Natural Resource Damage Assessment
Florida Seagrass Recovery Project
Monitoring Report 2022
Last Updated 7/18/2022

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 addresses 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 (AP) in Gulf County. A boater outreach and education component of the project installed non-regulatory *Shallow Seagrass Area* signage, updated existing signage and buoys, and installed educational signage and provided educational brochures about best practices for protecting seagrass habitats at popular boat ramps in St. Joseph Bay, Alligator Harbor, and St. Andrews Bay (Figure 1). The Florida Department of Environmental Protection's Central Panhandle Aquatic Preserves (CPAP) ensured project design was appropriate, monitored the implementation phase, and is responsible for monitoring the success of the project over a three-year period.

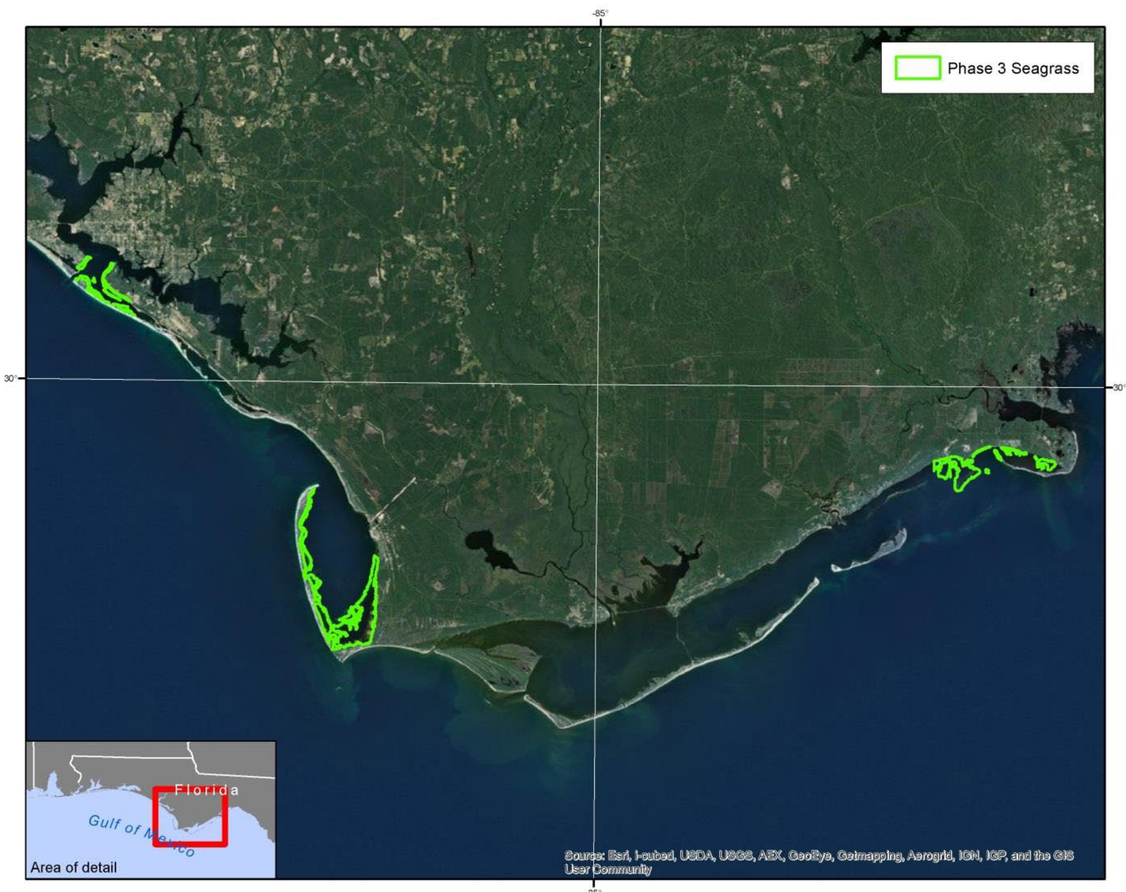


Figure 1. Location of Florida Seagrass Recovery Project.

Project Overview

The project addressed boat damage to SAV in the Florida Panhandle by restoring scars located primarily in turtle grass (*Thalassia testudinum)* habitats. Specifically, this included:

- Placement of 43,954 sediment tubes in 379 propeller scars in St. Joseph Bay AP in Gulf County.
- Installation of non-regulatory *Shallow Seagrass Area* buoy system in St. Joseph Bay AP (removed in June 2020 due to damage by boaters and Hurricane Michael)
- Updates to existing signage and buoys where applicable, installation of educational signage, and provision of brochures about best practices for protecting seagrass habitats at popular boat ramps in St. Joseph Bay, Alligator Harbor, and St. Andrews Bay.

Scarring occurs when boat propellers in shallow water cut up roots, stems, and leaves of seagrasses, producing long, narrow furrows devoid of vegetation. Since turtle grass, a common species of seagrass in the Panhandle, is particularly slow to rejuvenate naturally when injured, propeller damage can take many years to rejuvenate. In severely scarred areas, turtle grass may never completely recover.

The project aims to restore SAV habitat by addressing boat scars, which included surveying and mapping scars in three aquatic preserves in the Florida Panhandle. Additionally, sediment tubes were manufactured, filled with local fine grain sediment, and deployed in approximately two acres of seagrass propeller scars in St. Joseph Bay AP. Sediment tubes were installed in scars in eleven propeller scar restoration areas (PSRs).

Site Selection

Surveying and Mapping, LLC (SAM) was hired to survey and map using Small Unmanned Aerial Vehicle (sUAV) methodology. A BirdsEyeView Aerobatics FireFly 6 Pro (Figure 2) was flown at a height of no more than 400 feet above ground, carrying a Sony a6000 Digital Single Lens Reflex camera with a 24.3-megapixel sensor and a fixed 16mm lens. The FireFly 6 Pro was paired with FireFly Planner for mission control, which integrates the capability of processing corrected global positioning system (GPS) positions for application to the mission photos. Approximately 10,000 acres of seagrass areas within St. Joseph Bay (Figure 3) were flown to produce aerial imagery with a resolution of 6cm or less, which was used to identify seagrass propeller scars and trims.

Figure 2: BirdsEyeView Aerobatics FireFly 6 Pro, used to map and create aerial imagery of St. Joseph Bay

Figure 3. Flight areas flown in St. Joseph Bay using sUAV by NCG in 2018

Scar Selection

Atkins, a design, engineering, and project management consultant group was hired as the primary contractor for this project. Atkins used the aerial imagery produced through surveying and mapping to identify potential areas of propeller scarring within seagrass and to create eleven propeller scar restoration area (PSR) polygons in St. Joseph Bay (Figure 4). An Environmental Systems Research Institute (ESRI) ArcGIS software random point generator was used to generate a random sample of scars to be ground-truthed and compared with the imagery results. Ground-truthing occurred by boat and with mask and snorkel; length, width, depth, and GPS location was collected at each sample scar. Field data were compared to imagery to produce maps of scar location and intensity.

