

**MINUTES OF THE SHORE PROTECTION BOARD
HELD ON WEDNESDAY, DECEMBER 6, 2017**

1 • **Groin Rehabilitation**

2
3 Mr. Weber said that the federal permit is ongoing and staff already has the state permitting in
4 the Beach Management Agreement. Phase 1 of implementation should shift the priority to
5 Mid-Town rather than Reach 2. The federal permit will include all groins.

6
7 Alternate Member Ceriale asked if the Board could get a list of permits before the next meeting.

8
9 Mr. Weber affirmed.

10
11 • **Reach 8 EIS**

12
13 Chair Ecclestone asked if it is possible to get the Environmental Impact Study (EIS) out.

14
15 Mr. Weber responded he will get an updated list prior to the next Shore Protection Board
16 meeting showing where items are being held up.

17
18 • **Dune Planting**

19
20 Mr. Weber is finalizing the scope of work. He needs additional input from the Shore Protection
21 Board regarding the plant particular such as: size, age, spacing and species.

22
23 Discussion ensued.

24
25 Alternate Member Kinzelberg advocated for selecting bigger plants that can hold more sand
26 during severe weather.

27
28 Board Member Baker stated that more mature plants are available.

29
30 **XII. DRAFT ANNUAL SHORE PROTECTION BOARD REPORT TO TOWN COUNCIL**
31 *Robert Weber, Coastal Program Manager*

32
33 Mr. Weber showed a draft of the Annual Shore Protection Board Report that will be presented
34 to Town Council on Dec. 12, 2017 along with any edits mentioned by the board.

35
36 Alternate Member Jacoby stated that the 2017 Coastal Protection Projects bulleted items are
37 not in the budget and do not apply.

38
39 Chair Ecclestone noted a few minor changes to page 16 of 17. Added sections in Anticipated
40 2018 Shore Protection Board Actions, add Dune Plantings Plan and Implementation, Coastal
41 Vulnerability Assessment, and Innovative Technologies.

42
43 **XIII. SCHEDULING OF NEXT MEETING**
44 *H. Paul Brazil, P.E., Director of Public Works*

- 45 • Thursday, January 25, 2018
46 • Coastal Vulnerability Assessment update, Woods Hole Group

**MINUTES OF THE SHORE PROTECTION BOARD
HELD ON WEDNESDAY, DECEMBER 6, 2017**

- Annual Town-Wide Sediment Budget Review and Erosion Rates
- Permitting process and an outline of the agencies
- Project updates including next steps in the regulatory process
- Public/private partnership conversation with The Breakers
- Master plan for the groins for the backup

Public Works Director Paul Brazil provided an overview of the items for discussion for the upcoming meetings. Due to the large amount of topics to be discussed next month, Mr. Brazil suggested that the Innovative Technologies discussion, the Contracting Alternatives for Coastal Projects discussion, and Sand Transfer Plant discussion be postponed to another month.

XIV. ANY OTHER MATTERS - None

XVI. ADJOURNMENT

There being no further business, the Shore Protection Board of December 6, 2017, was adjourned at 11:12 a.m.

APPROVED:

E. Llwyd Ecclestone
Chairman

*Meeting audio is located at:
http://townofpalmbeach.granicus.com/ViewPublisher.php?view_id=3*

TOWN OF PALM BEACH

Information for Shore Protection Board Meeting on: January 23, 2018

TO: Shore Protection Board

FROM: Thomas G. Bradford, Town Manager

VIA: Robert Weber, Coastal Program Manager

RE: Coastal Projects Update
Item XIV.

DATE: January 19, 2018

STAFF RECOMMENDATION

Town staff requests the Shore Protection Board (SPB) provide any additional input as deemed necessary.

GENERAL INFORMATION

Listed below is a brief update of the ongoing activities for the Coastal Management Program. Town staff will provide more details of each item during the SPB meeting.

Lake Worth Inlet Maintenance Dredging

- Dredging operations were completed on January 10.
- Approximately 235,000 cubic yards of sand was placed on the dry beach in Reach 1 and the northern section of Reach 2 (between the inlet and Merrain Road).
- During a site visit for project closeout, the Town and the U.S. Army Corps of Engineers (USACE) identified rocks on the beach between Dolphin and Merrain Road. The USACE is working with their contractor to mobilize a Weeks Marine subcontractor to sift the beach and remove rock from Dolphin Road to approximately Merrain Road.
- Removal of rocks will take up to 15 days.

2017 Sand Forepassing

- Regulatory authorizations have been received from FDEP.
- Tetra Tech, Inc. has finalized the plans and specifications.
- Due to continued rough weather, the project area does not have sufficient dry beach to place sand an appropriate volume of sand that would appreciably enhance storm protection in the area.
- Town staff recommends that the project be delayed until the next inlet maintenance dredging project at the end of the 2019 calendar year.

Dune Planting

- The plans and specifications are being completed by Town staff. The Sand Forepassing area may be removed based on outcome of the recommendation as part of the 2017 forepassing item above with the 2018 planting effort.
- The plans and specifications are expected to be bid by end of the month and will be presented to Town Council for award at the March Town Council meeting.
- Town staff will work on the procurement process in anticipation for Town Council consideration at their March meeting.

Sand Transfer Plant Study

- The November 6, 2017 scope of work from Gahagan & Bryant has a cost of \$26,240.
- Sufficient funds exist in the Coastal fund to accommodate this work.
- Once started, the work will take approximately 2 months to complete.
- The purpose of the study is to evaluate options for improving sand bypassing efficiency at Palm Beach Inlet.

Lake Worth Lagoon Waterway Access Channel Maintenance Dredging

- All necessary permit authorizations have been received by the State and Federal agencies.
- Coston Marine, Inc. is the low bidder.
- The contractor has indicated that their equipment will begin to be mobilized later this month. The dredging work will likely start early in February 2018 and continue for as much as nine (9) months.

cc: H. Paul Brazil, P.E., Director of Public Works
Patricia Strayer, P.E., Town Engineer
Dean Mealy, Purchasing Manager

TOWN OF PALM BEACH

Information for Shore Protection Board Meeting on: January 23, 2018

TO: Shore Protection Board

FROM: Thomas G. Bradford, Town Manager

VIA: Robert Weber, Coastal Program Manager

RE: 2017 Town-wide Sediment Budget Review and Erosion Rates Discussion
Item XV.

DATE: January 19, 2018

STAFF RECOMMENDATION

Staff requests that the Shore Protection Board (SPB) review the attached information and provide any direction deemed necessary.

GENERAL INFORMATION

Each year, the Town contracts with a consultant to complete Town-wide physical surveys. This year, the survey was performed by Applied Technology & Management, Inc. (ATM). These surveys are generally conducted in the late summer/fall season. This data is used to compare the short-term change (annual) and the long-term change (20+ years, since the 1990 baseline) of both shoreline position and sand volume.

ATM organizes all physical monitoring data into a Town-wide report that is referred to as the Sediment Budget. The purpose of the Sediment Budget is to provide an analysis of the Town-wide coastal processes including volumetric change data. This analysis aids the Town in planning and implementing appropriate shore protection projects.

The Executive Summary of the Sediment Budget is attached. An explanation of the attached text, maps and figures, will be provided in a presentation by ATM at the January 23, 2018 SPB meeting.

Although the Executive Summary and the maps have been produced for the SPB (see attached), the Town-wide 2017 Physical Monitoring Report has not yet been finalized by ATM. Following ATM's completion of the final report, Woods Hole Group (WHG) will provide an independent review of the data and produce a supplement document to the 2017 Sediment Budget. WHG's review of the Sediment Budget is part of their overall annual review of the entire coastal program as specified in the Town's 10-Year Coastal Management Program

FUNDING/FISCAL IMPACTS

There are no funding or fiscal impacts from this item. The Coastal Management Program budget includes funding for the annual physical monitoring and reporting efforts.

Attachments

cc: H. Paul Brazil, P.E., Director of Public Works
Michael Jenkins, Ph.D., P.E., Applied Technology & Management, Inc.
Bob Hamilton, P.E., Woods Hole Group, Inc.

Town of Palm Beach Town-Wide 2017 Executive Summary

Prepared By:



Prepared For:



Palm Beach Island Beach Management Agreement (BMA)

IPA Permit Number: 0328802-002-BMA &

IPA Permit Number: 0328802-003-BMA

January 2018

Town of Palm Beach

2017 Town-Wide Physical Monitoring Report

EXECUTIVE SUMMARY

This report provides a summary of the Town of Palm Beach shoreline and beach volumetric performance based on physical monitoring data collected in August 2017 as compared to previous monitoring surveys. Additional analysis is provided regarding shoreline conditions north of the Lake Worth Inlet. It is important to note that the 2017 survey was completed before the passage of Hurricane Irma in late September, but does include impacts from Hurricane Matthew in 2016.

Analysis of the 2017 Town-Wide survey data suggest that over the most recent monitoring period, the Town's shorelines exhibited losses in volume throughout the Town, with a total net volume loss of 587,937 cubic yards (cy) as measured out to a depth of -26.2 ft. which is the recognized depth of closure (DOC). This overall loss is largely related to Hurricane Matthew, in addition to equilibration losses incurred following the nourishment of the Phipps/Reach 7 section of the shoreline, in which 1,045,742 cy of beach-quality material was placed between January and April, 2016. All reaches experienced losses with the greatest losses occurring in Reach 7 (Phipps Project Area) with losses of 285,408 cy out to the DOC and Reaches 3 & 4 (Mid-Town) with losses of 115,740 cy out to DOC. Despite the overall negative trend, volumetric gains were observed above the MHW line in Reaches 2, 5 and 6 over this monitoring period. Reaches 1, 3 & 4, 7, and 8 exhibited net losses above the MHW line during this period.

Long term, the Town's beaches have shown positive trends in both shoreline position and average beach volume, though these gains are not evenly distributed. In comparison to 1990 conditions, approximately 9.3 miles or 76.5 percent of the Town's shoreline has exhibited shoreline advance. This is a slight decrease in comparison to 2016. Since 1990, the Town's beaches have exhibited a net volumetric gain of 4,267,260 cy.

Over this monitoring period, approximately 2.7 miles (22.2 percent) of the Town's shoreline has experienced net volumetric gains (above the -26.2 NAVD contour). This represents a decrease in comparison to the 2016 estimate of 9.84 miles (80.7 percent).

The 2017 sediment budget suggests that over this time period, the beaches of the Town (out to a depth of -26.2 feet) have gained sand at a rate of 158,046 cubic yards per year (cy/yr), on average, since 1990. The long-term construction of beach projects in Mid-Town and Phipps has contributed significantly to this positive rate, adding approximately 231,770 cy/yr, on average, to the system. Accounting for this placement, the beaches of the Town have exhibited a net volumetric deficit on the order of 130,241 cy/yr over this time period. This value is an increase in the deficit estimate in comparison to the 2016 deficit value of 45,032 cy/yr. This value quantifies the annual volumetric need for the Town's shoreline and does not account for inlet sand bypassing at Lake Worth Inlet [both through maintenance dredging and the Sand Transfer Plant (STP)]. Assuming future conditions remain similar to the long-term monitoring trend, this conclusion suggests that a volume on the order of 130,241 cy/yr must be placed on an average-annual basis to maintain the current volume of sand within the Town's boundaries (independent of sand bypassing operations at the inlet). This value does not address the potential loss/gain of sand to

the system associated with inlet maintenance and STP operations. The results of the data analysis by reach are provided in the following table.

**Table E.S. 1
Data Analysis Results**

Location	Change
Short-Term Changes – September 2016 to August 2017	
Average (MHW) Shoreline Change:	
Reach 1: (R-76 to R-78)	-0.2 feet
Reach 2: (R-78 to R-90+400)	1.6 feet
Reaches 3 & 4: (R-90+400 to R-102+300)	-9.4 feet
Reach 5: (R-102+300 to R-110+100)	7.4 feet
Reach 6: (R-110+100 to R-116+500)	16.1 feet
Reach 7: (R-116+500 to R-128+500)	-17.6 feet
Reach 8: (R-128+500 to R-134)	10.7 feet
Town-Wide	-1.4 feet
Volumetric Changes (to -26.2* feet):	
Reach 1: (R-76 to R-78)	-31,050 cy
Reach 2: (R-78 to R-90+400)	-18,591 cy
Reaches 3 & 4: (R-90+400 to R-102+300)	-115,740 cy
Reach 5: (R-102+300 to R-110+100)	-64,739 cy
Reach 6: (R-110+100 to R-116+500)	-21,376 cy
Reach 7: (R-116+500 to R-128+500)	-285,408 cy
Reach 8: (R-128+500 to R-134)	-51,034 cy
Town-Wide	-587,937 cy
Long-Term Changes – August 1990 to September 2016	
Average (MHW) Shoreline Change:	
Reach 1: (R-76 to R-78)	178.3 feet
Reach 2: (R-78 to R-90+400)	49.3 feet
Reaches 3 & 4: (R-90+400 to R-102+300)	45.4 feet
Reach 5: (R-102+300 to R-110+100)	62.8 feet
Reach 6: (R-110+100 to R-116+500)	65.5 feet
Reach 7: (R-116+500 to R-128+500)	96.8 feet
Reach 8: (R-128+500 to R-134)	6.7 feet
Town-Wide	61.7 feet
Volumetric Changes (to -26.2* feet):	
Reach 1: (R-76 to R-78)	705,400 cy
Reach 2: (R-78 to R-90+400)	-227,750 cy
Reaches 3 & 4: (R-90+400 to R-102+300)	1,165,720 cy
Reach 5: (R-102+300 to R-110+100)	778,029 cy
Reach 6: (R-110+100 to R-116+500)	442,165 cy
Reach 7: (R-116+500 to R-128+500)	1,360,943 cy
Reach 8: (R-128+500 to R-134)	42,754 cy
Town-Wide	4,267,260 cy

*Note – All years prior to 2012 calculated to 26.5 feet NGVD

SUMMARY OF SHORELINE PERFORMANCE BY REACH

Reach 1: (R-76 to R-78)

Reach 1 experienced a net shoreline decrease of 0.2 foot during this monitoring period. Volumetric losses were at 31,050 cy, with the greatest losses occurring between -13.1 feet NAVD and the DOC.

Overall, this reach has exhibited a long-term substantial net shoreline advance of 178.3 feet and volumetric gain (to -26.2 feet NAVD) of 705,400 cy since 1990. This long-term advance in shoreline and volume is associated with discharge by the STP within this reach and direct placement of material from inlet maintenance operations.

Reach 2: (R-78 to R-90+400)

Over this monitoring period, the Reach 2 shoreline had an average increase of 1.6 feet. Both gains and losses occurred throughout the reach. In total, the reach lost a net volume of 18,591 cy. Volumetric losses were most prominent from R-82 through R-85 and R-86 to R-88 within the area beyond the DOC.

Since 1990, the reach has exhibited a net shoreline advance of 49.3 feet, although this gain primarily occurs within the northernmost portion of the reach between R-78 and R-80. Overall, this reach has lost a net volume of 227,750 cy since 1990. Reach 2 exhibits the most significant net long-term loss of volume between R-86 and R-88, and this reach is the only reach that exhibits a net long-term volumetric loss.

Reaches 3 & 4: (R-90+400 to R-102+300)

This segment comprises both north and south segments of the Mid-Town Beach Renourishment project. Over this monitoring period, the reach exhibited a net shoreline recession of 9.4 feet. Recession was most significant within the central portion of the area from R-97 to R-101. A maximum recession of 43.3 feet occurred at R-97. A portion of the recession observed is attributable to anticipated adjustment of the constructed beach profile from the 2015 Mid-Town nourishment project. The observed magnitude, however, is significantly greater than anticipated project-related cross-shore adjustment.

This segment exhibited a net volumetric loss of 115,740 cy. A prominent area of volumetric loss occurred between R-94 and R-101, within the area approximately from Royal Palm Way to El Brillo Way. In total, the volumetric loss in this area was on the order of 144,907 cy. Small gains were observed in the northern portion of the Mid-Town shoreline segment.

Since 1990, this shoreline segment has exhibited a net increase in volume of 1,165,720 cy and an average advance in shoreline position of 45.4 feet due to direct sand placement. These significant gains are directly attributable to repeated renourishment efforts within this area. These gains occur throughout this shoreline segment, including in the areas of recession noted within this monitoring period.

