Settlement plate elevations will be surveyed during topographic surveys.

4. Sediment cores will be collected concurrent with vegetation sampling in Year 1.

Sample Size:

1. As-built topographic survey. Construction contractor will survey MCAs after construction along transects spaced at approximately 500 feet and will perform operational corrections to achieve the required spatial extent (acres).

2. Aerial imagery. The spatial extent will capture the constructed marsh area.

3. Settlement plates. Approximately 25 settlement plates (to be determined) will be installed in the MCAs for monitoring. The initial survey of settlement plates will be conducted post-construction by the construction contractor.

4. Sediment cores. A minimum of 20 sediment cores will be collected for analysis consistent with CRMS methods (Folse et al. 2020).

Parameter #2 Land: Water Classification, Marsh Edge, and Fragmentation

Land-water analysis of created marshes will use aerial photography in conjunction with topographic surveys to evaluate the sustainability of the created marsh platform through the Project's 20-year life.

Method:

Land-Water Classification

A land and water classification will be created within the project boundary following the same methods used for the CRMS datasets. Digital Orthophoto Quarter Quadrangles (DOQQs) will be classified into land and water categories. The resulting raster image datasets will have 1-m classified pixels and will be published as a USGS data release, along with a map displaying the orthophotographs and the land water dataset, and associated metadata.

Fragmentation Statistics

The FRAGSTATS program will be used to classify fragmentation metrics for multiple polygons (zonal outputs) within the project area. FRAGSTATS is a spatial pattern analysis program for quantifying the spatial heterogeneity (i.e., composition and configuration) of landscapes and will be applied to measure the level of aggregation or "clumping" in the project area. Spatial pattern metrics describing the shape, isolation, and configuration of habitat patches will be computed based on methods developed by McGarigal & Marks (1995) and available at (http://www.umass.edu/landeco/research/fragstats/fragstats.html). The USGS automated delineation method on existing coastwide imagery, which is flown November/December every 3 years including 2021, will be used in the analysis. Input will be the created land-water datasets. Output will be in the form of a table.

Timing, Frequency, and Duration: A land-water dataset and a fragmentation or "clumping" index will be calculated for imagery collected in 2018 (preconstruction), 2021 or as-built, once in years 6-10, and once in years 11-20. If the project marsh converts to freshwater marsh, then the ratio will need to be based on aerial imagery collected during the spring or summer instead; two off-season imagery collection efforts have been added to the budget to cover this possibility.

Sample Size: The entire project area marshes will be photographed. Classification and statistics will be calculated within the project boundary.

Sites: All MCAs and reference marshes.

3.2 Objective #2 Marsh Connectivity

The project will create tidal channels, tidal pond, and marsh that are hydrologically connected to the larger Barataria Basin ecosystem and new marsh sub habitats that are utilized by the target nekton species.

Parameter #3 Water Levels

Water level measurements will be used to evaluate depth of water and tidal influence in the MCAs for comparison with reference marshes.

Method: Collect water level data in open water habitat using CRMS protocols, as described in Folse et al. (2020), and quantify depth of water for comparison with tidal influence. Use data from CRMS0248 for one year pre-construction and continuously for Project life.

Sample Size: a single station, the nearest CRMS station, CRMS0248.

Parameter #4 Presence and Abundance of Nekton Species

Nekton species and abundance will be used to assess biological connectivity between MCAs and Barataria Basin via constructed tidal channels. Data collected for this parameter will also be used to inform secondary productivity (Parameter #7, below).

For red drum, ~20 acoustic receivers will be placed in the project area. Data will show residence time and utilization of restored areas (movement of tagged red drum in and out of a cell). ~10 receivers will be placed in interior tidal channels and ~10 receivers will be placed around the perimeter, to cover the choke points and marsh creation areas (presence/absence). Also put in tidal pond (~10 receivers). 50 tags (with 3-4 year battery life).

Method: Collect nekton in and near the project area using appropriate gear types (per protocols outlined by LDWF, 2002):

- 50 foot seine and 6 foot trawl (white and brown shrimp, Gulf killifish, blue crabs)
- Throw traps or baited traps on marsh surface (Gulf killifish, blue crabs)
- Use acoustic tagging (red drum) to monitor residence time and use of restored areas (movement in and out of a cell).

