Barrier Island System Management (BISM)
Program Implementation Monitoring and Adaptive Management
Activity Implementation Plan

Introduction

The Deepwater Horizon (DWH) oil spill settlement in 2016 provides the Natural Resource Damage Assessment (NRDA) Trustees (Trustees) up to $8.8 billion, distributed over 15 years, to restore natural resources and services injured by the spill. As described in the DWH oil spill Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement (PDARP/PEIS; DWH NRDA Trustees. 2016a), the Trustees selected a comprehensive, integrated ecosystem approach to restoration. The Final PDARP/PEIS considers programmatic alternatives, composed of Restoration Types, to restore natural resources, ecological services, and recreational use services injured or lost as a result of the DWH oil spill incident. As shown in the PDARP/PEIS, the injuries caused by the DWH oil spill affected such a wide array of linked resources over such an enormous area that the effects must be described as constituting an ecosystem-level injury. The PDARP/PEIS and information on the settlement with British Petroleum Exploration and Production Inc. (called the Consent Decree) are available at the Gulf Spill Restoration website.

Given the unprecedented temporal, spatial, and funding scales associated with the DWH oil spill restoration effort, the Trustees recognized the need for robust Monitoring and Adaptive Management (MAM) to support restoration planning and implementation. As such, one of the programmatic goals established in the PDARP/PEIS is to "Provide for Monitoring, Adaptive Management, and Administrative Oversight to Support Restoration Implementation" to ensure that the portfolio of restoration projects provides long-term benefits to natural resources and services injured by the spill (Appendix 5.E of the PDARP/PEIS). This framework allows the Trustees to evaluate restoration effectiveness, address potential uncertainties related to restoration planning and implementation, and provide feedback to inform future restoration decisions.

A high-level objective identified within the Louisiana Trustee Implementation Group (LA TIG) MAM Strategy for Wetland, Coastal, and Nearshore Habitats (WCNH) is that barrier island habitat is created, restored, or maintained (resilient/maintained over time) to mitigate/offset land loss. The Monitoring and Adaptive Management (MAM) need identified in the LA TIG MAM Strategy is to develop and document approaches for assessing and characterizing barrier island response to natural processes. Designed with support from the National Fish and Wildlife Foundation (NFWF), the Barrier Island System Management (BISM) program enables barrier island restoration projects to be integrated components of a long-term, system-wide, and holistic regional sediment management (RSM) approach that supports increased restoration project longevity, land loss reduction, and a more sustainable barrier island system (Figure 1, Figure 2). In addition, BISM utilizes MAM to assess and predict the response of barriers to natural process, minimize costs, and maximize benefits while advancing barrier island restoration targets. The implementation of BISM builds upon years of experience restoring the Louisiana barrier island and headland system on a project-by-project basis, enabling the MAM programmatic goals from the PDARP/PEIS to be significantly advanced.

Figure 1. BISM enables a holistic, region-wide, and adaptive management approach to restoring and maintaining barrier islands and headlands along the Louisiana coast.

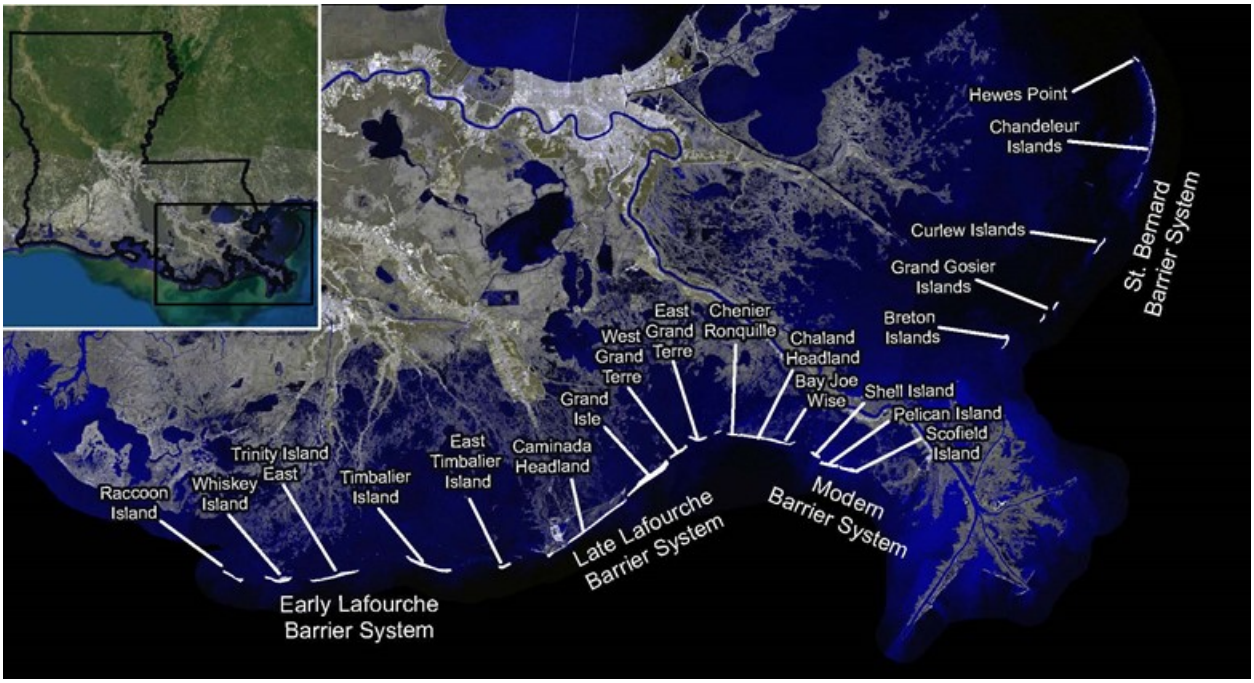

Figure 2. Barrier islands and headlands within the BISM domain.

Purpose of this document

This MAM Activities Implementation Plan (MAIP) describes the activity, "*Barrier Island System Management (BISM)*", to address MAM priorities identified within the LA TIG MAM Strategy for WCNH. This MAM activity is intended to support evaluation of regional restoration outcomes for barrier island restoration within the Louisiana Restoration Area through data aggregation and analysis; to identify and reduce critical information gaps related to the placement of sediment within the WCNH system; and to inform and improve the impact of barrier island restoration activities. This document provides information about the activities to be executed and the implementation of the BISM program.

This MAM activity is consistent with the LA TIG MAM Strategy and the DWH PDARP/PEIS. It addresses multiple fundamental objectives identified within the LA TIG Programmatic MAM Strategy[1]. This includes all three Fundamental Objectives established for barrier islands, namely: *WCNH #4 Maintain protective function (wave attenuation) of barrier islands*; *WCNH #5 Support natural processes of barrier island evolution through barrier island restoration projects (e.g., erosion, overwash that builds back-barrier platform, and longshore sediment transport within the littoral zone; barrier island rollover rate) through barrier island restoration projects*; and *WCNH #6 Maintain habitat heterogeneity to support resilient nearshore and coastal ecosystems*. This effort will specifically advance development of the Smart, Measurable, Achievable, Relative, appropriate Timeline (SMART) Objectives associated with these Fundamental Objectives, identified as a need within the Programmatic MAM Strategy.

In addition, as a programmatic and adaptive management approach to barrier island management that uses data to assess the efficacy of restoration and improve future restoration projects, BISM advances a Fundamental Objective identified by the LA TIG working group for all habitats, namely *Cross Restoration Type #1 Maximize the combined benefits of the various Restoration Types and approaches across the overall restoration portfolio (PDARP Section 5.5.1): 1.a. Evaluate the efficacy of various strategies in land creation/restoration (diversions, marsh platform creations, barrier island restoration, ridge restoration)*. Similarly, BISM help address a Programmatic MAM identified by the LA TIG, specifically *Programmatic MAM Need #2: Relative effectiveness of different restoration approaches are identified*.

