

**FINAL REPORT**

Produced for the Town of Nags Head, NC  
October 2022



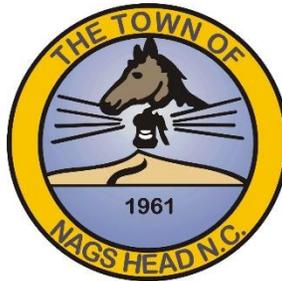
# SUMMER 2022 ANNUAL BEACH MONITORING SURVEY EVALUATION TOWN OF NAGS HEAD, NORTH CAROLINA



# TOWN OF NAGS HEAD

## 2022 SUMMER ANNUAL MONITORING SURVEY EVALUATION

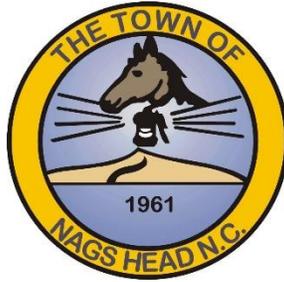
Prepared for:



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<b>Issue Purpose</b>	<b>Final Report</b>				
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<b>Checked</b>	<b>BJ/AN</b>				
<b>Approved</b>					

Prepared by:





**TOWN OF NAGS HEAD**

**2022 SUMMER ANNUAL MONITORING  
SURVEY EVALUATION**

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## EXECUTIVE SUMMARY

The Town of Nags Head Beach Monitoring and Maintenance Plan is sponsored by the Town of Nags Head (Town) as a continuation of the 2011 monitoring program initiated for assessing beach conditions. The primary purpose of the program is to assess current and historical shoreline conditions, determine shoreline and volumetric changes and evaluate the performance of beach nourishment and other restoration efforts. Evaluating and documenting these changes consistently over successive years provides information necessary to plan for future beach nourishments and to support development of the Town's multi-decadal Beach Nourishment Master Plan.

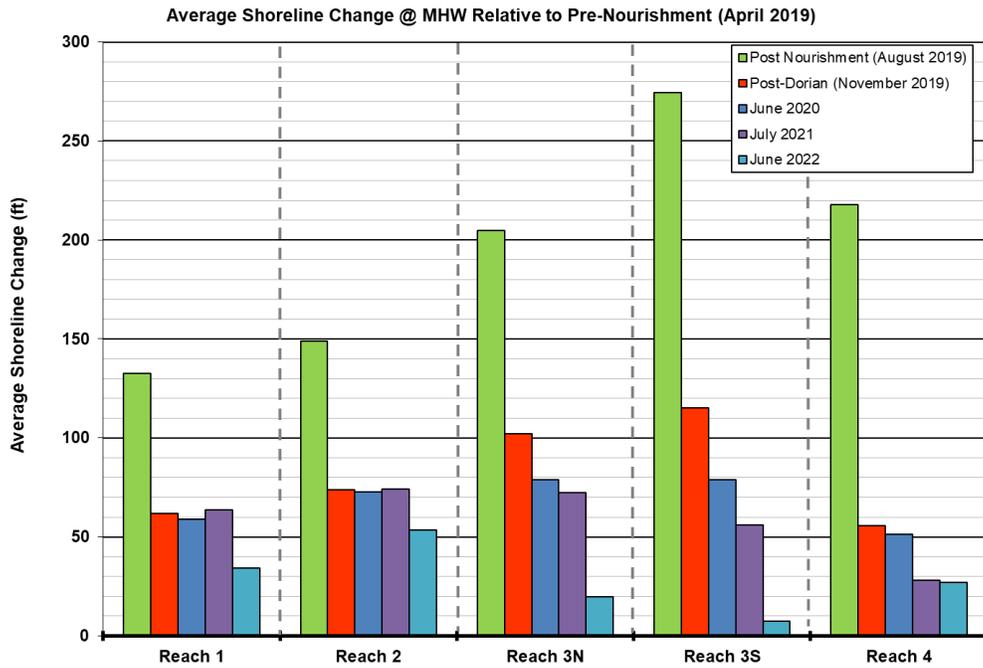
The most recent annual survey occurred during the summer of 2022 (June) and was performed by McKim & Creed. This report documents the data sources, methods, and results of a survey evaluation by Moffatt & Nichol comparing the June 2022 survey with a previous survey performed by McKim & Creed in July 2021.

The survey data was used to compute shoreline change at Mean High Water (MHW), which is designated as +1.18 ft NAVD88 for Nags Head, and volume change above +6 ft NAVD88 (berm), MHW, -6 ft NAVD88 (wading depth), -14 ft NAVD88 (outer bar), -19 ft NAVD88 (approximate depth of closure), and -30 ft NAVD88 (offshore). This allows a detailed review of the shoreline and active profile performance during the 2021-2022 monitoring period.

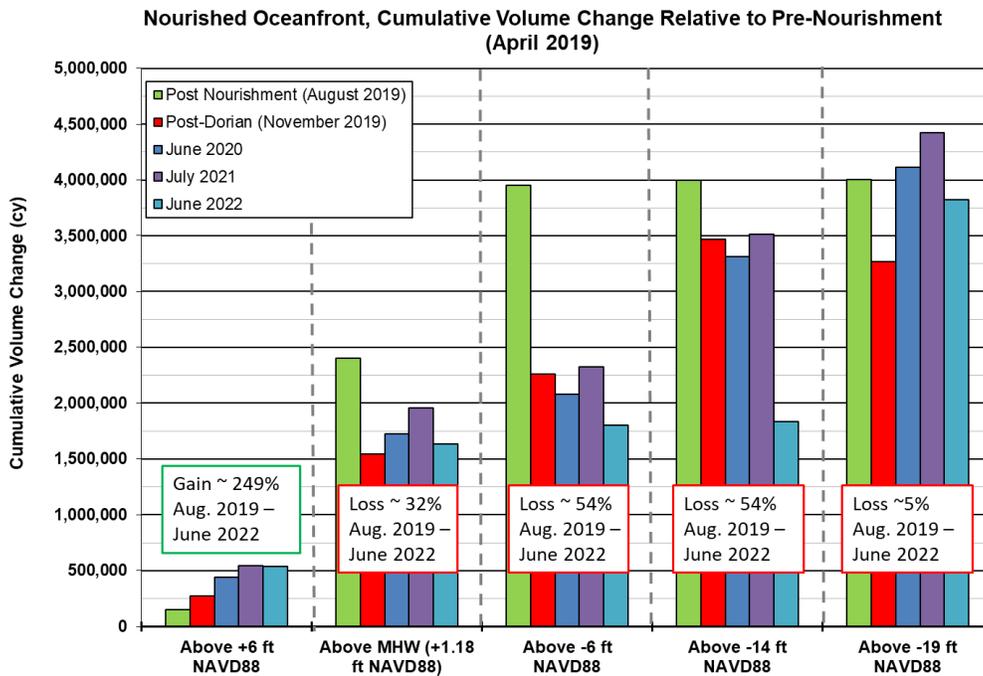
During the 2019 Beach Nourishment Project approximately 4.0 million cy of material was placed along approximately 10 miles of shoreline. The shoreline position and volume changes above six elevations relative to pre-nourishment conditions (April 2019) along the Nourished Oceanfront (Station 495+00 – 1025+00) are illustrated below.

**Figure ES-1** shows the shoreline changes relative to pre-nourishment condition (April 2019) along the Nourished Oceanfront. As can be seen from the figure, the shoreline experienced a significant landward recession along the Nourished Oceanfront since the completion of the 2019 nourishment project. The major part of the recession that has occurred since nourishment occurred before the post-Dorian survey which indicates that most of the recession can be attributed to Hurricane Dorian. However, during the 2021-2022 further significant recession occurred at all reaches except Reach 4.

**Figure ES-2** illustrates that the overall changes in sand volume vary with the depth above which volumes are assessed. The results confirmed that the total volume change above -19 ft NAVD88 since 2019 nourishment project was -182,016 cy (5 percent of the 2019 project volume). Since the completion of the 2019 nourishment project approximately 182,016 cy (-3.4 cy/ft) volume loss was observed above -19 ft NAVD88 along the Nourished Oceanfront. However, the results show large-scale shifts of sand cross-shore, across different elevations. Most notably, the figure shows that approximately 95% of the volume present in August 2019 above -19 ft NAVD88 remains in the system through the June 2022 survey.

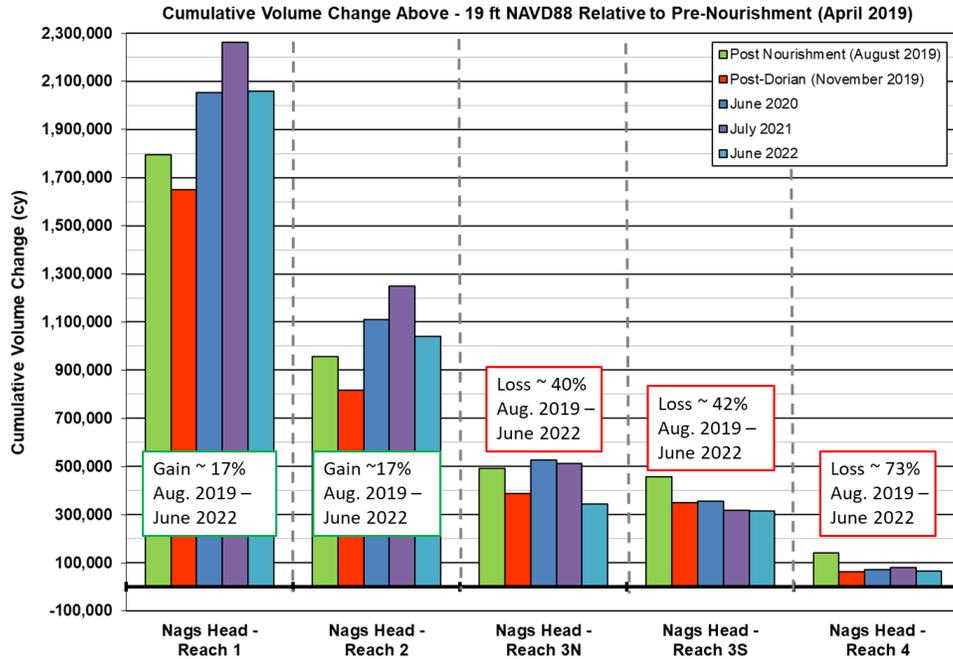


**Figure ES-1. Nourished Oceanfront Average Shoreline Change Relative to Pre-Nourishment Conditions**



**Figure ES-2. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment**

**Figure ES-3** presents the volume changes relative to pre-nourishment conditions (April 2019) above -19 ft NAVD88 along the Nourished Oceanfront. Reach 1 and Reach 2 show volume gain above -19 ft NAVD88 relative to the pre-nourishment conditions. However, at the remaining reaches of the nourished oceanfront, volume losses were observed extending below -19 ft NAVD88 indicating material loss well beyond the depth of closure that will likely not migrate back onshore.



**Figure ES-3. Cumulative Volume Change Above -19 ft NAVD88 Relative to Pre-Nourishment**

Volume changes during the monitoring period indicated that the Nourished Oceanfront and Total Monitored Oceanfront both experienced losses in material between July 2021 and June 2022 along all the analyzed elevations except -30 ft NAVD88. Key statistics for individual reaches along Nags Head along with the entire oceanfront shoreline were as follows:

**Table ES-1. Nags Head Shoreline and Average Unit Volume Change Statistics (2021 – 2022)**

<b>2021 vs. 2022 (Total Change)</b>	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - North	430+00 - 495+00	6,500	-29.5	-0.2	-5.6	-16.2	-6.0	-9.3	17.4
Nags Head - Reach 1	495+00 - 790+00	29,500	-20.9	1.8	-2.3	-6.6	-22.4	-6.9	18.5
Nags Head - Reach 2	790+00 - 920+00	13,000	-52.4	-1.2	-9.4	-14.9	-41.4	-16.2	7.6
Nags Head - Reach 3N	920+00 - 975+00	5,500	-48.6	-5.0	-16.8	-14.8	-58.8	-28.9	-17.0
Nags Head - Reach 3S	975+00 - 1010+00	3,500	-1.2	-4.8	-8.7	-9.0	-31.4	-0.8	4.8
Nags Head - Reach 4	1010+00 - 1025+00	1,500	7.0	-2.7	-4.2	-9.0	-16.1	-8.4	-8.3
National Seashore - North	1025+00 - 1200+00	17,500	18.0	-0.3	-0.3	-0.7	-14.2	-4.2	12.9
	Transects	Reach Length	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg
<b>Nourished Oceanfront</b>	<b>495+00 - 1025+00</b>	<b>53,000</b>	<b>-29.4</b>	<b>-0.2</b>	<b>-6.0</b>	<b>-9.7</b>	<b>-31.3</b>	<b>-11.1</b>	<b>10.5</b>
<b>Total Monitored Oceanfront</b>	<b>430+00 - 1200+00</b>	<b>77,000</b>	<b>-18.6</b>	<b>-0.2</b>	<b>-4.7</b>	<b>-8.2</b>	<b>-25.2</b>	<b>-9.4</b>	<b>11.6</b>

**Table ES-2. Nags Head Cumulative Volume Change Statistics (2021 – 2022)**

<b>2021 vs. 2022 (Total Change)</b>	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - North	430+00 - 495+00	6,500	-1,310	-33,641	-97,174	-35,918	-55,773	104,258
Nags Head - Reach 1	500+00 - 785+00	29,500	54,106	-68,497	-194,065	-661,266	-204,407	545,766
Nags Head - Reach 2	790+00 - 915+00	13,000	-15,103	-121,866	-193,265	-537,629	-210,098	98,910
Nags Head - Reach 3N	920+00 - 970+00	5,500	-28,673	-96,681	-85,271	-338,296	-166,218	-97,896
Nags Head - Reach 3S	975+00 - 1005+00	3,500	-16,714	-30,351	-31,671	-110,004	-2,709	16,663
Nags Head - Reach 4	1010+00 - 1025+00	1,500	-4,794	-7,309	-15,742	-28,157	-14,651	-14,582
National Seashore North	1030+00 - 1200+00	17,500	-4,477	-4,684	-11,673	-247,987	-73,314	225,532
	Transects	Reach Length	total	total	total	total	total	total
<b>Nourished Oceanfront</b>	<b>495+00 - 1025+00</b>	<b>53,000</b>	<b>-11,177</b>	<b>-324,704</b>	<b>-520,015</b>	<b>-1,675,352</b>	<b>-598,084</b>	<b>548,861</b>
<b>Total Monitored Oceanfront</b>	<b>430+00 - 1200+00</b>	<b>77,000</b>	<b>-16,965</b>	<b>-363,029</b>	<b>-628,861</b>	<b>-1,959,257</b>	<b>-727,171</b>	<b>878,650</b>

During the 2021-2022 monitoring period the most northern reaches significantly retreated whereas the southern reaches experienced minor recession or seaward advancement. Among the nourished reaches Reach 2 and Reach 3-North indicated high recession rates. The Reach 4 shoreline experienced minor seaward advancement whereas Reach 3-South

shoreline slightly retreated. The National Seashore-North reach to the south of the Nourished Oceanfront also experienced seaward shoreline advancement.

In all management reaches, most material loss was observed above -14 ft NAVD88. This material lost was mostly caused by the erosion and adjustment of the offshore bar. The smaller losses above -19 ft NAVD88 indicate the transport and capture of some of the eroded material above the depth of closure. Over the Nourished Oceanfront -598,084 cy or -11.1 cy/ft of material was lost above -19 ft NAVD88. The higher erosion rates can likely be attributed to an active 2021-2022 storm season bringing 13 events with significant wave heights greater than 8 ft. Four of those events had significant wave heights greater than 15 ft whereas historical records show at most 1 event of this magnitude during previous monitoring periods. This indicates the potential for multiple high erosion events.

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## **1.0 OBJECTIVE**

The Town of Nags Head Beach Monitoring and Maintenance Plan is sponsored by the Town of Nags Head (Town) as a continuation of the 2011 monitoring program initiated for assessing beach conditions. The primary purpose of the program is to assess current and historical shoreline conditions, determine shoreline and volumetric changes and evaluate the performance of beach nourishment and other restoration efforts. Evaluating and documenting these changes consistently over successive years provides information necessary to plan for future beach nourishments and to support development of the Town's multi-decadal Beach Nourishment Master Plan.

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## 2.0 SUMMARY OF PREVIOUS WORK

Moffatt & Nichol began preparing the Town’s annual beach and nearshore monitoring evaluations in 2020. At that time, Moffatt & Nichol reviewed previous beach monitoring studies performed by Coastal Science & Engineering Inc. (CSE) between 2010 and 2018 to gain an understanding of previous survey methods, associated coastal analysis, and observed trends. Shoreline and volume change data for each year was compared to an initial survey performed in 2010, taken before the 2011 beach nourishment project providing for some long-term analysis. **Figure 2-1** presents the extents of each of the monitoring shoreline reaches. It should be noted that the monitoring Reach 1 begins from Station 495+00 while the 2011 construction reach began from 497+00. **Table 2-1** shows the long-term volume changes from previous studies over the various reaches of shoreline.



**Figure 2-1: Prior Established Monitoring Reaches**

**Table 2-1. Long-term Volume Change (Previous Studies: 2010-2018)**

		Nov 2010- Nov 2011	Nov 2010- Jun 2012	Nov 2010- Nov 2012	Nov 2010- Jun 2013	Nov 2010- Jun 2014	Nov 2010- Jun 2015	Nov 2010- Jun 2016	Nov 2010- July 2017	Nov 2010- May 2018
		cy	cy							
<b>Dune to +6 ft NAVD88</b>	Reach 1 (495- 790)	135,789	213,713	124,589	344,963	456,407	466,904	505,144	551,781	526,825
	Reach 2 (790-920)	117,999	164,846	145,705	254,009	287,513	281,663	302,382	328,262	293,650
	Reach 3 (920-1010)	85,345	100,273	144,338	243,163	221,848	211,574	221,481	237,733	227,253
	Reach 4 (1010-1025)	10,824	17,767	13,678	26,771	35,216	18,915	5,486	9,292	2,746
	<b>Project Oceanfront</b>	<b>349,957</b>	<b>496,599</b>	<b>428,310</b>	<b>868,906</b>	<b>1,000,984</b>	<b>979,056</b>	<b>1,034,493</b>	<b>1,127,068</b>	<b>1,050,474</b>
<b>Dune to -6 ft NAVD88</b>	Reach 1 (495- 790)	1,138,026	1,032,425	1,014,648	1,219,411	1,085,981	1,079,356	1,086,961	1,194,858	985,588
	Reach 2 (790-920)	967,742	902,188	883,008	1,002,007	844,702	809,453	783,717	721,915	599,858
	Reach 3 (920-1010)	1,026,681	904,870	789,190	823,748	669,903	658,157	579,130	604,978	420,428
	Reach 4 (1010-1025)	110,880	118,284	93,392	90,268	77,033	31,752	29,024	22,168	-14,344
	<b>Project Oceanfront</b>	<b>3,243,329</b>	<b>2,957,767</b>	<b>2,780,238</b>	<b>3,135,434</b>	<b>2,677,619</b>	<b>2,578,718</b>	<b>2,478,832</b>	<b>2,543,919</b>	<b>1,991,530</b>
<b>Dune to -19 ft NAVD88</b>	Reach 1 (495- 790)	1,700,982	2,101,133	1,713,410	1,911,609	1,908,360	1,790,705	2,088,642	1,699,296	1,053,383
	Reach 2 (790-920)	1,297,082	1,373,586	1,141,685	1,292,398	1,346,691	1,268,412	1,305,026	888,118	573,200
	Reach 3 (920-1010)	1,281,379	1,296,493	1,003,944	1,137,586	1,025,817	799,182	760,191	408,100	157,253
	Reach 4 (1010-1025)	173,344	207,830	176,447	137,614	114,850	61,492	16,051	-59,743	-114,154
	<b>Project Oceanfront</b>	<b>4,452,787</b>	<b>4,979,042</b>	<b>4,035,486</b>	<b>4,479,207</b>	<b>4,395,718</b>	<b>3,919,791</b>	<b>4,169,910</b>	<b>2,935,771</b>	<b>1,669,682</b>

### 3.0 SURVEY PROCEDURES AND DATA PROCESSING

#### 3.1 Survey Transects and Reaches

The present monitoring survey and evaluation continue to use the existing transect lines and origins established by CSE in monitoring periods prior to 2020. Additional monitoring transects were added in 2020 as recommended by Moffatt & Nichol to better understand sand movement and trends at hotspots and along the National Seashore shoreline south of the Town limits. McKim & Creed conducted the summer 2022 survey in June 2022, including both the additional transects and the previously established transect lines. **Figure 3-1** shows the location of the original and additional survey lines and origins applied by McKim & Creed and Moffatt & Nichol. As shown, survey transect lines were stationed from north to south along Nags Head. A summary of streets/landmarks present at the start and end of each reach are provided in **Table 3-1**.

**Table 3-1. Reach Start and End Points**

Reach	Stations	Length (ft)	Start Point	End Point
Nags Head - North	430+00-495+00	6,750	E 8 <sup>th</sup> Street	Bonnett Street
Reach 1	495+00-790+00	29,000	Bonnett Street	Governor Street
Reach 2	790+00-920+00	13,000	Governor Street	James Street
Reach 3 - North	920+00-975+00	5,500	James Street	Limulus Drive
Reach 3 - South	975+00-1010+00	3,500	Limulus Drive	Loon Court
Reach 4	1010+00-1025+00	2,000	Loon Court	McCall Court
National Seashore - North	1025+00-1200+00	17,250	McCall Court	North of Oregon Inlet Campground
National Seashore - South	1200+00-1290+00	9,000	North of Oregon Inlet Campground	Oregon Inlet

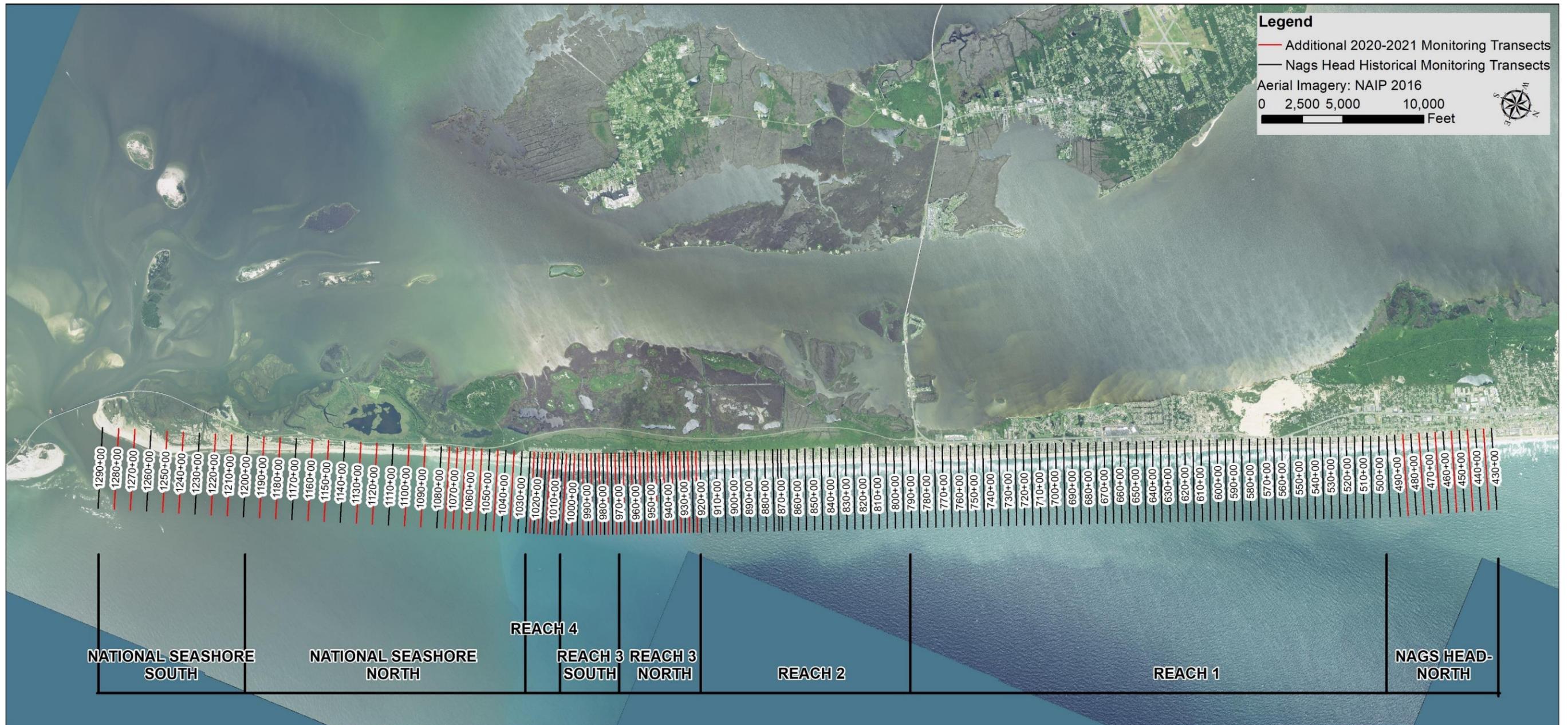


Figure 3-1. Nags Head Profile Line Locations

### **3.2 Survey Data Acquisition**

To enable a reproducible and consistent result for the monitoring analysis, the survey events for each shoreline segment are assigned a single date for their completion. Assigning the survey date allows the determination of a consistent timeframe for each monitoring period between survey events for use in calculating shoreline and volumetric change rates.

#### 2022 Survey Event

The most recent set of annual survey data was collected by McKim & Creed on June 20-29. The date used for the 2022 Nags Head profiles for this report is June 29, 2022, when the majority of the surveying was completed.

#### 2021 Survey Event

The previous set of annual survey data was by McKim & Creed on July 11-20 and on August 5. The date used for the 2021 Nags Head profiles for this report is July 20, 2021, when the majority of the surveying was completed.

#### 2019 Pre – Nourishment Survey Event

Before the 2019 Beach Nourishment Project, CSE conducted a pre-nourishment survey in April 2019. The date used for the 2019 Nags Head profiles for this report is April 8.

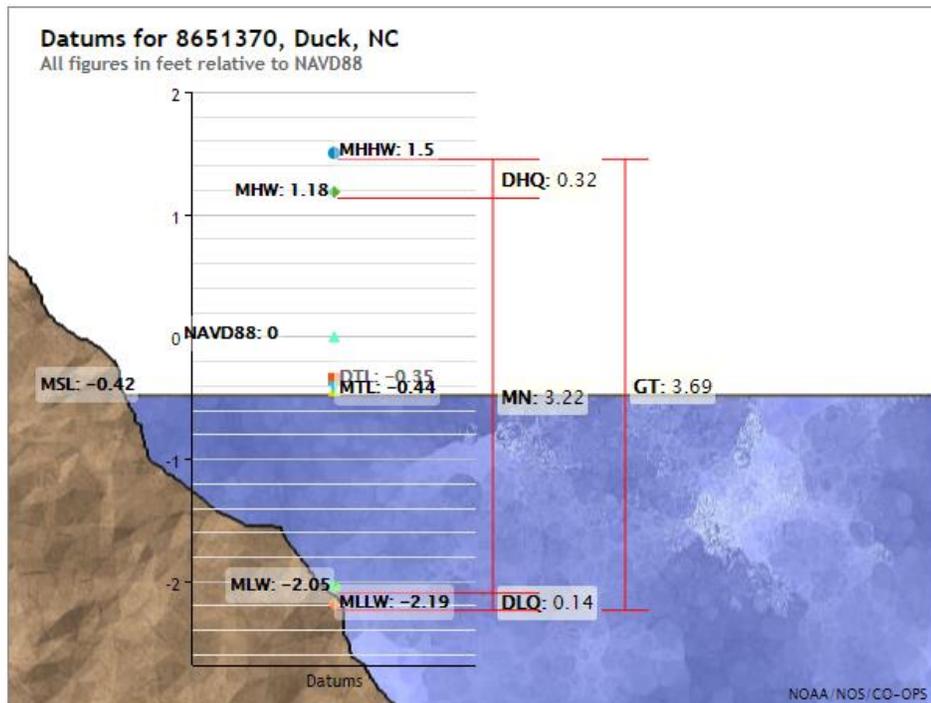
McKim & Creed provided the processed survey data to Moffatt & Nichol in ASCII (xyz), Excel (xyz), BMAP (free format), and GIS (shapefile, grid) formats allowing for compatibility with multiple programs. The data referenced the horizontal North American Datum 1983 (NAD83) State Plane North Carolina (U.S. survey feet) and elevations were provided in feet relative to the North American Vertical Datum of 1988 (NAVD88). A copy of the survey data files is included on the attached CD also containing an electronic copy of the report.

**Appendix A** contains the McKim & Creed 2022 Field Report which discusses, in detail, the singlebeam (bathymetric) and topographic data acquisition. The field report also provides the associated equipment and quality control procedures (QA/QC) utilized in the data collection and processing tasks.

## 4.0 SURVEY EVALUATION METHODS

### 4.1 Shoreline Change

Shoreline change designated at the MHW contour, defined as +1.18 ft NAVD88, was calculated at each transect between the July 2021 and June 2022 surveys. The MHW elevation is based on a National Oceanic and Atmospheric Administration (NOAA) tidal benchmark at Duck, NC shown in **Figure 4-1**. The resulting values represent the shoreline change (ft) over the time between surveys.



**Figure 4-1. Tidal Datum for Duck, NC Station 8651370**

### 4.2 Volume Change

Representative volume changes were calculated at each transect between the 2021 and 2022 surveys. Volume changes were calculated for six different elevation extents to better understand the processes occurring onshore and offshore of Nags Head. Calculations included volume change above the following elevations:

- above +6 ft NAVD88 (berm),
- above +1.18 ft NAVD88 (MHW),
- above -6 ft NAVD88 (wading depth/recreational beach),
- above -14 ft NAVD88 (outer bar),
- above -19 ft NAVD88 (depth of closure), and
- above -30 ft NAVD88.

For those profiles which did not extend to -30 ft NAVD88, volume calculations were performed above -30 ft NAVD88 out to the extent of the shortest survey. **Figure 4-2** presents a graphical display of the various elevations for which volume change calculations were made.

As with the shoreline change, the results represent volume change (cy/ft) over the period of time between surveys. In addition, the volume changes were converted to cumulative changes over each of the management reaches and for the entire shoreline. This was done by applying the average end area method to the unit volume changes (cy/ft) computed at each transect and summing the total volume changes between each neighboring pair of transects. The resulting value indicated the total loss or gain of material between survey periods based on the applicable profile extents.

It should be noted that the uncertainty in the hydrographic portion of the survey can result in a significant volumetric change in offshore areas where the slope of the seafloor declines gradually. If an uncertainty of  $\pm 0.11$  ft is applied along the portion of the profile between the seaward side of the depth of closure (approximately 2,050 ft offshore) and a depth of -30 ft NAVD88 (approximately 2,950 ft offshore) along all 77,000 ft of oceanfront shoreline, this lends itself to an uncertainty of approximately  $\pm 282,300$  cy. For this reason, more attention is given to the volume change calculations at -19 ft NAVD88 and above.

The profile volume calculation lenses (see **Figure 4-2**) were strategically chosen to help understand and track the movement of sand onshore and offshore. Volume changes calculated for portions of the profiles above +6 ft NAVD88 and above MHW are representative of changes in the amount of material in the dune system and on the subaerial beach. These areas of the profile are highly influenced by storm activity, and they are both very significant in the ability of the beach and dune to mitigate storm surge and wave impacts on landward structures and infrastructure. Volume comparisons for portions of the profiles above -6 ft NAVD88, an approximate wading depth, represent changes in the recreational beach area. Volume comparisons above -14 ft NAVD88 help to track sand movement to and from the outer sand bar and are valuable in decision making for future beach nourishment projects. Volume comparisons above -19 ft NAVD88 provide general estimates of the total volumetric change along the respective profile out to the depth of closure. Finally, volume comparisons above -30 ft NAVD88 allow the complete tracking of sand movement offshore. However, hydrographic survey measurement accuracy may impact these calculations. This is a proven, comprehensive way to assess the impact of storm activity on the subaerial beach and dune system as well as track the movement of sand offshore and quantify total gains and losses in the entire system.

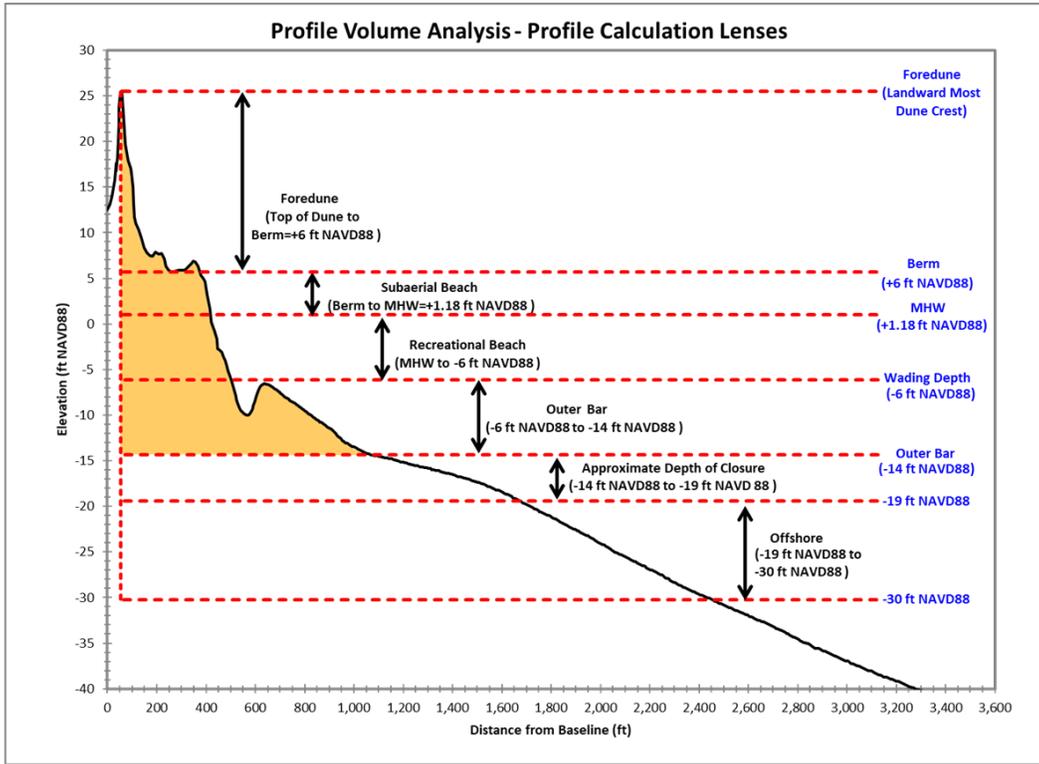


Figure 4-2. Profile Volume Calculation Lenses

## 5.0 DISCUSSION OF ANNUAL SURVEYING EVALUATION

This section discusses key events in the past year which influence the results of the annual analysis (i.e. nourishment projects, storms, etc.), development of background erosion rates, annual shoreline and volume change trends (2021 – 2022), and analysis of long-term trends (2011 – 2022).

### 5.1 Key Events During the Reporting Period

Beach changes are greatly influenced by natural and engineered processes. This section describes key events that occurred during the reporting period that likely had an impact on shoreline change as well as profile volume gains and losses.

#### 5.1.1 Sand Placement Events

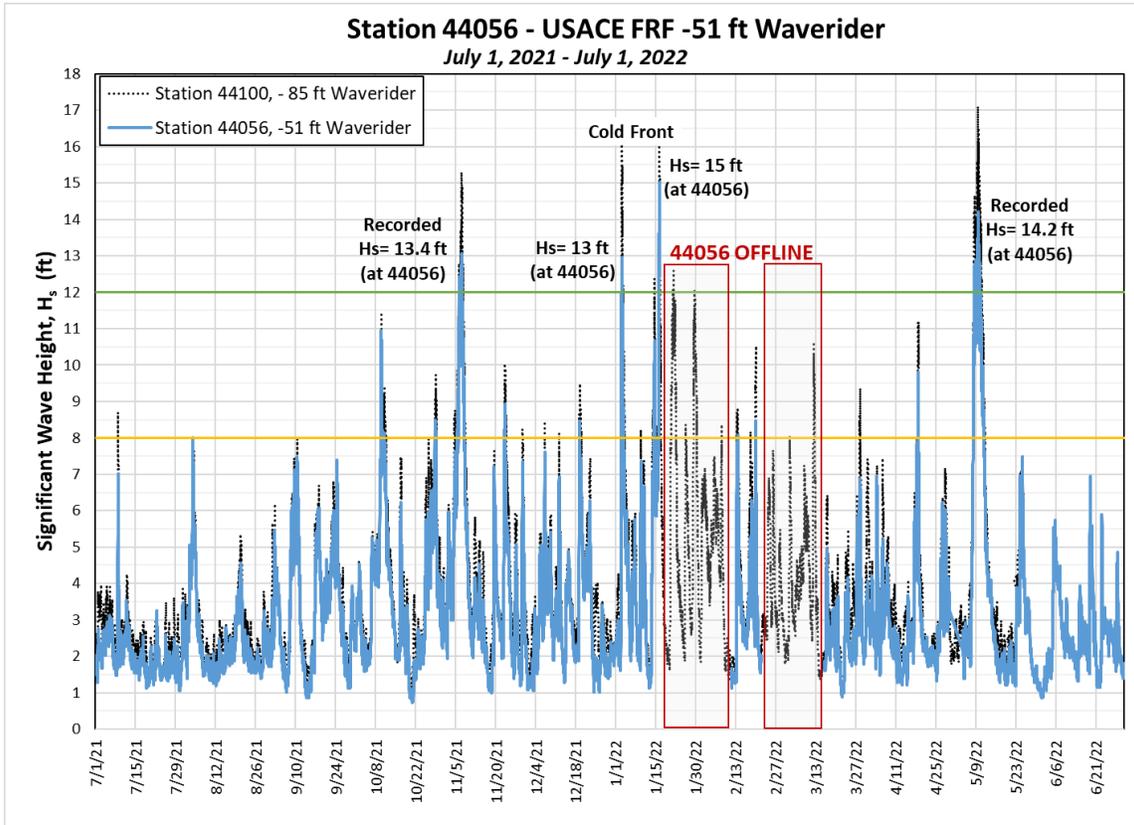
No sand placement events occurred during the 2021 – 2022 monitoring period.

#### 5.1.2 Wave Climate and Storm Events

Wave data from the National Data Buoy Center (NDBC) Station 44056 (USACE Field Research Facility (FRF)), located approximately 15 miles north of the Town, was downloaded for July 2021 through July 2022. The wave data was then plotted to analyze wave activity which may have impacted the Town. Additionally, to gain understanding of the wave climate during periods when the buoy was not recording, the data recorded at station 44100 which is located offshore of station 44056 was also downloaded. **Figure 5-1** shows the location of the buoys while **Figure 5-2** presents a plot of the wave heights during the reporting period.



**Figure 5-1. Wave Buoy Locations**

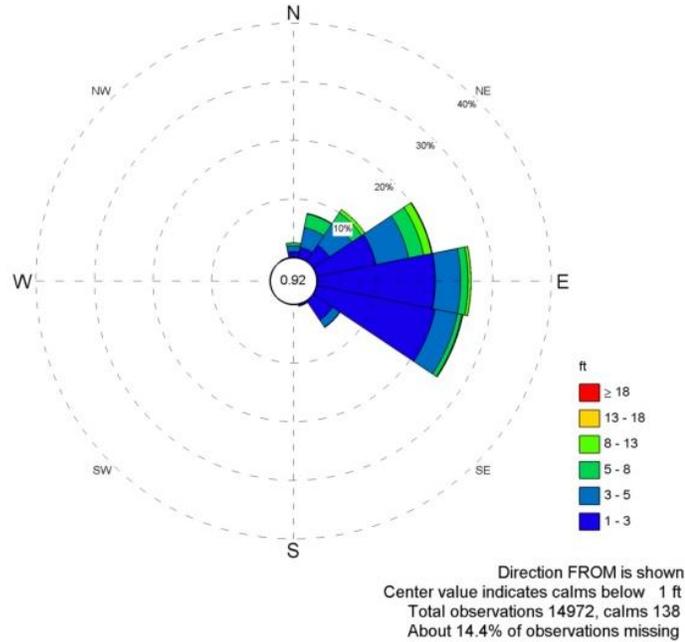


**Figure 5-2. USACE FRF Station 44056 Wave Height**

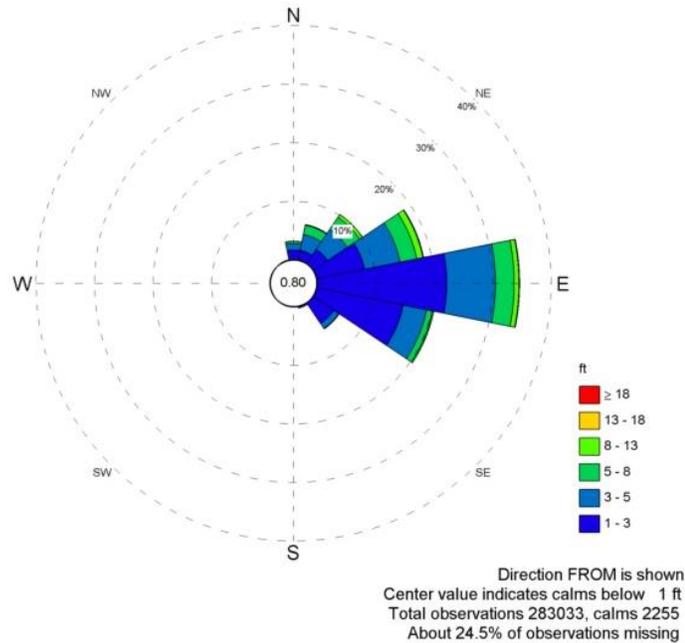
During the observation period the station 44056 buoy was unmoored two times in 2022; January 18 - February 11 and February 22 – March 16. In order to gain an understanding of the wave climate during these periods, the data recorded at station 44100 (offshore of station 44056) is also presented in **Figure 5-2**. The data indicates an active wave climate during the monitoring period. During fall/winter season (Oct. 2021 – Dec. 2022), 5 events occurred with wave heights higher than 8 ft. The recorded data winter storm season that followed (Jan. 2022 – May 2022) experienced 5 events with wave heights between 8 ft and 15 ft. Additionally the waves recorded at Station 44100 during the indicate at least three additional events with wave height exceeding 8 ft. The active storm season between the summer 2021 and summer 2022 surveys can cause higher erosion rates compared to average annual background erosion rates.

**Figure 5-3** and **Figure 5-4** presents the directional wave roses for the annual monitoring period and for the period between January 1997 (wave direction was not recorded prior to 1997) and July 2022, respectively. Based on the statistics, for both time periods the prevailing waves are from east-northeast to the east-southeast directions. Compared to historical wave height records the percentage of the waves coming from east decreased significantly (~8%) while percentage waves coming from east-southeast (~6%) and east-northeast (~2%) directions increased. Additionally, the percentage of waves higher than 5 ft coming from east direction has decreased significantly. The difference in wave direction distribution can cause a divergence from the historical erosion trends during the

observation period. However, it should be noted that 14% of observations were missing during the monitoring period, thus the conditions described by the data may not reflect the experienced wave conditions.

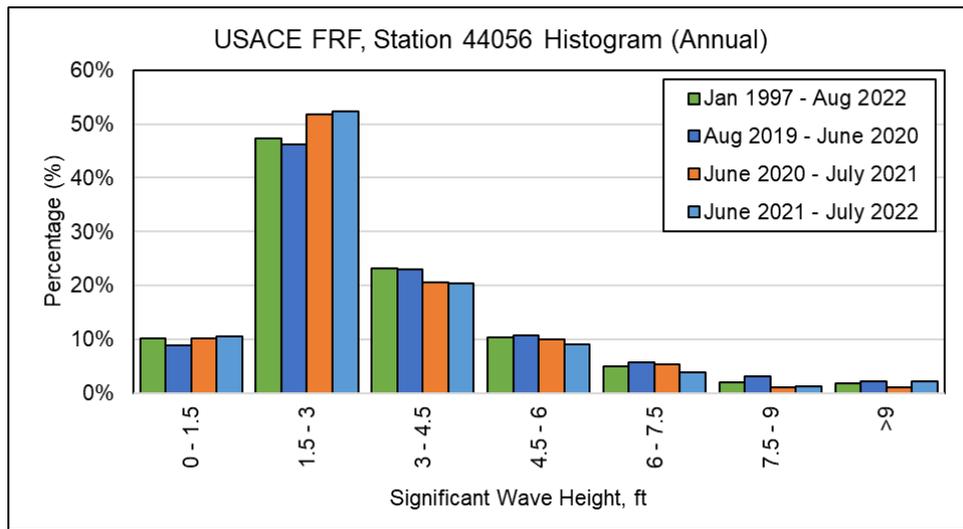


**Figure 5-3. Station 44056 Significant Wave Height Rose from July 2021 – July 2022**



**Figure 5-4. Station 44056 Significant Wave Height Rose from January 1997 – September 2022**

**Figure 5-5** presents the annual histograms of significant wave heights recorded for the current and previous annual monitoring periods, and for the time period between January 1997 and September 2022. The histogram shows that a slightly higher percentage (approximately 4%) of waves with height between 1.5–3.0 ft occurred during the monitoring period compared to the historical distribution. The distribution of wave heights for higher waves indicates lower occurrence rates. However, it should be noted that, from the recordings of the offshore gage shown at **Figure 5-2**, the data gaps at station 44056 generally occurred during events with significant wave heights greater than 5 ft. Thus, it is likely that during the monitoring period the waves higher than 4.5 ft occurred more than what is reflected in the recorded data.



**Figure 5-5. Station 44056 Significant Wave Height Histogram**

**5.2 Determination of Background Erosion Rates for Town of Nags Head (2011 – 2022)**

To develop long-term trends in volume losses/gains, it is important to determine background erosion rates which do not include the volume gains from nourishment events. Since the establishment of the beach monitoring program immediately after the construction of the 2011 beach nourishment project, the Nags Head oceanfront has undergone only one other beach nourishment project in 2019. **Table 5-1** shows the nourishment volume placed at each reach within the monitoring program during the 2019 nourishment project.

**Table 5-1. Nourishment Volumes Post-2011 by Management Reach**

Reach	Transects	Length	Nourishment Volume (cy)
<b>Nags Head - North</b>	430+00 - 495+00	6,750	0
<b>Nags Head - Reach 1</b>	495+00 - 790+00	29,500	1,762,213
<b>Nags Head - Reach 2</b>	790+00 - 920+00	13,000	885,587
<b>Nags Head - Reach 3N</b>	920+00 - 975+00	5,500	576,703
<b>Nags Head - Reach 3S</b>	975+00 - 1010+00	3,500	540,833
<b>Nags Head - Reach 4</b>	1010+00 - 1025+00	1,500	239,298
<b>National Seashore - North</b>	1025+00 - 1200+00	17,250	0
<b>Total</b>		77,000	4,004,634

Historical volume changes above -19 ft NAVD88 were documented from 2011 through 2022. **Table 5-2** shows the computed volume change (including nourishments) above -19 ft NAVD88 from 2011-2022 for the defined monitoring reaches.

**Table 5-2. Volume Change by Reach Above -19 ft NAVD88**

Reach	Volume Change (cy) 2011-2012	Volume Change (cy) 2012-2013	Volume Change (cy) 2013-2014	Volume Change (cy) 2014-2015	Volume Change (cy) 2015-2016	Volume Change (cy) 2016-2017	Volume Change (cy) 2017-2018	Volume Change (cy) 2018-2019	Volume Change (cy) 2019-2020	Volume Change (cy) 2020-2021	Volume Change (cy) 2021-2022
Nags Head - North (430+00 - 495+00)	12,512	459	-61,997	42,855	-21,464	-107,963	-76,609	-273	14,451	82,466	-9,240
Nags Head - Reach 1 (495+00 - 790+00)	199,722	-210,804	16,718	-110,558	294,941	-418,152	-644,783	1,441,871	253,604	205,765	-210,748
Nags Head - Reach 2 (790+00 - 920+00)	117,215	-195,136	54,157	-81,138	33,499	-429,523	-328,626	696,896	156,913	143,886	-206,347
Nags Head - Reach 3N (920+00 - 975+00)	85,381	-144,828	-13,818	-133,901	15,540	-252,798	-168,797	423,513	21,457	10,346	-159,340
Nags Head - Reach 3S (975+00 - 1010+00)	-32,942	-48,873	-101,531	-89,412	-54,799	-104,590	-84,187	383,465	-106,581	-60,949	-12,855
Nags Head - Reach 4 (1010+00 - 1025+00)	71,930	-105,463	-14,079	-33,271	-42,050	-57,636	-31,569	136,047	-42,197	-11,624	-8,292
National Seashore - North (1025+00 - 1200+00)	107,833	-235,944	153,705	-442,192	3,220	-470,987	-520,298	-181,579	-93,041	610,231	284,283
<b>Nourished Oceanfront (495+00 - 1025+00)</b>	<b>441,306</b>	<b>-705,102</b>	<b>-58,553</b>	<b>-448,280</b>	<b>247,132</b>	<b>-1,262,698</b>	<b>-1,257,961</b>	<b>3,081,792</b>	<b>283,196</b>	<b>287,425</b>	<b>-597,582</b>
<b>Total Monitored Oceanfront (430+00 - 1200+00)</b>	<b>561,651</b>	<b>-940,588</b>	<b>33,154</b>	<b>-847,616</b>	<b>228,887</b>	<b>-1,841,647</b>	<b>-1,854,868</b>	<b>2,899,940</b>	<b>204,606</b>	<b>980,122</b>	<b>-322,539</b>

To calculate the background erosion rate, the documented nourishment volumes were subtracted from total volume changes above -19 ft NAVD88 between 2011 and 2022 and annualized over the 11-year time period. **Table 5-3** shows the average annual background erosion rates for each management reach of the Nags Head oceanfront. The average background erosion rate for the Town’s Nourished Oceanfront and the Total Monitored Oceanfront shoreline is approximately -6.9 cy/ft/yr and -5.8 cy/ft/yr, respectively. Nags Head Reaches 3N, 3S, and 4 have considerably higher background erosion rates than the remainder of the oceanfront shoreline, signifying these areas need to be monitored closely and taken into special consideration during future planning and nourishment efforts.

**Table 5-3. Average Annual Background Erosion Rates (2011 - 2022)**

Reach (Transects)	Length	Volume Change Above -19 ft NAVD88 (cy) 2011-2022	Nourishment Volume (cy)	Background Erosion (cy)	Average Annual Background Erosion Rates (cy/ft/yr)
Nags Head - North (430+00 - 495+00)	6,500	-124,801	0	-124,801	-1.7
Nags Head - Reach 1 (495+00 - 790+00)	29,500	817,577	1,762,213	-944,636	-2.9
Nags Head - Reach 2 (790+00 - 920+00)	13,000	-38,203	885,587	-923,790	-6.5
Nags Head - Reach 3N (920+00 - 975+00)	5,500	-317,244	576,703	-893,947	-14.8
Nags Head - Reach 3S (975+00 - 1010+00)	3,500	-313,253	540,833	-854,086	-22.2
Nags Head - Reach 4 (1010+00 - 1025+00)	1,500	-138,204	239,298	-377,502	-22.9
National Nearshore - North (1030+00 - 1200+00)	17,500	-784,768	0	-784,768	-4.1
<b>Nourished Oceanfront (495+00 - 1025+00)</b>	<b>53,000</b>	<b>10,673</b>	<b>4,004,634</b>	<b>-3,993,961</b>	<b>-6.9</b>
<b>Total Monitored Oceanfront (430+00 - 1200+00)</b>	<b>77,000</b>	<b>-898,897</b>	<b>4,004,634</b>	<b>-4,903,531</b>	<b>-5.8</b>

### 5.3 Nags Head Shoreline and Volume Change Analysis (2021 – 2022)

This section discusses the results of the shoreline and volume change analysis for the defined monitoring reaches along Nags Head (see **Figure 3-1**). Key statistics were calculated to quantify average shoreline and volume changes for individual monitoring reaches as well as the entire oceanfront shoreline for Nags Head. The computed statistics include average shoreline change, average unit volume change, and cumulative volume change (e.g. total volume of material lost or gained along a section of shoreline). Evaluation of the computed statistics considers volume changes computed for portions of the profile above the berm (+6 ft NAVD88), above MHW (+1.18 ft NAVD88), above -6 ft NAVD88, above -14 ft NAVD88, above -19 ft NAVD88, and above -30 ft NAVD88 to better understand onshore and offshore processes.

**Appendix B** presents profile comparison plots for individual transects for the summer 2021 and the summer 2022 surveys. **Appendix C** provides the computed shoreline changes and volume changes measured at each transect between the summer 2021 and the summer 2022 surveys in tabular format.

5.3.1 Nags Head - North Reach (2021 - 2022)

The Nags Head – North survey reach extends approximately 6,500 ft between E 8<sup>th</sup> Street and Bonnett Street, containing 13 survey transects (Station 430+00 – 495+00) at approximately 1000 ft spacing (see **Figure 3-1**). As a reminder, six transects were added to this reach during the 2020 surveying effort, creating 500 ft spacing for the whole reach. A summary of average shoreline and volume changes between 2021 and 2022 for Nags Head – North in comparison with the Total Monitored Oceanfront is presented in **Table 5-4** and **Table 5-5**.

**Table 5-4. Average Shoreline and Average Unit Volume Change for Nags Head – North Reach (2021 – 2022)**

2021 vs. 2022 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - North	430+00 - 495+00	6,500	-29.5	-0.2	-5.6	-16.2	-6.0	-9.3	17.4
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-18.6	-0.2	-4.7	-6.7	-25.2	-9.4	11.6

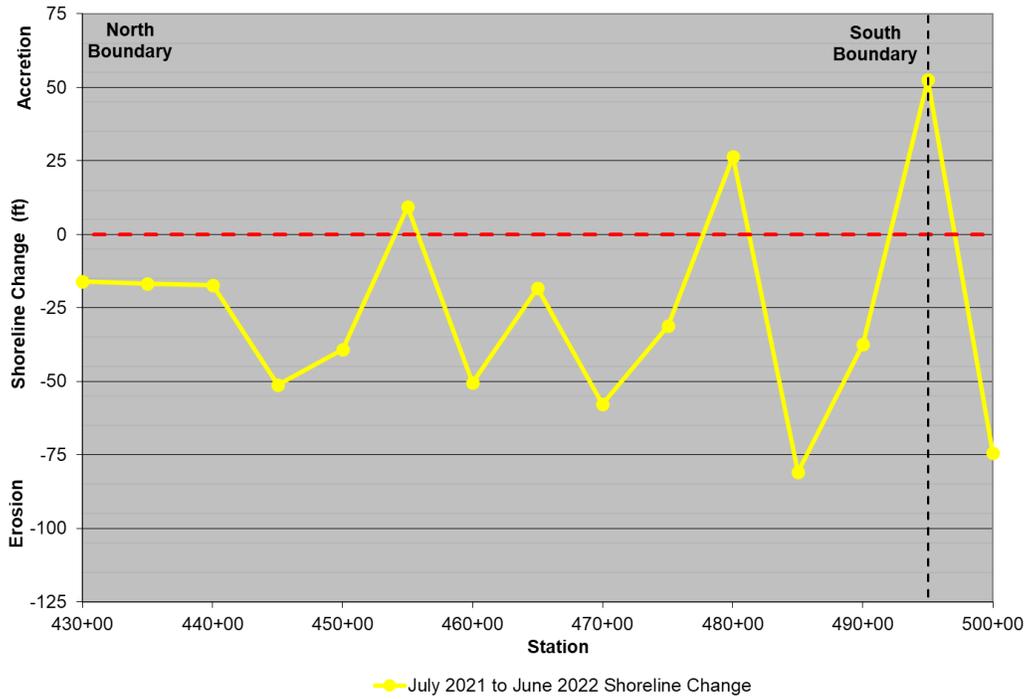
**Table 5-5. Cumulative Volume Change for Nags Head – North Reach (2021 – 2022)**

2021 vs. 2022 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - North	430+00 - 495+00	6,500	-1,310	-33,641	-97,174	-35,918	-55,773	104,258
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-16,965	-363,029	-513,934	-1,959,257	-727,171	878,650

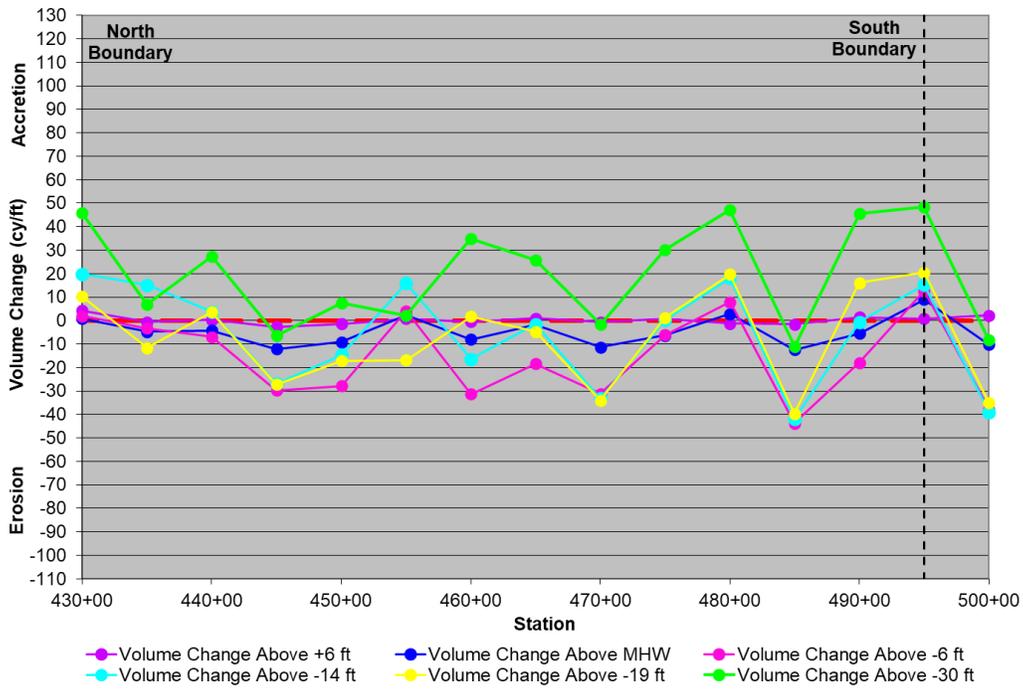
**Table 5-4** indicates that North Reach experienced a landward recession of the shoreline at MHW over the past year. This is likely due to an active 2021/2022 storm season. **Figure 5-6** presents the shoreline changes at each transect, indicating landward recession at the majority of the transects within the reach.

**Table 5-4** and **Table 5-5** indicates that the Nags Head – North reach experienced volume losses at all elevations above -19 ft NAVD88. Overall, North Reach experienced the largest volume losses above -6 ft NAVD88 (-97,174 cy or -16.2 cy/ft). Smaller losses of approximately -55,773 cy (-9.3 cy/ft) of material were observed above -19 ft NAVD88. The losses can be attributed to the active storm season during the 2021-2022 monitoring period.

**Figure 5-7** displays the unit volume change at each transect for the Nags Head – North reach. The majority of transects experienced berm erosion and adjustment of offshore bar. **Figure 5-8** presents an example of beach face erosion and bar moving offshore in the 2021 profile.



**Figure 5-6. Nags Head – North Shoreline Change (2021 – 2022)**



**Figure 5-7. Nags Head – North Unit Volume Change (2021 – 2022)**

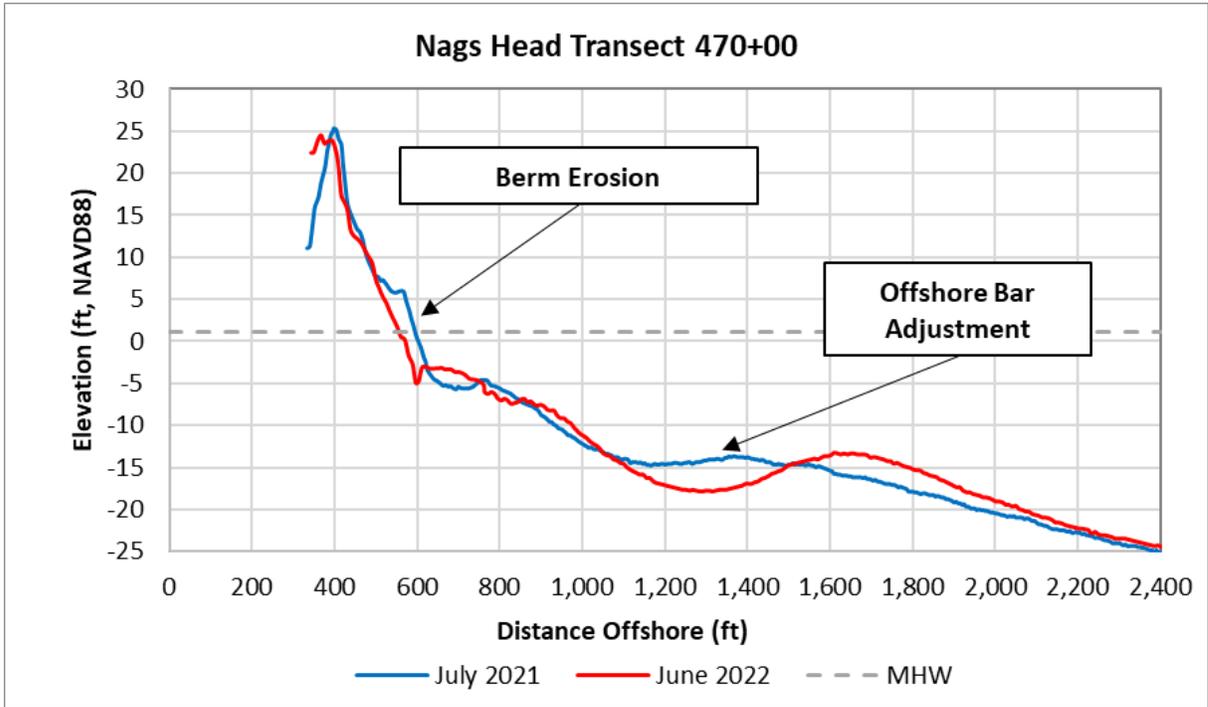


Figure 5-8. Example Nags Head – North Profile, Station 470+00 (E. Admiral St.)

### 5.3.2 Nags Head - Reach 1 (2021 - 2022)

The Nags Head – Reach 1 survey reach extends approximately 29,500 ft between Bonnett Street and Governor Street, containing 59 survey transects (Station 495+00 – 790+00), at 500 ft spacing (see **Figure 3-1**). A summary of average shoreline and volume changes between 2021 and 2022 for Reach 1 in comparison with the Total Monitored Oceanfront is presented in **Table 5-6** and **Table 5-7**.

**Table 5-6. Average Shoreline and Average Unit Volume Change for Reach 1 (2021 – 2022)**

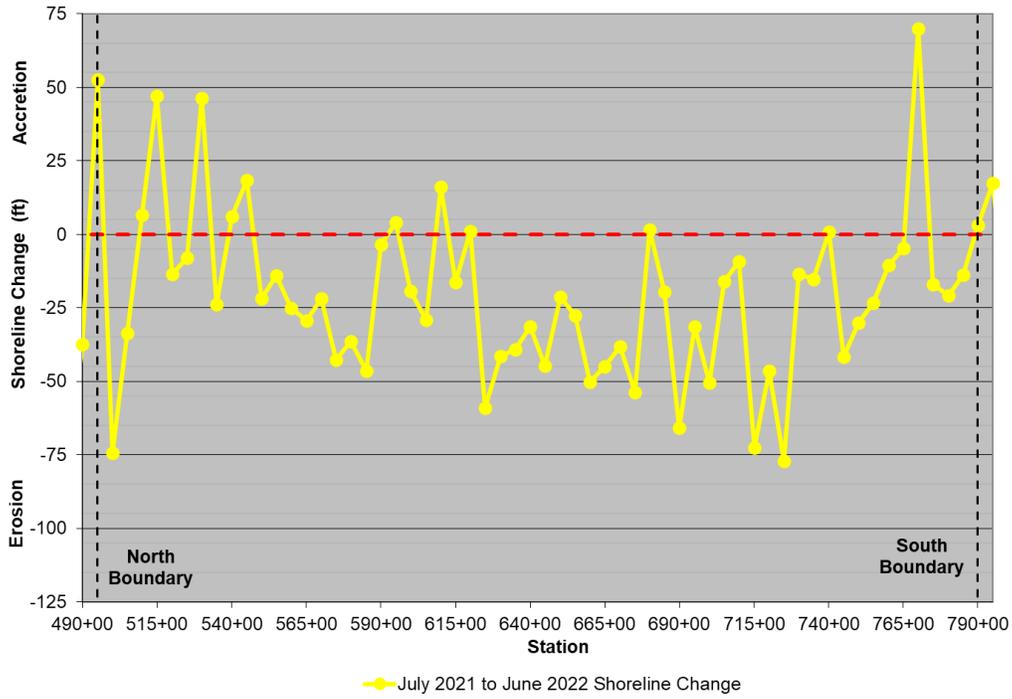
2021 vs. 2022 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 1	495+00 - 790+00	29,500	-20.9	1.8	-2.3	-6.6	-22.4	-6.9	18.5
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-18.6	-0.2	-4.7	-6.7	-25.2	-9.4	11.6

**Table 5-7. Cumulative Volume Change for Reach 1 (2021 – 2022)**

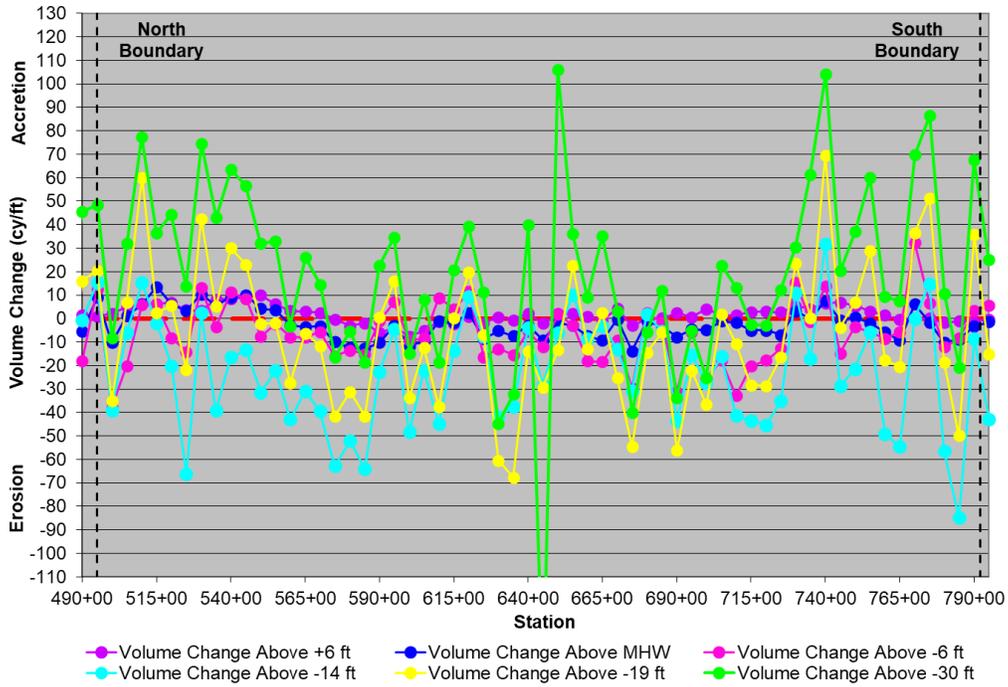
2021 vs. 2022 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 1	495+00 - 790+00	29,500	54,106	-68,497	-194,065	-661,266	-204,407	545,766
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-16,965	-363,029	-513,934	-1,959,257	-727,171	878,650

Shoreline change at MHW showed an overall average landward recession of -20.9 ft. **Figure 5-9** presents the shoreline changes at each transect from 2021 to 2022. While the most of the transects experienced recession, the figure also indicates widely varying shoreline movement patterns within the reach ranging between -77.2 ft at the station 725+00 to +69.8 ft at station 770+00.

**Table 5-6** and **Table 5-7** indicates that Reach 1 experienced volume losses above MHW, -6 ft NAVD88, -14 ft NAVD88 and -19 ft NAVD88. The largest volume losses were experienced above -14 ft NAVD88 (-661,266 cy or -22.4 cy/ft). Material losses above -19 ft NAVD88 (-140,727 cy or -46.9 cy/ft) were slightly smaller than losses above -14 ft NAVD88, indicating capture of a small portion of the losses above depth of closure. **Figure 5-10** displays the unit volume change at each transect above the six elevations analyzed. Transects at the north and south of the reach experienced material loss from the offshore bar while the transects in the middle of the beach observed material moving from upper elevations to form an offshore bar. Additionally, accretion was observed at the dune face in some transects at the north of the reach. Profile plots in **Appendix B** show profile comparison plots for individual transects. **Figure 5-11** presents an example profile from north of the reach where sand bar has been displaced and sand has been pushed to dune face. **Figure 5-12** presents an example profile from the middle of the reach, showing a trough formation seaward of the offshore bar.



