Mon Louis Island Restoration
2021 Marsh Monitoring

Prepared for

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September 7, 2021

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1.0 INTRODUCTION

The Mobile Bay National Estuary Program funded the project entitled “Mon Louis Island Restoration 2020 Marsh Monitoring” though a grant provided by the National Fish and Wildlife Foundation Gulf Environmental Benefit Fund, to restore the erosion-impacted northern tip of Mon Louis Island. The project is located at the mouth of East Fowl River, on the western shore of Mobile Bay, Alabama (Figure 1).

The restoration project began in July 2016, and included restoration and armoring of the receding shoreline, placement of dredged material to re-create eroded land, and creation of 4.8 acres of tidal marsh habitat. A 1,400-foot continuous rock breakwater was constructed roughly along the 1995 footprint of the island, completed in early September 2016. Sandy material was hydraulically pumped from the Fowl River Open Water Disposal Area in Mobile Bay to provide a suitable substrate for marsh creation. A channel was then created to provide tidal inundation into the site.

The restored marsh was initially prepared in March-April 2017 by planting nursery-grown stock of smooth cordgrass (*Spartina alterniflora*), salt meadow cordgrass (*Spartina patens*), and black needlerush (*Juncus roemerianus*). Barry A. Vittor & Associates, Inc. conducted a qualitative survey of the restoration site in July 2017 and found that some areas of the site had suffered high transplant mortality, particularly the black needlerush. Additional transplants were obtained and installed. Based on an inspection of the re-planted areas in mid-September 2017, it was concluded that the planting was satisfactorily completed.

Thompson Engineering, Inc. sub-contracted Barry A. Vittor & Associates, Inc. to perform environmental monitoring of the Mon Louis Island restoration. The initial monitoring was performed in September 2018. This report provides 2021 environmental survey data for Year 4 of the monitoring program.

2.0 METHODS

2.1 Sampling Plan

Vegetation metrics were collected within standard 1-m^2 quadrats along 10 transects. Transect and quadrat locations are presented in Figure 1. Quadrat data were collected at the beginning of each transect and then approximately every 5 meters. The data collected included percent cover of individual species, average height of the vegetation, and an estimate of overall vegetative cover. Plant taxonomy follows primarily Flora of North America series (FNA, 1993 onward) and Godfrey and Wooten (1979, 1981).

2.2 HGM Model Assessment

The hydrogeomorphic (HGM) model is a collection of concepts and methods that uses mathematically derived indices to assess the capacity of wetlands to perform specific ecological, geochemical, and hydrological functions, in comparison to similar wetlands within the Mississippi/Alabama coast reference domain (Schafer et al., 2007). A detailed hydrogeomorphic (HGM) model methodology is presented in Appendix A.