Timing, Frequency, and Duration: sampling will include pre- and post-construction events at intervals and frequencies appropriate for each species measured.

- 50 foot seine: pre-construction and post-construction; monthly during every other year for the project life; 3 locations.
- 6 foot trawl: pre-construction and post-construction; twice a month from April – July; every other year for the project life; three locations.
- Throw traps or baited traps on marsh surface; post-construction; every other year for the project life, for gulf killifish. Number of sample locations will be determined by power analysis.
- Crab traps: every year for the project life, for blue crab. Number of sample locations will be determined by power analysis.
- Acoustic tagging of red drum in year 3; acoustic receiver data collection continuously during post-construction years 3, 4, and 5. Year-round monitoring. Approximately 30 receivers (red drum) to monitor residence time and use of restored areas (movement in and out of a cell): ~10 in interior tidal channels and ~10 around the perimeter (presence/absence); ~10 receivers in tidal pond). Include 50 tags (3-4 year battery life).

Sample Size: Monitoring will include three trawl sample sites and three seine sites sampled in the project area. Approximately 50 red drum will be tagged, and approximately 20 acoustic receivers will be placed around the perimeter and within the tidal channels and ponds of the project area. The number and frequency of throw traps and baited traps will be determined by power analysis.

3.3 Objective #3 Marsh Productivity

Parameter #5 Vegetation Cover

Vegetation data will be used to assess the colonization and transition of vegetation on the created marsh platform and berm and to compare this vegetation to vegetation in the reference marsh at CRMS0248.

Method: Sample and record species and Braun-Blanquet cover categories for vegetation in MCAs and reference marsh (Mueller-Dombois & Ellenberg, 1974). Extract porewater from within vegetation plot and record soil salinity. Methods will follow Folse et al. (2020).

Timing, Frequency, and Duration: Monitoring during the eight-week period between August 1 and September 30, sampling and recording vegetation per CPRA protocols in each MCA and reference marsh for years 1, 3, and every three years thereafter to coincide with aerial photography and elevation surveys (Folse et al., 2018). Elevations will be measured at sample sites (following protocols described under Parameter #1).

Sample Size: A minimum of 20 sample plots, of 4 m^2 each, distributed amongst the MCAs and selected reference marsh areas.

Parameter #6 Primary Productivity

Method: Collect belowground biomass in 30-cm length cores and quantify live and dead roots and rhizomes from 0 to 24 cm. Collect aboveground biomass from 0.25 m^2 subplots and use data to calculate change in peak standing crop (the maximum total live and dead biomass collected) over time as a measure of primary production (Folse et al., 2020). Above and belowground biomass will be sampled from within Braun-Blanquet cover plots assigned under Parameter #5 (Vegetation Cover). Sample plots will be separate from CPRA plots to avoid potential impacts to the CPRA monitoring plots.

Timing, Frequency, and Duration: Years 1, 3, and then once per 3 years thereafter, at the end of the growing season (late summer/early fall).

Sample Size: An estimated minimum of 20 sample plots, of 0.25 m^2 each, distributed amongst the MCAs and selected reference marsh areas.

Parameter #7 Secondary Productivity

Secondary productivity will include measure of the changes in productivity (as biomass) of white shrimp, brown shrimp, and blue crab for comparison between the MCAs and the reference marshes. The same methods, timing, frequency, duration, and sample size described for Parameter #4 (Presence and Abundance of Nekton Species) will be used for secondary productivity.

4 ADAPTIVE MANAGEMENT

Monitoring information collected at the project level can also inform adaptive management. Adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty of that individual project (Pastorok et al., 1997; Williams & Brown, 2011). Within the Louisiana TIG, an adaptive management framework has been developed that identifies and characterizes the four main phases and is illustrated within a representative management cycle (see FIGURE 3).