Reach 5: (R-102+300 to R-110+100)

Over the current monitoring period, Reach 5 has experienced a net average shoreline advance of 7.4 feet, with gains occurring over most of the reach. The reach exhibited a net volumetric loss of 64,739 cy, with greatest losses in the southern portion of the reach from approximately R-108 to R-110. Gains were most significant above MHW.

Long term, this area has experienced a net shoreline advance of 62.8 feet since 1990 and has gained approximately 778,029 cy (above -26.2 feet NAVD) throughout the entire shoreline segment. Gains in shoreline position and volume are directly attributable to the movement of material into Reach 5 from the Mid-Town beach projects within Reaches 3 & 4. These net positive trends are likely to continue due to the availability of sand within the Mid-Town segment to the immediate north. Lacking regular renourishment of the Mid-Town Project, this reach would likely revert to a net erosion/recession condition consistent with conditions present prior to the initiation of the beach nourishment program.

Reach 6: (R-110+100 to R-116+500)

Over the most recent monitoring period, Reach 6 exhibited a net shoreline advance of 16.1 feet with gains occurring in the northern half of the reach and losses occurring in the southern portion. Reach 6 exhibited a net volumetric loss (above -26.2 feet NAVD) of 21,376 cy. Significant losses are observed only between R-114 and R-116. Since 1990, Reach 6 has exhibited a net shoreline advance of 65.5 feet and volumetric gain of 442,165 cy (above -26.5 feet NAVD).

In general, Reach 6 has remained stable, with a long-term trend of shoreline advance and volumetric gains. Much of this behavior can be attributed to the downdrift effect of the Mid-Town nourishment projects, which have provided a sediment source to both Reaches 5 and 6. The monitoring data suggest that the functional limit of this beneficial downdrift effect occurs within Reach 6, in the vicinity of the FDOT revetment (between R-111 and R-116).

Reach 7: (R-116+500 to R-128+500)

The Phipps/Reach 7 section of the shoreline was renourished between January and April 2016, during which time 1,022,318 cy of beach-quality material was placed from a nearshore borrow source. Over the most recent monitoring period, the Reach 7 shoreline has experienced a net retreat of 17.6 feet, with losses throughout most the reach. Over this monitoring period, Reach 7 lost a net volume of 285,408 cy, with the greatest losses occurring in the central portion of the reach. This loss is attributable to equilibration of the material placed within the reach.

Since 1990, Reach 7 has exhibited a net average advance of 96.8 feet. The reach has exhibited a net volumetric gain of 1,360,943 cy since 1990. Gains have occurred throughout the reach and are attributable to both the 2016 nourishment effort and a residual volume of sand remaining in the reach from the 2006 nourishment event.

Reach 8: (R-128+500 to R-134)

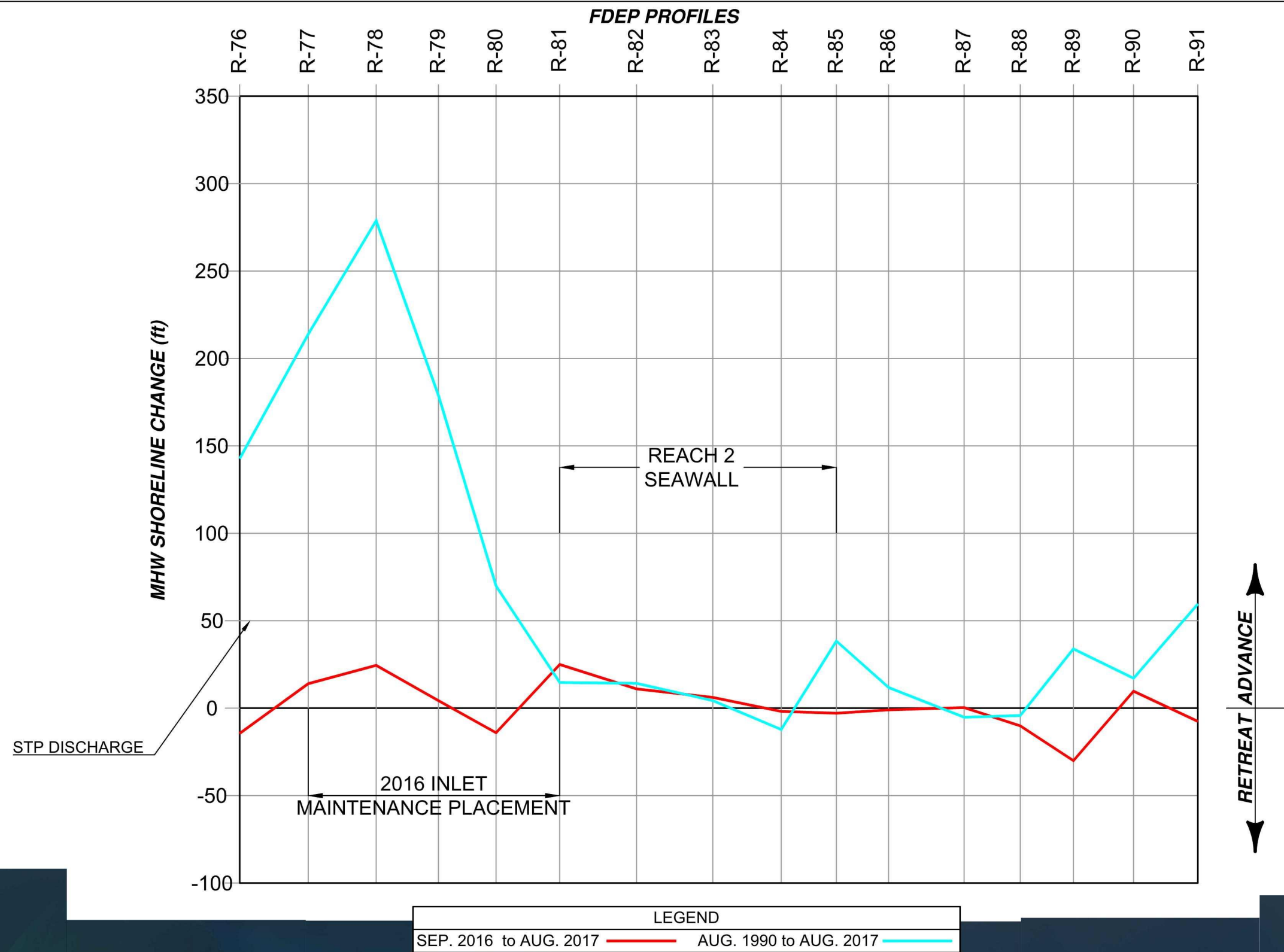
Over the past year, Reach 8 exhibited a net shoreline advancement of 10.7 feet. Shoreline advancement occurred throughout most of the reach, with the exception of monument R-131, which had a retreat of 4.4 feet. This reach exhibited a net volumetric loss of 51,034 cy over this monitoring period, with losses occurring everywhere. Losses were most significant from approximately -13.1 NAVD to beyond the DOC.

Since 1990, Reach 8 has exhibited a net average gain of 6.7 feet, although recession generally occurred at the north end of the reach and advancement was most prominent in the southern portions of the reach. Since 1990, the reach has exhibited a net gain of 42,754 cy (to a depth of -26.2 feet NAVD). This net gain is attributable to migration of material into the reach from previous Phipps/Reach 7 nourishment projects, in addition to repetitive upper beach (dune) projects.

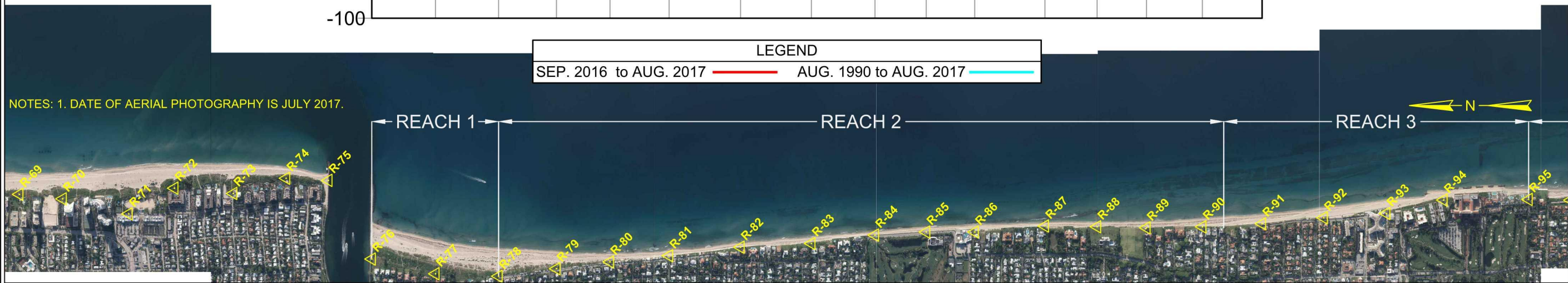
Beaches North of Lake Worth Inlet

Given the concern regarding the potential supply of sand to the STP, the Town's monitoring program has been extended north to include monuments up-drift of the inlet. Over this monitoring period, the 7,152-foot shoreline segment north of the inlet (from R-68 to R-75) exhibited a net volumetric loss of 12,406 cy. This behavior continues a negative trend within this region that occurred over the previous monitoring period, however, to a much lesser extent. The area retains a positive gain in volume in comparison to the condition in 2013. It is also notable that the STP has been operational over the past 3 years, with significant transport volumes reported during this monitoring period. Review of the profile in the vicinity of R-75 suggests that there is capacity for deposition within the expanded settling basin associated with the inlet. In total, the monitoring data do not suggest an immediate deficit in volume within this reach that would impair the ability of the STP to transfer sand into Reach 1.

LOCATION: CA WETLAND BEACH, SHARPES DRAINAGE PROJECTS V1-3100, 2017. TOP: TOWN-WIDE ANNUAL MONITORING V1-TOWN WIDE, 05-17. WIDE: CHANGES, R 1-2.DWG



NOTES: 1. DATE OF AERIAL PHOTOGRAPHY IS JULY 2017.





Page 25 of 73

LOCATION: CA WEST PALM BEACH SHORES DRAWINGS PROJECTS 17-3100 2017 TIDEP TOWN-WIDE ANNUAL MONITORING V TOWN-WIDE V 10-17 WIDE-CHANGES R 5-4 DWG

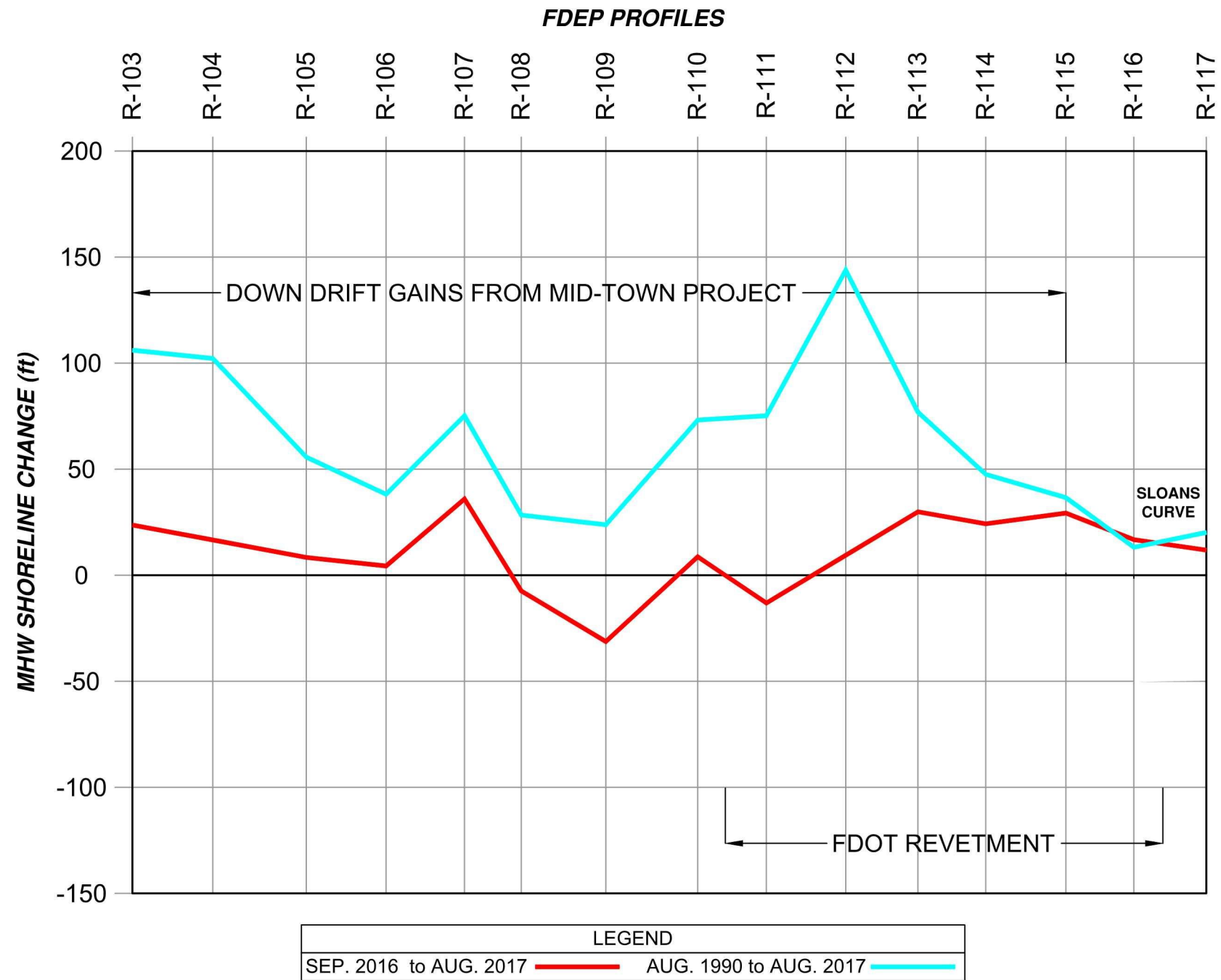
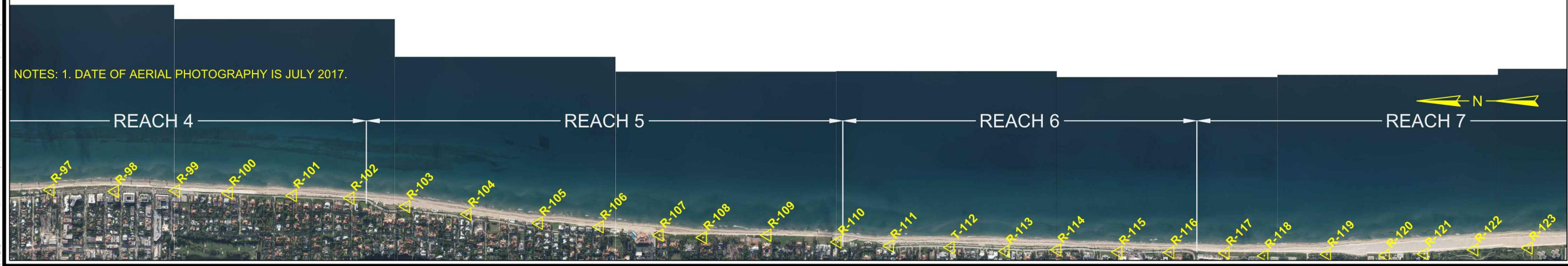
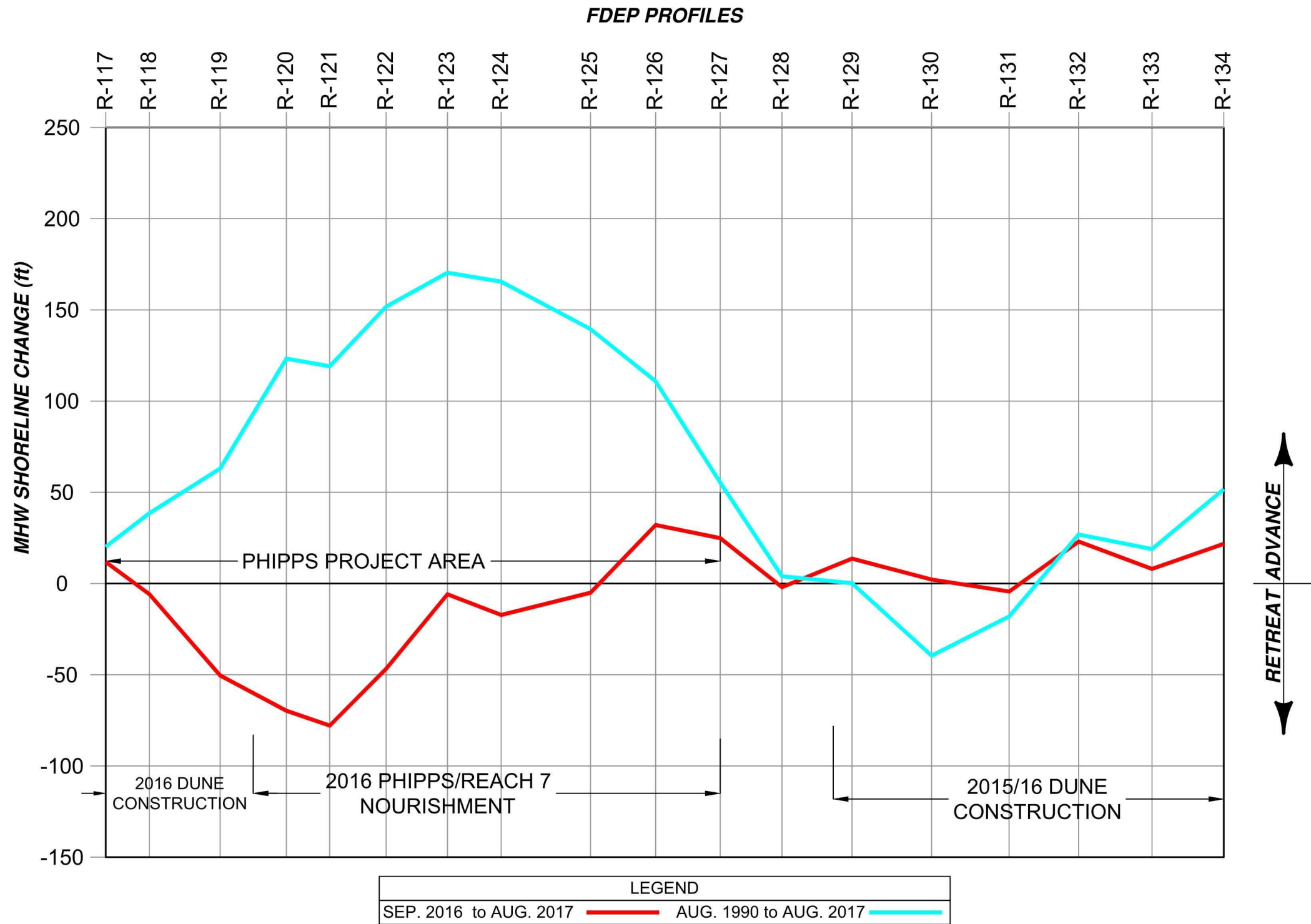