Monitoring and Adaptive Management: BISM Implementation

This MAM MAIP describes one MAM activity for Wetland, Coastal, and Nearshore Habitat to address MAM priorities preliminarily identified by the Louisiana Trustee Implementation Group. It addresses multiple Fundamental and SMART objectives identified within the LA TIG Programmatic MAM Strategy[2], including:

[1] Deepwater Horizon Louisiana Trustee Implementation Group. 2021. Louisiana Trustee Implementation Group Monitoring and Adaptive Management Strategy (LA TIG MAM Strategy). Baton Rouge, 55 p. Available: https://la-dwh.com/wp-content/uploads/2021/09/MAMstrategy.pdf

[2] Deepwater Horizon Louisiana Trustee Implementation Group. 2021. Louisiana Trustee Implementation Group Monitoring and Adaptive Management Strategy (LA TIG MAM Strategy). Baton Rouge, 55 p. Available: https://la-dwh.com/wp-content/uploads/2021/09/MAMstrategy.pdf

For barrier islands:

- *WCNH #4 Maintain protective function (wave attenuation) of barrier islands;*
    - BISM program implementation under this MAIP activity will enable barrier island restoration projects to be prioritized and planned based on the local and regional benefit they provide, including wave attenuation and protection of inshore habitat.
- *WCNH #5 Support natural processes of barrier island evolution through barrier island restoration projects (e.g., erosion, overwash that builds back-barrier platform, and longshore sediment transport within the littoral zone; barrier island rollover rate) through barrier island restoration projects;*
    - BISM implementation will support barrier island restoration projects to be selected and planned based on preservation and support of natural processes. BISM will leverage and support the Louisiana Sediment Management Program (LASMP), supporting maintenance and restoration of processes such as longshore sediment transport as part of maintaining the barrier island system.
- *WCNH #6 Maintain habitat heterogeneity to support resilient nearshore and coastal ecosystems.*
    - BISM will enable the benefits and impacts of barrier island restoration projects to associated habitats and species to be robustly considered in planning restoration projects.

Identified for all WCNH as part of advancing MAM:

- *Cross Restoration Type #1 Maximize the combined benefits of the various Restoration Types and approaches across the overall restoration portfolio: 1.a. Evaluate the efficacy of various strategies in land creation/ restoration and identify appropriate time scale for evaluating the significant change trajectory; and*
    - The toolkit developed in this project will use the wealth of data that have been collected in Louisiana to predict the impacts of potential restoration alternatives on the coast and associated habitats and species in a quantitative way, refining and advancing the smart objectives for use in evaluating effectiveness of restoration projects and approaches.
- *Programmatic MAM Need #2 Relative effectiveness of different restoration approaches are identified.*
    - The toolkit developed in this project will use the wealth of data that have been collected in Louisiana to predict the impacts of potential restoration alternatives on the coast and associated habitats and species in a quantitative way, refining and advancing the smart objectives for use in evaluating effectiveness of restoration projects and approaches. In addition to CPRA monitoring and planning efforts, potential data sources include completed, ongoing, and proposed NRDA projects, including under the LA TIG; federal monitoring programs; etc.

This MAM activity is intended to support evaluation of regional restoration outcomes for barrier island restoration within the Louisiana Restoration Area through data aggregation and analysis; to identify and reduce critical information gaps related to the placement of sediment within the WCNH system; and to inform and improve the impact of barrier island restoration activities.

MAM Activity Description

Background

Louisiana's barrier island restoration efforts have historically been implemented on a project-by-project basis ultimately leading to successful restoration of most of the barrier islands along the coast (Figure 1). However, this approach considered the islands as individual features and not as a continuous system within which sand is exchanged within the littoral zone on a regional scale. In addition, project-by-project restoration did not allow for robust implementation of adaptive management wherein targeted monitoring could be used to evaluate project outcomes and fully incorporate lessons learned into future project planning.

To address this need, the Louisiana Coastal Protection and Restoration Authority (CPRA) initiated the BISM program to enable projects to be integrated components of a long-term, system-wide restoration strategy that actively incorporates Adaptive Management (AM). Initially funded by NFWF, the BISM program enables restoration projects to be integrated components of a holistic RSM approach that supports increased restoration project longevity and a more sustainable barrier island system. In addition, BISM utilizes AM principles to minimize costs, maximize benefits, and achieve barrier island restoration targets.

Under the initial funding support provided by NFWF, programmatic goals and objectives were defined for BISM and a structured decision-making (SDM) based workflow was developed (Figure 3, Table 1). The workflow is used to objectively prioritize restoration projects and select sediment sources, however, the initial implementation of the workflow was qualitative and based on expert elicitation. Under the qualitative workflow, experts with knowledge of the Louisiana barrier island system provide input on assessing the current state of the coastal system, articulating restoration project alternatives, evaluating the impacts of those projects on the barrier system and objectives in barrier island restoration, and considering tradeoffs across restoration alternatives. This information is used to guide restoration project prioritization and sediment source selection. Although this approach enabled an objective, regional, and programmatic approach to barrier island restoration to be implemented quickly, it did not allow for direct incorporation of existing data or model output as part of a robust AM program, and was not fully integrated with existing CPRA programs such as the Coastal Master Plan, the Louisiana Sediment Management Program (LASMP), System-Wide Assessment and Monitoring Program (SWAMP), and Barrier Island Comprehensive Monitoring (BICM). Recognizing the need to expand on the initial program development, the *conceptual design of a quantitative toolkit* that could support full implementation of BISM was developed, along with identifying other next steps necessary to fully implement BISM as a successful AM-based program for managing the Louisiana barrier island and headland system.

BISM Programmatic Objectives:

1. Prioritize projects that provide the greatest value on a long-term, system-wide scale.
2. Reduce overall costs and delineate expected future costs to inform planning and budgeting.
3. Employ and advance RSM practices embedded in LASMP for efficient and cost-effective usage of limited sediment and to delineate expected future need.
4. Incorporate adaptive management into restoration of barrier islands on a regional scale.

5. Reduce implementation time for projects.

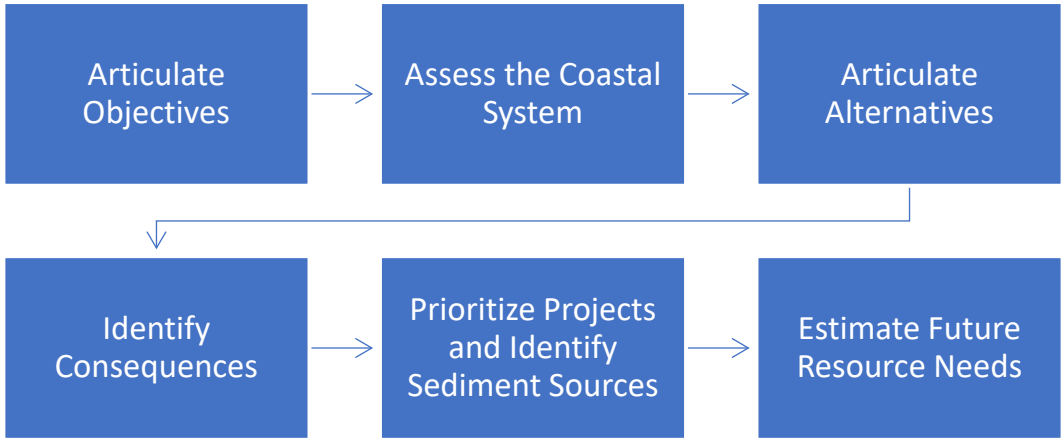

Figure 3. Steps in the BISM restoration project prioritization workflow. The primary outputs of this process are: (1) a list of prioritized barrier island restoration projects and (2) an estimate of future resource needs, including sediment and restoration funding.

