Draft Phase II Restoration Plan #3.2: Mid-Barataria Sediment Diversion

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Acronyms and Abbreviations

Ac	Acre
AWG	Alternatives Working Group
BBES	Barataria Bay Estuarine System
BMP	Best management practice
BP	BP Exploration and Production Inc.
CEMVN	United States Army Corps of Engineers, Mississippi Valley Division, New Orleans District
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CI	confidence interval
cm	Centimeter
CMAR	Construction Management At-Risk
CMP	Coastal Master Plan
Coastal Master Plan	Louisiana's Comprehensive Master Plan for a Sustainable Coast
CPRA	Coastal Protection and Restoration Authority
CRMS	Coastwide Reference Monitoring System
CWA	Clean Water Act
CWPPRA	Coastal Wetlands Planning, Protection, and Restoration Act
CWPPRA Project BA-33	Coastal Wetlands Planning, Protection, and Restoration Act Delta Building Diversion at Myrtle Grove Project
CWPPRA Project BA-143	Coastal Wetlands Planning, Protection, and Restoration Act Caminada Headland Restoration Project
DEIS	Draft Environmental Impact Statement
Delft3D model	Delft 3D Basinwide Model
DOI	United States Department of the Interior
Draft Phase II RP #3.2	Draft Phase II Restoration Plan #3.2: Mid-Barataria Sediment Diversion
Draft RP	Draft Phase II Restoration Plan #3.2: Mid-Barataria Sediment Diversion
DWH	*Deepwater Horizon*
EA	Environmental Assessment
E&D	engineering and design
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act

FAST-41	Fixing America's Surface Transportation Act
FCT	Federal Coordination Team
Final PDARP/PEIS	*Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement*
FR	Federal Register
ft	feet
GEBF	Gulf Environmental Benefit Fund
HAB	harmful algal bloom
HSI	Habitat Suitability Index
Incident	2010 *Deepwater Horizon* oil spill and associated oil spill response efforts
LA TIG	Louisiana Trustee Implementation Group
LCA	Louisiana Coastal Area
m	Meter
MAM	Monitoring and Adaptive Management
MBSD	Mid-Barataria Sediment Diversion
mi	mile
MMPA	Marine Mammal Protection Act
MMT	million metric ton
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MT	metric ton
$m\ yr^{-1}$	meters per year
$m^2\ m^{-1}\ y^{-1}$	square meters per meter per year
NEPA	National Environmental Policy Act
NFWF	National Fish and Wildlife Foundation
NMFS	National Marine Fisheries Service
NO_3	nitrate
NOAA	National Oceanic and Atmospheric Administration
NOGC	New Orleans and Gulf Coast Railway
NOI	Notice of Intent
NOV-NFL	New Orleans to Venice Non-Federal Levee
NPS	National Park Service
NRDA	Natural Resource Damage Assessment
OPA	Oil Pollution Act of 1990
OTF	outfall transition feature
PDARP	Programmatic Damage Assessment and Restoration Plan
PEIS	Programmatic Environmental Impact Statement
PO_4	phosphate

ppt	parts per thousand
Proposed MBSD Project	Proposed 75,000 cfs capacity Mid-Barataria Sediment Diversion Project
RESTORE Act	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
RM	river mile
ROD	Record of Decision
RP	Restoration Plan
SAV	submerged aquatic vegetation
SOP	Standard Operating Procedure
SRP/EA #3	Strategic Restoration Plan and Environmental Assessment #3: Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin, Louisiana
TIG	Trustee Implementation Group
TN	total nitrogen
TP	total phosphorus
TWI	The Water Institute of the Gulf
USACE	United States Army Corps of Engineers
USC	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

Executive Summary

The *Deepwater Horizon* (DWH) oil spill resulted in the oiling of more than 1,100 kilometers of wetlands, nearly all of which were located in coastal Louisiana (DWH NRDA Trustees, 2016). The heaviest oiling occurred in the Barataria Basin, resulting in substantial injuries to natural resources in the basin (DWH NRDA Trustees, 2016). The impact of those injuries was intensified by the fragile nature of the basin. Already suffering from significant coastal erosion, marshes in the Barataria Basin that experienced heavy oiling subsequently experienced double or triple the rate of marsh loss. Recognizing that the resulting loss of marsh productivity affected resources throughout the northern Gulf of Mexico ecosystem, the State of Louisiana and the federal Trustees that negotiated the DWH Natural Resource Damages settlement allocated $4 billion, almost half of the total settlement amount, to restoring Louisiana's wetland, coastal, and nearshore habitats.

The DWH Natural Resource Damage Assessment Trustees began analyzing strategies for restoring these coastal losses as part of the settlement process. In the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS), the Trustees noted that, "[c]onsidering the scale of impacts from the oil spill, the Trustees also understand the importance of increasing the resiliency and sustainability of this highly productive Gulf ecosystem through restoration" (DWH NRDA Trustees, 2016, page 5-25). To address these large-scale impacts, they agreed that "[d]iversions of Mississippi River water into adjacent wetlands have a high probability of providing these types of large-scale benefits for the long-term sustainability of deltaic wetlands" (DWH NRDA Trustees, 2016, page 5-25). In deciding that sediment diversions were a wetland restoration technique worth exploring, the Trustees also identified multiple potential benefits from such projects. These benefits included helping "maintain the Louisiana coastal landscape and its ability to overcome other environmental stressors by stabilizing wetland substrates; reducing coastal wetland loss rates; increasing habitat for freshwater fish, birds, and benthic communities; and reducing storm risks, thus providing protection to nearby infrastructure" (DWH NRDA Trustees, 2016, page 5-25).

Building on the Final PDARP/PEIS, the federal and state trustees responsible for the restoration of resources in the State of Louisiana (the Louisiana Trustee Implementation Group, or LA TIG) began evaluating restoration strategies that could restore injuries in the Barataria Basin, which resulted in the *Strategic Restoration Plan and Environmental Assessment #3: Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin, Louisiana* (SRP/EA #3). In that document, the LA TIG ultimately determined that a combination of "marsh creation and ridge restoration plus a large-scale sediment diversion 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 life cycle on productive and sustainable wetland habitats" (LA TIG, 2018, page 3-32) in the basin and in the broader northern Gulf of Mexico.

Since finalizing the SRP/EA #3, the LA TIG has been evaluating a variety of potential alternatives for a large-scale sediment diversion in the Barataria Basin. This Draft Restoration Plan (RP), along with the Draft Environmental Impact Statement being simultaneously released, encapsulate that evaluation. This Draft RP has taken advantage of decades of analysis of potential sediment diversion strategies that have been undertaken by the State of Louisiana, as well as extensive modeling and scientific analysis of potential diversion alternatives. The Trustees believe that the detailed scientific review of potential benefits and impacts from the project that are evaluated here and in the accompanying Draft Environmental Impact Statement present a robust statement of the science behind the Trustees' recommended path forward.

Ultimately, the Trustees' analysis has determined that, as with many environmental restoration projects, there would be ecological tradeoffs associated with any of the large-scale sediment diversion alternatives. The benefits would be significant and would primarily derive from the creation of thousands of acres of marsh that, with a steady supply of Mississippi River sediment, would be sustained over decades even in the face of rising sea levels and coastal erosion. After 50 years of operation of a diversion with a capacity of 75,000 cubic feet per second (cfs), over 20% of the marsh in the Barataria Basin is projected to have been created or sustained by the diversion. The Trustees believe that a sediment diversion is the only way to achieve a self-sustaining marsh ecosystem in the Barataria Basin.

This sustained marsh is expected to benefit many fish and wildlife species in the basin, including red drum, largemouth bass, blue crab, white shrimp, Gulf menhaden, and migratory waterfowl. These benefits to fish and wildlife species would translate to benefits to recreational users who watch, fish, or hunt those species. In addition, these benefits would not only accrue in the Barataria Basin but, through the transport of marsh productivity, also in the offshore ecosystems of the northern Gulf of Mexico.

The Trustees also recognize that any of the large-scale sediment diversion alternatives considered would also result in collateral injuries to some natural resources. Reconnecting the river to the basin to restore an estuary that has been degrading and becoming more saline for almost a century would produce significant changes to current conditions in the Barataria Basin, which will negatively affect the species that currently reside in the basin. The primary driver of this change would be a reduction in salinity; any of the large-scale sediment diversion alternatives considered would result in a substantial reduction in salinity in portions of the basin. That reduction in salinity would negatively impact fish and wildlife species that rely on higher saline waters and have moved further into the estuary as salinities have increased due to the severed connection between the river and the basin. Key species that would be affected include dolphins, brown shrimp, and oysters.

The large-scale sediment diversion alternatives considered would also affect storm hazards and tidal flooding in the vicinity of the diversion. The diversion would restore and expand existing marshes and thereby reduce storm surge and flooding in the communities north of the diversion. At the same time, the additional marsh created or sustained by the diversion is expected to somewhat accelerate tidal flooding and storm surge in communities south of the diversion that remain outside of levee protection (from Myrtle Grove south to Grand Bayou). During the first several decades of operation of the diversion, these communities could experience increases in the intensity and duration of flooding impacts; however, within 50 years, sea level rise and subsidence would overtake the effects of the diversion and return as the primary forces driving flooding in these communities.

The different large-scale diversion alternatives evaluated in this Draft RP result in different levels of impacts and benefits. After considering these impacts and benefits, the Trustees are recommending a diversion with a maximum capacity of 75,000 cfs (with the actual flow through the diversion dependent on the flow of the Mississippi River). The Trustees fully evaluated a smaller-capacity diversion with a maximum capacity of 50,000 cfs and found that such a diversion would provide substantially less benefit in marsh preservation and restoration, with only a small reduction in adverse impacts and a slight cost reduction.

The Trustees also fully evaluated a larger-capacity diversion with a maximum capacity of 150,000 cfs. While the marsh creation benefits of such a large diversion would be significantly greater, the collateral injuries and cost would also increase to levels unacceptable to the Trustees.

The Trustees are committed to continuing efforts to restore the resources that would be adversely affected by the diversion, many of which were also injured by the DWH oil spill. This Draft RP includes proposed strategies to help avoid, minimize, and mitigate collateral injuries to these resources. These includes proactive strategies to engage and work with the communities, individuals, and stakeholders that rely on the resources that could be harmed by the proposed diversion.

The Trustees now look forward to receiving and considering the feedback of interested members of the public on every aspect of this Draft RP.

References

DWH NRDA Trustees. 2016. *Deepwater Horizon* Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement. Available: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Accessed September 29, 2020.

LA TIG. 2018. Strategic Restoration Plan and Environmental Assessment #3: Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin, Louisiana. Available: https://www.gulfspillrestoration.noaa.gov/sites/default/files/2018_03_LA_TIG_Final_SRP_EA_508-Compliant.pdf. Accessed September 28, 2020.

1.0 Introduction

The *Deepwater Horizon* (DWH) oil spill Louisiana Trustee Implementation Group[1] (LA TIG) prepared this Draft Phase II Restoration Plan #3.2: Mid-Barataria Sediment Diversion (Draft Phase II RP #3.2 or Draft RP) to restore the natural resource injuries and losses caused by the April 20, 2010 DWH oil spill and associated oil spill response efforts (collectively, the Incident). In the 2018 Strategic Restoration Plan and Environmental Assessment #3: Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin, Louisiana (SRP/EA #3), the LA TIG identified a large-scale sediment diversion project in the Barataria Basin as one that should move forward for detailed planning and analysis under the Oil Pollution Act of 1990 (OPA). In SRP/EA #3, the LA TIG considered a range of strategic alternatives that would restore ecosystem-level injuries in the Gulf of Mexico through the restoration of critical wetlands, and coastal and nearshore habitat resources and services in the Barataria Basin. The LA TIG selected a high-level strategic alternative that included a sediment diversion, marsh creation, and ridge restoration projects. In SRP/EA #3, the LA TIG also selected a Mid-Barataria sediment diversion as the specific sediment diversion project to move forward for further analysis. See Section 2.3 for more in-depth discussion of the processes and analyses that led to the LA TIG's selection of this project for further planning.

The concept of using a river diversion to help restore the Barataria Basin has been scoped, evaluated, and discussed with stakeholders since 1984, when the United States Army Corps of Engineers (USACE) published a feasibility report on a river diversion project in the Barataria and Breton Sound basins (USACE, 1984). In 1998, the Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority proposed several large diversions in the Barataria Basin for marsh and barrier island restoration in a report entitled *Coast 2050: Toward a Sustainable Coastal Louisiana* (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority, 1998). The Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Task Force approved the initiation of a feasibility study in 2001 for the Delta Building Diversion at Myrtle Grove Project (CWPPRA Project BA-33); this study examined a range of diversion capacities, from 2,500 cubic feet per second (cfs) to 15,000 cfs. Concurrently, the USACE prepared a feasibility study for the Louisiana Coastal Area (LCA) Program to identify large-scale ecosystem restoration projects for the Louisiana coast (USACE, 2004) in which projects were evaluated through the use of ecological models; the USACE selected the Medium Diversion at Myrtle Grove as one of five, near-term critical restoration features (USACE, 2004). Due to funding limitations,

[1] The LA TIG is the group responsible for restoring natural resources and services within the Louisiana Restoration Area that were injured by the Incident. The LA TIG includes five Louisiana State Trustee agencies and four federal Trustee agencies: the Louisiana Coastal Protection and Restoration Authority (CPRA); the Louisiana Department of Natural Resources; the Louisiana Department of Environmental Quality; the Louisiana Oil Spill Coordinator's Office; the Louisiana Department of Wildlife and Fisheries; the United States Department of Commerce, represented by the National Oceanic and Atmospheric Administration (NOAA); the United States Department of the Interior (DOI), represented by the United States Fish and Wildlife Service (USFWS) and the National Park Service (NPS); the United States Department of Agriculture (USDA); and the United States Environmental Protection Agency (USEPA).

the CWPPRA Task Force transferred CWPPRA Project BA-33 to the USACE for further study under the LCA Program, where the USACE led a multidisciplinary team to develop hydrodynamic and salinity models of the basin under different diversion scenarios. CPRA also worked with several nongovernmental organizations in 2009 to support additional modeling of the proposed sediment diversion to answer key stakeholder questions about potential project impacts (CPRA, 2011). In 2012, CPRA completed its legislatively mandated draft of Louisiana's Comprehensive Master Plan for a Sustainable Coast (Coastal Master Plan or CMP), which was updated and approved by the Louisiana legislature in 2017 (CPRA, 2017). The CMP included a Mid-Barataria sediment diversion with a 75,000 cfs capacity. A more detailed history of the Mid-Barataria sediment diversion and the associated planning studies and evaluations are provided in Section 3.2.1.4 in this Draft RP and in Section 1.2 of the Mid-Barataria sediment diversion (MBSD) Draft Environmental Impact Statement (DEIS).[2]

This Draft RP presents the LA TIG's evaluation of a proposed 75,000 cfs capacity Mid-Barataria sediment diversion (i.e., the Proposed MBSD Project) and five alternatives for this project under OPA. This Draft RP does not include the National Environmental Policy Act (NEPA) analysis. Under OPA Natural Resource Damage Assessment (NRDA) regulations, Trustees typically choose to combine a Restoration Plan (RP) and the required NEPA analysis into a single document [33 Code of Federal Regulations (CFR) 990.23(a), (c)(1)]. Prior to evaluation of the Proposed MBSD Project by the LA TIG as a proposed restoration project under OPA, the USACE initiated scoping for the MBSD Project Environmental Impact Statement (EIS), which was initiated through a permit application for the project by CPRA. In this case, to increase efficiency, reduce redundancy, and be consistent with federal policy and Title 40 CFR § 1506.3, the four federal Trustees in the LA TIG (i.e., NOAA, DOI, USEPA, and USDA) decided to participate as cooperating agencies in the development of a single MBSD DEIS. As the lead agency, the USACE has primary responsibility for preparing the DEIS [40 CFR § 1501.5(a)].[3] The LA TIG is relying on the DEIS to evaluate potential environmental effects of the restoration alternatives proposed in this Draft Phase II RP #3.2. The final adoption of the Final EIS by the LA TIG will be completed upon signature of a Record of Decision (ROD).

This Draft RP provides the public with the LA TIG's evaluation of the Proposed MBSD Project and its alternatives under the requirements of OPA. The DEIS is a companion to this Draft RP and provides the NEPA analysis for the action proposed by the LA TIG. This Draft RP and the DEIS are being released concurrently to enable public review of both documents simultaneously. As noted in Section 1.8.2, there are separate public comment processes for this Draft RP and for the DEIS. Instructions for public comment on this Draft RP are outlined in Section 1.8.2.

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[2] The DEIS can be found at http://www.mvn.usace.army.mil/Missions/Regulatory/Permits/Mid-Barataria-Sediment-Diversion-EIS/.

[3] The EIS is being prepared using the 1978 Council on Environmental Quality (CEQ) NEPA regulations. Consistent with the 2020 revised CEQ NEPA regulations, NEPA reviews initiated prior to the effective date of the 2020 CEQ regulations (September 14, 2020) may be conducted using the 1978 regulations. Given that the preparation of this EIS began on April 27, 2017, when the Notice of Intent (NOI) to prepare a DEIS was published at 82 Federal Register (FR) 19361, USACE has decided to proceed under the 1978 regulations.

This Draft Phase II RP #3.2 is intended to inform decision-makers and members of the public about this proposed restoration action.

1.1 Background and Summary of the Settlement

On April 20, 2010, the DWH mobile drilling unit exploded, caught fire, and eventually sank in the Gulf of Mexico, resulting in a massive release of oil from the Macondo well, causing loss of life and extensive natural resource injuries. Initial efforts to cap the well following the explosion were unsuccessful, and for 87 days following the explosion, the well continuously and uncontrollably discharged oil and natural gas into the northern Gulf of Mexico. By the time the well was capped, the resulting ecological impacts were unprecedented in scale: the spill released an estimated 134 million gallons of oil into the Gulf of Mexico ecosystem and created a surface oil slick as large as the State of Virginia (DWH NRDA Trustees, 2016a).

The DWH oil spill occurred within a northern Gulf of Mexico ecosystem where ecological resources and habitats are closely linked: energy, nutrients, and organisms move between habitats in this region, such that injuries to one habitat or species can have cascading impacts across the entire ecosystem (DWH NRDA Trustees, 2016a). As part of the injury assessment for the DWH oil spill, the DWH NRDA Trustees (described below in Section 1.2) documented injuries to species including fish, shellfish, birds, marine mammals, and sea turtles. These injuries ranged from decreased growth rates to reproductive effects and mortality. Many of these injured species depend on the nearshore marsh and estuarine habitats exemplified by those in the Barataria Basin for one or more of their life stages.

On February 19, 2016, the DWH NRDA Trustees issued a Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement (PDARP/PEIS) detailing a programmatic RP to fund and implement restoration across the Gulf of Mexico region in the future as restoration funds became available. That document describes restoration types, approaches, and techniques that meet the Trustees' programmatic restoration goals, as described in the Final PDARP/PEIS. On March 29, 2016, in accordance with OPA and NEPA, the DWH NRDA Trustees published a Notice of Availability in the FR of a ROD for the Final PDARP/PEIS (81 FR 17438). Based on the DWH NRDA Trustees' injury determination established in the Final PDARP/PEIS, the ROD sets forth the basis for the DWH NRDA Trustees' decision to select Alternative A: Comprehensive Integrated Ecosystem Alternative. As described in the PDARP/PEIS, "Alternative A is an integrated restoration portfolio that emphasizes the broad ecosystem benefits that can be realized through coastal habitat restoration in combination with resource-specific restoration in the ecologically interconnected northern Gulf of Mexico ecosystem." The DWH NRDA Trustees' selection of Alternative A includes the funding allocations established in the Final PDARP/PEIS.

On April 4, 2016, the United States District Court for the Eastern District of Louisiana entered a Consent Decree resolving civil claims by the DWH oil spill Trustees against BP Exploration and Production Inc. (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.

Under the Consent Decree, BP agreed to pay (over a 15-year period) a total of up to $8.1 billion in natural resource damages (which includes $1 billion that 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 funding allocation for the Louisiana Restoration Area by Restoration Type is described in Section 5.10.2 of the PDARP/PEIS and presented below in Table 1-1.

Table 1-1.
Restoration Funding in Dollars for the Louisiana Restoration Area

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, Administrative Oversight, and Comprehensive Planning	
Monitoring and Adaptive Management (MAM)	225,000,000
Administrative Oversight and Comprehensive Planning	33,000,000

1.2 DWH NRDA Trustees, Trustee Council, and Trustee Implementation Groups

The DWH NRDA Trustees are the government entities authorized under OPA to act on behalf of the public to (1) assess the natural resource injuries resulting from the DWH oil spill, and then (2) plan and implement restoration to address those injuries. The DWH NRDA Trustees are responsible for the governance of restoration planning throughout the entire Gulf Coast. The DWH NRDA Trustees organized a Trustee Council composed of designated Natural Resource Trustee Officials, or their alternates, for each of the DWH NRDA Trustee agencies.

The following federal and state agencies are designated DWH NRDA Trustees:

- DOI, as represented by the NPS and USFWS
- NOAA, on behalf of the United States Department of Commerce

- USDA
- USEPA
- CPRA, the Louisiana Department of Natural Resources, the Louisiana Department of Environmental Quality, the Louisiana Oil Spill Coordinator's Office, and the Louisiana Department of Wildlife and Fisheries
- Mississippi Department of Environmental Quality
- Alabama Department of Conservation and Natural Resources, and Geological Survey of Alabama
- Florida Department of Environmental Protection, and Florida Fish and Wildlife Conservation Commission
- Texas Parks and Wildlife Department, Texas General Land Office, and Texas Commission on Environmental Quality.

As specified in the Consent Decree and PDARP/PEIS, the DWH NRDA funds were distributed geographically to address the diverse suite of injuries that occurred at both regional and local scales. Specific amounts of money were allocated to seven geographically defined Restoration Areas: each of the five Gulf States (Louisiana, Mississippi, Alabama, Florida, and Texas), Regionwide, and the Open Ocean. The DWH Consent Decree established that each Restoration Area would be governed by a Trustee Implementation Group (TIG). As described in the Consent Decree and specified in the Trustee Council Standard Operating Procedures (SOPs) (DWH NRDA Trustees, 2016b), these TIGs are composed of individual DWH Trustee agency representatives.

TIG members work together to accomplish restoration activities for their respective Restoration Areas, including interacting with the public and stakeholders, and to plan for, select, and implement specific restoration actions under the PDARP/PEIS. Each TIG makes all restoration decisions for the funding allocated to its Restoration Area and ensures that its actions are fully consistent with OPA and NEPA requirements, the PDARP/PEIS, the Consent Decree, and the Trustee Council SOP. The LA TIG oversees restoration planning in the Louisiana Restoration Area.

1.3 Authorities and Regulations

1.3.1 OPA Compliance and NRDA Evaluation Criteria

As an oil pollution incident, the DWH oil spill is subject to the provisions of OPA, 33 United States Code (USC) § 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. The DWH Trustee Council was established under the authority of OPA.

The NRDA regulations under OPA (15 CFR § 990) establish a process for restoration planning, including the development and evaluation of restoration alternatives and the development of RPs. These OPA NRDA regulations establish criteria for identifying and evaluating restoration alternatives (see Section 3.1). Restoration activities under OPA are intended to return injured natural resources and services to their baseline condition (i.e., primary restoration), and to compensate the public for interim losses from the time of the incident until the time resources and services recover to baseline conditions (i.e., compensatory restoration). To meet these goals, the restoration activities need to produce benefits that are related to or have a nexus (i.e., connection) to the natural resource injuries and service losses resulting from the spill.

1.3.2 Compliance with Other Laws

The selected alternative would be implemented in accordance with all applicable laws and regulations concerning the protection of environmental, cultural, and historical resources. The Proposed MBSD Project's compliance with NEPA, the Marine Mammal Protection Act (MMPA), and Fixing America's Surface Transportation Act (FAST-41) are described below; and compliance with other authorities is discussed in Section 4. Restoration projects must also meet any additional requirements specified in the DWH ROD, such as ensuring that federal environmental compliance responsibilities and procedures follow the *Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the Deepwater Horizon (DWH) Oil Spill* (DWH NRDA Trustees, 2016b).

1.3.2.1 NEPA

Federal trustees must comply with NEPA, 42 USC § 4321 *et seq.*, and its implementing regulations (40 CFR Parts 1500–1508) when planning restoration projects, as well as NEPA procedures specific to their own agency. NEPA provides a framework for federal agencies to determine if their proposed actions have significant environmental effects, consider these effects when choosing between alternative approaches, and inform and involve the public in the environmental review process. For major federal actions that would significantly affect the quality of the human environment, NEPA requires federal agencies to prepare a detailed, interdisciplinary EIS that assesses the environmental effects of the actions and alternatives to such actions before deciding whether to undertake them.

In June 2016, CPRA submitted a permit application to the USACE, Mississippi Valley Division, New Orleans District (CEMVN) for the Proposed MBSD Project. In its role as permitting authority under the Clean Water Act (CWA) and the Rivers and Harbors Appropriation Act of 1899, the CEMVN is the lead federal agency in developing a DEIS for the Proposed MBSD Project. In April 2017, the LA TIG issued a notice that described its decision to support the development of a single MBSD EIS that can satisfy NEPA requirements for both the USACE and the LA TIG federal Trustees. This decision increased efficiency and reduced redundancy by avoiding development of two separate NEPA analyses for the same project. Federal and state member agencies of the LA TIG are participating in the development of the DEIS as cooperating agencies. The LA TIG intends to rely on the DEIS to inform its decision under OPA and to fulfill the requirements of the federal Trustees under NEPA. Following public review of the DEIS and completion of the Final EIS, the federal Trustees of the LA TIG expect to adopt the Final EIS by signature on a ROD, which will document the LA TIG's decision.

1.3.2.2 MMPA

MMPA compliance for the Proposed MBSD Project has been addressed in accordance with Section 20201 of Title II of Public Law No: 115–123 (the "Bipartisan Budget Act of 2018"), which specifically addresses the Proposed MBSD Project. In accordance with the Bipartisan Budget Act of 2018, NOAA's National Marine Fisheries Service (NMFS) issued a Decision Memorandum for the issuance of a waiver under Sections 101(a) and 102(a) of the MMPA for the MBSD, Mid-Breton Sound Sediment Diversion, and Calcasieu Ship Channel Salinity Control Measures Projects (NMFS, 2018a); and issued an MMPA waiver for those projects on March 15, 2018 (NMFS, 2018b). Section 20201 of Title II of Public Law No: 115–123 also requires that the State of Louisiana, in consultation with NMFS: "(1) to the extent practicable and consistent with the purposes of the projects, minimize impacts on marine mammal species and population stocks; and (2) monitor and evaluate the impacts of the projects on such species and population stocks." Proposed measures developed in recognition of the impacts on marine mammals can be found in Appendices A and B.

1.3.2.3 FAST-41

In addition to the compliance requirements described above, the Proposed MBSD Project has been added to the inventory of "covered projects" pursuant to the requirements set forth in Title 41 of FAST-41. FAST-41 created a new governance structure, set of procedures, and funding authorities to improve the timeliness, predictability, and transparency of the federal environmental review and authorization process for covered infrastructure projects. It works to streamline the permitting process within the structure of existing federal environmental reviews and authorizations. FAST-41 calls for the designation of a lead federal agency and promotes early consultation and enhanced interagency coordination by requiring the development of a project-specific plan and timetable for the completion of environmental reviews and authorizations. As a "covered project," the Proposed MBSD Project has been placed on the Permitting Dashboard, and each federal agency with a role in the review and authorization of the Proposed MBSD Project has agreed to a coordinated project review schedule, aimed at eliminating redundancy and duplication in the environmental review process, and timely action on all necessary authorization decisions.

1.3.2.4 Other Laws, Regulations, and Permits

Compliance with other federal, state, and municipal laws and regulations is addressed further in Section 4. Before implementation, all necessary state and federal permits, authorizations, and any required consultations will be secured.

1.4 Restoration Goals and Objectives

The purpose of restoration, as discussed in this Draft RP and detailed more fully in the *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement* (Final PDARP/PEIS; DWH NRDA Trustees, 2016a), is to make the environment and the public whole for injuries resulting from the Incident by implementing restoration actions that return injured natural resources and services to the condition they would have been in but for the spill, and compensate for interim losses. Restoration actions are undertaken in accordance with OPA and associated NRDA regulations.

The Final PDARP/PEIS noted that "injuries affected such a wide array of linked resources over such an enormous area that the effects of the DWH spill must be described as constituting an ecosystem-level injury." Because of this ecosystem-level injury, the Trustees' preferred restoration alternative was a "comprehensive, integrated ecosystem restoration portfolio…." The Trustees further note in the Final PDARP/PEIS that:

> [t]his 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 (Gosselink and Pendleton, 1984), coastal and nearshore habitat restoration is the most appropriate and practicable mechanism for restoring the ecosystem-level linkages disrupted by this spill.

The Proposed MBSD Project in this Draft RP provides a critical element of the Trustees' preferred portfolio for comprehensive, integrated ecosystem restoration in the Final PDARP/PEIS.

The LA TIG developed the goals and objectives for the Proposed MBSD Project through an iterative restoration planning process, beginning with the restoration goals in the Final PDARP/PEIS, then developing SRP/EA #3 for the restoration of habitat and services in the Barataria Basin, and ending with project-specific goals; this is described more fully below.

As described in the Final PDARP/PEIS, the goals for the Wetlands, Coastal, and Nearshore Habitats Restoration Type include the following:

- Restore a variety of interspersed and ecologically connected coastal habitats in each of the five Gulf states to maintain ecosystem diversity, with a 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 geographic areas where the injuries occurred, while considering approaches that provide resilience 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 associated living coastal and marine resources; and restore the ecological functions provided by those habitats.

In SRP/EA #3, the LA TIG considered these Final PDARP/PEIS goals and selected a Mid-Barataria sediment diversion as the specific, large-scale sediment diversion project to move forward immediately for further analysis (LA TIG, 2018c). Large-scale sediment diversions can create significant additional marsh areas; help enhance degraded marshes; and provide necessary sediment, fresh water, and nutrients to maintain both existing and created marshes. The LA TIG noted that the Mid-Barataria sediment diversion has been included in the Coastal Master Plan and has been the subject of long discussions among experts as one of the most promising potential diversions in terms of its potential to create and help sustain marsh/wetlands complexes on an ecosystem scale. The CMP is the State of Louisiana's publicly vetted and scientifically founded approach to coastal restoration, which includes the goal of promoting sustainable ecosystems – a goal compatible with overall Final PDARP/PEIS goals.

By mimicking a deltaic process, the Proposed MBSD Project is expected to enhance the ecological productivity of the estuary and improve food web dynamics that would provide benefit to the northern Gulf of Mexico ecosystem. The Proposed MBSD Project is critical to achieving the overall goals of the Wetlands, Coastal, and Nearshore Habitats Restoration Type in the Final PDARP/PEIS, which include providing benefits across the interconnected northern Gulf of Mexico ecosystem, and placing particular emphasis on coastal and nearshore habitat restoration in the historical Mississippi River delta plain in Louisiana.

The Proposed MBSD Project-specific statement of purpose and need is:

> To restore for injuries caused by the DWH oil spill by implementing a large-scale sediment diversion in the Barataria Basin that will reconnect and re-establish sustainable deltaic processes between the Mississippi River and the Barataria Basin through the delivery of sediment, freshwater, and nutrients to support the long-term viability of existing and planned coastal restoration efforts. The proposed project is needed to help restore habitat and ecosystem services injured in the northern Gulf of Mexico as a result of the DWH oil spill.

Consistent with this statement of purpose and need, the LA TIG identified the following specific restoration goals and objectives for the Proposed MBSD Project:

- Deliver freshwater, sediment, and nutrients to the Barataria Basin through a large-scale sediment diversion from the Mississippi River.
- Reconnect and re-establish sustainable deltaic processes between the Mississippi River and the Barataria Basin (e.g., sediment retention and accumulation, new delta formation).
- Create, restore, and sustain wetlands and other deltaic habitats and associated ecosystem services.

1.5 Alternatives Evaluated in this Plan

This Draft RP evaluates a 75,000 cfs capacity[4] sediment diversion in the Mid-Barataria Basin (the Proposed MBSD Project), as well as five alternatives for this project. The alternatives for the Proposed MBSD Project are all focused on the same geographical location and have similar structural features, but the alternatives vary in size and maximum flows that can pass through the diversion, as well as the use of marsh terracing; consequently, their potential benefits and impacts also vary.

The structural features of the Proposed MBSD Project and its alternatives are located in south Louisiana on the west bank of the Mississippi River at River Mile (RM) 60.7, just north of the Town of Ironton. The anticipated outfall area for sediment, freshwater, and nutrients conveyed from the river is located within the Mid-Barataria Basin (see Figure 1-1). The area of the Proposed MBSD Project and its alternatives includes the hydrologic boundaries of the Barataria Basin and the lower Mississippi River Delta Basin, also known as the birdfoot delta. The Mississippi River itself, beginning near RM 60.7 and extending to the mouth of the river, is also included in the Proposed MBSD Project area. Further detailed information regarding the features

[4] The actual flow rate through the diversion would depend on the flow of the Mississippi River; more details about diversion operation under the Proposed MBSD Project are provided in Section 3.2.1.

of the Proposed MBSD Project and its alternatives can be found in Chapters 2 and 3 of the DEIS (USACE, 2021).

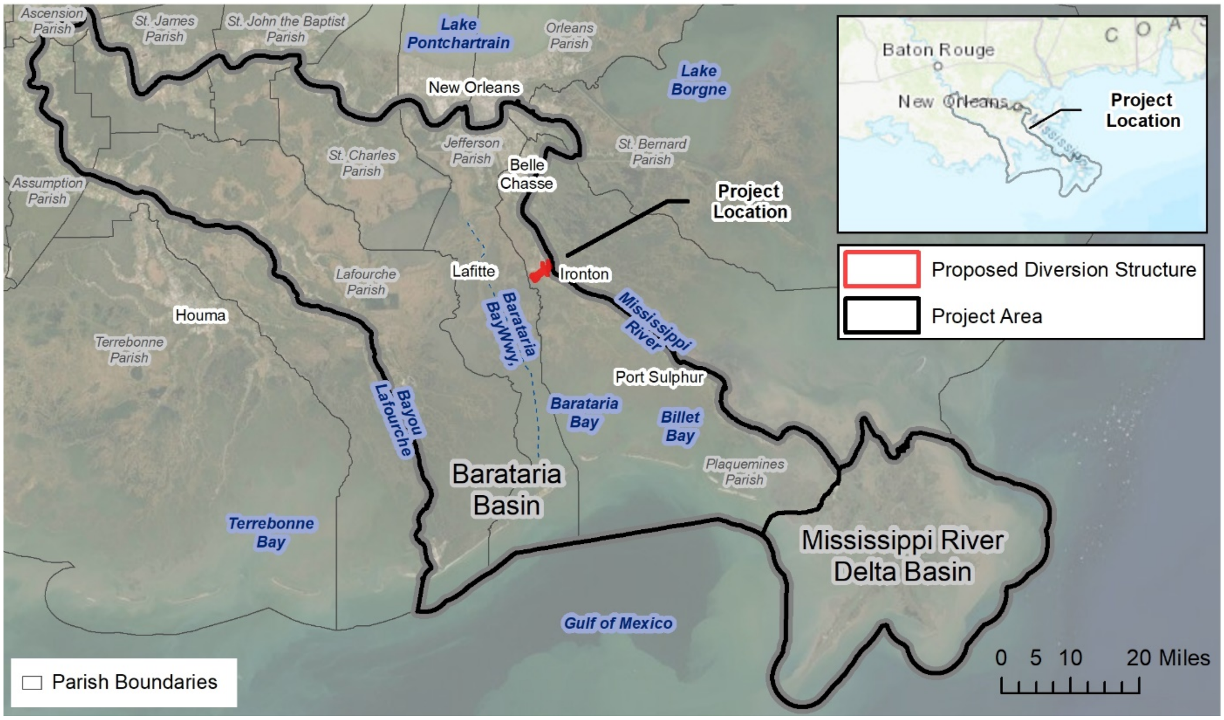


Figure 1-1. Location of Proposed MBSD Project Area. [Includes the Barataria Basin, the western portion of the lower Mississippi River Delta Basin (i.e., the birdfoot delta), the Mississippi River from RM 60.7 to the mouth, and a portion of the northern Gulf of Mexico]

The Proposed MBSD Project and its alternatives consist of a controlled sediment and freshwater intake diversion structure in Plaquemines Parish on the right-descending bank of the Mississippi River at RM 60.7. The Proposed MBSD Project and its alternatives would reconnect and re-establish sustainable deltaic processes between the Mississippi River and the Barataria Basin through a conveyance system that would discharge sediment, freshwater, and nutrients from the Mississippi River into the outfall area within the Mid-Barataria Basin in Plaquemines and Jefferson parishes (see Figure 1-2). The Proposed MBSD Project and its alternatives would support the long-term viability of existing and planned coastal restoration efforts, and enhance productivity and the food web, benefitting the northern Gulf of Mexico ecosystem.

The Proposed MBSD Project and its alternatives include a diversion operations plan that specifies conditions for the diversion to be opened and closed (see Chapter 3 and the DEIS for more details). Construction would require a minimum of three to five years to complete, depending on the extent of needed ground modifications and soil stabilization measures.

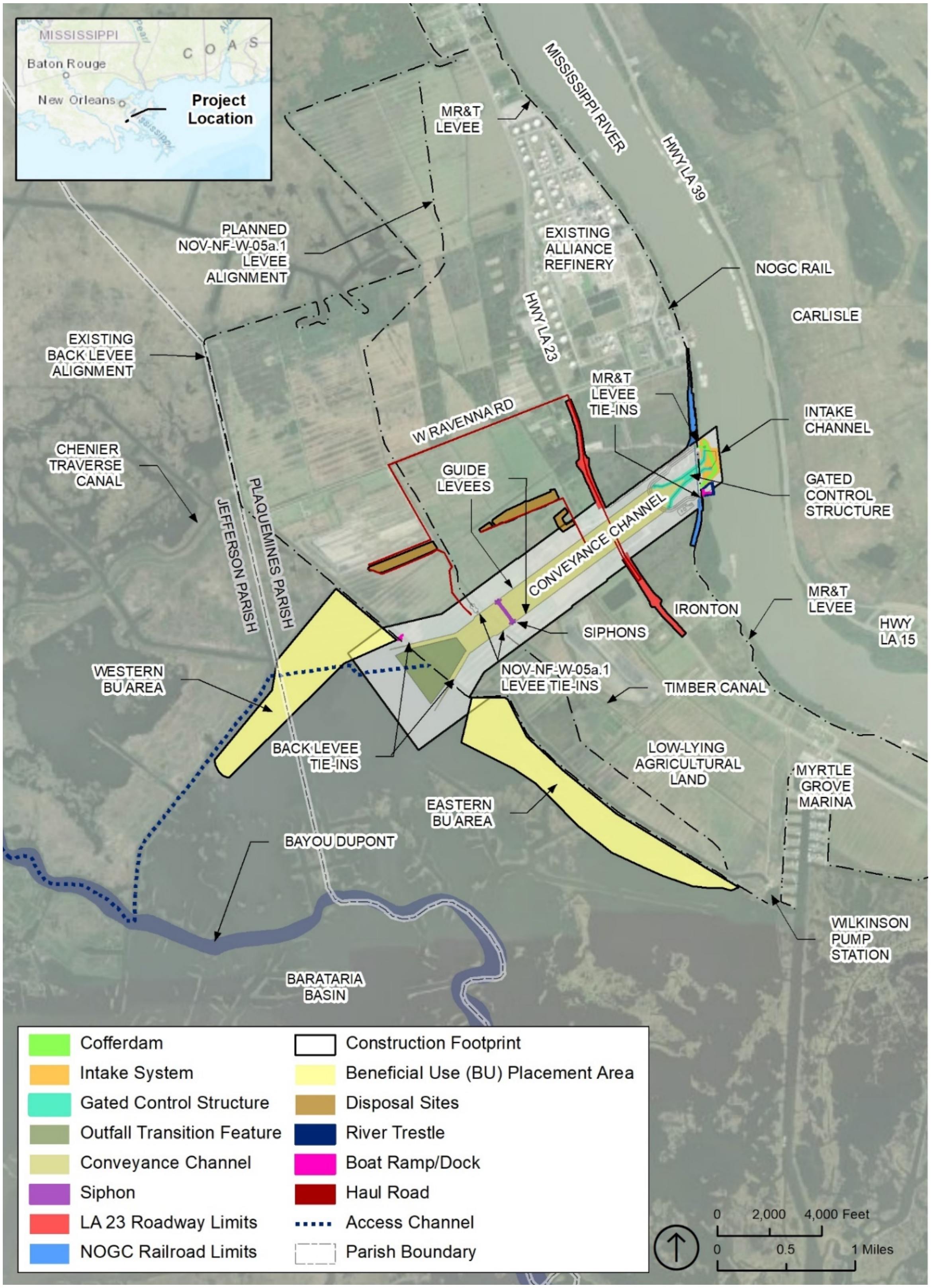


Figure 1-2. Design Features and Construction Footprint of the Proposed MBSD Project and Its Alternatives. NOGC = New Orleans and Gulf Coast Railway, NOV-NFL = New Orleans to Venice Non-Federal Levee.

In this Draft RP, the Proposed MBSD Project and its five alternatives are evaluated under OPA NRDA regulations (Table 1-2). As described in more detail in Chapter 3, the Proposed MBSD Project (Alternative 1) and Alternatives 2 and 3 vary by the maximum flow through the diversion, ranging from 50,000 cfs to 150,000 cfs; and Alternatives 4-6 include marsh terrace outfall features (Table 1-2). All of the proposed alternatives include a base flow of up to 5,000 cfs to help moderate and stabilize seasonal fluctuations in salinity that could negatively affect certain marsh areas and types; modeling suggested that a base flow with a maximum of 5,000 cfs would be sufficient to moderate seasonal salinities within the outfall area and immediately adjacent marshes (USACE, 2021, Section 2.4.3.3).

Table 1-2.
Summary of Proposed Restoration Alternatives Evaluated in this Draft RP

Proposed Restoration Alternatives	Maximum Flow-Through Diversion	Flow in Mississippi River Needed to Trigger Maximum Flow-Through Diversion[a]	On/Off Trigger for Full Diversion Operations[a, b]	Maximum Base Flow[c]	Outfall Features
1	75,000 cfs	≥ 1,000,000 cfs	450,000 cfs	5,000 cfs	Outfall transition feature (OTF)
2	50,000 cfs	≥ 1,000,000 cfs	450,000 cfs	5,000 cfs	OTF
3	150,000 cfs	≥ 1,000,000 cfs	450,000 cfs	5,000 cfs	OTF
4–6 (Alternatives 1, 2, or 3 with marsh terracing)	75,000 cfs, 50,000 cfs, and 150,000 cfs	≥ 1,000,000 cfs	450,000 cfs	5,000 cfs	OTF plus marsh terracing

[a] Flow measured at Belle Chasse gauge.
[b] Trigger of opening from and closing to base flow.
[c] Depending on river flow and head differential.

Alternative 1 would have a maximum diversion flow of 75,000 cfs, which would occur when the Mississippi River gauge in Belle Chasse reaches 1,000,000 cfs or higher. The diversion would operate at up to 5,000 cfs (base flow) when the river is below 450,000 cfs at Belle Chasse; at river flows above 450,000 cfs, the diversion would be opened fully, allowing flows beginning at approximately 25,000 cfs and maxing out at 75,000 cfs when the river reaches 1,000,000 cfs (see Table 1-2). Alternative 2 would have a maximum diversion flow of 50,000 cfs, while Alternative 3 would have a maximum diversion flow of 150,000 cfs. Alternatives 2 and 3 would be operated with the same on/off triggers and base flows described for Alternative 1 (Table 1-2).

Alternatives 4–6 are similar to Alternatives 1–3, respectively, but also would include marsh terrace outfall features. The terraces would be chevron or "v" shaped, and oriented toward the discharge current from the diversion. The marsh terrace features would aid in overall sediment retention, would help protect newly deposited sediment from erosion, and would be designed to avoid interfering with the ability of the basin to receive diversion flows. The alternatives are discussed further and evaluated in Chapter 3 of this Draft RP.