Figure 1c
Shoreline Changes

LOCATION: CA WEST PALM BEACH SHORES (BROWARD COUNTY PROJECTS) 17-1100 2017 TIDEP TOWNSHIP ANNUAL MONITORING REPORT WREVELE 05-17 WREVELE CHANGES R 7-8 PNG



NOTES: 1. DATE OF AERIAL PHOTOGRAPHY IS JULY 2017.

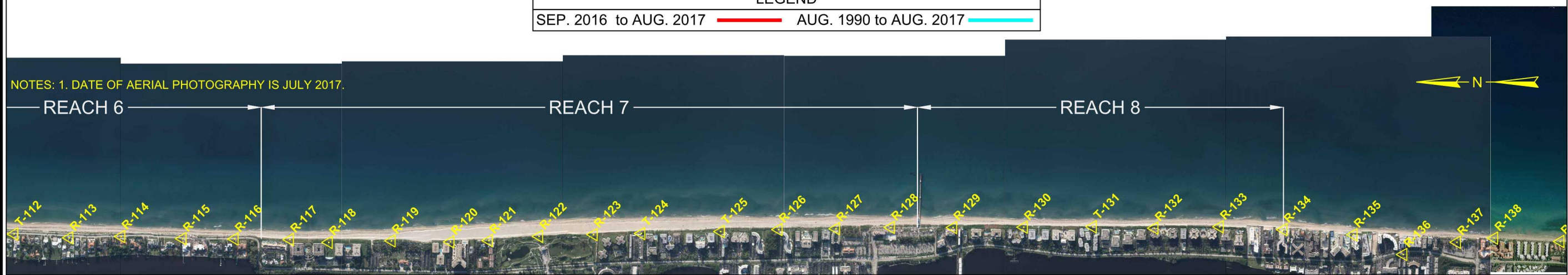


Figure 1d
Shoreline Changes



SEP. 2016 - AUG. 2017 VOLUME CHANGES ABOVE -26.2' NAVD
(CY PER LINEAL FEET)

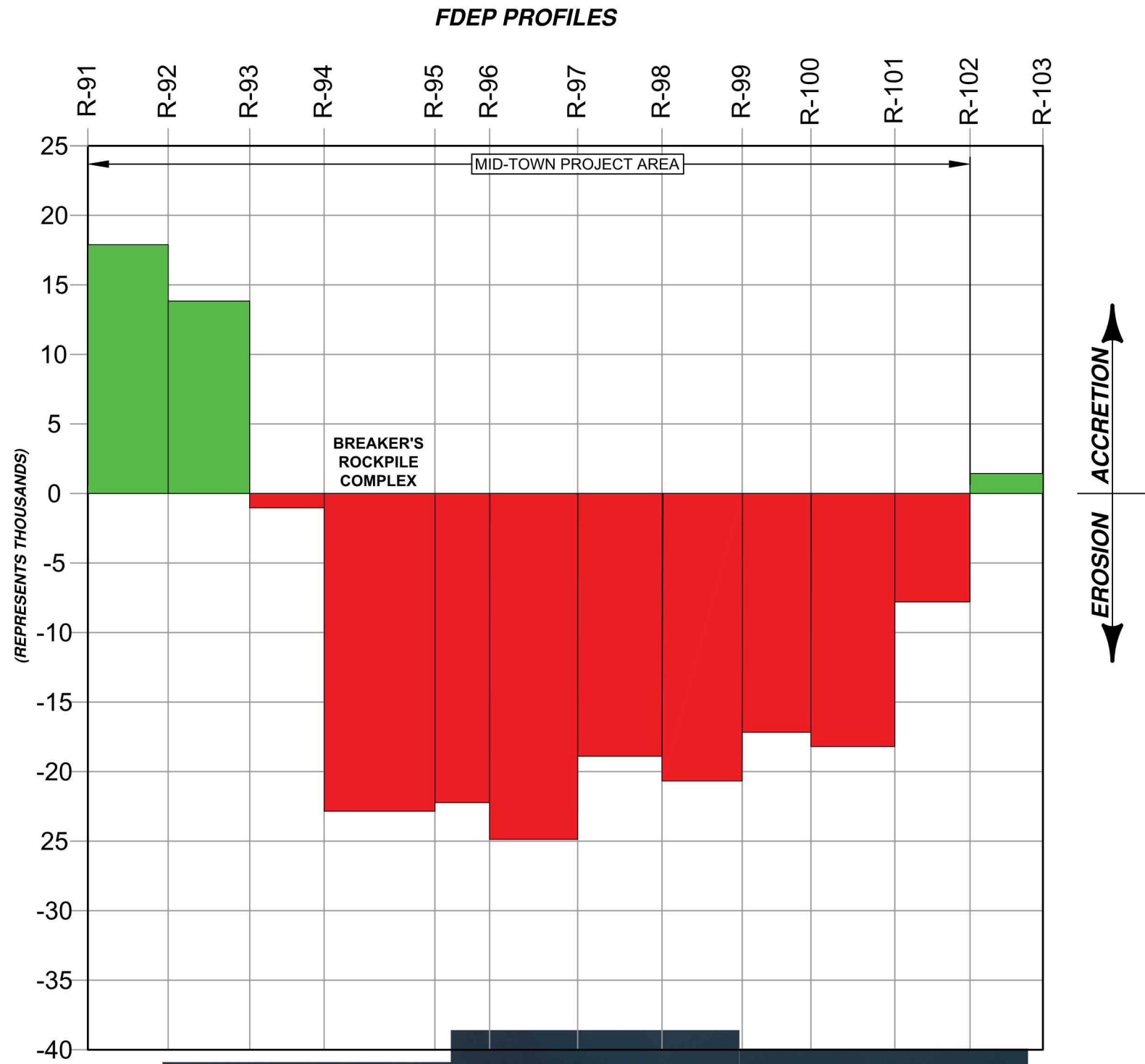
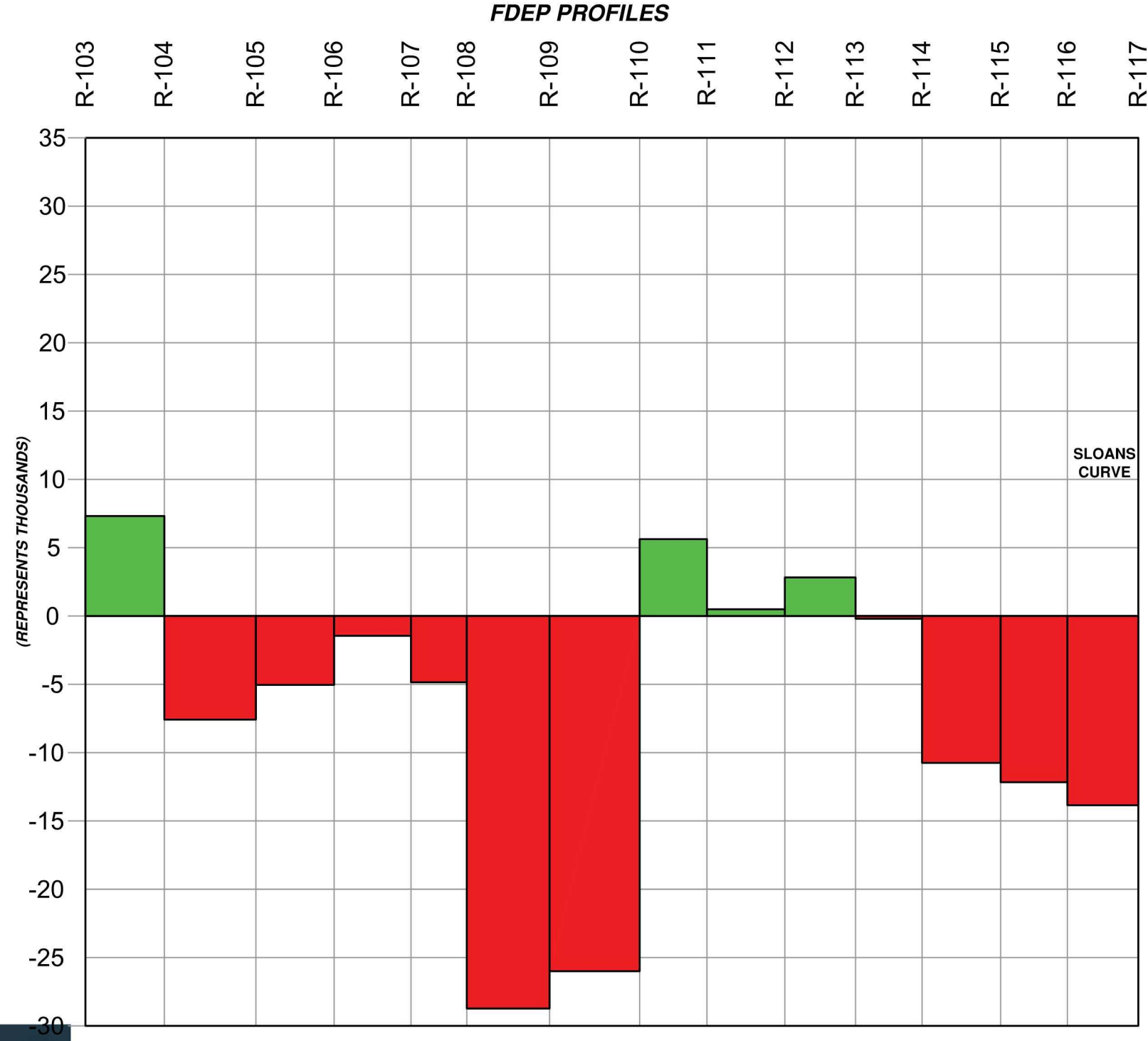


Figure 2b
Sep. 2016 - Aug. 2017 Volume Changes

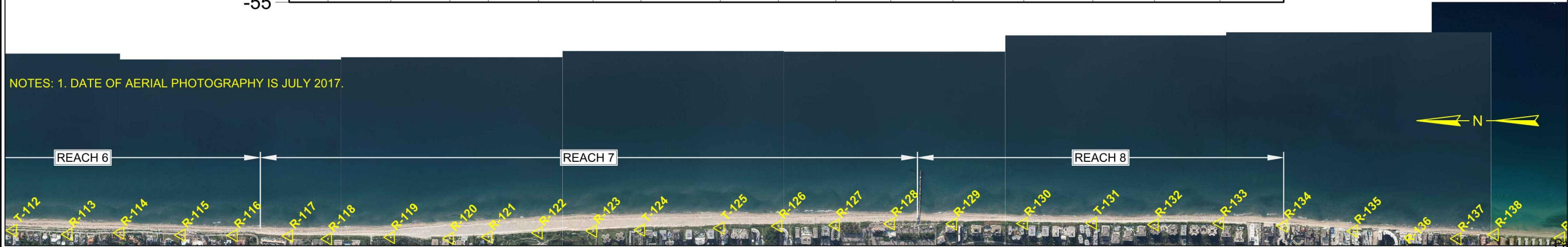


SEP. 2016 - AUG. 2017 VOLUME CHANGES ABOVE -26.2' NAVD
(CY PER LINEAL FEET)



EROSION ACCRETION

Figure 2c
Sep. 2016 - Aug. 2017 Volume Changes



SEP. 2016 - AUG. 2017 VOLUME CHANGES ABOVE -26.2' NAVD
(CY PER LINEAL FEET)

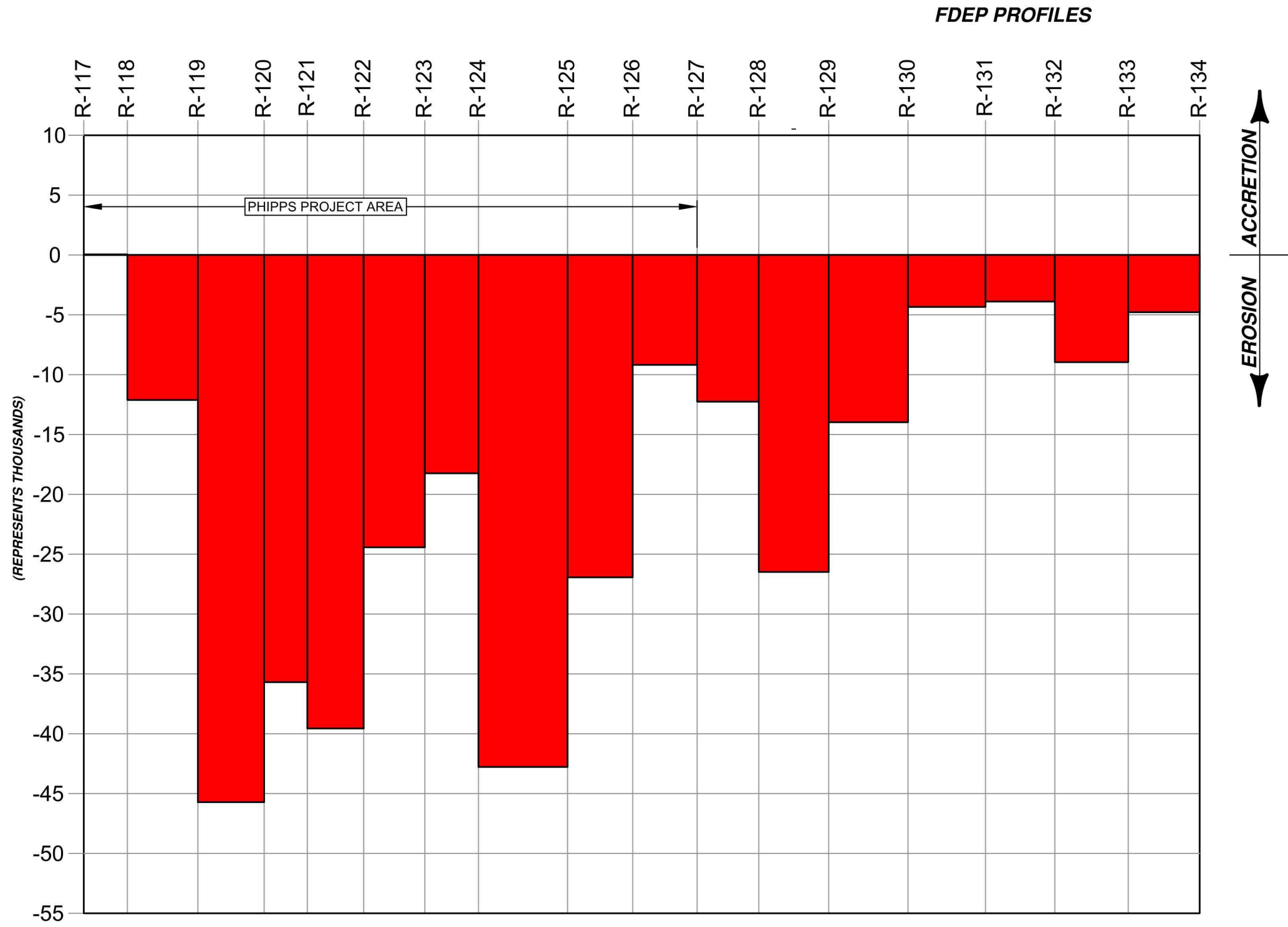


Figure 2d
Sep. 2016 - Aug. 2017 Volume Changes



AUG. 1990 - AUG. 2017 VOLUME CHANGES ABOVE -26.2' NAVD
(CY PER LINEAL FEET)