1. Goal-Setting Phase: Problem is identified or defined, and project goals and objectives are established based on multiple sources, including lessons learned, data and associated synthesis, and applied research from previous projects and from the knowledge base as a whole.
2. Development and Execution Phase: Project advances through select steps, including model development or refinement, identification and prioritization of uncertainties, plan formulation, engineering, design, and Project construction.
3. Monitoring and Performance Phase: Project operations, maintenance, and monitoring plans are developed, and Project assessment and evaluation criteria are identified.
4. Adaptive Management Coordination Phase: Project revisions are recommended and approved so that revisions result in alterations and redesign of project elements or changes to project operation and/or inform either the understanding of the overall problem statements or the refinement of attainable or realistic goals and objectives for future projects.

Where there are gaps in scientific understanding, project information collected (see Section 3, Project Monitoring) and evaluated (see Section 5, Evaluation) may be used to reduce key uncertainties and/or inform the selection, design, and optimization of future restoration projects.

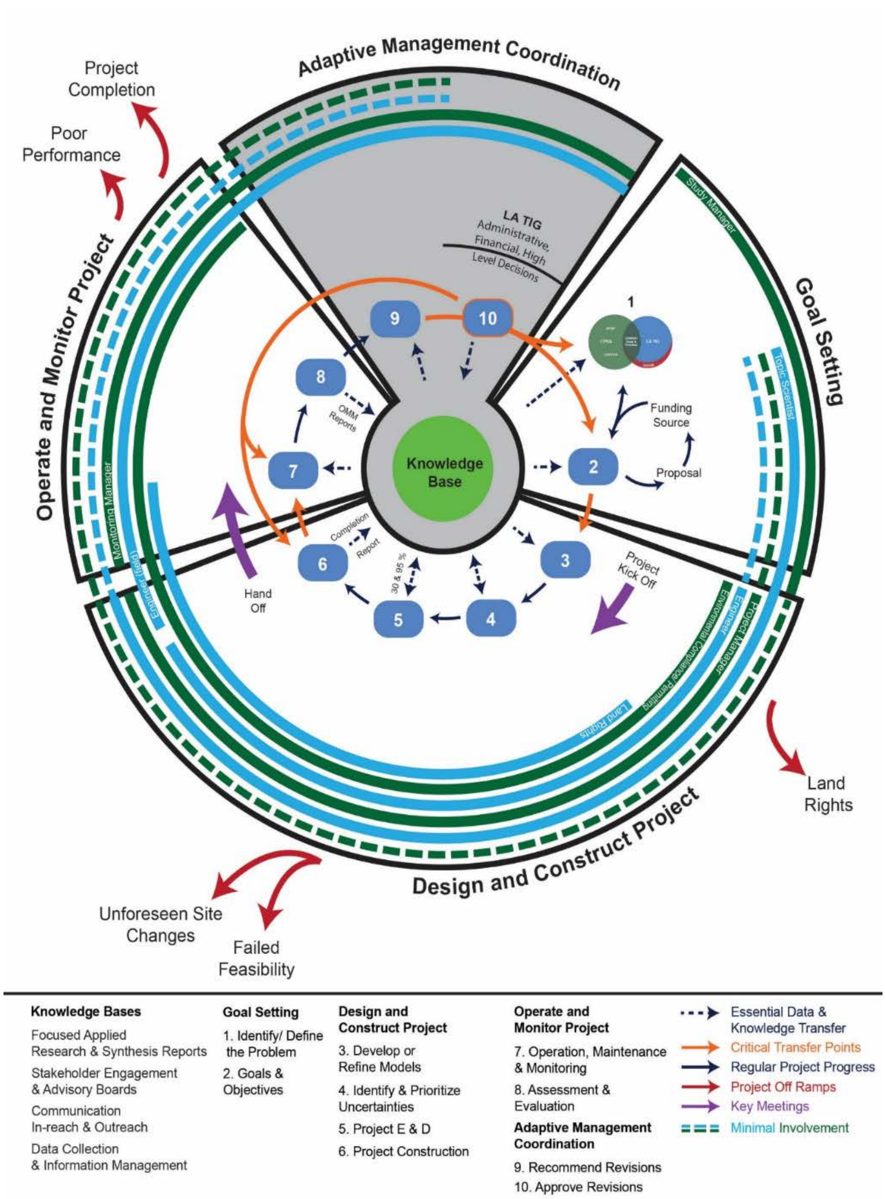

FIGURE 3. Louisiana TIG Adaptive Management Cycle (Source: The Water Institute of the Gulf, 2019).