For all alternatives, when the diversion is operating above base flow, the flow rate would be controlled by the difference in water surface elevation between the Mississippi River and the Barataria Basin (the "head differential"). When the Mississippi River flow and water level are high, this high head differential would push a higher volume of water and sediment through the diversion into the Barataria Basin. When the Mississippi River flow and water level are low, there would be less energy to push water and sediment through the diversion. When the water surface elevations in the Mississippi River and Barataria Basin are such that there would be a negative head differential, the diversion gates would be closed to avoid backwatering.

The Proposed MBSD Project and its alternatives also include a MAM Plan and a Mitigation Plan (see Appendices A and B, respectively). Both plans serve as an integral part of the proposed restoration action. The MAM Plan includes (1) methods for specific types of monitoring, (2) key performance measures/indicators for assessing the success of the Proposed MBSD Project in meeting its objectives, and (3) decision criteria and processes for modifying ("adapting") current or future management actions (Appendix A). The Mitigation Plan includes actions to help to address collateral impacts of construction and operation of the Proposed MBSD Project (Appendix B).

1.6 No-Action Alternative

As required by OPA NRDA regulations, the Final PDARP/PEIS considers a "natural recovery alternative in which no human intervention would be taken to directly restore injured natural resources and services to baseline" [15 CFR 990.53(b)(2)]. Under a natural recovery alternative (i.e., No-Action Alternative), the Trustees would not perform any additional restoration to accelerate the recovery of injured natural resources or to compensate for lost services. The Trustees would allow natural recovery processes to occur, which would result in one of four outcomes for the injured resources: (1) gradual recovery, (2) partial recovery, (3) no recovery, or (4) further deterioration. Although injured resources could presumably recover to baseline or near baseline conditions under this scenario, recovery would take much longer compared to a scenario in which restoration actions were undertaken. The Final PDARP/PEIS (DWH NRDA Trustees, 2016a, page 5-92) notes that interim losses of natural resources, and the services that natural resources provide, would not be compensated under a No-Action Alternative. Given that technically feasible restoration approaches are available to compensate for interim natural resource and service losses, the Trustees rejected the No-Action Alternative from further OPA evaluation in the Final PDARP/PEIS.

In SRP/EA #3, the LA TIG noted that the loss of deltaic processes in this estuarine ecosystem has resulted in a steady decline in the health of natural resources in the Barataria Basin, which is indicated by metrics such as decreased plant health, high rates of erosion, and higher salinities farther north in the basin (McKee et al., 2004; Alber et al., 2008; Wilson and Allison, 2008; Couvillion et al., 2011; Silliman et al., 2012, 2016; Khanna et al., 2013; McClenachan et al., 2013; Zengel et al., 2014, 2015; Rangoonwala et al., 2016; Turner et al., 2016; Beland et al., 2017). Further, the coastal habitats of the northern Gulf of Mexico support resources throughout the Gulf (Gunter, 1967; Nixon, 1980; Boesch and Turner, 1984; Baltz et al., 1993; Houde and Rutherford, 1993; Deegan et al., 2002). Thus, for the wetlands, coastal, and nearshore habitats in the Barataria Basin that are the focus of this Draft RP, the LA TIG concluded that a No-Action Alternative would result in further deterioration of injured resources within and beyond the Barataria Basin.

Based on these determinations, tiering this Draft RP from the Final PDARP/PEIS and SRP/EA #3, and incorporating those analyses by reference, the LA TIG did not further evaluate natural recovery as a viable alternative under OPA. For these reasons, the LA TIG rejects the No-Action

Alternative as a viable means of compensating the public for the injuries to natural resources, lost recreational use, and water quality injuries caused by the DWH oil spill; and natural recovery is not considered further in this Draft RP.

NEPA requires consideration of a No-Action Alternative in EISs [40 CFR 1502.14(c)]. This No-Action Alternative may be used as a basis for comparison of the potential environmental consequences of the action alternatives(s). Therefore, "no action" is evaluated as an alternative in the Draft MBSD EIS. While the LA TIG has rejected the No-Action-Alternative for this Draft RP, the OPA analysis provided in Chapter 3 integrates information about the DEIS No-Action Alternative because it provides a baseline against which the benefits and collateral injuries of the Proposed MBSD Project and its alternatives can be compared.

1.7 Coordination with Other Gulf Restoration Programs

As discussed in the Final PDARP/PEIS (Section 1.5.6), the DWH NRDA Trustees are committed to coordinating with other Gulf of Mexico restoration programs to maximize the overall ecosystem impact of DWH NRDA restoration efforts. During the course of the restoration planning process, the LA 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, as implemented by the Gulf Coast Ecosystem Restoration Council, the Gulf Environmental Benefit Fund (GEBF) managed by the National Fish and Wildlife Foundation (NFWF), and other state and federal restoration funding sources.

The LA TIG reviews the implementation of projects in other coastal restoration programs to create synergies, where feasible, with those programs to ensure the most effective use of available funds for maximum coastal ecosystem benefit. This coordination ensures that funds are allocated for critical restoration projects across the affected regions of the Gulf of Mexico and within appropriate coastal Louisiana areas. The LA TIG will continue to collaborate and partner with other restoration programs to maximize cost savings and restoration benefits to the resources in coastal Louisiana that were injured by the DWH oil spill.

In Louisiana, for example, CPRA partnered with GEBF to accelerate the planning of sediment diversion projects. This funding also included an Independent Technical Review of the diversion planning effort and a Diversion Advisory Panel. GEBF funding also allowed CPRA to accelerate the engineering and design (E&D) of the Proposed MBSD Project identified in SRP/EA #3 at a cost of approximately $118 million, which is currently under way. This GEBF funding has reduced the total amount of funding that the LA TIG needs to plan for and implement the Proposed MBSD Project.

In addition, GEBF funding has been used in the Barataria Basin to:

- Accelerate the engineering, design, and construction; and monitor Increment II of the Caminada Headland Restoration Project (CWPPRA Project 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 and 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 and the Barrier Island Comprehensive Monitoring Program.

In the Barataria Basin, funds from the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act) have been used to:

- Commence E&D of the West Grand Terre Beach Nourishment and Stabilization Project at a cost of approximately $7.3 million. These barrier islands were heavily impacted by the DWH oil spill. This project, once fully implemented, will restore and enhance dune and back-barrier marsh habitats 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 toward 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, at a cost of approximately $9.3 million. This planning effort will advance the science developed under the Louisiana Coastal Area 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.
- Implement the Jean Lafitte Canal Backfilling Project at a cost of approximately $8.7 million. Canals constructed to access well sites and pipelines constructed on lands that ultimately became the Jean Lafitte National Historical Park and Preserve resulted in wetland loss, groundwater and surface water alteration, saltwater intrusion, and soil compaction; and contributed to the introduction and spread of invasive species. NPS will restore freshwater wetland and shallow water habitats, and improve hydrologic exchange and aquatic organism access between these remnant canals (16.5 miles) and adjacent wetland areas by using material from spoil banks to fill the canals and thereby removing a barrier inhibiting this exchange.

The DWH NRDA Trustees implemented several projects in the Barataria Basin beginning in 2014 under the Early Restoration framework agreement with BP[5]:

- Louisiana Oyster Cultch Project: this project involved (1) the placement of oyster cultch onto public oyster seed grounds throughout coastal Louisiana, but specific to the Barataria Basin, along public oyster seed grounds in Hackberry Bay; and (2) the construction of an

[5] Additional information about restoration project planning, environmental compliance, and outreach for all projects led by Louisiana's Trustees is available at http://www.gulfspillrestoration.noaa.gov/restoration-areas/louisiana.

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 created approximately 104 acres (ac) of new brackish marsh in the Barataria Basin using hydraulically dredged sediment. The 104-ac 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 involved the restoration of beach, dune, and back-barrier marsh habitats; as well as improving habitat for brown pelicans, terns, skimmers, and gulls at four barrier islands in Louisiana. Specific to the Barataria Basin, this project included 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 project.

As part of the post-settlement process, the LA TIG produced several DWH RPs, which have resulted in the approval of over $1 billion in restoration projects, including MAM activities, since 2016[6]:

- Final Restoration Plan #1: Restoration of Wetlands, Coastal, and Nearshore Habitats; Habitat Projects on Federally Managed Lands; and Birds. In this RP, the LA TIG selected six restoration projects to proceed with E&D activities (Phase I) and evaluated design alternatives for construction of these projects (Phase II).
- Final Restoration Plan and Environmental Assessment #2: Provide and Enhance Recreational Opportunities. This RP and EA describes and selects projects intended to restore for lost recreational use opportunities caused by the Incident.
- Strategic Restoration Plan and Environmental Assessment #3: Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin. This RP and EA, which is described in more detail above, analyzes strategic restoration alternatives associated with the restoration of wetlands, coastal, and nearshore habitat resources and services in the Barataria Basin, which were heavily impacted by the Incident.
- Final Restoration Plan and Environmental Assessment #4: Nutrient Reduction (Nonpoint Source) and Recreational Use. This RP and EA describes and proposes restoration project alternatives that the LA TIG considered to improve water quality by reducing nutrients from nonpoint sources and to compensate for recreational use services lost as a result of the Incident.
- Final Restoration Plan and Environmental Assessment #5: Living Coastal and Marine Resources – Marine Mammals and Oysters. This RP and EA describes and proposes marine mammal and oyster projects to replenish and protect living coastal and marine resources in the Louisiana Restoration Area.

[6] For additional information about the LA TIG DWH RPs, see https://la-dwh.com/restoration-plans/ or https://www.gulfspillrestoration.noaa.gov/restoration-areas/Louisiana.

- Final Restoration Plan and Environmental Assessment #6: Restore and Conserve Wetlands, Coastal, and Nearshore Habitats. This RP and EA describes and proposes three projects to create or restore marsh, beach, and dune habitats; and protect shoreline habitat.
- Final Restoration Plan and Environmental Assessment #7: Wetlands, Coastal, and Nearshore Habitats and Birds. This RP and EA includes three proposed wetlands, coastal, and nearshore habitat projects; and two bird restoration projects.

1.8 Public Participation

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

The DWH NRDA Trustees conducted an extensive public outreach process as part of the development of the PDARP/PEIS[7] and SRP/EA #3. Pursuant to the PDARP/PEIS (82 FR 19659), the LA TIG published an NOI to prepare the Draft SRP/EA #3 for the Barataria Basin in Louisiana in April 2017. Upon releasing the Draft SRP/EA #3, the LA TIG made it available for public review and comment for 45 days and held a public meeting to further solicit input. After review, consideration, and response to public comments, the Final SRP/EA #3 was completed in March 2018.

Public engagement is also a vital element of developing the Proposed MBSD Project. Since 2016, CPRA has participated in nearly 200 outreach and engagement activities focused on the Proposed MBSD Project, reaching more than 7,000 people (Table 1-3). These public involvement efforts included a series of community meetings across coastal Louisiana. Over 30 Coastal Connections meetings provided coastal citizens and leaders – in Belle Chasse, Braithwaite, Empire, Ironton, Lafitte, Myrtle Grove, Phoenix, Port Sulfur, and other coastal communities – with regular conversations about sediment diversion projects, including the Proposed MBSD Project. CPRA also hosted meetings with local governments and local government officials, such as the Plaquemines and St. Bernard Parish Councils, and held numerous meetings with nongovernmental organizations and educational groups. For example, the CPRA Diversion Team held a meeting with Coastal Communities Consulting, which works on behalf of the Vietnamese fishing community; 175 people attended the meeting. As part of their efforts with Coastal Communities Consulting, the Diversion Team translated several resource materials – such as diversion frequently asked questions – into Vietnamese for community members. Throughout the planning process, CPRA also met with fisherman and industry representatives, including attending oyster, shrimp, and crab task force meetings; and met with members of the navigation community who rely on the Mississippi River for transport of goods and services. These outreach and engagement efforts provided the public with an opportunity to ask questions and obtain information about the Proposed MBSD Project. The feedback received by CPRA through public

[7] The process for PDARP/PEIS public outreach is described more fully in Chapter 8 of the PDARP/PEIS, available at https://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. More discussion on public outreach and involvement can also be found in previous phases of DWH NRDA restoration, including in the Early RPs, available at http://www.gulfspillrestoration.noaa.gov/restoration/early-restoration.

engagement also helped to refine the technical analysis and approach for the Proposed MBSD Project. It also strongly shaped the types of stewardship and mitigation efforts that would be supported through the Proposed MBSD Project (see Sections 3.2.1.1.5 and 3.2.1.1.6, and Appendix B).

Table 1-3.
Summary of Public Engagement Activities and Number of People Reached to Discuss Sediment Diversions in the Barataria Basin, including the Proposed MBSD Project, from 2016 to 2020[a]

Number and Type of Public Engagement Activities	Number of People Reached
51 Community events	2,506 community members and residents
13 Media events	1,737 listeners
19 CPRA board meetings and events	986 board members and public attendees
35 Coastal Connections	692 community members and residents
5 Conferences	555 attendees
28 Parish leadership and outreach	378 council members, committee members, and residents
16 Environmental nongovernmental organizations	353 representatives, members, and attendees
5 Business group meetings	178 members and attendees
8 Task force meetings	85 task force members
9 Governor's Advisory Commission	80 members and attendees
5 Federal agency meetings (e.g., USACE, United States Geological Survey, SeaGrant)	39 staff

[a] All activities occurred prior to, and are separate from, the public engagement process associated with this Draft RP; see Section 1.8.2 for more details about the planned Draft RP public comment process.

1.8.1 Coordination of Public Outreach with EIS

NEPA regulations require input from the public, stakeholders, and government agencies throughout the DEIS development process, which is consistent with the OPA NRDA planning process outlined in 40 CFR 990.23(c)(1)(ii). CEMVN published an initial NOI to prepare an EIS for the MBSD in the FR on October 4, 2013.[8] Thereafter, on April 27, 2017, CEMVN published a Supplemental NOI in the FR to initiate the EIS process, including initiating the public scoping process for the EIS.

CEMVN provided official public notice of scoping meetings and announced the 60-day formal public scoping period on July 5, 2017. Scoping meeting dates and locations were published in local newspapers (i.e., *Plaquemines Gazette, The Times Picayune*, and *The Advocate*), and press releases were issued on July 4, 5, 11, 14, and 17, 2017. Three public scoping meetings were held in Lafitte, Belle Chasse, and Port Sulphur on July 20, 25, and 27, 2017, respectively; over 300 residents attended these meetings.

[8] Following receipt of a Department of the Army permit application for the Proposed MBSD Project from CPRA, CEMVN developed a coordinated project plan, per the requirements of FAST-41, and made it available on the Permitting Dashboard and CEMVN websites on March 17, 2017.

1.8.2 Public Comment Process

The LA TIG and CEMVN are coordinating a public review process for both this Draft RP and the related DEIS.[9] Up to four public meetings for the Proposed MBSD Project are planned during the Draft RP and DEIS public comment periods. Given current restrictions on in-person gatherings due to COVID-19 and the uncertainty regarding this pandemic's prevalence in the future, public meetings may be converted to virtual meeting options. Virtual meetings may either be held in conjunction with in-person meetings, or a fourth meeting that is only virtual may be held. The most current status and logistics for all public engagements is available on the LA TIG website: http://www.gulfspillrestoration.noaa.gov/restoration-areas/louisiana.

The public is encouraged to review and comment on the Draft RP and on the related DEIS. The Draft RP will be made available for public review and comment for 60 days following its release, as specified in the public notice published in the Federal and Louisiana Registers. The public notice will also specify the date, time, and location of one or more public meetings, whether in-person or virtual, when comments will be received for the Draft RP and DEIS. Written comments on the Draft RP can be submitted during the comment period by the following methods:

- Via the internet: http://www.gulfspillrestoration.noaa.gov/restoration-areas/louisiana
- Via hard copy, mailing to: U.S. Fish & Wildlife Service, P.O. Box 49567, Atlanta, GA 30345.

Submissions must be postmarked no later than 60 days after the Draft RP release date.

Comments on the Draft RP received during public meetings and during the RP comment period will be summarized and responded to in the Final RP.

1.8.3 Administrative Record

During the development of this Draft RP, the Trustees fulfilled their responsibilities to maintain an Administrative Record per 40 CFR 990.45. After release of the Final RP, the Trustees will continue to add documents concerning implementation and monitoring to the Administrative Record.[10]

1.9 Document Organization

This Draft RP is organized as follows:

Chapter 1 (Introduction): this chapter provides introductory information and context for the Draft RP.

[9] The public review period for the USACE MBSD DEIS runs concurrent with public review of this Draft RP. All public meetings and materials will be coordinated such that materials about both the Draft RP and the DEIS will be presented in the same meeting. Complete information on public commenting opportunities for the USACE MBSD DEIS is available at http://www.gulfspillrestoration.noaa.gov/restoration-areas/louisiana.

[10] The Administrative Record for all TIG planning documents can be found at https://www.doi.gov/deepwaterhorizon/adminrecord.

Chapter 2 (Restoration Planning Process): this chapter includes background on the restoration planning decisions by the LA TIG, the relationship of this Draft RP to SRP/EA #3 and the Final PDARP/PEIS, a summary of injuries to resources resulting from the DWH oil spill that the LA TIG intends to address in this Draft RP, and the identification of restoration alternatives to address those injuries.

Chapter 3 (OPA Evaluation of the Alternatives): this chapter includes a description and evaluation of the Proposed MBSD Project and its alternatives under the OPA NRDA evaluation criteria, including the costs to carry out the alternatives, Trustee restoration goals and objectives, the likelihood of success, how to prevent future injuries and avoid collateral injuries, how the project will benefit multiple resources, and public health and safety.

Chapter 4 (Compliance with Other Laws and Regulations): this chapter includes a compilation of additional federal and state laws that may apply to the Proposed MBSD Project and its alternatives.

Chapter 5 (List of Preparers and Reviewers): this chapter identifies individuals who substantively contributed to the development of this document.

Chapter 6 (List of Repositories): this chapter includes a list of facilities that will receive copies of the Draft RP for review by the public.

Chapter 7 (References): this chapter includes all references that are cited in the text.

Appendix A (Monitoring and Adaptive Management Plan for the Proposed MBSD Project): this appendix provides the approaches that will be used to monitor and adaptively manage the Proposed MBSD Project.

Appendix B (Mitigation Plan for the Proposed MBSD Project): this appendix sets forth the specific measures that will be undertaken to mitigate the potential impacts of the implementation of the Proposed MBSD Project.

Appendix C (Alternatives Considered but Not Carried Forward for Detailed Evaluation): this appendix provides details about alternatives that were considered by the Trustees and USACE but were not carried forward for detailed analysis in this plan, including the rationale behind their exclusion from further analysis.

2.0 Restoration Planning Process

This chapter provides additional detail on the restoration planning process that the LA TIG undertook for the Proposed MBSD Project and its alternatives.

2.1 Summary of Injuries Addressed in this Draft RP

This Draft RP focuses on restoring wetlands, coastal, and nearshore habitats in the Barataria Basin. These habitats are critical components of the broader northern Gulf of Mexico ecosystem and suffered the greatest degree of oiling in Louisiana due to the Incident. Coastal and nearshore habitats provide food, shelter, and nursery grounds for numerous ecologically and economically important species, including fish, shrimp, shellfish, sea turtles, birds, and marine mammals. The Final PDARP/PEIS (DWH NRDA Trustees, 2016a) documented the nature, degree, and extent of injuries from the Incident to both natural resources and the services they provide. In the following bullets, key relevant injury information from the final PDARP/PEIS is presented, which helps establish the nexus for restoration planning for these particular resources in the Barataria Basin.

- The Incident resulted in over 1,100 kilometers of wetland oiling Gulf-wide. Approximately 95% of this marsh oiling occurred in coastal Louisiana, with the heaviest oiling in the Barataria Basin (PDARP/PEIS, Table 4.6-2; Nixon et al., 2015). The heaviest oiling occurred in marshes dominated by *Spartina alterniflora,* a perennial deciduous grass, and *Juncus roemerianus*, a flowering plant species (Visser et al., 1998; Lin and Mendelssohn, 2012; Silliman et al., 2012). These marshes provide critical habitats for estuarine-dependent species throughout the Gulf of Mexico.
- Gulf salt marshes are highly productive. The marsh edge habitat provides spawning, nursery, and feeding grounds for juvenile fish and invertebrates of ecological and commercial importance. The marsh edge was severely oiled and injured, and the impacts of this oiling were documented in the Barataria Basin. For example, growth rates of juvenile brown and white shrimp along this oiled marsh edge were reduced by up to 50% compared to those collected near shorelines that did not experience oiling (e.g., Rozas et al., 2014; van der Ham and de Mutsert, 2014). Growth rates of red drum along heavily oiled marsh shorelines were also reduced by approximately 50% in 2010 relative to non-oiled shorelines, and these reduced growth rates persisted through at least 2013 (e.g., Powers and Scyphers, 2016).
- The impacts of DWH oiling were ecosystem-wide, spanning multiple trophic levels. The negative effects of oiling on plants and lower trophic levels from the nearshore food web (e.g., amphipods, shrimp, snails) caused a cascade of impacts on higher trophic levels.
  - Areas with heavy oiling experienced reduced plant cover and aboveground biomass compared to areas with little or no oiling (DWH NRDA Trustees, 2016a; Hester et al., 2016).
  - Amphipods are a primary source of prey for many fish and invertebrates that utilize the marsh edge; heavy oiling reduced the availability of this important prey species

because the oiling resulted in growth and biomass reductions (DWH NRDA Trustees, 2016a; Powers and Scyphers, 2016).

- Marsh periwinkles are also an important part of the marsh-estuarine food chain. At the oiled marsh shoreline edge, densities of periwinkles were reduced by 80% to 90% compared to non-oiled areas, and reduced by 50% in the oiled marsh interior (DWH NRDA Trustees, 2016a; Zengel et al., 2016). Shoreline cleanup actions further reduced adult snail density and snail size (DWH NRDA Trustees, 2016a; Zengel et al., 2016).
- Forage fish were directly impacted by the oiling, including reductions in the biomass and hatch success of Gulf killifish, which lay their eggs on the marsh surface (DWH NRDA Trustees, 2016a; Powers and Scyphers, 2016).
- Predatory fish species such as southern flounder, which are closely associated with marsh sediment, were also directly negatively impacted by the oil (DWH NRDA Trustees, 2016a; Powers and Scyphers, 2016).

- The PDARP/PEIS states that substantial injury to marsh birds likely occurred. Birds that were present in the marsh habitat during the DWH spill were likely exposed to oil via multiple pathways. Heavily oiled marsh areas had extensive oiling on vegetation and soils, and contained oil-contaminated prey. Through walking, perching, or foraging, birds likely came into contact with and possibly ingested oil at levels that were detrimental to their health (DWH NRDA Trustees, 2016a).
- Marsh grasses help maintain the habitat in the Barataria Basin by protecting the marsh edge from erosion. Extensive oiling and loss of marsh vegetation in the Barataria Basin created an acceleration of land loss following the oil spill. The accelerated erosion due to the spill resulted in the permanent loss of coastal wetlands over large portions of the Barataria Basin (see Table 2-1; Silliman et al., 2012, 2015, 2016; McClenachan et al., 2013; Zengel et al., 2015; Turner et al., 2016).
- The marsh edge serves as the gateway for the movement of organisms and nutrients between intertidal and subtidal estuarine environments. Injuries to a specific resource in the nearshore marine ecosystem could cause direct and indirect effects on offshore resources. For example, Gulf killifish, a key connector of energy between marsh and open Gulf waters, are among the largest of the Gulf forage fish and are preyed upon by wildlife, birds, and many sport fish. Water column resources injured by the spill include species from all levels in the northern Gulf of Mexico food web, including estuarine-dependent species (DWH NRDA Trustees, 2016a).
- Other examples of impacts on specific species and resources, as described in the 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., DWH NRDA Trustees, 2016a).

Table 2-1.
Comparisons of Published Pre- and Post-Spill Erosion Rates in Louisiana

Erosion Rate	Time Period	Source
Barataria Basin locations		
Reference sites: 0.8–1.3 m yr^{-1} Heavily oiled sites: 2–3 times higher than reference sites	Post-DWH spill (spring 2010–fall 2012)	Zengel et al., 2015[a]
Reference sites: ~ 1.38 m yr^{-1} Oil-impacted sites: ~ 3.0 m yr^{-1}	7–22 months after DWH spill (October 2010–January 2012)	Silliman et al., 2012[a]
Low-oil sites: 1.0 m yr^{-1} High-oil sites: 1.33 m yr^{-1}	8–29 months after DWH spill (November 2010–August 2012)	McClenachan et al., 2013[a]
Non-oiled sites: 0.53 m^2 m^{-1} y^{-1} > 60% oiled sites: 0.66 m^2 m^{-1} y^{-1}	Pre-spill (2006–2010) (baseline for future oiled sites)	Beland et al., 2017[b]
Non-oiled sites: 0.71 m^2 m^{-1} y^{-1} > 60% oiled sites: 1.74 m^2 m^{-1} y^{-1}	Post-oiling from DWH spill (2010–2013)	Beland et al., 2017[b]
Non-oiled sites: 0.63 m^2 m^{-1} y^{-1} > 60% oiled sites: 0.81 m^2 m^{-1} y^{-1}	Post-oiling from DWH spill (2013–2016)	Beland et al., 2017[b]
Terrebonne Basin and Barataria Basin locations		
Unoiled islands: 1.53 m yr^{-1} Oiled islands: 3.07 m yr^{-1}	1–33 months after DWH spill (May 2010–December 2012)	Turner et al., 2016[B]
Louisiana sites (multiple locations)		
No oiling: 1.4 ± 0.5 m yr^{-1} 90–100% plant stem oiling: 4.0 ± 1.4 m yr^{-1}	7–42 months after the DWH spill (fall 2010–fall 2013)	Silliman et al., 2015[a]

[a] Study cited in the PDARP/PEIS.
[b] Study published after the release of the PDARP/PEIS.
m yr^{-1} = meters per year; m^2 m^{-1} y^{-1} = square meters per meter per year.

2.2 Additional Injuries Addressed by Other Plans

The restoration described in this Draft RP is intended to benefit resources that suffered the injuries described above in Section 2.1. However, the LA TIG also acknowledges that additional injuries to natural resources occurred in the Barataria Basin and in the Louisiana Restoration Area. Injured resources not addressed in this Draft RP have been addressed by previous RPs and are intended to be the focus of future RPs issued by the LA TIG.[11] For example:

- The PDARP/PEIS estimated that the oil spill resulted in higher adult mortality and higher rates of lost pregnancies for bottlenose dolphins in the Barataria Bay (DWH NRDA Trustees, 2016a). The LA TIG has begun to address restoration of marine mammals in DWH Final Restoration Plan and Environmental Assessment (RP/EA) #5: Living Coastal and Marine Resources – Marine Mammals and Oysters (LA TIG, 2020a).
- The PDARP/PEIS notes that subtidal oysters were killed as a result of the Incident (DWH NRDA Trustees, 2016a). As described in Section 1.7, the Louisiana Oyster Cultch Project implemented under the Early Restoration framework agreement addressed oyster injuries

[11] Links to all draft and final LA TIG RPs can be found at https://la-dwh.com/restoration-plans/.

in the Barataria Basin. As noted above, the LA TIG also has developed RP/EA #5, which addressed the restoration of oysters.

- The PDARP/PEIS describes lethal and sublethal injuries to birds from oil exposure, including injuries to offshore sea birds, shorebirds, waterfowl, marsh birds, and colonial nesting birds (DWH NRDA Trustees, 2016a). The LA TIG has addressed restoration of birds in RP #1: Restoration of Wetlands, Coastal, and Nearshore Habitats; Habitat Projects on Federally Managed Lands; and Birds. The LA TIG has also addressed restoration for birds in RP/EA #1.1: Queen Bess Island Restoration (LA TIG, 2019). While the restoration alternatives described in this Draft RP may also provide additional habitats for certain functional groups of birds, additional plans to address birds are expected in the future, including RP/EA #7: Wetlands, Coastal, and Nearshore Habitats and Birds (LA TIG, 2020b).
- The PDARP/PEIS describes losses to the public's use of natural resources for outdoor recreation, such as boating, fishing, and beachgoing (DWH NRDA Trustees, 2016a). The LA TIG has addressed restoration of lost recreational use within Louisiana in RP/EA #2: Provide and Enhance Recreational Opportunities (LA TIG, 2018a) and RP/EA #4: Nutrient Reduction (Nonpoint Source) and Recreational Use (LA TIG, 2018b). The restoration alternatives described in this Draft RP may also provide additional benefits to some recreational uses; the LA TIG may issue additional plans to address restoration of lost recreational use in the future.

2.3 Screening for a Reasonable Range of Alternatives

Under OPA NRDA regulations, alternatives considered in an RP should demonstrate a clear relationship to the resources and services injured. The DWH Trustee Council SOP Section 9.4.1.4 provides that "Screening will adhere to project selection criteria consistent with OPA regulations (15 CFR § 990.54), the PDARP/PEIS, and any additional evaluation criteria established by a TIG and identified in a restoration plan or public notice." The process used by the LA TIG to first select a Mid-Barataria Basin sediment diversion, and to screen and identify a reasonable range of project-specific alternatives for analysis, is described below.

2.3.1 Selection of a Mid-Barataria Basin Sediment Diversion for Further Analysis

This Draft RP tiers from two previous RPs: the PDARP and SRP/EA #3. This section briefly describes how the LA TIG utilized the analyses and planning processes included in the development of these RPs to select a large-scale sediment diversion in the Mid-Barataria Basin for further planning and evaluation under this Draft RP.

2.3.1.1 PDARP/PEIS

On February 19, 2016, the DWH NRDA Trustees issued a Final PDARP/PEIS outlining a programmatic RP to fund and implement restoration across the Gulf of Mexico region into the future as restoration funds became available. The PDARP/PEIS identified a need for ecosystem-scale restoration to offset ecosystem-scale losses. The document placed an emphasis on coastal and nearshore habitat restoration in the historic Mississippi River delta plain in Louisiana because of the connectivity between deltaic wetlands and aquatic productivity in the northern Gulf of Mexico ecosystem.

On March 29, 2016, in accordance with OPA and NEPA, the DWH NRDA Trustees published a Notice of Availability in the FR of the ROD for the Final PDARP/PEIS (81 FR 17438). Based on the DWH NRDA Trustees' injury determination explained in the Final PDARP/PEIS, the ROD set forth the basis for the DWH NRDA Trustees' decision to select Alternative A: Comprehensive Integrated Ecosystem Alternative. This alternative emphasized the restoration of wetland complexes and noted that "Considering the scale of impacts from the oil spill, the Trustees also understand the importance of increasing the resiliency and sustainability of this highly productive Gulf ecosystem through restoration. Diversions of Mississippi River water into adjacent wetlands have a high probability of providing these types of large-scale benefits for the long-term sustainability of deltaic wetlands" (DWH NRDA Trustees, 2016a). More information about Alternative A can be found in Sections 5.5 and 5.10 of the Final PDARP/PEIS (DWH NRDA Trustees, 2016a).

Following publication of the Final PDARP/PEIS, individual TIGs became responsible for developing RPs that propose specific projects consistent with the Final PDARP/PEIS and Consent Decree. All RPs are released in draft form for public review and comment prior to finalization. Individual projects in these RPs contribute to one or more of the goals established for the relevant Restoration Type in the PDARP/PEIS, and are based on one or more of the restoration approaches analyzed for the relevant Restoration Type in the PDARP/PEIS.

The LA TIG has conducted the restoration planning process for the Proposed MBSD Project and its alternatives in accordance with the PDARP/PEIS and Consent Decree.

2.3.1.2 Final SRP/EA #3 for Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin, LA

The LA TIG elected to develop a strategic RP for the Barataria Basin (SRP/EA #3) that evaluated a suite of restoration techniques and approaches to determine how to best support restoring ecosystem-level injuries in the Gulf of Mexico through restoration in the Barataria Basin. The LA TIG selected the Barataria Basin as the geographic scope for SRP/EA #3 because, in addition to the high rates of erosion in the basin, wetlands in the Barataria Basin experienced some of the heaviest and most persistent oiling and associated response activities from the DWH oil spill (LA TIG, 2018c). In developing strategic restoration alternatives to address ecosystem-level injuries, the LA TIG considered the restoration approaches identified in the PDARP/PEIS for the Wetlands, Coastal, and Nearshore Habitats Restoration Type. The LA TIG focused SRP/EA #3 on two approaches: creating, restoring, and enhancing coastal wetlands; and restoring and preserving Mississippi-Atchafalaya River processes (LA TIG, 2018c). The LA TIG determined that these approaches provide the most direct link to restoring, creating, and maintaining coastal wetland habitats in the Barataria Basin.

To evaluate the potential alternatives, SRP/EA #3 included a screening process for individual projects. During this process, the LA TIG considered all projects submitted through the Louisiana and federal Trustees' project portals.[12] It also considered all relevant projects included in Louisiana's 2017 Coastal Master Plan. The CMP guides the State of Louisiana's work toward achieving comprehensive coastal protection and restoration, and to combat Louisiana's coastal land loss crisis. The LA TIG considered projects in the 2017 CMP because it is the State of Louisiana's most current, publicly vetted, and scientifically founded approach to coastal restoration, based on a holistic understanding of the coastal environment over the next 50 years. The 2017 CMP also includes the goal of promoting sustainable ecosystems, which is compatible with overall PDARP/PEIS goals.

In SRP/EA #3, the LA TIG noted that the CMP documented the relative benefits and importance of large-scale sediment diversions compared to other land-building alternatives. For example, the 2012 CMP included a comparison of three restoration project types to a future without action scenario: large-scale sediment diversions, multiple small diversions, and a no diversions/mechanical land-building only alternative (CPRA, 2012). This comparison demonstrated that large-scale sediment diversions are critical to maximizing and maintaining land-building. In the "no diversions" alternative considered in SRP/EA #3, the total land expected to be created or maintained was half of the land expected to be gained by the large-scale sediment diversion. Modeling also indicated that a large-scale sediment diversion could both build marsh and reduce landscape-scale elevation deficit, slowing further wetland losses due to climate-predicted changes (e.g., subsidence, sea level rise) (Wang et al., 2014). Similarly, multiple small diversions were expected to create less land than a large-scale sediment diversion (Wang et al., 2014). The LA TIG also noted that project-specific computer modeling suggested that a large-scale MBSD could build and maintain significantly more marsh over 50 years than the marsh creation projects considered.

In the Final SRP/EA #3, the LA TIG selected a large-scale MBSD and one marsh creation project[13] in the Barataria Basin to carry forward for further evaluation in Phase II RPs and NEPA analyses (LA TIG, 2018c). These particular projects were selected based on the following:

- The location of the projects in the Mid-Barataria Basin, which places them in close proximity to some of the most heavily oiled portions of the Louisiana coastline.
- The cost efficiency of undertaking a large-scale marsh creation project using a nearby Mississippi River borrow source prior to sediment diversion construction so that the borrow source has time to replenish before the sediment diversion begins operation. If the Mississippi River borrow source were dredged for marsh creation after the MBSD was operational, it would not be able to replenish and would therefore decrease the effectiveness of sediment capture by the diversion.
- The proximity of the two projects to one another, which would maximize the synergistic benefits of the two projects because the marsh creation increment would be able to capture additional sediment from the diversion. In contrast, another potential project considered

[12] The LA TIG accepts restoration proposals for the DWH oil spill from the public. Projects can be submitted through the portal at https://la-dwh.com/project-submission/. The federal Trustees maintain a similar project portal at https://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/suggest-a-restoration-project.

[13] Phase II restoration planning has been completed for the Upper Barataria Marsh Creation Project.

by the LA TIG (the Ama Sediment Diversion) was located in the upper portion of the Barataria Basin and would not synergistically benefit other marsh creation projects.

- The likelihood of success based on the adequacy and availability of information for the two projects. For example, the MBSD has been studied in different iterations of the 2012 and 2017 CMP and multiple other studies, including in the Louisiana Coastal Area Hydrodynamic and Delta Management Study (Little and Biedenharn, 2014). It also has undergone project-specific E&D at CPRA.

2.3.2 Process for Screening Alternatives for the Proposed MBSD Project

This Draft RP focuses on identifying and evaluating restoration alternatives for the Proposed MBSD Project. The screening process narrowed down possible locations, operational regimes, and diversion outfall management approaches to arrive at a reasonable range of alternatives.

The LA TIG chose to engage in a coordinated alternatives evaluation process with CEMVN, so that a consistent set of alternatives could be evaluated in the Draft RP and the DEIS for the Proposed MBSD Project. As described previously, the environmental review required by NEPA for this RP is occurring through the EIS for the Proposed MBSD Project, which is also being used to inform the decisions of the USACE regarding a CWA Section 10/404 permit application and request for Section 408 permissions. As part of that EIS development process, CEMVN led an Alternatives Working Group (AWG), in coordination with the LA TIG and CPRA, to identify a reasonable range of alternatives to be carried forward for (1) further analysis in the DEIS as part of the NEPA review process, and (2) further analysis in this Draft RP as part of the OPA evaluation process. The intent was to eliminate alternatives that did not meet the identified purpose, need, and corresponding restoration objectives for the Proposed MBSD Project; were technically infeasible; or were not in accordance with applicable laws, regulations, or permits.

Throughout the collaborative process of alternative development and evaluation, the LA TIG considered the following factors:

- The purpose and need of the Proposed MBSD Project.
- NEPA regulations.
- Requirements of the CWA, OPA, and OPA NRDA regulations.
- The interests, needs, and requirements of the LA TIG under OPA.
- Recommendations in the 2017 CMP.
- Public and agency scoping comments regarding the EIS.

In general, the alternative formulation process consisted of the following sequence of steps:

- Develop screening criteria to evaluate the effectiveness of different alternatives in meeting the purpose and need established in the DEIS.
- Identify potential alternatives, including functional and operational/design alternatives; and consider prior studies and analyses, and public and agency scoping comments.

- Evaluate potential alternatives through an iterative process, applying the screening criteria and other factors and considerations derived from the purpose and need established in the MBSD EIS, and public and agency scoping comments relevant to the specific analysis.
- Formulate and select project alternatives for detailed analysis in the DEIS and Draft RP.

2.3.2.1 Development of Screening Criteria

The screening criteria for potential alternatives used by the LA TIG were as follows:

- Criterion 1: reconnects and re-establishes deltaic processes between the Mississippi River and the Barataria Basin to achieve the Proposed MBSD Project's purpose and need in a sustainable manner.
- Criterion 2: delivers sediment, freshwater, and nutrients in a sustainable manner.
- Criterion 3: supports the long-term viability of existing and planned coastal restoration efforts.
- Criterion 4: helps restore habitat and ecosystem services in the northern Gulf of Mexico injured by the DWH oil spill, and is consistent with SRP/EA #3.
- Criterion 5: is consistent with the Louisiana CMP.

In the screening process, additional consideration was given to E&D feasibility, cost of implementation, and timeliness of meeting objectives.

2.3.2.2 Identification of Potential Alternatives

As explained previously, an OPA screening for project alternatives was performed as a part of SRP/EA #3 (i.e., SRP/EA #3 screened potential projects and alternatives other than sediment diversions that could potentially provide some of the same functions as the Proposed MBSD Project). This Draft RP does not replicate the evaluation of "functional alternatives" to the Proposed MBSD Project that involved project types other than a large-scale sediment diversion. Rather, this Draft RP focuses on identifying potential restoration alternatives for the Proposed MBSD Project that involve different locations, operations, or design features.

To identify and evaluate potential alternatives, the LA TIG reviewed and considered:

- Relevant information and analysis in the PDARP/PEIS and SRP/EA #3.
- Previous studies of restoration needs and proposed projects in the Barataria Basin (e.g., Louisiana Coastal Area Ecosystem Restoration Study, the Louisiana CMP, and others; see Section 3.2.1.4 of this document, and Section 1.2 of the DEIS for a more detailed discussion of the studies that have been conducted to support the development of this project).
- Information and modeling input provided by CPRA.
- Public and agency scoping comments.

The LA TIG examined different alternatives for a large-scale sediment diversion and developed additional considerations for evaluating the effectiveness of these potential alternatives at achieving the Proposed MBSD Project's goals and objectives. These alternatives included considerations of alternative locations, different capacity alternatives, alternative "triggers" for initiating flow above base flow through the diversion, and alternatives for a base flow through the diversion. The final step involved examining different alternatives for the diversion outfall area, and evaluating the effectiveness of these potential alternatives at achieving the Proposed MBSD Project's goals and objectives.

An overview of the outcomes of this evaluation process is provided below. Additional details of the process and outcome of this evaluation are provided in Chapter 2 of the DEIS.

2.3.3 Proposed MBSD Project Location Alternatives

The LA TIG selected the Barataria Basin as the geographic scope for the Final SRP/EA #3 because wetlands in the Barataria Basin experienced some of the heaviest and most persistent oiling and associated response activities from the DWH oil spill. It is also an "area of critical need" due to its significant and continuing land loss (DWH NRDA Trustees, 2016a). Thus, location alternatives for a large-scale sediment diversion outside of the Barataria Basin did not meet the LA TIG's goals and objectives for this Draft RP. Therefore, the LA TIG evaluated multiple potential location alternatives for a large-scale sediment diversion within the Barataria Basin.

The LA TIG first reviewed the results of previous studies that had considered several general locations for a sediment diversion from the Mississippi River into the Barataria Basin. These locations are expressed as RM Above Head of Passes:

- Upper Barataria Basin [RMs 62.5–118 (Davis Pond Freshwater Diversion structure)]
- Mid-Barataria Basin (RMs 46.4–62.5)
- Lower Barataria Basin (below RM 46.4).

A project location in Lower Barataria Basin would provide restoration closest to where the heaviest oiling and permanently eroded marsh shorelines occurred. A project in this location would help replace the eroded marsh habitat, which would facilitate the replacement of other natural resources that depend on marsh in this location. However, a project location in the Lower Barataria Basin is not a reasonable alternative because this location consists of large expanses of relatively deep open water with smaller areas of highly fragmented marshes. Consequently, it would take longer, and require a larger sediment volume, for the coarse-grained sediments that are the foundation of wetland creation to build up from the basin floor to a subaerial elevation suitable for marsh development. In addition, the Lower Barataria Basin is more open to waves, tidal action, and storm surge that would erode the newly created marshes more quickly over time.

A project location in the Upper Barataria Basin could benefit natural resources and services by addressing existing stressors to resources, which include a lack of deltaic processes that provide sediment, freshwater, and nutrients to counteract marsh degradation and erosion. However, a project location in the Upper Barataria Basin is not a reasonable alternative because wetlands in this area are still relatively intact and more protected from the combined influence of erosion, relative sea level rise, and saltwater intrusion compared to lower reaches of the basin (Nelson et al., 2002; Fitzgerald et al., 2006; Zou et al., 2015; Couvillion et al., 2016). Additionally, as the most inland location, the Upper Barataria Basin continues to have the least-fragmented marshes and forested wetlands in the Barataria Basin (Couvillion et al., 2016), and was relatively protected from the oiling of the DWH spill (see Chapter 4 in the PDARP/PEIS). Thus, while this location would be buffered from excessive erosional forces and has existing vegetation present that could capture sediment effectively, this location does not address an area of critical need within the Barataria Basin and would not rebuild coastal resources in areas at high risk of future losses. In addition, while the Proposed MBSD Project could potentially provide protection against saltwater intrusion to the basin over time, the Upper Barataria Basin would not likely benefit from this aspect of the Proposed MBSD Project because the USACE constructed and operates the Davis Pond Freshwater Diversion for this purpose.

The LA TIG selected a project location in the Mid-Barataria Basin because a project in this location has the capacity to accept and disperse sediments and nutrients, and would promote the long-term sustainability of existing and newly created marshes by addressing existing stressors, including a lack of sediment, freshwater, and nutrients. This location is close to oiled shorelines but farther away from additional erosive forces found in the Lower Barataria Basin. Accordingly, the LA TIG considered the following Mississippi River location options that have been modeled in previous diversion studies (USACE, 2004; CPRA, 2011; Meselhe and Sadid, 2015):

- RMs 60.1–62.5
- RMs 59.3–59.8
- RMs 46.4–59.0.

