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# Periodic Survey Evaluation: Ocean View Beach Spring 2017

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Presented to:

City of Norfolk

*September 2017*

Prepared by:



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## 1. Executive Summary

The twenty-fourth consecutive twice-yearly survey of the Ocean View shoreline was conducted on May 23 - 25, 2017. The study area extends from the western end of Willoughby Spit to the western edge of Little Creek Inlet in East Ocean View. The periodic surveys are typically collected bi-annually in March/April and September/October to monitor the condition of the shoreline and the state of existing shore protection projects. However, the present survey was conducted in late May in order to capture the post-nourishment conditions of the Federal coastal storm damage reduction project, initially constructed by Norfolk District U.S. Army Corps of Engineers (USACE) in mid-May 2017. The coastal storm damage reduction project will be referred to as the Federal Project for the remainder of this report.

A baseline and transect locations were established with the first survey in September 2005 and have been used for each subsequent survey. Shoreline changes at Mean High Water (MHW) and volumetric changes above 0 feet NAVD88 and -15 feet NAVD88 are calculated at each transect. Differences in the region above 0 feet NAVD88 are indicative of changes to the dune and subaerial beach berm, while the differences above -15 feet NAVD88 indicate changes in the nearshore zone. Comparison of seasonal surveys (i.e. May 2016 to May 2017) eliminates seasonal variation of profiles in volumetric change analyses. Consecutive survey comparisons (fall to spring, and spring to fall) are useful to assess the direct impact of extreme events which have occurred during the six month period between surveys. This report documents the data sources, methods, and results of a periodic surveying evaluation performed to compare the May 2017 survey data with previous surveys taken in May 2016 (spring to spring comparison) and October 2016 (most recent periodic survey comparison) in the Ocean View Beach area between Willoughby Spit and Little Creek Inlet.

Comparison	Parameter	Quantity
May 2016 vs. May 2017	Average Shoreline Change Rate at MHW (+0.98 ft NAVD88)	92.37 ft/yr
	Cumulative Volume Change Rate Above 0 ft NAVD88	437,869 cy/yr
	Cumulative Volume Change Rate Above -15 ft NAVD88	984,332 cy/yr
October 2016 vs. May 2017	Average Shoreline Change at MHW (+0.98 ft NAVD88)	94.29 ft
	Cumulative Volume Change Above 0 ft NAVD88	499,725 cy
	Cumulative Volume Change Above -15 ft NAVD88	1,085,035 cy

Since the Federal Project placed approximately 1.2 million cubic yards after October 2016, both of the standard comparisons in these reports – i.e. over the past year and over the past six months – show very high magnitudes of volume gain and shoreline advance across the Ocean View monitoring area. In addition, the Federal Project represents a step-change in the shoreline position and overall volume in the profile. Since the present survey in May 2017 captured the immediate post-nourishment conditions of the initial Federal Project, future monitoring survey reports will be able to evaluate the performance of the Federal Project and will help the City and USACE to track project conditions, document damage associated with specific storms, and effectively plan for future renourishment needs.

There has been gain of the MHW shoreline along with volumetric gains above both 0 feet NAVD88 and -15 feet NAVD88 in the East Ocean View region over the past year. Over the current survey period, there was gain of the MHW shoreline and volumetric gain above 0 feet NAVD88 and -15 feet NAVD88. The behavior in each of the shoreline reaches for the May 2016 to May 2017, October 2016

to May 2017, and October 2016 to February 2017 periods are summarized in Table 1-1, Table 1-2, and Table 1-3, respectively.

As illustrated in Table 5-2, the Ocean View shoreline has experienced overall gain at MHW during May 2016 and May 2017 with a length-weighted average change rate of 92.37 ft/yr due to the Federal Project construction. The beach and dune above 0 feet NAVD88 gained sediment at a rate of 437,869 cy/yr from May 2016 to May 2017. The beach and dune above -15 feet NAVD88 gained sediment at a rate of 984,332 cy/yr from May 2016 to May 2017.

From October 2016 to May 2017, the MHW shoreline gained on average by 94.29 feet, as shown in Table 5-3. The volumetric change over the same period showed gain above 0 feet NAVD88 and above -15 feet NAVD88 of 499,725 cy and 1,085,035 cy, respectively.

The Ocean View shoreline overall gained 1,085,035 cy above -15 feet NAVD88 between October 2016 and May 2017, and it had a net 984,332 cy gain of sand volume above -15 feet NAVD88 over the year between May 2016 and May 2017.

From October 2016 to February 2017, the MHW shoreline gained on average by 0.27 feet. The linear volumetric change over the same period showed gain above 0 feet NAVD88 and above -15 feet NAVD88 of 1.98 cy/ft and 6.81 cy/ft, respectively. This was the behavior of the beach and nearshore system in the months leading up to construction of the Federal Project.

**Table 1-1: Regional Shoreline and Volume Change Statistics (May 2016 to May 2017)**

Region	Average Shoreline Change	Average Volume Change Rate Above 0 ft NAVD88	Cumulative Volume Change Rate Above 0 ft NAVD88	Average Volume Change Rate Above -15 ft NAVD88	Cumulative Volume Change Rate Above -15 ft NAVD88
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Willoughby Spit	95.86	13.26	59,838	19.88	89,710
800 Block Breakwaters	138.70	18.54	84,155	39.22	178,002
West Ocean View	101.11	12.92	91,376	34.26	234,503
Central Ocean View Breakwaters	124.88	16.14	55,984	35.92	124,602
Central Ocean View	43.88	4.39	54,898	13.53	169,239
East Ocean View	127.60	16.01	91,618	32.90	188,276
OVERALL	Weighted Avg (ft/yr)	Weighted Avg (cy/ft/yr)	Total (cy/yr)	Weighted Avg (cy/ft/yr)	Total (cy/yr)
	92.37	11.59	437,869	26.34	984,332

**Table 1-2: Regional Shoreline and Volume Change Statistics (October 2016 to May 2017)**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Willoughby Spit	103.72	13.87	62,569	25.14	113,452
800 Block Breakwaters	150.80	20.48	92,960	44.53	202,132
West Ocean View	103.02	13.57	103,215	31.34	238,328
Central Ocean View Breakwaters	137.16	18.30	63,476	39.38	136,577
Central Ocean View	34.35	5.46	68,351	14.69	183,750
East Ocean View	135.52	19.08	109,154	36.84	210,795
OVERALL	Weighted Avg (ft)	Weighted Avg (cy/ft)	Total (cy)	Weighted Avg (cy/ft)	Total (cy)
	94.29	13.03	499,725	28.29	1,085,035

**Table 1-3: Regional Shoreline and Volume Change Statistics (October 2016 to February 2017)**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88
	(ft)	(cy/ft)	(cy/ft)
Willoughby Spit	15.73	4.00	17.49
800 Block Breakwaters	12.94	2.38	6.56
West Ocean View	-0.50	0.05	0.02
Central Ocean View Breakwaters	-3.81	-1.65	-4.02
Central Ocean View	-8.07	3.46	10.34
East Ocean View	-0.24	1.58	6.45
OVERALL	Weighted Avg (ft)	Weighted Avg (cy/ft)	Weighted Avg (cy/ft)
	0.27	1.98	6.81

## 2. Objective

The City of Norfolk, Virginia has maintained a program of periodic surveying of the Ocean View shoreline since 2005. The periodic surveying data collection dates are shown in Table 2-1. This report documents the data sources, methods, and results of a periodic surveying evaluation performed to compare the May 2017 survey data with previous surveys taken in May 2016 (spring to spring comparison) and October 2016 (most recent periodic survey comparison) in the Ocean View Beach area between Willoughby Spit and Little Creek Inlet. In addition, the Federal Project pre-construction survey data (February 2017) was compared with the October 2016 periodic survey data.

**Table 2-1: Surveyors and Collection Dates**

Data Collection Date	Surveyor
September 2005	McKim & Creed
March 2006	McKim & Creed
October 2006	McKim & Creed
March 2007	McKim & Creed
October 2007	McKim & Creed
March 2008	McKim & Creed
October 2008	McKim & Creed
April 2009	McKim & Creed
October 2009	Geodynamics, LLC
March 2010	Geodynamics, LLC
October 2010	Geodynamics, LLC
April 2011	Geodynamics, LLC
October 2011	Geodynamics, LLC
March 2012	Geodynamics, LLC
September 2012	Geodynamics, LLC
April 2013	Geodynamics, LLC
October 2013	Geodynamics, LLC
March 2014	Geodynamics, LLC
October 2014	Geodynamics, LLC
April 2015	Geodynamics, LLC
October 2015	Geodynamics, LLC
May 2016	Geodynamics, LLC
October 2016	Geodynamics, LLC
February 2017	USACE (Great Lakes Dredge & Dock)
May 2017	USACE (Great Lakes Dredge & Dock)
May 2017	Geodynamics, LLC

### 3. Data Sources

Geodynamics, LLC, conducted the most recent survey of Ocean View Beach on May 23-25, 2017. The baseline and transects established for the September 2005 survey were used for the most recent survey. Figure 3-1 shows the location of the baseline, transects and the stationing applied by Geodynamics for the surveying. As shown in Figure 3-1, transects were stationed from west to east along the Ocean View shoreline. The survey data were provided in xyz and shapefile formats allowing for compatibility with multiple programs.

Geodynamics noted that typical vertical survey accuracy along the hydrographic portions of the profiles is approximately  $\pm 1$  cm. This ‘margin of error’, if applied over the entire length of the hydrographic profiles can potentially result in significant volumetric differences, in particular on the shallow-sloped and long profiles near Willoughby Spit. Therefore, volumetric changes discussed herein are analyzed with regard to potential volumetric margins of error.

On June 3, 2017, the Virginia Institute of Marine Science (VIMS) flew aerial photography of the Ocean View shoreline, georectified the images, and digitized the apparent MHW shoreline position from the images. The June 2017 aerial photos with the digitized shoreline positions from June 2017, November 2016, and May 2016 are presented in Appendix A. Since these photos cover a limited portion of area landward and seaward of the shoreline, a previous image (2009) is underlain for presentation purposes.

Post-fill survey data from the Federal Project collected in May 2017 was provided by Great Lakes Dredge & Dock (GLDD). The GLDD data was cross-checked against the Geodynamics data from May 2017, and a satisfactory agreement was found. Thus, the May 2017 Geodynamics data will serve as the baseline data for assessing the state of the Federal Project in future monitoring periods.

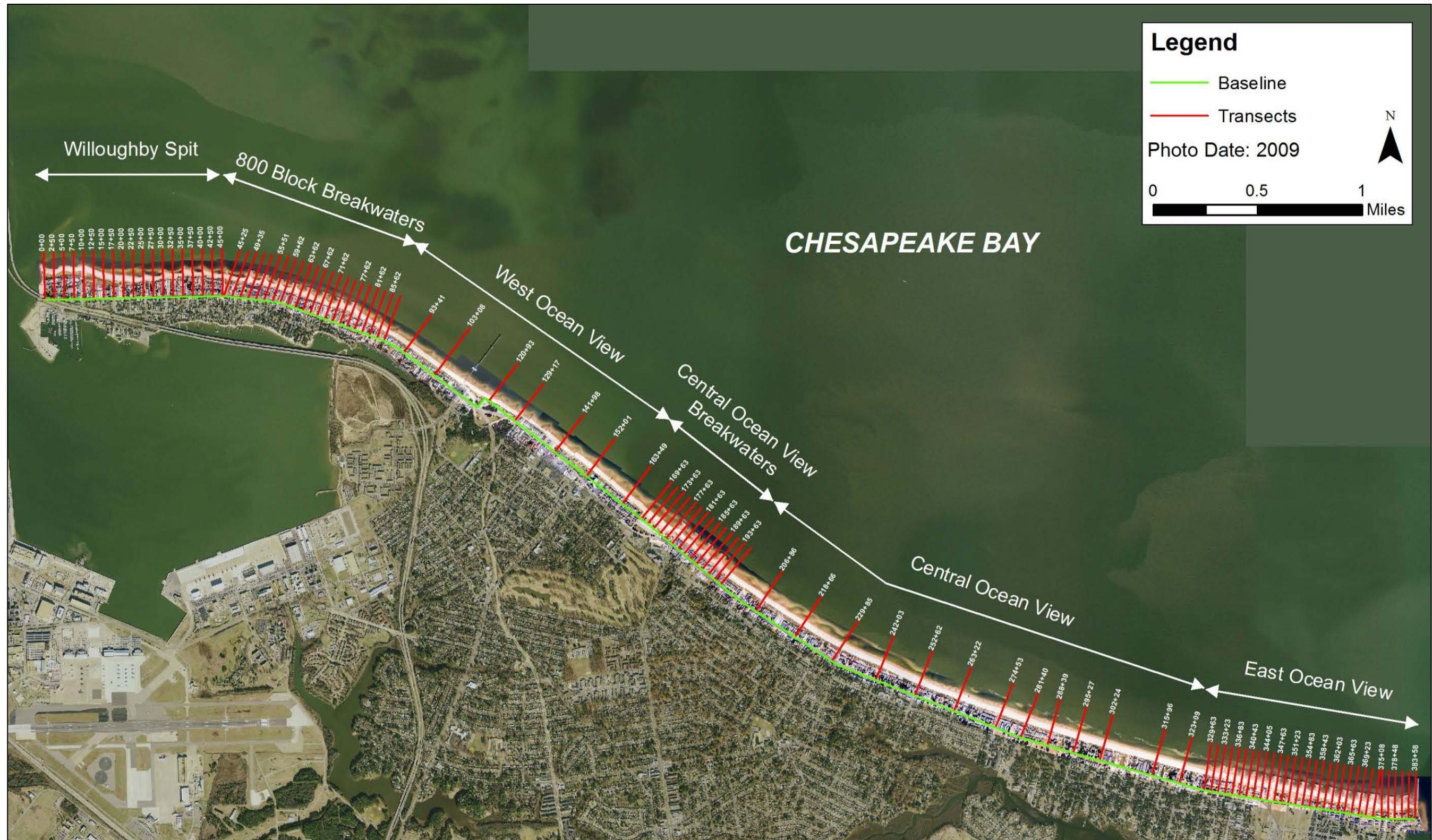


Figure 3-1: Survey Baseline and Transects

## 4. Methods

Survey comparisons and respective analysis were performed using a combination of Microsoft Excel, Golden Software Surfer, ESRI ArcGIS, and the USACE's Beach Morphology Analysis Package (BMAP). Surfer is a contouring and 3D surface mapping program utilized to create 3D surfaces for analysis. BMAP is a program developed by the USACE to analyze morphologic and dynamic properties of beach profiles.

The horizontal coordinate system used was Virginia South State Plane NAD 1983 (HARN), US Survey feet with a vertical datum of NAVD88. Individual profile plates showing the survey profile at each transect for each date are presented in Appendix B. From the profiles, shoreline changes and volumetric changes were then calculated at each transect for the following time periods:

1. May 2016 to May 2017 (Entire Shoreline)
2. October 2016 to May 2017 (Entire Shoreline)
3. October 2016 (Geodynamics) to February 2017 (GLDD) at selected locations where the two data sets' transects were near enough to enable a meaningful comparison

First, the change in shoreline based on the survey profiles at mean high water (MHW) was calculated at each transect for each time period mentioned. MHW along Ocean View beaches is defined as +0.98 feet NAVD88 based on NOAA tidal benchmark at Sewells Point. The resulting value represents the shoreline change (feet) over the time period between surveys. The shoreline change rate (ft/yr) was then calculated by dividing by the amount of time between survey dates.

Representative volume changes were also calculated at each transect for all time periods. Volume changes were calculated for two different extents in order to better understand the processes occurring onshore and offshore of the Ocean View beach area. Calculations included volume changes above -15 feet NAVD88 and volume changes above 0 feet NAVD88. The results represent volume change per linear foot of shoreline (cy/ft) over the period of time between surveys. The volume change rate (cy/ft/yr) was then calculated by dividing by the amount of time between survey dates. In addition, the volume changes were converted to cumulative changes over the entire shoreline. This was done by applying the average end area method to the unit volume changes (cy/ft) and unit volume change rates (cy/ft/yr) computed at each transect and summing the total volume changes over the entire shoreline. The resulting value indicated the total loss or gain of material (cy) between surveys based on the applicable profile extents.

Volume changes calculated for portions of the profiles above 0 feet NAVD88 are representative of changes in the amount of material in the dune system and on the subaerial beach. These areas are highly influenced by the performance of coastal structures and the impact of storm activity. Volume changes calculated for portions of the profiles above -15 feet NAVD88 allow for the tracking of sand movement in the submerged active profile; removing profile data deeper than the -15 feet NAVD88 contour from the analysis reduces uncertainty that would be associated with hydrographic data beyond this depth.

## 5. Discussion of Periodic Surveying Evaluation

This section discusses differences observed between the noted surveys, overall shoreline trends, regional shoreline trends and comparison with the pre- and post-construction surveys of the Federal Project. The computed shoreline changes and volume changes at each individual transect for the time periods covered are tabulated in Appendix C.

### 5.1. Differences in Survey Coverage

Variation in profile positions between surveys taken as part of the ongoing program of periodic surveying of the Ocean View shoreline (May 2016, October 2016, and May 2017) were minimal in the topographic portion of the survey due to use of the same baseline and transects put in place for the initial survey in September 2005. Profile extents and alignment were virtually the same when comparing the survey data.

### 5.2. Key Events During the Reporting Period

Beach processes are greatly influenced by natural and engineering processes. This section describes key events that happened during the present reporting period which likely had an impact on shoreline position changes and profile volume gains and/or losses.

#### 5.2.1. Storm Wave Events

Understanding of the wave climate immediately offshore of the Norfolk shoreline is vital for the design, monitoring, and understanding of projects along the shoreline and the behavior of the beach. The data used were collected from the City's AWAC (Acoustic Wave and Current) gage, which was deployed in 2006 directly offshore of the Norfolk Shoreline in approximately 23 feet of water. Wave data were collected throughout this survey period up to June 14, 2017.

A summary of the observed conditions during this deployment period yields the following general observations:

- The average significant wave height and peak period over the monitoring period (October 18, 2016 to June 14, 2017) was approximately 1.2 feet and 4.7 seconds.
- The largest significant wave height observed during this monitoring period was approximately 5.2 feet with a corresponding peak period of approximately 5.8 seconds and mean direction of 25 degrees (January 7, 2017).
- Waves approach from the northwest to southeast, with more than 75.0% approaching from 0 to 120 degrees North.

The overall wave climate during this period was typical for this location. Twenty-three storm events that occurred during the survey period for which the significant wave height at the wave gauge exceeded 3.3 feet (1.0 meter). These events are shown in Figure 5-1 through Figure 5-23.

The overall trends remained consistent with prior measurement periods with waves during calm periods being predominantly swell traveling into the bay from the ocean and having longer wave periods and

lower wave heights. Typically, the larger wave height events are driven by northerly and northeasterly storm winds within the bay and tend to have shorter wave periods. There were nine storm events identified during this period, and, as observed in the prior measurement periods, the wind data indicate that for large and sustained wind events there is a corresponding increase in significant wave height. A summary of wave statistics by month during this deployment is given in Table 5-1.

**Table 5-1: Monthly Wave Statistics Summary**

Wave Statistic	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16
Average Significant Wave Height, $H_s$ (ft)	1.1	1.2	0.6	1.0	1.7	1.8	1.3
Average Wave Period, $T_m$ (s)	2.5	2.4	2.3	2.4	2.8	2.8	2.7
Average Peak Wave Period, $T_p$ (s)	4.9	4.6	5.1	4.9	5.2	5.4	5.3
Maximum Observed Significant Wave Height, $H_s$ (ft)	3.2	4.7	2.3	2.5	7.2	7.6	3.9
Maximum Observed Wave Height, $H_{max}$ (ft)	6.0	7.6	3.2	4.5	13.3	12.7	6.5

Wave Statistic	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17
Average Significant Wave Height, $H_s$ (ft)	1.3	1.3	1.2	0.9	1.4	1.2	1.2
Average Wave Period, $T_m$ (s)	2.7	2.6	2.7	2.7	2.5	2.5	2.4
Average Peak Wave Period, $T_p$ (s)	5.3	4.6	4.6	5.1	4.1	4.8	4.0
Maximum Observed Significant Wave Height, $H_s$ (ft)	3.9	4.3	5.2	4.2	4.7	4.4	3.9
Maximum Observed Wave Height, $H_{max}$ (ft)	6.5	7.3	8.7	7.6	7.4	7.8	6.3

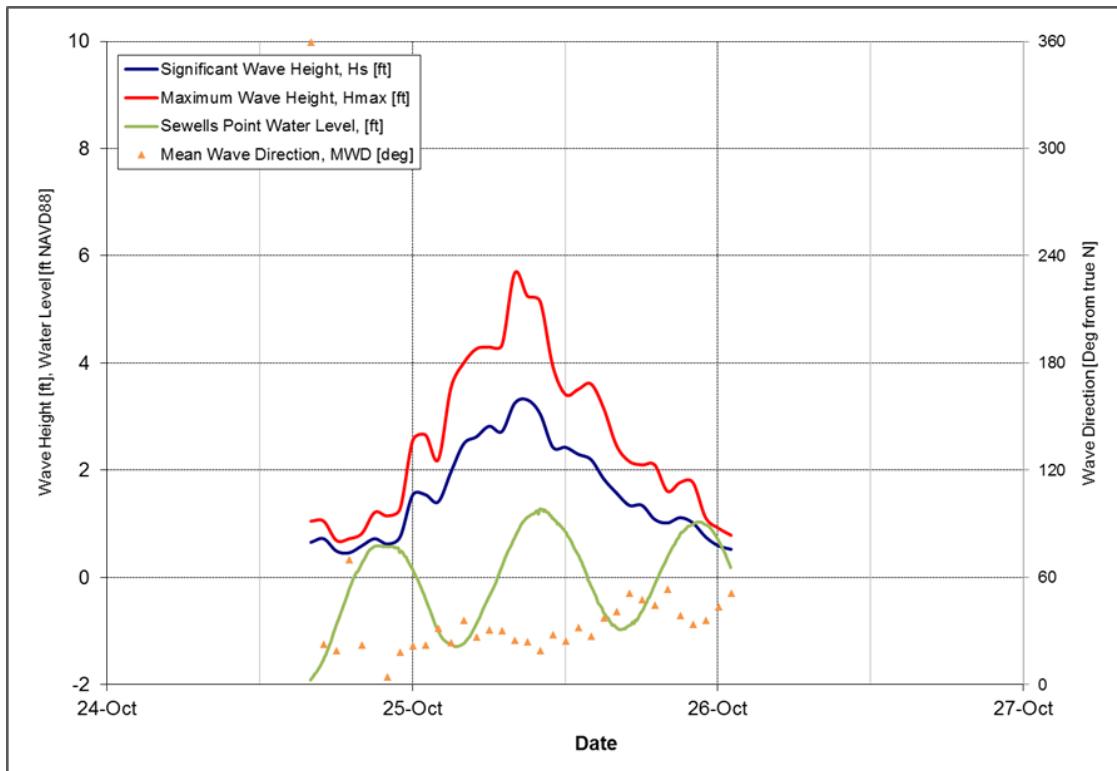


Figure 5-1: October 25, 2016 Storm

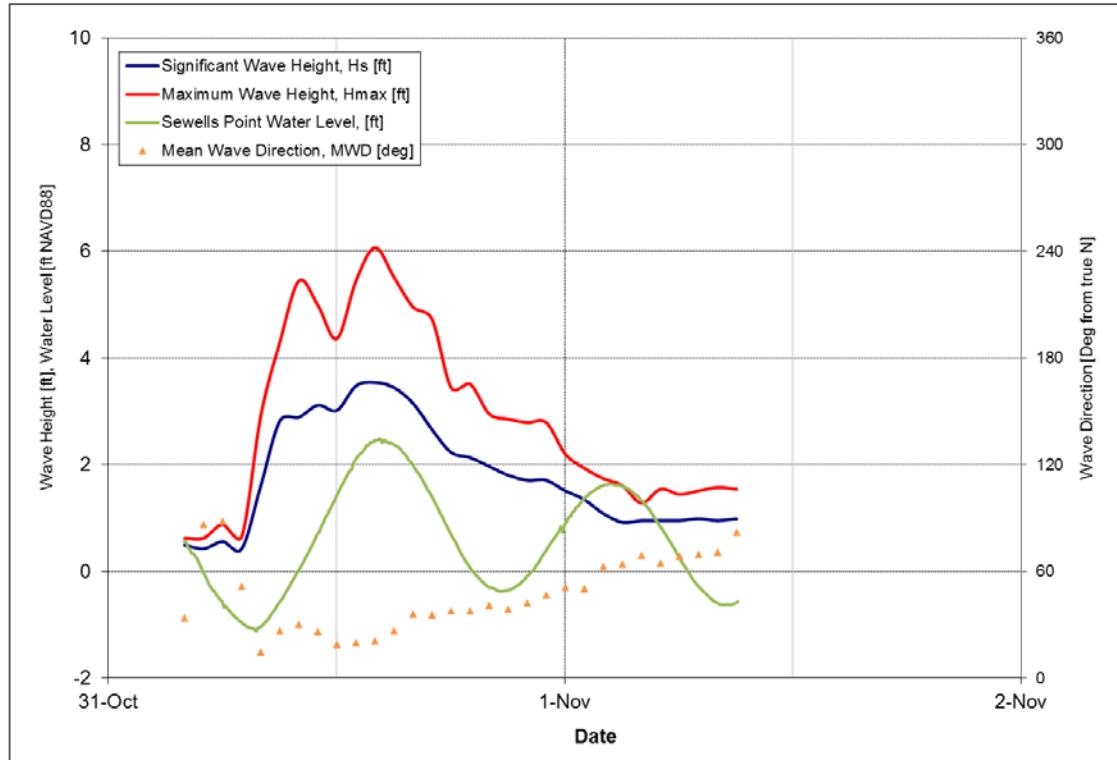


Figure 5-2: October 31, 2016 Storm

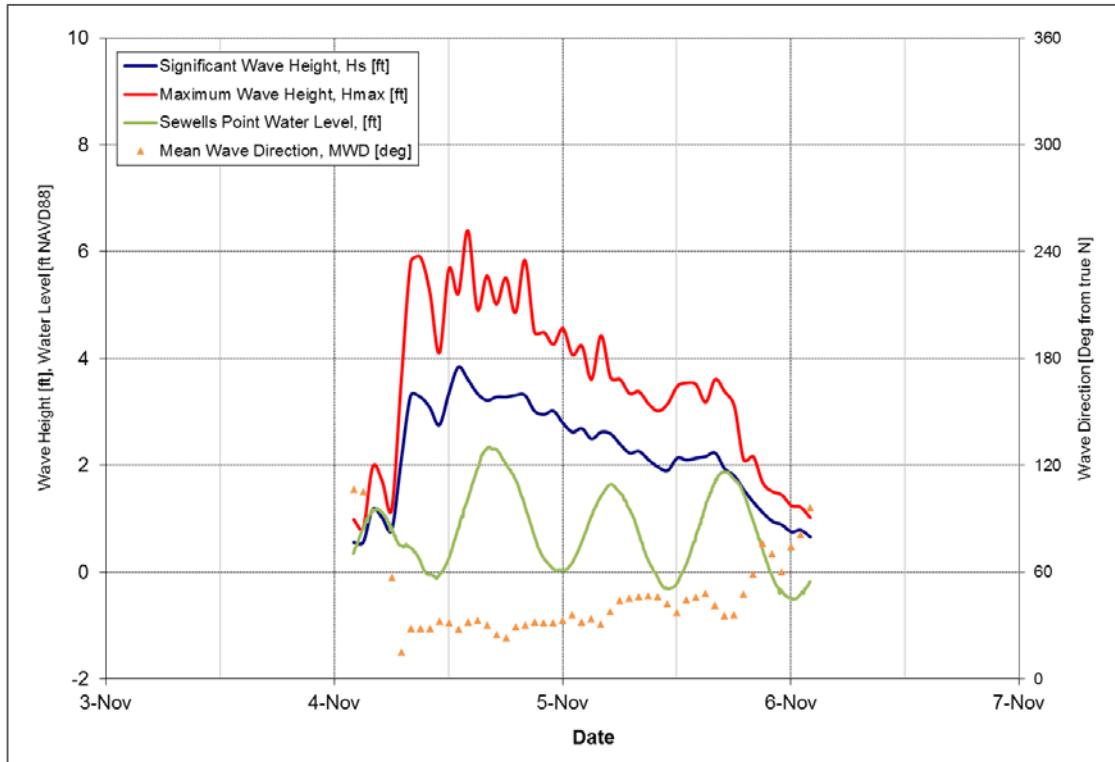


Figure 5-3: November 4, 2016 Storm

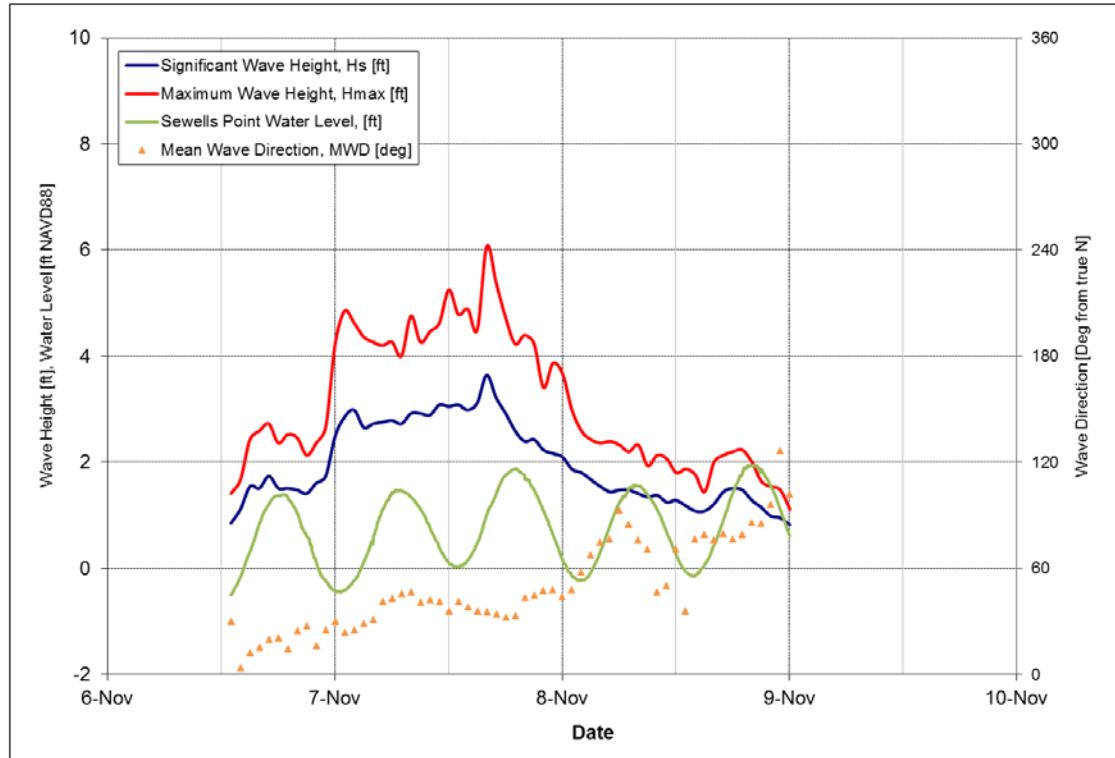
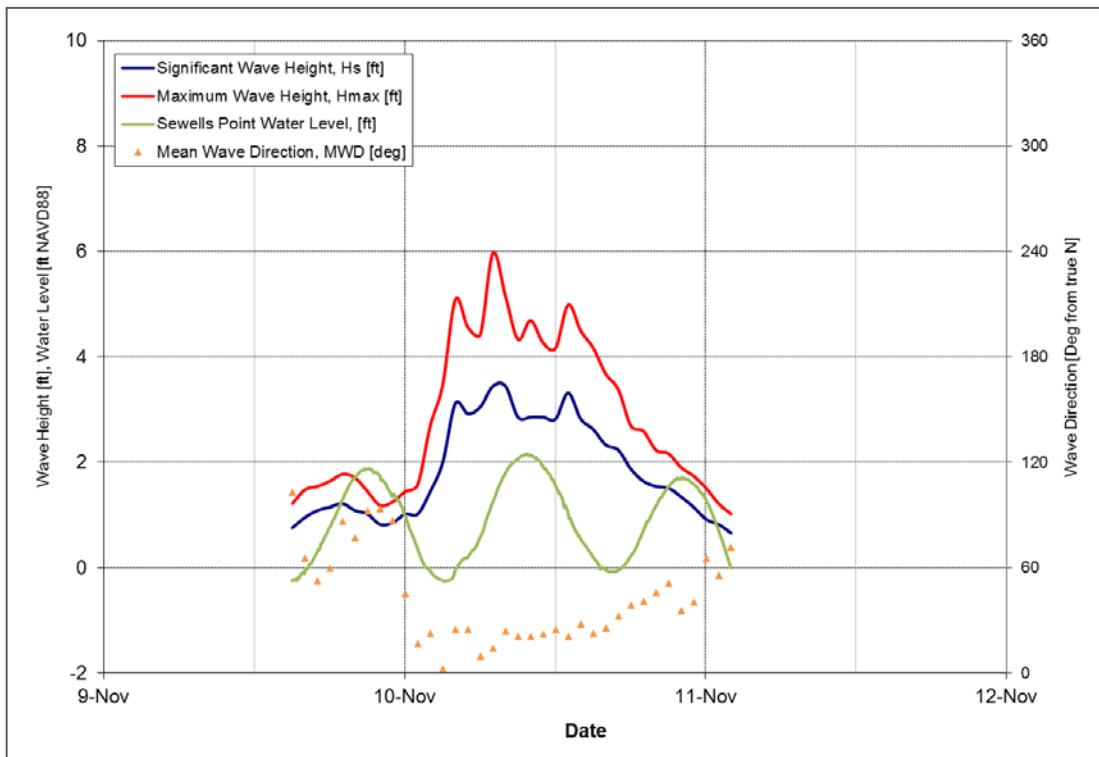
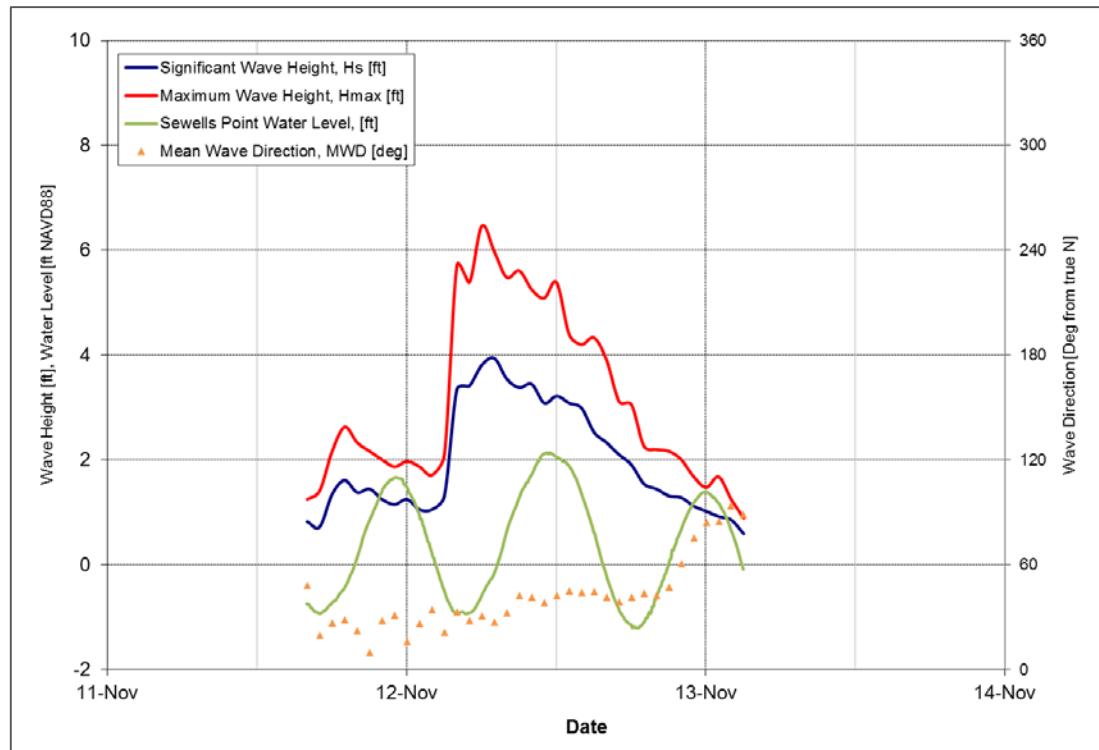
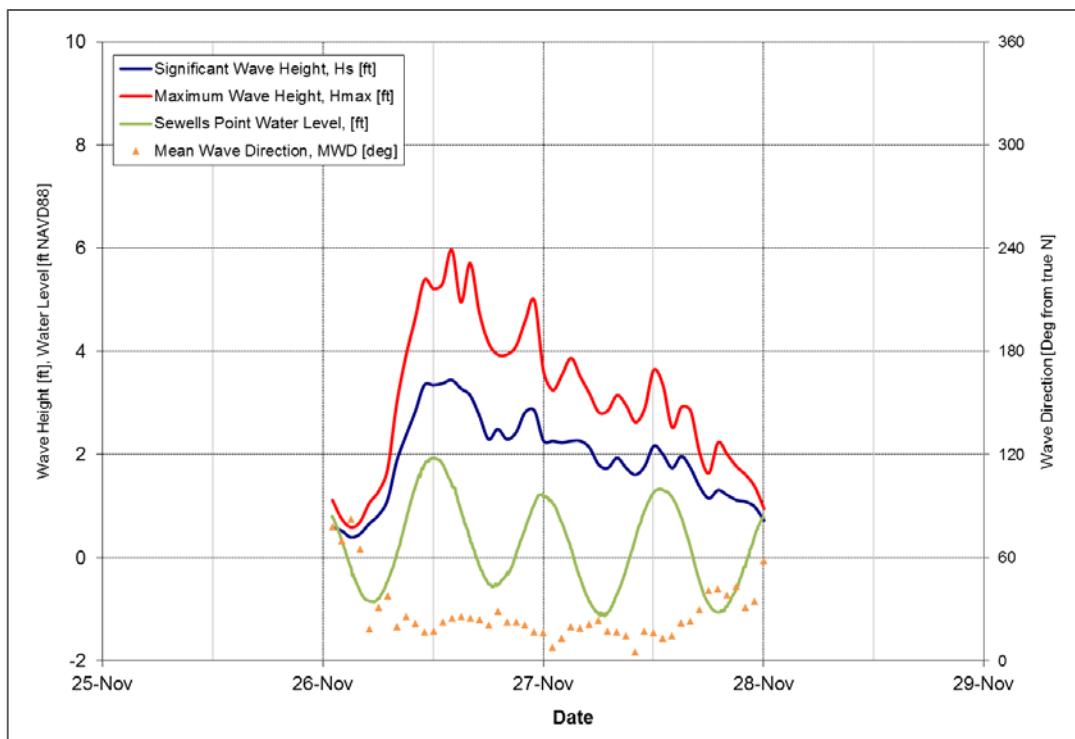
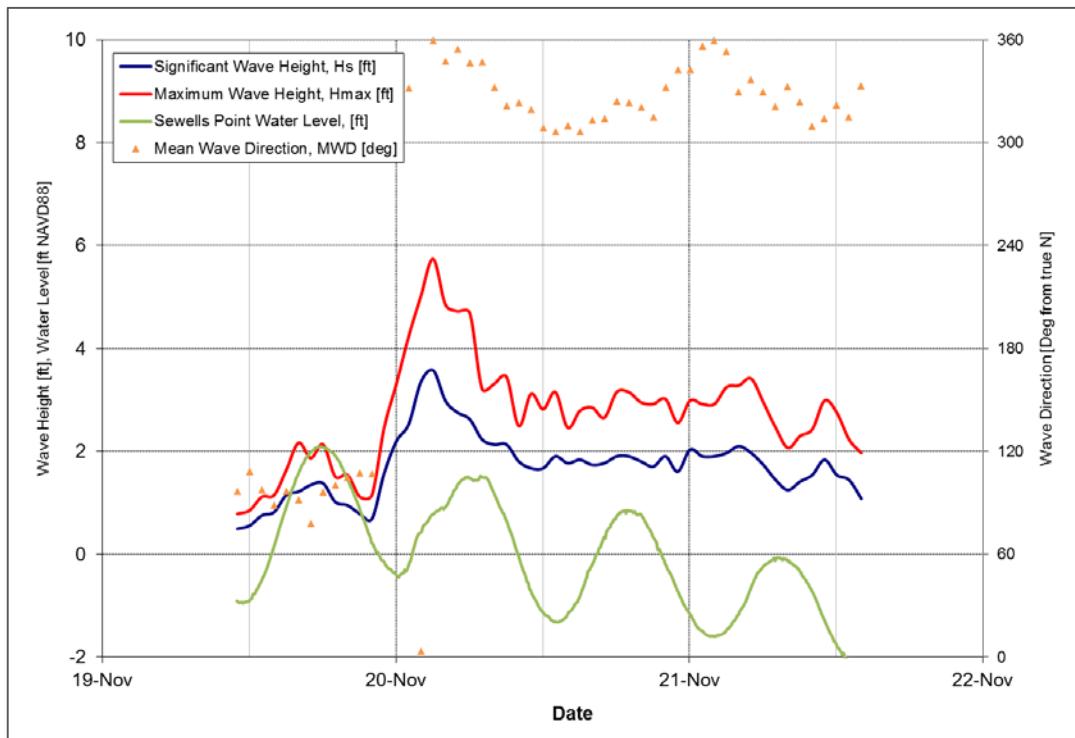


Figure 5-4: November 7, 2016 Storm

**Figure 5-5: November 10 2016 Storm****Figure 5-6: November 12 2016 Storm**



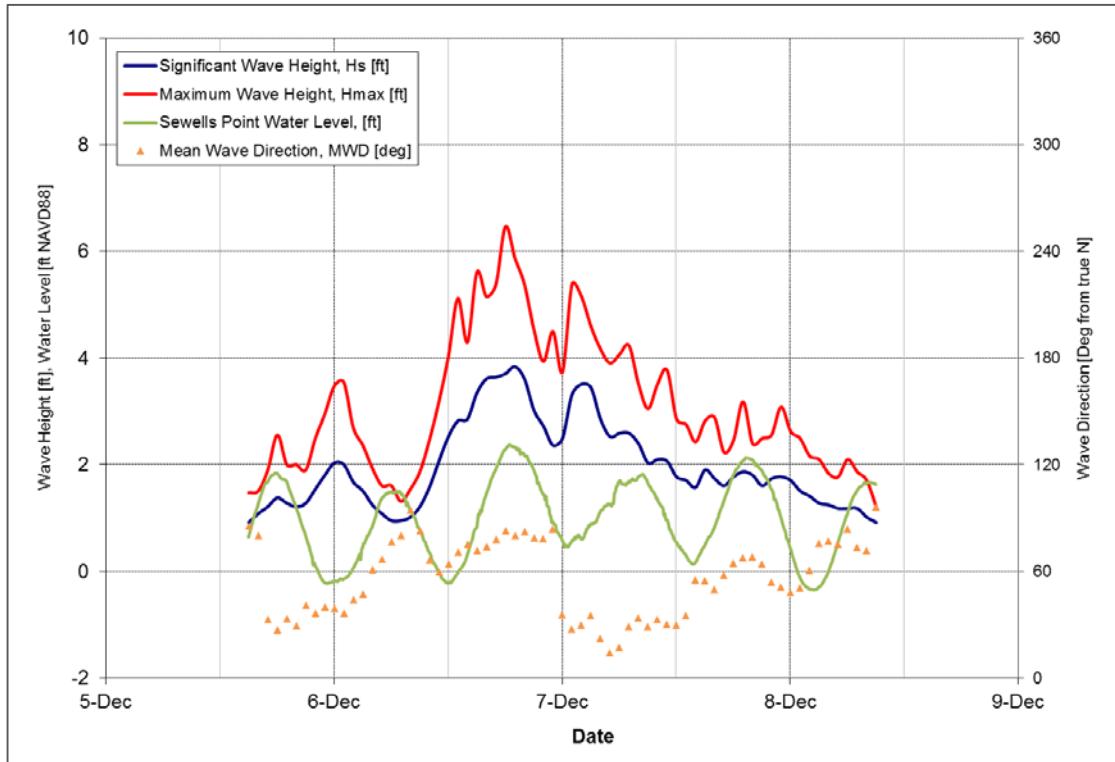


Figure 5-9: December 6 2016 Storm

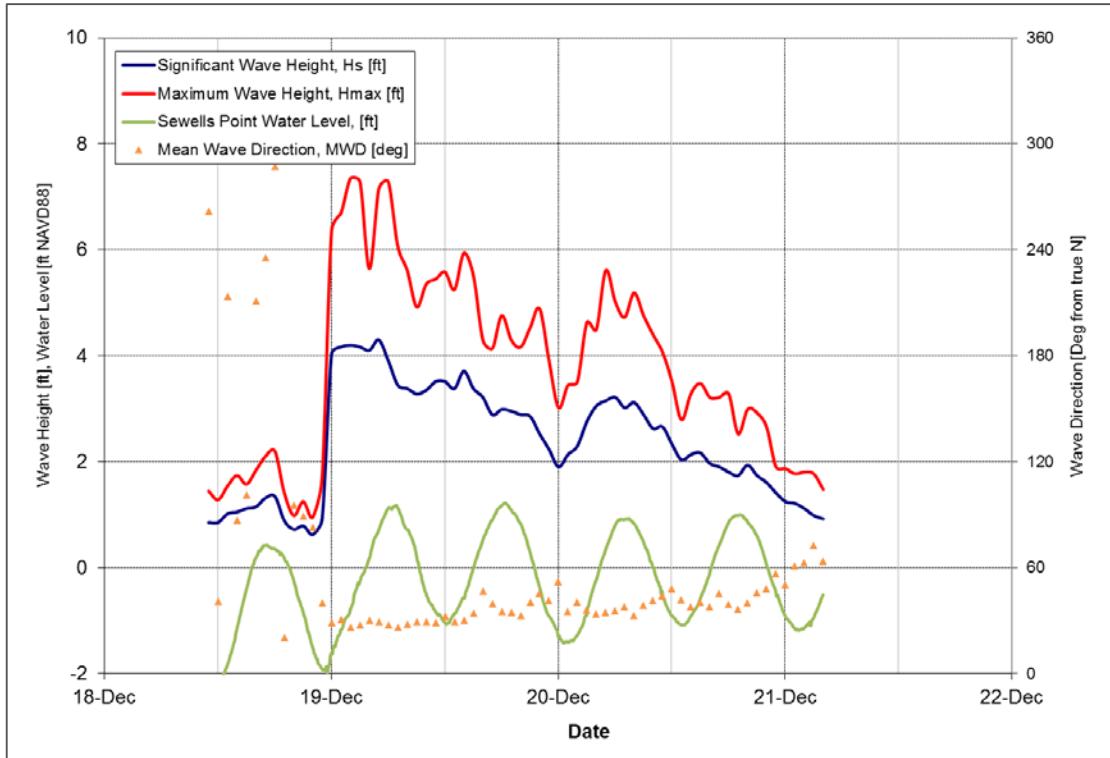


Figure 5-10: December 19 2016 Storm

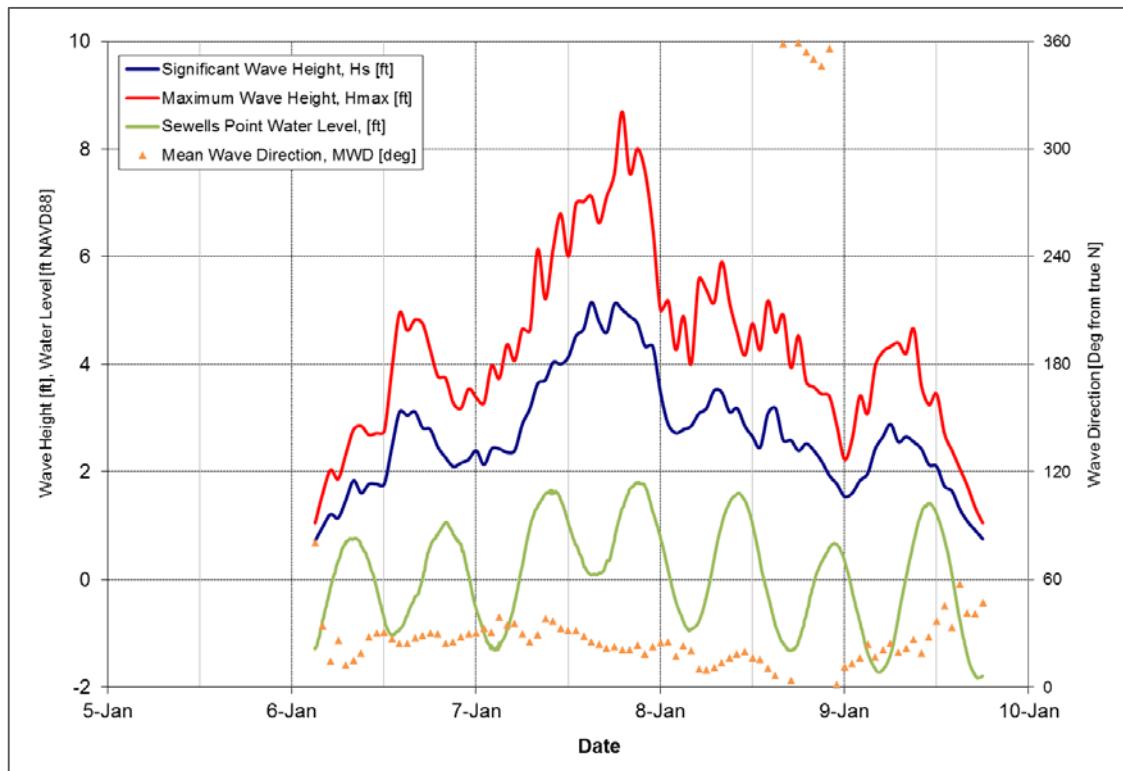


Figure 5-11: January 7 2017 Storm

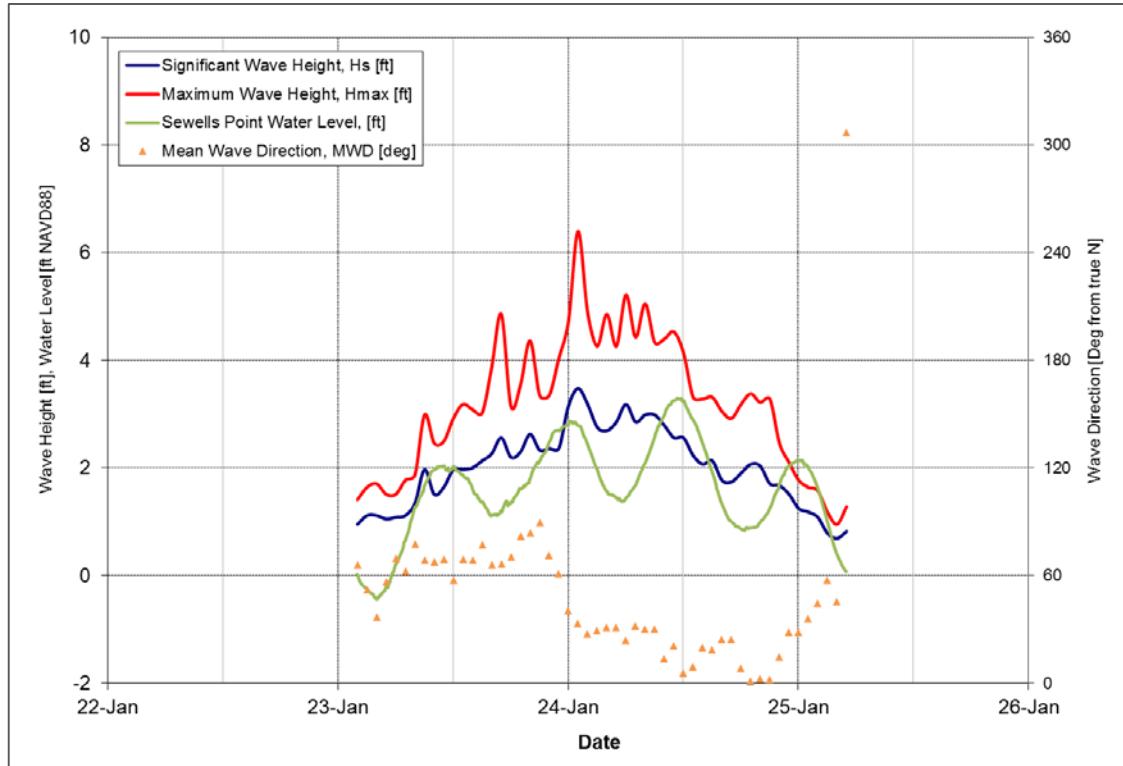


Figure 5-12: January 24 2017 Storm

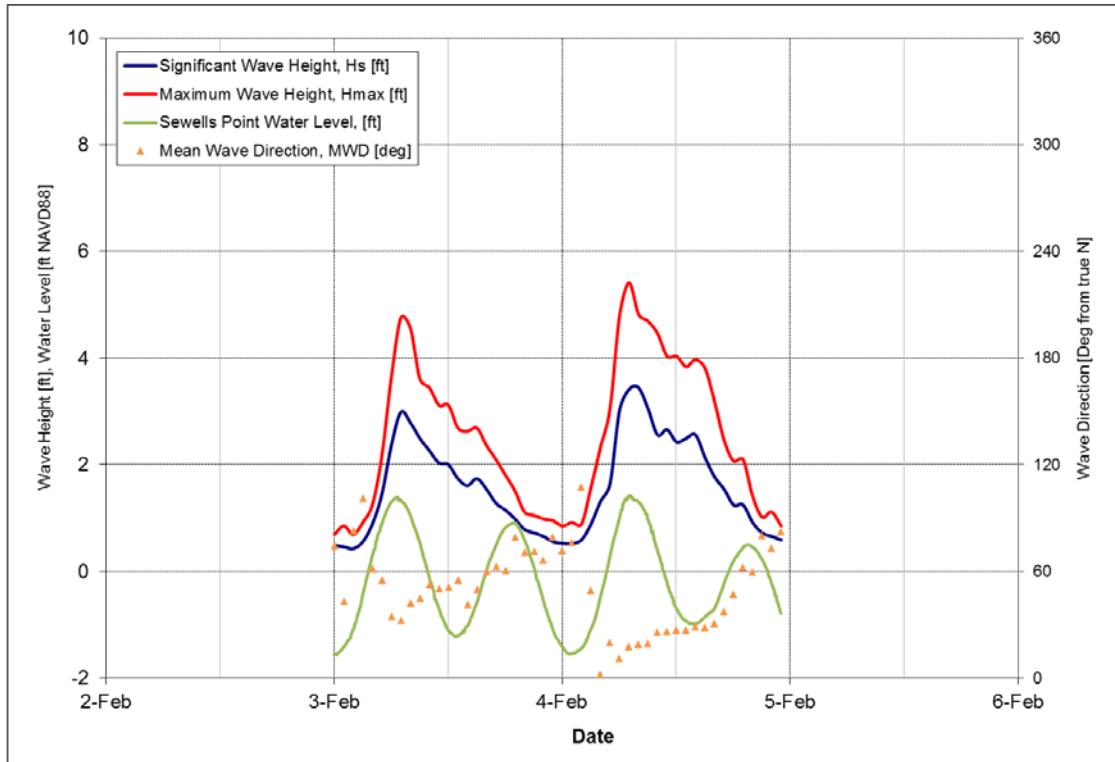


Figure 5-13: February 4 2017 Storm

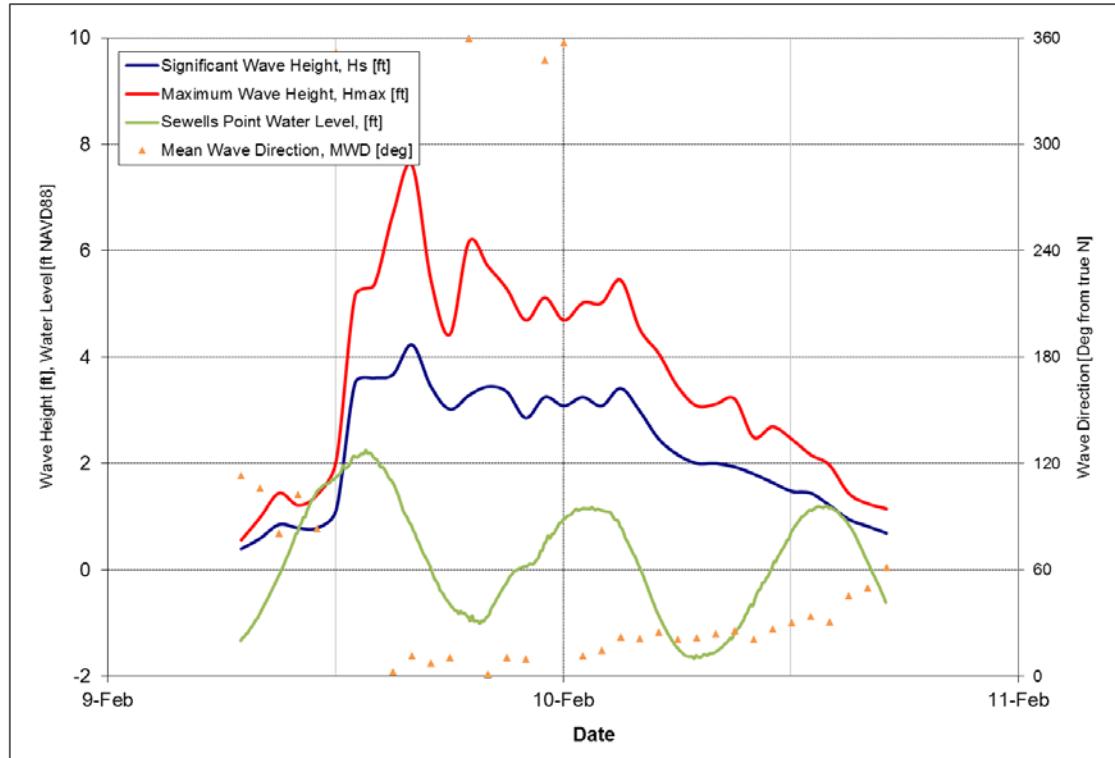


Figure 5-14: February 9 2017 Storm

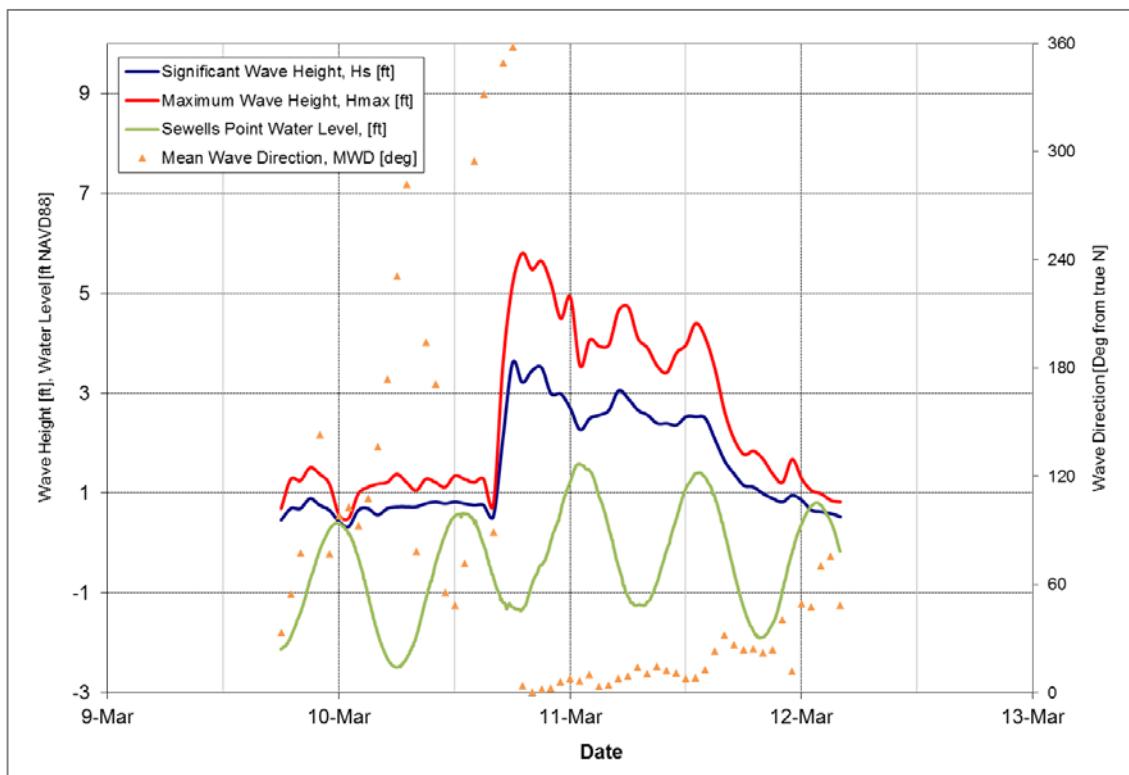


Figure 5-15: March 10, 2017 Storm

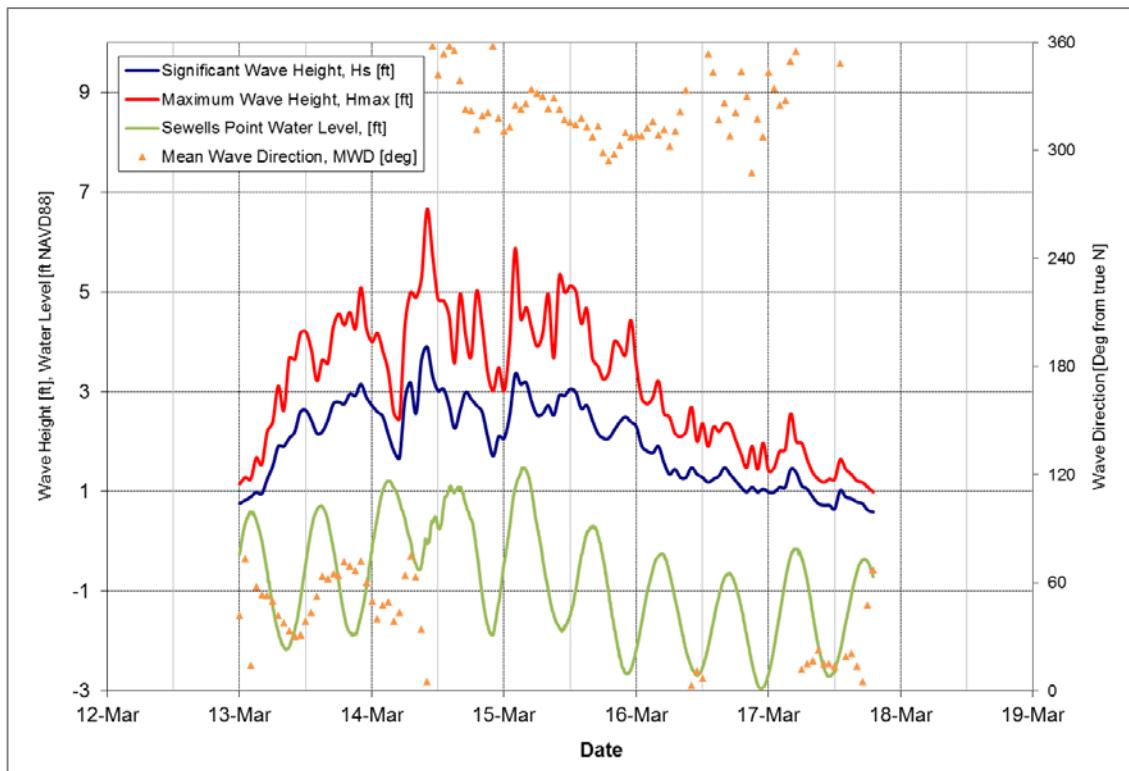


Figure 5-16: March 14, 2017 Storm

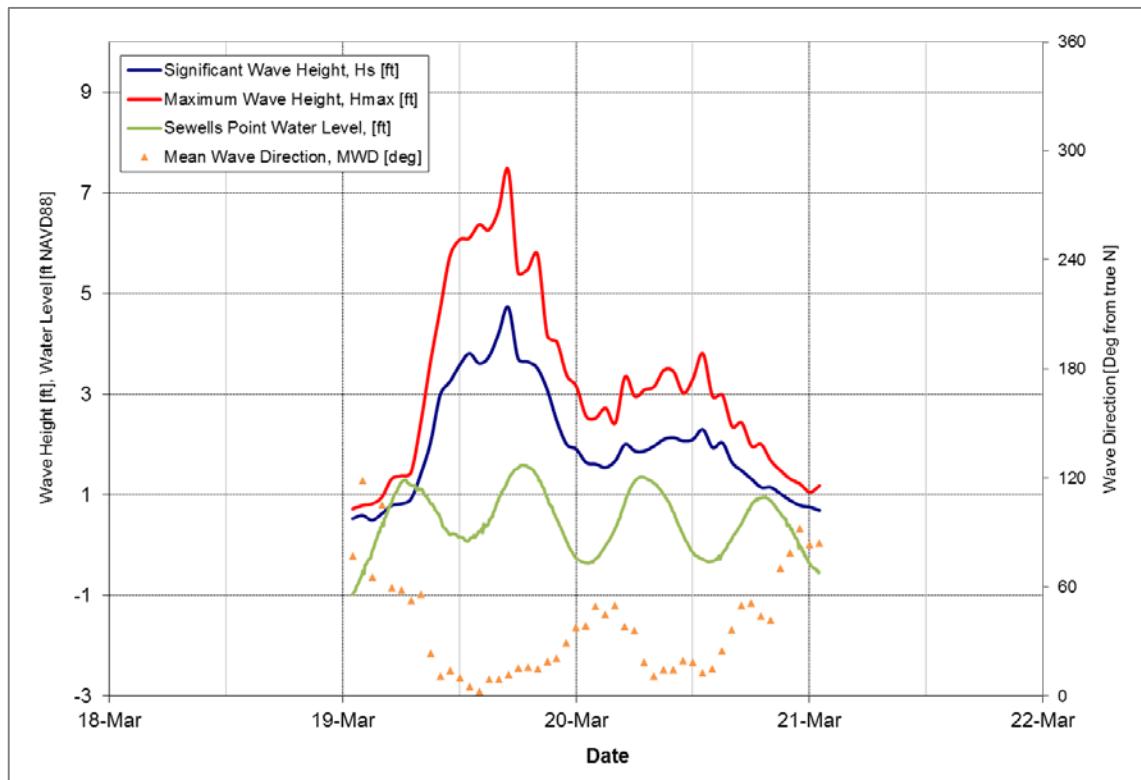


Figure 5-17: March 19, 2017 Storm

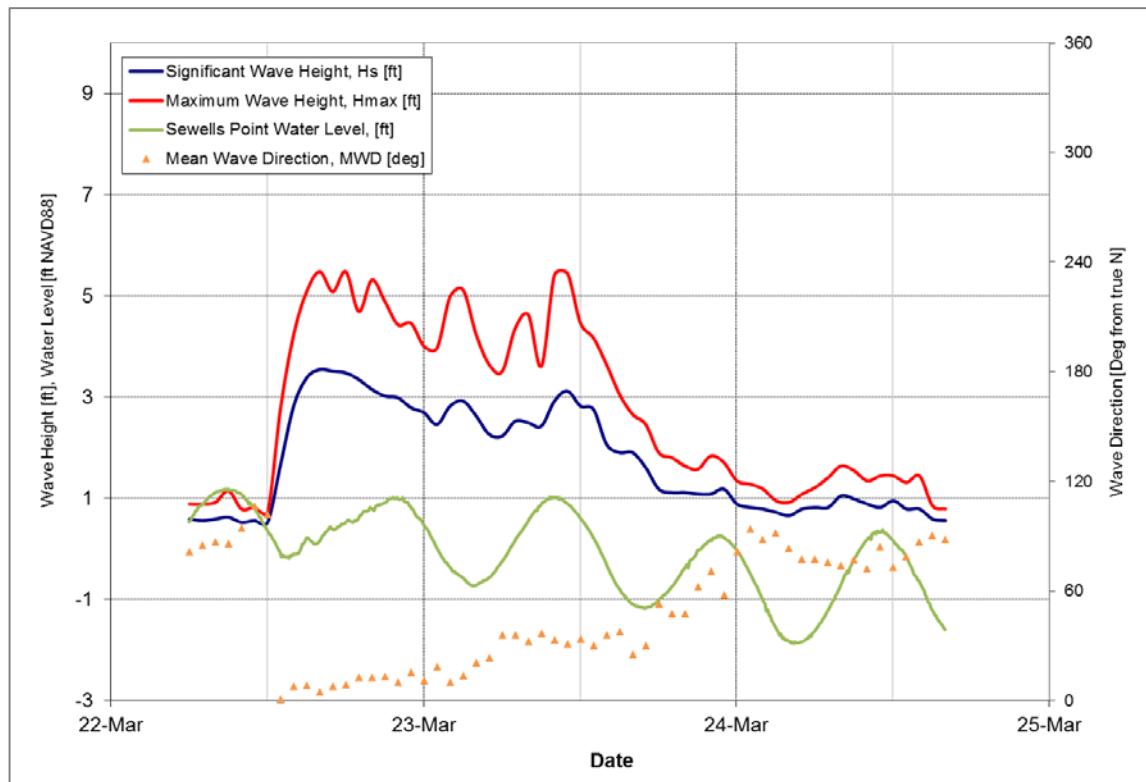


Figure 5-18: March 22, 2017 Storm

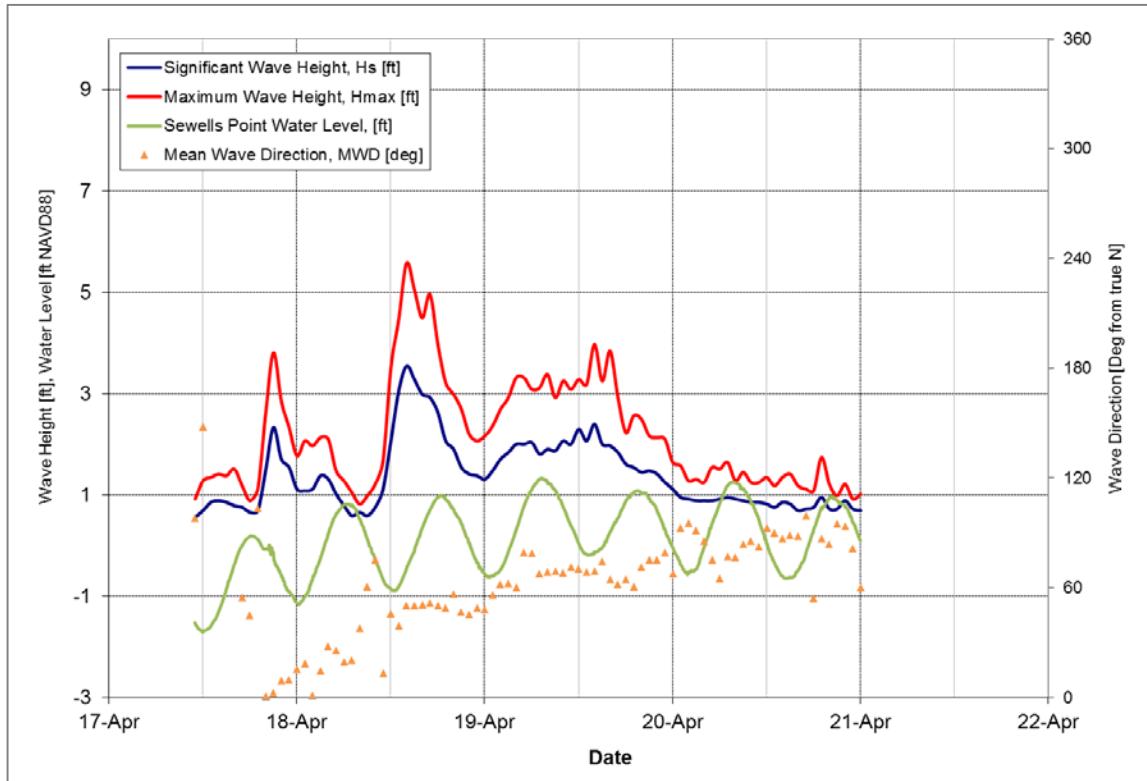


Figure 5-19: April 18, 2017 Storm

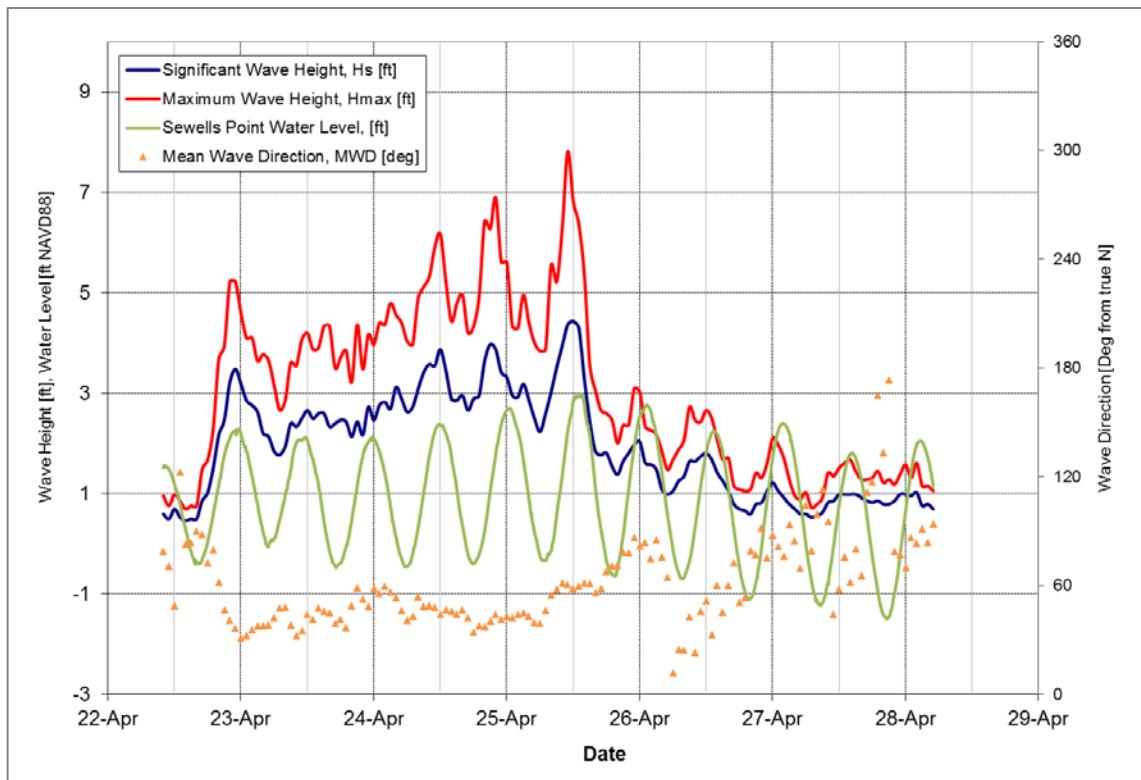


Figure 5-20: April 22, 2017 Storm

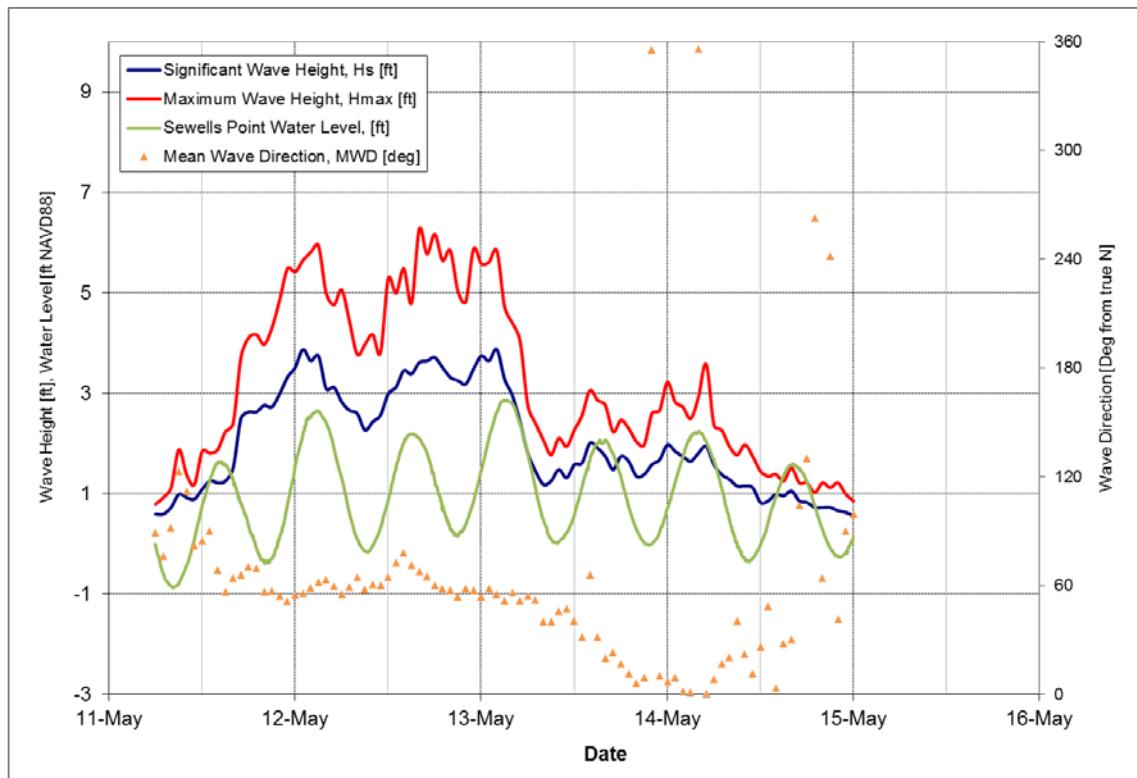


Figure 5-21: May 12, 2017 Storm

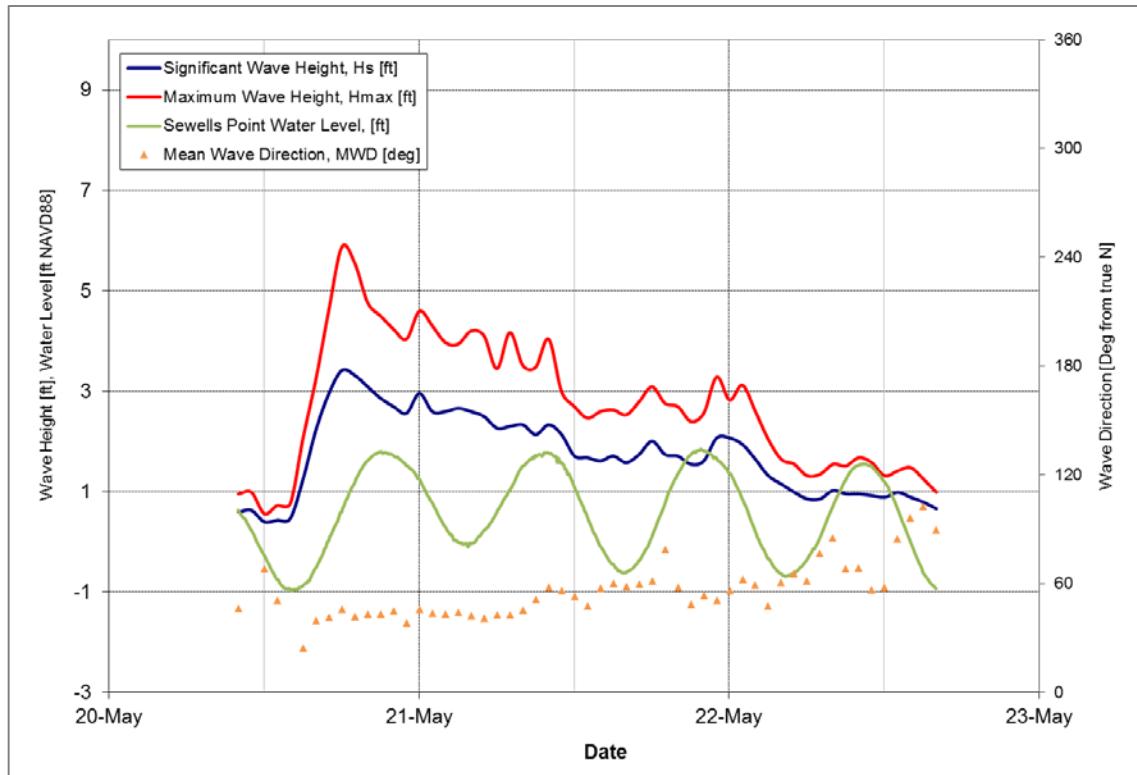
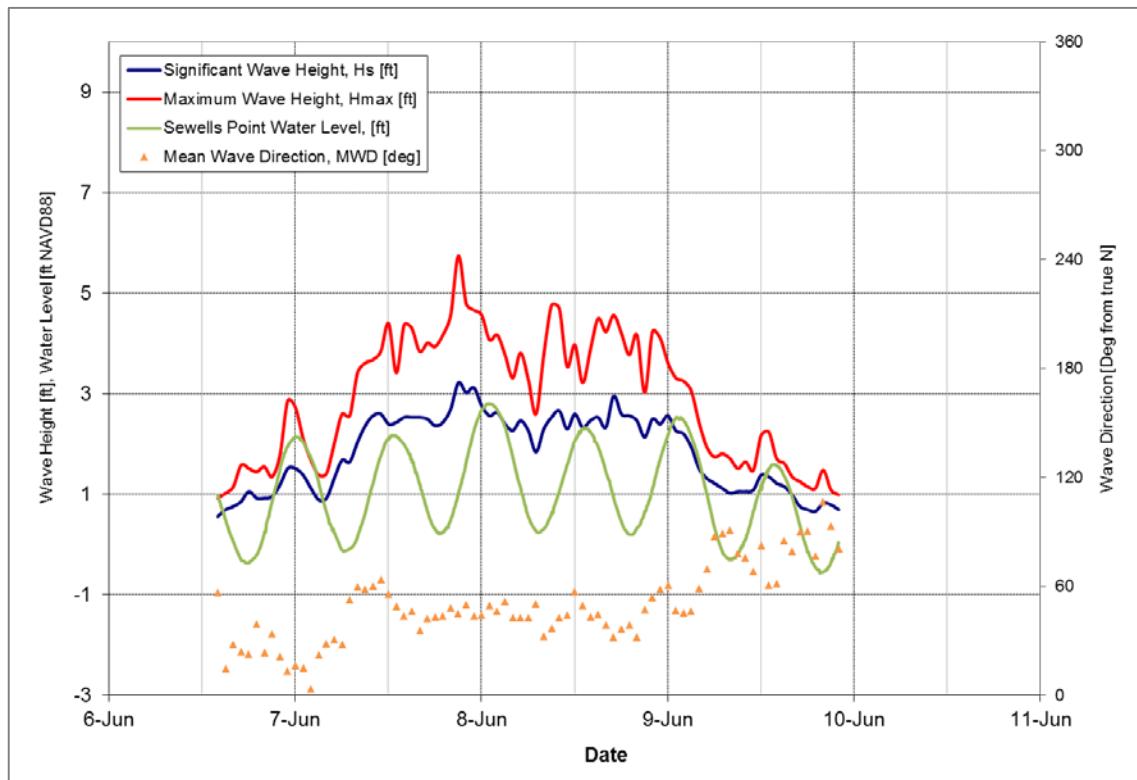


Figure 5-22: May 20, 2017 Storm



**Figure 5-23: June 7, 2017 Storm**

### 5.2.2. Engineering Activities

The Federal Willoughby and Vicinity Coastal Storm Damage Reduction Project (Federal Project) was constructed in March, April and May 2017. The Federal Project placed approximately 1.2 million cubic yards of sand from the Thimble Shoals Auxiliary Channel along most of the Ocean View shoreline. An exception is that the Federal Project did not place sand between Warwick Avenue (station 206+86) and 1<sup>st</sup> Bay Street (station 274+53).

### 5.3. General Shoreline Trends

Key statistics were calculated to describe the shoreline and volume change trends over the entire shoreline as well as for each region of the shoreline as defined in Figure 3-1. The computed statistics include average shoreline change, average volume change, and cumulative volume change (e.g. total volume of material lost or gained along a section of shoreline). A summary of the resulting statistics for the May 2016 to May 2017 comparison are presented in Table 5-2. A summary of the resulting statistics for the October 2016 to May 2017 comparison are presented in Table 5-3.

As illustrated in Table 5-2, the Ocean View shoreline has experienced overall gain at MHW during May 2016 and May 2017 with a length-weighted average change rate of 92.37 ft/yr due to the Federal Project construction. The beach and dune above 0 feet NAVD88 gained sediment at a rate of 437,869

cy/yr from May 2016 to May 2017. The beach and dune above -15 feet NAVD88 gained sediment at a rate of 984,332 cy/yr from May 2016 to May 2017.

From October 2016 to May 2017, the MHW shoreline gained on average by 94.29 feet, as shown in Table 5-3. The volumetric change over the same period showed gain above 0 feet NAVD88 and above -15 feet NAVD88 of 499,725 cy and 1,085,035 cy, respectively.

The Ocean View shoreline overall gained 1,085,035 cy above -15 feet NAVD88 between October 2016 and May 2017, and it had a net 984,332 cy gain of sand volume above -15 feet NAVD88 over the year between May 2016 and May 2017. These overall trends and the behavior of the system are better understood by looking at patterns of change on a reach-by-reach basis, as discussed in more detail in the following section.

**Table 5-2: Regional Shoreline and Volume Change Statistics (May 2016 to May 2017)**

Region	Average Shoreline Change	Average Volume Change Rate Above 0 ft NAVD88	Cumulative Volume Change Rate Above 0 ft NAVD88	Average Volume Change Rate Above -15 ft NAVD88	Cumulative Volume Change Rate Above -15 ft NAVD88
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Willoughby Spit (0+00 to 45+00)	95.86	13.26	59,838	19.88	89,710
800 Block Breakwaters (45+25 to 87+62)	138.70	18.54	84,155	39.22	178,002
West Ocean View (93+41 to 163+49)	101.11	12.92	91,376	34.26	234,503
Central Ocean View Breakwaters (169+63 to 195+63)	124.88	16.14	55,984	35.92	124,602
Central Ocean View (206+86 to 323+09)	43.88	4.39	54,898	13.53	169,239
East Ocean View (329+63 to 383+58)	127.60	16.01	91,618	32.90	188,276
OVERALL	Weighted Avg (ft/yr)	Weighted Avg (cy/ft/yr)	Total (cy/yr)	Weighted Avg (cy/ft/yr)	Total (cy/yr)
	92.37	11.59	437,869	26.34	984,332

**Table 5-3: Regional Shoreline and Volume Change Statistics (October 2016 to May 2017)**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Willoughby Spit (0+00 to 45+00)	103.72	13.87	62,569	25.14	113,452
800 Block Breakwaters (45+25 to 87+62)	150.80	20.48	92,960	44.53	202,132
West Ocean View (93+41 to 163+49)	103.02	13.57	103,215	31.34	238,328
Central Ocean View Breakwaters (169+63 to 195+63)	137.16	18.30	63,476	39.38	136,577
Central Ocean View (206+86 to 323+09)	34.35	5.46	68,351	14.69	183,750
East Ocean View (329+63 to 383+58)	135.52	19.08	109,154	36.84	210,795
OVERALL	Weighted Avg (ft)	Weighted Avg (cy/ft)	Total (cy)	Weighted Avg (cy/ft)	Total (cy)
	94.29	13.03	499,725	28.29	1,085,035

## 5.4. Regional Shoreline Trends

Regional shoreline trends are discussed below for the defined regions between Willoughby Spit and Little Creek Inlet (see Figure 3-1). A summary of the information in Table 5-2 and Table 5-3 has been created for each region of study. Figure 5-10 through Figure 5-13, following the discussion of regional shoreline trends, present the shoreline and volume change at each transect within the defined regions.

### 5.4.1. Willoughby Spit

The western end of the Willoughby Spit region has, since regular monitoring started in 2005, been a relatively stable and accreting region. The eastern end of this region contained an erosional hot spot that was studied in 2010, and that study recommended improvements to manage erosion rates. Prior to December 2012, coastal structures in this region included two offshore breakwaters, a rock terminal groin, and several timber groins. Construction of the Willoughby Spit Shoreline Improvement Project was completed by December 2013, and it included sand nourishment, the removal of the existing timber groin field, relocation of a prior existing breakwater in the 800 Block breakwater field, and addition of seven new detached breakwaters connecting the 800 Block breakwaters with the two prior existing Willoughby Spit breakwaters. A summary of average shoreline and volume change rates for the Willoughby Spit region between May 2016 and May 2017 and between October 2016 and May 2017 are presented in Table 5-4.

**Table 5-4: Average Shoreline and Volume Change Rates for Willoughby Spit**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
<b>May 2016 vs. May 2017 Comparison</b>					
Willoughby Spit (0+00 to 45+00)	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
<b>October 2016 vs. May 2017 Comparison</b>					
Willoughby Spit (0+00 to 45+00)	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)

On average, this region gained volume in the beach and dune above 0 feet NAVD88 over the seasonal comparison (October 2016 - May 2017). Willoughby Spit gained volume in the dune above 0 feet NAVD88 over the yearly comparison (May 2016 - May 2017). This region gained volume in the subaerial beach and in the submerged profile over the seasonal comparison (October 2016 - May 2017) and the yearly comparison (May 2016 - May 2017). For the yearly comparison, the MHW shoreline gained at a rate of 95.86 ft/yr while gaining volume above 0 feet and gaining volume above -15 feet NAVD88 at a rate of 59,838 cy/yr and 89,710 cy/yr, respectively. The seasonal comparison showed gain of the MHW shoreline of 103.72 feet on average and a cumulative sediment gain above 0 feet and -15 feet NAVD88 of 62,569 cy and 113,452 cy, respectively. The breakwaters that were part of the 2013 shoreline improvement project that connected to the previously existing 800 Block breakwaters have continued to provide stability to the majority of the Willoughby Spit reach as shown in Figure 5-11 and Figure 5-13.

### 5.4.2. 800 Block Breakwaters

The 800 Block Breakwaters region (Sta 45+25 to Sta 87+62) is characterized by a field of eight breakwaters. The easternmost breakwater was relocated in February 2006 along with removal of a pre-existing groin spur and toe extension. This relocated breakwater was placed further offshore to mitigate an excessive salient / tombolo formation, caused by the prior structural configuration that had impaired natural sediment transport to the west. In conjunction with the 2013 Willoughby Spit shoreline improvement project, the second easternmost breakwater in the 800 Block set was also relocated further offshore to enhance natural sediment transport in the region. A summary of average shoreline and volume change rates for the 800 Block Breakwaters region between May 2016 and May 2017 and between October 2016 and May 2017 are presented in Table 5-5.

**Table 5-5: Average Shoreline and Volume Change Rates for 800 Block Breakwaters**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
<b>May 2016 vs. May 2017 Comparison</b>					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
800 Block Breakwaters (45+25 to 87+62)	138.70	18.54	84,155	39.22	178,002
<b>October 2016 vs. May 2017 Comparison</b>					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
800 Block Breakwaters (45+25 to 87+62)	150.80	20.48	92,960	44.53	202,132

The 800 Block region gained volume over the seasonal comparison (October 2016 - May 2017) and over the yearly comparison (May 2016 - May 2017). Over the past year, there has been gain of the MHW shoreline of 138.70 ft/yr as well as an overall volume gain above 0 feet NAVD88 and overall volume gain above -15 ft NAVD88 of 84,155 cy/yr and 178,002 cy/yr, respectively. The seasonal comparison showed there was gain of the MHW shoreline of 150.80 feet and a gain of sediment volume above 0 feet NAVD88 and -15 feet NAVD88 of 92,960 cy and 202,132 cy, respectively.

### 5.4.3. West Ocean View

The West Ocean View area (Sta 93+41 to Sta 163+49), between the 800 Block and Central Ocean View breakwaters, was historically characterized by a series of timber groins. The 2013 West Ocean View Shoreline Improvement Project included the removal of all timber groins located between the Ocean View Fishing Pier and Station 141+98, the reconstruction of a rock groin at station 129+17, and 73,600 cy of sand nourishment placed in front of Sarah Constant Beach Park. A summary of average shoreline and volume change rates for the West Ocean View region between May 2016 and May 2017 and between October 2016 and May 2017 are presented in Table 5-6.

**Table 5-6: Average Shoreline and Volume Change Rates for West Ocean View**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
<b>May 2016 vs. May 2017 Comparison</b>					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
West Ocean View (93+41 to 163+49)	101.11	12.92	91,376	34.26	234,503
<b>October 2016 vs. May 2017 Comparison</b>					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
West Ocean View (93+41 to 163+49)	103.02	13.57	103,215	31.34	238,328

This region had gain over the yearly comparison (May 2016 - May 2017) with gain of the MHW shoreline at a rate of 101.11 ft/yr, and a volume gain above 0 feet NAVD88 and -15 feet NAVD88 at a rate of 91,376 cy/yr and 234,503 cy/yr respectively. The seasonal comparison (October 2016 - May 2017) showed an gain of the MHW shoreline of 103.02 feet, a gain of material above 0 feet NAVD88 of 103,215 cy and a gain of material above -15 feet NAVD88 of 238,328 cy.

#### 5.4.4. Central Ocean View Breakwaters

The Central Ocean View Breakwaters region covers the four offshore breakwaters at Central Ocean View and approximately 800 feet westward (Sta 169+63 to Sta 195+63). A summary of average shoreline and volume change rates for the Central Ocean View Breakwaters region between May 2016 and May 2017 and between October 2016 and May 2017 are presented in Table 5-7.

**Table 5-7: Average Shoreline and Volume Change Rates for Central Ocean View Breakwaters**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
<b>May 2016 vs. May 2017 Comparison</b>					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Central Ocean View Breakwaters (169+63 to 195+63)	124.88	16.14	55,984	35.92	124,602
<b>October 2016 vs. May 2017 Comparison</b>					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Central Ocean View Breakwaters (169+63 to 195+63)	137.16	18.30	63,476	39.38	136,577

This region was on average gain over the yearly comparison (May 2016 - May 2017) and seasonal comparison (October 2016 – May 2017) above -15 feet NAVD88. The yearly comparison showed overall gain of the MHW shoreline at a rate of 124.88 ft/yr and an overall volume gain above 0 feet NAVD88 and an overall volume gain above -15 feet NAVD88 at a rate of 55,984 cy/yr and 124,602 cy/yr. The seasonal comparison showed gain of the MHW shoreline of 137.16 feet and a gain of material above 0 feet NAVD88 and -15 feet NAVD88 of 63,476 cy and 136,577 cy respectively.

### 5.4.5. Central Ocean View

Central Ocean View (Sta 206+86 to Sta 323+09) is historically a stable region with slight accretion despite the absence of engineering interventions (e.g. beach fill or structures). A summary of average shoreline and volume change rates for the Central Ocean View region between May 2016 and May 2017 and between October 2016 and May 2017 are presented in Table 5-8.

**Table 5-8: Average Shoreline and Volume Change Rates for Central Ocean View**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
<b>May 2016 vs. May 2017 Comparison</b>					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Central Ocean View (206+86 to 323+09)	43.88	4.39	54,898	13.53	169,239
<b>October 2016 vs. May 2017 Comparison</b>					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Central Ocean View (206+86 to 323+09)	34.35	5.46	68,351	14.69	183,750

As shown in Table 5-8, the yearly comparison (May 2016 - May 2017) for the Central Ocean View region showed volume gain above 0 feet NAVD88. The seasonal comparison (October 2016 - May 2017) indicated volume gain. The volume gain over the current survey above 0 feet NAVD88 and -15 feet NAVD88 was 68,351 cy and 183,750 cy respectively. The average yearly shoreline gain rate was 43.88 ft/yr with an average of 34.35 ft of gain occurring over the reach during the current survey period.

The Central Ocean View shoreline and volume change rates shown in Figure 5-10 through Figure 5-13 are significantly less positive in magnitude than the adjacent reaches of Ocean View. This is due to the fact that the Federal Project did not place nourishment sand directly in the Central Ocean View region – partly due to the stable nature of that shoreline – and it does not imply any negative performance of the beach in Central Ocean View during the monitoring period.

### 5.4.6. East Ocean View

The East Ocean View region (Sta 329+63 to Sta 383+58) is characterized by 15 breakwaters of which the 5 westernmost were built in August of 2009. Prior to the breakwater construction, a beach renourishment project took place in March 2009, adding approximately 196,000 cy of material to the beach. Table 5-9 summarizes average shoreline and volume change rates for the East Ocean View region between May 2016 and May 2017 and between October 2016 and May 2017.

