LEE COUNTY, FLORIDA

SHORE PROTECTION PROJECT

GASPARILLA ISLAND SEGMENT

2013 BEACH RENOURISHMENT

THIRD ANNUAL POST CONSTRUCTION MONITORING REPORT

November 2017

US Army Corps
of Engineers
Jacksonville District

U.S. ARMY CORPS OF ENGINEERS

JACKSONVILLE DISTRICT

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Introduction

The federally-authorized Lee County, Gasparilla Island Shore Protection Project (SPP) consists of beach renourishment along 2.8 miles of Gulf coastline extending from the Lee County northern boundary to near Boca Grande Pass. The primary purpose of the project is to reduce the risk of damages to upland property from storm-induced erosion and flooding. Initial construction of the Lee County, Gasparilla Island SPP was completed in 2007. Completion of a Project Information Report for impacts sustained by Tropical Storm (T.S.) Debby in June 2012 resulted in a positive assignment of funds from the Flood Control and Coastal Emergencies (FCCE) program under the PL84-99 authority. The FCCE renourishment project was constructed during October through December 2013 and was supplemented with non-federal sponsor cost-shared funds.

The performance of the 2013 renourishment of the Lee County, Gasparilla Island SPP is the subject of this monitoring report. This report was prepared under the provisions of Florida Department of Environmental Protection (FDEP) Permit 0174403-001-JC, which requires annual beach profile monitoring of the project, borrow site surveys, and preparation of a monitoring report to present the results of each survey. This Third Annual Post Construction Monitoring Report will present the results of the most recent monitoring survey completed in July 2017 along with the comparisons of the previous surveys. This monitoring report will also provide the results of the survey completed in September 2017 following Hurricane Irma.

The surveyed beach profiles used in this monitoring study are based on the Department of Natural Resources (DNR), now renamed FDEP, monuments. The federal project extends from FDEP monument R-11 (North) to R-24 (South), as seen in **Figure 1**, with additional tapered extensions extending 1,200 ft North of R-11 and 600 ft South of R-24, shown in **Figure 2.** Note that the "FDEP-" survey monument designation is typically shortened to "R-" for convenience. The borrow area is located approximately 1 mile southwest of the southern end of Gasparilla Island, as shown in **Figure 1.**

Figure 1: Lee County Gasparilla Island Shore Protection Project Map

Figure 2: Limits of the 2013 renourishment construction project fill area depicted by elevation change from pre to post-construction and FDEP survey monuments

Authority

The Lee County, Florida, Shore Protection Project was authorized under the provisions of Section 201 of the 1965 Flood Control Act by Senate Resolution dated December 17, 1970, and House Resolution dated December 15, 1970. The authorized project provides for federal participation in beach erosion control measures for the gulf shoreline of Gasparilla Island, Captiva Island, and Estero Island in Lee County, Florida.

Project History

The local non-federal sponsor (Lee County) completed initial construction in 2007 under authority provided in Section 206 of the Water Resources Development Act of 1992 (WRDA92). The General Reevaluation Report (GRR) study was approved in 2004 with an April 2008 Addendum.

In January 2000 Lee County, under a cost-share agreement with the FDEP, initiated engineering design and permitting for initial construction on a reimbursement basis with the federal government under Section 206 Authority of the Water Resources and Development Act (WRDA) of 1992. The final design included a segmented breakwater located approximately 325 ft offshore of R-25; two T-head groins in the vicinity of R-26, and restoration from R-11 to R-24 using approximately 920,000 cubic yards (cy) of sand from an offshore borrow area. The intial construction of the restoration project was completed in April 2007 by Lee County. The design template consists of a 20 ft berm at elevation of +5 ft MLW with a foreshore slope of 1V:15H transitioning to a nearshore slope of 1V:25H at MLW extending out to the intersection with the existing profile. The source of material for the 2007 construction of the Lee County, Gasparilla Island Segment project was the borrow area located approximately 1 mile offshore Southwest of the Southern end of Gasparilla Island. The structures were scheduled for construction in 2010, but have not been constructed. The project was to include construction of 0.9 acres of artificial reef offshore of R-11 to mitigate for adverse impacts to nearshore hardbottom which was completed before initial construction. The renourishment volume has been projected to be 421,200 cy every 7 years (2001 GRR).

The Gasparilla Island Segment was in need of periodic nourishment after T.S. Debby in 2012, which was within the authorized 10 years of federal participation.

2013 Lee County Gasparilla SPP Renourishment

The 2013 renourishment of the Lee County, Gasparilla Island Segment SPP was constructed from October 26, 2013 through December 10, 2013 and is the subject of this monitoring report. This renourishment was performed to repair damages to the federal project resulting from T.S. Debby, which impacted Florida 23-27 June 2012. Completion of the Rehabilitation Effort for the Lee County Hurricane and Storm Damage Reduction Project Gasparilla Island Segment Project Information Report (PIR, February 2013) for impacts sustained by T.S. Debby (June 2012) resulted in a positive request for Flood Control and Coastal Emergencies (FCCE) and Construction General (CG) funds. The total project cost was $ 9.8 million with 17 % or $ 1.7 million attributed to the FCCE renourishment. The 2013 PIR recommended placement of 467,250 cy (31.6 cy/ft) to repair damages and rebuild affected portions of the Lee County, Gasparilla SPP to its full construction template. A portion of the total volume, 79,250 cy, was paid by the federal government at no cost to the local sponsor under FCCE funding. As shown

in **Figure 1**, project construction covered 2.8 miles of the southern end of Gasparilla Island. The 2013 project was constructed from R-24.5 to R-10.5, including tapers. The source of fill for the 2013 renourishment was the offshore borrow area located one mile southwest of the southern end of Gasparilla Island as shown in **Figure 1**.

Figure 3 shows a typical construction template as used in the 2013 renourishment. This fill template is consistent with the template used in the initial project. The Lee County SPP authorization requires the construction and maintenance of a specific design template in order to reduce damages due to storm-induced erosion along the project length. The construction cross-section includes the fill required to construct the design cross-section plus additional fill placed seaward of the design section for advanced nourishment. The construction template includes a 100-ft wide berm at an elevation of +3.8 North American Vertical Datum of 1988 (NAVD88), which is equivalent to +5.0 ft National Geodetic Vertical Datum of 1929 (NGVD29) and 2.55 ft Mean Low Water (MLW), sloping at 1V:10H to +3.0 ft NAVD88 (+4.2 ft NGVD29, 1.75 MLW) between monuments R-10.5 to R-24.5 (including tapers).

The final volume placed according to contract payment during the 2013 Lee County, Gasparilla Segment SPP renourishment was 457,800 cy. This volume of material was calculated based on acceptance section surveys, which are performed separately from the pre- and post- fill monitoring surveys. Acceptance section surveys are taken over short reaches of shoreline as the project progresses. As such, they are taken shortly after each section of fill is completed and do not typically reflect equilibration of material due to erosion or profile adjustment. The elapsed time between the pre- and post-construction FDEP profile monitoring surveys is typically much longer, in this case approximately 8 months (May 2013 to February 2014). During this time the project equilibrates to some degree following fill placement, i.e. constructed features that evolve with foreshore slopes are more representative of the pre-project beach. Also, since the entire length of the project is surveyed much more frequently for the FDEP datasets, these FDEP surveys give a better “snapshot” view of the project condition.

During the 2013 construction operation an adjustment was required to the fill template along Gasparilla Island. The contract volume was based on the May 2013 survey of Gasparilla Island Beach collected during plans and specifications phase (Spring of 2013), which yielded an estimated 480,000 cy of material required for the construction template—this was the volume that was used in the construction contract solicitation and engineering plans and specifications. The Gasparilla Island preliminary pre-construction survey, Before Dredge survey #13-207 (13-207 BD) was conducted in October 2013 using 500 ft intervals. This survey yielded a substantially lower volume of 341,000 cy of material resulting in a potential 29% underrun of the contract volume.

To account for a decrease in contract volume due to natural accretion and recovery of the beach, the contract plans were modified with an additional construction berm width of 30 ft (from 100 to 130 ft) from R-19 to R-21 and extended the construction berm width by 10 ft between R-10.5 and R-15.5.

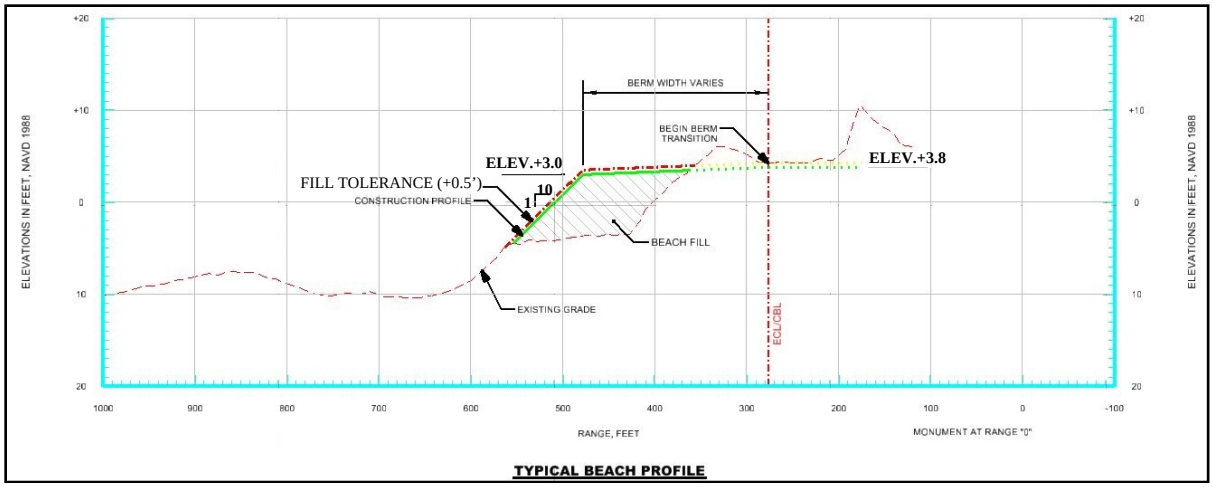


Figure 3: Typical profile and beach fill template

Approximately 55,000 cy of additional material was added to the project by increasing the berm width. This increase in berm width is considered additional advanced nourishment since it is beyond the 20-ft berm design width. The modified contract volumes were thus 128,000 cy of design berm (less required due to natural accretion and recovery), and 338,000 cy of advanced fill for a total volume of 466,000 cy. The total proposed advanced nourishment for this project with a 10-ft berm width adjustment is 338,000 cy, which is less than the advanced nourishment volume requirement of 421,200 cy as predicted in the 2001 GRR.

Impacts of the 2012-2013 Hurricane Season

The 2013 Lee County, Gasparilla Island Segment renourishment was performed to repair damages caused by T.S. Debby in 2012 and also included advanced nourishment to restore the project to its full project dimensions. Following T.S. Debby in 2012, Hurricane Isaac and Hurricane Sandy were the only tropical events to occur in the region throughout the remainder of 2012 (**Figure 4**). Hurricane Sandy, while a significant event on the Atlantic coast, was not significant on the Gulf coast, with maximum sustained winds of 25 knots and water levels less than 1.0 ft above predicted tides measured at Ft. Myers. Hurricane Issac was a tropical storm during most of its time in the Gulf of Mexico and did not become a Category 1 hurricane until just before landfall in Lousiana. Maximum sustained winds of 39 knots and a maximum storm surge of 2.3 ft were measured at Ft. Myers. These subsequent weather events in the project area were not significant and likely caused no more than normal background erosion.

Between the May 2013 pre- and Feb 2014 post-construction monitoring surveys three tropical events of minor significance occurred in the project vicinty, T.S. Andrea, Tropical Depression Dorian, and T.S. Karen (**Figure 5**). T.S. Andrea, occurring during 5 - 7 June 2013, had maximum sustained winds of 24 knots and waterlevels 1.3 ft above predicted tide measured at Ft. Myers. Tropical Depression Dorian following a path along the Florida Atlantic coast occurred during 23 July – 3 Aug 2013 and had maximum sustained winds of 17 knots and waterlevels 0.5 ft above the predicted tide measured at Ft. Myers. T.S. Karen occurred during 3 - 6 Oct 2013 and had maximum sustained winds of 25 knots of minimal duration with water levels 1.3 ft above predicted tide for a 24-hour period, as measured at Ft. Myers. No record of any significant extra-tropical events were found during the survey interval.

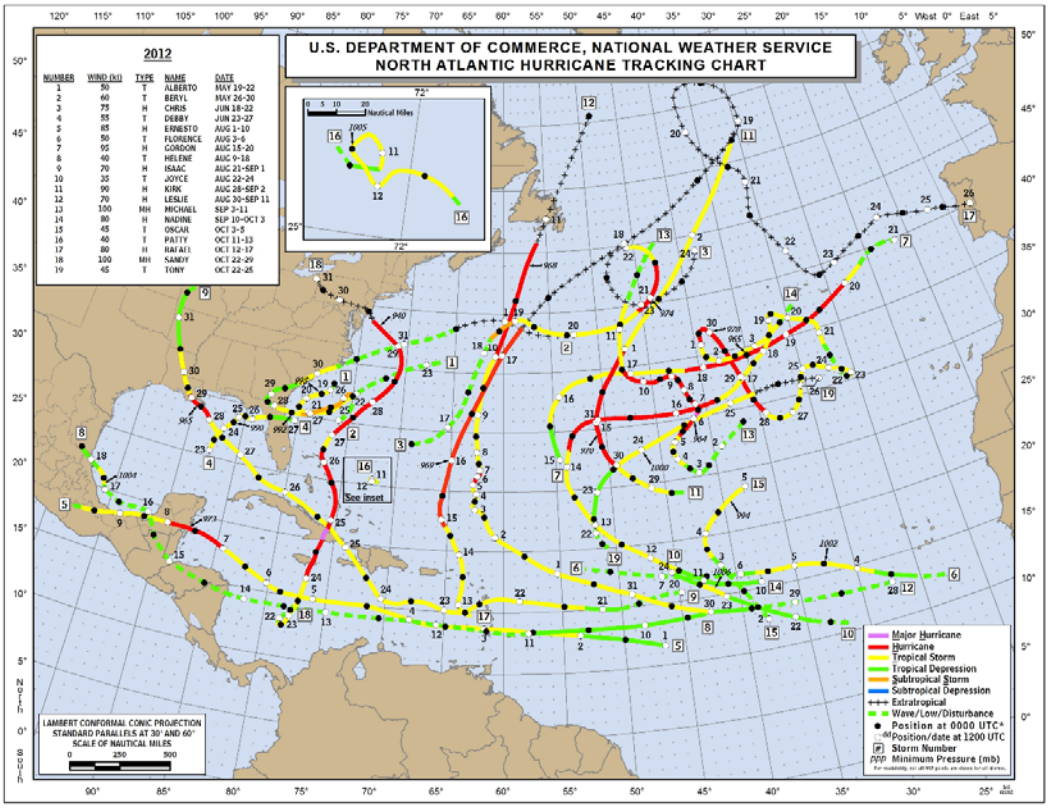


Figure 4: Hurricane and tropical storm tracks – 2012

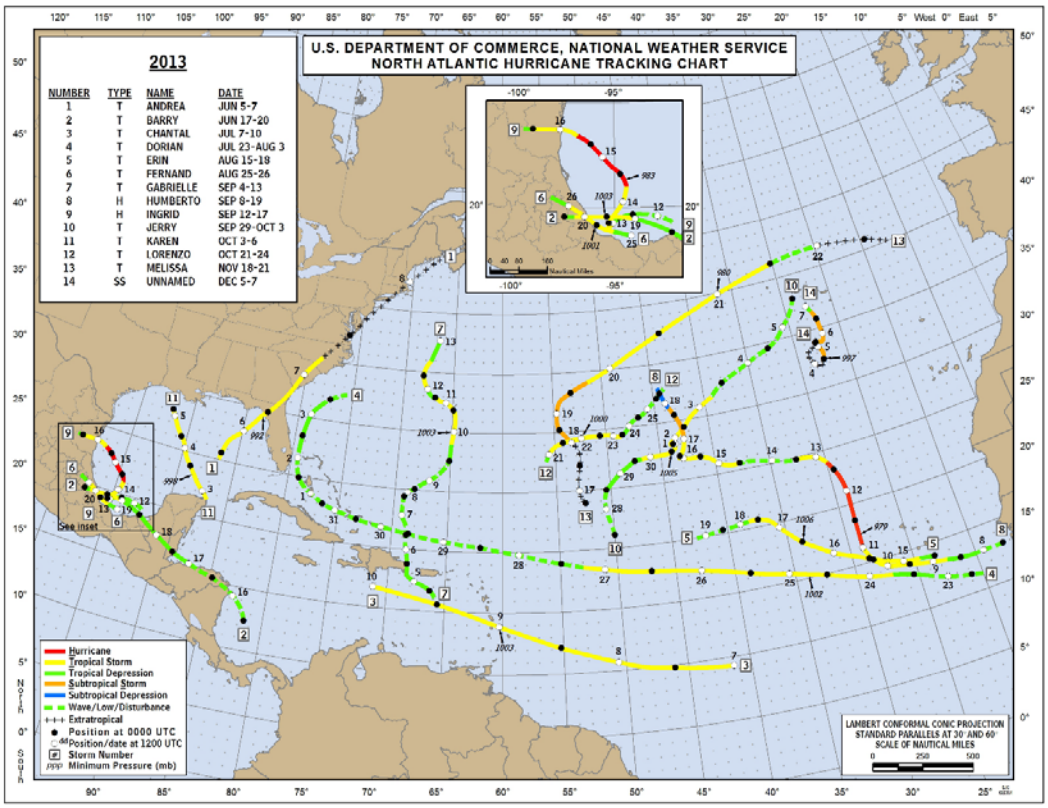


Figure 5: Hurricane and tropical storm tracks – 2013

Impacts of Hurricane Irma

Hurricane Irma impacted the Lee County SPP Gasparilla Segment during September of 2017. Hurricane Irma developed near the Cape Verde Islands and eventually strengthened into a Category 5 hurricane. The path of the hurricane can be seen in **Figure 6**. The hurricane made landfall near Marco Island, FL and again near Naples, FL. The hurricane moved up the central portion of Florida, weakened to a tropical depression over the Georgia-Alabama border, and then dissipated in Mississippi. Hurricane Irma had maximum sustained wind speeds in the area of 57.7 knots measured at Venice Beach. The water level rose 4.9 ft above the predicted tide on 10 September 2017 at Naples, FL. The winds and water levels from Hurricane Irma caused erosion to Gasparilla Island.

Figure 6: Hurricane Irma Track

Monitoring Surveys

Monitoring surveys (profile and borrow site) are summarized in **Table 1** and described below.

2013 and 2014 Monitoring Surveys

Both the pre-construction monitoring survey and post-construction monitoring survey consist of beach profile transects surveyed along the Lee County Gasparilla Island Segment shoreline. Degrove Surveyors Inc. performed the pre-construction monitoring survey (Post Sandy Survey 13-077) during 13 – 17 May 2013 which extends from R-10 (North) Southward to R-26A (South) with profiles approximately every 500 ft at R-monuments and half monuments and profile lengths of 3,000 ft. The pre-construction survey (Post Sandy Survey 13-077) also included the borrow area. Construction of the beach fill began at the south end of the project. The pre- and post- fill construction surveys were performed during construction between 26 October and 13 December 2013. The pre-/post- fill construction pay volume survey (Survey 13-207) extends from R-10 (North) Southward to R-24.5 (South) with profiles approximately every 100 ft (not specifically at R-monuments) and profile lengths of approximately 575 ft. A preliminary construction Before Dredge (13-207 BD) survey and an After Dredge (13-207 AD) survey were also conducted as part of the construction contract. These surveys were about

500 ft apart (not specifically at R-monuments) with profile lengths of about 1,000 ft. Construction of the beach fill was completed on 13 December 2013. USACE performed the post-construction monitoring survey (14-039) during 11-12 Feburary 2014 which extends from R-10 (North) Southward to R-26A (South) with profiles at R-monuments about every 1,000 ft and profile lengths of about 4,000 ft. USACE also conducted the post-construction borrow area survey (14-041) on 11 Feburary 2014.

2015 Monitoring Survey

Hyatt Survey Services, Inc. performed the first annual monitoring survey (15-085) between 29 June and 10 July 2015 which covered from R-10 (North) Southward to R-26A (South). USACE surveyed the borrow area from 5 May – 6 May 2015 under survey number 15-086. The 2015 monitoring datums are NAD83 (horizontal) and NAVD88 (vertical). Measurements are in feet (ft).

2016 Monitoring Survey

Hyatt Survey Services, Inc. completed the second annual monitoring survey (16-088) between 1 June and 3 June 2016 which extends from R-10 (North) Southward to R-26A (South). USACE conducted the borrow area monitoring survey (16-100) from 11-12 May 2016. Datums for both surveys are NAD83 (horizontal) and NAVD88 (vertical). Measurements are in feet (ft).

2017 Monitoring Survey

Hyatt Survey Services, Inc. completed the most recent monitoring survey (17-141) between 10 July and 11 July 2017 which extends from R-10 (North) Southward to R-26A (South). USACE conducted the borrow area monitoring survey (17-149) from 16-17 August 2017. Datums for both surveys are NAD83 (horizontal) and NAVD88 (vertical). Measurement are in feet (ft).

2017 Post-Hurricane Irma Survey

Coastal Engineering Consultants, Inc. completed the post-Hurricane Irma survey (18-018) between 10 July and 11 July 2017 which extends from R-10 (North) Southward to R-26A (South). Datums are NAD83 (horizontal) and NAVD88 (vertical). Measurements are in feet (ft).

Table 1: Monitoring Surveys

Survey	Date	Beach Profiles	Borrow Area
*****Post Sandy Survey (Pre Construction)13-077	13-17 May 2013	R10 – R26A	X
BD, Pre/Post Fill, AD 13-207	26 Oct to 13 Dec 2013	R10 – R24.5	
*****Post Construction Survey 14-039	11-12 Feb 2014	R10 – R26A	
Post Construction Borrow Area Survey 14-041	11 Feb 2014		X
*****First Annual Monitoring Survey 15-085	29 June to 10 July 2015	R10 – R26A	
First Annual Monitoring Borrow Area Survey 15-086	5-6 May 2015		X
*Second Annual Monitoring Survey 16-088	1-3 Jun 2016	R10 – R26A	
Second Annual Monitoring Borrow Area Survey 16-100	11-12 May 2016		X
*Third Annual Monitoring Survey 17-141	10-11 July 2017	R10 – R26A	
Third Annual Monitoring Borrow Area Survey 17-149	16-17 August 2017		X
*Post-Hurricane Irma Beach Profile Survey 18-018	28 September 2017	R10 – R26A	

***Surveys used for the MHW shoreline and volume analyses presented in this report.**

Tidal Datums

To evaluate the monitoring surveys with reference to a tidal datum such as Mean High Water (MHW), the geodetic datum North American Vertical Datum (NAVD88) must be related to the tidal datum in the project area. The nearest tidal datum in the project area is Port Boca Grande, Station No.8725577 available from the National Oceanic and Atmospheric Administration (NOAA). This gauge is located in Charlotte Harbor on the east side of Gasparilla Island just inside the Boca Grande Pass. Due to tidal compression, this gauge is not representative of the tide range that occurs on the Gulf side of Gasparilla Island where the project is located.

NOAA analysts (personal communication) recommended that the NOAA VDatum model should be applied to determine the relationship between NAVD88 and the tidal datums. A

confirmation of the VDatum model application was run at the Venice (NOAA Station 8725858) and Naples (NOAA Station 8725110) gauges, the two closest gulf side gauges, and three gauges in Gasparilla Sound and Pine Island Sound, all of which have NAVD88 and NGVD29 published along with the tidal datums. This exercise was performed as a check on the VDatum model. All values checked within a tolerance of +/- 0.01 feet (ft).

The VDatum model was then applied for three locations along the project, one at the northern end (R-10), the mid-point (R-17), and the final at the southern end (R-25). The VDatum model results at R-17 is shown in **Table 2**; VDatum output at R-17 (centrally located) is used for all conversions between NAVD88 and MHW for the survey analysis in this report. Mean High Water is 0.08 ft above NAVD88 and Mean Low Water (MLW) is 1.25 ft below NAVD88.

