PERIODIC SURVEY EVALUATION:
OCEAN VIEW BEACH

City of Norfolk, Virginia | Spring 2016 | PN: 7970-33

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Periodic Survey Evaluation: Ocean View Beach Spring 2016

Presented to:

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1. Executive Summary

The twenty-second consecutive twice-yearly survey of the Ocean View shoreline was conducted on May 9-12, 2016. 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 collected bi-annually in March/April and September/October to monitor the condition of the shoreline and the state of existing shore protection projects. 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. April 2015 to May 2016) eliminates seasonal variation of profiles in volumetric change analyses. Consecutive survey comparisons 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 2016 survey data with previous surveys taken in April 2015 (spring to spring comparison) and October 2015 (most recent periodic survey comparison) in the Ocean View Beach area between Willoughby Spit and Little Creek Inlet.

Comparison	Parameter	Quantity
April 2015 vs. May 2016	Average Shoreline Change Rate at MHW (+0.98 ft NAVD88)	-4.45 ft/yr
	Cumulative Volume Change Rate Above 0 ft NAVD88	-14,562 cy/yr
	Cumulative Volume Change Rate Above -15 ft NAVD88	-32,871 cy/yr
October 2015 vs. May 2016	Average Shoreline Change at MHW (+0.98 ft NAVD88)	-0.72 ft
	Cumulative Volume Change Above 0 ft NAVD88	80,280 cy
	Cumulative Volume Change Above -15 ft NAVD88	23,610 cy

The Ocean View region experienced an overall loss in material above 0 feet NAVD88 and above -15 feet NAVD88 over the past year (April 2015 to May 2016). The average MHW shoreline change over the past year shows an erosional trend. Over the most recent survey period (October 2015 to May 2016), there was also overall slight erosion of the average MHW shoreline. The Ocean View shoreline experienced a gain in material above 0 feet NAVD88 and above -15 feet NAVD88 during this period. The surveyed shoreline reaches were affected by several storms and experienced dune and subaerial beach erosion. It is important to note that the October 2015 survey was obtained two days after the October 2-6 storm dissipated, so that the survey reflects the conditions of the subaerial beach with little or no post-storm recovery; shoreline and volume changes between October 2015 and May 2016 would be expected to include some post-storm recovery from the October 2015 recently-impacted condition.

While the Ocean View system showed overall volume loss for the past year, there was variability within the defined shoreline regions. The Willoughby Spit region overall experienced slight erosion of the MHW shoreline and volumetric gains above 0 feet NAVD88 and -15 feet NAVD88 over the past year. There was an emergency nourishment project that placed sand in the dune and berm system in the vicinity of 11th View Street and Toler Place to help with the erosion that is occurring in this specific location.

In the 800 Block region, there has been erosion of the MHW shoreline, with volumetric loss above 0 feet NAVD88 and above -15 feet NAVD88 over the year due to the high wave climate during the previous monitoring period. Between October 2015 and May 2016 there has been accretion of the MHW shoreline and volumetric gains above 0 feet NAVD88 and above -15 feet NAVD88.

The reconstructed groin in West Ocean View has performed well over the past year. Even though the yearly analysis shows overall volumetric loss above both 0 feet NAVD88 and -15 feet NAVD88 as well as erosion of the MHW shoreline, there has been a gain in material above 0 feet NAVD88 and accretion of the MHW shoreline over the current survey period.

The Central Ocean View Breakwaters has remained fairly stable over the past year. This region experienced accretion of the MHW shoreline, with volumetric gain above 0 feet NAVD88 and -15 feet NAVD88 over the past year and the current survey period.

Typically a very stable region, Central Ocean View has experienced erosion of the MHW shoreline over the past year. However, there has been negligible volume change above 0 feet NAVD88 and volume gain above -15 feet NAVD88 in the past year. Over the current survey period, this region experienced shoreline retreat and a large volume gain above 0 feet NAVD88.

There has been erosion of the MHW shoreline along with volumetric losses 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 erosion of the MHW shoreline and volumetric gains above 0 feet NAVD88 and -15 feet NAVD88. The Bay Oaks breakwaters are continuing to perform well, trapping sediment and eliminating the hotspot at this location. The east end of the region, adjacent to the jetty, is more erosive than most areas west in this region due to the lack of a sediment source; therefore, this was the target of the sediment placement.

In addition to regional assessments, comparison of the May 2016 survey was made against post-fill surveys from the East Ocean View beach nourishment, Willoughby Spit to Central Ocean View dune restoration, and the West Ocean View Shoreline Improvement Project which took place in March 2009, January-March 2005, and October 2013 respectively.

Comparison	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
East Ocean View Nourishment vs. May 2016 Comparison	-106.65 ft	-19.85 cy/ft	-103,787 cy	-35.89 cy/ft	-187,482 cy
Central Ocean View Nourishment vs. May 2016 Comparison	-29.93 ft	-10.30 cy/ft	-189,582 cy	-7.32 cy/ft	-127,477 cy
West Ocean View Pre-Nourishment vs May 2016 Comparison	5.26 ft	2.20 cy/ft	10,758 cy	3.87 cy/ft	18,914 cy

Since the East Ocean View Nourishment project in 2009, 92% of the placed material above 0 feet NAVD88 has been lost. Since the Central Ocean View Nourishment project in 2005, 59% of the placed material above 0 feet NAVD88 has been lost. The Willoughby Spit Shoreline Improvement Project has alleviated a majority of the areas of concern in that reach; however, the eastern end of the reach

has been experiencing higher rates of erosion. This will continue to be monitored and studied in the near future. The West Ocean View Shoreline Improvement Project completed in 2013 has mitigated erosion in the hotspot between the 200 Block and Sarah Constant Shrine Park. The remaining volume for the 2013 West Ocean View project is approximately 18,900 cy out of the 73,600 cy placed, so that 26% of the original fill volume remained at the time of the May 2016 survey.

It is expected that the upcoming federal coastal storm damage reduction project will provide all of the Ocean View reaches (directly, or indirectly in the case of the Cottage Line area of Central Ocean View) with significant additional beach profile volume over the next one to two years. It is also expected that this bi-annual monitoring program will continue post-construction of the federal project, allowing the City and the federal agencies involved to track the evolution of the federal project over time and to respond to future storm impacts.

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 2016 survey data with previous surveys taken in April 2015 (spring to spring comparison) and October 2015 (most recent periodic survey comparison) in the Ocean View Beach area between Willoughby Spit and Little Creek Inlet. In addition, comparison of the most recent survey (May 2016) was made to: post-fill surveys from the Central Ocean View beach nourishment project that took place in January-March 2005; the most recent East Ocean View beach nourishment project which took place in March 2009; and the post-fill conditions of the 2013 West Ocean View nourishment project.

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

3. Data Sources

Geodynamics, LLC, conducted the most recent survey of Ocean View Beach on May 9-12, 2016. 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 ±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.

In late April 2016, 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 April 2016 aerial photos with the digitized shoreline positions from May 2016, October 2015, and April 2015 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 East Ocean View beach nourishment, collected in March 2009, were used as baseline data for assessing the current state of that nourishment project. Similarly, post-fill survey data from the Willoughby Spit dune restoration (February 2005), Central Ocean View dune restoration project (March 2005), and West Ocean View nourishment project (sand fill completed in November 2013) were utilized to assess the present state of those project areas. Post-fill data were available in xyz format from previous studies of these projects by Moffatt & Nichol.

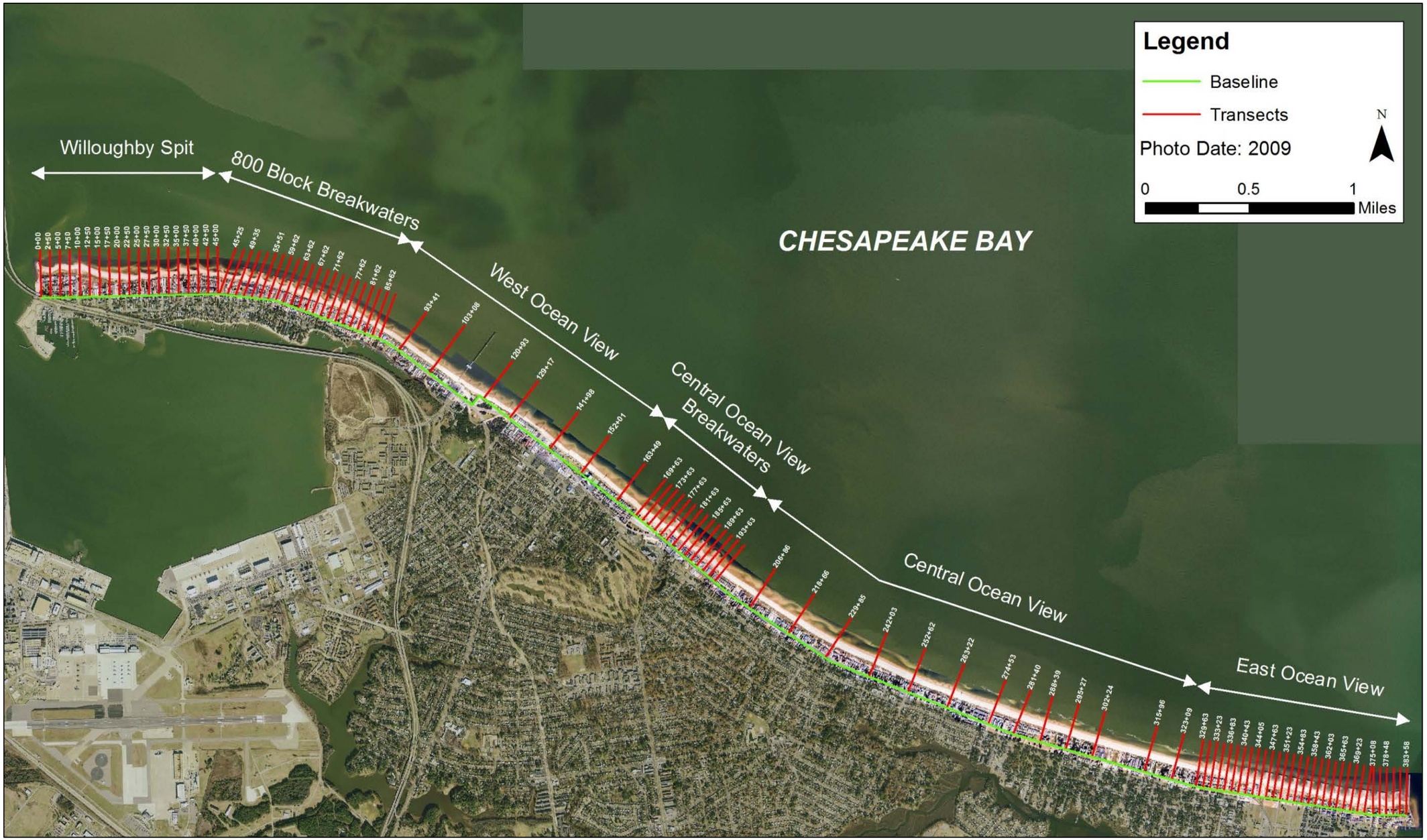

Figure 3-1: Survey Baseline and Transects

4. Methods

Survey comparisons and respective analysis were performed using a combination of Autodesk Civil 3D 2014 (Civil 3D), Microsoft Excel, Golden Software Surfer, and the USACE's Beach Morphology Analysis Package (BMAP). Civil 3D is an AutoCAD based program which allows the user to create and analyze Digital Terrain Models (DTMs). 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.

All pertinent survey data were imported into Civil 3D in xyz format. The horizontal coordinate system used was Virginia South State Plane NAD 1983 (HARN), US Survey feet with a vertical datum of NAVD88. DTMs were created for each set of survey data, and a beach profile was extracted at each survey transect in station-elevation format. Individual profile plates showing the extracted profile at each transect for each date are presented in Appendix B. From the profiles, shoreline change and volumetric change were then calculated at each transect for the following time periods:

1. April 2015 to May 2016 (Entire Shoreline)
2. October 2015 to May 2016 (Entire Shoreline)
3. March 2009 (East Ocean View post-fill) to May 2016 (Sta 329+63 through Sta 383+58)
4. March 2005 (Central Ocean View post-fill) to May 2016 (Sta 15+00 through Sta 195+63)
5. December 2004-February 2005 (Central Ocean View pre-fill) to May 2016 (Sta 15+00 through Sta 195+63)
6. June 2003 (East Ocean View pre-fill) to May 2016 (Sta 329+63 through Sta 383+58)
7. October 2013 (West Ocean View post-fill) to May 2016 (Sta 103+08 through Sta 152+01)

First, the change in shoreline based on the profiles extracted from Civil 3D 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 change above -15 feet NAVD88 and volume change 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 the 2009 East Ocean View and 2005 Central Ocean View nourishment projects. 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 (April 2015, October 2015, and May 2016) 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.

The pre-fill and post-fill surveys taken for the East Ocean View and Central Ocean View nourishment projects did not use the same baseline and transects or cover the same extents as the periodic surveys. Therefore, the profiles extracted from the DTMs in Civil 3D at the periodic surveying transects are interpolations between the actual pre- and post-fill data points. In addition, the pre- and post-construction surveys for the historical nourishment projects did not extend as far offshore as the regular periodic surveys, and this limits the extent of the computations and the ability to track the offshore movement of sand.

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 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 February 21, 2015.

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

- The average significant wave height and peak period over this measurement period was approximately 1.4 feet and 5.1 seconds.
- Waves approached 75% of the time from northeast to southeast, 20% of the time from north to northeast, and 2% of the time from northwest to north.

- The largest significant wave height observed during this deployment was approximately 7.6 feet with a corresponding peak period of approximately 5.6 seconds and mean direction of 44 degrees (January 23, 2016).

The overall wave climate was typical during this period. There were 19 events that occurred during the survey period for which the significant wave height at the wave gauge exceeded 3.3 feet (1.0 meter); however, the duration of some of these storms was shorter and often occurred back to back. These events are shown in Figure 5-1 through Figure 5-11.

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 nineteen 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	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16
Average Significant Wave Height, H_s (ft)	1.94	1.33	1.04	1.62	1.48	1.26	1.56	1.24
Average Wave Period, T_m (s)	2.93	2.89	2.84	2.65	2.66	2.60	2.70	2.63
Average Peak Wave Period, T_p (s)	5.34	5.27	5.32	5.81	4.88	4.95	4.73	5.52
Maximum Observed Significant Wave Height, H_s (ft)	6.53	4.00	4.07	7.64	4.49	5.22	5.28	2.82
Maximum Observed Wave Height, H_{max} (ft)	11.78	6.79	6.99	12.14	7.22	7.84	9.84	4.72

*May wave statistics include May 1st – May 9th

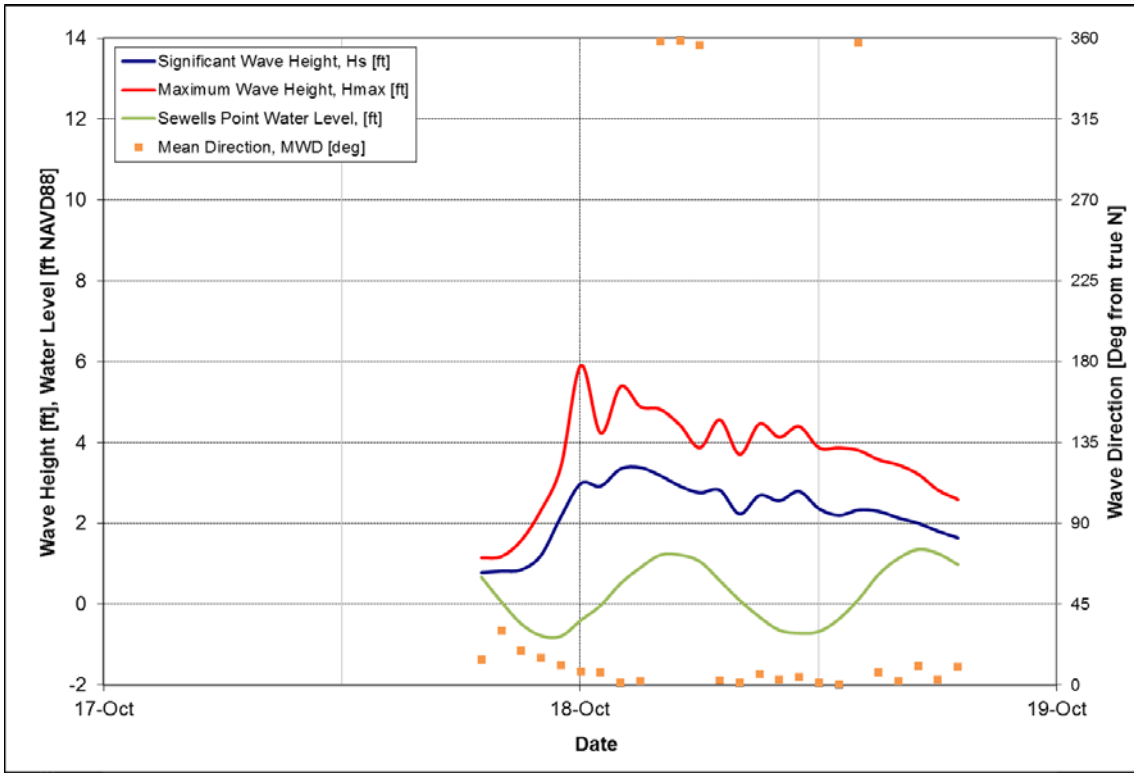

Figure 5-1: October 18, 2015 Storm

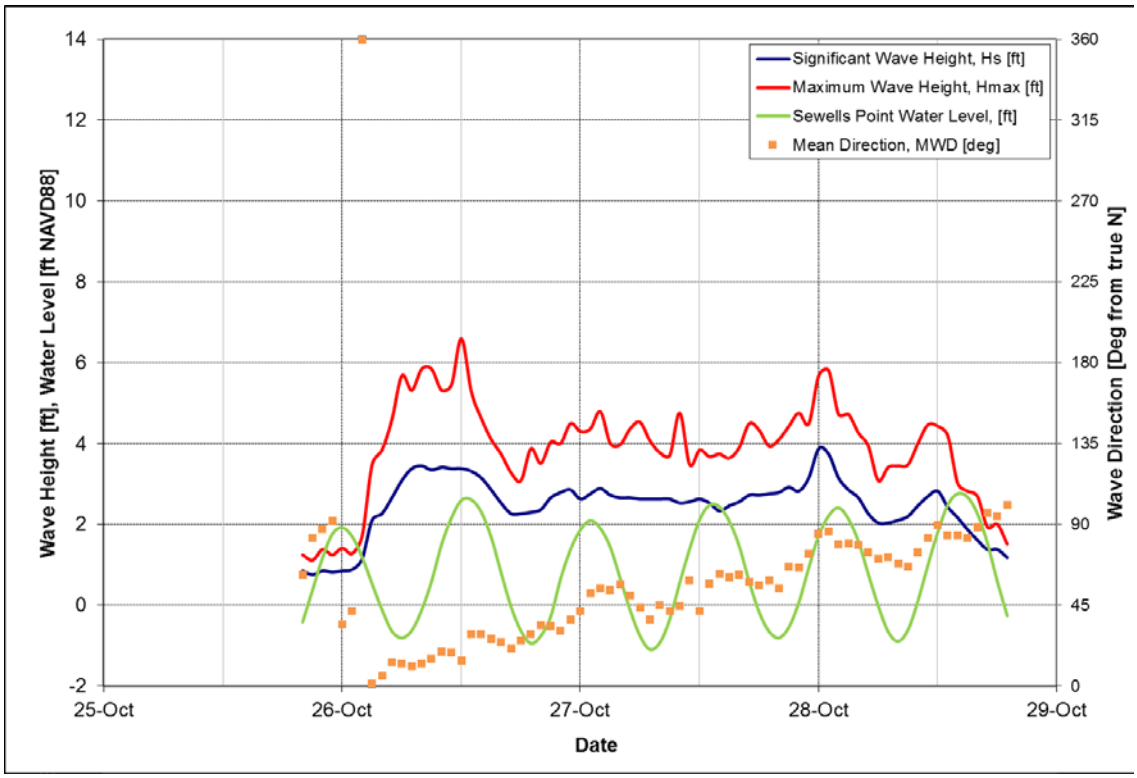

Figure 5-2: October 28, 2015 Storm

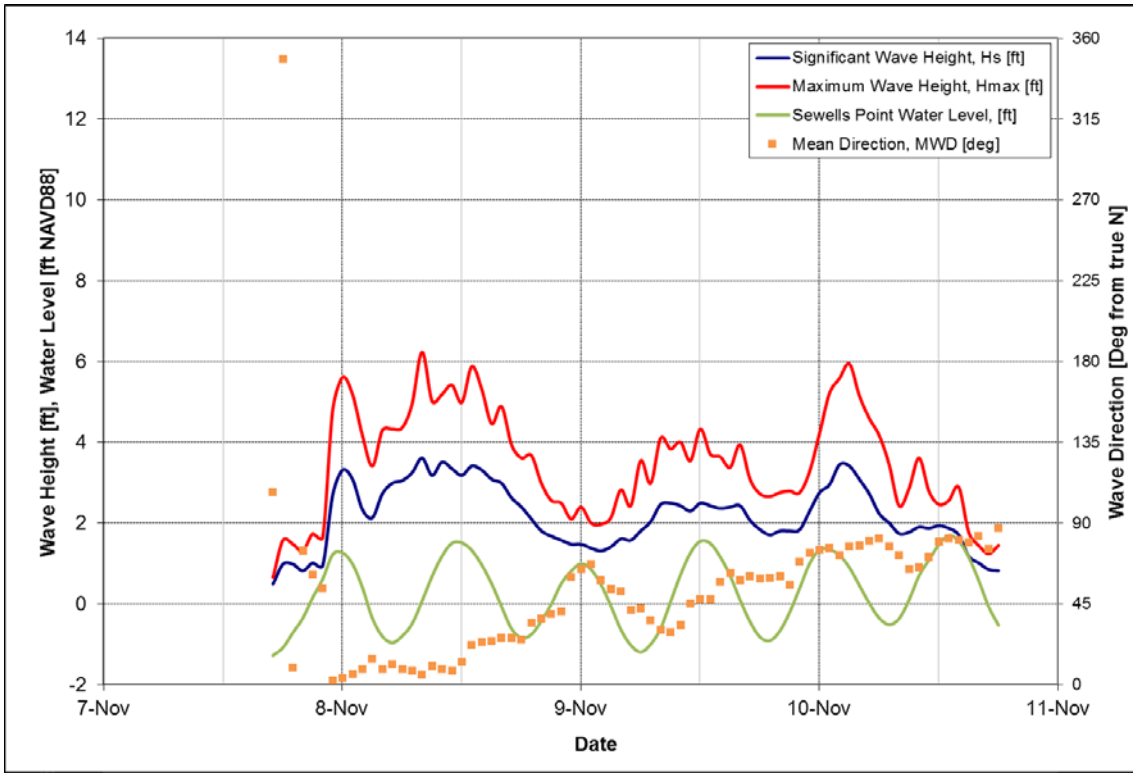

Figure 5-3: November 10, 2015 Storm

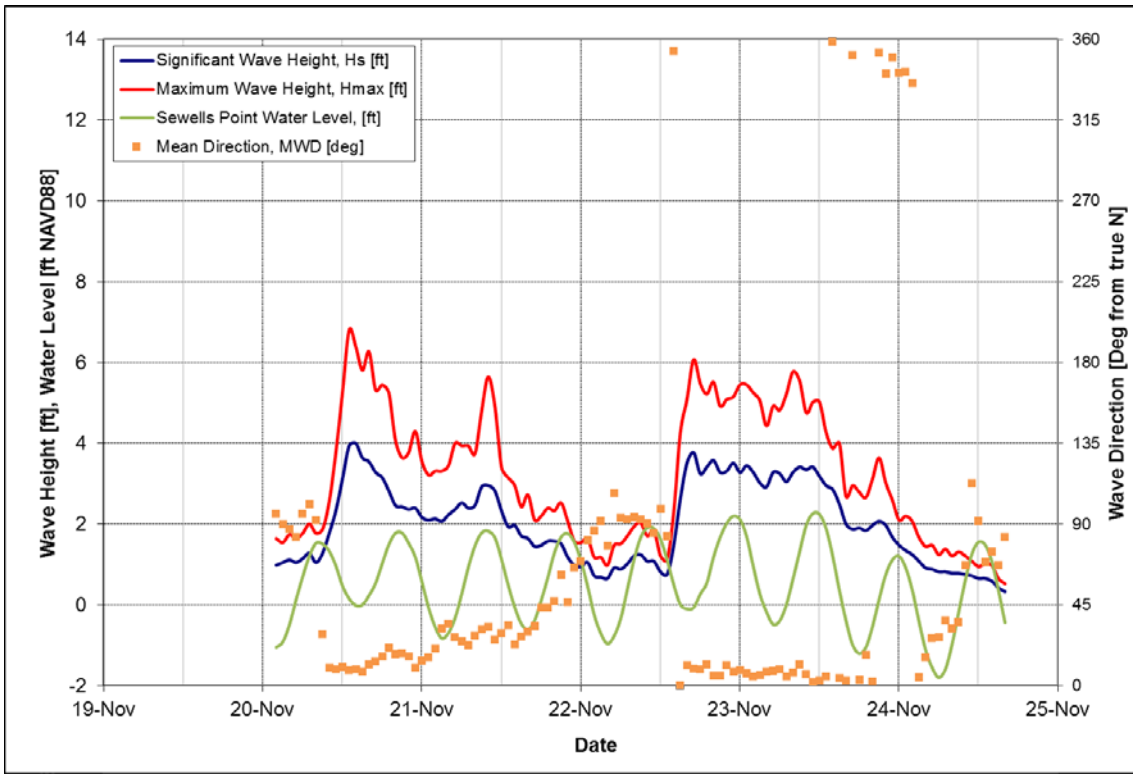

Figure 5-4: November 20, 2015 Storm

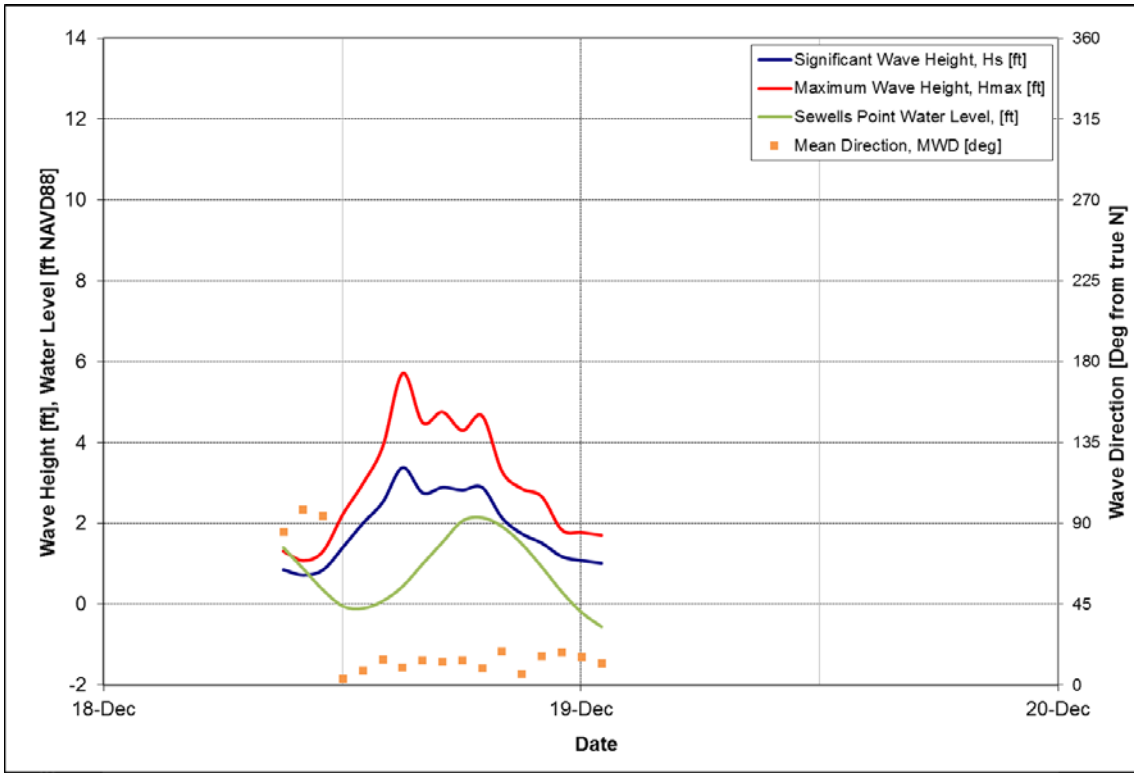

Figure 5-5: December 18, 2015 Storm

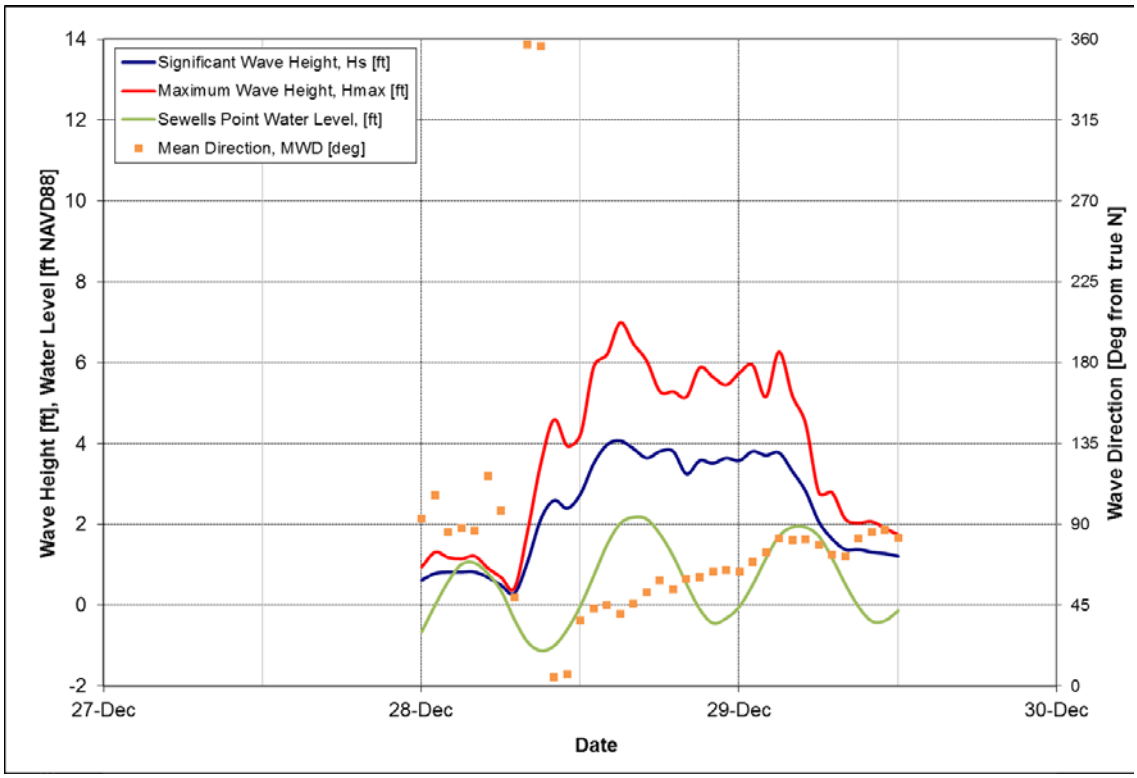

Figure 5-6: December 28, 2015 Storm

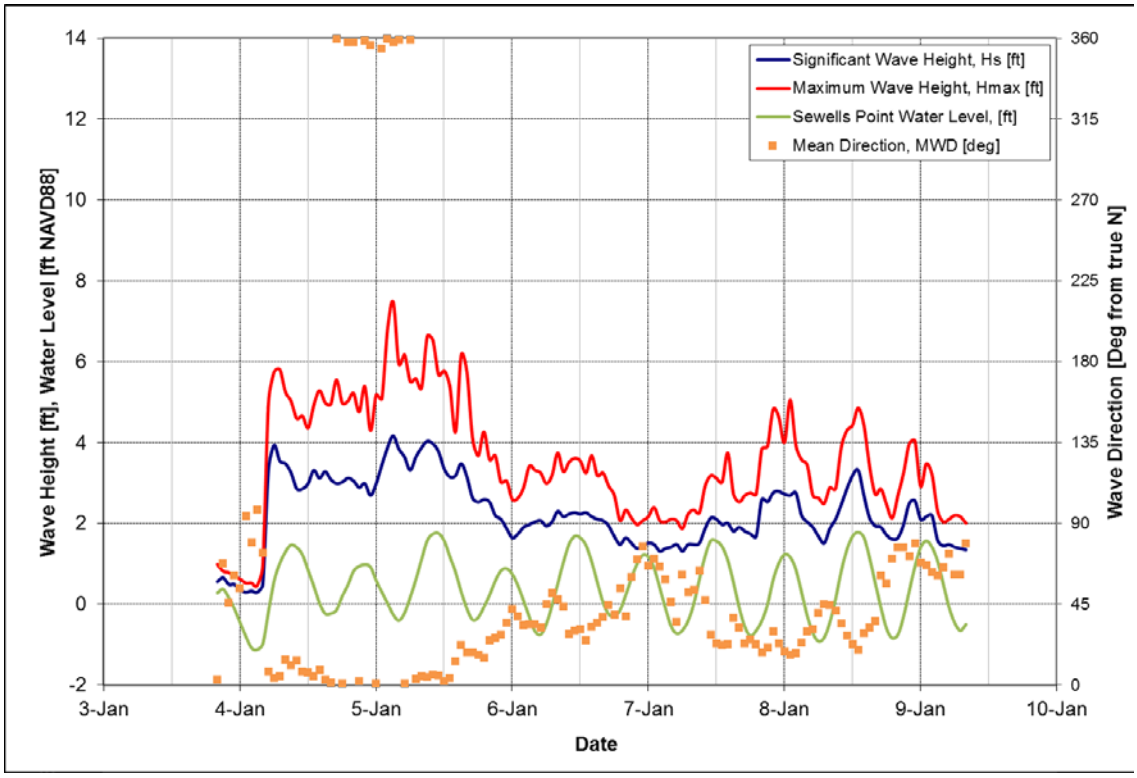

Figure 5-7: January 5, 2016 Storm and January 8, 2016 Storm

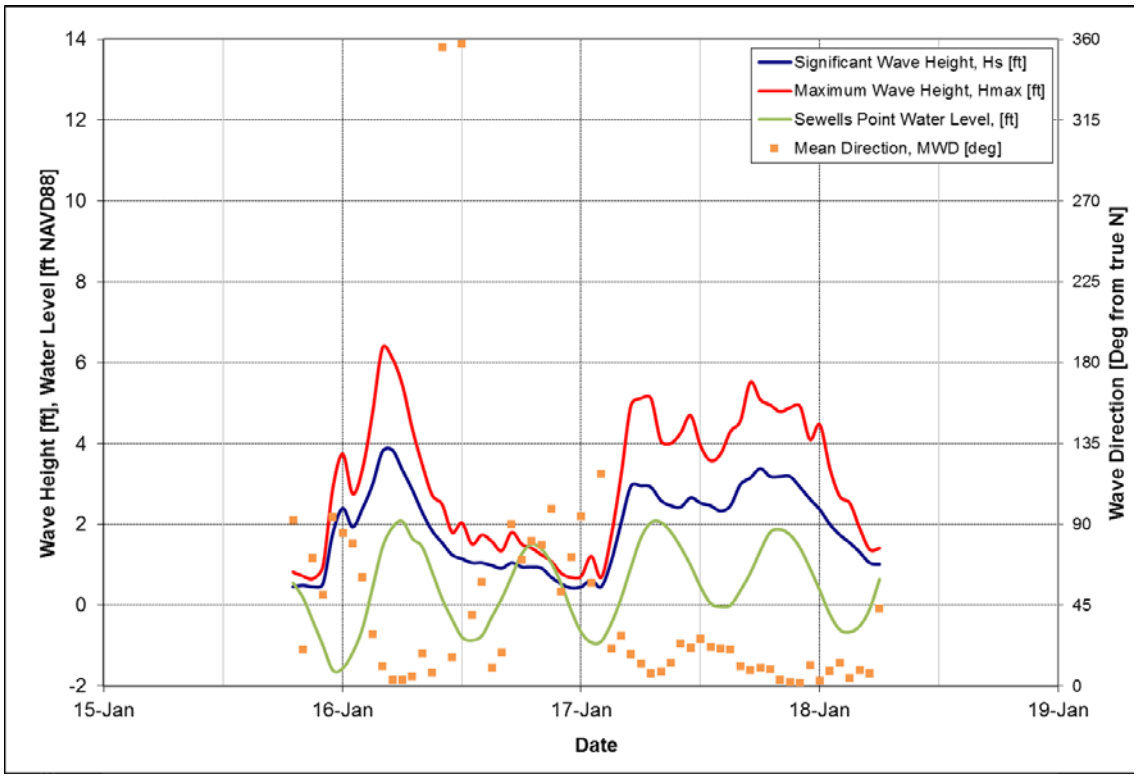

Figure 5-8: January 16, 2016 Storm and January 17, 2016 Storm

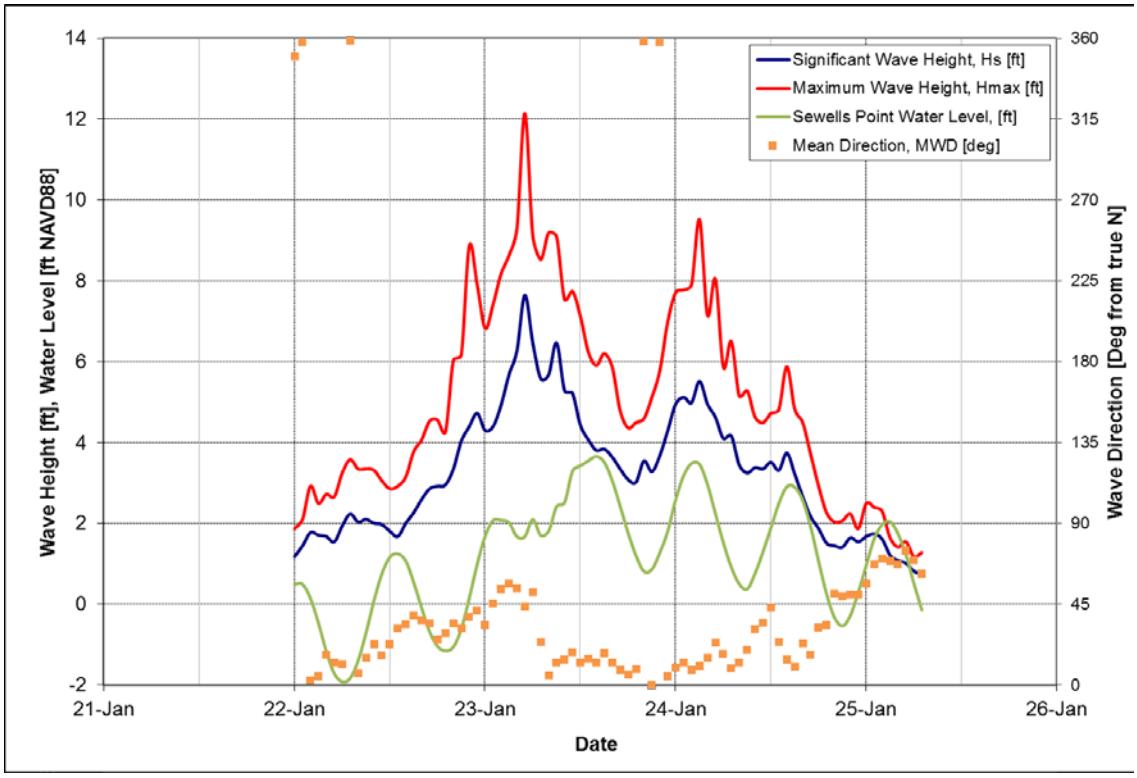

Figure 5-9: January 23, 2016 Storm

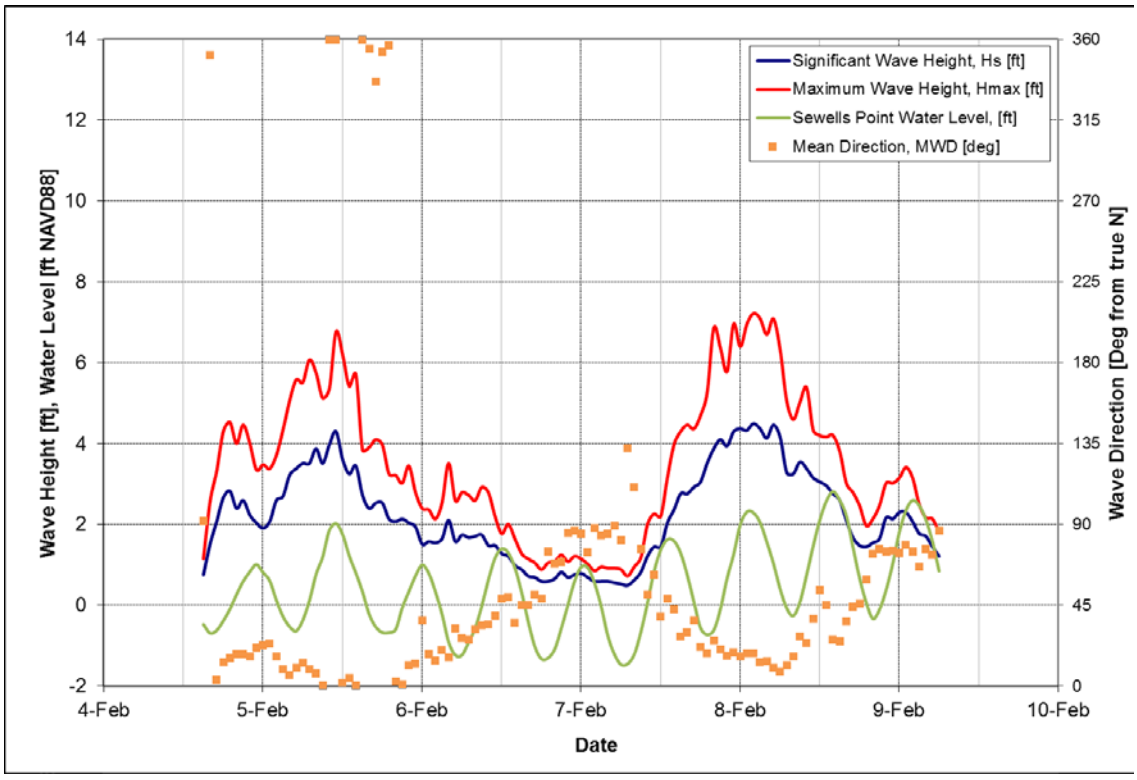

Figure 5-10: February 5, 2016 Storm and February 8, 2016 Storm

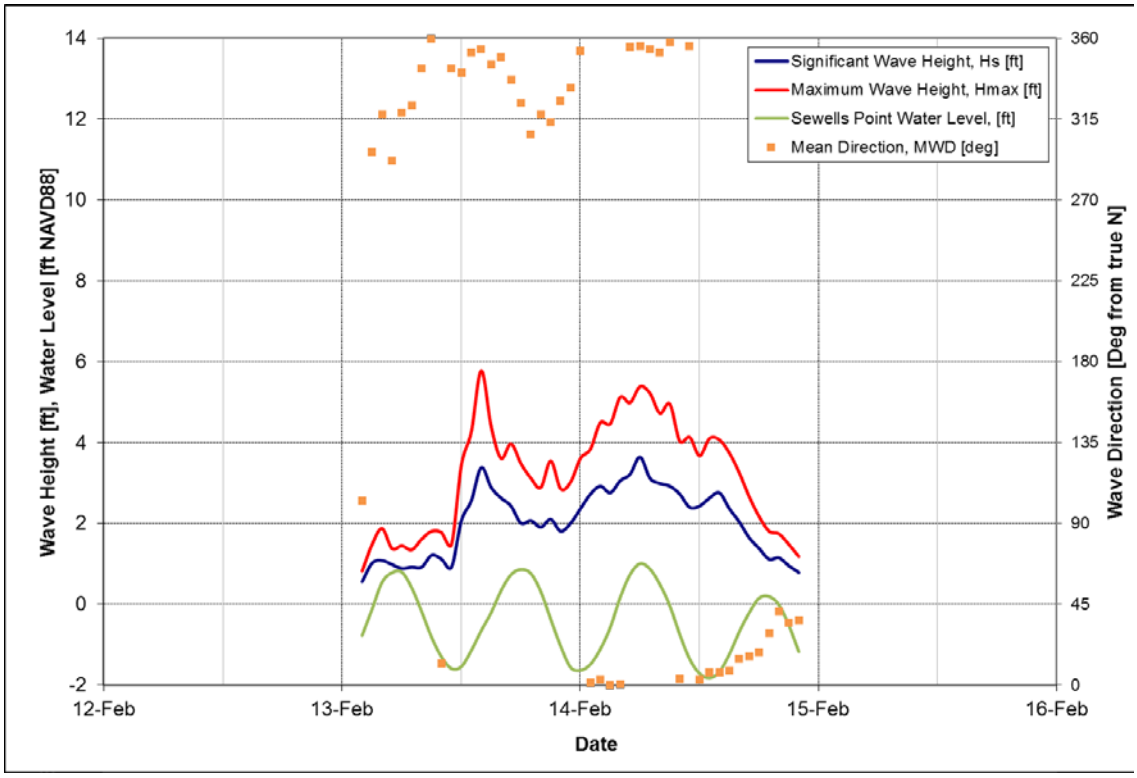

Figure 5-11: February 14, 2016 Storm

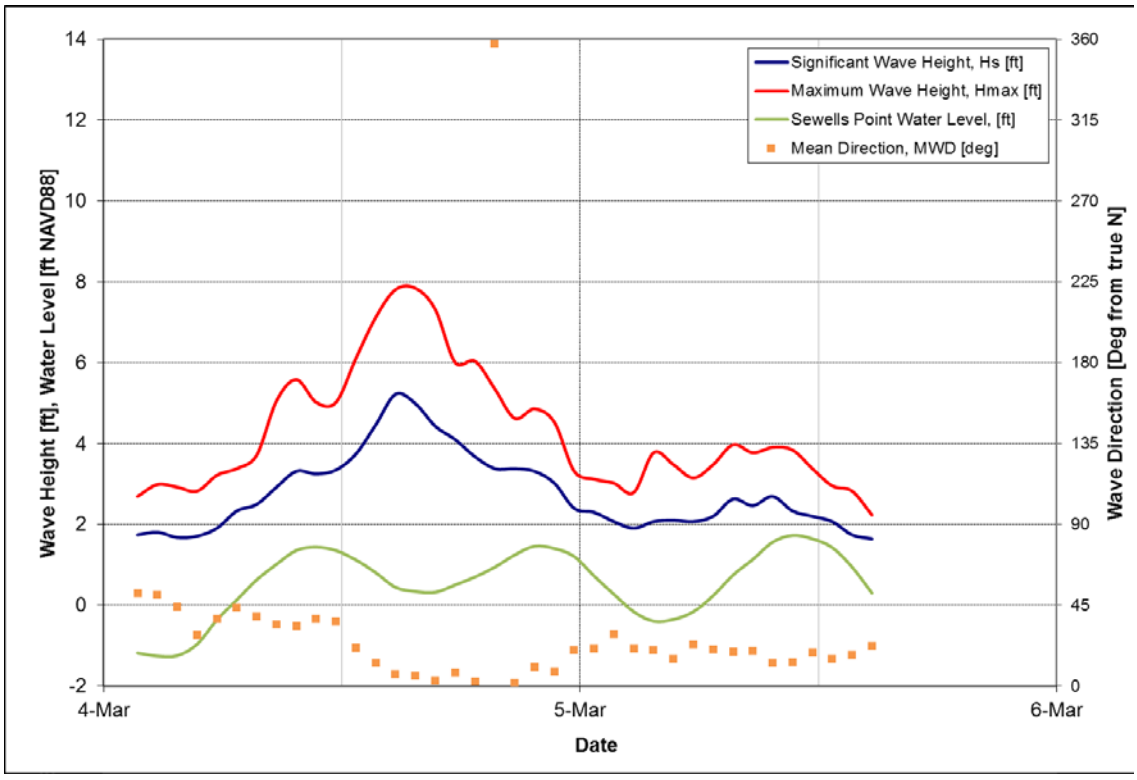

Figure 5-12: March 4, 2016 Storm

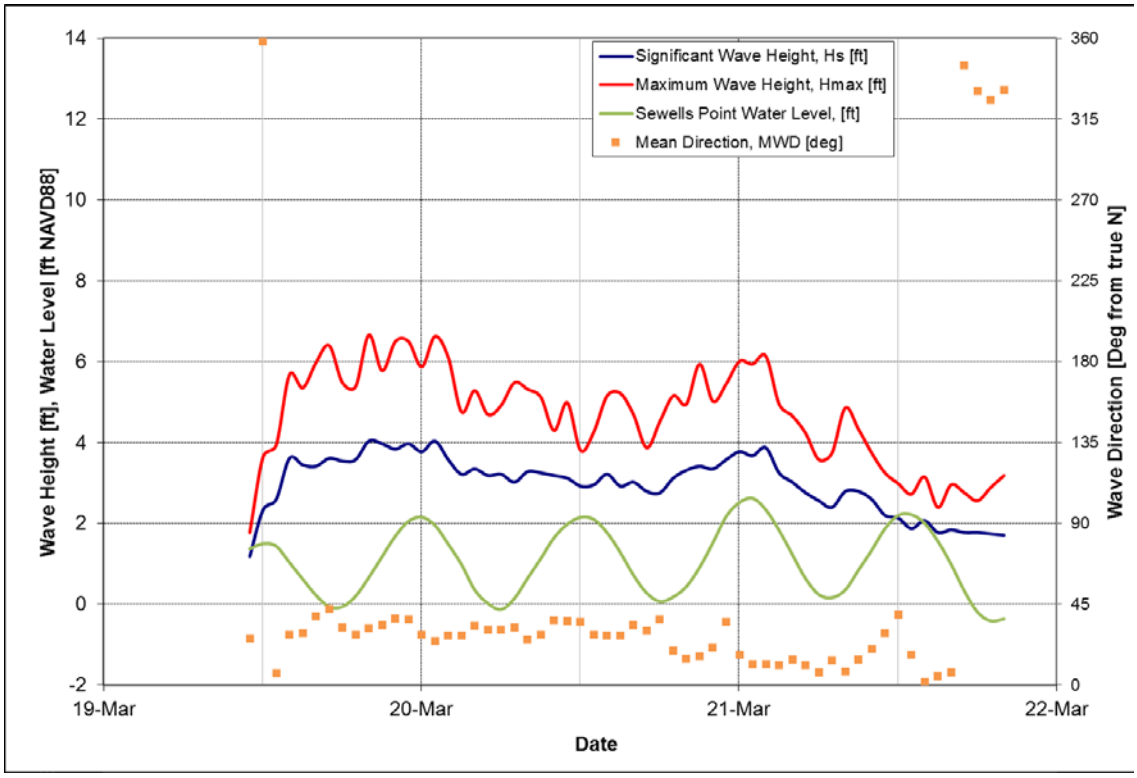

Figure 5-13: March 20, 2016 Storm

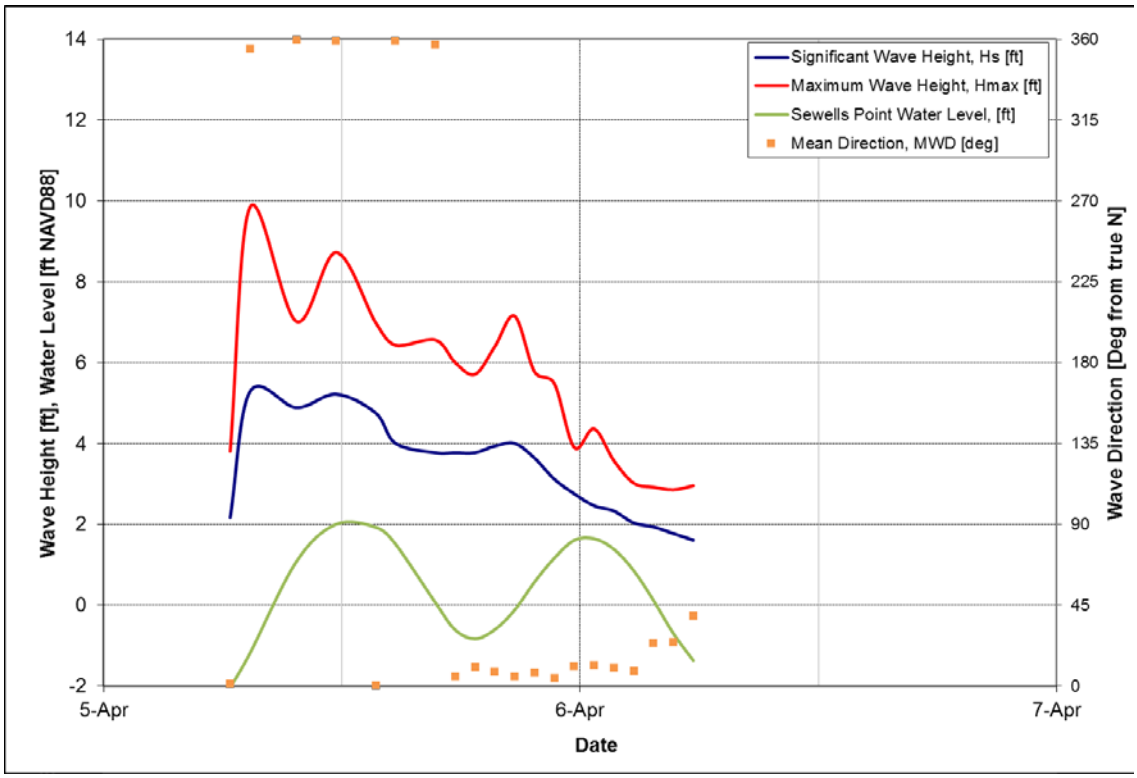

Figure 5-14: April 5, 2016 Storm

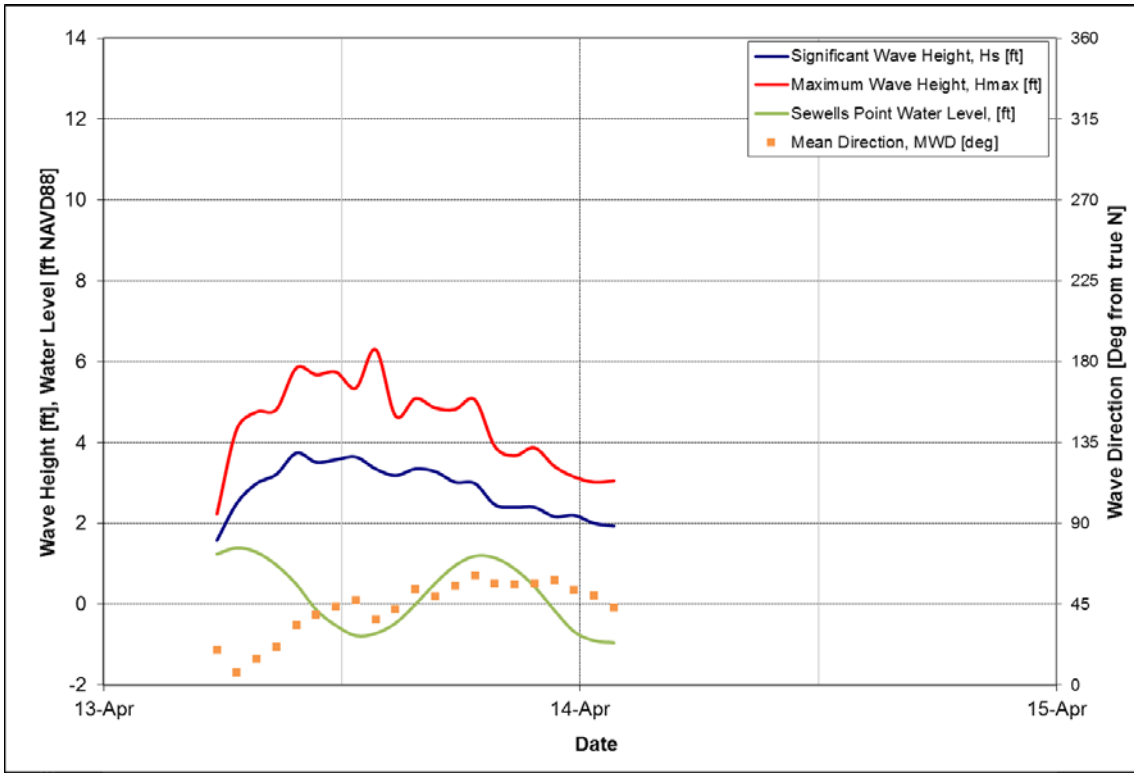

Figure 5-15: April 13, 2016 Storm

5.2.2. Engineering Activities

Two new emergency placement activities took place along the Ocean View Shoreline over the most recent monitoring period (October 2015 – May 2016). The first occurred between stations 35+00 and 49+35 in the Willoughby Spit and 800 Block Breakwaters reaches. Material was taken from the berm between stations 10+00 and 17+50. The second placement occurred in the East Ocean View reach between stations 380+18 and 383+58. Material for this placement was truck-hauled from an upland source outside of Norfolk. The effects of these events will be discussed in Section 5.4.

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 April 2015 to May 2016 comparison are presented in Table 5-2. A summary of the resulting statistics for the April 2015 to May 2016 comparison are presented in Table 5-3.

As illustrated in Table 5-2, the Ocean View shoreline has experienced overall erosion at MHW over the past year with a length-weighted average change rate of -4.45 ft/yr. The beach and dune above 0 feet and -15 feet NAVD88 lost sediment at a rate of 14,562 cy/yr and 32,871 cy/yr, respectively, over

the past year. From October 2015 to May 2016, the MHW shoreline retreated on average by -0.72 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 80,280 cy and 23,610 cy, respectively.

The Ocean View shoreline overall gained 23,610 cy above -15 feet NAVD88 between October 2015 and May 2016, though it had a net 32,871 cy loss of sand volume above -15 feet NAVD88 over the year between April 2015 and May 2016. 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 (April 2015 to May 2016)

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)	-1.75	0.80	3,593	2.17	9,796
800 Block Breakwaters (45+25 to 87+62)	-7.73	-2.40	-10,899	-3.90	-17,699
West Ocean View (93+41 to 163+49)	-4.88	-0.59	-3,553	-2.85	-17,995
Central Ocean View Breakwaters (169+63 to 195+63)	-0.90	1.23	4,273	0.95	3,295
Central Ocean View (206+86 to 323+09)	-6.06	0.00	-23	0.20	2,511
East Ocean View (329+63 to 383+58)	-2.07	-1.39	-7,952	-2.23	-12,778
OVERALL	Weighted Avg (ft/yr)	Weighted Avg (cy/ft/yr)	Total (cy/yr)	Weighted Avg (cy/ft/yr)	Total (cy/yr)
	-4.45	-0.40	-14,562	-0.95	-32,871

Table 5-3: Regional Shoreline and Volume Change Statistics (October 2015 to May 2016)

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)	-0.62	1.84	8,292	0.99	4,449
800 Block Breakwaters (45+25 to 87+62)	1.97	1.07	4,848	0.99	4,474
West Ocean View (93+41 to 163+49)	4.27	0.81	6,188	-0.80	-6,086
Central Ocean View Breakwaters (169+63 to 195+63)	6.50	1.96	6,782	1.53	5,315
Central Ocean View (206+86 to 323+09)	-2.87	3.34	41,735	0.88	11,063
East Ocean View (329+63 to 383+58)	-9.23	2.17	12,434	0.77	4,396
OVERALL	Weighted Avg (ft)	Weighted Avg (cy/ft)	Total (cy)	Weighted Avg (cy/ft)	Total (cy)
	-0.72	2.09	80,280	0.62	23,610

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 5-16 through Figure 5-19, 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 Willoughby Spit region (Sta 0+00 to Sta 45+00) has, since regular monitoring started in 2005, been a relatively stable and accreting region. 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 April 2015 and May 2016 and between October 2015 and May 2016 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
April 2015 vs. May 2016 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Willoughby Spit (0+00 to 45+00)	-1.75	0.80	3,593	2.17	9,796
October 2015 vs. May 2016 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Willoughby Spit (0+00 to 45+00)	-0.62	1.84	8,292	0.99	4,449

On average, this region gained volume in both the dune and subaerial beach and in the submerged profile over the seasonal comparison (October 2015 - May 2016) and the yearly comparison (April 2014 - May 2016). For the yearly comparison, the MHW shoreline eroded at a rate of -1.75 ft/yr while gaining volume above 0 feet and -15 feet NAVD88 at a rate of 3,593 cy/yr and 9,796 cy/yr, respectively. The seasonal comparison showed slight erosion of the MHW shoreline of -0.62 feet on average and a cumulative sediment gain above 0 feet and -15 feet NAVD88 of 8,292 cy and 4,449 cy, respectively. The observed volume gain includes volume added in January and February 2016 as the City constructed an emergency beach nourishment project to restore a buffer against storms. The localized gain in sediment experienced in this reach was primarily due to this project in the vicinity of Toler Place (between 11th View and 12th View Streets). The total amount of sediment placed in this reach was 16,400 cy, and it was obtained from the beach berm along the western end of Willoughby Spit. The profile dips within the western end of this reach shown in Figure 5-19 indicate the location of the borrow area within this reach. All material taken from the borrow area was placed above the MHW line, which accounts for the larger volumetric gain above 0 feet NAVD88 as noted in Table 5-4. This area will continue to be monitored closely in the future. The breakwaters that were part of the 2013 shoreline improvement project that connected the existing breakwaters to the 800 Block

breakwaters have continued to provide stability to the majority of the Willoughby Spit reach as shown in Figure 5-17 and Figure 5-19. A study of localized erosion in the Toler Place vicinity, at the intersection of the 2013 Willoughby Spit breakwaters and the 800 Block breakwaters, is being provided to the City as a separate document.

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 April 2015 and May 2016 and between October 2015 and May 2016 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
April 2015 vs. May 2016 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
800 Block Breakwaters (45+25 to 87+62)	-7.73	-2.40	-10,899	-3.90	-17,699
October 2015 vs. May 2016 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
800 Block Breakwaters (45+25 to 87+62)	1.97	1.07	4,848	0.99	4,474

The 800 Block region gained volume over the seasonal comparison (October 2015 - May 2016) but lost volume over the yearly comparison (April 2015 - May 2016). Over the past year, there has been erosion of the MHW shoreline of -7.73 ft/yr as well as an overall volume loss above 0 feet NAVD88 and -15 ft NAVD88 of -10,899 cy/yr and -17,699 cy/yr, respectively. The seasonal comparison showed there was accretion of the MHW shoreline of 1.97 feet and a gain of sediment volume above 0 feet NAVD88 and -15 feet NAVD88 of 4,848 cy and 4,474 cy, respectively. The gain over the previous survey period above 0 feet NAVD88 along the western end of the reach were due in part to the emergency nourishment project described above. The remainder of the reach remained fairly consistent with slight gains in sediment behind the breakwaters and slight losses between the gaps (Appendix B) as seen in Figure 5-16 - Figure 5-19.

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 April 2015 and May 2016 and between October 2015 and May 2016 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
April 2015 vs. May 2016 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
West Ocean View (93+41 to 163+49)	-4.88	-0.59	-3,553	-2.85	-17,995
October 2015 vs. May 2016 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
West Ocean View (93+41 to 163+49)	4.27	0.81	6,188	-0.80	-6,086

This region was predominantly erosional over the yearly comparison (April 2015 - May 2016) with erosion of the MHW shoreline at a rate of -4.88 ft/yr, and a volume loss above 0 feet NAVD88 and -15 feet NAVD88 at a rate of -3,553 cy/yr and -17,995 cy/yr respectively. The seasonal comparison (October 2015 - May 2016) showed an accretion of the MHW shoreline of 4.27 feet, a gain of material above 0 feet NAVD88 of 6,188 cy and a loss of material above -15 feet NAVD88 of -6,086 cy. As expected, the rock groin added in 2013 has continued to perform well. The area updrift of the rock groin at station 129+17 has remained fairly stable over the past year as shown in Figure 5-16 and Figure 5-17. The area downdrift of the terminal groin has experienced some recovery since October 2015 as shown in Figure 5-18 and Figure 5-19.

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 April 2015 and May 2016 and between October 2015 and May 2016 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
April 2015 vs. May 2016 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Central Ocean View Breakwaters (169+63 to 195+63)	-0.90	1.23	4,273	0.95	3,295
October 2015 vs. May 2016 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Central Ocean View Breakwaters (169+63 to 195+63)	6.50	1.96	6,782	1.53	5,315

This region was on average accretional over the yearly comparison (April 2015 - May 2016) and seasonal comparison (October 2015 – May 2016). The yearly comparison showed slight overall erosion of the MHW shoreline at a rate of -0.90 ft/yr and an overall volume gain above 0 feet NAVD88 and -15 feet NAVD88 at a rate of 4,273 cy/yr and 3,295 cy/yr. The seasonal comparison showed accretion of the MHW shoreline of 6.50 feet and a gain of material above 0 feet NAVD88 and -15 feet

NAVD88 of 6,782 cy and 5,315 cy respectively. This gain in sediment between October 2015 and May 2016 was in the foreshore zone most likely due to post-storm recovery (Appendix B). The end effects of the breakwaters in this region continue to be evident in this reach (see Figure 5-16 - Figure 5-19); however they were less dominant during the current survey period than in past survey periods. Overall, this reach has continued to fare well over the past few monitoring periods, with the current survey period experiencing higher rates of accretion as compared to the previous survey period.

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 April 2015 and May 2016 and between October 2015 and May 2016 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
April 2015 vs. May 2016 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
Central Ocean View (206+86 to 323+09)	-6.06	0.00	-23	0.20	2,511
October 2015 vs. May 2016 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
Central Ocean View (206+86 to 323+09)	-2.87	3.34	41,735	0.88	11,063

As shown in Table 5-8, the yearly comparison (April 2015 - May 2016) for the Central Ocean View region showed negligible cumulative volume change on average . The seasonal comparison (October 2014 - April 2015) indicated volume gain with the majority of this gain occurring above 0 feet NAVD88. The volume gain over the current survey above 0 feet NAVD88 and -15 feet NAVD88 was 41,735 cy and 11,063 cy respectively. Even with negligible volume change over the past year and a significant amount of volume gain during the current survey, there was still erosion of the MHW shoreline. The average yearly shoreline retreat rate was -6.06 ft/yr with an average of -2.87 ft of retreat occurring over the reach during the current survey period. The material from the subaerial beach that was deposited directly offshore by storms during the previous monitoring period has moved back onshore as shown in the profile plots in Appendix B.

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 April 2015 and May 2016 and between October 2015 and May 2016.

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
April 2015 vs. May 2016 Comparison					
	(ft/yr)	(cy/ft/yr)	(cy/yr)	(cy/ft/yr)	(cy/yr)
East Ocean View (329+63 to 383+58)	-2.07	-1.39	-7,952	-2.23	-12,778
October 2015 vs. May 2016 Comparison					
	(ft)	(cy/ft)	(cy)	(cy/ft)	(cy)
East Ocean View (329+63 to 383+58)	-9.23	2.17	12,434	0.77	4,396

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 loss over the yearly (April 2015 - May 2016) comparison; however, it experienced volume gain over the seasonal (October 2015 – April 2016) comparison. This gain included the placement of 1,500 cy of truck-hauled sand (from an upland source) that occurred during the current survey between stations 380+18 and 383+58. The MHW shoreline yearly comparison showed an overall erosion of the MHW shoreline at a rate of -2.07 ft/yr and an overall volume loss above 0 feet NAVD88 and -15 feet NAVD88 at a rate of -7,952 cy/yr and -12,779 cy/yr respectively. The seasonal comparison showed an erosion of the MHW shoreline of -9.23 feet and a gain of material above 0 feet NAVD88 and -15 feet NAVD88 of 12,434 cy and 4,396 cy respectively. A portion of the gain experienced in this reach was due to the nourishment that occurred in the eastern end of the reach. The remainder of the gain experienced was from sand moving from offshore to the subaerial beach as shown in Appendix B. The Bay Oaks breakwaters have continued to be very successful at retaining sand that may be eroding from the beach and eliminating the previous hotspot. Typically, the east end of the region, adjacent to the jetty, is more erosive than most areas west in this region due to the lack of a sediment source and the littoral sediment movement in this region going from east to west. Usually, this region has a fairly steady pattern of accretion on the profiles behind the breakwaters and erosion on the profiles between the breakwaters. This indicates the influence of the breakwaters on decreasing the wave heights and retaining sediment along the shore.

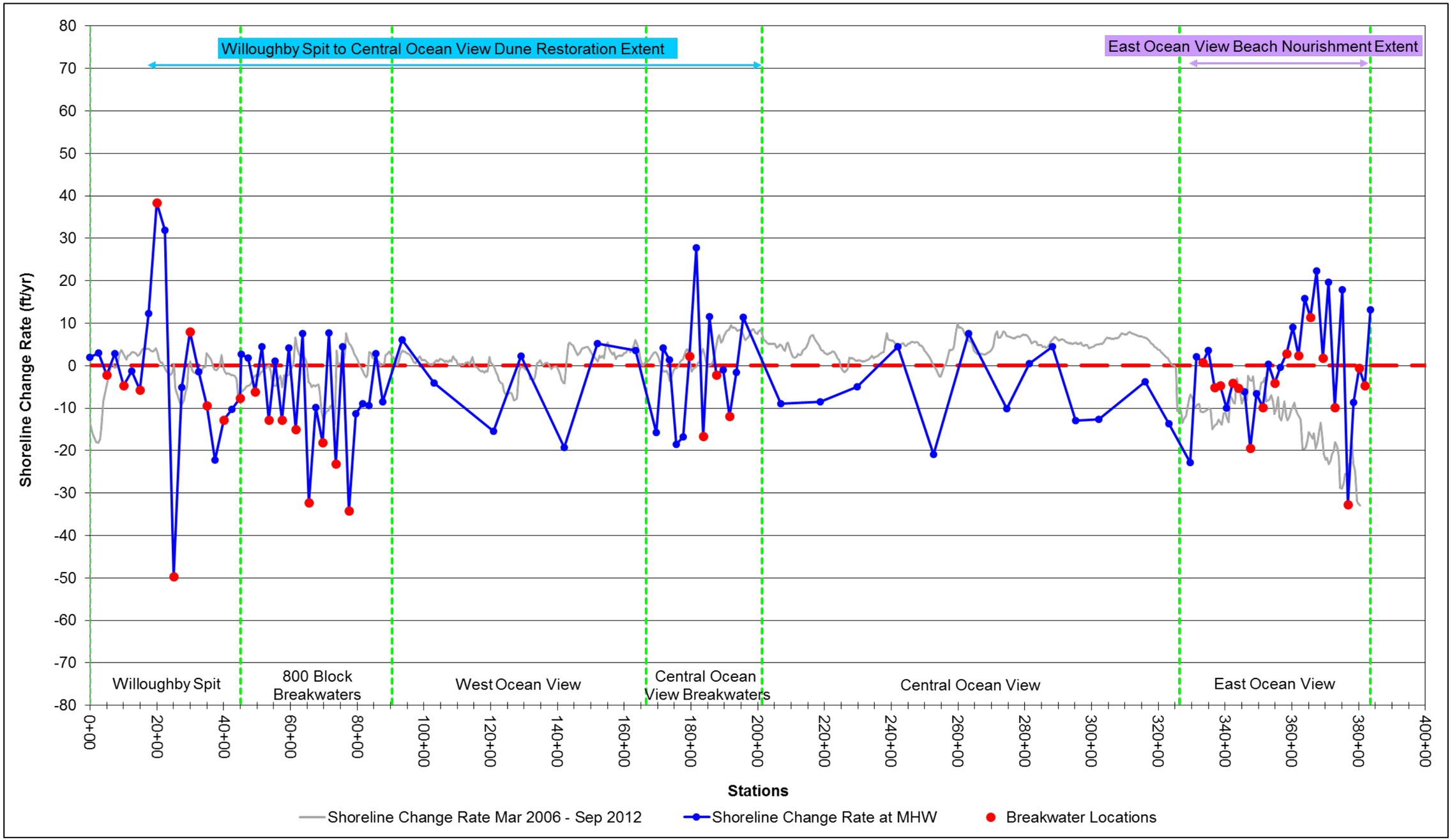

Figure 5-16: Shoreline Change Rate (ft/yr) at Mean High Water (+0.98 ft NAVD88) for April 2015 to May 2016 (Note: Positive = Accretion, Negative = Erosion)

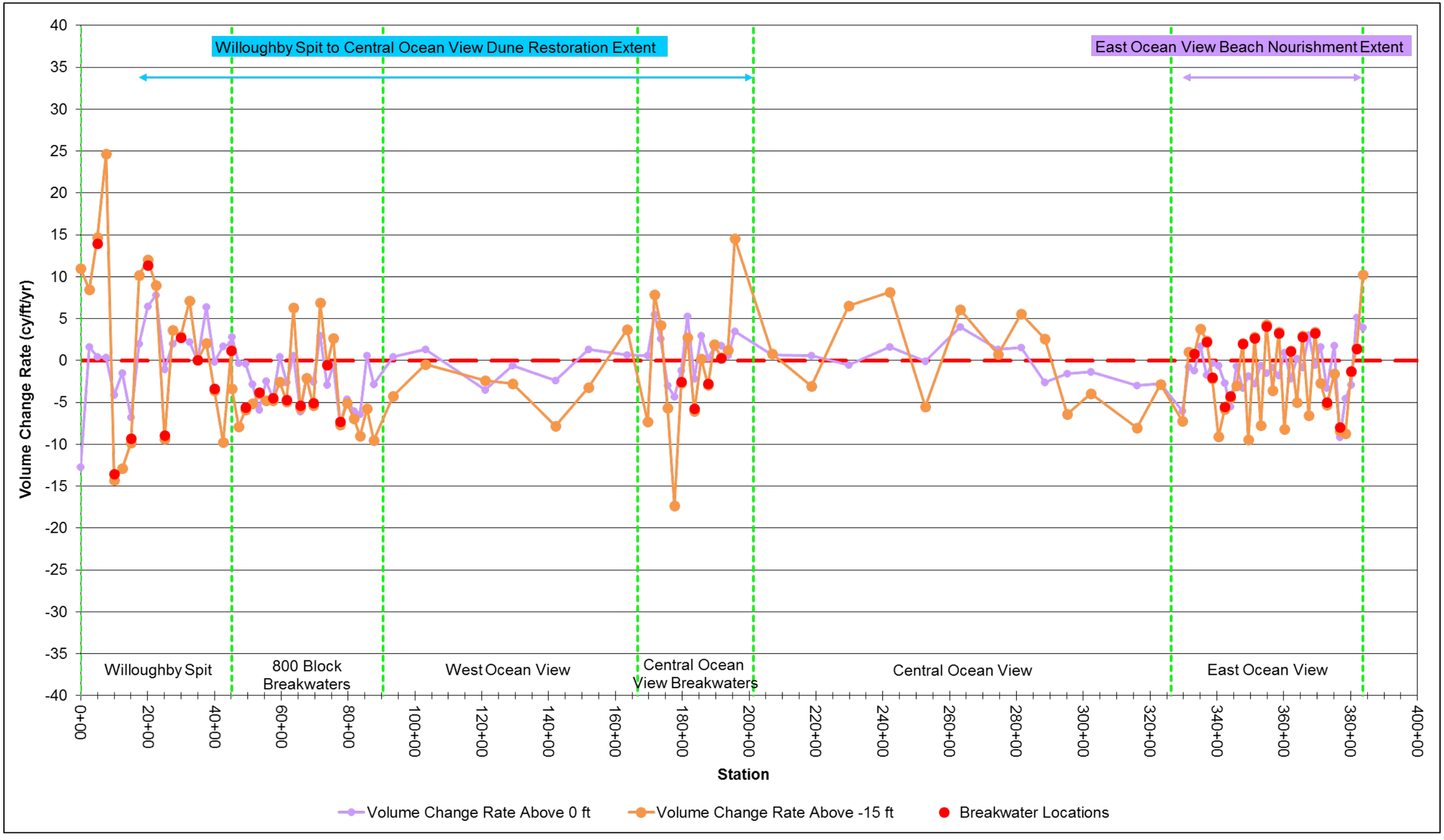

Figure 5-17: Volume Change Rate Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft/yr) for April 2015 to May 2016 (Note: Positive = Accretion, Negative = Erosion)

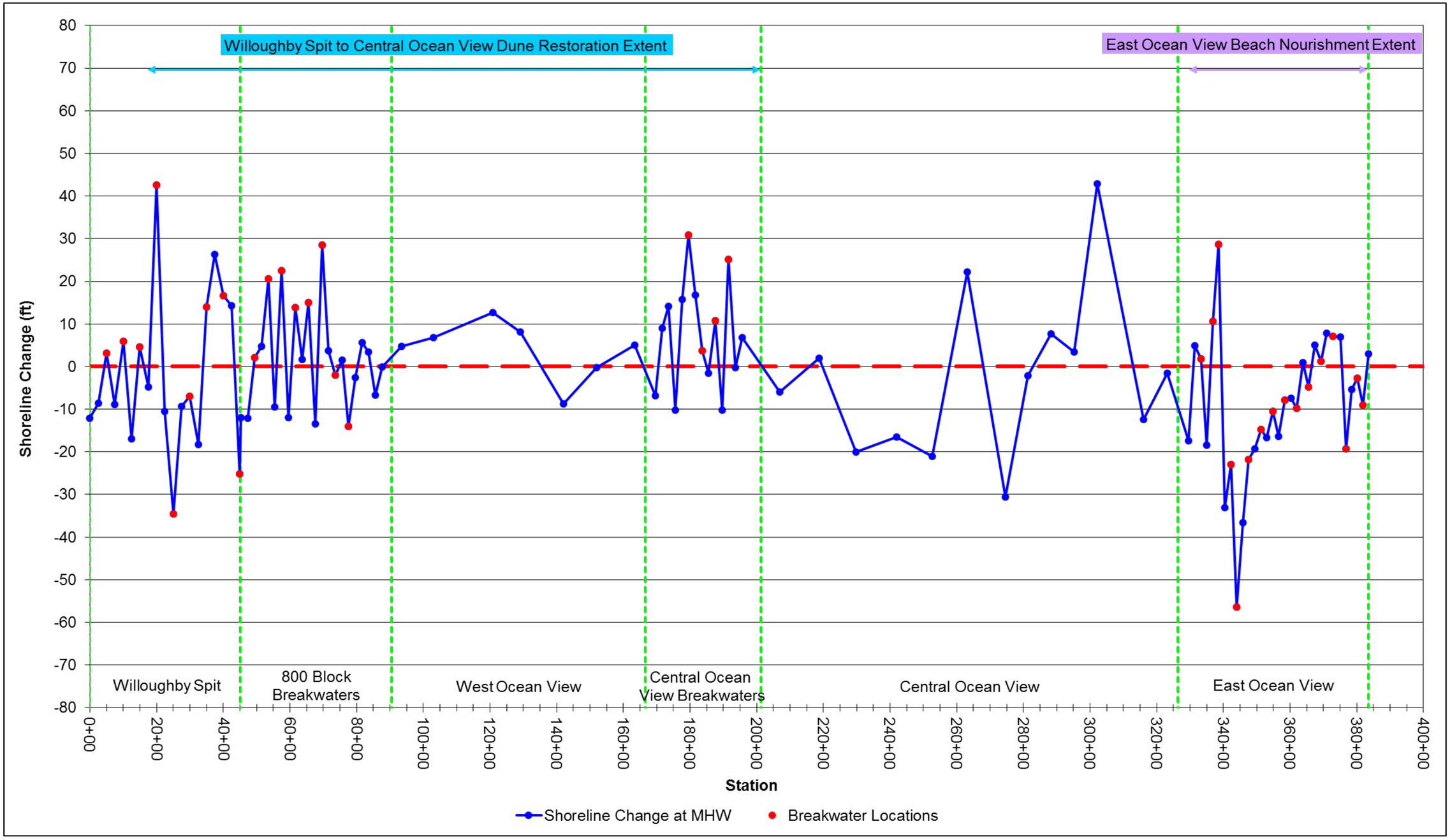

Figure 5-18: Shoreline Change (ft) at Mean High Water (+0.98 ft NAVD88) for October 2015 to May 2016 (Note: Positive = Accretion, Negative = Erosion)

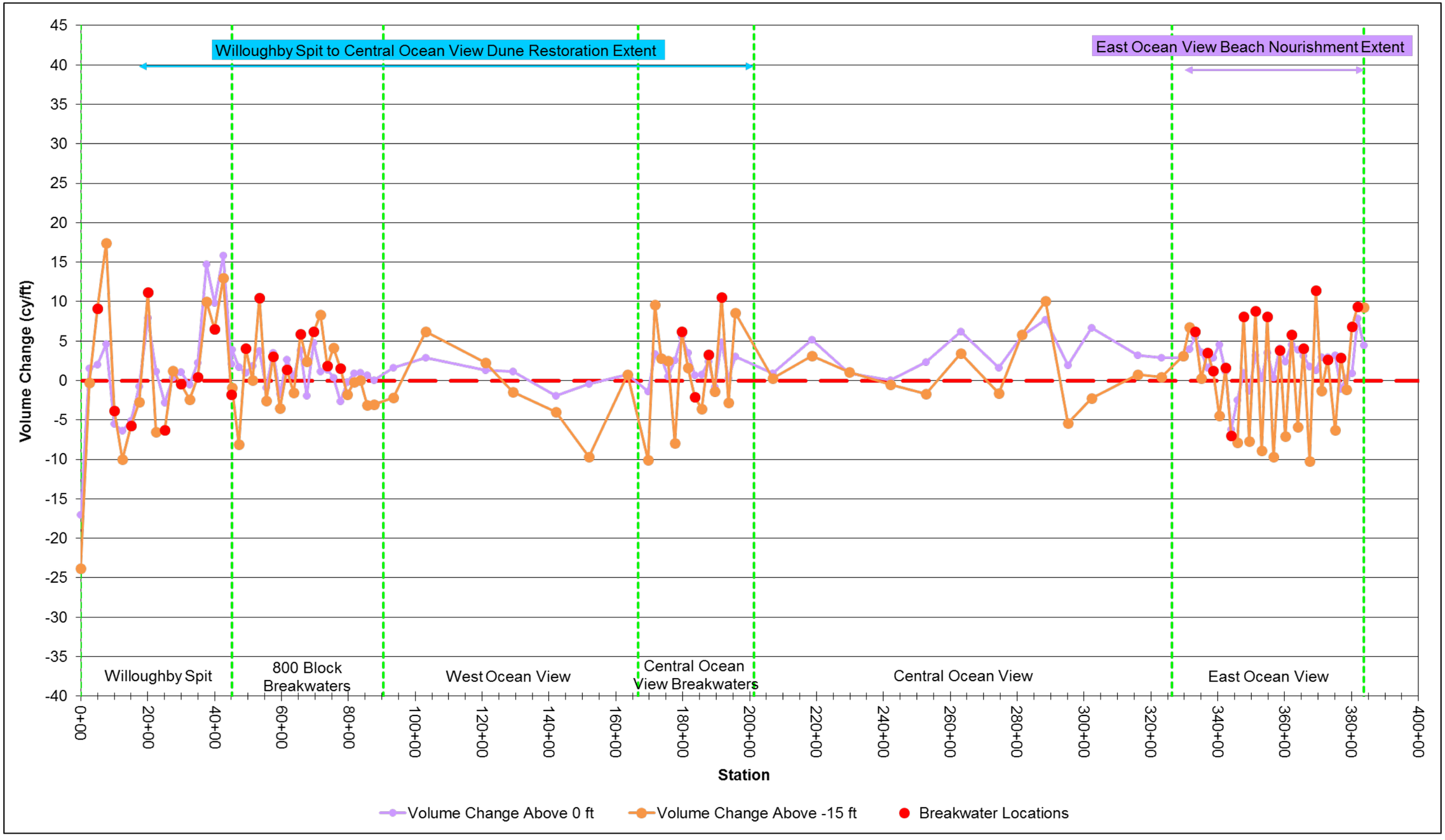

Figure 5-19: Volume Change Above 0 ft NAVD88 and -15 ft NAVD88 (cy/ft) for October 2015 to May 2016 (Note: Positive = Accretion, Negative = Erosion)

5.5. East Ocean View Beach Nourishment Project (2009)

An initial beach nourishment project took place along the East Ocean View shoreline in November 2003. Approximately 359,000 cy of material was placed on the beach between Station 329+63 and Station 383+58. More recently, the East Ocean View shoreline was renourished with approximately 196,000 cy of material in March 2009. The most recent periodic survey, taken in May 2016, was compared to the post-fill survey taken in March 2009. Table 5-10 presents the shoreline and volume change statistics comparing the two surveys.

Table 5-10: Overall Shoreline and Volume Change Statistics – East Ocean View Nourishment Project (March 2009 Post-Fill – May 2016 Comparison)

Region		Average Shoreline Change (ft)	Average Volume Change Above 0 ft NAVD88 (cy/ft)	Cumulative Volume Change Above 0 ft NAVD88 (cy)	Average Volume Change Above -15 ft NAVD88 (cy/ft)	Cumulative Volume Change Above -15 ft NAVD88 (cy)
East Ocean View (329+63 to 383+58)	Rate per Year	-14.93	-2.78	-14,525	-5.02	-26,239
	Total	-106.65	-19.85	-103,787	-35.89	-187,482

Results indicate that the East Ocean View MHW shoreline has continued to erode and that approximately 103,800 cy of the 113,000 cy originally placed above 0 feet NAVD88 (for approximately 92% loss) has been lost from the East Ocean View reach. The previous monitoring period indicated that the percentage loss at that time was 99%, which indicates there was some recovery of additional sediment over the most recent survey period. Though some volume was gained back since October 2015, the East Ocean View nourishment project is at the end of its effective performance life. Previous experience from the 2003 nourishment project indicates that the design life of projects in this area is limited to 4-5 years due to storm impact and lack of sediment source to the east, and from this perspective the 2009 East Ocean View nourishment project has performed well. The need for renourishment is indicated, and this is expected to be provided by the upcoming federal coastal storm damage reduction project.

Figure 5-20 shows areas of elevation change between the post-fill survey and the May 2016 survey. As depicted in the figure, there has been erosion of the beach face and nearshore, with more erosion in-between the breakwaters than in the areas directly behind the breakwaters. The magnitude of the loss is much larger in the east than in the west of the breakwater field, which is to be expected since this eastern shoreline is cut off from a sediment source by the jetty. Some of the sediment eroded from the beach face and nearshore in the East Ocean View breakwater field appears to have accreted within the Bay Oaks breakwaters. At Station 329+63, there seems to be some slight end effects from the Bay Oaks breakwaters. These breakwaters have continued to be successful in addressing the previous hotspot and providing a transition into the Central Ocean View region.

The May 2016 MHW shoreline was compared to the MHW shoreline from June 2003, before the first nourishment project in November 2003, as another way to measure the amount of protection being supplied by the March 2009 nourishment project. Areas where the current shoreline is within 20 feet of the June 2003 shoreline need to be targeted for nourishment. Figure 5-21 shows the MHW shoreline position difference between the June 2003 pre-fill and May 2016 shorelines. The Bay Oaks Breakwaters have experienced a recession at a majority of the stations. Currently 60% of the Bay Oaks

stations are within the 20 foot buffer zone, which is an increase from 10% in the previous monitoring period. The percentage of stations that have receded beyond the buffer decreased from 40% previously to 20% currently. Only two stations (342+23 and 344+05) within the Bay Oaks Breakwaters have remained outside of the 20 foot buffer for the pre-fill shoreline. The MHW shoreline at all stations along the East Ocean View Breakwaters have receded within 20 feet of the pre-fill shoreline with some receding beyond the pre-fill shoreline position. Currently 70% of the East Ocean View Breakwater stations have receded beyond the pre-fill shoreline. As stated previously, the upcoming Federal Project is expected to alleviate the concern within this reach.

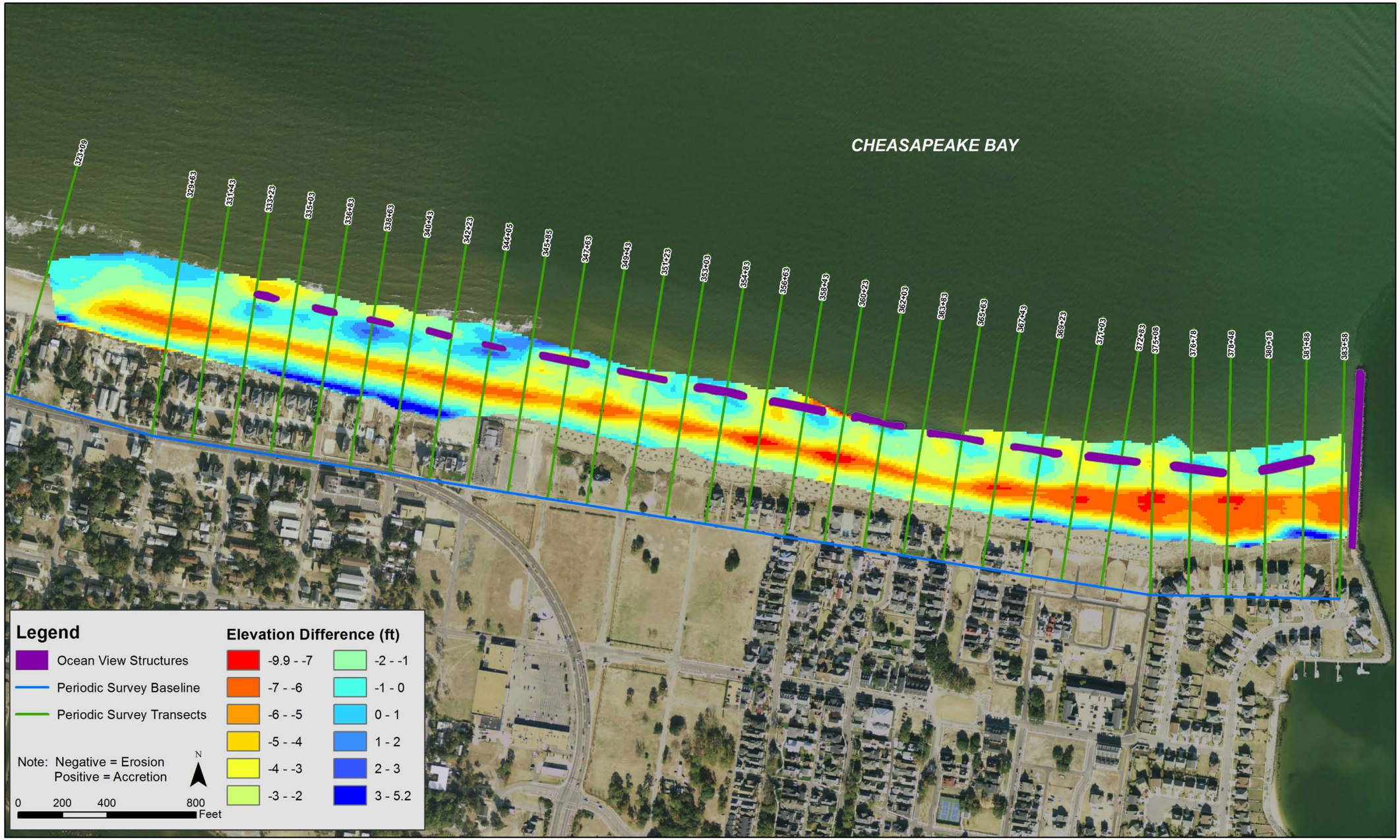

Figure 5-20: Net Volume Change Since the East Ocean View Nourishment Project (March 2009)

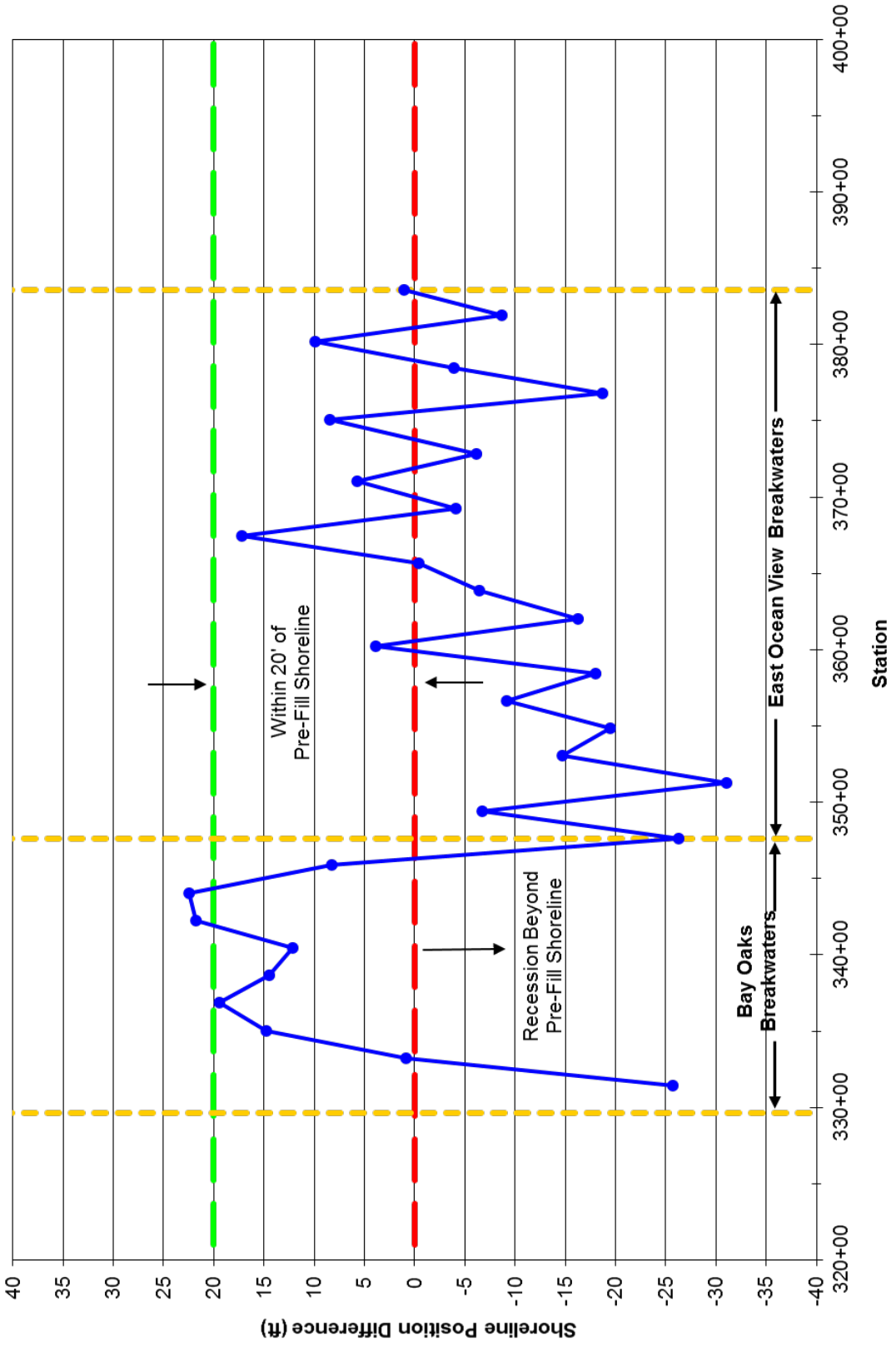

Figure 5-21: Shoreline Position Difference (ft) at MHW Between 2003 Pre-Fill and May 2016 Shorelines for East Ocean View

5.6. Central Ocean View Dune Restoration Project (2005)

The most recent periodic survey, taken in May 2016, was also compared to the post-fill survey taken in March 2005 after completion of the Willoughby Spit to Central Ocean View Dune Restoration project. A total of 504,300 cy of sand was placed in 2005 from Station 15+00 to Station 195+63. Table 5-11 presents the shoreline and volume change statistics comparing the two surveys.

