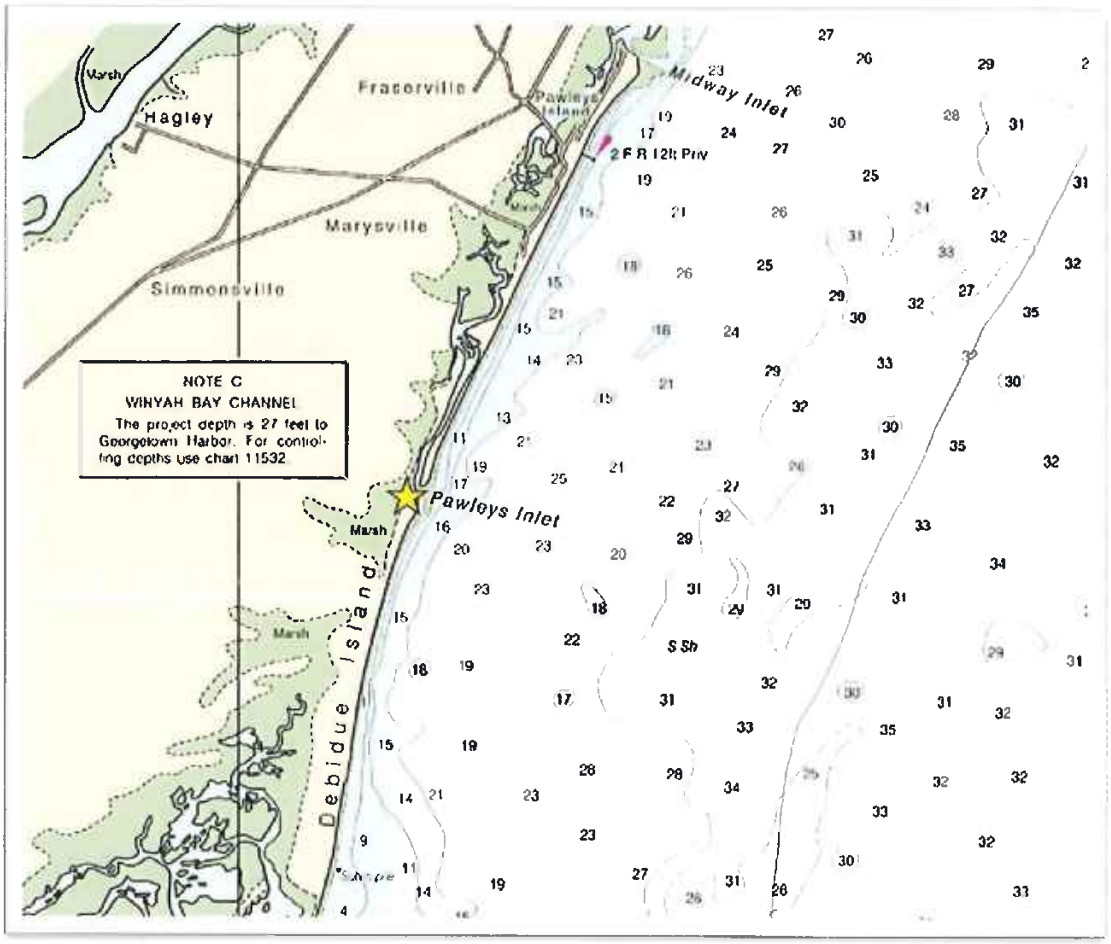
EXHIBIT A

Pawleys Inlet Migration and Erosion Impacts – Preliminary Assessment

Prince George Community Shoreline

Georgetown County, South Carolina



May 2022

ATM
A Geosyntec Company
Applied Technology & Management
www.appliedtm.com

Executive Summary: It is my professional opinion that the rapidly accelerated erosion on the northern end of Prince George is being caused by the recent Pawleys Island nourishment.

1.0 Introduction and Background

Applied Technology and Management (ATM) has completed an assessment of the ongoing southern migration of Pawleys Inlet its associated erosion impacts in Georgetown County, South Carolina. The recent 2019/2020 Pawleys Island beach nourishment has dramatically increased the rate of southerly migration of the inlet which has exacerbated erosion on the northern end of Debidue Island along the Prince George Community shoreline. This observed pattern of increased inlet migration and accelerated erosion is already significantly affecting the northern Debidue Island shoreline and will continue to negatively impact several oceanfront lots in the Prince George Community neighborhood (see Figure 1). Roadways, utility lines, and other infrastructure are also at risk.

ATM's assessment included a compilation and review of recent and historic aerials and shoreline information, and a site reconnaissance of existing conditions. Relevant previous studies related to Pawleys Inlet and nourishment project information were also reviewed.

Figure 1. March 17, 2022 Oblique Aerial Imagery of Pawleys Inlet and Erosion along Study Area Shoreline along north end of Debidue Island (outlined in red)

2.0 Project Setting

Pawleys Inlet is an unstabilized inlet that separates Debidue Island, to the south, from Pawleys Island, to the north. Figure 2 presents an overview of the study area. The focus area for this assessment is on the affected shoreline along the backside of the inlet and the northern end of Debidue Island, within the Prince George Community neighborhood.

Figure 2. Study Area and Surrounding Features Overview (April 2021 Aerial Imagery).

3.0 Long-Term Movement and Recent History Overview

Pawleys Inlet has migrated over the years within a well-defined range. As with most migrating inlets in the region, the inlet can naturally migrate south and then relocate north with a natural breach of Pawleys spit. While natural breaches of Pawleys spit occurred prior to the nourishment project, the nourishment project has fortified the spit where a breach (and relocation of the inlet to a more favorable location) is highly unlikely. The nourishment has also significantly increased the size and southern growth/migration of Pawleys spit. Additionally, there is little to no vegetation on the spit to help stabilize the sand, making for an immensely variable coastal shoreline feature.

The recent Pawleys Island nourishment placed over 1.1 million cubic yards of sand and net sediment transport in the area is to the south. Therefore, the majority of this newly placed sand is spreading south and increasing the southern migration of Pawleys Inlet which in turn has caused unprecedented erosion along the Prince George shoreline. The inlet is currently well south of the 100-year range of locations.

The recent nourishment was 5x larger than any other nourishment on Pawleys Island in history. This newly introduced material represents a shock to the littoral system. The project area is still equilibrating to this huge influx of sand and this effect should last several more years.

4.0 Inlet Migration – Timeline

Pawleys Inlet has a well-documented history of inlet migration. In general, the inlet migrates south until a breach of Pawleys spit occurs. Once a breach occurs, the inlet is naturally relocated to a more northern location. Aerial imagery showing progression of the inlet dating back to 1977 are provided in Appendix A. A 2010 inlet management zone technical report from Coastal Science and Engineering (CSE) is provided in Appendix B. The CSE report describes the inlet migration of Pawleys Inlet in great detail over ~140 years. CSE studied numerous available aerials and charts dating back to 1872 and found that Pawleys Inlet moves south at ~20 to 40 feet per year over the long-term.

4.1 ~2000 to 2018 (Pre-Nourishment) Conditions

The USACE began studying a Coastal Storm Damage Reduction (CSDR) project for Pawleys Island over 20 years ago and published a 2004 report for Pawleys Island:

> *USACE. 2004. Feasibility report for hurricane and storm damage reduction at Pawleys Island, South Carolina. USACE, Charleston District, South Carolina, PW/ 010606, 55 pp + appendices A-I.*

This report was for a USACE-sponsored nourishment for ~666,400 cy. At the time, this represented a substantial unit fill quantity where approximately 85 cubic yards would be placed per linear foot of shoreline. The previous 1998 project placed approximately 20 cy per linear foot. The USACE recommended plan was optimized around a 9-year periodic nourishment cycle through the 50-year period

of analysis. In comparison to the recent 2020 nourishment, the USACE recommended volume is about half the size of the recently placed sand and over 5 times larger than the 1998 nourishment project.

Besides the large project volume proposed by the USACE, a small terminal groin structure was included on the southern end of the island to reduce sand losses/migration to the south (towards Pawleys Inlet). An excerpt from the USACE report is shown below.

> issues associated with this part of the study area offset this constraint. The existing erosion rate specific to the length of the southern spit below existing groin no. 1 is high enough to justify some means of structural protection to provide stability for the south end parking lot and the length of beach immediately seaward of the parking lot. Although not in the Federal interest due to CBRA restrictions, a short groin structure no longer in length than the existing groins would serve to provide this stability and, at the same time, allow for continued downdrift movement of material through Pawleys Inlet.

Figure 3: Excerpt from the USACE Pawleys Island Report noting that southerly sand transport is to be expected.

The USACE experienced delays and other red-tape in fully funding the construction of this project and the Town of Pawleys Island chose a non-USACE project option that was primarily town funded (note that the non-USACE project qualifies as a FEMA "engineered beach" mitigation following any upcoming major storms).

Following the issuance of the 2004 report, the southern portion of Pawleys Island continued to suffer from relatively severe erosion. As seen in the 2006 OCRM State of the Beaches document:

> *"The dune that protects the public parking area has been chronically eroded for the past few years and has been rebuilt several times by emergency sand-scraping. This large public parking area, one of the few areas providing good public beach access in Georgetown County, is in jeopardy."*

In approximately 2008, Georgetown County made the decision to assess this terminal groin idea independently of the USACE. One major reason for this assessment was that the dune fronting the parking lot on the southern end of Pawleys Island was eroding rapidly and affecting the use of the public parking area.

ATM was subsequently contracted by Georgetown County on a small terminal groin assessment at the southern edge of the Pawleys Island public parking lot. Following the assessment, permitting was pursued. A required element of groin projects in South Carolina is a downdrift impact assessment. Downdrift of the groin project is to the south (based on net sediment transport). This downdrift impact assessment included Pawleys spit, Pawleys Inlet, and the Prince George shoreline south of Pawleys Inlet. Development of a downdrift post-project monitoring program was also required for the groin and nourishment project. Overall, the small groin and nourishment system was shown to have negligible impacts on the Prince George shoreline however Prince George did reach out to CSE for an independent review of the terminal groin project as well as a general overview of the migration of Pawleys Inlet.

CSE developed a few letters and reports on their independent downdrift impact including the 2010 report included in Appendix B titled:

CSE 2010. Historical Changes to Pawleys Inlet and a Conceptual Plan for an Inlet Management Zone, Pawleys Island, SC. Technical Report to the Town of Pawleys Island, South Carolina; CSE, Columbia, SC,59pp.

CSE's findings were that the proposed terminal groin project would have an "immeasurable" effect on the Prince George shoreline however CSE found that the inlet was well south of its historic range and proposed the development and implementation of an inlet management zone in order to minimize extreme fluctuations which can lead to extreme erosion. Figure 4 presents CSE's recommended Inlet Management Corridor from that report. A historical inlet corridor is also shown.

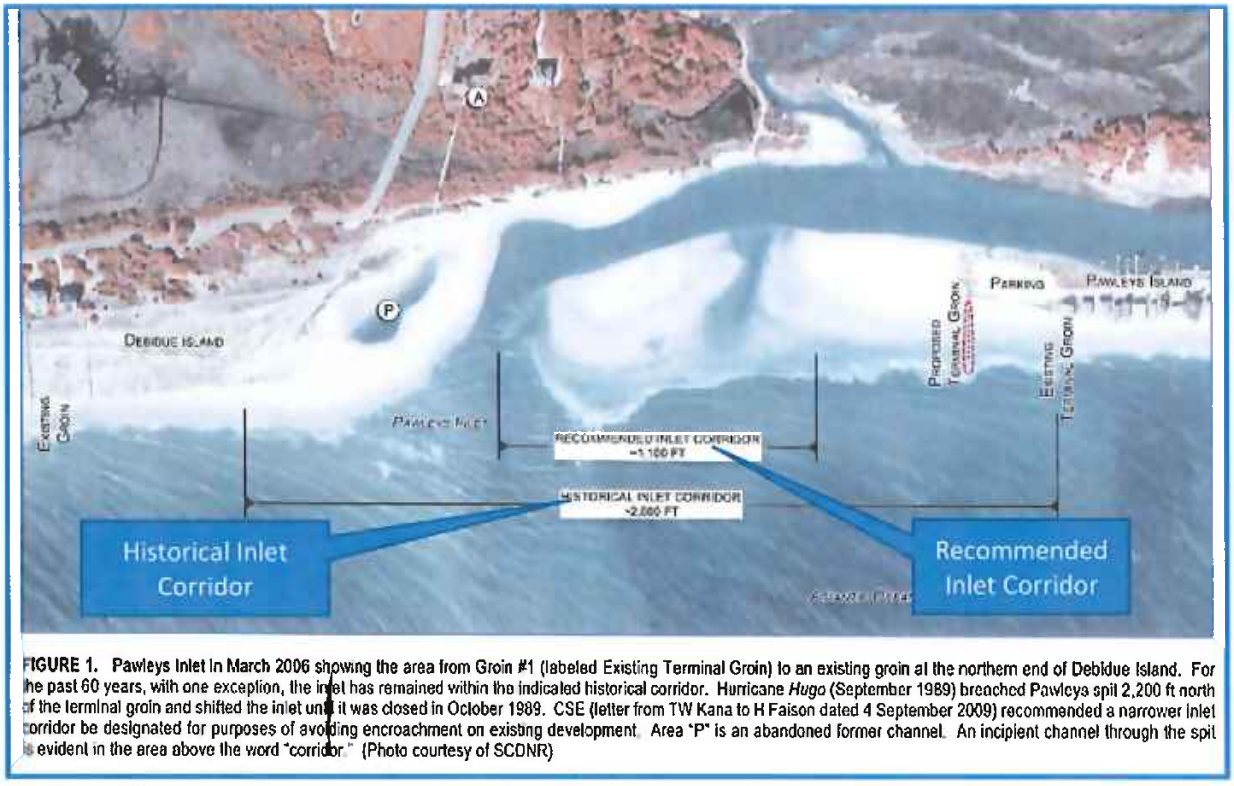


FIGURE 1. Pawleys Inlet in March 2006 showing the area from Groin #1 (labeled Existing Terminal Groin) to an existing groin at the northern end of Debidue Island. For the past 60 years, with one exception, the inlet has remained within the indicated historical corridor. Hurricane *Hugo* (September 1989) breached Pawleys spit 2,200 ft north of the terminal groin and shifted the inlet until it was closed in October 1989. CSE (letter from TW Kana to H Faison dated 4 September 2009) recommended a narrower inlet corridor be designated for purposes of avoiding encroachment on existing development. Area "P" is an abandoned former channel. An incipient channel through the spit is evident in the area above the word "corridor." (Photo courtesy of SCDNR)

Figure 4: Inlet Management Zone Excerpted figure from 2010 CSE report.

This inlet management zone was never implemented however it is currently needed. ATM agrees with CSE's findings on the inlet management zone concept and the 2010 CSE inlet corridors are shown on several figures later on in this report.

Pawleys Spit Breaching Potential

CSE believed there was potential for a breach or new channel to the north along Pawleys spit at the time. An excerpt from the 2010 report:

> In the case of Pawleys spit, breach potential is reduced in relation to the position of the inlet. When the inlet is in a northerly position, the tidal prism of the Pawleys creek system discharges more efficiently because of the shorter path of the inlet. The faster storm tide levels in the marsh return to normal, the shorter the time over which a new inlet can scour through the spit. While the most hydraulically efficient location for Pawleys Inlet would be in the vicinity of groin cells 6 or 7 (see Fig 11), such a location is impractical given the development. Continuing vulnerability of Pawleys spit to a breach event points to the need for a breach contingency plan such as some states have contemplated (eg – USACE 1996).

Figure 5: 2010 CSE excerpt on breaching of Pawleys spit and need for a plan related to management of the inlet location.

Georgetown County ultimately did not pursue the terminal groin project and the USACE funding for the Pawleys project was not allocated until a few years ago.

In the meantime (2011 to 2018), Pawleys Island continued to experience erosion and performed sand-scraping in 2017/2018 and when needed in response to major storm events (when sand-scraping is allowed by OCRM and the USACE).

The beach system has changed dramatically since the infusion of 1.1 million cubic yards in 2020, including increased inlet migration to the south and a much more robust Pawleys spit that has little chance of breaching naturally.

4.2 2019 Pre-Nourishment Inlet Conditions

Figure 6 presents a September 2019 aerial and approximate mean high water (MHW) line showing pre-nourishment conditions around the inlet. The historic inlet corridor and the recommended inlet corridor from the 2010 CSE report are also shown for reference. As the 2019 aerial shows, the inlet was south of the recommended inlet corridor location but within the historical inlet corridor. Also note that Pawleys Spit is much more likely to breach (and shift the inlet north) in this pre-nourishment aerial when compared to post-nourishment aerials.

Figure 6: September 2019 Pre-Nourishment Aerial and MHW Line. CSE 2010 Historical and recommended inlet corridors also shown (refer to Figure 5 and Appendix B).

4.3 2019/2020 Pawleys Island Nourishment Project

The recent Pawleys Island nourishment was a Town-sponsored beach renourishment project that placed 1,132,420 cubic yards (cy) of sand between Pawleys Inlet public parking lot at the south end and ~3rd Avenue near the north end between October 2019 and March 2020. Approximately half of the project material was placed along the southern shoreline of Pawleys Island (Reach 1). Fill volumes ranged from 20 cy/ft to 130 cy/ft over the entire project shoreline, with the greatest berm widths being constructed in Reach 1 where, on average, ~120 cy/ft of material was placed. Figure 7 presents pre- and post-nourishment oblique aerials in Reach 1 near Pawleys Inlet.

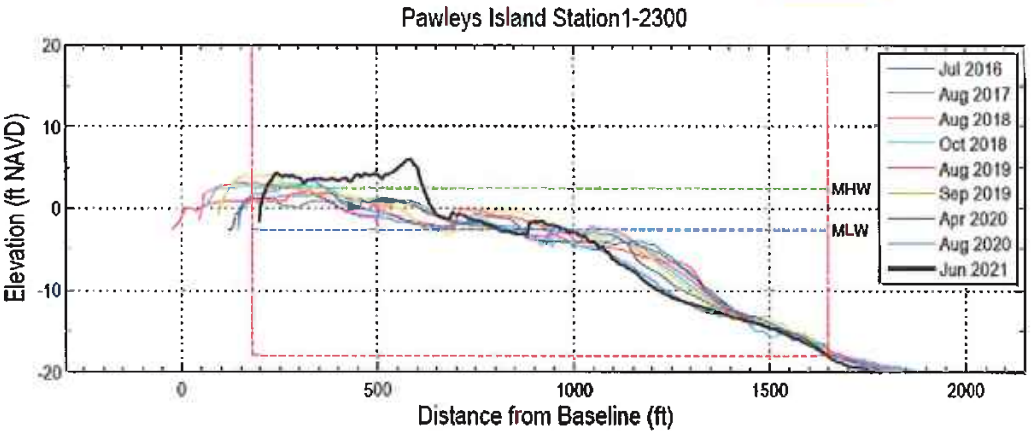
FIGURE B.1 (page 1 of 6). August 2019 [UPPER] and June 2021 [LOWER] images of Reach 1 at Pawleys Island (SC). Pawleys Inlet and Debidue Island are in the background. [*all images taken by D. Giles*]

Figure 7: Excerpt from CSE 1-yr post project monitoring report showing pre- and post-nourishment conditions along the southern end of Pawleys Island looking south towards Pawleys Inlet and Debidue Island. ~575,000 cy (~120 cy/ft on average) placed along the Reach 1 shoreline.