With regard to the locations between RMs 46.4 and 59.0, these studies concluded that this area was less likely to capture adequate sediment to support a sediment diversion. This area was also noted as the most vulnerable to saltwater intrusion and relative sea level rise (Visser et al., 2017). With regard to the locations between RMs 59.3 and 59.8, these same studies concluded that this reach lacked direct access to a point bar or to the depositional area adjacent to an inside bend of the river, resulting in lower sediment-removal efficiencies. As a result, a diversion in these locations would have lower capacity to capture the volume of sediment available to build on and sustain the basin-side marshes and wetlands compared to the Proposed MBSD Project location (RM 60.7; Allison, 2011; CPRA, 2011; Allison et al., 2014).

The location identified in the Proposed MBSD Project (RM 60.7) takes advantage of an existing point bar with appropriate sediments for marsh-building at the inside bend of the river between RMs 60.7 and 62.5. By locating the intake at the downriver end of this existing point bar, the diversion intake could capture and divert a sufficient volume of sediment through the diversion channel to meet the Proposed MBSD Project’s restoration goals.

The LA TIG determined that project alternatives at an RM other than RM 60.7 at the location of the existing point bar would not be effective in meeting the restoration objectives of the Proposed MBSD Project because they would not carry sufficient sediment into the basin. Therefore, the LA TIG did not carry forward additional location alternatives.

2.3.4 Proposed MBSD Project Operations

The next step in identifying potential alternatives to the Proposed MBSD Project involved evaluating different diversion operational scenarios. These alternatives included an evaluation of (1) the "on/off trigger" that would trigger full diversion operation, (2) the maximum discharge capacity, (3) the amount of base flow through the diversion, and (4) design options for the diversion.

2.3.4.1 On/Off Trigger

An important aspect of operating the sediment diversion is determining the environmental conditions under which the diversion gates should be opened to allow more than base flow ("turned on"), and under which river conditions the diversion gates would be closed to only allow base flow ("turned off"). These conditions are referred to as the "on/off trigger." The LA TIG evaluated alternatives for various operational trigger scenarios, including the concepts of triggering the operation of the diversion based on Mississippi River sediment load discharge, salinity, turbidity, or water temperature. These scenarios were not retained for further consideration because they were not as effective at capturing and transporting appropriate amounts of sediment to meet the goals and objectives of the Proposed MBSD Project (Liang et al., 2016; Messina and Meselhe, 2017), compared to an on/off trigger based on river flow. The LA TIG also evaluated the results of a study by The Water Institute of the Gulf (TWI; Liang et al., 2016), which examined several variations of "pulsing" operations (i.e., operating the diversion only for a certain number of consecutive days at a time, with the option of restricting or eliminating summer operations), as well as operating the diversion only during the rising limb of the Mississippi River hydrograph (as the discharge volume in the river increased). While pulsing improved sediment-capture efficiency, it also reduced total sediment capture, which translated into a reduction in the amount of material transported to the basin and a reduction in wetland creation and restoration over time (Liang et al., 2016). The simple trigger option with no pulsing provided the greatest total volume of sediment (Liang et al., 2016).

A study conducted by TWI included sensitivity testing of various triggers based on the flow of the Mississippi River at 50,000 cfs increments ranging from 300,000 cfs up to 700,000 cfs (Liang et al., 2016). Based on reviewing this and similar analyses, the LA TIG determined that a low trigger (300,000 cfs) would not efficiently allow for the distribution of fine- and coarse-grained sediments because the diversion would run at river flows that would be less effective at bringing coarse silts and sands from the riverbed into suspension, and distributing those sediments into the basin. A high trigger (600,000 cfs) also would not be effective in aiding in the potential for the accretion of sediment because the minimal days of operation associated with a high trigger would reduce the total volume of sediment transferred, and the area of wetlands created and sustained. Therefore, the high-trigger scenario would not effectively help promote long-term sustainability, address relative sea level rise, or promote the infilling of shallow open-water areas. In contrast, a 450,000 cfs trigger allows for diversion operations that capture the high-sediment loads associated with rapidly rising river discharges (Liang et al., 2016). On average, for years 2009–2015, a diversion with a 450,000 cfs trigger would have operated above base flow conditions for approximately 210 days of the year, compared to 290 days for a 300,000 cfs trigger and 135 days for a 600,000 cfs trigger (Liang et al., 2016). In consideration of these concepts, the proposed

450,000 cfs operational trigger would best meet the objectives of the Proposed MBSD Project, and the LA TIG did not carry forward other operational triggers as potential project alternatives.[14]

2.3.4.2 Maximum Discharge Capacity

The next step in the alternatives evaluation process involved examining different options for the maximum discharge capacity through the sediment diversion. The LA TIG evaluated an alternative that has a maximum discharge capacity of 75,000 cfs when the flow of the river is 1,000,000 cfs or higher, as well as alternatives with a smaller or larger maximum discharge capacity. Previous studies found that the diversion must operate above 45,000 cfs (maximum capacity) to transport coarse-grained sediments (> 63 microns) from the Mississippi River (at RM 60.7) into the basin effectively, and thus function as a sediment diversion (Allison, 2011; CPRA, 2011; Meselhe et al., 2011, 2012; Allison et al., 2014). Upon review of these studies, the LA TIG noted that the studies further demonstrated that the higher the capacity of water in the diversion channel, the greater the volume of sediment in the diverted water. Consequently, diversions with capacities higher than 75,000 cfs are expected to transport more of the materials critical to delta formation and at a higher sediment-water ratio. Larger diversions are also expected to be able to build and maintain marsh habitats under higher sea level rise scenarios because they are more able to provide the volume of sediment required to keep pace with faster sea level rise (CPRA, 2017), thus promoting the long-term sustainability of existing, created, and restored marshes.

The LA TIG determined that a diversion with a maximum capacity larger than 75,000 cfs at RM 60.7 should be considered in the evaluation of alternatives. The LA TIG also noted that previous studies did not evaluate a diversion at RM 60.7 between 45,000 cfs and 75,000 cfs, and concluded, in coordination with CEMVN, that for comparative purposes and in order to consider a range of adverse and beneficial impacts, a smaller diversion with a maximum capacity between 45,000 cfs and 75,000 cfs should also be considered in the evaluation of alternatives. To satisfy these considerations, the LA TIG chose to bring forward diversions with capacities of 150,000 cfs and 50,000 cfs in the evaluation of alternatives. The DEIS also considered the same alternatives.

2.3.4.3 Base Flow through the Diversion

Operation of a large-scale sediment diversion can also include varying the amount of base flow, which is a constant diversion discharge at Mississippi River flows less than the on/off trigger, although base flow would only occur when the water surface elevation of the Mississippi River is higher than the water surface elevation of the Barataria Basin. The primary purpose for the establishment of a base flow would be to moderate and stabilize seasonal fluctuations in salinity that could otherwise negatively affect marshes suited to a different salinity range. The alternatives evaluation process relied on several previous simulations of base flow options, each using historical conditions for years 2007 and 2010 in order to simulate a range in annual Mississippi River discharge, as well as environmental variables such as wind and rainfall. The 0 cfs base-flow scenario corresponded to the scenario with a simple trigger at 450,000 cfs (Liang et al., 2016). Other options tested included a 450,000 cfs on/off trigger, plus a base flow ranging from 1,000 cfs to 10,000 cfs. Based on the model results, a base flow of 5,000 cfs was determined

[14] Additional detailed analysis of the three flow-trigger options can be found in Section 2.4.2 of the DEIS.

as sufficient to moderate seasonal salinities both within the outfall area and in immediately adjacent marshes, while a base flow below 5,000 cfs was not effective in moderating seasonal salinities in the adjacent marshes (Messina and Meselhe, 2017). The modeled base flow of 10,000 cfs discharges more water than is necessary or desirable to moderate seasonal salinities within the outfall area and immediately adjacent marshes, and unintentionally freshens the basin farther from the outfall area (Messina and Meselhe, 2017). Thus, base flows of 10,000 cfs or below 5,000 cfs were not carried forward as alternatives for the Proposed MBSD Project.

2.3.4.4 Design Options

Next, the LA TIG considered several design options raised in scoping comments for the EIS, in addition to those previously considered by CPRA during development of the Proposed MBSD Project, to determine whether any of these design options could form the basis for separate alternatives. The following design options were evaluated:

- A siphon intake structure, which would use a siphon structure to transfer water from the Mississippi River to the Barataria Basin, instead of the proposed diversion conveyance channel.
    - This design option was not carried forward because the design of siphon structures is specific to freshwater diversions, and therefore may not be feasible to capture and transport the volume and range of sediment sizes to meet the goals and objectives of the Proposed MBSD Project.
- A “dog-leg” alignment, which would involve designing the diversion conveyance channel with two bends instead of using a straight channel.
    - This design option was not carried forward because this type of alignment can cause energy losses, which reduce water and sediment-carrying capacity (CPRA, 2011; Meselhe et al., 2011, 2012).
- A closed “tunnel-like” system for the diversion conveyance channel.
    - This design option was not carried forward because tunnel-like systems involve increased design and construction costs, and operations and maintenance challenges. More specifically, to reach a maximum design flow of 75,000 cfs, multiple tunnels would need to be constructed in parallel, which would subsequently lead to increased maintenance difficulties.
- Piping additional sediment from a Mississippi River dredge site into the diversion conveyance channel.
    - This design option was not carried forward because it is not feasible to identify a sufficient sediment source over the life of the Proposed MBSD Project that is not already dedicated to marsh creation/enhancement projects and that would not remove the upstream sediment expected to be captured by the diversion. In addition, the additional logistics and costs associated with placement and maintenance of a sediment pipeline from the source into the diversion channel were determined to be not practical.

The evaluation of these design options found that they were unlikely to be effective at meeting the restoration objectives of the Proposed MBSD Project for the reasons noted above, and thus were not carried forward as separate alternatives.

2.3.5 Sediment Diversion Outfall Features

The final step in identifying potential project alternatives focused on examining different options for features that could potentially expedite benefits of the Proposed MBSD Project in the outfall (or sediment deposition) area. These features are referred to herein as "outfall features." Public scoping comments for the EIS recommended constructing features in the diversion outfall area such as canals, bayous, terracing, impoundments, weirs, or chenier-like ridges, to manipulate the flow of water and sediment for water quality and sediment retention benefits; to create barriers for storm surge and wind; and to redirect waters away from oyster production and sensitive areas.

The LA TIG evaluated the following potential outfall features to address the scoping comments:

- Construction of canals, bayous, impoundments, and weirs.
  - These outfall features were not carried forward as alternatives because of the potential for such features to impede the development of the delta formation if constructed within or near the sediment deposition outfall area.
- Construction of marshes, ridges, and marsh terraces outside of the area where the delta would be expected to form.
  - Two different types of outfall features were considered further, as described below.

The LA TIG considered construction of a low ridge west of and running parallel to the northern terminus of Wilkinson Canal and its intersection with Round Lake. The purpose of this feature would be to prevent the deposition of sediment in the Wilkinson Canal and to promote deposition within the shallower adjacent waters and wetlands.

The second feature considered was the construction of marsh terraces or similar sediment-retention features adjacent to the Wilkinson Canal. After analyzing these two potential features, the LA TIG chose to propose marsh terracing as an alternative project feature in the range of alternatives to be analyzed further in the DEIS and the Draft RP because of the range of potential benefits associated with terraces. Terraces are intended to increase immediate benefits within the sediment deposition outfall area, and could also function to reduce sediment transport into the Wilkinson Canal by promoting deposition nearer the diversion.

2.4 Alternatives Not Considered for Further Evaluation in this Draft RP

Given the analysis conducted by the LA TIG summarized above, the LA TIG determined that some of the geographical and operational alternatives considered would not be carried forward for detailed evaluation in this Draft RP under the OPA NRDA evaluation criteria. See Appendix C (also an appendix to Chapter 2 of the DEIS) for a list of other alternatives considered but not carried forward for detailed evaluation because they did not meet the Proposed MBSD Project's goals and objectives.

2.5 Alternatives Considered for Further Evaluation in this Draft RP

Six alternatives are being carried forward for further analysis in this Draft RP, based on the screening described above. As previously noted in Section 1.6, these are the same alternatives being evaluated in the DEIS, which is being published concurrently with this Draft RP. The Proposed MBSD Project and its alternatives involve the construction of a large-scale sediment diversion connecting the Mississippi River with the adjoining Barataria Basin, and are consistent with SRP/EA #3, the 2017 CMP, and the purpose and need of the Proposed MBSD Project evaluated in the DEIS. These alternatives are described in further detail in Chapter 3, and are evaluated using the OPA NRDA evaluation criteria.

3.0 OPA Evaluation of the Alternatives

3.1 Summary of OPA NRDA Evaluation Criteria

According to the OPA NRDA regulations, Trustees are responsible for identifying a reasonable range of alternatives [15 CFR §990.53(a)(2)] that can be evaluated according to OPA evaluation standards (15 CFR §990.54). Once a reasonable range of alternatives is developed (as discussed in Section 2), the OPA NRDA regulations require Trustees to identify preferred restoration alternatives based on certain criteria:

- The cost to carry out the alternative.
- The extent to which each alternative is expected to meet Trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses (the ability of the restoration project to provide comparable resources and services, i.e., the nexus between the project and the injury).
- The likelihood of success of each alternative.
- The extent to which each alternative will prevent future injury as a result of the Incident, and avoid collateral injury as a result of implementing the alternative.
- The extent to which each alternative benefits more than one natural resource and/or service.
- The effect of each alternative on public health and safety.

3.2 OPA Evaluation of the Alternatives

The LA TIG screening process resulted in the identification of the following alternatives:

- Alternative 1 (the Proposed MBSD Project): A sediment diversion with a maximum flow of 75,000 cfs.
- Alternative 2: A sediment diversion with a maximum flow of 50,000 cfs.
- Alternative 3: A sediment diversion with a maximum flow of 150,000 cfs.
- Alternatives 4, 5, and 6: Equivalent to Alternatives 1, 2, or 3, respectively, with the addition of marsh terracing in the outfall area.

The alternatives considered by the LA TIG are variations in capacity and design of a large-scale sediment diversion, consistent with the LA TIG's previously documented decision in SRP/EA #3 to proceed with the further evaluation of a large-scale sediment diversion in the Mid-Barataria Basin. Because of this, the alternatives are broadly similar in terms of location, construction footprint, operation, and physical and biological mechanisms that affect the expected benefits and collateral injuries of the Proposed MBSD Project. However, the differences in capacity among the alternatives are projected to lead to variations in the magnitude, timing, or location of the benefits achieved; and the collateral injuries potentially incurred, which are critical to the evaluation of these distinct alternatives under OPA.

Given that the alternatives are variations of a large-scale sediment diversion in the Mid-Barataria Basin, and the importance of understanding the key differences among them, the LA TIG first provides a detailed description and analysis of Alternative 1 of the Proposed MBSD Project for all the OPA NRDA evaluation criteria. The remaining alternatives are then analyzed, and differences from Alternative 1 are highlighted in those analyses. This is followed by an integrated analysis across the alternatives, which describes how the LA TIG selected a Preferred Alternative.

3.2.1 Alternative 1: Sediment Diversion with a Variable Flow up to a Maximum of 75,000 cfs[15]

3.2.1.1 Alternative 1 Description

Under Alternative 1, the LA TIG would construct and operate a large-scale sediment diversion in the Mid-Barataria Basin to restore wetland habitat and ecosystem services adversely affected by the Incident.

The Barataria Basin was formed over 1,000 years ago as a part of the Lafourche delta complex. Historically, the Mississippi River deposited sediment, freshwater, and nutrients into the Barataria Basin during annual overbank flooding cycles and periodic crevasse splay events; these deposits nourished and sustained wetland habitats. Levees and channelization of the Mississippi River altered natural sediment transport from the river into the basin, eliminating the source of sediment and freshwater that built and maintained wetlands and marshes. As a result, the basin is suffering from significant coastal habitat loss (Couvillion et al., 2011; CPRA, 2012). The Barataria Basin lost approximately 25% of its total land area between 1932 and 2016 (Couvillion et al., 2017). These extreme rates of coastal erosion were significantly increased in specific locations by oiling from the Incident, injuring the resources that depend on these habitats, including vegetation, fish, crustaceans, birds, and other wildlife (DWH NRDA Trustees, 2016a).

Currently in coastal Louisiana, the areas that demonstrate sustained wetland building over decades are those where there are ongoing inputs of sediment, freshwater, and nutrients (e.g., the Atchafalaya Basin and crevasse areas in the birdfoot delta). The Proposed MBSD Project is designed to replicate a crevasse splay to restore natural resources injured by the Incident. More specifically, it would reconnect the Mississippi River to the Mid-Barataria Basin to:

- Mimic deltaic processes that deliver sediment, freshwater, and nutrients.
- Improve the function of existing habitats.
- Successfully develop deltaic habitats that connect nearshore and offshore ecosystems.

The ecosystem services provided by these deltaic habitats depend on ecological connections between the emergent wetlands and open-water habitats surrounding them. Building wetlands using a restoration approach that mimics deltaic processes – with a gradual and ongoing deposit of materials during the land-building process – allows plants, invertebrates, fish, crustaceans, and other wildlife to colonize the new areas over time as they encounter suitable conditions. Alternative 1 would provide a diversity of habitats associated with the delta-building process that would create a gradient in elevation from shallow subaqueous habitats to emergent marsh to

[15] Corresponds to Alternative 1 of the DEIS.

higher ridges. This diversity of habitats is expected to support fish and crustacean populations, and promote nutrient cycling and delta formation. Carle (2013) found that wetland vegetation in the Wax Lake Delta exhibits sharp zonation along an elevation gradient, with species such as black willow (*Salix nigra*) occurring at high elevations of the natural channel levees, dense meadows of mixed grasses and forbs occurring at intermediate elevations, and floating-leaved vegetation and SAV found at the lowest elevations and on newly formed shallow deposits. Similar elevation gradients for habitat would be expected in the Barataria Basin under Alternative 1.

The sediment diversion would transport large quantities of mineral sediments via high discharge volumes from the Mississippi River. Operation of the sediment diversion would be triggered by the volume of water flowing in the Mississippi River (as measured by the flow rate at the Belle Chasse gauge):

- When Mississippi River flows exceed 450,000 cfs, diversion operations above base flow would commence at variable flow rates. The Delft 3D Basinwide Model (hereafter the Delft3D model) assumes the diversion flow would start at approximately 25,000 cfs when the river flow is at 450,000 cfs, and diversion flows would increase proportionally as river flows increase.
- When Mississippi River flows reach 1,000,000 cfs, Alternative 1 would allow for a maximum diversion flow of 75,000 cfs through the diversion gates.
- When Mississippi River flows at the Belle Chasse gauge fall below 450,000 cfs, the diversion gates would be adjusted to reduce flow through the diversion to a base flow level of up to 5,000 cfs.

When the diversion is operating, the flow rate would be controlled by the physical difference in water surface elevation between the Mississippi River and the Barataria Basin (i.e., the “head differential”). As the Mississippi River flow and water level increase, the higher head differential would push a higher volume of water and sediment through the diversion into the Barataria Basin. When the Mississippi River flow and water level are low, there would be less energy to push water and sediment through the diversion. The diversion would be closed, when necessary, to prevent a reverse flow from the Barataria Basin to the Mississippi River. Also, diversion operations would be suspended before and during anticipated major tropical events.

At the downstream end of the diversion channel, an engineered area called an “outfall transition feature” would be constructed to guide and disperse the channel flow into the Barataria Basin. This engineered feature would increase the efficiency of water and sediment transport, and expedite the initial development of deltaic habitats. A more detailed description of this feature and other design elements of the Proposed MBSD Project can be found in Chapter 2 of the DEIS (USACE, 2021).

The LA TIG also developed a detailed MAM Plan to evaluate the Proposed MBSD Project’s benefits and impacts on the Barataria Basin, and consider how the management of the diversion may be adapted to better meet project goals (see Appendix A). The MAM Plan includes performance monitoring to measure progress toward the Proposed MBSD Project’s restoration objectives, and to better understand the ecological functions and services provided by the project. The MAM Plan also includes monitoring to characterize the nature and extent of potential collateral injuries.

The estimated total cost for this alternative is just under $2 billion (see Section 3.2.1.2). This cost reflects current cost estimates developed from the most current designs and information available to the LA TIG at the time of drafting this RP. Estimated costs reflect all costs associated with implementing the Proposed MBSD Project, potentially including, but not limited to, revising/finalizing E&D, permitting, mitigation, land acquisition, construction, MAM, Trustee oversight, associated stewardship actions, and contingencies. A portion of the engineering and permitting costs has been paid by the NFWF's GEBF.

In support of the DEIS, modeling was undertaken using the Delft3D model[16] to evaluate the projected impacts and benefits of the different Proposed MBSD Project alternatives. The LA TIG coordinated with the USACE in this process and is relying on the modeling results to inform the OPA analysis presented in this Draft RP. Modeling suggests significant and sustained wetland benefits across the expected lifetime of the Proposed MBSD Project. More specifically, the Proposed MBSD Project would be expected to:

- Deliver large quantities of sediment and nutrients to the Barataria Basin every year to form a new delta and sustain marshes.
- Deliver high flows of freshwater and nutrients during the spring, mimicking deltaic processes.
- Maintain a diversity of marsh types, which would help sustain the diversity of the ecologically connected habitats that historically made up the Barataria Basin.

Each of these project-associated changes is briefly described below, and in more detail in the DEIS (USACE, 2021).

3.2.1.1.1 Alternative 1 Would Deliver Large Quantities of Sediment to the Barataria Basin Every Year to Form New Deltaic Landforms and Sustain Marshes

Alternative 1 would deliver sediment to the Barataria Basin to create new deltaic landforms in the mid-basin, decrease water depths in other areas where sediment is deposited, and help sustain marshes through the retention of sediment. Over the 50-year analysis period, the Delft3D model projects that Alternative 1 would deliver approximately 280 million metric tons (MMT) of sediment to the Barataria Basin, including sand and fine sediments (Table 3-1).

[16] Delft3D is an advanced modeling suite used to investigate hydrodynamics, sediment transport and morphology, and water quality for fluvial, estuarine, and coastal environments. See Box 3-1 and https://oss.deltares.nl/web/delft3d/home for more information.

Table 3-1.
Alternative 1 Would Deliver a Total of Approximately 280 MMT of Sand and Fine Sediments to the Barataria Basin Every Year, for the 2030–2070 Modeled Period

Year	Cumulative Load of Sand Diverted (MT, rounded[a])	Cumulative Load of Fine Sediment Diverted (MT, rounded[a])	Total Cumulative Sediment Load Diverted (MT, rounded[a])
2030	6,585,000	39,220,000	45,805,000
2040	17,196,000	82,228,000	99,423,000
2050	29,711,000	132,256,000	161,968,000
2060	40,355,000	184,193,000	224,548,000
2070	51,122,000	230,144,000	281,266,000

[a] Values are rounded to four significant figures; totals may not sum due to rounding.
MT = metric ton.
Source: Delft3D model production runs from the DEIS (USACE, 2021).

By delivering these sediments on a continual basis when the diversion is operating, Alternative 1 would allow for the formation of deltaic landforms, which would reach a peak around the modeled year of 2050 (30 years after Proposed MBSD Project operations begin) and then decline due to inundation by anticipated sea level rise (Figure 3-1). Alternative 1 is projected to increase land area, including emergent wetlands and mudflats, in the Barataria Basin across the 50-year analysis period relative to the No-Action Alternative, with a maximum increase of 17,300 ac in 2050, at the approximate mid-point of the 50-year analysis period (Table 3-1). Because of the continual delivery of sediment, Alternative 1 would mitigate some of the projected impacts of sea level rise, with land continuing to be created by the Proposed MBSD Project in the Barataria Basin through the project's life, even though the rates of erosion and land loss are high. Thus, the percentage of land (i.e., emergent marsh and mudflats) attributed to Alternative 1 is projected to increase over the 50-year analysis period, reaching a maximum of about 21% of the total land in the basin in 2070 (Figure 3-2).

Even when sediment deposition is not sufficient to create emergent land, the habitat value would still increase from the shallowing of water depths. Many species rely on unvegetated shallow water habitat for foraging and reproduction, including waterfowl, wading birds, and many marine fishery species (Erwin, 1996; Seitz et al., 2014; USACE, 2021).

Box 3-1. Interpreting Delft3D Model Results

The LA TIG used results from the Delft3D model in its OPA analysis of the Proposed MBSD Project and its alternatives. The Delft3D model was used in the DEIS to assess the impacts of the Proposed MBSD Project and its alternatives, as well as a No-Action Alternative, in the Barataria Basin and the birdfoot delta. The model included observed large-scale processes, including subsidence and sea level rise; along with smaller-scale processes, such as tidal fluctuations, atmospheric and wind forcing, and rainfall.

The Delft3D model represents the best scientific tool currently available to compare the relative potential of each project alternative to achieve project benefits and result in collateral injuries. The LA TIG emphasizes to readers of this Draft RP and the DEIS that the model results ("model outputs") depend on the data used to run the model ("model inputs"), which are generally based on historical conditions. When assessing potential future conditions, the model outputs, such as acres of habitat created, should not be considered as absolute values or predictions of actual future conditions. The actual number of habitat acres created, for example, will depend on the actual conditions – such as the flow in the Mississippi River – that occur after the diversion is in operation. While modeling results should not be used to *predict* the exact future conditions in the basin, they are sufficiently robust to enable comparisons among alternatives in the nature, magnitude, and timing of benefits; and the potential injuries that they could create.

The Delft3D model used 50 years of observed Mississippi River flow hydrographs[17] (1964 to 2013) to project impacts of Proposed MBSD Project operations over a 50-year analysis period (modeled as the years 2020–2070). For example, the Mississippi River flows from years 1964 through 1973 were applied for the projected model years of 2020 through 2029, and so on. The projected landscape at the end of each decade of Proposed MBSD Project operations is the product of 10 modeled years of impacts from sea level rise, subsidence, project operations, sediment transport, and vegetation changes. To determine the potential impacts of the Proposed MBSD Project alternatives on water levels and water quality, TWI selected one Mississippi River hydrograph from the historical decadal hydrographs that was representative of conditions for each decade, which resulted in a total of five historical representative hydrographs, one for each decade of model simulations (see Figure 3-1). Projections of the Proposed MBSD Project benefits and collateral injury are based on these historical representative hydrographs, unless otherwise noted.

As a result, the LA TIG is only using the model outputs to compare results among different alternatives and not to compare the modeled outputs to existing or future conditions. For example, when the Draft RP refers to Delft3D modeling projections that are associated with specific points in time (e.g., 2050), the reader should understand that these projections are not *predictions* of basin conditions in 2050; rather, they are projections of the impact of the Proposed MBSD Project after 30 years of operation (which was assumed to begin operating in 2020 for the purpose of the modeling effort).

[17] A hydrograph is a graph showing the rate of flow (discharge) over time at a specific point in a river, channel, or conduit carrying flow. The rate of flow discussed in this EIS is expressed in cubic feet per second as measured at the USACE Tarbert Landing gage (located at Mississippi River mile 306 AHP).

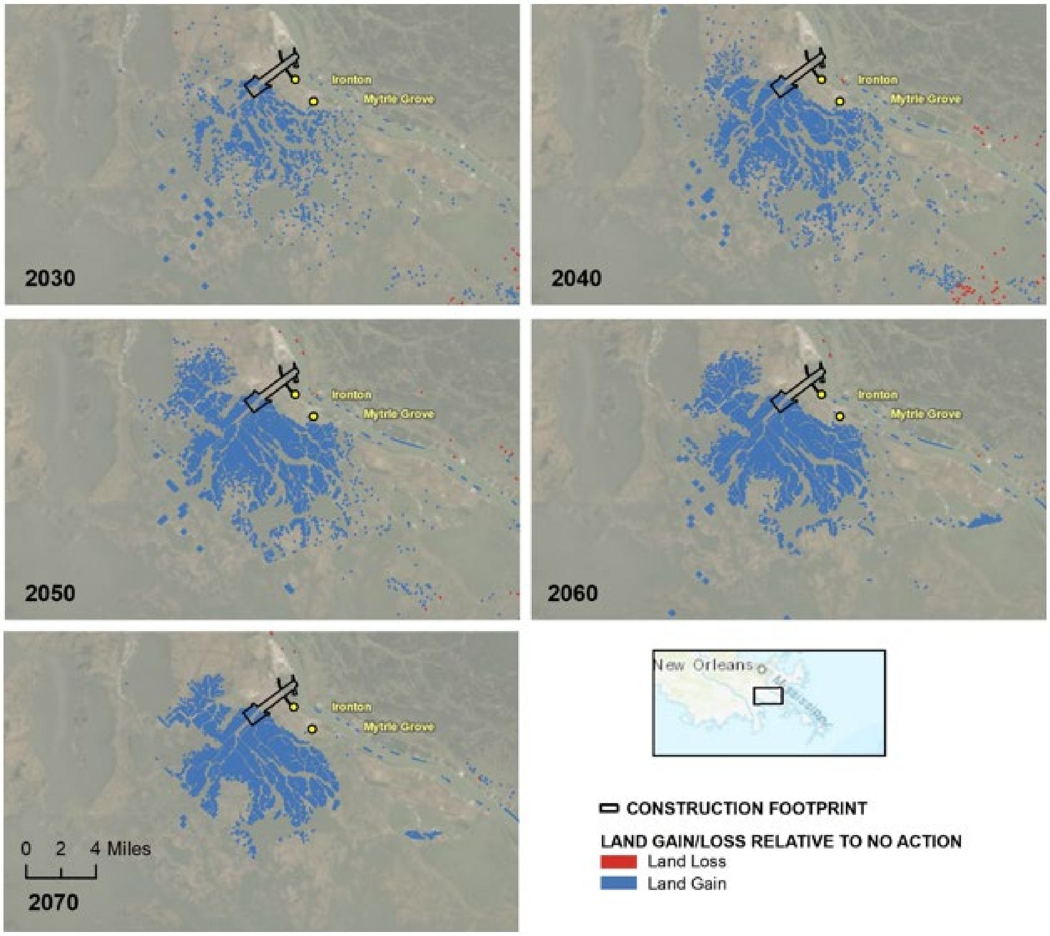


Figure 3-1. Alternative 1 Would Create New Deltaic Landforms and Build and Sustain Land (area shown in blue) in the Barataria Basin as Sediment Is Deposited. [Source: Delft3D model production runs from the DEIS, Section 4.2.3.2 (USACE, 2021)]

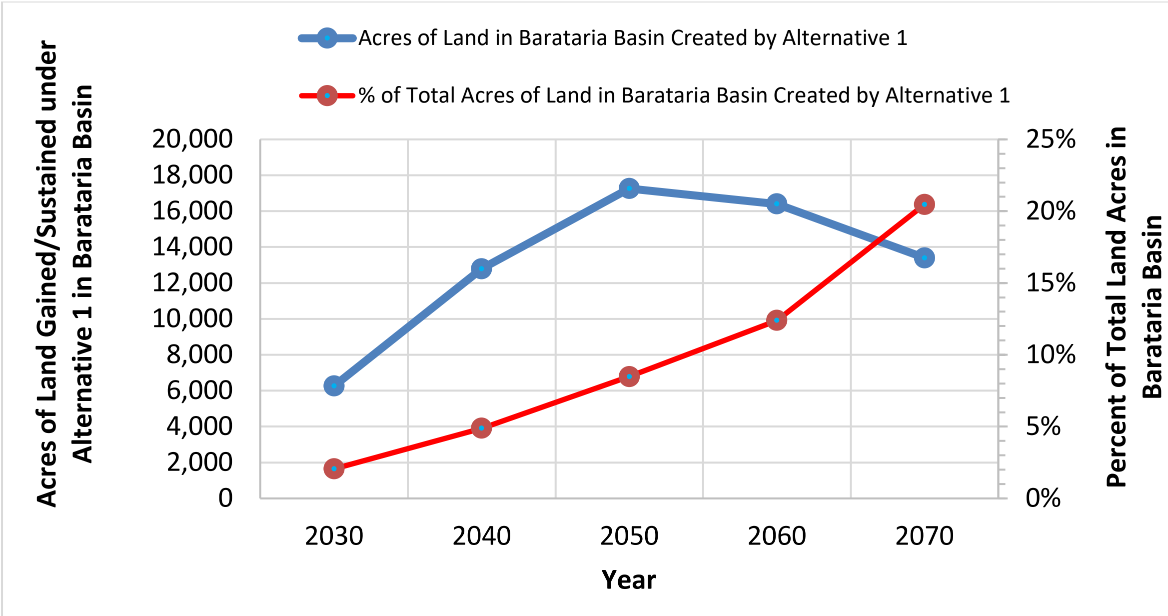


Figure 3-2. Percentage of Acres in the Barataria Basin Created by Alternative 1 Would Increase over Time, Even Though Total Land Gained Peaks after 30 Years. [Source: DEIS, Section 4.2.3.2 (USACE, 2021)].

3.2.1.1.2 Alternative 1 Would Deliver High Flows of Freshwater during High Mississippi River Flows in the Spring, Mimicking Deltaic Processes

Because large volumes of water are necessary to transport sufficient coarse silts and sands to support land-building (USACE, 2021, Section 2.4.3.2), Alternative 1 would deliver high flows of freshwater to the Barataria Basin when the diversion is operating at higher capacities, typically in the spring when the Mississippi River flow is high. These flows would deliver sediment and nutrients to the basin – mimicking the deltaic process where crevasse splays bring sediment, freshwater, and nutrients to the basin. Figure 3-3 shows how the diversion is projected to deliver the most freshwater (both in terms of quantity of flow and percentage of days the diversion is operating above base flow) when river flows exceed 450,000 cfs; this typically would occur during the winter and spring. In contrast, the diversion would operate primarily at base flow conditions when river flows are below 450,000 cfs, which would typically occur in the summer and fall.

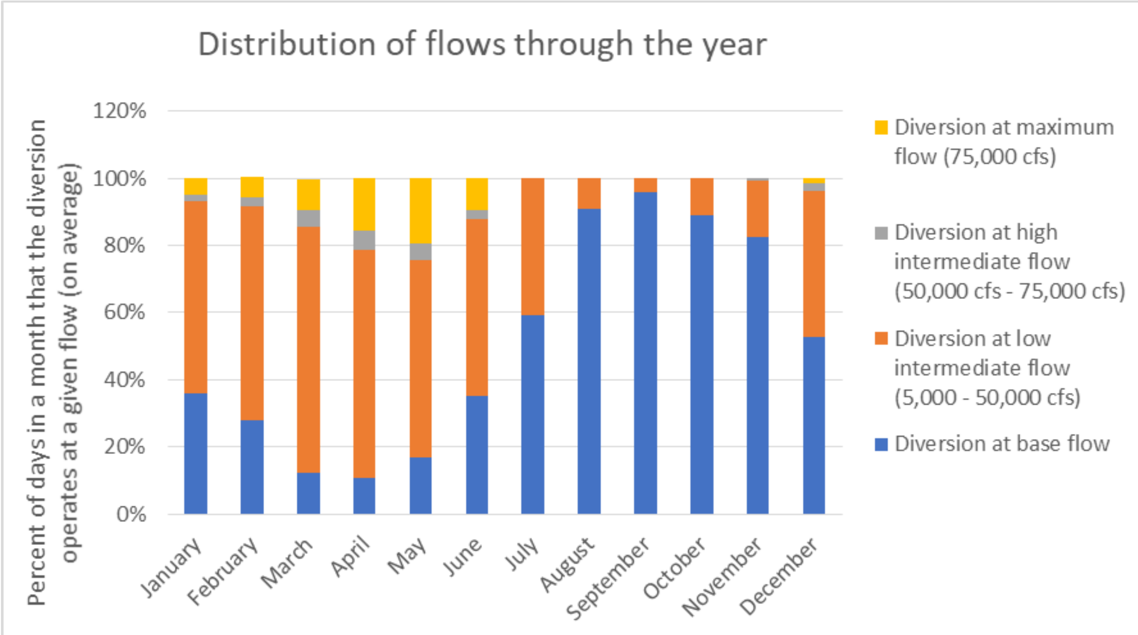


Figure 3-3. Alternative 1 Would Typically Deliver the Highest Diversion Flows in the Winter and Spring, and Operate under Base Flow Conditions in the Summer and Fall.
Average days/month are calculated using modeled results based on historical hydrographs for every year from 2020 to 2069. [Source: Delft3D modeling runs from the DEIS (USACE, 2021, Section 4.1.3)]

The delivery of freshwater to the Barataria Basin over the course of a year would result in changing salinity patterns. The lowest salinities would occur while the diversion is operating at higher capacities (typically in the winter and spring), and higher salinities would occur when the diversion is operating under base flow conditions (typically in the summer and fall; Figure 3-4).

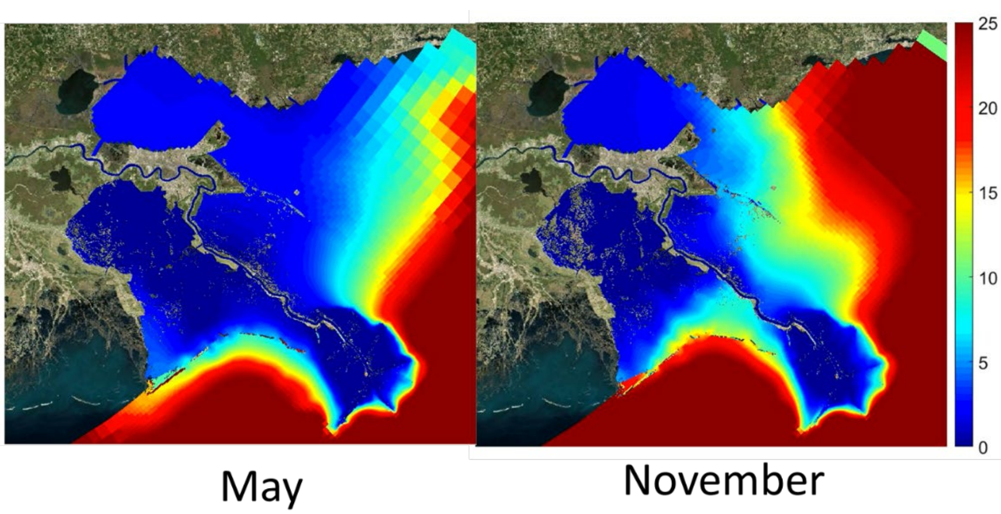


Figure 3-4. Operation of the Diversion Would Maintain a Seasonal Fluctuation in Salinity Characteristic of Estuaries. Red colors represent high salinites and blue colors low salinities. The basin would experience freshwater conditions when the Mississippi River is flowing at high flows (typically in the winter and spring), and a salinity gradient under low-flow conditions (typically in the summer and fall). (Source: Delft3D model production runs for years 2040–2049)

3.2.1.1.3 Alternative 1 Would Deliver Additional Nutrients to the Barataria Basin

The Mississippi River watershed covers 2 Canadian provinces and 31 of the contiguous 48 U.S. states. It is estimated to discharge 1.4 MMT of nitrogen and 140,000 tons of phosphorus to the northern Gulf of Mexico annually (USEPA, 1993, cited in Steinmuller et al., 2016). During flood events, the Mississippi River historically deposited a portion of its nutrient load into surrounding wetlands rather than into open waters of the northern Gulf of Mexico (DeLaune and White, 2011). Currently, the Barataria Basin receives water mainly through rainfall and the Davis Pond Freshwater Diversion Project (LDWF, 2015). Due to the hydrologic modifications in and adjacent to the Mississippi River, most of the Mississippi River water, nutrient, and suspended sediment loads are discharged into the Gulf of Mexico and off the continental shelf in a plume. There is currently very little nutrient input from the Mississippi River plume to the Barataria Basin except when river water levels are high, winds blow from the southwest, and the long-shore current cycles the western part of the plume around the barrier islands (Schiller et al., 2011).

Compared to the No-Action Alternative, Alternative 1 is projected to shift total nitrogen (TN) seasonally (corresponding to when the diversion is operating above base flow) in the Barataria Basin at all modeled stations except the birdfoot delta (USACE, 2021, Section 4.5.5.3). In general, slightly elevated TN concentrations are projected to persist for an increasingly longer period into the spring compared to the No-Action Alternative, demonstrating that Alternative 1 is effective at delivering nutrients to the basin. The shift in seasonality of TN is more pronounced at stations closer to the diversion structure [i.e., Coastwide Reference Monitoring System (CRMS) station 0276] and in the central basin (i.e., CRMS station 0224) than in the southern basin (i.e., Barataria Pass at Grand Isle), western basin (i.e., Little Lake near Cutoff), or the far northern basin (i.e., CRMS station 3985) (USACE, 2021, Section 4.5.5.3). The model projects that inorganic nitrate (NO_3), which generally represents the bioavailable form of nitrogen, would comprise between 0.3% and 80% of the TN under Alternative 1, and follow a similar seasonal variation as TN concentrations (USACE, 2021, Section 4.5.5.3). As an example, at CRMS station 0224 (central basin) under Alternative 1, the elevated NO_3 fraction of TN is predicted to persist for an increasingly longer period into the spring compared to the No-Action Alternative over the 50-year analysis period of the Proposed MBSD Project (Figure 3-5).

Phosphorus concentrations projected for Alternative 1 also follow seasonal trends at all modeled stations except the birdfoot delta. Compared to the No-Action Alternative, over the 50-year analysis period, the duration of elevated concentrations across the Barataria Basin is projected to extend further into the summer months, and the onset of lower/minimum concentrations becomes delayed by as much as 5 months by 2040 (USACE, 2021, Section 4.5.5.4). By 2060, the seasonal variability of both total phosphorus (TP) and inorganic phosphate (PO_4) are projected to be reversed from the variability projected for the No-Action Alternative (USACE, 2021, Section 4.5.5.4). This projected change may be related to the extended length of time that the diversion is expected to be operating above base flows in the last two modeled decades. The model projects that between 5% and 88% of TP would consist of inorganic PO_4, which generally represents bioavailable phosphorus. As an example, in the central basin (CRMS station 0224), the fraction of TP represented by PO_4 is projected to fluctuate seasonally, with higher levels occurring when flows through the diversion would be higher (typically winter and spring), and lower when flows through the diversion would be lower (typically summer and fall). The impacts of increased nutrient delivery to specific resources would vary between resources (Figure 3-6). These impacts are discussed in further detail in Sections 3.2.1.5 and 3.2.1.6.