Table 5-11: Regional and Overall Shoreline and Volume Change Statistics for Central Ocean View Nourishment Project (March 2005 Post-Fill – May 2016 Comparison)

Region		Average Shoreline Change (ft)	Average Volume Change Above 0 ft NAVD88 (cy/ft)	Cumulative Volume Change Above 0 ft NAVD88 (cy)	Average Volume Change Above -15 ft NAVD88 (cy/ft)	Cumulative Volume Change Above -15 ft NAVD88 (cy)
Willoughby Spit (0+00 to 45+00)	Rate per Year	0.18	-0.37	-943	-0.13	-95
	Total	1.98	-4.11	-10,528	-1.51	-1,064
800 Block Breakwaters (45+25 to 87+62)	Rate per Year	-5.50	-1.22	-5,348	-1.80	-7,868
	Total	-61.34	-13.60	-59,691	-20.09	-87,822
West Ocean View (93+41 to 163+49)	Rate per Year	-3.18	-1.42	-10,957	-1.00	-7,118
	Total	-35.51	-15.82	-122,300	-11.17	-79,447
Central Ocean View Breakwaters (169+63 to 195+63)	Rate per Year	-0.49	0.05	263	1.13	3,660
	Total	-5.46	0.53	2,937	12.57	40,857
OVERALL		Weighted Average	Total	Weighted Average	Total	Weighted Average
Rate per Year		-2.68	-0.92	-16,985	-0.66	-11,421
Total		-29.93	-10.30	-189,582	-7.32	-127,477

It is important to consider changes above the 0 feet contour since the project was primarily a dune restoration, placing the majority of sand above the intertidal zone. Table 5-11 shows that there has been significant loss of material in the dune system and subaerial beach above 0 feet NAVD88 since the project was completed. Approximately 189,600 cy of the 320,700 cy originally placed above 0 feet NAVD88 (for approximately 59% loss) has been lost from this reach. The previous monitoring period (October 2015) report indicated that the percentage loss at that time was 68%, which indicates there was a significant gain of additional sediment over the most recent survey period.

Figure 5-22 shows areas of elevation change between the March 2005 post-fill survey and the May 2016 survey. As depicted in the figure, there has been erosion of the beach face and nearshore in-between the Willoughby Spit breakwaters, the 800 Block Breakwaters, and the Central Ocean View Breakwaters. Losses are less in the Central Ocean View Breakwaters than in the 800 Block Breakwaters and Willoughby Spit breakwaters.

The losses in dune volume seen immediately west of the 800 Block Breakwaters (between Stations 42+50 and 47+30, in the 11th View and 12th View Street vicinity) persist even after the construction of the seven Willoughby Spit breakwaters in 2013 served to slow erosion of the shoreline and subaerial beach. At this location near 11th View Street, and in West Ocean View between Stations 129+17 and 141+98, the eroded condition means that there is a narrow beach and little dune volume fronting several

residential and commercial buildings The emergency nourishment project in January – February 2016 helped to alleviate the immediate concern between 11th View and 12th View Streets, and both areas will be closely monitored going forward. Additional localized nourishments may be needed in these areas, if tropical storms or significant nor'easters occur prior to the upcoming Federal Project which is now planned to begin in early 2017.

In addition, the May 2016 MHW shoreline was compared to the pre-fill MHW shoreline as another way to measure the amount of protection still being supplied by the January-March 2005 nourishment (dune restoration) project. The design life of the nourishment project was outlined in the M&N Willoughby Spit to Central Ocean View Dune Restoration Project Performance Analysis from October 2004. The study anticipated a project design life of 5 to 6 years with no major storm activity and 2 to 3 years at hot spot areas if there were impacts to this reach of shoreline from storms. The nourishment project is in its eleventh year and has been impacted by several storms since its construction, e.g. October 2006 and November 2009 nor'easters, Hurricane Irene in August 2011, and Hurricane Sandy in October 2012. Areas where the current shoreline is within 20 feet of the pre-fill shoreline need to be targeted for nourishment. Figure 5-23 shows the MHW shoreline position difference between the pre-fill and May 2016 shorelines. The May 2016 Willoughby Spit to Central Ocean View MHW shoreline comes within 20 feet of the pre-fill shoreline in several locations, and long segments of the shoreline have receded landward of the pre-fill shoreline. The shoreline has accreted bayward of the buffer zone at the western end of Willoughby Spit between stations 0+00 and 40+00 and within the Central Ocean View breakwaters. Specific areas of concern remain the shoreline to the west of the 800 Block breakwater field (as discussed above) and within the breakwater field itself at Stations 42+50 through 67+62. A short segment of the eastern end of the 800 Block Breakwaters (Stations 69+62 through 77+62) is bayward of the buffer, and the remainder of the breakwater field is now within the buffer zone. The majority of the western and central section of the West Ocean View shoreline (Stations 79+62 through 152+01) have receded landward of the pre-fill shoreline.

The upcoming federal coastal storm damage reduction project is expected to provide this reach with significant additional beach berm widths and associated beach profile volume between +3.5 feet and depth of closure in the submerged profile. However, the Federal Project is now expected to start in early 2017, so that the beach system will experience another tropical storm and winter storm season prior to receiving this large-scale renourishment.

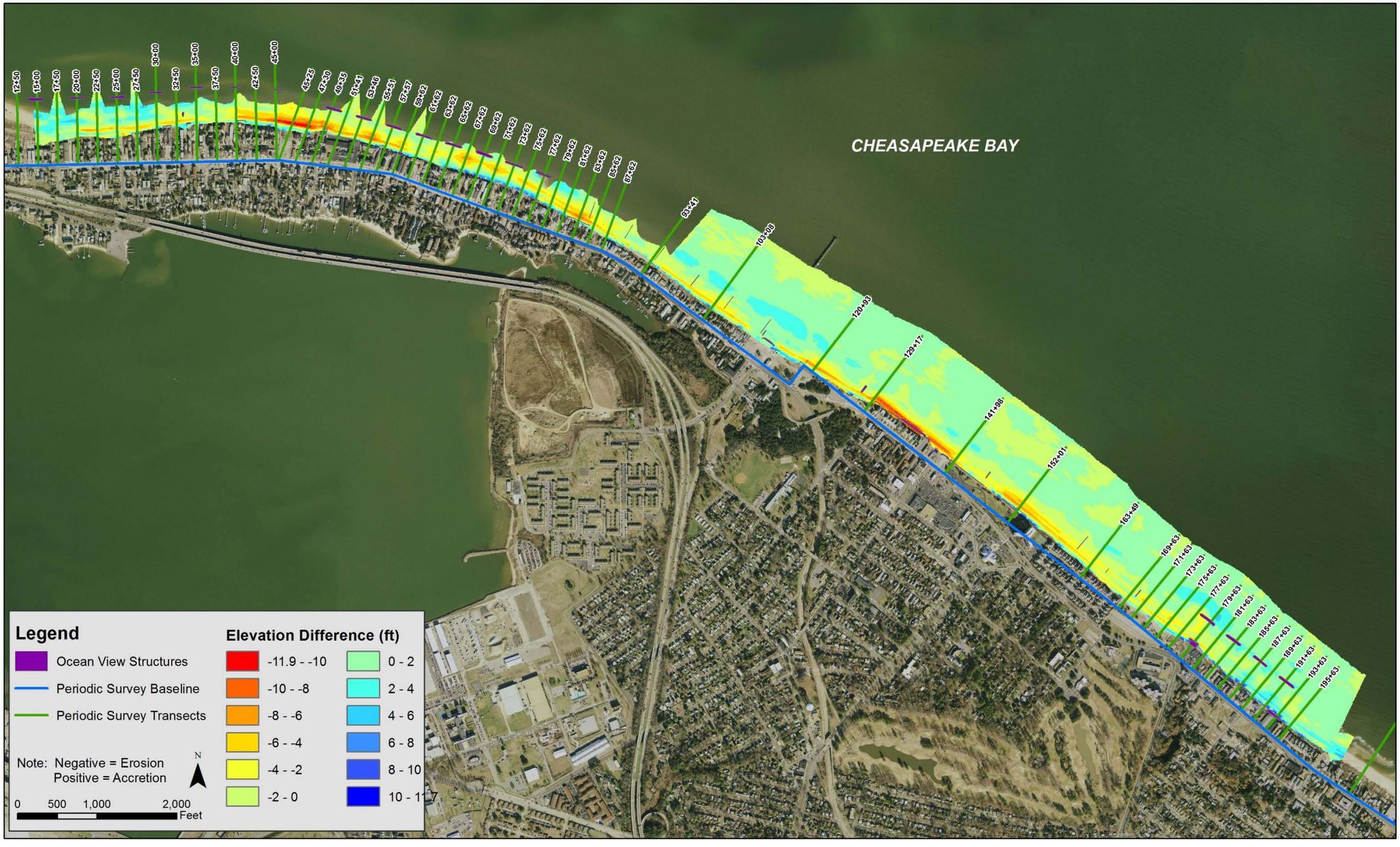

Figure 5-22: Net Volume Change Since the Willoughby Spit to Central Ocean View Dune Restoration Project (March 2005)

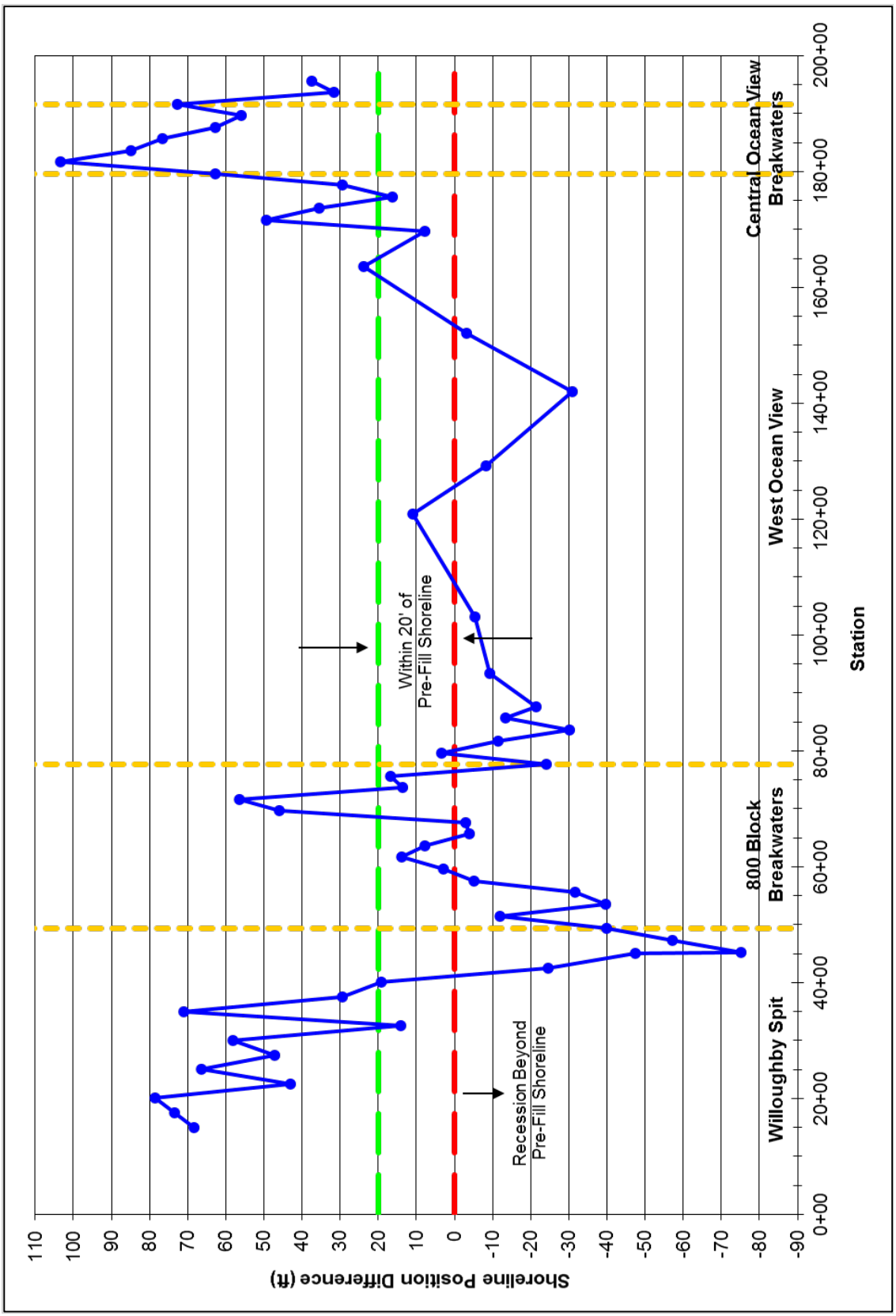

Figure 5-23: Shoreline Position Difference (ft) at MHW Between 2003 Pre-Fill and May 2016 Shorelines for Central Ocean View

5.7. West Ocean View Shoreline Improvement Project (2013)

The most recent periodic survey from May 2016 was compared to the October 2013 survey of the West Ocean View Shoreline Improvement Project area, where a total of 73,600 cy of sand was placed from Station 103+08 to Station 152+01 in November 2013.

Table 5-12: Overall Shoreline and Volume Change Statistics for West Ocean View shoreline Improvement Project (October 2013 – May 2016 Comparison)

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
West Ocean View (103+08 to 152+01)	Total	5.26 ft	2.20 cy/ft	10,758 cy	3.87 cy/ft	18,914 cy

Construction of the West Ocean View Shoreline Improvement Project was substantially complete prior to the March 2014 monitoring period. This project included the removal of the existing groin field east of the pier, reconstruction of a groin in between the 200 Block and Sarah Constant Shrine Park, and a 73,600 cy nourishment project, as shown in Figure 5-24**.** The new groin was designed to be shorter and more sand-tightened than the previous groins, helping to maintain adequate beach width in front of the 200 Block for vehicle access. The 73,600 cy nourishment project added 30 feet of berm width in front of Sarah Constant Beach Park, on the downdrift side of the groin.

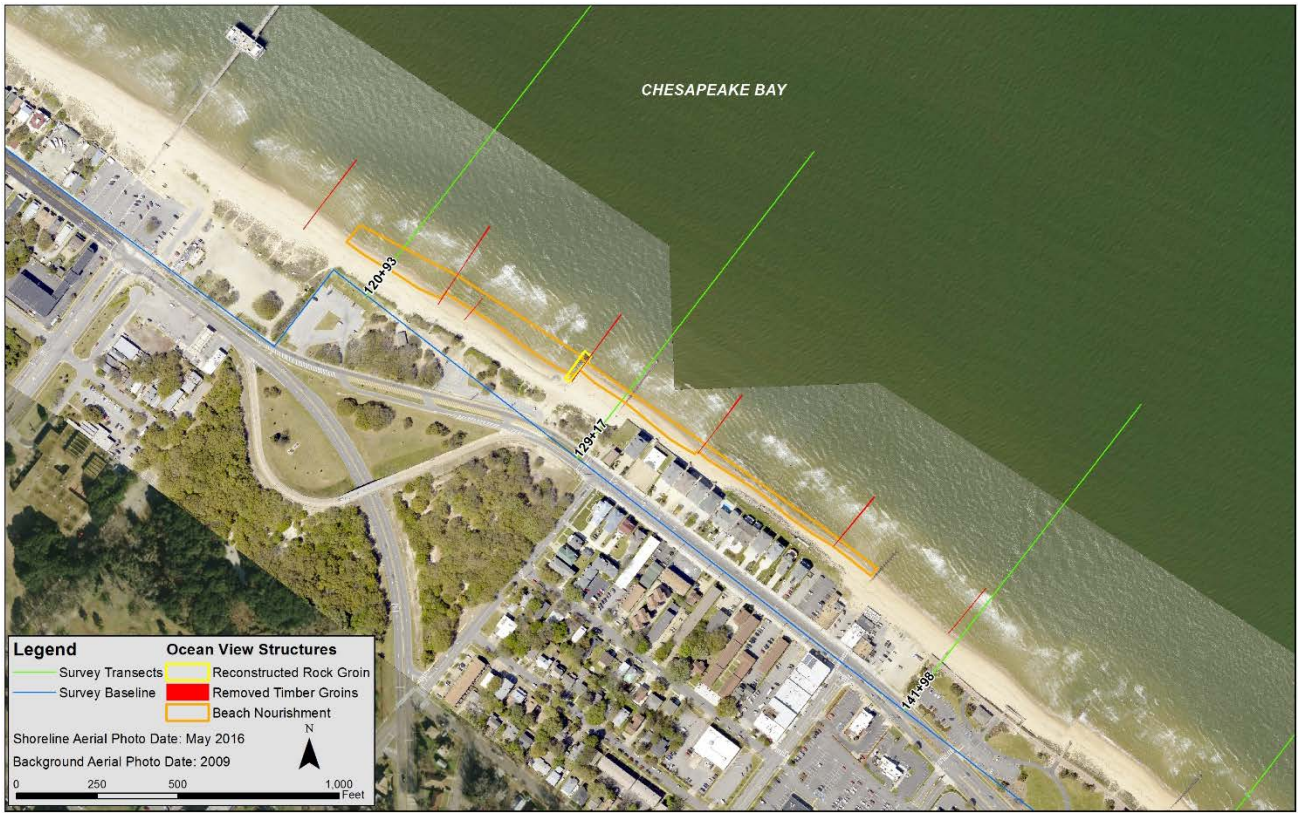

Figure 5-24: West Ocean View Shoreline Improvement Project Area

A majority of the material was placed above -3 ft NAVD88; therefore, the volume change above -15 ft NAVD88 was examined to capture as much of the remaining material as possible. Approximately 18,900 cy of material remains above -15 feet NAVD88, which is 26% of the 73,600 cy originally placed.

In addition, the May 2016 MHW shoreline was compared to the MHW shoreline from October 2013, before the shoreline improvement project was completed in November 2013, as another way to measure the amount of protection being supplied by this nourishment project. Areas where the current shoreline is within 10 feet of the October 2013 shoreline need to be targeted for nourishment. Figure 5-25 shows the MHW shoreline position difference between the October 2013 and May 2016 shorelines. There was an error in the shoreline position difference figure for the West Ocean View Project in the previous monitoring report. There are two lines shown in Figure 5-25, the blue solid line is the current (October 2013 – May 2016) shoreline difference, and the gray dashed line is the corrected shoreline difference for the previous monitoring period (October 2013 – October 2015). The groin at station 129+17 has been performing well and trapping sand as designed. The MHW shoreline at the two transects updrift of the groin are either at or above the 10 foot buffer zone. The remaining transects show the MHW shoreline having receded to the position of the prefill shoreline with one transect receding beyond the pre-fill shoreline. On average over the project area, the MHW shoreline has accreted 5.26 feet which was an increase from the previous monitoring period which eroded -0.3 feet on average.

The upcoming federal coastal storm damage reduction project is expected to provide this reach with significant additional beach berm widths and associated beach profile volume between +3.5 feet and depth of closure in the submerged profile

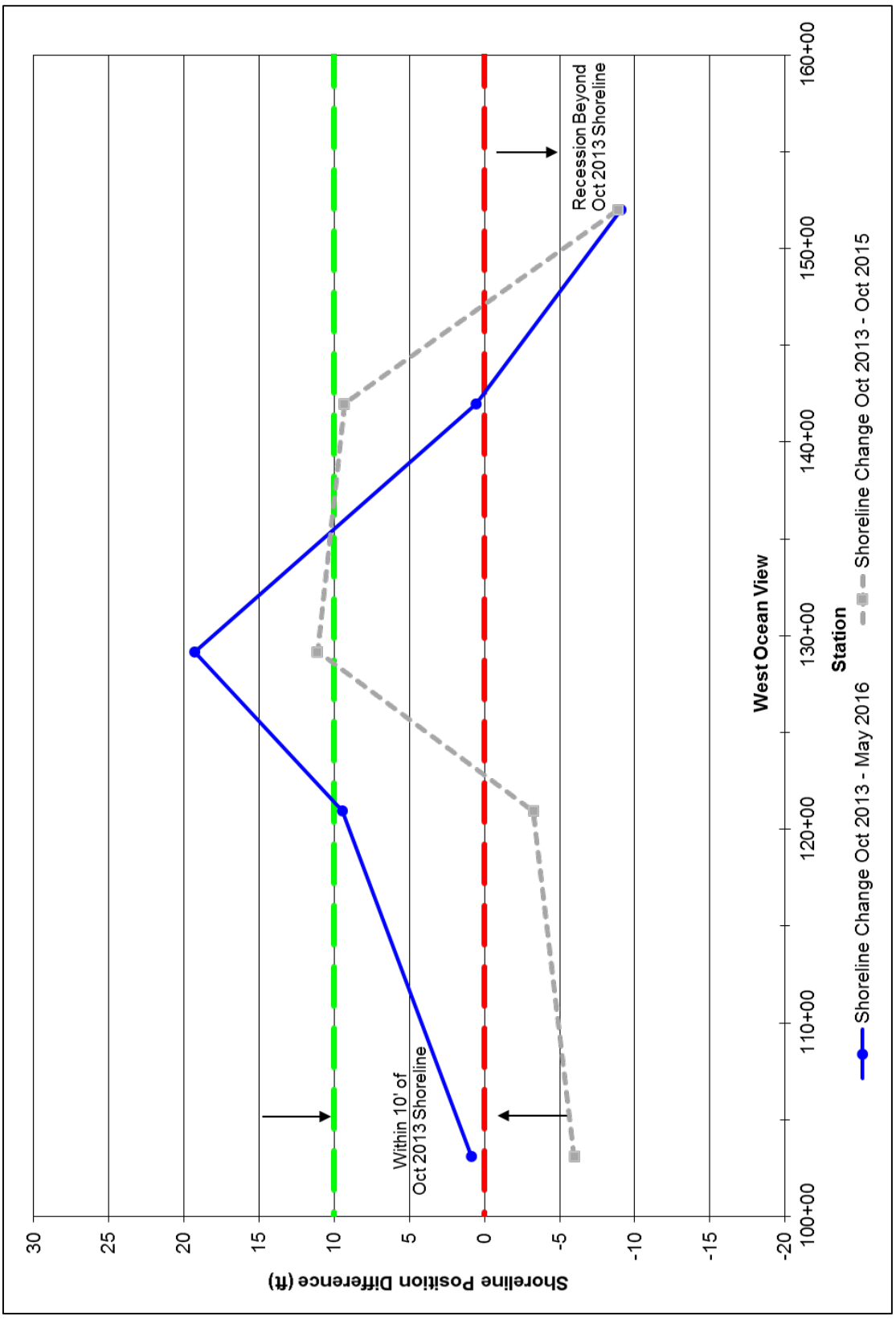

Figure 5-25: Shoreline Position Difference (ft) at MHW Between October 2013 and May 2016 Shorelines for West Ocean View

6. 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 2016. 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 2016 survey was compared with both the April 2015 and October 2015 surveys. The surveys were used to compute shoreline change at MHW and volume change above 0 feet NAVD88 and above -15 feet NAVD88.

In addition, the most recent survey in May 2016 was compared to pre- and post-fill surveys taken after the East Ocean View beach nourishment (March 2009), Willoughby Spit to Central Ocean View dune restoration (January-March 2005) projects, and West Ocean View shoreline improvement project (2013). This was done to quantify the amount of material loss since the projects were completed and condition of the shoreline with respect to pre-fill conditions.

Key statistics were computed for defined regions along Ocean View and the entire shoreline for the time period between the April 2015 and May 2016 surveys and between the October 2015 and May 2016 surveys.

Comparison	Parameter	Quantity
April 2015 vs. May 2016	Average Shoreline Change Rate at MHW (+0.98 ft NAVD88)	-4.45 ft/yr
	Cumulative Volume Change Rate Above 0 ft NAVD88	-14,562 cy/yr
	Cumulative Volume Change Rate Above -15 ft NAVD88	-32,871 cy/yr
October 2015 vs. May 2016	Average Shoreline Change at MHW (+0.98 ft NAVD88)	-0.72 ft
	Cumulative Volume Change Above 0 ft NAVD88	80,280 cy
	Cumulative Volume Change Above -15 ft NAVD88	23,610 cy

The average shoreline change rate for the entire shoreline at MHW between the April 2015 and May 2016 surveys was -4.45 ft/yr, and the cumulative volume changes above 0 feet NAVD88 and -15 feet NAVD88 were approximately -14,562 cy/yr and -32,871 cy/yr, respectively. The overall volumetric loss in the dune and subaerial beach and the system as a whole was largely due to the effects of the notable storms in late September, and early October 2015 and in January 2016.

The most recent six-month period of comparison (May 2016 - October 2015) depicts a slight erosion of the MHW line of -0.72 feet. The cumulative volume change above 0 feet NAVD88 indicates a sediment gain to the subaerial beach of 80,280 cy, and there was also a gain of sediment in the nearshore system above -15 feet NAVD88 of 23,610 cy.

Willoughby Spit

The Willoughby Spit region overall experienced slight erosion of the MHW shoreline with volumetric gains above 0 feet NAVD88 and -15 feet NAVD88 over the past year. There was an emergency nourishment project that placed sand in the dune and berm system along the eastern end of the reach to help with the erosion that occurred in this specific location.

800 Block Breakwaters

In the 800 Block region, there has been erosion of the MHW shoreline, with volumetric loss above 0 feet NAVD88 and above -15 feet NAVD88 over the year due to the high wave climate during the previous six months monitoring period. In the current six months monitoring period there has been accretion of the MHW shoreline and volumetric gains above 0 feet NAVD88 and above -15 feet NAVD88 indicating there has been some post-storm recovery.

West Ocean View

The reconstructed groin in West Ocean View has performed well over the past year. Though the yearly analysis shows overall volumetric loss above both 0 feet NAVD88 and -15 feet NAVD88 as well as erosion of the MHW shoreline, there has been a gain in material above 0 feet NAVD88 and accretion of the MHW shoreline over the current survey period.

Central Ocean View Breakwaters

The Central Ocean View Breakwaters has remained fairly stable over the past year. This region experienced accretion of the MHW shoreline over the current survey period, with volumetric gain above 0 feet NAVD88 and -15 feet NAVD88 over the past year and the current survey period.

Central Ocean View

Typically a very stable region, Central Ocean View has experienced erosion of the MHW shoreline; however, there has been negligible volume change above 0 feet NAVD88 and volume gain above -15 feet NAVD88 over the past year. Over the current survey period, this region experienced volume gains above 0 feet NAVD88 and -15 feet NAVD88. Like other regions, Central Ocean View experienced post storm recovery since the volume losses it experienced in the April 2015 – October 2015 period.

East Ocean View

There has been erosion of the MHW shoreline along with volumetric losses 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 erosion of the MHW shoreline and volumetric gains above 0 feet NAVD88 and -15 feet NAVD88. The Bay Oaks breakwaters are continuing to perform well, trapping sediment and eliminating the hotspot at this location. The east end of the region, adjacent to the jetty, is more erosive than most areas west in this region due to the lack of a sediment source.

In addition to regional assessments, comparison of the May 2016 survey was made against post-fill surveys from the East Ocean View beach nourishment, Willoughby Spit to Central Ocean View dune restoration, and the West Ocean View Shoreline Improvement Project which took place in March 2009, January-March 2005, and November 2013 respectively.

Comparison	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
East Ocean View Nourishment vs. May 2016 Comparison	-106.65 ft	-19.85 cy/ft	-103,787 cy	-35.89 cy/ft	-187,482 cy
Central Ocean View Nourishment vs. May 2016 Comparison	-29.93 ft	-10.30 cy/ft	-189,582 cy	-7.32 cy/ft	-127,477 cy
West Ocean View Pre-Nourishment vs May 2016 Comparison	5.26 ft	2.20 cy/ft	10,758 cy	3.87 cy/ft	18,914 cy

The 103,800 cy volumetric loss above 0 feet NAVD88 within the East Ocean View project (since construction in 2009) is roughly 92% of the original amount placed in this dune and subaerial beach area. The 189,600 cy loss above 0 feet NAVD88 in the Central Ocean View project area (since 2005) is roughly 59% of the original amount placed above 0 feet NAVD88. The remaining volume for the West Ocean View project is approximately 18,900 cy out of the 73,600 cy placed in 2013, which is 26% of the original fill volume remaining. Due to storm impacts and background erosion that has occurred, as anticipated, over the projects' design lives, there are areas in the East Ocean View and Central Ocean View regions that should be targeted for nourishment. The completed Willoughby Spit (2013) project and the West Ocean View (2013) projects have alleviated the concerns with these hot spots and have provided additional protection in vulnerable areas; however, this area as well as others may require additional nourishment to provide adequate storm protection. It is expected that the upcoming federal coastal storm damage reduction project will provide all of these reaches (directly, or indirectly in the case of the Cottage Line area of Central Ocean View) with significant additional beach profile volume over the next one to two years.

This is the twenty-second periodic survey report completed to date, and twenty-second 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. April 2015 to May 2016) 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 so that the rich survey data sets are best utilized.

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	***October 1998 City Survey***		***Entire Ocean View Shoreline***					
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	***October 1999 City Survey***		***Entire Ocean View Shoreline***					
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	***July 2000 City Survey***		***From Approx. 9th View St to Little Creek Inlet***					
39	August, 2000	Breakwater Construction	Critical Area 3: 21st Bay to Little Creek Inlet	nearshore breakwaters 2,3,4 constructed				
40	***October 2000 City Survey***		***From Approx. 12th View St to Little Creek Inlet***					
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	***October 2001 City Survey***		***Entire Ocean View Shoreline***					
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	***July 2002 City Survey***		***Entire Ocean View Shoreline - excluding approx. Sherwood Pl. to Warwick Ave.***					
49	***October 2002 City Survey***		***Entire Ocean View Shoreline - minimal survey data (no beach or bathymetric survey points)***					
50	***March 2003 City Survey***		***East Ocean View Shoreline (19th Bay to Little Creek Inlet)***					
51	***April 2003 City Survey***		***East Ocean View Shoreline (17th Bay to Little Creek Inlet)***					
52	***June 2003 Waterway Survey***		***East Ocean View Shoreline (17th Bay to Little Creek Inlet)***					
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	***October 2003 Waterway Survey***		***Post-Isabel Survey - East Ocean View Shoreline (17th Bay to Little Creek Inlet)***					
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	***Nov-Dec 2003 Post-Fill Survey***		***East OceanView Shoreline (17th Bay to Little Inlet Creek)***					
60	***Feb-April, 2004 Waterway Survey***		***From Approx. Willoughby Spit to 17th Bay St***					
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	***January-March 2005 Post-Fill Survey***		***Willoughby Spit to Warwick Ave.***					
64	***September 2005 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
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	***March 2006 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
69	***October 2006 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
70	***March 2007 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
71	***October 2007 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
72	***March 2008 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
73	***October 2008 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
74	March, 2009	Beach Nourishment	East Ocean View and Bay Oaks	Beach Nourishment	196,000			
75	***April 2009 McKim & Creed Periodic Survey***		***Entire Ocean View Shoreline***					
76	August-October, 2009	Breakwater Construction	Bay Oaks	5 Nearshore Breakwaters Constructed				
77	***October 2009 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
78	***November-December 2009 Post-Storm Survey***		***Entire Ocean View Shoreline***					
79	***March 2010 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
80	April, 2010	Dune Restoration	Willoughby Spit and 800 Block	Dune restoration using sediment from terminal groin and 800 block breakwaters				
81	***October 2010 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
82	***April 2011 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
83	***October 2011 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
84	***March 2012 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
85	***October 2012 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
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 Hual
87	January-May, 2013	Breakwater Relocation	800 Block	Breakwater 7 moved further offshore				
88	***April 2013 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
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	***October 2013 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
92	November 2013	Beach Nourishment	West Ocean View	Beach Nourishment	73,600			Truck Haul
93	***March 2014 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
94	***October 2014 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
95	***April 2015 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
96	***October 2015 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					
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 Hual Upland Source
99	***May 2016 Geodynamics Periodic Survey***		***Entire Ocean View Shoreline***					

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.

CHESAPEAKE BAY

0+00
2+50
5+00
7+50
10+00
12+50
15+00
17+50
20+00
22+50
25+00
27+50
30+00
32+50
35+00
37+50
40+00
42+50
45+00

Legend

- Digitized Shoreline (April 20, 2016)
- Digitized Shoreline (October 21, 2015)
- Digitized Shoreline (April 12, 2015)
- Survey Transects
- Survey Baseline

Shoreline Aerial Photo Date: April 2016
Background Aerial Photo Date: 2009

0 250 500 1,000 Feet

N

CHESAPEAKE BAY

45+25
47+30
49+35
51+41
53+46
55+51
57+57
59+62
61+62
63+62
65+62
67+62
69+62
71+62
73+62
75+62
77+62
79+62
81+62
83+62
85+62
87+62

Legend

- Digitized Shoreline (April 20, 2016)
- Digitized Shoreline (October 21, 2015)
- Digitized Shoreline (April 12, 2015)
- Survey Transects
- Survey Baseline

Shoreline Aerial Photo Date: April 2016
Background Aerial Photo Date: 2009

N

0 250 500 1,000 Feet

CHESAPEAKE BAY

93+41

103+08

120+93

129+17

141+98

152+01

163+49

Legend

- Digitized Shoreline (April 20, 2016)
- Digitized Shoreline (October 21, 2015)
- Digitized Shoreline (April 12, 2015)
- Survey Transects
- Survey Baseline

Shoreline Aerial Photo Date: April 2016
Background Aerial Photo Date: 2009

0 375 750 1,500 Feet

N


CHESAPEAKE BAY
Legend
Digitized Shoreline (April 20, 2016)
Digitized Shoreline (October 21, 2015)
Digitized Shoreline (April 12, 2015)
Survey Transects
Survey Baseline
Shoreline Aerial Photo Date: April 2016
Background Aerial Photo Date: 2009
0
250
500
1,000
Feet
N
163+49
169+63
171+63
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175+63
177+63
179+63
181+63
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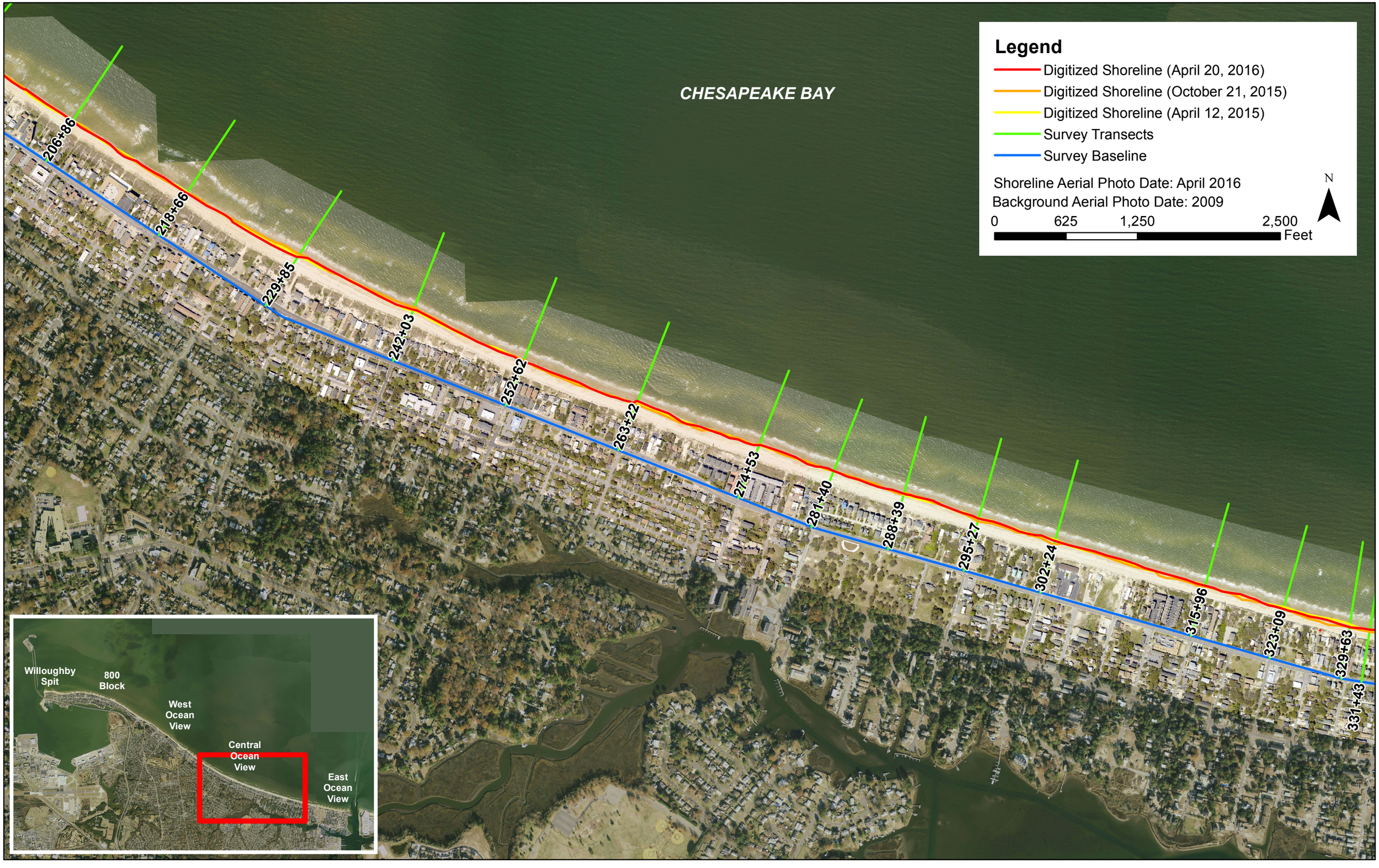
195+63
Willoughby Spit
800 Block
West Ocean View
Central Ocean View
East Ocean View


CHESAPEAKE BAY
206+86
218+66
229+85
242+03
252+62
263+22
274+53
281+40
288+39
295+27
302+24
315+96
323+09
329+63
331+43
Legend
Digitized Shoreline (April 20, 2016)
Digitized Shoreline (October 21, 2015)
Digitized Shoreline (April 12, 2015)
Survey Transects
Survey Baseline
Shoreline Aerial Photo Date: April 2016
Background Aerial Photo Date: 2009
0
625
1,250
2,500
Feet
N
Willoughby Spit
800 Block
West Ocean View
Central Ocean View
East Ocean View

CHESAPEAKE BAY

Legend

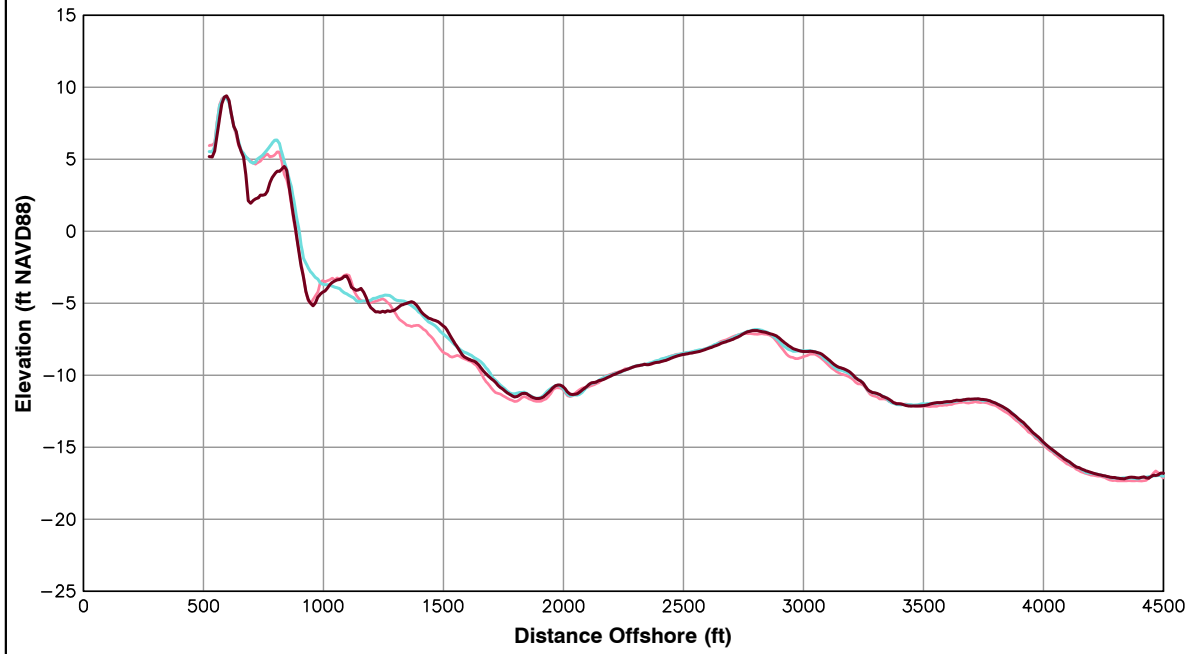
- Digitized Shoreline (April 20, 2016)
- Digitized Shoreline (October 21, 2015)
- Digitized Shoreline (April 12, 2015)
- Survey Transects
- Survey Baseline

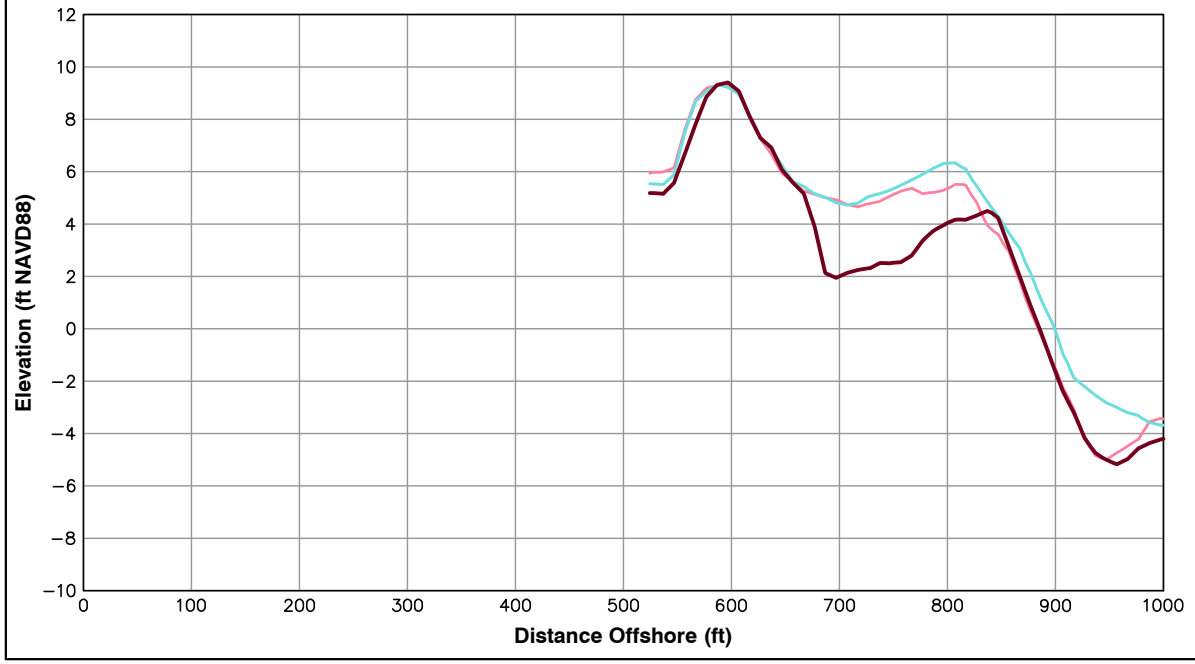
Shoreline Aerial Photo Date: April 2016
Background Aerial Photo Date: 2009

0 300 600 1,200 Feet

N

329+63 331+43 333+23 335+03 336+83 338+63 340+43 342+23 344+05 345+85 347+63 349+43 351+23 353+03 354+83 356+63 358+43 360+23 362+03 363+83 365+63 367+43 369+23 371+03 372+83 375+08 376+78 378+48 380+18 381+88 383+58





Survey Transect 0+00	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	1.98 ft/yr	-12.07 ft
Volume Change Above -15 ft NAVD88	10.42 cy/ft/yr	-23.84 cy/ft
Volume Change Above 0 ft NAVD88	-12.06 cy/ft/yr	-17.06 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
1. Stationing From West To East At Varying Intervals.
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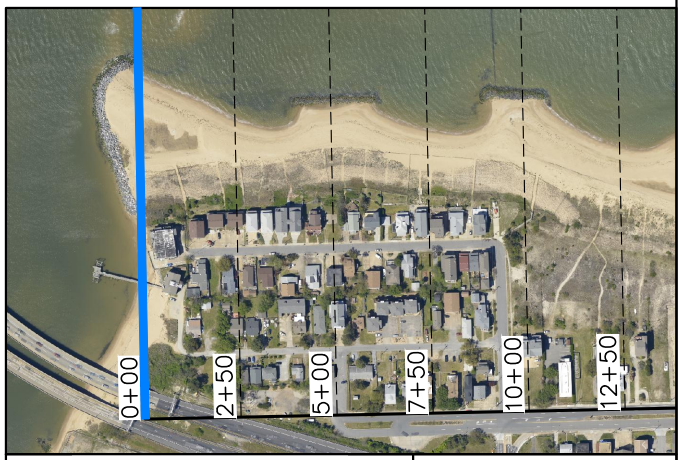
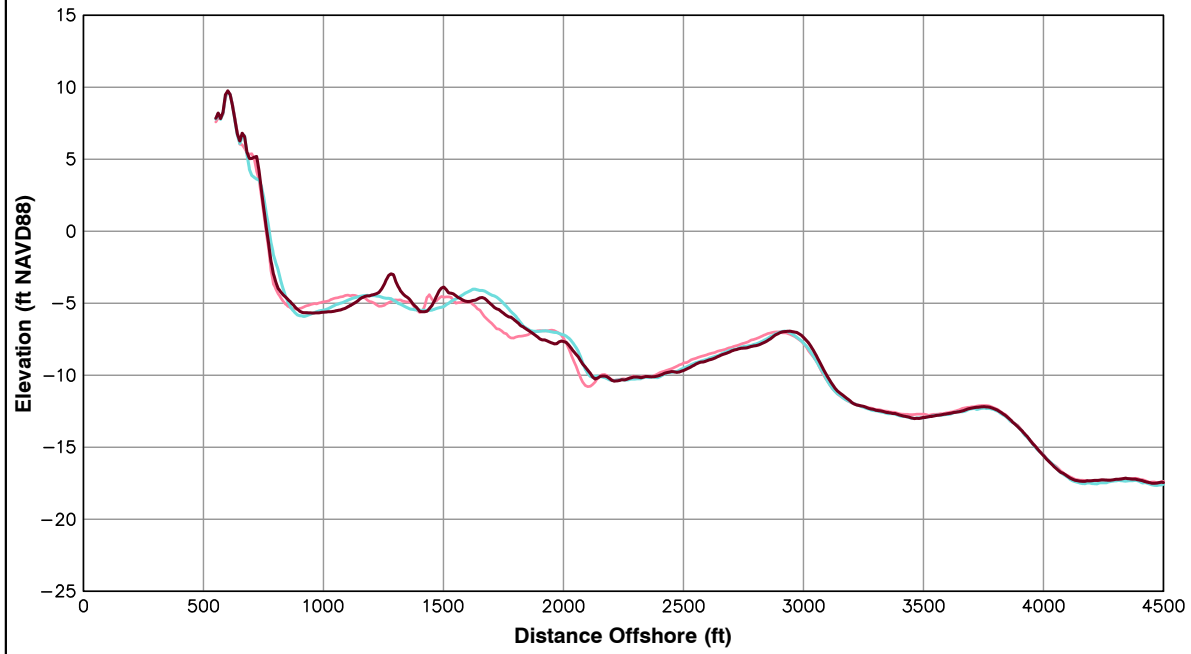
4. Survey Comparison Made To April 2015 and October 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

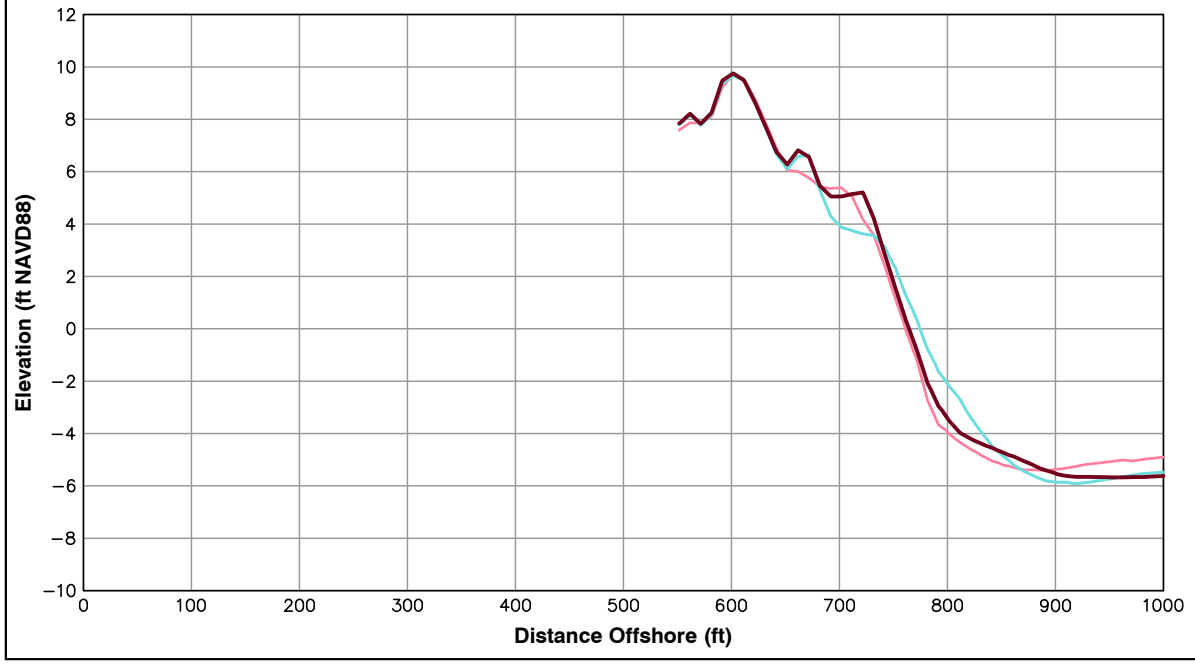


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

ST 0+00	Pg 1 of 106	Spring 2016





Survey Transect 2+50	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	2.94 ft/yr	-8.52 ft
Volume Change Above -15 ft NAVD88	8.01 cy/ft/yr	-0.30 cy/ft
Volume Change Above 0 ft NAVD88	1.58 cy/ft/yr	1.56 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
1. Stationing From West To East At Varying Intervals.
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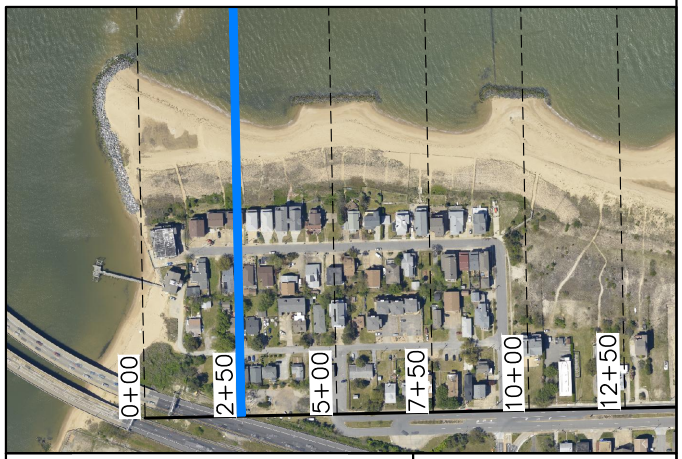
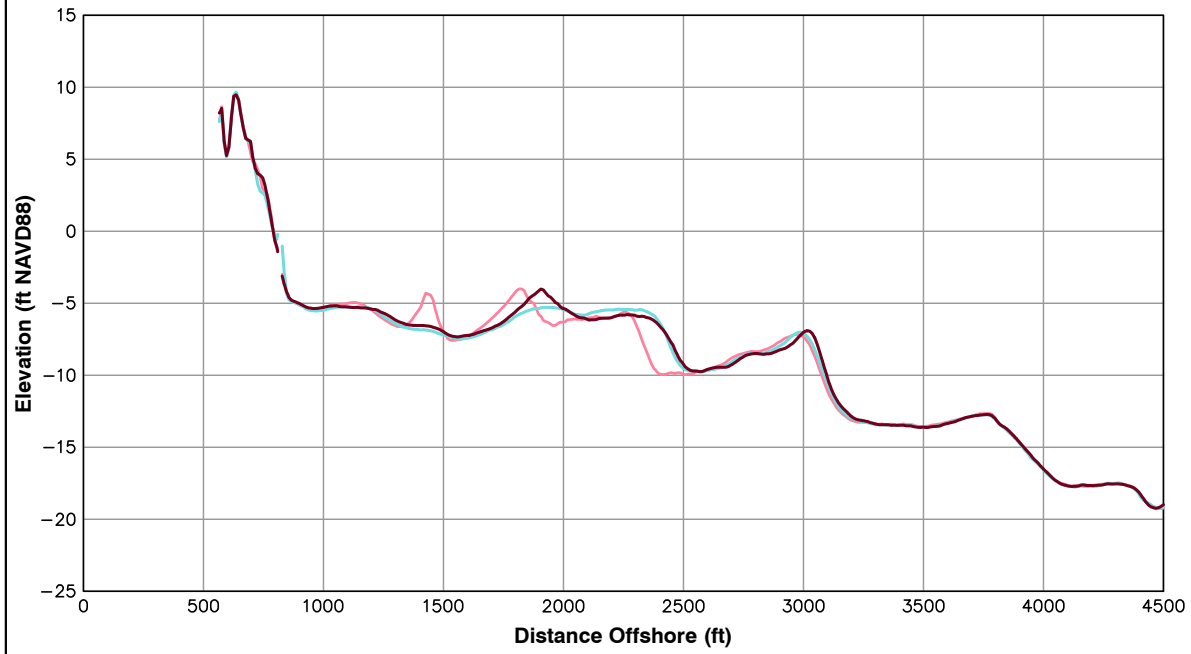
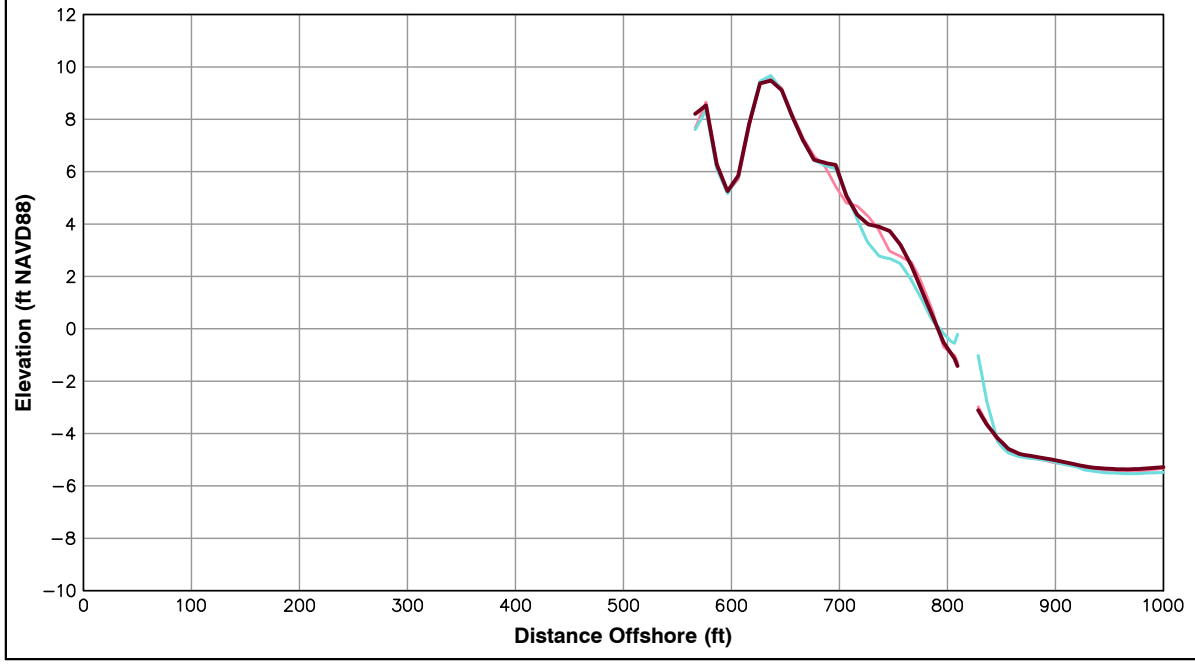


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

ST 2+50	Pg 2 of 106	Spring 2016





Survey Transect 5+00	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-2.23 ft/yr	3.16 ft
Volume Change Above -15 ft NAVD88	13.93 cy/ft/yr	9.15 cy/ft
Volume Change Above 0 ft NAVD88	0.44 cy/ft/yr	2.03 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
1. Stationing From West To East At Varying Intervals.
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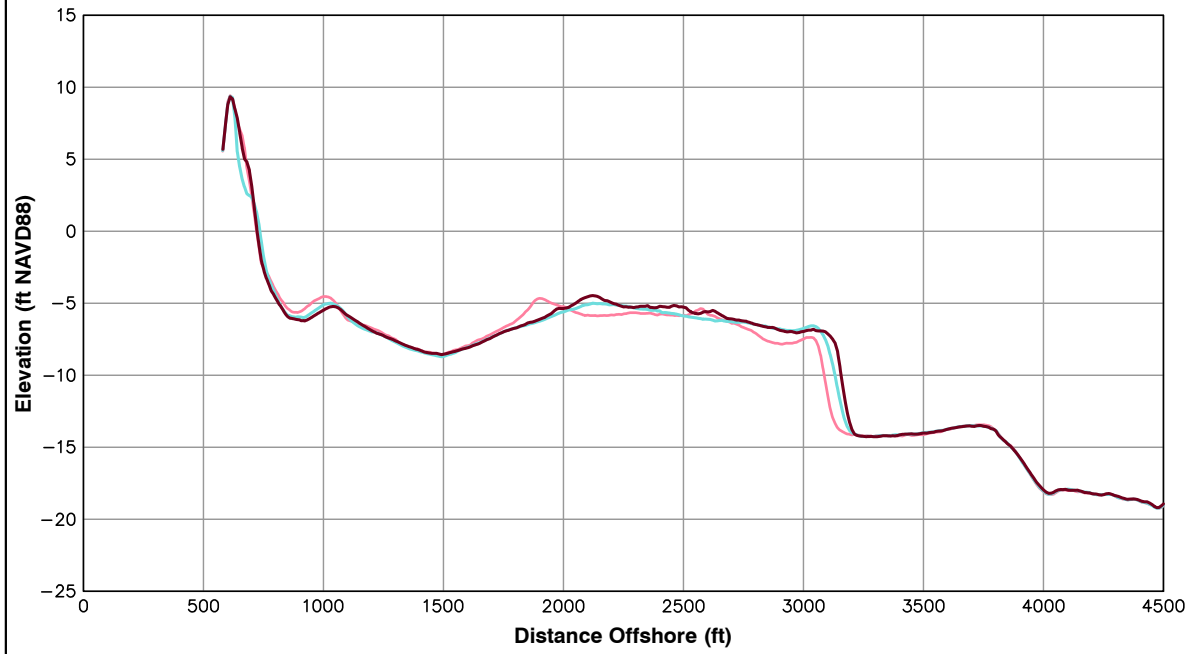
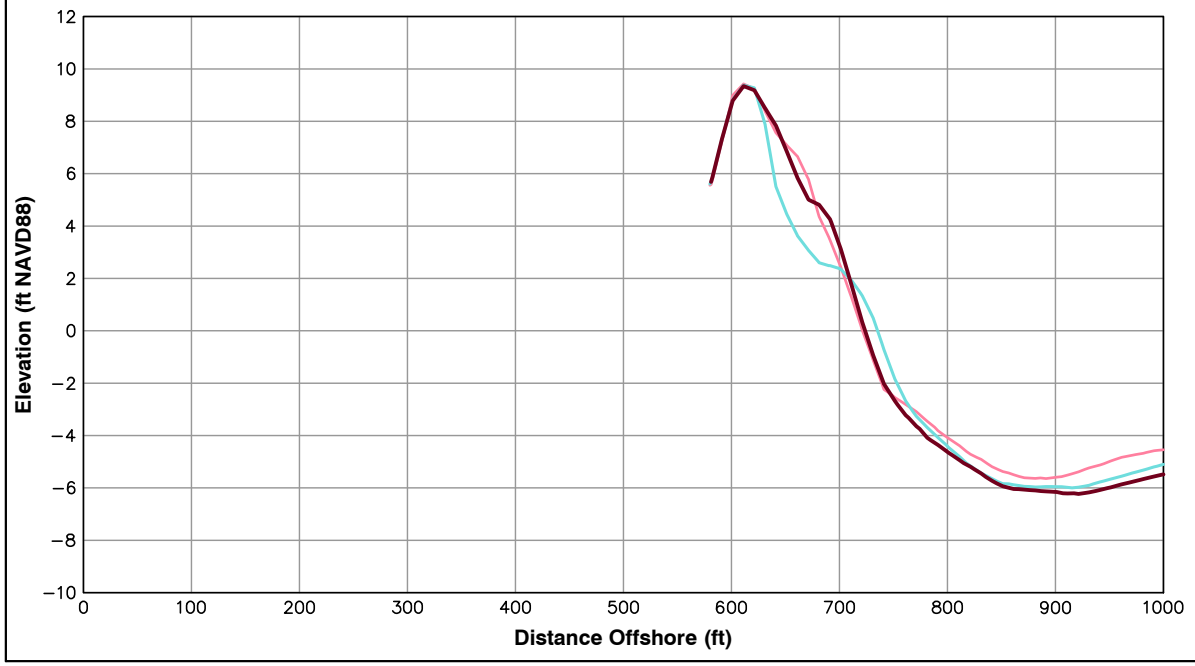
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 7+50	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	2.89 ft/yr	-8.84 ft
Volume Change Above -15 ft NAVD88	23.40 cy/ft/yr	17.39 cy/ft
Volume Change Above 0 ft NAVD88	0.33 cy/ft/yr	4.61 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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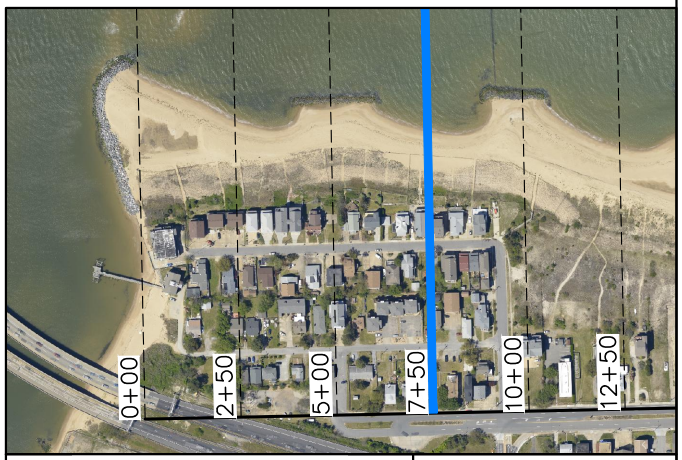
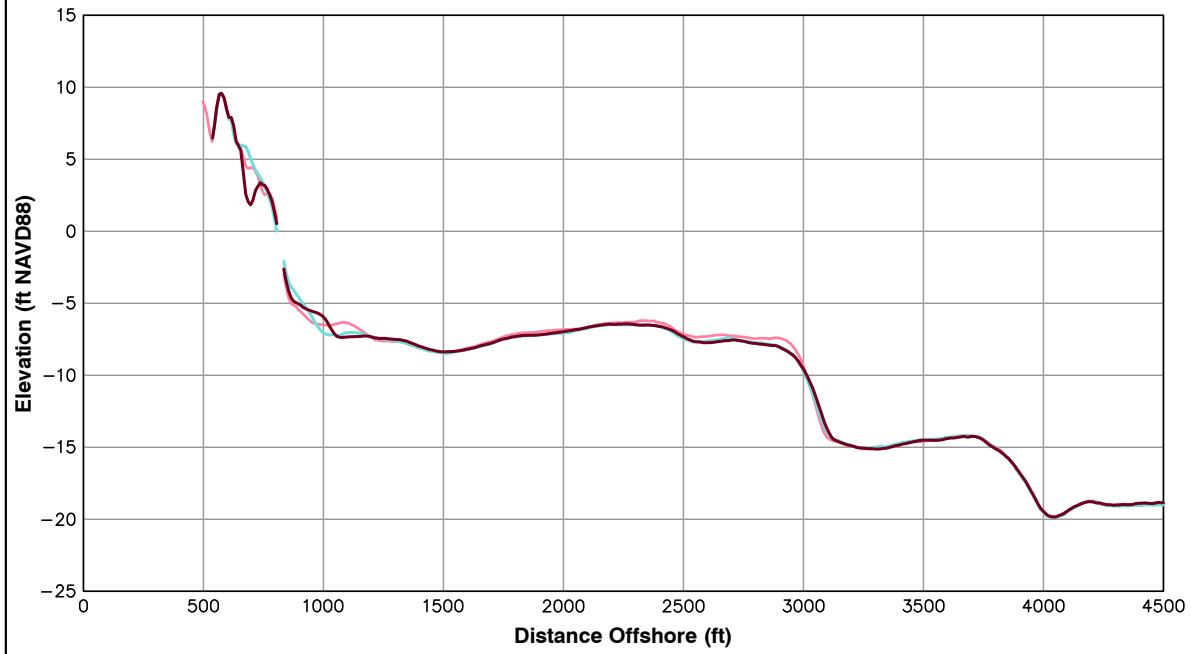
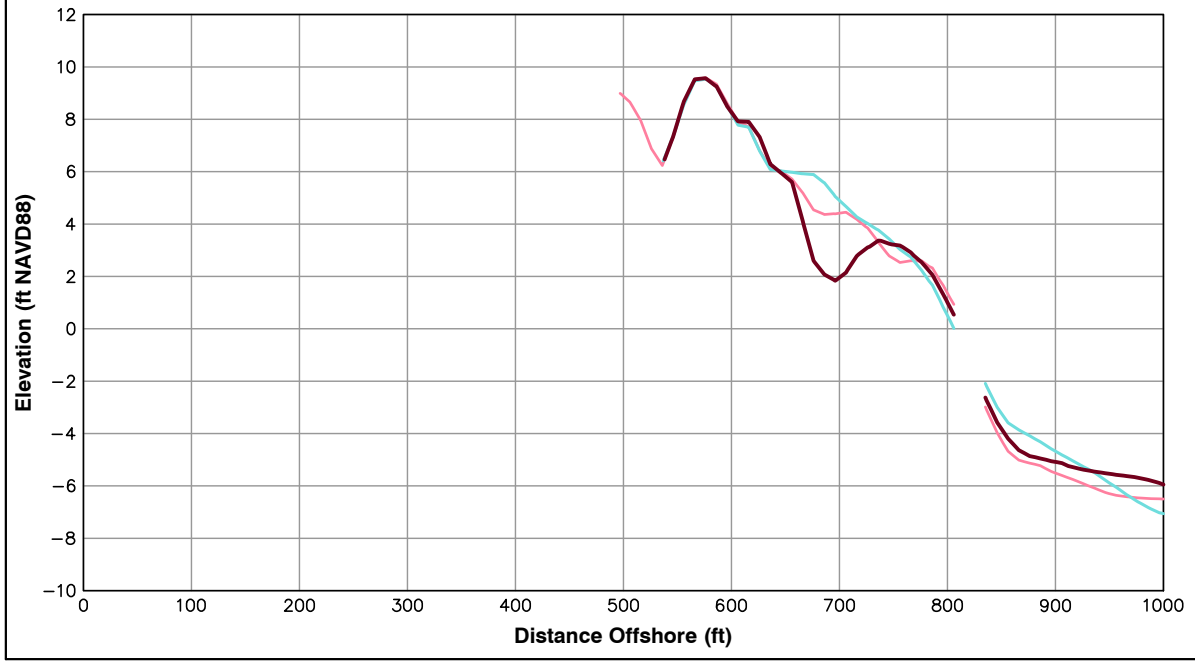


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 10+00	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-4.63 ft/yr	6.00 ft
Volume Change Above -15 ft NAVD88	-13.56 cy/ft/yr	-3.86 cy/ft
Volume Change Above 0 ft NAVD88	-3.91 cy/ft/yr	-5.48 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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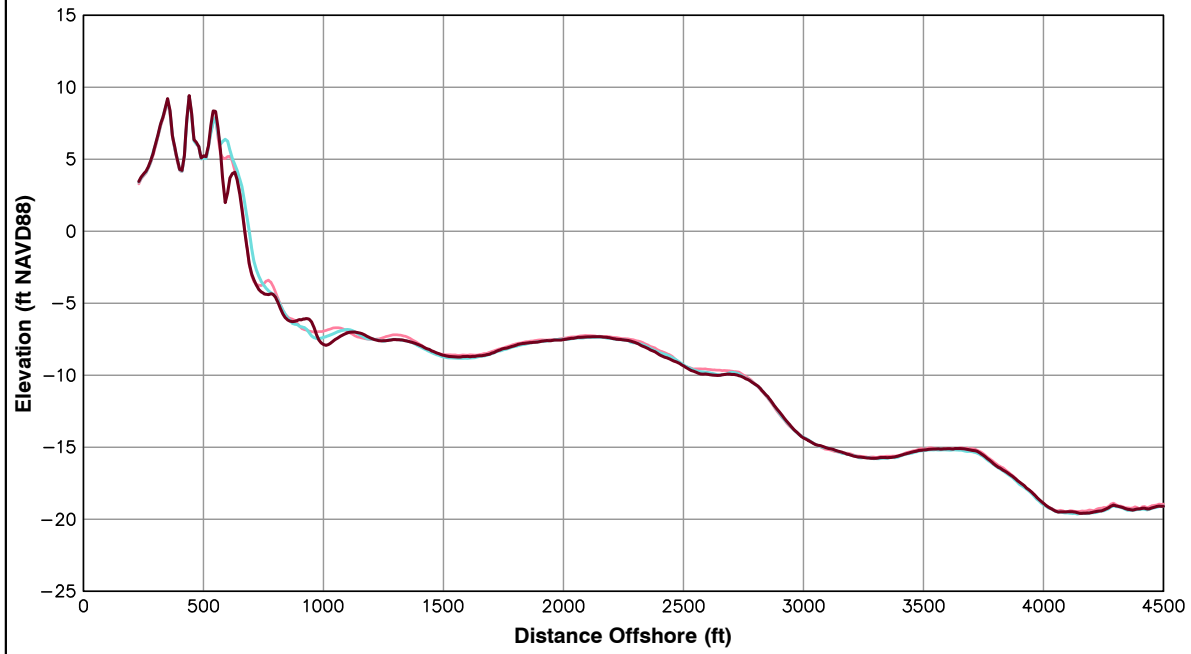
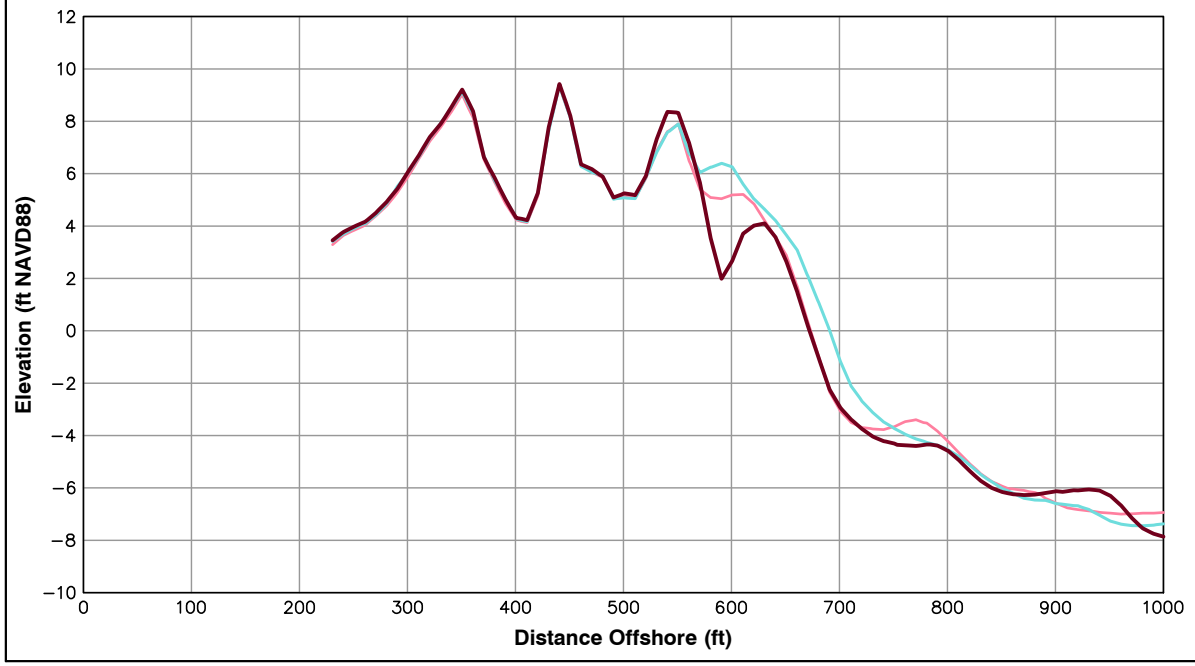
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 12+50	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-1.33 ft/yr	-16.99 ft
Volume Change Above -15 ft NAVD88	-12.20 cy/ft/yr	-9.97 cy/ft
Volume Change Above 0 ft NAVD88	-1.43 cy/ft/yr	-6.33 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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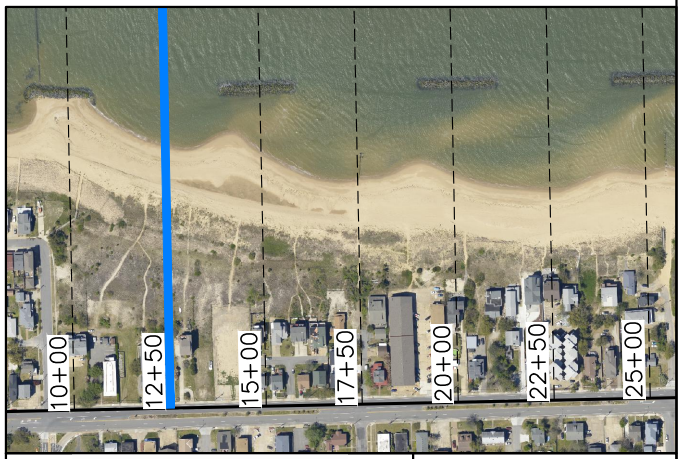

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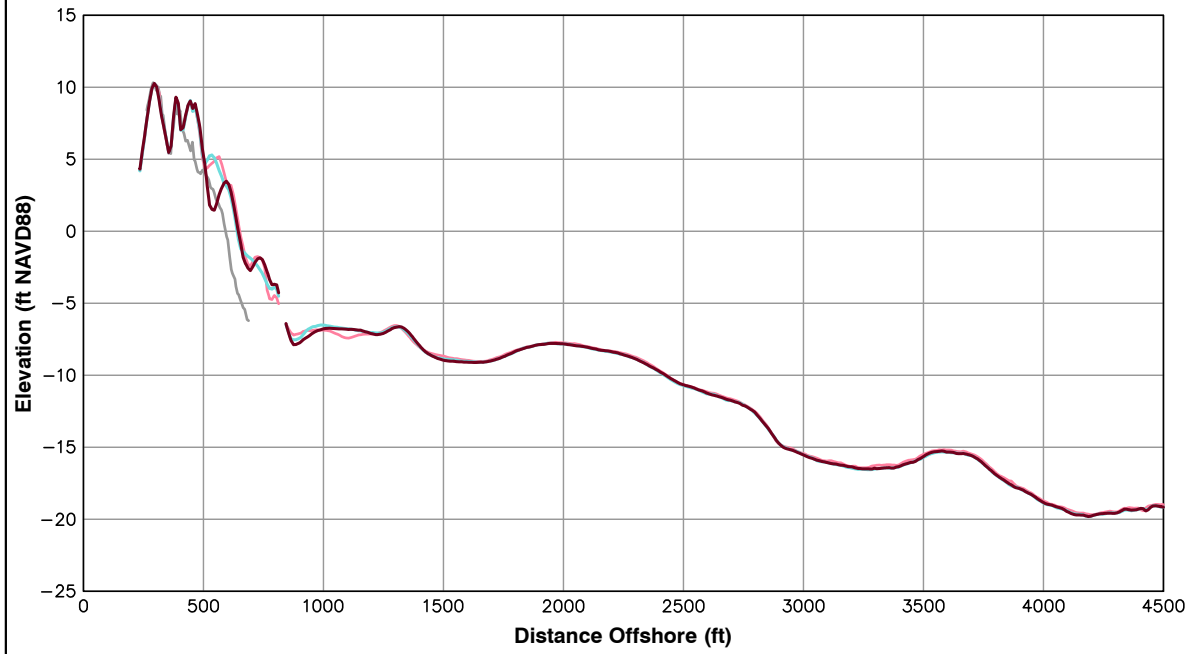
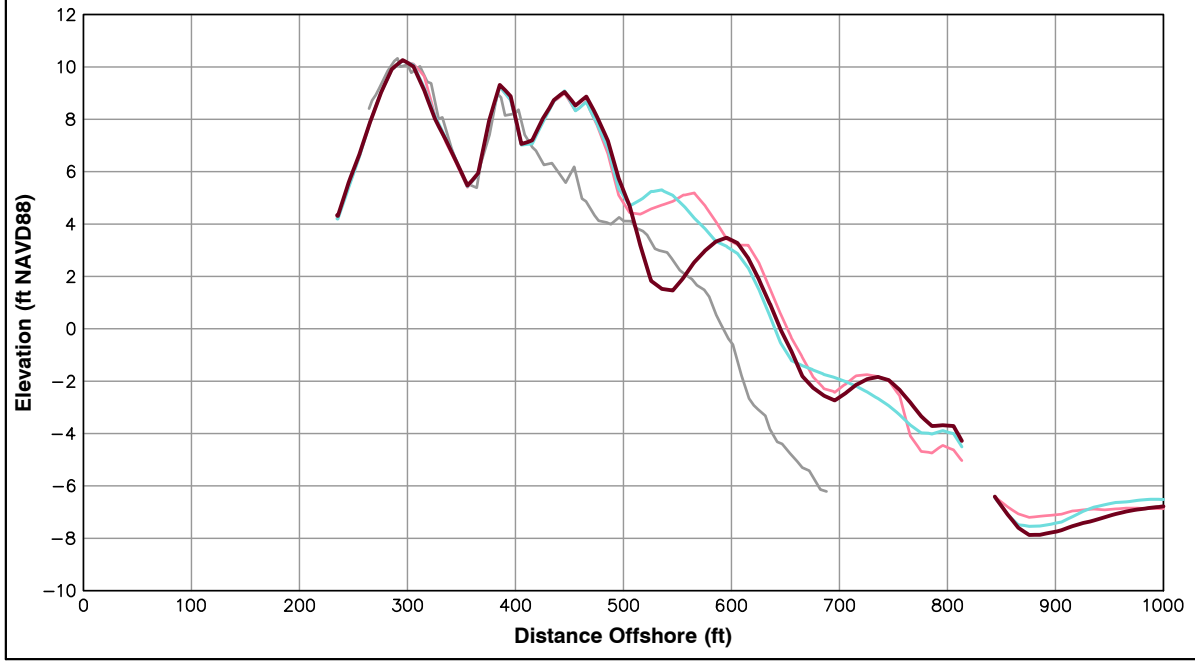
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 15+00	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-5.74 ft/yr	4.61 ft
Volume Change Above -15 ft NAVD88	-9.32 cy/ft/yr	-5.71 cy/ft
Volume Change Above 0 ft NAVD88	-6.44 cy/ft/yr	-5.06 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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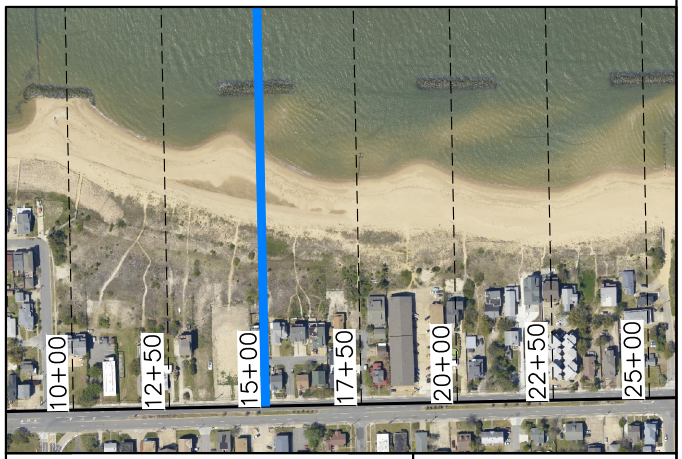

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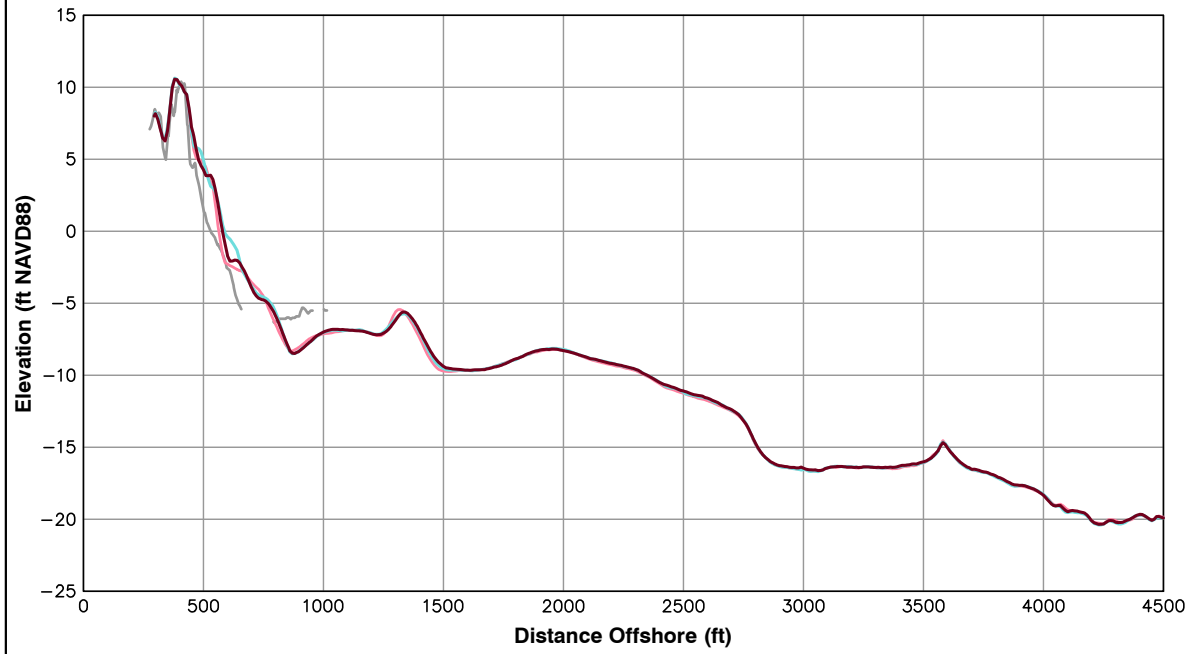
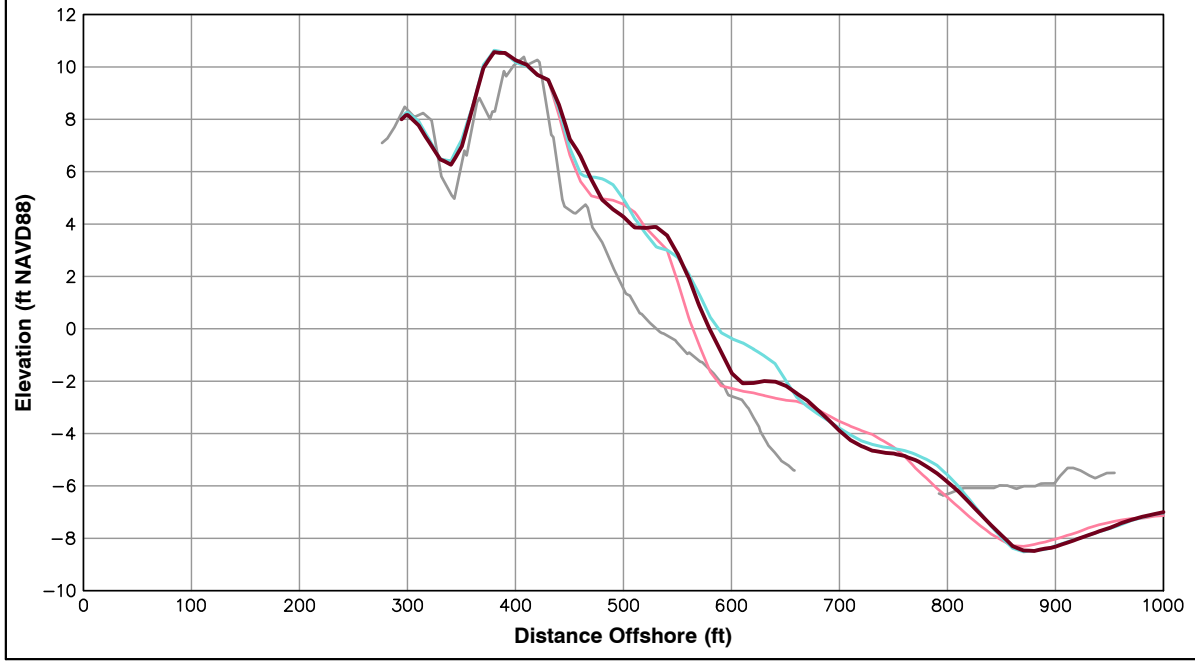
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 17+50	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	12.32 ft/yr	-4.80 ft
Volume Change Above -15 ft NAVD88	9.63 cy/ft/yr	-2.72 cy/ft
Volume Change Above 0 ft NAVD88	1.89 cy/ft/yr	-0.71 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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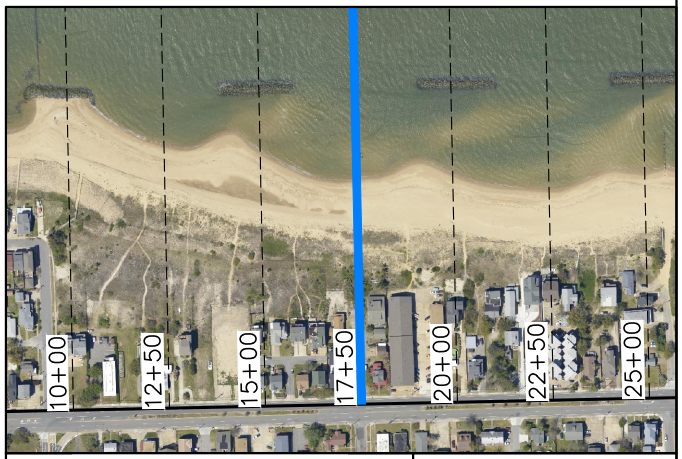
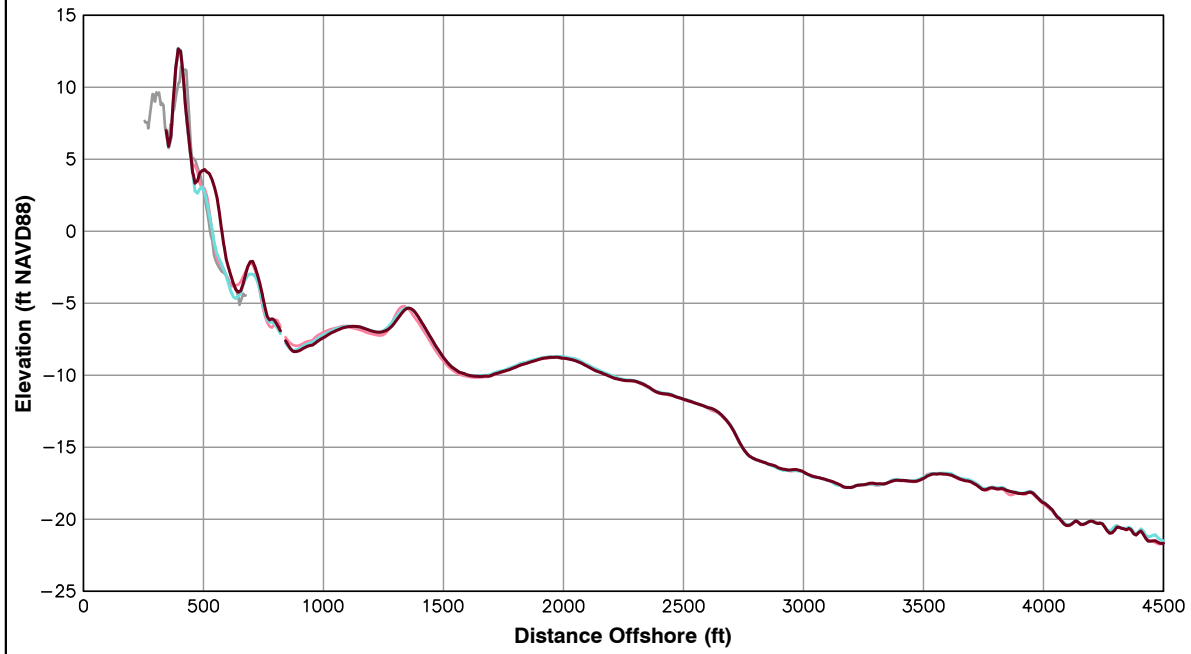
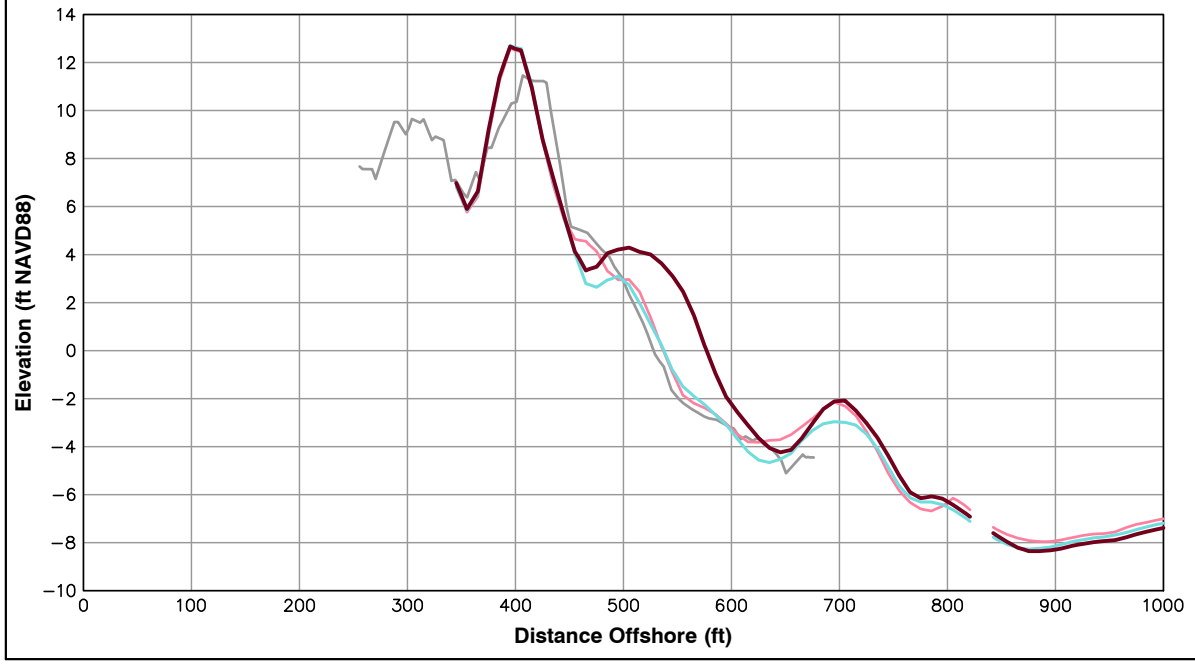


