Appendix B:

Monitoring and Adaptive Management Plans

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Monitoring and Adaptive Management Plans

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INTRODUCTION

Implementation of monitoring and Adaptive Management (MAM) was identified as one of the programmatic goals in the *Deepwater Horizon* (DWH) oil spill Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS). The DWH NRDA MAM Framework provides a flexible, science-based approach to effectively and efficiently implement restoration over several decades that provides long-term benefits to the resources and services injured by the DWH spill. The project MAM plans that follow in this appendix identify the monitoring needed to evaluate progress toward meeting project objectives and to support adaptive management of the restoration project. The plans identify key sources of uncertainty, incorporate monitoring data needs and decision points that address these uncertainties, and establish a decision-making process for making adjustments, if needed. MAM Plans are living documents and will be updated as needed to reflect changing conditions and/or new information. For example, a plan may need to be revised if the project design changes, if initial data analysis indicates that the sampling design is inadequate, or if any uncertainties are resolved or new uncertainties are identified during project implementation and monitoring. Any significant future revisions to MAM Plans will be made publicly available through the DIVER Restoration Portal.

Monitoring and adaptive management (MAM) are major responsibilities for the Alabama TIG. As described in the PDARP (section 7.5.1), TIGs are responsible for both resource- and project-level MAM activities. The AL TIG has developed and will implement MAM plans for all restoration projects consistent with guidance provided by the Trustee Council. Data generated through monitoring will provide the basis for annual project reporting which keeps the public fully informed about project progress and for adaptive management and corrective action decisions. Monitoring data will also be applied to improve the likelihood of success and benefits of future projects.

All of the projects in this Plan, with the exception of projects that are solely for engineering and design activities, have an associated MAM plan, which follow in this appendix. Many of the projects in this Plan will be implemented in partnership with entities that have deep expertise in their fields; this collaborative approach will leverage and expand existing efforts and increase confidence in outcomes and approaches for future restoration work.

The content of each MAM Plan depends on the type of project, the level of uncertainty associated with the implementation of the proposed activities

Some of the projects in this Plan propose to conduct activities associated with data gathering to fill critical information gaps that will reduce uncertainties and support the AL TIG in future work to develop and implement restoration projects successfully. Because the primary objective of these projects is to gain new knowledge, the associated MAM plans may or may not contain performance criteria or corrective actions. The AL TIG does not expect to conduct extensive project-level adaptive management for these projects, but they are an integral component to the AL TIG's commitment to adaptive management at the program/resource level because the completion of these projects will provide important knowledge that will inform future restoration actions.

There are three primary purposes of the MAM Plans:

1. The first purpose is to identify how restoration managers will measure and track progress towards achieving restoration goals and objectives. This work is accomplished via monitoring specific parameters that, individually and collectively, help the AL TIG understand the extent to which a project is achieving its restoration objectives.

2. The second purpose is to increase the likelihood of successful implementation through identification, before a project begins, of potential corrective actions that could be undertaken if a project does not proceed as expected. This is accomplished by conceptually outlining the reasons why a project might fail to meet its objectives and responses by the AL TIG that might be undertaken to correct these problems. The focus is on restoration planning uncertainties for the project and how these uncertainties may be best addressed through project design and implementation decisions.

3. The third purpose is to capture in a systematic way lessons learned or new information acquired that can be incorporated into future project selection, design, and implementation. The evaluation section of each Plan contains basic questions that the AL TIG will answer to help understand whether a project achieved its objectives and unanticipated issues were encountered during implementation and how such issues were addressed. Such information will provide insights for future project development. This section will be updated with additional information as monitoring methods are determined for each project. In the future, the AL TIG will work to identify ways to evaluate the overall success of their DWH restoration work by incorporating feedback from project-level evaluations into a larger resource-level framework to understand how projects could be expected to contribute collectively to restoration of injured resources and improved ecosystem conditions and function along the Alabama coast.

The Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0 provides detailed information regarding the importance and use of adaptive management.

MONITORING AND ADAPTIVE MANAGEMENT PLAN FOR DEEPWATER HORIZON NRDA PROJECT: MAGNOLIA RIVER LAND ACQUISITION—HOLMES TRACT

PROJECT OVERVIEW

The Holmes Tract is located in Baldwin County off Keith Lane along the Magnolia River (PIN 287940, 65806, and portion of 20643) and includes approximately 80 acres. The property is one of the largest undeveloped tracts on Magnolia River that has not been timbered. It contains more than 1 mile of frontage on Magnolia River and Weeks Creek, including a perimeter of small marsh and forested wetland fringe. The uplands interior of the property contains Gopher Tortoise (*Gopherus polyphemus*) habitat.

The purpose of this project is to acquire the property through a fee simple purchase by the Weeks Bay Foundation (WBF) and transfer it into the permanent ownership of the Weeks Bay National Estuarine Research Reserve (Weeks Bay NERR). The acquisition of this property would include an appropriate land protection instrument (i.e., deed restriction or conservation easement) placed on the property to ensure that the purpose of restoration as described in this plan is maintained in perpetuity. In addition, WBF would work with Weeks Bay NERR to create a management plan and prioritize restoration needs, including re-creating longleaf pine savannas, pitcher plant bogs, and marsh and swamp habitat (where appropriate). Restoration actions prioritized in the plan will then be implemented.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Programmatic goal: Restore and Conserve Habitat
- Restoration type: Wetlands, Coastal and Nearshore Habitat
- Restoration type goal: Restore a variety of interspersed and ecologically connected coastal habitats with particular focus on maximizing ecological functions for the range of resources injured by the spill, such as oysters, estuarine-dependent fish species, birds, marine mammals, and nearshore benthic communities
- Restoration approach: Protect and conserve marine, coastal, estuarine and riparian habitats
- Restoration technique: Acquire lands for conservation

Objective 1: Restore and conserve coastal habitat along Magnolia River, protecting habitats and increasing habitat connectivity within the corridor.

Objective 2: Develop a management plan and prioritize restoration needs.

Objective 3: Conduct stewardship and management activities as needed to enhance the quality of habitat.

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

As stated in the PDARP, coastal wetlands provide a wide range of ecological functions and services, including providing important habitat for fish and wildlife species, improving water quality, stabilizing shorelines, reducing storm-surge risk, and capturing and storing carbon in organic soils. The restoration approach utilized is to protect and conserve marine, coastal, estuarine, and riparian habitats. The specific technique under this restoration approach is to acquire lands for conservation. Conserving and protecting land parcels via acquisition or conservation easements can protect wetlands and other significant coastal, estuarine, and riparian habitats; create connections between protected areas;

remove direct threats of development; provide mechanisms for protected species management; provide nesting and foraging habitat for birds; protect critical freshwater inflows to estuaries; and improve coastal water quality.

The activities in this project include the acquisition of 80 acres of coastal habitat on the Magnolia River and subsequent placement of that acreage into conservation and active management, which will reduce stressors including urban development, habitat loss and alteration, fragmentation and erosion, leading to improved habitat conditions and quality as well as improved water quality. Long-term outcomes of the project include an increase in acres of lands managed for conservation purposes and increase in habitat connectivity and an overall enhancement of ecosystem services of Gulf Coast habitats and resources.

Sources of Uncertainty

The primary source of uncertainty for this project is related to the willingness of the seller for the purchase of the parcel. This uncertainty has been mitigated by working to find willing sellers as the project was developed. Additionally, restoration activities undertaken may be subject to environmental stressors or other conditions that could influence project outcomes. Other potential uncertainties that could influence project success include:

- Vegetation stress due to herbivory, disease and competition from invasive species;
- Land use changes; and
- Sustaining optimal hydrologic conditions.

These potential uncertainties will be addressed when specific restoration activities are identified in the management plan and the MAM plan will be updated accordingly.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and identify potential corrective actions, if needed. For each of the monitoring parameters identified below, information is provided on the intended purpose of each monitoring parameter (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. This section also describes applicable performance criteria and potential corrective actions for project parameters associated with project objectives.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria are used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. The decision to implement a corrective action will holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Parameter: Acquisition of Parcel

a. Purpose: To verify acquisition of high quality habitat.
b. Method: Submission of executed acquisition documents, such as a deed
c. Timing and Frequency: Once upon completion of acquisition

    d.   Sample Size: n=1
    e.   Sites: Holmes Tract
    f.   Performance Criteria: Executed acquisition document
    g.   Corrective Action(s): Identify another willing seller if parcel cannot be acquired

Parameter: Area Acquired, by Habitat Type

    a.   Purpose: To determine area of habitat restored/enhanced/protected by project
    b.   Method: Analysis of aerial imagery, ground survey or boundary survey that accompanies deed
    c.   Timing and Frequency: Once upon completion of acquisition
    d.   Sample Size: n=1
    e.   Sites: Holmes Tract
    f.   Performance Criteria: NA
    g.   Corrective Action(s): NA

Parameter: Completed Management Plan

    a.   Purpose: To prioritize and plan management actions for the parcel
    b.   Method: Provide copy of management plan that identifies and prioritizes restoration activities to ALTIG
    c.   Timing and Frequency: End of Year 1
    d.   Sample Size: NA
    e.   Sites: NA
    f.   Performance Criteria: Management plan should identify priority activities and habitats and rough cost estimates
    g.   Corrective Action(s): Revise and update as needed

Parameter: Vegetation Percent Cover and Composition

    a.   Purpose: To determine if vegetation is becoming established, increasing or being maintained
    b.   Method: Visual assessment of 1-4 m^2 plots for total percent cover of target and undesirable species. Percent cover of individual species by layer
    c.   Timing and Frequency: Baseline, as built (year zero) and annually for 3 years in mid-late summer
    d.   Sample Size: 1-4 m^2 plots
    e.   Sites: Throughout project footprint in areas where restoration activities are implemented
    f.   Performance Criteria: Performance criteria will be determined when specific management actions are identified.
    g.   Corrective Action(s): Adjust management techniques as necessary to reach performance criteria goals. This may include increasing or decreasing the prescribed fire frequency, increasing amount of mechanical removal of canopy species, or an increase in herbicidal treatment for invasive species.

Parameter: Area Enhanced and/or Restored, by Habitat Type

    a.   Purpose: To determine whether the goals of the management plan are being met
    b.   Method: Analysis of aerial imagery, ground survey and/or biological survey(s) completed during management plan development
    c.   Timing and Frequency: Annually in all areas where new work has been initiated
    d.   Sample Size: Total area
    e.   Sites: All sites
    f.   Performance Criteria: All activities implemented meet recommendations in management plan
    g.   Corrective Action(s): NA

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 1: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Project Monitoring (Years 1-3)
Acquisition of parcel	1		X	
Completed management plan	2		X	
(Area) Extent of habitat acquired	1		X	
Vegetation Percent Cover and Composition	3	X	X	X
Number of acres enhanced or restored	3		X	X

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (DWH NRDA Trustees 2016a, Appendix 5.E.1). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action.

Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management on specific conservation practices being implemented is not needed for this project due to the nature of the activities, the scale of the site and the robust understanding of the habitat enhancement activities that will be conducted. Additionally, the development of a management plan that contains prioritized restoration needs will assist in addressing and reducing uncertainties by identifying those activities most likely to be successful and enhance resources and/or habitats. Corrective actions may be undertaken on an as needed basis. Data, analysis and information obtained

from this project would be used to help inform future Restoration Plan development, priorities and project selection.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

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

These questions will be answered and compiled in annual monitoring reports for the project and revision to the MAM plan will be made if needed.

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy will be made and the original preserved.

Data Review and Clearance

After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used

for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata. All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual Version 1.0. Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. Some data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

REPORTING

Annual MAM reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

ROLES AND RESPONSIBILITIES

ADCNR is the lead Trustee agency for this project, and will ensure that the tract is acquired by the Weeks Bay Foundation.

WBF will purchase the property and transfer it into the permanent ownership of ADCNR, with management by the Weeks Bay NERR.

The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016a. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

DWH NRDA Trustees. 2017. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill. December.

National Research Council (NRC). 2004. *Adaptive Management for Water Resources Project Planning*. Washington, DC: The National Academies Press.

Pastorok, R.A., MacDonald, A., Sampson, J.R., Wilber, P., Yozzo, D.J., & Titre, J.P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9, 89-107.

Steyer, G.D. & Llewellyn, D.W. 2000. Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 26, 27-39.

Williams, B.K. 2011. Adaptive management of natural resources - Framework and issues. Journal of Environmental Management, 92, 1346-1353.

MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	6/1/2018	Draft to final version; Added parameter for acres enhanced/restored; added detail to parameters	Draft to final	MAM Plan Magnolia_Holmes_6.1.18

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MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
WEEKS BAY LAND ACQUISITION—EAST GATEWAY TRACT

PROJECT OVERVIEW

The proposed Weeks Bay Land Acquisition (East Gateway Tract) project would fund the Weeks Bay Foundation (WBF) to acquire the 175-acre East Gateway Tract through a fee simple purchase and transfer it into the permanent ownership of ADCNR with management by the Weeks Bay NERR. The East Gateway Tract is located in Baldwin County at the mouth of Weeks Bay and contains approximately 175 undeveloped acres. The project would protect the eastern shore of the mouth of Weeks Bay where a large salt marsh with an unnamed stream provides protected habitat and shelter for wading birds, duck species, and various indigenous marine life. This property contains more than 100 acres of wetlands, including estuarine intertidal marsh and freshwater forested wetlands. The bay front edge of the property is a popular place for anglers to anchor and fish for speckled trout and redfish.

WBF would purchase the property from a willing seller at or below the Yellow Book appraised value. The acquisition of this property would include an appropriate land protection instrument (i.e., deed restriction or conservation easement) to ensure that the purpose of restoration as described in this plan is maintained in perpetuity. WBF would work with Weeks Bay NERR to create a management plan and prioritize restoration needs, including re-creating longleaf pine savannas, pitcher plant bogs, and marsh and swamp habitat (where appropriate). This project would also include E&D for the removal of a bulkhead on the waterfront point of the property that splits Weeks Bay and Mobile Bay. The bulkhead is contributing to shoreline scouring and erosion. A shoreline restoration plan would be developed as part of the bulkhead removal E&D.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Programmatic goal: Restore and Conserve Habitat
- Restoration type: Wetlands, Coastal and Nearshore Habitat
- Restoration Type goal: Restore a variety of interspersed and ecologically connected coastal habitats with particular focus on maximizing ecological functions for the range of resources injured by the spill, such as oysters, estuarine-dependent fish species, birds, marine mammals, and nearshore benthic communities.
- Restoration approach: Protect and conserve marine, coastal, estuarine and riparian habitats
- Restoration technique: Acquire lands for conservation

Objective 1: Restore and conserve coastal habitat in the Weeks Bay watershed, protecting habitats and increasing habitat connectivity within the corridor.

Objective 2: Develop a management plan to prioritize restoration needs.

Objective 3: Conduct engineering and design for removal of a bulkhead and develop associated shoreline restoration plan.

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

The activities in this project include the acquisition of 175 acres of coastal habitat on the Magnolia River and subsequent placement of that acreage into conservation and active management, which will

reduce stressors including urban development, habitat loss and alteration, fragmentation and erosion, ultimately leading to improved habitat conditions and quality as well as improved water quality. This project meets the Trustees' wetlands, coastal, and nearshore habitats goals by permanently protecting, conserving, and restoring wetland and upland habitats that are directly connected ecologically to coastal and estuarine areas injured by the spill and that contribute to maximizing ecological functions in these areas. Long-term outcomes of the project increased an increase in management of connected habitats and an overall enhancement of ecosystem services of Gulf Coast habitats and resources.

As stated in the PDARP, coastal wetlands provide a wide range of ecological functions and services, including providing important habitat for fish and wildlife species, improving water quality, stabilizing shorelines, reducing storm-surge risk, and capturing and storing carbon in organic soils. The restoration approach utilized is to protect and conserve marine, coastal, estuarine, and riparian habitats. The specific technique under this restoration approach is to acquire lands for conservation. Conserving and protecting land parcels via acquisition or conservation easements can protect wetlands and other significant coastal, estuarine, and riparian habitats; create connections between protected areas; remove direct threats of development; provide mechanisms for protected species management; provide nesting and foraging habitat for birds; protect critical freshwater inflows to estuaries; and improve coastal water quality.

Sources of Uncertainty

The primary source of uncertainty for this project is related to the willingness of the seller and the purchase of the parcel. This uncertainty has been mitigated by working to find willing sellers as the project was developed. Additionally, future shoreline restoration activities undertaken as a result of recommendations in the shoreline restoration plan may be subject to environmental stressors or other conditions that could influence project outcomes. Other potential uncertainties that could influence project success include:

- Vegetation stress due to herbivory, disease and competition from invasive species;
- Land use changes; and
- Sustaining optimal hydrologic conditions.

These potential uncertainties will be addressed when specific restoration activities are identified and the MAM plan will be updated accordingly.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and identify potential corrective actions, if needed. For each of the monitoring parameters identified below, information is provided on the intended purpose of each monitoring parameter (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. This section also describes applicable performance criteria and potential corrective actions for project parameters associated with project objectives.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria are used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers

uncovered during the evaluation step may also determine the need for corrective actions. The decision to implement a corrective action will holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Parameter: Acquisition of Parcel

    a. Purpose: To verify acquisition of high quality habitat
    b. Method: Submission of executed acquisition documents, such as a deed
    c. Timing and Frequency: Once upon completion of acquisition
    d. Sample Size: n=1
    e. Sites: East Gateway Tract
    f. Performance Criteria: Executed acquisition document
    g. Corrective Action(s): Identify another willing seller if parcel cannot be acquired

Parameter: Area Acquired

    a. Purpose: Determine area of habitat restored/enhanced/protected by habitat type
    b. Method: Analysis of aerial imagery, ground survey or boundary survey that accompanies deed
    c. Timing and Frequency: Once upon completion of acquisition
    d. Sample Size: n=1
    e. Sites: Project footprint
    f. Performance Criteria: Acres purchased matches RP acreage
    g. Corrective Action(s): NA

Parameter: Completed Management Plan

    a. Purpose: To prioritize and plan management actions for the parcel
    b. Method: Provide copy of management plan that identifies and prioritizes restoration activities to ALTIG
    c. Timing and Frequency: End of year one
    d. Sample Size: NA
    e. Sites: NA
    f. Performance Criteria: Management plan should identify priority activities and habitats and rough cost estimates
    g. Corrective Action(s): Revise and update as needed

Parameter: Completion of Bulkhead Removal E&D

    a. Purpose: To plan and design a project to improve shoreline conditions
    b. Method: Provide plans and specs to ALTIG in annual report
    c. Timing and Frequency: By end of Year 3
    d. Sample Size: NA
    e. Sites: TBD
    f. Performance Criteria: Completed and submitted to ALTIG
    g. Corrective Action(s): NA

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 1: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Project Monitoring (Years 1-4)
Acquisition of parcel	1		X	
Completed management plan	2			X
(Area) Extent of habitat acquired	1		X	
Completion of bulkhead removal E&D	3			X

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (DWH NRDA Trustees, 2016a, Appendix 5.E.1). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action. Although adaptive management is a critical component of the restoration plan as a whole, the need for extensive adaptive management on specific conservation practices being implemented is not needed for this project due to the nature of the activities, the scale of the site and the robust understanding of the habitat enhancement activities that will be conducted. Additionally, the development of a management plan that contains prioritized restoration needs will assist in addressing and reducing uncertainties by identifying those activities most likely to be successful.

Corrective actions may be undertaken on an as needed basis. Data, analysis and information obtained from this project would be used to help inform future restoration plan development, priorities and project selection.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

- Were the project objectives achieved? If not, is there a reason why they were not met?
- Did acquisition of property increase the acreage of conserved habitat in the Weeks Bay Watershed?
- Was engineering and design for the bulkhead removal completed and was related shoreline restoration plan developed?
- Did the project produce unanticipated effects?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?

These questions will be answered and compiled in annual monitoring reports for the project and revision to the MAM plan be made if needed.

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy will be made and the original preserved.

Data Review and Clearance

After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata. All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual Version 1.0. Data will be made publicly available, in accordance with the Federal Open Data Policy

(Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. Some data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

REPORTING

Annual MAM reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

ROLES AND RESPONSIBILITIES

ADCNR is the lead Trustee agency for this project, and will ensure that the tract is acquired.

WBF will purchase the property and transfer it into the permanent ownership of ADCNR with management by the Weeks Bay NERR.

The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016a. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

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

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Steyer, G.D. & Llewellyn, D.W. 2000. Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 26, 27-39.

Williams, B.K. 2011. Adaptive management of natural resources - Framework and issues. Journal of Environmental Management, 92, 1346-1353.

MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	6/1/2018	Draft to final version; Added detail to parameters	Draft to final	MAM_Plan_WB_EastGateway_6.1.18

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MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
WEEKS BAY LAND ACQUISITION—HARROD TRACT

PROJECT OVERVIEW

The Harrod Tract is located in Baldwin County, Alabama off Sherwood Highland Road (PIN 065600). It is located along the Fish River near where Fish River meets Weeks Bay. The Harrod property contains a total of 231 acres, including over 100 acres of intact wetlands (marsh) habitat. The property is one of the largest remaining undeveloped parcels of swamp, marsh and river shoreline in coastal Alabama and is the largest privately-owned tract in the lower part of Fish River. The property is adjacent to protected wetlands and includes 7,600 feet of Fish River shoreline, including frontage along Turkey Branch and Waterhole Branch, two of Fish River's primary tributaries.

The proposed Weeks Bay Land Acquisition (Harrod Tract) project would fund WBF or the State of Alabama to acquire the 231-acre Harrod Tract through a fee simple purchase, and transfer it into the permanent ownership of ADCNR with management by the Weeks Bay NERR. The Weeks Bay Land Acquisition (Harrod Tract) project would protect approximately 231 acres in perpetuity to maintain its conservation value. A restoration plan would be developed, and associated restoration activities would be conducted on the purchased property, which could include invasive species control (prescribed burning or other methods), native vegetation planting, and limited erosion control measures.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Programmatic goal: Restore and Conserve Habitat
- Restoration type: Wetlands, Coastal and Nearshore Habitat
- Restoration type goal: Restore a variety of interspersed and ecologically connected coastal habitats with particular focus on maximizing ecological functions for the range of resources injured by the spill, such as oysters, estuarine-dependent fish species, birds, marine mammals, and nearshore benthic communities. The project also meets Trustee goals for wetlands, coastal, and nearshore habitats restoration through the inclusion of funds for invasive species control, native species planting, and erosion control, as well as through the provision of funding for future restoration planning to determine the feasibility of reestablishing longleaf pine savannahs and other historic landscapes.
- Restoration approach: Protect and conserve marine, coastal, estuarine and riparian habitats
- Restoration technique: Acquire lands for conservation

Objective 1: Restore and conserve coastal habitat in the Weeks Bay watershed.

Objective 2: Develop a management plan to prioritize restoration needs.

Objective 3: Conduct stewardship and management activities as needed to enhance the quality of habitat.

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

As stated in the PDARP, coastal wetlands provide a wide range of ecological functions and services, including providing important habitat for fish and wildlife species, improving water quality, stabilizing shorelines, reducing storm-surge risk, and capturing and storing carbon in organic soils. The restoration approach utilized is to protect and conserve marine, coastal, estuarine, and riparian habitats. The specific technique under this restoration approach is to acquire lands for conservation. Conserving and

protecting land parcels via acquisition or conservation easements can protect wetlands and other significant coastal, estuarine, and riparian habitats; create connections between protected areas; remove direct threats of development; provide mechanisms for protected species management; provide nesting and foraging habitat for birds; protect critical freshwater inflows to estuaries; and improve coastal water quality.

The activities in this project include the acquisition of 231 acres of coastal habitat and subsequent placement of that acreage into conservation and active management, which will reduce stressors including urban development, habitat loss and alteration, fragmentation and erosion, ultimately leading to improved habitat conditions and quality as well as improved water quality. Long-term outcomes of the project include an increase in acres of lands managed for conservation purposes, and increase in habitat connectivity and an overall enhancement of ecosystem services of Gulf Coast habitats and resources.

Sources of Uncertainty

The primary source of uncertainty for this project is related to the willingness of the seller for the purchase of the parcel, although the property owner has indicated they are willing to sell. If for any reason the State is unable to purchase the property, another parcel will be sought. Other potential uncertainties that could influence project success include:

- Vegetation stress due to herbivory, disease and competition from invasive species;
- Land use changes; and
- Sustaining optimal hydrologic conditions.

These potential uncertainties will be addressed when specific restoration activities are identified and the MAM plan will be updated accordingly.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and identify potential corrective actions, if needed. For each of the monitoring parameters identified below, information is provided on the intended purpose (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. This section also describes applicable performance criteria and potential corrective actions for project parameters associated with project objectives.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria are used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. The decision to implement a corrective action will holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Parameter: Acquisition of Parcel

a. Purpose: To verify acquisition of high quality habitat
b. Method: Submission of executed acquisition documents, such as a deed
c. Timing and Frequency: Once upon completion of acquisition

d. Sample Size: n=1
e. Sites: Harrod Tract
f. Performance Criteria: Executed acquisition document
g. Corrective Action(s): Identify another willing seller if parcel cannot be acquired

Parameter: Area Acquired

a. Purpose: Determine area of habitat restored/enhanced/protected by habitat type
b. Method: Analysis of aerial imagery, ground survey or boundary survey that accompanies deed
c. Timing and Frequency: Once upon completion of acquisition
d. Sample Size: n=1
e. Sites: Project footprint
f. Performance Criteria: Acres acquire matches RP acreage
g. Corrective Action(s): NA

Parameter: Completed Management Plan

a. Purpose: To prioritize and plan management actions for the parcel
b. Method: Provide copy of management plan that identifies and prioritizes restoration activities to ALTIG
c. Timing and Frequency: End of year one
d. Sample Size: NA
e. Sites: NA
f. Performance Criteria: Management plan should identify priority activities and habitats and rough cost estimates
g. Corrective Action(s): Revise and update as needed

Parameter: Vegetation Percent Cover and Composition

a. Purpose: To determine if vegetation is becoming established, increasing or being maintained
b. Method: Visual assessment of 1-4 m^2 plots for total percent cover of target and undesirable species. Percent cover of individual species by layer.
c. Timing and Frequency: baseline, as built (year zero) and annually in mid-late summer
d. Sample Size: 1-4 m^2 plots
e. Sites: Throughout project footprint
f. Performance Criteria: Performance criteria will be determined when specific management actions are identified
g. Corrective Action(s): Adjust management techniques as necessary to reach performance criteria goals. This may include increasing or decreasing the prescribed fire frequency, increasing amount of mechanical removal of canopy species, or an increase in herbicidal treatment for invasive species.

Parameter: Area (acres) Enhanced / Restored, by Habitat Type

a. Purpose: To determine whether the goals of the management plan are being met
b. Method: Analysis of aerial imagery, ground survey and/or biological survey(s) completed during management plan development
c. Timing and Frequency: Annually in all areas where new work has been conducted
d. Sample Size: Total area
e. Sites: All sites where work has been conducted
f. Performance Criteria: All activities undertaken meet recommendation in management plan
g. Corrective Action(s): NA

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 1: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Project Monitoring (Years 1-3)
Acquisition of parcel	1		X	
Area	1		X	
Vegetation Percent Cover and Composition	3	X	X	X
Number of acres enhanced/restored	3		X	X
Completed Management Plan	2			X

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (DWH NRDA Trustees 2016a, Appendix 5.E.1). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action.

Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management on specific conservation practices being implemented is not needed for this project due to the nature of the activities, the scale of the site and the robust understanding of the habitat enhancement activities that will be conducted. Additionally, the development of a management plan that contains prioritized restoration needs will assist in addressing and reducing uncertainties by identifying those activities most likely to be successful. Corrective actions may be undertaken on an as needed basis. Data, analysis and information obtained from this project would be used to help inform future Restoration Plan development, priorities and project selection.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Did acquisition of property increase the acreage of conserved habitat in the Weeks Bay Watershed?
- Did the restoration activities undertaken produce unanticipated effects?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?

These questions will be answered and compiled in annual monitoring reports for the project and revision to the MAM plan be made if needed.

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy will be made and the original preserved.

Data Review and Clearance

After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and ensure that all data are entered or converted into agreed

upon/commonly used digital format labeled with metadata. All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual Version 1.0. Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. Some data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

REPORTING

Annual MAM reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

ROLES AND RESPONSIBILITIES

ADCNR is the lead Trustee agency for this project, and will ensure that the tract is acquired by the WBF.

WBF will purchase the property and transfer it into the permanent ownership of ADCNR with management by the Weeks Bay NERR.

The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016a. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

DWH NRDA Trustees. 2017. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill. December.

National Research Council (NRC). 2004. *Adaptive Management for Water Resources Project Planning*. Washington, DC: The National Academies Press.

Pastorok, R.A., MacDonald, A., Sampson, J.R., Wilber, P., Yozzo, D.J., & Titre, J.P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9, 89-107.

Steyer, G.D. & Llewellyn, D.W. 2000. Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 26, 27-39.

Williams, B.K. 2011. Adaptive management of natural resources - Framework and issues. Journal of Environmental Management, 92, 1346-1353.

MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	6/1/2018	Draft to final version; Added detail to parameters; added parameter for acres enhanced/restored	Draft to final	MAM_Plan_WB_Harrod_6.1.18

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MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
LITTLE LAGOON LIVING SHORELINE

PROJECT OVERVIEW

This project is located in Little Lagoon, Gulf Shores, Alabama, and it aims to restore a minimum of 2,200 feet of shoreline on and adjacent to Bon Secour National Wildlife Refuge (BSNWR). The project would include evaluation, planning, implementation, and monitoring and adaptive management of a living shoreline project. Little Lagoon is a shallow body of water, 10 miles long and 0.5-mile-wide on the north side of the Gulf of Mexico on the Alabama coast. Its brackish water is a mix of overflow from the mostly fresh water Lake Shelby and salt water from the Gulf of Mexico that enters through the Little Lagoon Pass in Gulf Shores, Alabama.

Construction of a living shoreline would protect habitat on adjacent federal land by buffering the shoreline against erosion. The project would include planning, implementation, and monitoring of a living shoreline project that uses natural materials rather than hardened structures or barriers, strategically placed to provide protective erosion control management to restore natural habitat, functions, and processes. USDOI would be the implementing Trustee for this project.

One or two rows of biodegradable coconut fiber "coir" logs may be placed along the eroding shoreline to stabilize vegetation and attenuate wave action, and grass plantings (e.g., *Spartina alterniflora* or *Juncus roemerianus*) may be placed between the logs and the eroded shoreline to jump-start a vegetated buffer. Native mussels may also be seeded among the shoreline grasses. The specific restoration activities would be finalized during the evaluation and planning process.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

The project Restoration Type is Habitat Projects on Federally Managed Lands. The Restoration Type goals, approach and technique are:

- Programmatic goal: Restore and Conserve Habitat
- Restoration type goal: Restore federally managed habitats that were affected by the oil spill and response actions through an integrated portfolio of restoration approaches across a variety of habitats.
- Restoration approach: Protect and conserve marine, coastal, estuarine and riparian habitats
- Restoration technique: Construct breakwaters

Goal: Reduce rate of shoreline erosion.

Objective 1: Ensure proper installation and functionality of the living shoreline.

Objective 2: Project area has 80% native vegetative cover within 3 years of project completion.

Objective 3: Reduce rate of shoreline erosion.

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

The conceptual model, described below, forms the basis of this monitoring plan, and includes a summary of the project activities, the expected product or output of those activities and the desired project outcomes. Constructing a breakwater of biodegradable coconut fiber logs will help reduce stressors including erosion and habitat loss, ultimately improving ecosystem function, and/or biological

capacity. The construction of a living shoreline will result in reduction of erosion of shoreline protecting adjacent beach mouse habitat and will also increase the amount of biologically productive shoreline habitat. Planting vegetation will stabilize sediment and the shoreline, reduce erosion, encourage sediment deposition and contribute to ecosystem function.
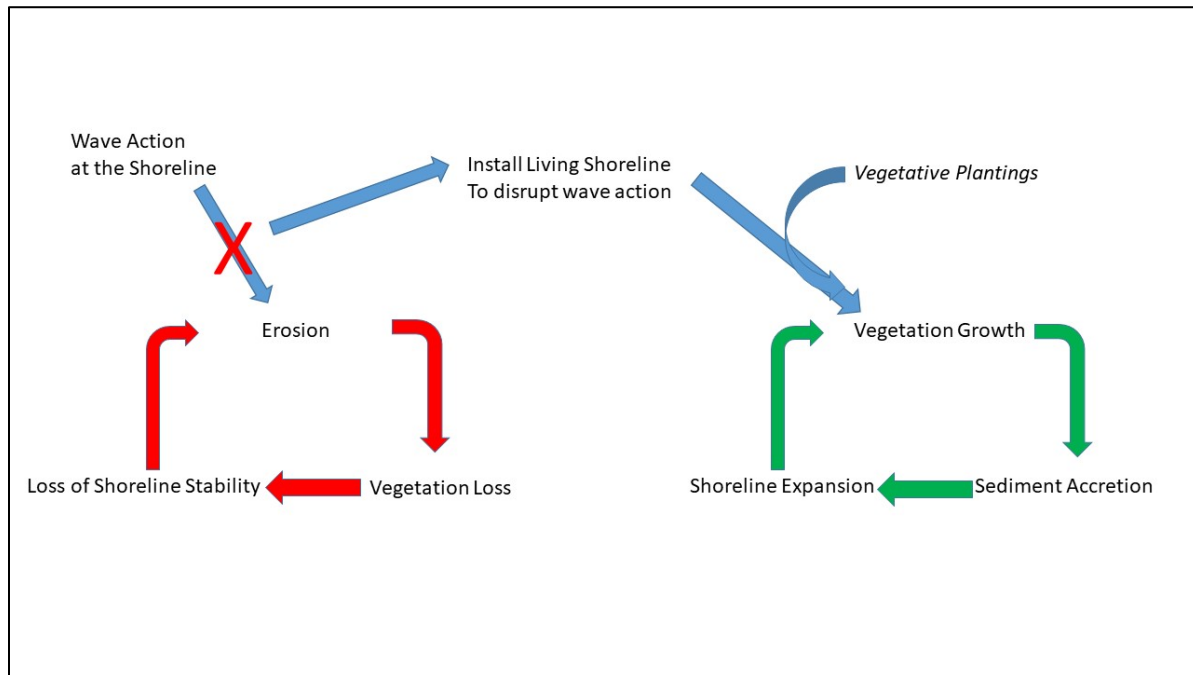
Figure 1. Conceptual model diagramming vegetated shoreline erosion processes vs. that of an enhanced living shoreline.

Sources of Uncertainty

The primary source of uncertainty for this project is related to the construction of the living shoreline as designed, on schedule and on budget. Other uncertainties include impact from potential storms, as well as the longevity and effectiveness of the materials used to construct the living shoreline. The materials proposed to be utilized have proven effective in other areas, reducing the likelihood of project failure. Other uncertainties include:

- Stress on planted vegetation due to herbivory, disease or competition
- Maintenance of optimal hydrologic conditions for the sustainability of restored areas
- Natural variability in ecological and physical processes
- Rate of sediment accretion
- Lifespan of coir logs in project environment
- Frequency or severity of storms during the grow-in stage

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring for this project, outlined below, is organized by project objective, with one or more monitoring parameters for each objective. For each of the monitoring parameters, information is provided on method, timing and frequency, duration, sample size, and sites. Also included is the intended purpose of each monitoring parameter (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), as

well as performance criteria for each parameter (if applicable) and example corrective actions that could be taken if the performance criteria are not met.

The adaptive management decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria would be used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. Information below does not include all possible options; rather, it includes a list of potential adaptive management actions for each individual parameter to be considered. The decision to implement a corrective action should holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Objective 1: Ensure proper installation and functionality of the living shoreline.

Parameter: Structural Integrity of Constructed Figures

a. Method: Conduct visual observations and photograph the project site. Visual surveys may be used subjectively to record the overall conditions, integrity, and effectiveness of the structure, including observations of material movement, changes in profile, change in habitat, etc. Particular attention should be paid to the stakes and ropes securing the coir logs, as well as the integrity of the jute net holding the log together.

b. Timing and frequency: The project is expected to be completed within a 90-day time frame. Project footprint as-built surveys will occur immediately following construction activities and delineate project components (e.g., location of coir log placement, area planted, etc.). Surveys will be repeated twice, 1- and 2-years post construction. Additionally, surveys should be conducted after any major storm event, particularly it there was high water in Little Lagoon and/or a strong easterly wind.

c. Sample size: Length of project

d. Sites: Length of project footprint

e. Performance criteria: Constructed as designed

f. Corrective action: If issues are discovered within the warranty period (the first-year post-construction) they will be documented and immediately referred to the contractor (through the CO) for repair or replacement. If issues are discovered outside of the warranty period (or are otherwise not the result of defective work) will be repaired by Refuge personnel. Loose coir logs that have not yet shifted position will be re-staked/re-tied. Logs that have moved will be returned to their original position, or secured in their new position as determined by Refuge staff.

Objective 2: Project area has 80% native vegetative cover within 3 years of project completion.

Parameter: Vegetation Percent Cover and Composition

a. Method: Establish plots within the project area and record plot locations with a GPS and/or mark the plots with corner poles to allow for revisiting over time. Determine species composition and estimate percent cover of each within a 1m2 plot. See U.S. EPA (2011) for additional guidance on performing visual estimates of vegetation percent cover.

b. Timing and Frequency: Immediately prior to construction activities, immediately following construction, then annually at peak of growing season 1 and 2 years post-construction.

c. Sample Size: 7 study plots and 1 baseline plot

d. Sites: Randomly located sample sites within the project footprint
e. Performance Criteria: 80% survival of planted species, 80% vegetative cover within 3 years
f. Corrective Action: Install additional vegetation, employ anti-herbivory measures, Check elevation

Objective 3: Reduce erosion to project shoreline.

Parameter: Shoreline Position

a. Method: Walk the shoreline (seaward edge of coir logs, and existing shoreline) while taking continuous measurements using an RTK GPS. Import the spatial information into ArcGIS and map the shoreline position. Import and analyze the data using spatial analysis software. Determine the shoreline loss/gain in meters per year. See Steyer and Llewellyn (2000) for more information on this method.
b. Timing and Frequency: Immediately prior to construction activities, immediately following construction, 1 and 2 years post construction
c. Sample Size: 1/year
d. Sites: Length of project footprint
e. Performance Criteria: Over monitoring period, no additional landward migration of shoreline
f. Corrective Action: Replace damaged or missing coir logs, install additional wave attenuation structures

Parameter 2: Sediment Accretion

a. Method: Bathymetric survey transects from the existing shoreline to the seaward-most line of coir logs
b. Timing and Frequency: Immediately prior to construction activities, immediately following construction, 1 and 2 years post construction
c. Sample Size: 1 Survey/year (12 transects)
d. Sites: Within project footprint
e. Performance Criteria: Over monitoring period, net increase in elevation landward of the coir logs
f. Corrective Action: Place additional sediment landward of coir logs

The schedule for project monitoring is shown in Table 2, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 2. Project Monitoring Schedule

Parameter	Objective	Pre-Execution	As-Built (Year 0)	Post-Execution (Years 1, 2)
Spatial extent	1		X	X
Vegetation Percent Cover and Composition	2	X	X	X
Shoreline Position	3	X	X	X
Sediment Accretion	3	X	X	X

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000).

Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (DWH NRDA Trustees, 2016a, Appendix 5.E.1, PDARP/PEIS). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action.

The need for extensive adaptive management on specific components of this project is not expected due to the nature of activities, scale of the site, and robust understanding of activities that will be conducted. Periodic maintenance may be necessary following severe weather events or other situations that would increase erosion potential. Adaptive management activities could include installing an additional row of coir logs or bagged oyster shells in front of or on top of the initial row of coir logs if they were placed too low or degrade too quickly. Data, analysis and information obtained from this project would be used to help inform future Restoration Plan development, priorities and project selection.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis will be used to answer the following questions:

- Were project restoration objectives achieved? If not, is there a reason why they were not met?
- Was project constructed as designed?
- Did planted vegetation establish successfully?
- Has erosion been reduced?
- Did the restoration project produce unanticipated effects?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?
- Have data been summarized and characterized in a way that allows for a clear understanding of results?
- What broader insights might be gained from implementation/monitoring of this project?

These questions will be answered and compiled in annual monitoring reports for the project and revision to this MAM plan be made if needed.

DATA MANAGEMENT

To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. All data will undergo proper QA/QC protocols, be reviewed, and verified following the process outlined in Section 3 of the MAM Manual. In general, electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created, and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved. Relevant Project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into Excel spreadsheets (or similar digital format). After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and would ensure that all data is entered or converted into agreed upon/commonly used digital format labeled with metadata.

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

REPORTING

Annual reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

ROLES AND RESPONSIBILITIES

DOI is the lead Trustee agency for this project and will ensure that the project is implemented. The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees, 2016a, Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees, 2016b, Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

National Research Council, 2004, Adaptive Management for Water Resources Project Planning. Washington, DC: The National Academies Press.

Pastorok, R.A., A. MacDonald, J.R. Sampson, P. Wilber, D.J. Yozzo, and J.P. Titre, 1997, An ecological decision framework for environmental restoration projects. Ecological Engineering, 9, 89-107.

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Williams, B.K, 2011, Adaptive management of natural resources - Framework and issues. Journal of Environmental Management, 92, 1346-1353.

MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version	3/18			
MAM Plan Little Lagoon Living Shoreline 05252018-plt	6/1/2018	Service project specific MAM review	Service MAM consistency	MAM Plan Little Lagoon Living Shoreline 060118

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MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
FOWL RIVER NUTRIENT REDUCTION PROJECT

PROJECT OVERVIEW

This project will restore resources injured by the *DWH* oil spill as outlined in the *DWH* PDARP/PEIS following the Natural Resource Damage Assessment process. The Fowl River Nutrient Reduction project would restore water quality through implementation of improved land management practices that reduce nutrient and sediment loadings to Mobile Bay. The implementation of land management practices using existing USDA-NRCS conservation practice standards and specifications would be the primary tool for reducing erosion and nutrient inputs in the watershed.

Excessive nutrient enrichment, or eutrophication, of Gulf Coast estuaries and their watersheds is a chronic threat that can lead to hypoxia (low oxygen levels), harmful algal blooms, habitat loss, and fish kills (DWH NRDA Trustees 2016a, section 5.5.4). This project would restore and enhance the ecological and hydrological integrity of water resources, including improving water quality and ensuring natural water quantity levels to coastal rivers and streams and coastal bays and estuaries. Toward this end, the objective of this project is to reduce rural nonpoint source pollution through the implementation of conservation practices on agricultural lands.

The primary goal for the nutrient reduction project is water quality improvement through nutrient and sediment reduction. The health of the Gulf of Mexico depends on the health of its estuaries, and the health of those coastal waters is influenced by land uses in the watersheds of its tributaries. In the five Gulf States, more than 80 percent of the acreage is in private ownership (USDA-NRCS 2014) and is used for forestry and agriculture.

Given the success of USDA NRCS Farm Bill programs and their strong acceptance by private landowners, there is a significant opportunity to implement conservation practices on private lands. The USDA-NRCS would provide outreach and technical assistance to voluntary participants (landowners), especially on the most vulnerable acres in the watersheds, to develop conservation plans and would use all available conservation practices typically planned and funded by USDA-NRCS programs. The project proposes to implement clusters of projects within the smallest watershed, to the extent practicable, with the goal of making a discernable difference in local water quality. While this targeted and concentrated approach is desired, the projects' proponents understand the voluntary nature of conservation implementation and will strive to reach the critical sources within the watershed. The proposed conservation practices would reduce nutrient losses from the landscape; reduce nutrient loads to streams and downstream receiving waters; and reduce water quality degradation in watersheds that could provide benefits to marine resources and benefits to coastal watersheds.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Programmatic goal: Restore Water Quality
- Restoration type: Nutrient Reduction (Non-point source)
- Restoration approach: Reduce nutrient loads to coastal watersheds
- Restoration technique: Agricultural conservation practices

- Restoration Type Goal: Reduce nutrient loadings to Gulf Coast estuaries, habitats, and resources that are threatened by chronic eutrophication, hypoxia, or harmful algal blooms or that suffer habitat losses associated with water quality degradation

Objective 1: Reduce sediment, phosphorous and nitrogen loads during storm events leaving private lands in the watershed.

The monitoring or project parameters are dependent upon the voluntary participation by landowners to implement conservation practices on their land. Implemented conservation practices may or may not be located in the same subwatershed, therefore sampling efforts may vary in scale at different watershed levels. The proposed conservation practices will reduce nutrient losses from the landscape, reduce nutrient loads to streams and downstream receiving waters, and reduce water quality degradation in watershed that would provide benefits to marine resources and coastal watersheds.

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

A conceptual model forms the basis of this monitoring plan, and includes a summary of the restoration project and the desired project outcomes. For this project, the specific stressors addressed include nutrient and sediment loading, agricultural activities and land cover conversion. This project will reduce those stressors by implementing conservation practices on private agricultural lands that will reduce sedimentation and nutrients that make their way into local waterbodies, resulting in improved water quality.

Table 1: Conceptual Model

Activity	Output	Short-term Outcome	Long-term Outcome
Implement conservation practices to reduce nutrient and sediment loading into receiving waters	Reduced nutrient and sediment loading into the system	Decrease in nutrient and sediment loadings in targeted watersheds	Enhancement of ecosystem services of Gulf coast habitats and living marine resources

Sources of Uncertainty

Critical uncertainties are defined as those that have the potential to impact or impede the decision-making process and the ability to achieve the restoration objective(s). Although many types of scientific and other uncertainties exist, the focus of uncertainty in this context is the uncertainty that affects the decisions being made for this project. Monitoring to resolve critical uncertainties affecting these decisions can allow for more effective expenditure of resources into the future as learning takes place.

The following uncertainties could potentially influence the success of the project. Efforts will be made in the planning and implementation phases to reduce and/or eliminate these uncertainties.

1. Willingness of landowners to participate. Strategy to resolve: identify other willing landowners.
2. Conservation practices may not result in measurable change in the receiving waters. Strategy to resolve: Conduct targeted in-stream monitoring at locations upstream and downstream of the implementation area. Monitoring data will be used to refine future management actions.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring for this project, outlined below, is organized by project objective, with one or more monitoring parameters for each objective. For each of the monitoring parameters information is provided on the monitoring methods, timing and frequency, sample size and sites. In addition, performance criteria for each parameter are identified (if applicable), including example corrective actions that could be taken if the performance criteria are not met. The parameters listed below may or may not be tied to performance criteria and/or corrective actions. These parameters will be monitored at the project site, in adjacent streams, and may also be monitored at appropriate reference and/or control sites to demonstrate how the project is trending toward the performance criteria.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria would be used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. Information below does not include all possible options; rather, it includes a list of potential adaptive management actions for each individual parameter to be considered. The decision to implement a corrective action should holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

This MAM Plan will be revised and updated as specific activities are identified.

Objective 1: Reduce sediment, phosphorous and nitrogen loads during storm events leaving private lands in the watershed.

- Were sediment, nitrogen and phosphorous loads to downstream waterbodies reduced?

Parameter: Number of Water Quality Improvement Practices Implemented

a. Method: Count number of projects implemented
b. Timing and Frequency: Annual
c. Sample size: All projects implemented
d. Sites: All sites
e. Performance criteria: Number of projects implemented by end of project period

Parameter: Area of Water Quality Improvement Activities Implemented (Acres)

a. Method: Number of acres where activities are implemented.
b. Timing and Frequency: Annual
c. Sample size: All projects implemented
d. Sites: All sites
e. Performance criteria: Number of acres impacted by end of project period

Parameter: Discharge (m³/s or cfs)

a. Method: Per MAM Manual
b. Timing and frequency: Ten measurements per year would be taken at one or more sets of one upstream and two downstream stations that bracket portions of the watershed where conservation practices are being implemented.
c. Sample size: The total number of sites is not yet determined and will be dependent on the amount and location of conservation practices in the watershed. It is anticipated that a total of

10 samples would be collected per year at each station. Samples would be taken at baseflow conditions when possible. Sites: Will be determined when sites are identified.

d. Sites: N/A
e. Performance criteria: N/A

Parameter: Total Suspended Solids (TSS) (mg/L or ppm) and Turbidity

a. Method: In-stream. Fixed station parameter reading using a data sonde, under baseflow conditions when possible, using standard monitoring protocols would occur at appropriately located upstream and downstream stations that bracket portions of watersheds with conservation practices.
b. Timing and frequency: Conduct pre-execution monitoring, then ten samples per year would be collected at one or more sets of one upstream and two downstream stations that bracket portions of the watershed where conservation practices are being implemented.
c. Sample size: The total number of sites is not yet determined and will be dependent on the number and location of conservation practices in the watershed. It is anticipated that a total of 10 samples would be collected per year at each station. Samples would be taken at baseflow conditions when possible.
d. Sites: Conservation practice implementation will be dependent on the participation of landowners in the target watersheds described above. Locations will be updated in the monitoring plan when landowners sign participation agreements with the NRCS. The geographic scope of the in-stream monitoring design will depend on the location of lands enrolled in the conservation program. Where a large number of acres are co-located in a small watershed (e.g., HUC 12), the design will likely include one upstream station (could be optional depending on upstream conditions) and one or more downstream stations depending on the location of the cluster of conservation practices.
e. Performance criteria: Change in the quantity of in-stream sediment over time.
f. Corrective Action: Actions would vary depending on the type of conservation practice implemented. Some conservation practices may require inspection and maintenance.

Parameter: Total Phosphorous (TP) (mg/L)

a. Method: In-stream. Sample collection consistent with Alabama standard monitoring protocols would occur at appropriately located upstream and downstream stations that bracket portions of the area with conservation practices.
b. Timing and frequency: Conduct pre-execution monitoring, then ten samples per year would be collected at one or more sets of one upstream and two downstream stations that bracket implementation areas.
c. Sample size: The total number of sites is not yet determined and will be dependent on the number and location of conservation practices in the watershed. It is anticipated that a total of 10 samples would be collected per year at each station. Samples would be taken at baseflow conditions when possible.
d. Sites: Conservation practice implementation will be dependent on the participation of landowners in the target watersheds described above. Locations will be updated in the monitoring plan when landowners sign participation agreements with the NRCS. The geographic scope of the in-stream monitoring design will depend on the location of lands enrolled in the conservation program. Where a large number of acres are co-located in a small watershed (e.g., HUC 12), the design will likely include one upstream station (could be optional depending on upstream conditions) and one or more downstream stations depending on the location of the cluster of conservation practices.

e. Performance criteria: Change in the quantity of in-stream phosphorous over time.
f. Corrective Action: Actions would vary depending on the type of conservation practice implemented. Some conservation practices may require inspection and maintenance.

Parameter: Total Nitrogen (TN) (mg/L)

a. Method: Sample collection using standard monitoring protocols will occur at appropriately located upstream and downstream stations that bracket portions of areas where conservation activities are being implemented.
b. Timing and frequency: Conduct pre-execution monitoring, then ten samples per year will be collected at one or more sets of one upstream and two downstream stations that bracket portions of the watershed where conservation activities are being implemented.
c. Sample size: The total number of sites is not yet determined and will be dependent on the amount and location of conservation practices in the watershed. It is anticipated that a total of 10 samples would be collected per year at each station. Samples would be taken at baseflow conditions when possible.
d. Sites: Conservation practice implementation will be dependent on the participation of landowners in the target watersheds described above. Locations will be updated in the monitoring plan when landowners sign participation agreements with the NRCS. The geographic scope of the in-stream monitoring design will depend on the location of lands enrolled in the conservation program. Where a large number of acres are co-located in a small watershed (e.g., HUC 12), the design will likely include one upstream station (could be optional depending on upstream conditions) and one or more downstream stations depending on the location of the cluster of conservation practices.
e. Performance criteria: Change in the quantity of in-stream nitrogen over time.
f. Corrective Action: Actions would vary depending on the type of conservation practice implemented. Some conservation practices may require inspection and maintenance.

Corrective actions that may be necessary include, but are not limited to, regrading/removing water control structures, planting/replanting desirable vegetation, and/or removing nuisance vegetation. Corrective actions will likely occur after implementation, but within the five-year time frame for this project. Corrective actions will be identified by USDA based on site evaluations and performance monitoring data and reports. Costs for addressing the corrective action will be evaluated by USDA to determine feasibility.

The schedule for project monitoring is shown in Table 2, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 2: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Post-Execution Monitoring (Years 1-4)
Number of projects implemented	1		X	X
Number of Acres impacted	1		X	X

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Post-Execution Monitoring (Years 1-4)
Discharge	1	X		X
TSS	1	X	X	X
TP	1	X	X	X
TN	1	X	X	X

ADAPTIVE MANAGEMENT

Implementation of the conservation practices, monitoring and adaptive management would utilize standardized actions using accepted tools and protocols at specific locations.

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (DWH NRDA Trustees 2016a, Appendix 5.E.1). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action. The need for adaptive management on specific conservation practices being implemented is not needed for this project due to the nature of the sampling approaches, the objectives of the project and the scales of the sites in which the data will be collected, and an understanding of the conservation practices that will be applied. Data, analysis and information obtained from this project will be used to help inform future Restoration Plan development, priorities and project selection and implementation.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Were sediment, nitrogen and phosphorous loads to downstream waterbodies reduced?

- Did the restoration project produce unanticipated effects?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?

The analysis methods would be applied to all monitoring parameters as follows:

Water Quality Data

Standard analytical techniques would be used to document water quality improvements between upstream and downstream stations that bracket areas with conservation systems, following guidance in Alabama's Quality Assurance Project Plan (QAPP). The QAPP is developed in accordance with ADEM SOP #8302, "Preparation, Review, Approval, Distribution, and Archival of Quality Assurance Program/Project Plans (QAPPs) and EPA Requirements for Quality Assurance Project Plans" (EPA QA/R-5, 2001).

PROJECT-LEVEL DECISIONS: PERFORMANCE CRITERIA AND POTENTIAL CORRECTIVE ACTIONS

Conservation practices will be implemented according to well-established USDA standards, specifications, engineering design, and performance criteria. Regular construction monitoring is a standard element of cooperator contracts. Contracts also have standard provisions for operation and maintenance, including replacement of failed practice elements as corrective actions.

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then Project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

Data Review and Clearance

After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate

monitoring data and information and ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata. All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual Version 1.0. Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. Some data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

REPORTING

Annual reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

ROLES AND RESPONSIBILITIES

ADCNR is the lead Trustee agency for this project, and will ensure that the project is completed.

USDA-NRCS is the implementing Trustee.

The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016a. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

DWH NRDA Trustees. 2017. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill. December.

Environmental Protection Agency (EPA). 2001. EPA Requirements for Quality Assurance Project Plans QA/R-5. EPA/240/B-01/003.

National Research Council (NRC). 2004. *Adaptive Management for Water Resources Project Planning*. Washington, DC: The National Academies Press.

Pastorok, R.A., MacDonald, A., Sampson, J.R., Wilber, P., Yozzo, D.J., & Titre, J.P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9, 89-107.

Steyer, G.D. & Llewellyn, D.W. 2000. Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 26, 27-39.

Williams, B.K. 2011. Adaptive management of natural resources - Framework and issues. Journal of Environmental Management, 92, 1346-1353.

MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	5/27/2018	Draft to Final; added parameter for acres impacted	Draft to final version	MAM_Plan_Fowl_River_NR_6.1.2018

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MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
WEEKS BAY NUTRIENT REDUCTION PROJECT

PROJECT OVERVIEW

This project will restore resources injured by the *DWH* oil spill as outlined in the *DWH* PDARP/PEIS following the Natural Resource Damage Assessment process. The Weeks Bay Nutrient Reduction project would restore water quality through implementation of improved land management practices that reduce nutrient and sediment loadings to Weeks and Mobile Bays. The implementation of land management practices using existing USDA-NRCS conservation practice standards and specifications would be the primary tool for reducing erosion and nutrient inputs in the watershed.

Excessive nutrient enrichment, or eutrophication, of Gulf Coast estuaries and their watersheds is a chronic threat that can lead to hypoxia (low oxygen levels), harmful algal blooms, habitat loss, and fish kills (DWH NRDA Trustees 2016a, section 5.5.4). This project would restore and enhance the ecological and hydrological integrity of water resources, including improving water quality and ensuring natural water quantity levels to coastal rivers and streams and coastal bays and estuaries. Toward this end, the objective of this project is to reduce rural nonpoint source pollution through the implementation of conservation practices on agricultural lands.

The primary goal for the nutrient reduction project is water quality improvement through nutrient and sediment reduction. The health of the Gulf of Mexico depends on the health of its estuaries, and the health of those coastal waters is influenced by land uses in the watersheds of its tributaries. In the five Gulf States, more than 80 percent of the acreage is in private ownership (USDA-NRCS 2014) and is used for forestry and agriculture.

Given the success of USDA NRCS Farm Bill programs and their strong acceptance by private landowners, there is a significant opportunity to implement conservation practices on private lands. The USDA-NRCS would provide outreach and technical assistance to voluntary participants (landowners), especially on the most vulnerable acres in the watersheds, to develop conservation plans and would use all available conservation practices typically planned and funded by USDA-NRCS programs. The project proposes to implement clusters of projects within the smallest watershed, to the extent practicable, with the goal of making a discernable difference in local water quality. While this targeted and concentrated approach is desired, the projects' proponents understand the voluntary nature of conservation implementation and will strive to reach the critical sources within the watershed. The proposed conservation practices would reduce nutrient losses from the landscape; reduce nutrient loads to streams and downstream receiving waters; and reduce water quality degradation in watersheds that could provide benefits to marine resources and benefits to coastal watersheds.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Programmatic goal: Restore Water Quality
- Restoration type: Nutrient Reduction (Non-point source)
- Restoration approach: Reduce nutrient loads to coastal watersheds
- Restoration technique: Agricultural conservation practices
- Restoration Type Goal: Reduce nutrient loadings to Gulf Coast estuaries, habitats, and resources that are threatened by chronic eutrophication, hypoxia, or harmful algal blooms or that suffer habitat losses associated with water quality degradation

Objective 1: Reduce sediment, phosphorous and nitrogen loads during storm events leaving private lands in the watershed.