**Figure 5-9. Nags Head – Reach 1 Shoreline Change (2021 – 2022)**



**Figure 5-10. Nags Head – Reach 1 Unit Volume Change (2021 – 2022)**

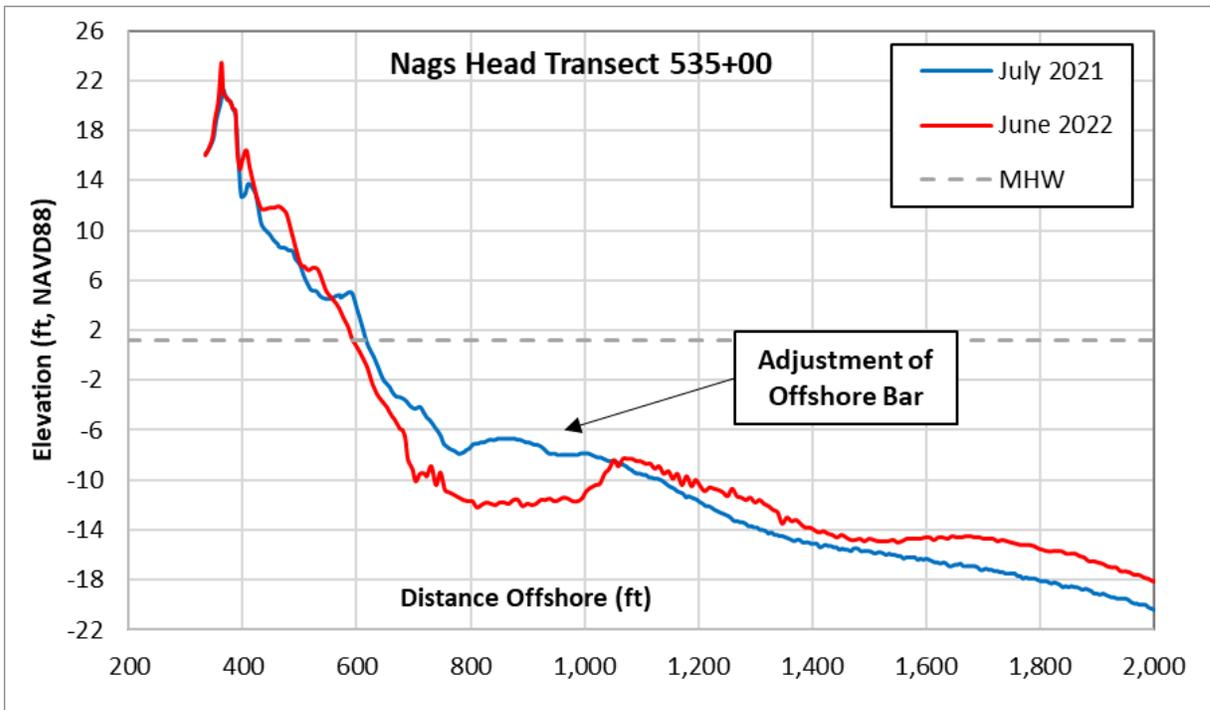


Figure 5-11. Example Reach 1 Profile, Station 535+00 (E Soundside Rd.)

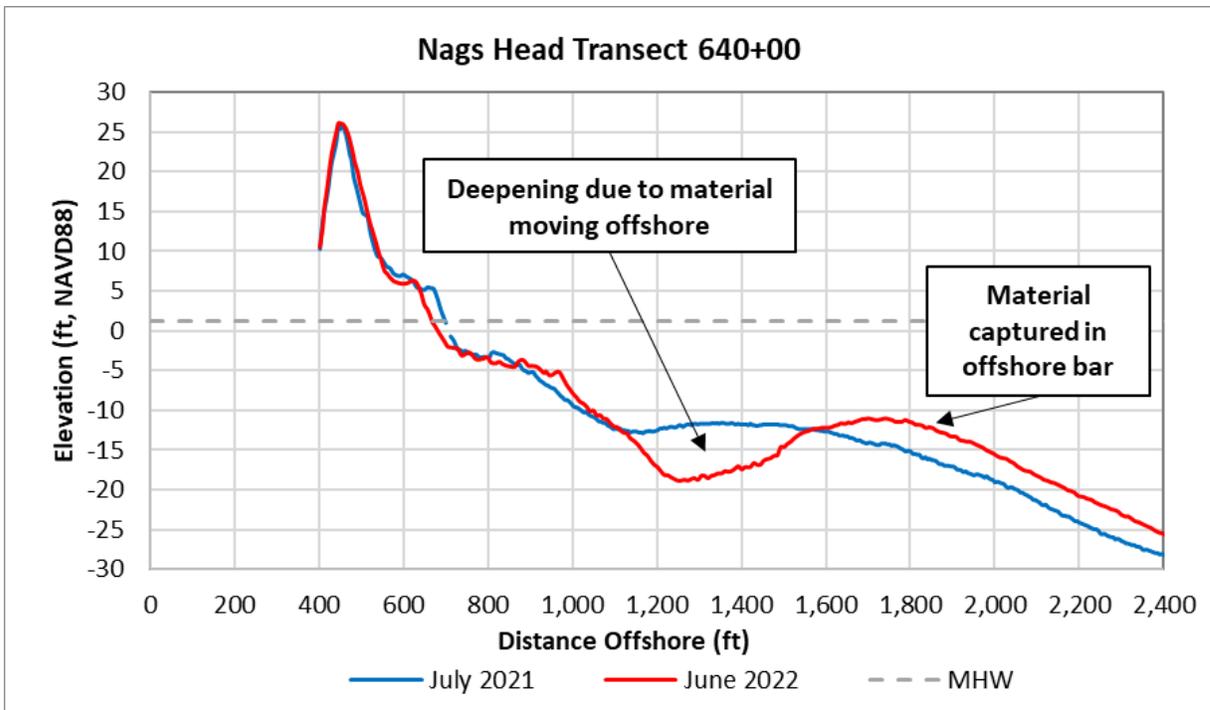


Figure 5-12. Example Reach 1 Profile, Station 640+00 (E Dunn St.)

5.3.3 *Nags Head - Reach 2 (2021 - 2022)*

The Nags Head – Reach 2 survey reach extends approximately 13,000 ft between Governor Street and James Street, containing 26 survey transects (Station 790+00 – 920+00), at 500 ft spacing (see **Figure 3-1**). A summary of average shoreline and volume changes between 2021 and 2022 for Nags Head – Reach 2 in comparison with the Total Monitored Oceanfront is presented in **Table 5-8** and **Table 5-9**.

**Table 5-8. Average Shoreline and Average Unit Volume Change for Reach 2 (2021 – 2022)**

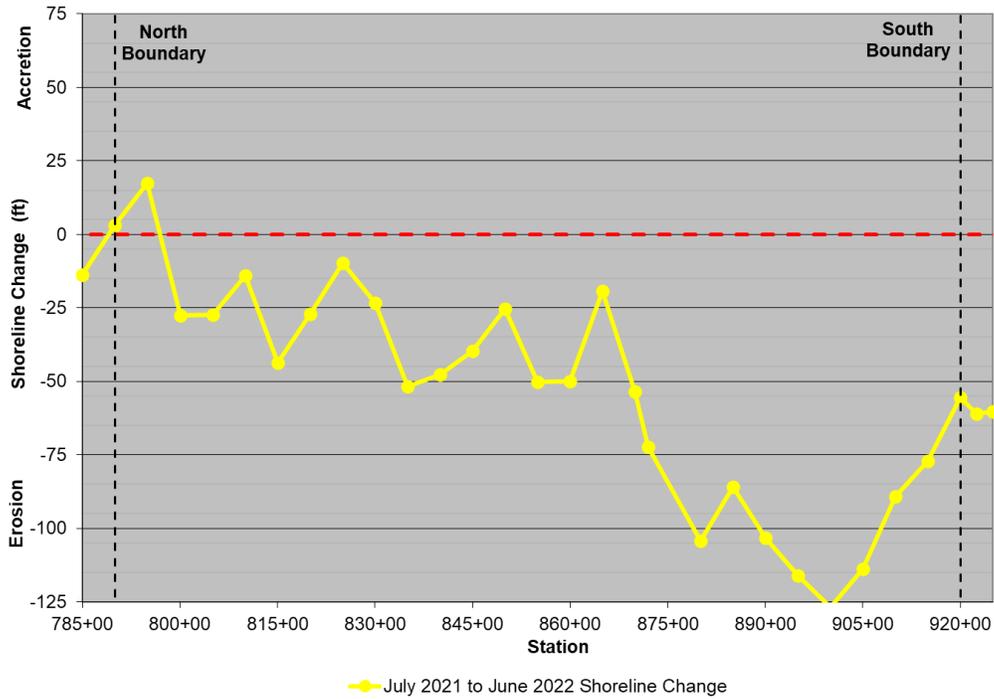
2021 vs. 2022 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 2	790+00 - 920+00	13,000	-52.4	-1.2	-9.4	-14.9	-41.4	-16.2	7.6
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-18.6	-0.2	-4.7	-6.7	-25.2	-9.4	11.6

**Table 5-9. Cumulative Volume Change for Reach 2 (2021 – 2022)**

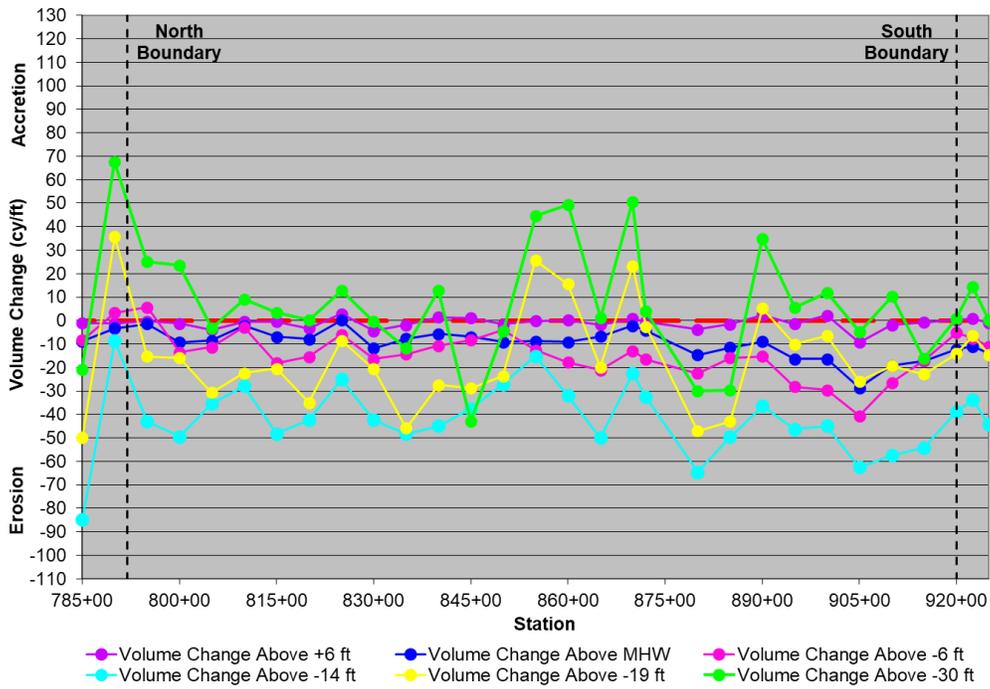
2021 vs. 2022 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 2	790+00 - 920+00	13,000	-15,103	-121,866	-193,265	-537,629	-210,098	98,910
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-16,965	-363,029	-513,934	-1,959,257	-727,171	878,650

Shoreline change at MHW showed an overall average recession of -52.4 ft. **Figure 5-13** presents the shoreline changes at each transect from 2021 to 2022. As can be seen from the figure, the majority of transects experienced erosion. The recession became more severe as the analysis moved south, reaching -126.9 ft at Station 900+00. Most of this landward recession can be attributed to the active storm season during the 2021-2022 monitoring period.

Volumetrically, **Table 5-8** and **Table 5-9** indicates that Reach 2 experienced significant volume losses in this monitoring period which can be attributed to the active 2021 – 2022 storm season following the fairly calm wave climate during 2020-2021 observation period. Overall, Reach 2 experienced volume losses above all the analyzed elevations except above -30 ft NAVD88. The largest volume losses were experienced above -14 ft NAVD88 (-537,629 cy or -41.4 cy/ft). Losses above -19 ft NAVD88 (-210,098 cy or – 16.2 cy/ft) were also significant although slightly smaller than losses above -14 ft NAVD88, indicating recovery of only a small portion of the losses above depth of closure. **Figure 5-14** displays the unit volume change at each transect above the six elevations analyzed. As can be seen, all transects experienced volume losses above -14 ft NAVD88.

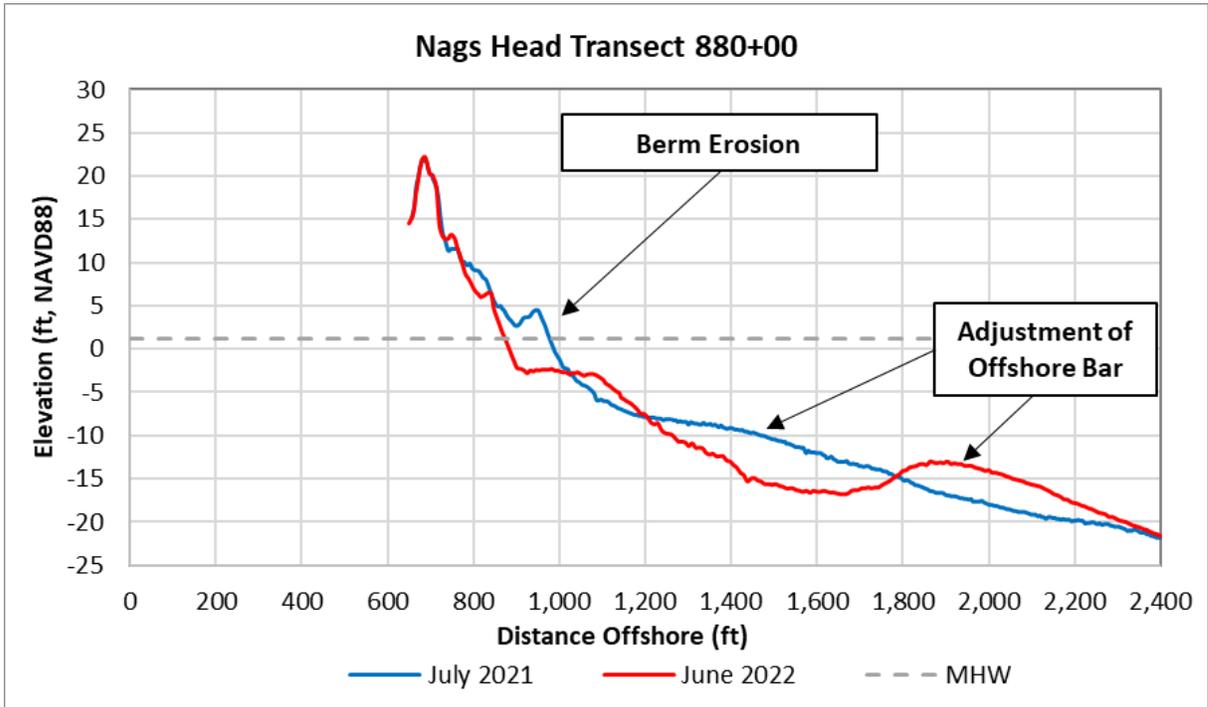


**Figure 5-13. Nags Head – Reach 2 Shoreline Change (2021 – 2022)**



**Figure 5-14. Nags Head – Reach 2 Unit Volume Change (2021 – 2022)**

Profile plots in **Appendix B** show many instances of berm erosion causing shoreline recession. Additionally, in a majority of profiles the offshore bar has moved seaward and adjusted to a lower elevation. **Figure 5-15** presents an example profile where shoreline receded, and sand bar has been displaced.



**Figure 5-15. Example Reach 2 Profile, Station 880+00 (E Islington St.)**

5.3.4 Nags Head - Reach 3 - North (2021 - 2022)

The Nags Head – Reach 3 - North survey reach extends approximately 5,500 ft between James Street and Limulus Drive, containing 22 survey transects (Station 920+00 – 975+00), at 500 ft spacing (see **Figure 3-1**). As a reminder, 11 of the transects were added to this reach during the 2020 surveying effort, creating 250 ft spacing for the whole reach. A summary of average shoreline and volume changes between 2021 and 2022 for Nags Head – Reach 3 - North in comparison with the Total Monitored Oceanfront is presented in **Table 5-10** and **Table 5-11**.

**Table 5-10. Average Shoreline and Average Unit Volume Change for Reach 3 - North (2021 – 2022)**

2021 vs. 2022 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 3 - North	920+00 - 975+00	5,500	-48.6	-5.0	-16.8	-14.8	-58.8	-28.9	-17.0
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-18.6	-0.2	-4.7	-6.7	-25.2	-9.4	11.6

**Table 5-11. Cumulative Volume Change for Reach 3 - North (2021 – 2022)**

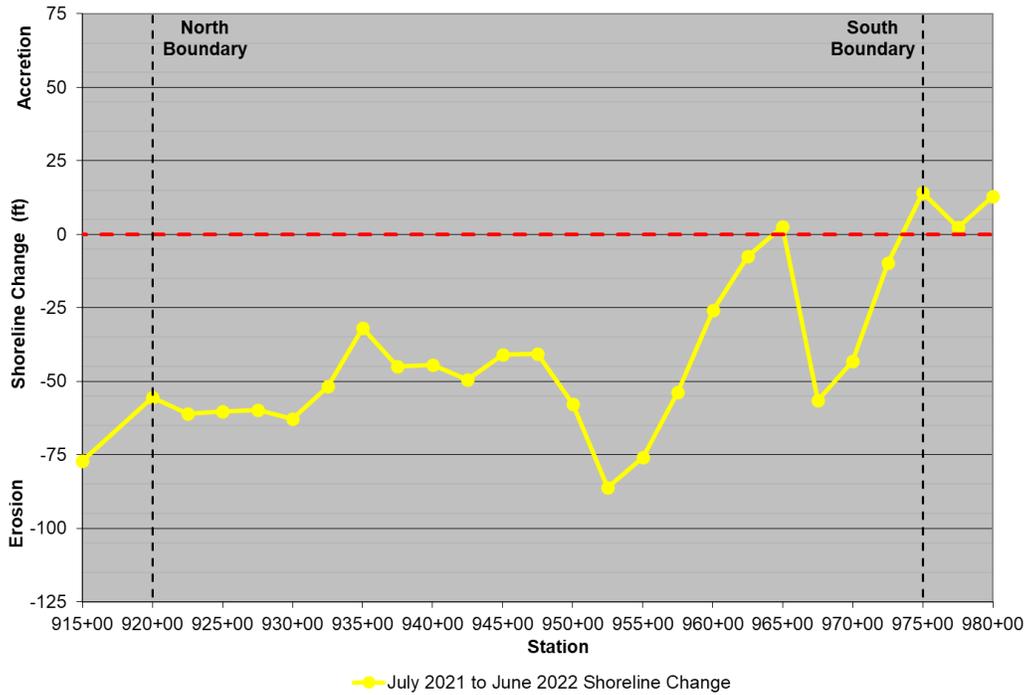
2021 vs. 2022 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 3 - North	920+00 - 975+00	5,500	-28,673	-96,681	-85,271	-338,296	-166,218	-97,896
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-16,965	-363,029	-513,934	-1,959,257	-727,171	878,650

Shoreline change at MHW showed a significant overall landward recession of -48.6 ft. **Figure 5-16** presents the shoreline changes at each transect from 2021 to 2022, showing up to -86 ft erosion (Station 952+50) along the transects.

Volumetrically, **Table 5-10** and **Table 5-11** indicates that Reach 3 - North experienced overall volume losses at all of the analyzed elevations. Significant volume losses were experienced above -14 ft NAVD88 (-338,296 cy or -58.8 cy/ft). Smaller losses above -19 ft NAVD88 (-166,218 cy or -28.9 cy/ft) indicate that some of the material loss above -14 ft NAVD88 was captured above depth of the closure. However, the volume loss experienced above -19 ft NAVD88 during the monitoring period is significantly higher than the average annual background erosion rate previously experienced at Reach 3 – North (-14.8 cy/ft/yr) (**Table 5-3**). Volume losses observed above -30 ft NAVD88 might indicate that some of the material was transported offshore completely or to adjacent reaches, as longshore transport rates in this area generally accelerate in comparison with the more stable northern reaches.

**Figure 5-17** displays the unit volume change at each transect above the six elevations analyzed. As can be seen, a majority of transects experienced volume losses at all the

analyzed elevations. Similar to Reach 2, the profile plots in **Appendix B** show many instances where the profile experienced berm erosion and the offshore bar lost material and moved offshore to lower elevations. **Figure 5-18** presents an example profile which shows berm erosion and adjustment of the offshore sand bar.



**Figure 5-16. Nags Head – Reach 3 - North Shoreline Change (2021 – 2022)**

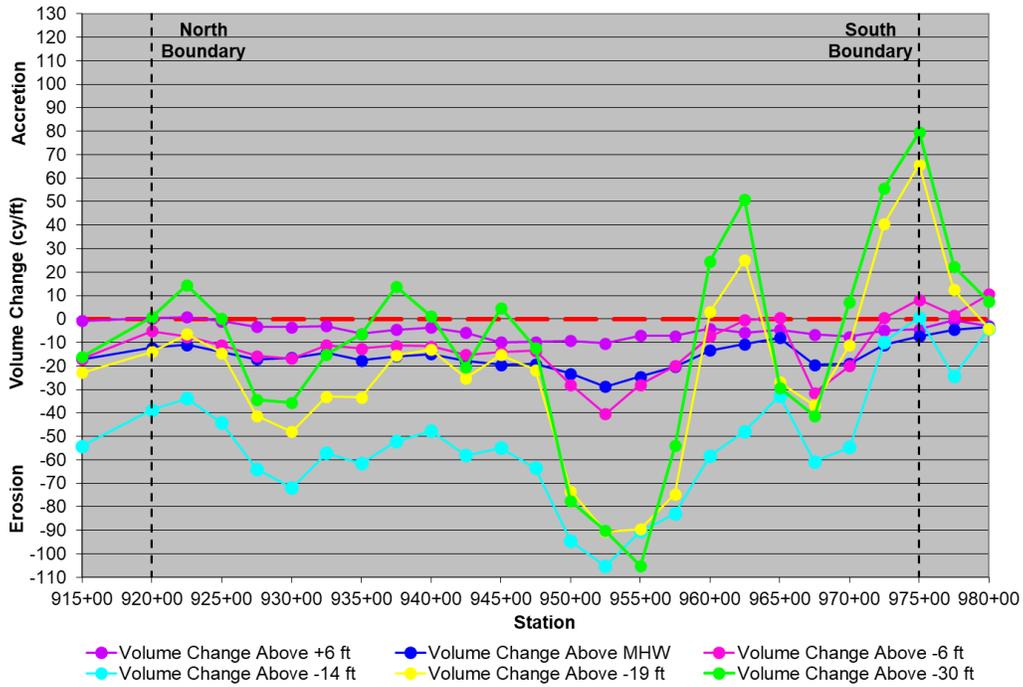


Figure 5-17. Nags Head – Reach 3 - North Unit Volume Change (2021 – 2022)

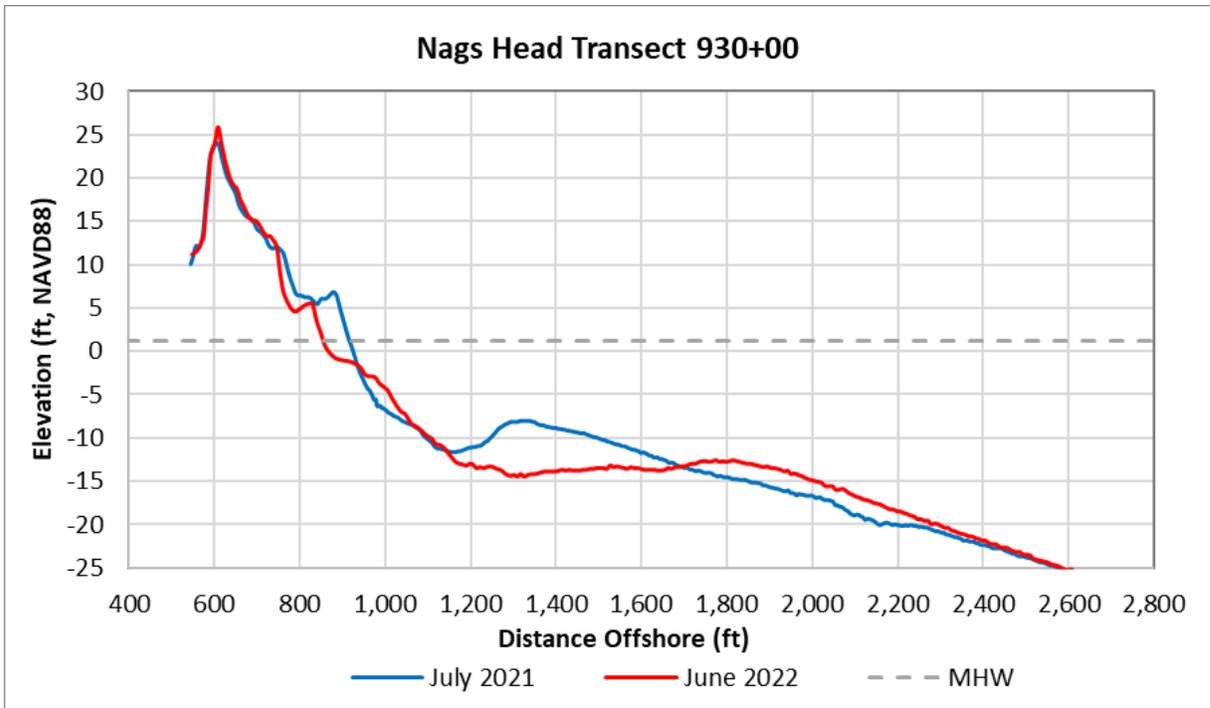


Figure 5-18. Example Reach 3 - North Profile, Station 930+00 (E Jacobs St.)

### 5.3.5 Nags Head - Reach 3 - South (2021 - 2022)

The Nags Head – Reach 3 - South survey reach extends approximately 3,500 ft between Limulus Drive and Loon Court, containing 14 survey transects (Station 975+00 – 1010+00) (see **Figure 3-1**). Seven of these transects were added to this reach during the 2020 surveying effort, creating 250 ft spacing for the whole reach. A summary of average shoreline and volume changes between 2021 and 2022 for Reach 3 – South in comparison with the Total Monitored Oceanfront is presented in **Table 5-12** and **Table 5-13**.

**Table 5-12. Average Shoreline and Average Unit Volume Change for Reach 3 - South (2021 – 2022)**

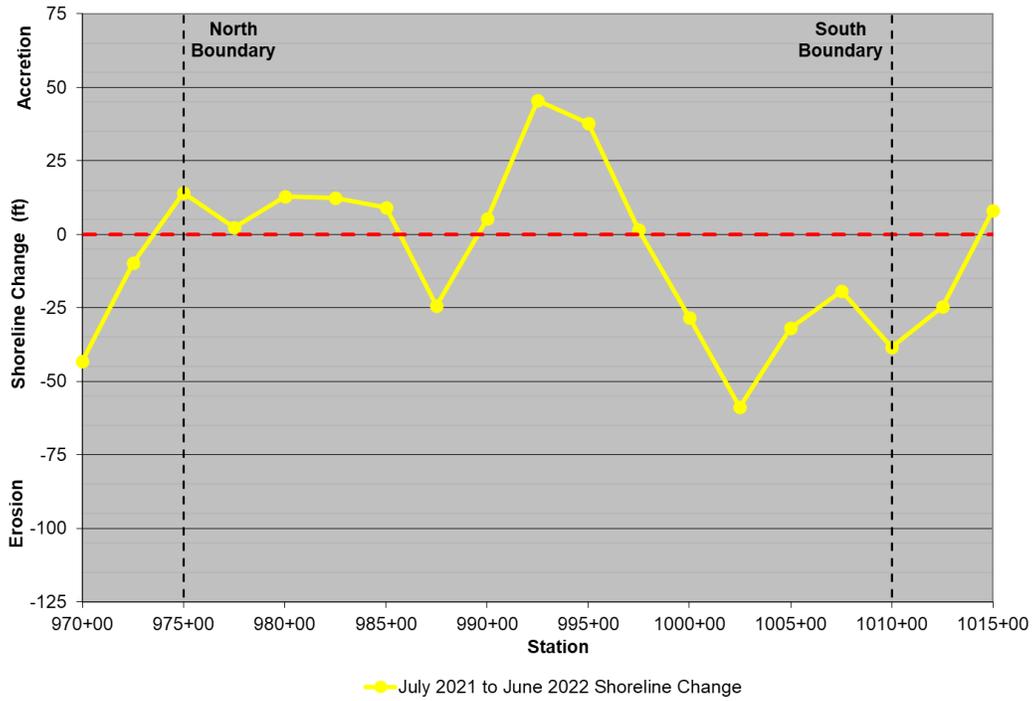
2021 vs. 2022 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 3 - South	975+00 - 1010+00	3,500	-1.2	-4.8	-8.7	-9.0	-31.4	-0.8	4.8
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-18.6	-0.2	-4.7	-6.7	-25.2	-9.4	11.6

**Table 5-13. Cumulative Volume Change for Reach 3 - South (2021 – 2022)**

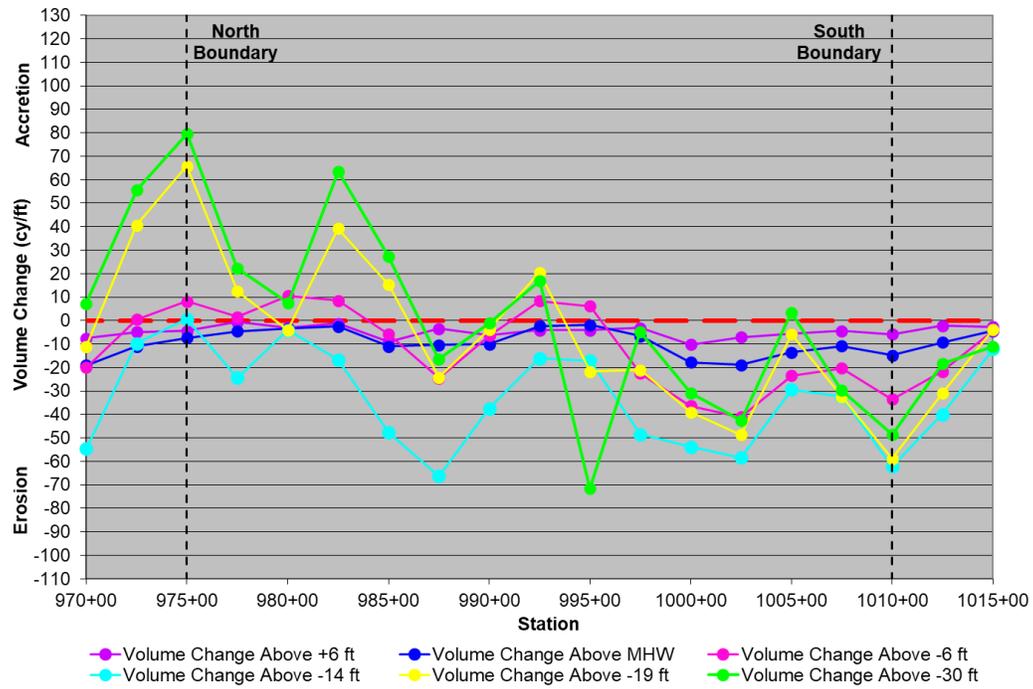
2021 vs. 2022 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 3 - South	975+00 - 1010+00	3,500	-16,714	-30,351	-31,671	-110,004	-2,709	16,663
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-16,965	-363,029	-513,934	-1,959,257	-727,171	878,650

Shoreline change at MHW showed a slight overall recession of -1.2 ft. **Figure 5-19** presents the shoreline changes at each transect from 2021 to 2022, showing erosion along most of the transects. The majority of recession in this reach occurs in the south portion.

Volumetrically, **Table 5-12** and **Table 5-13** indicates that Reach 3 - South experienced volume losses at all the analyzed elevations above -30 ft NAVD88. Overall, the largest losses were experienced above -14 ft NAVD88 (-110,004 cy or -31.4 cy/ft). However only minor losses were observed above -19 ft NAVD 88 (-2,709 cy or -0.8 cy/ft), indicating that much of the material was captured seaward of the offshore bar. Considering the active storm season during the monitoring period and the high average annual background erosion rates (-22.2 cy/ft/yr) for this reach, the present volume loss above -19 ft NAVD88 of -0.8 cy/ft is very minor. This is likely due to the littoral transport of material to the south from Reach 3 – North, where higher than average material loss was observed. **Figure 5-20** displays the unit volume change at each transect above the six elevations analyzed, showing volume losses above -14 ft NAVD88 at the majority of transects. Deposition of material between -14 ft NAVD88 and -19 ft NAVD88 can also be observed at most of the transects.

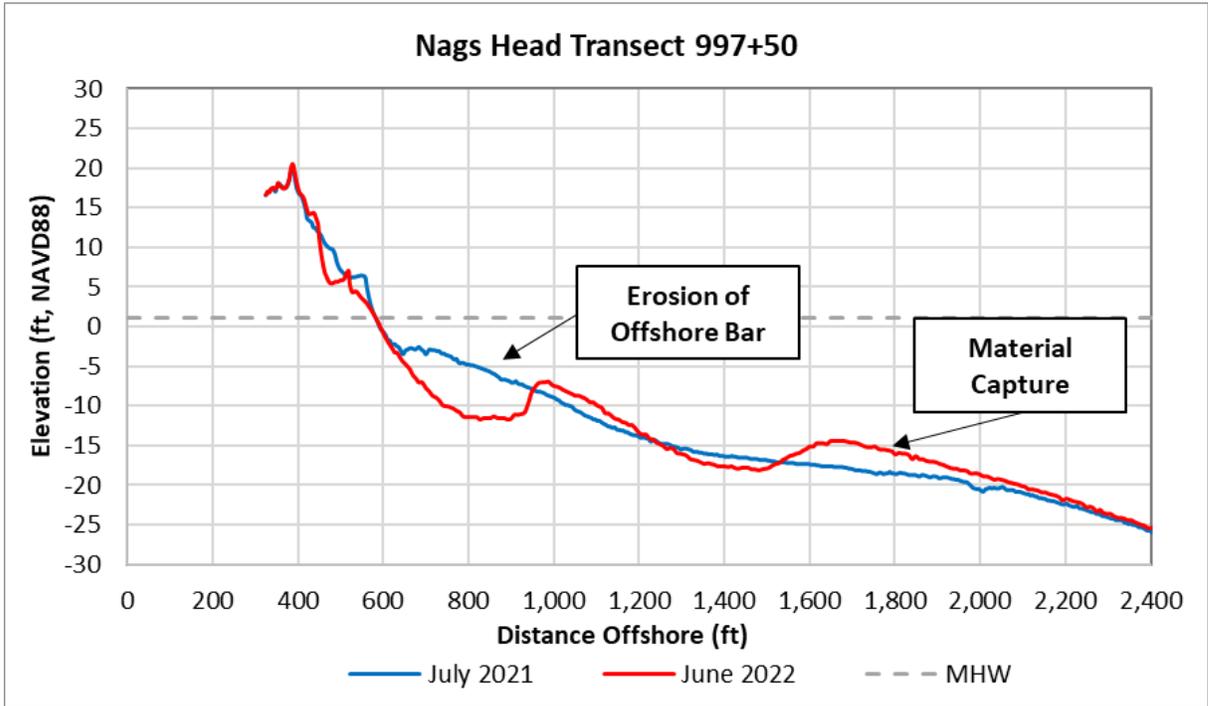


**Figure 5-19. Nags Head – Reach 3 – South Shoreline Change (2021 – 2022)**



**Figure 5-20. Nags Head – Reach 3 – South Unit Volume Change (2021 – 2022)**

The profile plots in **Appendix B** show material loss at offshore bar which created a trough in front of the offshore bar. The material lost from the offshore bar was captured above -19 ft NAVD88. **Figure 5-21** presents an example profile from Reach 3 - South that shows erosion and adjustment of the offshore bar followed by material capture between -14 ft NAVD88 to -19 ft NAVD88.



**Figure 5-21. Example Reach 3 - South Profile, Station 997+50 (E Loon Ct.)**

5.3.6 Nags Head - Reach 4 (2021 - 2022)

The Nags Head – Reach 4 survey reach extends approximately 1,500 ft between Loon Court and McCall Court, containing seven survey transects (Station 1010+00 – 1025+00), at 500 ft spacing (see **Figure 3-1**). Three of these transects were added to this reach during the 2020 surveying effort, creating 250 ft spacing for the whole reach. A summary of average shoreline and volume changes between 2021 and 2022 for Nags Head – Reach 4 in comparison with the Total Monitored Oceanfront is presented in **Table 5-14** and **Table 5-15**.

**Table 5-14. Average Shoreline and Average Unit Volume Change for Reach 4 (2021 – 2022)**

2021 vs. 2022 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - Reach 4	1010+00 - 1025+00	1,500	7.0	-2.7	-4.2	-9.0	-16.1	-8.4	-8.3
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-18.6	-0.2	-4.7	-6.7	-25.2	-9.4	11.6

**Table 5-15. Cumulative Volume Change for Reach 4 (2021 – 2022)**

2021 vs. 2022 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - Reach 4	1010+00 - 1025+00	1,500	-4,794	-7,309	-15,742	-28,157	-14,651	-14,582
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-16,965	-363,029	-513,934	-1,959,257	-727,171	878,650

Shoreline change at MHW showed a significant overall average seaward advancement of 7.0 ft. **Figure 5-22** presents the shoreline changes at each transect from 2021 to 2022, showing advancement at southern transects.

Volumetrically, **Table 5-14** and **Table 5-15** indicates that Reach 4 experienced minor volume losses above all the analyzed elevations over the monitoring period. Overall, Reach 4 experienced the largest losses above -14 ft NAVD88 (-28,157 cy or -16.1 cy/ft). Smaller losses above -19 ft NAVD88 (-14,651 cy or -8.4 cy/ft) indicate slight recovery of the losses at the offshore bar and beyond.

**Figure 5-23** displays the unit volume change at each transect above the six elevations analyzed. Profile plots in **Appendix B** show many instances of offshore bar moving seaward. Transects at the south also present some onshore material deposition and corresponding seaward advancement of the shoreline (**Figure 5-24**).

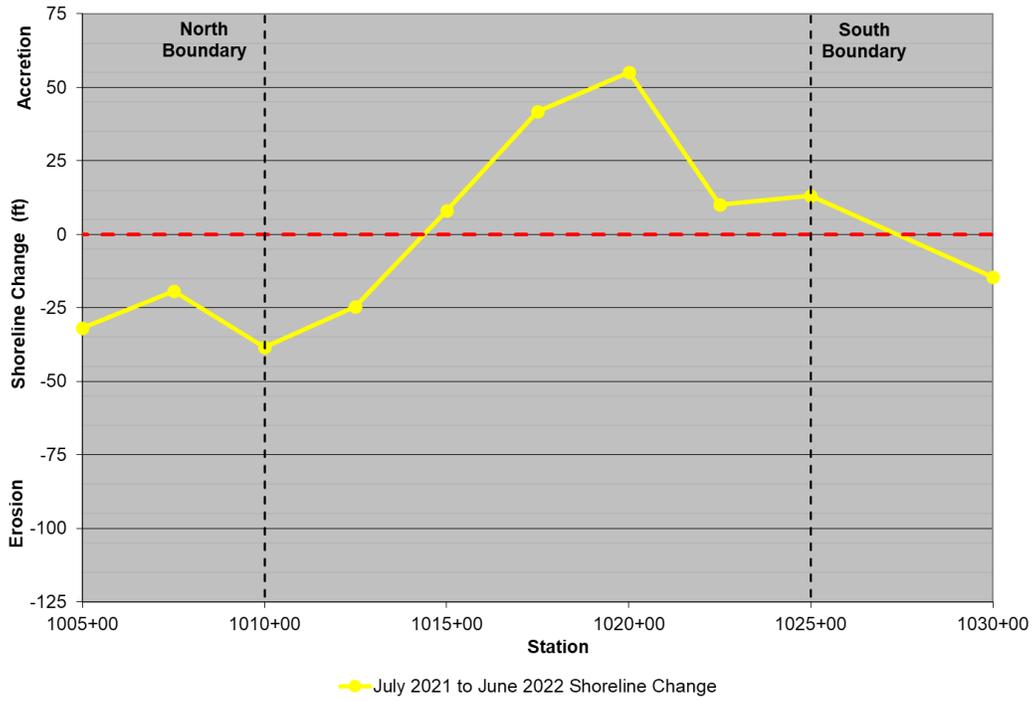


Figure 5-22. Nags Head – Reach 4 Shoreline Change (2021 – 2022)

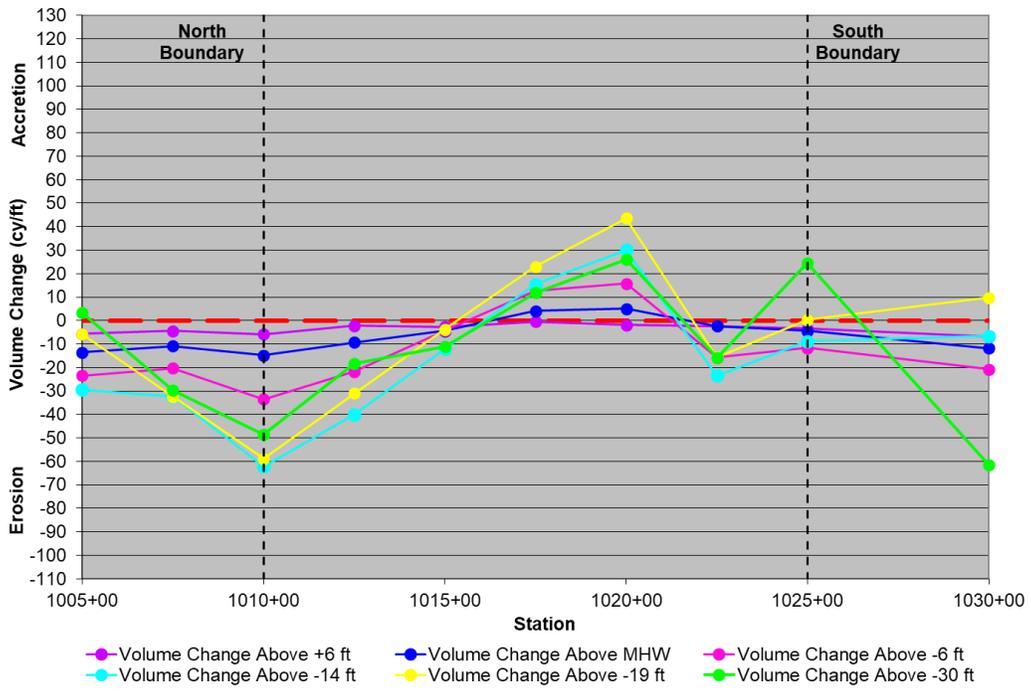


Figure 5-23. Nags Head – Reach 4 Unit Volume Change (2021 – 2022)

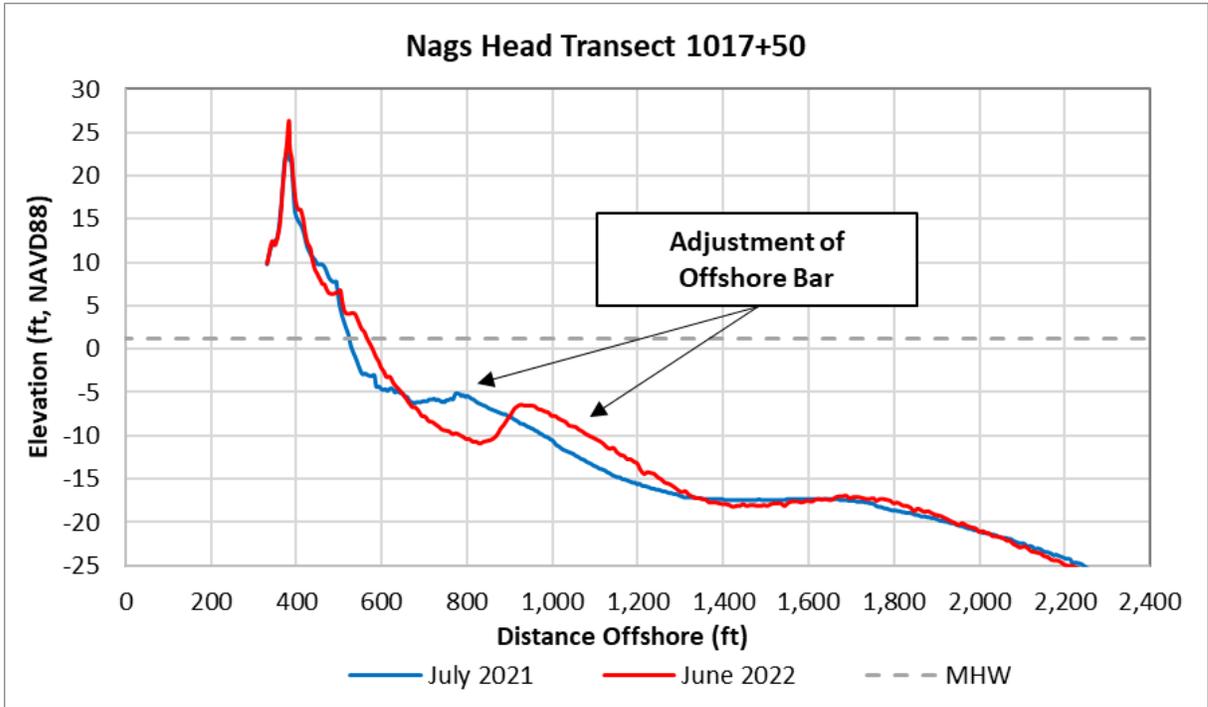


Figure 5-24. Example Reach 4 Profile, Station 1017+50 (S McCall Ct.)

5.3.7 National Seashore - North (2021 - 2022)

The National Seashore - North survey reach, extends approximately 17,500 ft between McCall Court and Oregon Inlet Campground. The National Seashore - North reach contains 23 survey transects (Station 1025+00 – 1200+00), varying in spacing between 1,000 ft (see **Figure 3-1**). A summary of average shoreline and volume changes between 2021 and 2022 for the National Seashore - North Reach is presented along with total oceanfront changes in **Table 5-16** and **Table 5-17**.

**Table 5-16. Average Shoreline and Average Unit Volume Change for National Seashore - North (2021 – 2022)**

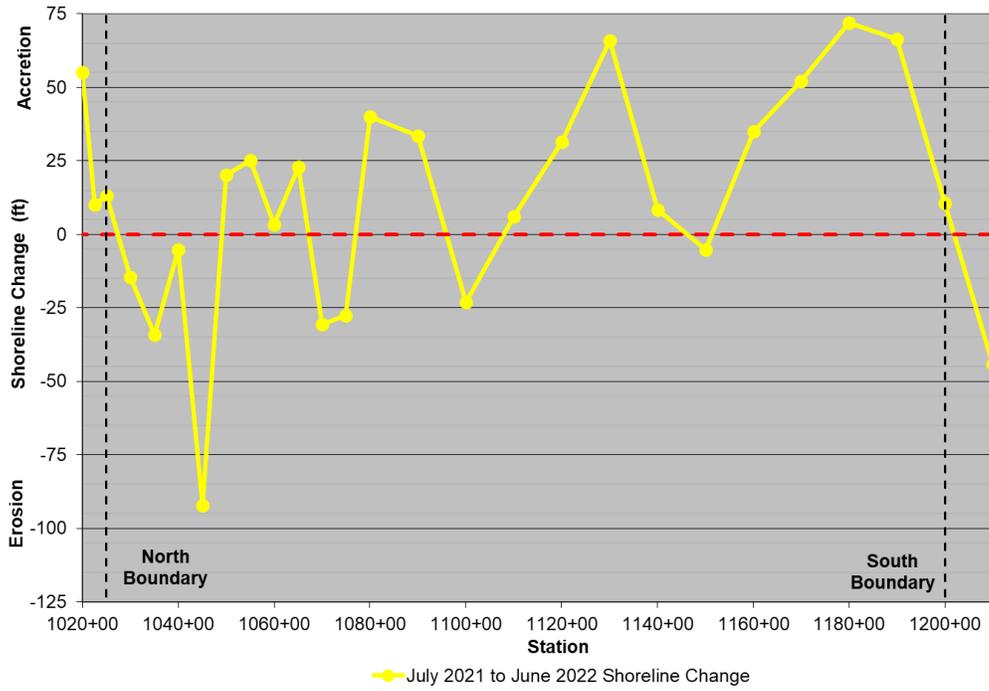
2021 vs. 2022 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
National Seashore - North	1025+00 - 1200+00	17,500	18.0	-0.3	-0.3	-0.7	-14.2	-4.2	12.9
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-18.6	-0.2	-4.7	-8.2	-25.2	-9.4	11.6

**Table 5-17. Cumulative Volume Change for National Seashore - North (2021 – 2022)**

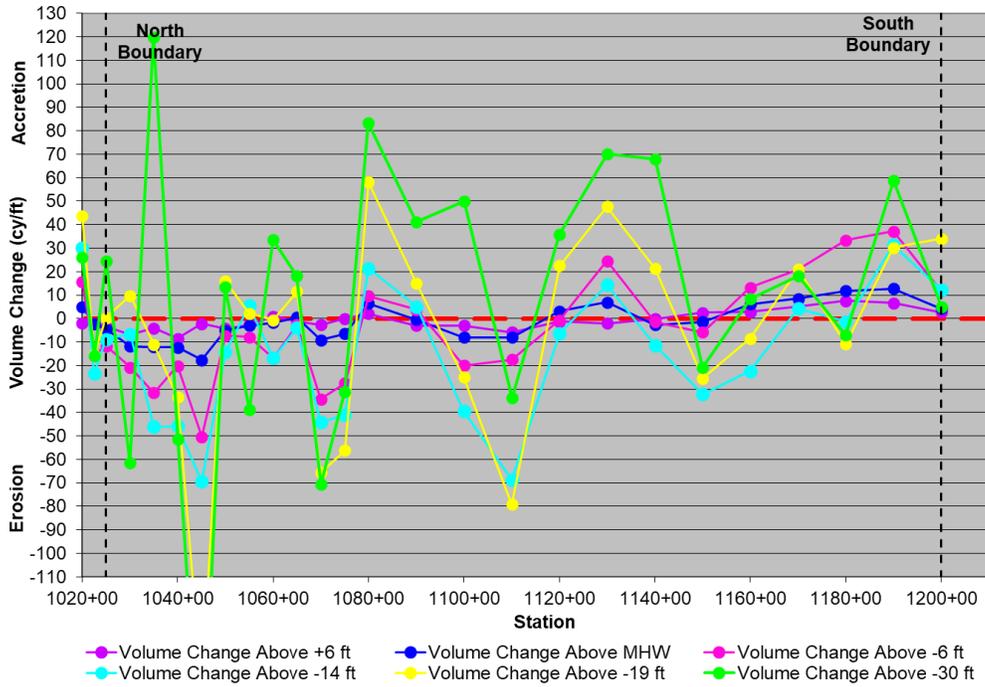
2021 vs. 2022 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
National Seashore - North	1025+00 - 1200+00	17,500	-4,477	-4,684	-11,673	-247,987	-73,314	225,532
Total Monitored Oceanfront	430+00 - 1200+00	77,000	-16,965	-363,029	-628,861	-1,959,257	-727,171	878,650

Shoreline change at MHW showed an overall average seaward advancement of 18.0 ft. **Figure 5-25** presents the shoreline changes at each transect, showing advancement along most of the transects.

Overall, the National Seashore - North reach experienced the largest volume losses above -14 ft NAVD88 of -247,987 cy (-14.2 cy/ft). **Figure 5-26** displays the unit volume change at each transect above the six elevations analyzed. As can be seen, a majority of transects experienced volume losses above -14 ft NAVD88. Profile plots in **Appendix B** show many instances where the offshore bar moved seaward to lower elevations. Additionally, in southern transects some material has been pushed onshore which led to seaward advancement of the shoreline. **Figure 5-27** shows an example profile that presents the seaward advancement of the shoreline and the offshore bar adjustment.



**Figure 5-25. National Seashore - North Shoreline Change (2021 – 2022)**



**Figure 5-26. National Seashore - North Unit Volume Change (2021 – 2022)**

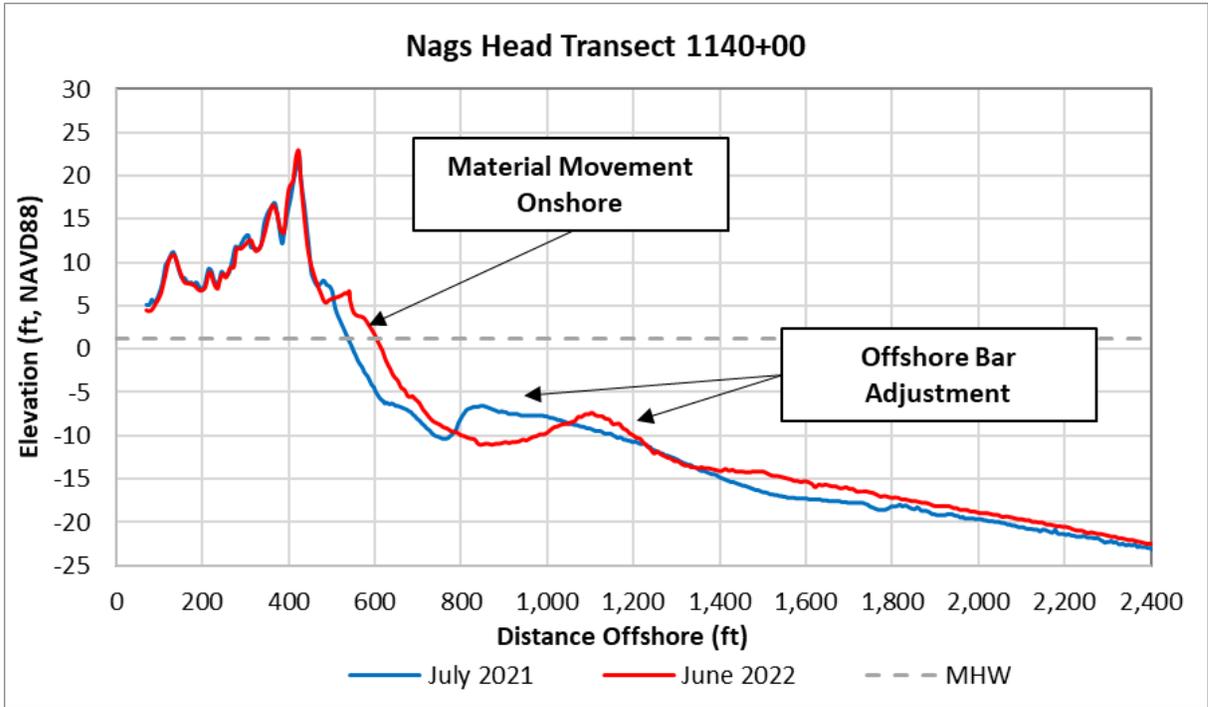
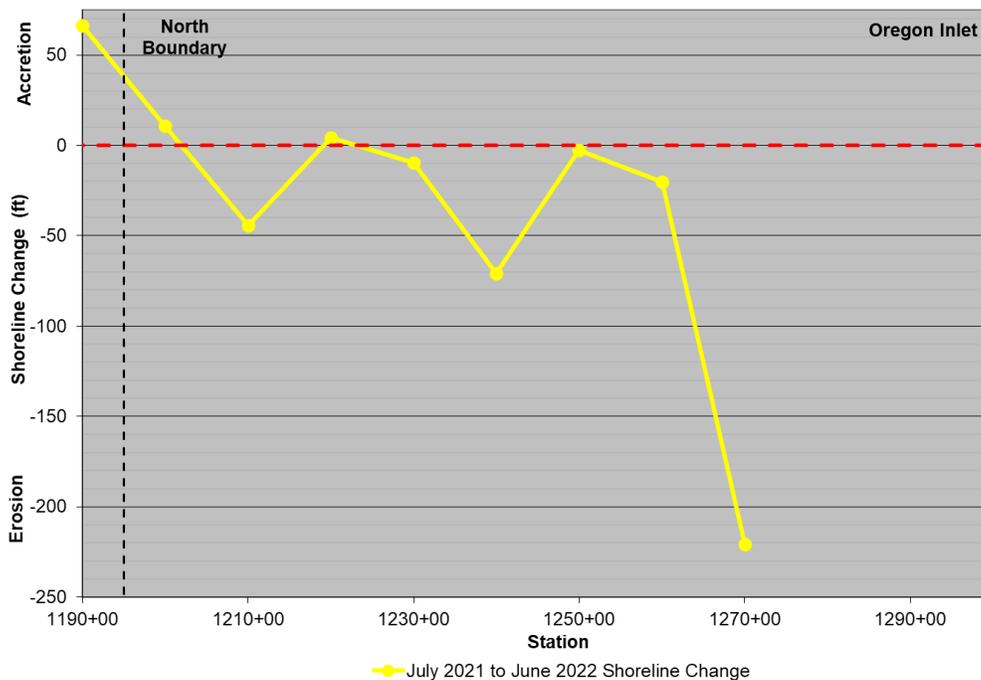


Figure 5-27. Example National Seashore - North Profile, Station 1130+00

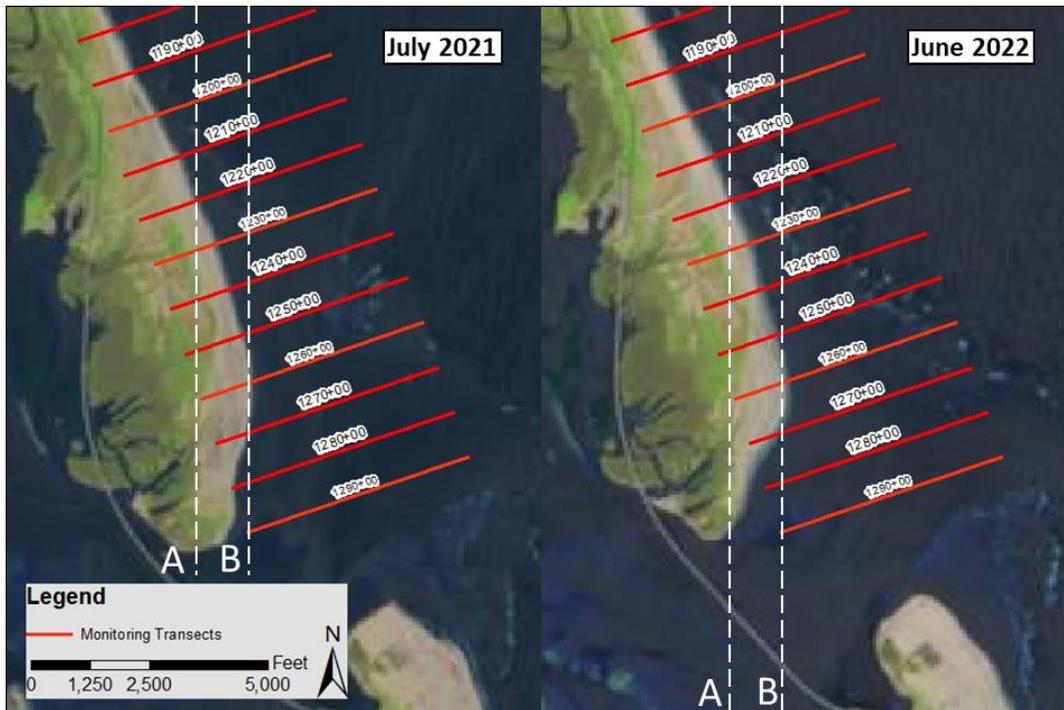
### 5.3.8 National Seashore - South (2021 - 2022)

The National Seashore - South survey reach extends approximately 9,000 ft north of Oregon Inlet, containing eight survey transects (Station 1200+00 – 1290+00), at 1,000 ft spacing (see **Figure 3-1**). Shorelines adjacent to an inlet are typically very active due to more complex hydrodynamics and often greater sediment transport rates, which can lead to more extreme profile changes from year to year. **Figure 5-28** presents the shoreline changes at each transect. As can be seen from the figure the majority of transects experienced recession or remained stable. **Figure 5-29** shows the aerial image of the Oregon Inlet from beginning and end of the monitoring period. During the monitoring period the Bodie Island Spit experienced material loss (**Figure 5-29**) which caused significant recession of the shoreline at Station 1270+00.

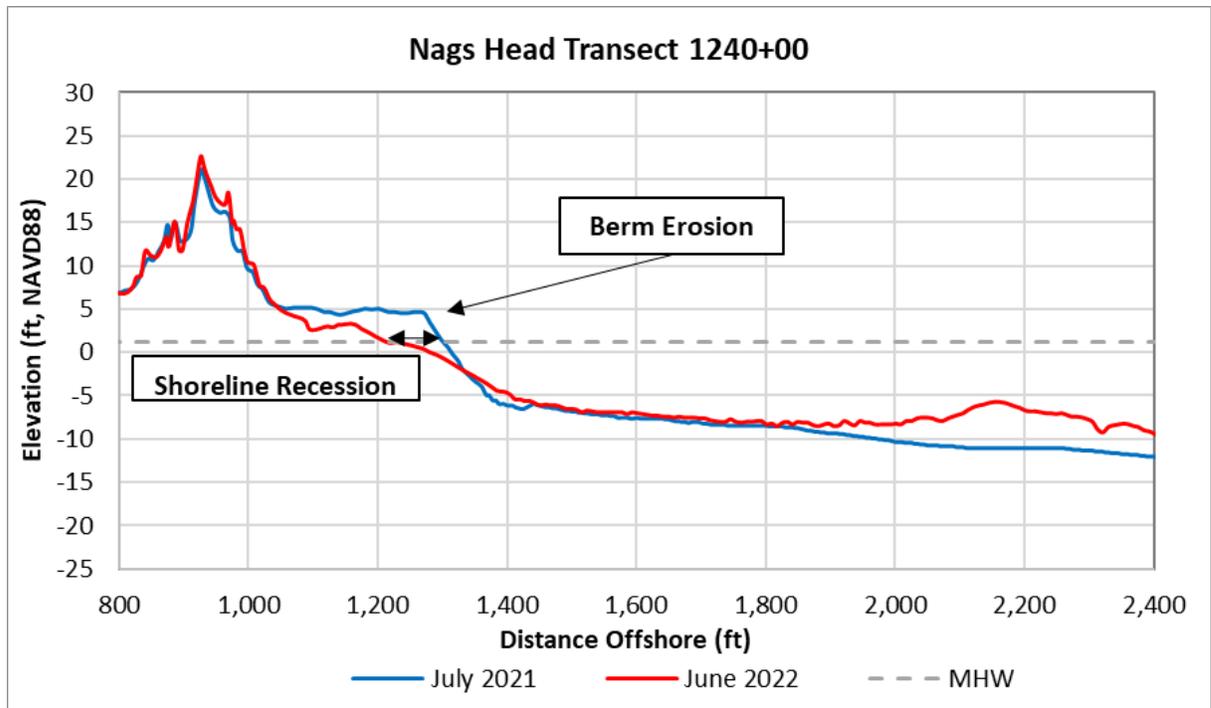
Due to the dynamic nature of Oregon Inlet, volume calculations were not meaningful. Instead, profile comparisons between summer 2021 and summer 2022 (**Appendix B**) were investigated to determine trends. At a majority of the profiles berm erosion was observed causing the recession of the shoreline. **Figure 5-30** shows an example profile that presents the erosion of the berm and resulting recession.



**Figure 5-28. National Seashore - South Shoreline Change (2021 – 2022)**



**Figure 5-29. Oregon Inlet Change (07/06/2021 USGS Sentinel Imagery; 06/26/2022 USGS-Sentinel Imagery)**



**Figure 5-30. Example National Seashore - North Profile, Station 1240 (Bodie Island Spit)**

5.3.9 Oceanfront Trends Summary for All Reaches (2021 - 2022)

**Table 5-18** and **Table 5-19** provides a summary of the shoreline and volume changes along Nags Head as presented in the previous sections along with average and total oceanfront values. For Nags Head, since each reach consists of a different length of shoreline, the calculations provide a weighted average for unit shoreline change (ft) and unit volume change (cy/ft) along the Nags Head oceanfront. The weighted average also accounts for differences in the shoreline length between each transect. **Figure 5-31** and **Figure 5-32** contains plots of the shoreline and volume changes between the summer 2021 and the summer 2022 surveys at each transect along Nags Head.

**Table 5-18. Nags Head Shoreline and Average Unit Volume Change Statistics (2021 – 2022)**

2021 vs. 2022 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - North	430+00 - 495+00	6,500	-29.5	-0.2	-5.6	-16.2	-6.0	-9.3	17.4
Nags Head - Reach 1	495+00 - 790+00	29,500	-20.9	1.8	-2.3	-6.6	-22.4	-6.9	18.5
Nags Head - Reach 2	790+00 - 920+00	13,000	-52.4	-1.2	-9.4	-14.9	-41.4	-16.2	7.6
Nags Head - Reach 3N	920+00 - 975+00	5,500	-48.6	-5.0	-16.8	-14.8	-58.8	-28.9	-17.0
Nags Head - Reach 3S	975+00 - 1010+00	3,500	-1.2	-4.8	-8.7	-9.0	-31.4	-0.8	4.8
Nags Head - Reach 4	1010+00 - 1025+00	1,500	7.0	-2.7	-4.2	-9.0	-16.1	-8.4	-8.3
National Seashore - North	1025+00 - 1200+00	17,500	18.0	-0.3	-0.3	-0.7	-14.2	-4.2	12.9
	Transects	Reach Length	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg
<b>Nourished Oceanfront</b>	<b>495+00 - 1025+00</b>	<b>53,000</b>	<b>-29.4</b>	<b>-0.2</b>	<b>-6.0</b>	<b>-9.7</b>	<b>-31.3</b>	<b>-11.1</b>	<b>10.5</b>
<b>Total Monitored Oceanfront</b>	<b>430+00 - 1200+00</b>	<b>77,000</b>	<b>-18.6</b>	<b>-0.2</b>	<b>-4.7</b>	<b>-8.2</b>	<b>-25.2</b>	<b>-9.4</b>	<b>11.6</b>

**Table 5-19. Nags Head Cumulative Volume Change Statistics (2021 – 2022)**

<b>2021 vs. 2022 (Total Change)</b>	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - North	430+00 - 495+00	6,500	-1,310	-33,641	-97,174	-35,918	-55,773	104,258
Nags Head - Reach 1	500+00 - 785+00	29,500	54,106	-68,497	-194,065	-661,266	-204,407	545,766
Nags Head - Reach 2	790+00 - 915+00	13,000	-15,103	-121,866	-193,265	-537,629	-210,098	98,910
Nags Head - Reach 3N	920+00 - 970+00	5,500	-28,673	-96,681	-85,271	-338,296	-166,218	-97,896
Nags Head - Reach 3S	975+00 - 1005+00	3,500	-16,714	-30,351	-31,671	-110,004	-2,709	16,663
Nags Head - Reach 4	1010+00 - 1025+00	1,500	-4,794	-7,309	-15,742	-28,157	-14,651	-14,582
National Seashore North	1030+00 - 1200+00	17,500	-4,477	-4,684	-11,673	-247,987	-73,314	225,532
	Transects	Reach Length	total	total	total	total	total	total
<b>Nourished Oceanfront</b>	<b>495+00 - 1025+00</b>	<b>53,000</b>	<b>-11,177</b>	<b>-324,704</b>	<b>-520,015</b>	<b>-1,675,352</b>	<b>-598,084</b>	<b>548,861</b>
<b>Total Monitored Oceanfront</b>	<b>430+00 - 1200+00</b>	<b>77,000</b>	<b>-16,965</b>	<b>-363,029</b>	<b>-628,861</b>	<b>-1,959,257</b>	<b>-727,171</b>	<b>878,650</b>

During the 2021-2022 monitoring period northern reaches significantly retreated whereas southern reaches experienced minor recession or seaward advancement. Among the nourished reaches, Reach 2 and Reach 3-North observed high recession rates. Reach 4 shoreline experienced minor seaward advancement whereas Reach 3-South shoreline slightly retreated. The National Seashore-North reach to the south of the Nourished Oceanfront also experienced seaward advancement.

The Nourished Oceanfront and Total Monitored Oceanfront both experienced losses in material along all the analyzed elevations except -30 ft NAVD88. In all management reaches, most material loss was observed above -14 ft NAVD88. This material loss was mostly caused by the erosion and adjustment of the offshore bar. The smaller losses above -19 ft NAVD88 indicate the transport and capture of some of the eroded material above the depth of closure. Over the Nourished Oceanfront -598,084 cy or -11.1 cy/ft of material was lost above -19ft NAVD88. The erosion experienced during the current year was higher than the historical background erosion rate (-6.9 cy/ft/yr). The higher erosion rates can likely be attributed to an active 2021-2022 storm season bringing 13 events with significant wave heights greater than 8 ft. Four of those events had significant wave heights greater than 15 ft whereas historical records show at most 1 event of this magnitude during previous monitoring periods. This indicates the potential for multiple high erosion events.