5 EVALUATION

Monitoring data will be evaluated to assess project performance in meeting restoration objectives, resolving key uncertainties, and determining whether corrective actions are needed. The results of the project evaluation analysis will be used to answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Did the restoration project produce unanticipated effects?
- Were there events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?

The proposed analysis methods for each of the monitoring parameters are included below and will be updated as necessary.

5.1 Marsh Creation

Using aerial orthophotographs, the perimeters of land area and water features within the project area will be digitized. The resulting polygons will be analyzed to determine total marsh area, marsh edge length, ratio of edge to interior, and tidal channel dimensions. Confined and unconfined edges would be distinguished from one another. These metrics will be compared between years to identify trends. Marsh elevation surveys will be evaluated to determine whether the marsh target elevation remains within the desired range throughout the project life. Water level measurements and marsh elevation surveys will be evaluated to determine whether the desired inundation frequency is occurring. Vegetation above-ground and below-ground biomass will be collected and quantified to inform understanding of ecosystem health, elevation gain, and subsurface expansion.

5.2 Connectivity

Hydrologic Connectivity: Water levels measured within the project area and at the nearest CRMS station (CRMS 0248) will be reviewed. If the tidal channels, tidal pond, and constructed marsh are hydrologically connected to the larger Barataria Basin ecosystem, the water levels may demonstrate a tidal signal. However, tidal oscillation usually dominates the water level variation in the summer, while tides are driven primary by wind in the winter (Li et al., 2011). Consequently, differences in tidal signals pre- and post-construction may not be apparent.

Degraded or degrading marsh demonstrates evidence of increased erosion, increased open water, and increased fragmentation across the landscape.

Biological Connectivity: Nekton data collected within each of the marsh subhabitats (tidal pond, tidal channel, marsh edge, and marsh platform) will be analyzed for presence/absence of the four target nekton species (blue crab, Gulf killifish, brown shrimp, and white shrimp).

5.3 Productivity

Primary productivity data for vegetation will be sampled at the end of the growing season (late summer/early fall) for both pre- and post- construction. Vegetative cover and composition will be compared to the corresponding vegetation metrics for the reference marsh at CRMS0248. Nekton data collected within each of the marsh sub-habitats (tidal pond, tidal channel, marsh edge, and marsh platform) will be analyzed for abundance and density of three of the target nekton species (blue crab, brown shrimp, white shrimp). General descriptive statistical analyses may include but are not limited to averages/means of the overall total cover and total cover by species; percent cover of key species; and/or average height of dominant/key species. Statistical comparisons will be made to assess changes in marsh cover and extent to determine if performance criteria are met.

Abundance of shrimp and blue crab in the project area will be compared to other sites in the LDWF network (control sites) using a multiple Before-After-Control-Impact (BACI) design. Many of the other LDWF sites are surrounded by more open water compared to the impact sites, which will be adjacent to the restored area. Using a greater sample size of the control sites will help to control for changes in the overall population, local variation, or other population trends that may not be due to site restoration. Effectiveness of "impact" sites will likely be related to the distance from the restoration site, based on the assumption the impacts will decrease with distance from the restoration site. The sampling design requires impact sites to be adjacent to restoration sites.

5.4 Learning Goals

In addition to performance indicators listed in Section 3, the sediment, vegetation, and nekton data will also be evaluated to address learning goals.

- Gulf killifish proximity to the tidal channels will be evaluated to determine whether connectivity increases the colonization rate.
- Blue crab abundance along the constructed unconfined marsh edge will be compared to the abundance along the diked marsh edge to determine whether abundance is correlated to edge habitat type.
- White and brown shrimp abundance along the unconfined edge will be compared to the abundance along the diked marsh edge to determine whether abundance is correlated to edge habitat type.
- Primary productivity in the MCAs will be compared to primary productivity at a reference site (CRMS0248) to determine whether project size and tidal flow are correlated with vegetation composition, abundance, and primary productivity. Changes in sediment properties (organic content) during the project life will be quantified to increase understanding of how constructed marsh sediments evolve.