Table 1. Outputs of each step in the BISM project prioritization workflow.

Workflow Step	Output
1. Articulate Objectives	Updated coastal protection and ecosystem restoration objectives for barrier island restoration and their current relative priority.
2. Assess the System	Description of the state (condition) of each coastal reach along the Louisiana coast. Includes regional metrics such as extent and condition of the marshes in the adjacent basin as well as metrics for barrier island and headland units.
3. Articulate Objectives	List of potential barrier island restoration project alternatives and their value in advancing the specific priorities identified in (2). At this stage, all potential alternatives will be considered but not yet prioritized.
4. Identify Consequences	Predict consequences (i.e., outcomes) of restoration. This will include characterizing the likely trajectory of each potential restoration site location identified in (3) with and without restoration action.
5. Prioritize Projects	**Prioritized list of barrier island restoration projects that will be pursued for immediate action.** This list is a primary outcome of BISM and is the basis for moving into project implementation.
6. Estimate Future Resource Needs	**Inventory of gaps in available sediment resources and/or funding to support future restoration action.** This outcome is used to inform need for investment in, for example, identification of new sediment sources and in budgeting to ensure long-term success of the BISM program.

The geographic scope of BISM includes the barrier island and headland system of coastal Louisiana (Figure 1, Figure 2, Figure 4). BISM will enable new projects to be selected and sediment sources for those projects chosen with consideration of existing projects or those already funded for construction, including through DWH funding. Because the tools that will be developed allow for varying restoration objectives to be included and/or weighted differently, it can also be used to select future DWH-funded projects based on their priorities (e.g., benefit to damaged resources, etc.).

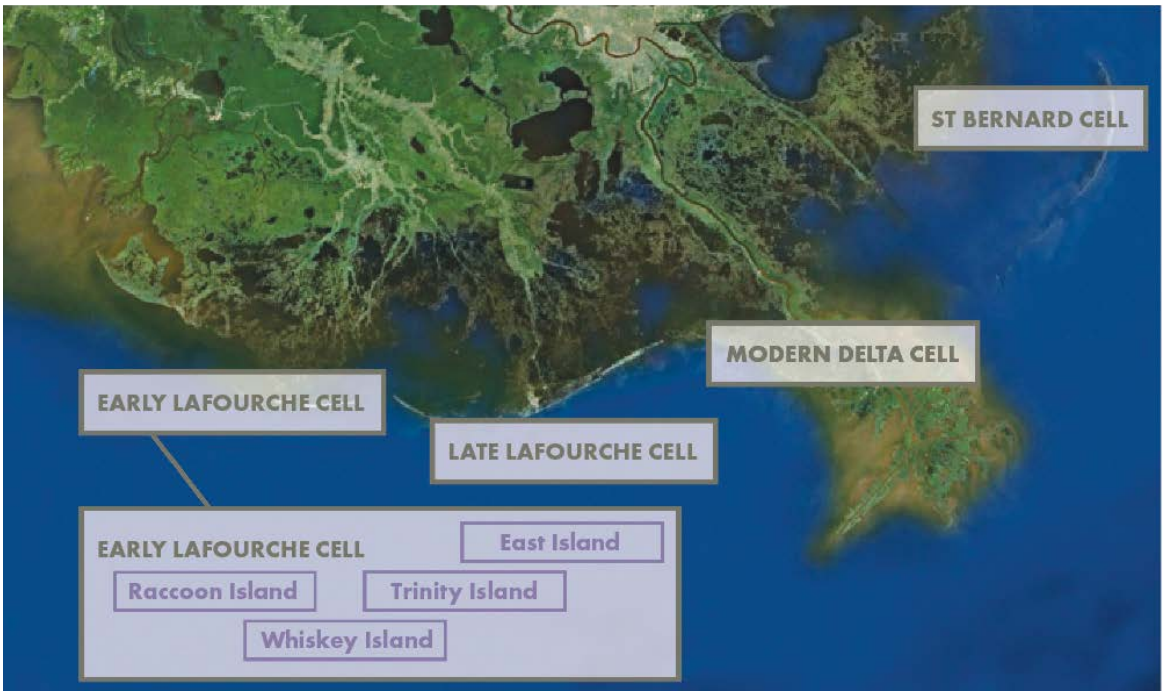

Figure 4. Coastal system management under BISM. The coast is divided into cells, in gray, which represents the primary organizational structure of the Coastal State Database described in Task 1. Coastal cells include barrier island and headland units, with examples for the Early Lafourche cell shown in purple.

Sediment is a valuable and limited resource that must be strategically, efficiently, and cost-effectively emplaced to provide the greatest overall and long-term benefits to the landscape. In Louisiana, considerable effort has been undertaken to incorporate RSM principles for adaptively managing sediment. Tools and data to support RSM have been developed under LASMP, including the Louisiana Sand Resources Database (LASARD), Surficial Sediment Distribution map, Operational Sediment Budget (OSB), and the Louisiana Sediment Availability and Allocation Program (LASAAP), all of which support identification and best-use of available sediment (Figure 5). The overlapping relationship between the two programs not only defray cost making the effort more cost effective but also helps restoration process efficient. Data to support understanding sediment need are collected under various programs (BICM, SWAMP, etc.), while the Breach Management Program has developed criteria for decisions on subaerial island management. BISM is intended to leverage and build off these programs as part of a comprehensive and AM approach to regional barrier island system management.

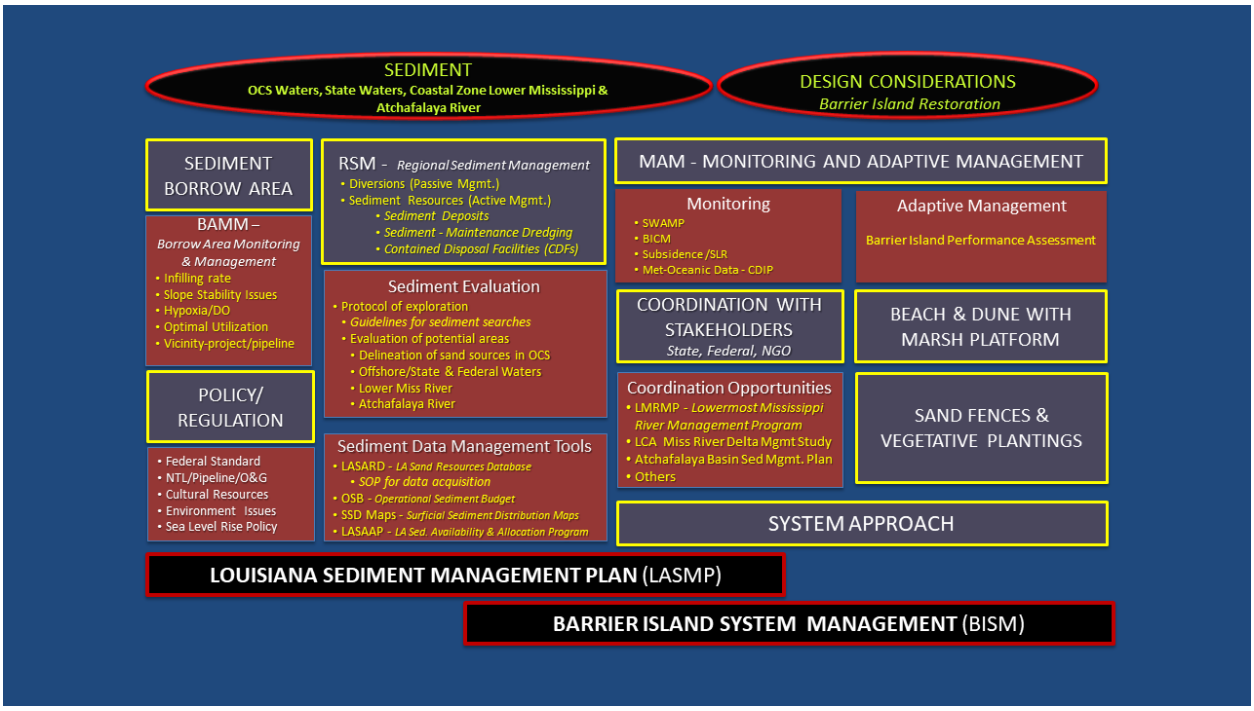

Figure 5. Conceptual diagram of interaction between the Barrier Island System Management (BISM) program and the Louisiana Sediment Management Plan (LASMP). {Courtesy: Syed Khalil}