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 20+00	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	38.45 ft/yr	42.55 ft
Volume Change Above -15 ft NAVD88	11.40 cy/ft/yr	11.20 cy/ft
Volume Change Above 0 ft NAVD88	6.16 cy/ft/yr	7.93 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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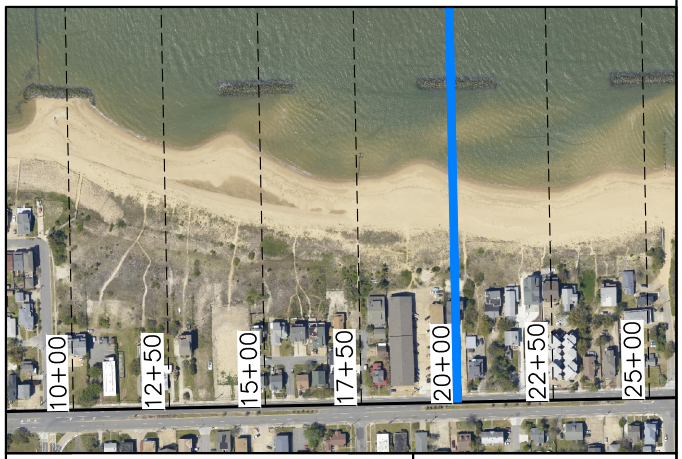
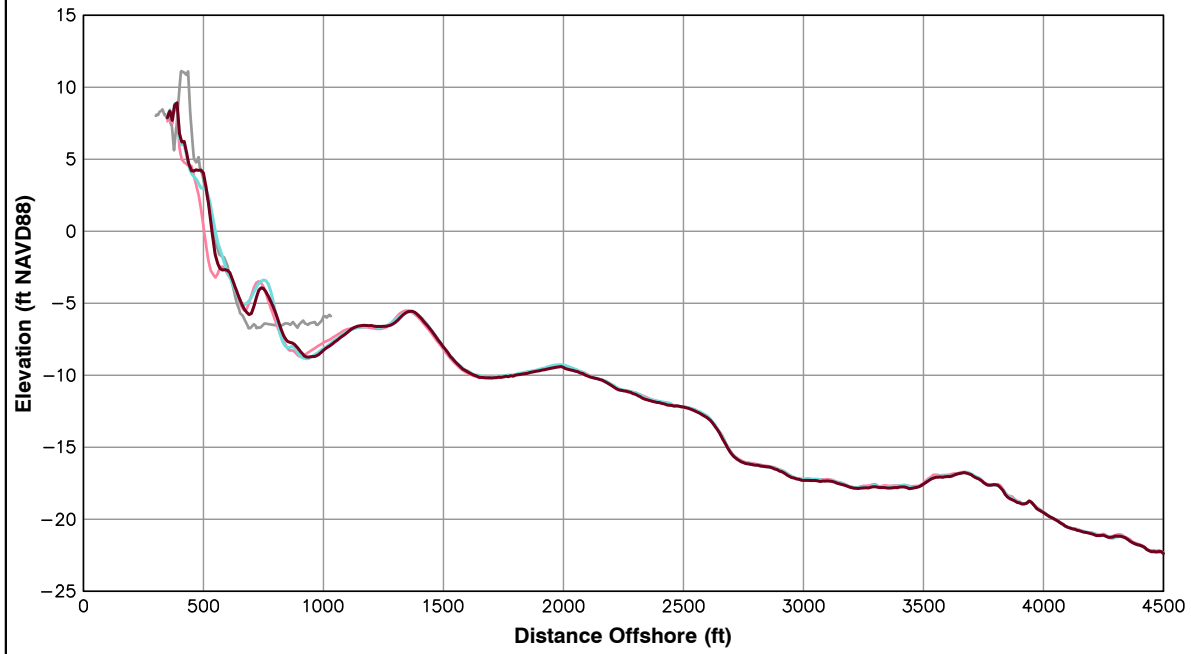
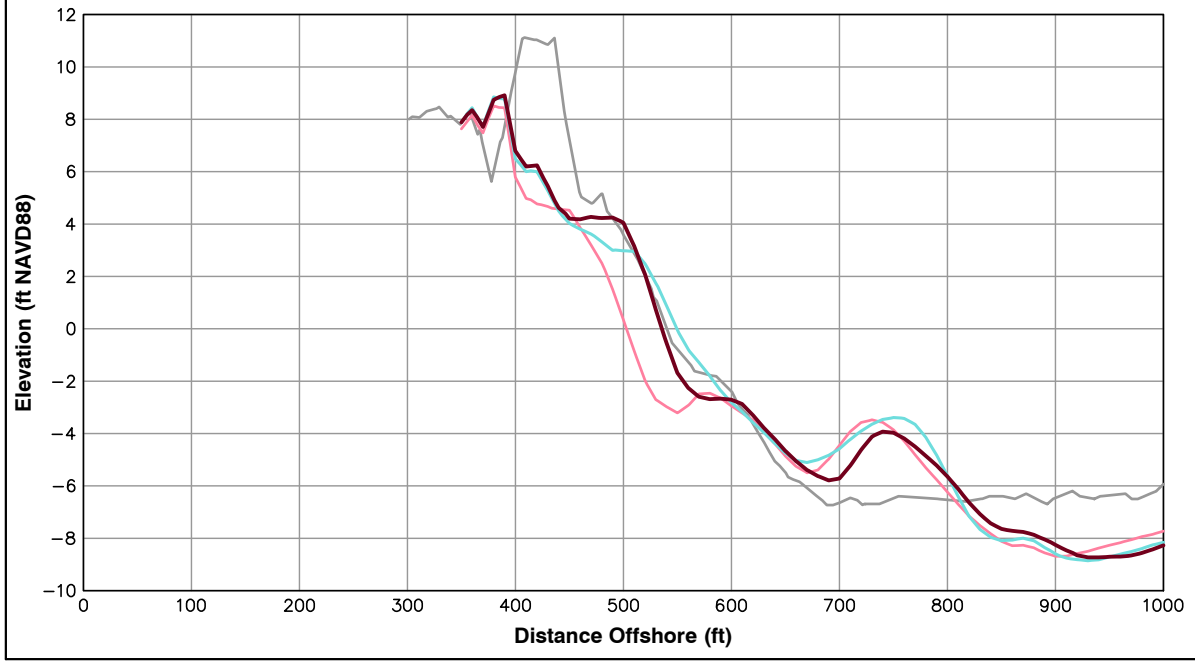


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 22+50	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	31.95 ft/yr	-10.51 ft
Volume Change Above -15 ft NAVD88	8.54 cy/ft/yr	-6.52 cy/ft
Volume Change Above 0 ft NAVD88	7.36 cy/ft/yr	1.17 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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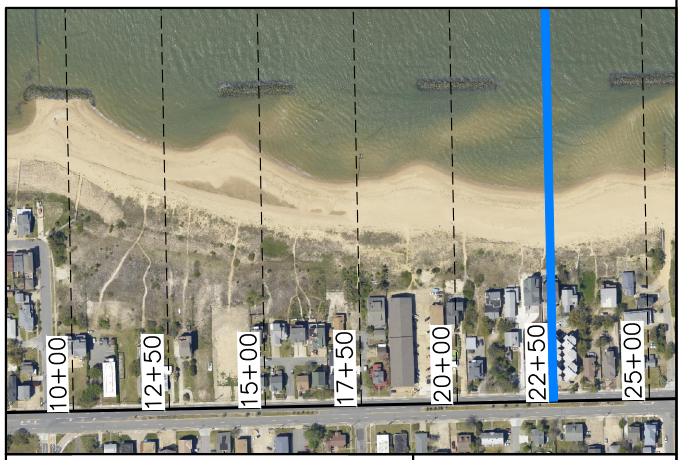
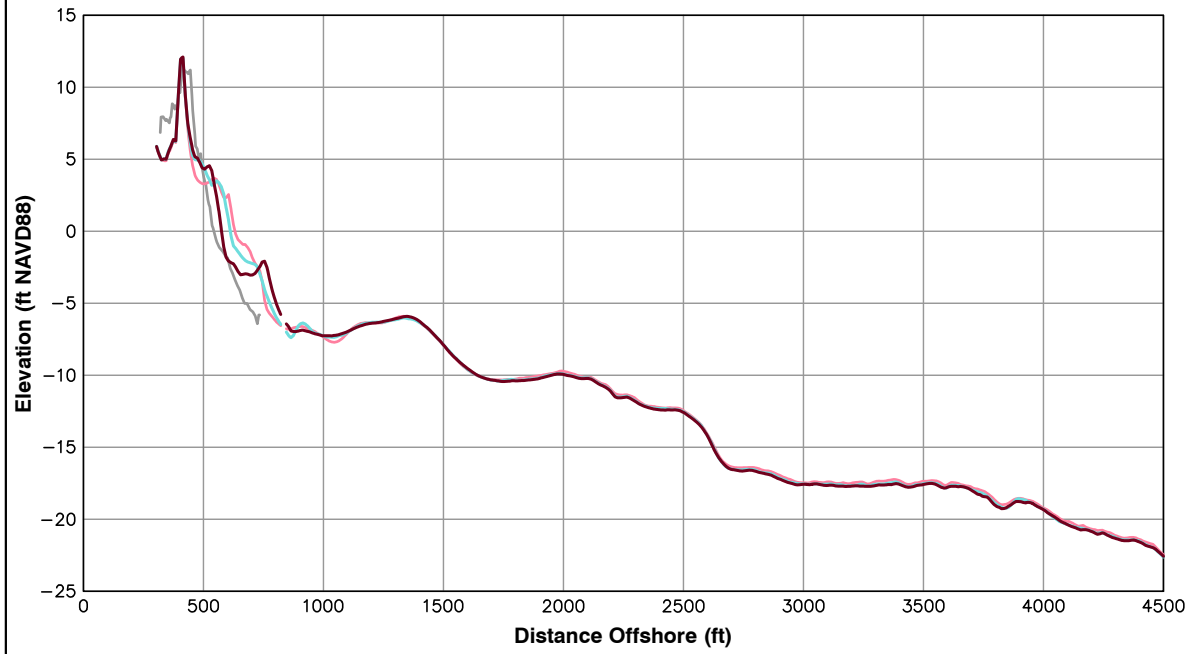
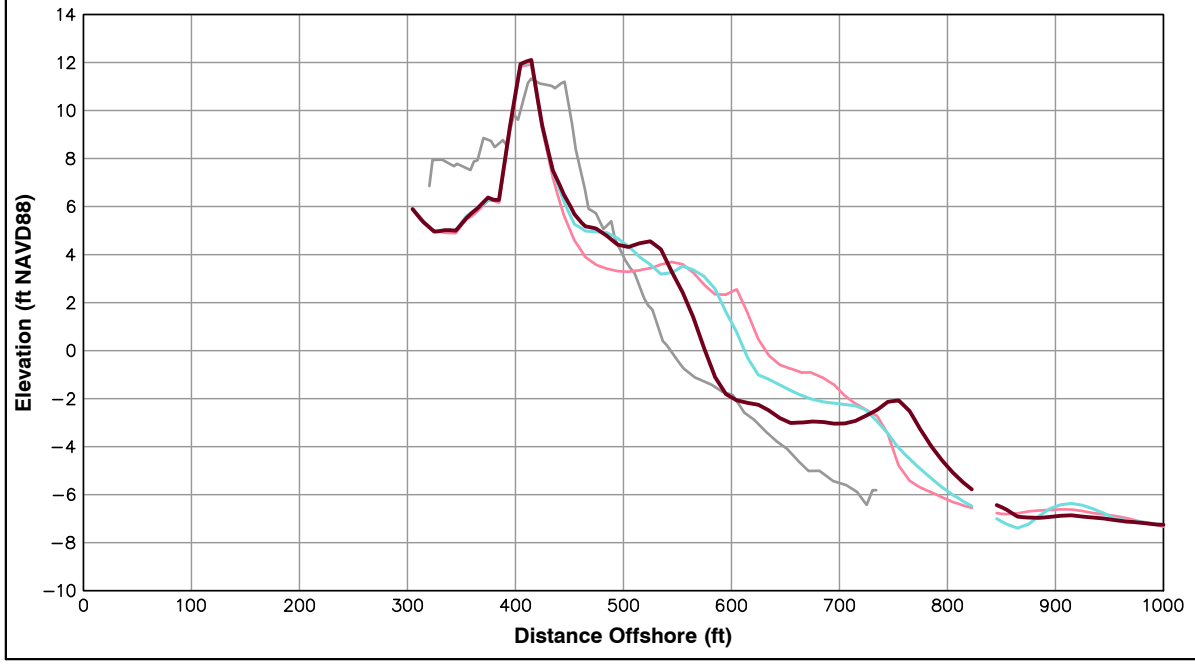


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 25+00	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-49.71 ft/yr	-34.51 ft
Volume Change Above -15 ft NAVD88	-8.90 cy/ft/yr	-6.31 cy/ft
Volume Change Above 0 ft NAVD88	-0.96 cy/ft/yr	-2.83 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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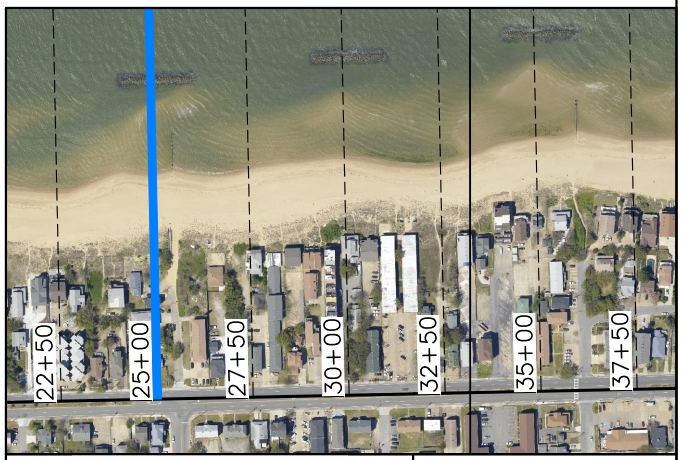
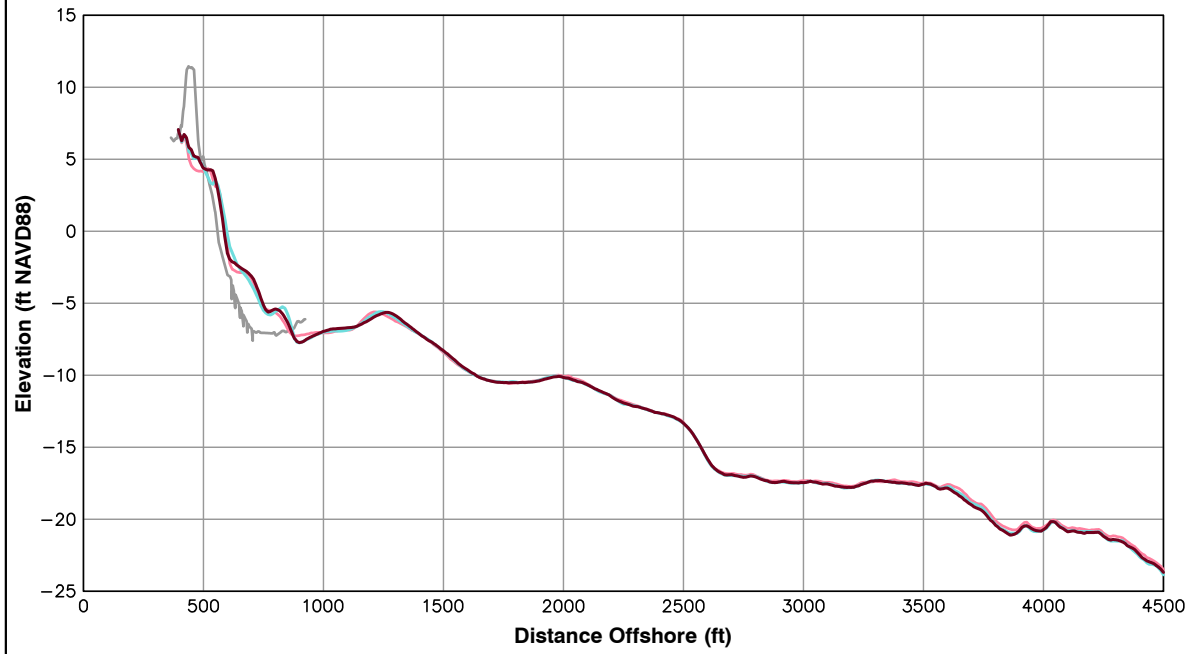
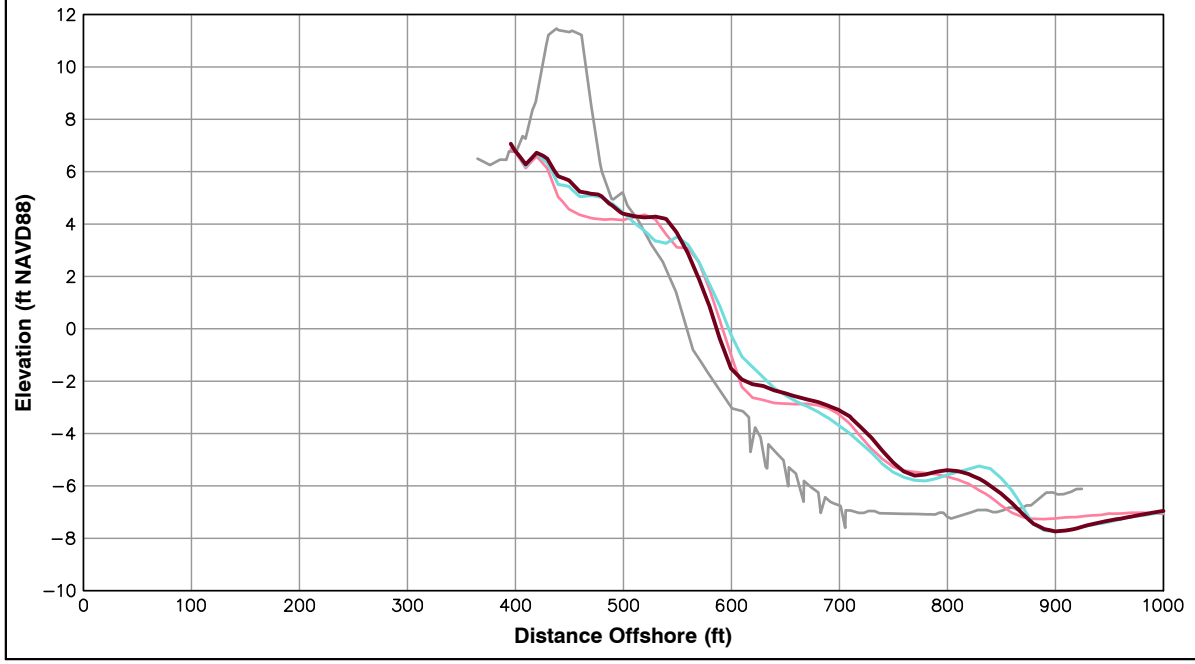


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 27+50	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-5.08 ft/yr	-9.32 ft
Volume Change Above -15 ft NAVD88	3.45 cy/ft/yr	1.23 cy/ft
Volume Change Above 0 ft NAVD88	1.93 cy/ft/yr	0.39 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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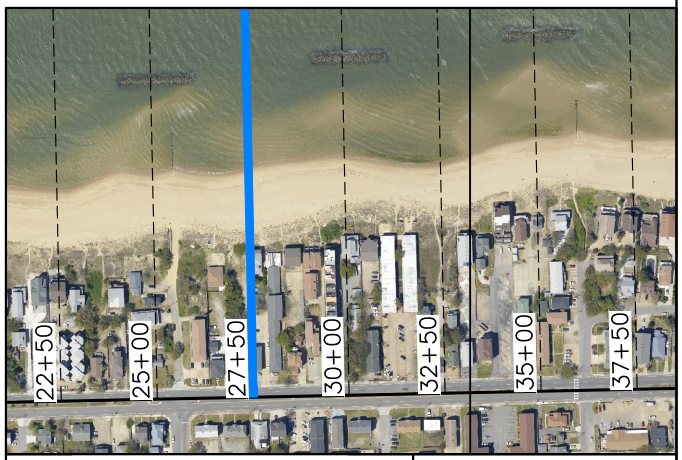
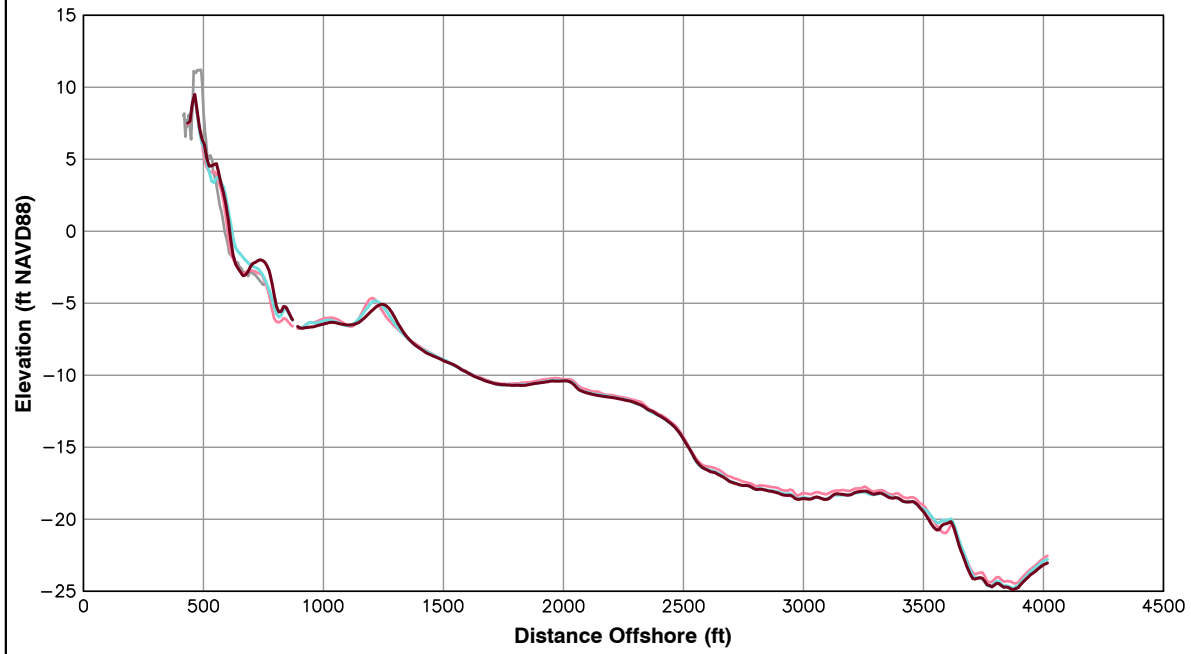
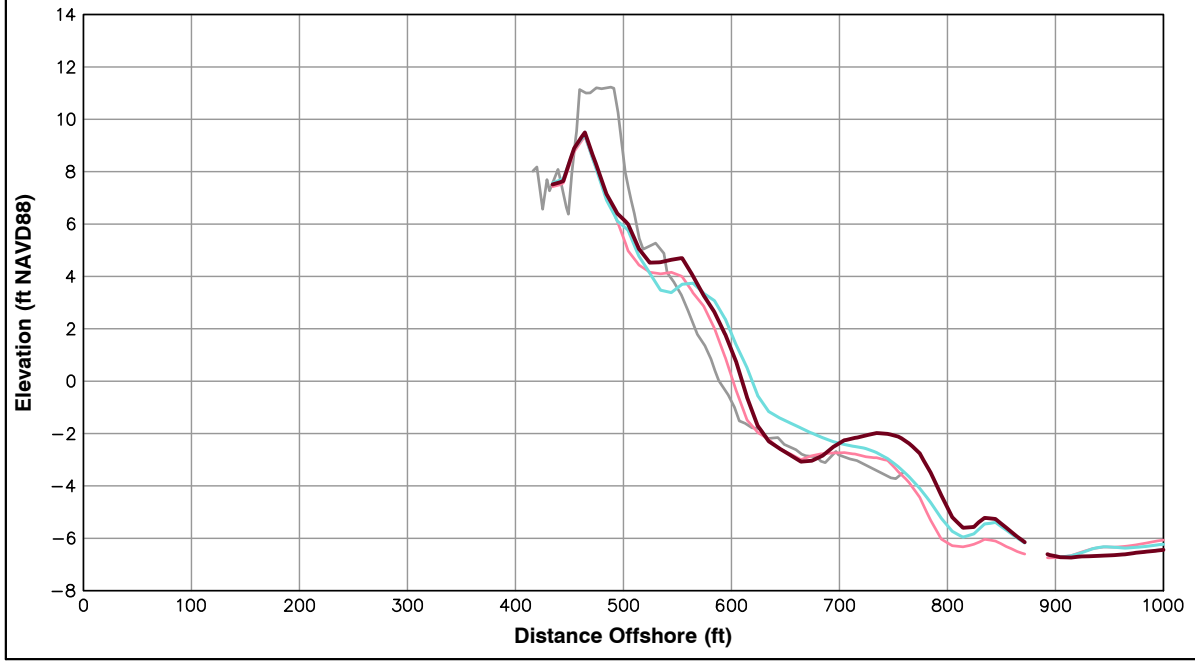


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 30+00	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	8.06 ft/yr	-6.94 ft
Volume Change Above -15 ft NAVD88	2.72 cy/ft/yr	-0.42 cy/ft
Volume Change Above 0 ft NAVD88	2.73 cy/ft/yr	1.06 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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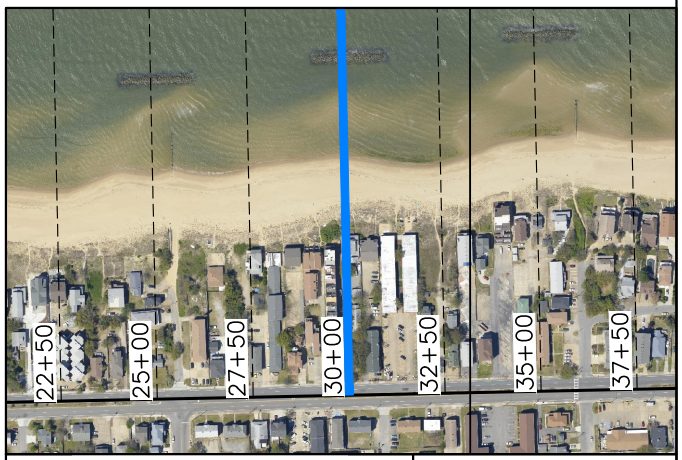

City of Norfolk

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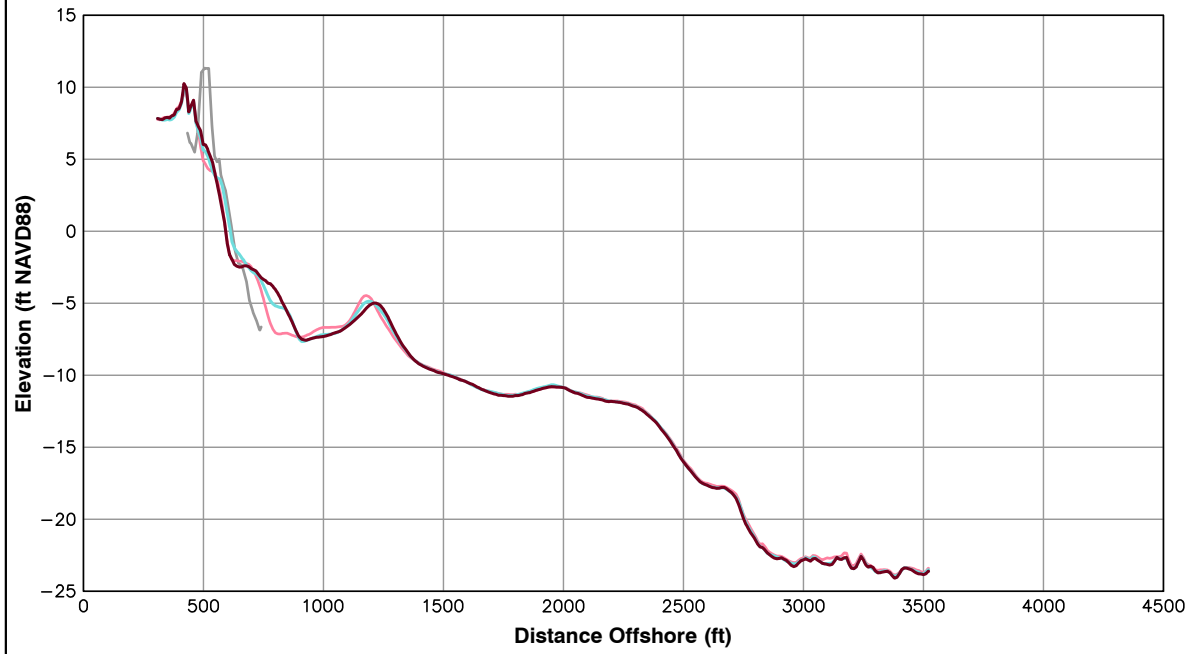
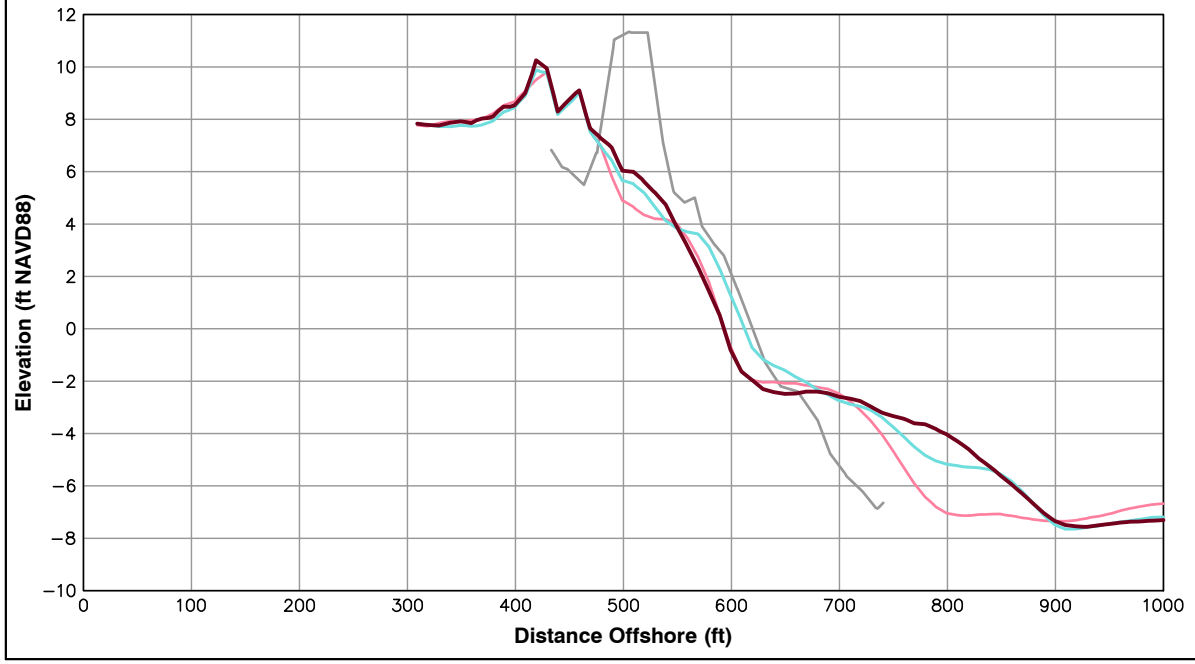
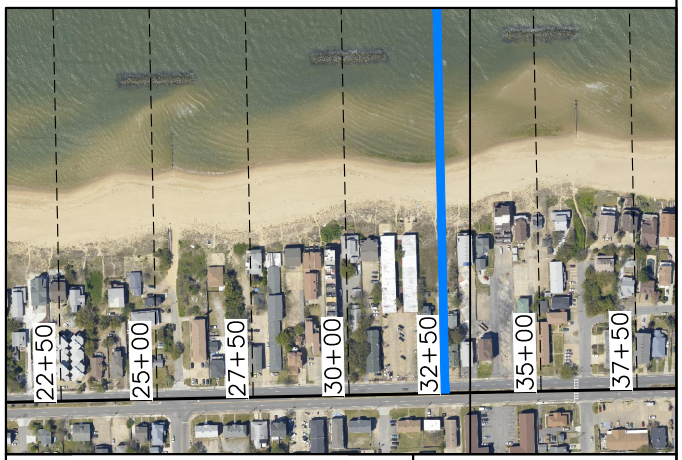




Survey Transect 32+50	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-1.37 ft/yr	-18.20 ft
Volume Change Above -15 ft NAVD88	6.74 cy/ft/yr	-2.42 cy/ft
Volume Change Above 0 ft NAVD88	2.11 cy/ft/yr	-0.51 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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 April 2015 and October 2015.
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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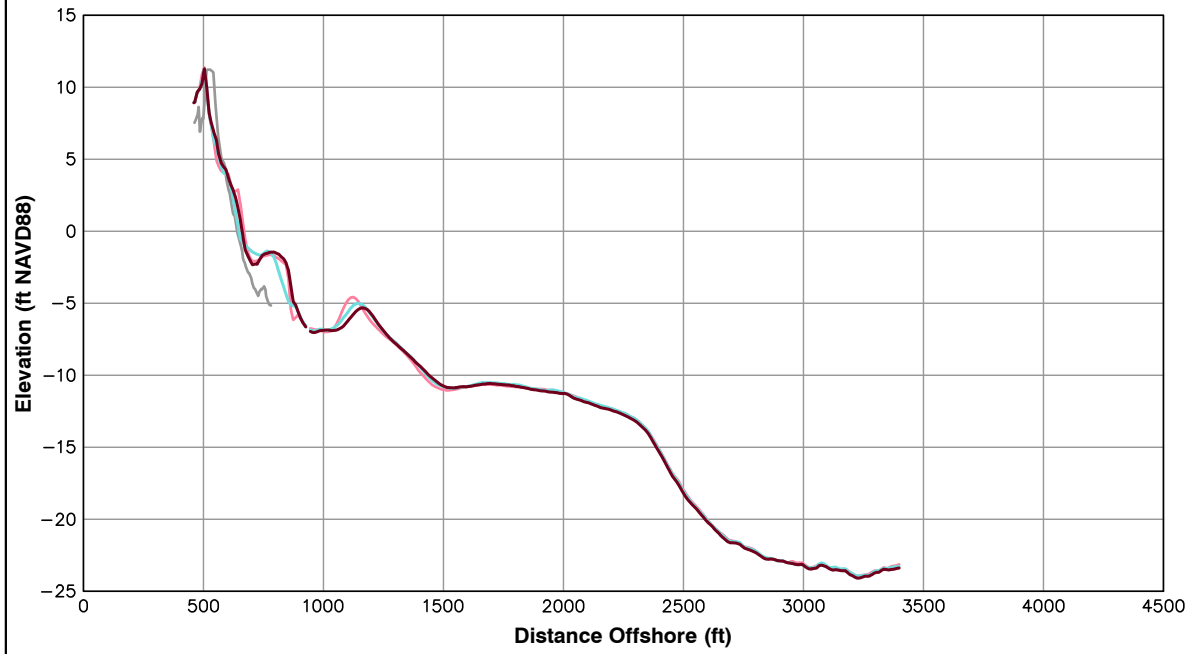
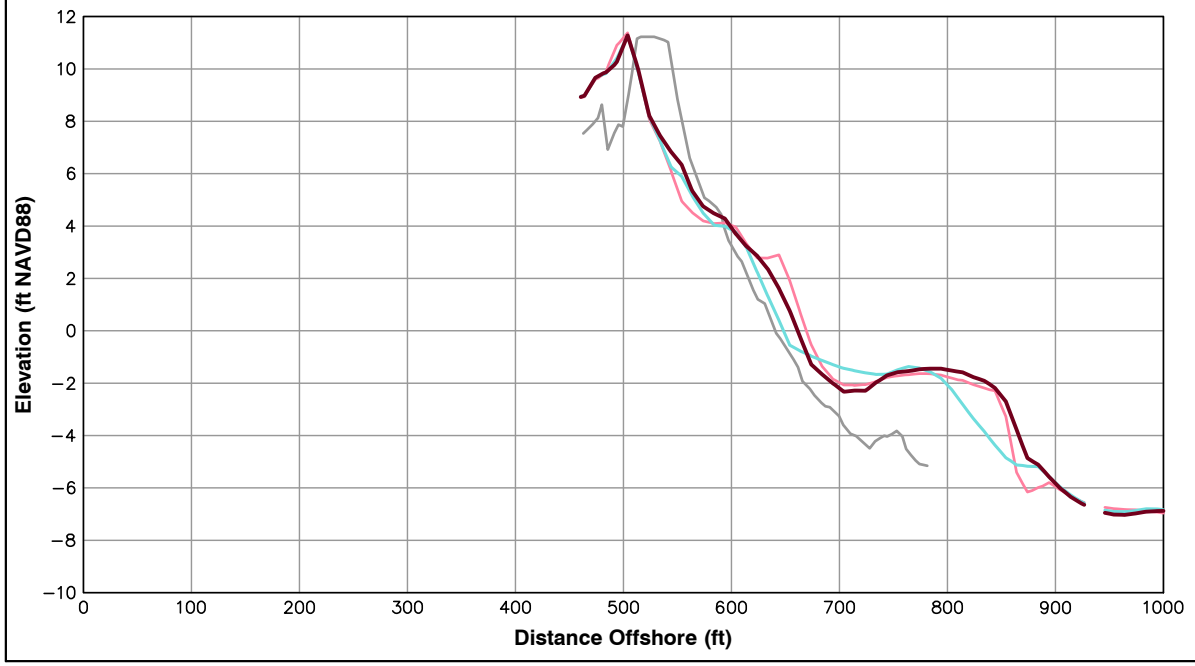
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

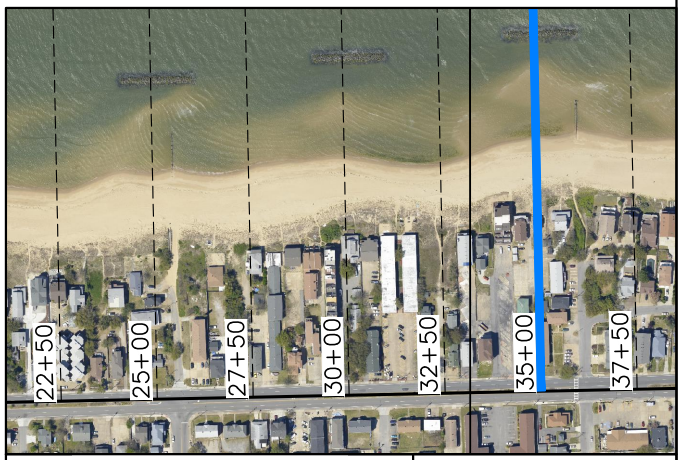




Survey Transect 35+00	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-9.46 ft/yr	13.93 ft
Volume Change Above -15 ft NAVD88	0.08 cy/ft/yr	0.45 cy/ft
Volume Change Above 0 ft NAVD88	0.01 cy/ft/yr	2.26 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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 April 2015 and October 2015.
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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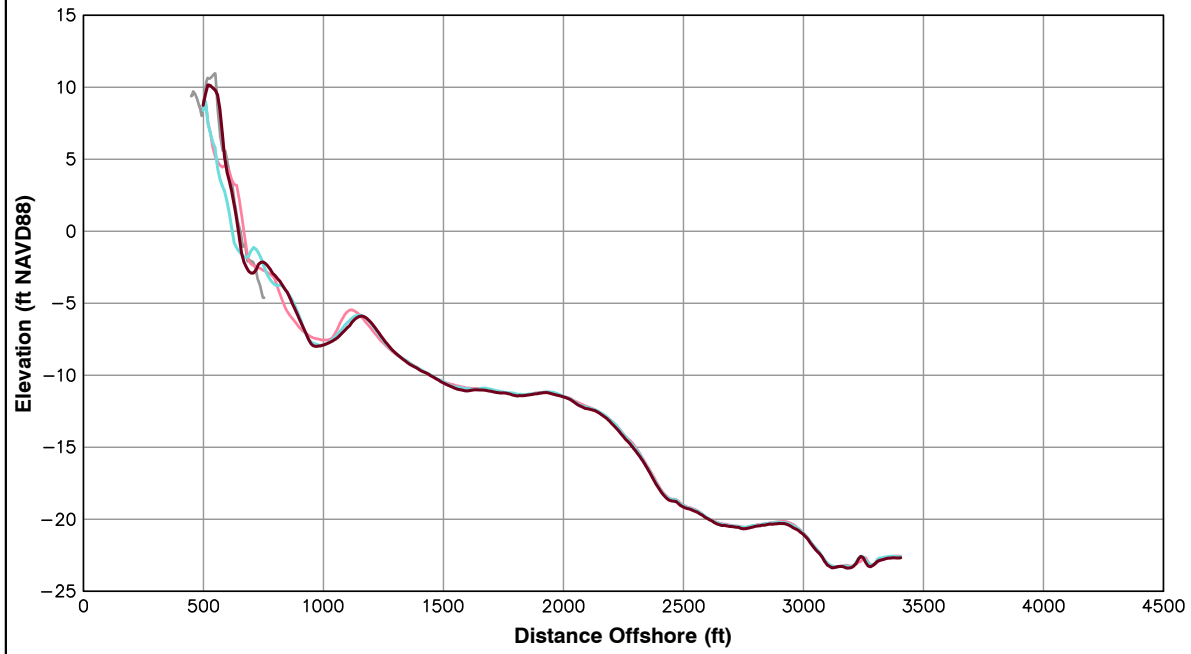
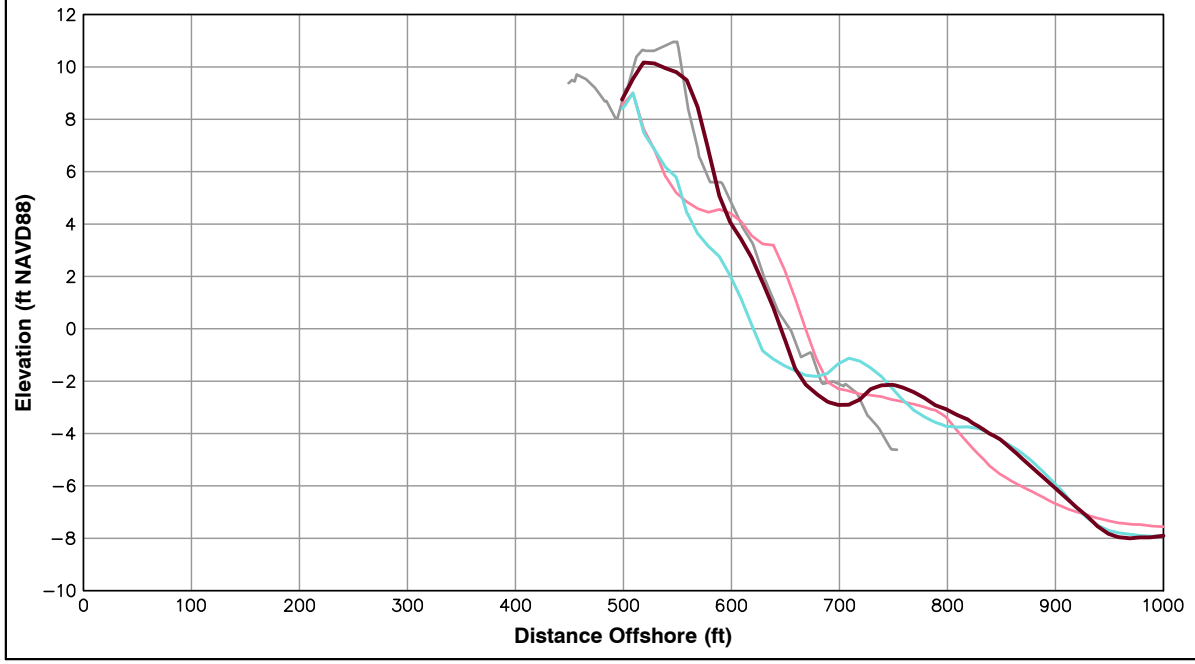
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

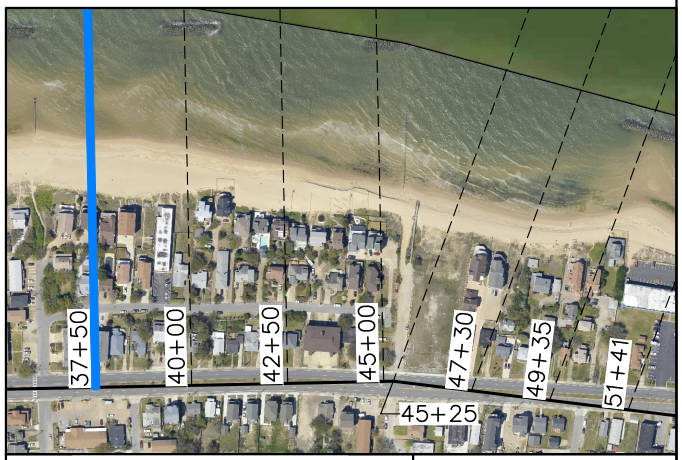




Survey Transect 37+50	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-22.28 ft/yr	26.31 ft
Volume Change Above -15 ft NAVD88	2.00 cy/ft/yr	10.02 cy/ft
Volume Change Above 0 ft NAVD88	6.07 cy/ft/yr	14.71 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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 April 2015 and October 2015.
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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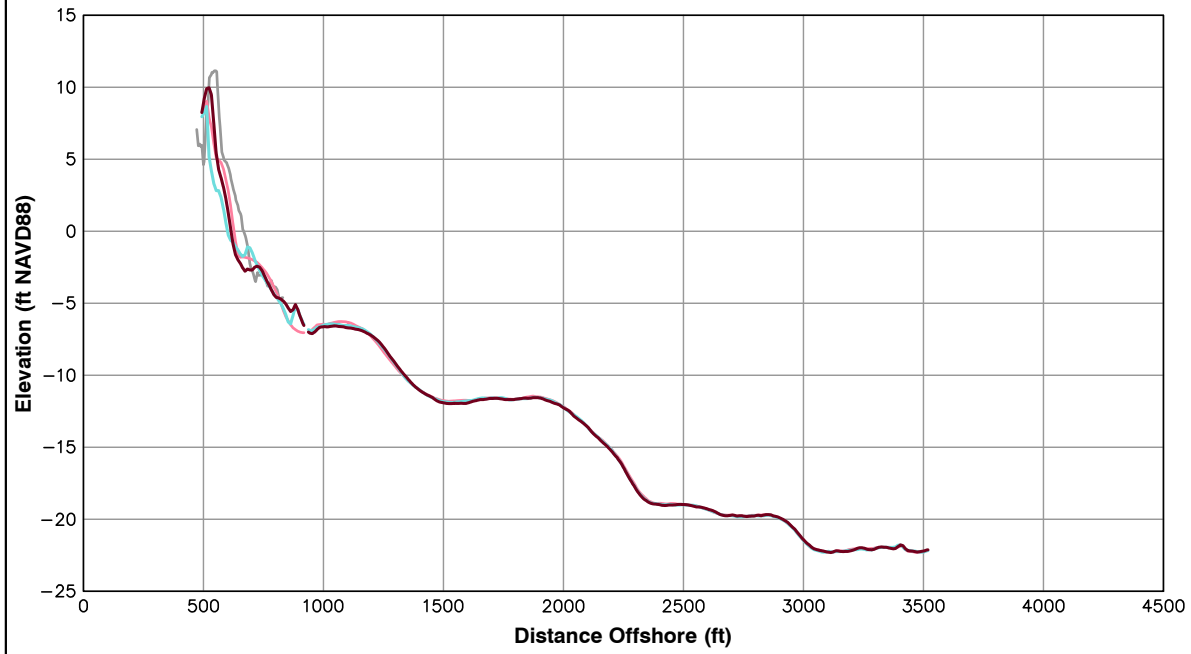
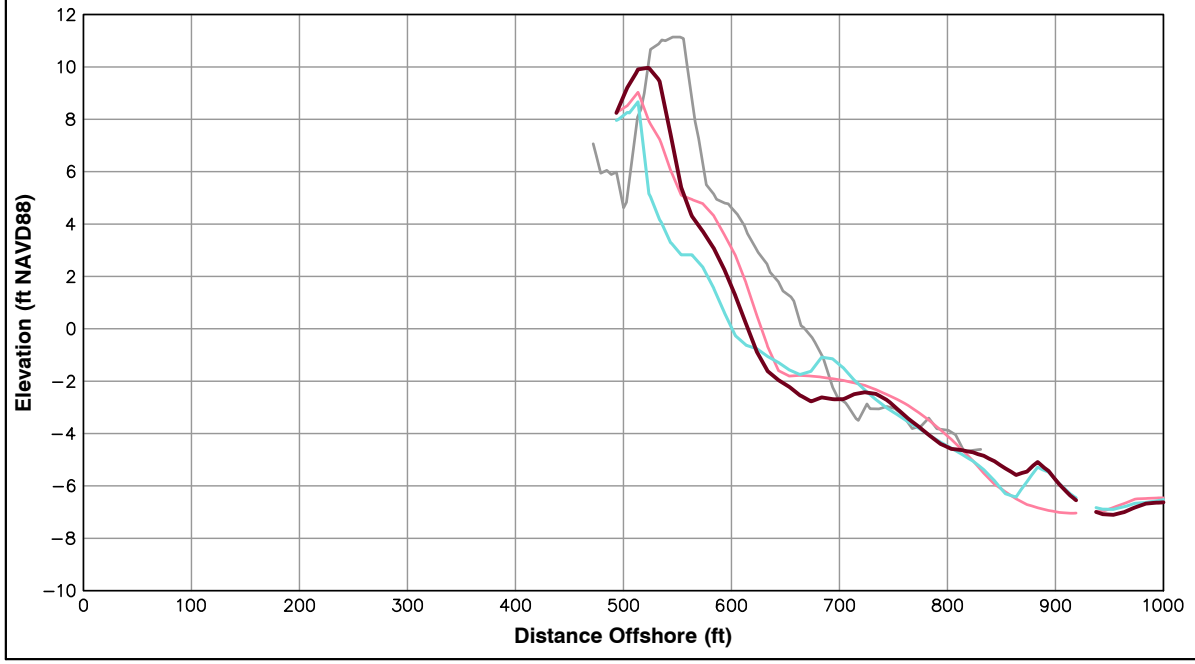
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

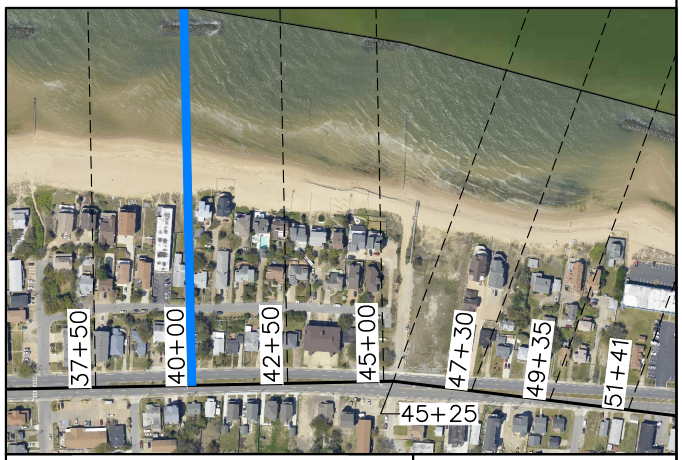




Survey Transect 40+00	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-12.79 ft/yr	16.58 ft
Volume Change Above -15 ft NAVD88	-3.38 cy/ft/yr	6.51 cy/ft
Volume Change Above 0 ft NAVD88	-0.12 cy/ft/yr	9.86 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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 April 2015 and October 2015.
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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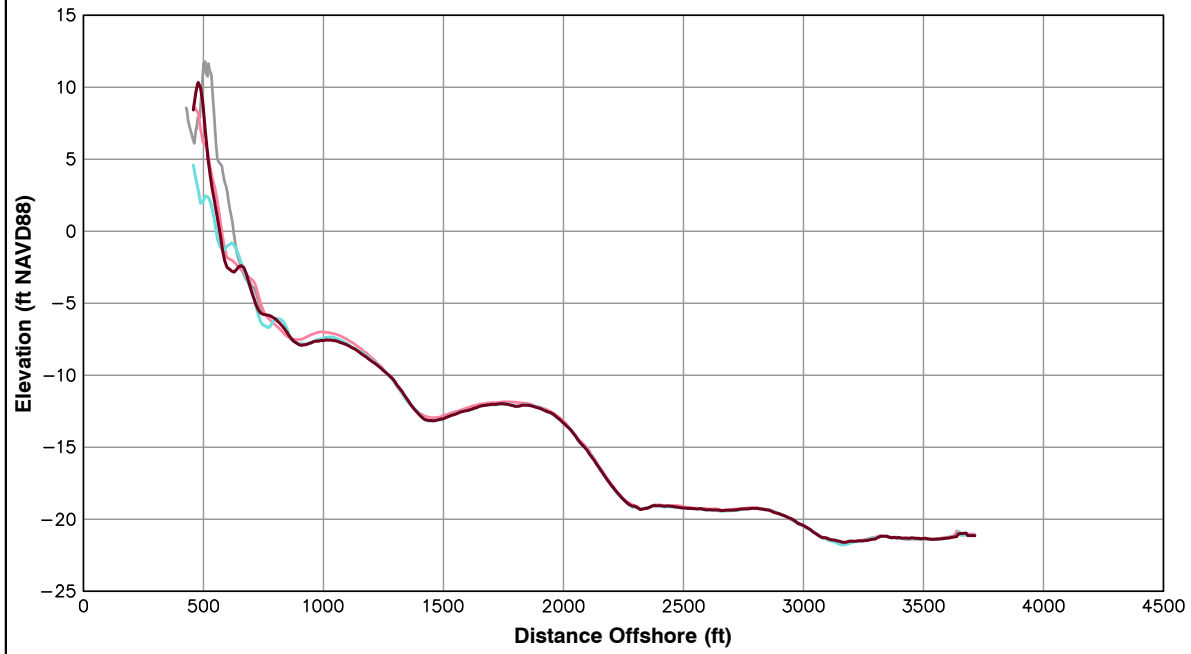
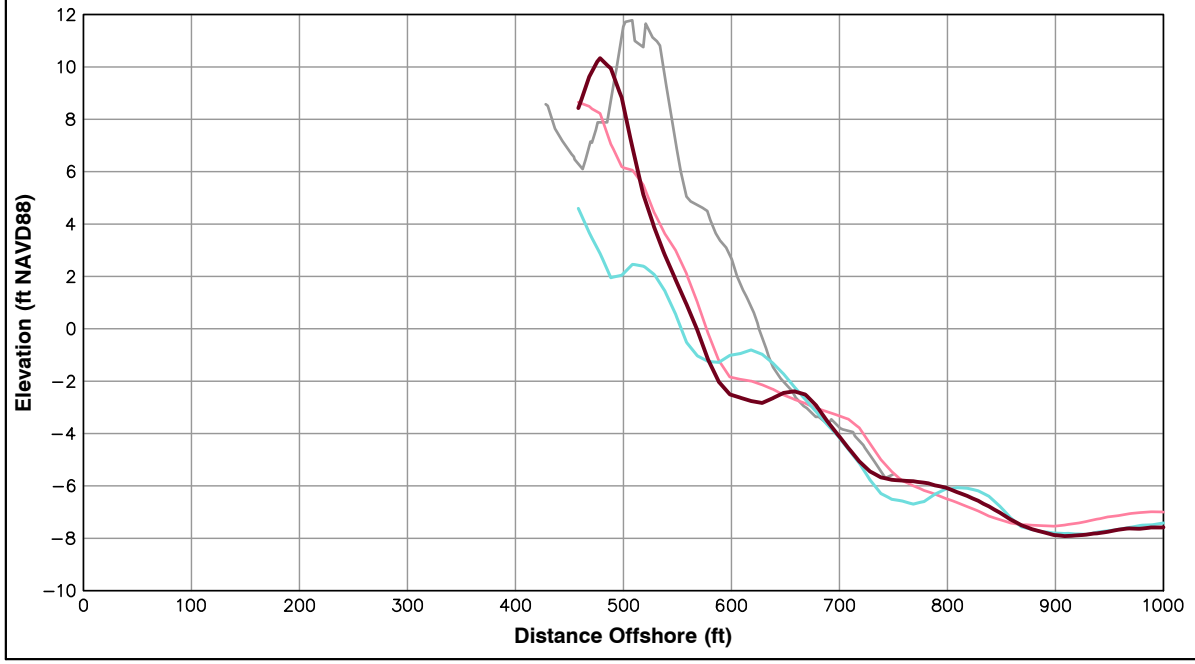
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 42+50	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-10.31 ft/yr	14.30 ft
Volume Change Above -15 ft NAVD88	-9.22 cy/ft/yr	13.01 cy/ft
Volume Change Above 0 ft NAVD88	1.44 cy/ft/yr	15.88 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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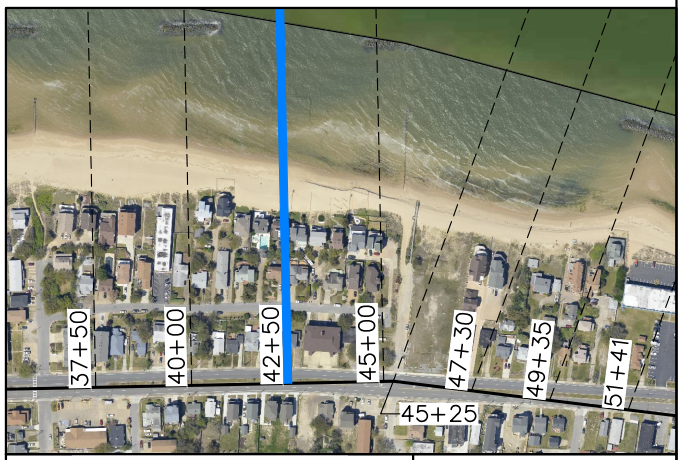
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



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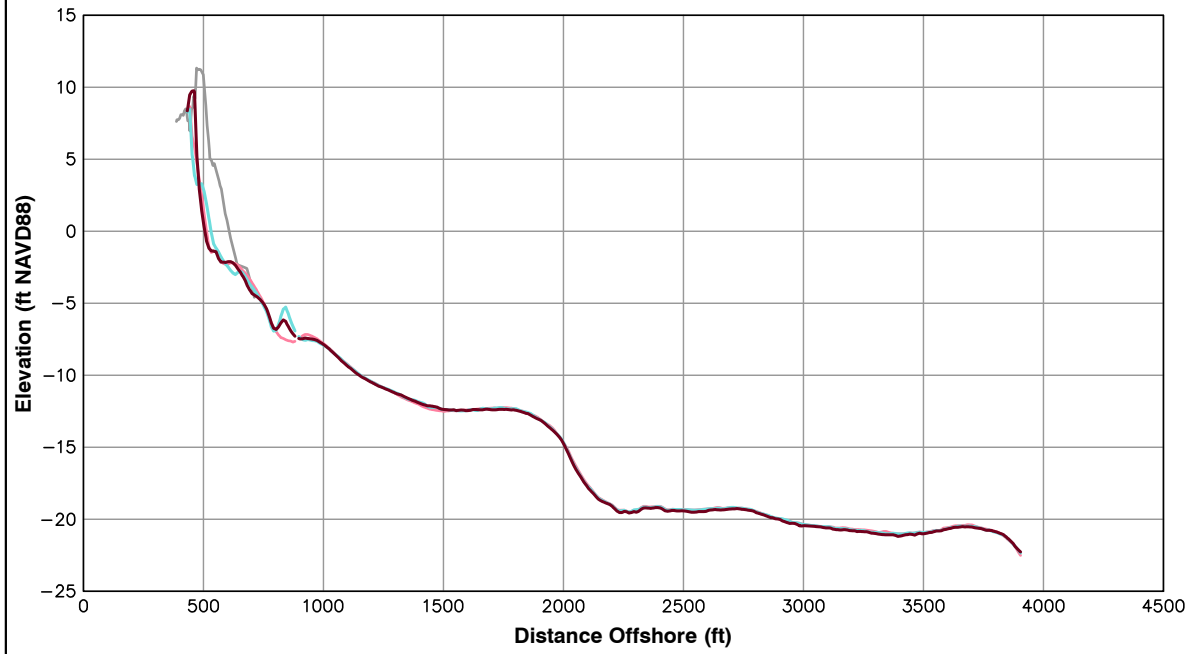
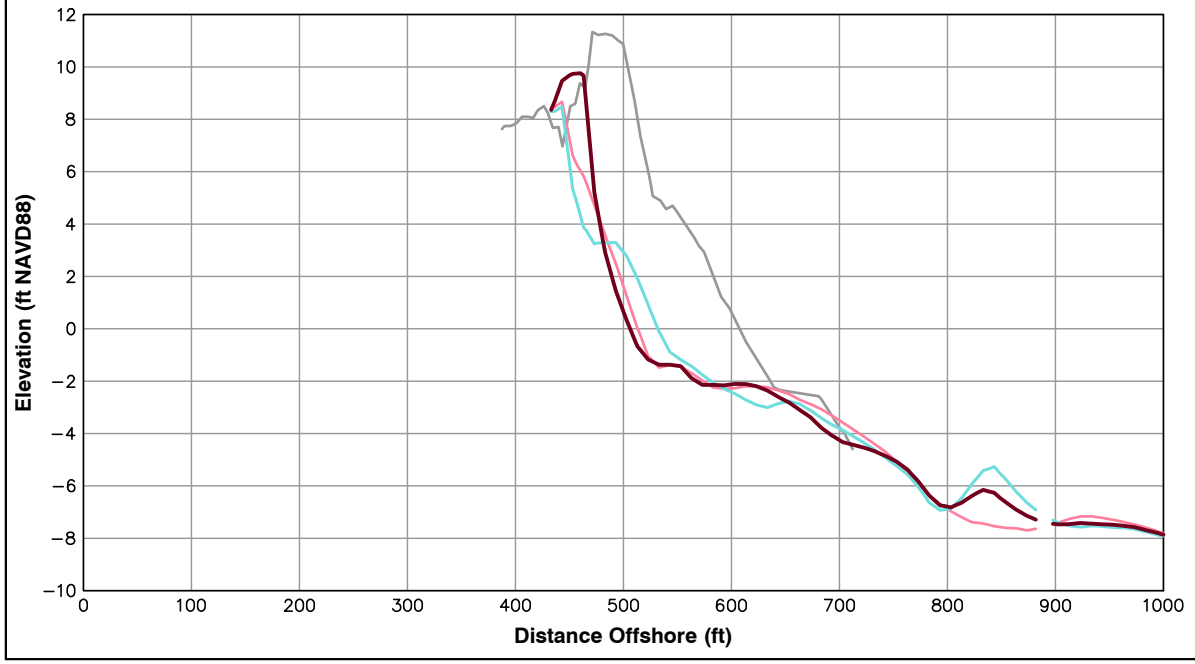
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 45+00	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-7.58 ft/yr	-25.19 ft
Volume Change Above -15 ft NAVD88	1.19 cy/ft/yr	-1.81 cy/ft
Volume Change Above 0 ft NAVD88	1.93 cy/ft/yr	2.07 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing From West To East At Varying Intervals.
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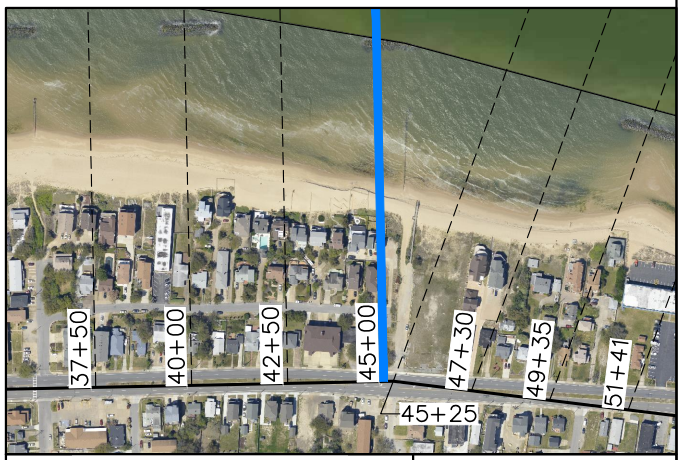
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.



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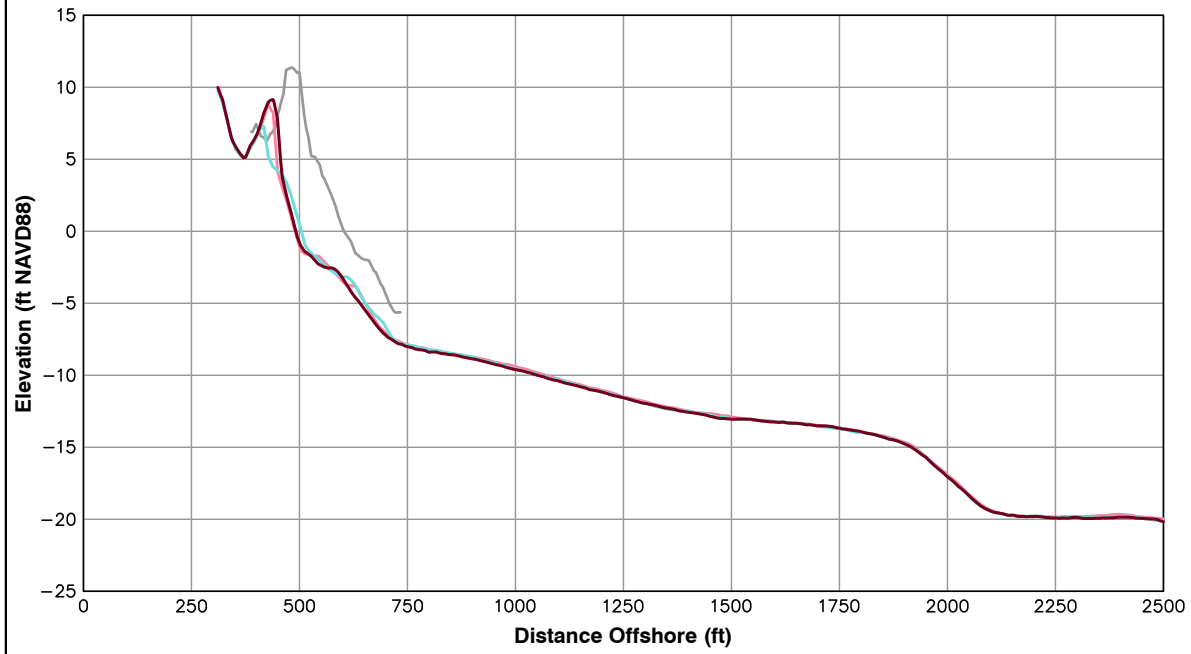
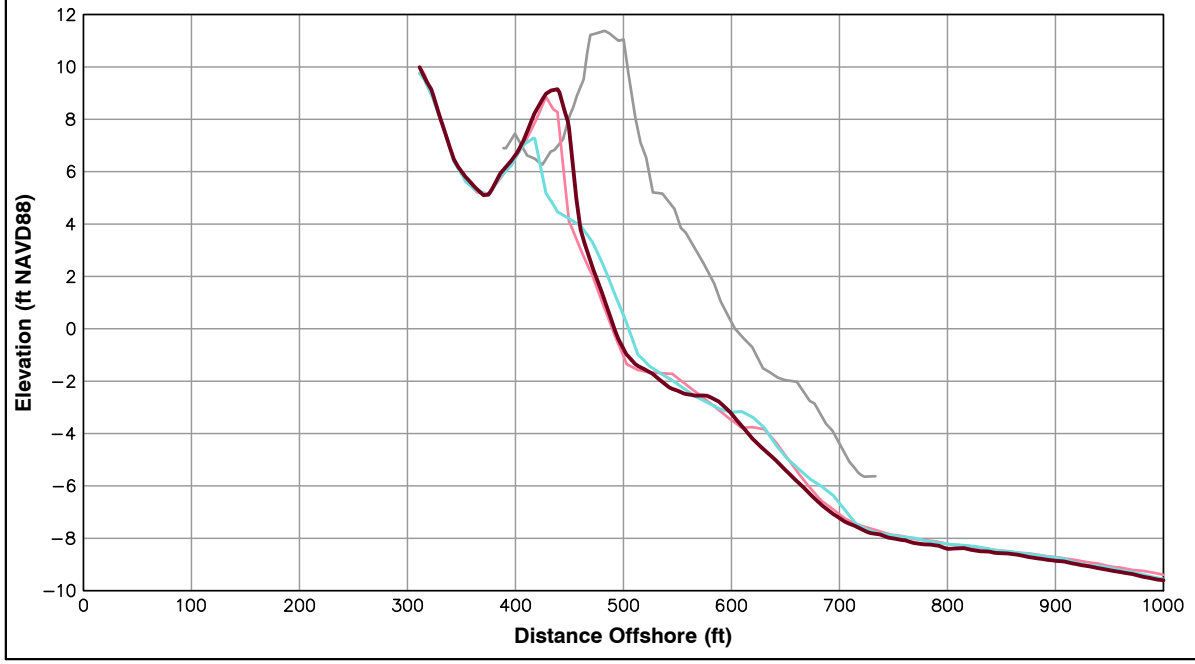
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 45+25	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	2.66 ft/yr	-11.90 ft
Volume Change Above -15 ft NAVD88	-3.17 cy/ft/yr	-0.89 cy/ft
Volume Change Above 0 ft NAVD88	2.65 cy/ft/yr	3.92 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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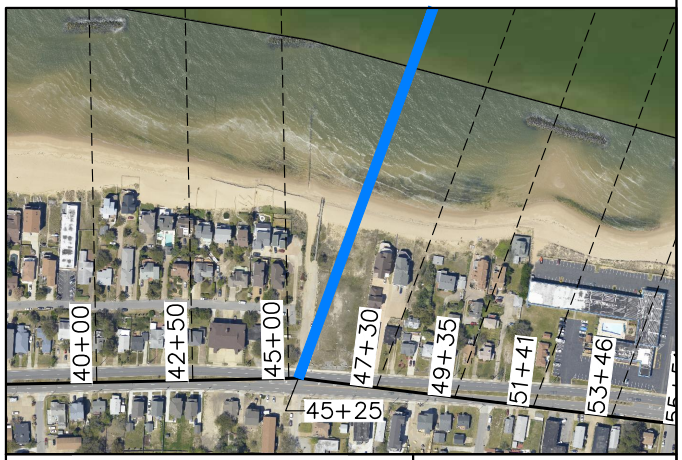

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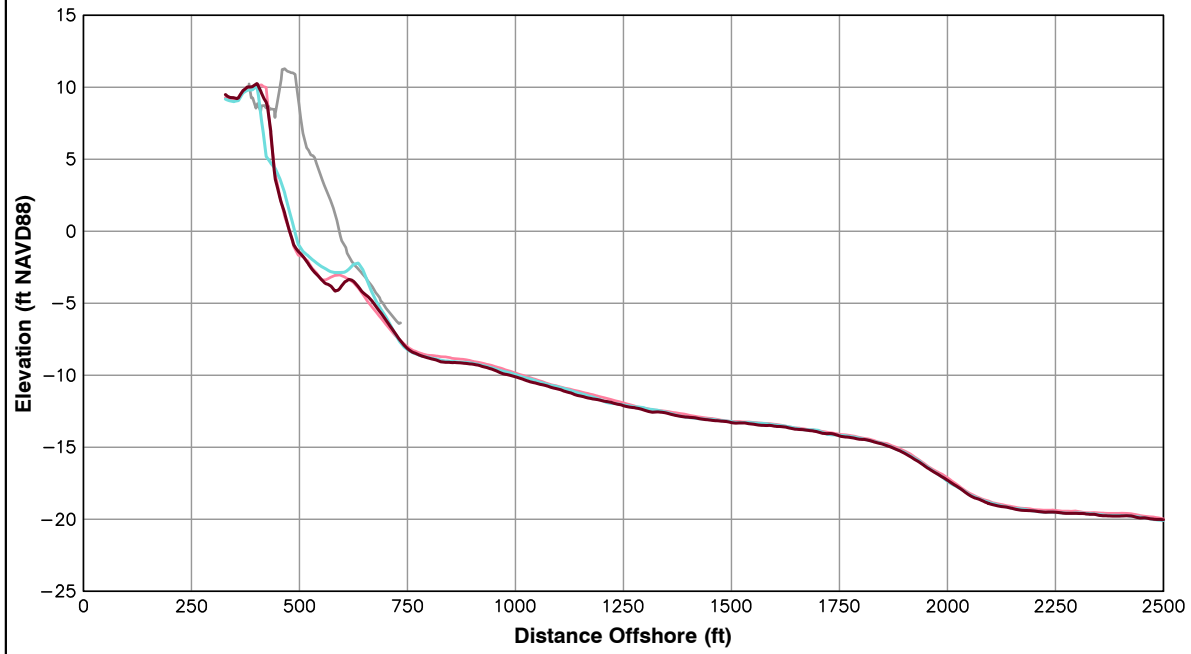
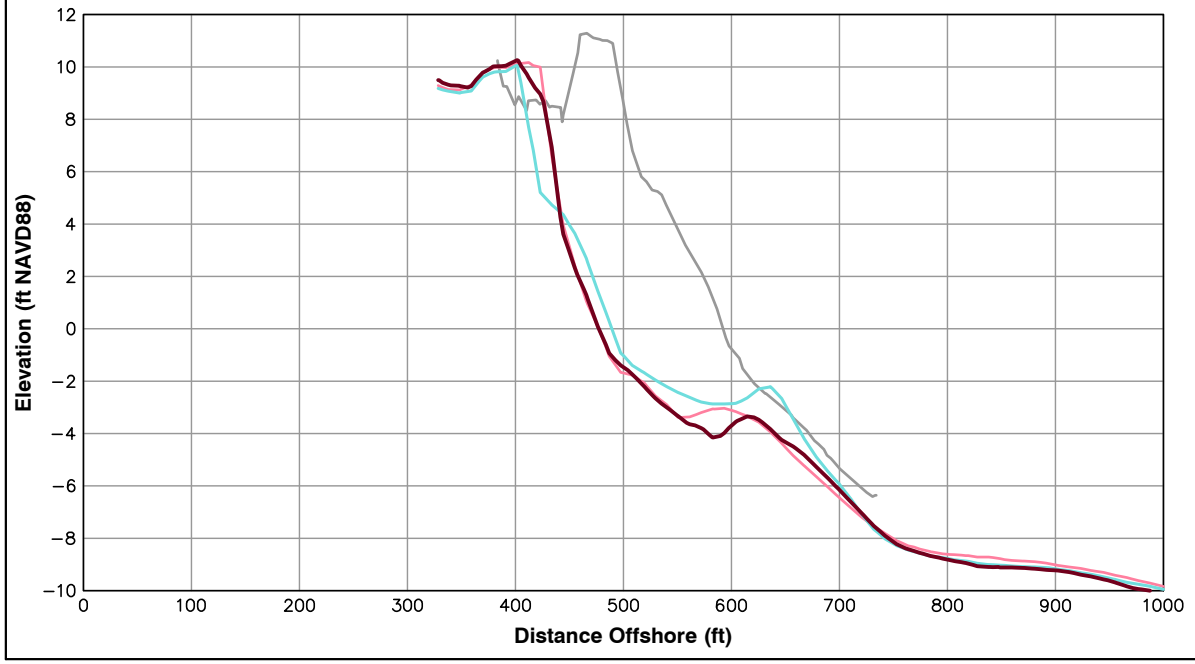
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 47+30	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	1.82 ft/yr	-12.09 ft
Volume Change Above -15 ft NAVD88	-7.48 cy/ft/yr	-8.06 cy/ft
Volume Change Above 0 ft NAVD88	-0.31 cy/ft/yr	1.72 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing From West To East At Varying Intervals.
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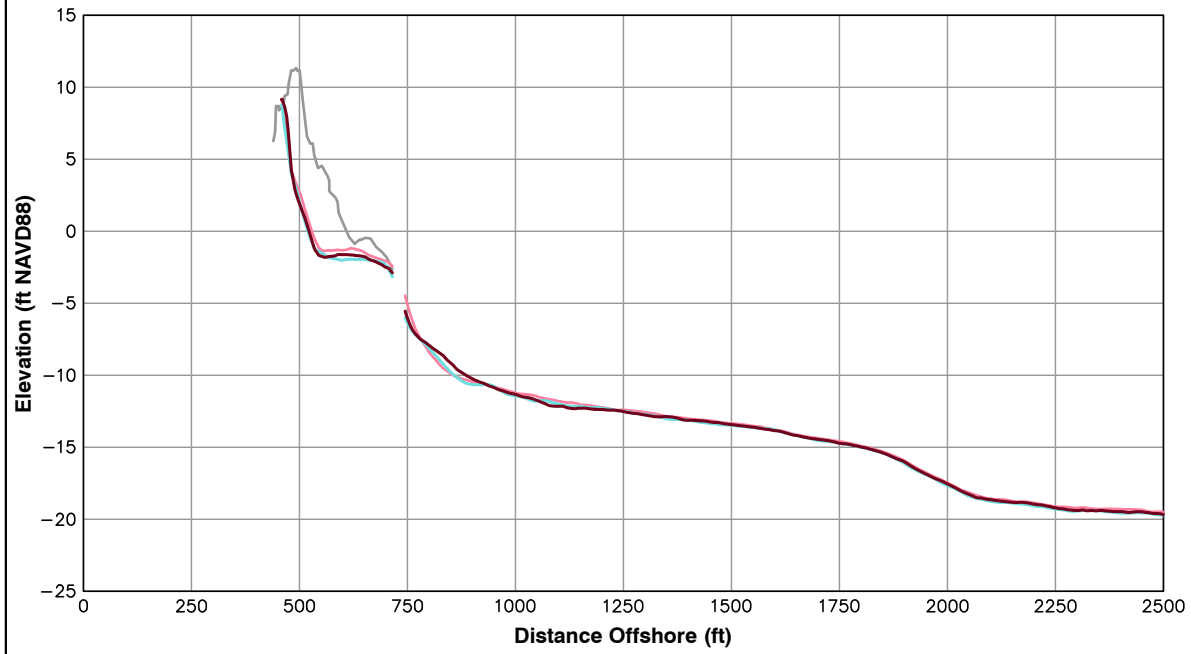
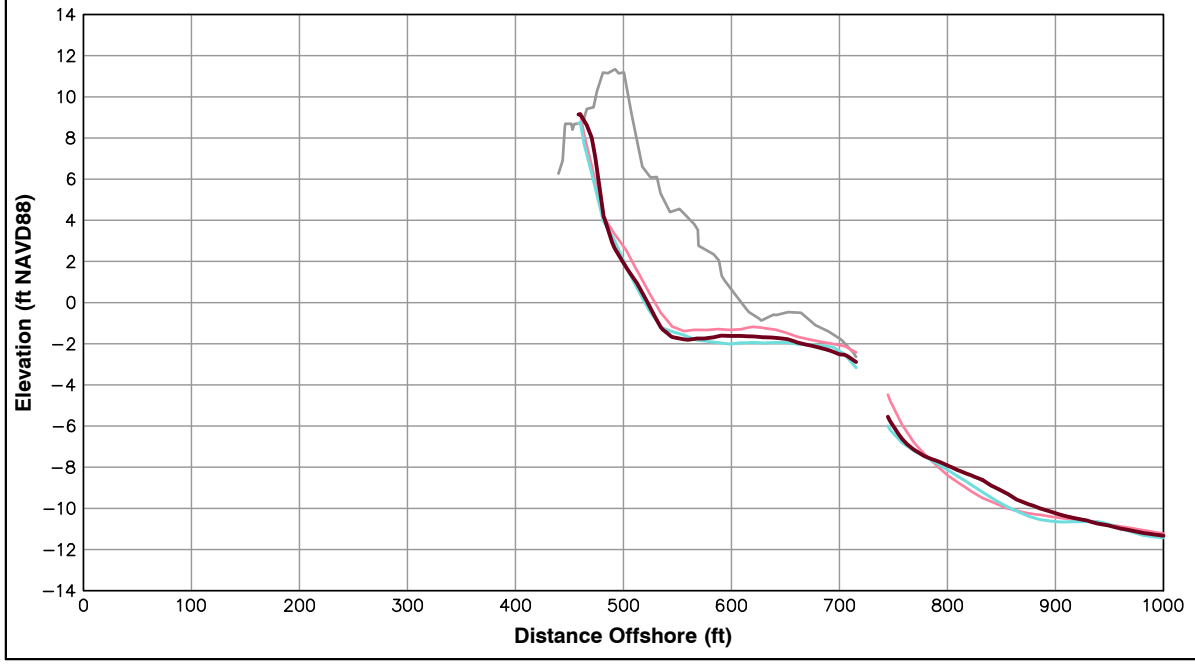
4. Survey Comparison Made To April 2015 and October 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 49+35	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-6.16 ft/yr	2.17 ft
Volume Change Above -15 ft NAVD88	-5.55 cy/ft/yr	4.04 cy/ft
Volume Change Above 0 ft NAVD88	-0.34 cy/ft/yr	0.95 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing From West To East At Varying Intervals.
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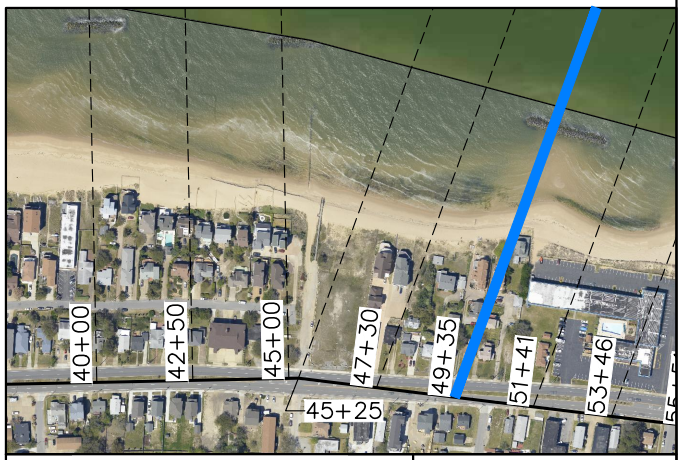

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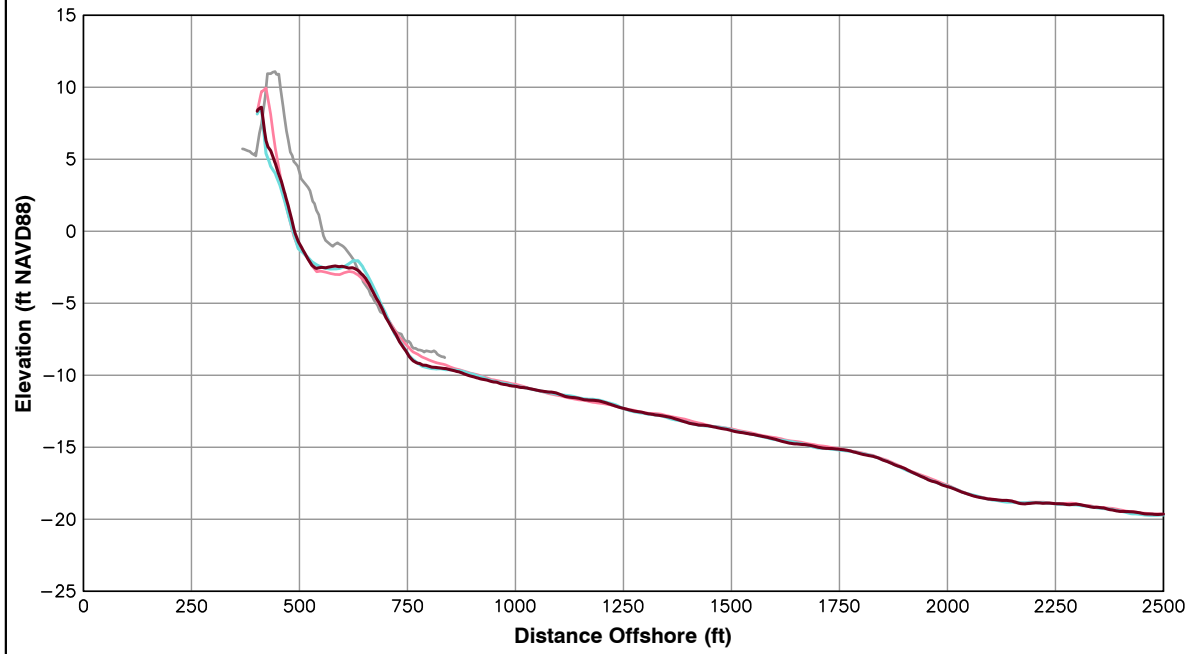
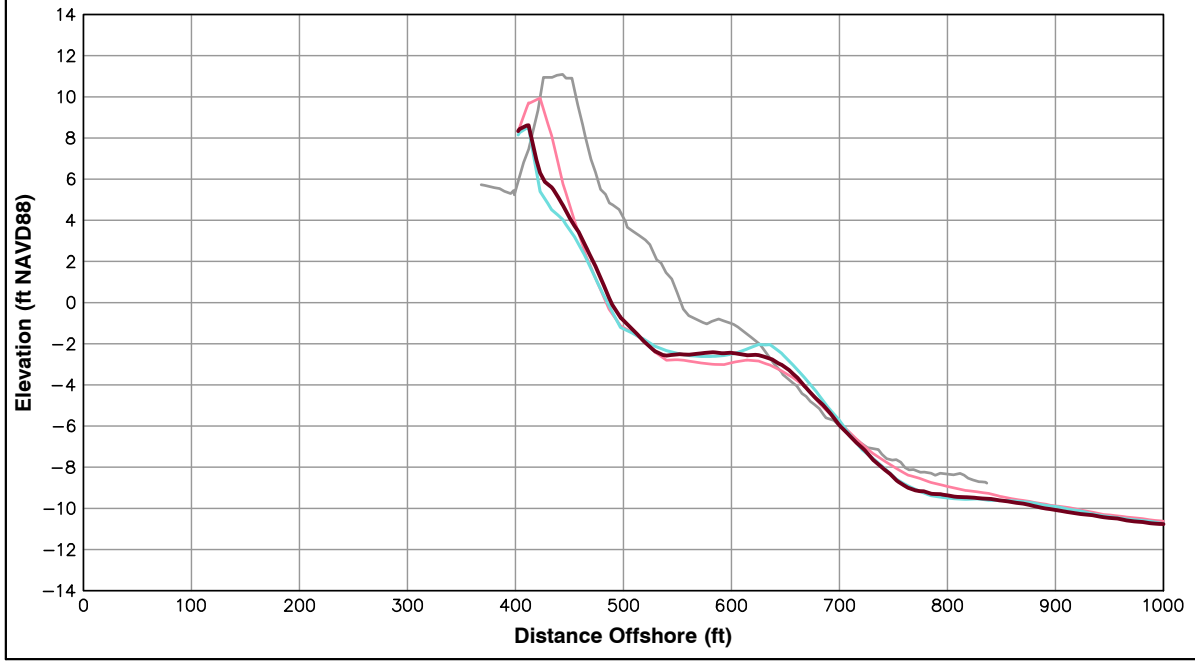
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 51+41	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	4.51 ft/yr	4.76 ft
Volume Change Above -15 ft NAVD88	-4.87 cy/ft/yr	0.07 cy/ft
Volume Change Above 0 ft NAVD88	-2.71 cy/ft/yr	1.83 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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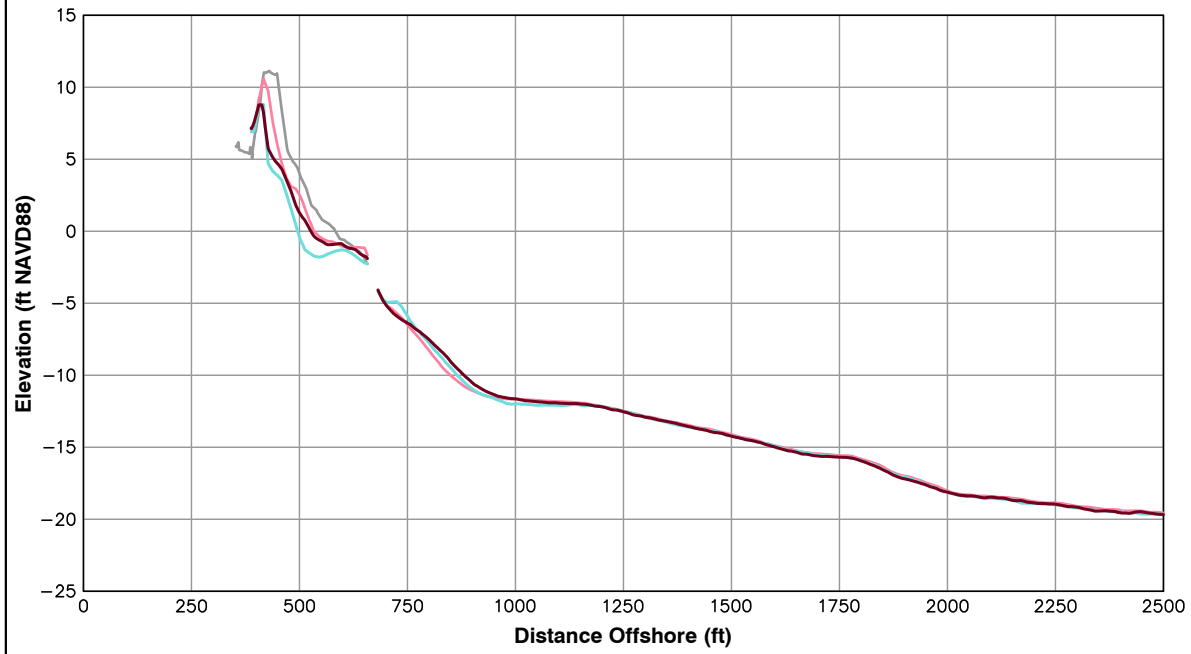
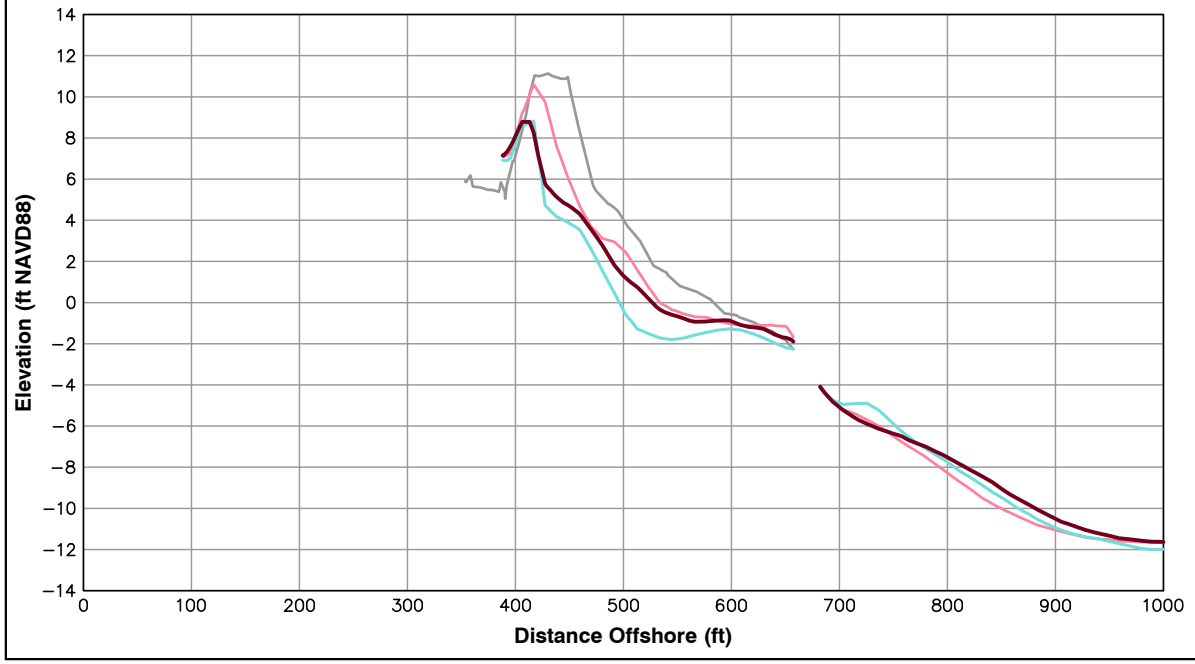
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 53+46	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-12.82 ft/yr	20.64 ft
Volume Change Above -15 ft NAVD88	-3.76 cy/ft/yr	10.45 cy/ft
Volume Change Above 0 ft NAVD88	-5.55 cy/ft/yr	3.77 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing From West To East At Varying Intervals.
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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.