6. PROJECT-LEVEL DECISIONS: PERFORMANCE CRITERIA AND POTENTIAL CORRECTION ACTIONS

This section identifies performance criteria for each of the project objectives, and potential corrective actions that could be taken to address each performance criterion that is not met. The evaluation of monitoring data will be used at the project level to determine whether the project is considered successful or whether corrective actions are needed. A project may not be achieving its intended objectives because of previously identified key uncertainties, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers. The decision to implement (or not implement) corrective actions is one type of decision within the larger adaptive management decision-making framework.

6.1 Marsh Creation

Performance Criteria	Potential Management Actions
The total marsh area built is equal to or greater than 1,163 acres.	Contractor will build to design and resurvey to confirm. Project will not be accepted if it is not built to design specifications.
The constructed marsh elevation is three feet (maximum) -0.5 feet NAVD88 immediately following construction.	Contractor will build to design and resurvey to confirm. Project will not be accepted if it is not built to design specifications.
The constructed marsh maintains an elevation of one-foot NAVD88 at the end of the Project life.	Identify errors in assumptions to inform future restoration planning. Identify causes of differential settlement (e.g., interior borrow, fill depth).
The total marsh platform area within the Project area 20 years post-construction does not exhibit a higher erosion rate than the reference marsh at CRMS0248.	Assess whether accelerated erosion is related to the ratio of above-ground to below-ground biomass. Plant species that can tolerate deeper water.

6.2 Connectivity

Performance criteria- Hydrologic Connectivity:

Performance Criteria	Potential Management Actions
Water level data collected at CRMS0248 will show the presence of a tidal signal.	Create additional gaps in containment dikes. Create marsh creeks. Create additional connections for tidal pond.
A measure of connectivity will be developed using FRAGSTATS (consistent with elevation surveys in the monitoring schedule, Section 7). Metrics will be selected that are representative of marsh connectivity, aggregation, disaggregation, and dispersion.	Identify errors in assumptions to inform future restoration planning. Identify causes.
The post-settlement marsh surface inundation will have a 10 to 90 percent exceedance frequency for the 20-year project life.	Identify errors in assumptions to inform future restoration planning. Identify causes of differential settlement (e.g., interior borrow, fill depth). An Operation and Maintenance (O&M) Plan may be added.

Performance criteria- Biological Connectivity:

Performance Criteria	Potential Management Actions
Tidal ponds have red drum, brown shrimp, white shrimp, Gulf killifish, and blue crab present.	Identify potential cause: accessibility, comparison to abundance at reference site. Evaluate monitoring protocols and substitute sampling gear types. For red drum, expand

Performance Criteria	Potential Management Actions
	VPS array and/or add additional year of VPS array monitoring.
Tidal channels have red drum, brown shrimp, white shrimp, Gulf killifish, and blue crab present.	Identify potential cause: accessibility, comparison to abundance at reference site. Evaluate monitoring protocols and substitute sampling gear types. For red drum, expand VPS array and/or add additional year of VPS array monitoring.
Marsh edge has brown shrimp, white shrimp, Gulf killifish, and blue crab present.	Identify potential cause: accessibility, comparison to abundance at reference site. Evaluate monitoring protocols and substitute sampling gear types.
Marsh platform has brown shrimp, white shrimp, Gulf killifish, and blue crab present.	Identify potential cause: accessibility, comparison to abundance at reference site. Evaluate monitoring protocols and substitute sampling gear types.
Unvegetated bottom has red drum, brown shrimp, white shrimp, Gulf killifish, and blue crab present.	Identify potential cause: accessibility, comparison to abundance at reference site. Evaluate monitoring protocols and substitute sampling gear types. For red drum, expand VPS array and/or add additional year of VPS array monitoring.