Full development of BISM - including leveraging those existing programs and information sources, developing quantitative tools for practical implementation of the BISM program, and the stakeholder and regulatory authority engagement needed for a programmatic restoration approach - was beyond the initial scope of effort. Under the work described in this MAIP, the data analysis, analytical tool development, and stakeholder engagement needed for BISM to be implemented as an AM program for Louisiana's barrier islands will be completed.

Objectives and Tasks

The overarching goal of the activity under this MAIP is the implementation of the BISM program. BISM will allow barrier island restoration projects to be integrated components of a long-term, system-wide, and holistic RSM and AM approach that supports increased restoration project longevity and a more sustainable barrier island system. Specific objectives include:

- Improvement of the barrier island restoration project selection and design process to reduce costs and increase the long-term benefit to the coastal system;
- Data synthesis and modeling to assess barrier island response to natural processes and their resiliency;
- Integration of BISM with other CPRA programs such as LASMP, the Coastal Master Plan, and the BICM Program;
- Stakeholder coordination; and
- Development of quantitative project prioritization and sediment source selection tools.

The outcome will be an operationalized framework (Figure 6) for implementing MAM for Louisiana barrier islands that supports the LA TIG, including in the drafting of SMART Objectives for barrier islands, while using data and outputs of other LA TIG projects where possible. BISM also leverages and integrates with other programs within CPRA (LASMP, BICM, the Coastal Master Plan, etc.) and the extensive institutional knowledge CPRA has developed in barrier island project planning and implementation, providing an avenue for integrating that information and experience into support for the LA TIG.

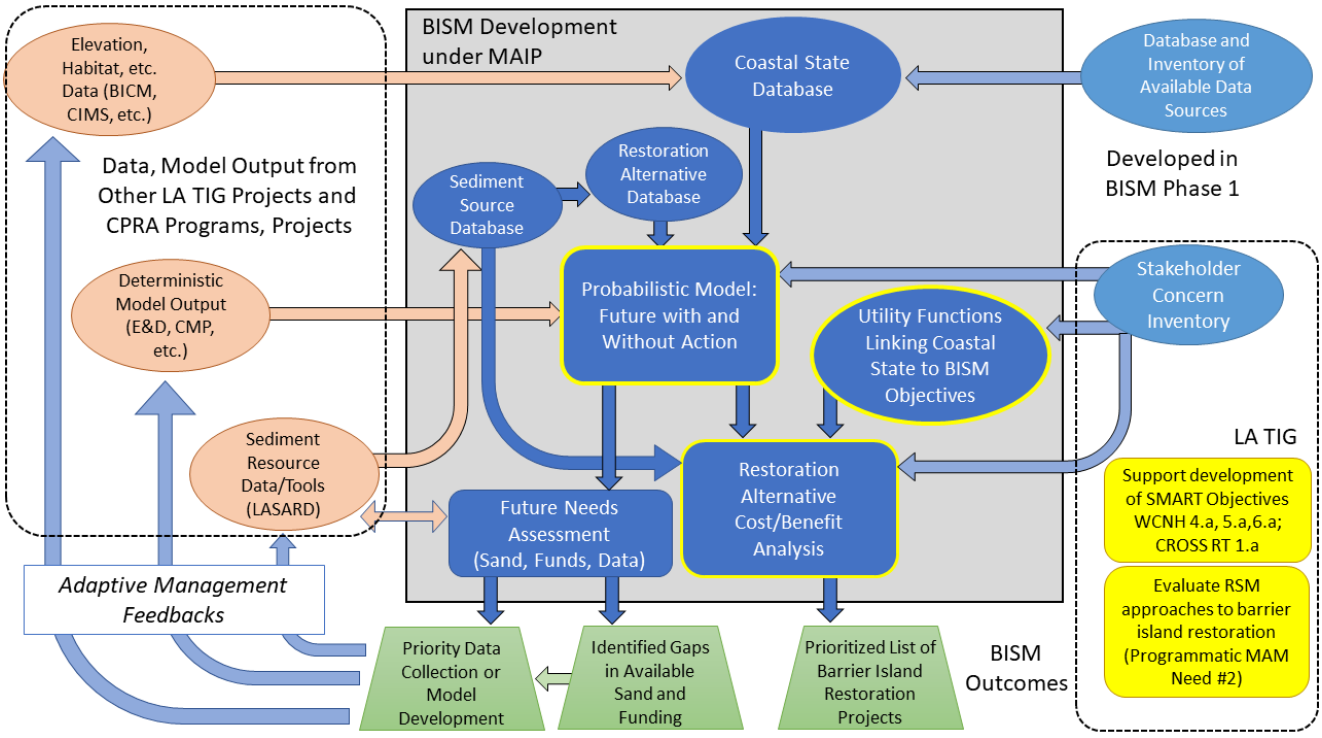

Figure 6. Tools that will be developed under this MAIP in support of BISM as an AM approach to regional sediment management for Louisiana. BISM will support and connect to LA TIG in multiple ways (illustrated with dashed line boxes), including the development of tools and products (outlined in yellow) that can be used in the development of SMART Objectives (see Task descriptions, below, for more information). Also shown are linkages to CPRA programs and projects, including the Barrier Island Comprehensive Monitoring (BICM) program and other data within the Louisiana Coastal Information Management System (CIMS); restoration Engineering & Design (E&D) models; the Coastal Master Plan (CMP), and the Louisiana Sediment Management Plan (LASMP) including the Louisiana SAnd Resources Database (LASARD) and other tools.

The tasks that will be completed during the 3-year project life and their linkages to the MAM SMART objectives are described below.

Task 1. Implement a quantitative workflow to assess barrier island integrity and function of natural processes to inform barrier island restoration action prioritization and directly incorporate data into project and sediment source selection (WCHN 4.a, 5.a., 6.a)

The qualitative BISM project prioritization and sediment sourcing workflow (Figure 3) relies on expert elicitation. Although this approach was rapid to deploy, it does not allow for a robust, data-driven approach to assessing barrier island integrity and function that is consistent with the LA-TIG MAM objectives. In addition, the needs of BISM for the development and application of metrics for characterizing barrier island integrity and linkage to ecosystem service and function overlap with the

next steps for the WCNH SMART objectives in the LA-TIG MAM strategy, which include development and refinement of SMART objectives and associated metrics for coastal habitats.