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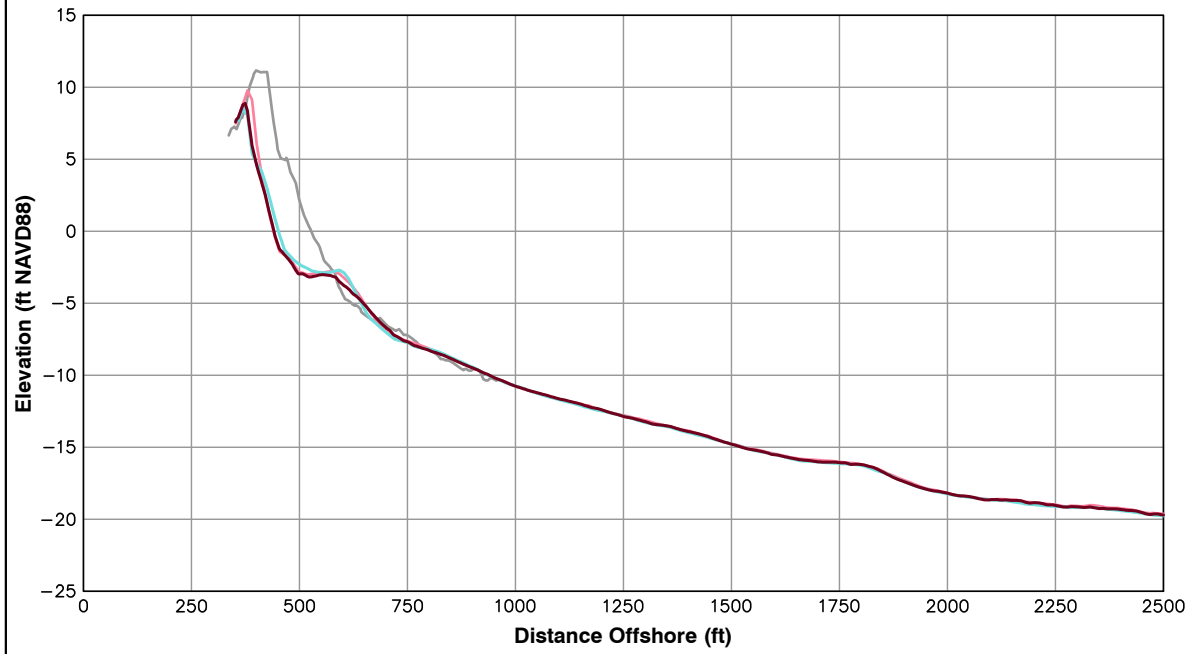
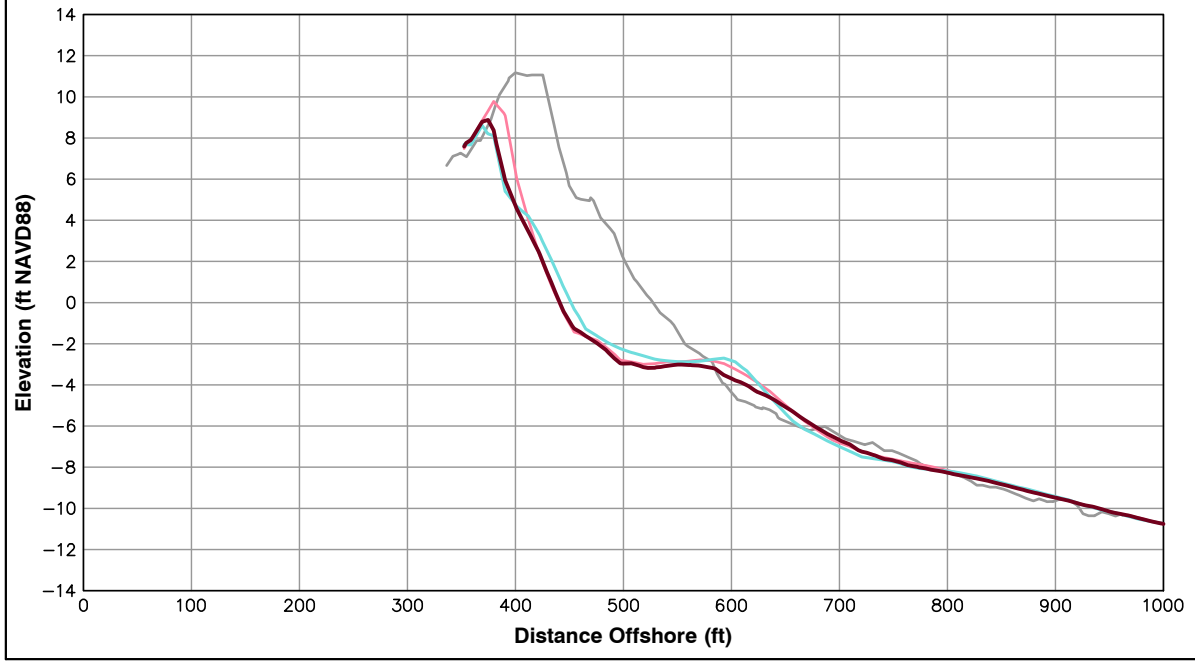
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 55+51	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	1.00 ft/yr	-9.41 ft
Volume Change Above -15 ft NAVD88	-4.52 cy/ft/yr	-2.55 cy/ft
Volume Change Above 0 ft NAVD88	-2.36 cy/ft/yr	-0.94 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing From West To East At Varying Intervals.
2. Sections Are Viewed Toward Decreasing Stationing.
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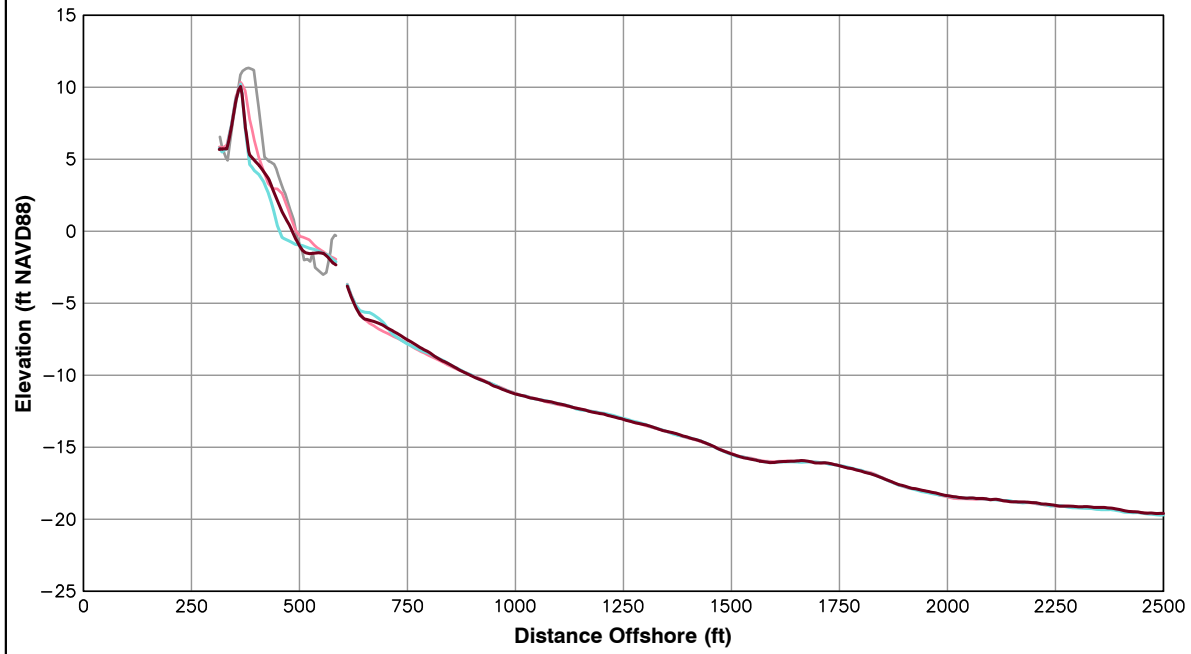
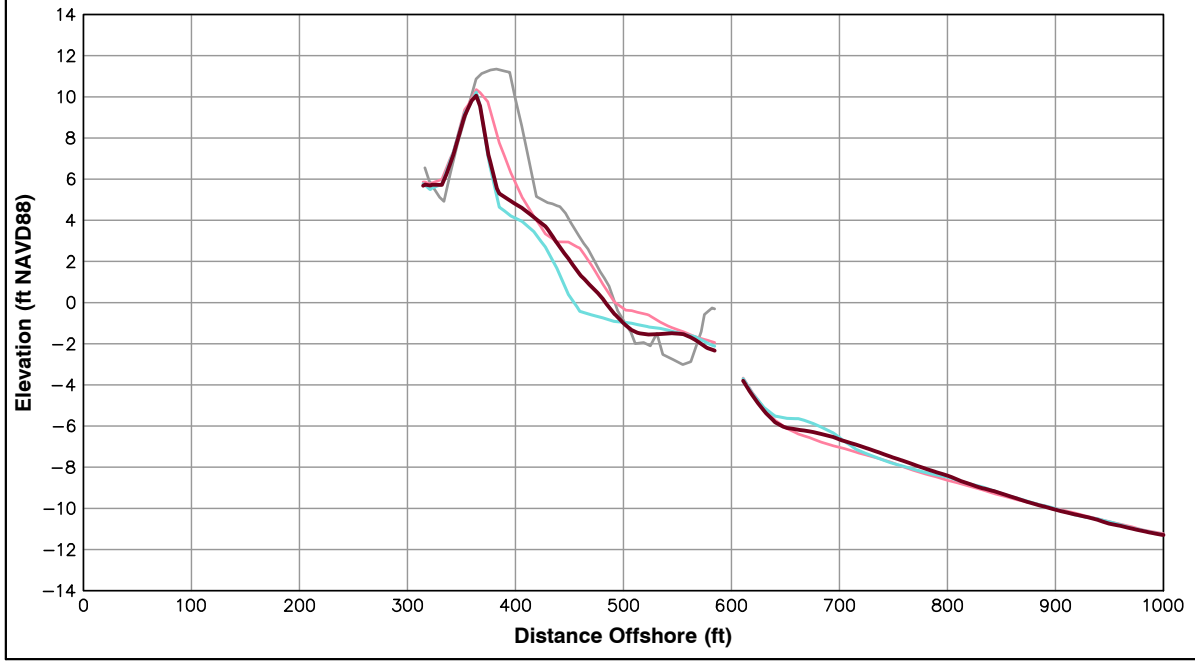
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 57+57	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-12.74 ft/yr	22.46 ft
Volume Change Above -15 ft NAVD88	-4.49 cy/ft/yr	3.01 cy/ft
Volume Change Above 0 ft NAVD88	-4.26 cy/ft/yr	3.53 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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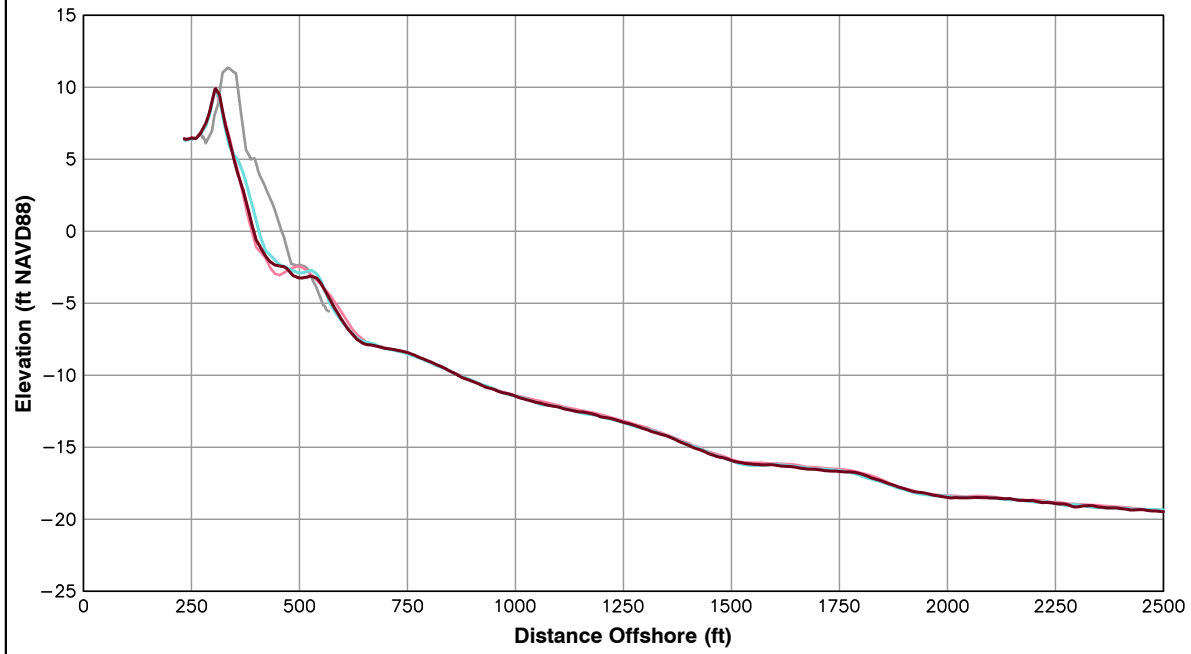
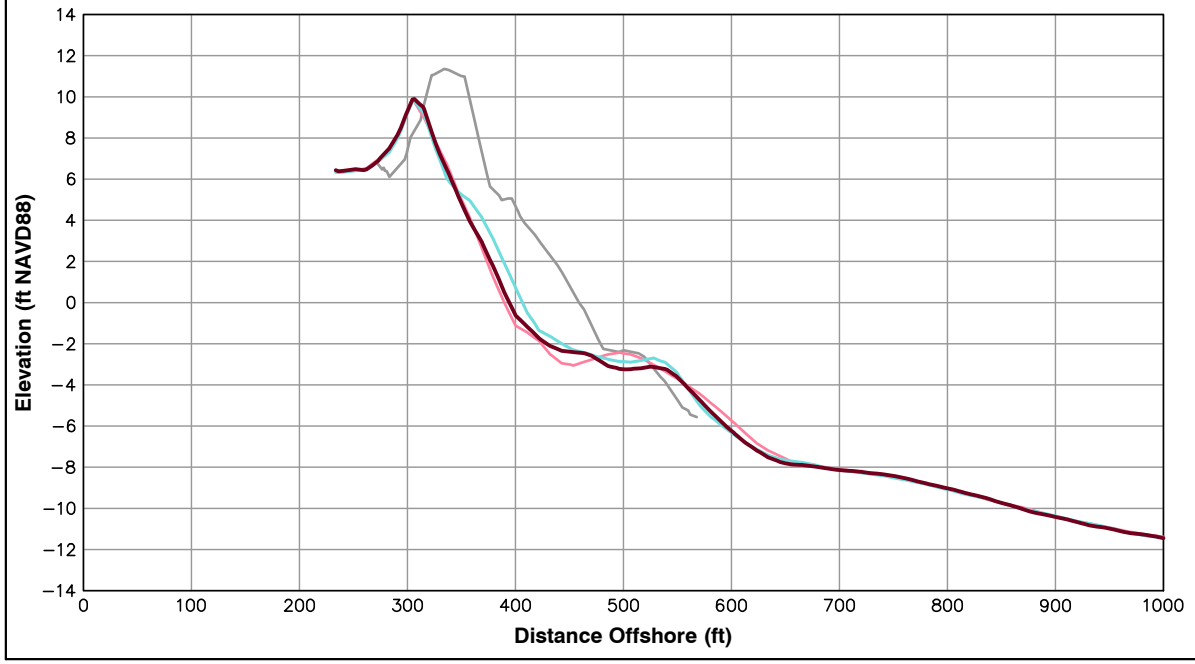
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 59+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	4.22 ft/yr	-12.02 ft
Volume Change Above -15 ft NAVD88	-2.40 cy/ft/yr	-3.49 cy/ft
Volume Change Above 0 ft NAVD88	0.45 cy/ft/yr	-1.70 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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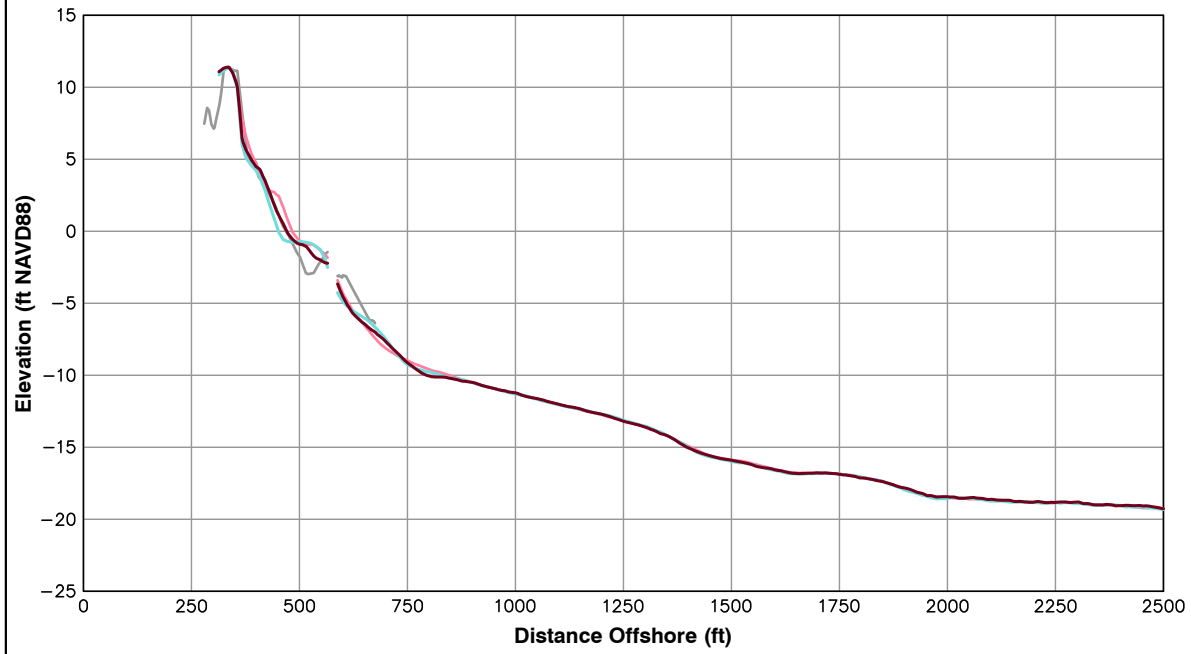
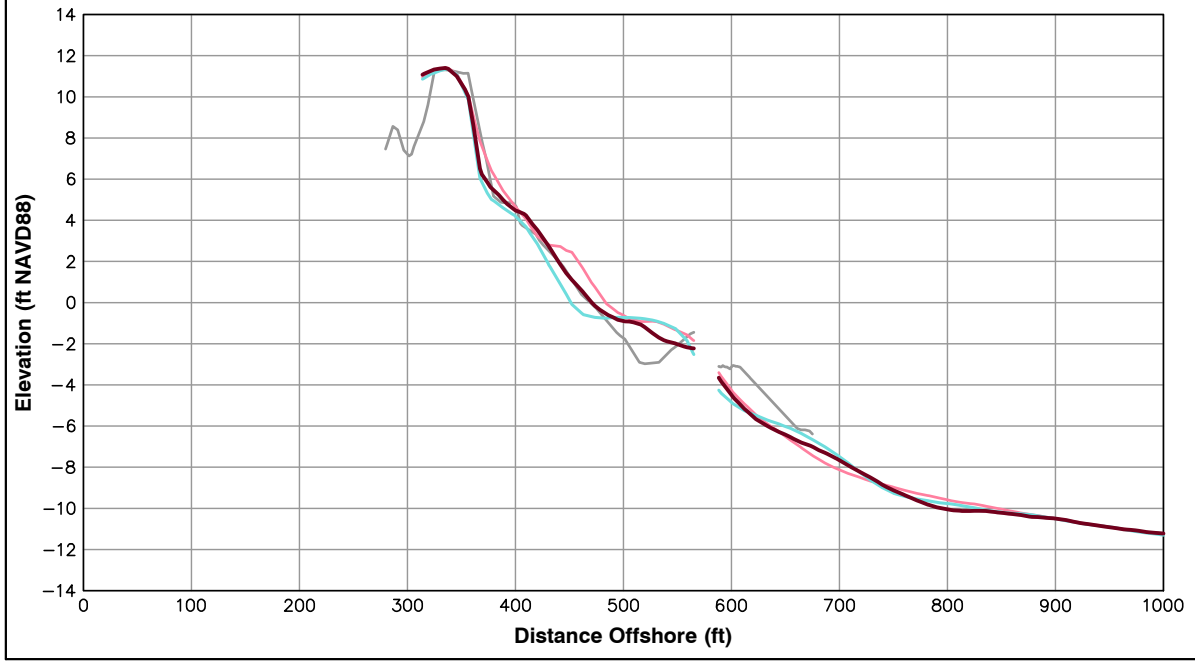
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





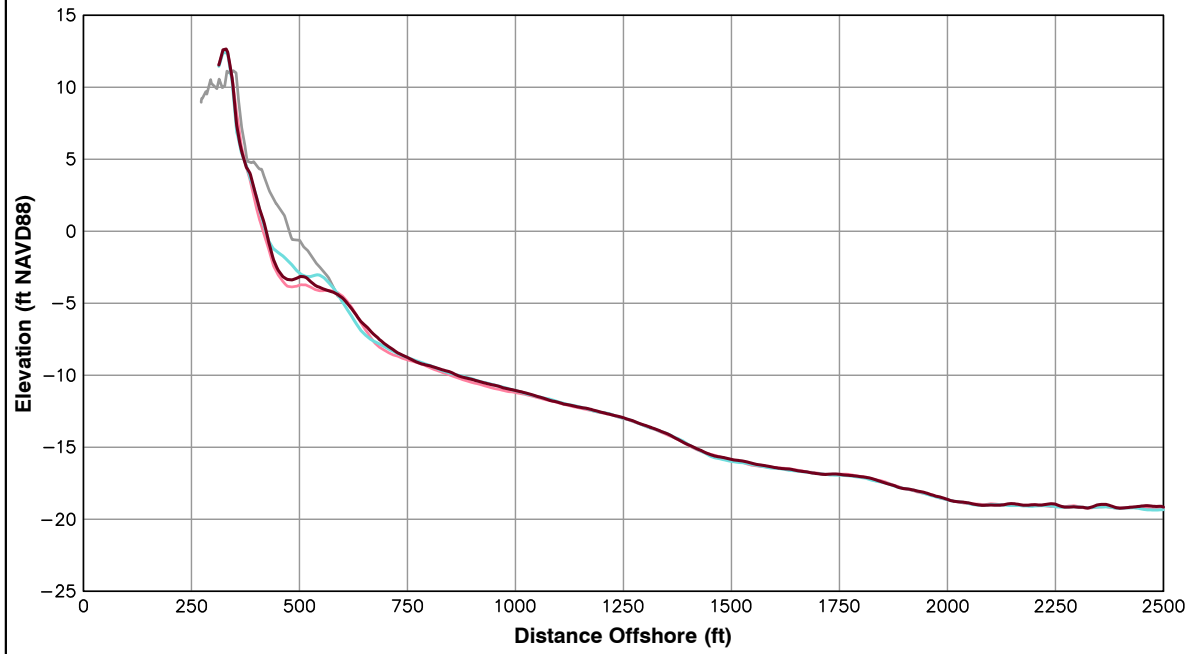
Survey Transect 61+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-15.00 ft/yr	13.86 ft
Volume Change Above -15 ft NAVD88	-4.69 cy/ft/yr	1.40 cy/ft
Volume Change Above 0 ft NAVD88	-2.46 cy/ft/yr	2.67 cy/ft

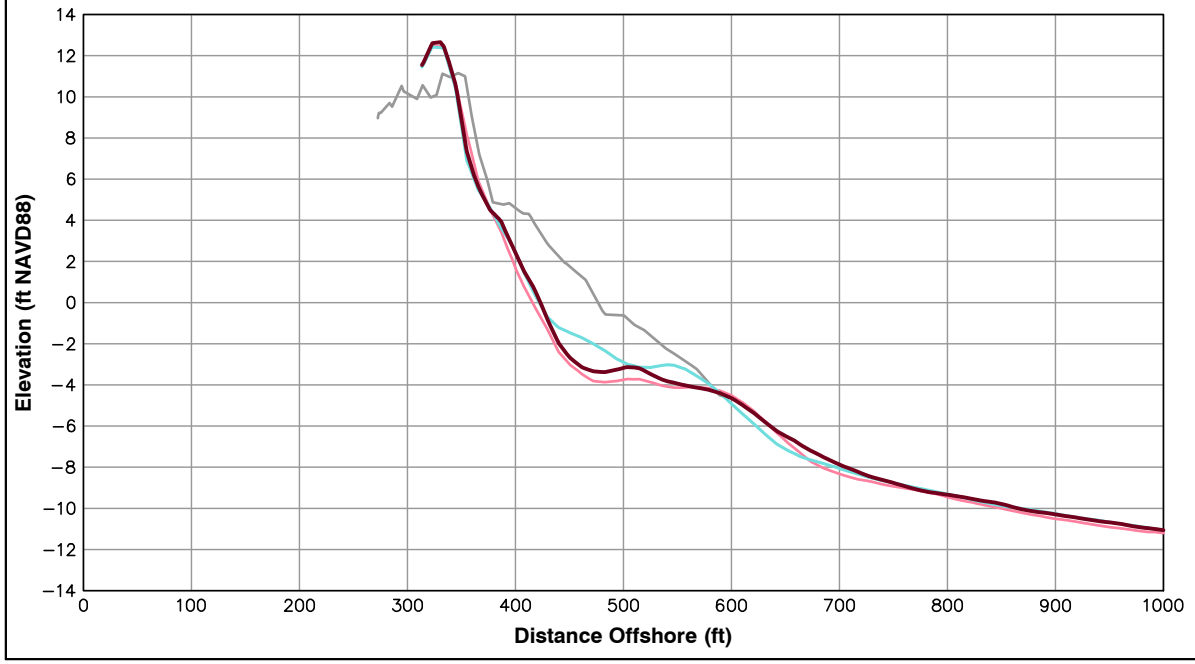
LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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 April 2015 and October 2015.
5. For Transects With Offshore Breakwaters, Volume Change Calculations Were Limited To The Portions Of The Profiles Both Landward And Seaward Of The Breakwater.

City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 63+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	7.53 ft/yr	1.61 ft
Volume Change Above -15 ft NAVD88	5.99 cy/ft/yr	-1.55 cy/ft
Volume Change Above 0 ft NAVD88	0.53 cy/ft/yr	0.61 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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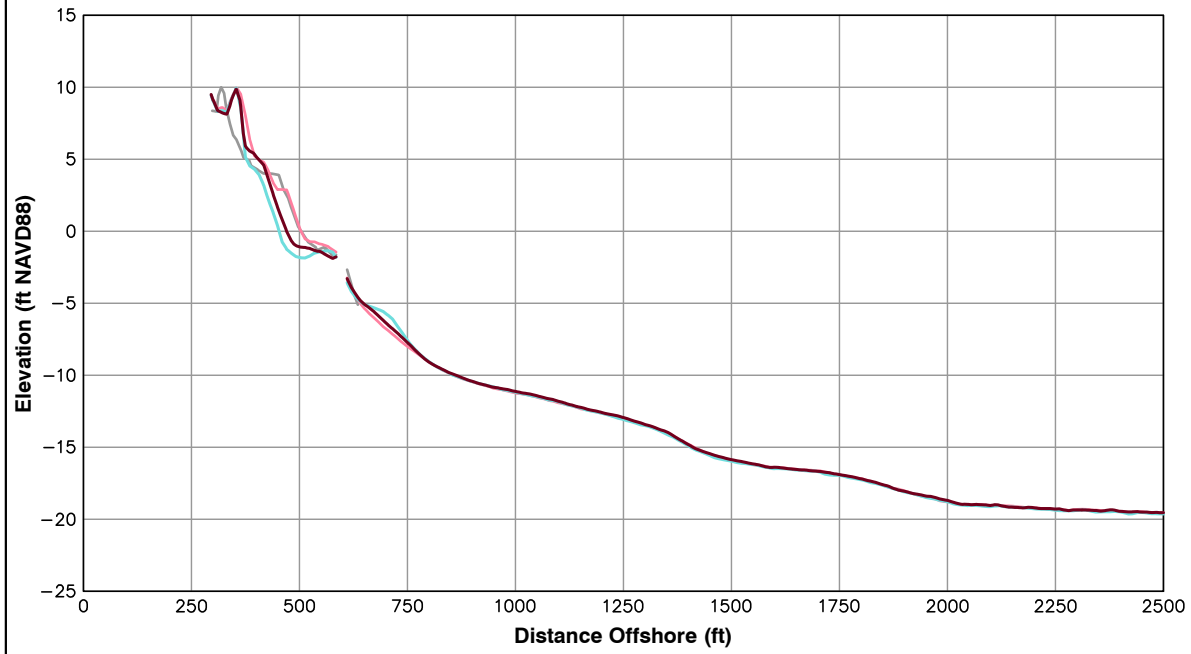
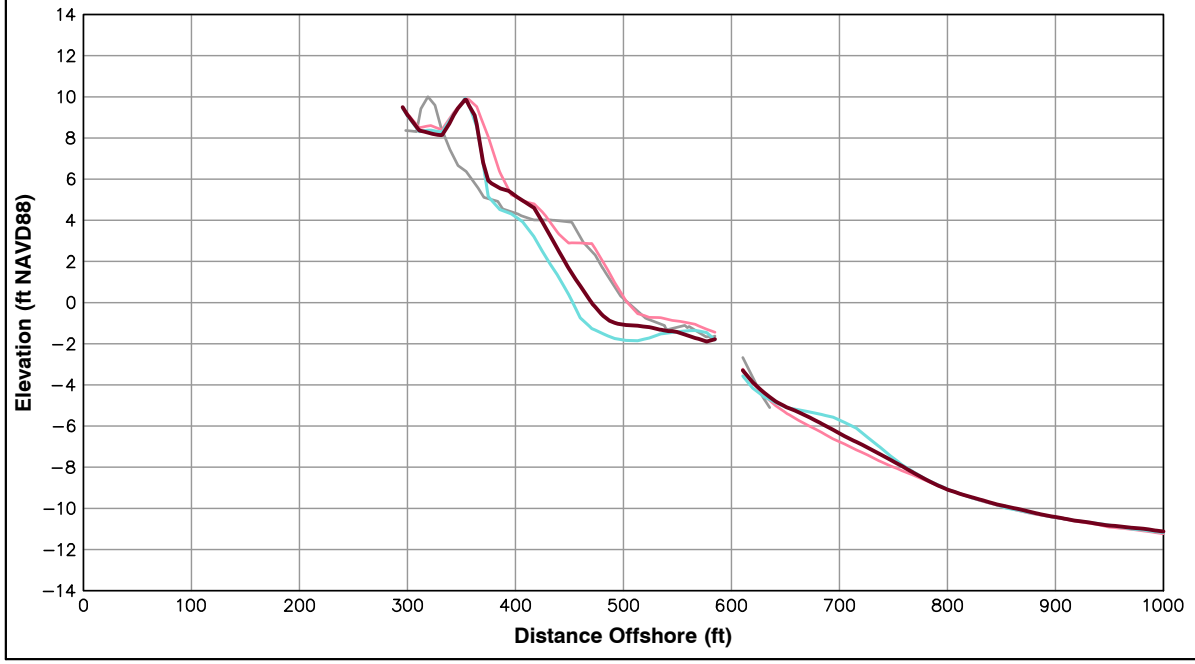
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 65+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-32.29 ft/yr	14.95 ft
Volume Change Above -15 ft NAVD88	-5.39 cy/ft/yr	5.91 cy/ft
Volume Change Above 0 ft NAVD88	-5.79 cy/ft/yr	3.86 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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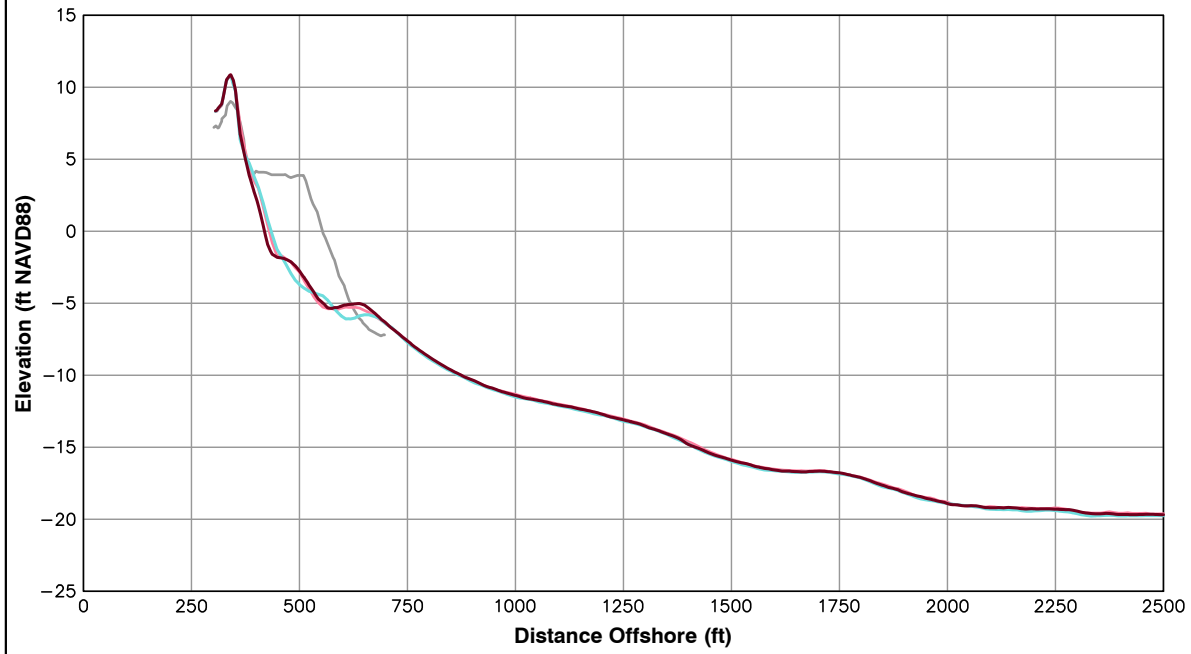
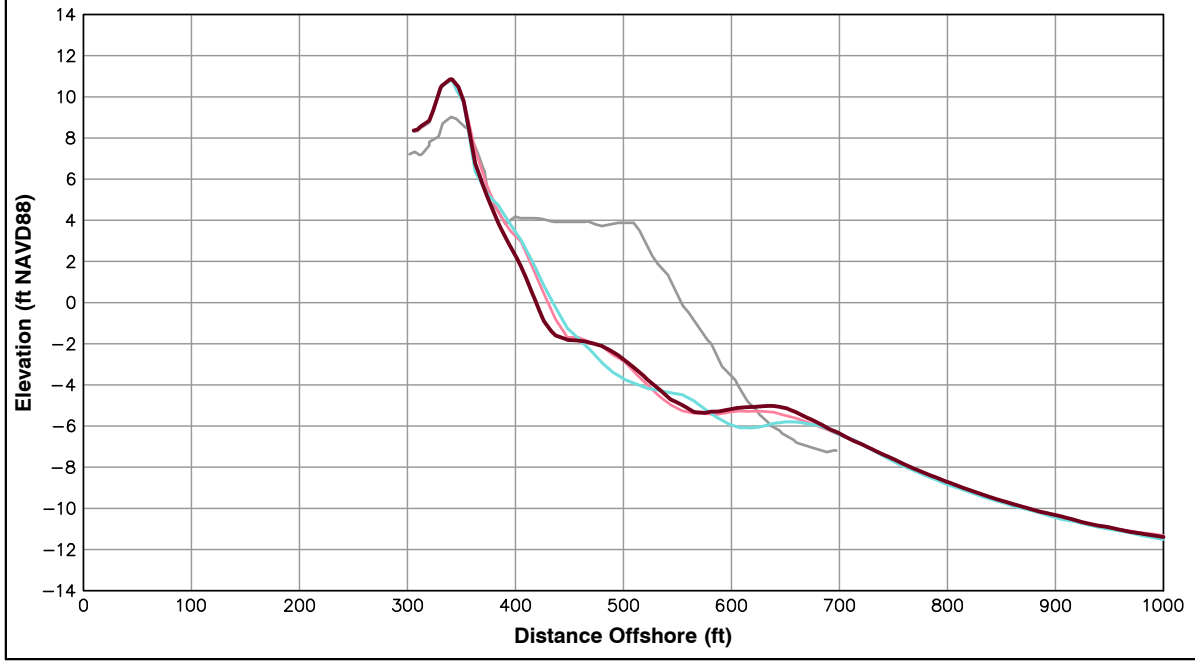
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 67+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-9.79 ft/yr	-13.40 ft
Volume Change Above -15 ft NAVD88	-2.00 cy/ft/yr	2.38 cy/ft
Volume Change Above 0 ft NAVD88	-1.91 cy/ft/yr	-1.97 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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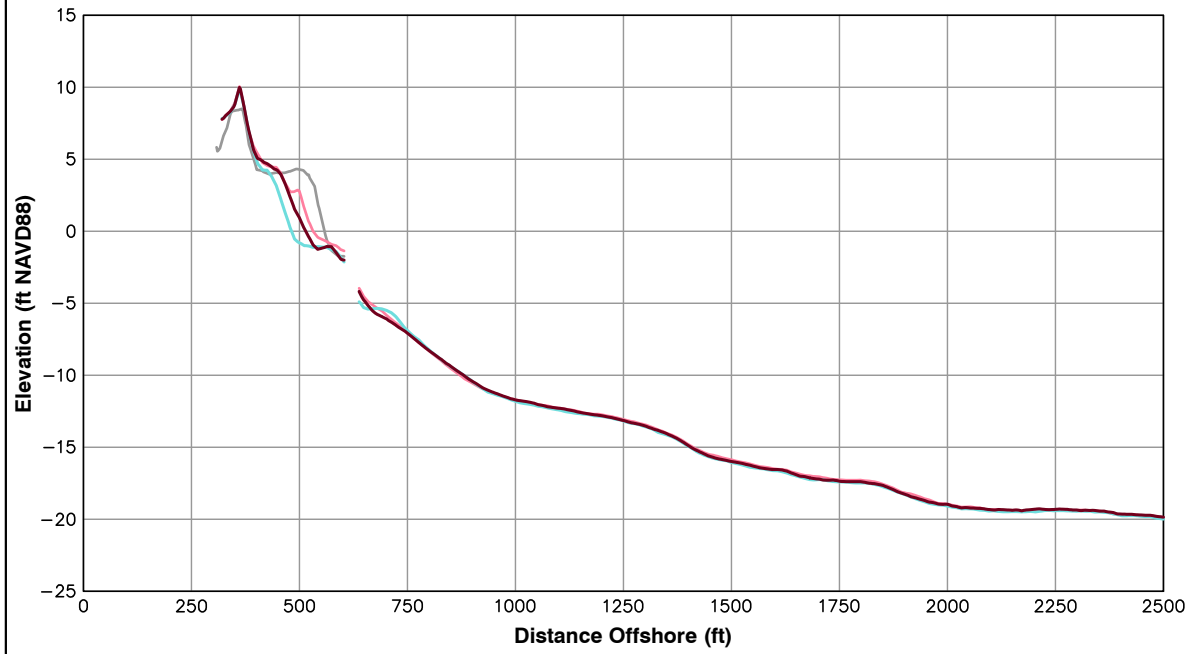
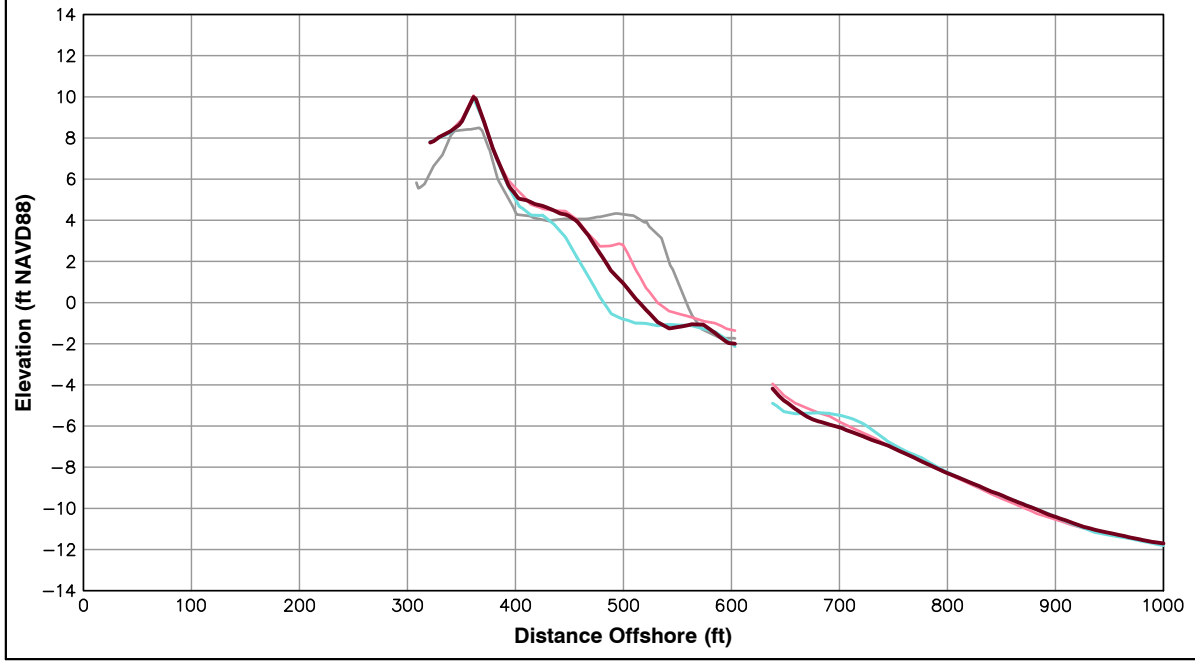
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 69+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-18.03 ft/yr	28.46 ft
Volume Change Above -15 ft NAVD88	-5.09 cy/ft/yr	6.23 cy/ft
Volume Change Above 0 ft NAVD88	-2.41 cy/ft/yr	4.80 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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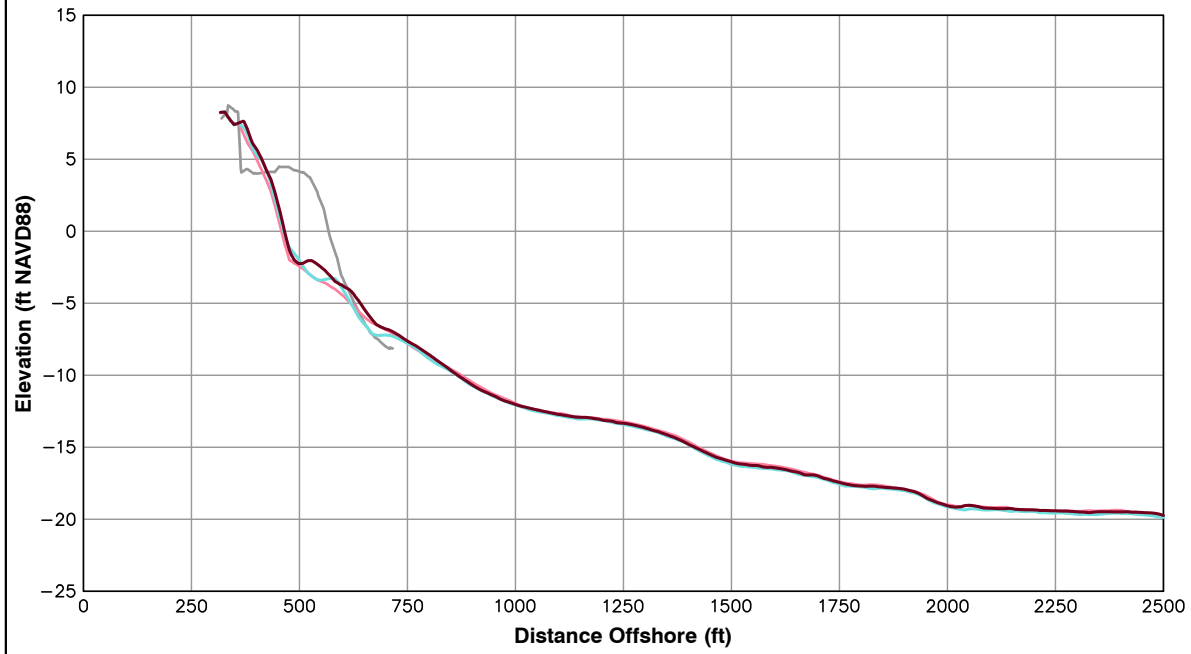
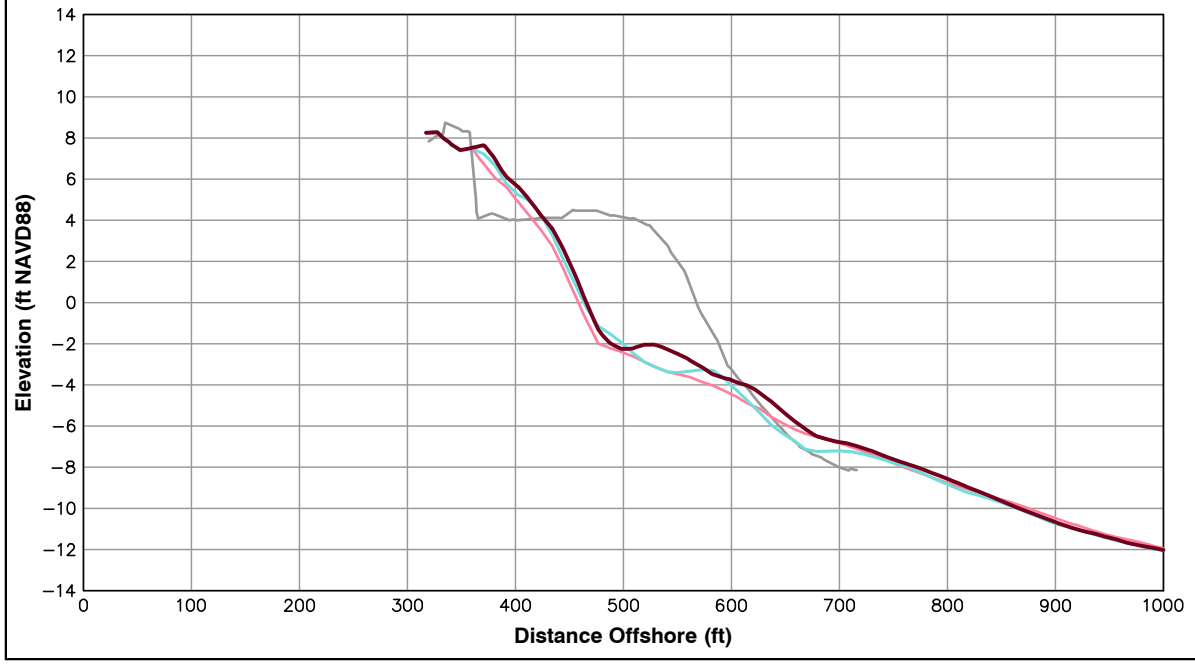
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 71+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	7.70 ft/yr	3.67 ft
Volume Change Above -15 ft NAVD88	6.58 cy/ft/yr	8.36 cy/ft
Volume Change Above 0 ft NAVD88	2.79 cy/ft/yr	1.11 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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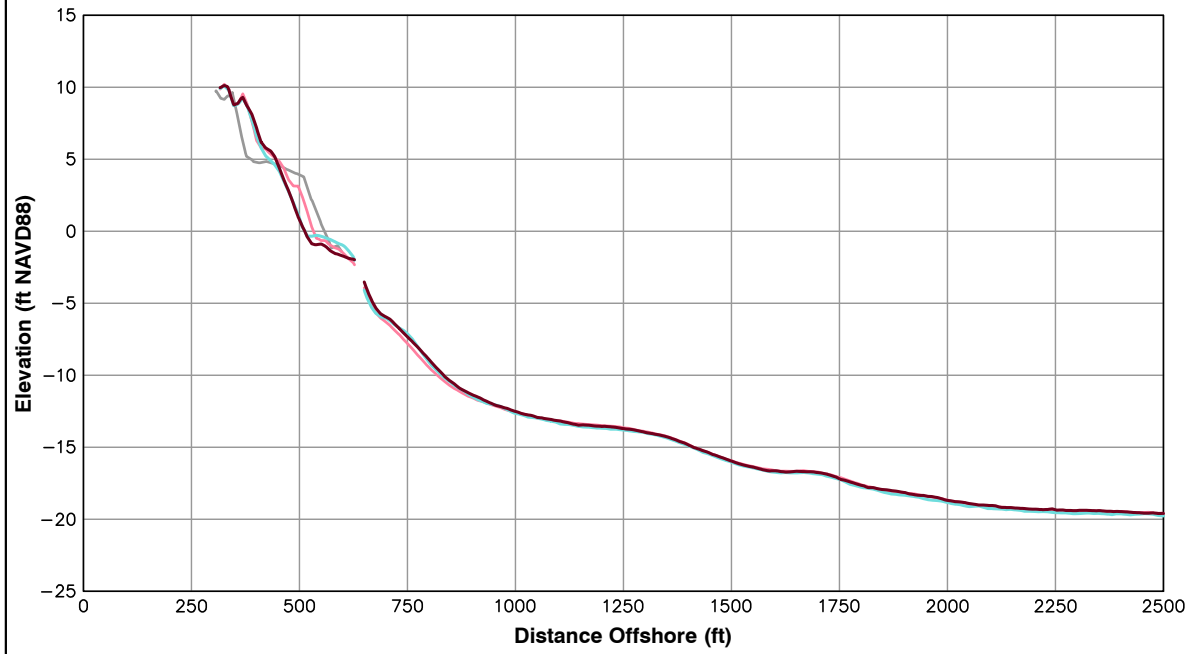
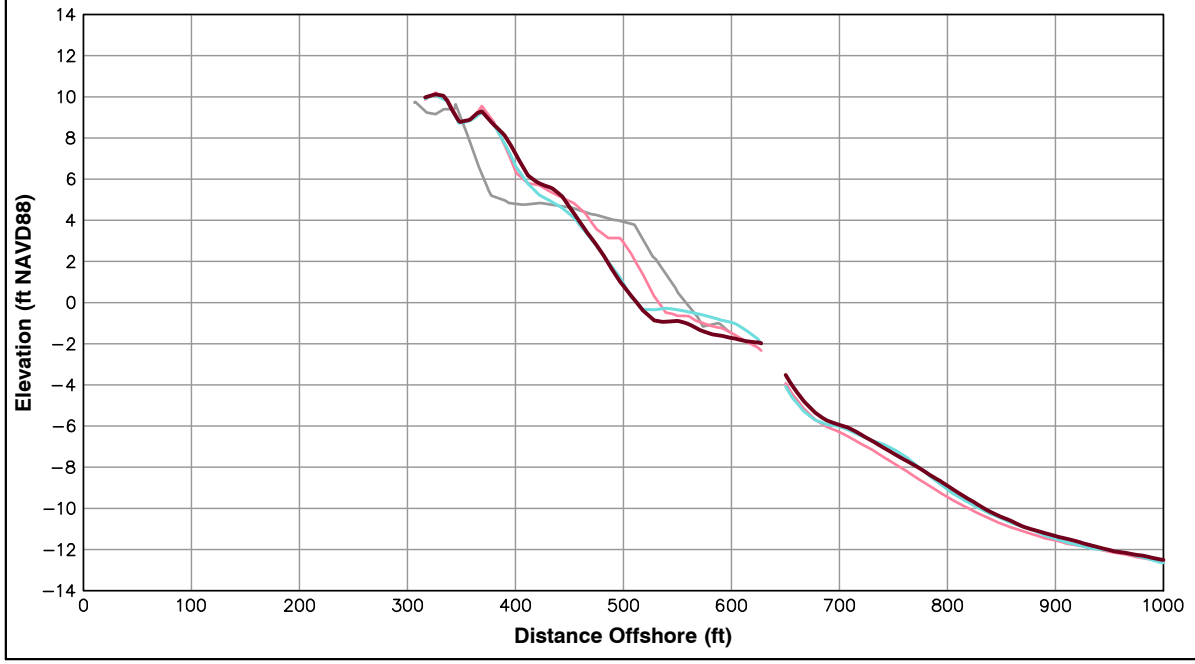
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 73+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-23.13 ft/yr	-1.95 ft
Volume Change Above -15 ft NAVD88	-0.50 cy/ft/yr	1.87 cy/ft
Volume Change Above 0 ft NAVD88	-2.77 cy/ft/yr	1.41 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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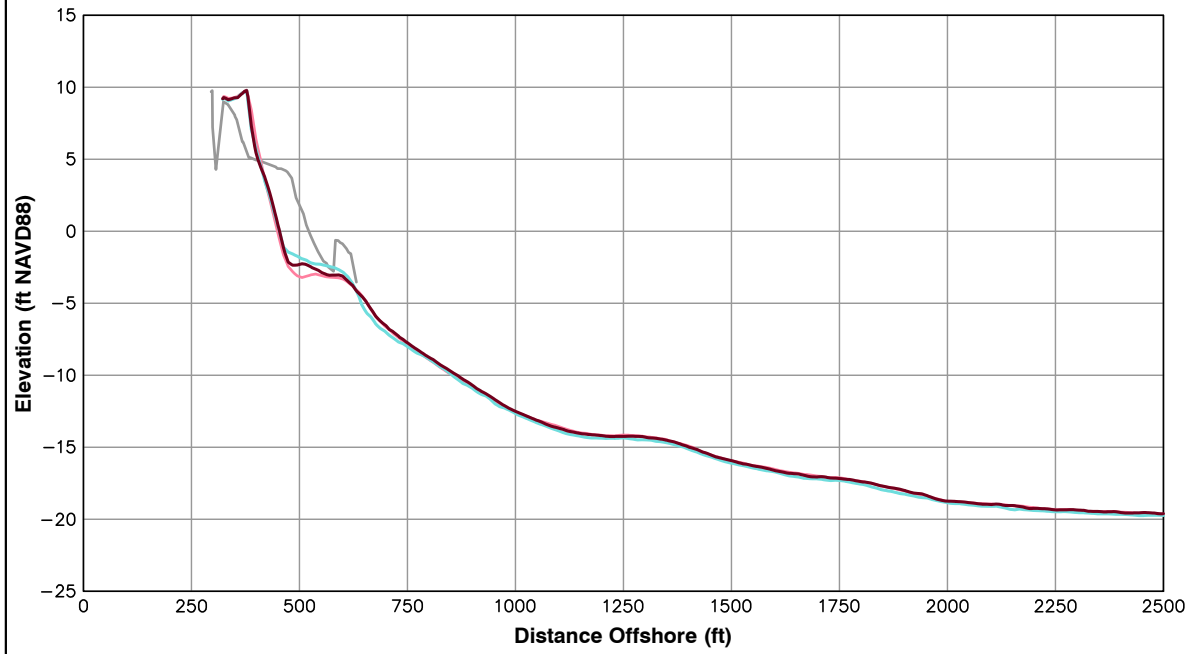
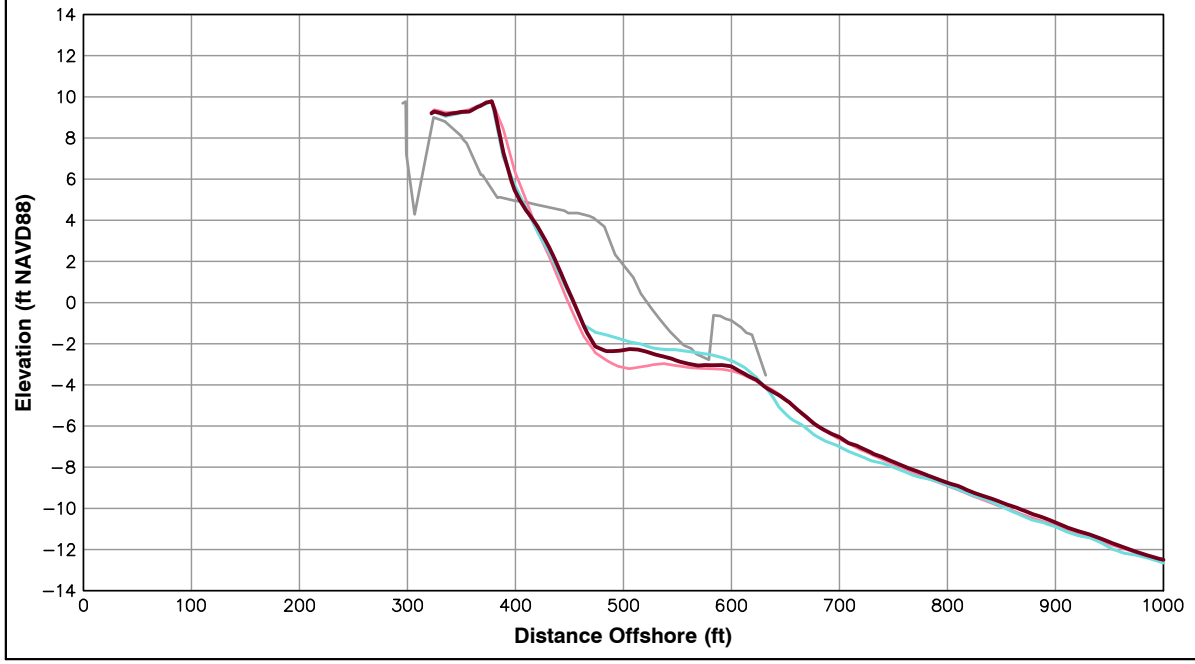
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 75+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	4.46 ft/yr	1.53 ft
Volume Change Above -15 ft NAVD88	2.56 cy/ft/yr	0.35 cy/ft
Volume Change Above 0 ft NAVD88	-0.48 cy/ft/yr	0.35 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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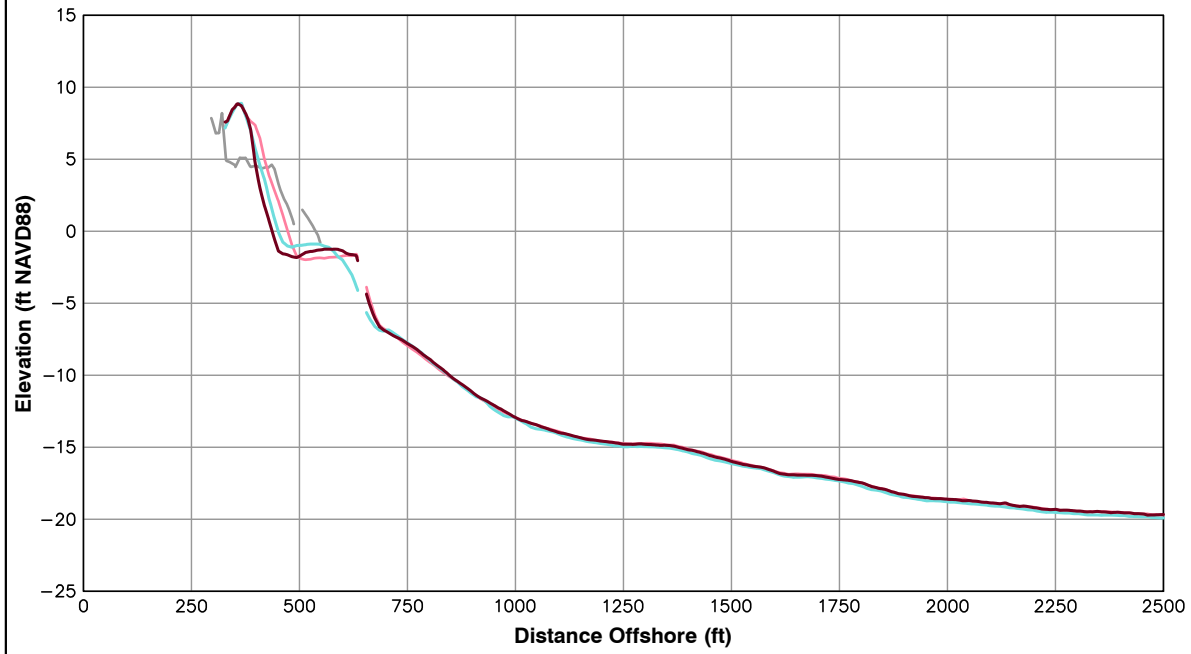
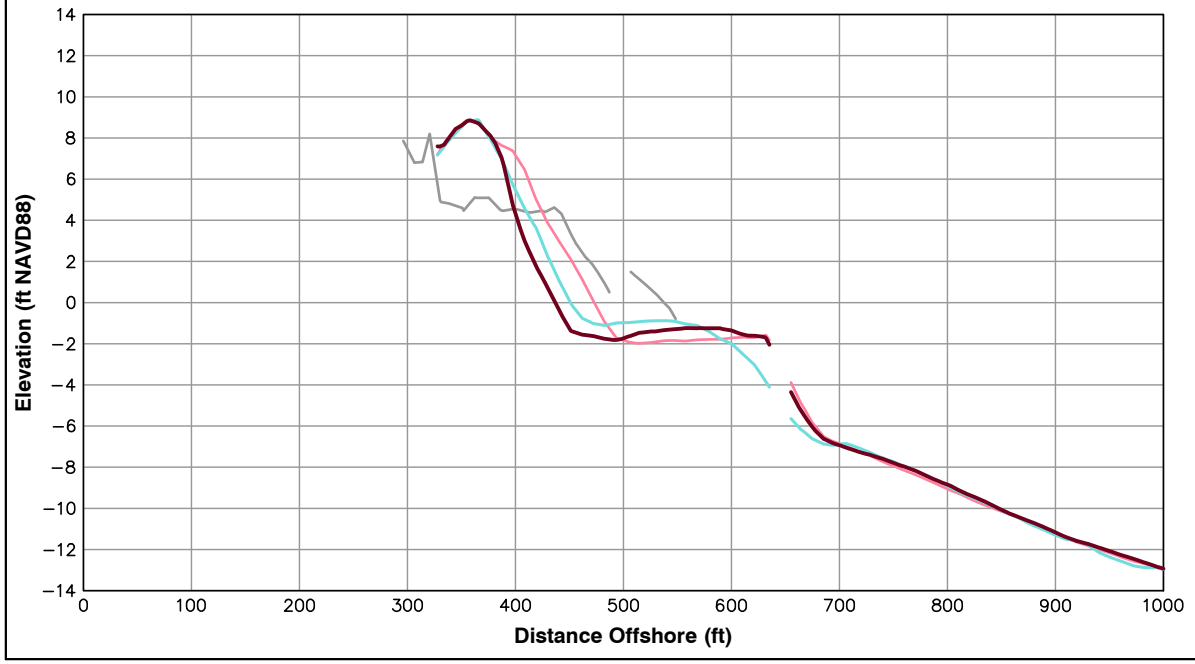
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 77+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-34.14 ft/yr	-14.04 ft
Volume Change Above -15 ft NAVD88	-7.26 cy/ft/yr	1.58 cy/ft
Volume Change Above 0 ft NAVD88	-7.24 cy/ft/yr	-2.62 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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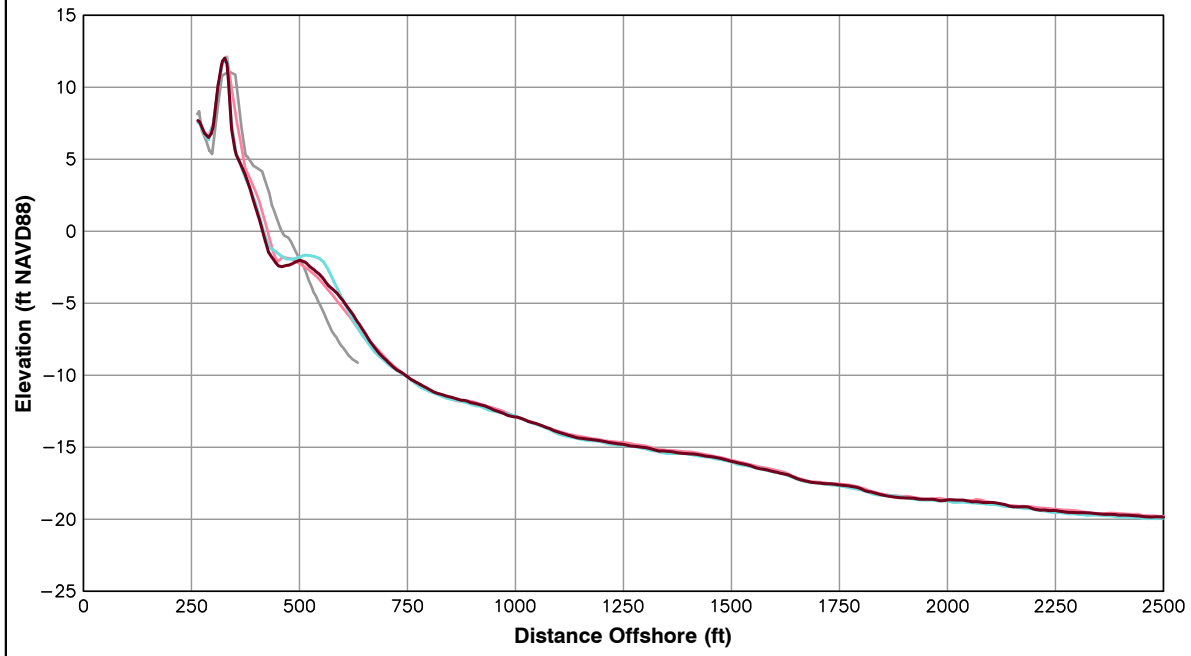
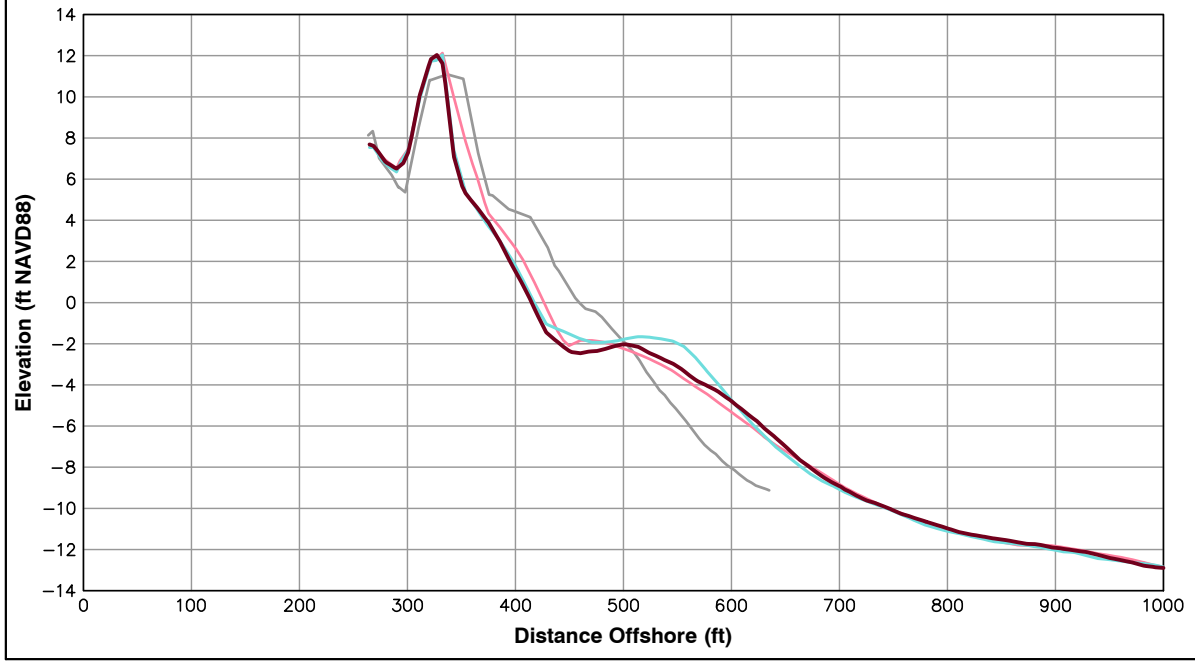
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 79+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-11.38 ft/yr	-2.51 ft
Volume Change Above -15 ft NAVD88	-4.80 cy/ft/yr	-1.78 cy/ft
Volume Change Above 0 ft NAVD88	-4.40 cy/ft/yr	-0.23 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing From West To East At Varying Intervals.
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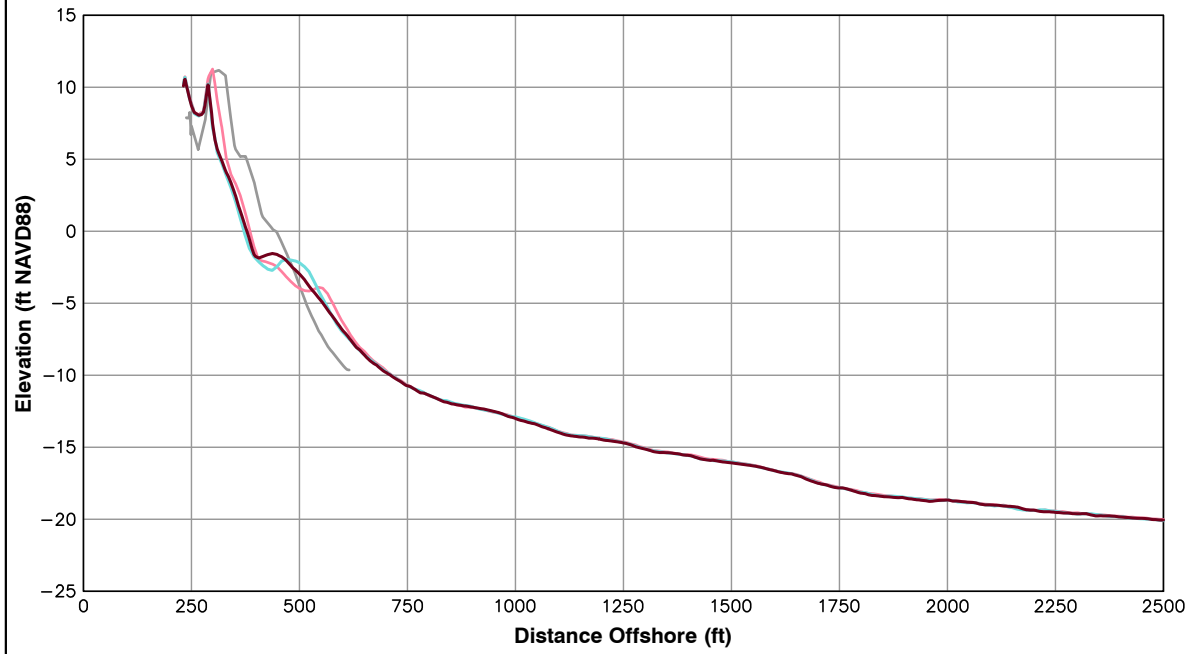
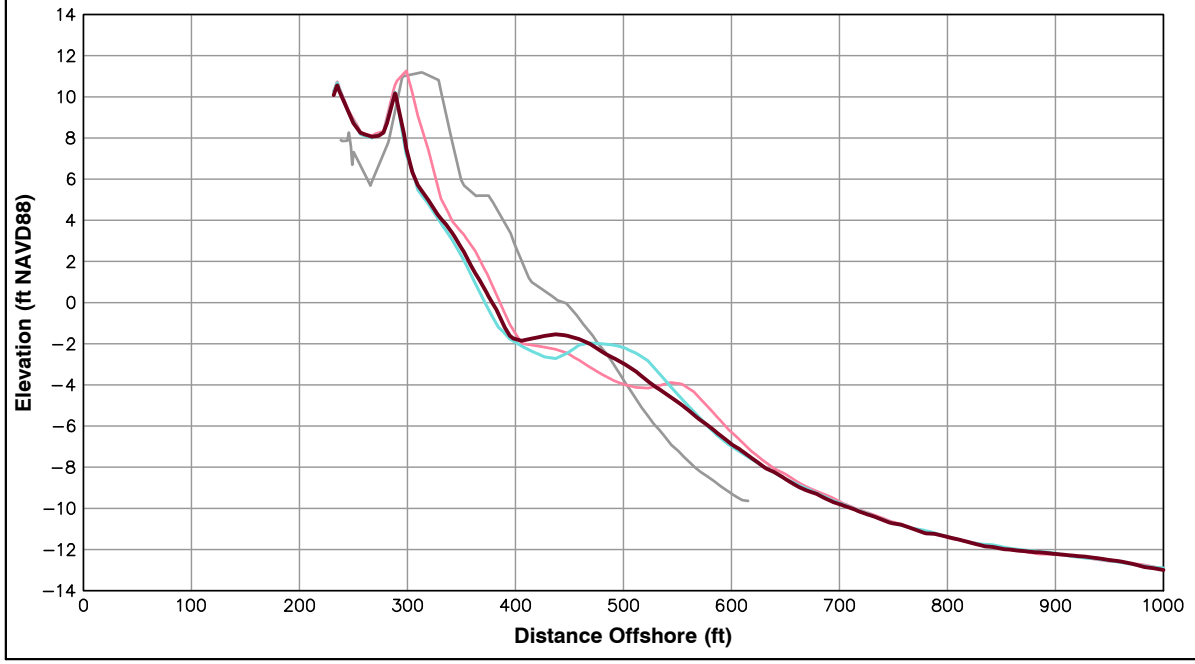
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 81+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-8.93 ft/yr	5.59 ft
Volume Change Above -15 ft NAVD88	-6.57 cy/ft/yr	-0.22 cy/ft
Volume Change Above 0 ft NAVD88	-5.69 cy/ft/yr	0.89 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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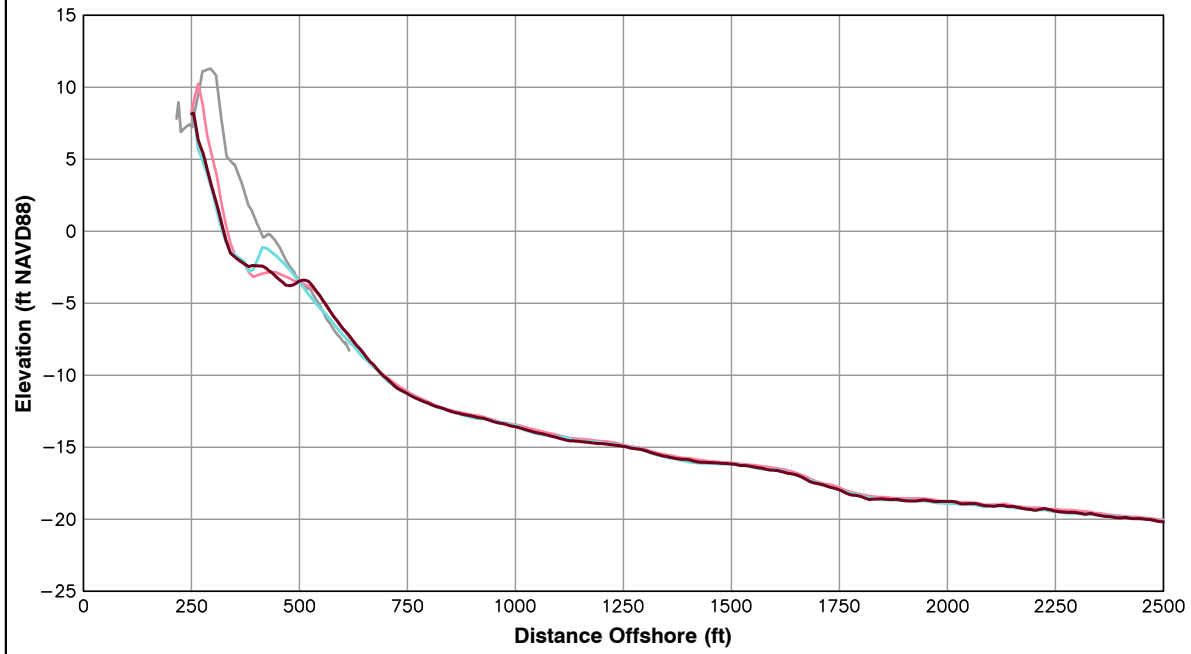
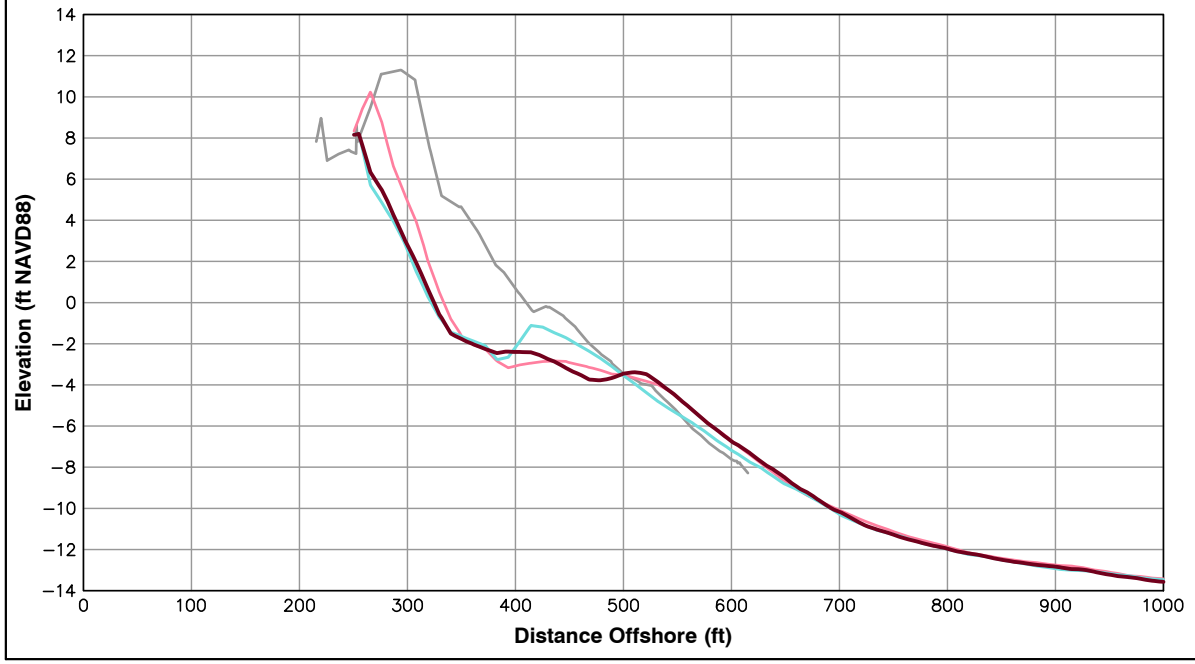
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 83+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-9.39 ft/yr	3.45 ft
Volume Change Above -15 ft NAVD88	-8.56 cy/ft/yr	0.03 cy/ft
Volume Change Above 0 ft NAVD88	-6.05 cy/ft/yr	0.98 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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City of Norfolk

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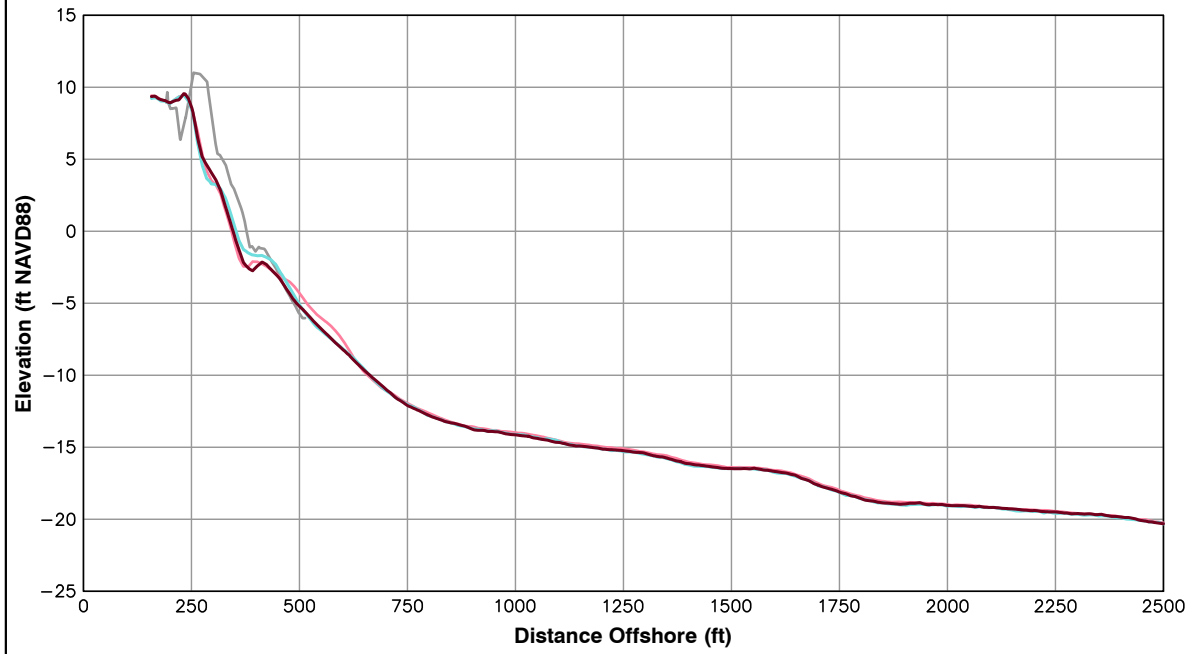

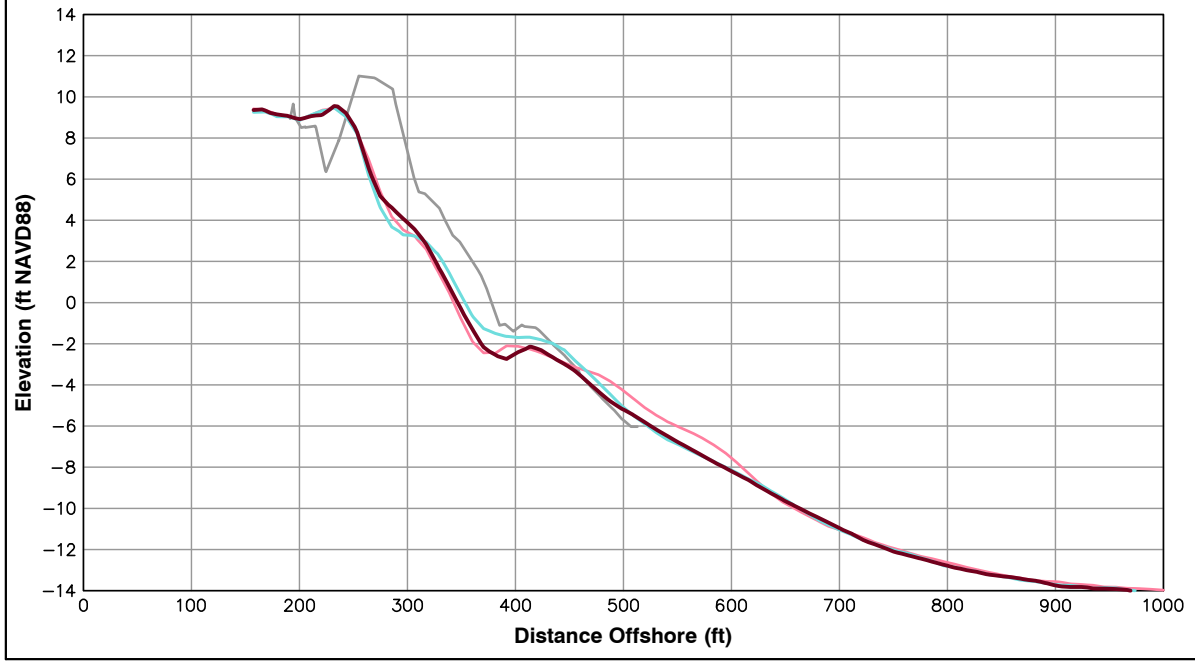

Survey Transect 85+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	2.82 ft/yr	-6.74 ft
Volume Change Above -15 ft NAVD88	-5.41 cy/ft/yr	-3.13 cy/ft
Volume Change Above 0 ft NAVD88	0.57 cy/ft/yr	0.66 cy/ft

LEGEND:
- 2016 MAY
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- 2015 APR
- POST-FILL

Notes:
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City of Norfolk

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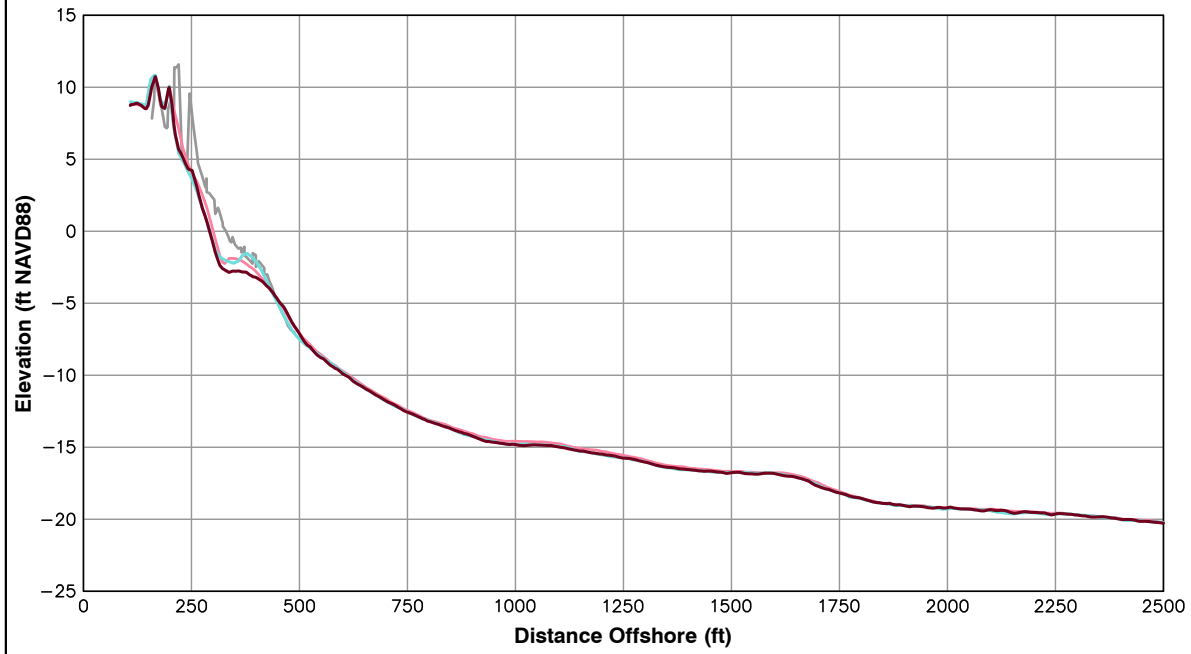

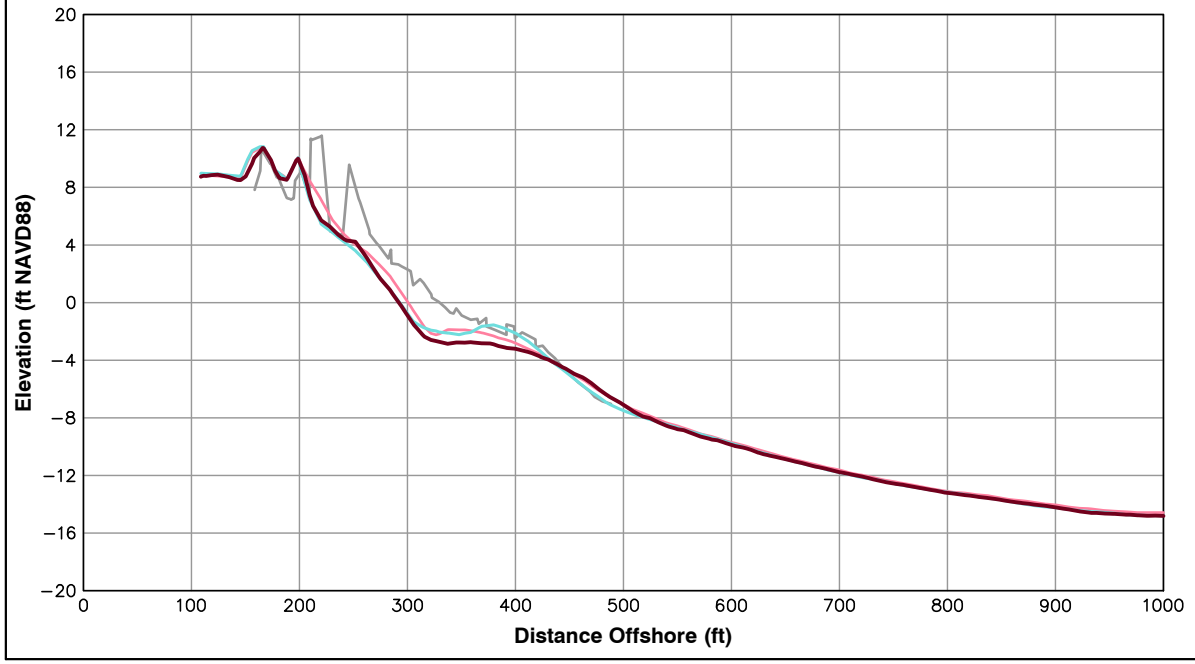

Survey Transect 87+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-8.56 ft/yr	-0.04 ft
Volume Change Above -15 ft NAVD88	-9.04 cy/ft/yr	-3.06 cy/ft
Volume Change Above 0 ft NAVD88	-2.68 cy/ft/yr	0.02 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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City of Norfolk

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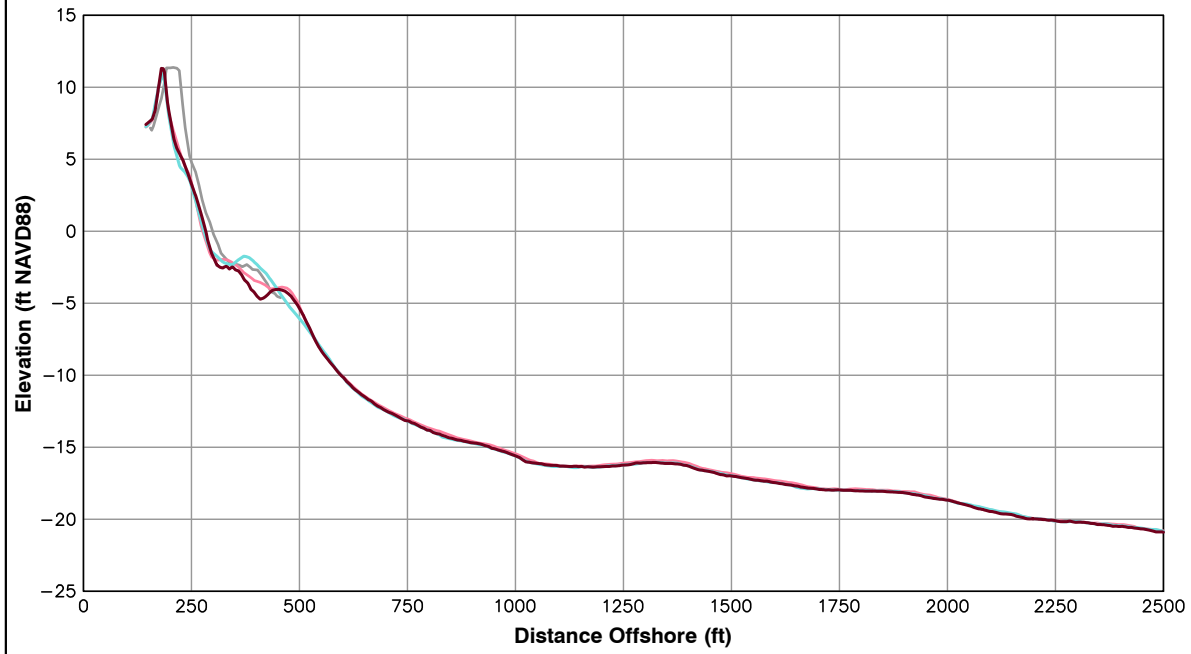

