State of Florida's Monitoring Plan for *Deepwater Horizon* NRDA Early Restoration Phase III Project:

Florida Seagrass Recovery Project

Prepared by: State of Florida DWH NRDA Trustees
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1 Introduction

As a result of the *Deepwater Horizon* oil spill and related response activities, submerged aquatic vegetation (SAV) habitat in Florida's Panhandle was adversely impacted. The Florida Seagrass Recovery project will address boat damage to shallow seagrass beds in the Florida Panhandle by restoring scars located primarily in turtle grass (*Thalassia testudinum*) habitats in St. Joseph Bay Aquatic Preserve in Gulf County, with additional potential sites in Alligator Harbor Aquatic Preserve in Franklin County, and St. Andrews State Park Aquatic Preserve, in Bay County. A boater outreach and education component of the project will install non-regulatory *Shallow Seagrass Area* signage, update existing signage and buoys where applicable, and install educational signage and provide educational brochures about best practices for protecting seagrass habitats at popular boat ramps in St. Joseph Bay, Alligator Harbor, and St. Andrews Bay (see Figure 1).

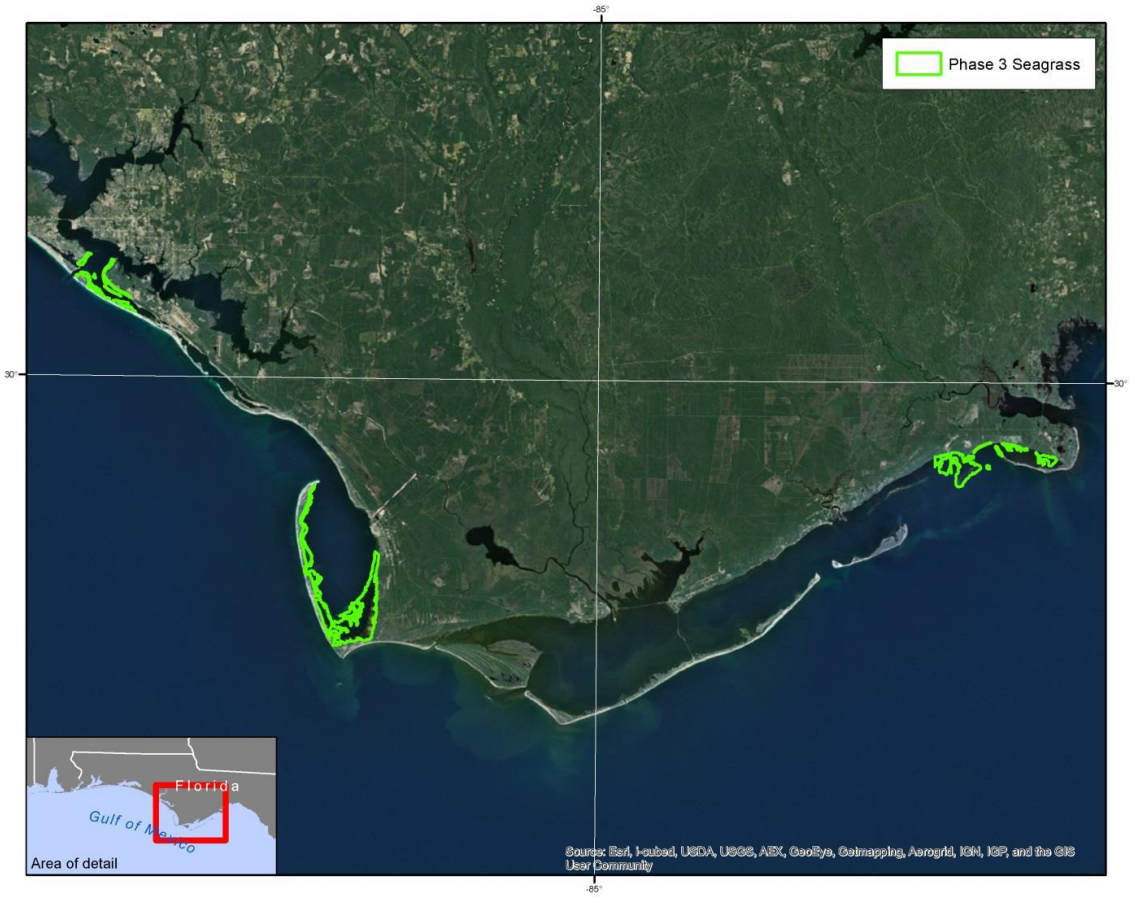

Figure 1. Location of Florida Seagrass Recovery Project.