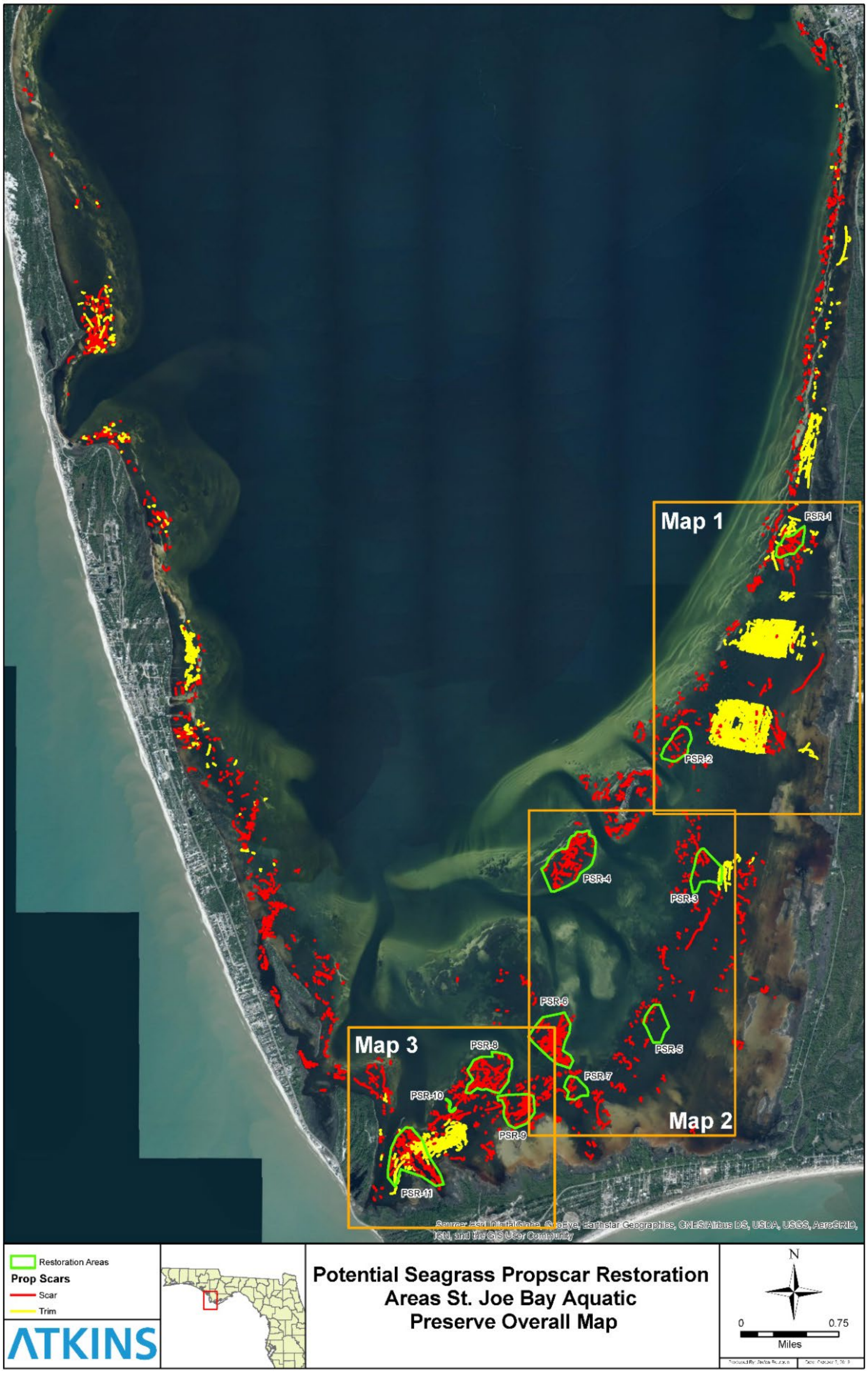
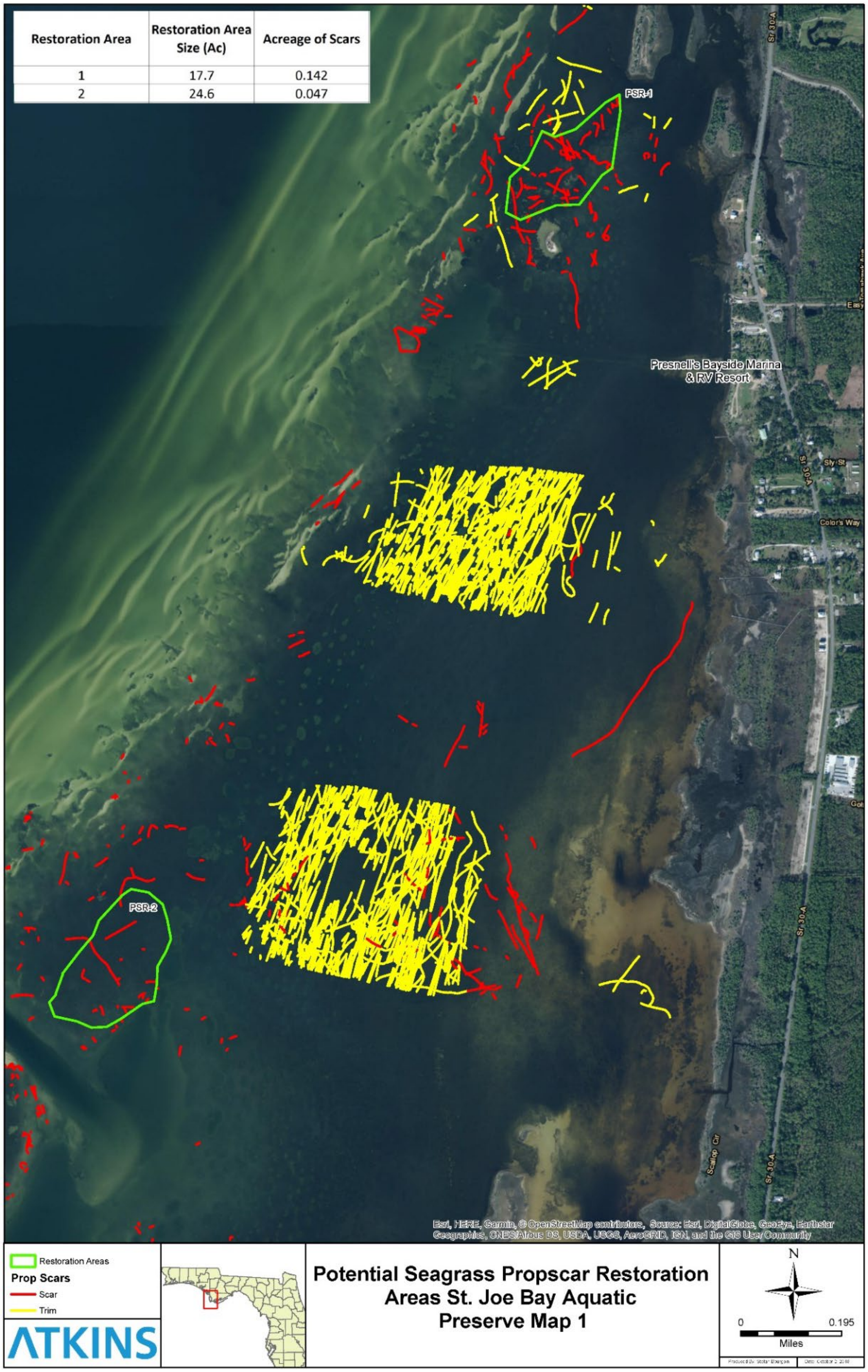
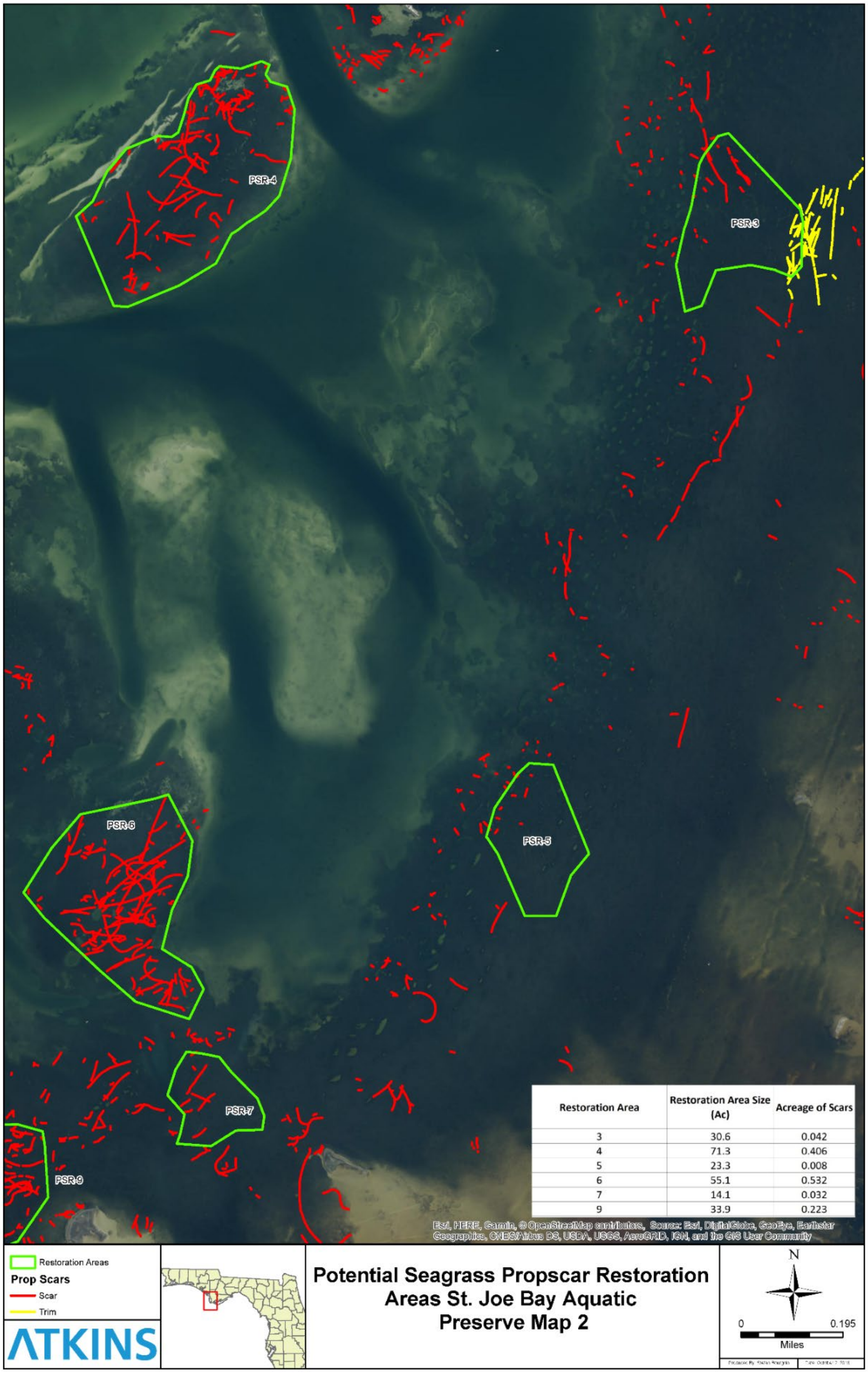