Table 2: VDatum Tidal Datums at R-17

Datum	**Value**(ft)
Mean High Water (MHW)	1.77
North American Vertical Datum of 1988(NAVD88)	1.69
Mean Sea Level (MSL)	1.12
National Geodetic Vertical Datum of 1929 (NGVD29)	0.54
Mean Low Water (MLW)	0.44
Mean Lower Low Water (MLLW)	0.00

Survey Analysis

The USACE Coastal Engineering Design and Analysis System (CEDAS) Regional Morphology Analysis Package (RMAP) software was used to analyze the latest monitoring survey (17-141). The present analysis, which analyzes changes between 2016 and 2017, appends the results of the 2013, 2014, 2015, and 2016 monitoring surveys for the 2013 renourishment event. Comparative profiles were plotted for each monument location and are provided in **Appendix – Beach Profiles**.

The survey analysis consists of two components: a mean high water (MHW) position change analysis and a volumetric change analysis. For the mean high water position change analysis, the differences between MHW positions were measured from each plotted cross-section in the beach fill area for each survey interval using CEDAS-RMAP software. The resulting shoreline position change values are summarized in **Table 3**. Data from **Table 3** were plotted graphically in **Figure 7**. More detailed views of shoreline responses at each profile can be seen in the plotted cross-sections in **Appendix – Beach Profiles**. These cross-sections are referenced to North American Vertical Datum 1988 (NAVD88).

In a similar manner, volumetric changes were calculated between the pre-construction, post-construction, first annual monitoring survey, second annual monitoring surveys, third annual monitoring surveys, and the pre- and post-Hurricane Irma surveys. The unit volume from each plotted cross-section in the beach fill area was calculated utilizing the CEDAS-RMAP software. Changes in beach fill volumes between adjacent profile lines were then computed using the Average End-Area method. Volumetric change computations include the area extending in the cross-shore direction from the dune seaward to a depth of closure of -13 ft

(MHW). The 13 ft depth is the outer limit of active sediment transport for the majority of forcing conditions within the project area.

MHW Position Changes

As expected, analysis of pre-constuction (May 2013) and post-construction (February 2014) surveys indicated a substantial shoreline advance along the length of the federal project, which is a direct result of the placement of beach fill during this period. From February 2014 to the first annual monitoring survey completed in July 2015, the MHW shoreline position retreated minimally throughout most of the beach fill area. This is expected behavior for a shoreline following a nourishment event. The changes in MHW position were measured from beach profiles at each FDEP monument (shown in **Appendix – Beach Profiles**), and these measured values are tabulated in **Table 3**. **Figure 7** provides a graphical representation of the same data.

Between February 2014 and July 2015, individual profile MHW changes vary from a maximum shoreline retreat of -47.4 ft at R-14 to a maximum shoreline advance of +21.1 ft at R-23. As shown in **Table 3** the average MHW retreat over the length of the beach fill area during this time was -17.2 ft. The MHW position from R-11 to R-15 and R-18 to R-21 experienced the greatest shoreline retreat from February 2014 to July 2015 relative to the rest of the beach fill area. During construction of the project in 2013, the 100 ft construction template berm was extended by 10 ft from R-11 to R-15.5 and by 30 ft from R19 to R-21. The areas of greatest MHW retreat are, in general, the same areas where the construction template was extended seaward during the 2013 nourishment. This indicates a smoothing out of the seaward berm as the shoreline naturally straightens itself across the beach fill area. The advance of the MHW position at R-23 and R-24 from February 2014 to July 2015 may be a result of the armored headland at R-25 functioning to retain sand on the dry beach at the Southern end of the beach fill area.

The maximum and minimum MHW position changes from July 2015 to June 2016 were a shoreline advance of +1 ft at R-10 and a shoreline retreat of -37.5 ft at R-18, respectively. The average MHW retreat over the length of the beach fill area during this time was -17.1 ft, which is very similar to the -17.2 ft average for the 2014 to 2015 time period. The area of greatest MHW retreat is migrating towards the center of the project, which is typical for beach renourishments as they mature. A sign of shoreline stabilization can be seen in the comparison of MHW position change for February 2014 to July 2015 and July 2015 to June 2016 within **Figure 7**. These two data sets show consistent shoreline retreat.

Between June 2016 and July 2017 only two of the surveyed profiles experienced shoreline advance. The other profiles all experienced retreat. The maxiumum MHW position change was +5.9 ft at R-23. The minimum MHW position change was -39.4 ft at R-16. The average MHW retreat over the length of the beach fill area during this time period was -9.1 ft, which is less retreat than the previous two monitoring periods (-17.2 and -17.1 ft). However, the pattern of shoreline retreat along the project was inconsitent. R-14, R-16, R-19, and R-24 had much greater MHW retreat, ranging from -17.1 to -34.9 ft.

Comparison of the pre-construction survey (13-077) in May 2013 to the latest monitoring survey (17-141) in July 2017, reveals that the current average MHW position is 57.0 ft seaward of the pre-construction MHW position across the beach fill area. The cumulative shoreline change following the 2013 pre-construction monitoring survey is reduced towards the south

end of the project; likely a result of the structure at the southern end of the project, the net littoral drift in the area (North to South), or a combination of both. This is supported within **Table 3**, in which the percent remaining is shown to be largest at the southern section of the project (R-20 to R-24).

Table 3: Mean High Water Position Change

	MHW Position Change (feet)					
FDEP R-Monument	May2013-Feb2014	Feb2014-Jul2015	Jul2015-Jun2016	Jun2016-Jul2017	May2013-Jul2017	Percent Remaining Feb 2014 to Jul 2017
10	35.0	-7.1	1.0	0.4	29.2	84%
11	72.1	-26.3	-15.1	-1.3	29.4	41%
12	86.5	-26.0	-25.5	-7.4	27.6	32%
13	91.6	-35.2	-25.3	-3.7	27.5	30%
14	105.5	-47.4	-23.0	-17.1	18.1	17%
15	106.0	-26.8	-16.8	-3.7	58.7	55%
16	87.8	-5.2	-30.1	-34.9	17.6	20%
17	95.3	-12.0	-30.0	-8.8	44.4	47%
18	106.2	-20.1	-37.5	-3.1	45.5	43%
19	141.1	-30.8	-23.7	-21.0	65.7	47%
20	147.0	-24.8	-7.5	-11.3	103.5	70%
21	157.5	-20.0	-14.2	-2.3	120.9	77%
22	133.0	-4.0	-3.2	-1.4	124.5	94%
23	83.7	21.1	-5.5	5.9	105.2	126%
24	55.9	7.4	-0.6	-26.2	36.7	66%
AVG	**100.3**	**-17.2**	**-17.1**	**-9.1**	**57.0**	**56%**

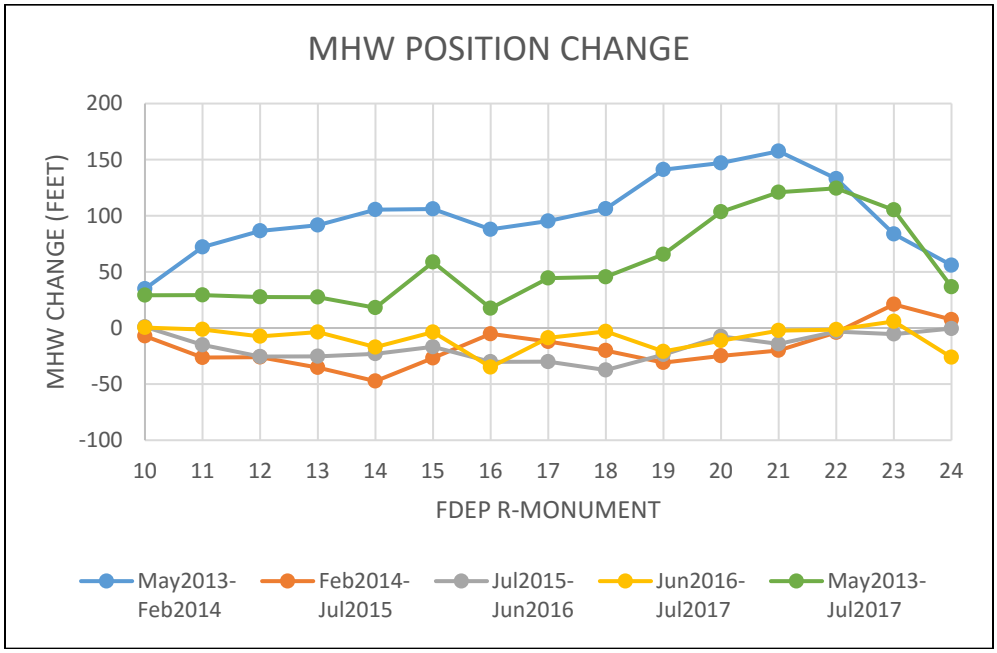


Figure 7: MHW Position Change

Between July 2017 and October 2017, Gasparilla Island experienced shoreline recession at 11 out of 15 profiles due to Hurricane Irma (**Table 4**). The maximum MHW change was +6.2 ft at R-10 and the minimum MHW Change was -22.4 at R-15. The southern portion of the beach, which has been healthy, experienced the most recession from Hurricane Irma. All of the profiles from R-17 to R-24 experienced recession, while some of the northern profiles advanced. **Figure 8** shows the MHW position change after Hurricane Irma. The current average MHW position is 49.7 ft seaward of the pre-construction MHW line.

Table 4: MHW Position Change due to Hurricane Irma

	MHW Position Change (feet)				
FDEP R-Monument	May2013-Feb2014	May2013-Jul2017	July2017-Oct2017	May2013 - Oct2017	Percent Remaining Feb2014 to Oct 2017
10	35.0	29.2	6.2	35.4	101%
11	72.1	29.4	5.7	35.1	49%
12	86.5	27.6	-3.0	24.6	28%
13	91.6	27.5	0.5	28.0	31%
14	105.5	18.1	-8.5	9.6	9%
15	106.0	58.7	-22.4	36.3	34%
16	87.8	17.6	2.0	19.6	22%
17	95.3	44.4	-21.4	23.0	24%
18	106.2	45.5	-7.8	37.8	36%
19	141.1	65.7	-5.7	60.0	43%
20	147.0	103.5	-7.2	96.2	65%
21	157.5	120.9	-3.8	117.1	74%
22	133.0	124.5	-9.0	115.5	87%
23	83.7	105.2	-19.3	85.9	103%
24	55.9	36.7	-15.7	21.0	38%
AVG	**100.3**	**57.0**	**-7.3**	**49.7**	**50%**

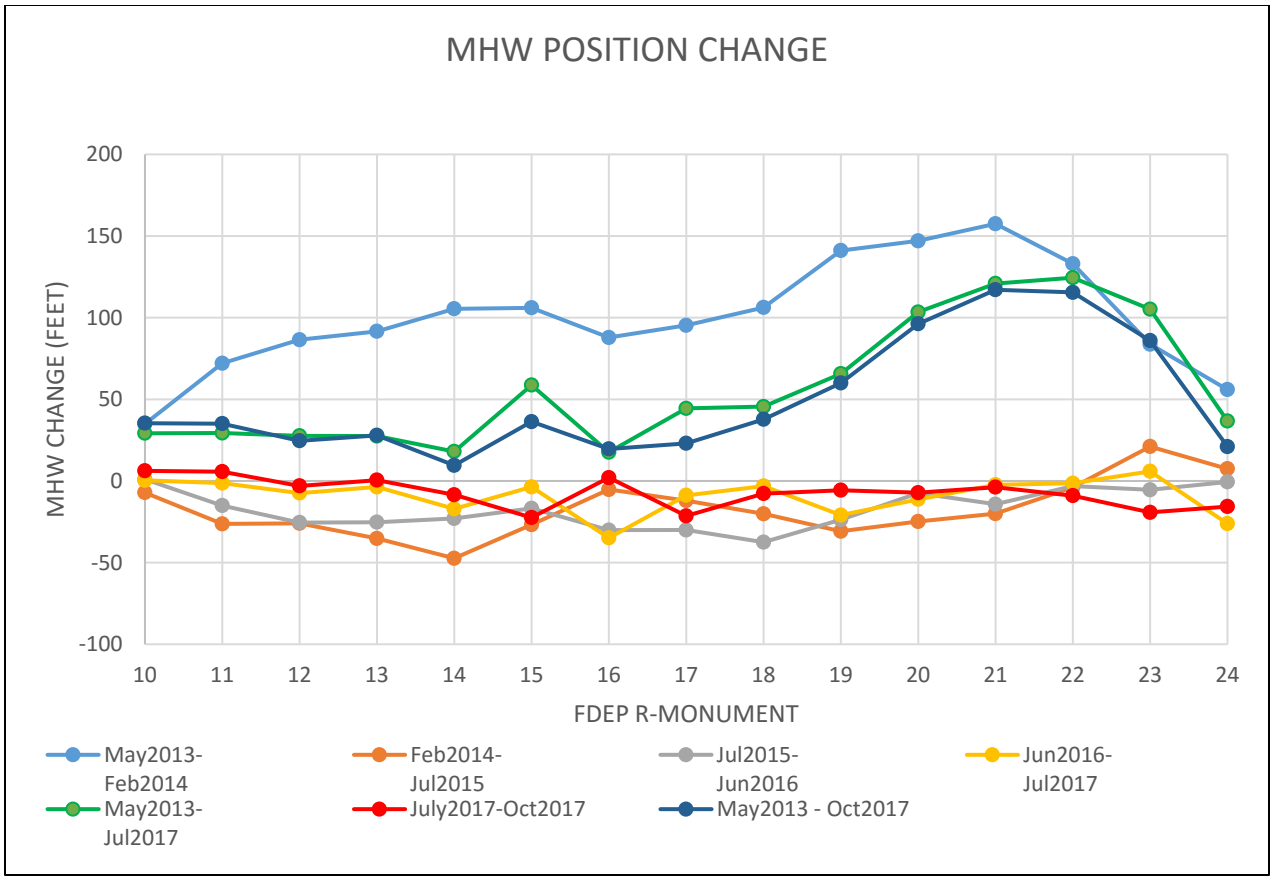


Figure 8: MHW Position Change Including Hurricane Irma

Volumetric Changes

Volumetric changes were measured directly from adjacent beach profile pairs in a manner similar to the methodology presented above for the MHW change analysis. Volumetric calculations extend from the dune to approximately -13 ft MHW, corresponding to the zone of most active sediment transport. **Table 5, Table 6, Table 7, Table 8, and Table 9** present the total volumetric changes between profiles in the beach fill area for the intervals from May 2013 to February 2014, February 2014 to July 2015, July 2015 to June 2016, June 2016 to July 2017, and May 2013 to July 2017, respectively, with all volumetric changes measured in cubic yards (cy). The volumetric changes above the 13-ft MHW depth contour are presented graphically in **Figure 9**.

Consistent with the MHW analysis above, volumetric gains occurred during the pre-construction (May 2013) to post-construction (February 2014) monitoring period, a direct result of the 2013 beach nourishment. Individual profile unit volume changes varied from a minimum gain of 13.0 cy/ft at R-10 to a maximum gain of 50.1 cy/ft at R-15. The average unit volumetric gain across all of the profiles in the beach fill area during this time was 34.3 cy/ft. The total volume gain in the beach fill area from May 2013 to February 2014 was 510,500 cy. Of this total volume gain, 188,500 cy was gained above MHW and 322,000 cy was gained between 0 ft MHW and -13 ft MHW. This volume is 52,700 more than the payment volume (457,800 cy) perhaps due to the timing of the surveys, continued natural post-storm recovery, and/or equilibration that occurred between payment surveys and monitoring surveys.

Between February 2014 and July 2015, individual profile unit volume changes vary from a maximum loss of 22.0 cy/ft at R-14 to a maximum gain of 5.4 cy/ft at R-17. The average unit volumetric change across all of the profiles in the beach fill area during this time was -7.0 cy/ft. The total volume loss in the beach fill area from February 2014 to July 2015 was 100,900 cy. Of this total volume loss, 21,500 cy came from above MHW and 79,400 cy came from between 0 ft MHW and -13 ft MHW. The total volume loss in the beach fill area from February 2014 to July 2015 accounts for approximately 20% of the volume gain observed between the pre and post-construction monitoring surveys. Approximately 89% of the volume gained above MHW from pre to post-construction remained in place in July 2015.

The stretch of shoreline between R-16 and R-17 was the only area that experienced a net gain in volume above -13 ft MHW between February 2014 to July 2015. This stretch of shoreline lies in between the two areas where the berm template was extended seaward during the 2013 construction. The accretion in this area is indicative of a smoothing out of the seaward berm extensions created during the 2013 nourishment, as the shoreline naturally straightens itself across the beach fill area.

The stretch of shoreline from R-21 to R-24.5 gained volume above MHW between February 2014 to July 2015. This may be a result of the armored headland at R-25 functioning to retain sand on the dry beach at the southern end of the beach fill area. Another reason for the volume gain above MHW along this stretch is that the beach in this area is backed by a very wide gently sloping vegetated fore dune. Patches of vegetation in this area appear to be extending seaward which can help to trap and retain sand. A slight increase in the elevation of this fore dune area is noticable when comparing the February 2014 and July 2015 profiles for this area (**Appendix – Beach Profiles**).

From July 2015 to June 2016 a maximum gain of 14.9 cy/ft occurred at R-10 while a maximum loss of -7.2 cy/ft occurred at R-12. Gains outside the placment limits are indicative of continued lateral spreading of renourishment material. The average unit volumetric change across all of the profiles in the beach fill area from July 2015 to June 2016 was 3.0 cy/ft which equates to a net gain in volume of 35,600 cy. Of this total volume gain, 34,100 cy was lost above MHW while 69,700 cy was gained from 0 ft MHW to -13 ft MHW. Throughout all of the R-monuments from July 2015 to June 2016 the beach profile is generally eroding above MHW and accreting in the nearshore sand bar from 0 ft MHW to -13 ft MHW, which is typical of cross-shore equilibration for a beach following a renourishment.

From June 2016 to July 2017 a maximum gain of 7.6 cy/ft occurred at R-20 while a maximum loss of -33.4 cy/ft occurred at R-24. R-18, R-20, R-21 are the only monuments where accretion occurred. All of the other monuments experienced erosion. This varies from the Second Annual Monitoring Report, which showed accretion at 9 out of the 15 R-Monuments. The average unit volumetric change across all of the beach fill area from June 2016 to July 2017 was -6.6 cy/ft with a total net loss of volume of 84,500 cy. Throughtout all of the R-monuments from June 2016 to July 2017 the beach profile is generally eroding below MHW (0 to -13 ft MHW) and slightly accreting above MHW. The surveys show that the total volume gained above MHW is 8,000 cy (0.6 cy/ft) and the total volume loss below MHW is 92,500 cy (-7.2 cy/ft). This erosional trend suggests that some of the sand in the nearshore sand bar was pushed back above the MHW line while the majority was pulled outside of the -13 ft MHW contour. The pattern of erosion from June 2016 to July 2017 is similar to the pattern from February 2014 to July

2015. During both sets of years the project lost approximately 20% of its remaining advanced volume.

Hurricane Irma impacted the Gasparilla Island Segment in October 2017. From July 2017 to October 2017 a maximum gain of 3.4 cy/ft occurred at R-11. This was the only profile that saw a net gain in volume. This is expected from a strong hurricane such as Irma. The average unit volumetric change across the entire beach fill area was -3.9 cy/ft with a total net loss of 52,000 cy. Across all of the R-monuments, the beach profile eroded above MHW. The majority of the profiles also eroded below MHW (0 to -13 ft MHW). The surveys show that the total volume loss above MHW is 45,000 cy (-3.0 cy/ft) and the total volume loss below MHW is 7,000 cy (0.5 cy/ft). During Hurricane Irma, the sand from above MHW was pulled into nearshore sandbars, while the sand that was below MHW was pulled outside of the -13 ft MHW contour. The sand from above MHW replaces some of the material which was lost below MHW, which is the reason for the relatively low erosional rate seen below MHW. The volumetric change in the northern part of the project (R-10 to R-14) between 0 ft and -13 ft MHW was positive which suggests that the energy from the storm was predominantly out of the south (which is expected). This resulted in material eroding from the southern portion of the project being deposited in the northern part of the project, creating net volume gains in those areas.

From May 2013 to July 2017 it can be seen that a net volume of 360,700 cy has been retained since project construction, of which 141,000 cy is above MHW and 219,700 cy remains from 0 ft MHW to -13 ft MHW. Roughly 71% of the original volume that was placed in 2013 remains with 29% eroded as of July 2017. About 75% remains above MHW and 68% remains between MHW and -13ft. Refer to **Table 11** for percent remaining of fill volume at all R-monuments. The average erosion rate within the project limits between February 2014 and July 2017 is 44,000 cy/yr. This is less what was anticipated when the project was originally designed (60,000 cy/yr). This is predominately due to the lack of significant storms that have occurred within the project location since the 2013 renourishment (prior to Hurricane Irma).

From July 2017 to October 2017 it was shown that a net volume of 308,700 cy has been retained, of which 96,000 cy is above MHW and 212,700 cy remains from 0 ft MHW to -13 ft MHW. Roughly 60% of the original volume that was placed in 2013 remains with 40% eroded as of October 2017. About 51% remains above MHW and 66% remains between MHW and -13 ft. The average erosion rate within the project limits between February 2014 and October 2017(factoring in Hurricane Irma) is 59,000 cy/yr. This is slightly lower than the anticipated erosion rate of 60,000 cy/yr but does include a major hurricane. These values show that the anticipated erosion rate has been an effective predictor of the losses in the project since its construction in 2013.