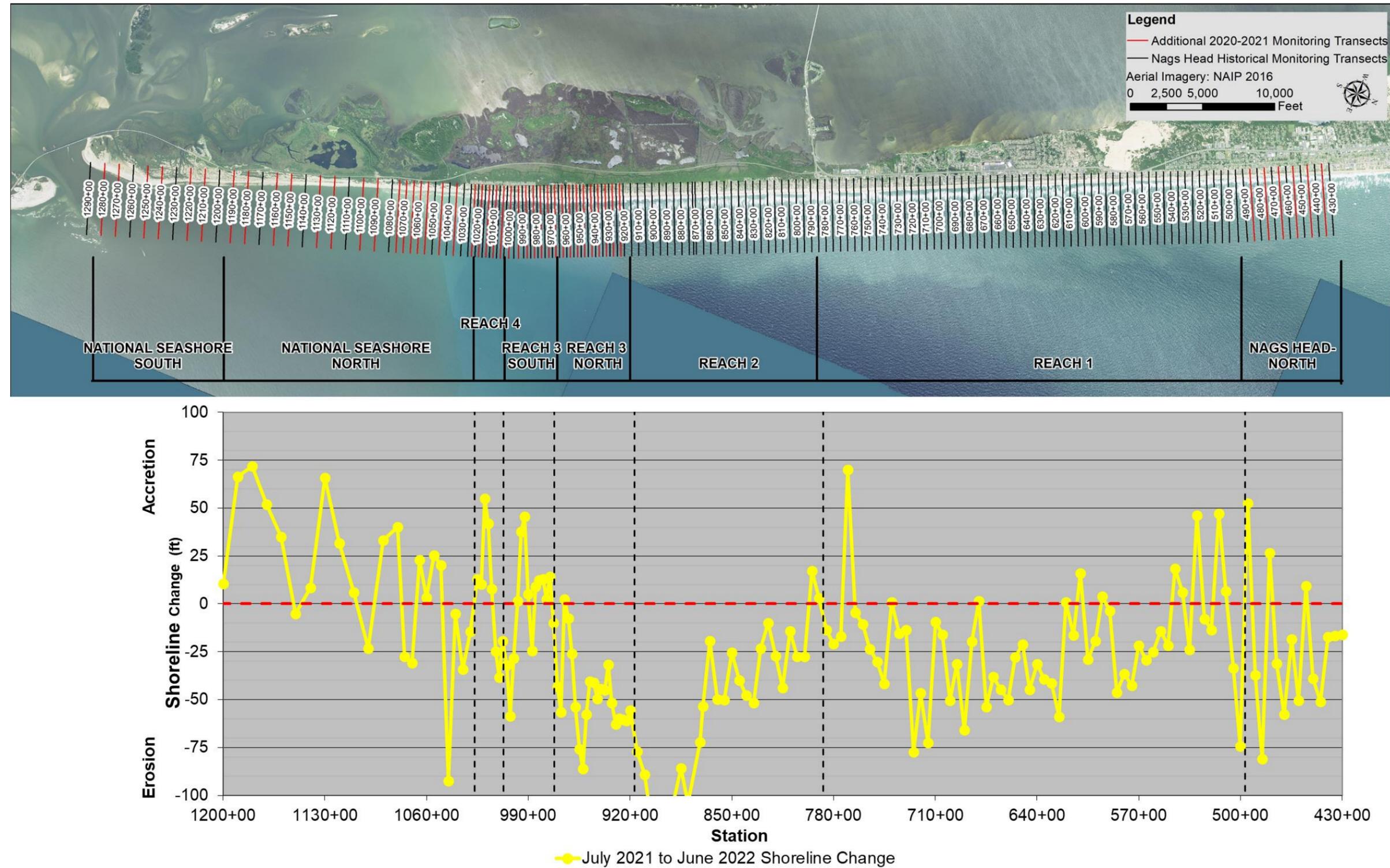


Figure 5-31. Nags Head – Oceanfront Shoreline Change (2021 – 2022)

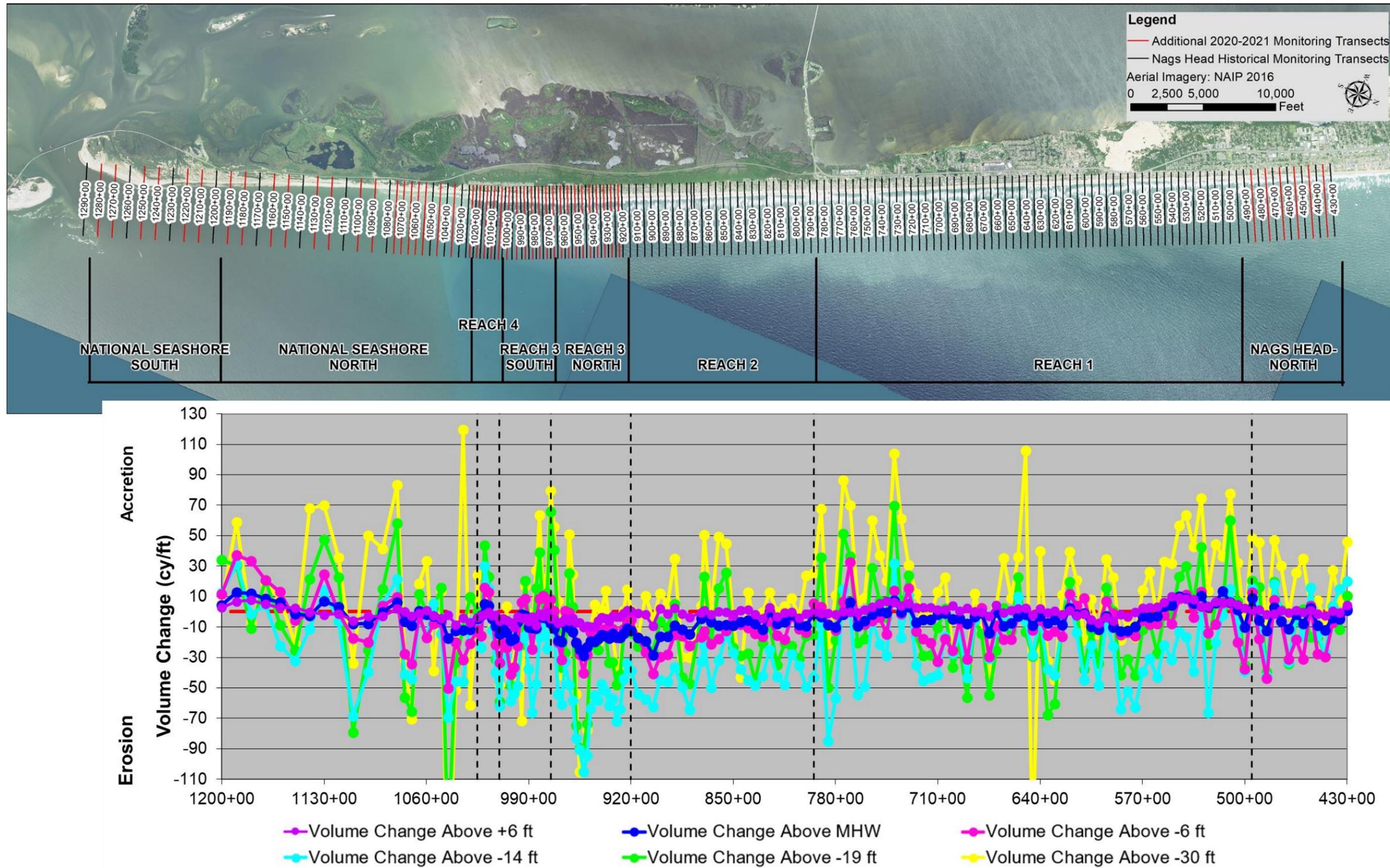
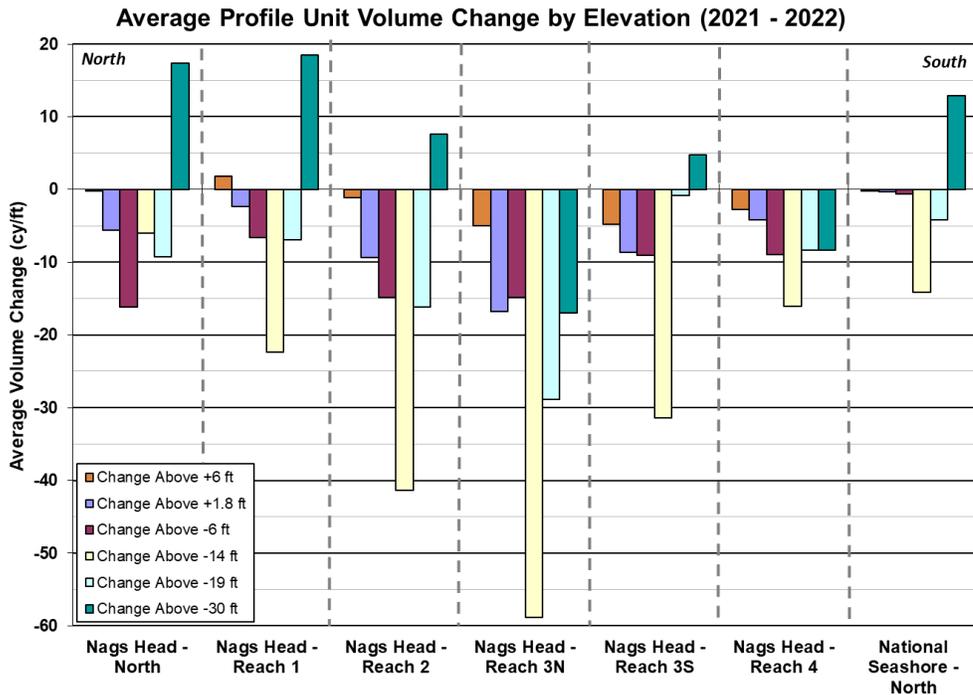


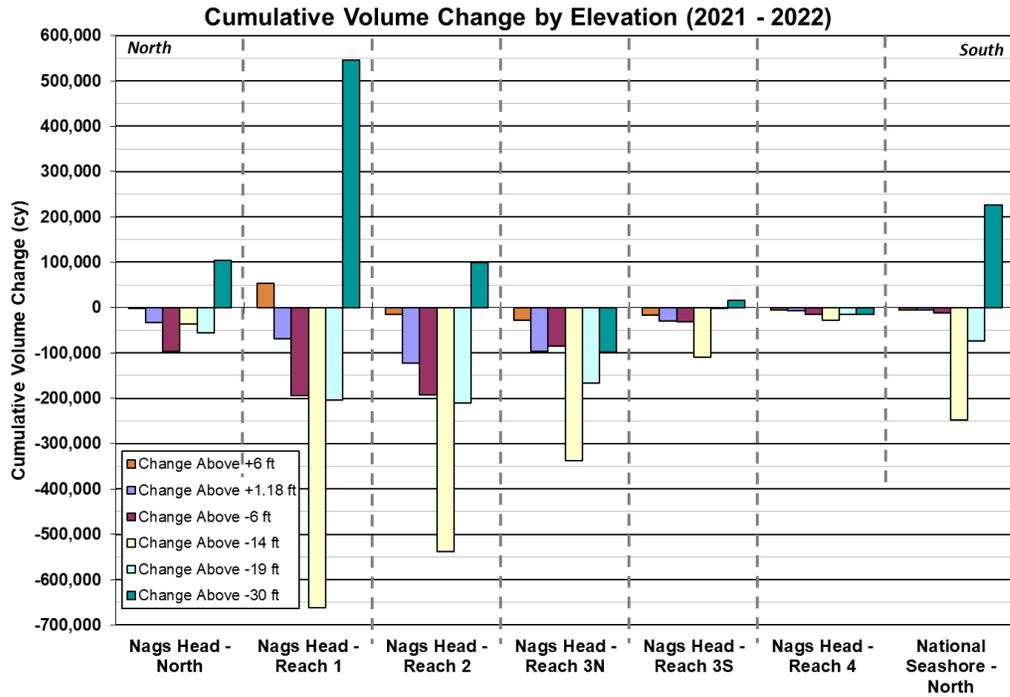
Figure 5-32. Nags Head – Unit Volume Change (2021 – 2022)

**Figure 5-33** and **Figure 5-34** display the trends seen in **Table 5-18** and **Table 5-19** with bar plots of the average unit volume changes as well as total cumulative volume changes at each sub-reach to help visualize changes that occurred to the Nags Head monitoring area as a whole and how the magnitude of changes compares from one reach to the next. Both figures show significant volume losses above -14 ft NAVD88 along all the monitored shoreline reaches. Apparent from these figures are increases in material loss above -14 ft NAVD88 and -19 ft NAVD88 along Reach 1, Reach 2 and Reach 3N; the rate of material loss above -19 ft NAVD88 decreased at the southern reaches Reach 3S and Reach 4. The minor material loss above -19 ft NAVD88 at Reach 3S and relatively small loss at Reach 4 compared to historical erosion rates (**Table 5-3**) might indicate drift of material from northern reaches to southern reaches.

The survey data can indicate the volume change experienced across the surveyed area, but analysis of the data alone is not always sufficient to determine how or why these changes occurred. A detailed explanation of the processes by which the indicated gains and losses occurred is beyond the scope of this monitoring evaluation report. Numerical modeling and coastal engineering analysis taking place as part of the Town’s ongoing beach nourishment master planning project may further investigate those sediment movement processes.



**Figure 5-33. Average Unit Volume Change Within Each Reach (2021 – 2022)**

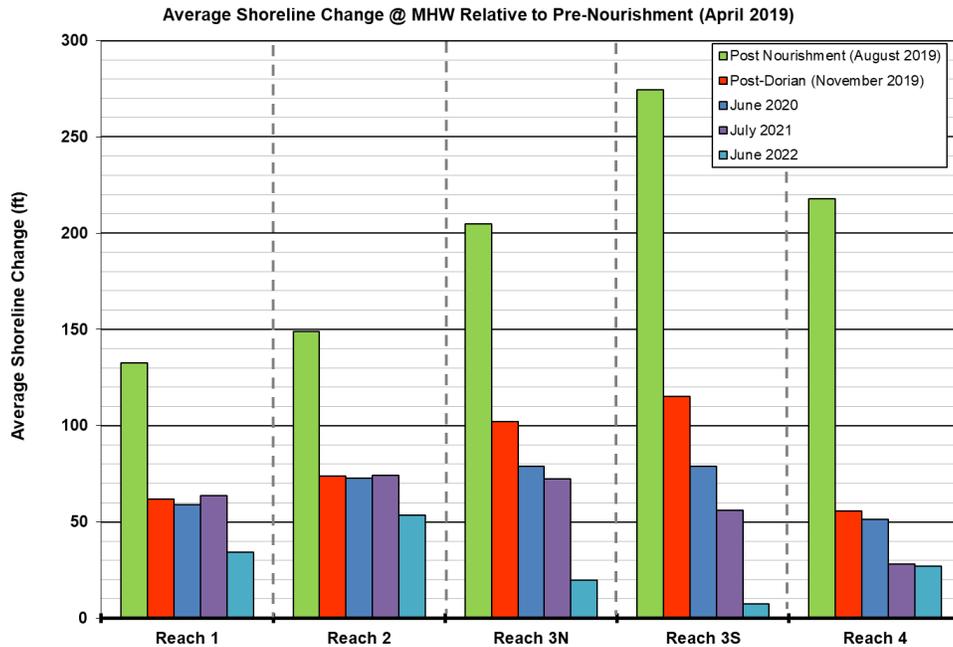


**Figure 5-34. Cumulative Volume Change Within Each Reach (2021 – 2022)**

### 5.4 Nourished Oceanfront Performance Relative to Pre-Nourishment

Construction of the 2019 Nags Head Beach Nourishment Project was carried out between May 1, 2019 and August 18, 2019. During the project, a total of 4 million cy of material was placed along approximately 10 miles of shoreline. CSE conducted a pre-construction survey in April 2019. To quantify the performance of the nourishment project, the volume changes between the pre-nourishment survey and the subsequent monitoring surveys were analyzed.

**Figure 5-35** illustrates the shoreline changes relative to pre-nourishment condition (April 2019) along the Nourished Oceanfront. As can be seen from the figure, the shoreline experienced a significant landward recession along the Nourished Oceanfront since the completion of the 2019 nourishment project. The major part of the recession that has occurred since nourishment occurred before the post-Dorian survey which indicates that most of the recession can be attributed to Hurricane Dorian. However, during the 2021-2022 further significant recession occurred at all reaches except Reach 4.



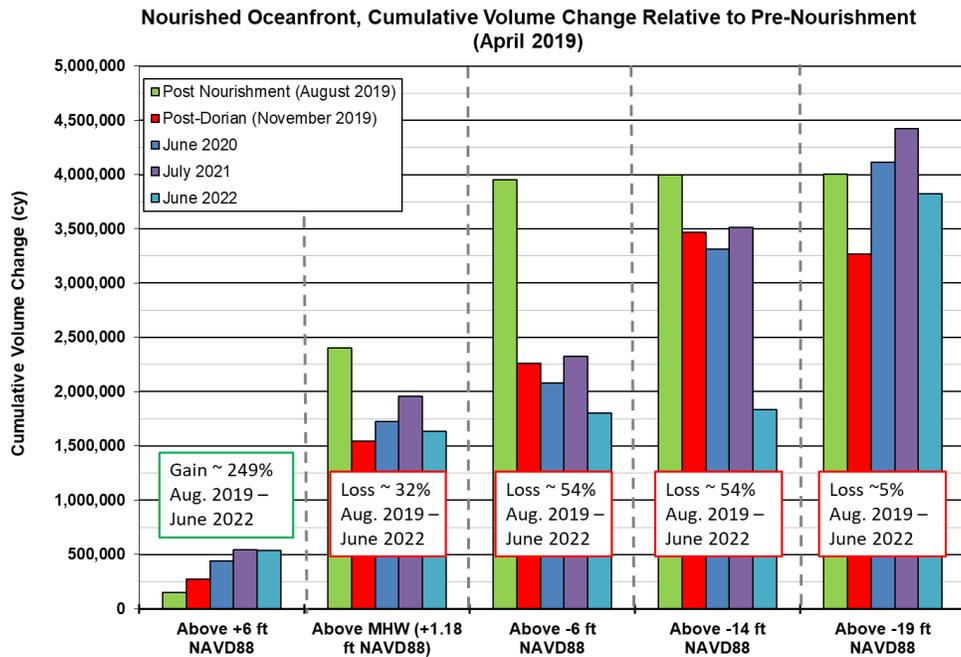
**Figure 5-35. Nourished Oceanfront Average Shoreline Change Relative to Pre-Nourishment Conditions**

**Figure 5-36** and **Table 5-20** presents the volume changes relative to pre-nourishment conditions (April 2019) above six elevations along the Nourished Oceanfront. The Nourished Oceanfront experienced gains in material along the upper (+6 ft NAVD88) portions of the profiles. Material losses were experienced above MHW, -6 ft NAVD88 and -14 ft NAVD88 and -19 ft NAVD88.

**Table 5-20** shows that the total volume change above -19 ft NAVD88. The results confirmed that since the completion of the 2019 nourishment project approximately 182,016 cy (-3.4 cy/ft) volume loss was observed above -19 ft NAVD88 along the Nourished Oceanfront. However, the results show large-scale shifts of sand cross-shore, across different elevations. Most notably, the results show that approximately 95% of the volume present in August 2019 above -19 ft NAVD88 remains in the system through the June 2022 survey.

**Table 5-20. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment Conditions**

	Reaches	Stations	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88
Pre-Nourishment (April 2019) -Post Nourishment (August 2019)	Reach 1	495+00 - 790+00	47,918	1,258,165	1,693,618	1,755,354	1,762,213
	Reach 2	790+00 - 920+00	15,959	568,190	861,317	883,160	885,587
	Reach 3N	920+00 - 975+00	45,018	447,070	602,835	579,316	576,703
	Reach 3S	975+00 - 1010+00	24,590	94,184	521,783	538,928	540,833
	Reach 4	1010+00 - 1025+00	19,612	37,063	270,325	242,401	239,298
	<b>Nourished Oceanfront</b>	<b>495+00 - 1025+00</b>	<b>153,098</b>	<b>2,404,672</b>	<b>3,949,879</b>	<b>3,999,158</b>	<b>4,004,634</b>
Pre-Nourishment (April 2019) -Post Dorian (November 2019)	Reach 1	495+00 - 790+00	122,742	890,211	1,043,259	1,670,583	1,649,959
	Reach 2	790+00 - 920+00	53,589	441,740	550,539	906,718	817,193
	Reach 3N	920+00 - 975+00	53,200	273,200	304,616	414,929	388,407
	Reach 3S	975+00 - 1010+00	29,753	-14,098	295,230	387,901	350,928
	Reach 4	1010+00 - 1025+00	10,924	-47,450	67,788	85,461	62,951
	<b>Nourished Oceanfront</b>	<b>495+00 - 1025+00</b>	<b>270,208</b>	<b>1,543,604</b>	<b>2,261,432</b>	<b>3,465,591</b>	<b>3,269,438</b>
Pre-Nourishment (April 2019) - June 2020	Reach 1	495+00 - 790+00	193,057	964,264	991,610	1,633,023	2,052,621
	Reach 2	790+00 - 920+00	110,115	502,260	554,438	935,933	1,109,539
	Reach 3N	920+00 - 975+00	72,432	288,994	261,920	383,133	526,039
	Reach 3S	975+00 - 1010+00	41,649	-4,082	235,215	316,084	354,188
	Reach 4	1010+00 - 1025+00	21,996	-28,740	33,984	45,101	71,796
	<b>Nourished Oceanfront</b>	<b>495+00 - 1025+00</b>	<b>439,248</b>	<b>1,722,697</b>	<b>2,077,167</b>	<b>3,313,273</b>	<b>4,114,183</b>
Pre-Nourishment (April 2019) - July 2021	Reach 1	495+00 - 790+00	272,387	1,144,705	1,177,224	1,849,575	2,263,667
	Reach 2	790+00 - 920+00	139,655	559,446	705,370	1,035,767	1,250,047
	Reach 3N	920+00 - 975+00	75,007	303,408	242,005	349,588	511,176
	Reach 3S	975+00 - 1010+00	39,685	-14,715	184,822	252,470	316,292
	Reach 4	1010+00 - 1025+00	18,948	-35,699	15,219	22,910	79,520
	<b>Nourished Oceanfront</b>	<b>495+00 - 1025+00</b>	<b>545,682</b>	<b>1,957,146</b>	<b>2,324,639</b>	<b>3,510,310</b>	<b>4,420,702</b>
Pre-Nourishment (April 2019) - June 2022	Reach 1	495+00 - 790+00	326,493	1,076,208	983,159	1,188,310	2,059,260
	Reach 2	790+00 - 920+00	124,552	437,580	512,104	498,138	1,039,949
	Reach 3N	920+00 - 975+00	46,334	206,727	156,733	11,292	344,958
	Reach 3S	975+00 - 1010+00	22,972	-45,066	153,151	142,466	313,583
	Reach 4	1010+00 - 1025+00	14,154	-43,008	-523	-5,248	64,869
	<b>Nourished Oceanfront</b>	<b>495+00 - 1025+00</b>	<b>534,504</b>	<b>1,632,442</b>	<b>1,804,624</b>	<b>1,834,958</b>	<b>3,822,618</b>

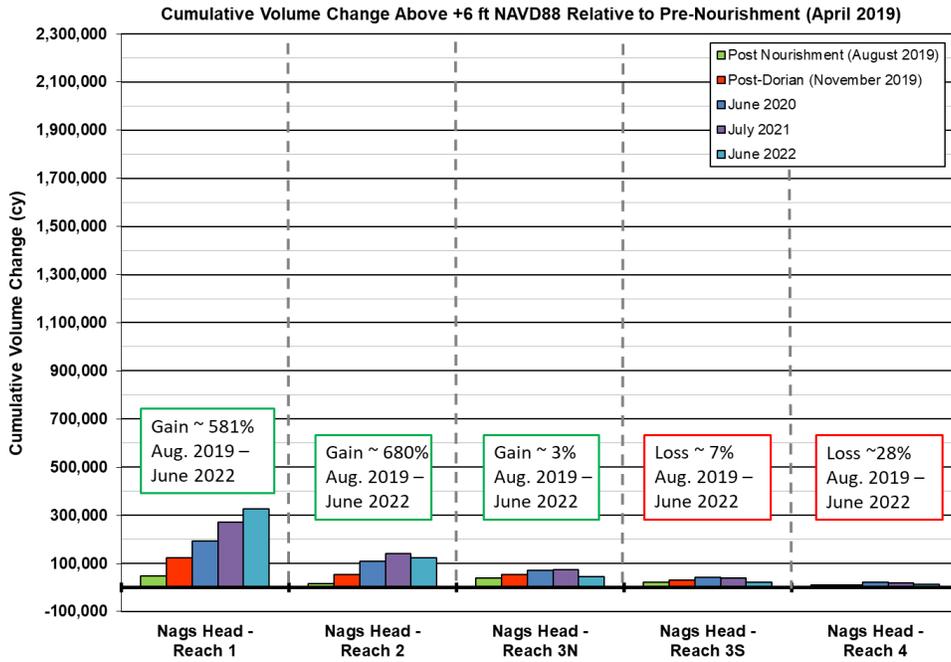


**Figure 5-36. Nourished Oceanfront Cumulative Volume Change Relative to Pre-Nourishment**

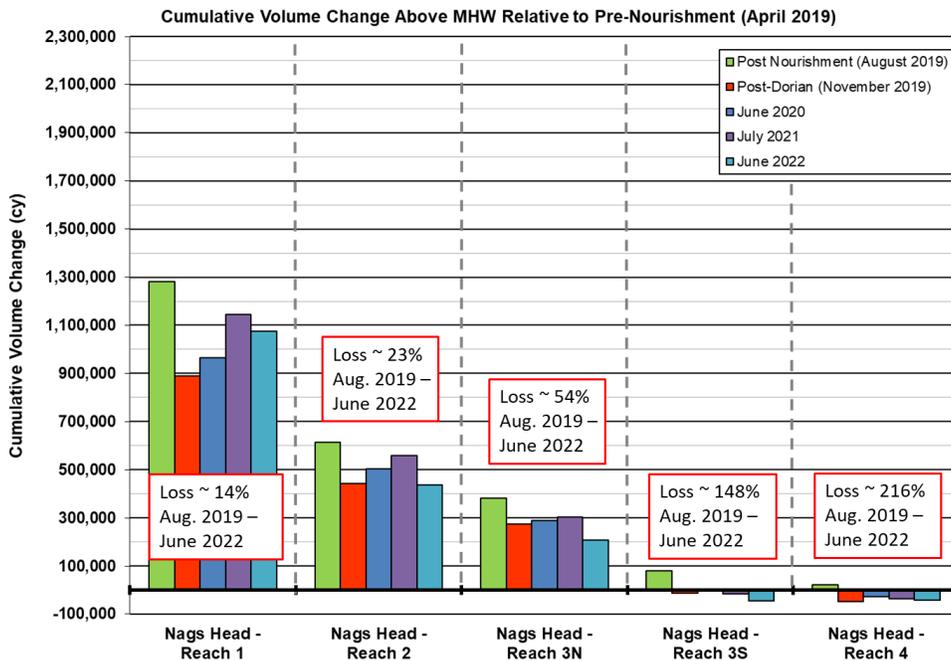
**Figure 5-37** illustrates the volume changes relative to pre-nourishment conditions (April 2019) above +6 ft NAVD88 along the Nourished Oceanfront. During the current monitoring period Reach 3S and Reach 4 showed some volume loss above +6 ft NAVD88 since the completion of nourishment project.

**Figure 5-38** shows the volume changes relative to pre-nourishment conditions (April 2019) above MHW (+1.18 ft NAVD88) along the Nourished Oceanfront. All the reaches lost material above MHW since the completion of nourishment project. The majority of losses occurred due to Hurricane Dorian. During the current monitoring all reaches experienced material losses above MHW. Reaches 3S and Reach 4 loss all the material that was placed above MHW during the 2019 nourishment project.

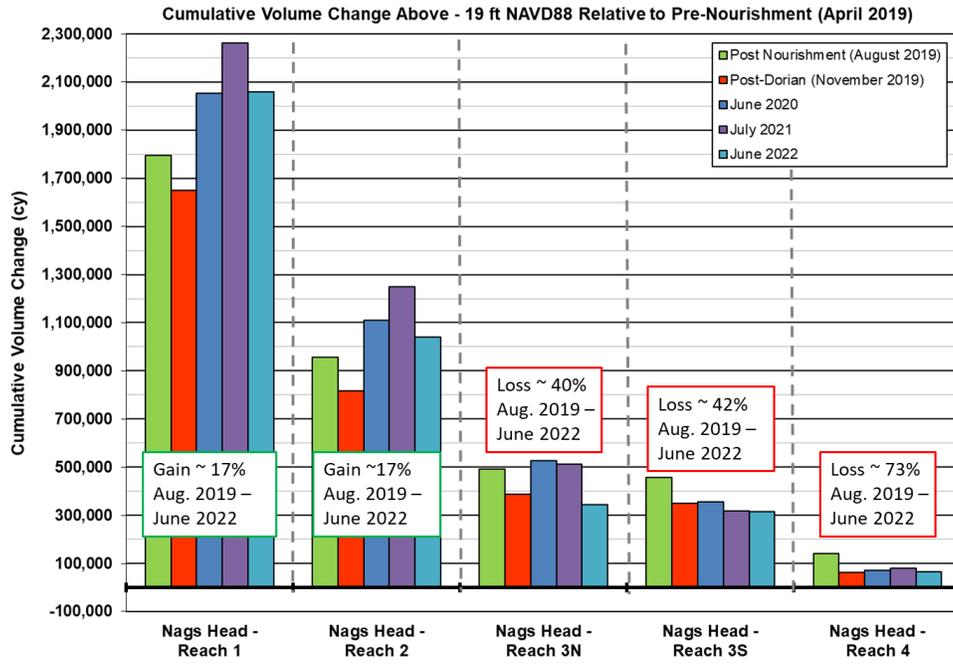
**Figure 5-39** presents the volume changes relative to pre-nourishment conditions (April 2019) above -19 ft NAVD88 along the Nourished Oceanfront. Reach 1 and Reach 2 show volume gain above -19 ft NAVD88 relative to the pre-nourishment conditions. However, at the remaining reaches of the nourished oceanfront, volume losses were observed extending below -19 ft NAVD88 indicating material loss well beyond the depth of closure that will likely not migrate back onshore.



**Figure 5-37. Cumulative Volume Change Above +6 ft NAVD88 Relative to Pre-Nourishment**



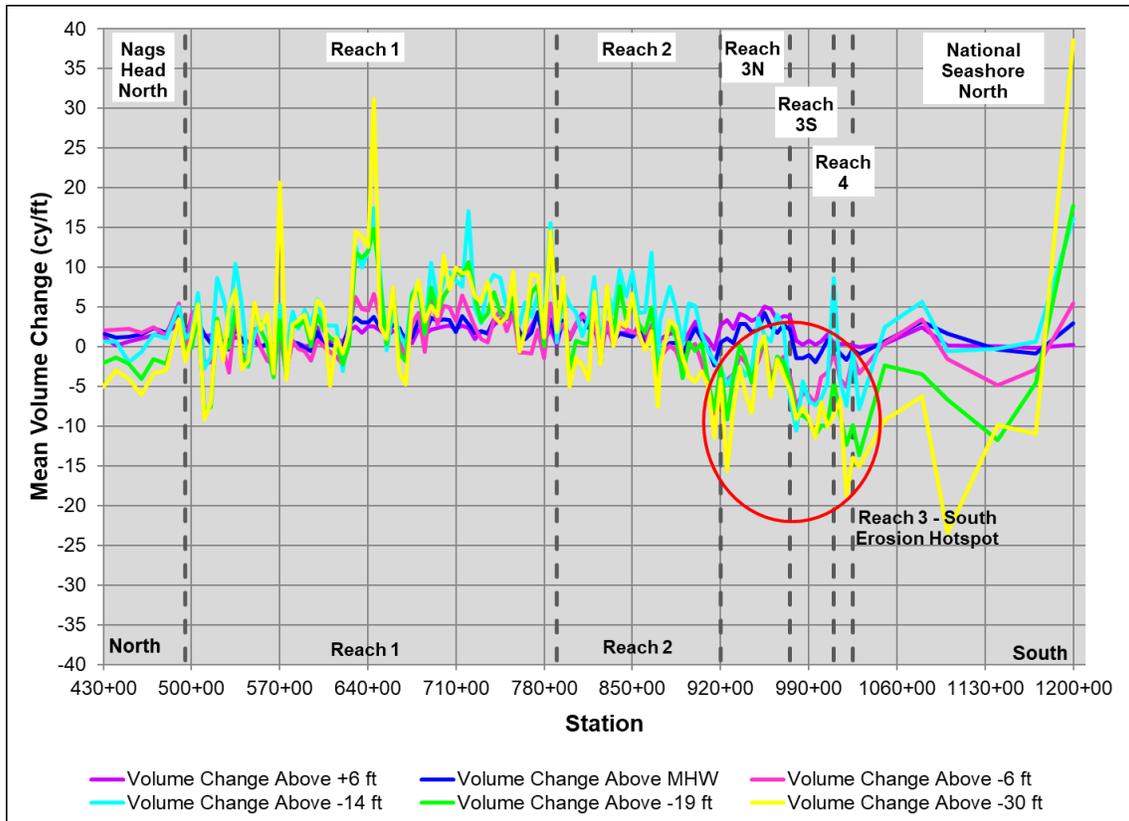
**Figure 5-38. Cumulative Volume Change Above MHW Relative to Pre-Nourishment**



**Figure 5-39. Cumulative Volume Change Above -19 ft NAVD88 Relative to Pre-Nourishment**

### 5.5 Long-Term Change Trends (2011 – 2021)

To determine the long-term trends along Nags Head, annual volume changes from the present and previous monitoring reports were averaged at each transect. Material placed during the 2019 Beach Nourishment project was subtracted out of the total volume change at each transect in order to determine the background erosion rate. **Figure 5-40** shows the mean volume change from 2011 to 2022 with nourishment, and **Figure 5-41** shows the mean volume change over the same years with the nourishment subtracted out. In comparison of the two figures, the hotspot at Reach 3-South (in the center of the red circle on each figure) is very visible when nourishment effects are subtracted out. In both figures increases in volume losses from north to south can be observed. The majority of profiles to the south of Reach 2 experience volume losses above all elevations analyzed when the nourishment material is subtracted.



**Figure 5-40. Mean Volume Change per year (2011 – 2022) (With Nourishment)**

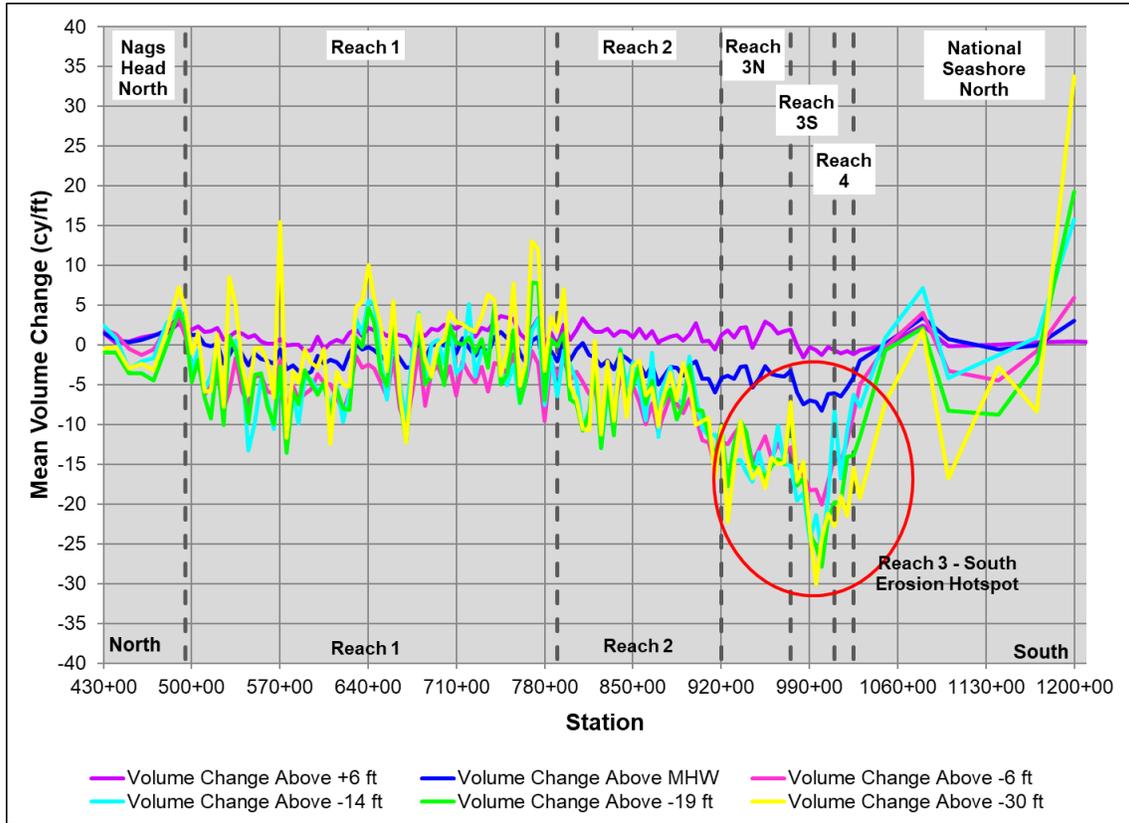


Figure 5-41. Mean Volume Change per year (2011 – 2022) (Without Nourishment)

## 5.6 Dune Volume Trends

After the 2011 Beach Nourishment study it was noted (CSE 2018) that sand fencing has managed to capture the wind-blown sand and caused steady dune growth until 2014. The dune growth rates declined after 2014 as the available sand for aeolian transport decreased. Shoreline recession and reduction in dry beach width for aeolian transport caused dunes to lose sand from 2016 to 2018. The wider beaches created by the 2019 Beach Nourishment Project allowed for aeolian transport, and during the next two monitoring periods (2019-2020 and 2020-2021) dune growth was observed above +6 ft NAVD88. During the current monitoring period dune growth was only observed at Reach 1. Most significant material losses above +6 ft NAVD88 was observed at Reach 3-North and Reach 3-South of -28,673 cy (-5.0 cy/ft) and -16,714 cy (-4.8 cy/ft) respectively (**Table 5-18**).

In an attempt to determine the vulnerable locations, the mean volume change +6 ft NAVD88 in between 2011 and 2019 beach nourishment projects was examined. **Figure 5-42** shows the mean volume change above +6 ft NAVD88, indicating two erosional locations. The first location is observed at Reach 1, in front of the Jockey's Ridge State Park, between E Hollowell Street and E Soundside Road. The second area covers the south part of the monitoring area starting from the hotspot location at Reach 3-South and extending south to National Seashore – North reach. The rest of the dunes across the Nags Head Oceanfront display either volume gain or no overall change.

To investigate how the volume changes occurred over time a moving average analysis was done by averaging the unit volume of a profile with profiles within 1,000 ft distance to it. Using moving average helps visualize the trends by displaying the localized trends while smoothing the instantaneous changes of volume between profiles. **Figure 5-43** presents the moving average analysis of unit volumes above +6 NAVD88 ft along the monitoring shoreline from 2019 to 2022, displaying the same dune erosion locations.

Dune growth/erosion locations observed during the current monitoring period were mostly similar to the locations observed during the monitoring periods following the 2019 nourishment. However, during current monitoring period 4 locations outside of the historical erosion locations were observed, where dune volumes were smaller compared to 2019 post-nourishment dunes. These locations were marked in the **Figure 5-43** with arrows. Following the 2019 Nourishment project dune growth is observed south of the 1130+00 transect along the National Park Service (NPS) managed area. This is likely due to material shifting south and providing more material to boost aeolian transport.

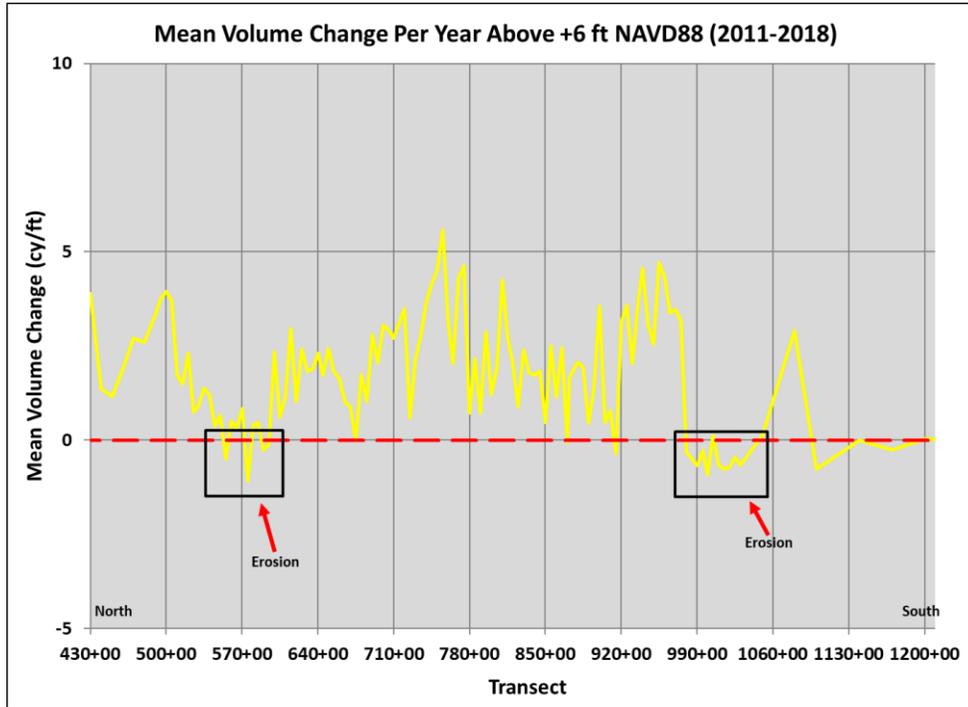


Figure 5-42. Unit Dune Volume Change from 2011 to 2018 (Moving Average Trend Above +6 ft NAVD88)

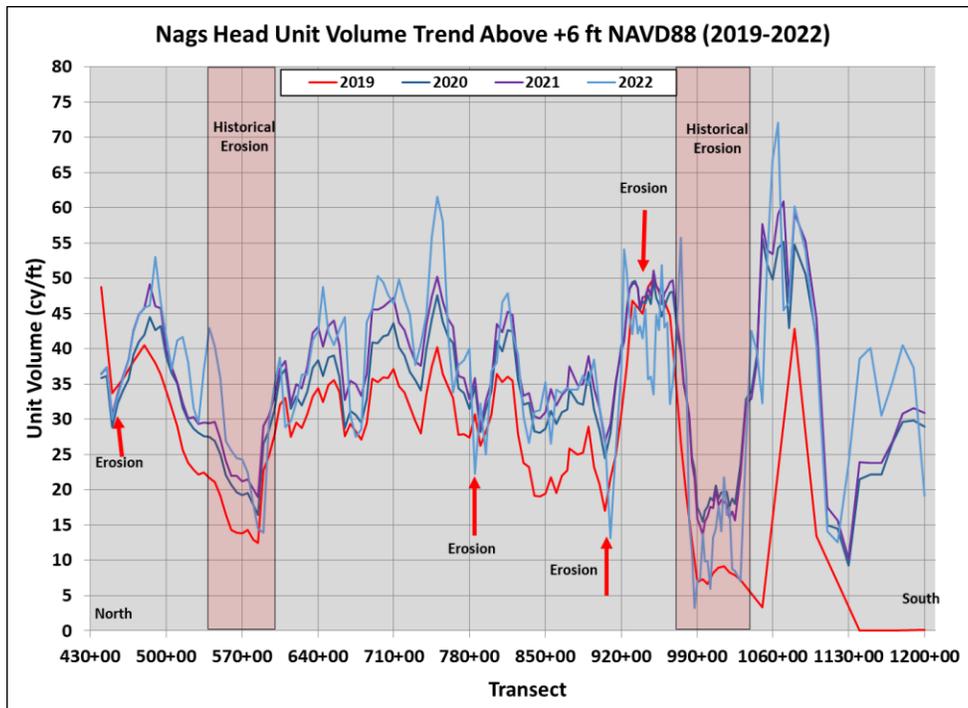


Figure 5-43. Unit Dune Volume by Year (Moving Average Trend Above +6 ft NAVD88)

## 6.0 SUMMARY

The Town of Nags Head Beach Monitoring and Maintenance Plan is sponsored by the Town of Nags Head (Town) as a continuation of the 2011 monitoring program initiated for assessing beach conditions. The primary purpose of the program is to assess current and historical shoreline conditions, determine shoreline and volumetric changes and evaluate the performance of beach nourishment and other restoration efforts. Evaluating and documenting these changes consistently over successive years provides information necessary to plan for future beach nourishments and to support development of the Town's multi-decadal Beach Nourishment Master Plan.

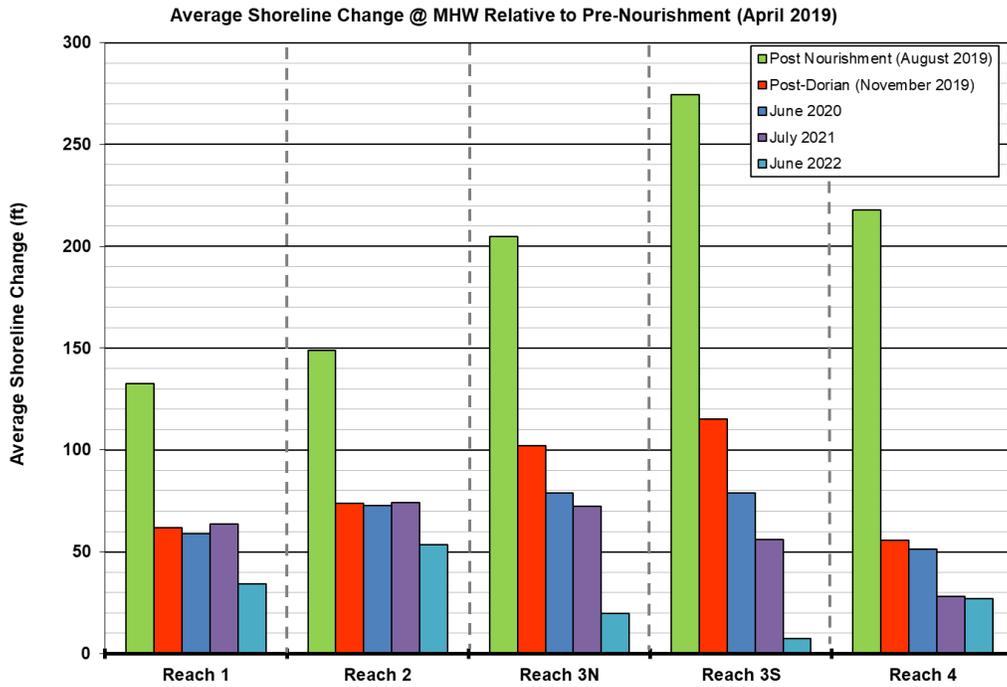
The most recent set of annual survey data was collected by McKim & Creed on June 21-29. This report documents the data sources, methods, and results of a survey evaluation by Moffatt & Nichol performed to compare the June 2022 with a previous survey performed by McKim & Creed in July 2021.

The survey data was used to compute shoreline change at Mean High Water (MHW), which is designated as +1.18 ft NAVD88 for Nags Head, and volume change above +6 ft NAVD88 (berm), MHW, -6 ft NAVD88 (wading depth), -14 ft NAVD88 (outer bar), -19 ft NAVD88 (approximate depth of closure), and -30 ft NAVD88 (offshore). This allows a detailed review of the shoreline and active profile performance during the 2021-2022 monitoring period.

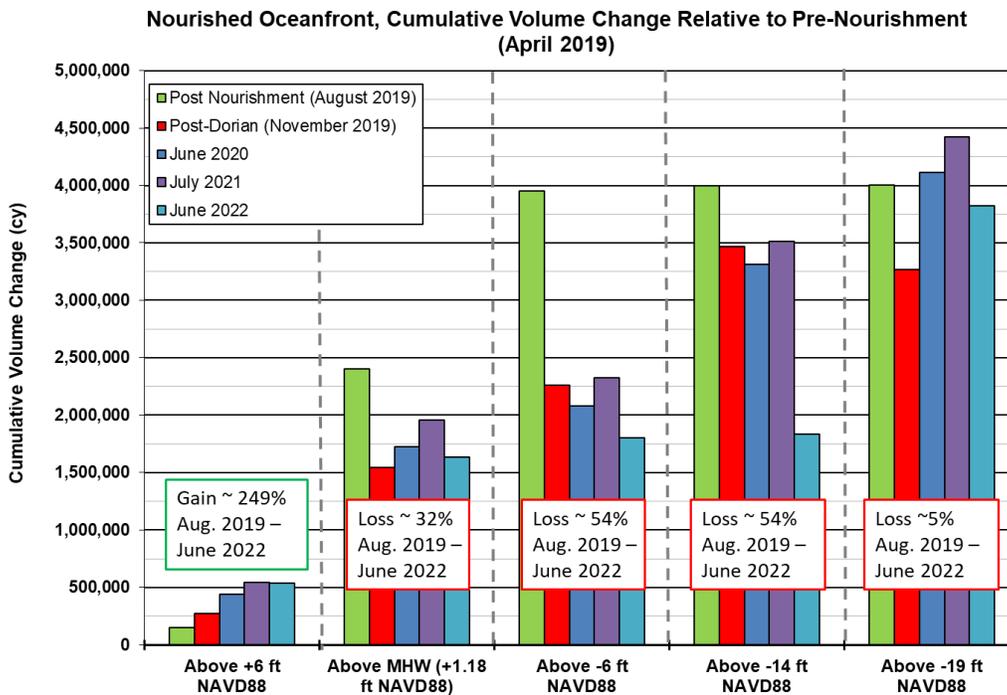
During 2019 Beach Nourishment Project approximately 4.0 million cy of material was placed along approximately 10 miles of shoreline. The shoreline position and volume changes above six elevations relative to pre-nourishment conditions (April 2019) along the Nourished Oceanfront (Station 495+00 – 1025+00) are illustrated below.

**Figure 6-1** shows the shoreline changes relative to pre-nourishment condition (April 2019) along the Nourished Oceanfront. As can be seen from the figure, the shoreline experienced a significant landward recession along the Nourished Oceanfront since the completion of the 2019 nourishment project. The major part of the recession that has occurred since nourishment occurred before the post-Dorian survey which indicates that most of the recession can be attributed to Hurricane Dorian. However, during the 2021-2022 further significant recession occurred at all reaches except Reach 4.

**Figure 6-2** illustrates that the overall changes in sand volume vary with the depth above which volumes are assessed. The results confirmed that since the completion of the 2019 nourishment project approximately 182,016 cy (-3.4 cy/ft) volume loss was observed above -19 ft NAVD88 along the Nourished Oceanfront. However, the results show large-scale shifts of sand cross-shore, across different elevations. Most notably, the figure shows that approximately 95% of the volume present in August 2019 above -19 ft NAVD88 remains in the system through the June 2022 survey.

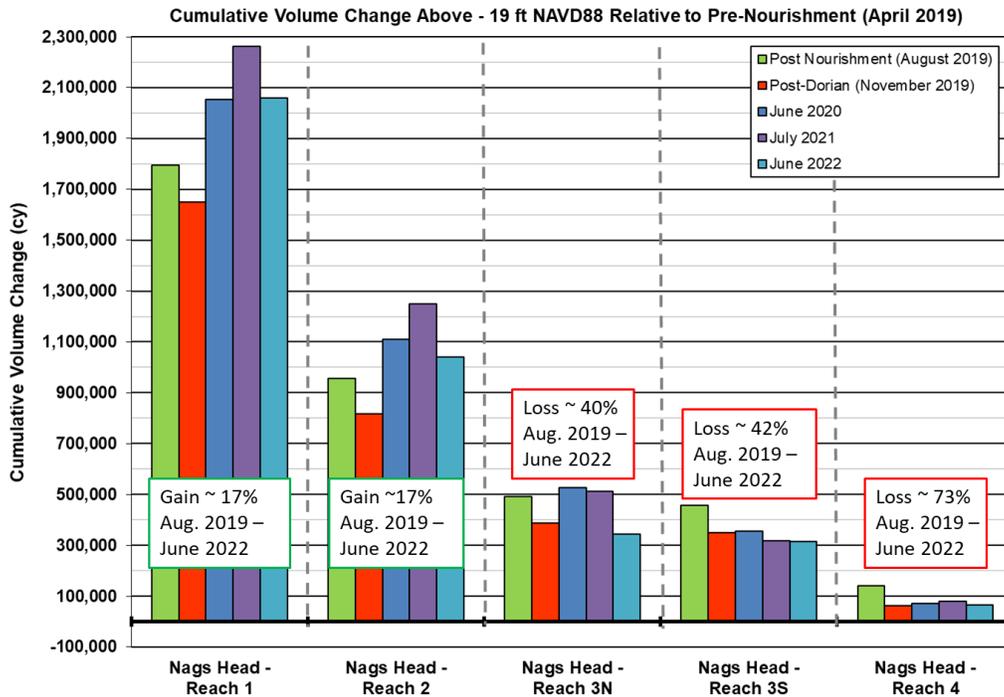


**Figure 6-1. Nourished Oceanfront Average Shoreline Change Relative to April 2019 Pre-Nourishment Conditions**



**Figure 6-2. Nourished Oceanfront Cumulative Volume Change Relative to April 2019 Pre-Nourishment Conditions**

**Figure 6-3** presents the volume changes relative to pre-nourishment conditions (April 2019) above -19 ft NAVD88 along the Nourished Oceanfront. Reach 1 and Reach 2 show volume gain above -19 ft NAVD88 relative to the pre-nourishment conditions. However, at the remaining reaches of the nourished oceanfront, volume losses were observed extending below -19 ft NAVD88 indicating material loss well beyond the depth of closure that will likely not migrate back onshore.



**Figure 6-3. Cumulative Volume Change Above -19 ft NAVD88 Relative to Pre-Nourishment**

Volume changes during the monitoring period indicated that the Nourished Oceanfront and Total Monitored Oceanfront both experienced losses in material along all the analyzed elevations except -30 ft NAVD88. Key statistics for individual reaches along Nags Head along with the entire oceanfront shoreline were as follows:

2021 vs. 2022 (Total Change)	Transects	Reach Length	avg shoreline change @ +1.18 ft NAVD88	avg volume change above +6 ft NAVD88	avg volume change above +1.18 ft NAVD88	avg volume change above -6 ft NAVD88	avg volume change above -14 ft NAVD88	avg volume change above -19 ft NAVD88	avg volume change above -30 ft NAVD88
Reach	#	ft	ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft	cy/ft
Nags Head - North	430+00 - 495+00	6,500	-29.5	-0.2	-5.6	-16.2	-6.0	-9.3	17.4
Nags Head - Reach 1	495+00 - 790+00	29,500	-20.9	1.8	-2.3	-6.6	-22.4	-6.9	18.5
Nags Head - Reach 2	790+00 - 920+00	13,000	-52.4	-1.2	-9.4	-14.9	-41.4	-16.2	7.6
Nags Head - Reach 3N	920+00 - 975+00	5,500	-48.6	-5.0	-16.8	-14.8	-58.8	-28.9	-17.0
Nags Head - Reach 3S	975+00 - 1010+00	3,500	-1.2	-4.8	-8.7	-9.0	-31.4	-0.8	4.8
Nags Head - Reach 4	1010+00 - 1025+00	1,500	7.0	-2.7	-4.2	-9.0	-16.1	-8.4	-8.3
National Seashore - North	1025+00 - 1200+00	17,500	18.0	-0.3	-0.3	-0.7	-14.2	-4.2	12.9
	Transects	Reach Length	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg	weighted avg
<b>Nourished Oceanfront</b>	<b>495+00 - 1025+00</b>	<b>53,000</b>	<b>-29.4</b>	<b>-0.2</b>	<b>-6.0</b>	<b>-9.7</b>	<b>-31.3</b>	<b>-11.1</b>	<b>10.5</b>
<b>Total Monitored Oceanfront</b>	<b>430+00 - 1200+00</b>	<b>77,000</b>	<b>-18.6</b>	<b>-0.2</b>	<b>-4.7</b>	<b>-8.2</b>	<b>-25.2</b>	<b>-9.4</b>	<b>11.6</b>

**Table 6-1. Nags Head Shoreline and Average Unit Volume Change Statistics (2021 – 2022)**

2021 vs. 2022 (Total Change)	Transects	Reach Length	cumulative volume change above +6 ft NAVD88	cumulative volume change above +1.18 ft NAVD88	cumulative volume change above -6 ft NAVD88	cumulative volume change above -14 ft NAVD88	cumulative volume change above -19 ft NAVD88	cumulative volume change above -30 ft NAVD88
Reach	#	ft	cy	cy	cy	cy	cy	cy
Nags Head - North	430+00 - 495+00	6,500	-1,310	-33,641	-97,174	-35,918	-55,773	104,258
Nags Head - Reach 1	500+00 - 785+00	29,500	54,106	-68,497	-194,065	-661,266	-204,407	545,766
Nags Head - Reach 2	790+00 - 915+00	13,000	-15,103	-121,866	-193,265	-537,629	-210,098	98,910
Nags Head - Reach 3N	920+00 - 970+00	5,500	-28,673	-96,681	-85,271	-338,296	-166,218	-97,896
Nags Head - Reach 3S	975+00 - 1005+00	3,500	-16,714	-30,351	-31,671	-110,004	-2,709	16,663
Nags Head - Reach 4	1010+00 - 1025+00	1,500	-4,794	-7,309	-15,742	-28,157	-14,651	-14,582
National Seashore North	1030+00 - 1200+00	17,500	-4,477	-4,684	-11,673	-247,987	-73,314	225,532
	Transects	Reach Length	total	total	total	total	total	total
<b>Nourished Oceanfront</b>	<b>495+00 - 1025+00</b>	<b>53,000</b>	<b>-11,177</b>	<b>-324,704</b>	<b>-520,015</b>	<b>-1,675,352</b>	<b>-598,084</b>	<b>548,861</b>
<b>Total Monitored Oceanfront</b>	<b>430+00 - 1200+00</b>	<b>77,000</b>	<b>-16,965</b>	<b>-363,029</b>	<b>-628,861</b>	<b>-1,959,257</b>	<b>-727,171</b>	<b>878,650</b>

**Table 6-2. Nags Head Cumulative Volume Change Statistics (2021 – 2022)**

During the 2021-2022 monitoring period northern reaches significantly retreated whereas southern reaches experienced minor recession or seaward advancement. Among the nourished reaches Reach 2 and Reach 3-North observed high recession rates. Reach 4 shoreline experienced minor seaward advancement whereas Reach 3-South shoreline

slightly retreated. The National Seashore-North reach to the south of the Nourished Oceanfront also experienced seaward advancement.

In all management reaches, most material loss was observed above -14 ft NAVD88. This material lost was mostly caused by the erosion and adjustment of the offshore bar. The smaller losses above -19 ft NAVD88 indicate the transport and capture of some of the eroded material above the depth of closure. Over the Nourished Oceanfront -598,084 cy or -11.1 cy/ft of material was lost above -19ft NAVD88. The higher erosion rates can likely be attributed to an active 2021-2022 storm season bringing 13 events with significant wave heights greater than 8 ft. Four of those events had significant wave heights greater than 15 ft whereas historical records show at most 1 event of this magnitude during previous monitoring periods. This indicates the potential for multiple high erosion events.

The long-term dune erosion locations remained the same during the current monitoring period. The first location is observed at Reach 1, between East Hollowell Street and East Soundside Road. The second area covered the south part of the monitoring area starting from the hotspot location at Reach 3-South and extending south through Reach 4.

## **7.0 REFERENCES**

Coastal Science & Engineering Inc. (CSE), 2018. Monitoring and Analyses of the 2011 Nags Head Beach Nourishment Project. Year 7 (2018) Beach Monitoring Report for Town of Nags Head., NC. Columbia, SC. October 2018.

Moffatt & Nichol (MN), 2020. Town of Nags Head Beach Monitoring Analysis Program. 2020 Summer Annual Monitoring Survey Evaluation. Raleigh, NC. October 2020.

# APPENDIX A

## MCKIM & CREED SURVEY REPORT





August 2, 2022

# TOWN OF NAGS HEAD, NORTH CAROLINA BEACH MONITORING SURVEY

## GENERAL SCOPE OF WORK

The work under the Task Order shall consist of performing topographic and hydrographic surveys along 125 historic profile lines and another 48 optional lines, bringing the number of lines to be surveyed to a total of 173.

## SURVEY AREA

The study area starts on the North between the Town of Nags Head and Kill Devil Hills and ends South at Oregon Inlet. This area has total linear distance of approximately 18 statute miles.

## PLANNING

On June 17<sup>th</sup>, 2022, McKim & Creed Field Manager held a meeting with field and office crews to discuss the scope of work entailing the 173 beach monitoring profiles survey to be conducted in Nags Head, North Carolina. In the two weeks prior to the meeting, preparations started to get the boat ready, arrange accommodations, create HYPACK project, gather control point information, line files, etc.

## FIELD WORK

The field team started monitoring the weather conditions in the beginning of June to decide when it would be the best time to mobilize to the survey area. Multiple survey crews traveled to the survey area on June 20<sup>th</sup>, 2022 and started surveying on the same day.

All profile lines were surveyed from June 20<sup>th</sup> to June 29<sup>th</sup>, 2022. Below is the timeline for the field work.

DATE	ACTIVITIES
<b>06/17/2022</b>	Scope Meeting at the office.
<b>06/20/2022</b>	Three survey crews mobilized to the job site. Survey was performed on lines: Land - 920+00 to 1025+00 Hydro offshore- 977+50 to 1030+00
<b>06/21/2022</b>	Survey was performed on lines: Land - 745+00 to 815+00 and 870+00 to 910+00 Wade - 860+00 to 1025+00 Hydro nearshore - 860+00 to 1290+00 Hydro offshore - 860+00 to 975+00 and 1040+00 to 1290+00
<b>06/22/2022</b>	Survey was performed on lines: Land - 820+00 to 865+00 and 1190+00 to 1250+00 Wade - 735+00 to 855+00 and 1030+00 to 1270+00 Hydro full lines- 735+00+00 to 855+00
<b>06/23/2022</b>	Survey was performed on lines: Land - 430+00 to 470+00, 590+00 to 740+00, and 1130+00 to 1180+00 *No hydro or wade due to sea conditions.
<b>06/24/2022</b>	Survey was performed on lines: Land - 475+00 to 585+00 *No hydro or wade due to sea conditions. * Land survey was completed on all lines.
<b>06/25/2022</b>	Survey was performed on lines: Wade - 685+00 to 730+00 Hydro nearshore - 730+00 to 685+00 Hydro offshore - 430+00 to 730+00
<b>06/26/2022</b>	Survey was performed on lines: Wade - 620+00 to 680+00 Hydro nearshore - 535+00 to 680+00
<b>06/27/2022</b>	Survey was performed on lines: Wade - 475+00 to 690+00
<b>06/28/2022</b>	No survey was performed due to rough sea conditions
<b>06/29/2022</b>	Survey was performed on lines:

Wade – 430+00 to 470+00  
Hydro nearshore - 430+00 to 530+00  
Demobilization.

#### Special comments:

- Lines that ended at a building or other man-made structure: 430+00 to 450+00, 460+00, 470+00 to 490+00, 500+00, 510+00, 515+00, 525+00 to 545+00, 555+00 to 570+00, 580+00 to 595+00, 605+00, 610+00, 620+00 to 640+00, 650+00, 665+00, 685+00, 695+00 to 715+00, 725+00 to 750+00, 760+00 to 795+00, 805+00 to 860+00, 870+00 to 885+00, 895+00, 905+00 to 927+50, 935+00 to 955+00, 960+00, 965+00 to 970+00, 977+50 to 987+50, 995+00, 1000+00 to 1005+00, 1010+00, 1022+50, 1030+00, 1035+00
- Lines that ended due to thick vegetation: 615+00, 645+00, 655+00, 660+00, 675+00, 720+00, 755+00, 800+00, 865+00, 890+00, 930+00, 932+50, 957+50, 962+50, 972+50, 975+00, 990+00, 992+50, 997+50, 1007+50, 1012+50 to 1017+50, 1025+00, 1040+00, 1050+00 to 1130+00, 1170+00, 1230+00, 1240+00
- Lines 1200+00 and 1210+00 ended on campsite.
- Incomplete land data on lines 1260+00 to 1290+00 due to nesting area.
- Lines 490+00, 620+00, 625+00, 640+00, 690+00 and 710+00: due to riptide and rough sea conditions these lines have gaps, no overlaps or line was over 25ft offline at the surf zone
- Line 872+00 was run in place of 875+00 due to Jennette's pier online.
- There is a groin close to lines 555+00 and 1022+50
- Lines 1025+00 to 1290+00 are inside the Cape Hatteras National Seashore and the National Park requires a permit to enter.