Figure 4. Propeller Scar Restoration areas (PSRs) in St. Joseph Bay Aquatic Preserve



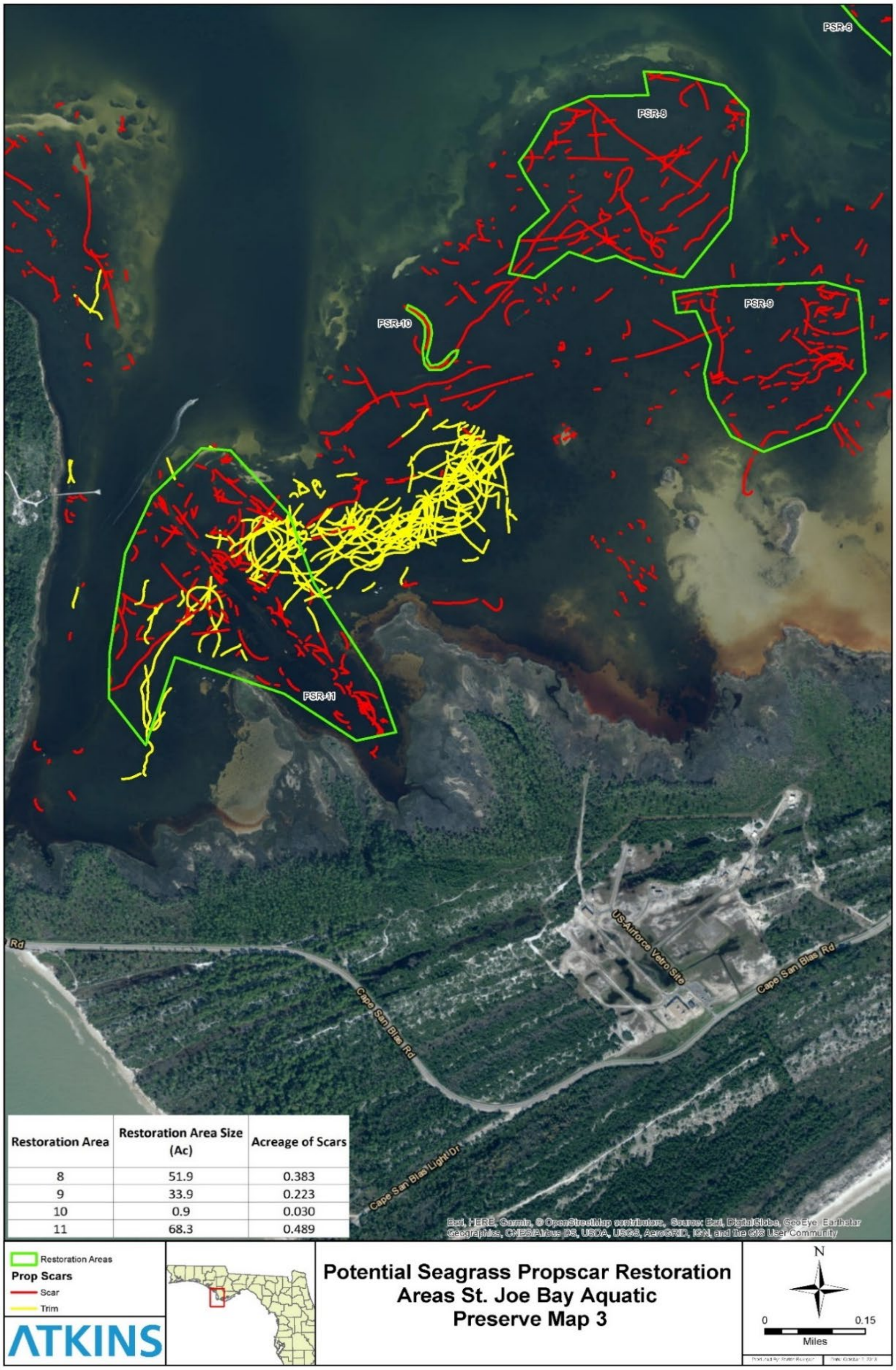
Restoration Area	Restoration Area Size (Ac)	Acreage of Scars
1	17.7	0.142
2	24.6	0.047

Figure 4a. Propeller Scar Restoration areas (PSRs) 1 and 2 in St. Joseph Bay Aquatic Preserve



Restoration Area	Restoration Area Size (Ac)	Acreage of Scars
3	30.6	0.042
4	71.3	0.406
5	23.3	0.008
6	55.1	0.532
7	14.1	0.032
9	33.9	0.223

Figure 4b. Propeller Scar Restoration areas (PSRs) 3-7, 9 in St. Joseph Bay Aquatic Preserve



Restoration Area	Restoration Area Size (Ac)	Acreage of Scars
8	51.9	0.383
9	33.9	0.223
10	0.9	0.030
11	68.3	0.489

Figure 4c. Propeller Scar Restoration areas (PSRs) 8-11 in St. Joseph Bay Aquatic Preserve

Once the PSR polygons were established, the intensity of scarring for each polygon was categorized based on the Comparison Chart for Visual Estimation of Percent Composition (Sargent et al. 1995). Polygons were designated as light (less than 5% scarring) intensity, moderate (5-20% scarring) intensity, and severe (more than 20% scarring) intensity (Figure 5). Moderate and severe intensity areas were the focus for restoration efforts.

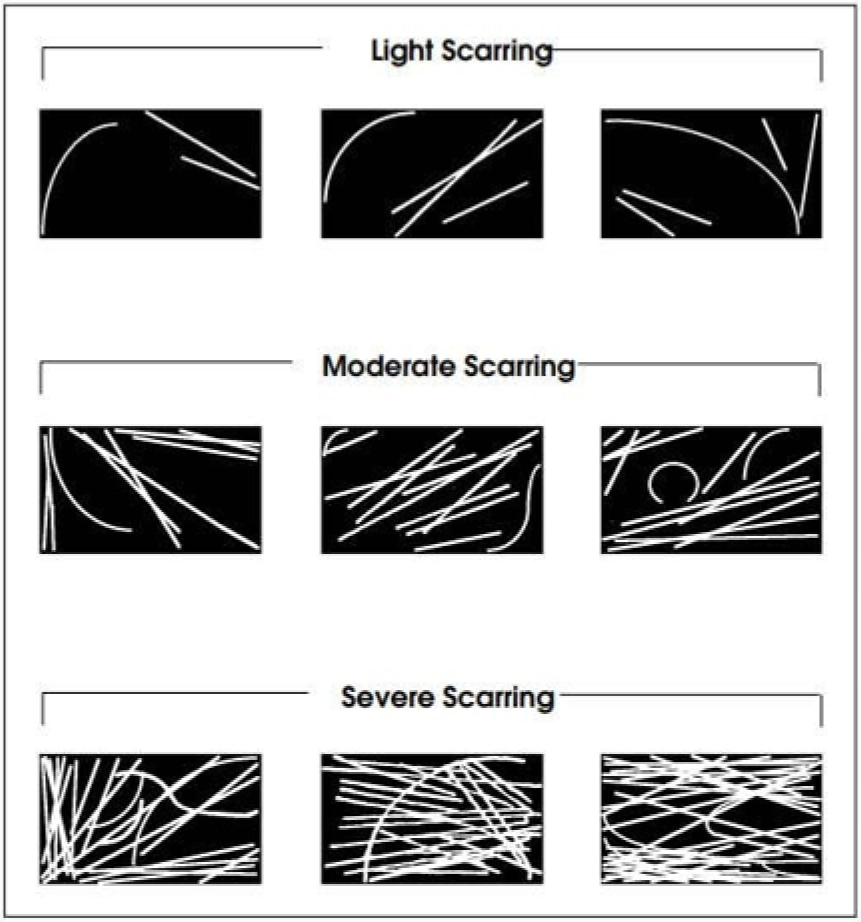


Figure 5. Examples of light, moderate, and severe scarring, as explained by Sargent et al. 1995.