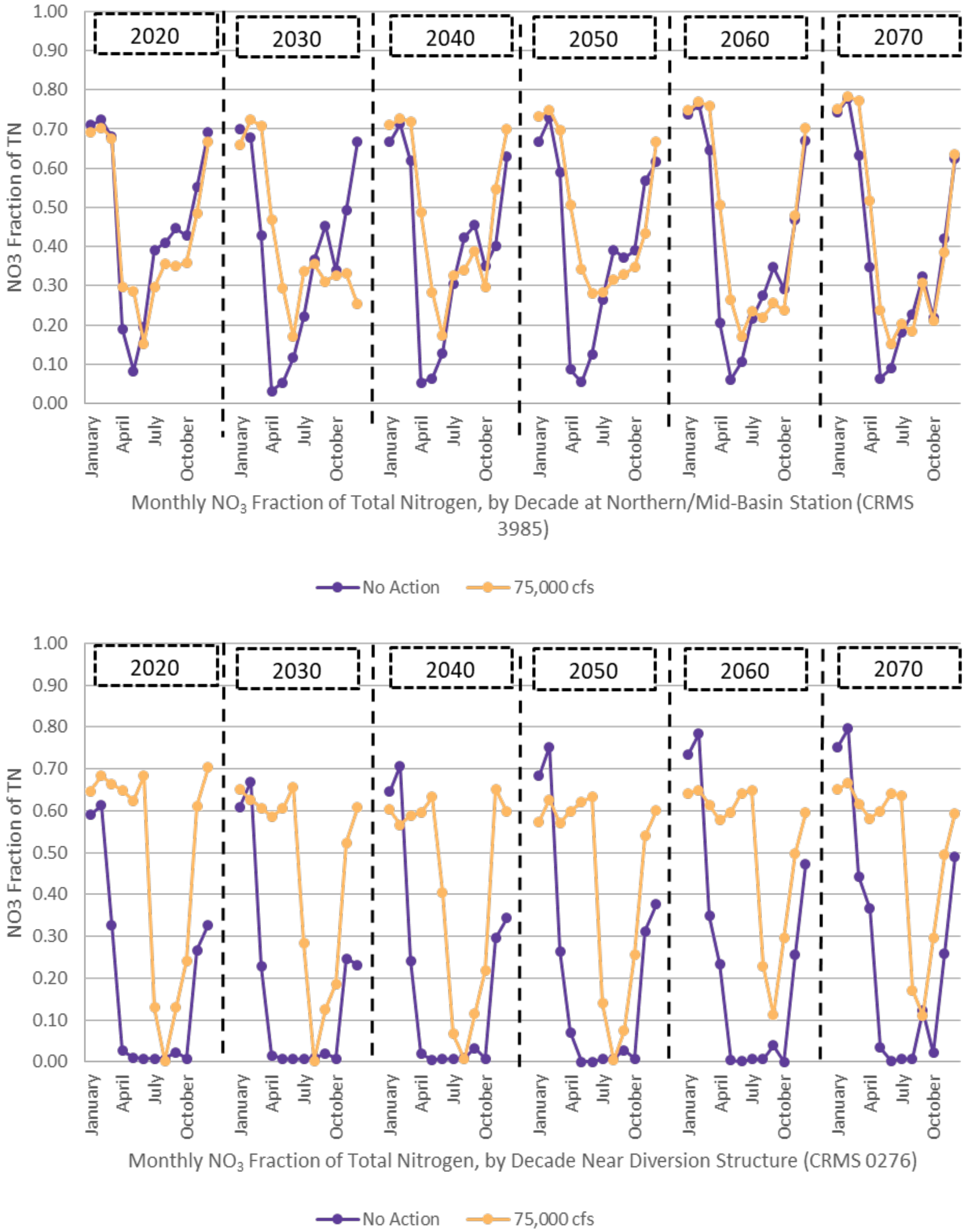


Figure 3-5. Alternative 1 Would Increase the Average NO_3 Fraction of TN at Northern/Mid-Basin CRMS Station 3985 and CRMS Station 0276 Nearest the Diversion Compared to the No-Action Alternative . Overlapping graph lines indicate negligible differences in model projections. (Source: USACE, 2021, Section 4.5.5.3)

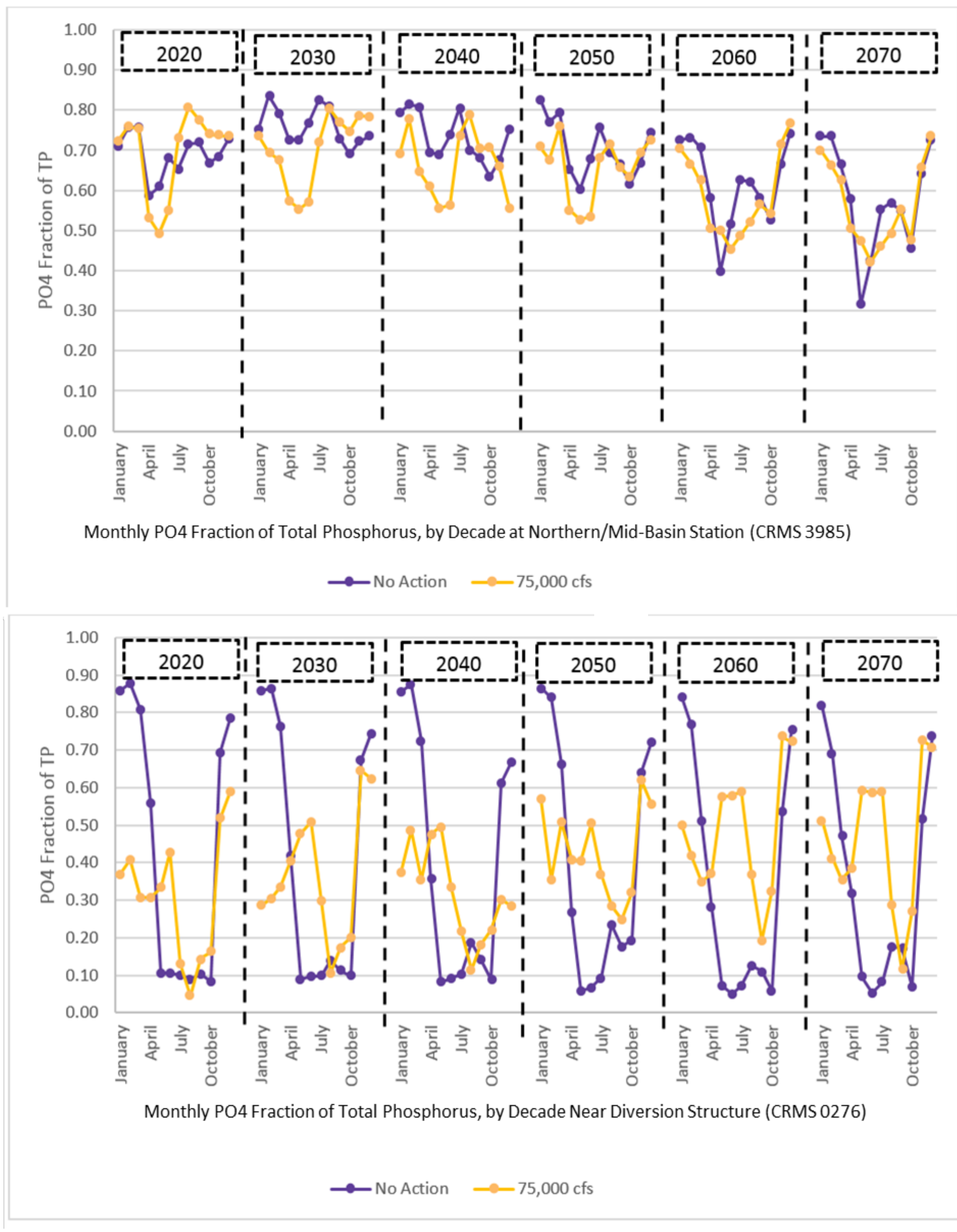


Figure 3-6. Alternative 1 Would Increase the Average PO_4 Fraction of TP at Northern/Mid-Basin CRMS Station 3985 and CRMS Station 0276 Nearest the Diversion Compared to the No-Action Alternative. Overlapping graph lines indicate negligible differences in model projections. (Source: USACE, 2021, Section 4.5.5.4)

3.2.1.1.4 Alternative 1 Would Maintain a Gradient of Fresh to Saline Estuarine Habitat Types

Alternative 1 would maintain a gradient of estuarine habitat types, including fresh, intermediate, brackish, and saline marshes, which support important refugia, foraging, and resting habitats for a wide variety of aquatic, terrestrial, and avian species (Figure 3-7). However, the relative amounts of brackish and saline habitats are reduced under this alternative compared to the No-Action Alternative (Figure 3-7, Figure 3-8).

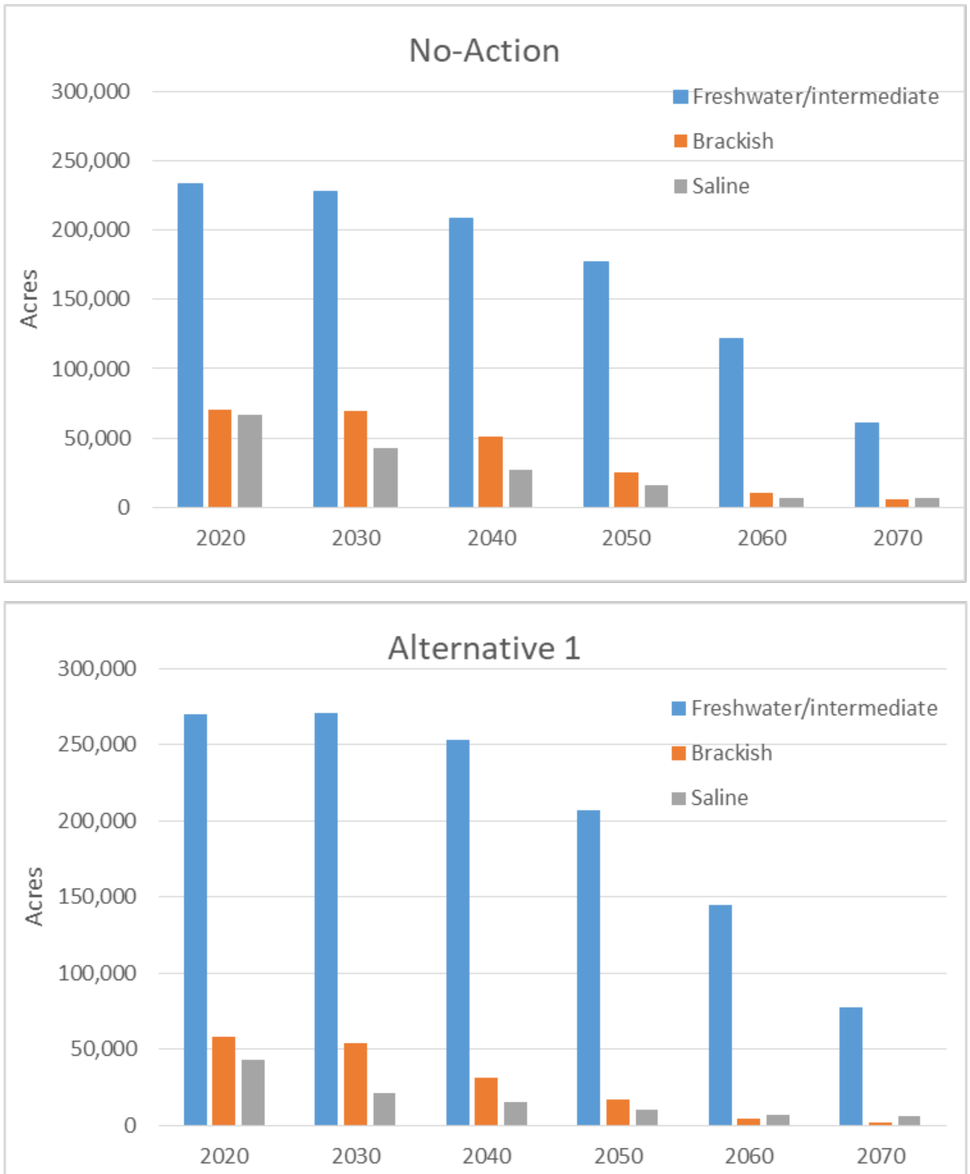


Figure 3-7. While Wetland Habitat Declines under Both Alternatives, More Brackish and Saline Habitat Is Lost over Time, and More Freshwater/Intermediate Habitats Are Retained or Created under Alternative 1 than the No-Action Alternative. (Source: USACE, 2021, Section 4.6.5.1)

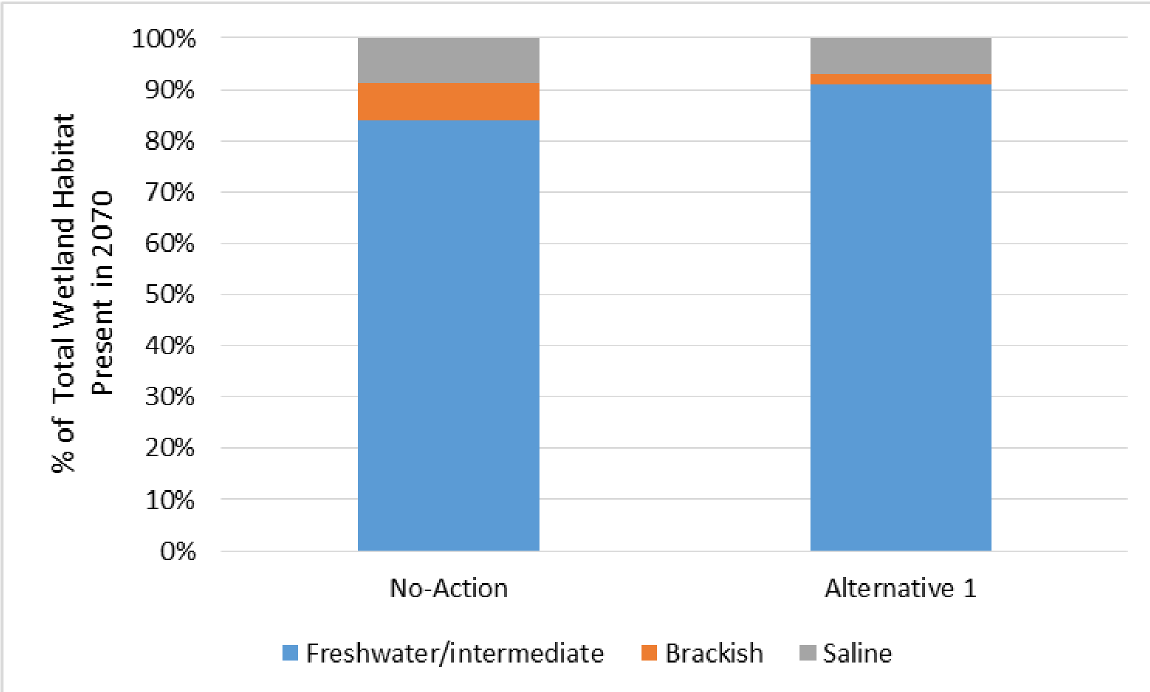


Figure 3-8. Operation of the Diversion Will Maintain a Diversity of Habitat Types under Alternative 1, Although the Relative Amount of Brackish and Saline Habitats Are Lower under Alternative 1 than the No-Action Alternative by 2070. (Source: USACE, 2021, Section 4.6.5.1)

3.2.1.1.5 Associated Stewardship Measures

Under Alternative 1 and all other Proposed MBSD Project alternatives, the Trustees would also design and implement a suite of stewardship measures in recognition of the collateral injury that would potentially result from the implementation of the Proposed MBSD Project (see Sections 3.2.1.5 and 3.2.2.5). These stewardship measures are described briefly below by resource and in more detail in Appendix B.[18]

Marine Mammals

Changes in salinity projected to occur as a result of Alternative 1 are anticipated to significantly impact the bottlenose dolphin population within the Barataria Basin (see Sections 3.2.1.5 and 3.2.2.5). In recognition of collateral injury to bottlenose dolphins, the LA TIG would implement three key stewardship measures to benefit dolphins in Louisiana. First, the LA TIG would support a statewide stranding program for 20 years that would improve the survival and health outcomes of marine mammal populations injured by the DWH spill, especially coastal and estuarine stocks of bottlenose dolphins. Enabling a more rapid response to a live stranded cetacean would increase that animal's chance of survival by reducing the time spent on the beach, reducing stress on the animal, providing rapid treatment, and, if appropriate, transport to an authorized rehabilitation facility for additional treatment and care. In addition, this program would improve diagnoses of the causes of illness and death in cetaceans to better understand natural and anthropogenic threats, which will inform restoration planning and MAM. Second, the LA TIG would support activities that reduce stressful interactions between dolphins and humans (e.g., by

[18] See Appendix S of the DEIS for an environmental compliance analysis of these measures.

reducing dolphin mortalities associated with recreational fishing; reducing illegal fishing of dolphins; and assessing and mitigating the impacts of marine vessels, noise, and other threats on marine mammals in the Barataria Basin). Third, the LA TIG would provide funding to support stranding surge capacity in response to unusual marine mammal mortality events.

Oysters

Changes in salinity that are projected to occur through the implementation of Alternative 1 are anticipated to adversely affect oysters (see Sections 3.2.1.5 and 3.2.2.5). However, the Proposed MBSD Project-related changes in salinity in the Lower Barataria Basin could create suitable conditions for oyster culture in areas that are currently unsuitable, creating an opportunity to mitigate for the loss of oyster culture areas elsewhere in the basin. The LA TIG would support a variety of restoration efforts in recognition of the collateral injury of the Proposed MBSD Project to oysters. First, the LA TIG would help re-establish public seed grounds in the basin to help offset losses to these seed grounds that occur as a result of Proposed MBSD Project operations. These seed grounds would be located in areas with environmental conditions that would best support oysters after the diversion has begun operating. Second, the LA TIG would support efforts to provide additional cultch material to current lessees, which could help maintain oyster reefs in areas where sediment could bury suitable oyster habitat. Third, the LA TIG would support the creation of broodstock reefs within the Barataria Basin, in recognition of losses in broodstocks that result from the operation of the diversion. Fourth, the LA TIG would support alternative oyster culture, which means growing oysters outside of reefs and off the water bottom – typically in some kind of mesh container. Growing oysters in this way makes it feasible to cultivate them in areas where suitable reef habitat is lacking; it can also improve oyster growth due to lower turbidity. The LA TIG would also provide funding to improve marketing and enhance the value of dockside harvests. Finally, the LA TIG would provide public access opportunities within the Barataria Basin to support subsistence oyster harvesting (see the Recreational and Subsistence Use section below).

Brown Shrimp and Finfish

Changes in salinity due to the implementation of Alternative 1 are anticipated to adversely affect brown shrimp (see Sections 3.2.1.5 and 3.2.2.5). A variety of approaches would be utilized in recognition of collateral injuries associated with specific fish and shellfish species that support recreational and commercial fishing. For the brown shrimp fishery, these restoration actions include supporting improvements in fishing gear and vessel refrigeration installation. For brown shrimp and finfish fisheries, the LA TIG would support marketing to improve the dockside value of landings, as well as workforce training to improve business practices or to facilitate transitions to a new type of employment. The LA TIG would also provide public access opportunities within the Barataria Basin to support recreational and subsistence shrimp harvesting (see the Recreational and Subsistence Use section below).

Recreational and Subsistence Use

In recognition of collateral injuries related to recreational and subsistence use of the Barataria Basin, particularly in areas near the diversion complex utilized by low-income and minority communities, the LA TIG would provide access to public waterways to facilitate recreational access for fishing and birding, a pier for subsistence fishing, a kayak/pirogue launch, and views of the marsh creation area near the diversion structure. These public amenities would serve to enhance access to quality subsistence fishing; and would improve public access to recreational boating, fishing, and birding.

3.2.1.1.6 Property Acquisitions to Support the Proposed MBSD Project

Alternative 1 and all Proposed MBSD Project alternatives would include the acquisition of property interests from landowners within the footprint of the proposed diversion, as well as temporary easement rights for any construction staging areas. Property acquisition would preferably be achieved through a negotiated sale, where CPRA would pay a negotiated amount of compensation to landowners in exchange for the property interests needed for the Proposed MBSD Project. However, if this is not possible, CPRA may, in appropriate circumstances, exercise the state's eminent domain authority to acquire the needed real estate interests. Consistent with applicable law, the landowner would be paid just compensation for any real estate interest acquired to enable the implementation of Alternative 1. Real estate acquisition by CPRA is governed generally by state law in accordance with La. Const. Article 1, Section 4(F), La. R.S. 49:214.1 et seq., La. R.S. 49:214.5.6, and La. R.S. 49:214.6.1(A)(1).

In addition, as explained in Sections 3.2.1.7 and 3.2.2.7, as well as in the DEIS, Alternative 1 is projected to increase flooding in several communities that are located outside of flood protection (i.e., within 1 mile to approximately 20 miles south of the diversion). CPRA may acquire property interests from property owners within these communities to compensate them for the increased flooding on their properties that could occur as a result of Alternative 1. As with the acquisitions for the proposed project footprint and construction staging areas, CPRA would first attempt to acquire any such easements through a voluntary negotiation process. However, if that voluntary process is unsuccessful, CPRA may, if necessary and in appropriate circumstances, exercise the state's eminent domain authority to acquire the affected property interests. Consistent with applicable law, the landowner would be paid just compensation for any real estate interest acquired by CPRA to enable the implementation of Alternative 1. Real estate acquisition by CPRA is governed generally by state law in accordance with La. Const. Article 1, Section 4(F), La. R.S. 49:214.1 et seq., La. R.S. 49:214.5.6, and La. R.S. 49:214.6.1(A)(1).

The LA TIG has not yet made a final decision regarding whether to fund Alternative 1 or any of its alternatives. However, if the LA TIG decides to fund Alternative 1 or any of its alternatives, the approved project may include some or all of the costs of acquisition of the real property interests described above; such costs have been estimated and are included in Sections 3.2.1.2 and 3.2.2.2 below.

3.2.1.2 Cost to Carry Out the Alternative

The current cost estimate of Alternative 1 is $1,982,910,000, including $1,531,250,000 for construction, $80,626,000[19] for planning and design, $55,626,000 for services during construction, $9,419,000 for permitting, $268,318,000 for land acquisitions and related costs[20] and services, $16,560,000 for project monitoring, and $21,111,000 for CPRA project and design management costs. The total cost also includes $90 million for the associated stewardship projects that would be implemented in recognition of the potential collateral injuries of the

[19] Does not include the $108 million in leveraged funding from NFWF that is noted below.
[20] The state will be separately responsible for any costs of acquisition acquired via eminent domain.

project, including the identified potential for disproportionate impacts to low-income and minority communities (see Section 3.2.1.1.5). Project E&D is ongoing, and these costs may shift between these categories as the project's development continues. However, the overall project costs that would be funded by DWH NRDA funds are not anticipated to exceed $2,000,000,000.

The LA TIG has evaluated several factors to ensure the reasonableness of the cost of the alternative, including leveraging funds from other potential funding streams, the development and implementation of a robust MAM Plan, and innovative project delivery methods.

With regard to leveraging funds, the LA TIG leveraged funds from other DWH oil spill funding sources and will continue to evaluate the utilization of alternative funding sources to leverage existing LA TIG funding. Specifically, $108,000,000 in funding for E&D was provided by NFWF's GEBF.

As noted in Section 3.2.1.1, the Proposed MBSD Project costs would also cover the implementation of a robust MAM Plan. Monitoring data would inform progress toward meeting Proposed MBSD Project objectives and to support adaptive management of this project. For example, under the MAM Plan, there would be extensive monitoring of the Mississippi River, the conveyance structure, and the Barataria Basin to inform Proposed MBSD Project effectiveness and to document natural and human community responses.

The State of Louisiana, through CPRA, would also ensure cost efficiency by awarding the work in compliance with Louisiana's Construction Management At-Risk (CMAR) project delivery model, ensuring a high-quality design and using a cost-effective approach. CMAR is a project delivery model that creates an intentional overlap between the designer, the State of Louisiana for the Proposed MBSD Project, and the CMAR contractor, allowing the CMAR contractor to bring construction insight as early as practical into the design process. This early collaboration between the CMAR contractor and designer integrates constructability considerations throughout the design process, improving the quality and constructability of the project and reducing overall risk. The CMAR contractor's involvement during the design phase can also reduce design misunderstandings and the potential for claims during construction. CMAR also provides for progressive and detailed cost estimating led by the CMAR contractor, which allows for scope revision during the design phase to meet the project budget, purpose, and need. The use of the CMAR approach increases the LA TIG's confidence that Alternative 1 for the Proposed MBSD Project would be designed and constructed in a cost-efficient manner.

In SRP/EA #3, the LA TIG found that the costs for the preferred strategic alternative (Marsh Creation and Ridge Restoration Plus Large-Scale Sediment Diversions) were reasonable and appropriate. The LA TIG noted that large-scale sediment diversions were anticipated to be more cost-effective than other ecosystem-level restoration projects, because the marsh creation benefits realized by a large-scale sediment diversion would have more longevity and be more self-sustainable over time (i.e., sediment transport and associated land building would continue as long as the diversion operates).

3.2.1.3 Meets Trustee Restoration Goals and Objectives

Alternative 1 was explicitly designed to meet the LA TIG's three specific goals for the Proposed MBSD Project:

1. Deliver freshwater, sediment, and nutrients to the Barataria Basin through a large-scale sediment diversion from the Mississippi River.
2. Reconnect and re-establish sustainable deltaic processes between the Mississippi River and the Barataria Basin (e.g., sediment retention and accumulation, new delta formation).
3. Create, restore, and sustain wetlands and other deltaic habitats and associated ecosystem services.

These three goals are intertwined. Delivering freshwater, sediment, and nutrients is the mechanism by which sustainable deltaic processes between the Mississippi River and the Barataria Basin would be reconnected and re-established. The re-establishment of these deltaic processes would then result in creating, restoring, and sustaining wetlands and other deltaic habitats; and associated ecosystem services. The LA TIG has committed to evaluating the effectiveness of the diversion through monitoring many parameters that are associated with each goal (see Appendix A).

In this section, the LA TIG examines the extent to which Alternative 1 would meet each of the goals, enabling a comparison of alternatives in subsequent sections. To do this, the LA TIG reviewed multiple sources of evidence, including projections of the amount of freshwater, sediment, and nutrients that would be delivered; the projected maximum increase in land area in the Barataria Basin as evidence of delta formation; and the total area of created and sustained wetlands representing the different habitat types that provide essential nursery and foraging habitats for fish and birds. A summary of relevant metrics is provided in Table 3-2, and a discussion of how these metrics demonstrate that Alternative 1 would meet each goal is provided below.

Table 3-2.
Metrics Demonstrating How Alternative 1 of the Proposed MBSD Project Meets LA TIG Goals for this Project

Goals	Metrics for Evaluating Goals and Objectives	Alternative 1 (75,000 cfs diversion)
1: Deliver freshwater, sediment, and nutrients	Total sediment load delivered by 2070[a]	280 MMT
2: Reconnect and re-establish sustainable deltaic processes	Maximum increase in land area in Barataria Basin relative to No-Action Alternative (2050)[b]	17,300 ac
	Projected increase in bed elevation, 10 mi south of diversion, in 2050[c]	0.3 ft (0.1 m)
3: Create, restore, and sustain wetlands and other deltaic habitats and associated ecosystem services	Area of different marsh habitat types in Barataria Basin in 2050[d]	Fresh/intermediate: 207,000 ac Brackish: 16,600 ac Saline: 10,400 ac

[a] Delft3D modeling runs.
[b] Source: USACE, 2021, Table 4.2-4.
[c] Source: USACE, 2021, Table 4.4-3.
[d] Source: USACE, 2021, Table 4.6-3.
m = meter, mi = mile.

3.2.1.3.1 Goal 1: Deliver Freshwater, Sediment, and Nutrients to the Barataria Basin through a Large-Scale Sediment Diversion from the Mississippi River

Alternative 1 would meet Goal 1 by delivering freshwater, sediment, and nutrients to the Barataria Basin, conveyed by a maximum flow of 75,000 cfs through the diversion structure (see Table 3-1 and Figure 3-3). Alternative 1 would meet this Trustee goal every year that the diversion is in operation, unlike mechanical marsh creation projects that deliver sediment primarily at the initiation of a project (and sometimes on a subsequent occasion with a "maintenance lift" of new sediment).

The amount of flow through the diversion depends on the flow rate in the Mississippi River. On average, the sediment diversion would be anticipated to deliver freshwater, sediment, and nutrients at flows higher than base flow conditions for more than half of all days from January to June. During other times of the year, when the flow rate of the Mississippi River would be anticipated to be lower, flows through the diversion would be correspondingly lower (Figure 3-3).

Previous studies have found that a 75,000 cfs diversion would deliver a greater volume of sediment and relatively more coarse-grained sediments compared to a smaller-capacity diversion [i.e., the ratio of sediment to water and the fraction of coarse-grained sediments is expected to increase as the capacity of the diversion increases (CPRA, 2011; Meselhe et al., 2012)]. Sand-rich sediment loads are preferred for land-building from diversions; these coarser-grained sediments would be deposited closer to the outfall area (USACE, 2021, Section 4.2.3.2). The projected total sediment load that Alternative 1 would deliver to the Barataria Basin by 2070 is approximately 280,000,000 MT, of which 18% is projected to be sands.

3.2.1.3.2 Goal 2: Reconnect and Re-Establish Sustainable Deltaic Processes between the Mississippi River and the Barataria Basin (e.g., sediment retention and accumulation, new delta formation)

Alternative 1 would meet Goal 2 by reconnecting and re-establishing sustainable deltaic processes between the Mississippi River and the Barataria Basin, as demonstrated by the projected formation of new deltaic landforms at the outfall of the diversion (Figure 3-1). Alternative 1 would also decrease water depth in other areas where sediment is deposited.

Under Alternative 1, the Delft3D model projects formation of new deltaic landforms in the Barataria Basin to begin within the first decade of diversion operation, and reach a peak around 2050. Compared to the No-Action Alternative, Alternative 1 is projected to create a maximum of 17,300 ac in 2050 in the Barataria Basin. After peaking around 2050, the Delft3D model results project a decline in land acreage due to relative sea level rise, although the deltaic landforms would still be prominent in 2070 (USACE, 2021, Table 4.2-4).

Time periods of rapid formation of deltaic landforms under Alternative 1 (as well as other alternatives) would likely be episodic and tied to high-flow events in the Mississippi River when the diversion would be flowing at its peak. Modeling and study of the Wax Lake Delta have shown that the rate of land growth at a diversion site depends on a balance between sediment sources and losses of sediment; the periods of rapid growth corresponded with flood events (Rosen and Xu, 2013).

The Delft3D model projects that the restoration of deltaic processes (and specifically sediment transport) would result in increases in the elevation of the bottom of Barataria Basin ("bed elevation") for Alternative 1 compared to the No-Action Alternative. For example, by 2050, projected bed elevations near the diversion outfall area would increase by 2.8 feet (ft; 0.86 m), while approximately 10 miles south, bed elevations are projected to increase by 0.3 ft (0.1 m) (USACE, 2021, Table 4.4-3). As elevations increase, areas of the basin could become emergent vegetated wetlands (if the elevation is sufficiently high) or mudflats that are exposed at certain tidal levels (at intermediate elevation), or they could remain as shallow-bay bottom. As noted in Section 3.2.1.1.1, even when sediment deposition is insufficient to create emergent land, the diversion would create shallow water habitats that would benefit a variety of species, including waterfowl, wading birds, and marine fishery species.

3.2.1.3.3 Goal 3: Create, Restore, and Sustain Wetlands and Other Deltaic Habitats and Associated Ecosystem Services

Alternative 1 would meet Goal 3 by creating, restoring, and sustaining the different wetland habitats that directly support invertebrates, fish, birds, and other resources in the Barataria Basin; and indirectly supporting resources in the northern Gulf of Mexico that depend on the estuary as a source of nutrients and food.

Sediment accretion would raise the land elevation in submerged areas to allow wetland vegetation to establish and grow; nutrients transported by the diversion could contribute to increased primary production (above- and belowground plant biomass); and changes in average annual salinity would allow for freshwater and intermediate wetland species to establish, survive, and potentially expand in areas of the Barataria Basin that have been adversely impacted by saltwater intrusion (USACE, 2021, Section 4.6.5.1). In addition, Alternative 1 is expected to increase the overall coverage and biomass of SAV in the basin once salinity regimes stabilize and new freshwater or intermediate communities become established (USACE, 2021, Section 4.10.4.1). SAV is managed as essential fish habitat in the Barataria Basin, providing structured habitat that is of greater value for fish and crustaceans than unstructured habitats, such as soft bottoms (USACE, 2021, Section 4.10.4.4).

Under Alternative 1, the Barataria Basin is projected to retain a diversity of marsh habitat types by 2050, with a projected acreage of approximately 207,000 ac of freshwater/intermediate marsh, 16,600 ac of brackish marsh, and 10,400 ac of saline marsh (USACE, 2021, Table 4.6-3). These wetlands provide ecosystem services, including habitat and forage for fish and crustaceans, birds, and other wildlife and aquatic species; improve water quality; and sequester carbon (see Section 3.2.1.6 for additional discussion). Because of the projected increases in relative sea level rise over time, the Barataria Basin would continue on a trend toward wetland loss from 2020 to 2070 and beyond, even under Alternative 1 (see Figure 3-7). However, the wetlands that are created or sustained by Alternative 1 would provide valuable ecosystem functions. As the total acreage of wetlands in the Barataria Basin decreases over time, the relative importance of the remaining wetlands is greater.

The land created under Alternative 1 is projected to have a high degree of spatial complexity (horizontally and vertically), which provides important habitat value to a variety of species (USACE, 2021, Figure 4.4-4). Such diversity of habitats supports important refugia, foraging, and resting habitats for a wide variety of aquatic, terrestrial, and avian species (see Section 3.2.1.6 for further discussion).

The sediments introduced into the Barataria Basin through the diversion under Alternative 1 would help offset land loss and sustain or increase bed elevations, primarily within roughly 100 square miles of the diversion. These sediments would benefit wetlands in the area of delta formation near the diversion outfall area, as well as help sustain adjacent marsh creation projects in the Barataria Basin by providing an ongoing source of sediment.

3.2.1.4 Likelihood of Success

In SRP/EA #3, the LA TIG found that the preferred strategic alternative (Marsh Creation and Ridge Restoration Plus Large-Scale Sediment Diversions) had the highest likelihood of success of the alternatives considered because the combination of a marsh creation/ridge restoration project and a diversion would provide sustainable and long-term benefits to injured resources. More specifically, SRP/EA #3 noted that “the marsh creation and ridge restoration components can build habitat quickly, while the sediment diversion component can help to make this new habitat sustainable” (LA TIG, 2018c, page 3-8). The LA TIG’s analysis in the strategic plan also drew on information from the PDARP/PEIS, which noted that sediment diversions “will help maintain the Louisiana coastal landscape and its ability to overcome other environmental stressors by stabilizing wetland substrates; reducing coastal wetland loss rates; increasing habitat for freshwater fish, birds, and benthic communities; and reducing storm risks, thus providing protection to nearby infrastructure (Barbier et al., 2013; Day et al., 2012; Day et al., 2009; DeLaune et al., 2013; Falcini et al., 2012; Roberts et al., 2015; Rosen and Xu, 2013)” (DWH NRDA Trustees, 2016a). The LA TIG has already completed and released an associated Final Phase II RP/EA for marsh restoration in the Upper Barataria Basin (LA TIG, 2020d).

The Proposed MBSD Project analyzed in this Draft RP (Alternative 1) is an innovative, ecosystem-scale restoration project that would affect multiple ecosystem dynamics simultaneously. Because the use of a sediment diversion to support ecosystem-scale restoration is novel and the ecosystem components affected would be wide-ranging, there are inherent uncertainties associated with Alternative 1’s likelihood of success. Thus, the LA TIG considered three key factors when assessing the likelihood of success of this alternative:

- The general efficacy of diversions in rebuilding marsh ecosystems.
- The extensive scientific and modeling efforts that have been undertaken since the 1990s to develop and refine the concept of a sediment diversion in the Barataria Basin.
- The implementation of the MAM Plan for the Proposed MBSD Project, which would support adaptive management of this project over time.

3.2.1.4.1 Efficacy of Diversions in Rebuilding Marsh Ecosystems

Natural river diversions are responsible for the landscape of coastal Louisiana, where delta lobes have formed, eroded, and reformed for thousands of years. Intentional, engineered diversions have existed since the mid-1940s. Although existing human-made diversions were primarily designed and constructed either to control flooding or to control saltwater intrusion by delivering freshwater into estuaries, they have also demonstrated that freshwater diversions can successfully rebuild wetlands. For example, the Wax Lake Outlet has created thousands of acres of deltaic marshes that are very resilient to coastal storm disturbance (Carle and Sasser, 2015). The Caernarvon Freshwater Diversion has created a deltaic system in the open-water area called "Big Mar" (Lopez et al., 2014) in the Breton Sound Basin, and the Davis Pond Freshwater Diversion has restored marsh in portions of its outfall area in the northern Barataria Basin (CPRA, 2013; Plitsch, 2018). Crevasses have also been successful at creating and restoring marshes in shallow water habitats (Gossman and Gisclair, 2018). For example, the naturally occurring Davis crevasse, which formed in 1884, created between 40,000 and 50,000 ac of crevasse splay and is still clearly visible in aerial photographs (Day et al., 2016; Day and Erdman, 2018). While Alternative 1 differs from these freshwater diversions and natural crevasses through designs that deliver sediment to wetlands to reverse rapid land loss, these examples suggest that Alternative 1 should succeed in building and maintaining wetland habitat in a resilient and sustainable manner.

3.2.1.4.2 Extensive Investments in Developing and Vetting a Large-Scale Sediment Diversion in the Mid-Barataria Basin

Given the recognition that disconnecting the Mississippi River from coastal estuaries has contributed to wetland loss and a loss of deltaic functions, the concept of developing a large sediment diversion project for coastal restoration has been a cornerstone of Louisiana coastal management planning for many years (CPRA, 2017). Because of the novelty of this restoration technique, CPRA and the USACE have undertaken detailed scientific studies and developed sophisticated technical models to understand the key river and estuarine dynamics that would be influenced by sediment diversion projects, including the Proposed MBSD Project (CPRA, 2017). More specifically, the following studies, often with participation of some of the same federal agencies that are also LA TIG Trustees, have explored the use of sediment diversions to restore the Barataria Basin (USACE, 2021, Section 1.2.2.1); the information and models developed through these studies have been applied in the design of the proposed MBSD Project:

- The *Coast 2050: Toward a Sustainable Coastal Louisiana* plan is aimed at implementing projects that restore and sustain the coastal ecosystem for the benefit of coastal Louisiana communities and resources, including regional strategies to restore and sustain marshes in the Barataria Basin through sediment diversions (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority, 1998).
- The *Mississippi River Sediment, Nutrient and Freshwater Redistribution Study* evaluated the potential environmental and socioeconomic impacts from several alternative designs and flow rates for diverting sediment, freshwater, and nutrients from the river to the Barataria Basin (USACE, 2000).
- The *Delta Building Diversion at Myrtle Grove Project* (CWPPRA Project BA-33) evaluated the feasibility of a controlled diversion structure and conveyance system, with alternative design flows ranging from 2,500 to 15,000 cfs, coupled with the beneficial placement of dredged materials in identified material deposition sites within the Mid-Barataria Basin (LCWCRTF, 2003).
- The *LCA Ecosystem Restoration Study Report and Programmatic EIS* (USACE, 2004) and the subsequent 2005 Chief's Report and Title VII of the Water Resources Development Act of

2007 authorized 15 coastal restoration projects, including the 2,500 to 15,000 cfs Medium Diversion at Myrtle Grove with Dedicated Dredging Project.

- The 2012 *Louisiana's Coastal Management Plan for Sustainable Coast* recommended eight sediment diversions along the Mississippi River as a land-building restoration tool, including the Proposed MBSD Project (CPRA, 2012). This recommendation elevated sediment diversion projects as a vital component of coastal restoration.
- The *LCA Program – Mississippi River Hydrodynamic and Delta Management Study* (Meselhe and Sadid, 2015) developed cutting-edge technical models to better understand and predict the effects of using river resources for large-scale restoration projects, such as Mississippi River sediment diversions as well as projects in adjacent basins. These models have improved the understanding of river and estuarine dynamics, and have led to the development of river- and basinwide models to support project implementation in the Barataria and Breton basins.
- *Louisiana's 2017 CMP* used models, as well as advanced planning and E&D of sediment diversions, to inform how to operate sediment diversions in a way that builds and sustains land without producing excessive flooding, as well as how to optimize the delivery of sediment to wetland basins. The 2017 CMP included a MBSD Project with a 75,000 cfs capacity, with a base flow, as a recommended project (CPRA, 2017).

These studies and models highlight the significant investments and level of effort needed to ensure that sediment diversion projects succeed. Complex models – including the computer-generated, Delft3D model – use significant data and undergo testing and sensitivity analyses to ensure that the diversion design is technically feasible and would deliver the freshwater, sediment, and nutrients needed to create the desired beneficial outcomes in the Barataria Basin (CPRA, 2011; USACE, 2021, Appendix E). Thus, although a sediment diversion of the proposed size of Alternative 1 has not been built previously in Louisiana, the LA TIG believes that the use of sound engineering methods, combined with the scientific expertise available to the project, would make Alternative 1 likely to succeed.

3.2.1.4.3 Implementation of the MBSD MAM Plan

A comprehensive MAM process for all of the restoration techniques, and especially for the Proposed MBSD Project, is a critical element for assessing progress toward this project's goals, minimizing risk, and addressing uncertainties on an ongoing basis. During and after implementation of Alternative 1, the LA TIG would apply the MAM Plan (CPRA, 2020) to review monitoring data to inform how it is meeting Proposed MBSD Project objectives and to support adaptive management of this project. Implementation of this MAM Plan would help the Proposed MBSD Project provide long-term benefits to the resources and services injured by the Incident.

3.2.1.5 Avoids Collateral Injury

Under OPA NRDA regulations, a restoration project is evaluated based on the extent to which it will prevent future injury as a result of the Incident and will avoid collateral injury as a result of its implementation. The Proposed MBSD Project has not been designed to address future injury as a result of the Incident to natural resources; rather, it has been designed to provide restoration for natural resource injuries incurred through the Incident. Thus, the LA TIG has focused its analysis for this OPA criterion on whether and to what extent Alternative 1 would either avoid or result in collateral injury to resources and associated services.

Under Alternative 1, the Proposed MBSD Project would incorporate best management practices (BMPs), environmental protection measures, and engineering specifications during construction and operation to avoid and minimize potential collateral injury. These measures are described in detail in both Chapter 4 and Appendix R of the DEIS (USACE, 2021), but some examples include:

- Designing the construction footprint of the Proposed MBSD Project to minimize excavation and fill activities in the Mississippi River riparian wetland area.
- Constructing silt fences and sediment traps, such as hay bales, at stormwater drainage locations to prevent sedimentation of nearby waterways.
- Using grading methods to avoid concentrated flows, which could erode habitat.
- Redirecting stormwater runoff into temporary sediment basins or vegetated swales to trap sediment.
- Designing access routes for vehicles, vessels, equipment, and material transport to avoid or minimize wetland impacts to the greatest extent practicable.
- Directing Proposed MBSD Project vessels associated with construction to use existing transit paths to minimize the potential for vessel strikes of sea turtles.
- Minimizing disturbance in noise-sensitive areas by limiting construction activities to daytime hours, typically between 7:00 a.m. and 7:00 p.m., on Mondays through Fridays.
- Limiting the amount of outdoor lighting installed, using dimming lights at night, and directing light downward.
- Adhering to USFWS BMPs regarding the West Indian manatee and sea turtles to reduce construction- and traffic-related harm to these resources.

These measures would help reduce collateral injury that could result from construction-related habitat loss, habitat degradation and erosion, vehicle and vessel traffic, lights, noise, loss of habitat, and habitat degradation and erosion.

While the LA TIG would implement associated stewardship actions in recognition of the collateral injury associated with the Proposed MBSD Project and minimize collateral injury through the use of BMPs, collateral injuries could occur due to the implementation of Alternative 1 that the LA TIG has considered in its analysis. Below, the LA TIG provides a separate discussion for resources with (1) low, (2) medium, and (3) high levels of expected collateral injury from Alternative 1.[21]

[21] This discussion of collateral injuries is derived from analyses and modeling results that are presented in the DEIS, issued concurrently with this Draft RP. Additional detail on several impacts is provided in the DEIS. In the case of any conflict between the description of potential impacts in this Draft RP and the DEIS, readers should refer to the more detailed analysis of impacts in the DEIS.

3.2.1.5.1 Resources with a Low Level of Expected Collateral Injury from Alternative 1

For most natural resources injured by the Incident, the projected collateral impacts of Alternative 1 are expected to be relatively low. The resources in this category align with those described in the DEIS as likely to experience no to negligible adverse impacts from Alternative 1, or that would be affected only within or proximal to the footprint of the diversion complex (see the DEIS for more information; USACE, 2021).