1.1 Project Overview

The project will address boat damage to SAV in the Florida Panhandle by restoring scars located primarily in turtle grass (*Thalassia testudinum)* habitats. Scarring occurs when boat propellers in shallow water cut up roots, stems, and leaves of seagrasses, producing long, narrow furrows devoid of vegetation. Turtle grass is a common species of seagrass in the Panhandle that is particularly slow to rejuvenate naturally when injured. Turtle grass with propeller damage can take many years to rejuvenate, or in severely scarred areas may never completely recover. The project will primarily be located in St. Joseph Bay Aquatic Preserve in Gulf County, with additional potential sites in Alligator Harbor Aquatic Preserve in Franklin County, and St. Andrews State Park Aquatic Preserve in Bay County.

The project will restore SAV habitat by addressing boat scars, which will include surveying and mapping scars in three Aquatic Preserves in the Florida Panhandle. Additionally, sediment tubes will be manufactured, filled with local fine grain sediment, and deployed in approximately 2 acres of seagrass propeller scars in St. Joseph Bay Aquatic Preserve (AP). However, if approximately 2 acres of propeller scars are not found to be available for this restoration project in St. Joseph Bay AP after initial assessments, then additional potential sites will be selected in Alligator Harbor AP and/or St. Andrews AP to achieve the overall project goal of restoring approximately 2 acres of scars.

The sediment tubes, which are made of biodegradable cotton fabric filled with sediment, will then be placed into propeller scars to enhance seagrass recovery by raising the scar elevation to ambient grade with clean sediment of appropriate grain size, thereby offering suitable habitat for seagrass recruitment. Restoration will be facilitated by placing bird stakes in the restoration project area. The stakes attract birds to perch and supply natural fertilizer in the form of feces, which is rich in phosphorus and nitrogen (Kenworthy et al. 2000). Bird stakes will be installed in water depths of 1.5m or less at mean high tide. Following completion of installation, any bird stakes remaining after two years will be removed.

Two growing seasons (approximately 18 to 24 months) after placement of sediment tubes and bird stakes is completed, scars that do not naturally revegetate to a minimum score of 3 (25 to 50% coverage) on the Braun-Blanquet scale will either be planted with seagrass species transplanted from potential donor sites within the AP, or planted with purchased seagrass planting units, as funding allows.

Finally, a boater outreach and education component of the project will install non-regulatory *Shallow Seagrass Area* signage at sites where restoration takes place, update existing signage and buoys where applicable, install educational signage, and provide brochures about best practices for protecting seagrass habitats at popular boat ramps in St. Joseph Bay, Alligator Harbor, and St. Andrews Bay. The total budget for this project is $2,691,867.

1.2 Restoration Objectives and Performance Criteria

The objective of this restoration project is to restore SAV habitat in Florida by addressing boat scars in up to three Aquatic Preserves in the Florida Panhandle.

Performance criteria will be used to determine restoration success or the need for corrective action (15 CFR 990.55(b)(1)(vii)). Specific performance criteria for this project are identified below.

- Performance Criterion #1: Two growing seasons (approximately 18 to 24 months) after placement of sediment tubes, bird stakes, and signage, scars that do not naturally revegetate to a minimum score of 3 (25 to 50% coverage) on the Braun-Blanquet scale will be planted with seagrass species transplanted from potential donor sites within the AP, or seagrass planting units will be purchased and installed, as funding allows.
- Performance Criterion #2: At year 3, treated scars revegetate to a minimum score of 4 (50 to 75% coverage) on the Braun-Blanquet scale in scarred areas at the completion of the project, using the Braun-Blanquet assessment method, or other appropriate techniques.
- Performance Criterion #3: All installed buoys remain intact 1 year after installation.

1.3 Conceptual Model and Monitoring Questions

Table 1, below, outlines the conceptual model for this restoration type that forms the basis of the monitoring plan, including a summary of the project activities, the expected product or output of those activities, and the desired project outcomes.

Table 1. Conceptual Model for Restoration.

Activity	Output	Short-term outcome	Long-term outcome
Construction: • Install a seagrass buoy system • Survey and map seagrass scars • Fill in scars using sediment tubes • Install bird stakes and temporary signage • Install educational signage Monitoring: • Monitor SAV growth and plant seagrass only if restoration is deemed unsuccessful after 18 to 24 months	• Approximately 2 acres of seagrass beds are restored and protected	• Scars fill to ambient grade with sediment	• Seagrass growth occurs and habitat is restored for the expected lifespan of the project

This monitoring plan has been designed around the objectives and desired outcomes for this restoration project, and is intended to address the following monitoring questions:

Objective: Restore SAV habitat in Florida by addressing boat scars in up to three Aquatic Preserves in the Florida Panhandle.