ArcMap was used to calculate lengths and widths for each scar, which were compared to field-collected data, and total scar acreage for each PSR was determined to ensure that a total of 2 acres of propeller scars would be restored during the project (Figure 6). Across the PSR's, 18% were classified as having light scarring, 46% were classified as being moderately scarred and the remaining 36% were classified as heavily scarred. The total average prop scar width for the PSR's was 13.2 inches (33.5 cm) and the total average prop scar length was 138.1 feet. Please refer to Table 1 for a breakdown of average dimensions for each PSR.

Table 1. Propeller Scar Restoration Area Scar Acreage

Propeller Scar Restoration Area	Scarring Severity	Total Number Of Scars	Total Average Length of Scars (feet)	Restoration Area (Acres)	Propeller Scar (Acres)
1	Moderate	58	114.8	20.8	0.171
2	Light	19	135.3	26.4	0.069
3	Moderate	19	105.6	11.5	0.054
4	Moderate	114	130.0	71.3	0.406
5	Moderate	31	108.2	23.1	0.086
6	Heavy	119	166.0	55.1	0.532
7	Moderate	10	128.9	14.1	0.032
8	Heavy	80	179.1	51.9	0.383
9	Heavy	79	108.9	33.9	0.223
10	Light	4	319.5	0.9	0.034
11	Heavy	256	134.0	68.3	0.489
Total	**NA**	**789**	**1630.3**	**377.3**	**2.479**

Since initial surveys and ground-truthing occurred in 2018, and commencement of the project installation did not occur until 2020, Atkins swam each identified scar prior to sediment tube placement to ensure the scar still met the criteria for restoration. After the second field verification, Atkins prepared a Sediment Tube Restoration Plan (Atkins 2019) describing proposed actions for restoring propeller scars in St. Joseph Bay; this plan included permitting, site selection, sediment analysis and selection, sediment tube preparation and implementation, and safety procedures associated with the project.

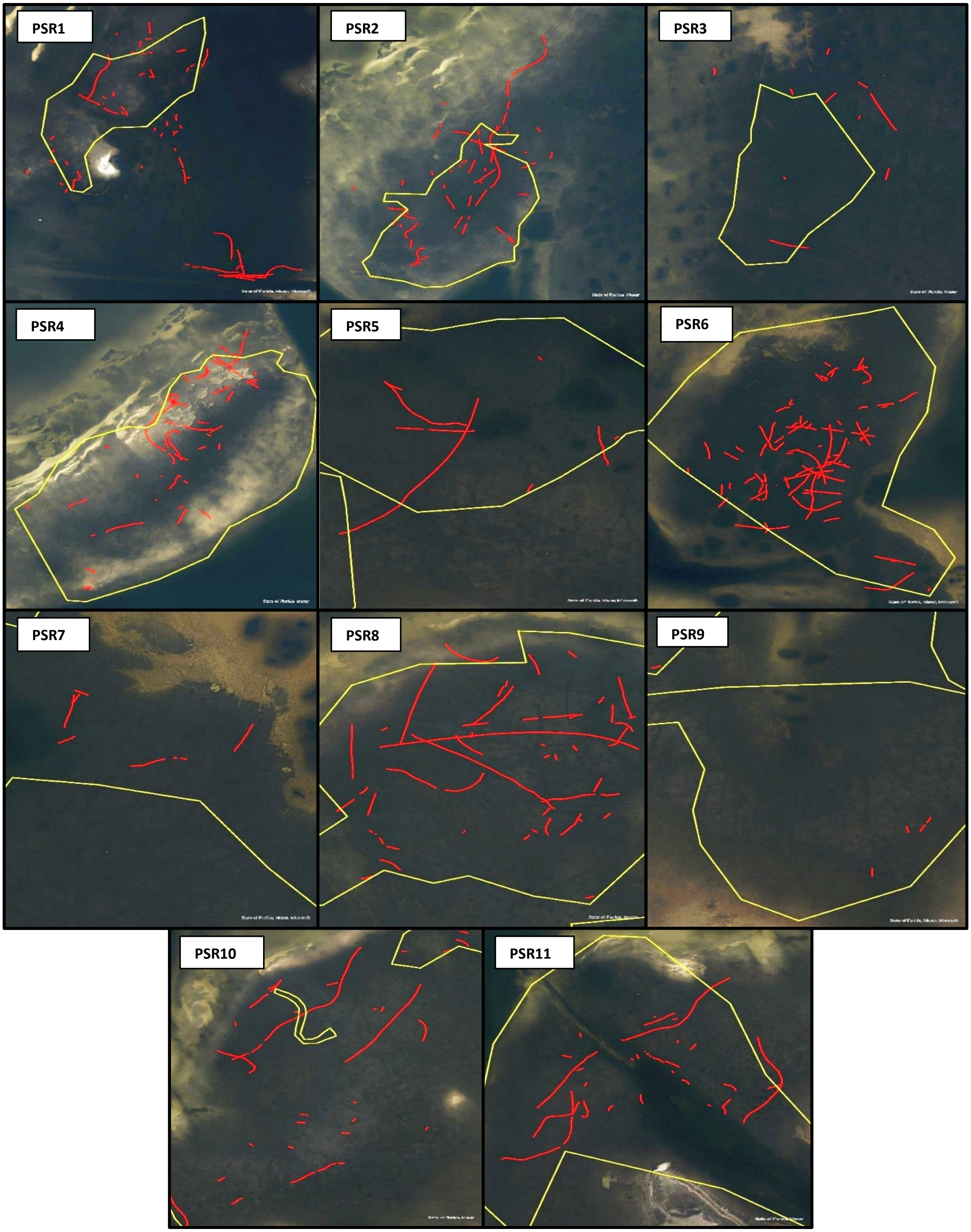


Figure 6. All propeller scars to be monitored during this project, sorted by PSR.

Sediment Tube Filling

The sediment tubes, which are made of biodegradable cotton fabric, were filled with clean sediment of appropriate grain size, which was determined through granulometry analysis at Mote Marine Lab on three representative sediment cores from within the project area. Sediment (sand) was delivered from Taunton Sand, LLC to Presnell's Bayside Marina & RV Resort, and the sediment tubes were filled on land. Loftis Marine Division, Inc. (Loftis) contractors completed the tube filling and tube installation portions of the project. A Caterpillar rubber-track skid steer loader was used to transport fill from the pile and into the tubes, which were pre-positioned using a system comprised of wood and PVC (Figure 7). To combat the effects of rainfall and humidity on the sand, Loftis created fires within the pile to keep the sediment dry (Figure 8). Once filled, sediment tubes were laid out on wooden pallets (Figure 9), which were later transported to floating platforms staged at Presnell's Marina (Figure 10).

Figure 7. At the fill site, several sediment tubes were filled at a time using a skid steer loader.

Figure 8. Fires were built within the sediment pile to keep it dry despite summertime storms

Figure 9. Filled sediment tubes laid out on wooden pallets, awaiting transport to the staging area

Figure 10. Filled sediment tubes on the floating platform staging area at Presnell's Marina, ready to be transported to the restoration area for installation.