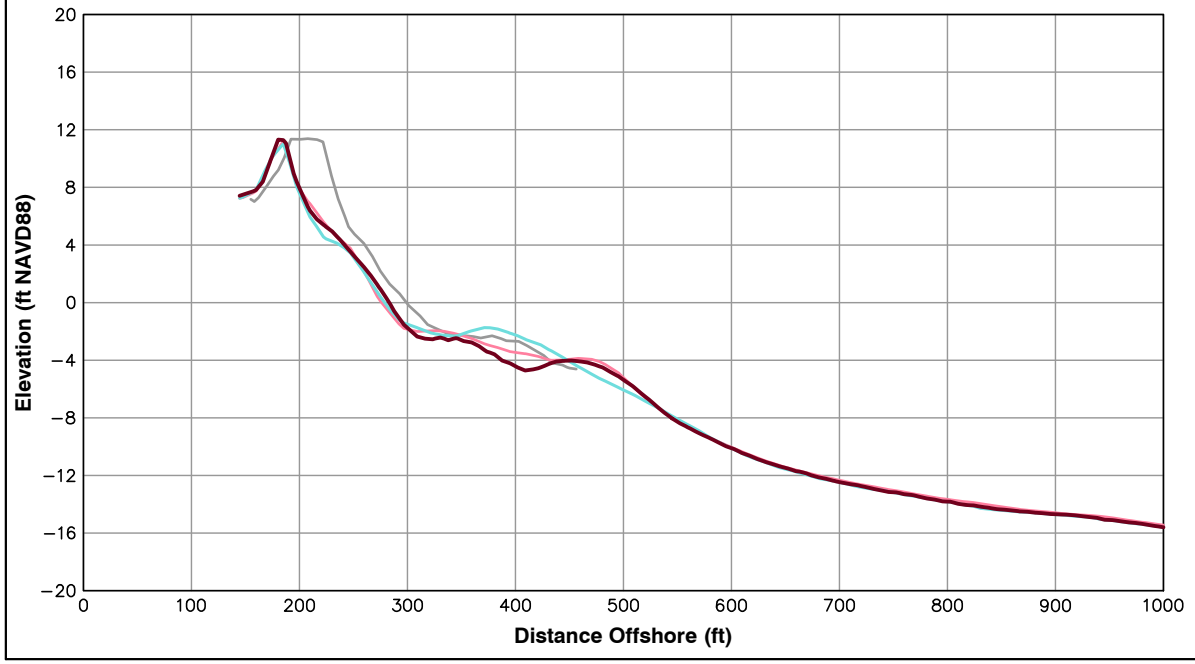

Survey Transect 93+41	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	6.05 ft/yr	4.68 ft
Volume Change Above -15 ft NAVD88	-3.99 cy/ft/yr	-2.21 cy/ft
Volume Change Above 0 ft NAVD88	0.41 cy/ft/yr	1.64 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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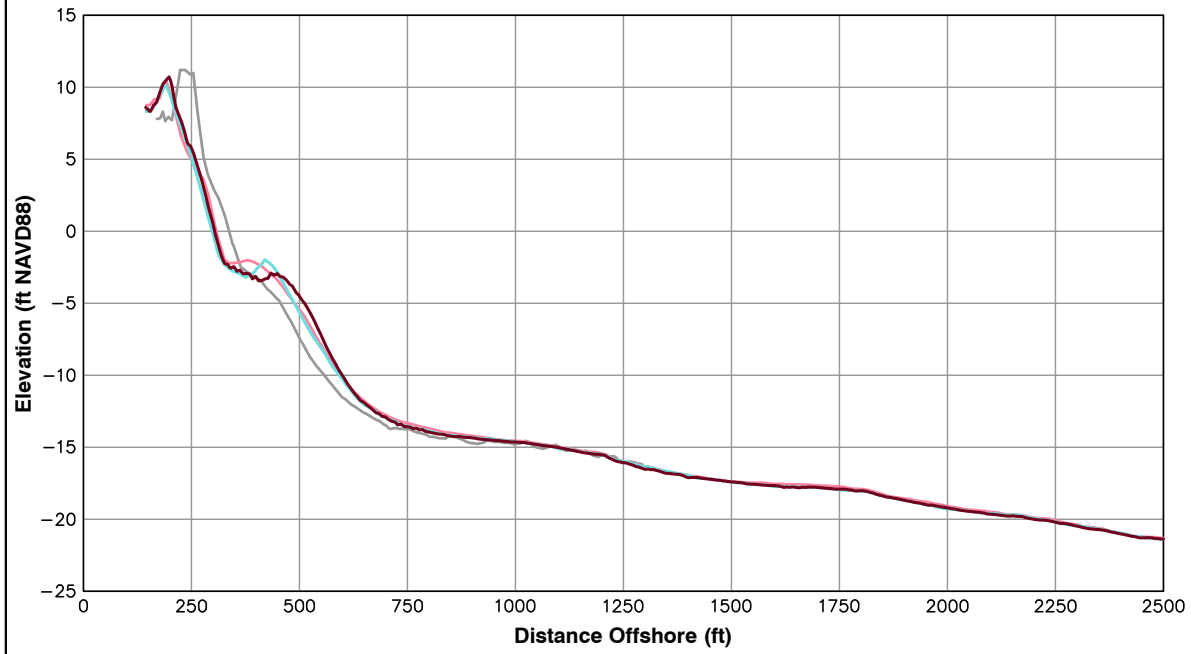
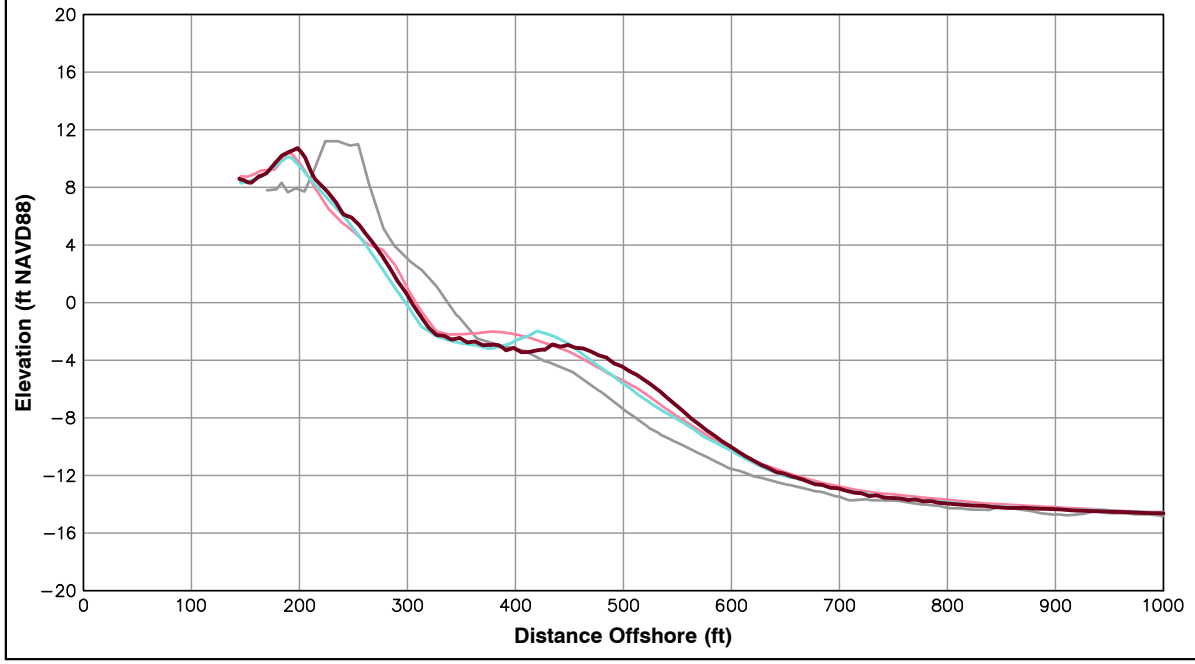
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 103+08	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-4.11 ft/yr	6.84 ft
Volume Change Above -15 ft NAVD88	-0.40 cy/ft/yr	6.21 cy/ft
Volume Change Above 0 ft NAVD88	1.25 cy/ft/yr	2.92 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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 April 2015 and October 2015.
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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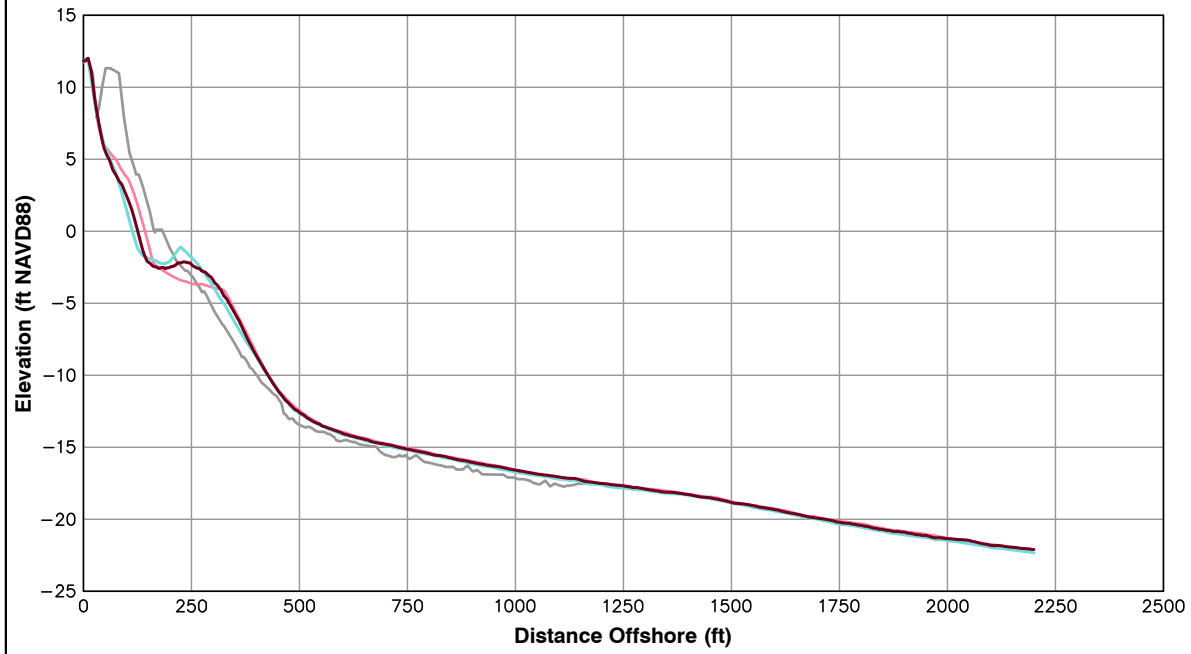
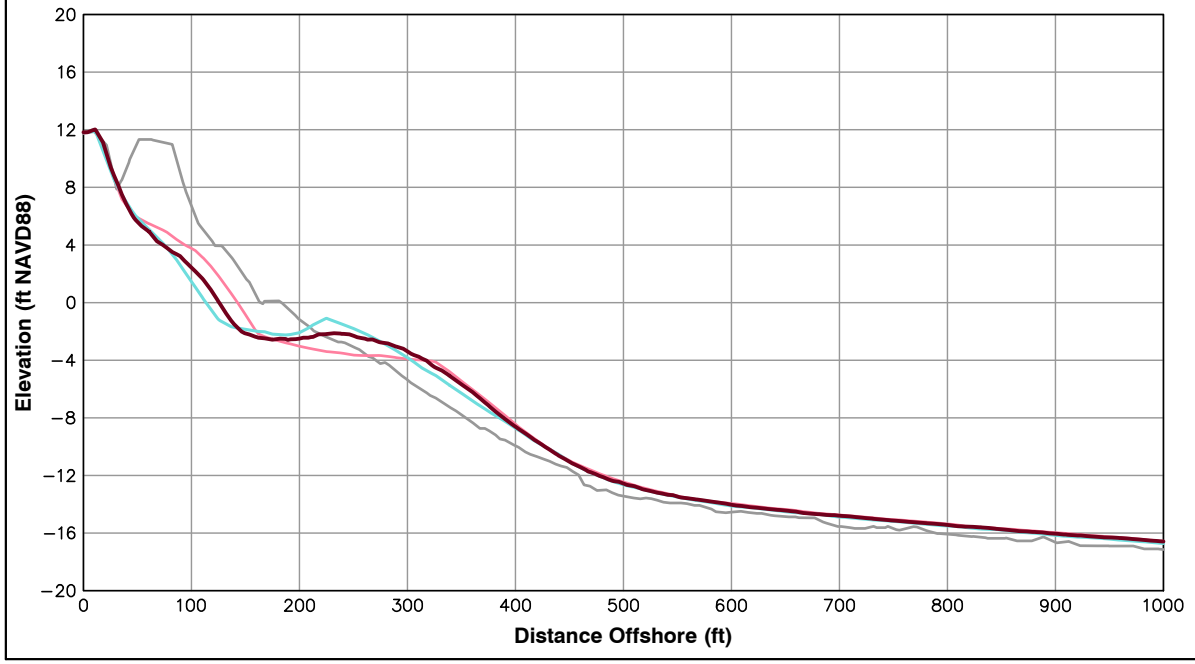
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 120+93	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-15.48 ft/yr	12.72 ft
Volume Change Above -15 ft NAVD88	-2.24 cy/ft/yr	2.24 cy/ft
Volume Change Above 0 ft NAVD88	-3.30 cy/ft/yr	1.33 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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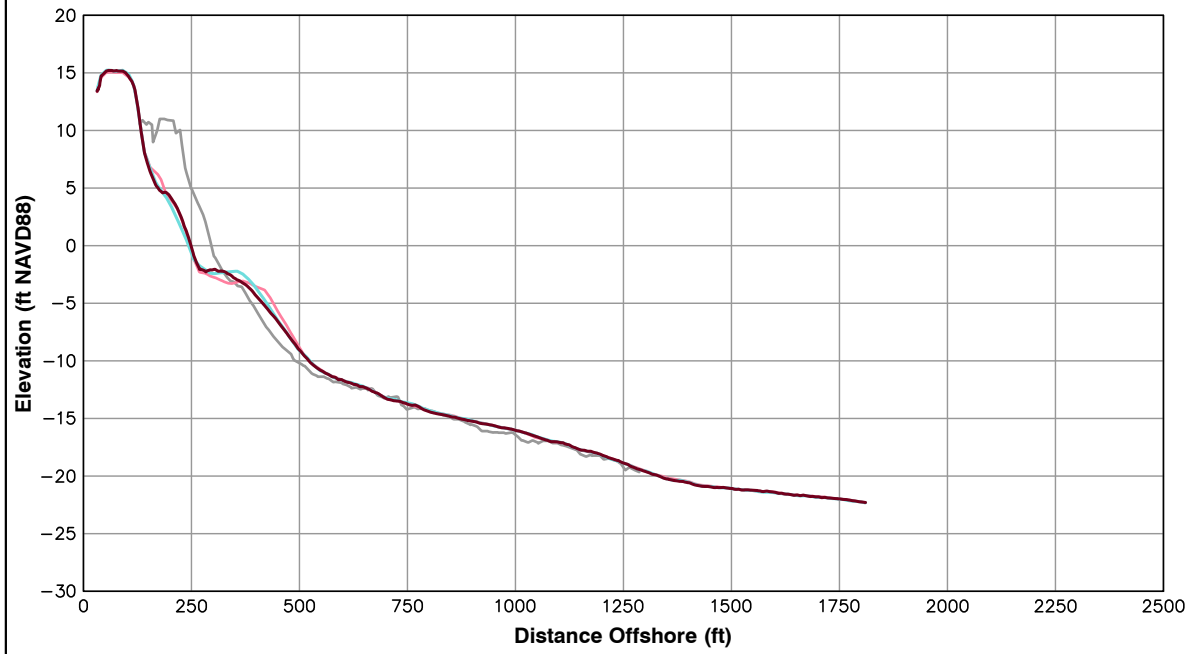
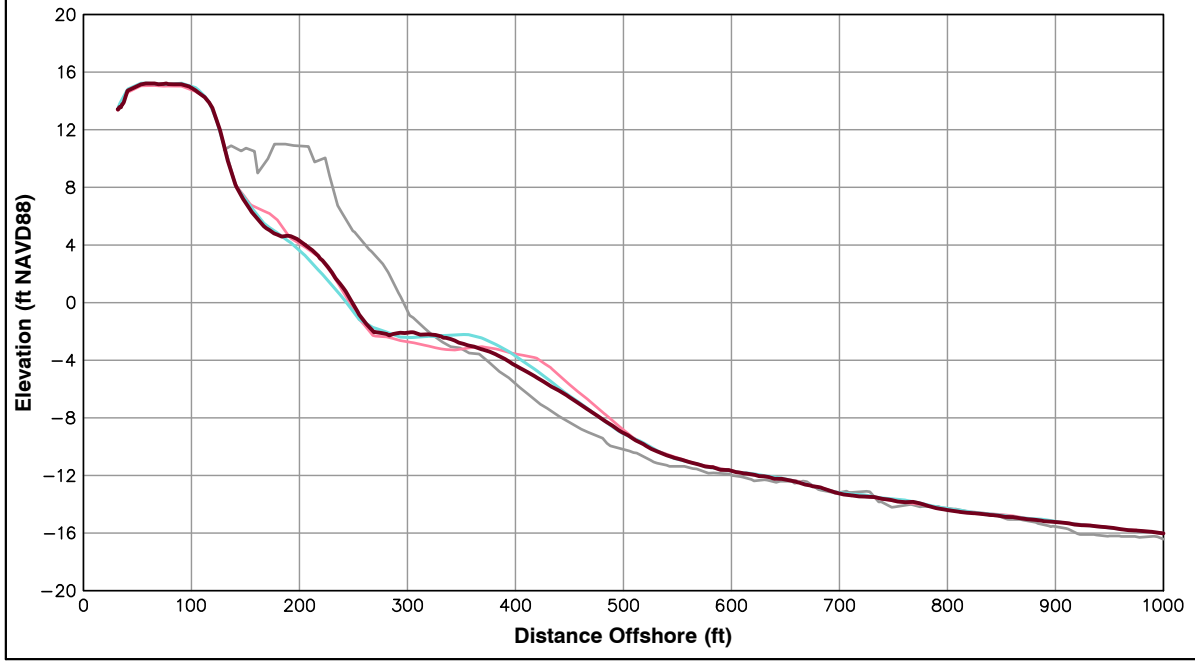
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 129+17	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	2.22 ft/yr	8.18 ft
Volume Change Above -15 ft NAVD88	-2.64 cy/ft/yr	-1.45 cy/ft
Volume Change Above 0 ft NAVD88	-0.60 cy/ft/yr	1.14 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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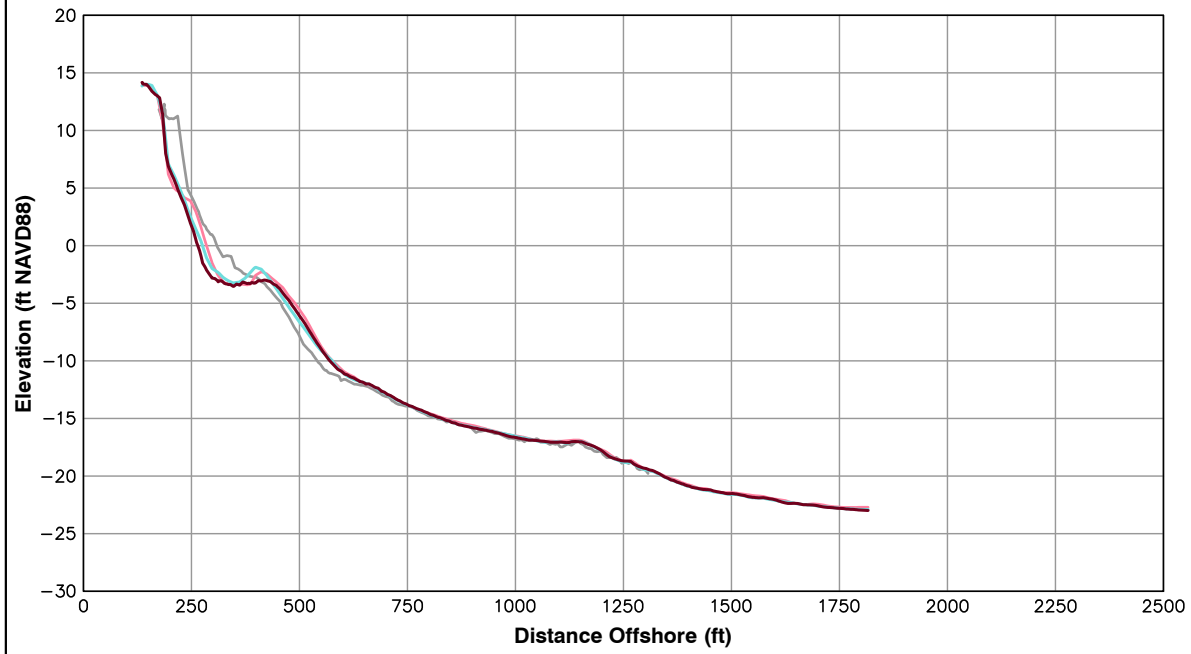
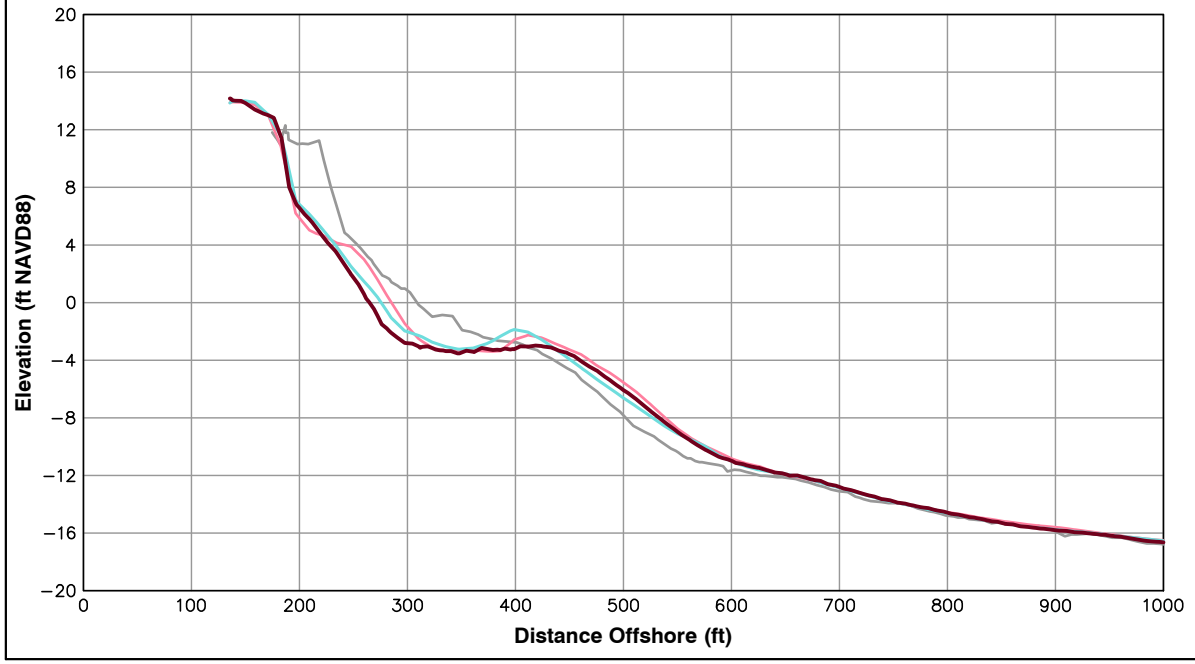
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 141+98	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-19.29 ft/yr	-8.75 ft
Volume Change Above -15 ft NAVD88	-7.42 cy/ft/yr	-4.01 cy/ft
Volume Change Above 0 ft NAVD88	-2.25 cy/ft/yr	-1.93 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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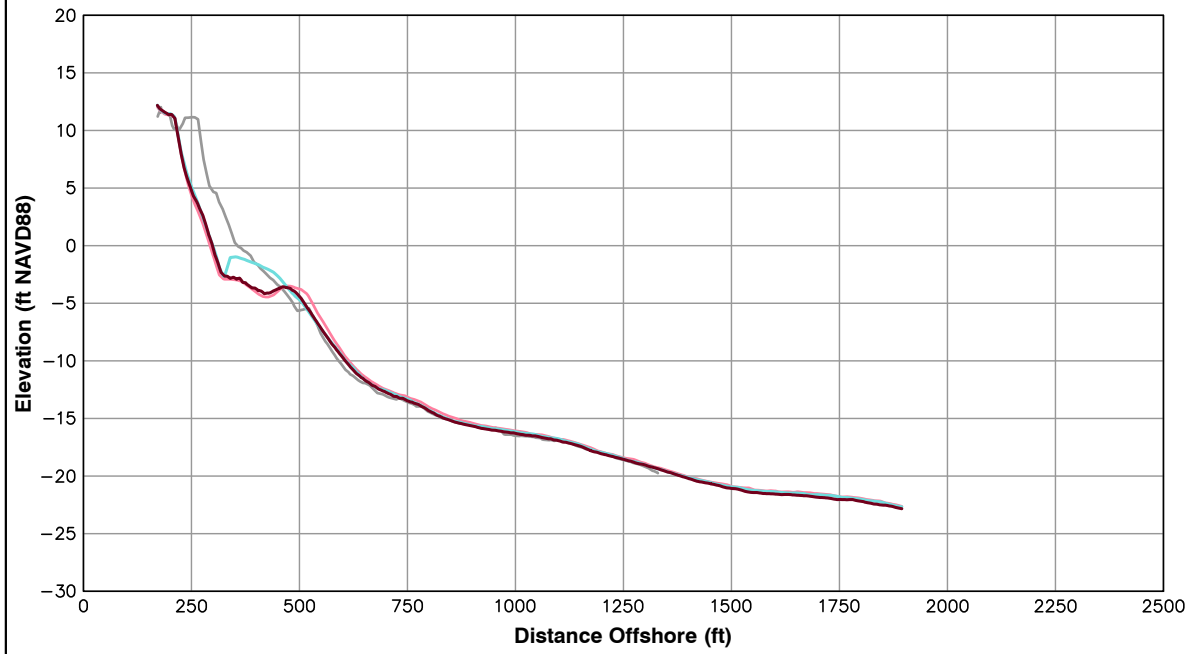
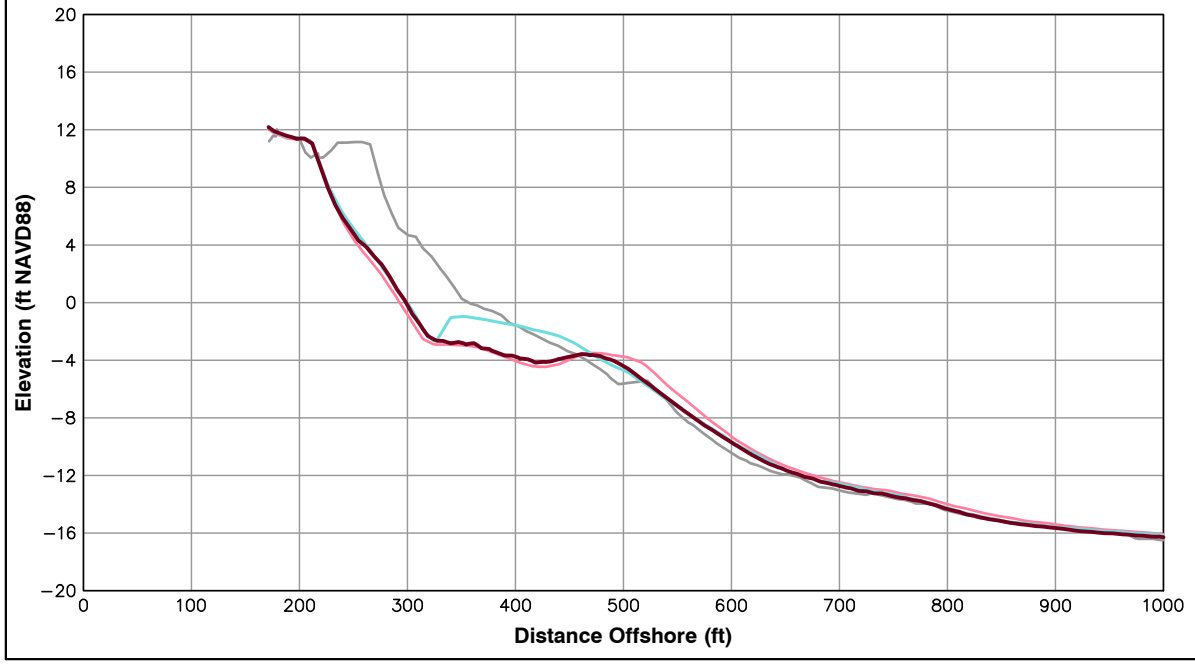
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 152+01	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	5.14 ft/yr	-0.20 ft
Volume Change Above -15 ft NAVD88	-3.07 cy/ft/yr	-9.67 cy/ft
Volume Change Above 0 ft NAVD88	1.25 cy/ft/yr	-0.46 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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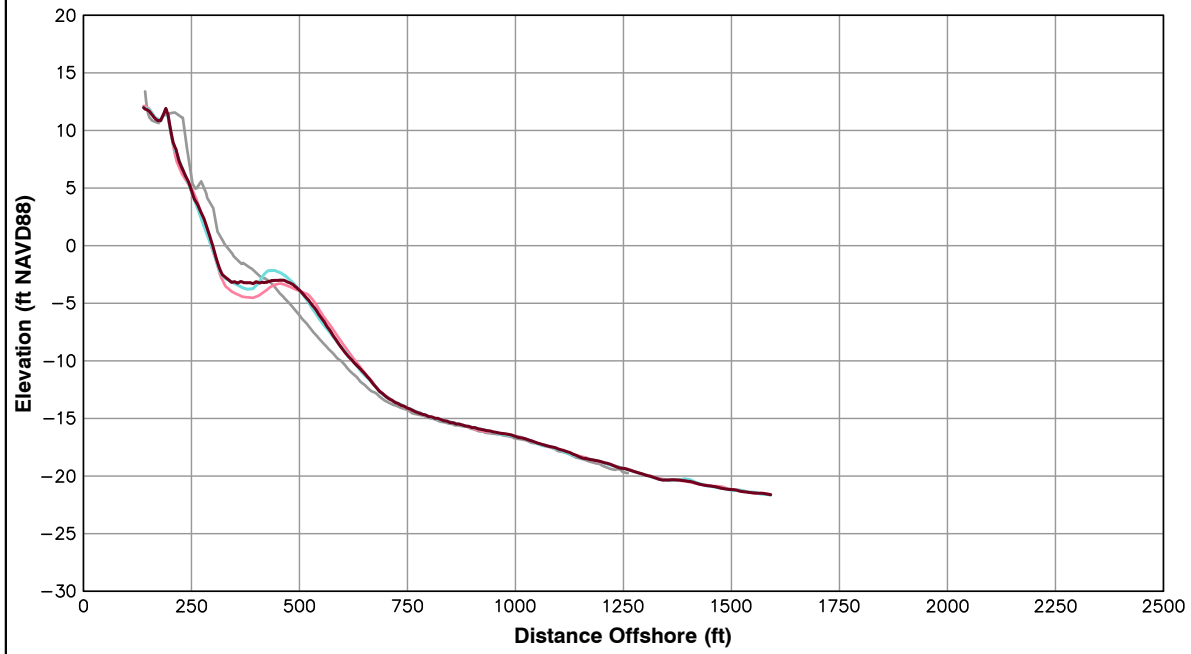

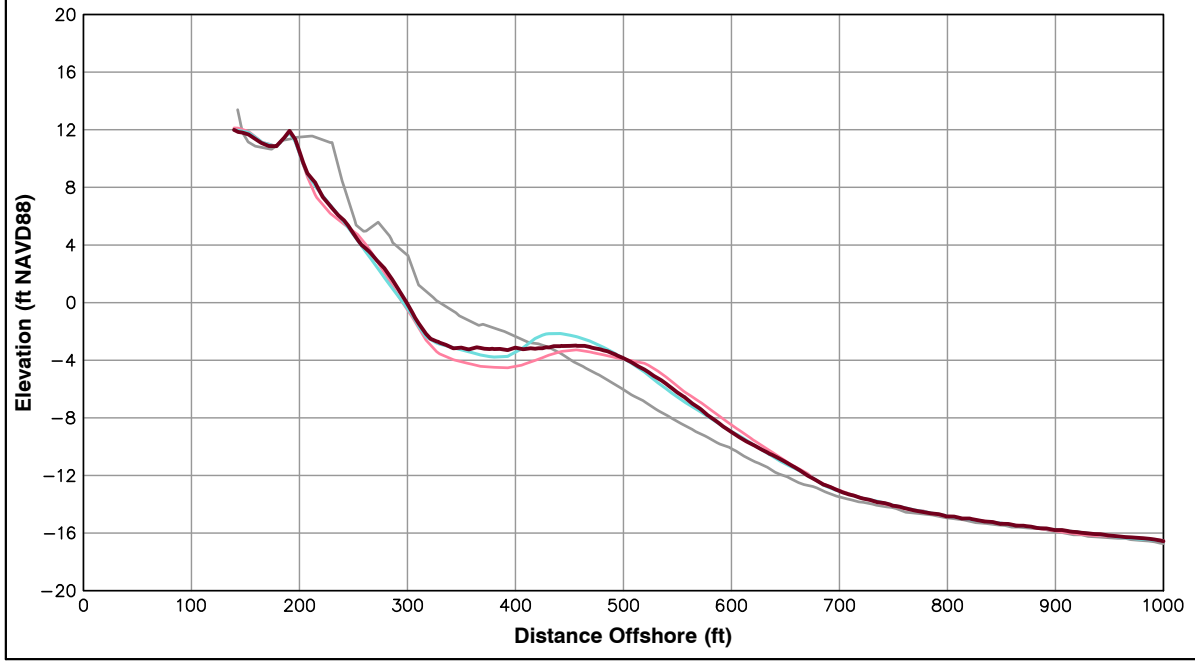

Survey Transect 163+49	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	3.58 ft/yr	5.02 ft
Volume Change Above -15 ft NAVD88	3.53 cy/ft/yr	0.74 cy/ft
Volume Change Above 0 ft NAVD88	0.64 cy/ft/yr	0.74 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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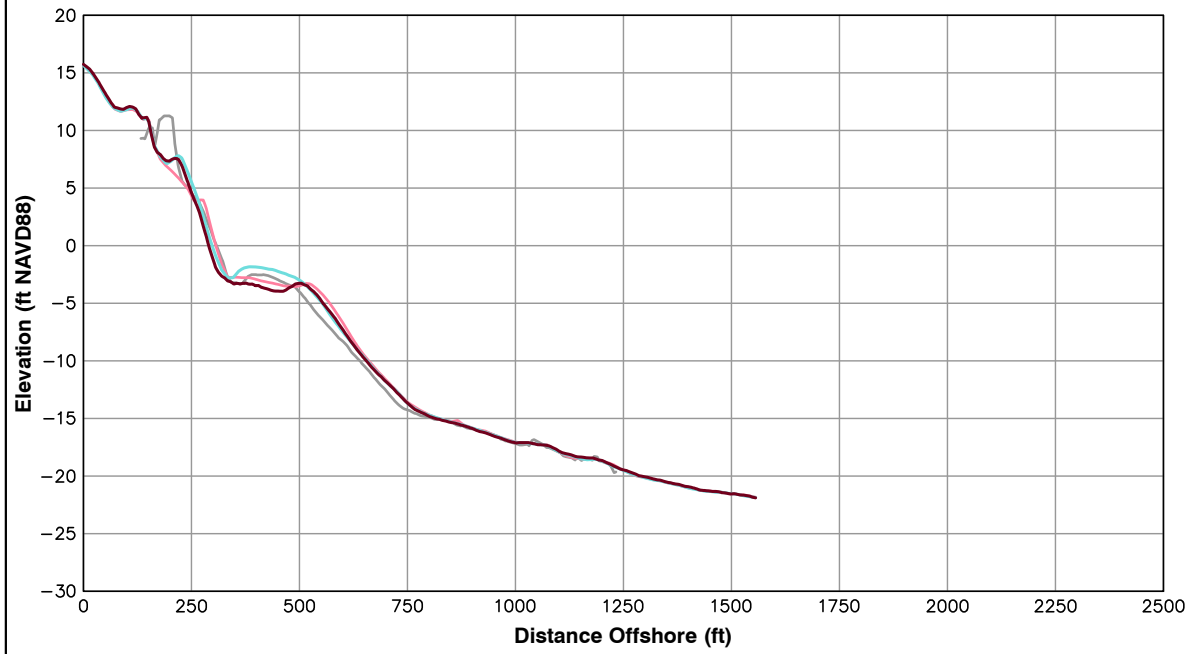

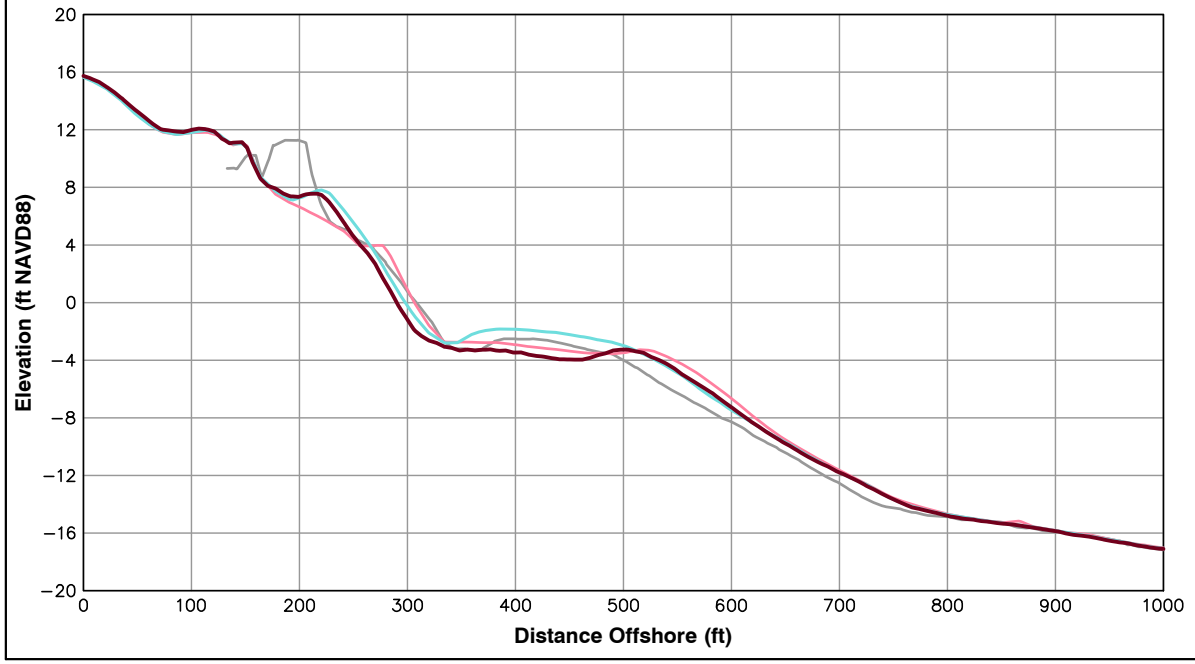

Survey Transect 169+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-15.70 ft/yr	-6.76 ft
Volume Change Above -15 ft NAVD88	-6.92 cy/ft/yr	-10.09 cy/ft
Volume Change Above 0 ft NAVD88	0.55 cy/ft/yr	-1.39 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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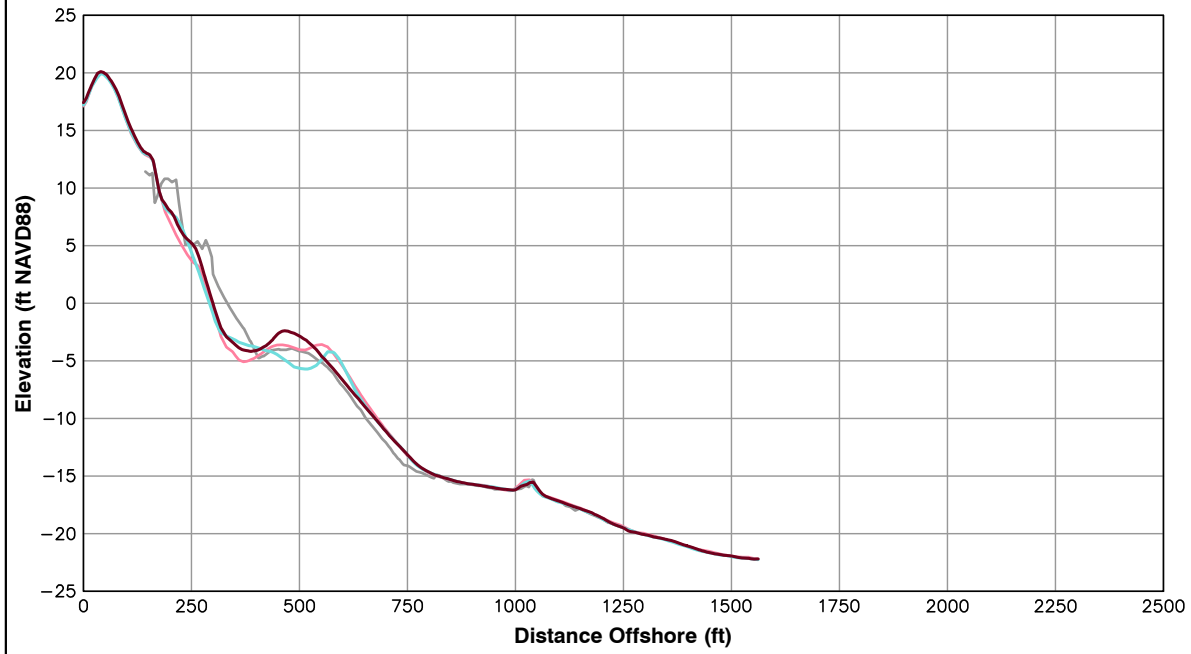
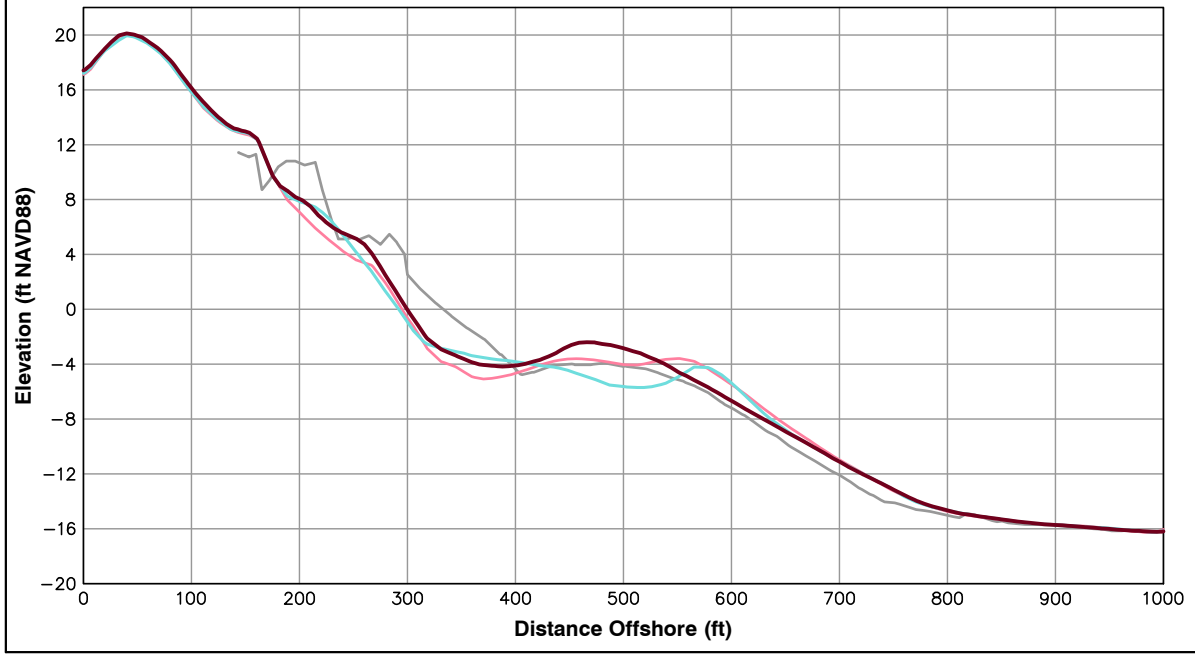
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 171+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	4.24 ft/yr	9.05 ft
Volume Change Above -15 ft NAVD88	7.49 cy/ft/yr	9.56 cy/ft
Volume Change Above 0 ft NAVD88	5.17 cy/ft/yr	3.34 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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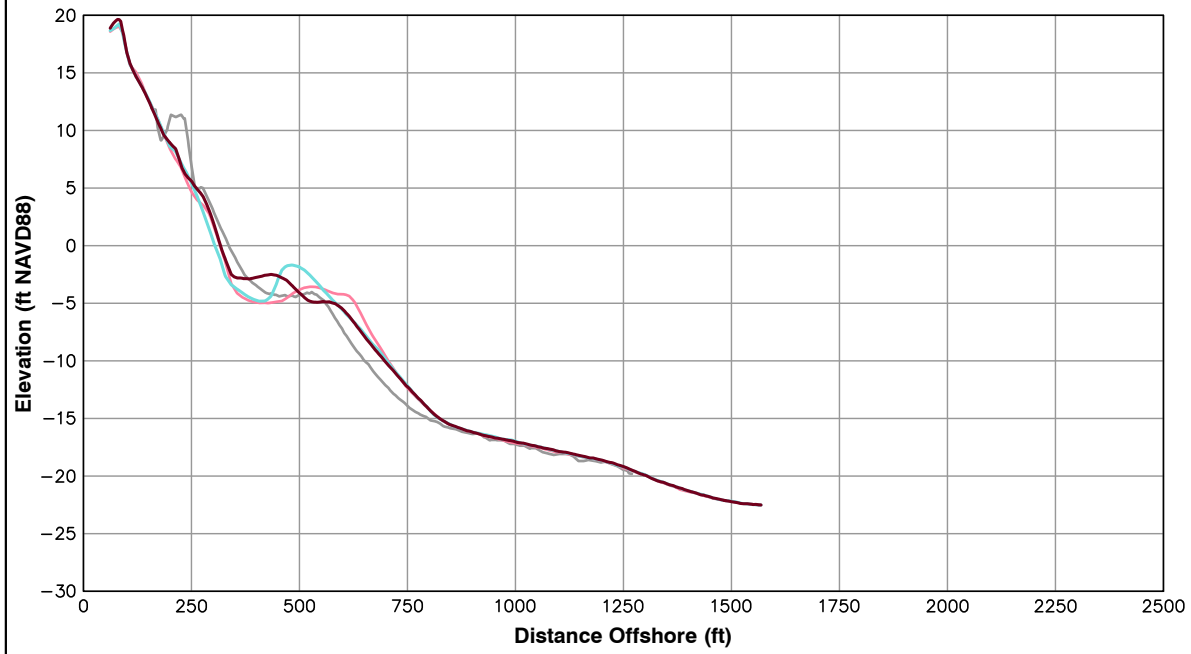
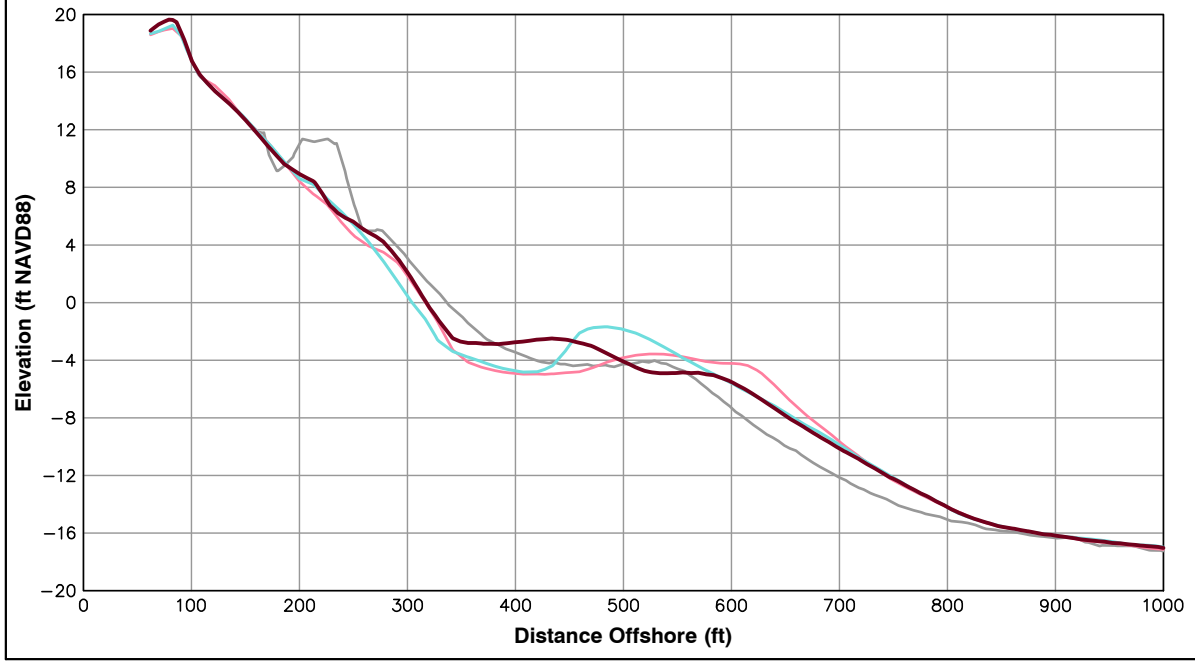
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 173+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	1.40 ft/yr	14.12 ft
Volume Change Above -15 ft NAVD88	4.03 cy/ft/yr	2.84 cy/ft
Volume Change Above 0 ft NAVD88	2.47 cy/ft/yr	2.95 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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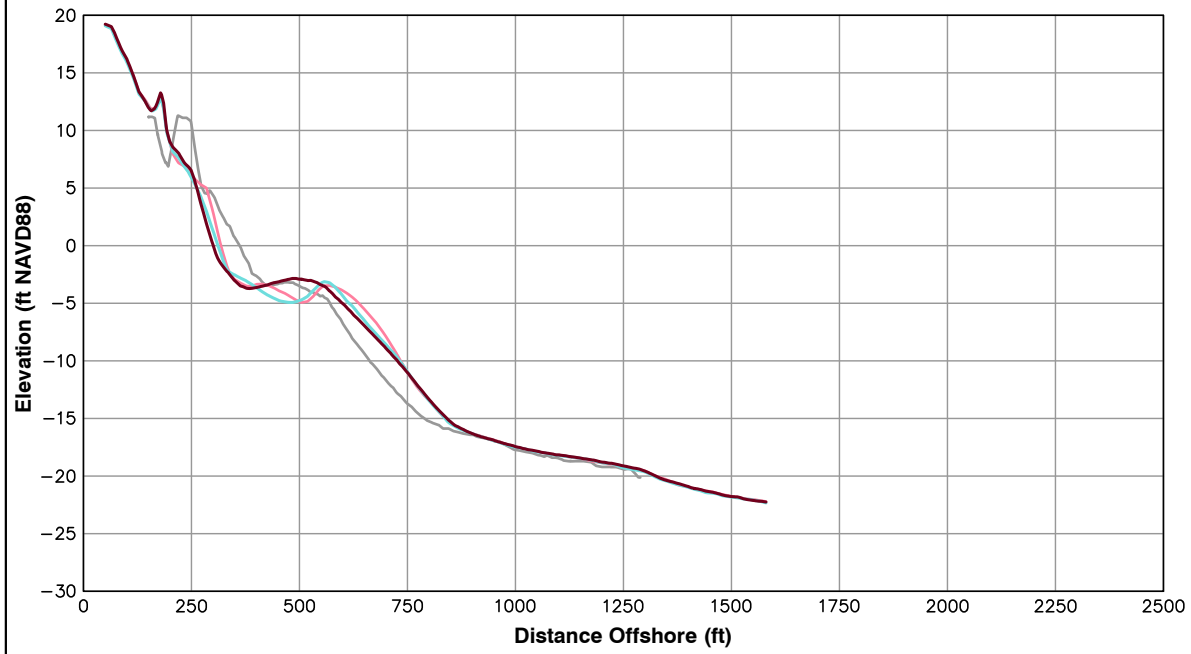
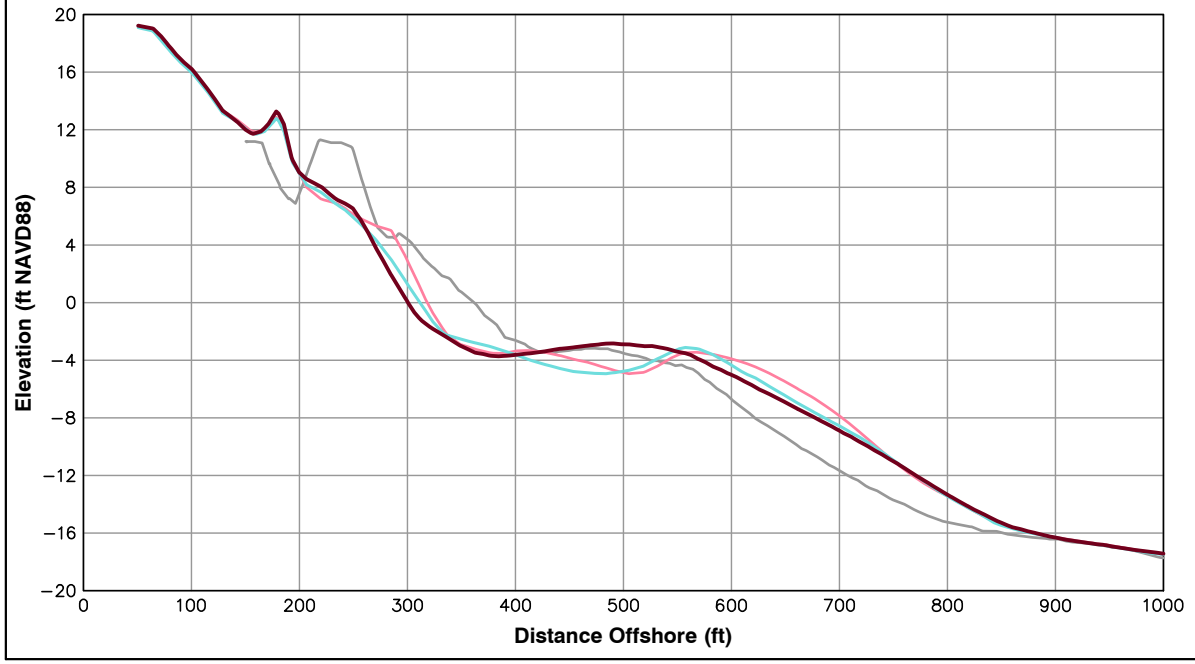
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 175+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-18.60 ft/yr	-10.21 ft
Volume Change Above -15 ft NAVD88	-5.37 cy/ft/yr	2.52 cy/ft
Volume Change Above 0 ft NAVD88	-2.82 cy/ft/yr	0.50 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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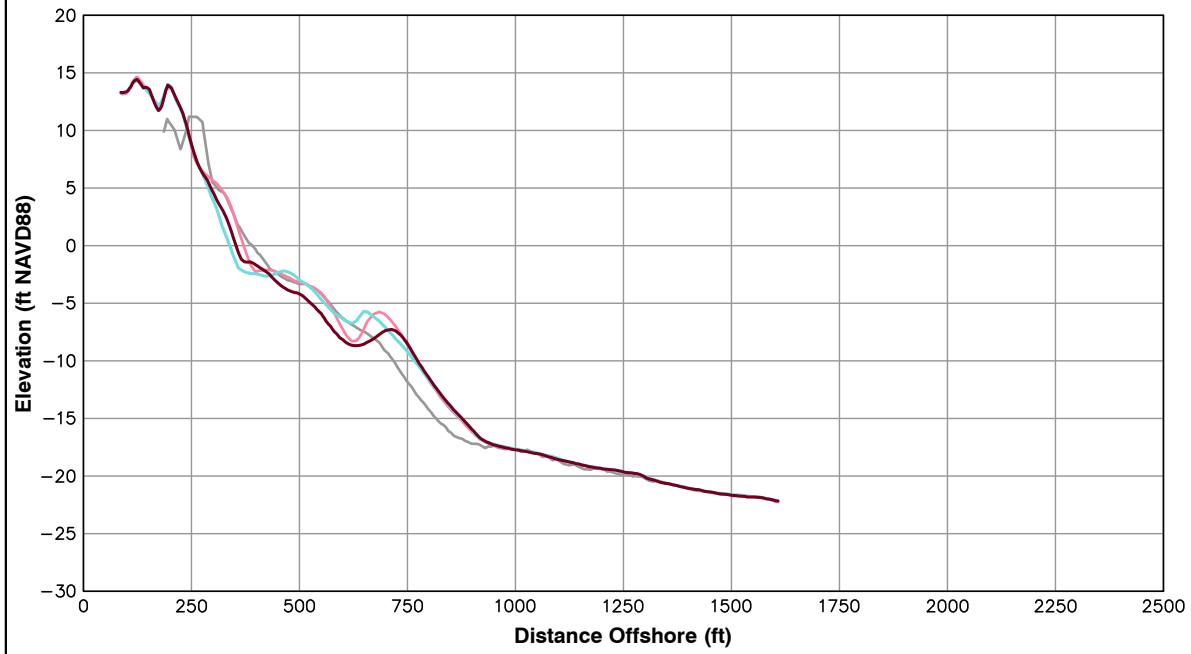
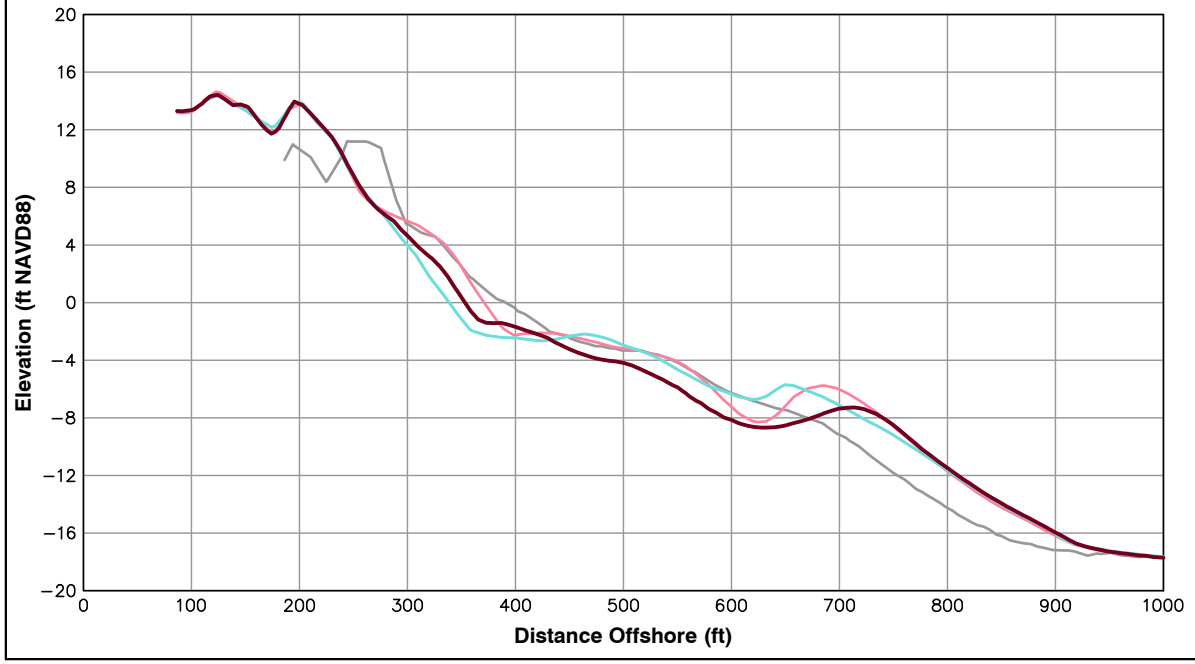
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 177+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-16.74 ft/yr	15.75 ft
Volume Change Above -15 ft NAVD88	-16.45 cy/ft/yr	-7.90 cy/ft
Volume Change Above 0 ft NAVD88	-4.13 cy/ft/yr	2.59 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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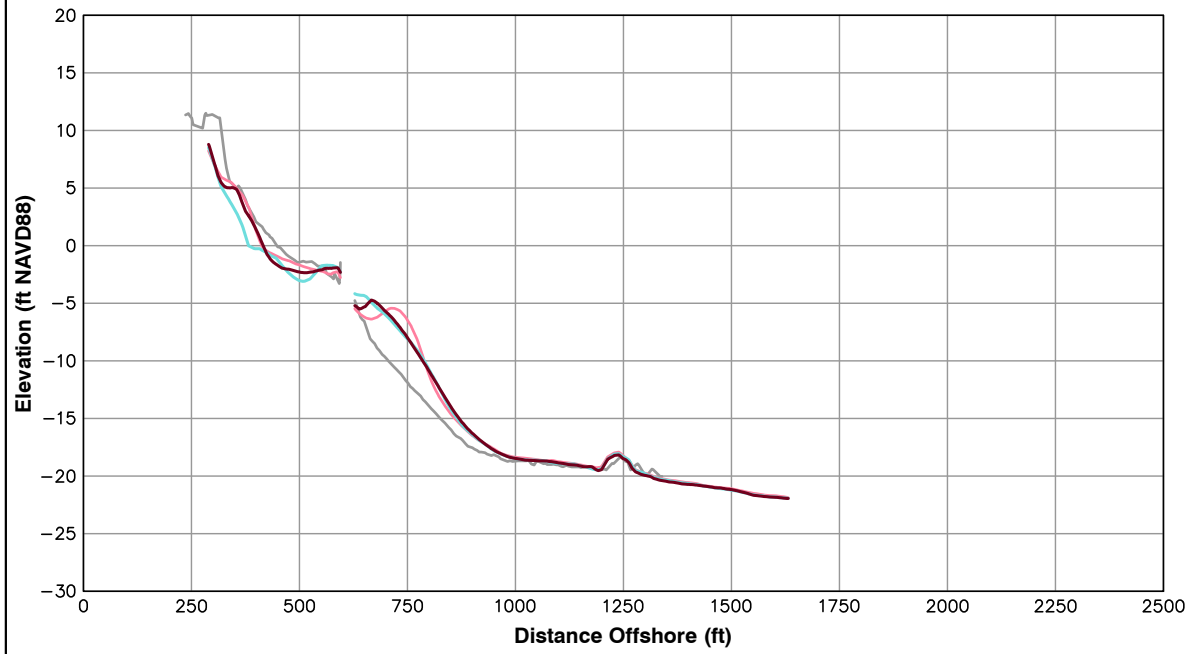
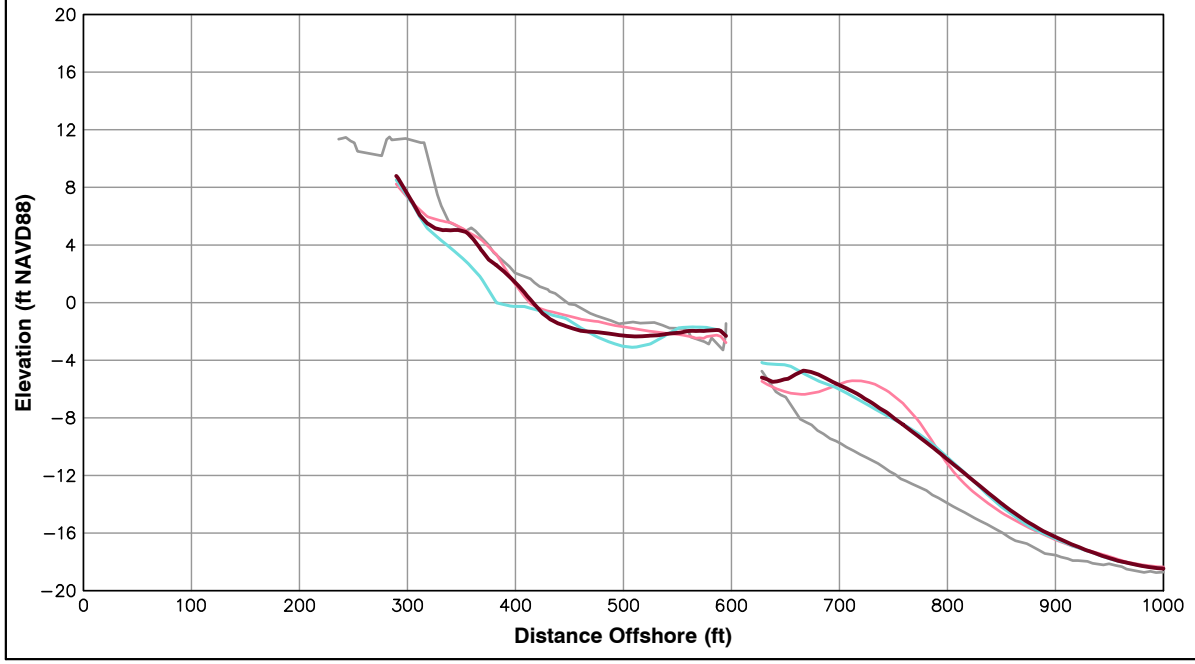
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 179+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	2.19 ft/yr	30.80 ft
Volume Change Above -15 ft NAVD88	-2.55 cy/ft/yr	6.18 cy/ft
Volume Change Above 0 ft NAVD88	-1.17 cy/ft/yr	5.60 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
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Notes:
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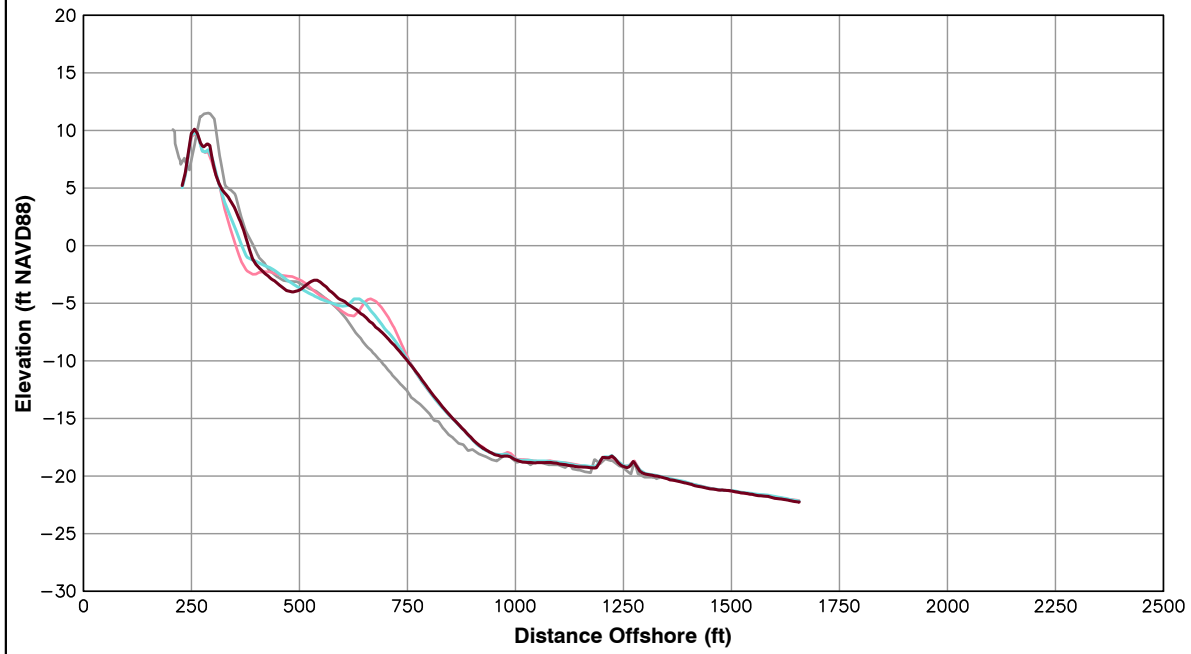
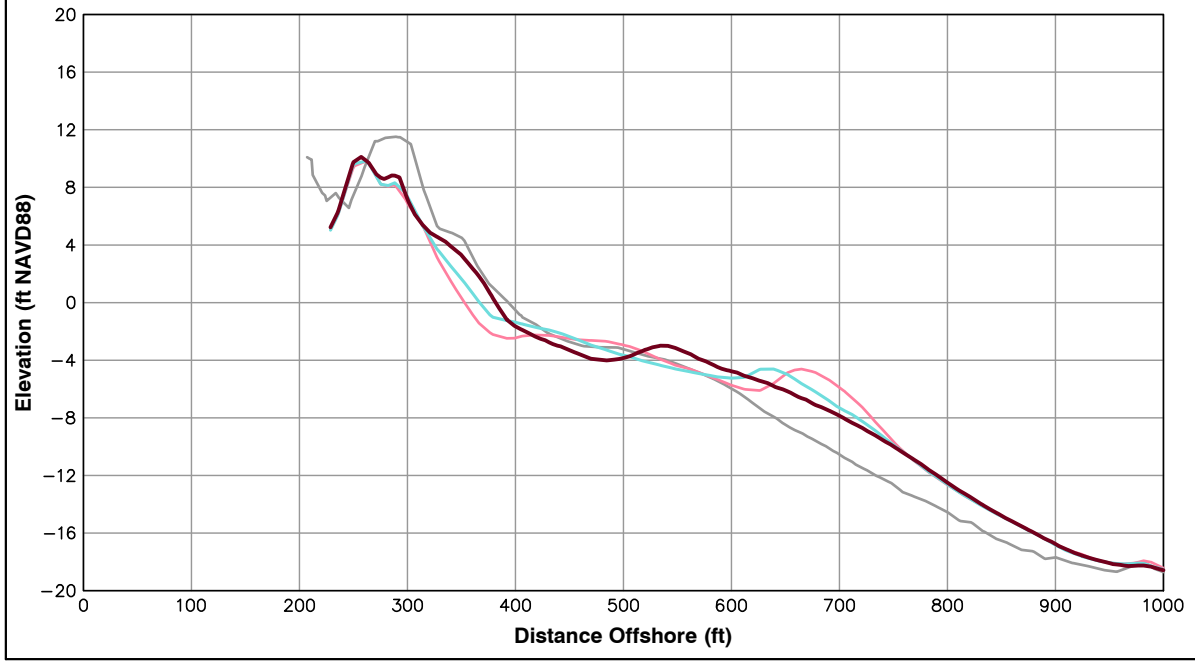
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 181+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	27.80 ft/yr	16.81 ft
Volume Change Above -15 ft NAVD88	2.63 cy/ft/yr	1.63 cy/ft
Volume Change Above 0 ft NAVD88	5.03 cy/ft/yr	3.50 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
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- POST-FILL

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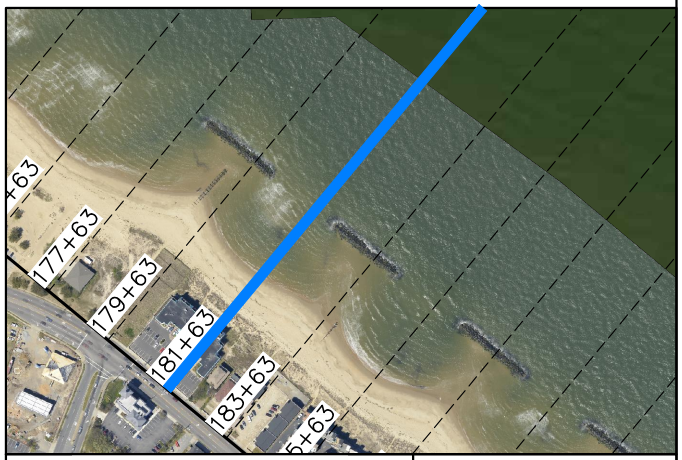

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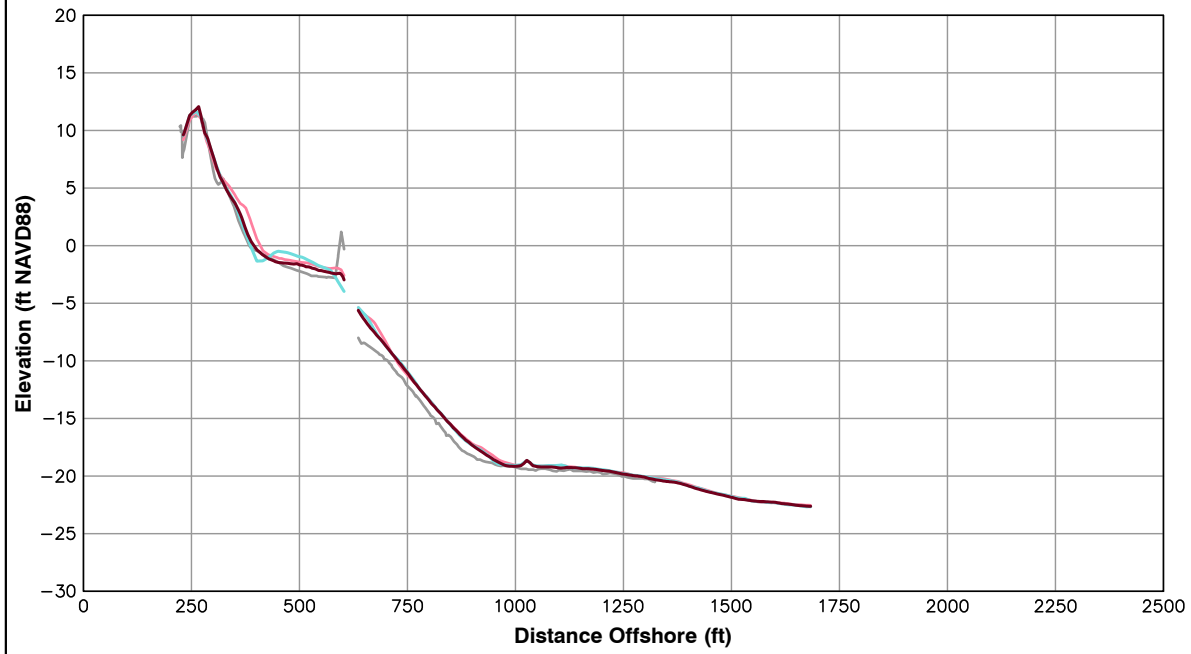
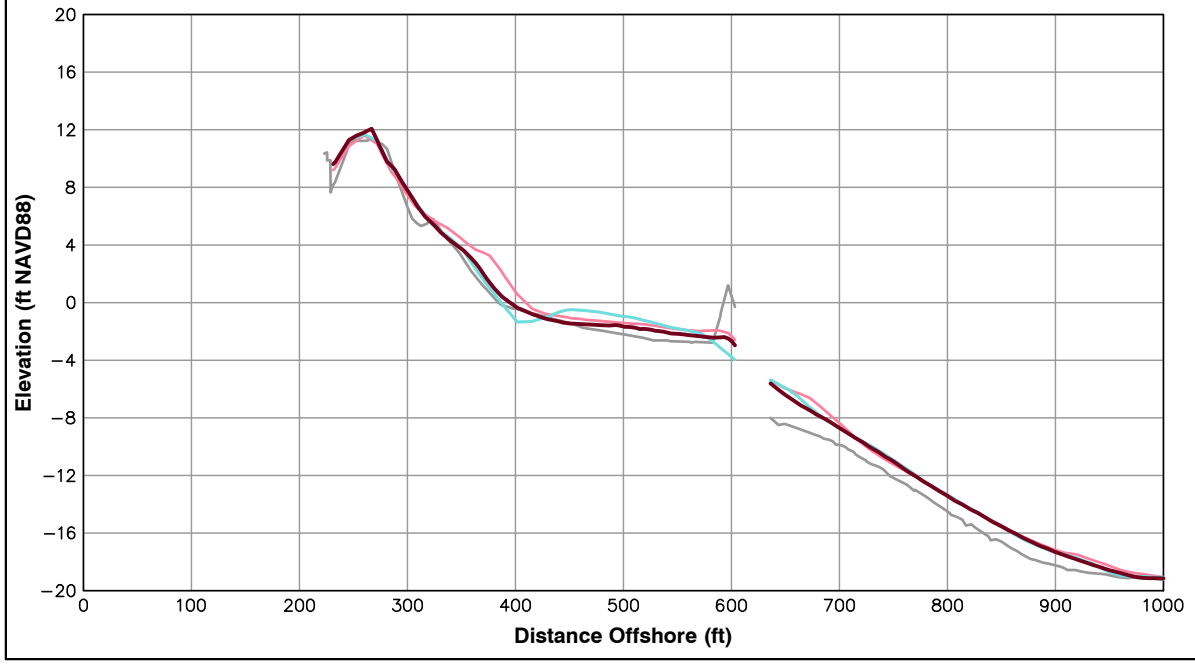
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 183+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-16.55 ft/yr	3.80 ft
Volume Change Above -15 ft NAVD88	-5.73 cy/ft/yr	-2.08 cy/ft
Volume Change Above 0 ft NAVD88	-2.06 cy/ft/yr	0.67 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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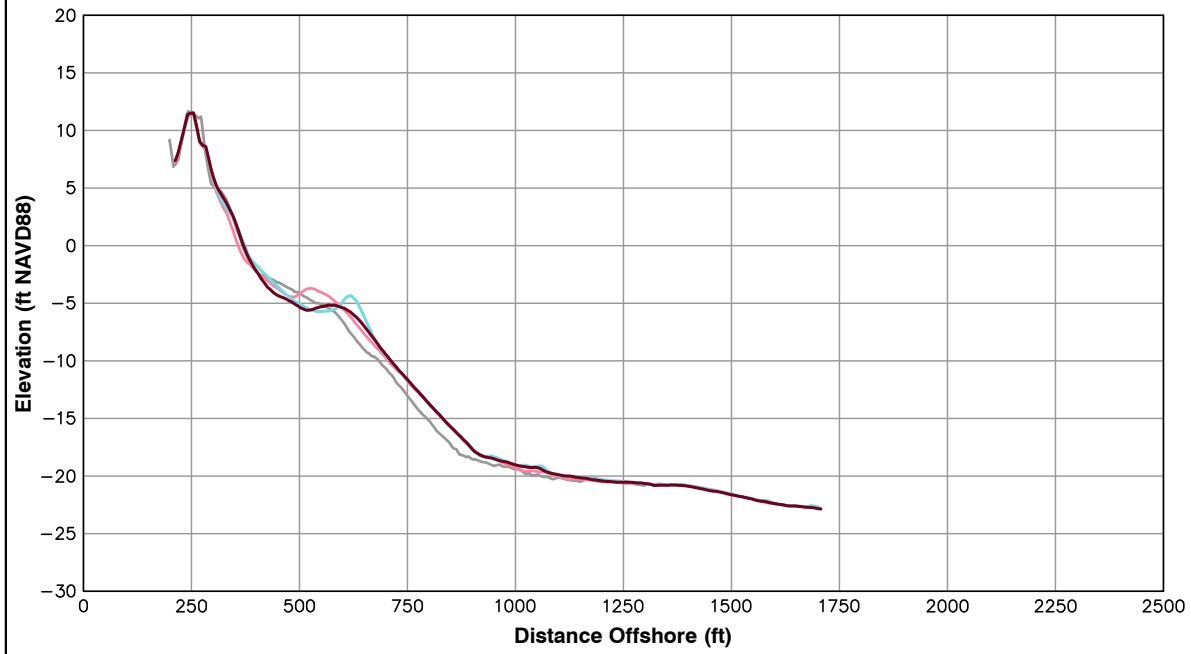
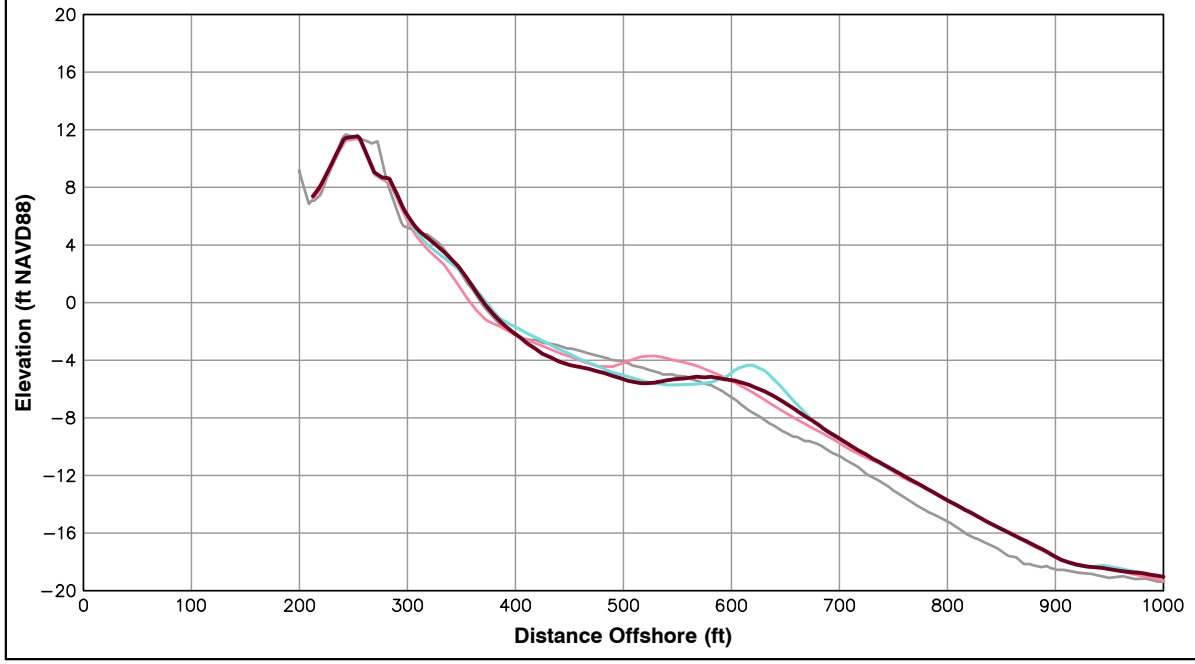
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 185+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	11.62 ft/yr	-1.50 ft
Volume Change Above -15 ft NAVD88	0.23 cy/ft/yr	-3.58 cy/ft
Volume Change Above 0 ft NAVD88	2.84 cy/ft/yr	0.79 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
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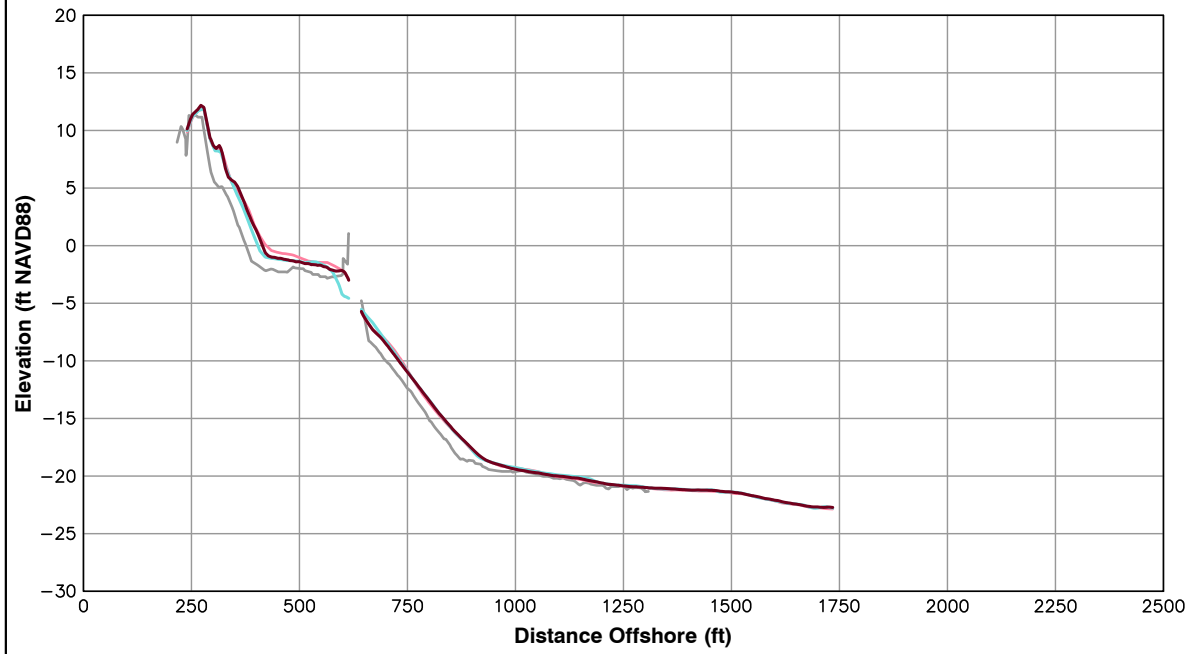
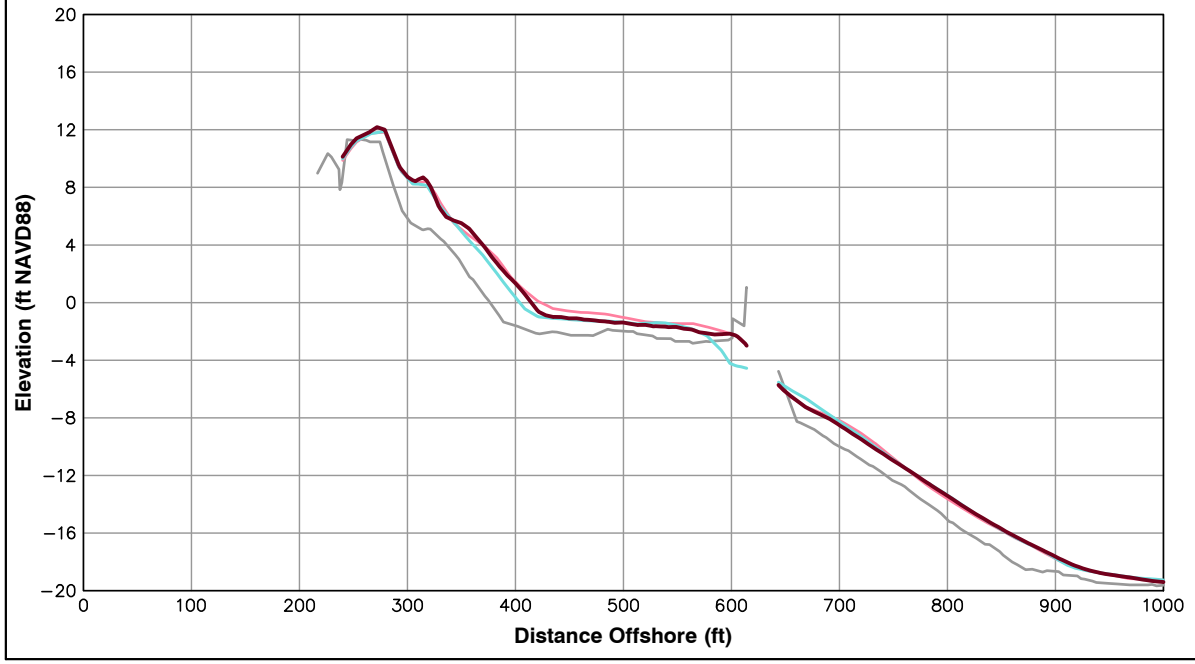
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 187+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-2.15 ft/yr	10.76 ft
Volume Change Above -15 ft NAVD88	-2.74 cy/ft/yr	3.26 cy/ft
Volume Change Above 0 ft NAVD88	0.24 cy/ft/yr	2.42 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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.