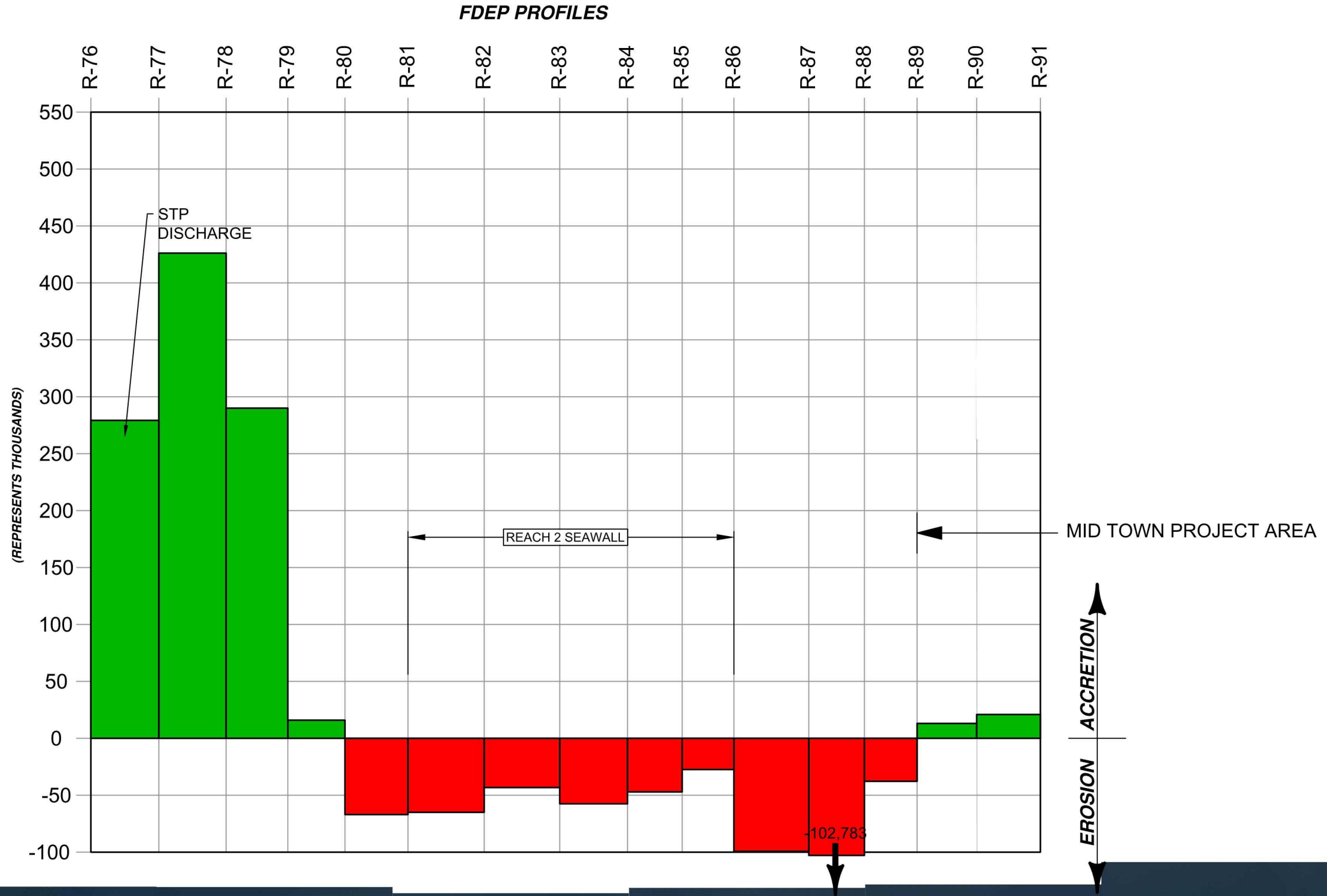
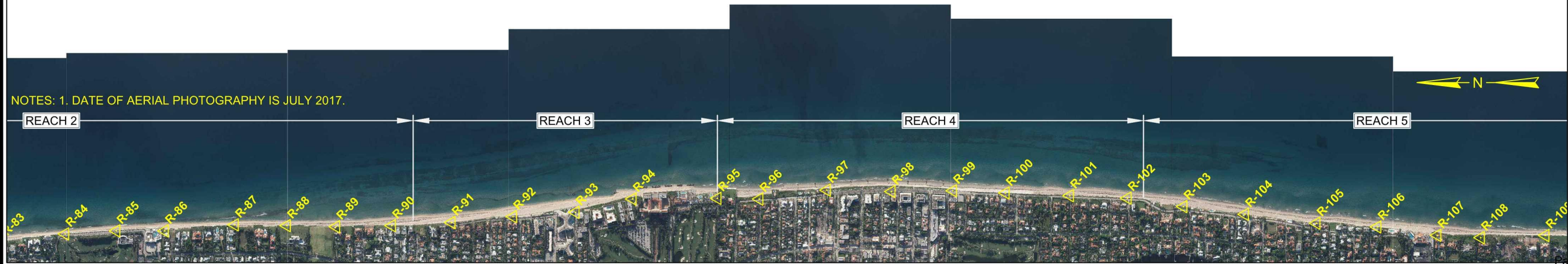


Figure 3a
Aug. 1990 - Aug. 2017 Volume Changes



AUG. 1990 - AUG. 2017 VOLUME CHANGES ABOVE -26.2' NAVD
(CY PER LINEAL FEET)

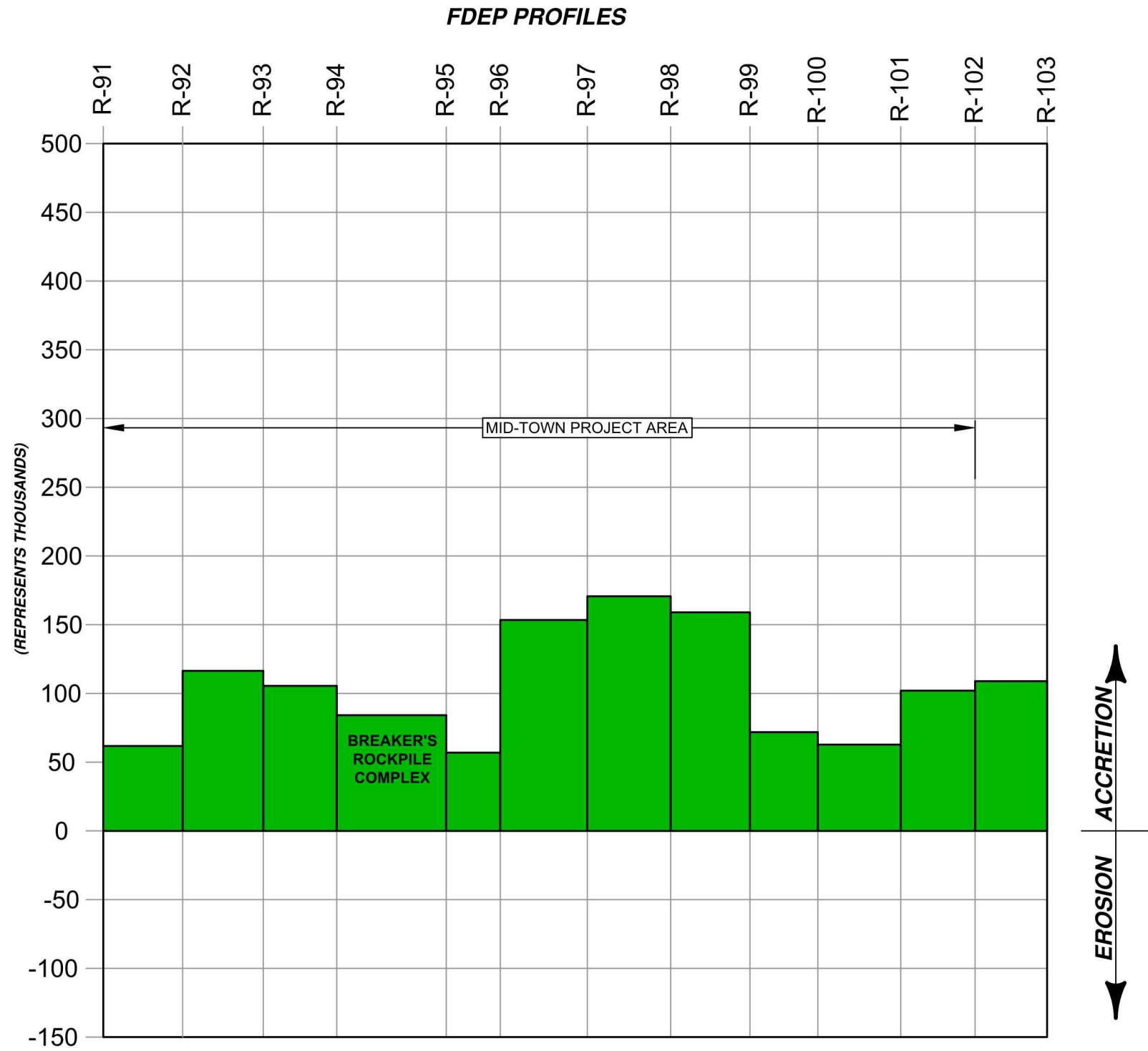


Figure 3b
Aug. 1990 - Aug. 2017 Volume Changes



AUG. 1990 - AUG. 2017 VOLUME CHANGES ABOVE -26.2' NAVD
(CY PER LINEAL FEET)

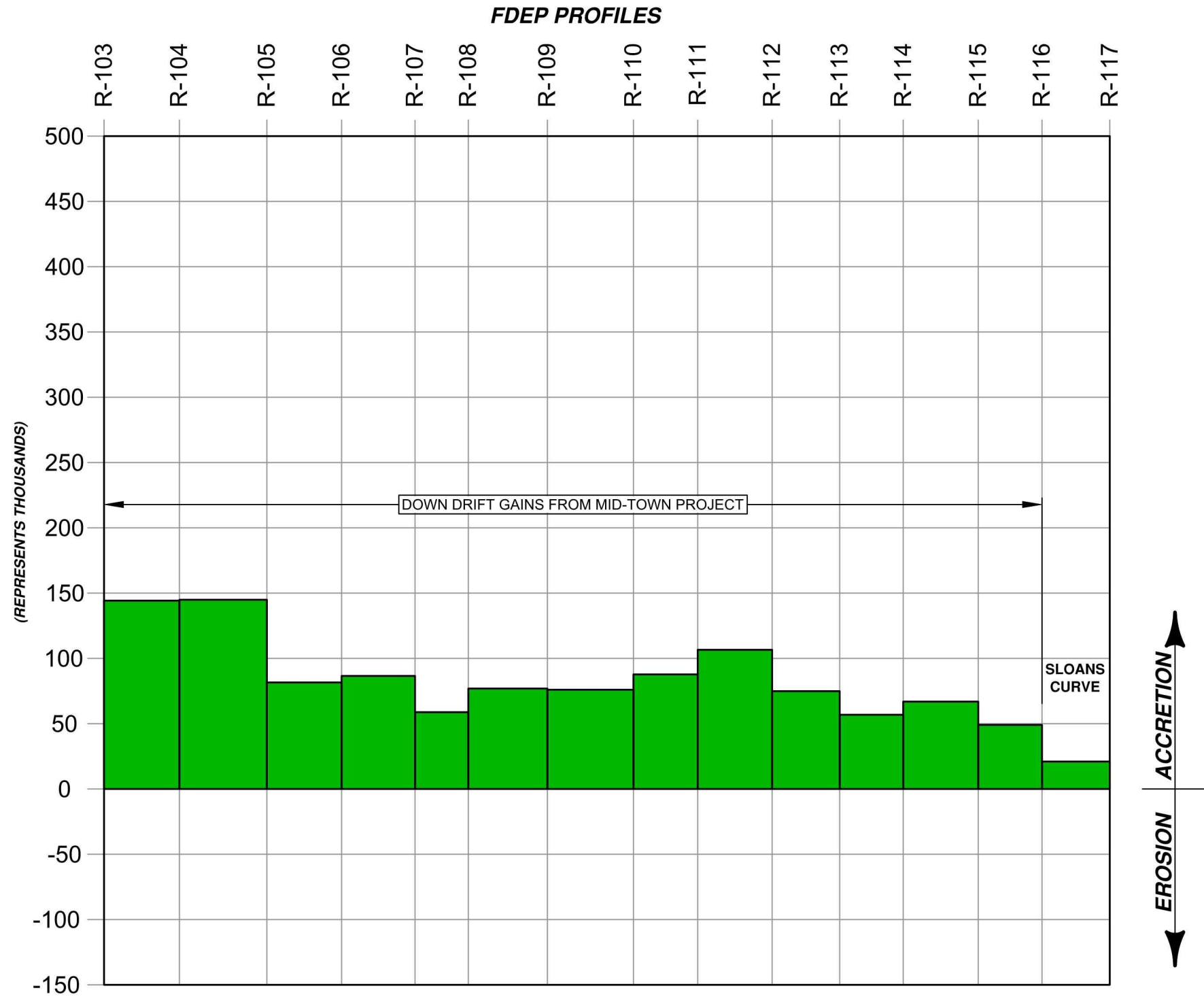


Figure 3c
Aug. 1990 - Aug. 2017 Volume Changes

TOWN OF PALM BEACH

Information for Shore Protection Board Meeting on: January 23, 2018

TO: Shore Protection Board

FROM: Thomas G. Bradford, Town Manager

VIA: Robert Weber, Coastal Program Manager

RE: Coastal Vulnerability Update
Item XVI.

DATE: January 19, 2018

STAFF RECOMMENDATION

Town staff requests the Shore Protection Board (SPB) provide any additional input as deemed necessary.

GENERAL INFORMATION

This item was postponed from the November 3, 2017 SPB meeting.

Woods Hole Group (WHG) has periodically reviewed the Town's coastal program since the 1990's. WHG conducted a peer review of the Town's Comprehensive Coastal Management Program Update in 1998 and introduced the concept of applying 'adaptive management' when implementing coastal projects. WHG is a well-respected firm that has provided many local and state governments with coastal program reviews and recommendations.

In 2013, WHG completed a technical review of the proposed coastal management program and provided input directly to Town Council prior to Town Council's adoption of the 10-Year plan. While their report identified recommended projects for each respective reach along the shoreline, the report also included island-wide recommendations that extended through multiple reaches. The island-wide recommendations included items such as groin maintenance, improved communications with the public, and dune vegetation maintenance.