- Was the project implemented as designed?
- Are the seagrass buoys intact?
- Is planted seagrass surviving (if planting occurred)?
- Are seagrass beds recovering?

1.4 Roles and Responsibilities

The Florida Department of Environmental Protection or its contractor will be responsible for the monitoring for this project. Aquatic Preserve staff will be consulted on all aspects of the restoration project.

2 Project Monitoring

The proposed monitoring for this restoration project is outlined below. For each of the identified monitoring parameters, information is provided on the methods, timing and frequency, sample size, and sites. In addition, performance criteria for each parameter are identified, including corrective actions that could be taken if the performance criteria are not met. Monitoring will be conducted to ensure project designs were correctly implemented and to evaluate project effectiveness. Performance criteria will be used to determine project success or the need for corrective actions. Monitoring has been designed around the overall project objective, which is to restore injured SAV habitat, primarily turtle grass (*Thalassia testudinum*), in the Florida Panhandle. Specific restoration objectives are the creation of new SAV habitat in previously scarred areas that meets project design criteria and is sustained for the expected life of the project. Field surveys will be performed in accordance with the monitoring schedule (see Table 2) during early spring and/or late summer depending upon the parameters being surveyed, to monitor the progress of restoration activities.

Post-construction performance monitoring will initially focus on revegetation of the previously scarred areas. This monitoring will include collection of habitat information such as percent vegetative cover of scars using the Braun-Blanquet assessment method (Braun-Blanquet 1972) or other appropriate techniques. Pre- and post-project monitoring will compare restoration progress in both treated, untreated, and control (adjacent seagrass that is unaffected by scarring) areas. A select number of randomly chosen untreated scars will be compared to treated scars to determine if sediment tubes create conditions more suitable for rapid seagrass recovery (Gudeman et al. 2010). The criteria for choosing both treated and untreated propeller scars for comparison will require that they do not have statistically significant differences in dimension (length and width), and that they are located in areas that contain similar seagrass densities. Methods designed to measure percent cover and shoot counts will be used to compare recovery rates of propeller scars located within treated and untreated locations of the project area. Permanent (fixed) transects will be incorporated into the study to monitor changes in the number of untreated propeller scars.

Measurements will be taken along the perimeter or length/width of each scar using a differential Global Positioning System (GPS). Data layers will be created using spatial analysis software such as ArcMap to determine the increase or decrease in scar number, length, and area over time using GIS data. Additionally, as funding allows, aerial photography or a similar technique will be used to establish permanent visual documentation along selected portions of planted scars to document the progression of coverage of seagrass, and water quality parameters will be measured.

Objective: The objective of this restoration project is to restore SAV habitat in Florida by addressing boat scars in up to three Aquatic Preserves in the Florida Panhandle.

- Was the project implemented as designed?
- Are the seagrass buoys intact?
- Is planted seagrass surviving (if planting occurred)?
- Are seagrass beds recovering?

Parameter #1: Length, number and/or area of scars

a) Method: Take continuous measurements along the perimeter or length of each scar using a differential Global Positioning System (GPS) and measure the width of the scar (Sargent et al. 1995). Import and analyze data using spatial analysis software.
b) Timing and Frequency: Pre-construction (once); Post-construction at year 0 and at year 3.
c) Sample Size: To be determined during project design.
d) Sites: Restoration site(s).
e) Performance Criteria: N/A
f) Corrective Action: N/A

Parameter #2: Seagrass species composition, percent cover, and shoot density

a) Method: Determine seagrass species composition, visually estimate percent cover of seagrass, and count shoot density within standard-sized quadrats using Braun-Blanquet methodology (Braun-Blanquet 1972) or other appropriate techniques.
b) Timing and Frequency: Pre-construction (once); Post-construction [Biannually (early spring and late summer) for year 1, and then at least annually (late summer) for years 2 and 3].
c) Sample Size: To be determined during project design.
d) Sites: Restoration site(s) (treated and untreated) and control site(s).
e) Performance Criteria:
    i. Two growing seasons (approximately 18 to 24 months) after placement of sediment tubes, bird stakes, and signage, scars that do not naturally revegetate to a minimum score of 3 (25 to 50% cover) on the Braun-Blanquet scale will be planted with seagrass species transplanted from potential donor sites within the AP, or seagrass planting units will be purchased and installed, as funding allows.
    ii. At year 3, treated scars revegetate to a minimum score of 4 (50 to 75% coverage) on the Braun-Blanquet scale in scarred areas at the completion of the project, using the Braun-Blanquet assessment method, or other appropriate techniques.
f) Corrective Action: Add planting units and/or transplant seagrass from potential donor sites within the Preserve. Add signage, buoys, and/or bird stakes, prioritized as appropriate and as funding allows.