In the 1-year post-project monitoring report, the most significant losses of sand were documented at the southern end of Pawleys Island (see excerpt below), and this material is moving downdrift (southward) as evidenced by the significant accretion in the 1-year post-project surveying at the southern-most survey transect on Pawleys spit, closest to the inlet and ~2,300 feet south of the limits of the 2019 project template (see Figure 9).

> CSE is pleased to enclose the Year 1 Post-Project (2021) Monitoring Report for the 2020 Beach Restoration project at Pawleys Island.
>
> Between April 2020 and June 2021, ~76,500 cubic yards (cy) of sediment was lost along the project area above –18 ft NAVD. This is equivalent to an average unit volume decrease of ~4.7 cubic yards per foot (cy/ft), or approximately 5 ft of landward horizontal shoreline movement. Most of these losses were concentrated between groins 1 and 8, near the southern portions of the fill template area. This part of the fill template featured higher unit volumes placed via dredge, so relatively high losses are expected following nourishment completion. As the template equilibrates to natural background wind and wave conditions, the relative severity of these losses compared to other reaches is expected to decrease.

Figure 8: losses near the southern end are going south to inlet.



Date	Vol to 0 ft	Vol 0 to -18	Vol to -18
Jul 2016	10.2	662.3	672.5
Aug 2017	0.0	628.7	628.7
Aug 2018	15.2	714.3	729.5
Oct 2018	29.7	697.8	727.5
Aug 2019	18.7	713.7	732.5
Sep 2019	26.1	714.1	740.3
Apr 2020	8.6	699.6	708.2
Aug 2020	20.5	716.4	736.9
Jun 2021	60.3	681.0	741.2

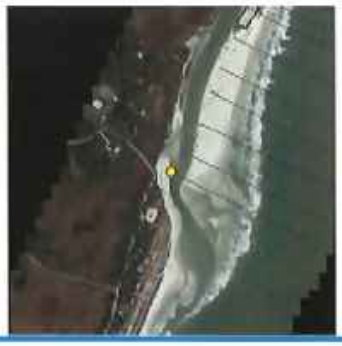


Figure 9: Excerpt from CSE 1-yr post project monitoring report showing the southernmost survey transect. Note Pawleys spit is clearly gaining material as the nourishment sand is moving south towards the inlet and Debidue Island.

Note that CSE post-project monitoring does not discuss inlet-related shoreline erosion on Debidue Island.

4.4 2021 Post-Nourishment Inlet Conditions

An April 2021 aerial and mean high water line (approximately 1-year post-nourishment) is shown on Figure 10. The 2019 MHW line is shown for reference, illustrating the significant widening and lengthening of Pawleys spit as a result of the nourishment and the downdrift spreading of the project material. The spit and inlet migrated south ~400 feet and, due to the nourishment, Pawleys spit is over 500 feet wide and not likely to breach naturally. In April of 2021, the inlet had moved south of the historic inlet corridor. MHW erosion along the Prince George shoreline has been much worse over the last year.

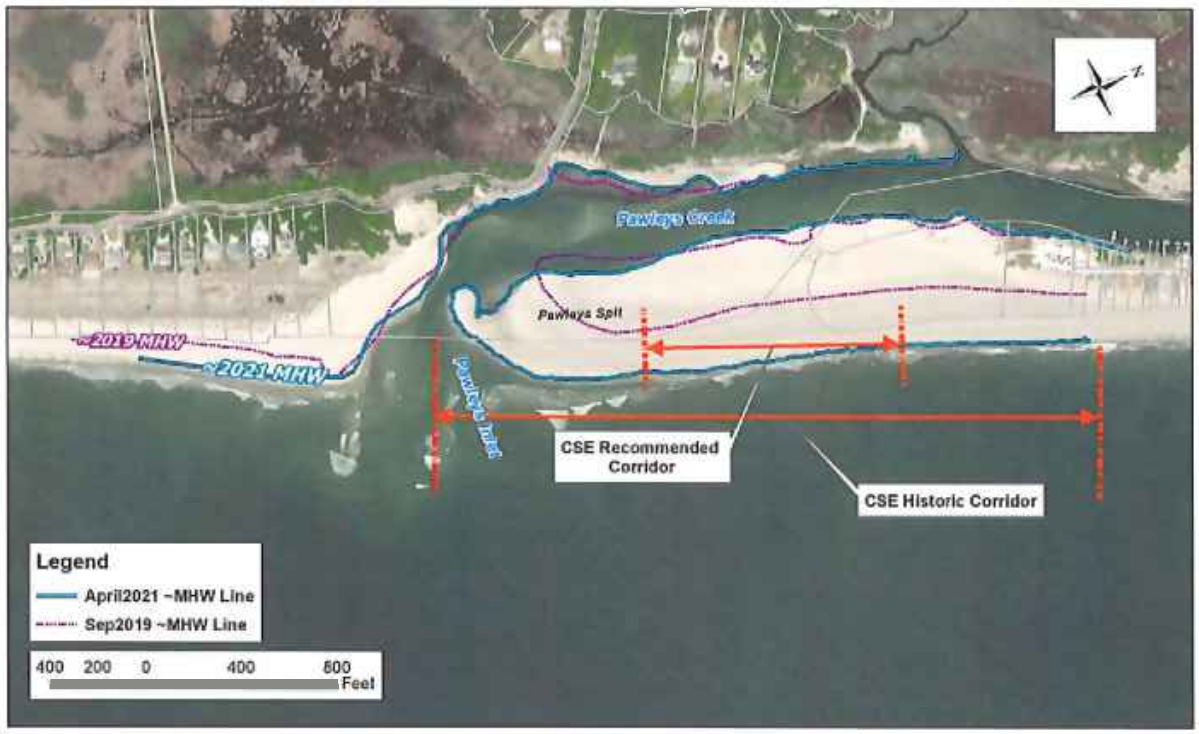


Figure 10: April 2021 (Post-Nourishment) Aerial and MHW Line. 2019 Pre-Nourishment MHW Line also shown for reference. Note significant growth and movement of Pawleys spit towards the Prince George Community shoreline since the nourishment project.

4.5 2022 Existing Conditions

ATM visited the site in March of 2022 to assess existing conditions of the inlet and surrounding shorelines. A geo-referenced drone aerial image obtained during the site visit is shown on Figure 11. Approximate mean high water lines from March 2022 and April 2021 are also shown. Ground photos of site conditions are provided on Figure 12.

As Figure 11 shows, Pawleys Inlet continues to migrate south and is causing extreme erosion and dune scarping along the Prince George shoreline. Over 300 feet of erosion was observed in less than a year and the Pawleys Island nourishment sand continues to spread south. The inlet has moved 200-300 feet south since April of 2021 (much faster than normal migration rates of ~40-75 ft/year) and is now well south of the historic inlet corridor.

Mature dune and upland vegetation (including large trees) have eroded and significant losses in sediment volume and beach/upland habitat have occurred. Over 5 acres of dry beach and vegetated dune were lost between April 2021 and March 2022. Much of the observed dune and vegetation loss occurred in the last 6 months. The ground photographs show the extreme scarping and mature vegetation loss taking place on the Prince George shoreline. Based on the observed scarping conditions and using the April 2021 and March 2022 aerial shorelines, it is estimated 50,000 cy to 75,000 cy of material has been lost on the Prince George shoreline.

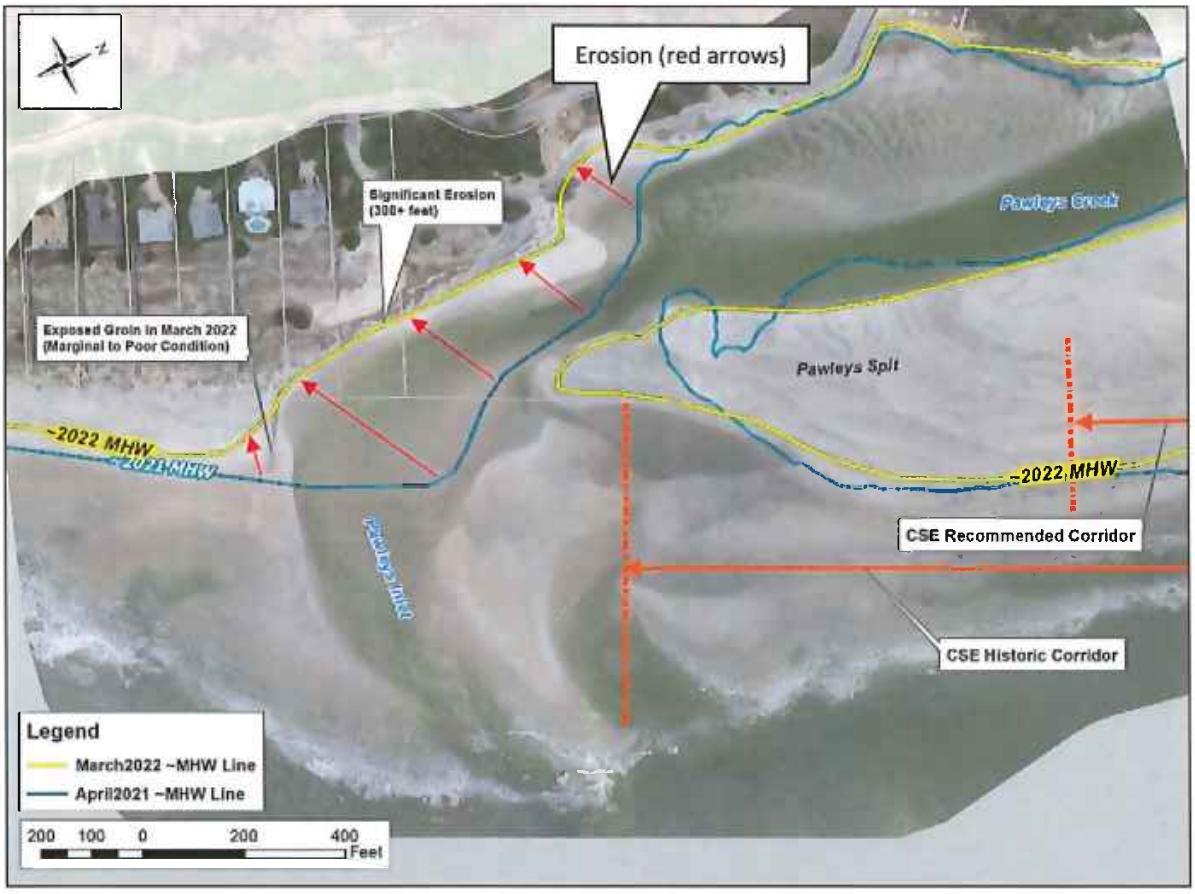


Figure 11: March 17, 2022 Existing Conditions Drone Aerial and MHW Line. April 2021 Post-Nourishment MHW Line also shown for reference. Note significant erosion along Prince George shoreline and substantial southerly inlet movement.

Additionally, the northern-most groin on Debidue Island is now partially exposed at its seaward end due to this erosion (see photo and aerial). The exposed portions of the timber groin are in marginal to poor

condition and it is doing little to trap sand in place along the Prince George Community shoreline. It is anticipated with the continued erosion caused by the inlet this groin will soon be fully exposed, severely damaged, and become entirely non-functional.

Figure 12: Site shoreline existing conditions along north end of Debidue Island (March 17, 2022). Note extreme scarping (8-10 ft high), vegetation loss, and exposed timber groin in marginal to poor condition.

As mentioned previously, Pawleys spit is much larger and very wider since the nourishment. No breach is likely as a result and continued southern migration of the inlet is expected. The southern-most groins on Pawleys Island are currently "not working" as they are completely buried and nourishment material is

readily migrating southward. Therefore, without an engineered relocation of Pawleys Inlet, unprecedented erosion along the Prince George Community shoreline will continue.

Based on the calculated inlet movement and shoreline erosion between the two most recent aerials, shoreline conditions were extrapolated to predict future conditions for 2023 and 2025 (1-year and 3-year projections, respectively) shown in the following sections.

4.6 1-Year Prediction

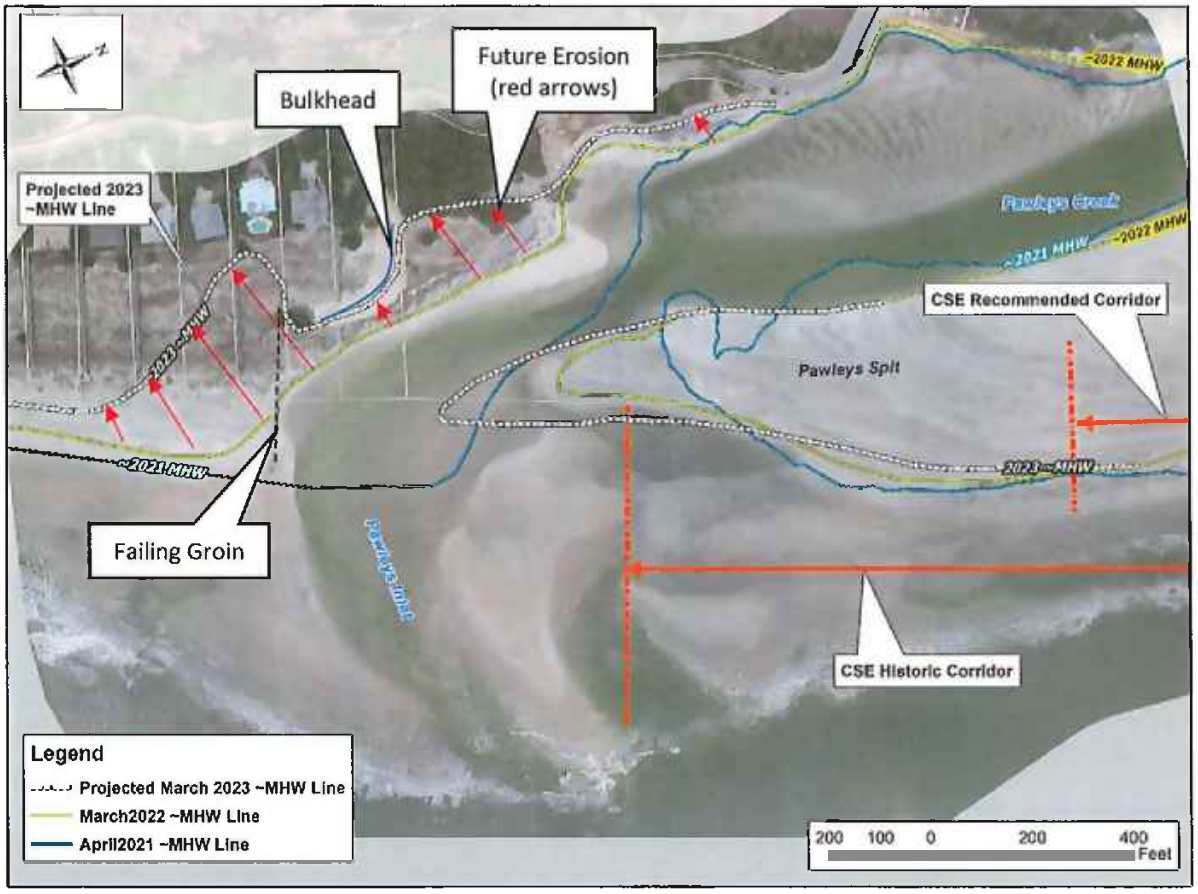


Figure 13: 2023 Predicted MHW shoreline (white). 2021 and 2022 MHW shorelines shown for reference.

4.7 3-Year Prediction

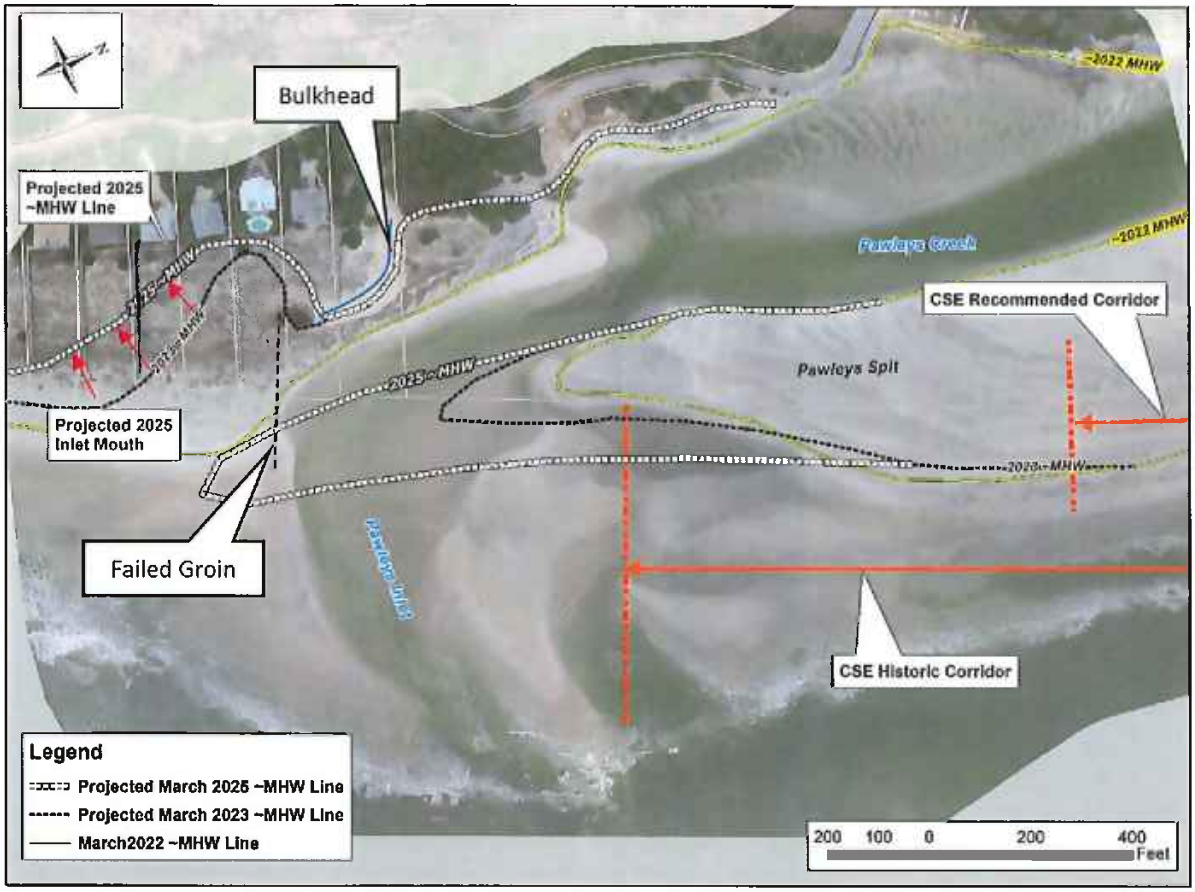


Figure 14: 2025 Predicted MHW shoreline (white). 2022 MHW shoreline and 2023 predicted MHW shoreline shown for reference.