More specifically, a low level of collateral injury or service loss is expected to result from Alternative 1 for the following categories from the PDARP:

- Terrestrial wildlife and habitat[22]
- Short-term impacts on SAV[23]
- Some species of birds[24]
- Sea turtles
- Threatened and endangered species (with the exception of pallid sturgeon, which is addressed in the next section)
- Recreational use.[25]

While a more exhaustive analysis and description of the potential injury associated with Alternative 1 are provided in the DEIS (USACE, 2021), examples of the nature and extent of low-level potential injuries that would occur to the above resources include:

- **Temporary habitat degradation associated with Proposed MBSD Project construction.** Project construction could minimally impact wildlife through displacement, stress, and direct mortality of some individuals within or close to the diversion complex footprint (see Chapter 4 of the DEIS). Habitats affected include forests, wetlands, SAV, and agricultural lands (USACE, 2021). Some wildlife (e.g., birds, sea turtles) might relocate to similar habitats nearby when construction activities commence and thereby reduce the collateral injury to these resources. For example, construction noise and the presence of people could lead bald eagles to avoid or abandon their nests (USFWS, 2007). However, collateral injury to bald eagles would be minimal because there are currently no known nests within 3 mi of construction and the timeframe for construction is limited.
- **Permanent habitat loss associated with the Proposed MBSD Project construction footprint.** This type of injury is relevant to terrestrial wildlife and habitat, and birds that would use habitat within the construction footprint of the Proposed MBSD Project. The total habitat lost is expected to be relatively small (i.e., approximately 500 ac, including

[22] Injury to terrestrial wildlife and terrestrial vegetation communities was not directly described in the PDARP; however, the potential to avoid or result in collateral injury to terrestrial resources due to the MBSD Project is analyzed here for completeness.
[23] SAV is projected to benefit overall from this alternative as it is projected to increase SAV area by 1,500 ac (CPRA, 2020).
[24] Alternative 1 is expected to result in net benefits for many bird species (see Section 3.2.1.6.3).
[25] Alternative 1 is also expected to provide some recreational fishing, hunting, and bird-watching benefits (see Section 3.2.1.6.4).

forests, wetlands, and agricultural land), particularly in comparison to the habitat being created and restored through this alternative (USACE, 2021). However, this includes the loss of 129 ac of forests, including 10 ac of bottomland hardwood forest, which would adversely affect non-avian species (e.g., bobcat, deer) that use this type of habitat due to the relative scarcity of forested lands in the immediate vicinity of the Proposed MBSD Project (USACE, 2021). Habitat loss would be expected to occur during the construction of the Proposed MBSD Project and be permanent.

- **Decreases in open-water areas.** Operation of the diversion would decrease open-water habitat and increase marsh in the diversion outfall. While this impact would be an intended effect of the Proposed MBSD Project (i.e., increasing land area reduces open-water area), resources that depend on open-water areas (e.g., gadwall and other waterfowl) could be displaced to other areas in the Barataria Basin with more open-water habitat.
- **Ongoing disturbance from Proposed MBSD Project operations.** Following construction, the diversion complex could result in some collateral injuries to terrestrial and aquatic resources. For example, the Proposed MBSD Project could impede the movement of terrestrial wildlife between up- and down-river areas along the west bank, which might impede their ability to evade competition and predators and find appropriate habitat. During Proposed MBSD Project operations, operational lighting and noise could result in minor collateral injuries to terrestrial wildlife and to birds, including displacement and stress. Habitat for Kemp's ridley sea turtles could be degraded due to extended periods when water temperatures are below sea turtle temperature thresholds during the high-flow winter months within the lower basin and in the immediate outfall of the diversion. However, such impacts would likely be minor, as tagging and capture data suggest that this species does not currently utilize the area affected by the Proposed MBSD Project in the winter.
- **Changes in recreational fishing opportunities.** Projected low-level adverse effects of Alternative 1 on spotted seatrout (see the DEIS and Section 3.2.1.5.2) would be detrimental to anglers and result in recreational service losses. The spotted seatrout was cited by more than 46% of recreational anglers in the Barataria Basin as their primary target; thus, even small potential declines in the abundance of the species could result in recreational angling service losses.

3.2.1.5.2 Resources with a Medium Level of Expected Collateral Injury from Alternative 1

The resources in this category, which align with those in the DEIS, are described as potentially experiencing minor-to-moderate adverse impacts from Alternative 1 (USACE, 2021). As with the above section, a more exhaustive discussion of these potential injuries can be found in Chapter 4 of the DEIS. Below, we discuss potential collateral injury to aquatic species, benthic resources, invasive species, and wetland habitat in the birdfoot delta; as well as recreational use losses.

- **Aquatic species.** In addition to brown shrimp and oysters (which are addressed in the next section), some fish and water column invertebrates could experience measurable levels of collateral injury from Alternative 1, particularly when the diversion is running at or close to maximum flow (USACE, 2021, Section 4.10.4.5). For example, species such as spotted seatrout, which have a low tolerance to low salinity, are expected to be adversely affected to some degree by the operation of Alternative 1 (USACE, 2021, Section 4.10.4.5). In addition to sensitivity of early life stages to low salinity, spotted seatrout require more energy to maintain their fluid and electrolyte balance ("osmoregulation") in low-salinity conditions (Wohlschlag and Wakeman, 1978). Additionally, flows above base flow could impact the recruitment of larvae and juveniles of a variety of species into wetlands and waterbodies in the central and eastern portions of the mid-basin. Species with a wide range of salinity tolerance (e.g., flounder) are not likely to be affected by the water-quality changes resulting from operations of the diversion, but could experience minor collateral injuries due to temporary shifts in prey composition and distribution or suboptimal salinity affecting early life stages (USACE, 2021, Section 4.10.4.5). Both construction and operation of the diversion would also result in minor collateral injury to the endangered pallid sturgeon (LA TIG, 2020c). During construction, pallid sturgeon might be present near pile-driving activities and experience behavioral avoidance or injury because of the underwater noise generated (LA TIG, 2020c). Operation of the diversion is expected to result in collateral injury to pallid sturgeon that become caught or entrained in the diversion flow, and are relocated to the Barataria Basin, which does not provide suitable habitat. However, these effects are estimated to reduce annual population growth rates by less than 0.5%, depending on the entrainment scenario assumed (LA TIG, 2020c). Aquatic species could also suffer collateral injury if the increased nutrient inputs from the diversion result in the frequency or intensity of harmful algal blooms (HABs); however, it is not known if HABs will or will not occur based on currently available knowledge (USACE, 2021).

- **Benthic resources.** Benthic resources include infauna, epifauna, and algae. Most benthic infauna live in the top 3.9 inches of the seabed and must maintain some connection to the sediment/water interface for ventilation and feeding (Miller et al., 2002). Direct injury to benthic resources would occur as a result of the removal of approximately 419 ac of benthic habitat within the aquatic portion of the construction footprint. Dredging during construction may also result in transient injury, but would be expected to resolve within months to a few years (USACE, 2021, Section 4.10.3.2). During Proposed MBSD Project operations, benthos in or near the immediate outfall area would be most affected by turbidity and sedimentation, but injury would decrease with increasing distance from the immediate outfall area as the sediments settle out (USACE, 2021, Section 4.10.4.2). The degree of potential injury is expected to decrease with distance from the outfall. In addition, projected wetland losses in the birdfoot delta would result in associated injuries to benthic resources in the area, but the reduction in land loss in the Barataria Basin is expected to more than offset these injuries.
- **Invasive aquatic plants and animals.** Water diversion projects can result in the further expansion of invasive species because they increase hydrological connectivity and make it easier for invasive species to disperse (Kettenring and Adams, 2011; Zhan et al., 2015). Freshwater areas are also more susceptible to invasive species introduction and expansion due to relatively benign environmental conditions compared to saline areas, where the general intolerance of salt by plants and the reduced availability of freshwater for most animals preclude their establishment (USACE, 2021, Section 4.10.4.6). Alternative 1 may also increase the introduction and expansion of invasive aquatic animals in the basin (USACE, 2021, Section 4.10.4.6). Invasive fish species such as carp and cichlid, while

typically found in open water, also use freshwater marshes and coastal wetlands as nursery or forage habitat and could travel with the flow of freshwater. The aggressive competition of bighead and silver carp with native filter feeder fish species for food and habitat could be potentially disruptive of the entire food web and occur over a large area (Wolfe et al., 2009). Larger and more extensive populations of grass carp could consume additional SAV and reduce available habitat for native fish species, while black carp could continue to forage on and threaten populations of native snails and mussels (Kravitz et al., 2005). Zebra mussels, Asian clams, and giant apple snails could also be expected to increase in distribution and abundance throughout the basin. Apple snails would reduce the amount of SAV for fish, while zebra mussels and Asian clams would gain habitat, with a corresponding loss in habitat for native species (USACE, 2021, Section 4.10.4.6).

- **Recreational use.** Proposed MBSD Project construction would result in some temporary losses in recreational activities near the project's construction footprint (USACE, 2021, Section 4.16.4.2). During operations, Alternative 1 could result in restricted access to some recreational sites because of increased tidal flooding (USACE, 2021, Section 4.16.5.2). Sediment transport from the diversion into navigation canals used by recreational boaters could impede deeper-draft vessel access to the Barataria Basin if maintenance dredging does not occur. These construction activities and operational impacts could result in localized losses in recreational opportunities near the Proposed MBSD Project site, but are not expected to affect recreational use overall at a basin scale.
- **Wetland habitat in the birdfoot delta** While operation of the diversion would transport sediment into the Barataria Basin, it would also result in less sediment being deposited in the birdfoot delta, leading to accelerated losses of wetlands in the area. More specifically, approximately 2,900 ac of wetland habitat in the birdfoot delta would be lost by 2070 under Alternative 1 compared to the No-Action Alternative (which would retain approximately 6,400 ac; USACE, 2021, Section 4.6.5.1). These injuries would also result in collateral injuries to the wildlife in this area that depend on wetlands (e.g., fish, shellfish, birds; USACE, 2021, Section 4.9.4.2). However, almost all wetlands in the birdfoot delta (89%) would be lost even without the Proposed MBSD Project, due to ongoing trends of erosion, subsidence, and relative sea level rise (USACE, 2021, Section 4.6.5.1).

3.2.1.5.3 Resources with a High Level of Expected Collateral Injury from Alternative 1

The LA TIG included resources in this category that align with those described in the DEIS as potentially experiencing major adverse impacts from Alternative 1 (USACE, 2021, Chapter 4). The analyses presented in the DEIS show that marine mammals, oysters, and brown shrimp may decline in abundance in the Proposed MBSD Project area due to the environmental changes associated with this alternative (USACE, 2021, Chapter 4). Importantly, the magnitude of collateral injury for these resources would likely differ substantially across the alternatives considered by the LA TIG, and would be dependent on the amount of freshwater diverted to the Barataria Basin. Below, we briefly describe the nature and extent of collateral injuries for each of these resources for Alternative 1 to allow a more robust comparison with other alternatives later in the document.

The LA TIG notes that the area affected by the Proposed MBSD Project has been severed from its historical hydrological connection to the Mississippi River, resulting in unnaturally high salinity in an area that historically experienced ongoing freshwater and sediment inputs (CPRA, 2017). The collateral injuries described below are being incurred primarily because the current ecosystem has been heavily altered – the intended restoration of this area to more natural conditions would result in collateral injury to species that depend on the current higher-salinity conditions in the basin.

Marine Mammals

Increased freshwater inputs and decreased salinities under Alternative 1 are expected to result in collateral injury to marine mammals in the Barataria Bay, particularly the common bottlenose dolphin (*Tursiops truncatus*) that is part of the "Barataria Bay Estuarine System" (BBES) dolphin stock. Potential impacts on other bottlenose dolphin stocks and marine mammal species are discussed in the DEIS and are less likely to occur than the expected collateral injury to BBES dolphins (see USACE, 2021, Section 4.11).

The Barataria Basin supports approximately 2,100 common bottlenose dolphins in the middle and lower portions of the basin (Garrison et al., 2020). The highest density of dolphins occurs near the barrier islands (this group is called the Island stratum), with lower densities north of the barrier islands and east of the Barataria Bay Waterway (i.e., the Central stratum). The lowest densities are found north of the barrier islands and west of the Barataria Bay Waterway (i.e., the West stratum) and to the east/southeast past Billet Bay (i.e., the Southeast stratum; Wells et al., 2017; Garrison et al., 2020).

The primary stressor on common bottlenose dolphins in the Barataria Basin from Alternative 1 would be the direct physiological effects of prolonged exposure to low-salinity water, which can negatively affect dolphins through direct contact with the skin or external surfaces of the animal, and through freshwater ingested incidentally during foraging. Exposure can cause visible changes to the skin, resulting in lesions such as color changes, sores, or sloughing, which indicate progressive stages of the skin's impaired ability to maintain an effective barrier (e.g., Simpson and Gardner, 1972; Greenwood et al., 1974; Colbert et al., 1999; Wilson et al., 1999; Gulland et al., 2008). As the severity of skin lesions is not always predictive of internal physiological response, animals may die before their severe skin lesions are noted from remote visual assessment. As exposure continues, the skin biome changes and may become overgrown with external mats that are composed of fungi, algae, and/or bacteria. As the physiological and morphological integrity of the skin is altered, secondary infections and increased water ingestion may occur. Low-salinity water ingestion may also contribute to osmotic imbalance, cellular damage, and increased susceptibility for localized and/or systemic infections. The intensity and duration of impact on individual dolphins (e.g., mortality, morbidity) would vary depending on the length and intensity of freshwater exposure (i.e., for how long and how low). The amount and duration of exposure is dependent on the volume and duration of diverted water. Indirect impacts could occur as water quality (e.g., HABs, contaminants) habitat and food web dynamics shift over time, and if common bottlenose dolphins that use the Barataria Basin shift their movement patterns and distribution within the basin over time (USACE, 2021, Section 4.11.5.1).

Under some circumstances, adverse health effects from low-salinity exposure can result in the death of individuals. Especially in situations when additional stressors (e.g., low temperatures, extreme weather, exposure to contaminated environments, human activities) are present, adverse effects may be more severe and therefore more likely to result in reduced reproductive success and survival (USACE, 2021, Section 4.11.5.1).

Garrison et al. (2020) developed a simulation approach to quantify the probable effects of changes in salinity resulting from the Proposed MBSD Project on BBES dolphins. The DEIS incorporated these model results to identify the potential impact of low-salinity exposure on the mean annual survival rate of BBES dolphins (Table 3-3). The results suggest that, relative to the No-Action Alternative, the mean population survival rate would decline by an estimated 34% [95% confidence interval (CI): 15.3–62.7%] in any given year of the diversion's operation, based on the representative hydrograph provided in the Delft3D model. The greatest impacts would be on dolphins inhabiting the central and western portions of the Barataria Bay (Table 3-3; Garrison et al., 2020). The modeling also suggests that after a decade of diversion operations under Alternative 1, the Island stratum would be the only stratum with a population that could potentially persist. It is important to note that the modeling used to assess the impacts on BBES dolphins assumes, based on evidence from published studies, that most of them cannot or would not shift their range, regardless of prolonged and/or drastic changes in environmental conditions (Hubard et al., 2004; Irwin and Würsig, 2004; Balmer et al., 2008, 2018, 2019; Urian et al., 2009; Bassos-Hull et al., 2013; Wells, 2014; Mullin et al., 2015, 2017; Aichinger-Dias et al., 2017; Wells et al., 2017; Fazioli and Mintzer, 2020; Cloyed et al., In prep.; Takeshita et al., In prep.).

Table 3-3.

Alternative 1 Would Reduce Mean Annual Survival Rates due to Low-Salinity Exposure for a Simulated Dolphin Population Compared to the No-Action Alternative. Values shown are the calculated median survival rates in any given year based on the representative (or average) hydrograph,[a] with 95% confidence limits in parentheses. Discrepancies in the differences are due to rounding.

Stratum	No-Action Alternative	Alternative 1	Difference
Overall	0.89 (0.75 to 0.98)	0.59 (0.28 to 0.83)	-0.30 (-0.02 to -0.64)
Island	1.00 (1.00 to 1.00)	0.94 (0.61 to 1.00)	-0.07 (-0.40 to 0.00)
West	0.96 (0.86 to 1.00)	0.56 (0.12 to 0.89)	-0.40 (-0.06 to -0.84)
Central	0.86 (0.61 to 0.99)	0.29 (0.04 to 0.68)	-0.57 (-0.14 to -0.88)
Southeast	0.81 (0.58 to 0.97)	0.68 (0.37 to 0.93)	-0.12 (0.21 to -0.48)

[a] Rates would be lower for wet years and higher for dry years, and change based on the decade cycle.
Source: Garrison et al., 2020.

Overall, the anticipated collateral injury of Alternative 1 on BBES dolphins in the Barataria Basin includes (1) immediate and permanent impacts on survival rates from low-salinity exposure, especially for dolphins residing in the western and central regions of the basin; (2) adverse effects on health and reproduction from multiple stressors, including low-salinity exposure, wetland loss (which also occurs in the No-Action Alternative), lower temperatures, an increased risk of HABs, and residual effects from the Incident; and (3) based on the estimated decreases in survival rates, there would be a substantial reduction in population numbers. For more detailed information, see Section 4.11.5.1 of the DEIS (USACE, 2021).

Importantly, as noted in Section 3.2.1.1.5, in recognition of the anticipated impacts on marine mammals from the Proposed MBSD Project, stewardship measures are being implemented to increase understanding, improve management, and provide benefits to marine mammals across the state. These measures further the restoration and adaptive management intent of the PDARP.

Oysters

Increased freshwater inputs and decreased salinities under Alternative 1 would likely result in collateral injury to oysters, primarily because the diversion would decrease salinities below the range required for successful oyster spawning. As noted above, the disconnection of the Mississippi River from the Barataria Basin increased salinity in the basin, allowing oysters to establish in areas that would have had much lower salinities under natural conditions.

Oysters are tolerant of a wide range of salinity concentrations (i.e., 5 to 40 parts per thousand or ppt); however, the formation of dense oyster reefs primarily occurs at intermediate salinities (10 to 20 ppt; Shumway, 1996). The amount of freshwater needed to suspend and distribute river sediment into the Barataria Basin under Alternative 1 would push optimal annual and seasonal salinity areas for oysters seaward. This change would negatively affect several areas that support oyster reefs and public seed grounds, which have become established in recent decades as a result of Mississippi River management regimes. In contrast, without the Proposed MBSD Project, the continuation of current river management, and factors such as sea level rise, would potentially push optimal salinity zones farther landward. Oyster harvesters have noted that the loss of coastal wetlands in the Barataria Basin has led to the creation of new oyster reefs farther inland than was the case historically (Melancon, 1990).

Alternative 1 would significantly influence the suitability of habitat for oysters in the Barataria Basin (Figure 3-9). The data depicted in Figure 3-9 show a potential, large-scale reduction in oyster habitat suitability under Alternative 1 in the spring, when diversion flows would be the greatest. However, the habitat suitability index (HSI) model used for this analysis focused solely on areas where suitable salinity conditions for oysters could occur in the future, and it assumed that substrates were not limiting. Because substrate availability is a key driver of oyster abundance and reproductive success, the realized losses in oyster habitat from Alternative 1 are likely to be smaller than suggested in Figure 3-9 Under low-flow conditions, the impact of Alternative 1 on oysters would also be expected to be much less pronounced (USACE, 2021). See Section 4.10.4.5 in the DEIS for more detailed information.

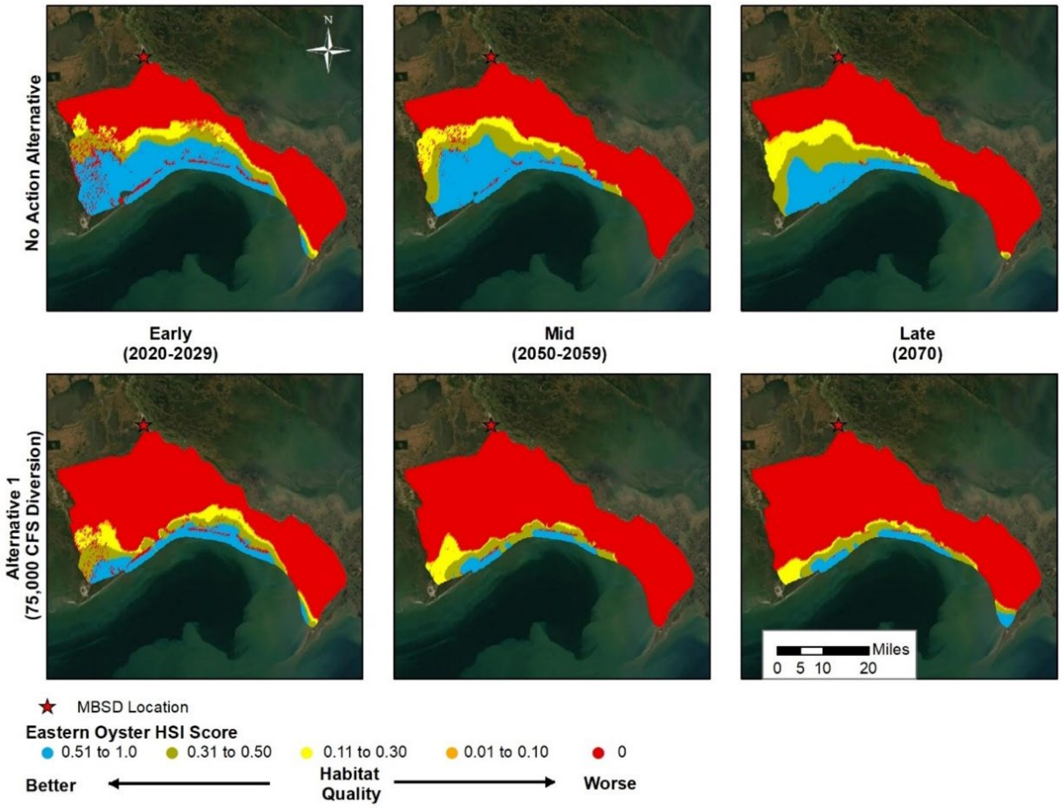


Figure 3-9. Oyster HSIs for Eastern Oysters Decrease in the Barataria Basin under Alternative 1 Compared to the No-Action Alternative due to Increased Freshwater Associated with the Diversion, Assuming Unlimited Availability of Substrate. (Source: Delft3D modeling results)

Overall, Alternative 1 is expected to cause a gradual but major decrease in oyster abundance over time, with the largest decreases after 2050. As with brown shrimp, similar declines in suitable habitat for oysters for many areas of the basin are projected to occur even without the Proposed MBSD Project, but such declines would occur more gradually (USACE, 2021, Section 4.10.4.5). Without the Proposed MBSD Project, increased salinities from sea level rise, particularly in the southernmost portion of the basin, could increase the risk of oyster infection and predation. In addition, the loss of marshes over time would allow for freshwater from the Mississippi River to flow more freely into portions of the Barataria Basin, reducing the suitability of habitat for oysters in the central and eastern areas (USACE, 2021, Section 4.10.4.5).

Importantly, as noted in Section 3.2.1.1.5, the LA TIG would support implementation of several stewardship actions in recognition of the potential collateral injury to oysters and the fishermen who rely on the oyster fishery. More specifically, the LA TIG would support:

- Re-establishing public seed grounds in the basin to help offset losses to public seed grounds that occur as a result of the Proposed MBSD Project operation.
- Providing additional cultch material to current lessees, which could help maintain oyster reefs in areas where sediment could bury suitable oyster habitat.

- Creating broodstock reefs, both within and outside of the Barataria Basin, to offset losses in broodstocks that result from the operation of the diversion.
- Expanding alternative oyster culture, which can help cultivate oysters in areas where suitable reef habitat is lacking.
- Funding efforts to improve marketing and enhance the value of dockside harvests.

Brown Shrimp

Brown shrimp adults, spawning adults, and early life stages occur in the Proposed MBSD Project area as well as offshore. However, adult brown shrimp spawn outside of the estuary, and the earlier life stages (i.e., eggs and early larvae) occur offshore (see O'Connell et al., 2017, for a review of brown shrimp life history). Thus, these life stages are not anticipated to be directly or indirectly affected by Alternative 1, and impacts would likely be restricted to the post-larval, juvenile, and sub-adult life stages that occur in the Barataria Basin.

Larval brown shrimp are carried from offshore to the nearshore, and into the Barataria Basin by shelf currents and tides, with migration occurring from January through June (Zein-Eldin and Renaud, 1986). Juveniles, found within estuarine habitats, prefer complex and vegetated habitats such as SAV, emergent marsh, and oyster reefs, but have also been found in soft and sand/shell bottom habitats. Sub-adult brown shrimp reside in the soft mud bottom and sand/shell bottom habitats in deeper estuarine channels and nearshore habitats before beginning their migration to offshore areas in the summer (GMFMC, 2016). The principal drivers of growth, survival, and perceived habitat preferences of brown shrimp in the basin include salinity, temperature, habitat (e.g., Minello and Rozas, 2002; O'Connell et al., 2017), food supply, and successful larval recruitment.

Diversion-related changes in the flow direction and velocity of water within the Barataria Basin could negatively affect brown shrimp post-larvae during their larval transport period (USACE, 2021, Section 4.10.4.5). Substantial impacts would be expected because high-diversion flows during most years would overlap the majority of the brown shrimp larval transport period. While the duration and spatial extent of this injury would vary depending on Mississippi River flows and ongoing changes in wetland coverage, it would be a permanent and recurring annual injury (USACE, 2021, Section 4.10.4.5).

Collateral injuries are also likely to occur due to the decreased salinities associated with increased freshwater inputs to the mid-basin area, particularly in the initial decades of diversion operation (USACE, 2021, Section 4.10.4.5). More specifically, a measure of the suitability of habitat for a given species – the HSI – is projected to decline markedly for brown shrimp in years 2020 to 2040 relative to the No-Action Alternative (Figure 3-10). This is because prolonged salinities of 0 ppt would be present in the mid-basin during periods when the diversion is open, and post-larvae present in freshwater over prolonged periods could experience high mortality (USACE, 2021, Section 4.10.4.5). Thus, operation of the diversion, especially when it is running at maximum capacity, would likely preclude use of the mid-basin near the diversion outfall area by brown shrimp and decrease, but not eliminate, the suitability of the lower portions of the Barataria Basin for small juvenile brown shrimp. Importantly, declines in suitable habitat for brown shrimp are projected to occur even without the Proposed MBSD Project due to losses of wetland habitat, but these declines would occur gradually over time and be greatest at the end of the project's analysis period (i.e., 2070).

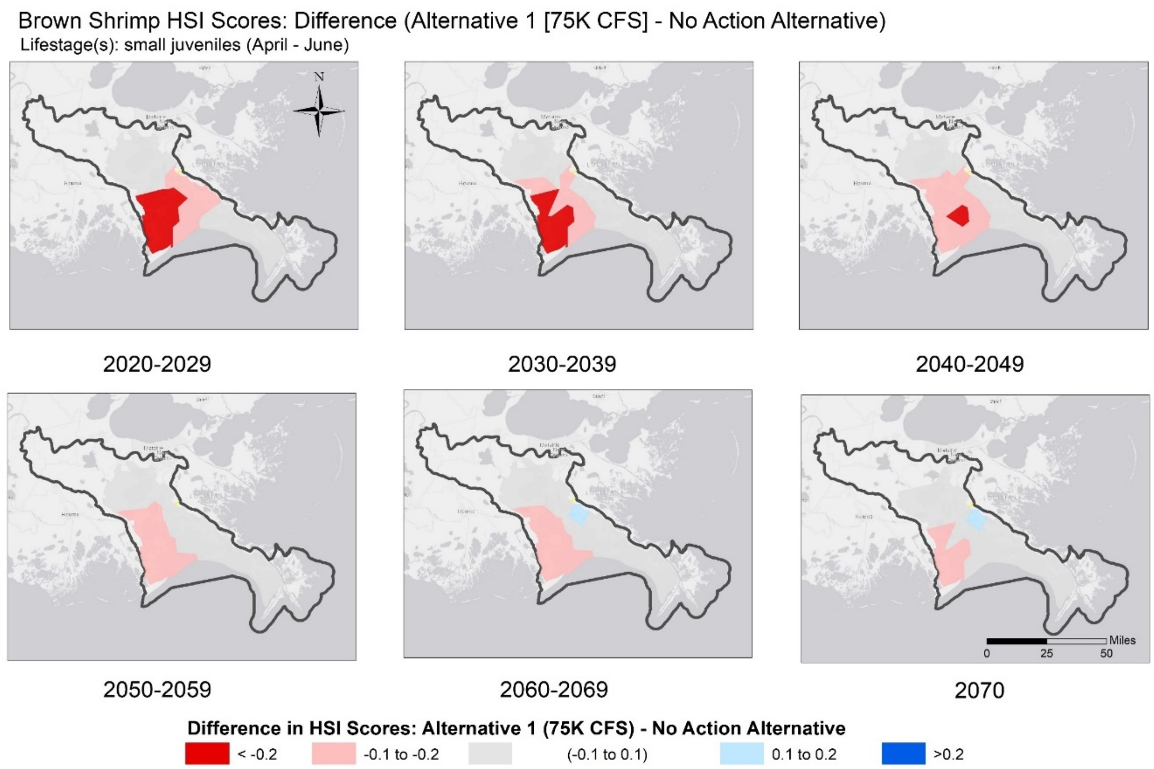


Figure 3-10. Habitat Suitability Decreases for Small Juvenile Brown Shrimp in the Mid-Barataria Basin under Alternative 1 (Future with Project) Compared to the No-Action Alternative (Future without Project) Modeling Scenario because of Increased Freshwater Associated with the Diversion. By 2070, differences in suitability between Alternative 1 and the No-Action Alternative become smaller because of the increase in marsh habitat associated with Alternative 1. See the DEIS (USACE, 2021, Section 4.10.4.5) for more information on HSI models and potential impacts on brown shrimp.

Altogether, Alternative 1 is expected to decrease brown shrimp abundance in the basin, but the viability of the population is not anticipated to be affected (USACE, 2021, Section 4.10.4.5).

As noted in Section 3.2.1.1.5, the LA TIG would support several stewardship actions in recognition of the potentially collateral injury to brown shrimp and the fishermen who rely on the brown shrimp fishery.

3.2.1.5.4 Synthesis of Potential Collateral Injury under Alternative 1

As noted above, Alternative 1 is intended to provide ongoing inputs of freshwater, sediment, and nutrients to sustain and create marsh and other wetland habitats, which can then support resident and transient aquatic resources, as well as provide nursery habitat for open-water/nearshore species. These ongoing inputs of freshwater and sediment would necessarily change the current conditions of the Barataria Basin, including lowering salinities across the basin when the diversion is operating above base flow, in proportion to the amount of freshwater being diverted by the Proposed MBSD Project. The LA TIG expects that resources that depend on the current higher salinities found in the basin would suffer high levels of collateral injury from operation of the Proposed MBSD Project under Alternative 1. These injured resources include bottlenose dolphins, oysters, and brown shrimp. The construction and operation of the diversion may also result in injuries to pallid sturgeon, spotted seatrout, benthic resources, and boating-related recreational use. Other, lower levels of potential collateral injuries associated with construction and operation of the physical structure of the diversion are expected to be localized in time and space. The LA TIG would implement a suite of associated stewardship actions in recognition of potential collateral injuries to marine mammals and trust resources that support fisheries (i.e., oysters and shrimp). These would include implementing a statewide marine mammal stranding network for 20 years, supporting activities that would reduce harmful human interactions with marine mammals, providing stranding surge capacity in response to unusual marine mammal mortality events, enhancing oyster habitat and productivity through the development of public seed banks, provisioning oyster cultch material, creating oyster broodstock reefs, advancing alternative oyster culture, improving shrimp fishing gear and on-board refrigeration, and improving the marketing of harvested shellfish.

The effects of Alternative 1 on non-trust resources, including socioeconomics, commercial fisheries, tourism, cultural resources, and environmental justice were examined in detail in the DEIS; see Sections 4.13, 4.14, 4.15, and 4.24 for more information.

3.2.1.6 Benefits Multiple Resources

This section evaluates the extent to which Alternative 1 would provide benefits to multiple resources. The Proposed MBSD Project is an ecosystem-level restoration project designed to address an ecosystem-level injury from the Incident. Thus, the implementation of Alternative 1 of the Proposed MBSD Project would, by design, benefit multiple resources in the Barataria Basin and the northern Gulf of Mexico (Figure 3-11). More specifically, Alternative 1 is expected to result in substantial benefits for nearshore marine ecosystems, water column resources (including fish and invertebrates), and birds and terrestrial wildlife (Figure 3-11). Offshore ecosystem benefits are also expected. Below, more details about the nature and magnitude of specific expected benefits within each of these resource categories under Alternative 1 are discussed.

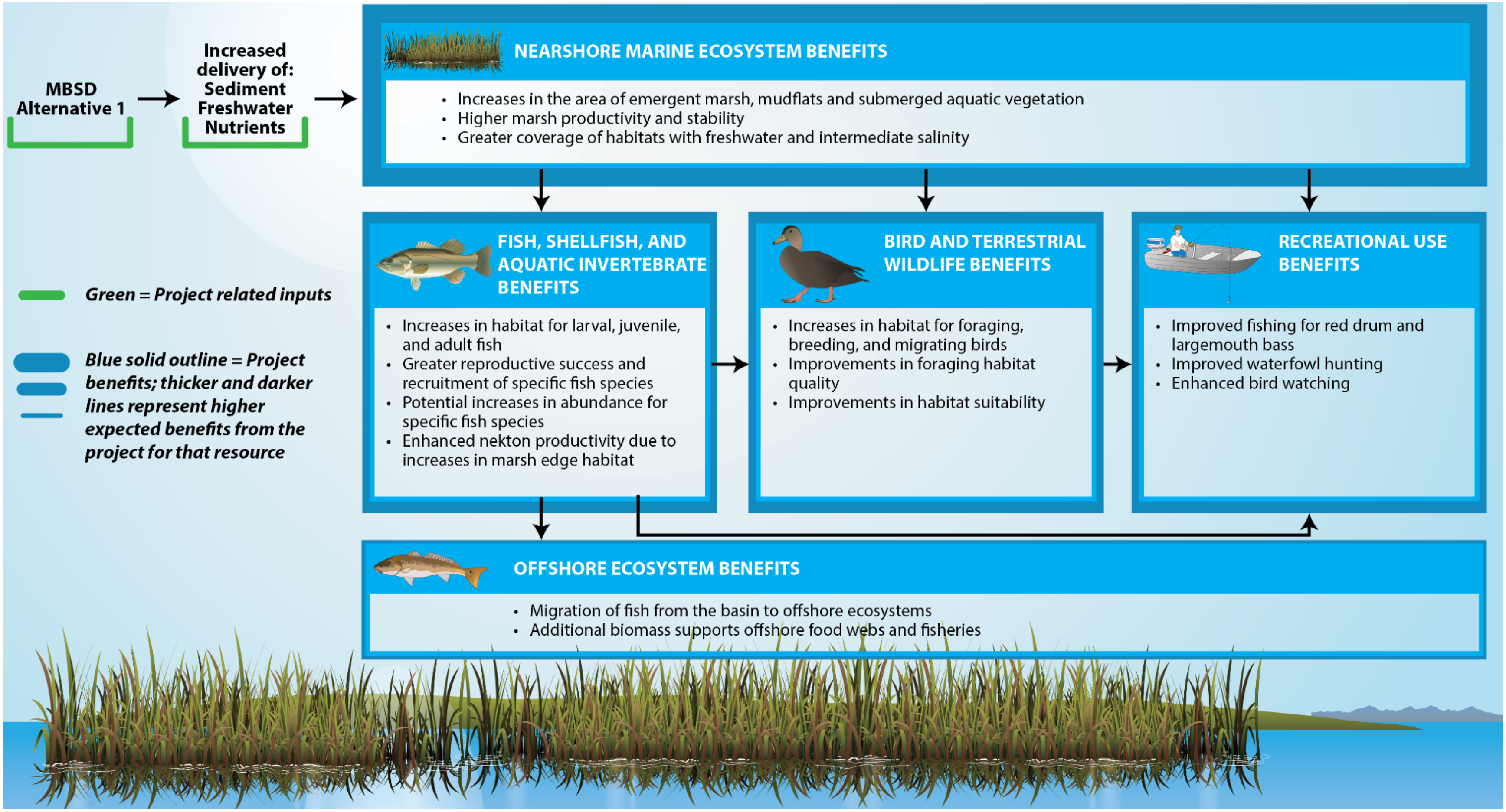


Figure 3-11. Integrated, High-Level Overview of the Types of Benefits that Are Expected for Major Natural Resources Categories under the Implementation of Alternative 1. More details about the nature and magnitude of specific benefits are provided in the following sections. Some symbols adapted from and used are through the courtesy of the Integration and Application Network (https://ian.umces.edu/symbols/).

3.2.1.6.1 Benefits to Nearshore Marine Ecosystems

Habitats in the nearshore marine ecosystems of the Barataria Basin are a key focus for the Proposed MBSD Project, and they are expected to benefit substantially from the diversion under Alternative 1.[26] More specifically, the delivery of sediment into the Barataria Basin is expected to result in the formation of deltaic landforms at the outfall of the diversion (see USACE, 2021, Section 4.2.3.2). The rate of land growth at a river diversion site depends on the balance between sediment sources and sediment sinks, such as erosion (Edmonds, 2012). When sediment builds up to a sufficient depth, vegetation can quickly colonize and begin to grow. This forms a positive feedback cycle, where vegetation helps stabilize the delta by capturing more sediment, reducing erosion rates, and contributing aboveground plant litter and belowground organic matter to the soil (Figure 3-12).

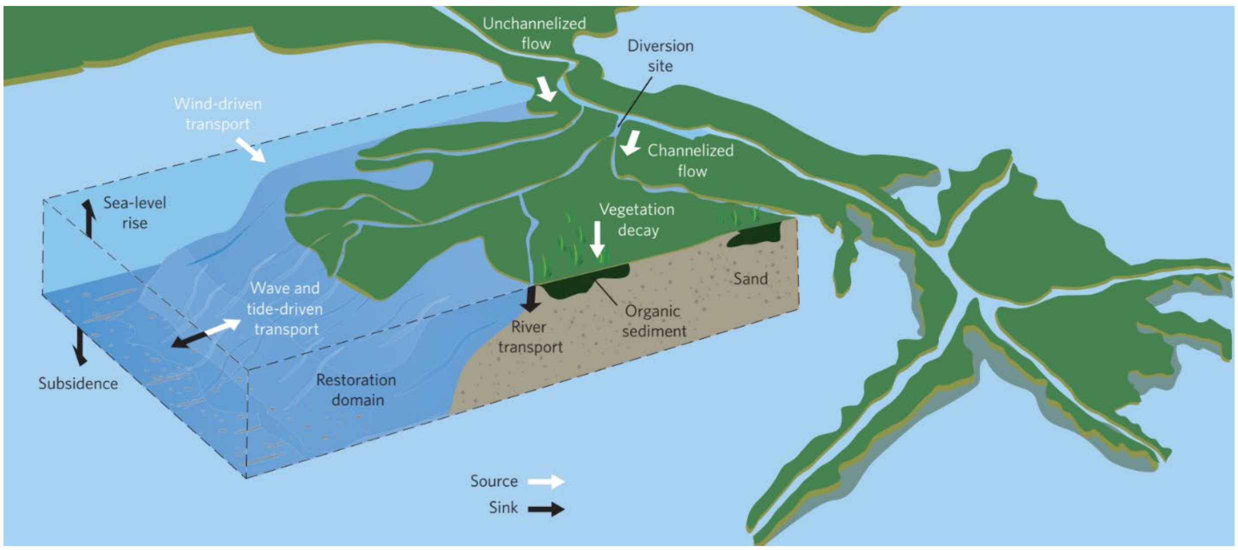


Figure 3-12. Land-Building Sediment Process in a Hypothetical Diversion off the Mississippi River as a Balance of Sources and Sinks with Organic and Inorganic Processes.
(Source: Edmonds, 2012)

As a river delta accretes vertically and matures, the plant community changes and undergoes succession over time. In temperate, river-dominated deltas, SAV may first establish on newly formed subaerial, shallow mudflats; only to be replaced by floating-leaved vegetation, emergent vegetation, diverse high-marsh meadow communities, and eventually canopies of small trees and shrubs as elevation increases over time (Johnson et al., 1985; Carle et al., 2015). In addition, land-building also creates more marsh "edge" habitat, which is the productive zone where the edge of the marsh meets open water. In a comprehensive study of the utilization of fish and crustaceans ("nekton") of coastal habitats in the northern Gulf of Mexico, Hollweg et al. (2020) found that the marsh edge supports higher densities of nekton compared to the marsh interior or open-water, unvegetated bottom habitats. Together, this diversity of habitats supports important refugia, foraging, and resting habitats for a wide variety of aquatic, avian, and terrestrial species,

[26] All habitats mentioned in this section are expected to experience a "high" level of benefit, which aligns with resources described in the DEIS that are expected to experience major benefits from Alternative 1.

including essential fish habitats that support multiple managed species (see USACE, 2021, Section 4.10); some of these benefits are described in more detail below.

In addition to restoring and maintaining vegetated marsh habitat, Alternative 1 would also help create and maintain shallow subaqueous habitats. Operation of the diversion is expected to result in the deposition of sediment throughout the Proposed MBSD Project area, which would help counteract factors such as subsidence, sea level rise, and tidal scouring that tend to lead to increased deepening of water bottoms over time. Shallow-water bottoms support several processes important to maintaining the productivity of an estuarine system. High primary productivity supported generally by microalgae that live in the sediment (e.g., diatoms) is an important ecological function of shallow-water habitats. Other important processes include nutrient regeneration, decomposition of organic matter, and increased secondary production of benthic invertebrates (Ray, 2005). Shallow-water areas are more productive than deeper-water areas due to their more-favorable conditions for sunlight, oxygen, and temperature (Roy, 2012). Shallower water provides greater bottom accessibility for waterfowl and improved foraging habitat for wading birds. Shallow-water habitats also are important foraging and nursery habitats for several economically important marine fishery species. In Louisiana's turbid coastal estuaries, in part due to reduced light penetration, SAV is generally limited to shallow-water habitat (i.e., those areas generally less than 2 ft in depth).

As noted in the Proposed MBSD Project description (see Section 3.2.1.1), Alternative 1 is expected to maintain a gradient in salinity from north to south across the Barataria Basin, creating habitat for a wide spectrum of species with varying salinity tolerances. Overall, operation of the diversion would decrease salinity in the Barataria Basin compared to the No-Action Alternative, with greater decreases occurring when the diversion is operating above base flow and in areas closer to the diversion outfall area. Near the diversion, salinity is projected to reach or approach 0 ppt for prolonged periods of the year. Further from the diversion (e.g., at Barataria Pass near Grand Isle), salinities are projected to peak and fall more quickly, depending on diversion operations, which in turn are contingent on Mississippi River flows (i.e., higher river flows translate to more water and sediment being sent through the diversion). All organisms within an estuary must find areas with acceptable combinations of both salinity and habitat type. Areas with low salinities are considered critical to the life histories of many organisms and offer habitat to a wide variety of adult and juvenile freshwater, estuarine, and marine fishes (Rozas and Hackney, 1983). Olsen (2019) notes that higher estuarine salinities are typically correlated with decreasing species diversity, and fresher estuaries are correlated with a more diverse and even species assemblage.

The ecological dynamics described above would jointly contribute to realizing the following large-scale benefits to nearshore marine ecosystems under Alternative 1:

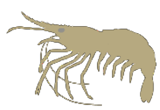
- An increase in emergent mudflats and marsh habitat of approximately 13,400 ac.
- An increase in SAV of approximately 1,500 ac in the freshwater/intermediate areas of the Barataria Basin.
- Maintenance of an appropriate gradient of freshwater to saline marshes in the Barataria Basin.

As discussed above and shown in Figure 3-11, these benefits to nearshore marine ecosystems would further provide benefits to water column resources, birds and terrestrial wildlife, and offshore marine ecosystems (see below).