Under this task, the tools needed to directly leverage the extensive data already collected in Louisiana, particularly under BICM, will be developed (Figure 6). Methods and metrics will be created for characterizing the historical and current condition and trajectory of the coastal system (Table 2). These metrics will be incorporated into a Coastal State Database (Figure 4) characterizing the Louisiana barrier islands that can be regularly updated with new data. The database and associated datasets will be incorporated into CIMS and uploaded to DIVER for public dissemination and access. In addition, techniques for quantifying the short- and long-term benefits that restoration alternatives provide will be advanced through the development of Objective Utility Functions that link characteristics of barrier islands to ecosystem services, habitat and species outcomes, and other objectives of restoration. This task will thereby also advance and refine the DWH SMART objectives and metric calculation methods as specified in the MAM strategy. This task will support LA TIG refinement of SMART objectives including: "Objective related to wave attenuation by DWH NRDA created barrier islands"; "Objective related to maintenance of natural processes of barrier island evolution"; "Objective related to maintenance of habitat heterogeneity in barrier islands"; and "Objective on efficacy of land creation/restoration strategies". Specifically, the drafting of these objectives will be supported through the development and analysis of utility functions for assessing how well natural and restored barrier islands meet restoration objectives of increasing habitat value, enhancing coastal resiliency, and supporting the long-term sustainability of the coastal system. Note, there is close synergy between this task and the proposed *DOI_WCNH_01, "Characterizing barrier island topographic state: Indicators of resistance vs resilience",* and the team will exchange information and collaborate if both activities are funded.

Additional information on the metrics that will be developed under BISM can be found here: https://thewaterinstitute.org/assets/docs/projects/Barrier-Island-System-Management-BISM-A-Holistic-System-Approach-to-Adaptively-Manage-Louisianas-Barrier-Islands-and-Headlands.pdf

Table 2. Preliminary (draft) list of metrics used to assess the coastal system. Metric calculation from available BICM data will be finalized and automated under this activity, allowing objective evaluation of the coastal system. Metrics include both basin-wide and regional metrics, characterizing coastal cells (Early Lafourche, Late Lafourche, Modern Delta, St. Bernard; Figure 4), and barrier island and headland metrics to characterize the condition of those landforms.

Basin-wide and Regional Metrics	Barrier Island and Headland Metrics
• Socioeconomic metrics of local or regional value, including infrastructure associated with the barrier island and along the basin in the lee of the island • Wetland vs open water area in the estuary (and change trajectory) • Salinity and water quality indicators	• Island dimensions/characteristics (width, height, subaerial and littoral system sediment volume, subaerial land area) • Shoreline length and long-term retreat rate • Beach dimensions (width, slope, sand volume) • Dune dimensions (height, width, sand volume) • Breaching and breaching potential • Inlet size • Backbarrier marsh width, acreage, and width relative to overall island width • Habitat metrics o Overall acreage o Utilization

	o Distribution of habitat, e.g., backbarrier marsh, dune, seagrass meadows, etc.

Task 2. Refine the existing Operational Sediment Budget that is based on BICM data and the Louisiana Sediment Availability and Allocation (LASAAP) tool and automate the update process of incorporating BICM and LASMP data into the decision model (WCNH 5.a.)

The LASAAP is a pilot tool for evaluating the best-use of available sediment for individual projects using sediment resources identified within LASARD, while the OSB depicts the dynamism of sediment transport along the Louisiana coast by identifying sources (accretion) and sinks (erosion). LASARD and the analyses provided by the LASAAP and OSB tools are not yet incorporated into BISM, but need to be. In addition, monitoring data being collected this year under the BICM program can be used to update the OSB to capture the current state of the coastal system. Under this task, the OSB will be updated based on the latest BICM bathymetric data and seafloor change analyses. The sediment source selection algorithms in LASAAP, incorporating advancements developed under Northern Gulf Sand Availability and Allocation Program (NGSAAP), and LASARD will be incorporated into (or linked to) the BISM quantitative toolkit developed in Task 1 (Figure 6), allowing these resources and information to be leveraged directly by BISM and used to maximize the benefit of restoration as part of an integrated RSM approach.

Task 3. Implement a forecast and tradeoff analysis toolkit and restoration alternative database (PROGRAMMATIC 2, CROSS RT 1.a)

After the tools and analysis methods needed to evaluate the integrity, trajectory, and function of barrier island systems and the potential sediment sources for restoration are advanced in Tasks 1 and 2, the next task is to develop a decision-support tool for evaluating potential restoration projects based on their overall benefit to the coastal system. This task provides the tools necessary to incorporate AM into a holistic, regional approach to barrier island restoration in Louisiana, and to advance MAM objectives of more effective restoration approaches that maximize ecosystem benefit. Under this task, a Restoration Alternative Database will be developed containing potential restoration project alternatives with an estimate of sediment volume needs and financial cost. Restoration alternatives for the database will be identified through collaboration with the LA TIG, as well as incorporating those alternatives identified through the NFWF-supported Phase 1 of BISM development. In addition, a Probabilistic Coastal Forecast Tool will be created that uses existing model output and data to probabilistically predict the evolution of the coast for each restoration alternative within the database. The forecast tool will predict the movement of sediment through the system and the evolution of the state of the barrier islands on decadal time-scales as characterized by a set of metrics. The choice of metrics and the specific time scale of prediction will be refined during tool development based on available input data sources, but will likely include topographic and bathymetric variables such as island width, longshore extent, and berm elevation predicted on time scales of 20-30 years (Figure 7). The development and application of this tool for evaluating the response of the barrier island system to restoration projects will inform identification of appropriate time scales for evaluating changes in barrier island trajectory (CROSS RT 1.a). Lastly, a Tradeoff Analysis Tool will be created for conducting benefit analysis to prioritize barrier island and headland restoration projects based on their local and regional benefits, quantified through their impacts to restoration objectives (Figure 6, Figure 7). Application of this tool will evaluate the benefit of holistic, RSM-based approaches to barrier island restoration, thereby supporting the LA TIG in addressing the need for understanding the relative effectiveness of different restoration approaches

(Programmatic MAM Need #2). The Tradeoff Analysis will also enable the concerns of stakeholders to be incorporated and weighted in selecting the portfolio of restoration projects to implement. The LA TIG will be involved in this process through direct engagement; in addition, this approach will allow projects designed and funded for a specific purpose - such as to restore habitat for species that incurred damage during the Deepwater Horizon Oil Spill - to be appropriately prioritized.