At the October 27, 2016 SPB meeting, the Board recommended to move forward with the flooding vulnerability study. Town Council approved this study at the date of the Town Council meeting.

This study began December 13, 2016 and is scheduled to be completed in December 2018. Bob Hamilton with WHG will provide an update of the study at the January 23, 2018 Town Council meeting.

Another one of the island-wide recommendations was to perform a flooding vulnerability assessment. The purpose of the assessment would be to supplement the Town's Comprehensive Coastal Management Plan (CCMP) with the identification of areas presently at high risk of storm damage and flood.

Following an unanimous recommendation from the Shore Protection Board, Town Council awarded a contract to Woods Hole Group in December 2016 to perform a Coastal Vulnerability Assessment. The scope of this effort is expected to take nearly two years to complete. During the early months of this process, WHG has gathered pertinent data and information from both the Town and from FEMA. Although Woods Hole has not yet reached the completion for their work, Woods Hole Group will be providing an update on their study. Bob Hamilton will be at the January 23, 2018 SPB meeting to present their ongoing work.

FUNDING/FISCAL IMPACTS

The cost of the two-year study was funded through the FY 2016 (\$50,000) and FY 2017 (\$50,000) Town Council approved budgets, and consistent within the Shore Protection Board's recommended long-term 10-Year Coastal Management Plan.

cc: H. Paul Brazil, P.E., Director of Public Works
Bob Hamilton, Woods Hole Group, Inc.

TOWN OF PALM BEACH

Information for Shore Protection Board Meeting on: January 23, 2018

TO: Shore Protection Board

FROM: Thomas G. Bradford, Town Manager

VIA: Patricia Strayer, P.E., Town Engineer

RE: Review of State and Federal Permitting Processes
Item XVII.

DATE: January 19, 2018

STAFF RECOMMENDATION

This item is being presented as requested. No action is required.

GENERAL INFORMATION

At the December 6, 2017 Shore Protection Board (SPB) meeting, the SPB requested that Town staff provide background related to the State and Federal beach permitting processes. In addition, the SPB requested a list of the current projects in permitting be provided with an update on their respective progress. The list is being finalized and will be provided to the SPB at the January 23, 2018 meeting.

This review is limited to the projects being permitted on the beach or in the ocean. Projects that occur above the Mean High Water (MHW) line do not require Federal regulatory review. The State of Florida Department of Environmental Protection (FDEP) issues permits for beach activities that occur on the beach but above the MHW line but below the CCCL line. FDEP receives input from advisory agencies, such as the Florida Fish and Wildlife Conservation Commission (FWC) and the State Historic Preservation Office (SHPO). The typical timeframe for this permitting process, called Coastal Construction Control Line (CCCL) permitting is about 6 months. However, depending on project specifics, the process can be permitted in as little as 90 days up to a year or more. More complex or controversial projects have taken as much as a year or more.

Projects that occur below the MHW line require federal regulatory review from the U.S. Army Corps of Engineers (USACE). Like FDEP, the USACE receives input from their advisory agencies. These agencies include the United States Fish and Wildlife Service and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service. Because the federal advisory agencies do not have firm review time constraints, permitting review often exceeds one year and commonly takes many years. If a project has the potential to cause significant adverse impacts, the USACE typically requires that the applicant have either an Environmental Assessment or Environmental Impact Statement (EIS) performed. In this case, permitting is suspended until these environmental studies are performed. The typical timeframe for an EIS to be completed exceeds three years.

SPECIAL CONSIDERATION

The FDEP Beach Management Agreement (BMA) with the Town is a perpetual agreement which satisfies state authorization for specific CCCL pre-approved beach management projects including the placement of sand associated with the Lake Worth Inlet Maintenance Dredging, Sand Transfer Plant discharge extensions, Mid-Town Beach Nourishment, Phipps Ocean Park Beach Nourishment, dune restoration, and groin rehabilitation. However, with the exception of dune restoration, all other projects require federal authorization. Although the USACE is not a BMA signatory, USACE staff has recognized the exhaustive review of BMA projects and expedite the USACE's permitting review as much as possible.

cc: H. Paul Brazil, P.E., Director of Public Works

TOWN OF PALM BEACH

Information for Shore Protection Board Meeting on: January 23, 2018

TO: Shore Protection Board

FROM: Thomas G. Bradford, Town Manager

VIA: Robert Weber, Coastal Program Manager

RE: Review of Groin Rehabilitation Plan
Item XVIII.

DATE: January 19, 2018

STAFF RECOMMENDATION

Town staff requests the Shore Protection Board (SPB) provide any additional input as deemed necessary.

GENERAL INFORMATION

A Townwide groin rehabilitation plan is part of the Town's 10-Year Town Council-adopted Coastal Management Program. CB&I Coastal Planning and Engineering (CPE) finalized the draft execution plan for this program in October 2014. These preliminary findings were presented to the Shore Protection Board (SPB). The board made recommendations to the Town Council concerning the type of groin that would be used and the proposed phased approach to construction. The Town Council accepted those recommendations and our consultant finalized an execution plan in February 2015 based on that direction.

The Groin Rehabilitation Execution Plan is attached for your review. Appendix A (Plan Views of Groin Locations), Appendix B (Site Visit Report), and Appendix C (Details of Execution Plan) are lengthy and were not included with this memorandum. These appendices can be provided separately, if requested.

Staff and CPE, now APTIM, will be available at the January 23, 2018 SPB meeting to provide additional detail of the plan and an update of the ongoing State and Federal permitting.

SPECIAL CONSIDERATION

Since completion of the Execution Plan in 2015, changes in shoreline conditions may reprioritize the phases of implementation. Increased concerns within the Mid-Town public beach area would suggest that permitting efforts be refocused to more urgently address this portion of the shoreline.

FUNDING/FISCAL IMPACTS

The Town Council-adopted 10-Year Coastal Management Program includes an annual line item for Groin Rehabilitation. Because the execution plan was not completed prior to the completion of the current 10-year plan, the plan included an annual appropriation of \$500,000 which totals \$5,000,000. Because the groin efforts could be bonded, the total amount of the 10-year line item was included in the 2013 bond issue.

The 2013 bond issue funds must be spent by December 2019. At the direction of Town Council during FY2018 budget development \$2,750,000 of the funds allocated for groins were redirected to capital improvements due to the limited time remaining to expend the funds. The remaining available funds for groins is \$2,724,186.33.

The finalized CPE execution plan includes a comprehensive approach to addressing many of the 124 groins identified in the Town. Previous preliminary plans were not as comprehensive. As a result, the anticipated construction cost will exceed the total amount bonded to date. Sufficient funds likely exist to complete an initial phase of construction, whether this includes Phase 1 of the Execution Plan or a refocus on rehabilitation of the Mid-Town groins.

Additional construction phases will be considered at a later time. No changes are proposed to the 10-Year Coastal Management Program budget at this time with respect to the Groin Rehabilitation item until actual costs are obtained through the competitive bidding process.

Attachment

cc: H. Paul Brazil, P.E., Director of Public Works
Thomas Pierro, P.E., D.CE., APTIM

**TOWN OF PALM BEACH
GROIN REHABILITATION EXECUTION PLAN**

Prepared For:

Town of Palm Beach

Prepared By:

CB&I Coastal Planning & Engineering, Inc.

February 2015

TOWN OF PALM BEACH GROIN REHABILITATION EXECUTION PLAN

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	STUDY AREA.....	1
III.	LITERATURE REVIEW	3
IV.	SITE VISIT AND INVENTORY UPDATE	6
V.	IMPLEMENTATION ASSESSMENT	9
VI.	PERMITTING CONSIDERATIONS	13
VII.	RECOMMENDATIONS	15
VIII.	EXECUTION PLAN	16
XI.	SCHEDULE	17
X.	REFERENCES.....	18

List of Figures

Figure No.

1	Location Map	2
2	Number of groins by Reach as of 2014	6
3	Conceptual Replacement with Concrete King Pile and Panel Groin.....	14

List of Tables

Table No.

1	Conceptual Groin Rehabilitation Plan	5
2	Structure Grouping.....	8
3	Comparison of Approximate Costs.....	12
4	Anticipated Schedule	17

List of Appendices

Appendix No.

A	Plan Views of Groin Locations
B	Site Visit Report
C	Details of Execution Plan

TOWN OF PALM BEACH GROIN REHABILITATION EXECUTION PLAN

I. INTRODUCTION

The Town of Palm Beach (Town) is located on the southeast coast of Florida in Palm Beach County on Palm Beach Island. The Town's coastline has a total of 124 groins of multiple construction types that are in various states of functionality. The purpose of this execution plan is to update the groin inventory and set priorities for addressing those needing repair, rehabilitation or removal based on recent changes to beach and groin conditions.

In September 2012, CB&I Coastal Planning & Engineering, Inc. (CB&I) completed a peer review of the Town's coastal structures to consolidate findings of the previous coastal structure assessments. As part of the peer review report, an independent assessment was developed based on field observations of the coastal structures in Reaches 2-6. The evaluation provided an assessment of groin performance and the value of maintaining, modifying or improving groins as they relate to the Town's Comprehensive Coastal Management Plan.

The conceptual groin rehabilitation plan developed in 2012 established regional management goals for the maintenance of the groins and beaches throughout the Town. The plan provides a basis to facilitate incremental improvement of the coastal structures and assumes that the current nourishment programs will continue, as well as regular monitoring of the coastal structures. The recommendations of the plan to maintain the Town's coastal structures were based on maintaining stabilization of the beach and avoiding nearshore hardbottom impacts, while providing storm protection consistent with the Town's comprehensive plan.

The primary objective of this document is to describe execution strategies and priorities for a multi-year phased approach to implement the Town's groin rehabilitation plan. The plan recommendations are based on previous studies, an updated groin inventory and present areas of most immediate concern. The plan may be modified based on site condition changes, regulatory feedback and other priorities during the course of implementation.

II. STUDY AREA

The Town of Palm Beach shoreline extends from Florida Department of Environmental Protection (FDEP) monuments R-76 to R-134+120 (Figure 1) and covers approximately 12.2 miles of coastline. This area is part of Palm Beach Island, which extends approximately 15.7 miles from Lake Worth Inlet in the north to South Lake Worth Inlet in the south. For management purposes, the shoreline in the Town of Palm Beach was divided into Reaches, with start and end points referencing FDEP monument designations (ATM, 1998). These Reaches were defined considering both coastal zone features and local political boundaries. Recently, the Town redefined the boundary between Reach 7 and Reach 8 at the Lake Worth Municipal Pier. The Reach designations are shown on Figure 1. The groins described in this report are located in Reaches 2 through 6.

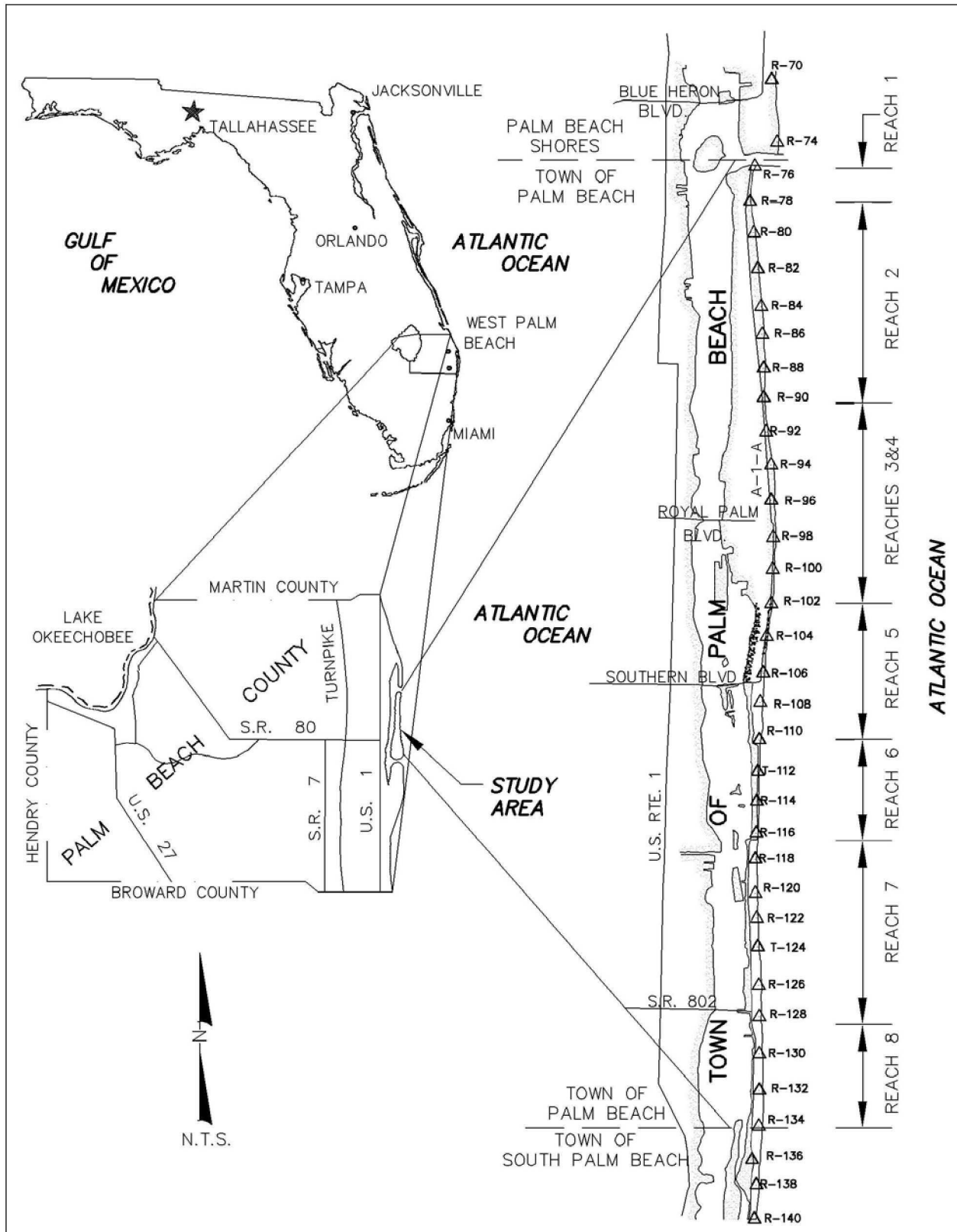


Figure 1. Location map.

III. LITERATURE REVIEW

Recent reports related to coastal structures and performance monitoring of the beaches from Reach 2 through Reach 6 serve as the basis for this planning document. The reports are primarily focused on the coastal groins within the Town limits, but also include discussion of other coastal protection measures from the perspective of how they relate to groin performance and vice-versa. The following are the primary documents that comprise this review:

1. Town of Palm Beach Groin and Armoring Inventory Isiminger & Stubbs Engineering, Inc. 2010

The objective of the I&S report was to document the existing groins and seawalls in the Town of Palm Beach. The report presents a description and summary of all the exposed groin structures and coastal armoring structures along the Atlantic Ocean shoreline within the Town of Palm Beach based on a field investigation and survey. The field work was conducted in September-November 2009.

A total of 75 groins and 95 segments of armoring (41,000 LF) were located and documented as part of the I&S study. Data for each groin was presented in a table containing a groin ID, general groin type, coordinates (northing and easting), length, elevation, size and elevation of rubble (if existent), presence of seawall, permeability, shoreline offset, localized scour, relative functionality and relative condition.

The report provides an abundance of details on most of the existing groins and seawalls, although additional groins have been exposed and located since the report was completed. The report also provides a basis for comparison and a nomenclature for groin identification that has been proven to be very useful and carried forward.

2. Coastal Structures Plan for the Town of Palm Beach Coastal Technology Corporation (2011)

The 2011 Coastal Tech report provides an assessment of the existing groins in the Town and an initial conceptual plan for the Town to address them. The assessment included field observations performed June 2010, empirical analyses and numerical modeling.

Coastal Tech analyzed each groin using historic aerial photography, shoreline and volume changes based on beach profile surveys, data in the Groin and Armoring Inventory report (Isiminger & Stubbs, 2010) and field observations. The objective was to determine the condition and function of each groin as a basis to recommend removal, repair, replacement, or to take no action, and/or add new groins in the vicinity of existing groins.