The predicted 2023 and 2025 shorelines shown above represent future conditions if no action is taken to relocate the inlet. Pawley's inlet will continue migrating southward resulting in continued detrimental erosion to the dry upper beach and vegetated dune system along the north end of Debidue Island. It is estimated at least another 4 acres of dry beach and vegetated dune will be lost by 2023.

The timber groin along the Prince George shoreline may help to slow erosion some, however, this is expected to fail soon as the inlet moves closer bringing erosion and damaging conditions directly to the timber structure. The timber groin is decades old and the seaward portion is in very poor condition while wave overtopping along the entire groin structure has already occurred. Unmitigated erosion will cause further loss of mature upland vegetation by 2023 and will begin affecting habitable structures potentially by 2025. By 2025, Pawley's Inlet is predicted to be located over 800 ft south of the historical inlet corridor limit. The timber groin structure is expected to completely fail by 2025.

In summary, the recent Pawleys Island nourishment project has caused unprecedented erosion along the Prince George Community shoreline. The inlet is currently well south of any locations over the last 100 years and has eroded/destroyed mature trees and vegetation which had existed for decades. As a result of the Pawleys Island nourishment, Pawleys Inlet will continue its accelerated southerly migration and

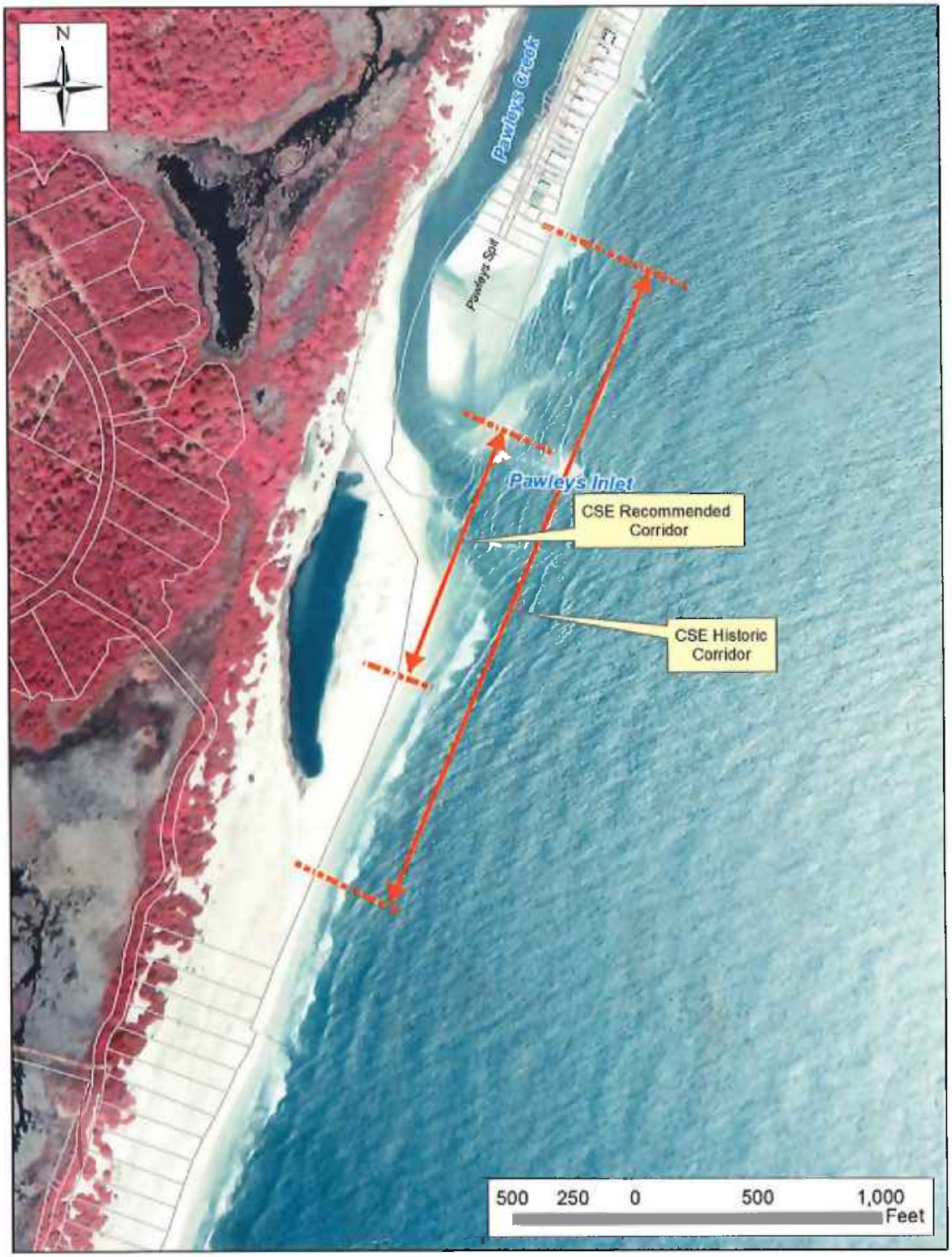
Pawleys spit will not breach naturally anytime in the foreseeable future. Accelerated erosion along the Prince George Community shoreline is expected to continue over the next few years and will result in significant losses of mature dune systems, upland habitat and even habitable structures.

Signed,

Fran Way, P.E.
Senior Coastal Professional Engineer

APPENDIX A: HISTORIC INLET MOVEMENT

1977



2003

2010

2017

2019

2021

2022

APPENDIX B

TECHNICAL REPORT

HISTORICAL CHANGES AT PAWLEYS INLET AND A CONCEPTUAL PLAN FOR AN INLET MANAGEMENT ZONE

PAWLEYS ISLAND SC

Prepared for:

Prince George Community Association Inc
Pawleys Island SC

CSE

COASTAL SCIENCE & ENGINEERING

TECHNICAL REPORT

Historical Changes at Pawleys Inlet and a Conceptual Plan for an Inlet Management Zone Pawleys Island South Carolina

Prepared for:

Prince George Community Association Inc
(c/o Henry Falson and Phillip Lammonds)
PO Box 2308 Pawleys Island SC 29585-2308

Prepared by:

Coastal Science & Engineering (CSE)
PO Box 8056 Columbia SC 29202-8056

[2327TR]
AUGUST 2010

SYNOPSIS

Pawleys Inlet (South Carolina) is an unstable, migrating inlet that has shifted position, impacting the developed shorelines of Pawleys Island and Debidue Beach, as well as the mainland shore adjacent to the channel. CSE has recommended establishment of an inlet management zone (IMZ) at Pawleys Inlet to reduce the impacts of channel migration on developed property. Preliminary to developing an IMZ with input from affected communities, this report presents the history of inlet changes since 1872 and offers a prognosis on future conditions if no action is taken. The history is based on historical maps, aerial photographs, and miscellaneous surveys.

Pawleys Inlet was situated near present-day Pritchard Street in 1872. Between 1872 and 1939, it migrated south 3,800 feet (ft), an average of ~56.6 feet per year (ft/yr). The first vertical, aerial photograph in October 1939 shows the end of Pawleys spit terminating between present-day Groin #1 and Groin #2. The inlet continued to migrate south until 1969 when it reached a point ~2,400 ft from present-day Groin #1. During the period 1939 to 1969, its average rate of migration was ~91.5 ft/yr.

A northeast storm in July 1969 breached Pawleys spit and shifted the inlet ~1,500 ft north to the area near the present-day county parking area on the south side of Groin #1. Between 1969 and Hurricane *Hugo* in September 1989, Pawleys Inlet resumed its southerly migration, moving over 200 ft/yr during the mid 1980s. Rapid, southerly migration rates correlated with northeast storms which erode Pawleys Island and accelerate longshore transport, the process most responsible for southerly spit growth and inlet migration. Hurricane *Hugo* breached Pawleys spit between Groin #4 and Groin #5 (~2,200 ft north of Groin #1). After emergency breach closure in October 1989, the inlet resumed its course, discharging about 2,500 ft south of Groin #1.

Pawleys spit and the attached shoals of the inlet were used as a borrow source for beach nourishment projects in 1990 and 1999. These projects recycled sand back to Pawleys Island and shifted the channel north (or reduced its southerly migration and encroachment on Debidue Beach). Between February 1999 and March 2008, the channel entrance was centered between ~1,500 ft and 2,000 ft from Groin #1. During the past two years, the inlet has shifted over 500 ft south and is once again encroaching on developed property at the northern end of Debidue Island.

The analysis herein indicates that Pawleys spit from Pritchard Street to Pawleys Inlet remains exceedingly vulnerable to a breach event because of its low elevations, narrow width, and inadequate dune volumes. The presence of groins along much of the spit does little to reduce the breach threat. Water levels associated with 10- to 20-year return-period storms (or greater) are considered sufficient to initiate breach events north or south of the county parking area. Further, the history of breaching suggests at least one breach event can be expected every 10-20 years.

The threat of a breach anywhere along the spit, including through the groin field and existing development, increases as the inlet shifts south. This is due to the fact that the tidal flows become less hydraulically efficient as the channel (behind the spit) is elongated. Lower efficiencies cause the lagoon tide to remain higher after storm surges peak. This creates more favorable conditions for the lagoon surge level to exceed the ocean tide level. It is the difference in elevation between the lagoon tide and ocean tide which generates the flows that produce spit breaches such as the event during Hurricane *Hugo* (between Groins #4 and #5).

The present analysis also indicates that Pawleys Inlet has a more favorable impact on the county parking area when it is positioned approximately midway between Groin #1 and Prince George. This is because the seaward shoals of the inlet function like a groin, trapping and retaining an updrift "fillet" (wedge of sand) which widens the dry beach. The favorable impact of the inlet fillet shifts with the channel and therefore diminishes along the county parking area when the inlet is near its southernmost point.

This report offers a series of recommended steps for implementation if an IMZ for Pawleys Inlet (see Section 4.2 on page 31). CSE recommends an initial forum with community leaders and property owners (ie – Town of Pawleys Island, Georgetown County, University of South Carolina, and Prince George Community Association) to discuss the issues associated with Pawleys Inlet and develop a mutually acceptable conceptual plan. Implementation of an IMZ will require approval from state and federal regulatory and resource agencies.

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1.0 INTRODUCTION

This report is prepared in connection with a conceptual plan to establish an inlet management zone (IMZ) at Pawleys Inlet (Pawleys Island, South Carolina). The Prince George Community Association Inc (PGCA) noted severe encroachment of Pawleys Inlet along community property in 2009. CSE offered an opinion on the erosion and its relation to a plan for construction of a terminal groin at the southern beach access on Pawleys Island (ATM 2009). Appendix 1 includes a copy of CSE's opinion along with a conceptual plan for limiting Pawleys Inlet to an ~1,100-foot (ft) corridor (Fig 1). In recent historic times, the inlet has shifted over an ~2,800-ft corridor between the Pawleys Island groin field and Prince George. This does not include the 1989 breach of Pawleys spit which occurred ~2,200 ft north the county parking area.

The basic purpose of an IMZ is to establish a set of parameters by which a particular inlet is maintained so that adverse impacts along adjacent shorelines are minimized. Inlet management can range from a passive approach to total control. Where there is no development, a passive approach could entail designating a long length of coastline free of development over which an unstable inlet is allowed to migrate. Where there is dense development near an inlet, the channel may be stabilized via jetties and a sand-bypassing plan implemented. This is a practice that has been applied in some Florida inlets (eg – FLDEP 2000). Between these ends of the management spectrum are a range of alternate approaches depending on the specific setting.

While the state of South Carolina has not formally established inlet management plans for any inlet, it recognizes fundamental differences between stabilized and unstabilized inlets under the Beach Management Act. Regulations establish lines of jurisdiction ("baselines" and "setback lines") based on inlet and shoreline movement over the previous 40 years (cf – SCCC 1992). Many South Carolina inlets are deep and positionally stable (Fitz-Gerald et al 1978), being anchored in ancestral river channels (eg – Dewees Inlet, Stono Inlet, North Edisto Inlet). However, a number of small inlets have a history of migration and breaching (Hayes 1977) which causes their channels to shift over a corridor many times greater than their channel widths (eg – Midway Inlet, Pawleys Inlet, and Captain Sams Inlet).

FIGURE 1. Pawleys Inlet in March 2006 showing the area from Groin #1 (labeled Existing Terminal Groin) to an existing groin at the northern end of Debidue Island. For the past 60 years, with one exception, the inlet has remained within the indicated historical corridor. Hurricane *Hugo* (September 1989) breached Pawleys spit 2,200 ft north of the terminal groin and shifted the inlet until it was closed in October 1989. CSE (letter from TW Kana to H Faison dated 4 September 2009) recommended a narrower inlet corridor be designated for purposes of avoiding encroachment on existing development. Area "P" is an abandoned former channel. An incipient channel through the spit is evident in the area above the word "corridor." (Photo courtesy of SCDNR)

Some of the bigger challenges in coastal zone management (CZM) are associated with small migratory inlets such as Pawleys Inlet. Breach events as well as inlet encroachment on downdrift shorelines has created recurring problems. Prior to 1988, it was possible to deal with channel encroachment using hard structures. However, under South Carolina's Beach Management Act (SCCC 1992), hard solutions to erosion are severely restricted in favor of soft solutions such as wider development setbacks or periodic inlet relocation (Kana 1989, Kana and McKee 2003).

This report reviews the history of Pawleys Inlet and various controlling structures that exist to limit its normal movement to a particular ~3,400-ft-long section of coast. This is preliminary to a specific design and detailed analysis of potential impacts of an IMZ for the inlet. Given the presence of valuable development and habitats on either side of Pawleys Inlet, it is in the collective interest of the surrounding communities to manage the inlet position over some defined corridor.

2.0 DATA SOURCES, PRIOR STUDIES, AND PROJECTS

CSE reviewed previous reports and obtained copies of maps and aerial photographs for purposes of compiling a history of Pawleys Inlet movement. Principal studies included:

Anders et al 1990	Shoreline movements: Tybee Island, Georgia, to Cape Fear, North Carolina, 1851-1983
Gaudiano 1998	Shoal bypassing in South Carolina tidal inlets: geomorphic variables and empirical predictions for nine inlets
USACE 2004	Feasibility report for hurricane and storm damage reduction at Pawleys Island, South Carolina
ATM 2008	Downdrifts and alternatives analysis: Pawleys Island groin and beach nourishment project

Other data sources included:

- US Department of Agriculture vertical aerial photography for various dates
- NOAA-NOS 1983 historical shoreline maps
- USACE 1962
- Hubbard et al 1977
- Zarillo et al 1985
- ATM/OA 1987
- SCCC 1987
- Kana 1988
- Stauble et al 1990

Recent, controlled aerial photographs were obtained from South Carolina Department of Natural Resources (SCDNR), Georgetown County, and ESRI ©2010 i-cubed. Also, CSE maintains unpublished survey data for select dates and sites which filled in certain data gaps.

The above-referenced sources provided 26 discrete inlet positions encompassing the period June 1872 to December 2009.

CSE examined the various data sources and prepared orthorectified or scale-adjusted images for import into AutoCAD® Civil 3D®. Principal inlet shorelines were digitized using the wet-sand/dry-sand contact on each image. A low-tide channel centerline where the

inlet discharges into the ocean was interpreted using the imagery, shoreline maps by others, and various unpublished survey data.

CSE established a reference control line paralleling the beach with stations numbered from north to south (engineering nomenclature). Station 0+00 was set at Groin #1 (southernmost groin on Pawleys Island). The existing groin at the northern end of Debidue Beach along the Prince George community is approximately station 34+50 (ie – 3,450 ft south of Groin #1).

The majority of inlet centerline positions fell between station 0+00 and approximately station 28+00. However, on several dates, the inlet was situated north of Groin #1. For these latter observations, negative distances are used (measured north from Groin #1).

CSE also digitized the spit shoreline and area around Groin #1 for purposes of correlating shoreline change at the southern end of Pawleys Island with the position of Pawleys Inlet.

2.1 General Inlet History

The present report is not intended to be a comprehensive review of prior studies and projects around Pawleys Inlet. However, the following are some events of interest.

1872	Earliest verified inlet position in the vicinity of present-day Pritchard Street, a distance of ~4,150 ft north of Groin #1
1870–1950	South spit of Pawleys Inlet formed, shifting the inlet ~5,900 ft to the south
1950-1957	South spit is developed
circa 1959	Groins constructed along Pawleys Island south spit
1969	Debidue Island groin constructed ~3,450 ft south of Groin #1 on Pawleys Island, fixing the present inlet corridor
1969	July storm breaches Pawleys spit and shifts the inlet north through the area of the present county parking lot
1986-1987	Northeast storms cause extensive beach erosion and strong southerly longshore transport, shifting the inlet south
1989	Hurricane *Hugo* breaches Pawleys Island spit between Groins #4 and #5, ~2,150 ft north of Groin #1 – the breach channel is closed in October by the US National Guard
1990	A post-storm nourishment project borrows sand from Pawleys Inlet and the south spit, and the northern end of Pawleys Island, for redistribution by trucks to eroded sections of the island – a total of ~220,000 cubic yards (cy) was moved of which an estimated 40-65 percent was obtained from Pawleys Inlet attached shoals

1999	A Town- and State-sponsored project rebuilds 22 groins and nourishes the groin cells borrowing ~270,000 cy from the southern spit and attached shoals of the inlet with the limit of excavations set ~600 ft south of the county parking area
2004	USACE completes a feasibility study which recommends nourishment totaling ~666,400 cy along ~7,500 linear feet at the southern end of Pawleys Island
2009	Georgetown County applies for a permit to construct a terminal groin at the southern end of the county parking area on Pawleys spit, based on a plan by ATM (2008)
2009	Prince George Community Association Inc installs emergency protection landward of jurisdictional setback lines along Beach Bridge Road in anticipation of inlet encroachment ~2,500 linear feet south of Groin #1

Figure 2 shows historical shorelines prepared by NOAA-NOS in 1983 as part of a cooperative shoreline movement study in South Carolina. These data are derived from US Coast and Geodetic Survey charts (now NOAA-NOS) dating back to 1872. The earliest map shows Pawleys Inlet discharging between present-day Groins #7 and #8 near Pritchard Street. By 1934, Pawleys spit had formed and extended south to present-day Groin #2.

The first vertical aerial photograph of the island was obtained by the US Department of Agriculture in October 1939 (Fig 3) when the inlet was centered ~350 ft north of present-day Groin #1. Appendix 2 contains the set of aerial photographs available to CSE for the analysis. Each image shows CSE's interpretation of the spit shoreline (dry-sand/wet-sand contact line) which represents approximate mean high water .