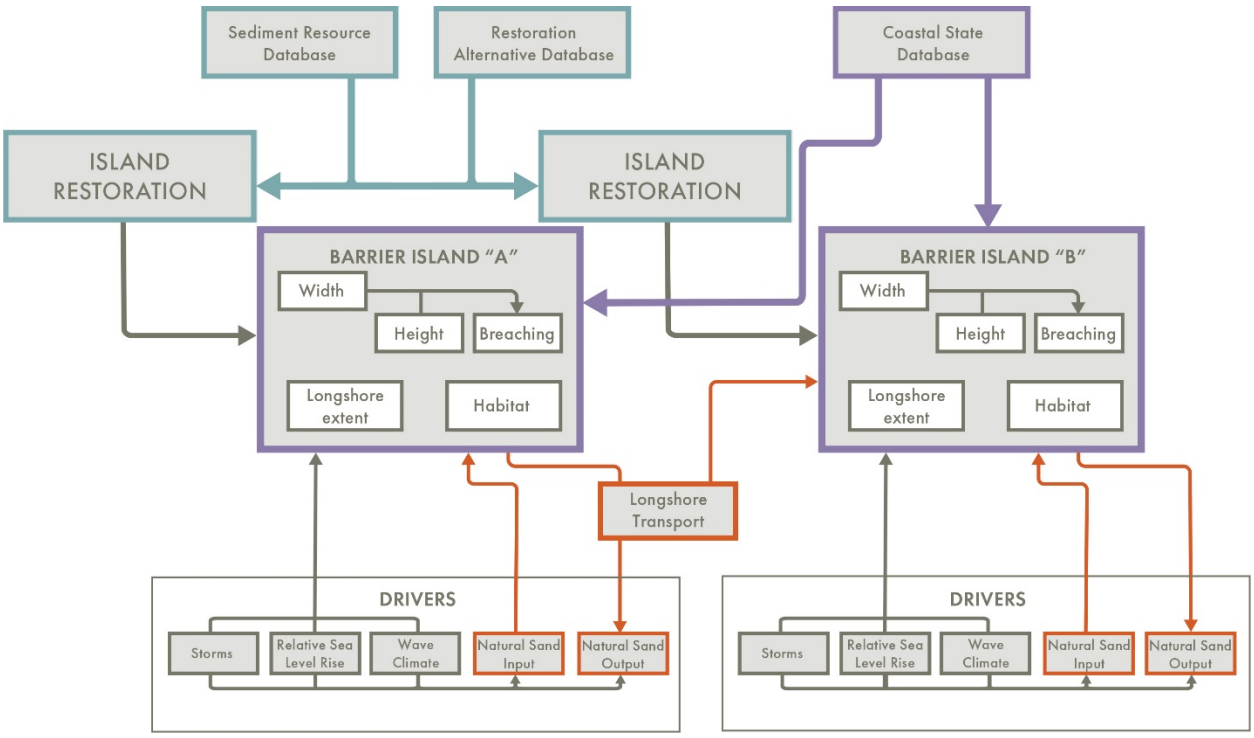

Figure 7. Conceptual diagram of a portion of the probabilistic coastal forecast model. Each barrier island or headland is characterized by metrics contained within the Coastal State Database. The evolution of those characteristics with and without restoration as a function of drivers such as storms and relative sea level rise is predicted probabilistically, informed by existing data and deterministic models. Figure does not include all metrics for characterizing a barrier island and only two barrier islands are shown; model would include the full suite of metrics from the Coastal State Database and all barrier islands and headlands in the system.

Task 4. Integrate BISM tools with the Coastal Master Plan process and models (PROGRAMMATIC 2, CROSS RT 1.a)

The development of barrier island modeling for the 2023 Louisiana Coastal Master Plan was based on the assumption that the BISM program will execute projects that maintain the integrity of the barrier island system, and formulations within the modeling framework were developed to be consistent with this assumption. The approach used within the modeling framework does not allow for comprehensive assessment of sediment transport and morphology feedbacks related to restoration or for analysis of the impacts stochastic storm events will have on the barrier system or restoration sediment volume needs. The tools developed in Tasks 1-3 of this MAIP would be advanced to fill these gaps and enable more robust prediction of coastal evolution under specific restoration alternatives. Under this task, coordination will occur with the Coastal Master Plan team to update and improve barrier island predictions within subsequent master plan models.

Task 5. Work with Trustees and other stakeholders, develop a strategy to assess needs and prioritize barrier island restoration actions (to guide development of SMART objectives for WCHN 4.a., 5.a., 6.a. and CROSS RT 1.a, and to support the PROGRAMMATIC 2)

The foundation of this task will be the development of a working group with representation across Trustees, regulatory agencies, and other stakeholders with interest and/or authority over barrier island restoration (e.g., U.S. Army Corp of Engineers [USACE]; National Oceanic and Atmospheric Administration's [NOAA] National Marine Fisheries Service [NMFS] and Office of Coastal Management [OCM]; State Historic Preservation Office [SHPO] and National Park Service [NPS]; Bureau of Ocean Energy Management [BOEM]; U.S. Fish and Wildlife Service [USFWS]; Louisiana Department of Wildlife and Fisheries [LDWF] and Department of Environmental Quality [LDEQ], etc.). The working group will be used to elicit input on the other tasks associated with BISM implementation (see above) to ensure the strategies and tools for assessing and prioritizing barrier island restoration are informative for, and incorporated into, advancement of PDARP and LA-TIG MAM priorities. In addition, the working group will evaluate approaches to NEPA documentation and compliance that can make BISM more efficient as a program by streamlining and reducing barrier island restoration project implementation timelines, such as by pursuing the possibility of a Programmatic Environmental Assessment (PEA). This task is foundational to BISM and the other tasks described in this MAIP in that it allows for Trustee and other stakeholder input and advancement of a programmatic and AM approach to RSM and barrier island management.

The outputs of this project across all tasks will include:

- Identify metrics, develop tools, and conduct analyses to support the LA TIG in developing SMART Objectives for barrier islands (WCNH 4-6 in the LA TIG MAM Strategy) and identifying appropriate time scales for monitoring and analyzing barrier island data to evaluate their trajectory (CROSS RT 1.a in the LA TIG MAM Strategy) [Task 1]
- Coastal State Database: Uniform set of metrics evaluating the condition and resources associated with Louisiana barrier island habitats that can be regularly updated with new data [Task 1]
- Objective Utility Functions: Set of functions linking characteristics of barrier islands in Coastal State Database to ecosystem services, habitat and species outcomes, and objectives of restoration [Task 1]
- Sediment Resource Database (extension of LASARD): Linkage to the Louisiana Sand Resource Database (LASARD) [Task 2]
- Restoration Alternative Database: Database identifying potential restoration projects, which can be updated regularly [Task 3]
- Probabilistic Coastal Forecast and Tradeoff Analysis Tool: Set of analysis tools for predicting the response of the barrier islands to restoration alternatives, calculating tradeoffs of impacts to habitats and ecosystem services, and identifying decision-relevant uncertainty to address through data collection as part of programmatic MAM [Task 3]
- Strengthening of linkages between BISM and other CPRA programs and activities, including the Coastal Master Plan, as well as to the objectives identified by LA TIG MAM working group, objectives of the PDARP, and goals of coastal restoration following the Deepwater Horizon Oil Spill [Tasks 1,2,4]

- Programmatic approach to addressing NEPA documentation and compliance to streamline project implementation and reduce implementation times [Task 5]
- Support the LA TIG in the drafting and finalization of SMART Objectives for barrier islands (WCNH 4-6 in the LA TIG MAM Strategy) and the identification of time scales for evaluating significant changes and trajectories of barrier islands (CR 1.a in the LA MAM Strategy), including use of the other outputs of BISM [Task 5]
- Support the LA TIG in the use of the analyses, tools, and outcomes of BISM in evaluating the relative effectiveness of coastal restoration approaches, particularly the use of RSM and a holistic and regional approach to barrier island restoration, and coordinate with LA TIG on the incorporation of BISM analysis results and lessons learned into project-scale planning (Programmatic MAM Need #2 in the LA TIG MAM Strategy) [Task 5]
- Synthesis report documenting the development and use of tools and analysis in support of the BISM Program [All Tasks]

The databases and associated datasets developed as outputs under BISM will be incorporated into CIMS and uploaded to DIVER for public dissemination and access.

Budget

The total budget (Table 3) for this activity accounts for participation by a contractor, CPRA's implementation role, engagement of external partners as necessary, and the LA TIG Trustee agency participation in the development and review of deliverables.

CPRA will be the Implementing Trustee. CPRA will coordinate with the LA TIG, providing overall direction and oversight for the MAM activity, including contract administration, compliance, financial tracking, annual reporting, data hosting and management, and approval of deliverables. CPRA will also support integration of BISM tools and processes with existing programs (BICM, LASMP, etc.)

Contracted work under the direction of CPRA will include execution of activities described in Tasks 1-3, support for integration of BISM with existing CPRA programs under Tasks 1-4, and coordination of Task 5, development of reports and deliverables, and subcontracting as needed with CPRA approval to provide input and support.

LA TIG agencies will have the opportunity to join the working group as described in Task 5.

Table 3. Summary budget for the proposed MAM activity.