3.2.1.6.2 Benefits to Water Column Resources (i.e., fish, shellfish, and other species)

The wetland and aquatic habitats provided by Alternative 1, described above, are critical for a wide variety of water column resources, including invertebrates and fish, which use nearshore habitats for foraging, refugia from predators, resting places during migration, and reproduction. Thus, increasing the available suitable habitat for water column resources is expected to have substantial benefits to the wide array of aquatic species[27] using the Barataria Basin. As noted above, the creation of marsh edge habitat would enhance nekton productivity (Hollweg et al., 2020), but there are also specific species benefits that may accrue from Alternative 1. Below, some key benefits for specific fish species are highlighted.[28] It is important to note that the species highlighted here may experience minor levels of collateral injury due to factors such as impacts from Proposed MBSD Project construction, habitat loss in the birdfoot delta, adverse larval transport, or increased energy requirements associated with lower salinities. However, these injuries are expected to be small for the species described below and to be more than offset by the benefits that result from Alternative 1. In addition, these species were those chosen for detailed analysis in the DEIS; however, any fish or aquatic species that depends on wetland or SAV would be expected to similarly benefit from the creation and maintenance of marsh and SAV habitat. See Section 3.2.1.5 (Avoids Collateral Injury) above and the DEIS for more detailed information (USACE, 2021, Section 4.10.4.5).

White Shrimp



White shrimp are generally considered more tolerant of low salinities than brown shrimp. Alternative 1 is expected to benefit white shrimp through increased marsh and SAV habitat, and increased primary production (USACE, 2021, Section 4.10.4.5). The increased primary production for many regions of the estuary following diversion releases could provide additional prey to benefit shrimp consumption and growth. The potential shifts and changes in prey biomass for juvenile and sub-adult white shrimp would likely provide permanent benefits to the white shrimp population in the Barataria Basin. White shrimp are also expected to benefit from new and sustained marsh vegetation in the outfall area, and increased SAV and primary production in areas of the basin. Beneficial primary productivity impacts are expected to begin at the onset of operations and last throughout the time the diversion is operating, whereas the benefits associated with new and sustained marsh would be realized after 2050 (USACE, 2021, Section 4.10.4.5). While low levels of collateral injury to white shrimp may occur due to the disruption of larval transport or juvenile settlement and the energetic demands of decreased salinity, the overall impact of Alternative 1 on white shrimp is expected to be beneficial.

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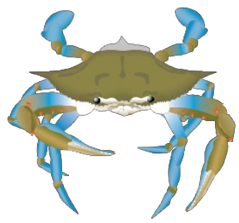
[27] All symbols in Section 3.2.1.6.2 are used through the courtesy of the Integration and Application Network (https://ian.umces.edu/symbols/).

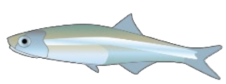
[28] All species listed are expected to experience a “medium” level of benefit, which aligns with the species described in the DEIS that are expected to experience minor-to-moderate benefits from Alternative 1.

Blue Crab



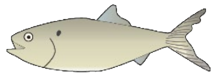
Blue crabs spend most of their life cycle within the estuary, where the juveniles are generalist omnivores. Similar to white shrimp, Alternative 1 is expected to benefit blue crab through increased marsh and SAV habitats, and increased primary production (USACE, 2021, Section 4.10.4.5). Early juveniles settling in SAV or the new emergent marsh, as well as the later life stages of blue crab that utilize these habitats, would benefit from the anticipated increase in wetland acreage and SAV biomass for Alternative 1 compared to the No-Action Alternative (USACE, 2021, Section 4.10.4.5). The creation and maintenance of marsh in the outfall area would increase habitat suitability scores in these polygons above 0.8, which is considered highly suitable and near optimum for blue crab. In other areas of the basin, favorable habitat conditions are projected under Alternative 1 and the No-Action Alternative, with little difference in habitat suitability scores. The increased primary production for many regions of the estuary following diversion releases could provide additional prey to benefit crab consumption and growth. While low levels of collateral injury could occur related to blue crab mating, transport, and early juvenile settlement near the diversion outfall area, the overall impact of Alternative 1 on blue crab is expected to be beneficial.

Bay Anchovy



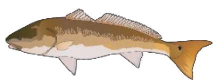
Bay anchovy are a schooling forage fish that spend their entire life cycle within and around the estuary. Alternative 1 is expected to benefit bay anchovy through increased marsh and SAV habitats, and increased primary production (USACE, 2021, Section 4.10.4.5). The increased primary production for many regions of the estuary following diversion releases could provide additional prey-related benefits to bay anchovy. Habitat suitability for juvenile bay anchovy, as projected by the HSI model, shows a small increase in suitability in the outfall area in 2050 for Alternative 1 compared to the No-Action Alternative (USACE, 2021, Section 4.10.4.5). This is due to created and sustained marsh in this area, which would provide increased potential feeding and cover habitat for juvenile bay anchovy. As the salinity in the mid-basin decreases, an increase in SAV biomass is anticipated, which would benefit early schooling juveniles utilizing low-salinity SAV or emergent marsh areas. Further, sediments accumulating in the outfall area over time would result in shallower water depths, providing bay anchovy with increased habitat for refuge. While low levels of collateral injury could occur related to larval transport disruption near the diversion outfall area, the overall impact of Alternative 1 on bay anchovy is expected to be beneficial.

Gulf Menhaden



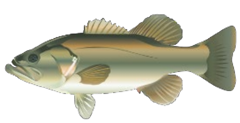
All life stages of Gulf menhaden occur in the Barataria Basin except for spawning adults, eggs, and the early larvae that are found on the continental shelf (Christmas et al., 1982). Alternative 1 is expected to benefit Gulf menhaden through increased low-salinity juvenile nursery habitat and increased prey biomass. More marsh vegetation would be created or maintained under Alternative 1 compared to the No-Action Alternative, providing more potential feeding and nursery habitat over time (USACE, 2021, Section 4.10.4.5). Further, as the salinity in the mid-basin decreases, an increase in SAV biomass is anticipated, which would benefit early schooling juveniles utilizing SAV or emergent marsh. The juvenile Gulf menhaden habitat suitability scores, predominately in the mid-to-lower western region of the Barataria Basin, increase slightly (to a maximum difference of 0.1) for Alternative 1 compared to the No-Action Alternative in simulated years 2020 through 2050, primarily due to increased chlorophyll A levels (USACE, 2021, Section 4.10.4.5). The HSI scores also project a small decrease in habitat suitability (maximum difference of -0.1) after 2050 near the outfall area. Primary production could provide additional prey to benefit Gulf menhaden consumption and growth. While low levels of collateral injury could occur related to larval migration and retention, the overall impact of Alternative 1 on Gulf menhaden is expected to be beneficial.

Red Drum



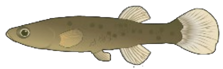
Red drum larvae, early juveniles (young-of-year before first birthday), immature, and mature adult red drum occur in the Barataria Basin. Alternative 1 would create or maintain more marsh vegetation, providing more potential feeding and nursery habitat over time when compared to the No-Action Alternative, as long as the red drum that have settled within and near the outfall area are not flushed out or otherwise impaired by increased flow and turbidity during high-diversion operations in the early spring (USACE, 2021, Section 4.10.4.5). Under Alternative 1, the new and sustained marsh vegetation in the Proposed MBSD Project outfall area, increased primary production, and increased prey and SAV biomass throughout the basin would benefit red drum. These benefits may result in a slight increase in species abundance over time (USACE, 2021, Section 4.10.4.5). The beneficial primary productivity impacts are expected to begin at the onset of operations and last throughout the time the diversion is operating, whereas the benefits associated with new and sustained marsh and SAV biomass would be realized primarily after 2050.

Largemouth Bass



All life stages of largemouth bass are present in the Barataria Basin, primarily in the upper basin north of the proposed diversion structure. Largemouth bass prefer areas of low (less than 5 ppt) salinity, minimal turbidity, and proximal vegetative cover, although adults are adapted to a variety of habitat characteristics. Alternative 1 is expected to benefit largemouth bass through increased low-salinity habitat, SAV, and prey (USACE, 2021, Section 4.10.4.5). The juvenile largemouth bass HSI scores increase in the middle estuary under Alternative 1 compared to the No-Action Alternative for years 2020 through 2050, and increase near the outfall throughout the analysis period (USACE, 2021, Section 4.10.4.5). The increase in habitat suitability near the outfall area is due to sustained marsh vegetation in this location; while the increase in suitability in the middle estuary from 2020 through 2050 is due to reduced salinities that are more optimal for largemouth bass, as well as increased prey. Overall, even though the recurring high-flow diversion operations in late winter through spring would likely deter use of the outfall area by largemouth bass, the extent of low-salinity areas with higher SAV and prey biomass in other regions of the Barataria Basin should provide moderate benefits to the largemouth bass population. The impact is expected to be moderate because expanded low-salinity areas with higher SAV and prey could allow largemouth bass to expand their range and potentially outcompete other estuarine predatory fishes (Kazumi and Keita, 2003; Brown et al., 2009).

Saltmarsh Topminnow



The saltmarsh topminnow, a state endangered species, favors quiet freshwaters protected by wetlands. Alternative 1 is projected to benefit the saltmarsh topminnow as wetlands are maintained and created in the outfall area, benefiting the species through the presence of quieter waters protected by 12,700 more acres of wetlands compared to the No-Action Alternative (USACE, 2021, Section 4.12.3.1). These moderate benefits are projected to occur primarily after 2050 as wetlands are maintained and created in the outfall area. Changing habitat and increased sedimentation would result in adverse impacts on the saltmarsh topminnow, but Alternative 1 would also benefit the species by maintaining more wetland habitat compared to the No-Action Alternative (USACE, 2021, Section 4.12.3.1). Overall, the combination of these adverse and beneficial impacts is anticipated to provide minor-to-moderate benefits to the saltmarsh topminnow in the Proposed MBSD Project area.

3.2.1.6.3 Benefits to Birds and Terrestrial Wildlife

Birds and terrestrial wildlife that use emergent marsh, mudflats, and SAV for foraging, reproducing, or refueling during migration are expected to substantially benefit from the creation and maintenance of the nearshore marine habitats described above (Figure 3-11).[29] Specifically, waterfowl would substantially benefit from restoration and maintenance of fresh and intermediate marshes, as many species (including the mottled duck) have seen previous population declines that are at least partially attributed to wetland loss and degradation (Hartke, 2013; Fontenot and DeMay, 2018). In addition, mudflats could be used by multiple species (e.g., shorebirds) prior to the establishment of marsh vegetation. Although multiple species could use these mudflats, they would be particularly beneficial to female mottled ducks and their broods, which require wetlands with short emergent vegetation and mudflats on which the ducklings can rest (Hartke, 2013).

Plant species diversity, and therefore habitat importance to waterfowl, increases with a decrease in salinity, such that fresh marshes are considered to be the most-valuable marsh to most dabbling waterfowl, followed by intermediate and brackish marshes (Gulf Coast Joint Venture, 2002). As operations continue and the fresher marshes are re-established or maintained near the outfall, it is likely that many waterfowl populations, some colonial waterbird species, and other species that prefer less-saline habitats (e.g., alligators) would increase in the outfall area.

The anticipated benefits of increased marsh in the outfall area are supported by HSI models for the select species in coastal Louisiana. Habitat suitability nearest the immediate outfall area (polygons 8 and 12) generally increases for ducks, with the HSI scores increasing by up to 0.37 for the green-winged teal and up to 0.39 for the mottled duck by 2070 (USACE, 2021, Section 4.9.4.2). These increased scores are likely based on the presence of land/emergent marsh and on shallower depths in areas of land accretion. Similar increases in HSI scores in the outfall area are not projected for the gadwall, likely due to the decrease in open-water areas that would be concurrent with the projected wetland gains; impacts on this species from habitat changes

[29] All species mentioned in this section are expected to experience a "medium" level of benefit, which aligns with the species described in the DEIS that are expected to experience minor-to-moderate benefits from Alternative 1.

would likely be negligible. As wetland losses and increasing depths continue in other portions of the Proposed MBSD Project area, habitat suitability for modeled ducks outside of the outfall area generally decreases or remains similar (maximum decrease of -0.11 for mottled duck in the southwestern Basin) to the No-Action Alternative over time and space USACE, 2021, Section 4.9.4.2.

For the black rail, a federally threatened species under the Endangered Species Act (ESA), Alternative 1 would change the composition of available prey resources but would also preserve and increase the area of available marsh habitat in the mid-basin over time. Long-term effects to the black rail, which do not show preference between marsh types, are anticipated to be small, with the black rail benefiting from areas of marsh habitat creation and preservation (USACE, 2021, Section 4.12.2.5).

3.2.1.6.4 Recreational Use Benefits

Some of the benefits described above to fish, shellfish, and birds are likely to translate to recreational use benefits (Figure 3-11). For example, recreational fishers in the basin are known to target species that are expected to benefit from Alternative 1, including blue crab, red drum, and largemouth bass (USACE, 2021, Section 4.16.5.2). While recreational fishing for spotted seatrout is likely to be negatively affected by decreasing salinities under Alternative 1 (see Section 3.2.1.5), anglers that target species that prefer lower salinities and marsh habitat (e.g., red drum, largemouth bass) are likely to have improved fishing experiences. In fact, such trends have been borne out for anglers that fish near the Davis Pond Freshwater Diversion near Lafitte, Louisiana; the changes in salinity and habitat created by the diversion have led anglers to describe the area as having “incredible bass habitat” (Felsher, 2014).

Similarly, the projected benefits of Alternative 1 for birds described above could support recreational use for hunting and birdwatching. For example, the projected increase in waterfowl habitat under Alternative 1 may result in more birds and potentially a greater species diversity, which could increase the number of days that individual hunters spend hunting throughout the basin (USACE, 2021, Section 4.16.5.2). In fact, the presence of the Davis Pond Freshwater Diversion has been credited for some exceptional hunting seasons in Lake Cataouatche, the recipient of flows from the diversion (Taylor, n.d.). In addition, improved wetland habitat under Alternative 1 may attract more breeding and foraging wetland birds, resulting in increased opportunities for bird watching in some areas of the Barataria Basin (USACE, 2021, Section 4.16.5.2).

3.2.1.6.5 Benefits to Offshore Ecosystems

Alternative 1 is expected to increase nutrients in the Barataria Basin that would support the aquatic food web in the basin and offshore in the Gulf of Mexico. Increases in nutrient loading can increase phytoplankton and zooplankton (Buyukates and Roelke, 2005; Roy et al., 2016), which are important food sources for fish that develop in estuaries before migrating out to the marine environment. For example, one study found that 23% of the TN available to predator fish and other organisms higher in the food chain in coastal ecosystems was derived from pinfish (*Lagodon rhomboides*), a species that migrates from estuaries into coastal waters (Nelson et al., 2013). Similarly, young-of-the-year menhaden leaving estuaries directly support coastal fisheries and food webs as direct biomass; in addition, the magnitude of the carbon, nitrogen, and phosphorus equivalents associated with this estuarine emigration is equivalent to 5–10% of the total primary production in the estuaries studied (Deegan, 1993). Other studies also have demonstrated that nitrogen, phosphorus, and carbon produced in estuaries support offshore fishery production (Iverson, 1990; Deegan, 1993). Given that nutrients from the Proposed MBSD Project can be expected to increase productivity in the Barataria Basin, the LA TIG expects that the project could increase the flow of carbon ("energy") to offshore waters, stimulating marine productivity.

The LA TIG also notes that there is a possibility that Alternative 1 could contribute to efforts to reduce the size and severity of the low oxygen "dead zone" in the Gulf of Mexico by restoring coastal wetlands and increasing the uptake of nutrients in the Barataria Basin. The Mississippi River/Gulf of Mexico Hypoxia Task Force (2018, page 4) found that "channelization and impoundment of the Mississippi River and its tributaries throughout the basin and the Mississippi Delta, and the loss of coastal wetlands" are two factors that contribute to excess nutrients reaching Gulf water. Alternative 1 should reverse some of these conditions in the Barataria Basin by allowing the river to flow through the diversion into the basin and create additional acreage of coastal wetlands. Although acknowledged as uncertain, any action that helps to shrink the size and severity of the dead zone would provide multiple benefits to fish and shellfish populations in the Gulf of Mexico.

3.2.1.6.6 Synthesis of How Alternative 1 Benefits Multiple Resources

Alternative 1 is expected to result in substantial benefits to nearshore marine ecosystems, water column resources (including fish and invertebrates), birds, terrestrial wildlife, and offshore marine ecosystems (Figure 3-9). The increase in sediment, nutrient, and freshwater delivery from Alternative 1 would support plant community succession and diversity in the nearshore marine ecosystems of the Barataria Basin over time, helping build and sustain a dynamic, interconnected landscape with a combination of shallow mudflat, SAV, floating-leaved vegetation, and emergent marsh habitat (Figure 3-11 and Figure 3-13). In fact, Alternative 1 is projected to increase (1) emergent marsh and mudflat habitat by 13,400 ac, and (2) SAV by 1,500 ac in the Barataria Basin compared to the No-Action Alternative. The land-building under Alternative 1 would also create more productive marsh "edge" habitat. These nearshore marine ecosystem benefits would also directly benefit fish, shellfish, and invertebrates that use nearshore marine habitats (Figure 3-11 and Figure 3-13). Specific species that would be expected to benefit include white shrimp, blue crab, bay anchovy, Gulf menhaden, red drum, largemouth bass, and saltmarsh topminnow. The restoration and maintenance of shallow water habitat, mudflats, SAV, and emergent marsh are also expected to benefit a variety of bird species known to rely on these habitats, including shorebirds, waterfowl (e.g., mottled ducks, green teal), and secretive marsh birds (e.g., black rail) (Figure 3-11 and Figure 3-13). Alternative 1 could also benefit offshore marine ecosystems by enhancing the productivity of fish that develop in estuaries before migrating out to the marine environment; this would increase the flow of energy to offshore waters, stimulating marine productivity (Figure 3-11). Figure 3-13 provides a conceptual representation of these benefits, highlighting how key ecological dynamics in the Proposed MBSD Project area would improve, particularly when compared to a future without this project.

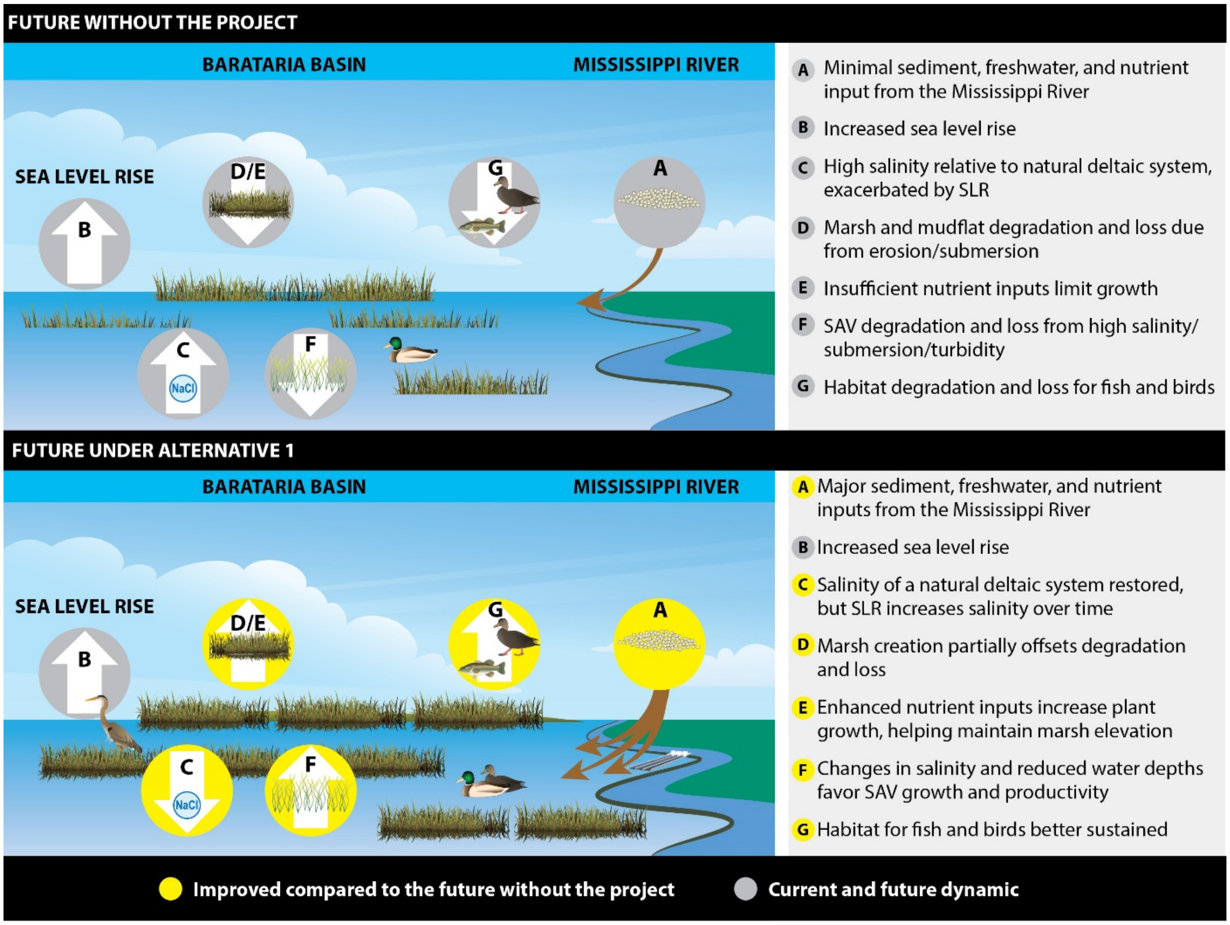


Figure 3-13. Conceptual Representation of Alternative 1 Benefits. Under future conditions, a lack of connectivity to the Mississippi River, in combination with sea level rise, leads to the degradation and loss of wetland habitat and SAV. Alternative 1 delivers sediment, freshwater, and nutrients to the basin, helping restore and sustain mudflats, aquatic vegetation, and wetlands, which benefits fish and bird species that rely on these habitats. Some symbols adapted from and used are through the courtesy of the Integration and Application Network (https://ian.umces.edu/symbols/).

3.2.1.7 Public Health and Safety

This section evaluates the extent to which Alternative 1 could affect public health and safety. The LA TIG focused its analysis on the projected changes in storm hazards and tidal inundation associated with the implementation of Alternative 1. Storm hazards occur during severe weather events, particularly storm events and hurricanes, which may result in the loss of life, injury, and flood-related health hazards. Repeated tidal flooding, while not typically associated with injury or loss of life, can impact public health and safety as a result of damage to homes and infrastructure, including roads, water supply systems, and wastewater treatment facilities (USACE, 2021, Section 4.20). Potential hazards to public health and safety associated with construction are expected to be minimized through preventative actions (USACE, 2021, Section 4.20.4.1) and are not discussed further here.

3.2.1.7.1 Storm Hazard Impacts

For communities north of the Proposed MBSD Project, including large population centers, Alternative 1 is projected to have a positive net effect on public health and safety by creating and protecting coastal marshes that would provide natural storm protection. These potential benefits include storm surge and wave protection during large storm events for numerous communities, including the west bank and areas near New Orleans, where important industries and areas with a high percentage of minority households and households below the poverty line are located. These benefits would occur because coastal marshes can help attenuate waves and stabilize shorelines (Shepard et al., 2011). Large marshes with productive, dense vegetation are more effective at attenuating wave energy and stabilizing shorelines than deteriorating or severely altered marshes (Shepard et al., 2011). Furthermore, wetland losses can result in increased storm surge risk (Wamsley et al., 2010).

More specifically, Alternative 1 is projected to increase the topographic elevations around the diversion outfall area and, by 2070, create 13,400 ac of land in the Barataria Basin (USACE, 2021, Section 4.20). This increase in land area would reduce the extent of inland storm surge and limit the height of waves inland of the diversion, benefiting the public health and safety of populated areas north of the Proposed MBSD Project area, including areas outside of the federal levee systems (e.g., Lafitte, Des Allemands, Paradis, Boutte) (USACE, 2021, Section 4.20; Figure 3-14). These areas are some of the more densely populated and heavily built areas in coastal Louisiana, and include the highest concentration of productive assets in the state (Barnes and Virgets, 2018). Thus, Alternative 1 is likely to contribute to a positive net effect on public health and safety in an economically critical region of Louisiana. For example, in 2014, the New Orleans region supported 36,000 businesses and 537,000 jobs, as well as the highest concentration of built infrastructure along Louisiana's coast (Barnes and Virgets, 2018).

Simultaneously, however, Alternative 1 is projected to have a negative impact on public health and safety for smaller, less-populated communities that are Gulfward of the diversion and outside of the federal levee system (e.g., Myrtle Grove, Woodpark, Hermitage, Suzie Bayou, Happy Jack, Grand Bayou). These communities would be negatively affected by potential increases in storm surge in areas already affected by ongoing land loss, sea level rise, and subsidence (Figure 3-14; USACE, 2021, Section 4.20.4.2). In these areas, Alternative 1 is projected to increase surge elevations during large storm events (e.g., during a 100-year storm, surge is projected to increase by up to 0.7 ft by 2040 and by up to 1.7 ft by 2070; USACE, 2021, Section 4.20.4.2). However, such impacts are not projected for the Gulfward areas that lie within 5 to 10 mi of the diversion outfall area, where storm surge is projected to decrease due to land-building (USACE, 2021, Section 4.20.4.2). Wave heights are not projected to change notably in Gulfward areas under Alternative 1 compared to the No-Action Alternative (USACE, 2021, Section 4.20.4.2). Changes in storm surge elevation from the diversion are projected to increase in magnitude and spatial extent over time (USACE, 2021, Section 4.20.4.2). However, by 2070, sea level rise, not the diversion, would become the dominant driver of storm surge (USACE, 2021, Section 4.20.4.2; Figure 3-14). Increases in storm surge elevation could result in increased economic impacts for these areas when storm events occur.

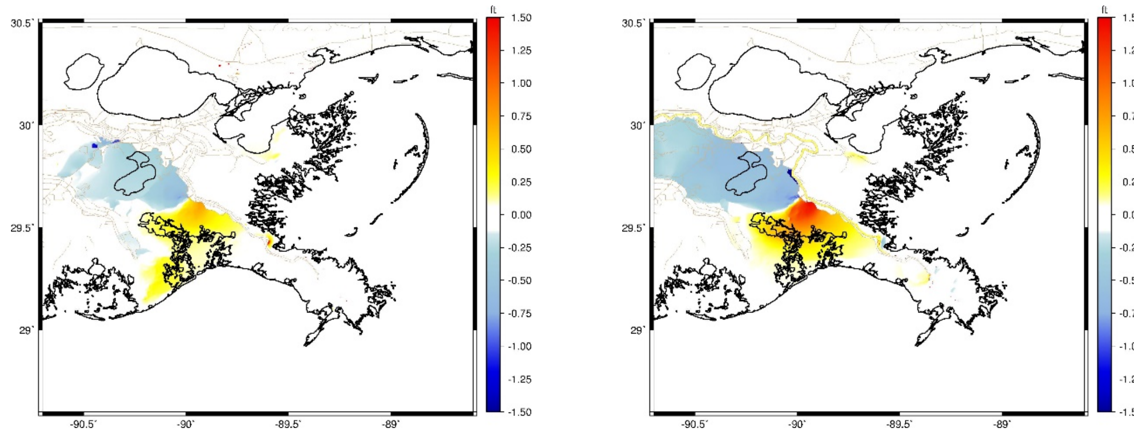


Figure 3-14. Difference in Storm Surge Elevations between the No-Action Alternative and Alternative 1 in 2040 (left) and 2070 (right) where Blue Shading (north of the diversion) Depicts Areas with Reduced Storm Surge, while Yellow-to-Red Shading (south of the diversion) Depicts Areas with Increased Storm Surge. (Source: USACE, 2021, Section 4.20)

For communities inside of federal levee systems, Alternative 1 would reduce the risk of overtopping hurricane protection levees in the areas north of the diversion, where reductions in storm surge and wave elevations are expected to occur. These include the West Bank and Vicinity portion of the Hurricane and Storm Damage Risk Reduction System and the northern reaches of the NOV-NFL System (USACE, 2021, Section 4.20.4.2). However, for areas Gulfward of the diversion, there would be a small increase in the risk of levees being overtopped due to projected increases in storm surge and waves. Potentially affected areas include the southern reaches of the NOV-NFL and the NOV systems (USACE, 2021, Section 4.20.4.2).

3.2.1.7.2 More Substantial Tidal Inundation Effects to Communities Gulfward of the Proposed MBSD Project

Alternative 1 is projected to result in some tidal flooding increases in communities north of the diversion outside of the federal levee system. For example, in Lafitte, Alternative 1 is projected to increase the annual number of days when tidal flooding exceeds the height of existing flood protection by 4 to 13 days annually in the first two decades of diversion operations. In 2050, this is projected to increase to a maximum of 30 days (about 25% more than would occur without the diversion), but the difference between Alternative 1 and the No-Action Alternative is only 1 day by 2070, as sea level rise becomes the dominant driver of tidal flooding (Table 3-4; USACE, 2021, Section 4.20.4.2).

Alternative 1 is projected to increase tidal flooding risk more substantially in communities south of the diversion complex, some of which have a large percentage of minority households and households below the poverty line. For example, in Grand Bayou, Alternative 1 is projected to increase the annual number of days of tidal flooding by between 45 and 56 days in the first 2 decades of diversion operations compared to the No-Action Alternative (Table 3-4). Tidal flooding events are projected to further increase closer to the diversion: in Myrtle Grove, Alternative 1 is projected to increase the number of days per year of tidal flooding by more than 110 days in each of the first two decades of diversion operations compared to the No-Action Alternative (Table 3-4). In these communities, as with Lafitte, the influence of the diversion on tidal flooding is projected to diminish over time as sea level rise becomes the dominant driver; in fact, the effect of Alternative 1 on annual days of tidal flooding is projected to almost entirely disappear (i.e., fall below 10 days per year) by 2050 in Grand Bayou and by 2060 in Myrtle Grove (Table 3-4). In other words, for some communities, the diversion would serve to accelerate tidal flooding impacts that would happen in the future without the diversion, due to sea level rise.

These projections are based on the 2011 Mississippi River hydrograph, which is representative of a high, late spring flood flow; thus, these projections capture how tidal inundation might be affected during high-flow years, when the diversion could be operated at its maximum capacity for extended periods of time. In lower-flow years, Alternative 1 could result in less tidal inundation frequency or duration than these projections suggest.

Related periodic inundation events are not expected to damage existing residential and non-residential structures in the areas south of the diversion, primarily because most of these structures are elevated, thus minimizing potential threats to public health and safety. However, damage may occur to roads and other infrastructure, which could result in impacts on public health and safety if the functionality of all infrastructure is not maintained.

Table 3-4.
Influence of Alternative 1 on Annual Days of Tidal Flooding Decreases over Time

Community	Alternative	2020	2030	2040	2050	2060	2070
Lafitte	No-Action Alternative	1	9	50	122	283	346
	Alternate 1 (75,000 cfs)	5	22	65	152	304	347
	Difference	4	13	15	30	21	1
Myrtle Grove	No-Action Alternative	62	128	219	322	353	357
	Alternate 1 (75,000 cfs)	181	239	286	362	362	362
	Difference	119	111	67	40	9	5
Grand Bayou	No-Action Alternative	68	176	297	343	358	362
	Alternate 1 (75,000 cfs)	124	221	318	348	357	362
	Difference	56	45	21	5	-1	0

[a] Fixed thresholds for Grand Bayou, Myrtle Grove, and Lafitte are 1.5 ft [45.7 centimeters (cm)], 1.75 ft (53.3 cm), and 2.5 ft (76.2 cm), respectively. Based on hydrograph year 2011 (high, late spring flood flow).
Source: USACE, 2021, Table 4.20-2.

3.2.2 Alternatives 2–6

In this section, the LA TIG provides an OPA evaluation of Alternatives 2–6 for the Proposed MBSD Project. As noted in the introduction to this section, all of the alternatives are similar in terms of construction footprint as well as the physical and biological mechanisms that would affect the benefits achieved and the collateral injuries potentially incurred. However, the alternatives differ in cost and in the magnitude, timing, and location of the benefits achieved and the injuries potentially incurred. This information was used to guide the LA TIG's evaluation of alternatives and selection of the Preferred Alternative. To enable this contrast between alternatives, the LA TIG's analysis of Alternatives 2–6 focuses on how each differs from Alternative 1.

3.2.2.1 Alternative Descriptions

Alternatives 2–6 consist of a large-scale sediment diversion similar to that described for Alternative 1. The primary difference between Alternatives 2 and 3 and Alternative 1 is that they operate at different maximum capacities of the diversion (50,000 cfs for Alternative 2 and 150,000 cfs for Alternative 3). Alternatives 4, 5, and 6 are the 75,000 cfs diversion, the 50,000 cfs diversion, and the 150,000 cfs diversion with marsh terracing, respectively. Because Alternatives 4, 5, and 6 focus solely on the additional effects of marsh terracing on the Proposed MBSD Project, and the effect of marsh terraces is not expected to vary markedly with diversion capacity, these latter three alternatives are usually analyzed together as "Alternatives 4–6" in the remainder of the document. A summary of the alternatives considered here is as follows:

- Alternative 2[30]: 50,000 cfs capacity diversion
- Alternative 3[31]: 150,000 cfs capacity diversion
- Alternatives 4–6[32]: 75,000, 50,000, and 150,000 cfs capacity diversions plus marsh terracing, respectively.

See the DEIS for more details on the design and operational aspects of Alternatives 2–6 (USACE, 2021, Chapter 2).

Alternatives 2–6 would, like Alternative 1, include implementation of the LA TIG's MAM Plan to evaluate the Proposed MBSD Project's benefits and impacts on the Barataria Basin, and consider how the management of the diversion may be adapted to better meet the Proposed MBSD Project's goals (see Appendix A).

The estimated total costs for Alternatives 2 and 3 are $1,716,503,000 and $2,804,463,000, respectively (see Table 3-5 for more details). The addition of marsh terraces for Alternatives 4–6 would add $1,500,000 to the cost of the diversion of the same capacity without terraces (see Section 3.2.2.2 for more information on the costs for these alternatives). These estimates were developed from the most current information available to the LA TIG at the time of drafting this Draft RP. As with Alternative 1, estimated costs reflect all costs associated with implementing the Proposed MBSD Project, such as revising/finalizing the E&D, permitting, mitigation, land acquisition, construction, MAM, Trustee oversight, and efforts to address collateral injury and contingencies. A portion of the engineering and permitting costs have been paid by NFWF's GEBF.

Modeling results project that Alternatives 2–6 would have significant and sustained benefits across the expected lifetime of the Proposed MBSD Project that are very similar in nature to Alternative 1. However, the magnitude of the projected changes to the basin vary across the alternatives. More specifically, similar to Alternative 1, Alternatives 2–6 are expected to:

- Deliver large quantities of sediment to the Barataria Basin every year to form a new delta and sustain marshes.

[30] Corresponds to Alternative 3 in the DEIS.
[31] Corresponds to Alternative 5 in the DEIS.
[32] Corresponds to Alternatives 2, 4, and 6 in the DEIS, respectively.

- Deliver high flows of freshwater during the spring, mimicking deltaic processes.
- Deliver additional nutrients to the Barataria Basin.
- Sustain a gradient of marsh types, which would help sustain the diversity of the ecologically connected habitats that have historically made up the Barataria Basin.

Each of these Proposed MBSD Project-associated changes are discussed in more detail below. See the DEIS for more details (USACE, 2021).

3.2.2.1.1 Effects of Alternatives 2–6 on Sediment Delivery and Land Creation

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs) and 3 (150,000 cfs) are projected to be successful at delivering sediment to the Barataria Basin, with sediment delivery expected to support the creation of a new delta in the mid-basin portion of the basin, and help sustain marshes through the retention of sediment and associated nutrients. Over the 50-year analysis period, the Delft3D model estimates that Alternative 2 would deliver approximately 200 MMT of sediment to the Barataria Basin, 80 million tons less than Alternative 1 (Figure 3-15). Conversely, Alternative 3 would deliver approximately 240 million more metric tons than Alternative 1 in the same timeframe (Figure 3-15). Alternatives 4–6 (sediment diversion plus terracing), which would affect the Proposed MBSD Project only through the addition of marsh terracing in the outfall area, would not affect sediment delivery to the basin through the diversion.

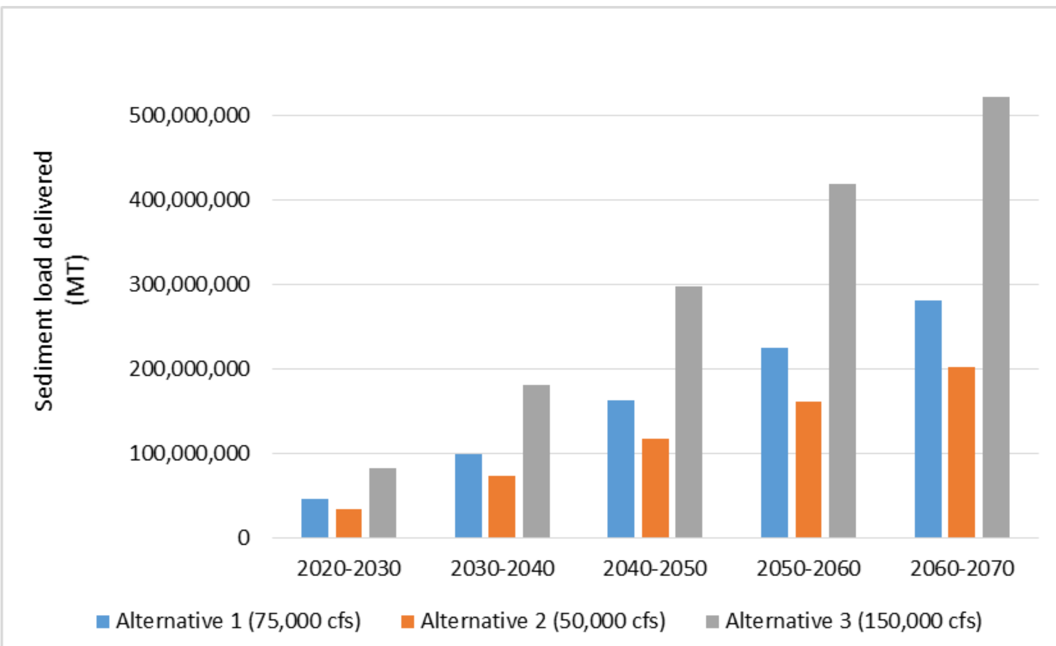


Figure 3-15. Cumulative Sediment Load Delivered (MT) to the Barataria Basin by 2070 is Lowest under Alternative 2 and Highest under Alternative 3, with Alternative 1 Falling in-between These Alternatives. [Source: Delft3D model production runs from the DEIS (USACE, 2021)].

By delivering sediment when the diversion is operating, Alternatives 2–6 allow for the formation of deltaic landforms that, similar to Alternative 1, reach a peak around 2050 and then decline due to sea level rise (Figure 3-16). Alternative 2 (50,000 cfs) is projected to increase land area in the Barataria Basin across the 50-year analysis period relative to the No-Action Alternative, with a maximum increase of 12,600 ac in 2050, which is 4,700 fewer acres than Alternative 1 (75,000 cfs; Figure 3-16). The projected maximum land area created by Alternative 3 (150,000 cfs) is 31,400 ac, or 14,100 more acres than Alternative 1 (75,000 cfs). Similar to Alternative 1, Alternatives 2 and 3 would mitigate some of the projected impacts of sea level rise, with land still being created by the Proposed MBSD Project even when the rates of erosion and land loss are high; however, the percentage of land attributed to this project reaches a maximum of 16% in 2070 for Alternative 2 (50,000 cfs) and 36% for Alternative 3 (150,000 cfs), compared to 20% for Alternative 1 (USACE, 2021, Section 4.2.3.2). Alternatives 4–6 (sediment diversion plus terracing) would increase the amount of land area under each alternative by a modest amount, creating between 0 and 400 more acres of land compared to alternatives without marsh terracing; however, the magnitude of this difference falls within the CIs of the Delft3D model output and may only reflect model "noise" (USACE, 2021, Section 4.2.3.2).

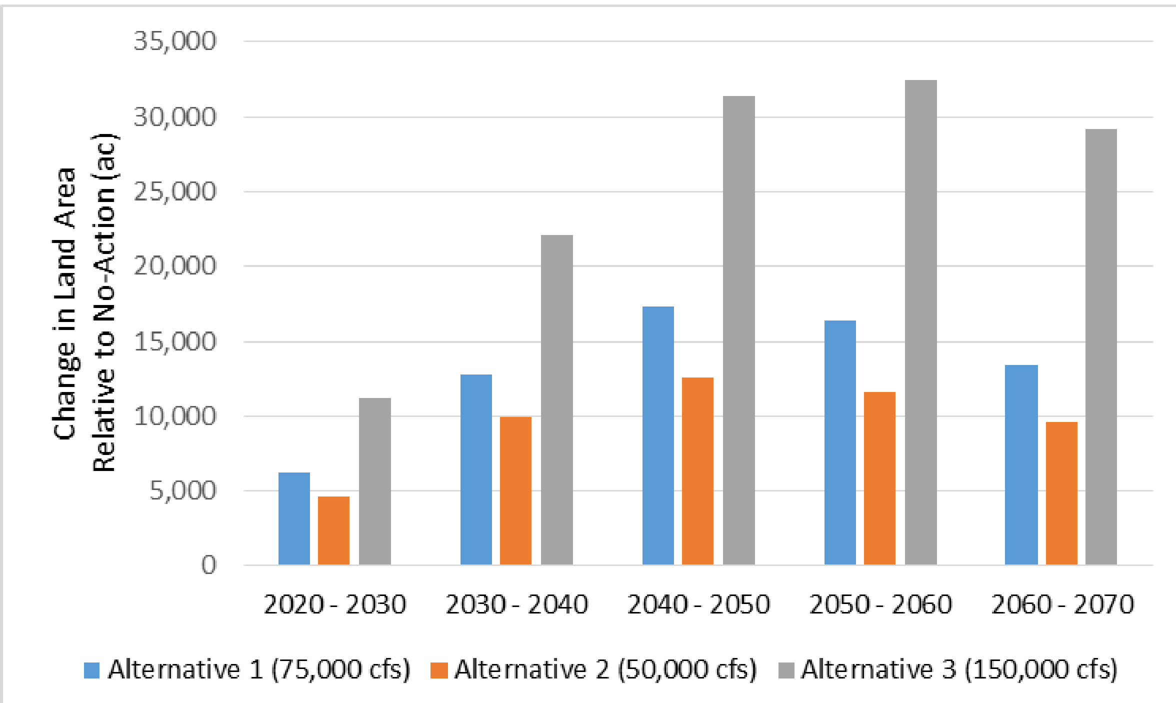


Figure 3-16. Increases in Land Area in the Barataria Basin Would Be Lowest under Alternative 2 and Highest under Alternative 3, with Alternative 1 Falling in-between These Alternatives. [Source: DEIS, Section 4.2.3.2 (USACE, 2021)]

3.2.2.1.2 Effects of Alternatives 2–6 on Freshwater Delivery

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would increase freshwater flows during the spring months, mimicking the deltaic processes that bring freshwater, sediment, and nutrients to the basin. By design (i.e., the different capacities of the alternatives), the amount of freshwater delivered to the Barataria Basin would be lowest under Alternative 2 (50,000 cfs) and highest under Alternative 3

(150,000 cfs), with Alternative 1 (75,000 cfs) falling in-between these two alternatives. Alternatives 2–6, similar to Alternative 1, would result in the lowest salinities when the diversion is running at higher capacities, typically in the winter and spring (USACE, 2021, Section 4.1.3.1). Higher salinities would occur when the diversion is running under base flow conditions, typically in the summer and fall.

3.2.2.1.3 Effects of Alternatives 2–6 on Nutrient Delivery

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would deliver additional nutrients to the Barataria Basin, and there would only be minor differences in nutrient flows among these alternatives. More specifically, all alternatives are projected to result in minor-to-moderate increases in TN compared to the No-Action Alternative, and the influence of all Proposed MBSD Project alternatives on nitrogen concentrations would be similar in terms of seasonal trends (USACE, 2021, Section 4.5.5.3). However, Alternative 2 (50,000 cfs) is expected to result in lower TN loading from the river and slightly decreased nitrogen concentrations in the basin compared to Alternative 1 (75,000 cfs), and Alternative 3 (150,000 cfs) is expected to result in slightly higher TN loading and basin nitrogen concentrations than Alternative 1 (75,000 cfs) (USACE, 2021, Section 4.5.5.3). Marsh terracing is not expected to affect nitrogen loading in the basin. The same general trends are also true for phosphorus [i.e., the effects of all alternatives on TP loading are generally similar, with slightly less TP loading under Alternative 2 (50,000 cfs) than Alternative 1 (75,000 cfs), and slightly more TP loading under Alternative 3 (150,000 cfs) than Alternative 1 (75,000 cfs)] (USACE, 2021, Section 4.5.5.4).