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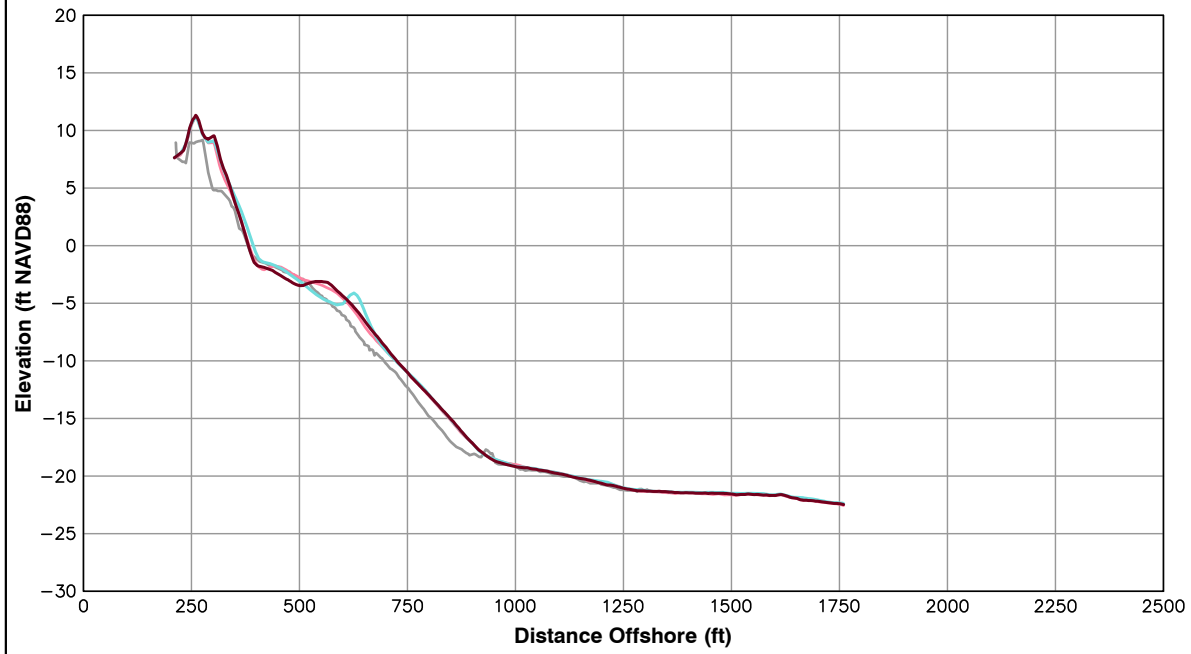
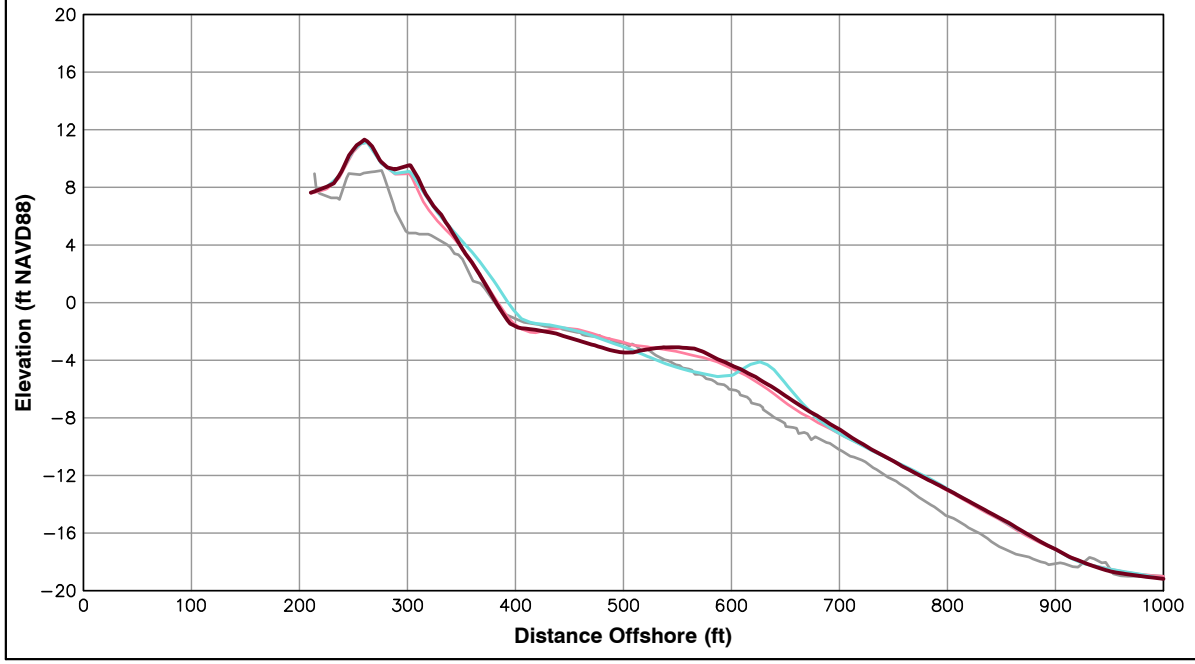
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

ST 187+63	Pg 58 of 106	Spring 2016





Survey Transect 189+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-0.92 ft/yr	-10.23 ft
Volume Change Above -15 ft NAVD88	1.80 cy/ft/yr	-1.39 cy/ft
Volume Change Above 0 ft NAVD88	1.47 cy/ft/yr	-0.81 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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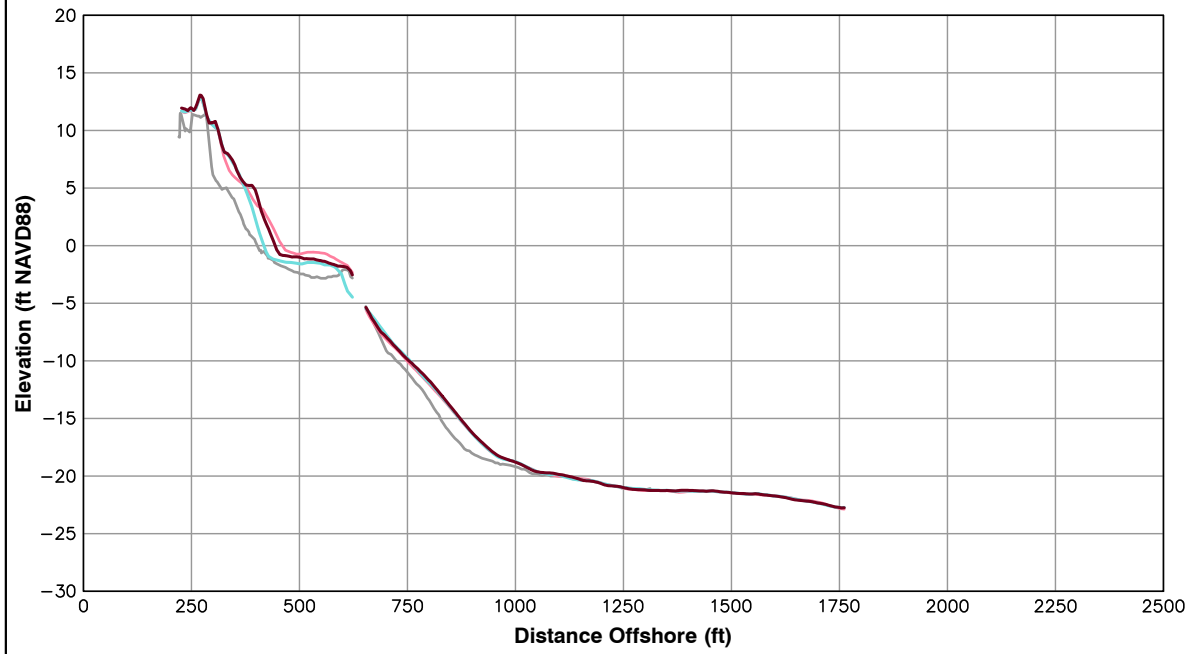
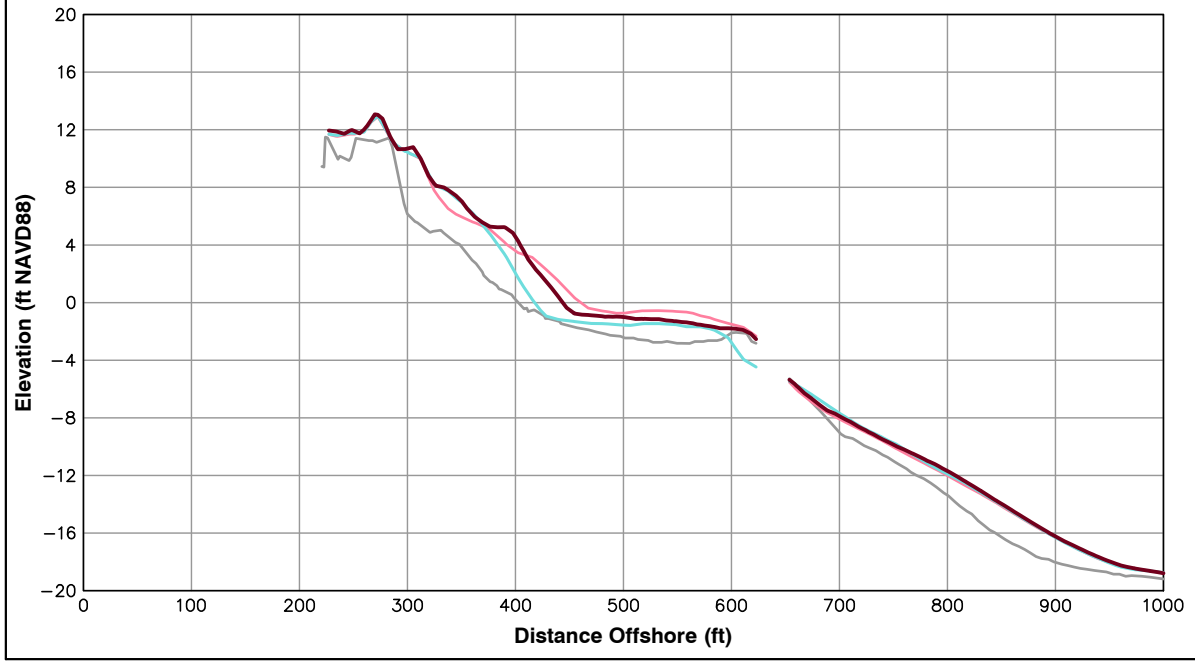
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 191+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-11.92 ft/yr	25.18 ft
Volume Change Above -15 ft NAVD88	0.32 cy/ft/yr	10.54 cy/ft
Volume Change Above 0 ft NAVD88	1.67 cy/ft/yr	4.87 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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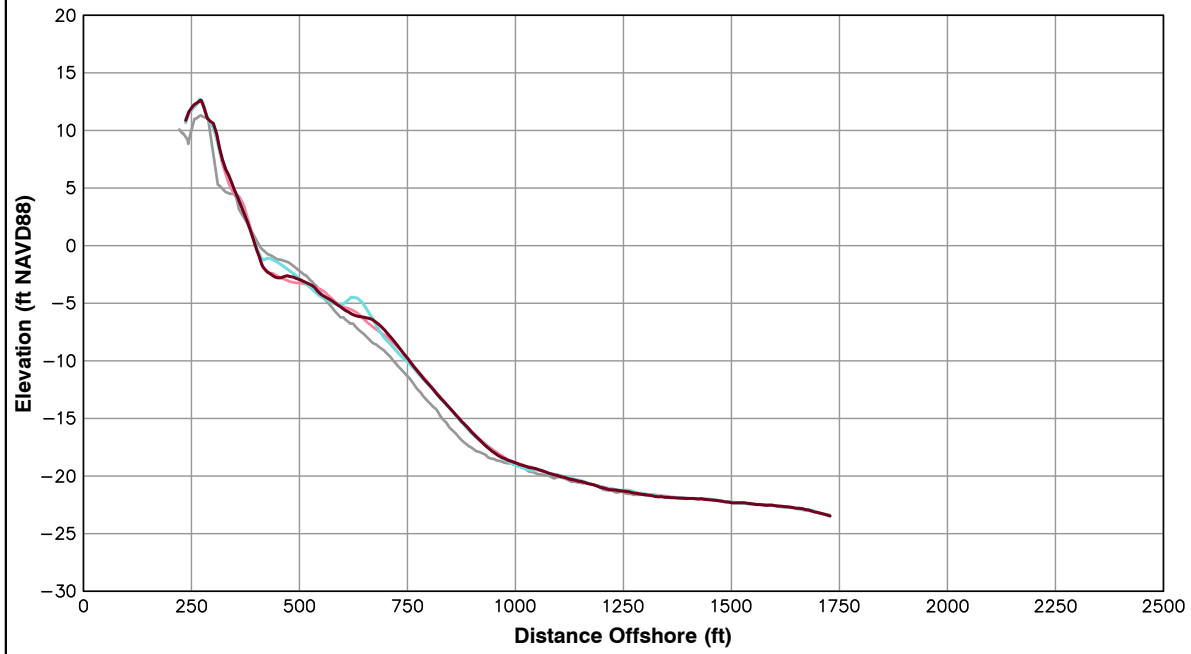
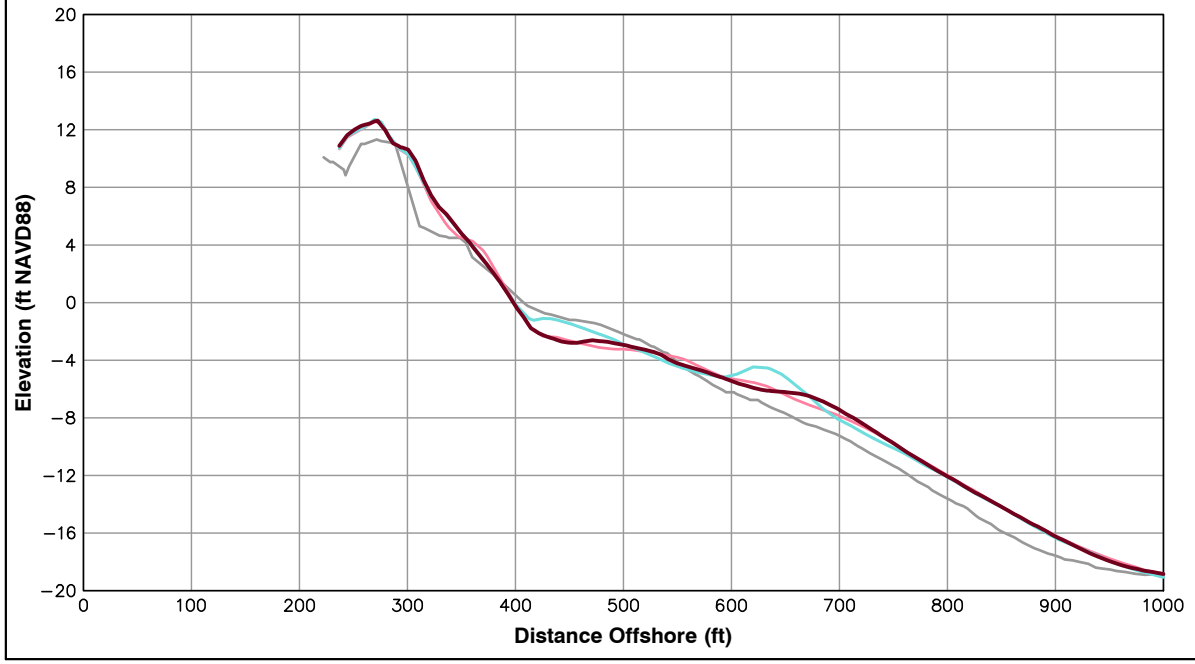
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 193+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-1.60 ft/yr	-0.22 ft
Volume Change Above -15 ft NAVD88	1.20 cy/ft/yr	-2.77 cy/ft
Volume Change Above 0 ft NAVD88	0.58 cy/ft/yr	0.32 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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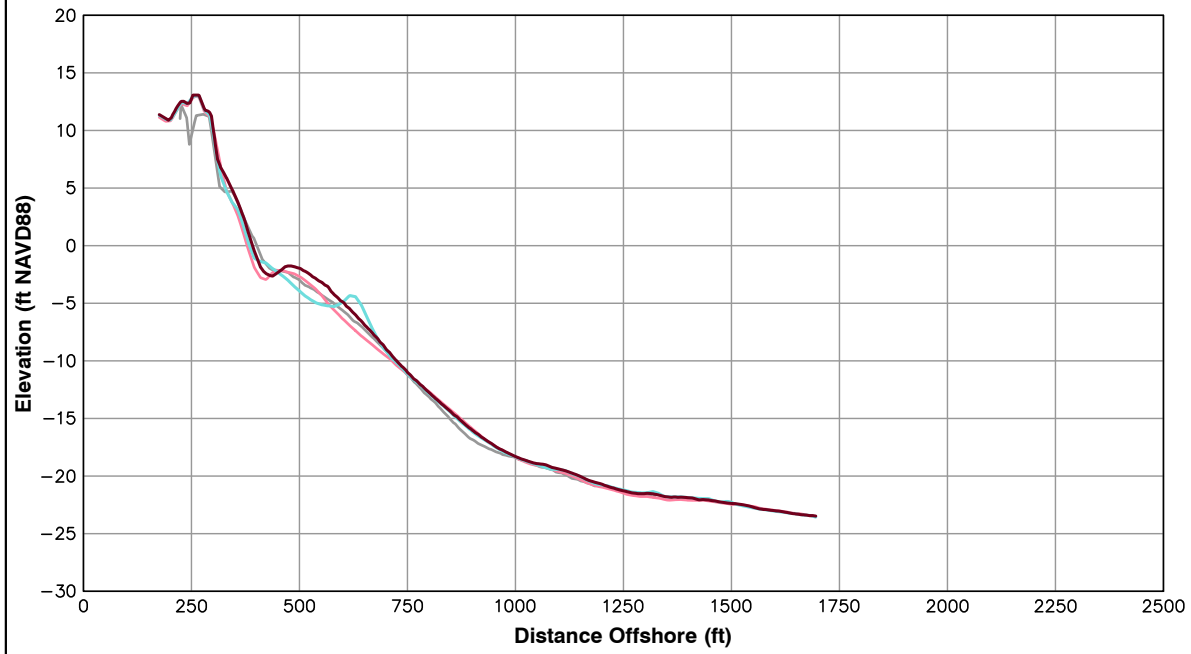
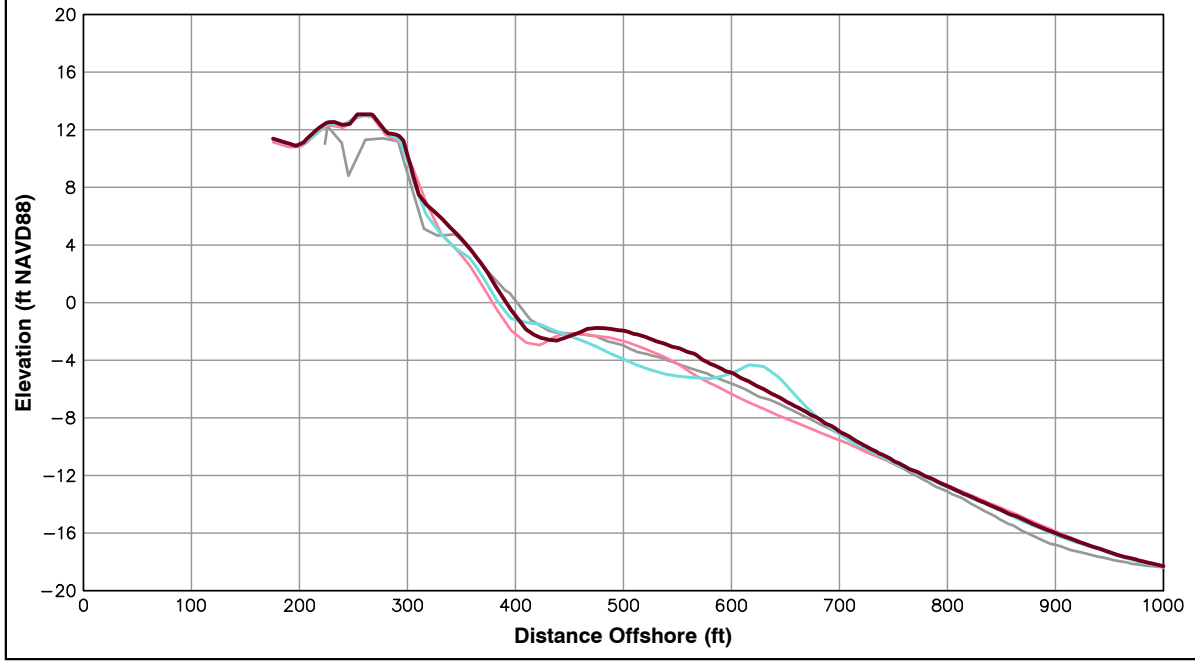
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 195+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	11.36 ft/yr	6.76 ft
Volume Change Above -15 ft NAVD88	13.82 cy/ft/yr	8.56 cy/ft
Volume Change Above 0 ft NAVD88	3.31 cy/ft/yr	3.03 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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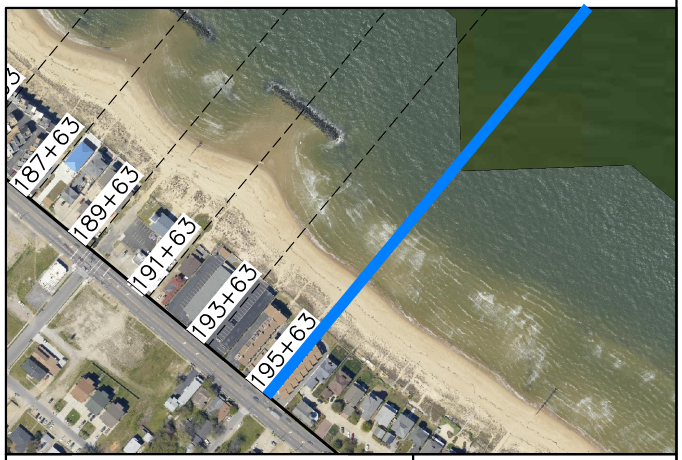

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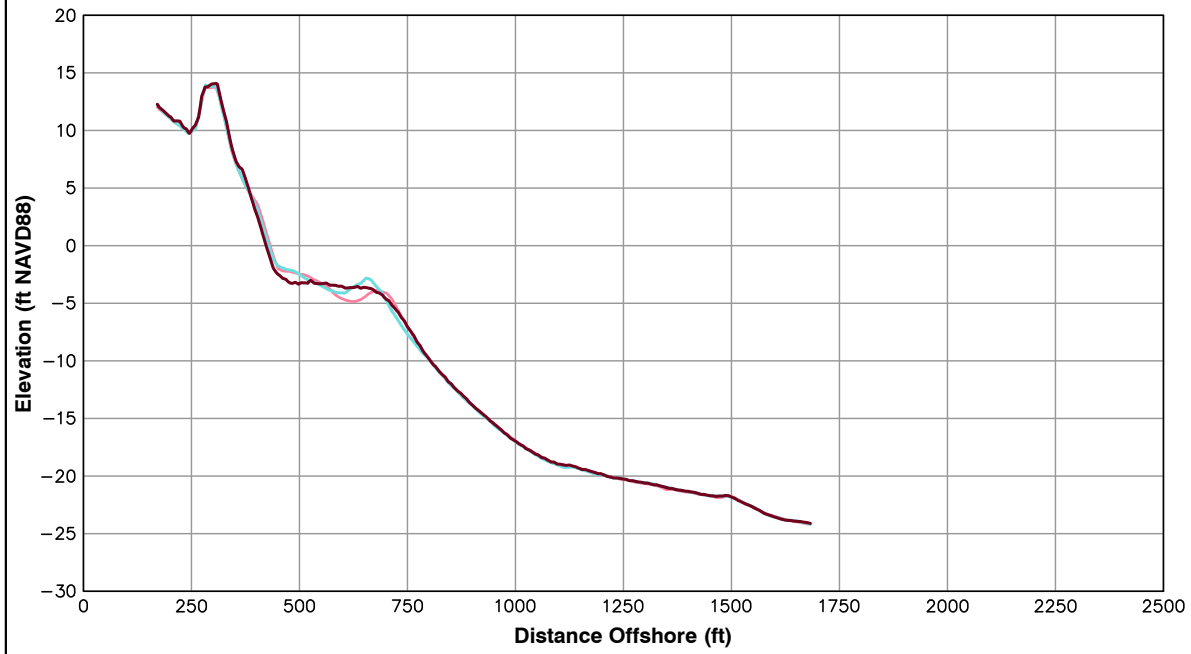
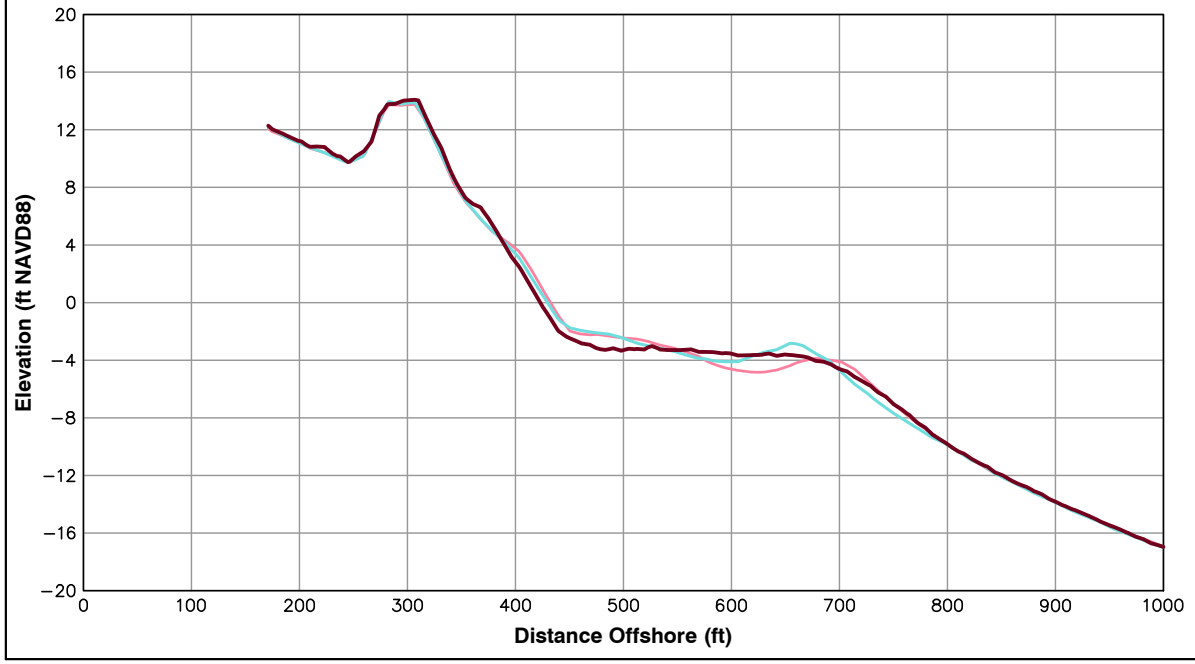
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS

ST 195+63	Pg 62 of 106	Spring 2016





Survey Transect 206+86	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-8.95 ft/yr	-5.95 ft
Volume Change Above -15 ft NAVD88	0.75 cy/ft/yr	0.31 cy/ft
Volume Change Above 0 ft NAVD88	0.66 cy/ft/yr	0.95 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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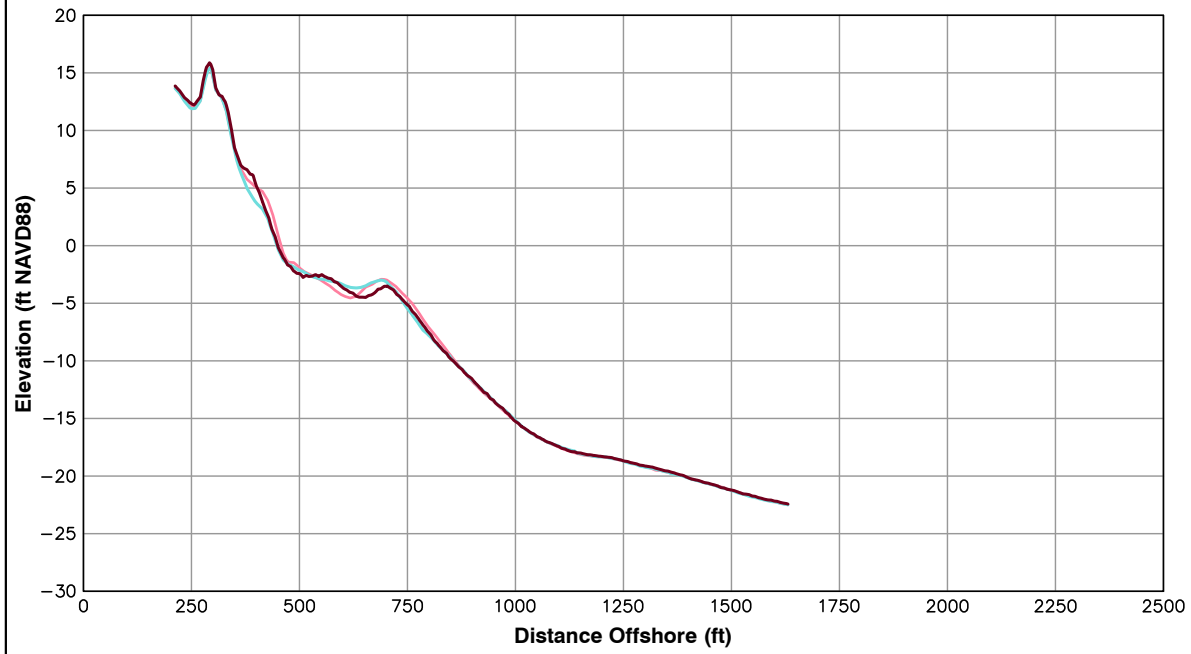
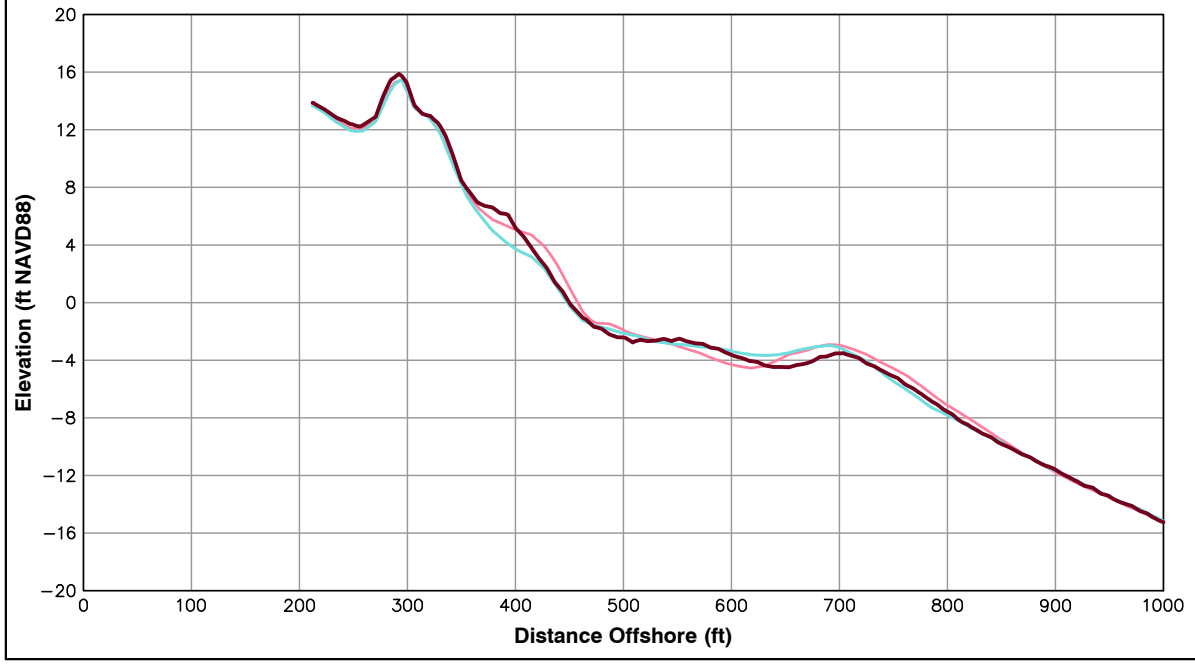
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 218+66	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-8.56 ft/yr	2.00 ft
Volume Change Above -15 ft NAVD88	-2.88 cy/ft/yr	3.10 cy/ft
Volume Change Above 0 ft NAVD88	0.55 cy/ft/yr	5.19 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

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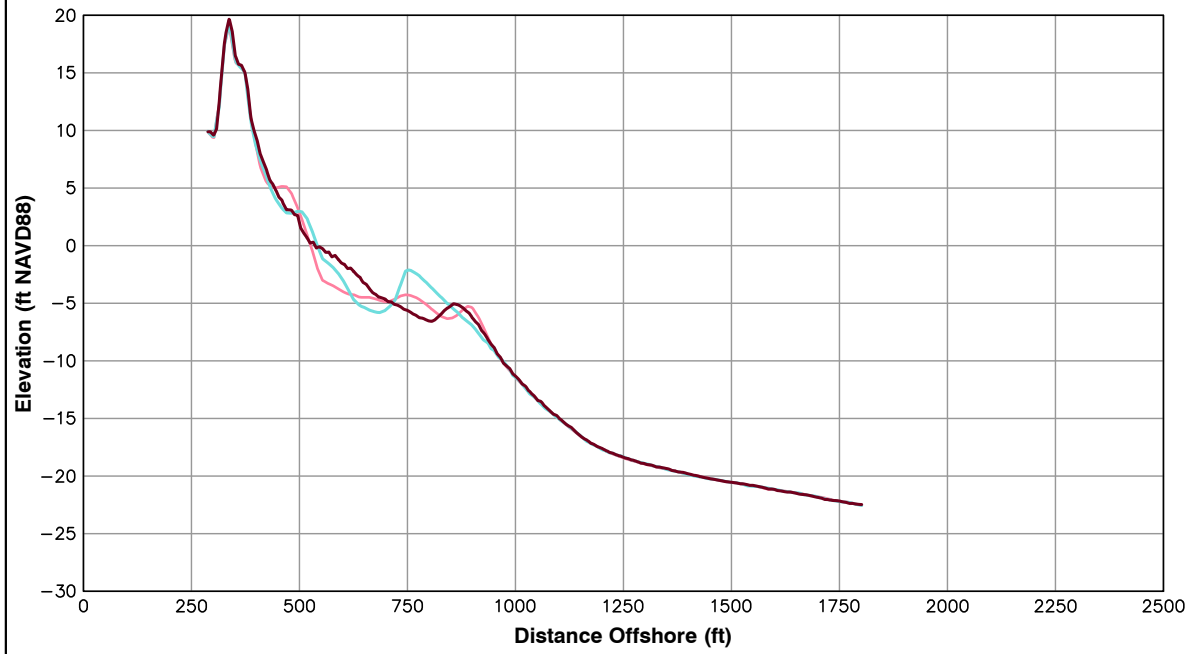
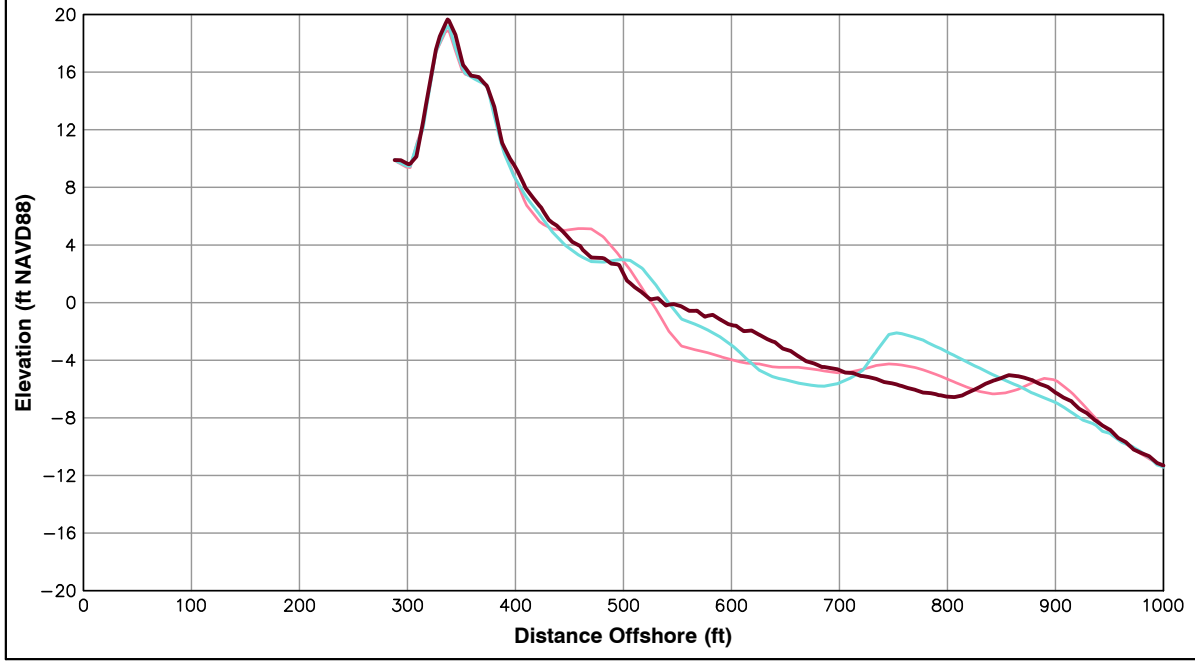
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 229+85	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-5.01 ft/yr	-20.09 ft
Volume Change Above -15 ft NAVD88	6.21 cy/ft/yr	1.03 cy/ft
Volume Change Above 0 ft NAVD88	-0.49 cy/ft/yr	0.91 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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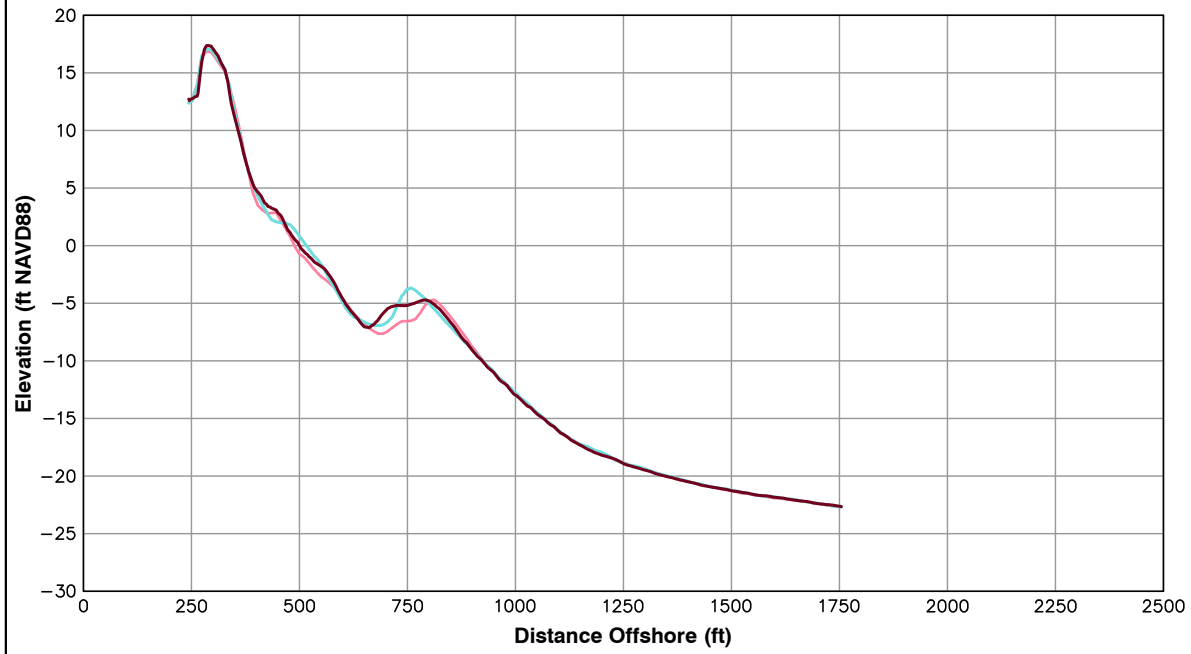
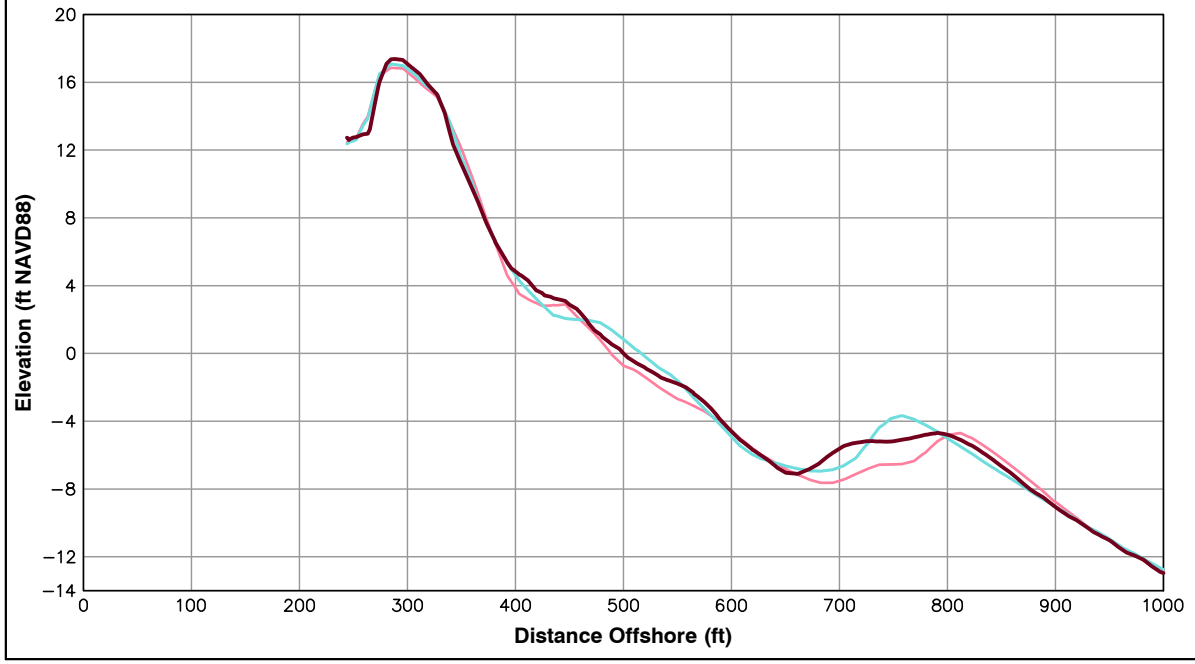
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 242+03	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	4.51 ft/yr	-16.57 ft
Volume Change Above -15 ft NAVD88	7.72 cy/ft/yr	-0.47 cy/ft
Volume Change Above 0 ft NAVD88	1.56 cy/ft/yr	0.03 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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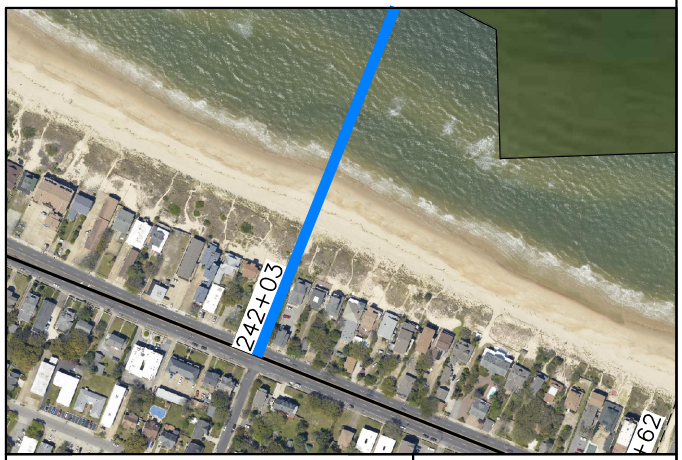

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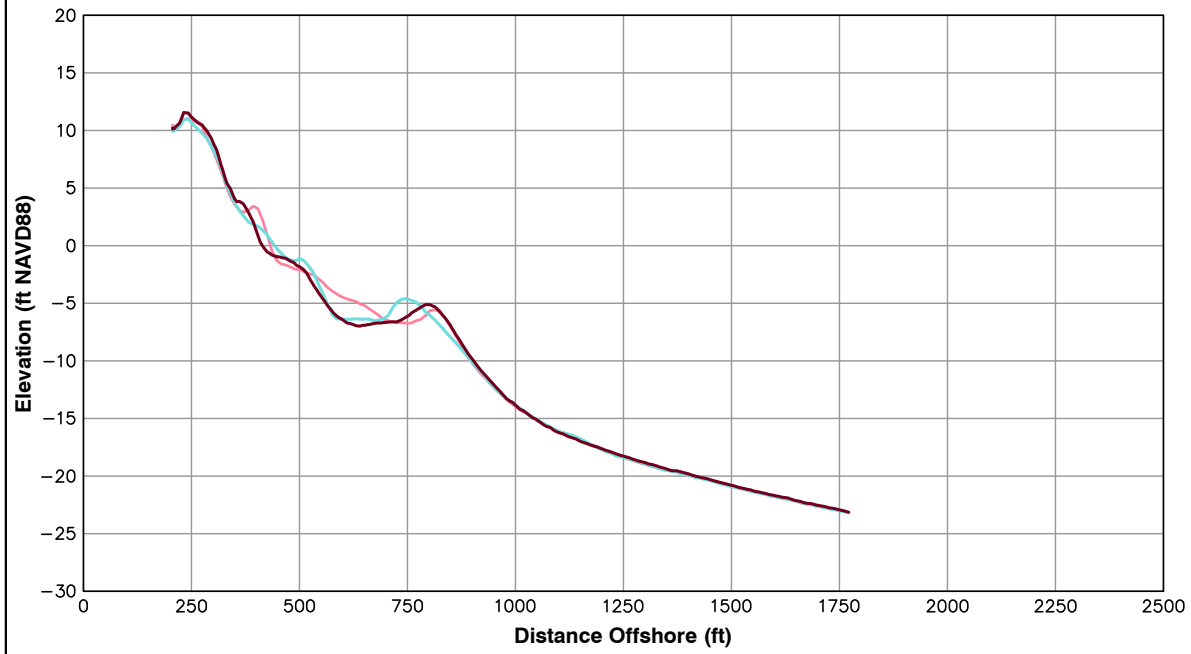
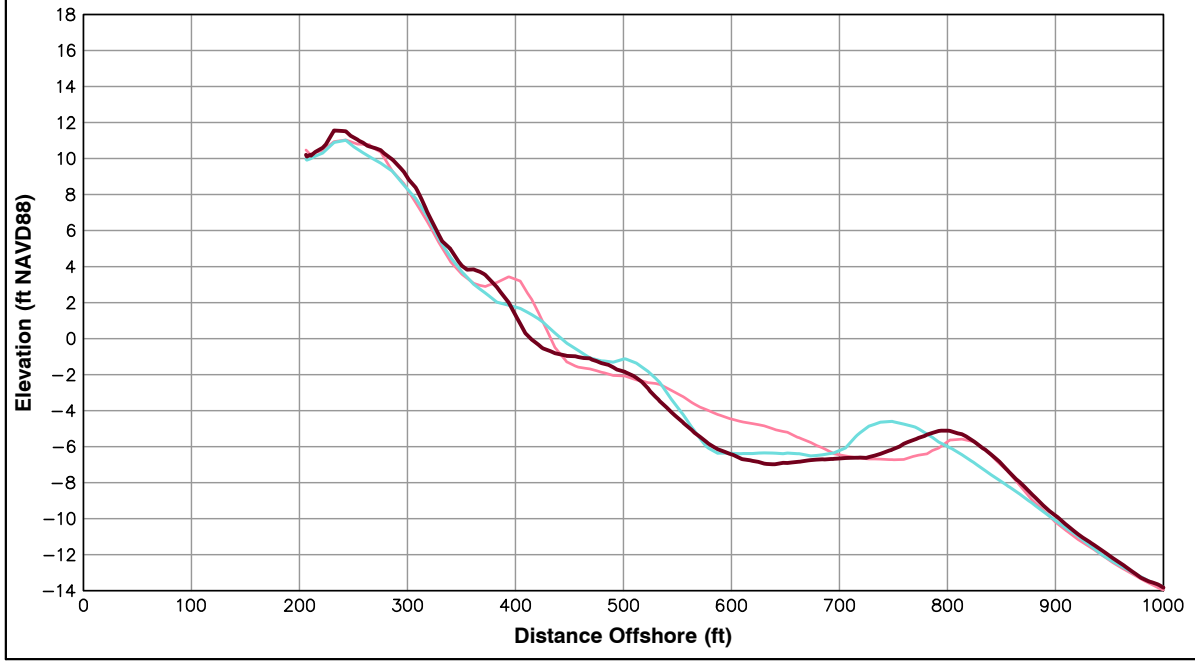
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 252+62	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-20.84 ft/yr	-21.00 ft
Volume Change Above -15 ft NAVD88	-5.24 cy/ft/yr	-1.66 cy/ft
Volume Change Above 0 ft NAVD88	-0.05 cy/ft/yr	2.36 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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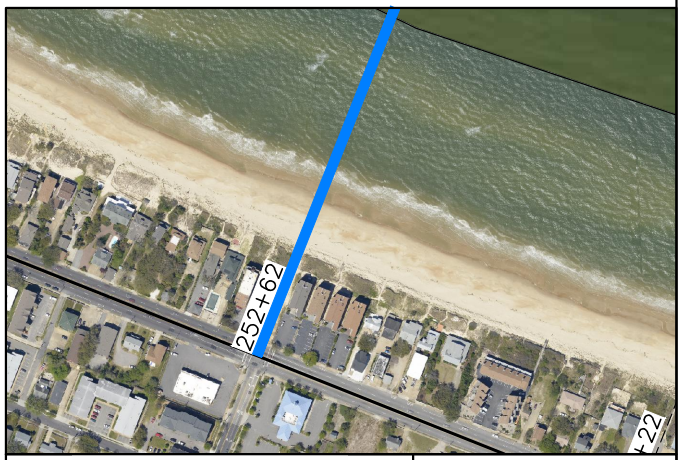
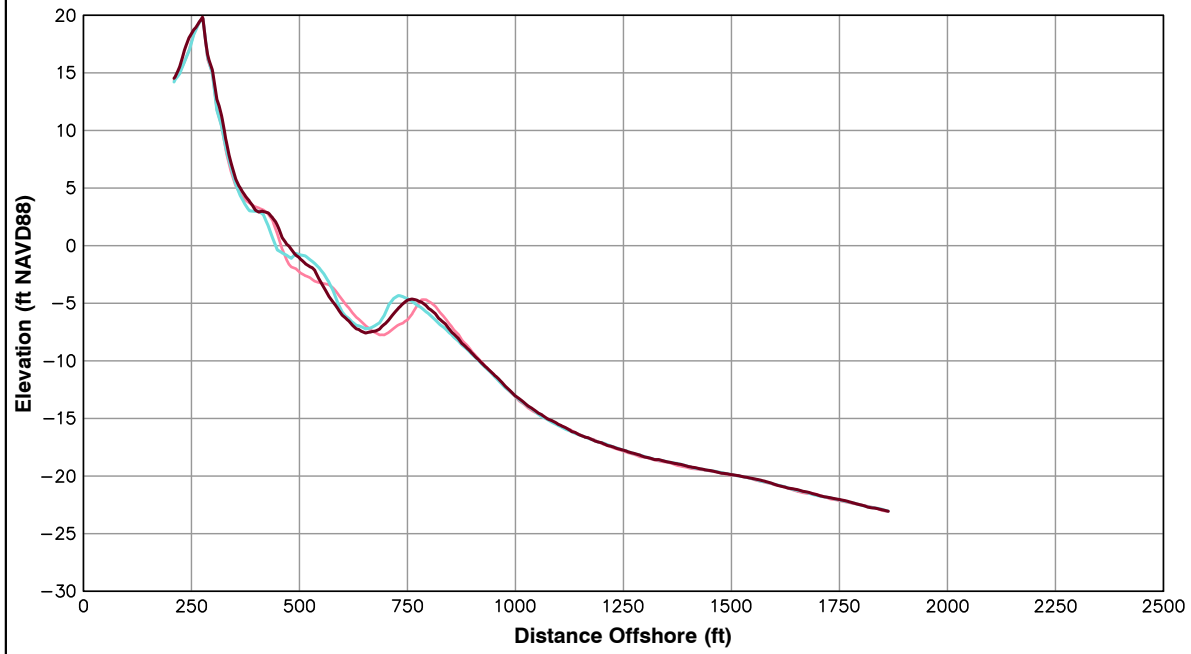
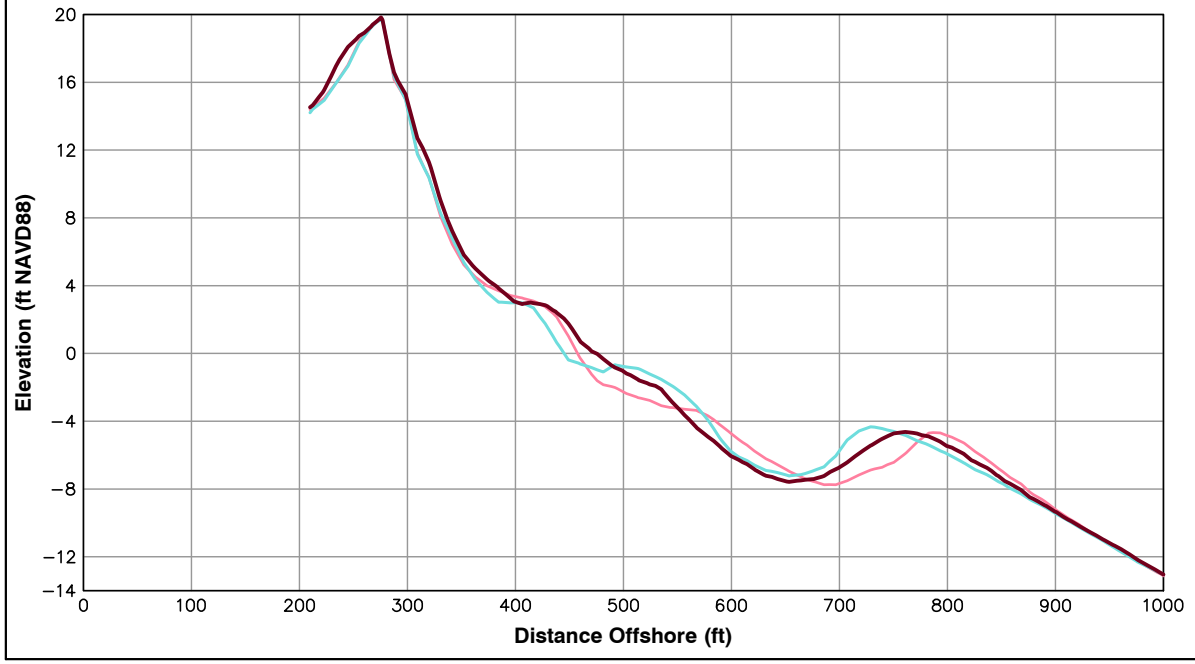


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 263+22	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	7.51 ft/yr	22.24 ft
Volume Change Above -15 ft NAVD88	5.79 cy/ft/yr	3.41 cy/ft
Volume Change Above 0 ft NAVD88	3.78 cy/ft/yr	6.23 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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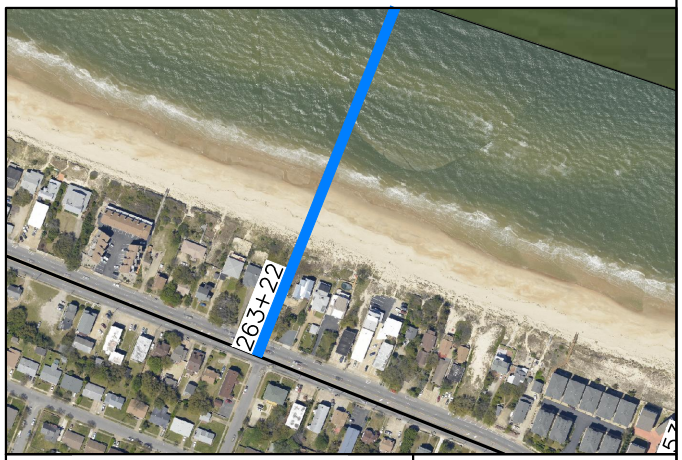

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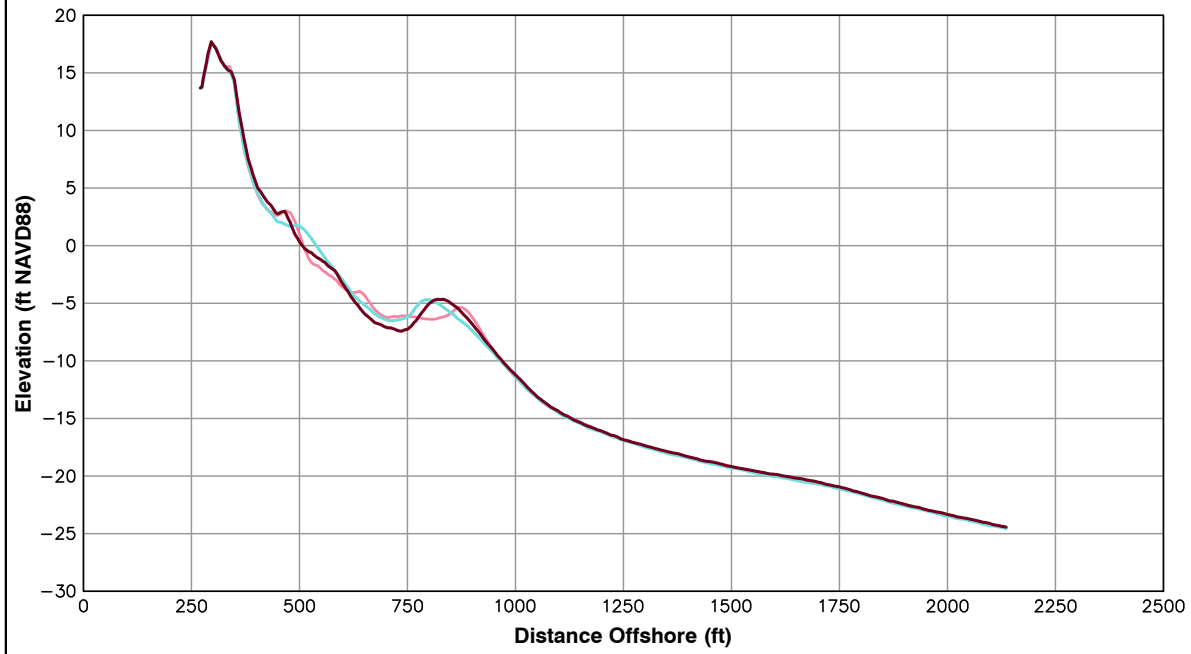
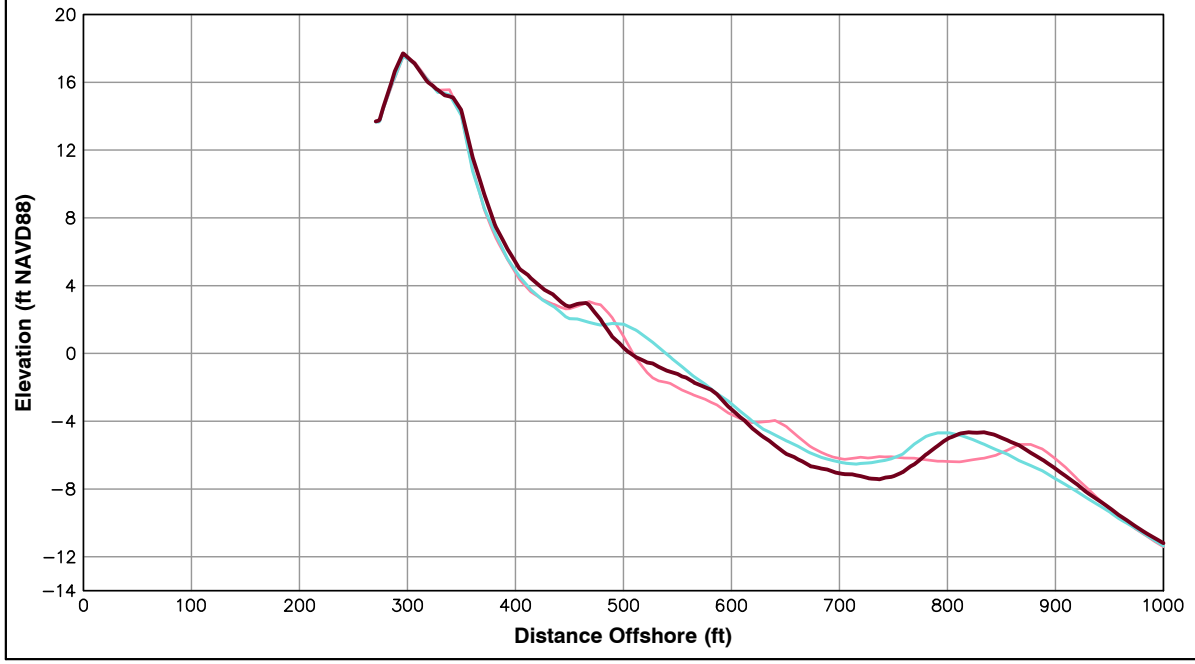
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 274+53	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-10.13 ft/yr	-30.55 ft
Volume Change Above -15 ft NAVD88	0.70 cy/ft/yr	-1.61 cy/ft
Volume Change Above 0 ft NAVD88	1.25 cy/ft/yr	1.60 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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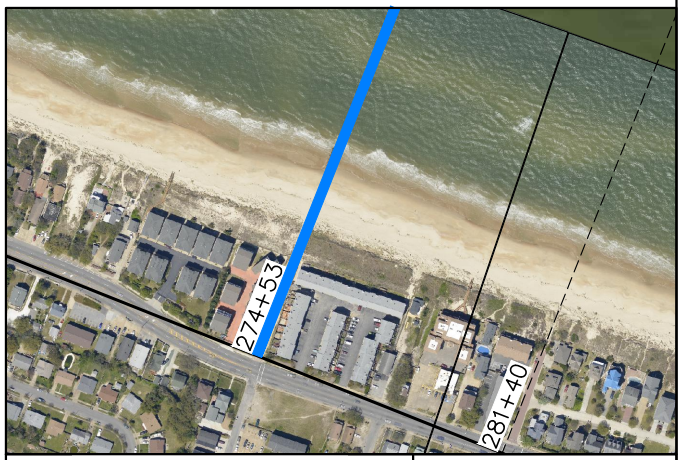

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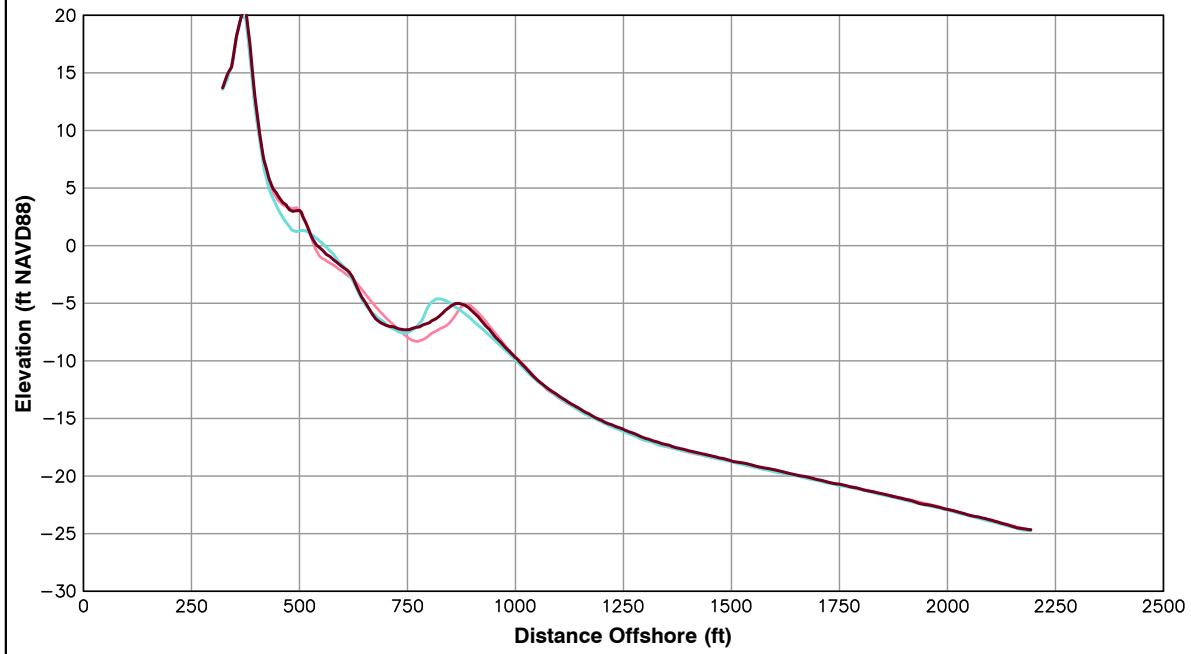
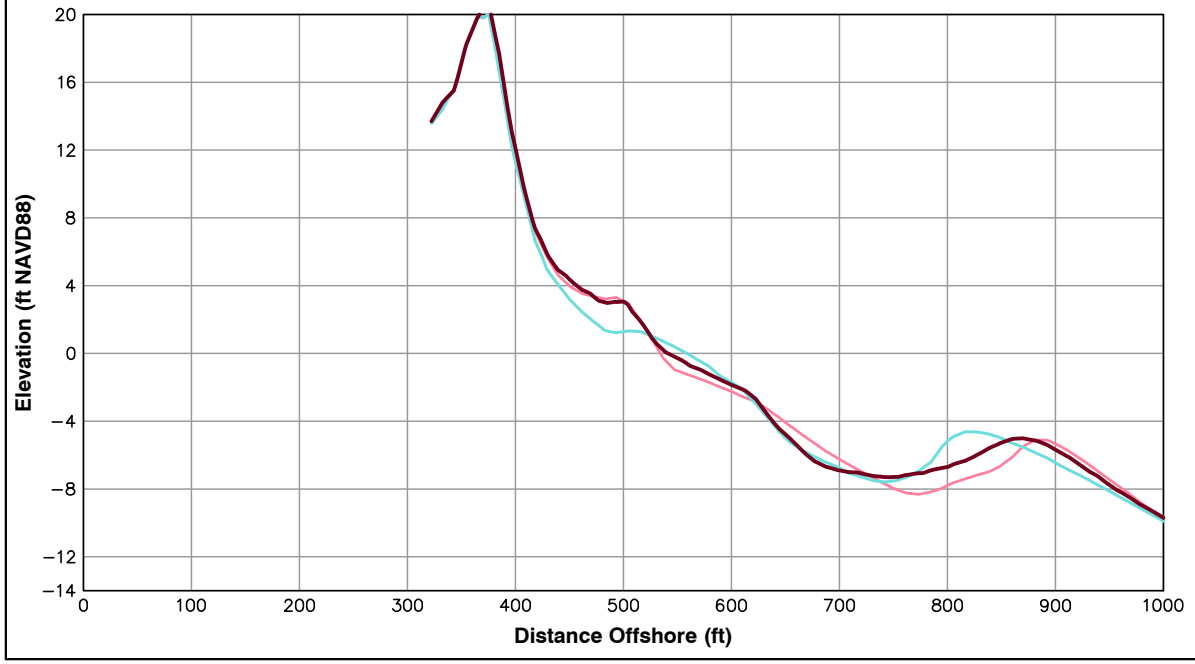
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 281+40	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	0.53 ft/yr	-2.20 ft
Volume Change Above -15 ft NAVD88	5.26 cy/ft/yr	5.84 cy/ft
Volume Change Above 0 ft NAVD88	1.47 cy/ft/yr	5.68 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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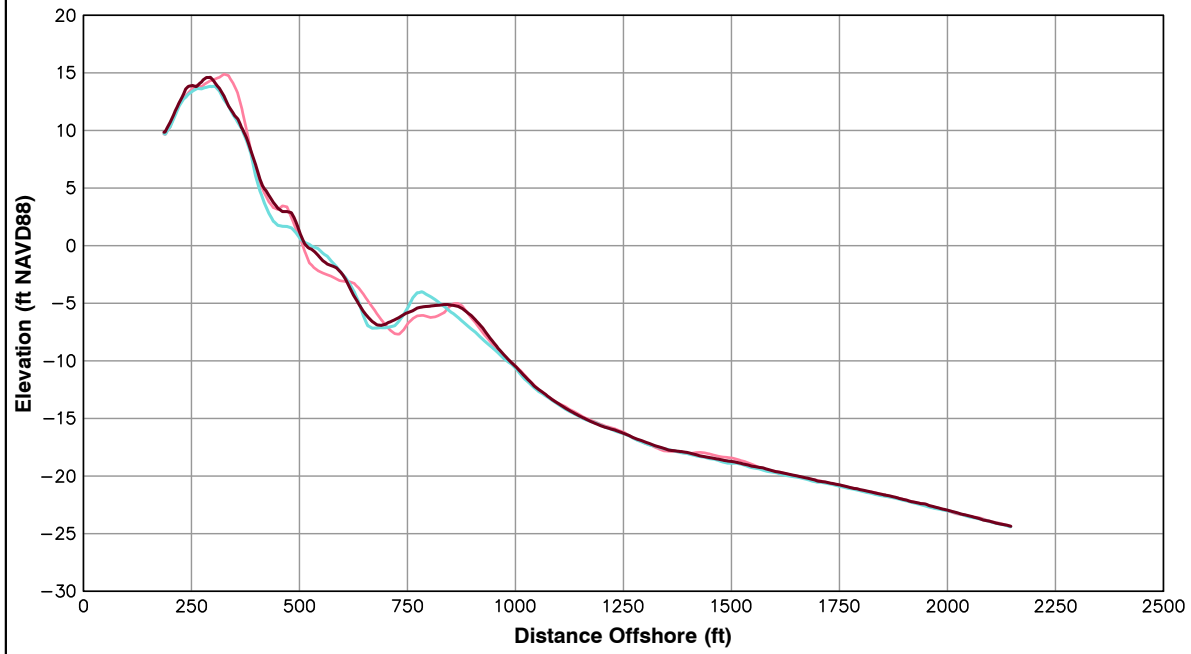
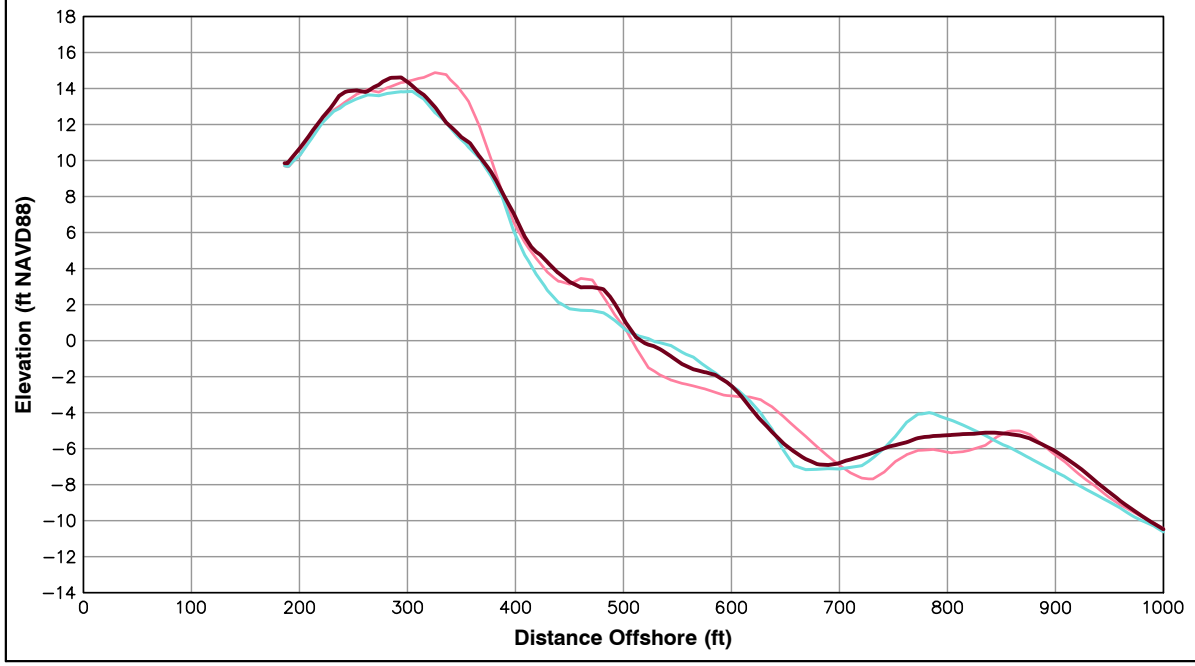
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 288+39	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	4.54 ft/yr	7.75 ft
Volume Change Above -15 ft NAVD88	2.47 cy/ft/yr	10.05 cy/ft
Volume Change Above 0 ft NAVD88	-2.51 cy/ft/yr	7.72 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

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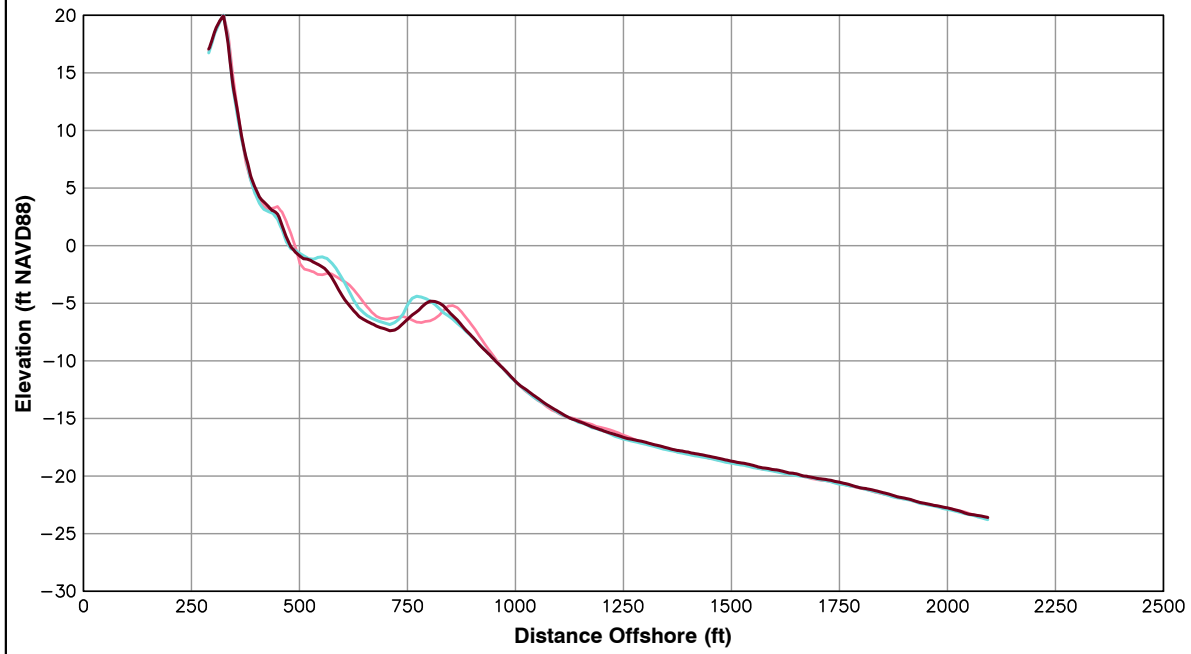
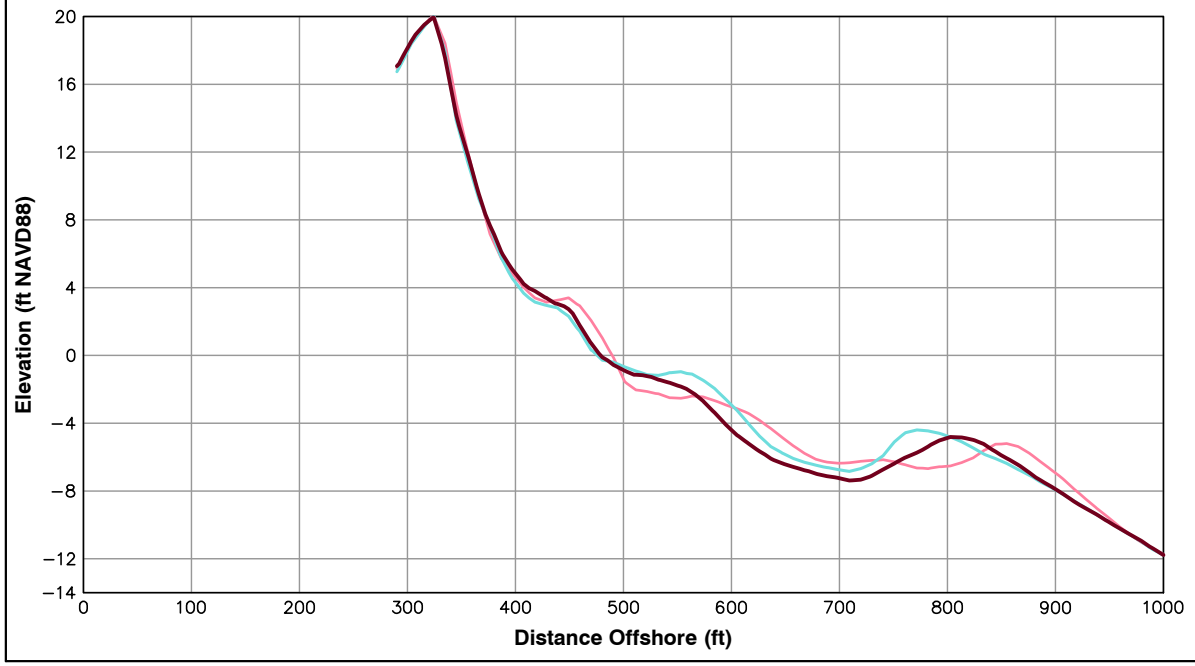
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 295+27	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-12.91 ft/yr	3.49 ft
Volume Change Above -15 ft NAVD88	-6.09 cy/ft/yr	-5.44 cy/ft
Volume Change Above 0 ft NAVD88	-1.45 cy/ft/yr	1.97 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
1. Stationing 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 April 2015 and October 2015.
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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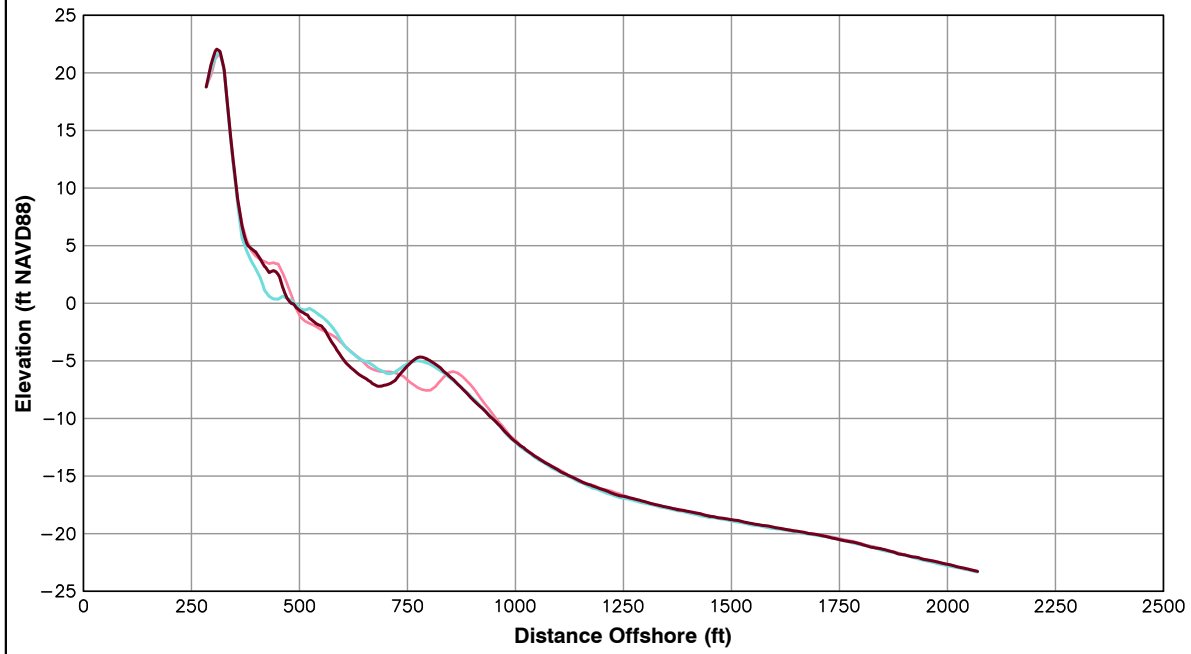
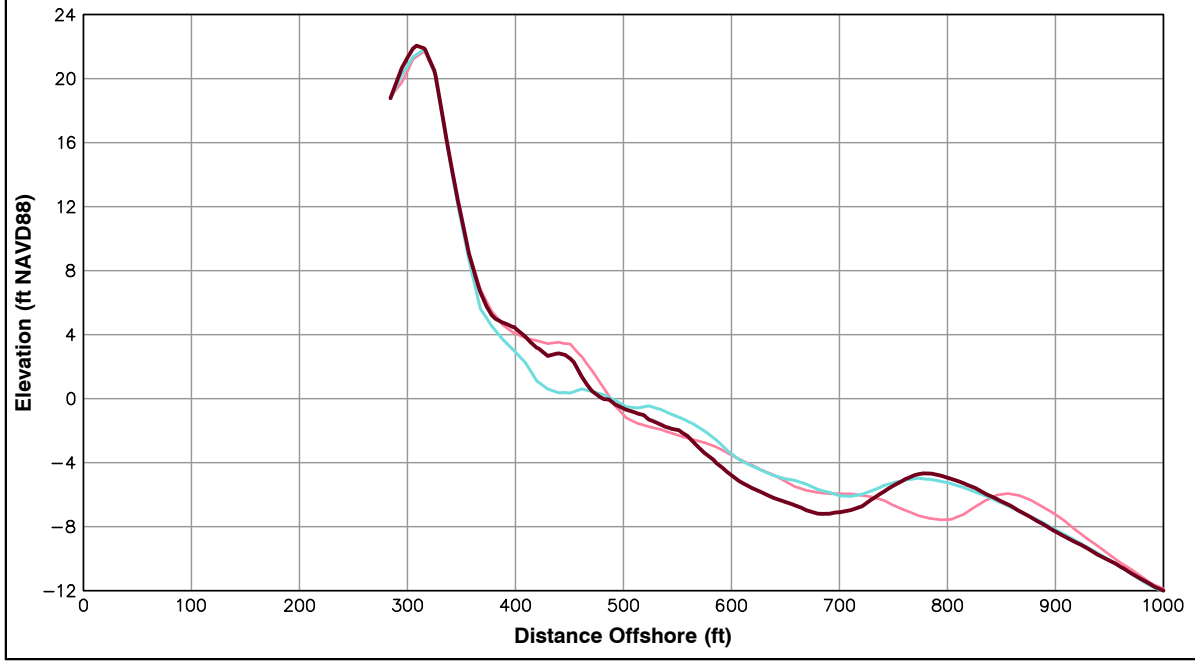
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 302+24	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-12.66 ft/yr	42.95 ft
Volume Change Above -15 ft NAVD88	-3.74 cy/ft/yr	-2.25 cy/ft
Volume Change Above 0 ft NAVD88	-1.30 cy/ft/yr	6.64 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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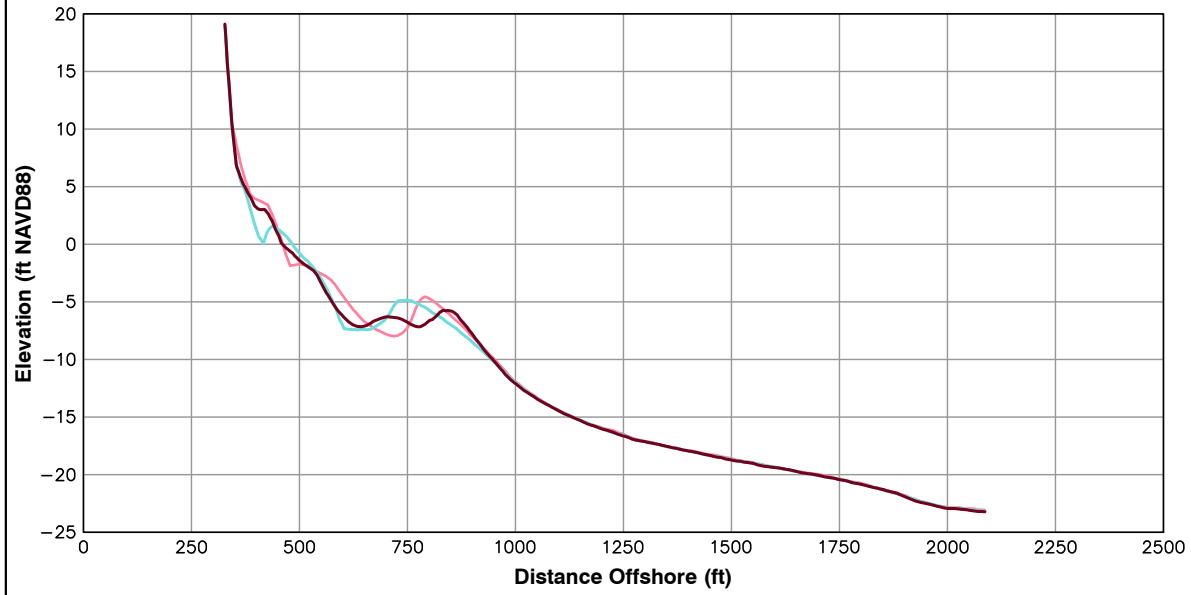
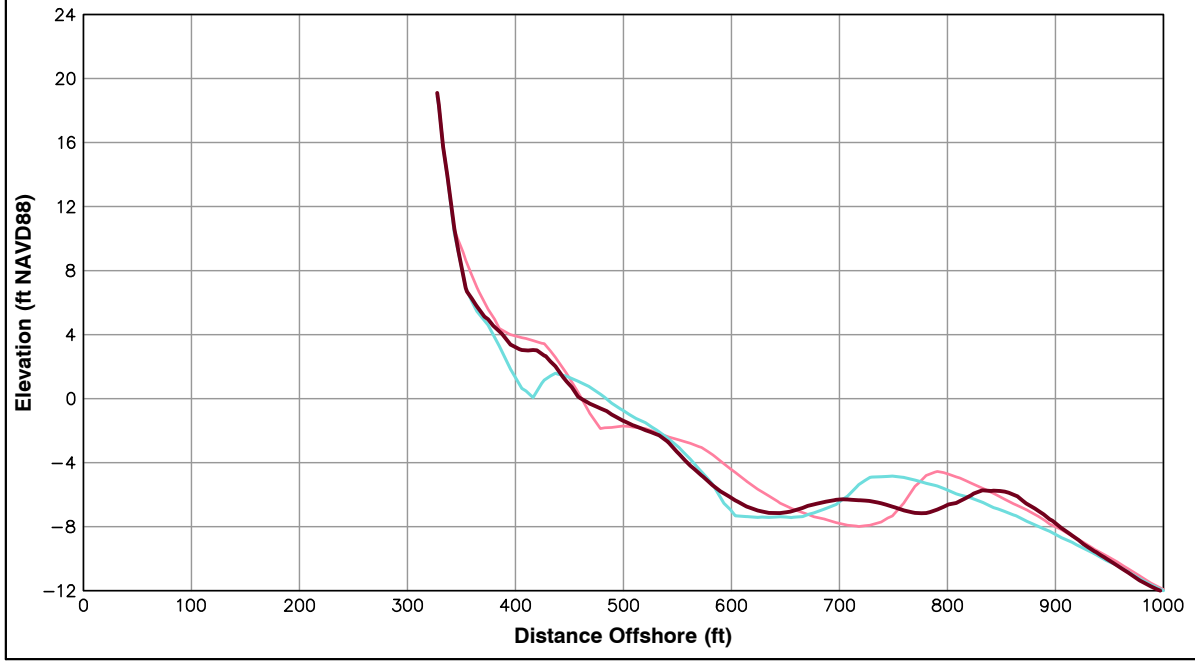
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 315+96	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-3.85 ft/yr	-12.40 ft
Volume Change Above -15 ft NAVD88	-7.64 cy/ft/yr	0.74 cy/ft
Volume Change Above 0 ft NAVD88	-2.86 cy/ft/yr	3.21 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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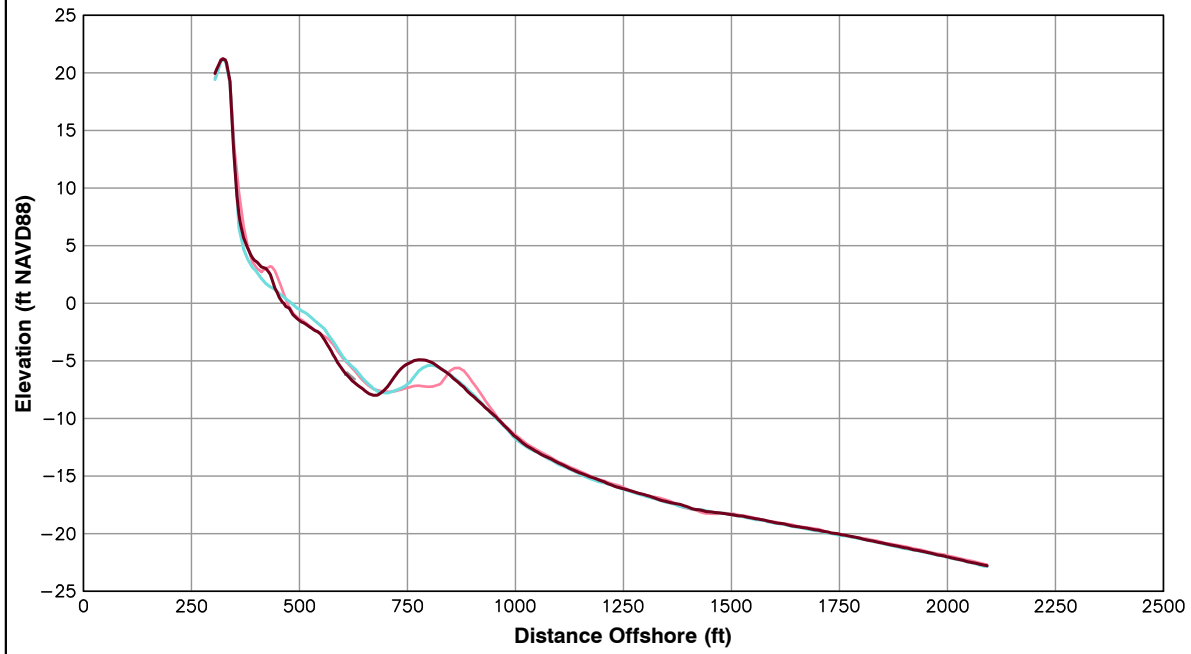

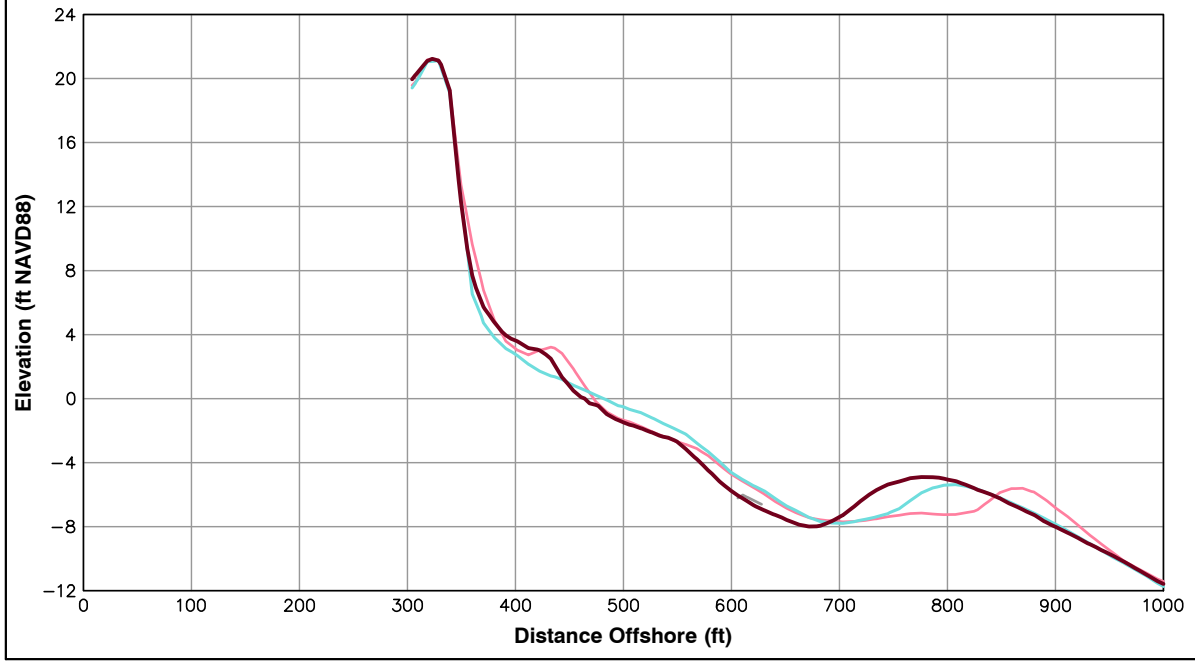

Survey Transect 323+09	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-13.66 ft/yr	-1.58 ft
Volume Change Above -15 ft NAVD88	-2.65 cy/ft/yr	0.43 cy/ft
Volume Change Above 0 ft NAVD88	-2.60 cy/ft/yr	2.86 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR

Notes:
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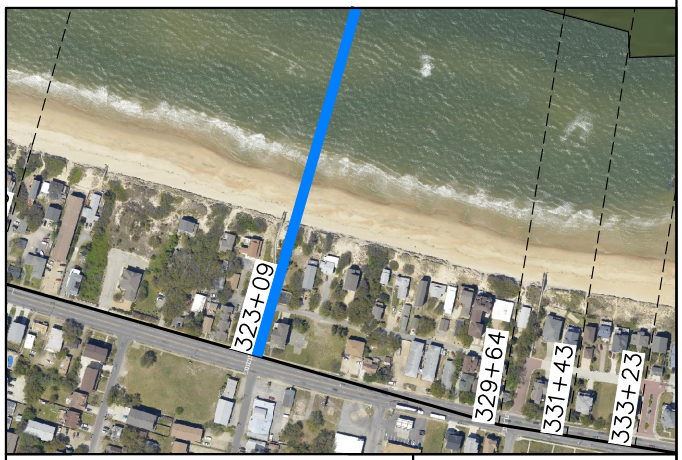

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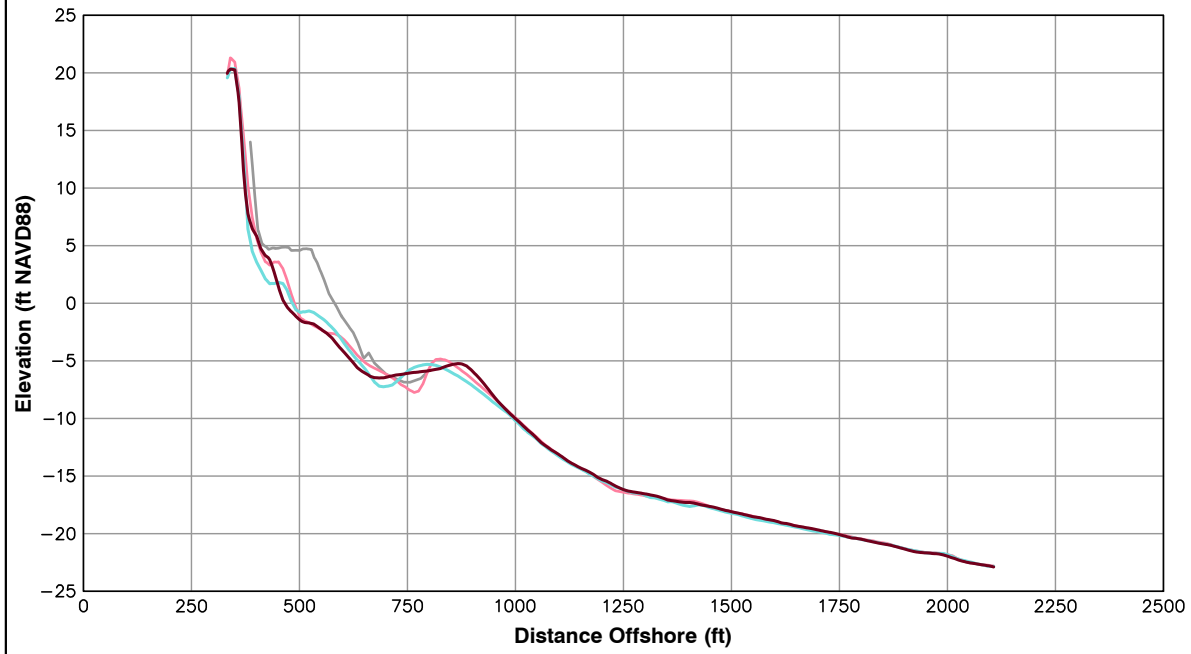
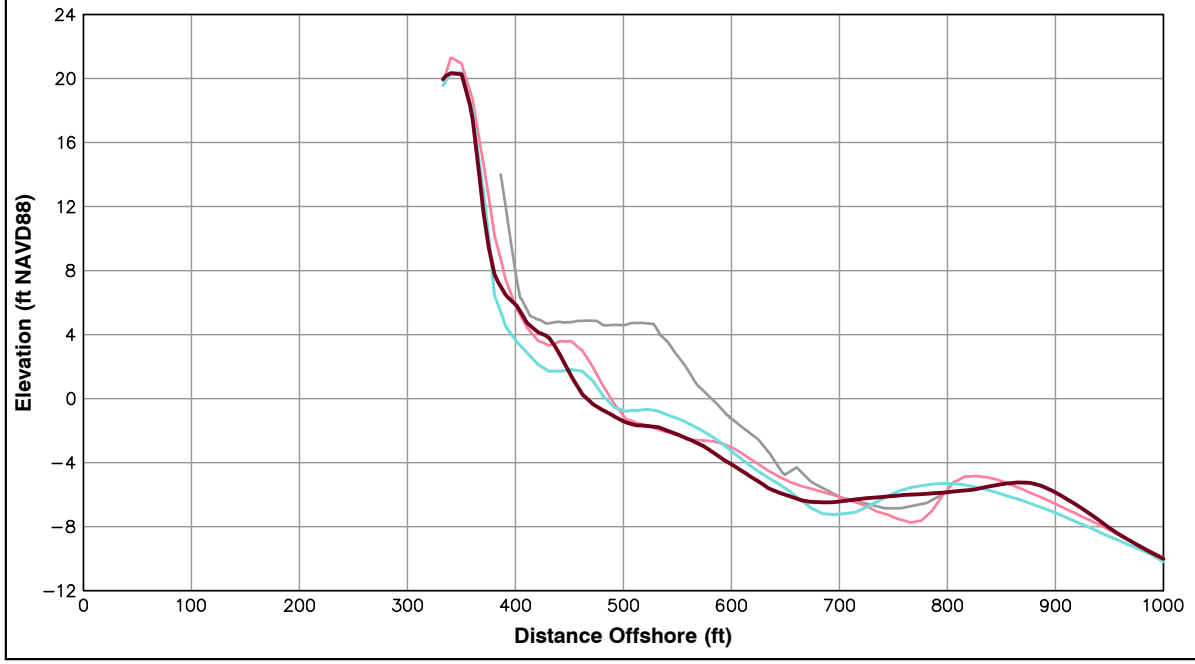
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 329+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-22.88 ft/yr	-17.45 ft
Volume Change Above -15 ft NAVD88	-6.86 cy/ft/yr	3.15 cy/ft
Volume Change Above 0 ft NAVD88	-5.70 cy/ft/yr	2.85 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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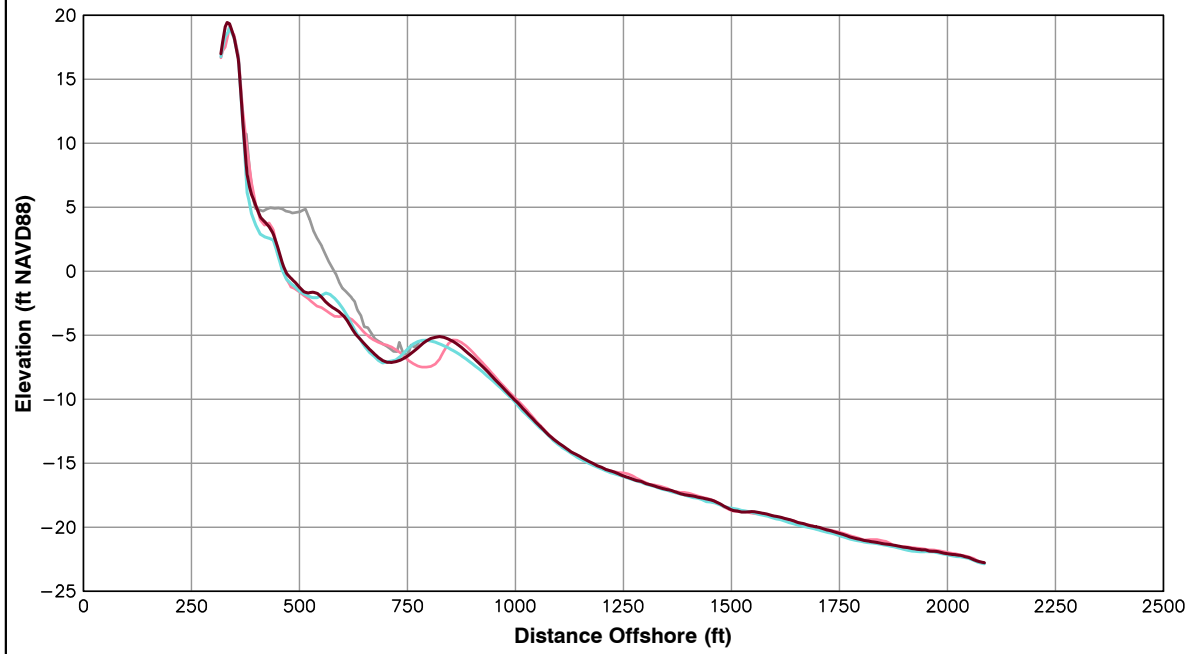
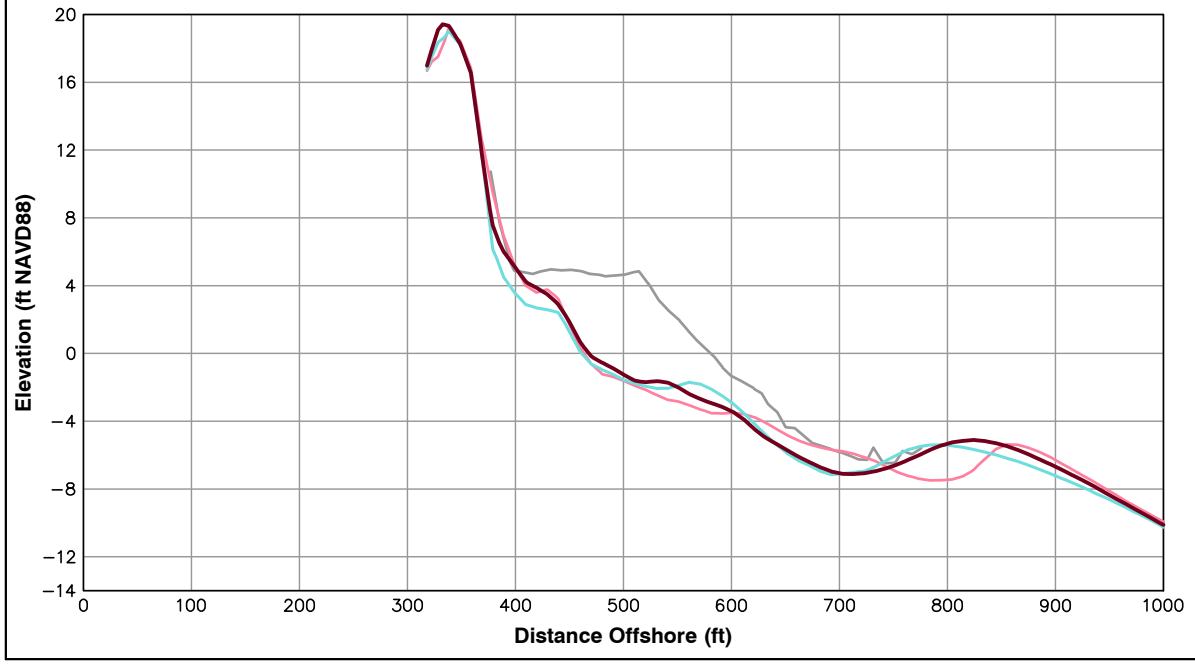
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 331+43	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	2.04 ft/yr	4.84 ft
Volume Change Above -15 ft NAVD88	1.01 cy/ft/yr	6.77 cy/ft
Volume Change Above 0 ft NAVD88	-0.68 cy/ft/yr	4.02 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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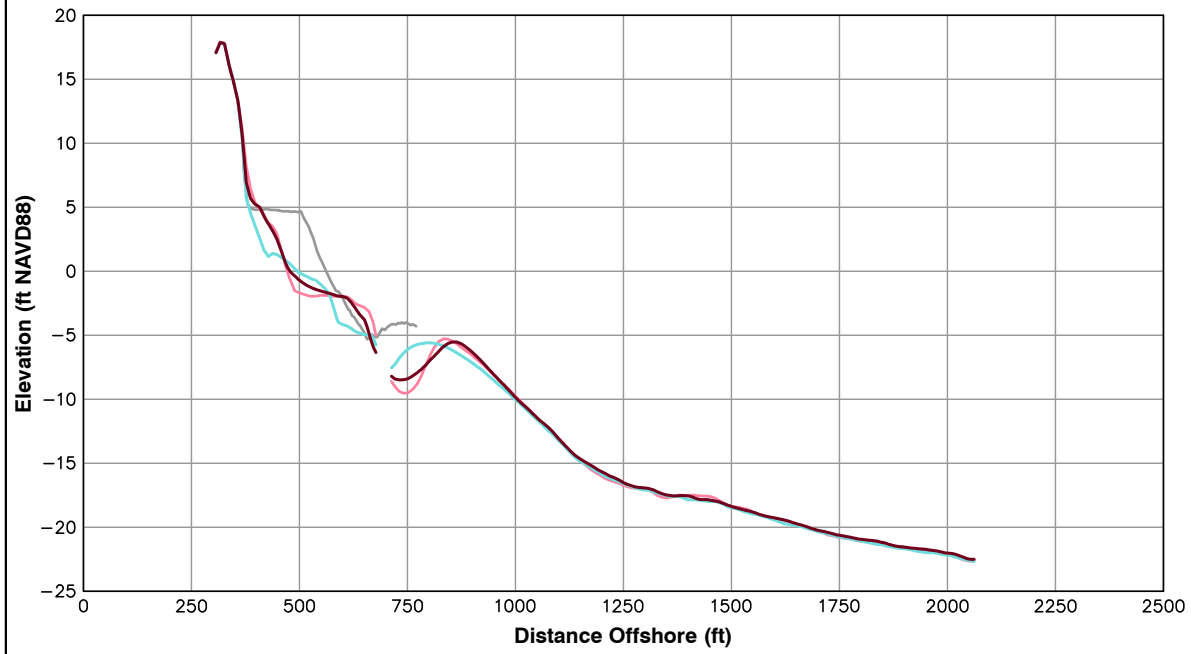