Organization	Role	Cost
CPRA	Lead Implementing Trustee. Overall management of Program including MAM activities, along with direction and oversight, TIG coordination, compliance, contract administration. Technical input into MAM activities.	$120,500
Contractor	Coordinates MAM Activity. Engages TIG representatives, resource managers, and regulator entities as needed for Task 5. Engages TIG SMEs and external researchers and specialists as needed for	$1.5M

	Tasks 2-4, and coordinates with CPRA on execution of all Tasks. Leads development of deliverables including toolkit and decision-support frameworks.	
External Researchers	Technical Input and Support, as needed	Included in Contractor budget. Team will also collaborate with researchers and practitioners on synergistic projects funded by LA TIG and other sources.
Other Trustees and Agencies	Input to develop a strategy to assess needs and prioritize barrier island restoration actions (Task #5)	Working session costs included in Contractor budget.
	NOAA	$ 9,600
	DOI	$2,427
	Grand Total	$1,632,527

Activity implementation

Timeline

The tasks described under this activity will occur over a period of 36 months from time of execution of the project. The timeline of tasks over each year of the activity are shown in Table 4.

Table 4. Timeline indicating the tasks that will occur over the 36 month period of the Barrier Island System Management (BISM) Implementation activity.

Task	Year 1	Year 2	Year 3
Task 1. Implement a quantitative workflow to assess barrier island integrity and function of natural processes to inform barrier island restoration action prioritization and directly incorporate data into project and sediment source selection	X	X	
Task 2. Update the existing Operational Sediment Budget based on latest BICM data; customize the Louisiana Sediment Availability and Allocation (LASAAP) tool; and automate the update process of incorporating BICM and LASMP data into the decision model	X	X	
Task 3. Implement a forecast and tradeoff analysis toolkit and restoration alternative database		X	X
Task 4. Integrate BISM tools with the Coastal Master Plan process and models			X
Task 5. Work with Trustees and other stakeholders, develop a strategy to assess needs and prioritize barrier island restoration actions	X	X	X

Data management and reporting

This activity does not include the collection of new field data. However, model and decision tool results will be documented and archived for transparency and accessibility by CPRA and members of the LA-TIG. Model results will be in a common, readable format (such as csv). Data storage and accessibility will be consistent with the guidelines in Section 3.1.3 of the MAM Manual. Model output and tool output will be QA/QCed by CPRA and the Contractor prior to archiving. The QA/QCed output will follow standards established for DIVER and will be archived by CPRA in the Louisiana Coastal Information Management System (CIMS).

In addition to electronic files, CPRA will report the status of the proposed activity via the Data Integration, Visualization, Exploration, and Reporting (DIVER) Restoration Portal annually, as outlined in Chapter 7 of the PDARP/PEIS (DWH Trustees, 2016). Additionally, the Contractor and CPRA will prepare a final technical report outlining the outcomes of the tasks under this activity. The summary report will also include lessons learned relevant to the LA TIG MAM SMART objectives. This report and other documentation developed in support of BISM will be publicly available after finalization by CPRA and the LA TIG, with technical reports provided on CIMS and uploaded to DIVER.

Consistency of MAM Activity with the PDARP/PEIS

This MAM activity supports and is consistent with multiple programmatic goals (section 5.3) in the PDARP/PEIS, including a variety of restoration types (section 5.5) and restoration approaches (Appendix 5.D). Specifically, this MAM activity supports programmatic goals of: (1) Restore and Conserve Habitat; (2) Replenish and Protect Living Coastal and Marine Resources; (3) Provide and Enhance Recreational Opportunities; and (4) Provide for Monitoring, Adaptive Management, and Administrative Oversight to Support Restoration Implementation (Section 5.3.1). Implementation of the BISM program will support barrier island restoration, supporting the PDARP/PEIS restoration type *Wetlands, Coastal, and Nearshore Habitats* (section 5.5.2). Barrier islands, beaches, and dunes are among the habitat types specifically mentioned within the PDAR/PEIS. BISM implementation will provide a framework for selecting and planning projects to maximize benefits to these habitats, consistent with *Planning and Implementation Considerations* (section 5.5.2.3). In addition, BISM implements adaptive management for restoration of the Louisiana barrier islands and therefore advances *Monitoring and Adaptive Management* (Appendix 5.E, as well as throughout the PDARP/PEIS). The geographic scope of BISM includes the Chandeleur Islands, part of the Breton National Wildlife Refuge, therefore it supports 5.5.3, *Habitat Projects on Federally Managed Lands*. Through the nesting, foraging, and other habitat uses barrier islands provide to fauna, as well as the protection barrier islands provide to Submerged Aquatic Vegetation, this MAM activity supports goals in PDARP/PEIS 5.5.6, 5.5.8*, Submerged Aquatic Vegetation;* 5.5.10*, Sea Turtles;* and 5.5.12*, Birds;* while the recreational opportunities associated with barrier islands support 5.5.14, *Provide and Enhance Recreational Opportunities.* In addition, BISM implementation includes developing linkages to the Louisiana Coastal Master Plan and the consideration of basin-wide benefits of barrier island restoration in prioritization and planning as part of a data-driven adaptive management approach. Therefore, BISM also supports preservation and restoration of other wetland, coastal, and nearshore habitats associated with the Louisiana's bays and coastal basins.

The details of how this MAM activity supports and is consistent with restoration approaches in PDARP/PEIS appendices 5.D and 5.E are provided below. Restoration approaches listed in the PDARP/PEIS are appropriate under the Oil Pollution Act (OPA).

- Habitat Restoration Approaches (D.1)
  - Create, Restore, and Enhance Barrier and Coastal Islands and Headlands (D.1.4)
    - Barrier islands and headlands represent coastal landforms and habitats important to coastal stability and ecology in the Gulf of Mexico.
    - BISM is an adaptive management framework for selecting and planning barrier island restoration projects. It will directly utilize monitoring data collected under BICM and includes development of models and decision-support tools for prioritizing and planning projects based on their overall benefit to barrier islands and headlands.
  - Restore and Enhance Dunes and Beaches (D.1.5)
    - Dunes and beaches provide important coastal habitat for shorebirds, federally listed threatened and endangered beach mice, and sea turtles among other ecosystem services.
    - Louisiana barrier islands include dune and beach habitat.
    - BISM implementation will allow for barrier island projects to be selected and planned based on the impact the restoration will have in the short- and long-term, including for associated habitats such as dunes and beaches. BISM will allow for the value of potential restoration projects to be evaluated through use of data-driven predictive modeling and cumulative effects analysis, thereby supporting implementation of barrier island projects that provide the most benefit.
  - Restore and Enhance Submerged Aquatic Vegetation (D.1.6)
    - Healthy SAV serves critical ecological functions in the Gulf of Mexico, including habitat and forage for fish and wildlife, decreased wave energy, soil protection, and increased sediment accretion
    - Seagrasses in Louisiana are associated with the Chandeleur Islands that are included in the geographic scope of BISM.
    - BISM implementation will allow for barrier island projects to be selected and planned based on the impact restoration will have in the short- and long-term, including for associated habitats such as SAV. The Chandeleur Islands attenuate wave attenuation and storm surge to provide the low-energy hydrodynamic conditions necessary for SAV. BISM will allow for the value of potential restoration projects to be evaluated through use of data-driven predictive modeling and cumulative effects analysis, thereby supporting implementation of barrier island projects that provide the most benefit, including to SAV that relies on the integrity of the fronting islands to be maintained.
  - Protect and Conserve Marine, Coastal, Estuarine, and Riparian Habitats (D.1.7)
    - This approach can provide habitat connectivity across habitat types or geographic areas, and minimize habitat loss by reducing or avoiding impacts from activities such as development.
    - In addition, protecting habitats can provide public access for the use and enjoyment of the Gulf of Mexico's natural resources.
    - Large sections of the Louisiana Barrier Islands and Headlands are managed through Federal or State agencies.
    - In addition to directly providing coastal habitat, barrier islands provide protection (wave and storm surge attenuation) to habitats associated with coastal bays and basins inshore of the islands. BISM is an AM framework through which data and modeling will be used to select and plan restoration projects that provide the greatest local and regional benefit, thereby supporting protection and conservation of multiple habitat types.