3.2.2.1.4 Effects of Alternatives 2–6 on Wetland Habitat Types

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would maintain a gradient of estuarine habitat types, including fresh, intermediate, brackish, and saline marshes. More specifically, all alternatives would increase the cover of fresh and intermediate marshes relative to the No-Action Alternative (USACE, 2021, Section 4.6.5.1). However, Alternative 2 (50,000 cfs) would support less fresh and intermediate habitat marshes than Alternative 1 (75,000 cfs), and Alternative 3 (150,000 cfs) would support more fresh and intermediate habitat marshes than Alternative 1 (75,000 cfs) (USACE, 2021, Section 4.6.5.1). Conversely, Alternative 2 (50,000 cfs) would support more brackish and saline habitats than Alternative 1 (75,000 cfs), and Alternative 3 (150,000 cfs) would support less brackish and saline habitats than Alternative 1 (75,000 cfs) (USACE, 2021, Section 4.6.5.1). For illustrative purposes, Figure 3-17 shows the projected relative acreage of the different types of wetland habitats under the No-Action Alternative and Alternatives 1–3 in 2050. Marsh terracing under Alternatives 4–6 (sediment diversion plus terracing) is not expected to affect wetland habitat types present in the basin.

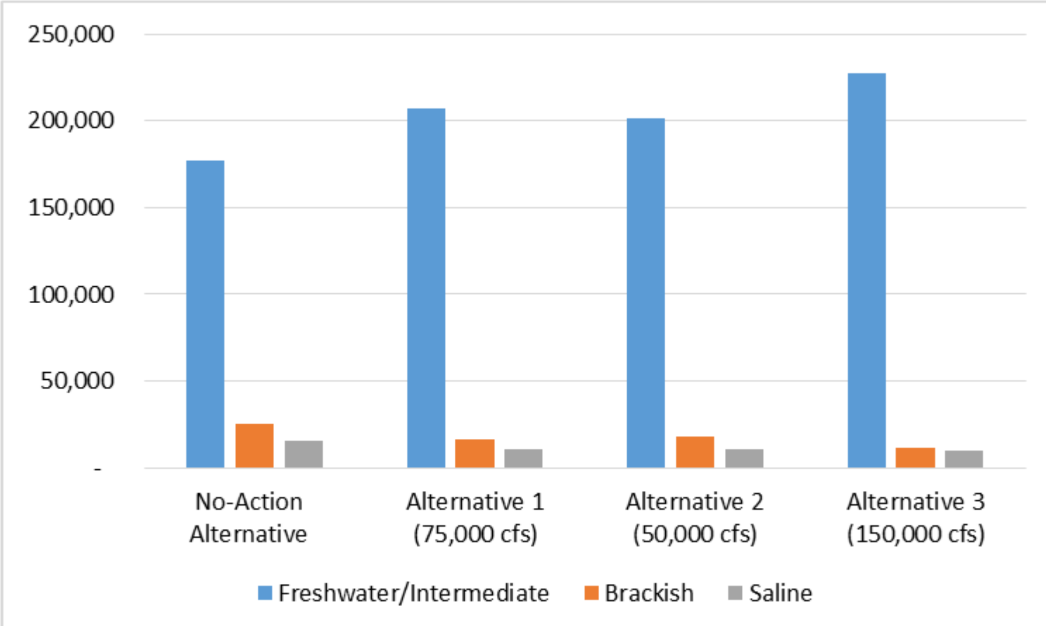


Figure 3-17. All Alternatives Are Projected to Increase the Area of Freshwater and Intermediate Marsh Habitats, and Decrease the Area of Brackish and Saline Marshes, in the Barataria Basin Relative to the No-Action Alternative; Data Shown Are Modeling Results for 2050, the Peak of Projected Land Cover in the Barataria Basin. Alternative 2 is projected to have the least effect on marsh habitat type, while Alternative 3 is projected to have the greatest effect. Alternative 1 falls in-between these alternatives. Vegetated and unvegetated land areas are included, and results are shown by decade. (Source: USACE, 2021, Section 4.6.5.1)

3.2.2.2 Cost to Carry Out the Alternatives

The current cost estimates for implementing Proposed MBSD Project Alternatives 2–6 range from approximately $1.7 billion to $2.8 billion (Table 3-5). As with Alternative 1, these costs include $90 million for the associated stewardship projects that would be implemented in recognition of the potential collateral injuries of the project. As noted earlier, the overall costs for the Proposed MBSD Project were reduced by leveraging $108,000,000 in funding for E&D from NFWF's GEBF.

Table 3-5. Cost to Carry Out Different Proposed MBSD Project Alternatives

Cost Category	Alternative 1 (75,000 cfs diversion)	Alternative 2 (50,000 cfs diversion)	Alternative 3 (150,000 cfs diversion)	Alternatives 4–6 (additional terracing costs)
Construction	$1,531,250,000	$1,391,160,000	$2,410,474,000	$1,500,000
Planning and design	$80,626,000	$80,626,000	$94,236,000	N/A
Services during construction	$55,626,000	$52,845,000	$80,658,000	N/A
Permitting	$9,419,000	$9,419,000	$11,324,000	N/A
Land acquisition	$268,318,000	$252,858,000	$268,418,000	N/A
Project monitoring	$16,560,000	$16,310,000	$18,810,000	N/A
CPRA design and management	$21,111,000	$20,285,000	$28,543,000	N/A
Leveraged funding	($108,000,000)	($108,000,000)	($108,000,000)	N/A
Total	$1,874,910,000	$1,716,503,000	$2,804,463,000	$1,500,000

Similar to Alternative 1, the efficiency of Alternatives 2–6 would be improved through implementation of the MAM Plan, and the Proposed MBSD Project would be compliant with Louisiana's CMAR model.

3.2.2.3 Meets Trustee Restoration Goals and Objectives

This section evaluates the extent to which Alternatives 2–6 of the Proposed MBSD Project would meet Trustee restoration goals and objectives. Similar to Alternative 1, Alternatives 2–6 of the Proposed MBSD Project are expected to meet the LA TIG's three specific goals for this project. This is because the Proposed MBSD Project was explicitly designed to meet these goals, and because the mechanisms through which the goals would be achieved are the same under all alternatives. However, the extent to which each alternative is projected to meet these goals is likely to vary for the different diversion capacities. Below, we discuss each goal, focusing on differences between Alternative 1 and the other alternatives.

A summary of the metrics for evaluating Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) vs. the LA TIG goals for the Proposed MBSD Project is provided in Table 3-6.

Table 3-6.
Metrics Demonstrating How Alternatives 1–6 of the Proposed MBSD Project Meet LA TIG Goals for this Project

Goals	Metrics for Evaluating Goals and Objectives	Alternative 1 (75,000 cfs diversion)	Alternative 2 (50,000 cfs diversion)	Alternative 3 (150,000 cfs diversion)	Alternatives 4–6 (diversion plus terraces)
1: Deliver freshwater, sediment, and nutrients	Total sediment load delivered by 2070[a]	280 MMT	200 MMT	520 MMT	(No difference from Alternatives 1 to 3)
2: Reconnect and re-establish sustainable deltaic processes	Maximum increase in land area in the Barataria Basin relative to the No-Action Alternative (2050)[b]	17,300 ac	12,600 ac	31,400 ac	Terraces change acres by 0 to 400 ac
	Projected increase in bed elevation, near the diversion, in 2050[c]	2.8 ft (0.9 m)	2.2 ft (0.7 m)	4.8 ft (1.5 m)	Reduced bed elevation (0.2 ft to 0.9 ft less)
3: Create, restore, and sustain wetlands and other deltaic habitats and associated ecosystem services	Area of different marsh habitat types in the Barataria Basin in 2050[d]	Fresh/ intermediate: 207,000 ac Brackish: 16,600 ac Saline: 10,400 ac	Fresh/ intermediate: 201,000 ac Brackish: 18,100 ac Saline: 11,100 ac	Fresh/ intermediate: 227,000 ac Brackish: 11,300 ac Saline: 10,000 ac	No change in total acres across capacities; small changes (< 5%) for acres of specific habitats

[a] Delft3D modeling runs.
[b] Source: USACE, 2021, Table 4.2-4.
[c] Source: USACE, 2021, Table 4.4-3.
[d] Source: USACE, 2021, Table 4.6-3.

3.2.2.3.1 Goal 1: Deliver Freshwater, Sediment, and Nutrients to the Barataria Basin through a Large-Scale Sediment Diversion from the Mississippi River

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would meet Goal 1 by delivering freshwater, sediment, and nutrients to the Barataria Basin. Because flows that would trigger the diversion opening above the base flow are the same for all capacities, the timing of the diversion opening is expected to be the same across all alternatives. The extent to which each alternative would meet this goal differs, however. Due to its lower capacity, Alternative 2 (50,000 cfs) would deliver less sediment (Table 3-6); and, conversely, the higher capacity of Alternative 3 (150,000 cfs) would deliver more sediment. Alternatives 4–6 (sediment diversion plus terracing) would not affect the amount of sediment delivered to the basin.

3.2.2.3.2 Goal 2: Reconnect and Re-Establish Sustainable Deltaic Processes between the Mississippi River and the Barataria Basin (e.g., sediment retention and accumulation, new delta formation)

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would meet Goal 2 by reconnecting and re-establishing sustainable deltaic processes between the Mississippi River and the Barataria Basin, as demonstrated by the projected formation of new deltaic landforms at the outlet of the diversion. All of the alternatives would also decrease water depth in other areas where sediment is deposited.

The extent to which each alternative would meet this goal differs. Due to its lower capacity and lower amount of sediment delivered, Alternative 2 (50,000 cfs) would create fewer acres of land in the Barataria Basin in 2050 (12,600 ac), compared to Alternative 1 (17,300 ac; Table 3-6). In contrast, Alternative 3 (150,000 cfs) would deliver more sediment and create more acres of land in the Barataria Basin in 2050 (31,400 ac; Table 3-6). For each capacity size, adding terraces under Alternatives 4–6 would result in a negligible change in total acres created.

Similarly, all of the alternatives are projected to raise bed elevations, but the extent of this increase varies according to capacity. For Alternative 2 (50,000 cfs), projected bed elevations near the diversion outfall area in 2050 would increase by 2.3 ft (0.7 m) compared to 3.0 ft (0.9 m) for Alternative 1 (75,000 cfs; Table 3-6). In comparison, for Alternative 3 (150,000 cfs), projected bed elevations near the diversion outfall area in 2050 would increase by 4.9 ft (1.5 m; USACE, 2021, Table 4.4-3). For Alternatives 4–6, the addition of terraces would result in smaller increases in bed elevation. For the 75,000 cfs and 150,000 cfs diversions, adding terraces would reduce bed elevations near the diversion outfall area by 1.0 foot (0.3 m; Table 3-6). For the 50,000 cfs diversion, adding terraces would reduce bed elevations near the diversion outfall area by 0.33 ft (0.1 m; Table 3-6).

3.2.2.3.3 Goal 3: Create, Restore, and Sustain Wetlands and Other Deltaic Habitats and Associated Ecosystem Services

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would meet Goal 3 by creating, restoring, and sustaining wetlands and other deltaic habitats and associated ecosystem services. The extent to which each alternative would meet this goal differs.

With a lower delivery of sediment and freshwater compared to Alternative 1 (75,000 cfs), Alternative 2 (50,000 cfs) would result in fewer fresh/intermediate wetland acres in the Barataria Basin in 2050 (201,000 ac for Alternative 2 vs. 207,000 ac for Alternative 1; Table 3-6). However, the area of brackish and saline habitats would be greater for Alternative 2 (50,000 cfs) than for Alternative 1 (75,000 cfs), with 1,500 more acres of brackish habitat and 700 more acres of saline habitat (Table 3-6). The larger area of brackish and saline habitats suggests that Alternative 2 would provide more diverse ecosystem services, benefiting species that prefer the brackish and saline habitat types. For example, Hollweg et al. (2020) found a higher density of nekton (fish and crustaceans) in brackish and saline habitats compared to intermediate marshes.

In contrast, Alternative 3 would result in greater fresh/intermediate acres in the Barataria Basin in 2050 [227,000 ac for Alternative 3 (150,000 cfs) vs. 207,000 ac for Alternative 1 (75,000 cfs), with a smaller area of brackish and saline habitats (Table 3-6)]. This suggests that Alternative 3 would provide less-diverse ecosystem services compared to Alternatives 1 and 2; however, the total productivity from Alternative 3 would likely be greater because of the larger total number of wetland acres. Increased productivity would increase ecosystem services associated with the productivity of water column resources and exports to offshore ecosystems (see Section 3.2.1.6).

Alternatives 4–6 (sediment diversion plus terracing) would result in very small changes in the acreage of specific habitat types. Alternative 4 would add habitat diversity to each of the capacity alternatives by creating additional habitat acreage of the terraces themselves. Marsh terraces generally have high densities of nekton (Hollweg et al., 2020).

3.2.2.4 Likelihood of Success

As with Alternative 1, the LA TIG considered the same three key factors when assessing the likelihood of success for Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) of the Proposed MBSD Project:

- The general efficacy of diversions in rebuilding marsh ecosystems.
- The extensive scientific and modeling efforts that have been undertaken since the 1990s to develop and refine the concept of a sediment diversion in the Barataria Basin.
- The implementation of the MAM Plan for the Proposed MBSD Project, which would inform progress toward this project’s objectives and support adaptive management of it.

As described below, Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) are very similar to Alternative 1 in terms of likelihood of success.

3.2.2.4.1 Efficacy of Diversions and Marsh Terracing in Rebuilding Marsh Ecosystems

Similar to Alternative 1, Alternatives 2–6 rely on a diversion to deliver sediment to wetlands to reverse rapid land loss. Intentional, engineered diversions have existed since the mid-1940s, and several examples (see Section 3.2.1.4.1) suggest that the Proposed MBSD Project should succeed in building and maintaining wetland habitat in a resilient and sustainable manner. Alternatives 4–6 include marsh terracing, which has been widely implemented since 1990 and is used at many sites in Louisiana to build and retain marsh areas (Castellanos and Aucoin, 2004; Hymel and Breaux, 2012; Wood et al., 2012), reduce fetch and the erosive action of waves (Thibodeaux and

Guidry, 2004), with benefits to nekton habitat (Rozas and Minello, 2001; Bush Thom et al., 2004; La Peyre et al., 2007; Rozas et al., 2007).

3.2.2.4.2 Extensive Investments in Developing and Vetting a Large-Scale Sediment Diversion in the Mid-Barataria Basin

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) rely on multiple scientific studies and cutting-edge technical models to understand the key river and estuarine dynamics that would be influenced by sediment diversion projects (CPRA, 2017). In addition to the studies cited under Alternative 1 (all of which are relevant under this analysis as well), several studies have also considered differences in designs and flow rates for diverting sediment, such as the *Mississippi River Sediment, Nutrient, and Freshwater Redistribution Study* (USACE, 2000), CWPPRA Project BA-33 (LCWCRTF, 2003), and Louisiana's CMP (CPRA, 2017; see Section 3.2.1.4.2 for more detail about these studies and models). These studies and models highlight the significant investments and level of effort to ensure that sediment diversion projects succeed. Additionally, LA TIG members have utilized or endorsed the use of marsh terraces (USACE, 2021, Section 2.5.1). The LA TIG believes that the use of sound engineering methods, combined with the scientific expertise available to the Proposed MBSD Project, would make all alternatives likely to succeed.

3.2.2.4.3 Implementation of the MBSD MAM Plan

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would include implementation of the MAM Plan (CPRA, 2020) to inform progress toward meeting the Proposed MBSD Project's objectives and to support adaptive management of this project. Therefore, the LA TIG believes that the use of the MAM Plan would increase the likelihood of success of any alternative implemented.

3.2.2.5 Avoids Collateral Injury

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would incorporate BMPs, environmental protection measures, and engineering specifications during construction and operation to avoid and minimize potential collateral injury. These actions would help reduce collateral injury that could result from construction-related habitat loss, habitat degradation and erosion, vehicle and vessel traffic, lights, noise, loss of habitat, and habitat degradation and erosion.

While the LA TIG would work to minimize collateral injury through the implementation of BMPs, Alternatives 2–6 are expected to cause collateral injuries that the LA TIG considered carefully in evaluating all alternatives and designating a Preferred Alternative. Because the alternatives represent a similar project in the same location and using the same mechanisms of benefit delivery, the nature of the collateral injuries that would potentially be incurred are expected to be qualitatively similar to those described for Alternative 1. However, in some cases, the magnitude, timing, or location of the potential injuries would be expected to vary among the alternatives.

More specifically, the magnitude of high-level injury is expected to increase with the capacity of the diversion [i.e., while diversion benefits are expected to be dependent on the diversion capacity (see Section 3.2.1.6), higher-diversion capacities would also deliver more freshwater to the basin, resulting in more collateral injury]. Below, we describe how the expected collateral injuries to resources under Alternatives 2–6 compare to those described for Alternative 1; this is discussed separately for resources with (1) low, (2) medium, and (3) high levels of expected injury to facilitate comparisons with Alternative 1.

3.2.2.5.1 Resources with a Low Level of Expected Collateral Injury

As with the OPA analysis provided for Alternative 1, the resources in this category align with those described in the DEIS as likely to experience no to negligible adverse impacts from Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing); or that would be affected only within or proximal to the footprint of the diversion complex (see the DEIS for more information; USACE, 2021). In general, the collateral injuries expected for this "low level" category from the implementation of Alternatives 2–6 are not notably different from those described for Alternative 1. However, for completeness, the LA TIG describes how the alternatives compare with respect to the low-level injuries discussed in Section 3.2.1.5.1 for Alternative 1:

- **Temporary habitat degradation associated with Proposed MBSD Project construction.** The Proposed MBSD Project effects on wildlife through displacement, stress, and direct mortality of individuals within or close to the diversion complex footprint are expected to be similar across all alternatives. However, the construction of Alternative 2 (50,000 cfs) is expected to take less time than Alternative 1 (75,000 cfs) because of its smaller size (USACE, 2021, Section 4.9.3.3). This would reduce the timeframe over which construction-related injuries would occur, likely reducing overall levels of this type of low-level injury. Conversely, the larger size of Alternative 3 (150,000 cfs) would mean longer construction times (by several months), a longer timeframe of construction-related injury, and thus relatively more of this low-level injury (USACE, 2021, Section 4.9.3.3). Alternatives 4–6 (sediment diversion plus terracing) would be associated with slightly more construction-related habitat degradation than the alternatives without terraces, due to the additional construction needed for terrace building.
- **Permanent habitat loss associated with the Proposed MBSD Project construction footprint.** For all alternatives, the overall Proposed MBSD Project footprint is expected to be similar. However, Alternative 2 (50,000 cfs) is expected to have a narrower intake channel, conveyance channel, and outfall transition feature than Alternative 1 (75,000 cfs); and thus would be expected to result in slightly less permanent habitat loss (USACE, 2021, Section 4.9.3.3). Conversely, Alternative 3 (150,000 cfs) would be larger and thus would likely lead to slightly more permanent habitat loss from construction (USACE, 2021, Section 4.9.3.3). Alternatives 4–6 (sediment diversion plus terracing) are expected to result in similar levels of construction-related collateral injuries as the alternatives without terracing.
- **Decreases in open-water areas.** Even though land creation varies across the Proposed MBSD Project alternatives, injuries to resources that depend on open-water areas (e.g., gadwall, other waterfowl) are expected to be similar across all alternatives (USACE, 2021, Section 4.9.4.3).
- **Ongoing disturbance from Proposed MBSD Project operations.** Alternatives 2–6 are expected to result in similar levels of low-level collateral injury associated with Proposed

MBSD Project operations as Alternative 1 (e.g., impeding the movement of wildlife up- and down-river along the west bank, operational lighting and noise-related disturbance, and exceedance of water temperatures thresholds during high-flow winter months within the lower basin and near the diversion outfall area) (USACE, 2021, Section 4.9.4.3).

- **Changes in recreational fishing opportunities.** Expected collateral injuries on recreational use, through minor effects on spotted seatrout, are similar across all alternatives for the Proposed MBSD Project (USACE, 2021, Section 4.10.4.5).

3.2.2.5.2 Resources with a Medium Level of Expected Collateral Injury

As with the corresponding section for Alternative 1 (see Section 3.2.1.5.2), the resources in this category align with those in the DEIS described as potentially experiencing minor-to-moderate adverse impacts from Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) (USACE, 2021); a more comprehensive discussion of these impacts can be found in Chapter 4 of the DEIS.

For each of the resources listed in this category of collateral injury under Alternative 1 (aquatic species other than brown shrimp and oysters, which are addressed in the next section; benthic resources; invasive species; recreational use; and wetland habitat in the birdfoot delta), the level of collateral injury is expected to be qualitatively similar across Alternatives 2–6 (USACE, 2021). While there are differences among alternatives in salinity, wetland and SAV habitats, temperature, and potential for entrainment, at a basinwide scale, these differences were not large enough to result in differences in collateral injuries for the resources in this category (USACE, 2021, Section 4.10.4.5). Potential collateral injuries falling into this medium category include:

- Spotted seatrout, through changes in salinity and disruption of larval and juvenile recruitment
- Pallid sturgeon, through noise during construction and entrainment through the diversion into unsuitable habitat in the Barataria Basin
- A range of aquatic species, potentially harmed by increases in HAB frequency or intensity
- The loss of benthic habitat due to construction, or benthic habitat degradation from turbidity near the outfall
- A range of aquatic species, potentially through increases in the presence and abundance of invasive species
- Recreational use losses, through temporarily reduced access near the diversion outfall area during Proposed MBSD Project construction, restricted access to some recreational sites from increased tidal flooding during operation, and sedimentation of some navigation canals used by recreational boaters
- Wetland habitat loss and related resource injuries in the birdfoot delta, through the diversion of sediment to the Barataria Basin that would otherwise settle in the birdfoot area.

3.2.2.5.3 Resources with a High Level of Expected Collateral Injury

As with the corresponding section for Alternative 1 (see Section 3.2.1.5.3), the resources in this category align with those in the DEIS as potentially experiencing major adverse impacts from Alternative 1 (USACE, 2021). While the mechanisms driving the collateral injuries that would potentially be incurred are the same under all Proposed MBSD Project alternatives, the magnitude and location of the injuries vary across them. Below, separate discussions of the influence of the alternatives on potential collateral injury are discussed for marine mammals, oysters, and brown shrimp. The associated stewardship actions described in Section 3.2.1.1.5 would also be implemented under Alternatives 2–6 in recognition of the collateral injury for this resource.

Marine Mammals

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would be expected to result in substantial collateral injury to BBES dolphins due to exposure to low salinity, but the magnitude of those impacts depends on the maximum flow rate of the diversion (USACE, 2021, Section 4.11).

Changes in the maximum and minimum salinity levels in areas that BBES dolphins utilize do not appear to be greatly influenced by either the variable flow or the presence of terraces (USACE, 2021, Section 4.11). However, overall, alternatives with higher maximum operational flow rates would result in longer periods of low salinity, while alternatives with lower maximum operational flow rates would result in shorter periods of low salinity. This leads to a relatively greater exposure of dolphins to lower salinities in the first decade of Proposed MBSD Project operation (Table 3-7). Even though differences among the alternatives are sometimes small, the projected exposure of BBES dolphins to low salinity is generally lowest under Alternative 2 (50,000 cfs), highest under Alternative 3 (150,000 cfs), and in-between these alternatives for Alternative 1 (75,000 cfs; Table 3-7).

Table 3-7.
Differences in Projected Duration (continuous days) of Low-Salinity Exposure (less than 5 ppt) for Simulated BBES Dolphin Populations among Alternatives 1, 2, and 3 and the No-Action Alternative in the First Decade of Diversion Operation [a]

Stratum	Alternative 1 (75,000 cfs) vs. No-Action Alternative (days)	Alternative 2 (50,000 cfs) vs. No-Action Alternative (days)	Alternative 3 (150,000 cfs) vs. No-Action Alternative (days)
Overall	38 (25 to 52)	31 (18 to 44)	67 (53 to 81)
Island	11 (7 to 15)	6 (4 to 8)	38 (28 to 48)
West	49 (21 to 79)	40 (10 to 73)	87 (59 to 117)
Central	72 (47 to 95)	60 (37 to 83)	107 (89 to 126)
Southeast	14 (-12 to 41)	13 (-14 to 40)	33 (5 to 61)

[a] Values are number of days in a given year in the first decade, with the 95% CI in parentheses (Garrison et al., 2020).

These differences in exposure translate to differences in projected survival rates, particularly under Alternative 3 (Table 3-8; Garrison et al., 2020). The projected mean annual survival rate for the simulated populations are lower under Alternatives 1–6 than the No-Action Alternative (USACE, 2021, Section 4.11.5.2). However, Alternative 3 (150,000 cfs), because of the larger amount of freshwater that would be sent through the diversion, would have a more marked negative effect on survival rates than Alternatives 1 and 2, mostly due to the drastic differences in projected survival in the Island stratum and differences in projected survival in the West and Central strata (Table 3-8). While there is uncertainty in these projected differences in mortality, the potential for Alternative 3 to reduce survival of the Island stratum by nearly 0.4 is particularly concerning for BBES dolphins, as this stratum has the highest density of all the strata. Alternatives 4–6 (sediment diversion plus terracing) are not expected to differ from non-terraced alternatives in terms of collateral injury to dolphins.

Table 3-8.
Differences in Projected Median Survival Rates due to Low-Salinity Exposure of Simulated BBES Dolphin Populations among Alternatives 1, 2, and 3 and the No-Action Alternative[a]

Stratum	Alternative 1 (75,000 cfs) vs. No-Action Alternative	Alternative 2 (50,000 cfs) vs. No-Action Alternative	Alternative 3 (150,000 cfs) vs. No-Action Alternative
Overall	-0.30 (-0.02 to -0.64)	-0.22 (0.00 to -0.49)	-0.54 (-0.17 to -0.82)
Island	-0.07 (0.00 to -0.40)	-0.02 (0.00 to -0.15)	-0.39 (-0.02 to -0.91)
West	-0.40 (-0.06 to -0.84)	-0.27 (-0.01 to -0.63)	-0.71 (-0.28 to -1.00)
Central	-0.57 (-0.14 to -0.88)	-0.45 (-0.07 to -0.78)	-0.79 (-0.38 to -0.99)
Southeast	-0.12 (0.21 to -0.48)	-0.09 (0.21 to -0.41)	-0.26 (0.13 to -0.64)

[a] Values are median survival rates in a given year in cycle 0 from bootstrap samples, with the 95% CI in parentheses (Garrison et al., 2020).
Source: USACE, 2021, Section 4.11.5.2.

Oysters

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would be expected to result in substantial collateral injury to oysters due to salinity-related decreases in habitat suitability (USACE, 2021; Figure 3-18). However, there are specific areas in the lower basin where projected levels of collateral injury to oysters differ due to their differential influences on salinity (Figure 3-19). More specifically, the lower flows of Alternative 2 (50,000 cfs) are projected to result in slightly better habitat for oysters, and thus slightly less collateral injury, in the lower basin than Alternative 1 (75,000 cfs) (Figure 3-19). Conversely, the higher flows of Alternative 3 (150,000 cfs) are expected to provide less-suitable habitat for oysters, and thus slightly more collateral injury in the lower basin (Figure 3-19). The reduction of available habitat in the lower basin would also likely hamper Trustee efforts to create new public seed grounds in that area via the stewardship actions described in Section 3.2.1.1.5. Alternatives 4–6 (sediment diversion plus terracing) are not expected to show different results from the non-terraced alternatives.

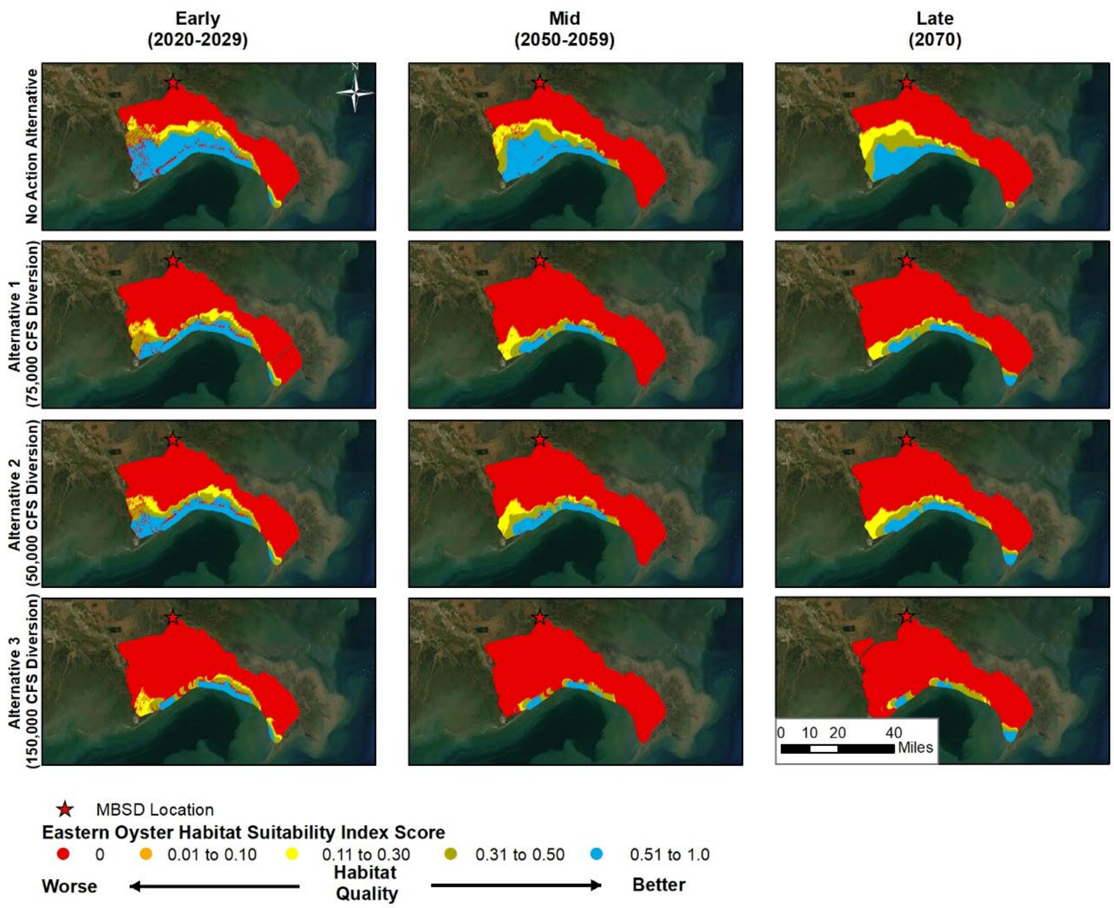


Figure 3-18. Habitat for Oysters is Projected to Be Substantially Lower under Alternatives 1, 2, and 3 Compared to the No-Action Alternative; and Basinwide Changes in Habitat Are Projected to Be Broadly Similar under All Alternatives. (Source: Delft3D modeling runs)

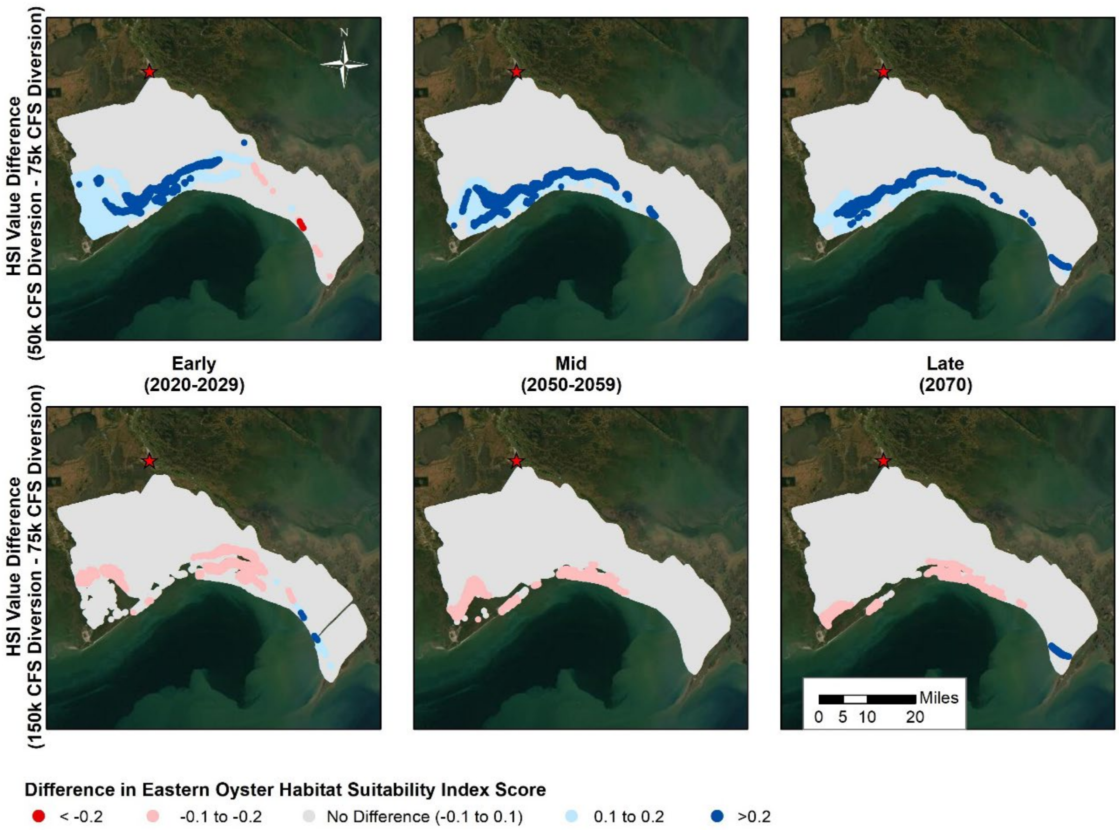


Figure 3-19. Differences in Habitat Suitability between Alternative 2 (50,000 cfs) and Alternative 1 (75,000 cfs) – Top Panel – and between Alternative 3 (150,000 cfs) and Alternative 1 (75,000 cfs) – Lower Panel. Habitat suitability for oysters is higher under Alternative 2 (50,000 cfs) than Alternative 1 (75,000 cfs), and lower under Alternative 3 (150,000 cfs) than Alternative 1 (75,000 cfs). (Source: Delft3D modeling runs)

Brown Shrimp

Similar to Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would be expected to result in substantial collateral injury to shrimp due to the disruption of larval transport and a reduction in suitable habitat due to reductions in salinity (USACE, 2021, Figure 3-20). While the habitat suitability of the overall basin is not projected to change substantially among the alternatives (Figure 3-20), analyses that examined shrimp habitat suitability at a finer geographic scale reveal that collateral injury to shrimp in some areas may vary across the alternatives. More specifically, analyses included in the DEIS examined how impacts on shrimp changed among different geographic areas ("polygons") in the basin (Figure 3-21). These data reveal that while near the diversion outfall area there were few differences among Proposed MBSD Project alternatives in potential injury to brown shrimp, shrimp in the lower basin would experience less injury under Alternative 2 (50,000 cfs) than Alternative 1 (75,000 cfs), and more injury under Alternative 3 (150,000 cfs) than Alternative 1 (75,000 cfs; Figure 3-22). It is important to note that even under the No-Action Alternative, habitat suitability for brown shrimp would decline substantially over time (Figure 3-20). Furthermore, near the diversion outfall area, all alternatives would reduce this baseline loss of shrimp habitat over time (Figure 3-15). Alternatives 4–6 (sediment diversion plus terracing) are not expected to show different results from the non-terraced alternatives.

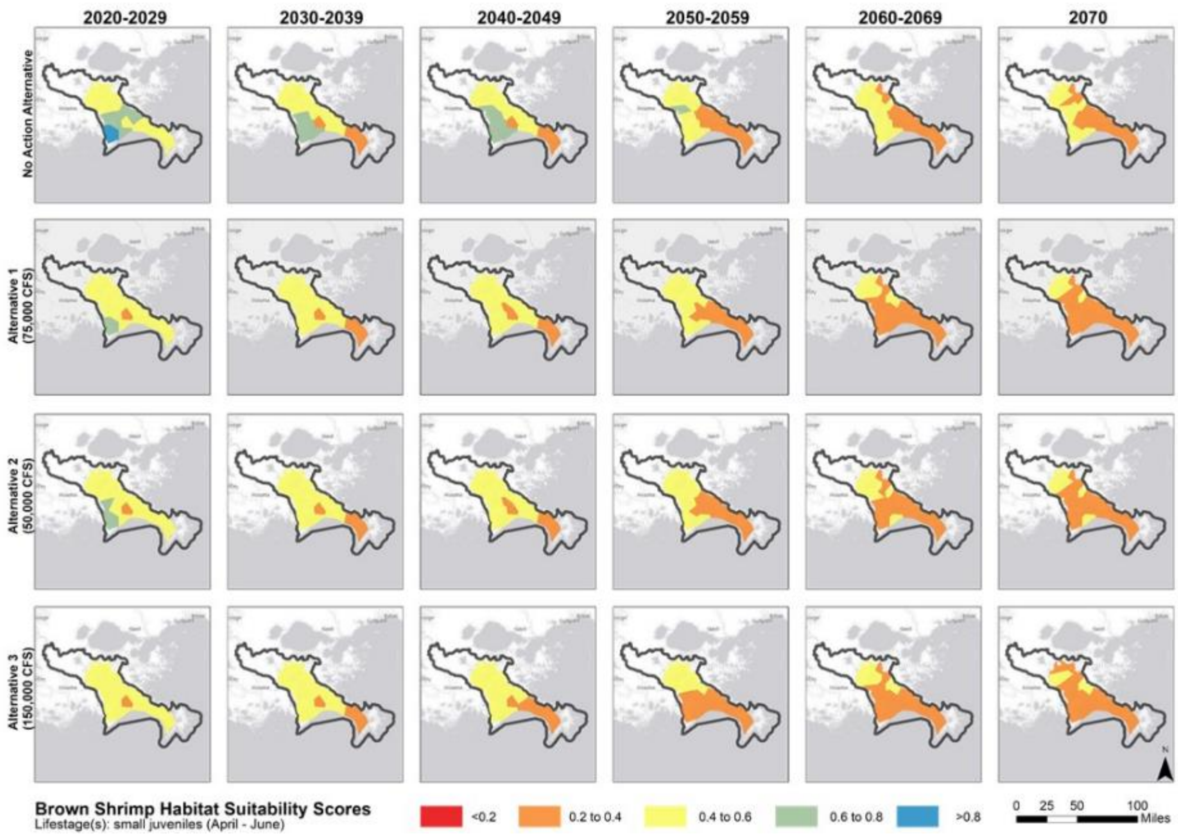


Figure 3-20. Overall Juvenile Brown Shrimp Habitat Suitability Is Projected to Be Substantially Lower under Alternatives 1, 2, and 3 Compared to the No-Action Alternative; and Basinwide Changes in Habitat Are Projected to Be Quite Similar under Alternatives 2–6. [Source: Delft3D modeling runs (USACE, 2021, Section 4.10.4.5)]

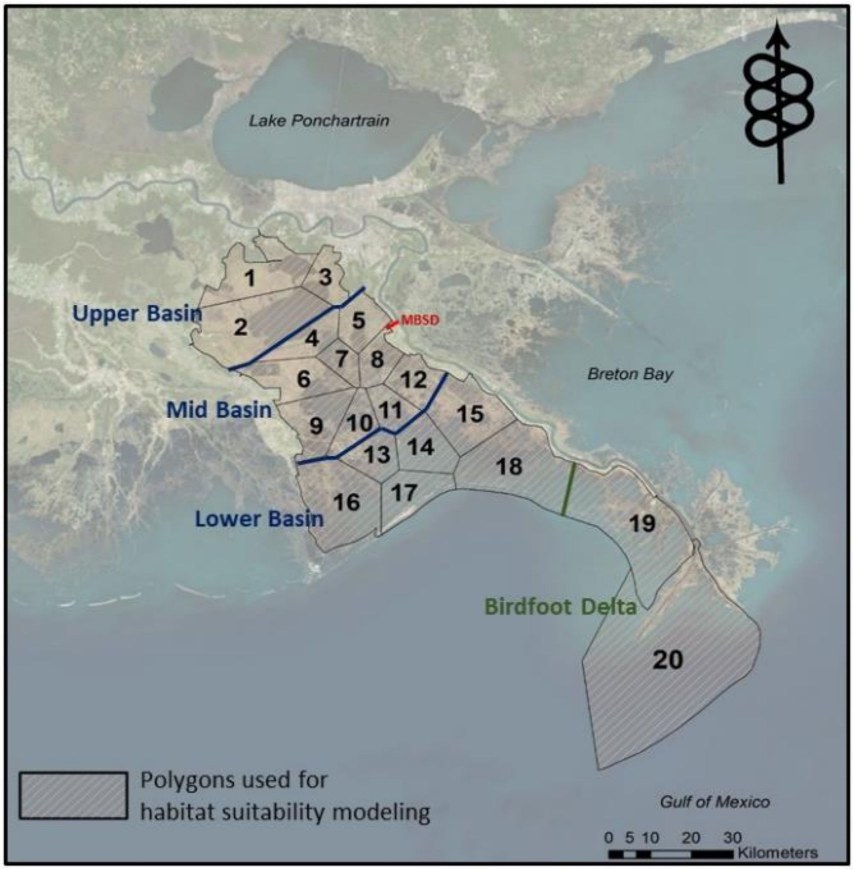


Figure 3-21. Geographic Areas ("polygons") Used for Spatial Analysis of Brown Shrimp Collateral Injuries.