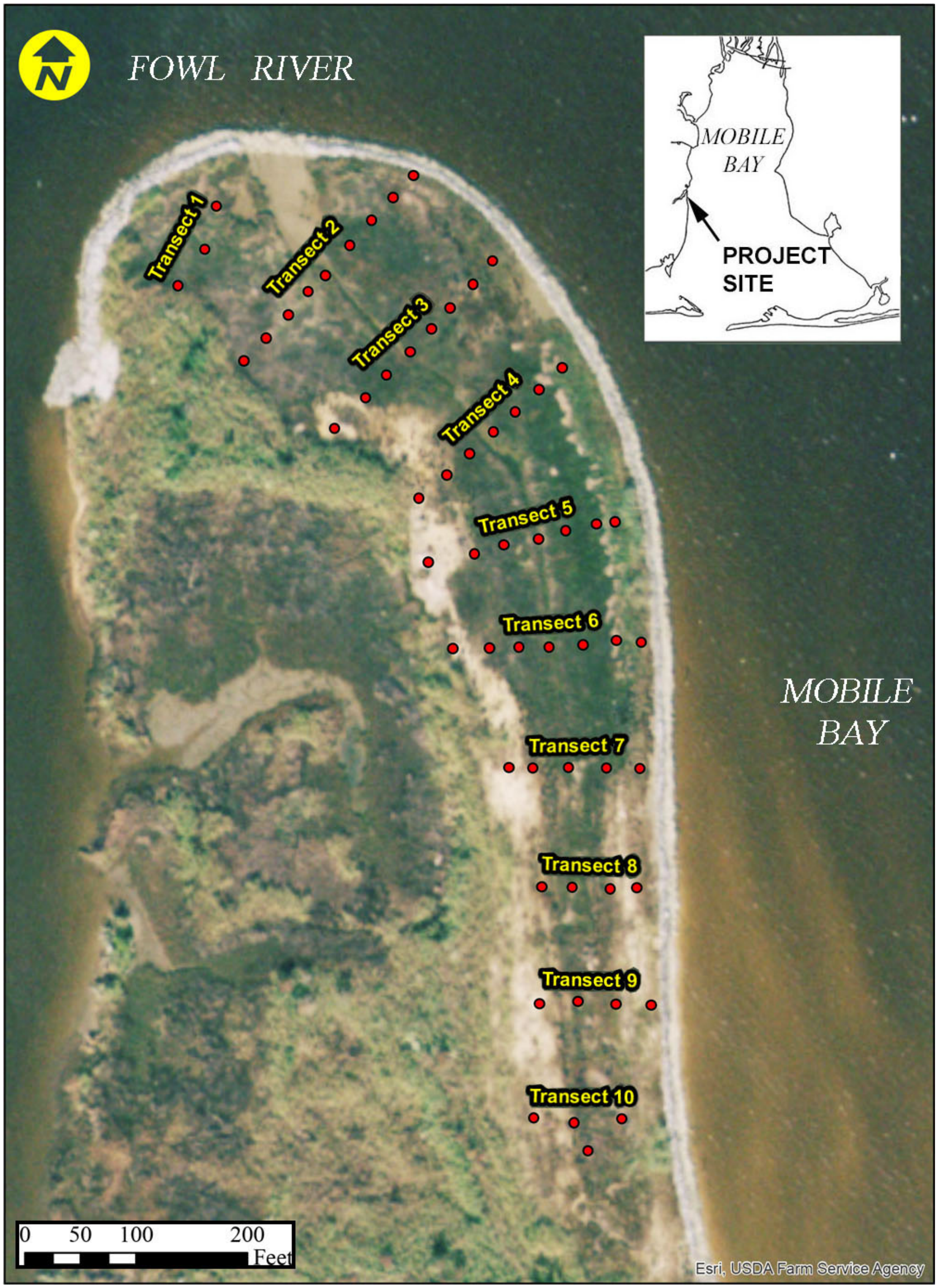

Figure 1. Location of the Mon Louis Island Project and 2021 sampling transects.

3.0 RESULTS

A phylogenetic list of plant species and their percent cover in survey quadrats are presented in Appendix A. A total of 23 vascular plant species were identified. Vegetated coverage by native herbaceous species was 85.9%. Smooth cordgrass (*Spartina alterniflora*) averaged 48.5% of vegetative cover and occurred in 84.5% of the quadrats, followed by sturdy bulrush (*Bolboschoenus robustus*), which averaged 12.9% vegetative cover and occurred in 39.7% of the quadrats (Table 3-1). Salt meadow cordgrass (*Spartina patens*) and black needlerush (*Juncus roemerianus*) each averaged 7.8% cover and were present in 20.7% and 22.4% of the sampled quadrats, respectively.