Figure 4 shows a sketch map of the spit prepared by Stauble et al (1991) following Hurricane *Hugo*, which impacted South Carolina on 21 September 1989. The map shows the general location of a breach channel through the spit. Accompanying photos in Figure 4 show the breach channel in September prior to closure and in October after closure.

Figure 5 is the most recent vertical photo of the island, obtained from the Georgetown County GIS Department. Superimposed on the image is CSE's control line and stationing relative to Groin #1. [Note: Negative-numbered stations extending north from Groin #1 are not shown but are similarly referenced to Groin #1.]

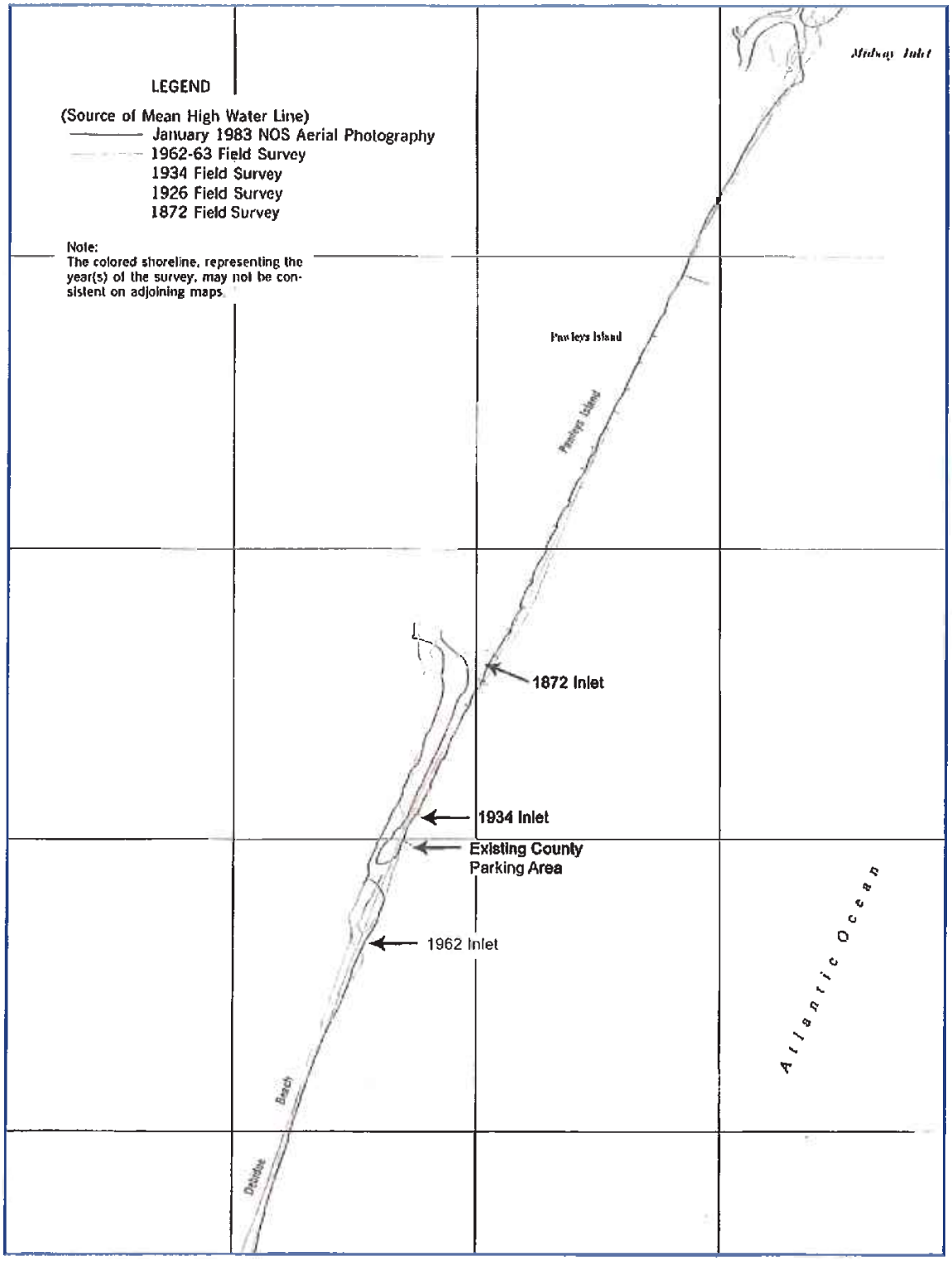


FIGURE 2. Historical shorelines (approximate mean high water) for the Pawleys Inlet area from NOAA-NOS (1983) cooperative shoreline study.

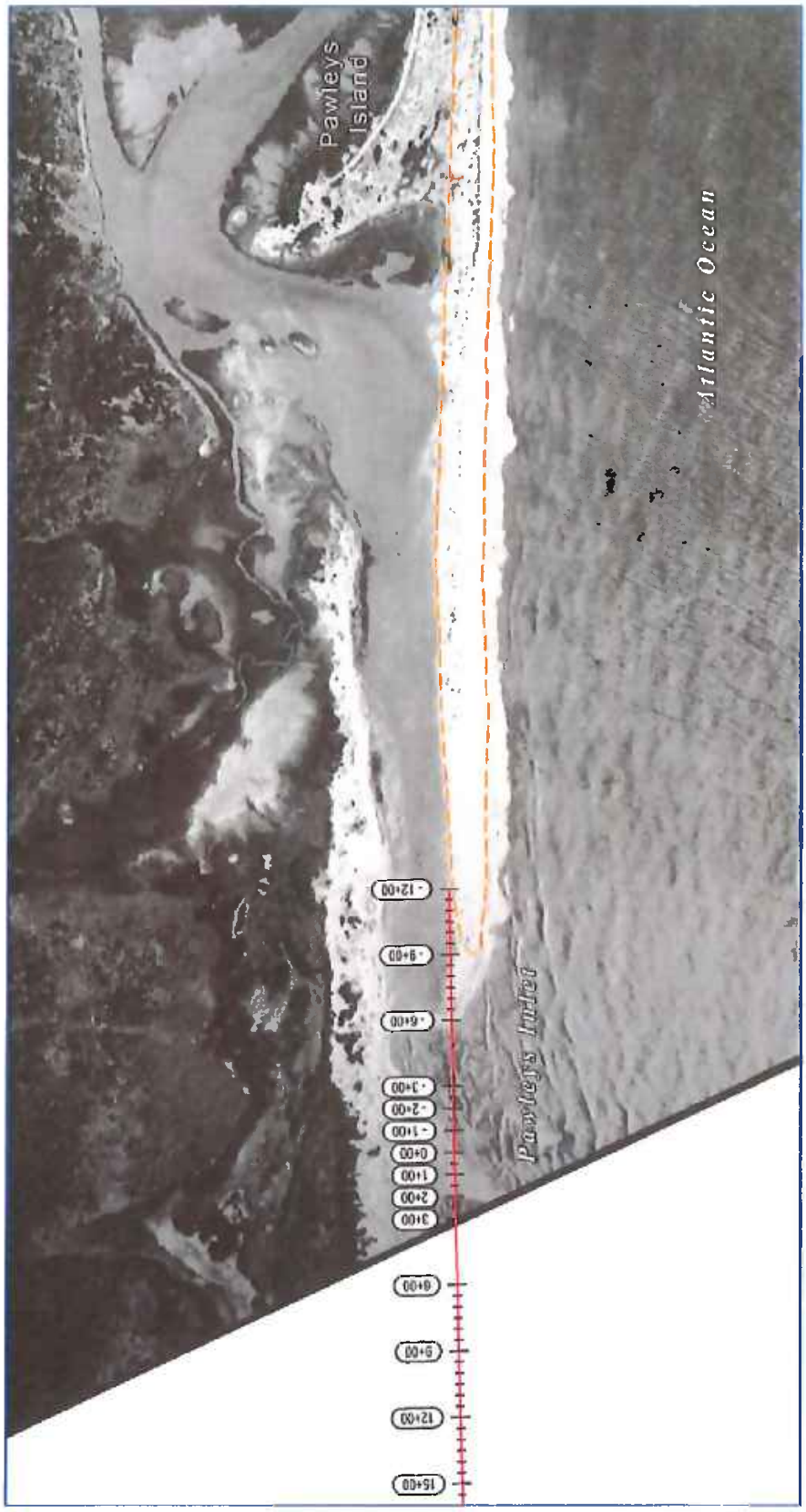


FIGURE 3. Portion of the first (17 October 1939) vertical aerial photograph of Pawleys Inlet showing undeveloped spit. Reference line and stationing originate at present-day Groin #1. Dashed line is CSE's interpretation of the dry-sand/wet-sand contact line which roughly corresponds to local mean high water. [Source: US Department of Agriculture]

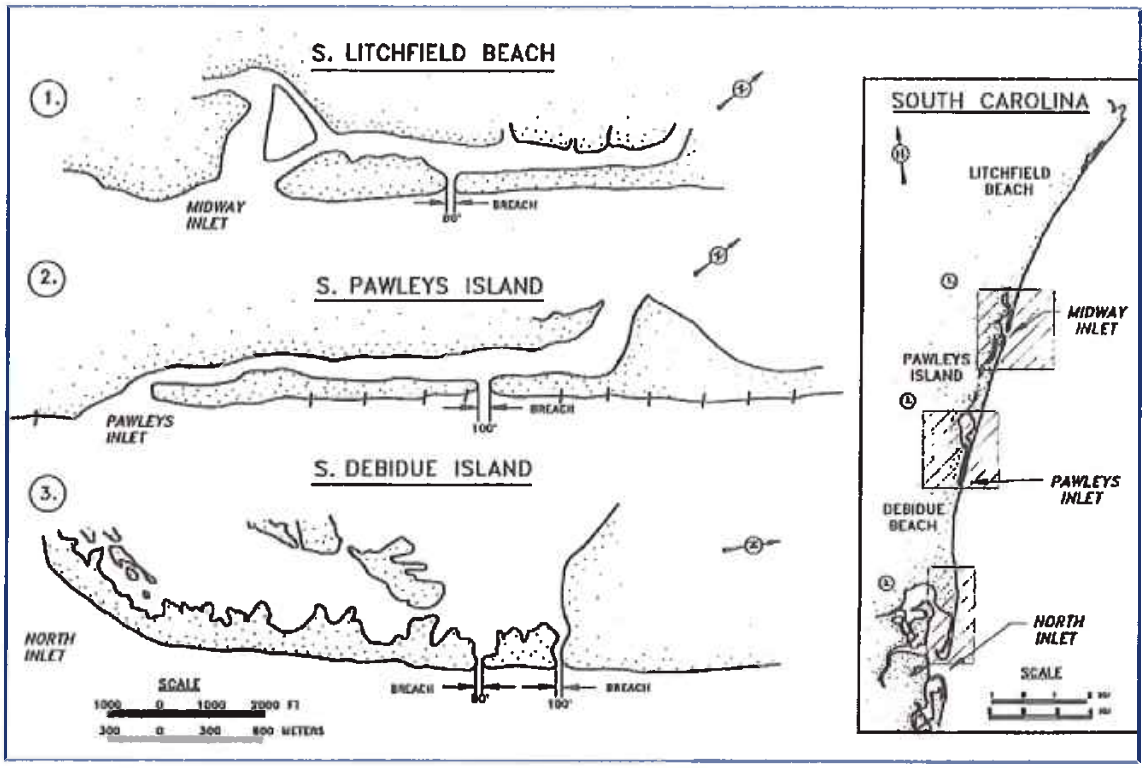


FIGURE 4.

Sketch map of Pawleys Inlet area after Hurricane *Hugo* (21 September 1989) prepared by Stauble et al (1991 – Journal of Coastal Research, Special Issue No 8, pg 147).

Photos show the breach in September 1989 prior to closure (upper photo courtesy of SC Coastal Council) and after closure on 23 October 1989 (lower photo by CSE).

The other breaches were along undeveloped spits which healed naturally.

FIGURE 5. Most recent vertical aerial photograph showing position of Pawleys Inlet in March 2009 (courtesy of Georgetown County GIS Department). Note proximity to Beach Bridge Road, an access road within the Prince George community on the south side of the inlet. The PGCA installed emergency shore protection (buried) in August 2009 landward of jurisdictional setback lines to protect the road and utilities.

Among the findings of prior studies, the USACE (1949) noted Pawleys Inlet migrated ~4,900 ft to the south between 1851 and 1948 (a rate of ~50 ft per year). The 1851 reference date could not be verified as having a documented survey of the inlet and may be in error based on the lack of subsequent references to that date. NOAA-NOS data (Fig 2) for 1872 to 1934 show ~3,670 ft of southerly migration (~59 ft per year). USACE (2004, pg 20) reported the inlet "migrated approximately 6,500 feet south from 1872 to 1934" (a rate of 105 ft per year). These rates are checked in the next section of the present report.

Previous studies also report events which caused the inlet to shift north in connection with breaches of Pawleys' south spit. USACE (2004) reported a 1,500-ft shift in the channel position in July 1969 during an extratropical storm event. Hurricane *Hugo* (1989) breached the developed portion of the spit nearly 4,800 ft north of its pre-hurricane position (Stauble et al 1991). Nourishment and sand-borrowing activities in 1999 had the effect of shifting the channel north by an uncertain distance. Conditions along Pawleys spit today (2010) are essentially the same as they were when *Hugo* produced the breach inlet.

While Pawleys' south spit has generally grown to the south, groins installed around 1959 have likely reduced the rate of sand loss along the oceanfront (Kana 1988). The southern approximate third of the island has receded an average of ~1.3 feet per year (ft/yr) according to US Army Corps of Engineers' studies (USACE 2004, pg 22). Low erosion rates are characteristic of the Grand Strand and barrier islands of northern Georgetown County (Hubbard et al 1977, ATM/OA 1987).

2.2 Controlling Coastal Processes

Pawleys Inlet is one of the smaller inlets along the South Carolina coast (Zarillo et al 1985). Inlet size is proportional to tidal prism (the volume of water entering and exiting the inlet on each tide). With an average tide range of 4.4 ft (NOAA 1994), the marsh-filled lagoon flushed by Pawleys Inlet exchanges roughly 2 million cubic meters (~70 million cubic feet) with each tide (Gaudiano 1998). This produces an equilibrium cross-section of about 170 square meters (~1,800 square feet) (Jarrett 1976). Thus, for an average depth of 8 ft, the typical width of the channel would be ~225 ft. Many inlets in South Carolina are deeper and wider because the marshes they flush are many times greater in area.

Shallow inlets, such as Pawleys Inlet, migrate through sandy deposits that are easily eroded. By comparison, South Carolina's major inlets (eg – Charleston Harbor, Port Royal Sound, North Edisto River Inlet) are ancient river channels anchored in deeper, consolidated material such as the "Cooper River marl" (Hayes and Michel 2008). These inlets tend to be positionally stable (FitzGerald et al 1978).

Inlets migrate where the sediments are unconsolidated and easily eroded, such as the sands of South Carolina's barrier beaches. The process of migration is related to the longshore transport of sand on beaches (Bruun and Gerritsen 1961). At Pawleys Island and Debidue Beach, more sand moves south (during northeast storm events) than north (during fair-weather winds and waves from the south). This produces a net sediment transport at Pawleys Inlet from north to south. Sand eroded from Pawleys Island accumulates on the spit, building it up and forcing the channel south.

While Pawleys Inlet parallels the spit for thousands of feet, at some point, the channel discharges into the ocean. Channel curvature near the mouth of the inlet will cause bank erosion along the Debidue (Prince George) shoreline. And while inlet currents may sometimes be the primary driver of inlet migration (Aubrey and Speer 1984), they are considered secondary to longshore transport along South Carolina's small inlets (FitzGerald 1984, Kana and Mason 1988). In short, Pawleys Inlet tends to migrate south in relation to the rate of longshore transport and sand supplied from Pawleys Island. Southerly migration is interrupted when the spit breaches; then migration resumes from the breach point.

An important characteristic of migratory inlets like Pawleys Inlet is their increasing vulnerability to an upcoast breach the further south the inlet moves (FitzGerald et al 1978). This is due to the fact that the more elongated the channel becomes (behind Pawleys spit), the less efficient the channel is for the existing tidal prism. Breaches through spits offer a quicker way for storm tides to exit the lagoon. Pawleys spit from Pritchard Street to the county parking area is exceedingly vulnerable to breach events because of its narrow width and low elevation. Storm surges and high waves initiate breach events from the ocean side, then exiting tides cut the channel (Hayes 1967).

There has been considerable advancement in our understanding of the formation of breach inlets through the work of Leatherman (1981), Visser (1988), Fitzgerald (1996), Basco and Shin (1999), Kraus et al (2002), and Kraus (2003), among others. The recent

history of spit breaching at Pawleys Inlet (1969, 1989) suggests that an event sufficient to relocate the inlet to a more northerly position occurs every decade or two.

The next section presents the history of inlet migration, tracking the approximate location of the centerline of the mouth of the inlet.

3.0 PAWLEYS INLET CHANGES

CSE delineated the low-tide centerline of the mouth of Pawleys Inlet for available maps, aerial photographs, and surveys. Table 1 provides the data with inlet centerlines measured from Groin #1. The data encompass the period June 1872 to December 2009. Annualized inlet migration rates are calculated for all periods (time between successive maps, photos, or surveys) exceeding 0.5 years. Positive values represent migration to the south, while negative values represent movement to the north. As Table 1 indicates, the average rate of migration for available random time periods has been ~75 ft/yr to the south. Highest sustained migration rates occurred between 1939–1950 (~205 ft/yr) and 1983–1989 (~225 ft/yr). Certain short-term events, such as a northeaster in 1969 and Hurricane *Hugo* in 1989, accounted for sudden shifts in inlet position.

The net change in inlet position from 1872 to 2009 (137.5 years) was ~6,600 ft (ie – 48 ft/yr to the south). Figure 6 shows available inlet position data along with a "best-fit" trend line equivalent to ~40 ft/yr southerly migration. This rate is lower than the average rate for 1872 to 2009 because of reduced rates of change since approximately 1950. From 1872 to 1939, inlet migration was relatively constant (although this is only based on four data points), averaging ~56.6 ft/yr. From 1939 to 2009, a net change of ~2,800 ft yields an average migration rate of 40 ft/yr.

Figure 7 shows the recent 70 years of data for the inlet position with annotations of certain key events. In recent decades, there has been more variation in migration rates, although the inlet has remained within a 2,500-ft corridor for nearly 70 years (1939–2009). [Note: The *Hugo* breach shifted the inlet ~2,200 ft north the corridor.] A best-fit trend line yields a net southerly migration rate of ~18.7 ft/yr with a poor coefficient of determination (r^2 = 0.1).