**Table 5-9: Average Shoreline and Volume Change Rates for East Ocean View**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88	Cumulative Volume Change Above 0 ft NAVD88	Average Volume Change Above -15 ft NAVD88	Cumulative Volume Change Above -15 ft NAVD88
<b>May 2016 vs. May 2017 Comparison</b>					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
East Ocean View (329+63 to 383+58)	127.60	16.01	91,618	32.90	188,276
<b>October 2016 vs. May 2017 Comparison</b>					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
East Ocean View (329+63 to 383+58)	135.52	19.08	109,154	36.84	210,795

This region is normally characterized by a consistent erosional pattern due to sediment movement along the shoreline from east to west with no external sand source due to the terminal groin at Little Creek Inlet. East Ocean View experienced volume gain over the yearly (May 2016 - May 2017) comparison and over the seasonal (October 2016 – May 2017) comparison. The MHW shoreline yearly comparison showed an overall gain of the MHW shoreline at a rate of 127.60 ft/yr and an overall volume gain above 0 feet NAVD88 and -15 feet NAVD88 at a rate of 91,618 cy/yr and 188,276 cy/yr respectively. The seasonal comparison showed a gain of the MHW shoreline of 135.52 feet and a gain of material above 0 feet NAVD88 and -15 feet NAVD88 of 109,154 cy and 210,795 cy respectively.

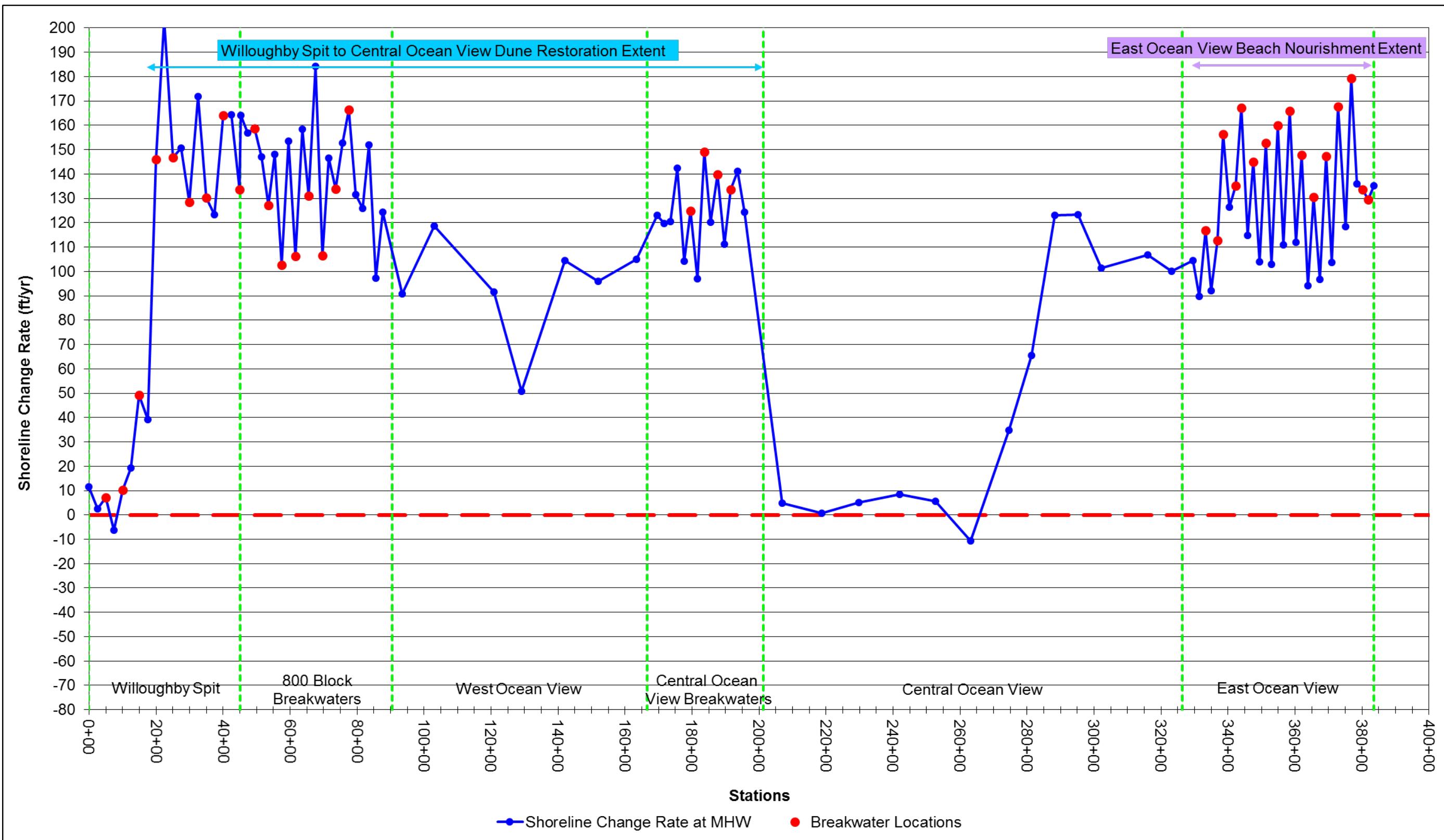


Figure 5-24: Shoreline Change Rate (ft/yr) at Mean High Water (+0.98 ft NAVD88) for May 2016 to May 2017 (Note: Positive = Accretion, Negative = Erosion)

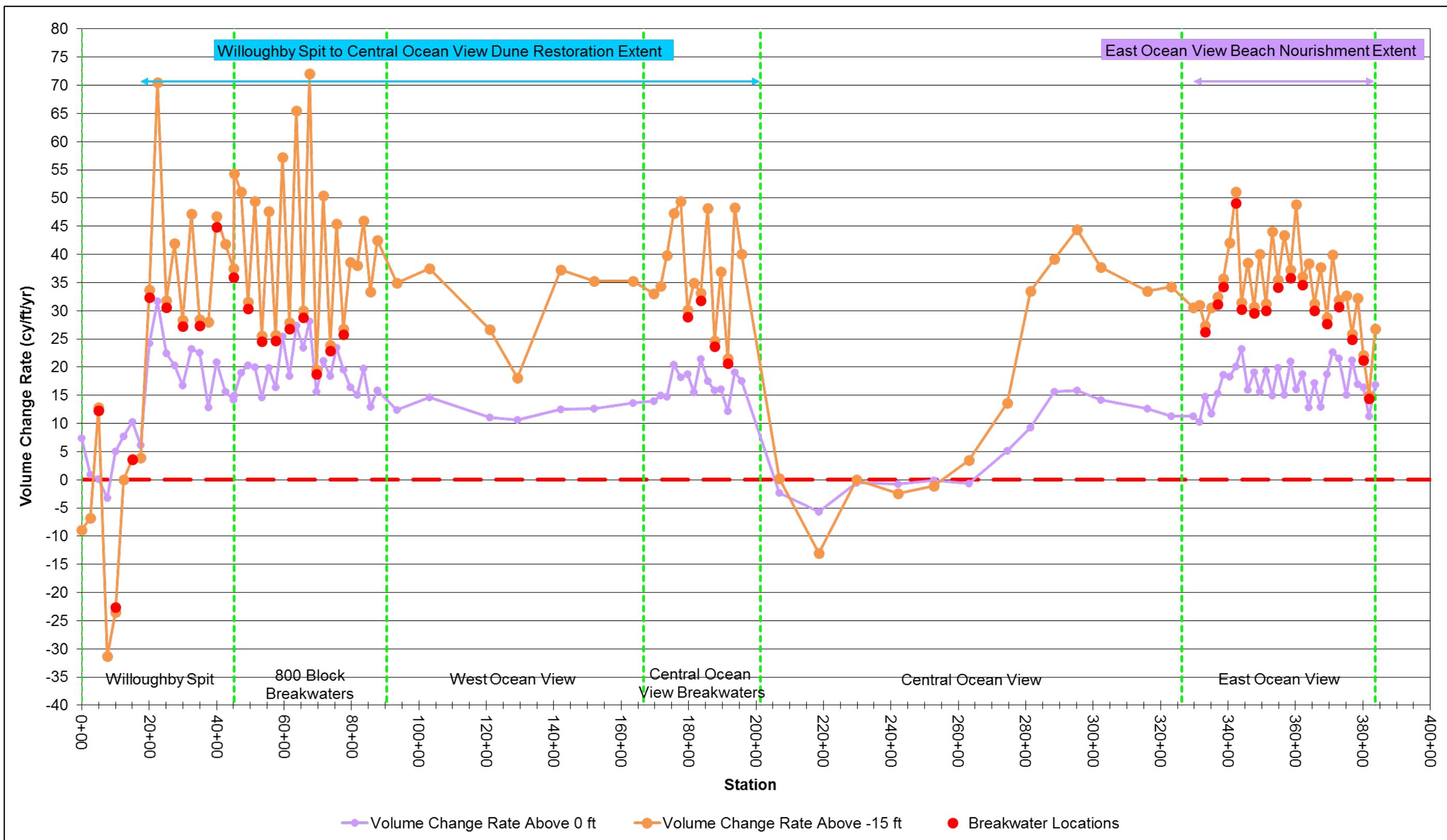


Figure 5-25: Volume Change Rate Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft/yr) for May 2016 to May 2017 (Note: Positive = Accretion, Negative = Erosion)

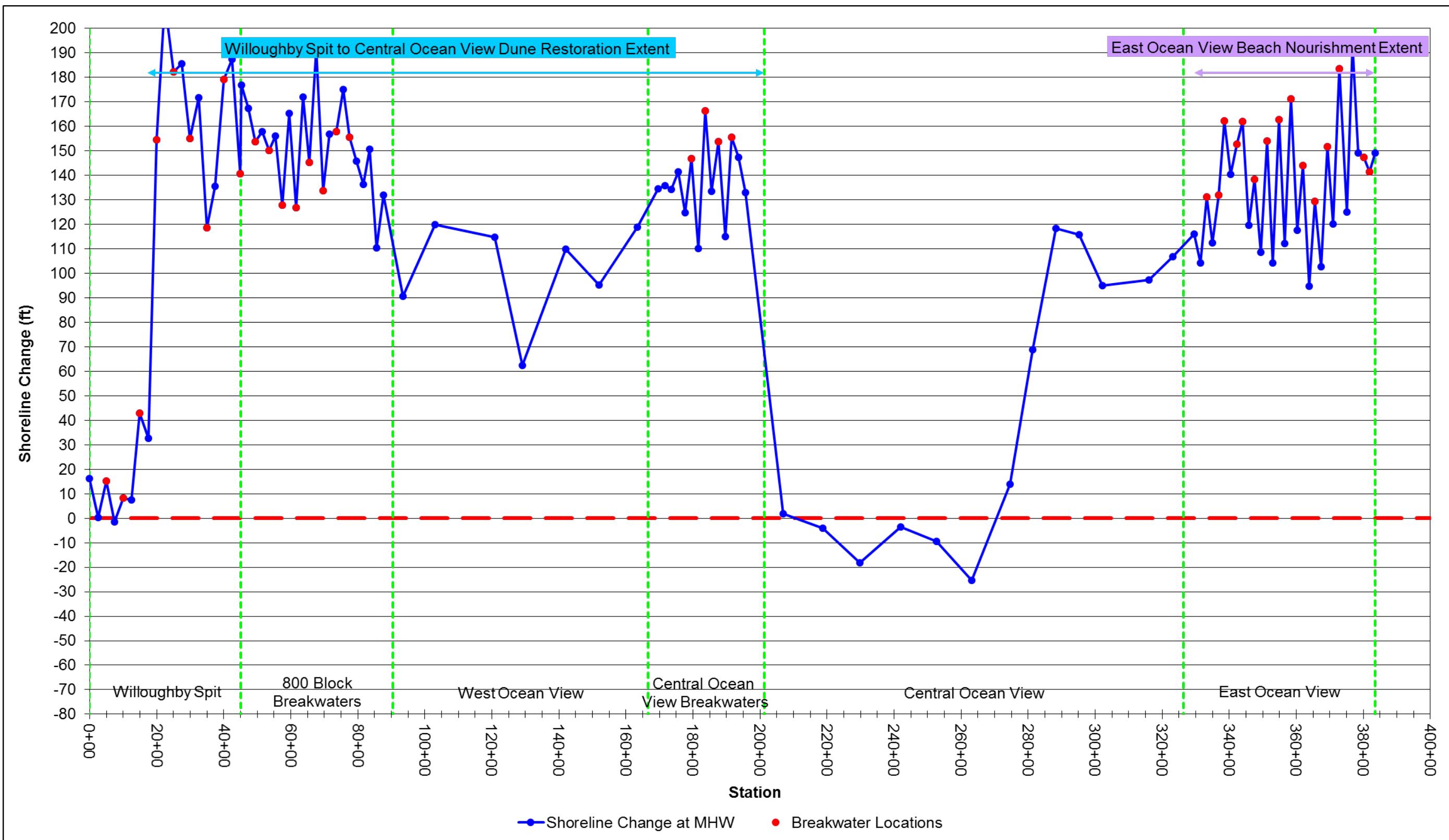


Figure 5-26: Shoreline Change (ft) at Mean High Water (+0.98 ft NAVD88) for October 2016 to May 2017 (Note: Positive = Accretion, Negative = Erosion)

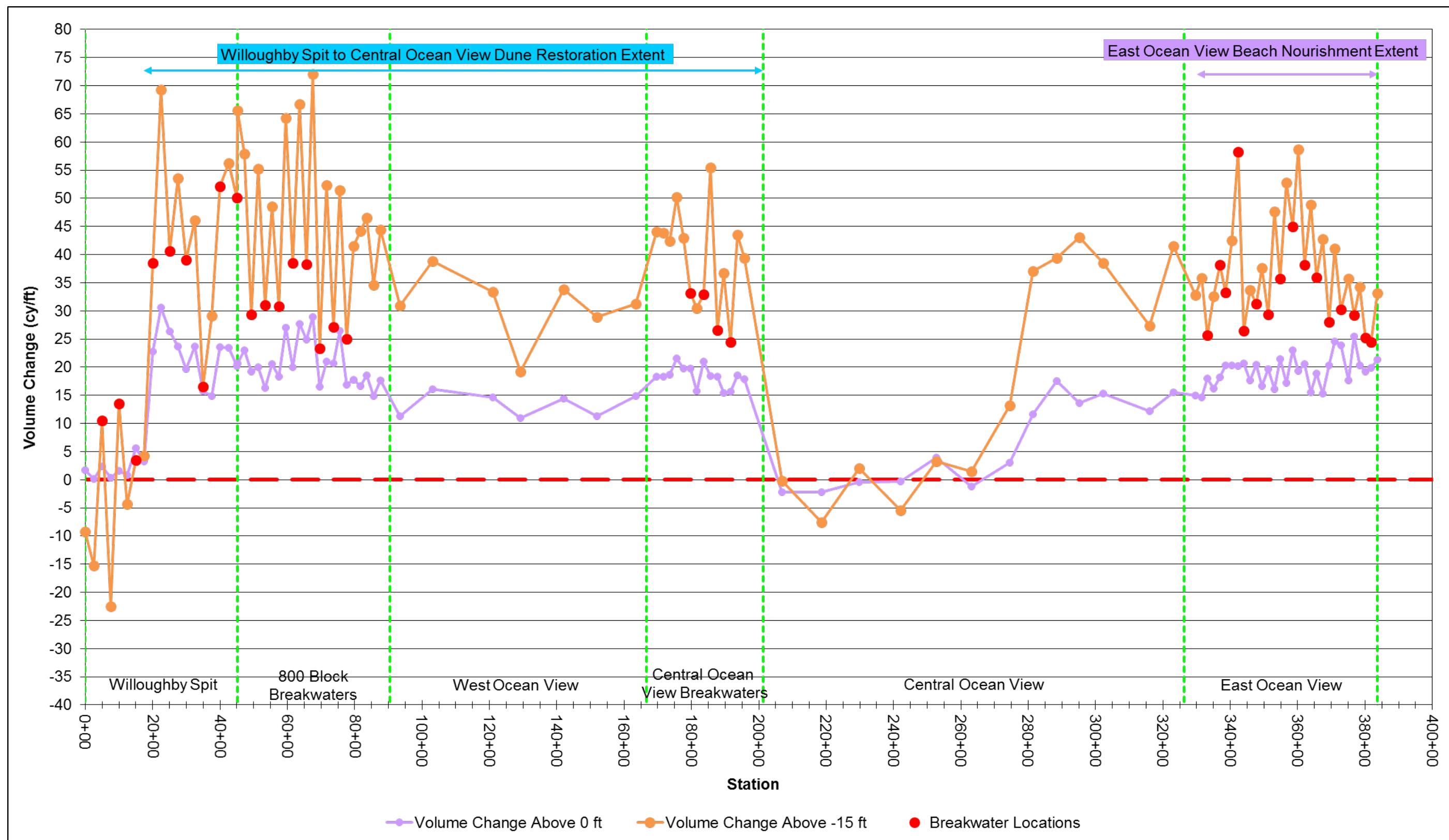


Figure 5-27: Volume Change Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft) for October 2016 to May 2017 (Note: Positive = Accretion, Negative = Erosion)

## 6. Federal Coastal Storm Damage Reduction Project

### 6.1. Initial Construction of the Federal Project

In section 5, the periodic surveying evaluation was discussed in which the federal May 2017 coastal storm damage reduction project was included. In this section, the periodic surveying evaluation was discussed without the May 2017 federal project.

### 6.2. Shoreline and Volume Changes from October 2016 to Federal Project Pre-Construction

The Federal Project pre-construction survey data from February 2017, provided by Great Lakes Dredge & Dock (GLDD, with permission of USACE), was used to evaluate shoreline change and volumetric change since October 2016. The Federal Project survey transects were not located at the same positions as the City's monitoring survey transects. Thus, this evaluation utilized selected monitoring survey transects which had a Federal Project GLDD transect sufficiently close to allow meaningful comparisons. A total of 23 transects were selected as presented in Table 6-1 and as illustrated in Figure 6-1, and plots of the selected transects are illustrated in Appendix E.

**Table 6-1: Transects for Comparison of February 2017 Survey with October 2016 Survey**

Transect		Transect	
GLDD	Geodynamics	GLDD	Geodynamics
365+00	17+50	210+00	171+63
360+00	22+50	200+00	181+63
350+00	32+50	109+00	274+53
340+00	42+50	100+00	281+40
320+00	59+62	90+00	295+27
310+00	69+62	80+00	302+24
300+00	79+62	65+00	315+96
260+00	120+93	60+00	323+09
250+00	129+17	50+00	333+23
240+00	141+98	40+00	344+05
230+00	152+01	20+00	363+83
220+00	163+49	-	-

The average shoreline change and average volume change were calculated at each pair of transects, and the resulting statistics for the October 2016 to February 2017 comparison are presented in Table 6-2. From October 2016 to February 2017, the MHW shoreline gained on average by 0.27 feet. The linear volumetric change over the same period showed gain above 0 feet NAVD88 and above -15 feet NAVD88 of 1.98 cy/ft and 6.81 cy/ft, respectively. This was the behavior of the beach and nearshore system in the months leading up to construction of the Federal Project.

**Table 6-2: Regional Shoreline and Volume Change Statistics (October 2016 to February 2017)**

Region	Average Shoreline Change	Average Volume Change Above 0 ft NAVD88		Average Volume Change Above -15 ft NAVD88	
	(ft)	(cy/ft)		(cy/ft)	
Willoughby Spit (0+00 to 45+00)	15.73	4.00		17.49	
800 Block Breakwaters (45+25 to 87+62)	12.94	2.38		6.56	
West Ocean View (93+41 to 163+49)	-0.50	0.05		0.02	
Central Ocean View Breakwaters (169+63 to 195+63)	-3.81	-1.65		-4.02	
Central Ocean View (206+86 to 323+09)	-8.07	3.46		10.34	
East Ocean View (329+63 to 383+58)	-0.24	1.58		6.45	
OVERALL	Weighted Avg (ft)	Weighted Avg (cy/ft)		Weighted Avg (cy/ft)	
	0.27	1.98		6.81	



**Figure 6-1: Transects for Comparison of February 2017 Survey with October 2016 Survey**

## 7. Summary

Comprehensive periodic surveying of the entire Ocean View shoreline began with an initial survey in September 2005. The most recent survey was completed in May 2017, immediately following the initial construction of the Federal Project. The beach and bathymetric surveys performed by Geodynamics utilized baseline and transect positions established in September 2005 which are used for all periodic surveys. For this periodic evaluation, the May 2017 survey was compared with both the prior year and prior six months' surveys (May 2017 compared to May 2016 and October 2016, respectively) and to the February 2017 pre-construction survey of the Federal Project. The surveys were used to compute shoreline change at MHW and volume change above 0 feet NAVD88 and above -15 feet NAVD88.

Key statistics were computed for defined regions along Ocean View and the entire shoreline for the time period between the May 2016 and May 2017 surveys and between the October 2016 and May 2017 surveys.

Comparison	Parameter	Quantity
May 2016 vs. May 2017	Average Shoreline Change Rate at MHW (+0.98 ft NAVD88)	92.37 ft/yr
	Cumulative Volume Change Rate Above 0 ft NAVD88	437,869 cy/yr
	Cumulative Volume Change Rate Above -15 ft NAVD88	984,332 cy/yr
October 2016 vs. May 2017	Average Shoreline Change at MHW (+0.98 ft NAVD88)	94.29 ft
	Cumulative Volume Change Above 0 ft NAVD88	499,725 cy
	Cumulative Volume Change Above -15 ft NAVD88	1,085,035 cy

The average shoreline change rate for the entire shoreline at MHW between the May 2016 and May 2017 surveys was 92.37 ft/yr, and the cumulative volume changes above 0 feet NAVD88 and -15 feet NAVD88 were approximately 437,869 cy/yr and 984,332 cy/yr, respectively.

The average shoreline change rate for the entire shoreline at MHW between the October 2016 and May 2017 surveys was 94.29 ft/yr, and the cumulative volume changes above 0 feet NAVD88 and -15 feet NAVD88 were approximately 499,725 cy/yr and 1,085,035 cy/yr, respectively.

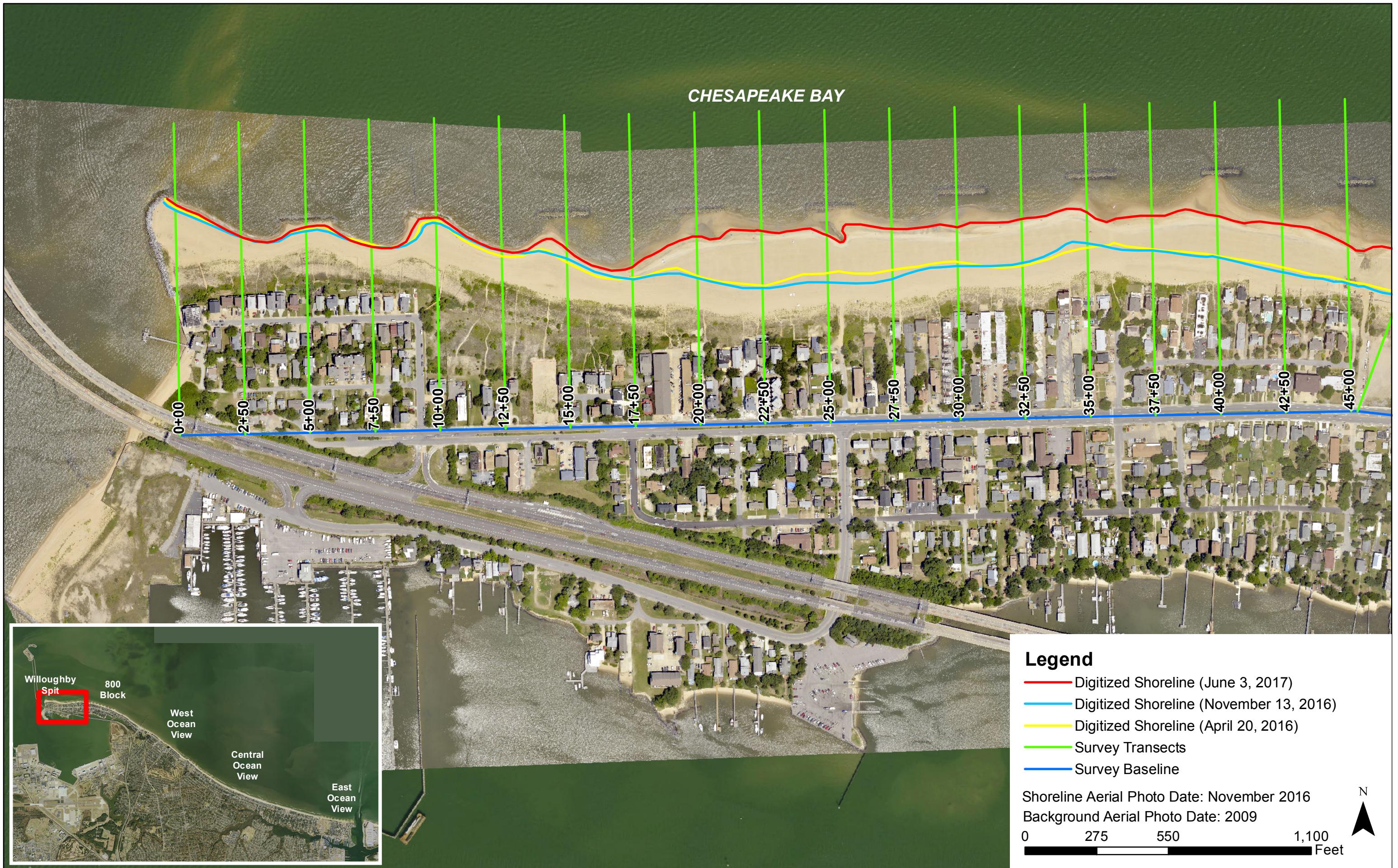
All of the reaches in the monitoring area experienced volume gain and shoreline advancement during the prior year and prior six month intervals, due to the placement of 1.2 million cubic yards by the USACE contractor in the initial construction of the Federal Project. Comparing the four months of time between the October 2016 survey by Geodynamics and the February 2017 pre-construction survey by the USACE contractor, it is observed that:

- the Willoughby Spit, 800 Block Breakwaters, Central Ocean View and East Ocean View reaches gained volume above 0 ft NAVD88 and above -15 ft NAVD88;
- the West Ocean View reach was stable in volume with a very minor shoreline retreat;
- the Central Ocean View Breakwaters reach lost volume and its shoreline retreated approximately 4 feet;

- the Willoughby Spit and 800 Block Breakwaters experienced with 13 to 16 feet in shoreline advance, while the other reaches experienced minor to moderate shoreline retreat, with the greatest retreat of approximately 8 feet occurring in Central Ocean View.

This is the twenty-fourth periodic survey report completed to date, and the twenty-fourth evaluation of a consistent survey period utilizing beach and bathymetric surveys. As noted, there are inevitable margins of error associated with the survey data that may reduce the accuracy of volumetric change analyses. Therefore, it is essential to thoroughly review the beach and bathymetric profiles using various analytical techniques and general engineering judgment to assure that results are not falsely interpreted. Comparison of surveys taken at the same season of the year (i.e. May 2016 to May 2017) mitigates seasonal variation of profiles in volumetric change analyses. Consecutive spring-fall or fall-spring survey comparisons are useful to assess the direct impact of extreme events which may occur during the six month period between surveys.

Future periodic survey evaluations will continue to improve on analysis techniques and will track changes in and the condition of the Federal Project, to assist the City to manage these beaches and coordinate with USACE regarding Federal Project maintenance.

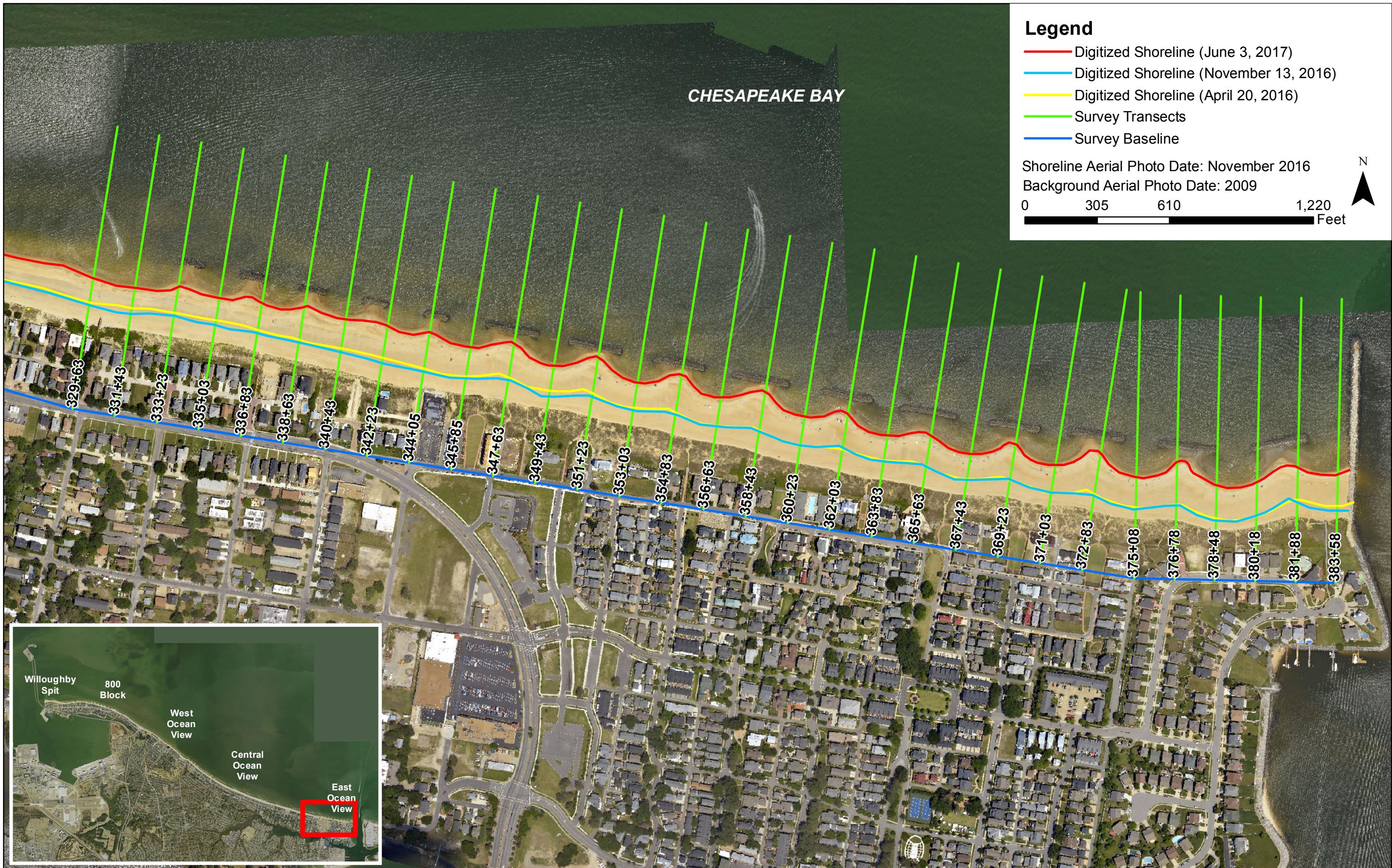


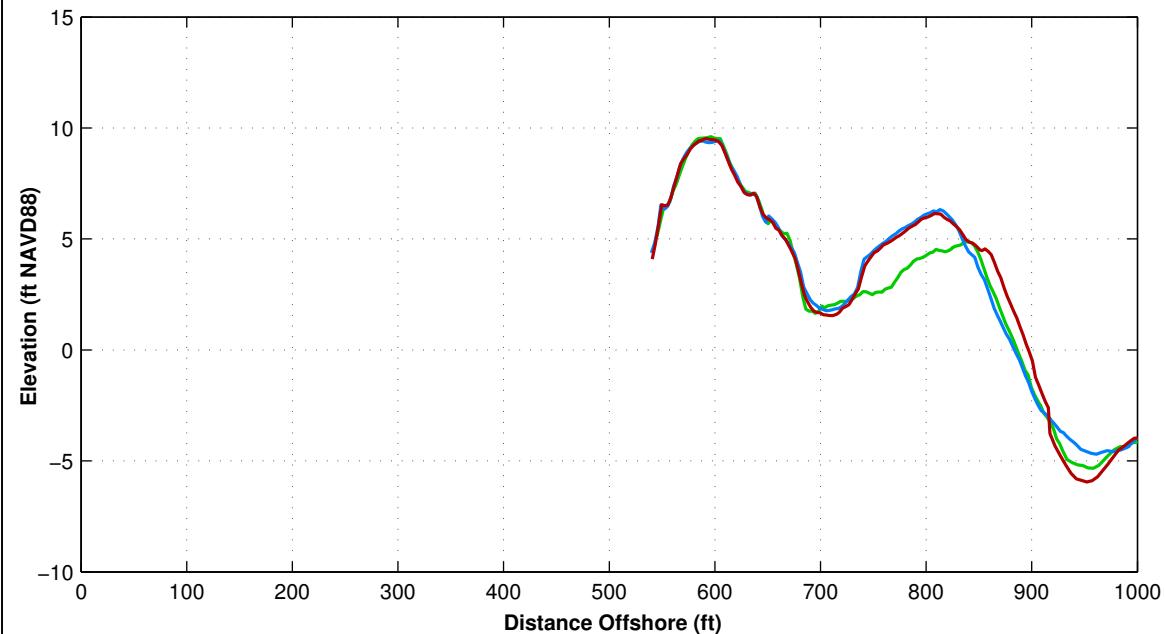
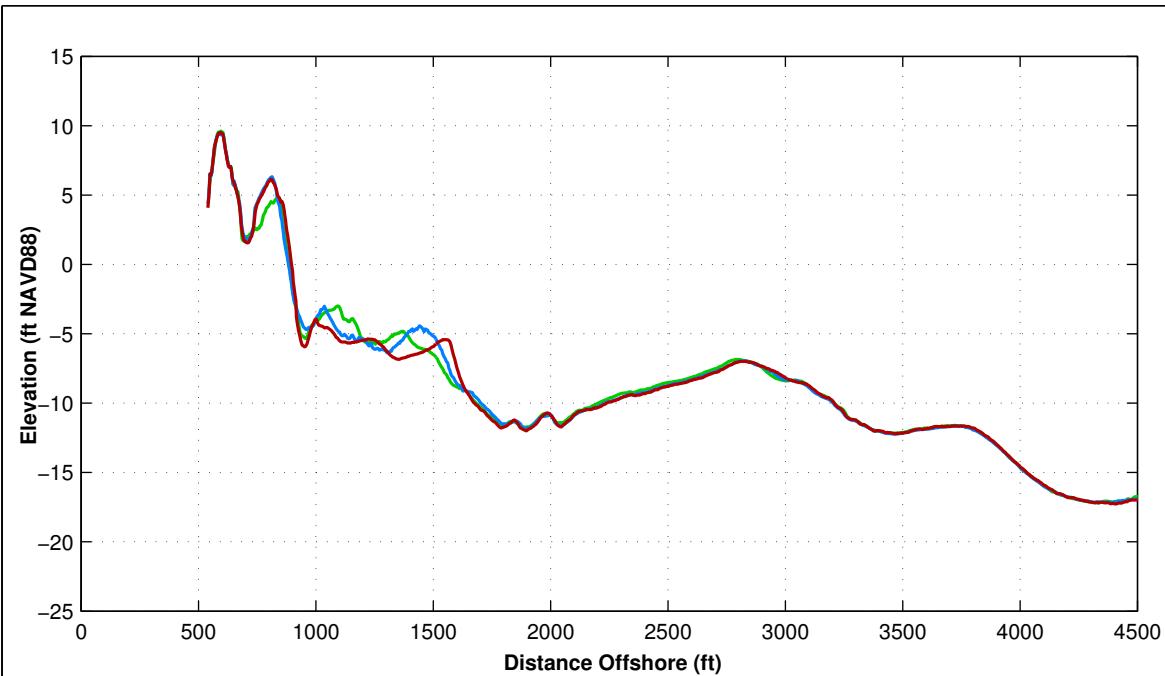












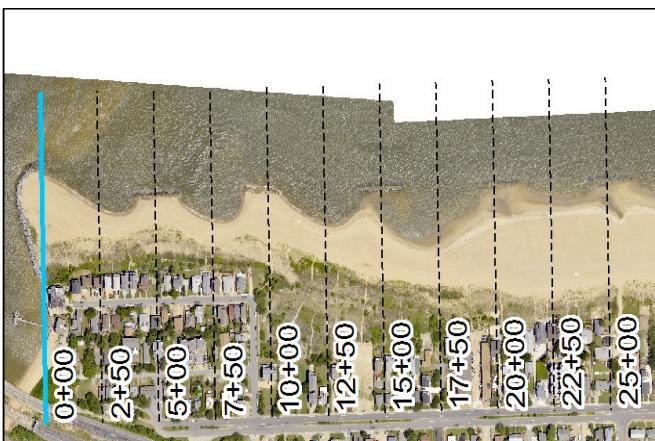
Survey Transect 0+00	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	12.02 ft/yr	16.19 ft
Volume Change Above -15 ft NAVD88	-8.85 cy/ft/yr	-9.27 cy/ft
Volume Change Above 0 ft NAVD88	7.37 cy/ft/yr	1.73 cy/ft

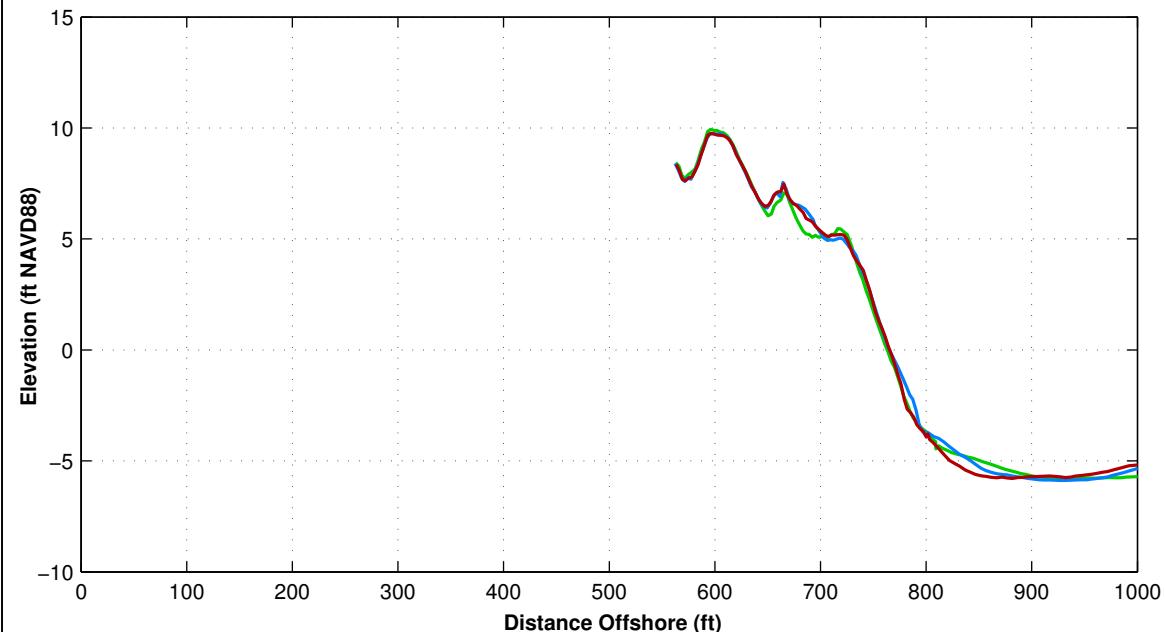
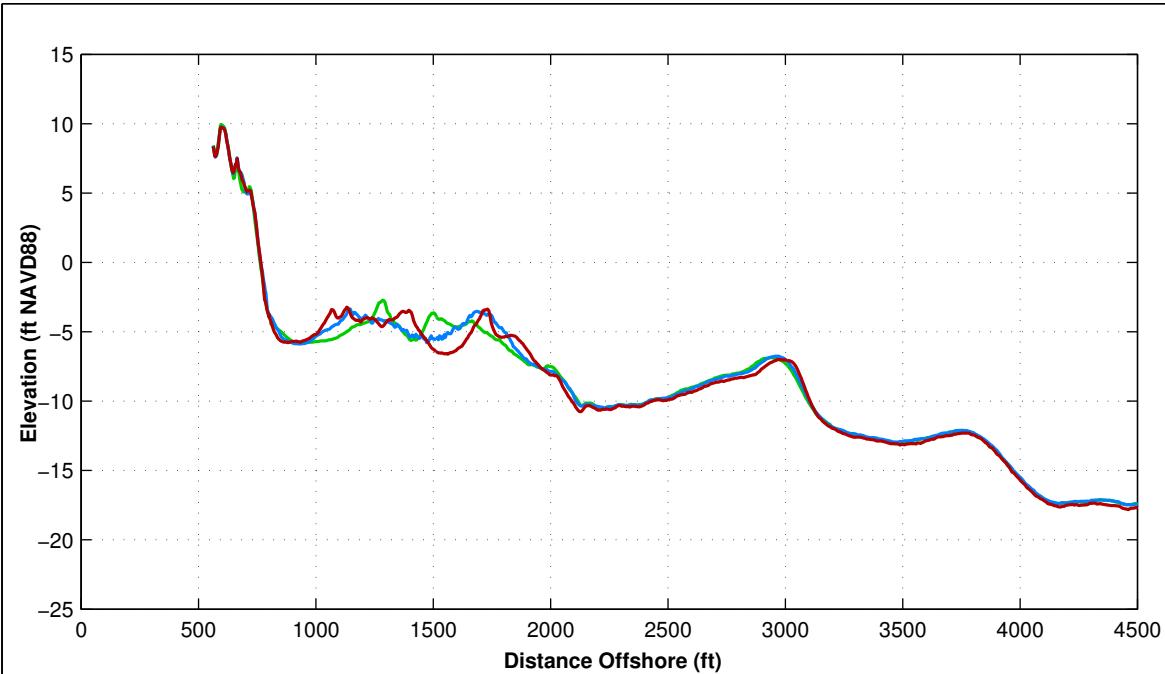
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





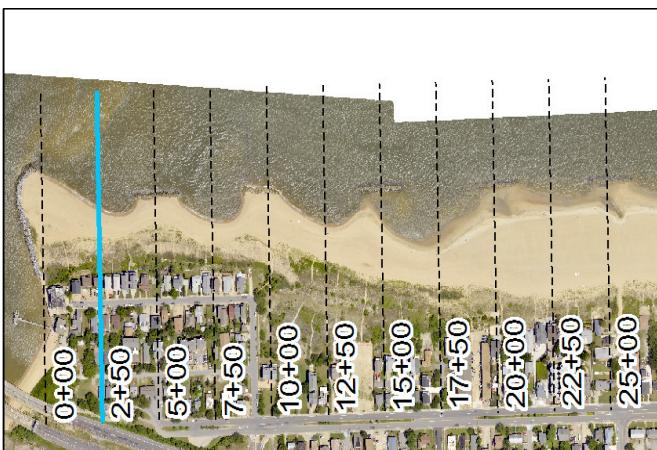
Survey Transect 2+50	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	2.61 ft/yr	0.42 ft
Volume Change Above -15 ft NAVD88	-6.84 cy/ft/yr	-15.29 cy/ft
Volume Change Above 0 ft NAVD88	0.92 cy/ft/yr	0.08 cy/ft

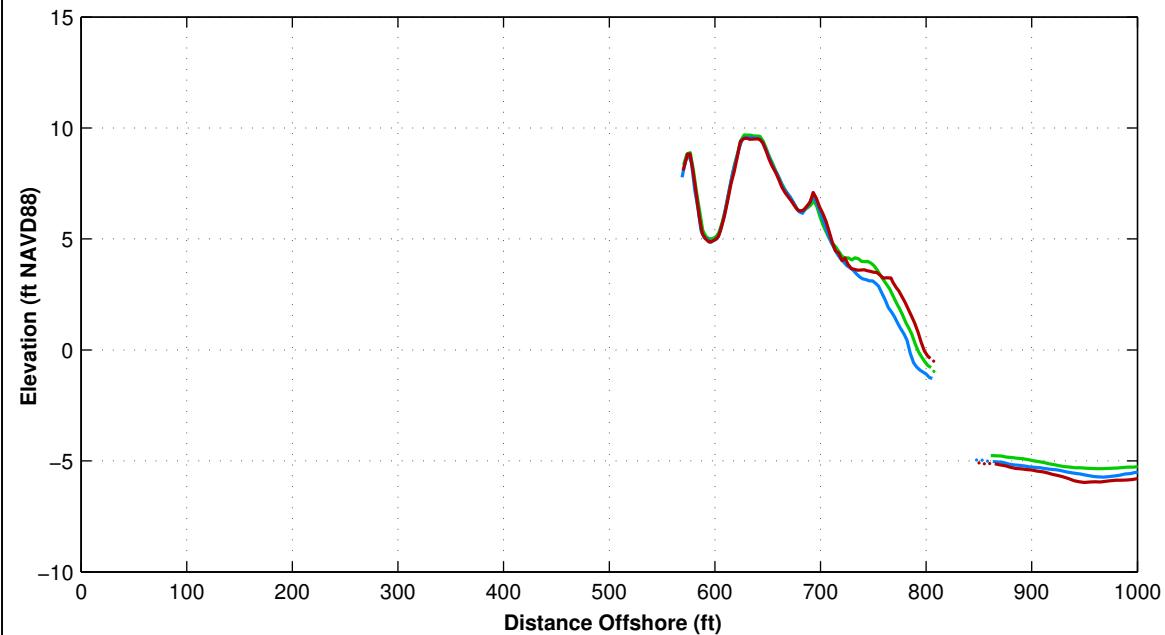
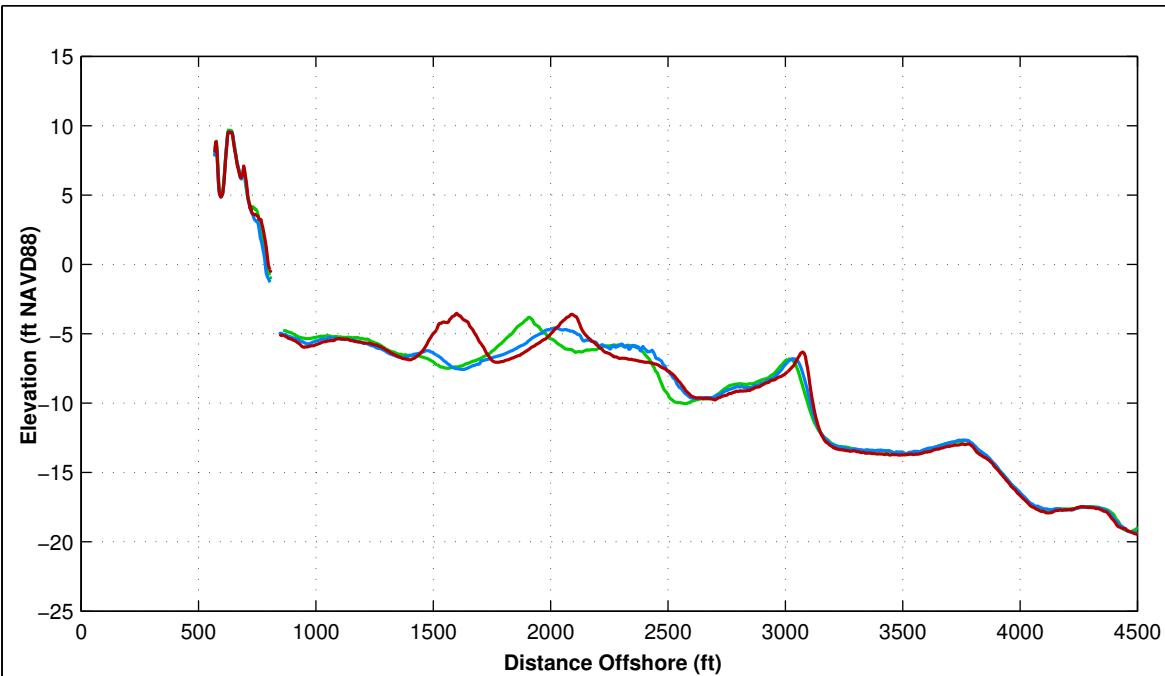
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

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2. Sections Are Viewed Toward Decreasing Stationing.
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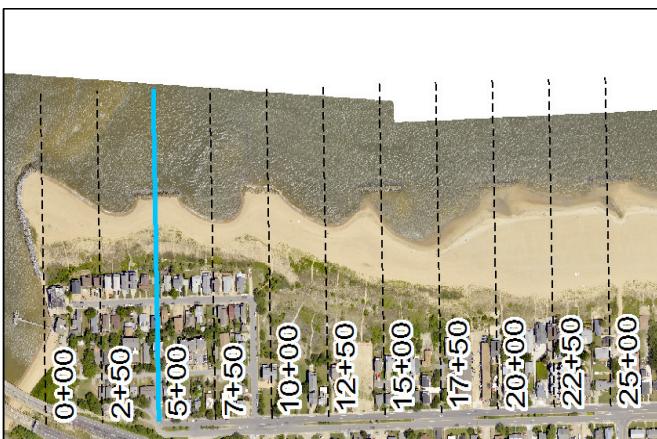
Survey Transect 5+00	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	7.40 ft/yr	15.24 ft
Volume Change Above -15 ft NAVD88	12.79 cy/ft/yr	10.53 cy/ft
Volume Change Above 0 ft NAVD88	0.19 cy/ft/yr	2.33 cy/ft

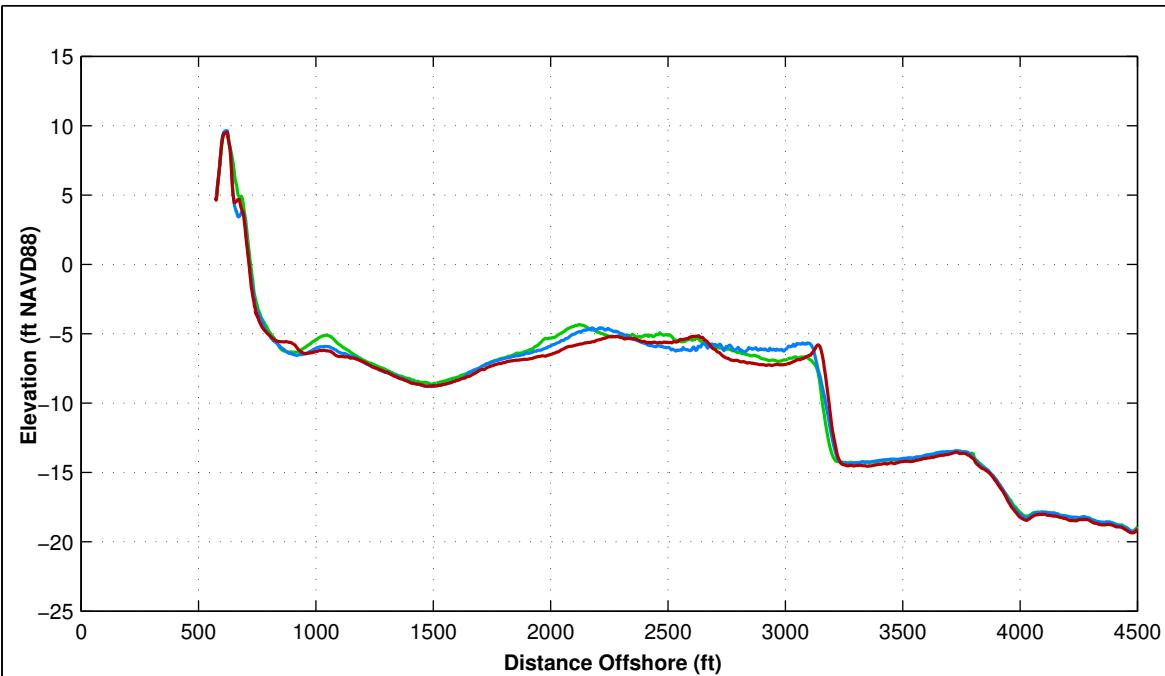
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

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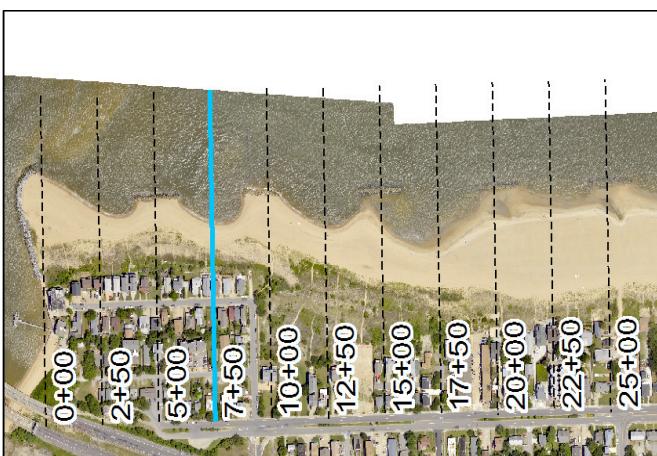
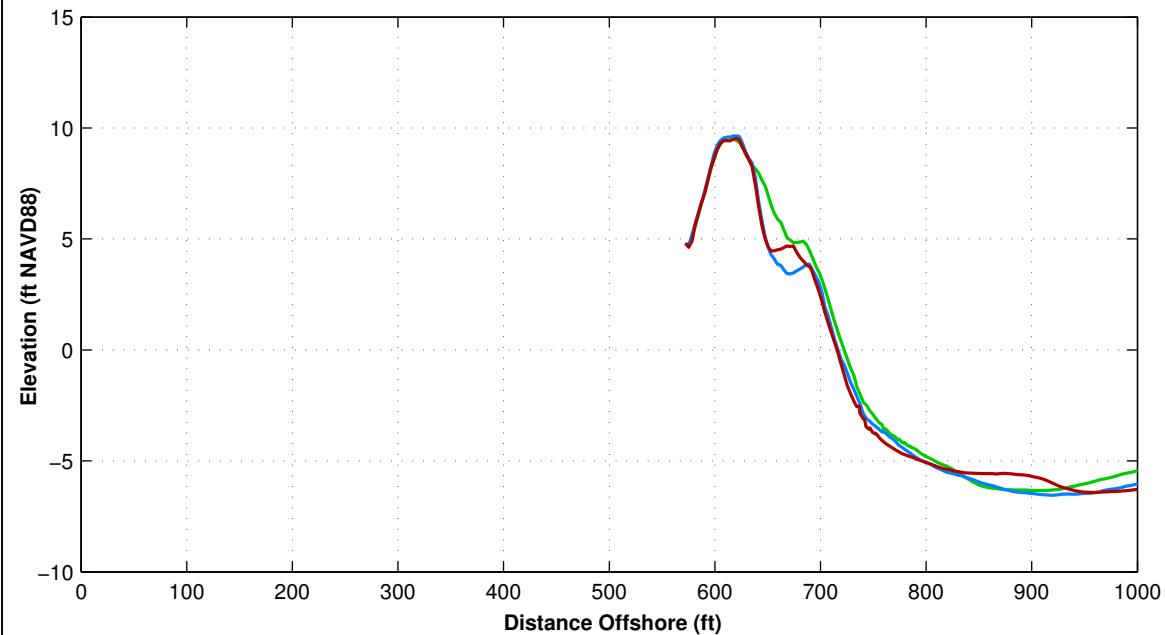


**LEGEND:**

MAY 2017	—	—
OCT 2016	—	—
MAY 2016	—	—

Notes:

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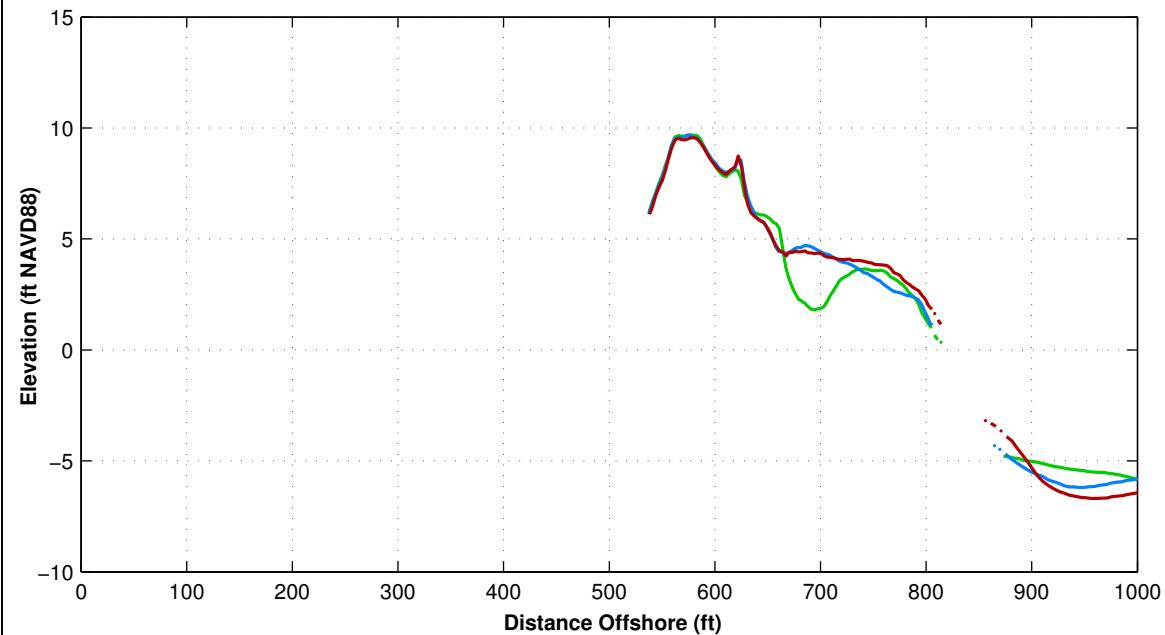
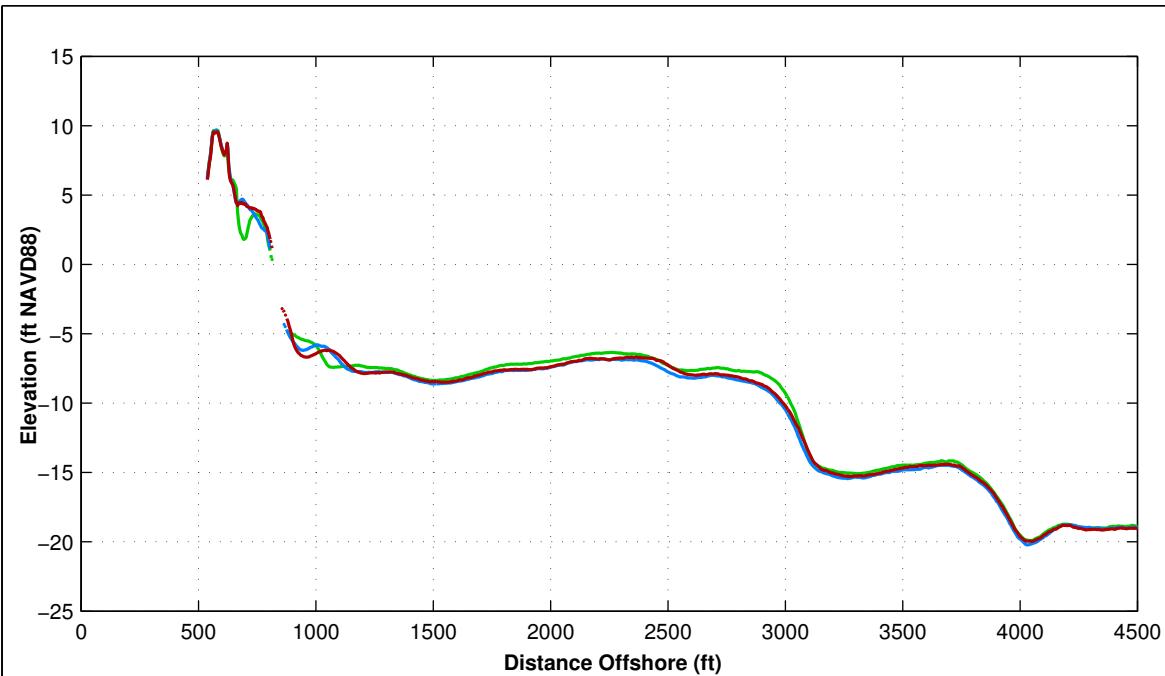
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PUBLIC WORKS

ST 7+50

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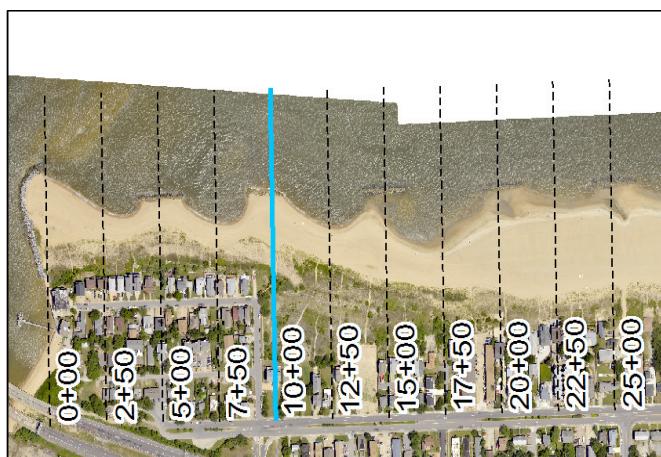
Survey Transect 10+00	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	10.74 ft/yr	8.20 ft
Volume Change Above -15 ft NAVD88	-23.55 cy/ft/yr	13.56 cy/ft
Volume Change Above 0 ft NAVD88	5.09 cy/ft/yr	1.63 cy/ft

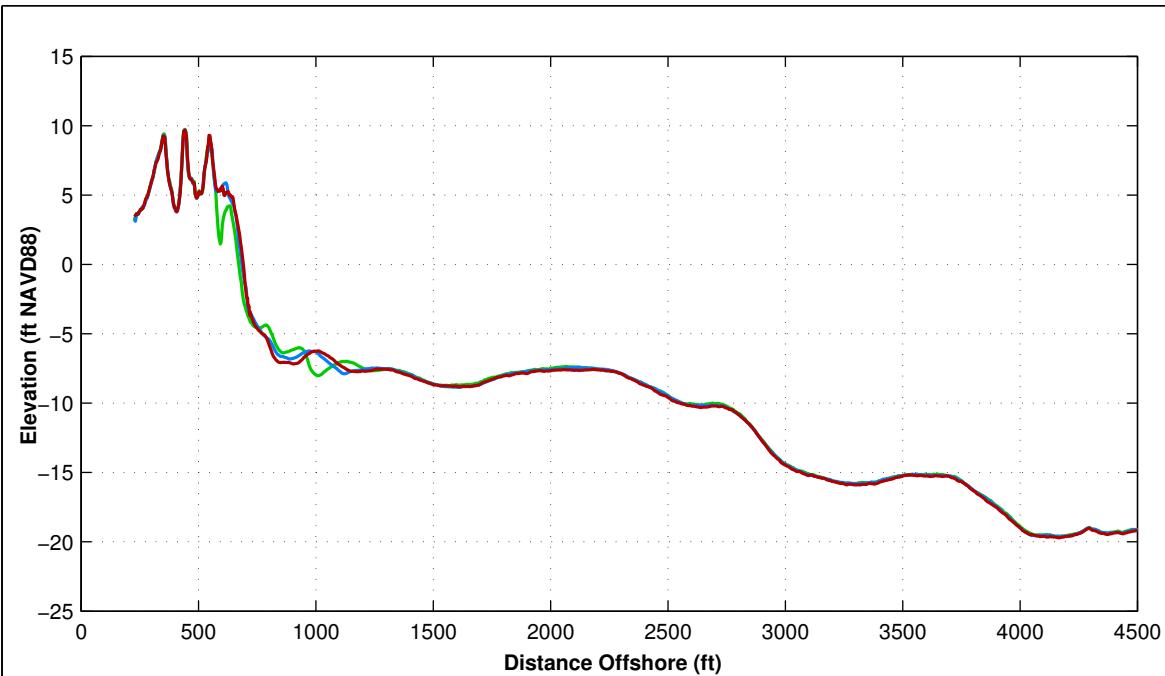
LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

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Survey Transect 12+50

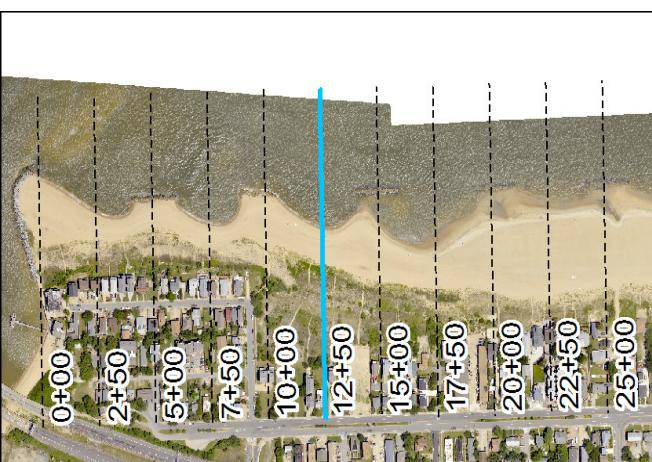
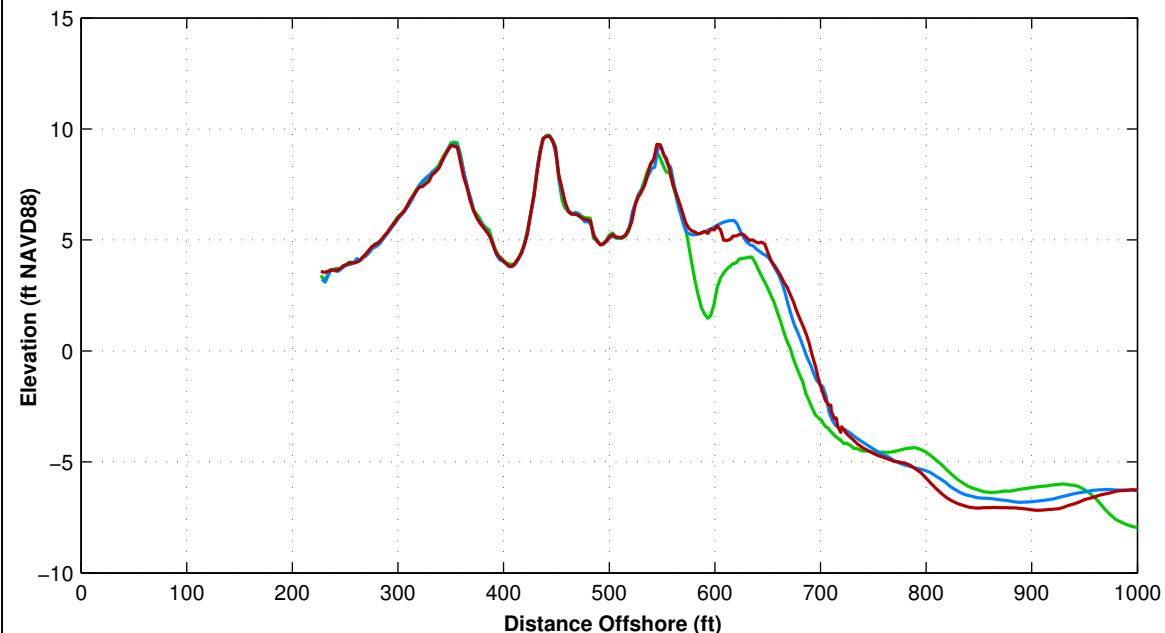
	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	20.17 ft/yr	7.43 ft
Volume Change Above -15 ft NAVD88	0.01 cy/ft/yr	-4.32 cy/ft
Volume Change Above 0 ft NAVD88	7.70 cy/ft/yr	0.78 cy/ft

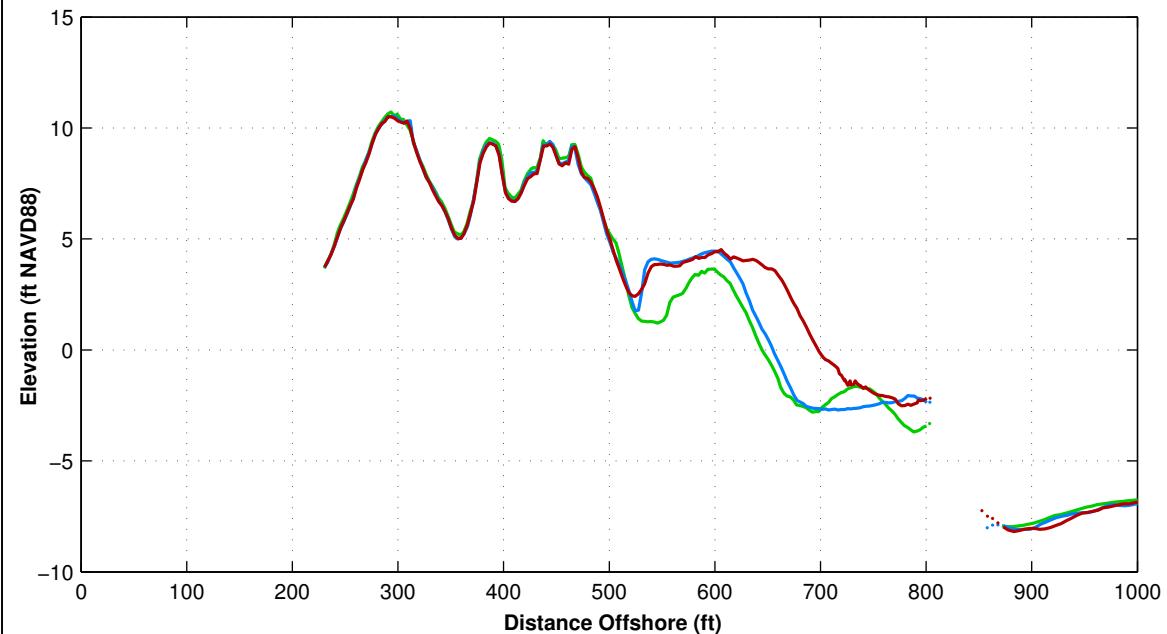
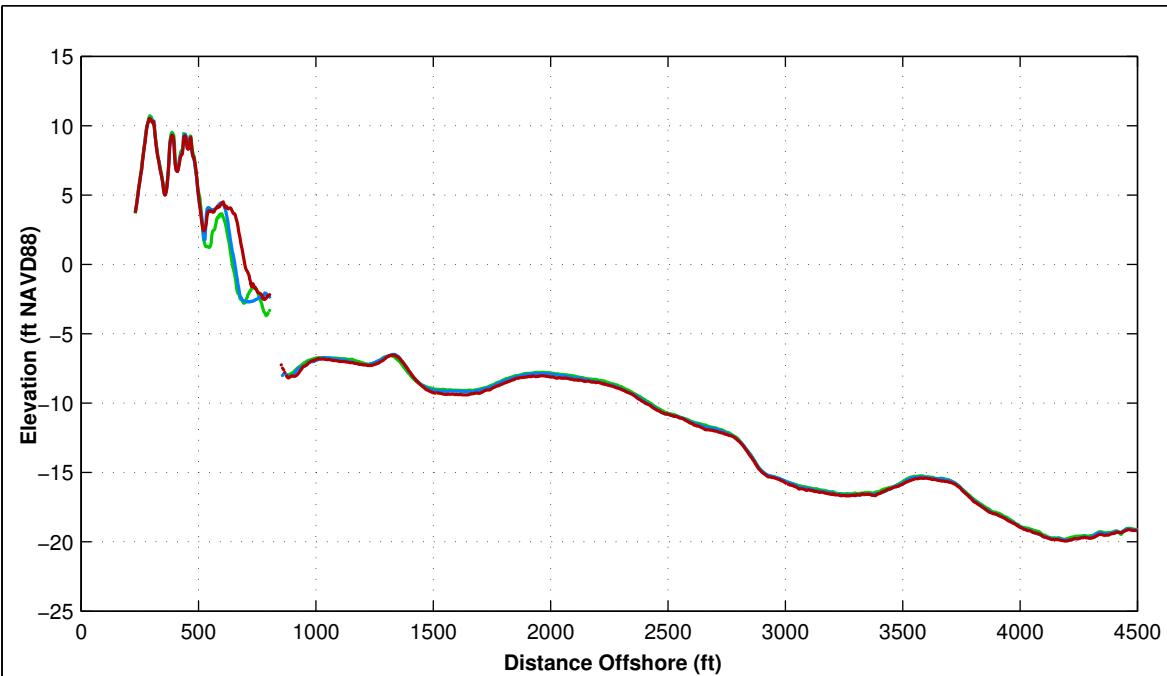
LEGEND:

MAY 2017	—
OCT 2016	—
MAY 2016	—

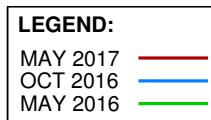
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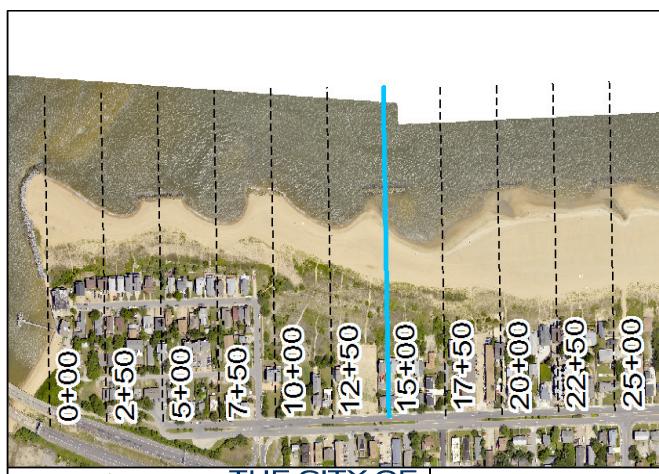


Survey Transect 15+00	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	51.37 ft/yr	42.92 ft
Volume Change Above -15 ft NAVD88	3.69 cy/ft/yr	3.53 cy/ft
Volume Change Above 0 ft NAVD88	10.25 cy/ft/yr	5.59 cy/ft



Notes:

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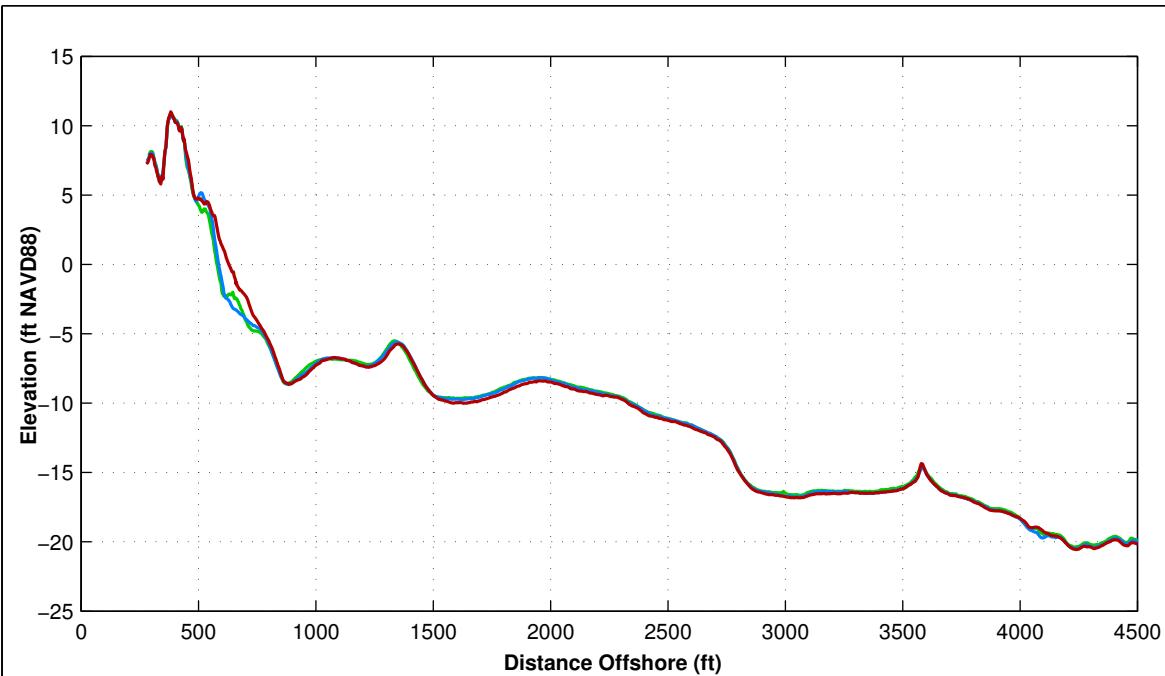
THE CITY OF  
**NORFOLK**  
PUBLIC WORKS

ST 15+00

OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS

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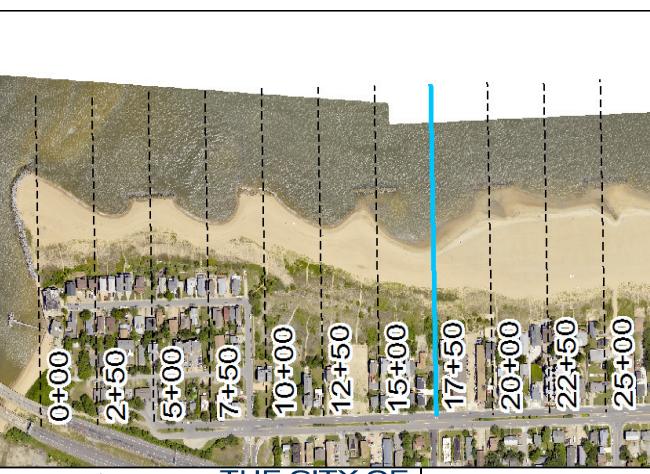
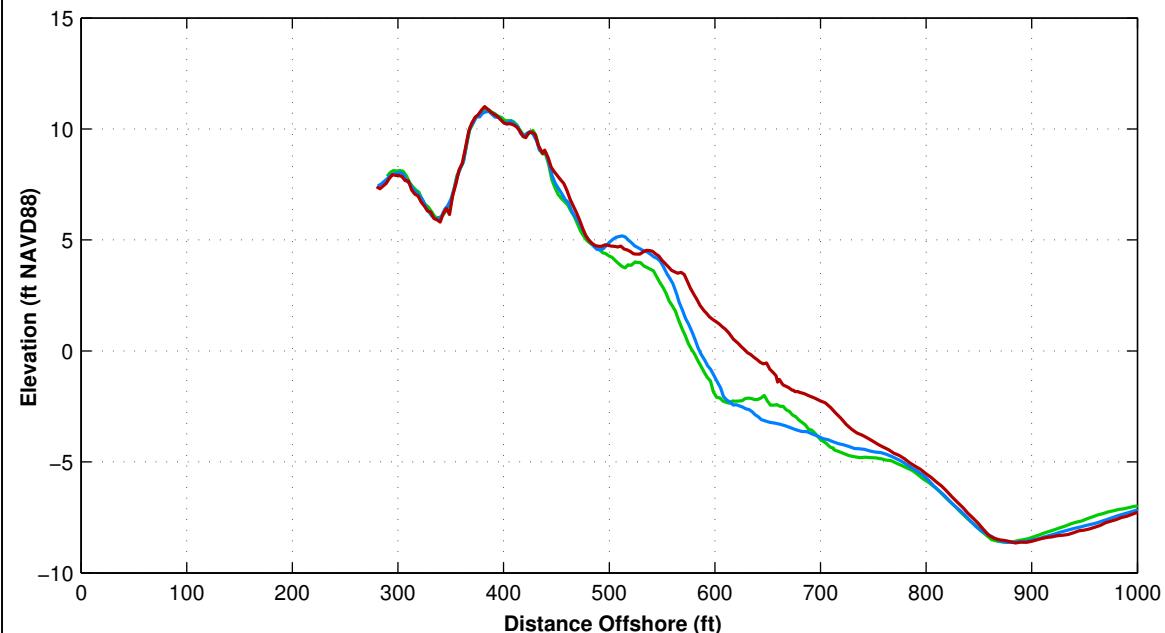


Survey Transect 17+50	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	40.74 ft/yr	32.68 ft
Volume Change Above -15 ft NAVD88	3.91 cy/ft/yr	4.21 cy/ft
Volume Change Above 0 ft NAVD88	6.12 cy/ft/yr	3.30 cy/ft

**LEGEND:**  
 MAY 2017 — Red line  
 OCT 2016 — Blue line  
 MAY 2016 — Green line

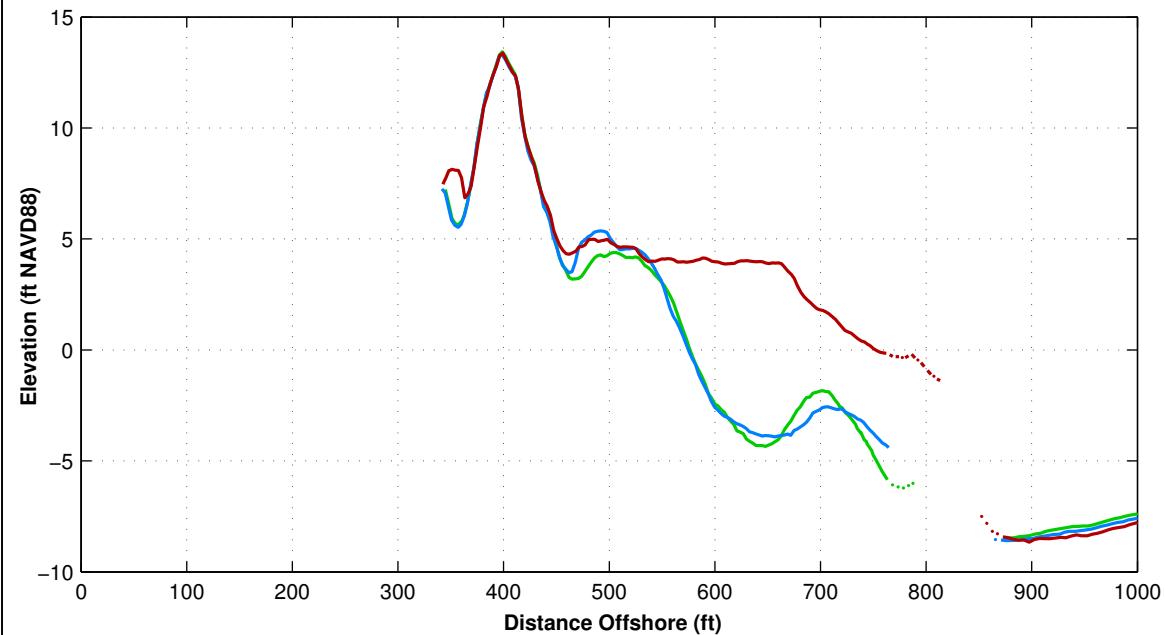
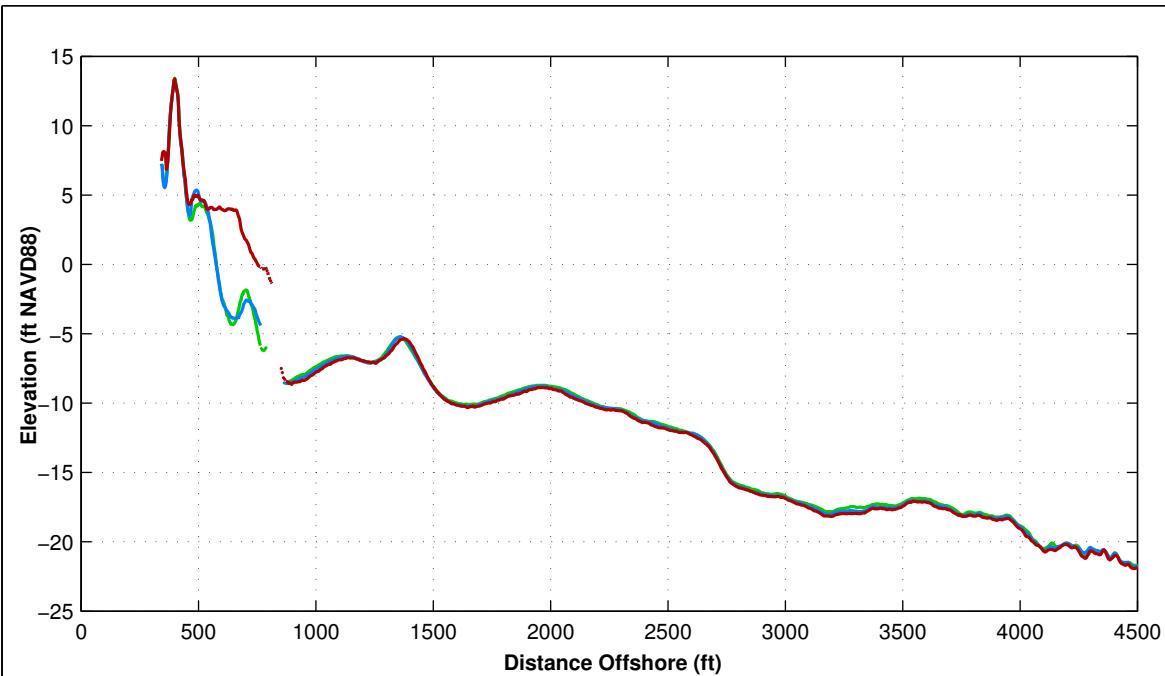
Notes:

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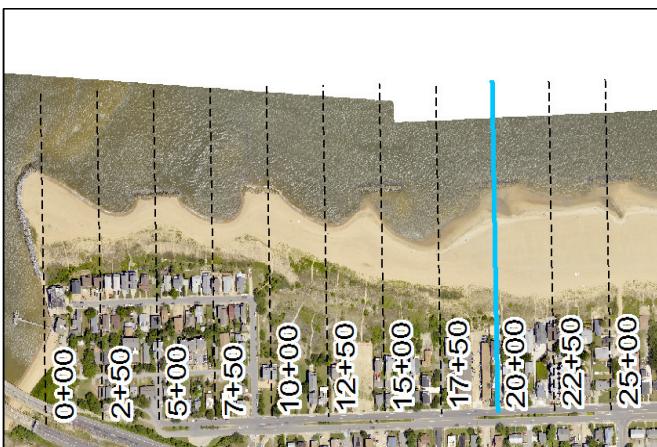
Survey Transect 20+00	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	152.12 ft/yr	154.61 ft
Volume Change Above -15 ft NAVD88	33.66 cy/ft/yr	38.50 cy/ft
Volume Change Above 0 ft NAVD88	24.28 cy/ft/yr	22.75 cy/ft

**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

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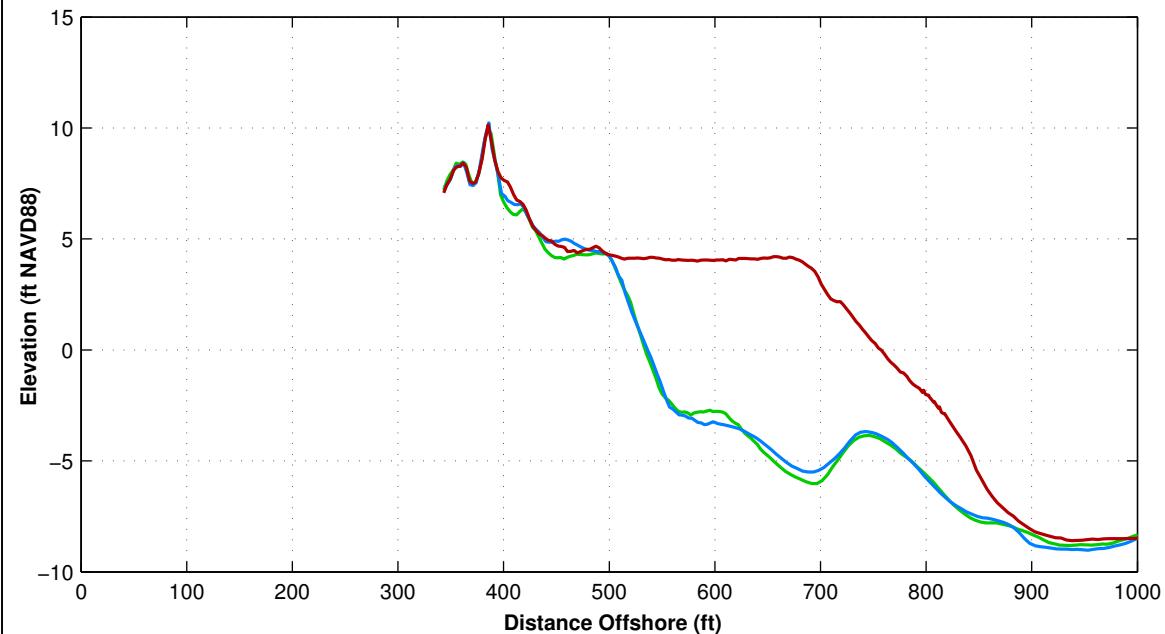
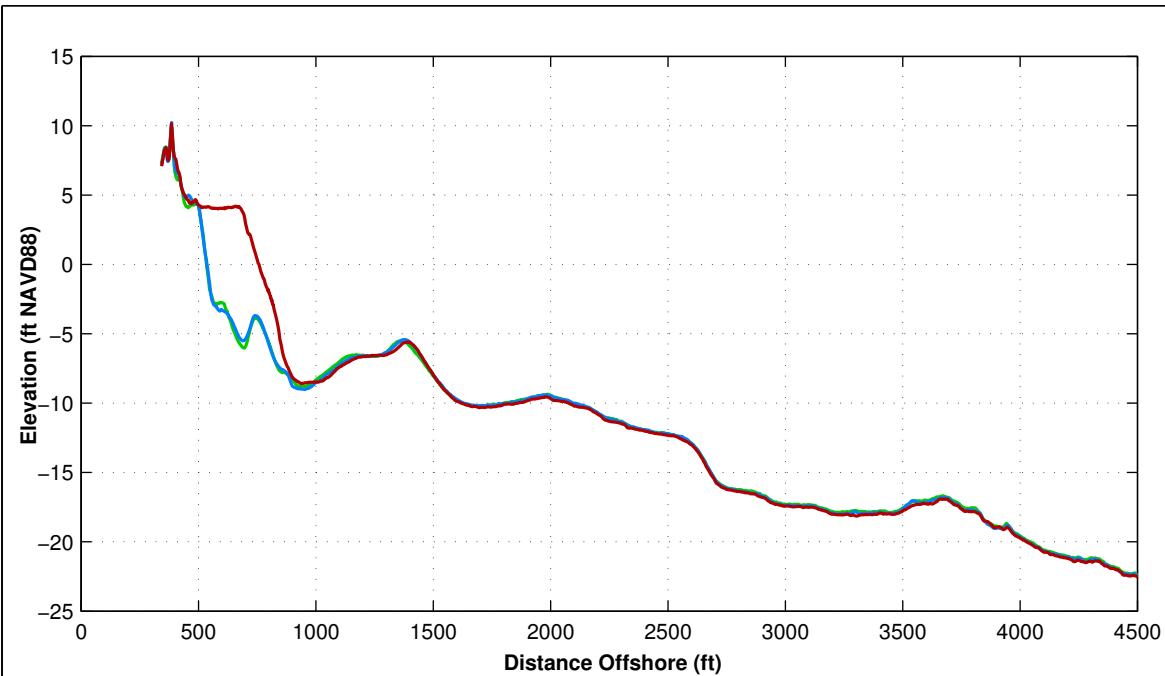
**THE CITY OF NORFOLK**  
PUBLIC WORKS

ST 20+00

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

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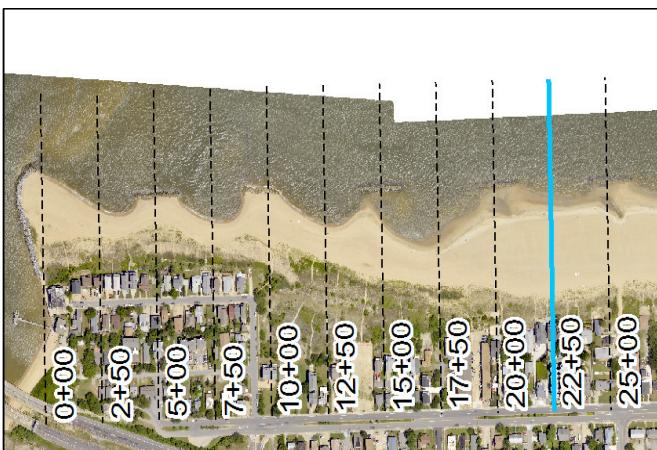
Survey Transect 22+50	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	211.56 ft/yr	211.38 ft
Volume Change Above -15 ft NAVD88	70.55 cy/ft/yr	69.28 cy/ft
Volume Change Above 0 ft NAVD88	31.71 cy/ft/yr	30.54 cy/ft

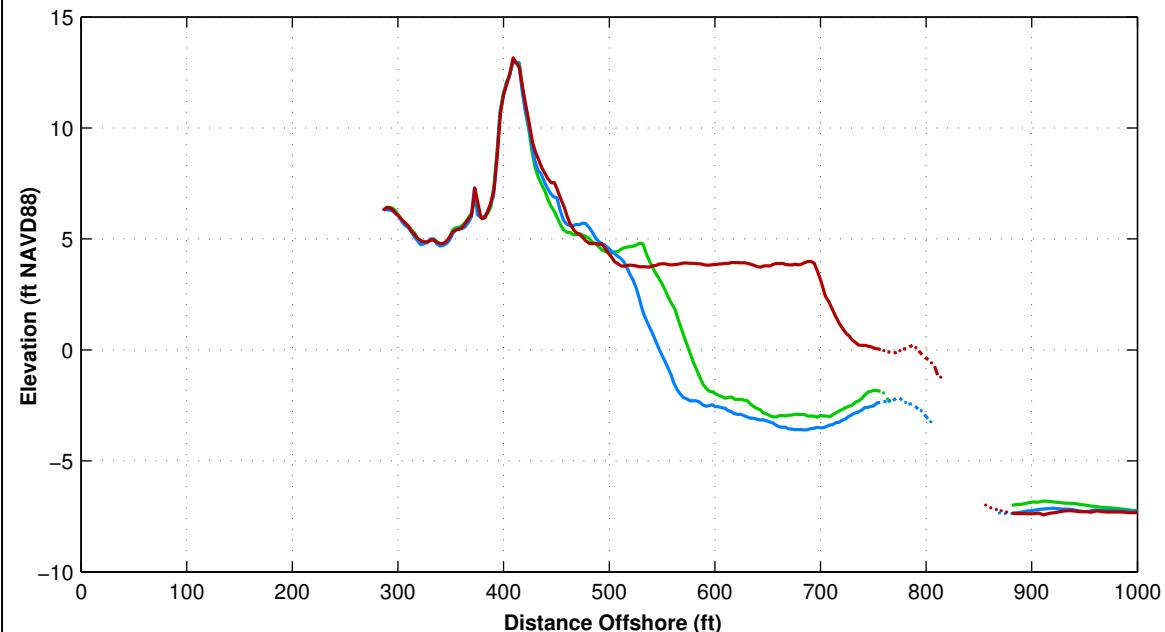
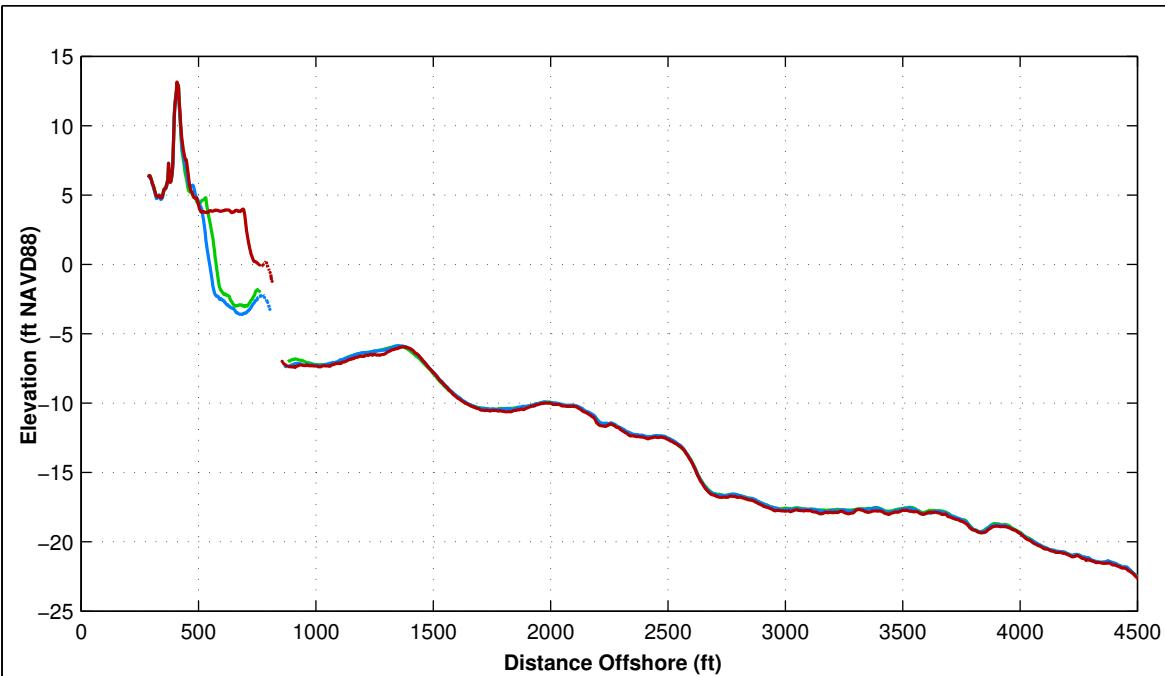
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