Table 3-1. Plant species with at least 0.5% average quadrat cover. († = exotic/invasive)

Species	Average % Cover	No. of Quadrats (% of total)
Spartina alterniflora	48.5	49 (84.5)
Bolboschoenus robustus	12.9	23 (39.7)
Juncus roemerianus	7.8	13 (22.4)
Spartina patens	7.8	12 (20.7)
Panicum repens †	2.7	4 (6.9)
Phragmites mauritianus †	2.5	6 (10.3)
Schoenoplectus pungens	2.5	5 (8.6)
Paspalum vaginatum	1.9	3 (5.2)
Solidago mexicana	1.5	6 (10.3)
Distichlis spicata	1.4	4 (6.9)
Morella cerifera	1.2	1 (1.7)
Baccharis halimifolia	0.8	4 (6.9)
Lythrum lineare	0.6	4 (6.9)
Sesbania vesicaria	0.6	1 (1.7)
Strophostyles helvula	0.5	2 (3.4)

Table 3-2 lists individual and average Functional Capacity Index (FCI) scores for the five ecosystem functions evaluated in the HGM model assessment for the post-construction monitoring period (2018 through 2021).

Table 3-2. Functional Capacity Index (FCI) scores for ecosystem functions evaluated by the tidal marsh HGM model.

HGM Function	2021 FCI	2020 FCI	2019 FCI	2018 FCI
Wave Energy Attenuation	0.71	0.65	0.67	0.62
Biogeochemical Cycling	0.91	0.67	0.77	0.53
Nekton Utilization Potential	0.92	0.92	0.92	0.92
Habitat for Tidal Marsh Dependent Wildlife	0.91	0.76	0.80	0.72
Plant Community Composition/Structure	0.75	0.40	0.60	0.20
Average FCI	0.84	0.68	0.75	0.60

Except for Nekton Utilization Potential, which has remained consistent since the initial 2018 assessment, FCI scores increased in 2021 due primarily to greater vegetative coverage. The site received an improved value of 0.75 in 2021 for Plant Community Composition/Structure, compared to 0.40 in 2020. The improved plant coverage resulted in FCI increases for Wave Energy Attenuation, Biogeochemical Cycling, and Habitat for Tidal Marsh Dependent Wildlife. Overall, the average of the five FCI scores increased to 0.84 in 2021 from 0.68 in 2020 (Table 3-2).

4.0 CONCLUSIONS

The average cover of native tidal marsh species at Mon Louis Island increased to 85.9% in 2021 from 49.3% in 2020. To compare the percent vegetative cover at Mon Louis Island with a natural marsh, quadrat sampling was performed at the Deer River marsh on Mobile Bay in September 2021. Vegetated coverage in Deer River quadrats averaged 72.1%. Vittor & Associates previously performed monitoring at the Deer River reference marsh in 2009 for the Choctaw Point Terminal mitigation monitoring, and at that time measured vegetated coverage at 73% (BVA, 2014).

Average cover of smooth cordgrass (*Spartina alterniflora*) increased to 48.5% in 2020 coverage from 27.0% in 2020, and was more widespread, occurring in 84.5% of the 2021 quadrats compared to 76% in 2020. Black needlerush (*Juncus roemerianus*) coverage increased to 7.8% average coverage in 2021 from 2.6% in 2020, and occurred in 22.4% of the 2021 quadrats compared to 18% in 2020.

Of the native species that have recruited naturally into the restoration site, several continued to increase their average coverage in 2021, including narrowleaf loosestrife (*Lythrum lineare*), common threesquare (*Schoenoplectus pungens*), and sturdy bulrush (*Bolboschoenus robustus*). Sturdy bulrush coverage increased to 12.9% in 2021 from only 2.8% in 2020, and occurred in 39.7% of the 2021 quadrats compared to 23% in 2020.

Average cover of exotic invasive plants increased to 5.2% in 2021, compared to 3.0% in 2020. Most of the invasive coverage was due to an increase in torpedo grass (*Panicum repens*), which had 2.7% average cover in 2021 compared to 0.8% in 2020. Common reed (*Phragmites mauritianus*) accounted for 2.5% of the 2021 coverage, compared to 2.2% in 2020.