Table 5: Volumetric Change – May 2013 to February 2014

May2013-Feb2014 *(13-077 to 14-039)*		Unit Volume Change (cy/lf)			Volume Change (cy)		
FDEP R-Mon	**Dist Btw Mon (feet)**	**Above 0' MHW**	**0' to -13' MHW**	**Above -13' MHW**	**Above 0' MHW**	**0' to -13' MHW**	**Above -13' MHW**
10		3.6	9.4	13.0			
	1,358				8,907	19,356	28,263
11		9.5	19.1	28.6			
	1,097				10,509	20,218	30,728
12		9.7	17.7	27.4			
	1,011				11,712	19,184	30,896
13		13.5	20.2	33.7			
	1,009				14,565	25,446	40,011
14		15.4	30.2	45.6			
	1,062				15,888	34,924	50,812
15		14.5	35.6	50.1			
	1,070				13,370	33,479	46,849
16		10.5	27.0	37.5			
	1,043				11,545	26,736	38,281
17		11.7	24.3	35.9			
	995				12,808	25,609	38,417
18		14.1	27.2	41.3			
	1,000				17,230	23,437	40,666
19		20.4	19.7	40.1			
	965				19,803	22,167	41,970
20		20.7	26.3	46.9			
	965				19,834	19,584	39,418
21		20.5	14.3	34.8			
	986				17,177	18,884	36,060
22		14.4	24.0	38.4			
	905				9,821	19,236	29,057
23		7.3	18.5	25.8			
	718				4,227	10,794	15,021
24		4.5	11.6	16.0			
	509				1,134	2,941	4,075
24.5		0.0	0.0	0.0			
Average	980	12.7	21.7	34.3	12,569	21,466	34,035
Total	14,693				188,529	321,995	510,524

Table 6: Volumetric Change – February 2014 to July 2015

Feb2014-Jul2015 *(14-039 to 15-085)*		Unit Volume Change (cy/lf)			Volume Change (cy)		
FDEP R-Mon	**Dist Btw Mon (feet)**	**Above 0' MHW**	**0' to -13' MHW**	**Above -13' MHW**	**Above 0' MHW**	**0' to -13' MHW**	**Above -13' MHW**
10		-0.7	-2.0	-2.7			
	1,358				-2,765	-2,961	-5,726
11		-3.4	-2.3	-5.7			
	1,097				-3,263	-1,824	-5,087
12		-2.6	-1.0	-3.6			
	1,011				-3,695	-4,896	-8,591
13		-4.7	-8.7	-13.4			
	1,009				-5,700	-12,157	-17,857
14		-6.6	-15.4	-22.0			
	1,062				-5,347	-14,085	-19,431
15		-3.5	-11.1	-14.6			
	1,070				-1,459	-5,849	-7,309
16		0.8	0.2	1.0			
	1,043				548	2,773	3,321
17		0.3	5.1	5.4			
	995				-1,667	77	-1,590
18		-3.6	-5.0	-8.6			
	1,000				-2,591	-2,005	-4,595
19		-1.6	1.0	-0.6			
	965				-1,708	-584	-2,292
20		-2.0	-2.2	-4.2			
	965				-577	-2,879	-3,456
21		0.8	-3.8	-3.0			
	986				1,265	-8,677	-7,413
22		1.8	-13.8	-12.0			
	905				2,226	-13,876	-11,651
23		3.1	-16.9	-13.7			
	718				2,392	-9,843	-7,451
24		3.5	-10.6	-7.0			
	509				895	-2,687	-1,792
24.5		0.0	0.0	0.0			
Average	980	-1.2	-5.8	-7.0	-1,430	-5,298	-6,728
Total	14,693				-21,447	-79,473	-100,919

Table 7: Volumetric Change – July 2015 to June 2016

Jul2015-Jun2016 *(15-085 to 16-088)*		Unit Volume Change (cy/lf)			Volume Change (cy)		
FDEP R-Mon	**Dist Btw Mon (feet)**	**Above 0' MHW**	**0' to -13' MHW**	**Above -13' MHW**	**Above 0' MHW**	**0' to -13' MHW**	**Above -13' MHW**
10		-0.5	15.4	14.9			
	1,358				-1,968	13,520	11,552
11		-2.4	4.5	2.1			
	1,097				-2,641	-148	-2,789
12		-2.4	-4.8	-7.2			
	1,011				-2,503	-3,547	-6,050
13		-2.5	-2.2	-4.8			
	1,009				-3,176	-529	-3,706
14		-3.8	1.2	-2.6			
	1,062				-2,990	7,161	4,171
15		-1.9	12.3	10.4			
	1,070				-3,053	10,270	7,218
16		-3.8	6.9	3.1			
	1,043				-4,049	5,071	1,022
17		-3.9	2.8	-1.1			
	995				-4,341	2,044	-2,296
18		-4.8	1.3	-3.5			
	1,000				-3,660	2,839	-821
19		-2.5	4.4	1.9			
	965				-1,108	4,119	3,011
20		0.2	4.2	4.4			
	965				-2,005	3,255	1,250
21		-4.4	2.6	-1.8			
	986				-2,863	7,193	4,331
22		-1.4	12.0	10.6			
	905				-292	10,031	9,739
23		0.8	10.2	10.9			
	718				406	6,460	6,866
24		0.4	7.8	8.2			
	509				92	1,991	2,083
24.5		0.0	0.0	0.0			
Average	980	-2.2	5.2	3.0	-2,277	4,649	2,372
Total	14,693				-34,151	69,731	35,579

Table 8: Volumetric Change – June 2016 to July 2017

Jun2016-July2017 *(16-088 to 17-141)*		Unit Volume Change (cy/lf)			Volume Change (cy)		
FDEP R-Mon	**Dist Btw Mon (feet)**	**Above 0' MHW**	**0' to -13' MHW**	**Above -13' MHW**	**Above 0' MHW**	**0' to -13' MHW**	**Above -13' MHW**
10		1.2	-5.3	-4.1			
	1,358				1,025	-6,012	-4,987
11		0.3	-3.6	-3.2			
	1,097				-24	-6,681	-6,705
12		-0.4	-8.6	-9.0			
	1,011				329	-6,915	-6,586
13		1.0	-5.1	-4.0			
	1,009				-121	-6,965	-7,085
14		-1.3	-8.7	-10.0			
	1,062				-467	-7,385	-7,852
15		0.4	-5.2	-4.8			
	1,070				-1,341	-9,284	-10,626
16		-2.9	-12.2	-15.1			
	1,043				-254	-8,275	-8,529
17		2.4	-3.7	-1.3			
	995				2,698	-3,060	-362
18		3.0	-2.5	0.6			
	1,000				-132	-1,256	-1,388
19		-3.3	-0.1	-3.3			
	965				-1,249	3,313	2,064
20		0.7	6.9	7.6			
	965				-47	4,763	4,716
21		-0.8	2.9	2.2			
	986				1,781	-4,551	-2,770
22		4.4	-12.2	-7.8			
	905				4,145	-13,406	-9,261
23		4.8	-17.4	-12.7			
	718				1,731	-18,291	-16,559
24		0.1	-33.5	-33.4			
	509				14	-8,526	-8,512
24.5		0.0	0.0	0.0			
Average	980	0.6	-7.2	-6.6	539	-6,169	-5,629
Total	14,693				8,089	-92,531	-84,442

Table 9: Volumetric Change – May 2013 to July 2017

May2013-July2017 *(13-077 to 17-141)*		Unit Volume Change (cy/lf)			Volume Change (cy)		
FDEP R-Mon	**Dist Btw Mon (feet)**	**Above 0' MHW**	**0' to -13' MHW**	**Above -13' MHW**	**Above 0' MHW**	**0' to -13' MHW**	**Above -13' MHW**
10		3.6	17.5	21.1			
	1,358				5,199	23,903	29,102
11		4.0	17.7	21.8			
	1,097				4,581	11,566	16,147
12		4.3	3.4	7.7			
	1,011				5,843	3,827	9,669
13		7.2	4.2	11.5			
	1,009				5,568	5,795	11,363
14		3.8	7.3	11.1			
	1,062				7,084	20,616	27,699
15		9.6	31.5	41.1			
	1,070				7,517	28,616	36,133
16		4.5	21.9	26.4			
	1,043				7,790	26,305	34,095
17		10.4	28.5	38.9			
	995				9,499	24,670	34,169
18		8.7	21.1	29.7			
	1,000				10,847	23,015	33,862
19		13.0	24.9	38.0			
	965				15,739	29,015	44,753
20		19.6	35.2	54.8			
	965				17,205	24,723	41,928
21		16.1	16.0	32.1			
	986				17,360	12,849	30,208
22		19.1	10.0	29.1			
	905				15,900	1,984	17,884
23		16.0	-5.6	10.4			
	718				8,756	-10,880	-2,124
24		8.4	-24.7	-16.3			
	509				2,134	-6,281	-4,146
24.5		0.0	0.0	0.0			
Average	980	9.9	13.9	23.8	9,401	14,648	24,049
Total	14,693				141,020	219,722	360,742

Table 10: Volumetric Change – July 2017 to October 2017

July2017-Oct2017 *(17-141 to Post-Irma FCCE)*		Unit Volume Change (cy/lf)			Volume Change (cy)		
FDEP R-Mon	**Dist Btw Mon (feet)**	**Above 0' MHW**	**0' to -13' MHW**	**Above -13' MHW**	**Above 0' MHW**	**0' to -13' MHW**	**Above -13' MHW**
10		-1.8	0.6	-1.2			
	1,358				-1,993	3,522	1,529
11		-1.1	4.6	3.4			
	1,097				-2,429	3,615	1,186
12		-3.3	2.0	-1.3			
	1,011				-3,396	2,654	-742
13		-3.4	3.2	-0.2			
	1,009				-3,439	2,826	-613
14		-3.4	2.4	-1.0			
	1,062				-3,924	-175	-4,099
15		-4.0	-2.7	-6.7			
	1,070				-2,373	-1,745	-4,118
16		-0.4	-0.5	-1.0			
	1,043				-2,612	-1,814	-4,426
17		-4.6	-2.9	-7.5			
	995				-4,262	-3,287	-7,549
18		-4.0	-3.7	-7.7			
	1,000				-3,398	-2,988	-6,386
19		-2.8	-2.3	-5.1			
	965				-2,947	-2,192	-5,139
20		-3.3	-2.2	-5.6			
	965				-3,446	-499	-3,945
21		-3.8	1.2	-2.6			
	986				-3,651	-374	-4,025
22		-3.6	-2.0	-5.5			
	905				-3,301	-2,202	-5,502
23		-3.7	-2.9	-6.6			
	718				-2,772	-3,019	-5,791
24		-4.0	-5.5	-9.5			
	509				-1,018	-1,402	-2,420
24.5		0.0	0.0	0.0			
Average	980	-3.2	-0.7	-3.9	-2,997	-472	-3,469
Total	14,693				-44,958	-7,081	-52,039

Table 11: Percent of Beach Fill Volume Remaining

		2014 (Post Construction) - 2015		2014 (Post Construction) - 2016		2014 (Post Construction) - July 2017		2014 (Post Construction) - Hurricane Irma (Oct 2017)	
FDEP R-Mon	**Dist Btw Mon (feet)**	**Total Volume Change (cy)**	**Percent Remaining**	**Total Volume Change (cy)**	**Percent Remaining**	**Total Volume Change (cy)**	**Percent Remaining**	**Total Volume Change (cy)**	**Percent Remaining**
10									
	1358	22,537	80%	34,089	121%	29,102	103%	30,631	108%
11									
	1097	25,641	83%	22,852	74%	16,147	53%	17,333	56%
12									
	1011	22,305	72%	16,255	53%	9,669	31%	8,928	29%
13									
	1009	22,154	55%	18,448	46%	11,363	28%	10,750	27%
14									
	1062	31,381	62%	35,552	70%	27,699	55%	23,600	46%
15									
	1070	39,541	84%	46,758	100%	36,133	77%	32,015	68%
16									
	1043	41,602	109%	42,624	111%	34,095	89%	29,669	78%
17									
	995	36,827	96%	34,530	90%	34,169	89%	26,620	69%
18									
	1000	36,071	89%	35,250	87%	33,862	83%	27,477	68%
19									
	965	39,678	95%	42,689	102%	44,753	107%	39,615	94%
20									
	965	35,962	91%	37,212	94%	41,928	106%	37,983	96%
21									
	986	28,648	79%	32,978	91%	30,208	84%	26,183	73%
22									
	905	17,406	60%	27,145	93%	17,884	62%	12,382	43%
23									
	718	7,570	50%	14,435	96%	-2,124	0%	-7,915	0%
24									
	509	2,283	56%	4,366	107%	-4,146	0%	-6,566	0%
24.5									
Total	14,693	409,604	80%	445,184	87%	360,742	71%	308,703	60%

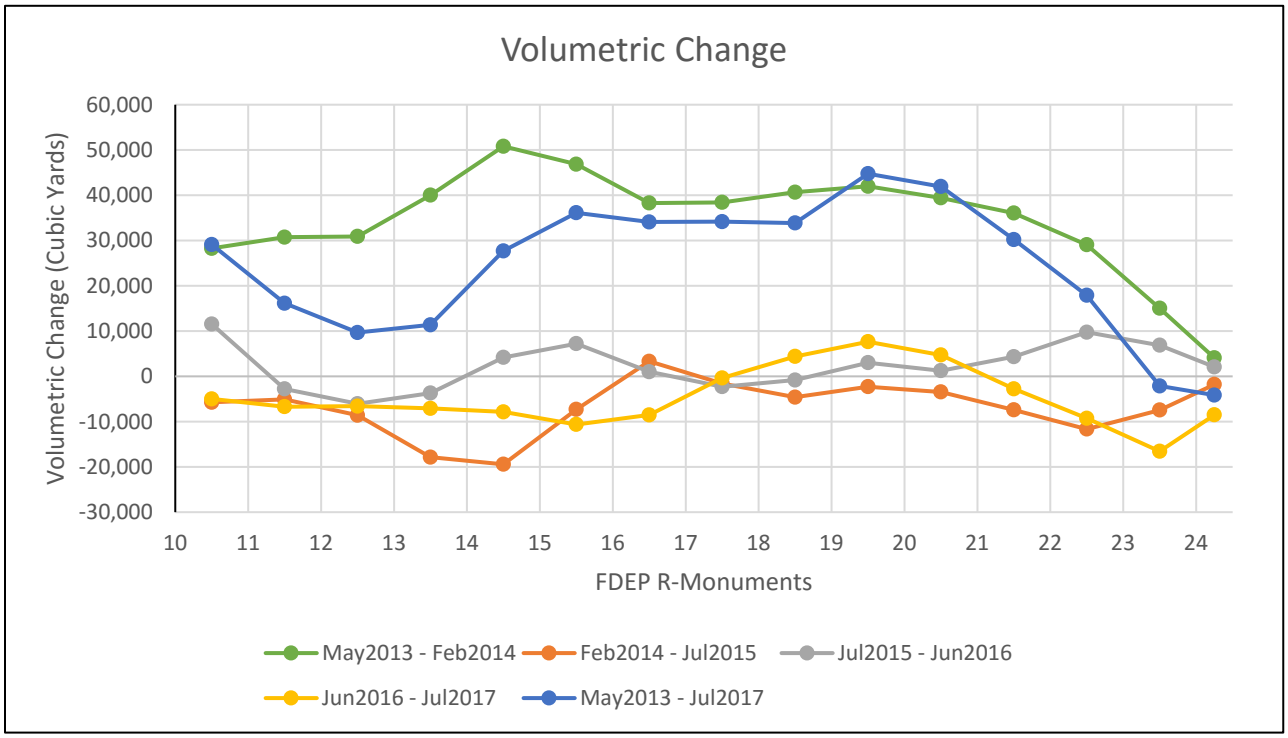


Figure 9: Volumetric Change from Dune to -13 ft MHW in the Beach Fill Area

Borrow Area Survey Analysis

This section asseses the current condition of the borrow area based on survey 17-149 performed on August 16-17, 2017. **Figure 10, Figure 11, Figure 12, Figure 13, and Figure 14** show the borrow area depths from the pre-construction, post-construction, the first annual, the second annual, and the third annual monitoring surveys, respectively. **Figure 15, Figure 16, Figure 17, and Figure 18** display the bathymetric changes from the pre-construction (May 2013) to post-construction (February 2014), post-construction (February 2014) to first annual (May 2015), first annual (May 2015) to second annual (May 2016), and second annual (May 2016) to third annual (July 2017) monitoring surveys respectively. **Figure 20** shows the bathymetric change from pre-contruction to July 2017.

The offshore borrow area for the 2013 Lee County, Gasparilla Island Segment SPP renourishment project is located approximately 1 mile southwest of the southern end of Gasparilla Island, in pre-dredging water depths of about -10 ft, NAVD88. The maximum permitted excavation limits in the borrow area used for this nourishment were -25.2 ft, NAVD88 (equivalent to -23.46 ft MLLW and -24.0 ft NGVD29). The dimensions of the permitted borrow area are approximately 1,200 ft (North-South) by 5,800 ft (East-West).

The pre-construction survey was conducted during 13-17 May 2013 (Survey 13-077 Post Sandy Survey). The post-construction borrow area survey was performed on 11 February 2014. The total net volume change measured within the limits of the permitted borrow area was -398,800 cy. This is lower than the measured contract pay volume within the fill template on the beach (457,800 cy). The difference may represent some sediment movement into the borrow area given the length of time between the end of construction and the post-construction

monitoring survey of the borrow area. Also a volume difference of -86,700 cy was calculated for the borrow area access, Cut 1, which could be due to sediment movement out of Cut 1 and possibly into Cut 2. Analysis of the pre- and post-construction borrow area monitoring surveys indicates that the area was dredged relatively uniformly, and no areas were dredged beyond the permitted limits.

The May 2015 monitoring survey indicates that the cuts dredged for the 2013 project have all gained volume since February 2014. Cut 2 has filled in with 128,100 cy and cut 3 has filled in with 31,400 cy. In **Figure 16** cool colors represent volume gains while warm colors indicate volume losses between the February 2014 and May 2015 surveys.

The May 2016 monitoring survey also showed a gain in volume since May 2015. Cut 2 accumulated 117,500 cy, while Cut 3 accreted 20,000 cy. **Figure 17** depicts from the volume changes between May 2015 and May 2016. The borrow area is still accreting sediment, but at a slower rate than the previous monitoring period.

The July 2017 monitoring survey had a gain since May 2016. Cut 2 accumulated 45,600 cy and Cut 3 accumulated 32,200 cy. **Figure 18** depicts the volume changes between the second and third monitoring surveys.

The cumulative change in borrow area volume since the pre-construction monitoring survey (May 2013) is shown in **Figure 19**. Comparing the pre-construction survey (May 2013) to the third annual survey (July 2017), the borrow area contains roughly 25,700 cy less than the 2013 survey. Of the total, a deficit of 4,400 cy and 21,300 cy remains for Cut 2 for Cut 3, respectively.

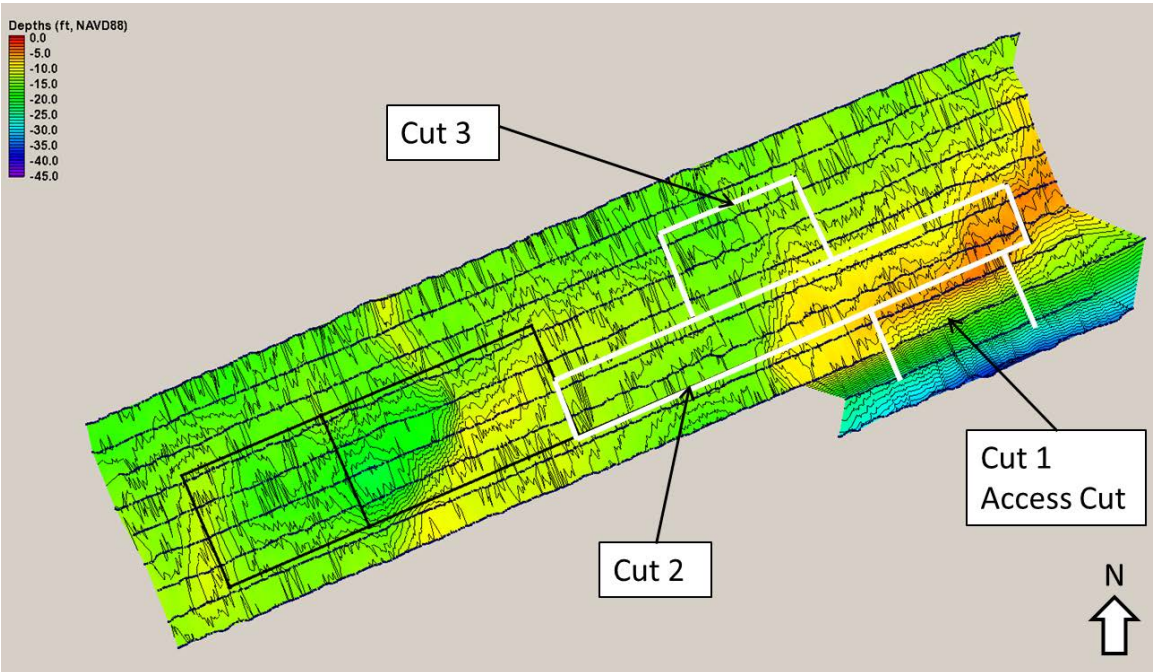


Figure 10: Pre-Construction Borrow Area Depths (Survey 13-077, May 2013)

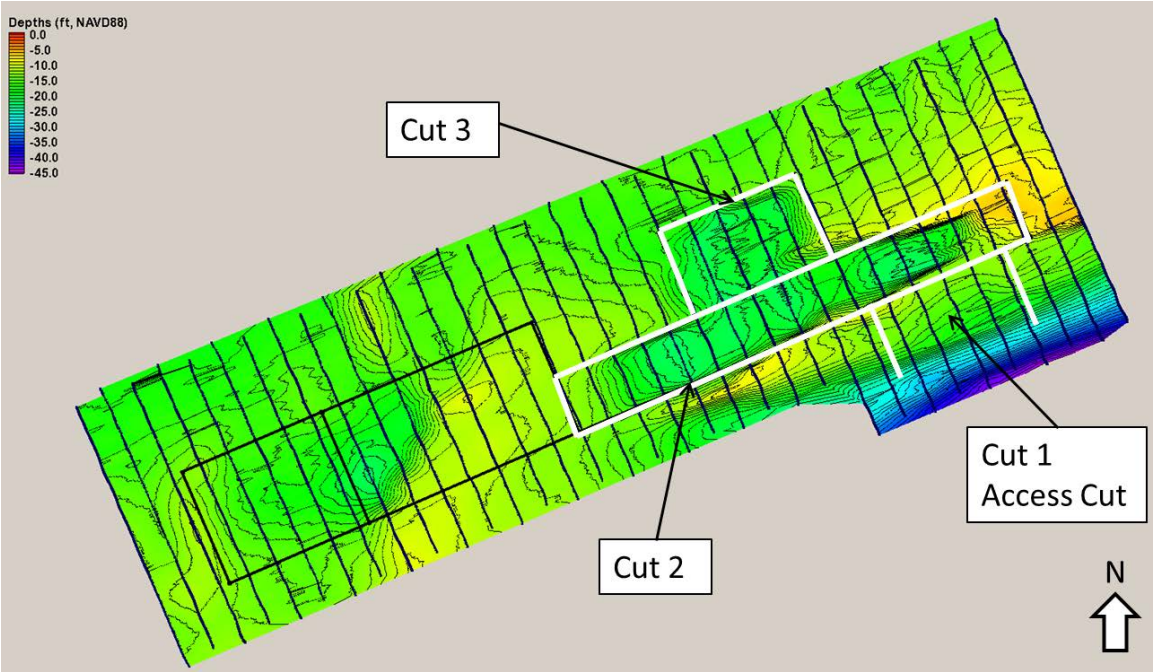


Figure 11: Post-construction Borrow Area Depths (Survey 14-041, Feb 2014)

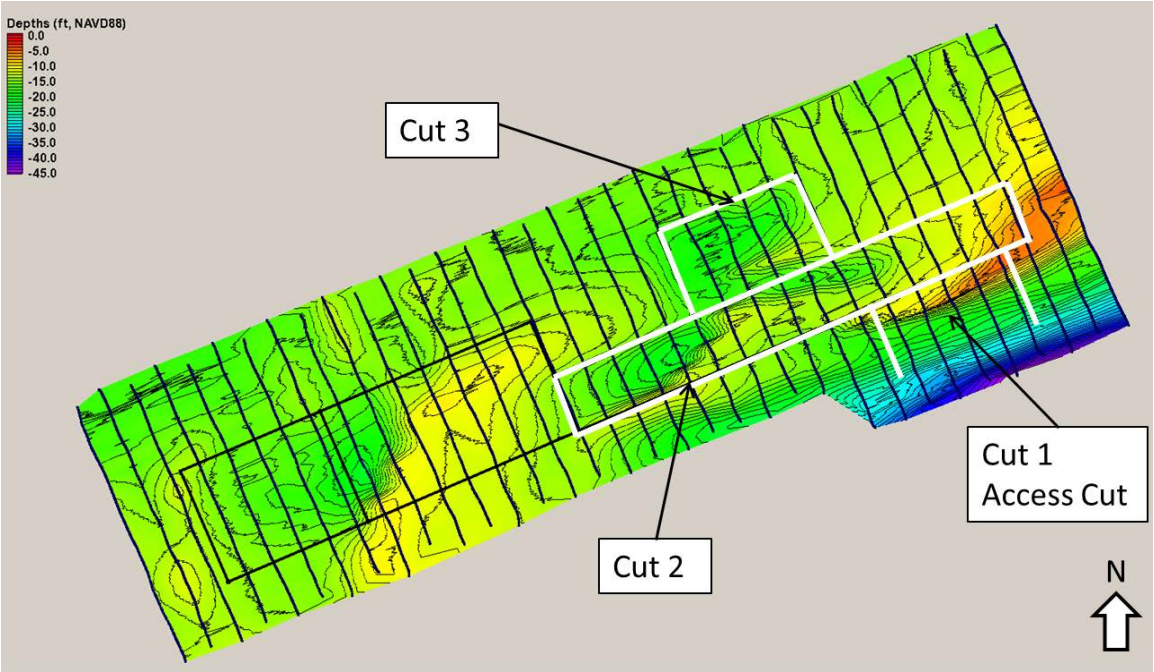


Figure 12: First Annual Monitoring Borrow Area Depths (Survey 15-086, May 2015)

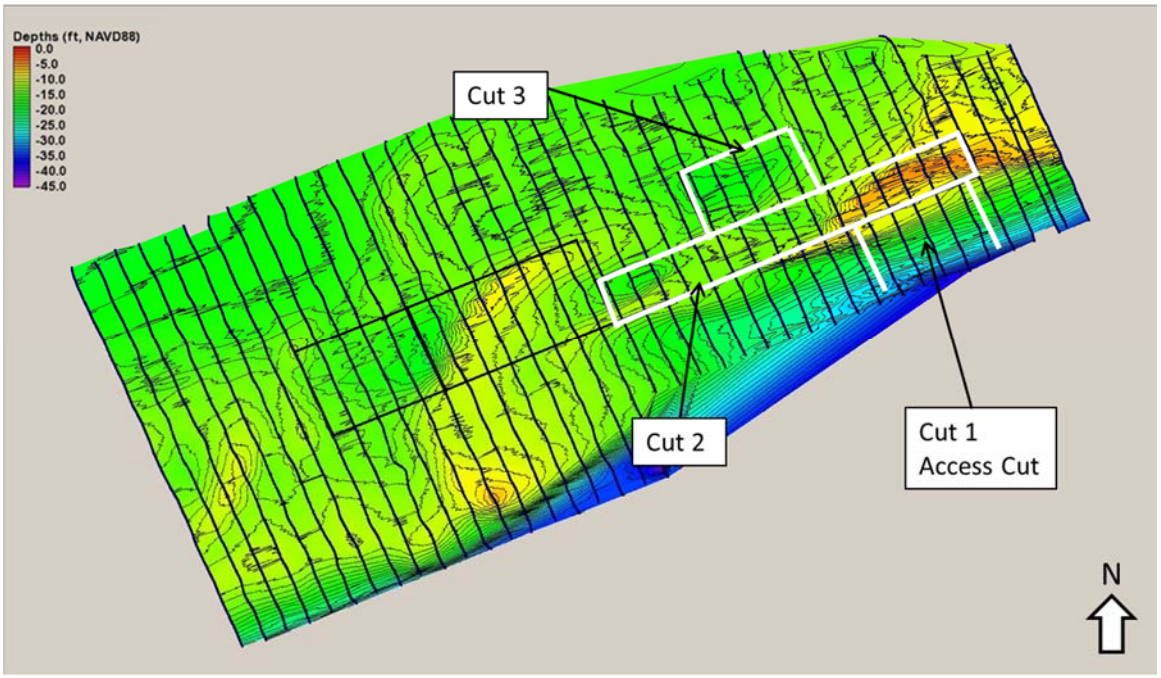


Figure 13: Second Annual Monitoring Borrow Area Depths (Survey 16-100, May 2016)