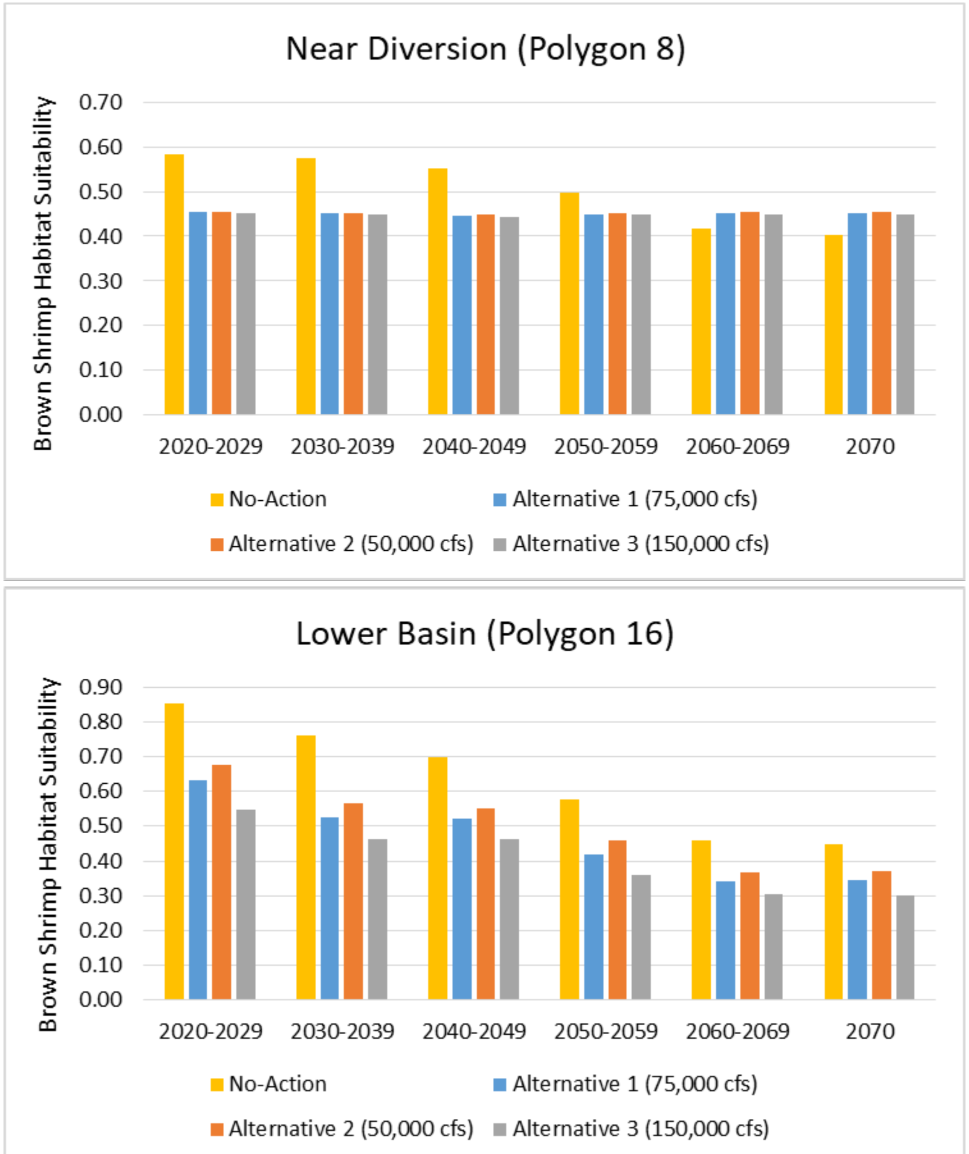


Figure 3-22. Near the Diversion (top panel), Habitat Suitability for Juvenile Brown Shrimp Is Projected to Be Similar under Alternatives 1, 2, and 3; However, in the Lower Basin (bottom panel), Habitat Suitability Is Highest under Alternative 2 (50,000 cfs), Intermediate under Alternative 1 (75,000 cfs), and Lowest under Alternative 3 (150,000 cfs). (Source: Delft3D modeling runs)

3.2.2.5.4 Synthesis of the Extent to Which Collateral Injury Is Avoided under Alternatives 2–6

As noted earlier, the Proposed MBSD Project is designed to provide ongoing inputs of freshwater, sediment, and nutrients to sustain and create marsh and other wetland habitats, which can then support resident and transient aquatic resources, as well as provide nursery habitat for open-water/nearshore species. These ongoing inputs of freshwater and sediment would necessarily change the current conditions of the Barataria Basin, and in some cases would result in collateral injuries to natural resources. For resources expected to experience low or medium levels of collateral injury, the expected collateral injuries under all Proposed MBSD Project alternatives would be the same. However, for resources expected to experience high levels of collateral injury, the timing and magnitude of the injury is expected to be dependent on the amount of freshwater being diverted by the Proposed MBSD Project [i.e., the least amount of collateral injury is expected from Alternative 2 (50,000 cfs), the most from Alternative 3 (150,000 cfs), and an intermediate level of injury from Alternative 1 (75,000 cfs)]. Terracing under Alternatives 4–6 is not expected to affect the magnitude of collateral injury.

The effects of each of these alternatives on non-trust resources, including socioeconomics, commercial fisheries, tourism, cultural resources, and environmental justice were examined in detail in the DEIS; see Sections 4.13, 4.14, 4.15, and 4.24 for more information.

3.2.2.6 Benefits Multiple Resources

This section evaluates the extent to which Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) of the Proposed MBSD Project would provide benefits to multiple resources. Similar to Alternative 1, Alternatives 2–6 are expected to benefit multiple resources in the Barataria Basin and the northern Gulf of Mexico. This is because the Proposed MBSD Project was explicitly designed to achieve multiple benefits, and because the mechanisms through which benefits would accrue would be the same under all alternatives. As with Alternative 1, Alternatives 2–6 would result in substantial benefits to nearshore marine ecosystems, water column resources (including fish and invertebrates), birds, and terrestrial wildlife (see Figure 3-11). However, the benefits of each alternative are expected to be dependent on the capacity of the diversion (i.e., because higher-diversion capacities create more habitat, more benefits are likely to result). Below we discuss benefits to the major resource categories noted above, focusing on differences between Alternative 1 and the other alternatives.

3.2.2.6.1 Benefits to Nearshore Marine Ecosystems

Similar to Alternative 1, Alternatives 2–6 would provide substantial benefits to nearshore marine ecosystems in the Barataria Basin (Figure 3-11).[33] These other alternatives would, similar to Alternative 1, deliver large amounts of sediment into the Barataria Basin, supporting the formation of land and the creation and maintenance of a variety of ecosystem types (including shallow, subaqueous habitats).

While the nature of the benefits, and the mechanisms that drive them, are not expected to differ between Alternative 1 and Alternatives 2–6, the magnitude of the benefits accrued would differ. For example, due to its lower capacity, Alternative 2 (50,000 cfs) is expected to create and sustain less emergent mudflat and marsh habitat than Alternative 1 (75,000 cfs; see Table 3-9). Conversely, the higher capacity of Alternative 3 (150,000 cfs) is expected to create and sustain more habitat than Alternative 1 (75,000 cfs; Table 3-9). As noted in the Proposed MBSD Project descriptions in Section 3.2.2 above, Alternatives 4–6 (sediment diversion plus terracing) are not expected to create notable amounts of additional marsh habitat in the Barataria Basin, irrespective of the capacity of the diversion (USACE, 2021).

[33] All habitats mentioned in this section are expected to experience a “high” level of benefit, which aligns with resources described in the DEIS that are expected to experience major benefits from Alternatives 2 to 4.

Table 3-9.
Benefits to Nearshore Ecosystems Vary with Diversion Capacity – the Most Benefits over the No-Action Alternative Are Achieved under Alternative 3 (150,000 cfs) and the Least under Alternative 2 (50,000 cfs)

Metric[a]	Alternative 1 (75,000 cfs)	Alternative 2 (50,000 cfs)	Alternative 3 (150,000 cfs)
Increase in emergent mudflats and marsh habitat (acres)	13,400	9,660	29,200
Freshwater/intermediate, brackish, and saline habitats in 2070 (acres)	77,700 (freshwater/ intermediate) 1,710 (brackish) 6,050 (saline)	74,100 (freshwater/ intermediate) 1,810 (brackish) 6,080 (saline)	93,600 (freshwater/ intermediate) 793 (brackish) 4,170 (saline)

[a] All metrics are for the year 2070.
Source: USACE, 2021, Table 4.6-3.

The relative cover of different marsh types is also expected to change among Alternatives 1, 2, and 3 (Table 3-9, Figure 3-23). For example, while both Alternatives 1 and 2 sustain all three types of wetlands in 2070 to a similar extent, the amount of saline and brackish wetland habitat retained is lowest under Alternative 3 due its higher inputs of freshwater (Table 3-9, Figure 3-23). As under Alternative 1, retaining this diversity of habitat types helps support a wide array of resources and ecosystem services in the Barataria Basin.

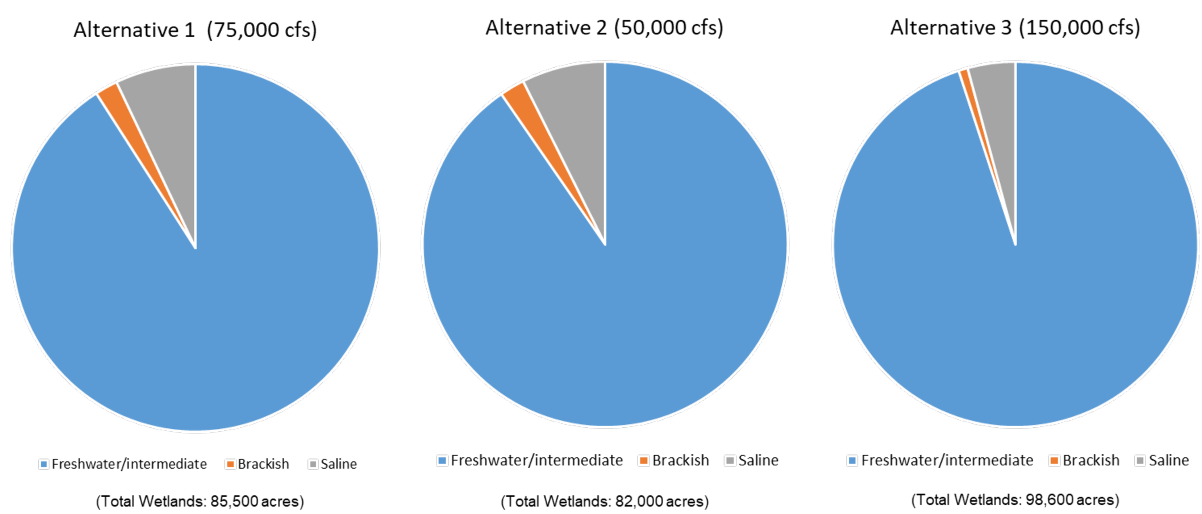


Figure 3-23. All Alternatives Are Projected to Sustain a Diversity of Marsh Habitat Types by 2070, but the Amount of Brackish and Saline Habitat Retained is Lowest under Alternative 3. (Source: USACE, 2021, Table 4.6-3)

While the Proposed MBSD Project alternatives are expected to have varying effects on salt marsh habitat in the basin, Alternatives 1–3 are expected to have similar effects on SAV. Neither Alternative 2 (50,000 cfs) nor Alternative 3 (150,000 cfs) appears to have a consistent or sufficiently large influence on salinities, compared to Alternative 1 (75,000 cfs), to create clear differences in SAV habitat supported. While the turbidity and rapid changes in salinity associated with the diversion could result in early die-offs of species intolerant of the new salinity regime, this is expected to be more than offset by the beneficial impacts in the overall coverage and biomass of SAV in the basin once the salinity regimes stabilize (USACE, 2021).

The effects of Alternatives 4–6 (sediment diversion plus terracing) on SAV are expected to be positive. While terracing was not found to directly affect salinities in the Barataria Basin (a key driver of SAV habitat), terraces are believed to create conditions favorable to more SAV cover when compared to the non-terraced alternatives (USACE, 2021). Field studies have found that marsh terraces in Louisiana promote the occurrence of SAV and increased SAV biomass compared to unterraced shallow marsh ponds (Cannaday, 2006; Brasher, 2015). Terracing reduces fetch across the water surface, resulting in reduced wave action, erosion, and turbidity, and therefore greater opportunities for SAV establishment. Terraced ponds had more than three times the biomass of SAV compared to unterraced ponds in one study (Cannaday, 2006). Others have found that terracing improves habitat for fisheries and waterbirds (Rozas et al., 2005; O'Connell and Nyman, 2011). La Peyre et al. (2007) attributed greater numbers of marsh and SAV-oriented nekton species in terraced sites, due in part to the greater SAV biomass found in terraced ponds, and the increased marsh habitat created by the terraces themselves. Therefore, each terracing alternative would result in small, additional benefits to SAV and associated nekton.

Similar to Alternative 1, these benefits under Alternatives 2–6 to nearshore marine ecosystems would further provide benefits to water column resources, birds and terrestrial wildlife, and offshore marine ecosystems (see below).

3.2.2.6.2 Benefits to Water Column Resources

As with Alternative 1 (75,000 cfs), Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) are expected to provide important benefits to water column resources through the creation and maintenance of critical nearshore marine habitats that are described above (see Figure 3-11). As previously noted, these habitats are critical for a wide variety of water column resources, including invertebrates and fish, which use nearshore habitats for foraging, refugia from predators, resting places during migration, and reproduction.

Because the alternatives are similar in the types of benefits they provide to nearshore marine ecosystems, the types of benefits to the fish species analyzed in the DEIS are also expected to be similar under all alternatives. The large drivers of benefits for key fish species in the Barataria Basin include changes in salinity, temperature, marsh and SAV coverage, and water flow and tidal transport (USACE, 2021, Section 4.10.4.5). Basinwide, Alternatives 1–6 do not drastically differ in terms of changes in salinity or temperatures, though they do differ in their impacts on salinity at smaller scales (i.e., areas closer to the diversion vs. areas in the lower basin) (USACE, 2021, Section 4.10.4.5). As noted above, SAV coverage is also expected to be similar across the alternatives, with higher SAV coverage for Alternatives 4–6.

However, as noted above, there would be changes in the amount of marsh habitat created through the different alternatives, which may affect water column resources. For example, the higher amount of wetland habitat created under Alternative 3 (150,000 cfs) would likely benefit species that use wetland habitat. However, the additional wetlands are expected to be created close to the diversion outfall area, restricting these benefits to a relatively small portion of the basin (USACE, 2021, Section 4.10.4.5). There would also be differences in water flow and velocity among the alternatives that may affect larval transport during high-flow periods; however, these effects are not expected to affect the overall level of benefits expected from the Proposed MBSD Project. In fact, the influence of the different alternatives on habitat suitability within the Barataria Basin was examined in detail in the DEIS for blue crab and largemouth bass for six specific polygons in the basin (i.e., 8–12 and 16; see Figure 3-21), and only minor differences were projected among all the alternatives (USACE, 2021, Section 4.10.4.5). While the differences among alternatives are minor, the habitat suitability data suggest that Alternative 2 would provide the least benefit to these species, Alternative 3 would provide the most benefit, with Alternative 1 falling in-between these alternatives.

3.2.2.6.3 Benefits to Birds and Terrestrial Wildlife

Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would provide similar benefits to birds and terrestrial wildlife as Alternative 1 (75,000 cfs), as they would be able to utilize the additional wetland, mudflat, and SAV habitats created and maintained for foraging, reproducing, or refueling during migration (see Figure 3-21). However, due to the differences in habitats created by the different alternatives, benefits are expected to differ somewhat. For example, habitat benefits for green-winged teals, mottled ducks, and alligators would be slightly less pronounced under Alternative 2 (50,000 cfs) than under Alternative 1 (75,000 cfs), and slightly more pronounced under Alternative 3 (150,000 cfs); no differences in habitat suitability for the gadwall are projected under these alternatives (USACE, 2021, Section 4.9.4.3). The incremental increases in SAV under Alternatives 4–6 (sediment diversion plus terracing) are not expected to provide substantially more benefits to birds and terrestrial wildlife.

3.2.2.6.4 Benefits to Offshore Ecosystems

Benefits to offshore ecosystems would be expected to materialize under all Proposed MBSD Project alternatives, mediated through the benefits to water column resources (see Figure 3-11). While these impacts on offshore systems have not been modeled or quantified, they would be expected to be dependent on the benefits to water column resources that each alternative provides [i.e., Alternative 3 (150,000 cfs) would likely provide the most benefits and Alternative 2 (50,000 cfs) the least, with benefits from Alternative 1 (75,000 cfs) falling somewhere in-between]. Terracing under Alternatives 4–6 is not expected to affect the magnitude of offshore benefits.

3.2.2.7 Public Health and Safety

This section evaluates the extent to which Alternatives 2 (50,000 cfs), 3 (150,000 cfs), and 4–6 (sediment diversion plus terracing) would beneficially or adversely affect public health and safety. Similar to Alternative 1 (75,000 cfs), Alternatives 2–6 are expected to provide some public health and safety benefits to more highly populated areas north of the diversion, while adversely affecting smaller communities Gulfward of the diversion that fall outside of the federal levee system. These impacts would be most pronounced within areas nearest to the diversion outfall area and in the initial decades of the diversion's operation.

3.2.2.7.1 Changes in Storm Hazards

Alternative 2 (50,000 cfs) is projected to result in a smaller magnitude and spatial extent of bathymetry change, and a smaller acreage of created and maintained wetlands than Alternative 1 (75,000 cfs); whereas Alternative 3 (150,000 cfs) is projected to result in a larger magnitude and spatial extent of bathymetry change, and a larger acreage of created and maintained wetlands than Alternative 1 (75,000 cfs). Modeling of storm surges and wave height projects differences of approximately 0.5 ft in maximum storm surge elevation or wave height between the alternatives. At the end of the 50-year analysis period, the projected difference in maximum surge elevation for Alternatives 2 (50,000 cfs) and 3 (150,000 cfs) is +/- 0.5 ft from Alternative 1 (75,000 cfs), with a slightly lower surge elevation projected north or inland of the diversion, and a slightly higher elevation south of the diversion (USACE, 2021, Section 4.20). A similar difference in maximum wave height is also expected (USACE, 2021, Section 4.20). Differences in surge elevation and wave height of +/- 0.5 ft are not expected to result in a noticeable difference in public health and safety across the alternatives. As the addition of terrace features in Alternatives 4–6 is expected to have a negligible impact on storm surge or wave-induced flooding (USACE, 2021, Section 4.20), the storm-related impacts on public health and safety are expected to be similar for Alternatives 1–6.

3.2.2.7.2 Changes in Tidal Inundation

Compared to Alternative 1 (75,000 cfs), the number of days of tidal inundation would be lower under Alternative 2 (50,000 cfs), but higher under Alternative 3 (150,000 cfs) during the first two decades of diversion operation (USACE, 2021, Section 4.20). These differences would diminish over time, with negligible differences among the alternatives by 2060 because of the influence of sea level rise and subsidence. The locations that would be affected by the increases in tidal inundation (i.e., communities within approximately 10 mi north and 20 mi south of the diversion outfall area) would be similar under all of the alternatives. Similar to Alternative 1, these periodic inundation events would not be expected to cause damages to existing residential and non-residential structures since most of these structures are already elevated. However, damages may occur to roads and other infrastructure, which could have indirect negative impacts on public health and safety. Within the federal levee systems, communities would be subject to the same increased pumping demands under Alternatives 1–6 and the No-Action Alternative (USACE, 2021, Section 4.20). Terracing under Alternatives 4–6 is not expected to affect tidal inundation.

3.2.3 No-Action Alternative

As noted in Section 1.6, pursuant to the OPA NRDA regulations, the Final PDARP/PEIS considered a No-Action 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 NRDA Trustees, 2016a, page 5-92). The loss of deltaic processes in the Barataria Basin has resulted in a steady decline in the health of natural resources, which is indicated by metrics such as decreased plant health, high rates of erosion, and increases in salinity (Mckee et al., 2004; Alber et al., 2008; Wilson and Allison, 2008; Couvillion et al., 2011; Silliman et al., 2012, 2016; Khanna et al., 2013;

McClenachan et al., 2013; Zengel et al., 2014, 2015; Rangoonwala et al., 2016; Turner et al., 2016; Beland et al., 2017). Further, the coastal habitats of the northern Gulf of Mexico support resources throughout the Gulf (Gunter, 1967; Nixon, 1980; Boesch and Turner, 1984; Baltz et al., 1993; Houde and Rutherford, 1993; Rogers et al., 1993; Deegan et al., 2002). Under the No-Action Alternative, the ongoing coastal land loss in the Barataria Basin would be expected to continue. The submergence of wetlands in coastal Louisiana has been measured to be one of the highest rates worldwide – approximately 45 square kilometers per year (Couvillion et al., 2011). In the absence of intervention, such as the Proposed MBSD Project, coastal land loss in the Barataria Basin, which totaled approximately 432 square miles for the 1932–2016 period and is the second greatest among the 10 Louisiana coastal basins, would continue and/or increase (Couvillion et al., 2017).

Due to this extensive land loss, Louisiana faces increased and widespread storm damage and storm-related economic disruptions, with associated direct and indirect impacts on public health and safety. Barnes and Virgets (2018) estimated the potential economic damage if a major storm were to hit the Louisiana coast in the next 25 or 50 years. Due to the future expected loss in wetlands that currently serve as a buffer zone to the New Orleans area, damages are estimated to be much higher than they were in 2005. Under these two scenarios (storms in 25 and 50 years), total replacement costs[34] range from $5.5 billion to $129.6 billion.[35] Most of this impact would occur in the New Orleans region (including Plaquemines and Jefferson parishes), with up to $26 billion in lost economic output from business disruptions (2015$; Barnes and Virgets, 2018).[36]

Given that technically feasible restoration approaches are available to compensate for interim natural resource and service losses from the Incident, the DWH NRDA Trustees rejected this alternative from further OPA evaluation in the Final PDARP/PEIS (DWH NRDA Trustees, 2016a). Based on this determination and incorporating that analysis by reference, the LA TIG did not fully evaluate the No-Action Alternative as a viable alternative under OPA.

3.2.4 Overall OPA Evaluation Conclusions

The LA TIG reviewed the evaluation of all alternatives under the set of OPA NRDA evaluation criteria. A summary of this evaluation is found in Figure 3-24, which synthesizes key metrics for each criterion to enable comparison across Proposed MBSD Project alternatives. A discussion of the conclusions of the OPA evaluation is found below, followed by the LA TIG's rationale for selecting a Preferred Alternative.

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[34] Total replacement costs represent the cost to replace the physical assets (i.e., residential and business properties) that are expected to be damaged in a storm event.

[35] The large increase in damages between the 25- and 50-year scenarios is due to the modeled failure of levees in the City of New Orleans (Barnes and Virgets, 2018).

[36] The study measured the increase in storm damage in a future without action for three storm scenarios to characterize the potential economic risks facing coastal Louisiana. The storms include an eastern-track storm with a path similar to Hurricane Katrina; a western-track storm with a path similar to Hurricane Rita; and a 100-year storm, which indicates the level of flooding across the coast that would be expected only once every 100 years. The figures reported represent the worst-case impacts of the three types of events.

3.2.4.1 Cost to Carry Out the Alternative

Based on the analysis presented in this Draft RP, the LA TIG anticipates that all alternatives would have an acceptable level of cost, particularly given the substantial benefits that the Proposed MBSD Project would provide (see Sections 3.2.1.6 and 3.2.2.6). In addition, the implementation of a robust MAM Plan for the Proposed MBSD Project would help inform progress toward meeting the project's objectives and support its adaptive management. Finally, using the CMAR technique would improve the quality and constructability of any alternative, reduce overall risk, and allow for scope revision during the design phase to meet the alternative's budget, purpose, and need.

In comparing alternatives to each other, the range of estimated costs varied from a low of about $1.7 billion for Alternative 2 (50,000 cfs) to a high of about $2.8 billion for Alternative 6 (150,000 cfs plus terracing). Compared to the estimated cost for Alternative 1 of about $2.0 billion, the other alternatives varied by approximately 60%.

3.2.4.2 Meets Trustee Restoration Goals and Objectives

The LA TIG found that all of the alternatives would meet the Proposed MBSD Project-specific goals and objectives. All of the alternatives would:

- Deliver freshwater, sediment, and nutrients to the Barataria Basin through a large-scale sediment diversion from the Mississippi River.
- Reconnect and re-establish sustainable deltaic processes between the Mississippi River and the Barataria Basin (e.g., sediment retention and accumulation, new delta formation).
- Create, restore, and sustain wetlands and other deltaic habitats and associated ecosystem services.

In comparing the alternatives to each other, the LA TIG looked at multiple metrics including sediment load delivered, land created, increases in bed elevation, and area of different marsh habitat types (see Table 3-6).

- Compared to Alternative 1 (75,000 cfs), for the metrics relevant to Goals 1 and 2, Alternative 2 (50,000 cfs) would provide 72% of the sediment load (202 MMT vs. 281 MMT), 73% of the land acreage in 2050 (12,600 ac vs. 17,300 ac), and 77% of the bed elevation gain near the diversion outfall area (2.3 ft vs. 3.0 ft). For the metrics relevant to Goal 3 (total area of different marsh habitat types in the Barataria Basin in 2050), Alternative 2 would provide 97% of the fresh/intermediate habitat (201,000 ac vs. 207,000 ac), 109% of the brackish habitat (18,100 ac vs. 16,600 ac), and 107% of the saline habitat (11,100 ac vs. 10,400 ac). Overall, Alternative 2 (50,000 cfs) meets Goals 1 and 2 to a lesser extent than Alternative 1 (75,000 cfs), but provides some increase in brackish and saline habitats compared to Alternative 1, which would benefit the ecosystem services associated with those habitat types.
- Compared to Alternative 1 (75,000 cfs), for the metrics relevant to Goals 1 and 2, Alternative 3 (150,000 cfs) would provide 186% of the sediment load (523 MMT vs. 281 MMT), 182% of the land acreage in 2050 (31,400 ac vs. 17,300 ac), and 163% of the bed elevation gain near the diversion outfall area (4.9 ft vs. 3.0 ft). For the metrics relevant to Goal 3 (total area of different marsh habitat types in the Barataria Basin in 2050),

Alternative 3 (150,000 cfs) would provide 110% of the fresh/intermediate habitat (227,000 ac vs. 207,000 ac), 68% of the brackish habitat (11,300 ac vs. 16,600 ac), and 96% of the saline habitat (10,000 ac vs. 10,400 ac). Overall, Alternative 3 meets Goals 1 and 2 to a greater extent than Alternative 1, but results in decreases in brackish and saline habitats compared to Alternative 1.

- Alternatives 4–6 do not affect the total sediment load delivered and have a minimal effect on the number of acres created (the maximum difference for an alternative with vs. without a terrace is 300 ac). Terraces result in smaller increases in bed elevation near the diversion outfall area (0.33–0.98 ft less), and in no change in total marsh habitat acreage in the Barataria Basin in 2050. Overall, Alternatives 4–6 do not substantially change the extent to which the corresponding alternatives with similar capacity and without terraces meet the Proposed MBSD Project's goals and objectives.

3.2.4.3 Likelihood of Success

The LA TIG found that all of the alternatives would be likely to succeed, based on an analysis of the general efficacy of sediment diversions in rebuilding marsh ecosystems (as seen with examples from both natural and engineered diversions of river flow into shallow basins); the extensive scientific and modeling efforts that have been undertaken since the 1990s to develop and refine the concept of a sediment diversion in the Barataria Basin; and the implementation of the MAM Plan for the Proposed MBSD Project, which would help adaptively manage this project over time. The LA TIG did not find evidence to suggest that any one of the alternatives would be less likely to succeed than another. Therefore, this criterion did not differentiate among the alternatives.

3.2.4.4 Avoids Collateral Injury

The LA TIG notes that all of the alternatives would incorporate BMPs, environmental protection measures, and engineering specifications during construction and operation to avoid and minimize potential collateral injury. These actions would help reduce collateral injury that could result from construction-related habitat loss, habitat degradation and erosion, vehicle and vessel traffic, lights, noise, loss of habitat, and habitat degradation and erosion.

The LA TIG also notes that all of the alternatives would result in some collateral injury to different resources – at "low," "medium," or "high" levels – depending on the resource. In general, the magnitude of high-level injury would increase with the capacity of the diversion [i.e., while the larger-capacity diversions would create more benefits by diverting more sediment and nutrients to the basin (see Section 3.2.4.5), the higher amounts of freshwater that are needed to deliver this sediment would result a greater degree of collateral injury]. In comparing the alternatives to each other, the LA TIG focused on the "high level" of potential collateral injuries because collateral injuries in the "low-level" and "medium-level" categories were not notably different across the alternatives (see Section 3.2.2.5).

For the "high level" of potential collateral injury, the LA TIG examined differences across alternatives for brown shrimp, oysters, and marine mammals.

- Compared to Alternative 1 (75,000 cfs), Alternative 2 (50,000 cfs) would result in less collateral injury for dolphins primarily because of less exposure to lower salinities, resulting in better survival rates compared to Alternative 1 (75,000 cfs). Specifically, compared to the No-Action Alternative, Alternative 2 would reduce the overall median annual survival rate by 0.22 under the representative hydrograph, while Alternative 1 would reduce the overall median survival rate by 0.30 (Table 3-8). Similarly, Alternative 2 (50,000 cfs) would result in less collateral injury for shrimp and oysters in the lower basin because of lower freshwater flows and higher salinities (see Figure 3-22 and Figure 3-19).

- Compared to Alternative 1 (75,000 cfs), Alternative 3 would result in greater collateral injury for dolphins because of relatively greater exposure to lower salinities, which decreases projected annual survival rates. Of particular concern is the potential for Alternative 3 to substantially reduce the median survival rate of the Island stratum, the stratum with the highest dolphin density (i.e., by 0.39 compared to the No-Action Alternative; Table 3-8). In comparison, under the representative (i.e., average) hydrograph, Alternative 1 (75,000 cfs) would reduce the annual survival rate of the Island stratum by only 0.07 (Table 3-8). Similarly, Alternative 3 (150,000 cfs) would result in greater collateral injury for brown shrimp and oysters in the lower basin because of higher freshwater flows and lower salinities (see Figure 3-22 for brown shrimp and Figure 3-19 for oysters). The reduction of available oyster habitat in the lower basin under Alternative 3 would also likely hamper Trustee efforts to create new public seed grounds in that area via the stewardship actions described in Section 3.2.1.1.5.
- Collateral injuries under Alternatives 4–6 (diversion plus terracing) are not expected to be different from the non-terraced alternatives because the “high level” of injury is tied to salinities in the basin and the terraces do not affect overall salinity levels.

3.2.4.5 Benefits Multiple Resources

Based on the analysis presented in this Draft RP, the LA TIG anticipates that all of the alternatives would benefit multiple resources in the Barataria Basin and the northern Gulf of Mexico, including providing benefits for nearshore marine ecosystems, water column resources (including fish and invertebrates), birds, and terrestrial wildlife. However, the benefits of each alternative would be expected to be dependent on the capacity of the diversion (i.e., because higher-diversion capacities create more habitat, more benefits are likely to result).

- Compared to Alternative 1 (75,000 cfs), Alternative 2 (50,000 cfs) is expected to provide similar benefits to nearshore marine ecosystems but with a lower magnitude of benefit because of less habitat created. In addition, Alternative 2 would result in decreased suitability for species that benefit from more freshwater marshes, such as green-winged teals, mottled ducks, and alligators.
- Compared to Alternative 1 (75,000 cfs), Alternative 3 (150,000 cfs) is expected to provide similar benefits to nearshore marine ecosystems but with an increased magnitude of benefit because of more habitat created. In addition, Alternative 3 would result in increased suitability for species that benefit from more freshwater marshes, such as green-winged teals, mottled ducks, and alligators.
- Alternatives 4–6 (diversion plus terracing) are expected to provide similar benefits to the non-terraced alternatives, with the exception that terraces are expected to create conditions favorable to more SAV cover when compared to the non-terraced alternatives

(USACE, 2021), and to result in associated increased benefits to the fish and crustaceans that preferentially use SAV habitat.

3.2.4.6 Public Health and Safety

Based on the analysis presented in this Draft RP, the LA TIG anticipates that all of the alternatives would provide public health and safety benefits to the populated areas north of the diversion, while adversely affecting communities Gulfward of the diversion that fall outside of the federal levee system. Increased wetland acreage has a positive benefit for public safety by decreasing surge elevation and wave height, while higher-diversion flows tend to increase the magnitude and frequency of tidal inundation for areas outside of the federal levee system.

- Compared to Alternative 1 (75,000 cfs), Alternative 2 (50,000 cfs) would result in a smaller magnitude and spatial extent of bathymetry change, and a smaller acreage of created and maintained wetlands than Alternative 1. However, there are minimal differences in storm surge or wave height between these two alternatives. Alternative 2 would increase water levels less than Alternative 1, which would result in decreased flooding inundation frequency compared to Alternative 1, better protecting public health and safety, and reducing damages to roads and other infrastructure. As the driver for tidal inundation shifts from the Proposed MBSD Project to sea level rise over time, the relative benefits of Alternative 2 would decrease over time.
- Compared to Alternative 1 (75,000 cfs), Alternative 3 (150,000 cfs) would result in a greater magnitude and spatial extent of bathymetry change, and a greater acreage of created and maintained wetlands than Alternative 1 (USACE, 2021). However, the projected difference in storm surge or wave height between Alternatives 3 and 1 is slight (< 0.5 ft), and only is present in localized areas. Alternative 3 would increase water levels more than Alternative 1 in the first two decades of diversion operation, which results in projections of increased flooding inundation frequency compared to Alternative 1 (USACE, 2021), negatively affecting public health and safety, and increasing damage to roads and other infrastructure.
- Alternatives 4–6 are expected to have a negligible impact on storm surge and wave-associated flooding, and on tidal inundation compared to the comparable non-terraced alternatives.

3.2.4.7 Identification of a Preferred Alternative

The LA TIG completed the OPA evaluation of the reasonable range of alternatives, and strove to identify an alternative that would provide the right balance in terms of being cost-appropriate, meeting Trustee goals, having a high likelihood of success, avoiding collateral injury, benefiting multiple resources, and protecting public health and safety. While the LA TIG concluded that all alternatives sufficiently satisfied each OPA criterion, there were clear tradeoffs among the alternatives in terms of likely benefits achieved and risks related to collateral injury and public health and safety (see Figure 3-24; i.e., increasing the capacity of the diversion is likely to yield more benefits to natural resources but also incur more collateral injury and reduce public safety). Given these tradeoffs, the LA TIG proposes Alternative 1 as the Preferred Alternative. The following bullets explain in more detail the LA TIG's reasoning behind the identification of Alternative 1 as preferred (and the exclusion of the other alternatives):

- Alternative 1 (75,000 cfs) is preferred because it was most favorably evaluated when integrating across all of the OPA NRDA evaluation criteria (see Figure 3-24). The LA TIG anticipates that Alternative 1 would meet the Proposed MBSD Project's goals and objectives – creating marsh and shallow-water habitats that provide ecosystem-level benefits to nearshore marine ecosystems, water column resources (including fish and invertebrates), birds, and terrestrial wildlife that were injured in the Incident (Figure 3-24). Alternative 1 balances meeting LA TIG goals and objectives for the Proposed MBSD Project, while reducing the extent of collateral injury to resources, such as brown shrimp, oysters, and dolphins, compared to larger-capacity alternatives. Given the necessary tradeoffs between benefits and collateral injury, the LA TIG found that Alternative 1 strikes the best balance between providing benefits that restore natural resources and reducing collateral injury.
- Alternative 4 has the same capacity as Alternative 1, with the addition of terraces. Alternative 4 is not preferred because the terraces are anticipated to provide little additional benefit to injured resources and result in increased costs. Because these two alternatives were equally preferable, the LA TIG has chosen Alternative 1 as more cost-effective [15 CFR §990.54(b)].
- Although Alternative 2 (50,000 cfs) would result in the least collateral injury, Alternative 2 was not preferred because it would meet Trustee goals to a lesser extent and provide fewer benefits to multiple resources. Similarly, Alternative 5 was not preferred because although it adds terraces to Alternative 2, it does not substantially change the overall level of benefit. Alternative 5 (Alternative 2 with marsh terraces) is also not preferred for the same reasons (i.e., terracing would also increase costs with little additional benefit to injured resources).
- Although Alternative 3 (150,000 cfs) would result in the greatest degree of benefit (best meets Trustee goals and provides more benefits to multiple resources), it was not preferred because it results in the greatest degree of collateral injury, particularly to shrimp, oysters, and dolphins, as well as greater impacts on public health and safety. The LA TIG's decision to reject this alternative was strongly influenced by the potentially substantial, if uncertain, impacts on dolphins, particularly in the Island stratum. Similarly, Alternative 6 was not preferred because although it adds terraces to Alternative 3, it does not change the degree of collateral injury or the impacts on public health and safety. Alternative 6 (Alternative 3 with marsh terraces) is also not preferred for the same reasons (i.e., terracing would also increase costs with little additional benefit to injured resources).

OPA NRDA Evaluation Criteria		Alternative 1 (75,000 cfs)	Alternative 2 (50,000 cfs)	Alternative 3 (150,000 cfs)	Alternatives 4–6 (diversion plus terracing)
Cost	• Cost (vs. other alternatives)	• Intermediate[b]	• Lowest[a]	• Highest[c]	• Terracing adds cost without substantially increasing benefits
Meets Trustee Goals and Objectives	• Meets Trustee goals and objectives? • Relative amount of sediment delivered, land created, and diversity of marsh habitat sustained (vs. other alternatives)	• Yes • Intermediate[b]	• Yes • Lowest[c]	• Yes • Highest[a]	• Yes • No notable difference from non-terraced alternatives
Likelihood of Success	• High likelihood of success? • Evidence from previous diversions, extensive study and vetting, and the implementation of a Project MAM Plan all support likelihood of success?	• Yes • Yes	• Yes • Yes	• Yes • Yes	• Yes • No notable difference from non-terraced alternatives
Avoids Collateral Injury	• Avoids collateral injury through BMPs, mitigation, and ancillary restoration actions? • Relative extent of collateral injury to shrimp, oysters, and dolphins (vs. other alternatives)	• Yes • Intermediate[b]	• Yes • Lowest[a]	• Yes • Highest[c]	• Yes • No notable difference from non-terraced alternatives
Benefits Multiple Resources	• Benefits multiple resources? • Magnitude of benefits (vs. other alternatives)	• Yes • Intermediate[b]	• Yes • Lowest[c]	• Yes • Highest[a]	• Yes • No notable difference from non-terraced alternatives
Public Health and Safety	• Protects public safety by reducing overall storm surge to communities inside levee systems inland of the diversion? • Relative amount of added tidal inundation for communities outside levee systems (vs. other alternatives)[d]	• Yes • Intermediate[b]	• Yes • Lowest[a]	• Yes • Highest[c]	• Yes • No notable difference from non-terraced alternatives

Figure 3-24. Summary of OPA NRDA Evaluation Criteria across Restoration Alternatives. A cell's green shading indicates the alternative was evaluated most favorably under that criterion by the LA TIG, red shading indicates the alternative was evaluated least favorably by the LA TIG for that criterion, and yellow shading indicates the alternative was evaluated as intermediate between the other two primary alternatives; comparisons among alternatives are focused within rows (i.e., by criterion). Grey shading indicates there were no differences between the terraced and non-terraced alternatives for that criterion. See Section 3 for more details about the analysis of each criterion that are summarized at a high level in this figure.

[a] Evaluated as most favorable of the alternatives by Trustees for that criterion.

[b] Evaluated as intermediate among the alternatives by Trustees for that criterion.

[c] Evaluated as least favorable of the alternatives by Trustees for that criterion.

[d] Differences in tidal inundation effects among alternatives are projected to be most pronounced in the first two decades of diversion operation, with no notable differences among alternatives in later decades.

4.0 Compliance with Other Laws and Regulations

In addition to OPA and NEPA requirements, other laws may apply to the proposed alternatives for the Proposed MBSD Project. Prior to implementation, all necessary state and federal permits, authorizations, and any required consultations must be secured. These permits, authorizations, and consultations include, but are not limited to, those related to the CWA; the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA); the ESA; the Fish and Wildlife Coordination Act; the Migratory Bird Treaty Act; Section 106 of the National Historic Preservation Act; the Louisiana State and Local Coastal Resources Management Act; and Louisiana Administrative Code 33:IX 1101, which establishes water quality standards within Louisiana.

Restoration projects must also meet any additional requirements specified in the DWH ROD, such as ensuring that federal environmental compliance responsibilities and procedures would follow the *Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the Deepwater Horizon (DWH) Oil Spill* (Section 1.4.3 of DWH NRDA Trustees, 2016b).

The LA TIG would ensure compliance with all applicable state and local laws, and other applicable federal laws and regulations. The LA TIG has requested technical assistance from appropriate regulatory agencies during the Proposed MBSD Project's planning phase and in conjunction with the development of the DEIS. The LA TIG has initiated the consultations, and reviews are in process for Alternative 1 (Table 4-1).

Table 4-1.
Current Status of Compliance with State and Federal Laws

Federal/State Law	Status of Review
ESA – Marine Species (NMFS)	In progress
ESA – Terrestrial Species (USFWS)	In progress
MSFCMA (NMFS)	In progress
Rivers and Harbors Act/ CWA (USACE)	In progress
Coastal Zone Management Act (Louisiana Department of Natural Resources)	In progress
Coastal Barrier Resources Act (USFWS)	In progress
MMPA (NMFS)	Completed
Bipartisan Budget Act of 2018 (NMFS)	In progress
MMPA (USFWS)	In progress
Bald and Golden Eagle Protection Act (USFWS)	In progress
National Historic Preservation Act (DOI)	In progress

A more thorough listing of federal laws and regulations that may be applicable include, but are not limited to:

- Clean Air Act of 1970
- CWA of 1977
- Fish and Wildlife Coordination Act of 1958
- ESA of 1973
- MSFCMA
- Coastal Zone Management Act of 1972
- Coastal Barrier Resources Act and Coastal Barrier Improvement Act
- MMPA
- Bipartisan Budget Act of 2018, Section 20201
- Marine Protection, Research, and Sanctuaries Act
- Estuary Protection Act of 1968
- Anadromous Fish Conservation Act
- Migratory Bird Treaty Act and Migratory Bird Conservation Act
- Wild and Scenic River Act of 1968
- Submerged Lands Act of 1953
- Rivers and Harbors Act of 1899
- National Historic Preservation Act of 1966
- Resource Conservation and Recovery Act; Comprehensive Environmental Response, Compensation, and Liability Act; Toxic Substances Control Act of 1976
- Farmland Protection Policy Act of 1981
- Archaeological Resource Protection Act
- Bald and Golden Eagle Protection Act.

Additional Executive Orders (EOs) that may be applicable include, but are not limited to:

- EO 11988: Floodplain Management
- EO 11990: Protection of Wetlands
- EO 12898: Environmental Justice
- EO 13112: Invasive Species
- EO 12962: Recreational Fisheries
- EO 13175: Consultation and Coordination with Indian Tribal Governments

- EO 13186: Responsibilities of Federal Agencies to Protect Migratory Birds
- EO 13693: Planning for Federal Sustainability in the Next Decade.

Potentially applicable state laws include:

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

5.0 List of Preparers and Reviewers

Table 5-1.
List of Preparers and Reviewers

Agency/Firm	Name	Position
State of Louisiana		
Coastal Protection and Restoration Authority	Brian Lezina	Coastal Resources Assistant Administrator
Coastal Protection and Restoration Authority	Elizabeth L. Davoli	Coastal Resources Scientist Manager
Coastal Protection and Restoration Authority	Matt Mumfrey	Attorney
Coastal Protection and Restoration Authority	David Peterson	
Coastal Protection and Restoration Authority	Maury Chatellier	
Louisiana Department of Wildlife and Fisheries	B. Carter	Coastal Resources Scientist Manager, Office of Fisheries
Office of the Governor, Governor's Office of Coastal Activities	Chris Barnes	Legal Advisor, Attorney
Abt Associates, Consultant	Karim Belhadjali	Principal Associate
Abt Associates, Consultant	Kaylene Ritter	Principal Associate
Abt Associates, Consultant	Karen Carney	Associate
Abt Associates, Consultant	Michelle Krasnec	Senior Associate
Abt Associates, Consultant	Heather Hosterman	Associate
Independent Consultant	Diana Lane	Consultant
Jacobs Engineering Group, Consultant	Tim Smith	
Jacobs Engineering Group, Consultant	Guerry Holm	
Jacobs Engineering Group, Consultant	Shanna Richard	
Confluence Environmental	Chris Cziesla	
Confluence Environmental	Phil Bloch	
SWCA Environmental Consultants	Sue Wilmot	
National Oceanic and Atmospheric Administration		
NOAA Restoration Center	Mel Landry	Marine Habitat Resource Specialist
NOAA Restoration Center	Ramona Schreiber	Marine Habitat Resource Specialist
NOAA Fisheries Southeast Regional Office	Steve Giordano	Ecosystem Restoration and Environmental Compliance Program Manager
NOAA-ERT	Courtney Schupp	Marine Habitat Resource Specialist
NOAA-ERT	Brittany Jensen	Marine Habitat Resource Specialist
United States Department of Agriculture		
Gulf Coast Ecosystem Restoration Team	Ron Howard	Natural Resource Specialist
Gulf Coast Ecosystem Restoration Team	Mark Defley	Biologist
United States Environmental Protection Agency		
USEPA	J. Douglas Jacobson	NRDA Louisiana Team Leader
USEPA	Patricia Taylor	Environmental Engineer

Agency/Firm	Name	Position
United States Department of the Interior		
DOI	John Tirpak	Louisiana Restoration Area Coordinator
DOI	Erin Chandler	
DOI	Rachel Kirpes	
DOI	Catherine Breaux	
DOI	Clare Cragan	
DOI	John Rudolph	
United States Department of Justice		
DOJ	Rachel Hankey	

6.0 List of Repositories

Table 6-1.
List of Repositories

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

7.0 References

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