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Appendix A – Vegetation Data and Hydrogeomorphic Model Analysis

Plant Species List - July 2021 (**†** = non-native, invasive exotic**)**

Order	Family	Species and Common Name
Poales	Juncaceae	*Juncus roemerianus* - black needlerush
Poales	Cyperaceae	*Bolboschoenus robustus* - sturdy bulrush
Poales	Cyperaceae	*Fimbristylis castanea* - marsh frimby
Poales	Cyperaceae	*Schoenoplectus pungens* - common three square
Poales	Poaceae	*Distichlis spicata* -saltgrass
Poales	Poaceae	*Panicum repens* - torpedo grass †
Poales	Poaceae	*Paspalum vaginatum* - seashore paspalum
Poales	Poaceae	*Phragmites mauritianus* - mauritius reed †
Poales	Poaceae	*Spartina alterniflora* - smooth cordgrass
Poales	Poaceae	*Spartina patens* - salt meadow cordgrass
Fabales	Fabaceae	*Sesbania vesicaria* - bladderpod
Fabales	Fabaceae	*Strophostyles helvula* - trailing fuzzy bean
Fabales	Fabaceae	*Vigna luteola* - hairy-pod cow pea
Fagales	Myricaceae	*Morella cerifera* - wax myrtle
Myrtales	Lythraceae	*Lythrum lineare* - narrowleaf loosestrife
Caryophyllales	Amaranthaceae	*Amaranthus australis* - southern water hemp
Gentianales	Gentianaceae	*Sabatia stellaris* - rose of Plymouth
Asterales	Asteraceae	*Ambrosia artemisiifolia* **-** annual ragweed
Asterales	Asteraceae	*Baccharis halimifolia* - eastern baccharis
Asterales	Asteraceae	*Iva frutescens* - bigleaf sumpweed
Asterales	Asteraceae	*Solidago mexicana* - southern seaside goldenrod
Asterales	Asteraceae	*Symphyotrichum tenuifolium* - perennial salt marsh aster
Apiales	Araliaceae	*Hydrocotyle bonariensis* - large-leaf pennywort

Average percent cover of plant species in quadrats at Mon Louis Island - July 2021

Species	Wetland Indicator Status	Average Cover	# of Quadrats	% Occurrence
Amaranthus australis	FACW	< 0.1%	1	1.7
Ambrosia artemisiifolia	FACU	< 0.1%	1	1.7
Baccharis halimifolia	FAC	0.8%	4	6.9
Bolboschoenus robustus	OBL	12.9%	23	39.7
Distichlis spicata	OBL	1.4%	4	6.9
Fimbristylis castanea	OBL	< 0.1%	1	1.7
Hydrocotyle bonariensis	FACW	< 0.1%	1	1.7
Iva frutescens	FACW	0.3%	1	1.7
Juncus roemerianus	OBL	7.8%	13	22.4
Lythrum lineare	OBL	0.6%	4	6.9
Morella cerifera	FAC	1.2%	1	1.7
Panicum repens	FACW	2.7%	4	6.9
Paspalum vaginatum	OBL	1.9%	3	5.2
Phragmites mauritianus	FACW	2.5%	6	10.3
Sabatia stellaris	OBL	0.3%	1	1.7
Schoenoplectus pungens	OBL	2.5%	5	8.6
Sesbania vesicaria	FAC	0.6%	1	1.7
Solidago mexicana	FACW	1.5%	6	10.3
Spartina alterniflora	OBL	48.5%	49	84.5
Spartina patens	FACW	7.8%	12	20.7
Strophostyles helvula	FAC	0.5%	2	3.4
Symphyotrichum tenuifolium	OBL	0.4%	3	5.2
Vigna luteola	FACW	0.3%	1	1.7

OBL = obligate; FAC = facultative; FACW = facultative wet; FACU = facultative upland

