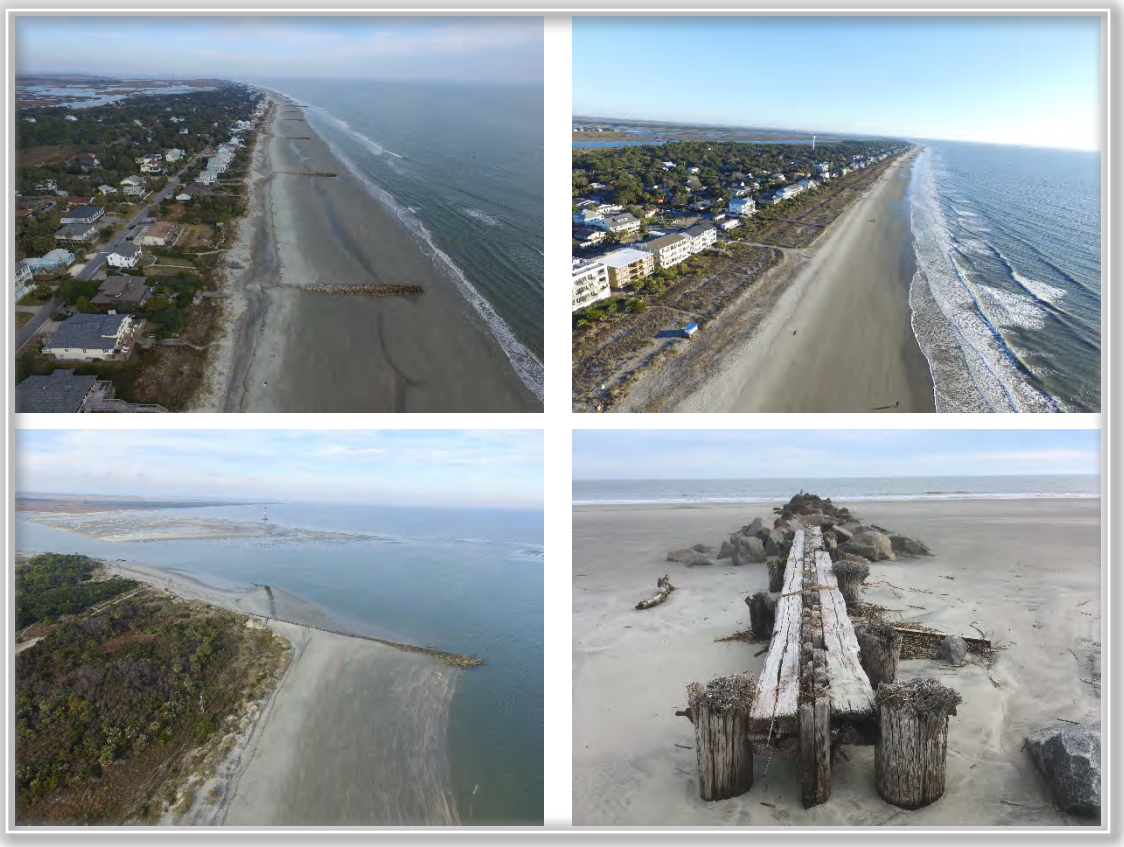
Folly Beach
Island-Wide Groin Rehabilitation Master Plan

City of Folly Beach, South Carolina



May 10, 2022

Prepared By:

ATM

A Geosyntec Company

Applied Technology & Management

www.appliedtm.com

Prepared For:

CITY OF FOLLY BEACH SOUTH CAROLINA

Contents

1.0 Introduction and Background

The City of Folly Beach Island-Wide Groin Rehabilitation Master Plan is intended to provide a decision-support tool with recommendations for planning, rehabilitation, and management of the existing groin structures along the island's beachfront shoreline. The Plan encompasses both City and Charleston County beachfront to ensure a comprehensive island-wide planning approach. Related historic background, current issues, and phased project plan details are included.

1.1 Motivation

The motivation for this Plan originates from the need for a comprehensive, island-wide planning approach to properly manage the fifty (50) existing groin structures and related issues. This need is realized in recommendations and issues identified in the City's long-term planning documents, including:

- Comprehensive Plan (2015) and 5-yr Update (2021)
    - *Since the 2015 Comp Plan the City has renovated nine existing groins between 8th Street West and the Washout. This project was completed in 2018 with a cost of approximately $3 million. The project has been successful in retaining sand and the City hopes to continue the work prior to or during the next renourishment cycle.*
- Local Comprehensive Beach Management Plan (LCBMP, 2021)
    - *Select [groin] rehabilitation projects can help to retain nourished material on the beach and extend the life of the federal nourishment projects. The City plans to apply for permits and set aside a portion of the beach preservation funds to rehabilitate additional groins in the future.*
- Strategic Plan 2021 Update
    - *EMERGENCY VEHICLE ACCESS OVER GROINS: This project has been carried over and work will be prioritized for 2021 per Council's directive.*
    - *CONSTRUCT GROINS PHASE 2: This item has is carried over. As a result, all budget projections have been pushed out by two years. We are proposing to move $150k into a reserve for professional services/hard costs related to getting the project started with a goal of construction during the 24/25 Fiscal Year.*
- Dune Management Plan (2018)
    - *Prior to the 2018 federal beach renourishment project, the City restored nine (9) deteriorated timber groins located between 8th St. E. and the Washout in an effort to retain nourished sand longer and restore the beach and dune system. Maintaining a dune northeast of the Washout has proven difficult due to high erosion rates.*

1.2 Context and Purpose

Groins act as shore perpendicular erosion control structures used to stabilize critical or vulnerable sections of the shoreline. They help to reduce volume requirements and frequency of nourishment projects, thus reducing future shoreline management costs. One of the most critical design requirements of a groin system is to stabilize the shoreline sufficiently while concurrently minimizing downdrift shoreline impacts.

Folly Beach currently has 50 groins along the entire oceanfront (Figure 1) with the groins in varying conditions. The majority of groins were constructed decades ago, and many are in need of rehabilitation or repair. Two major projects (constructed in 1993 and 2018) have rehabilitated a total of 18 groins along the central portion of Folly Beach and a terminal groin was constructed in 2013 on the western end of the island. While beach nourishment remains the City's and USACE's primary activity in establishing a robust storm buffer and healthy beach/dune system, groin structures along Folly Beach have proven effective in minimizing erosion and increasing the longevity of beach nourishments.

While beach nourishment remains the City's and USACE's primary activity in establishing a robust storm buffer and healthy beach/dune system, groin structures along Folly Beach have proven effective in minimizing erosion and increasing the longevity of beach nourishments.