The positions and dates of installation of Groin #1 (Pawleys Island) and the Debidue Beach terminal groin are shown in Figure 7 along with a central corridor situated ~950-2,050 ft from Groin #1 (ie – the recommended IMZ corridor). Periods when the inlet was north of the corridor include 1939 to ~1946, 1969 to ~1981, and one month in 1989 after Hurricane *Hugo* (~20 of 70 years). The inlet has been situated within the 1,100-ft corridor during the periods 1946 to 1961, 1981 to 1987, and 1999 to 2007 (~30 of 70 years). Periods when the inlet was south of the corridor include 1961 to 1969, 1987 to 1999, and 2008 to present (~20 of 70 years).

TABLE 1. Pawleys Inlet positions and migration rates between dates — 1939 to 2008.

Data Source	Date	Day # Since 1870	Year #	Year	Distance From Groin 1 (0+00) (ft)	Inlet Migration To Next Date (ft)	Years to Next	Migration (ft/yr) to Next
NOAA NOS (~MHW)	29-Jun-1872	913	2.5	1872.50	-4150	2825	54.00	52.3
NOAA NOS (~MHW)	30-Jun-1926	20,635	56.5	1926.50	-1325	845	8.00	105.6
NOAA NOS (~MHW)	1-Jul-1934	23,558	64.5	1934.50	-480	135	5.30	25.5
USDA (TCL)	17-Oct-1939	25,492	69.8	1939.79	-345	2120	10.31	205.7
USDA (CSE)	5-Feb-1950	29,256	80.1	1950.10	1775	-35	7.17	(4.9)
USDA (TCL)	7-Apr-1957	31,874	87.3	1957.27	1740	650	6.66	97.6
USDA (CSE)	5-Dec-1963	34,307	93.9	1963.93	2390	10	5.57	1.8
USACE 2004 Report	1-Jul-1969	36,342	99.5	1969.50	2400	-1500	0.04	NA
USACE 2004 Report	15-Jul-1969	36,356	99.5	1969.54	900	-364	3.66	(99.4)
USDA (TCL)	13-Mar-1973	37,693	103.2	1973.20	536	508	10.03	50.6
USDA (CSE)	26-Mar-1983	41,358	113.2	1983.23	1044	1096	4.64	236.2
CSE 1988 Survey*	15-Nov-1987	43,053	117.9	1987.87	2140	360	1.85	194.8
Stauble et al 1990	20-Sep-1989	43,728	119.7	1989.72	2500	-4650	0.00	NA
Stauble et al 1990	21-Sep-1989	43,729	119.7	1989.72	-2150	4650	0.09	NA
Stauble et al 1990	25-Oct-1989	43,763	119.8	1989.82	2500	185	0.26	NA
USDA (CSE)	27-Jan-1990	43,857	120.1	1990.07	2685	-190	4.13	(46.0)
SCDNR	15-Mar-1994	45,365	124.2	1994.20	2495	-108	4.59	(23.6)
CSE Project Data	15-Oct-1998	47,040	128.8	1998.79	2387	183	0.25	NA
CSE Project Data	15-Jan-1999	47,132	129.0	1999.04	2570	-1076	0.07	NA
Georgetown County GIS	10-Feb-1999	47,158	129.1	1999.11	1494	421	0.09	NA
SCDNR	15-Mar-1999	47,191	129.2	1999.20	1915	-132	5.92	(22.3)
Georgetown County GIS	15-Feb-2005	49,353	135.1	2005.12	1783	152	1.08	140.6
SCDNR	15-Mar-2006	49,748	136.2	2006.20	1935	39	2.00	19.5
ESRI (2009 I-cubed)	15-Mar-2008	50,479	138.2	2008.20	1974	356	1.00	356.2
Georgetown County GIS	15-Mar-2009	50,844	139.2	2009.20	2330	120	0.75	159.4
CSE Survey	15-Dec-2009	51,119	140.0	2009.96	2450	NA	NA	NA
						*Average**	*73.8*	ft/yr-south
						Std Dev	*116.6*	ft/yr
*Nov 87 based on Kana 1988 - Fig 1						*sustained rates over >0.5 years		

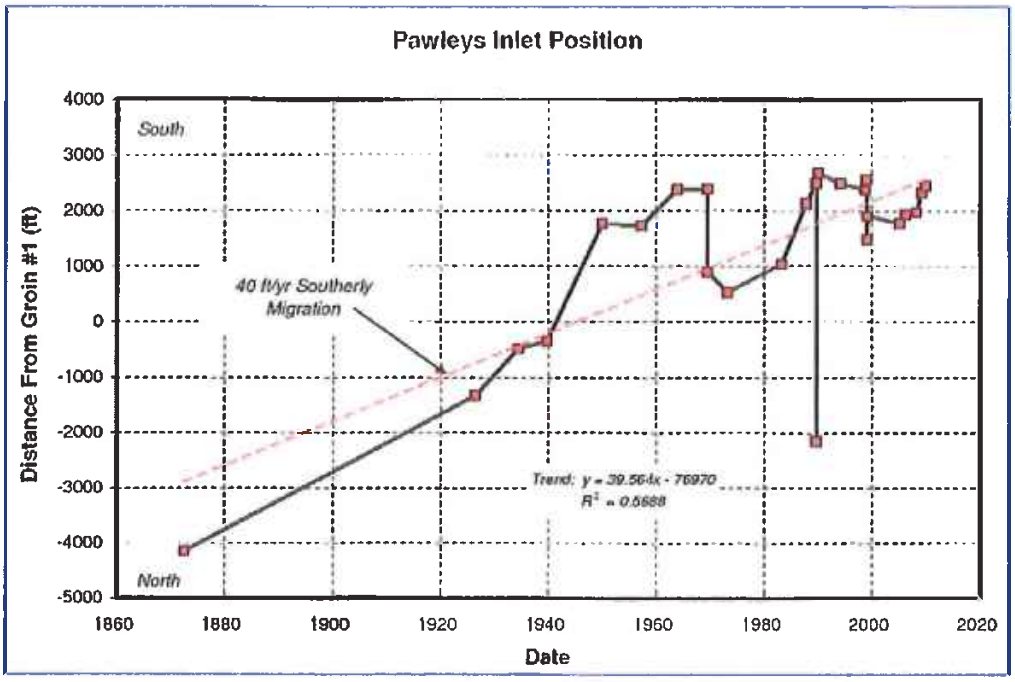


FIGURE 6. Position of the mouth of Pawleys Inlet (approximate centerline at low tide perpendicular to the average shoreline azimuth) for available maps, aerial photos, and survey dates based on the data in Table 1.

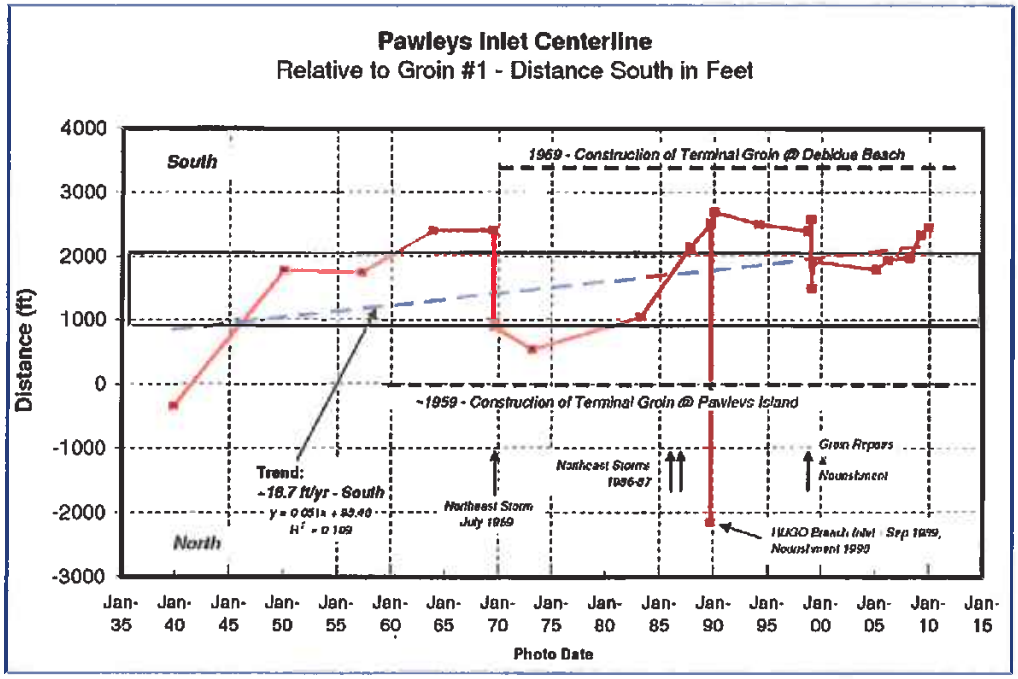


FIGURE 7. The inlet position between October 1939 and December 2009 with key events annotated. The rectangle through the data represents the proposed inlet management corridor 950-2,050 ft south of Groin #1.

Other events that appear to have influenced the position of Pawleys Inlet include:

July 1969	Northeast storm which breached the spit and shifted the channel ~1,500 ft north (USACE 2004)
Mid 1980s	Northeast storms which produced strong southerly longshore transport and shifted the channel upward of 1,000 ft (Kana 1988)
Early 1999	Nourishment and groin repair project by the Town of Pawleys Island which borrowed sand from the inlet and shifted the centerline ~1,000 ft north

Pawleys Inlet remained relatively stable from 2000 to 2008, centered about 1,900 ft south of Groin #1. Rapid southerly migration (>200 ft/yr) occurred in 2008 and 2009.

3.1 Changes Around Groin #1

CSE determined the shoreline position immediately updrift and downdrift of Groin #1 using six transects spaced 100 ft apart. The shoreline position (approximate mean high water) for available photo dates was taken as the dry-sand/wet-sand contact line (dashed line on Appendix 2 images). Table 2 provides the raw data along with certain averages and minimum or maximum values by station and groups of stations. The average offset in shoreline position between the upcoast (north) and downcoast (south) sides of Groin #1 has been ~15 ft. However, at certain times, the offset has been as high as 85 ft (eg – February 2005). Times of highest offset generally reflect periods when there was the greatest erosion along the county parking area which is protected by a (usually buried) rock revetment (see USACE 2004, Fig 3-2).

Figure 8 shows the shoreline position around Groin #1 over time at each station, with the two closest stations to the groin in bold lines. From 1950 to 1963, there was essentially no offset in the shoreline position. In fact, the beach widened from north to south in the vicinity of today's Groin #1 (also, the beach widened to the south with respect to CSE's reference line herein). After 1963, offsets (ie – separation between the red and green lines at any date) were quite variable. The graph also shows seaward and landward fluctuation on both sides of the groin, which partly reflects inaccuracies inherent with aerial photo analysis. Some dates (ie – 1990 and 1999) show negligible offset. Interestingly, the offset in 2008-2009 is reversed from the normal trend with the south side of the groin seaward of the north side. Figure 8 indicates the majority of "high water" positions fall 125-225 ft seaward of the reference control line. (See Figure 3 and Appendix 2 for control line positions.) Times when the beach fronting the county parking area was most likely eroded were the 1960s to 1983 (much of which predated the parking area), 1994, and 2005-2006.

TABLE 2. Shoreline position updrift and downdrift of Groin #1. Distances in feet.

Control Line Offset to Wet/Dry Contact								
	Updrift North Side			Downdrift South Side			Average Offset	Offset
Date	Updrift -3+00	Updrift -2+00	Updrift -1+00	Downdrift 1+00	Downdrift 2+00	Downdrift 3+00	*+/- 300 ft from Groin #1*	@+/-100 ft
17-Oct-1939	inlet	inlet	inlet	inlet	inlet	inlet	*(+) seaward; (-) landward*	NA
5-Feb-1950	286	294	302	311	315	315	19.7	9
7-Apr-1957	185	191	197	212	222	236	32.3	15
5-Dec-1963	137	136	140	147	158	171	21.0	7
13-Mar-1973	203	207	212	131	inlet	inlet	-76.3	-81
26-Mar-1983	176	182	191	145	125	108	-57.0	-46
27-Jan-1990	211	210	209	208	207	207	-2.7	-1
15-Mar-1994	147	154	165	131	127	129	-26.3	-34
15-Mar-1999	178	180	180	187	192	185	-1.3	7
1-Feb-2005	186	197	202	123	108	100	-84.7	-79
15-Mar-2006	141	138	135	110	91	84	-43.0	-25
15-Mar-2008	196	200	212	226	230	232	26.7	14
1-Mar-2009	202	206	217	237	236	235	27.7	20
	Updrift -3+00	Updrift -2+00	Updrift -1+00	Downdrift 1+00	Downdrift 2+00	Downdrift 3+00		@+/-100 ft
Max	286	294	302	311	315	315	32	20
Min	137	136	135	110	91	84	85	-81
Averages	187	191	197	181	183	179	-14	-16
Standard Dev	39.7	41.5	43.2	60.0	67.7	72.1	42.5	36.4

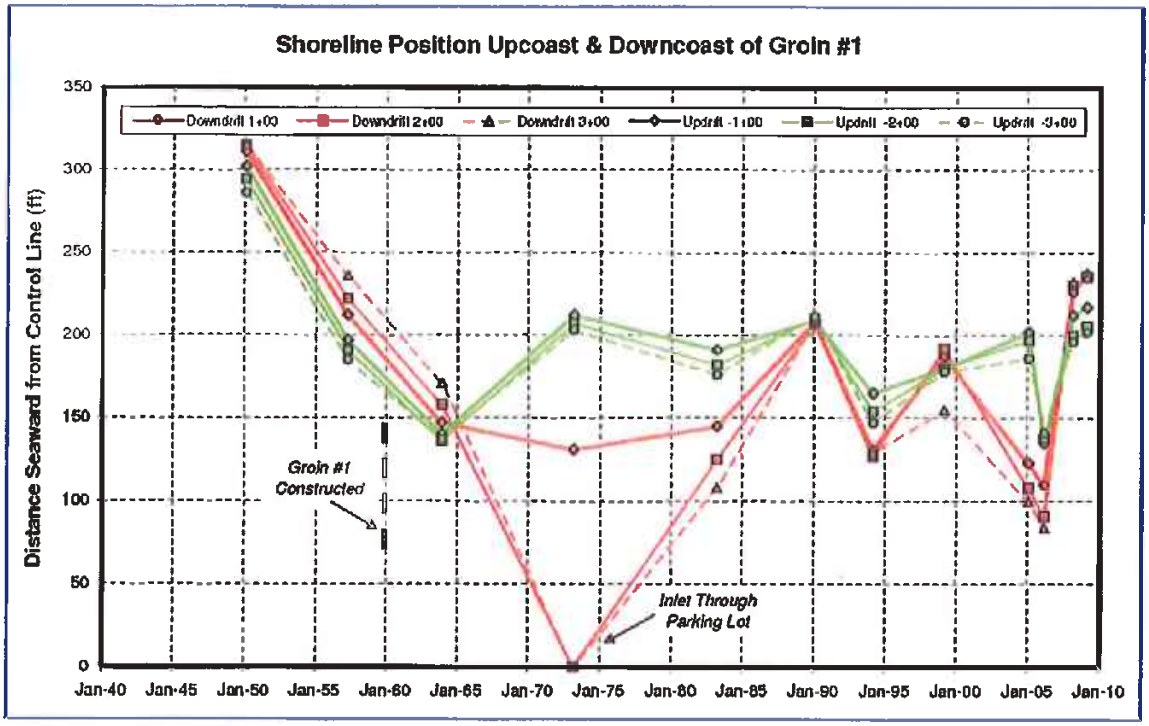


FIGURE 8. Shoreline position on the north (updrift) side and south (downdrift) side of Groin #1. During three periods, there was a positive offset: 1950-1963, ~1999, and 2008-2009. During remaining periods, the offset was negative at variable amounts, reflecting sand trapping by Groin #1 on its north (upcoast) side.

Figure 9 shows the maximum, minimum, and average shoreline positions around Groin #1 for available photos spanning 1950 to 2009. The small seaward inflection in the line from station -3+00 to station -1+00 reflects the "updrift fillet." (A fillet is a wedge of dry-sand beach that tends to accumulate on the north side of each groin at Pawleys Island after periods of waves from the north.) The maximum (seaward) shoreline position reflects onshore movement of sand bars during fair-weather conditions (producing a seaward shift of the high waterline). The minimum shoreline position generally reflects post-storm conditions and beach recession, such as the period after Pawleys Inlet shifted north in July 1969. The inlet channel encroached stations 2+00 and 3+00 (200-300 ft south of Groin #1) in the early 1970s.

There is a moderate to low correlation between the degree of shoreline offset at Groin #1 and the position of Pawleys Inlet. Figure 10 plots relative inlet position (distance downcoast divided by 10) against the shoreline offset at Groin #1. Positive values (>0) in offset mean the beach along the county parking area is seaward of the beach north of Groin #1. The results show moderate correlation between the two measures with values around 0.5 for the periods 1850-2010 and 1983-2010. For the period 1990-2010, the correlation coefficient falls below 0.4.

There is an obvious adverse relationship between inlet position and shoreline recession at the county parking area in the 1970s. When the inlet shifted north around 1969, it drew sand off the south spit and created a channel through the present-day parking area. This condition is likely to recur as long as there is a limited supply of sand within the Pawleys Island groin field. Present conditions are increasingly favorable for a breach of the developed or undeveloped sections of Pawleys spit because of a lack of dunes and general sand deficiencies along the beach. After the 1969 breach channel equilibrated (through the present county parking area) and resumed its southerly migration, shoreline offsets around Groin #1 diminished.

For all but one date after 1983 when the inlet was situated at least 1,000 ft from Groin #1, the shoreline offset at Groin #1 was less than 50 ft. Further, during the past 25 years, there is no clear relationship between shoreline offset (ie – erosion at the county parking area) and inlet position. This period includes the effect of Hurricane *Hugo* (1989), post-*Hugo* sand borrowing from attached inlet shoals (1990), and the sand borrowing from the channel and attached shoals in 1999.