- Sea Turtle Restoration Approaches (D.4)
  - Enhance Sea Turtle Hatchling Productivity and Restore and Conserve Nesting Beach Habitat (D.4.3)
    - While limited in Louisiana, improving and maintaining the suitability of nesting beach habitat for sea turtles is important.
    - Sea turtle testing has been documented at barrier islands such as the Chandeleur Islands, which are within the geographic scope of BISM.
    - BISM implementation will allow for barrier island projects to be selected and planned based on the impact the restoration will have in the short- and long-term, including for associated habitats such as beaches that support sea turtle nesting. BISM will allow for the value of potential restoration projects to be evaluated through use of data-driven predictive modeling and cumulative effects analysis, thereby supporting implementation of barrier island projects that provide the most benefit to beach habitat and associated species, including sea turtles.
- Bird Restoration Approaches (D.6)
  - Restore and Conserve Bird Nesting and Foraging Habitat (D.6.1)
    - Barrier islands and headlands provide important habitats necessary for conserving and restoring target habitat areas or land parcels for bird resources.
    - Dunes and beaches provide important coastal habitat for shorebirds among other ecosystem services.
    - BISM implementation will allow for barrier island projects to be selected and planned based on the impact the restoration will have in the short- and long-term, including for associated habitats such as beaches that support bird nesting and foraging. In addition, barrier islands such as Breton Island support mangroves that in turn provide habitat for birds. BISM will allow for the value of potential restoration projects to be evaluated through use of data-driven predictive modeling and cumulative effects analysis, thereby supporting implementation of barrier island projects that provide the most benefit to beach habitat and associated species, including birds.
- Recreational Use Restoration Approaches (D.8)
  - Enhance Public Access to Natural Resources for Recreational Use (D.8.1)
    - Barrier islands and headlands provide important habitats for various recreational activities
    - Maintaining and management of access and creating new or improved access to natural resources without negative impacts for recreational purposes is important.
    - BISM will allow for the value of potential restoration projects to be evaluated through use of data-driven predictive modeling and cumulative effects analysis, thereby supporting implementation of barrier island projects that provide benefit in the short- and long-term, including for recreational use.
- Monitoring and Adaptive Management (5.E)
  - BISM is designed and will be implemented as an adaptive management program. As described in PDARP/PEIS section E.2.1, “adaptive management is a form of structured decision-making (SDM)”; BISM directly utilizes an SDM and AM framework in the workflow for barrier island restoration project and sediment source selection.
  - BISM will support *Project Level Monitoring and Adaptive Management* (section E.3.1) through implementing a framework for monitoring data and analyses to be used to establish baseline conditions, predict the impacts of potential barrier island restoration projects, and prioritize/plan individual projects and sediment source selection based on that information.
  - BISM will support *Resource Level Monitoring and Adaptive Management* (section E.3.2) by providing a programmatic framework for planning and evaluating Louisiana barrier island

restoration based on regionwide impact to the habitats on, and associated with, these islands, which are within the PDARP/PEIS *Wetlands, Coastal, and Nearshore Habitats* restoration type.

- BISM will also support *Cross-Resource-Level Monitoring and Adaptive Management* (section E.3.3). The BISM evaluation framework for selecting and planning barrier island restoration projects includes consideration of the local and regional benefits that restoration projects may provide once constructed. These benefits span multiple coastal habitats and provide benefit across numerous named resources within the PDARP/PEIS.

The overall outcome of BISM will be the implementation of a comprehensive and programmatic MAM approach to CPRA's management of the Louisiana barrier island system, consistent with the PDARP/PEIS as described above. BISM implementation will leverage monitoring data, modeling, and the evaluation of local and regional benefits of restoration projects to select and plan barrier island projects, thereby maximizing the benefit to these systems and the habitats and species they support.

Evaluation of NEPA Requirements

The Trustees' approach to compliance with NEPA summarized in this section is consistent with the PDARP/PEIS Section 6.4.14 where applicable. Resources considered and impacts definitions (minor, moderate, major) align with the PDARP/PEIS. Relevant analyses from the PDARP/PEIS are incorporated by reference. Such incorporation by reference of information from existing plans, studies or other material is used in this analysis to streamline the NEPA process and to present a concise document that briefly provides sufficient evidence and analysis to address the Louisiana TIG's compliance with NEPA (40 CFR 1506.3, 40 CFR § 1508.9). All source documents relied upon are available to the public and links are provided in the discussion where applicable.

As discussed in Chapter 6 of the PDARP/PEIS, a TIG may propose funding a planning phase (e.g., initial engineering, design, and compliance) in one plan for a conceptual project, or for studies needed to maximize restoration planning efforts. This would allow the TIG to develop information needed leading to sufficient project information to develop a more detailed analysis in a subsequent restoration plan, or for use in the restoration planning process. Where these conditions apply and activities are consistent with those described in the PDARP/PEIS, NEPA evaluation is complete and no additional evaluation of individual activities is necessary at this time.

NEPA Review of MAM Activity

The activities and tasks described here consist exclusively of desktop analysis of existing data resources, computational modeling, and engagement of stakeholders and regulatory entities. Consistent with the impacts considered in the PDARP/PEIS, this activity would include preliminary restoration planning and data-base activities with no field activities. As such, there will be no impact to resources as defined with the PDARP/PEIS. Analysis of existing data, planning meetings, development of decision-support frameworks, and preparation of reports are data-based, desktop analysis components of this activity.

NEPA Conclusion

After review of the proposed activities against those actions previously evaluated in the PDARP/PEIS, the Louisiana TIG determined that the environmental consequences resulting from this MAM activity falls

within the range of impacts described in Section 6.4.14 of the PDARP/PEIS, thus no additional NEPA evaluation is necessary at this time.

Compliance with Environmental Laws and Regulations

The Louisiana TIG has completed technical assistance with the appropriate regulatory agencies for this project. Due to the nature of the project, which consists of data analysis, desktop modeling, and stakeholder engagement with no proposed field activities, permits and consultations are not required. Other projects proposed under Louisiana MAM may directly fund field work, thus existing permits and consultations will be reviewed to determine if they are sufficient to complete the work or if additional compliance work is needed.

Federal environmental compliance responsibilities and procedures follow the Trustee Council Standard Operating Procedures (SOP), which are laid out in Section 9.4.6 of that document. Following the SOP, the Implementing Trustees for each activity will ensure that the status of environmental compliance (e.g., completed vs. in progress) is tracked through the Restoration Portal.

Documentation of regulatory compliance will be available in the Administrative Record that can be found at the DOI's Online Administrative Record repository for the DWH NRDA (https://www.doi.gov/deepwaterhorizon/adminrecord). The current status of environmental compliance can be viewed at any time on the Trustee Council's website: http://www.gulfspillrestoration.noaa.gov/environmental-compliance/.

Activity Close Out

In accordance with Section 9.5.1.6 of the Trustee Council Standard Operating Procedures (TC SOPs), the Implementing Trustee (CPRA) shall provide the LA TIG with a closeout report after all activities and expenditures have been accomplished. The Final Report shall include a description and any documentation of the completed activity, estimated benefits to natural resources, the final funding balances and any transfers described in Section 7 of the TC SOPs, a summary of the results of monitoring, and any recommendations on adaptive management for the activity. Upon request, the Implementing Trustee shall provide the LA TIG with additional information and supporting documents to complete the closeout report.