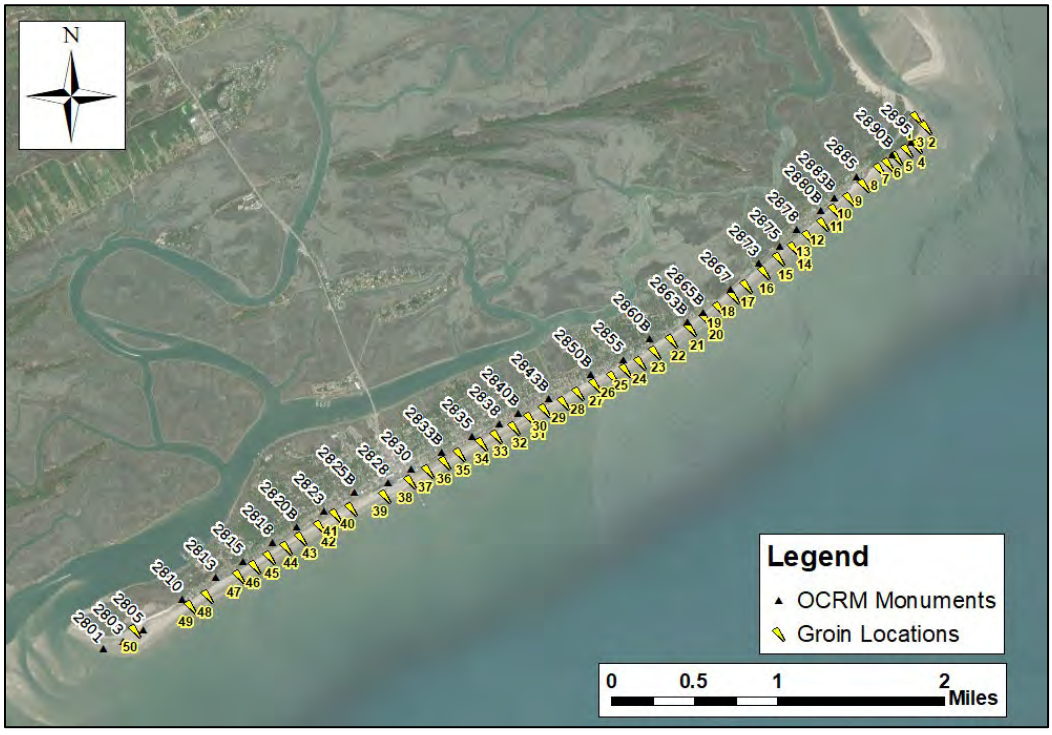


Figure 1. Overview of Folly Beach Groin Locations and Numbering. SCDHEC-OCRM Beach Survey Monument Stations also shown for reference.

Building upon the success of existing, recently rehabilitated, and constructed groins along Folly Beach, and in concert with other beach management activities, this document provides a master plan for future decision-making efforts related to the groin structures. The purpose of existing groins and any future groin projects along Folly Beach include:

- Reduce high erosion rates and sediment losses of ongoing nourishment projects;
- Stabilize the shoreline and maintain a healthy dry berm;
- Establish a more robust dune system;
- Increase opportunities for recreation, turtle nesting, and beach access through a maintained upper berm and dune system along the project shoreline; and
- Enhance the storm buffer for private and public infrastructure.

1.3 Groin History

The majority of Folly Beach's groins were originally constructed by the City of Folly Beach or the SC Department of Transportation (SCDOT) in the late 1940's, 1950's, or 1960's. Original construction typically used a combination of timber sheetpile and/or armor stone.

In 1993, nine groins between Center Street and 8th St. E. (groins #30 to #38) were rehabilitated by the USACE in conjunction with the federal nourishment project. New repaired structures were constructed along-side existing structure footprints using steel sheetpile with concrete cap and rock protection.

In 2013, a terminal groin (groin #50) was built at the west end of the island at Folly Beach County Park by the Charleston County Park and Recreation Commission with a concurrent local nourishment. Construction used sheetpile with concrete cap and rock protection.

In 2018, nine groins between 8th St. E. and the "Washout" (#21 - #29) were rehabilitated by the City in conjunction with the federal nourishment project. Construction rehabilitated the groins in their existing footprints, removing degraded timber elements, re-using existing stone, adding new stone, and grouting the rock mound structures using marine concrete. Note that some concrete cap repair also occurred for groins #30 to #38 in 2018.

Figure 2 on the next page illustrates the various types of groin construction found along the Folly Beach shoreline.

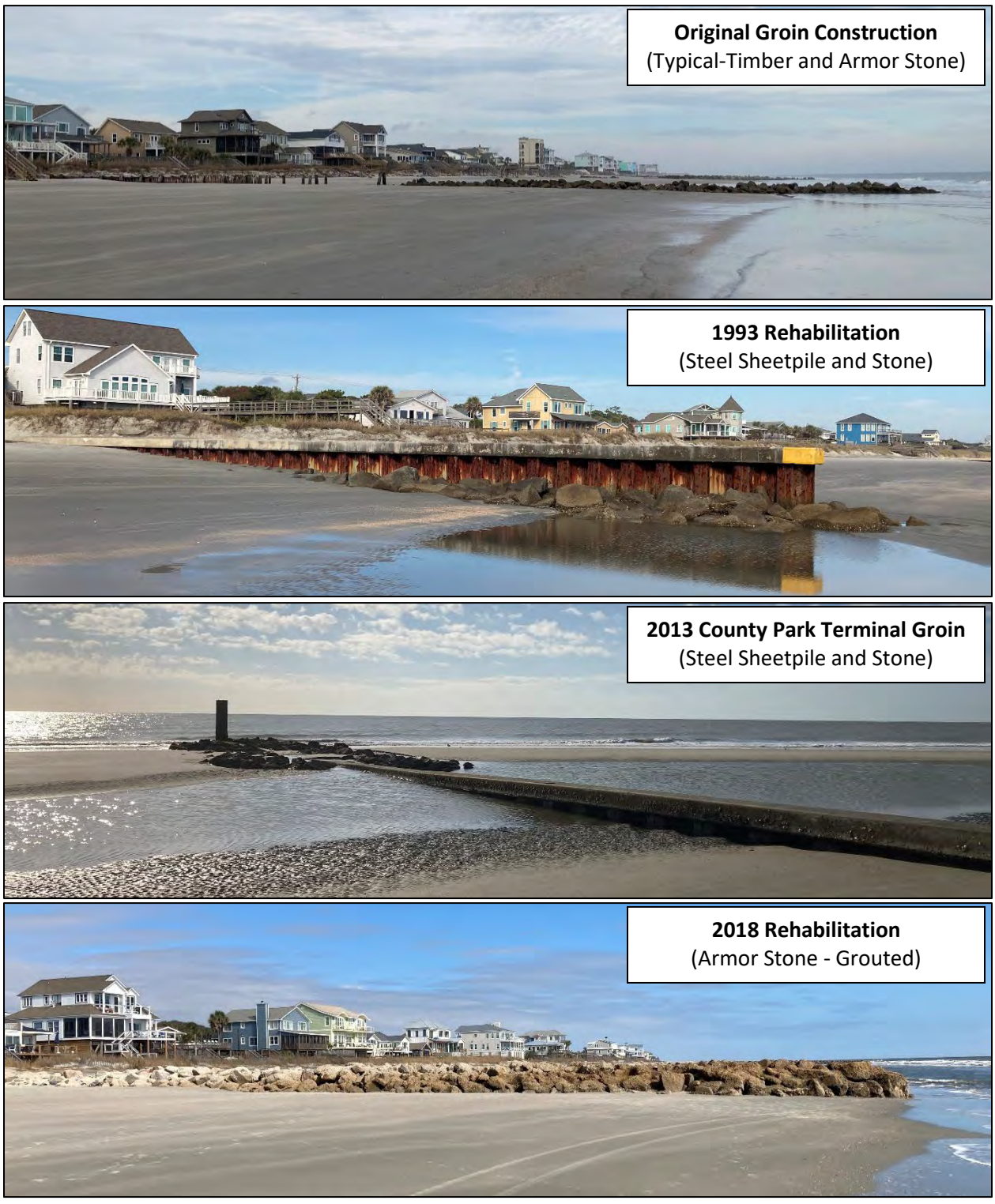


Figure 2. Groin Structure Types Found on Folly Beach

1.4 Ongoing and Related Efforts

Planning and execution of groin projects on Folly Beach must necessarily consider other relevant ongoing activities and planning efforts. The complexity of the beachfront and coastal system means that a variety of activities may impact one other. Such activities and planning efforts are listed below but is not considered inclusive.