## LIST OF EQUIPMENT USED DURING THE SURVEY

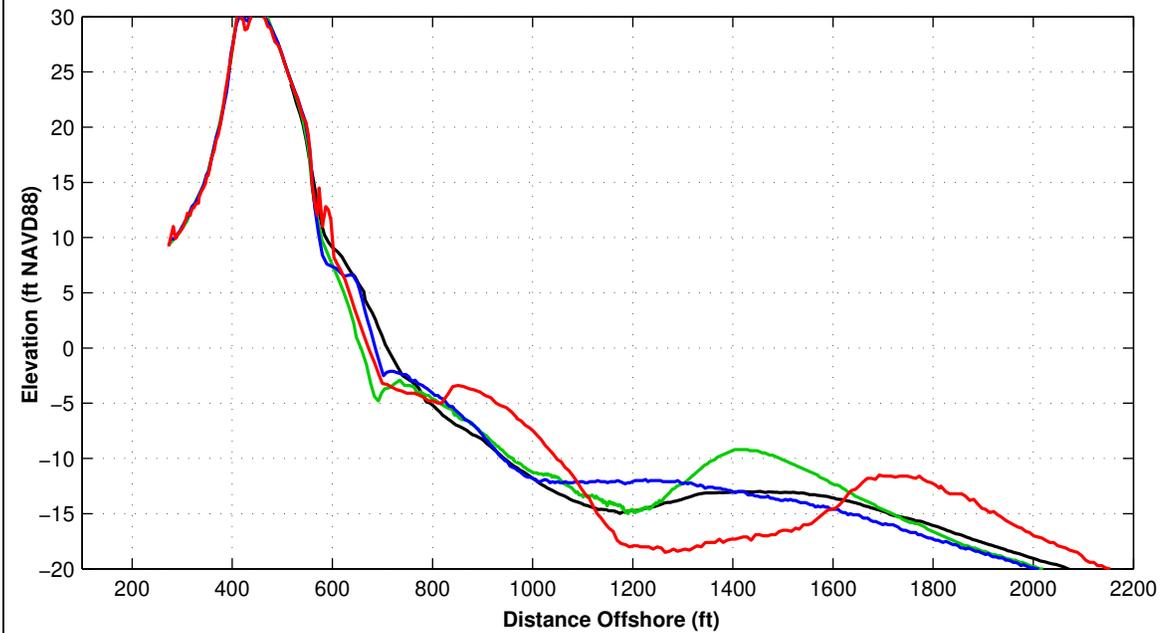
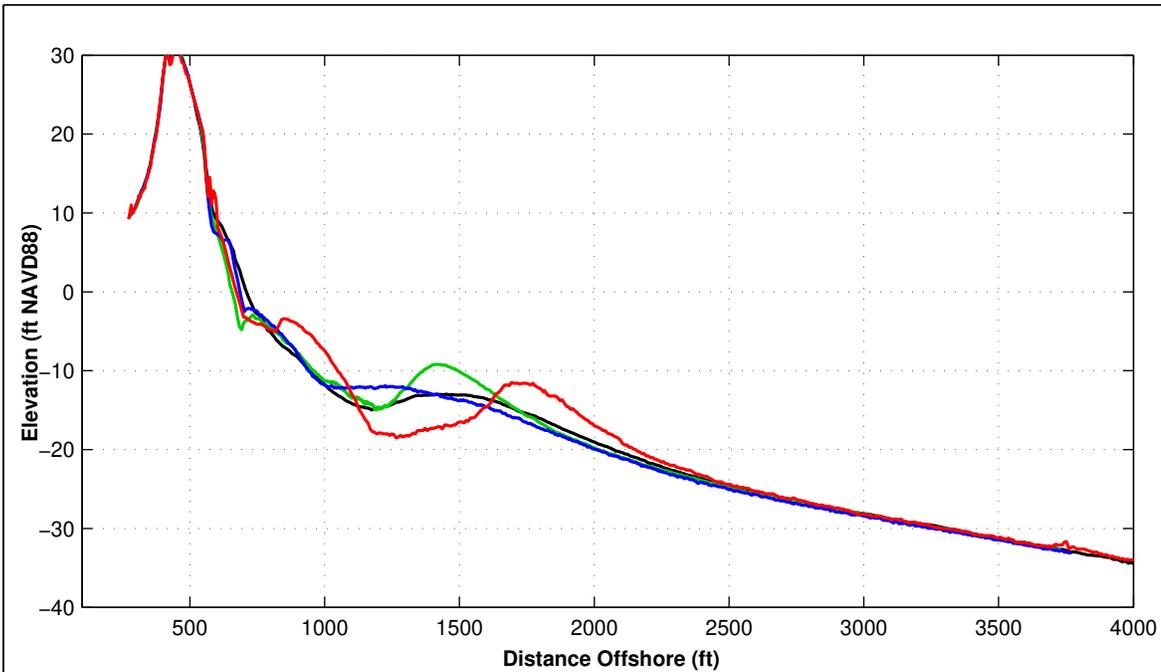
Below is a list of equipment used during the survey:

- 28' Survey Vessel "Clock"
- Odom CV200 and Odom transducer 200 kHz
- Applanix Pos-MV Inertia Navigation System I2NS
- Sound Velocity Profiler AML CTD Base X Profiler
- Hypack 2021/2022 for hydrographic data collection and processing
- Kawasaki mule side by side
- Trimble R8 GNSS Receivers/ TSC3 data collectors
- Trimble R10 GNSS Receivers/ TSC3 data collectors

# APPENDIX B

## SURVEY PROFILE COMPARISON PLOTS



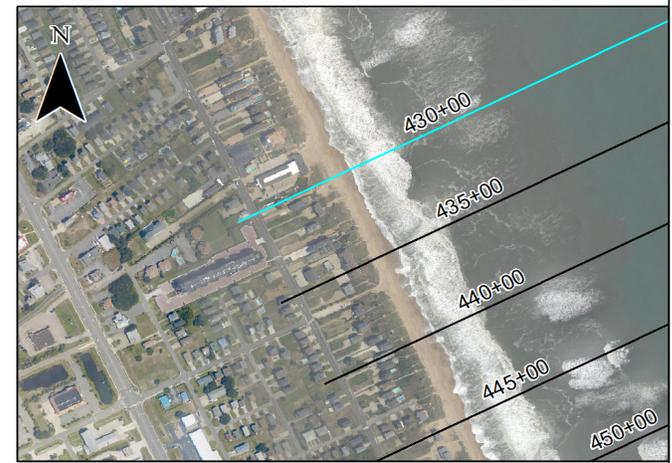


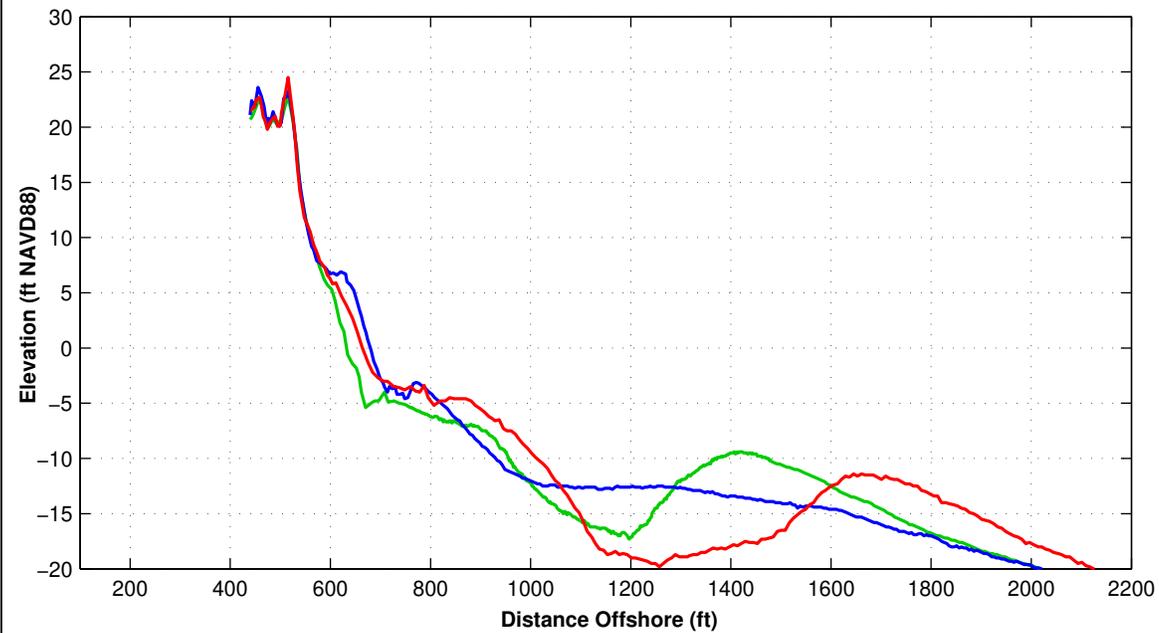
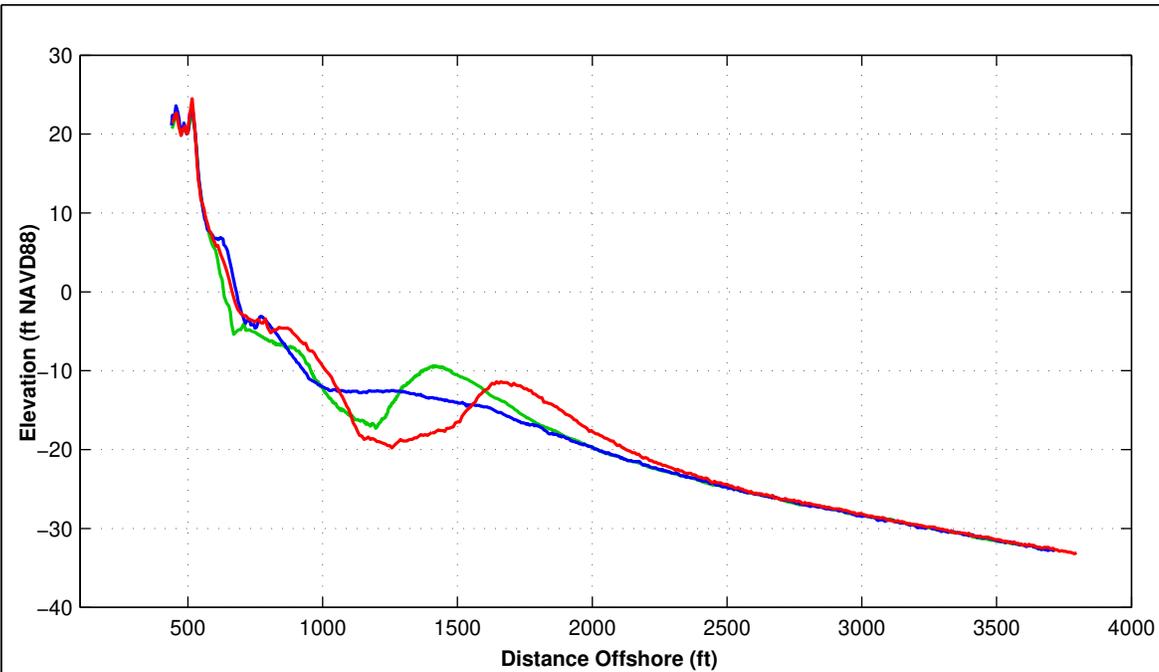
Survey Transect 430+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	31.72 ft	-16.09 ft
Volume Change Above +6 ft NAVD88	0.37 cy/ft	4.30 cy/ft
Volume Change Above 1.18 ft NAVD88	5.96 cy/ft	0.79 cy/ft
Volume Change Above -6 ft NAVD88	15.53 cy/ft	1.96 cy/ft
Volume Change Above -14 ft NAVD88	-9.54 cy/ft	19.84 cy/ft
Volume Change Above -19 ft NAVD88	-17.77 cy/ft	10.29 cy/ft
Volume Change Above -30 ft NAVD88	-28.06 cy/ft	45.82 cy/ft

**LEGEND:**

JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



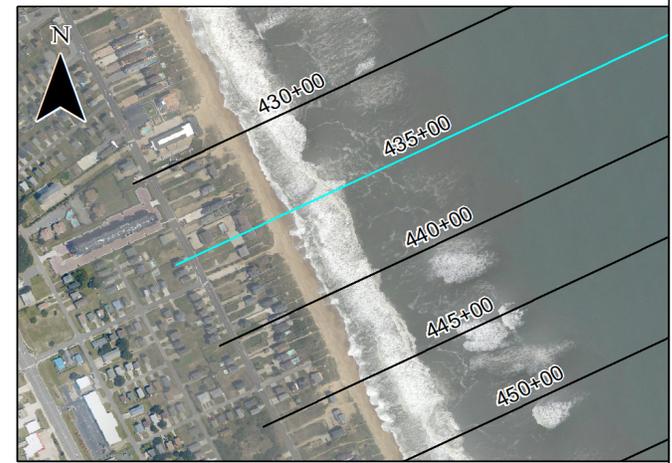


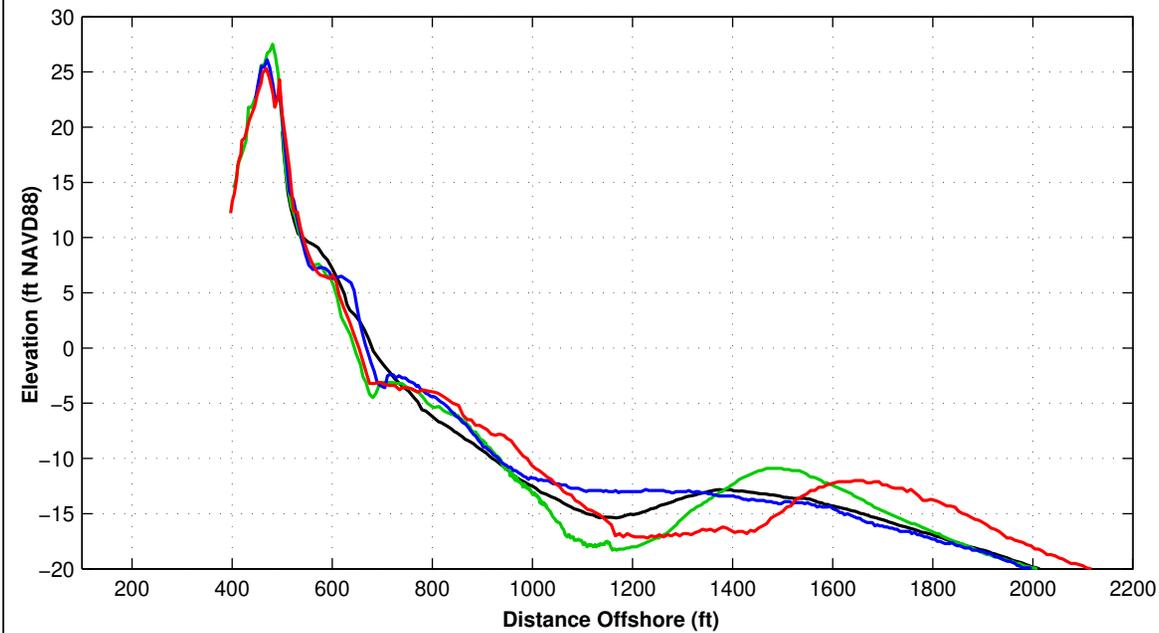
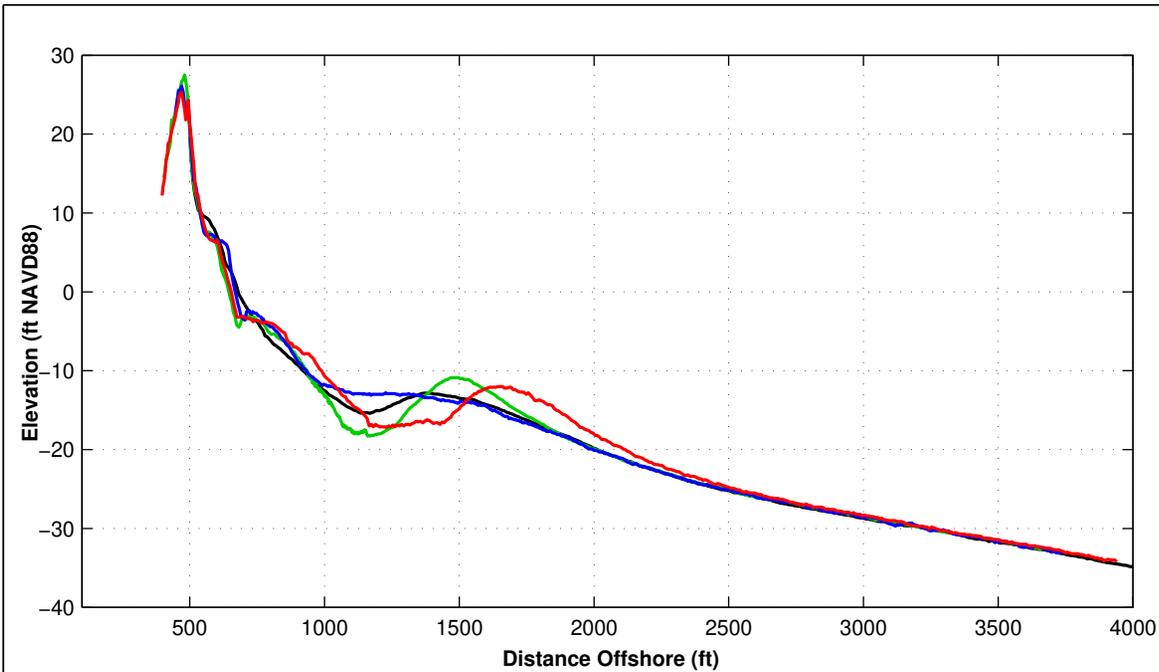
Survey Transect 435+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	44.15 ft	-16.76 ft
Volume Change Above +6 ft NAVD88	1.57 cy/ft	-0.65 cy/ft
Volume Change Above 1.18 ft NAVD88	9.48 cy/ft	-4.73 cy/ft
Volume Change Above -6 ft NAVD88	26.24 cy/ft	-3.30 cy/ft
Volume Change Above -14 ft NAVD88	0.99 cy/ft	15.07 cy/ft
Volume Change Above -19 ft NAVD88	5.44 cy/ft	-11.70 cy/ft
Volume Change Above -30 ft NAVD88	5.64 cy/ft	6.92 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



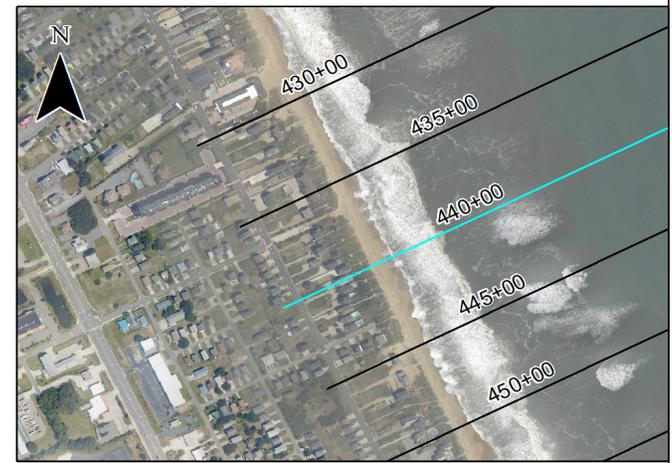


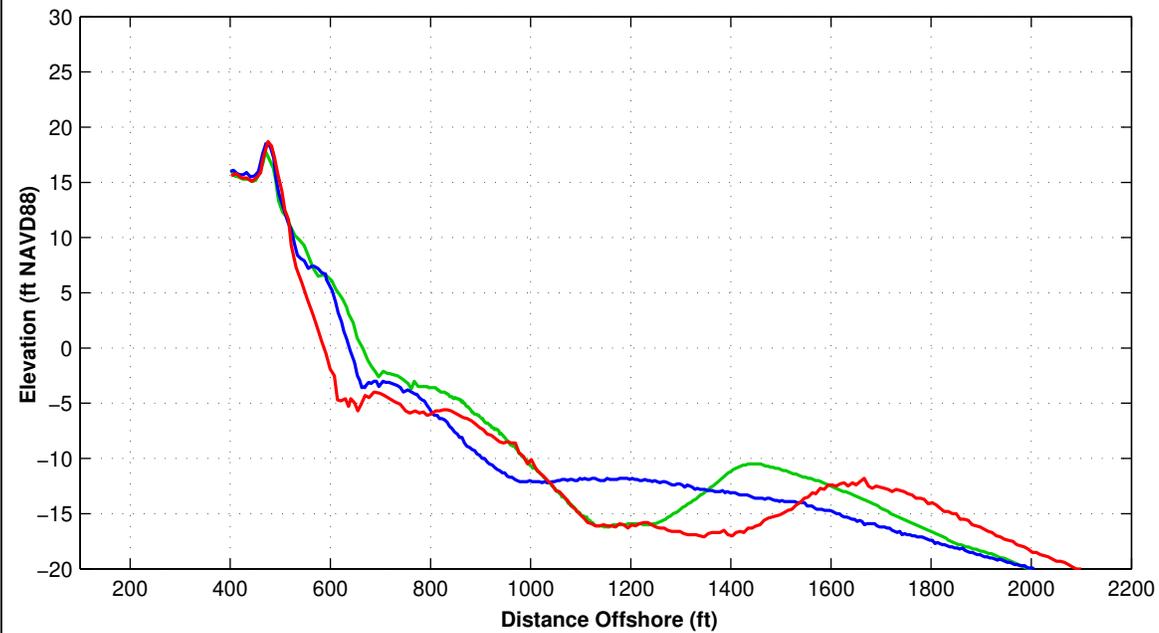
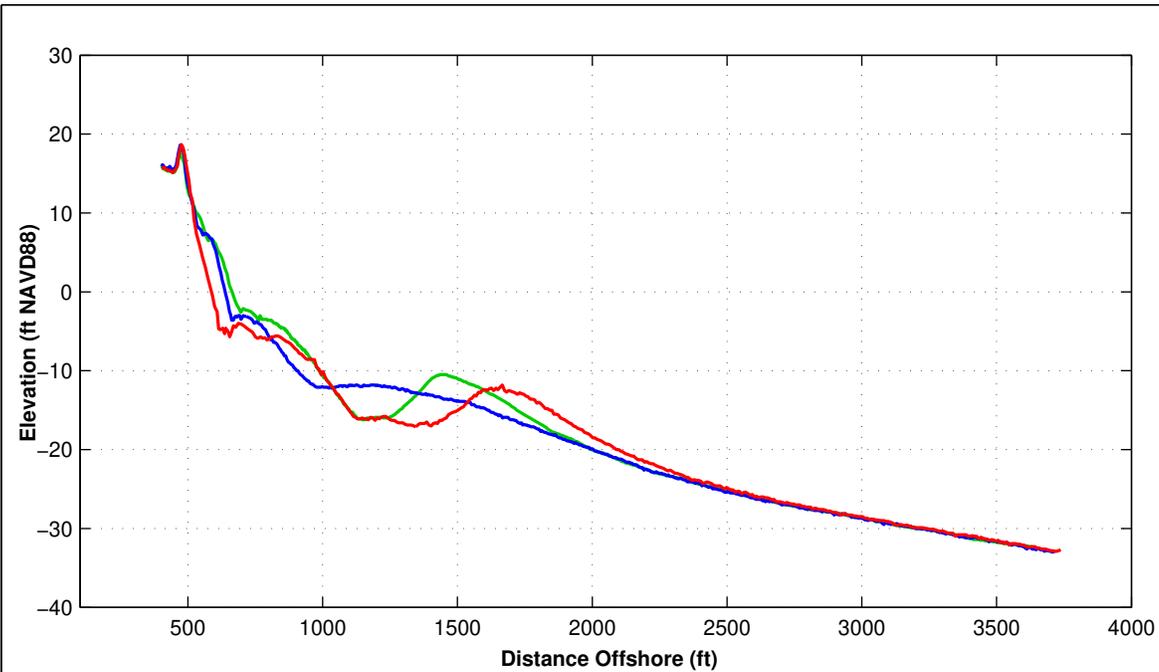
Survey Transect 440+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	24.87 ft	-17.31 ft
Volume Change Above +6 ft NAVD88	-0.49 cy/ft	0.37 cy/ft
Volume Change Above 1.18 ft NAVD88	5.58 cy/ft	-4.19 cy/ft
Volume Change Above -6 ft NAVD88	13.18 cy/ft	-6.99 cy/ft
Volume Change Above -14 ft NAVD88	8.77 cy/ft	3.76 cy/ft
Volume Change Above -19 ft NAVD88	32.02 cy/ft	3.69 cy/ft
Volume Change Above -30 ft NAVD88	30.84 cy/ft	27.27 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



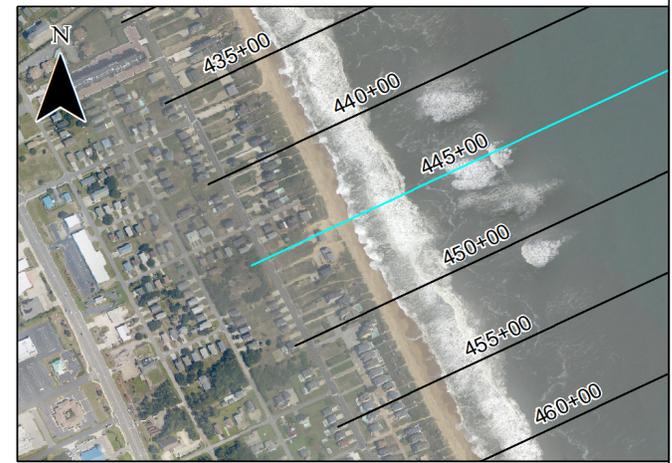


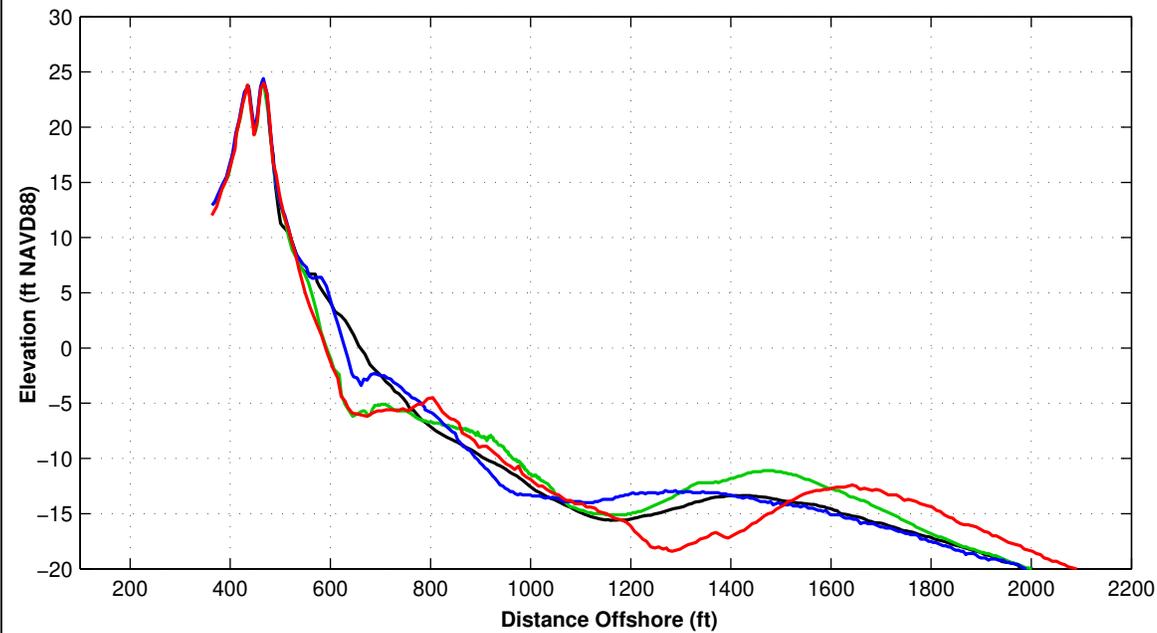
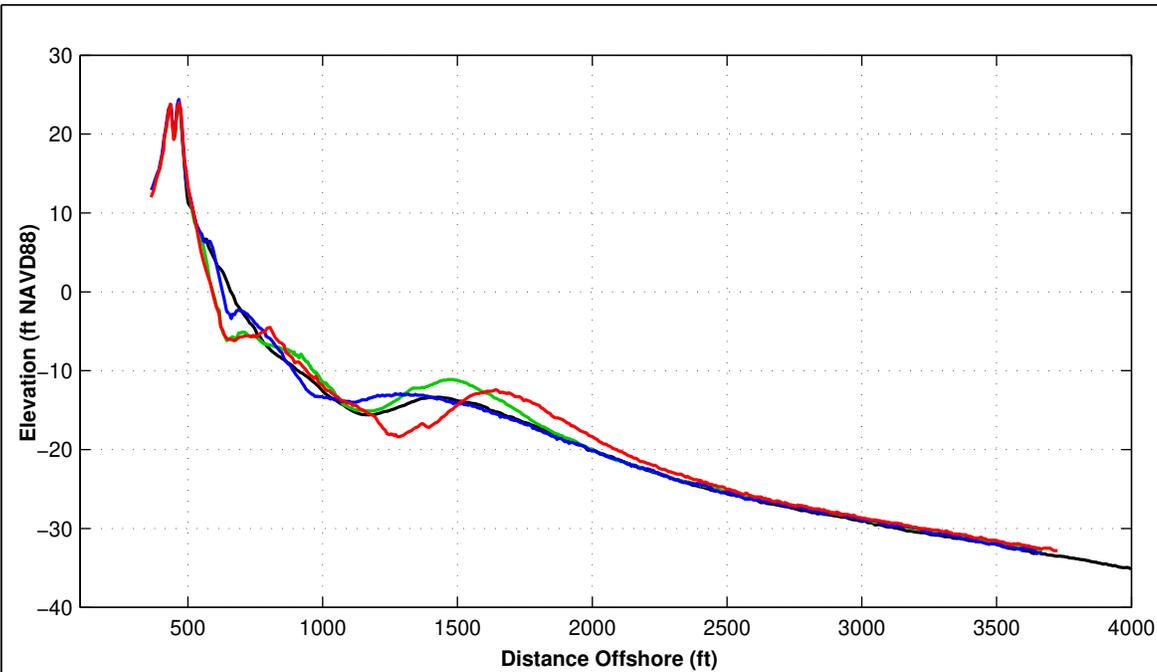
Survey Transect 445+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-22.40 ft	-51.15 ft
Volume Change Above +6 ft NAVD88	-0.33 cy/ft	-2.61 cy/ft
Volume Change Above 1.18 ft NAVD88	-3.46 cy/ft	-12.05 cy/ft
Volume Change Above -6 ft NAVD88	-17.02 cy/ft	-29.66 cy/ft
Volume Change Above -14 ft NAVD88	-37.75 cy/ft	-26.98 cy/ft
Volume Change Above -19 ft NAVD88	-37.43 cy/ft	-27.16 cy/ft
Volume Change Above -30 ft NAVD88	-37.71 cy/ft	-6.23 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



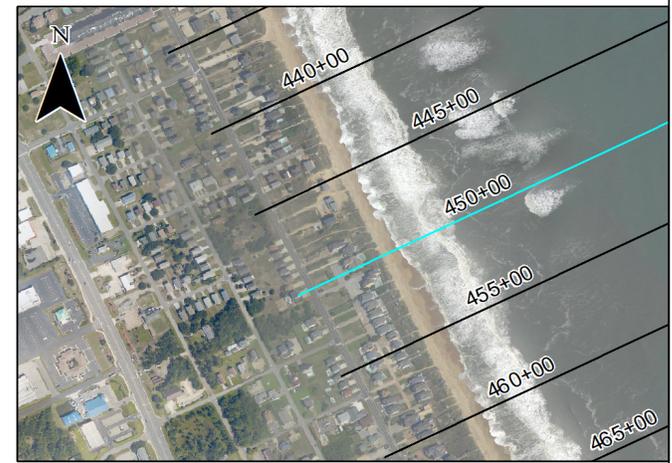


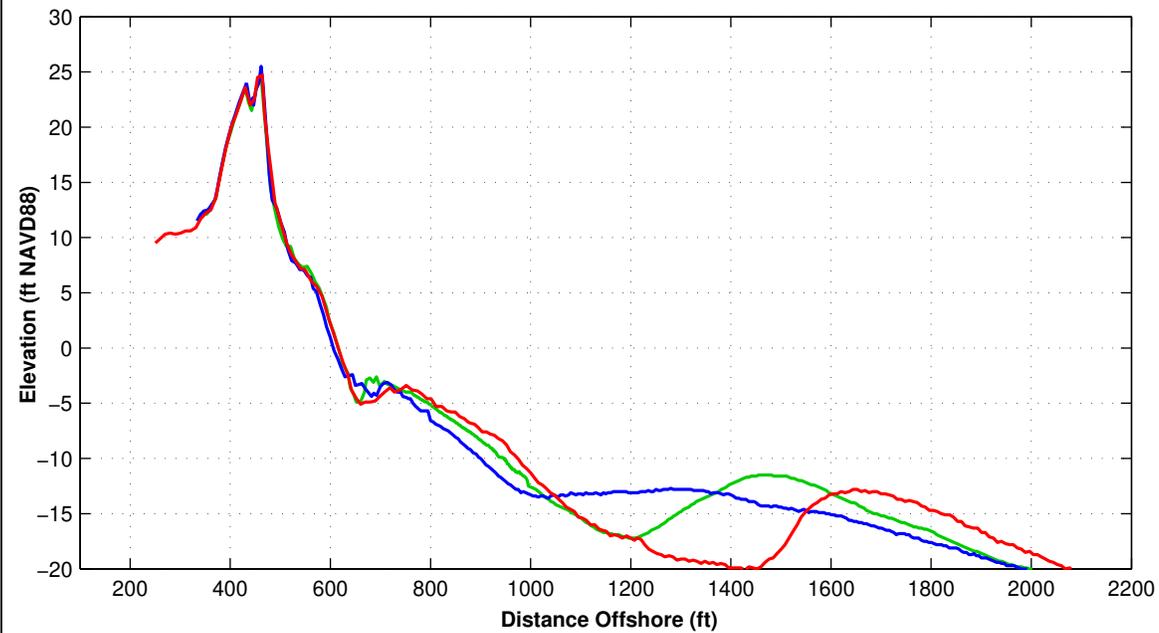
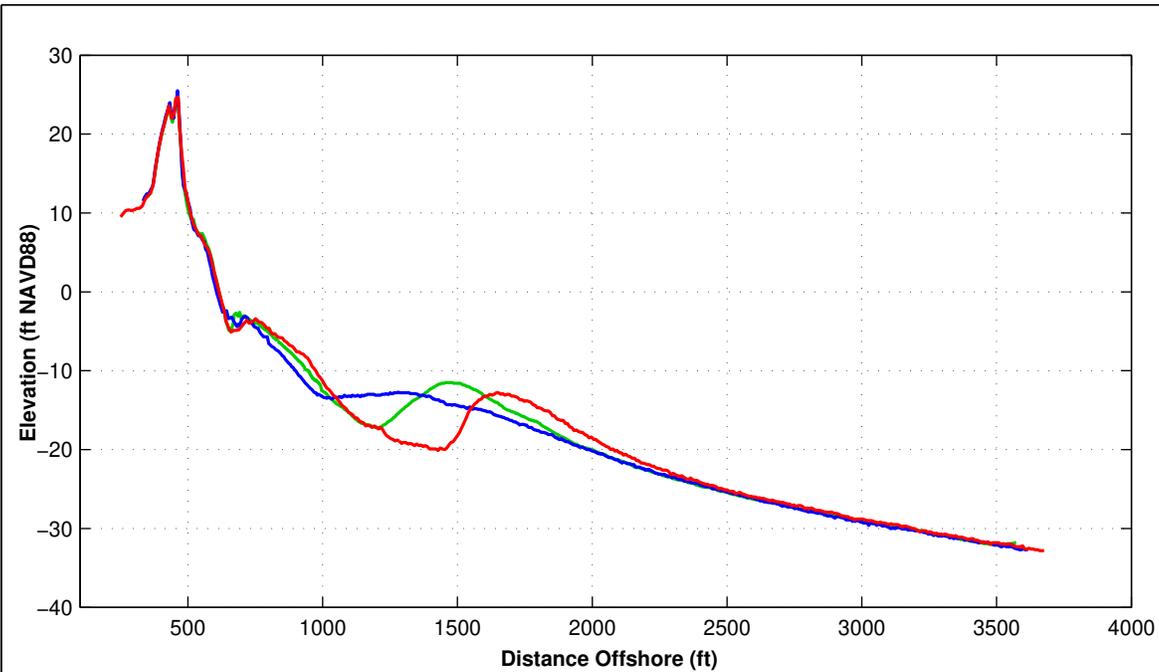
Survey Transect 450+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	37.79 ft	-39.03 ft
Volume Change Above +6 ft NAVD88	1.99 cy/ft	-1.34 cy/ft
Volume Change Above 1.18 ft NAVD88	8.25 cy/ft	-9.16 cy/ft
Volume Change Above -6 ft NAVD88	28.09 cy/ft	-27.77 cy/ft
Volume Change Above -14 ft NAVD88	-5.32 cy/ft	-14.58 cy/ft
Volume Change Above -19 ft NAVD88	-13.74 cy/ft	-17.14 cy/ft
Volume Change Above -30 ft NAVD88	-16.30 cy/ft	7.47 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



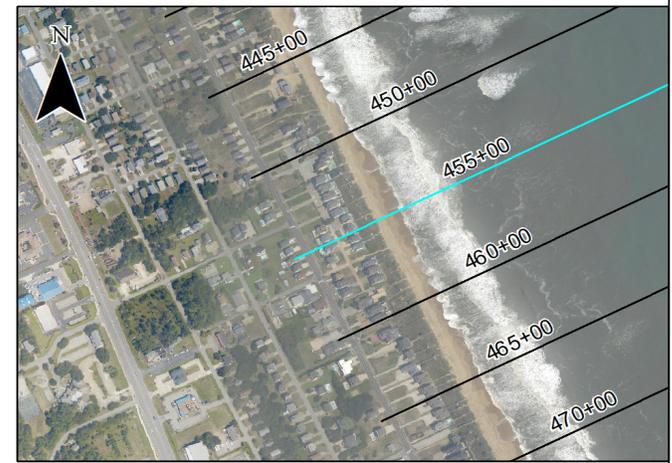


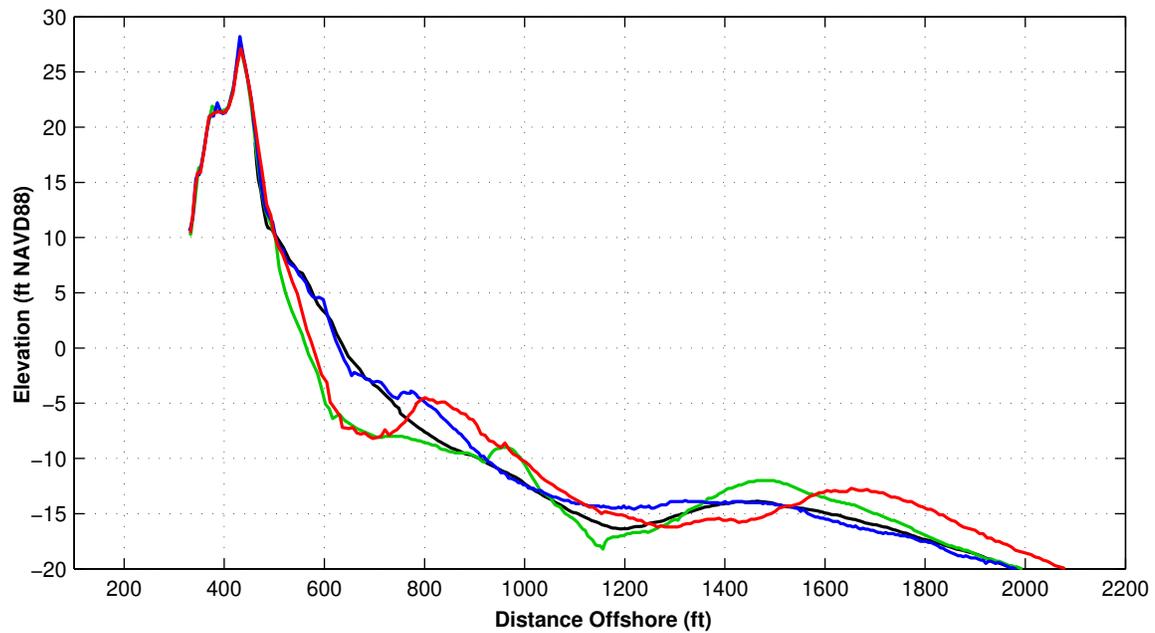
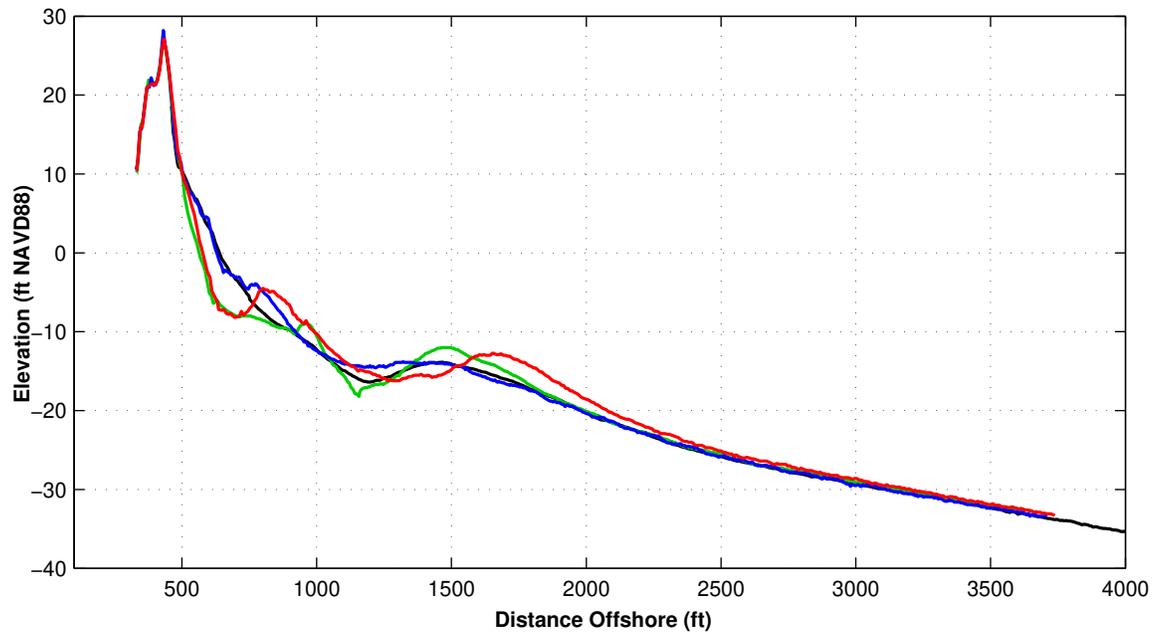
Survey Transect 455+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-10.19 ft	9.26 ft
Volume Change Above +6 ft NAVD88	0.52 cy/ft	0.81 cy/ft
Volume Change Above 1.18 ft NAVD88	-1.19 cy/ft	2.25 cy/ft
Volume Change Above -6 ft NAVD88	-4.38 cy/ft	4.11 cy/ft
Volume Change Above -14 ft NAVD88	-20.59 cy/ft	15.98 cy/ft
Volume Change Above -19 ft NAVD88	-15.56 cy/ft	-16.80 cy/ft
Volume Change Above -30 ft NAVD88	-17.89 cy/ft	2.01 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.

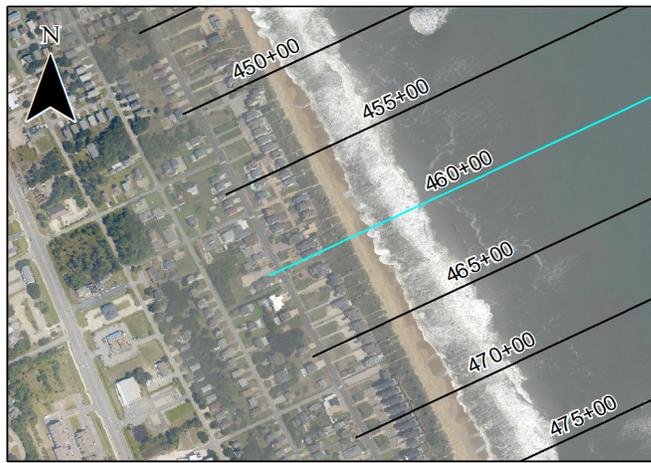


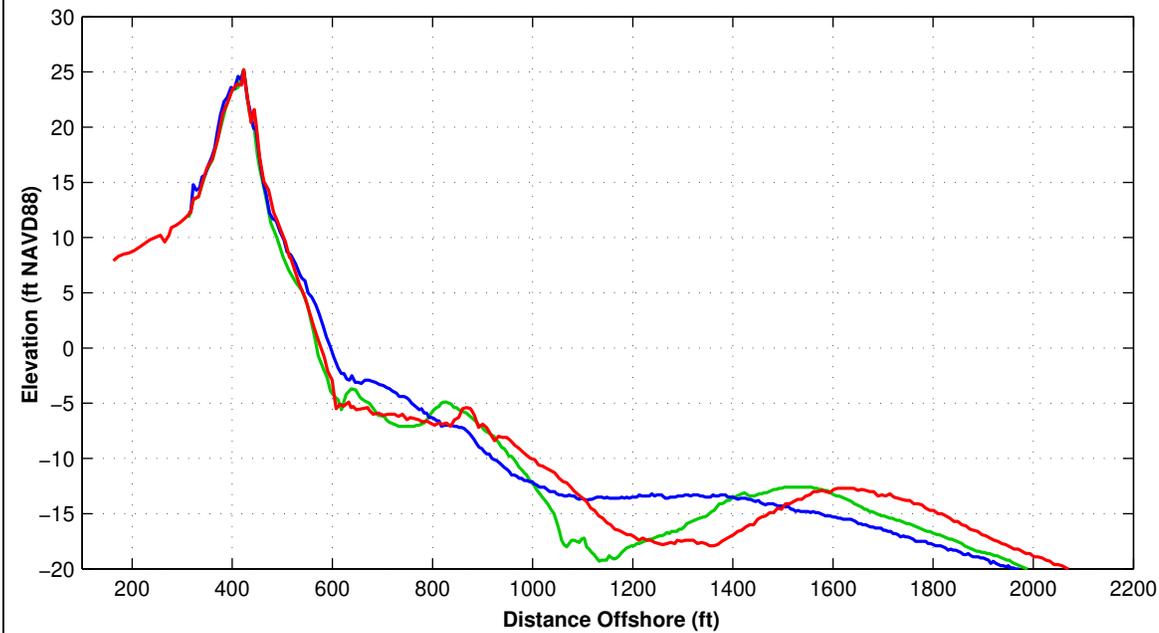
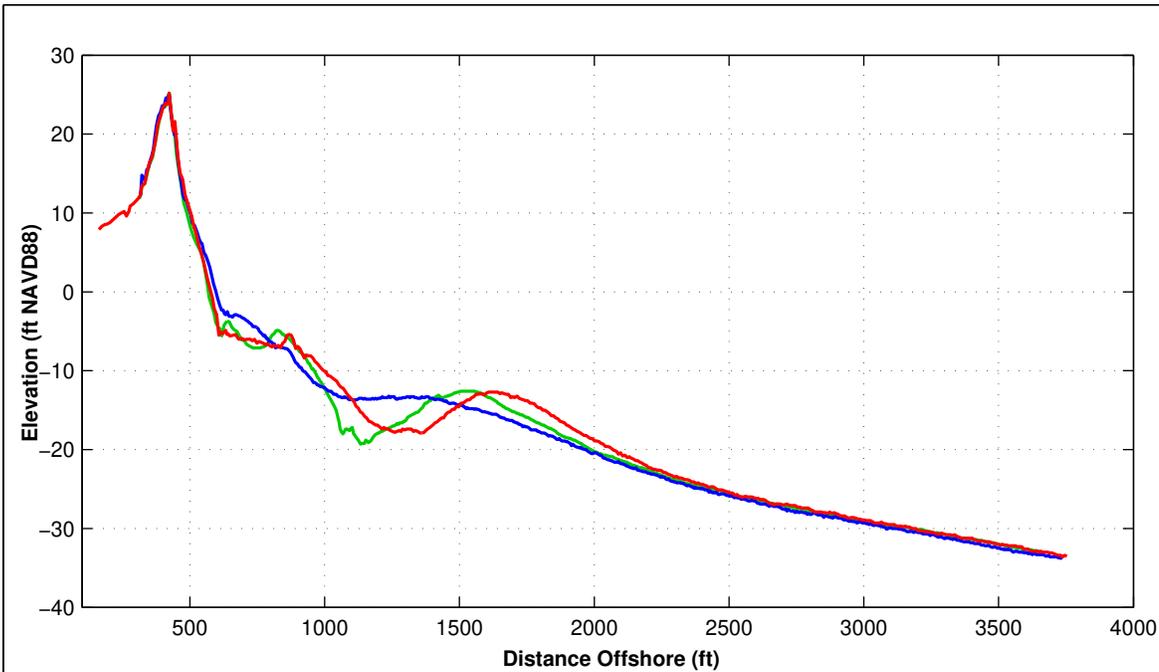


Survey Transect 460+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	63.07 ft	-50.40 ft
Volume Change Above +6 ft NAVD88	4.30 cy/ft	-0.42 cy/ft
Volume Change Above 1.18 ft NAVD88	15.27 cy/ft	-7.99 cy/ft
Volume Change Above -6 ft NAVD88	45.16 cy/ft	-31.30 cy/ft
Volume Change Above -14 ft NAVD88	46.74 cy/ft	-16.31 cy/ft
Volume Change Above -19 ft NAVD88	51.95 cy/ft	1.75 cy/ft
Volume Change Above -30 ft NAVD88	45.77 cy/ft	34.93 cy/ft

**LEGEND:**  
 JUNE 2022 ———— (red line)  
 JULY 2021 ———— (blue line)  
 JUNE 2020 ———— (green line)  
 AUGUST 2019 ———— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.



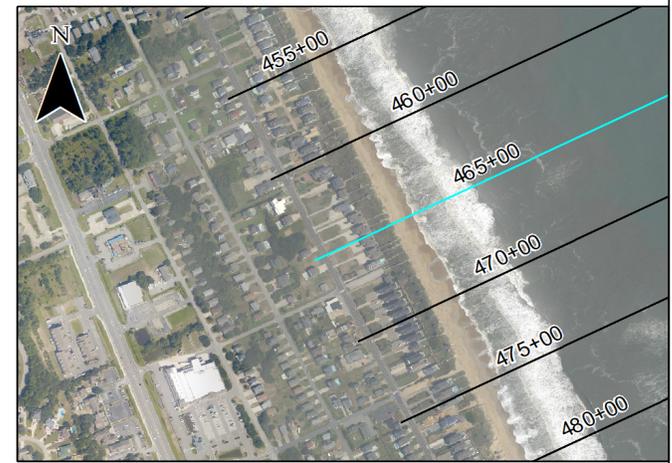


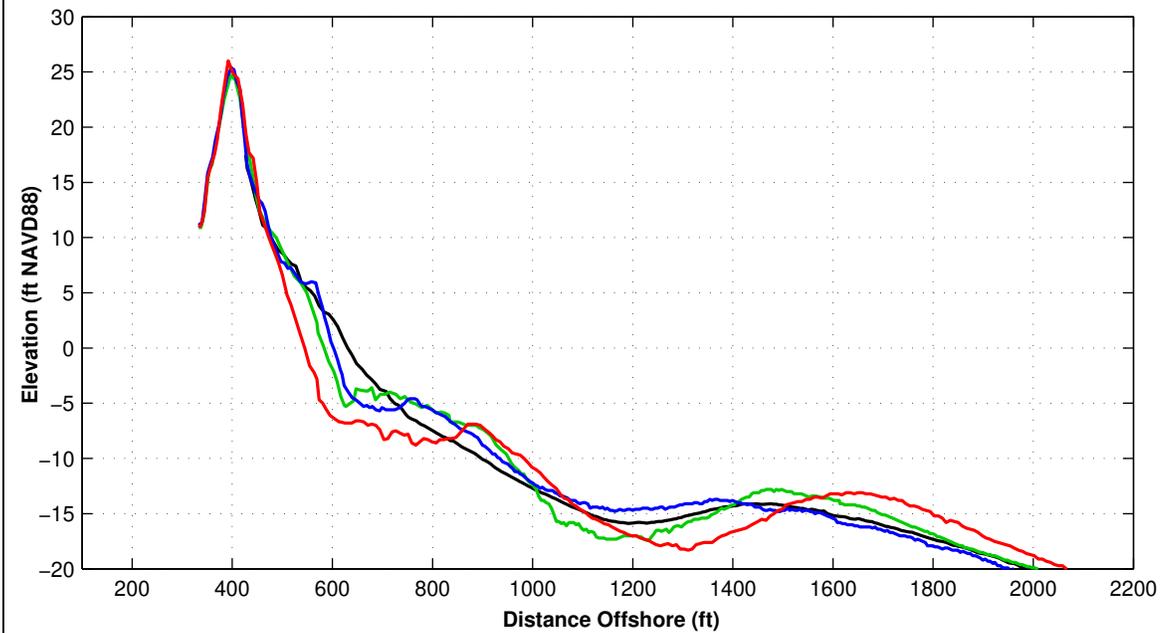
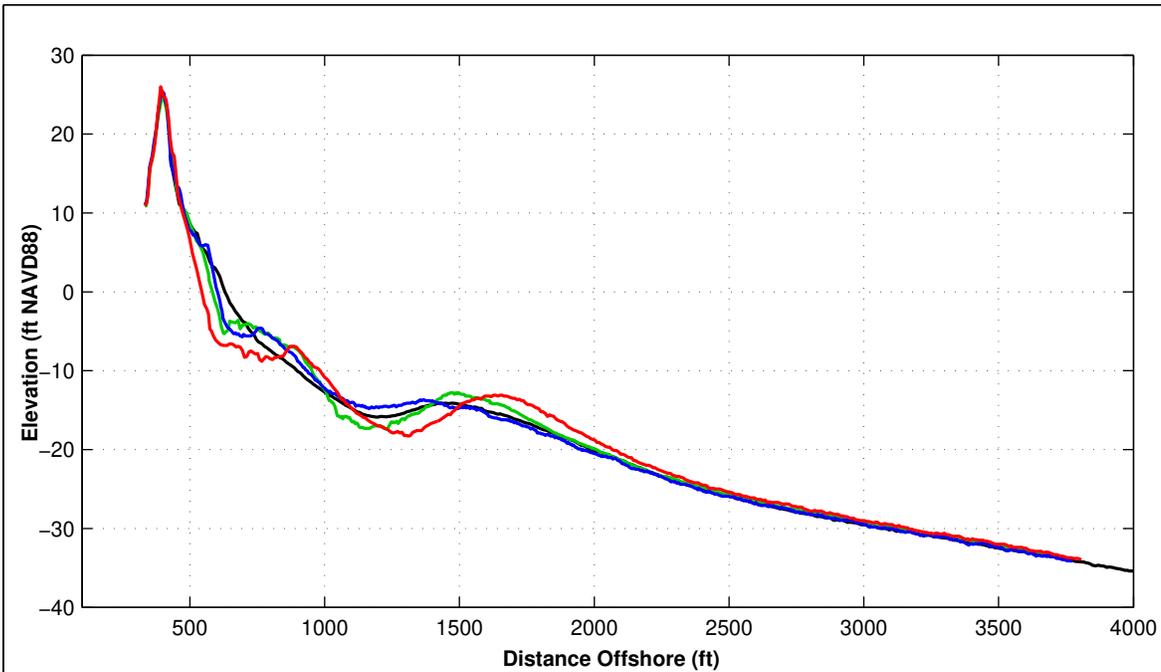
Survey Transect 465+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	23.11 ft	-18.38 ft
Volume Change Above +6 ft NAVD88	3.84 cy/ft	0.97 cy/ft
Volume Change Above 1.18 ft NAVD88	7.04 cy/ft	-1.88 cy/ft
Volume Change Above -6 ft NAVD88	21.38 cy/ft	-18.33 cy/ft
Volume Change Above -14 ft NAVD88	15.04 cy/ft	-1.49 cy/ft
Volume Change Above -19 ft NAVD88	37.46 cy/ft	-4.65 cy/ft
Volume Change Above -30 ft NAVD88	23.57 cy/ft	25.75 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
1. Station From North To South At Varying Intervals.
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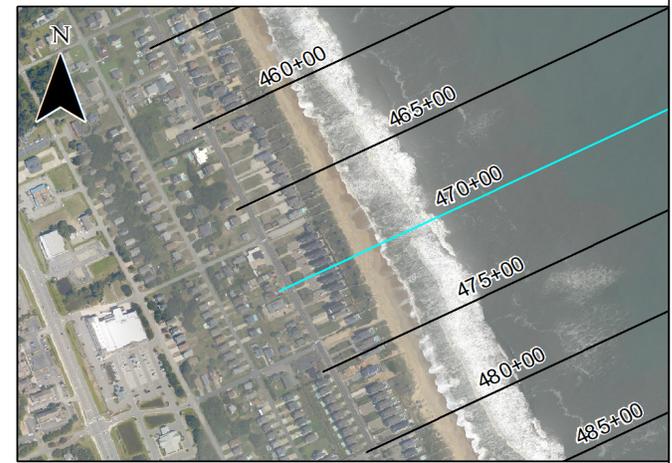


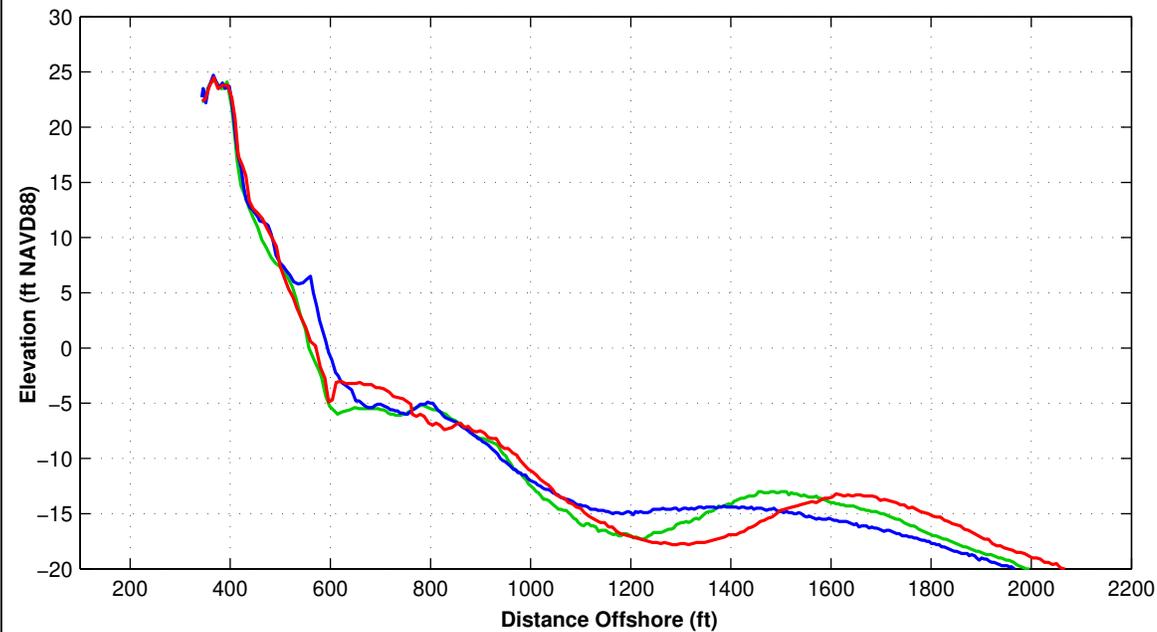
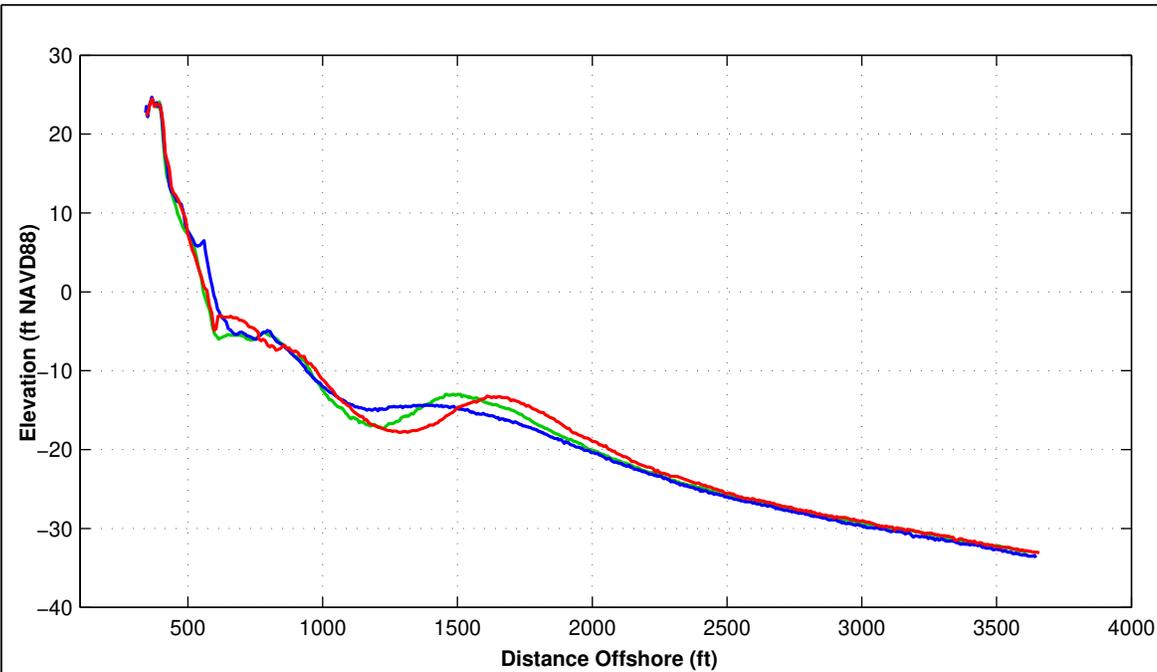
Survey Transect 470+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	20.75 ft	-57.78 ft
Volume Change Above +6 ft NAVD88	-0.52 cy/ft	-0.55 cy/ft
Volume Change Above 1.18 ft NAVD88	3.29 cy/ft	-11.29 cy/ft
Volume Change Above -6 ft NAVD88	2.85 cy/ft	-31.18 cy/ft
Volume Change Above -14 ft NAVD88	-4.09 cy/ft	-33.16 cy/ft
Volume Change Above -19 ft NAVD88	3.93 cy/ft	-34.04 cy/ft
Volume Change Above -30 ft NAVD88	-9.84 cy/ft	-1.71 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



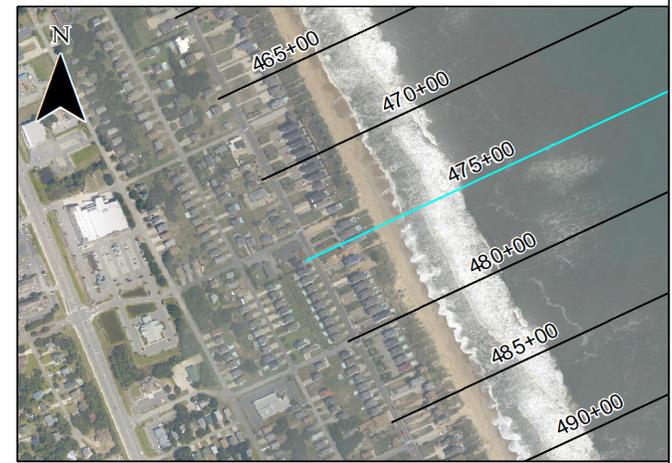


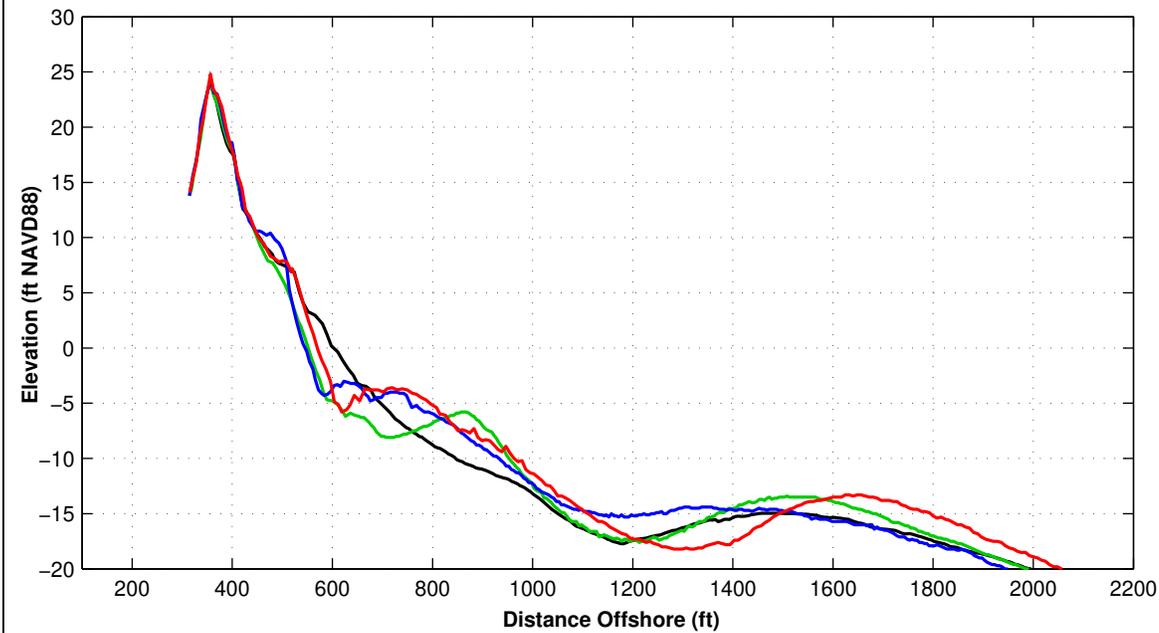
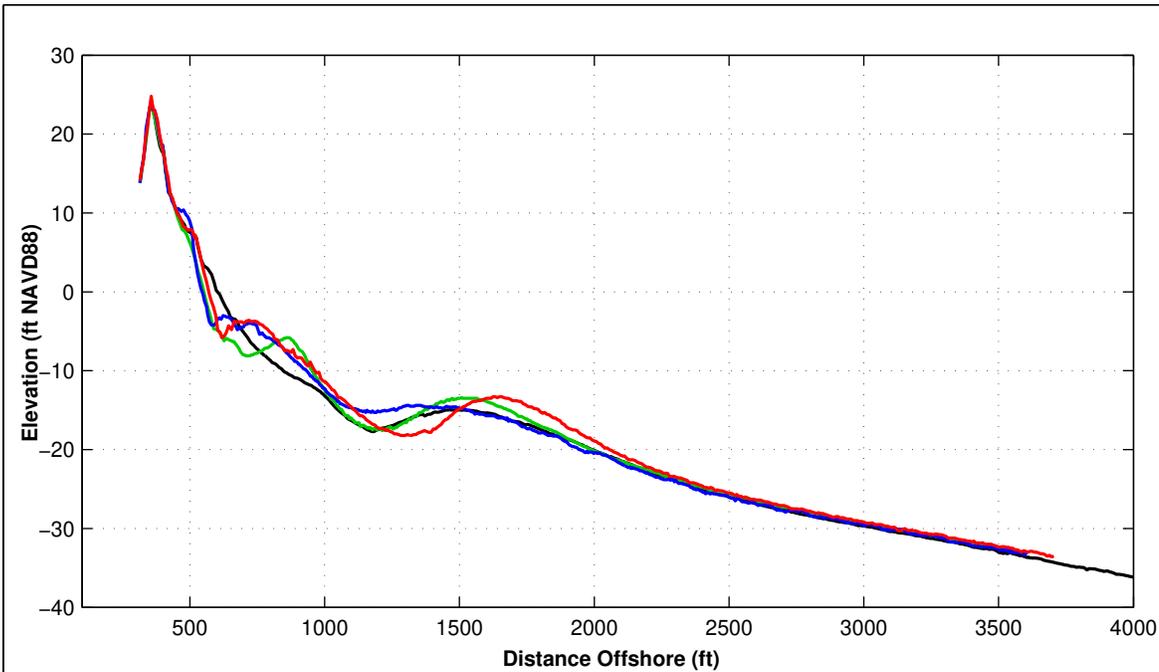
Survey Transect 475+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	34.93 ft	-31.14 ft
Volume Change Above +6 ft NAVD88	4.55 cy/ft	0.80 cy/ft
Volume Change Above 1.18 ft NAVD88	11.03 cy/ft	-6.21 cy/ft
Volume Change Above -6 ft NAVD88	23.08 cy/ft	-6.10 cy/ft
Volume Change Above -14 ft NAVD88	19.20 cy/ft	0.26 cy/ft
Volume Change Above -19 ft NAVD88	18.40 cy/ft	1.20 cy/ft
Volume Change Above -30 ft NAVD88	6.13 cy/ft	30.26 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



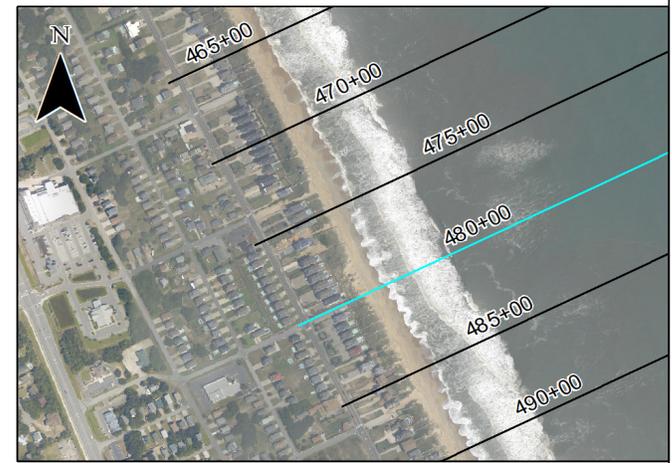


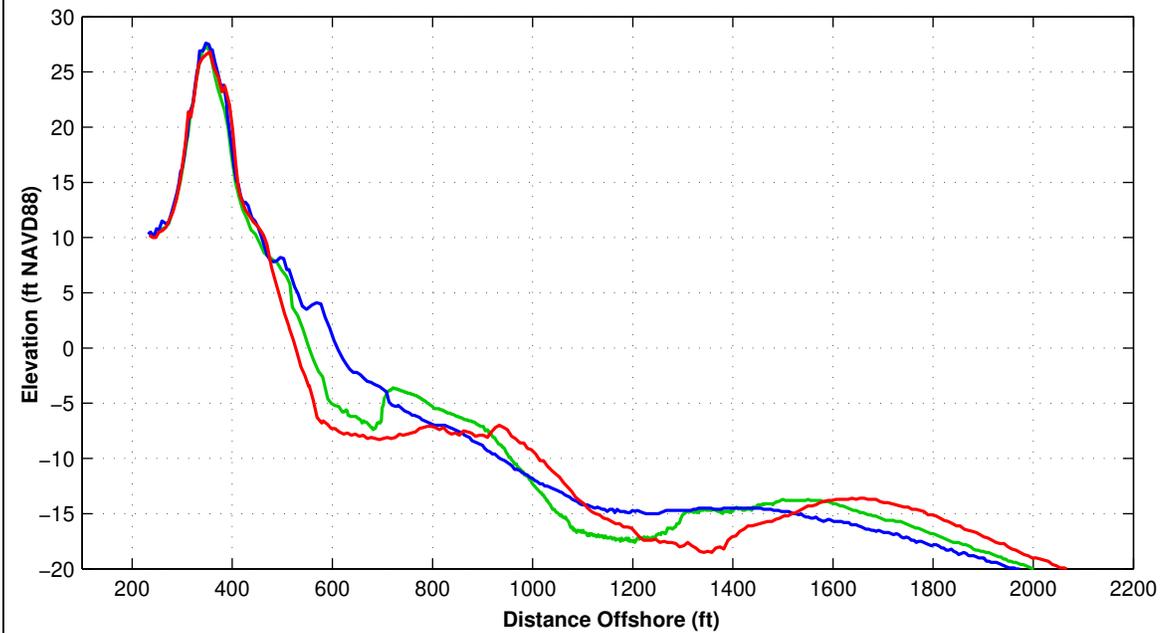
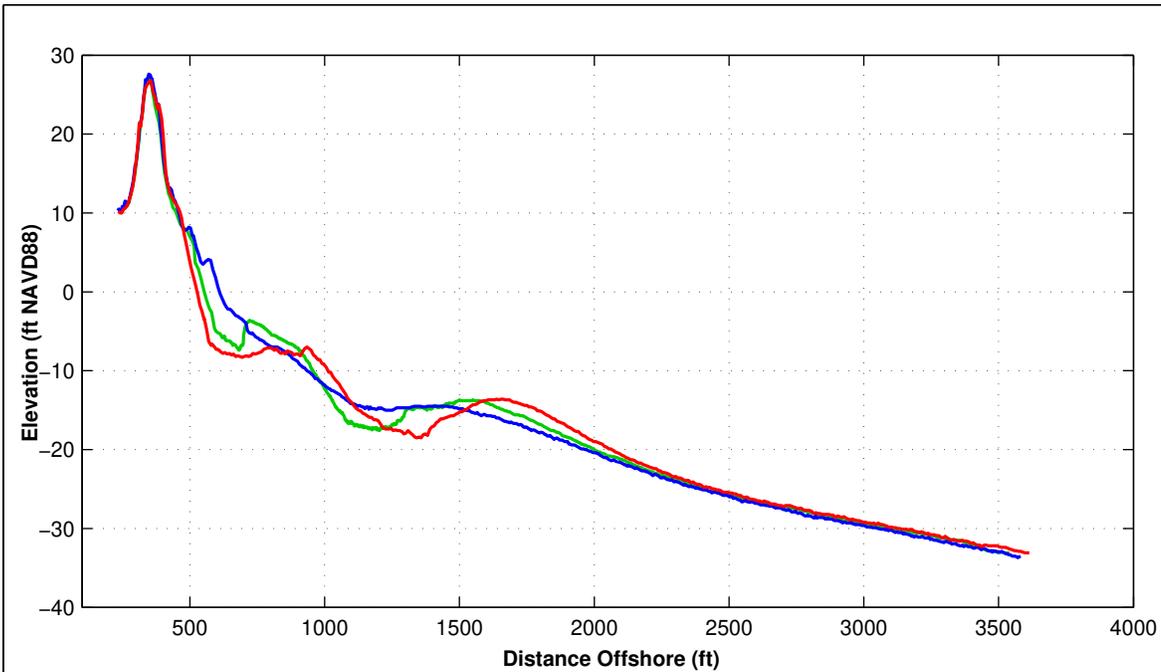
Survey Transect 480+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-7.32 ft	26.48 ft
Volume Change Above +6 ft NAVD88	5.36 cy/ft	-1.21 cy/ft
Volume Change Above 1.18 ft NAVD88	5.26 cy/ft	2.80 cy/ft
Volume Change Above -6 ft NAVD88	16.21 cy/ft	7.96 cy/ft
Volume Change Above -14 ft NAVD88	14.43 cy/ft	18.12 cy/ft
Volume Change Above -19 ft NAVD88	17.21 cy/ft	19.72 cy/ft
Volume Change Above -30 ft NAVD88	3.40 cy/ft	47.23 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



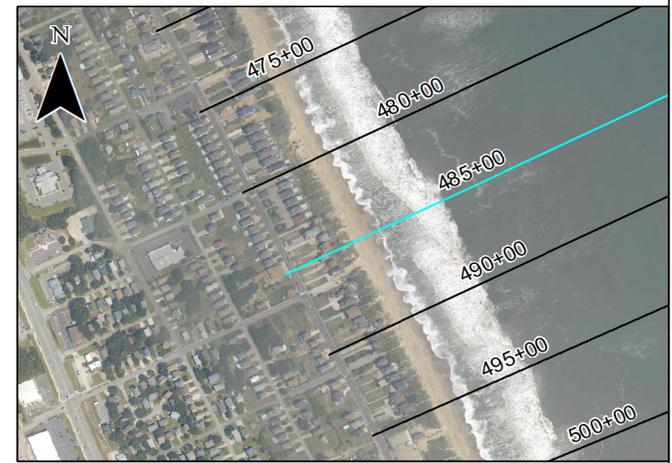


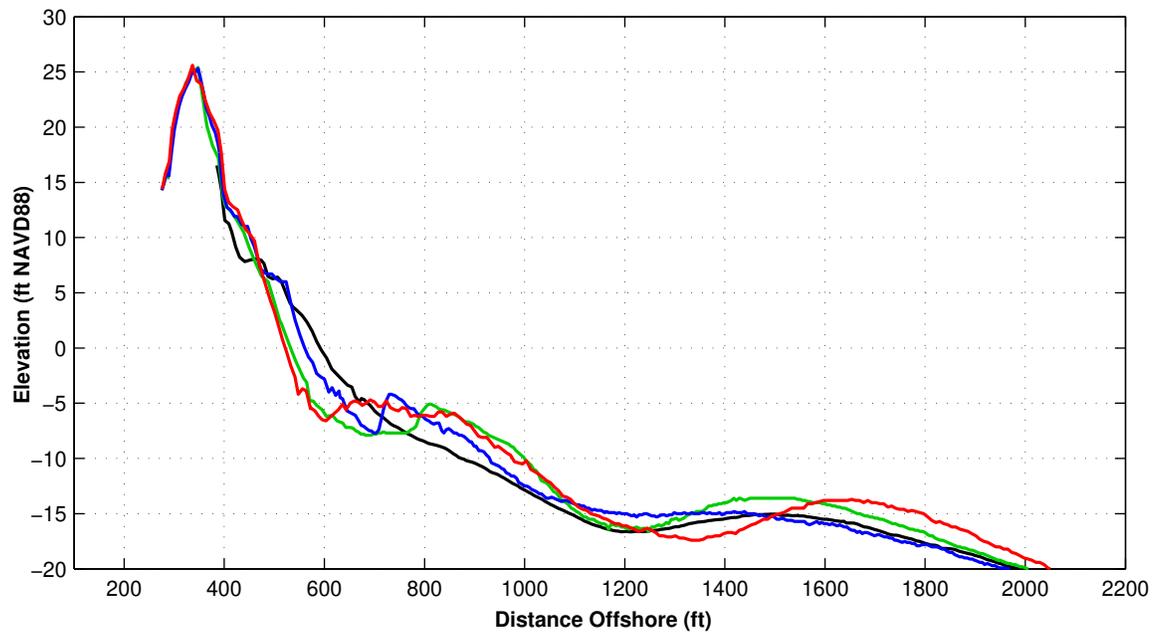
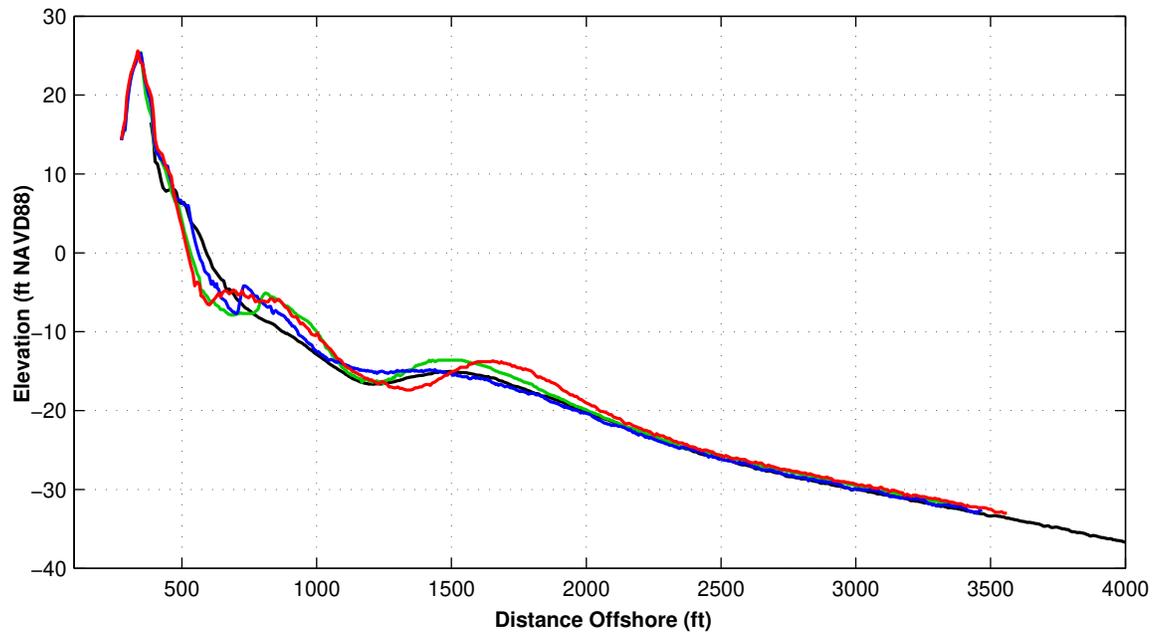
Survey Transect 485+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	54.50 ft	-80.84 ft
Volume Change Above +6 ft NAVD88	5.45 cy/ft	-1.62 cy/ft
Volume Change Above 1.18 ft NAVD88	11.95 cy/ft	-12.44 cy/ft
Volume Change Above -6 ft NAVD88	27.72 cy/ft	-43.78 cy/ft
Volume Change Above -14 ft NAVD88	22.73 cy/ft	-42.08 cy/ft
Volume Change Above -19 ft NAVD88	25.43 cy/ft	-39.62 cy/ft
Volume Change Above -30 ft NAVD88	12.31 cy/ft	-11.06 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.