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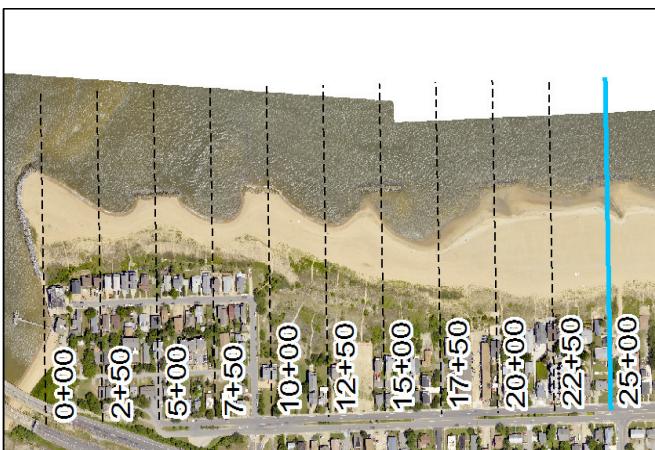
Survey Transect 25+00	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	152.86 ft/yr	182.35 ft
Volume Change Above -15 ft NAVD88	31.85 cy/ft/yr	40.63 cy/ft
Volume Change Above 0 ft NAVD88	22.39 cy/ft/yr	26.29 cy/ft

**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

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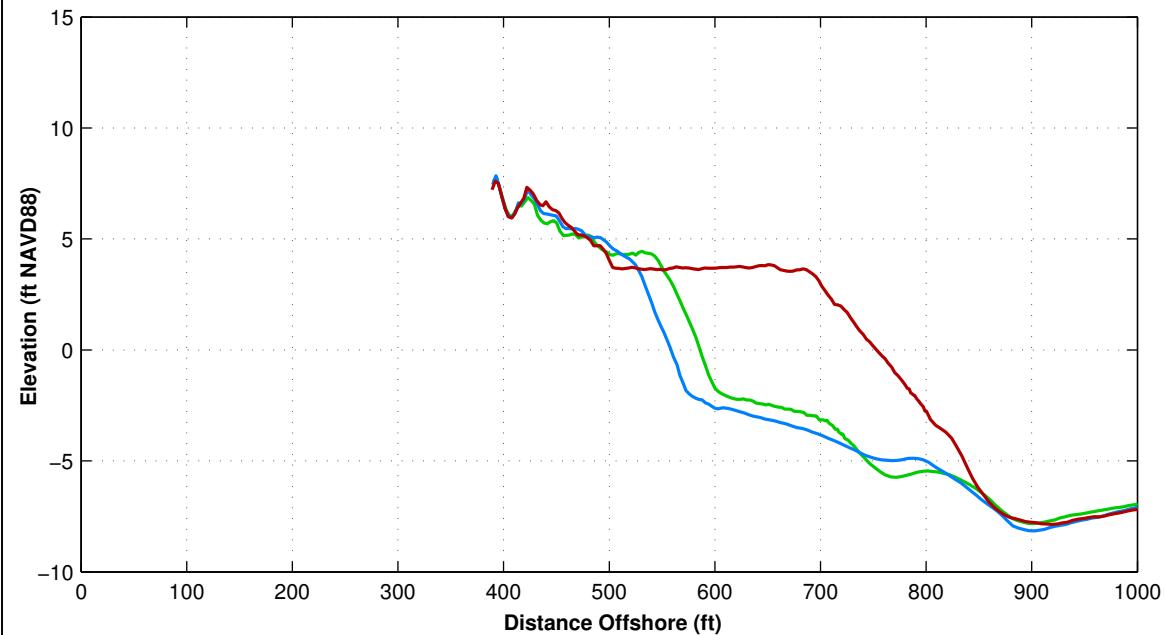
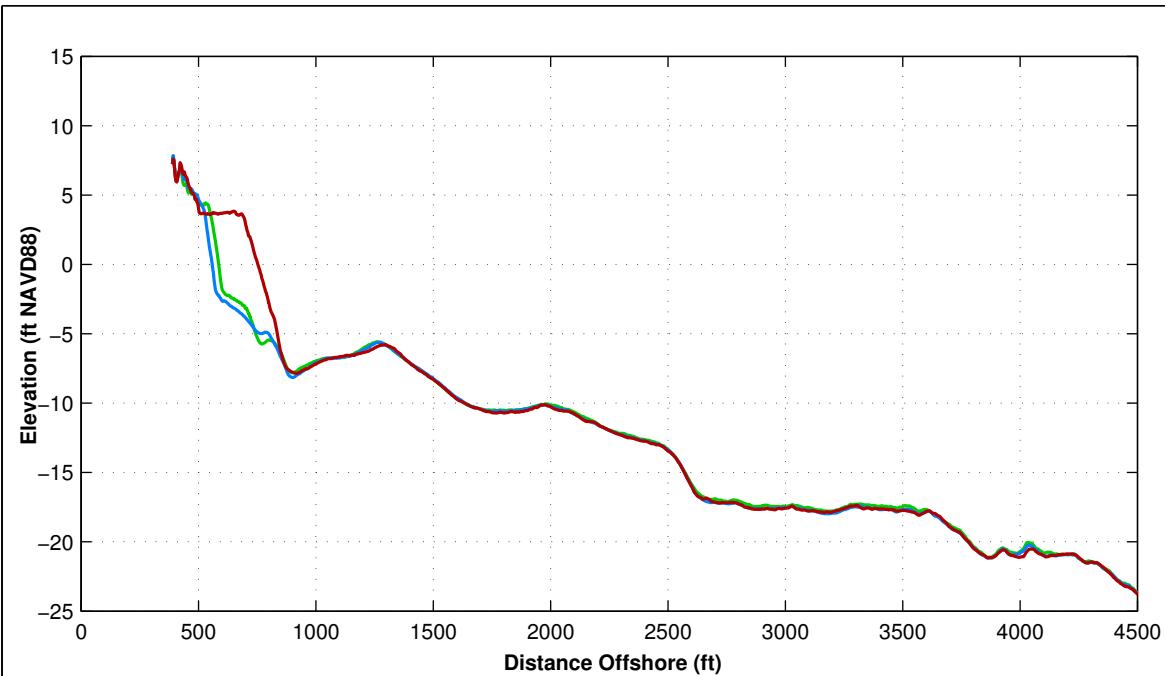
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PUBLIC WORKS

ST 25+00

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

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Spring 2017



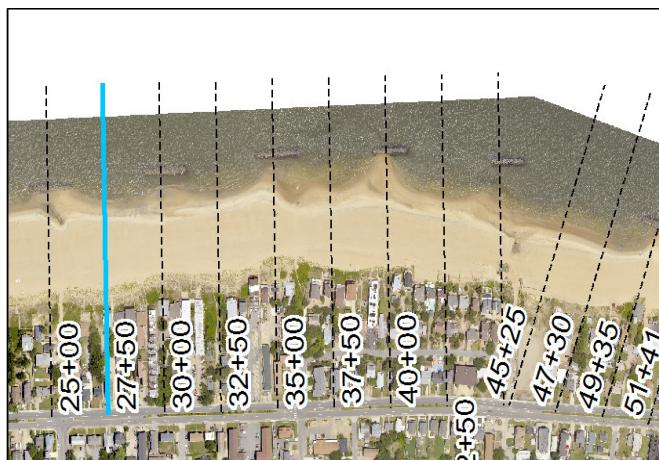
Survey Transect 27+50	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	156.88 ft/yr	185.52 ft
Volume Change Above -15 ft NAVD88	42.00 cy/ft/yr	53.56 cy/ft
Volume Change Above 0 ft NAVD88	20.29 cy/ft/yr	23.66 cy/ft

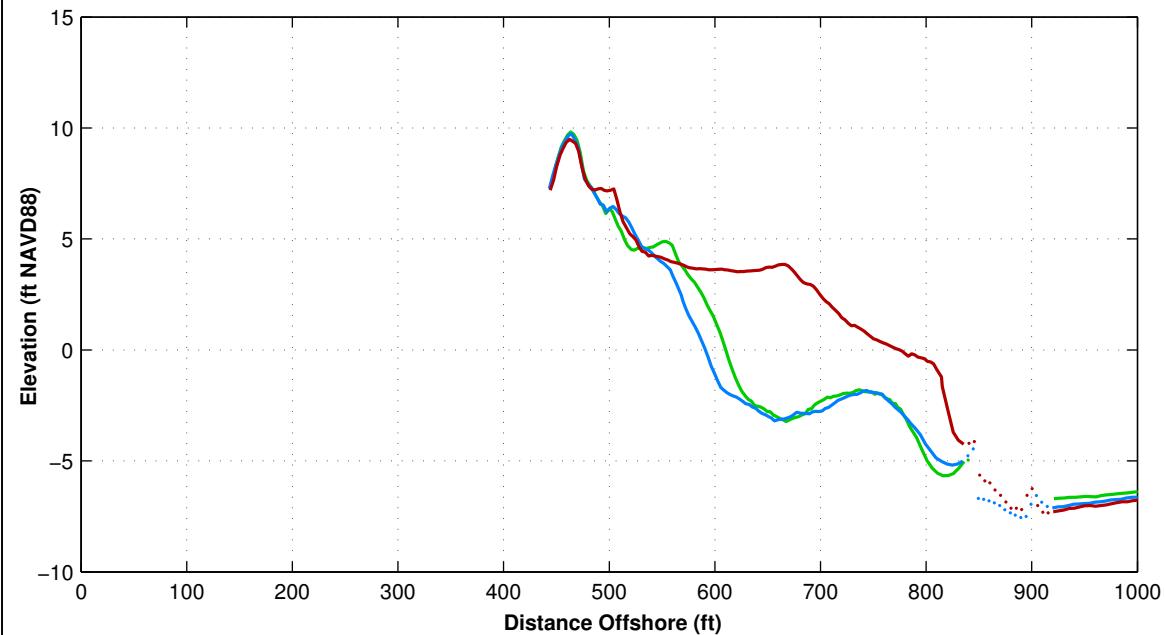
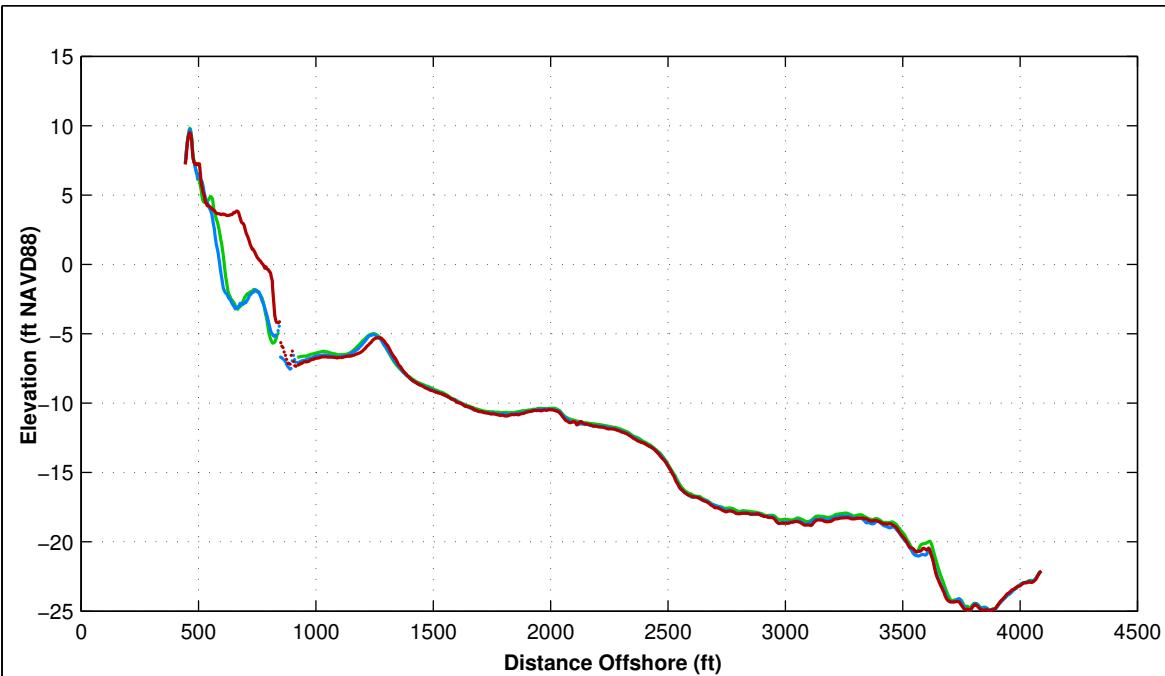
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

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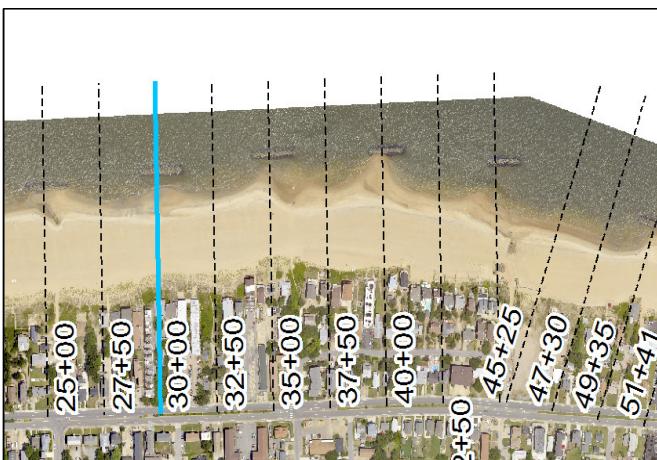
Survey Transect 30+00	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	133.69 ft/yr	154.95 ft
Volume Change Above -15 ft NAVD88	28.36 cy/ft/yr	39.02 cy/ft
Volume Change Above 0 ft NAVD88	16.75 cy/ft/yr	19.61 cy/ft

**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

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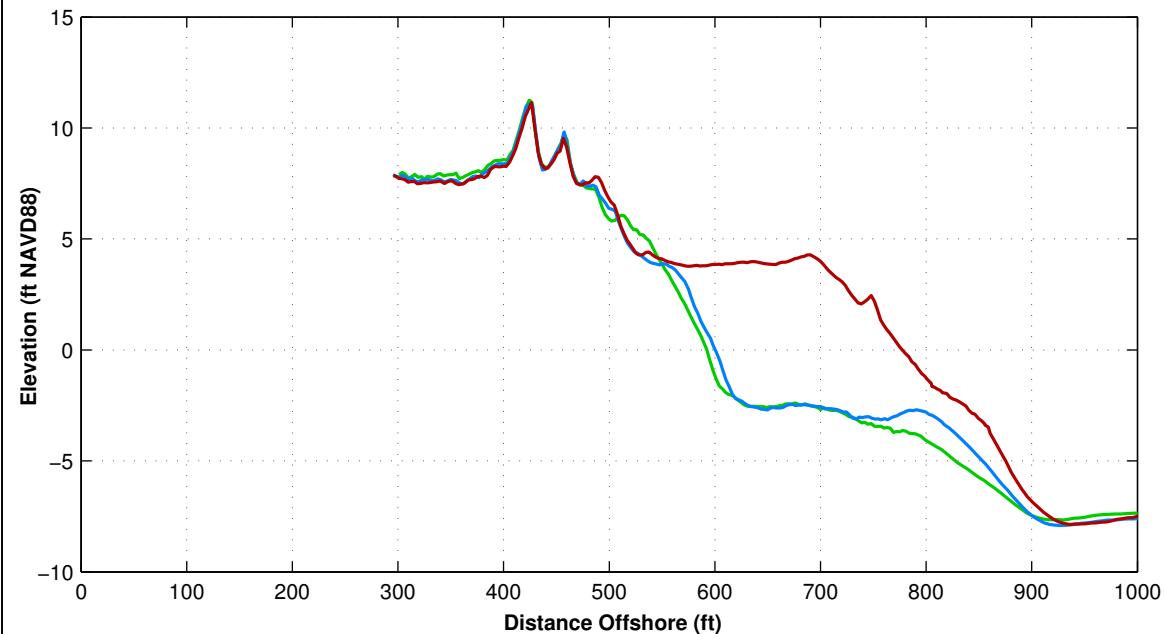
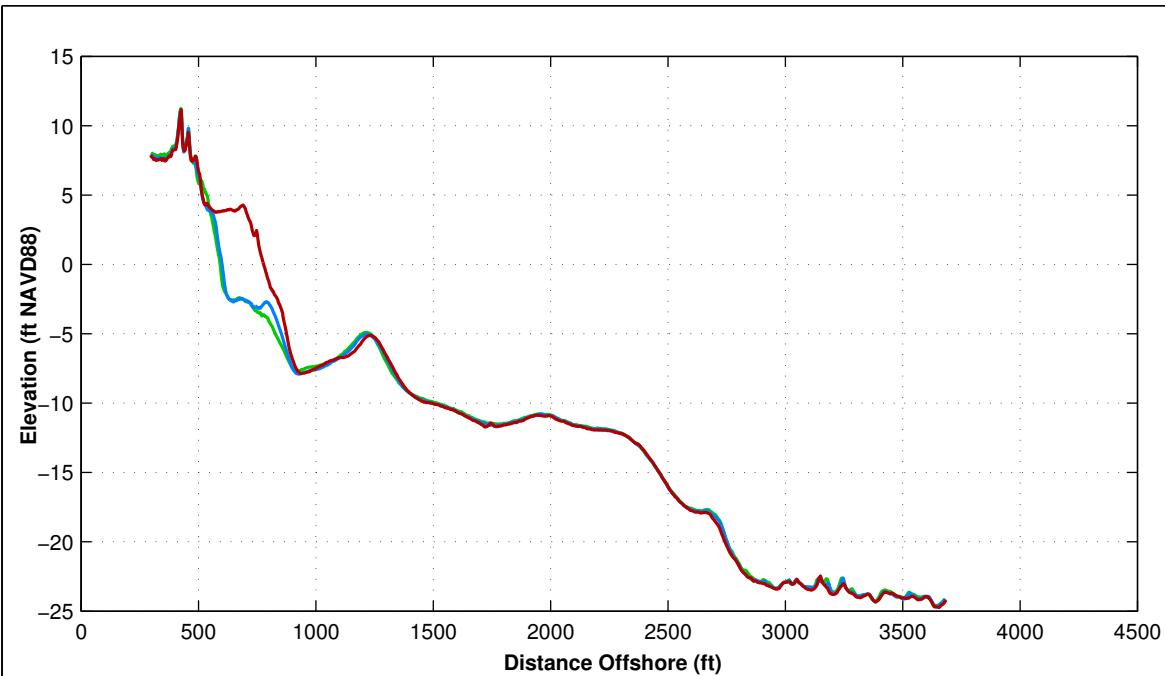
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ST 30+00

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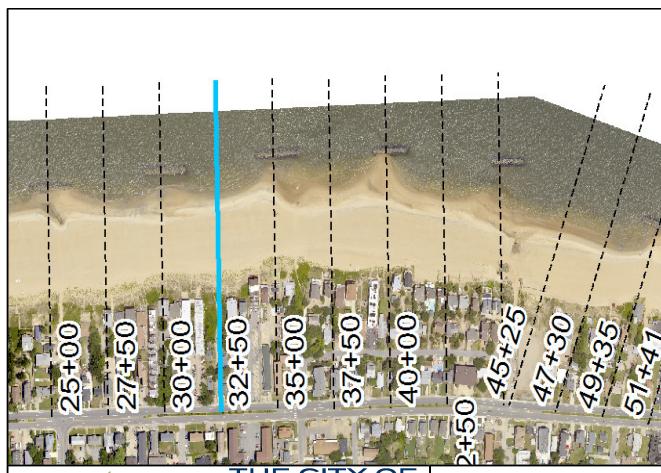
Survey Transect 32+50	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	179.01 ft/yr	171.69 ft
Volume Change Above -15 ft NAVD88	47.19 cy/ft/yr	46.06 cy/ft
Volume Change Above 0 ft NAVD88	23.24 cy/ft/yr	23.72 cy/ft

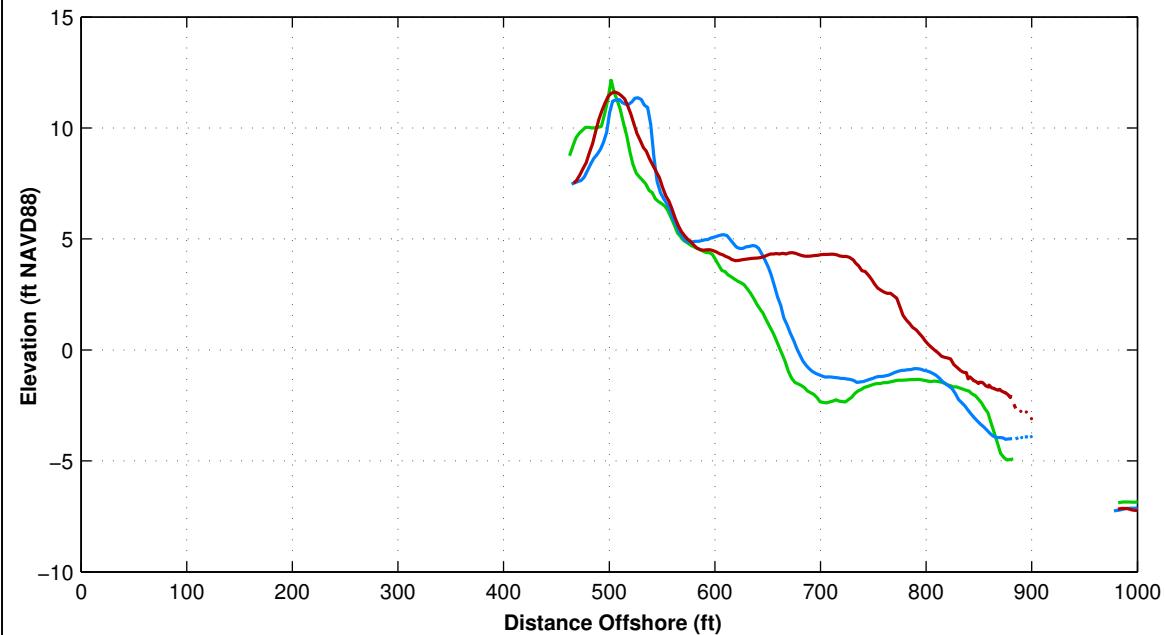
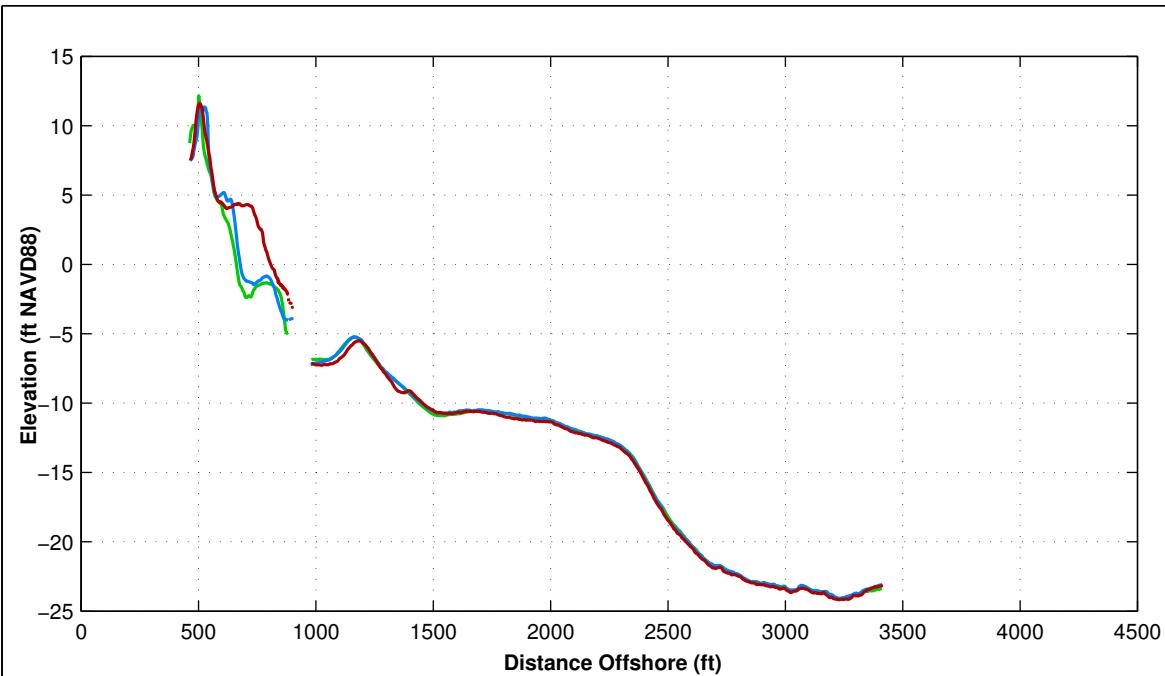
LEGEND:

- MAY 2017 – Red line
- OCT 2016 – Blue line
- MAY 2016 – Green line

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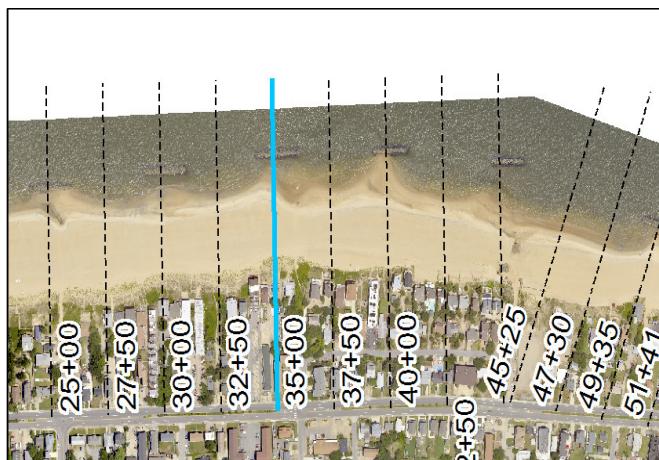
Survey Transect 35+00	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	135.67 ft/yr	118.73 ft
Volume Change Above -15 ft NAVD88	28.45 cy/ft/yr	16.55 cy/ft
Volume Change Above 0 ft NAVD88	22.59 cy/ft/yr	15.76 cy/ft

**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

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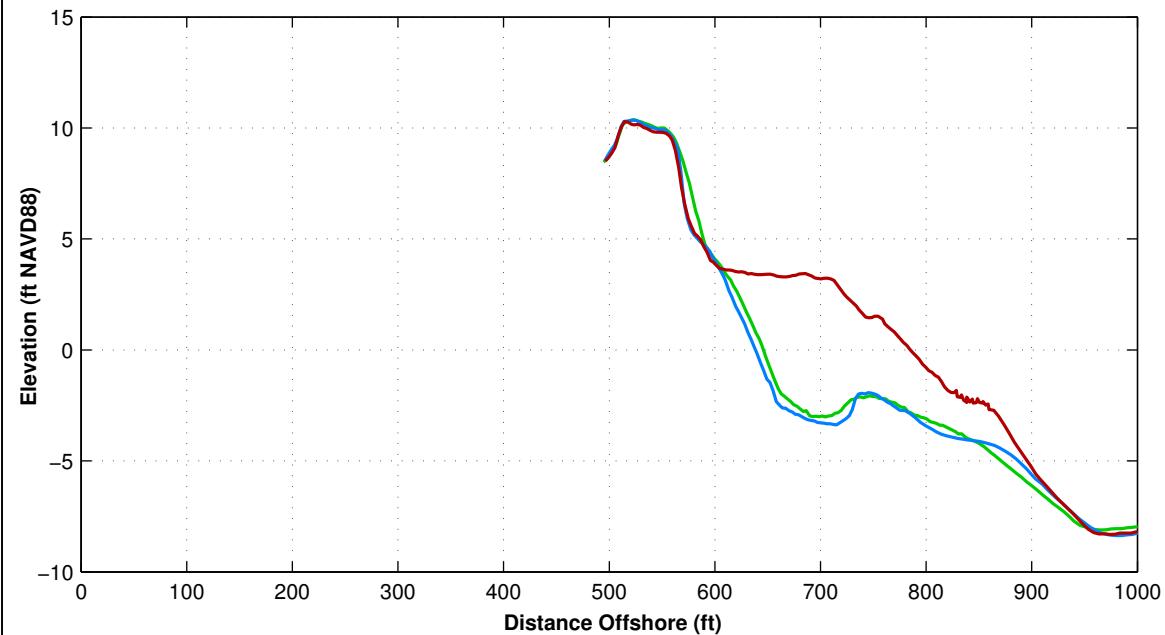
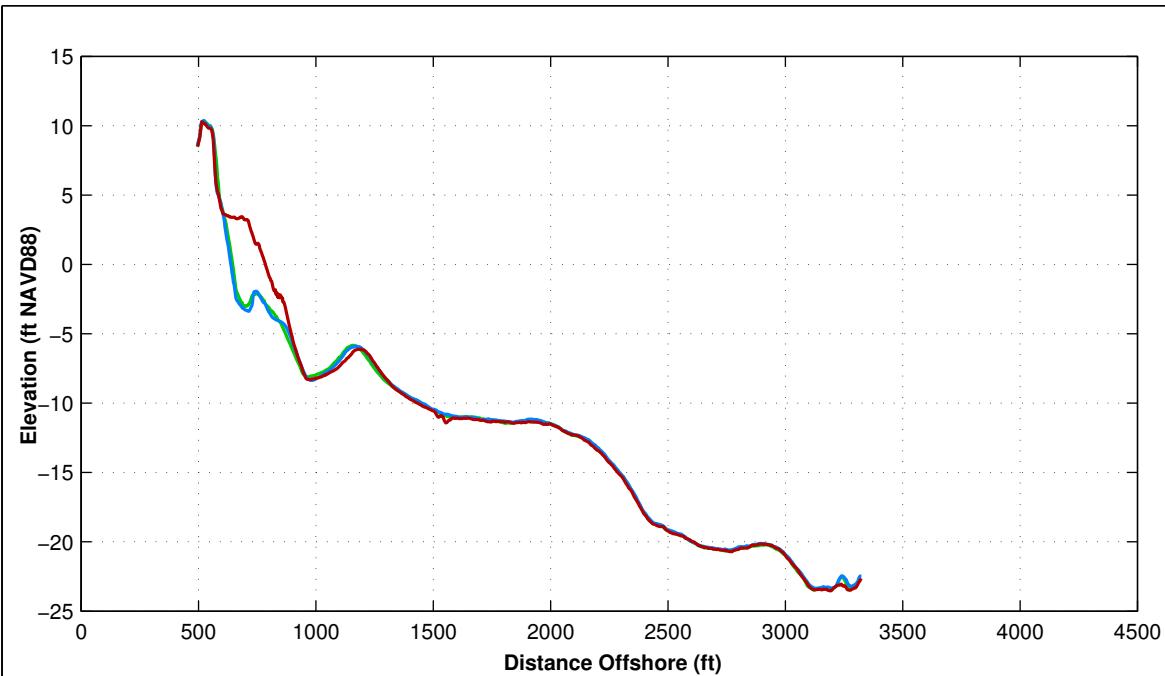
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ST 35+00

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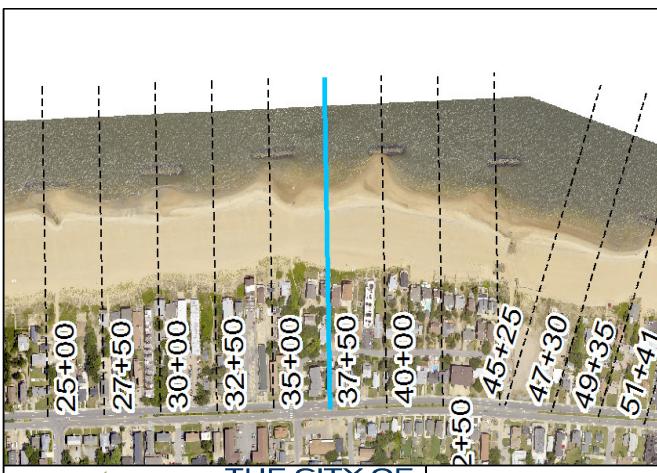
Survey Transect 37+50	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	128.47 ft/yr	135.66 ft
Volume Change Above -15 ft NAVD88	28.04 cy/ft/yr	29.16 cy/ft
Volume Change Above 0 ft NAVD88	12.82 cy/ft/yr	14.90 cy/ft

**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

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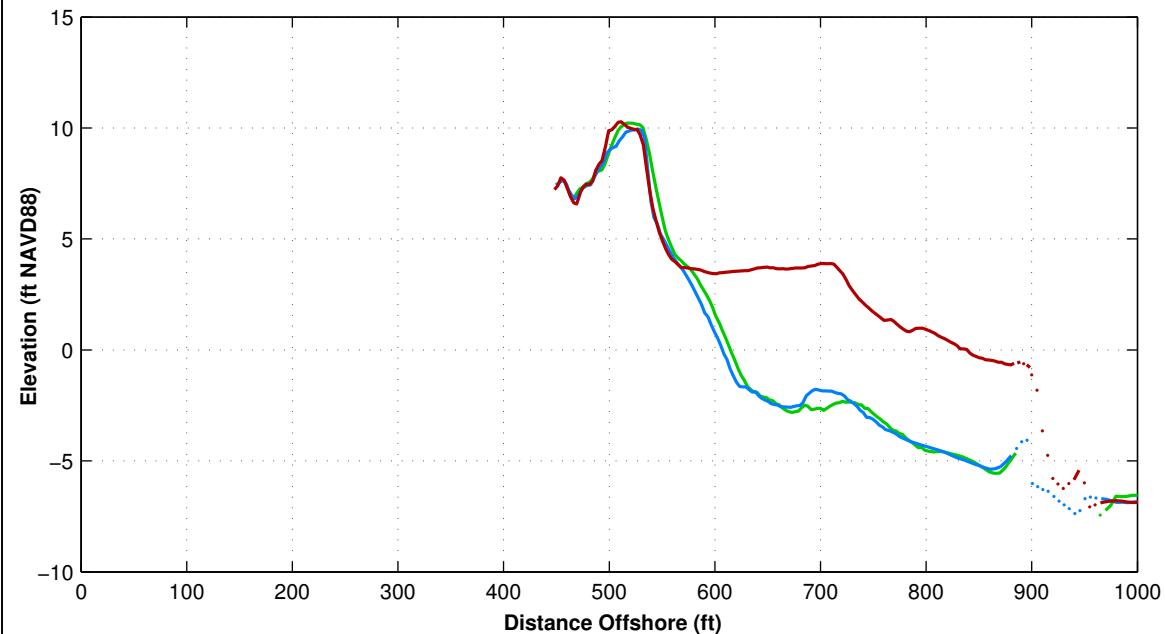
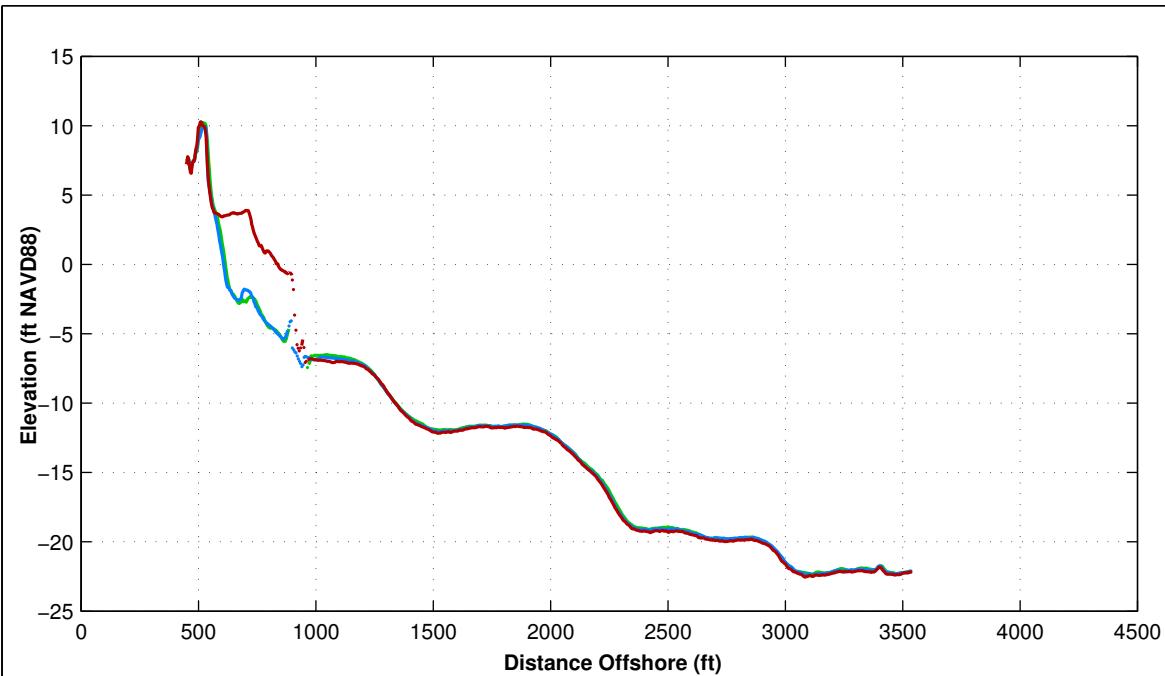
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ST 37+50

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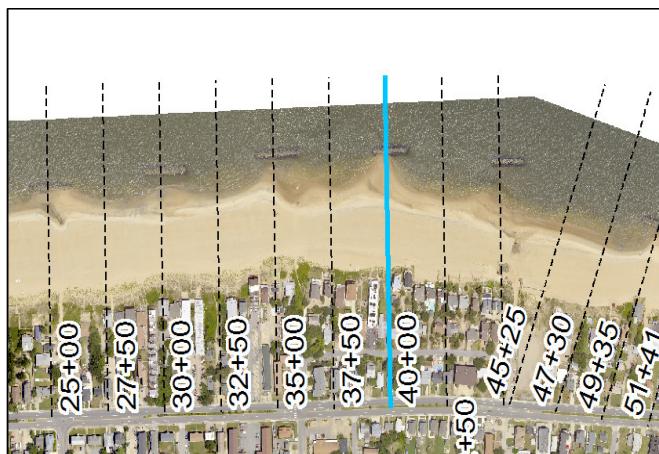
Survey Transect 40+00	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	170.89 ft/yr	179.11 ft
Volume Change Above -15 ft NAVD88	46.76 cy/ft/yr	52.13 cy/ft
Volume Change Above 0 ft NAVD88	20.93 cy/ft/yr	23.59 cy/ft

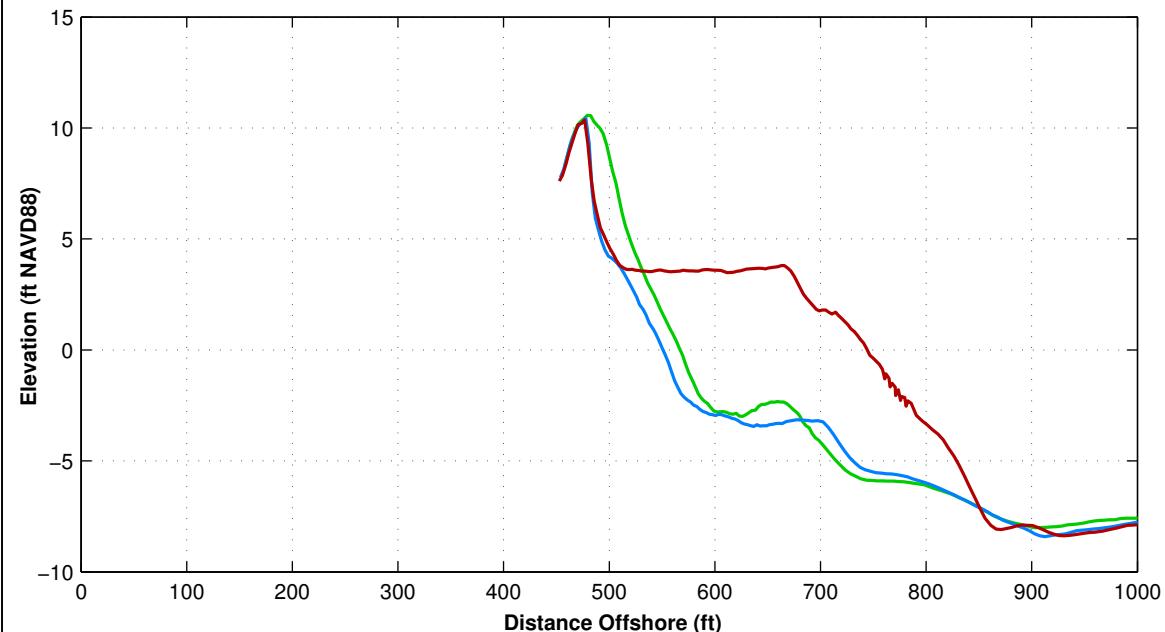
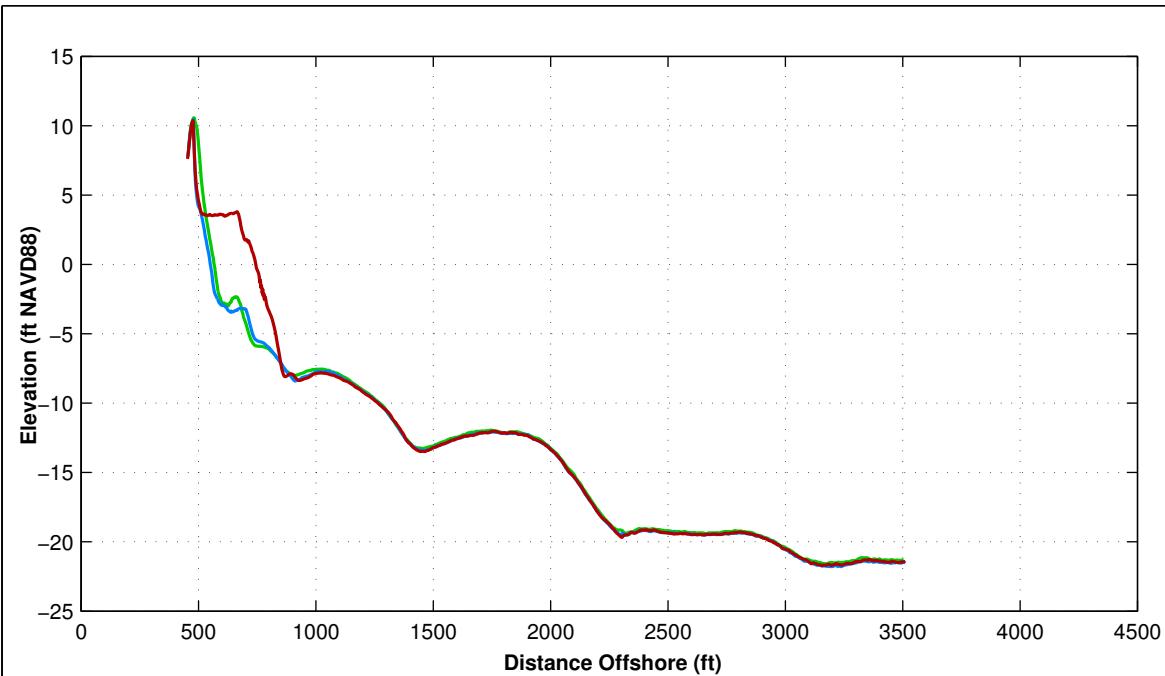
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





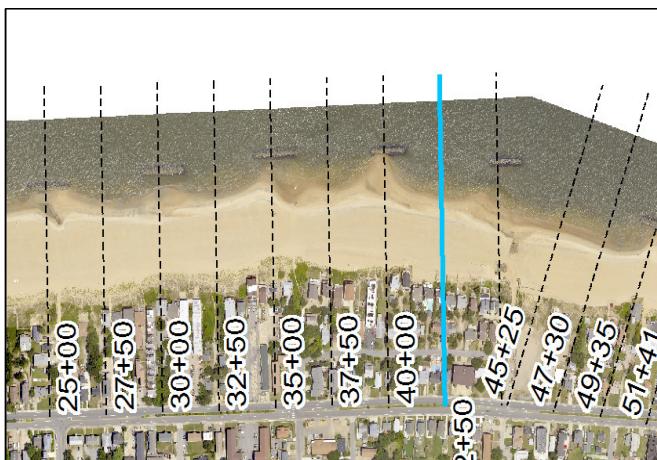
Survey Transect 42+50	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	171.23 ft/yr	187.34 ft
Volume Change Above -15 ft NAVD88	41.83 cy/ft/yr	56.28 cy/ft
Volume Change Above 0 ft NAVD88	15.64 cy/ft/yr	23.43 cy/ft

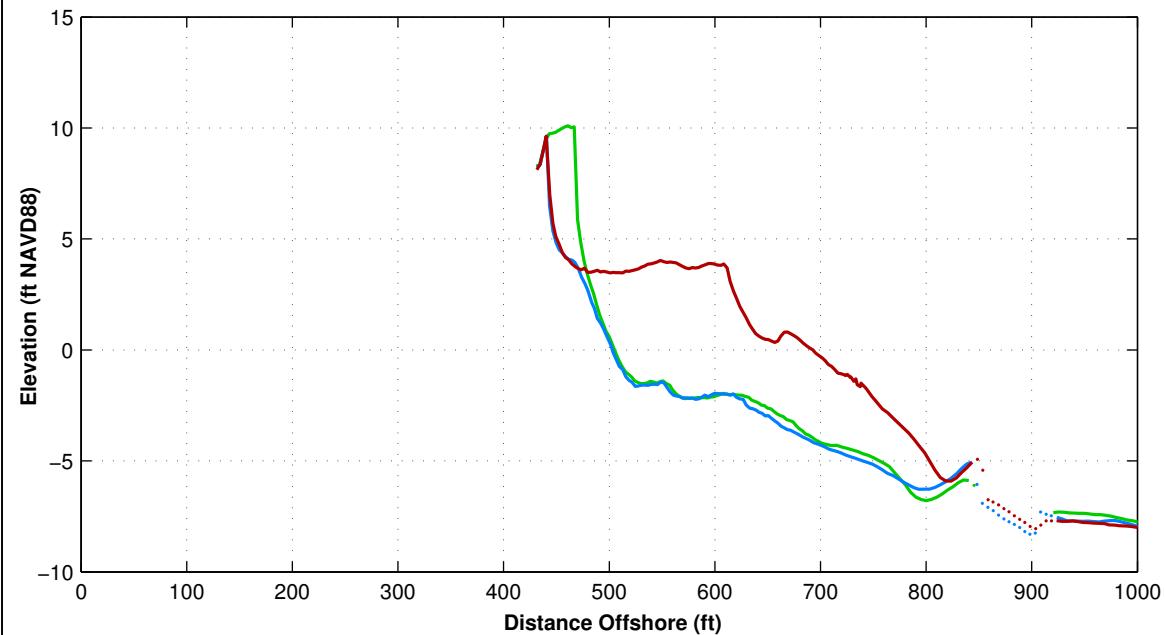
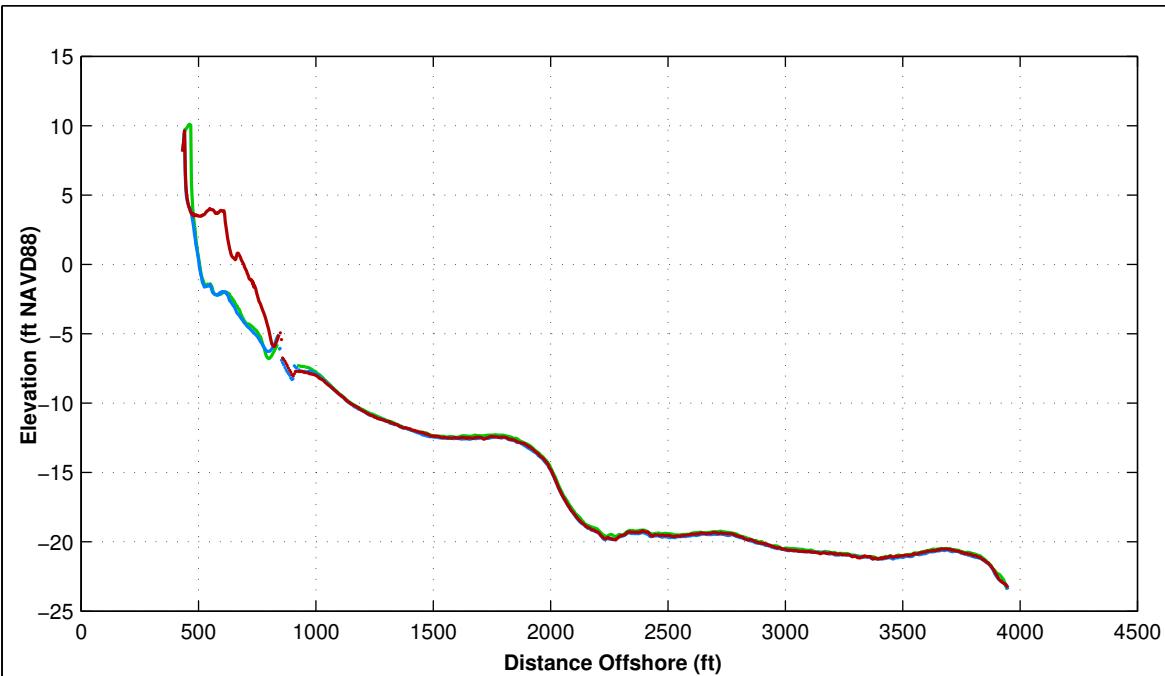
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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Survey Transect  
45+00

Shoreline Change at MHW  
(0.98 ft NAVD88)

Volume Change Above  
-15 ft NAVD88

Volume Change Above  
0 ft NAVD88

MAY 2017 –  
MAY 2016

139.22  
ft/yr

37.46  
cy/ft/yr

14.21  
cy/ft/yr

MAY 2017 –  
OCT 2016

140.70  
ft

50.05  
cy/ft

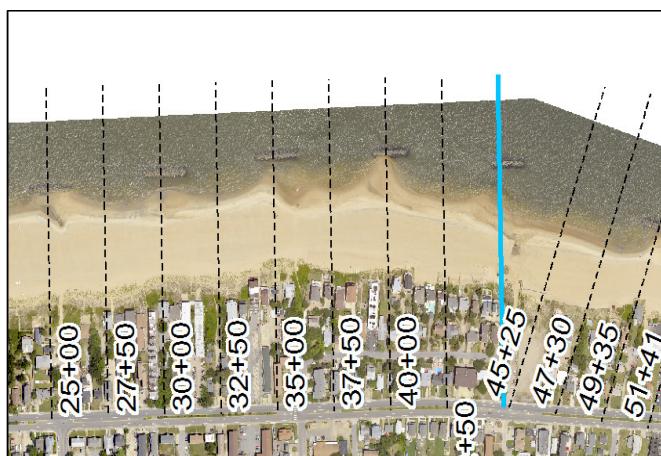
20.25  
cy/ft

**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

1. Station From West To East At Varying Intervals.
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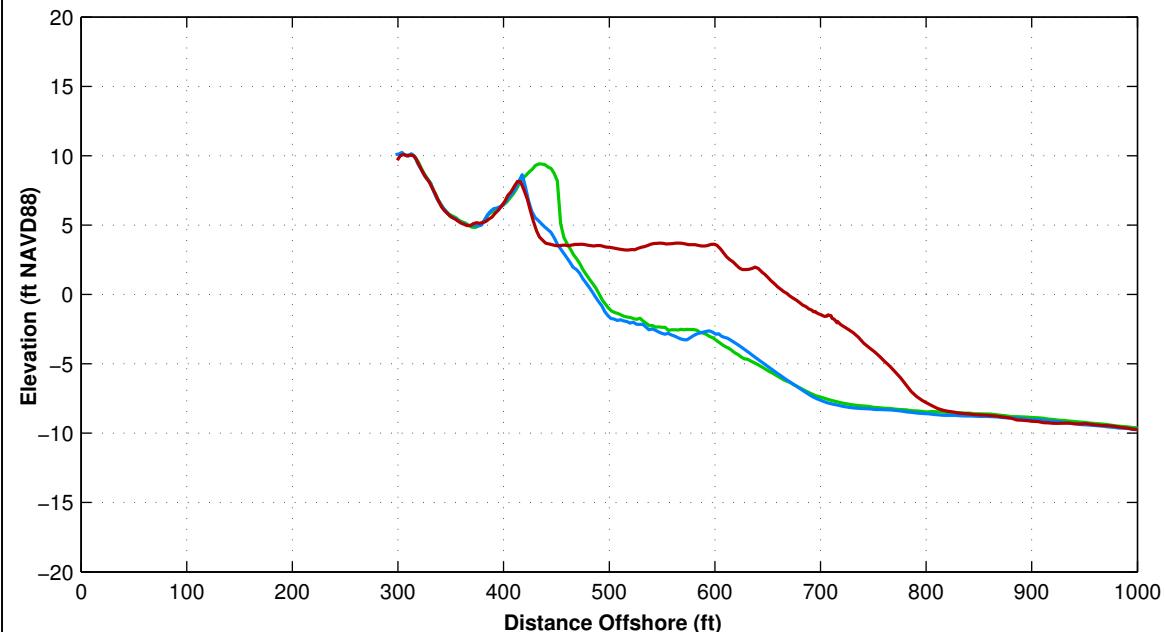
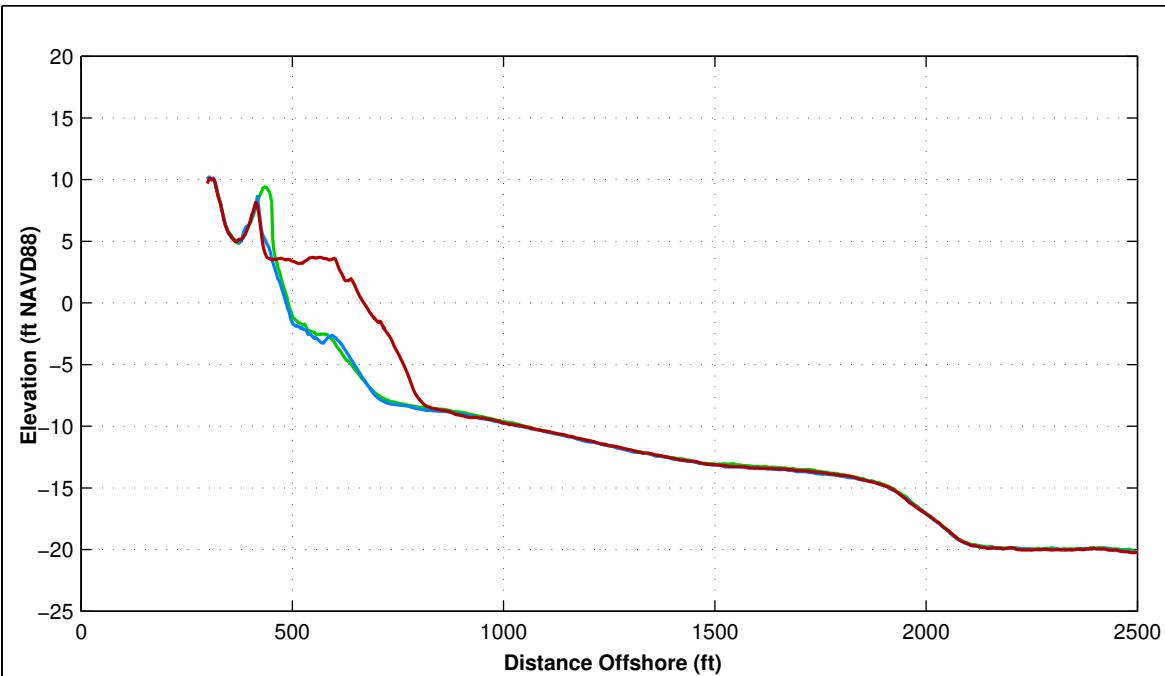
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OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

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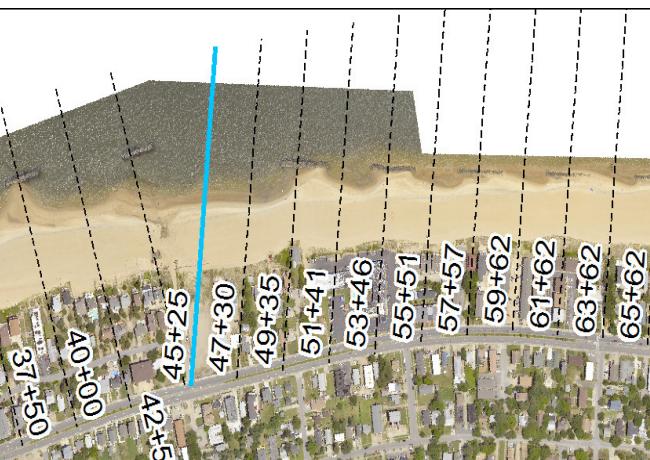
Survey Transect 45+25	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	170.87 ft/yr	176.87 ft
Volume Change Above -15 ft NAVD88	54.30 cy/ft/yr	65.65 cy/ft
Volume Change Above 0 ft NAVD88	14.95 cy/ft/yr	20.64 cy/ft

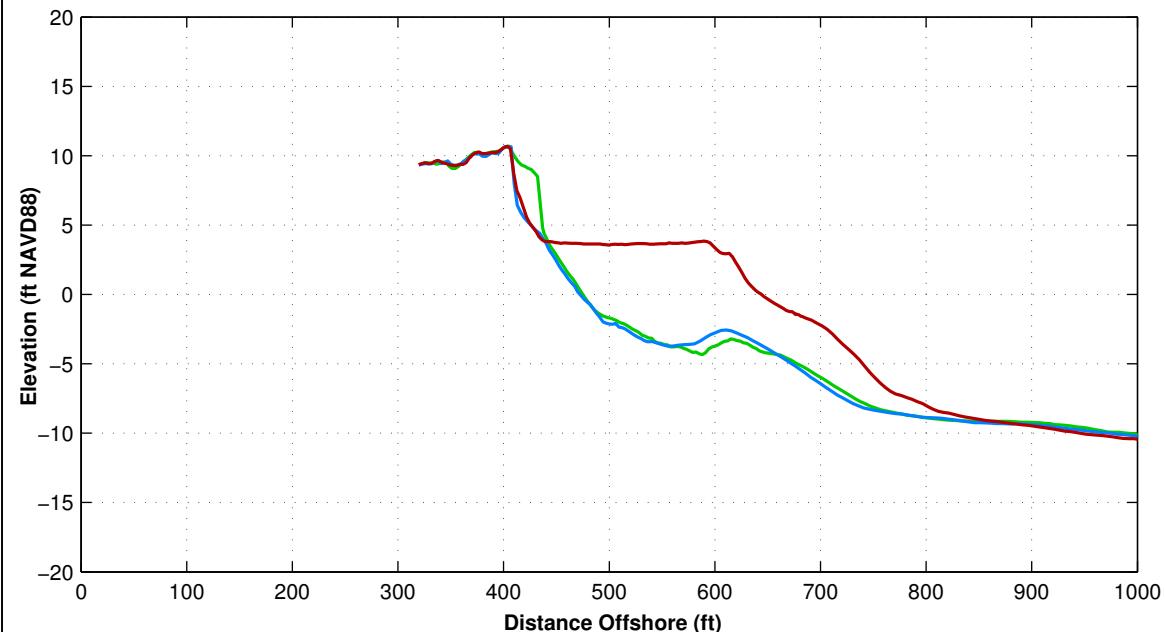
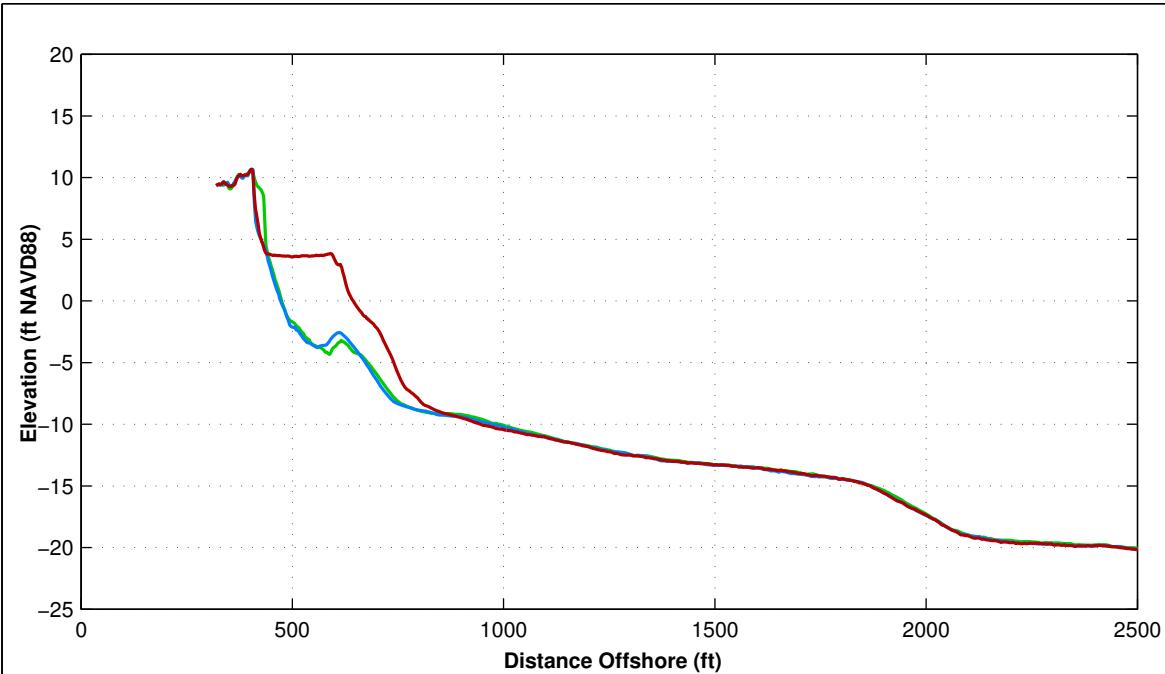
**LEGEND:**

MAY 2017	—
OCT 2016	—
MAY 2016	—

**Notes:**

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





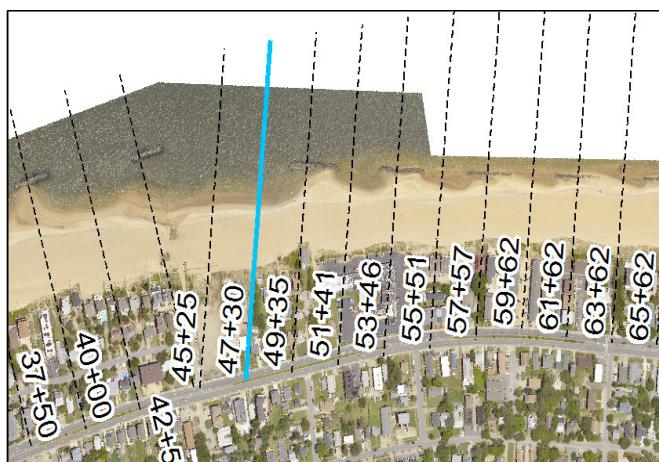
Survey Transect 47+30	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	163.35 ft/yr	167.45 ft
Volume Change Above -15 ft NAVD88	51.13 cy/ft/yr	57.87 cy/ft
Volume Change Above 0 ft NAVD88	18.97 cy/ft/yr	23.01 cy/ft

LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

Notes:

1. Station From West To East At Varying Intervals.
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3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



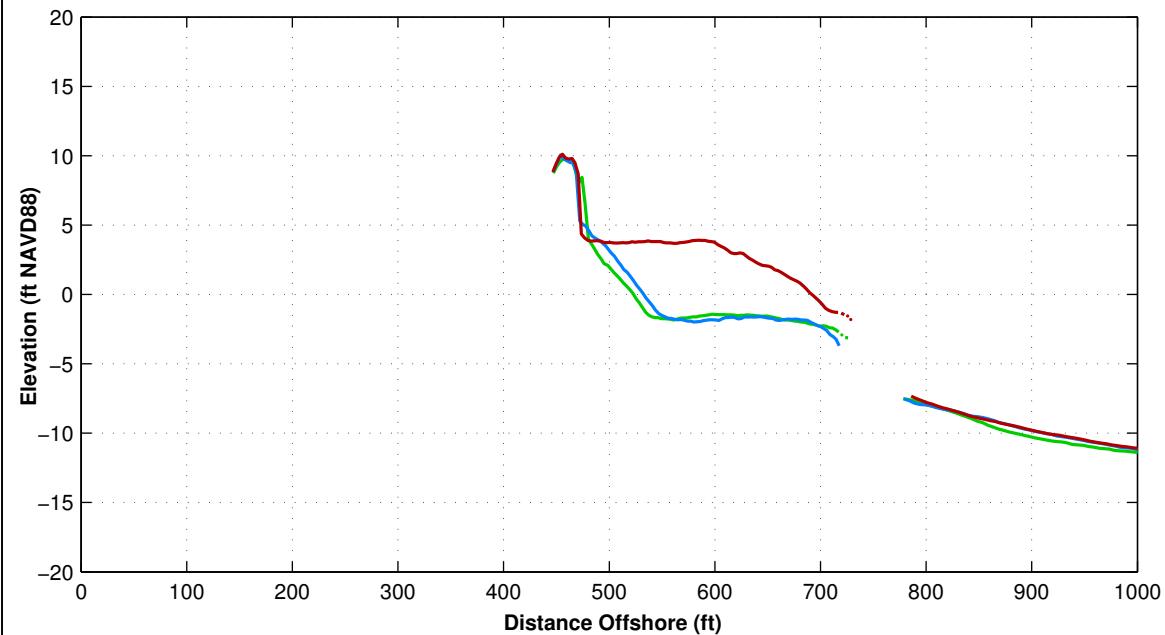
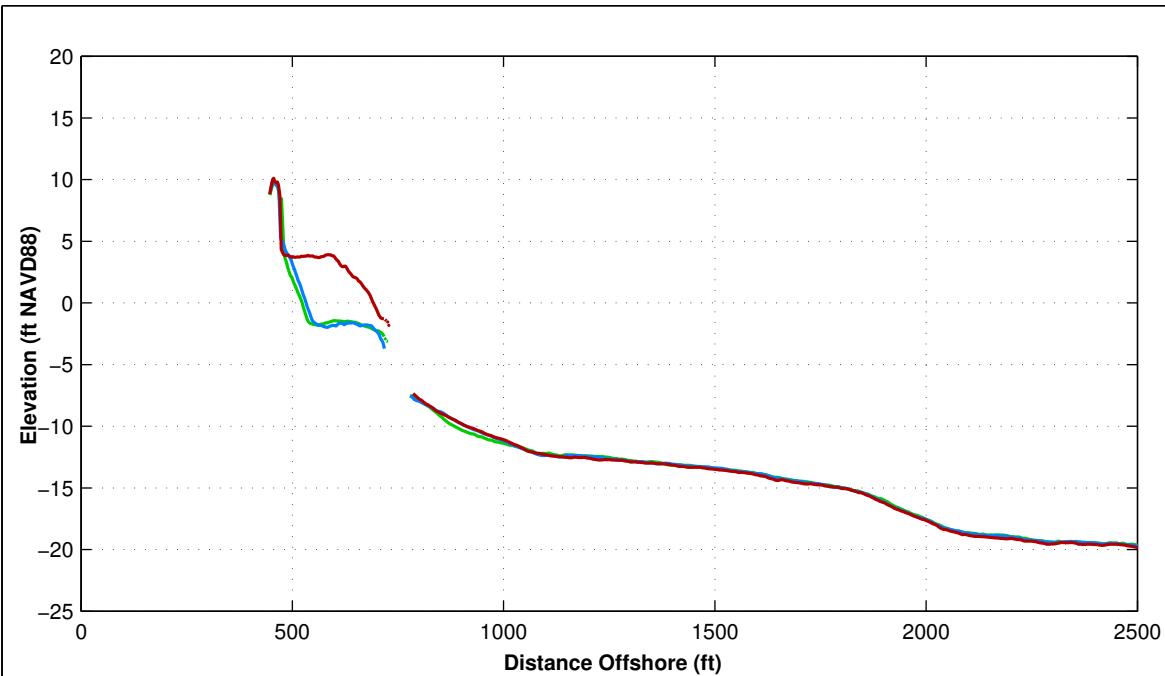
THE CITY OF  
**NORFOLK**  
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OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS

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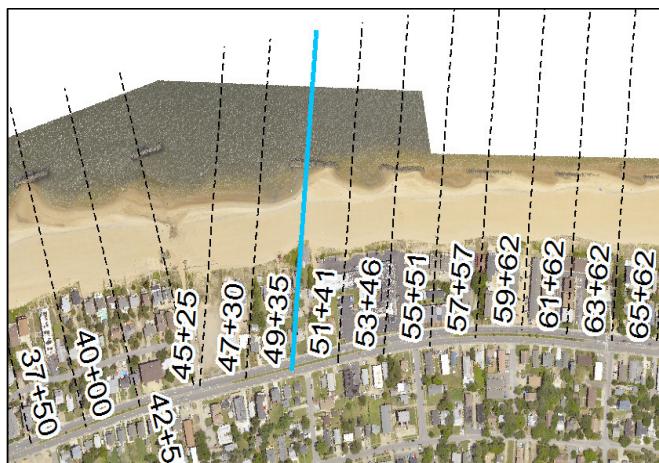


Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
49+35		
Shoreline Change at MHW (0.98 ft NAVD88)	165.11 ft/yr	153.83 ft
Volume Change Above -15 ft NAVD88	31.57 cy/ft/yr	29.31 cy/ft
Volume Change Above 0 ft NAVD88	20.37 cy/ft/yr	19.16 cy/ft

**LEGEND:**  
 MAY 2017 — Red line  
 OCT 2016 — Blue line  
 MAY 2016 — Green line

Notes:

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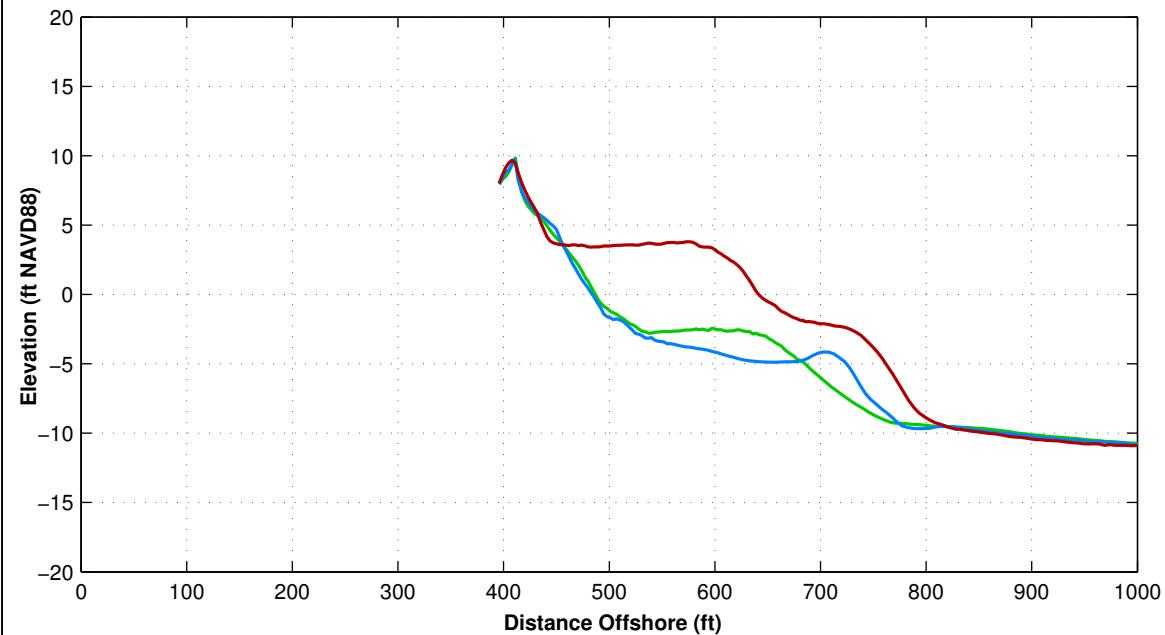
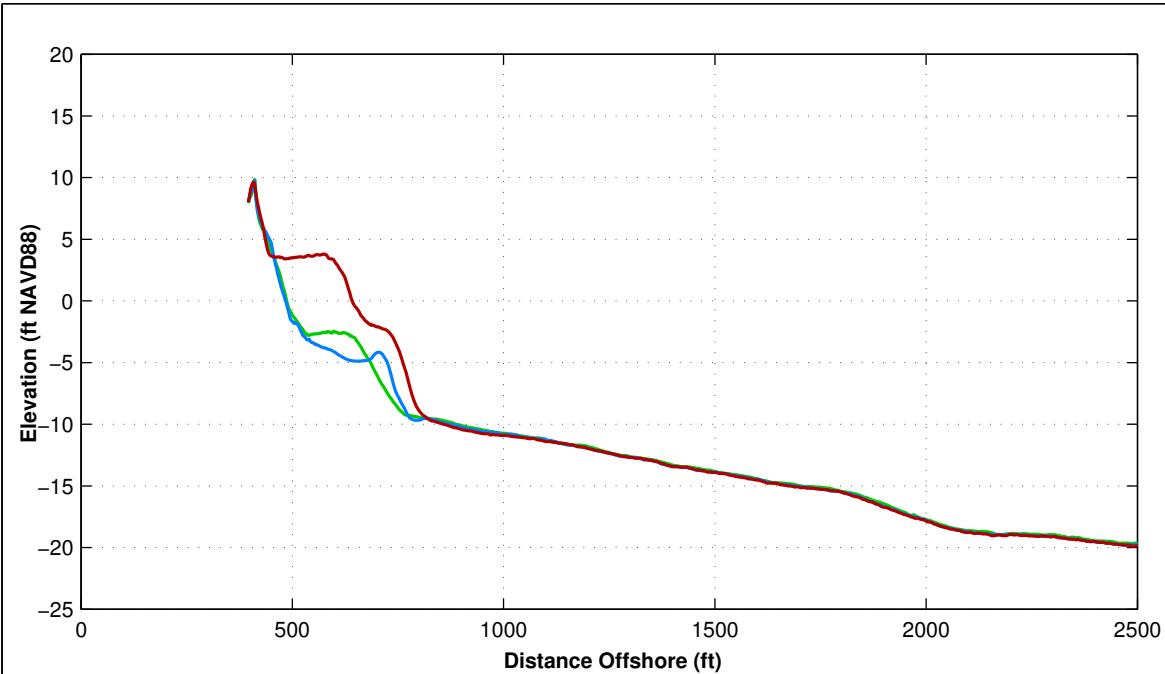
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ST 49+35

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 SURVEYING DATA &  
 ANALYSIS

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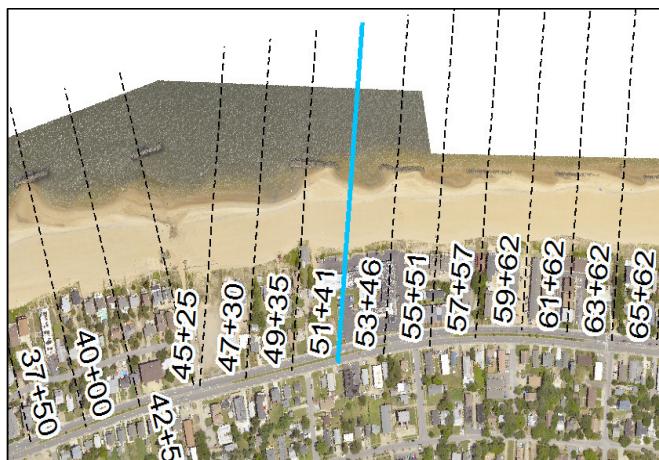
Survey Transect 51+41	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	153.08 ft/yr	157.93 ft
Volume Change Above -15 ft NAVD88	49.48 cy/ft/yr	55.27 cy/ft
Volume Change Above 0 ft NAVD88	19.96 cy/ft/yr	19.96 cy/ft

LEGEND:

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



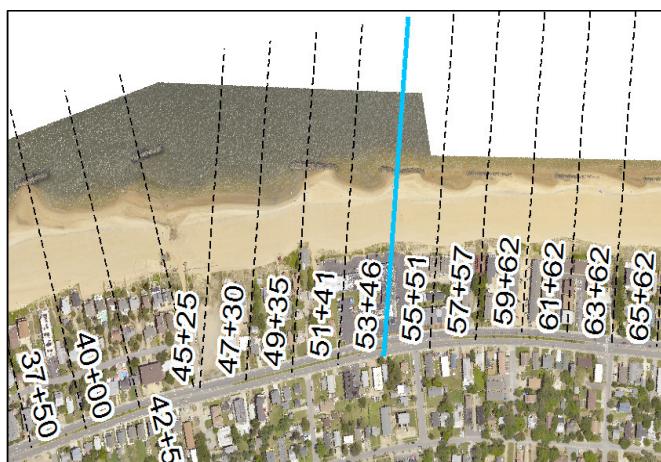
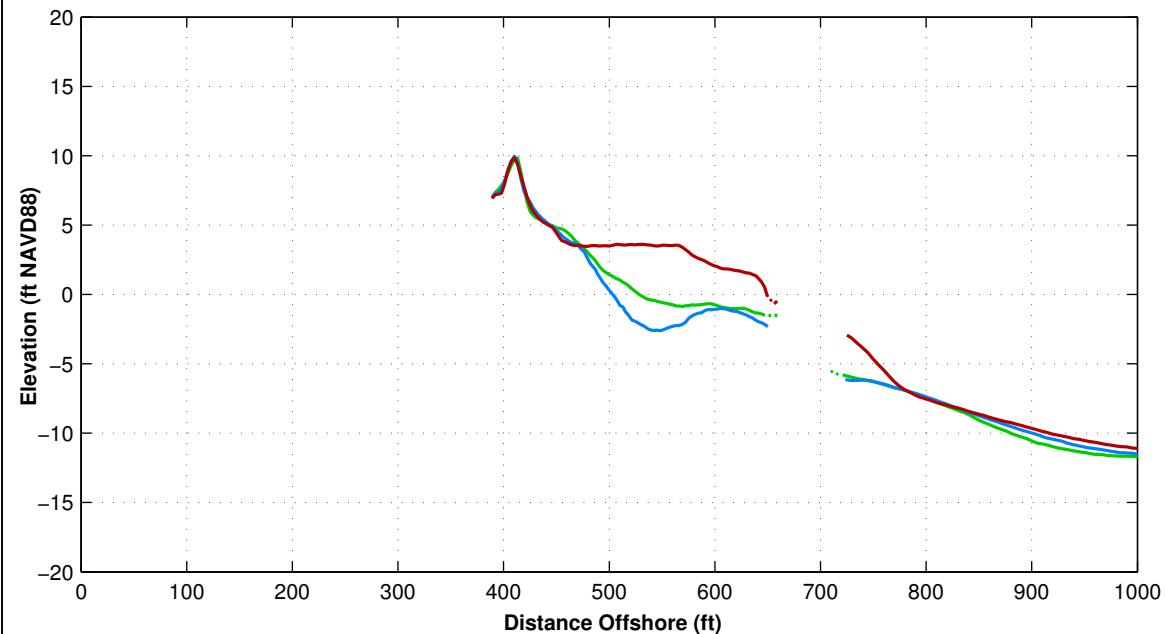
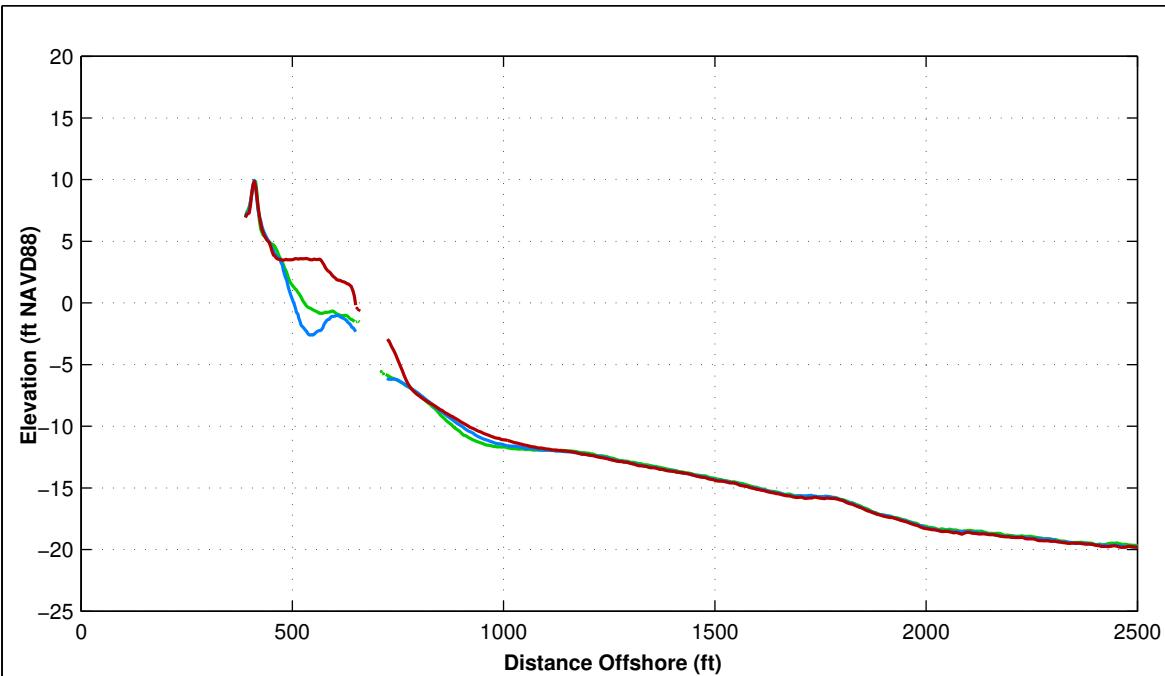
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**NORFOLK**  
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ST 51+41

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SURVEYING DATA &  
ANALYSIS

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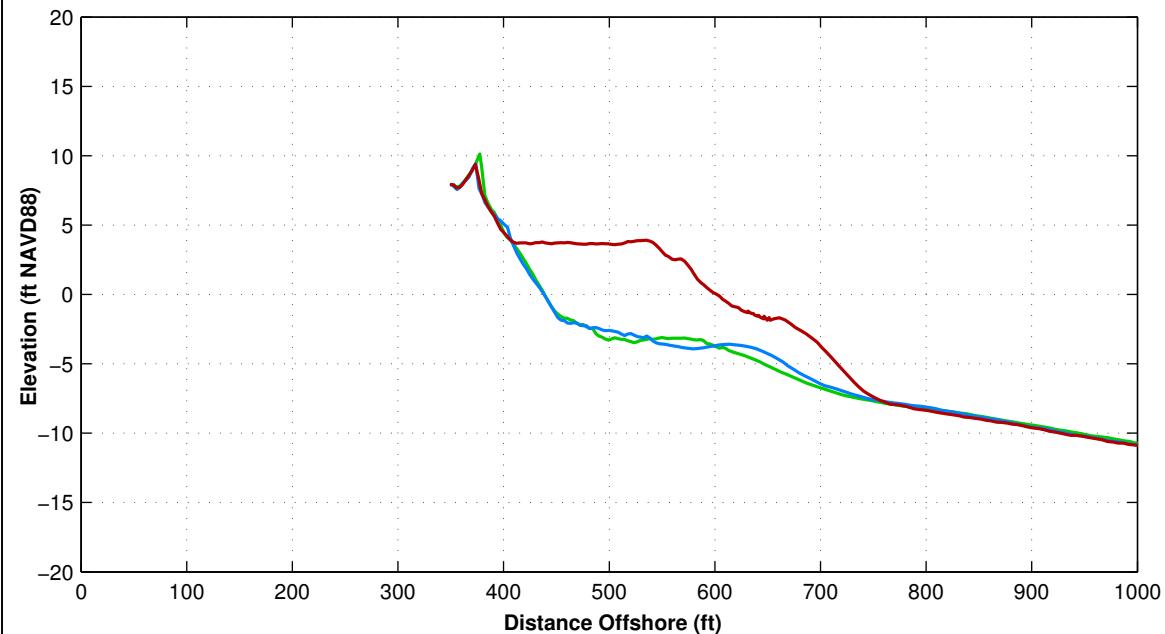
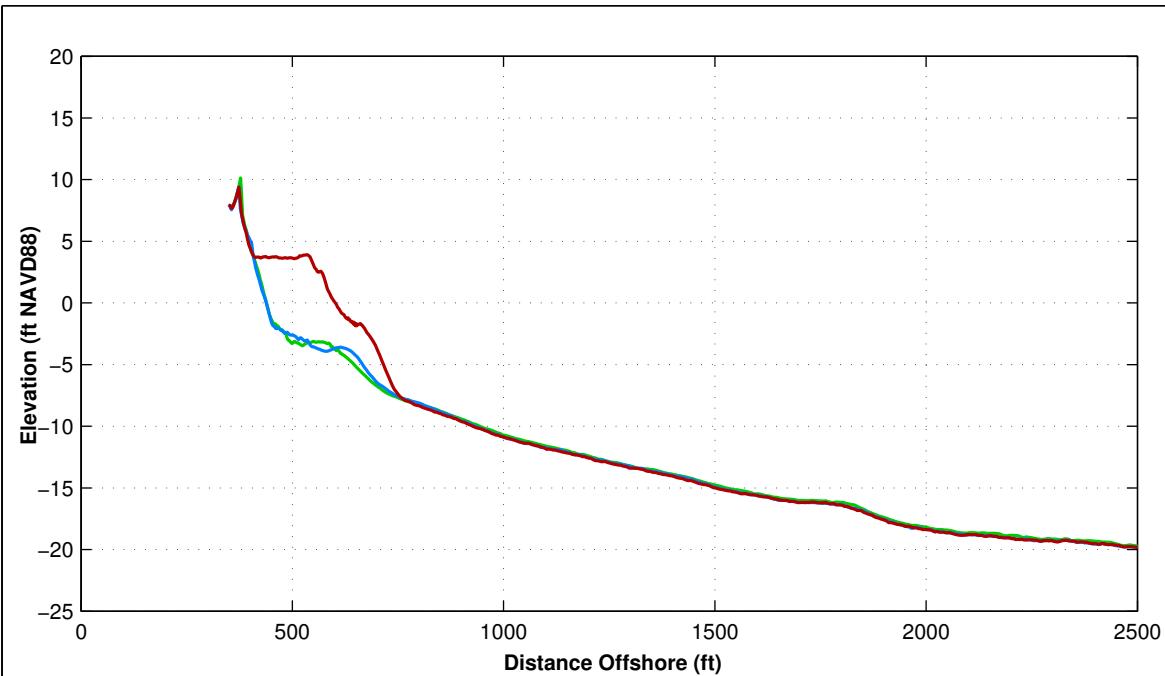
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**NORFOLK**  
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ST 53+46

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SURVEYING DATA &  
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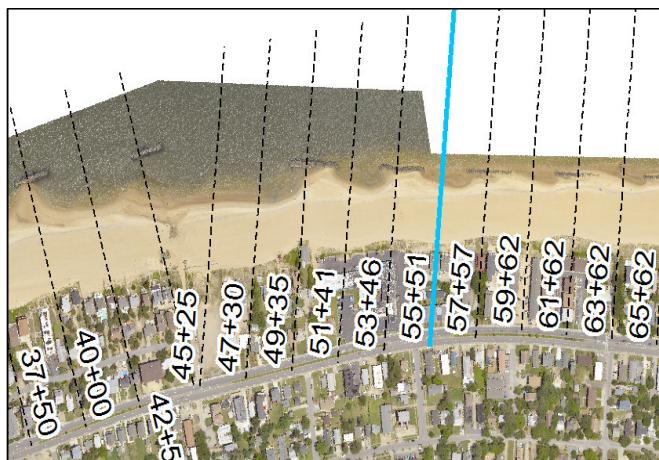
Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	154.17 ft/yr	156.11 ft
Volume Change Above -15 ft NAVD88	47.68 cy/ft/yr	48.59 cy/ft
Volume Change Above 0 ft NAVD88	19.84 cy/ft/yr	20.56 cy/ft

**LEGEND:**

MAY 2017	—
OCT 2016	—
MAY 2016	—

**Notes:**

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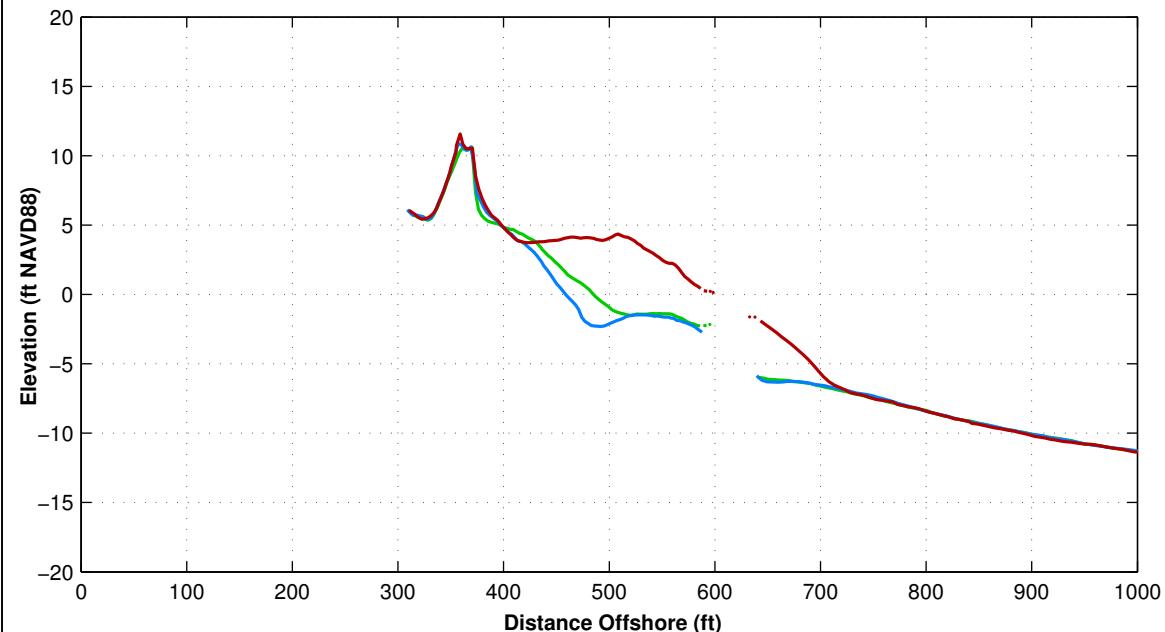
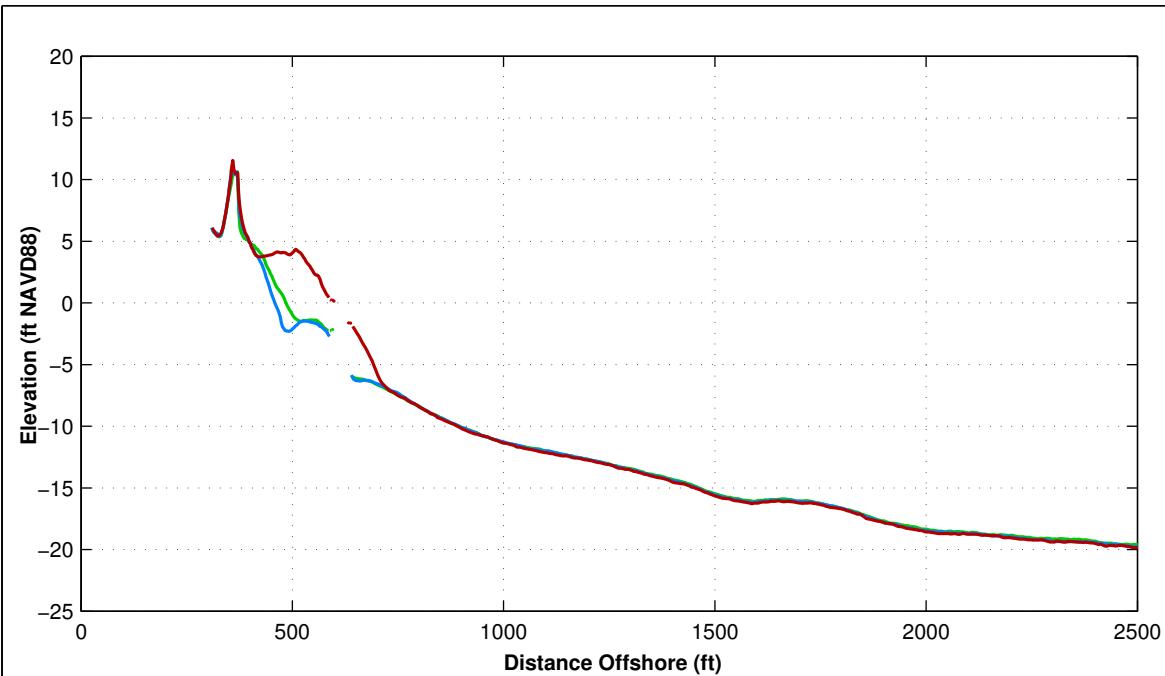
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ST 55+51

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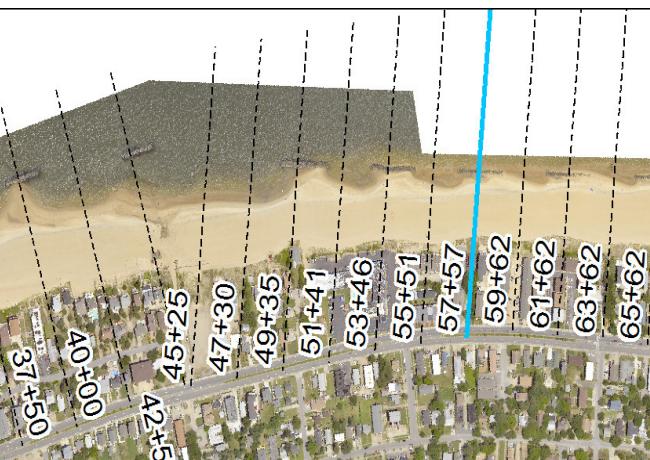
Survey Transect 57+57	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	106.83 ft/yr	127.97 ft
Volume Change Above -15 ft NAVD88	25.63 cy/ft/yr	30.80 cy/ft
Volume Change Above 0 ft NAVD88	16.47 cy/ft/yr	18.29 cy/ft

**LEGEND:**

MAY 2017	—
OCT 2016	—
MAY 2016	—

**Notes:**

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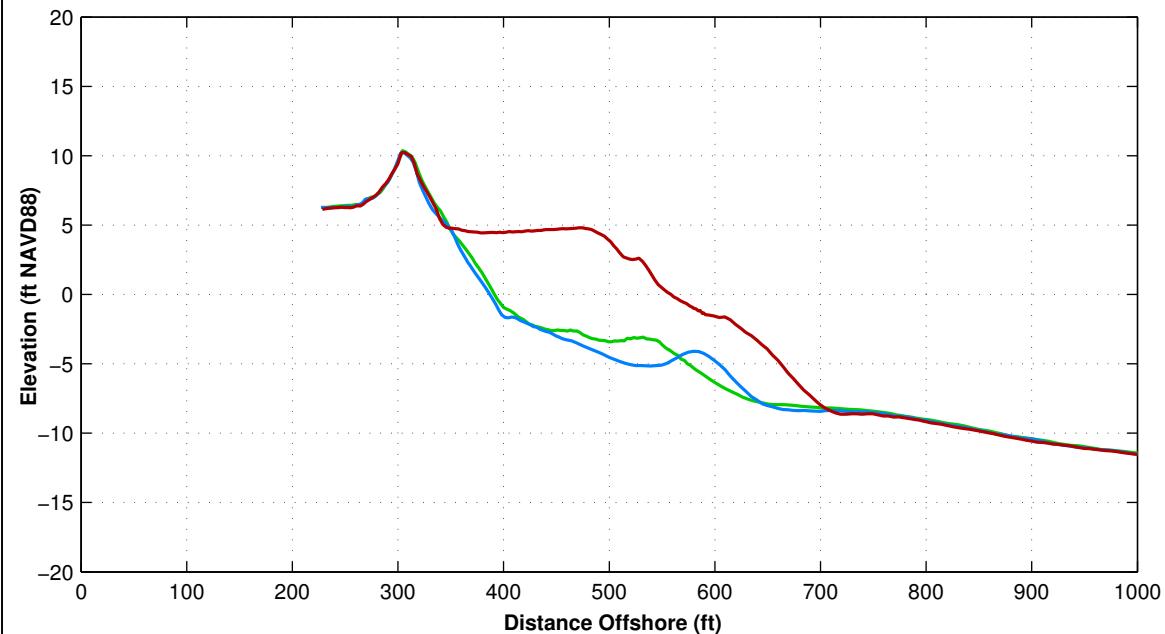
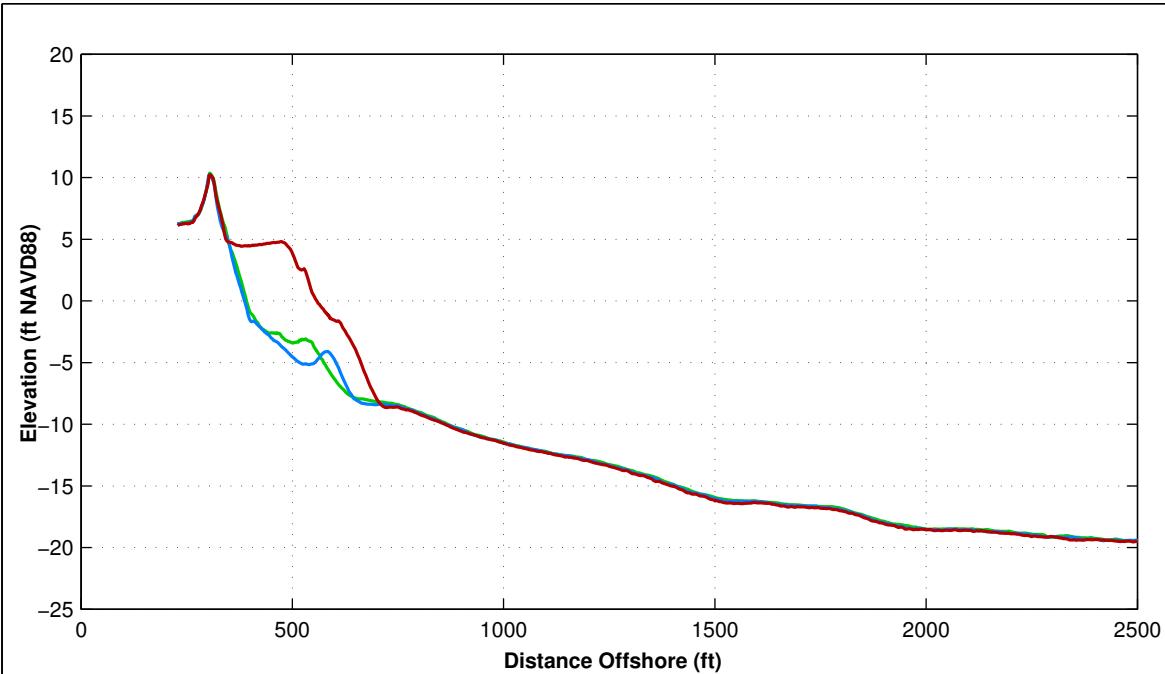
THE CITY OF  
**NORFOLK**  
PUBLIC WORKS