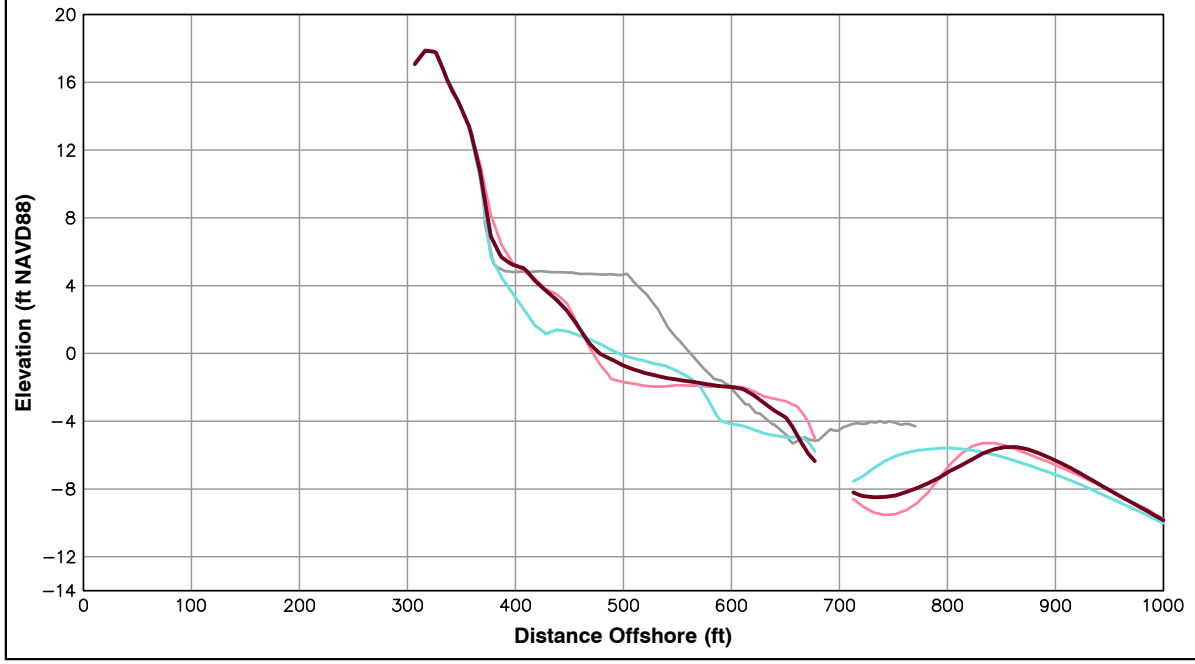

Survey Transect 333+23	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	0.80 ft/yr	1.80 ft
Volume Change Above -15 ft NAVD88	0.78 cy/ft/yr	6.21 cy/ft
Volume Change Above 0 ft NAVD88	-1.16 cy/ft/yr	5.46 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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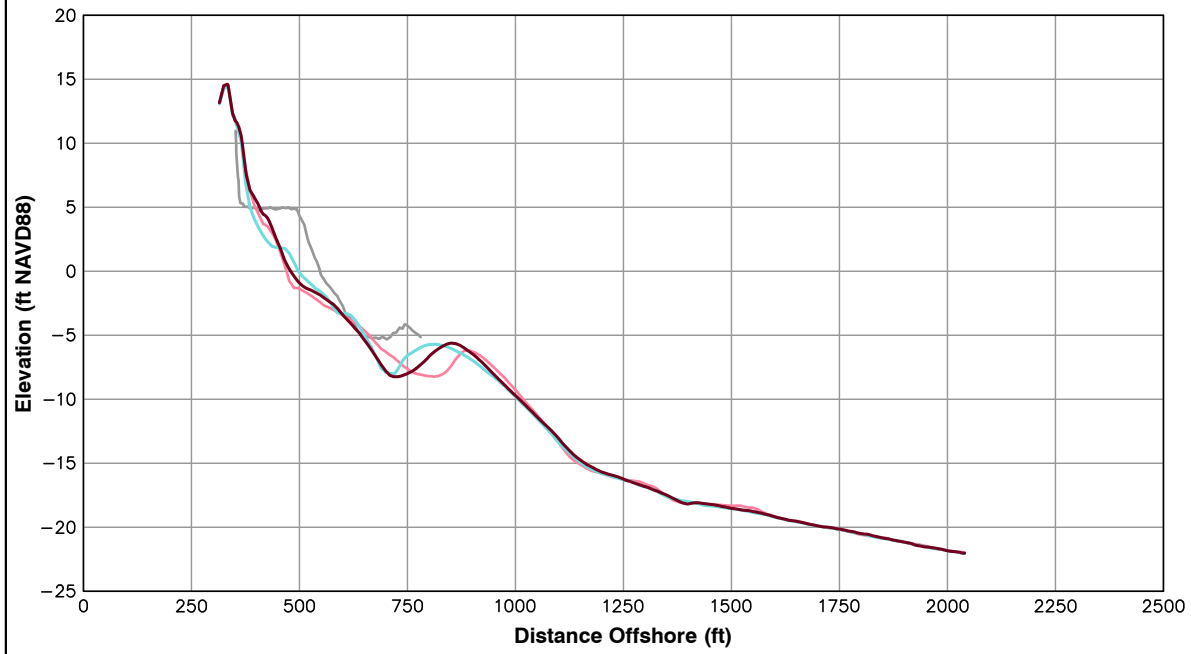
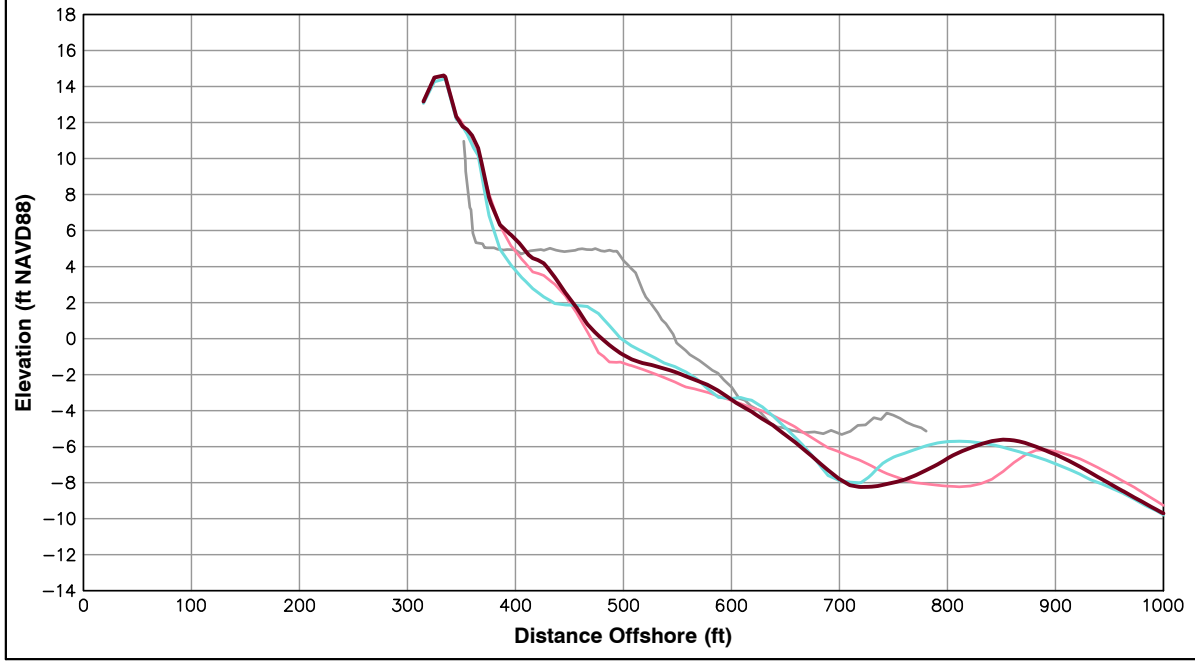
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 335+03	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	3.55 ft/yr	-18.47 ft
Volume Change Above -15 ft NAVD88	3.60 cy/ft/yr	0.28 cy/ft
Volume Change Above 0 ft NAVD88	1.59 cy/ft/yr	3.57 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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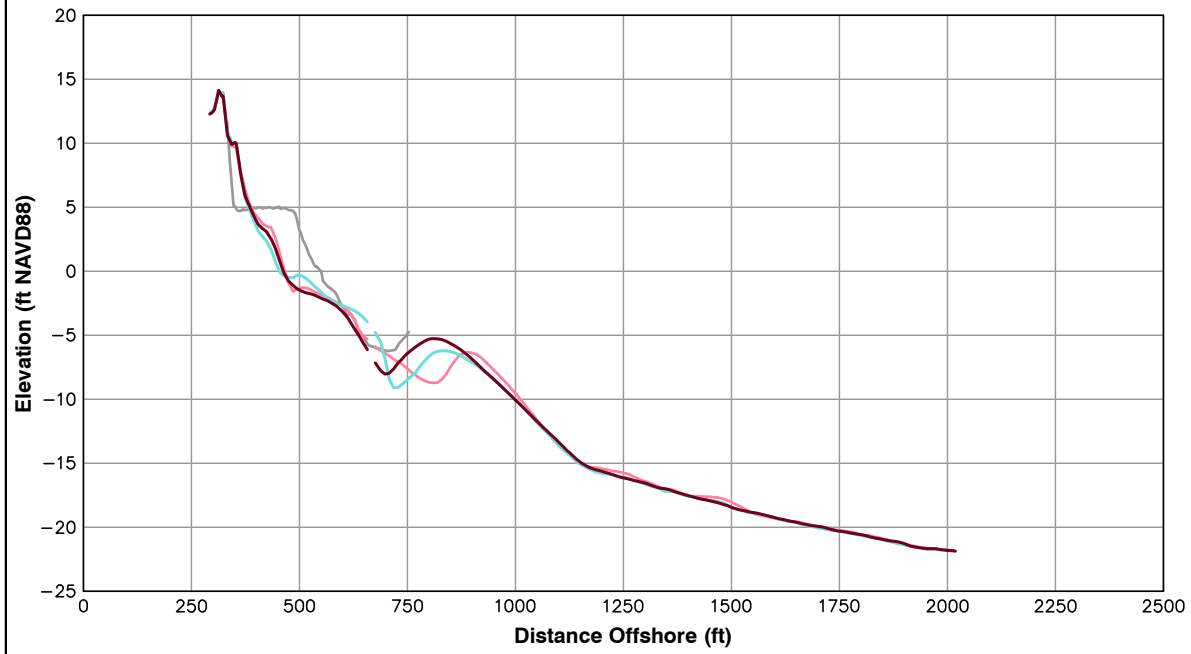
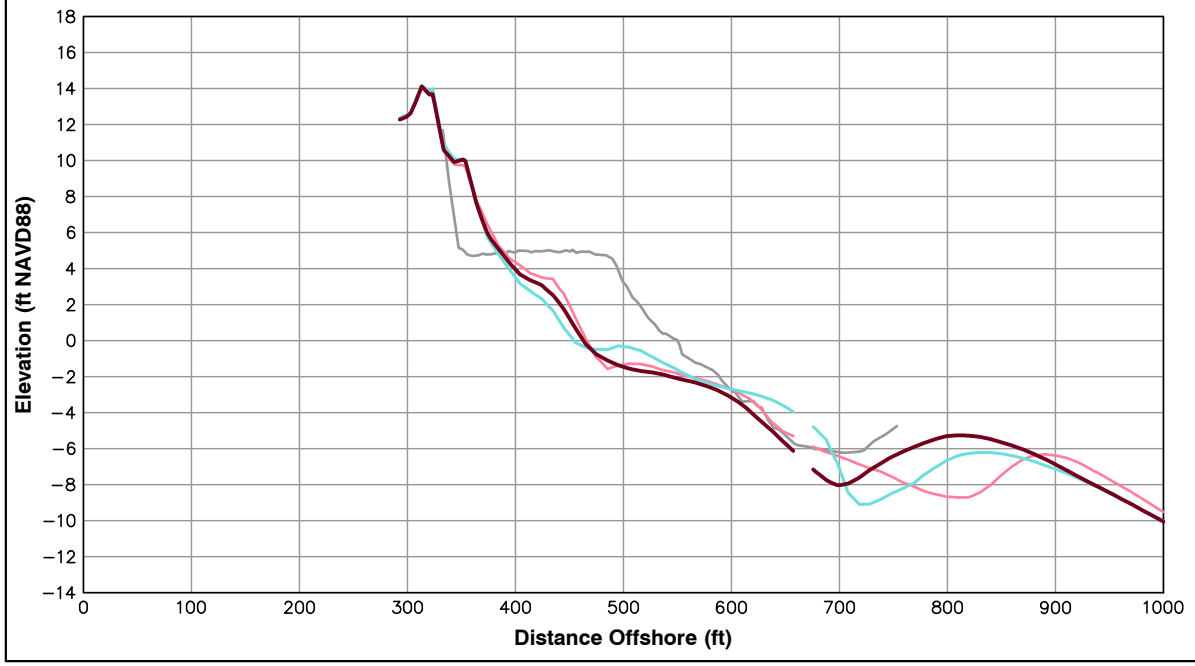
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 336+83	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-5.06 ft/yr	10.59 ft
Volume Change Above -15 ft NAVD88	2.26 cy/ft/yr	3.52 cy/ft
Volume Change Above 0 ft NAVD88	-1.61 cy/ft/yr	1.64 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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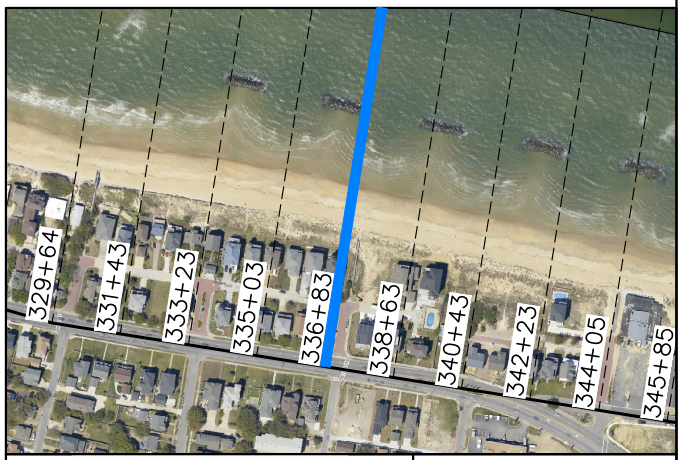
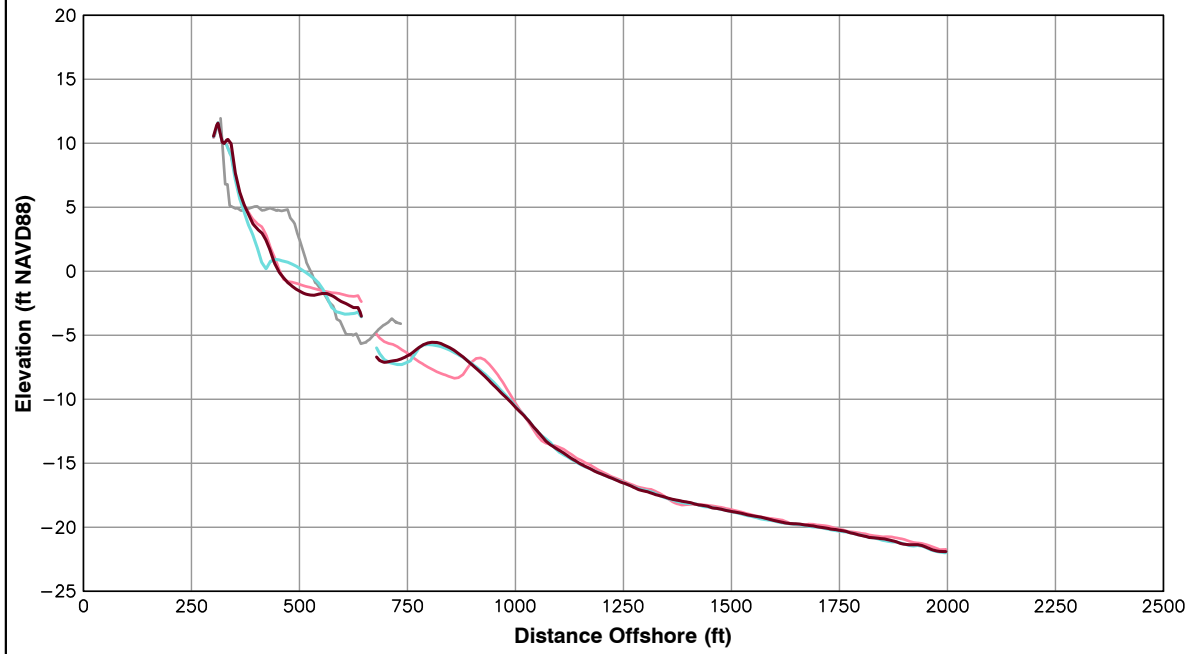
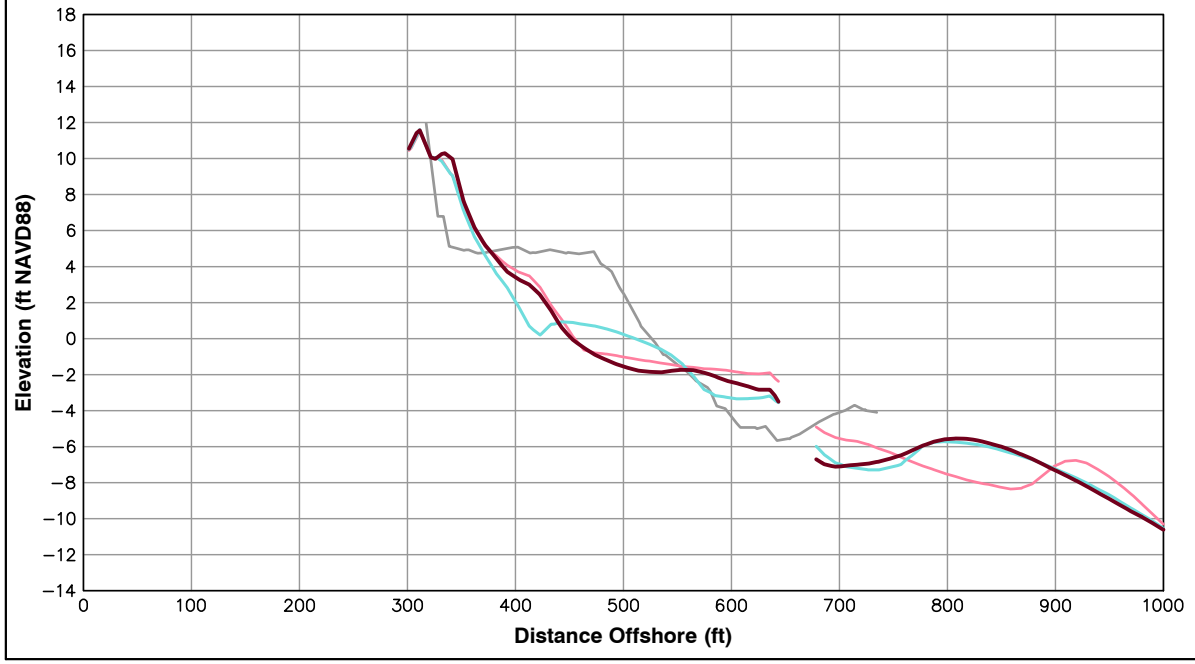


City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 338+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-4.63 ft/yr	28.71 ft
Volume Change Above -15 ft NAVD88	-2.05 cy/ft/yr	1.20 cy/ft
Volume Change Above 0 ft NAVD88	-0.29 cy/ft/yr	2.90 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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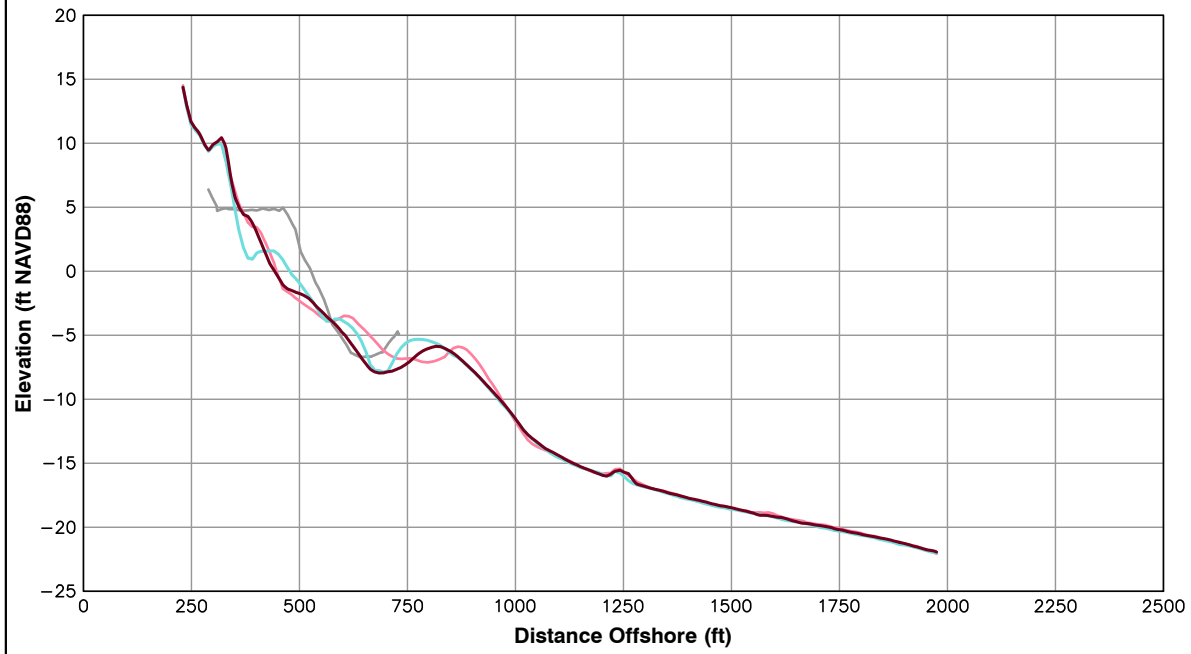
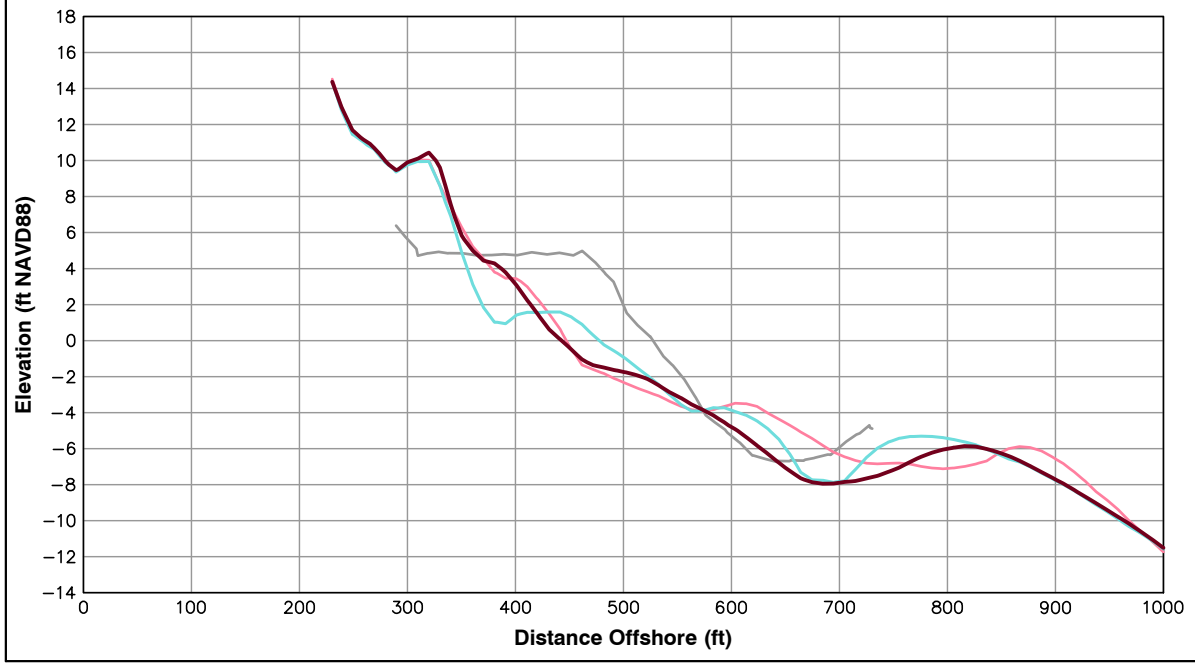
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 340+43	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-9.95 ft/yr	-33.03 ft
Volume Change Above -15 ft NAVD88	-8.62 cy/ft/yr	-4.47 cy/ft
Volume Change Above 0 ft NAVD88	-0.59 cy/ft/yr	4.53 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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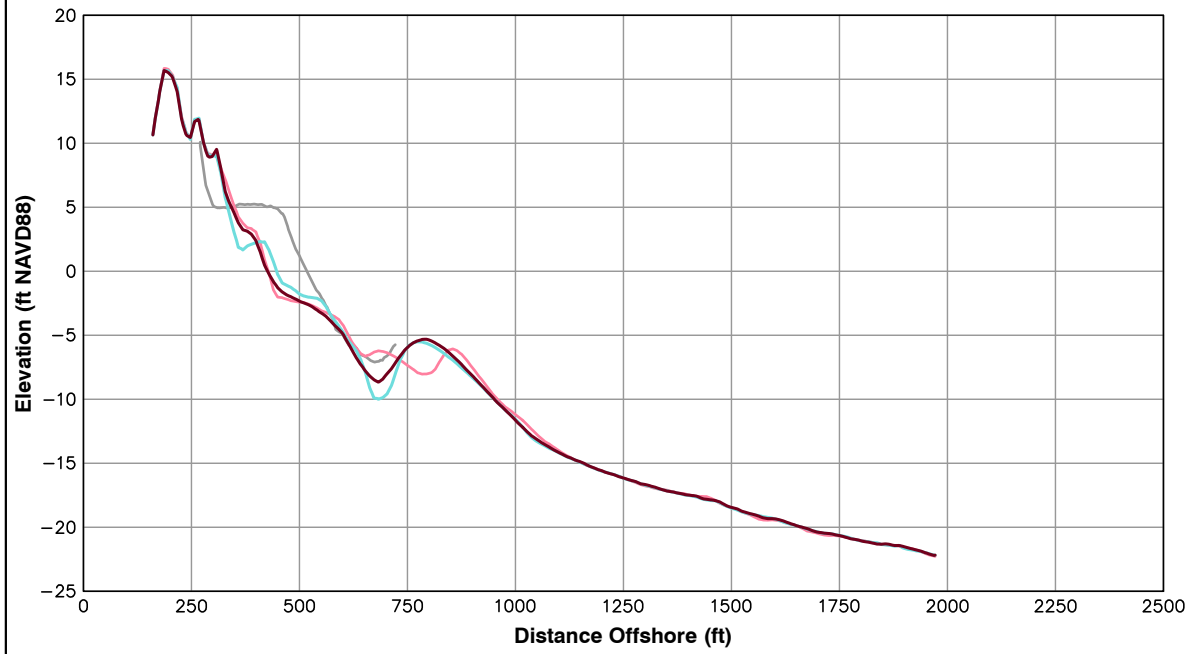
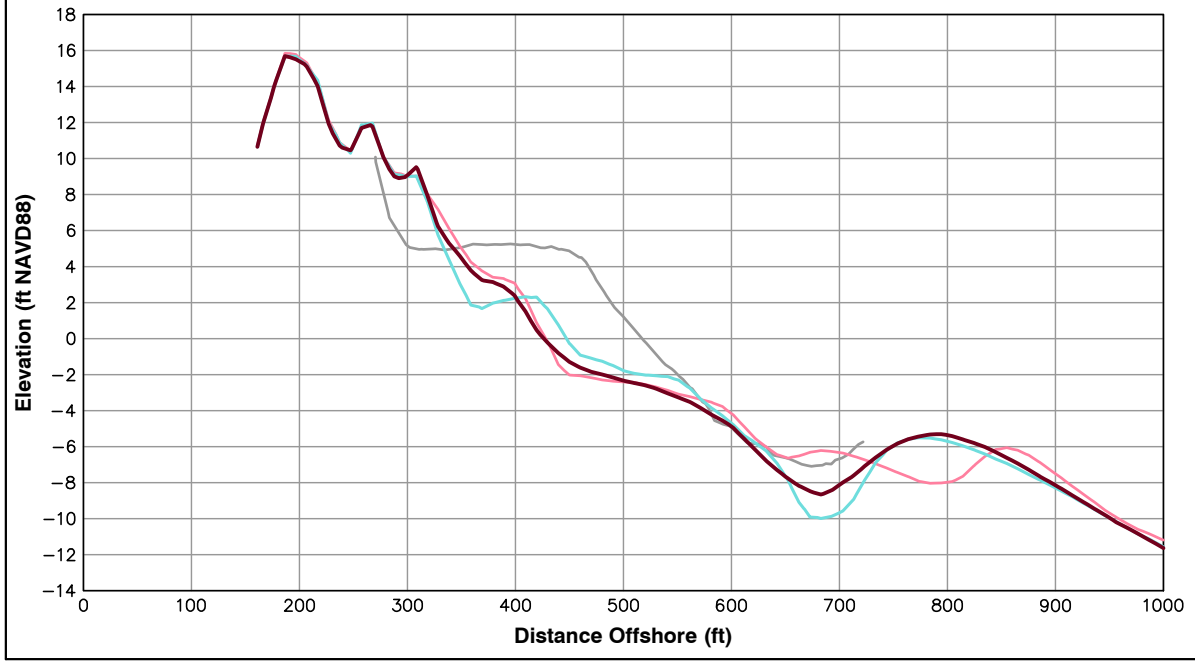
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 342+23	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-4.15 ft/yr	-22.92 ft
Volume Change Above -15 ft NAVD88	-5.50 cy/ft/yr	1.62 cy/ft
Volume Change Above 0 ft NAVD88	-2.56 cy/ft/yr	1.19 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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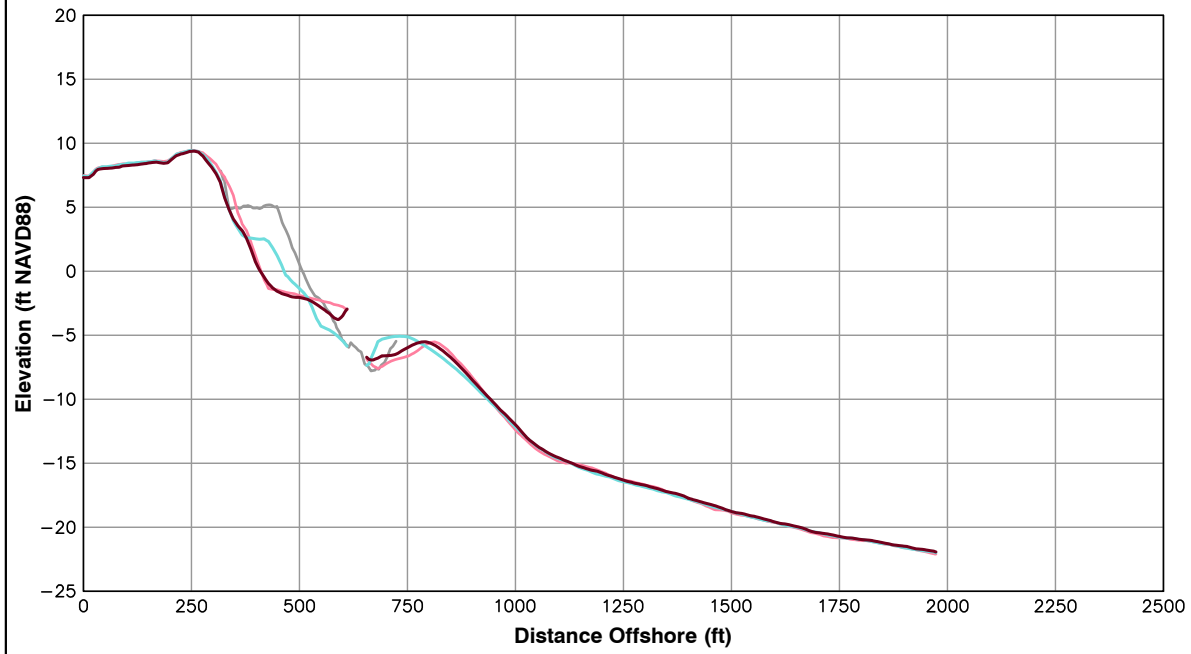
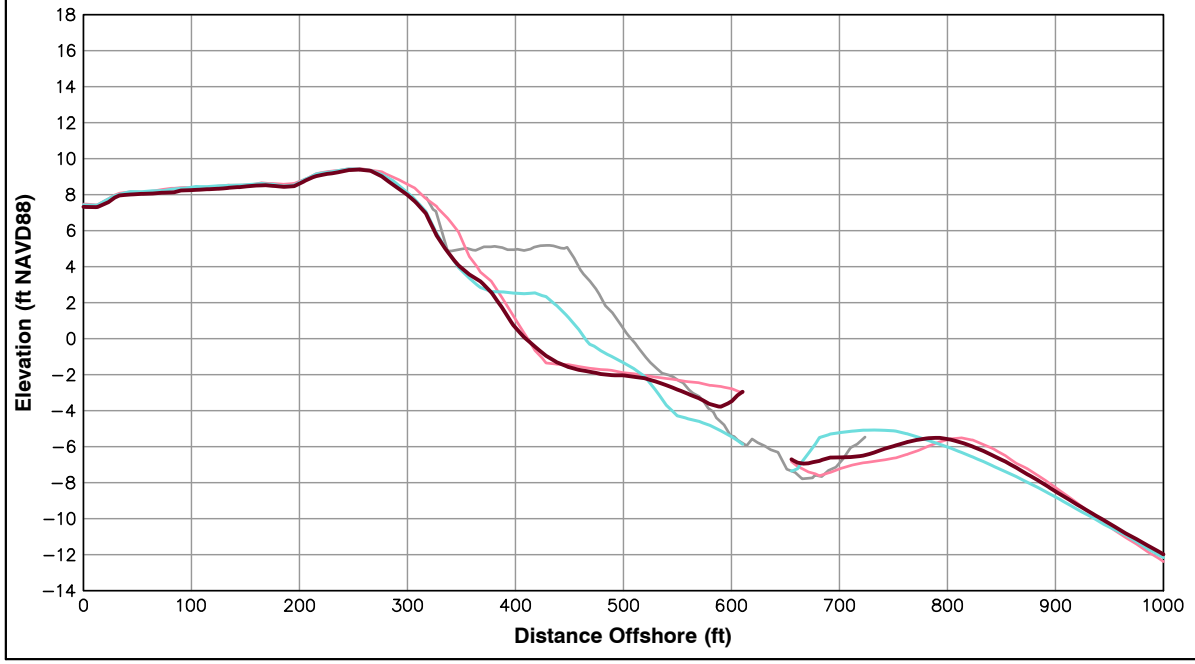
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 344+05	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-5.23 ft/yr	-56.38 ft
Volume Change Above -15 ft NAVD88	-4.23 cy/ft/yr	-6.97 cy/ft
Volume Change Above 0 ft NAVD88	-5.26 cy/ft/yr	-6.20 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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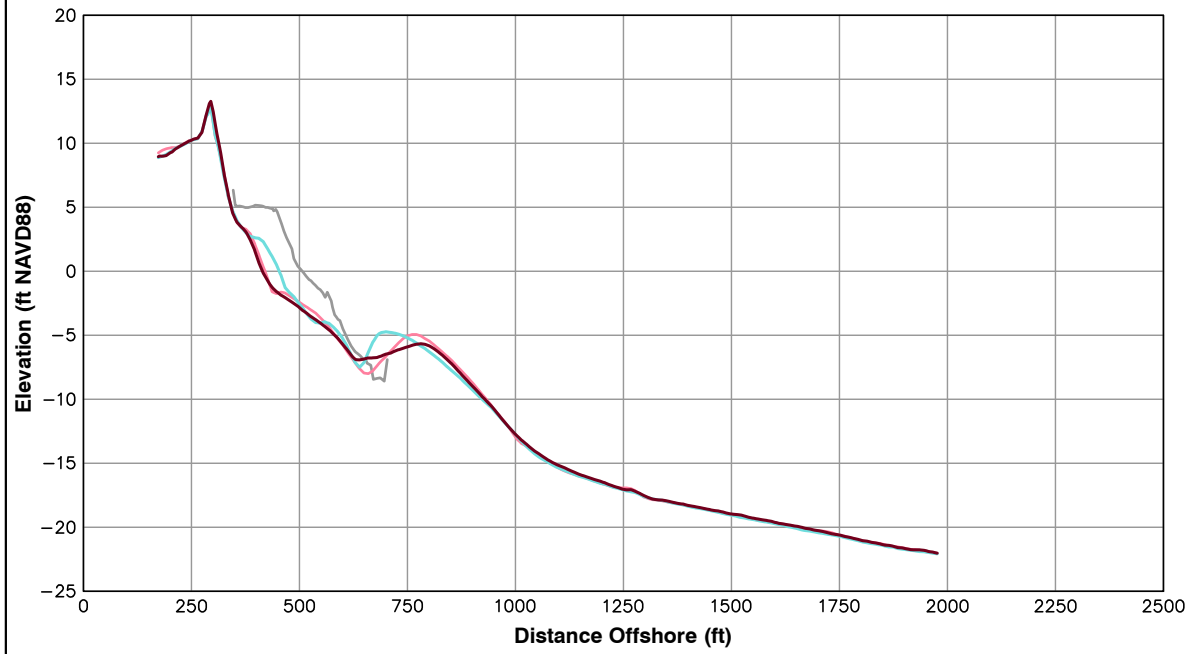
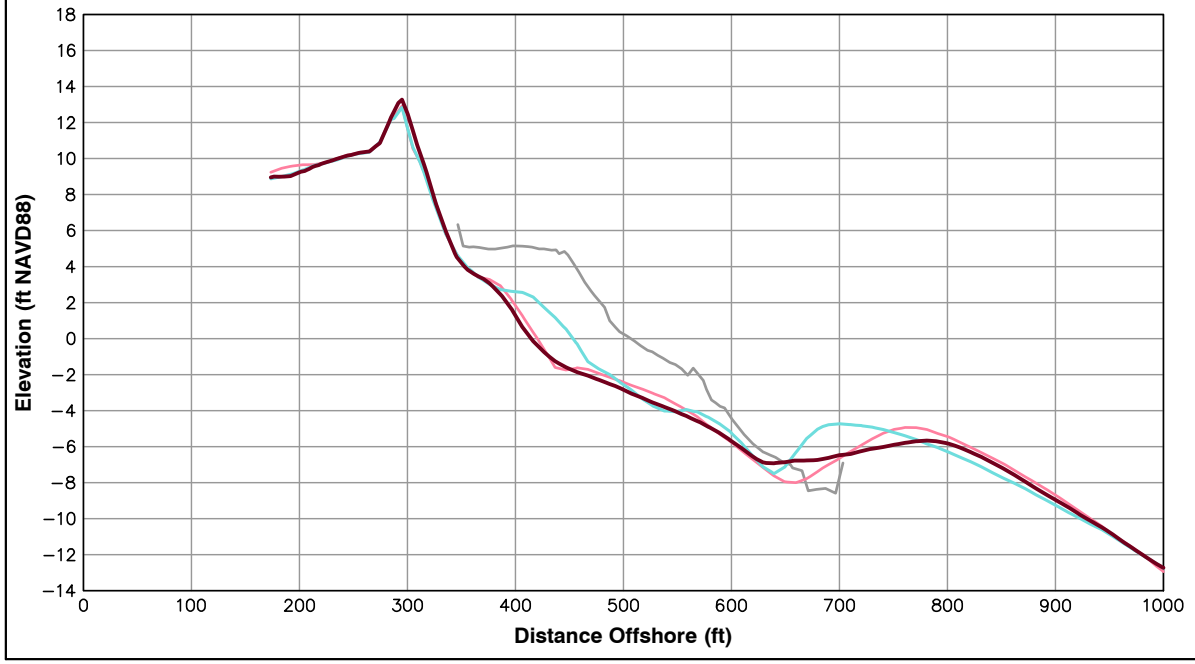
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 345+85	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-6.18 ft/yr	-36.63 ft
Volume Change Above -15 ft NAVD88	-2.82 cy/ft/yr	-7.82 cy/ft
Volume Change Above 0 ft NAVD88	-0.64 cy/ft/yr	-2.47 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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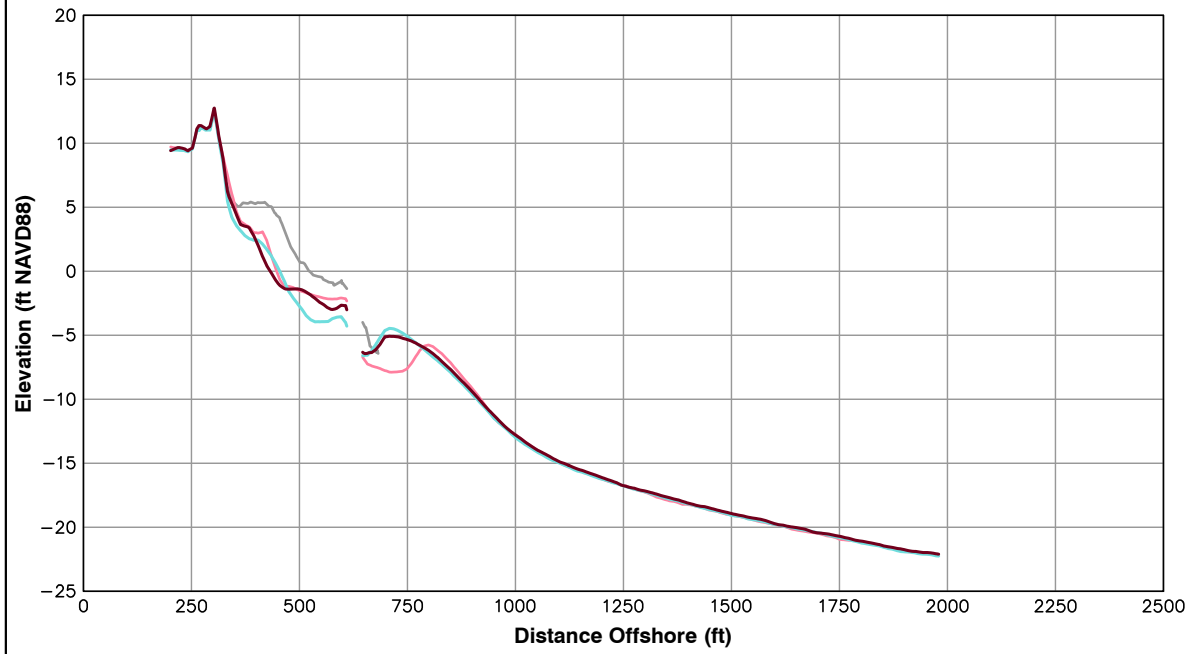

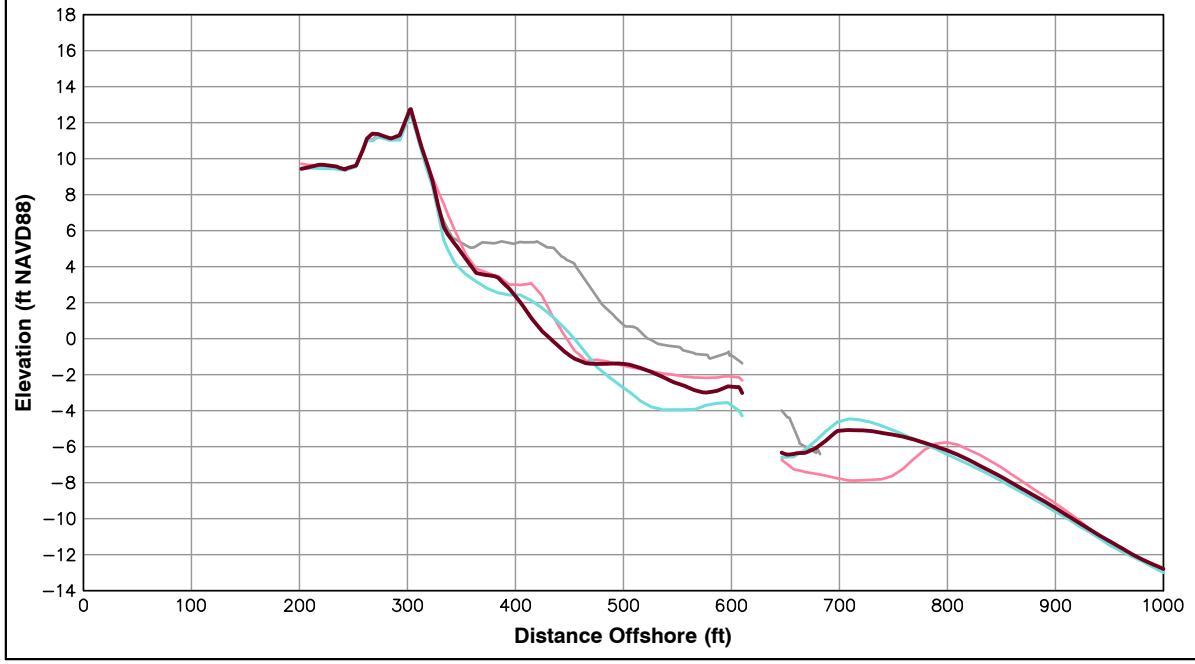

Survey Transect 347+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-19.36 ft/yr	-21.73 ft
Volume Change Above -15 ft NAVD88	1.99 cy/ft/yr	8.11 cy/ft
Volume Change Above 0 ft NAVD88	-3.09 cy/ft/yr	1.01 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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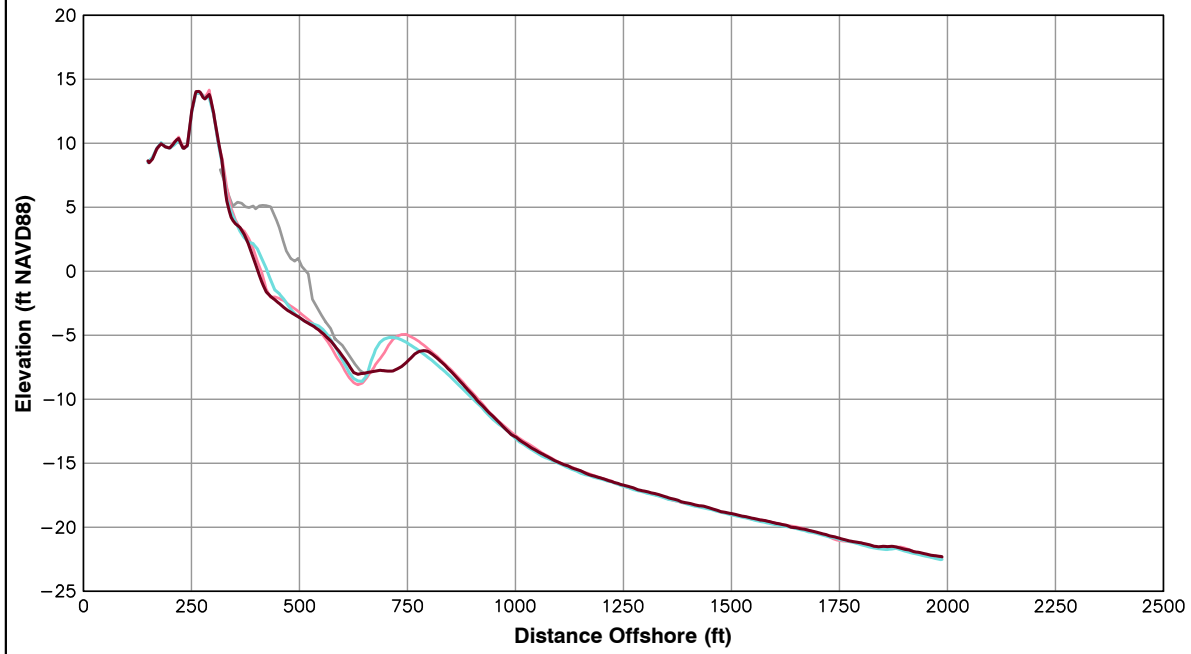
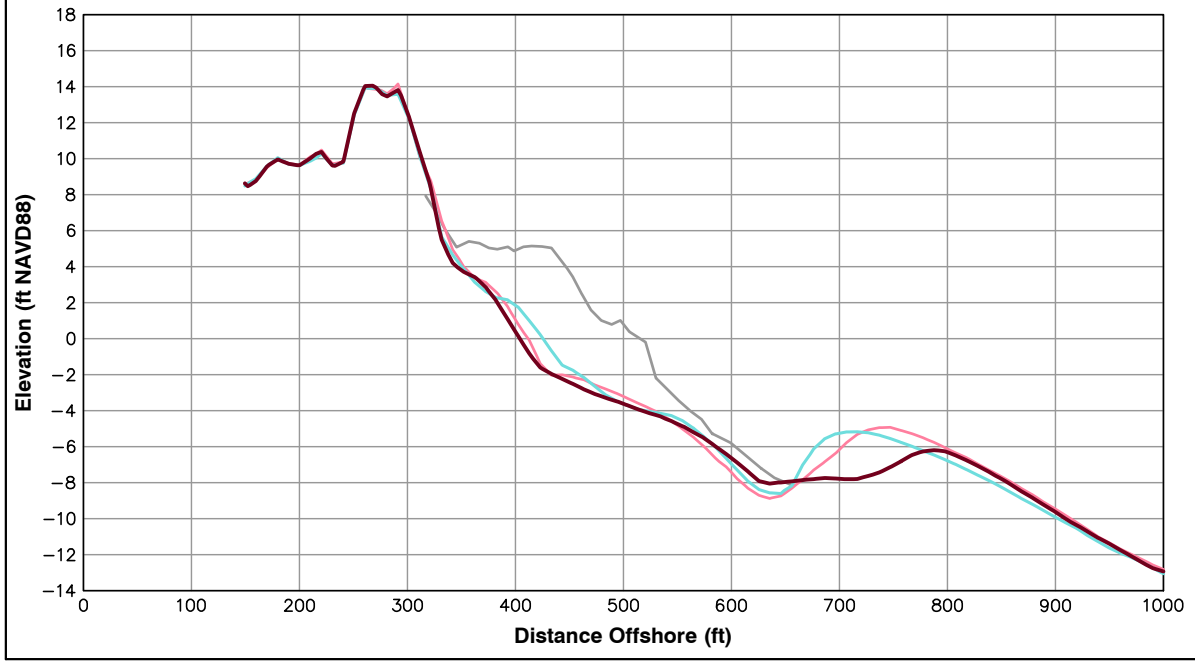
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 349+43	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-6.55 ft/yr	-19.27 ft
Volume Change Above -15 ft NAVD88	-8.94 cy/ft/yr	-7.67 cy/ft
Volume Change Above 0 ft NAVD88	-1.76 cy/ft/yr	-1.30 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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 April 2015 and October 2015.
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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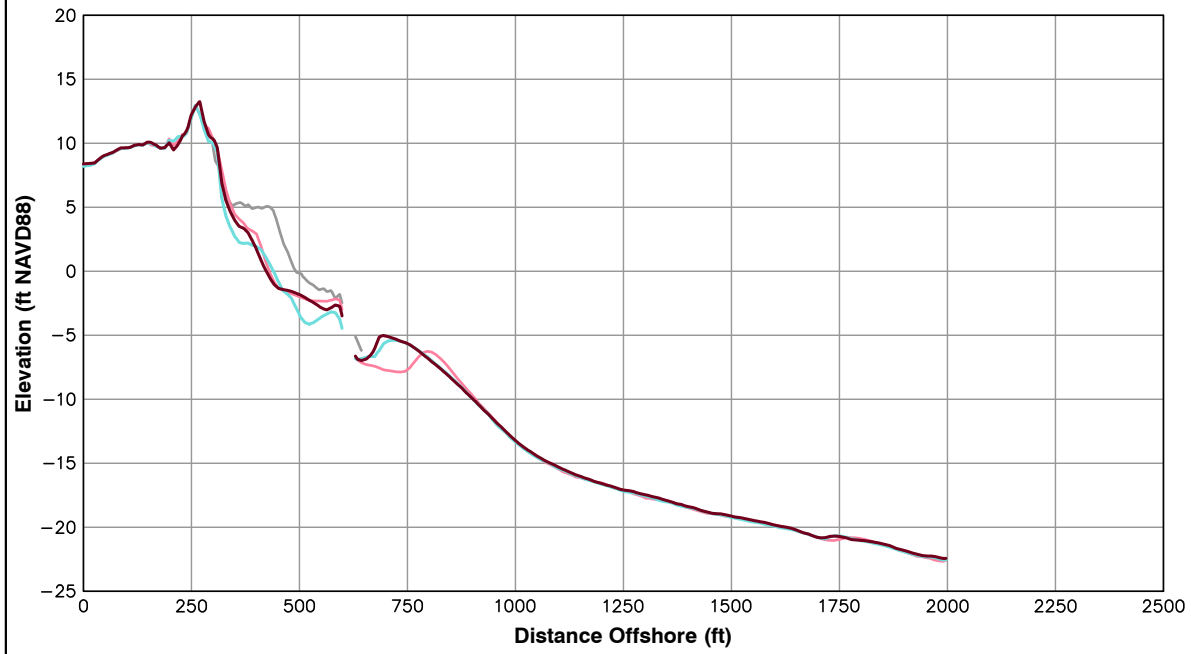
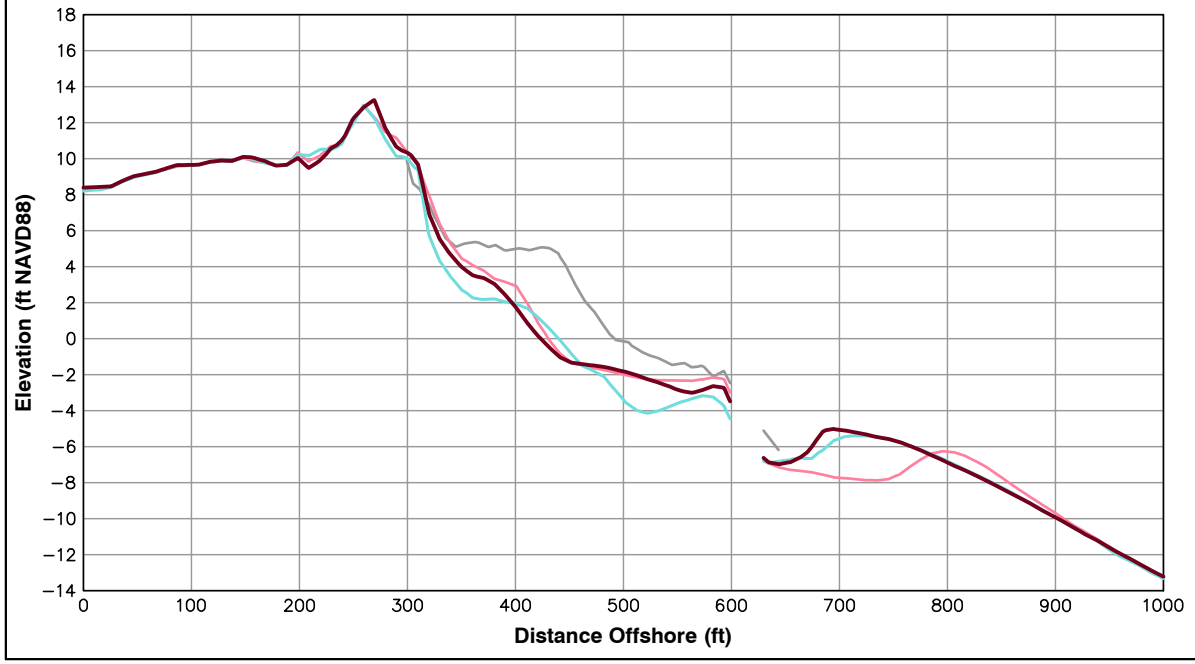
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 351+23	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-9.79 ft/yr	-14.72 ft
Volume Change Above -15 ft NAVD88	2.64 cy/ft/yr	8.81 cy/ft
Volume Change Above 0 ft NAVD88	-2.62 cy/ft/yr	3.23 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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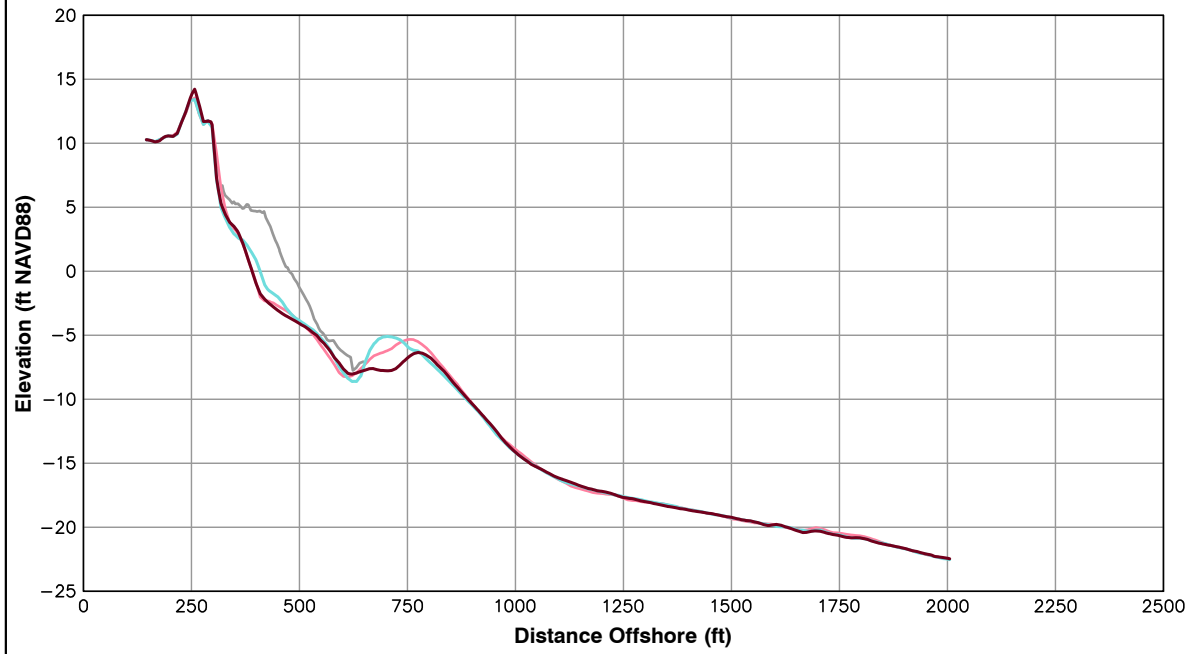
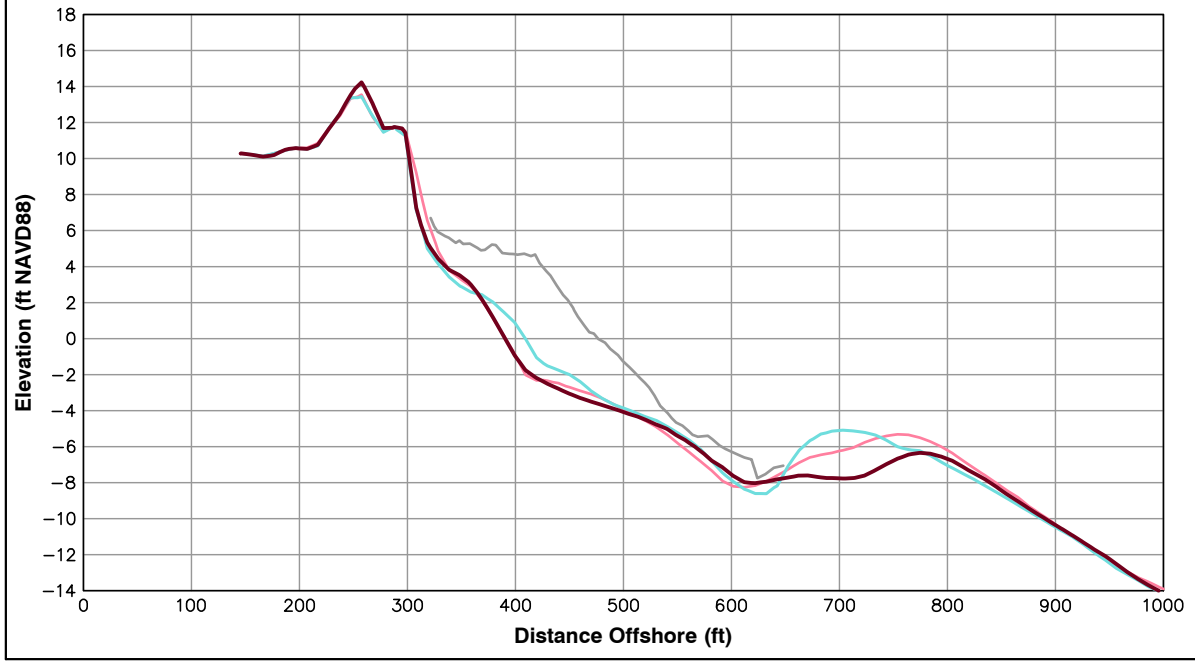
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 353+03	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	0.33 ft/yr	-16.71 ft
Volume Change Above -15 ft NAVD88	-7.31 cy/ft/yr	-8.88 cy/ft
Volume Change Above 0 ft NAVD88	-0.55 cy/ft/yr	0.31 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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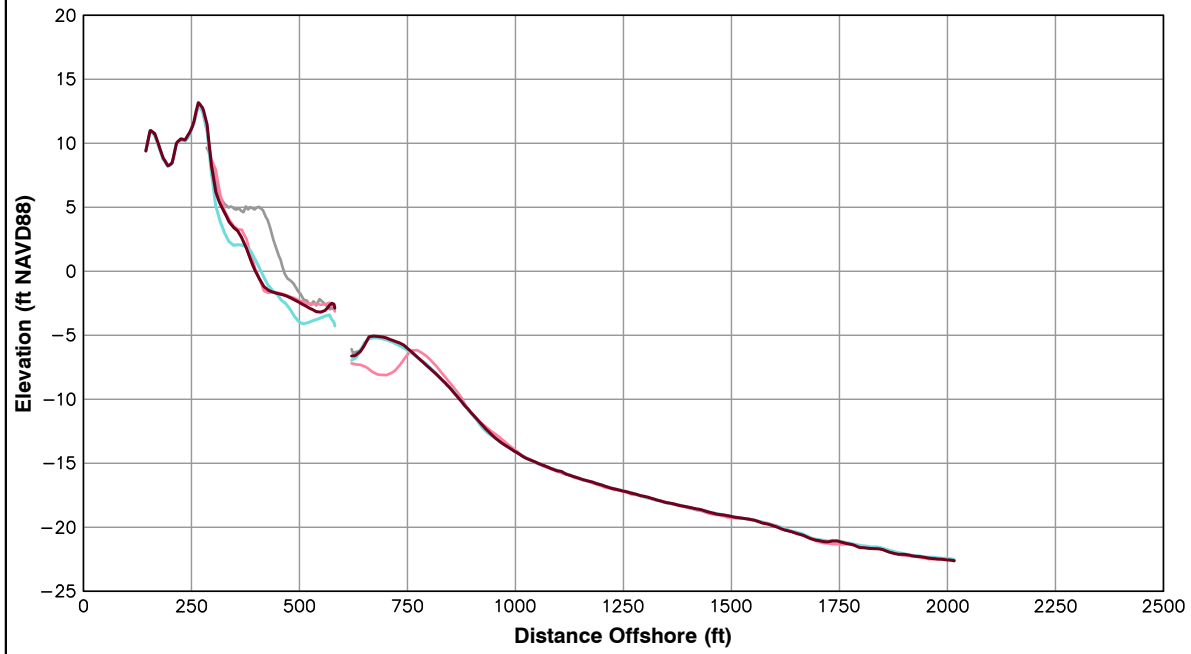
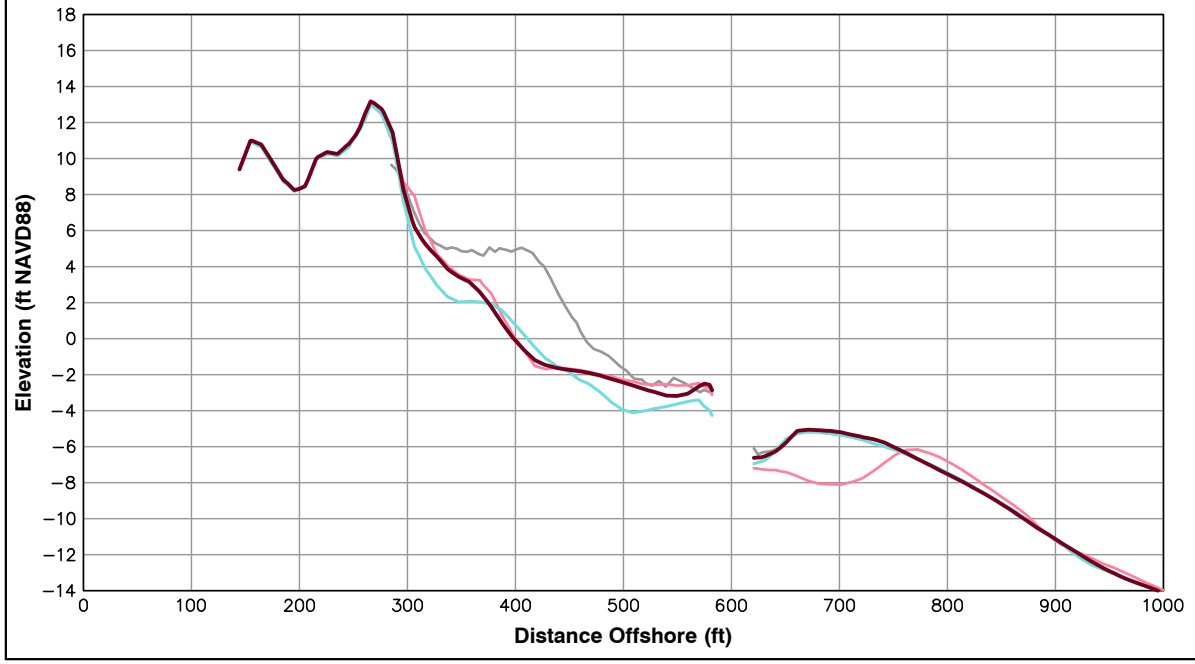
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 354+83	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-4.11 ft/yr	-10.49 ft
Volume Change Above -15 ft NAVD88	4.12 cy/ft/yr	8.09 cy/ft
Volume Change Above 0 ft NAVD88	-1.39 cy/ft/yr	3.53 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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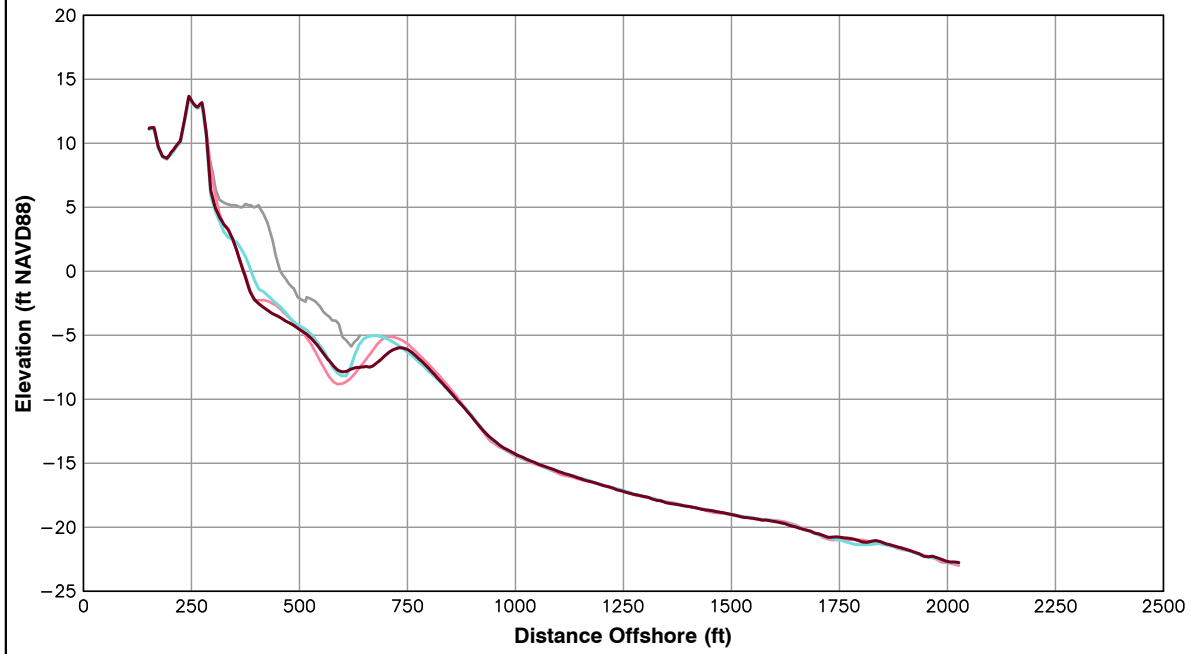
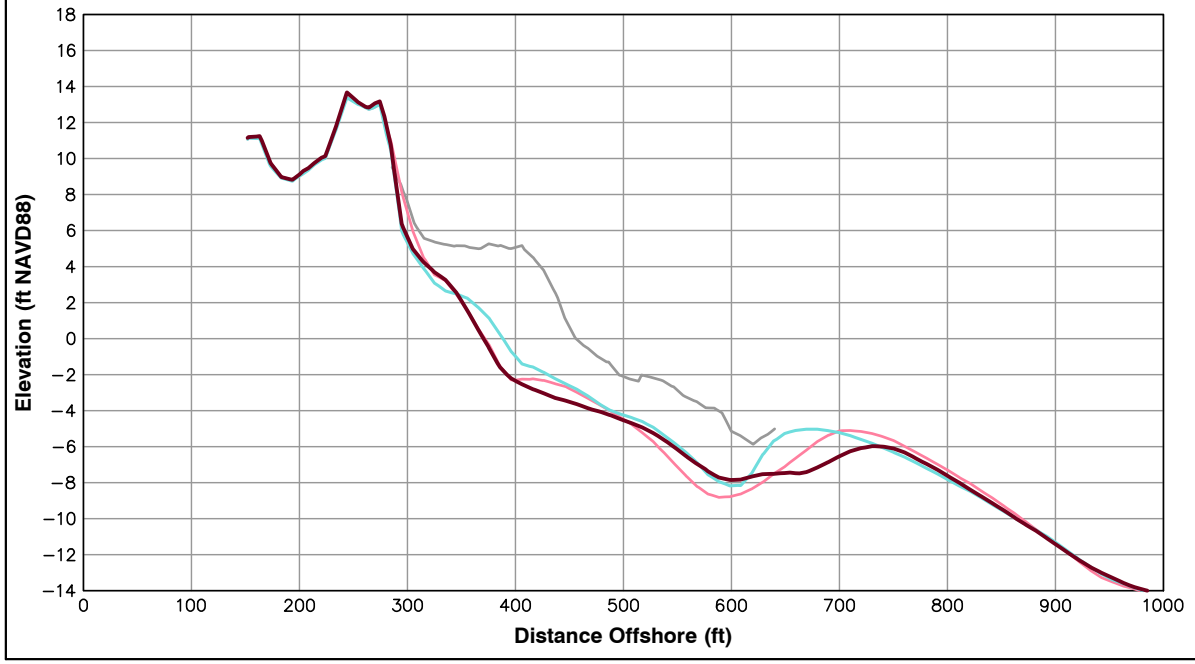
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 356+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-0.40 ft/yr	-16.43 ft
Volume Change Above -15 ft NAVD88	-3.37 cy/ft/yr	-9.64 cy/ft
Volume Change Above 0 ft NAVD88	-0.75 cy/ft/yr	0.39 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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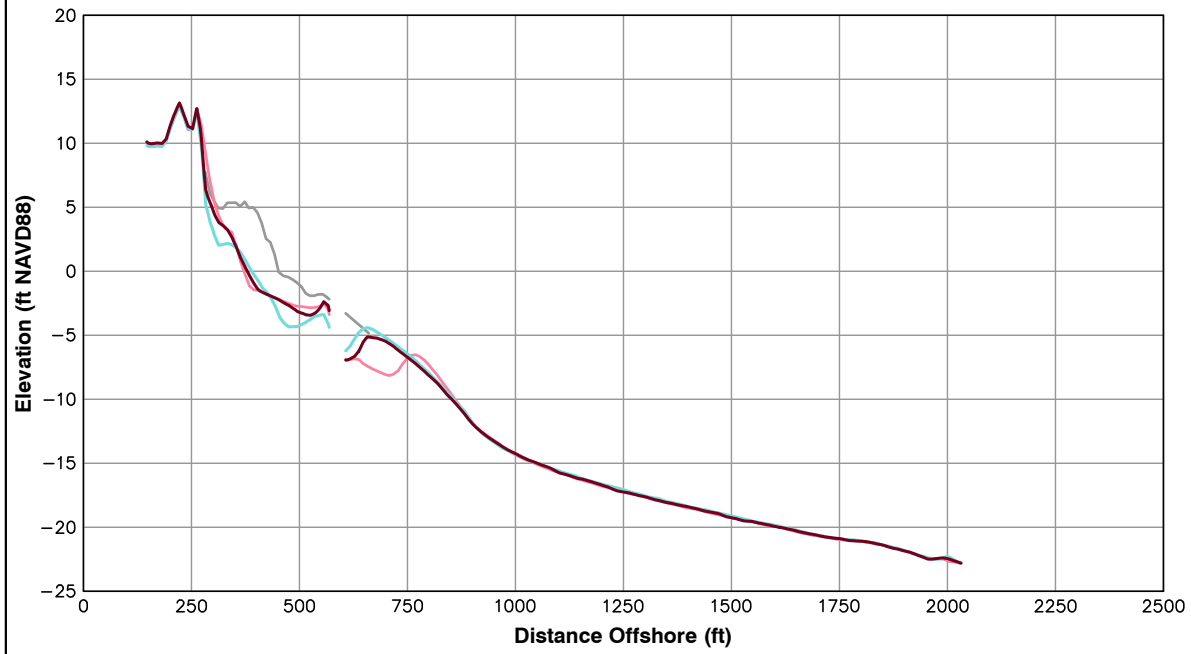
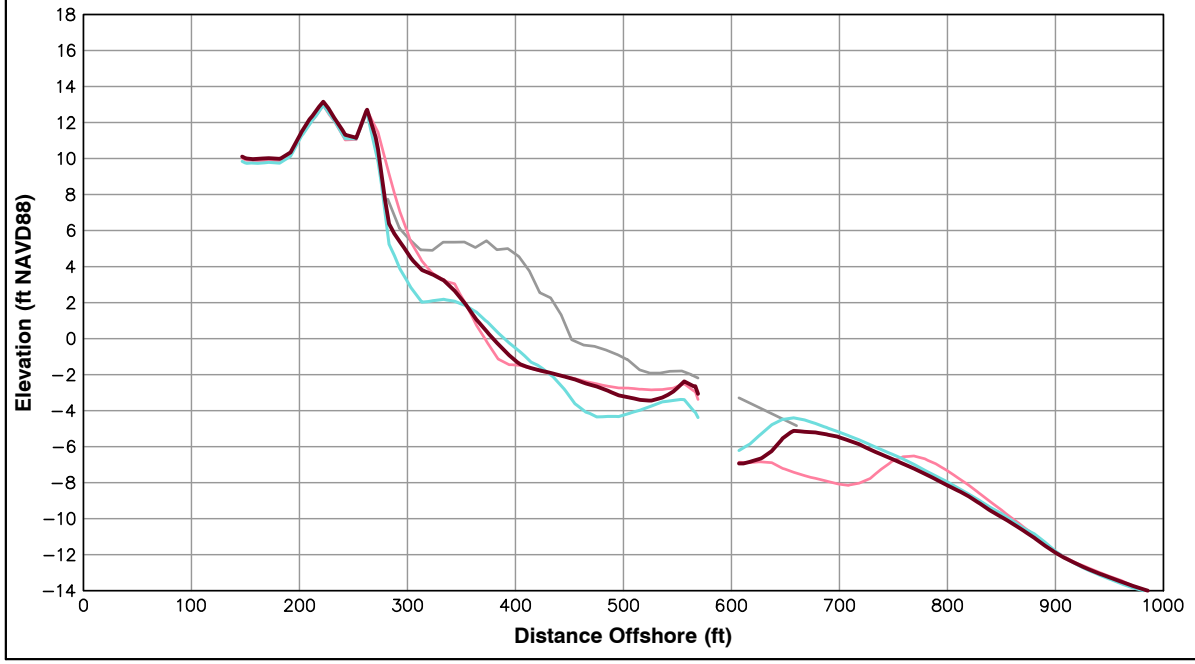
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 358+43	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	2.89 ft/yr	-7.82 ft
Volume Change Above -15 ft NAVD88	3.27 cy/ft/yr	3.86 cy/ft
Volume Change Above 0 ft NAVD88	-1.68 cy/ft/yr	4.11 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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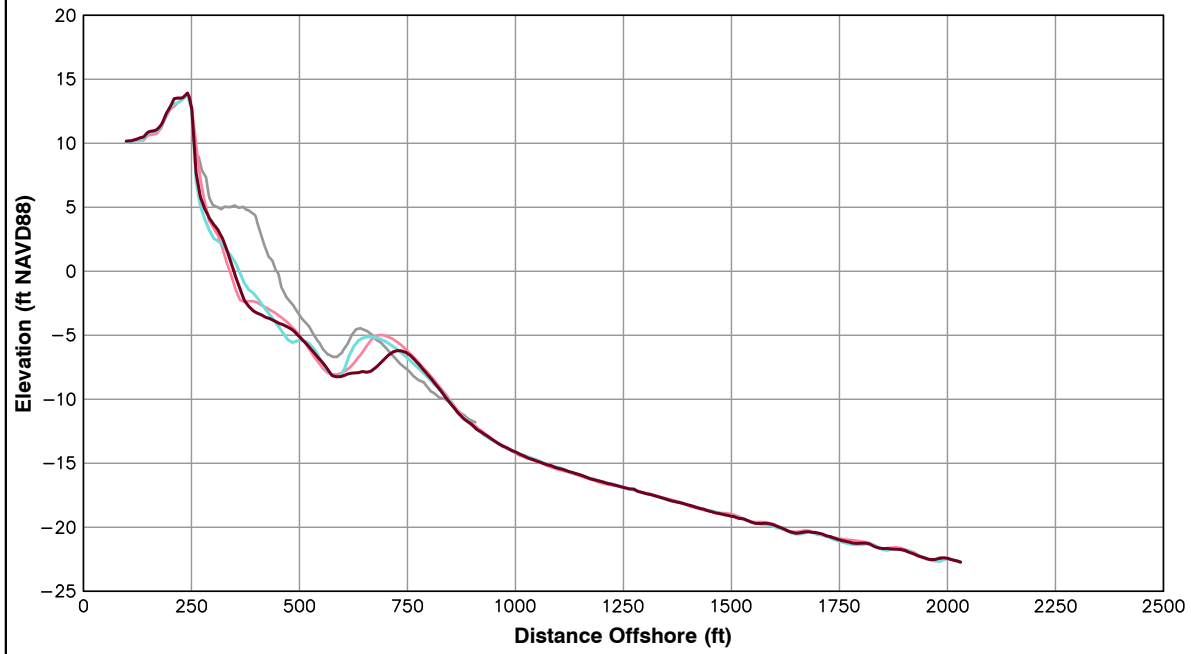
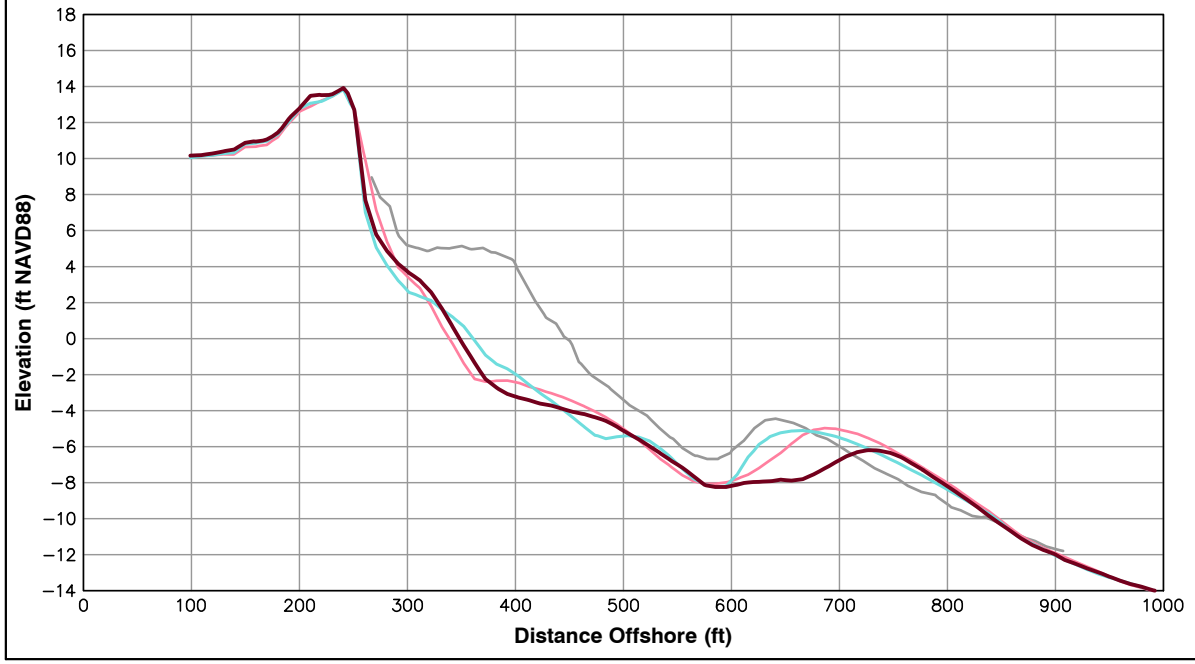
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 360+23	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	9.11 ft/yr	-7.43 ft
Volume Change Above -15 ft NAVD88	-7.76 cy/ft/yr	-7.06 cy/ft
Volume Change Above 0 ft NAVD88	0.89 cy/ft/yr	2.41 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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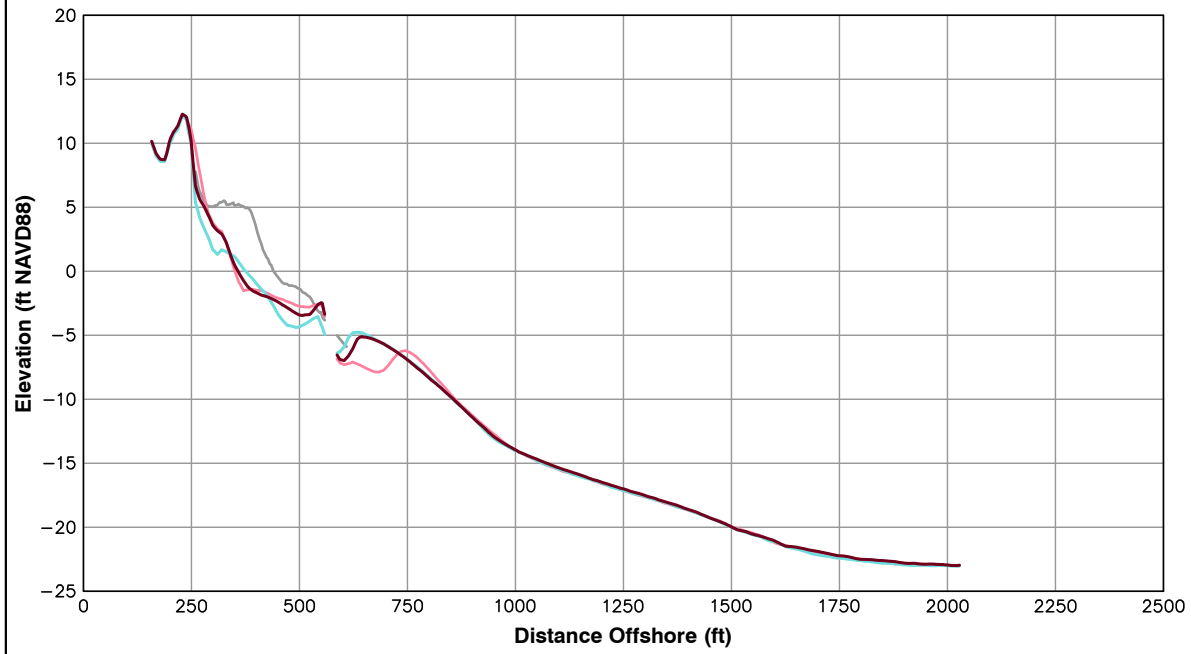
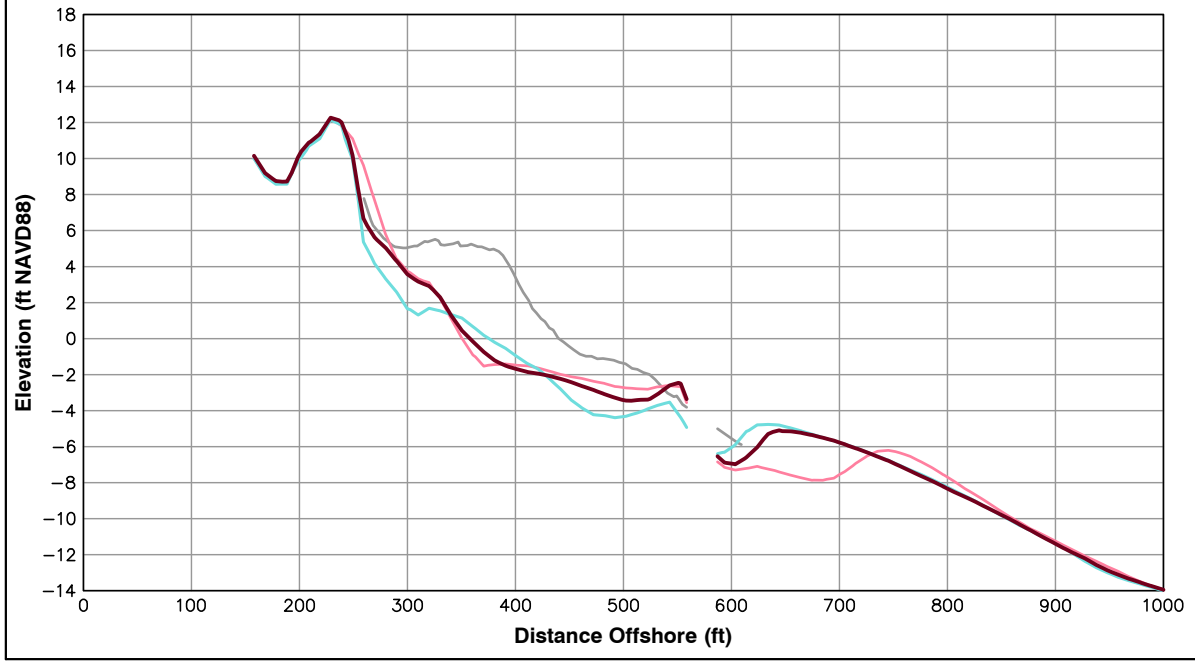
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 362+03	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	2.37 ft/yr	-9.74 ft
Volume Change Above -15 ft NAVD88	1.09 cy/ft/yr	5.82 cy/ft
Volume Change Above 0 ft NAVD88	-2.08 cy/ft/yr	4.55 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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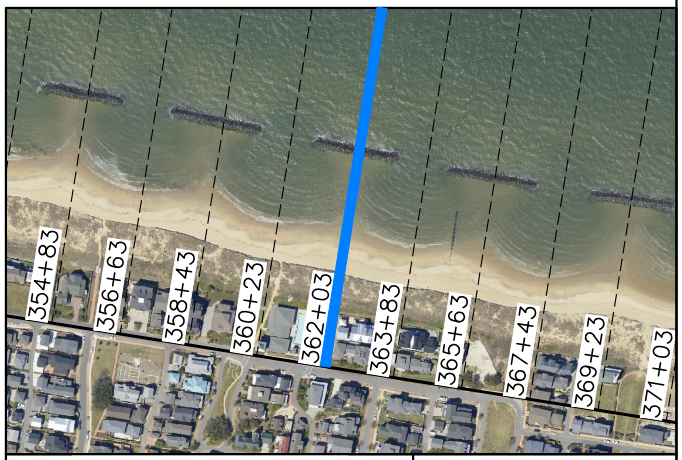