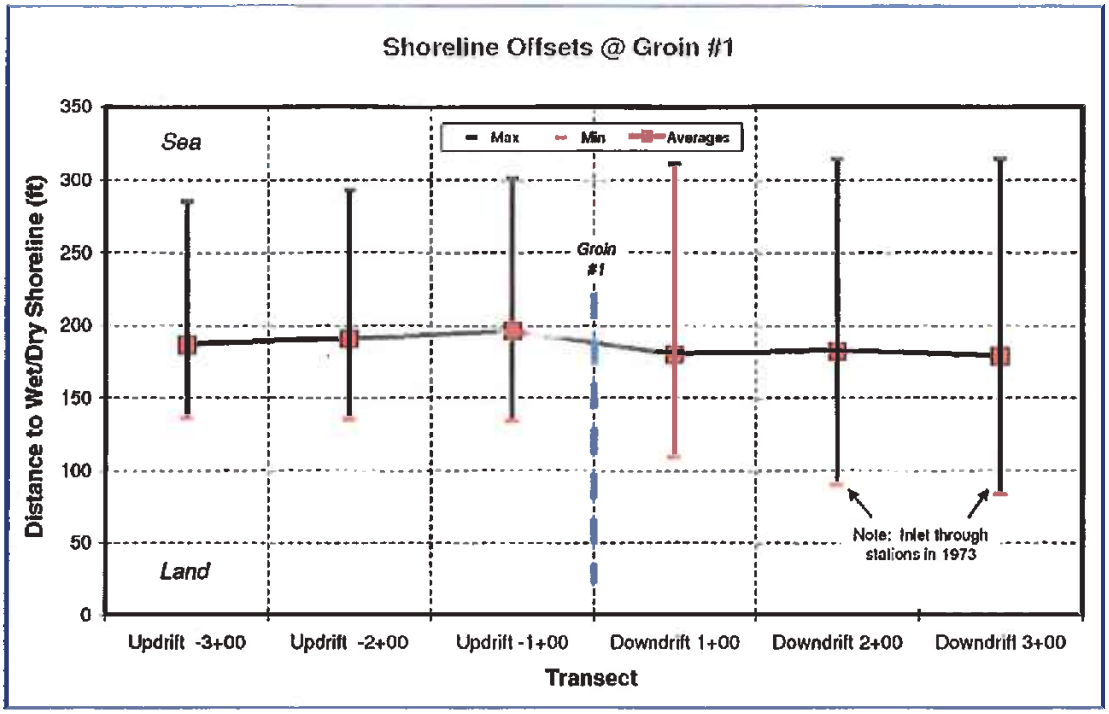


FIGURE 9. Maximum, minimum, and average shoreline positions north (updrift) and south (downdrift) of Groin #1 for available data spanning 1950 to 2009. Note relatively small average offset across the groin.

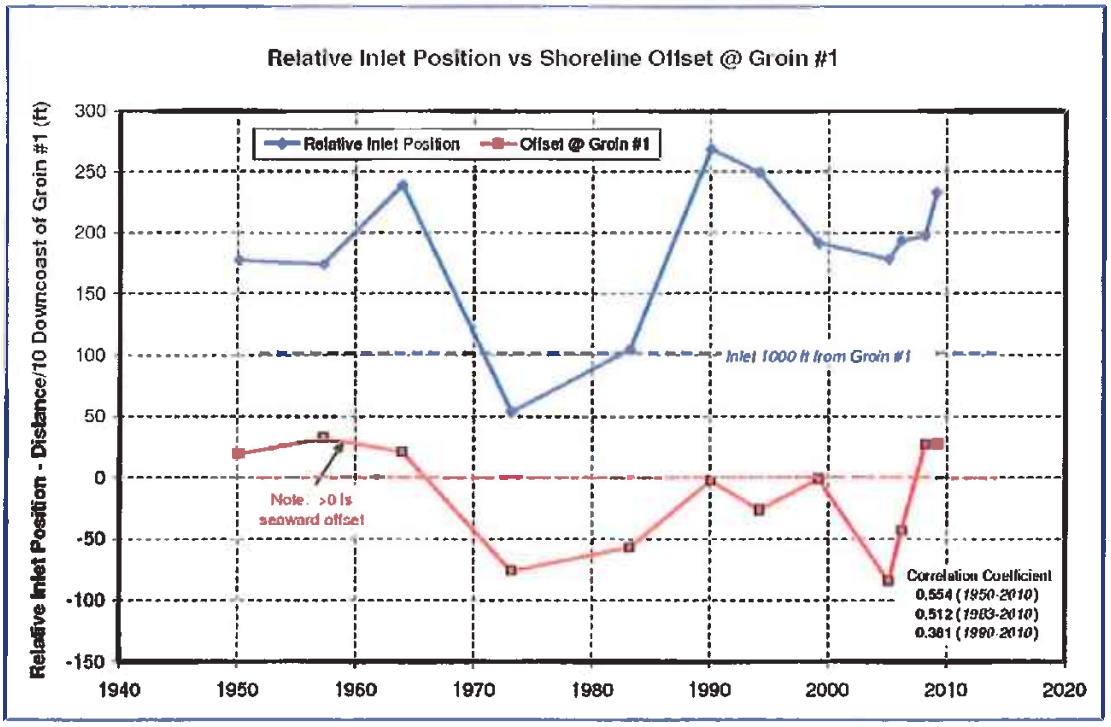


FIGURE 10. Relative inlet position (inlet centerline distance divided by 10) versus shoreline offset (red) at Groin #1. Correlation between the two measures is moderate to fair. Periods of high negative shoreline offset (ie – >50 ft) are more likely to be periods of erosion along the county parking area.

3.2 Likelihood of Spit Breaching

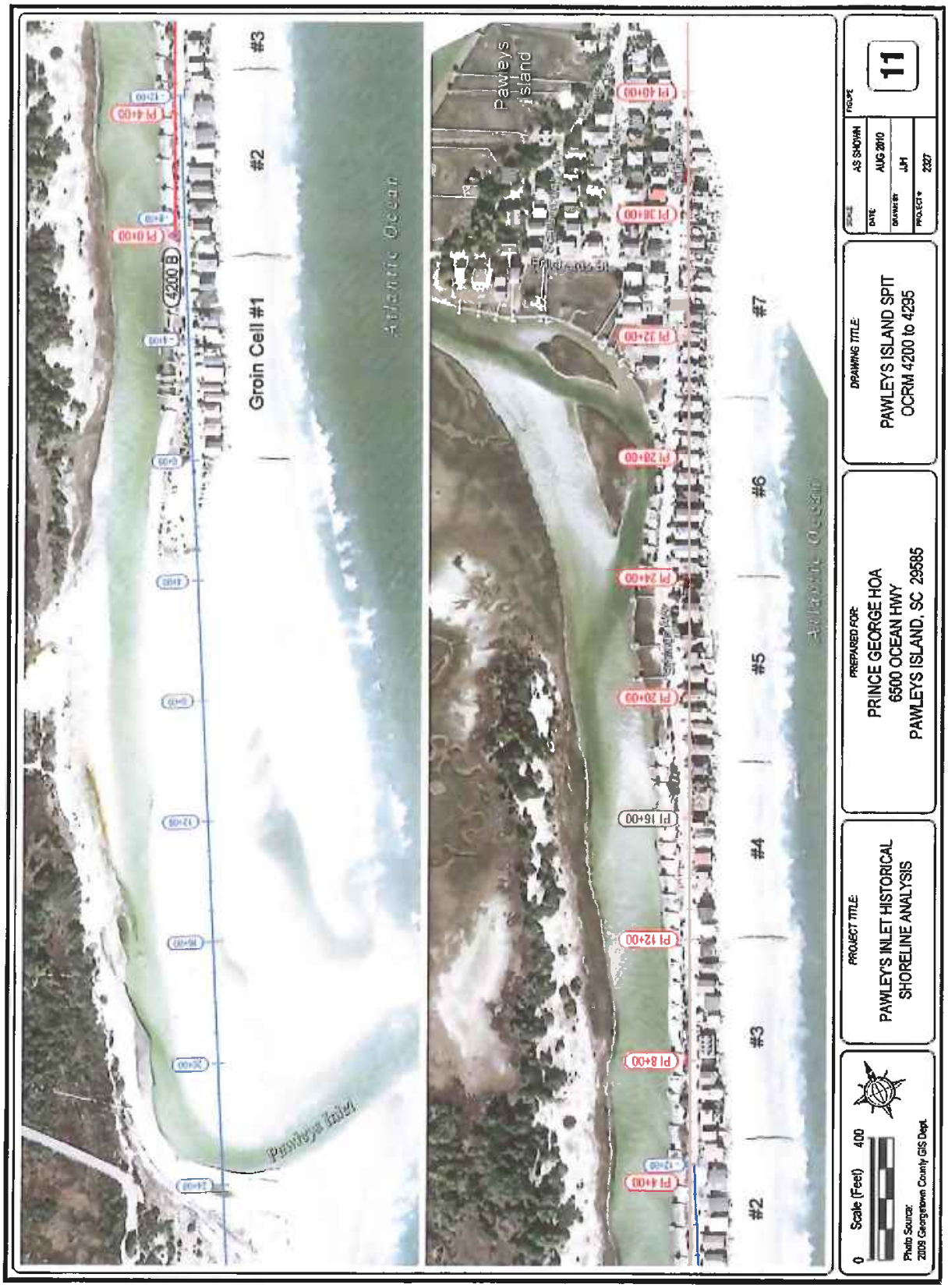
Pawleys spit has generally uniform width and elevation from Pritchard Street to the inlet. Figure 11 shows conditions in 2009 within the groin field. The typical width of the spit from high water on the ocean side to high water on the creek side is 150-180 ft. Figure 12 illustrates how narrow the spit is, with little room for the main access road and one row of houses. The foredune tends to be low or non-existent in groin cells 1-6, making the spit vulnerable to breach events. A typical elevation across Pawleys spit is 7-8 ft NGVD. Ocean waves frequently run up to these elevations. The foredune (see Fig 12-lower) provides some protection during minor storm events but with a base less than 30 ft wide, it is inadequate for absorbing storm-wave energy. Once the foredune is eroded, storm waves tend to wash over the spit.

A measure of the breach vulnerability is the relation between the stillwater flood level on the creek side of the spit and the typical spit elevation. FEMA (1989) predicts a "10-year" storm surge of ~6.6 ft NGVD and a "20-year" surge of ~8.0 ft. At these stillwater levels, there is nearly guaranteed to be a connection between the tide in Pawleys Creek and ocean waters on the seaward side, somewhere along the spit. Whether such connections produce a complete breach depends next on the duration of the surge and whether scour across the spit (due to differences between the ocean water level and creek water levels) has sufficient energy to cut a section away. The narrowness of Pawleys spit increases the chance of a complete breach because little volume must be removed to keep pace with the falling tide (cf – Kraus 2003).

Obviously at higher return periods (less frequent events), the storm surge and duration of erosive tidal flows across the spit will be even greater than the 10-year or 20-year return-period events. While the likelihood of a breach increases with storm-surge elevations, it is still difficult to predict exactly where breaches will occur. Empirical data suggest that the pre-storm spit cross-sections with the lowest elevations above high water and the narrowest widths will most likely breach. Other factors which influence breach locations are the presence of driveways perpendicular to the shoreline which provide easy pathways for return flows (Nummedal 1983).

FIGURE 11. (following page) Pawleys Island spit in March 2009 showing general uniformity in width (~150-180 ft) between high water on the ocean side and Pawleys Creek. The majority of houses along the spit lack dune protection. The red reference line shows stations used during the 1999 beach restoration project. [Image courtesy of Georgetown County GIS Department]

Appendix B



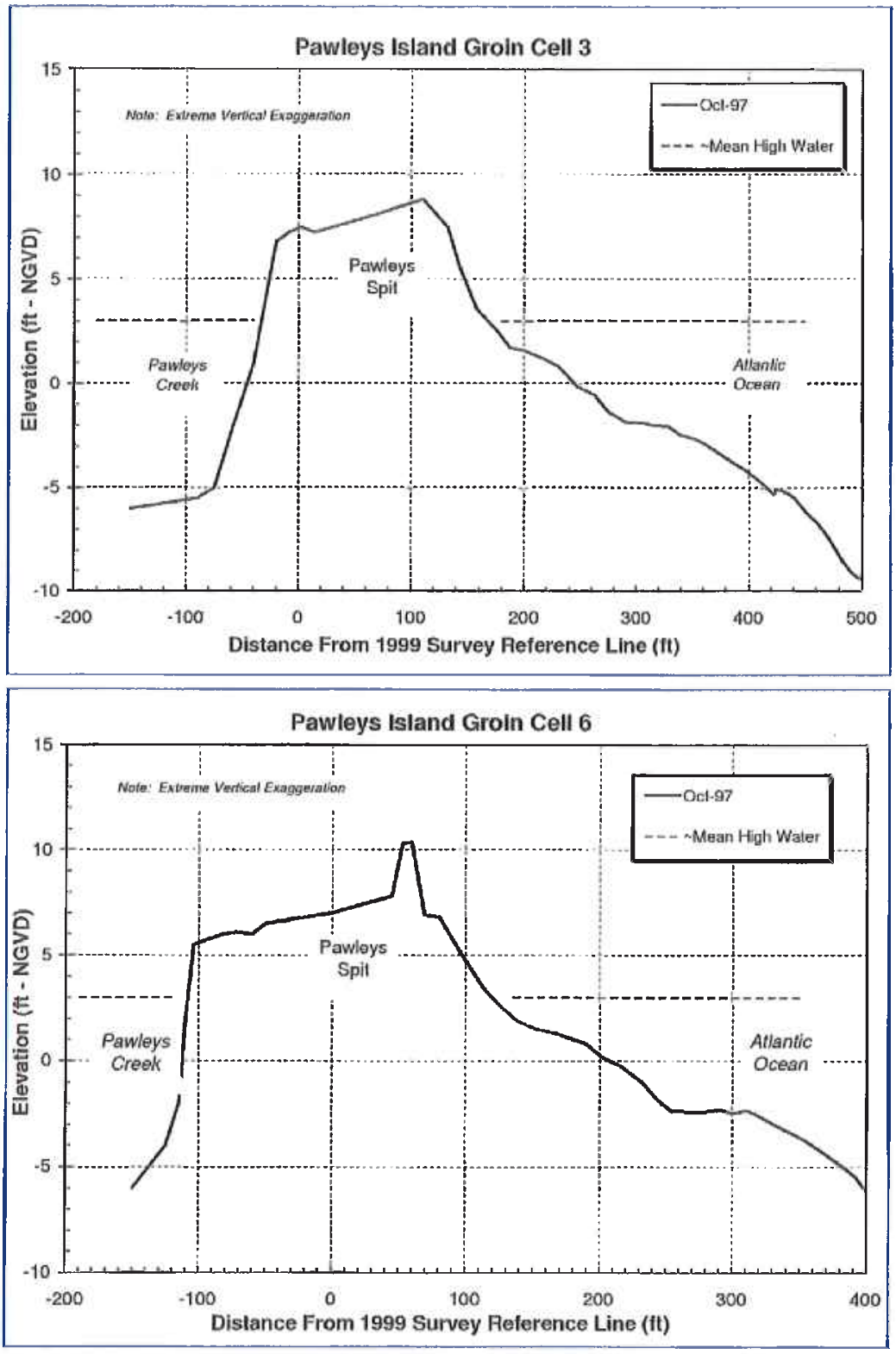


FIGURE 12. Typical sections through Pawleys spit (see Figure 11 for localities) showing low elevations relative to mean high water and narrow separation between Pawleys Creek and the ocean.

In the case of Pawleys spit, breach potential is reduced in relation to the position of the inlet. When the inlet is in a northerly position, the tidal prism of the Pawleys creek system discharges more efficiently because of the shorter path of the inlet. The faster storm tide levels in the marsh return to normal, the shorter the time over which a new inlet can scour through the spit. While the most hydraulically efficient location for Pawleys Inlet would be in the vicinity of groin cells 6 or 7 (see Fig 11), such a location is impractical given the development. Continuing vulnerability of Pawleys spit to a breach event points to the need for a breach contingency plan such as some states have contemplated (eg – USACE 1996).

4.0 DISCUSSION AND FINDINGS

When Pawleys Inlet shifts north, it leaves an abandoned channel on the downcoast side which is quickly sealed off by sand bars. This creates a "cat-eye" pond (Hayes 1976) similar to area "P" in Figure 1. That pond in 2006 was a remnant of the one formed around 1999 when excavations shifted the channel north. An earlier cat-eye pond (from the 1970s) is visible at the top of Figure 13, an oblique aerial photograph taken at low tide on 15 May 1985 when the entrance channel was positioned about 1,200 ft south of Groin #1. Note in this configuration the updrift shoals of Pawleys Inlet (between Groin #1 and the mouth of the inlet) formed an extensive swash platform seaward of Pawleys spit.

Figure 14 illustrates the sand-trapping effect of inlets. In fact, the immediate updrift beach at many South Carolina inlets tends to be stabilized by the inlet shoals, much like a fillet on the updrift side of a groin. The principal difference is the large scale of sand trapping by inlets relative to most groins. As Figure 13 shows, the inlet retains an intertidal shoal platform (area A) on the north side which is nearly as large as the dry-sand area of the spit (south of Groin #1). By comparison, Groin #1 traps a tiny fillet.

In CSE's opinion, there is likely to be an optimal position of the inlet which will trap sand and hold the Pawleys spit shoreline in place while protecting the county parking area. The configuration of the inlet in 1985 was not necessarily optimal for today's parking area, but it shows a relatively healthy, dry beach. Sand volumes and beach width along fillets decrease with distance from the channel entrance. As Figure 14 implies, the beach in the vicinity of the county parking area on Pawleys spit is likely to be wider when the inlet is further north (upper sketch), but obviously not immediately adjacent to Groin #1.

Figure 13 illustrates what Pawleys Inlet would look like if the channel were maintained within the recommended ~1,100-ft corridor (see Fig 1). There would be at least 1,000 ft of dry beach between Groin #1 and the inlet. The downcoast beach at Prince George would similarly retain a buffer zone of at least 500 ft between the channel and community infrastructure.

The history of Pawleys Inlet suggests the following future trends with implications for the Pawleys Island community and the Prince George community.

FIGURE 13. Pawleys Inlet at low tide on 15 May 1985 when the channel was positioned about 1,200 ft south of Groin #1 (visible near the lower center of the photo). Note the intertidal shoal platform (area A) on the updrift side of the inlet which acts as a fillet and helps maintain the spit. An abandoned channel ("cat-eye" pond) is at the top of the image.