Sediment Tube Deployment

On each day, scars that were deemed restorable by Atkins were named and marked using a PVC pole to be easily located by the installation crew (Figure 11). An aluminum frame barge was used to push the floating platforms loaded with sediment tubes to the current PSR (Figure 12). Sediment tubes were installed into propeller scars by Loftis workers (Figure 13). Streamlined methods were used when placing the sediment tubes to ensure uniform placement and area size of each unit, though there was some variation due to scar size and shape (Figure 14). The width of scars determined how many bags were laid side-by-side, and some deeper scars required multiple vertical layers to raise the scar elevation to ambient grade, thereby offering suitable habitat for seagrass recruitment (Hall et al. 2006).

Figure 11: PVC poles placed to identify target scars for restoration.

Figure 12. An aluminum barge was used to transport prepared sediment tubes to the restoration areas.

Figure 13. Sediment tubes staged adjacent to a propeller scar in preparation for installation.

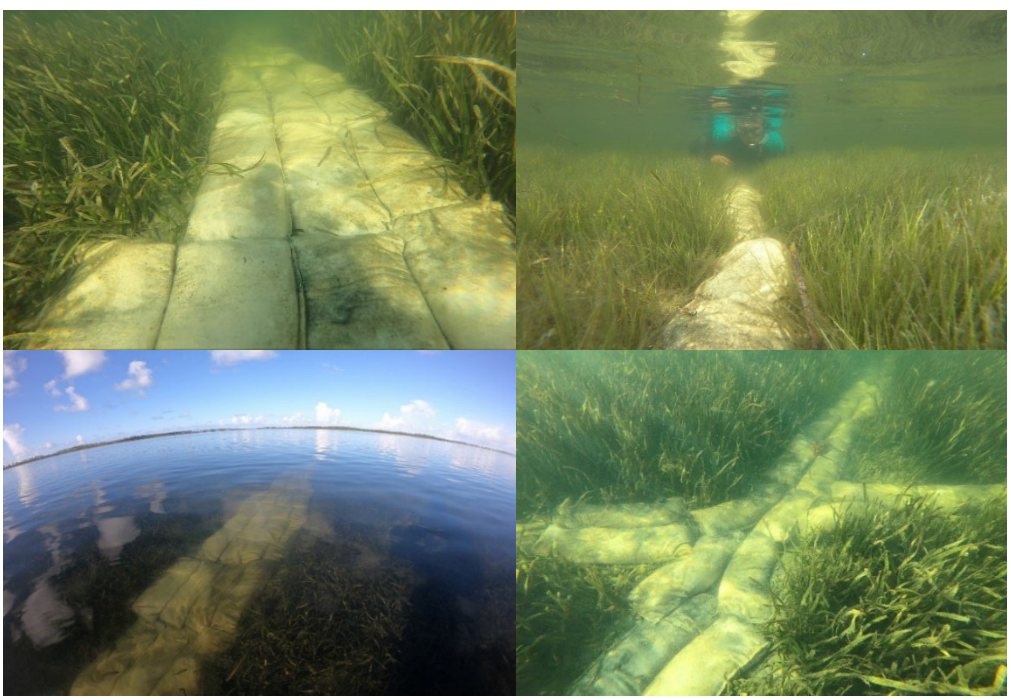


Figure 14: Examples of treated scars.

Restoration Objectives

1. Length, number, and/or area of scars is equal to or greater than 2 acres.
    - Performance Criteria: N/A
        - **Achieved**: 2.018 acres of scars were treated within 379 scars in St. Joseph Bay AP.
2. Restored scars achieve the designed percent cover of seagrass.
    - Performance Criteria: At Year 2, scars should naturally revegetate to a minimum score of 3 (25 to 50% cover) on the Braun-Blanquet scale.
        - **To Be Determined (TBD)**: At Year 1, 9.50% of scars have revegetated to a minimum score of 3, and 51.19% have revegetated to a minimum score of 1 on the Braun-Blanquet Scale.
    - Performance Criteria: At Year 3, treated scars should revegetate to a minimum score of 4 (50 to 75% coverage) on the Braun-Blanquet scale.
        - **TBD:** See above
3. Installation of seagrass buoy system
    - Performance Criteria: All installed buoys remain intact 1 year after installation.
        - **Not Achieved**: damaged buoys were replaced in 2017, but the system was removed in summer 2020 primarily due to ongoing boater damage of the buoys
4. Survival of seagrass planting units or transplants, if they are used.
    - Performance Criteria: N/A
        - **Not relevant**: no seagrass has been planted/transplanted.

Monitoring Schedule

The objective of the Florida Seagrass Recovery Project is to restore SAV habitat in Florida by addressing boat propeller scars in up to three aquatic preserves in the Florida Panhandle. Monitoring will occur to determine the success in meeting this objective and to determine if implementation of corrective actions is necessary (Table 2). Safety is the top priority when determining survey dates, as this type of monitoring is weather dependent. Monitoring occurs once a year during years one through three post-construction. Year One monitoring started in July 2021, and scars were monitored in order of completion. Due to staffing issues and environmental factors, this round of monitoring was completed in June 2022.

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
Vegetation survey (composition, % cover, density)	✓		✓	X	X
Percent survival of planting units or transplants (if used)				2X	

Monitoring Protocol

1. Site Selection:

All 379 restored scars are monitored. A handheld GPS is used to navigate to the scar coordinates, and maps indicating scar shape, position, and length aid with identifying scars.

2. Field Surveys:

A transect is laid out the entire length of the scar using a 100 m tape. For scars longer than 100 meters, multiple meter tapes are used. Total measured scar length is recorded. Starting at 0 meters (from either the South or East end, depending on the orientation of the scar), scar width is measured and a 0.0625m² (0.25m x 0.25m) quadrat is placed in the center of the scar. Within the quadrat, seagrass and macroalgae species are noted, and total coverage is determined on a scale of 0.1-5 using Braun-Blanquet (B&B) methodology (Table 3). Sediment type (silt, sand, rock, mud, or shell), height (short, medium, or tall), and epiphytic algae density (clean, light, medium, or heavy) are also noted. This process is repeated every ten meters along the length of the scar. Water quality abiotic parameters are recorded at each site as well.

Table 3: Modified Braun-Blanquet Scale (Braun-Blanquet, 1972)

Score	Description
NGIQ	No grass in quad
0.1	Solitary
0.5	Sparse (2-5 individuals)
1	<5% Cover
2	5-25% Cover
3	25-50% Cover
4	50-75% Cover
5	75-100% Cover

Control data is collected starting at the zero-meter mark, occurring every 50 meters. The 0.0625m^2 quadrat is placed one meter into the undisturbed grass on each side of the scar. The same measurements are collected in these control quadrats as those taken within the scar.

Overall representative data is also collected at each scar including environmental conditions, scallop and urchin counts, any other species of interest, and notable comments regarding the scar appearance or condition. Representative videos are taken on selected scars and water quality data is taken in each PSR monitored that day.

3. Data Entry:
All data are entered into an Excel spreadsheet. Water quality parameters, weather conditions, wind, currents, and latitude and longitude are also entered into Excel. Next, all the data are proofed for quality control/quality assurance and any errors are corrected. All Excel data and scanned copies of original data sheets are stored on the CPAP server.

4. Data Analysis:
An average B&B score is determined for each scar and control data is averaged for each scar. Data is then analyzed to determine restoration success.

5. Generation of Technical Reports:
Annual monitoring reports will be produced detailing the status of the scars and the vegetation coverage within restored scars, as well as the water quality and environmental parameters measured, and any recommendation for improving the enhanced site's productivity.

Results:

Objective 1 – Length, number, and/or area of scars is equal to or greater than 2 acres
2.018 acres of scar were treated.

Discussion
This number was calculated using the size of the sediment tube (8" x 36", or 2ft^2) and the total count (43,954) of bags on the top layer (some scars were deep enough to require multiple vertical layers of sediment tubes) in each scar. It was determined that 87,908 ft^2 of propeller scars have been treated, which converts to 2.018 acres. Slight discrepancies in bag placement may mean the actual area is slightly greater or less than this calculation.

Objective 2 - Restored scars achieve the designed percent cover of seagrass
At Year One monitoring, 9.50% of treated propeller scars had been restored to a B&B score of at least 3 (Figure 15), while 51.19% had been restored to a B&B score of at least 1 (Figure 16). Of the 379 scars that were treated with sediment tubes, 32 (8.44% of total scars restored) scars had an average B&B score less than 0.5, 62 (16.36%) had an average B&B score between 0.5 and 0.9, 104 (27.44%) had an average B&B score between 1.0 and 1.9, 56 (14.78%) had an average B&B score between 2.0 and 2.9, 25 (6.60%) had an average B&B score between 3.0 and 3.9, and 11 scars (2.90%) had an average B&B score between 4.0 and 5.0 (Figure 17). Of the 379 scars monitored, 88 (23.22% of all restored scars) were not

able to be located and were therefore labeled as "No Discernable Scar" (Figure 18). These scars were usually located in areas where seagrass beds had become denuded, leaving large expanses of sandy bottom where scars could no longer be seen. It is suspected that increased urchin grazing pressure contributed to the creation of these bare areas.