The monitoring or project parameters are dependent upon the voluntary participation by landowners to implement conservation practices on their land. Implemented conservation practices may or may not be located in the same subwatershed, therefore sampling efforts may vary in scale at different watershed levels. The proposed conservation practices will reduce nutrient losses from the landscape, reduce nutrient loads to streams and downstream receiving waters, and reduce water quality degradation in watershed that would provide benefits to marine resources and coastal watersheds.

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

A conceptual model forms the basis of this monitoring plan, and includes a summary of the restoration project and the desired project outcomes. For this project, the specific stressors addressed include nutrient and sediment loading, agricultural activities and land cover conversion. This project will reduce those stressors by implementing conservation practices on private agricultural lands that will reduce sedimentation and nutrients that make their way into local waterbodies, resulting in improved water quality.

Table 1: Conceptual Model

Activity	Output	Short-term Outcome	Long-term Outcome
Implement conservation practices to reduce nutrient and sediment loading into receiving waters	Reduced nutrient and sediment loading into the system	Decrease in nutrient and sediment loadings in targeted watersheds	Enhancement of ecosystem services of Gulf coast habitats and living marine resources

Sources of Uncertainty

Critical uncertainties are defined as those that have the potential to impact or impede the decision-making process and the ability to achieve the restoration objective(s). Although many types of scientific and other uncertainties exist, the focus of uncertainty in this context is the uncertainty that affects the decisions being made for this project. Monitoring to resolve critical uncertainties affecting these decisions can allow for more effective expenditure of resources into the future as learning takes place.

The following uncertainties could potentially influence the success of the project. Efforts will be made in the planning and implementation phases to reduce and/or eliminate these uncertainties.

1. Willingness of landowners to participate. Strategy to resolve: identify other willing landowners.
2. Conservation practices may not result in measurable change in the receiving waters. Strategy to resolve: Conduct targeted in-stream monitoring at locations upstream and downstream of the implementation area. Monitoring data will be used to refine future management actions.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring for this project, outlined below, is organized by project objective, with one or more monitoring parameters for each objective. For each of the monitoring parameters information is

provided on the monitoring methods, timing and frequency, sample size and sites. In addition, performance criteria for each parameter are identified (if applicable), including example corrective actions that could be taken if the performance criteria are not met. The parameters listed below may or may not be tied to performance criteria and/or corrective actions. These parameters will be monitored at the project site, in adjacent streams, and may be monitored at appropriate reference and/or control sites to demonstrate how the project is trending toward the performance criteria.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria would be used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. Information below does not include all possible options; rather, it includes a list of potential adaptive management actions for each individual parameter to be considered. The decision to implement a corrective action should holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

This MAM Plan will be revised and updated as specific activities are identified.

Objective 1: Reduce sediment, phosphorous and nitrogen loads during storm events leaving private lands in the watershed.

- Were sediment, nitrogen and phosphorous loads to downstream waterbodies reduced?

Parameter: Number of Water Quality Improvement Practices Implemented

a. Method: Count number of projects implemented
b. Timing and Frequency: Annual
c. Sample size: All projects implemented
d. Sites: All sites
e. Performance criteria: Number of projects implemented by end of project period

Parameter: Area of Water Quality Improvement Activities Implemented (Acres)

a. Method: Number of acres where activities are implemented
b. Timing and Frequency: Annual
c. Sample size: All projects implemented
d. Sites: All sites
e. Performance criteria: Number of acres impacted by end of project period

Parameter: Discharge (m^3/s or cfs)

a. Method: Per MAM Manual
b. Timing and frequency: Ten measurements per year would be taken at one or more sets of one upstream and two downstream stations that bracket portions of the watershed where conservation practices are being implemented.
c. Sample size: The total number of sites is not yet determined and will be dependent on the amount and location of conservation practices in the watershed. It is anticipated that a total of 10 samples would be collected per year at each station. Samples would be taken at baseflow conditions when possible.
d. Sites: N/A
e. Performance criteria: N/A

Parameter: Total Suspended Solids (TSS) (mg/L or ppm) and Turbidity

a. Method: In-stream. Fixed station parameter reading using a data sonde, under baseflow conditions when possible, using standard monitoring protocols would occur at appropriately located upstream and downstream stations that bracket portions of watersheds with conservation practices.

b. Timing and frequency: Conduct pre-execution monitoring, then ten samples per year would be collected at one or more sets of one upstream and two downstream stations that bracket portions of the watershed where conservation practices are being implemented.

c. Sample size: The total number of sites is not yet determined and will be dependent on the number and location of conservation practices in the watershed. It is anticipated that a total of 10 samples would be collected per year at each station. Samples would be taken at baseflow conditions when possible.

d. Sites: Conservation practice implementation will be dependent on the participation of landowners in the target watersheds described above. Locations will be updated in the monitoring plan when landowners sign participation agreements with the NRCS. The geographic scope of the in-stream monitoring design will depend on the location of lands enrolled in the conservation program. Where a large number of acres are co-located in a small watershed (e.g., HUC 12), the design will likely include one upstream station (could be optional depending on upstream conditions) and one or more downstream stations depending on the location of the cluster of conservation practices.

e. Performance criteria: Change in the quantity of in-stream sediment over time.

f. Corrective Action: Actions would vary depending on the type of conservation practice implemented. Some conservation practices may require inspection and maintenance.

Parameter: Total Phosphorous (TP) (mg/L)

a. Method: In-stream. Sample collection using standard monitoring protocols would occur at appropriately located upstream and downstream stations that bracket portions of the area with conservation practices.

b. Timing and frequency: Conduct pre-execution monitoring, then ten samples per year would be collected at one or more sets of one upstream and two downstream stations that bracket implementation areas.

c. Sample size: The total number of sites is not yet determined and will be dependent on the number and location of conservation practices in the watershed. It is anticipated that a total of 10 samples would be collected per year at each station. Samples would be taken at baseflow conditions when possible.

d. Sites: Conservation practice implementation will be dependent on the participation of landowners in the target watersheds described above. Locations will be updated in the monitoring plan when landowners sign participation agreements with the NRCS. The geographic scope of the in-stream monitoring design will depend on the location of lands enrolled in the conservation program. Where a large number of acres are co-located in a small watershed (e.g., HUC 12), the design will likely include one upstream station (could be optional depending on upstream conditions) and one or more downstream stations depending on the location of the cluster of conservation practices.

e. Performance criteria: Change in the quantity of in-stream phosphorous over time.

f. Corrective Action: Actions would vary depending on the type of conservation practice implemented. Some conservation practices may require inspection and maintenance.

Parameter: Total Nitrogen (TN) (mg/L)

a. Method: Sample collection using standard monitoring protocols will occur at appropriately located upstream and downstream stations that bracket portions of areas where conservation activities are being implemented.

b. Timing and frequency: Conduct pre-execution monitoring, then ten samples per year will be collected at one or more sets of one upstream and two downstream stations that bracket portions of the watershed where conservation activities are being implemented.

c. Sample size: The total number of sites is not yet determined and will be dependent on the amount and location of conservation practices in the watershed. It is anticipated that a total of 10 samples would be collected per year at each station. Samples would be taken at baseflow conditions when possible.

d. Sites: Conservation practice implementation will be dependent on the participation of landowners in the target watersheds described above. Locations will be updated in the monitoring plan when landowners sign participation agreements with the NRCS. The geographic scope of the in-stream monitoring design will depend on the location of lands enrolled in the conservation program. Where a large number of acres are co-located in a small watershed (e.g., HUC 12), the design will likely include one upstream station (could be optional depending on upstream conditions) and one or more downstream stations depending on the location of the cluster of conservation practices.

e. Performance criteria: Change in the quantity of in-stream nitrogen over time.

f. Corrective Action: Actions would vary depending on the type of conservation practice implemented. Some conservation practices may require inspection and maintenance.

Corrective actions that may be necessary include, but are not limited to, regrading/removing water control structures, planting/replanting desirable vegetation, and/or removing nuisance vegetation. Corrective actions will likely occur after implementation, but within the five-year time frame for this project. Corrective actions will be identified by USDA based on site evaluations and performance monitoring data and reports. Costs for addressing the corrective action will be evaluated by USDA to determine feasibility.

The schedule for project monitoring is shown in Table 2, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 2: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Post-Execution Monitoring (Years 1-4)
Number of projects implemented	1		X	X
Number of Acres impacted	1		X	X
Discharge	1	X		X
TSS	1	X	X	X

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Post-Execution Monitoring (Years 1-4)
TP	1	X	X	X
TN	1	X	X	X

ADAPTIVE MANAGEMENT

Implementation of the conservation practices, monitoring and adaptive management would utilize standardized actions using accepted tools and protocols at specific locations.

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (DWH NRDA Trustees 2016a, Appendix 5.E.1). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action. The need for adaptive management on specific conservation practices being implemented is not needed for this project due to the nature of the sampling approaches, the objectives of the project and the scales of the sites in which the data will be collected, and an understanding of the conservation practices that will be applied. Data, analysis and information obtained from this project will be used to help inform future Restoration Plan development, priorities and project selection and implementation.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Were sediment, nitrogen and phosphorous loads to downstream waterbodies reduced?
- Did the restoration project produce unanticipated effects?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?

- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?

The analysis methods would be applied to all monitoring parameters as follows:

Water Quality Data

Standard analytical techniques would be used to document water quality improvements between upstream and downstream stations that bracket areas with conservation systems, following guidance in Alabama's Quality Assurance Project Plan (QAPP). The QAPP is developed in accordance with ADEM SOP #8302, "Preparation, Review, Approval, Distribution, and Archival of Quality Assurance Program/Project Plans (QAPPs) and EPA Requirements for Quality Assurance Project Plans" (EPA QA/R-5, 2001).

PROJECT-LEVEL DECISIONS: PERFORMANCE CRITERIA AND POTENTIAL CORRECTIVE ACTIONS

Conservation practices will be implemented according to well-established USDA standards, specifications, engineering design, and performance criteria. Regular construction monitoring is a standard element of cooperator contracts. Contracts also have standard provisions for operation and maintenance, including replacement of failed practice elements as corrective actions.

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then Project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

Data Review and Clearance

After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and would ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata. All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual

Version 1.0. Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. Some data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

REPORTING

Annual reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

ROLES AND RESPONSIBILITIES

ADCNR is the lead Trustee agency for this project, and will ensure that the project is completed.

USDA-NRCS is the implementing Trustee.

The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016a. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

DWH NRDA Trustees. 2017. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill. December.

Environmental Protection Agency (EPA). 2001. EPA Requirements for Quality Assurance Project Plans QA/R-5. EPA/240/B-01/003.

National Research Council (NRC). 2004. *Adaptive Management for Water Resources Project Planning*. Washington, DC: The National Academies Press.

Pastorok, R.A., MacDonald, A., Sampson, J.R., Wilber, P., Yozzo, D.J., & Titre, J.P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9, 89-107.

Steyer, G.D. & Llewellyn, D.W. 2000. Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 26, 27-39.

Williams, B.K. 2011. Adaptive management of natural resources - Framework and issues. Journal of Environmental Management, 92, 1346-1353.

MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	5/27/2018	Draft to Final; added parameter for acres impacted	Draft to final version	MAM_Plan_Weeks_Bay_NR_6.1.2018

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MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
COASTAL ALABAMA SEA TURTLE (CAST) CONSERVATION PROGRAM

PROJECT OVERVIEW

The proposed Coastal Alabama Sea Turtle (CAST) Conservation Program project is designed to support existing sea turtle programs in Alabama in order to strengthen efforts to protect nesting sea turtles and enhance the survival of sea turtle hatchlings in Alabama. The proposed project would provide funding for the continued operation, expansion, and enhancement of the existing Share the Beach Sea Turtle Nest Monitoring Program ("Share the Beach"), which as of January 2018 is proposed to be managed by the Alabama Coastal Foundation (ACF). ACF is an organization dedicated to environmental stewardship, and has considerable experience in program management, fundraising, and volunteer recruitment, training, and management. ACF's administration of the program would allow better overall project expenditures (e.g., to manage, analyze, and report data collected under the program). Previously this program has been managed by Friends of Bon Secour National Wildlife Refuge.

The CAST Conservation Program would expand and enhance ACF's Share the Beach program by providing funds to expand the Share the Beach program and continue actions necessary to support sea turtle restoration in Alabama, such as conducting nest monitoring and reducing threats on nesting beaches. Under this project, additional staff experienced in sea turtle nest monitoring protocol would be hired to work with Share the Beach. This project would also help support a greater emphasis on public education, focused on minimizing anthropogenic threats to sea turtles, such as artificial lighting and nesting obstacles, and promoting the region's potential for ecotourism while avoiding disturbance to or manipulation of sea turtle nests and hatchlings.

TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Programmatic Goal: Replenish and Protect Living Coastal and Marine Resources
- Restoration Type: Sea Turtles
- Restoration Type Goal – Restore injuries by addressing primary threats to sea turtles in the marine and terrestrial environment such as bycatch in commercial and recreational fisheries, acute environmental changes (e.g., cold water temperatures), loss or degradation of nesting beach habitat (e.g., coastal armoring and artificial lighting), and other anthropogenic threats.
- Restoration Approach - Enhance sea turtle hatchling productivity, and restore and conserve nesting beach habitat

Objective 1: Enhance hatchling productivity by expanding the Share the Beach program.

Objective 2: Minimize anthropogenic threats to sea turtles by conducting education and outreach activities.

Objective 3: Increase understanding of Alabama sea turtle populations via data collection related to anthropogenic threats (lighting disorientation, nesting obstacle interactions, depredation, vandalism).

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

A conceptual model forms the basis of this monitoring plan, and includes a summary of the project activities, the expected product or output of those activities and the desired project outcomes. Activities that will be conducted include volunteer training, sea turtle nest monitoring and protection, and outreach and education activities. These proposed activities will address a number of stressors that

impact hatchling success, including predation and anthropogenic impacts. Together, the activities will result in increased nesting and hatchling productivity as well as increased understanding by the public regarding the negative impacts of anthropogenic stressors on sea turtles.

Sources of Uncertainty

The program is already operating successfully by the Friends of the Bon Secour National Wildlife Refuge. However, operation, expansion, and enhancement of the existing Share the Beach program by ACF would help enhance the active volunteer recruitment and oversight and also ensure its continued operation of the program, which otherwise cannot be guaranteed. There is some uncertainty around the successful recruitment, training and retention of volunteers sufficient to patrol and monitor the extent of sea turtle nesting habitat in Alabama. However, the strategy to resolve this uncertainty has been addressed in the selection of the program operator: ACF staff have the expertise and experience to fully implement the activities proposed under the program since they actively run other volunteer efforts in the region (e.g., the Alabama oyster shell recycling program, the Mobile Bay Estuary Corps, and the "Eco-Team"), including training activities, oversight of public volunteers, and education and outreach. As part of this project, the ACF will hire a biologist that has experience with the collection and management of sea turtle nesting data. Long-term funding for the program is an uncertainty, though ACF has committed to funding the continuation of the program after this project period. Finally, some factors affecting hatchling productivity, such as inundation of nests by high tides and washover events, are beyond the project's control.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and identify potential corrective actions, if needed. For each of the monitoring parameters identified below, information is provided on the intended purpose (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. This section also describes applicable performance criteria and potential corrective actions for parameters associated with project objectives.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria are used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. The decision to implement a corrective action will holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Parameter: Number of Volunteers and Volunteer Hours

   a. Purpose: To understand if volunteer numbers are sufficient to cover shoreline during nesting season
   b. Method: Count by accumulating and synthesizing volunteer time logs
   c. Timing and Frequency: Synthesize volunteer time logs monthly/quarterly for 3 years and for the 2018 season when the program transitioned to ACF
   d. Sample Size: All volunteer hours
   e. Sites: All sites - Baldwin County & Dauphin Island / all patrol shifts

f. Performance Criteria: Steady or increased number of volunteers each year based on 2018 baseline

g. Corrective Action(s): Evaluate recruitment and training, make adjustments as needed

Parameter: Number of Nests Identified and Protected

a. Purpose: To understand how many nests are present on Alabama beaches, and track predator protection, nest relocation, etc.

b. Method: Count and report in accordance with the USFWS Alabama Sea Turtle Conservation Manual (Updated and revised January 2017b)

c. Timing and Frequency: Report total nests identified in daily trips during entirety of ST nesting season May - October each year for 3 years; raw data entered weekly; synthesized monthly; and reported annually.

d. Sample Size: All nests in AL

e. Sites: Identified nests in Baldwin County & on Dauphin Island

f. Performance Criteria: Protect 100% of the nests identified

g. Corrective Action(s): Evaluate training program annually and make adjustments as needed

Parameter: Number of Patrols Conducted

a. Purpose: To understand if the volunteer program is sufficient to cover nesting shoreline areas in Baldwin and Mobile Counties (approximately 46.7 miles)

b. Method: Count and report total number of patrols conducted

c. Timing and Frequency: Number of patrols will be counted monthly/quarterly and synthesized/summed each year for 3 years

d. Sample Size: All patrols

e. Sites: Provide map of patrol segments in Baldwin County & Dauphin Island in report

f. Performance Criteria: steady or increased number of patrols each year based on 2017 baseline

g. Corrective Action(s): Add additional patrol shifts or patrol areas to program

Parameter: Miles of Shoreline Patrolled Daily

a. Purpose: To understand the extent of nesting beach that is patrolled daily

b. Method: Count and report total miles patrolled during nesting season. Methods could include walking the shoreline taking continuous GPS points or taking a GPS point at start/finish of each day for each shift, or could be calculated based on patrol segments and volunteer shifts taken for each segment.

c. Timing and Frequency: Report total in Annual Report and provide a daily average and percentage of total miles in program (approx. 46.7 miles) covered on a daily basis

d. Sample Size: All miles patrolled by volunteers

e. Sites: Total number of miles patrolled

f. Performance Criteria: Steady or increased patrol miles based on baseline from 2018 season

g. Corrective Action(s) Recruit additional volunteers, assign volunteers to specific areas if needed. Add additional patrol shifts or patrol areas to program

Parameter: Number of Hatchlings

a. Purpose: To understand if number of hatchlings is increasing due to increased patrol and nest protection efforts

b. Method: Provide summary of hatchling and nest info per the protocols references in the Alabama Sea Turtle Conservation Manual

c. Timing and Frequency: Hatchlings are counted at the time of hatching for each nest and number of eggs is counted at time of excavation for each nest; data sheets are synthesized and analyzed monthly during nesting season May-Oct each year for 3 years plus one year of prior season data (2018).
d. Sample Size: All nests identified
e. Sites: All nests
f. Performance Criteria: Steady or increased mean number of hatchlings over project duration compared to previous 3 years seasonal data, taking into account storm/high tide activity that may impact hatchling survival
g. Corrective Action(s): Relocate nests per protocol as needed. Protect nests with predator control as appropriate

Parameter: Number of Outreach and Education Materials Developed

a. Purpose: To increase understanding of the importance of reducing anthropogenic threats to sea turtles
b. Method: STB staff will review existing outreach materials, identify gaps and/or needed updates, work with stakeholders, develop targeted audience messaging, and produce a minimum number of outreach materials such as web content, social media content, PSA's, brochures / hand-outs, etc.
c. Timing and Frequency: Coordinate with stakeholders and complete development of education and outreach material by end of Year 2
d. Sample Size: All materials developed
e. Sites: NA
f. Performance Criteria: Year 1: Develop a minimum of one social media post per month and a minimum of 2 outreach materials in coordination with stakeholder, could include brochures, stickers, door hangs or other items. Years 2: Develop one social media post per week and a minimum of 2 additional outreach materials also in coordination with stakeholders. Purpose/need and approach for development should be described in annual project progress reports and copies of outreach materials provided. Summarize these efforts annually and provide copies of materials as appropriate.
g. Corrective Action(s): Continue coordination with stakeholders and revise materials as needed

Parameter: Number of Outreach Materials Distributed

a. Purpose: To increase understanding of the importance of reducing anthropogenic threats to sea turtles as outlined in the Northwest Atlantic Loggerhead Recovery Plan (NMFS, et al., 2008).
b. Method: Note total numbers distributed and note locations for distribution. Methods of distributing outreach materials could include a combination of email blasts, social media posts, web content updates, direct mail, PSAs; news articles, brochures, web videos, etc.
c. Timing and Frequency: Timing and frequency of each outreach method will be based upon and follow the timing and frequency of outreach materials developed
d. Sample Size: Total number of materials distributed
e. Sites: Distributed at a minimum of 15 locations/events annually in coastal AL including Gulf Shores, Dauphin Island, Orange Beach, Gulf State Park, and Bon Secour National Wildlife Refuge. Also, broadly via the internet / email blasts
f. Performance Criteria: Distribute all materials developed/updated at a minimum of 15 locations/events annually (locations can include public outreach events, web, media, etc.)
g. Corrective Action(s): Identify additional locations for distribution

Parameter: Enhanced Staff Capacity

   a. Purpose: To provide consistent, science-based support to a volunteer program to increase understanding of sea turtle nesting in Alabama and improve efficacy of program
   b. Method: Hire qualified staff
   c. Timing and Frequency: Within Year 1
   d. Sample Size: NA
   e. Sites: NA
   f. Performance Criteria: 8 positions hired in year 1
   g. Corrective Action(s): Advertise position in additional locations if appropriate hire(s) cannot be found.

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 1: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Project Monitoring (Years 1-3)
Number of Volunteers and Volunteer Hours	1	X		X
Number of nests identified and protected	1	X		X
Number of patrols conducted	3	X		X
Miles of shoreline patrolled daily	1	X		X
Number of Hatchlings	1	X		X
Number of outreach materials developed	2			X
Number of outreach materials distributed	2			X
Enhanced staff capacity	1			X

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed

outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (DWH NRDA Trustees, 2016a, Appendix 5.E.1). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action. This project is based on an existing project with a 15-year history. Although corrective actions will be undertaken as needed, extensive project-level adaptive management activities are not expected.

Under the administration of ACF, the Share the Beach program would be reviewed annually to evaluate its effectiveness, including: (1) lessons learned from the previous year; (2) consulting on new scientific information about sea turtles in order to update educational and training materials; and (3) collaboration with USFWS to review sea turtle data collection, monitoring, and handling protocols. Additional activities that would be continued and expanded include continual recruitment and engagement of volunteers, volunteer training, nest monitoring and related data collection, outreach and education to residents and tourists, and data management.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

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

These questions will be answered and compiled in annual monitoring reports for the project and revision to the MAM plan be made if needed.

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017a). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are

unavailable or not readily amendable to record project-specific data, then Project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

Data Review and Clearance

After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata. All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual Version 1.0. Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. Some data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

REPORTING

Annual MAM reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

ROLES AND RESPONSIBILITIES

ADCNR is the lead Trustee agency for this project, and will ensure that the project is completed.

ACF will administer the program and be responsible for the timely submission of reports to the TIG.

DOI will consult.

The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016a. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

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MAM PLAN REVISION HISTORY

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	6/1/2018	Draft to final version; Added detail to parameters	Draft to final	MAM_Plan_CAST_Project_6.1.18

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MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
COASTAL ALABAMA SEA TURTLE (CAST) TRIAGE

PROJECT OVERVIEW

The CAST Triage project would provide a new, appropriately equipped facility and program for the initial triage, treatment, release, and/or transfer of injured or ill sea turtles. Currently, there are no facilities in Alabama equipped for handling sea turtle strandings. The project would construct a new facility on property owned by the City of Orange Beach and establish a program that would be supported by the City of Orange Beach in the future. Funding would not be provided for staff, which would be provided by the City of Orange Beach. This facility would complement and enhance the current Alabama Sea Turtle Stranding and Salvage Network (ALSTSSN).

This facility and associated program would allow sea turtles injured in AL and proximity in adjacent states to be treated and released faster and with less stress on the animal from handling and transport. The expectation is that faster intervention, along with shorter periods of captivity and minimized handling, would improve the outcomes for injured or ill turtles by decreasing the time to receive treatment and providing a local resource to contact for citizens to report injured or distressed turtles. The program would also work to educate the public about (1) anthropogenic threats to sea turtles treated at the facility, (2) current science on how best to address the threats, and (3) conservation for sea turtles in the wild. Educational materials would be coordinated with Alabama's Share the Beach Sea Turtle Nest Monitoring Program to create a consistent and unified message. Project funding is expected to fully support the program for 5 years. The City of Orange Beach would incur operational costs into the future.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Project Type: Sea Turtles
- Programmatic Goal: Replenish and Protect Living Coastal and Marine Resources
- Restoration Type Goal: Restore injuries by addressing primary threats to sea turtles in the marine and terrestrial environment such as bycatch in commercial and recreational fisheries, acute environmental changes (e.g., cold water temperatures), loss or degradation of nesting beach habitat (e.g., coastal armoring and artificial lighting), and other anthropogenic threats.
- Restoration Approach: Increase sea turtle survival through enhanced mortality investigation, and early detection of and response to anthropogenic threats and emergency events

Objective 1: Construct facility to provide for initial triage and treatment of injured or ill sea turtles.

Objective 2: Increase sea turtle survival through enhanced local triage, treatment, release and/or transfer of injured or ill sea turtles.

Objective 3: Conduct public education and outreach about conservation of sea turtles and how to reduce anthropogenic threats.

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

A conceptual model forms the basis of this monitoring plan, and includes a summary of the project activities, the expected product or output of those activities and the desired project outcomes. This project will treat impacts to sea turtles from a number of stressors, which could include vessel strikes,

fishing activities and bycatch. This project will reduce mortality associated with those stressors by providing enhanced capability to triage, treat, release or transfer injured or ill sea turtles. Together, the activities will result in decreased mortality as well as increased understanding by the public regarding the negative impacts of anthropogenic stressors on sea turtles.

Sources of Uncertainty

The primary source of uncertainty for this project is related to the construction of the facility as designed, on schedule and on budget. Additionally, long-term funding sustainability for the project is a potential uncertainty. The City of Orange Beach would incur operational costs into the future. The facility will track illness, injury type, transfer and release information over time—this information can be utilized to understand the causes of injury, illness and mortality in order to take actions to reduce those threats over time, including informing future restoration projects.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and identify potential corrective actions, if needed. For each of the monitoring parameters identified below, information is provided on the intended purpose of each monitoring parameter (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. This section also describes applicable performance criteria and potential corrective actions for project parameters associated with project objectives.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria are used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. The decision to implement a corrective action will holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Parameter: Compare as-built construction to terms of contract and permit requirements

a. Purpose: On-site monitoring will be conducted during construction to ensure facility is constructed according to plans and to ensure that construction activities comply with the full set of environmental permit conditions.
b. Method: On-site monitoring
c. Timing and Frequency: Monitoring will occur during all construction activities from start to completion; the project is expected to be completed within a 90-day time frame.
d. Sample Size: Dependent on frequency and duration of construction activities
e. Sites: City of Orange Beach, AL property, adjacent to Cotton Bayou
f. Performance Criteria: Constructed as designed
g. Corrective Action(s): Resolution with contractor such that all contract terms and permit requirements are met

Parameter: Collect baseline data and synthesize existing data on injury/illness type rates and outcomes

   a. Purpose: To understand the causes and types of injury/illness and to understand impact of turtle triage facility
   b. Method: To the extent possible, synthesize previous 3 years' data from ALSTSSN
   c. Timing and Frequency: Provide summary and synthesis of baseline data within 1 year
   d. Sample Size: All turtles entering facility and all turtles from previous 3 years of ALSTSSN
   e. Sites: Triage Facility
   f. Performance Criteria: NA
   g. Corrective Action(s): NA

Parameter: Number of sea turtles entering facility

   a. Purpose: To track use of facility
   b. Method: Documented on data sheet as each animal enters the facility; transposed to larger data set, and data synthesized monthly
   c. Timing and Frequency: Synthesize monthly and report annually
   d. Sample Size: All turtles entering facility
   e. Sites: Triage Facility
   f. Performance Criteria: NA
   g. Corrective Action(s):NA

Parameter: Illness/injury type

   a. Purpose: To understand the causes and types of injury/illness
   b. Method: Per FWS standard permit conditions for care and maintenance of captive sea turtles
   c. Timing and Frequency: Report annually
   d. Sample Size: All turtles entering facility
   e. Sites: Triage Facility
   f. Performance Criteria: NA
   g. Corrective Action(s): NA

Parameter: Release, recovery and mortality rates

   a. Purpose: To understand the number of turtles that are treated and released and the number that are transported to another facility
   b. Method: Calculate rate on a monthly basis and average each year
   c. Timing and Frequency: Report annually
   d. Sample Size: All turtles entering facility
   e. Sites: Triage Facility
   f. Performance Criteria: NA
   g. Corrective Action(s):NA

Parameter: Number of outreach materials created

   a. Purpose: To educate the public about (1) anthropogenic threats to sea turtles treated at the facility, (2) current science on how best to address the threats, and (3) conservation for sea turtles in the wild
   b. Method: Coordinate with stakeholders including USFWS's Alabama Ecological Services Field Office, the ALSTSSN coordinator, and the Alabama State Biologist to develop targeted audience

messaging, and produce a minimum number of outreach materials such as web content, social media content, PSA's, brochures / hand-outs, etc.

c. Timing and Frequency: By end of Year 2
d. Sample Size: n=1
e. Sites: NA
f. Performance Criteria: TBD based on identified needs. A minimum of 2 outreach materials should be developed
g. Corrective Action(s): Revise and update materials as needed in consultation with stakeholders

Parameter: Number of outreach material distributed

a. Purpose: To educate the public about (1) anthropogenic threats to sea turtles treated at the facility, (2) current science on how best to address the threats, and (3) conservation for sea turtles in the wild
b. Method: Methods of distributing outreach materials include a combination of email blasts, social media posts, web content updates, direct mail, PSAs; news articles, brochures, web videos, etc.
c. Timing and Frequency: Timing and frequency of each outreach method will be based upon and follow the timing and frequency of outreach materials developed
d. Sample Size: n=1
e. Sites: Note locations of distributions
f. Performance Criteria: NA
g. Corrective Action(s): Identify additional locations for distribution

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 1: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Post-Execution Monitoring (Years 1-5)
Level of construction to terms of contract and permit requirements			X	X
Baseline data on injury/illness type rates and outcomes	1	X		
Illness/Injury type	1			X
Number of sea turtles entering facility	2			X
Release/recovery/mortality rates	2			X
Number of outreach materials created	3			X

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Post-Execution Monitoring (Years 1-5)
Number of outreach materials distributed	3			X

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (DWH NRDA Trustees 2016a, Appendix 5.E.1). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action.