Recommendations for Reaches 2, 4 and 5 incorporated maintenance and repair as budget allows for existing groins, coupled with groin assessment at least every 5 years. The report included conceptual probable cost of construction and an assessment of permit feasibility. The resulting plan was intended to provide a partial basis for the Town to update and/or refine the Town's previously adopted Comprehensive Coastal Management Plan (CCMP) (ATM, 1998).

3. Town of Palm Beach Coastal Structures Plan Peer Review Coastal Planning & Engineering, Inc. (2012)

In 2012, Coastal Planning & Engineering, Inc. reviewed the coastal structure reports prepared by Coastal Technology Corporation and Isiminger & Stubbs Engineering, Inc., along with the Comprehensive Coastal Management Plan Update (ATM, 1998). The report consolidates findings of the previous coastal structure assessments and documents the results of field observations performed June/July 2012, which focused on the coastal groins in Reaches 2 through 6. This independent assessment described groin performance, storm protection vs. recreational benefits, the value and costs of maintaining, modifying or improving groins, most effective groin locations, and potential safety issues.

As part of the study, a conceptual Groin Rehabilitation Plan was developed to establish regional management goals for the maintenance of the groins and beaches throughout the Town. The plan facilitates incremental improvement of the coastal structures as a long-term program assuming that the current nourishment programs will continue, as well as regular monitoring of the coastal structures. The recommendations of the plan to maintain the Town's coastal structures were based on the following primary findings:

- The majority of the beaches in the Town have been stabilized by coastal groins in one form or another.
- Combined with beach nourishment and inlet bypassing, groins have contributed to widespread and long-term benefits for the Town's coastal program.
- Removal of the Town's groins could cause a destabilization of the coastal system that would have to be mitigated for with additional beach nourishment.
- Additional beach fill would likely be required for installation of new groins or significant modifications (improvements) to existing groins.
- Actions such as groin modifications and beach fill that result in impacts to nearshore hardbottom would require the Town to construct artificial mitigation reefs.
- Implementing groin improvements with the existing nourishment program is a feasible approach for long term coastal management in the Town.

Based on the results of the study and the findings discussed above, it was recommended that the Town pursue groin rehabilitation as a multi-year capital improvement program for implementation in phases. A preliminary conceptual plan was described in the report and included in the Beach Management Agreement developed for Palm Beach Island. Additional studies, design and engineering were recommended for implementation as part of the Town's comprehensive coastal management program. The suggested goals from the conceptual plan are presented in Table 1.

Table 1. Conceptual Groin Rehabilitation Plan (CPE, 2012).

Reach	Groin Rehabilitation Plan Goals	
Reach 1	1.1	There are no coastal structures currently managed by the Town in this Reach.
Reach 2	2.1	Leave the eight (8) groins north of R-88 in place.
	2.2	Maintain the groin field between R-88 and R-89 by leaving structures in place and repair those with damages.
	2.3	Manage the hotspot between R-89 and R-90 by removing existing unevenly spaced, deteriorated groins and repair groins at regular spacing.
Reach 3	3.1	Leave the groins in place and continue the Mid-Town nourishment projects.
Reach 4	4.1	Leave the groins along the public beach in place.
	4.2	Stabilize the beach at the south end of the public beach by constructing one groin.
	4.3	Repair the five-structure groin field in the south end of Reach 4.
	4.4	Extend the groin field into Reach 5 or manage with beach fill.
Reach 5	5.1	Repair groins to widen beach at north end of Reach 5 or manage with beach fill.
	5.2	Leave the remaining structures in Reach 5 in place.
Reach 6	6.1	Leave the structures in Reach 6 in place.
Reach 7	7.1	There are no coastal structures currently managed by the Town in this Reach.
Reach 8	8.1	There are no coastal structures currently managed by the Town in this Reach.

IV. SITE VISIT AND INVENTORY UPDATE

Site visits performed by CB&I Coastal Planning & Engineering, Inc. (CB&I) in 2012 and 2014 confirmed that the current physical condition of the majority of the previously documented structures is comparable to previous reports, with the exception of the groins at The Breakers due to the recent rehabilitation project.

In support of the execution plan development, CB&I performed site visits on July 24 and 25, 2014, in Reaches 2 through 6 to observe the groin conditions from a coastal processes standpoint and update the groins structures inventory. The current condition and effectiveness of the existing structures was observed and documented for comparison with any changes in visual condition and effectiveness since the previous field observations in June/July 2012. Observations were limited to exposed sections of the groins.

As of the 2014 site visit, there are a total of 121 groins and three (3) shore-parallel structures documented in the Town. This is an additional 28 groin structures compared to the 93 groins documented as of 2012 (CPE, 2012). The beach condition at the time of the site visits greatly influences the visibility of the groins, resulting in known groins and recently identified groins, or portions thereof, being observed at different times. The number of “Known” groins from the prior site visits (I&S, 2009; Coastal Tech, 2011; and CPE 2012) and the number of “Recently Identified” groins from 2014 are shown by Reach in Figure 2. Plan view drawings depicting the locations of the groins are included in Appendix A.

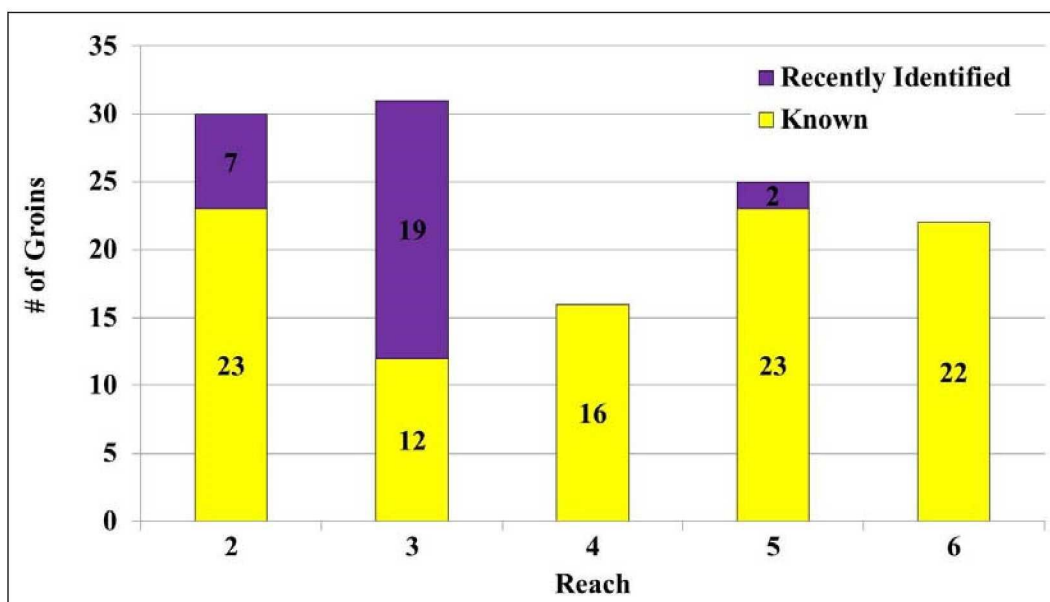


Figure 2. Number of groins by Reach as of 2014.

A site visit report, which includes observations by reach and photos (ground level and aerials) documenting the condition of the structures from 2012 to 2014, is included as Appendix B. The following findings were drawn from the 2012 and 2014 site visits:

- The structures are constructed of various materials including steel sheet pile, concrete, timber, rubble mound, steel rebar, and combinations thereof.
- The structures are constructed of various techniques including but not limited to steel sheet pile with steel waler, steel sheet pile with concrete cap, steel sheet pile with concrete core, steel sheet pile with rubble mound, timber pile & panel, and rubble mound.
- The structures are ephemeral as sand migrates alongshore resulting in periods of varying levels of exposure and burial. Not all of the documented groins were observed during each site visit. There may be additional groins that have not been documented herein.
- The dimensions and spacing of the structures vary. Their cross-shore lengths range extending up to approximately 300 feet from the existing seawalls (or dune vegetation). Their crest elevations range from approximately 2-3 feet above to 3-4 feet below the water surface. Their alongshore spacing average approximately 350 feet, but range to more than 1,000 feet.
- The conditions and effectiveness of the structures are in various states. Steel sheet piles have deteriorated becoming porous. Rubble mound stones have settled reducing the crest elevation and have been displaced increasing porosity. Timber has weathered and become dilapidated. Concrete has spalled and cracked exposing steel rebar.
- Many structures are holding sand at low beach elevations and in the water. The conditions of the structures may be causing a “salient” response vs. a “saw-tooth” pattern at the shoreline.
- The structures are functioning to varying degrees and providing benefits in fields or groups.
- Ephemeral hardbottom exists offshore of the structures. The hardbottom formations appear to be affecting shoreline response in some areas, specifically in areas where the hardbottom is close to the shoreline.
- If structures are removed, sand may be released to cross-shore and longshore transport resulting in increased erosion and hardbottom impacts.
- Seawalls, revetments, and retaining walls currently exist along a majority of the coastline. They have been constructed and repaired at various times over the years. Their level of toe protection, stability, and design life are unknown. Sand held by the structures appears to provide additional toe protection to the seawalls, revetments, and retaining walls.
- The conditions of the structures may pose potential safety hazards to the public.

The 124 groins that have been identified within Reaches 2 through 6 as of the 2014 site visit were organized into structural groups as outlined in Table 2. The groups were based on structure type and spacing, beach condition, and overall coastal setting.

Table 2. Structure Grouping.

Reach	Structure Group	Condition of Structure Group
Reach 1	R-76 of R-78+500	No coastal structures managed by the Town.
Reach 2	<u>2A</u> R-78+500 to R-87 G71208 through G74650 (14 structures)	Low crested, steel sheet pile or rubble mound groins spaced approximately 600 feet alongshore. Groins extend cross-shore between seawalls and hardbottom.
	<u>2B</u> R-87 to R-89 G73655 through G72800 (6 structures)	The seawalls and hardbottom diverge south R-87. The length of the groins are longer than Group 2A and the crest elevations are above high tide. The groins are constructed of steel sheet pile with concrete caps spaced approximately 300 feet alongshore. Steel sheet pile at the shoreline has deteriorated becoming porous.
	<u>2C</u> R-89 to R-90+400 G72663 through G71633 (10 structures)	The crest elevations are above high tide at the landward end and slope down becoming submerged during low tide at the seaward end. The groins are of mixed construction types including steel sheet pile, timber, and rubble mound spaced approximately 200 feet alongshore. Steel sheet pile at the shoreline has deteriorated becoming porous.
Reach 3	<u>3A</u> R-90+400 to R-93+500 G71208 through G67812 (24 structures)	Low crested, steel sheet pile groins spaced approximately 200 feet alongshore. Groins extend cross-shore between seawalls and hardbottom.
	<u>3B</u> R-93+500 to R-95 G67472 through G65583 (7 structures)	T-head groins managed by the Breakers Hotel. The structures were rehabilitated the winter of 2011/2012.
Reach 4	<u>4A</u> R-95 to R-99+500 G64334 through G61703 (11 structures)	Groins within the Mid-Town Beach Nourishment Project Area. The groins are spaced approximately 350 feet alongshore. They are comprised of Prefabricated Erosion Prevent (PEP) units overlain by 2-3 foot diameter limestone boulders.
	<u>4B</u> R-99+500 to R-102+300 G60352 through G58554 (5 structures)	Low crested, steel sheet pile groins spaced approximately 500 feet alongshore. Groins extend cross-shore between seawalls and hardbottom.
Reach 5	<u>5A</u> R-102+300 to R- 104+500 G57512 through G56253 (4 structures)	Low crested, steel sheet pile groins unevenly spaced alongshore (average 650 feet). Groins have deteriorated becoming porous.
	<u>5B</u> R-104+500 to R-107+500 G54947 through G51896 (11 structures)	Groins are uniformly spaced approximately 300 feet alongshore. The crest elevations generally slope or step-down as they extend offshore such that only the landward ends are exposed during high tide. They are constructed of concrete encased by steel sheets. The northern two groins have deteriorated becoming porous at the landward ends.
	<u>5C</u> R-107+500 to R-110+100 G51225 through G48688 (10 structures)	Groins are uniformly spaced approximately 300 feet alongshore. The crest elevations generally slope or step-down as they extend offshore such that only the landward ends are exposed during high tide. They are constructed of constructed of steel sheet pile, of steel sheet pile with a concrete cap, or of mixed construction materials. The groins have deteriorated becoming porous, but a dry beach is maintained throughout seasonal fluctuations.
Reach 6	<u>6A</u> R-110+100 to R-116+500 G48338 through G42198 (22 structures)	Low crested, steel sheet pile groins that are uniformly spaced approximately 300 feet alongshore. Groins in front of the FDOT revetment along SR A1A are intact and extend offshore to hardbottom. The two groins at the north end of the FDOT revetment have lower crest elevations.
Reach 7	R-116+500 to R-128+530	No coastal structures managed by the Town.
Reach 8	R-128+530 to R-134+135	No coastal structures managed by the Town.

V. IMPLEMENTATION ASSESSMENT

1. Existing Conditions

The long term trend for the coastline within Reaches 2 through 6 of the Town of Palm Beach is erosional with short term periods of accretion. The dry beach width fluctuates on a seasonal basis as sand is transported by breaking waves from north to south along the coastline. The supply of sand within the system is affected by the rate of sand naturally transported, beach and dune nourishment, and mechanical by-passing around Lake Worth Inlet at the north end of Reach 1.

Historically, groins have been constructed to manage erosional trends by slowing the transport of sand through a particular area. In the Town of Palm Beach, initial groin construction dates back to the 1930's. Since that time, many groins have been installed, repaired, rebuilt, modified, removed, and additional groins installed. The most recent rehabilitation was completed during the winter of 2011/2012 in front of the Breakers Hotel.

The approach of using groins over the years to address erosion has resulted in the installation of a variety of types in terms of construction materials, alongshore spacing, crest lengths and elevations, and levels of effectiveness. For assessment purposes, the groins were organized into structural groups with an overview of their existing conditions in Table 2.

2. Design Intent

Over the many years since installation, the conditions of the groins have deteriorated as they have reached the end of their typical service life. In these areas, the coastal system has responded accordingly and is generally characterized by narrow beaches stabilized with various combinations of structures. The intent of the execution plan is to maintain the current level of function through groin rehabilitation, while minimizing changes to coastal system. The following primary objectives have been defined to implement this design intent:

- Remove or cut down redundant and ineffective groins.
- Repair or replace effective groins to renew structural integrity.
- Enhance aesthetics and continuity with uniform construction materials.
- Decrease public safety risks by reducing hazards associated with deteriorated groins.