The complexity of the beachfront and coastal system means that a variety of activities may impact one other.

- Folly Beach
  - Dune Management Plan
  - Local Comprehensive Beach Management Plan
  - Comprehensive Plan
  - Strategic Plan
  - Island-Wide Drainage Plan
  - Sea Level Rise Adaptation Plan and other resiliency measures
  - Marshfront Management Plan
  - Land Use, Zoning, and Building
  - Annual beach and groin monitoring activities
  - Public access and walkover improvement activities
  - Sea turtle nest monitoring and other wildlife studies/surveys (shorebirds, etc.)

- Charleston County
  - Folly Beach Pier activities
  - Five Year Plan
  - County Park and County-owned land activities

- SCDHEC-OCRM
  - Beach Monitoring

- USACE
  - Beach nourishment projects
  - Monitoring activities
  - Tracer Study
  - South Atlantic Coastal Study (SACS) Report
  - 50-yr Plan

- Sand fencing and vegetation planting activities (various entities)

- Private beachfront property owner (residential and commercial) activities

2.0 Existing Conditions and Groin Inventory

2.1 Coastal Setting and Beach Health

Beach health is a key metric in the prioritization of future groin rehabilitation projects and improved overall beach health is the primary goal of future activities. Folly Beach is an approximately 6-mile-long barrier island between Stono Inlet (to the southwest) and Lighthouse Inlet (to the northeast). Figure 3 presents a regional overview map showing the coastal setting of Folly Beach, located south of Morris Island and Charleston Harbor. The Charleston Harbor jetties were constructed to stabilize the federal navigation channel into Charleston Harbor and have played a large role in impacting the overall beach health and management strategies for Folly Beach. The natural flow of sand is blocked by the jetties causing a decreased supply of sand to Folly Beach which has led to chronic erosion.

As a result, both the City and federal government have made long-term commitments to beach nourishment and the City has relied on federal beach renourishment since the 1990s. The most recent of these nourishments occurred in 2018 in conjunction with the 2018 groin rehabilitation project between 8th and 14th St E (Groins #21 through 29).

Figure 3. Overview Coastal Setting Map of Folly Beach, Nearby Islands, and Charleston Harbor Jetties.

Several monitoring strategies are currently in place for routinely assessing beach health on Folly Beach. Monitoring is conducted periodically by SCDHEC-OCRM as well as by the City of Folly Beach. Coastal Carolina University has also been involved in beach monitoring along Folly Beach. The monitoring

is used to assess annual changes to monitor beach nourishment performance and overall beach health and is done following hurricanes and large storm events to quantify damage to the beach and dune system.

Thirty-one (31) permanent beach profile monuments have been installed by SCDHEC-OCRM along Folly Beach which are surveyed by OCRM and the City for analyzing changes to the beach over time. Figure 4 presents the monitoring profiles and the beach/shoreline zones, as designated by OCRM. The 2021 Folly Beach Local Comprehensive Beach Management Plan (LCBMP) provides a succinct overview of the general shoreline characteristics of Folly Beach based on OCRM's most recent analysis:

> *The Beachfront Management Act defines three shoreline zones. A standard zone is a segment of shoreline which is not directly influenced by an inlet or associated shoals. An unstabilized inlet zone is a segment of shoreline along or adjacent to a tidal inlet which is directly influenced by an inlet and its associated shoals and which is not stabilized by jetties, terminal groins, or other structures. A stabilized inlet erosion zone is a segment of shoreline along or adjacent to a tidal inlet which is directly influenced by the inlet and its associated shoals and which is stabilized by jetties, terminal groins, or other structures.*
>
> *All of the developed beachfront on Folly Beach is classified as a standard erosion zone. The northeast end of the island adjacent to Lighthouse Inlet is classified as a stabilized inlet zone. At the time of publication, the southwest end of the island at Folly Beach County Park was classified as an unstabilized inlet zone, however this area may stabilize due to the 2013 construction of a terminal groin in this location.*

Long-term average annual shoreline change rates from OCRM's monitoring of Folly Beach are summarized in the SCDHEC-OCRM Line Report (2019) and are provided in Table 1. Figure 4 presents the locations of the monitoring stations. In addition to OCRM data collection and analysis, the City performs annual monitoring and this analysis is also discussed in the following section.

Sediment transport is primarily caused by wave direction and alongshore currents. Annual net sediment transport on Folly Beach is predominantly from northeast to southwest for the majority of the island. Note that there are also seasonal changes in net sediment transport. For example, wind-and-wave events from the south predominate during the typical March through July timeframe. As a result, net sediment transport during this time is from southwest to northeast. Shoreline orientation also plays a role in sediment transport rates and direction The change in shoreline orientation from the washout area to Lighthouse inlet is minor however it can create measurable differences in net sediment transport rates and direction . Beach nourishment activies and groin design are based on sediment transport processes and to "work with nature" to the greatest extent possible.

> ...The central portions of Folly Beach are relatively more stable (less erosional) than the northeastern reach as well as near the inlets. The entire island is subject to chronic erosion with the northeast section (including the wash out) as the most critical present hot spot.