In addition to allowing more animals to be treated and released more quickly and with less stress on the animal, this project will contribute important information regarding the most frequent types of injury and illness for sea turtles, which can be utilized to understand the most frequent causes of injury, illness and mortality in order to take actions to reduce those threats over time, and inform future restoration projects.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

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

- Were any new uncertainties identified?
- Have data been summarized and characterized in a way that allows for a clear understanding of results?
- Have any trends or patterns been identified, and if so, how can they be characterized?
- What broader insights might be gained from implementation/monitoring of this project?

These questions will be answered and compiled in annual monitoring reports for the project and revision to the MAM plan be made if needed.

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then Project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

Data Review and Clearance

After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and would ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata. All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual Version 1.0. Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. Some data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

REPORTING

Annual MAM reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

ROLES AND RESPONSIBILITIES

ADCNR is the lead Trustee agency for this project, and will ensure that the project is implemented.

The City of Orange Beach will maintain the facility.

The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016a. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

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MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	6/1/2018	Draft to final version; Added detail to parameters	Draft to final	MAM_Plan_CAST_Triage_6.1.18

MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
COASTAL ALABAMA SEA TURTLE (CAST) HABITAT USAGE AND POPULATION DYNAMICS

PROJECT OVERVIEW

Sea turtles spend the majority of their lives at sea, yet little is known about their oceanic life compared to what is known about the biology of females and hatchlings on coastal nesting beaches. Population modeling has shown that the sub-adult life-stage is the most critical to the stability and recovery of sea turtle populations (Crouse et al. 1987), with high elasticity (contribution to population growth) for this life stage. Recovery plans for the three most common species in the northern Gulf of Mexico (GoM) (loggerheads [*Caretta caretta*], Kemp's ridleys [*Lepidochelys kempii*] and green turtles [*Chelonia mydas*]) all include monitoring of juveniles/immature turtles at in-water sites as a primary objective for recovery of the species (NMFS and USFWS 1991, NMFS and USFWS 2008, NMFS et al. 2011).

Very little is known about in-water turtle populations in the northern GoM. However, available data indicate that the northern GoM supports a large number of individuals (Foley et al. 2007, Turtle Expert Working Group 2009, NMFS et al. 2011, Avens et al. 2012). A fundamental issue in studies of sea turtle demography is the characterization of the functional demographic units (Chaloupka & Musick 1997, Rees et al. 2016), including the variability of demographic parameters (Bjorndal et al. 2014, Tucek et al. 2014). Along these lines, Bjorndal et al. (2011) identified seven priorities for sea turtle restoration plans following the Deepwater Horizon oil spill. One of these priorities is to elucidate genetic links among and within populations. Demographics and habitat use can be determined, in part, by collecting genetic and stable isotope data (Wallace et al. 2010). Such data will help natural resource practitioners ensure that management actions support sustainable populations. The PDARP/PEIS acknowledges these data gaps, concluding that …"[I]nformation on sea turtle spatiotemporal distribution, migration patterns, life history parameters, and habitat use is critical for interpreting population trends, improving sea turtle population models, and helping assess progress toward recovery goals. Furthermore, monitoring and scientific support will be important for evaluating the effects of restoration actions on sea turtle recovery from injuries associated with the spill" (DWA NRDA Trustees 2016, Section 5.5.10.4; pages 5-64 and 5-65). The need to collect these types of data is also discussed in the Strategic Framework for Sea Turtle Restoration Activities (DWH NRDA Trustees 2016, Module 4, pages 20-21). The CAST Habitat Usage and Population Dynamics project is designed to inform and enhance restoration of the Sea Turtles Restoration Type by providing information to the AL TIG regarding sea turtle demographics and habitat use in Alabama waters. These data will help the AL TIG identify human activities that may disrupt important connections within and among populations, and thus potential opportunities for restoration actions.

The CAST Habitat Usage and Population Dynamics project would study habitat use and distribution patterns of sea turtles along the Alabama Coast. The project objective is to initiate a long-term monitoring program designed to determine distribution and habitat use, vital rates (including survival rates), connectivity, and potential impacts of anthropogenic activities for sea turtles in coastal and nearshore waters of Alabama. Genetic information on sea turtles collected by the project will help determine the relationship between sea turtles using Alabama waters and those in other areas of the GoM. Stable isotope analyses will help identify diet, trophic level and foraging areas (Vander Zanden et al. 2015). These data will inform the AL TIG and other state and federal initiatives about the locations

and types of activities that would provide the most cost-effective means of reducing threats to sea turtles and increasing their populations in coastal Alabama.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

The project Restoration Type is Sea Turtles. The goal of this project is to provide the AL TIG with data on the demographics and habitat use of sea turtles using Alabama waters, as well as their connectivity to the broader GoM population. This information will assist the AL TIG with prioritizing restoration approaches which best help to restore Sea Turtles. In summary, the Restoration Type goals are:

- Programmatic Goal: Replenish and Protect Living Coastal and Marine Resources
- Restoration Type Goal: Implement an integrated portfolio of restoration approaches to address all injured life states (hatchling, juvenile, and adult) and species of sea turtles
- Project Goal: Generate information to better target restoration projects that will provide the maximum benefits to Sea Turtles in coastal Alabama

The project objectives are to implement targeted resource level monitoring and scientific support activities to fill substantial gaps in scientific understanding, which limits restoration planning, implementation, evaluation, and/or understanding of sea turtle restoration (DHW NRDA Trustees 2016, page 5-88). In summary, the project objectives are:

Objective 1: Provide baseline data on demographics and distribution of sea turtles using AL waters.

Objective 2: Provide baseline data on foraging ecology (including diet, trophic level and habitat use) of sea turtles using AL waters.

Objective 3: Refine existing threats analyses (impacts of anthropogenic activities) for sea turtles in Alabama waters. (Hart et al. 2018; Love et al 2017; NMFS/USFWS 2008; NMFS/USFWS 2011).

CONCEPTUAL MODEL, ANTICIPATED OUTCOMES AND FUTURE ACTIVITIES

Although nest counts and limited stranding data exist for sea turtles in Alabama, little else is known about in-water sea turtle activities compared to neighboring GoM states. Building on recent work (Hart et al. 2013; Hart et al. 2014), a more complete understanding of current numbers of sea turtles by species and their use of in-water and onshore habitats within Alabama would improve the geographic and temporal focus of restoration activities and provide more concrete reference points against which to measure their success.

Data collected, analyzed, and processed under this effort will result in the first description of population structure for turtles using AL waters, including species composition, size classes, seasonal availability, tropic levels, site fidelity and genetic connectivity to other sea turtle populations. It will also identify potential anthropogenic threats for turtles using AL waters. Data collection methods are well tested and accepted in the peer-reviewed scientific literature (e.g., see Shamblin et al. 2012, Lamont et al. 2015a, Hart et al. 2016, Vander Zanden et al. 2015). This information will build on information used in species Recovery Plans (e.g., Hart et al. (2013), Hart et al. (2014), and Lamont et al. (2015b)).

Sources of Uncertainty

The project implementation approaches are well tested in the field and accepted in the peer-reviewed literature, and project implementers are experienced with the proposed activities. Some uncertainty exists regarding the ability of researchers to capture and sample the desired number of sea turtles. However, overall sample sizes are expected to be large enough to yield statistically meaningful results. Some uncertainty also exists regarding recapturing enough marked turtles to conduct mark-recapture

analyses for determination of vital rates; however this information will help guide future work (i.e., documenting sea turtle use hot spots, or if turtles are not recaptured, satellite tracking should be undertaken to help determine turtle movements) and data on population structure such as genetics, stable isotopes, size classes, species composition and seasonal densities will still be provided and will serve as baseline data for Alabama.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

This MAM plan was developed to evaluate project performance, key uncertainties, and the need for potential corrective actions, if needed. The methods proposed for collecting these data include mark-recapture monitoring, genetic analyses, stable isotope analyses, and habitat modeling (including anthropogenic threats). Sea turtles will be captured by hand, dip nets, tangle (set) nets and/or trawling at several sites along the Alabama coast, including inshore waters (i.e., Perdido Bay, Bon Secour Bay, Mobile Bay, and the Mississippi Sound) and the nearshore waters of the GoM. Data from the Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS) will help identify prime capture locations and capture methods in Alabama waters. Captures will begin the first year of project implementation and continue through the third year.

Included below are potential corrective actions for each performance criteria (as defined in NRDA regulations (15 CFR 990.55(b) (1) (vii)). This list may not include all possible options; rather, it includes a list of potential actions for each individual parameter to be considered if the project is not performing as expected. Other corrective actions may be identified and implemented, as appropriate. The decision of whether or not a corrective action should be implemented for a project should holistically consider the overall outcomes of the project (i.e., looking at the combined evaluation of multiple performance criteria) in order to understand why project performance deviates from the predicted or anticipated outcome. The decision to implement a corrective action and the knowledge gained from the process could also inform the larger decision-making framework, such as whether prioritization of objectives should change or how to implement the project to improve the likelihood of achieving favorable project outcomes in future applications.

Objective 1: Provide baseline data on demographics and distribution of sea turtles using AL waters

Parameter 1: Population and Distribution Mark-recapture

a. Purpose: Analyses of these data would be used to characterize where sea turtles forage, migration patterns, habitat use, and life history parameters for sea turtles using Alabama waters
b. Method: Mark-recapture. Captured sea turtles will be marked with flipper and Passive Integrated Transponder (PIT) tags and assigned a unique ID number. All data on captured turtles, including GPS coordinates of capture location, will be recorded and transferred to a digital file
c. Timing and frequency: All sea turtles captured will be marked; data will be recorded on all previously marked turtles
d. Sample size: Target of at least 100 turtles per year
e. Sites: all capture locations
f. Performance criteria: Target of 100 turtles captured and recaptured each year, and a minimum of 40 turtles per species over the 3-year lifespan of the project
g. Corrective action: If needed, utilize information from concurrent (non-NRDAR) GoMMAPPS work to identify additional, potential capture areas or to confirm the chance there are not a lot of

turtles using Alabama waters. Satellite track some individuals to help identify additional capture areas and to confirm site-fidelity or year-round residence in AL waters.

Parameter 2: Genetic Analysis

a. Purpose: Elucidate patterns in local demographics and relationships between sea turtles using Alabama waters and those in other areas of the Gulf of Mexico.
b. Method(s): Morphometric data, including size and weight, would be gathered from all sampled turtles, and a visual health assessment would be conducted. Blood and skin samples will be gathered from each individual. Samples will be placed on ice and transported to a USGS facility in either Davie, FL or Gainesville, FL where they will be stored at -20°C until shipment to a contract lab for analysis.
c. Timing, frequency, and duration: One sample from each turtle will undergo genetic analysis
d. Sample size: Target of 60 turtles per year, including 40 greens, 15 Kemp's and 5 loggerheads
e. Sites: all capture locations
f. Performance criteria: At least 40 turtles sampled
g. Corrective action: same as parameter 1

Objective 2: Provide baseline data on foraging ecology (including diet, trophic level and habitat use) of sea turtles using AL waters

Parameter 1: Stable Isotope Analysis

a. Purpose: Help identify diet, trophic level and foraging areas
b. Method(s): Scute, blood and tissue samples will be gathered from each individual. Samples will be marked with the corresponding sea turtle identification numbers and stored until shipment to a contract lab for stable isotope analysis
c. Timing, frequency, and duration: Two samples from each turtle will undergo stable isotope analyses to determine both short- and long-term resource use patterns
d. Sample size: Target of 60 turtles per year, including 40 greens, 15 Kemp's and 5 loggerheads
e. Sites: all capture locations
f. Performance criteria: At least 40 turtles sampled
g. Corrective action: same as Objective 1

Objective 3: Refine existing threats analyses (impacts of anthropogenic activities) for sea turtles in Alabama waters.

Parameter 1: Overlay of Turtle Activity and Anthropogenic Threats

a. Purpose: Assist with threats analysis/guide potential restoration actions
b. Method(s): Turtle capture locations will be compared to available information on anthropogenic threats such as locations of oil platforms and shrimping and commercial fishing intensity (see Hart et al. 2013 and 2014). In addition, all injuries to captured turtles will be noted
c. Timing, frequency, and duration: A location will be collected from every captured turtle. Threat layers will be gathered in year 3 for comparison to capture locations
d. Sample size: Target of 60 turtles per year, including 40 greens, 15 Kemp's and 5 loggerheads
e. Sites: all capture locations
f. Performance criteria: NA
g. Corrective Action: NA

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Execution monitoring occurs when project has been fully executed as planned. Investigators' current 5-year,

renewable National Marine Fisheries Service (NMFS) permit (#17304-03) allows these activities and is undergoing modification/renewal to extend 5 additional years at this time; therefore, capture, marking, and sampling for this project could be initiated immediately upon receipt of funds.

Table 1. Project Monitoring Schedule

Monitoring Parameter	Objective	Baseline	Year 1	Year 2	Year 3
Population and distribution mark-recapture	1		X	X	X
Genetic analysis	2			X	X
Stable isotope analysis	2			X	X
Threats analyses report	3				X
Report (Annual and Final)	1,2		X	X	X
Data made publicly available	2		X	X	X

ADAPTIVE MANAGEMENT

Because this project entails the collection of data using established methods, project-level adaptive management is not expected to be extensive. If target sample numbers are not being met, Trustees will evaluate capture methods and timing of trips to recommend modifications to the sampling plan as needed. This project supports a larger commitment to adaptive management at the program level: data generated as a result of this project will help reduce future uncertainties regarding the siting and success of sea turtle restoration projects.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed to meet project goals. In this section, we describe how updated knowledge gained from the evaluation of monitoring data would be used at the project scale to determine whether the project is considered successful or whether it requires corrective actions. This evaluation lends itself to an adaptive approach to decision making for future actions regarding Sea Turtles, including the collection of additional data informing restoration and/or implementation and monitoring of restoration actions.

As part of the larger decision-making context beyond the project scale, monitoring data from this project would be compiled and evaluated in annual reports. The results of the analysis would be used to answer the following questions:

- Were the project objectives achieved? If not, is there a reason why they were not met?
- Was data collected and synthesized to better understand population distribution, habitat usage, demographics, connectivity and potential impacts of anthropogenic impacts?
- Did the project produce unanticipated effects?
- Were there unanticipated events unrelated to the project that potentially affected the results?
- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?

- Have data been summarized and characterized in a way that allows for a clear understanding of results?
- Have any trends or patterns been identified, and if so, how can they be characterized?
- What broader insights might be gained from implementation/monitoring of this project?

DATA MANAGEMENT

To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created, and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved. Relevant project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into Excel spreadsheets (or similar digital format). After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and would ensure that all data is entered or converted into agreed upon/commonly used digital format labeled with metadata.

All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual. Data will be made publicly available, in accordance with the Open Data Policy, through the DIVER Explorer Interface within a year of when the data collection occurred. Direct data sharing with other efforts (e.g., GOMMAPPS) would follow standard NRDA, BOEM, and USGS protocols.

REPORTING

Once all data have been reviewed for accuracy and completeness, they will be submitted to and be made publicly available through the Restoration Project Database through the DIVER Explorer Interface. Annual reports and a final report will include data summaries, evaluation and/or interpretation of results.

Data summaries and interim analyses and interpretation will be compiled in annual monitoring reports. At a minimum, annual reports will be made available through the DIVER Explorer Interface within a year of report development. In addition, a Final Report will be provided at the end of the project within the period-of-performance. It is anticipated that at least 1 scientific peer-reviewed publication will result from this project. It is fully anticipated and expected that the following deliverables will be provided:

- all QA/QC data, datasets, databases, geospatial data associated with habitat-related analyses, home range estimation and habitat use analyses, etc. as appropriate
- all statistical output, models, and code associated with producing the Final Report
- all final PowerPoint presentations given at professional meetings (travel-related to professional meetings are not funded by the project)
- all final abstracts for professional meetings
- Annual Reports beginning the 1st year post-award
- Final Report towards the end of the period-of-performance
- at least 1 scientific peer-reviewed publication and copies of any/all publications related to this project (page charges for publications are not funded by the project)

- Explicit identification of funding for this project in Acknowledgments sections of all published papers

ROLES AND RESPONSIBILITIES

USDOI is the lead Trustee agency for this project and will ensure that the project is completed, in collaboration with Alabama Department of Conservation and Natural Resources. Field work will primarily be conducted by USGS. The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

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MAM PLAN REVISION HISTORY

Old Version #	Revision Date	Changes Made	Reason for Change	New Version #
Draft published with draft RP II/EA.	3/18			
	6/12	Updated information added, including monitoring objectives and parameters.	Development of MAM plan following receipt of public comment on draft RP II/EA and in preparation for final RP II/EA.	

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MONITORING AND ADAPTIVE MANAGEMENT PLAN FOR DEEPWATER HORIZON NRDA PROJECT: COASTAL ALABAMA SEA TURTLE (CAST) PROTECTION: ENHANCEMENT AND EDUCATION

PROJECT OVERVIEW

Conducting education and outreach; using voluntary actions; and enforcing existing federal, state, and local regulations and ordinances are crucial tools for reducing activities and behaviors that harm sea turtles in state waters. The CAST Protection: Enhancement and Education project would enhance state enforcement of federal regulations and increase turtle protections in Alabama state waters by: (1) increasing awareness and understanding of the ESA and applicable regulations through education of state enforcement officers; (2) increasing resources for state enforcement agencies to more proactively dedicate efforts toward ESA-related activities (i.e., patrols, public education, enforcement hours); (3) taking steps to reduce fisheries bycatch (i.e., conduct social science surveys, which would likely involve focus groups, and through purchasing and distributing turtle excluder devices for the skimmer trawl fishery); and (4) taking steps to reduce impacts on nesting turtles, such as reducing nest vandalism and lighting harassment.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Project Type: Sea Turtles
- Programmatic Goal: Replenish and Protect Living Coastal and Marine Resources
- Restoration Type Goal: Restore injuries by addressing primary threats to sea turtles in the marine and terrestrial environment such as bycatch in commercial and recreational fisheries, acute environmental changes (For example: cold water temperatures), loss or degradation of nesting beach habitat (For example: coastal armoring and artificial lighting), and other anthropogenic threats. Restoration Approach: Reduce sea turtle bycatch in commercial fisheries through identification (ID) and implementation of conservation measures.
- Restoration Approach - Reduce sea turtle bycatch in commercial fisheries through enhanced training and outreach to the fishing communities
- Approach - Reduce sea turtle bycatch in Recreational Fisheries through Development and Implementation of Conservation Measures
- Approach - Reduce sea turtle bycatch in commercial fisheries through enhanced state enforcement efforts to improve compliance with existing sea turtle conservation requirements

Objective 1: Reduce interactions with sea turtles in Alabama state waters by (1) increasing awareness and understanding of the ESA and applicable regulations through education to assist state enforcement efforts, and (2) increasing resources for voluntary gear modifications and for state enforcement agencies to more proactively dedicate efforts towards ESA-related activities.

Objective 2: Conduct social science study to characterize attitudes and perceptions of vessel-based eco-tourism and their patrons regarding harmful interactions with sea turtles.

Objective 3: Develop a public education and outreach campaign tailored to public needs after a social science study is complete.

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

A conceptual model forms the basis of this monitoring plan, and includes a summary of the project activities, the expected product or output of those activities and the desired project outcomes. Vessel strikes, fishing activities and bycatch are critical stressors for sea turtles. The prosed activities for this project include increased enforcement capacity and increased targeted outreach and education, which will work to reduce the occurrence of these stressors in coastal Alabama by enhancing state enforcement of the ESA and sustaining activities in hot-spot areas, which will result in a decreased number of interactions between vessels and sea turtles.

Sources of Uncertainty

Uncertainties related to this project include: ability of enforcement officers to document and prevent interactions, and whether a reduction in interactions will contribute to a subsequent reduction in by-catch. Additional uncertainties exist as to whether outreach and education will result in changed behaviors. Strategy to resolve: by conducting a social science study prior to the development of outreach and education activities, targeted outreach materials can be developed that are directly responsive to current attitudes, perceptions and likely causes of interactions.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and identify potential corrective actions, if needed. For each of the monitoring parameters identified below, information is provided on the intended purpose of each monitoring parameter (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. This section also describes applicable performance criteria and potential corrective actions for project parameters associated with project objectives.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria are used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. The decision to implement a corrective action will holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Parameter: Number of Fishermen Voluntarily Adopting Recommended Gear Modifications and Best Practices

    a. Purpose: To reduce bycatch of sea turtles.
    b. Method: Report number and type of modifications made.
    c. Timing and Frequency: Years 3 and 4
    d. Sample Size: Total number
    e. Sites: NA
    f. Performance Criteria: Number of modifications made target goal: 10
    g. Corrective Action(s): Increase outreach efforts to promote program and target relevant stakeholders to participate in the program

Parameter: Number of Participants in Surveys/Focus Groups

a. Purpose: To reduce interactions by increasing targeted outreach and education efforts.
b. Method: Count total number of participants
c. Timing and Frequency: Baseline; and year 2
d. Sample Size: All participants
e. Sites: Note locations of activities and provide education materials used
f. Performance Criteria: Target Number: 150 participants
g. Corrective Action(s): Hold additional focus groups, refine outreach to solicit participation.

Parameter: Number of Individuals Trained Per Year

a. Purpose: To ensure officers have the education needed to reduce interactions
b. Method: Report number of individuals trained and provide copies of training materials
c. Timing and Frequency: Annually in years 2, 3, and 4
d. Sample Size: All individuals
e. Sites: Note site where training occurred
f. Performance Criteria: Provide copy of training materials and results of any quizzes
g. Corrective Action(s): Refine and update materials as needed

Parameter: Number of Individuals Receiving Continuing Enforcement Education

a. Purpose: To ensure officers have the education needed to reduce interactions
b. Method: Report number of individuals receiving continuing education and provide copies of training materials
c. Timing and Frequency: Conduct annually in years 3 and 4
d. Sample Size: All individuals
e. Sites: Note sites where training occurred
f. Performance Criteria: 18 individuals per year
g. Corrective Action(s): Refine and update materials as needed

Parameter: Number of Days ESA Dedicated Patrol

a. Purpose: To track the number of hours of patrol dedicated to ESA patrols
b. Method: Report number of patrol days and general locations
c. Timing and Frequency: Report total number of days annually
d. Sample Size: All days
e. Sites: Identify locations
f. Performance Criteria: 12 per year
g. Corrective Action(s): Adjust frequency depending on amount of activity witnessed

Parameter: Number of Outreach Materials Created

a. Purpose: To increase understanding of the importance of reducing anthropogenic threats to sea turtles.
b. Method: Staff will review existing outreach materials, identify gaps and/or needed updates, work with stakeholders, develop targeted audience messaging, and produce a minimum number of outreach materials such as web content, social media content, PSA's, brochures / hand-outs, etc.
c. Timing and Frequency: Annually in years 2 and 3
d. Sample Size: All materials developed
e. Sites: Report and provide copies of all materials developed

f. Performance Criteria: Develop a minimum of 1 educational document to be distributed through a variety of outlets including print, social media, etc.

g. Corrective Action(s): Revise and update materials as needed

Parameter: Number of Outreach Materials Distributed

a. Purpose: To increase understanding of the importance of reducing anthropogenic threats to sea turtles

b. Method: Count total distributed and note locations for distribution. Methods of distributing outreach materials include a combination of email blasts, social media posts, web content updates, direct mail, PSAs; news articles, brochures, web videos, etc.

c. Timing and Frequency: Years 3 and 4

d. Sample Size: Total number of materials distributed

e. Sites: Report number of materials distributed and primary locations for distribution

f. Performance Criteria: Distribute all materials developed/updated at a minimum of 15 locations/events annually (locations can include public outreach events, web, media, etc.)

g. Corrective Action(s): Identify additional locations for distribution

Parameter: Number of Interactions Encountered and Stopped by MRD Law Enforcement Officers

a. Purpose: To understand if increased enforcement actions are reducing the number of interactions

b. Method: Count number and identify nature and location of interactions

c. Timing and Frequency: Report all interactions annually

d. Sample Size: All interactions

e. Sites: Note all sites and identify which interactions occurred in hot spot areas

f. Performance Criteria: 6 per year

g. Corrective Action(s): Citations / Case Packets where needed

Parameter: Number and Location of Hot Spot Areas

a. Purpose: To understand where negative actions are most likely to occur and where enforcement enhancements should be focused.

b. Method: NOAA NMFS protected resources staff, USFWS, and AMRD biologists would work together to identify and prioritize hot spot areas for potential ESA violations and those areas that need increased and consistent enforcement efforts.

c. Timing and Frequency: Year 1

d. Sample Size: TBD

e. Sites: TBD

f. Performance Criteria: Develop patrol frequency guidelines for determined hot spot areas

g. Corrective Action(s): Adjust hot spot areas and patrol frequencies as needed to maximize compliance

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 1: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Project Monitoring (Years 1-4)
Number of gear modifications	1, 3		X	X
Number and location of hot spot areas	1			X
Number of participants in surveys/focus groups	2	X		X
Number of individuals trained per year	1	X		X
Number of individuals receiving continuing enforcement education	1	X		X
Number of days ESA dedicated patrol	1	X		X
Number of outreach materials created	3			X
Number of outreach materials distributed	3			X
Number of interactions encountered and stopped by MRD law enforcement officers	1	X		X

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the

benefit of a particular resource (DWH NRDA Trustees 2016a, Appendix 5.E.1). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action.

NMFS, USFWS, and ADCNR would work collaboratively with ADCNR Marine Resources Division (AMRD) law enforcement and federal offices of law enforcement to determine law enforcement training needs, how best to conduct consistent training, and to identify specific training and educational needs/products. A communication pathway between the state and federal agencies and law enforcement would also be established to continuously reevaluate needs to ensure consistency in enforcement enhancement efforts.

This project would fund the completion of a social science study to characterize attitudes and perceptions of vessel-based ecotourism and sea turtle interactions. The results of this study will inform the creation of targeted outreach materials. Additionally, project managers will seek to identify targeted hot spot areas in order to maximize the benefits of patrol hours in places where negative interactions are most likely to occur. These project elements will increase the likelihood of success of the project by targeting activities based on local data.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

- Were interactions between sea turtles and the public characterized and methods to reduce interactions identified?
- Are causes of harmful interactions addressed in education and outreach materials?
- Were hotspots identified and were any common attributes among hotspots identified?
- Was enforcement enhanced?
- Were the project objectives achieved? If not, is there a reason why they were not met?
- Did the project produce unanticipated effects?
- Were there unanticipated events unrelated to the project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?
- Have data been summarized and characterized in a way that allows for a clear understanding of results?
- Have any trends or patterns been identified, and if so, how can they be characterized?

These questions will be answered and compiled in annual monitoring reports for the project and revision to the MAM plan be made if needed.

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 ([DWH NRDA Trustees 2017a](#)). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then Project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

Data Review and Clearance

After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and would ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata. All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual Version 1.0. Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. Some data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

REPORTING

Annual MAM reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

ROLES AND RESPONSIBILITIES

ADCNR is the lead Trustee agency for this project, and will ensure that the project is completed.

NOAA will collaborate.