3. Construction Considerations

The replacement and removal of groins along the Town's coastline requires many considerations such as the physical restrictions that increase the complexity of executing the work and effect cost. Challenges associated with removing existing groins, working around other nearby structures, various construction types, and comparative costs were considered and are discussed below in general terms:

- Removal of existing groins involves dismantling the structures in their entirety, or portions thereof. The coastal setting and variable beach widths will make removal operations challenging. Portions of the structures that extend seaward of the dry beach will require work within and below the water surface and all the resulting debris must be taken off-site and disposed. The various existing construction materials present additional challenges, such as:
 - Steel sheet piles become corroded over time causing the interlocking sheets to seize. Removal typically requires splitting the sheets and vibrating them as they are lifted during extraction. Extraction may not be possible if the sheets are driven into underlying rock. In situations where sheets cannot be extracted, they are cut down to a lower elevation to reduce frequency of exposure.
 - Rubble mound structures can contain variable stones sizes that range from small armor stones to large boulders that settle, become displaced, and are buried over time. Removal requires excavating stones and lifting each stone from the structure. Stones buried deep in the beach may not be observed or removed. As the beach fluctuates, other stones may become exposed requiring removal at a later date if they pose a hazard to the coastal system or beach users.
 - Concrete loses its strength over time and internal reinforcing metal corrodes causing fracturing (spalling) of the concrete. These issues are typical of all concrete structures, but are amplified in the coastal environment. Removing concrete requires breaking the concrete into pieces that can then be lifted and removed from the structure. Once broken, removal techniques are similar to that for rubble mound stones. Similar to steel sheet piles, removal may be limited to a given (lower) elevation.
 - Timber becomes weathered and deteriorates quickly in the coastal environment. Wooden piles and connecting panels may break apart upon removal while being lifted out of place. Similar to steel sheet piles, removal may be limited to a given (lower) elevation.
- Nearby structures in proximity of the groins would need to be considered during the removal and replacement. Aside from the physical restrictions associated with accessing the work sites, vibrations from construction operations could damage seawalls, revetments, infrastructure, and upland property. Acceptable vibration levels will depend on the age, condition, design, and construction materials of the nearby structures. Vibration control and monitoring would help to reduce the potential for impacts and general disruption.
- Considering the construction types that currently exist within the Town, several replacement options are available:

- Timber Pile and Panel Groins would involve driving timber piles spaced approximately 10 feet on center. Between the piles, wooden panels would be installed. Penetration of the underlying hardbottom may be necessary to stabilize to the groin, which may require pre-drilling. The porosity of the groin may be considered ahead of time to approximate the performance of the existing structure. The limited service life of timber structures may not be practical.
- Concrete King Pile and Panel Groins would be similar to the timber pile and panel groins, except that the components would be made of precast concrete. The concrete piles and panels would be reinforced with internal steel rebar and prefabricated offsite. The piles would be installed approximately 12 feet on center with drilling and jetting techniques, connected by the concrete panels. The porosity of the groin may be controlled by the number of panels between piles to approximate the performance of the existing structure, which may be modified post-construction.
- Steel Sheet Pile Groins would require interlocking piles to be driven to a predetermined elevation. Similar to the pile and panel groins, the sheet may have to be driven into the underlying hardbottom. Like many of the existing groins, the steel will corrode and deteriorate over time. Flexibility of the structures permeability is not typical and post-construction adjustment is not likely.
- Steel Sheet Pile Groins with Concrete Cap would involve driving steel sheets as noted above along with casting a concrete cap around the top of the piles. The cap would improve the stability of the structure but adjustment is not possible.
- Steel Sheet Pile Groins with Concrete Core would involve driving parallel sets of piles and pouring concrete between the sheets to create a core. The core would aid in the stability of the structure similar to a cap and provide a form to cast the concrete onsite. Like the other related steel and concrete structures, exterior corrosion would occur and adjustment is not possible.
- Rubble Mound Groins with Marine Mattress Foundation would involve stacking armor stones in a trapezoidal shape to create a gravity supported structure. The bottom layer stones would be placed on top of a marine mattress foundation to reduce settlement of the structure. Readjustment of rubble mound structures post-construction is difficult and costly.
- Considering the various types of construction materials that are available to construct coastal groins, a general cost comparison was developed. The costs vary depending on the materials and equipment needed for installation and will be effected by location on a case by case basis. However, in order to provide a method of comparison, an approximate cost for 100 linear feet of structure of each type was estimated as shown in Table 3. The cost for removal of existing groins is highly variable due to the variety of construction types, location and lengths, and is not included in these estimates.

Table 3. Comparison of Approximate Costs.

Construction Type	Cost (\$/100 LF)
Timber Pile and Panel	\$100,000
Concrete King Pile and Panel	\$150,000
Steel Sheet Pile	\$200,000
Steel Sheet Pile with Concrete Cap	\$300,000
Steel Sheet Pile with Concrete Core	\$400,000
Rubble Mound with Marine Mattress Foundation	\$750,000
Removal of Existing Groin	Variable

The estimated costs in Table 3 are provided for comparison purposes only. The costs for individual groins may vary significantly by location, methods and access. Mobilization is not included in the costs, but is estimated to be on the order of approximately \$500,000 per construction phase.

4. Timing and Access

Construction access, mobilization of equipment and materials alongshore will be challenging due to the unique setting of the Town of Palm Beach and general expanse of coastal development. Environmental limitations, regulatory construction windows, and other permit conditions will increase the complexity of executing this multi-phased project. Considering that the work will likely overlap with times of high resident and visitor presence, public awareness will also be a critical matter. These considerations are discussed in more detail below and will likely be adapted during construction:

- **Construction Access** – Access to the beach is limited. The coastline is characterized by seawalls and revetments that restrict access to the beach for land based equipment. For example, twelve (12) potential land access locations were identified based on aerial photography but are irregularly spaced (in some instances 2 miles apart) and are typically narrow. While the Town has ownership or right-of-way of some access points, others will require coordination with and approval from upland owners. Water access is limited by nearshore hardbottom that exists almost continuously along the coastline. The water depths in the vicinity of these nearshore hardbottom formations may be less than 2-3 feet in many locations. Water based equipment may be needed to execute the work, but measures must be taken to avoid impacts to hardbottom resources.
- **Mobilization of Equipment and Materials** – Access alongshore is dependent upon the condition of the beach at the time of construction. The beach width fluctuates as sand migrates alongshore resulting in periods of time where water intercepts the seawalls. Regardless of whether the beach is accessed by land or water, the fluctuations in the beach width may restrict the ability to traverse alongshore. Traversing the beach is further complicated by the existing groins extending across the beach. Depending on the conditions at the time, groins may be exposed with limited or no sand cover for equipment to track over. The contractor's mobilization and general work plan will need

to consider these factors as they relate to equipment, delivery of materials and removal of debris.

- Easements – Access to the beach may be facilitated by obtaining easements from private property owners. If the upland owner is agreeable, a construction easement would allow the Town to pass through private lands for access and performance of the work. Coordination with owners should commence well in advance of construction so that the means and methods of accessing the work sites can be determined for planning purposes.
- Construction Windows – Construction will be restricted to the winter months (November through May) to avoid impacts to nesting sea turtles. However, the winter months coincide with nor'easter storm events and the season of high beach use by the public. The nor'easter storms can last for several days and occur one after another with less than a week between events. The elevated water levels and wave conditions coupled with a narrow dry beach can delay construction and damage construction equipment. When storms are not directly impacting local weather, the Town's beaches are heavily utilized by beach goers.
- Public Awareness – The winter months coincide with high beach usage by the Town's residents and seasonal visitors, who may be negatively affected by equipment, work areas, and noise associated with construction. An outreach program should be developed to disseminate information about the project and increase public awareness. This program could be complemented by a publically accessible website that can be updated during construction to keep residents and visitors informed on project phasing and progress.

VI. PERMITTING CONSIDERATIONS

While it is anticipated that construction will be broken into separate phases over multiple years with each phase spread over many months based on the project execution plan, the design work and permit applications should be addressed in a comprehensive manner for efficiency in processing. Depending on pre-application agency coordination, individual project approval may be required for each phase of construction. Coordination with the regulatory agencies and the resulting permit conditions will dictate the final sequencing.

- FDEP – Individual Project Approval (IPA) from the Florida Department of Environmental Protection (FDEP) will be sought under the authorization provided by the Beach Management Agreement (BMA). The IPA consists of an informal pre-application process and formal individual project review based on the submitted application. The application will include permit drawings for each structure, material selection, design and construction details, final construction plans and specifications and other related information required by FDEP per the BMA.
- USACE – The groin rehabilitations will also require a Department of the Army Permit from the U.S. Army Corps of Engineers (USACE). However, additional coordination is not expected to be required with the National Marine Fisheries Service (NMFS) and the

U.S. Fish and Wildlife Service (FWS) since the FDEP will invite their representatives to the IPA Application Review Meeting. Information will be provided by the USACE for consideration under the Nationwide 3 Permit for maintenance to existing structures or as required for the Public Notice and Biological Opinion(s), if required.

- Construction Type – There are a variety of construction types throughout the Town. However, the concrete king pile and panel groin should be considered as the primary replacement type for continuity and to balance construction costs, permeability, and durability over the next 30 years. In addition, the modular nature of the king pile and panel groin allows the structure to be adjusted and customized to resemble the size and dimensions of the groins to be replaced (Figure 3). This should be viewed favorably by the regulatory agencies and facilitate the comprehensive permitting approach.

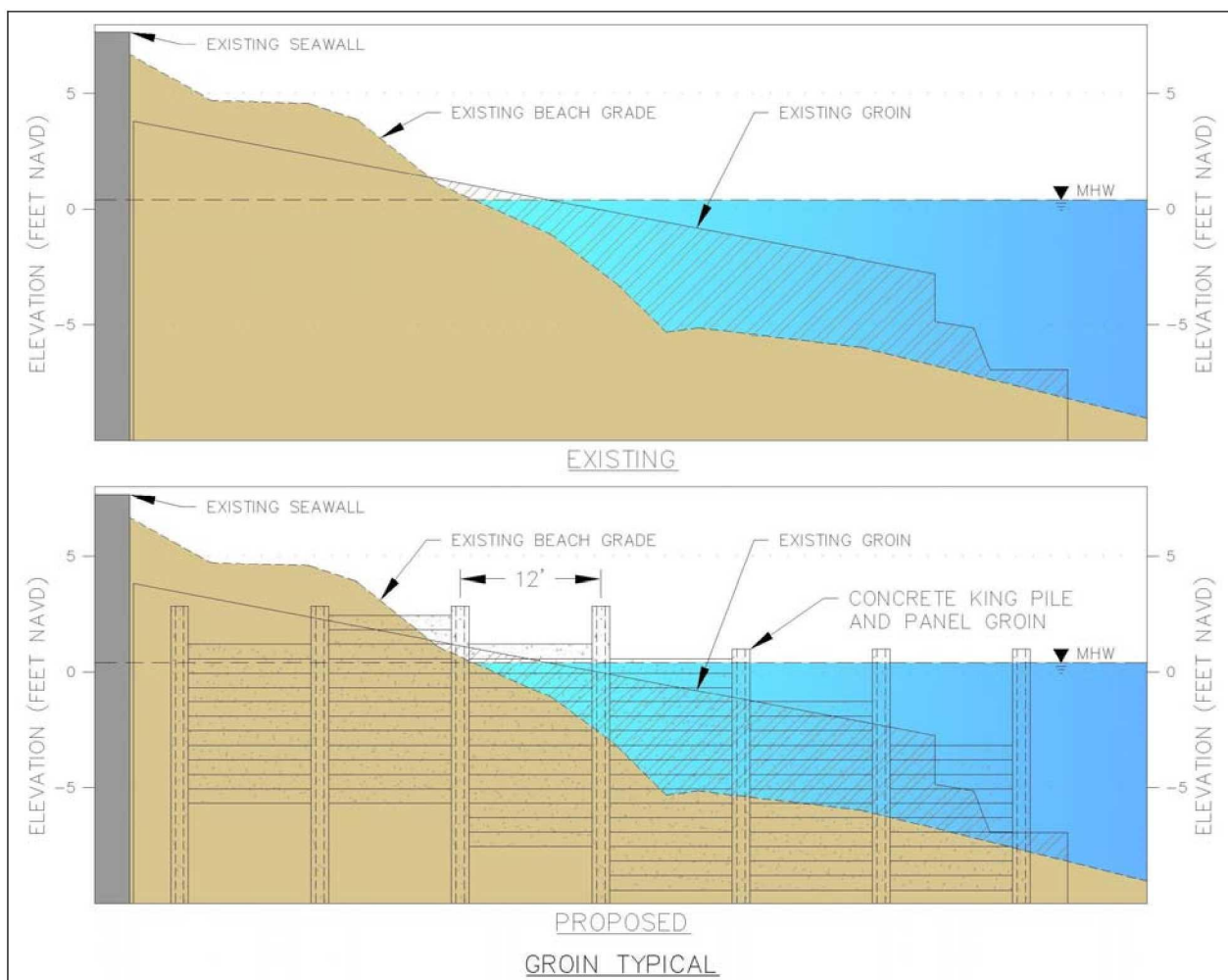


Figure 3. Conceptual Replacement with Concrete King Pile and Panel Groin.

VII. RECOMMENDATIONS

Site visits, recent reports related to coastal structures, and performance monitoring coupled with prior knowledge of the coastal system within the Town were used as a basis for the recommendations presented below.

- **Maintain Current Level of Function** – The existing groins have experienced various levels of deterioration. A number of the groins appear to have a minimal influence on the coastal system and may be removed to reduce safety concerns. Others are having a beneficial effect on the stabilization of sand within the coastal system. Replacing the groins will help to maintain the function that would otherwise be reduced as the groins continue to deteriorate. Groins that are replaced should be installed such that they imitate the current level of function to the extent practical.
- **Improve Aesthetics** – The aesthetic quality of the groins in the coastal system may be improved by consistent spacing, limiting construction types, and reconstruction of deteriorated groins. Removing groins that have a minimal influence on the coastal system will also help to establish a more uniform spacing between the groins that are more effective. The severely deteriorated groins pose potential public safety issues, which can be reduced by the removing or cutting them down. Rehabilitating the more effective groins by replacing them with concrete king pile and panel groins will improve the continuity of the groins throughout the Town.
- **Implement Through Phased Construction** – A phased construction approach will be necessary given the seasonal construction window that avoid impacts to nesting sea turtles. The number of phases is dependent upon the number of groins selected for action, the type of action to be taken, construction access to the project site, and mobilization alongshore. Precise timing of project phasing may not be fully known and will likely be adjusted based on the means, methods and skill of the contractor.
- **Continue Beach Nourishment Program** – The Town plans to complete the Mid-Town Beach Nourishment Project during winter 2014/2015. Phased construction for the groins is expected to follow the nourishment event, organized from north to south. The sand placed during the nourishment will be allowed to continue to migrate naturally and facilitate alongshore access and staging on the beach in the early phases of the work. Additional projects included in the Town's Comprehensive Coastal Management Plan will help to maintain the Town's beaches and work in unison with the groin rehabilitation program.
- **Coordinate with Regulatory Agencies** – The Town should use the information gathered by past studies as summarized in this document as a basis to continue coordination with the agencies to facilitate the permitting process. The coordination should occur early in the planning process to allow adequate time for consideration by the regulatory agencies and to address any potential concerns.

- **Continue Physical Monitoring** – It is essential to continue with the Town-wide monitoring to track sand migration year to year and over the long term. This will help identify any needs for adjustment to the groin structures and provide a basis for regulatory approvals as needed.
- **Periodically Update Structure Inventory** – The BMA authorizes the Town to update the list of groins every 5 years for repair, rehabilitation, or removal within Reaches 2 through 6. The list of groins included in the BMA originated from the Coastal Structures Plan for the Town of Palm Beach (Coastal Tech, 2011). The execution plan developed as part of this work should be used as the basis for the first update to the BMA.

VIII. EXECUTION PLAN

Given the limited construction access, the intent of the phases is to address groins within regions that can be completed within a single construction window. The phases comprising the execution plan are outlined below. Details including construction type, proposed action, lengths, and construction costs for each groin are presented in Appendix C

- **Phase 1 – Groups 2A, 2B, and 2C**

Phase 1 is anticipated to be completed in the winter 2015/2016 (Year 1). It would include work performed on a total of 26 groins in Reach 2. Fifteen (15) groins would be removed and 11 would be replaced. The construction cost for Phase 1 is estimated at approximately \$4.95 million.

- **Phase 2 – Group 3A**

Phase 2 is anticipated to be completed Year 2. It would include work performed on a total of 24 groins in Reach 3. Seventeen (17) groins would be removed and seven (7) would be replaced. The construction cost for Phase 2 is estimated at approximately \$4.66 million.

- **Phase 3 – Groups 4B, 5A, and 5B (northern 2 groins)**

Phase 3 is anticipated to be completed Year 3. It would include work performed on a total of 11 groins in Reaches 4 and 5, all of which would be replaced. The construction cost for Phase 3 is estimated at approximately \$3.86 million. Phase 3 may be combined with Phase 4 depending on timing and costs.

- **Phase 4 – Groups 5B (southern groin), 5C, and 6A**

Phase 4 is anticipated to be completed Year 4. It would include work performed on a total of 14 groins in Reaches 5 and 6. Two (2) groins would be removed and 12 would be replaced. The construction cost for Phase 4 is estimated at approximately \$5.59 million. Phase 4 may be combined with Phase 3 depending on timing and costs.

- **Phase 5 – Modifications (As Needed)**

Phase 5 is anticipated to be completed Year 5 or as needed during the course of Phases 1 through 4. This work could involve old groins that have become re-exposed, removal of additional debris, adjustments to the new groins that were replaced, and other similar efforts. The construction cost for Phase 5 is entirely dependent upon the work that may be required at a given time, which is unknown at this time.

IX. SCHEDULE

The anticipated schedule of project milestones is shown in Table 4. The schedule is presented for planning purposes only. Construction and sequencing of Phases 1 through 5 will be determined by the Town during implementation of the plan.

Table 4. Anticipated Schedule.