ST 57+57

OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS

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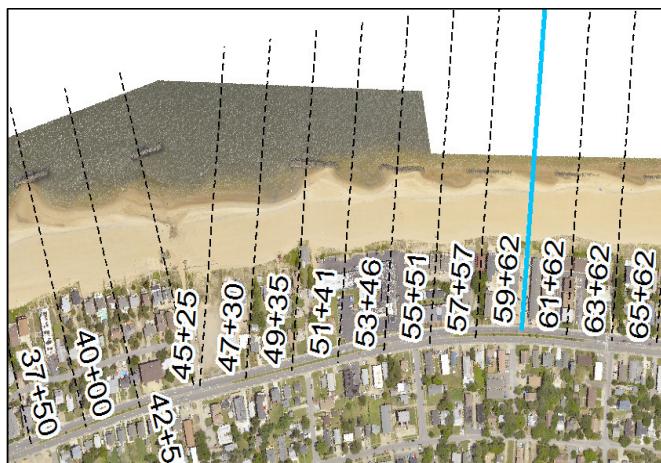
Survey Transect 59+62	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	159.70 ft/yr	165.38 ft
Volume Change Above -15 ft NAVD88	57.28 cy/ft/yr	64.21 cy/ft
Volume Change Above 0 ft NAVD88	25.42 cy/ft/yr	26.99 cy/ft

LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

Notes:

1. Station From West To East At Varying Intervals.
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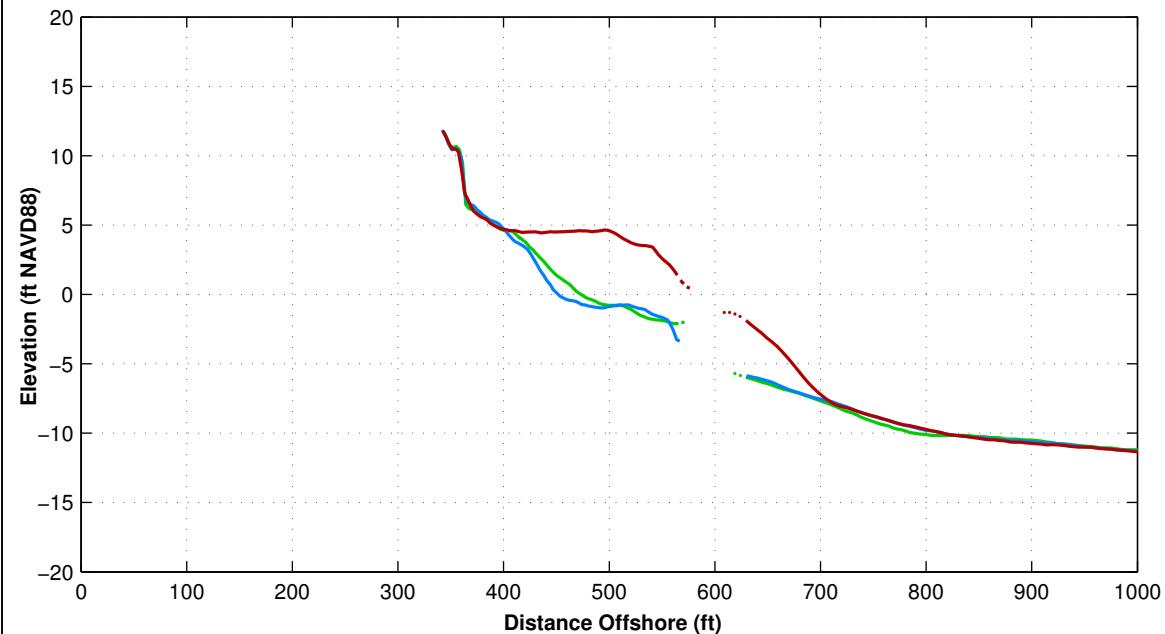
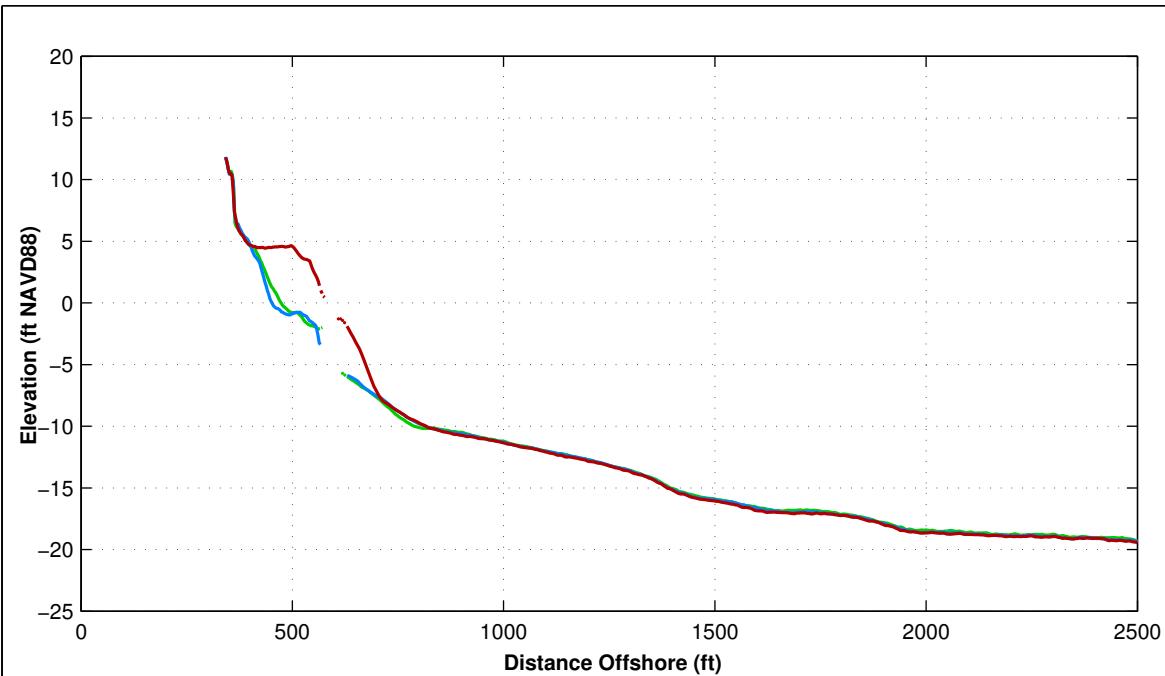
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**NORFOLK**  
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ST 59+62

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ANALYSIS

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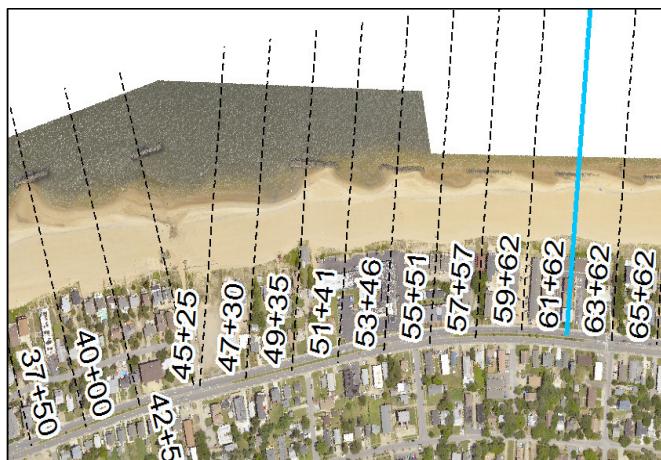
Survey Transect 61+62	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	110.63 ft/yr	126.94 ft
Volume Change Above -15 ft NAVD88	27.91 cy/ft/yr	38.53 cy/ft
Volume Change Above 0 ft NAVD88	18.40 cy/ft/yr	20.00 cy/ft

LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

Notes:

1. Station From West To East At Varying Intervals.
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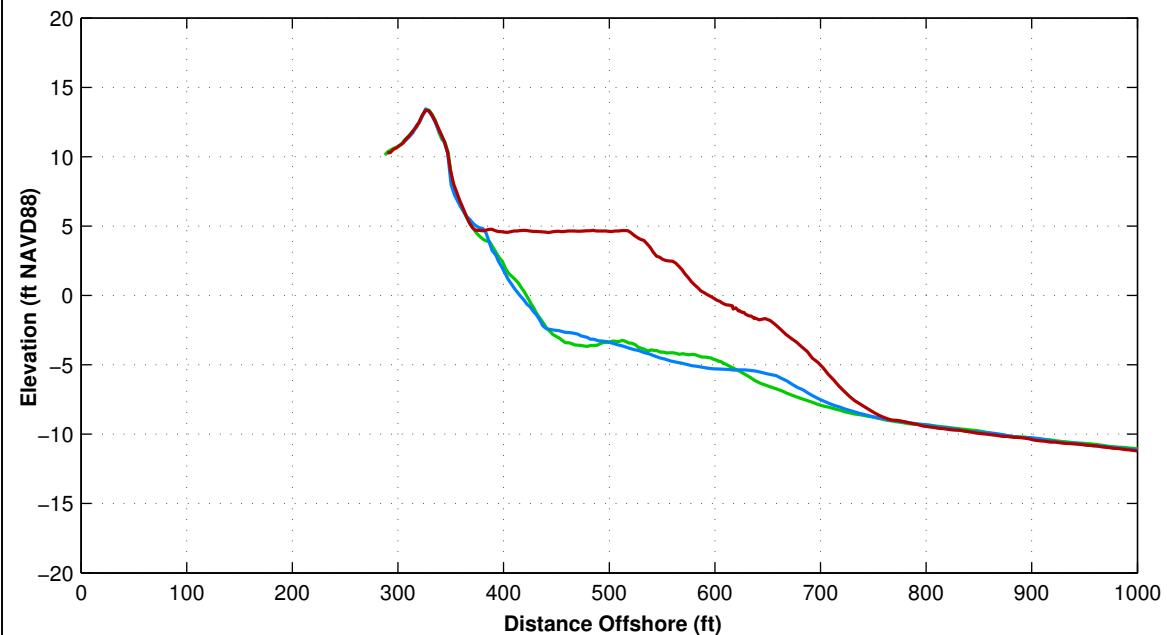
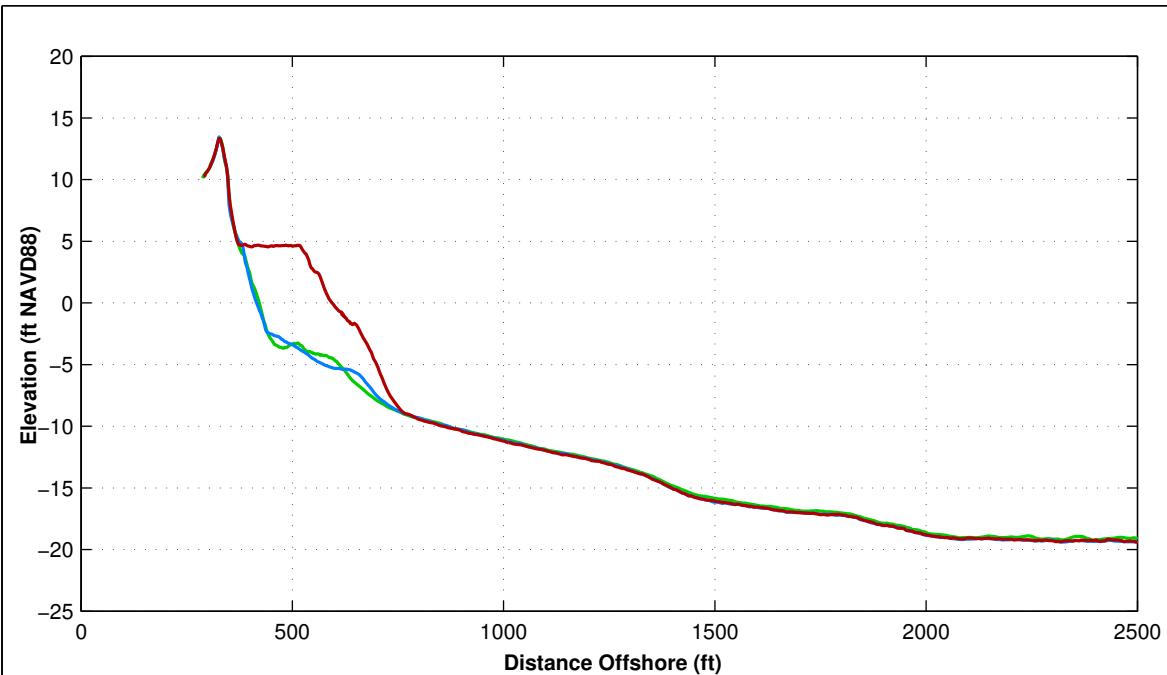
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ST 61+62

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SURVEYING DATA &  
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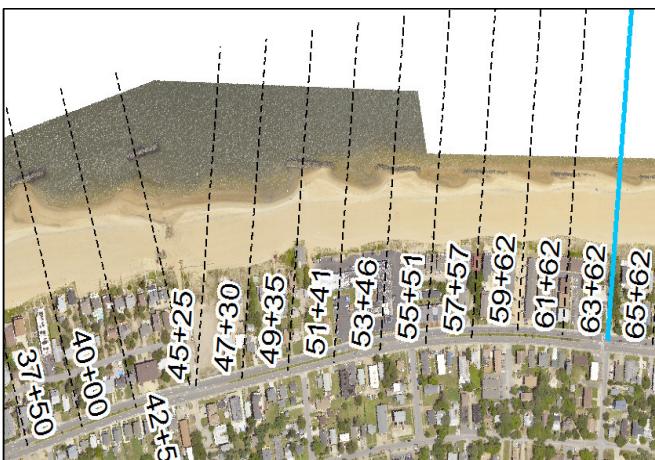


Survey Transect 63+62	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	165.03 ft/yr	171.89 ft
Volume Change Above -15 ft NAVD88	65.49 cy/ft/yr	66.75 cy/ft
Volume Change Above 0 ft NAVD88	27.33 cy/ft/yr	27.74 cy/ft

**LEGEND:**  
 MAY 2017 — Red line  
 OCT 2016 — Blue line  
 MAY 2016 — Green line

Notes:

1. Station From West To East At Varying Intervals.
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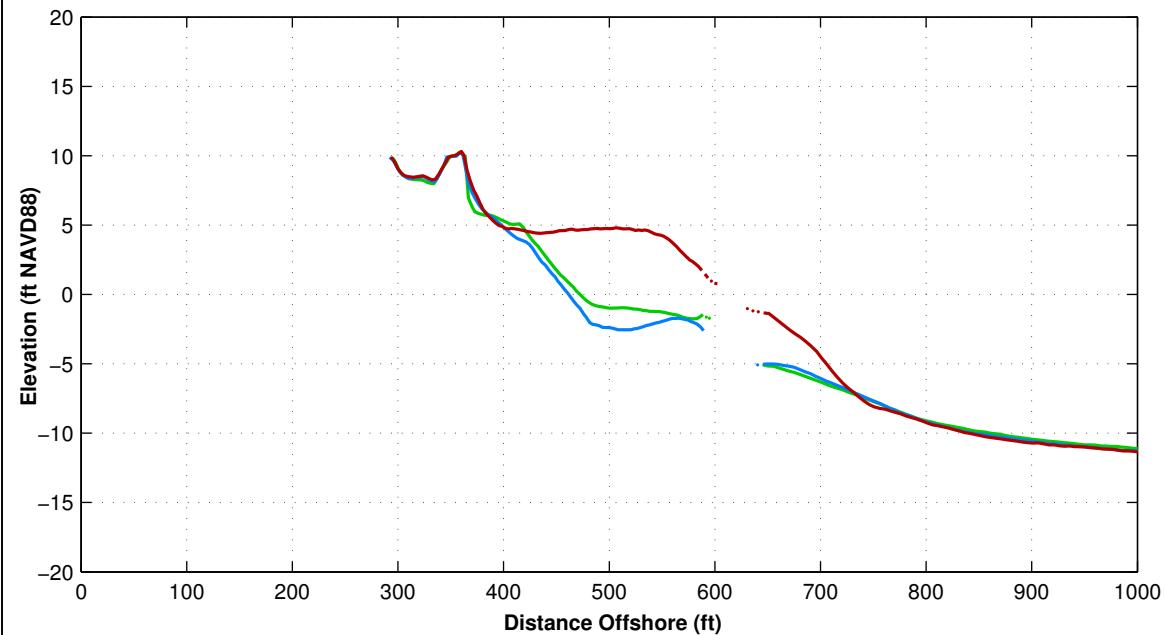
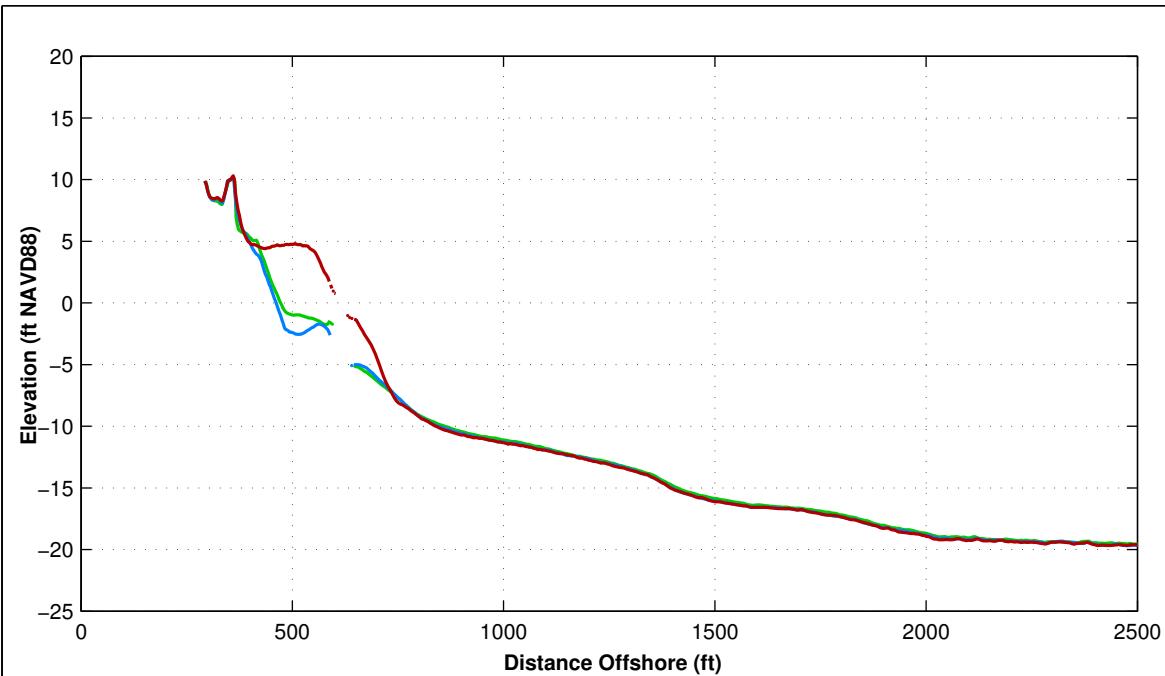
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ST 63+62

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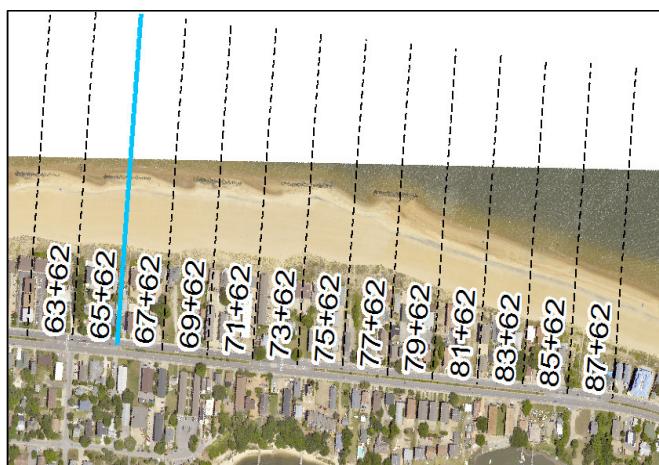


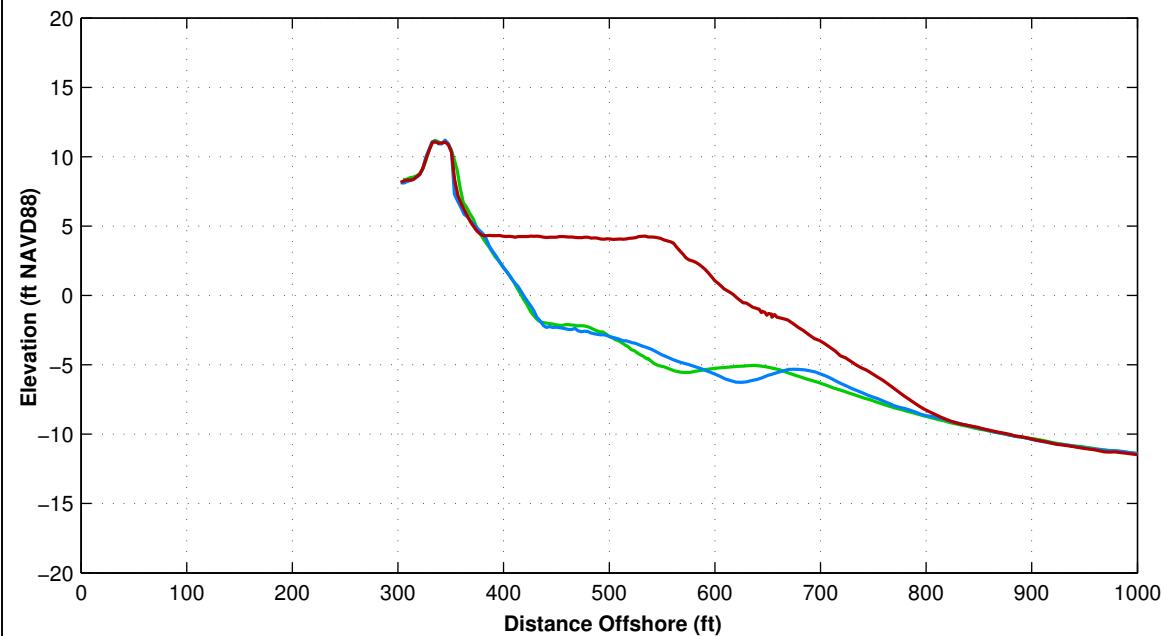
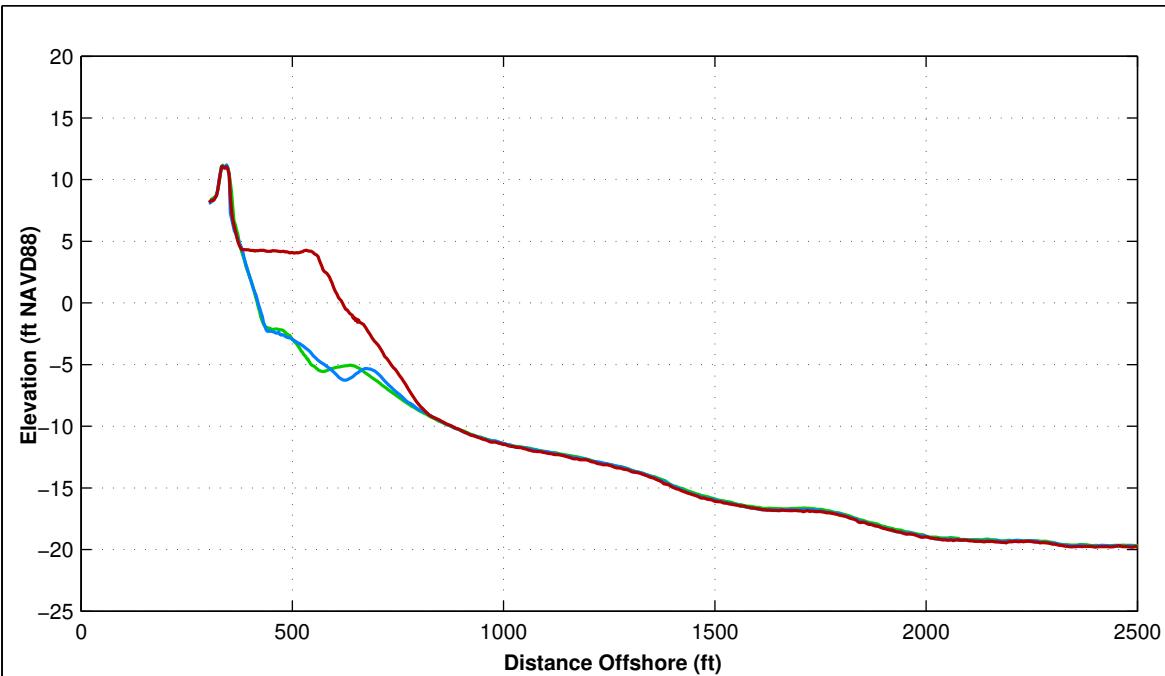
Survey Transect 65+62	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	136.47 ft/yr	145.35 ft
Volume Change Above -15 ft NAVD88	30.03 cy/ft/yr	38.29 cy/ft
Volume Change Above 0 ft NAVD88	23.50 cy/ft/yr	24.86 cy/ft

**LEGEND:**  
 MAY 2017 — Red line  
 OCT 2016 — Blue line  
 MAY 2016 — Green line

Notes:

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5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





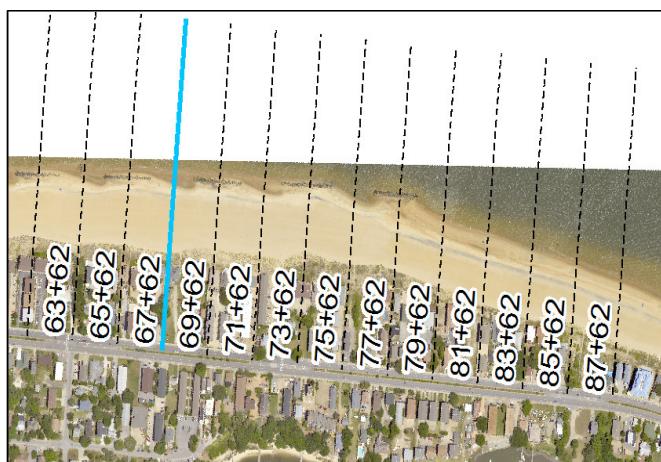
Survey Transect 67+62	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	191.67 ft/yr	191.55 ft
Volume Change Above -15 ft NAVD88	72.03 cy/ft/yr	72.08 cy/ft
Volume Change Above 0 ft NAVD88	28.15 cy/ft/yr	28.90 cy/ft

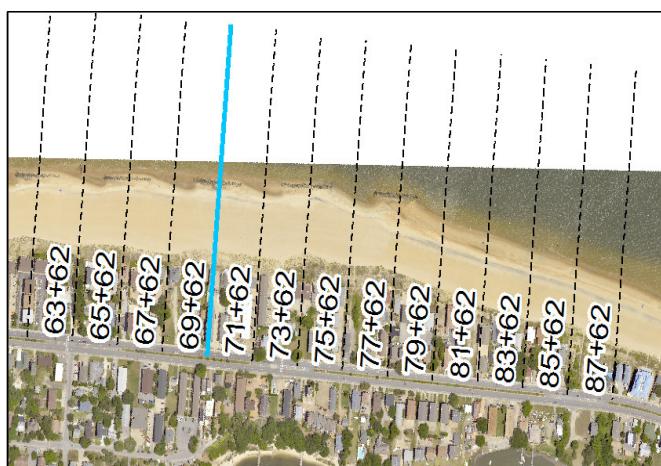
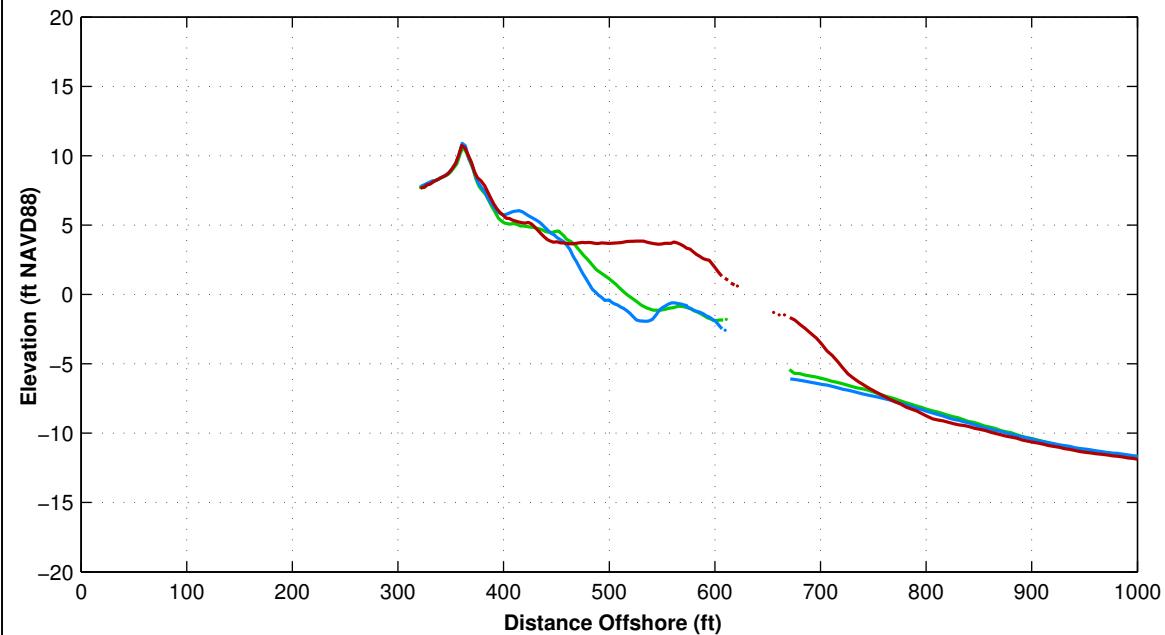
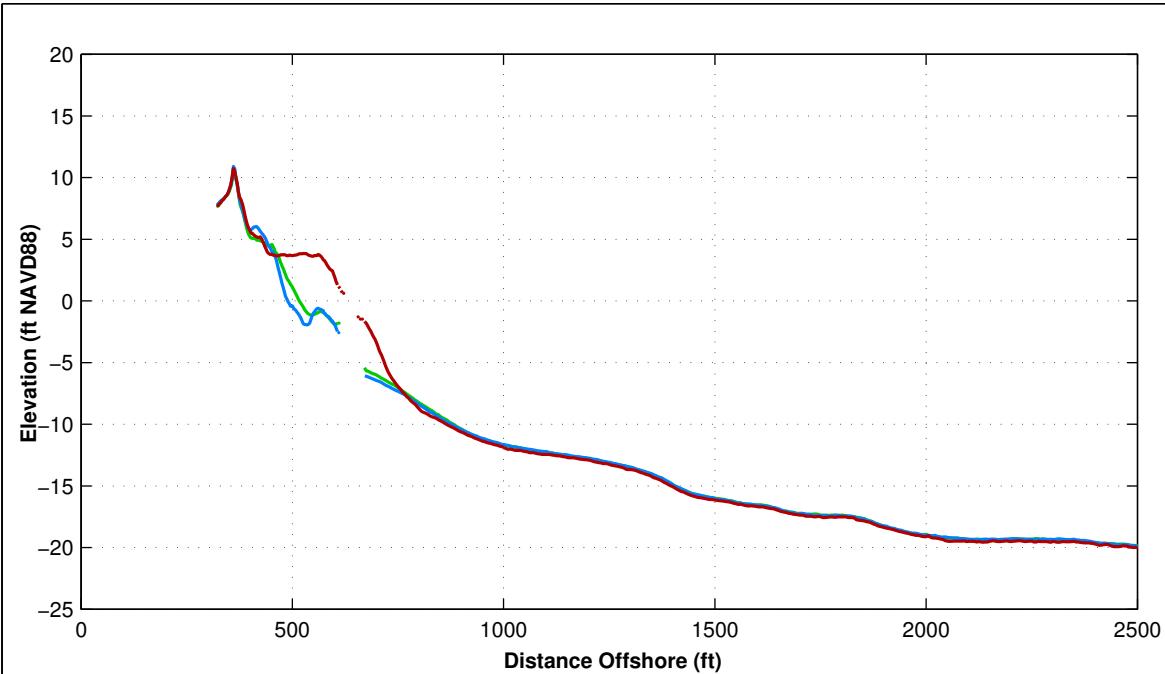
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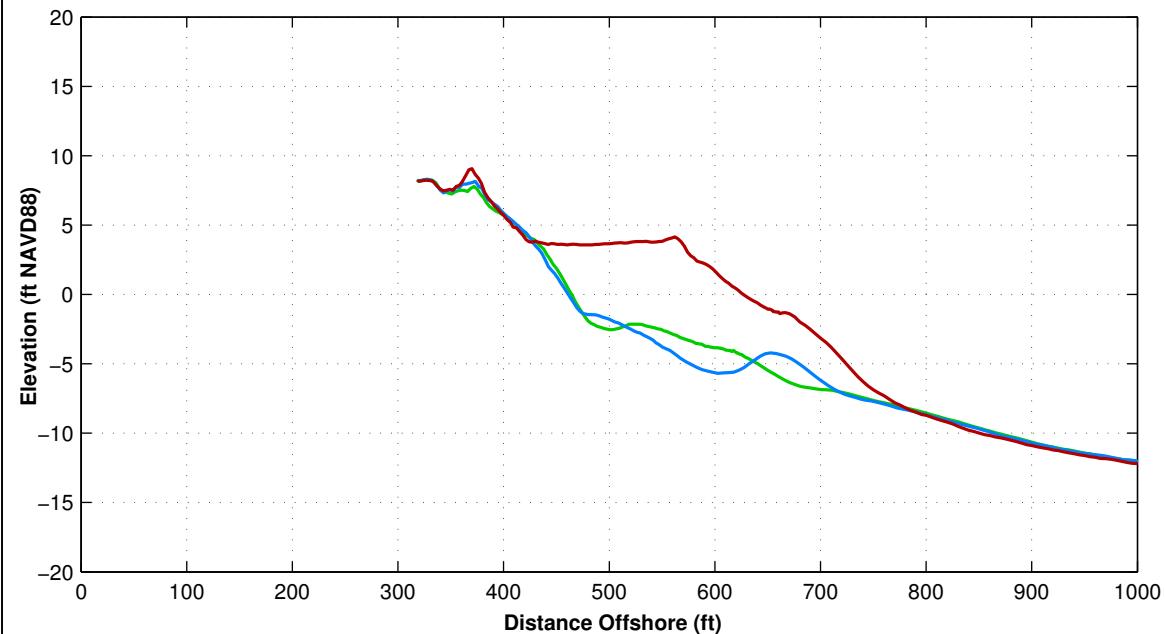
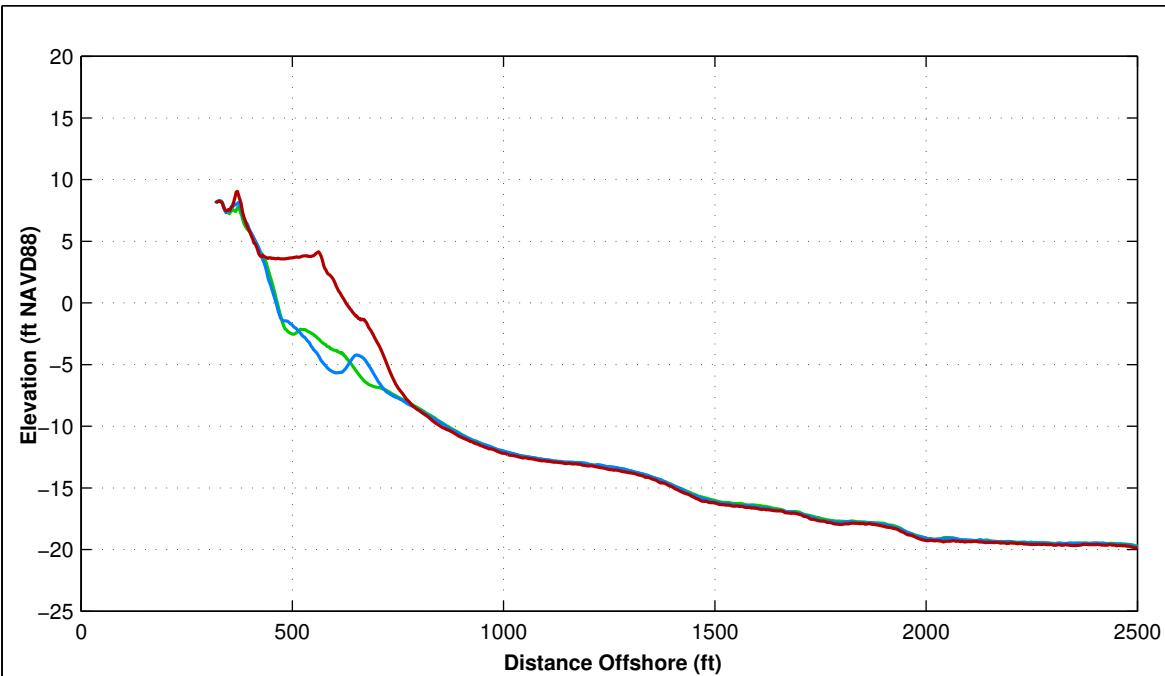
- MAY 2017 — Red line
- OCT 2016 — Blue line
- MAY 2016 — Green line

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.







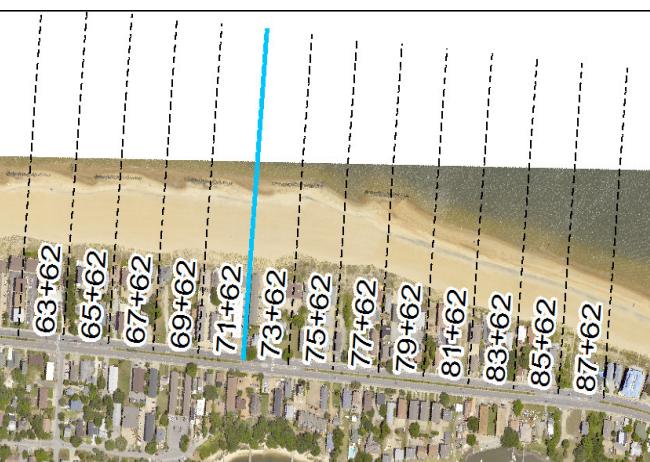
Survey Transect 71+62	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	152.52 ft/yr	156.74 ft
Volume Change Above -15 ft NAVD88	50.40 cy/ft/yr	52.37 cy/ft
Volume Change Above 0 ft NAVD88	21.05 cy/ft/yr	20.96 cy/ft

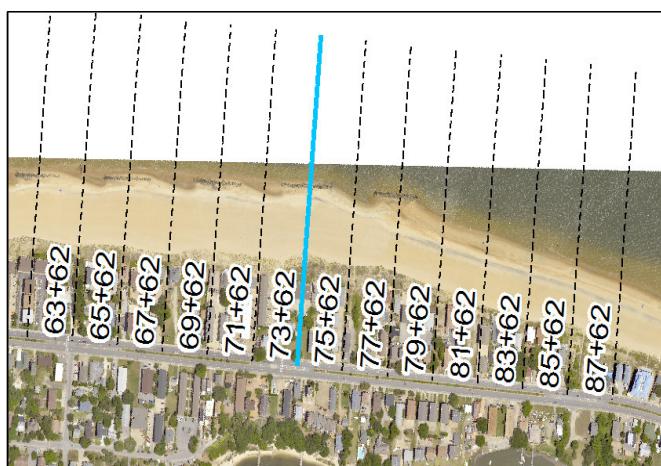
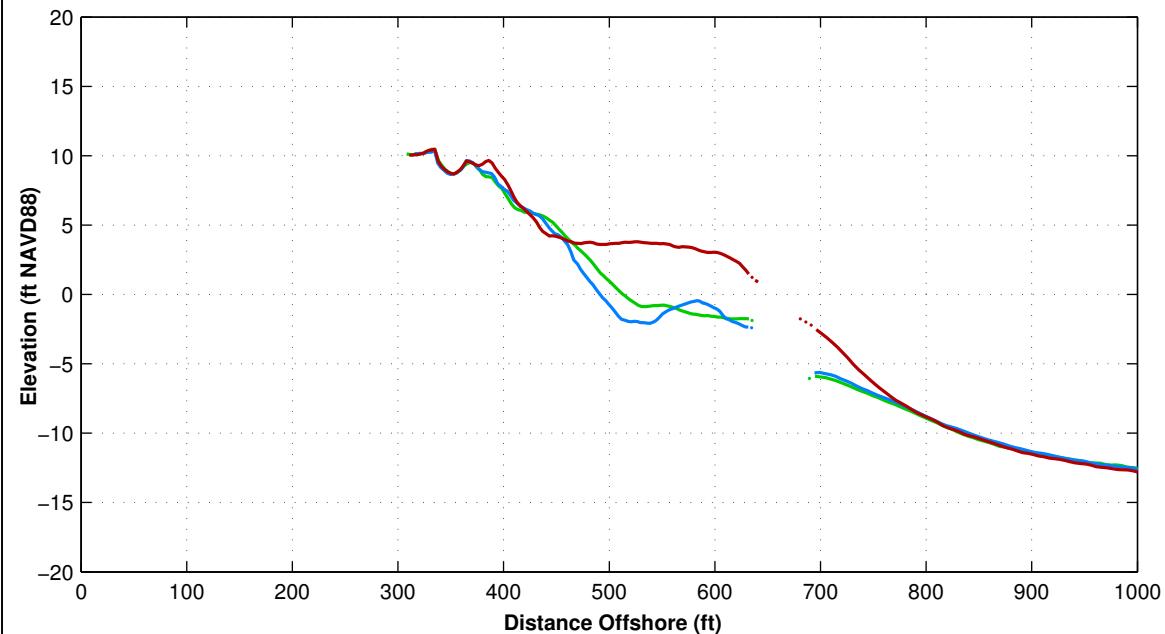
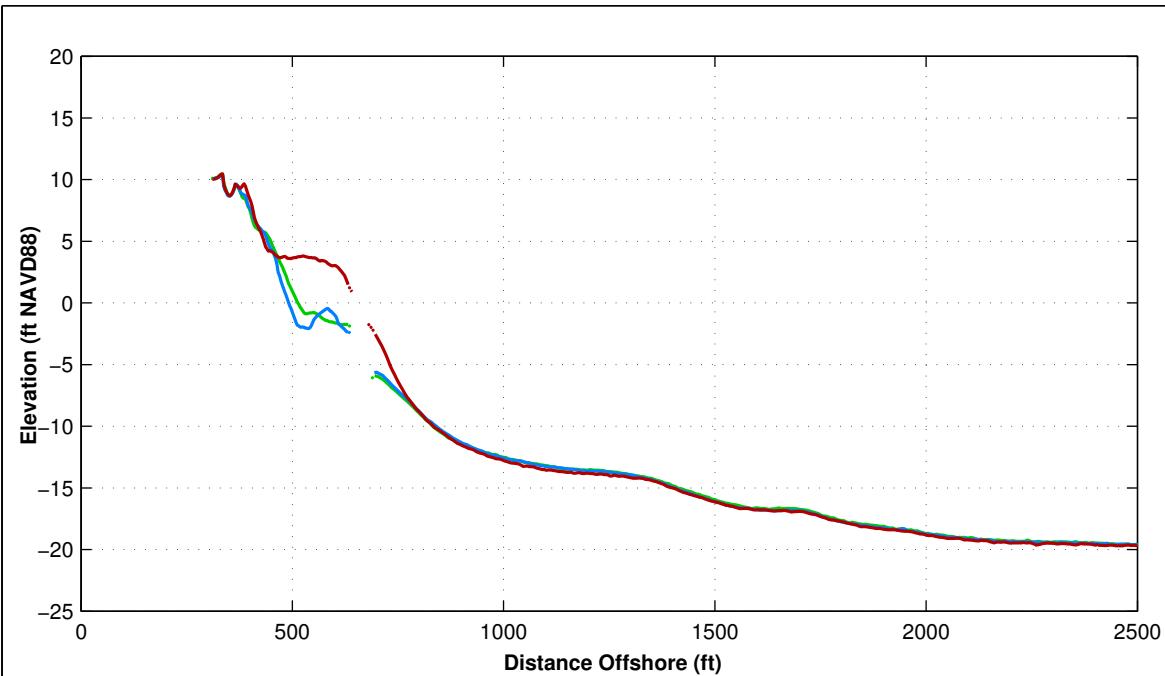
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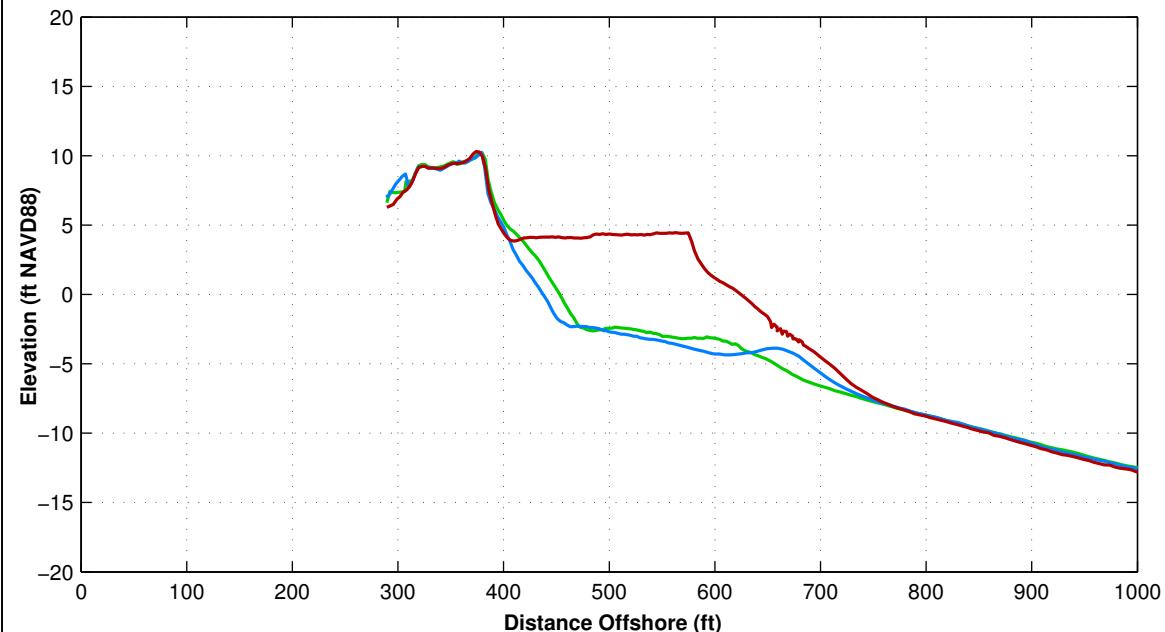
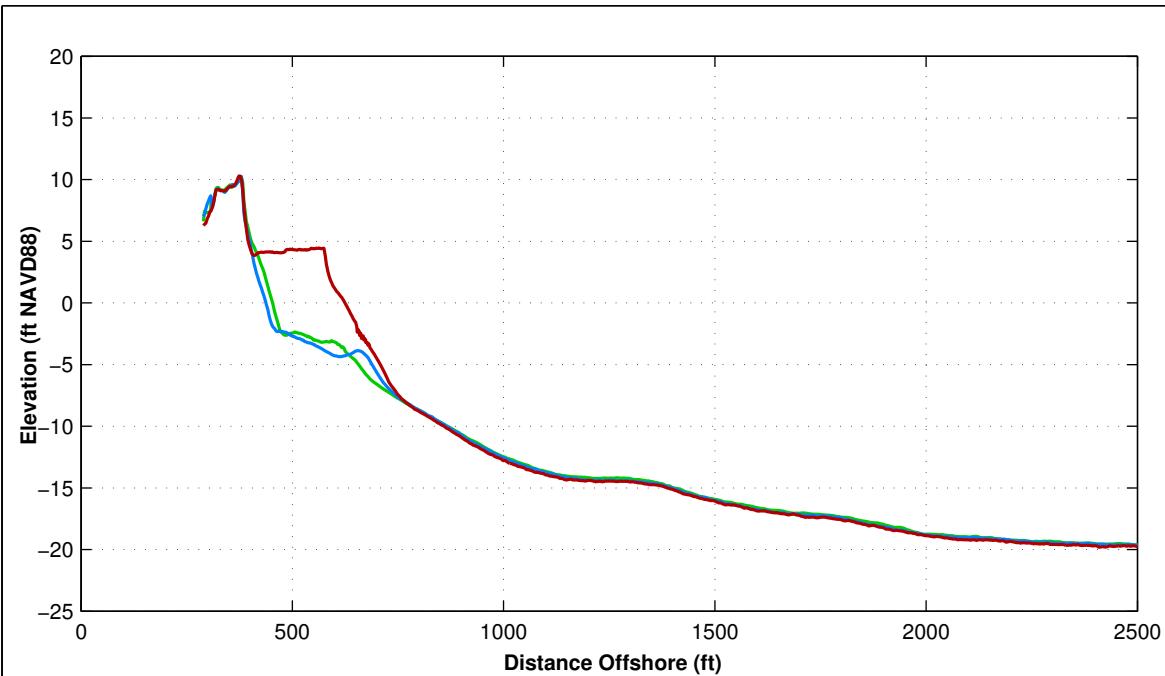
MAY 2017	—
OCT 2016	—
MAY 2016	—

**Notes:**

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
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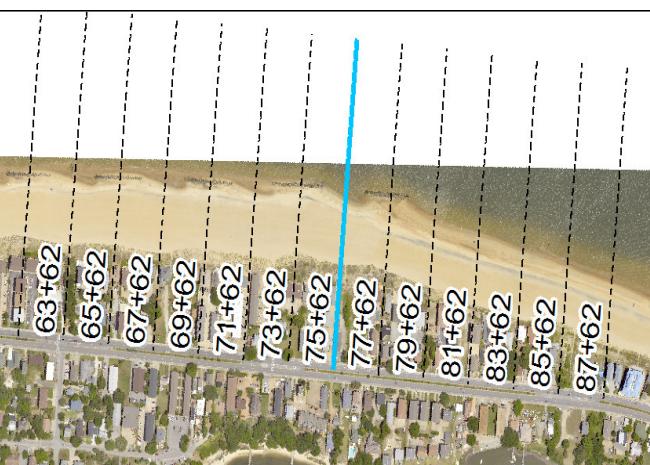
Survey Transect 75+62	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	158.94 ft/yr	175.20 ft
Volume Change Above -15 ft NAVD88	45.43 cy/ft/yr	51.49 cy/ft
Volume Change Above 0 ft NAVD88	23.43 cy/ft/yr	26.48 cy/ft

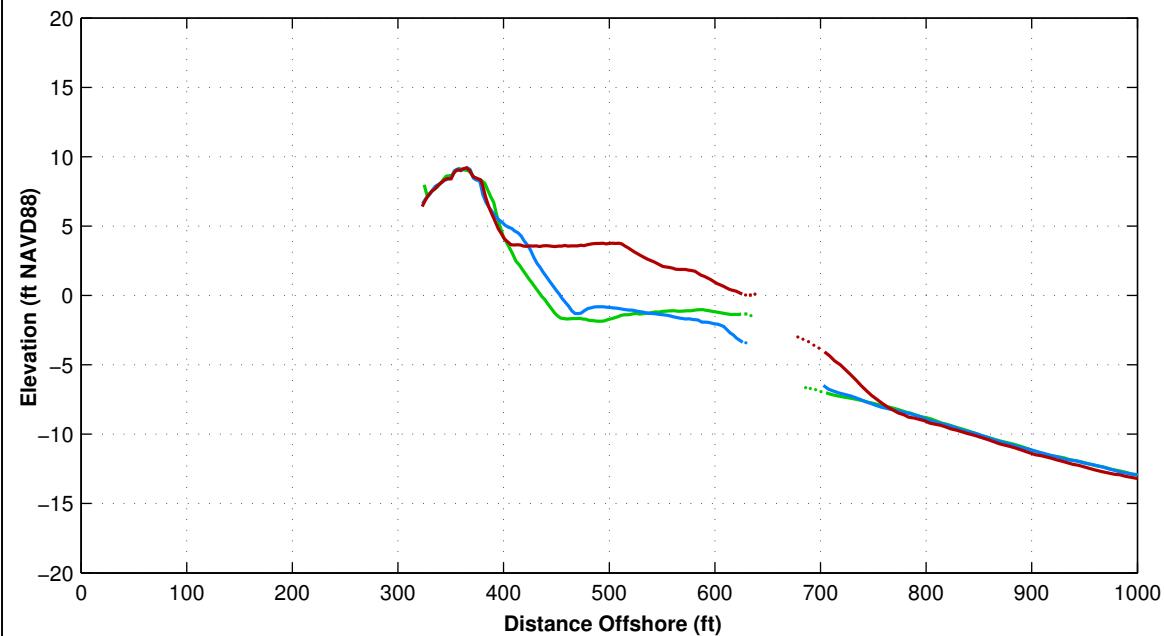
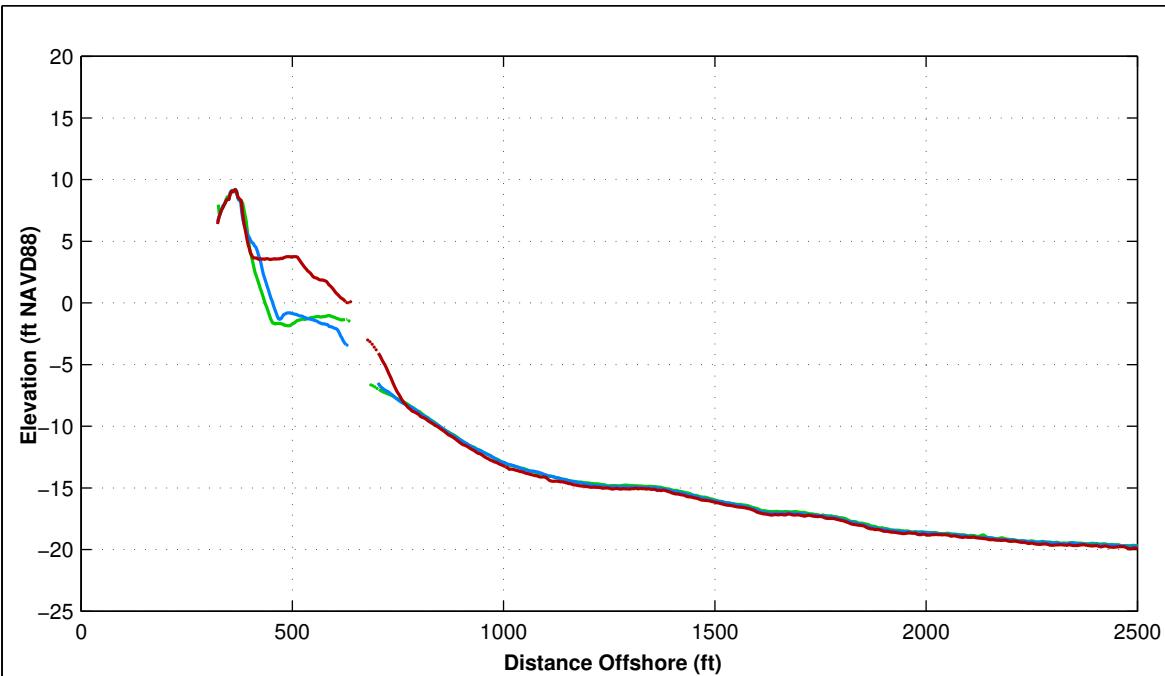
**LEGEND:**

MAY 2017	—	—
OCT 2016	—	—
MAY 2016	—	—

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





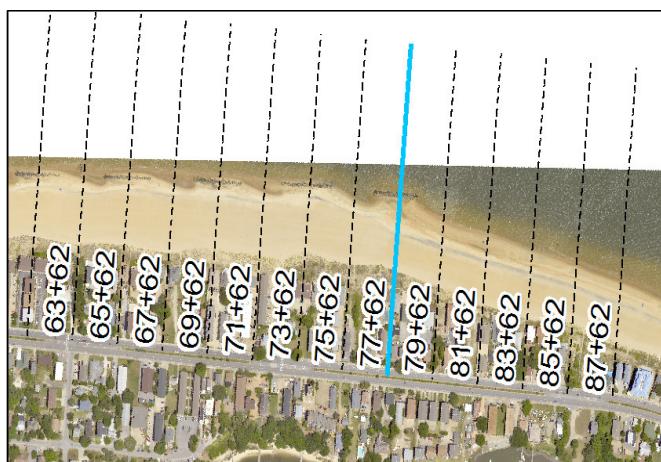
Survey Transect 77+62	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	173.36 ft/yr	155.62 ft
Volume Change Above -15 ft NAVD88	26.83 cy/ft/yr	24.96 cy/ft
Volume Change Above 0 ft NAVD88	19.58 cy/ft/yr	16.92 cy/ft

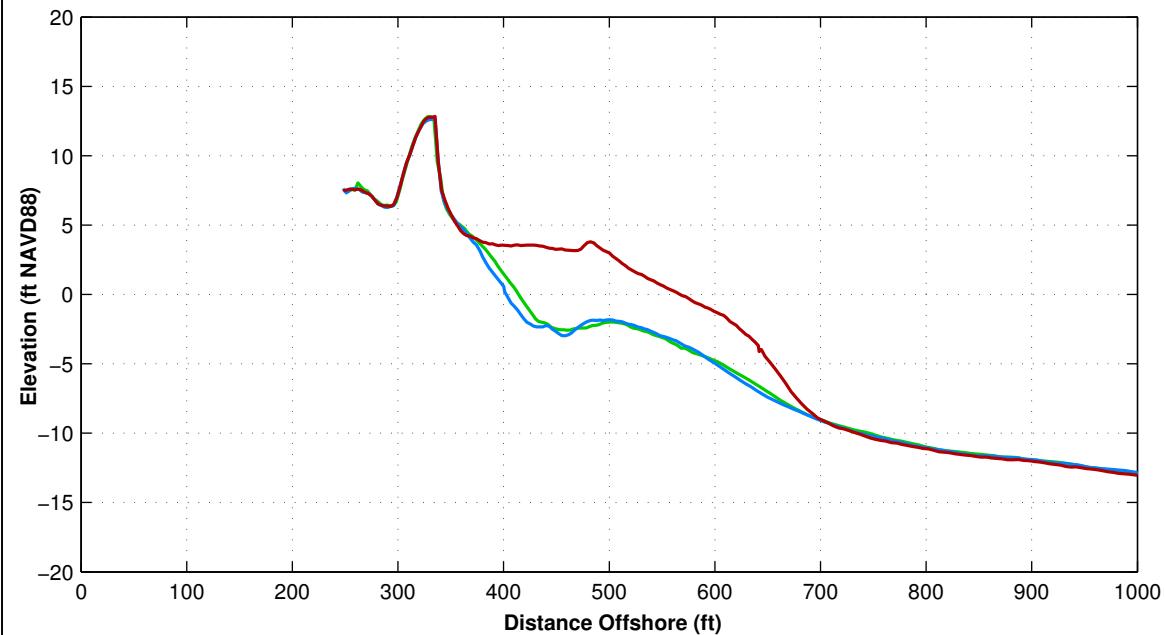
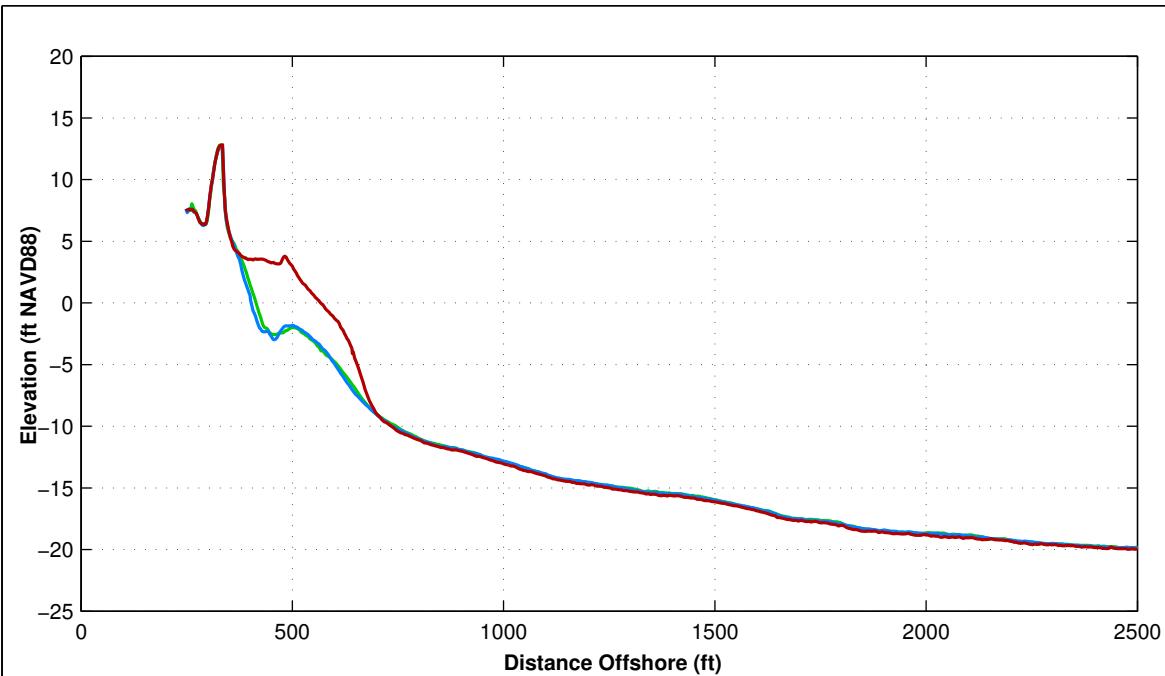
LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
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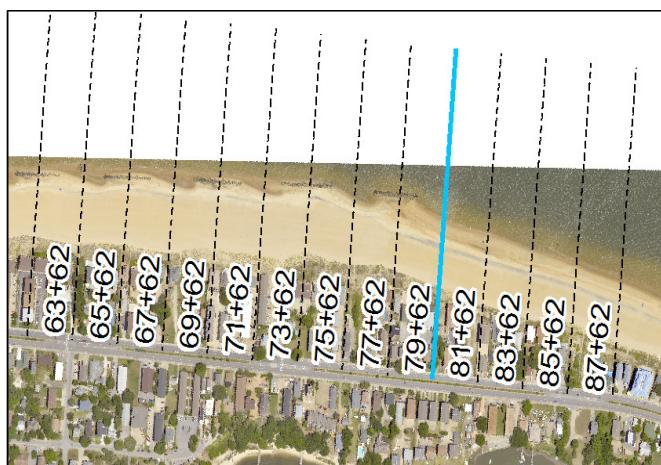
Survey Transect 79+62	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	136.85 ft/yr	145.92 ft
Volume Change Above -15 ft NAVD88	38.62 cy/ft/yr	41.53 cy/ft
Volume Change Above 0 ft NAVD88	16.37 cy/ft/yr	17.76 cy/ft

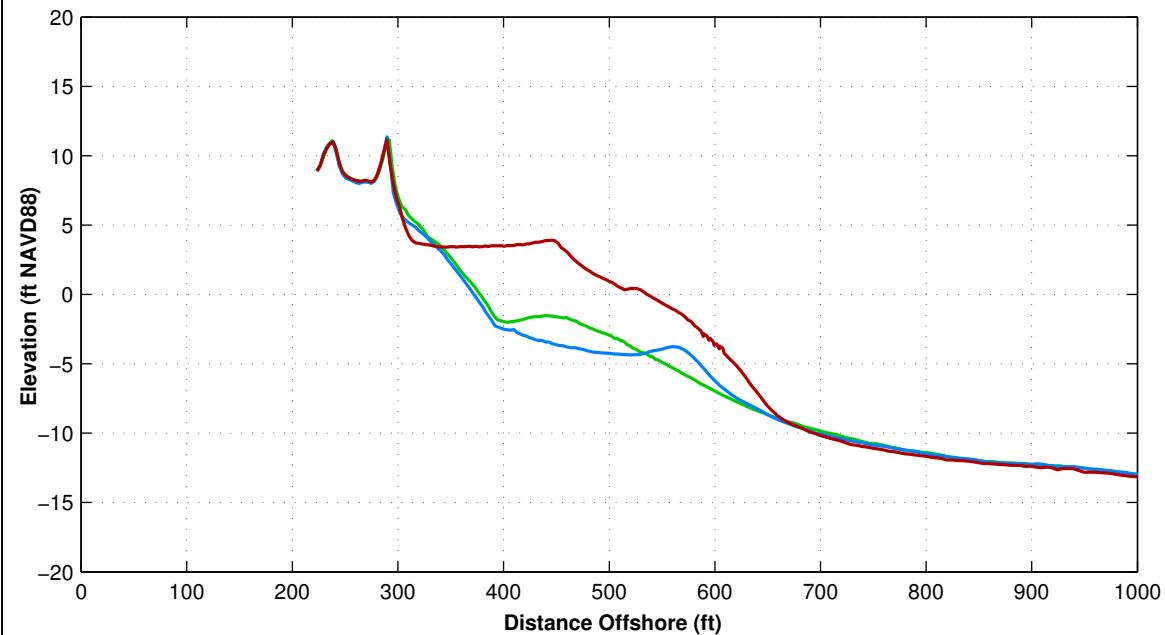
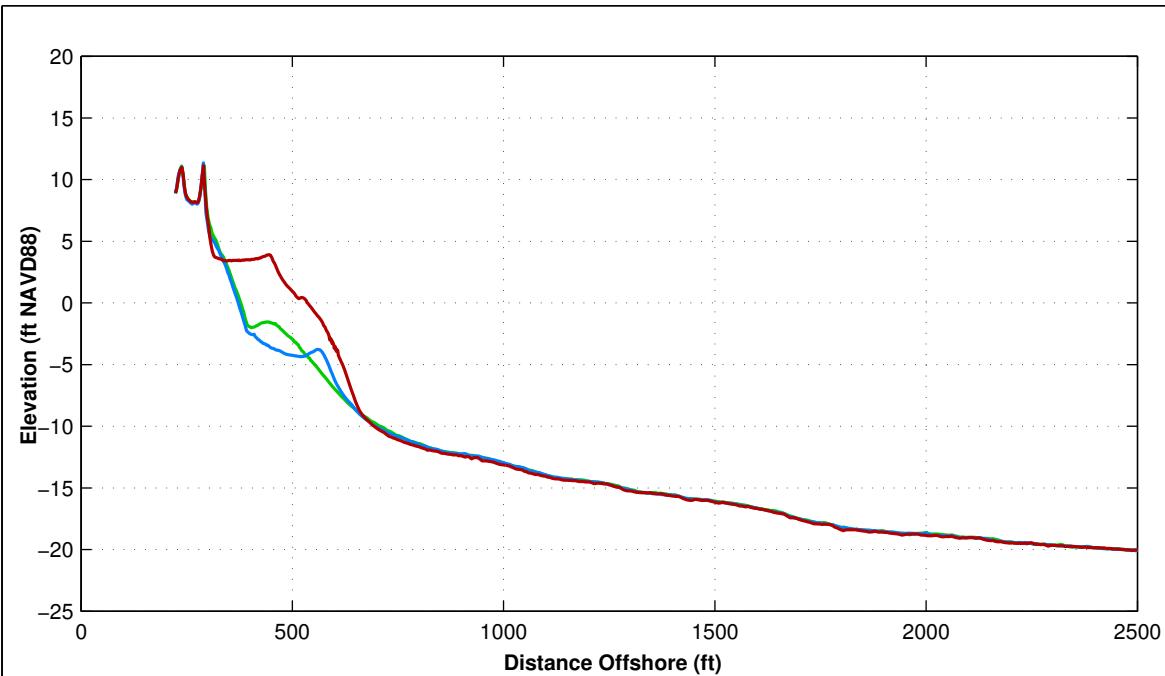
LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

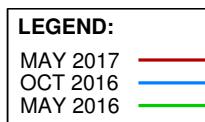
Notes:

1. Station From West To East At Varying Intervals.
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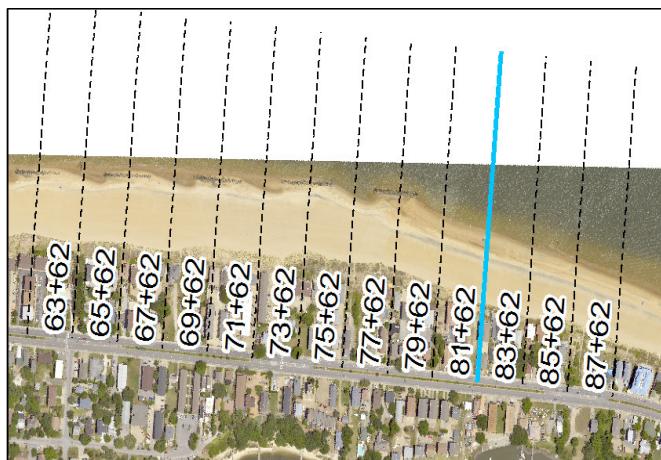


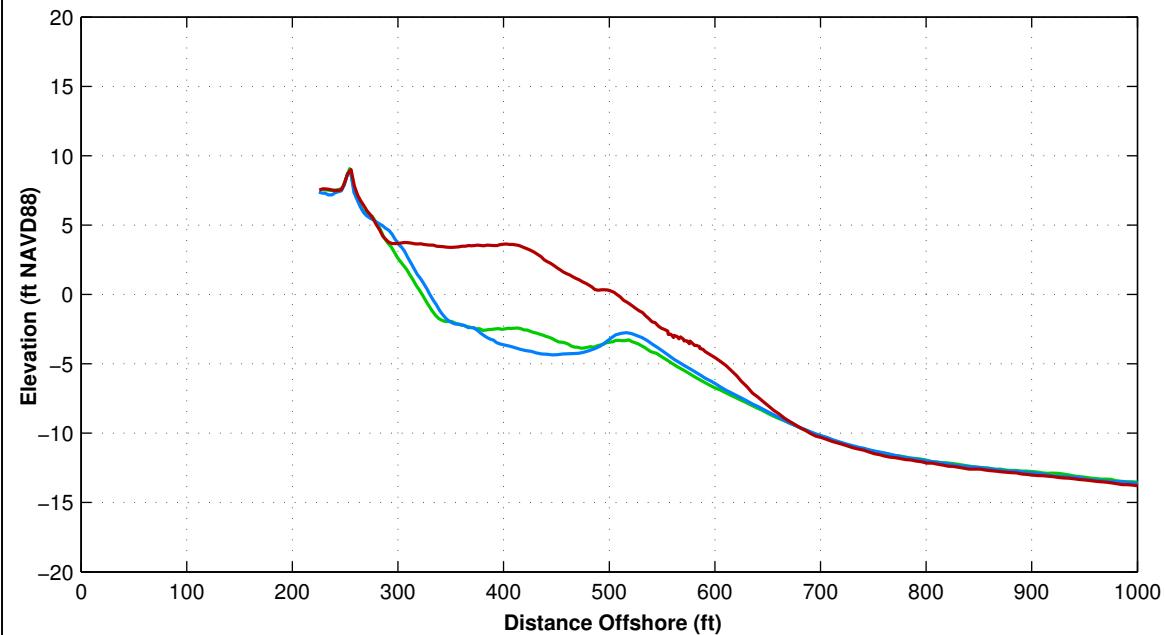
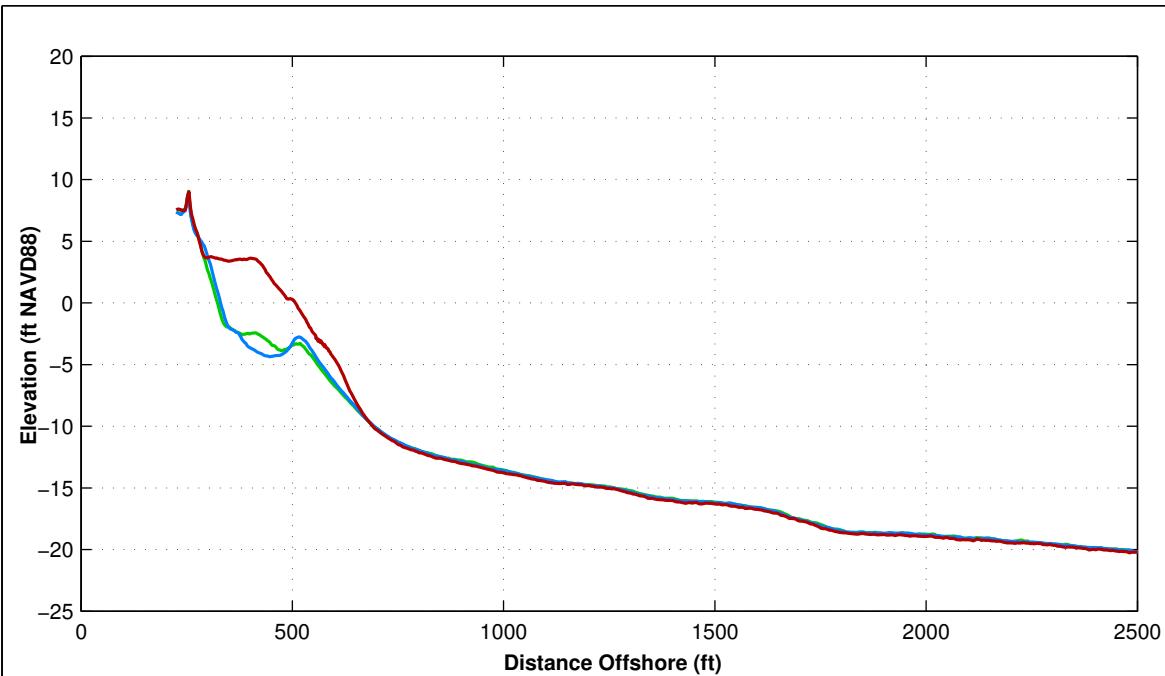
Survey Transect 81+62	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	131.18 ft/yr	136.41 ft
Volume Change Above -15 ft NAVD88	38.03 cy/ft/yr	44.21 cy/ft
Volume Change Above 0 ft NAVD88	15.04 cy/ft/yr	16.66 cy/ft



Notes:

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4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





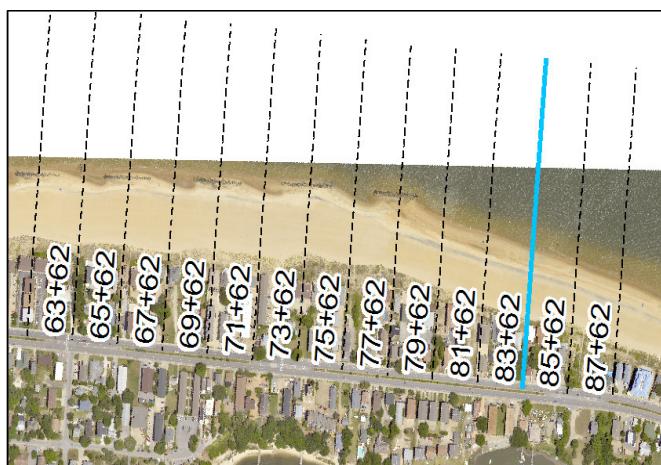
Survey Transect 83+62	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	158.32 ft/yr	150.58 ft
Volume Change Above -15 ft NAVD88	45.92 cy/ft/yr	46.56 cy/ft
Volume Change Above 0 ft NAVD88	19.78 cy/ft/yr	18.51 cy/ft

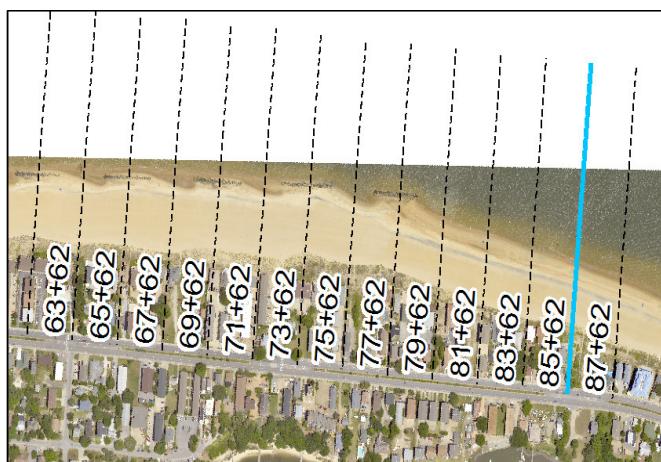
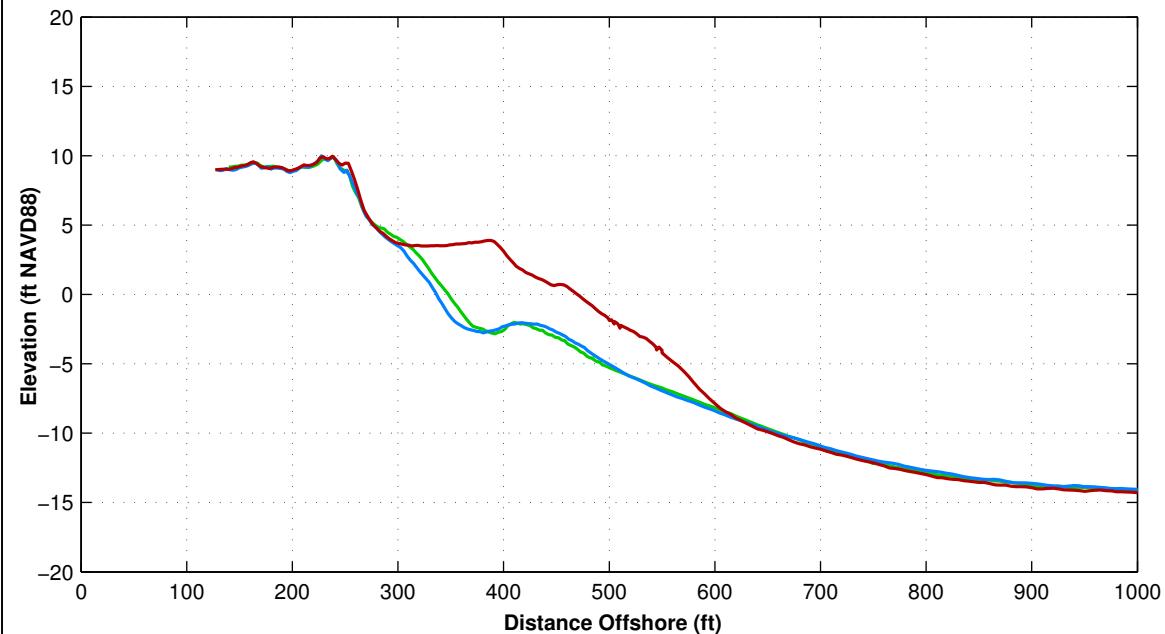
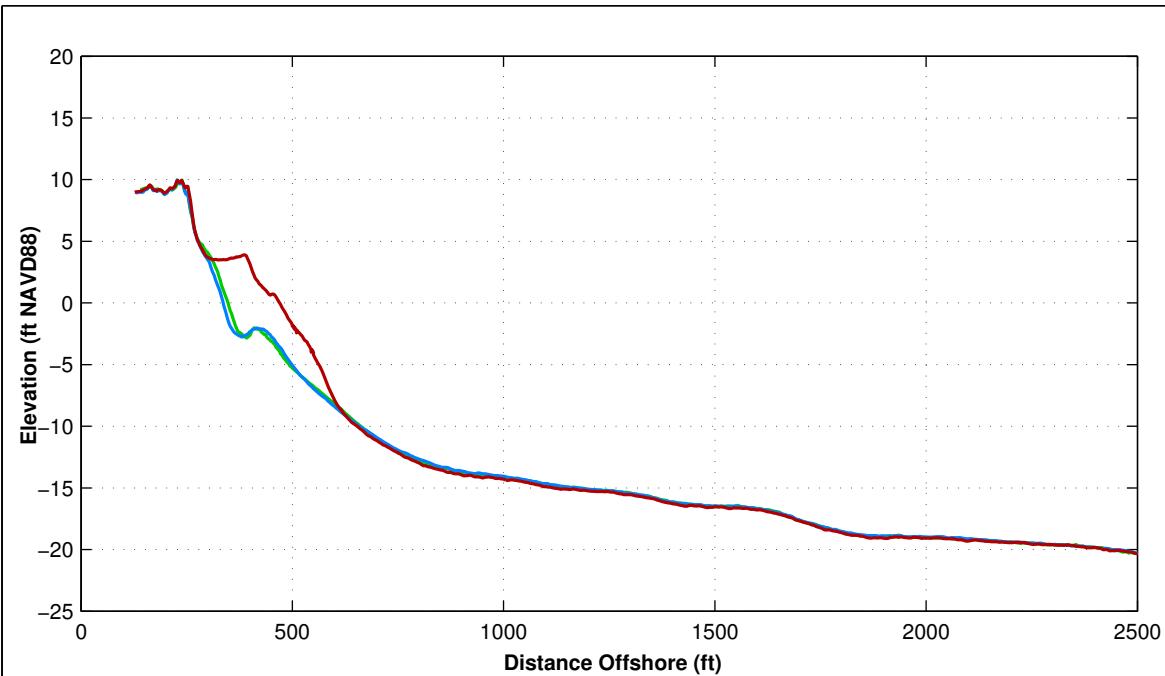
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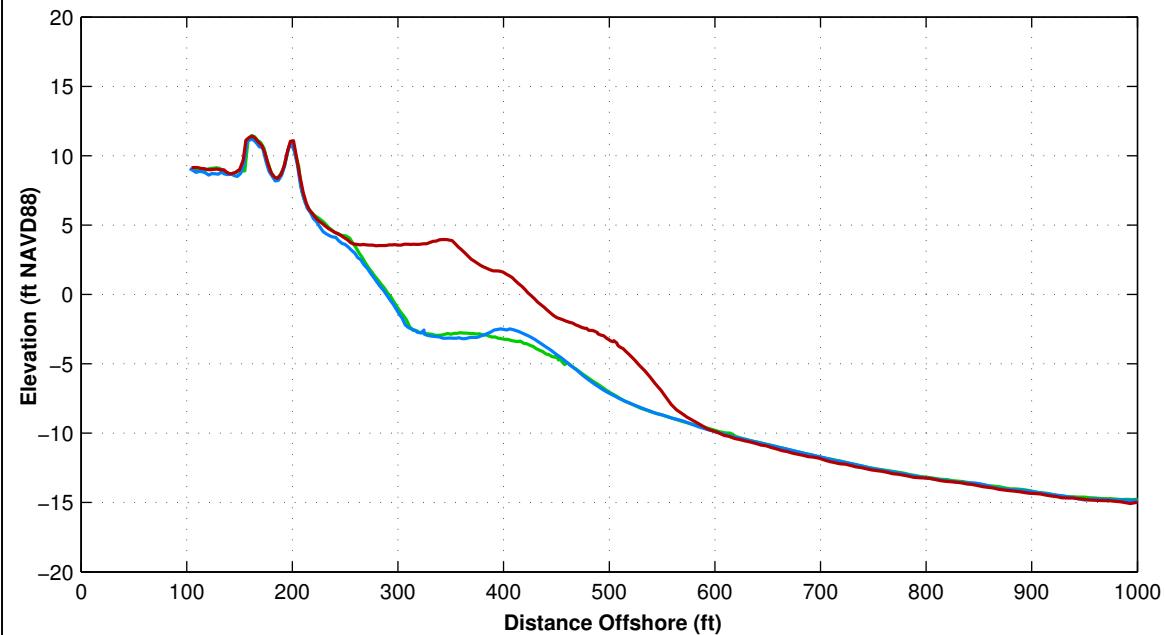
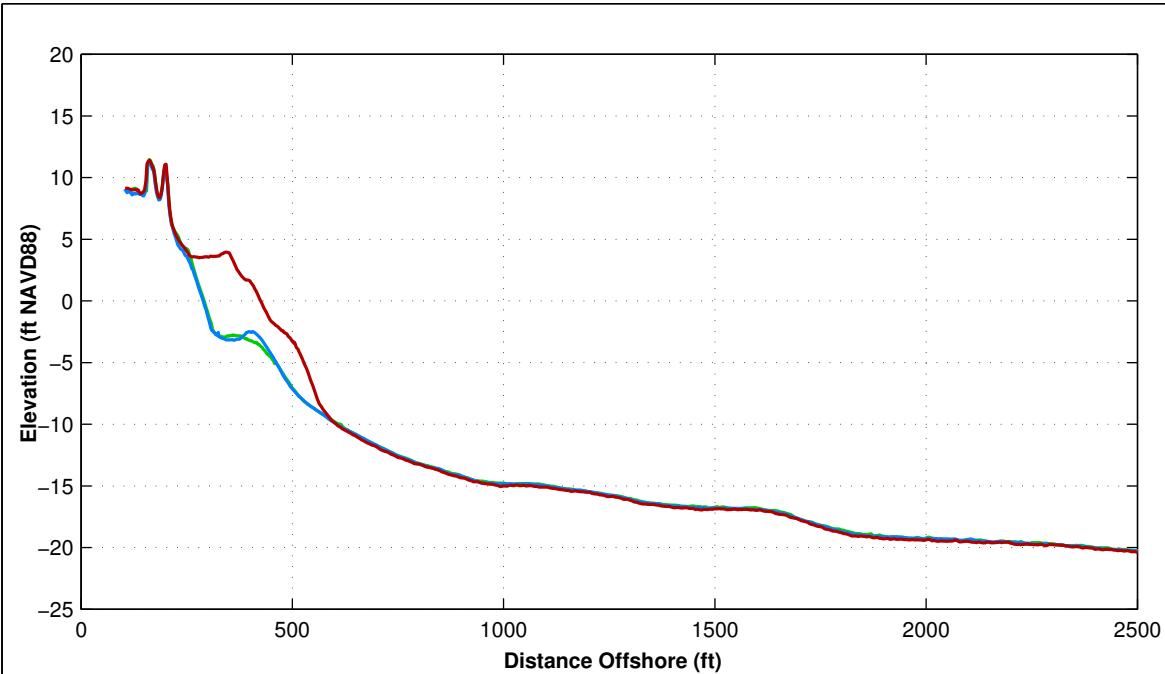
- MAY 2017
- OCT 2016
- MAY 2016

Notes:

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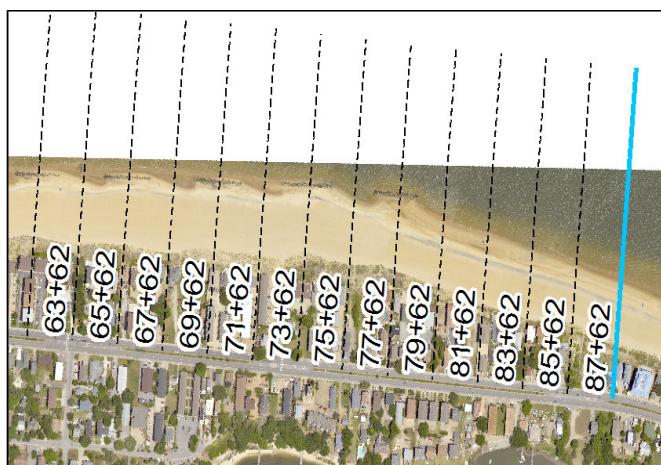
Survey Transect 87+62	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	129.56 ft/yr	132.06 ft
Volume Change Above -15 ft NAVD88	42.47 cy/ft/yr	44.36 cy/ft
Volume Change Above 0 ft NAVD88	15.88 cy/ft/yr	17.66 cy/ft

LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

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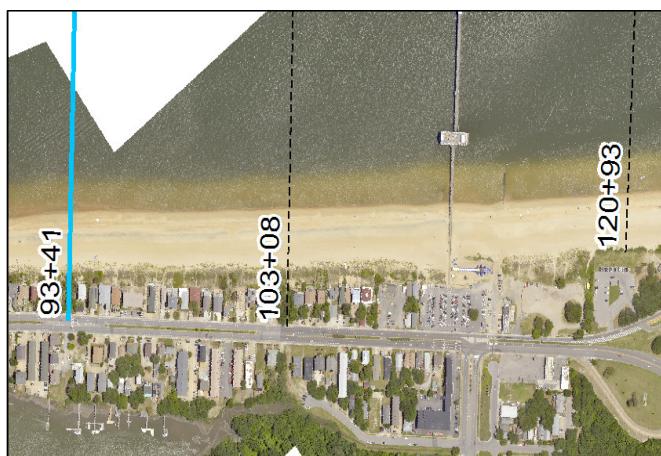
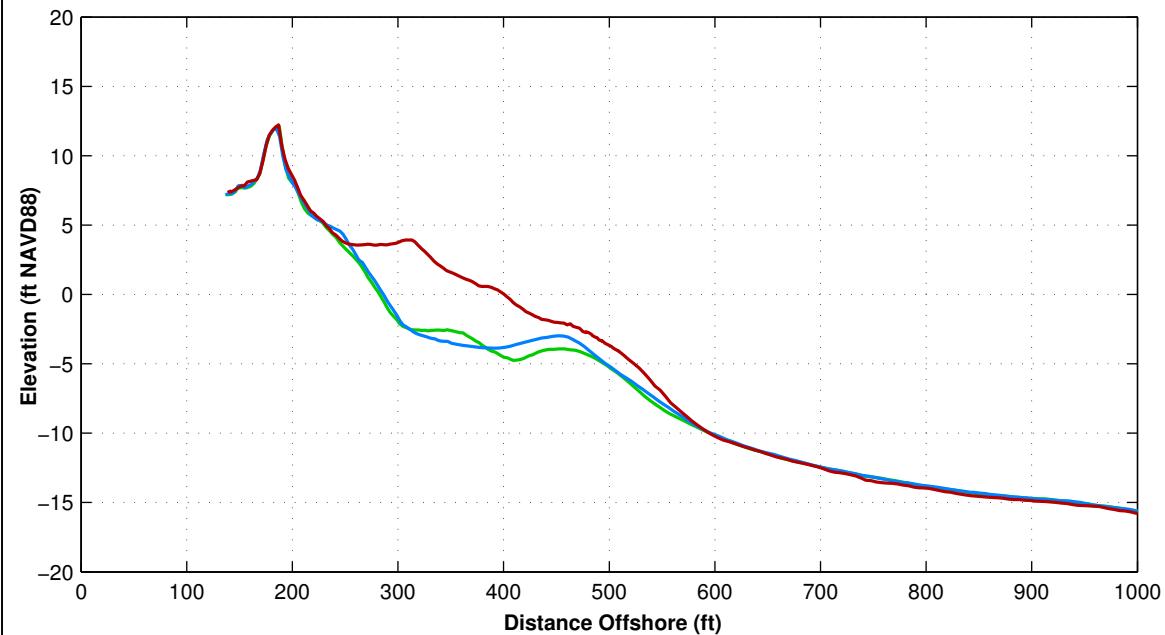
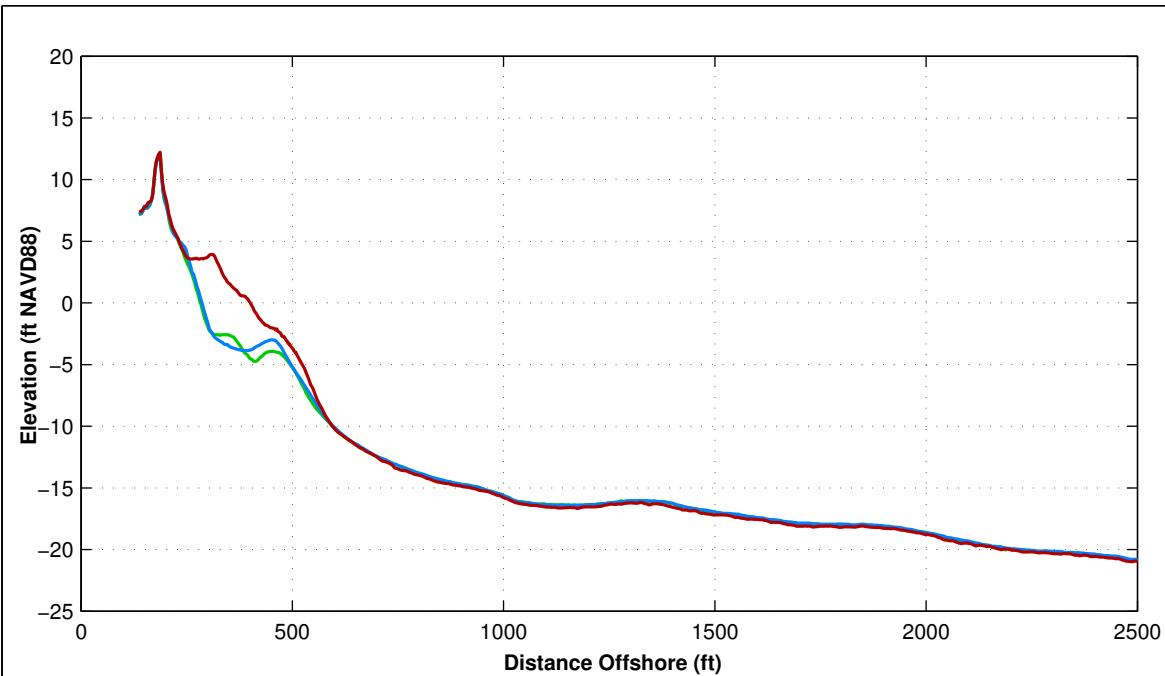
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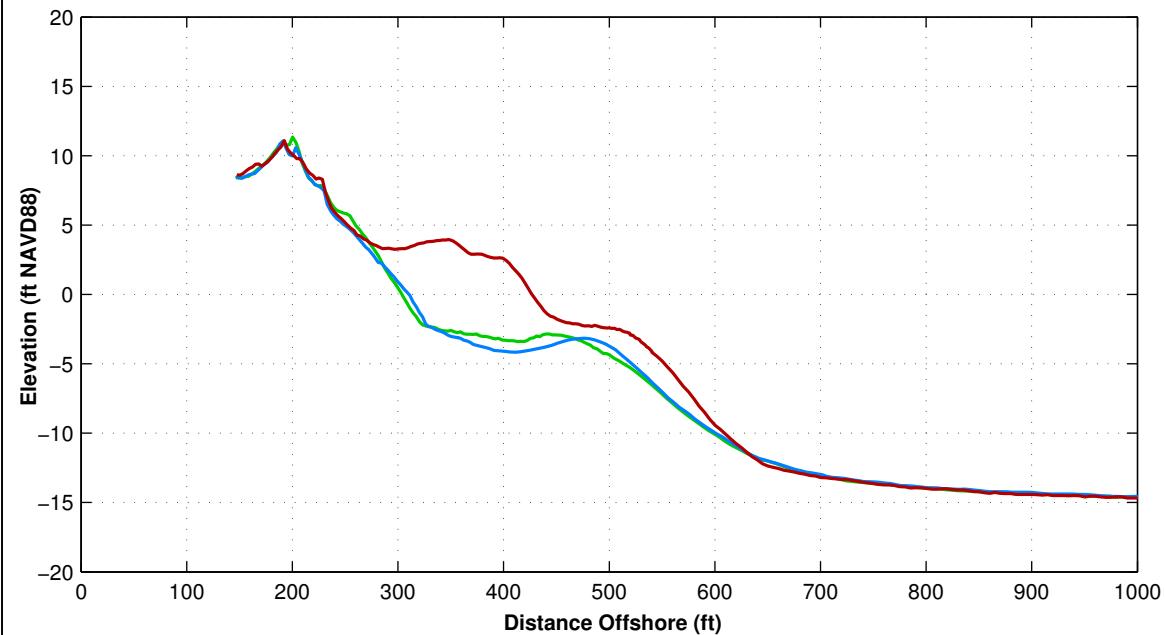
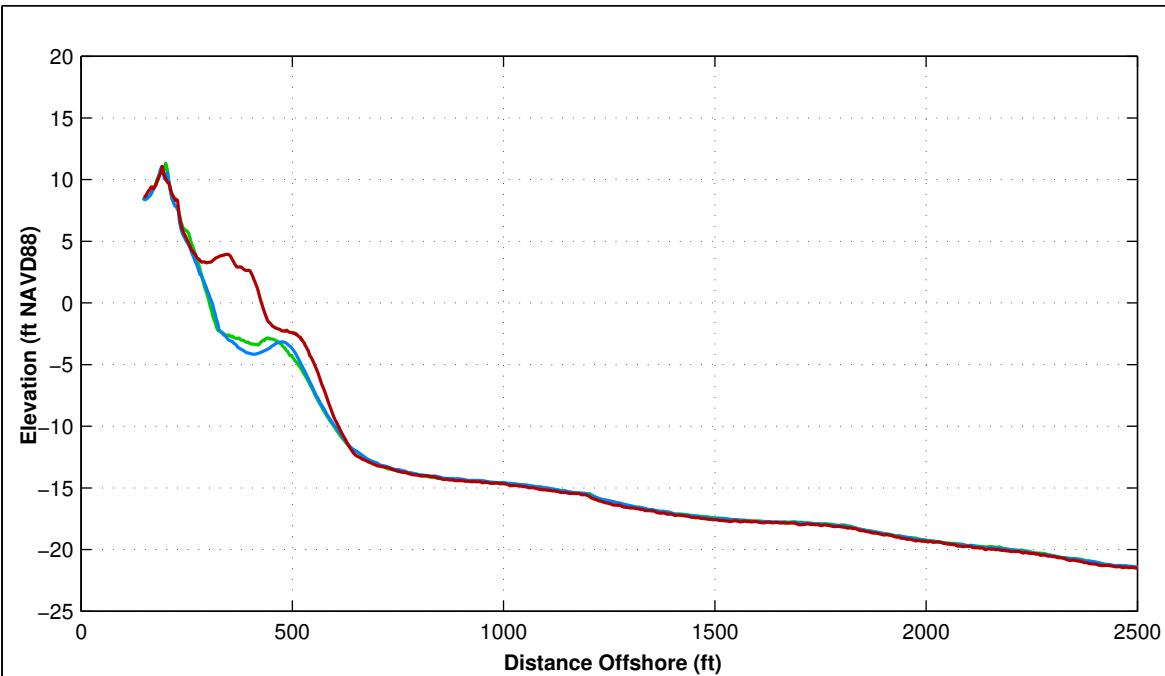
ST 87+62