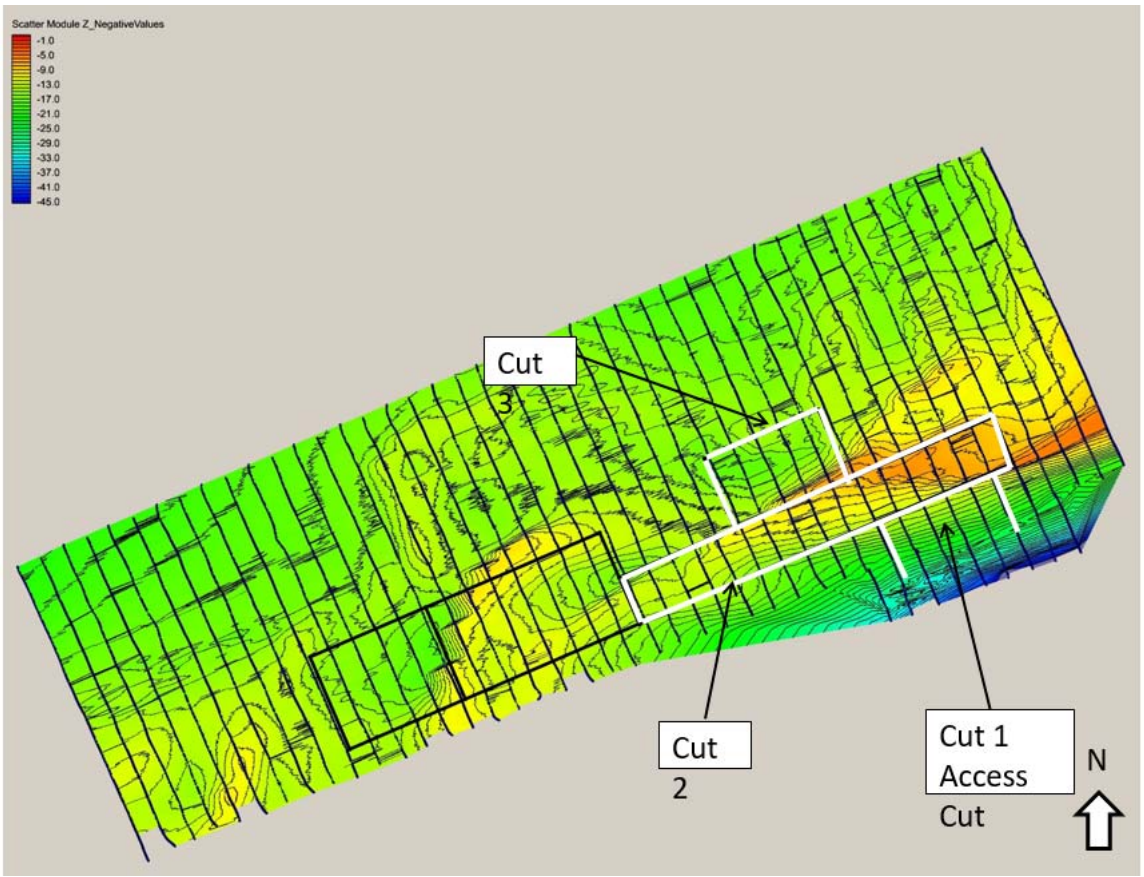


Figure 14: Third Annual Monitoring Borrow Area Depths (Survey 17-149, July 2017)

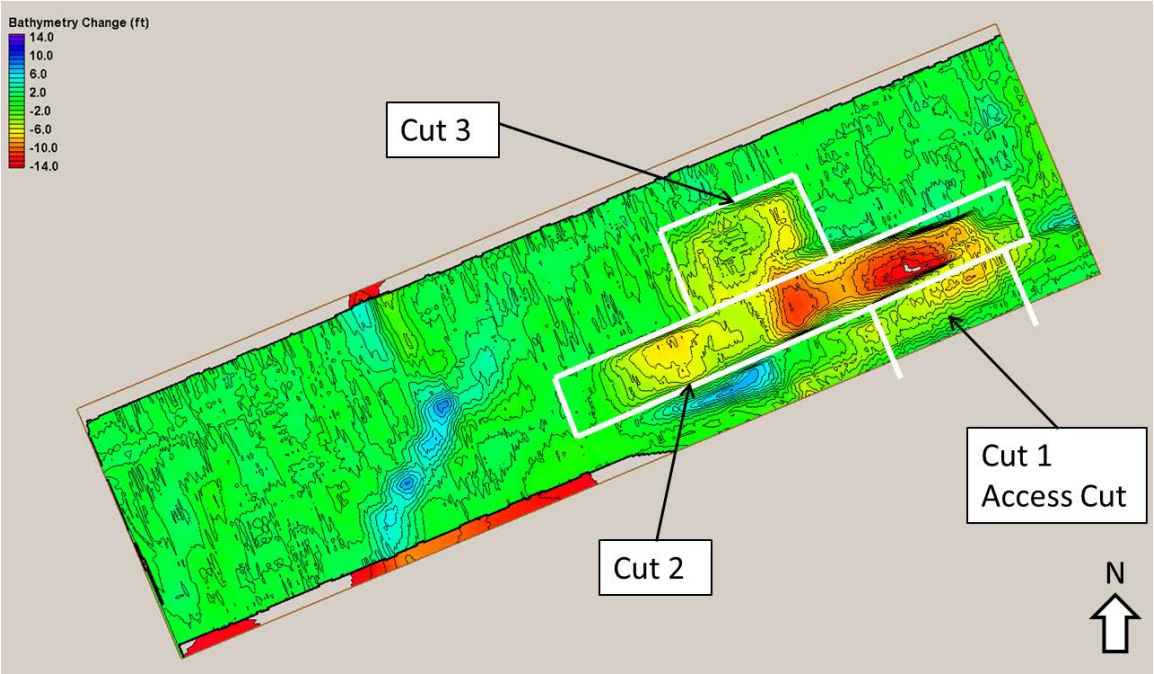


Figure 15: Borrow Area Pre To Post-Construction Bathmetry Change

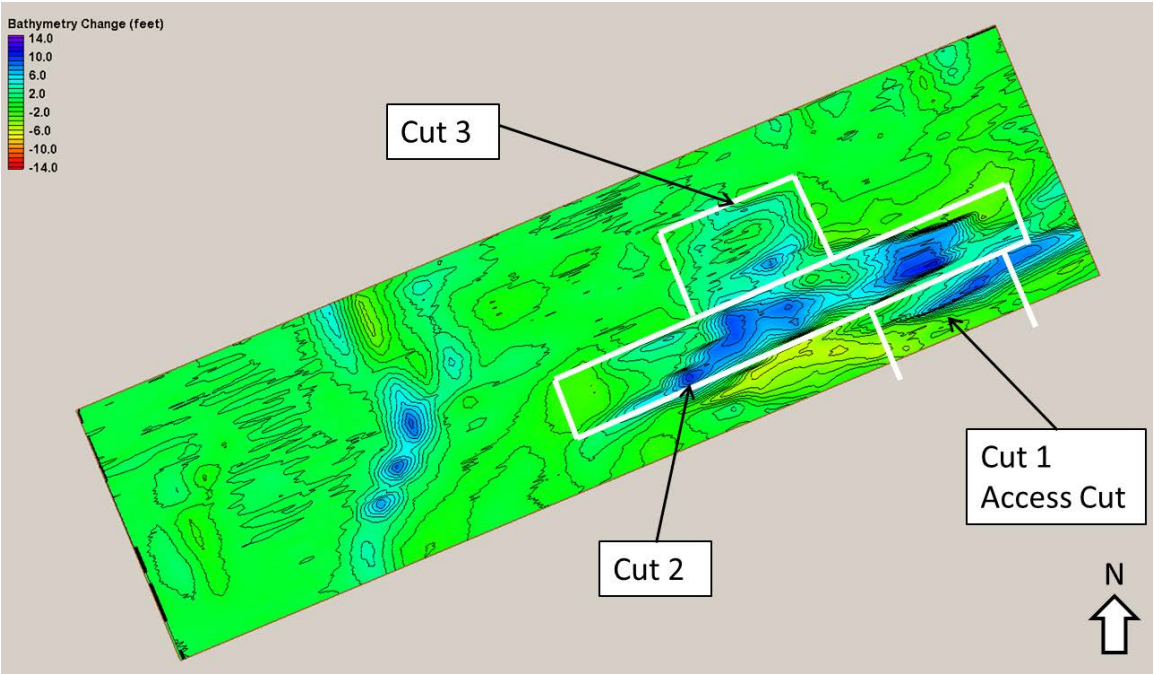


Figure 16: Borrow Area Post-Construction To First Annual Bathymetry Change

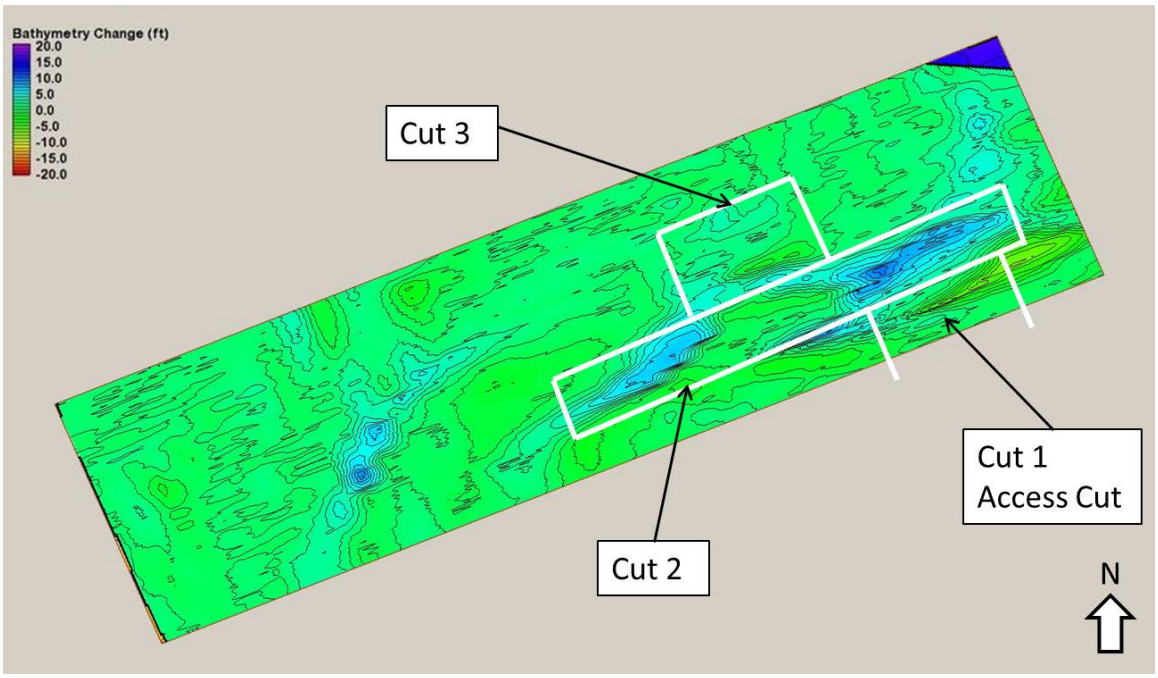


Figure 17: Borrow Area First Annual To Second Annual Bathymetry Change

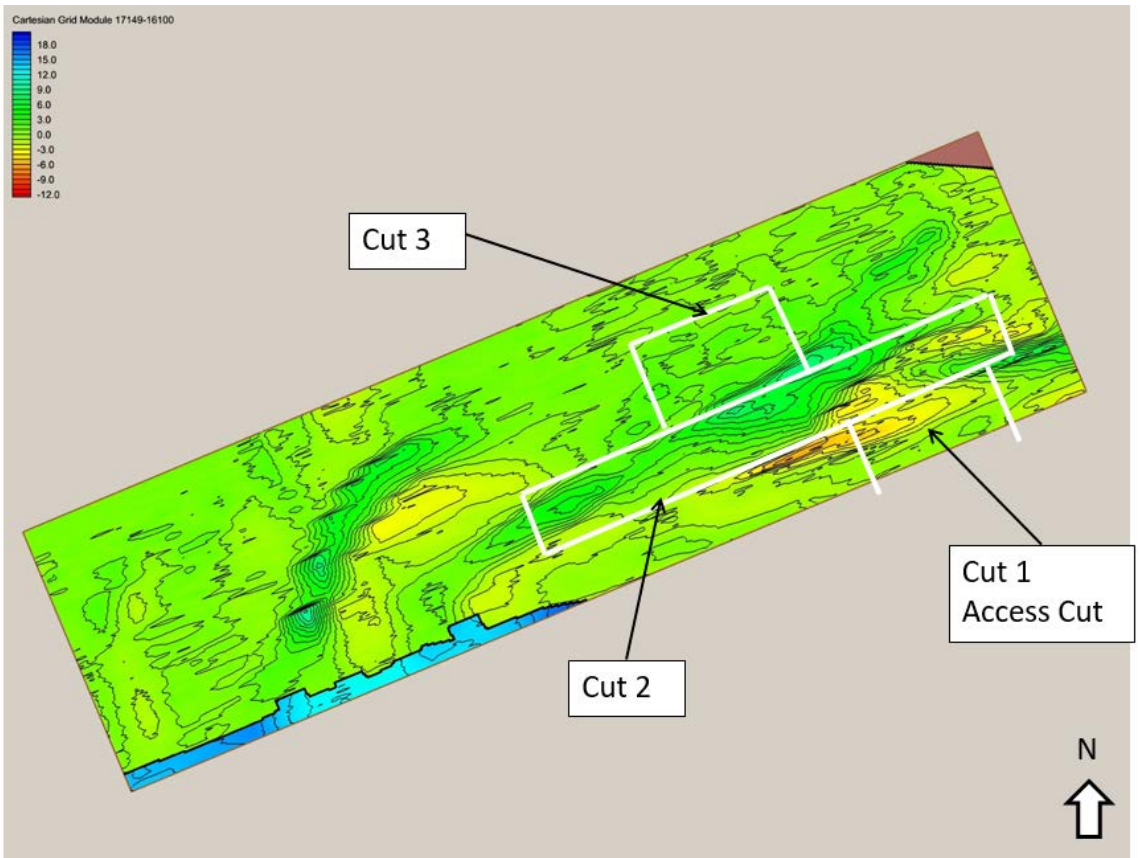


Figure 18: Borrow Area Second To Third Annual Bathymetry Change

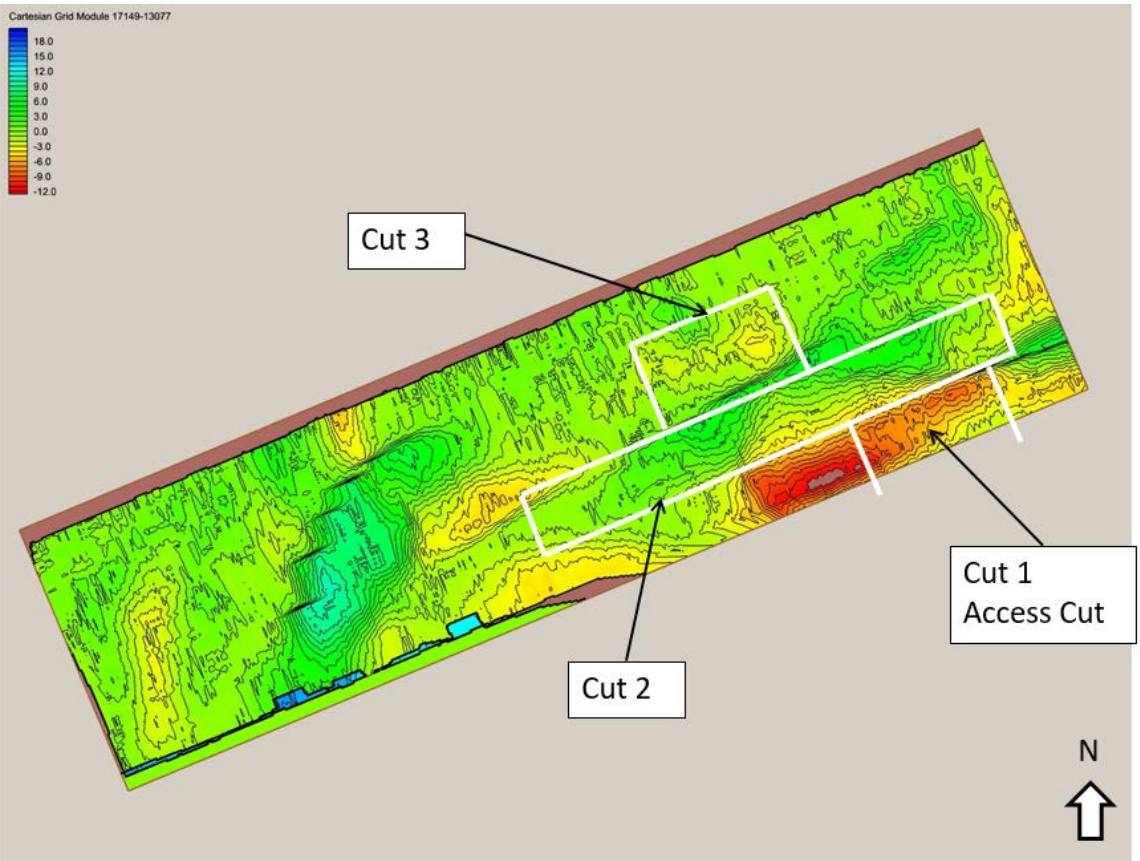


Figure 19: Borrow Area Pre-Construction To July 2017 Bathymetry Change

Summary

This report summarizes the history of the Lee County, Gasparilla Island Segment SPP and provides details on the construction and performance of the 2013 renourishment project. The changes between the pre-construction (13-077), post-construction (14-039 and 14-041), first annual (15-085 and 15-086), the second annual (16-088 and 16-100), and the third annual monitoring (17-141 and 17-149) surveys were evaluated along with the post-Hurricane Irma beach survey (18-018).

The average MHW position was at 57.0 ft seaward of the pre-construction MHW position across the beach fill area in July 2017 and after Hurricane Irma it is 49.7 ft seaward of the 2013 position. Although the MHW position has moved slightly landward over the past year, it seems to be equilibrating as expected. Areas outside the fill area are benefitting from the lateral equilibration of the fill material.

Erosion of 84,500 cy occurred between June 2016 and July 2017, which is high compared with the annual net loss of 60,000 cy predicted in the 2001 GRR based on historic volume changes. The Gasparilla Island Segment experienced another 52,000 cy of erosion between July 2017 and October 2017 due to Hurricane Irma. Of the 510,500 cy placed in 2013, 360,700 cy (71%) and 308,700 cy (60%) remain in July 2017 and October 2017.

The borrow area cuts dredged for the 2013 project have all experienced an in-filling of material. Cuts 2 and 3 gained 159,500 cy between the post-construction and first annual monitoring surveys. Additionally, between the first to second annual monitoring surveys the borrow area accreted 137,600 cy. Between May 2016 and July 2017 the borrow area accreted 77,800 cy. A deficit of 25,700 cy remains in the borrow area following the 2013 renourishment event.

In general, the project is performing approximately as expected. The average erosion rate within the project limits folowing the 2013 construction is 59,000 cy/yr (including the effects of Hurricane Irma). This is very close to what was anticipated when the project was originally designed (60,000 cy/yr).

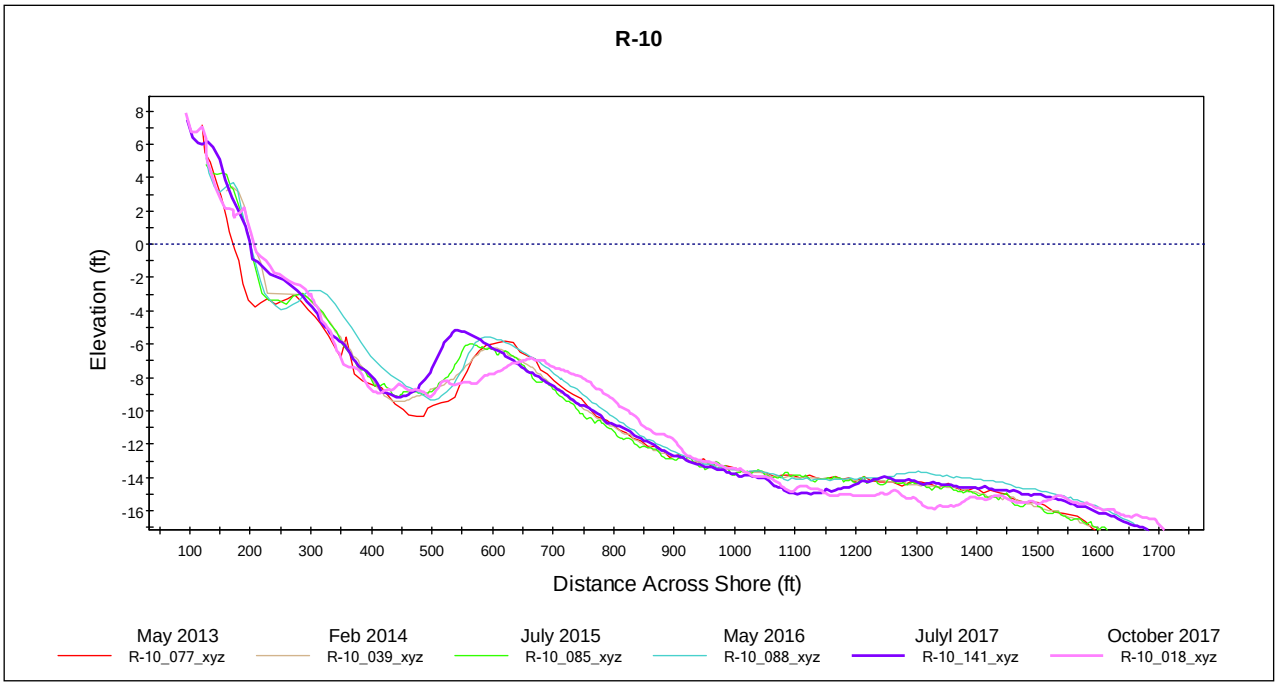
Appendix – Beach Profiles

The following profiles are plotted with elevations referenced to NAVD 88. The distance across shore is relative to the R-monument location.

There are two plots presented for each R-monument. The first plot is zoomed in to more clearly show the changes in the dune, berm, and nearshore features. The second plot is zoomed out to show the full extent of the profile covered by the surveys.

The six profiles plotted at each R monument are:

- “R-#_077_xyz” : Pre-construction monitoring survey, May 2013.
- “R-#_039_xyz” : Post-construction monitoring survey, February 2014.
- “R-#_085_xyz” : 2015 monitoring survey, July 2015.
- “R-#_088_xyz” : 2016 monitoring survey, June 2016.
- “R-#_141_xyz” : 2017 monitoring survey, July 2017.
- “R-#_018_xyz” : Post-Hurricane Irma survey, October 2017.