Since unexpected urchin grazing has impacted healthy seagrass and restored scars in some PSRs, adjusted percentages were also calculated to account for the non-discernible scars located in these areas. With these adjusted numbers, 11.03% have been restored to an average B&B score of 0.49 or less, 21.38% have been restored to an average B&B score of 0.5-0.9, 35.86% have been restored to an average B&B score of 1.0-1.9, 19.31% have been restored to an average B&B score of 2.0-2.9, 8.62% have been restored to an average B&B score of 3.0-3.9, and 3.79% have been restored to an average B&B score of 4.0-5.0 (Figure 19). Of the monitored scars (adjusted to account for non-discernible scars), 66.90% have been restored to an average B&B score of at least 1.0 (Figure 20), and 12.41% have been restored to an average B&B score of at least 3 (Figure 21). So far, the total average B&B score of all monitored scars is 1.50.

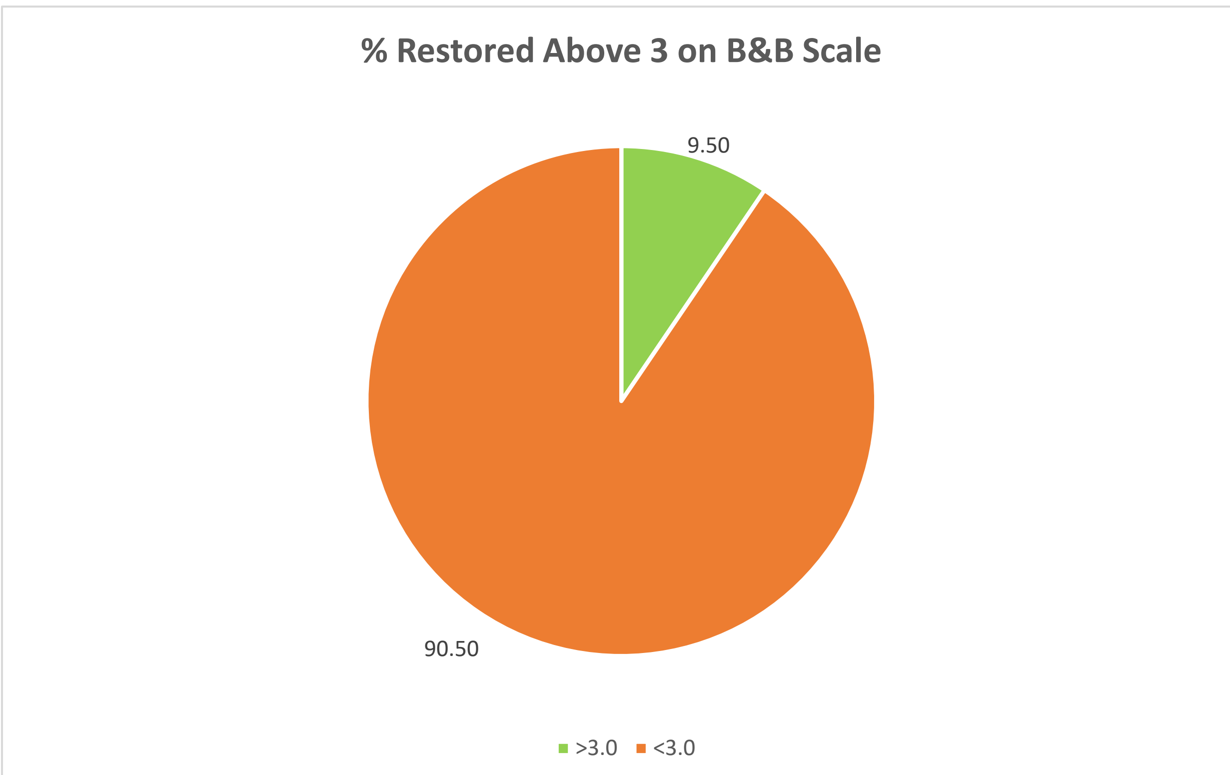


Figure 15: Percent of treated scars (out of 379) restored to an average B&B score of at least 3 at Year 1.

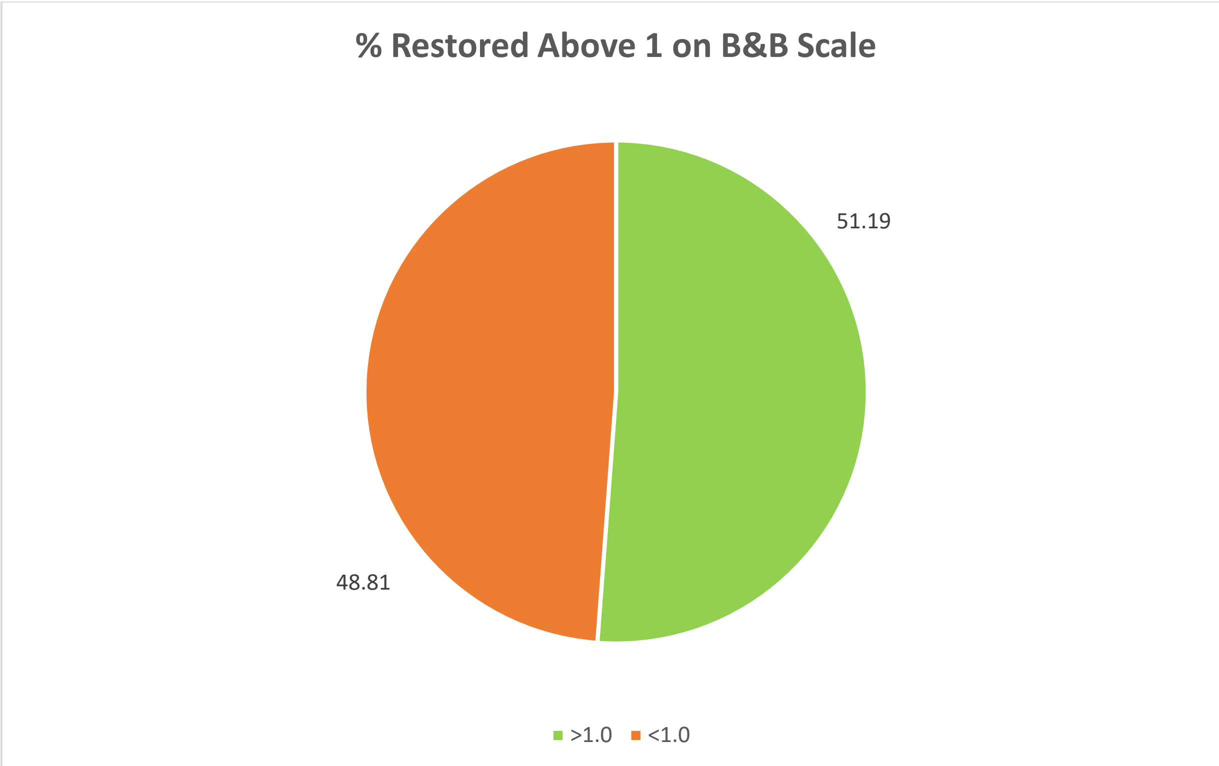


Figure 16: Percent of treated scars (out of 379) restored to an average B&B score of at least 1 at Year 1