The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

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MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	6/1/2018	Draft to final version; Added info on parameters	Draft to final	MAM_Plan_CAST_Educ_Enhance_6.1.18

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MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
ENHANCING CAPACITY FOR THE ALABAMA MARINE MAMMAL STRANDING NETWORK

PROJECT OVERVIEW

The Enhancing Capacity for the Alabama Marine Mammal Stranding Network (ALMMSN) project would enhance the capacity of the ALMMSN by providing funding for staff time, equipment and supplies, and sample analyses and would address the ending of the current funding source through NFWF-GEBF. ALMMSN is operated out of the Dauphin Island Sea Lab (DISL) on Dauphin Island, Alabama. This project would allow ALMMSN to use and expand on its existing infrastructure for cetacean stranding response, and communications and data management in order to enhance the ALMMSN's operations. The project would allow ALMMSN to better respond to live or dead stranded cetaceans, to necropsy animals, and to analyze samples collected from cetaceans stranded in Alabama waters in order to better understand the causes of marine mammal illness and death. It would also support increased data consistency for information collected from stranded marine mammals by supporting ALMMSN to enter its data into a regional marine mammal health database (known as GulfMAP, hosted by NOAA). The project is expected to increase survival of rescued animals and recovery of populations affected by the DWH oil spill by improving marine mammal stranding response, data collection, data analyses, and reporting for Alabama waters, through better understanding of the causes of illness/mortality and through the early detection and intervention of anthropogenic and natural threats.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Project Type: Marine Mammals
- Programmatic Goal: Replenish and Protect Living Coastal and Marine Resources
- Restoration Type Goal: Identify and implement actions that support ecological needs of the stocks; improve resilience to natural stressors; and address direct human-caused threats such as bycatch in commercial fisheries, vessel collisions, noise, industrial activities, illegal feeding and harassment, and hook-and-line fishery interactions
- Restoration Approach: Increase marine mammal survival through better understanding of the causes of illness and death, as well as early detection and intervention for anthropogenic and natural threats

Objective 1: Increase trained staff capacity of ALMMSN.

Objective 2: Maintain and/or decrease average reporting time and/or response time.

Objective 3: Collect additional data to increase understanding of marine mammal population.

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

Funding the ALMMSN will better fill gaps in stranding coverage, reduce stranding response time, improve quantity, quality and consistency of reporting Level A, B, and C data for marine mammals, increase the number of personnel trained for stranding response in the region, increase the number of biological samples analyzed to determine causes of death and population status, expand community awareness, and provide long-term data sharing, storage and retrieval capacity. These efforts will reduce marine mammal mortality in Alabama waters, better define the specific causes of serious injury and

death among stranded marine mammals, and establish baseline conditions or shifts from previous conditions for comparison to immediate and longer-term threats to marine mammals. This project will meet the immediate need to provide data to assess the DWHOS as well as build capacity for collecting scientifically rigorous data for other sources of serious injury and mortality to marine mammals in the future.

In the longer term, these efforts will increase the abundance and stability of marine mammal populations in the region, identify larger patterns in stranding data that will inform managers and policy makers to define and focus management and conservation efforts, provide reliable stranding datasets that can be compared to environmental data to identify and define boundaries for essential habitat, improve knowledge of and response to future environmental emergencies like the DWHOS or longer term effects such as climate change and habitat loss, and potentially reduce the likelihood of future unusual or mass mortality events. These benefits are possible because the ability to predict, prepare for, respond to, and prevent strandings depends on quality data. These outcomes will necessarily feedback to further support the health and stability of marine mammal populations and achieve optimum sustainable populations within the carrying capacity of the system. The enhanced collaborations with network responders and local researchers will, in turn, foster development of future collaborative work, and provide opportunities for synergistic research, training, and educational activities.

Sources of Uncertainty

The sources of uncertainty that could influence the success of this project include the number of strandings and their state of decomposition (limiting samples collected), emerging threats and diseases, the ability to hire qualified personnel, and the incorporation of data collected into marine mammal management activities. This project has a high likelihood of successfully strengthening and growing Alabama's marine mammal populations. The program is already operating successfully and funding of this effort would ensure its continued operation, which otherwise cannot be guaranteed, and its enhancement and expansion. The proposed expansion and enhancement of the program under its existing manager, DISL, is expected to be a success. DISL staff have the expertise and experience to implement the activities proposed under the program—including sample collection, necropsies, sample analysis, and data management.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and identify potential corrective actions, if needed. For each of the monitoring parameters identified below, information is provided on the intended purpose of each monitoring parameter (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. This section also describes applicable performance criteria and potential corrective actions for project parameters associated with project objectives.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria are used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. The decision

to implement a corrective action will holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Parameter: Increase Staff Capacity

a. Purpose: Increase capacity of network to respond to strandings
b. Method: Hire qualified staff
c. Timing and Frequency: Year 1
d. Sample Size: NA
e. Sites: NA
f. Performance Criteria: number of staff hired
g. Corrective Action(s): Advertise position more broadly if qualified staff cannot be found

Parameter: Average Response Time

a. Purpose: Understand if increased staff capacity reduces stranding response time
b. Method: Provide summary of response actions and average response time
c. Timing and Frequency: Report annually
d. Sample Size: All responses during a given year
e. Sites: NA
f. Performance Criteria: Average response time is maintained or reduced
g. Corrective Action(s): Update response protocols as needed

Parameter: Percent of Successful Responses to Reported Strandings

a. Purpose: To understand the number of reported strandings annually as well as increasing understanding of the potential causes of strandings and hot spot areas
b. Method: Count and provide summary of response action
c. Timing and Frequency: Report annually
d. Sample Size: All responses
e. Sites: Note location of stranding
f. Performance Criteria: 100% of calls received are responded to
g. Corrective Action(s): Update response protocols as needed

Parameter: Collection of Stranding Data to Increase Understanding of Population

a. Purpose: Increase survival of rescued animals and recovery of population by improving understanding of marine mammal population and threats.
b. Method: Summarize stranding information collected and provide report on new insights that could help managers identify and mitigate impacts on marine mammals from natural and anthropogenic threats.
c. Timing and Frequency: Data will be collected during each response event, analyzed, and uploaded consistent with the *Data Management* and *Reporting* sections, below.
d. Sample Size: NA
e. Sites: NA
f. Performance Criteria: Summary report provided to ALTIG should provide detail on potential causes of strandings, and identify potential actions to reduce threats as well as identification of any hot spot areas for strandings. Data will also be uploaded consistent with the Data Management and Reporting sections, below.
g. Corrective Action(s): Revise if needed

Parameter: Percent of Biological Samples Collected that are Analyzed

a. Purpose: Understand if funding is resulting in increased analysis and subsequent increased understanding of marine mammal populations
b. Method: Count and provide data in GulfMAP and summary of sample results in annual report per protocols
c. Timing and Frequency: Data will be collected during each response event, analyzed, and uploaded consistent with the Data Management and Reporting sections, below
d. Sample Size: All samples collected within a given year
e. Sites: NA
f. Performance Criteria: 100%
g. Corrective Action(s): NA

Parameter: Percent of Stranded Animals Reported that are Necropsied

a. Purpose: Understand if funding is resulting in increased analysis and subsequent increased understanding of marine mammal populations
b. Method: Count, upload necropsy reports to GulfMap, and provide summary in annual report
c. Timing and Frequency: Report annually
d. Sample Size: All necropsies performed
e. Sites: NA
f. Performance Criteria: 100% of Code 2 animals for which a necropsy is feasible
g. Corrective Action(s): NA

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 1: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Project Monitoring (Years 1-4)
Increase staff capacity	1, 2	X		X
Percent of stranded animals that are necropsied	3	X		X
Collection of stranding data to increase understanding of population	3			X
Average Response Time	2	X		X
Percent of biological samples collected that are analyzed	3	X		X

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Project Monitoring (Years 1-4)
Percent of successful responses to reported strandings	2	X		X

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (Appendix 5.E.1, PDARP/PEIS). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action.

The activities proposed in this project are well-established and known to be effective and the program activities have been underway at DISL for several years. The information collected by ALMMSN from stranded cetaceans should would enable managers to mitigate impacts to marine mammals from natural and anthropogenic threats and to monitor population recovery post-DWH. Although extensive adaptive management activities are not expected to be necessary for this project, information gained will be useful in planning future restoration efforts for marine mammals.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

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

- Have data been summarized and characterized in a way that allows for a clear understanding of results?
- Have any trends or patterns been identified, and if so, how can they be characterized?

- What broader insights might be gained from implementation/monitoring of this project?

These questions will be answered and compiled in annual monitoring reports for the project and revisions to the MAM plan be made if needed.

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017a). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then Project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

Data Review and Clearance

After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata. All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual Version 1.0. Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. Some data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

All stranding data is submitted to GulfMAP as well as GoMDIS to ensure data sharing and collaboration among neighboring GOM networks. Additionally, with any strandings showing evidence of human interaction, the data is forwarded to the NMFS Office of Protected Resources Bottlenose Dolphin Conservation Coordinator. All data sharing will be consistent with the protocols set forth in the "Marine Mammal Conservation and Recovery in the Gulf of Mexico through support of the Alabama Marine Mammal Stranding Network, AL" project through the NFWF Gulf Environmental Benefit Fund.

REPORTING

Annual MAM reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface and in accordance with the MAM Manual MAM Report Template.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

ALMMSN would maintain ADCNR reporting, metadata publications, MMHSRP reporting, and necropsy reports, but also increase the number of metadata records relative to the samples processed for cetaceans (~10; estimated at 1-2 additional metadata records per year), increase necropsy reporting consistent with a greater number of animals sampled, and increase the number of publications (~3 total due to increased research capacity), plus share up to 2 newsletter articles per year (~10 total).

ROLES AND RESPONSIBILITIES

ADCNR is the implementing Trustee for this project, and will ensure that the project is completed.

The DISL ALMMSN is the project partner.

The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

DWH NRDA Trustees. 2017a. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill. December.

DWH NRDA Trustees. 2017b. Deepwater Horizon Oil Spill Natural Resource Damage Assessment: Strategic Framework for Marine Mammal Restoration Activities. June. Available: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

National Research Council. 2004. *Adaptive Management for Water Resources Project Planning*. Washington, DC: The National Academies Press.

Pastorok, R.A., MacDonald, A., Sampson, J.R., Wilber, P., Yozzo, D.J., & Titre, J.P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9, 89-107.

Steyer, G.D. & Llewellyn, D.W. 2000. Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 26, 27-39.

Williams, B.K. 2011. Adaptive management of natural resources - Framework and issues. Journal of Environmental Management, 92, 1346-1353.

MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	6/1/2018	Draft to final version; Added detail to parameters	Draft to final	MAM_Plan_Enhancing _Capacity_ALMMSN_6.1.18

MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
ASSESSMENT OF ALABAMA ESTUARINE BOTTLENOSE DOLPHIN POPULATIONS AND HEALTH

PROJECT OVERVIEW

This project is aimed at examining common bottlenose dolphin distribution, abundance, and population structure within Alabama state waters to assess the status of bottlenose dolphins using Alabama waters by collecting data on dolphin abundance, stock structure, distribution, habitat use, mortality rates, contaminant loads, biotoxin exposures, and feeding habits. The project is a data collection and analysis effort to: (1) investigate stock structure and demography across Mobile Bay, Perdido Bay, and nearshore AL waters based on biopsy sampling and genetic analysis for stock structure and estimate the seasonal (summer/winter) abundance, distribution, and habitat use of common bottlenose dolphins in Alabama waters through photo-ID surveys and capture-mark-recapture analysis; (2) assess dolphin condition following the DWH Oil Spill utilizing assessment of external body condition through images from surveys and assessment of contaminant loads and biotoxin exposures through analyses of tissues collected during remote biopsy sampling, which would inform future restoration planning, and 3) assessment of diet through prey sampling and stable isotope and fatty analysis of remote biopsy samples. This data collection effort would provide valuable resource-level monitoring for bottlenose dolphin stocks in Alabama waters, a largely unstudied top predator in Alabama waters, informing pre-restoration baselines and providing more effective restoration planning and implementation. ADCNR would be the implementing trustee.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Project Type: Marine Mammals
- Programmatic Goal: Replenish and Protect Living Coastal and Marine Resources
- Restoration Type Goal: Identify and implement restoration activities that mitigate key stressors to support resilient populations. Collect and use monitoring information, such as population and health assessments and spatiotemporal distribution information.

Objective 1: To estimate seasonal abundance, distribution, and habitat use of bottlenose dolphin populations of Perdido Bay, Mobile Bay and adjacent coastal waters by conducting photo-ID surveys and capture-mark-recapture analysis.

Objective 2: To investigate stock structure, body condition and toxicology assessments, and dietary analysis by conducting 4 remote biopsy surveys in the same areas (two per site).

ANTICIPATED OUTCOMES AND FUTURE ACTIVITIES

For this project, the specific stressors addressed include toxic chemical loading as well as gaps in knowledge about Alabama's bottlenose dolphin population. This project will contribute to a greater understanding of Alabama's bottlenose dolphin populations, and will ultimately be utilized to improve management activities associated with the protection of this marine mammal species. The completion of this project will result in the availability of data that will support the development of future marine mammal restoration projects. This project plays an important role in filling major scientific information or data gaps for marine mammal abundance, distribution and population structure, which in the longer term will feed directly into the AL TIG's efforts to address marine mammal impacts. Data will be

comparable and transferable to inform Gulf-wide research and conservation efforts. Most importantly, research will provide valuable post-spill data for bottlenose dolphins, a largely unstudied top predator in Alabama waters.

Sources of Uncertainty

This project utilizes existing standards and protocols that have proven effective. The likelihood of success is high. Some uncertainty exists regarding the ability of researchers to meet target tissue sample numbers to meet the analytical requirements for the interpretation. Weather and other physical delays may cause delays in sampling trips. The ability to accommodate the multiple analyses proposed and selected to represent each sampling location and time relative to sex and age class of the sampled population depend on the quantity, type (age, sex classes) and quality of the samples obtained. For persistent organic pollutant analyses, samples will be randomly selected from the male individuals (determined by genetics) in a statistically robust manner. . This project will reduce uncertainty in future marine mammal restoration projects by filling knowledge gaps.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and identify potential corrective actions, if needed. For each of the monitoring parameters identified below, information is provided on the intended purpose of each monitoring parameter (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. This section also describes applicable performance criteria and potential corrective actions for project parameters associated with project objectives.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria are used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. The decision to implement a corrective action will holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Parameter: Submission of Annual Project Progress Report

a. Purpose: Annual project progress report should detail the surveys conducted and information collected, locations, number and type of samples taken and analyzed and an update/summary on any results and lessons learned
b. Method: Progress report should accumulate, analyze, and synthesize data collected and any insights gained
c. Timing and Frequency: 30 days following end of calendar year
d. Sample Size: Annually
e. Sites: NA
f. Performance Criteria: NA
g. Corrective Action(s): Revise and update as needed

Parameter: Number of Remote Biopsy Samples

a. Purpose: Determine whether appropriate sample volumes and numbers per site, sex class and season for the project are obtained

b. Method: A total of 4 remote biopsy surveys will be conducted and each seasonal remote biopsy survey will be conducted during a 42-day window using 1 boat staffed with 4 scientists. Biopsy samples will include skin and blubber collected from below the dorsal fin by standard techniques (Krutzen et al. 2006) using biopsy darts fired from a crossbow or rifle (.22 caliber). Animals will be photographed before biopsy attempts to ensure the integrity of photo-ID records for each animal.

c. Timing and Frequency: A total of 4 survey periods will be used to to obtain adequate seasonal sample for genetic stock structure analysis, toxicology assessments, and dietary analyses, and to inform body condition. Winter 2019/20 and summer 2020 remote biopsy surveys will be conducted across Perdido Bay and adjacent coastal waters (>2 km from the shoreline) Remote biopsy sampling in Mobile Bay and adjacent coastal waters will be conducted during the winter 2020/21 and summer 2021 sampling season.

d. Sample Size: 4 survey periods; 2 locations per survey period

e. Sites: 3 sites--Mobile Bay, Perdido Bay, and Alabama Coastal Waters (> 2 km from the shoreline)

f. Performance Criteria: Obtained appropriate sample volumes and numbers per site, sex class and season

g. Corrective Action(s): NA

Parameter: Number of Samples Analyzed and Analyses Performed

a. Purpose: Obtain an appropriate sample size (volume and numbers) for the project

b. Method: Two hundred (200) samples will be analyzed for stable isotope and fatty acid analyses for the purpose of diet assessment. 260 samples will be analyzed for genetics analyses for stock structure, sex determination, species confirmation, and morphotype determination.

c. Timing and Frequency: Tissue Analysis will begin immediately following each biopsy survey and will commence from late 2019 to late 2021

d. Sample Size: All 260 samples

e. Sites: 3 sites--Mobile Bay, Perdido Bay, and Alabama Coastal Waters (> 2km from the shoreline)

f. Performance Criteria: Number of samples collected is sufficient to inform stock structure analyses.

g. Corrective Action(s): NA

Parameter: Number of Photo-ID Surveys

a. Purpose: Obtain an appropriate sample size for the project.

b. Method: Methods described in: (Rosel et al. 2011) such that a single mark-recapture session will consist of one primary mark (~2 days) and two secondary recapture periods (~3 days each), separated by 1 day each for a total of 14 days per session including weather days, repeated during summer and winter seasons for each embayment. All track lines for a given survey will be completed in the shortest time possible and under optimal sighting conditions (< Beaufort Sea State 3) to maximize detection probabilities and reduce violating capture probability assumptions. Each seasonal photo-ID mark-recapture survey in Perdido Bay will be conducted by one boat staffed with three scientists. Mobile Bay surveys will require two boats staffed with three scientists each. Photos will be collected using high-resolution digital photography of dorsal fin and flanks of each animal. Observers will note environmental conditions, animals' location (GPS), group sizes, numbers of adults and juveniles (by relative size and ontogenetic

morphology), movement patterns, behavioral states (e.g., travel, feed, social) and evidence of foraging (and prey species, when visible).
c. Timing and Frequency: A total of 12 seasonal photo-ID surveys will be conducted in Perdido Bay and Mobile Bay during 6 time periods: Summer 2019, 2020, 2021 and Winter 2019/20, 2020/21, 2022/23)
d. Sample Size: 12 surveys
e. Sites: Mobile Bay, Perdido Bay, Adjacent Coastal Waters (> 2 km from the shoreline)
f. Performance Criteria: 12 (2 per year) in Perdido and Mobile Bays
g. Corrective Action(s): NA

Parameter: Number of Dolphins Observed or Sampled Per Trip

a. Purpose: To track number of dolphins sampled per trip to determine whether project targets are being met
b. Method: Synthesize daily / weekly data sheets
c. Timing and Frequency: Report all trips conducted on an annual basis
d. Sample Size: Note all trips conducted in report
e. Sites: All
f. Performance Criteria: Note all trips conducted in report.
g. Corrective Action(s): Adjust locations if requisite number of dolphins are not being sampled

Parameter: Completion of Analysis

a. Purpose: A final analysis of data collected will provide Trustees insight as to the locations and types of activities most likely to reduce threats to marine mammal populations
b. Method: Submission of final report that details information gained from completing study. Report should identify potential locations for restoration activities and types of activities that provide the most cost-effective means of reducing threats to dolphins and increasing their populations in coastal Alabama.
c. Timing and Frequency: Upon project completion
d. Sample Size: All
e. Sites: NA
f. Performance Criteria: Analysis should provide insight that assists ALTIG in future decision-making regarding those actions most likely to address known threats to marine mammals
g. Corrective Action(s): Revise if needed

Parameter: Abundance Estimates

a. Purpose: estimate population size
b. Method: follow established methods for photo-ID mark-recapture surveys per Rosel et.al 2011
c. Timing and Frequency: twice per year (summer and winter) for 3 years
d. Sample Size: 1 sample per season (2 seasons) per year (3 years) per location (2 bays) for a total of 12 estimates of abundance
e. Sites: Mobile Bay, Perdido Bay, and Adjacent coastal waters
f. Performance Criteria: Submission of abundance estimate to ALTIG in final report
g. Corrective Action(s): NA

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 1: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Post-Execution Monitoring (Years 1-4)
Annual Project Progress Report	1			X
Number of remote biopsy samples	2			X
Number of samples analyzed and analyses performed	2			X
Number of photo-id surveys	1			X
Number of dolphins observed or sampled per trip	1			X
Completion of analyses	1, 2			X
Abundance Estimates	1			X

PROJECT IMPLEMENTATION

Trustees propose to measure seasonal (summer/winter) dolphin abundance, distribution and habitat use, investigate stock structure and assess condition (based on observation and biopsy sampling) of bottlenose dolphin stocks within Alabama state waters after the DWHOS. DISL will conduct the proposed surveys, biopsy sampling, sample analyses, and data analyses, and write reports and publications with assistance and guidance from NOAA NMFS Mississippi Laboratories. A benefit of this proposal is that it will build capacity for research in the region because staff from NOAA NMFS Mississippi Laboratories will provide new training for DISL personnel in biopsy sampling techniques and enhance existing knowledge in photo-id image collection and analyses techniques. With support from NOAA NMFS Mississippi Laboratories, DISL has in place the infrastructure and staff necessary to manage the project, including coordinating fieldwork with collaborators, performing sample processing and analyses, and submitting annual reports to ADCNR. Analyses of data will be consistent with data analyses for other BSE populations.

This project has a 4-year timeline. As proposed, identifying survey routes selection and staff training would occur during spring 2019. Photo-ID surveys would begin during summer 2019 and repeated during summers 2020 and 2021, as well as winters 2019-2020 and 2021-2022. Remote biopsy surveys would be performed during winter 2019/20 and summer 2020 and 2021. Tissue and data analysis would begin after the first surveys are completed and continue through the duration of the study. Final reporting is expected by winter 2022. Data would be stored in compliance with Trustee's Standard Operating Procedures.

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (Trustees 2016, Appendix 5.E.1, PDARP/PEIS). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action.

Because there are current gaps in scientific understanding regarding these species, this project supports an adaptive management approach to marine mammal restoration by conducting this work to reduce key uncertainties and conduct analyses that will inform the selection, design and optimization of future project portfolios. The effective use of project funds to support addressing uncertainties will inform restoration planning, implementation and evaluation of marine mammal restoration projects in Alabama. This approach may evolve over time as Trustees gain new insight and knowledge from restoration activities.

Because this project entails the collection of data utilizing established methods, project-level adaptive management will be minimal. However, this project supports a larger commitment to adaptive management at the program level as the data generated as a result of this project will reduce future uncertainties regarding the siting and success of future marine mammal restoration projects.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Did the restoration project produce unanticipated effects?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?
- Have data been summarized and characterized in a way that allows for a clear understanding of results?

- Have any trends or patterns been identified, and if so, how can they be characterized?
- What broader insights might be gained from implementation/monitoring of this project?

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017a) and standard data management used for cetacean work. Images will be archived in finbase and FinFindR will be used for analyses and matching. To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then Project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

Data Review and Clearance

After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata. All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual Version 1.0. Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. Some data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information

collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

REPORTING

Data will be provided in the Marine Mammal Monitoring and Analyses Platform, GulfMAP, and GoMDIS.

Annual MAM reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A FINAL MAM REPORT FOR THE PROJECT WILL BE DEVELOPED PRIOR TO PROJECT CLOSEOUT AND SUBMITTED TO THE DIVER RESTORATION PORTAL. ROLES AND RESPONSIBILITIES

ADCNR is the lead Trustee agency for this project, and will ensure that the project is completed.

The project would be implemented by the DISL in collaboration with NOAA NMFS Mississippi Laboratories Southeast Fisheries Science Center (genetics, fieldwork) and NOAA's Marine Mammal Health and Stranding Program (contaminants and health assessments).

The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

DWH NRDA Trustees. 2017a. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill. December.

DWH NRDA Trustees. 2017b. Deepwater Horizon Oil Spill Natural Resource Damage Assessment: Strategic Framework for Marine Mammal Restoration Activities. June. Available: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

National Research Council. 2004. *Adaptive Management for Water Resources Project Planning*. Washington, DC: The National Academies Press.

Pastorok, R.A., MacDonald, A., Sampson, J.R., Wilber, P., Yozzo, D.J., & Titre, J.P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9, 89-107.

Steyer, G.D. & Llewellyn, D.W. 2000. Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 26, 27-39.

Williams, B.K. 2011. Adaptive management of natural resources - Framework and issues. Journal of Environmental Management, 92, 1346-1353.

MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	6/1/2018	Draft to final version; Added detail to parameters	Draft to final	MAM_Plan_Assessment_AL_Estuarine_Bottlenose_Dolphin_Populations_Health_6.1.18

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MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
ALABAMA ESTUARINE BOTTLENOSE DOLPHIN PROTECTION: ENHANCEMENT AND EDUCATION

PROJECT OVERVIEW

This project would reduce injury and mortality in Alabama estuarine bottlenose dolphins. This would be accomplished by (1) increasing resources for ADCNR AMRD to dedicate toward MMPA-related activities and increasing patrol hours; (2) increasing awareness and understanding of the MMPA through education to assist state enforcement efforts; (3) conducting social science studies (e.g., interviews, focus groups) to help (a) characterize the nature and extent of the illegal feeding of dolphins, vessel-based harassment, and interactions of dolphins with hook and line fishing gear in Alabama, and (b) understand attitudes and perceptions of these user groups; (4) conducting systematic fishery surveys to help characterize the nature and extent of dolphin interactions with commercial fishing vessels and hook-and-line gear in Alabama; and (5) developing and implementing a comprehensive and targeted outreach plan based on the results of these social science studies and systematic fishery surveys.

Resources and equipment necessary to increase and sustain state enforcement activities in hotspot areas would be identified, and state enforcement would be increased/enhanced in areas of need to reduce harm from illegal activities. A communication pathway between the state and federal agencies and law enforcement would be established to reevaluate needs on an ongoing basis to ensure consistency in enforcement enhancement efforts.

This project would also enhance public knowledge of marine mammal protection and the MMPA by contracting with a company who would conduct a social science survey, which would inform the creation of a well-informed, targeted education and outreach program for the Alabama coast.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Project Type: Marine Mammals
- Programmatic Goal: Replenish and Protect Living Coastal and Marine Resources
- Restoration Type Goal: Identify and implement actions that support ecological needs of the stocks; improve resilience to natural stressors; and address direct human-caused threats such as bycatch in commercial fisheries, vessel collisions, noise, industrial activities, illegal feeding and harassment, and hook-and-line fishery interactions.
- Restoration Approaches:
  - Reduce commercial fishery bycatch through collaborative partnerships
  - Reduce injury and mortality to bottlenose dolphins from hook-and-line fishing gear
  - Reduce injury, harm, and mortality to bottlenose dolphins by reducing illegal feeding and harassment activities
  - Reduce marine mammal takes through enhanced state enforcement related to the MMPA

Objective 1: Characterize dolphin interactions with commercial and recreational vessels operating in Alabama state waters.

Objective 2: Reduce lethal impacts to dolphins from illegal feeding and harassment activities and fishing interactions known to occur within Alabama state waters by effectively changing human behaviors through a targeted outreach and education strategy in a phased approach.

Objective 3: Reduce activities known to cause harm to marine mammals by enhancing state enforcement of the Marine Mammal Protection Act in Alabama state waters.

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

For this project, the specific stressors addressed include impacts from fishing activities, boating interactions, harassment and other anthropogenic stressors to marine mammals. This project will reduce those stressors by reducing related impacts through development of information needed to conduct targeted outreach and education strategy, and by enhancing state law enforcement to reduce activities known to cause harm to marine mammals.