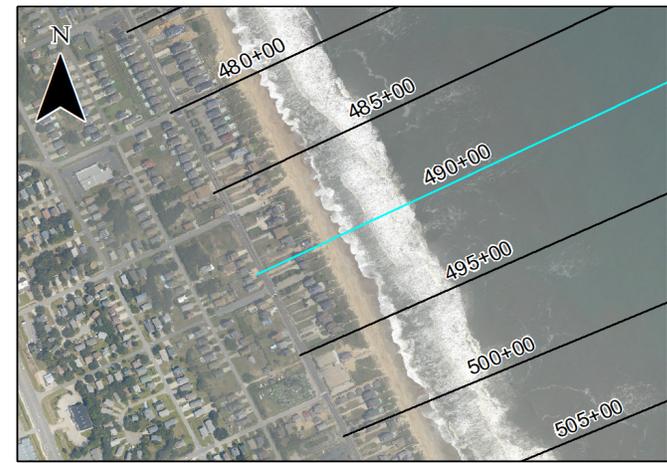
Survey Transect 490+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	28.49 ft	-37.30 ft
Volume Change Above +6 ft NAVD88	4.46 cy/ft	1.36 cy/ft
Volume Change Above 1.18 ft NAVD88	10.17 cy/ft	-5.56 cy/ft
Volume Change Above -6 ft NAVD88	22.27 cy/ft	-17.93 cy/ft
Volume Change Above -14 ft NAVD88	10.13 cy/ft	-0.67 cy/ft
Volume Change Above -19 ft NAVD88	-7.59 cy/ft	16.12 cy/ft
Volume Change Above -30 ft NAVD88	-23.67 cy/ft	45.56 cy/ft

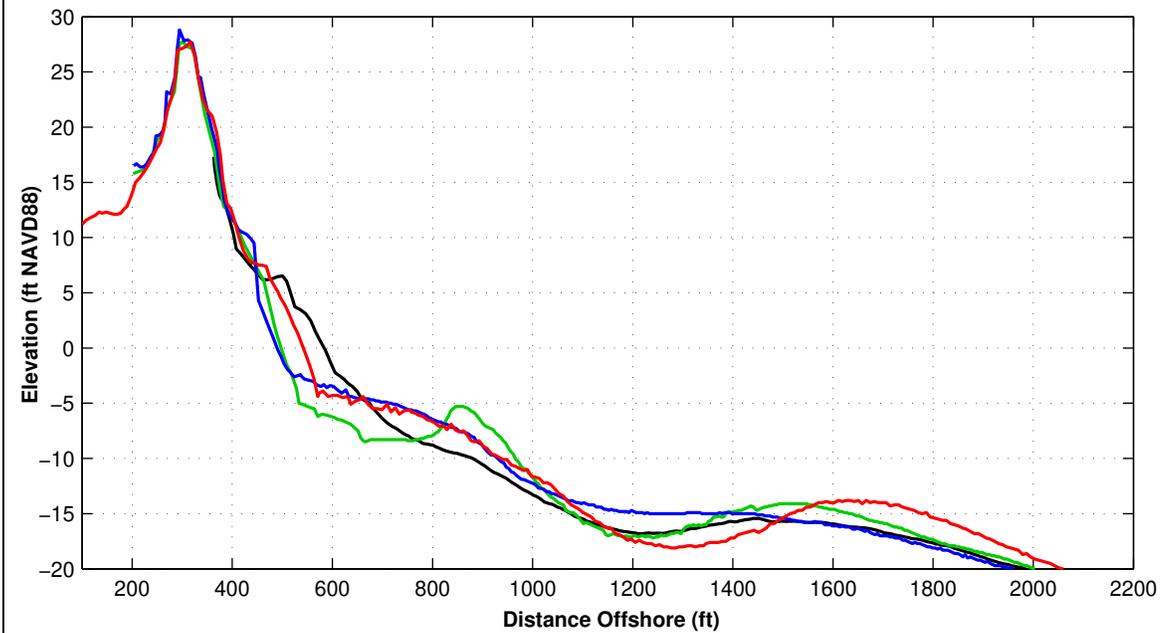
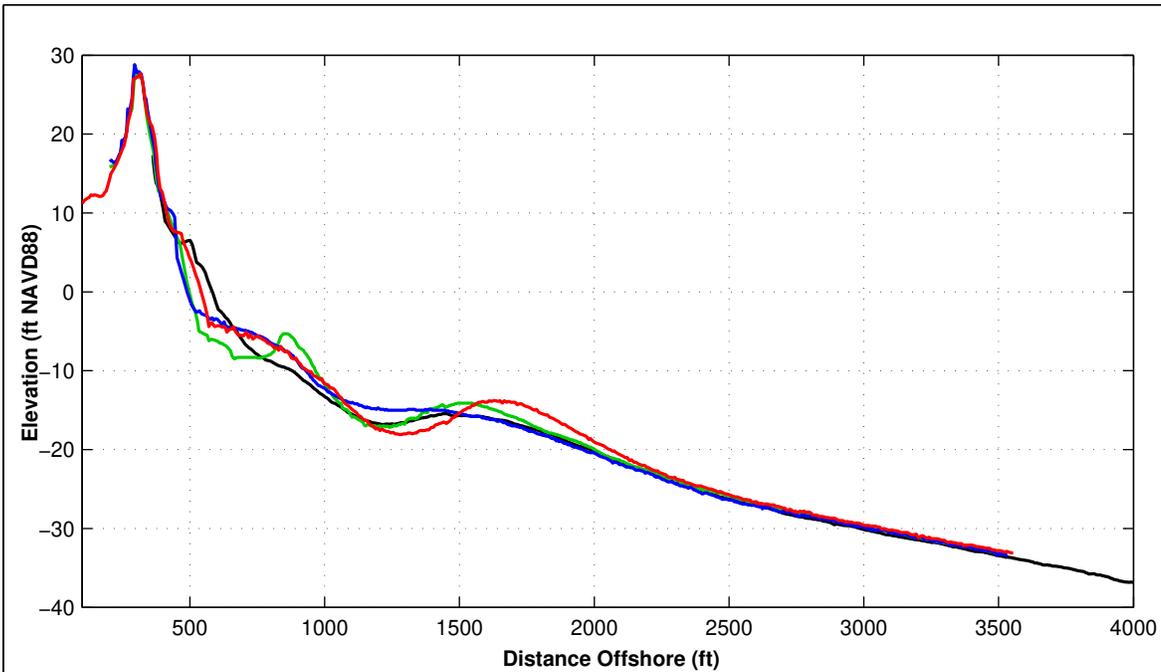
**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

**Notes:**

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.



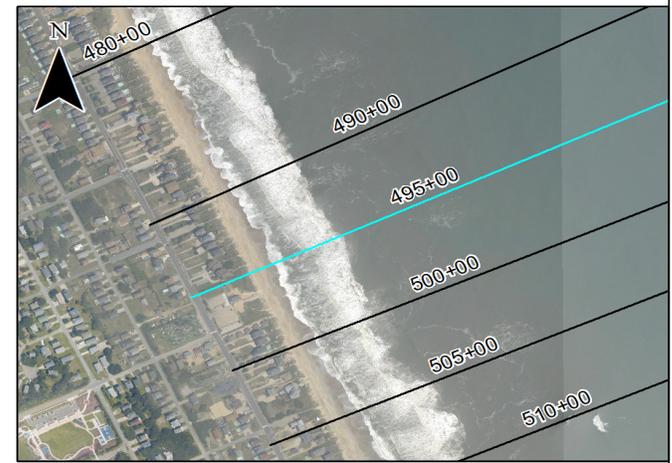


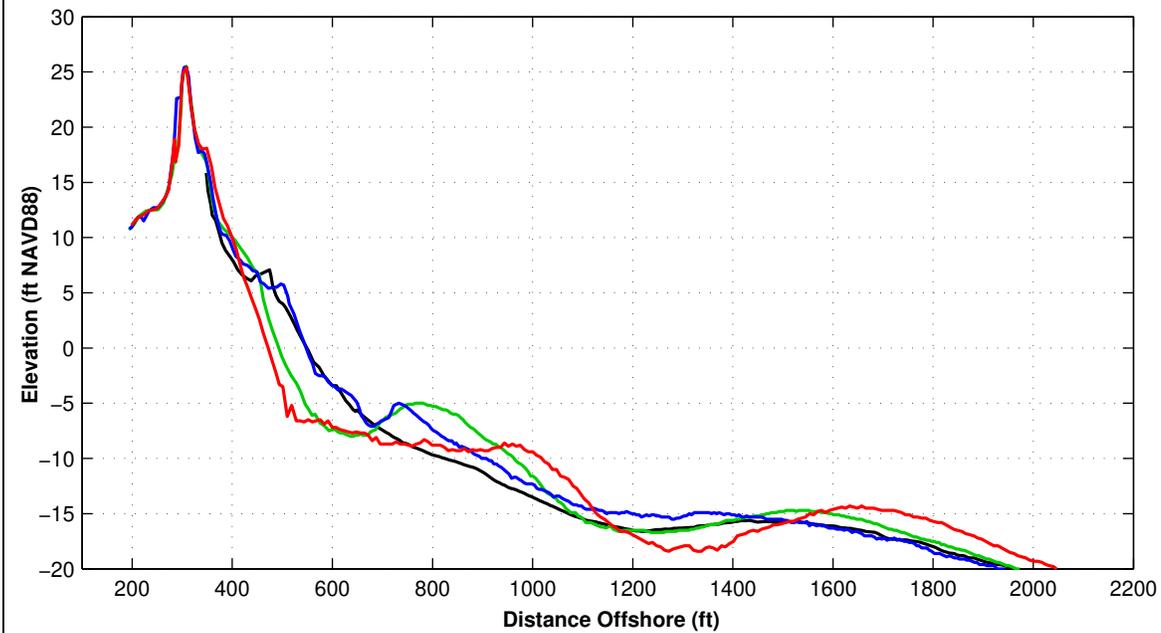
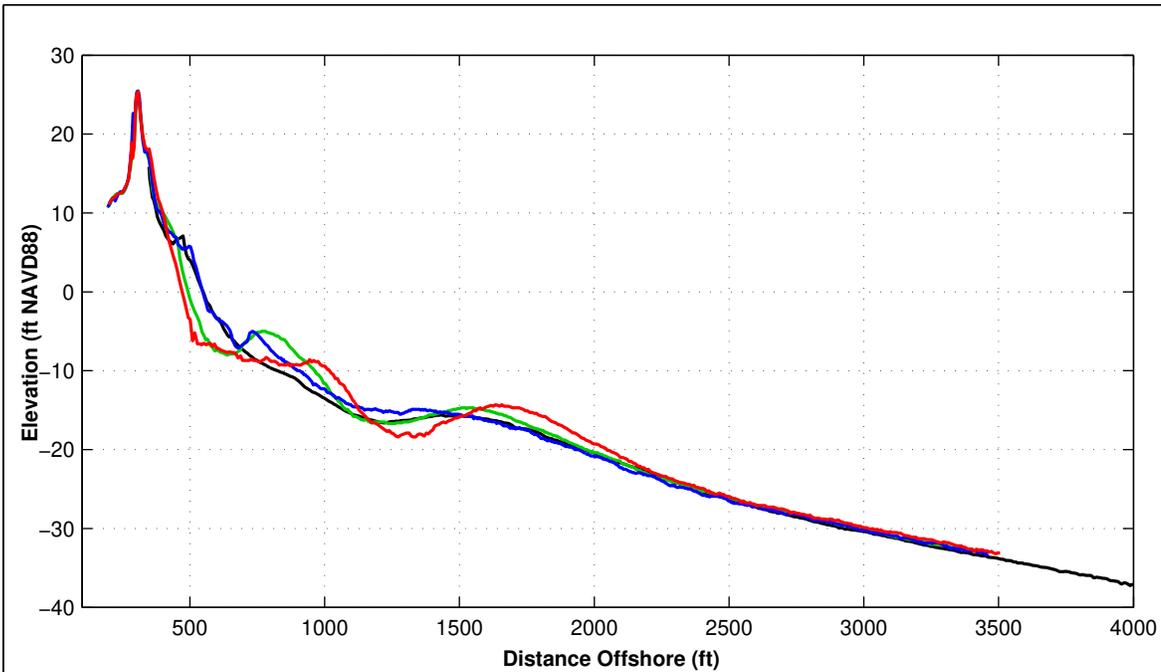
Survey Transect 495+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-9.85 ft	52.49 ft
Volume Change Above +6 ft NAVD88	3.58 cy/ft	0.74 cy/ft
Volume Change Above 1.18 ft NAVD88	0.82 cy/ft	9.02 cy/ft
Volume Change Above -6 ft NAVD88	13.71 cy/ft	12.56 cy/ft
Volume Change Above -14 ft NAVD88	18.13 cy/ft	15.31 cy/ft
Volume Change Above -19 ft NAVD88	18.78 cy/ft	20.42 cy/ft
Volume Change Above -30 ft NAVD88	5.20 cy/ft	48.30 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



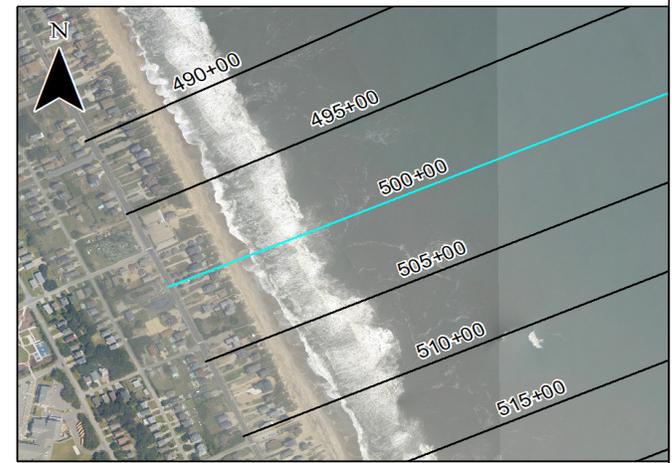


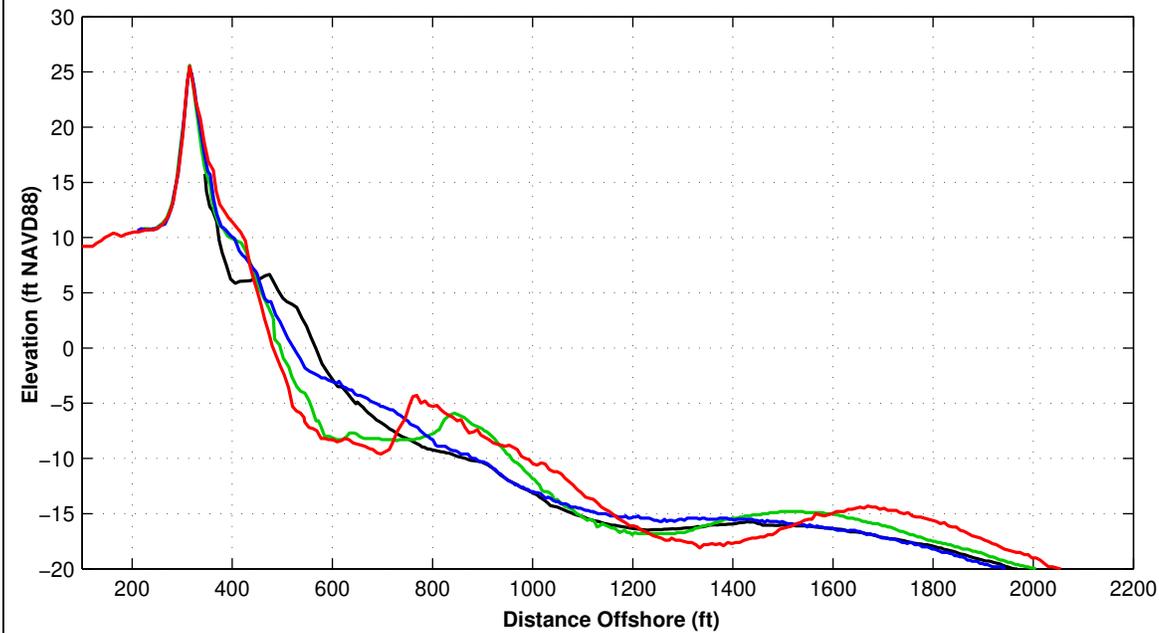
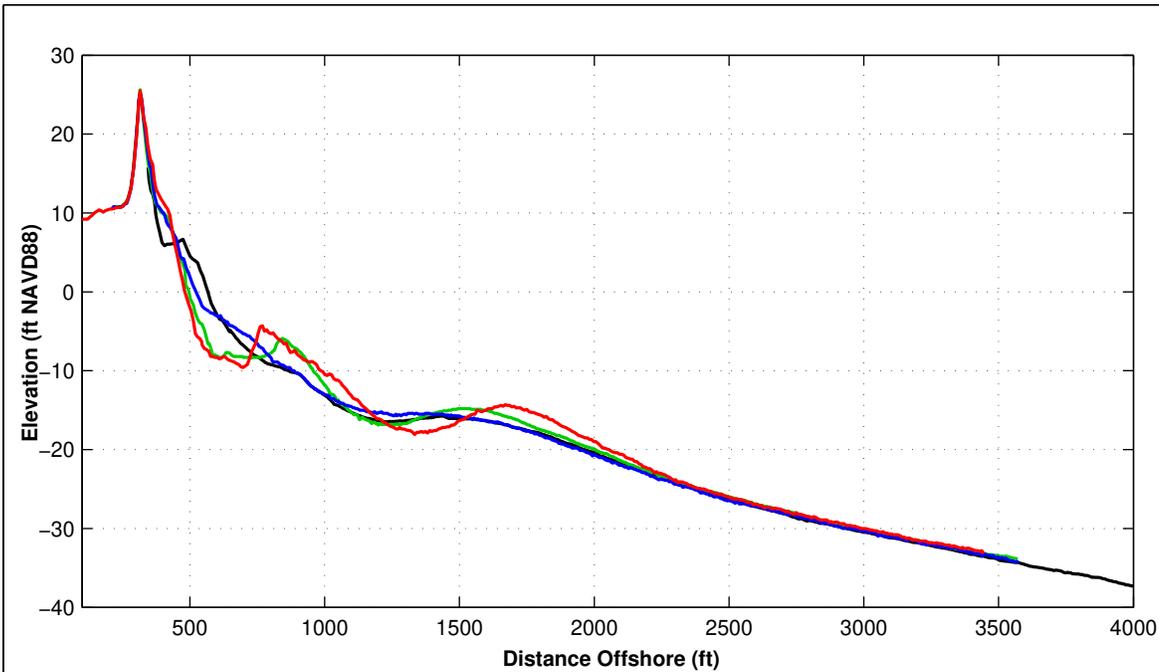
Survey Transect 500+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	54.07 ft	-74.31 ft
Volume Change Above +6 ft NAVD88	-1.95 cy/ft	2.26 cy/ft
Volume Change Above 1.18 ft NAVD88	6.50 cy/ft	-10.15 cy/ft
Volume Change Above -6 ft NAVD88	23.63 cy/ft	-37.78 cy/ft
Volume Change Above -14 ft NAVD88	14.73 cy/ft	-39.01 cy/ft
Volume Change Above -19 ft NAVD88	15.27 cy/ft	-35.12 cy/ft
Volume Change Above -30 ft NAVD88	3.06 cy/ft	-8.23 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



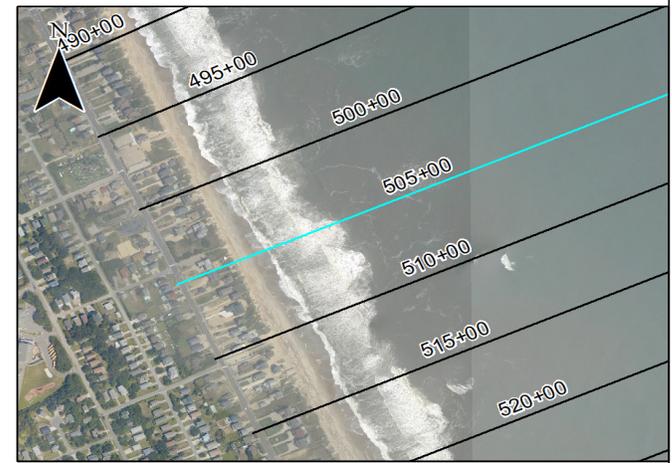


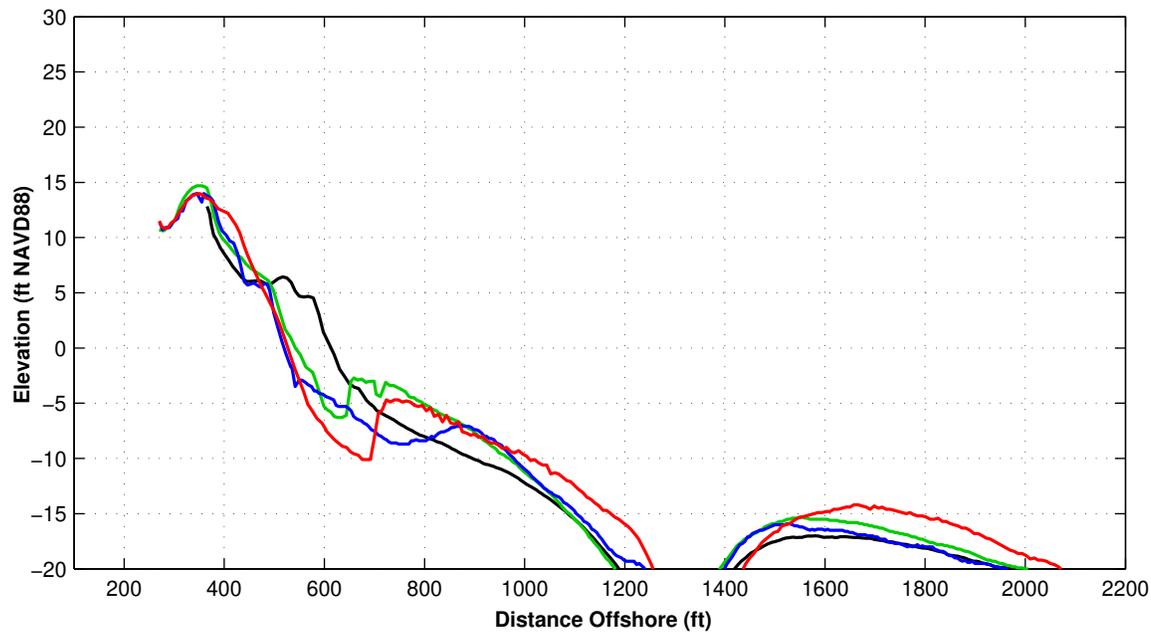
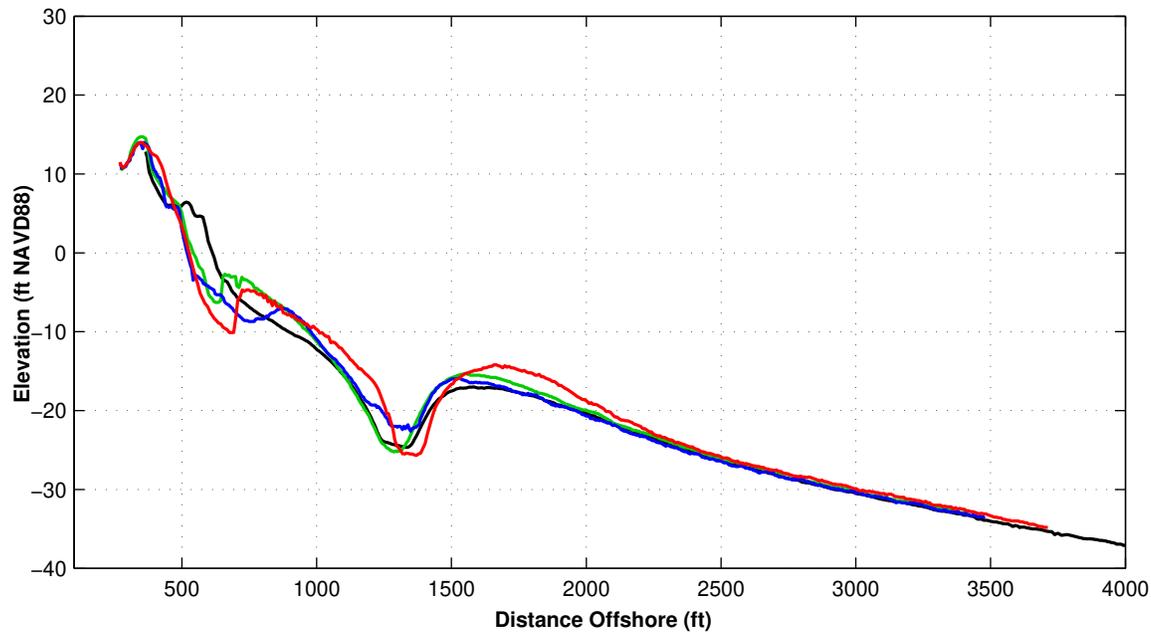
Survey Transect 505+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	23.89 ft	-33.62 ft
Volume Change Above +6 ft NAVD88	1.22 cy/ft	4.86 cy/ft
Volume Change Above 1.18 ft NAVD88	2.90 cy/ft	1.13 cy/ft
Volume Change Above -6 ft NAVD88	21.61 cy/ft	-20.21 cy/ft
Volume Change Above -14 ft NAVD88	17.10 cy/ft	-6.03 cy/ft
Volume Change Above -19 ft NAVD88	11.91 cy/ft	6.80 cy/ft
Volume Change Above -30 ft NAVD88	-5.09 cy/ft	32.04 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.

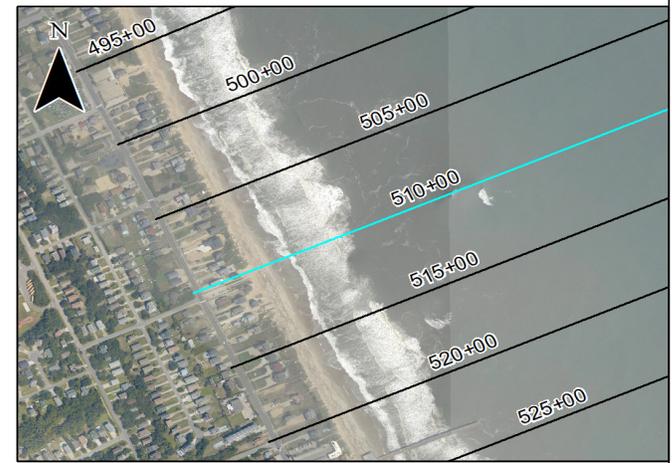


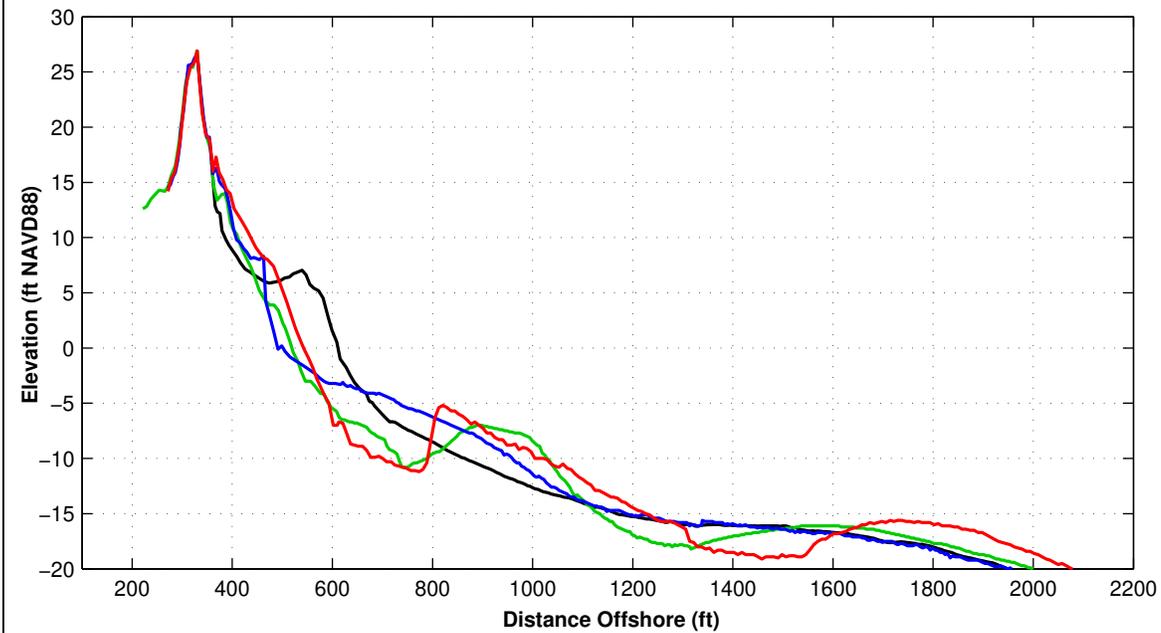
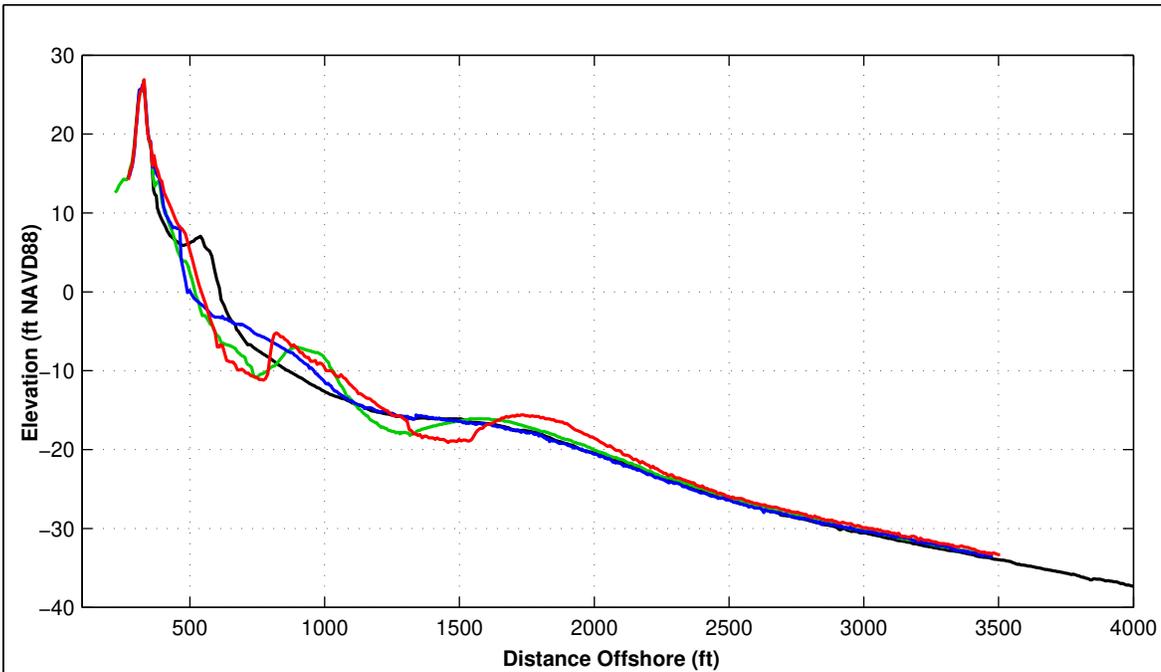


Survey Transect 510+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-17.62 ft	6.58 ft
Volume Change Above +6 ft NAVD88	-2.27 cy/ft	6.12 cy/ft
Volume Change Above 1.18 ft NAVD88	-4.65 cy/ft	6.17 cy/ft
Volume Change Above -6 ft NAVD88	-21.42 cy/ft	5.97 cy/ft
Volume Change Above -14 ft NAVD88	-32.84 cy/ft	15.21 cy/ft
Volume Change Above -19 ft NAVD88	-41.52 cy/ft	60.19 cy/ft
Volume Change Above -30 ft NAVD88	-41.87 cy/ft	77.45 cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.



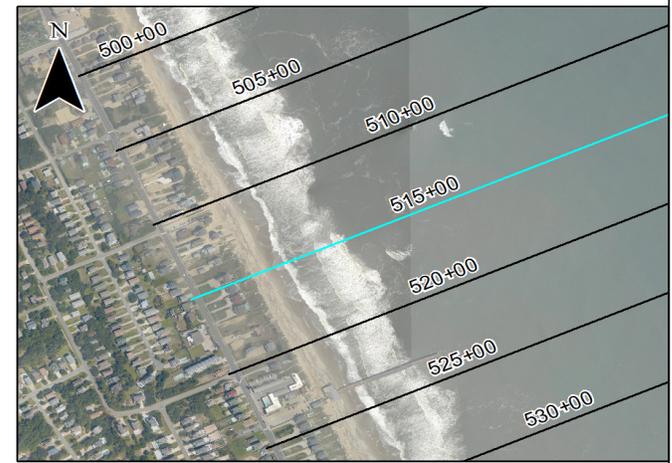


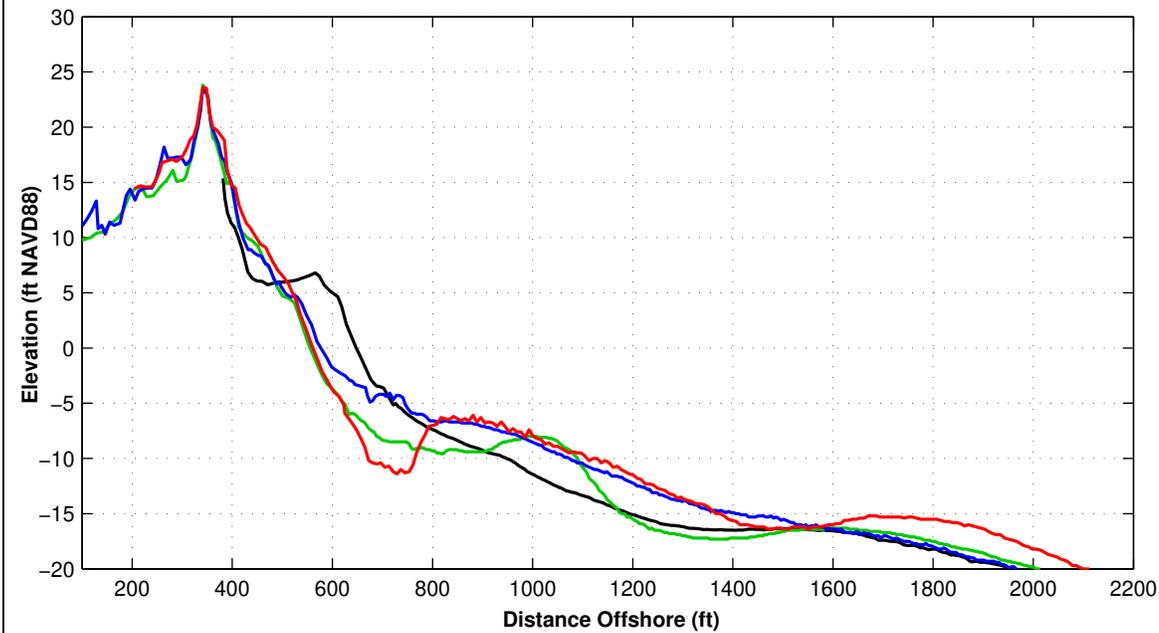
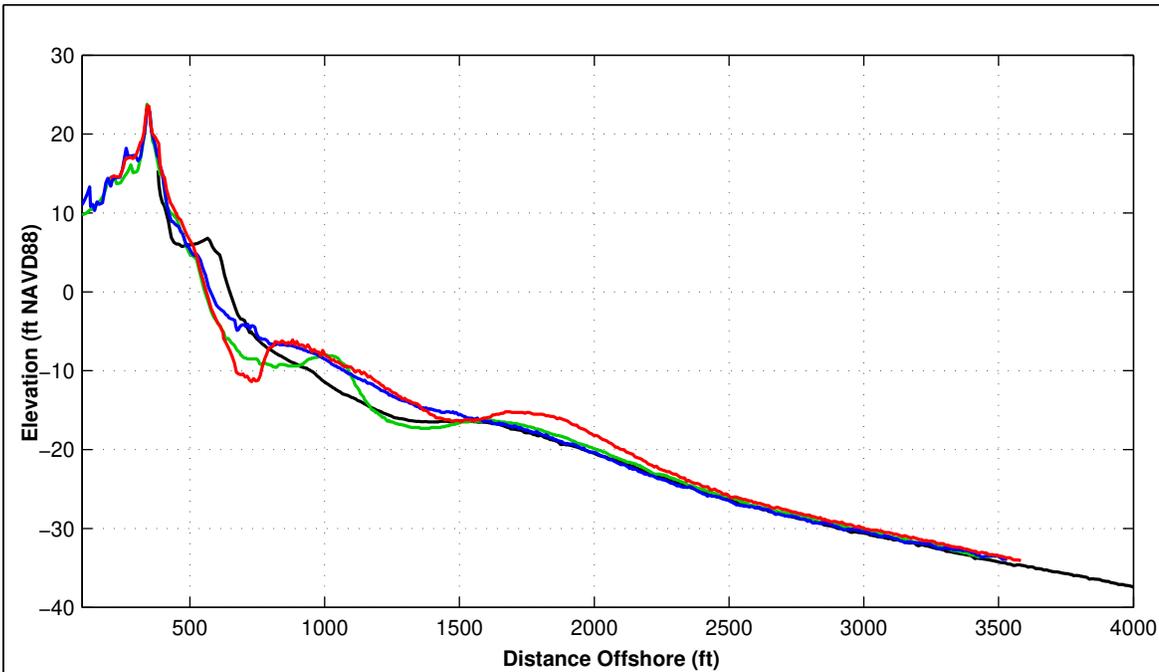
Survey Transect 515+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-26.16 ft	47.06 ft
Volume Change Above +6 ft NAVD88	4.04 cy/ft	6.31 cy/ft
Volume Change Above 1.18 ft NAVD88	2.44 cy/ft	13.55 cy/ft
Volume Change Above -6 ft NAVD88	14.79 cy/ft	5.88 cy/ft
Volume Change Above -14 ft NAVD88	22.22 cy/ft	-1.96 cy/ft
Volume Change Above -19 ft NAVD88	31.52 cy/ft	2.60 cy/ft
Volume Change Above -30 ft NAVD88	16.44 cy/ft	36.30 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



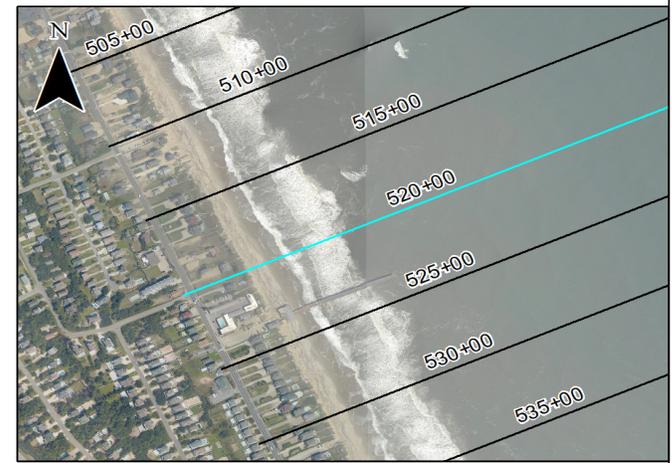


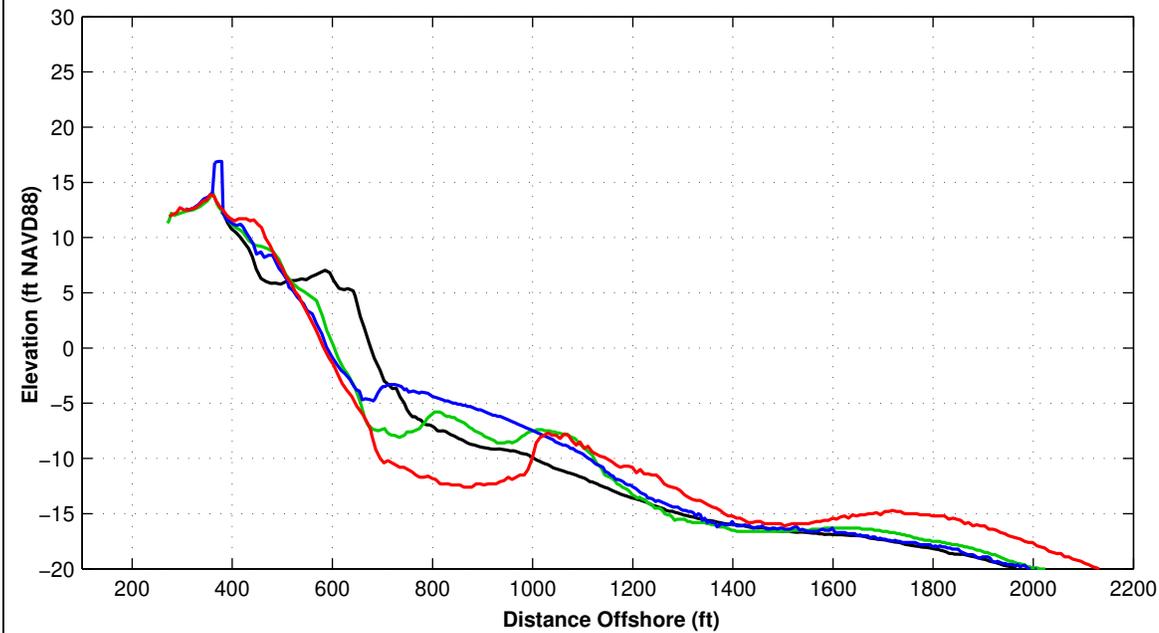
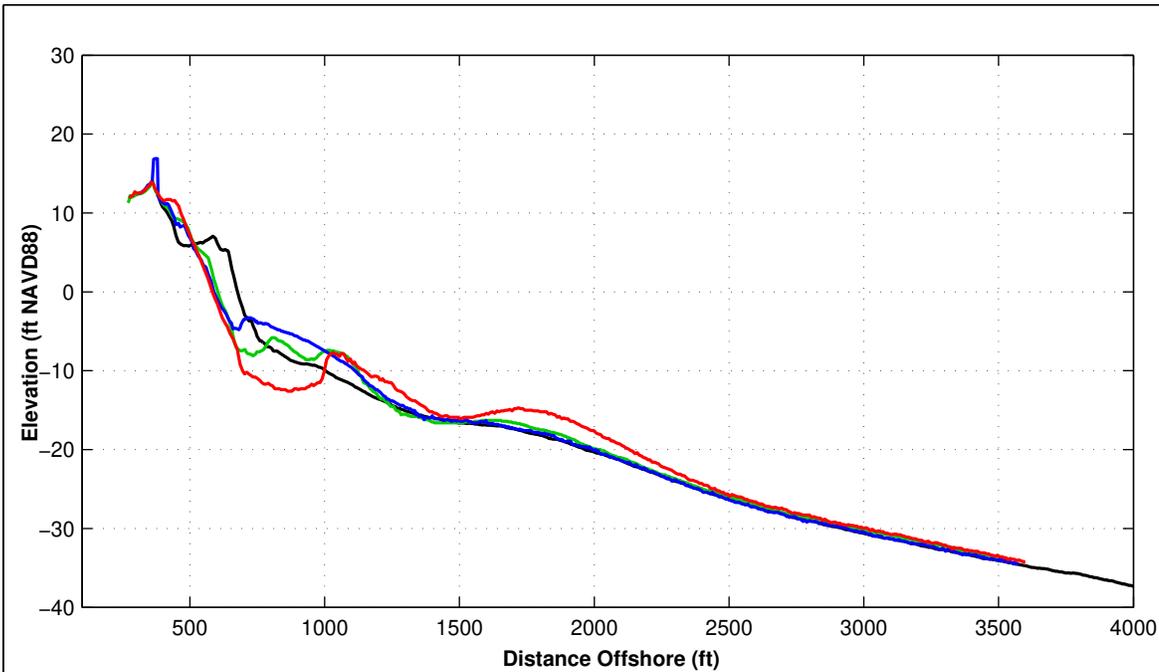
Survey Transect 520+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	19.11 ft	-13.56 ft
Volume Change Above +6 ft NAVD88	0.01 cy/ft	6.72 cy/ft
Volume Change Above 1.18 ft NAVD88	2.63 cy/ft	6.01 cy/ft
Volume Change Above -6 ft NAVD88	17.43 cy/ft	-8.21 cy/ft
Volume Change Above -14 ft NAVD88	49.76 cy/ft	-20.06 cy/ft
Volume Change Above -19 ft NAVD88	73.07 cy/ft	5.53 cy/ft
Volume Change Above -30 ft NAVD88	56.65 cy/ft	44.33 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

- Notes:
1. Station From North To South At Varying Intervals.
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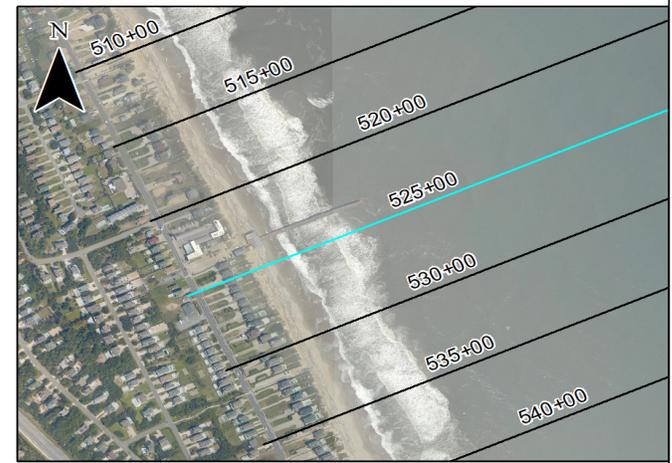


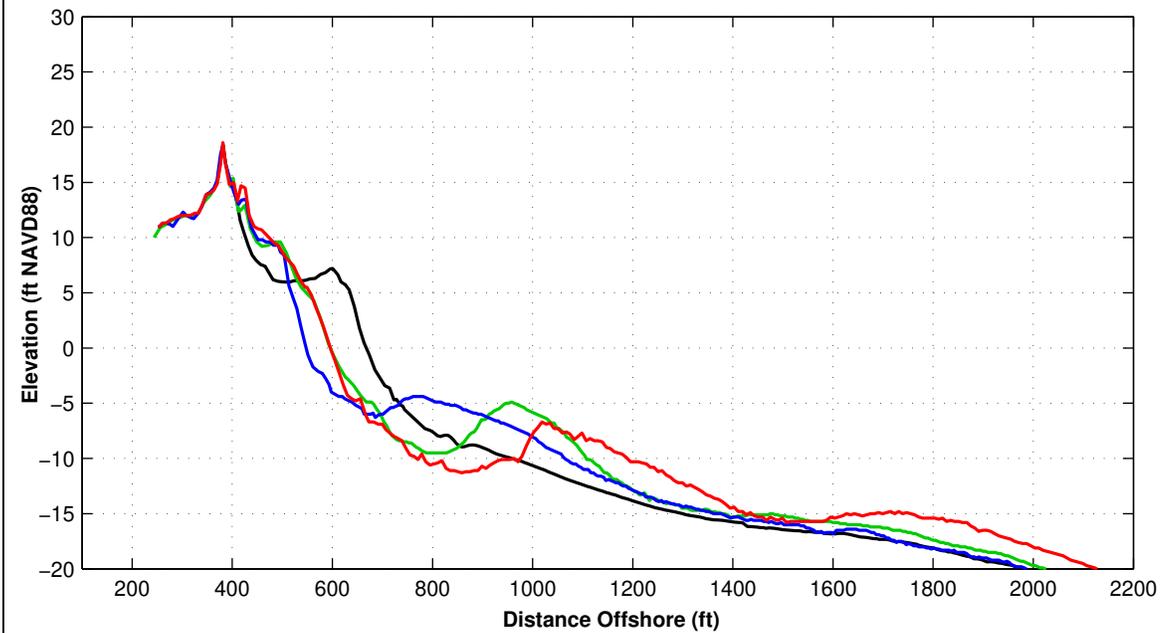
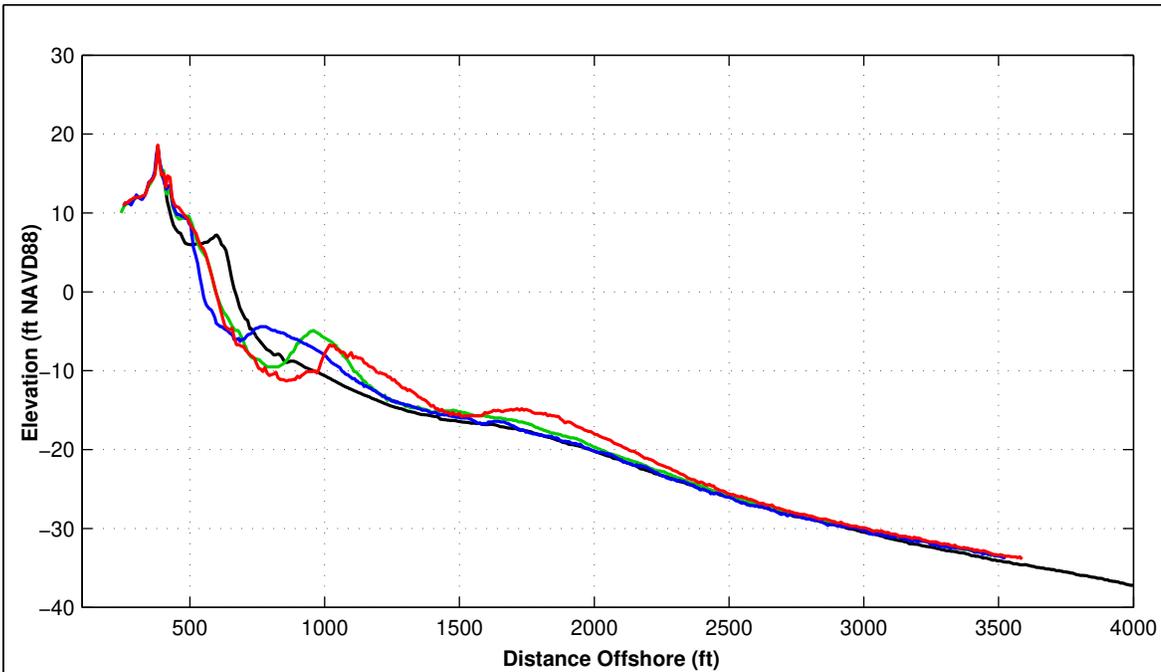
Survey Transect 525+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-13.19 ft	-7.95 ft
Volume Change Above +6 ft NAVD88	0.22 cy/ft	3.68 cy/ft
Volume Change Above 1.18 ft NAVD88	-3.36 cy/ft	3.29 cy/ft
Volume Change Above -6 ft NAVD88	9.46 cy/ft	-14.12 cy/ft
Volume Change Above -14 ft NAVD88	23.62 cy/ft	-66.31 cy/ft
Volume Change Above -19 ft NAVD88	22.16 cy/ft	-21.65 cy/ft
Volume Change Above -30 ft NAVD88	10.79 cy/ft	13.94 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
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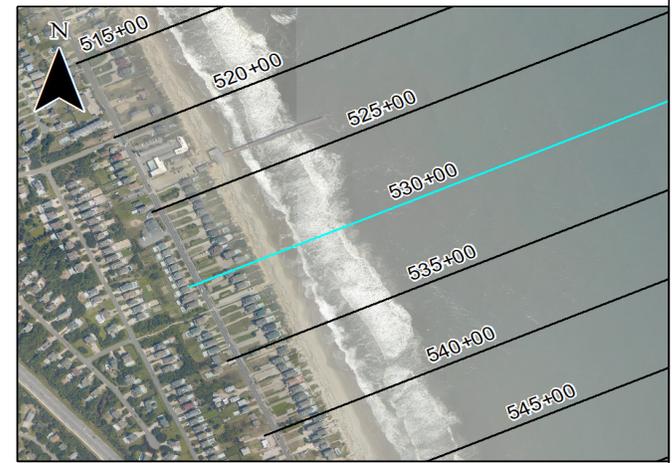


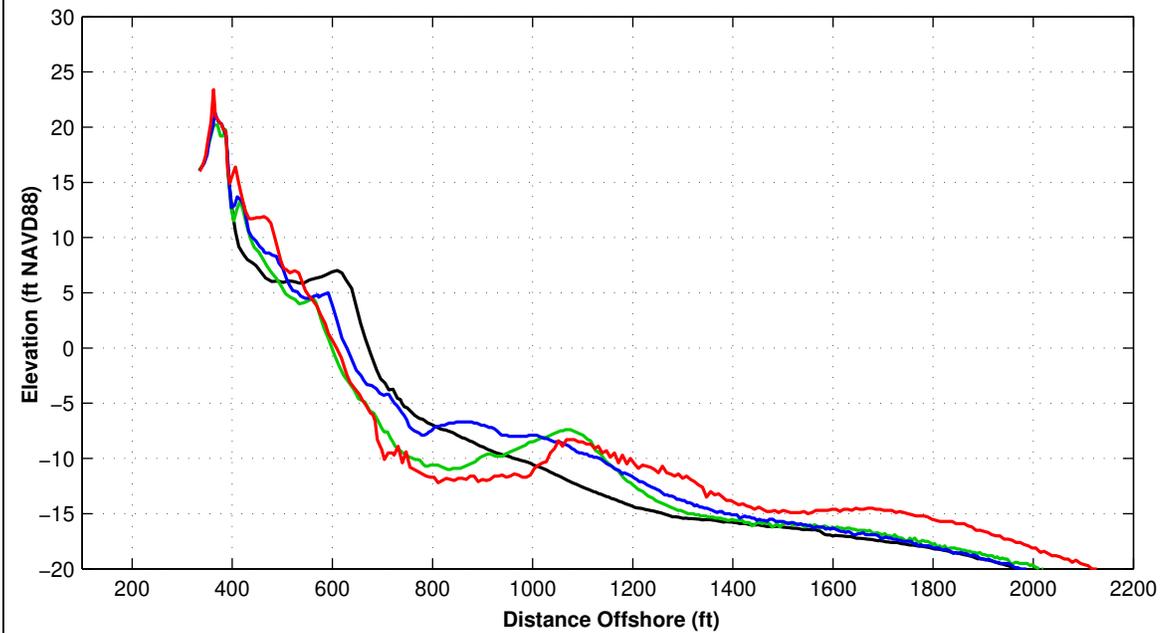
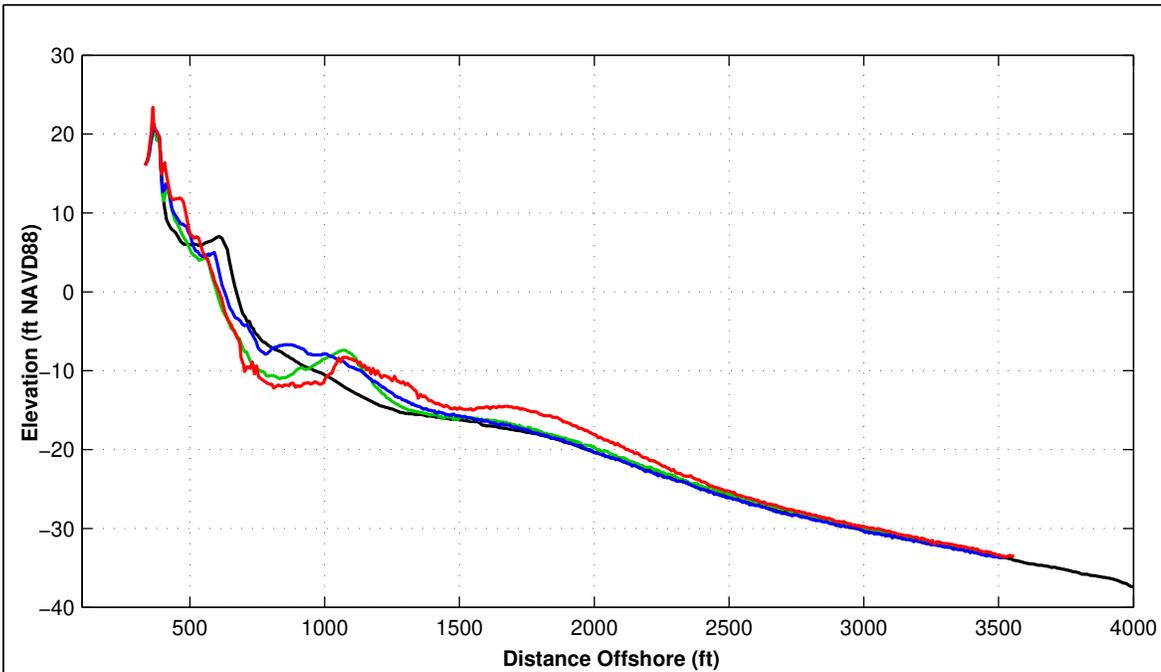
Survey Transect 530+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-45.51 ft	46.31 ft
Volume Change Above +6 ft NAVD88	-0.45 cy/ft	3.38 cy/ft
Volume Change Above 1.18 ft NAVD88	-7.15 cy/ft	10.47 cy/ft
Volume Change Above -6 ft NAVD88	-14.71 cy/ft	13.00 cy/ft
Volume Change Above -14 ft NAVD88	-9.37 cy/ft	2.30 cy/ft
Volume Change Above -19 ft NAVD88	-22.80 cy/ft	42.49 cy/ft
Volume Change Above -30 ft NAVD88	-35.20 cy/ft	74.47 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



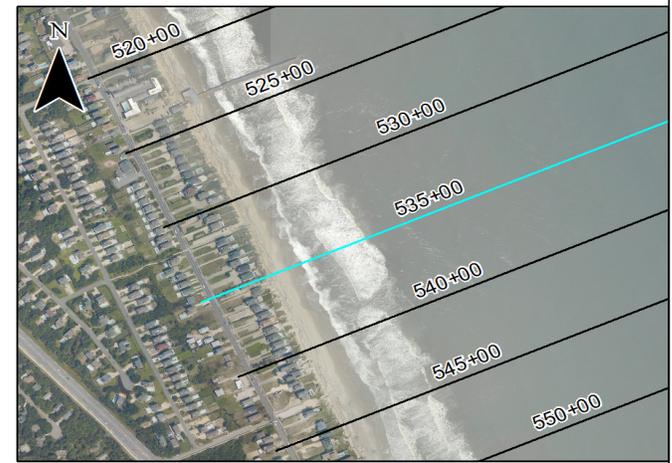


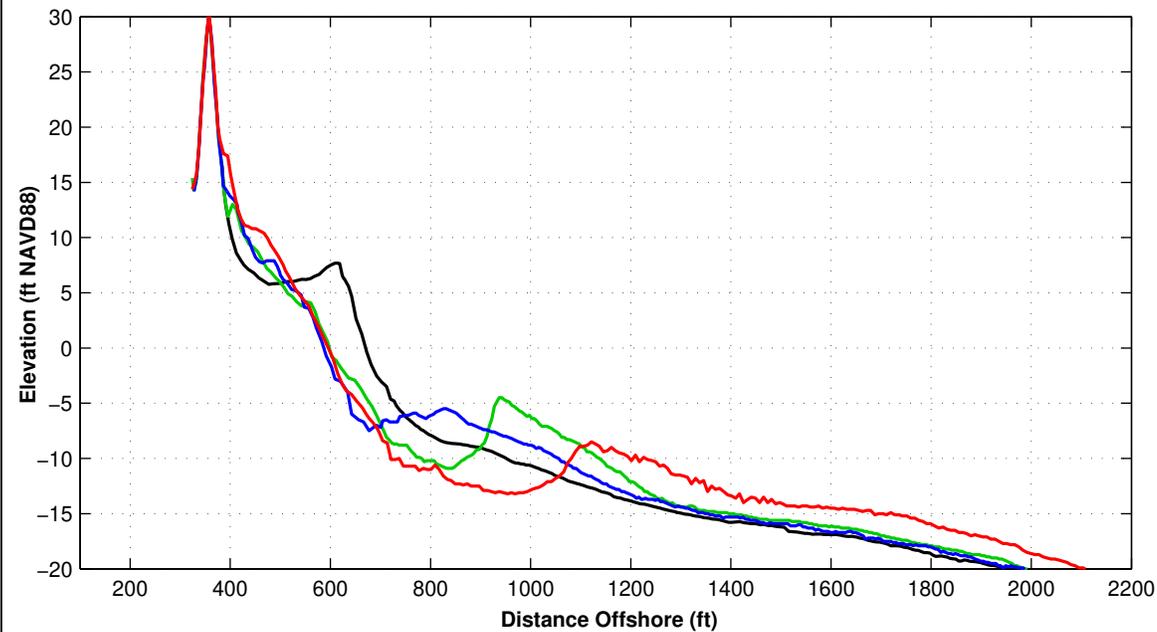
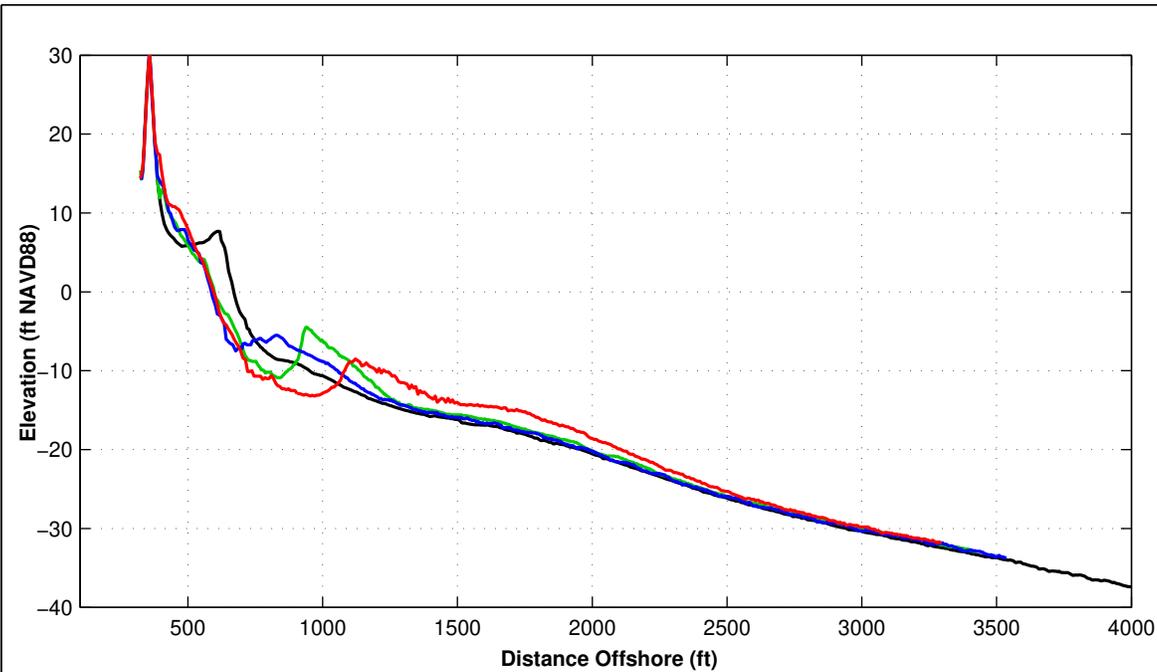
Survey Transect 535+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	28.34 ft	-23.83 ft
Volume Change Above +6 ft NAVD88	4.41 cy/ft	8.20 cy/ft
Volume Change Above 1.18 ft NAVD88	10.15 cy/ft	5.53 cy/ft
Volume Change Above -6 ft NAVD88	20.78 cy/ft	-3.65 cy/ft
Volume Change Above -14 ft NAVD88	49.88 cy/ft	-39.23 cy/ft
Volume Change Above -19 ft NAVD88	51.34 cy/ft	5.18 cy/ft
Volume Change Above -30 ft NAVD88	35.23 cy/ft	43.05 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.





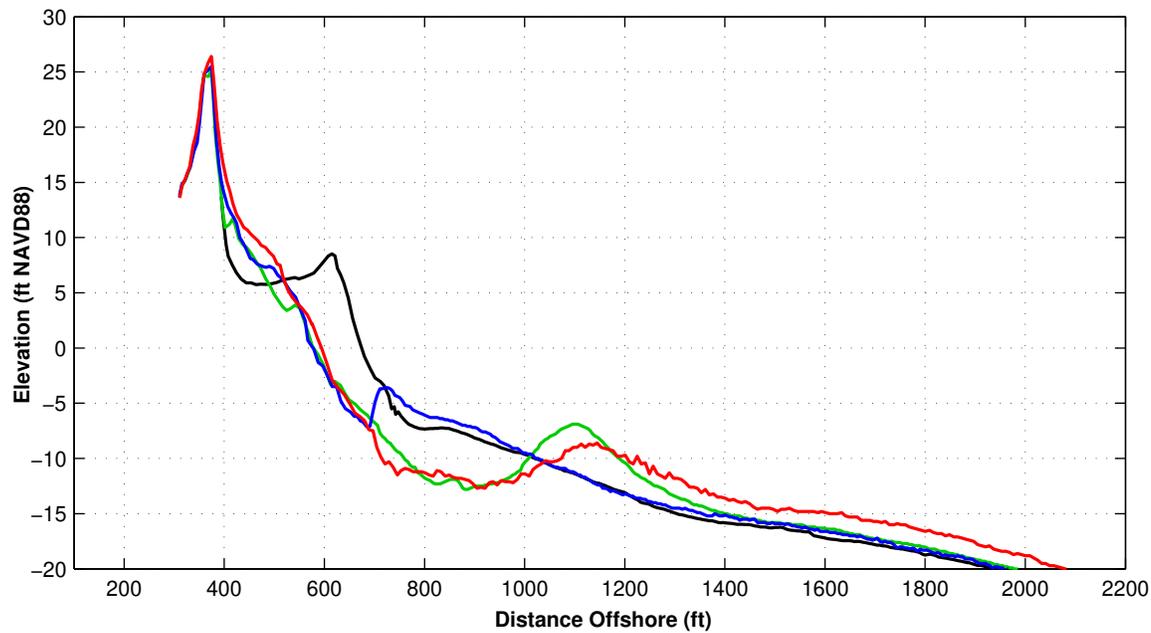
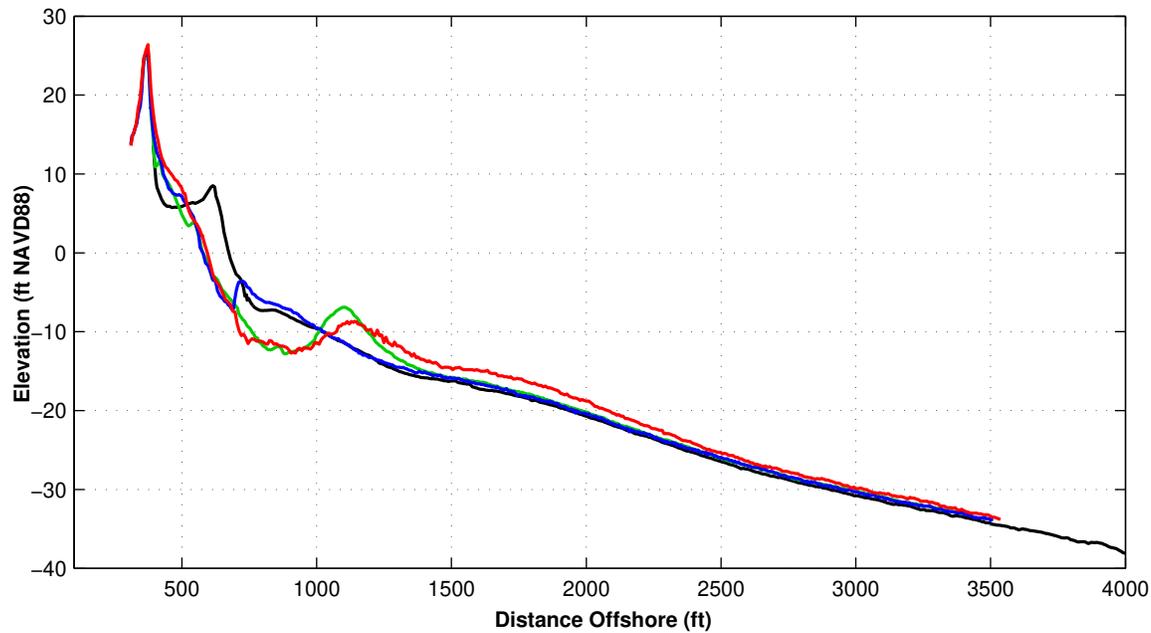
Survey Transect 540+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-10.40 ft	6.18 ft
Volume Change Above +6 ft NAVD88	2.25 cy/ft	8.38 cy/ft
Volume Change Above 1.18 ft NAVD88	2.35 cy/ft	9.12 cy/ft
Volume Change Above -6 ft NAVD88	-5.68 cy/ft	11.15 cy/ft
Volume Change Above -14 ft NAVD88	-5.81 cy/ft	-16.56 cy/ft
Volume Change Above -19 ft NAVD88	-13.20 cy/ft	30.07 cy/ft
Volume Change Above -30 ft NAVD88	-21.35 cy/ft	63.50 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.