Average percent cover of plant species in quadrats at Deer River Marsh - September 2021

Species	Wetland Indicator Status	Average Cover	# of Quadrats	% Occurrence
Bolboschoenus robustus	OBL	14.1%	3	42.9
Distichlis spicata	OBL	2.2%	1	14.3
Juncus roemerianus	OBL	25.0%	2	28.6
Spartina alterniflora	OBL	22.9%	5	71.4
Spartina cynosuroides	OBL	2.2%	1	14.3
Spartina patens	FACW	0.4%	1	14.3
Symphyotrichum tenuifolium	OBL	5.4%	1	14.3

Percent cover of plants in quadrats at Deer River Marsh - September 2021

Quadrat	% Cover
1	85.5
2	53.0
3	71.0
4	37.5
5	83.0
6	87.5
7	87.5
Average Cover	72.1

Hydrogeomorphic (HGM) Model Analysis

Background
The Hydrogeomorphic (HGM) Approach is a collection of concepts and methods that uses mathematically derived indices to assess the capacity of a wetland to perform specific ecological, geochemical, and hydrological functions in comparison to similar wetlands within a geographic region. The HGM approach was originally developed to be used within the framework of the Federal Section 404 regulatory program permit review process to evaluate project alternatives, minimize project impacts, and determine compensatory mitigation requirements (Smith et al., 1995). Additional applications include the planning design and monitoring of habitat restoration projects outside the context of the Section 404 program.

The development of the HGM approach involves: 1) classification of wetlands within a defined region; 2) development of functional assessment models and indices, and 3) development and application of assessment protocols. The advantage of the HGM approach is that an individual site may be assessed for a suite of functions or a subset of functions, as determined by project management objectives. HGM is a rapid-assessment procedure designed to be implemented in a relatively short period of time at minimal expense (Shafer et al., 2007).

Classification
HGM classifies wetlands based on three separate criteria; geomorphic setting, water source, and hydrodynamics (Brinson, 1993). The classification criteria are used to group wetlands into five basic geomorphic classes at a continental scale (depressional, flat, slope, riverine and fringe wetlands). Flats can be further subdivided into organic and mineral flats, and fringe wetlands into lacustrine and tidal fringe. At a finer geographic scale, the three classification criteria are applied to identify regional wetland subclasses, which typically corresponds to existing, commonly recognized wetland types; for example oligohaline salt marsh along the Gulf of Mexico coastline (Shafer and Yozzo, 1998).

Reference Wetlands
In HGM, reference wetlands are sites selected to represent the variability that occurs within a regional wetland subclass. The reference domain is the geographic area represented by the reference wetlands. Ideally, the reference domain will mirror the geographic area encompassed by the regional wetland subclass; however, constraints on time, personnel, and fiscal resources, as well as agency jurisdictional boundaries often limit the size of a regional reference domain.

Reference wetlands establish the range and variability of conditions expressed by HGM model variables and provide data needed to calibrate HGM assessment models. Reference wetlands exhibiting the highest sustainable level of function across a suite of observed or documented functions are referred to as reference standard wetlands. When a model variable is within the range of conditions observed in reference standard wetlands a variable sub-index value of 1.0 is assigned. As the condition deviates from that observed in reference standard wetlands, the variable sub-index is assigned based on the observed relationship between model variable condition and functional capacity (on a scale of 0.0 to 1.0).

Assessment Protocol
The HGM assessment protocol is a series of tasks that allow the user to assess the functions of a particular wetland using the functional indices presented in a published Regional Guidebook. The first task in an HGM assessment is characterization, which involves describing the wetland and it’s surrounding landscape, describing the proposed project and it’s potential impacts, and identifying the wetland assessment areas (WAAs). The second task is collection of field data for

model variables. The final task is analysis, which involves calculation of functional indices and units.