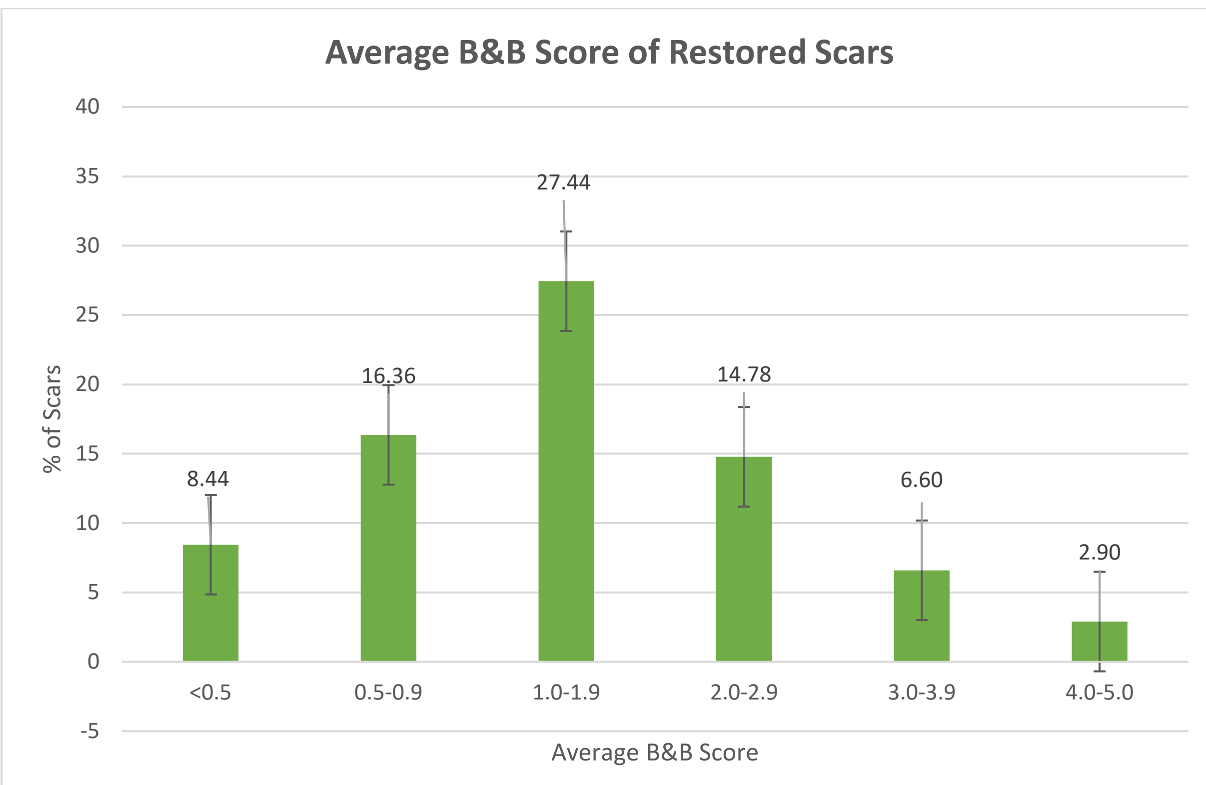


Figure 17: Distribution of the Average B&B Score of Restored Scars after one year, out of all 379 scars originally restored. Error bars represent the standard error.

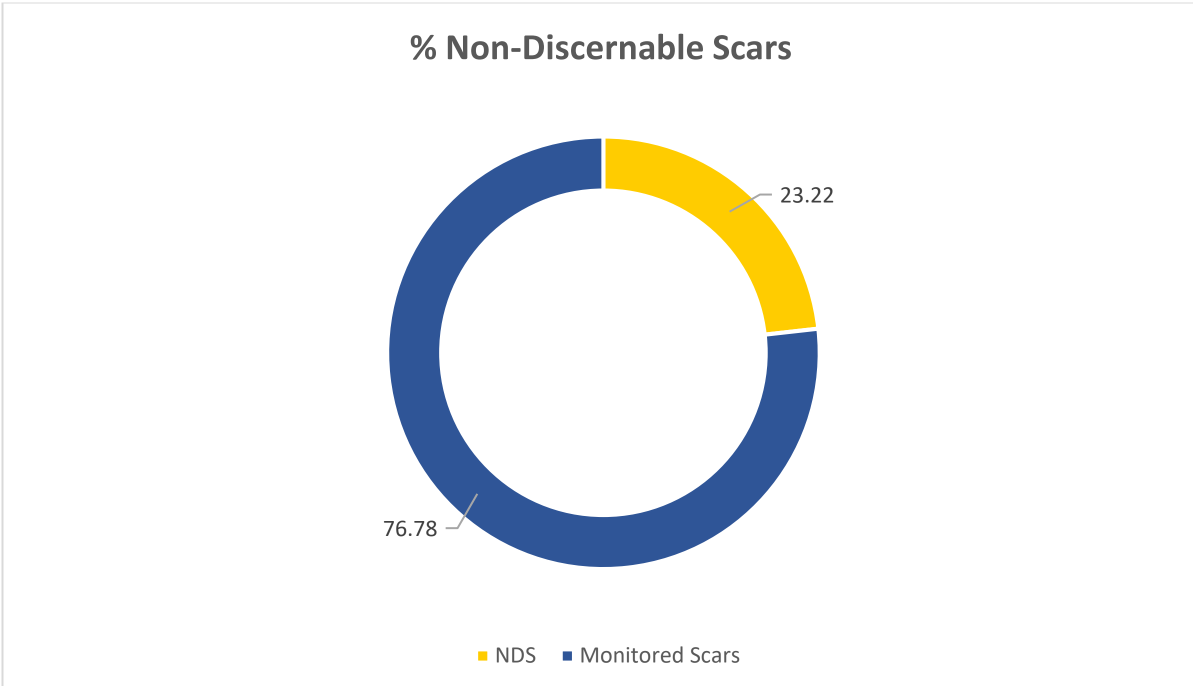


Figure 18: Percent of the 379 treated scars that were monitored vs. non-discernible.

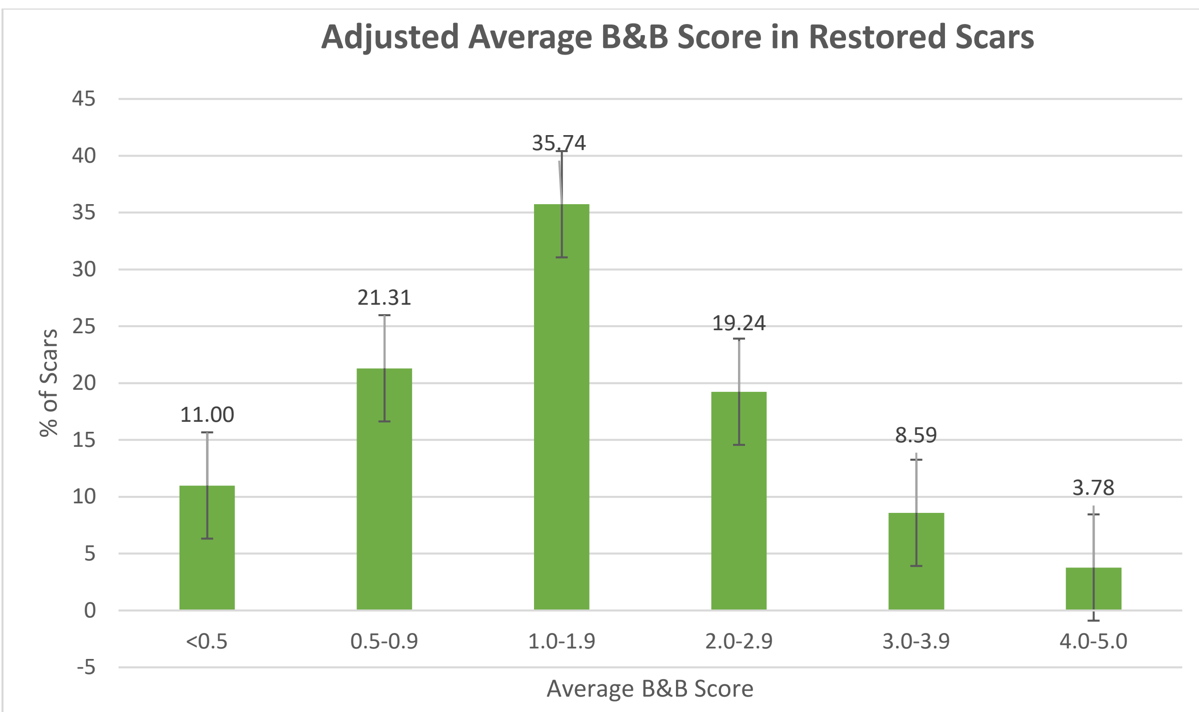
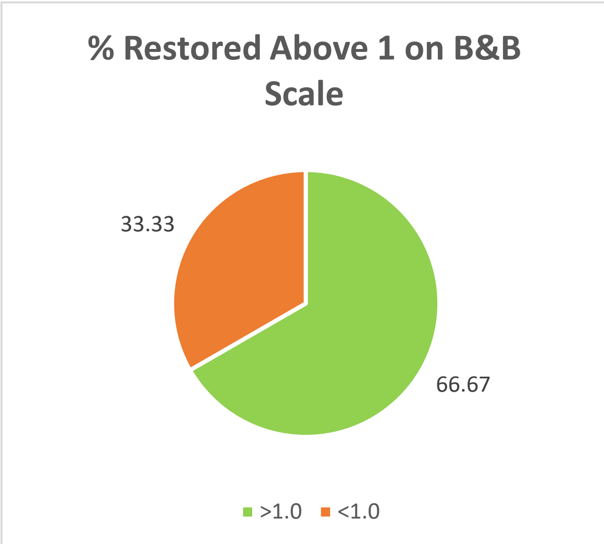


Figure 19: Distribution of the Adjusted Average B&B Score of Restored Scars after one year, of 291 monitored scars. Error bars represent the standard error.