Survey Transect 545+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-3.65 ft	18.48 ft
Volume Change Above +6 ft NAVD88	3.51 cy/ft	9.19 cy/ft
Volume Change Above 1.18 ft NAVD88	6.63 cy/ft	10.03 cy/ft
Volume Change Above -6 ft NAVD88	9.01 cy/ft	8.53 cy/ft
Volume Change Above -14 ft NAVD88	25.73 cy/ft	-13.37 cy/ft
Volume Change Above -19 ft NAVD88	20.03 cy/ft	22.99 cy/ft
Volume Change Above -30 ft NAVD88	16.72 cy/ft	56.55 cy/ft

**LEGEND:**

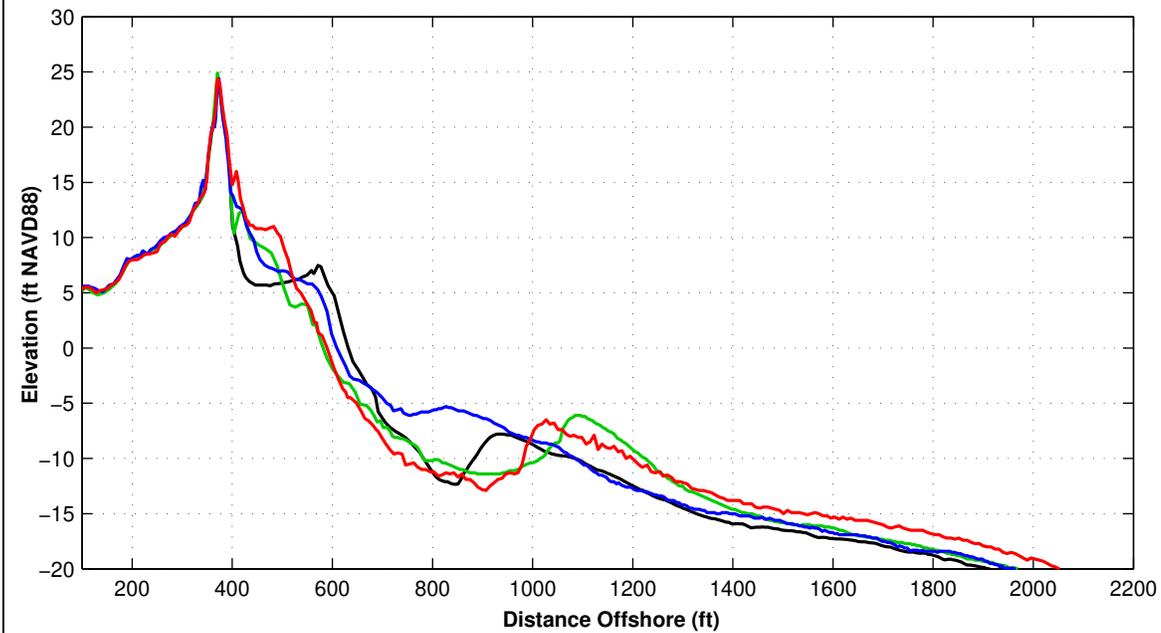
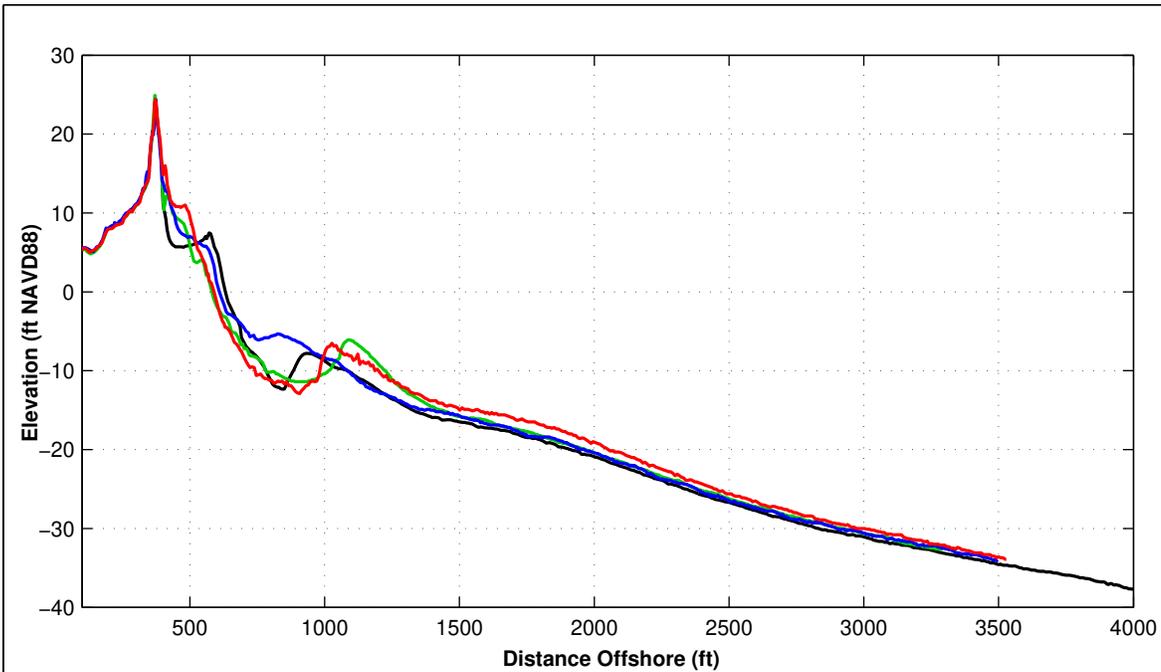
JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

**Notes:**

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.



**Town of Nags Head Periodic Surveying Data Analysis**



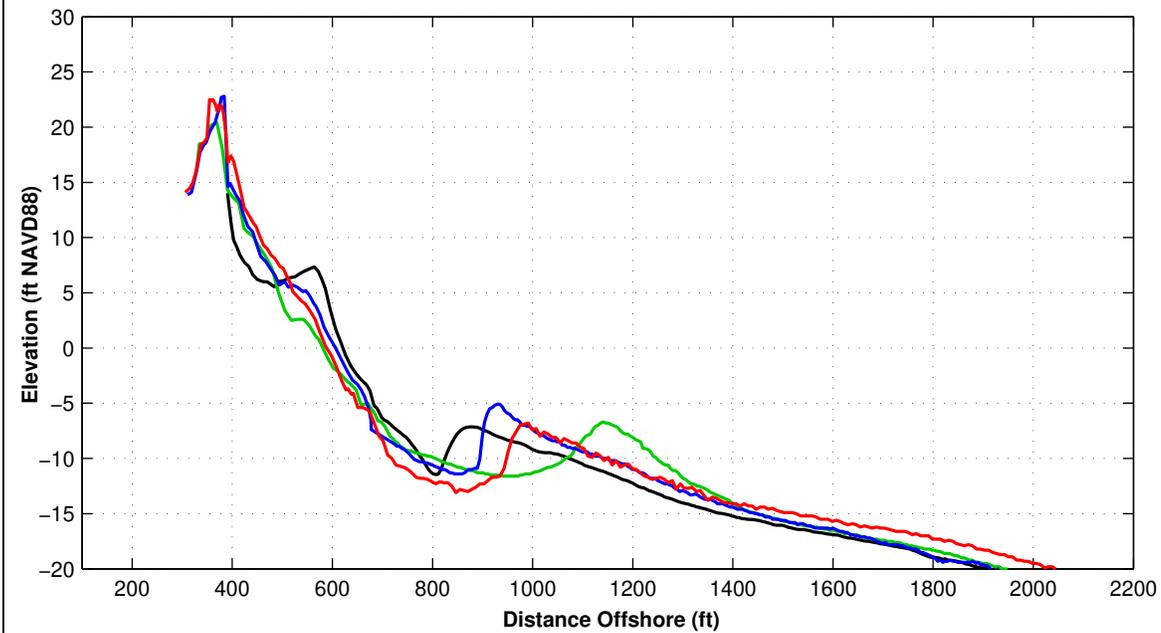
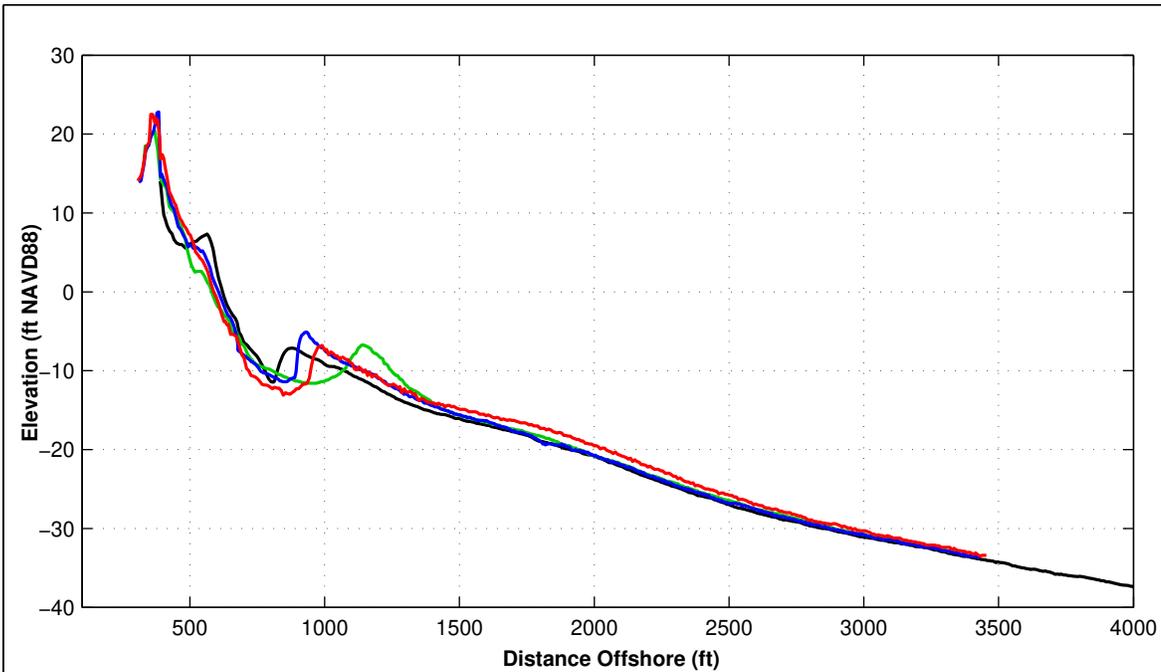
Survey Transect 550+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	26.06 ft	-21.72 ft
Volume Change Above +6 ft NAVD88	-0.02 cy/ft	9.92 cy/ft
Volume Change Above 1.18 ft NAVD88	8.32 cy/ft	4.28 cy/ft
Volume Change Above -6 ft NAVD88	19.18 cy/ft	-7.72 cy/ft
Volume Change Above -14 ft NAVD88	30.68 cy/ft	-31.54 cy/ft
Volume Change Above -19 ft NAVD88	25.77 cy/ft	-2.16 cy/ft
Volume Change Above -30 ft NAVD88	20.66 cy/ft	31.89 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



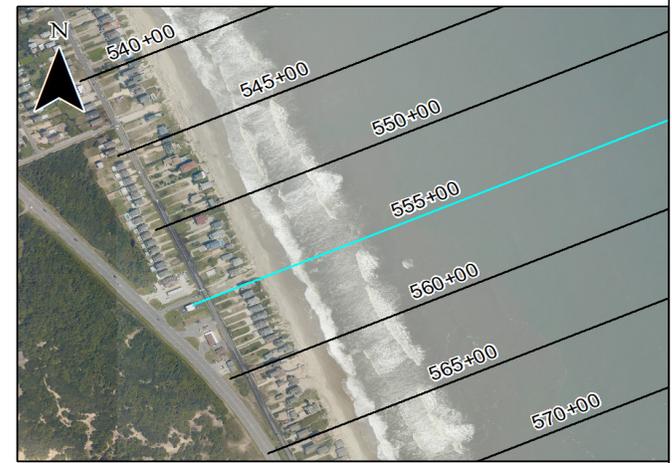


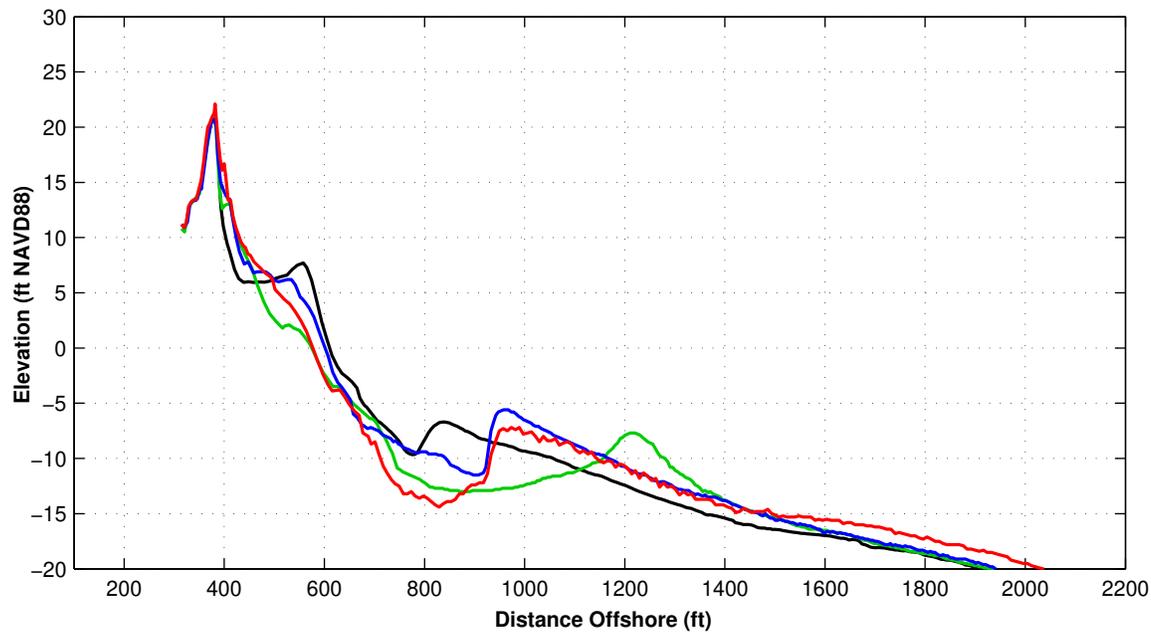
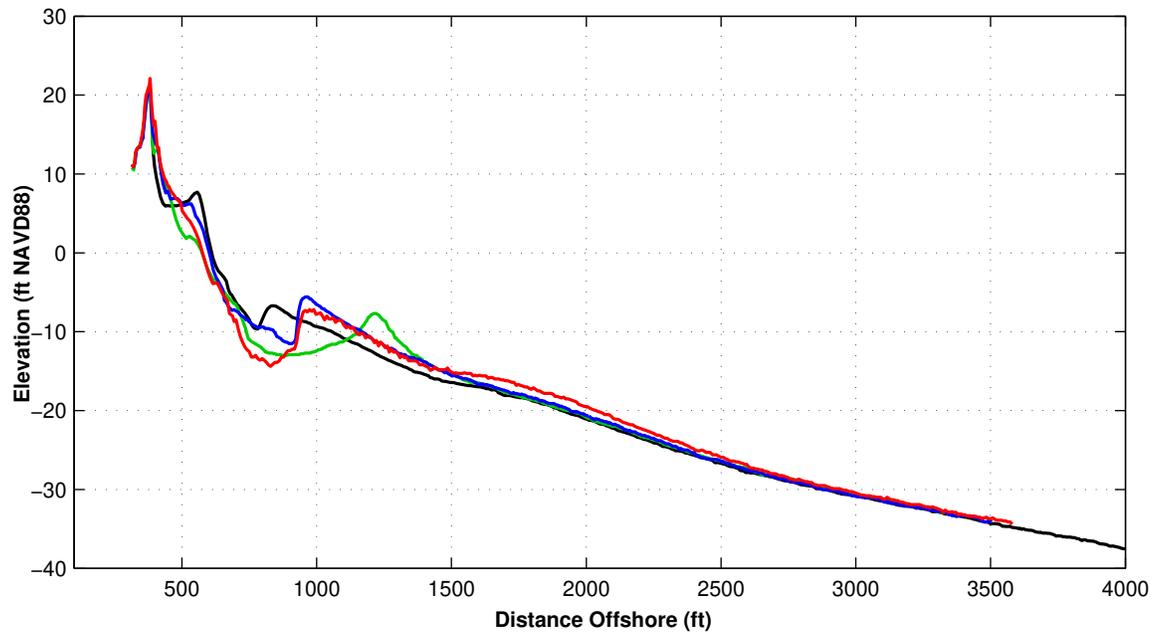
Survey Transect 555+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	26.36 ft	-14.10 ft
Volume Change Above +6 ft NAVD88	3.37 cy/ft	6.13 cy/ft
Volume Change Above 1.18 ft NAVD88	11.77 cy/ft	3.56 cy/ft
Volume Change Above -6 ft NAVD88	16.91 cy/ft	-2.17 cy/ft
Volume Change Above -14 ft NAVD88	18.12 cy/ft	-22.15 cy/ft
Volume Change Above -19 ft NAVD88	15.83 cy/ft	-2.05 cy/ft
Volume Change Above -30 ft NAVD88	9.49 cy/ft	32.94 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.

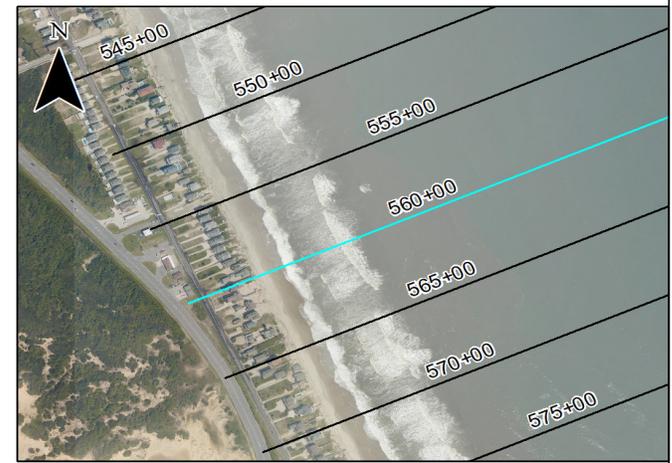


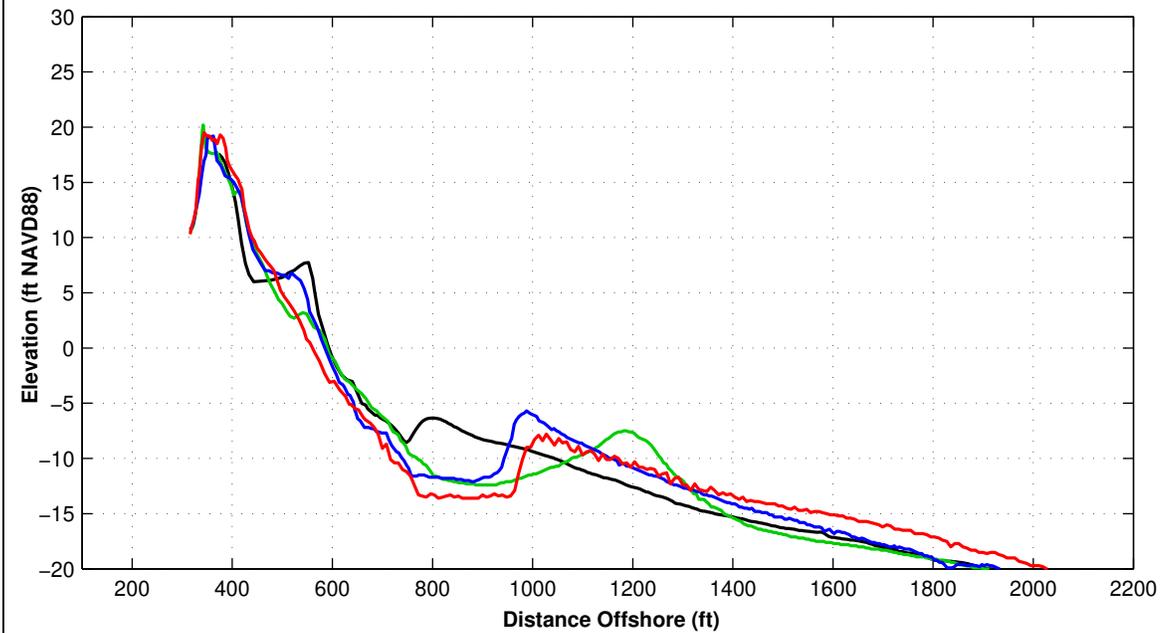
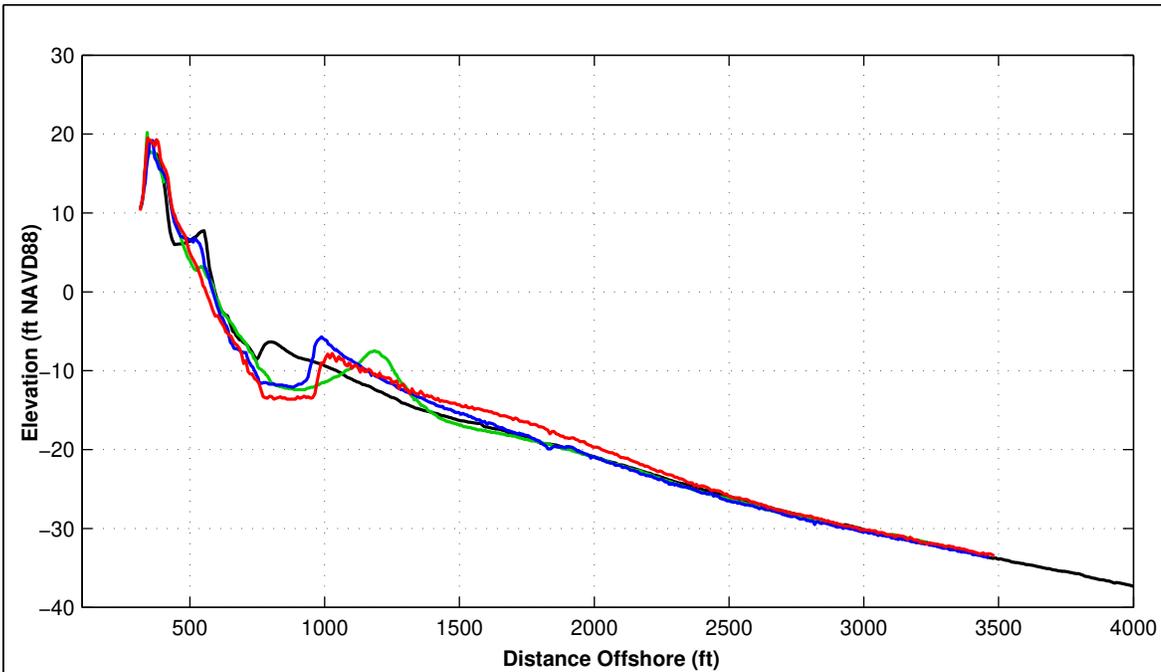


Survey Transect 560+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	34.41 ft	-25.06 ft
Volume Change Above +6 ft NAVD88	1.42 cy/ft	3.24 cy/ft
Volume Change Above 1.18 ft NAVD88	14.48 cy/ft	-2.75 cy/ft
Volume Change Above -6 ft NAVD88	18.47 cy/ft	-7.78 cy/ft
Volume Change Above -14 ft NAVD88	53.24 cy/ft	-43.02 cy/ft
Volume Change Above -19 ft NAVD88	54.79 cy/ft	-27.32 cy/ft
Volume Change Above -30 ft NAVD88	56.27 cy/ft	-3.10 cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.



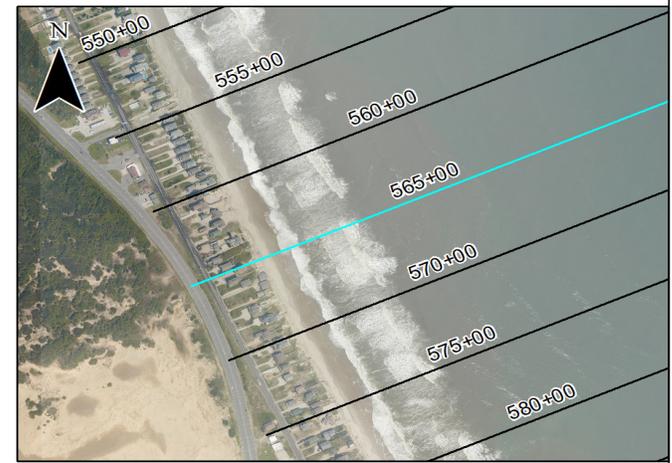


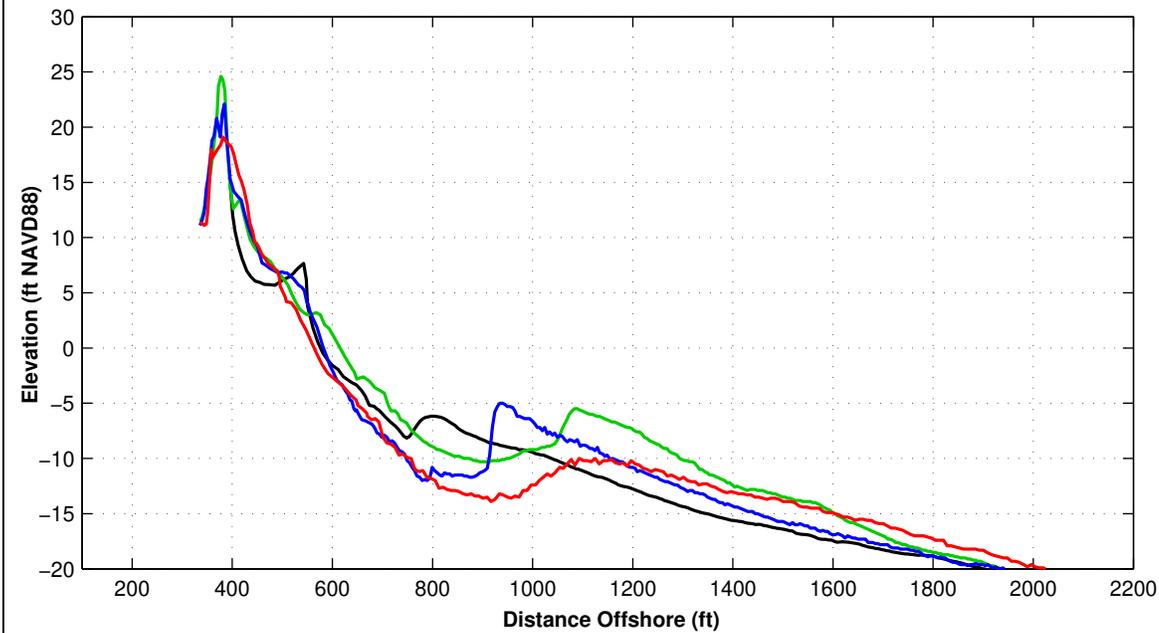
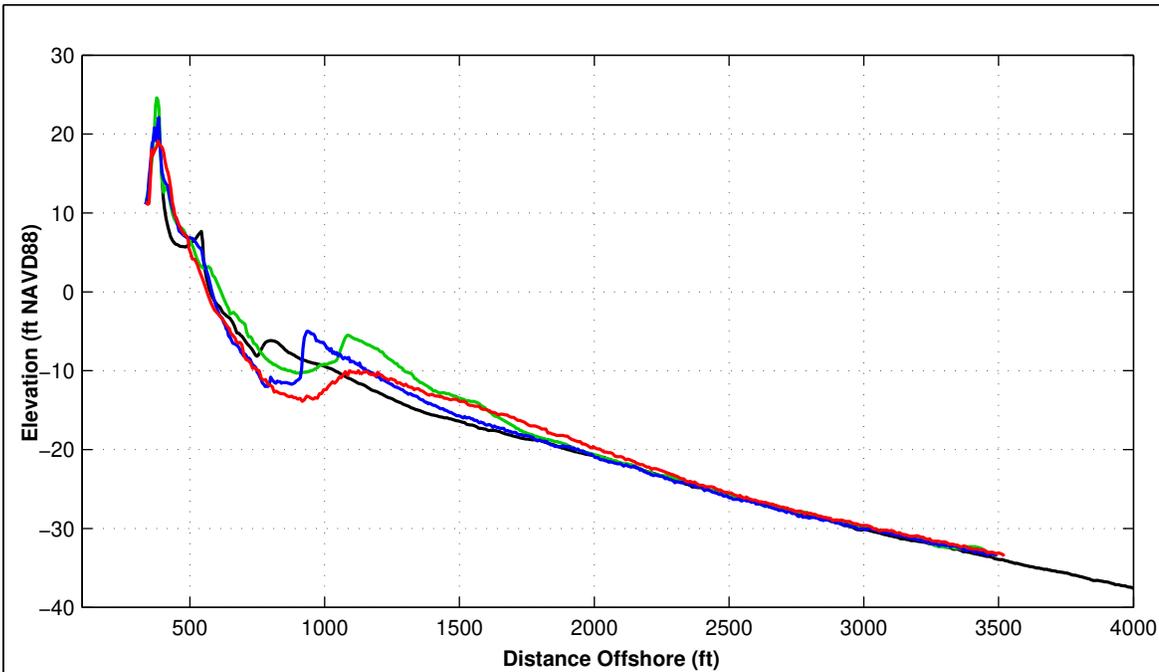
Survey Transect 565+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-4.81 ft	-29.27 ft
Volume Change Above +6 ft NAVD88	1.59 cy/ft	2.99 cy/ft
Volume Change Above 1.18 ft NAVD88	8.11 cy/ft	-3.57 cy/ft
Volume Change Above -6 ft NAVD88	3.73 cy/ft	-8.07 cy/ft
Volume Change Above -14 ft NAVD88	8.31 cy/ft	-30.84 cy/ft
Volume Change Above -19 ft NAVD88	24.50 cy/ft	-6.34 cy/ft
Volume Change Above -30 ft NAVD88	20.50 cy/ft	26.17 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
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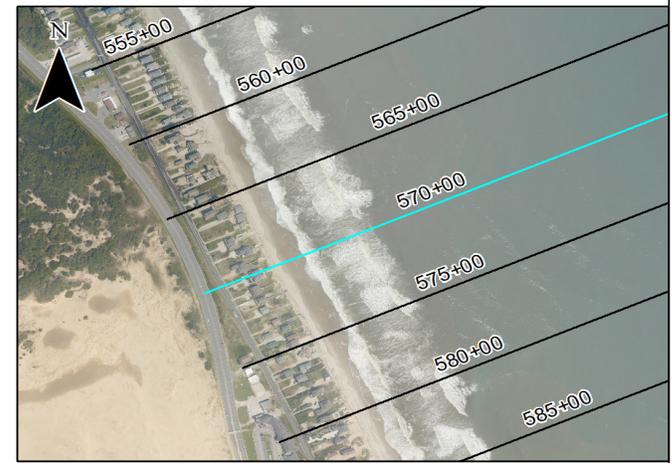


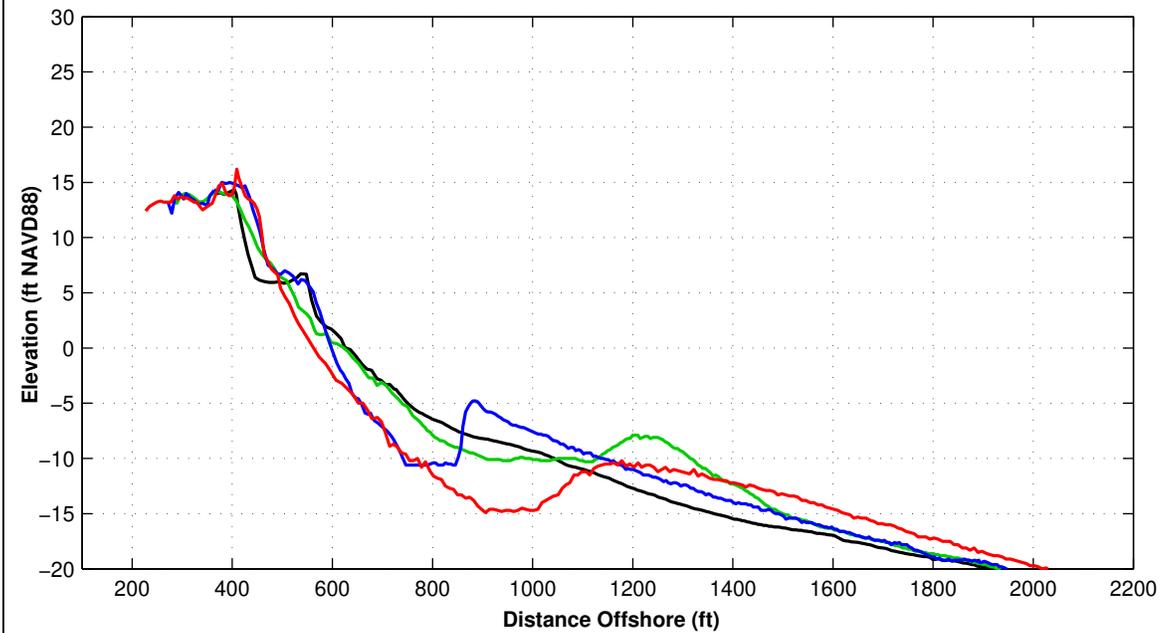
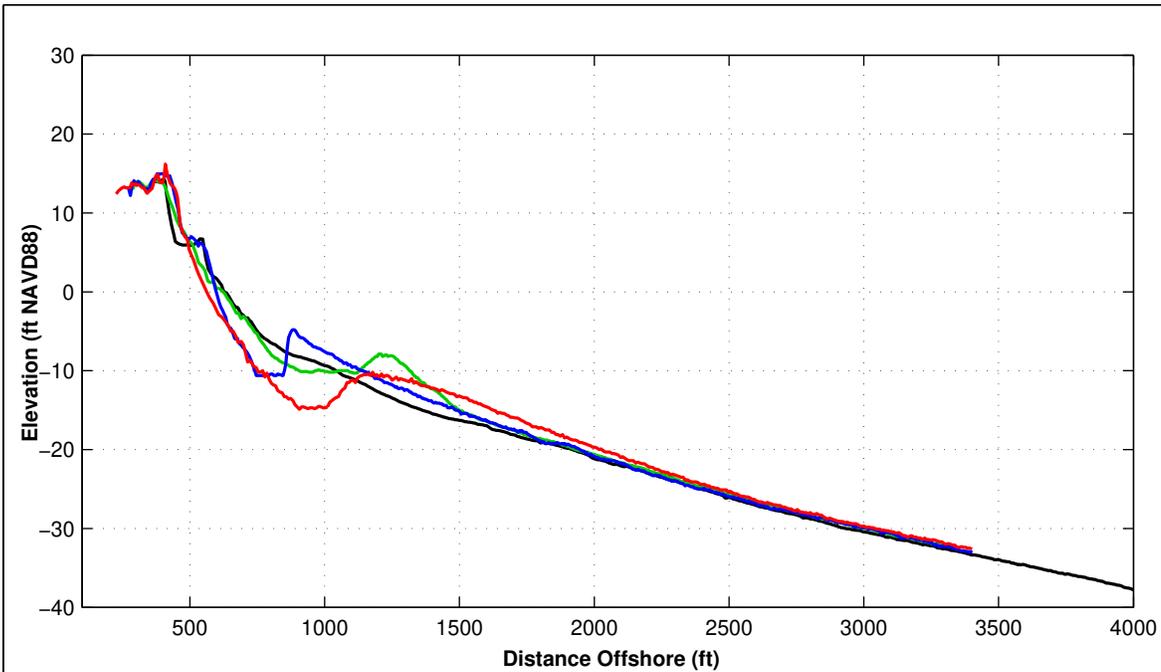
Survey Transect 570+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-27.06 ft	-21.88 ft
Volume Change Above +6 ft NAVD88	-0.32 cy/ft	2.57 cy/ft
Volume Change Above 1.18 ft NAVD88	0.66 cy/ft	-3.09 cy/ft
Volume Change Above -6 ft NAVD88	-12.33 cy/ft	-5.73 cy/ft
Volume Change Above -14 ft NAVD88	-57.21 cy/ft	-39.46 cy/ft
Volume Change Above -19 ft NAVD88	-75.82 cy/ft	-11.67 cy/ft
Volume Change Above -30 ft NAVD88	-85.12 cy/ft	14.29 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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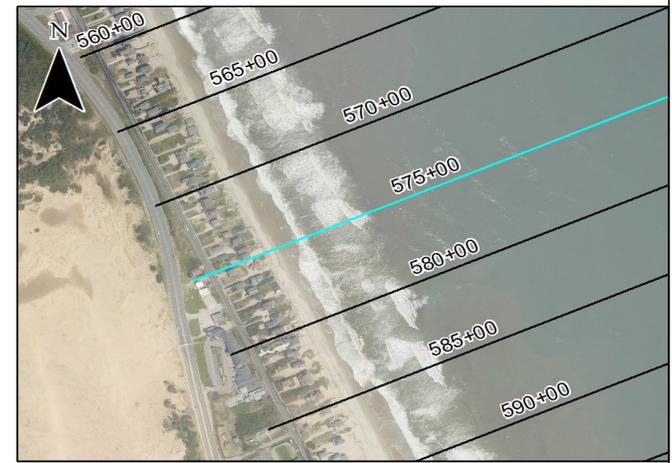


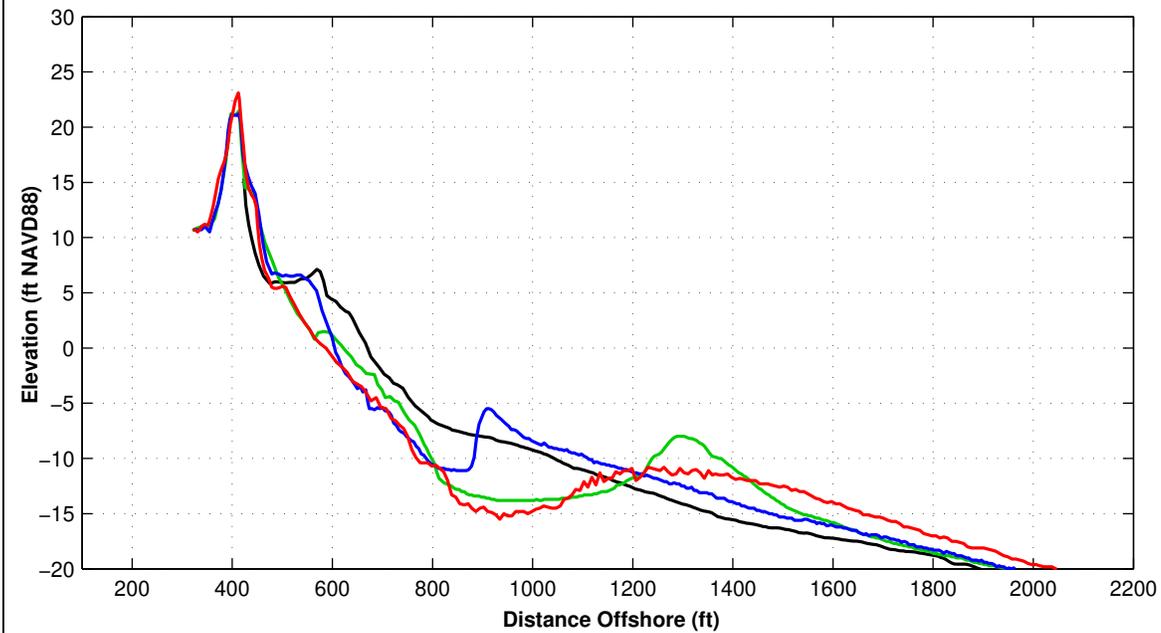
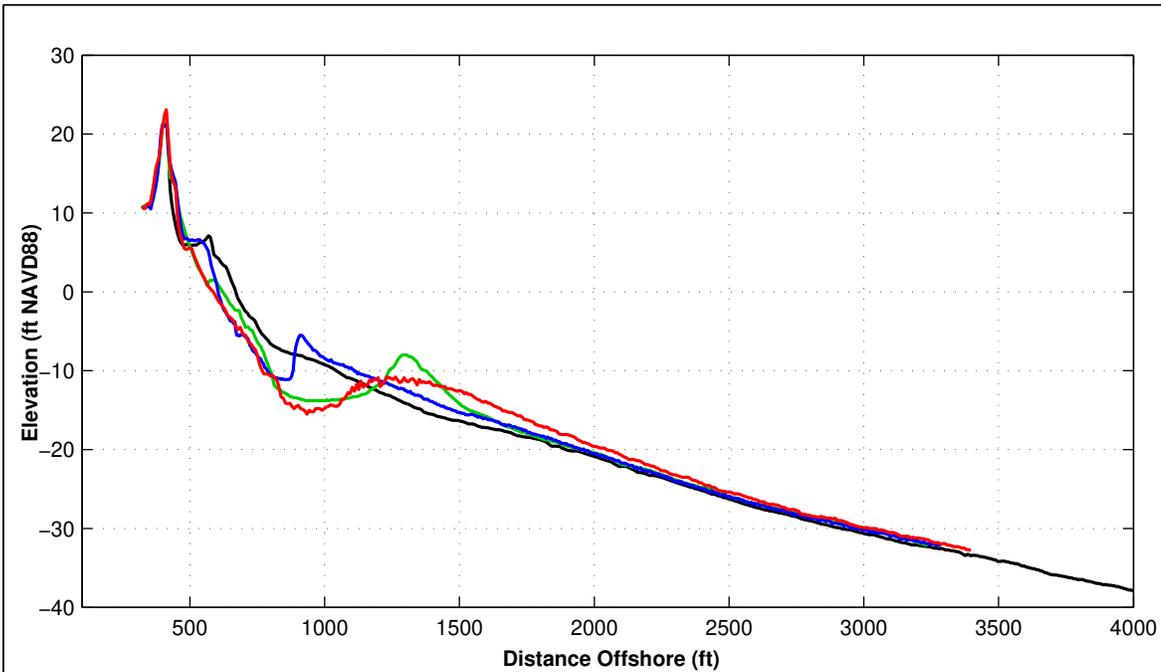
Survey Transect 575+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-0.72 ft	-42.59 ft
Volume Change Above +6 ft NAVD88	5.56 cy/ft	-0.30 cy/ft
Volume Change Above 1.18 ft NAVD88	11.23 cy/ft	-9.86 cy/ft
Volume Change Above -6 ft NAVD88	-1.23 cy/ft	-16.03 cy/ft
Volume Change Above -14 ft NAVD88	-19.78 cy/ft	-62.72 cy/ft
Volume Change Above -19 ft NAVD88	-20.74 cy/ft	-41.74 cy/ft
Volume Change Above -30 ft NAVD88	-27.27 cy/ft	-16.51 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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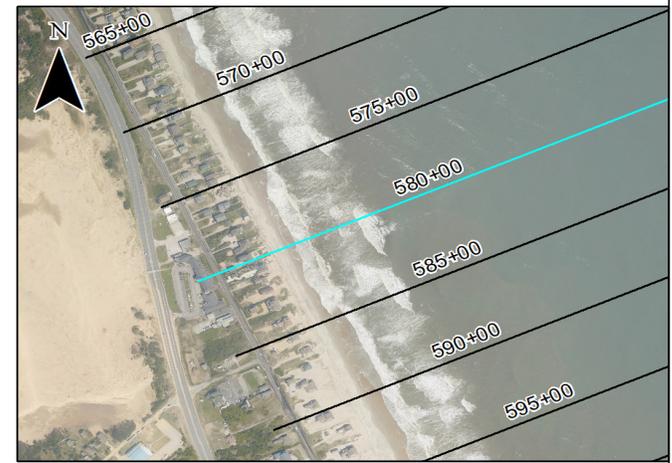


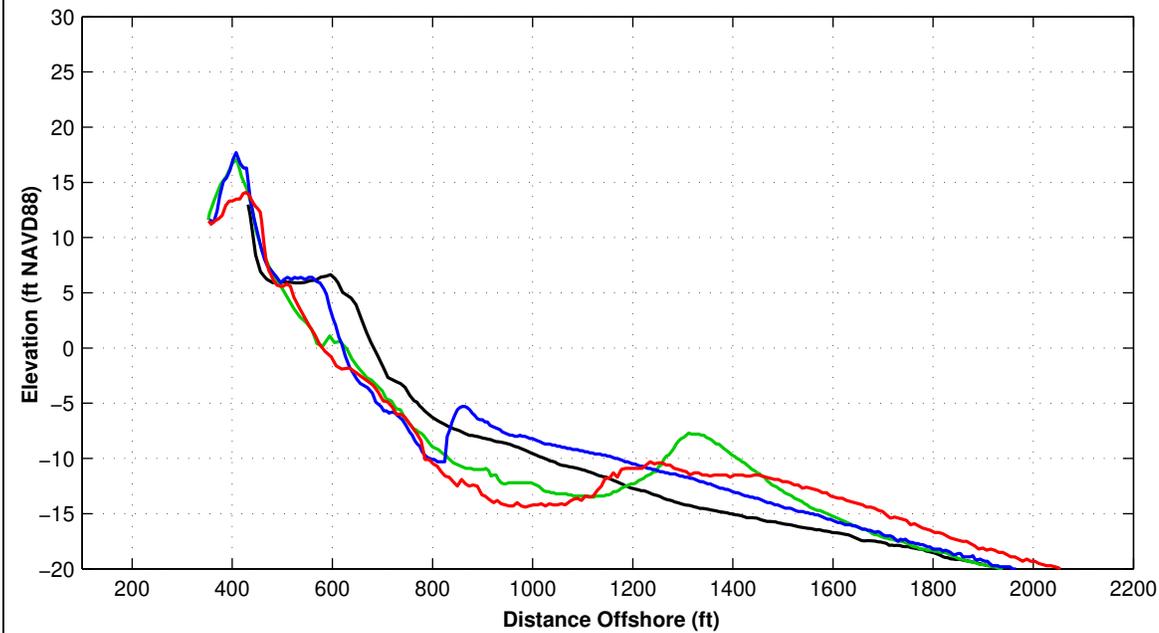
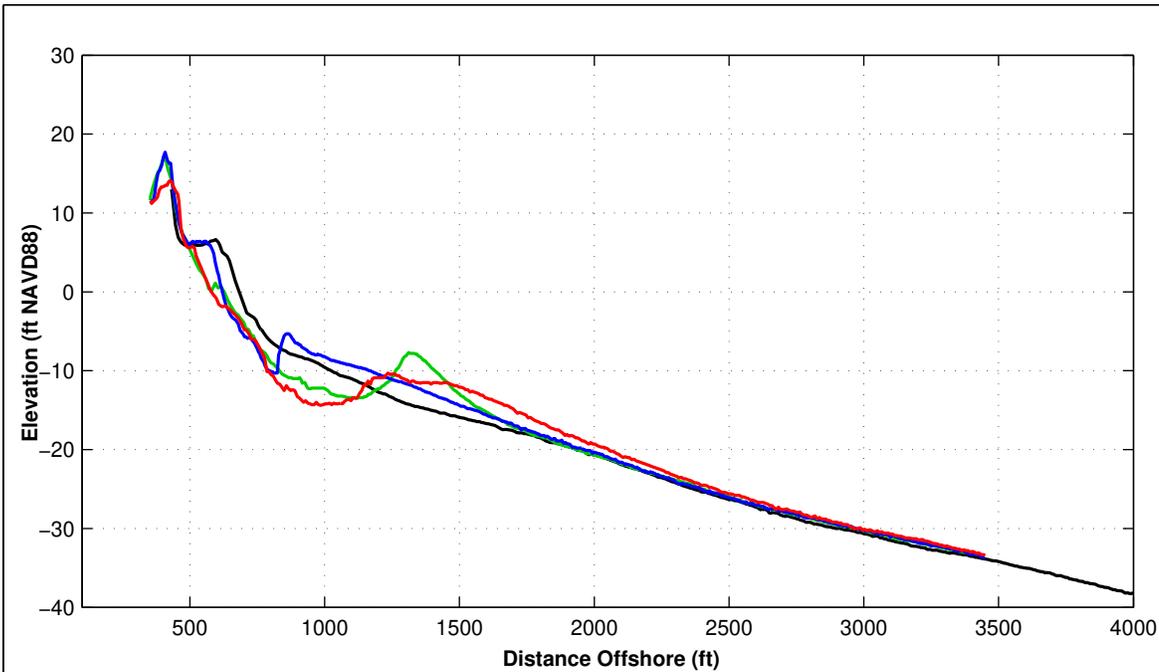


Survey Transect 580+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-2.08 ft	-36.43 ft
Volume Change Above +6 ft NAVD88	1.32 cy/ft	-3.11 cy/ft
Volume Change Above 1.18 ft NAVD88	10.30 cy/ft	-12.44 cy/ft
Volume Change Above -6 ft NAVD88	1.37 cy/ft	-13.59 cy/ft
Volume Change Above -14 ft NAVD88	27.75 cy/ft	-52.11 cy/ft
Volume Change Above -19 ft NAVD88	24.94 cy/ft	-31.10 cy/ft
Volume Change Above -30 ft NAVD88	22.60 cy/ft	-5.53 cy/ft

**LEGEND:**  
 JUNE 2022 ———— (red line)  
 JULY 2021 ———— (blue line)  
 JUNE 2020 ———— (green line)  
 AUGUST 2019 ———— (black line)

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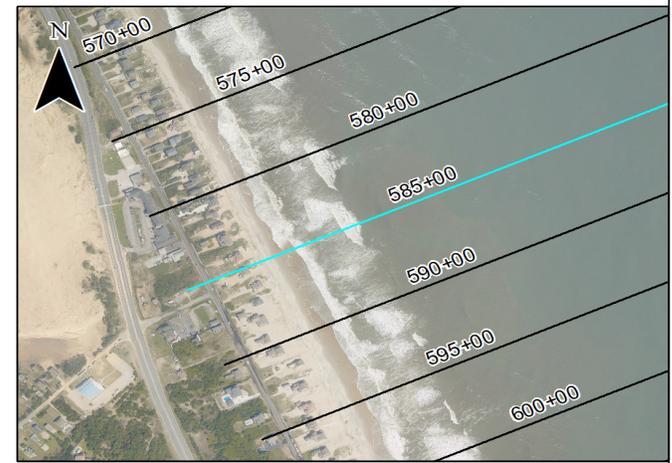


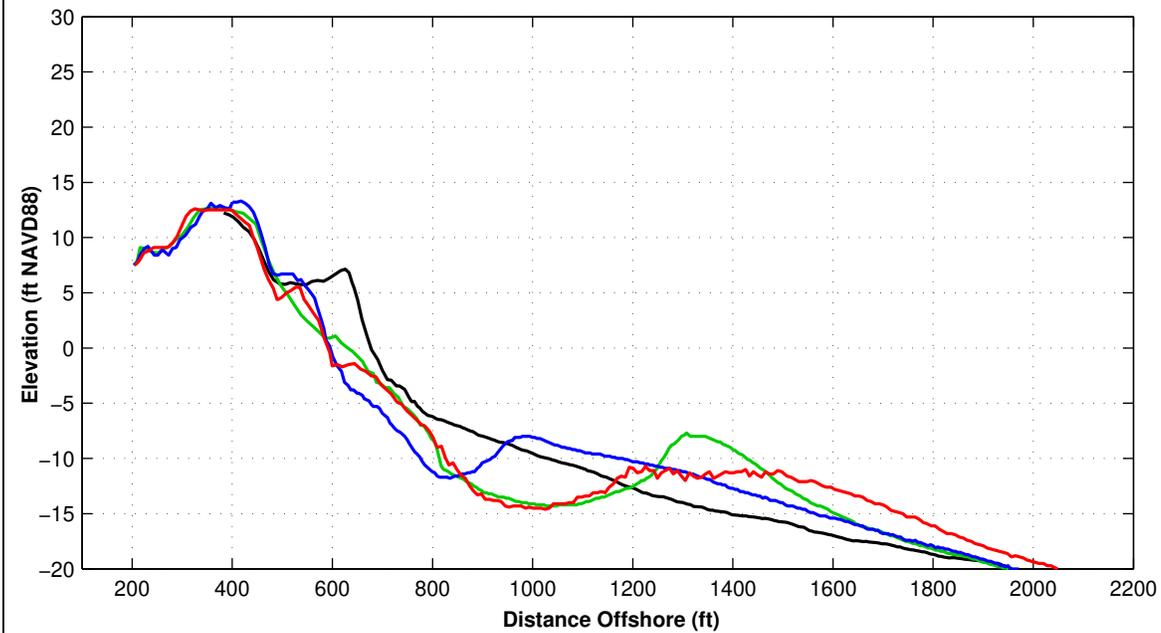
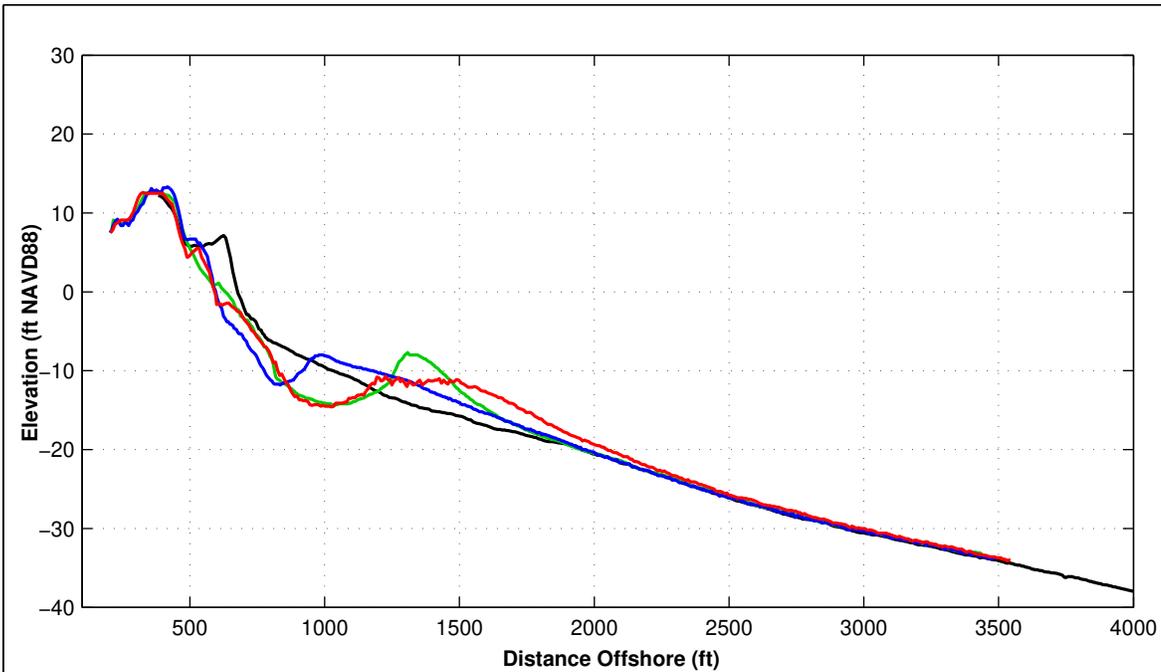
Survey Transect 585+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	48.74 ft	-46.34 ft
Volume Change Above +6 ft NAVD88	1.83 cy/ft	-1.86 cy/ft
Volume Change Above 1.18 ft NAVD88	14.16 cy/ft	-12.71 cy/ft
Volume Change Above -6 ft NAVD88	11.27 cy/ft	-15.10 cy/ft
Volume Change Above -14 ft NAVD88	37.50 cy/ft	-64.07 cy/ft
Volume Change Above -19 ft NAVD88	36.66 cy/ft	-41.58 cy/ft
Volume Change Above -30 ft NAVD88	39.24 cy/ft	-18.68 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

- Notes:
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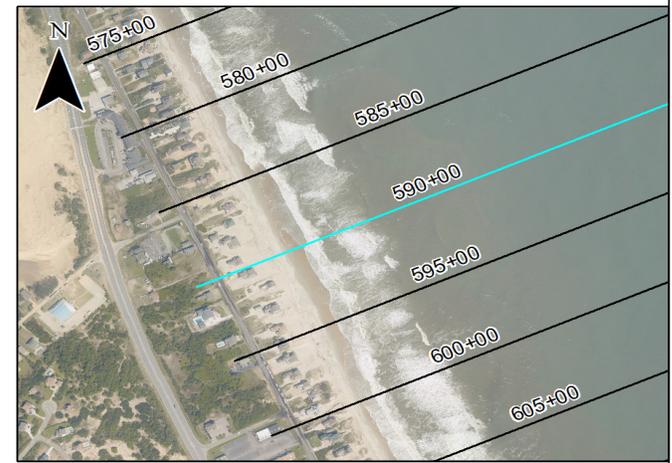


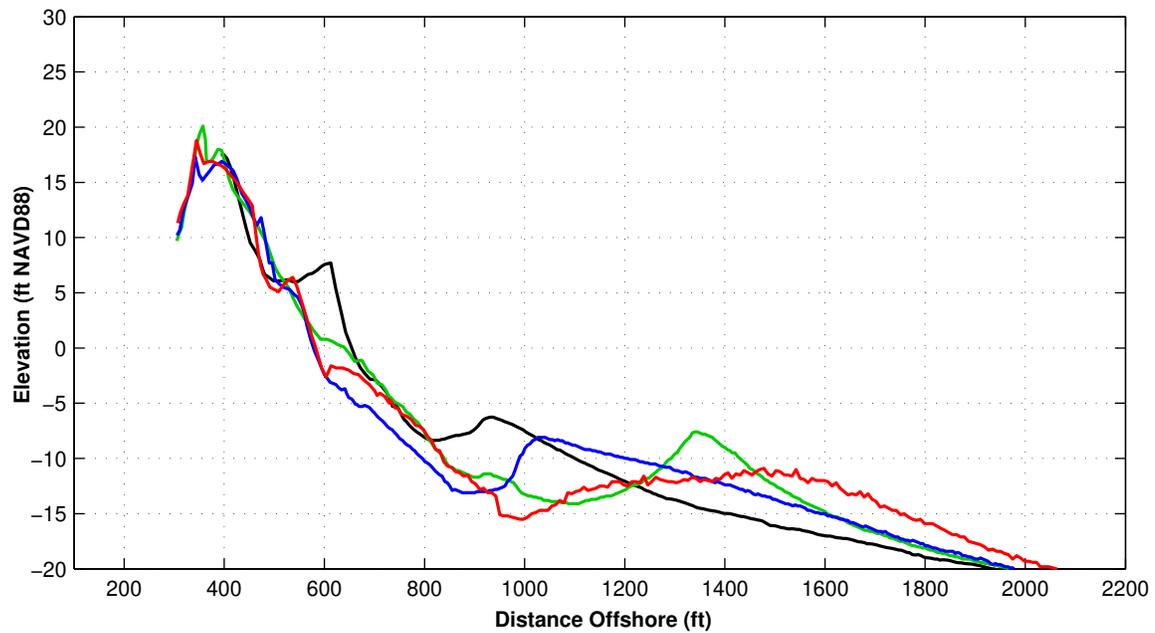
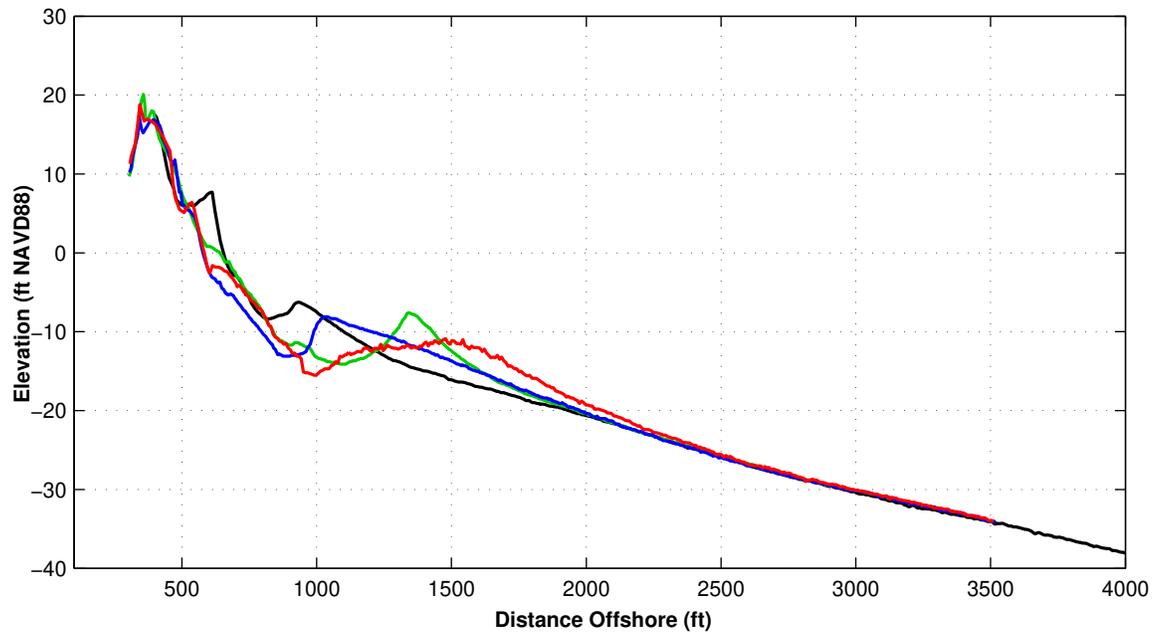
Survey Transect 590+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	5.96 ft	-3.48 ft
Volume Change Above +6 ft NAVD88	2.59 cy/ft	-6.07 cy/ft
Volume Change Above 1.18 ft NAVD88	9.17 cy/ft	-10.18 cy/ft
Volume Change Above -6 ft NAVD88	-5.07 cy/ft	-0.96 cy/ft
Volume Change Above -14 ft NAVD88	11.35 cy/ft	-22.69 cy/ft
Volume Change Above -19 ft NAVD88	10.80 cy/ft	0.67 cy/ft
Volume Change Above -30 ft NAVD88	9.10 cy/ft	22.62 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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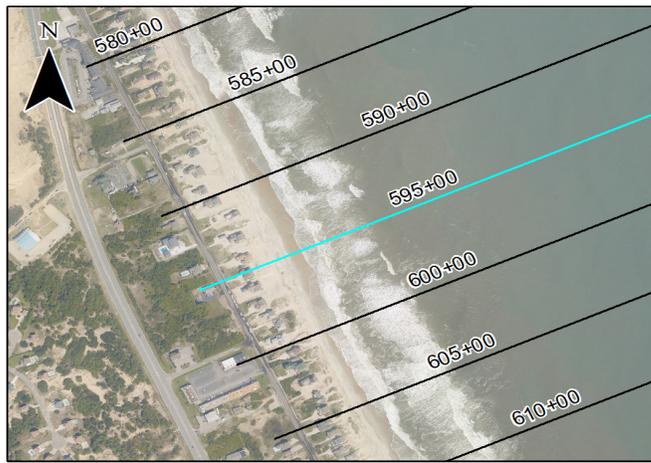


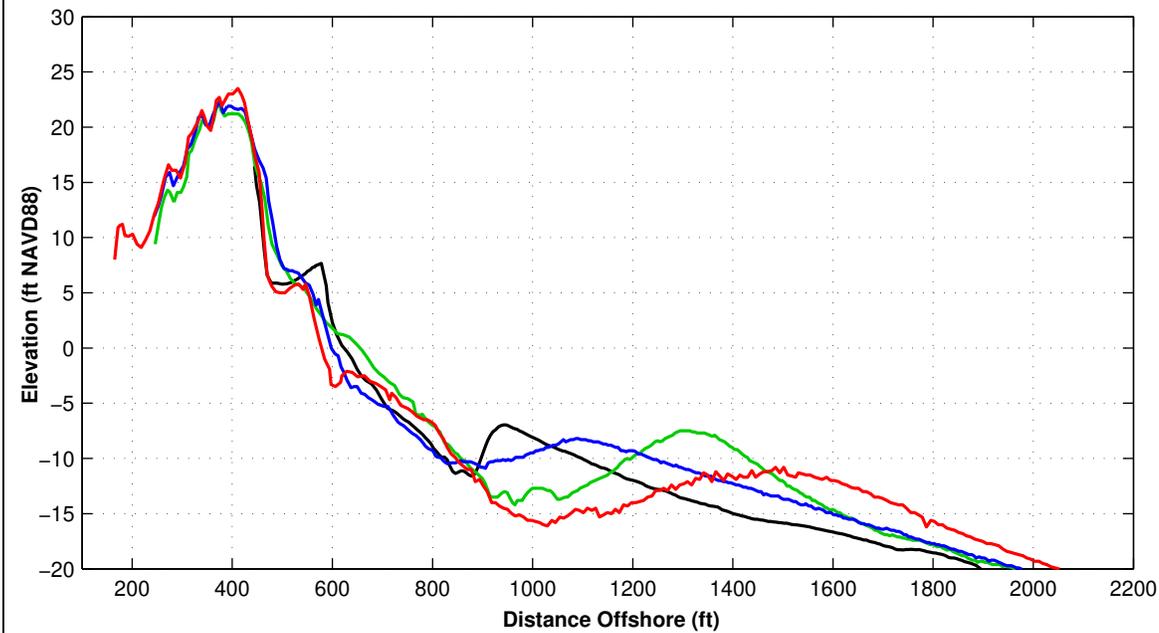
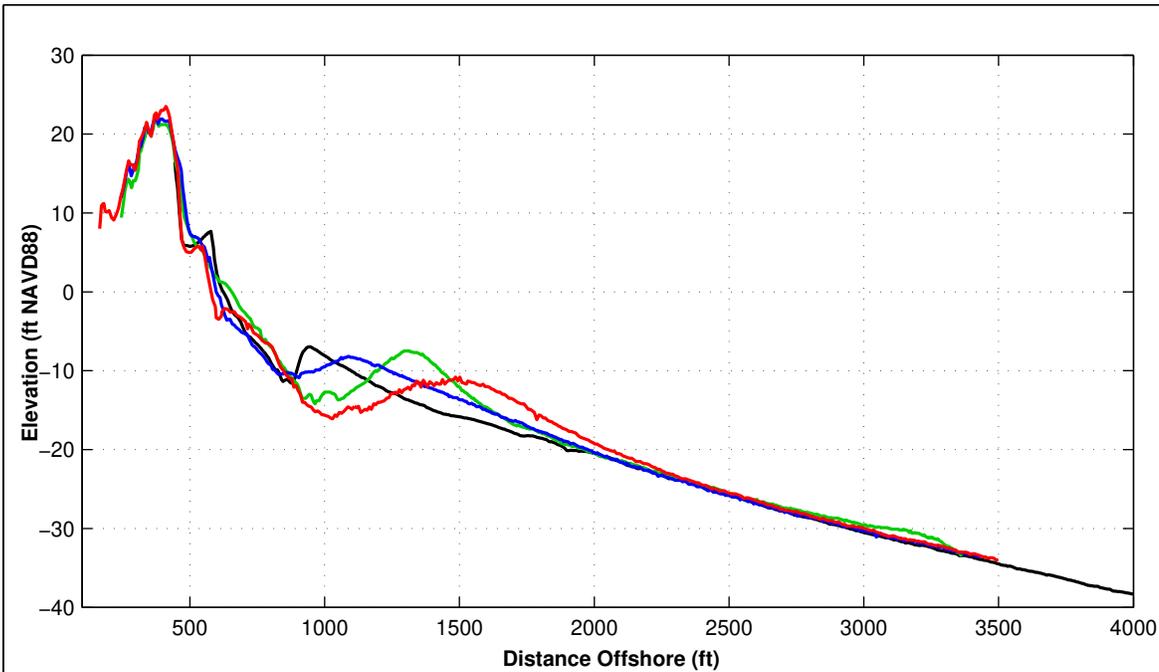
Survey Transect 595+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-15.57 ft	3.96 ft
Volume Change Above +6 ft NAVD88	1.28 cy/ft	-3.56 cy/ft
Volume Change Above 1.18 ft NAVD88	1.29 cy/ft	-2.89 cy/ft
Volume Change Above -6 ft NAVD88	-18.54 cy/ft	7.17 cy/ft
Volume Change Above -14 ft NAVD88	-16.81 cy/ft	-4.49 cy/ft
Volume Change Above -19 ft NAVD88	-15.33 cy/ft	15.95 cy/ft
Volume Change Above -30 ft NAVD88	-17.04 cy/ft	34.64 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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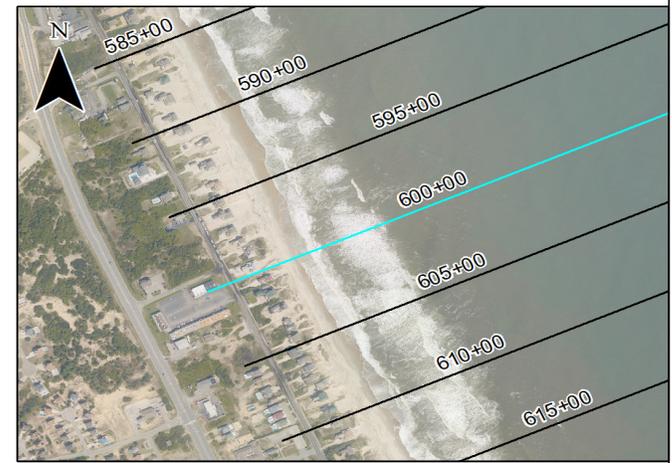


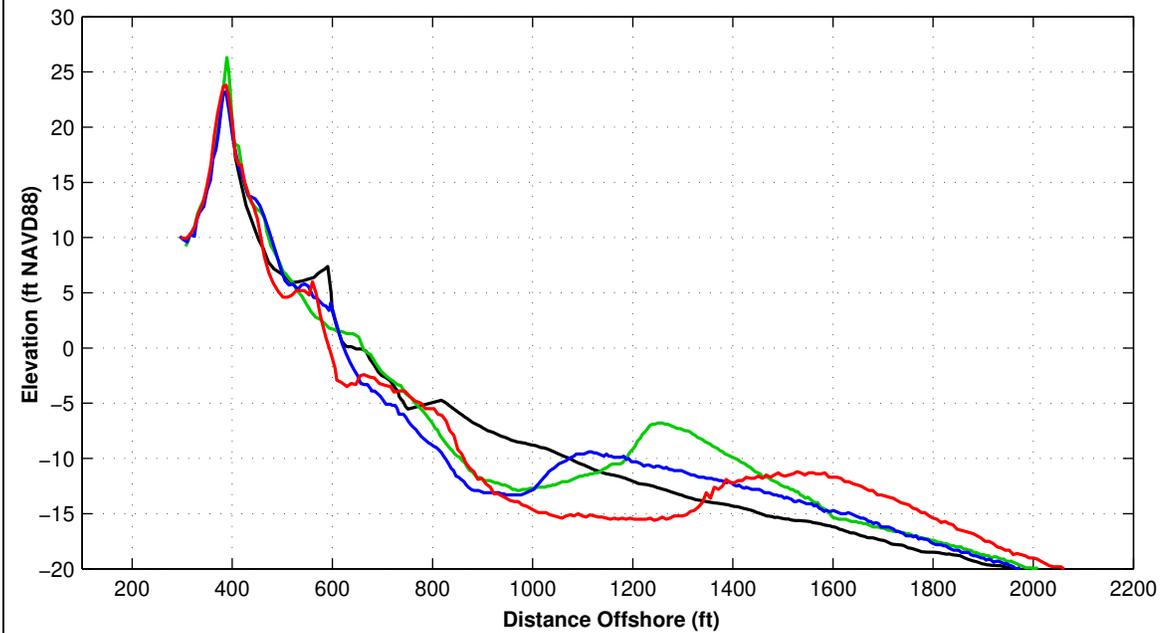
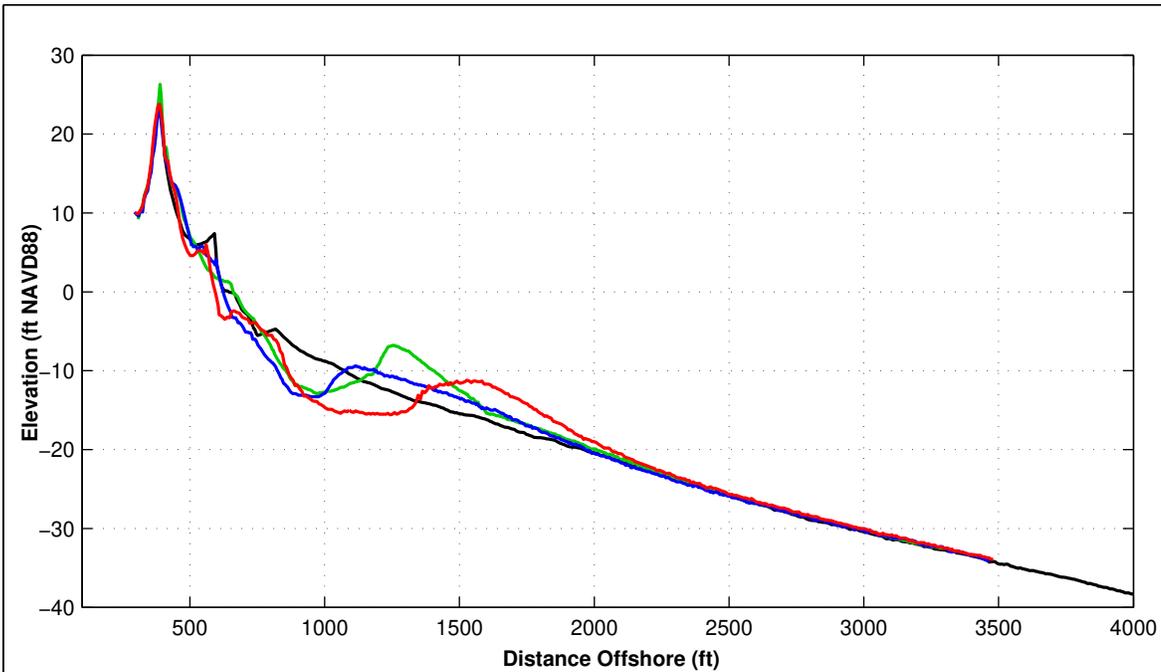
Survey Transect 600+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-32.52 ft	-19.21 ft
Volume Change Above +6 ft NAVD88	5.86 cy/ft	-7.47 cy/ft
Volume Change Above 1.18 ft NAVD88	6.49 cy/ft	-11.62 cy/ft
Volume Change Above -6 ft NAVD88	-10.55 cy/ft	-9.19 cy/ft
Volume Change Above -14 ft NAVD88	-10.98 cy/ft	-48.24 cy/ft
Volume Change Above -19 ft NAVD88	-10.06 cy/ft	-33.84 cy/ft
Volume Change Above -30 ft NAVD88	-22.02 cy/ft	-14.89 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
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  2. All Survey Elevations In Feet Referenced to NAVD88.