Models and Indices
An HGM assessment model is a simple representation of a wetland function. It defines the relationship among one or more wetland characteristics or processes (variables). Functional capacity is the ability of the wetland to perform a function relative the level of performance observed or measured in reference standard wetlands.

Variables are combined mathematically in a functional assessment model to produce a functional capacity index (FCI). The mathematical expressions used vary, depending on the type of interaction to be represented (e.g. fully or partially compensatory, cumulative, limiting, controlling, etc.). A complete discussion of variable interactions and model development is presented in Smith and Wakeley (2001). FCIs are multiplied by the wetland assessment area (typically in hectares) to produce functional capacity units (FCUs), which represent the "currency" used to determine mitigation ratios within the context of the Federal Section 404 regulatory program.

Mississippi/Alabama HGM Guidebook
The methodology employed in the data collection and HGM assessment generally follows the protocol described in the Mississippi/Alabama HGM Guidebook (Schafer et al., 2007). http://el.erdc.usace.army.mil/wetlands/guidebooks.cfm)

METHODS

Field Data Collection
Field assessment of the Mon Louis Island site was conducted in September 2018. Transects were generally aligned perpendicular to the shoreline edge along the hydrologic gradient of decreasing elevation (following Schafer et al., 2007).

Vegetation metrics used in the HGM assessment were collected within meter-squared quadrats. Data recorded included the average height of vegetation (recorded in centimeters up to one meter), and the combined overall percent cover of native wetland vegetation occurring within the quadrat. Estimates of percent cover were made using cover class categories presented in **Table B-2**.

Table B-2. Cover classes and midpoint values for percent cover estimates in quadrats.

Class	% Cover Estimate	Midpoint Value Assigned
1	<5	2.5%
2	5-25	15.0%
3	25-50	37.5%
4	50-75	62.5%
5	>75	87.5%

Desktop/GIS Assessment Variables
The HGM assessment procedure is twofold. First, site information is gathered and assessed in a GIS during the "desktop" component of the procedure. Wetland assessment areas (WAAs) are identified from maps and air photos (color infra-red is preferred, but high-quality true color air photos are acceptable, and were used in the current evaluations). A standardized scale is

critical, and the methodology requires that all air photo work be conducted using a scale of 1:4800 (1 in. = 400 ft.).

The following HGM variables were assessed during the desktop procedure:

V_{SIZE} (Wetland Patch Size): The size of the contiguous wetland patch within which the WAA occurs.

$V_{LANDUSE}$ (Adjacent Land Use): The proportion of the wetland perimeter occupied by various land use types.

V_{WIDTH} (Mean Marsh Width): The distance (m) that wind and vessel-generated waves must travel across intervening tidal fringe wetland (distance from the shoreline)

V_{EXPOSE} (Wave Energy Exposure): A qualitative classification of the potential for a wetland to attenuate wind and vessel-generated wave energy based on geomorphic setting and fetch distance – unitless.

V_{EDGE} (Aquatic Edge): The length (m) of vegetated tidally connected marsh/water interface or edge expressed as a proportion of total WAA area (ha).

V_{HYDRO} (Hydrologic Regime): The degree of alteration to the normal tidal hydrology typical of the subclass – unitless.

Field Assessment Variables

The HGM approach also incorporates site-specific information on vegetation metrics and habitat diversity collected in the field. The field assessments generated data on the following HGM variables:

V_{NHD} (Nekton Habitat Diversity): A measure of the heterogeneity of the site, based on comparison of the number of habitats actually present at a site relative to the number of possible habitats known to occur in the regional subclass.

V_{WHD} (Wildlife Habitat Diversity): A measure of the occurrence of habitat types known to support selected marsh-dependent wildlife species within the WAA.

V_{COVER} (Mean Percent Cover Emergent Marsh Vegetation):The mean total percent cover of native non-woody plant species with a wetland indicator status of OBL or FACW

V_{HEIGHT} (Vegetation Height): The most frequently occurring height of the plants within the tallest zone of the emergent marsh plant community.