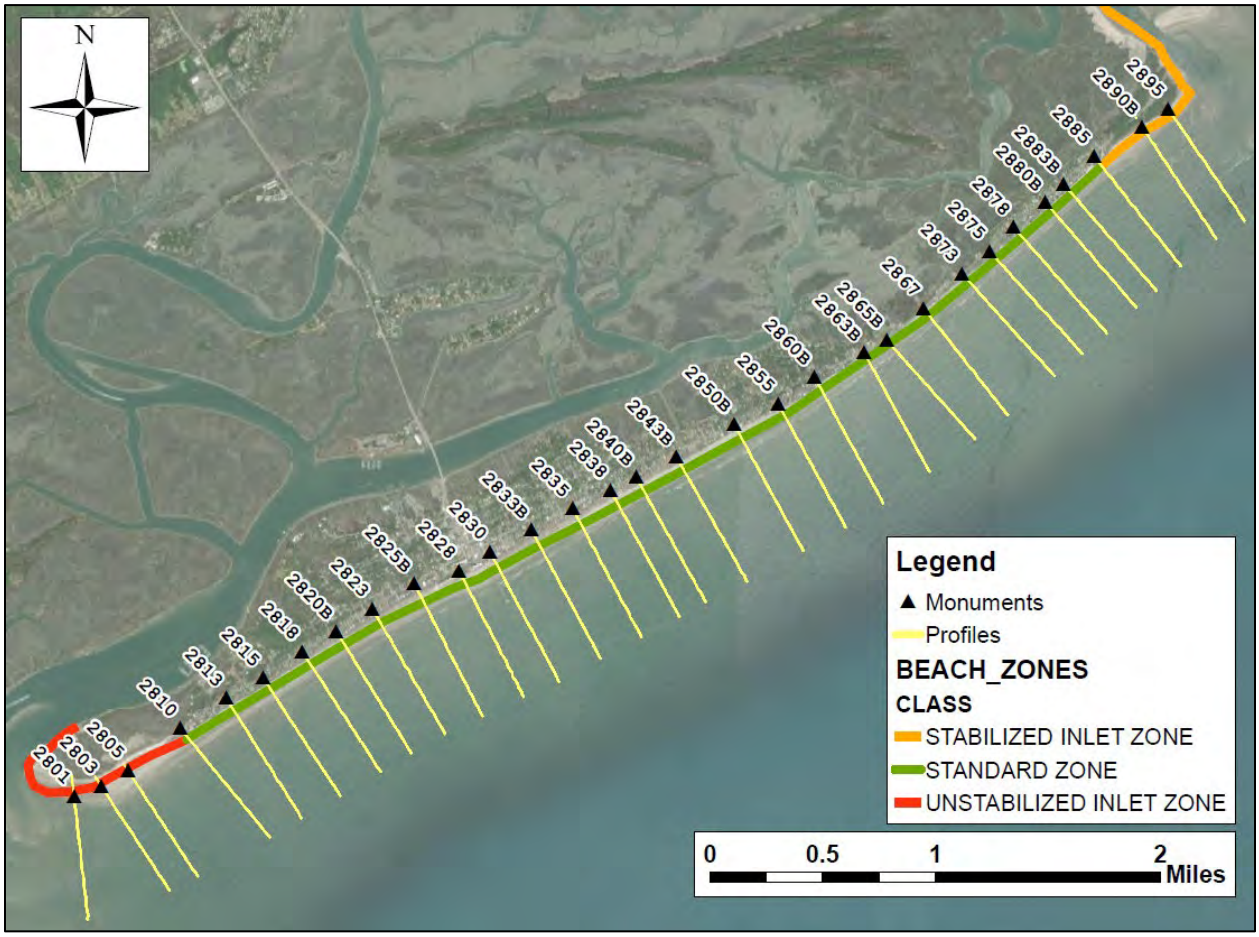


Figure 4. OCRM Monitoring Monuments and Profiles for Folly Beach and OCRM Shoreline Zone Classification – "BEACH ZONES".

Table 1. Folly Beach Average Annual Shoreline Change Rates (adapted from SCDHEC-OCRM Line Report, 2019)

Location Description (From Southwest to Northeast)	*Shoreline Change Rate (ft/year) **
From the parking lot at Folly Beach County Park north for 2,564 feet to 9th Street W.	-5.0
Transition north for 192 feet, then north for 4,854 feet to the Charleston Oceanfront Villas	-3.5
Transition north for 189 feet, then north for 2,815 feet to 3rd Street E.	-1.1
Transition north for 277 feet, then north for 4,186 feet	^
Transition north for 195 feet, then from 9th Street E. north for 8,496 feet	-1.5
Transition north for 194 feet, then north for 7,037 feet to the north end of Folly	^
Transition for 185 feet, then wrapping the north end of Folly for 1,215 feet	-4.0

* A negative number indicates erosion.
^ Indicates a shoreline change rate greater than -0.5 ft/year (indicative of a stable or accretional shoreline).

The most recent beach profile survey and assessment of beach conditions is documented in the Folly Beach 3-Yr Post-Nourishment Monitoring Report (Elko, 2021). This report analyzed the changes of the 2018 nourishment project and summarized the recent trends and overall beach conditions. The monitoring revealed that project upper berm widths now meet the threshold for renourishment, due to erosion over the past three years. Note that "upper berm widths" essentially refer to the upper beach system generally from the spring mean-high-water wrack line up to and including the dunes. The upper berm width provides critical storm buffering for the island.

The 2021 monitoring report documents a generally stable to accretional central and west beach over the past year, with the majority of erosion taking place northeast of the 2018 rehabilitated groin field. The 2018 rehabilitated groins are functioning as designed and are having a promising effect, as described in the Folly Beach monitoring report.

> *The most significant difference in the 2014 and 2018 renourishment performance is the effect of the rehabilitated groin field between 8th and 14th St. E. is functioning as designed and perhaps exceeding expectations. Previous monitoring reports have noted a transition zone between the erosional east end and the more stable central and west ends of the project area near 8th St. E. As a result of the groin field, between the 2018 renourishment and June 2021, this transition area appears to have shifted to The Washout.*

Similar to the 1993 project, the 2018 rehabilitated groins are helping to stabilize vulnerable sections of the shoreline and also aid to reduce the volume requirements and frequency of nourishment projects, thus reducing future shoreline management costs. Figure 5 visually compares beach health (measured by contour locations and established dune vegetation widths) of a shoreline that has benefited from the 1993 groin rehabilitation project (left) versus a shoreline along a poorly functional groin system (right). Note the wide healthy dune system and wider beach at the functional groin location (left) compared to that at a poorly functional groin location. This location was subsequently rehabilitated during the 2018 groin project.

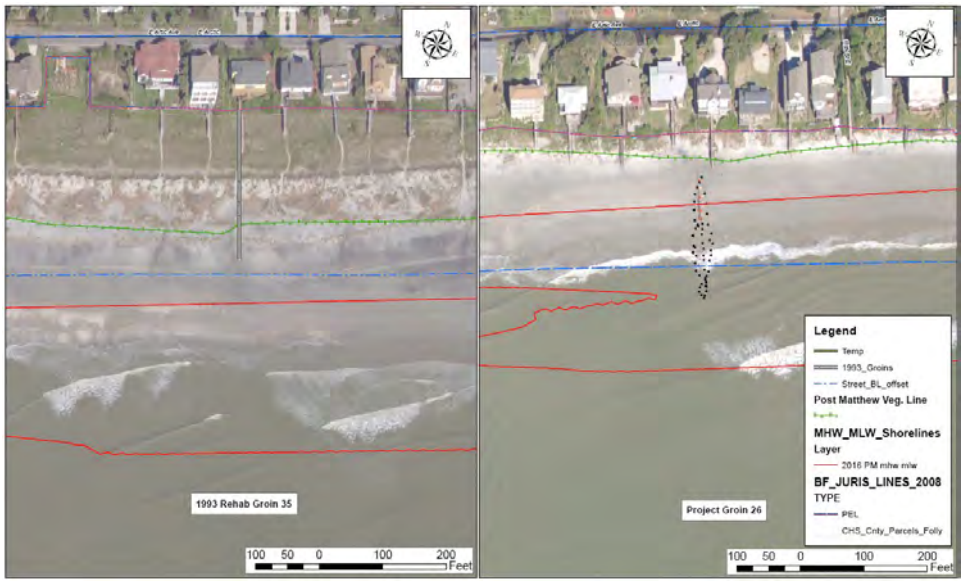


Figure 5. Comparison of beach health at functional (left) and poorly functional (right) groin systems. Note much healthier and wider dune system on the left image.

2.2 Groin Inventory and Conditions

Folly Beach currently has 50 groins along the entire oceanfront which are in varying conditions. The majority of these are timber and/or armor stone, with the exception of the more recently rehabilitated or constructed groins (refer to Section 1.3). Visual inspections were performed for all 50 groins during late 2021 to inventory and document the existing condition and functionality of each groin structure. The results of the inspection, including key measures and identifiers, are summarized in Table 2. Photographic documentation of each groin (ground level and drone aerial photographs obtained during December 2021 site visits) showing current conditions are included as Appendix A. In addition to identifiers, key measures include:

- Length - The approximate length based on the maximum of available documentation including: original/full-length from the LCBMP structural inventory, historic design documentation, previous assessments, and historical aerial imagery (specifically 1970s aerials, which show the exposed full-length, intact groins for the majority of Folly Beach).