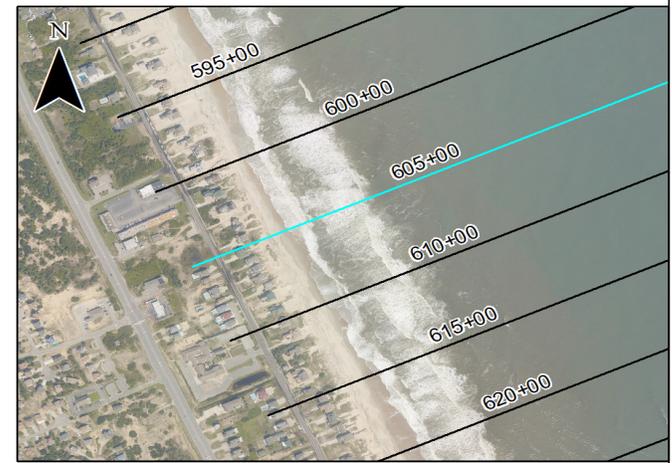


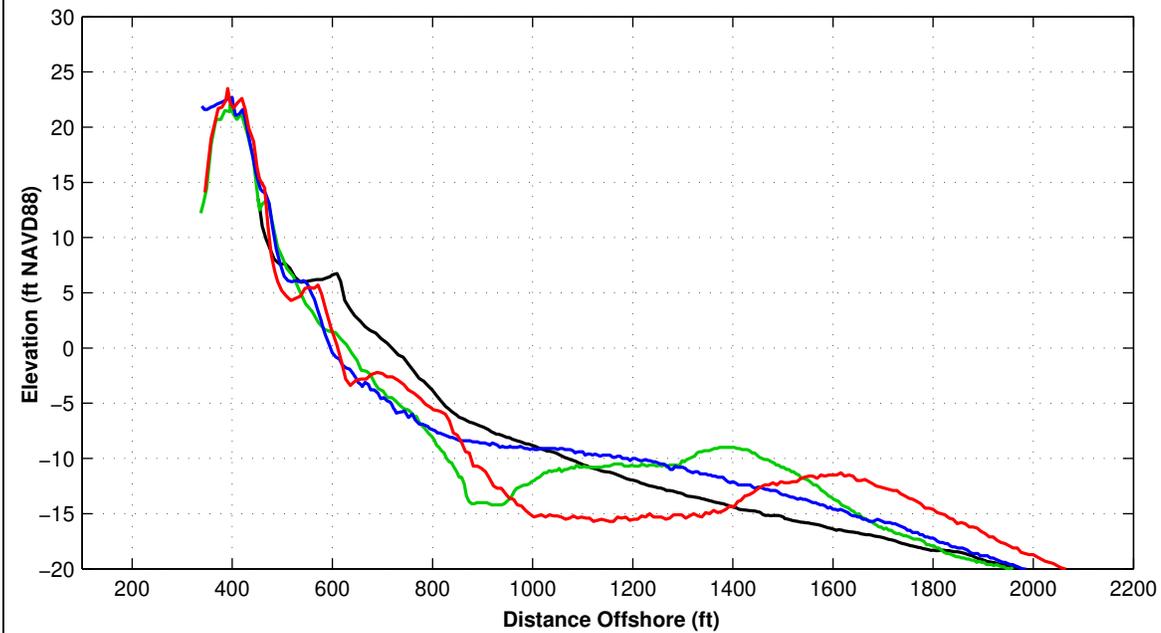
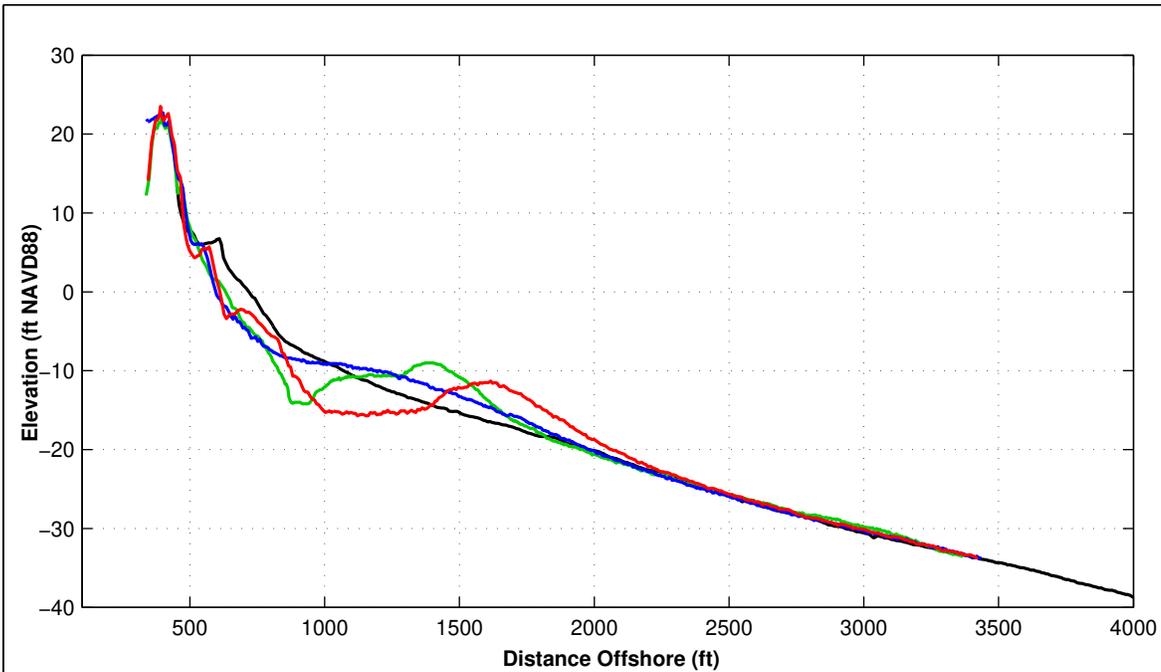
Survey Transect 605+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-31.25 ft	-29.13 ft
Volume Change Above +6 ft NAVD88	-0.75 cy/ft	-5.10 cy/ft
Volume Change Above 1.18 ft NAVD88	3.34 cy/ft	-9.66 cy/ft
Volume Change Above -6 ft NAVD88	-10.37 cy/ft	-8.37 cy/ft
Volume Change Above -14 ft NAVD88	-45.07 cy/ft	-22.01 cy/ft
Volume Change Above -19 ft NAVD88	-44.83 cy/ft	-12.43 cy/ft
Volume Change Above -30 ft NAVD88	-53.56 cy/ft	8.06 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



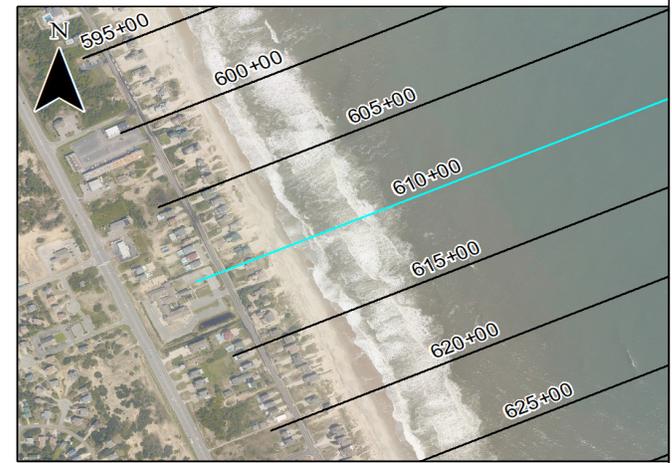


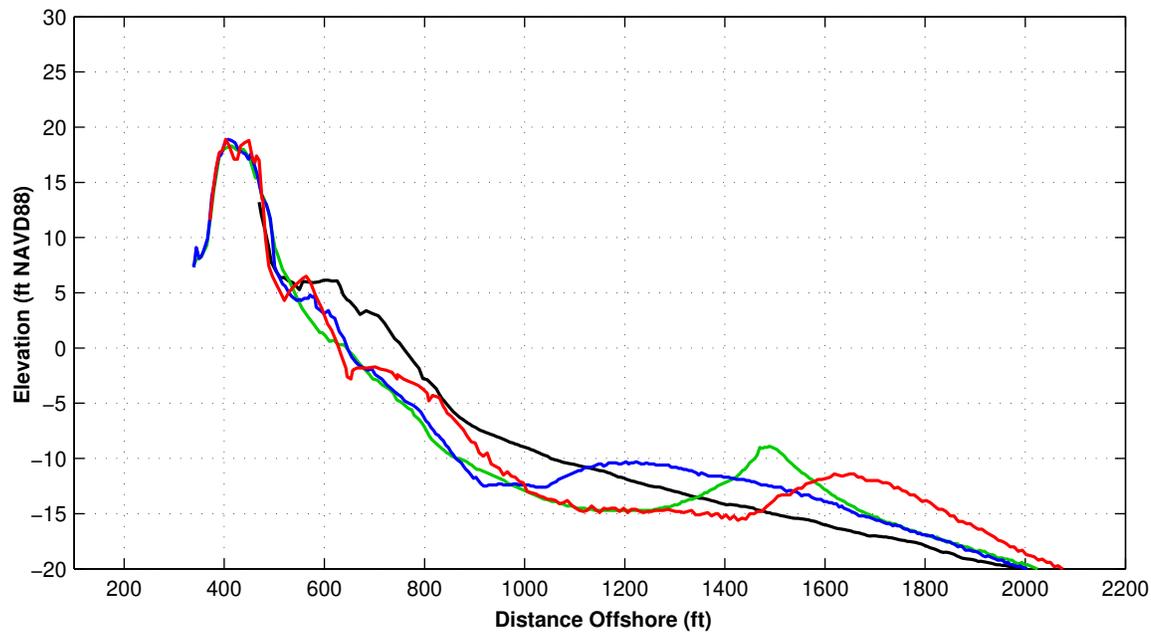
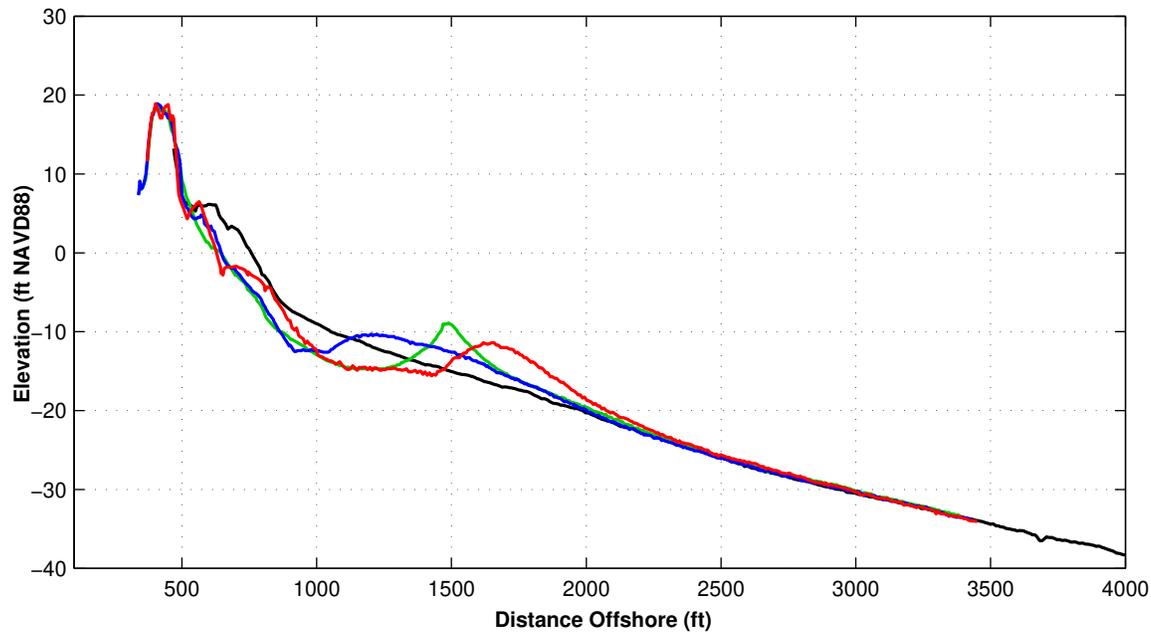
Survey Transect 610+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-24.23 ft	16.02 ft
Volume Change Above +6 ft NAVD88	0.23 cy/ft	-1.26 cy/ft
Volume Change Above 1.18 ft NAVD88	2.32 cy/ft	-1.02 cy/ft
Volume Change Above -6 ft NAVD88	-4.70 cy/ft	8.82 cy/ft
Volume Change Above -14 ft NAVD88	10.69 cy/ft	-44.84 cy/ft
Volume Change Above -19 ft NAVD88	14.88 cy/ft	-37.50 cy/ft
Volume Change Above -30 ft NAVD88	9.74 cy/ft	-18.63 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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Survey Transect 615+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	34.26 ft	-16.20 ft
Volume Change Above +6 ft NAVD88	-0.81 cy/ft	-2.34 cy/ft
Volume Change Above 1.18 ft NAVD88	3.47 cy/ft	-1.72 cy/ft
Volume Change Above -6 ft NAVD88	6.01 cy/ft	4.06 cy/ft
Volume Change Above -14 ft NAVD88	28.54 cy/ft	-13.54 cy/ft
Volume Change Above -19 ft NAVD88	31.32 cy/ft	0.37 cy/ft
Volume Change Above -30 ft NAVD88	21.79 cy/ft	20.79 cy/ft

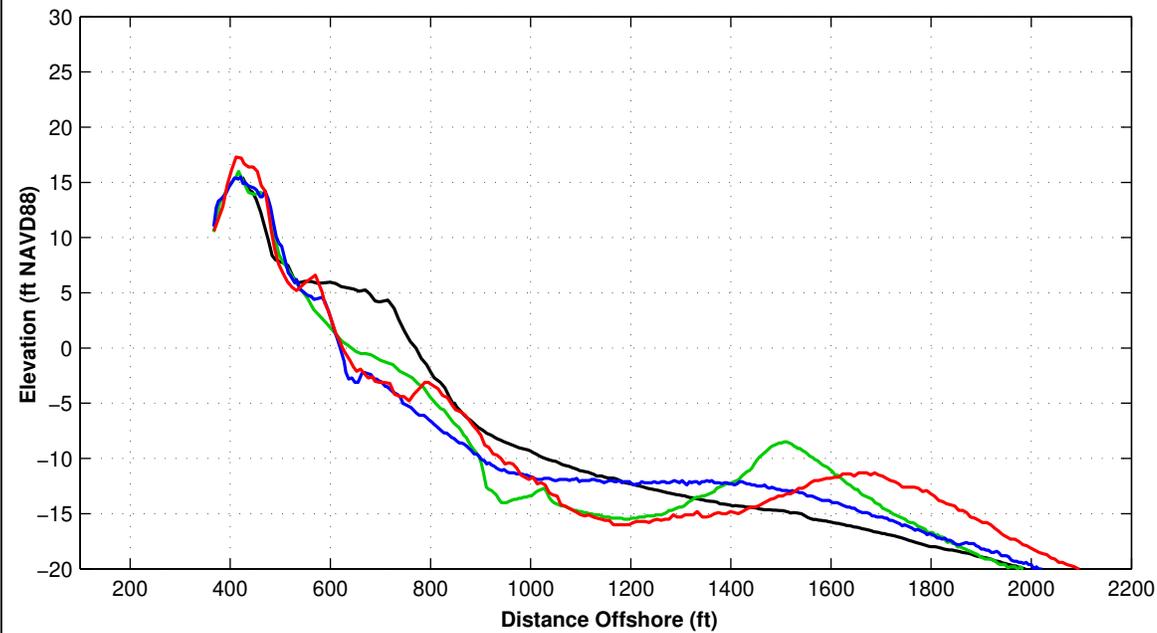
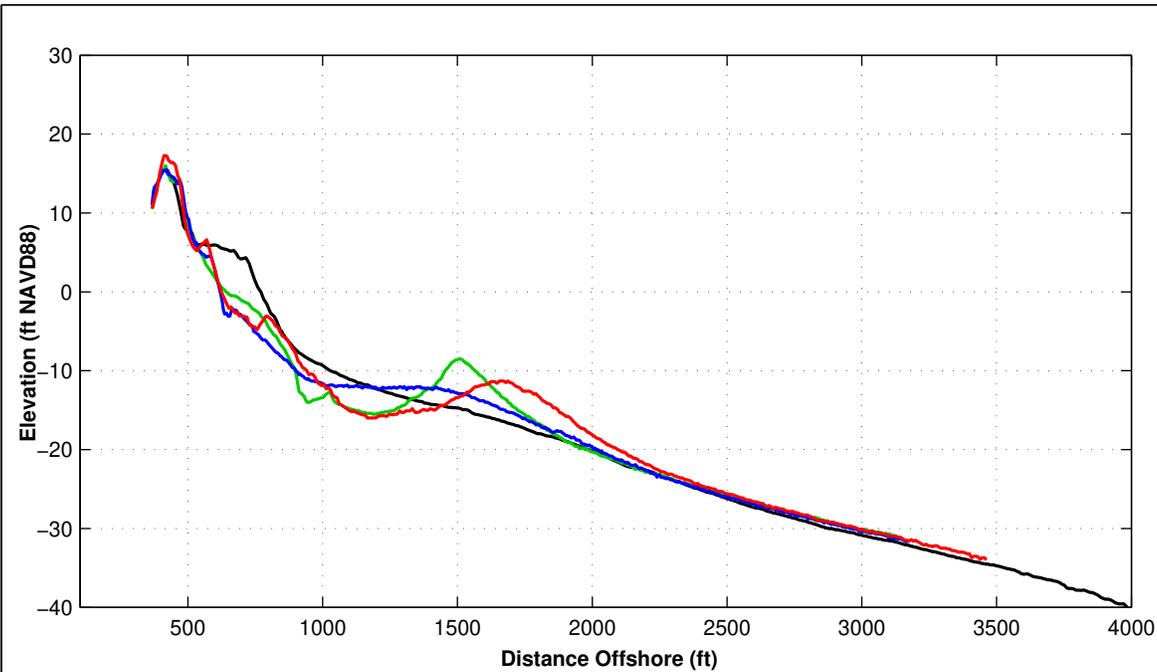
**LEGEND:**

JUNE 2022 ———— (red line)  
 JULY 2021 ———— (blue line)  
 JUNE 2020 ———— (green line)  
 AUGUST 2019 ———— (black line)

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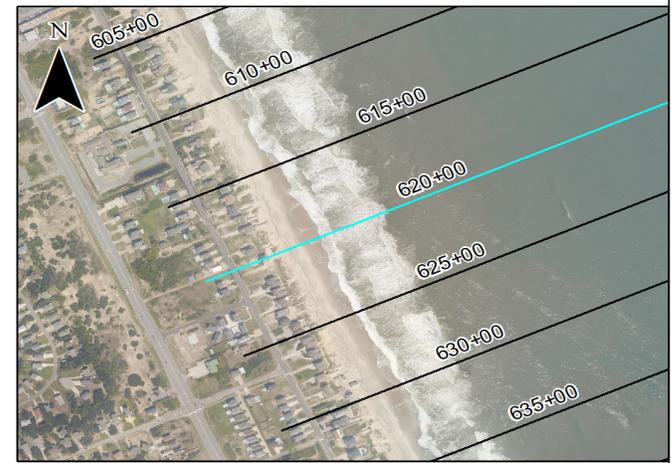


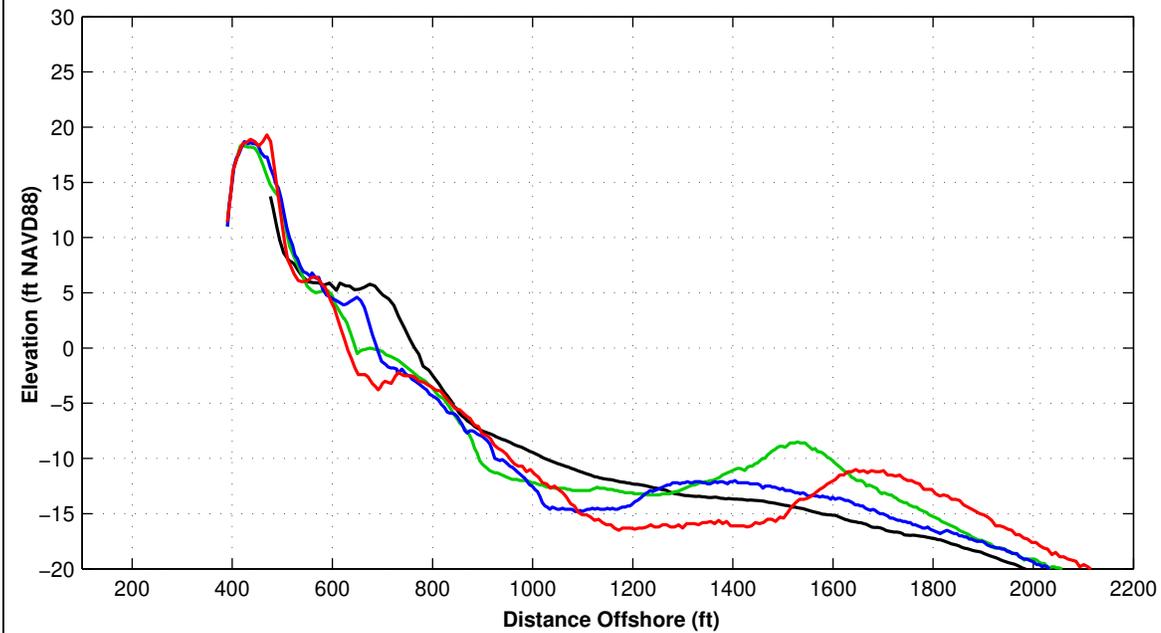
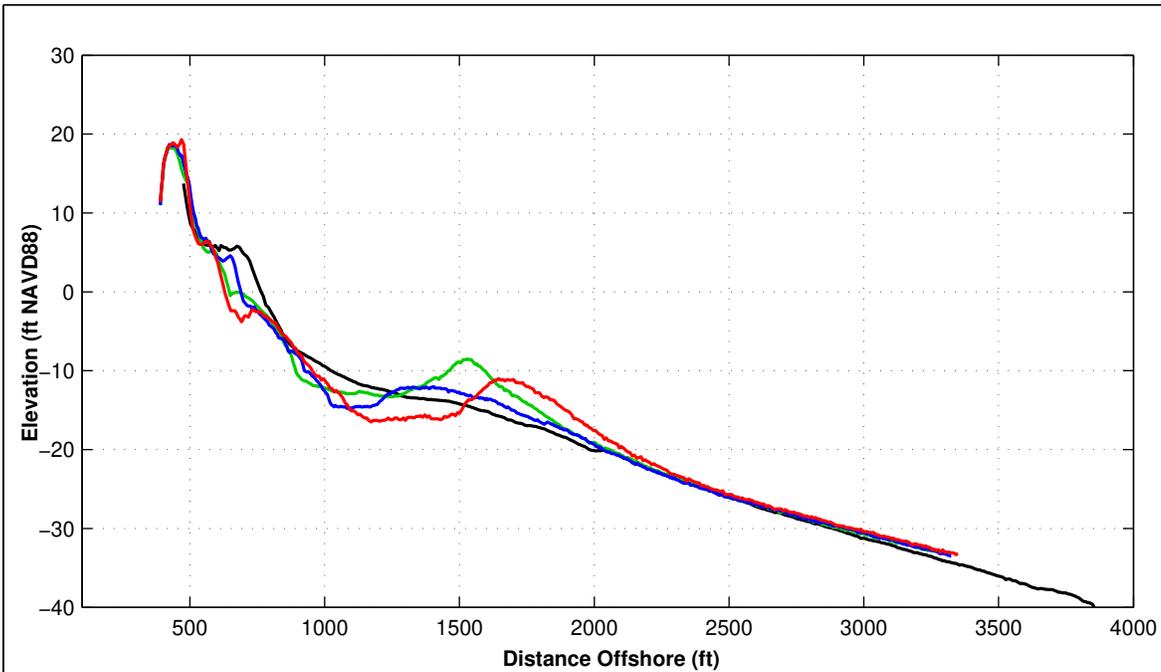
Survey Transect 620+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-1.39 ft	1.05 ft
Volume Change Above +6 ft NAVD88	1.14 cy/ft	0.91 cy/ft
Volume Change Above 1.18 ft NAVD88	3.50 cy/ft	2.38 cy/ft
Volume Change Above -6 ft NAVD88	-12.88 cy/ft	11.44 cy/ft
Volume Change Above -14 ft NAVD88	-10.45 cy/ft	9.43 cy/ft
Volume Change Above -19 ft NAVD88	-3.26 cy/ft	19.77 cy/ft
Volume Change Above -30 ft NAVD88	-2.87 cy/ft	39.38 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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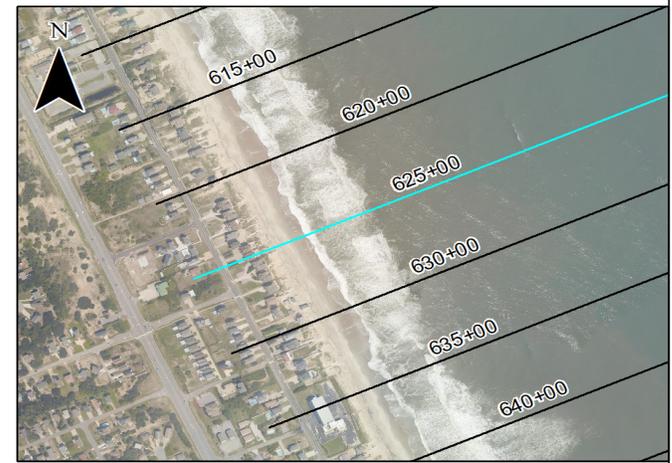


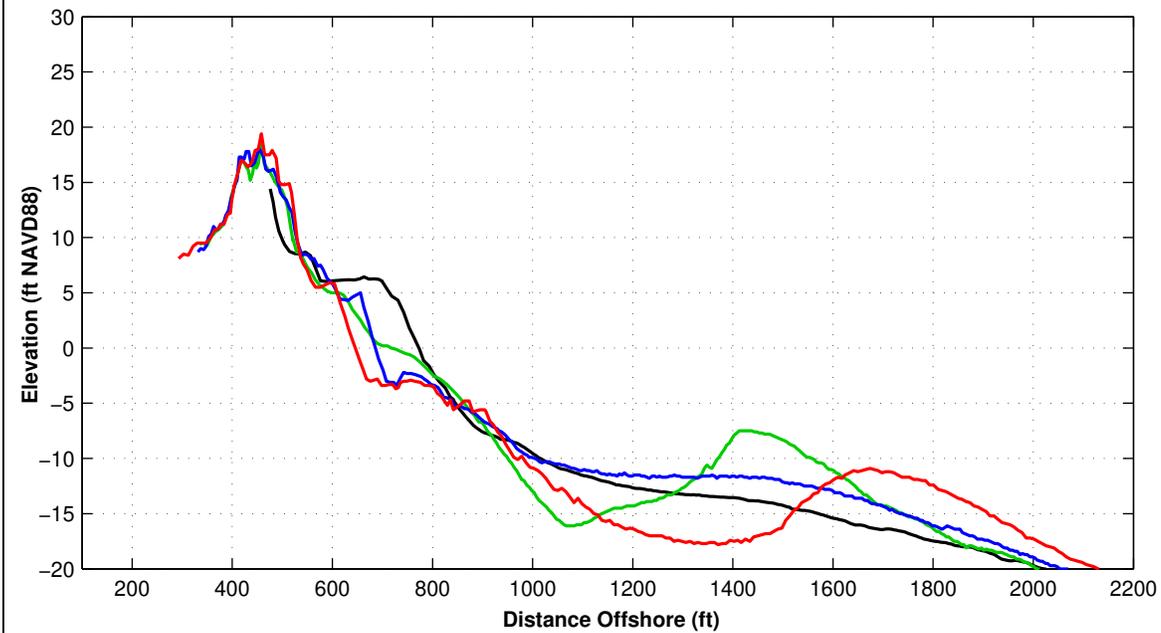
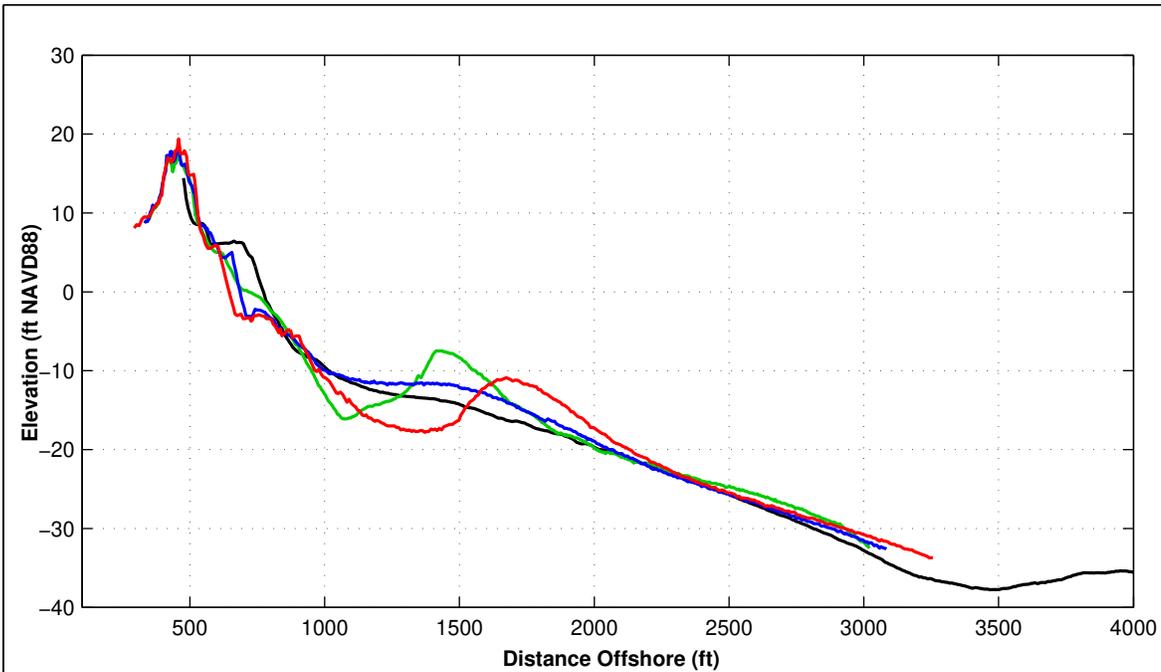
Survey Transect 625+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	42.74 ft	-59.02 ft
Volume Change Above +6 ft NAVD88	3.74 cy/ft	-1.93 cy/ft
Volume Change Above 1.18 ft NAVD88	9.88 cy/ft	-8.59 cy/ft
Volume Change Above -6 ft NAVD88	8.13 cy/ft	-16.34 cy/ft
Volume Change Above -14 ft NAVD88	-26.11 cy/ft	-7.52 cy/ft
Volume Change Above -19 ft NAVD88	-38.59 cy/ft	-6.92 cy/ft
Volume Change Above -30 ft NAVD88	-41.74 cy/ft	11.24 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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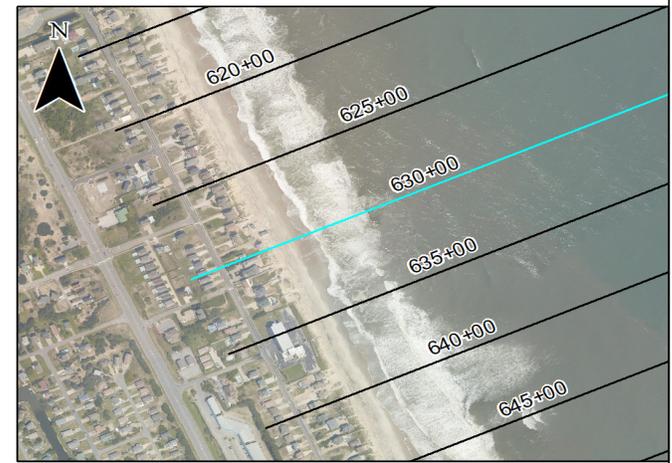


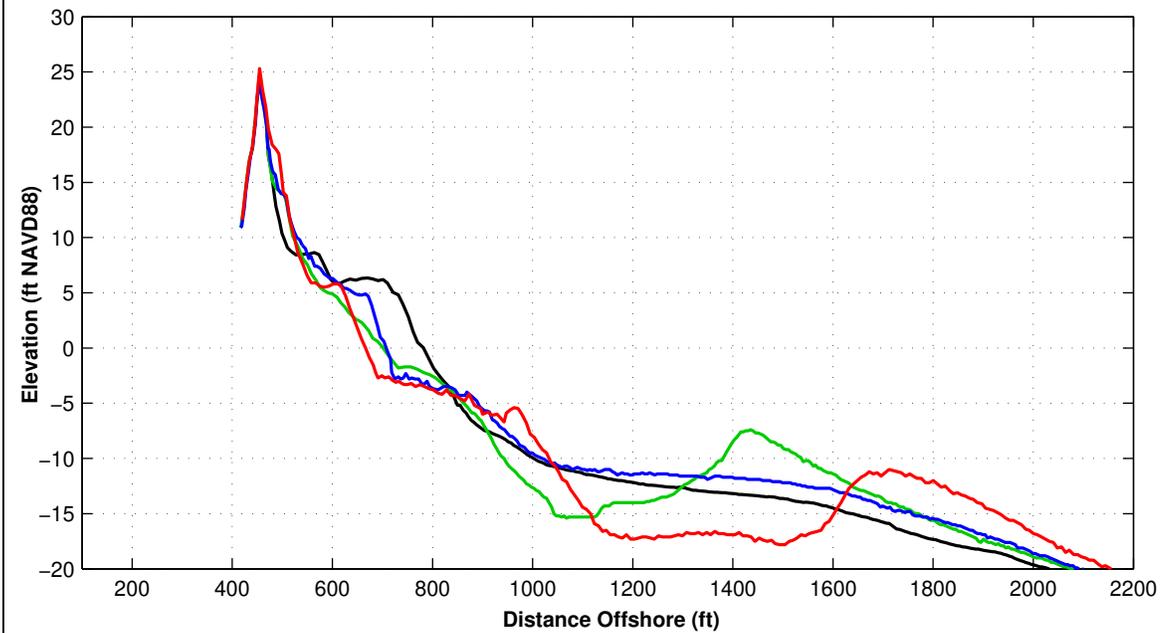
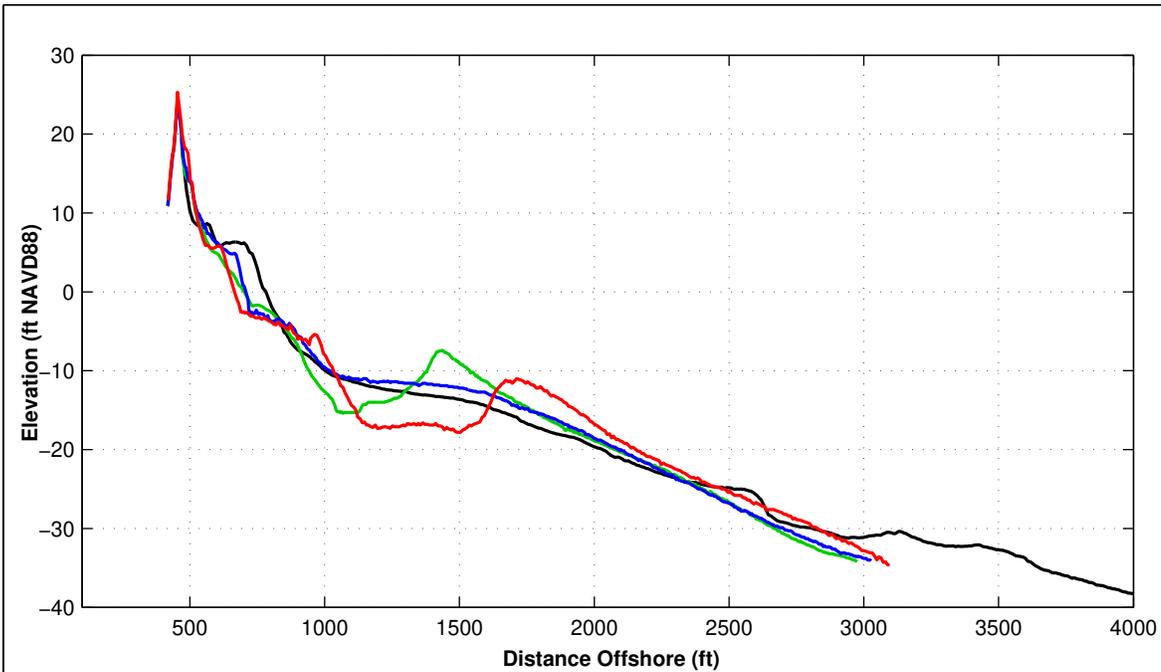
Survey Transect 630+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	2.07 ft	-41.47 ft
Volume Change Above +6 ft NAVD88	4.74 cy/ft	0.66 cy/ft
Volume Change Above 1.18 ft NAVD88	7.68 cy/ft	-5.24 cy/ft
Volume Change Above -6 ft NAVD88	-2.93 cy/ft	-12.90 cy/ft
Volume Change Above -14 ft NAVD88	1.59 cy/ft	-41.78 cy/ft
Volume Change Above -19 ft NAVD88	14.87 cy/ft	-60.50 cy/ft
Volume Change Above -30 ft NAVD88	-5.00 cy/ft	-44.74 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
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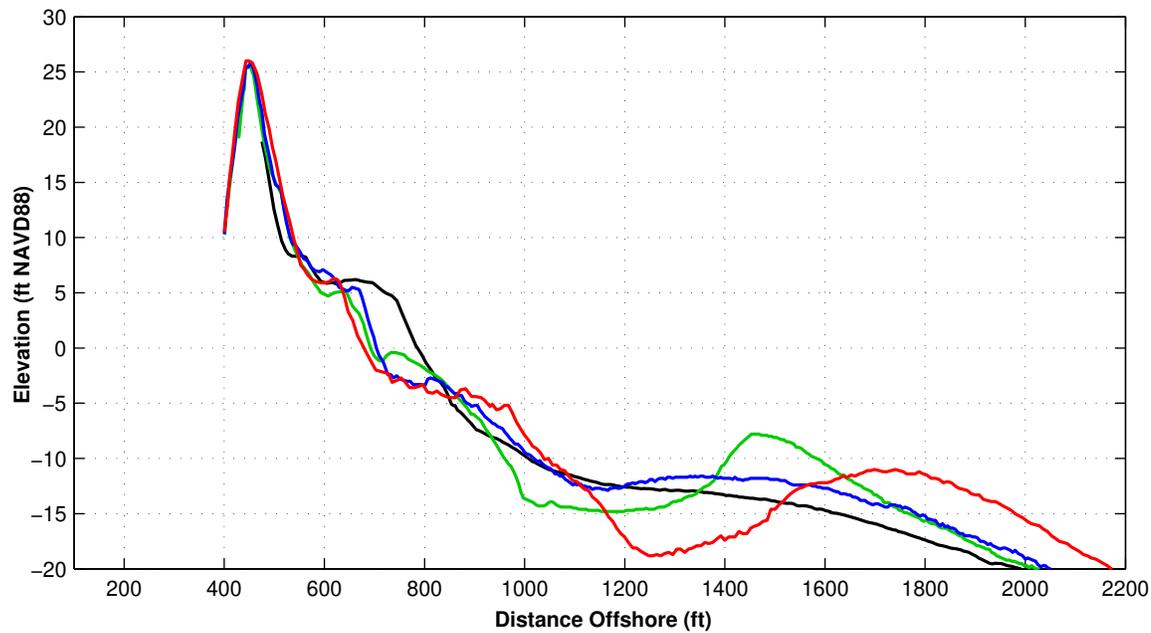
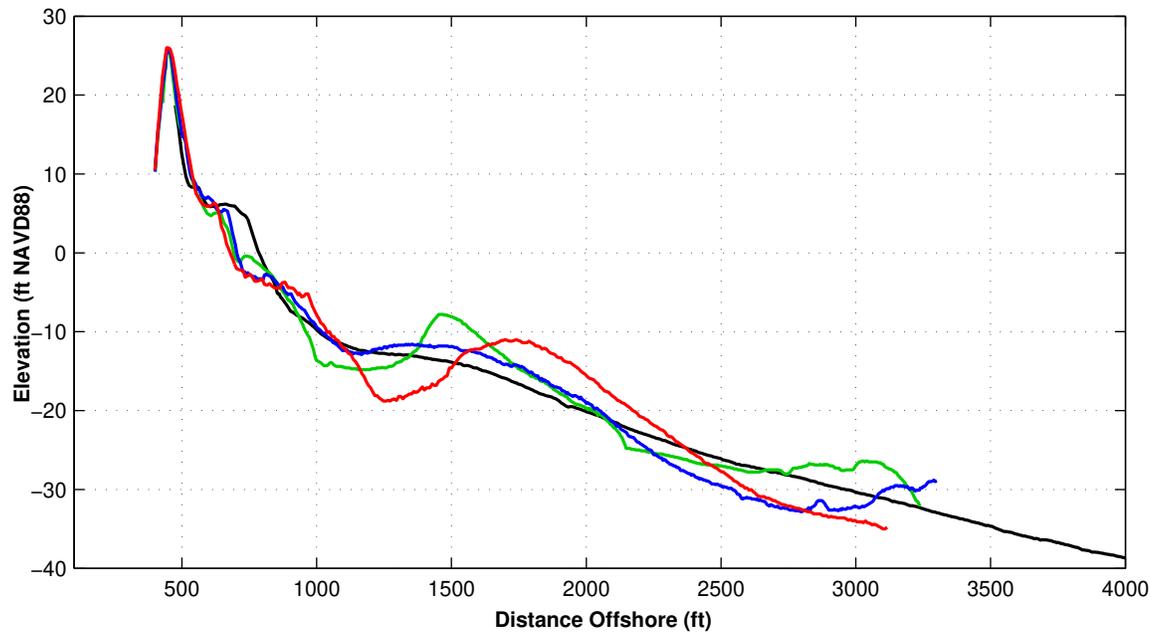
Survey Transect 635+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	17.44 ft	-39.27 ft
Volume Change Above +6 ft NAVD88	3.51 cy/ft	-0.59 cy/ft
Volume Change Above 1.18 ft NAVD88	11.36 cy/ft	-7.44 cy/ft
Volume Change Above -6 ft NAVD88	10.42 cy/ft	-15.34 cy/ft
Volume Change Above -14 ft NAVD88	21.73 cy/ft	-37.68 cy/ft
Volume Change Above -19 ft NAVD88	28.83 cy/ft	-67.69 cy/ft
Volume Change Above -30 ft NAVD88	28.09 cy/ft	-32.24 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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Survey Transect 640+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	12.81 ft	-31.45 ft
Volume Change Above +6 ft NAVD88	4.23 cy/ft	2.23 cy/ft
Volume Change Above 1.18 ft NAVD88	8.94 cy/ft	-2.90 cy/ft
Volume Change Above -6 ft NAVD88	4.27 cy/ft	-5.55 cy/ft
Volume Change Above -14 ft NAVD88	8.96 cy/ft	-3.96 cy/ft
Volume Change Above -19 ft NAVD88	18.09 cy/ft	-13.82 cy/ft
Volume Change Above -30 ft NAVD88	-55.85 cy/ft	39.97 cy/ft

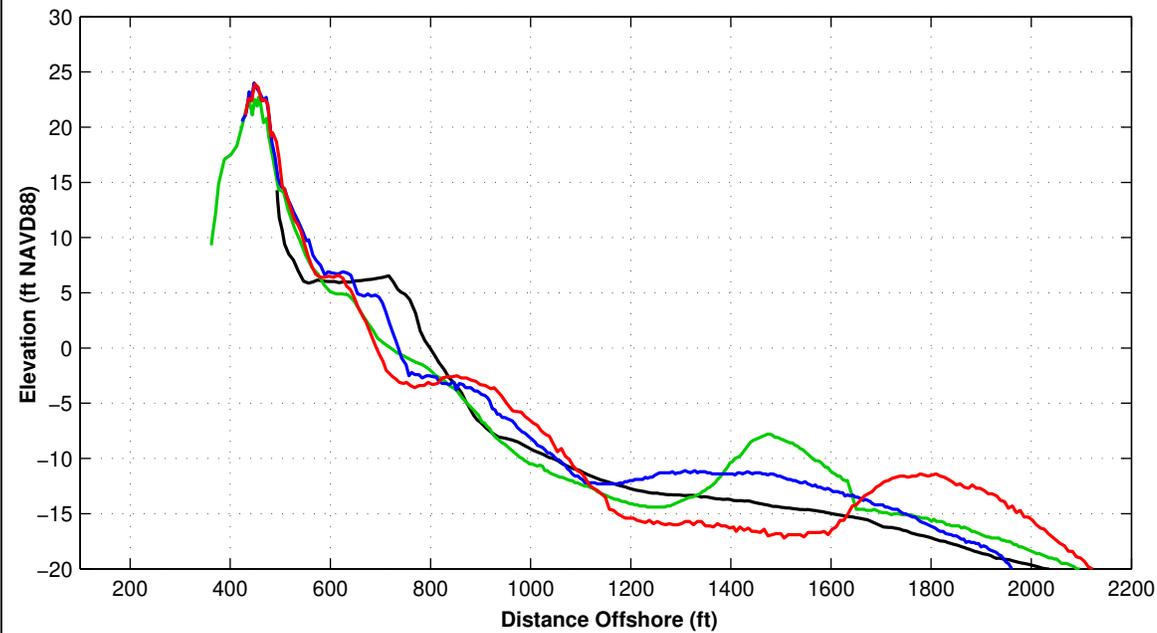
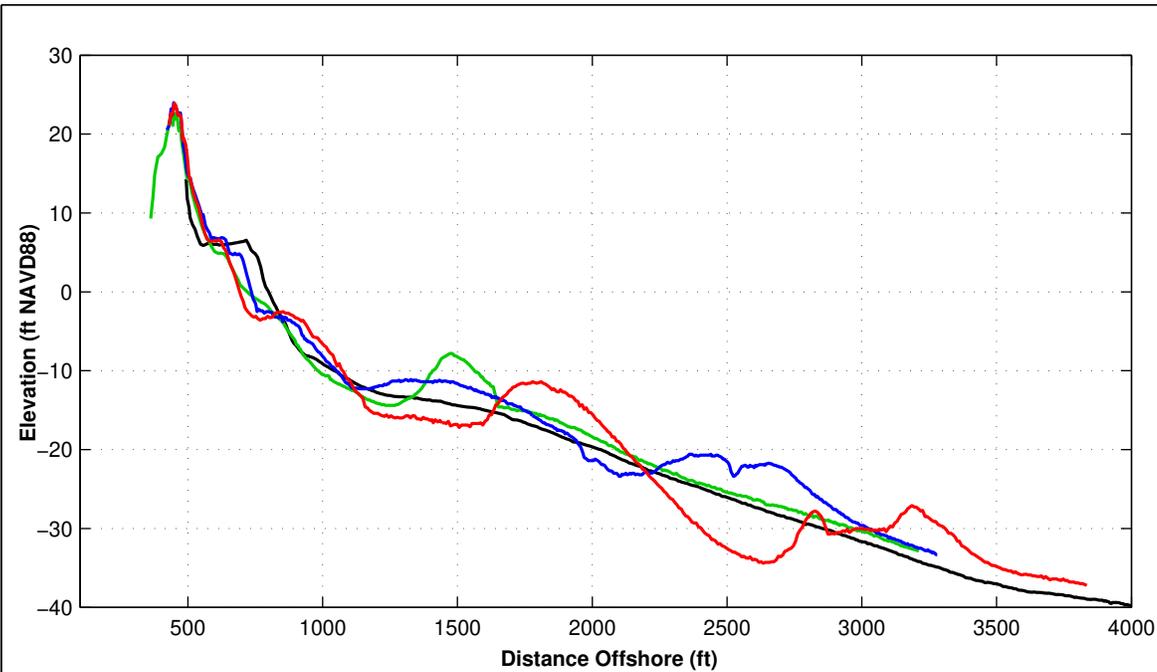
**LEGEND:**

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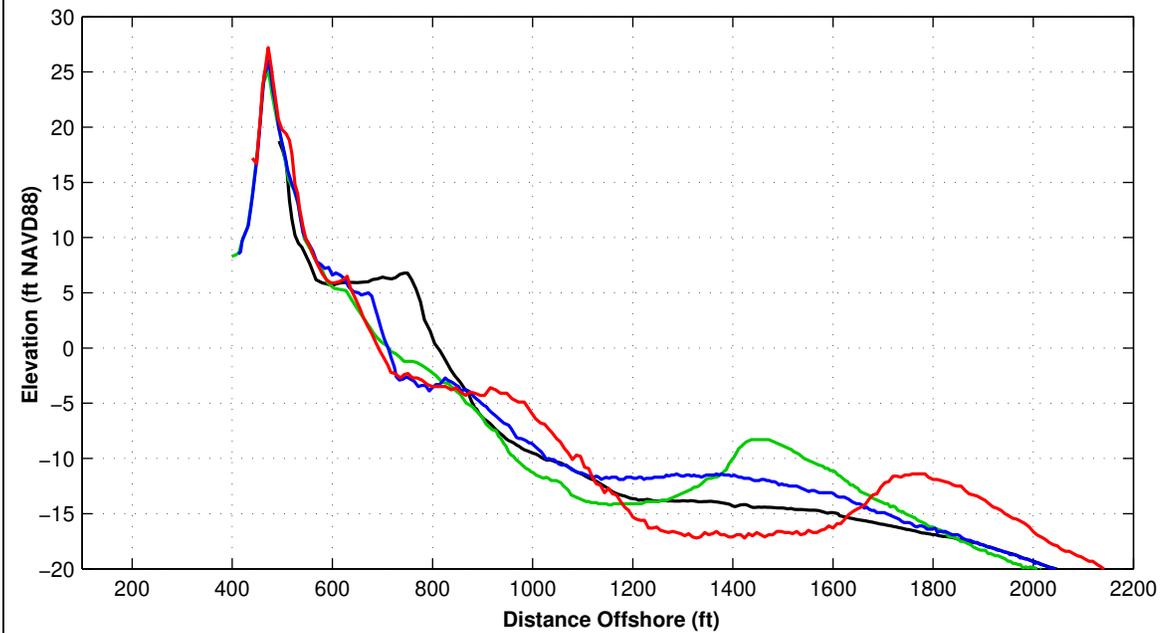
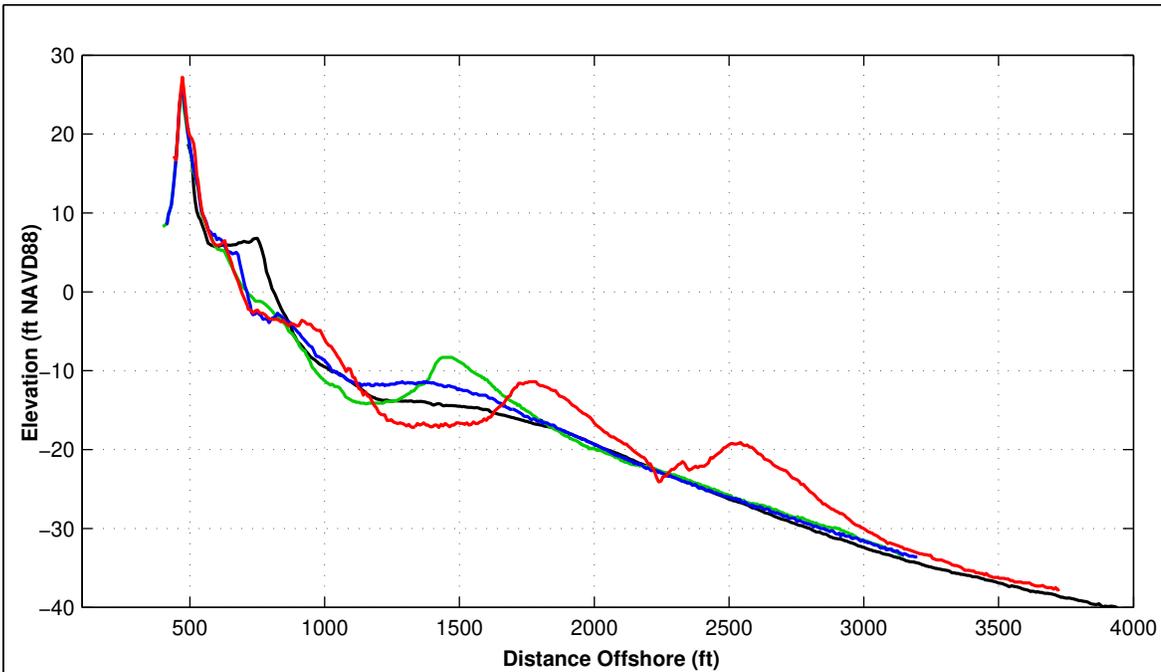
Survey Transect 645+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	35.88 ft	-44.70 ft
Volume Change Above +6 ft NAVD88	8.39 cy/ft	-1.98 cy/ft
Volume Change Above 1.18 ft NAVD88	17.11 cy/ft	-9.05 cy/ft
Volume Change Above -6 ft NAVD88	20.30 cy/ft	-11.98 cy/ft
Volume Change Above -14 ft NAVD88	29.26 cy/ft	-28.40 cy/ft
Volume Change Above -19 ft NAVD88	23.51 cy/ft	-29.28 cy/ft
Volume Change Above -30 ft NAVD88	85.68 cy/ft	-160.69 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
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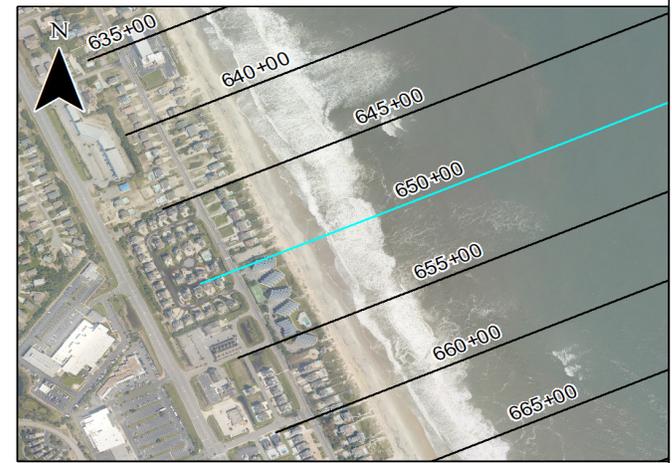


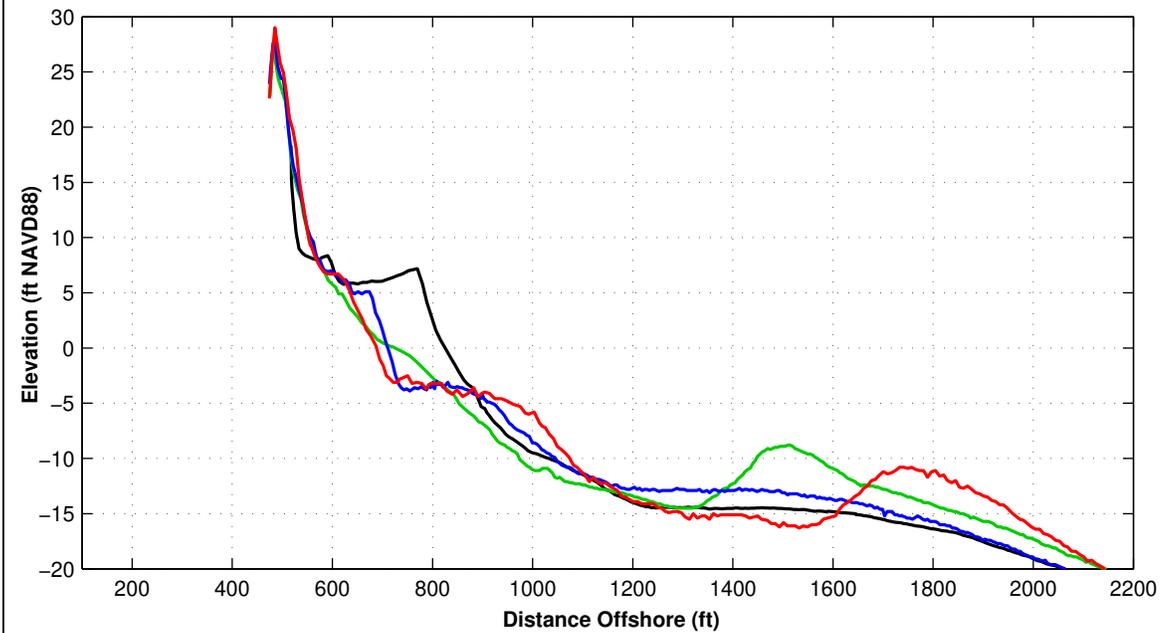
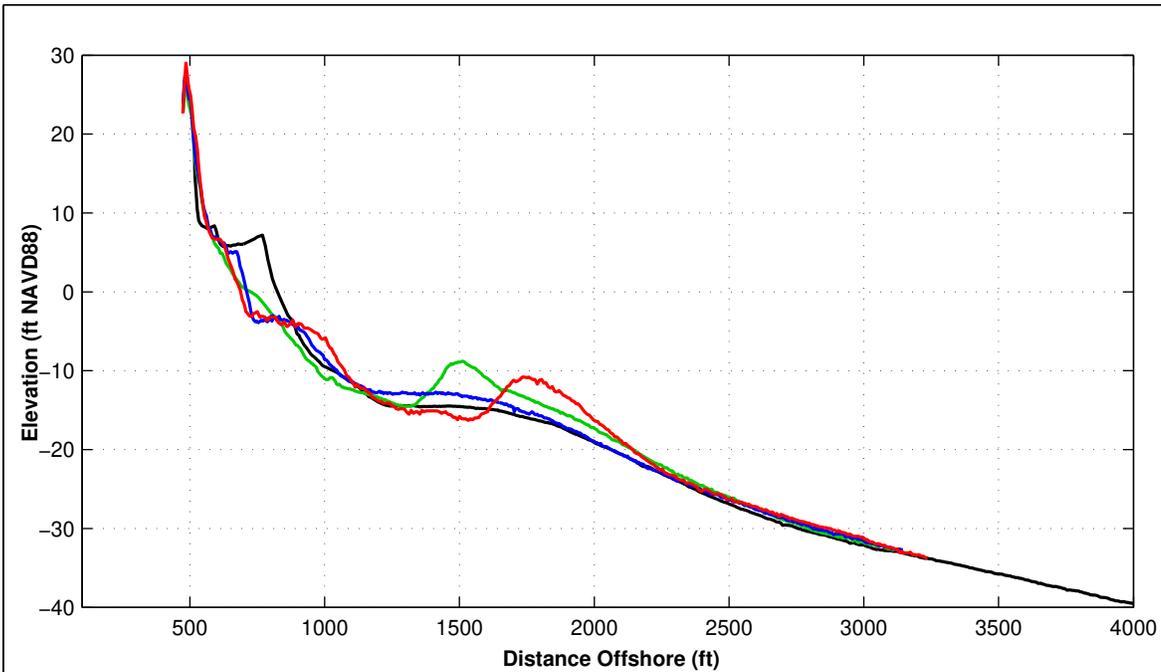
Survey Transect 650+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	15.87 ft	-21.28 ft
Volume Change Above +6 ft NAVD88	2.68 cy/ft	2.27 cy/ft
Volume Change Above 1.18 ft NAVD88	8.14 cy/ft	-1.79 cy/ft
Volume Change Above -6 ft NAVD88	5.39 cy/ft	1.73 cy/ft
Volume Change Above -14 ft NAVD88	11.11 cy/ft	-6.06 cy/ft
Volume Change Above -19 ft NAVD88	10.11 cy/ft	-13.29 cy/ft
Volume Change Above -30 ft NAVD88	5.88 cy/ft	105.98 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
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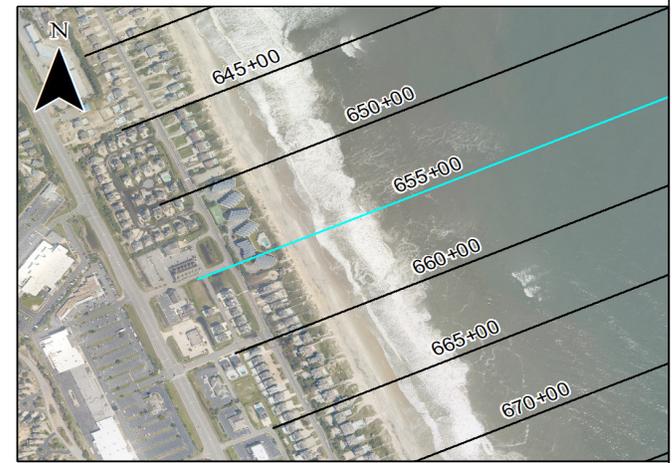


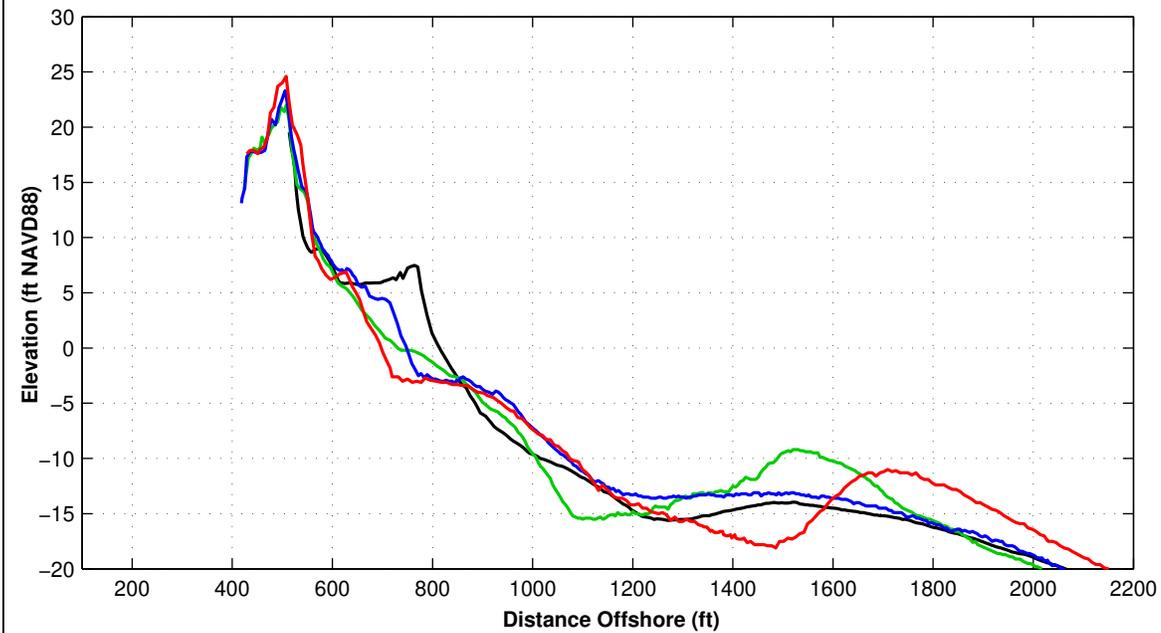
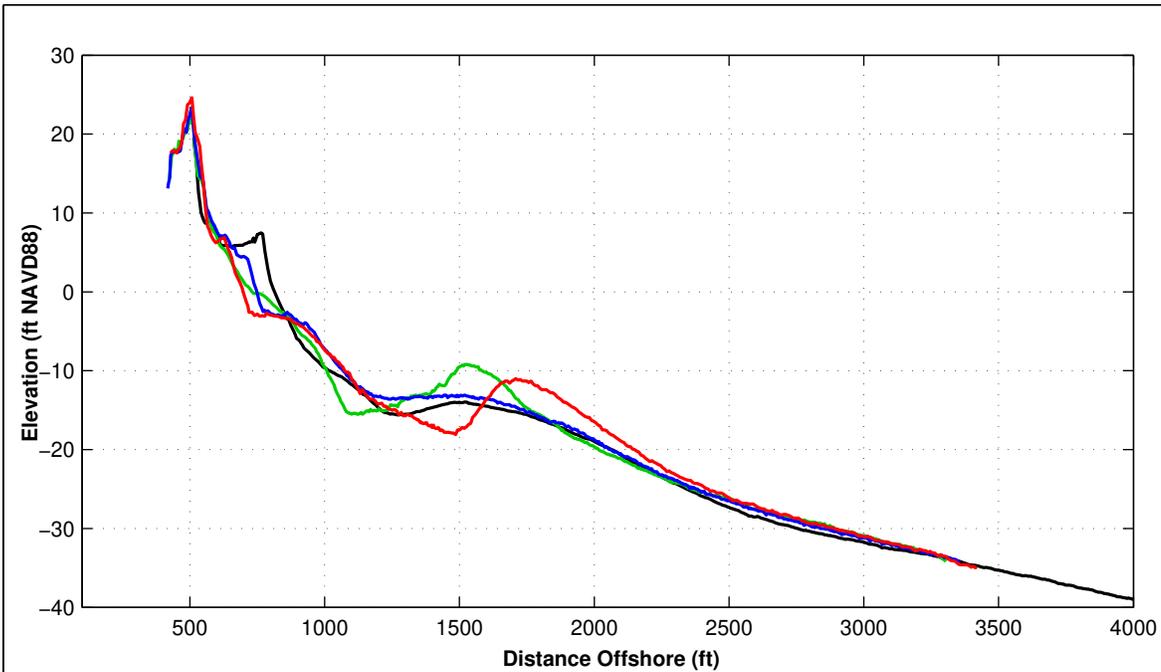
Survey Transect 655+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	20.13 ft	-27.66 ft
Volume Change Above +6 ft NAVD88	2.26 cy/ft	2.18 cy/ft
Volume Change Above 1.18 ft NAVD88	9.39 cy/ft	-2.90 cy/ft
Volume Change Above -6 ft NAVD88	7.35 cy/ft	-2.81 cy/ft
Volume Change Above -14 ft NAVD88	-2.56 cy/ft	10.06 cy/ft
Volume Change Above -19 ft NAVD88	-20.83 cy/ft	22.73 cy/ft
Volume Change Above -30 ft NAVD88	-34.90 cy/ft	36.09 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