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ANALYSIS

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Survey Transect  
103+08

MAY 2017 –  
MAY 2016

MAY 2017 –  
OCT 2016

Shoreline Change at MHW  
(0.98 ft NAVD88)

123.51  
ft/yr

119.90  
ft

Volume Change Above  
-15 ft NAVD88

37.51  
cy/ft/yr

38.89  
cy/ft

Volume Change Above  
0 ft NAVD88

14.65  
cy/ft/yr

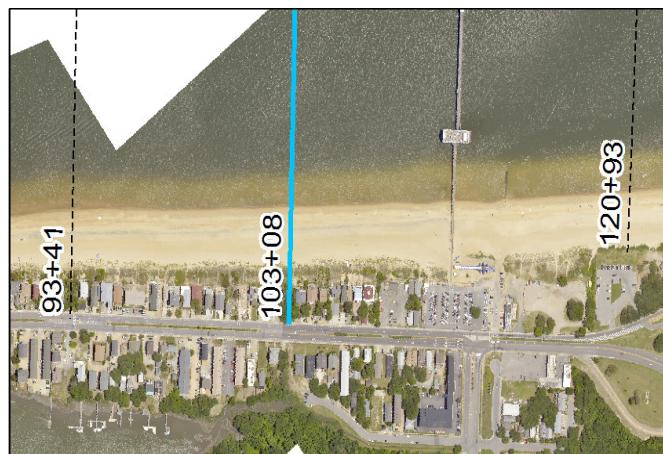
16.05  
cy/ft

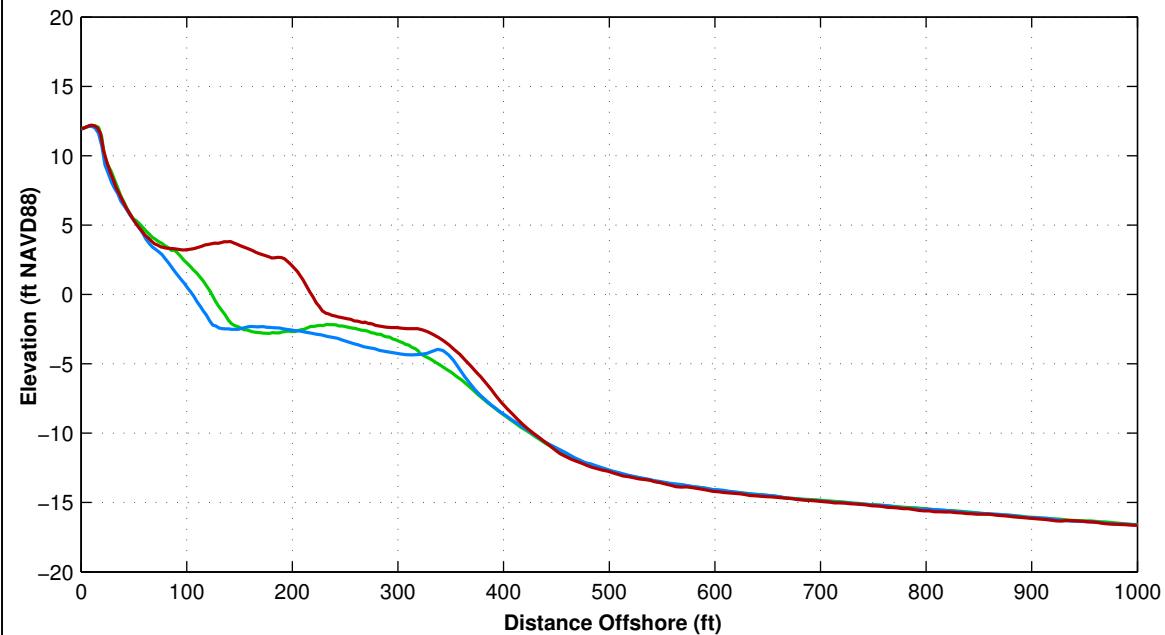
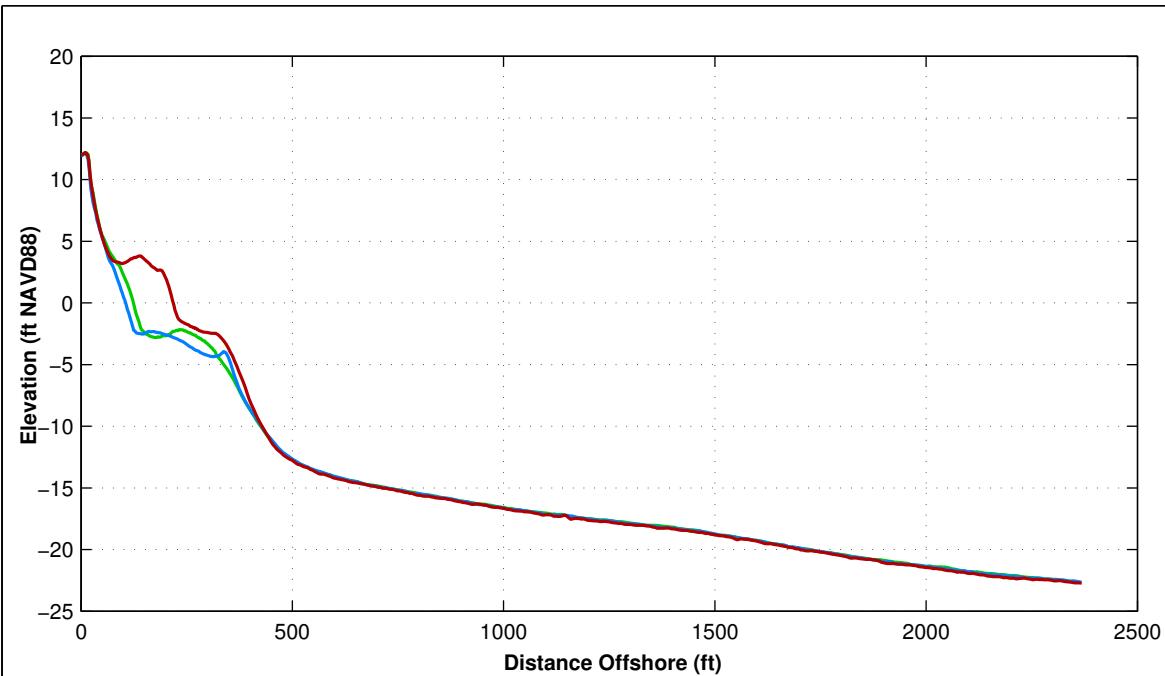
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

1. Station From West To East At Varying Intervals.
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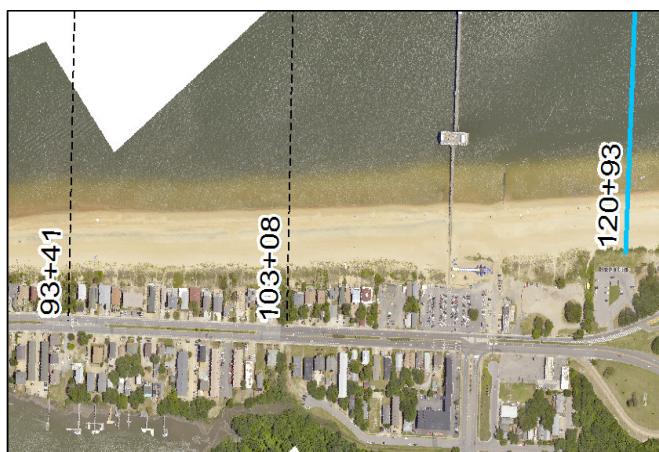


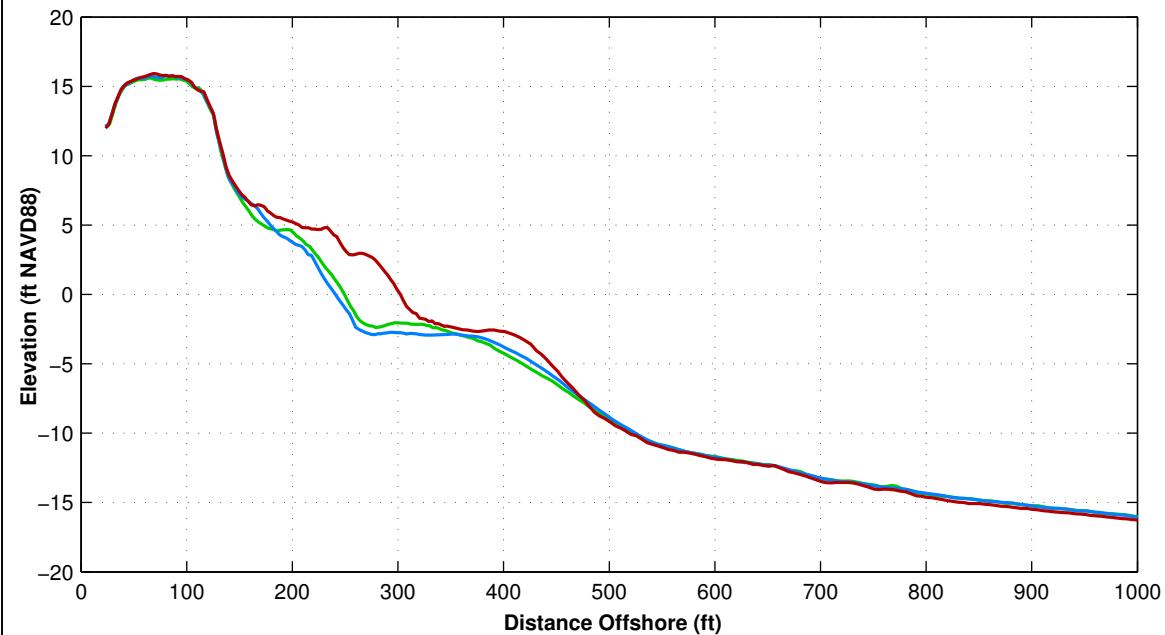
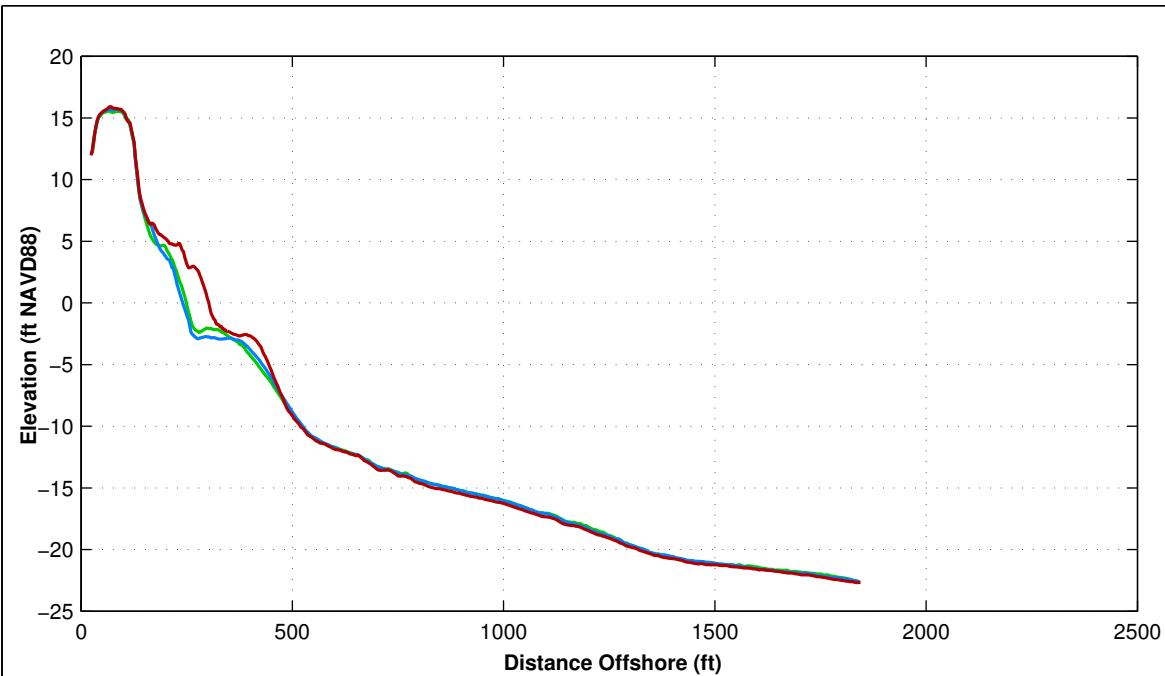
Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
120+93		
Shoreline Change at MHW (0.98 ft NAVD88)	95.30 ft/yr	114.89 ft
Volume Change Above -15 ft NAVD88	26.71 cy/ft/yr	33.32 cy/ft
Volume Change Above 0 ft NAVD88	11.10 cy/ft/yr	14.68 cy/ft

**LEGEND:**  
 MAY 2017 — Red line  
 OCT 2016 — Blue line  
 MAY 2016 — Green line

Notes:

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Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
129+17		
Shoreline Change at MHW (0.98 ft NAVD88)	52.86 ft/yr	62.40 ft
Volume Change Above -15 ft NAVD88	18.14 cy/ft/yr	19.15 cy/ft
Volume Change Above 0 ft NAVD88	10.59 cy/ft/yr	10.96 cy/ft

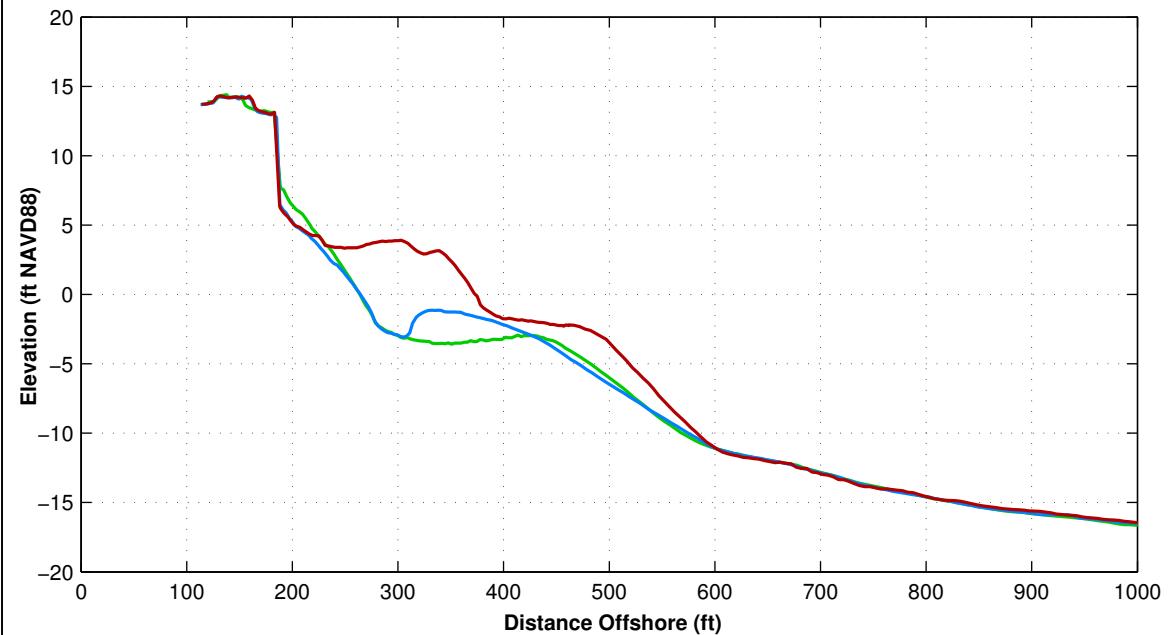
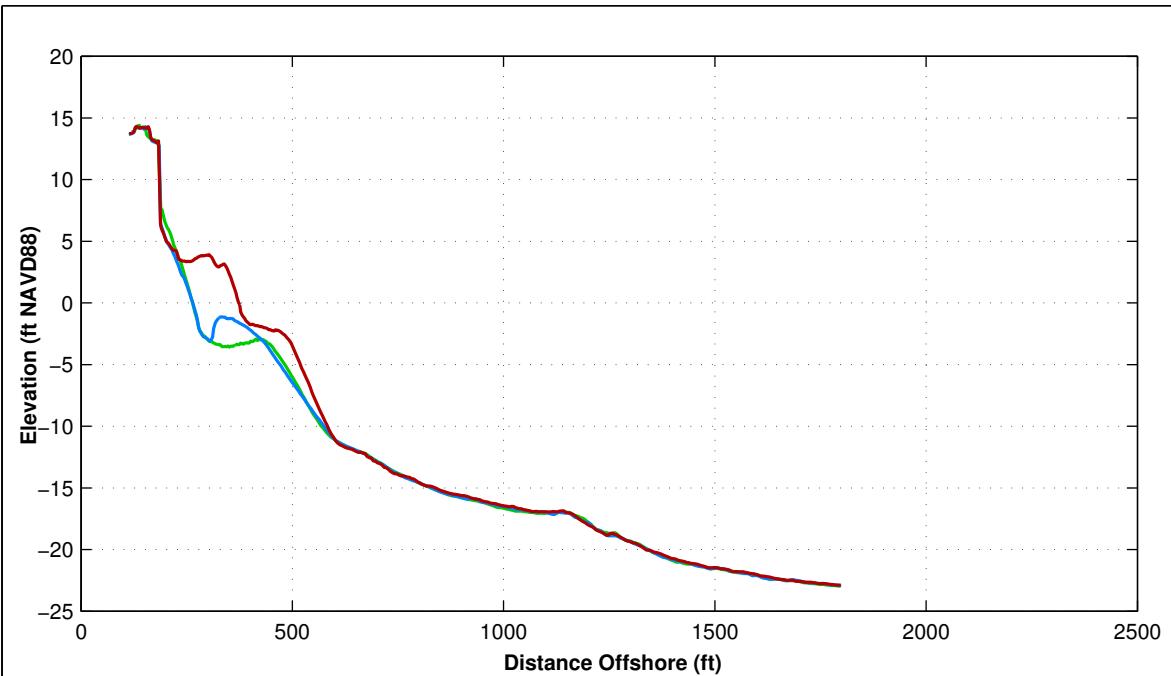
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

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Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
141+98		
Shoreline Change at MHW (0.98 ft NAVD88)	108.90 ft/yr	109.97 ft
Volume Change Above -15 ft NAVD88	37.27 cy/ft/yr	33.87 cy/ft
Volume Change Above 0 ft NAVD88	12.49 cy/ft/yr	14.39 cy/ft

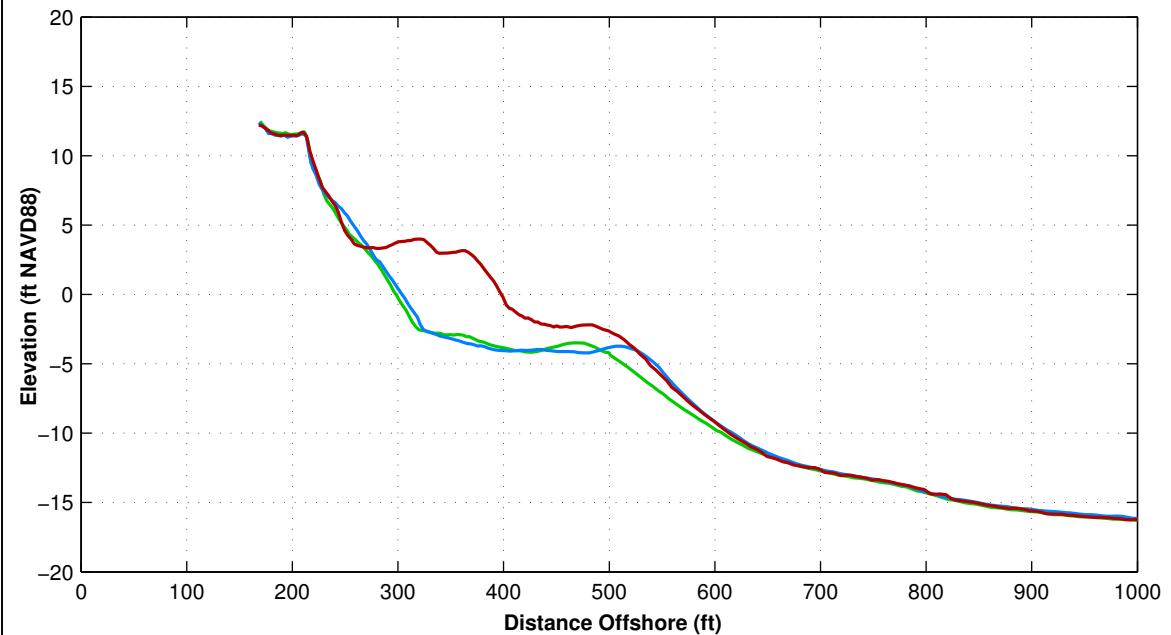
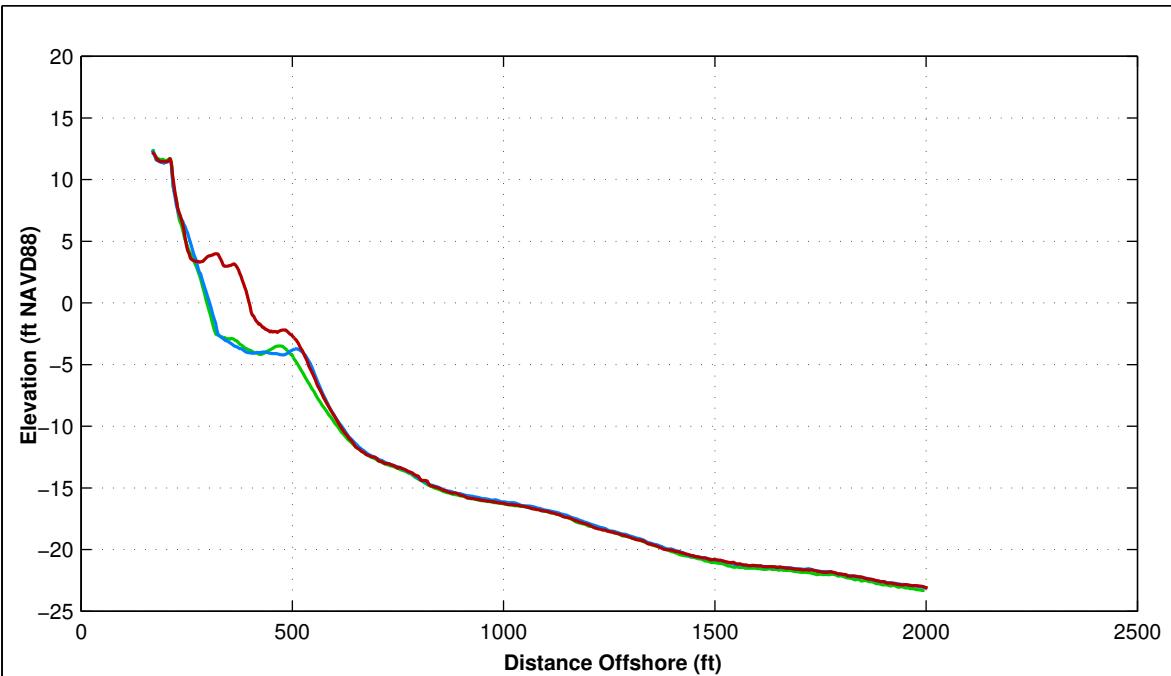
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

1. Station From West To East At Varying Intervals.
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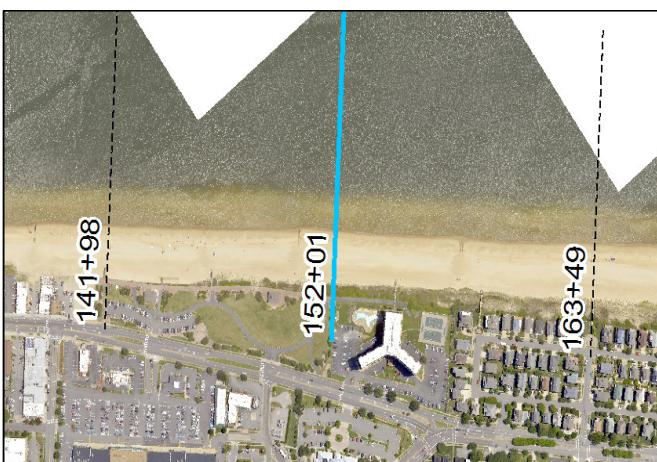
Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
152+01		
Shoreline Change at MHW (0.98 ft NAVD88)	99.89 ft/yr	95.22 ft
Volume Change Above -15 ft NAVD88	35.26 cy/ft/yr	28.91 cy/ft
Volume Change Above 0 ft NAVD88	12.58 cy/ft/yr	11.33 cy/ft

**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

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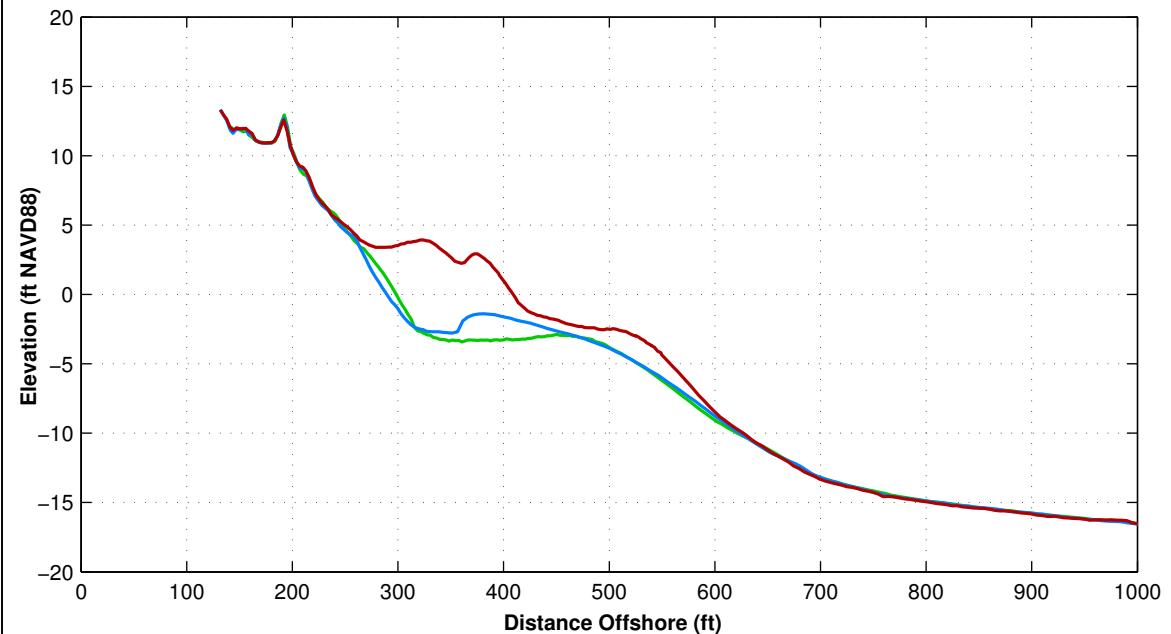
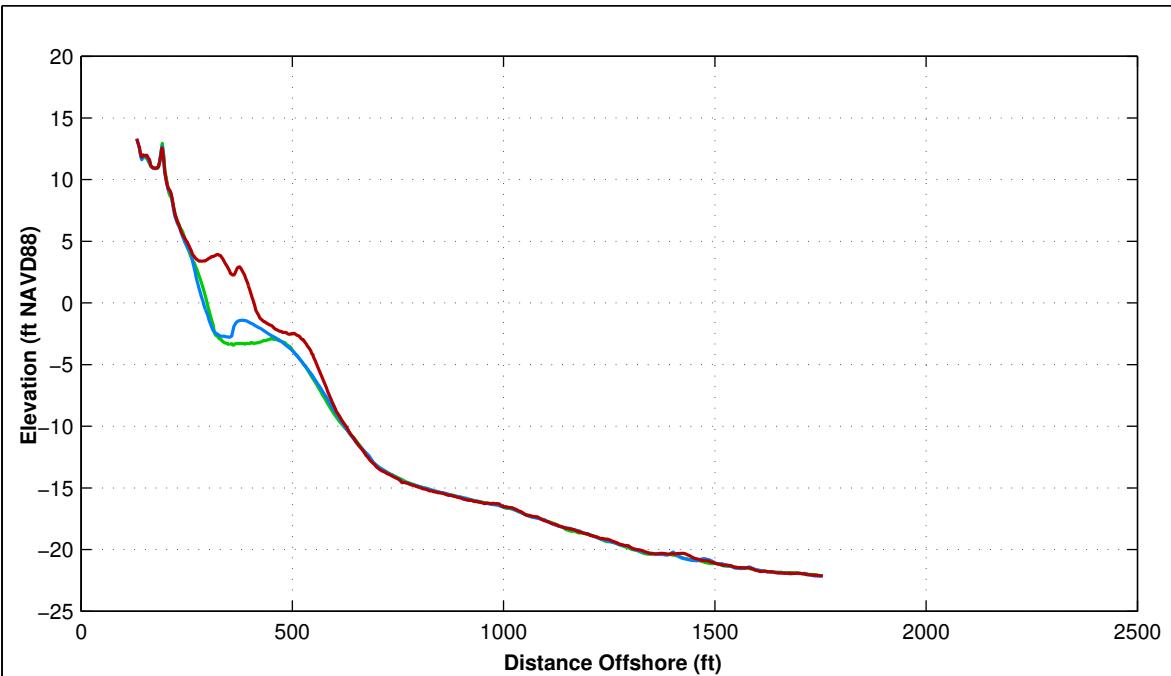
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ST 152+01

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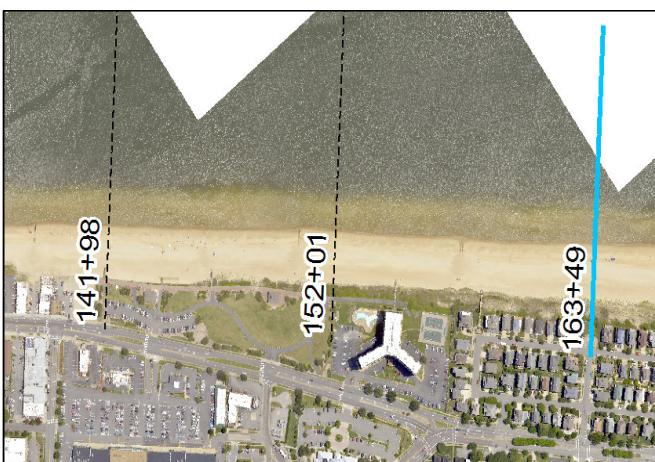
Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
163+49		
Shoreline Change at MHW (0.98 ft NAVD88)	109.24 ft/yr	118.92 ft
Volume Change Above -15 ft NAVD88	35.27 cy/ft/yr	31.20 cy/ft
Volume Change Above 0 ft NAVD88	13.61 cy/ft/yr	14.86 cy/ft

**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

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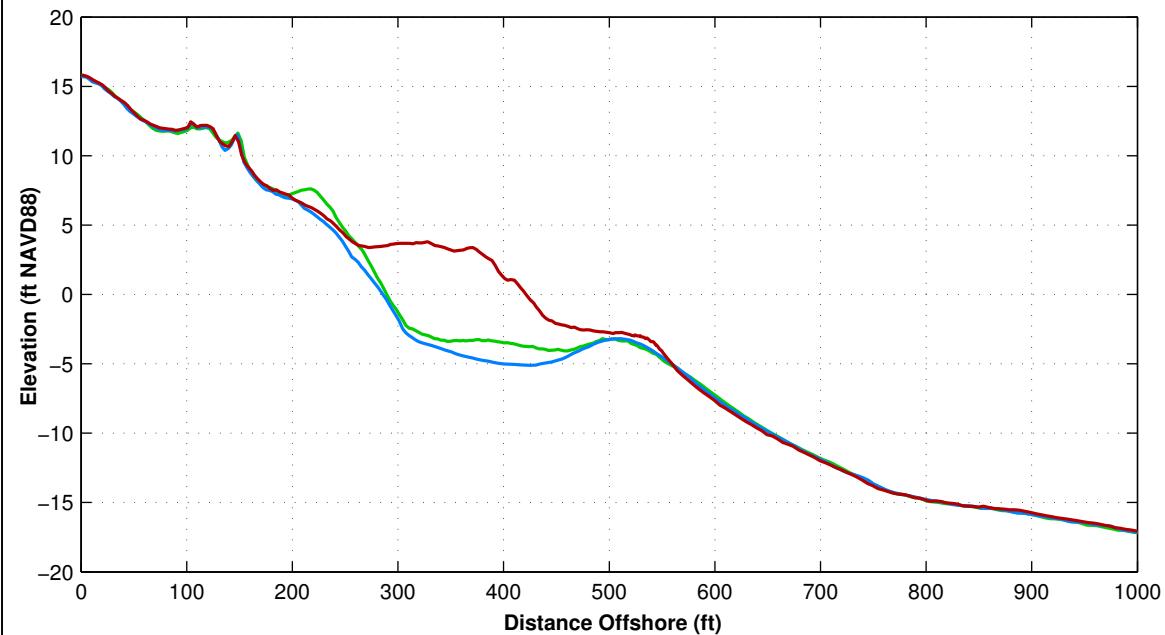
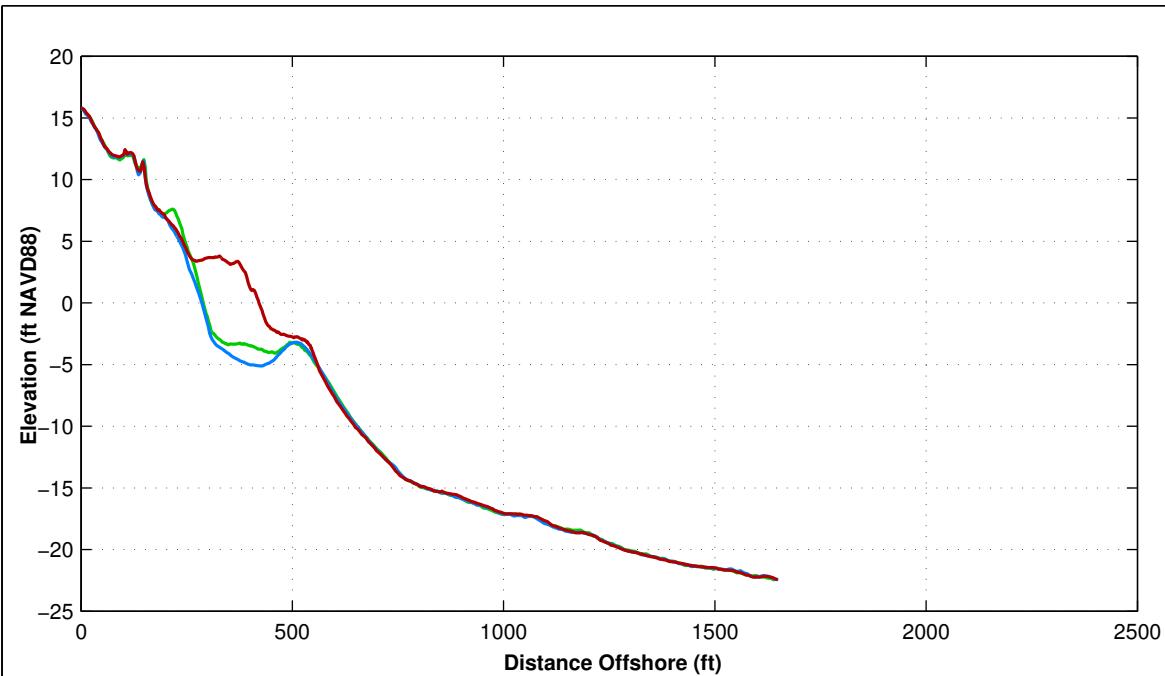
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ST 163+49

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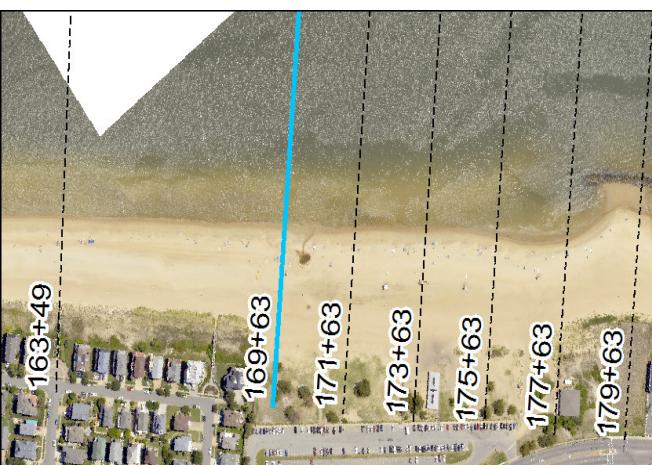
Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
169+63		
Shoreline Change at MHW (0.98 ft NAVD88)	128.23 ft/yr	134.44 ft
Volume Change Above -15 ft NAVD88	33.09 cy/ft/yr	44.12 cy/ft
Volume Change Above 0 ft NAVD88	13.92 cy/ft/yr	18.29 cy/ft

**LEGEND:**

MAY 2017	—
OCT 2016	—
MAY 2016	—

**Notes:**

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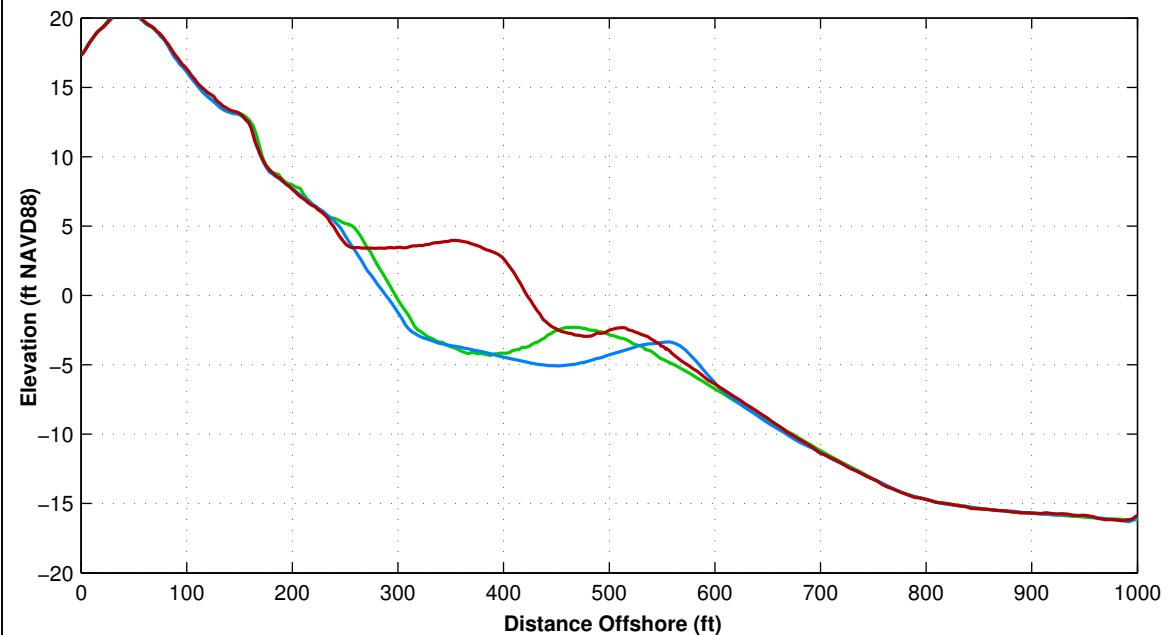
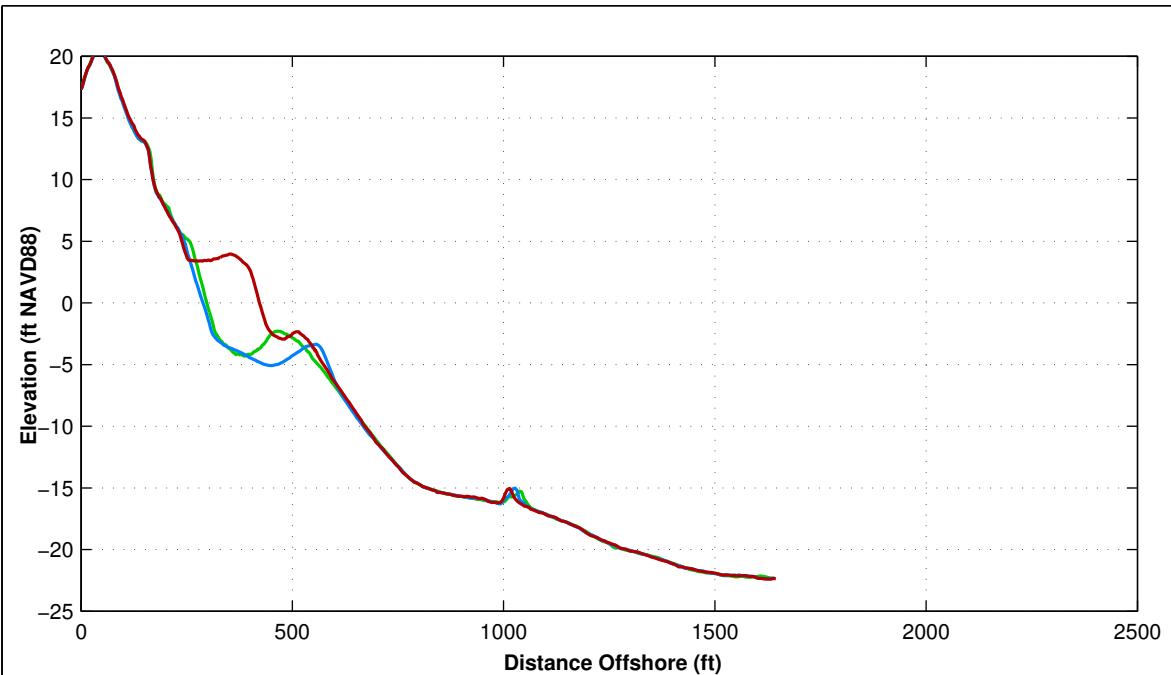
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ST 169+63

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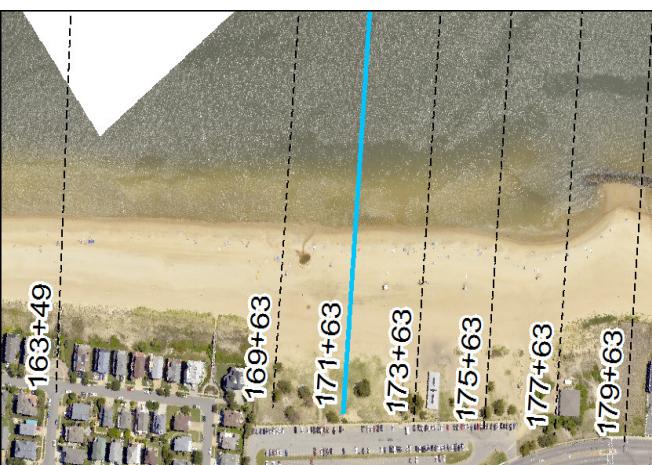


Survey Transect 171+63	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	124.74 ft/yr	135.89 ft
Volume Change Above -15 ft NAVD88	34.37 cy/ft/yr	43.87 cy/ft
Volume Change Above 0 ft NAVD88	14.93 cy/ft/yr	18.26 cy/ft

**LEGEND:**  
 MAY 2017 — Red line  
 OCT 2016 — Blue line  
 MAY 2016 — Green line

Notes:

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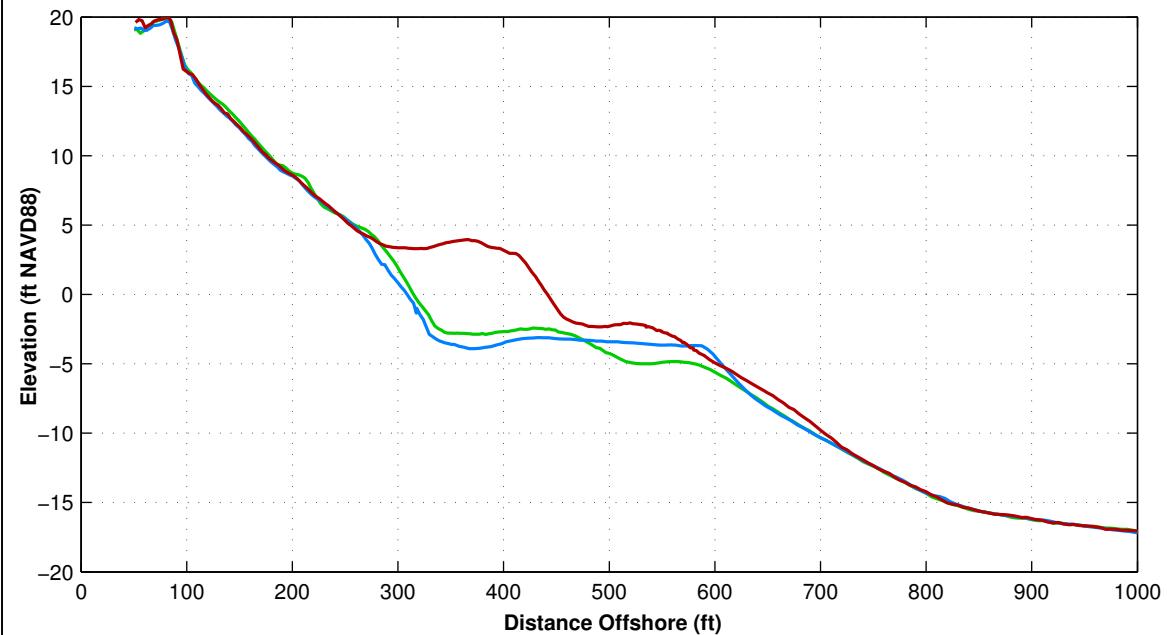
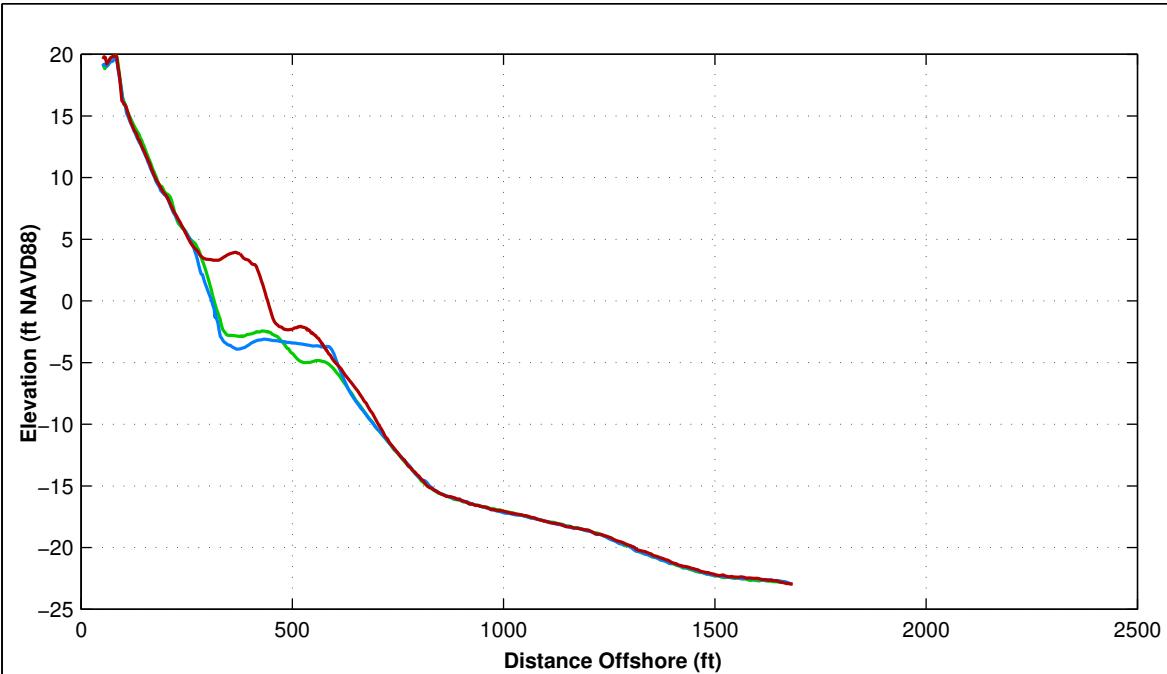
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ST 171+63

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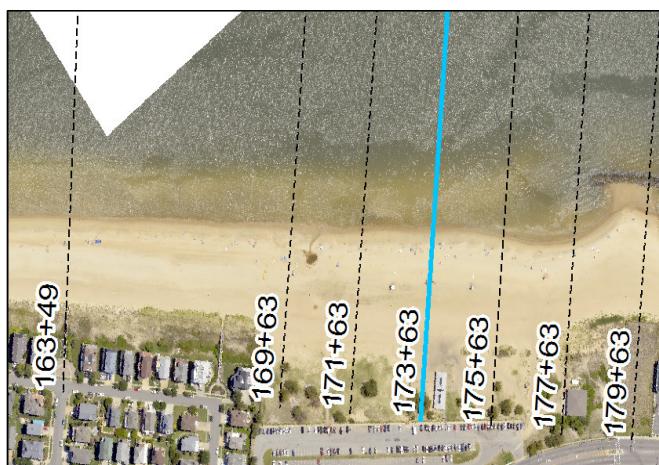
Survey Transect 173+63	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	125.30 ft/yr	134.30 ft
Volume Change Above -15 ft NAVD88	39.87 cy/ft/yr	42.39 cy/ft
Volume Change Above 0 ft NAVD88	14.80 cy/ft/yr	18.61 cy/ft

LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



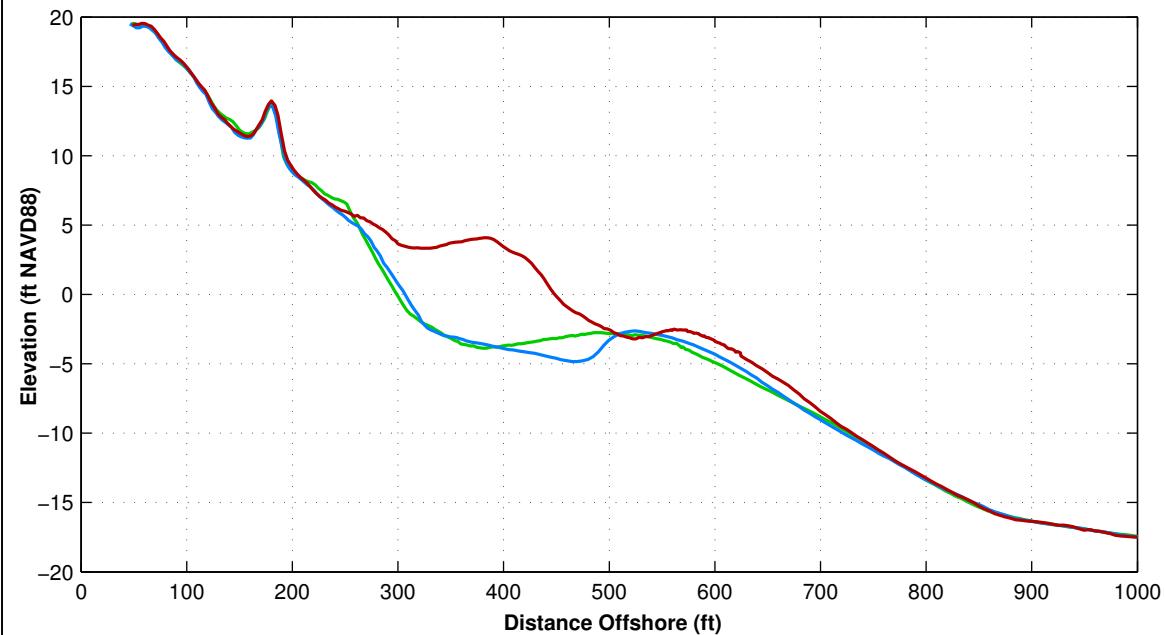
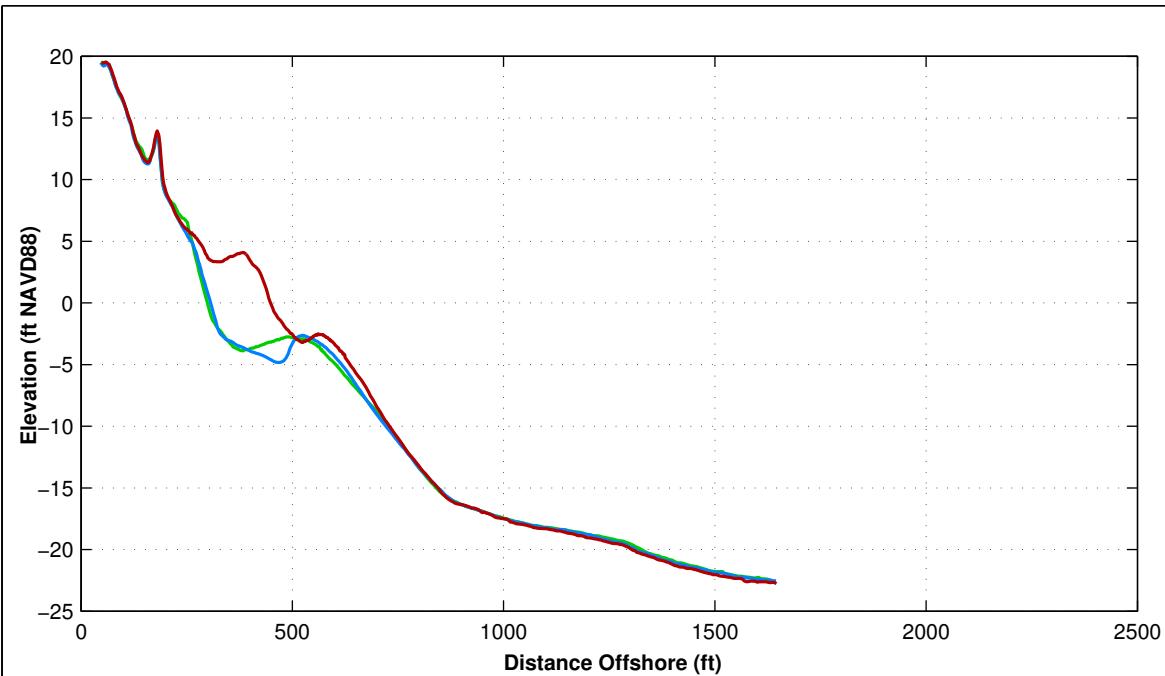
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ST 173+63

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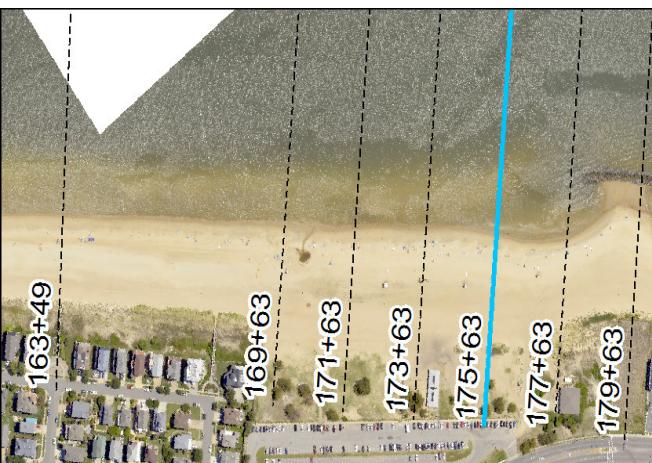


Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
175+63		
Shoreline Change at MHW (0.98 ft NAVD88)	148.35 ft/yr	141.52 ft
Volume Change Above -15 ft NAVD88	47.26 cy/ft/yr	50.19 cy/ft
Volume Change Above 0 ft NAVD88	20.48 cy/ft/yr	21.50 cy/ft

**LEGEND:**  
 MAY 2017 — Red line  
 OCT 2016 — Blue line  
 MAY 2016 — Green line

Notes:

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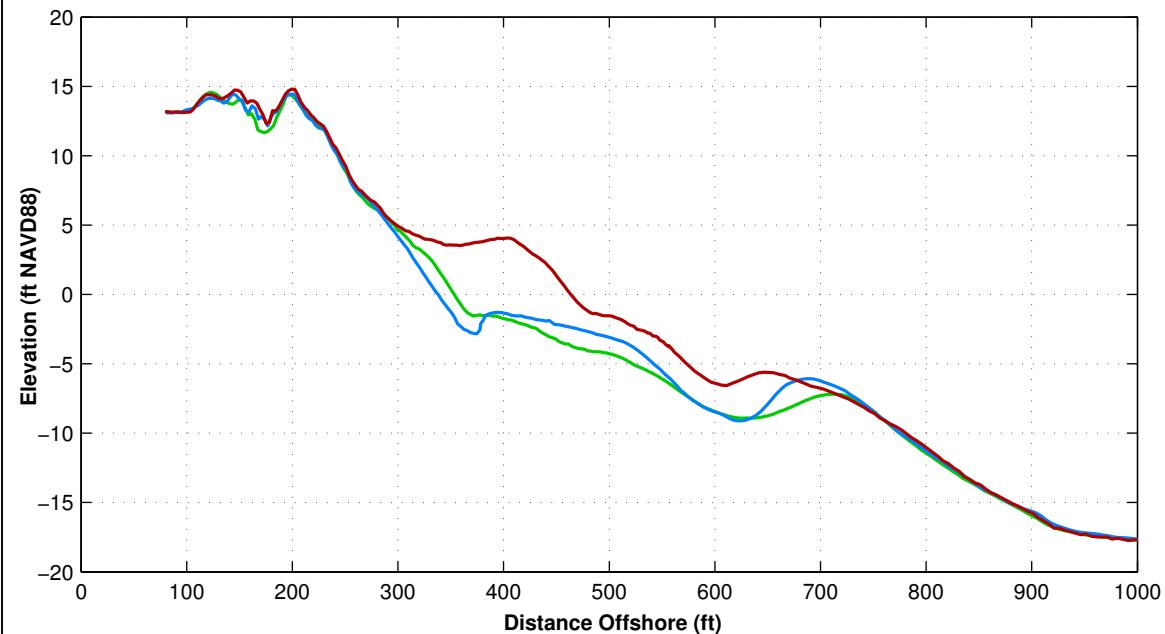
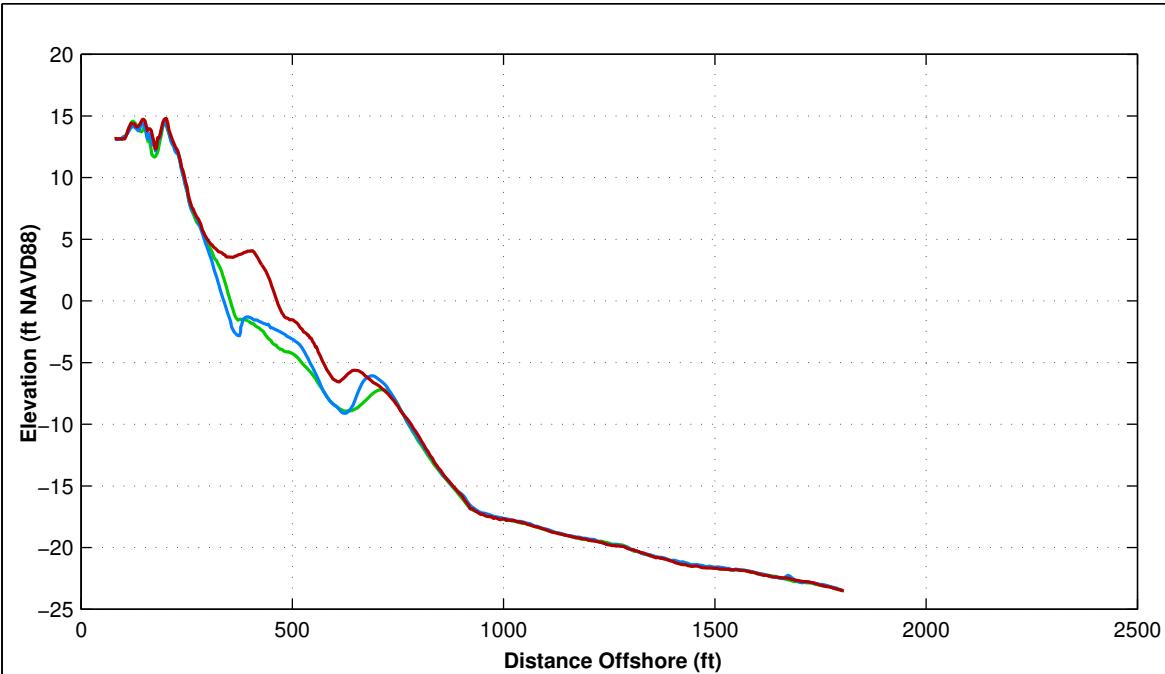
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ST 175+63

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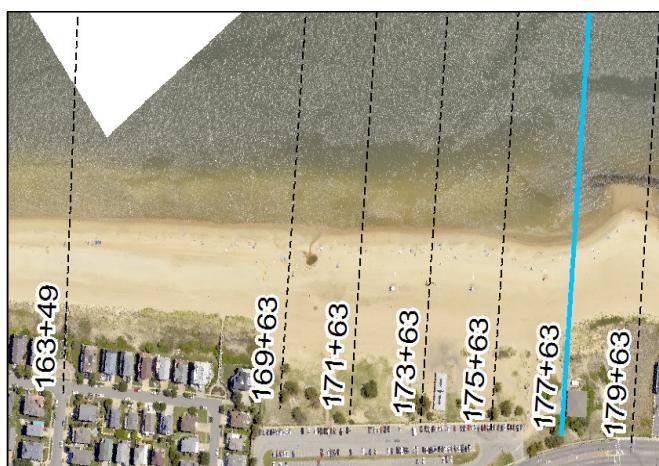
Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
177+63		
Shoreline Change at MHW (0.98 ft NAVD88)	108.46 ft/yr	124.81 ft
Volume Change Above -15 ft NAVD88	49.45 cy/ft/yr	42.91 cy/ft
Volume Change Above 0 ft NAVD88	18.18 cy/ft/yr	19.79 cy/ft

**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

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2. Sections Are Viewed Toward Decreasing Stationing.
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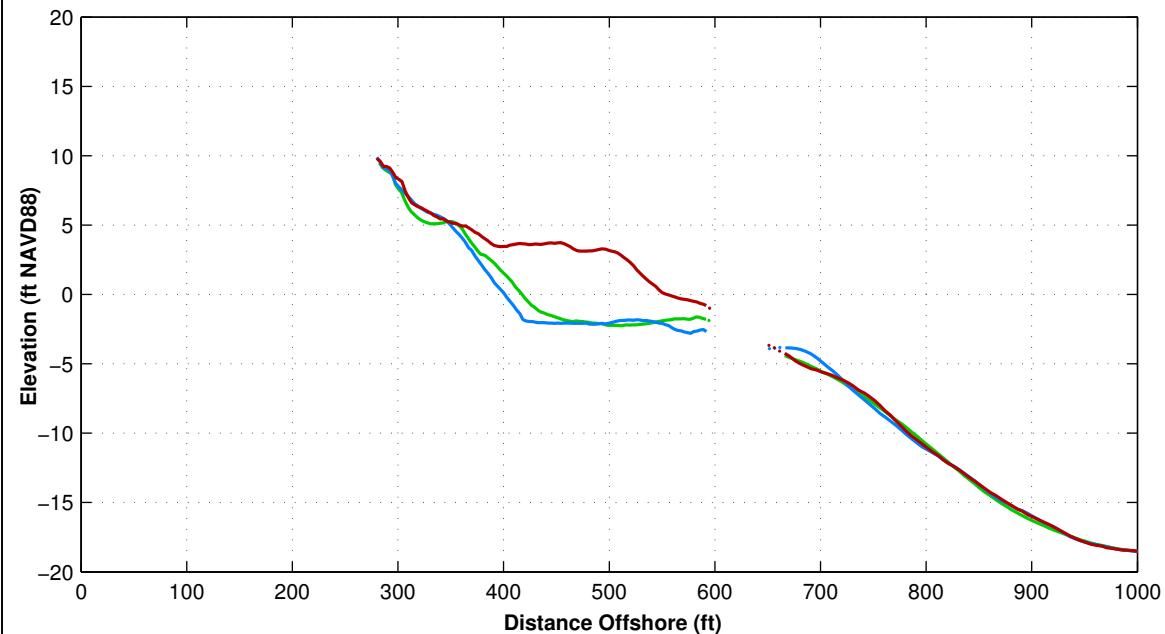
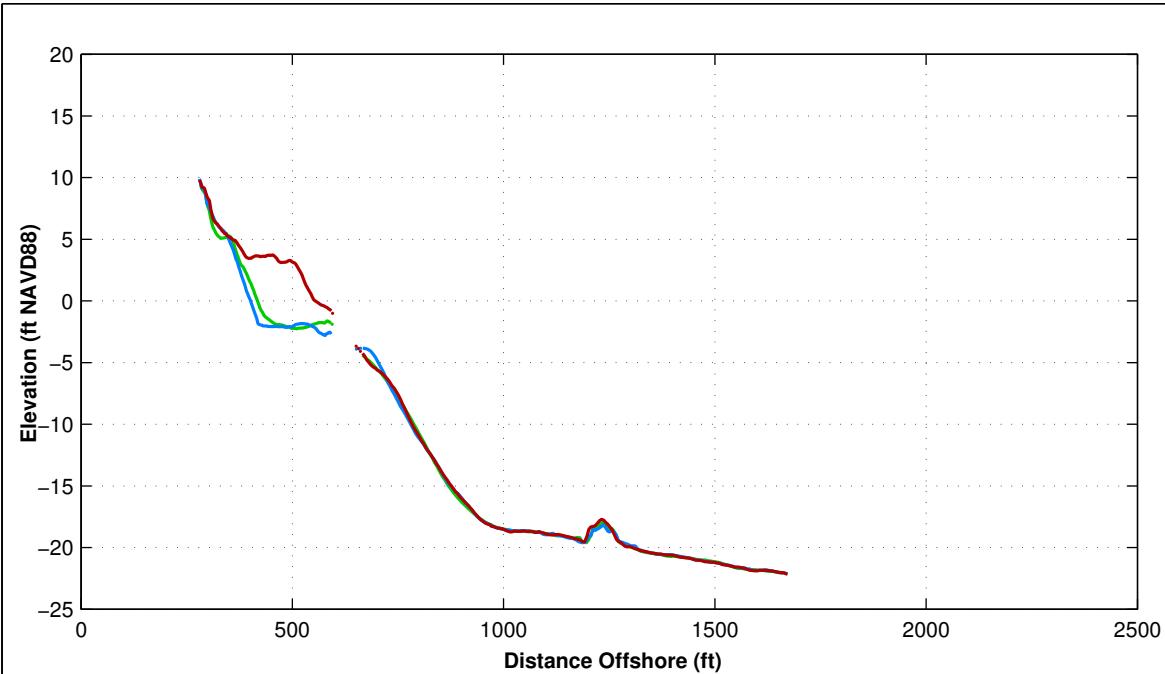
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PUBLIC WORKS

ST 177+63

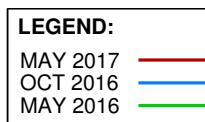
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

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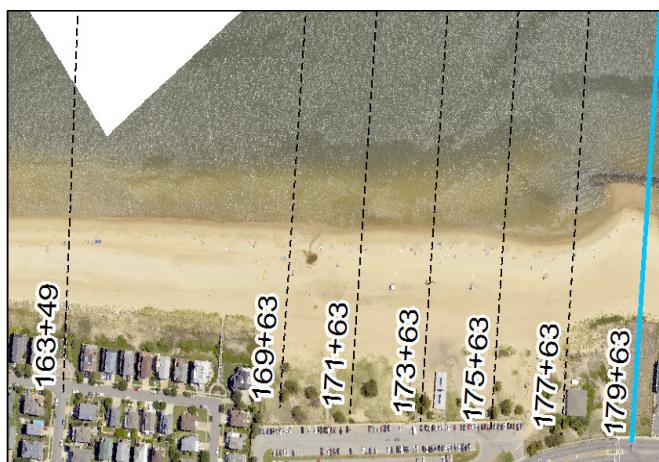


Survey Transect 179+63	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	130.01 ft/yr	146.84 ft
Volume Change Above -15 ft NAVD88	30.13 cy/ft/yr	33.20 cy/ft
Volume Change Above 0 ft NAVD88	18.76 cy/ft/yr	19.75 cy/ft



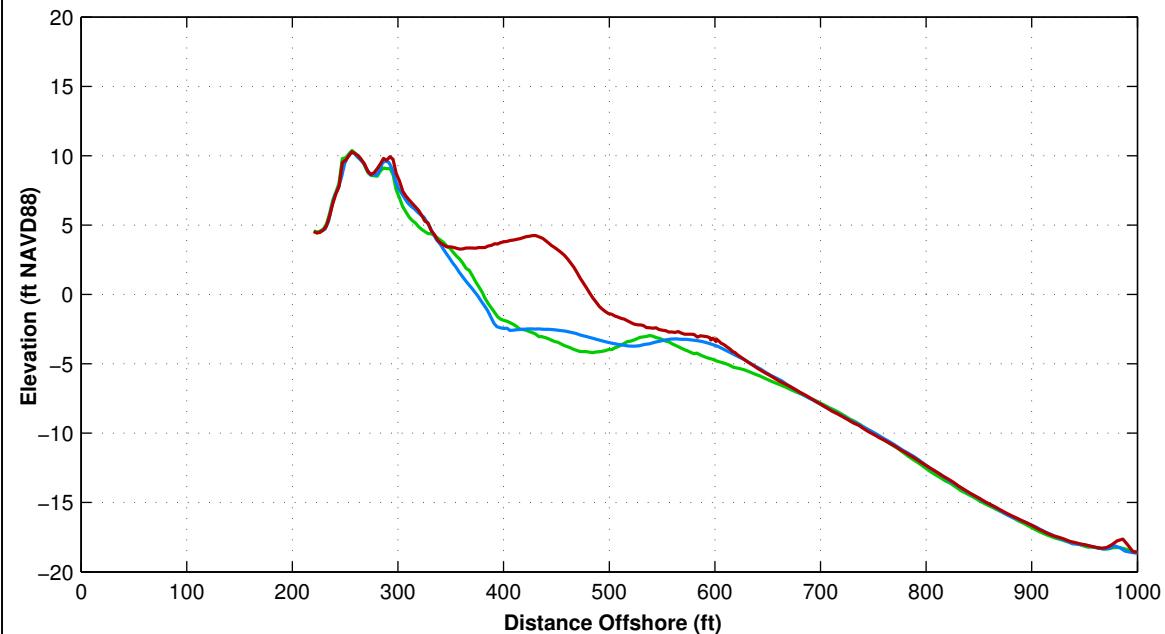
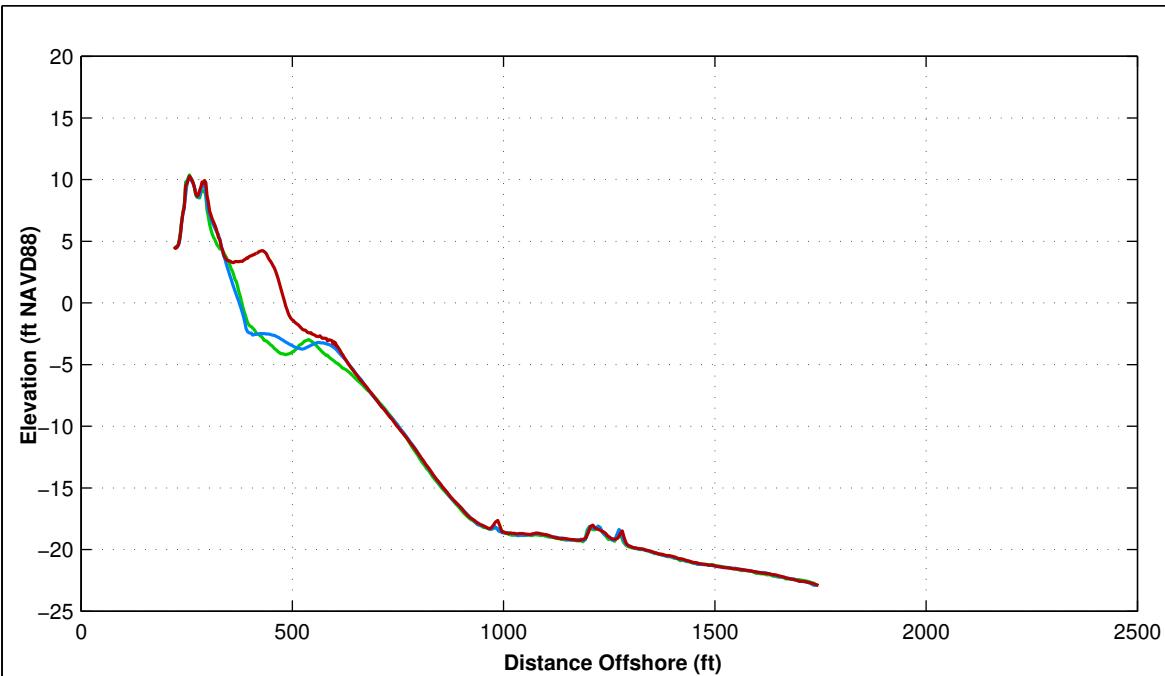
Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



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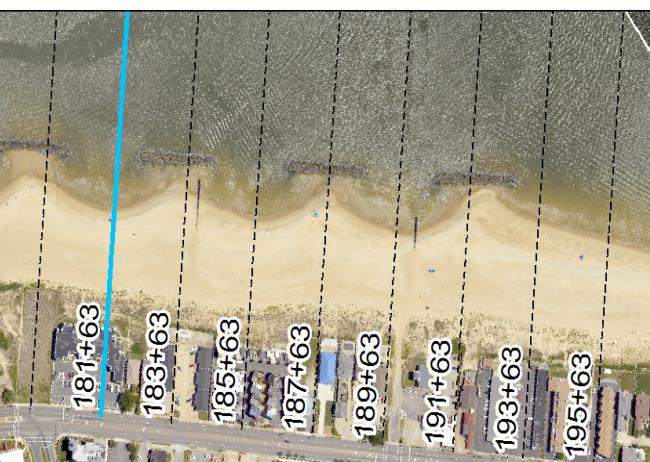
Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
181+63		
Shoreline Change at MHW (0.98 ft NAVD88)	100.99 ft/yr	110.13 ft
Volume Change Above -15 ft NAVD88	34.90 cy/ft/yr	30.42 cy/ft
Volume Change Above 0 ft NAVD88	15.51 cy/ft/yr	15.73 cy/ft

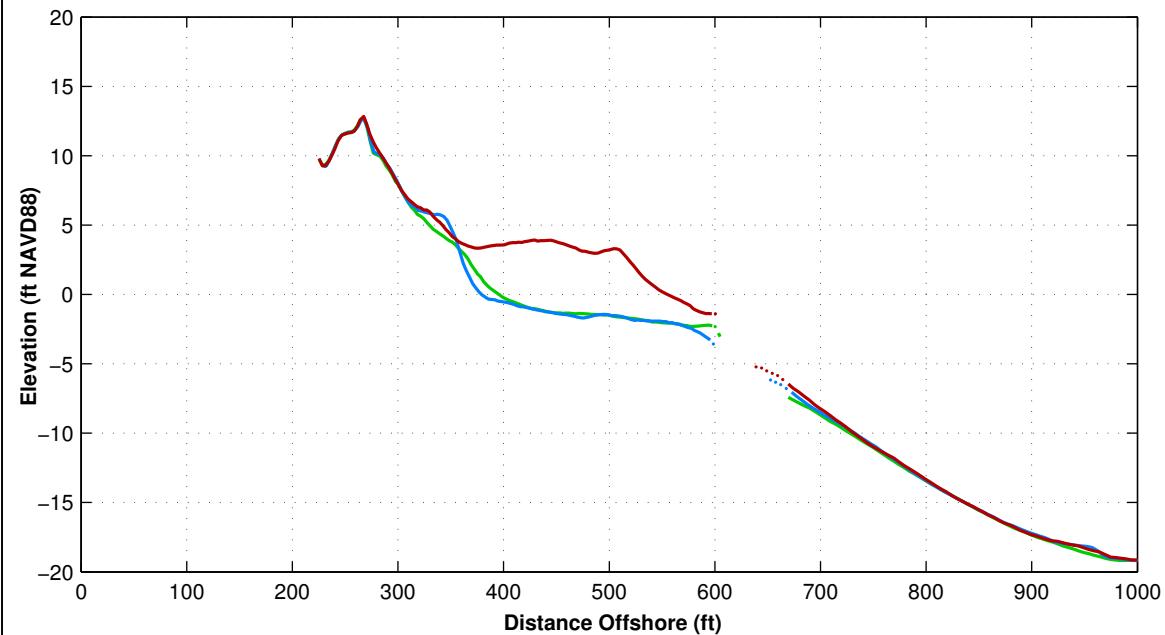
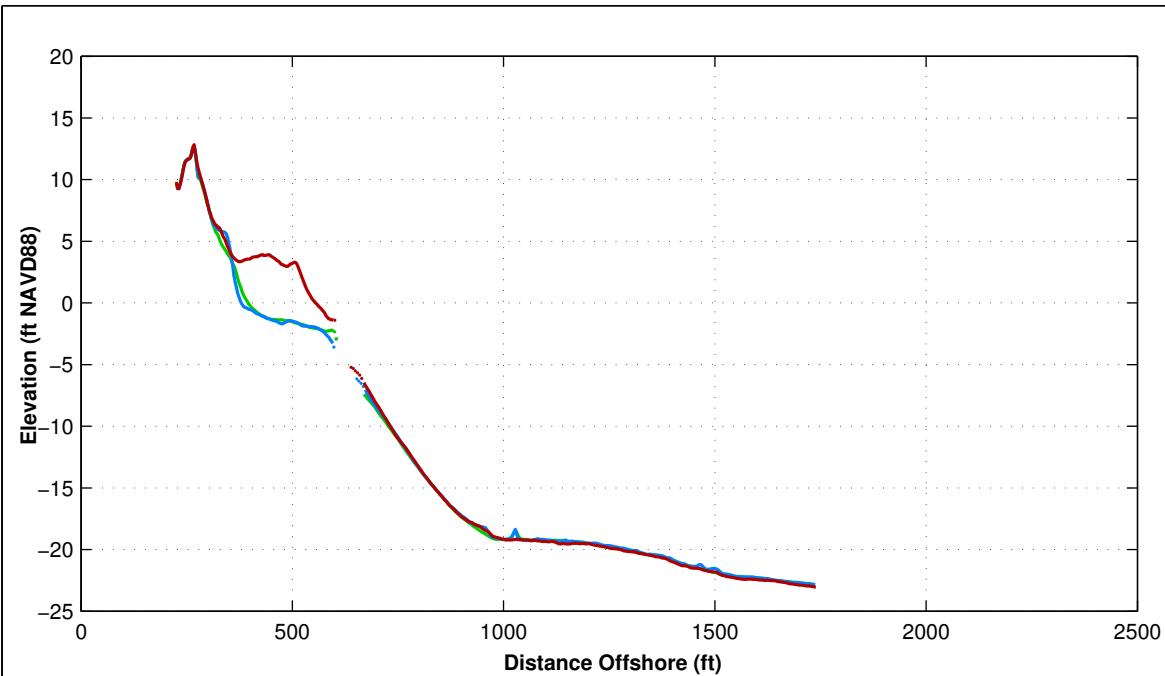
**LEGEND:**

MAY 2017	—
OCT 2016	—
MAY 2016	—

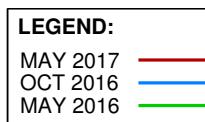
**Notes:**

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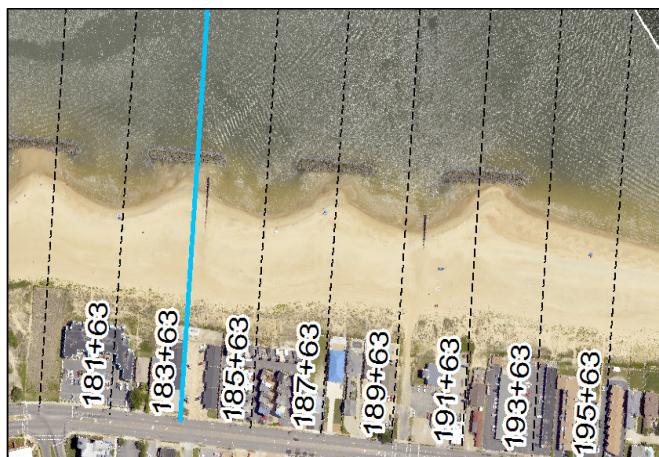


Survey Transect 183+63	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	155.26 ft/yr	166.45 ft
Volume Change Above -15 ft NAVD88	33.15 cy/ft/yr	32.96 cy/ft
Volume Change Above 0 ft NAVD88	21.41 cy/ft/yr	21.01 cy/ft



Notes:

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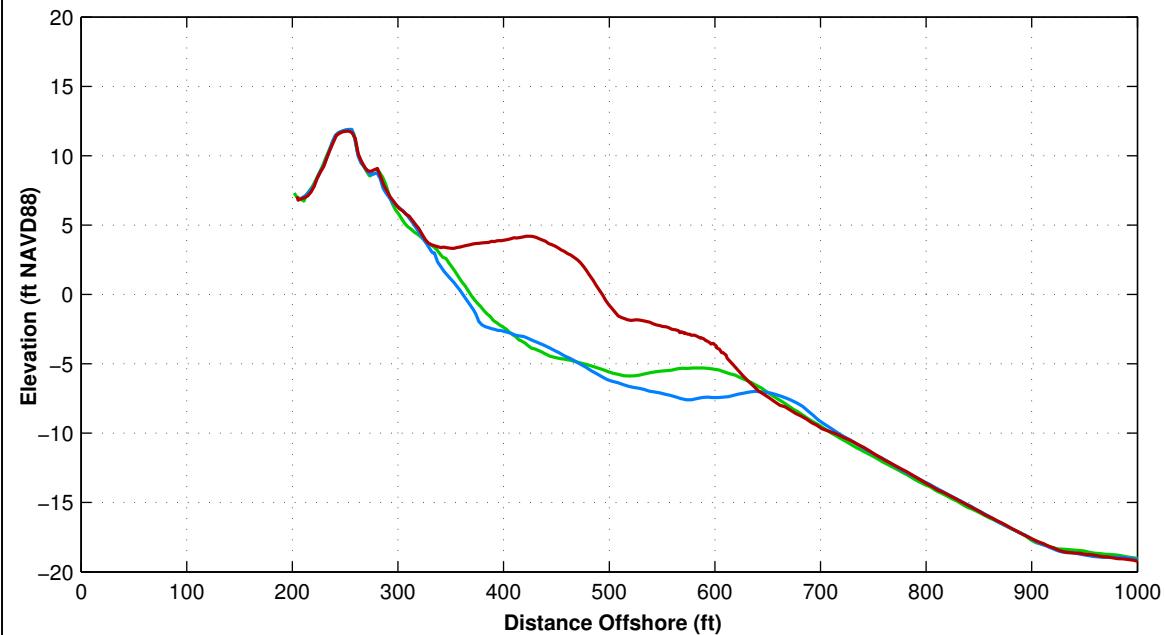
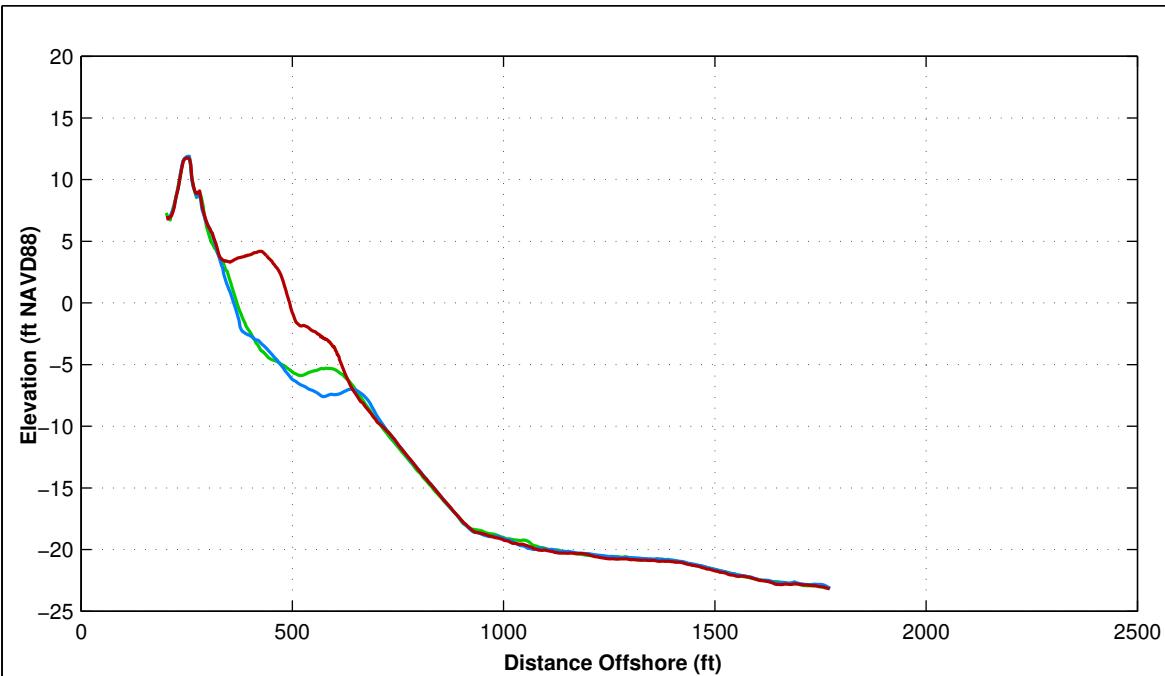
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PUBLIC WORKS

ST 183+63

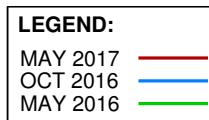
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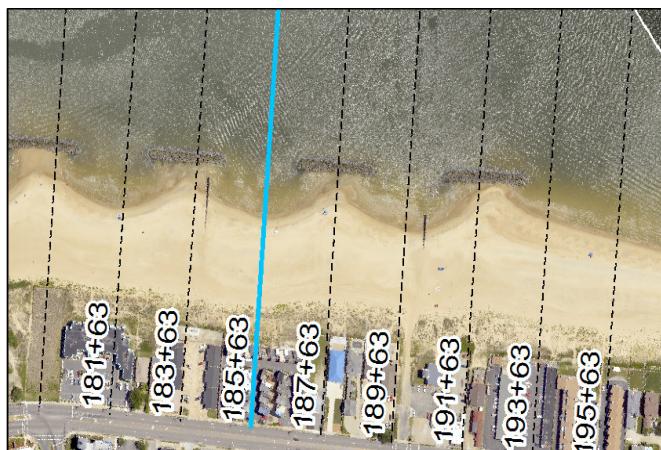


Survey Transect 185+63	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	125.10 ft/yr	133.44 ft
Volume Change Above -15 ft NAVD88	48.23 cy/ft/yr	55.50 cy/ft
Volume Change Above 0 ft NAVD88	17.58 cy/ft/yr	18.40 cy/ft



Notes:

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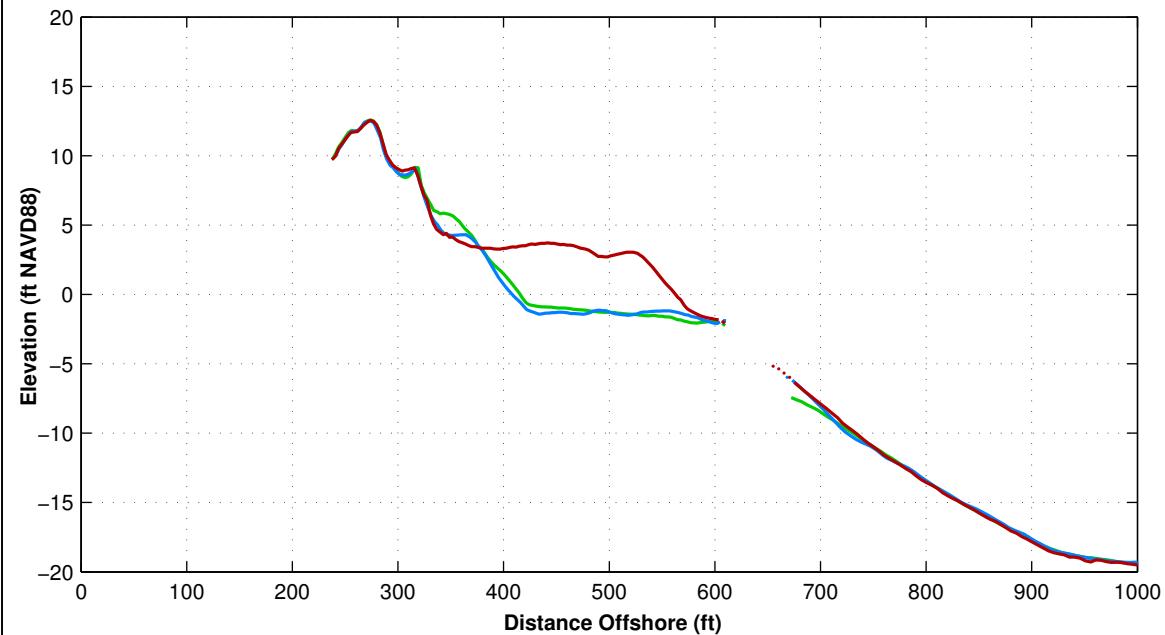
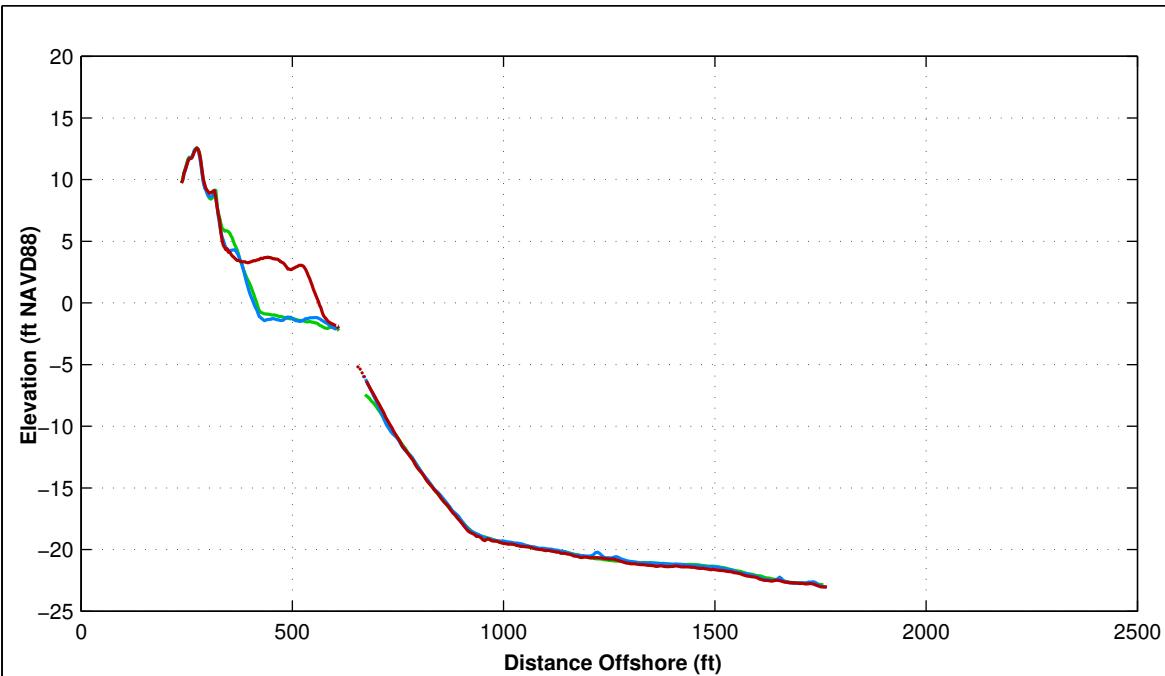
THE CITY OF  
**NORFOLK**  
PUBLIC WORKS

ST 185+63

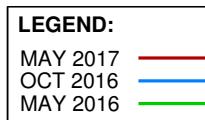
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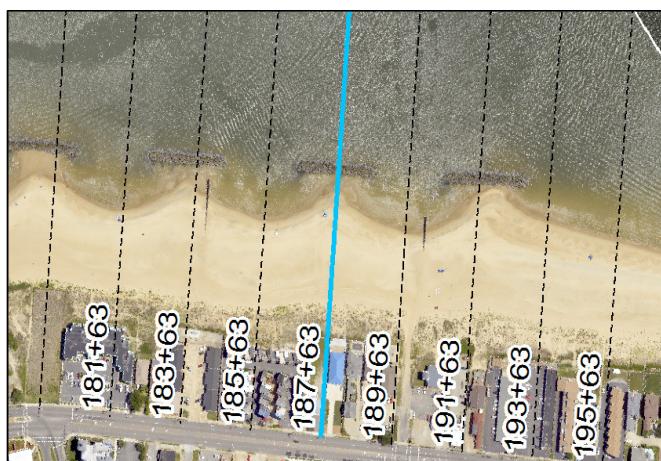


Survey Transect 187+63	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	145.71 ft/yr	153.71 ft
Volume Change Above -15 ft NAVD88	24.65 cy/ft/yr	26.62 cy/ft
Volume Change Above 0 ft NAVD88	15.90 cy/ft/yr	18.35 cy/ft



Notes:

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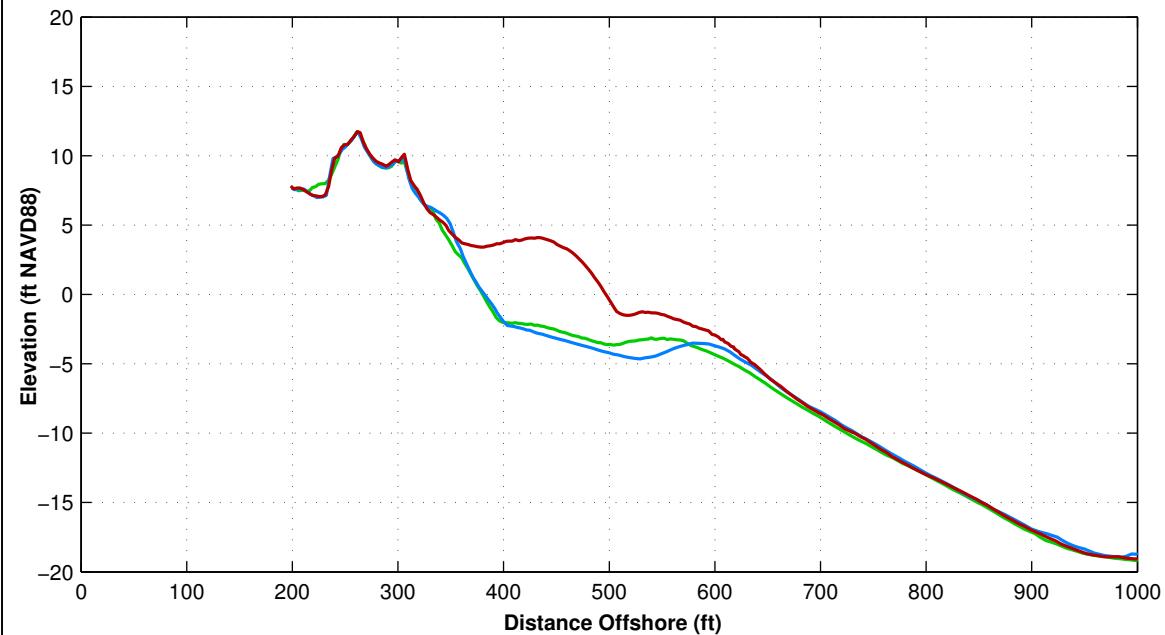
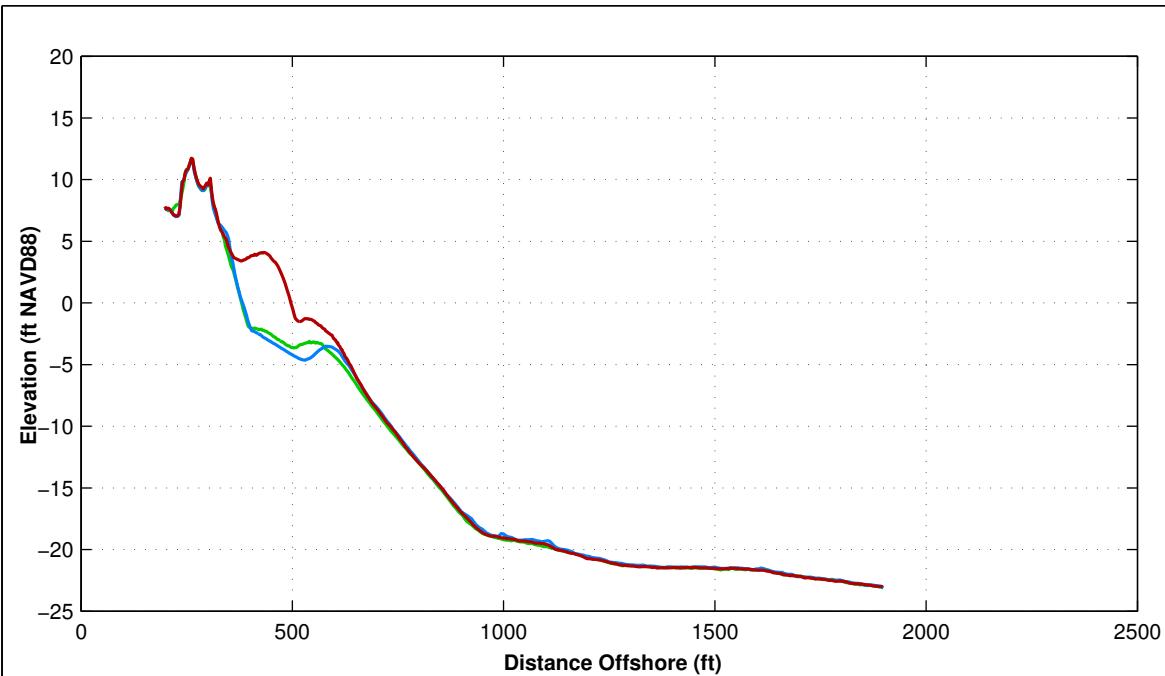
THE CITY OF  
**NORFOLK**  
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ST 187+63

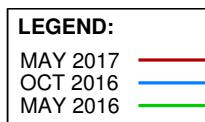
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Survey Transect 189+63	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	115.83 ft/yr	115.15 ft
Volume Change Above -15 ft NAVD88	36.98 cy/ft/yr	36.71 cy/ft
Volume Change Above 0 ft NAVD88	16.07 cy/ft/yr	15.41 cy/ft



Notes:

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4. Survey Comparison Made to MAY 2016 and OCT 2016
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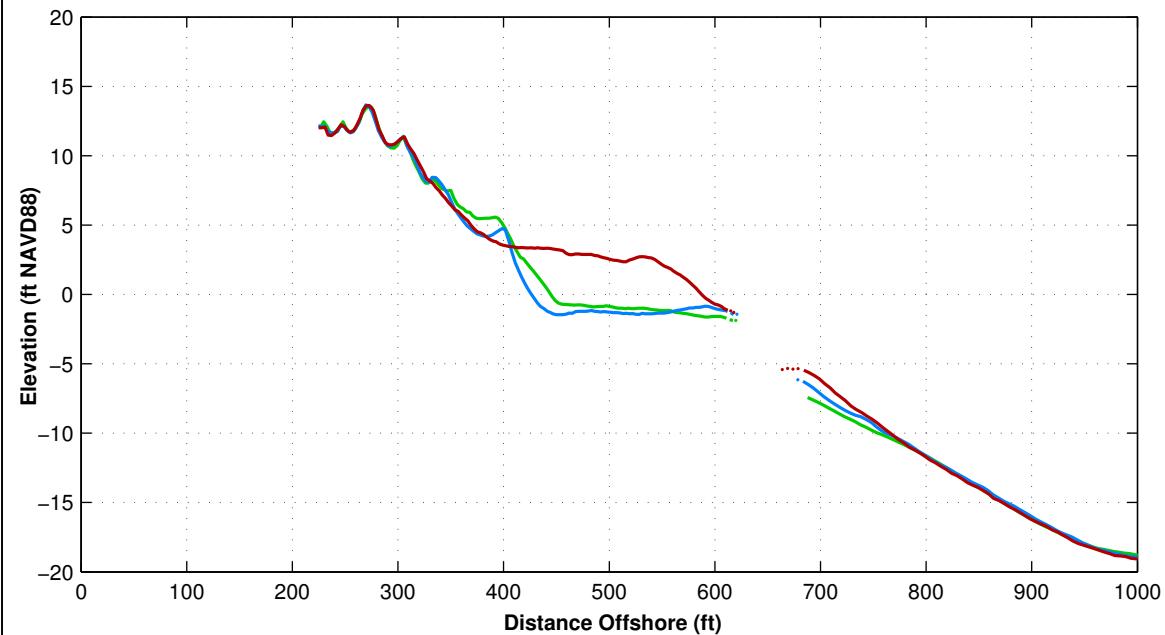
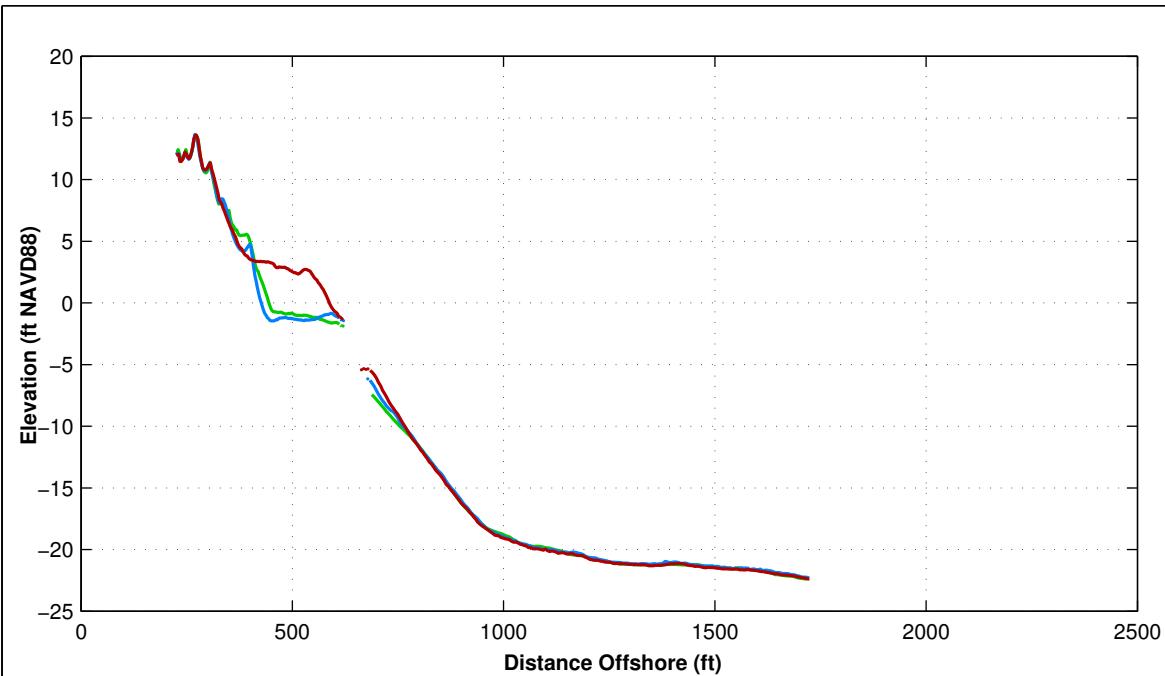
THE CITY OF  
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PUBLIC WORKS

ST 189+63

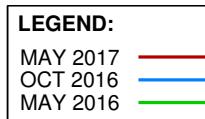
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Survey Transect 191+63	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	139.16 ft/yr	155.65 ft
Volume Change Above -15 ft NAVD88	21.56 cy/ft/yr	24.48 cy/ft
Volume Change Above 0 ft NAVD88	12.23 cy/ft/yr	15.66 cy/ft



Notes:

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3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



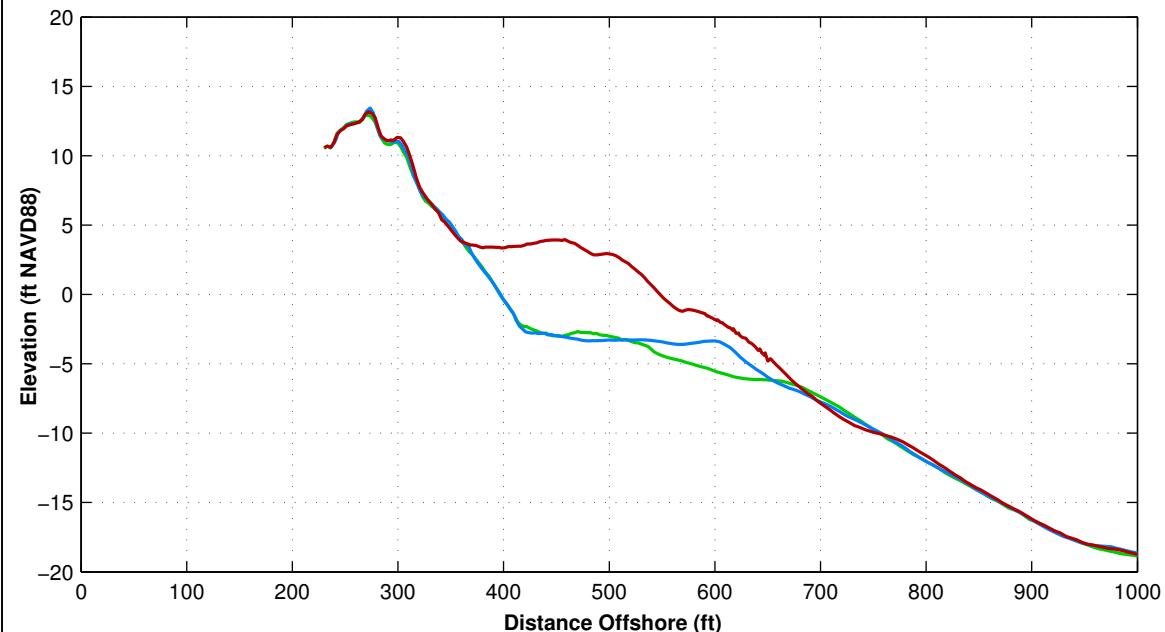
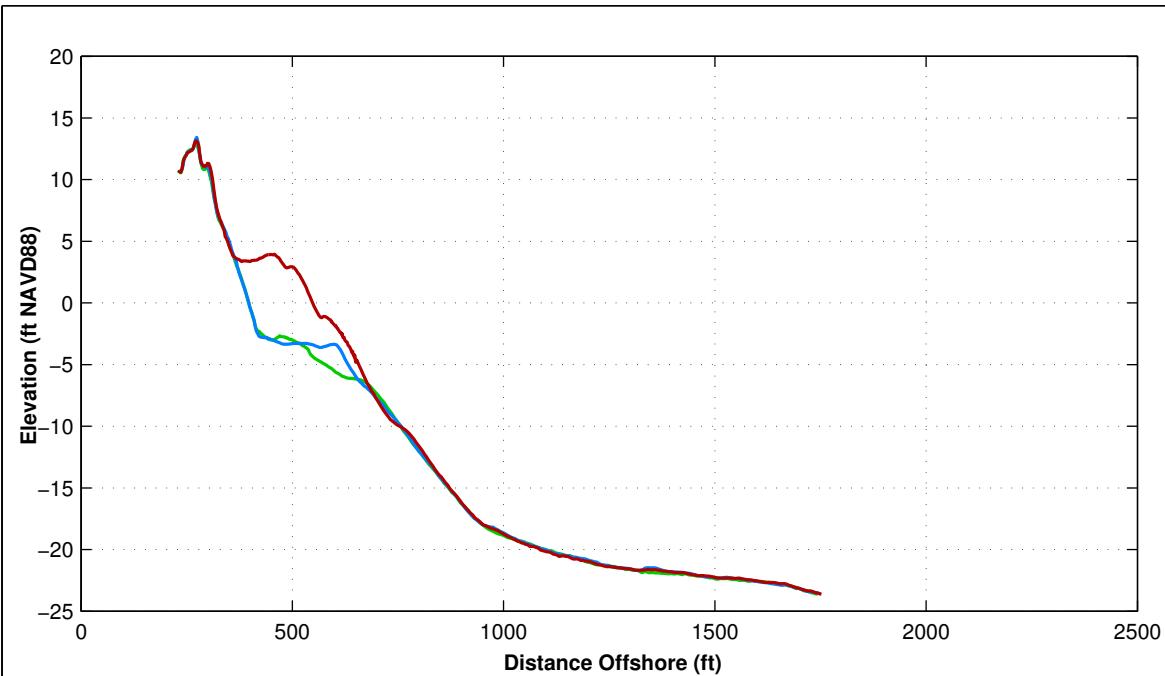
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ST 191+63

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Survey Transect 193+63	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	147.04 ft/yr	147.49 ft
Volume Change Above -15 ft NAVD88	48.31 cy/ft/yr	43.54 cy/ft
Volume Change Above 0 ft NAVD88	19.14 cy/ft/yr	18.51 cy/ft

LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

Notes:

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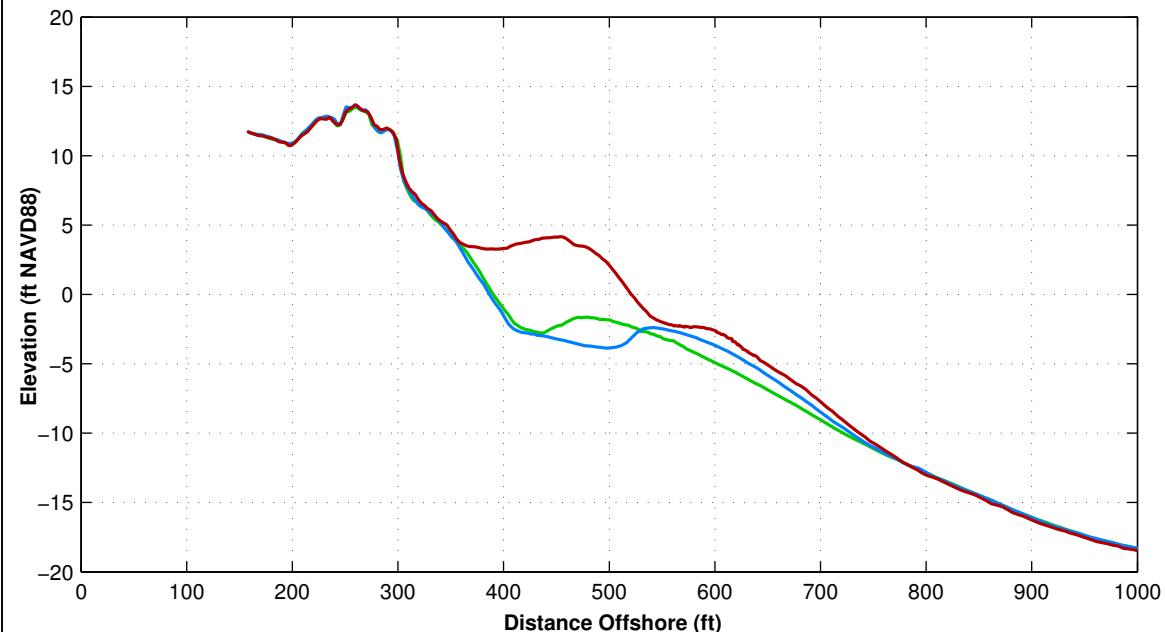
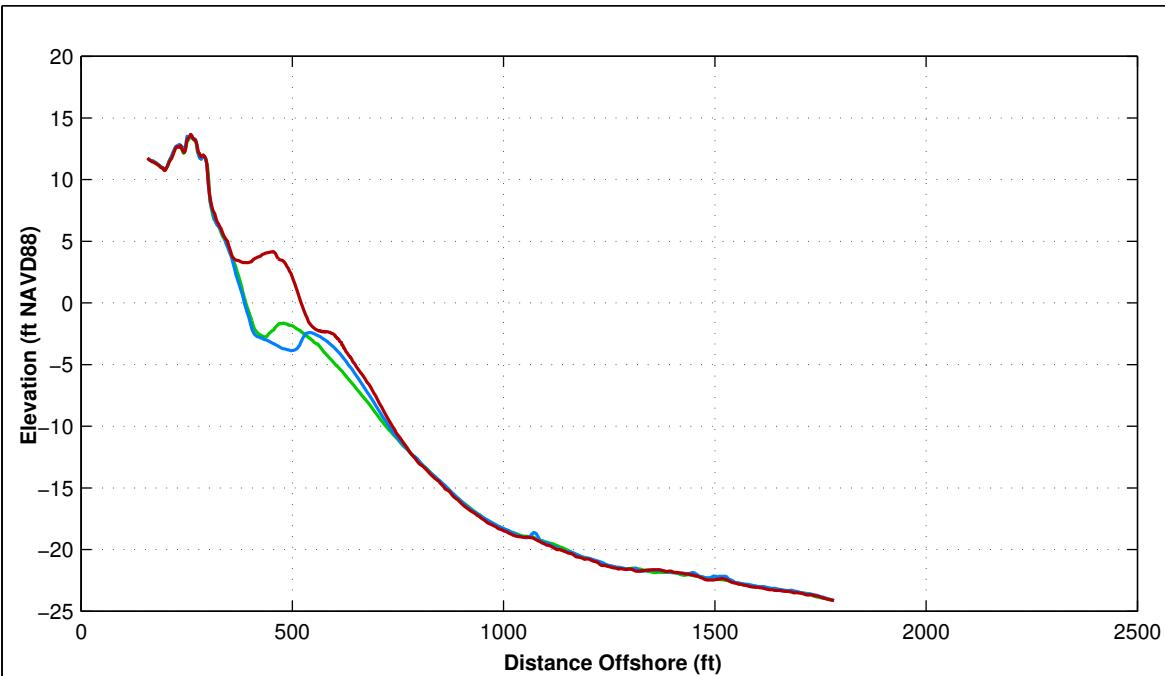
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Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
195+63		
Shoreline Change at MHW (0.98 ft NAVD88)	129.35 ft/yr	132.93 ft
Volume Change Above -15 ft NAVD88	40.04 cy/ft/yr	39.40 cy/ft
Volume Change Above 0 ft NAVD88	17.57 cy/ft/yr	17.90 cy/ft

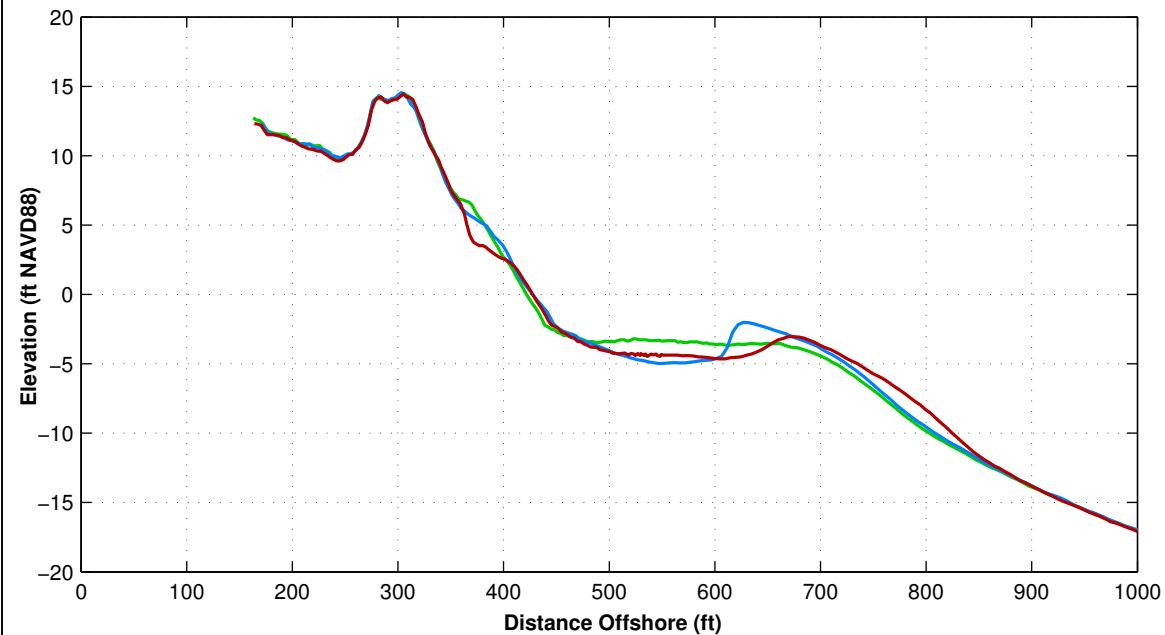
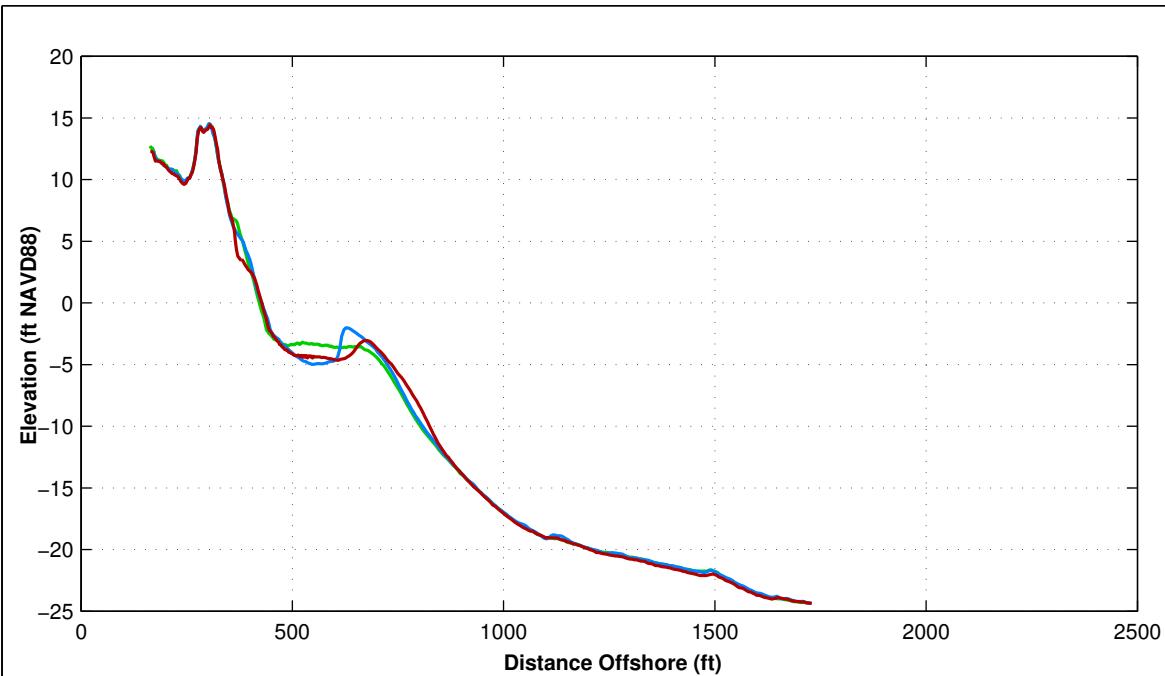
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

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Survey Transect 206+86	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	5.11 ft/yr	1.92 ft
Volume Change Above -15 ft NAVD88	0.24 cy/ft/yr	-0.15 cy/ft
Volume Change Above 0 ft NAVD88	-2.32 cy/ft/yr	-2.21 cy/ft

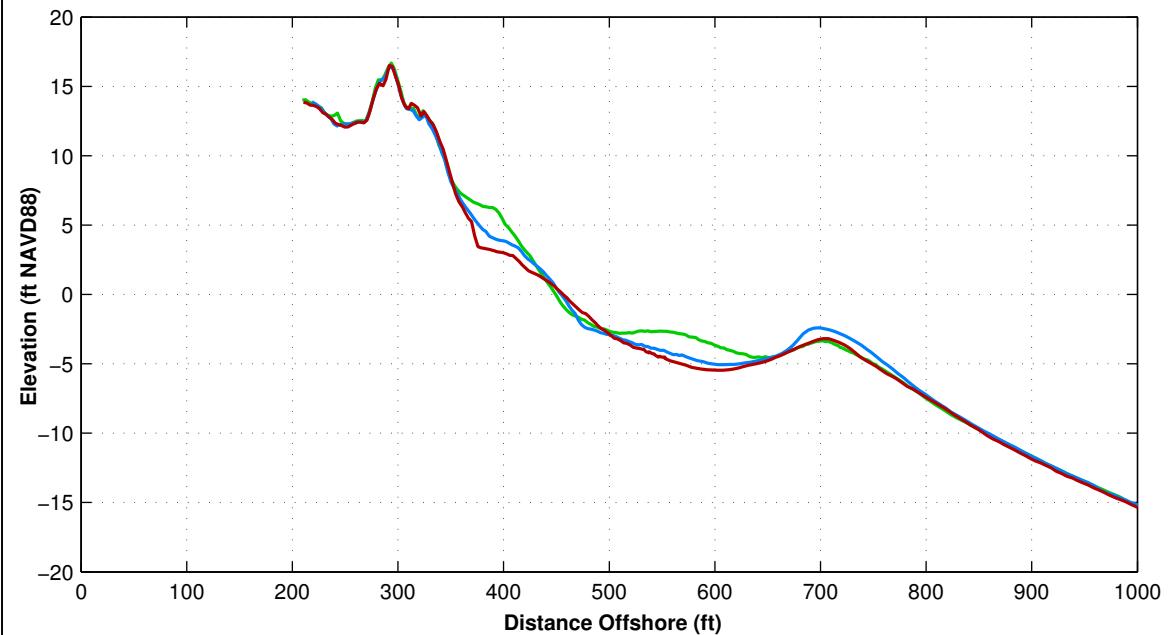
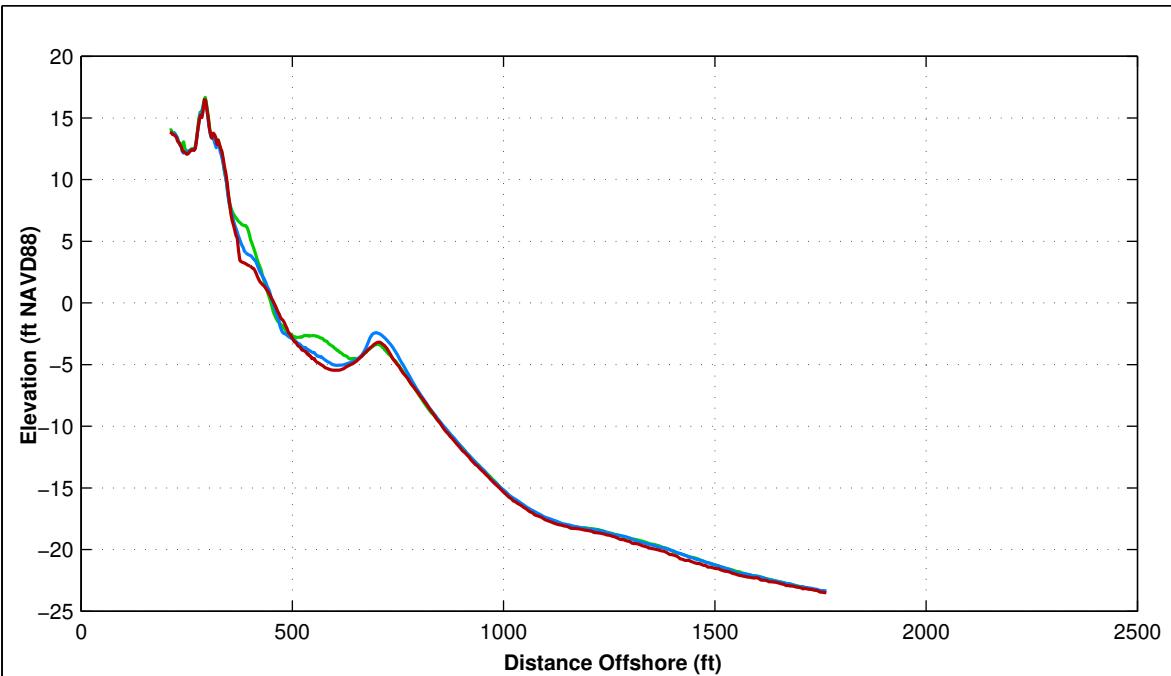
LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
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5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





Survey Transect 218+66	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	0.87 ft/yr	-3.94 ft
Volume Change Above -15 ft NAVD88	-13.01 cy/ft/yr	-7.53 cy/ft
Volume Change Above 0 ft NAVD88	-5.67 cy/ft/yr	-2.21 cy/ft

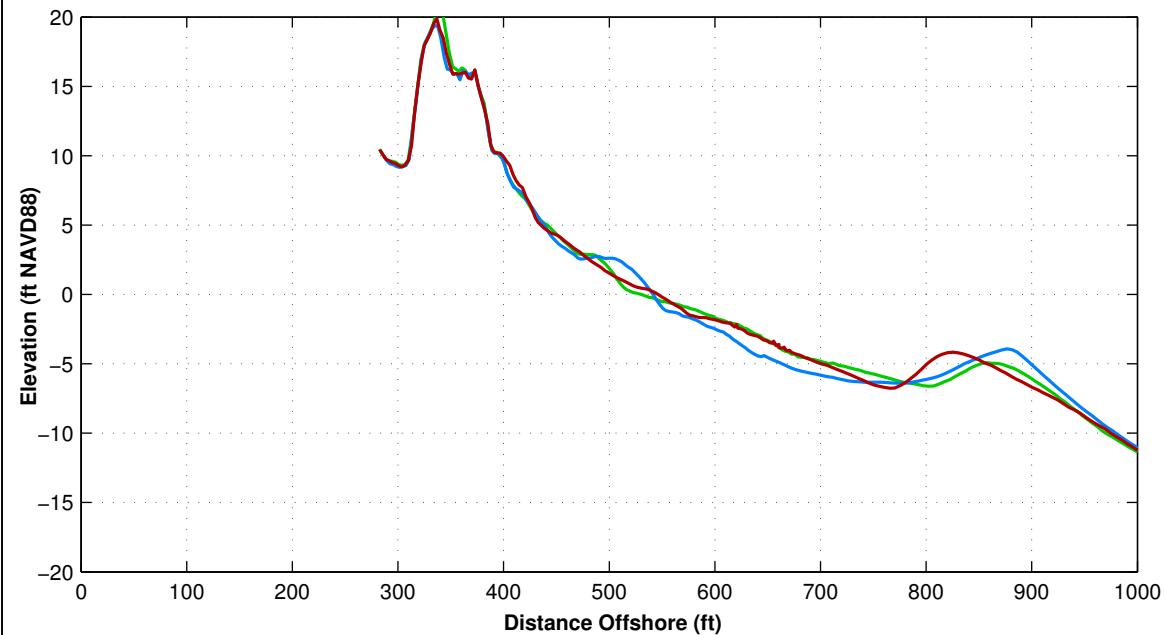
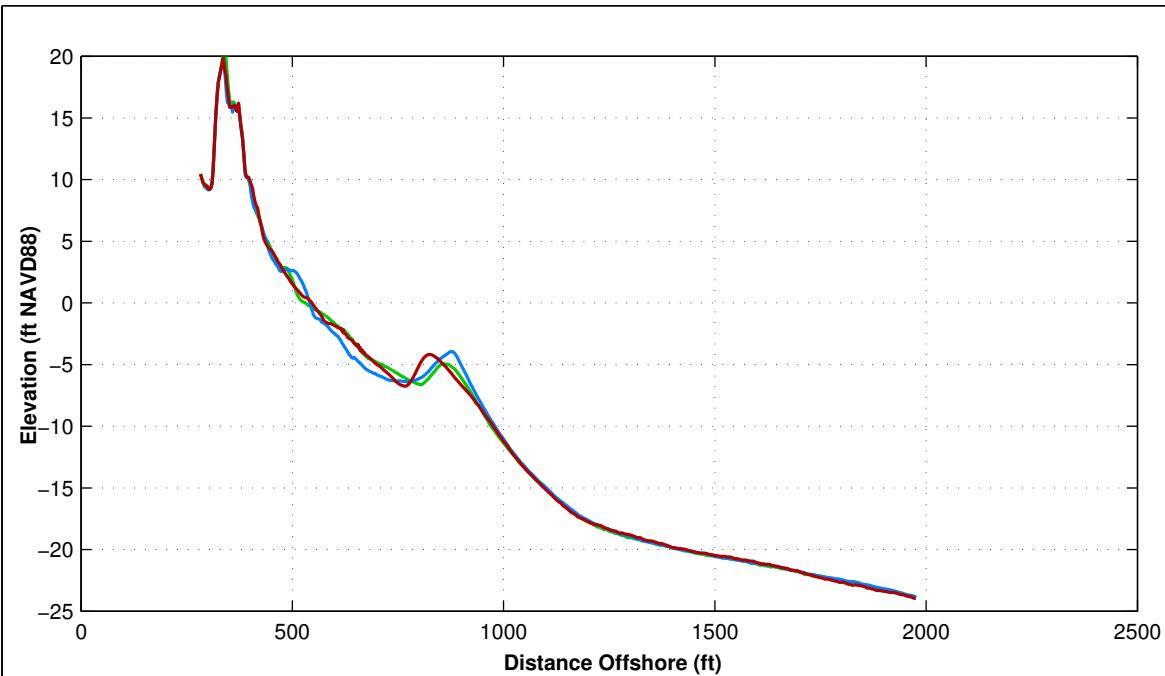
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

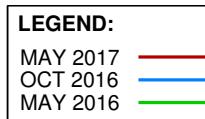
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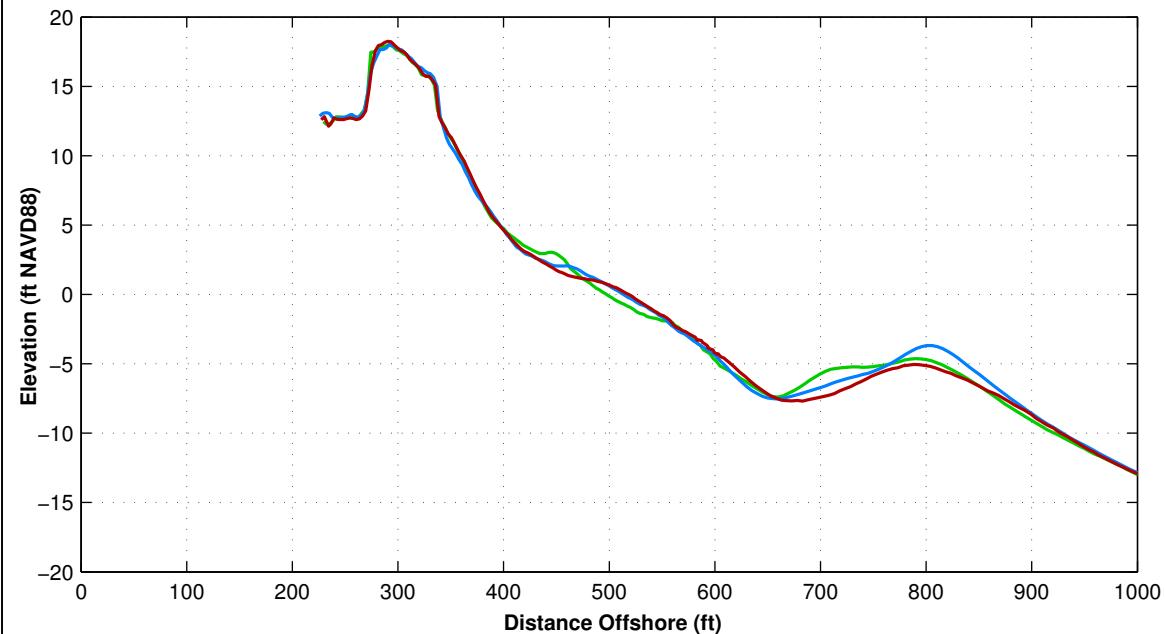
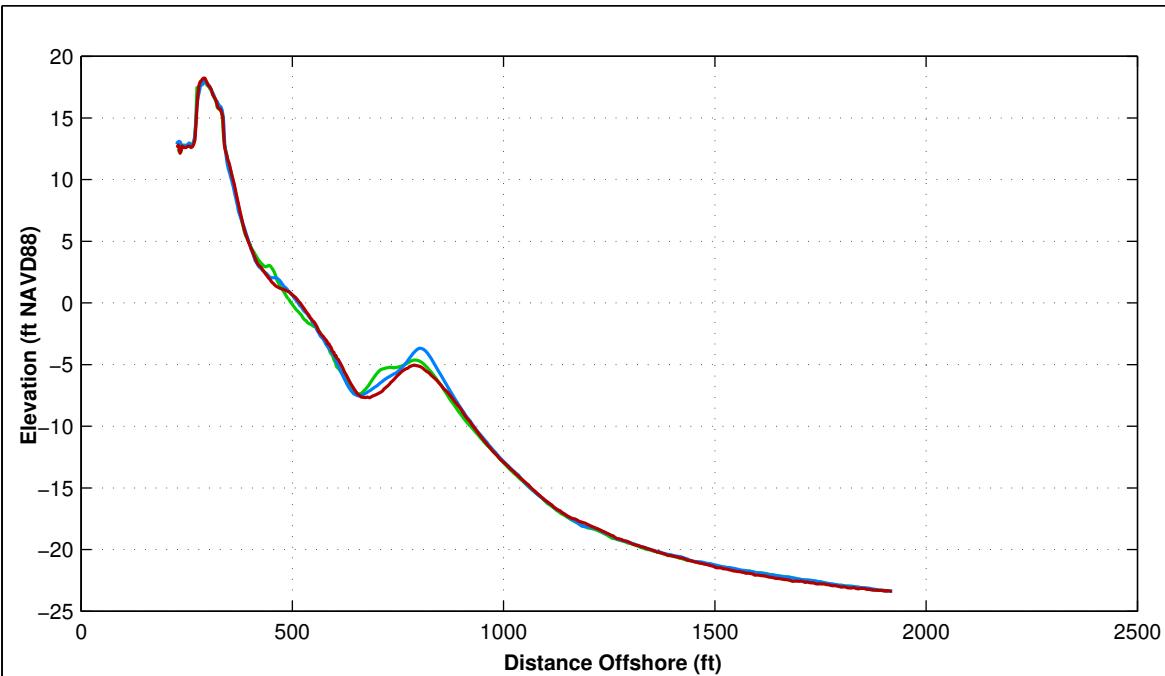
Survey Transect 229+85	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	5.34 ft/yr	-18.05 ft
Volume Change Above -15 ft NAVD88	0.06 cy/ft/yr	2.00 cy/ft
Volume Change Above 0 ft NAVD88	-0.56 cy/ft/yr	-0.45 cy/ft



Notes:

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3. All Survey Elevations In Feet Referenced to NAVD88.
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Survey Transect 242+03

	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	8.90 ft/yr	-3.60 ft
Volume Change Above -15 ft NAVD88	-2.44 cy/ft/yr	-5.46 cy/ft
Volume Change Above 0 ft NAVD88	-0.79 cy/ft/yr	-0.35 cy/ft

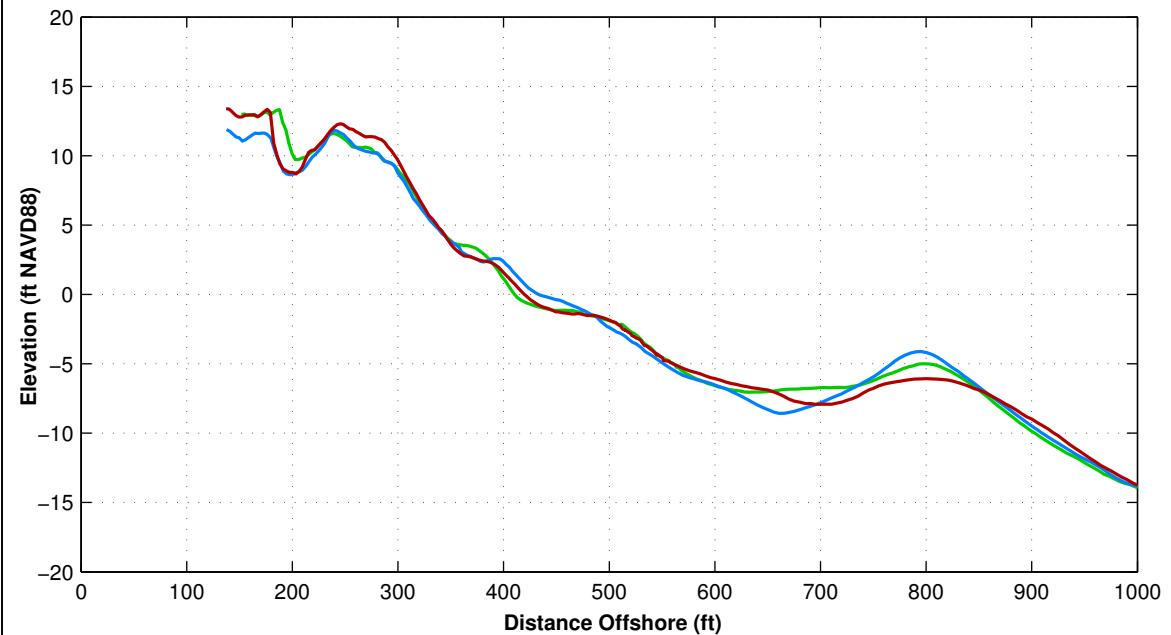
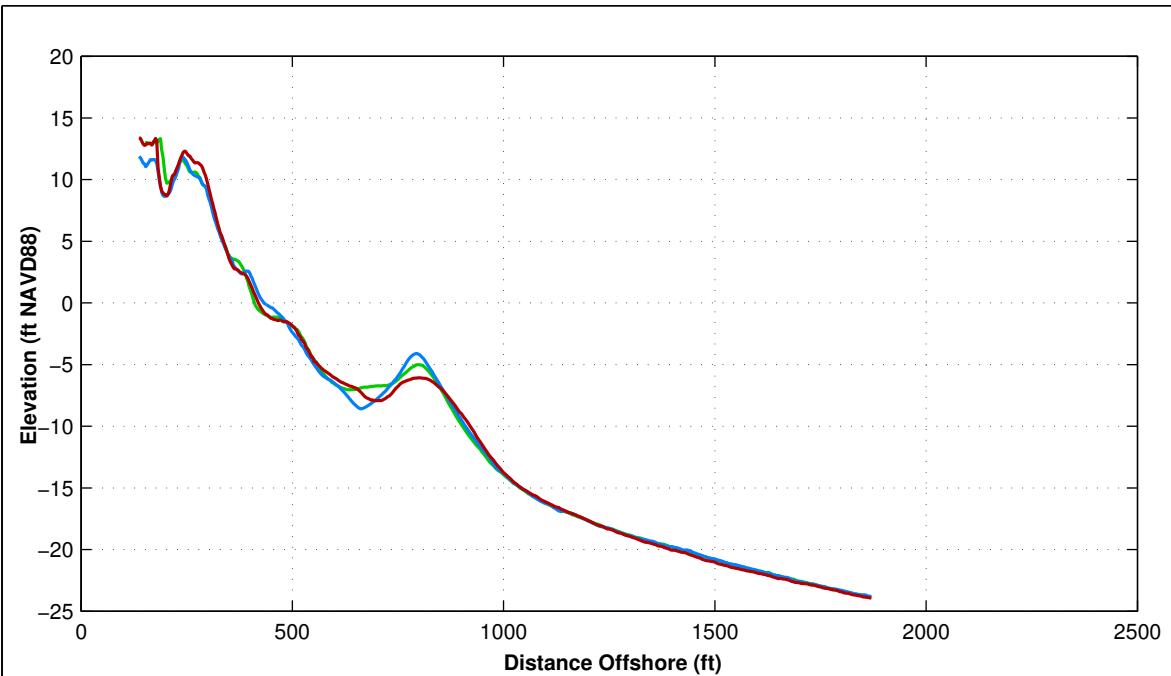
**LEGEND:**

MAY 2017	—
OCT 2016	—
MAY 2016	—

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
252+62		
Shoreline Change at MHW (0.98 ft NAVD88)	5.92 ft/yr	-9.54 ft
Volume Change Above -15 ft NAVD88	-1.15 cy/ft/yr	3.27 cy/ft
Volume Change Above 0 ft NAVD88	-0.04 cy/ft/yr	3.94 cy/ft

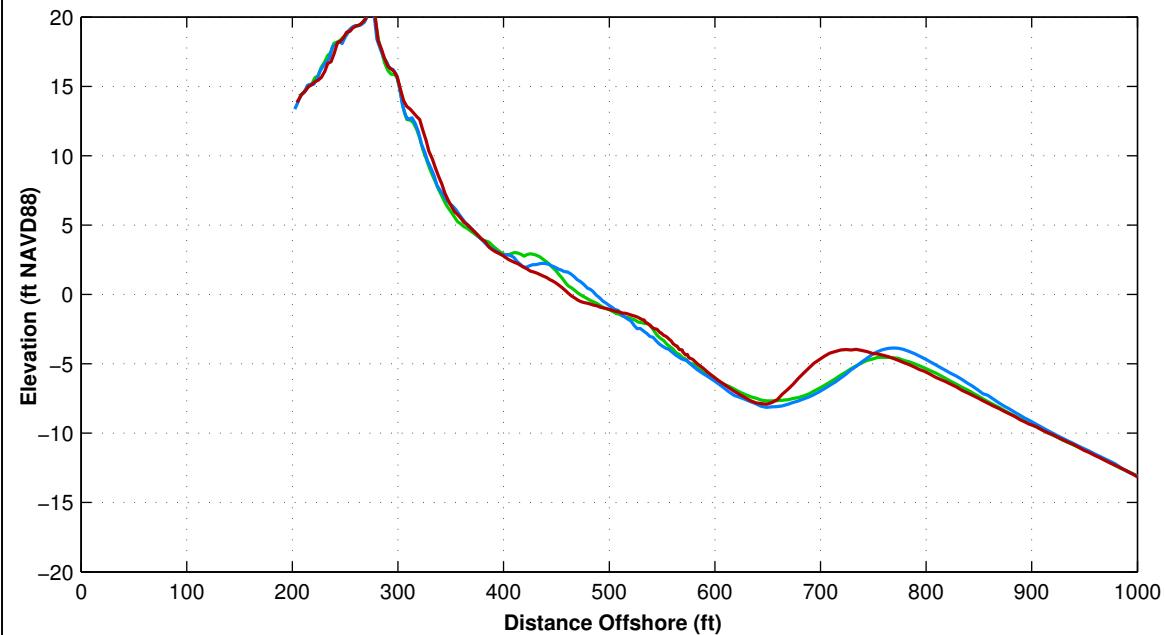
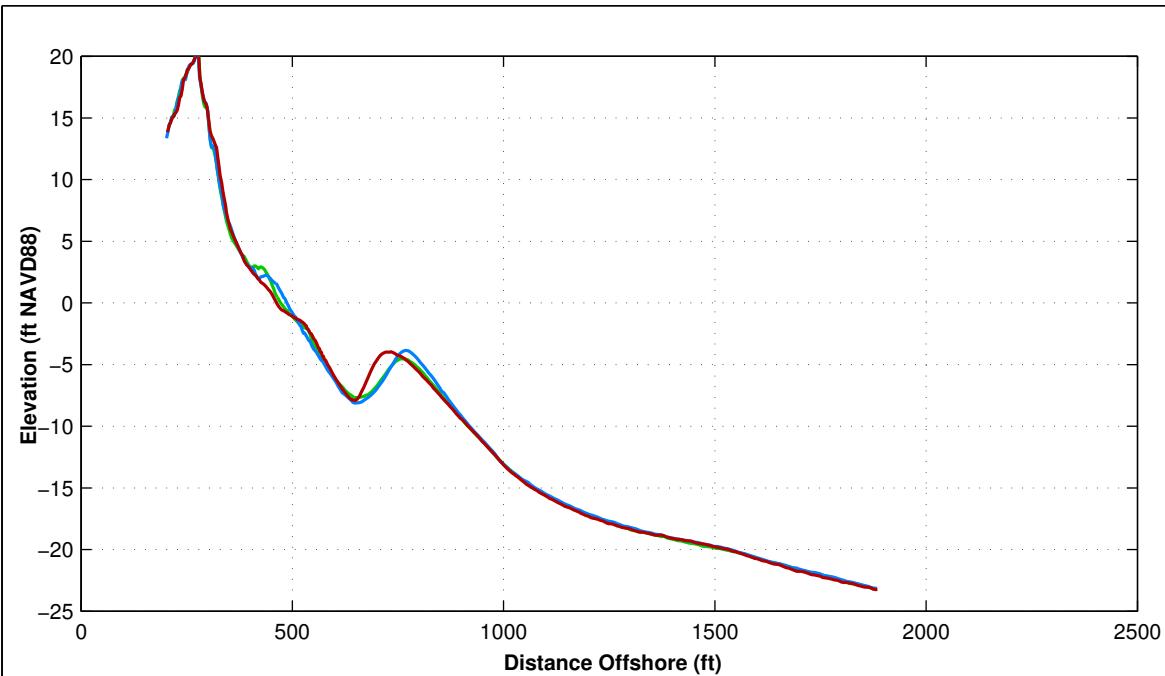
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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4. Survey Comparison Made to MAY 2016 and OCT 2016
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Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
263+22		
Shoreline Change at MHW (0.98 ft NAVD88)	-11.10 ft/yr	-25.44 ft
Volume Change Above -15 ft NAVD88	3.50 cy/ft/yr	1.47 cy/ft
Volume Change Above 0 ft NAVD88	-0.61 cy/ft/yr	-1.19 cy/ft

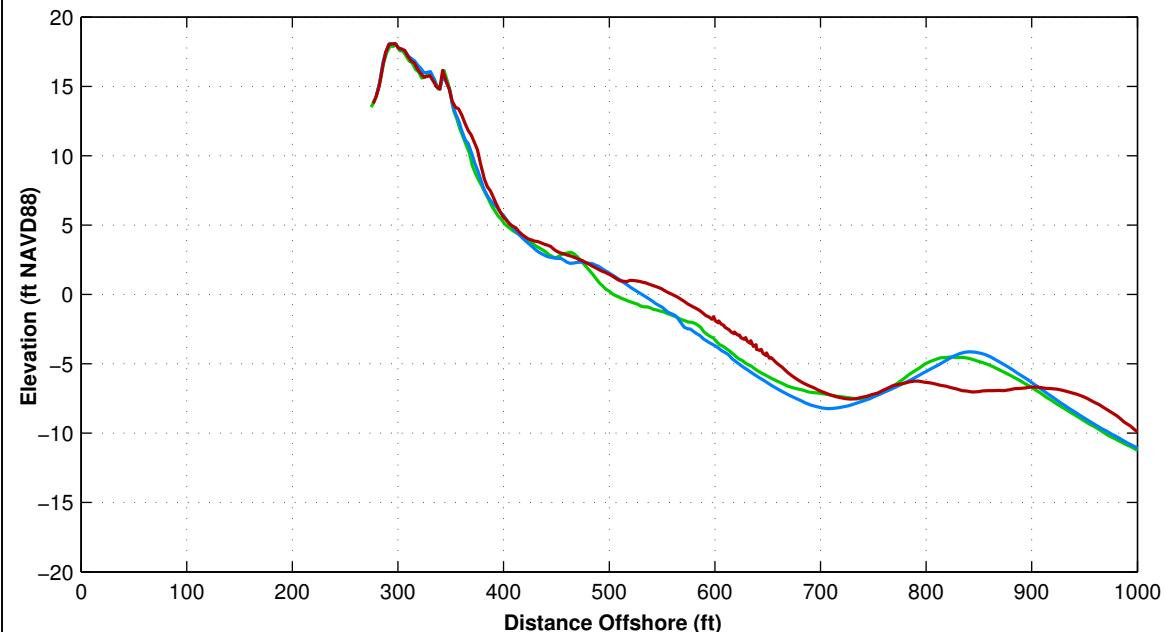
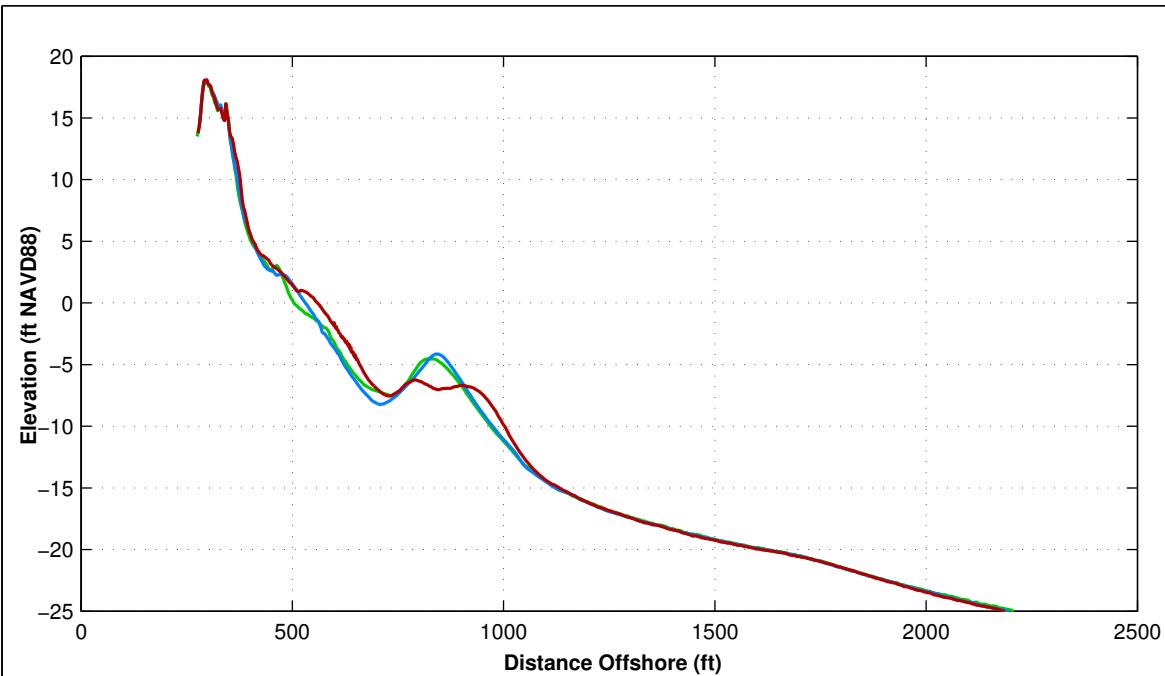
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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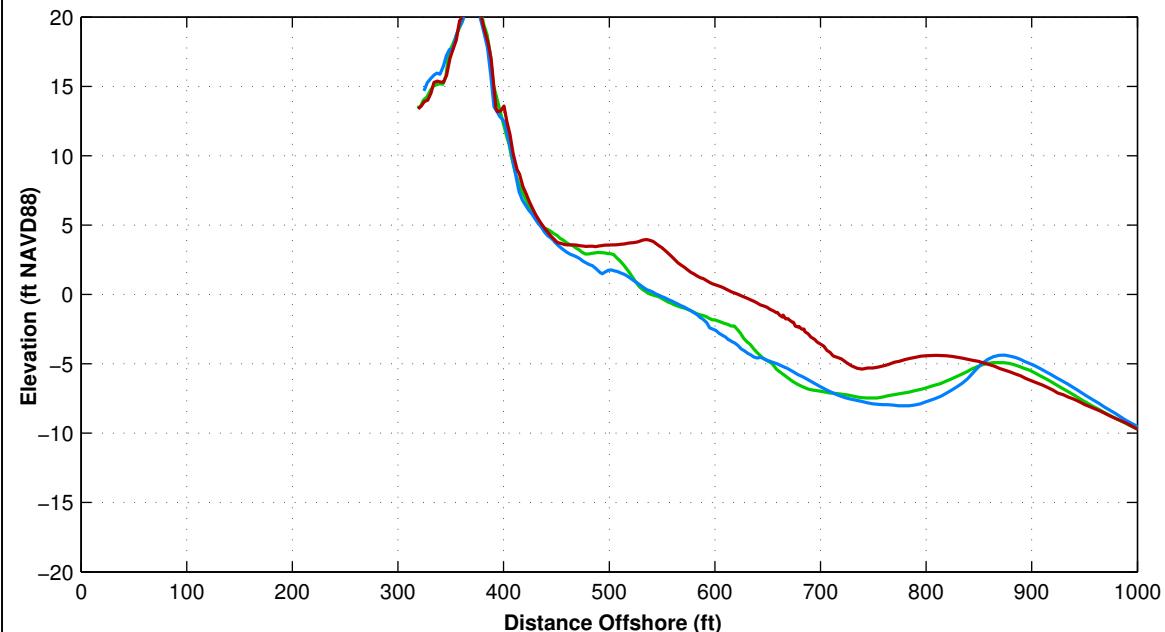
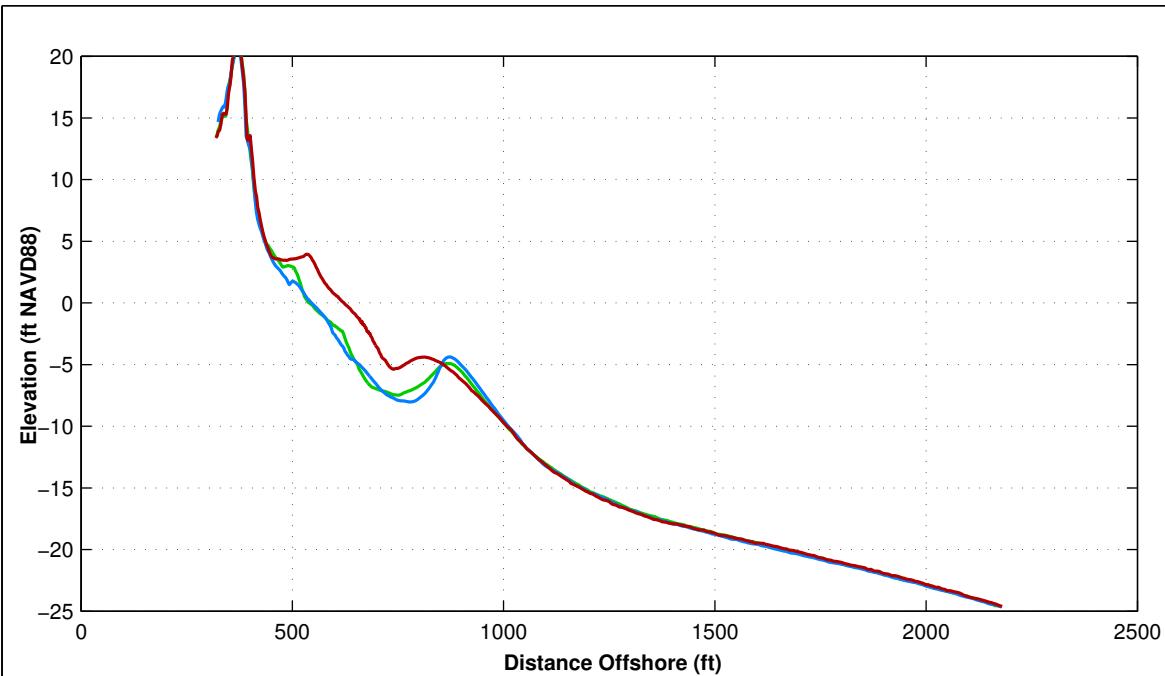




Notes:

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4. Survey Comparison Made to MAY 2016 and OCT 2016
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Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
281+40		
Shoreline Change at MHW (0.98 ft NAVD88)	68.12 ft/yr	68.92 ft
Volume Change Above -15 ft NAVD88	33.45 cy/ft/yr	37.05 cy/ft
Volume Change Above 0 ft NAVD88	9.31 cy/ft/yr	11.62 cy/ft

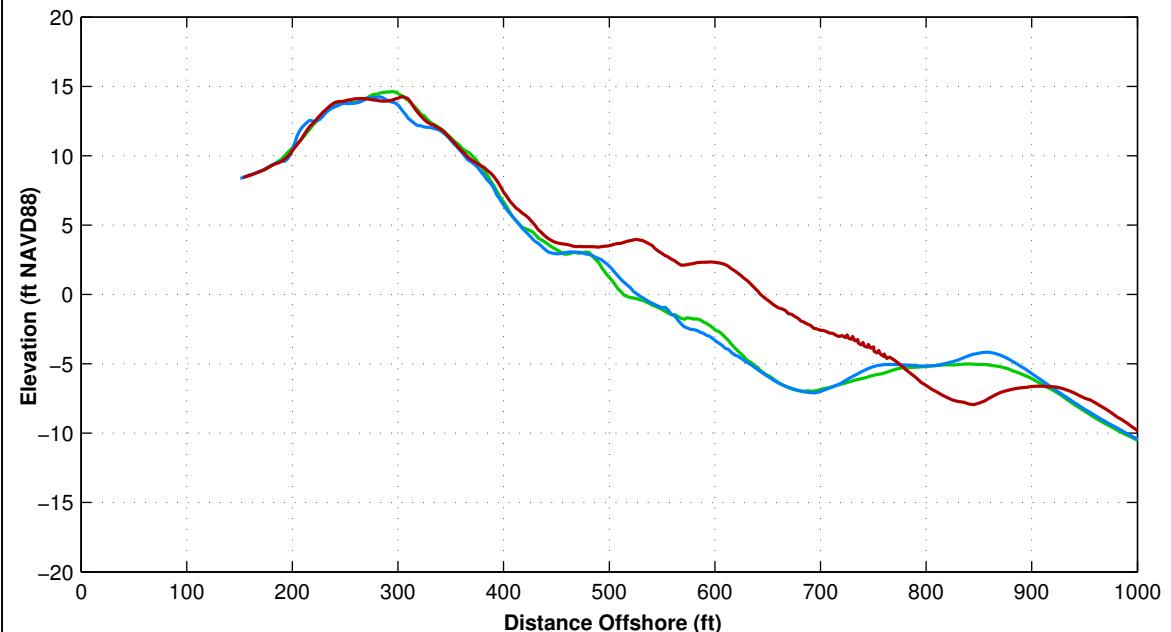
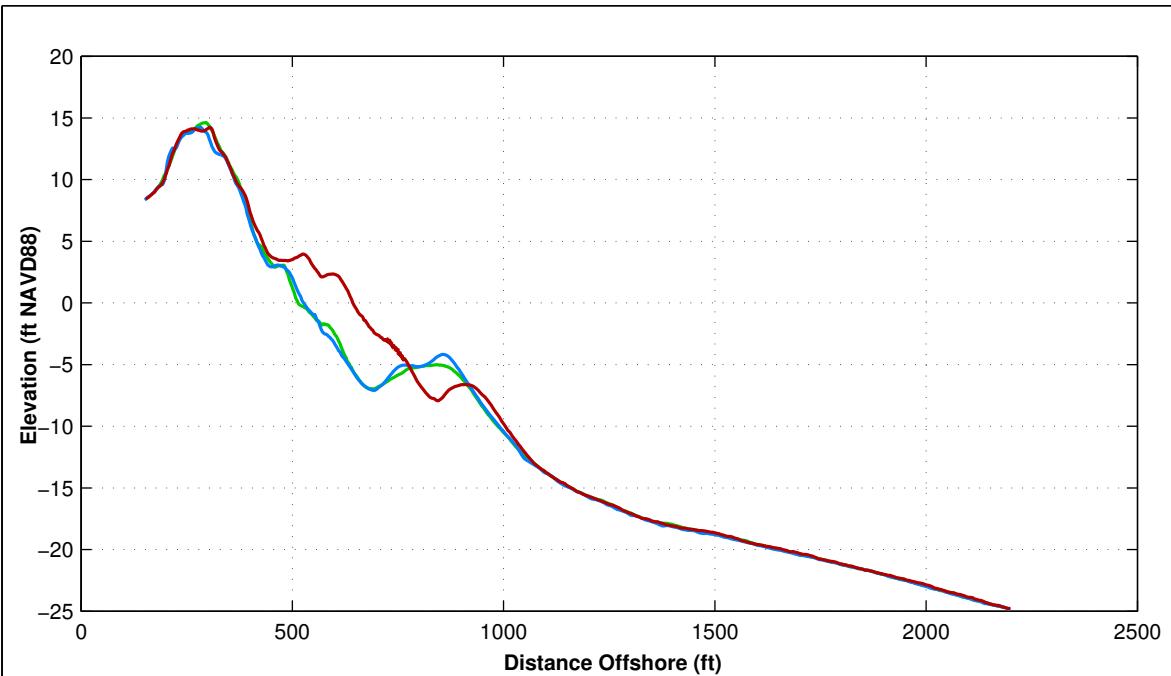
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

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Survey Transect 288+39	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	128.15 ft/yr	118.37 ft
Volume Change Above -15 ft NAVD88	39.21 cy/ft/yr	39.35 cy/ft
Volume Change Above 0 ft NAVD88	15.63 cy/ft/yr	17.51 cy/ft

LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

Notes:

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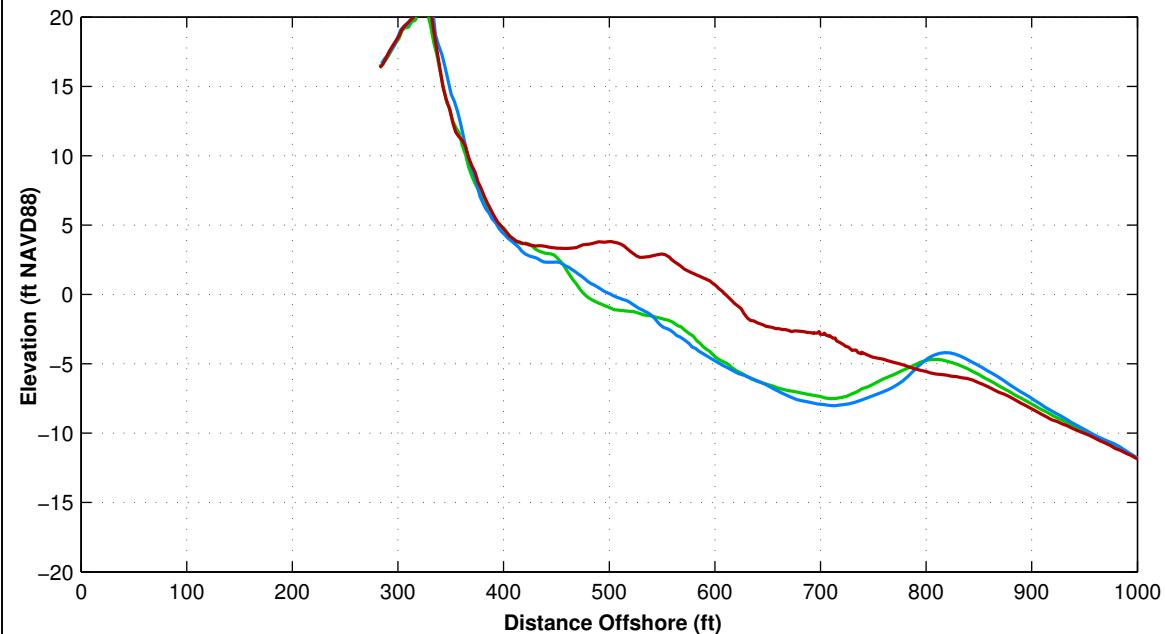
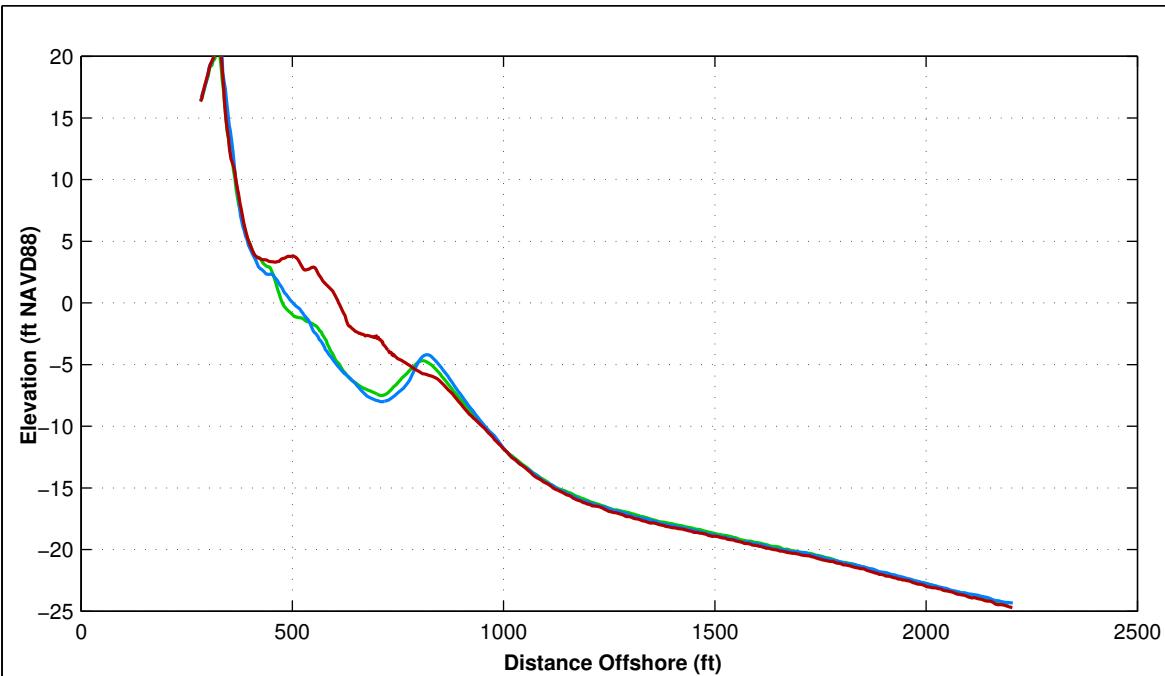
THE CITY OF  
**NORFOLK**  
PUBLIC WORKS

ST 288+39

OCEAN VIEW PERIODIC  
SURVEYING DATA &  
ANALYSIS

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Spring 2017



Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
295+27		
Shoreline Change at MHW (0.98 ft NAVD88)	128.39 ft/yr	115.83 ft
Volume Change Above -15 ft NAVD88	44.46 cy/ft/yr	43.07 cy/ft
Volume Change Above 0 ft NAVD88	15.91 cy/ft/yr	13.67 cy/ft

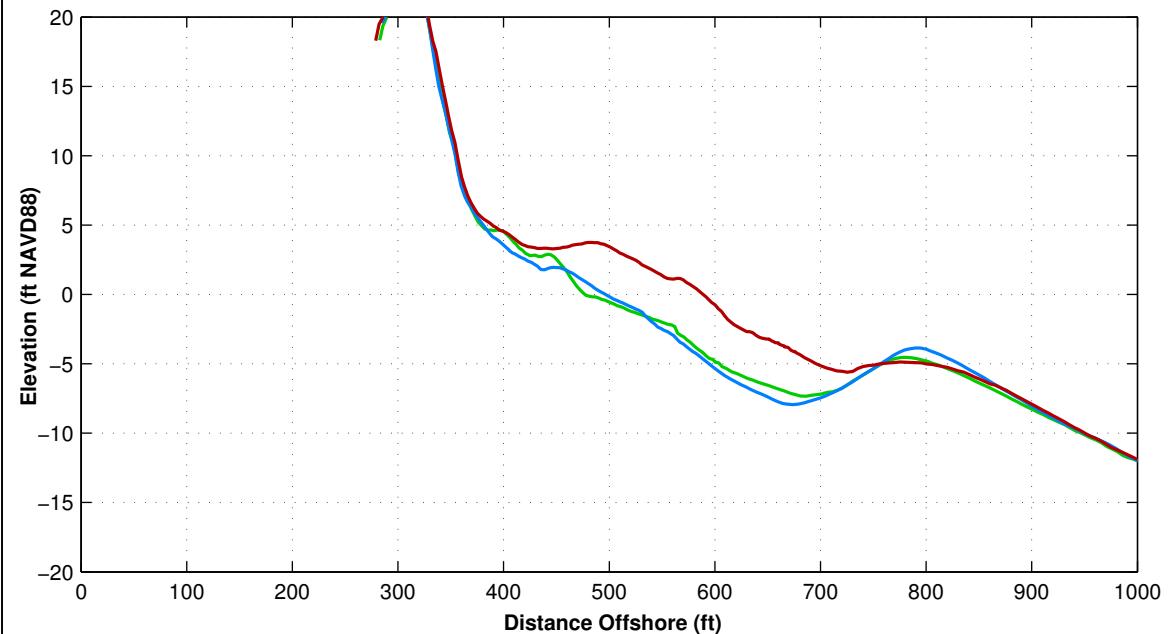
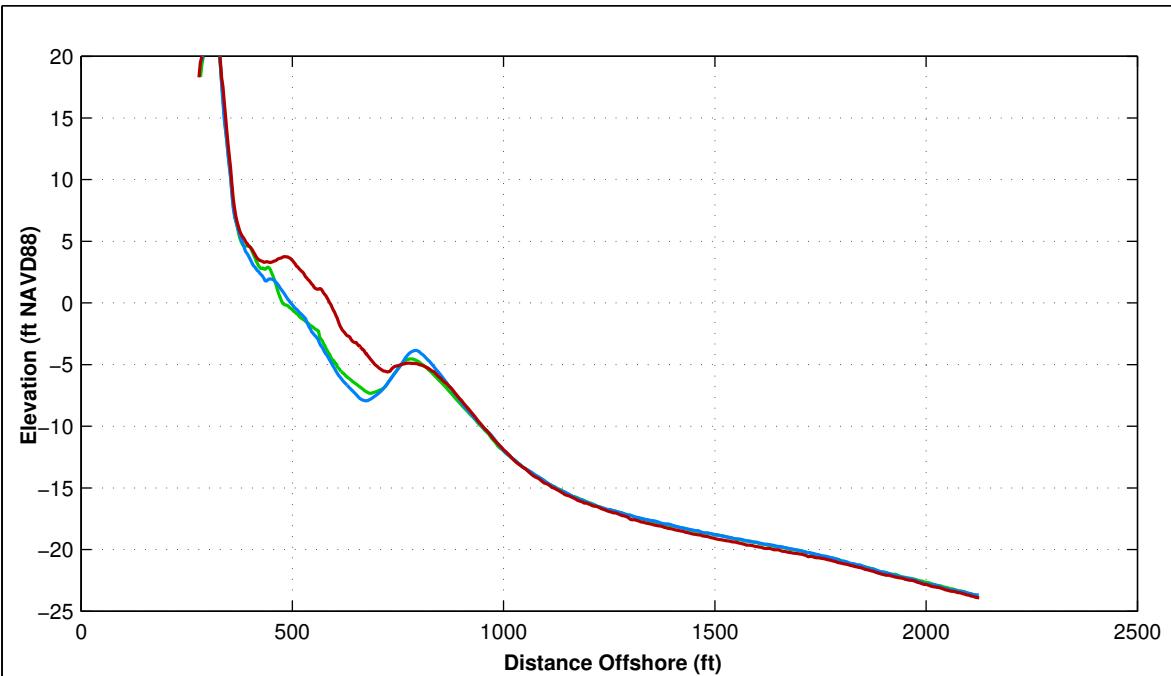
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

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Survey Transect 302+24	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	105.52 ft/yr	94.91 ft
Volume Change Above -15 ft NAVD88	37.74 cy/ft/yr	38.50 cy/ft
Volume Change Above 0 ft NAVD88	14.21 cy/ft/yr	15.25 cy/ft

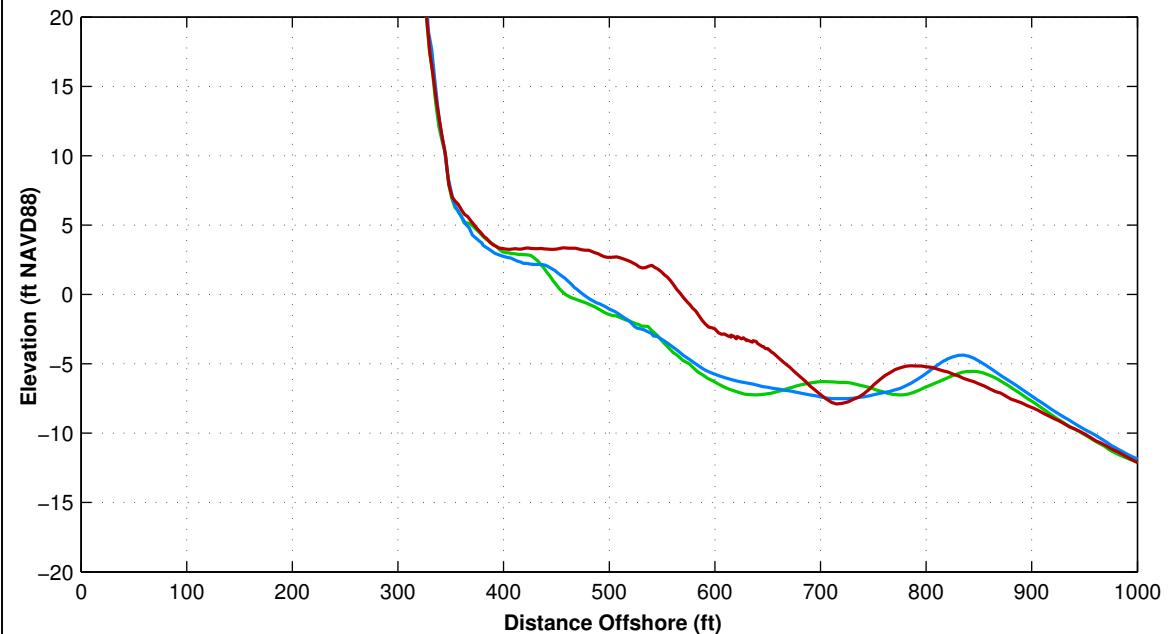
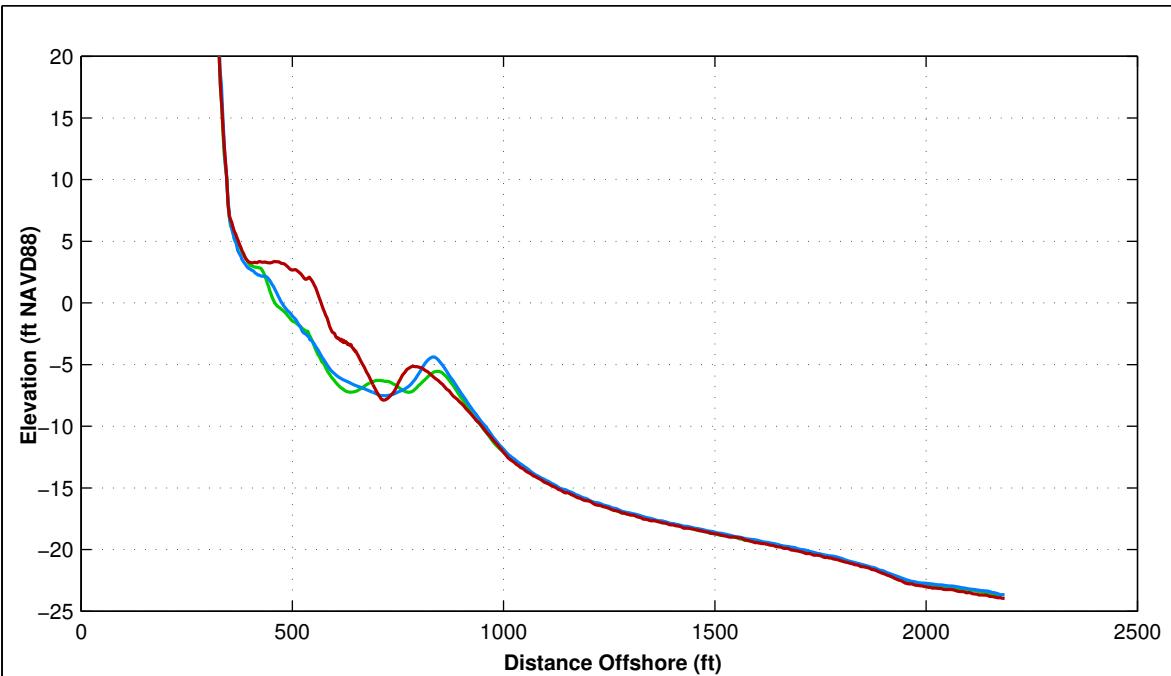
LEGEND:

- MAY 2017 — Red line
- OCT 2016 — Blue line
- MAY 2016 — Green line

Notes:

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Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	111.09 ft/yr	97.29 ft
Volume Change Above -15 ft NAVD88	33.51 cy/ft/yr	27.33 cy/ft
Volume Change Above 0 ft NAVD88	12.65 cy/ft/yr	12.19 cy/ft

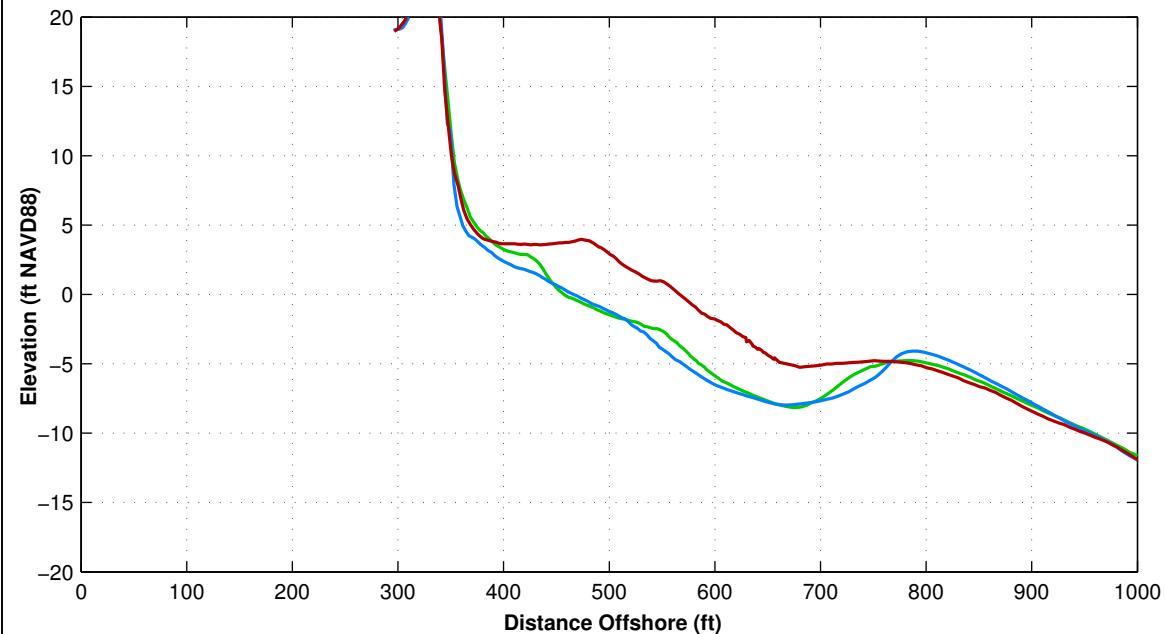
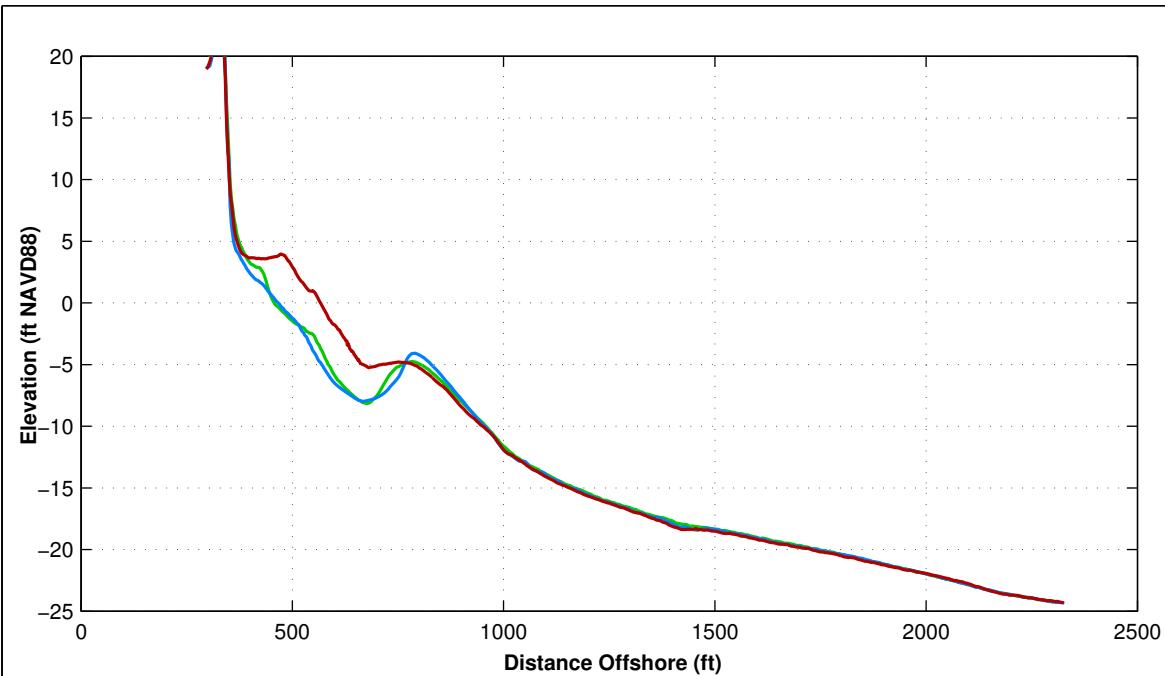
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

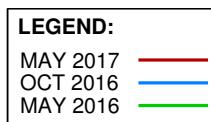
**Notes:**

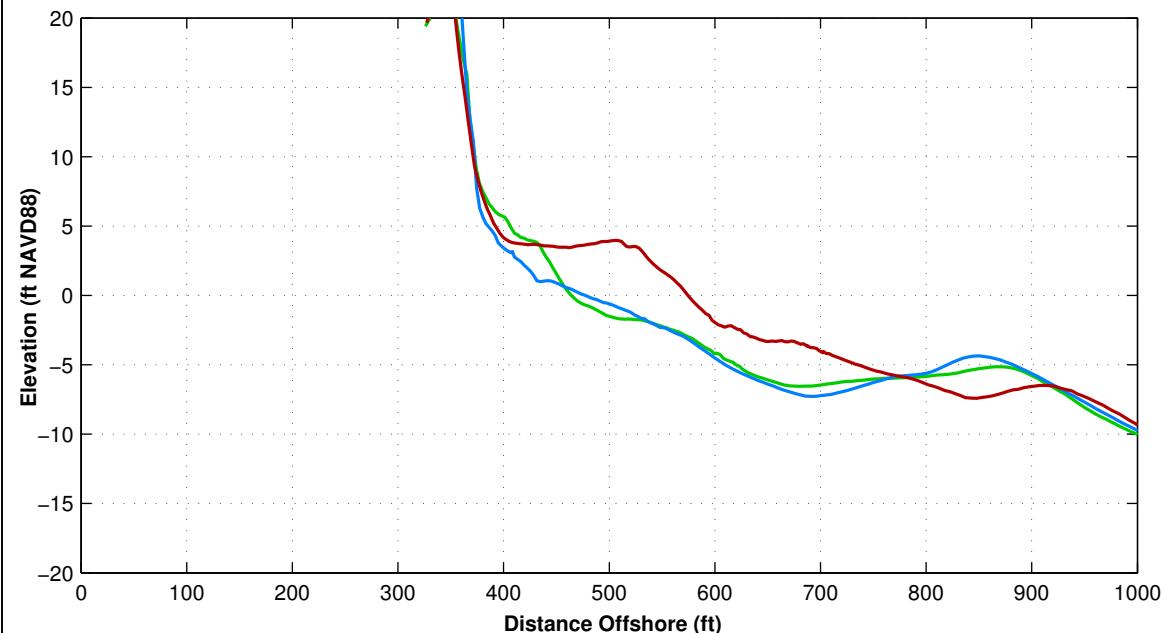
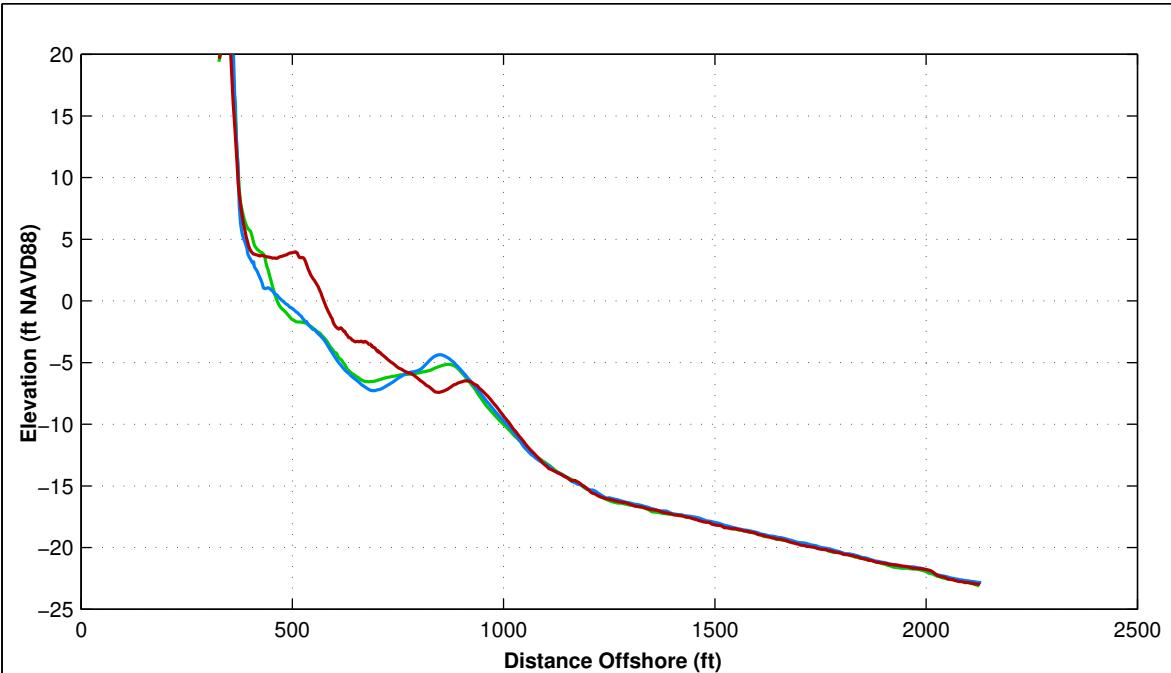
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Survey Transect 323+09	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	ft/yr	ft
Volume Change Above -15 ft NAVD88	cy/ft/yr	cy/ft
Volume Change Above 0 ft NAVD88	cy/ft/yr	cy/ft





Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
329+63		
Shoreline Change at MHW (0.98 ft NAVD88)	108.65 ft/yr	116.00 ft
Volume Change Above -15 ft NAVD88	30.53 cy/ft/yr	32.81 cy/ft
Volume Change Above 0 ft NAVD88	11.29 cy/ft/yr	15.02 cy/ft

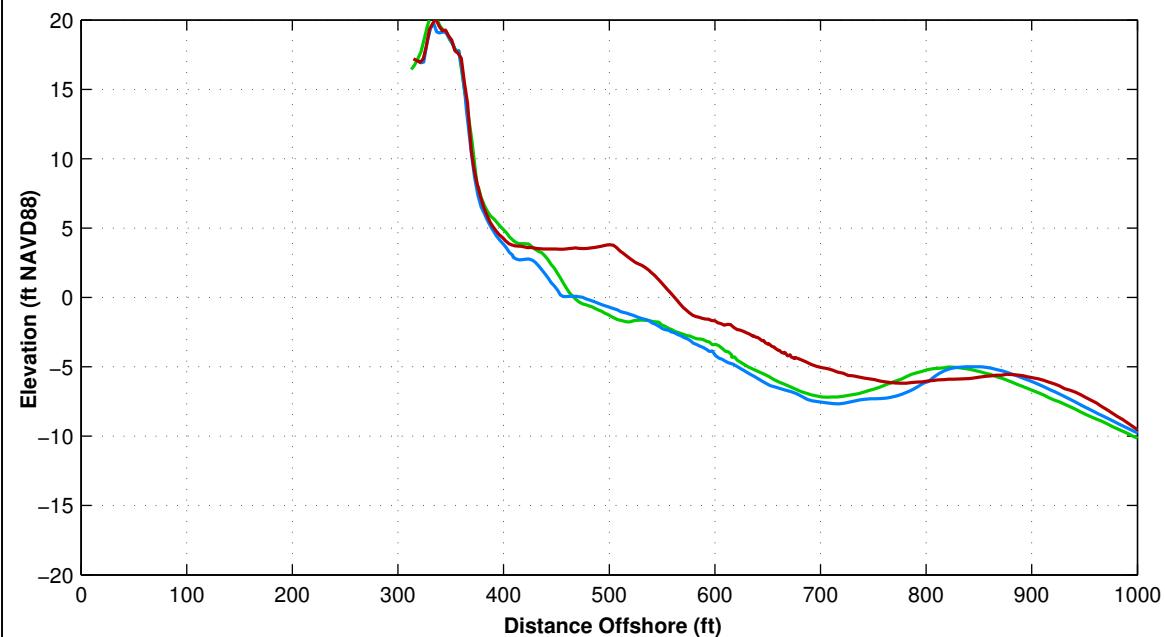
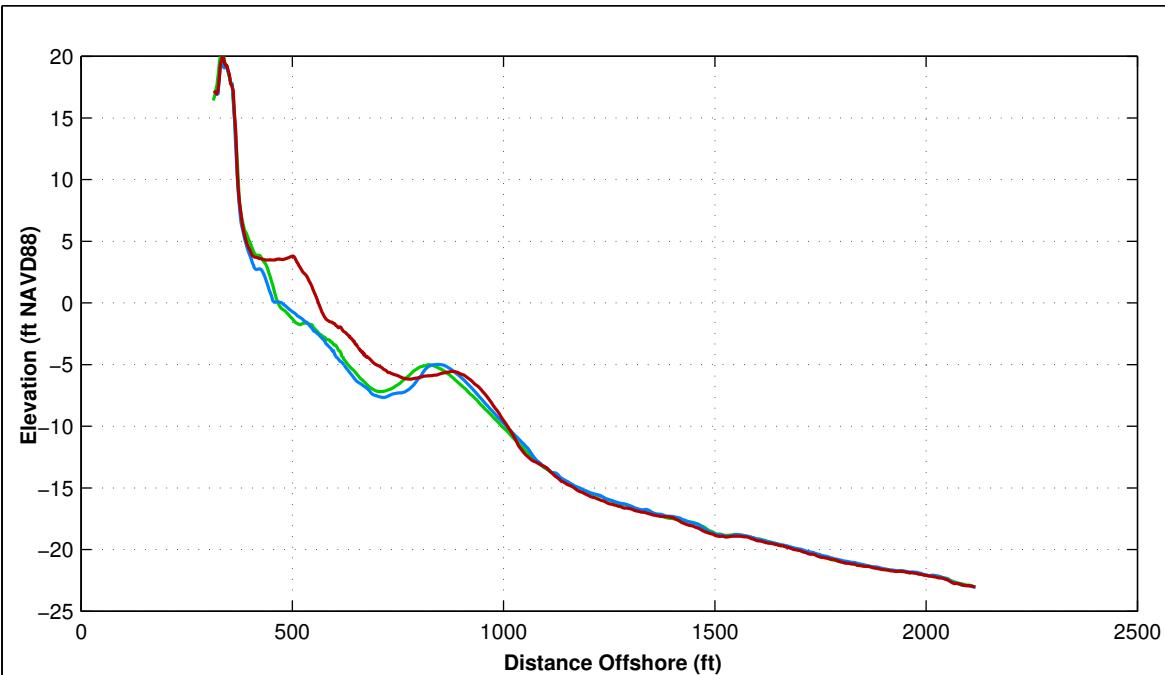
**LEGEND:**