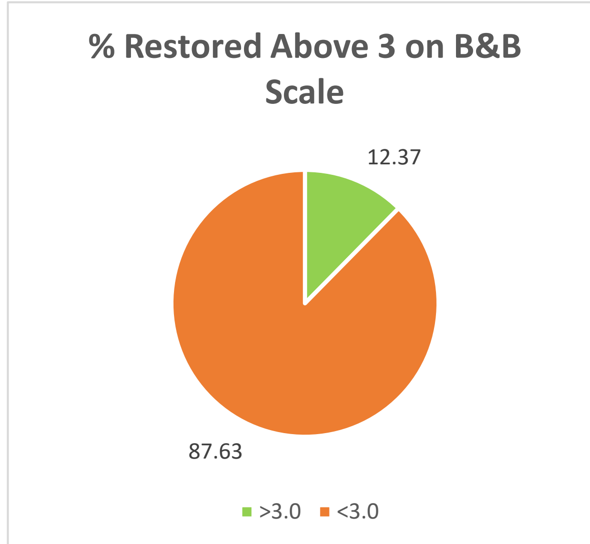


Figure 20 and **Figure 21**: Adjusted percent of monitored scars (291) restored to an average B&B score of at least 1 and 3, respectively, at Year 1

Discussion
Urchin grazing has been seen in several areas of restoration, including PSR 6, PSR 8, PSR 4, and PSR 11. PSR 6 was the most impacted by the urchin grazing, containing 63 of the 89 non-discernible scars documented. PSR 8 was the next most impacted area, with 21 of the non-discernible scars. In these areas, what once were extensive seagrass beds are now large expanses of mostly bare sand, likely due to urchin grazing. Large numbers of urchins are present in these areas, and the only seagrass that typically remains has been cut down to the sediment. Other factors that could contribute to this loss include water quality, sea turtle grazing, and human disturbance. If non-discernible scars are not included in the analysis, 12.41% of all scars monitored to date have been restored to an average B&B score of at least 3, which is 87.59% off of the goal to have 100% of restored scars at a B&B score of at least 3 by Year 2.

<u>Objective 3 - Installation of seagrass buoy system</u>
Buoys were removed in summer 2020 due to damage.

Discussion
The Shallow Seagrass Buoy System, comprised of 49 buoys marking shallow seagrass areas in the southern end of St. Joseph Bay (Figure 22), was completed in May 2016. In 2017, nine of the buoys installed were leaning and/or had been damaged and were replaced. Over the next few years, more damage occurred to the buoy system, and most of the buoys were either missing or damaged (Figure 23). Much of this damage was caused by boaters and Hurricane Michael in October 2018. Due to the extent of the damage, the system became a hazard to boaters and was removed in June 2020. As an alternative to the buoy system, efforts are now focused on increasing boater awareness of seagrasses through outreach, education, and signage. Some of these efforts include updates to existing signage where applicable, installation of educational signage, and provision of brochures about best practices for protecting seagrass habitats at popular boat ramps in St. Joseph Bay, Alligator Harbor, and St. Andrews Bay (Figure 24).

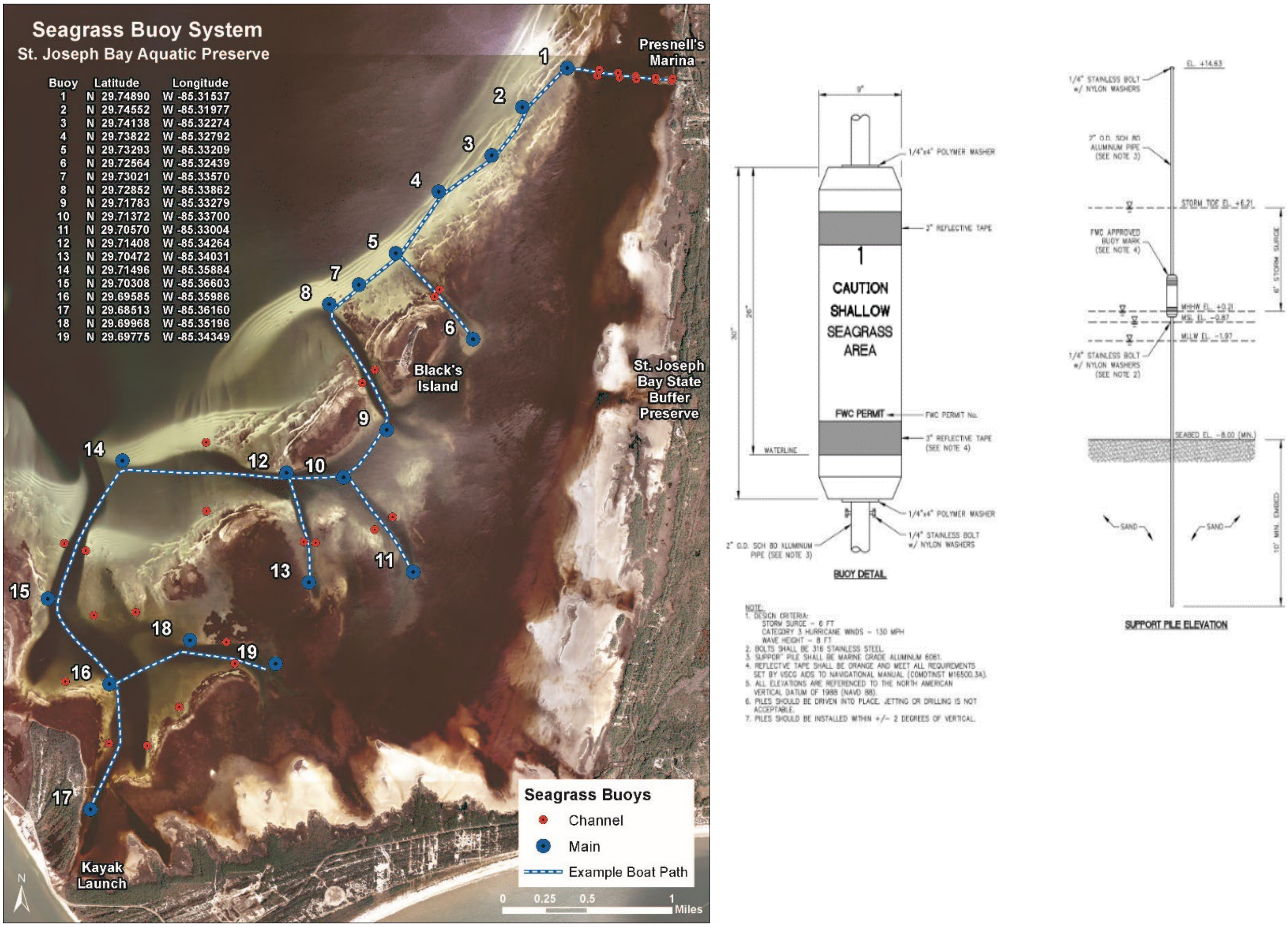


Figure 22. Schematic of buoys (Right) and map for the Shallow Seagrass Buoy system completed in 2016.

Figure 23. Examples of damaged and fallen seagrass buoys.

Figure 24. Shallow Seagrass Buoy System Kiosk (Left) and example of additional educational signage (R) to increase boater awareness of seagrasses.

<u>Objective 4 - Survival of seagrass planting units or transplants, if they are used.</u>
No seagrass has been planted or transplanted.

Discussion
If the project does not meet its performance criteria 18 to 24 months after restoration, and is deemed unsuccessful, seagrass planting units or transplants may be used to aid in meeting restoration goals. If plants are installed, survival of these units will be evaluated 30 to 90 days after planting.

References

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