6.3 Productivity

Performance criteria- Primary Productivity:

Performance Criteria	Potential Management Actions
Primary productivity for aboveground biomass within three years of construction is equal to or greater than reference conditions at CRMS0248; for belowground biomass, 15-17 years for recovery to reference conditions anticipated (Ebbets et al. 2019, Fricano et al. 2020).	Identify potential cause; plant vegetation if natural colonization does not occur.
Within six years of construction, marsh cover is not significantly less than reference marshes at CRMS0248.	Identify potential cause; plant vegetation if natural colonization does not occur. Evaluate soil salinity, pH.
The marsh vegetation composition is typical of a healthy intertidal marsh (reference marsh at CRMS0248 after three years).	Potential invasive species control. Plant desired species. Assess whether water salinity is leading to marsh conversion.
Secondary productivity of three of the target nekton species (blue crab, brown shrimp, white shrimp) is equal to or greater than pre-construction at the Project site.	Identify potential cause. Identify errors in assumptions to inform future restoration planning.

Performance criteria – Secondary Productivity:

Performance criteria were developed using data from Lefcheck et al. (2019) to estimate potential effect size of marsh restoration by comparing production between unvegetated areas and those adjacent to marsh habitats, or marsh to unstructured habitat. Data from these source were used at the Family level for Penaeidae and Portunidae using the escalc function in the Metafor package in R 3.5.1 for calculating a ratio of means effect size (Viechtbauer, 2010).

Performance Criteria	Potential Management Actions
White and brown shrimp are 1.5 - 2.7x more abundant in Project area than in other sites in the LDWF network using a multiple Before-After-Control-Impact (BACI) design.	Identify potential cause: accessibility, comparison to abundance at reference site. Evaluate monitoring protocols and substitute sampling gear types.
Blue crab abundance increases over time, reaching 3-6x greater abundance compared to other sites in the LDWF network using a multiple BACI design	Identify potential cause: accessibility, comparison to abundance at reference site. Evaluate monitoring protocols and substitute sampling gear types.

7 MONITORING SCHEDULE

Monitoring efforts will be aligned with other programmatic efforts after construction is completed. Coastwide aerial photos are flown that year and once per three years thereafter. Much of the monitoring schedule is aligned to have multiple parameters sampled during the same year.

		Monitoring Time Frame								
		Pre Construction Monitoring	As Built Monitoring (initial)	Post Construction Monitoring (ongoing)						
Monitoring Parameters	Method	Year 1	As built (Year 0)	Year 1	Year 2	Year 3	Year 4	Year 5	Years 6 10	Years 11 20
1. Spatial extent of marsh platform										
Marsh elevation*	Transects	NA	X	O	O	X	O	O	X	X
Marsh area**	Imagery, USGS classification every 3 years	X	X	O	O	X	O	O	X	X
Settlement plate surveys	With Transect Surveys	NA	X	X	O	X	O	X	X	X
2. Land: Water Classification, marsh edge, and fragmentation										
Marsh edge and fragmentation	Imagery, USGS classification every 3 years	X	X	O	O	X	O	O	X	X
3. Water levels										
Marsh inundation	Water level	X	X	X	X	X	X	X	X	X
Hydrology- tidal flow through pond/channel	Water level	X	X	X	X	X	X	X	X	X
Salinity	CRMS	X	X	X	X	X	X	X	X	X
Sediment properties	Cores at 6-year intervals	NA	O	X	O	O	O	O	X	X