Sources of Uncertainty

There is uncertainty around whether people who receive education subsequently change their behavior, and whether those behavioral changes result in decreased interactions and/or mortality. However, the activities described in the project narrative are generally known to be effective and have been implemented successfully in other coastal locations. Hot spot locations for potential MMPA violations and areas that need increased and consistent enforcement efforts will be prioritized in order to reduce uncertainty regarding the ability of officers to witness and halt interactions.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and identify potential corrective actions, if needed. For each of the monitoring parameters identified below, information is provided on the intended purpose of each monitoring parameter (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. This section also describes applicable performance criteria and potential corrective actions for project parameters associated with project objectives.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria are used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. The decision to implement a corrective action will holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Parameter: Number of Patrons, Fisherman and Business Owners Reached and Educated Regarding Safe Viewing and Interaction Practices

    a. Purpose: Used to estimate the proportion of the population exposed to outreach material
    b. Method: Count and report on number of people educated, by type (e.g., patrons, fishermen, business owners)
    c. Timing and Frequency: Throughout project
    d. Sample Size: All people reached
    e. Sites: Note interactions and primary locations
    f. Performance Criteria: Target Number 800
    g. Corrective Action(s): Concentrate efforts in areas with high probability of wildlife interactions

Parameter: Number of Participants in Surveys/Focus Groups

a. Purpose: To develop an informed, comprehensive outreach plan to educate target audiences
b. Method: Report total number of participants
c. Timing and Frequency: Year 1
d. Sample Size: targeted number of respondents and number of focus groups per audience type
e. Sites: TBD
f. Performance Criteria: Target Number 200
g. Corrective Action(s): Identify best locations to maximize participation

Parameter: Number of Outreach Documents Developed

a. Purpose: To increase understanding of the importance of reducing anthropogenic threats to marine mammals
b. Method: Staff will develop outreach materials based on results of social science studies, work with stakeholders, develop targeted audience messaging, and produce a minimum number of outreach materials such as web content, social media content, PSA's, brochures / hand-outs, etc.
c. Timing and Frequency: after completion of the social science studies and development of the comprehensive educational strategy
d. Sample Size: All materials developed
e. Sites: Report and provide copies of all materials developed
f. Performance Criteria: Develop a minimum of 1 educational document to be distributed through a variety of outlets based on results of social science studies
g. Corrective Action(s): Revise and update materials as needed

Parameter: Number of Outreach Documents Distributed

a. Purpose: To increase understanding of the importance of reducing anthropogenic threats to marine mammals
b. Method: Count total distributed and note locations for distribution. Methods of distributing outreach materials include a combination of email blasts, social media posts, web content updates, direct mail, PSAs; news articles, brochures, web videos, etc. and will be informed by results of social science studies.
c. Timing and Frequency: Years 3,4 after completion of the social science studies and development of the comprehensive educational strategy
d. Sample Size: Total number of materials distributed
e. Sites: Report number of materials distributed and primary locations for distribution
f. Performance Criteria: Distribute all materials developed/updated at a minimum of 15 locations/events annually (locations can include public outreach events, web, media, etc.)
g. Corrective Action(s): Identify additional locations for distribution

Parameter: Number of Interactions Encountered and Stopped by DMR Law Enforcement Officers

a. Purpose: To reduce threats to marine mammal populations
b. Method: Count number and identify nature and location of interactions
c. Timing and Frequency: Throughout project
d. Sample Size: All interactions encountered and stopped
e. Sites: Note location and nature of interaction
f. Performance Criteria: 6 per year

g. Corrective Action(s): Citations / Case Packets where needed

Parameter: Number Hours Dedicated MMPA Patrol

a. Purpose: To understand if increased enforcement actions are halting and, over time, reducing the number of negative interactions
b. Method: Report number of patrol days and general locations
c. Timing and Frequency: Report total number of days annually
d. Sample Size: All days
e. Sites: Identify locations
f. Performance Criteria: 96 per year
g. Corrective Action(s): Adjust frequency depending on amount of activity

Parameter: Completion of Social Science Study

a. Purpose: To focus efforts on activities most likely to enhance understanding of how to reduce threats to marine mammals.
b. Method: Was study completed?
c. Timing and Frequency: Year 1, prior to development of comprehensive outreach strategy
d. Sample Size: TBD
e. Sites: NA
f. Performance Criteria: Provide summary report upon completion that identifies outreach and education needs that were identified.
g. Corrective Action(s): Implement necessary changes, if needed, in order to meet criteria

Parameter: Completion of Fisheries Science Survey

a. Purpose: To determine the scope, scale and frequency of dolphin and hook and line gear interactions and characterize the nature of these interactions
b. Method: Was study completed?
c. Timing and Frequency: Year 1
d. Sample Size: TBD
e. Sites: NA
f. Performance Criteria: Provide summary report upon completion that identifies key issues and strategies to address
g. Corrective Action(s): Implement necessary changes, if needed, in order to meet criteria

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 1: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Project Monitoring (Years 1-5)
Number of participants in surveys/focus groups	1			X

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Project Monitoring (Years 1-5)
Number of interactions encountered and stopped by MRD law enforcement officers	3	X		X
Number of patrons and business owners reached and educated regarding safe viewing and interaction practices	2	X		X
Number of fishermen voluntarily adopting recommended gear modifications and best practices	2			X
Number of outreach documents developed	2			X
Number of outreach documents distributed	2			X
Number of hours dedicated MMPA patrol	3	X		X
Completion of social science study	1, 2			X
Completion of fisheries science survey	1, 2			X

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not

have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (Trustees, 2016, Appendix 5.E.1, PDARP/PEIS). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action.

Training of AMRD enforcement officers, in collaboration with NMFS, would be conducted and outreach products to aid enforcement's efforts produced and distributed by partnering with local, state, and federal stakeholders. NMFS, NOAA OLE, and AMRD biologists would also work together to identify and prioritize hotspot areas for potential MMPA violations and areas that need increased and consistent enforcement efforts, maximizing available resources.

Enhancing capacity for enforcement may result in an initial increase in the documentation of interactions, but this number should decline over time as education and outreach activities contribute to better public understanding and reduced negative interactions. If the numbers of interactions or survey responses indicate that education and outreach is not as effective as planned, then revisions and reassessment may be required.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

- Were interactions between dolphins and the public characterized and methods to reduce interactions identified?
- Are causes of harmful interactions addressed in education and outreach materials?
- Was enforcement enhanced?
- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Did the restoration project produce unanticipated effects?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?

These questions will be answered and compiled in annual monitoring reports for the project and revision to the MAM plan be made if needed.

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017a). To the extent practicable, all environmental and biological data generated during monitoring

activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then Project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

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Data Storage and Accessibility

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Data Sharing

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REPORTING

Once all data have been reviewed for accuracy and completeness, they will be made publicly available through the DIVER Explorer Interface.

Annual MAM reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

ROLES AND RESPONSIBILITIES

ADCNR is the lead Trustee agency for this project, and will ensure that the project is completed.

NMFS and ADCNR would work collaboratively with AMRD law enforcement and NOAA Office of Law Enforcement to determine law enforcement training needs and how best to conduct consistent training and to identify specific training and educational needs/products. AMRD would hire a biologist to implement training of enforcement officers on the MMPA and public outreach topics related to marine mammals. The biologist would coordinate with the NMFS Southeast Regional Office to receive and stay up-to-date on issues and information related to marine mammal protection. ADCNR would be the implementing Trustee. The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

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National Research Council. 2004. *Adaptive Management for Water Resources Project Planning*. Washington, DC: The National Academies Press.

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Steyer, G.D. & Llewellyn, D.W. 2000. Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 26, 27-39.

Williams, B.K. 2011. Adaptive management of natural resources - Framework and issues. Journal of Environmental Management, 92, 1346-1353.

MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	6/1/2018	Draft to final version; Added detail to parameters	Draft to final	MAM_Plan_BD_Educ_Enhance_6.1.18

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MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
COLONIAL NESTING WADING BIRD TRACKING AND HABITAT USE ASSESSMENT

PROJECT OVERVIEW

Additional information is needed to address information gaps for the metapopulation of several species of colonial wading birds breeding along the Alabama coast in the northern Gulf of Mexico to inform restoration planning. Specifically, there is interest in better understanding the contributions of individual nesting colonies to the metapopulation of Ardieds (herons, egrets, and bitterns), daily and seasonal movements, and habitat use (i.e., foraging sites v. roosting/loafing sites v. nesting sites) to guide restoration of these DWH-injured resources within the coastal areas of Alabama. The study area falls within the Mobile Bay Initiative Area of the Gulf Coast Joint Venture (Manlove et al. 2002). The species (see Objectives below) of colonial nesting wading birds targeted in this study are identified in the Southwestern Coffee Island Habitat Restoration Project-Phase I proposal, were injured by the DWH oil spill, and are targets for restoration efforts via the Natural Resource Damage Assessment.

Several environmental factors may affect wading bird productivity in the northern Gulf of Mexico (GOMAMN 2018). Several key ecosystem-level processes that were identified across 7 species of colonial wading birds (reddish egret, tricolored heron, little blue heron, great egret, white ibis, roseate spoonbill, wood stork) were: production and availability of prey during nesting created by aquaculture (e.g., crawfish farms in LA), production of freshwater prey affected by hydroperiod (e.g., natural and anthropogenic factors influencing inundation frequency, intensity, and periodicity), production of coastal prey affected by salinity, sea-level rise narrows salinity range(s) in foraging habitat, and nesting and productivity affected by mammalian predator composition, distribution, and abundance (Frederick et al. *In Prep.*, see also [Burger 2017](#)). Currently, the AL TIG is unable to effectively weigh the relative merits of potential bird restoration approaches given the uncertainty about alternatives (e.g., greater emphasis on predator controls v. increasing availability of nesting habitat v. actions to increase the availability of forage resources) for the target wading bird species herein (tricolored heron, and either the little blue heron or white ibis) ([NAS 2017](#)). This project would initiate monitoring studies expected to inform and enhance future restoration planning for key colonial nesting wading bird species along the Alabama coast that were injured by the DWH oil spill (PDARP/PEIS; [DWH NRDA Trustees 2016:table 4.7-3](#)). The goals of this proposed project are to better understand the extent to which declines in colonial nesting wading bird populations result from habitat limitation versus other potential population-limiting factors (Newton 1998), and in turn, which restoration approaches and techniques ([DWH NRDA Trustees 2017](#)) are most appropriate to effectively target and restore injuries to the Birds Restoration Type in Alabama ([NAS 2017](#)).

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

The project Restoration Type is Birds. The goal of this project is to provide data on the dynamics of prominent wading bird nesting colonies along the Alabama coast, as well as the use of local habitats by these species that support nesting and reproduction. This information will assist the Alabama TIG with prioritizing restoration approaches that best help to restore Birds. In summary, the Restoration Type goals are:

- *Programmatic Goal*: Replenish and Protect Living Coastal and Marine Resources
- *Restoration Type Goal*: Restore injured birds by species where actions would provide the greatest benefits within the geographic ranges that include the Gulf of Mexico

- *Project Goal*: Generate information to better target restoration projects that will provide the maximum benefits to wading birds in coastal Alabama
- *TIG*: Alabama
- *Restoration Plan*: Alabama Restoration Plan II (2018)

The project objectives are to track the movements and habitat use of breeding wading birds along the Alabama coast to help reduce uncertainty about restoration approaches to more effectively meet the Restoration Type goals. In summary, the project objectives[1] are:

Objective 1: Determine daily and seasonal movements, fidelity and dispersal of two wading bird species (i.e., tricolored heron and little blue heron; cattle egret and white ibis as potential alternatives[2]) among nesting colonies at three important breeding areas--Mississippi Sound, Gaillard Island, and Perdido Bay.

Objective 2: Identify important foraging and other habitat areas within the study area.

The implementing Trustee for this project is the U.S. Fish and Wildlife Service working collaboratively with AL TIG and state agency representatives and other conservation partners, e.g., Gulf Coast Joint Venture (Manlove et al. 2002).

CONCEPTUAL MODELS, ANTICIPATED OUTCOMES, AND FUTURE ACTIVITIES

A number of potentially competing hypotheses have been posed for apparent declines of coastal wading birds, beach-nesting shorebirds and seabirds in the Gulf of Mexico, both pre- and post DWH oil spill (see Burger 2017, 2018). Results from this monitoring effort of wading birds should allow simultaneous evaluation of multiple competing hypotheses (e.g., nesting habitat limitation hypothesis, predator limitation hypothesis, foraging habitat limitation hypothesis) (Lebreton et al. 1992, Newton 1998). The data collected from this project are expected to provide useful insights into these questions and will assist the AL TIG in planning more effective restoration (NAS 2017:chapt. 7) of bird species injured by the DWH oil spill. In general, and at the scale of the Gulf of Mexico, ecological processes affecting populations of tricolored (Fig. 1) and little blue herons (Fig. 2) may be fairly similar (GoMAMN 2017, Frederick et al. *In Prep*.). In addition, specific factors limiting tricolored and little blue heron and/or white ibis populations *may* differ and certainly could vary spatially and temporally across the northern Gulf of Mexico and within Alabama. A better understanding of factors influencing foraging habitat quantity and quality, identification of important foraging sites, foraging distances from nesting colonies and how these affect foraging success and ultimately, productivity for the target species will greatly assist in understanding population-limiting factors in Alabama.

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[1] Refer to Section 2 Project Monitoring for additional level of detail per the above identified objectives, i.e., how these broad project-level objectives will be explicitly addressed.

[2] Identified here as potential alternative target species for monitoring, not additional species to be monitored, per se. Potential uncertainties associated with this project are identified below in Sect. 1.4.
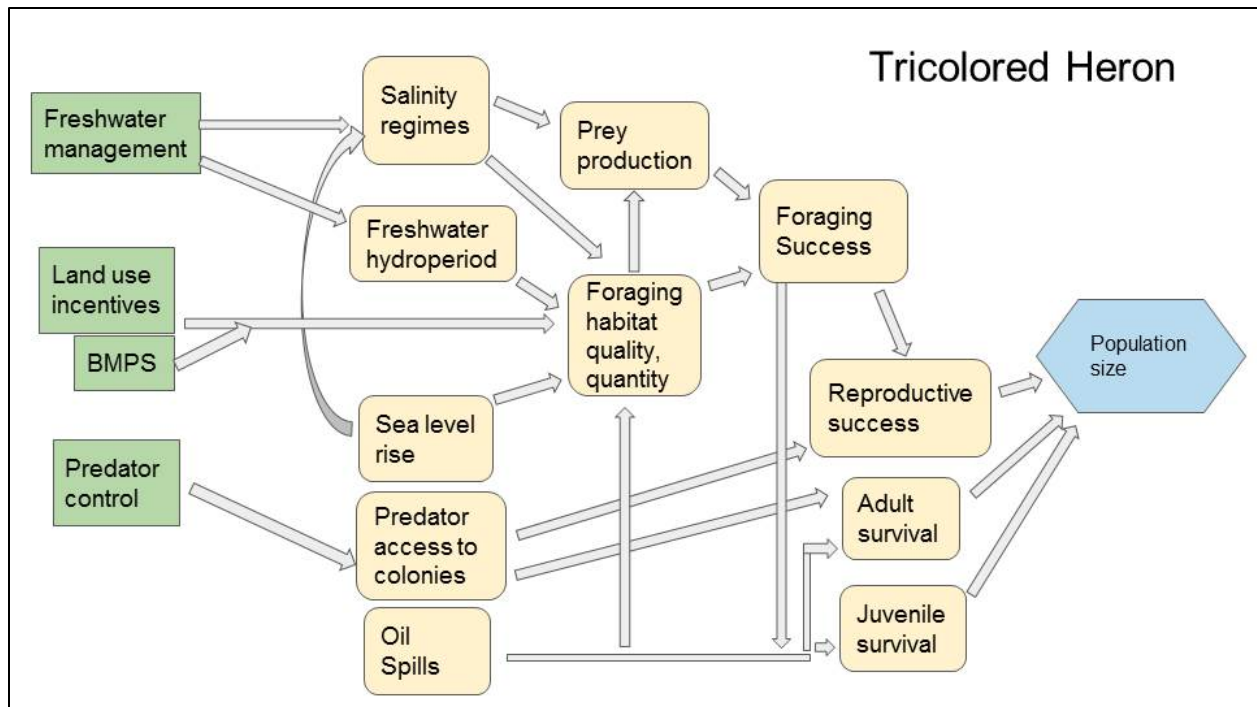
Figure 1. Influence diagram of factors, processes, and ecological relationships thought to influence tricolored heron population size in the northern Gulf of Mexico. The flow of the diagram is from left to right beginning with management or restoration actions (green boxes) via ecological processes (tan boxes) and associated relationships (tan boxes and arrows) that ultimately affect population parameters (i.e., reproductive success and adult and juvenile survival) and population size (blue hexagon). Refer to the GoMAMN objectives hierarchy and other relevant information: https://gomamn.org/. (NOTE: this is a *draft* product of the GoMAMN Strategic Monitoring Planning effort via the Wading Bird Working Group with Dr. Peter Frederick (University of Florida) as the Working Group lead.)
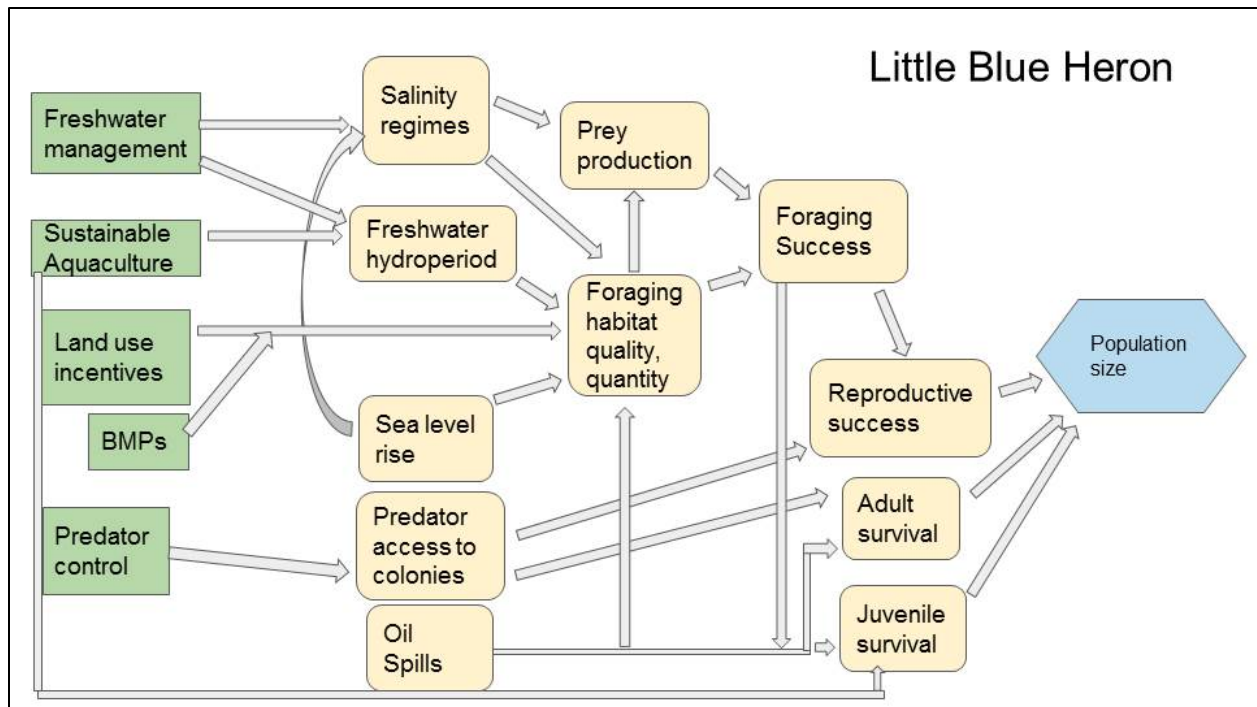
Figure 2. Influence diagram of factors, processes, and ecological relationships thought to influence little blue heron population size in the northern Gulf of Mexico. The flow of the diagram is from left to right beginning with management or restoration actions (green boxes) via ecological processes (tan boxes) and associated relationships (tan boxes and arrows) that ultimately affect population parameters (i.e., reproductive success and adult and juvenile survival) and population size (blue hexagon). Refer to the GoMAMN objectives hierarchy and other relevant information: https://gomamn.org/. (NOTE: this is a *draft* product of the GoMAMN Strategic Monitoring Planning effort via the Wading Bird Working Group with Dr. Peter Frederick (University of Florida) as the Working Group lead.)

Anticipated outcomes are identified above and are more fully described in the sections below. Future activities post-project will likely include on-the-ground restoration projects specifically to restore injured wading birds (PDARP/PEIS; DWH NRDA Trustees 2016: table 4.7-3). In addition, there will likely be either project-level or resource-level monitoring of known wading bird colonies in Alabama (e.g., colony overflights; Ford et al. 2010, Ford 2011) to evaluate local population status and trends in response to restoration or creation of nesting and/or foraging habitats. For example, one could use aerial photographic survey design and protocols developed by Ford et al. (2010) to re-survey the same islands sampled in 2010/2011 as a comparison to results from contemporary aerial surveys, and sample any/all newly created or restored islands to establish a baseline by species.

Sources of Uncertainty

The intent of the project is to reduce uncertainty to allow the Trustees to better focus restoration by addressing the primary drivers of wading bird productivity. For additional details regarding uncertainty, types of uncertainty, and its potential effects on management of natural resources, please refer to Williams et al. (2009) and Williams (2011).

The TIG aims to propose and select projects that are feasible and have a high probability of success. In some instances, projects may have restoration techniques or project components that are more innovative which may result in a higher degree of uncertainty. Sources of uncertainty, the degree of uncertainty, and the level of uncertainty associated with projects will vary. Potential uncertainties are

defined as those that may affect the ability to achieve project restoration objective(s). Monitoring can be used to inform these uncertainties and inform the selection of appropriate corrective actions in the event a project is not meeting its performance criteria. The potential uncertainties identified for this project vary from larger spatial-scale factors beyond project implementers control to project-level with which implementers have a reasonable ability to control associated specifically with wading bird monitoring at specific breeding sites once identified. Potential key uncertainties, mitigation measure(s) and probability of events as related to project success are provided in hierarchical order (big scale with no control to site-scale with control) below.

1. Major weather events or storm events (i.e., Hurricanes or Tropical Storms) that may result in complete colony abandonment and potential loss of marked individuals or loss of complete cohorts in a given year
   - Mitigation(s) = though nest initiation and peak nesting is likely to vary annually, in general, nesting activities should occur prior to peak timing of major weather events like hurricanes and tropical storms, thereby reducing potential for complete colony abandonment or loss of an entire cohort. Marking efforts will occur during late incubation or soon after hatch thereby reducing potential for temporal overlap with said activities and major weather events. Though most of the wading bird colonies in Alabama occur over a relatively small spatial scale, the probability of such an event decimating all colonies is seemingly low. Marking will occur at >3 sites and therefore, the spatial separation should somewhat mitigate potential impacts of major weather event.
   - Probability of Event = considered low to moderate
2. Disease outbreaks (i.e., botulism, cholera, avian influenza, West Nile Virus) that may result in complete colony abandonment and potential loss of marked individuals or loss of complete cohorts in a given year
   - Mitigation(s) = to our knowledge, there have been no recent major disease outbreaks affecting nesting populations of wading birds in the northern Gulf of Mexico
   - Probability of Event = considered low
3. Contamination/pollution (i.e., Pb, Mg, Se, OCs, PCBs, etc.) events that may result in complete colony abandonment and potential loss of marked individuals or loss of complete cohorts in a given year
   - Mitigation(s) = likely would not result in direct mortality of complete breeding cohorts or colonies, and *if present*, it would likely manifest itself through reduced reproductive performance (i.e., low nesting probability, smaller clutch sizes, reduced eggshell thickness, reduced egg viability and hatchability, smaller body size at hatch and fledging, or reduced fledging success and survival) by affected individuals
   - Probability of Event = considered low to moderate
4. Human disturbance, boat-related disturbance, military aircraft overflights, or related events that may result in complete colony abandonment and potential loss of marked individuals or loss of complete cohorts in a given year
   - Mitigation(s) = likely would not result in complete abandonment across all known breeding colonies or loss of complete cohorts, and therefore, the project would still be able to move forward, albeit with a year-gap or spatial-gap at the impacted colony
   - Probability of Event = considered moderate to high; for individual colonies, particularly, the small colony at Perdido Bay, but lesser so at colonies in Mississippi Sound, on Galliard Island, or in the Mobile-Tensas Delta
5. Mammalian predation events that may result in complete colony abandonment and potential loss of marked individuals or loss of complete cohorts in a given year

- Mitigation(s) = likely would not result in complete abandonment across all known breeding colonies or loss of complete cohorts, and therefore, the project would still be able to move forward, albeit with a year-gap or spatial-gap at the impacted colony
- Probability of Event = considered moderate to high; for individual colonies, particularly, the small colony at Perdido Bay, but lesser so at colonies in Mississippi Sound, on Galliard Island, or in the Mobile-Tensas Delta

6. Inability to achieve the benchmark target sample size for deployment of transmitters for *both species at each colony every year* (assuming there is a sufficient # of breeding pairs of the target species at each of the breeding colonies *every year*) **due to capture difficulties**
   - Mitigation(s) = likely would not affect overall results per species or on an individually-marked bird basis, per se, but the larger sample size of transmittered bird's x species x colony increases both power and ability to make inferences to the target population
   - Probability of Event = considered low; any challenges or limitations with capturing birds should be resolved by the 2nd field season
   - Inability to achieve the benchmark target sample size for deployment of transmitters for *both species at each colony every year* (assuming there is a sufficient # of breeding pairs of the target species at each of the breeding colonies *every year*) **due to weather, access-related issues, transmitters not arriving in time for fieldwork, boat-related problems, etc.** Mitigation(s) = likely would not affect overall results per species or on an individually-marked bird basis, per se, but the larger sample size of transmitted bird's x species x colony increases both power and ability to make inferences to the target population
   - Probability of Event = considered low; contingencies will be in place to ensure all of these potential issues are covered. Any transmitters not deployed in the year expected, will be deployed the following year.

7. Inability to achieve the benchmark target sample size for deployment of transmitters for *both species at each colony every year* (assuming there is a sufficient # of breeding pairs of the target species at each of the breeding colonies *every year*) **due to transmitter failure, mortality, loss of transmitter, loss of signal, etc.**
   - Mitigation(s) = likely would not affect overall results per species or on an individually-marked bird basis, per se, but the larger sample size of transmittered birds x species x colony increases both power and ability to make inferences to the target population
   - Probability of Event = considered moderate; it should be clearly understood that transmitter-related issues for some fraction (1-2 out of 10) or proportion ($\leq$20%) of transmitters is "normal"

The approaches herein are well-tested in the field and are accepted in the peer-reviewed literature, and project implementers are experienced with the proposed activities. Some uncertainty exists regarding the ability of the researches to achieve the target number of transmittered birds per species per colony per year. However, sample sizes are expected to be large enough to yield statistically valid and biologically meaningful results. The project implementers should have the flexibility to utilize existing budget resources to maximize the number of transmitters and requisite personnel to capture and deploy all transmitters on an annual basis. In addition, it may very well be that additional satellite transmitters may be more useful for addressing the objectives (see Sect. 2 below) than deploying both satellite and VHF transmitters, largely owing to the much larger effort (and associated costs) required to collect VHF transmitter data every 24 hours. This project will reduce uncertainty (i.e., structural or process uncertainty; Williams et al. 2009:sect. 5.2) in future bird restoration projects by filling knowledge gaps and increasing our understanding of ecological relationships for the target species (Figs. 1-2).

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring for this project, outlined below, is organized by project objective, with one or more monitoring parameters for each objective. For each of the monitoring parameters, information is provided on method, timing and frequency, duration, sample size, and sites. Also included is the intended purpose of each monitoring parameter (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), as well as performance criteria for each parameter (if applicable) and example corrective actions that could be taken if the performance criteria are not met. The adaptive management decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, the performance criteria below would be used to determine project success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. Information below does not include all possible options; rather, it includes a list of potential adaptive management actions for each individual parameter to be considered. The decision to implement a corrective action should holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

The project study area focuses on coastal Alabama. Target bird capture areas include those of prominent and persistent wading bird nesting colonies along the coast: Mississippi Sound, Gaillard Island, and Perdido Bay (Fig. 3).
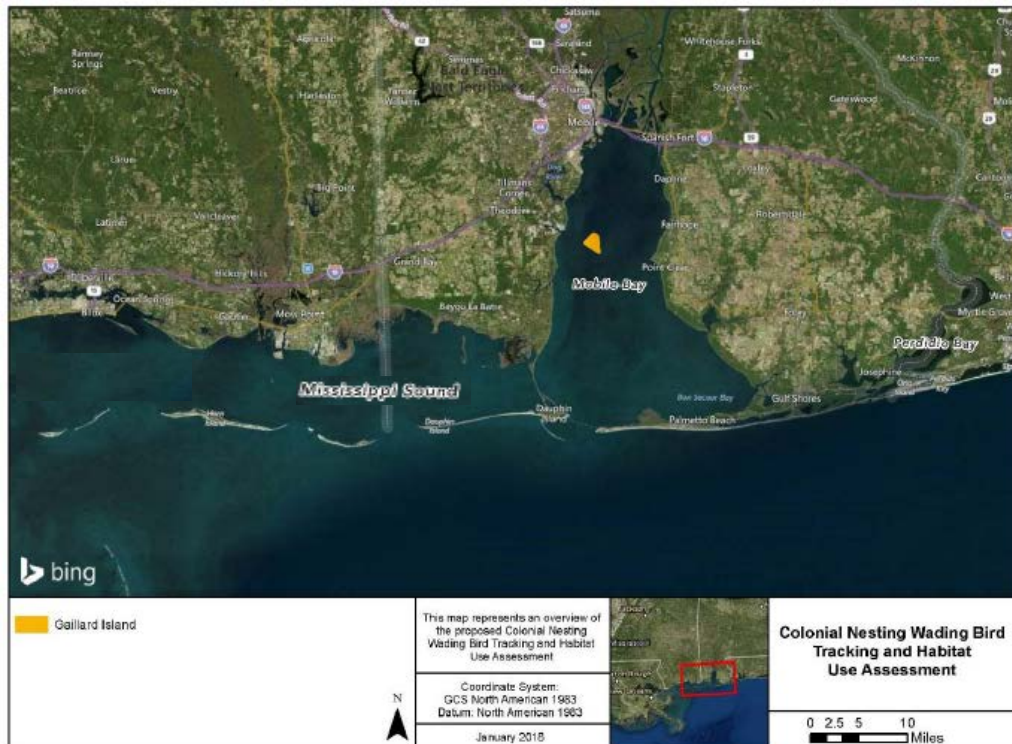

Figure 3. Colonial nesting wading bird tracking and habitat use assessment target bird capture areas.

Objective 1: Determine daily and seasonal movements, fidelity and dispersal of two wading bird species (tri-colored heron and either the little blue heron or the white ibis) among nesting colonies at three important breeding areas--Mississippi Sound, Gaillard Island, and Perdido Bay.

Parameter 1: Capture and Tracking of Birds

a. Methods: Because locations of colonies and numbers of birds by species within a colony often fluctuates from year to year, we will use a combination of local knowledge (e.g., Alabama Department of Conservation and Natural Resources staff) and preliminary reconnaissance surveys at sites to determine locations of suitable colonies to use as capture sites. Care will be taken to minimize disturbance to colonies and reduce the risk of colony abandonment.