Parameter #3: Seagrass buoy system

a) Method: Conduct visual observations. At the completion of installation (year 0) the contractor shall provide FDEP with the compass headings from buoy to buoy, distance between buoys in nautical miles, and the Global Positioning System (GPS) locations for each installed buoy.
b) Timing and Frequency: Post-construction at year 0 and on an annual basis following completion of installation[1].
c) Sample Size: 41 buoys

[1] Additional surveys may be warranted if the project site is directly impacted by a major storm.

d) Sites: St. Joseph Bay Aquatic Preserve.
e) Performance Criteria: All installed buoys remain intact 1 year after installation.
f) Corrective Action: Replace all buoys that have failed within the first year after installation, and in subsequent years as funding allows.

Parameter #4: Survival of seagrass planting units or transplants, if they are used. SAV would be planted only if restoration is deemed unsuccessful after 18 to 24 months.

a) Method: Count live and dead seagrass planting units or transplants to estimate the percent survival within the planted area (Gudeman et al. 2010).
b) Timing and Frequency: 30 and 90 days after planting of seagrass units or transplants, which would potentially occur in year 2.
c) Sample Size: To be determined during project design.
d) Sites: Planted areas within restoration site(s).
e) Performance Criteria: N/A
f) Corrective Action: N/A

Additional activities may be undertaken if necessary and as budget allows. As available, other existing information will be used, such as aerial imagery.

Example #1: Underwater photographs

a) Method: Take underwater photographs of the restoration site(s) and reference site(s).
b) Timing and Frequency: Pre-construction (once); Post-construction (at year 0, and biannually at years 1 to 3 in early spring and late summer).
c) Sample Size: To be determined during project design.
d) Sites: Restoration site(s) (treated and untreated) and control site(s).

Example #2: Water depth, temperature, salinity, and light penetration

a) Method: Measure water depth, water temperature, salinity, and light penetration using appropriate instrumentation (e.g., Photosynthetically Active Radiation [PAR]).
b) Timing and Frequency: Pre-construction (once); Post-construction (biannually for years 1 to 3).
c) Sample Size: To be determined during project design.
d) Sites: Restoration site(s) and control site(s).

3 Monitoring Schedule

The schedule for the project monitoring is shown in Table 2, separated by monitoring activity. Pre-construction monitoring will occur before project implementation. Construction monitoring typically occurs within 90 days following project construction (year 0). Performance monitoring will occur in the years following project construction (years 1 to 3).

Table 2. Monitoring Schedule.

Monitoring Parameters	Monitoring Timeframe				
	Construction		Performance		
	Pre-Const. Monitoring	Const. Monitoring	Post-Construction Monitoring		
		As-built (Year 0)	Year 1	Year 2	Year 3
Length, number and/or area of scars (GPS data)	X	X			X
Vegetation survey (composition, % cover, density)	X		2X	X	X
Observations of buoy system		X	X	X	X
Percent survival of planting units or transplants (if used)				2X	

4 Reporting and Data Requirements

Reporting of monitoring progress, data, and analysis will be conducted and submitted as required by the stipulations agreed to by the NRDA Trustee Council. Quarterly progress reports and annual monitoring reports will be produced that will include all raw data gathered in pre-post surveys, an analysis of collected data, conclusions of the project's success, and recommendations for further restoration efforts.

5 References

Braun-Blanquet, J. 1972. Plant Sociology: the study of plant communities. Hafner, New York.

Gudeman, C., R. Mezich, K. Smith, and P. Carlson. 2010. Restoration, monitoring and management of boat propeller scars in St. Andrews Bay, Florida. Florida Fish and Wildlife Conservation Commission Tech. Rep. Project number: FWS – T-13-R-1 - CFDA# 15.634. 26p.

Kenworthy, W.J., M.S. Fonseca, P.E. Whitfiled, K. Hammerstrom, and A.C. Schwartzschild. 2000. A Comparison of Two Methods for Enhancing the Recovery of Seagrass into Propeller Scars: Mechanical injection of a nutrient and growth hormone solution vs. defecation by roosting seabirds. Final report submitted to the Florida Keys Environmental Restoration Trust Fund.

Sargent, F.J., T.J. Leary, D.W. Crewz, and C.R. Kruer. 1995. Scarring of Florida's seagrasses: assessment and management options. FMRI Tech. Rep. TR-1. Florida Marine Research Institute, St. Petersburg, Florida. 37 p. plus appendices.