Monitoring Parameters	Method	Monitoring Time Frame								
		Pre Construction Monitoring	As Built Monitoring (initial)	Post Construction Monitoring (ongoing)						
		Year 1	As built (Year 0)	Year 1	Year 2	Year 3	Year 4	Year 5	Years 6 10	Years 11 20
4. Presence/ abundance of nekton species										
Gulf killifish	Throw traps, baited traps	NA	X	X	O	X	O	X	X	X
White shrimp	50' seine and 6' trawl	X	O	X	O	X	O	X	X	X
Brown shrimp	50' seine and 6' trawl	X	O	X	O	X	O	X	X	X
Blue crab	50' seine and/or traps	X	X	X	O	X	O	X	X	X
Red drum	Acoustic monitoring	O	O	O	O	X	X	X	O	O
5. Vegetation cover										
Vegetation percent cover	20 quadrats	NA	NA	X	X	X	O	O	X	X
Vegetation composition	20 quadrats	NA	NA	X	X	X	O	O	X	X
6. Primary Productivity										
Vegetation above-ground and below-ground biomass	$0.25m^2$ Subplots coincident with quadrats; 30-cm cores	NA	NA	X	O	X	O	O	X	X
7. Secondary productivity										
Gulf killifish	Throw traps, baited traps	NA	X	X	O	X	O	X	X	X
White shrimp	50' seine and 6' trawl	X	O	X	O	X	O	X	X	X
Brown shrimp	50' seine and 6' trawl	X	O	X	O	X	O	X	X	X
Blue crab	50' seine and/or traps	X	X	X	O	X	O	X	X	X
Red drum	Acoustic monitoring	O	O	O	O	X	X	X	O	O

Note: X are required data acquisitions; O are optional.
*Elevation surveys may also be completed following severe events that are likely to alter the land surface of the created marshes.
**Additional aerial imagery may need to be collected following major events such as tropical storms, or changes to the CWPPRA program collection of coastwide imagery.

8 DATA MANAGEMENT

8.1 Data Description

Qualitative and quantitative data would be collected as part of this MAM plan. The type of data to be collected, as well as how those data would be collected, processed, reviewed, stored, and shared, will follow the data standards outlined in the MAM Procedures and Guidelines Manual Version 1.0 and this MAM plan for the LSMC-UBC (DWH Trustees, 2016).

All data would be collected either by hand on monitoring or survey forms or by tablet on electronic forms. If data are recorded on hardcopy field datasheets, these entries would be scanned to a Portable Document Format (PDF) file and archived, along with the hardcopy. All photographs, datasheets, notebooks, and revised data files would be retained. Metadata would be developed for consistency for all data collected electronically. All electronic files would be stored in a secure location, such as on Data Integration Visualization Exploration and Reporting (DIVER), in such a way that the Louisiana TIG would have guaranteed access to all versions of the data. The final versions will be available through DIVER as files or links to CRMS or another database.

Data will be collected via site visits, field surveys, in situ continuous recorder devices, and remote sensing. Data types include hydrologic (e.g., water level), bathymetric/topographic (e.g., land/water area, elevations, accretion), biological (e.g., fish, invertebrates, vegetation), and GIS (e.g., vector, raster, aerial and satellite imagery). Some data will be collected as part of existing programs, including those coordinated by CPRA (e.g., CRMS, SWAMP) or other agencies (e.g., LDWF, USGS, NOAA).

8.2 Data Review and Clearance

A Quality Assurance Project Plan (QAPP) would be required by the Louisiana TIG prior to Project implementation. This QAPP would outline the appropriate quality assurance/quality control (QA/QC) process in accordance with the data management section of the MAM Manual (*DWH* Trustees, 2016). The plan should include, at minimum, information and guidance on the following QA/QC procedures:

1. Data verification: Ensure the data were collected correctly, errors are identified and addressed appropriately, and that any metadata are in standard format. In addition, if transcription of data is required, then the QAPP should include a process to verify that the transcription process is completely accurately.
2. Data procurement: Ensure that the submittal of data to the DWH Trustees via the online portal, DIVER, is done correctly.
3. Data validation and final QA/QC: Ensure that NOAA and LDWF can adequately conduct a final QA/QC check for non-data entry errors (e.g., date/time, latitude/longitude, units, expected value range).
4. Information package creation: Guidance for NOAA and LDWF to create a public information package.

8.3 Data Storage and Accessibility

The DIVER Restoration Portal will store or link to data collected for this MAM plan. Data would be submitted as soon as possible, but no more than one year from when the data were collected. Data storage and accessibility would be consistent with the guidelines in Section 3.1.3 of the MAM Manual (*DWH* Trustees, 2016).