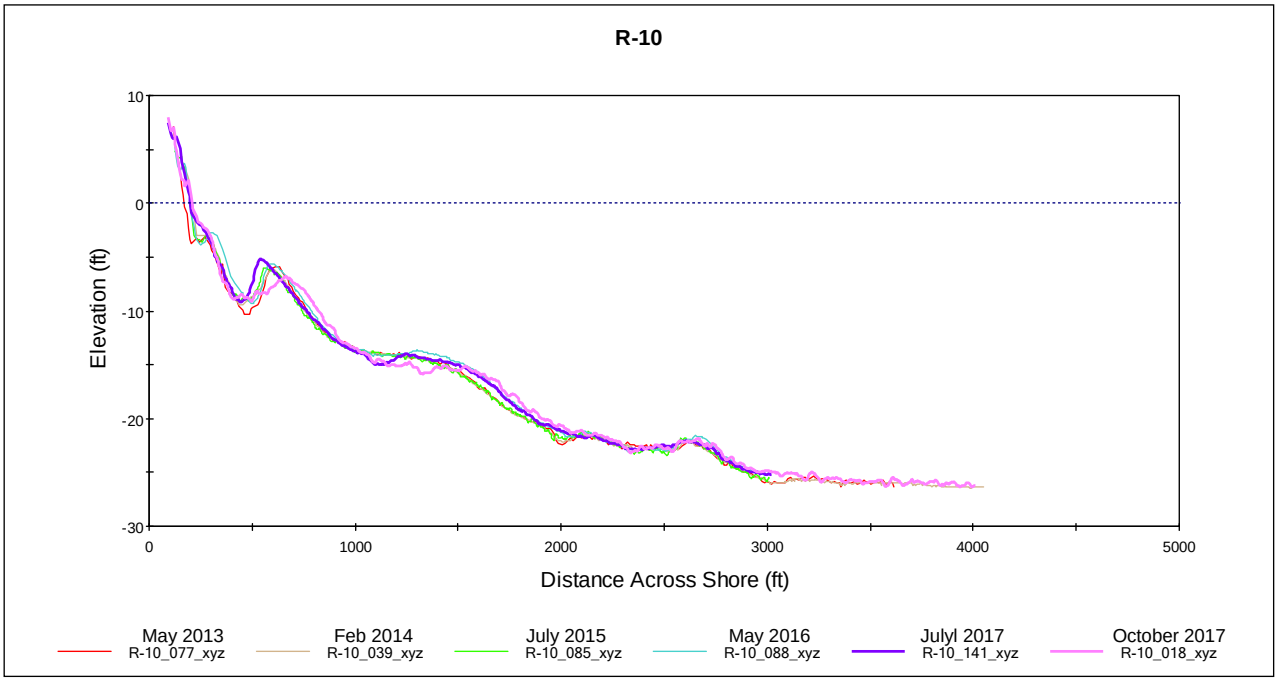
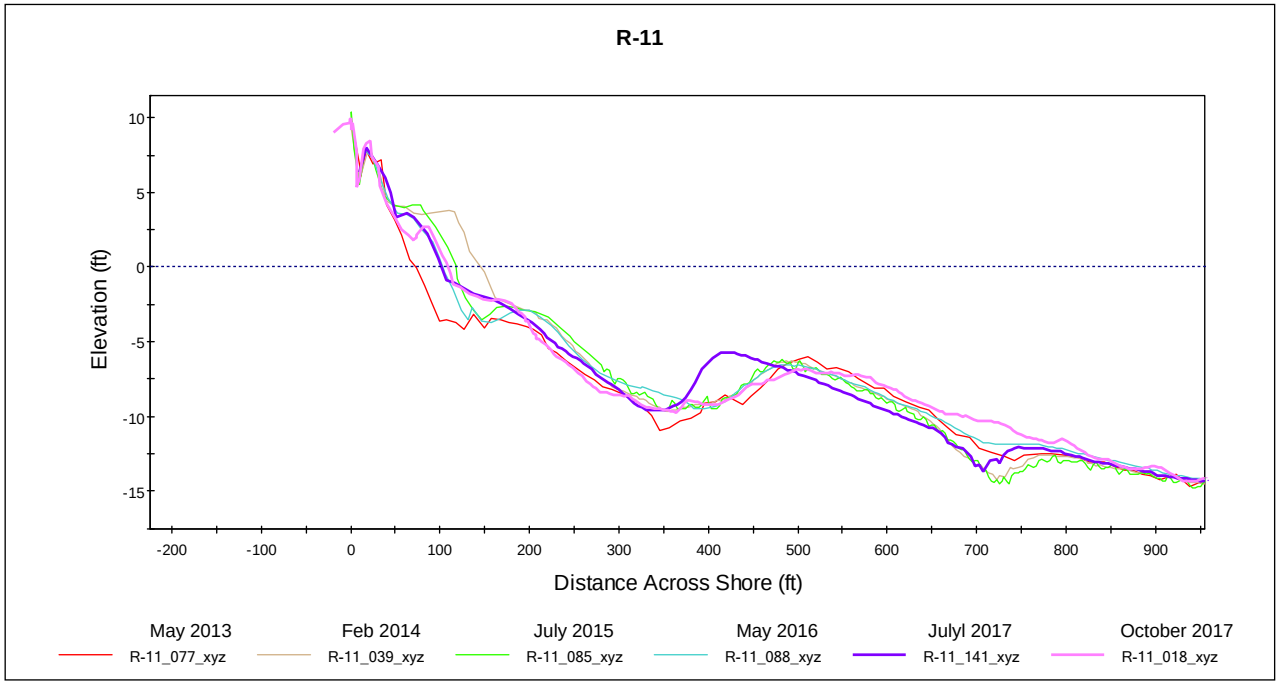


Figure 20: Survey Profiles at R-10.
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



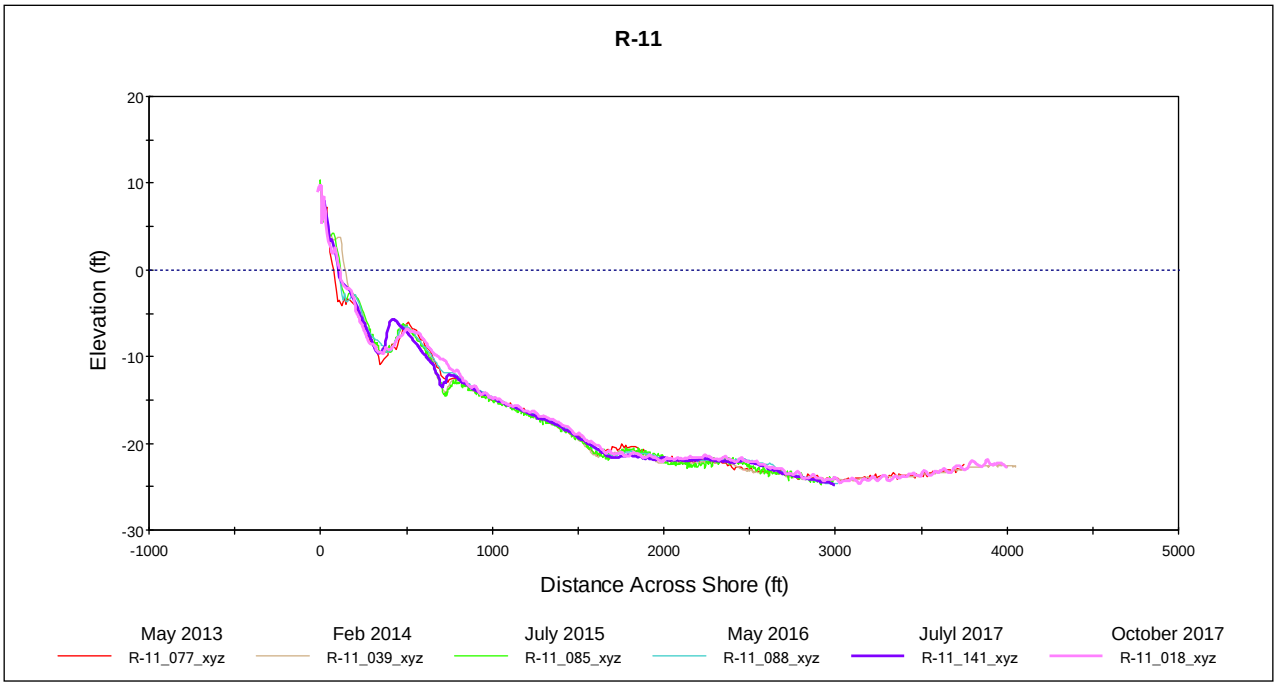
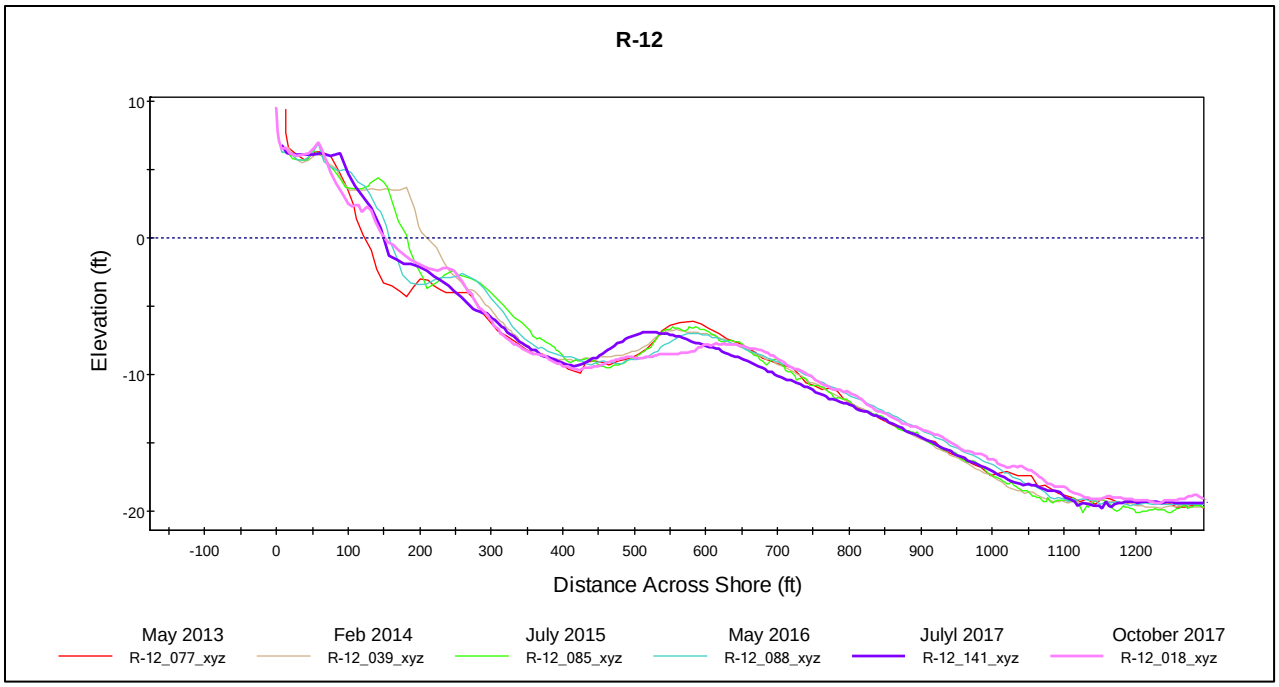


Figure 21: Survey Profiles at R-11
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



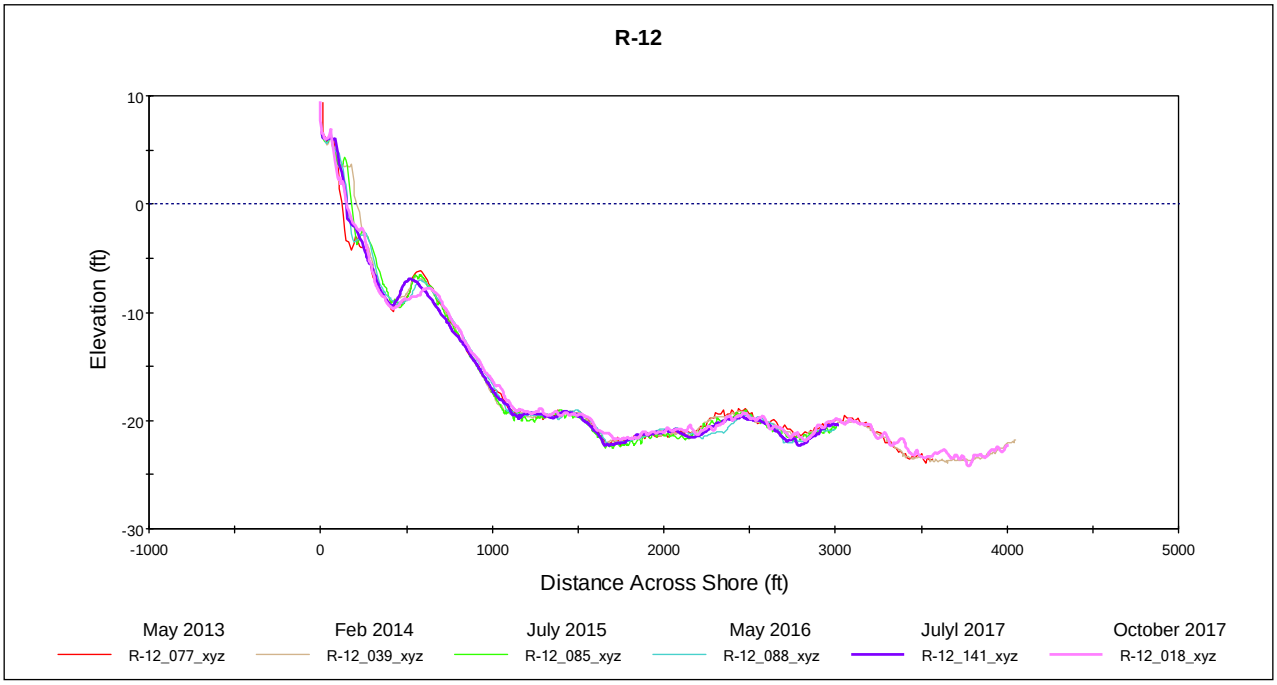
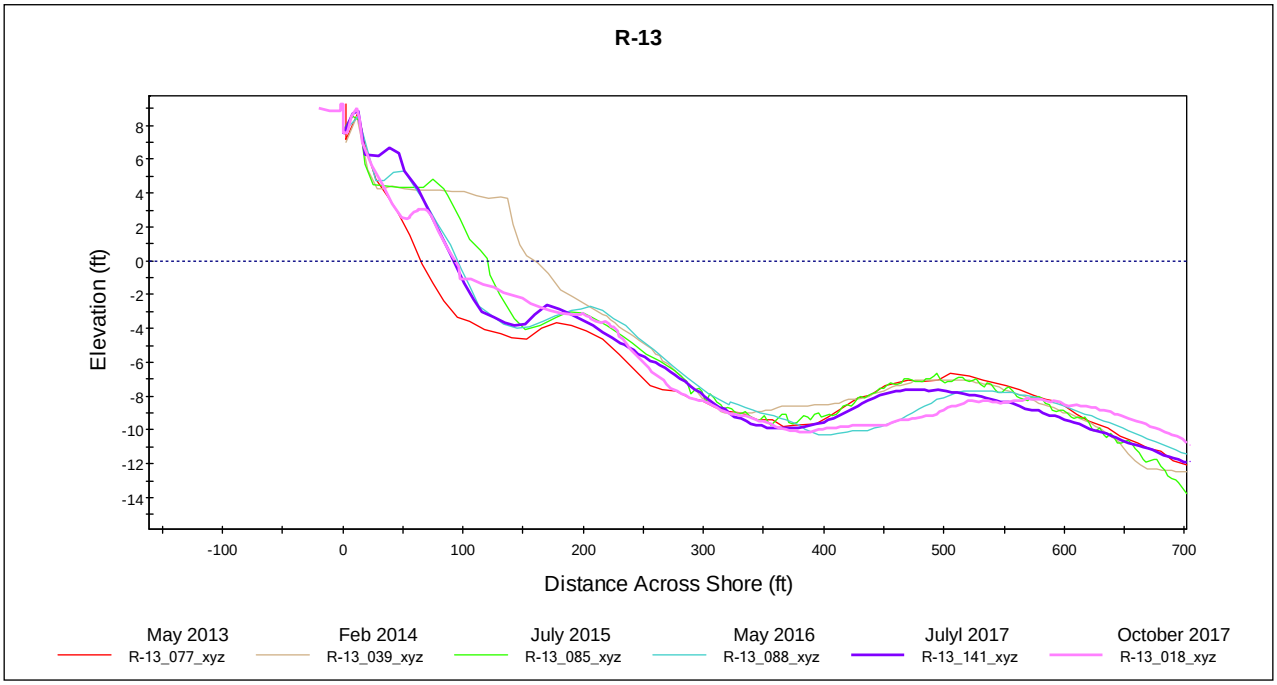


Figure 22: Survey Profiles at R-12
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



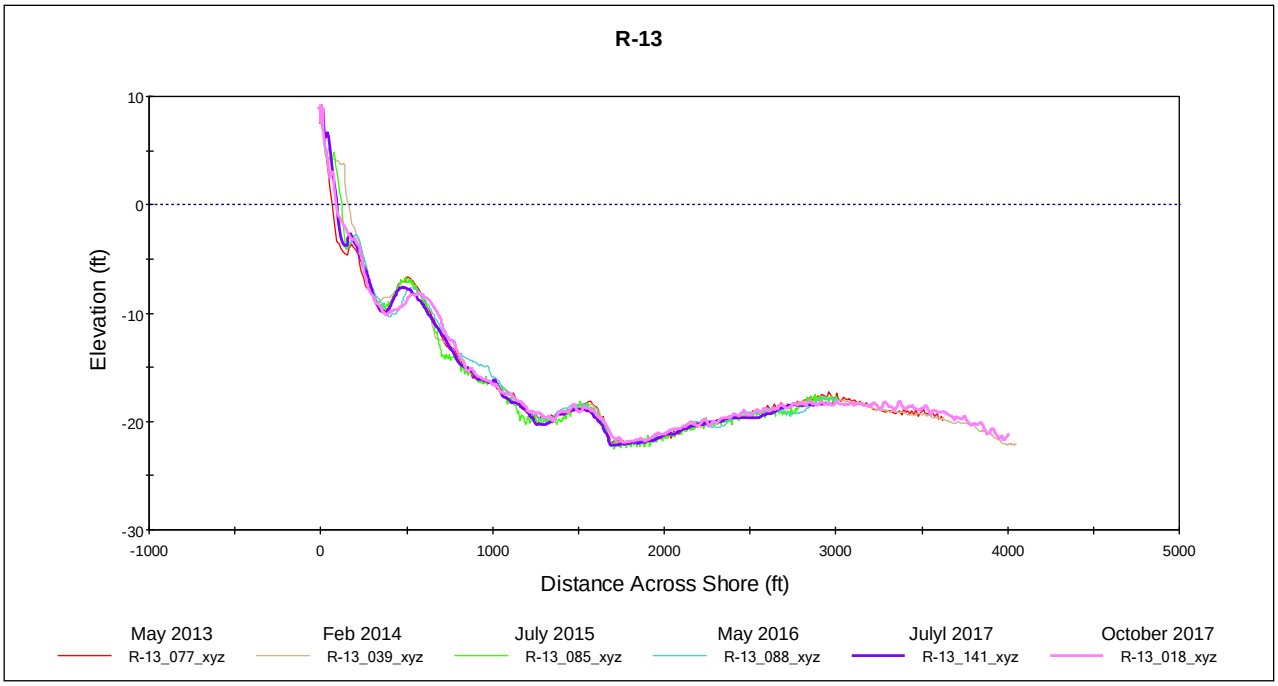
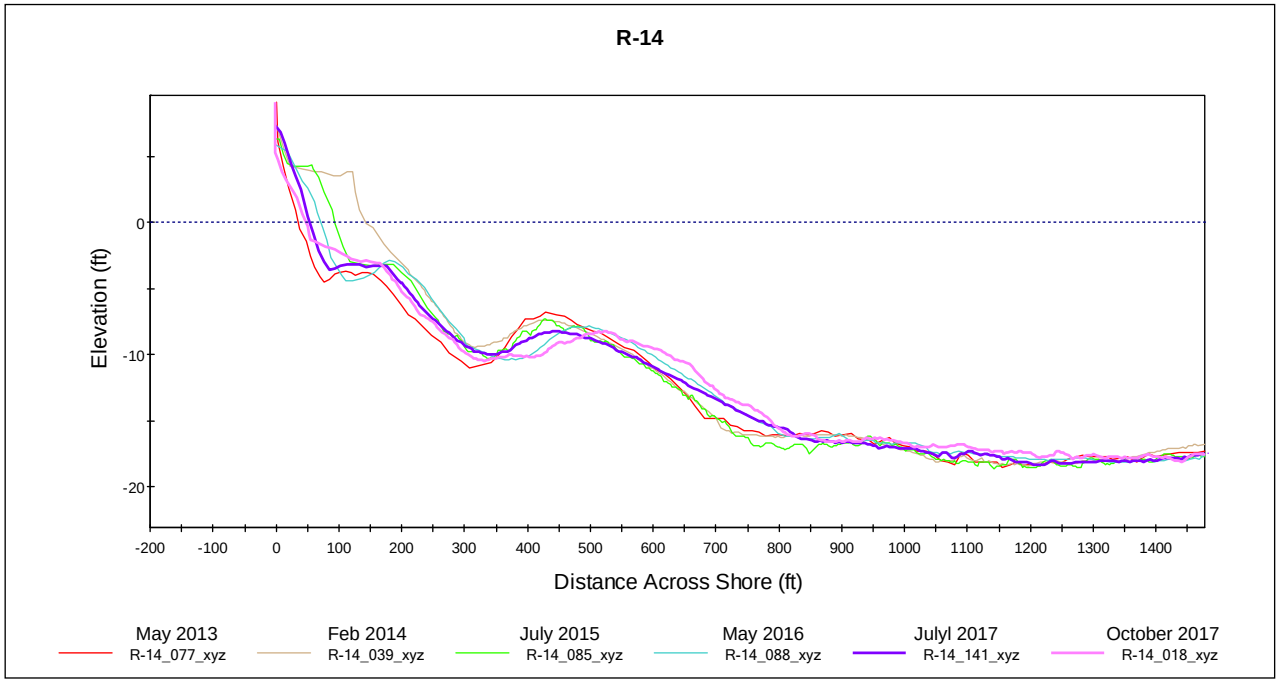


Figure 23: Survey Profiles at R-13
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