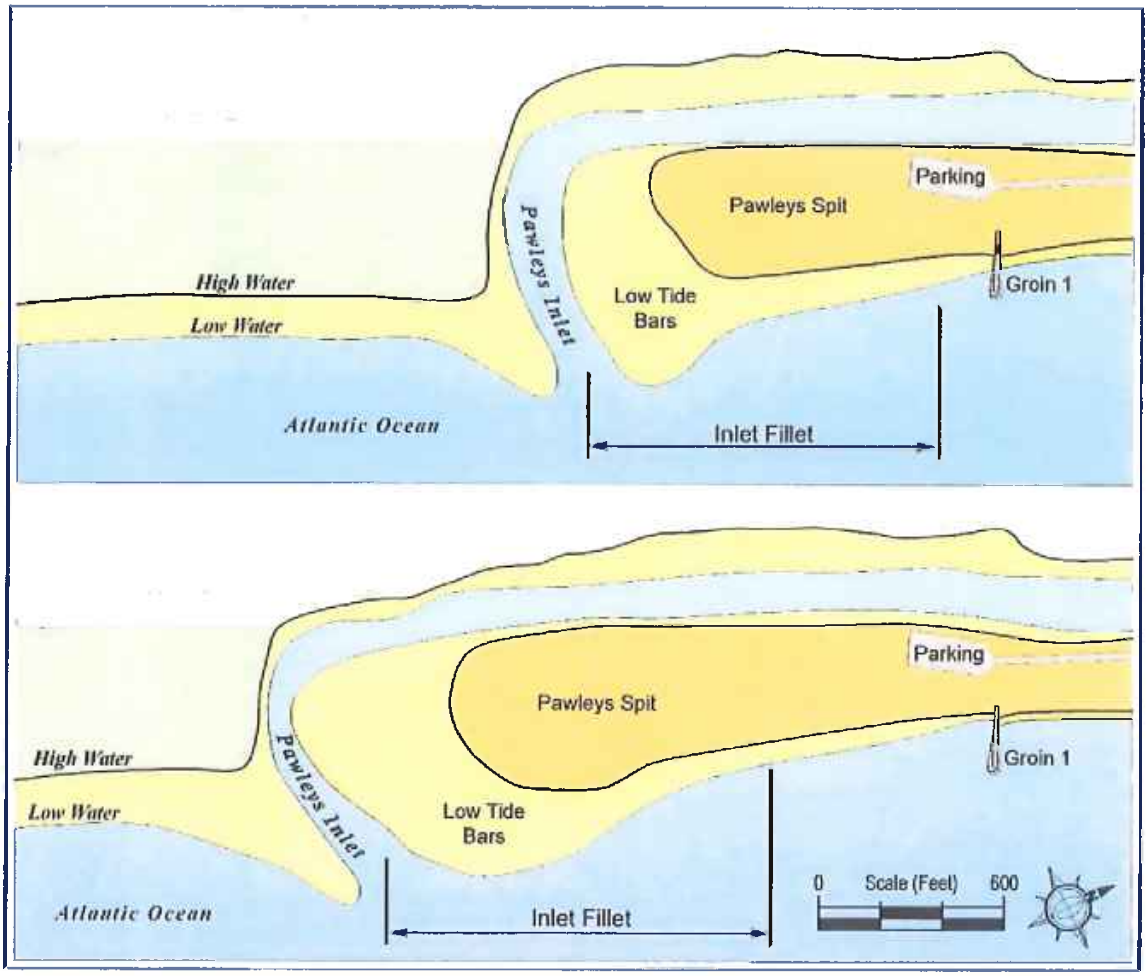


FIGURE 14. The shoals of Pawleys Inlet extend seaward and produce an inlet "fillet" (accumulation of sand on the updrift side of the channel). The fillet produces a bulge in the high waterline along the spit and helps maintain its stability. As the inlet shifts south (lower image), the positive effect of the fillet is displaced, leaving updrift areas with a narrower beach.

- Southerly migration will remain the dominant underlying trend with an expected long-term average rate in the range 20-40 ft/yr (cf – Figs 6 and 7).

- All of Pawleys Island spit from Pritchard Street to the present inlet will remain vulnerable to a breach event during a major storm.

- Hurricane surges are more likely to trigger breach channels through the spit because they typically produce highest tides; however, strong northeasters have produced breaches of the spit.

- Pawleys Inlet becomes less hydraulically efficient the further south it is positioned. This increases the likelihood of a breach through Pawleys spit.

- Where spit width, cross-section volumes, and dune elevation are at minimum values, breach potential is greatest. For Pawleys spit, this tends to be the area between the center and the updrift end of each groin cell.

- Breach potential is partially mitigated when the inlet is positioned further north.

- The updrift fillet associated with Pawleys Inlet is effective in holding and trapping excess sand along Pawleys spit over a distance of ~1,000-1,500 ft based on the size of the inlet. The stabilizing effect of the fillet migrates with the inlet.

- A planned nourishment project by the US Army Corps of Engineers (USACE 2004), if implemented, would produce a large influx of sand along Pawleys spit which would tend to feed the longshore transport system and shift the inlet further south (via the process of spit growth). While positive for updrift areas, further southerly migration of the inlet would cause encroachment on Debidue Beach and Prince George. A plan to control the position of the inlet, such as the IMZ outlined herein, would mitigate this problem.

4.1 Impacts Along the Mainland Shoreline of the Inlet

Pawleys Inlet migrates primarily due to spit growth. The channel elongates more or less parallel to the spit following its historical corridor. With inlet migration, the mainland shoreline in the lee of the entrance channel becomes more exposed to ocean waves. When ocean waves penetrate the entrance, they cause erosion on the mainland beach through the simple process of flattening of the profile*. As the entrance migrates past an area of

the mainland, some natural recovery and accretion occur because the spit shelters the mainland shore once again.

> *The slope of a beach varies in relation to wave energy and sediment size (Komar 1998). High waves tend to produce more gently sloping profiles, whereas low waves allow steeper profiles to develop. Thus, the beach along the oceanfront tends to be flatter and wider than the beach on the lagoon side of Pawleys spit. The mainland shoreline varies according to its exposure to the mouth of Pawleys Inlet. When the mouth is opposite a segment of mainland beach, there will be a tendency for erosion of the upper beach and deposition along the low-tide beach.

While localized erosion on the western side of Pawleys Inlet is a concern and has impacted an existing waterline (J Avant, pers comm, June 2009) and property owned by the University of South Carolina (R Rockafellow, pers comm, August 2009), its extent is likely to be limited to a corridor similar in scale to the width of the existing inlet channel (ie ~ ~200 ft). Erosion along the mainland shoreline may have been exacerbated by large-scale sand borrowing along the spit in 1990 (after Hurricane *Hugo*) or in 1998 in connection with a Town nourishment project. Regardless of the cause of erosion, today there is negligible high ground between Pawleys Creek and interior wetlands (Tipperary Pond).

The principal impacts of erosion along the mainland shore of the inlet are encroachment into existing wetlands and conversion of some fresh or brackish water habitat to saltwater habitat (Fig 15). Infrastructure such as power lines or water lines, if needed, could be relocated under the channel and wetlands by way of horizontal directional drilling (HDD) with minimal impact on the wetlands. In 2006, the narrow sand ridge separating the inlet from interior wetlands had a small breach channel connecting with Pawleys Inlet (visible on Figure 15). Virtually all the adjacent wetlands on the Prince George side of the inlet are vulnerable to breaches such as this with resulting transformation of the wetlands to saltwater habitat.

FIGURE 15. Pawleys Inlet in March 2006 showing (right to left) an incipient channel through the end of Pawleys spit at ~1,000 ft south of Groin #1, the main entrance channel ~2,000 ft south of Groin #1, and a remnant channel ("cat-eye" pond) on the Debidue Island side of the inlet. Note the breach of the mainland shoreline north of Pawleys spit (dry-sand area). The breach channel has created a connection with the large brackish water impoundment, Tipperary Pond. Continued southerly migration of Pawleys Inlet increases the likelihood of a breach into Canvasback Pond, which contains extensive fresh-water wetlands.

4.2 Recommended Steps for Implementation of an IMZ for Pawleys Inlet

Based on the foregoing analysis of Pawleys Inlet, CSE expects continued southerly migration and encroachment on Prince George development and infrastructure. It is also clear that the developed portion of Pawleys spit south of Pritchard Street will remain highly vulnerable to a breach event during hurricanes unless the beach is widened and a protective dune of significant dimension can be established seaward of houses.

An IMZ for Pawleys Inlet whereby the entrance channel is maintained within a limited corridor is recommended for several reasons:

1) Reduces channel encroachment on Prince George property by providing some minimum buffer.

2) Reduces the breach potential along the developed portion of Pawleys spit and the county parking area.

3) Provides a soft (non-structural) solution to erosion consistent with existing CZM rules and regulations.

4) Maintains a buffer and recreational beach on the Pawleys Island side of the inlet with easier access to the inlet entrance compared with periods when the inlet is approximately one-half mile from the county parking area.

5) Can be implemented as needed, allowing the channel to move naturally for periods of ~4–10 years (ie – periods reflecting various inlet migration rates over an ~1,100-ft corridor).

6) Excavations necessary to effect each inlet realignment can be recycled back to erosion hot spots along Pawleys spit and used to build up the foredune. A relatively small volume (order of 5,000–20,000 cy) is required to relocate the channel (versus ~250,000 cy excavated by the town of Pawleys Island in 1998 for nourishment).

7) The updrift fillet associated with Pawleys Inlet is more likely to favorably impact the county parking area if the inlet is ~1,000–2,000 ft south, compared with its effect when the entrance is >2,000 ft south.

To implement an IMZ for Pawleys Inlet, CSE recommends the following next steps.

- Convene a meeting with community representatives to discuss the issues and conceptual plan (ie – Town of Pawleys Island, Georgetown County, University of South Carolina, and PGCA).
- Identify outstanding questions and develop analyses of impacts of an IMZ on adjacent property owners.
- Identify potential environmental impacts (and opportunities) and present findings to state and federal resource and regulatory agencies.
- Meet with regulatory agencies and discuss the conceptual plan and permitting requirements.
- Develop a cost of implementation based on regulatory requirements and realistic assumptions of project frequency.
- Prepare and submit a permit application.
- Prepare and submit supporting environmental documents.
- Develop a long-term funding and maintenance plan.

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ACKNOWLEDGMENTS

This report was prepared at the request of representatives of the Prince George community (c/o Henry Faison). The purpose of the report was to provide a history of the inlet and prognosis of future changes, preliminary to development of an inlet management plan for Pawleys Inlet.

CSE thanks Phillip Lammonds (general manager) and Johnny Avant (maintenance superintendent) for providing access and general information on the Prince George infrastructure. CSE also benefitted from discussions with Pawleys Island's mayor, William Otis Jr., along with University of South Carolina's director of the Development Foundations, Richard Rockafellow, and director of University Foundations, Professor Jerome Odom.

CSE acknowledges and appreciates the historical data, maps, surveys, and photographs provided by various agencies listed in Table 1. Trey Hair assembled the data and prepared the shoreline and channel delineations and graphics. The analysis and report were prepared by Dr. Tim Kana (SC PG 564) with technical support by Trey Hair and Diana Sangster.

APPENDIX 1

Opinion Letter

from TW Kana to H Faison

(dated 4 September 2009)

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September 4, 2009

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RE: Prince George Community Association – Pawleys Inlet Erosion (SC) [CSE 2327]

Dear Mr. Faison:

This letter is in response to your 14 July request for an opinion regarding erosion at Pawleys Inlet in the vicinity of your property at Prince George (SC) and a proposal by Georgetown County to construct a terminal groin at the south end of the County parking area on Pawleys Island spit.

I have reviewed the permit application for the groin, the study by ATM which recommends the groin, and certain historical data regarding migration of Pawleys Inlet and periodic breaching of the spit downcoast of the parking lot. This opinion is based on a site visit and meeting with you on 13 August 2009.

Inlet Movement and Erosion

Pawleys Inlet has a history of southerly migration (toward Debidue) and periodic spit breaching within an ~3,000 foot (ft) inlet corridor marked on the enclosed 2006 orthophotograph (source: SCDNR). Your property (labeled "A") was fronted by a "cat-eye" pond in 2006 (labeled "P"). This pond is a relict inlet channel from circa 1990 when the inlet was situated close to its southernmost limit.

Because Pawleys spit is narrow and low, it is frequently overwashed, and incipient channels come and go across the spit. A secondary channel is clearly visible on the 2006 aerial. Secondary channels become the primary inlet channel once they capture most of the tide exiting Pawleys Creek. The former channel becomes blocked with sand, leaving an isolated "cat-eye" pond such as "P".

As the inlet shifts, there is a natural tendency for erosion to occur along the Prince George shoreline in the lee of the channel. Waves move through the inlet, cross Pawleys Creek, and break on the adjacent shoreline. This focused wave energy causes localized erosion; however, it tends to be limited in its landward extent because the inlet keeps migrating.

From the mid 1970s to early 1980s, Pawleys Inlet was situated close to the last house on Pawleys spit. There was no public parking lot at that time. As the spit grew south after 1980, about 300 ft at the northern end were cordoned off for public parking. Georgetown County has had to shore up the area of the parking lot because of localized erosion immediately downcoast of the existing groin field. A new "terminal" groin is proposed for the southern end of the parking lot for purposes of holding a protective beach in place. At ~225 ft long, it will be positioned ~300 ft south of the existing groin. **Plans call for the new terminal groin to be filled to capacity using sand from an inland source (~5,000 cubic yards).**

Sand Trapping by Groins and Inlets

A common concern with any groin is its tendency to trap sand that would otherwise move downcoast. That is why nourishment is prescribed in connection with groin construction along the South Carolina coast. By nourishing the upcoast groin "cell", other sand will move unimpeded around or over the new groin. The scale of sand trapping by the groin will be small in comparison with the volume of sand on Pawleys spit or the volume trapped within the seaward shoals of the inlet. (Combined, this represents nearly 1 million cubic yards, or about 200 times more sand than the groin can hold.) Viewed another way, the terminal groin will influence a relatively short segment of coastline over any given time frame compared with the zone of influence of Pawleys Inlet. The zone of influence (accretion on the updrift side and erosion on the downdrift side) is proportional to the volume trapped.

Cause of Erosion Along Your Property

Since 2006, Pawleys Inlet has migrated hundreds of feet to the south. It now fronts your property and is encroaching on the Prince George shoreline, leaving erosional escarpments and threatening a breach into Canvasback Pond. This erosion is a direct result of the inlet channel fronting your property. The opening brings larger waves onto your shoreline.

Based on historical trends, I would expect erosion to continue and cause a breach of the remaining dune ridge into Canvasback Pond. In my opinion, erosion is not likely to penetrate to your house. The land where it sits has been stable for at least a century. The landward margin of Pawleys Creek has not encroached that far landward in historic times. Erosion along your property would quickly abate if the inlet were shifted to a more northerly position along the spit. If its southerly migration continues, it will threaten the access road to properties along the Prince George oceanfront. This should be apparent given its present encroachment on you boardwalk, which is only ~180 ft from the access road.

In all probability, Pawleys spit has built in elevation as well as length in the past decade. Present elevations across the spit appear to be above the normal high-tide wave limit, so there are no

incipient breach channels or secondary inlets. Clearly, the healthier and higher the spit is (updrift of your property), the less chance there is of a breach.

Inlet Management Plan

Sections of the coast near tidal inlets are inherently less stable than areas away from inlets. Pawleys Inlet is an ephemeral, shallow inlet cut into modern sandy deposits that are easily eroded. Unlike such positionally stable inlets as Price, Capers, or Stono to the south, inlet migration will continue to occur in relation to the influx of sand along the spit. Northeast waves will drive sand south and force the inlet to migrate. **This natural process can be managed by periodically realigning the channel to an updrift position across the spit.**

Given the interests of Pawleys Island and Georgetown County in maintaining parking and public access along the spit and the Prince George community's interest in preventing encroachment of the inlet on developed property, **CSE recommends establishment of an inlet management zone for the area**. It is feasible and cost-effective, in my opinion, to maintain the inlet within a defined corridor, such as the zone identified on the enclosed drawing. While inlet position at any time is difficult to predict given the irregularity of historical breaches and channel realignments, the inlet can be maintained in a narrower zone by strategic excavations of pilot channels across the spit. Such work could be triggered when the channel moves outside the inlet corridor (in either direction). The indicated corridor would provide a minimum ~800-ft buffer zone for beachgoers at Pawleys spit and a similar zone for Prince George. A relatively small volume (order of 5,000–10,000 cubic yards) would have to be excavated across the spit to initiate channel realignment in most cases. Excavations could be hauled by truck to erosion hot spots elsewhere on Pawleys Island. Costs of such projects are directly proportional to the volume moved, with unit costs expected to be in the range $5–$10 per cubic yard in today's market.

A primary advantage of establishing an inlet management zone is it reduces the threat of erosion and property loss to either side of the inlet. When the inlet is shifted northward, the abandoned inlet shoals feed Debidue Beach.

Impact of the Proposed Terminal Groin

In my opinion, the proposed terminal groin will have an immeasurable impact on Prince George property or the position of Pawleys Inlet. If it were many times longer and no nourishment accompanied the project, the groin would likely cause severe local recession of the northern portion of the spit. This might have the beneficial (to Prince George) effect of triggering a breach and realignment of Pawleys Inlet closer to the parking lot. However, the small scale of the structure (~225 ft long) and its concomitant nourishment mean there will be little adverse impact along the majority of the spit and **no measurable impact on your property.**

As a practical recommendation, I believe it would be beneficial to your community as well as Georgetown County and Pawleys Island if **the groin permit were modified such that the nourishment sand is excavated from Pawleys spit (within the recommended corridor) in a way that promotes relocation of the inlet.** A pilot channel ~400 ft long by ~75 ft wide by ~6 ft deep (across the spit) would provide sufficient volume to fill the new groin cell and initiate inlet relocation.

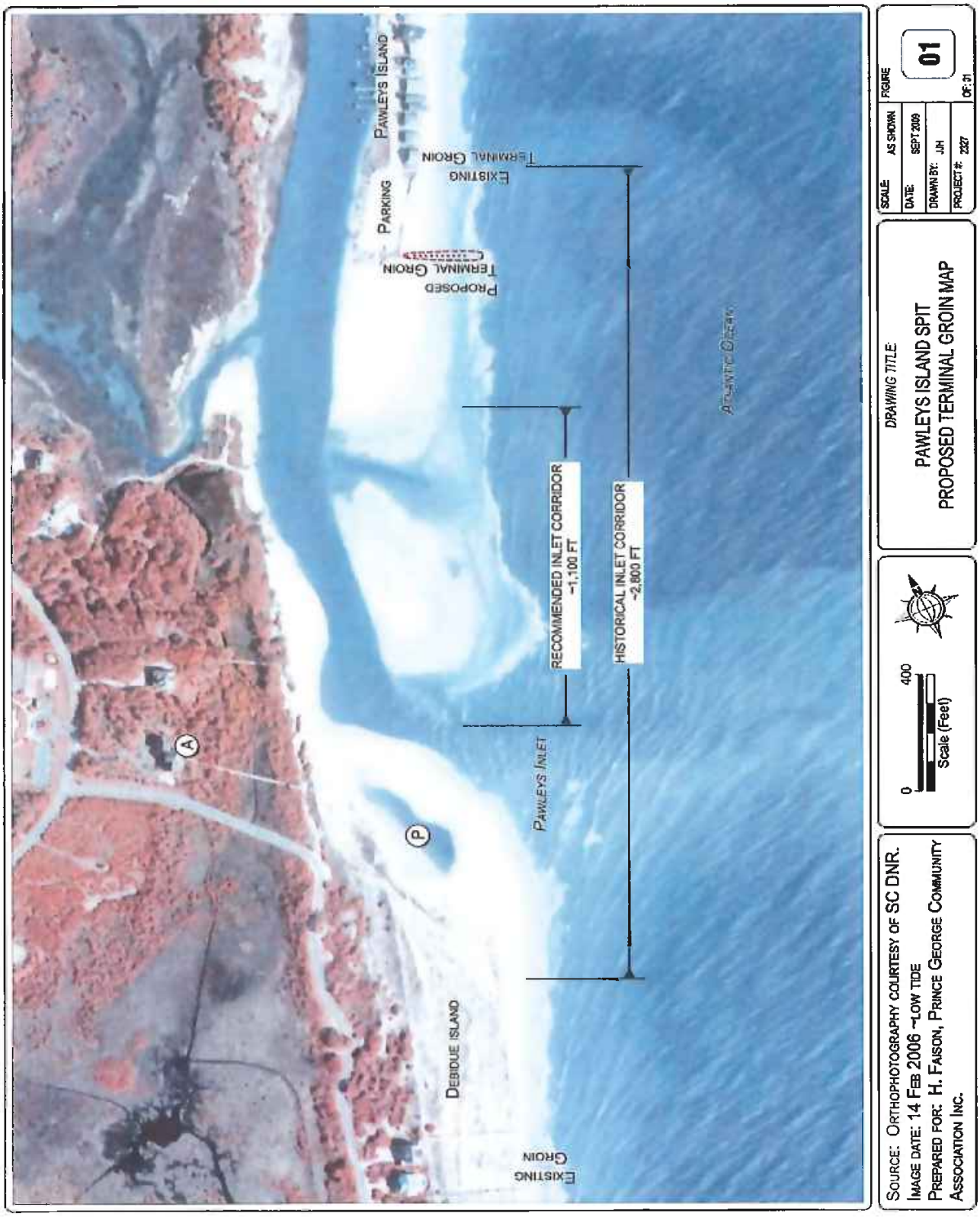
Please contact me if you have any questions about these findings and recommendations. Thank you for your consideration.