- Functionality - The condition assessment was performed using both site ground and drone aerial observations and measurements of the existing groins. The "functionality" of each groin was categorized as "good", "marginal", or "poor" by visually assessing the exposed groin elements (rock, timber, sheetpile, concrete), measuring the exposed heights above grade, measuring the linear gaps between existing exposed sections along each groin (if/where gaps are present due to damaged and/or buried groin sections), to qualitatively evaluate the overall current functionality (i.e., to promote accretion and shoreline stabilization). Figure 6 presents photographs of representative groins of the three condition classification types to illustrate the differences.

- Vegetated Dune Width - The analysis also included assessing the dune and upper beach conditions to aid in groin rehabilitation phasing, prioritization, and decision-making. The vegetated dune widths shown in Table 2 represent an average value of vegetated dune widths measured at and in the vicinity of each groin location (generally to ~200 ft on each side) using the December 2021 drone aerial imagery and other recent available satellite imagery. This is similar to the "upper berm width" threshold metric used in annual monitoring reports.

The rehabilitated groins, including the 1993 groins, are in overall good condition (although some maintenance of these sheetpile structures will be required in the future). The original groins are in poor or marginal condition, with the majority being in poor condition.

The northeast shoreline (northeast of the 2018 rehabilitated groins) is characterized by marginal to poor functioning groins. Additionally, the majority of the shore parallel rock revetments located along this reach are also exposed and the dune system that Folly Beach critically relies on for storm buffering and for providing habitat to shorebirds and sea turtles is in poor to nonexistent condition in this area.

Many of the groins southwest of the 1993 rehabilitated groins are in poor condition and/or buried, however, these reaches generally exhibit a healthier dry upper beach and wider vegetated dunes providing more of a protective buffer to the upland compared with other more vulnerable areas.

Table 2. 2021 Groin Condition Assessment Overview

Groin_ID	*Approximate Street Address*	*Descriptor*	*~ Length (Feet)*	*Groin Condition / Functionality*	*Vegetated Dune Width (Feet)*
1	County Park East End	East End Groin (Rock and Timber)	230	Marginal	50
2	County Park East End		480	Marginal	50
3	County Park East End		700	Marginal	50
4	County Park East	Partially Buried Groins (Rock and/or Timber)	300	Marginal	60
5	County Park East		190	Poor	60
6	County Park East	Completely Buried Groins (Rock and/or Timber)	230	Poor	50
7	County Park East		210	Poor	50
8	County Park East	Partially Buried Groin (Rock and/or Timber)	260	Poor	70
9	1721 E Ashley Ave	Partially Buried Groins (Rock and/or Timber)	275	Poor	15
10	1702 E Ashley Ave		300	Marginal	20
11	1679 E Ashley Ave		305	Marginal	25
12	1663 E Ashley Ave		300	Marginal	50
13	1643 E Ashley Ave		310	Marginal	40
14	1621 E Ashley Ave		275	Marginal	20
15	1603 E Ashley Ave		290	Marginal	30
16	1583 E Ashley Ave		265	Poor	15
17	1563 E Ashley Ave		280	Poor	20
18	1803 E Ashley Ave		285	Poor	50
19	1522 E Ashley Ave		290	Poor	35
20	1506 E Ashley Ave		290	Poor	40
21	1409 E Ashley Ave	2018 Rehabilitated Groins (Rock and Grouted)	273	Good	90
22	1311 E Ashley Ave		304	Good	50
23	1215 E Arctic Ave		270	Good	25
24	12th St E Access		338	Good	60
25	1107 E Arctic Ave		243	Good	60
26	1015 E Arctic Ave		253	Good	55
27	921 E Arctic Ave		278	Good	75
28	901 E Arctic Ave		278	Good	80
29	804 E Arctic Ave		278	Good	70
30	711 E Arctic Ave	1993 Rehabilitated Groins (Sheetpile with Concrete Cap)	250	Good	85
31	617 E Arctic Ave		250	Good	115
32	6th St E Access		245	Good	120
33	505 E Arctic Ave		240	Good	125
34	411 E Arctic Ave		235	Good	150
35	311 E Arctic Ave		235	Good	190
36	221 E Arctic Ave		215	Good	185
37	2nd St E Access		200	Good	140
38	Pier (101 W Arctic Ave)	Completely Buried 1993 Groin (Sheetpile with Concrete Cap)	120	Good	0
39	201 W Arctic Ave (COV)	Completely Buried Groins (Rock and/or Timber)	175	Poor	25
40	313 W Ashley Ave		235	Poor	140
41	403 W Ashley Ave		240	Poor	150
42	5th St W Access		245	Poor	150
43	6th St W Access		190	Poor	120
44	615 W Ashley Ave	Partially Buried Groins (Rock and/or Timber)	210	Poor	110
45	713 W Ashley Ave		190	Poor	100
46	805 W Ashley Ave		220	Poor	100
47	9th St W Access		200	Poor	65
48	1011 W Ashley Ave		225	Poor	50
49	County Park West	Partially Buried Groin (Rock and/or Timber)	220	Poor	65
50	County Park West End	2013 West End Groin (Sheetpile with Concrete Cap)	740	Good	200

Figure 6. Folly Beach Existing Groin Condition Photographs. Representative poor, marginal, and good condition groins shown.

3.0 Master Planning Considerations

3.1 Stakeholders

Project stakeholders include individuals, groups, or entities that have an interest in Folly Beach groin or beach projects, the environment they take place in, or potential impacts to relevant interests. Consideration of interests, and if needed, pro-active engagement of these groups can result in improved project support, reduced objections, and scrutiny during permitting, potential funding sources/partnerships, and more. Anticipated key stakeholders for Folly Beach groin projects may include:

- City of Folly Beach
- Charleston County (and subordinated departments/agencies)
    - Charleston County Parks and Recreation Commission
- State of South Carolina (and subordinated departments/agencies)
    - SC Department of Parks, Recreation, and Tourism
- Local residents, particularly beachfront property owners
- Local business owners, particularly beachfront
- Regulatory authorities (USACE, SCDHEC-OCRM, etc.)
- SC Department of Transportation
- Environmental or Conservations Groups
- Other "beach enthusiast" groups such as sea turtle volunteers, surfers, or similar.

3.2 Regulatory

Regulatory review and approvals must be considered in planning efforts since the permit process can take long and unpredictable lengths of time. It is typical to assume nine (9) months or longer of regulatory review after submittal of the permit application prior to any approval decision. For Folly Beach, these permit processes will likely be separated from the required concurrent nourishment projects which requires additional coordination, review, and time. Key regulatory guidance, processes, and considerations are summarized below.

It is typical to assume nine (9) months or longer of regulatory review after submittal of the permit application prior to any approval decision.

- SCDHEC-OCRM – Critical Area Permitting
    - Under F, the Folly Beach Groins are considered Critical Areas and therefore regulated by SCDHEC-OCRM and require a Critical Area Permit (State portion of the JPA). According to R.30-15G, existing groins may be reconstructed, repaired, and maintained. Existing groins may be reconstructed only if there is an ongoing beach nourishment effort and meets additional criteria. The additional criteria include the institution of a minimum of 5-year monitoring program to determine erosion and accretion rates and reasonable demonstration that the reconstruction will not cause detrimental effect on adjacent or downdrift areas.