   Juvenile birds will be captured at the nest by hand or dip net (Semones 2003, Bates et al. 2015, Geary et al. 2015) at the age (for the species) just before leaving the nest at fledging. In some cases, if juveniles have left the nest, they will be captured with a dip net (Bates et al. 2015, Geary et al. 2015). We will use a variety of methods to capture adult birds, depending on the species and habitats. Methods may include a modified foot-hold trap (Brzorad and Maccarone 2014), mist-nets, modified net gun, or noose carpets (Fidorra et al. 2016, Welch 2016, Koczur et al, 2017). We will collect standard morphometric measurements (body mass, tarsus length, culmen length; Dzubin and Cooch 1992) from all birds captured to evaluate their potential effects on important parameters of interest (Cooch and White 2014:chapt. 11). We will also collect a blood sample from each bird to determine sex for juveniles and those adults that cannot be sexed through morphometrics and plumage characteristics. Blood will be collected from the brachial vein using a 27-gauge needle and capillary tubes.

   Each bird captured will be fitted with a USGS metal band and a unique combination of plastic alpha-numeric color bands. For birds that weigh enough to support a satellite transmitter and harness (target weight for each species will be determined so that the harness and transmitter are ≤ 3% of their body weight; Phillips et al. 2003, but see Barron et al. 2010, Vandenabeele et al. 2011), transmitters will be fitted on the back using a backpack-style harness made of tubular Teflon ribbon (Semones 2003, Herring and Gawlik 2010, Bzrorad et al. 2015, Fidorra et al. 2016, Lamb et al. 2017). For example, tricolored (Frederick 2013) and little blue herons (Rogers and Smith 2012) would need to weigh ≥300 g for a 9.5 g transmitter.

b. Timing and frequency: Timing of funding will dictate the previously mentioned tasks and those identified in Table 1. Initial captures will only occur after on-the-ground assessments of nesting colonies to determine species composition, abundance, nest timing, and further clarifying how best to access colonies while minimizing disturbance. Some flexibility and deference will be provided to the project proponents and potential PI in the first calendar year to (at a minimum): (1) secure required federal and state permits, (2) hire a graduate student, (3) hire technicians, (4) secure necessary vehicles, boats, and other logistical considerations, (5) secure requisite make and model of transmitters, (6) properly train all personnel on protocols and methodologies regarding capture and attachment of transmitters, as well as banding, and (7) scout potential colony sites. Assuming funding is awarded early enough in FY19 to address all of the previously identified uncertainties and project-related expectations and deliverables, there is the potential that capture and marking of target species would occur during the 2019 nesting season.

c. Sample size: We will target **a minimum of 15 adults and 15 juveniles of each species** (*n* = 60 total) to receive transmitters. If the budget allows, we will increase the sample size of transmitters deployed for the two-target species. To maximize the temporal component of satellite tracking (i.e., number of years tracked), we will attempt to capture our target sample size the first year of capture

effort. Target sample sizes may be adjusted upward if only satellite tags are used given potential flexibility in the budget. Ideally, one would capture and mark individuals of both species at all colony sites identified herein assuming (1) there is a sufficient breeding population of all target species are all breeding colonies and (2) representatives of target species are accessible at all breeding colonies and capture and marking could be achieved with minimal disturbance to the entire colony. It should be noted here and is relevant throughout, that individual fixes or locations *may* not be considered independent and we *assume that* marked individuals are representative of the target population and that the process of capturing, handling, and marking individuals and that the presence of the mark (in this case, a transmitter) does not affect outcomes of the marked individual, e.g., behavior and survival (Brownie et al. 1985).

d. <u>Corrective action</u>: If we do not capture our target sample sizes in the first field season, we will trap again the following breeding season until we achieve our target sample size. If for some reason there are not enough birds available to be captured and marked to achieve our target sample size, we can adjust by choosing an alternative species of interest (e.g., white ibis). Alternatively, we will simply mark more individuals of the target species in one of the other breeding colonies. If there appear to be mortalities or transmitter failures in the first year after deployment, we will attempt to make up for these losses through additional capture and marking in the second field season. Target samples sizes for transmitters identified in text above could be increased depending on the budget and if the decision is made to only use 1 type of transmitter versus the other. Ideally, we would have reasonably similar number of transmitters allocated across species, sites, and years. See above for additional information regarding key uncertainties.

Parameter 2: Daily and Seasonal Movements

a. <u>Methods and performance criteria</u>: We will determine the duty cycles for satellite transmitters to meet our objectives of tracking daily and seasonal movements within the constraints of the transmitters, which will likely be 6-8 locations per day. Data will be received through Service ARGOS (CLS America) and downloaded on a daily basis. For analyses, we will eliminate low-accuracy location classes using the Douglas Argos-filter (Douglas et al. 2012, Geary et al. 2015). We will determine mortality by combining diagnostic information from the devices and locations (e.g., no movements from a location for several days). A combination of analytical techniques will be used to determine daily and seasonal (breeding, post-breeding, and winter) movements by species, sex, and age class. If we have a sufficient sample of marked birds for each of the colonies per species, we will attempt to get colony-level data. Filtered locations will be imported into ArcGIS to for visualization and some spatial analyses. We will use state-space models (Jonsen et al. 2005, Patterson et al. 2008) to analyze movements at multiple temporal and spatial scales.

b. <u>Corrective action</u>: There is no reason to believe that the target sample sizes for each species identified herein will not be achieved. To reiterate, the level of detail that can be achieved regarding both daily and seasonal movements is dependent on (1) the number of transmitters deployed per species, (2) potential mortalities or transmitter failures, and (3) transmitter longevity or how long an individual transmitter on a marked bird is actually transmitting or 'on the air'. If there appear to be mortalities or transmitter failures in the first year after deploying transmitters, we will attempt to make up for these losses through additional capture and marking in the second field season. See above for additional information regarding key uncertainties.

Parameter 3: Fidelity and Dispersal

a. <u>Methods</u>: An attempt will be made to estimate both fidelity and dispersal from colonies in which birds are marked. Estimating these parameters are dependent on the number of transmitters

deployed per species per colony, the number of either transmitter failures and mortalities, and transmitter longevity, the latter two of which reduce realized sample size. In addition, given flexibility in the budget and sufficient personnel and time, both parameters may also be (jointly) estimated using Capture-Mark-Recapture (C-M-R) methods (Kendall and Nichols 2004, Kendall et al. 2006) for resighting color-banded birds using Program MARK (White and Burnham 1999, White et al. 2001). We will use great-circle distances from natal colonies to determine dispersal from natal/breeding colonies (Geary et al. 2015).

b. <u>Timing and frequency</u>: At this time, it is difficult to predict a specific number of estimates that will be generated for either fidelity or dispersal. However, at a minimum, it should be possible to provide estimates for each of these parameters by species by cohort, i.e., age, and ideally by colony. These may represent single point estimates at the end of the study or possibly annual estimates for both fidelity and dispersal. Second- and third-year location data will determine whether birds (adults or juveniles) show inter-annual fidelity to breeding/natal colonies. Mean and maximum distances from breeding/natal colonies will be determined annually to compare locations of capture sites to locations during subsequent breeding seasons.

c. <u>Sites</u>: Ideally, we would like to be able to generate estimates of fidelity to breeding/natal colonies, as well as dispersal (both mean and maximum distances). As per above, it should be realistic to be able to generate mean and maximum dispersal distances for each marked bird at each colony. The exact number for each of these parameters is difficult to predict at this time, but should represent a minimum of six mean values (assuming there is a sufficient number of birds by species at each colony), one for each colony (3 colonies) by species (two species). Total dispersal distances that could be estimated for this project is entirely dependent on the number of birds captured and marked with transmitters, then mortality and transmitter failure-rate, and transmitter longevity. Thus, it is extremely difficult to predict. Assuming no mortalities and no transmitter failures and sufficient transmitter longevity, this final value is equal to the *total* number of transmitters deployed. A reasonable range of total dispersal distance estimates by individual birds could be $\geq$40.

d. <u>Performance criteria</u>: If we are able to generate both estimates of fidelity and dispersal for two species at three separate breeding colonies one should consider this a success. Estimating these parameters, in addition to other competing parameters, for more than one species in a single project is a major feat. Also, estimating these parameters are important in understanding population dynamics in the larger metapopulation context (Erwin et al. 1995, Esler 2000) within the broader context of evaluating restoration projects (Block et al. 2001).

e. <u>Corrective action</u>: We will remain adaptive, flexible, and nimble during project implementation to ensure that this parameter remains as important as the various other competing parameters identified herein. If the target sample sizes are met regarding the number of transmittered birds and transmitter duration is sufficient to capture the temporal aspects of this parameter. If mortality or transmitter failure occurs early-on in the first year, we will capture and mark additional birds in the second year. In addition, there will be a sample of color-banded birds, i.e., a marked population, with which one could use to derive survival estimates either independently from or jointly with transmittered birds. See above for additional information regarding key uncertainties.

Parameter 4: Post-fledging and Adult Seasonal and Annual Survival

a. <u>Methods</u>: We will estimate seasonal and annual survival of juveniles and adults of each species using Kaplan-Meier estimates in the known-fate-model of MARK (Oppel and Powell 2010, Koczur et al. 2017). We will model survival monthly, seasonally, and annually rates by sex and age class (Oppel and Powell 2010, Koczur et al. 2017). It should be noted here that survival can be defined as either apparent or true survival depending on marking techniques and associated assumptions in estimating survival (Gilroy et al. 2012, Cooch and White 2014). In any case, survival estimates will be

generated for two age classes (fledging/juvenile and adult) and two-time periods (post-fledging and annual). Certainly, it would be most useful to generate colony-level survival estimates for both species and both age classes, but this may or may not be feasible. As well, assuming flexibility in the budget and sufficient personnel and time, survival may also be (jointly) estimated using C-M-R methods (Kendall and Nichols 2004, Kendall et al. 2006) for resighting color-banded birds using Program MARK (White and Burnham 1999, White et al. 2001).

b. Timing and frequency: At this time, it is difficult to predict a specific number of survival estimates that will be generated for either post-fledging survival or adult annual survival. However, at a minimum, it is realistic to expect to generate estimates for each of these parameters by species by age-class. For example, it is anticipated that for the two species, we will generate post-fledging survival estimates by year (colonies pooled), as well as adult annual survival estimates by species by year (colonies pooled) for say, three years. Annual survival analyses will take place in year three to maximize the temporal component of the study. However, we will conduct preliminary analyses after each year to determine monthly and seasonal survival if sample sizes permit. Though this parameter was not explicitly identified in the AL RP II (2018), it *may* be achievable *if* a sufficient sample of transmittered birds are captured and marked *and* battery-life for each transmitter is for a sufficient duration of time to generate period-specific and annual survival estimates. In addition, it is possible to generate survival estimates using C-M-R methods *if* there is sufficient effort dedicated towards resighting color-banded individuals in the population.

c. Sample size: To increase power, individuals within a given cohort, e.g., sex, age, colony will be pooled by species. The target sample size is difficult to predict at this time. However, it is anticipated that there will be a sufficient sample of marked birds to generate survival estimates for two species and two age-classes, likely pooled across colonies.

d. Performance criteria: If we are able to generate survival estimates for both species by age-class one should consider this a success. Estimating these particular parameters, in addition to other competing parameters, for more than one species within a single project is a major under-taking. Survival estimation, in particular, has been identified as critical information need identified elsewhere for evaluating success of restoration projects (Block et al. 2001, Smallwood 2001, NAS 2017).

e. Corrective action: We will remain adaptive, flexible, and nimble during project implementation to ensure that this parameter remains as important as the various other competing parameters identified herein. If the target sample sizes are met regarding the number of transmittered birds and transmitter duration is sufficient to capture the temporal aspects of this parameter. If mortality or transmitter failure occurs early-on in the first year, we will capture and mark additional birds in the second year. In addition, there will be a sample of color-banded birds, i.e., a marked population, with which one could use to derive survival estimates either independently from or jointly with transmittered birds. See above for additional information regarding key uncertainties.

Objective 2: Identify important foraging and other habitat areas within the study area

Parameter 1: Habitat Use Analyses

a. Methods: Spatial distributions for each species during winter and breeding will be described using core use areas with fixed kernel home range analyses using location data imported into GIS and Hawth's tools for GIS (Oppel and Powell 2010). Depending on whether location data are sufficient to determine foraging (many short distance movements within a day), breeding (minimal movements within a day during breeding season), or roosting (minimal movements during nonbreeding season), we will first bin location data into these use categories. Then location data for each use category will

be overlaid onto habitat maps using ArcGIS. We will use modeling approaches to determine which habitat variables explain spatial use by each species in each season (Aarts et al. 2005, Lamb 2016).

b. Timing and frequency: Habitat use analyses will likely take place in year three or the final year of this project to maximize both the spatial and temporal aspects of bird movement data. However, we will conduct preliminary analyses for the marked sample available for each species after each year, assuming sample sizes permit.

c. Sample size: To increase power, individuals within a given cohort, e.g., sex, age, colony will likely be pooled by species. The target sample size for habitat use analyses is difficult to predict at this time. However, it is anticipated that there will be a sufficient sample of marked birds to generate habitat use estimates for two species and possibly, the juvenile and adult age-classes. We are unsure at this time if there will be sufficient marked sample at each breeding colony to provide colony-level habitat use estimates. Therefore, habitat use may be pooled across colonies. The initial sample size represents the number of transmitters actually deployed. However, it is anticipated that there may be some mortalities, some transmitters may fail, some transmitters may not be operable for the requisite period of time, and some location fixes may not be of sufficient quality to be included in habitat use estimates.

d. Sites: Preferably, we would like to be able to generate habitat use estimates by species and cohort for each of the respective breeding/natal colonies in which birds are marked. However, this may or may not be realistic and achievable. As per above, it should be realistic to generate habitat use by species and season, pooled across colonies. The exact number of habitat use estimates would simply be two species by two seasons or four. Accounting for potential colony-level effect is entirely dependent on the budget and the number of transmitters deployed per colony per species. Then, it becomes an issue of attrition of transmitters versus those transmitters still operational and on the air. Thus, it is extremely difficult to predict.

f. Performance criteria: If we are able to generate survival estimates for both species by age-class one should consider this a success. Estimating these particular parameters, in addition to other competing parameters, for more than one species within a single project is a major under-taking. Survival estimation, in particular, has been identified as critical information need identified elsewhere for evaluating success of restoration projects (Block et al. 2001, Smallwood 2001, NAS 2017).

g. Corrective action: Corrective actions associated with this parameter are nearly identical to the corrective actions identified in the daily and seasonal movement parameters identified above. Therefore, they are not repeated here. We have no reason to believe there will not be the appropriate existing geospatial data sources available at the appropriate spatial resolution to evaluate habitat use by marked birds in this study. We will work with staff from the Gulf Coast Joint Venture and the Gulf Coastal Plains and Ozarks LCC, as well as staff within the USFWS and USGS to determine the most appropriate datasets given our objectives. See above for additional information regarding key uncertainties.

The schedule for project monitoring is shown in Table 1, separated by monitoring activity.

Table 1. Project Monitoring Schedule for the Colonial Nesting Wading Bird Tracking and Habitat Use Assessment Project Identified in AL RP II (March 2018)

Monitoring Parameter	Objective	Pre-Execution	Year 1	Year 2	Year 3	Year 4
Capture of birds[1]	1		X	X		

Monitoring Parameter	Objective	Pre-Execution	Year 1	Year 2	Year 3	Year 4
Daily and seasonal movement tracking[2]	1		X	X	X	
Fidelity and dispersal tracking[3]	1			X	X	
Habitat use analyses[4]	2			X	X	
Reporting[5]	1, 2			X	X	X

[1] When birds are captured largely depends on which of the 2 transmitter types, i.e., satellite v. VHF are used and deployed. If VHF transmitters are used then capture and deployment would occur annually in years 1-3 or 2-4, whereas if satellite transmitters are used then capture and deployment would likely occur in years 2 and 3. VHF requires active accumulation of data on a 24hr to weekly basis by personnel with equipment to determine locations of individually marked birds. Conversely, satellite transmitters acquire the data passively and location data are downloaded and inspected remotely. With satellite transmitters one can adjust the settings when the transmitter is "on" v. "off" with potential trade-offs between battery life and time spent "on". The current information in the Table is based on the assumption of satellite-transmitters only. The PI should have the flexibility to make decisions as to which of the technologies is best suited to address the objectives given the budget.

[2] Refer to superscript 1 above- depends on type of transmitter deployed.

[3] Refer to superscript 1 above- depends on type of transmitter deployed.

[4] Refer to superscript 1 above- depends on type of transmitter deployed.

[5] Reporting requirements are not entirely clear and/or expectations of what level of detail is expected in annual reports, but assume annual reports are required/mandatory and that a final report would be provided within the period-of-performance, but after all data have been collected and analyzed.

ADAPTIVE MANAGEMENT

As discussed in the PDARP, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997, Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer and Llewellyn 2000).

Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (PDARP/PEIS; DWH NRDA Trustees 2016:app. 5.E.1). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action. The project implementation team has the expertise and experience to successfully implement this project. There is flexibility within the budget, within the study design, and this MAM Plan to adaptively manage this project given the key uncertainties identified herein. We will remain nimble and flexible during the implementation of this project to ensure project success. Additional information regarding key uncertainties and associated mitigation measures and potential corrective actions for this project are discussed above.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties.

The results of the analysis would be used to answer the following questions:

- Were the project objectives achieved? If not, is there a reason why they were not met?
- Did the project produce unanticipated effects?
- Were there unanticipated events unrelated to the project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?
- Have data been summarized and characterized in a way that allows for a clear understanding of results?
- Have any trends or patterns been identified, and if so, how can they be characterized?
- What broader insights might be gained from implementation of this project?

This project supports planning and evaluation of future restoration approaches for the Birds Restoration Type by providing baseline data on wading bird movements and habitat use. Questions such as the above will be used to evaluate the efficacy of methodologies employed by this project in providing the AL TIG with information to inform restoration planning. Answers will 1) improve the effectiveness of restoration planning and implementation, 2) help identify any additional data gaps causing uncertainty in the same, and/or 3) inform the need to adjust monitoring methods to increase the usefulness of results. The sampling design plan will be periodically evaluated during implementation to ensure the project is on track towards collecting desired information. Adaptive management within the project may be necessary to address any issues that may arise. Decisions regarding adaptive management and adjustments will be discussed and decided by the project implementers. If adjustments will result in project budget changes or major scope changes, these changes will be evaluated and decided by the AL TIG.

It is anticipated and expected that this project will not only fully and successfully acquire all the data identified above, but also this project will deliver associated statistical analyses, modeling, and interpretation of the data as part of project reporting.

DATA MANAGEMENT

To the extent practicable, all data generated during monitoring activities will be documented using standardized field datasheets. Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created, and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved. Relevant Project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into Excel spreadsheets (or similar digital format). After transcription of the data, a second person not associated with data transcription will perform a verification of the data

in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and would ensure that all data is entered or converted into agreed upon/commonly used digital format labeled with metadata.

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record Project-specific data, then Project-specific datasheets will be drafted prior to conducting any Project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant Project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files. Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual. Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents).

Once all data has been QA/QC'ed it will be submitted to the Restoration Portal. Any databases created as part of the proposed project will be stored according to USFWS and HAPET office policies. Any such databases will be mapped/linked/integrated into the DIVER platform (DIVER 2017). Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data will be made publicly available, in accordance with the Federal Open Data Policy, through the DIVER Explorer Interface within one year of when the data collection occurred. Some of the data collected is protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

REPORTING

Data summaries and interim analyses and interpretation will be compiled in annual monitoring reports. At a minimum, annual reports will be made available through the DIVER Explorer Interface within a year of report development. In addition, a Final Report will be provided at the end of the project within the period-of-performance. It is anticipated that at least 1 scientific peer-reviewed publication will result from this project. It is fully anticipated and expected that the following deliverables will be provided:

- all QA/QC data, datasets, databases
- all geospatial data associated with all habitat-related analyses, home range estimation and habitat use analyses
- all final Figures and Tables associated with Annual and Final Reports

- all statistical output, models, and code associated with producing the Final Report
- all final PowerPoint presentations given at professional meetings (travel-related to professional meetings are not funded by the project)
- all final abstracts for professional meetings
- Annual Reports beginning the 1st year post-award
- Final Report towards the end of the period-of-performance
- at least 1 scientific peer-reviewed publication and copies of any/all publications related to this project (page charges for publications are not funded by the project)
- Explicit identification of funding for this project in Acknowledgments sections of all published papers

Additional details and associated timelines regarding reporting and deliverables will be provided at the time of award.

ROLES AND RESPONSIBILITIES

USDOI is the lead Trustee agency for this project, and will ensure that the project is completed. Work will be conducted by contractor or cooperative agreement with university or other entity. The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

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MAM PLAN REVISION HISTORY

Old Version #	Revision Date	Changes Made	Reason for Change	New Version #
AL TIG RP II/EA version	3/18			
MAM Plan ColonialWadingBirdTracking 052518-plt-Service reviewed060118.docx	06/01/18	USFWS project specific MAM review	Service MAM consistency	MAM Plan ColonialWadingBirdTracking 052518-plt-Service reviewed060118.docx

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MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
OYSTER CULTCH RELIEF AND REEF CONFIGURATION

PROJECT OVERVIEW

The Oyster Cultch Relief and Reef Configuration project would deploy different types of cultch material in various configurations to facilitate positive settlement and growth of oysters on selected reef areas in Mobile Bay, Alabama. Since 2005, the oyster density on publicly harvested reefs has been in decline, due to damage and silting associated with hurricanes Ivan and Katrina and drought conditions. This has caused the proliferation of the predatory oyster drill on historically productive reefs. AMRD is proposing to investigate the merit of deploying different types of cultch material in various configurations to enhance settlement and growth of oysters on selected reef areas in Mobile Bay. In addition to the direct goal of restoring the reefs selected for project implementation, the project has three additional study objectives: (1) determine if there are differences in oyster settlement, growth, and survival on reefs of differing levels of relief and/or orientation relative to currents; (2) determine optimum reef material relief needed to restore oyster density on specific reefs within historical reef areas in which hydrology parameters such as oxygen and salinity and oyster recruitment and survival are highly variable; and (3) estimate the cost/benefits of deploying cultch in configurations differing from traditional cultch broadcast methods. The broader goal is to inform and increase the success of future oyster reef restoration activities. For project implementation, two sites have been tentatively selected for pre-monitoring surveys--a 36-acre reef approximately 1 mile north-northeast of the mouth of East Fowl River and Denton Reef (70 acres) located approximately 3 miles southeast of the mouth of East Fowl River.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Project Type: Oysters
- Programmatic Goal: Replenish and Protect Living Coastal and Marine Resources
- Restoration Type Goal: Restore a diversity of oyster reef habitats that provide ecological functions for estuarine-dependent fish species, vegetated shoreline and marsh habitats, and nearshore benthic communities
- Restoration Approach: Restore or create oyster reefs through placement of cultch in nearshore and subtidal habitats

Objective 1: Restore subtidal reef habitats in various configurations along a salinity gradient.

Objective 2: Determine if there are differences in oyster settlement, growth, and survival on reefs of differing levels of relief and/or orientation relative to currents.

Objective 3: Determine optimum reef material relief needed to restore oyster density on specific reefs within historical reef areas in which hydrology parameters such as oxygen and salinity and oyster recruitment and survival are highly variable

Objective 4: Estimate the cost/benefits of deploying cultch in certain configurations as opposed to traditional cultch broadcast methods.

Sources of Uncertainty

Weather-related events may necessitate the maintenance of the cultch mounds and furrows including the deployment of additional cultch. This project is a study, designed to increase certainty around

which restoration methods are most likely to lead to meet restoration performance objectives for oysters. AMRD experts expect this alternative would provide useful insights into improved methods for locating cultch sites in coastal Alabama similar to other studies that have been conducted, selecting appropriate cultch materials, and constructing reefs with the most effective degree of relief. The project design takes into account the key factors that are known to affect the success of settlement and growth of oysters. Through systematic variation of these factors, it is expected that improved cultch materials and placement methods can be identified.

CONCEPTUAL MODEL, ANTICIPATED OUTCOMES AND FUTURE ACTIVITIES

The completion of this project will result in a better understanding of what reef configurations and deployment techniques are best suited for successful restoration of oysters in Alabama.

Stressors negatively impact habitat condition and habitat relationships, resulting in loss of habitat, function or capacity. For this project, the specific stressors addressed include habitat loss as well as changes in local conditions that historically supported oysters. Predation and changes in water quality also impact oyster resources. The purpose of this project is to identify techniques and configurations for reef restoration activities, which will result in reduced uncertainties for future restoration projects. Where these methods prove successful, the project would also result in productive restored oyster reef. This project plays an important role in filling information gaps for oyster restoration through the identification of what reef configurations, salinity gradients, deployment configurations and other factors are best suited to support oysters, which in the longer term would feed directly into the AL TIG's efforts to mitigate oyster survivorship in Alabama coastal waters. This project will increase oyster survival and reproduction by identifying effective methods and conditions for oyster reef restoration.

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (Trustees 2016, Appendix 5.E.1, PDARP/PEIS). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action.

The project design takes into account the key factors that are known to affect the success of settlement and growth of oysters. Through systematic variation of these factors, it is expected that improved cultch materials and placement methods can be identified. Final project site selection, cultch height, and reef area would be determined by the results of pre-monitoring surveys. Physical conditions would determine which type of plot would be used in each project site.

This project supports a larger commitment to adaptive management at the program level as the data generated as a result of this project will reduce future uncertainties regarding the siting and success of future oyster reef restoration projects.

In future planning efforts, the ALTIG will review the data generated from this project in developing restoration options for oysters in addition to utilizing other information including scientific literature, other restoration projects and consultation with experts.

PROJECT IMPLEMENTATION

Site selection and pre-monitoring may include the use of side-scan sonar imaging, hand dredging, cane-pole sounding, and/or SCUBA quadrat sampling. Baseline data would be collected at each study site prior to project deployment, including an estimate of juvenile and adult oysters as well as an evaluation of existing cultch at each site (oyster shell, limestone rock, and fossilized shell). Although not included in this project budget, side-scan sonar imaging of each test area would be performed after cultch deployment. For construction, a contractor would be hired to transport and deploy cultch material by push boat or barge. The cultch would be deployed off the deck using skid steers and excavator shovels. High-pressure water hoses would be used to distribute the cultch into three experimental configurations including mounding, elongated furrows, and control plots utilizing typical cultch broadcasting methods. Within the designated area(s) a total of nine mounds, six furrows, and six control plots would be created. The size and each mound's area and height would depend on the depth of the bottom in which it is placed and would comply with the United States Army Corps of Engineers (USACE)-authorized minimum clearance requirement depth. Length, height, and orientation of each furrow would also depend on the depth and direction of currents at the study site. It is anticipated that the width of each furrow would be approximately 2 feet wide, although the actual width would depend on the material deployed. Maintenance of the cultch mounds and furrows, including the deployment of additional cultch, may be needed in the event of a disaster such as a hurricane or tropical storm. Deployment of oyster cultch is an approved activity by USACE under a Nationwide Permit. Post-construction monitoring of sites may include the use of hand dredging, cane pole sounding, and/or SCUBA quadrat sampling.