Yours truly,

Timothy W Kana PhD (PG 564)
President

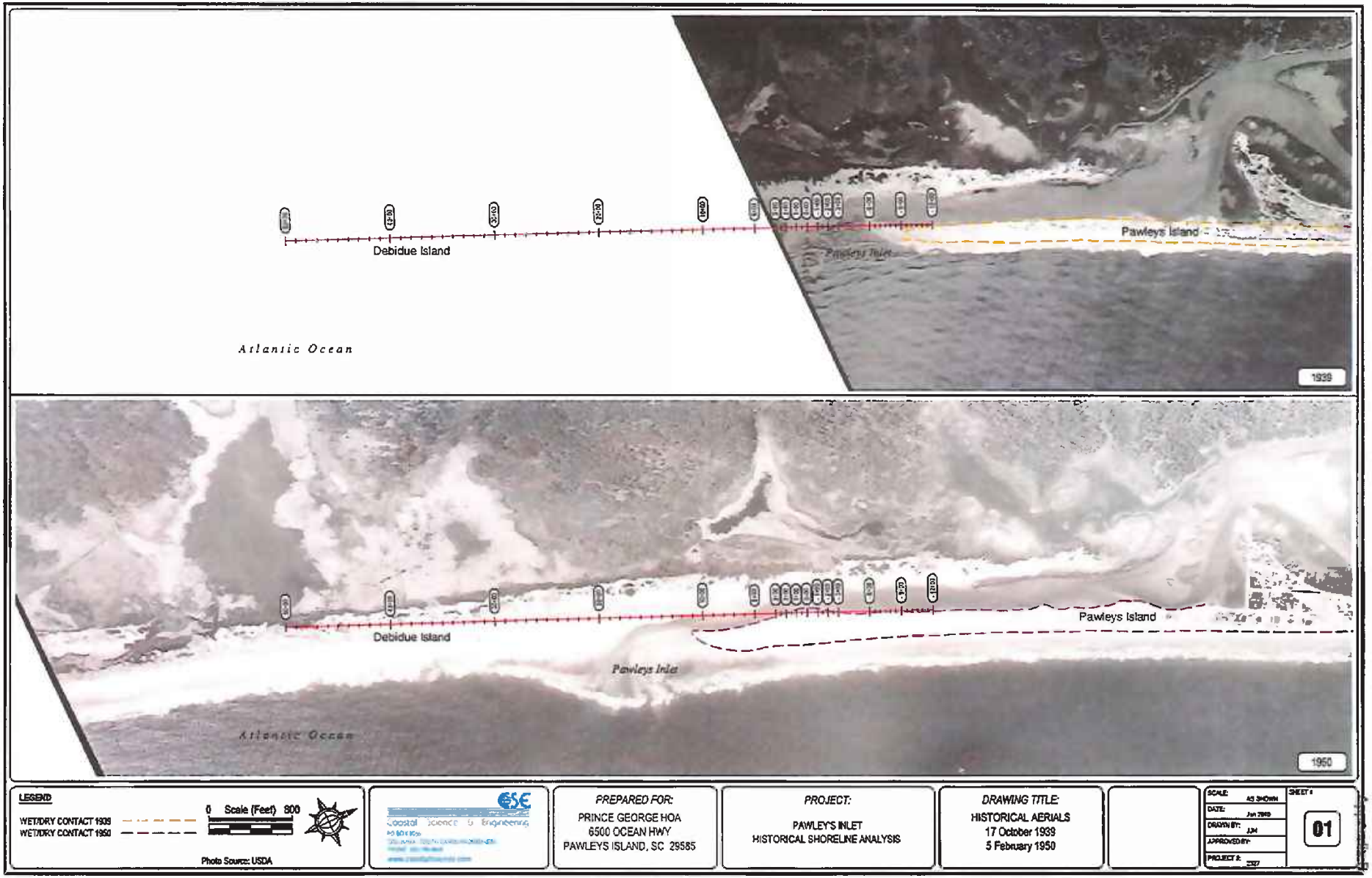
Enclosure

cc: Phillip Lammonds



APPENDIX 2

Aerial Photographs



LEGEND

WET/DRY CONTACT 1939

WET/DRY CONTACT 1950

0 Scale (Feet) 800

Photo Source: USDA

ESE Coastal Science & Engineering

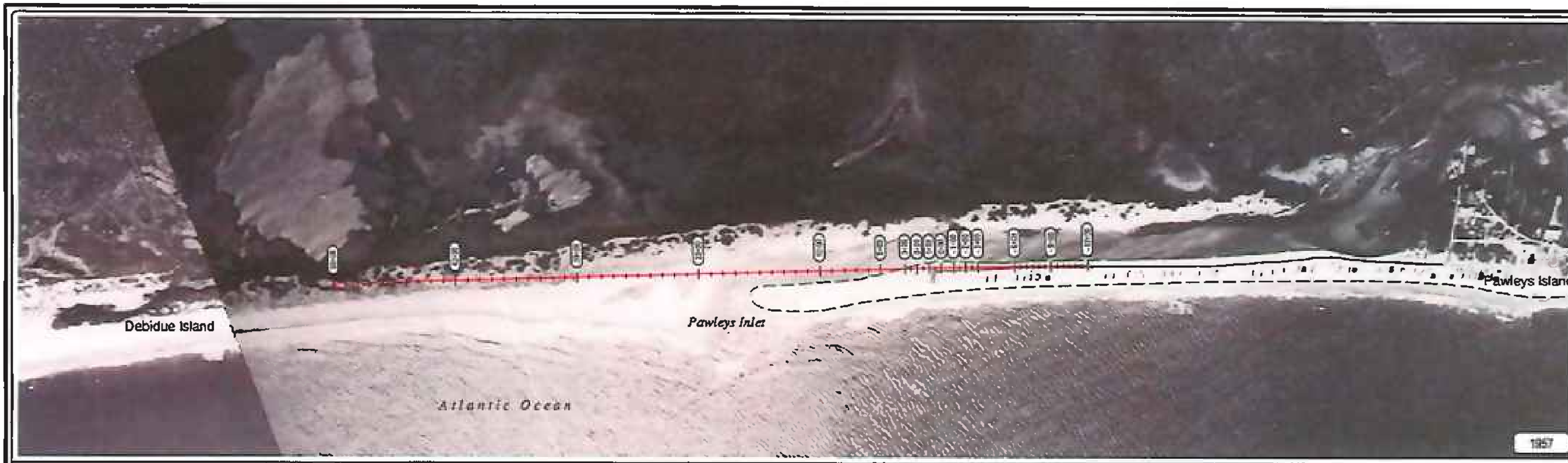
PREPARED FOR:
PRINCE GEORGE HOA
6500 OCEAN HWY
PAWLEYS ISLAND, SC 29585

PROJECT:
PAWLEY'S INLET
HISTORICAL SHORELINE ANALYSIS

DRAWING TITLE:
HISTORICAL AERIALS
17 October 1939
5 February 1950

SCALE: AS SHOWN
DATE: Jun 2019
DRAWN BY: JJH
APPROVED BY:
PROJECT #: 2327

SHEET #
01



LEGEND

WET/DRY CONTACT 1957

WET/DRY CONTACT 1963

0 Scale (Feet) 800

Photo Source: USDA

CSE

PREPARED FOR:

PRINCE GEORGE HOA
6500 OCEAN HWY
PAWLEYS ISLAND, SC 29585

PROJECT:

PAWLEY'S INLET
HISTORICAL SHORELINE ANALYSIS

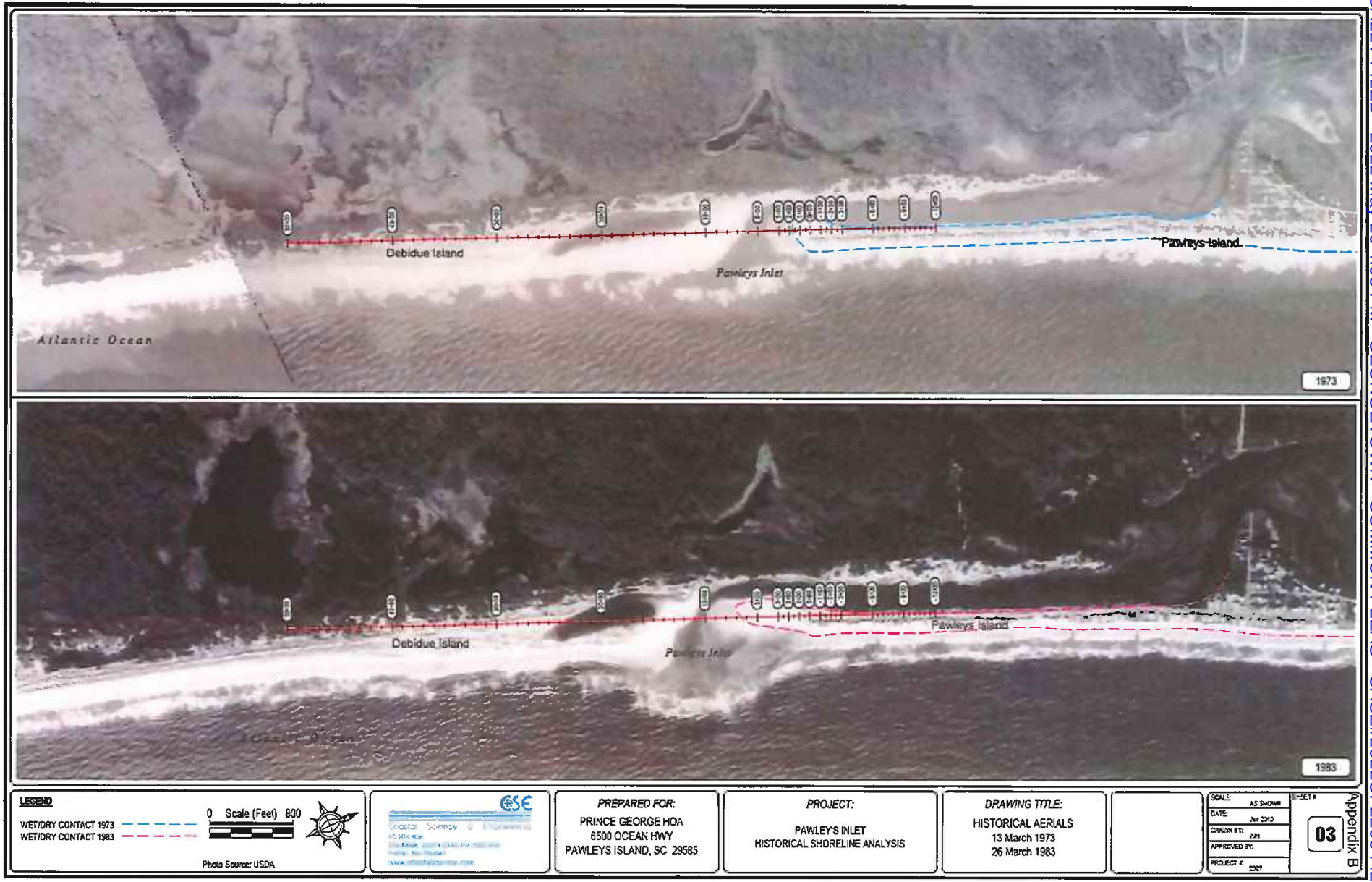
DRAWING TITLE:

HISTORICAL AERIALS
7 April 1957
5 December 1963

SCALE: AS SHOWN
DATE: Jan 2010
DRAWN BY:
APPROVED BY:
PROJECT #:

SHEET #
02

Appendix B



LEGEND

WET/DRY CONTACT 1990
WET/DRY CONTACT 1994

0 Scale (Feet) 800

Photo Source: USDA and SCDNR

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PRINCE GEORGE HOA
6500 OCEAN HWY
PAWLEYS ISLAND, SC 29585

PROJECT:

PAWLEY'S INLET
HISTORICAL SHORELINE ANALYSIS

DRAWING TITLE:

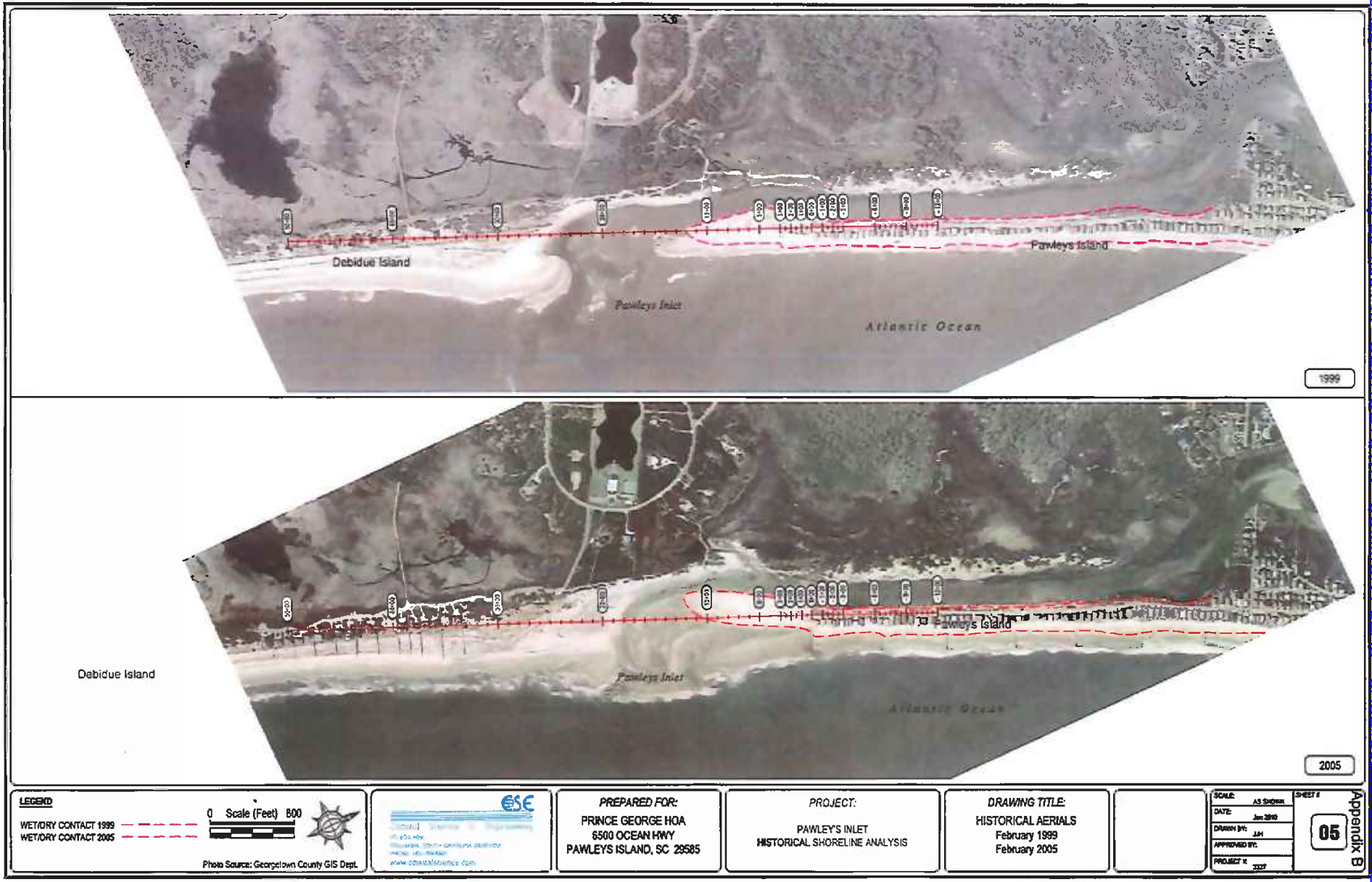
HISTORICAL AERIALS
27 January 1990
15 March 1994

SCALE:	AS SHOWN
DATE:	
DRAWN BY:	
APPROVED BY:	
PROJECT #:	2127

SHEET #

04

Appendix B



LEGEND

WET/DRY CONTACT 1999

WET/DRY CONTACT 2005

0 Scale (Feet) 800

Photo Source: Georgetown County GIS Dept.

PREPARED FOR:
PRINCE GEORGE HOA
6500 OCEAN HWY
PAWLEYS ISLAND, SC 29585

PROJECT:
PAWLEY'S INLET
HISTORICAL SHORELINE ANALYSIS

DRAWING TITLE:
HISTORICAL AERIALS
February 1999
February 2005

SCALE: AS SHOWN
DATE: Jan 2010
DRAWN BY: JJH
APPROVED BY:
PROJECT #: 2337

SHEET #
05

Appendix B

LEGEND

WET/DRY CONTACT 2006

WET/DRY CONTACT 2008

0 Scale (Feet) 800

Photo Source:
2006 - SCDNR
2008 - Copyright: ©2009 i-cubed

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PRINCE GEORGE HOA
6500 OCEAN HWY
PAWLEYS ISLAND, SC 29585

PROJECT:
PAWLEYS INLET
HISTORICAL SHORELINE ANALYSIS

DRAWING TITLE:
HISTORICAL AERIALS
15 March 2006
15 March 2008

SCALE: AS SHOWN
DATE: Jun 2019
DRAWN BY: JJH
APPROVED BY:
PROJECT #: 2227

Appendix B
06

LEGEND

WET/DRY CONTACT 2009

0 Scale (Feet) 800

Photo Source: Georgetown County GIS Dept.

CSE

Coastal Science & Engineering

PREPARED FOR:	PROJECT:	DRAWING TITLE:
PRINCE GEORGE HOA 6500 OCEAN HWY PAWLEYS ISLAND, SC 29585	PAWLEYS INLET HISTORICAL SHORELINE ANALYSIS	HISTORICAL AERIALS March 2009

SCALE: AS SHOWN

DATE:

DRAWN BY:

APPROVED BY:

PROJECT #:

SHEET #

07

Appendix B