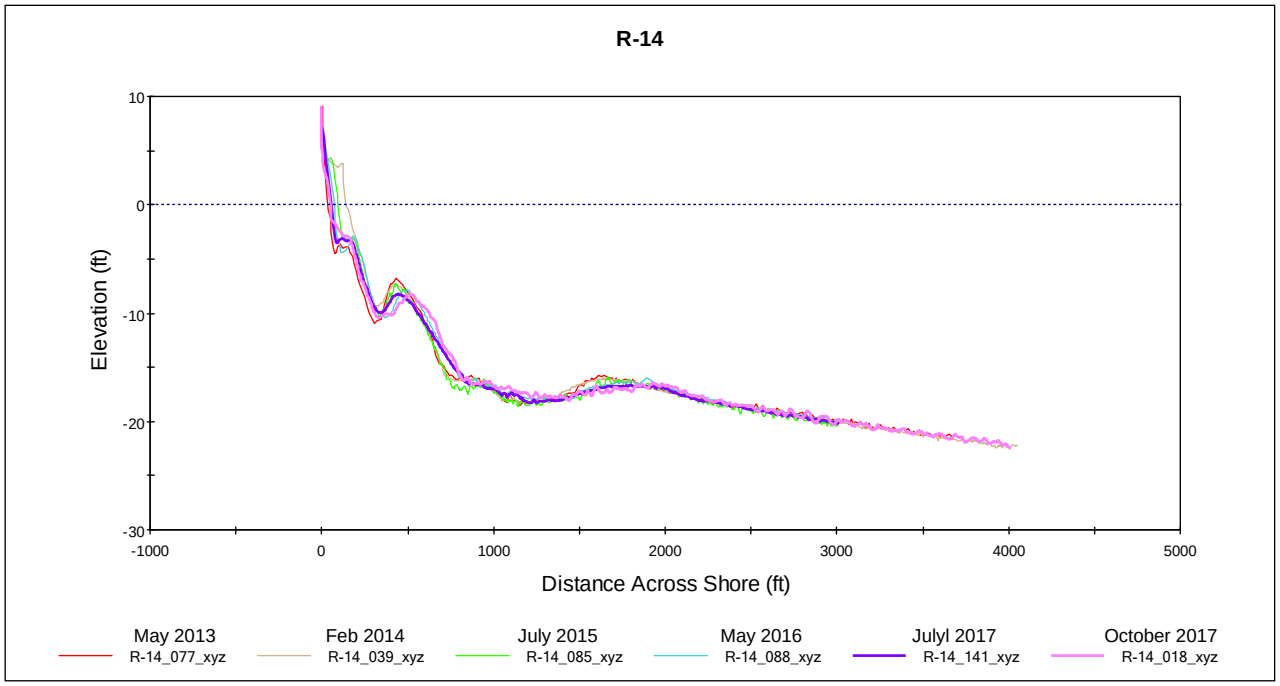
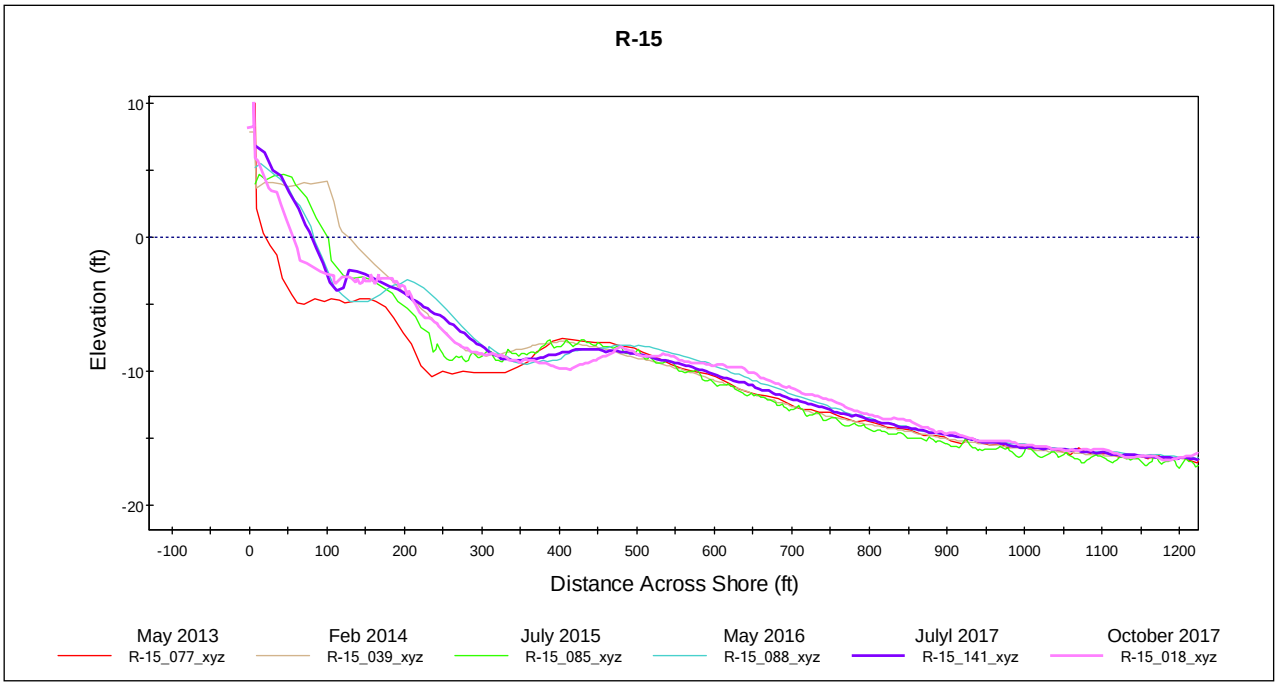


Figure 24: Survey Profiles at R-14
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



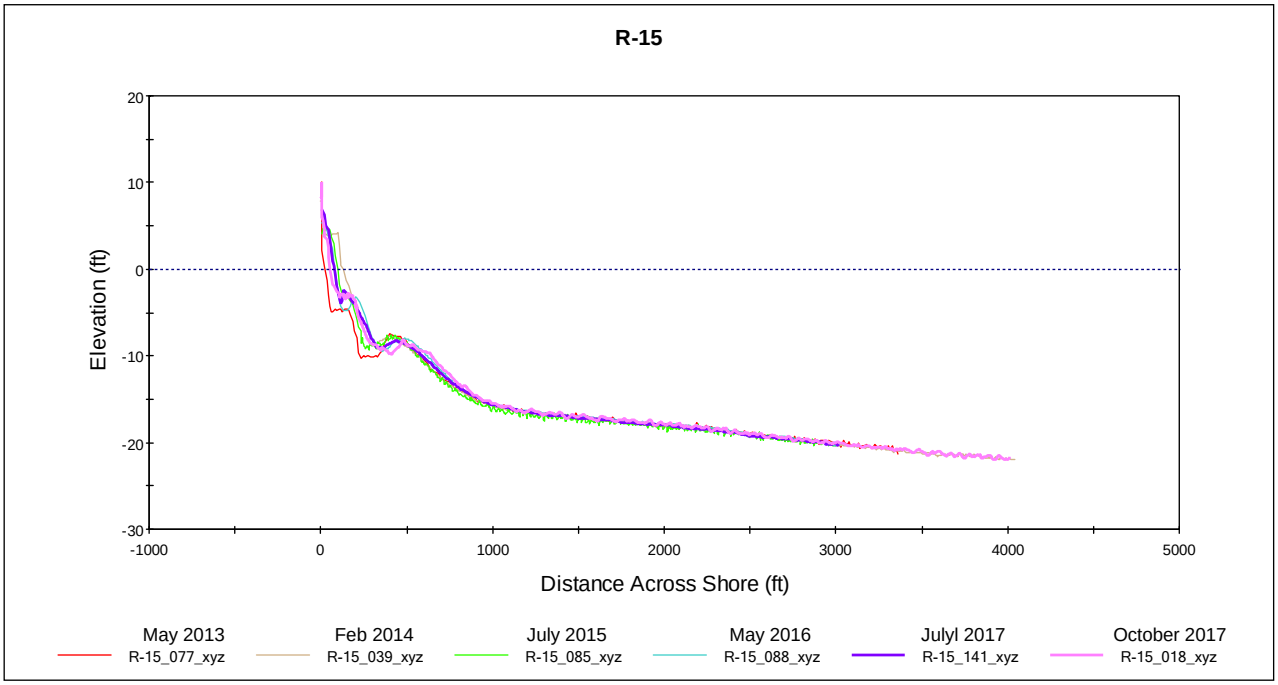
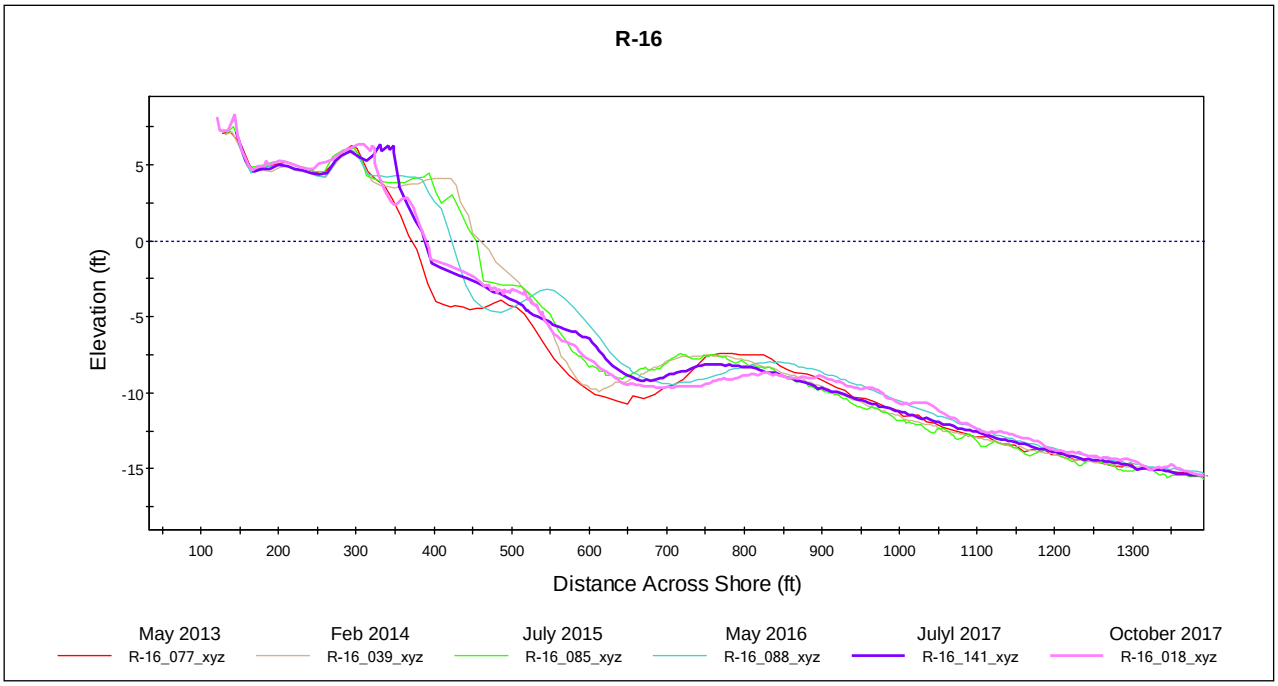


Figure 25: Survey Profiles at R-15
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



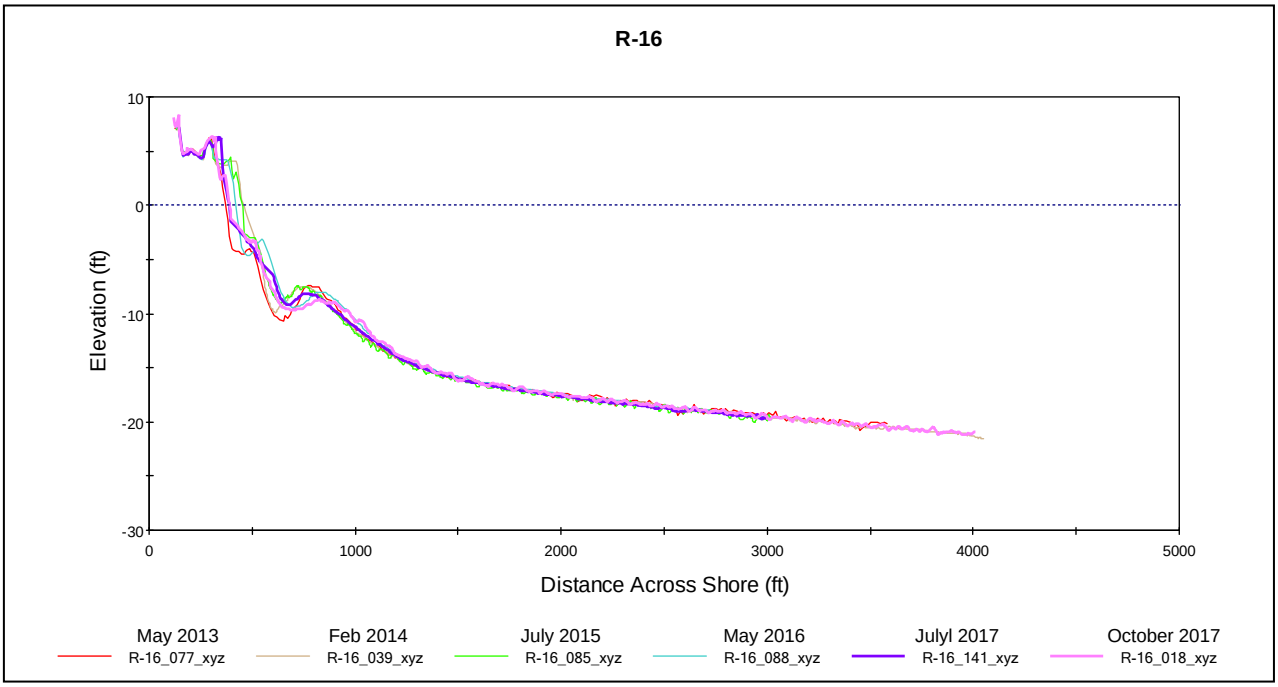
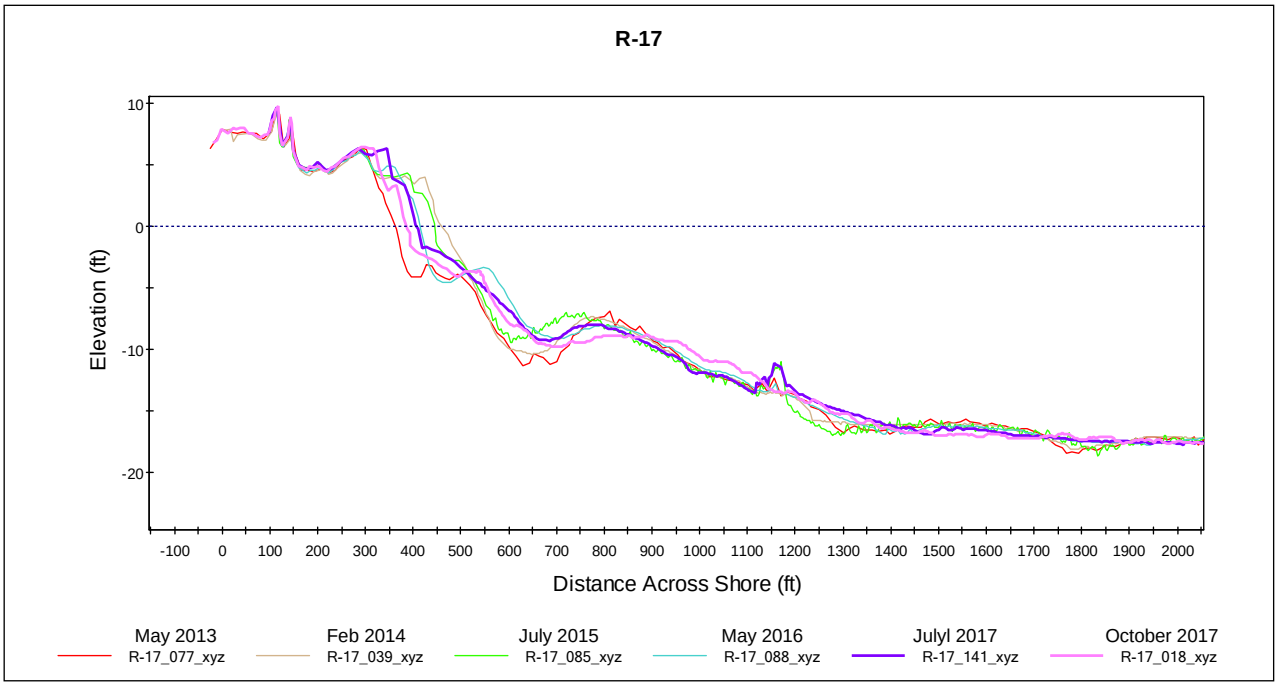


Figure 26: Survey Profiles at R-16
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



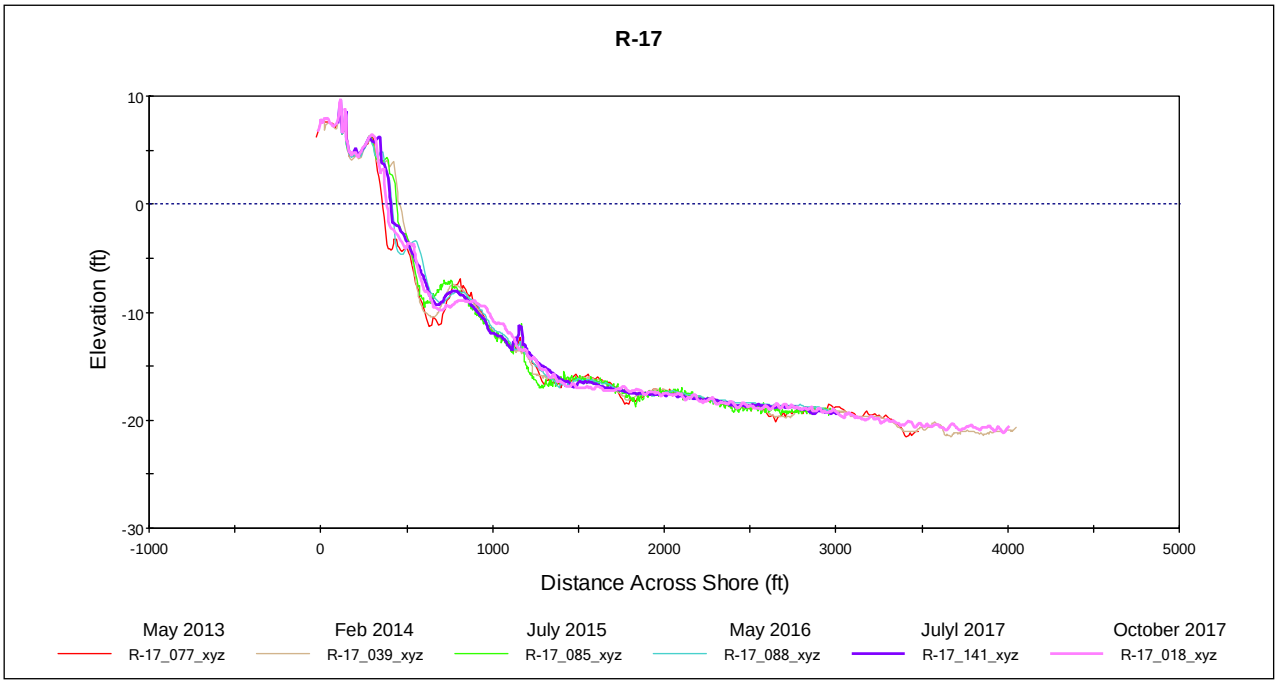
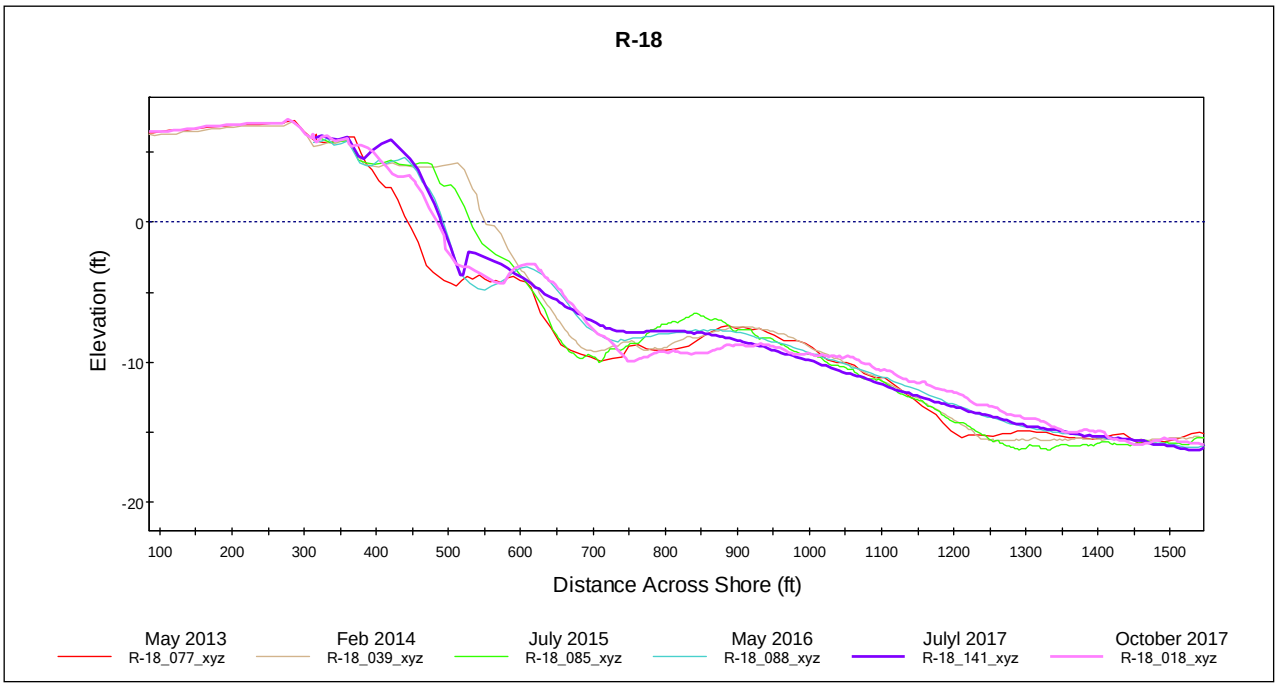


Figure 27: Survey Profiles at R-17
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



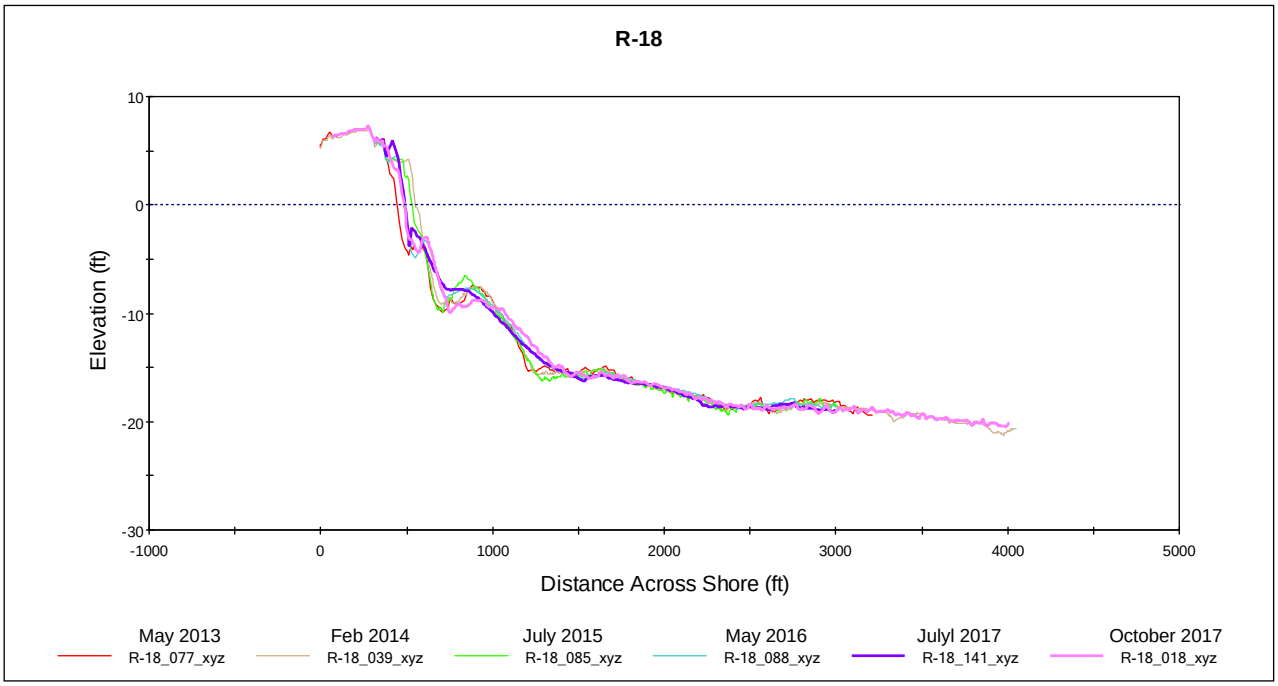
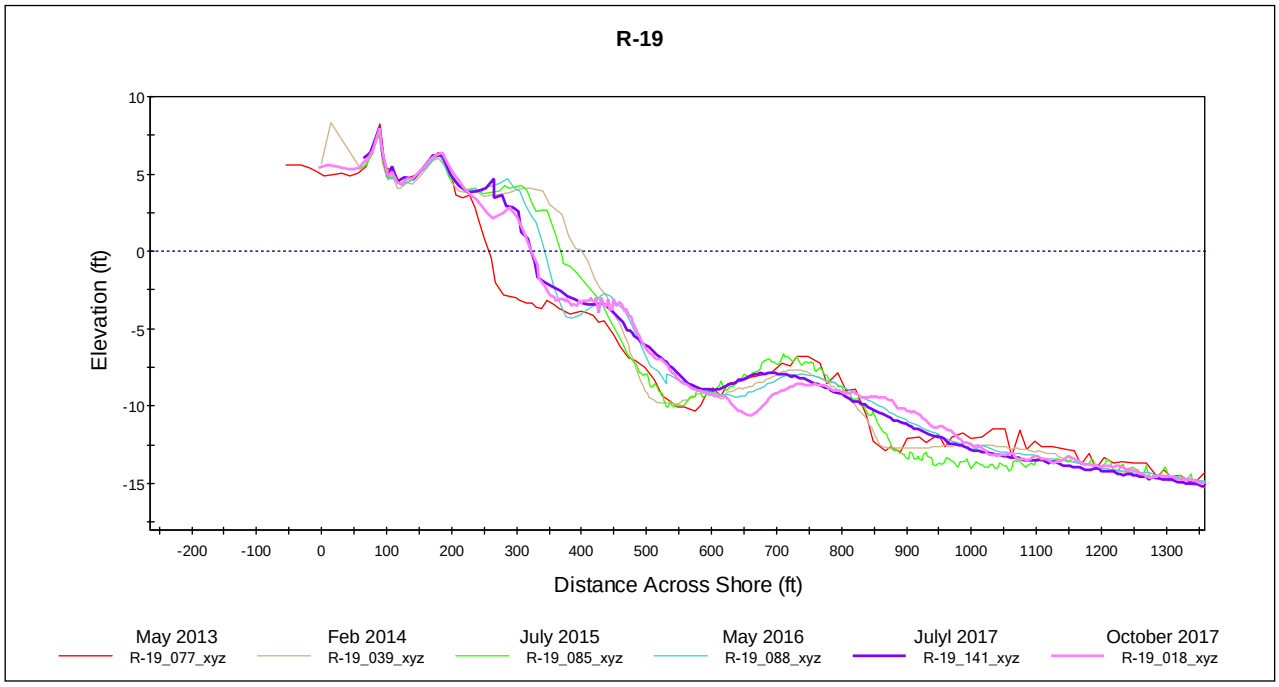