8.4 Data Sharing

The Louisiana TIG would ensure that data sharing follows standards and protocols set forth in the Open Data Policy (*DWH* Trustees, 2016; Section 10.6.6). No data release can occur if it is contrary to federal or state laws (*DWH* Trustees, 2016; Section 10.6.4). The DWH NRDA Trustees would provide notification to the Cross-TIG MAM work group when new data and information packages have been uploaded to DIVER (*DWH* Trustees, 2016). In the event of a public records request related to project data and information that are not already publicly available, the Trustee to whom the request is addressed would provide notice to the other Louisiana TIG Trustees prior to releasing any project data that are the subject of the request.

As noted in Section 8.3, the project's data would be stored in, or linked from, the DIVER Restoration Portal. These data would be shared with the public by publishing the data to the Trustee Council website (*DWH* Trustees, 2016; Section 10.6.6). For further instructions on this process, see the DIVER Restoration Portal User Manual at https://www.diver.orr.noaa.gov/.

Some of the data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act) and therefore would not be publicly distributed.

9 REPORTING

Reporting should follow the guidelines set forth in Section 2.6.3 and Attachment D of the MAM Manual (*DWH* Trustees, 2016). Information to be reported includes the following:

1. An introduction that provides an overview of the project, location, and restoration activities, as well as restoration objectives and performance criteria applicable to the project. This information can be taken from this MAM plan and repeated in all reports.
2. A detailed description of the methods used for implementation of the MAM plan. This information can be taken from this MAM plan and repeated in all reports.
3. Results from the reporting period or, in the case of the final report, a comprehensive summary of results from the entire MAM plan implementation period. Results should be presented clearly and show progress that has been made toward performance criteria and/or restoration objectives. Information that can be used to present results includes tables or graphs, site visit summaries, and other datasets that support analysis of the project's progress toward meeting performance standard.
4. A discussion of the results (optional for interim reports, required for final report).
5. Conclusions that summarize the findings, progress toward meeting performance criteria and restoration objectives, and recommendations for corrective actions (optional for interim reports, required for final report).
6. Project highlights showcasing lessons learned to inform future project planning and implementation.
7. Transmission of data and metadata used in the report, as well as a description of all data collected during the reporting period, even if they were not used in the report.
8. A complete list of references.

Reports should be submitted, excluding any additional reports deemed necessary as a result of corrective actions that require an extension of the monitoring period. The first report should be submitted after the completion of pre-construction monitoring, the second report should be submitted after the completion of construction monitoring, and one report should be submitted after completion of each annual post-construction monitoring for four years.

The DWH Trustees, as stewards of public resources under OPA, should inform the public on the restoration project's progress and performance. Therefore, the Louisiana TIG should report the status of the project via the DIVER Restoration Portal, as outlined in Chapter 7 of the PDARP/PEIS (*DWH* Trustees, 2016).

10 ROLES AND RESPONSIBILITIES

The Louisiana TIG is responsible for "addressing MAM objectives that pertain to their restoration activities and for communicating information to the Trustee Council or Cross-TIG MAM work group" (*DWH* Trustees, 2016). This includes reviewing and approving MAM plans, identifying MAM priorities for the Louisiana Restoration Area, ensuring that MAM implementation is compatible with the MAM Manual guidelines and that data are submitted to the DIVER Restoration Portal, aggregating and evaluating MAM data, ensuring quality control of MAM data, and communicating regarding implementation status and results of MAM with the Trustee Council and Cross-TIG MAM work group.

As the implementing Trustee, NOAA is responsible for developing the MAM plan, conducting or arranging for the execution of all monitoring activities, evaluating project progress toward restoration objectives using the identified performance criteria, identifying and proposing corrective actions to the Louisiana TIG, and submitting MAM data and project information into the DIVER Restoration Portal in accordance with the data management procedures outlined within this MAM plan (*DWH* Trustees, 2016).

The project proponent, NOAA, is responsible for all maintenance activities and costs related to the LSMC-UBC Project, including any repairs needed over the life of the Project.

11 MONITORING AND ADAPTIVE MANAGEMENT BUDGET

The estimated cost of Project monitoring, adaptive management, and reporting is approximately $4,609,000 for 20 years post-construction.

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13 MAM PLAN REVISION HISTORY

Old Version #	Revision Date	Changes Made	Reason for Change	New Version #

Appendix E – FONSI