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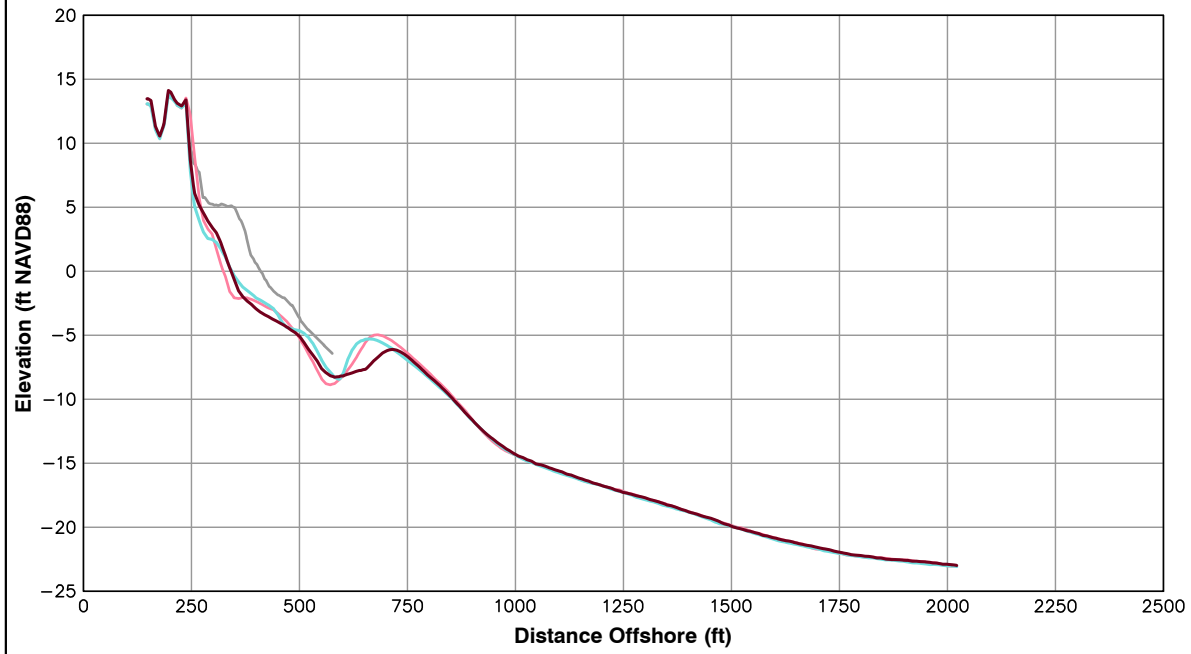
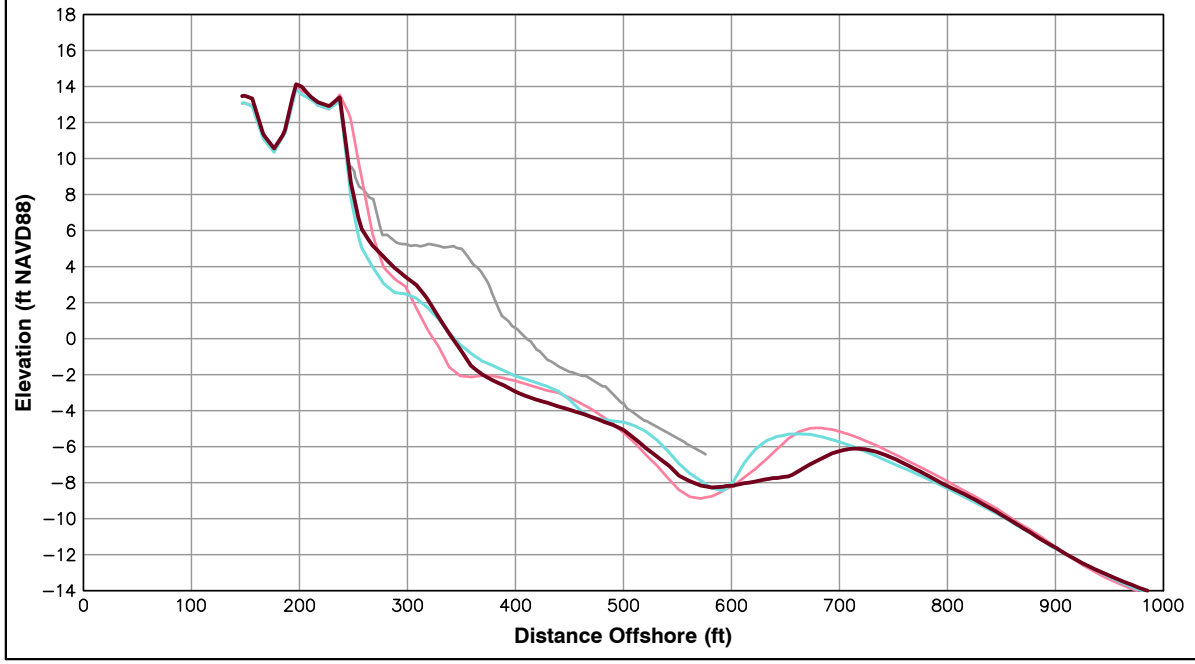
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 363+83	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	15.84 ft/yr	0.96 ft
Volume Change Above -15 ft NAVD88	-4.73 cy/ft/yr	-5.91 cy/ft
Volume Change Above 0 ft NAVD88	0.21 cy/ft/yr	3.93 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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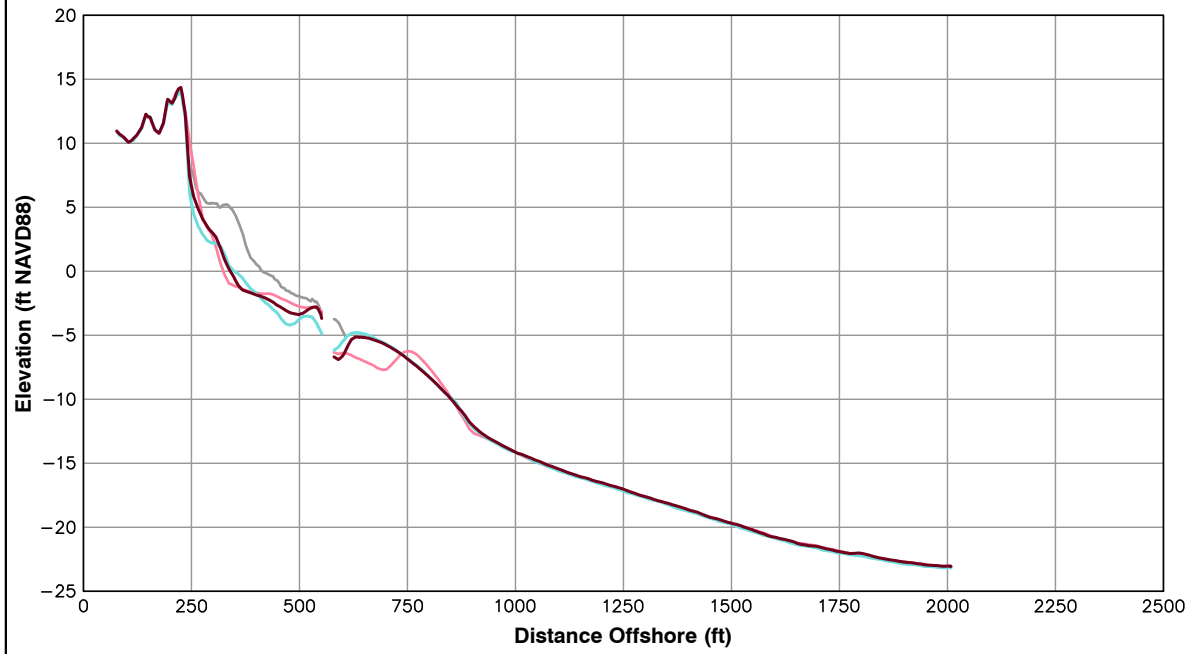
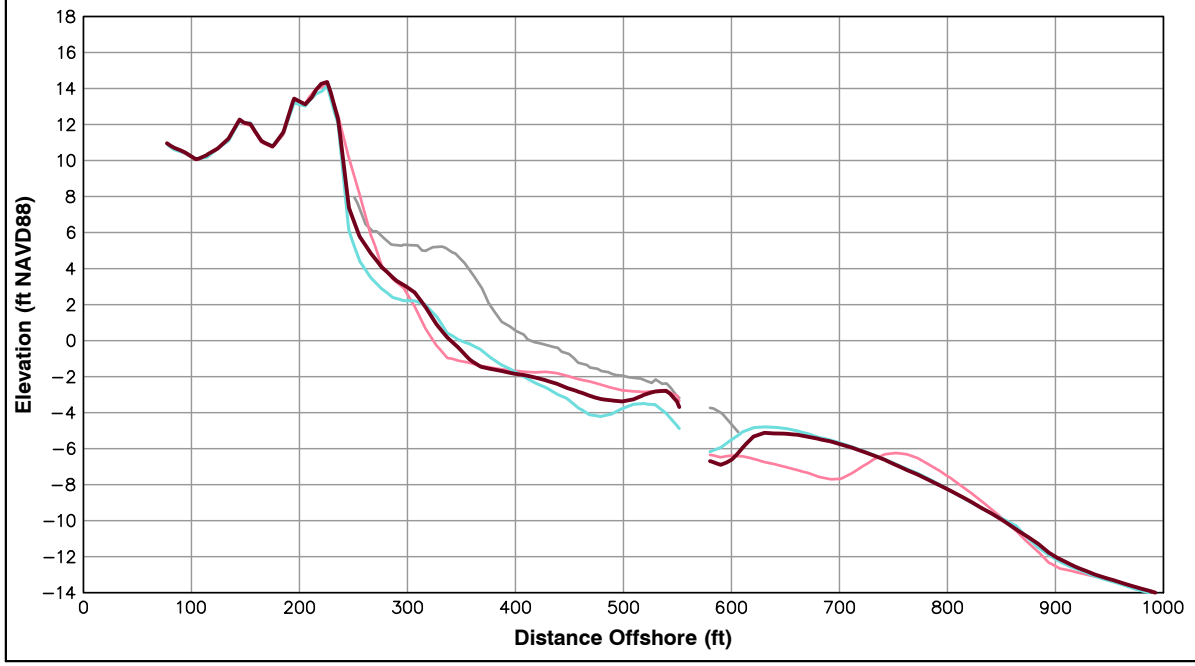
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 365+63	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	11.34 ft/yr	-4.77 ft
Volume Change Above -15 ft NAVD88	2.84 cy/ft/yr	4.05 cy/ft
Volume Change Above 0 ft NAVD88	-0.77 cy/ft/yr	3.12 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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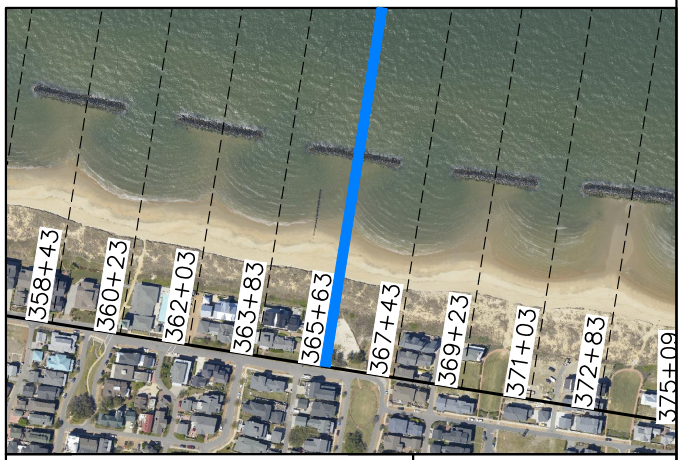

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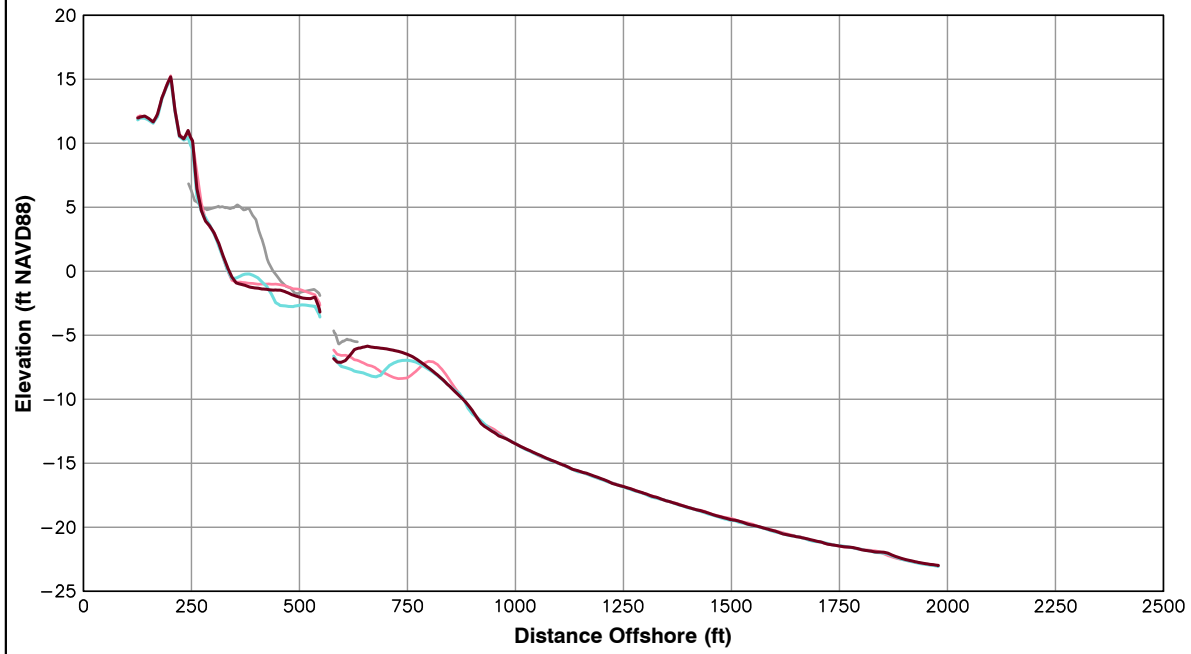
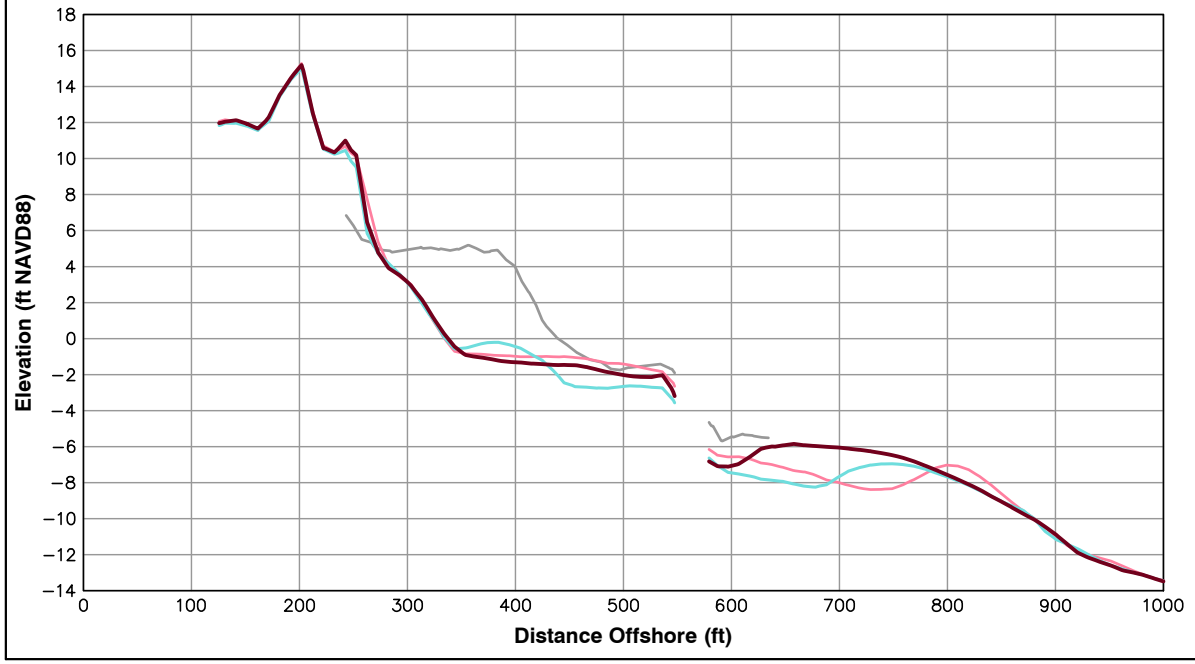
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 369+23	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	1.75 ft/yr	1.28 ft
Volume Change Above -15 ft NAVD88	3.25 cy/ft/yr	11.44 cy/ft
Volume Change Above 0 ft NAVD88	-0.47 cy/ft/yr	1.31 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
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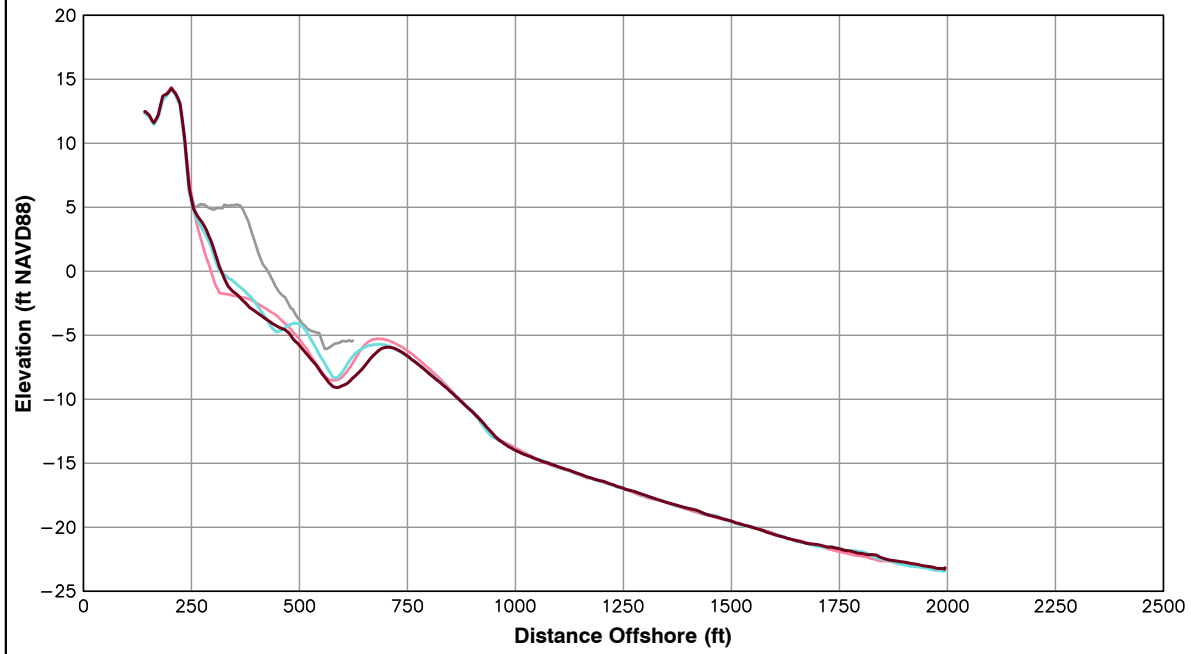
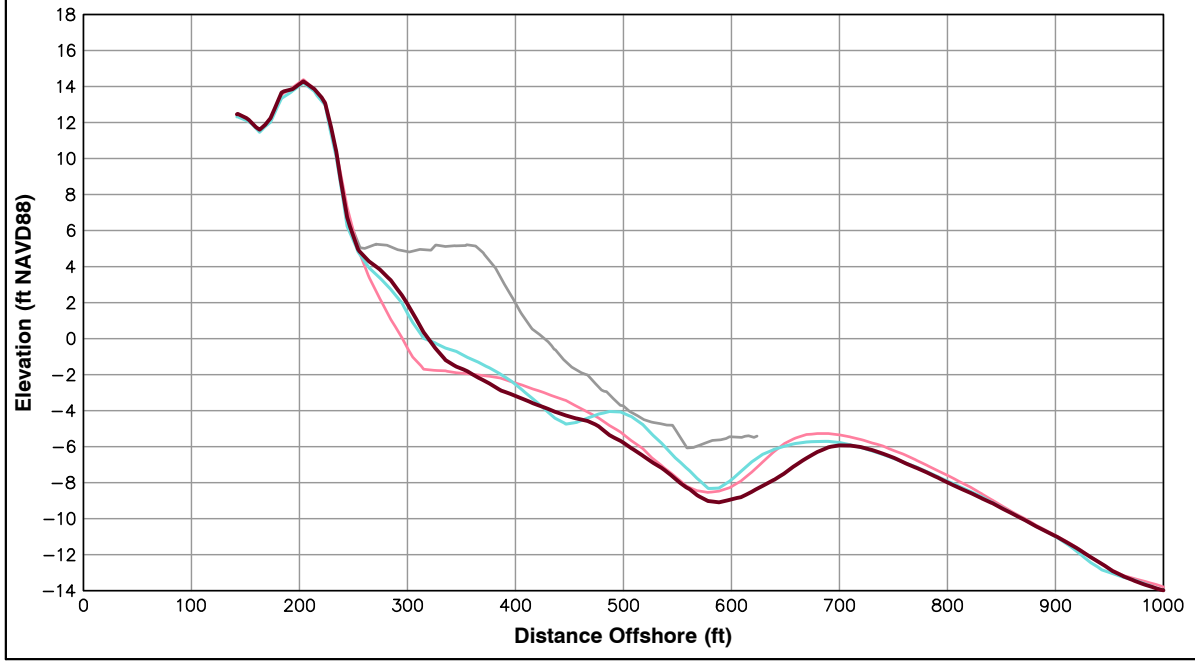
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 367+43	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	22.37 ft/yr	5.03 ft
Volume Change Above -15 ft NAVD88	-6.20 cy/ft/yr	-10.23 cy/ft
Volume Change Above 0 ft NAVD88	2.90 cy/ft/yr	1.79 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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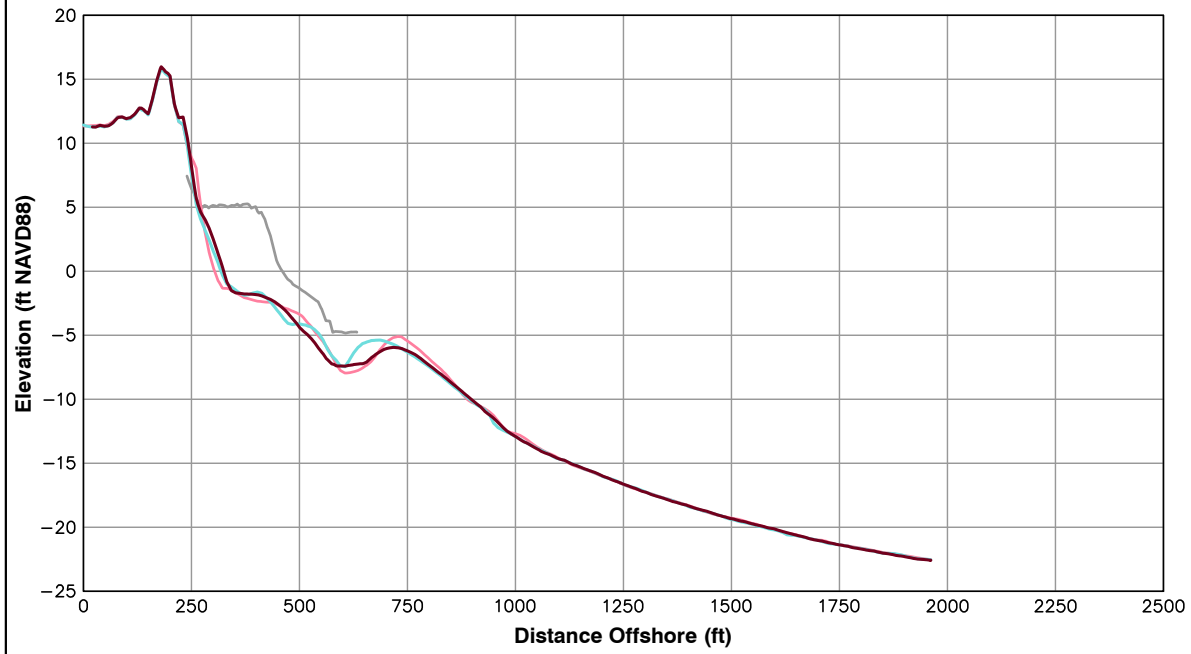
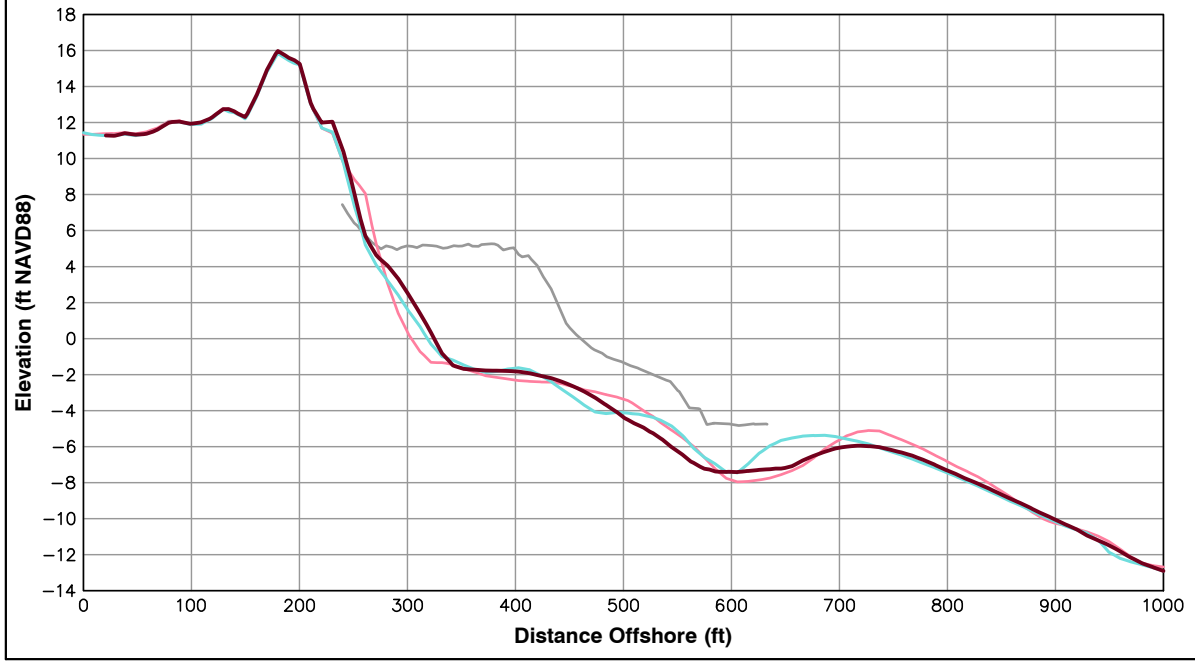
City of Norfolk

OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 371+03	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	19.61 ft/yr	7.84 ft
Volume Change Above -15 ft NAVD88	-2.53 cy/ft/yr	-1.30 cy/ft
Volume Change Above 0 ft NAVD88	1.57 cy/ft/yr	2.99 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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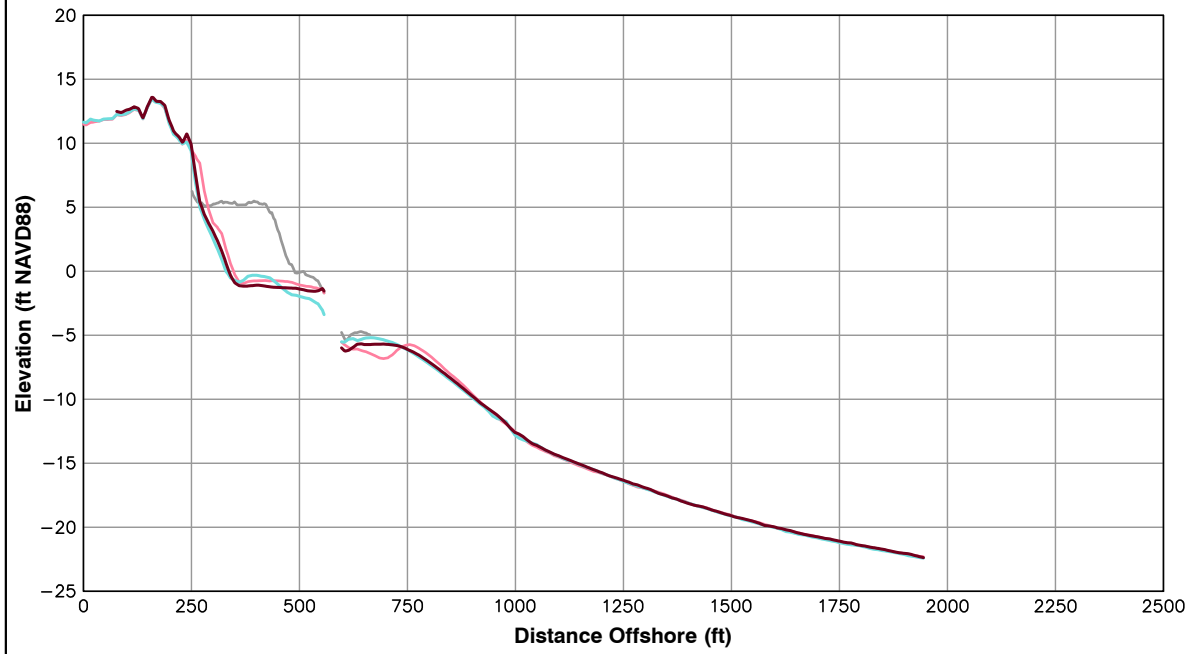
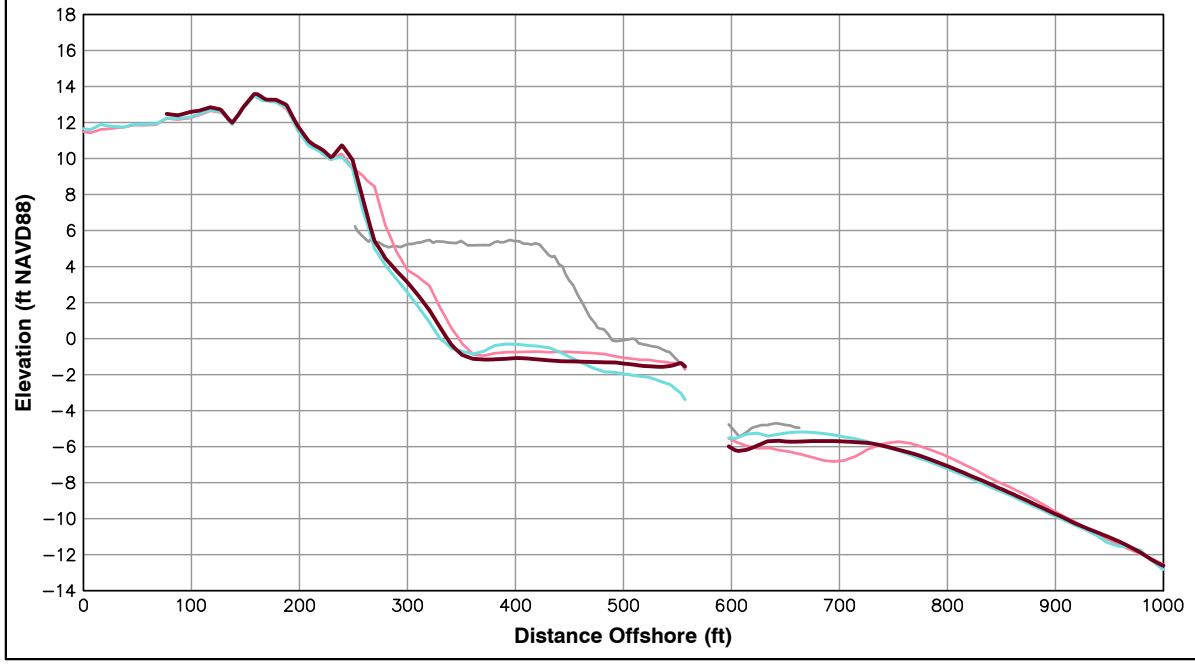
OCEAN VIEW PERIODIC SURVEYING DATA & ANALYSIS





Survey Transect 372+83	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-9.90 ft/yr	7.03 ft
Volume Change Above -15 ft NAVD88	-4.99 cy/ft/yr	2.61 cy/ft
Volume Change Above 0 ft NAVD88	-3.13 cy/ft/yr	2.94 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

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City of Norfolk

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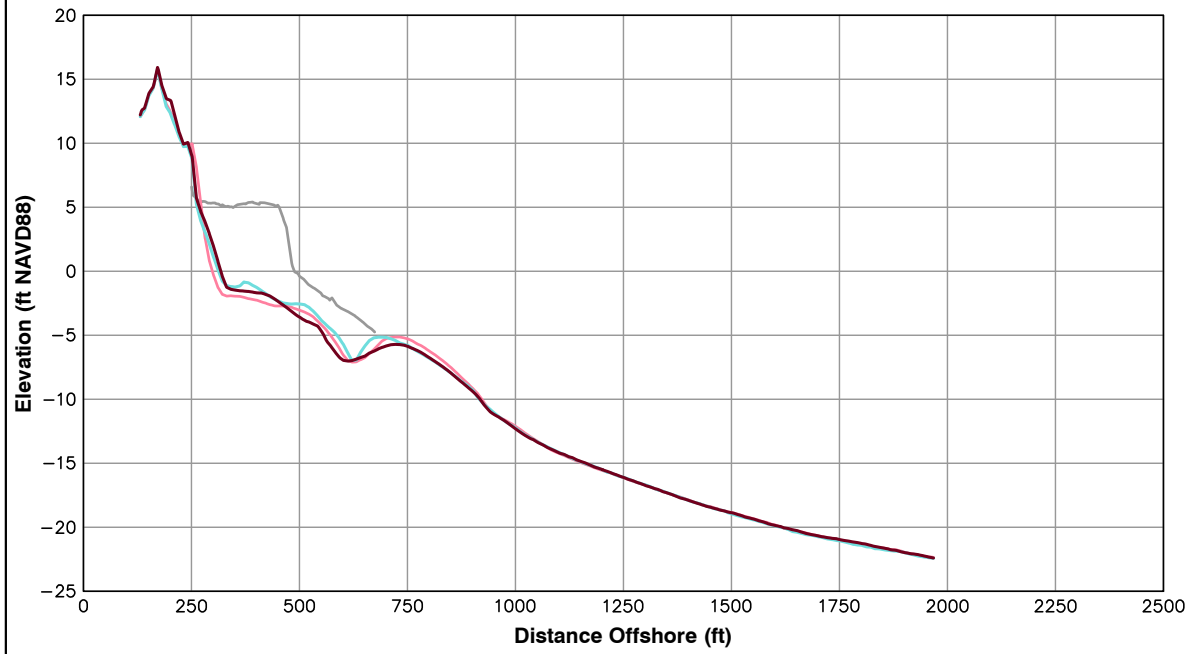

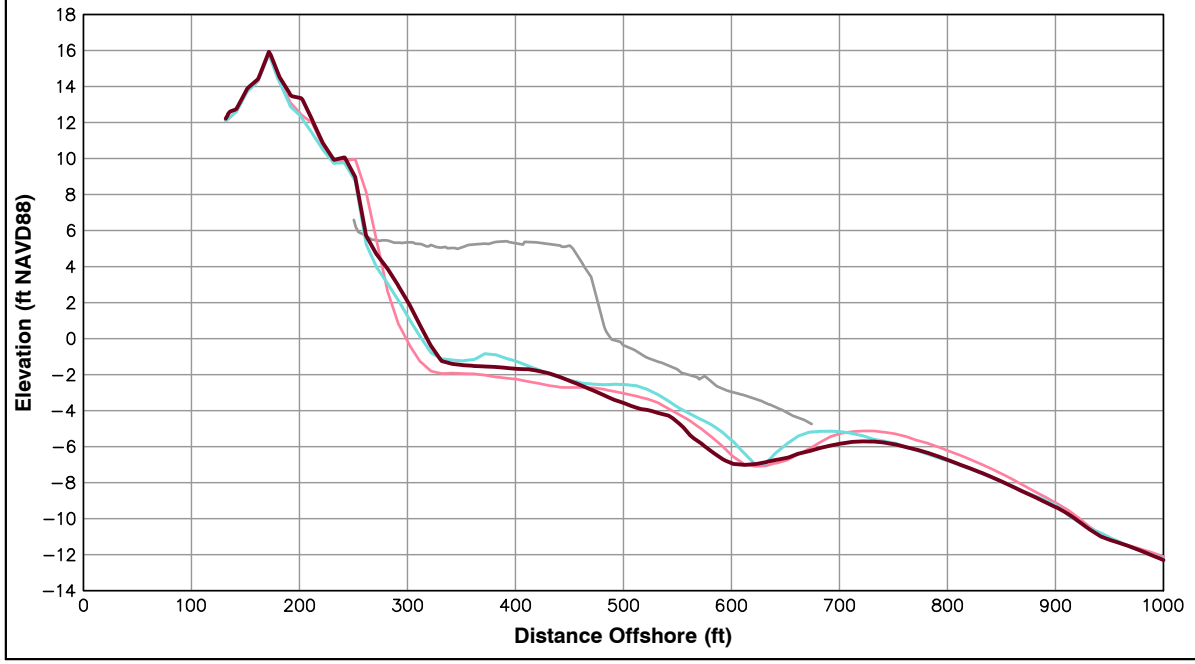

Survey Transect 375+08	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	17.89 ft/yr	6.92 ft
Volume Change Above -15 ft NAVD88	-1.48 cy/ft/yr	-6.29 cy/ft
Volume Change Above 0 ft NAVD88	1.70 cy/ft/yr	3.23 cy/ft

LEGEND:
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- 2015 OCT
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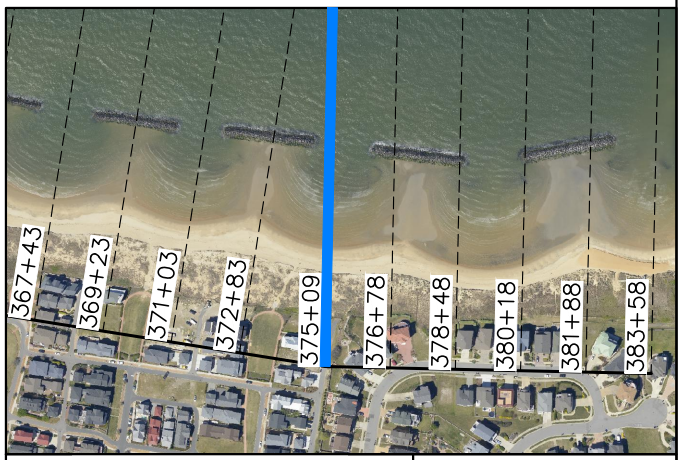

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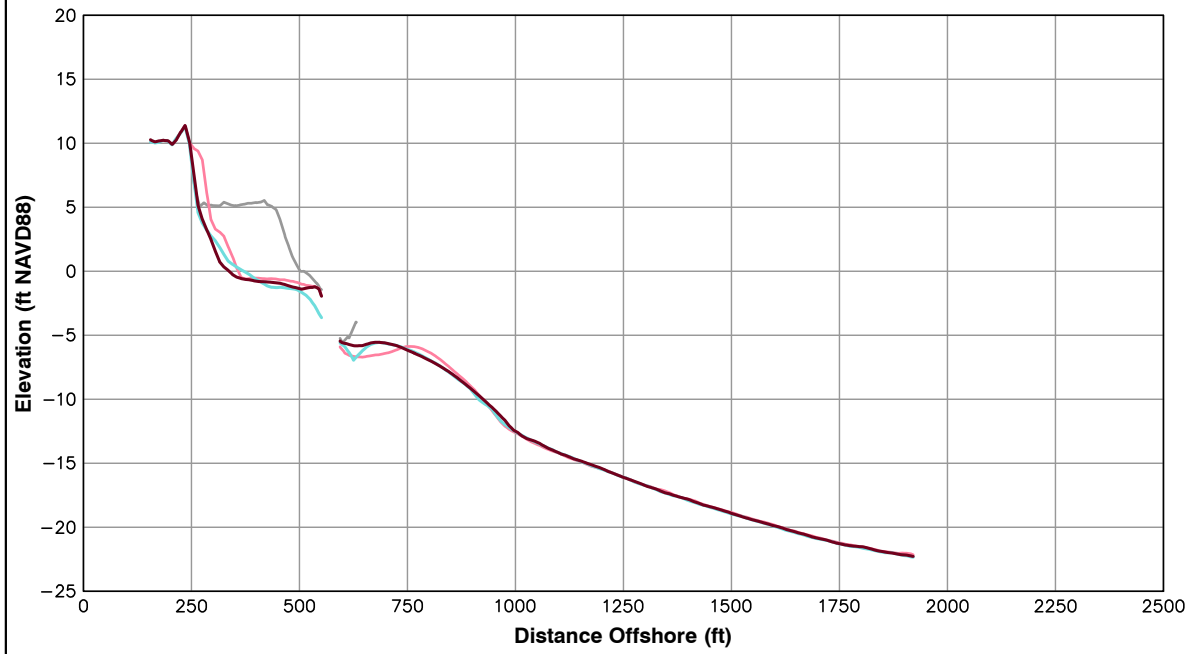
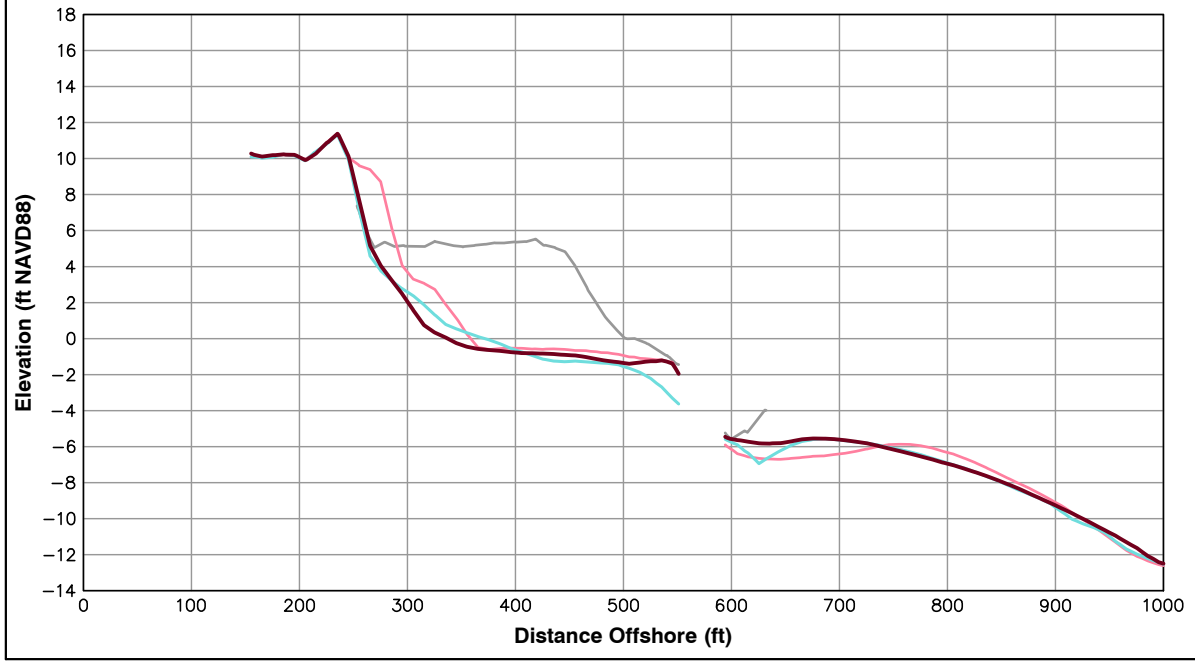
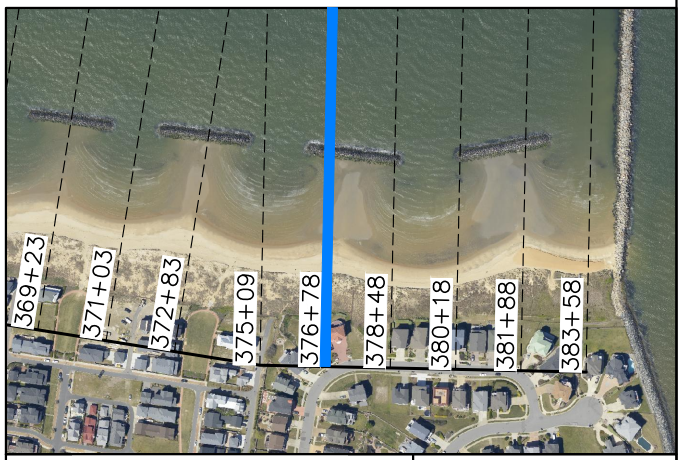




Survey Transect 376+78	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-32.71 ft/yr	-19.25 ft
Volume Change Above -15 ft NAVD88	-7.97 cy/ft/yr	2.91 cy/ft
Volume Change Above 0 ft NAVD88	-8.65 cy/ft/yr	-1.08 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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 April 2015 and October 2015.
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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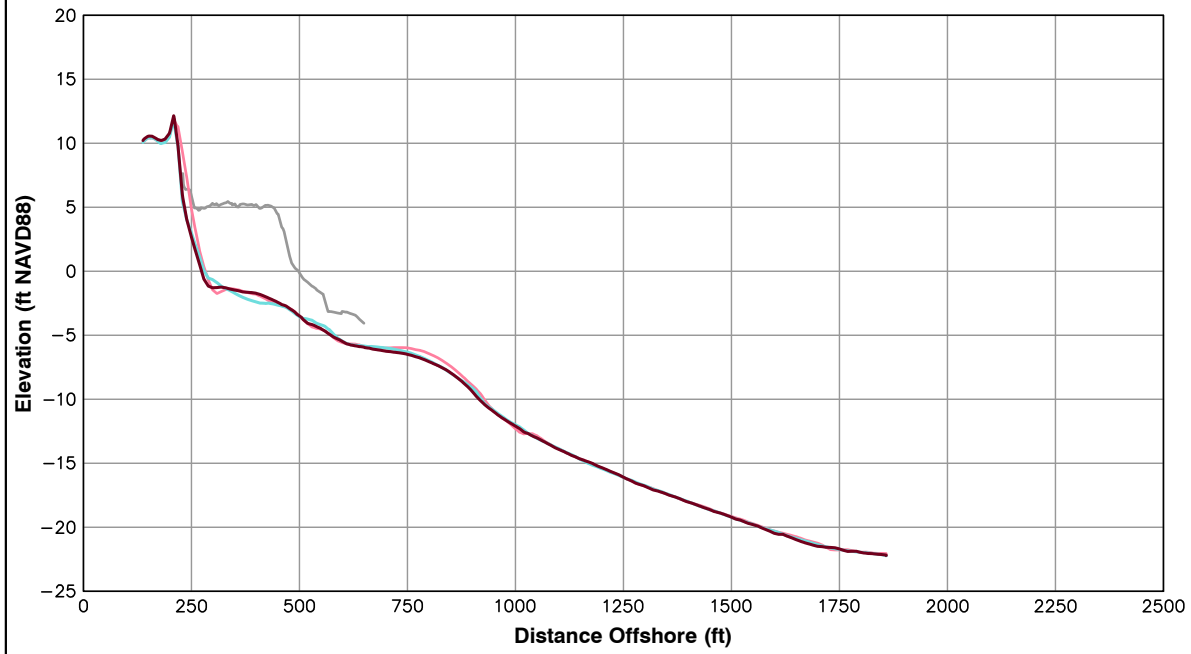
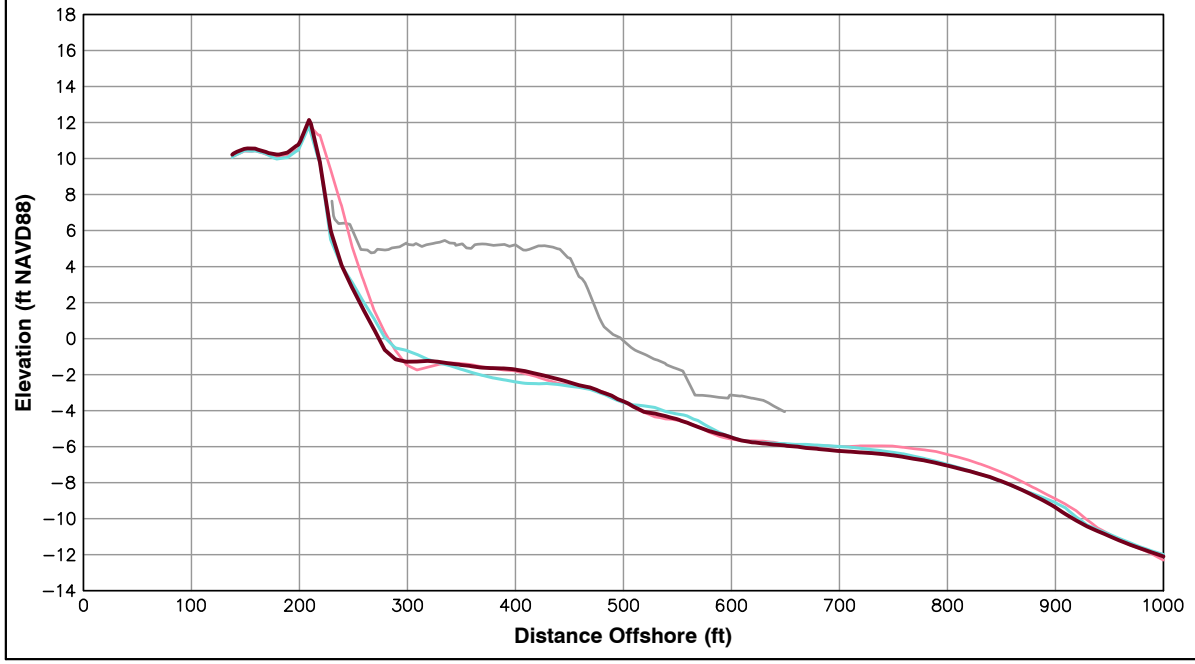
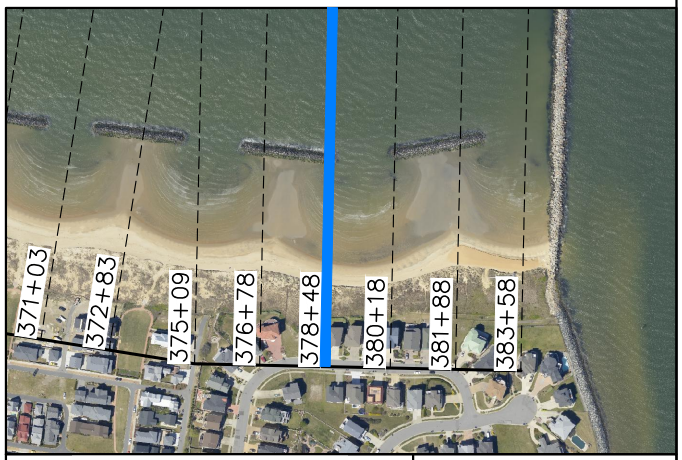




Survey Transect 378+48	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-8.59 ft/yr	-5.38 ft
Volume Change Above -15 ft NAVD88	-8.27 cy/ft/yr	-1.18 cy/ft
Volume Change Above 0 ft NAVD88	-4.30 cy/ft/yr	0.27 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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 April 2015 and October 2015.
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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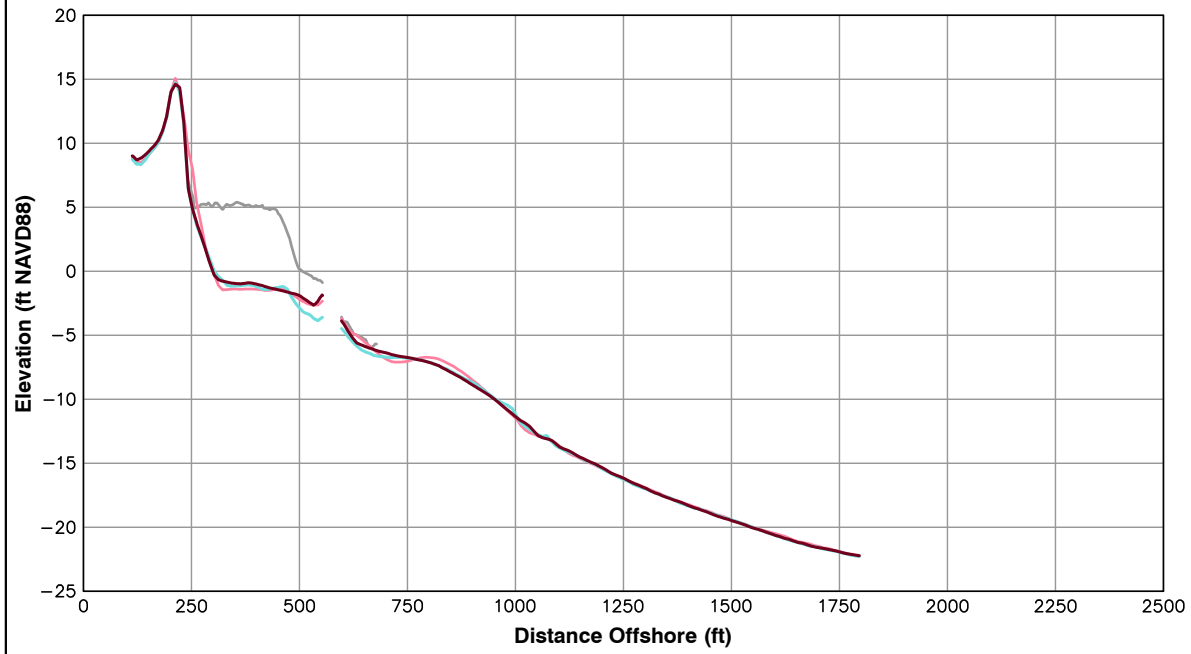
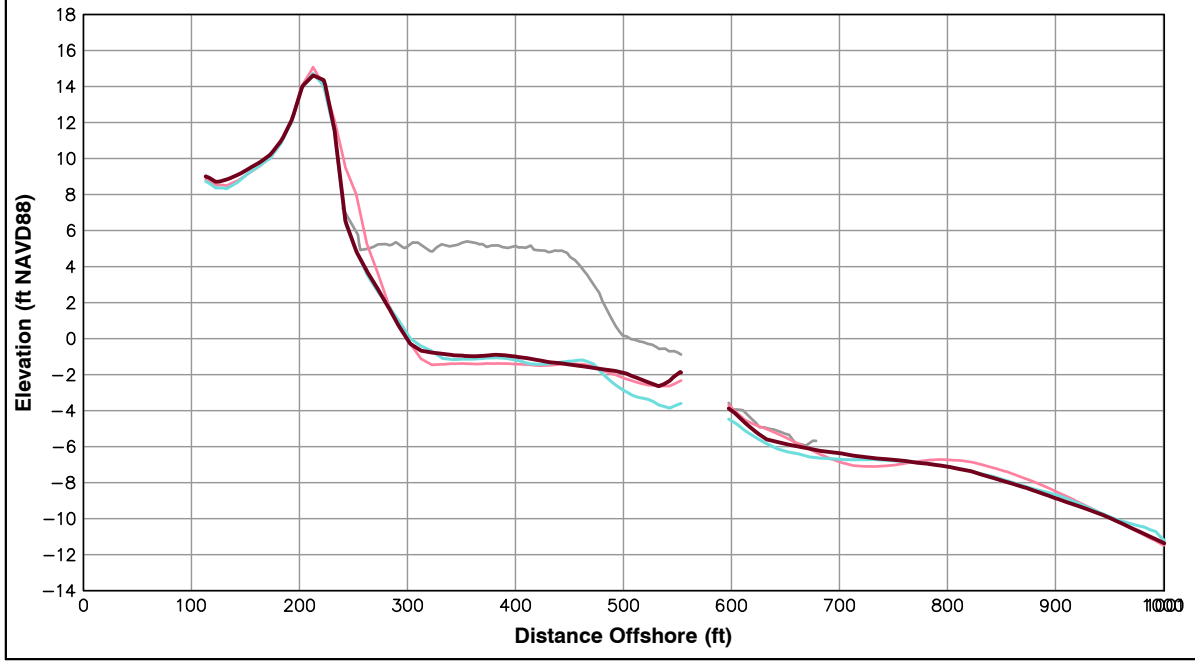
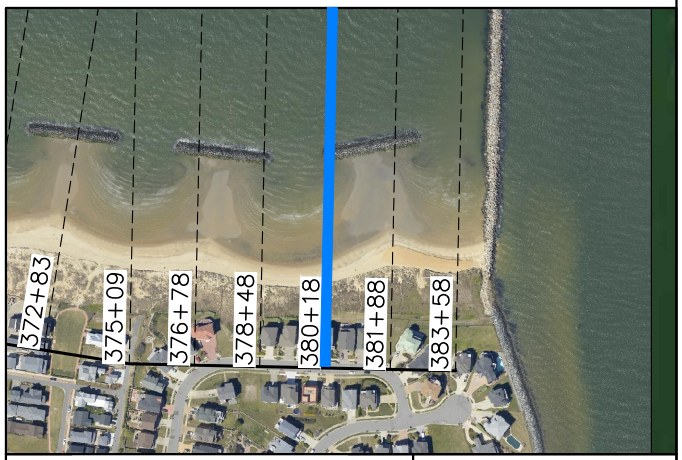




Survey Transect 380+18	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-0.57 ft/yr	-2.69 ft
Volume Change Above -15 ft NAVD88	-1.26 cy/ft/yr	6.83 cy/ft
Volume Change Above 0 ft NAVD88	-2.77 cy/ft/yr	0.93 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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 April 2015 and October 2015.
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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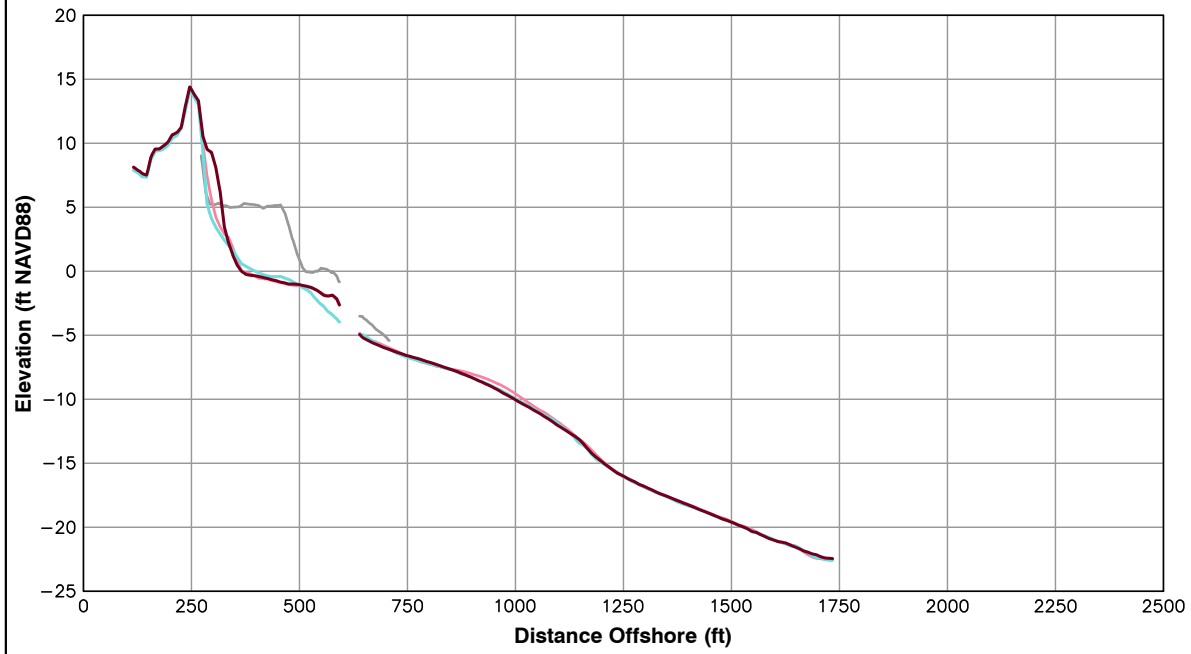
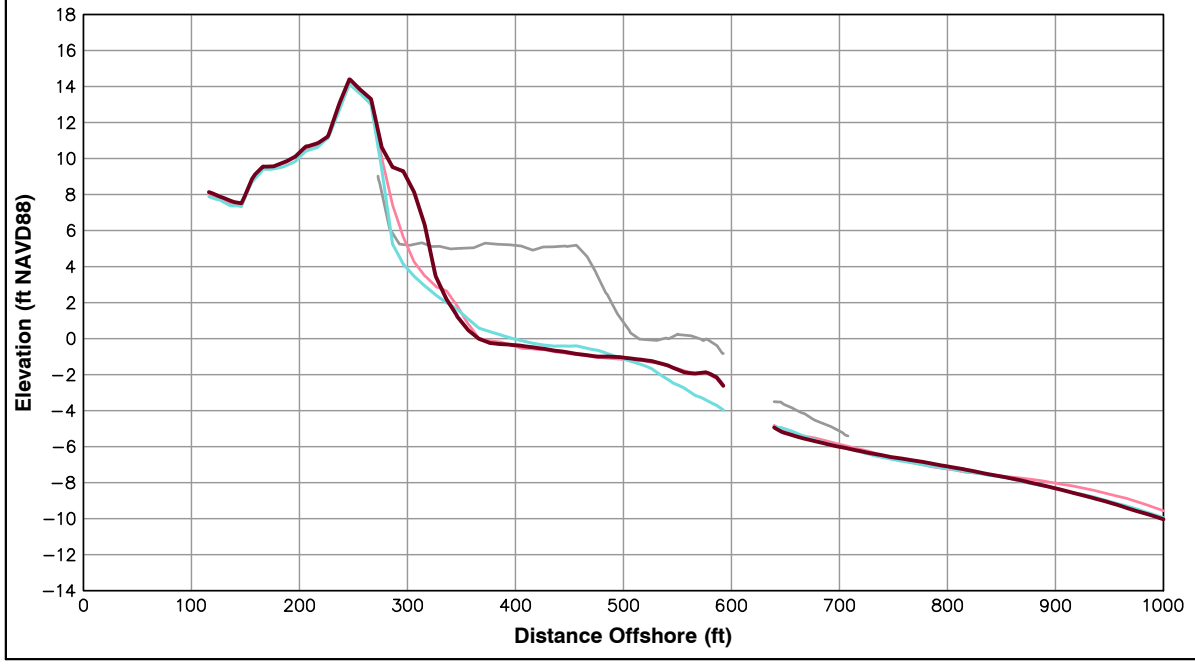
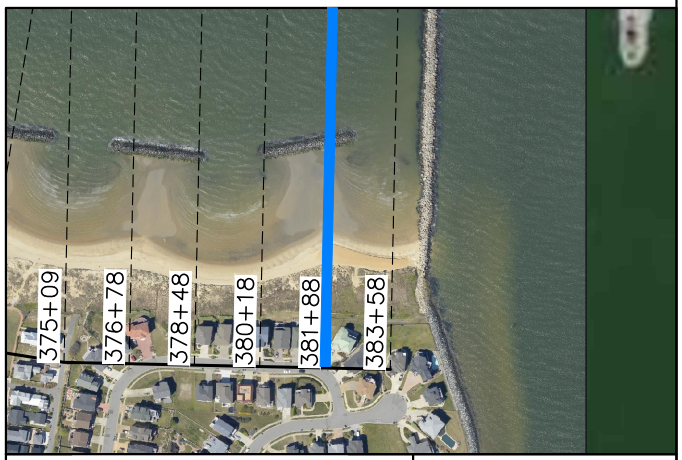




Survey Transect 381+88	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	-4.74 ft/yr	-8.97 ft
Volume Change Above -15 ft NAVD88	1.42 cy/ft/yr	9.33 cy/ft
Volume Change Above 0 ft NAVD88	4.85 cy/ft/yr	7.84 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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 April 2015 and October 2015.
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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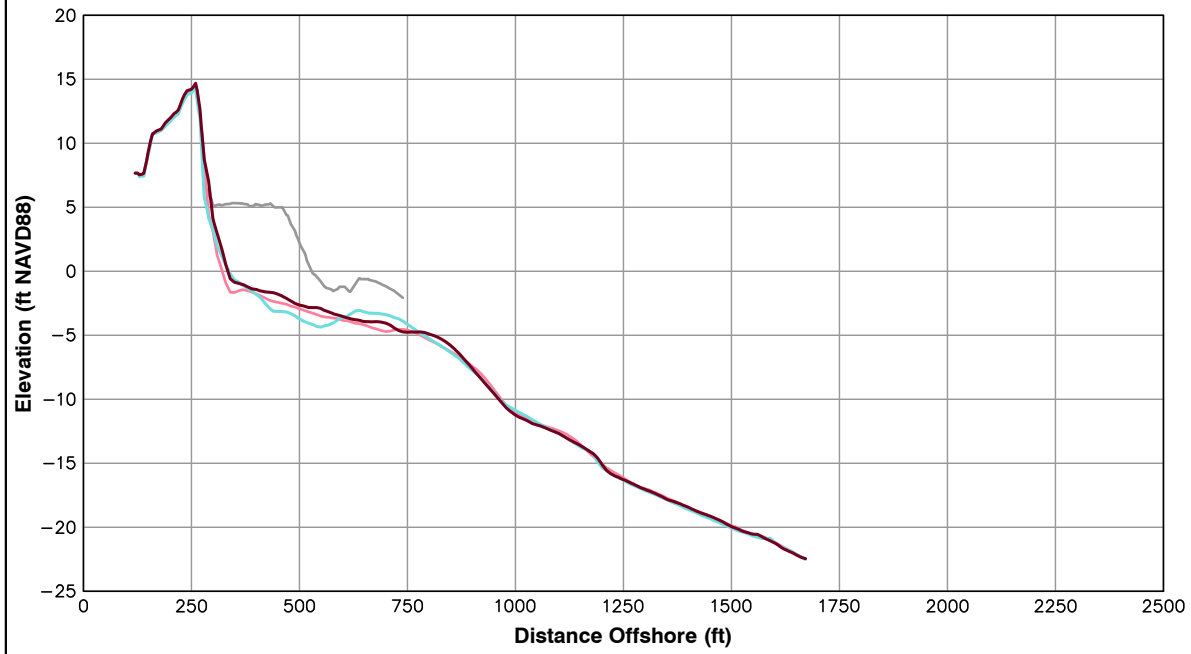

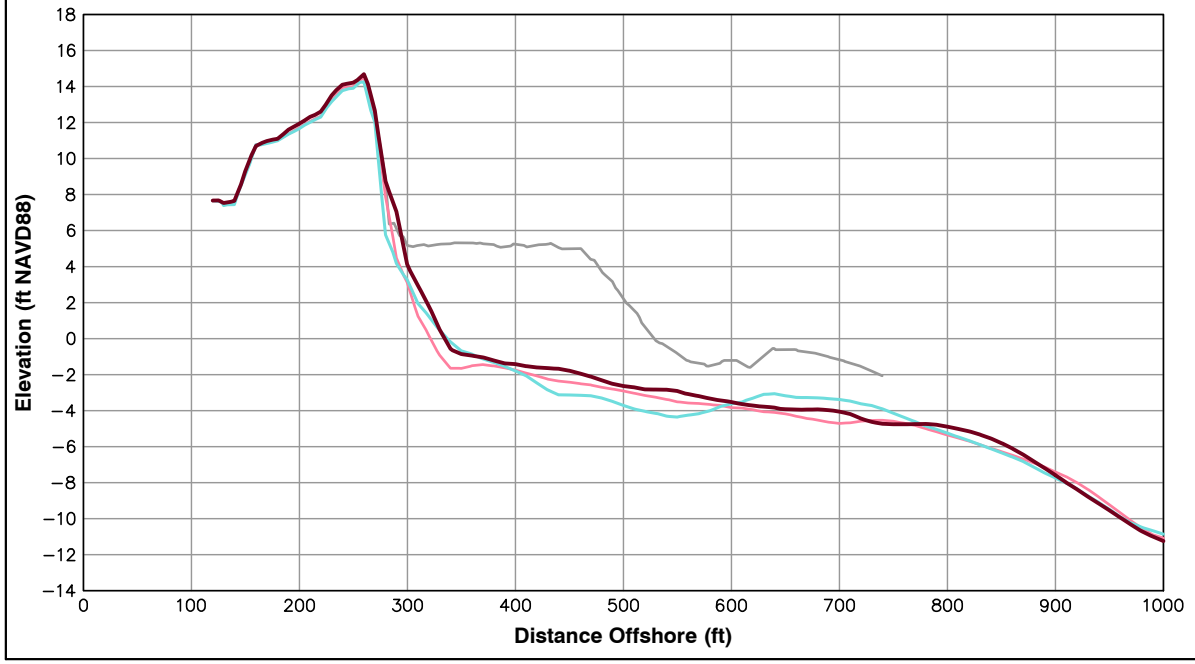

Survey Transect 383+58	May 2016 - April 2015	May 2016 - October 2015
Shoreline Change at MHW (0.98 ft NAVD88)	13.10 ft/yr	3.03 ft
Volume Change Above -15 ft NAVD88	9.72 cy/ft/yr	9.27 cy/ft
Volume Change Above 0 ft NAVD88	3.72 cy/ft/yr	4.48 cy/ft

LEGEND:
- 2016 MAY
- 2015 OCT
- 2015 APR
- POST-FILL

Notes:
1. Stationing 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 April 2015 and October 2015.
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 383+58	Pg ---- of 106	Spring 2016

Table C-1. Summary of Shoreline Change and Volume Change (April 2015 to May 2016)

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 April 21, 2015 to May 10, 2016.

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	4/21/2015	5/10/2016	1.98	-12.06	10.42
2+50	4/21/2015	5/10/2016	2.94	1.58	8.01
5+00	4/21/2015	5/10/2016	-2.23	0.44	13.93
7+50	4/21/2015	5/10/2016	2.89	0.33	23.40
10+00	4/21/2015	5/10/2016	-4.63	-3.91	-13.56
12+50	4/21/2015	5/10/2016	-1.33	-1.43	-12.20
15+00	4/21/2015	5/10/2016	-5.74	-6.44	-9.32
17+50	4/21/2015	5/10/2016	12.32	1.89	9.63
20+00	4/21/2015	5/10/2016	38.45	6.16	11.40
22+50	4/21/2015	5/10/2016	31.95	7.36	8.54
25+00	4/21/2015	5/10/2016	-49.71	-0.96	-8.90
27+50	4/21/2015	5/10/2016	-5.08	1.93	3.45
30+00	4/21/2015	5/10/2016	8.06	2.73	2.72
32+50	4/21/2015	5/10/2016	-1.37	2.11	6.74
35+00	4/21/2015	5/10/2016	-9.46	0.01	0.08
37+50	4/21/2015	5/10/2016	-22.28	6.07	2.00
40+00	4/21/2015	5/10/2016	-12.79	-0.12	-3.38
42+50	4/21/2015	5/10/2016	-10.31	1.60	-9.22
45+00	4/21/2015	5/10/2016	-7.58	1.93	1.19
45+25	4/21/2015	5/10/2016	2.66	2.65	-3.17
47+30	4/21/2015	5/10/2016	1.82	-0.31	-7.48
49+35	4/21/2015	5/10/2016	-6.16	-0.34	-5.55
51+41	4/21/2015	5/10/2016	4.51	-2.71	-4.87
53+46	4/21/2015	5/10/2016	-12.82	-5.55	-3.76
55+51	4/21/2015	5/10/2016	1.00	-2.36	-4.52
57+57	4/21/2015	5/10/2016	-12.74	-4.26	-4.49
59+62	4/21/2015	5/10/2016	4.22	0.45	-2.40
61+62	4/21/2015	5/10/2016	-15.00	-2.46	-4.69
63+62	4/21/2015	5/10/2016	7.53	0.53	5.99
65+62	4/21/2015	5/10/2016	-32.29	-5.79	-5.39
67+62	4/21/2015	5/10/2016	-9.79	-1.91	-2.00
69+62	4/21/2015	5/10/2016	-18.03	-2.41	-5.09
71+62	4/21/2015	5/10/2016	7.70	2.79	6.58
73+62	4/21/2015	5/10/2016	-23.13	-2.77	-0.50
75+62	4/21/2015	5/10/2016	4.46	-0.48	2.56
77+62	4/21/2015	5/10/2016	-34.14	-7.24	-7.26
79+62	4/21/2015	5/10/2016	-11.38	-4.40	-4.80
81+62	4/21/2015	5/10/2016	-8.93	-5.69	-6.57
83+62	4/21/2015	5/10/2016	-9.39	-6.05	-8.56
85+62	4/21/2015	5/10/2016	2.82	0.57	-5.41
87+62	4/21/2015	5/10/2016	-8.56	-2.68	-9.04

Table C-1. Summary of Shoreline Change and Volume Change (April 2015 to May 2016) Cont.

Central Ocean View Nourishment (March 2005 to May 2016) Cont.

1. Positive changes indicate accretion or gain in volume along the profile and negative changes

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 April 21, 2015 to May 10, 2016.

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	4/21/2015	5/10/2016	6.05	0.41	-3.99
103+08	4/21/2015	5/10/2016	-4.11	1.25	-0.40
120+93	4/21/2015	5/10/2016	-15.48	-3.30	-2.24
129+17	4/21/2015	5/10/2016	2.22	-0.60	-2.64
141+98	4/21/2015	5/10/2016	-19.29	-2.25	-7.42
152+01	4/21/2015	5/10/2016	5.14	1.25	-3.07
163+49	4/21/2015	5/10/2016	3.58	0.64	3.53
169+63	4/21/2015	5/10/2016	-15.70	0.55	-6.92
171+63	4/21/2015	5/10/2016	4.24	5.17	7.49
173+63	4/21/2015	5/10/2016	1.40	2.47	4.03
175+63	4/21/2015	5/10/2016	-18.60	-2.82	-5.37
177+63	4/21/2015	5/10/2016	-16.74	-4.13	-16.45
179+63	4/21/2015	5/10/2016	2.19	-1.17	-2.55
181+63	4/21/2015	5/10/2016	27.80	5.03	2.63
183+63	4/21/2015	5/10/2016	-16.55	-2.06	-5.73
185+63	4/21/2015	5/10/2016	11.62	2.84	0.23
187+63	4/21/2015	5/10/2016	-2.15	0.24	-2.74
189+63	4/21/2015	5/10/2016	-0.92	1.47	1.80
191+63	4/21/2015	5/10/2016	-11.92	1.67	0.32
193+63	4/21/2015	5/10/2016	-1.60	0.58	1.20
195+63	4/21/2015	5/10/2016	11.36	3.31	13.82
206+86	4/21/2015	5/10/2016	-8.95	0.66	0.75
218+66	4/21/2015	5/10/2016	-8.56	0.55	-2.88
229+85	4/21/2015	5/10/2016	-5.01	-0.49	6.21
242+03	4/21/2015	5/10/2016	4.51	1.56	7.72
252+62	4/21/2015	5/10/2016	-20.84	-0.05	-5.24
263+22	4/21/2015	5/10/2016	7.51	3.78	5.79
274+53	4/21/2015	5/10/2016	-10.13	1.25	0.70
281+40	4/21/2015	5/10/2016	0.53	1.47	5.26
288+39	4/21/2015	5/10/2016	4.54	-2.51	2.47
295+27	4/21/2015	5/10/2016	-12.91	-1.45	-6.09
302+24	4/21/2015	5/10/2016	-12.66	-1.30	-3.74
315+96	4/21/2015	5/10/2016	-3.85	-2.86	-7.64
323+09	4/21/2015	5/10/2016	-13.66	-2.60	-2.65
329+63	4/21/2015	5/10/2016	-22.88	-5.70	-6.86
331+43	4/21/2015	5/10/2016	2.04	-0.68	1.01
333+23	4/21/2015	5/10/2016	0.80	-1.16	0.78
335+03	4/21/2015	5/10/2016	3.55	1.59	3.60
336+83	4/21/2015	5/10/2016	-5.06	-1.61	2.26
338+63	4/21/2015	5/10/2016	-4.63	-0.29	-2.05
340+43	4/21/2015	5/10/2016	-9.95	-0.59	-8.62
342+23	4/21/2015	5/10/2016	-4.15	-2.56	-5.50

Table C-1. Summary of Shoreline Change and Volume Change (April 2015 to May 2016) 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 April 21, 2015 to May 10, 2016.

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	4/21/2015	5/10/2016	-5.23	-5.26	-4.23
345+85	4/21/2015	5/10/2016	-6.18	-0.64	-2.82
347+63	4/21/2015	5/10/2016	-19.36	-3.09	1.99
349+43	4/21/2015	5/10/2016	-6.55	-1.76	-8.94
351+23	4/21/2015	5/10/2016	-9.79	-2.62	2.64
353+03	4/21/2015	5/10/2016	0.33	-0.55	-7.31
354+83	4/21/2015	5/10/2016	-4.11	-1.39	4.12
356+63	4/21/2015	5/10/2016	-0.40	-0.75	-3.37
358+43	4/21/2015	5/10/2016	2.89	-1.68	3.27
360+23	4/21/2015	5/10/2016	9.11	0.89	-7.76
362+03	4/21/2015	5/10/2016	2.37	-2.08	1.09
363+83	4/21/2015	5/10/2016	15.84	0.21	-4.73
365+63	4/21/2015	5/10/2016	11.34	-0.77	2.84
367+43	4/21/2015	5/10/2016	22.37	2.90	-6.20
369+23	4/21/2015	5/10/2016	1.75	-0.47	3.25
371+03	4/21/2015	5/10/2016	19.61	1.57	-2.53
372+83	4/21/2015	5/10/2016	-9.90	-3.13	-4.99
375+08	4/21/2015	5/10/2016	17.89	1.70	-1.48
376+78	4/21/2015	5/10/2016	-32.71	-8.65	-7.97
378+48	4/21/2015	5/10/2016	-8.59	-4.30	-8.27
380+18	4/21/2015	5/10/2016	-0.57	-2.77	-1.26
381+88	4/21/2015	5/10/2016	-4.74	4.85	1.42
383+58	4/21/2015	5/10/2016	13.10	3.72	9.72

Table C-2. Summary of Shoreline Change and Volume Change (October 2015 to May 2016)

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 10, 2015 to May 10, 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)
0+00	10/10/2015	5/10/2016	-12.07	-17.06	-23.84
2+50	10/10/2015	5/10/2016	-8.52	1.56	-0.30
5+00	10/10/2015	5/10/2016	3.16	2.03	9.15
7+50	10/10/2015	5/10/2016	-8.84	4.61	17.39
10+00	10/10/2015	5/10/2016	6.00	-5.48	-3.86
12+50	10/10/2015	5/10/2016	-16.99	-6.33	-9.97
15+00	10/10/2015	5/10/2016	4.61	-5.06	-5.71
17+50	10/10/2015	5/10/2016	-4.80	-0.71	-2.72
20+00	10/10/2015	5/10/2016	42.55	7.93	11.20
22+50	10/10/2015	5/10/2016	-10.51	1.17	-6.52
25+00	10/10/2015	5/10/2016	-34.51	-2.83	-6.31
27+50	10/10/2015	5/10/2016	-9.32	0.39	1.23
30+00	10/10/2015	5/10/2016	-6.94	1.06	-0.42
32+50	10/10/2015	5/10/2016	-18.20	-0.51	-2.42
35+00	10/10/2015	5/10/2016	13.93	2.26	0.45
37+50	10/10/2015	5/10/2016	26.31	14.71	10.02
40+00	10/10/2015	5/10/2016	16.58	9.86	6.51
42+50	10/10/2015	5/10/2016	14.30	15.88	13.01
45+00	10/10/2015	5/10/2016	-25.19	2.07	-1.81
45+25	10/10/2015	5/10/2016	-11.90	3.92	-0.89
47+30	10/10/2015	5/10/2016	-12.09	1.72	-8.06
49+35	10/10/2015	5/10/2016	2.17	0.95	4.04
51+41	10/10/2015	5/10/2016	4.76	1.83	0.07
53+46	10/10/2015	5/10/2016	20.64	3.77	10.45
55+51	10/10/2015	5/10/2016	-9.41	-0.94	-2.55
57+57	10/10/2015	5/10/2016	22.46	3.53	3.01
59+62	10/10/2015	5/10/2016	-12.02	-1.70	-3.49
61+62	10/10/2015	5/10/2016	13.86	2.67	1.40
63+62	10/10/2015	5/10/2016	1.61	0.61	-1.55
65+62	10/10/2015	5/10/2016	14.95	3.86	5.91
67+62	10/10/2015	5/10/2016	-13.40	-1.97	2.38
69+62	10/10/2015	5/10/2016	28.46	4.80	6.23
71+62	10/10/2015	5/10/2016	3.67	1.11	8.36
73+62	10/10/2015	5/10/2016	-1.95	1.41	1.87
75+62	10/10/2015	5/10/2016	1.53	0.35	4.14
77+62	10/10/2015	5/10/2016	-14.04	-2.62	1.58
79+62	10/10/2015	5/10/2016	-2.51	-0.23	-1.78
81+62	10/10/2015	5/10/2016	5.59	0.89	-0.22
83+62	10/10/2015	5/10/2016	3.45	0.98	0.03
85+62	10/10/2015	5/10/2016	-6.74	0.66	-3.13
87+62	10/10/2015	5/10/2016	-0.04	0.02	-3.06

Table C-2. Summary of Shoreline Change and Volume Change (October 2015 to May 2016) Cont.

Central Ocean View Nourishment (March 2005 to May 2016) Cont.

1. Positive changes indicate accretion or gain in volume along the profile and negative changes

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 10, 2015 to May 10, 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	10/10/2015	5/10/2016	4.68	1.64	-2.21
103+08	10/10/2015	5/10/2016	6.84	2.92	6.21
120+93	10/10/2015	5/10/2016	12.72	1.33	2.24
129+17	10/10/2015	5/10/2016	8.18	1.14	-1.45
141+98	10/10/2015	5/10/2016	-8.75	-1.93	-4.01
152+01	10/10/2015	5/10/2016	-0.20	-0.46	-9.67
163+49	10/10/2015	5/10/2016	5.02	0.74	0.74
169+63	10/10/2015	5/10/2016	-6.76	-1.39	-10.09
171+63	10/10/2015	5/10/2016	9.05	3.34	9.56
173+63	10/10/2015	5/10/2016	14.12	2.95	2.84
175+63	10/10/2015	5/10/2016	-10.21	0.50	2.52
177+63	10/10/2015	5/10/2016	15.75	2.59	-7.90
179+63	10/10/2015	5/10/2016	30.80	5.60	6.18
181+63	10/10/2015	5/10/2016	16.81	3.50	1.63
183+63	10/10/2015	5/10/2016	3.80	0.67	-2.08
185+63	10/10/2015	5/10/2016	-1.50	0.79	-3.58
187+63	10/10/2015	5/10/2016	10.76	2.42	3.26
189+63	10/10/2015	5/10/2016	-10.23	-0.81	-1.39
191+63	10/10/2015	5/10/2016	25.18	4.87	10.54
193+63	10/10/2015	5/10/2016	-0.22	0.32	-2.77
195+63	10/10/2015	5/10/2016	6.76	3.03	8.56
206+86	10/10/2015	5/10/2016	-5.95	0.95	0.31
218+66	10/10/2015	5/10/2016	2.00	5.19	3.10
229+85	10/10/2015	5/10/2016	-20.09	0.91	1.03
242+03	10/10/2015	5/10/2016	-16.57	0.03	-0.47
252+62	10/10/2015	5/10/2016	-21.00	2.36	-1.66
263+22	10/10/2015	5/10/2016	22.24	6.23	3.41
274+53	10/10/2015	5/10/2016	-30.55	1.60	-1.61
281+40	10/10/2015	5/10/2016	-2.20	5.68	5.84
288+39	10/10/2015	5/10/2016	7.75	7.72	10.05
295+27	10/10/2015	5/10/2016	3.49	1.97	-5.44
302+24	10/10/2015	5/10/2016	42.95	6.64	-2.25
315+96	10/10/2015	5/10/2016	-12.40	3.21	0.74
323+09	10/10/2015	5/10/2016	-1.58	2.86	0.43
329+63	10/10/2015	5/10/2016	-17.45	2.85	3.15
331+43	10/10/2015	5/10/2016	4.84	4.02	6.77
333+23	10/10/2015	5/10/2016	1.80	5.46	6.21
335+03	10/10/2015	5/10/2016	-18.47	3.57	0.28
336+83	10/10/2015	5/10/2016	10.59	1.64	3.52
338+63	10/10/2015	5/10/2016	28.71	2.90	1.20
340+43	10/10/2015	5/10/2016	-33.03	4.53	-4.47

Table C-2. Summary of Shoreline Change and Volume Change (October 2015 to May 2016) 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 10, 2015 to May 10, 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)
342+23	10/10/2015	5/10/2016	-22.92	1.19	1.62
344+05	10/10/2015	5/10/2016	-56.38	-6.20	-6.97
345+85	10/10/2015	5/10/2016	-36.63	-2.47	-7.82
347+63	10/10/2015	5/10/2016	-21.73	1.01	8.11
349+43	10/10/2015	5/10/2016	-19.27	-1.30	-7.67
351+23	10/10/2015	5/10/2016	-14.72	3.23	8.81
353+03	10/10/2015	5/10/2016	-16.71	0.31	-8.88
354+83	10/10/2015	5/10/2016	-10.49	3.53	8.09
356+63	10/10/2015	5/10/2016	-16.43	0.39	-9.64
358+43	10/10/2015	5/10/2016	-7.82	4.11	3.86
360+23	10/10/2015	5/10/2016	-7.43	2.41	-7.06
362+03	10/10/2015	5/10/2016	-9.74	4.55	5.82
363+83	10/10/2015	5/10/2016	0.96	3.93	-5.91
365+63	10/10/2015	5/10/2016	-4.77	3.12	4.05
367+43	10/10/2015	5/10/2016	5.03	1.79	-10.23
369+23	10/10/2015	5/10/2016	1.28	1.31	11.44
371+03	10/10/2015	5/10/2016	7.84	2.99	-1.30
372+83	10/10/2015	5/10/2016	7.03	2.94	2.61
375+08	10/10/2015	5/10/2016	6.92	3.23	-6.29
376+78	10/10/2015	5/10/2016	-19.25	-1.08	2.91
378+48	10/10/2015	5/10/2016	-5.38	0.27	-1.18
380+18	10/10/2015	5/10/2016	-2.69	0.93	6.83
381+88	10/10/2015	5/10/2016	-8.97	7.84	9.33
383+58	10/10/2015	5/10/2016	3.03	4.48	9.27

Table C-3. Summary of Shoreline Change and Volume Change from East Ocean View Nourishment (March 2009 to May 2016)

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 March 20, 2009 to May 10, 2016.

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)
329+63	3/20/2009	5/10/2016	-15.51	-3.12	-
331+43	3/20/2009	5/10/2016	-15.04	-2.71	-
333+23	3/20/2009	5/10/2016	-11.75	-1.98	-
335+03	3/20/2009	5/10/2016	-10.08	-1.20	-
336+83	3/20/2009	5/10/2016	-10.52	-1.43	-
338+63	3/20/2009	5/10/2016	-10.52	-1.39	-
340+43	3/20/2009	5/10/2016	-11.82	-0.90	-
342+23	3/20/2009	5/10/2016	-12.44	-1.63	-
344+05	3/20/2009	5/10/2016	-13.95	-2.76	-
345+85	3/20/2009	5/10/2016	-11.81	-2.41	-
347+63	3/20/2009	5/10/2016	-11.09	-2.31	-
349+43	3/20/2009	5/10/2016	-12.14	-2.50	-
351+23	3/20/2009	5/10/2016	-9.68	-2.07	-
353+03	3/20/2009	5/10/2016	-11.15	-2.24	-
354+83	3/20/2009	5/10/2016	-9.67	-2.00	-
356+63	3/20/2009	5/10/2016	-12.07	-2.70	-
358+43	3/20/2009	5/10/2016	-11.16	-2.39	-
360+23	3/20/2009	5/10/2016	-13.26	-2.82	-
362+03	3/20/2009	5/10/2016	-11.54	-2.47	-
363+83	3/20/2009	5/10/2016	-8.69	-2.15	-
365+63	3/20/2009	5/10/2016	-8.82	-2.05	-
367+43	3/20/2009	5/10/2016	-14.14	-2.76	-
369+23	3/20/2009	5/10/2016	-13.90	-2.36	-
371+03	3/20/2009	5/10/2016	-18.25	-3.38	-
372+83	3/20/2009	5/10/2016	-20.34	-3.96	-
375+08	3/20/2009	5/10/2016	-23.97	-4.77	-
376+78	3/20/2009	5/10/2016	-24.32	-4.73	-
378+48	3/20/2009	5/10/2016	-29.97	-5.86	-
380+18	3/20/2009	5/10/2016	-28.10	-5.36	-
381+88	3/20/2009	5/10/2016	-20.95	-3.24	-
383+58	3/20/2009	5/10/2016	-26.59	-4.82	-

Table C-4. Summary of Shoreline Change and Volume Change from Central Ocean View Nourishment (March 2005 to May 2016)

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 March 15, 2005 to May 10, 2016.

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)
15+00	3/15/2005	5/10/2016	4.80	1.15	-
17+50	3/15/2005	5/10/2016	5.33	1.39	-
20+00	3/15/2005	5/10/2016	4.42	0.54	-
22+50	3/15/2005	5/10/2016	-0.31	-0.80	-
25+00	3/15/2005	5/10/2016	3.20	-0.45	-
27+50	3/15/2005	5/10/2016	2.40	-0.63	-
30+00	3/15/2005	5/10/2016	2.02	-0.15	-
32+50	3/15/2005	5/10/2016	-2.37	-0.97	-
35+00	3/15/2005	5/10/2016	1.81	0.08	-
37+50	3/15/2005	5/10/2016	-0.29	-0.12	-
40+00	3/15/2005	5/10/2016	-4.66	-1.02	-
42+50	3/15/2005	5/10/2016	-5.28	-1.55	-
45+00	3/15/2005	5/10/2016	-8.75	-2.25	-
45+25	3/15/2005	5/10/2016	-9.61	-2.63	-
47+30	3/15/2005	5/10/2016	-10.41	-2.98	-
49+35	3/15/2005	5/10/2016	-7.42	-2.17	-
51+41	3/15/2005	5/10/2016	-5.85	-1.75	-
53+46	3/15/2005	5/10/2016	-3.73	-1.44	-
55+51	3/15/2005	5/10/2016	-7.13	-2.31	-
57+57	3/15/2005	5/10/2016	-1.63	-1.08	-
59+62	3/15/2005	5/10/2016	-5.60	-1.55	-
61+62	3/15/2005	5/10/2016	0.05	-0.01	-
63+62	3/15/2005	5/10/2016	-4.68	-0.69	-
65+62	3/15/2005	5/10/2016	-2.82	-0.03	-
67+62	3/15/2005	5/10/2016	-11.92	-1.50	-
69+62	3/15/2005	5/10/2016	-4.61	-0.50	-
71+62	3/15/2005	5/10/2016	-9.18	-1.04	-
73+62	3/15/2005	5/10/2016	-4.23	-0.01	-
75+62	3/15/2005	5/10/2016	-5.86	-0.45	-
77+62	3/15/2005	5/10/2016	-4.91	-0.10	-
79+62	3/15/2005	5/10/2016	-3.68	-0.90	-
81+62	3/15/2005	5/10/2016	-4.26	-1.48	-
83+62	3/15/2005	5/10/2016	-7.14	-2.27	-
85+62	3/15/2005	5/10/2016	-3.08	-1.18	-
87+62	3/15/2005	5/10/2016	-3.20	-0.75	-
93+41	3/15/2005	5/10/2016	-1.19	-0.78	-
103+08	3/15/2005	5/10/2016	-2.92	-0.89	-
120+93	3/15/2005	5/10/2016	-3.53	-1.82	-
129+17	3/15/2005	5/10/2016	-4.37	-2.47	-
141+98	3/15/2005	5/10/2016	-3.34	-1.20	-
152+01	3/15/2005	5/10/2016	-4.85	-1.79	-

Table C-4. Summary of Shoreline Change and Volume Change from Central Ocean View Nourishment (March 2005 to May 2016) 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 March 15, 2005 to May 10, 2016.

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)
163+49	3/15/2005	5/10/2016	-2.06	-0.96	-
169+63	3/15/2005	5/10/2016	-1.36	-0.50	-
171+63	3/15/2005	5/10/2016	-2.43	-0.66	-
173+63	3/15/2005	5/10/2016	-1.39	-0.79	-
175+63	3/15/2005	5/10/2016	-4.80	-0.93	-
177+63	3/15/2005	5/10/2016	-2.35	-0.44	-
179+63	3/15/2005	5/10/2016	-2.02	-0.82	-
181+63	3/15/2005	5/10/2016	-0.56	-0.66	-
183+63	3/15/2005	5/10/2016	0.72	0.24	-
185+63	3/15/2005	5/10/2016	0.17	0.01	-
187+63	3/15/2005	5/10/2016	3.37	1.17	-
189+63	3/15/2005	5/10/2016	0.25	0.94	-
191+63	3/15/2005	5/10/2016	4.41	1.92	-
193+63	3/15/2005	5/10/2016	-0.33	0.67	-
195+63	3/15/2005	5/10/2016	-0.53	0.51	-