Figure 28: Survey Profiles at R-18
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



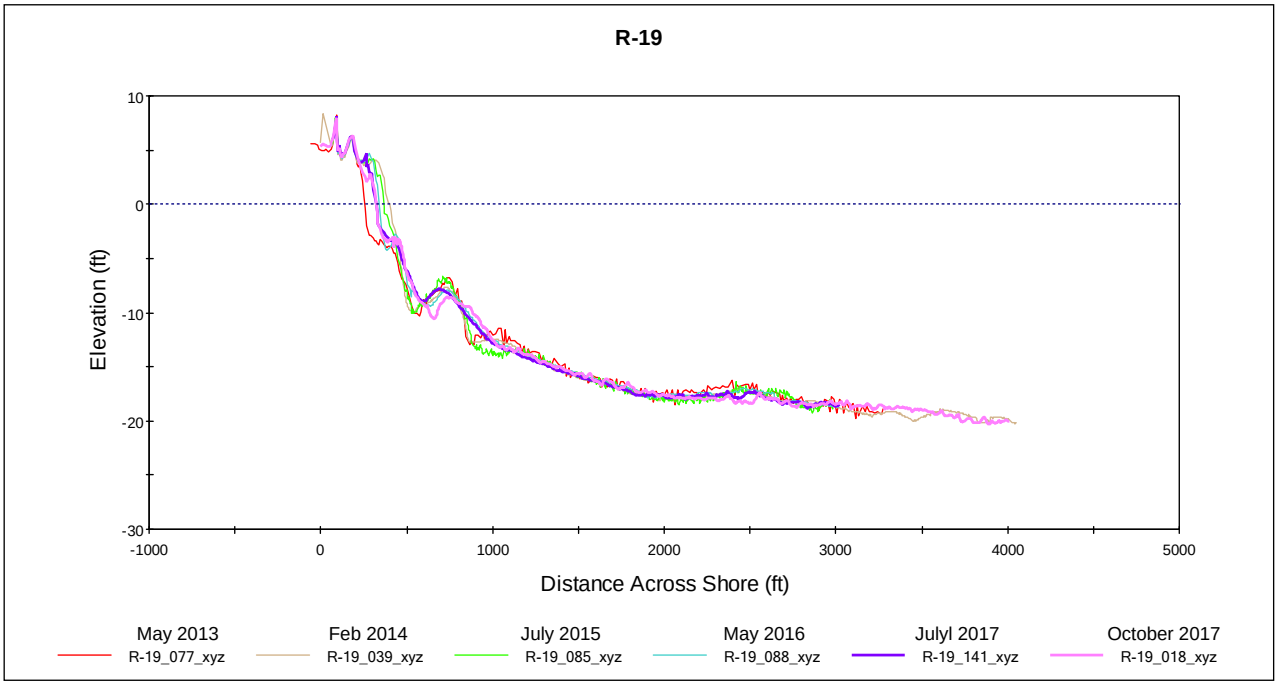
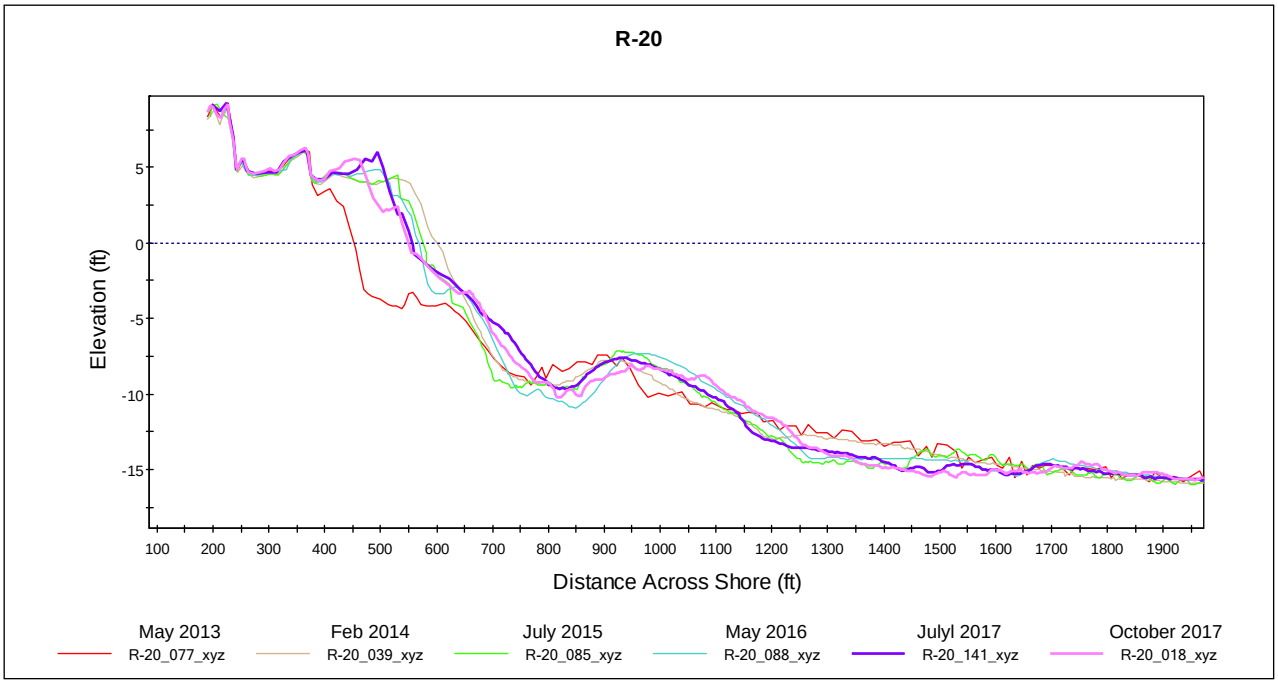


Figure 29: Survey Profiles at R-19
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



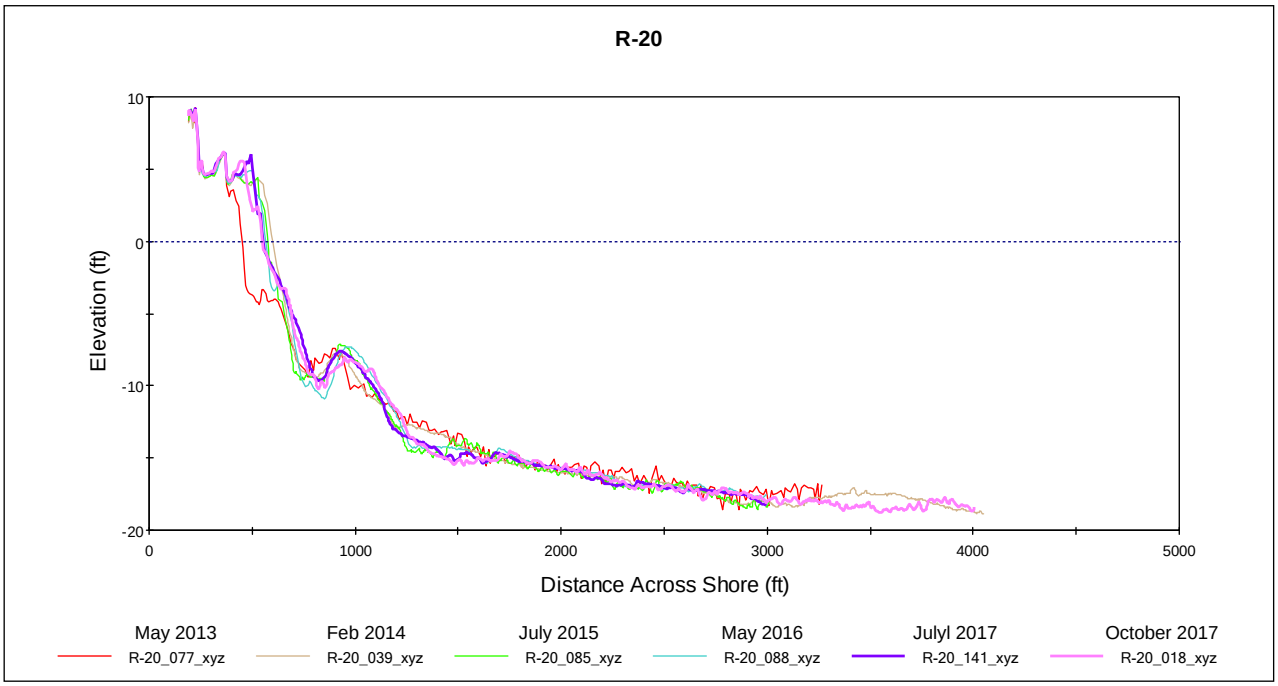
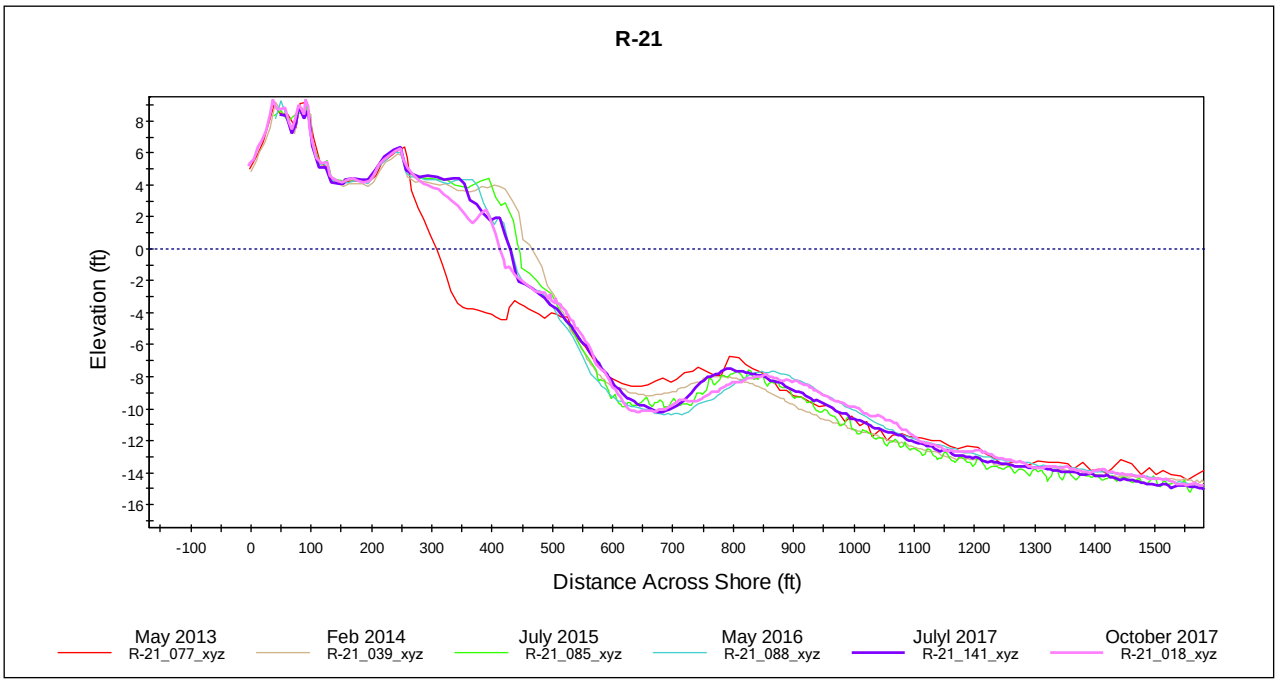


Figure 30: Survey Profiles at R-20
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



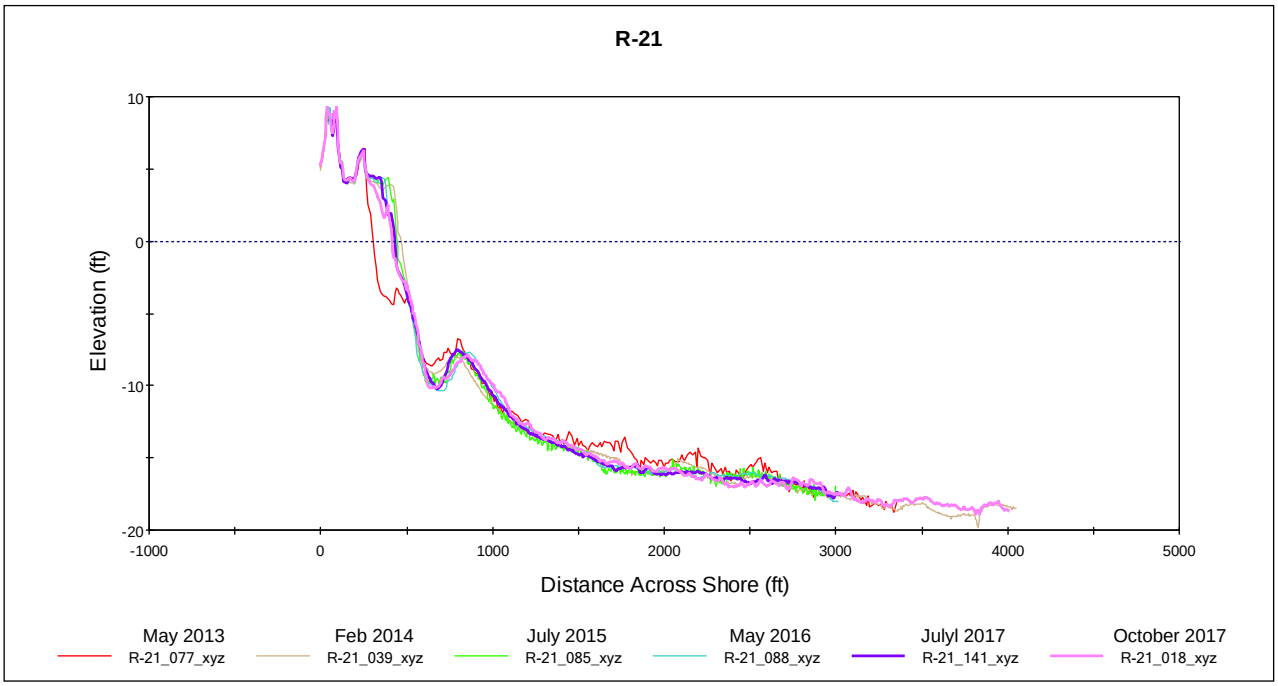
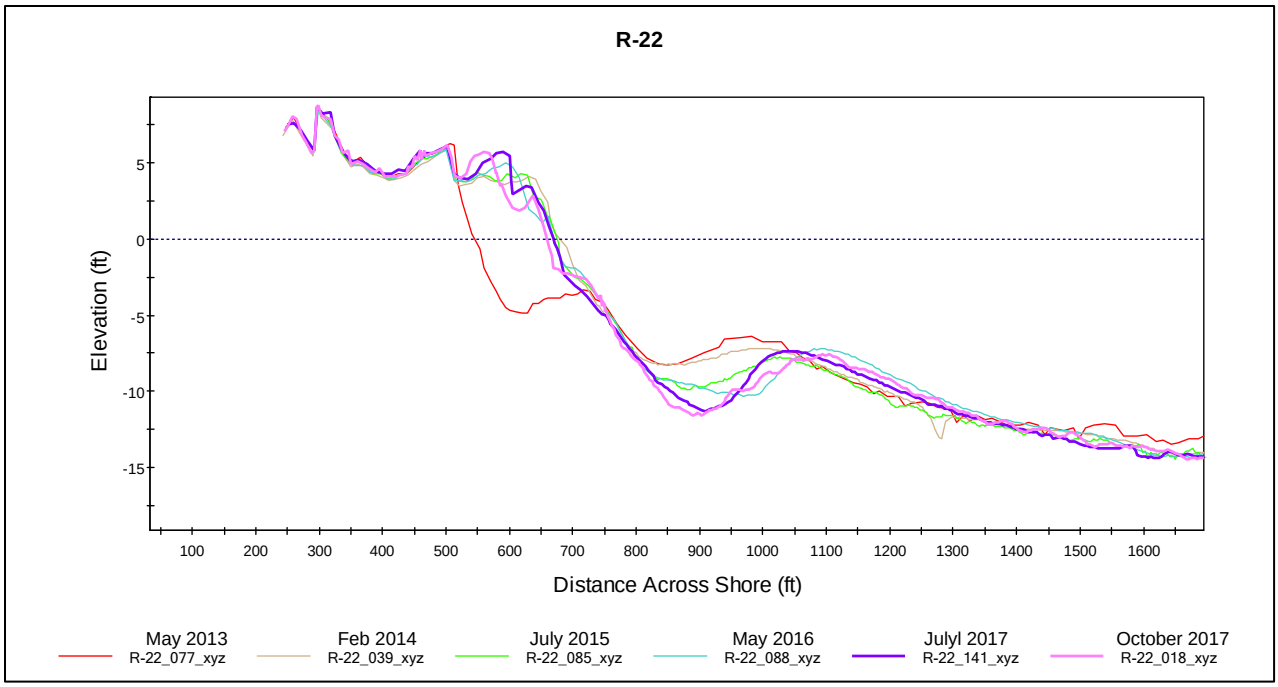


Figure 31: Survey Profiles at R-21
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



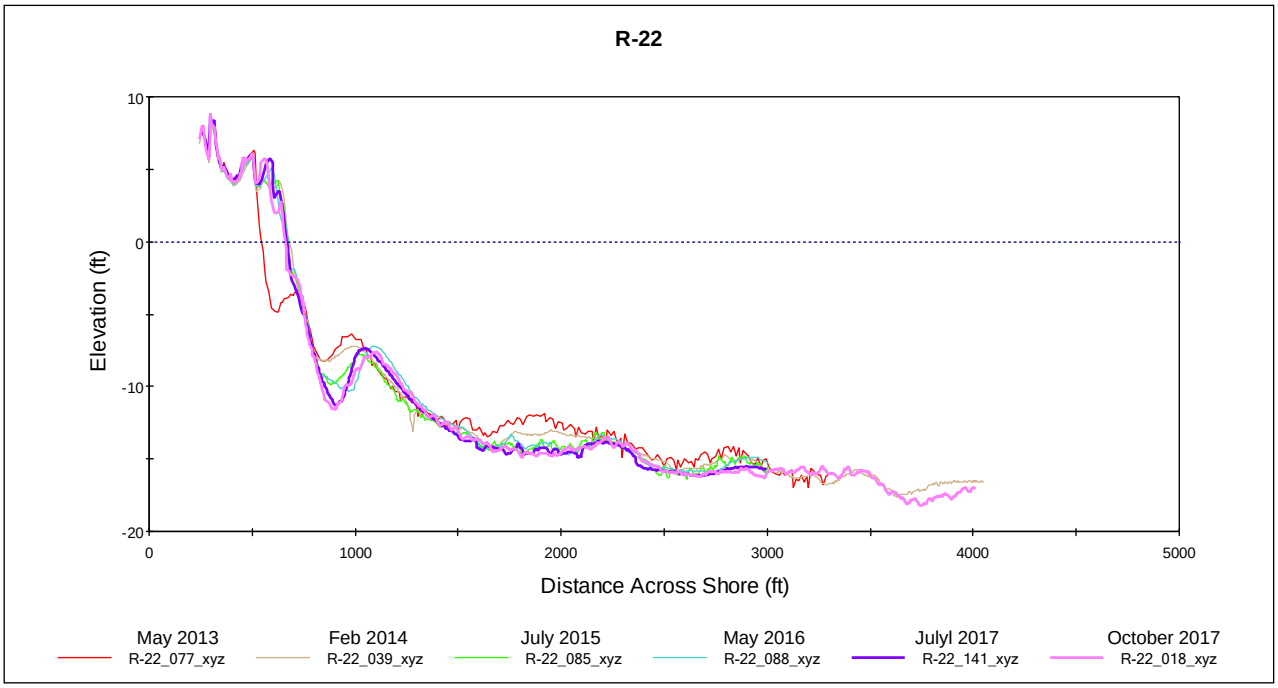
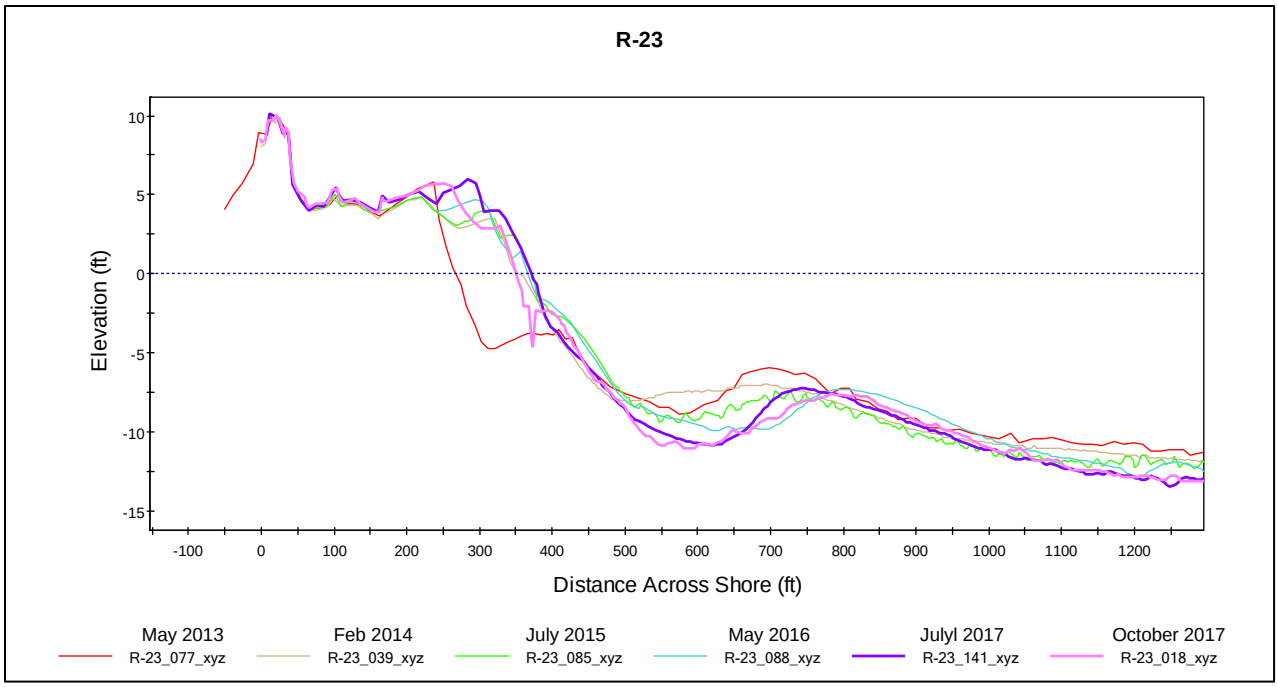


Figure 32: Survey Profiles at R-22
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