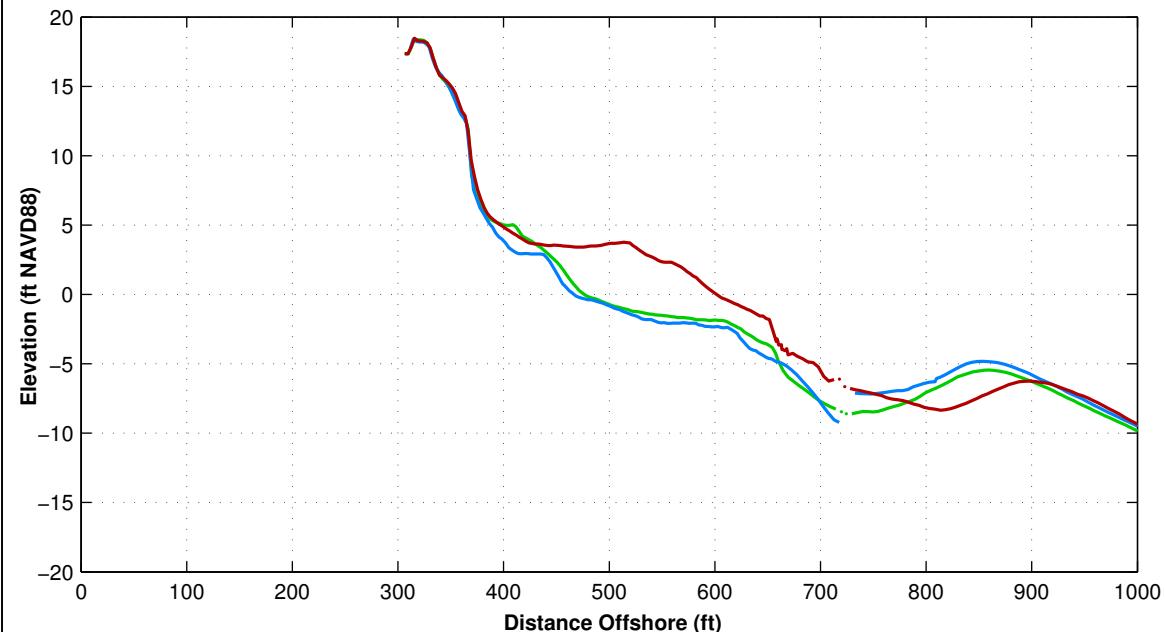
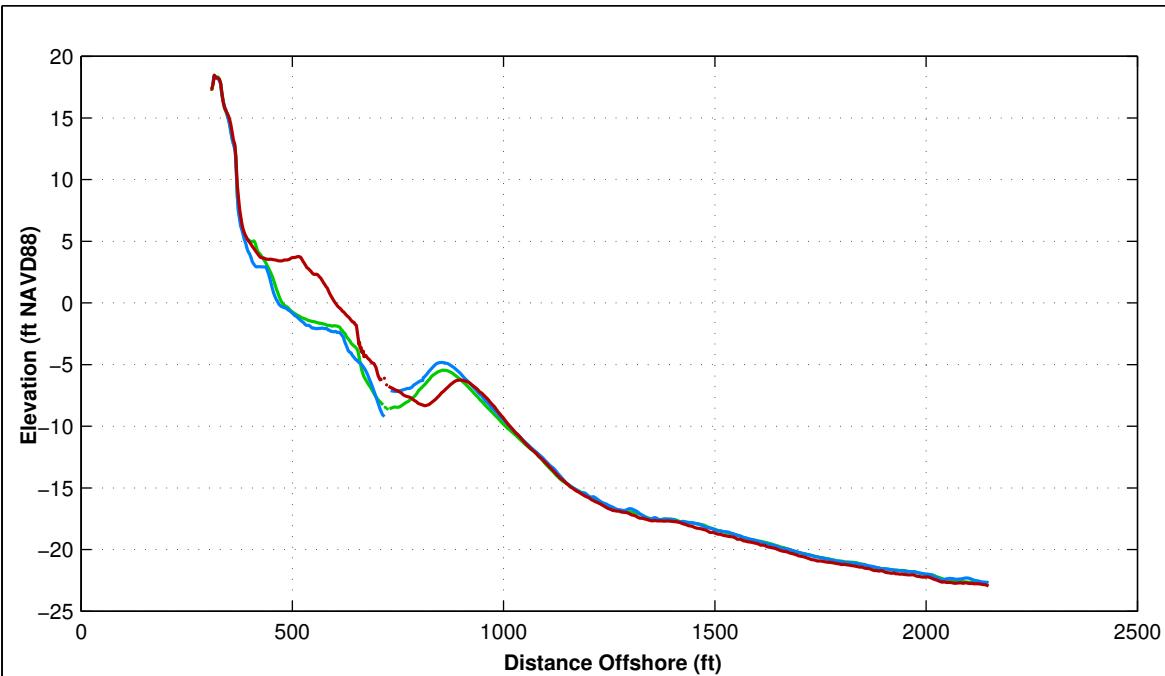
MAY 2017	—
OCT 2016	—
MAY 2016	—

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Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	121.69 ft/yr	131.16 ft
Volume Change Above -15 ft NAVD88	27.34 cy/ft/yr	25.71 cy/ft
Volume Change Above 0 ft NAVD88	14.79 cy/ft/yr	18.00 cy/ft

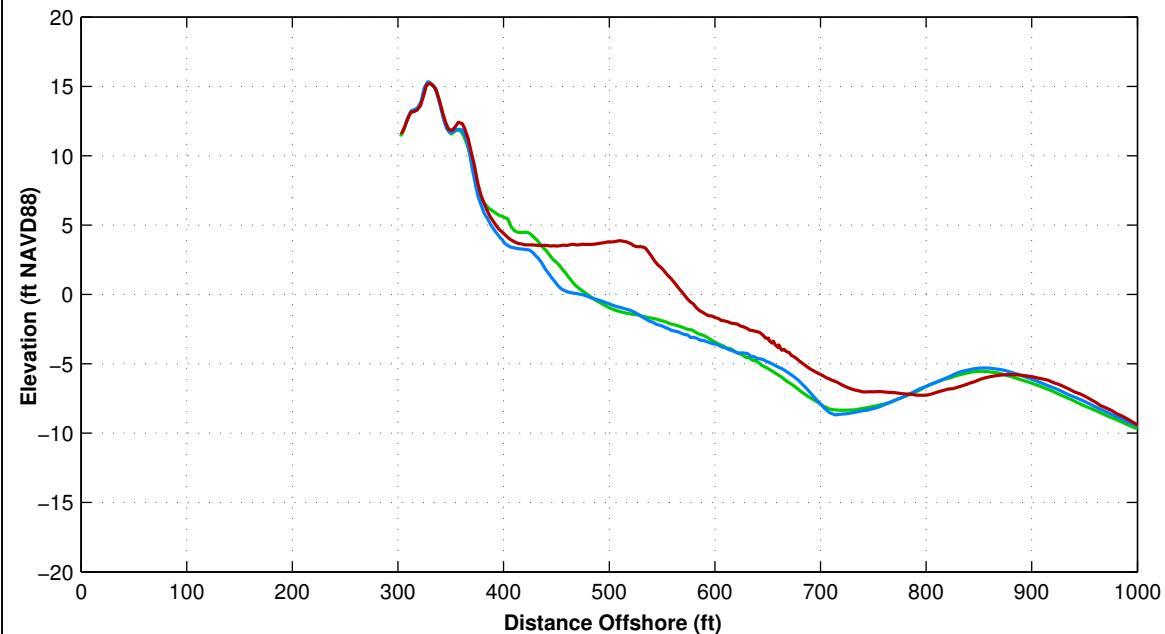
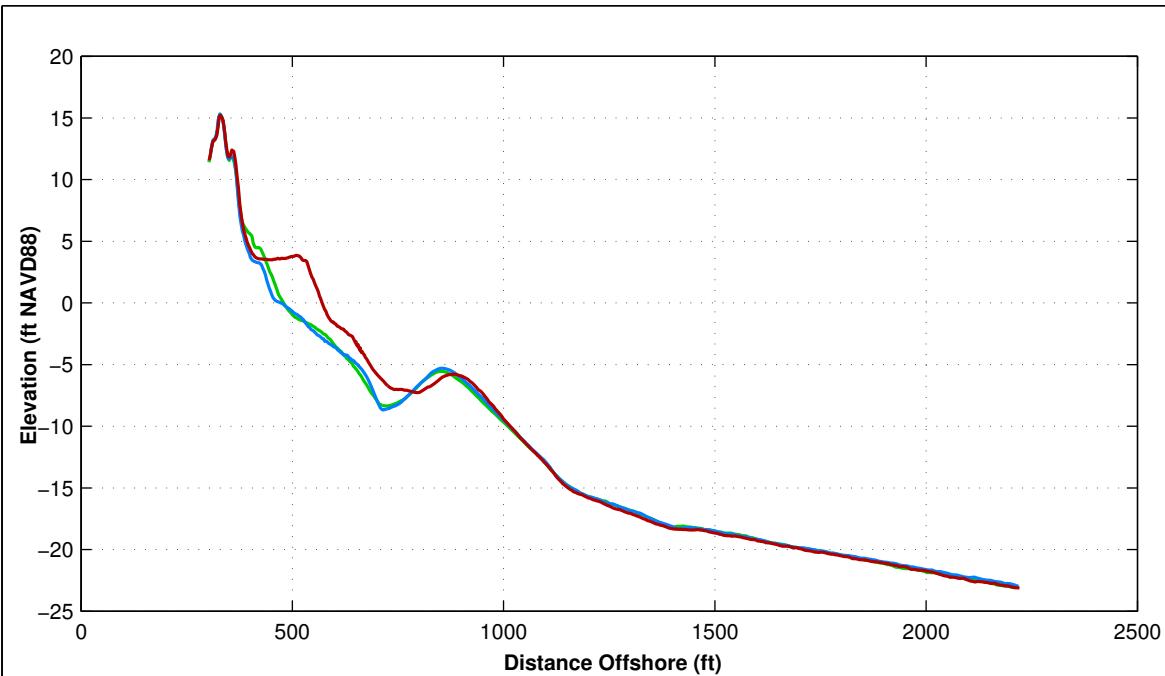
**LEGEND:**

MAY 2017	—
OCT 2016	—
MAY 2016	—

Notes:

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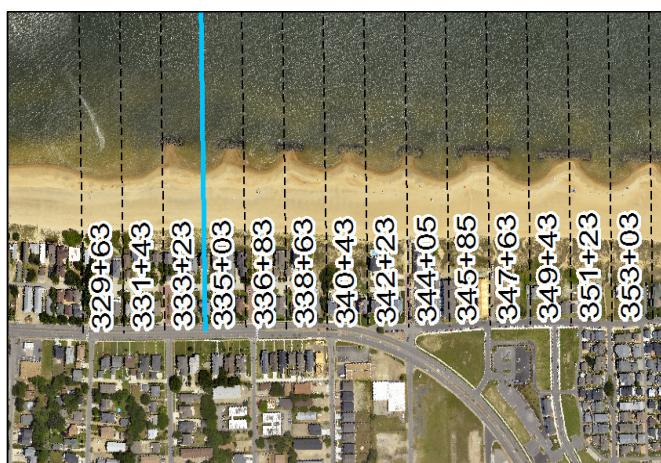
Survey Transect 335+03	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	96.00 ft/yr	112.36 ft
Volume Change Above -15 ft NAVD88	30.59 cy/ft/yr	32.62 cy/ft
Volume Change Above 0 ft NAVD88	11.77 cy/ft/yr	16.15 cy/ft

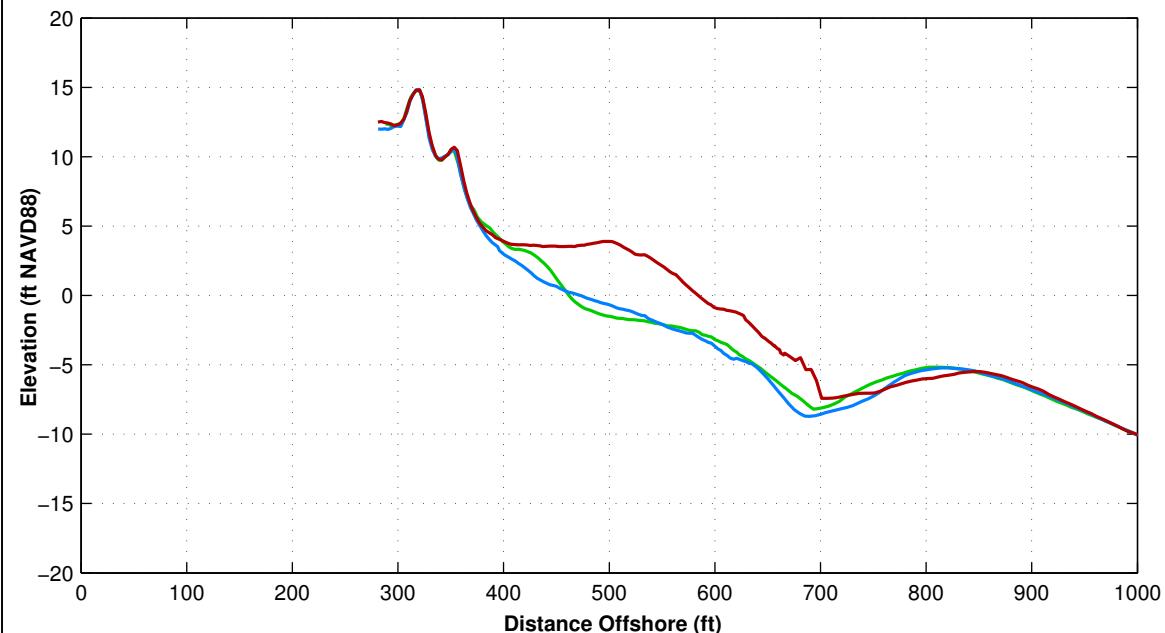
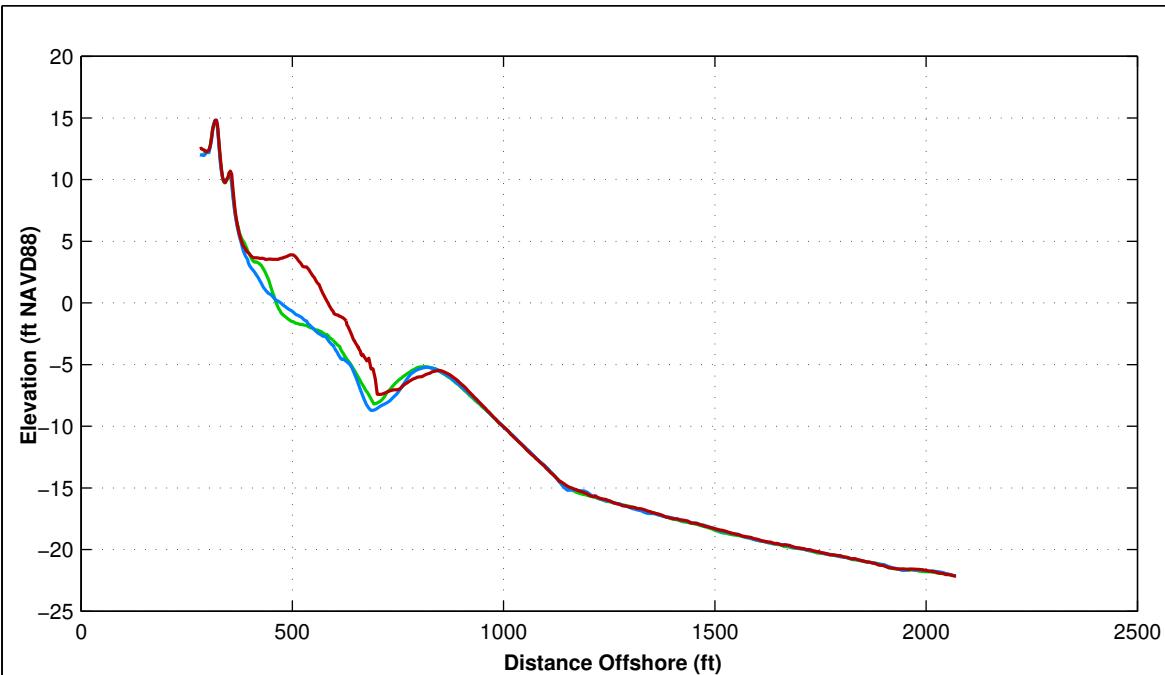
LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

Notes:

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Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
336+83		
Shoreline Change at MHW (0.98 ft NAVD88)	117.42 ft/yr	131.84 ft
Volume Change Above -15 ft NAVD88	32.47 cy/ft/yr	38.12 cy/ft
Volume Change Above 0 ft NAVD88	15.26 cy/ft/yr	18.25 cy/ft

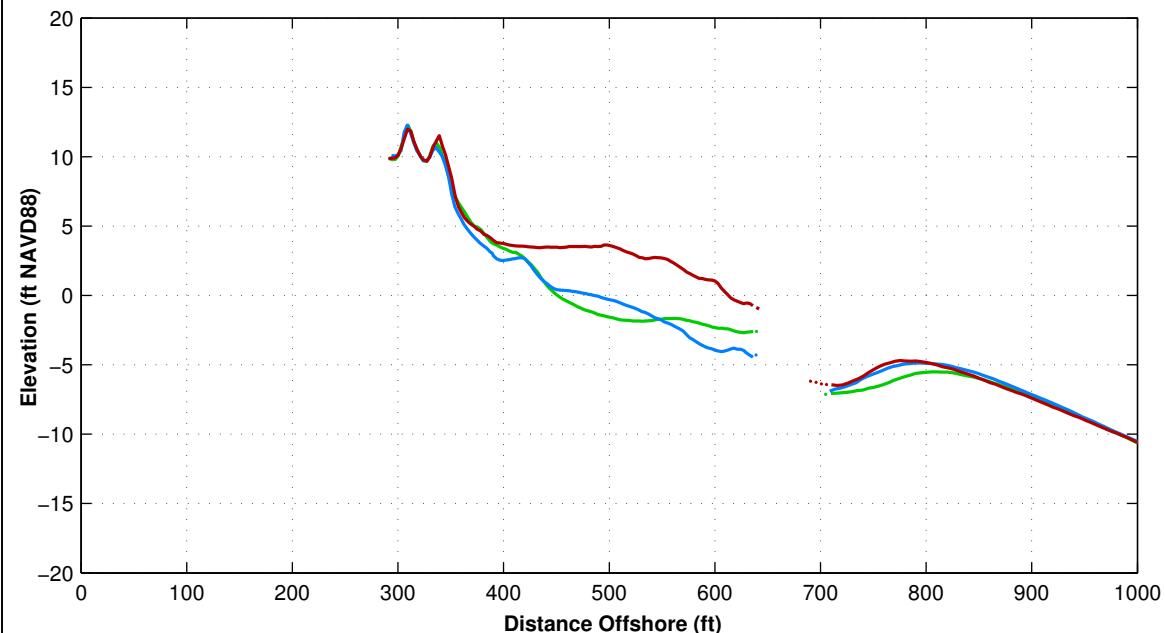
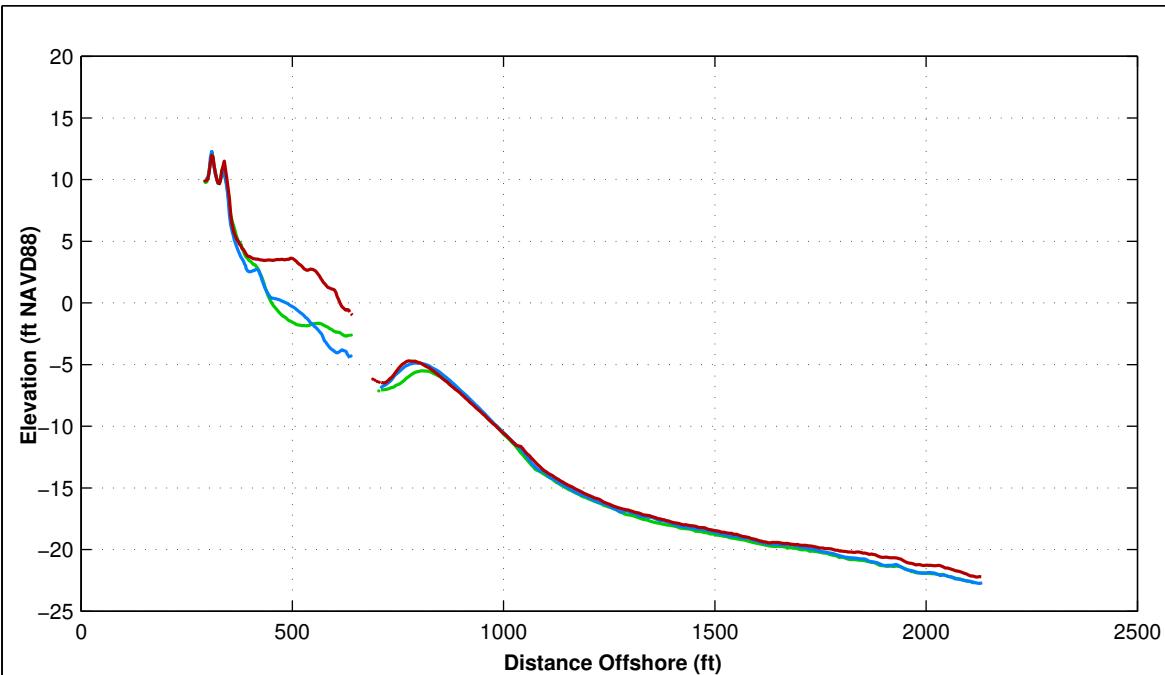
**LEGEND:**

MAY 2017 — Red Line  
OCT 2016 — Blue Line  
MAY 2016 — Green Line

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Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
338+63		
Shoreline Change at MHW (0.98 ft NAVD88)	162.70 ft/yr	162.17 ft
Volume Change Above -15 ft NAVD88	35.68 cy/ft/yr	33.29 cy/ft
Volume Change Above 0 ft NAVD88	18.63 cy/ft/yr	20.34 cy/ft

**LEGEND:**

MAY 2017 — Red Line  
OCT 2016 — Blue Line  
MAY 2016 — Green Line

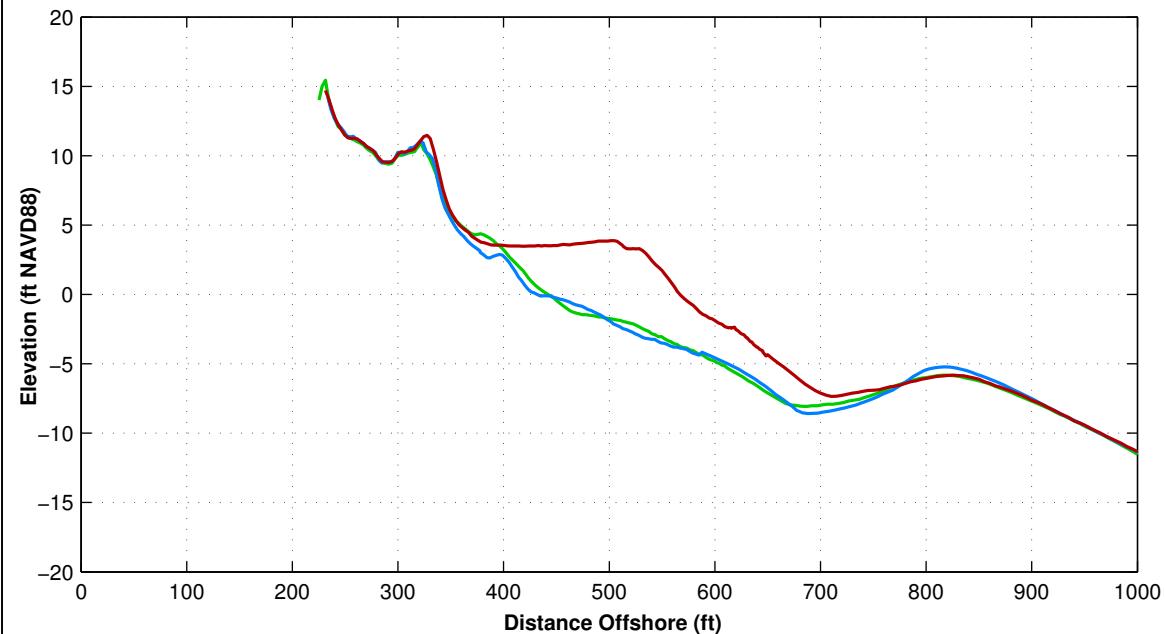
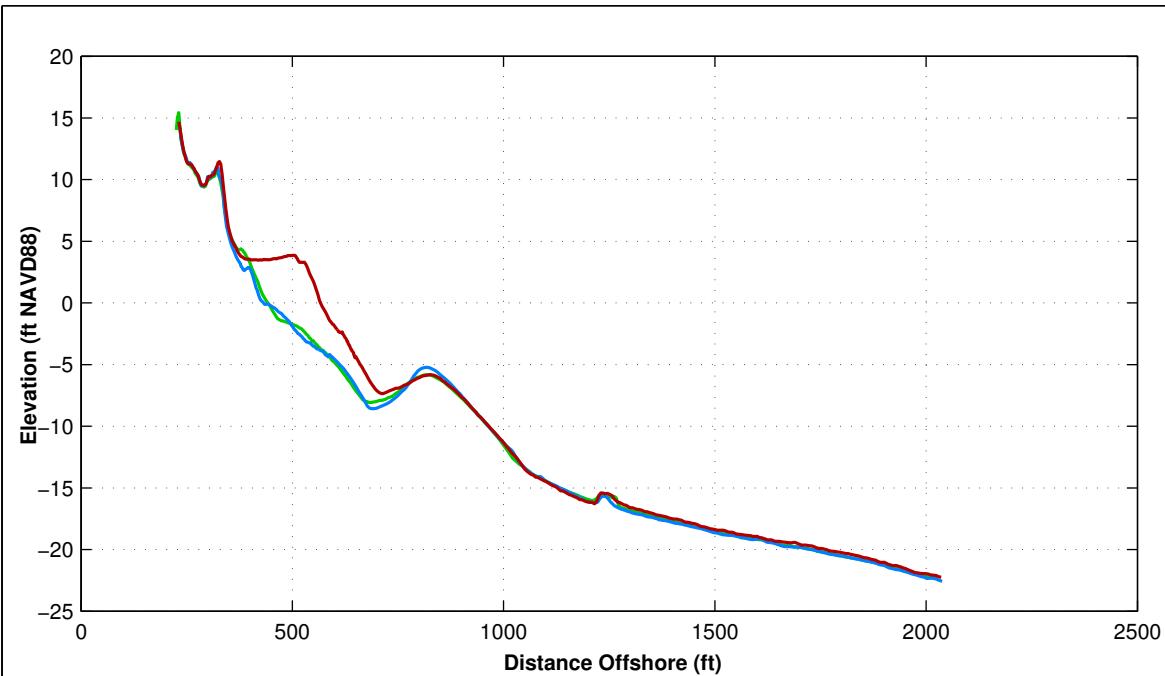
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Survey Transect 340+43	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	131.73 ft/yr	140.39 ft
Volume Change Above -15 ft NAVD88	42.08 cy/ft/yr	42.49 cy/ft
Volume Change Above 0 ft NAVD88	18.33 cy/ft/yr	20.37 cy/ft

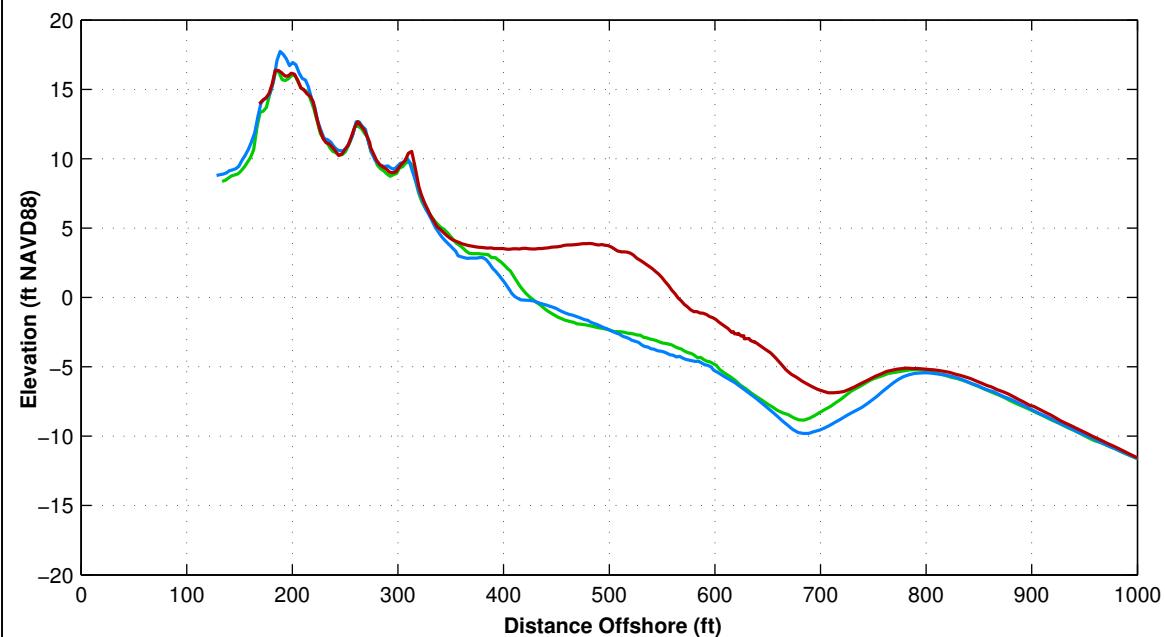
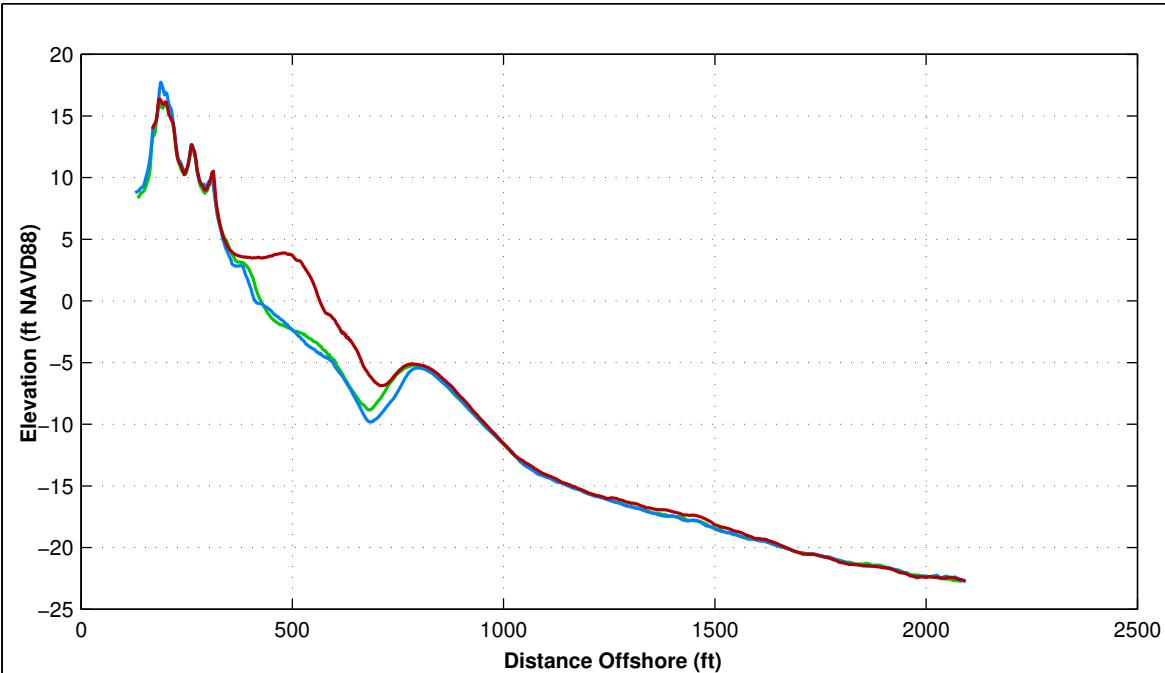
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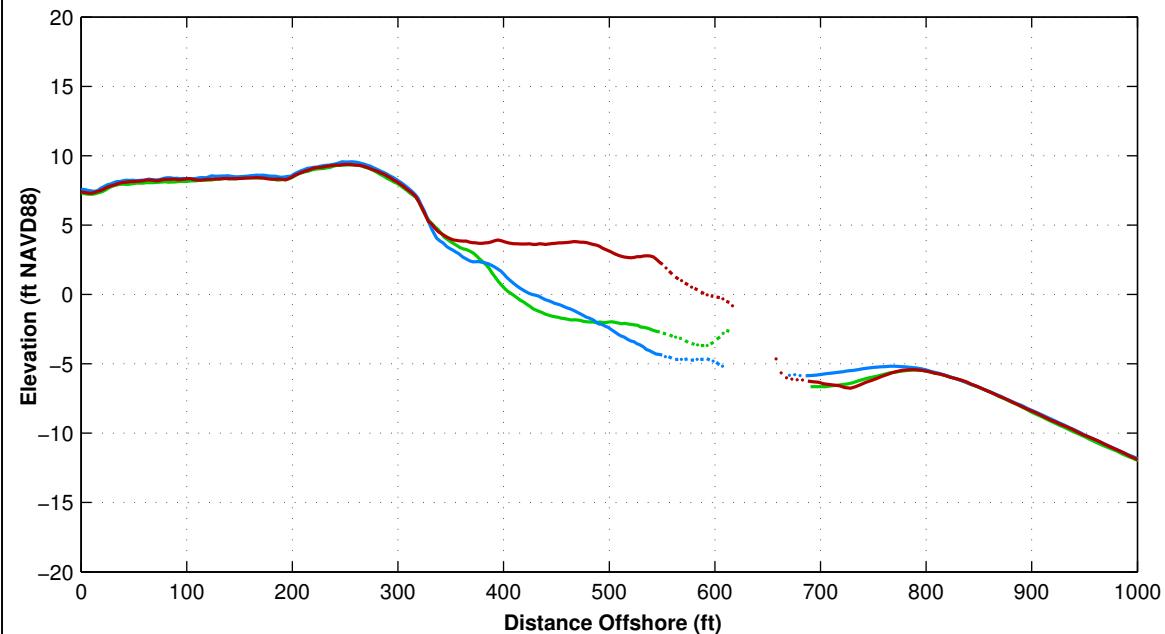
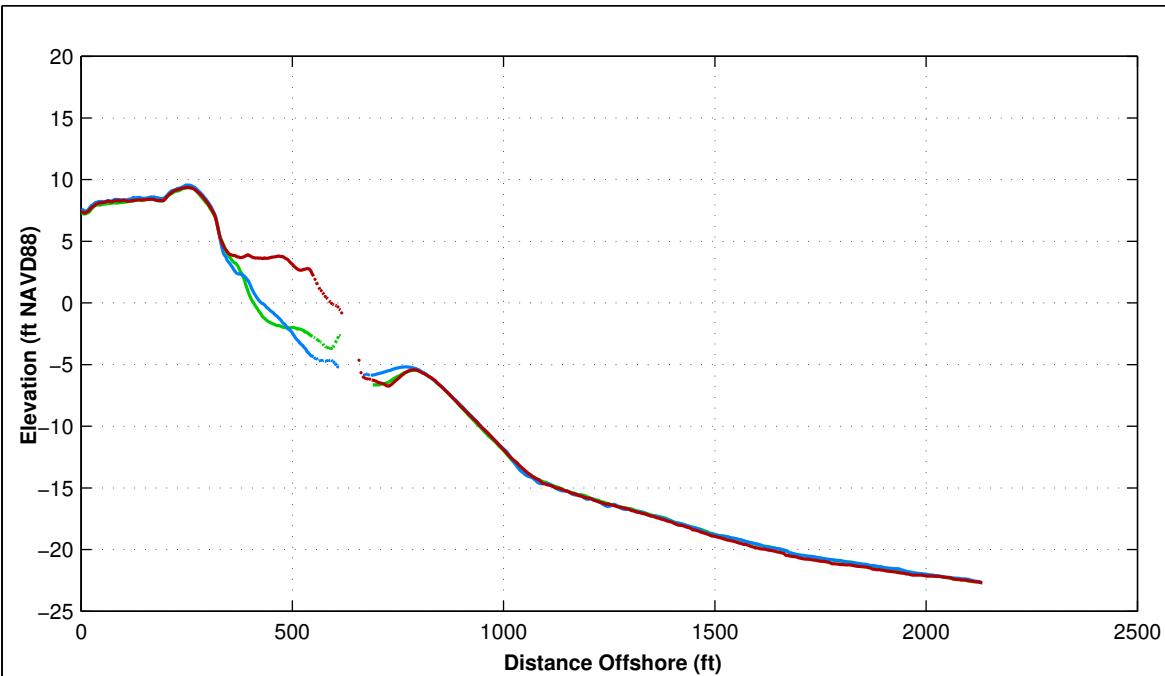
MAY 2017 — Red Line  
OCT 2016 — Blue Line  
MAY 2016 — Green Line

**Notes:**

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Survey Transect  
344+05

Shoreline Change at MHW  
(0.98 ft NAVD88)

Volume Change Above  
-15 ft NAVD88

Volume Change Above  
0 ft NAVD88

MAY 2017 –  
MAY 2016

174.15  
ft/yr

31.51  
cy/ft/yr

23.27  
cy/ft/yr

MAY 2017 –  
OCT 2016

162.03  
ft

26.48  
cy/ft

20.66  
cy/ft

**LEGEND:**

MAY 2017 — Red Line

OCT 2016 — Blue Line

MAY 2016 — Green Line

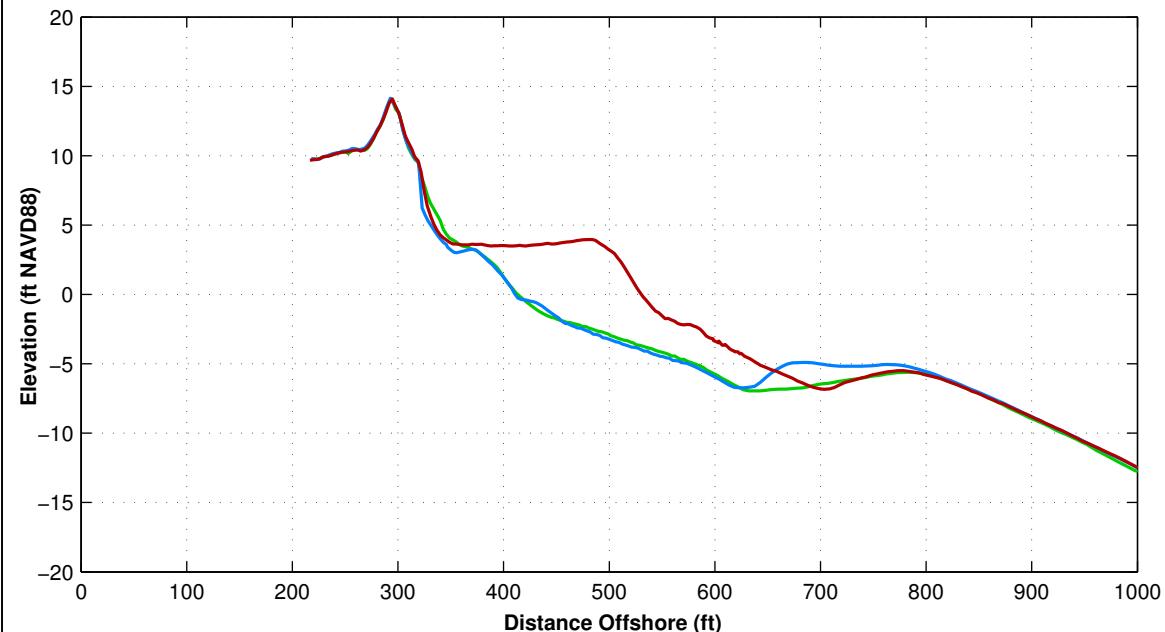
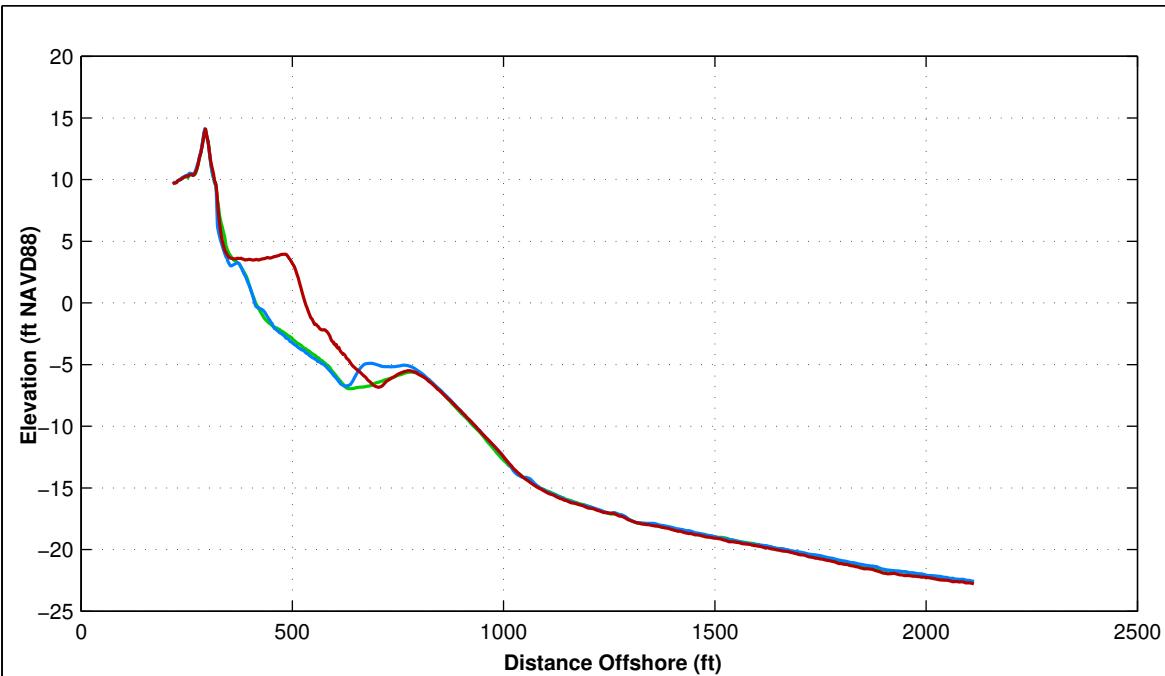
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Survey Transect 345+85	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	119.63 ft/yr	119.67 ft
Volume Change Above -15 ft NAVD88	38.49 cy/ft/yr	33.75 cy/ft
Volume Change Above 0 ft NAVD88	15.96 cy/ft/yr	17.62 cy/ft

LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

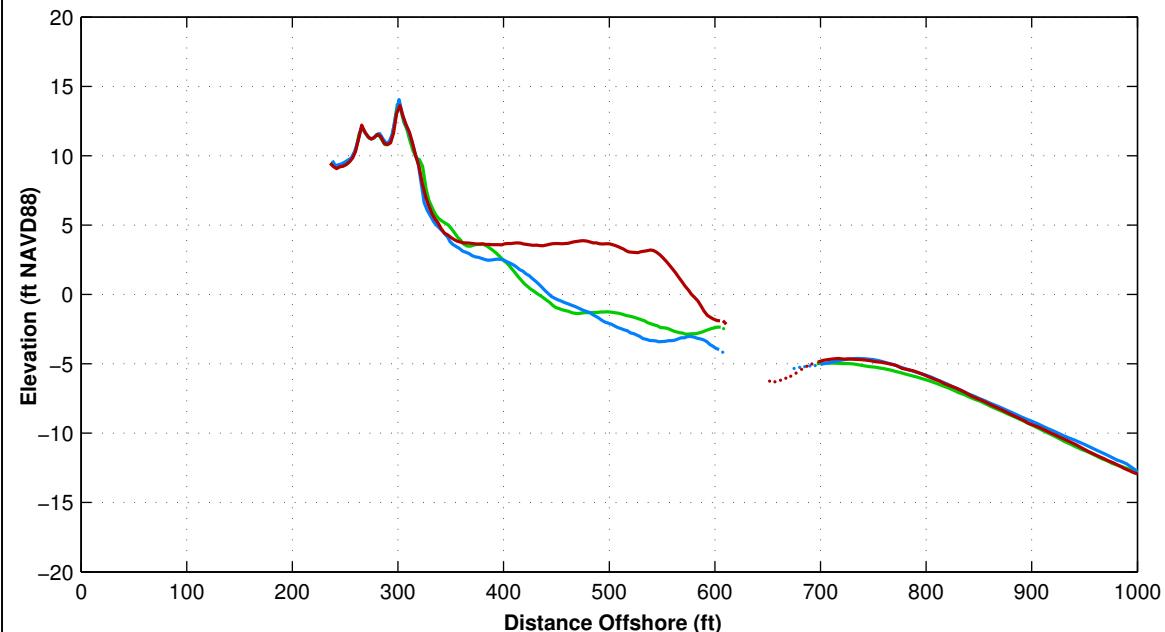
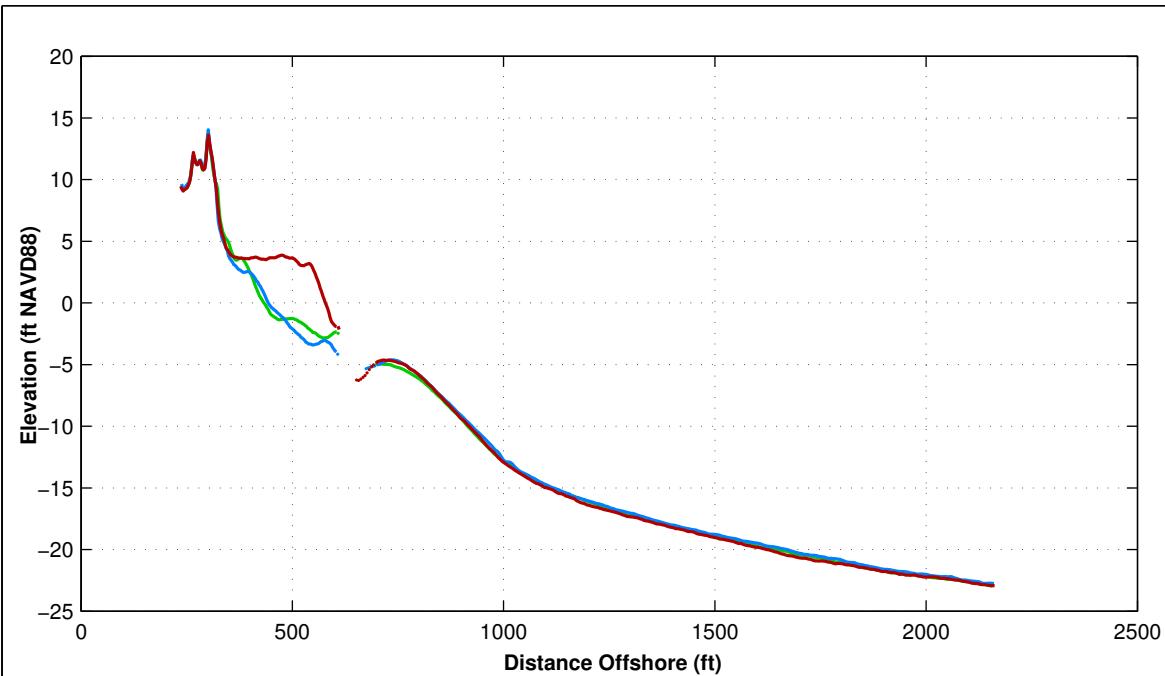
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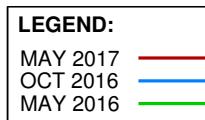


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ANALYSIS



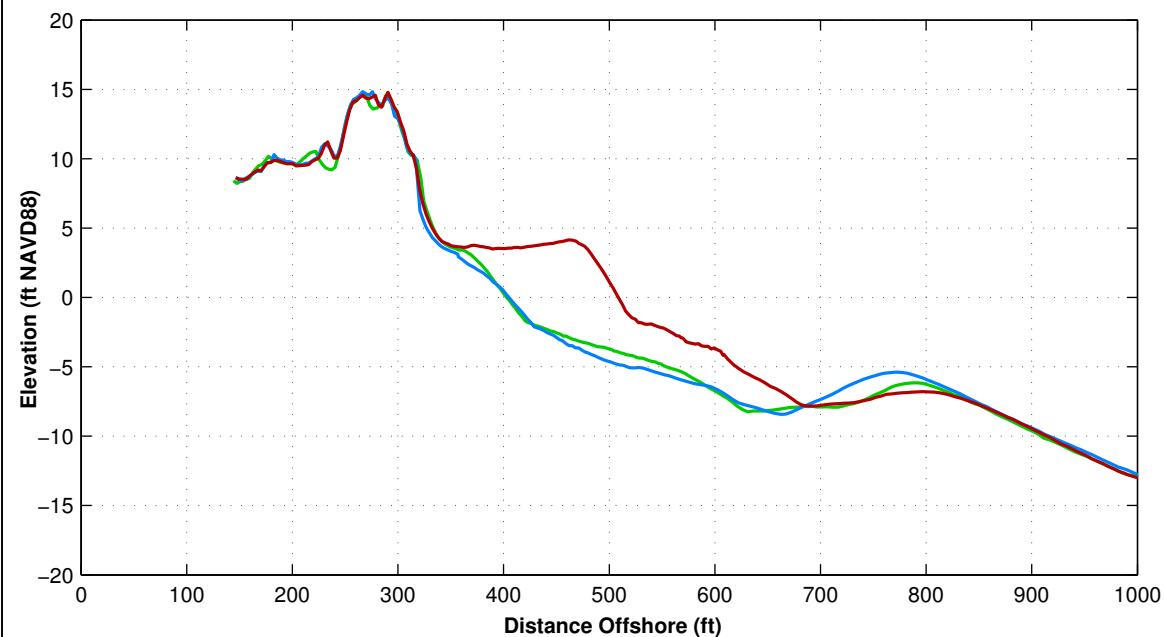
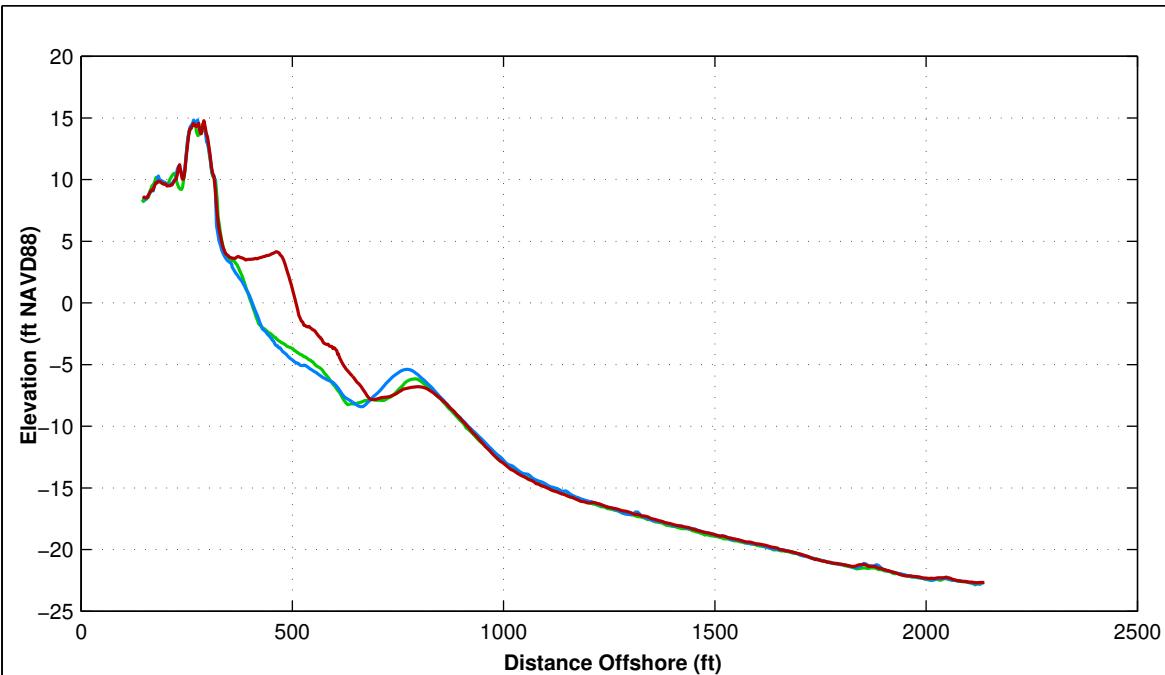
Survey Transect 347+63	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	151.08 ft/yr	138.48 ft
Volume Change Above -15 ft NAVD88	30.75 cy/ft/yr	31.21 cy/ft
Volume Change Above 0 ft NAVD88	19.13 cy/ft/yr	20.39 cy/ft



Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





Survey Transect 349+43	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	108.15 ft/yr	108.59 ft
Volume Change Above -15 ft NAVD88	40.07 cy/ft/yr	37.59 cy/ft
Volume Change Above 0 ft NAVD88	15.63 cy/ft/yr	16.68 cy/ft

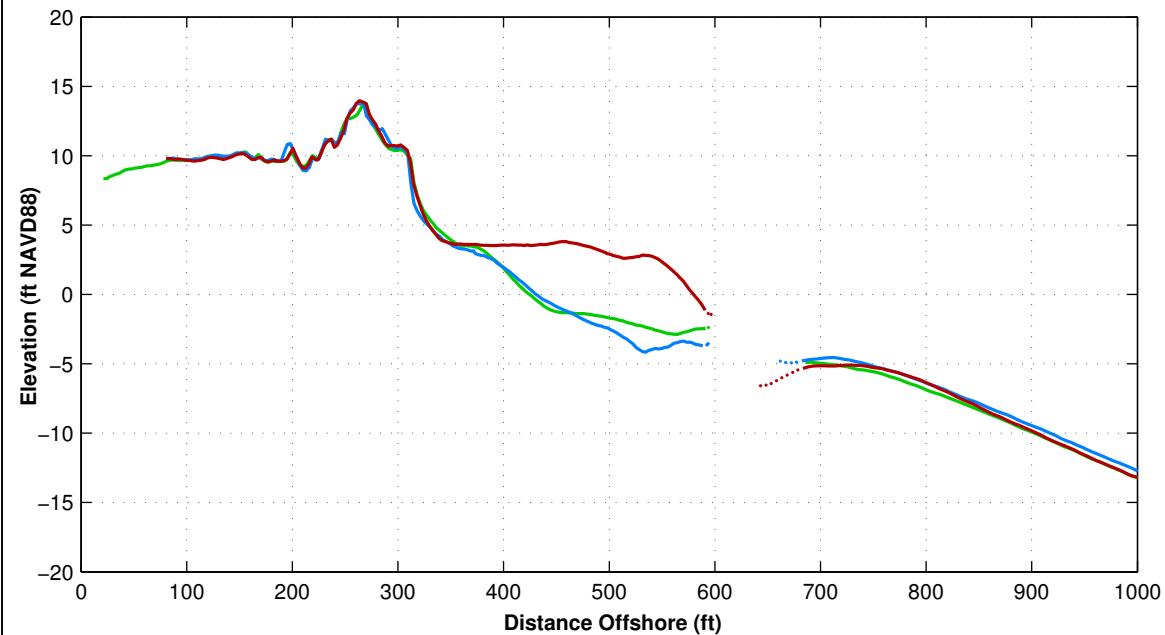
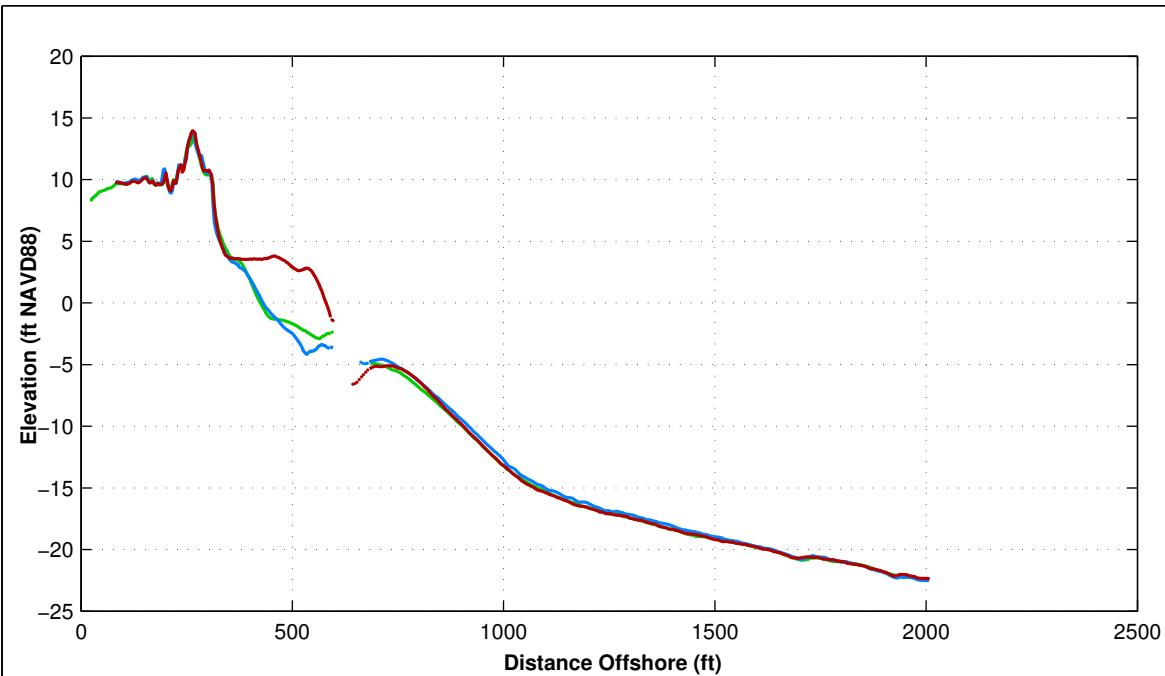
LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





Survey Transect 351+23	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	159.15 ft/yr	153.97 ft
Volume Change Above -15 ft NAVD88	31.30 cy/ft/yr	29.35 cy/ft
Volume Change Above 0 ft NAVD88	19.33 cy/ft/yr	19.65 cy/ft

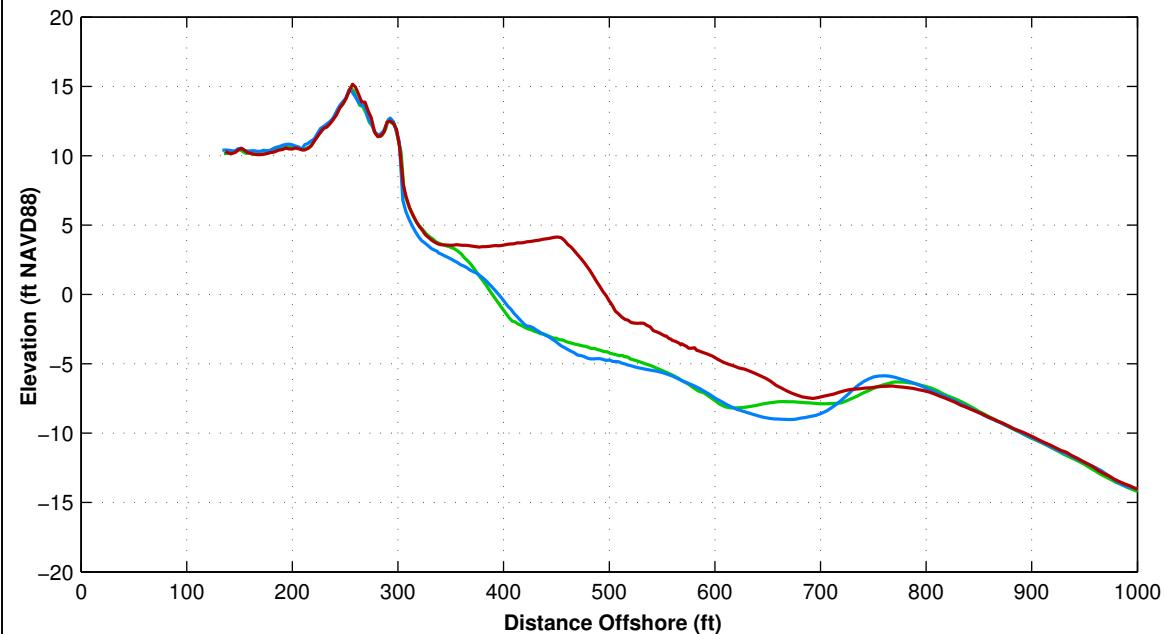
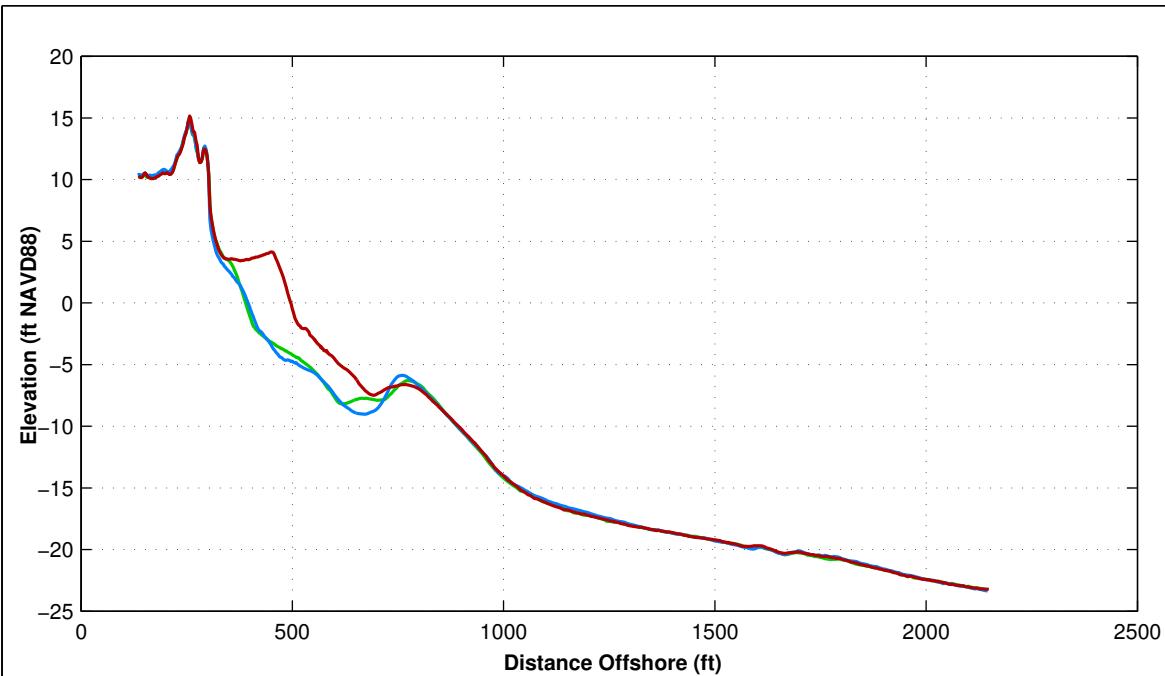
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





Survey Transect 353+03	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	107.09 ft/yr	104.26 ft
Volume Change Above -15 ft NAVD88	44.09 cy/ft/yr	47.61 cy/ft
Volume Change Above 0 ft NAVD88	14.97 cy/ft/yr	16.08 cy/ft

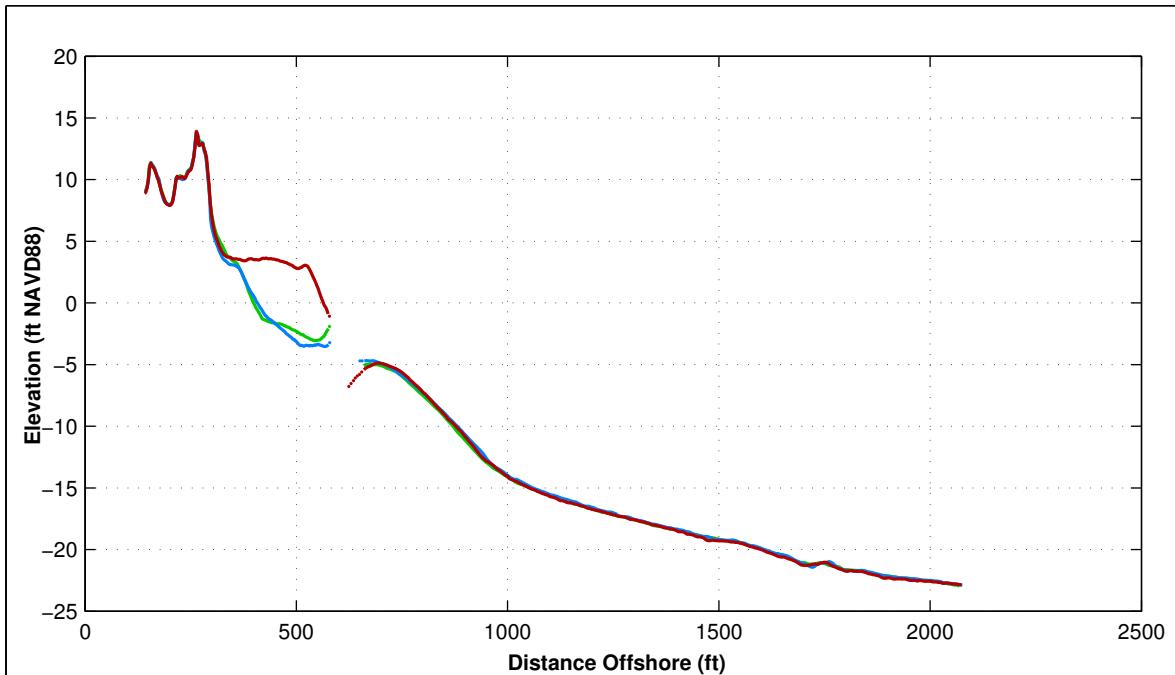
**LEGEND:**

MAY 2017	—
OCT 2016	—
MAY 2016	—

**Notes:**

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.

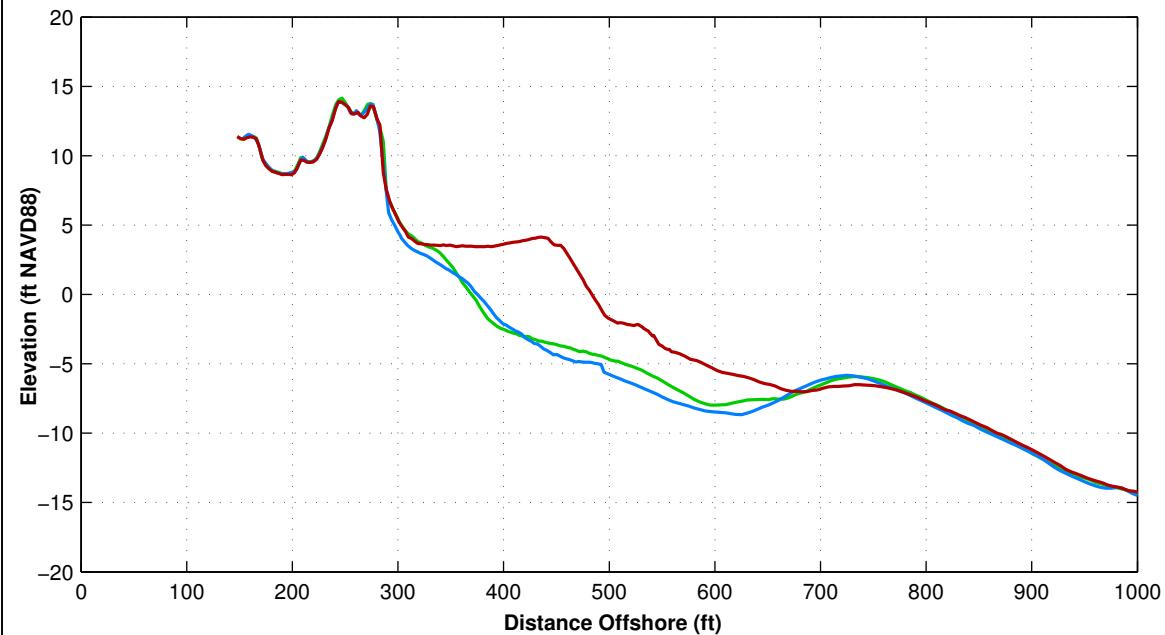
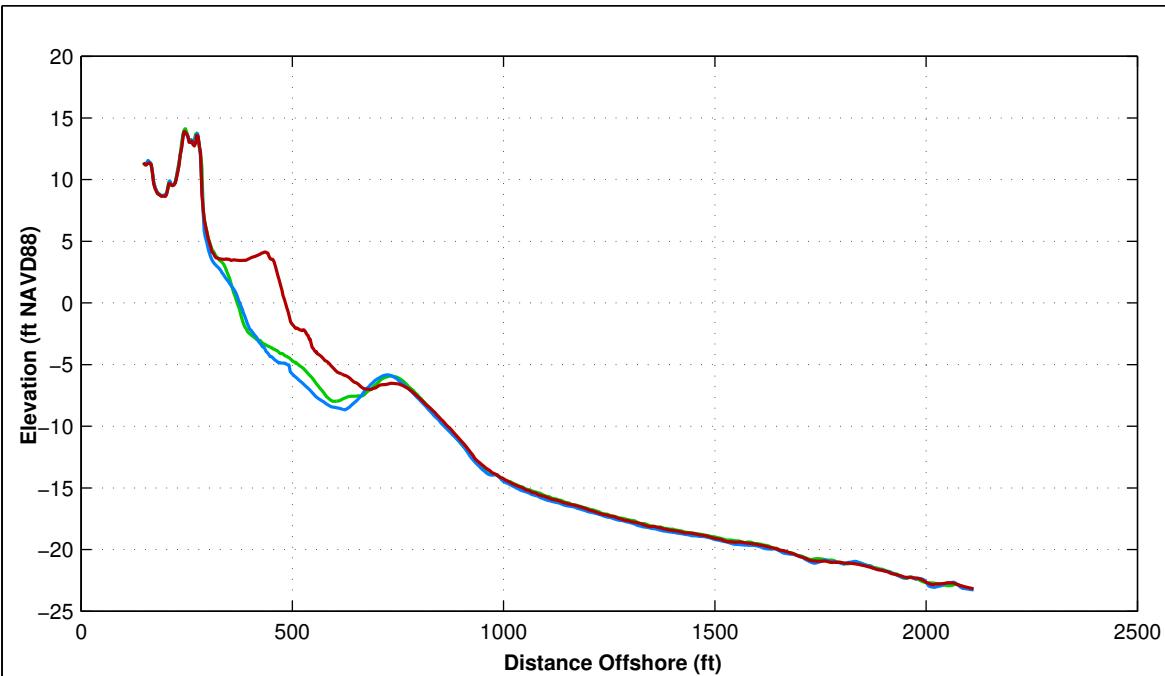




Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





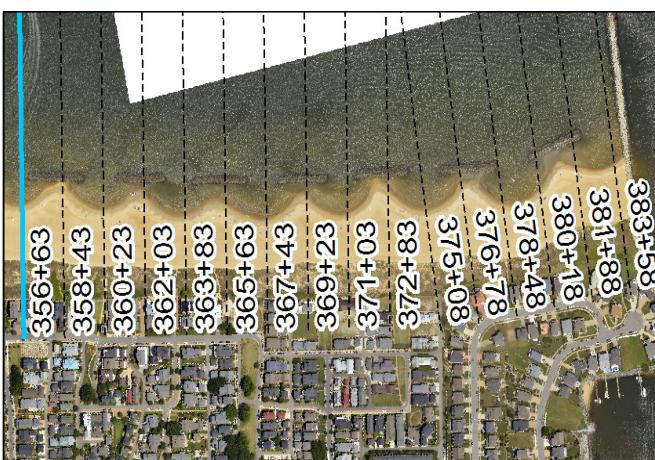
Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
356+63		
Shoreline Change at MHW (0.98 ft NAVD88)	115.60 ft/yr	112.26 ft
Volume Change Above -15 ft NAVD88	43.37 cy/ft/yr	52.76 cy/ft
Volume Change Above 0 ft NAVD88	15.03 cy/ft/yr	17.20 cy/ft

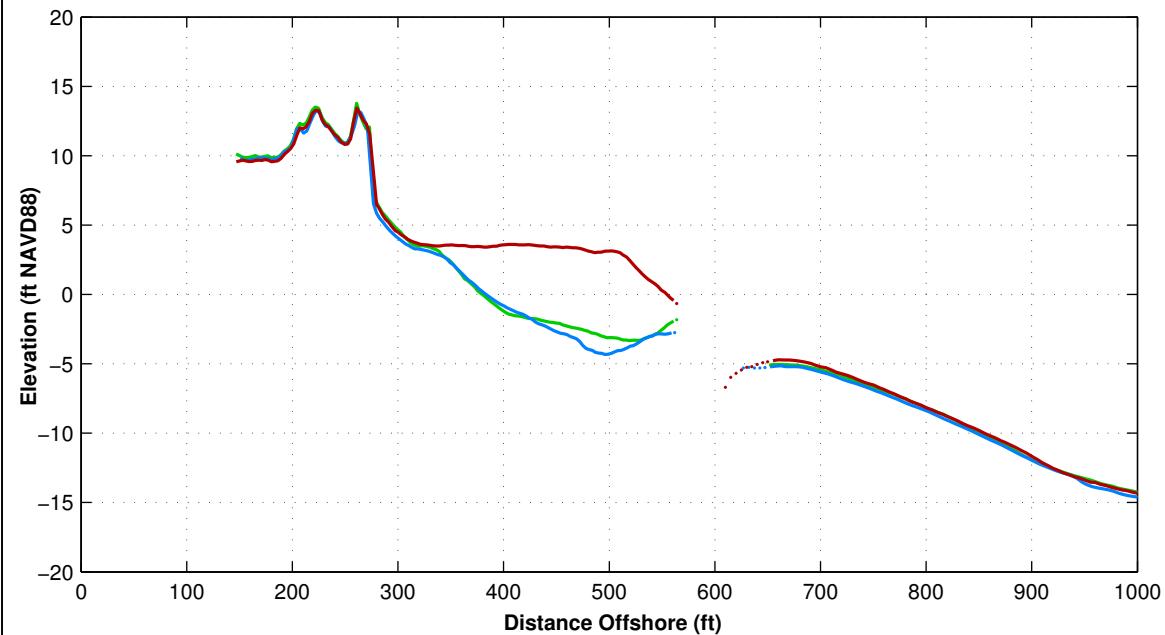
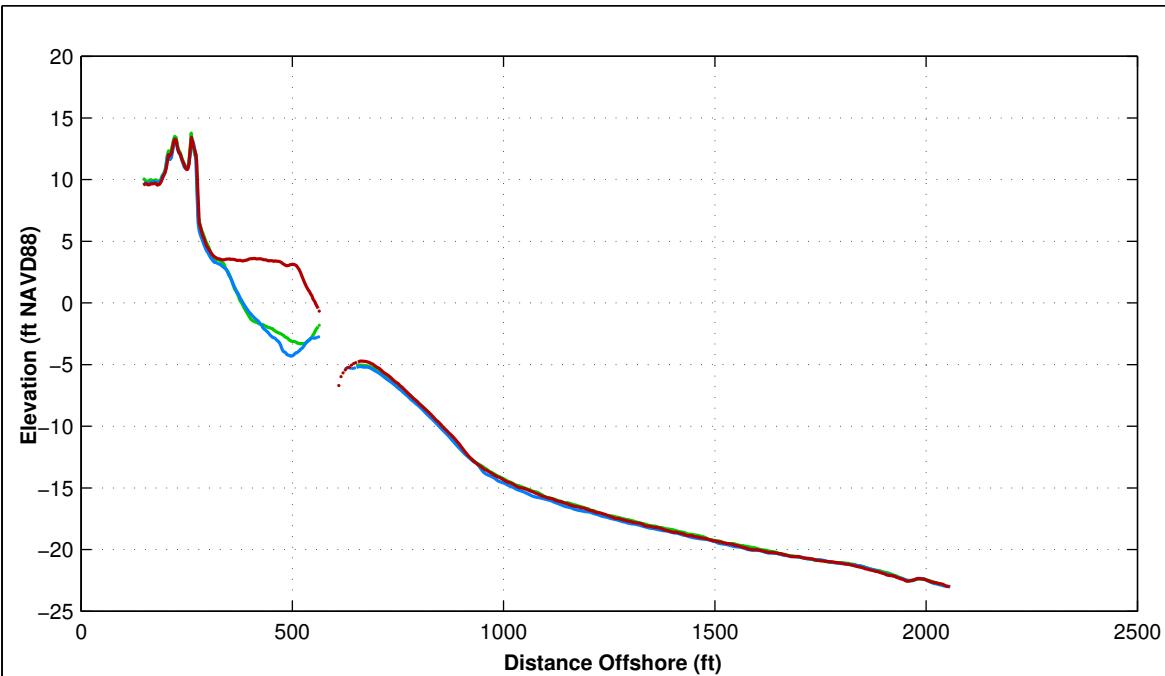
**LEGEND:**

MAY 2017 — Red line  
OCT 2016 — Blue line  
MAY 2016 — Green line

**Notes:**

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





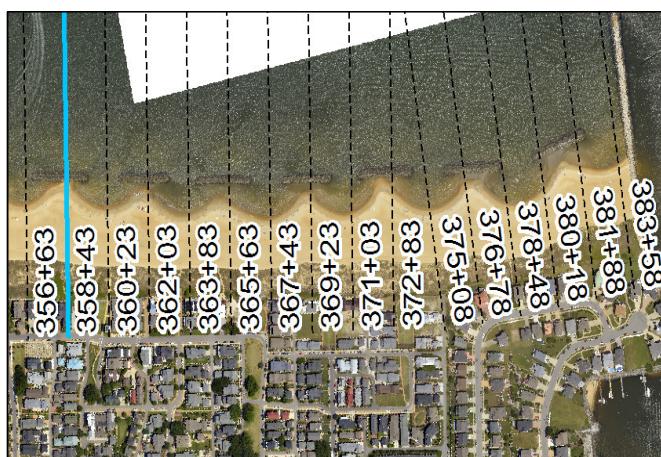
Survey Transect 358+43	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	172.80 ft/yr	171.33 ft
Volume Change Above -15 ft NAVD88	37.24 cy/ft/yr	44.92 cy/ft
Volume Change Above 0 ft NAVD88	21.03 cy/ft/yr	23.05 cy/ft

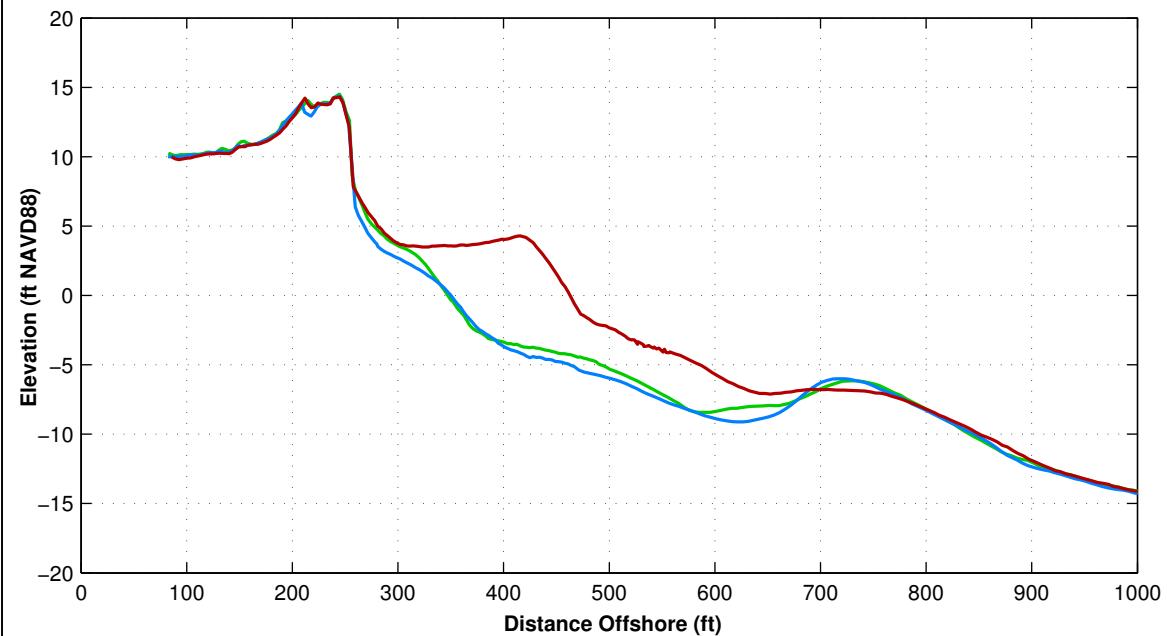
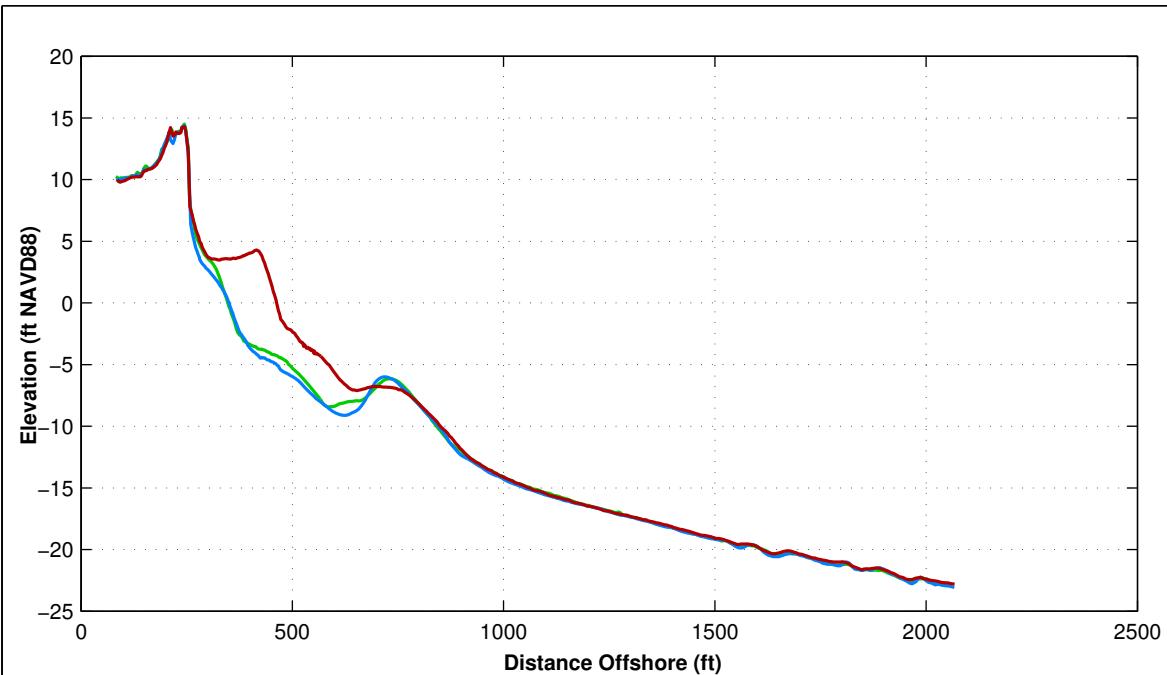
LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





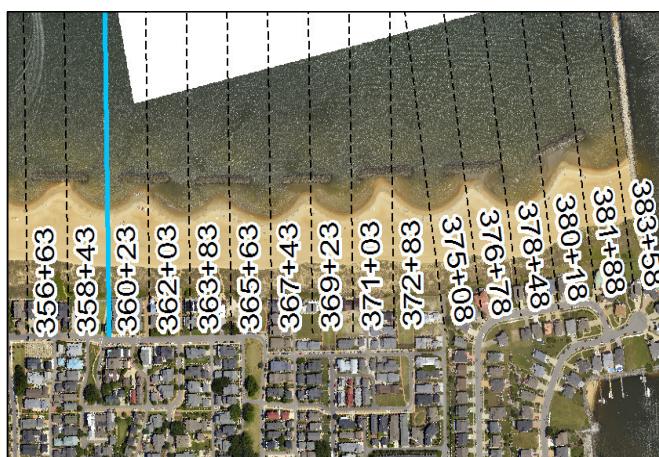
Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
360+23		
Shoreline Change at MHW (0.98 ft NAVD88)	116.52 ft/yr	117.60 ft
Volume Change Above -15 ft NAVD88	48.83 cy/ft/yr	58.70 cy/ft
Volume Change Above 0 ft NAVD88	16.07 cy/ft/yr	19.35 cy/ft

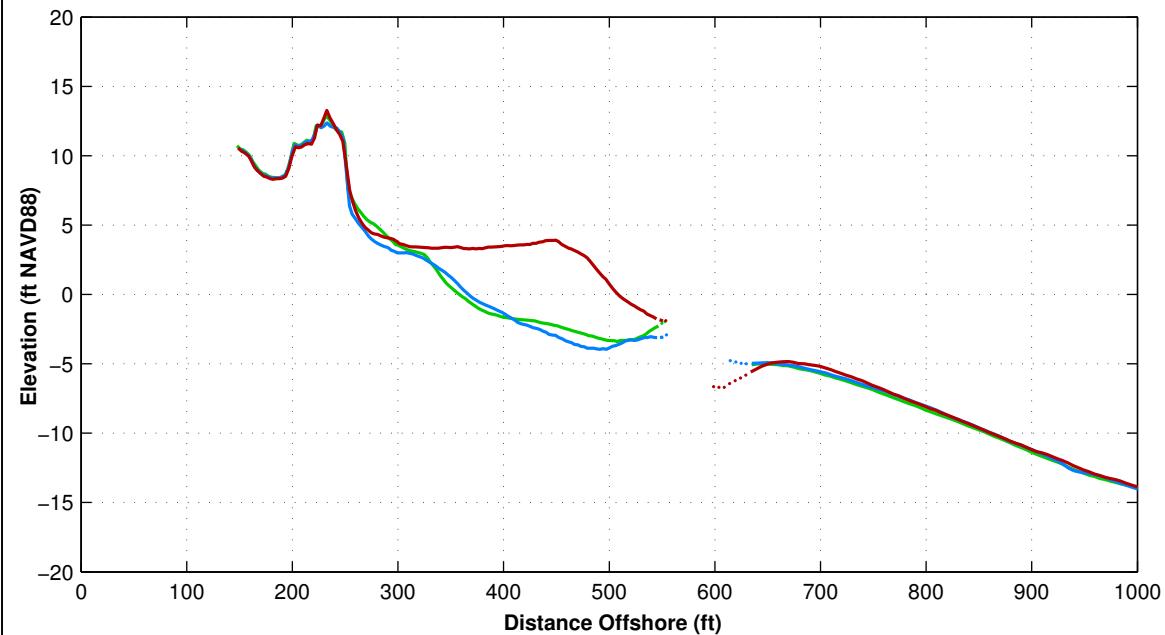
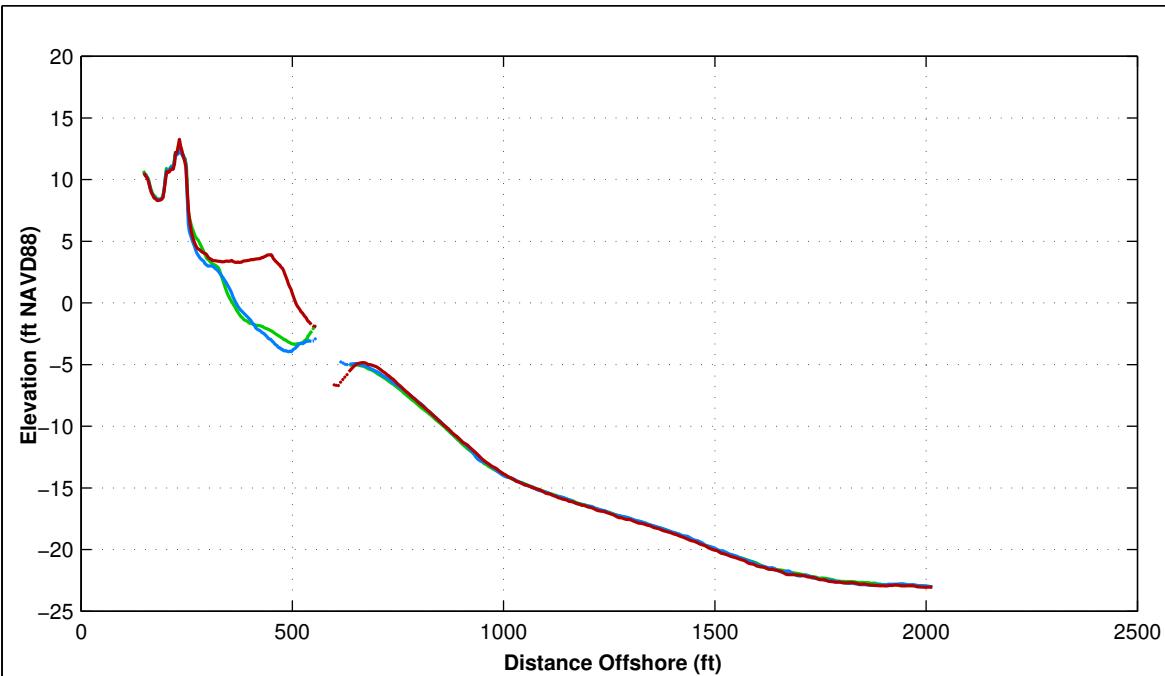
**LEGEND:**

MAY 2017 — —  
 OCT 2016 — —  
 MAY 2016 — —

**Notes:**

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





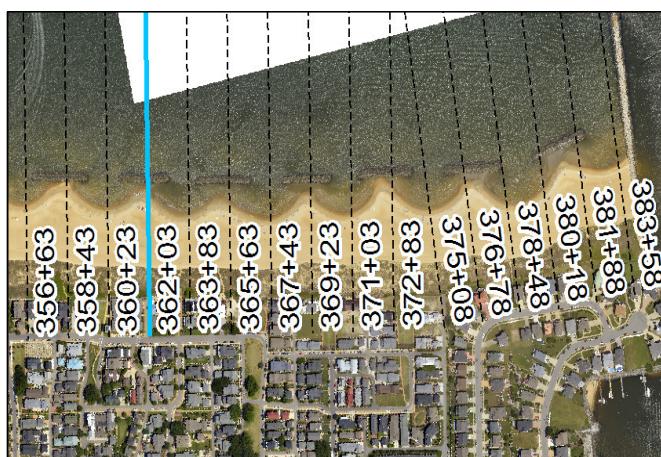
Survey Transect 362+03	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	153.84 ft/yr	143.94 ft
Volume Change Above -15 ft NAVD88	36.06 cy/ft/yr	38.16 cy/ft
Volume Change Above 0 ft NAVD88	18.77 cy/ft/yr	20.56 cy/ft