V_{EXOTIC} (Percent Cover of Invasive or Exotic Species): The proportion of the site that is covered by non-native or invasive plant species.

V_{WOODY} (Percent Cover by Woody Plant Species): The proportion of the site that is covered by shrub-scrub or other woody plant species.

V_{WIS} (Wetland Indicator Status): The ratio of percent cover of FAC and FACU plants to the cover of emergent herbaceous wetland (OBL or FACW) plants.

Ecosystem Functions (FCIs and FCUs)

The data collected during the desktop and field assessments (i.e., the thirteen variables listed above) are combined using various mathematical expressions to estimate five ecosystem functions attributed to tidal fringe wetlands in the AL/MS Gulf coast reference domain (Schafer et al., 2007):

> Wave Attenuation: Ability of a wetland to attenuate wind and vessel-generated wave energy based on geomorphic setting and fetch distance
>
> Biogeochemical Cycling: The ability of a tidal wetland to receive, transform, and export various elements and compounds through natural biogeochemical processes.
>
> Nekton Utilization: The potential utilization of a marsh by resident and seasonally occurring non-resident adult or juvenile fish and macrocrustacean species.
>
> Provide Habitat for Tidal Marsh Dependant Wildlife: The capacity of a tidal marsh to provide critical life requisites to selected components of the vertebrate wildlife community.
>
> Maintain Characteristic Plant Community Structure: The ability of a tidal marsh to support a native plant community of characteristic species composition and structure.

Calculation of FCIs

A Microsoft Excel file provided by USACE-ERDC was used to facilitate data entry and to calculate FCIs for each of the functions assessed. Formulas used to calculate FCIs were:

Functional Capacity Equations	
Wave Energy Attenuation	$FCI = [(3V_{WIDTH} + V_{COVER}) / 4 X V_{EXPOSE}]^{1/2}$
Biogeochemical Cycling	$FCI = [V_{HYDRO} X V_{COVER} X V_{LANDUSE}]^{1/3}$
Nekton Utilization Potential	$FCI = (V_{EDGE} + V_{HYDRO} + V_{NHD}) / 3$
Provide Habitat for Tidal Marsh Dependent Wildlife Species	FCI = [VSIZE X {(VHEIGHT + VCOVER)/2} X {(VEDGE + VWHD) / 2}] 1/3
Maintain Plant Community Composition and Structure	FCI = (Minimum (V_{COVER} or V_{EXOTIC} or V_{WIS} or V_{WOODY})

FCI and FCU Calculations for the Tidal Fringe HGM Regional Subclass in the North Central Gulf of Mexico (Version of 04/2007)

Project:	**Mon Louis Island 2021**		
WAA		**Area (ha):**	**1.95**

Variable	Metric Value	Units	Subindex
V_{COVER}	85.9	%	1.000
V_{EDGE}	High	Qualitative	1.000
V_{EXPOSE}	Moderate	NA	0.600
V_{EXOTIC}	5.2	%	1.000
V_{HEIGHT}	101	cm	1.000
V_{HYDRO}	Minor	NA	0.750
$V_{LANDUSE}$	100%	%	1.000
V_{NHD}	7	EA	1.000
V_{SIZE}	1.95	ha	0.750
V_{WIS}	3	%	0.750
V_{WOODY}	2	%	1.000
V_{WHD}	4	EA	1.000
V_{WIDTH}	50.7	m	0.800

Function	Functional Capacity Index (FCI)	Functional Capacity Units (FCU)
Wave Energy Attenuation	0.71	1.393
Biogeochemical Cycling	0.91	1.772
Nekton Utilization Potential	0.92	1.788
Provide Habitat for Tidal Marsh Dependent Wildlife Species	0.91	1.772
Maintain Plant Community Composition and Structure	0.75	1.463
Overall Average	0.84	8.186

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