Planning, pre-monitoring, and site selection are anticipated to take 3 months (January–March of project year). The invitation to bid and contractor bid process is anticipated to take 1 month (March of project year). Construction is anticipated to take 1 month and conclude by May of the first year.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and identify potential corrective actions, if needed. For each of the monitoring parameters identified below, information is provided on the intended purpose of each monitoring parameter (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. This section also describes applicable performance criteria and potential corrective actions for project parameters associated with project objectives.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria are used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However,

unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. The decision to implement a corrective action will holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Parameter: Reef Dimensions

    a. Purpose: Determination of reef dimension is critical to estimating the survival and density of oysters in relation to water depth

    b. Method: Measure: Reef height (Measure using graduated rod and transit, or survey equipment; subtidal, use sonar or depth finder; Reef area (Measure area of each patch reef dGPS, surveyor's measuring wheel or transect tape, or aerial imagery; subtidal, use sonar or depth finder with ground truthing. Sum all patches/sites to get total reef area)

    c. Timing and Frequency: Immediately after construction and annually throughout project period

    d. Sample Size: Poling (side scan) all reef sites and data sondes at one site/treatment

    e. Sites: All sites constructed—9 mound and 3 control sites at Denton Reef, 3 furrow and 3 control sites at east of Fowl River

    f. Performance Criteria: Constructed as designed

    g. Corrective Action(s): Consider additional monitoring after an event that could alter reef footprint. Additional cultch material may be added if needed

Parameter: Oyster Mortality Associated with Water Quality

    a. Purpose: To understand how environmental conditions drive oyster mortality

    b. Method: Oysters of known quantity and size will be placed in cage with data sonde and observed monthly for mortality

    c. Timing and Frequency: Measured monthly (June-September)

    d. Sample Size: 50 oysters cage

    e. Sites: One reef site/treatment with the exception that no broadcast sites at Denton Reef will be monitored

    f. Performance Criteria: This project is a study. Successful configurations that will be considered for future restoration efforts would experience less mortality

    g. Corrective Action(s): This project is a study. Successful configurations that will be considered for future restoration efforts would likely experience less mortality

Parameter: Oyster Density and Size Distribution

    a. Purpose: The size and number of oysters on a reef provide information on population age structure

    b. Method: Quadrat (0.5 m^2)

    c. Timing and Frequency: Annually at the end of growing season for 3 years

    d. Sample Size: Four quadrats/mound reef, three quadrats/furrow reef, and three quadrats/broadcast reef

    e. Sites: Nine mounds sites, three furrow sites and six broadcast sites

    f. Performance Criteria: This project is a study. Successful configurations that will be considered for future restoration efforts would experience less mortality

    g. Corrective Action(s): This project is a study. Successful configurations that will be considered for future restoration efforts would experience less mortality

Parameter: Settlement

    a. Purpose: To determine qualitative estimates of oyster recruitment throughout study period

b. Method: Use of settlement tiles and caged oyster shell
c. Timing and Frequency: Placed prior to anticipated spawning and maintained through spawning season. Ties and cages will be sampled every 3 weeks
d. Sample Size: Two cages with three settlement tile each per site
e. Sites: Denton and east of E. Fowl River
f. Performance Criteria: This project is a study. Successful configurations that will be considered for future restoration efforts would experience less mortality
g. Corrective Action(s): NA

Parameter: Water Temperature

a. Purpose: Temperature may influence oyster distribution and their physiological rate processes such as feeding and growth rates
b. Method: temperature probe
c. Timing and Frequency: Continuous
d. Sample Size: NA
e. Sites: 2 sondes at each reef location, centrally located
f. Performance Criteria: NA
g. Corrective Action(s): NA

Parameter: Salinity

a. Purpose: Oyster reefs can be found along a salinity gradient. Changes in salinity may influence oyster spawning activities.
b. Method: Collection via data sonde
c. Timing and Frequency: Continuous
d. Sample Size: NA
e. Sites: 2 sondes at each reef location, centrally located
f. Performance Criteria: NA
g. Corrective Action(s): NA

Parameter: Dissolved Oxygen

a. Purpose: DO plays a role in oyster survival and growth
b. Method: Collection via data sonde
c. Timing and Frequency: Continuous
d. Sample Size: NA
e. Sites: 2 sondes at each reef location, centrally located at appropriate depths
f. Performance Criteria: NA
g. Corrective Action(s): More cultch may be added in areas where DO is measured at less than 4 mg/l for an extended period of time

Parameter: Submission of Project Progress Report

a. Purpose: Project progress report should provide details regarding insights gained as a result of the project including optimum reef materials needed to restore oyster density as well as the cost-benefits of deploying cultch in certain configurations as opposed to traditional cultch broadcast methods.
b. Method: Progress report should accumulate, analyze, and synthesize data collected and any insights gained
c. Timing and Frequency: 90 days following completion of monitoring activities in final year of project

d. Sample Size: NA
e. Sites: NA
f. Performance Criteria: NA
g. Corrective Action(s): Revise and update as needed

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 1: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Post-Execution Monitoring (Years 1-5)
Oyster Density and size class distribution	1, 2, 3, 4			X
Reef Dimensions	1, 2, 3, 4		X	X
Settlement	1, 2, 3, 4			X
Oyster Mortality	1, 2, 3, 4			X
Water Temp	1, 2, 3, 4	X	X	X
Salinity	1, 2, 3, 4	X	X	X
DO	1, 2, 3, 4	X	X	X
Project Progress Report	3, 4			

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Were effective techniques and methods identified? If so, how can they be utilized in future projects?
- Did the restoration project produce unanticipated effects?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any of the uncertainties identified prior to project implementation resolved?

- Have data been summarized and characterized in a way that allows for a clear understanding of results?
- Have any trends or patterns been identified, and if so, how can they be characterized?
- What broader insights might be gained from implementation/monitoring of this project?
- Were any new uncertainties identified?

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017a). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then Project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

Data Review and Clearance

After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and would ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata. All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual Version 1.0. Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. Some data collected may be protected from public disclosure under federal and

state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

REPORTING

Annual MAM reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

ROLES AND RESPONSIBILITIES

ADCNR is the lead Trustee agency for this project, and will ensure that the project is completed.

The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

DWH NRDA Trustees. 2017a. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill. December.

DWH NRDA Trustees. 2017b. Deepwater Horizon Oil Spill Natural Resource Damage Assessment: Strategic Framework for Oyster Restoration Activities. June. Available: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

National Research Council. 2004. *Adaptive Management for Water Resources Project Planning*. Washington, DC: The National Academies Press.

Pastorok, R.A., MacDonald, A., Sampson, J.R., Wilber, P., Yozzo, D.J., & Titre, J.P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9, 89-107

Steyer, G.D. & Llewellyn, D.W. 2000. Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 26, 27-39.

Williams, B.K. 2011. Adaptive management of natural resources - Framework and issues. Journal of Environmental Management, 92, 1346-1353.

MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	6/1/2018	Draft to final version; Added detail to parameters	Draft to final	MAM_Plan__Oyster_Cultch_Relief_Reef_Configuration_6.1.18

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MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
OYSTER HATCHERY AT CLAUDE PETEET MARICULTURE CENTER

PROJECT OVERVIEW

The Alabama Marine Resources Division (AMRD) is proposing to construct an oyster hatchery at AMRD's Claude Peteet Mariculture Center (CPMC) in Gulf Shores and operate the facility within a four-year project period. The oyster spat produced as a result of this project will be used to encourage oyster recruitment in portions of Mobile Bay that has experienced reduced oyster production compared to the early 20th century. The objectives of this project are to produce spat to be used for oyster restoration projects in Alabama and to develop a comprehensive oyster restoration plan for coastal Alabama. Project components would also include remote setting and deployment from the MRD facility at Dauphin Island. Additionally, the project would result in the deployment of cultch material, including spat on shell, to areas identified as suitable for oyster growth. Together, these activities aim to restore oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Project Type: Oysters
- Programmatic Goal: Replenish and Protect Living Coastal and Marine Resources
- Restoration Type Goal: Restore oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs.
- Restoration Approach: Enhancement of regional hatchery capacity and remote setting facilities

Objective 1: Construct an oyster hatchery to produce spat that will be used to encourage oyster recruitment in portions of Mobile Bay that have experienced reduced oyster populations.

Objective 2: Deploy spat in in portions of Mobile Bay that have experienced reduced oyster production compared to the early 20th century.

Objective 3: Develop a comprehensive oyster restoration plan for coastal Alabama.

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

A conceptual model forms the basis of this monitoring plan, and includes a summary of the project activities, the expected product or output of those activities and the desired project outcomes. Project activities include the construction of a hatchery facility and the subsequent deployment of spat to restore the larval pool in coastal Alabama. This project addresses losses in oyster production, and will result in increased oyster survival and reproduction in Alabama. In addition, the development of an oyster restoration plan will result in an increased understanding of local oyster populations, including larval transport and recruitment trends, as well as environmental factors that affect them. This information will be utilized in future restoration activities.

Sources of Uncertainty

Natural variability in ecological or physical processes have the potential to impact oyster survival. Whether the project is constructed as designed, on-time and on-budget is one source of uncertainty. Long-term funding for maintenance and operation of the facility is another source of uncertainty. The deployment of spat and subsequent attachment depends on the placement of spat in areas that are

conducive to oyster survival. The proposed approach is well documented and has been successfully implemented previously.[1] In conjunction with the other potential initiatives under consideration by the TIG that would identify optimal locations and methods for ensuring recruitment, the project has a strong likelihood of contributing towards the AL TIG's broad goal of increasing survivorship of oysters in Mobile Bay and Mississippi Sound. ADCNR's commitment to fund continuing operation and maintenance at the facility after the funding for this project ends will further enhance the long-term benefits of the project.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and identify potential corrective actions, if needed. For each of the monitoring parameters identified below, information is provided on the intended purpose of each monitoring parameter (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. This section also describes applicable performance criteria and potential corrective actions for project parameters associated with project objectives.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria are used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. The decision to implement a corrective action will holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Parameter: Level of construction of facility to terms of contract and permit requirements

a. Purpose: On-site monitoring will be conducted during construction to ensure facility is constructed according to plans and to ensure that construction activities comply with the full set of environmental permit conditions
b. Method: On-site monitoring
c. Timing and Frequency: Monitoring will occur during all construction activities from start to completion; the project is expected to be completed within a 90-day time frame after notice to proceed
d. Sample Size: Dependent on frequency and duration of construction activities
e. Sites: Claude Peteet Mariculture Center, and Dauphin Island
f. Performance Criteria: Constructed as designed
g. Corrective Action(s): Resolution with contractor such that all contract terms and permit requirements are met

Parameter: Update of Oyster Restoration Plan

a. Purpose: The purpose of the comprehensive oyster restoration plan is to develop a long-term strategy to develop and sustain stable and resilient oyster populations in coastal Alabama.
b. Method:

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[1] See http://www.aces.edu/dept/fisheries/aumerc/AuburnUniversityShellfishLaboratory_000.php

    c.   Timing and Frequency: End of Year 1
    d.   Sample Size: NA
    e.   Sites: NA
    f.   Performance Criteria: Completed report by end of Year 1
    g.   Corrective Action(s): Revise and update as needed

Parameter: Hatchery Production

    a.   Purpose: Produce oyster spat on shell to enhance natural population
    b.   Method: Maintain and spawn oyster collected from Alabama waters in a hatchery
    c.   Timing and Frequency: Seven month spawning season beginning in the Spring
    d.   Sample Size: NA
    e.   Sites: Claude Peteet Mariculture Center and Dauphin Island
    f.   Performance Criteria: 65 million 10 day old spat/yr
    g.   Corrective Action(s): Acquire additional brood stock if production is lower than anticipated and/or switch to a live algae production system for larval feeding

Parameter: Oyster Density and Size Class Distribution

    a.   Purpose: The size and number of oysters provide information on the efficacy of using hatcheries to enhance oyster populations
    b.   Method: Patent tongs
    c.   Timing and Frequency: Annually at the end of growing season
    d.   Sample Size: Three Patent tong grabs/site
    e.   Sites: Deployment locations are TBD. Monitoring will not take place at hatchery facility
    f.   Performance Criteria: NA
    g.   Corrective Action(s): Consider alternate deployment locations as needed

Parameter: Oyster Mortality

    a.   Purpose: To understand how environmental conditions drive oyster mortality
    b.   Method: Calculated based on the number of dead and live oysters collected for Oyster Density and size distribution parameter and documentation of potential cause of mortality (e.g oyster drill, low DO, etc.)
    c.   Timing and Frequency: Baseline at placement sites, then annually thereafter
    d.   Sample Size: Three Patent tong grabs/site
    e.   Sites: Deployment locations are TBD
    f.   Performance Criteria: Less than 50% per year
    g.   Corrective Action(s): Consider alternate deployment locations as needed

Parameter: Water Temperature

    a.   Purpose: Temperature may influence oyster distribution and their physiological rate processes such as feeding and growth rates
    b.   Method: Discrete samples
    c.   Timing and Frequency: Conducted in association with deployment and annual sampling
    d.   Sample Size: NA
    e.   Sites: Deployment locations are TBD
    f.   Performance Criteria: NA
    g.   Corrective Action(s): NA

Parameter: Salinity

a. Purpose: Oyster reefs can be found along a salinity gradient. Changes in salinity may influence oyster spawning activities as well as disease and predation
b. Method: Discrete samples using a hand-held salinity/conductivity probe or refractometer
c. Timing and Frequency: Conducted in association with deployment and annual sampling
d. Sample Size: NA
e. Sites: Deployment locations are TBD
f. Performance Criteria: NA
g. Corrective Action(s): NA

Parameter: Dissolved Oxygen

a. Purpose: DO plays a role in oyster survival and growth
b. Method: A dissolved oxygen meter, water quality sonde or data logging system will be used to record measurement data taken with a DO sensor
c. Timing and Frequency: Conducted in association with deployment and annual sampling
d. Sample Size: NA
e. Sites: Deployment locations are TBD
f. Performance Criteria: NA
g. Corrective Action(s): NA

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Pre-execution monitoring will occur before project execution. Execution monitoring occurs when project has been fully executed as planned. Performance monitoring will occur in the year following initial project execution.

Table 1: Monitoring Schedule

Monitoring Parameter	Objective	Pre-Execution Monitoring	As-Built (Year 0)	Post-Execution Monitoring (Years 1-4)
Construction of facility as designed	1		X	
Hatchery Production	1			X
Oyster Density and Size Class Distribution	2	X		X
Oyster Mortality	2	X		X
Water Temp	2	X	X	X
Salinity	2	X	X	X
Dissolved Oxygen	2	X	X	X
Update of Oyster Restoration Plan	3			X

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (Trustees 2016, Appendix 5.E.1, PDARP/PEIS). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action.

To increase the likelihood of successful deployment, this project would use information gained from mapping relic oyster reefs identified in the late 1960s as described in the Side-scan Mapping of Mobile Bay Relic Oyster Reefs Project. Information from areas mapped with side-scan technology in previous efforts and as part of another proposed project in this Restoration Plan would be assessed to determine suitability (i.e., hardness of bottom, sediment burden) for spat deployment. Side-scan images would be used to identify water bottoms suitable for cultch and spat placement in areas recognized as conditionally approved for oyster harvest, while other areas would be identified in conditionally restricted or restricted waters. Spat produced in the proposed hatchery would be deployed to both areas as conditions allow. Cultch material could also be deployed as needed.

If hatchery is not producing sufficient numbers of spat, methods will be evaluated and amended as needed. As stated above, the proposed approach is well documented and has been successfully implemented previously.

Additionally, this project would fund the development of comprehensive oyster restoration plan for Coastal Alabama. The plan would analyze existing literature, pull together data from previous and ongoing projects (including side-scan sonar, larval transport studies, and habitat suitability index), develop overall restoration goals and priorities, and provide specific recommendations to meet overall restoration goals and objectives.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?

- Did the restoration project produce unanticipated effects?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any of the uncertainties identified prior to project implementation resolved?
- Were any new uncertainties identified?
- Have data been summarized and characterized in a way that allows for a clear understanding of results?
- Have any trends or patterns been identified, and if so, how can they be characterized?
- What broader insights might be gained from implementation/monitoring of this project?

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017a). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then Project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

Data Review and Clearance

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Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred. Some data collected may be protected from public disclosure under federal and state law (e.g., personally identifiable information under the Privacy Act or observer information collected under Magnuson–Stevens Fishery Conservation and Management Act (MSFCMA), etc.) and therefore will not be publicly distributed.

REPORTING

Annual MAM reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

ROLES AND RESPONSIBILITIES

ADCNR is the lead Trustee agency for this project, and will ensure that the project is completed.

The Trustee Council facilitates consistency in monitoring and data management procedures and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

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DWH NRDA Trustees. 2017b. Deepwater Horizon Oil Spill Natural Resource Damage Assessment: Strategic Framework for Oyster Restoration Activities. June. Available: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

National Research Council. 2004. *Adaptive Management for Water Resources Project Planning*. Washington, DC: The National Academies Press.

Pastorok, R.A., MacDonald, A., Sampson, J.R., Wilber, P., Yozzo, D.J., & Titre, J.P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9, 89-107.

Steyer, G.D. & Llewellyn, D.W. 2000. Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 26, 27-39.

Williams, B.K. 2011. Adaptive management of natural resources - Framework and issues. Journal of
Environmental Management, 92, 1346-1353.

MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	6/1/2018	Draft to final version; added detail to parameters; removed parameter for oyster mortality	Draft to final	MAM_Oyster_Hatchery_Claude_Peteet_6.1.18

MONITORING AND ADAPTIVE MANAGEMENT PLAN
FOR DEEPWATER HORIZON NRDA PROJECT:
OYSTER GROW-OUT AND RESTORATION REEF PLACEMENT

PROJECT OVERVIEW

This project would establish up to three protected oyster gardening program grow-out areas located in Grand Bay, Portersville Bay, and Bon Secour Bay and use these adult sized oysters for restoration reef placement. The project, to be conducted and managed by the Alabama Cooperative Extension System (ACES) in coordination with its other oyster gardening activities, would grow out oysters to at least 1 year old, place these oysters on existing reef sites, including existing complementary living shoreline sites in Mobile Bay and Mississippi Sound as well as clutched sites, and identify and prioritize future restoration reef locations (including nearshore living shorelines and intertidal reefs). Additionally, the project would include including monitoring the success in terms of oyster survival and reproduction of both the grow-out areas and restoration sites to determine effective techniques to increase the sustainability of oyster populations in Alabama.

RESTORATION TYPE GOALS AND PROJECT RESTORATION OBJECTIVES

- Programmatic goal: Replenish and Protect Living Coastal and Marine Resources.
- Restoration type: Oysters. Restore oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs.
- Restoration approach: Restore oyster reef habitat.
- Restoration technique: Enhance Oyster Reef Productivity through Spawning Stock Enhancement Projects Such as Planting Hatchery-Raised Oysters, Relocating Wild Oysters to Restoration Sites, Oyster Gardening Programs, and Other Similar Projects.
- Restoration type goal: Restore oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs.

Objective 1: Create up to three protected oyster gardening program grow-out areas.

Objective 2: Grow out oysters to one year old and place on existing reef sites.

Objective 3: Identify and prioritize future restoration reef locations (including nearshore living shorelines and intertidal reefs).

CONCEPTUAL SETTING AND ANTICIPATED OUTCOMES

A conceptual model forms the basis of this monitoring plan, and includes a summary of the project activities, the expected product or output of those activities and the desired project outcomes. Stressors negatively impact habitat condition and habitat relationships, resulting in loss of habitat, function or capacity. For this project, the specific stressors addressed include predation, loss of habitat and water quality issues (e.g., low dissolved oxygen) that results in poor spat recruitment. Activities including the placement of spat in designated grow out areas and placement of grow out oysters on reefs will result in increased settlement in grow-out areas, and an increase in abundance or larger class size oysters, as well as anticipated reduced predation by the oyster drill.

Sources of Uncertainty

Stressors like storms and changes in water quality may negatively impact the success of this project by disturbing grow-out structures. Predation is also a concern. Previous efforts have demonstrated that

oysters can be successfully grown "off-bottom," although not using the specific techniques proposed by this project.[1] The proposed initiative would further test the salinity and other environmental conditions under which grow-out can take place. The project would also provide a better understanding of the economics of these grow-out approaches. Additionally, the project would monitor the success of the grow-out areas at increasing the oyster larval pool nearby. Since this technique has not been used previously, the likelihood of success is unknown; however, in areas that currently have low densities of oyster larvae, such as Bon Secour Bay, it is likely that a dense aggregation of living, spawning age oysters will enhance the larval pool.

PROJECT MONITORING, PERFORMANCE CRITERIA, POTENTIAL CORRECTIVE ACTIONS AND MONITORING SCHEDULE

The proposed monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and identify potential corrective actions, if needed. For each of the monitoring parameters identified below, information is provided on the intended purpose of each monitoring parameter (e.g., monitor progress toward meeting one or more of the restoration objectives, regulatory compliance, support adaptive management of the project), monitoring methods, timing and frequency, duration, sample size, and sites. This section also describes applicable performance criteria and potential corrective actions for project parameters associated with project objectives.

The decision-making process requires a structured approach for incorporating new information gained from monitoring and evaluation. As specified in the NRDA regulations, performance criteria are used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). However, unanticipated consequences, previously unknown conditions or unanticipated environmental drivers uncovered during the evaluation step may also determine the need for corrective actions. The decision to implement a corrective action will holistically consider the overall outcomes of the restoration project by assessing the results of all monitoring parameters compiled in the evaluation step.

Parameter: Number of oysters at grow-out site

    a. Purpose: To understand if project is producing anticipated number of oysters
    b. Method: Estimate count
    c. Timing and Frequency: Annually at the end of growing season
    d. Sample Size: up to 3 grow out sites (300 square feet / site)
    e. Sites: Up to 3 grow-out sites
    f. Performance Criteria: 40,000 oysters / grow out site per year
    g. Corrective Action(s): Supplement with additional hatchery grown oysters

Parameter: Oyster mortality (grow-out and placement sites)

    a. Purpose: To understand how environmental conditions drive oyster mortality
    b. Method: Calculated based on the number of dead and live oysters collected for Oyster Density and size distribution parameter and documentation of potential cause of mortality (e.g oyster drill, low DO, etc.)
    c. Timing and Frequency: Baseline at placement sites, annually for grow-out and placement sites for Years 2-5 at end of growing season
    d. Sample Size: 3 grow out sub-sites per area (75 square feet per site)

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[1]See http://www.aces.edu/pubs/docs/A/ANR-1207/index2.tmpl

e. Sites: Up to 3 grow-out sites
f. Performance Criteria: Less than 50% per year
g. Corrective Action(s): Structures will be retrofitted with effective predator controls as needed

Parameter: Oyster density and size class distribution (placement sites)

a. Purpose: The size and number of oysters on a reef provide information on population age structure
b. Method: Quadrat
c. Timing and Frequency: Baseline at placement sites, Annually at placement sites for Years 2-5 at end of growing season
d. Sample Size: Placement areas are TBD and number and size of quadrats will be determined based on placement site
e. Sites: Placement areas are TBD
f. Performance Criteria: TBD
g. Corrective Action(s): Choose different sites if there is high mortality

Parameter: Spat settlement

a. Purpose: To understand if project is resulting in increased settlement over time
b. Method: Settlement tiles or French Tubes
c. Timing and Frequency: Annually for grow-out sites for Years 2-5 at end of growing season
d. Sample Size: At least three tiles or tubes per grow-out site
e. Sites: Up to 3 grow-out sites
f. Performance Criteria: Positive evidence of settlement
g. Corrective Action(s): NA

Parameter: Water temperature

a. Purpose: Temperature may influence oyster distribution and their physiological rate processes such as feeding and growth rates
b. Method: thermometer or temperature probe
c. Timing and Frequency: Discrete sampling in conjunction with other monitoring activities
d. Sample Size: NA
e. Sites: Up to 3 grow-out areas
f. Performance Criteria: NA
g. Corrective Action(s): NA

Parameter: Salinity

a. Purpose: Oyster reefs can be found along a salinity gradient. Changes in salinity may influence oyster spawning activities
b. Method: Discrete samples with hand-held probe
c. Timing and Frequency: Discrete sampling in conjunction with other monitoring activities
d. Sample Size: NA
e. Sites: Up to 3 grow-out areas
f. Performance Criteria: NA
g. Corrective Action(s): NA

Parameter: Dissolved Oxygen

a. Purpose: DO plays a role in oyster survival and growth
b. Method: dissolved oxygen meter, water quality sonde or data logging system

c. Timing and Frequency: Discrete sampling in conjunction with other monitoring activities
d. Sample Size: NA
e. Sites: Up to 3 grow-out areas
f. Performance Criteria: NA
g. Corrective Action(s): NA

The schedule for project monitoring is shown in Table 1, separated by monitoring activity. Performance monitoring will begin with baseline monitoring (as-built, Year 0) and continue through Year 5. This schedule may be revised as needed depending on changing site conditions over time.

Table 1: Monitoring Schedule

Monitoring Parameter	Objective	Pre-execution Monitoring	As-Built (Year 0)	Year 1	Year 2	Year 3	Year 4	Year 5
Number of oysters at grow-out site	1		X	X	X	X	X	X
Oyster density and size class distribution	2, 3	X (placement sites only)			X	X	X	X
Oyster mortality	2, 3	X (placement sites only)			X	X	X	X
Spat Settlement	1, 2				X	X	X	X
Water temperature	1, 2	X	X	X	X	X	X	X
Salinity	1, 2	X	X	X	X	X	X	X
Dissolved Oxygen	1, 2	X	X	X	X	X	X	X

ADAPTIVE MANAGEMENT

As discussed in the PDARP/PEIS, adaptive management is a form of structured decision-making applied to the management of natural resources in the face of uncertainty (Pastorok et al. 1997; Williams 2011). It is an iterative process that integrates monitoring and evaluation of management actions with flexible decision-making, where adjustments are made to management approaches based on observed outcomes (NRC 2004). Within the context of ecological restoration, adaptive management addresses key uncertainties by linking science to restoration decision-making (Steyer & Llewellyn 2000). Although adaptive management is a critical component of the restoration plan as a whole, the need for adaptive management may vary on a project-by-project basis. Some projects may be well understood and not have uncertainties which warrant adaptive management. The monitoring and adaptive management framework may be more robust for elements of the restoration plan with high degrees of uncertainty or where numerous restoration projects are planned within a given geographic area and/or for the benefit of a particular resource (Trustees 2016, Appendix 5.E.1, PDARP/PEIS). Under OPA NRDA regulations, restoration projects clearly identify performance criteria that would be used to determine project success or the need for corrective action.

Periodic maintenance may be necessary following severe weather events or other situations that would disturb the grow-out sites. If the structures were disturbed, they would need to be repaired and/or reinstalled. Further, the grow-out sites would be adaptively managed over time to retrofit the structures with the most effective predator controls. ACES would work with the AL TIG, AMRD, and other restoration practitioners to determine the need for additional locations for other oyster gardening program grow-out sites if needed.

This project consists of a feasibility assessment of an alternative approach to restoring oyster resources. This project would fill an important data gap by determining how best to reduce predation on oyster populations in Alabama, which would provide information that is easily transferrable to other northern Gulf States and decrease uncertainties for future implementation activities. If the alternative is successful, it could lead to the development of new restoration methods.

EVALUATION

Evaluation of monitoring data is needed to assess the performance of the project in meeting its restoration objectives, resolving uncertainties to increase understanding, and determine whether corrective actions are needed.

As part of the larger decision-making context beyond the project scale, the evaluation of monitoring data from the individual projects would be compiled and assessed at the Restoration Type and TIG level, and the results would be used to update the knowledge base to inform decisions such as future TIG project prioritization and selection, implementation techniques, and the identification of critical uncertainties. The results of the analysis would be used to answer the following questions:

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

- Have data been summarized and characterized in a way that allows for a clear understanding of results?
- Have any trends or patterns been identified, and if so, how can they be characterized? What broader insights might be gained from implementation/monitoring of this project?

DATA MANAGEMENT

Data Description

All data collected will follow the data standards as per the MAM Manual 1.0 (DWH NRDA Trustees 2017a). To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then Project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets and notebooks and photographs will be retained by the Implementing Trustee. Relevant project data that are handwritten on hardcopy datasheets or notebooks will be transcribed (entered) into standard digital format. All field datasheets and notebook entries will be scanned to PDF files.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, QA/QC procedures, other information about data such as meaning, relationships to other data, origin, usage, and format – can reference different documents). Electronic data files will be named with the date on which the file was created and will include a ReadMe file that describes when the file was created and by whom, and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

Data Review and Clearance

After transcription of the data, a second person not associated with data transcription will perform a verification of the data in the electronic data sheets against the original hardcopy datasheets and/or notebooks, and would make any corrections to transcription errors as appropriate before data are used for any analyses or distributed outside of the agency. Implementing Trustees will verify and validate monitoring data and information and ensure that all data are entered or converted into agreed upon/commonly used digital format labeled with metadata. All data will undergo proper QA/QC protocols, be reviewed and verified following the process outlined in Section 3 of the MAM Manual Version 1.0. Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

Data Storage and Accessibility

Once all data have been verified by quality assurance/quality control procedures, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible and no more than one year from when data are collected.

Data Sharing

Data will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface within a year of when the data collection occurred.

REPORTING

Annual MAM reports describing results of project monitoring and evaluation will be made publicly available, in accordance with the Federal Open Data Policy (Section 10.6.6 of SOP; DWH NRDA Trustees 2016b), through the DIVER Explorer Interface.

A final MAM report for the project will be developed prior to project closeout and submitted to the DIVER Restoration Portal.

Roles and Responsibilities

ADCNR is the lead Trustee agency for this project, and will ensure that the project is completed.

The project would be conducted and managed by the Alabama Cooperative Extension System (ACES).

The Trustee Council facilitates consistency in monitoring and data management procedures to evaluate and report on progress towards meeting restoration goals articulated in the PDARP/PEIS.

REFERENCES

DWH NRDA Trustees. 2016. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan (PDARP) and final programmatic environmental impact statement (PEIS).

DWH NRDA Trustees. 2016b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* Oil Spill. Originally approved May 4, 2016; revised November 15, 2016.

DWH NRDA Trustees. 2017a. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill. December.

DWH NRDA Trustees. 2017b. Deepwater Horizon Oil Spill Natural Resource Damage Assessment: Strategic Framework for Oyster Restoration Activities. June. Available: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

National Research Council. 2004. *Adaptive Management for Water Resources Project Planning*. Washington, DC: The National Academies Press.

Pastorok, R.A., MacDonald, A., Sampson, J.R., Wilber, P., Yozzo, D.J., & Titre, J.P. 1997. An ecological decision framework for environmental restoration projects. Ecological Engineering, 9, 89-107.

Steyer, G.D. & Llewellyn, D.W. 2000. Coastal Wetlands Planning, Protection and Restoration Act: A programmatic application of adaptive management. Ecological Engineering, 26, 27-39.

Williams, B.K. 2011. Adaptive management of natural resources - Framework and issues. Journal of Environmental Management, 92, 1346-1353.

MAM PLAN REVISION HISTORY

Old File Name	Revision Date	Changes Made	Reason for Change	New File Name
AL TIG RP II/EA version				
	6/1/2018	Draft to final version; Added detail to parameters; removed parameter for oyster density	Draft to final	MAM_Establishment_of_oyster_grow_out_6.1.18