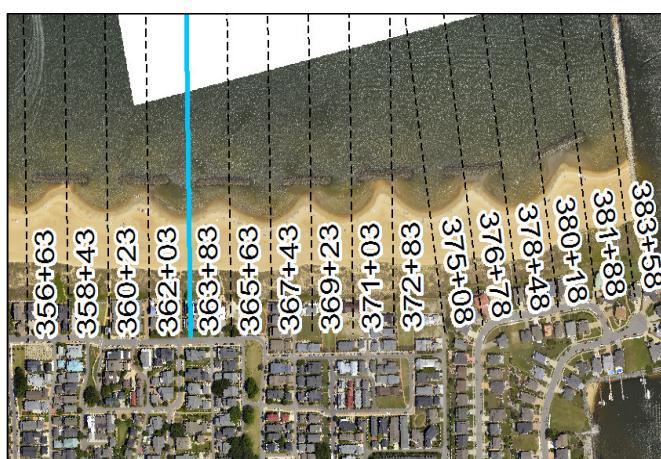
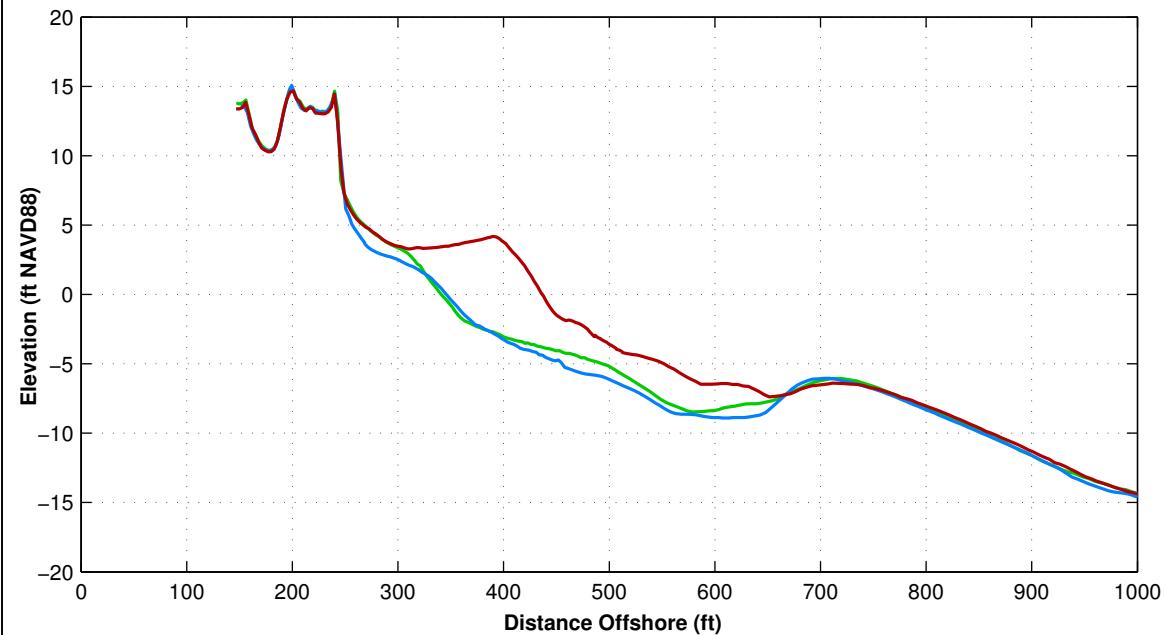
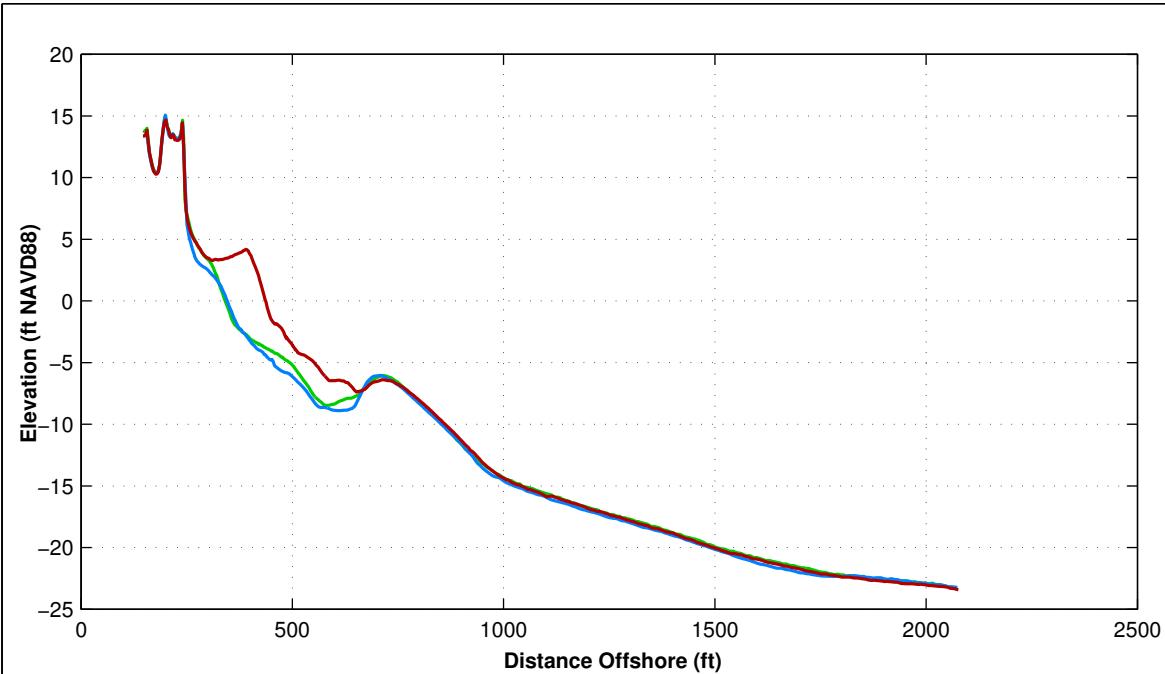
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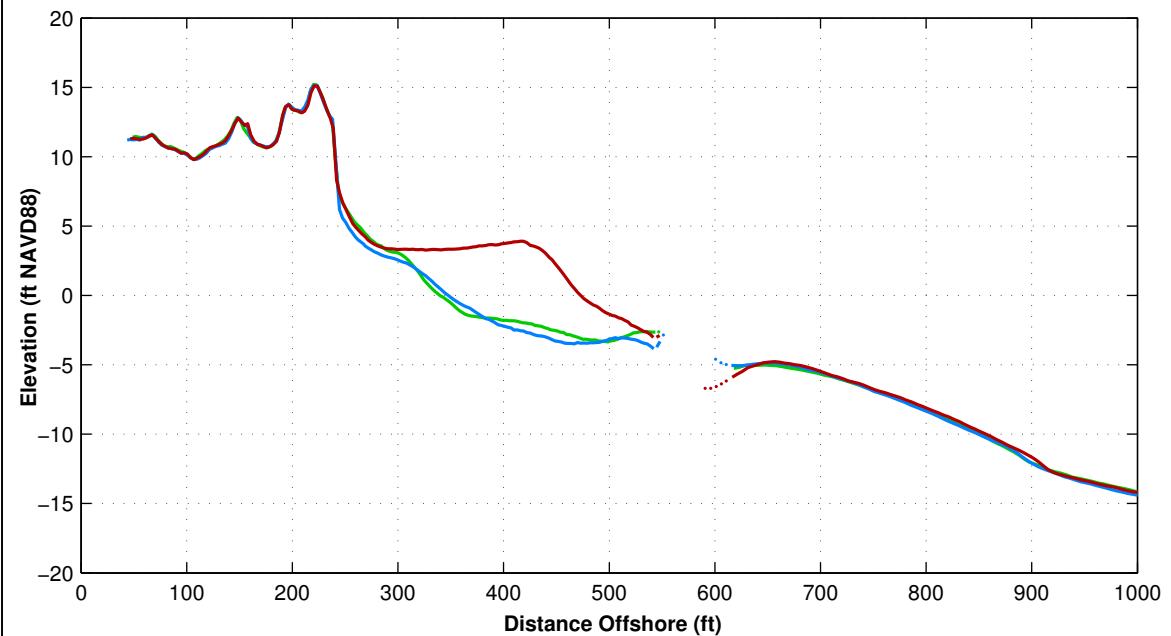
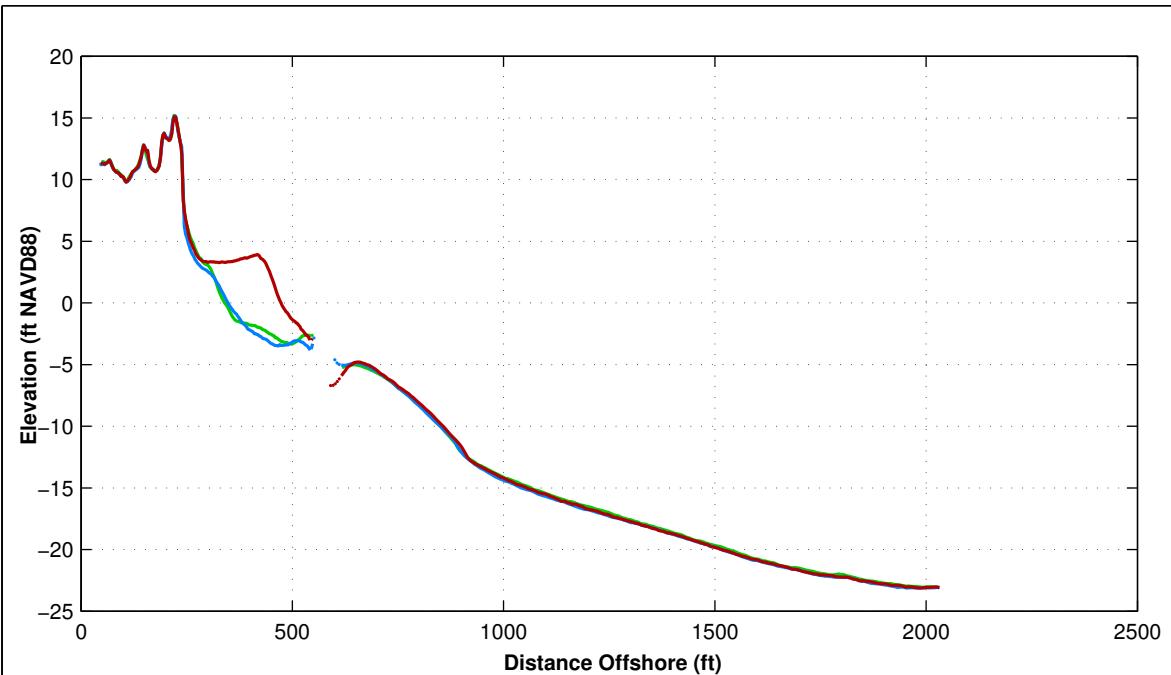
- MAY 2017
- OCT 2016
- MAY 2016

Notes:

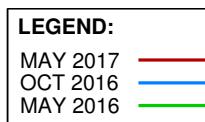
1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
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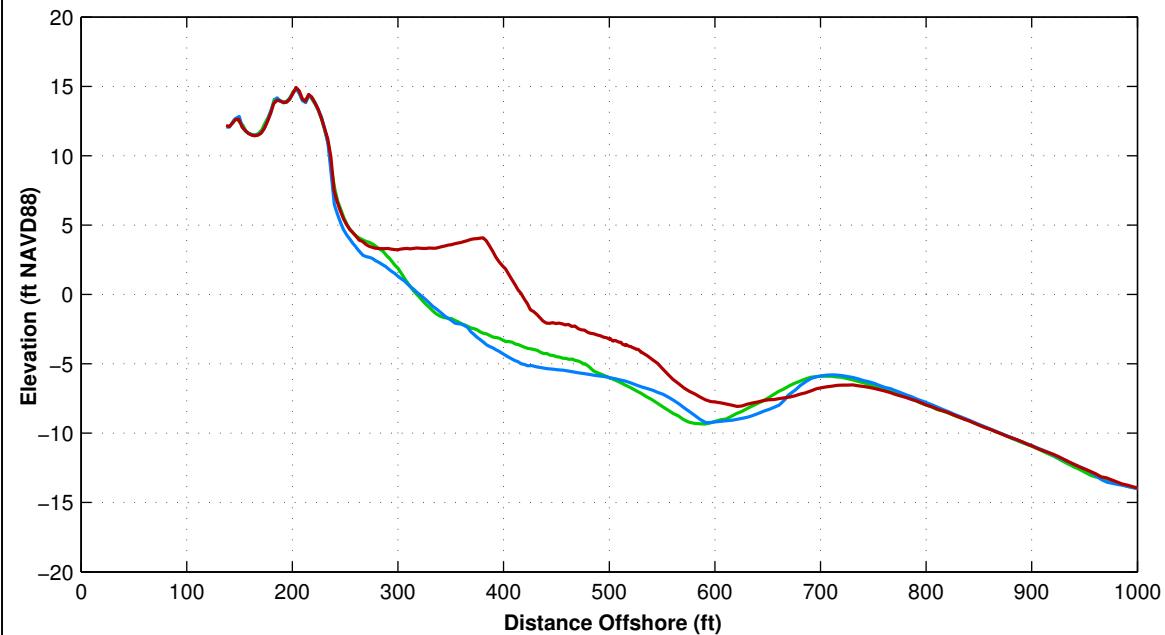
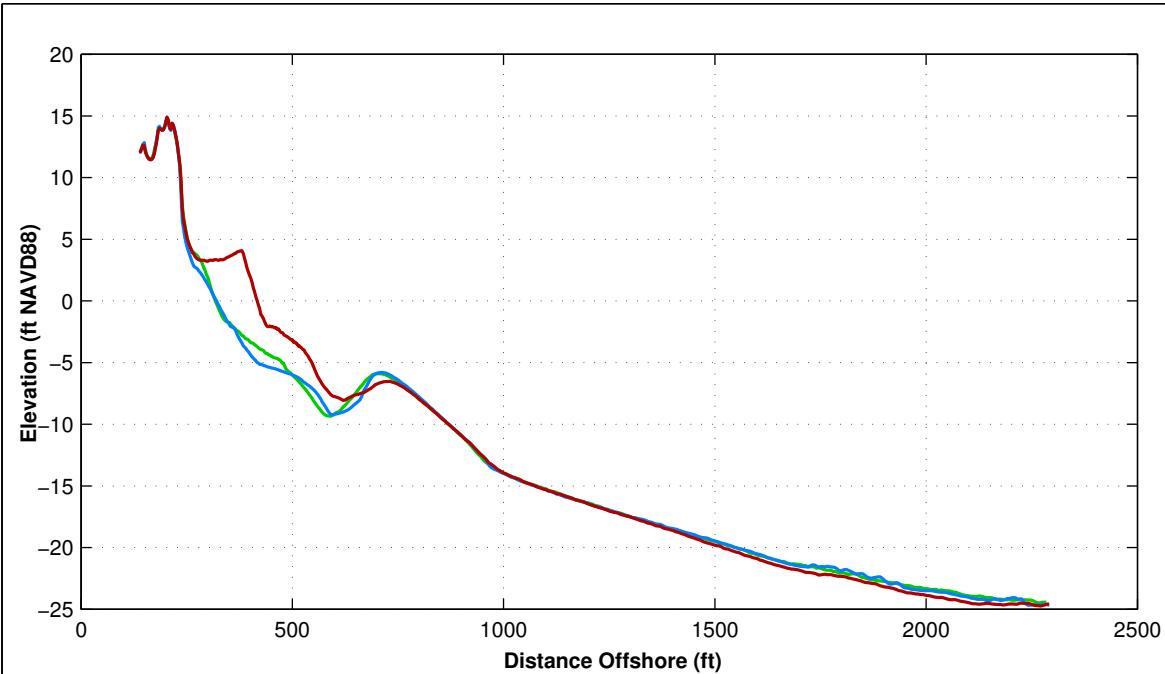
Survey Transect 365+63	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	135.80 ft/yr	129.35 ft
Volume Change Above -15 ft NAVD88	31.20 cy/ft/yr	35.97 cy/ft
Volume Change Above 0 ft NAVD88	17.25 cy/ft/yr	18.91 cy/ft



Notes:

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4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



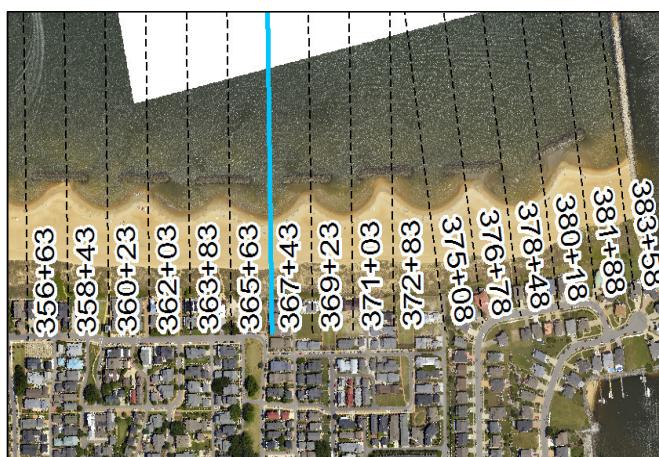


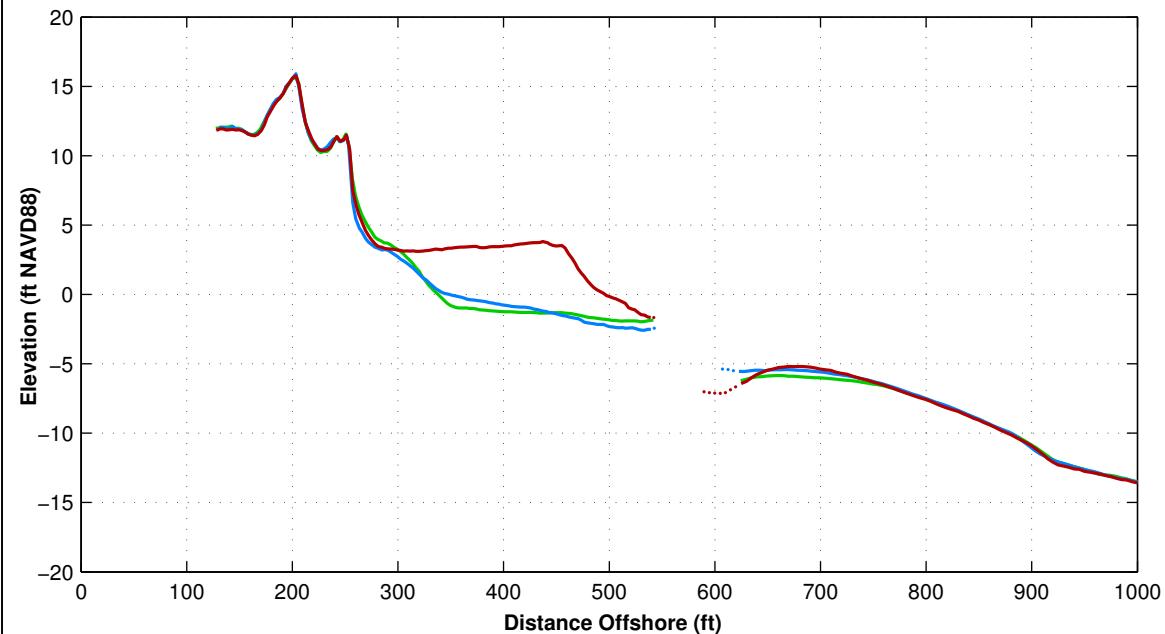
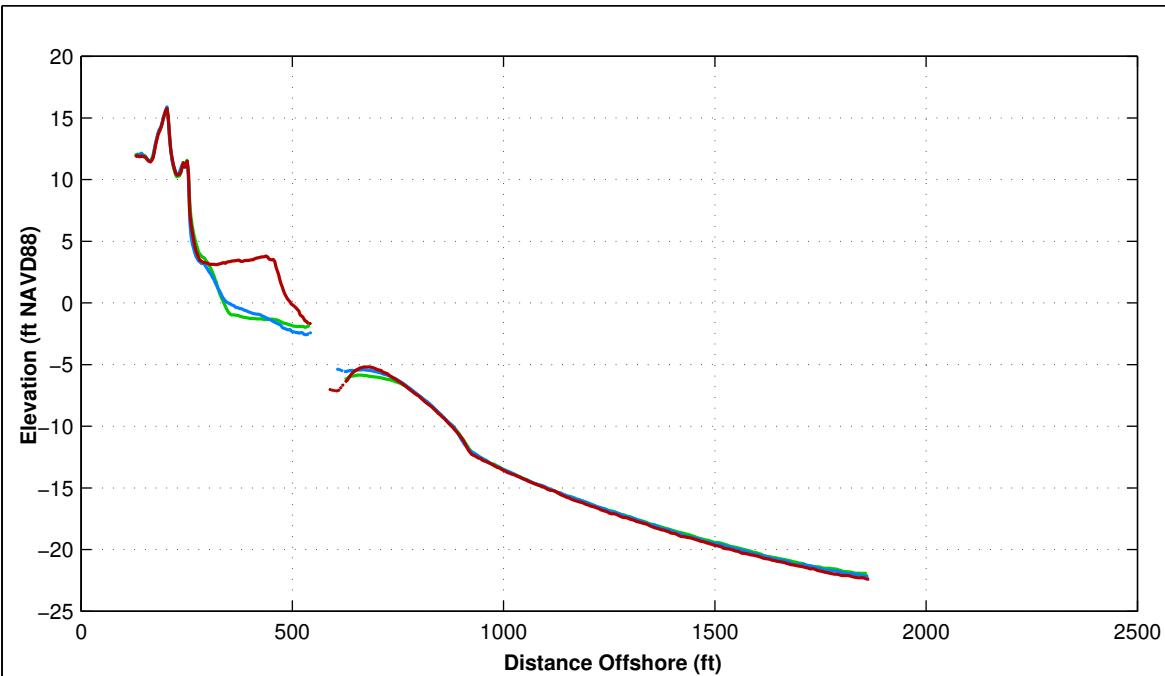
Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
367+43		
Shoreline Change at MHW (0.98 ft NAVD88)	100.77 ft/yr	102.60 ft
Volume Change Above -15 ft NAVD88	37.76 cy/ft/yr	42.75 cy/ft
Volume Change Above 0 ft NAVD88	12.96 cy/ft/yr	15.27 cy/ft

**LEGEND:**  
 MAY 2017 — Red line  
 OCT 2016 — Blue line  
 MAY 2016 — Green line

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
369+23		
Shoreline Change at MHW (0.98 ft NAVD88)	153.36 ft/yr	151.79 ft
Volume Change Above -15 ft NAVD88	28.83 cy/ft/yr	28.07 cy/ft
Volume Change Above 0 ft NAVD88	18.76 cy/ft/yr	20.28 cy/ft

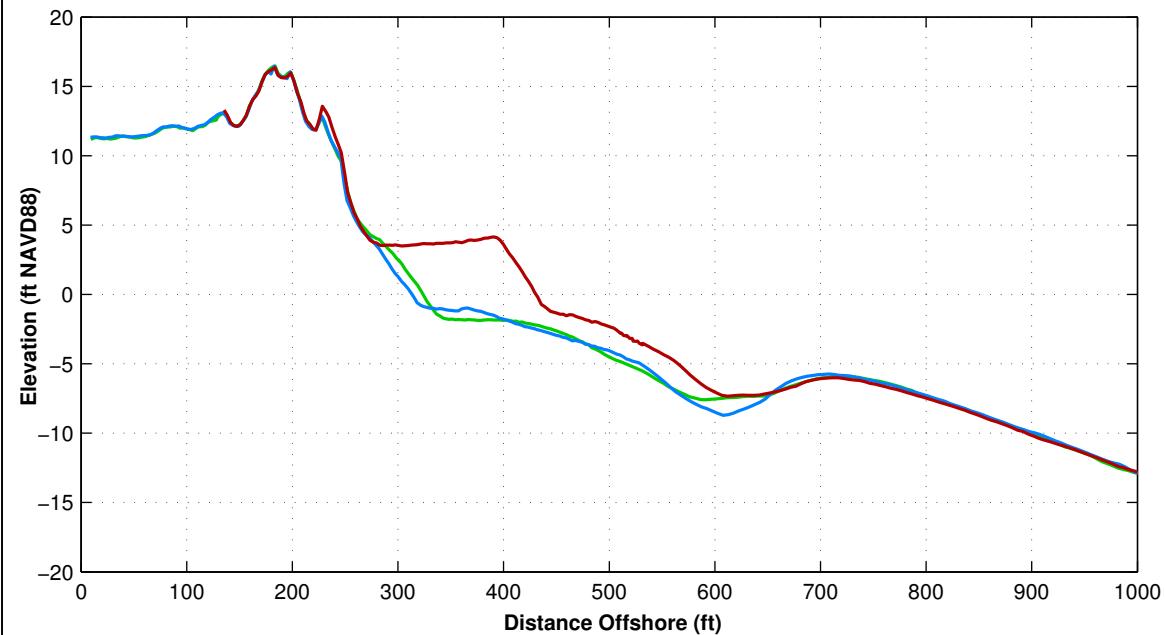
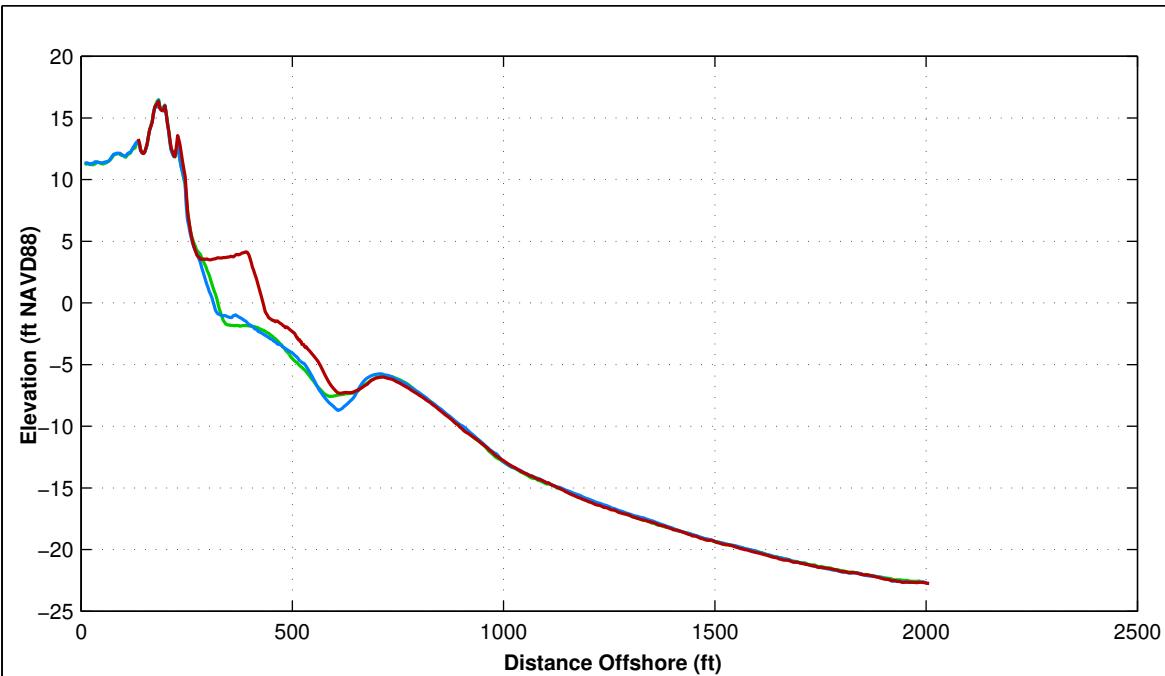
**LEGEND:**

MAY 2017	—
OCT 2016	—
MAY 2016	—

**Notes:**

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



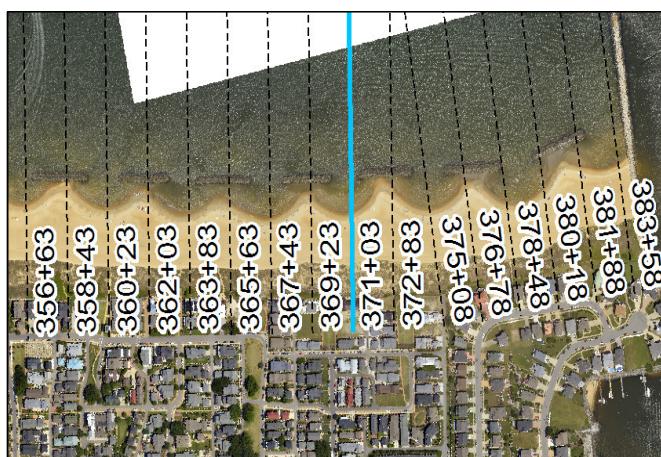


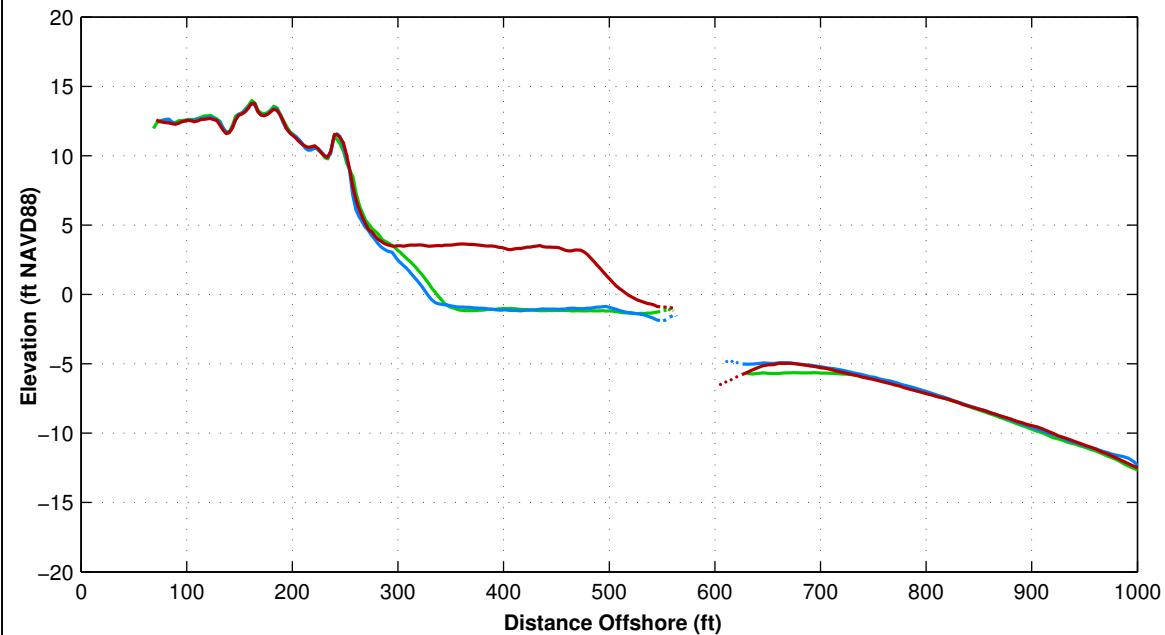
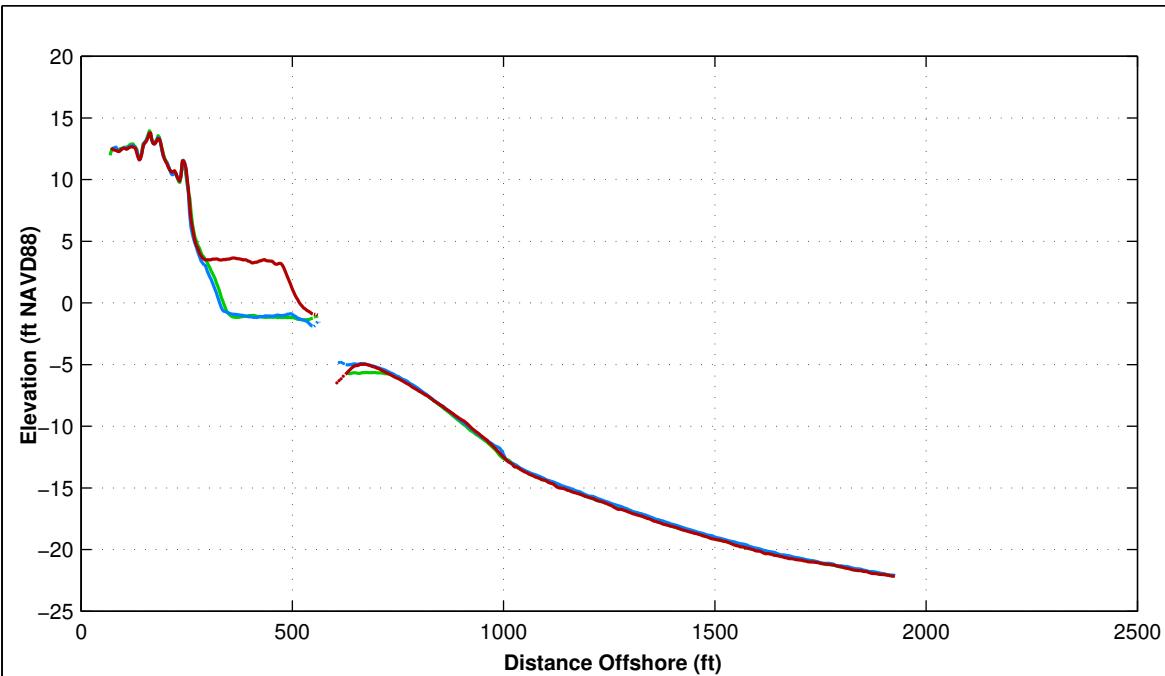
Survey Transect 371+03	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	ft/yr	ft
Volume Change Above -15 ft NAVD88	cy/ft/yr	cy/ft
Volume Change Above 0 ft NAVD88	cy/ft/yr	cy/ft

**LEGEND:**  
 MAY 2017 — Red line  
 OCT 2016 — Blue line  
 MAY 2016 — Green line

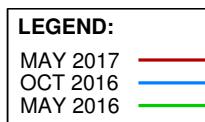
Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



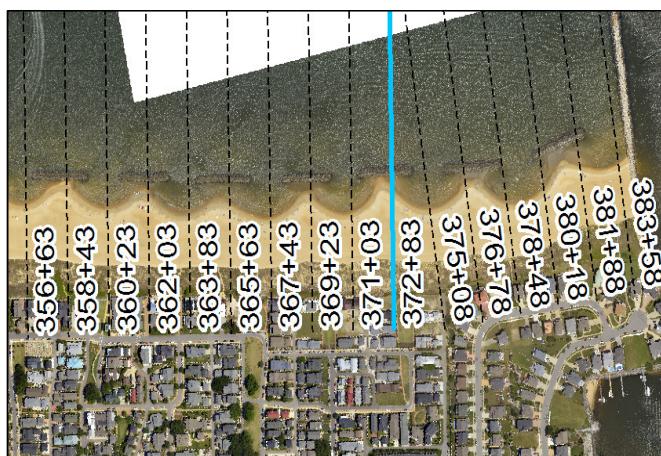


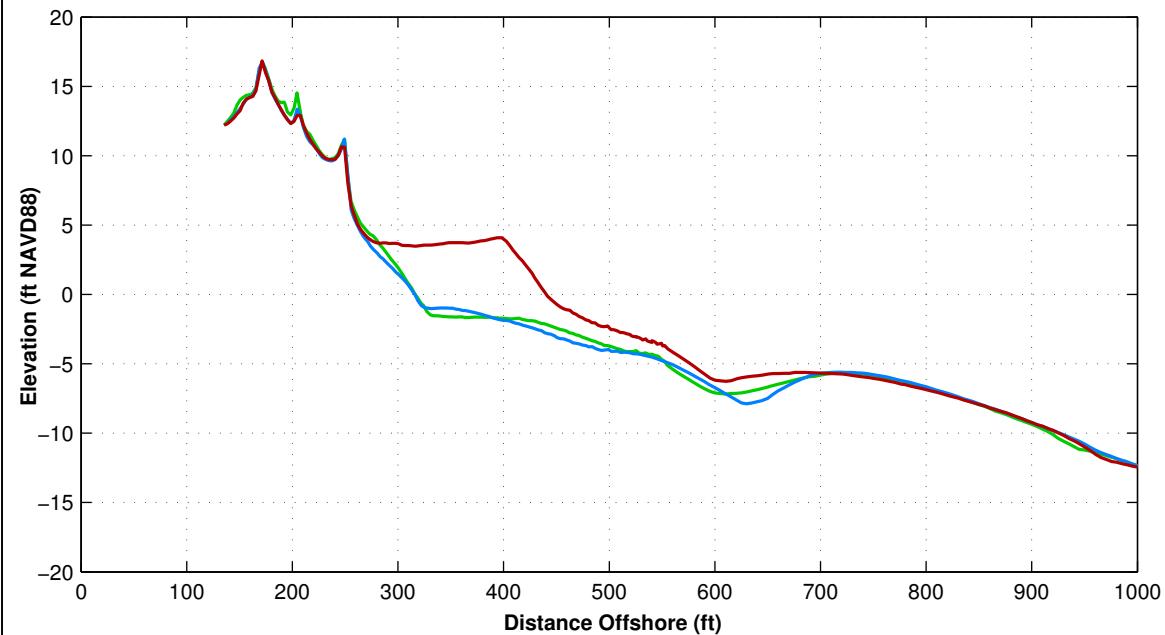
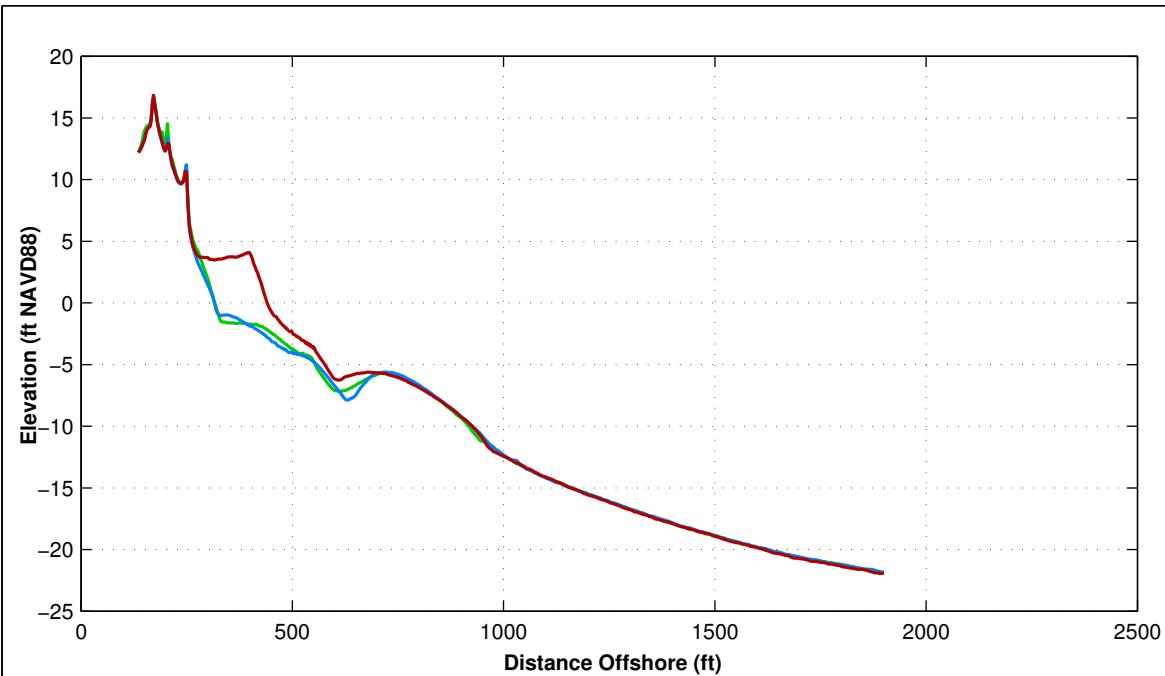
Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	174.73 ft/yr	183.65 ft
Volume Change Above -15 ft NAVD88	31.91 cy/ft/yr	30.20 cy/ft
Volume Change Above 0 ft NAVD88	21.53 cy/ft/yr	23.89 cy/ft



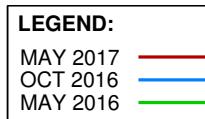
Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
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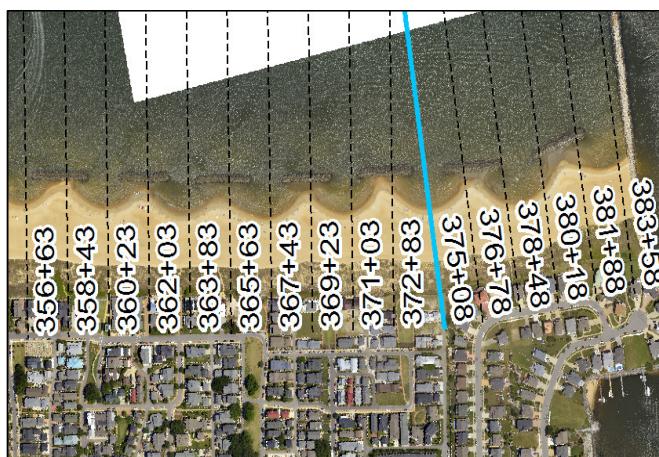


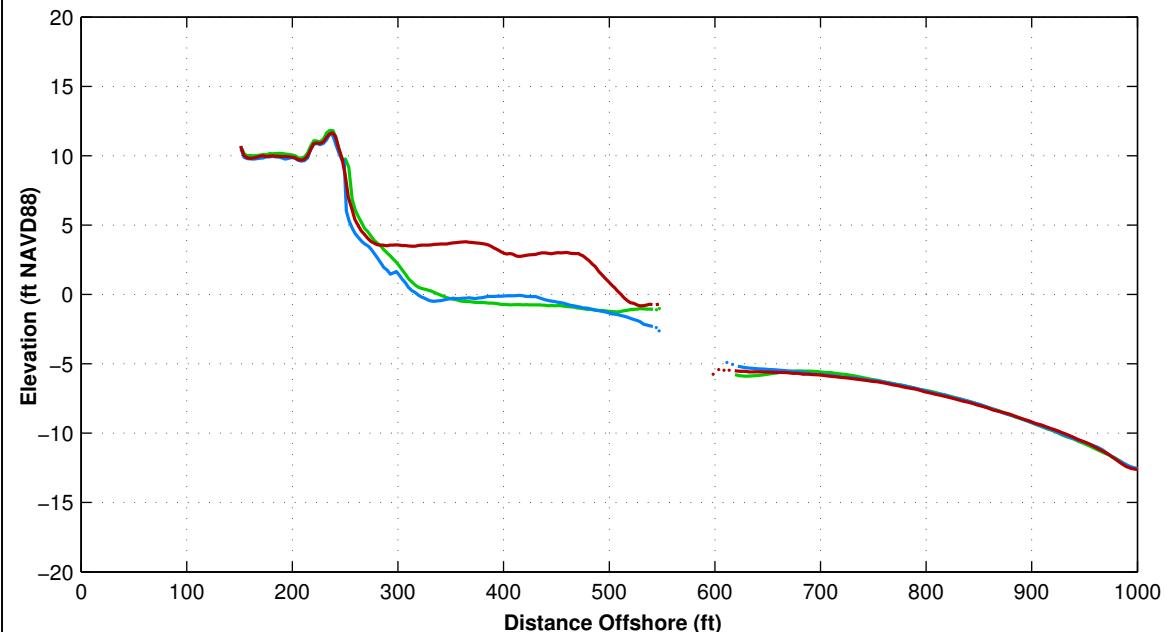
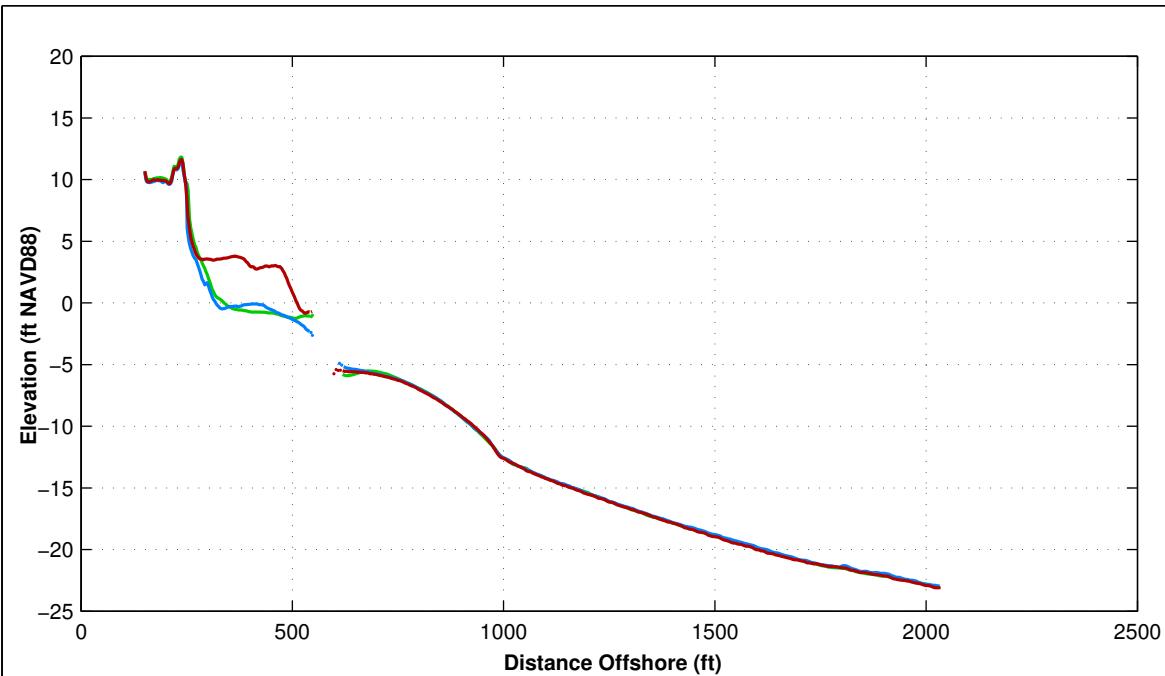
Survey Transect	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	123.33 ft/yr	124.97 ft
Volume Change Above -15 ft NAVD88	32.74 cy/ft/yr	35.75 cy/ft
Volume Change Above 0 ft NAVD88	15.09 cy/ft/yr	17.68 cy/ft



Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



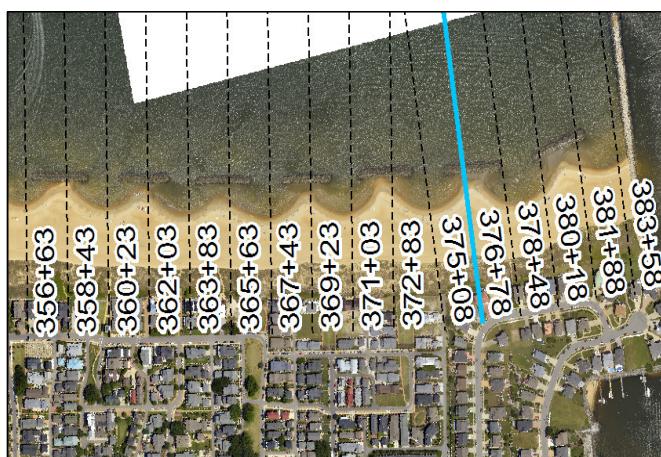


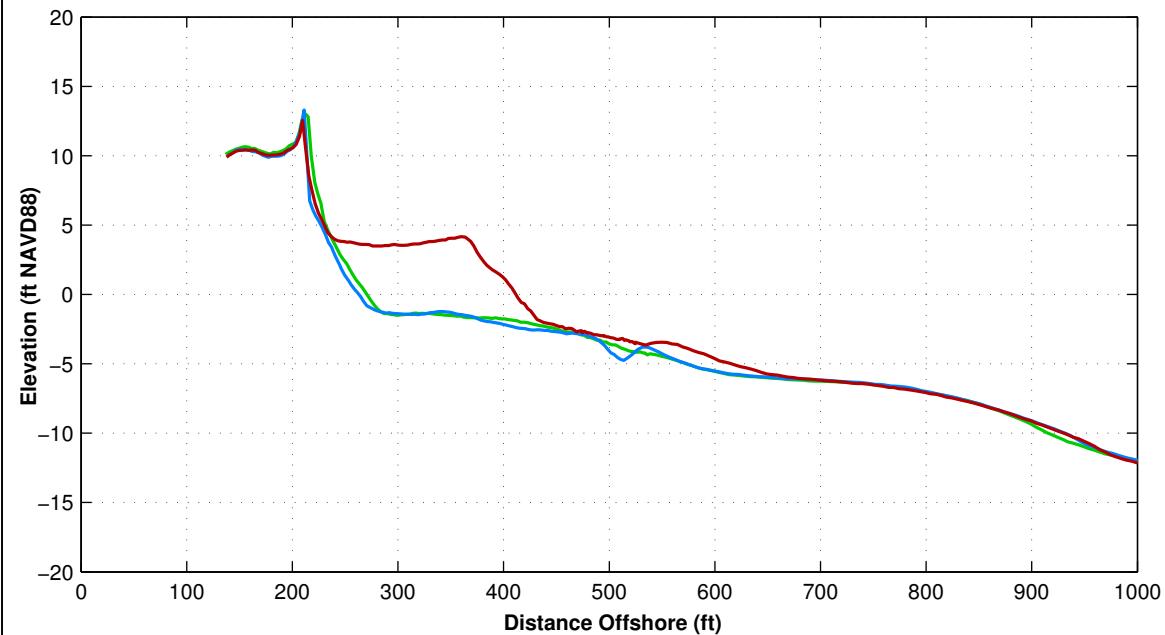
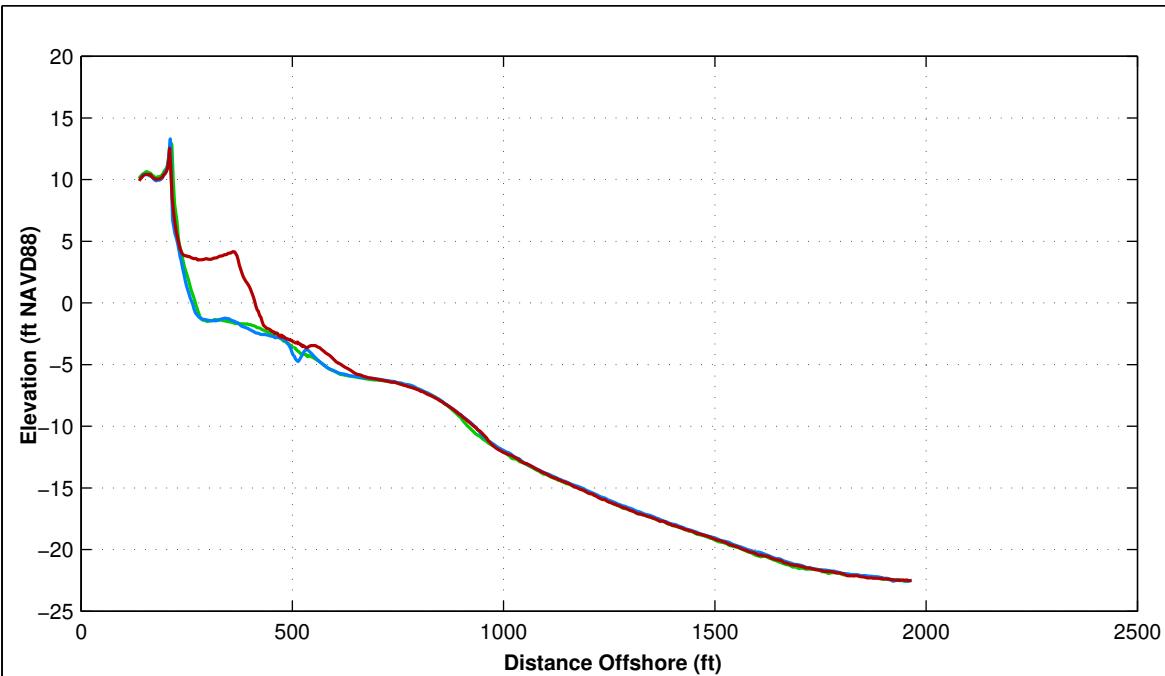
**LEGEND:**

MAY 2017	—
OCT 2016	—
MAY 2016	—

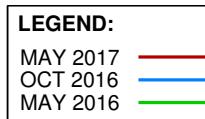
**Notes:**

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2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
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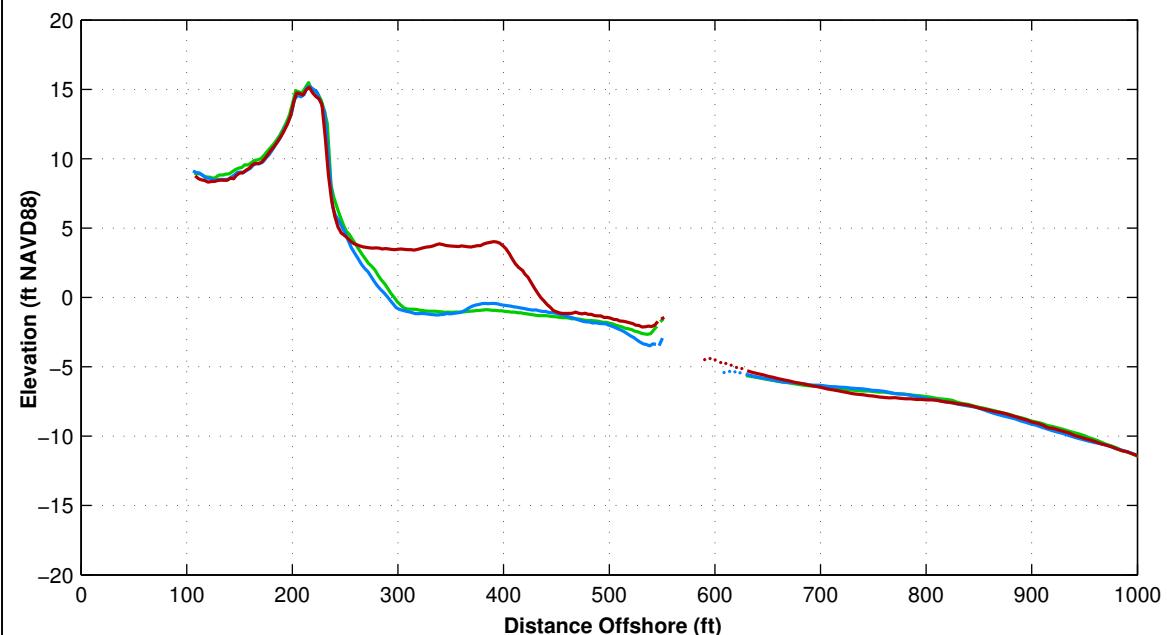
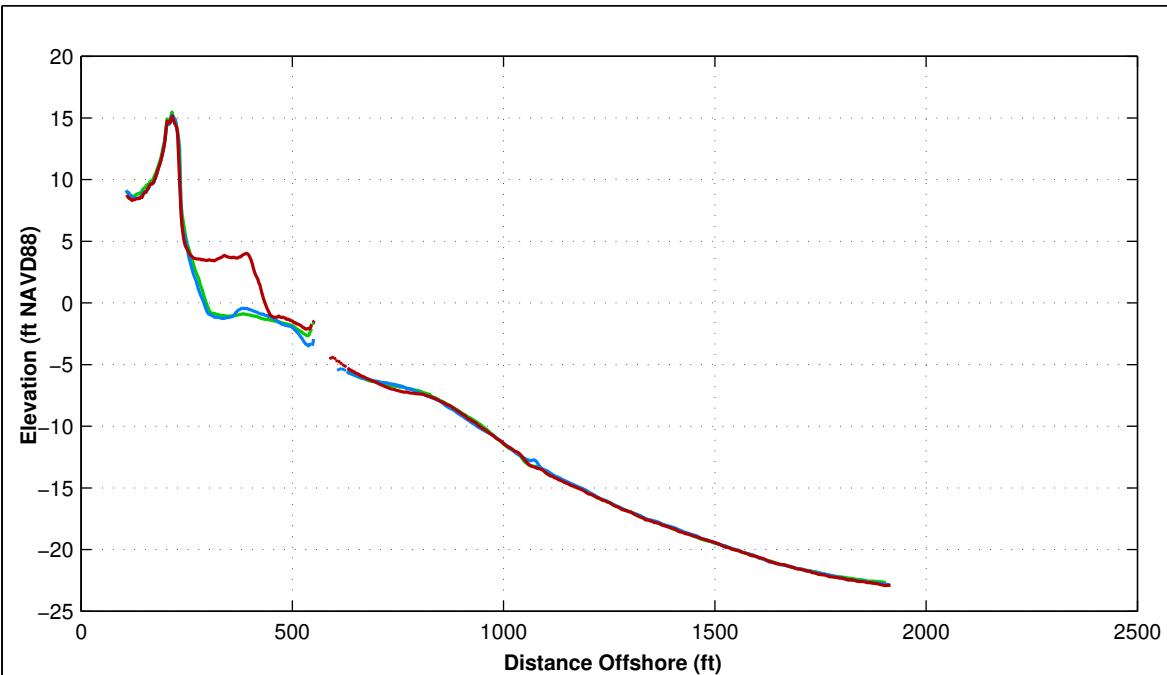
Survey Transect 378+48	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	141.50 ft/yr	149.25 ft
Volume Change Above -15 ft NAVD88	32.26 cy/ft/yr	34.30 cy/ft
Volume Change Above 0 ft NAVD88	16.99 cy/ft/yr	20.29 cy/ft



Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





Survey Transect 380+18

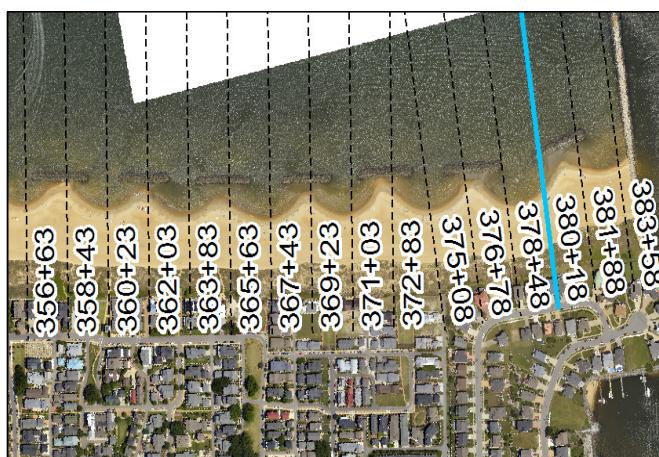
	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	139.20 ft/yr	147.48 ft
Volume Change Above -15 ft NAVD88	22.13 cy/ft/yr	25.24 cy/ft
Volume Change Above 0 ft NAVD88	16.46 cy/ft/yr	19.15 cy/ft

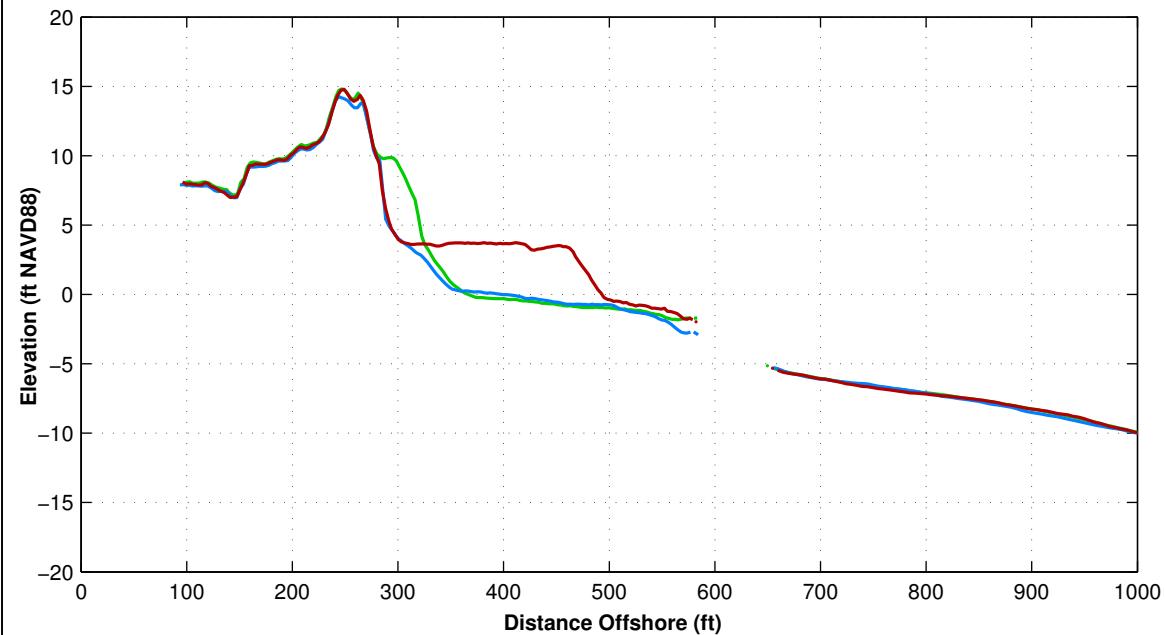
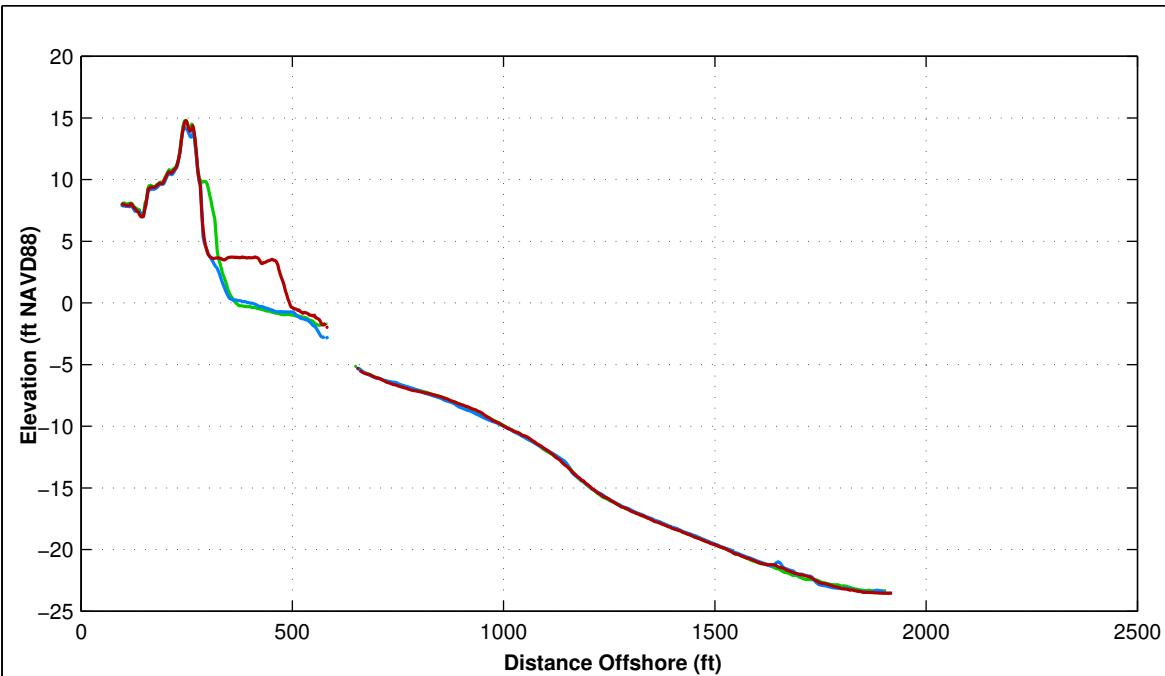
**LEGEND:**

MAY 2017	—
OCT 2016	—
MAY 2016	—

Notes:

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2. Sections Are Viewed Toward Decreasing Stationing.
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4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.





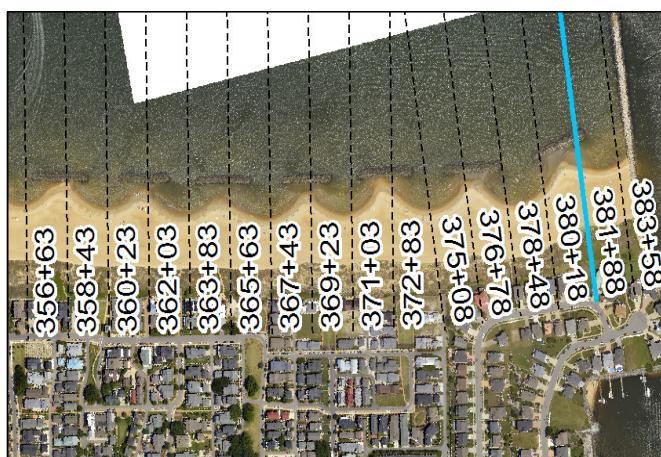
Survey Transect 381+88	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	134.91 ft/yr	141.42 ft
Volume Change Above -15 ft NAVD88	15.02 cy/ft/yr	24.41 cy/ft
Volume Change Above 0 ft NAVD88	11.29 cy/ft/yr	19.87 cy/ft

LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

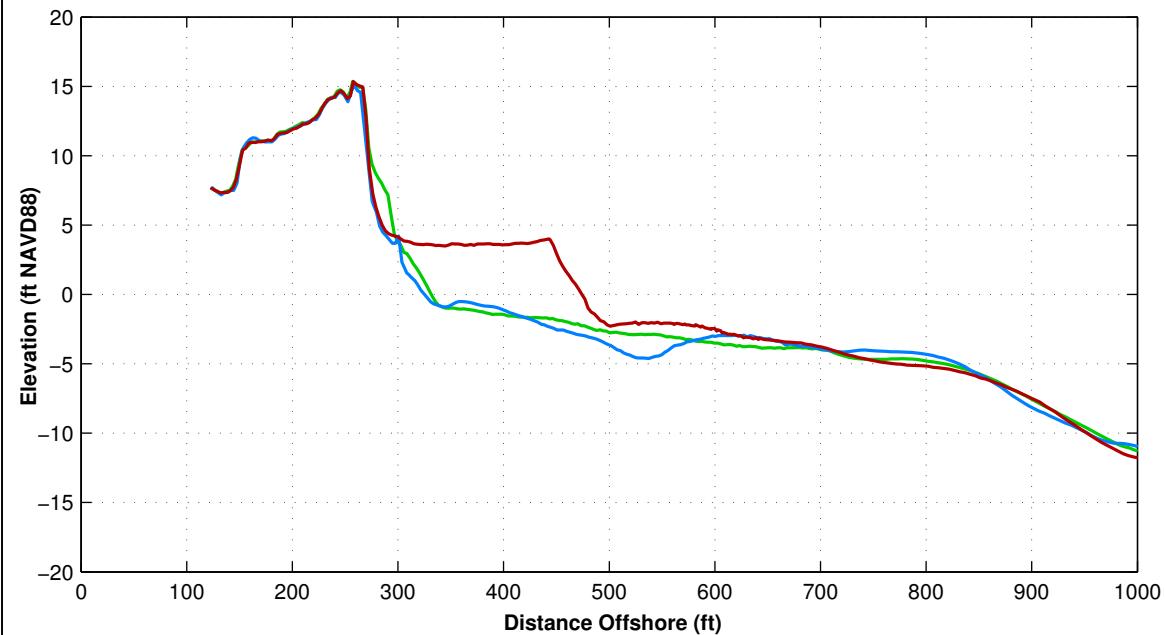
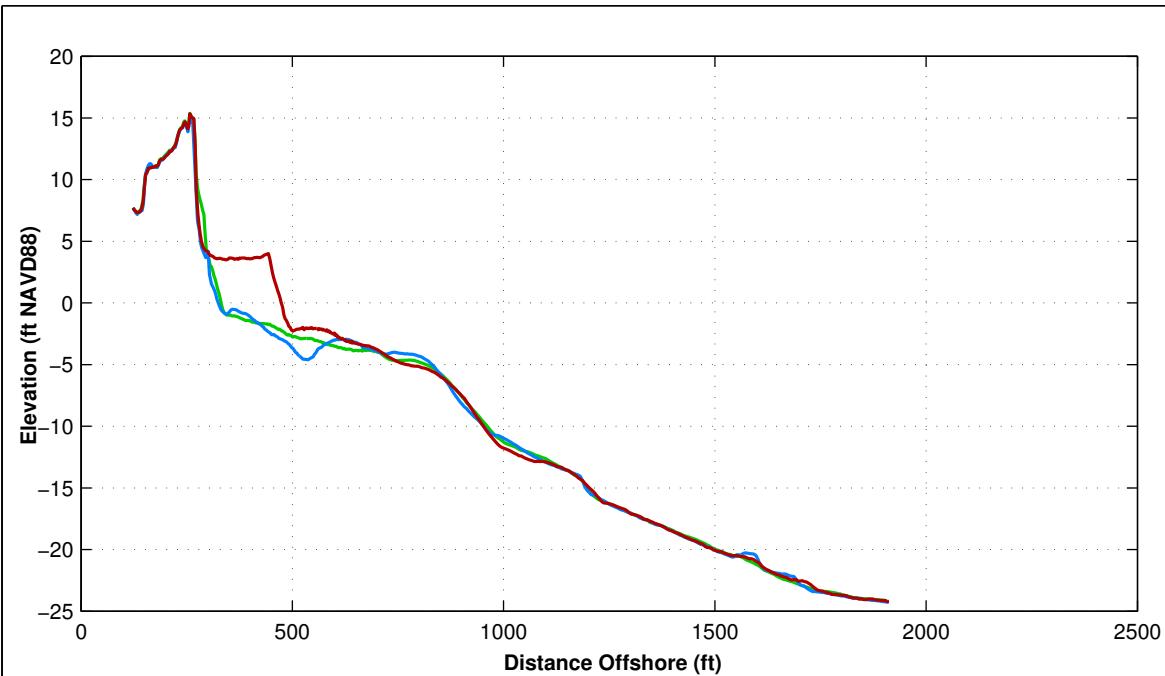
Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



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ANALYSIS



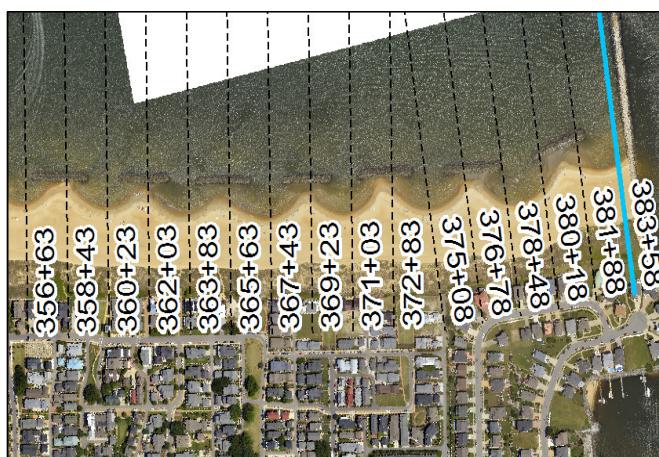
Survey Transect 383+58	MAY 2017 – MAY 2016	MAY 2017 – OCT 2016
Shoreline Change at MHW (0.98 ft NAVD88)	140.70 ft/yr	149.29 ft
Volume Change Above -15 ft NAVD88	26.79 cy/ft/yr	33.15 cy/ft
Volume Change Above 0 ft NAVD88	16.87 cy/ft/yr	21.30 cy/ft

LEGEND:

- MAY 2017
- OCT 2016
- MAY 2016

Notes:

1. Station From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
3. All Survey Elevations In Feet Referenced to NAVD88.
4. Survey Comparison Made to MAY 2016 and OCT 2016
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward and Seaward Of The Breakwater.



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Spring 2017

**Table C-1. Summary of Shoreline Change and Volume Change  
(May 2016 to May 2017)**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from May 10, 2016 to May 25, 2017.

Transect Number (Station)	Old Survey Date	New Survey Date	Shoreline Change Rate at MHW (ft/yr)	Volume Change Rate Above 0 ft NAVD88 (cy/ft/yr)	Volume Change Rate Above -15 ft NAVD88 (cy/ft/yr)
0+00	5/10/2016	5/25/2017	11.55	7.08	-8.50
2+50	5/10/2016	5/25/2017	2.51	0.88	-6.57
5+00	5/10/2016	5/25/2017	7.11	0.18	12.29
7+50	5/10/2016	5/25/2017	-6.27	-3.09	-30.04
10+00	5/10/2016	5/25/2017	10.32	4.89	-22.62
12+50	5/10/2016	5/25/2017	19.37	7.40	0.01
15+00	5/10/2016	5/25/2017	49.34	9.85	3.55
17+50	5/10/2016	5/25/2017	39.13	5.88	3.75
20+00	5/10/2016	5/25/2017	146.12	23.32	32.33
22+50	5/10/2016	5/25/2017	203.21	30.46	67.77
25+00	5/10/2016	5/25/2017	146.83	21.50	30.59
27+50	5/10/2016	5/25/2017	150.69	19.49	40.34
30+00	5/10/2016	5/25/2017	128.41	16.08	27.24
32+50	5/10/2016	5/25/2017	171.94	22.32	45.32
35+00	5/10/2016	5/25/2017	130.31	21.70	27.32
37+50	5/10/2016	5/25/2017	123.40	12.32	26.93
40+00	5/10/2016	5/25/2017	164.14	20.10	44.91
42+50	5/10/2016	5/25/2017	164.47	15.03	40.17
45+00	5/10/2016	5/25/2017	133.72	13.65	35.98
45+25	5/10/2016	5/25/2017	164.13	14.36	52.16
47+30	5/10/2016	5/25/2017	156.90	18.22	49.11
49+35	5/10/2016	5/25/2017	158.59	19.57	30.32
51+41	5/10/2016	5/25/2017	147.04	19.17	47.53
53+46	5/10/2016	5/25/2017	127.23	14.07	24.53
55+51	5/10/2016	5/25/2017	148.08	19.06	45.80
57+57	5/10/2016	5/25/2017	102.61	15.82	24.62
59+62	5/10/2016	5/25/2017	153.40	24.42	55.02
61+62	5/10/2016	5/25/2017	106.26	17.67	26.81
63+62	5/10/2016	5/25/2017	158.52	26.25	62.91
65+62	5/10/2016	5/25/2017	131.08	22.57	28.85
67+62	5/10/2016	5/25/2017	184.10	27.03	69.18
69+62	5/10/2016	5/25/2017	106.46	14.98	18.79
71+62	5/10/2016	5/25/2017	146.50	20.22	48.41
73+62	5/10/2016	5/25/2017	133.97	17.74	22.91
75+62	5/10/2016	5/25/2017	152.67	22.50	43.64
77+62	5/10/2016	5/25/2017	166.52	18.81	25.77
79+62	5/10/2016	5/25/2017	131.45	15.72	37.10
81+62	5/10/2016	5/25/2017	126.00	14.45	36.53
83+62	5/10/2016	5/25/2017	152.07	19.00	44.11
85+62	5/10/2016	5/25/2017	97.26	12.41	32.02
87+62	5/10/2016	5/25/2017	124.45	15.26	40.79

**Table C-1. Summary of Shoreline Change and Volume Change  
(May 2016 to May 2017) Cont.**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from May 10, 2016 to May 25, 2017.

Transect Number (Station)	Old Survey Date	New Survey Date	Shoreline Change Rate at MHW (ft/yr)	Volume Change Rate Above 0 ft NAVD88 (cy/ft/yr)	Volume Change Rate Above -15 ft NAVD88 (cy/ft/yr)
93+41	5/10/2016	5/25/2017	90.88	11.88	33.59
103+08	5/10/2016	5/25/2017	118.63	14.08	36.03
120+93	5/10/2016	5/25/2017	91.54	10.66	25.65
129+17	5/10/2016	5/25/2017	50.77	10.17	17.43
141+98	5/10/2016	5/25/2017	104.60	11.99	35.80
152+01	5/10/2016	5/25/2017	95.95	12.09	33.87
163+49	5/10/2016	5/25/2017	104.93	13.07	33.87
169+63	5/10/2016	5/25/2017	123.17	13.37	31.78
171+63	5/10/2016	5/25/2017	119.82	14.34	33.01
173+63	5/10/2016	5/25/2017	120.35	14.22	38.29
175+63	5/10/2016	5/25/2017	142.49	19.67	45.39
177+63	5/10/2016	5/25/2017	104.18	17.47	47.49
179+63	5/10/2016	5/25/2017	124.88	18.02	28.94
181+63	5/10/2016	5/25/2017	97.00	14.90	33.52
183+63	5/10/2016	5/25/2017	149.13	20.56	31.84
185+63	5/10/2016	5/25/2017	120.16	16.88	46.33
187+63	5/10/2016	5/25/2017	139.96	15.27	23.68
189+63	5/10/2016	5/25/2017	111.26	15.44	35.53
191+63	5/10/2016	5/25/2017	133.67	11.75	20.71
193+63	5/10/2016	5/25/2017	141.24	18.38	46.40
195+63	5/10/2016	5/25/2017	124.24	16.88	38.46
206+86	5/10/2016	5/25/2017	4.91	-2.23	0.23
218+66	5/10/2016	5/25/2017	0.84	-5.45	-12.50
229+85	5/10/2016	5/25/2017	5.13	-0.54	0.05
242+03	5/10/2016	5/25/2017	8.55	-0.76	-2.35
252+62	5/10/2016	5/25/2017	5.69	-0.04	-1.10
263+22	5/10/2016	5/25/2017	-10.66	-0.59	3.36
274+53	5/10/2016	5/25/2017	34.85	4.94	13.12
281+40	5/10/2016	5/25/2017	65.43	8.94	32.12
288+39	5/10/2016	5/25/2017	123.09	15.01	37.66
295+27	5/10/2016	5/25/2017	123.32	15.28	42.71
302+24	5/10/2016	5/25/2017	101.35	13.65	36.25
315+96	5/10/2016	5/25/2017	106.70	12.15	32.18
323+09	5/10/2016	5/25/2017	100.14	10.87	32.90
329+63	5/10/2016	5/25/2017	104.36	10.85	29.32
331+43	5/10/2016	5/25/2017	89.70	9.88	29.75
333+23	5/10/2016	5/25/2017	116.89	14.20	26.26
335+03	5/10/2016	5/25/2017	92.21	11.31	29.38
336+83	5/10/2016	5/25/2017	112.79	14.65	31.19
338+63	5/10/2016	5/25/2017	156.28	17.90	34.28
340+43	5/10/2016	5/25/2017	126.53	17.61	40.42
342+23	5/10/2016	5/25/2017	135.09	19.32	49.12

**Table C-1. Summary of Shoreline Change and Volume Change  
(May 2016 to May 2017) Cont.**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from May 10, 2016 to May 25, 2017.

Transect Number (Station)	Old Survey Date	New Survey Date	Shoreline Change Rate at MHW (ft/yr)	Volume Change Rate Above 0 ft NAVD88 (cy/ft/yr)	Volume Change Rate Above -15 ft NAVD88 (cy/ft/yr)
344+05	5/10/2016	5/25/2017	167.28	22.35	30.26
345+85	5/10/2016	5/25/2017	114.91	15.33	36.97
347+63	5/10/2016	5/25/2017	145.12	18.37	29.54
349+43	5/10/2016	5/25/2017	103.88	15.01	38.49
351+23	5/10/2016	5/25/2017	152.87	18.57	30.06
353+03	5/10/2016	5/25/2017	102.86	14.38	42.35
354+83	5/10/2016	5/25/2017	159.97	19.05	34.12
356+63	5/10/2016	5/25/2017	111.04	14.44	41.66
358+43	5/10/2016	5/25/2017	165.98	20.20	35.77
360+23	5/10/2016	5/25/2017	111.92	15.43	46.91
362+03	5/10/2016	5/25/2017	147.77	18.03	34.64
363+83	5/10/2016	5/25/2017	94.18	12.38	36.84
365+63	5/10/2016	5/25/2017	130.44	16.57	29.97
367+43	5/10/2016	5/25/2017	96.79	12.45	36.27
369+23	5/10/2016	5/25/2017	147.31	18.02	27.69
371+03	5/10/2016	5/25/2017	103.64	21.77	38.40
372+83	5/10/2016	5/25/2017	167.83	20.68	30.65
375+08	5/10/2016	5/25/2017	118.46	14.49	31.44
376+78	5/10/2016	5/25/2017	179.30	20.33	24.91
378+48	5/10/2016	5/25/2017	135.91	16.32	30.99
380+18	5/10/2016	5/25/2017	133.71	15.81	21.26
381+88	5/10/2016	5/25/2017	129.58	10.84	14.42
383+58	5/10/2016	5/25/2017	135.15	16.21	25.73

**Table C-2. Summary of Shoreline Change and Volume Change  
(October 2016 to May 2017)**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from October 18, 2016 to May 25, 2017.

Transect Number (Station)	Old Survey Date	New Survey Date	Shoreline Change at MHW (ft)	Volume Change Above 0 ft NAVD88 (cy/ft)	Volume Change Above -15 ft NAVD88 (cy/ft)
0+00	10/18/2016	5/25/2017	16.19	1.73	-9.27
2+50	10/18/2016	5/25/2017	0.42	0.08	-15.29
5+00	10/18/2016	5/25/2017	15.24	2.33	10.53
7+50	10/18/2016	5/25/2017	-1.60	0.31	-22.46
10+00	10/18/2016	5/25/2017	8.20	1.63	13.56
12+50	10/18/2016	5/25/2017	7.43	0.78	-4.32
15+00	10/18/2016	5/25/2017	42.92	5.59	3.53
17+50	10/18/2016	5/25/2017	32.68	3.30	4.21
20+00	10/18/2016	5/25/2017	154.61	22.75	38.50
22+50	10/18/2016	5/25/2017	211.38	30.54	69.28
25+00	10/18/2016	5/25/2017	182.35	26.29	40.63
27+50	10/18/2016	5/25/2017	185.52	23.66	53.56
30+00	10/18/2016	5/25/2017	154.95	19.62	39.02
32+50	10/18/2016	5/25/2017	171.69	23.72	46.06
35+00	10/18/2016	5/25/2017	118.73	15.76	16.55
37+50	10/18/2016	5/25/2017	135.66	14.90	29.16
40+00	10/18/2016	5/25/2017	179.11	23.59	52.13
42+50	10/18/2016	5/25/2017	187.34	23.43	56.28
45+00	10/18/2016	5/25/2017	140.70	20.25	50.05
45+25	10/18/2016	5/25/2017	176.87	20.64	65.65
47+30	10/18/2016	5/25/2017	167.45	23.01	57.87
49+35	10/18/2016	5/25/2017	153.83	19.16	29.31
51+41	10/18/2016	5/25/2017	157.93	19.96	55.27
53+46	10/18/2016	5/25/2017	150.18	16.27	31.04
55+51	10/18/2016	5/25/2017	156.11	20.56	48.59
57+57	10/18/2016	5/25/2017	127.97	18.29	30.80
59+62	10/18/2016	5/25/2017	165.38	26.99	64.21
61+62	10/18/2016	5/25/2017	126.94	20.01	38.54
63+62	10/18/2016	5/25/2017	171.89	27.74	66.75
65+62	10/18/2016	5/25/2017	145.35	24.86	38.29
67+62	10/18/2016	5/25/2017	191.55	28.90	72.08
69+62	10/18/2016	5/25/2017	133.89	16.57	23.39
71+62	10/18/2016	5/25/2017	156.74	20.96	52.37
73+62	10/18/2016	5/25/2017	157.96	20.63	27.15
75+62	10/18/2016	5/25/2017	175.20	26.48	51.49
77+62	10/18/2016	5/25/2017	155.62	16.92	24.96
79+62	10/18/2016	5/25/2017	145.92	17.76	41.53
81+62	10/18/2016	5/25/2017	136.41	16.66	44.21
83+62	10/18/2016	5/25/2017	150.58	18.51	46.56
85+62	10/18/2016	5/25/2017	110.32	14.85	34.60
87+62	10/18/2016	5/25/2017	132.06	17.66	44.36

**Table C-2. Summary of Shoreline Change and Volume Change  
(October 2016 to May 2017) Cont.**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from October 18, 2016 to May 25, 2016.

Transect Number (Station)	Old Survey Date	New Survey Date	Shoreline Change at MHW (ft)	Volume Change Above 0 ft NAVD88 (cy/ft)	Volume Change Above -15 ft NAVD88 (cy/ft)
93+41	10/18/2016	5/25/2017	90.74	11.30	30.97
103+08	10/18/2016	5/25/2017	119.90	16.05	38.89
120+93	10/18/2016	5/25/2017	114.89	14.68	33.32
129+17	10/18/2016	5/25/2017	62.40	10.96	19.15
141+98	10/18/2016	5/25/2017	109.97	14.39	33.87
152+01	10/18/2016	5/25/2017	95.22	11.33	28.91
163+49	10/18/2016	5/25/2017	118.92	14.86	31.20
169+63	10/18/2016	5/25/2017	134.44	18.29	44.12
171+63	10/18/2016	5/25/2017	135.89	18.26	43.87
173+63	10/18/2016	5/25/2017	134.30	18.61	42.39
175+63	10/18/2016	5/25/2017	141.52	21.50	50.19
177+63	10/18/2016	5/25/2017	124.81	19.79	42.91
179+63	10/18/2016	5/25/2017	146.84	19.75	33.20
181+63	10/18/2016	5/25/2017	110.13	15.73	30.42
183+63	10/18/2016	5/25/2017	166.45	21.01	32.96
185+63	10/18/2016	5/25/2017	133.44	18.40	55.50
187+63	10/18/2016	5/25/2017	153.71	18.35	26.62
189+63	10/18/2016	5/25/2017	115.15	15.41	36.71
191+63	10/18/2016	5/25/2017	155.65	15.66	24.48
193+63	10/18/2016	5/25/2017	147.49	18.51	43.54
195+63	10/18/2016	5/25/2017	132.93	17.90	39.40
206+86	10/18/2016	5/25/2017	1.92	-2.21	-0.15
218+66	10/18/2016	5/25/2017	-3.94	-2.21	-7.53
229+85	10/18/2016	5/25/2017	-18.05	-0.45	2.00
242+03	10/18/2016	5/25/2017	-3.60	-0.35	-5.46
252+62	10/18/2016	5/25/2017	-9.54	3.94	3.27
263+22	10/18/2016	5/25/2017	-25.44	-1.19	1.47
274+53	10/18/2016	5/25/2017	13.92	3.01	13.13
281+40	10/18/2016	5/25/2017	68.92	11.62	37.05
288+39	10/18/2016	5/25/2017	118.37	17.51	39.35
295+27	10/18/2016	5/25/2017	115.83	13.67	43.07
302+24	10/18/2016	5/25/2017	94.91	15.25	38.50
315+96	10/18/2016	5/25/2017	97.29	12.19	27.33
323+09	10/18/2016	5/25/2017	106.75	15.54	41.47
329+63	10/18/2016	5/25/2017	116.00	15.02	32.81
331+43	10/18/2016	5/25/2017	104.15	14.64	35.78
333+23	10/18/2016	5/25/2017	131.16	18.01	25.71
335+03	10/18/2016	5/25/2017	112.36	16.15	32.62
336+83	10/18/2016	5/25/2017	131.84	18.25	38.12
338+63	10/18/2016	5/25/2017	162.17	20.34	33.29
340+43	10/18/2016	5/25/2017	140.39	20.37	42.49

**Table C-2. Summary of Shoreline Change and Volume Change  
(October 2016 to May 2017) Cont.**

**NOTES:**

1. Positive changes indicate accretion or gain in volume along the profile and negative changes indicate erosion or loss of volume along the profile.
2. MHW assumed at +0.98 ft-NAVD88.
3. Shoreline Change and Volume Change is calculated for the period between surveys from October 18, 2016 to May 25, 2017.

Transect Number (Station)	Old Survey Date	New Survey Date	Shoreline Change at MHW (ft)	Volume Change Above 0 ft NAVD88 (cy/ft)	Volume Change Above -15 ft NAVD88 (cy/ft)
342+23	10/18/2016	5/25/2017	152.86	20.16	58.28
344+05	10/18/2016	5/25/2017	162.03	20.66	26.48
345+85	10/18/2016	5/25/2017	119.67	17.62	33.75
347+63	10/18/2016	5/25/2017	138.48	20.39	31.21
349+43	10/18/2016	5/25/2017	108.59	16.68	37.59
351+23	10/18/2016	5/25/2017	153.97	19.65	29.35
353+03	10/18/2016	5/25/2017	104.26	16.08	47.61
354+83	10/18/2016	5/25/2017	162.73	21.47	35.70
356+63	10/18/2016	5/25/2017	112.26	17.20	52.76
358+43	10/18/2016	5/25/2017	171.33	23.05	44.92
360+23	10/18/2016	5/25/2017	117.60	19.35	58.70
362+03	10/18/2016	5/25/2017	143.94	20.56	38.16
363+83	10/18/2016	5/25/2017	94.84	15.55	48.84
365+63	10/18/2016	5/25/2017	129.35	18.91	35.97
367+43	10/18/2016	5/25/2017	102.60	15.27	42.75
369+23	10/18/2016	5/25/2017	151.79	20.28	28.07
371+03	10/18/2016	5/25/2017	120.08	24.57	41.07
372+83	10/18/2016	5/25/2017	183.65	23.89	30.20
375+08	10/18/2016	5/25/2017	124.97	17.68	35.75
376+78	10/18/2016	5/25/2017	193.13	25.44	29.24
378+48	10/18/2016	5/25/2017	149.25	20.29	34.30
380+18	10/18/2016	5/25/2017	147.48	19.15	25.24
381+88	10/18/2016	5/25/2017	141.42	19.87	24.41
383+58	10/18/2016	5/25/2017	149.29	21.30	33.15

**ENGINEERING ACTIVITIES LOG AND LOG OF SURVEYS FOR ENTIRE OCEAN VIEW SHORELINE**

No	Date	Project Type	Location	Description	Vol (cy)	Extent (ft)	Unit Vol (cy/ft)	Sand Source
1	1920-1937	Groin Construction	Willoughby Spit Shoreline	62 groins built by private property owners				
2	Dec 1926-Jan 1928	Jetty Construction	Little Creek Inlet	East Jetty Construction				
3	Dec 1926-Nov 1928	Jetty Construction	Little Creek Inlet	West Jetty Construction				
4	1938	Groin Construction	Between Willoughby Spit and Chesapeake Blvd.	37 timber groins built by City of Norfolk				
5	1953	Beach Nourishment	18th Bay St to 27th Bay St (East Ocean View)	Beach Nourishment	1,260,000	3,000	420	
6	1953	Beach Nourishment	27th Bay St to West Jetty (East Ocean View)	Beach Nourishment	500,000	1,800	278	
7	1960	Beach Nourishment	East End Parking Lot to West Jetty (East Ocean View)	Beach Nourishment	159,000	900	177	
8	1962	Beach Nourishment	Terminal Groin to 9th View St (Willoughby Spit)	Beach Nourishment	176,000	6,900	25	
9	1981	Groin reconstruction	Willoughby Spit area	5 timber groins were reconstructed				
10	1982	Beach Nourishment	East Ocean View	Beach Nourishment	400,000			Pretty Lake
11	1983	Groin Removal	Ocean View Park area	3 groins removed				
12	1983	Groin Construction	Western end of Willoughby Spit	5 groins built by the City of Norfolk				
13	Jan-Apr 1984	Beach Nourishment	Terminal Groin to 5th View St (Willoughby Spit)	Beach Nourishment	537,500	11,000	49	Navy Piers
14	Aug-Nov 1984	Beach Nourishment	21st Bay St to East End Parking Lot (East Ocean View)	Beach Nourishment	400,000	3,000	133	Pretty Lake
15	1985	Beach Nourishment	6th View St to Sarah Constant Shrine Park	Beach Nourishment	50,000			Navy's Willoughby project site
16	1987	Beach Nourishment	5th View St to Mason Creek	Beach Nourishment	50,000	2,000	25	Truck Haul
17	1988	Beach Access Construction	Willoughby and Ocean View	19 pedestrian beach access ways constructed				
18	Spring 1988	Dune Repair	Willoughby Beach	used 10,000 cy of accretion from terminal groin				
19	June, 1989	Dune Repair	Willoughby Beach	used 25,000 cy of accretion from terminal groin				
20	1989	Beach Nourishment	21st Bay St to East End Parking Lot (East Ocean View)	Beach Nourishment	133,000	3,000	44	Cape Henry Channel
21	1990	Breakwater Construction	Western end of Willoughby Spit-Lea View Ave.	2 near shore breakwaters				
22	1990	Terminal Groin Reconstruction	Western end of Willoughby Spit-Lea View Ave.	Original wooden groin raised and extended using rock				
23	1990	Beach Nourishment	Willoughby Spit-Near Terminal Groin	Beach Nourishment	100,000			West of Terminal Groin
24	1990-1991	Dune Stabilization/repair	Various Locations	dune vegetation planting,sand fence construction, elevated public access way, cross-over structures, and timber roads for vehicles				
25	1995	Beach Nourishment	Willoughby Spit	Beach Nourishment	240,000			15th View
26	December, 1995	Beach Nourishment	13th View St to 12 View St (in 4 groin pockets)	Beach Nourishment	4,000			15th View
27	December, 1995	Beach Nourishment	Critical Area 1: 8th View St to 7th View St	Beach Nourishment	30,000	1,000	30	15th View
28	March, 1997	Terminal Groin (trunk) Elevated	Willoughby Spit	terminal groin (trunk) elevated +4 ft				
29	Jan 1997- April 1997	Breakwater Construction	Critical Area 1: Worth St to 8th View	nearshore breakwaters 1-4 constructed				
30	December 1997 - March 1998	Breakwater Construction	Critical Area 1: Worth St to 8th View	nearshore breakwaters 5-7 constructed				
31	<b>October 1998 City Survey</b>		<b>Entire Ocean View Shoreline</b>					
32	December, 1998	Beach Nourishment	Critical Area 1: East of 8th View St-near site of future groin spur	Beach Nourishment	500	175	3	
33	<b>October 1999 City Survey</b>		<b>Entire Ocean View Shoreline</b>					
34	1999	Breakwater Construction	Critical Area 2: Just east of Community Beach	4 nearshore breakwaters constructed				
35	November-December 1999	Groin Spur Construction	Critical Area 1: Worth St to 8th View	groin spur construction				
36	December, 1999	Beach Nourishment	Center of COV breakwaters	Beach Nourishment	4,000			
37	December, 1999	Beach Nourishment	Critical Area 1: East of 8th View St-leeward of newly constructed groin spur	Beach Nourishment	1,000	200	5	15th View
38	<b>July 2000 City Survey</b>		<b>From Approx. 9th View St to Little Creek Inlet</b>					
39	August, 2000	Breakwater Construction	Critical Area 3: 21st Bay to Little Creek Inlet	nearshore breakwaters 2,3,4 constructed				
40	<b>October 2000 City Survey</b>		<b>From Approx. 12th View St to Little Creek Inlet</b>					
41	July, 2001	Beach Nourishment	Critical Area 1: Worth St to 8th View	Beach Nourishment	500			Truck Haul
42	September, 2001	Beach Nourishment	Critical Area 1: East of 8th View St-between breakwater 7 and groin spur	Beach Nourishment	2,000	300	7	15th View
43	<b>October 2001 City Survey</b>		<b>Entire Ocean View Shoreline</b>					
44	November, 2001	Breakwater Construction	Critical Area 3: 21st Bay to Little Creek Inlet	nearshore breakwaters 1,5,6,7 constructed				
45	March - April, 2002	Breakwater Work	Critical Area 1: breakwater 7	work on toe extensions				
46	May, 2002	Beach Nourishment	Critical Area 1: East of 8th View St-between breakwater 7 and groin spur	Beach Nourishment	3,438	300	11	15th View
47	June, 2002	Groin Removal	Critical Area 1: Worth St to 8th View	Removal of timber groin channalward of rock spur				
48	<b>July 2002 City Survey</b>		<b>Entire Ocean View Shoreline - excluding approx. Sherwood Pl. to Warwick Ave.</b>					
49	<b>October 2002 City Survey</b>		<b>Entire Ocean View Shoreline - minimal survey data (no beach or bathymetric survey points)</b>					
50	<b>March 2003 City Survey</b>		<b>East Ocean View Shoreline (19th Bay to Little Creek Inlet)</b>					
51	<b>April 2003 City Survey</b>		<b>East Ocean View Shoreline (17th Bay to Little Creek Inlet)</b>					
52	<b>June 2003 Waterway Survey</b>		<b>East Ocean View Shoreline (17th Bay to Little Creek Inlet)</b>					
53	September, 2003	Beach Nourishment	Critical Area 1: West of 8th View St beach access	Beach Nourishment	1,100	350	3	15th View

No	Date	Project Type	Location	Description	Vol (cy)	Extent (ft)	Unit Vol (cy/ft)	Sand Source
54	<b>October 2003 Waterway Survey</b>		<b>Post-Isabel Survey - East Ocean View Shoreline (17th Bay to Little Creek Inlet)</b>					
55	October, 2003	Beach Nourishment	Critical Area 3: 19th Bay St	Beach Nourishment	6,000	545	11	upland sand trucked in
56	October, 2003	Beach Nourishment	Critical Area 3: East of 30th Bay St	Beach Nourishment	1,000	150	7	upland sand trucked in
57	December, 2003	Beach Nourishment	Critical Area 3: 17th Bay St to Little Creek Inlet	Beach Nourishment	359,000	5,280	68	Thimble Shoal Channel
58	December, 2003	Beach Nourishment	Critical Area 1: 9th View St to 7th View St (+400 ft)	Beach Nourishment	39,800	1,260	32	
59	<b>Nov-Dec 2003 Post-Fill Survey</b>		<b>East OceanView Shoreline (17th Bay to Little Inlet Creek)</b>					
60	<b>Feb-April, 2004 Waterway Survey</b>		<b>From Approx. Willoughby Spit to 17th Bay St</b>					
61	August, 2004	Beach Nourishment	13th View to 11th View, Behind Western 4 Breakwaters at 800 Block, 1200' East of dogleg	Beach Nourishment	37,000	4,950	7	Truck Haul
62	January-March, 2005	Dune Restoration	Willoughby Spit to Central Ocean View (14th View St to Warwick Ave)	Willoughby Spit to Central Ocean View Dune Restoration Project	504,329	18,300	28	Thimble Shoal Channel
63	<b>January-March 2005 Post-Fill Survey</b>		<b>Willoughby Spit to Warwick Ave.</b>					
64	<b>September 2005 McKim &amp; Creed Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
65	January-February, 2006	Groin Spur & Toe Extension Removal	Critical Area 1: East of 8th View	groin spur removal				
66	January-February, 2006	Breakwater Construction	Critical Area 1: East of 8th View	nearshore breakwater 8 constructed				
67	January-February, 2006	Breakwater Construction	Critical Area 3: 29th Bay to Little Creek Inlet	nearshore breakwaters 8, 9, & 10 constructed				
68	<b>March 2006 McKim &amp; Creed Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
69	<b>October 2006 McKim &amp; Creed Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
70	<b>March 2007 McKim &amp; Creed Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
71	<b>October 2007 McKim &amp; Creed Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
72	<b>March 2008 McKim &amp; Creed Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
73	<b>October 2008 McKim &amp; Creed Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
74	March, 2009	Beach Nourishment	East Ocean View and Bay Oaks	Beach Nourishment	196,000			
75	<b>April 2009 McKim &amp; Creed Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
76	August-October, 2009	Breakwater Construction	Bay Oaks	5 Nearshore Breakwaters Constructed				
77	<b>October 2009 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
78	<b>November-December 2009 Post-Storm Survey</b>		<b>Entire Ocean View Shoreline</b>					
79	<b>March 2010 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
80	April, 2010	Dune Restoration	Willoughby Spit and 800 Block	Dune restoration using sediment from terminal groin and 800 block breakwaters				
81	<b>October 2010 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
82	<b>April 2011 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
83	<b>October 2011 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
84	<b>March 2012 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
85	<b>October 2012 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
86	January-May, 2013	Breakwater Construction	Willoughby Spit	7 Nearshore Breakwaters Constructed				
87	January-May, 2013	Dune Restoration/Beach Nourishment	Willoughby Spit	Dune Restoration at Lea View Ave and Beach Nourishment from 11th View to 13th View	35,000			Willoughby Spit / Truck Haul
87	January-May, 2013	Breakwater Relocation	800 Block	Breakwater 7 moved further offshore				
88	<b>April 2013 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
89	May-October, 2013	Timber Groin Removal	West Ocean View	7 Timber Groins removed east of the Pier				
90	October, 2013	Rock Groin Construction	West Ocean View	Rock Groin Constructed between Sarah Constant Shrine Park and the 200 Block				
91	<b>October 2013 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
92	November 2013	Beach Nourishment	West Ocean View	Beach Nourishment	73,600			Truck Haul
93	<b>March 2014 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
94	<b>October 2014 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
95	<b>April 2015 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
96	<b>October 2015 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
97	January-February 2016	Beach Nourishment	Toler Place (between 11th View and 12th View Streets)	Emergency nourishemnt placed above MHW	16,400			Willoughby Spit
98	February 2016	Beach Nourishment	Adjacent to Terminal Groin	Emergency nourishemnt placed above MHW	1,500			Truck Haul Upland Source
99	<b>May 2016 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
100	<b>October 2016 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					
101	<b>February 2017 Federal Project Ore-Construction Survey (by GLDD)</b>		<b>Entire Ocean View Shoreline</b>					
102	March-May 2017	Beach Nourishment	14th View Street to Warwick Avenue, and 1st Bay Street to Little Creek Inlet	Initial Construction of the Federal Project by USACE	1,200,358		variable	Thimble Shoal Aux. Channel
103	<b>May 2017 Federal Project Post-Construction Survey (by GLDD)</b>		<b>Entire Ocean View Shoreline</b>					
104	<b>May 2017 Geodynamics Periodic Survey</b>		<b>Entire Ocean View Shoreline</b>					

**REFERENCE\***

Critical area 1: Worth St to 8th View
Critical area 2: Chesapeake Blvd. to Atlans St.
Critical area 3: 21st Bay to Little Creek Inlet

\*Critical areas of concern for erosional damage defined in

Andrews, Miller & Assoc., Inc. "Beach Management Plan, City of Norfolk Virginia", January, 1993.