- USACE - Individual Permit
  - Regulatory review is required for the reconstruction of groins under regulation 33 CFR Part 323 which covers the requirements for discharges of dredged or fill material into waters of the United States.
  - Section 408 Review
    - In order to ensure that USACE civil works projects continue to provide their intended benefits to the public, Congress mandated that any use or alteration of a Civil Works project by another party is subject to the approval of USACE. This requirement was established in Section 14 of the Rivers and Harbors Act of 1899, which has since been amended several times and is codified at 33 USC 408 (Section 408).
    - Section 408 provides that USACE may grant permission for another party to alter a Civil Works project upon a determination that the alteration proposed will not be injurious to the public interest and will not impair the usefulness of the Civil Works project.
    - Folly Beach groin projects would fall under this review process because of the potential impacts the ongoing federal USACE nourishment program.

- Joint Permit Application
  - Approvals for future major rehabilitation projects of Folly Beach groins will likely require a full individual permit process, similar to the permitting process completed in 2018. The Joint Permit Application (JPA) is the individual permit application for approval from SCDHEC-OCRM and USACE. Federal projects that may include discharges to State waters may also require a Section 401 Water Quality Certification which is issued by the State (SCDHEC-WQM). The greatest concern for the regulators in regard to groin rehabilitation is downdrift impacts.

- Permit Special Requirements
  - Monitoring Program
    - The applicant shall institute a monitoring program for the life of the project to measure beach profiles along the groin area and adjacent and downdrift beach areas sufficient to determine erosion/accretion rates. For the first five years of the project, the monitoring program must include establishment of monuments, determination of annual volume and sand transport, and annual aerial photographs.
  - Downdrift Analysis and Beach History
    - Description of the beach history and demonstration that the groins will not have significant downdrift impacts.
  - Construction Window
    - Construction activities must occur outside of the Turtle Nesting Season which is May 1 – October 31 (although extensions can be requested with additional turtle monitoring requirements).
  - Concurrent Nourishment
    - Existing groins may be reconstructed only if there is an ongoing beach nourishment effort and meets additional criteria.

- Active Permits
  - There are two active permits for the rehabilitation of groins #21-#29. The active permits are SCHEC-OCRM permit #2017-00730 and USACE permit #SAC-2017-00730 which expire on February 16, 2023 and March 31, 2023, respectively. These permits were for the work completed in 2018 which included the addition of grouted armor to the nine specified groins within the footprint of the existing groins.

- Maintenance Activities
  - Maintenance activities are currently allowed with few requirements and the appropriate approvals from the agencies.
  - OCRM has a "Normal and Maintenance Repairs" exception where a critical area permit may not be required if the proposed activity is considered Normal Maintenance and Repair. Normal maintenance and repair applies only to work on a structure which has been previously permitted or is grand-fathered and still generally intact and functional in its present condition. The work may only extend to the original dimensions of the structure, and any expansion, additions, or major rebuilding will require either a Department permit or documentation to and written approval from the DHEC OCRM.
  - USACE Nationwide Permit #3 –Under 33 CFR 330.3 a Nationwide permit may apply for the repair, rehabilitation or replacement of any previously authorized, currently serviceable structure or fill. Maintenance does not include any modification that changes the character, scope, or size of the original fill design.
  - USACE does not require a permit for maintenance, including emergency reconstruction of recently damaged parts, of currently serviceable structures. Maintenance does not include any modification that changes the character, scope, or size of the original fill design. Emergency reconstruction must occur within a reasonable period of time after damage occurs in order to qualify for this exemption.
  - Some minor groin maintenance projects may fall under "maintenance activies" for simple regulatory approval, but most large-scale rehabilitation projects will likely require a full Joint Permit Application Process for an individual permit.

Some minor groin maintenance projects may fall under "maintenance activies" for simple regulatory approval, but most large-scale rehabilitation projects will likely require a full Joint Permit Application Process for an individual permit.

3.3 Current and Future Issues

Current beach management issues are documented in the 2021 LCBMP and relevant issues for this groin master plan are summarized below:

- *chronic beach erosion and the preservation of the beach system for storm protection, economic, and ecosystem benefits;*
- *dilapidated groins have become ineffective at holding sand and stabilization the shoreline and pose safety, operational, and potential environmental concerns;*
- *management and maintenance of sand dunes to balance needs for storm protection, ecosystem restoration;*
- *potential for septic systems to become exposed due to erosion of beachfront;*
- *historic and recent construction of erosion control structures (e.g., seawalls or revetements) on private property landward of the state jurisdictional line.*

Additional current and future issues include:

- Public access and walkover structures
    - Planning of future groin projects must consider locations of public access and may require closure, demolition, reconfiguration, or reconstruction of accesses and structures temporarily during construction or permanently after project completion. Permanent closure of public access is not considered acceptable and can be avoided.

- Emergency vehicle access
    - The ability for emergency vehicles to traverse the shoreline unimpeded by obstacles is critical for emergency and operational services.
    - Groin projects must include design elements to aid in vehicular access over or around the structures under varying conditions (such as healthy wide beach or after a storm on a severely eroded beach). The 2018 groin rehabilitation project included vehicular ramps integrated into the structures to address this issue.

- Sea Level Rise
    - Sea level rise, increased storm activity, and associated changes in coastal processes impacting the Folly Beach shoreline must be considered in the planning and design of future groin projects when practicable. Potential grant funding may also be available for resiliency related groin projects.

4.0 Plan Components and Alternatives

4.1 Reach Delineation

The oceanfront shoreline of Folly Beach can be divided into sections or "reaches" for the purposes of planning large-scale coastal projects. Generally, shoreline reaches are segmented based on key characteristics including:

- governing coastal processes (e.g., erosion rates, transport directions);
- type of shoreline;
- presence and condition of structures; and
- upland ownership, zoning, or development type.

Potential project reaches for Folly Beach groin master planning efforts were delineated using the above characteristics, as well as results from the groin condition and beach health assessment. Figure 7 shows the proposed reach delineations along the Folly Beach shoreline. These reaches can be considered individually or in groups for future groin rehabilitation projects. Note that Groins 1 through 3 at the northeastern end of Folly Beach (within Reach 1) may also be considered separately from the larger reaches as future needs dictate.

4.2 Design Alternatives

4.2.1 Groin Rehabilitation Design

Technical

The design of groin rehabilitation projects on Folly Beach could utilize a variety of materials already present along the beach. These include:

- timber sheetpile,
- steel sheetpile,
- armor stone,
- grouted armor stone, and
- combinations of the above.

Other materials and structural configurations are also possible, such as precast concrete elements or composite sheeptile.

The structures could be designed immediately alongside the existing groins they are replacing (similar to the 1993 groin rehabilitation), in completely new locations (such as the 2013 terminal groin), or constructed in the same footprint as the existing structures (similar to the 2018 groin rehabilitation).