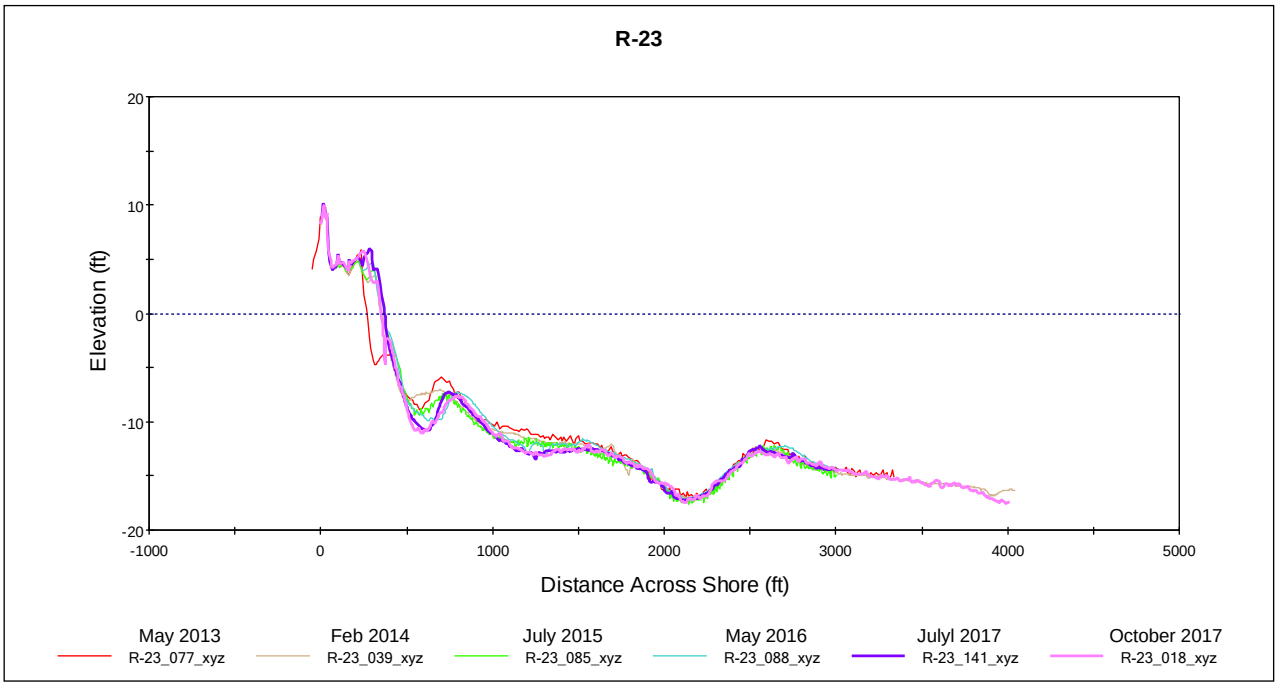
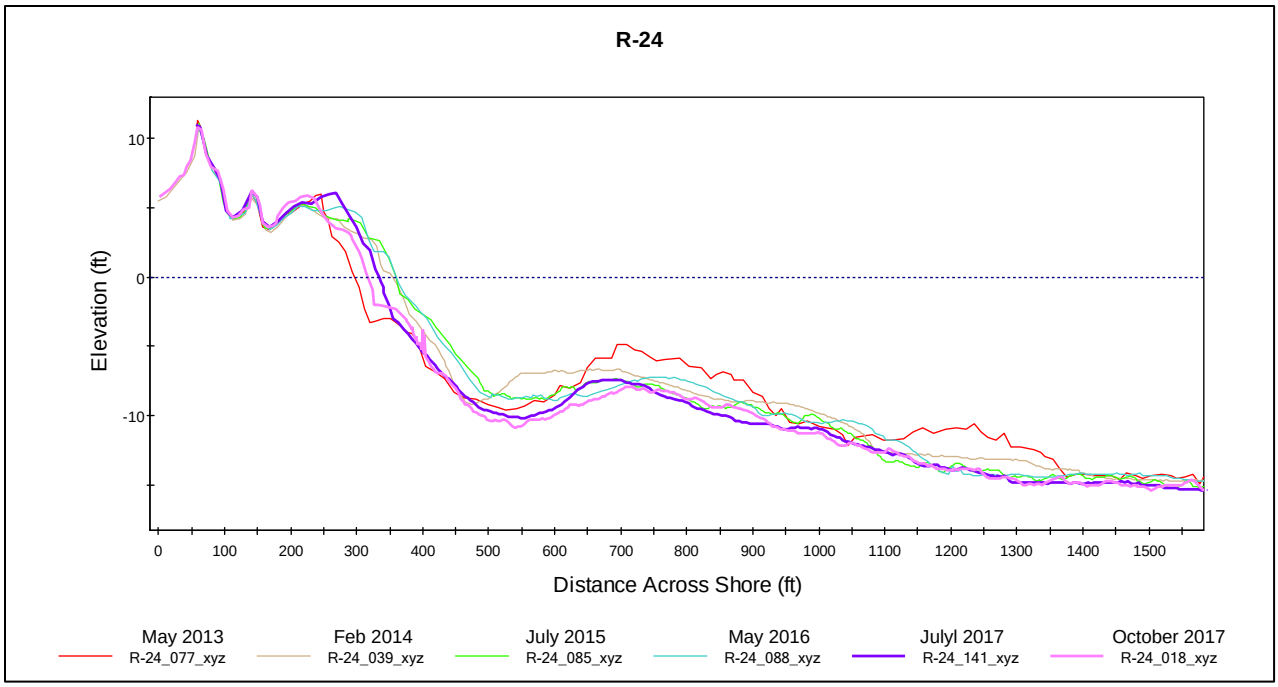


Figure 33: Survey Profiles at R-23
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



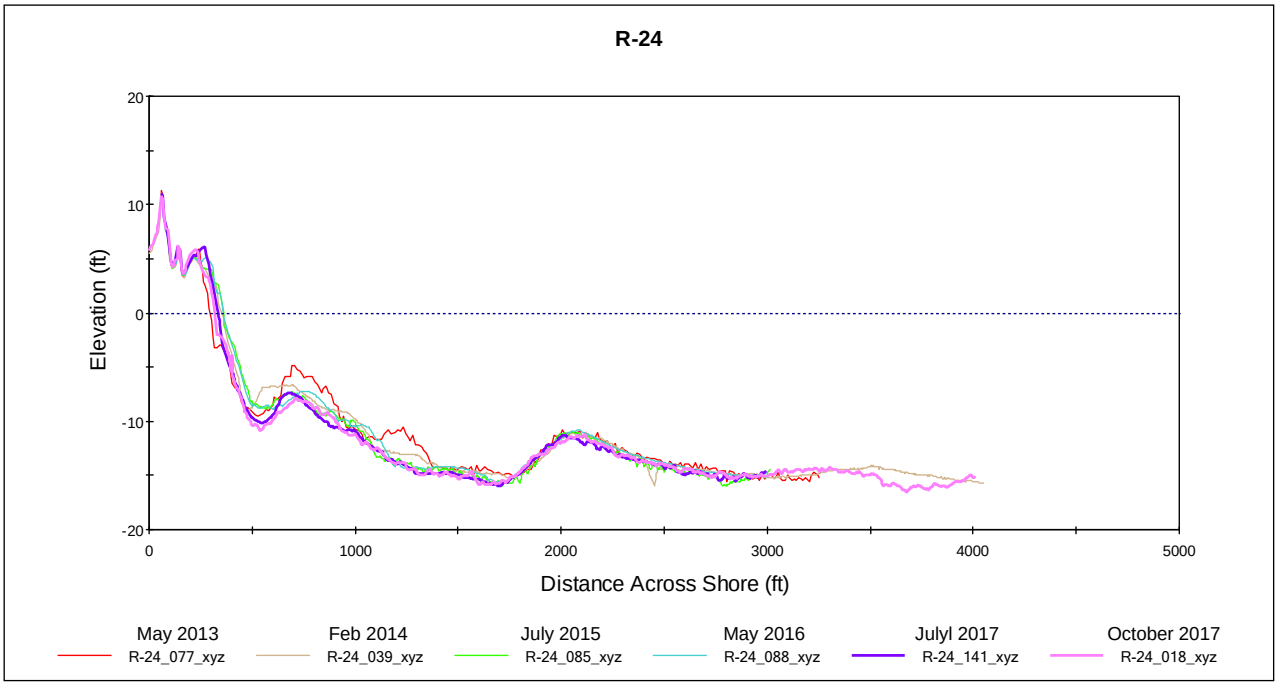
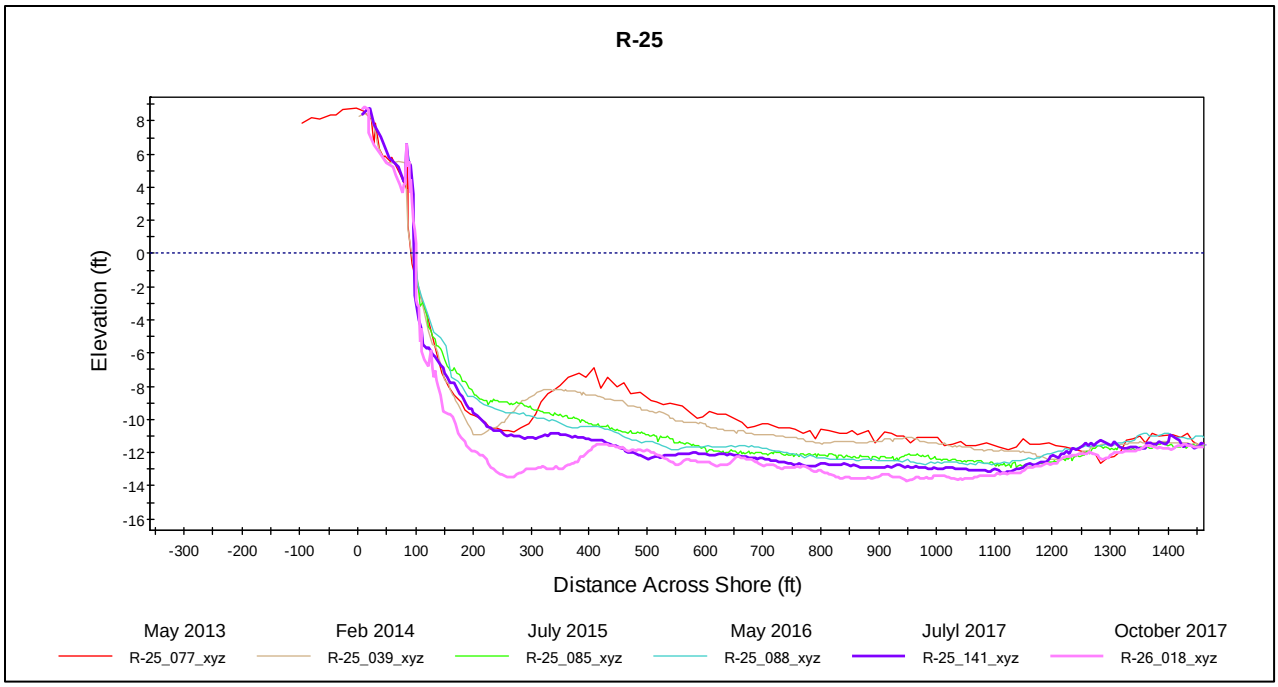


Figure 34: Survey Profiles at R-24
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



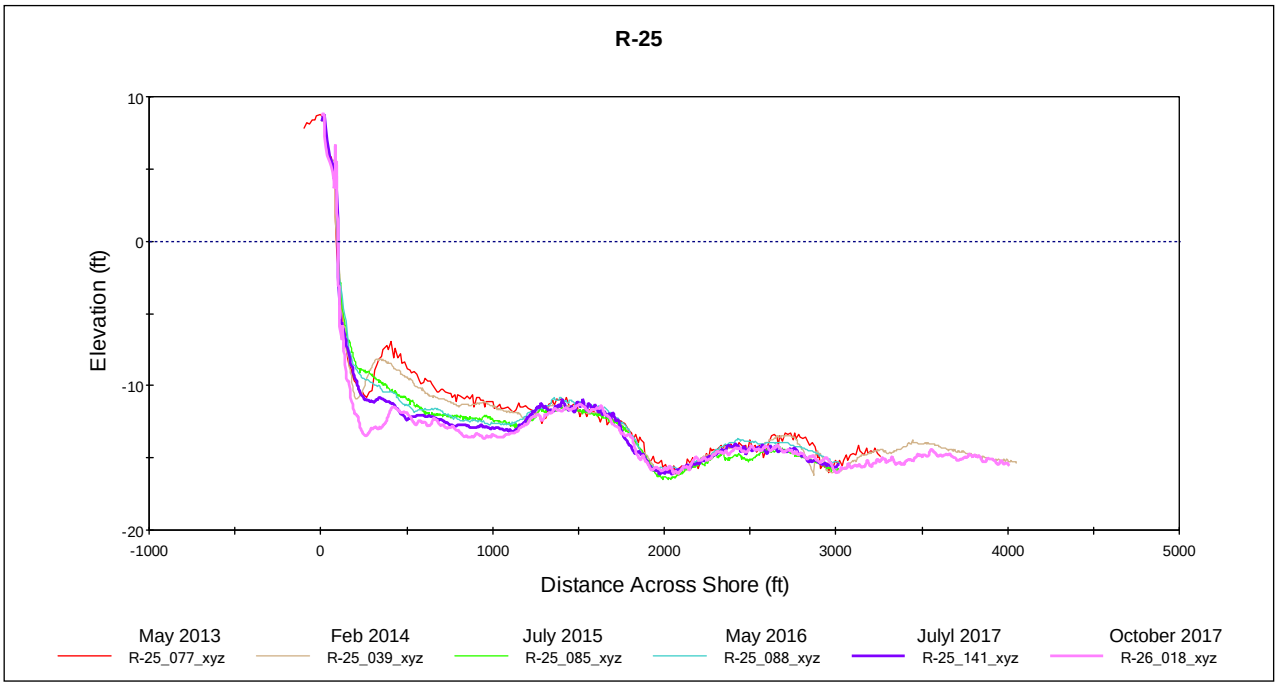
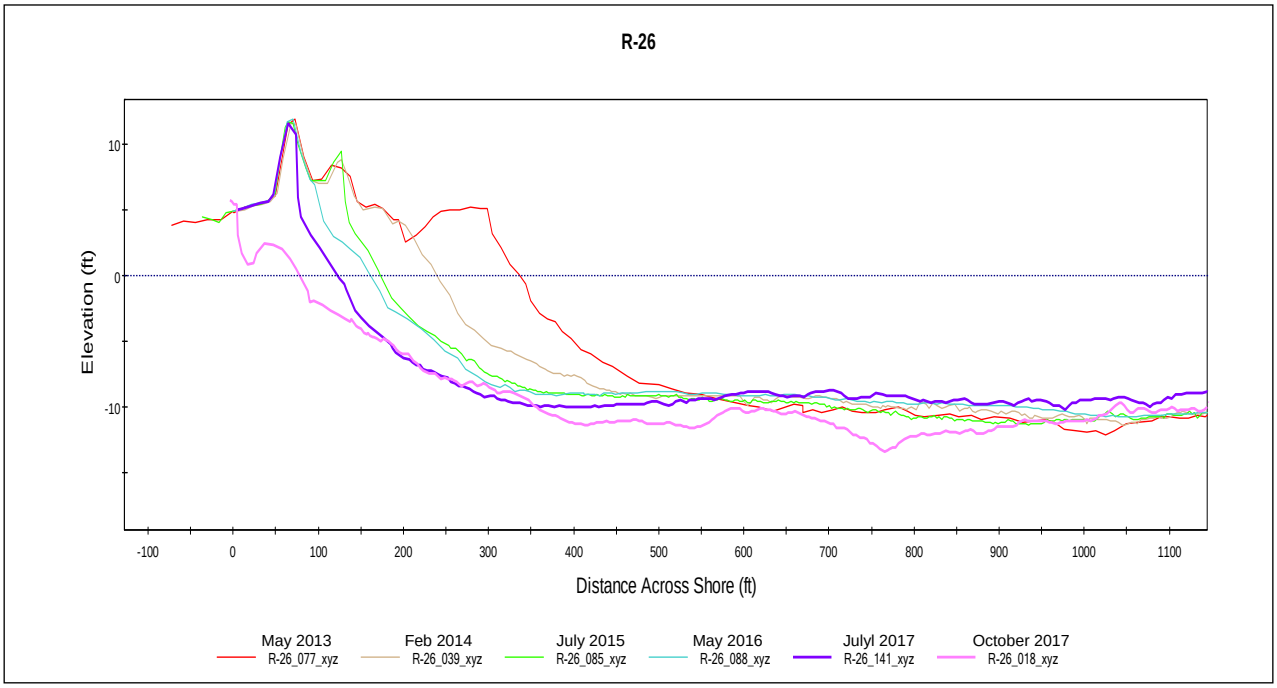


Figure 35: Survey Profiles at R-25
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



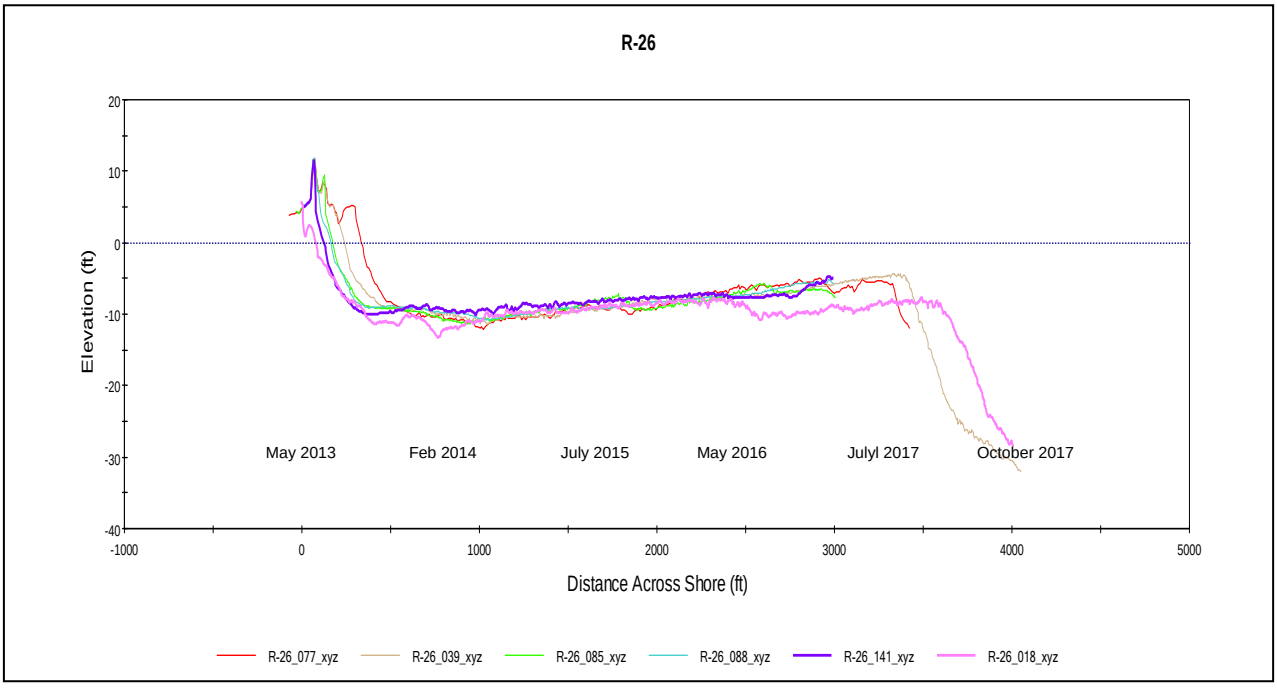
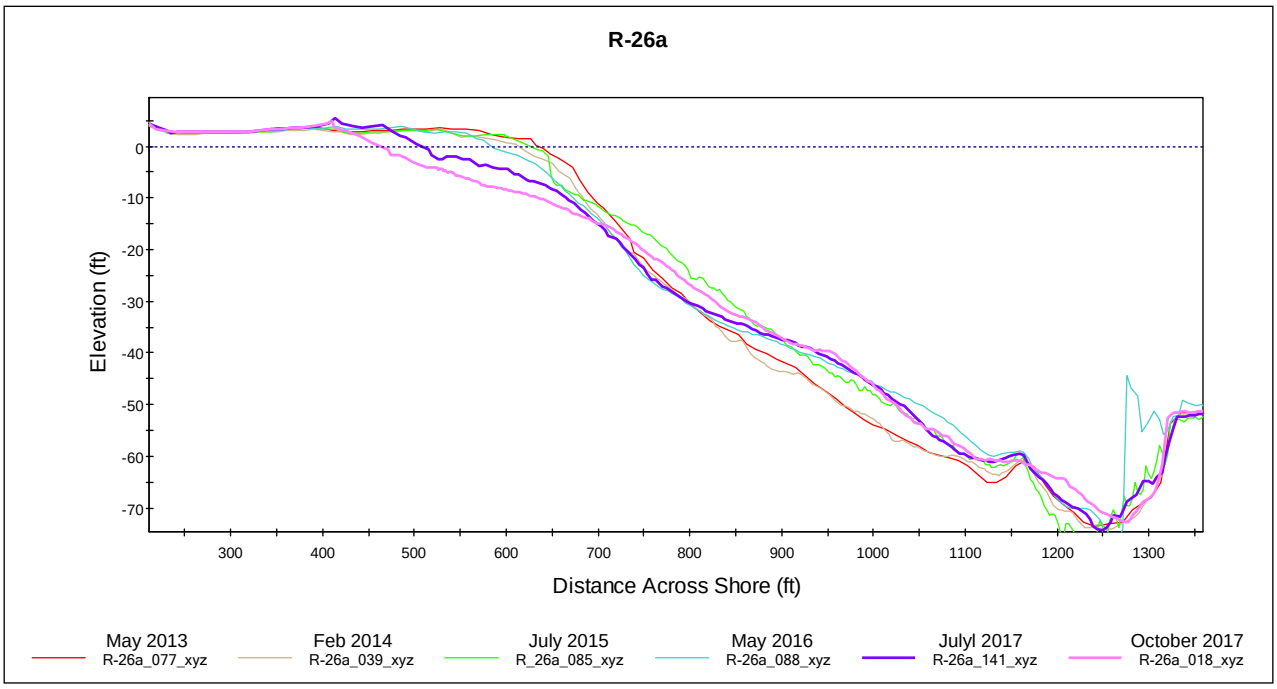


Figure 36: Survey Profiles at R-26
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument



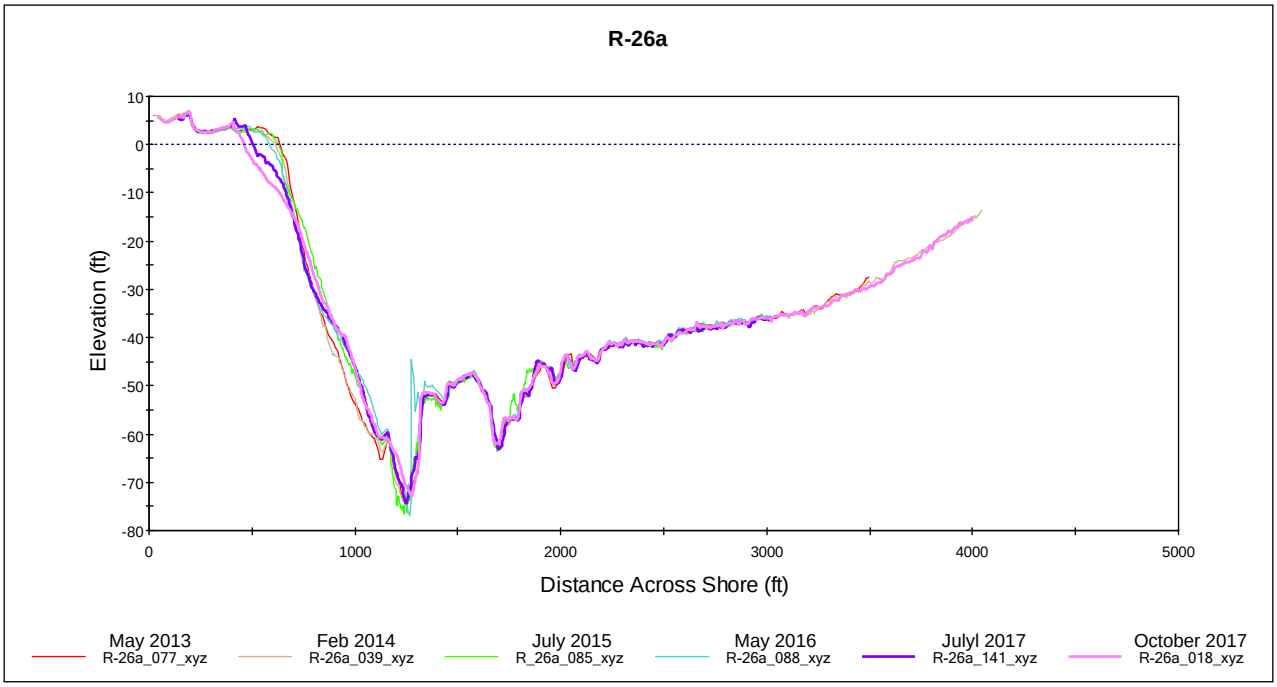


Figure 37: Survey Profiles at R-26a
Elevation is in ft NAVD88, Distance is from the FDEP R-Monument