Date	Project Milestone	Status
October 2014	Present preliminary findings from site visit to Shore Protection Board	Complete
January 2014	Obtain concurrence from Town staff on the details of the execution plan	Complete
February 2015	Submit execution plan document to the Town; Present plan to the Shore Protection Board	Ongoing
March 2015	Meet with regulatory agencies to discuss execution plan	
April 2015	Complete field investigations, surveys, designs, and cost estimates	
May 2015	Submit permit applications	
August 2015	Obtain permits; Develop construction documents	
December 2015	Commence Phase 1 construction	
Year 2	Commence Phase 2 construction	
Year 3	Commence Phase 3 construction	
Year 4	Commence Phase 4 construction	
Year 5	Commence Phase 5 construction	

Note: Phase 3 and Phase 4 may be combined and Phase 5 may start earlier as needed.

X. REFERENCES

Applied Technology & Management, Inc. (1998). Comprehensive Coastal Management Plan.

Coastal Planning & Engineering, Inc. (2012). Town of Palm Beach, Town of Palm Beach Coastal Structures Plan Peer Review.

Coastal Technology Corp. (2011). Coastal Structures Plan for the Town of Palm Beach.

Florida Department of Environmental Protection (FDEP). 2013. Palm Beach Island Beach Management Agreement (BMA). <http://www.dep.state.fl.us/beaches/pb-bma/docs/BMA-MainAgreement.pdf>.

Isiminger & Stubbs Engineering, Inc. (2010). Town of Palm Beach Groin and Armoring Inventory.

APPENDIX A

Plan Views of Groin Locations

APPENDIX B
Site Visit Report

APPENDIX C

Details of Execution Plan

TOWN OF PALM BEACH

Information for Shore Protection Board Meeting on: January 23, 2018

TO: Shore Protection Board

FROM: Thomas G. Bradford, Town Manager

VIA: Robert Weber, Coastal Program Manager

RE: The Breakers/Clarke Avenue/Mid-Town Continued Discussion
Item XIX.

DATE: January 19, 2018

STAFF RECOMMENDATION

Town staff requests the Shore Protection Board (SPB) provide any additional input as deemed necessary.

GENERAL INFORMATION

At the December 6, 2017 SPB meeting, Town staff informed the board that the Applied Technology & Management, Inc. (ATM) scope of work was being finalized based on input from the Florida Department of Environmental Protection to include the establishment of a Technical Advisory Committee (TAC). The scope of work was finalized and presented to Town Council on January 9, 2018. Town Council approved Resolution No. 03-2018 approving a purchase order to ATM in the amount of \$189,732.

ATM will begin to assemble the TAC as the first milestone of this effort. Following the formation of the TAC, a project kickoff meeting is expected in the next 60 days. The modeling, detailed design development, and Phase 1 permitting is to take approximately 300 days. Town staff will continue to update the Shore Protection Board as milestones are reached.

Attachment

cc: H. Paul Brazil, P.E., Director of Public Works
Paul Leone, The Breakers Palm Beach
Mike Jenkins, Ph.D., P.E., Applied Technology & Management, Inc.

December 15, 2017

Rob Weber
Coastal Program Manager
Public Works Department
P.O. Box 2029
Palm Beach, FL 33480-2029

**RE: Work Proposal: Breakers/Clarke Avenue Numerical Modeling, Detailed Design
Development and Phase 1 Permitting**

Dear Mr. Weber:

This letter is provided as a Work Proposal to develop a consensus based, comprehensive, detailed design to address ongoing erosion concerns within the Breakers/Clarke Avenue/Mid-Town Area (Reaches 3 and 4). This Work Order, when executed, shall be incorporated in and become an integral part of the Agreement for professional services between the Town of Palm Beach (TOWN), Florida and Applied Technology & Management, Inc. (CONSULTANT), hereafter referred to as the Agreement.

This effort will be conducted on a Time and Materials Not to Exceed Basis at rates consistent with the CONSULTANT's General Services Agreement with the TOWN.

Introduction

This effort is a continuation of a process that was initiated under a previous work order. Efforts to date have included extensive consultation with project stakeholders and the development of a consensus based conceptual approach. A total of six specific corrective actions are proposed to fully address the needs of this area. These are defined by the following actions:

1. Breaker's Groin Field: Modify existing structures

Modifications to the existing Breakers groin field are proposed to increase the potential for sand movement to the south. This will require strategic manipulation of the existing structures and a likely seaward

movement of a portion of the groin field. Wave protection to the upland property must be retained within the modified design.

2. North Lauder Wall: Construct new structure

A new structure at the north corner of the Lauder wall is proposed to facilitate movement of sand around the wall. Details of the structure are to be determined and the structure must be minimized in planform extent to address turtle concerns.

3. South Lauder Wall: Construct new structure

A new structure at the south corner of the Lauder wall is proposed to facilitate movement of sand around the wall. Details of the structure are to be determined and the structure must be minimized in planform extent to address turtle concerns. In addition, this structure must consider the influence on wave breaking relative to surfing at Clarke Avenue.

4. South Clarke Boundary: Construct new structure

A new structure in the vicinity of the north corner of the Ecclestone wall is proposed to retain additional sand volume at Clarke Avenue and facilitate movement of sand around the wall. Details of the structure are to be determined and the structure must be minimized in planform extent to address turtle concerns.

5. Mid-Town Groin Field: Rehabilitate existing structures

Rehabilitation of the existing groin field is proposed to increase sand retention and structure field performance.

6. Mid-Town North Groins: Extend existing structures seaward

Strategic extension of groins within the northern portion of the field is proposed to increase sand retention and better align the groin field with the offset associated with the Breakers/Clarke Avenue area.

While in concept implementation of these recommended actions will materially address the multiple issues within the area, further refinement of these approaches is required to advance the project. This Work Proposal delineates the tasks required to advance the design to a level of detail sufficient for project evaluation, costing and the initiation of project permitting.

Certain elements of the plan, most notably rehabilitation of the existing Mid-Town Groin Field (Task 5) may be advanced on an expedited schedule by the Town as a separate effort in parallel with this study. This study will need to consider such actions as they relate to the overall plan. The advancement of this study will be coordinated with any expedited project elements.

As with efforts conducted to date, it is assumed that the design will be advanced through a consensus based approach utilizing the existing body of work as a basis for additional efforts.

Design Approach

This effort will focus on the development of a detailed design for all project elements based on comprehensive modeling and engineering analysis. Given the complexities of the area and the need to engage multiple stakeholders within the process, it is assumed that a Technical Advisory Committee (TAC) will be convened and engaged throughout the study. The TAC provides a forum for a consensus based development of project alternatives and evaluation. Formation of the TAC is typically conducted in conjunction with FDEP concurrence and participation. Additional seats on the TAC are allotted to technical representatives of relevant stakeholders under mutual agreement between the local sponsor and FDEP.

While it is acknowledged that considerable analysis and modeling has been conducted to date, additional modeling is warranted to establish the performance of all project elements as one cohesive system. Additional modeling efforts will include an expanded model domain which encompasses the area of influence of all project elements. In addition, this effort will include consideration of project performance over timeframes consistent with the area nourishment program.

Through regular engagement with the TAC project efforts will be vetted with project stakeholders and FDEP technical staff as the study progresses. This approach allows for incorporation of feedback into the study to ensure that the preferred project alternative is consistent with the expectations of all parties including FDEP technical staff. As such the work as proposed initiates the regulatory and permitting process.

Scope of Services

The following is a description of the Scope of Services to be provided under this Work Proposal. The CONSULTANT shall provide the following services:

Task 1 – Technical Advisory Committee (TAC) Coordination and Project Coordination

Significant engagement with the TAC, the Town and key project stakeholders is proposed to encourage consensus throughout the study. The following subtasks are proposed to ensure stakeholder engagement:

Task 1.1 Technical Advisory Committee (TAC) Coordination

ATM will coordinate with the Town and FDEP staff in the formation of a Technical Advisory Committee (TAC) to review elements of the project study and provide relevant technical input. At a minimum, the TAC will be engaged at the following key project milestones:

1. Project Kickoff Meeting and Review of Proposed Study Elements
2. Review of Initial Model Development and Calibration
3. Review of Analytic Studies and Alternative Identification
4. Review of Initial Model Output and Alternative Refinement
5. Review of Alternatives and Study Conclusions

The above milestones may be combined if deemed appropriate by the TAC. Additional engagement with the TAC as a body or individual members is assumed on an as-needed basis. Meeting format will be at the discretion of the TAC and may include in-person, remote meetings or by conference call. It is assumed for the purposes of this proposal that Tac meetings will be held in South Florida with the option for remote participation by those unable to attend in person.

Task 1.1 Deliverables: A meeting summary will be prepared for each TAC meeting. ATM will prepare the summary and solicit review of the summary by the TAC. Meeting summaries for informal meetings may be prepared if relevant to the study.

Task 1.2 Project Coordination

Additional coordination beyond the TAC is proposed to allow for engagement with Town staff and relevant project stakeholders throughout the study process. Under this task, ATM will engage relevant parties on an as-needed basis. This may include specific meetings with parties, conference calls or presentations to the Shore Board, Town Commission, or other engagement as needed. Coordination will occur in consultation with and under the direction of Town staff.

Task 1.2 Deliverables: Meeting documentation will be prepared as appropriate and may include meeting summaries, status memoranda, PowerPoint presentations or other documentation as necessary.

Task 2 – Alternatives Development and Modeling

Under this task ATM will conduct engineering analysis and numerical modeling to quantify coastal processes within the study area. Specific sub-tasks include the following:

Task 2.1 Analytic Screening of Alternatives

ATM will conduct a review of the project area based on steady-state analytic methods and existing data and studies. The review will include consideration of geometric approaches to quantify beach dimension in relation to proposed structure modifications and new structures. The study will also include a review of the beach nourishment project template in regard to structure performance. Results from this sub-task will

be reviewed with the TAC and will provide the basis for the delineation of project alternatives for further consideration within the numerical modeling tasks.

Task 2.1 Deliverables: A summary memorandum and TAC presentation will be prepared. These will be included as an appendix to the modeling study report developed in Task 2.4.

Task 2.2 Wave Runup Modeling

Based on work to date it has been established that a reduction in wave run-up is a critical design feature particularly with respect to the Breaker's groin field. Any modification of the structures in this area must ensure that the modified structures provide sufficient reduction in wave run-up to limit overtopping of the seawall and reduce the potential for impacts to upland structures. To date, no quantification of run-up has been conducted in this area. Under this task an assessment of wave overtopping will be conducted utilizing the Cornell Breaking Wave and Structures (COBRAS) model. The COBRAS model is a two-dimensional numerical model that solves the Reynolds Averaged, Navier-Stokes (RANS) 2DV equations, with a three dimensional nonlinear $k-\epsilon$ turbulence model. The model is capable of quantifying non-linear run-up behavior, including wave-structure interactions. Calibration of the model will be based on available hindcast wave data and historic instances of significant wave run-up.

The model will be developed for four representative cross-sections based on available survey data. The model will be run for up to three wave scenarios. Model output consists of water surface elevations in time, including quantification of wave run-up in terms of volumetric flow rate. The model will be utilized to quantify wave run-up for existing and alternate groin cross-sections. This will allow for the assessment of wave run-up for scenarios in which modifications to the groin field structures are implemented. Model output will be reviewed with the TAC.

Task 2.2 Deliverable: A summary memorandum and TAC presentation will be prepared. These will be included as an appendix to the modeling study report developed in Task 2.4.

Task 2.3 Sediment Transport Modeling

ATM will develop a sediment transport model to evaluate project area coastal processes and provide a basis for alternative evaluation. This study will utilize the Coastal Modeling System (CMS) modeling suite as the basis for the model. Modeling modules include wave transformation, nearshore transport and beach change (morphology) components. It is noted, that a CMS model was developed previously by others to evaluate this area. This study will where practicable utilize elements of this previous study, however, this model will be expanded to allow for evaluation of the entire study area over timeframes consistent with the

nourishment interval of the Mid-Town Nourishment Project. The study will be advanced in consultation with the TAC. Specific elements of the model will include:

1. Model domain: At a minimum, the model will extend from R-88 to R-102 to include all project elements
2. The model will consider timeframes consistent with the intended Mid-Town renourishment interval of 6 to 8 years. This will include consideration of performance throughout the project nourishment cycle.
3. The model will consider optimization of the Mid-Town Nourishment Project through the implementation of the 6 recommended actions. If appropriate, the model will consider modifications to the Mid-Town Nourishment Project template.
4. The model will also include potential implementation of the southern Mid-Town groin that has been previously permitted but to date has not been constructed.

Task 2.3 Deliverable: A summary memorandum and TAC presentation will be prepared. These will be included as an appendix to the modeling study report developed in Task 2.4.

Task 2.4 Development of Modeling Report

ATM will prepare a modeling report, which will include a summary of modeling tasks conducted under Sub-Tasks 2.1 through 2.3. The report will include relevant graphs, figures, tables and discussion regarding modeling and analysis tasks.

Task 2.4 Deliverable: ATM will prepare a draft modeling report document for review by Town staff. A final report will be prepared based on Town staff comments.

Task 3 – Detailed Design of Preferred Alternative

Elements of the preferred design will be developed under Task 2 efforts. Following identification of the preferred project alternative(s) additional effort will be implemented to advance the design to a level sufficient to support project permitting. The effort will include the following sub-tasks:

Task 3.1 Development of Detailed Design

ATM will advance the preferred alternative to a level of detail sufficient to quantify structure volumes and support project regulatory review. This will include development of engineering drawings of proposed structure modifications and additional structures.

Task 3.1 Deliverable: ATM will prepare signed and sealed engineering drawings of the preferred project design. ATM will prepare a memorandum summarizing design details.

Task 3.2 Development of Project Costs

Based on the Sub-Task 3.1 Detailed Design, ATM will develop an engineering cost estimate sufficient to support project planning.

Task 3.2 Deliverable: ATM will prepare a memorandum summarizing probable means and methods of construction and itemized engineering cost estimate for each project phase.

Compensation

This effort will be conducted on a Time and Materials Not to Exceed Basis for a total cost of **\$189,732**. A summary of costs by task is provided in Table 1 and are detailed further in the attached spreadsheet (Attachment A).

Table 1
Summary of Costs

Task Description and Breakdown		ATM Total Labor	Internal Direct Expenses*	Total Task Budget
Task 1	Technical Advisory Committee (TAC) and Project Coordination			
1.1	Technical Advisory Committee (TAC) Coordination	\$10,870	\$200	\$11,070
1.2	Project Coordination	\$10,870	\$200	\$11,070
Total Cost - Task 1		\$21,740	\$400	\$22,140
Task 2	Alternatives Development and Modeling			
2.1	Analytic Screening of Alternatives	\$22,080	\$100	\$22,180
2.2	Wave Run-up Modeling	\$20,540	\$100	\$20,640
2.3	Sediment Transport Modeling	\$82,120	\$1,000	\$83,120
2.4	Development of Modeling Report	\$14,392	\$200	\$14,592
Total Cost - Task 2		\$139,132	\$1,400	\$140,532
Task 3	Detailed Design of Preferred Alternative			
3.1	Development of Detailed Design	\$21,740	\$100	\$21,840
3.2	Development of Project Costs	\$5,120	\$100	\$5,220
Total Cost - Task 3		\$26,860	\$200	\$27,060
Total Task Order Costs		\$187,732	\$2,000	\$189,732

Note: * Internal direct expenses include costs of reproduction and model related costs.

Project Schedule

The following Project Milestone schedule is proposed though it is noted that the scheduling of TAC engagement will require coordination with multiple parties and is beyond the direct control of the CONSULTANT:

Project Milestone	Milestone Completion
Formation of Technical Advisory Committee (TAC)	within 30 days of NTP
Project Kickoff Meeting and Review of Proposed Study Elements	within 60 days of NTP
Review of Initial Model Development and Calibration	within 120 days of NTP
Review of Analytic Studies and Alternative Identification	within 150 days of NTP
Review of Initial Model Output and Alternative Refinement	within 240 days of NTP
Review of Alternatives and Study Conclusions	within 300 days of NTP

Should you have any questions regarding this proposal, please feel free to contact me at your convenience.

Sincerely,

Applied Technology & Management, Inc.



Michael G. Jenkins, Ph.D., P.E.
Coastal Engineering Principal