Groin ID	Functionality	Vegetated Dune Width (ft)
1	Marginal	50
2	Marginal	50
3	Marginal	50
4	Marginal	60
5	Poor	60
6	Poor	50
7	Poor	50
8	Poor	70
9	Poor	15
10	Marginal	20
11	Marginal	25
12	Marginal	50
13	Marginal	40
14	Marginal	20
15	Marginal	30
16	Poor	15
17	Poor	20
18	Poor	50
19	Poor	35
20	Poor	40
21	Good	90
22	Good	50
23	Good	25
24	Good	60
25	Good	60
26	Good	55
27	Good	75
28	Good	80
29	Good	70
30	Good	85
31	Good	115
32	Good	120
33	Good	125
34	Good	150
35	Good	190
36	Good	185
37	Good	140
38	Good	0
39	Poor	25
40	Poor	140
41	Poor	150
42	Poor	150
43	Poor	120
44	Poor	110
45	Poor	100
46	Poor	100
47	Poor	65
48	Poor	50
49	Poor	65
50	Good	200

Figure 7. Folly Beach Groin Master Planning Reach Delineation

Regulatory

Regulations and regulators place restrictions and preferences on design, construction, and locations of new (or rehabilitated groins). Generally, they indicate that maintenance or rehabilitation of existing structures:

- must remain within the footprint (location and extents) of the existing structures, and
- must utilize similar materials as the existing structures.

Preferred

Folly Beach representatives indicated that the preferred design is that used in the 2018 groin rehabilitation project and included:

- rehabilitation of groin structures within their existing footprint,
- use of grouted armor stone materials, and
- inclusion of vehicular access ramps.

The above approach has proven technically and operationally effective and agreeable to regulatory agencies.

4.3 Phasing and Priorization

Based on the current conditions and anticipated performance of existing and future projects, Table 3 presents a potential phasing and prioritation for planning purposes. Note that groin rehabilitation projects will coincide with Corps nourishment efforts as groins still require nourishment sand to work effectively and to minimize any potential downdrift impacts. Groins #9 to #20 are proposed for the next rehabilitation phase. Note that the proposed long-term phasing and prioritization matrix can be adapted/adjusted based on future conditions.

Groins #1 to #3 are adjacent to Lighthouse Creek and can be considered one structure (with two "spur" features). These groins are on County property (Lighthouse Creek Heritage Preserve) and are a critical feature in stabilizing the inlet shoreline. These groins are also critical in stabilizing the oceanfront shoreline in this area. Some sand bypassing from Morris Island has improved this shoreline area however sand contributions via natural bypassing from Morris Island are expected to decline in the future. Groins #1 to #3 are high priority due to the importance of their location.

Groins #4 to #8 are also on the County's Lighthouse Creek Heritage Preserve and are generally in poor condition. These groins are deemed lower priority as there is little upland infrastructure including structures along this reach of shoreline.

Groins #9 to #20 are the next proposed rehabilitation phase and this reach stretches from the washout to the east end (adjacent to County property).

Groins #21 to #29 were rehabilitated in 2018 and in good condition while the upper beach is also in much healthier conditions. Downdrift monitoring also shows no detrimental effects. Downdrift refers to the shoreline to the west (i.e., groins #30 to #38 and higher).

Groins #30 to #38 are the 1993 steel sheetpile structures. The steel has rusted and these groins are almost 30 years old and will require some maintenance in the future. Epoxy coating of the sheetpile can be applied and/or additional rock (armor stone) can be added to these groins.

Groin #39 is just west of the pier and currently buried. Groins west of here (#40 to #49) are generally buried or in poor condition however beach health is generally good along this stretch of shoreline. Buried groins are typically considered as "not working" as alongshore sand transport is unaffected by their presence. Beach monitoring will continue in this area and these groins may be re-prioritized based on future conditions.

Groin #50 is the terminal groin at the County park which was constructed in 2013. Negligible maintenance will be required for this groin over the next ~20 years.

Table 3. Master Plan Groin Project Phasing and Prioritization

Phasing and Prioritization					
Priority	**Timeframe**	**Project Type**	**Location**	**Groins Affected**	**Notes**
Major Projects					
High	1 to 3 yrs.	Rehabilitation	Reach 2	9 - 20	Washout to east end (before County park)
Moderate	3 to 5 yrs.	Rehabilitation	Reach 1 (Partial)	1 - 3	Groins at Lighthouse Inlet
Low	5 to 10 yrs.	Rehabilitation	Reach 1 (Partial)	4-8	County preserve on east end
Future	10+ yrs.	Rehabilitation	Reach 5	39	Just west of pier
Future	10+ yrs.	Rehabilitation	Reach 6	40 - 48	West of pier
Future	10+ yrs.	Rehabilitation	Reach 7 (Partial)	49	Limit of County Park
Maintenance					
Moderate	3 to 5 yrs.	Maintenance	Reach 4	30 - 38	Steel Sheetpile Coating
Low	5 to 10 yrs.	Maintenance	Reach 4	30 - 38	Concrete Cap Repairs
Low	5 to 10 yrs.	Maintenance	Reach 4	50	Concrete Cap Repairs (County Park terminal groin)
Future	10+ yrs.	Maintenance	Reach 7 (Partial)	50	Sheetpile Coating (County Park terminal groin)

Maintence of groins not previously rehabilited or recently construction is not anticipated.

4.4 Probable Cost Estimates

Probable cost estimates were developed for the high priority project identified above (groins #9 to #20) and consists of twelve (12) structures. This cost is based upon estimated quantities, review of 2018 bidding and construction cost data, estimated unit pricing and percentage increases from local contractors experienced with this type of construction, regional available project bid data, and engineering judgement. Future groin rehabilitation project estimation can utilize similar values with updated quantities and adjusted for inflation of by a minimum of 3% per year. ATM recently contacted several groin construction contractors to confirm more recent cost estimates. The twelve groin structures represent 3,465 feet in total length (linear feet, LF). Note that the Year of Project is dependent on the timing of the federal beach renourishment project, tentatively scheduled for 2024.

Probable Construction Cost Estimate					
Year of Project	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
2024	**Phase 1 - Groin Rahibilitation (Reach 2, Groins 9 - 20)**				
	General Conditions	1	LS	$ 590,000	$ 590,000
	Groin Structure Rehabilation	3465	LF	$ 1,805	$ 6,255,692
				Contingency (10%)	*$ 684,569*
				Total	**$ 7,530,261**

Maintence Effort Probable Costs

Concrete Cap Repair: Cost Estimate (2022 USD) $300/LF

Steel Sheetpile Recoating: Cost Estimate (2022 USD) $90/SF

5.0 References

Elko and Braud, 2018. City of Folly Beach Dune Management plan.

Elko Coastal Consulting, Inc., 2021. Folly Beach 3-Yr Post-Nourishment Monitoring Report.

Elko Coastal Consulting, Inc., 2021. Local Comprehensive Beachfront Management Plan (LCBMP).

City of Folly Beach, 2021. 2021 Strategic Plan. Resolution 08-21.

Folly Beach City Council, 2015. City of Folly Beach Comprehensive Plan.

Folly Beach City Council, 2021. City of Folly Beach Comprehensive Plan (Five Year Update).

Rivers and Harbors Act Section 10, 1899. 33 Code of Federal Regulations Part § 322. USACE Nationwide Permit Authorization.

South Carolina Coastal Zone Management Act, S.C. Code Ann. § 48–39–10, et seq., 1997. Chapter 30 Department of Health and Environmental Control – Coastal Division.

South Carolina Department of Environmental Control – Office of Ocean and Coastal Resource Management (SCDHEC-OCRM), 2017. Critical Area Permit & Coastal Zone Consistency Certification. City of Folly Beach. Permit Number 2017-00730. Issued February 16, 2018.

SCDHEC-OCRM, 2019. Line Report: Proposed Setback Line Folly Beach. Published October 6, 2017. Revised December 18, 2019.

United States Army Corps of Engineers (USACE), 2017. Department of the Army Individual Permit. City of Folly Beach. Permit Number SAC-2017-00730. Issued March 9, 2018.

United States EPA. Clean Water Act Section 404, 1977. 33 Code of Federal Regulations Part § 323. Requirements for Discharges of Dredged or Fill Material into Waters of the United States.

Appendix A – Groin Conditions Photo Log

Groin 1

Groin 1

Groin 2

Groin 2

Groin 3

Groin 3

Groin 4

Groin 4

Groin 5

Groin 5

Groin 6 (Buried)

Groin 6 (Buried)

Groin 7 (Buried)

Groin 7 (Buried)

Groin 8 (Buried)

Groin 8 (Buried)

Groin 9

Groin 9

Groin 10

Groin 10

Groin 11

Groin 11

Groin 12

Groin 12

Groin 13

Groin 13

Groin 14

Groin 14

Groin 15

Groin 15

Groin 16

Groin 16

Groin 17

Groin 17

Groin 18

Groin 18

Groin 19

Groin 19

Groin 20

Groin 20

Groin 21

Groin 21

Groin 22

Groin 22

Groin 23

Groin 23

Groin 24

Groin 24

Groin 25

Groin 25

Groin 26

Groin 26

Groin 27

Groin 27

Groin 28

Groin 28

Groin 29

Groin 29

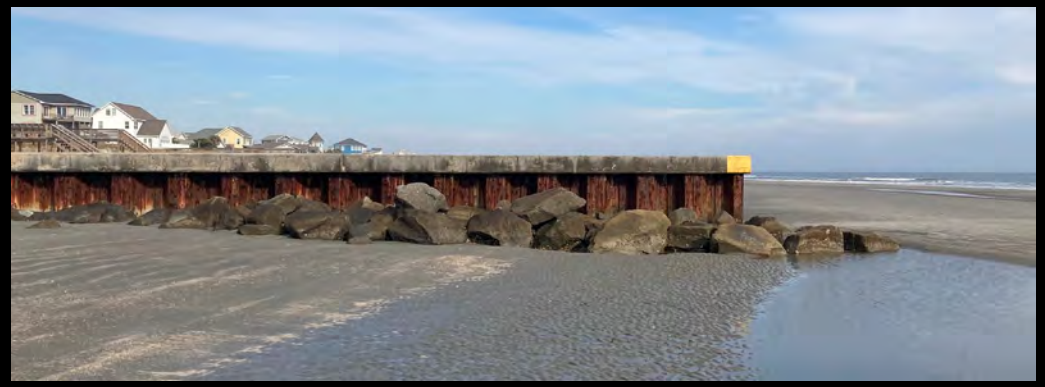
Groin 30

Groin 30

Groin 31

Groin 31

Groin 32



Groin 32

Groin 33

Groin 33

Groin 34

Groin 34

Groin 35

Groin 35

Groin 36

Groin 36

Groin 37

Groin 37

Groin 38 (Buried)

Groin 38 (Buried)

Groin 39 (Buried)

Groin 39 (Buried)

Groin 40 (Buried)

Groin 40 (Buried)

Groin 41 (Buried)

Groin 41 (Buried)

Groin 42 (Buried)

Groin 43 (Buried)

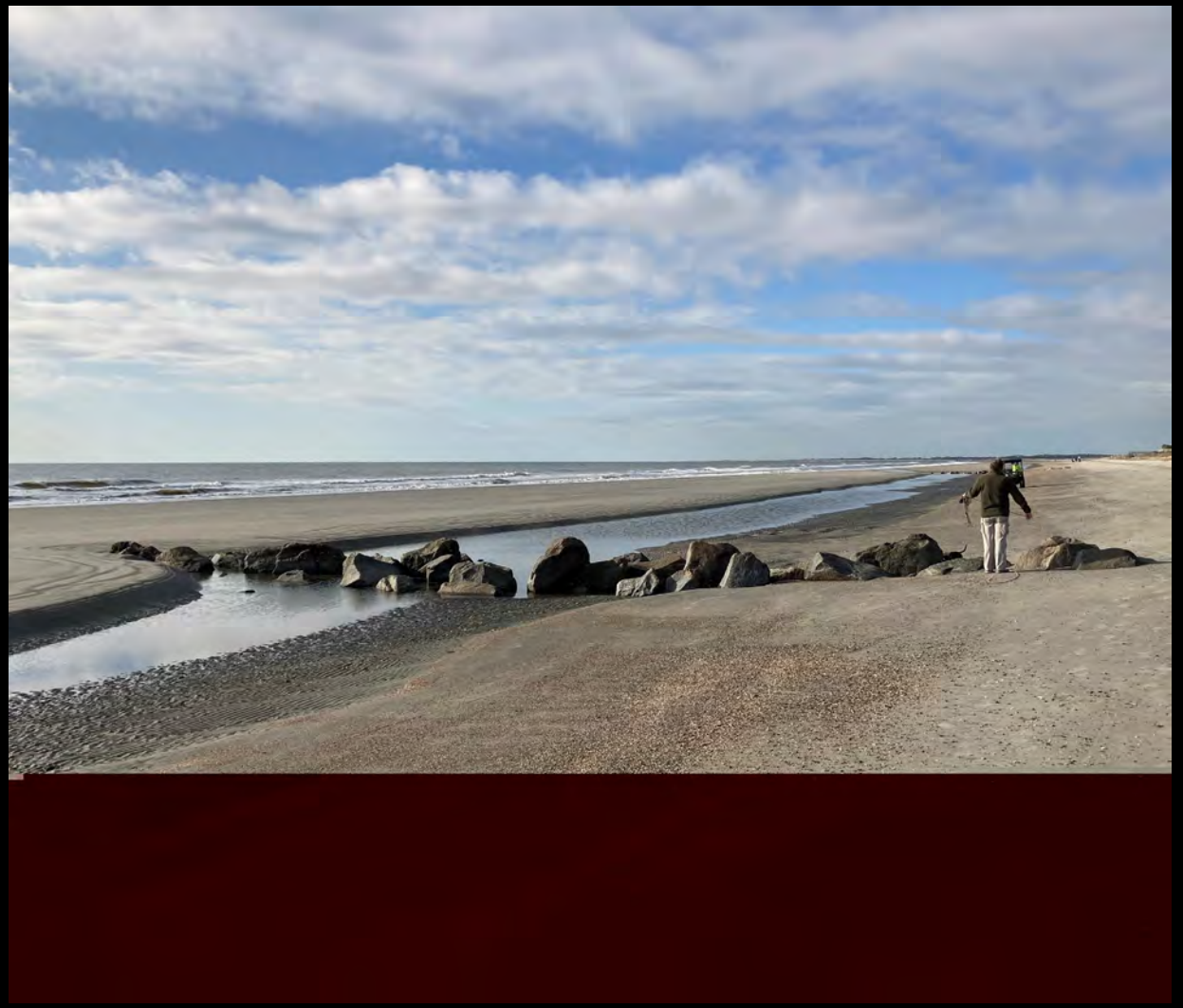
Groin 44 (Buried)

Groin 44 (Buried)

Groin 45

Groin 45

Groin 46



Groin 46

Groin 47

Groin 47

Groin 48

Groin 48

Groin 49

Groin 49

Groin 50

Groin 50