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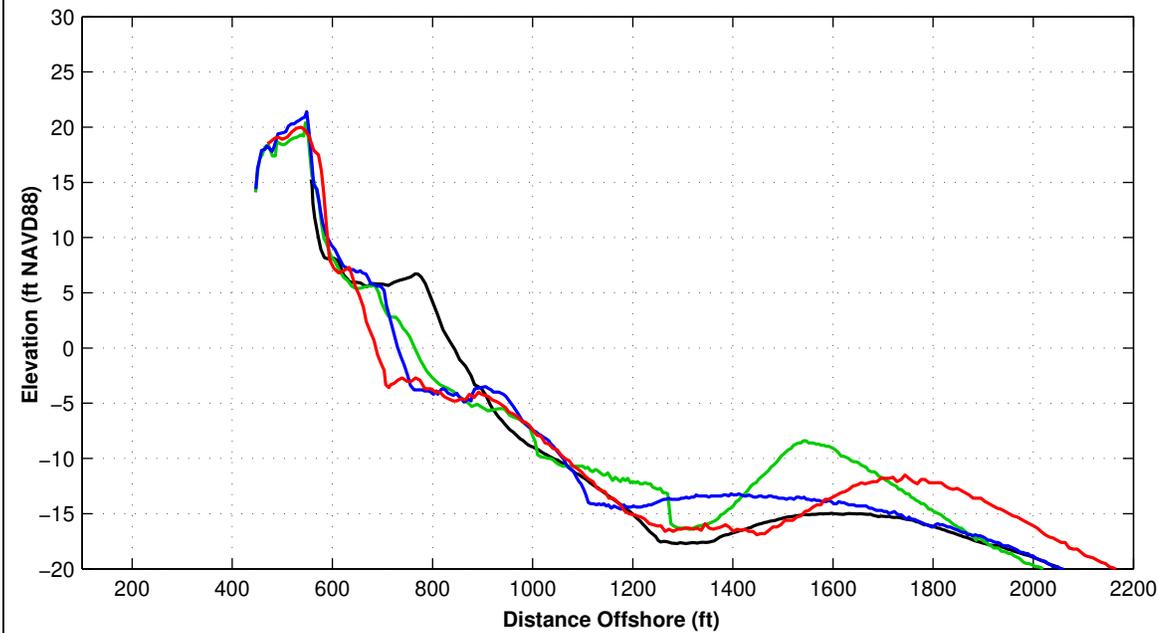
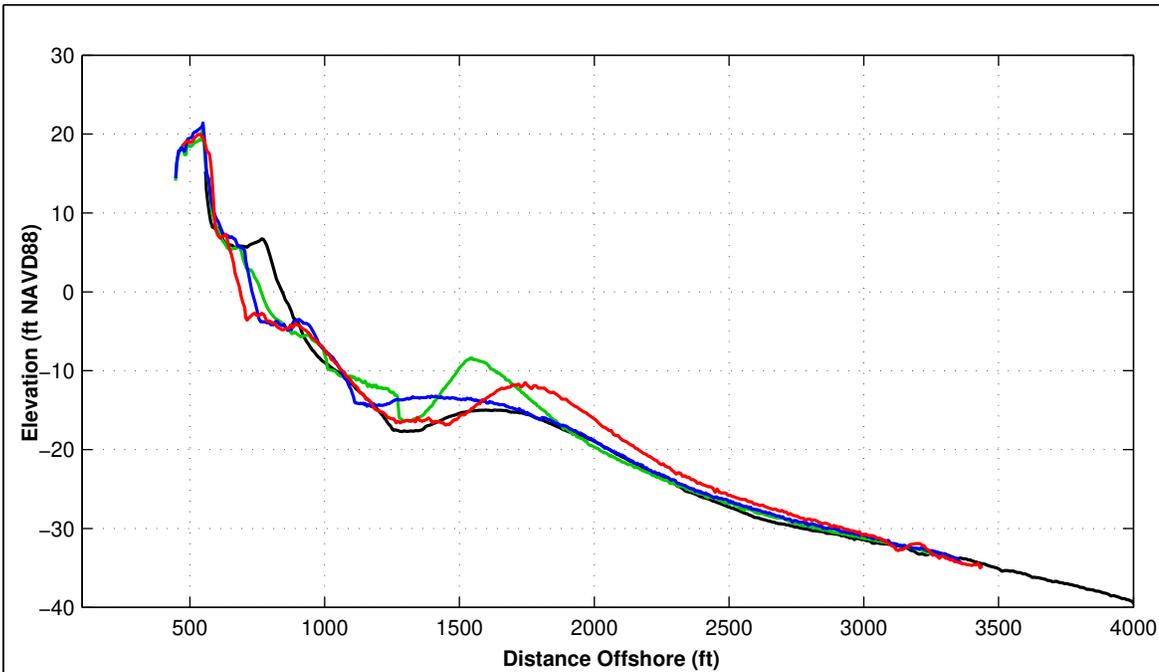
Survey Transect 660+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	35.33 ft	-50.27 ft
Volume Change Above +6 ft NAVD88	4.83 cy/ft	0.86 cy/ft
Volume Change Above 1.18 ft NAVD88	13.41 cy/ft	-7.35 cy/ft
Volume Change Above -6 ft NAVD88	14.77 cy/ft	-18.07 cy/ft
Volume Change Above -14 ft NAVD88	5.70 cy/ft	-8.45 cy/ft
Volume Change Above -19 ft NAVD88	15.58 cy/ft	-12.90 cy/ft
Volume Change Above -30 ft NAVD88	18.53 cy/ft	8.94 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
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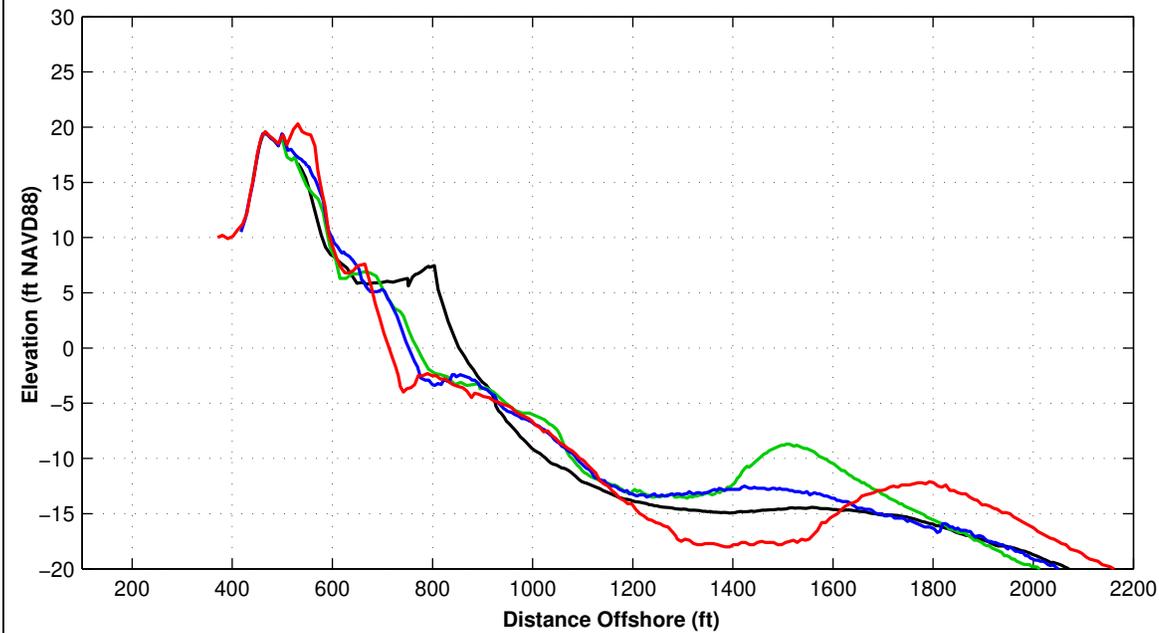
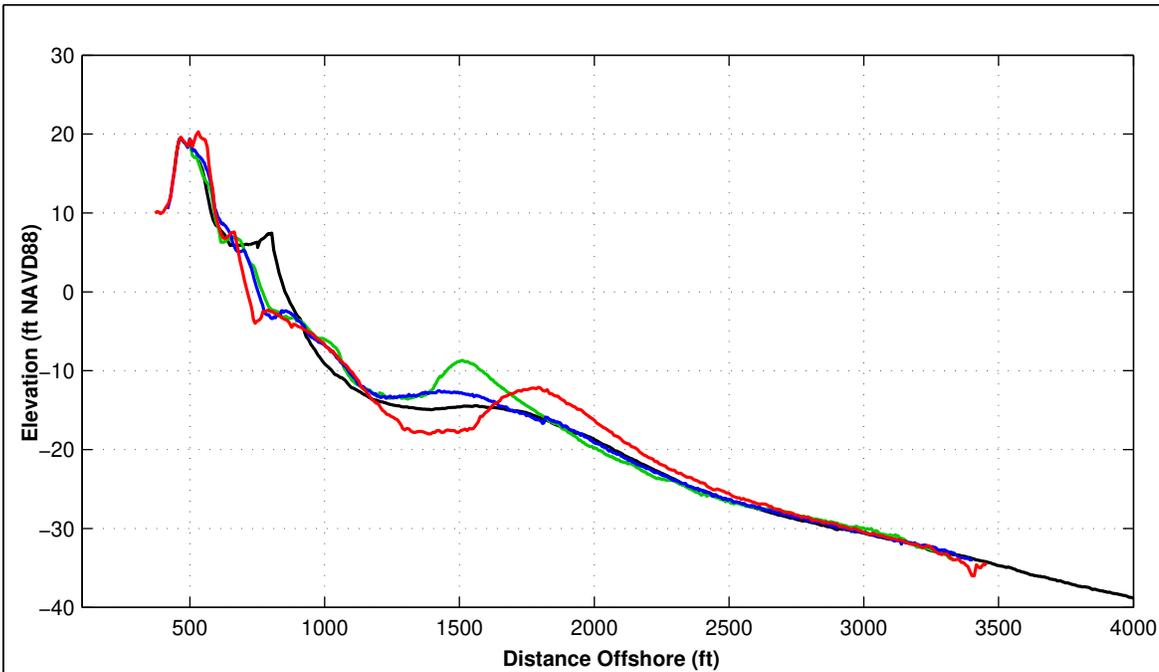
Survey Transect 665+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-28.41 ft	-44.85 ft
Volume Change Above +6 ft NAVD88	6.85 cy/ft	-0.67 cy/ft
Volume Change Above 1.18 ft NAVD88	7.33 cy/ft	-9.22 cy/ft
Volume Change Above -6 ft NAVD88	4.12 cy/ft	-18.32 cy/ft
Volume Change Above -14 ft NAVD88	-42.92 cy/ft	-3.23 cy/ft
Volume Change Above -19 ft NAVD88	-41.38 cy/ft	2.36 cy/ft
Volume Change Above -30 ft NAVD88	-28.70 cy/ft	35.17 cy/ft

**LEGEND:**

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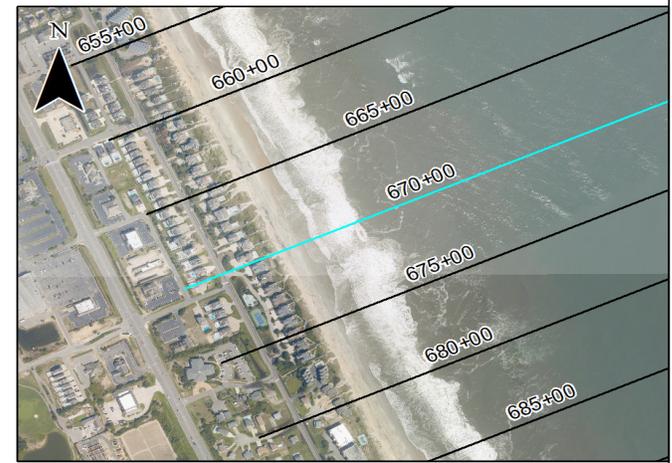


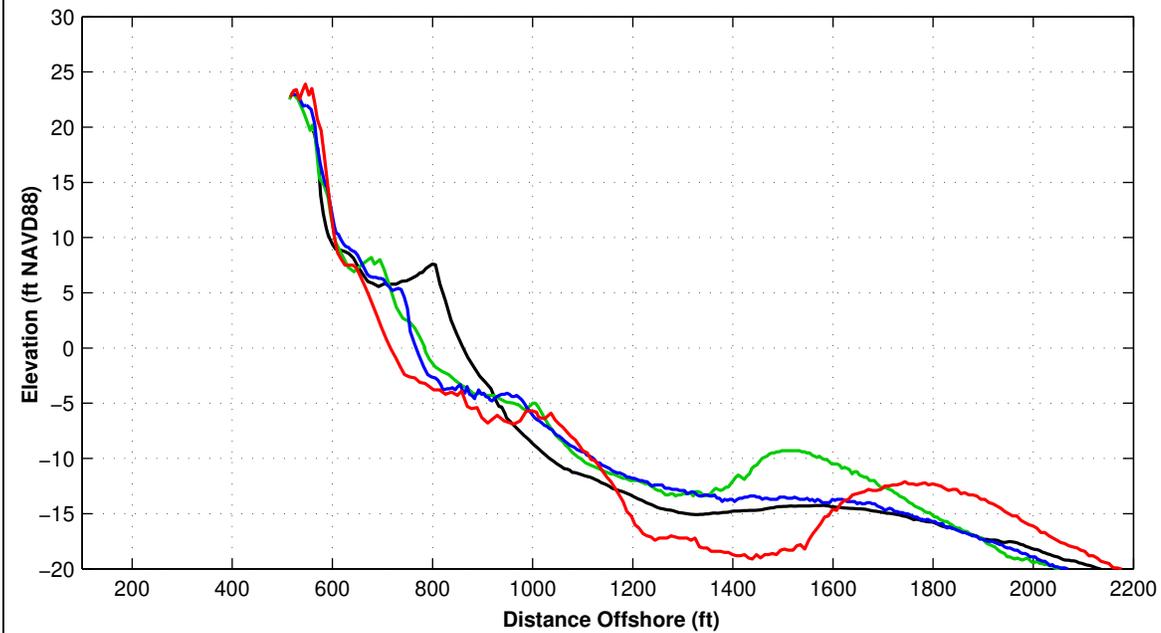
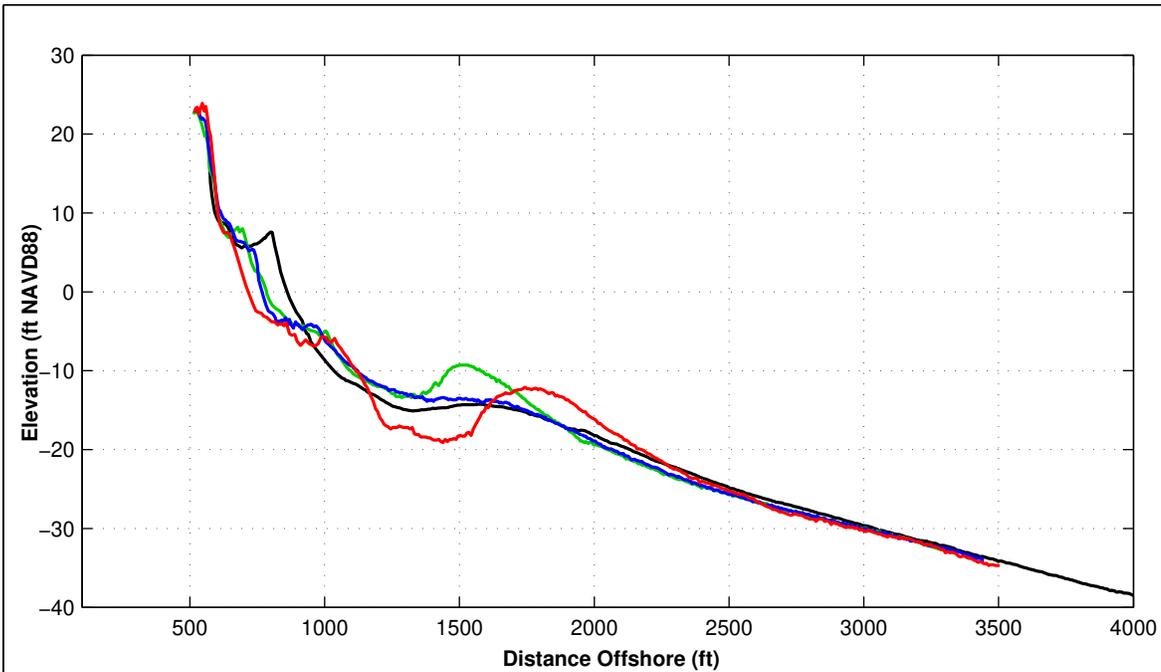
Survey Transect 670+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-13.88 ft	-38.10 ft
Volume Change Above +6 ft NAVD88	6.05 cy/ft	4.26 cy/ft
Volume Change Above 1.18 ft NAVD88	3.97 cy/ft	-0.36 cy/ft
Volume Change Above -6 ft NAVD88	0.28 cy/ft	-9.10 cy/ft
Volume Change Above -14 ft NAVD88	-32.07 cy/ft	-12.97 cy/ft
Volume Change Above -19 ft NAVD88	-35.40 cy/ft	-25.35 cy/ft
Volume Change Above -30 ft NAVD88	-29.59 cy/ft	3.06 cy/ft

**LEGEND:**

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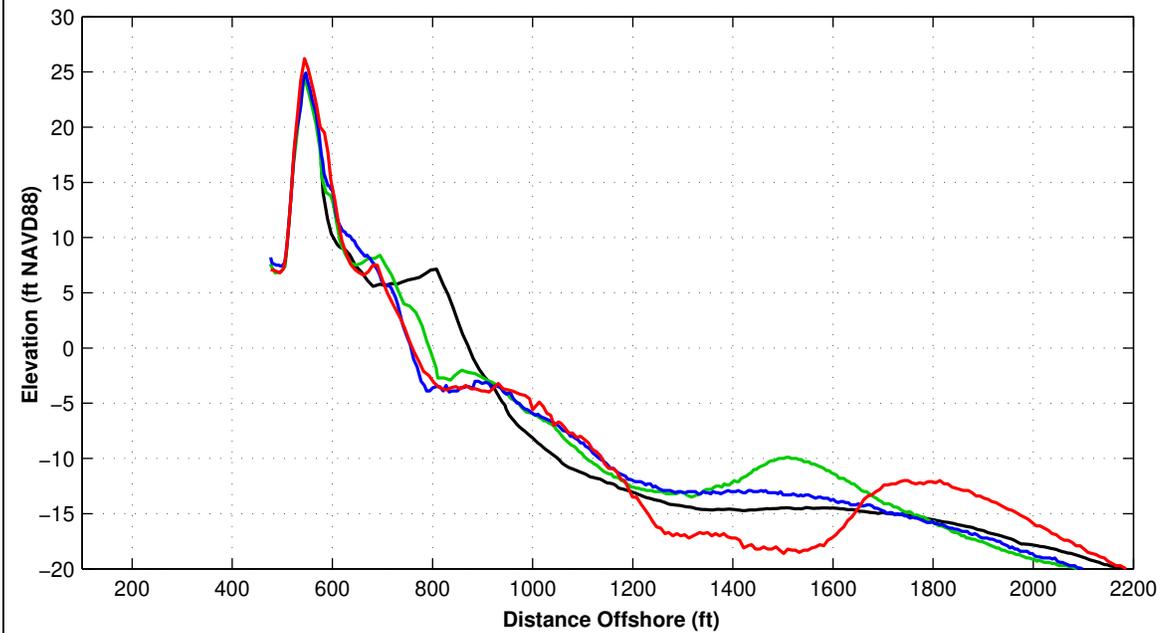
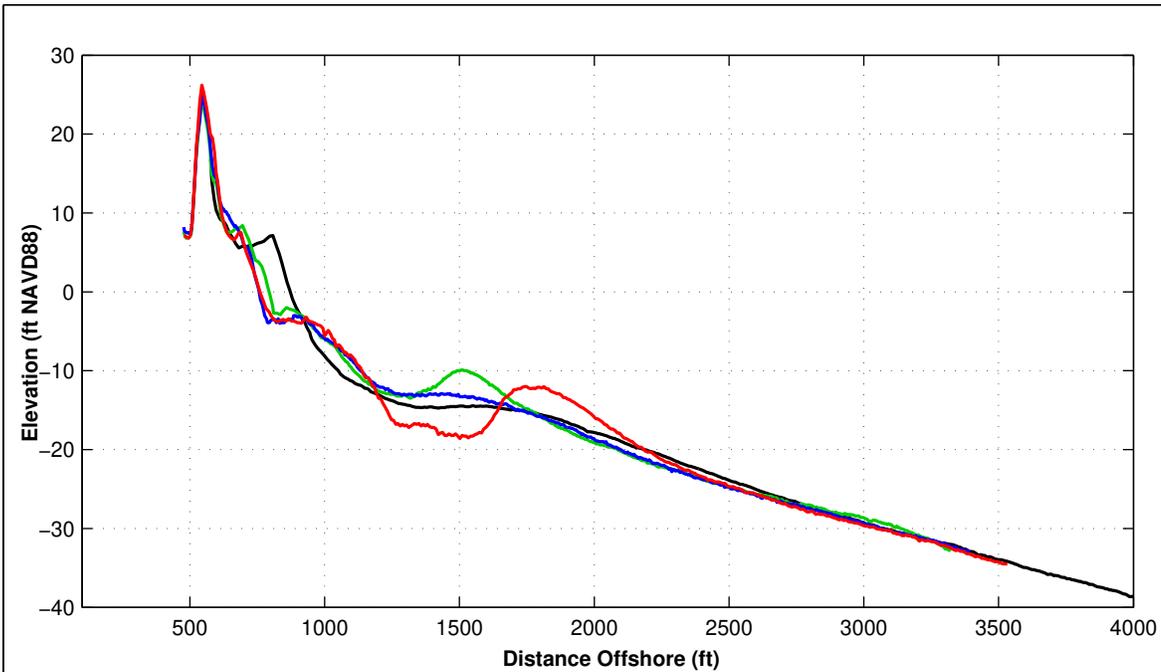
Survey Transect 675+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-14.62 ft	-53.68 ft
Volume Change Above +6 ft NAVD88	-0.27 cy/ft	-2.94 cy/ft
Volume Change Above 1.18 ft NAVD88	1.21 cy/ft	-13.81 cy/ft
Volume Change Above -6 ft NAVD88	-3.06 cy/ft	-29.69 cy/ft
Volume Change Above -14 ft NAVD88	-38.60 cy/ft	-30.76 cy/ft
Volume Change Above -19 ft NAVD88	-41.01 cy/ft	-54.61 cy/ft
Volume Change Above -30 ft NAVD88	-36.63 cy/ft	-40.17 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
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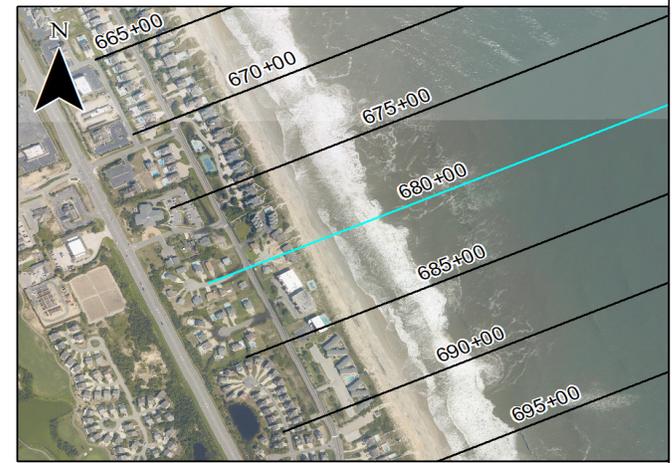


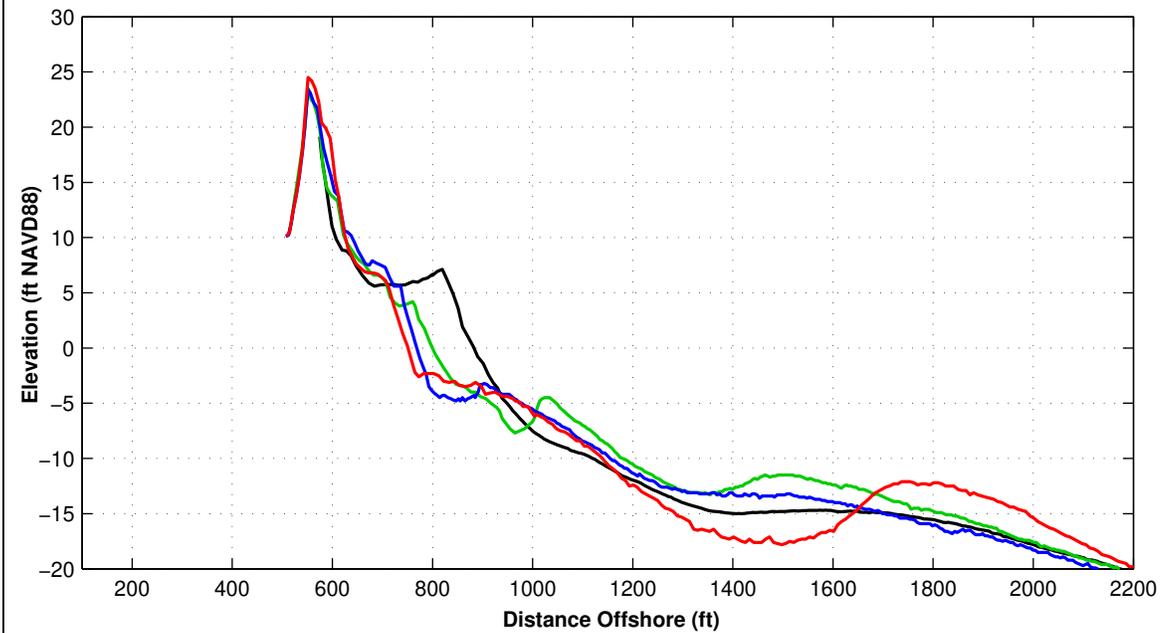
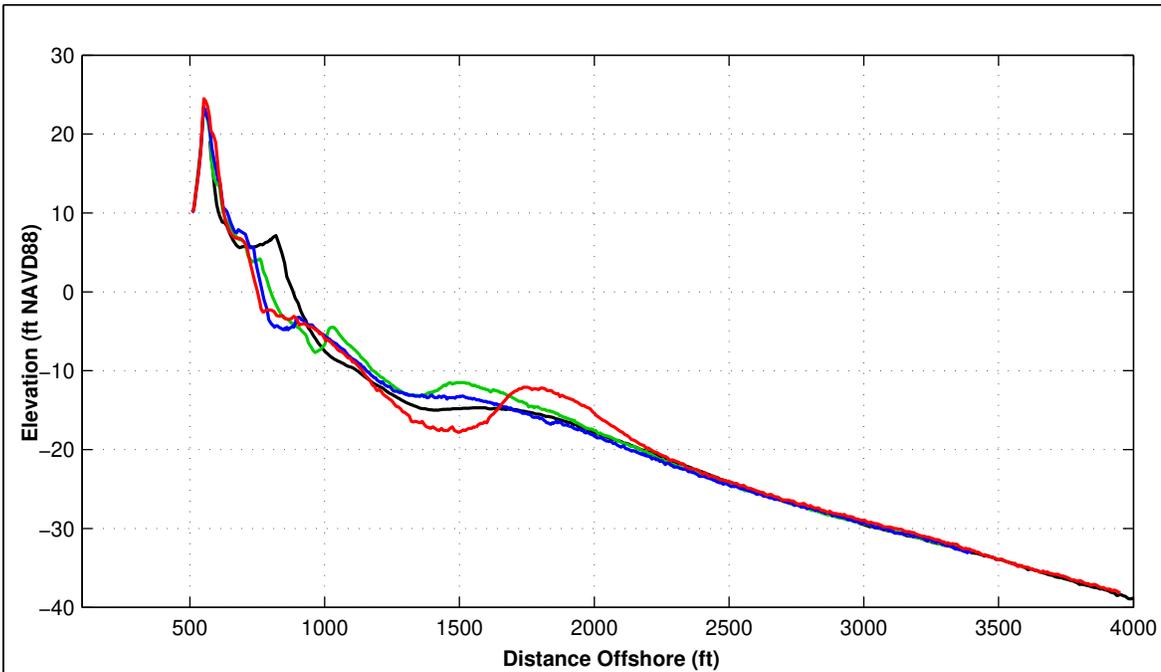
Survey Transect 680+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-36.85 ft	1.59 ft
Volume Change Above +6 ft NAVD88	3.63 cy/ft	-0.13 cy/ft
Volume Change Above 1.18 ft NAVD88	-0.85 cy/ft	-1.05 cy/ft
Volume Change Above -6 ft NAVD88	-11.07 cy/ft	2.51 cy/ft
Volume Change Above -14 ft NAVD88	-29.60 cy/ft	1.76 cy/ft
Volume Change Above -19 ft NAVD88	-28.92 cy/ft	-14.52 cy/ft
Volume Change Above -30 ft NAVD88	-34.84 cy/ft	-5.83 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



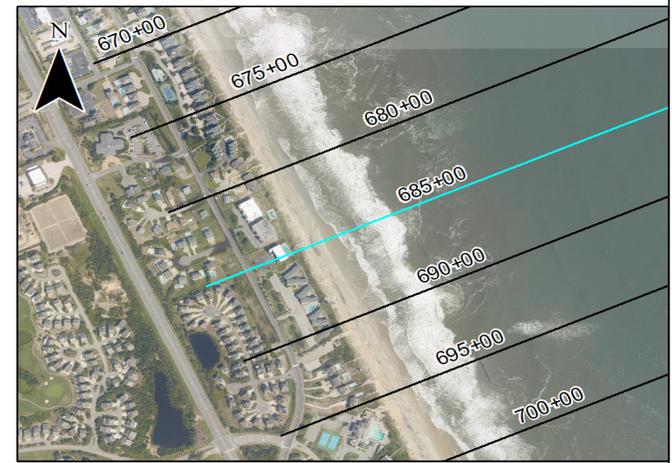


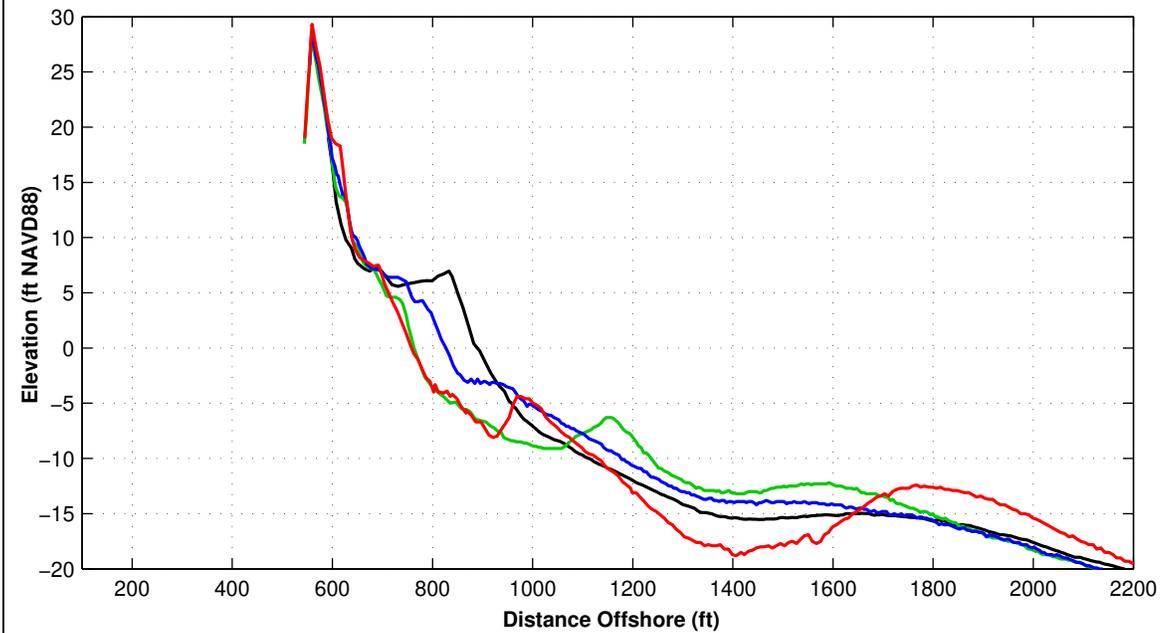
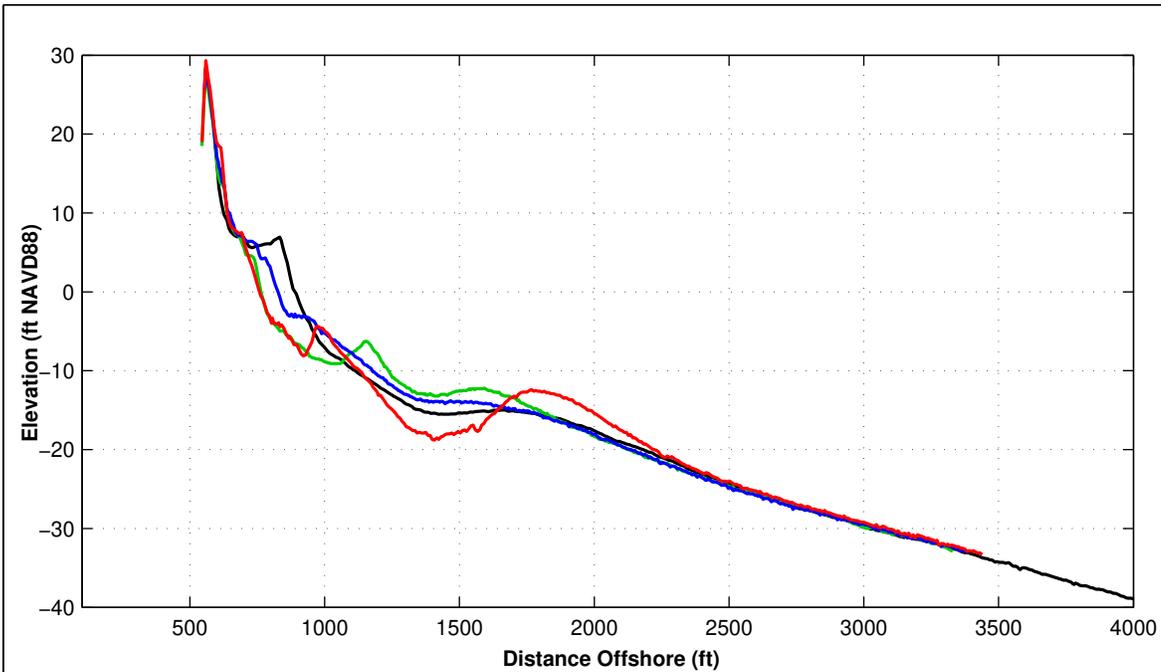
Survey Transect 685+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-27.77 ft	-19.62 ft
Volume Change Above +6 ft NAVD88	5.59 cy/ft	0.24 cy/ft
Volume Change Above 1.18 ft NAVD88	4.85 cy/ft	-3.40 cy/ft
Volume Change Above -6 ft NAVD88	-1.75 cy/ft	-1.70 cy/ft
Volume Change Above -14 ft NAVD88	-23.96 cy/ft	-5.38 cy/ft
Volume Change Above -19 ft NAVD88	-38.85 cy/ft	-5.79 cy/ft
Volume Change Above -30 ft NAVD88	-42.65 cy/ft	11.80 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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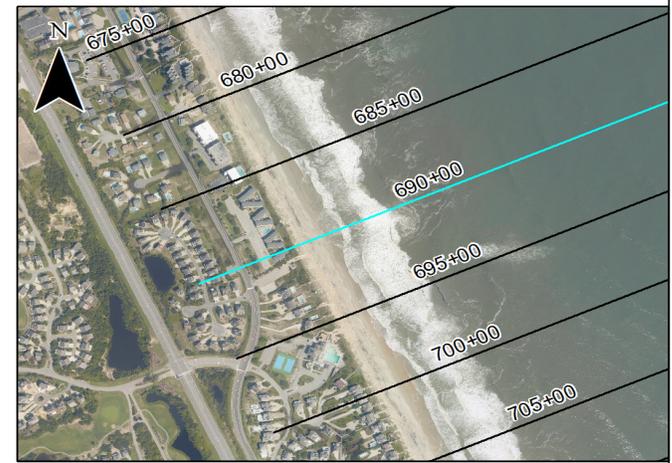


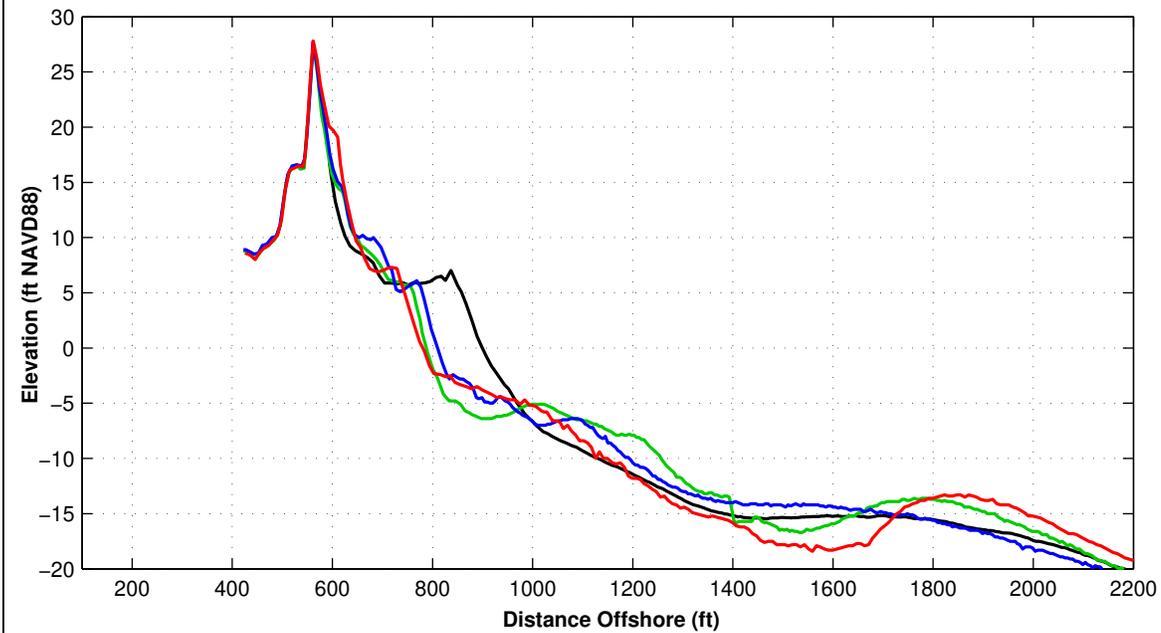
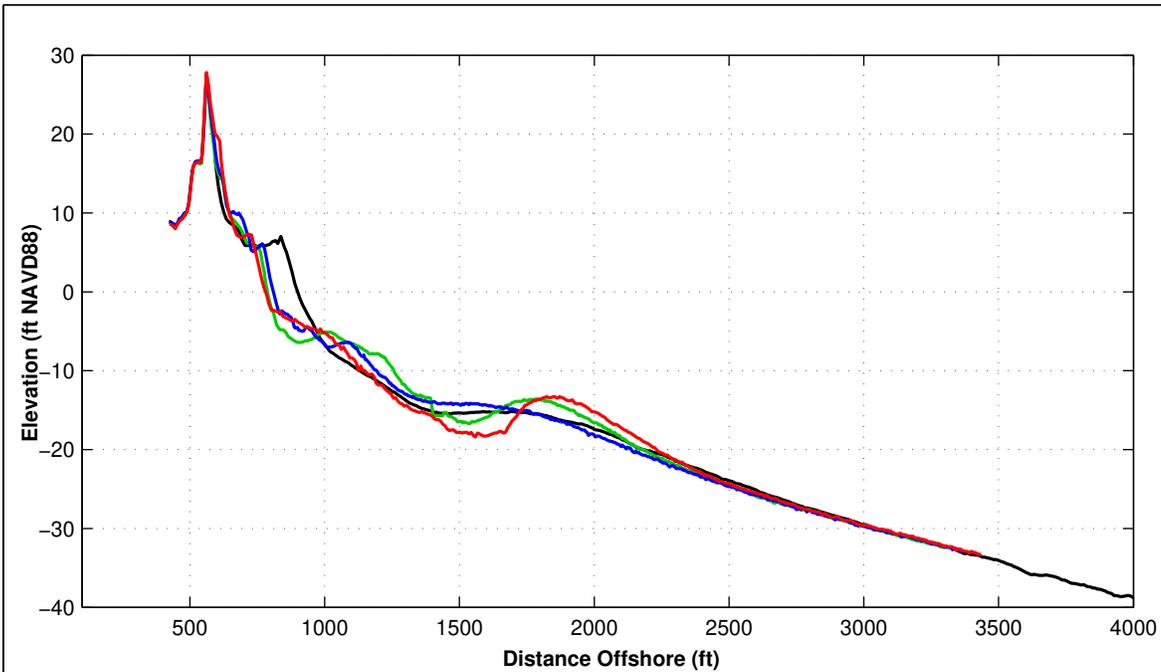
Survey Transect 690+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	57.80 ft	-65.77 ft
Volume Change Above +6 ft NAVD88	3.80 cy/ft	2.34 cy/ft
Volume Change Above 1.18 ft NAVD88	12.63 cy/ft	-7.86 cy/ft
Volume Change Above -6 ft NAVD88	39.08 cy/ft	-31.19 cy/ft
Volume Change Above -14 ft NAVD88	24.18 cy/ft	-43.47 cy/ft
Volume Change Above -19 ft NAVD88	18.86 cy/ft	-56.17 cy/ft
Volume Change Above -30 ft NAVD88	17.71 cy/ft	-33.73 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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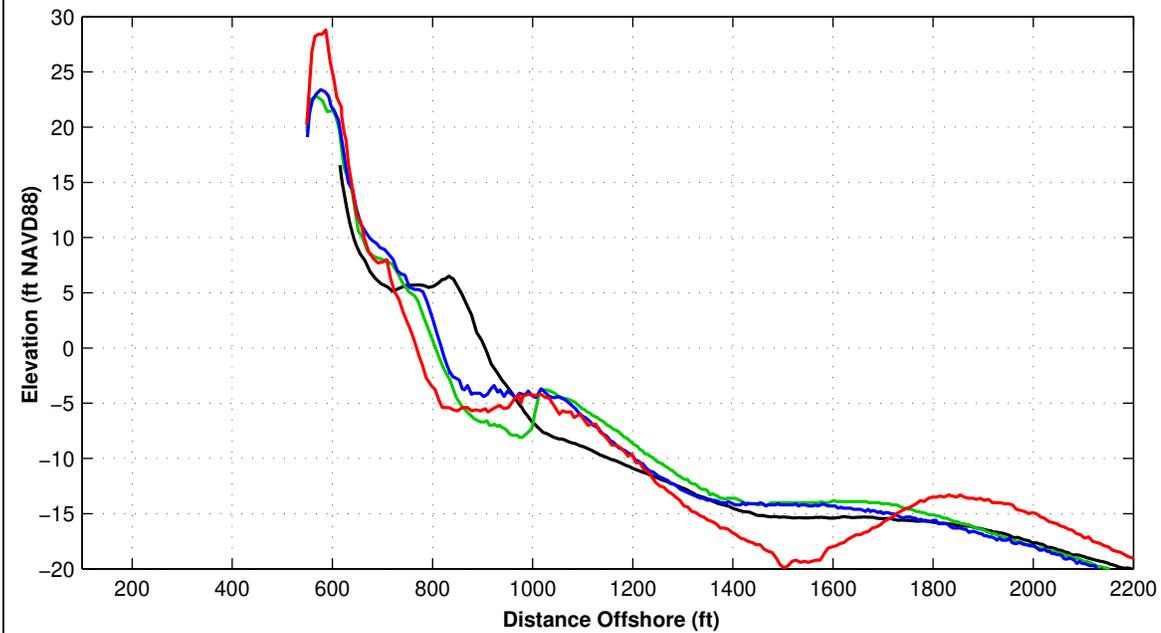
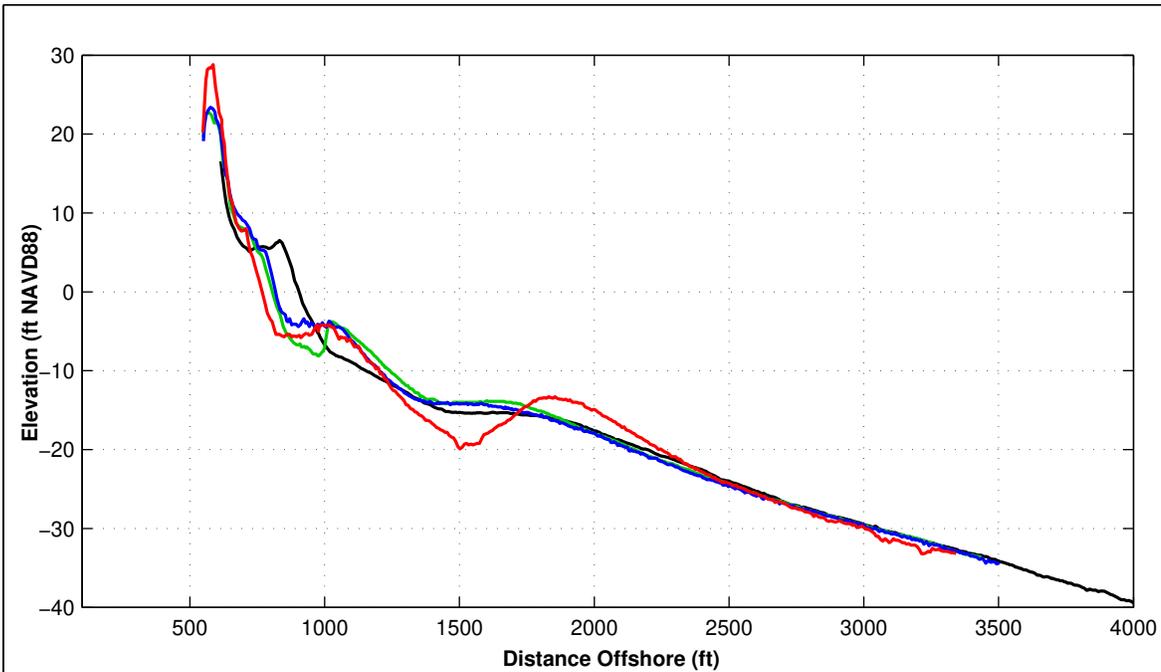
Survey Transect 695+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	20.36 ft	-31.39 ft
Volume Change Above +6 ft NAVD88	5.19 cy/ft	0.67 cy/ft
Volume Change Above 1.18 ft NAVD88	7.86 cy/ft	-4.56 cy/ft
Volume Change Above -6 ft NAVD88	18.06 cy/ft	-5.66 cy/ft
Volume Change Above -14 ft NAVD88	1.91 cy/ft	-15.55 cy/ft
Volume Change Above -19 ft NAVD88	-6.04 cy/ft	-22.14 cy/ft
Volume Change Above -30 ft NAVD88	-12.02 cy/ft	-5.07 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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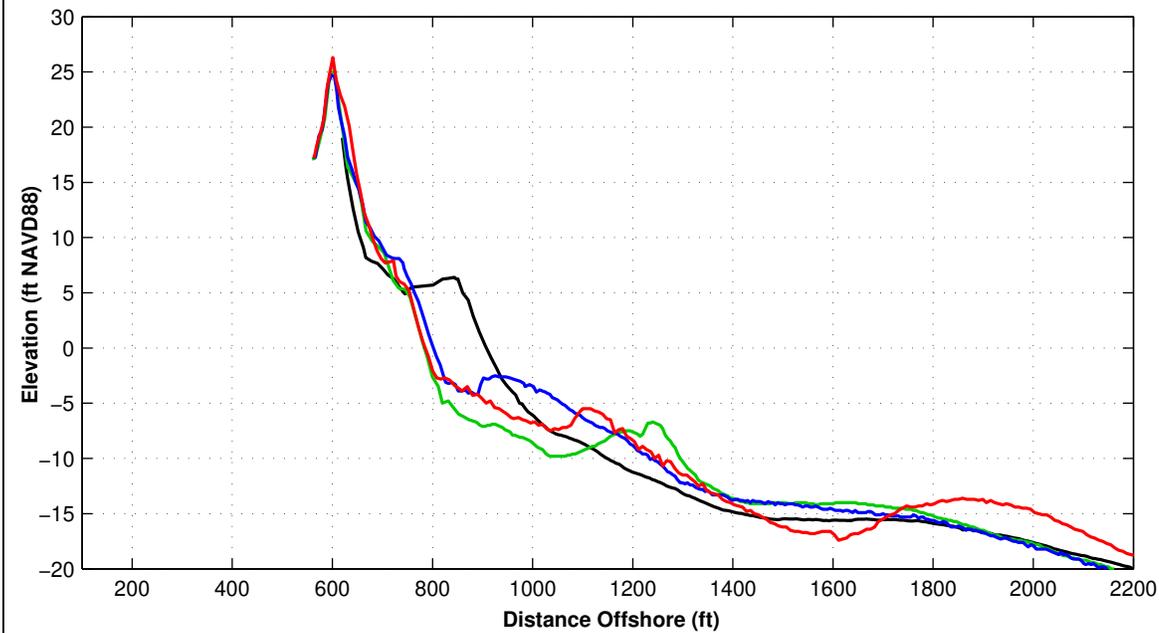
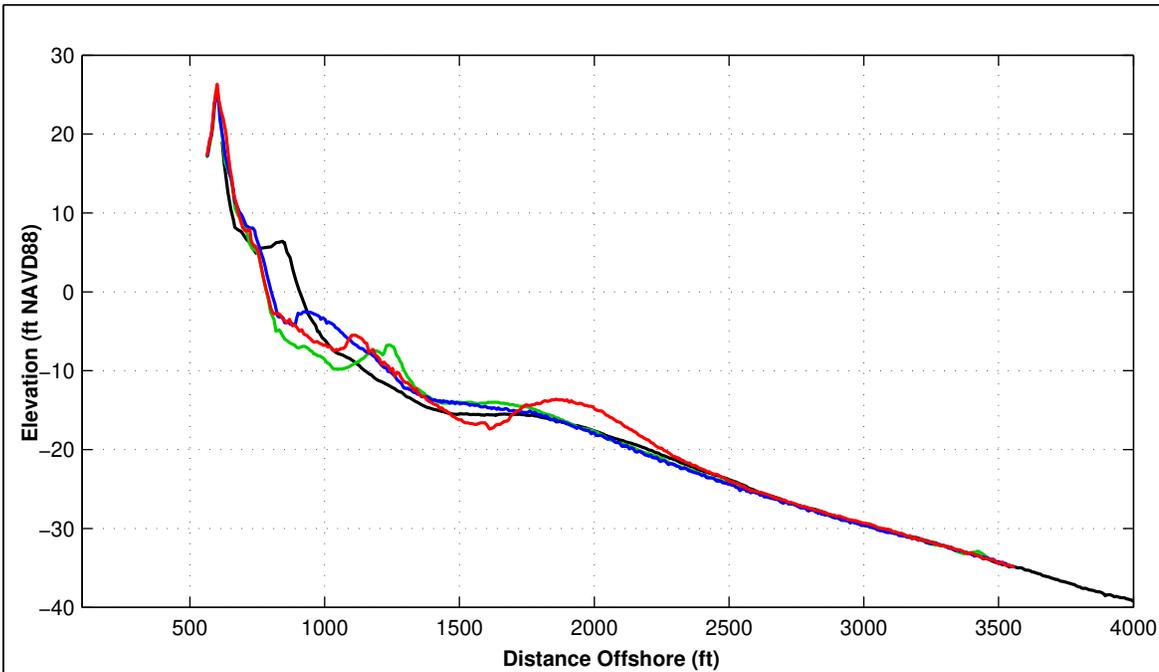
Survey Transect 700+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	13.58 ft	-50.38 ft
Volume Change Above +6 ft NAVD88	5.21 cy/ft	4.11 cy/ft
Volume Change Above 1.18 ft NAVD88	8.16 cy/ft	-4.90 cy/ft
Volume Change Above -6 ft NAVD88	20.31 cy/ft	-25.49 cy/ft
Volume Change Above -14 ft NAVD88	14.59 cy/ft	-27.42 cy/ft
Volume Change Above -19 ft NAVD88	5.30 cy/ft	-36.59 cy/ft
Volume Change Above -30 ft NAVD88	0.16 cy/ft	-25.28 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
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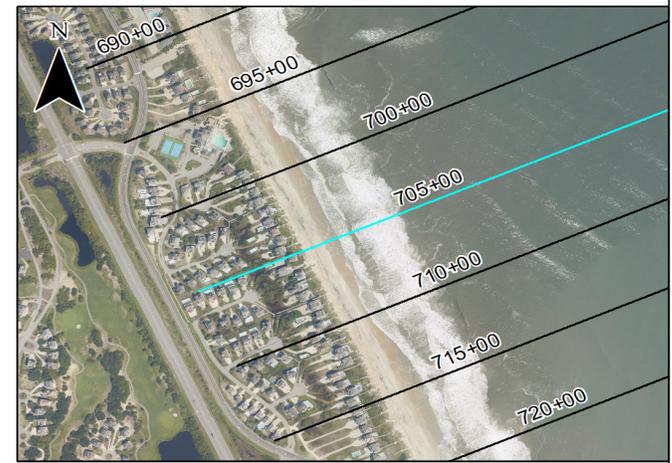


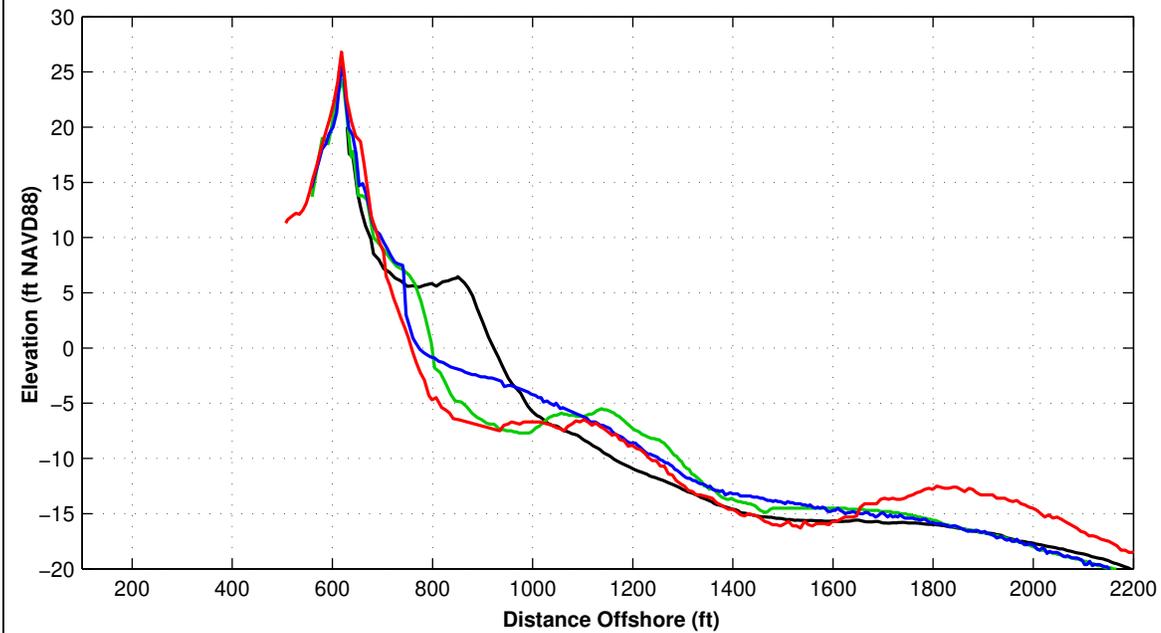
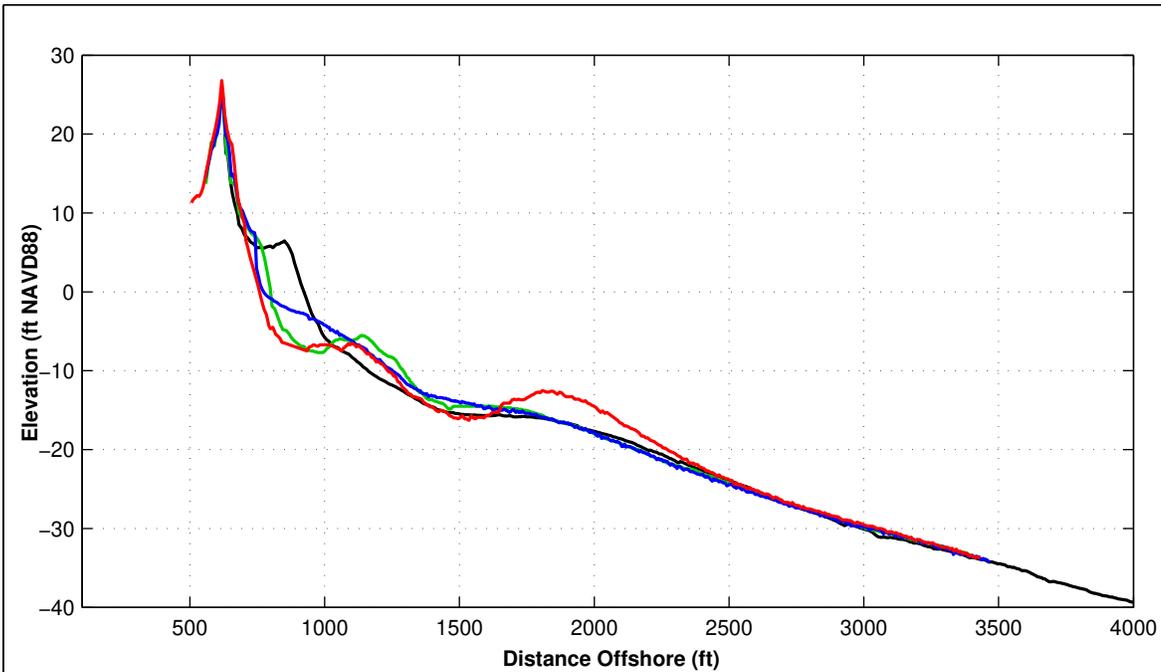
Survey Transect 705+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	16.68 ft	-16.02 ft
Volume Change Above +6 ft NAVD88	3.80 cy/ft	1.36 cy/ft
Volume Change Above 1.18 ft NAVD88	6.83 cy/ft	-1.08 cy/ft
Volume Change Above -6 ft NAVD88	32.49 cy/ft	-17.79 cy/ft
Volume Change Above -14 ft NAVD88	43.11 cy/ft	-16.21 cy/ft
Volume Change Above -19 ft NAVD88	35.11 cy/ft	1.88 cy/ft
Volume Change Above -30 ft NAVD88	31.30 cy/ft	22.67 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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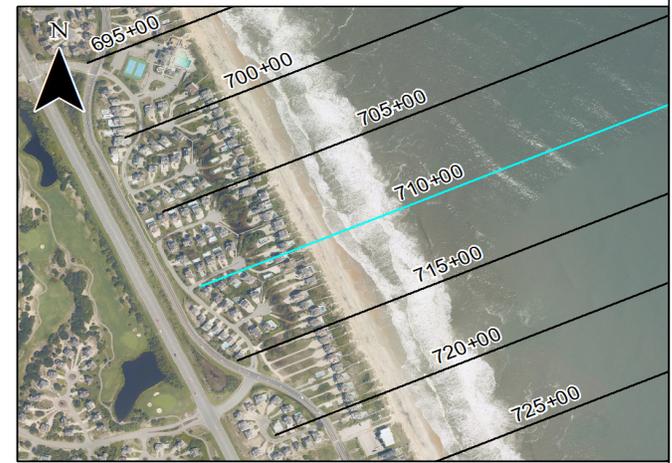


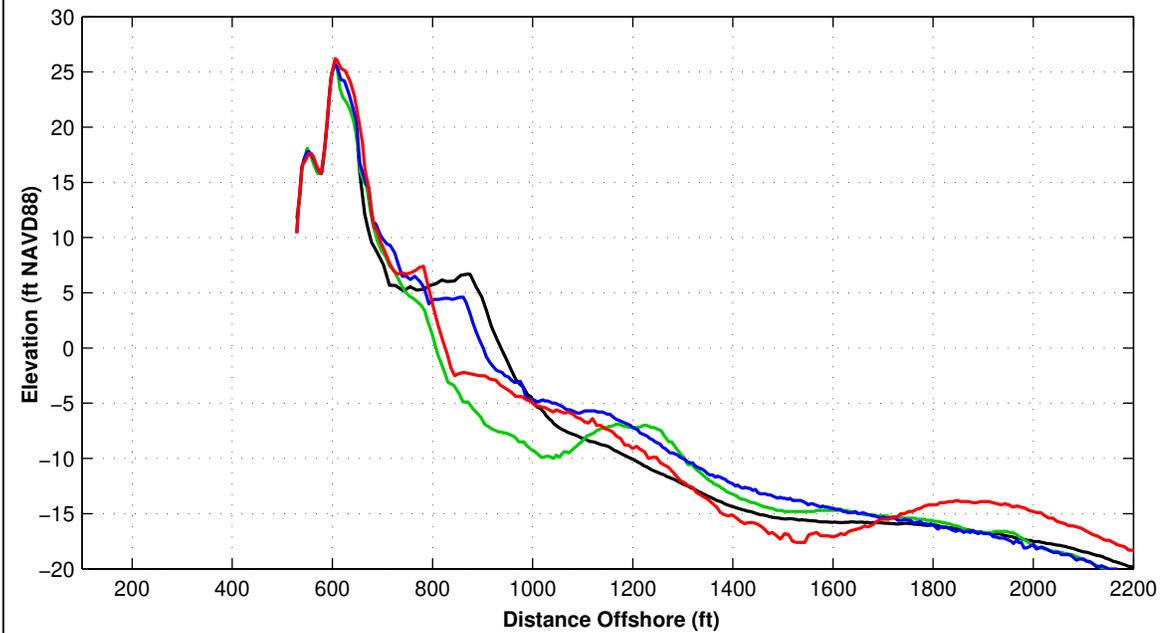
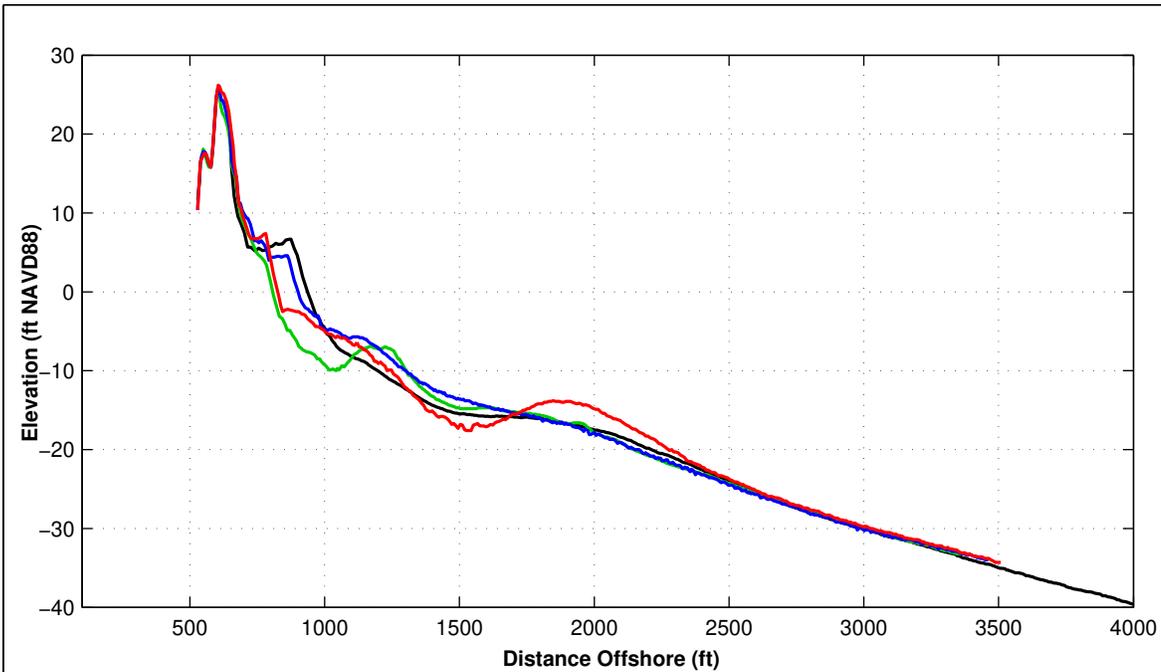
Survey Transect 710+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-34.96 ft	-9.27 ft
Volume Change Above +6 ft NAVD88	2.99 cy/ft	1.41 cy/ft
Volume Change Above 1.18 ft NAVD88	-2.70 cy/ft	-1.77 cy/ft
Volume Change Above -6 ft NAVD88	16.89 cy/ft	-32.83 cy/ft
Volume Change Above -14 ft NAVD88	15.21 cy/ft	-41.44 cy/ft
Volume Change Above -19 ft NAVD88	15.10 cy/ft	-10.64 cy/ft
Volume Change Above -30 ft NAVD88	10.96 cy/ft	13.21 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

- Notes:
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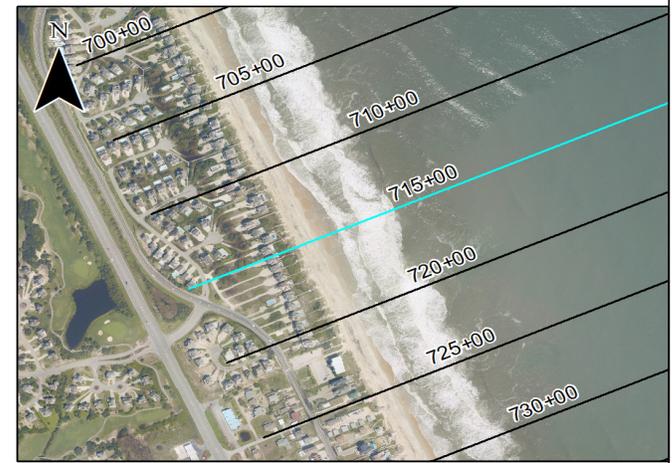


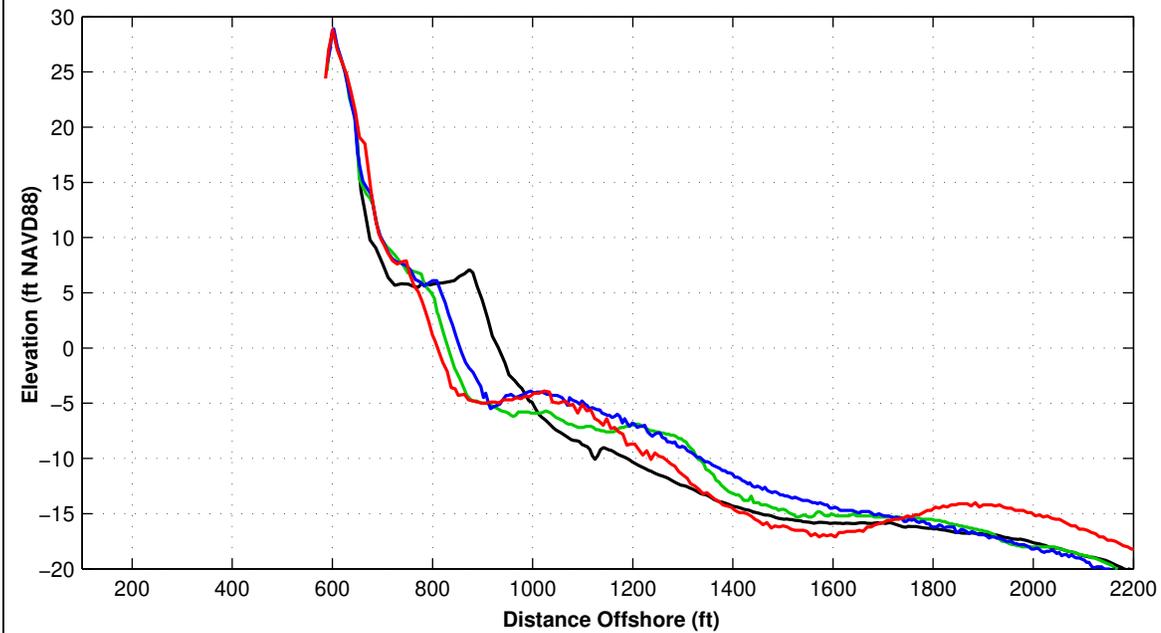
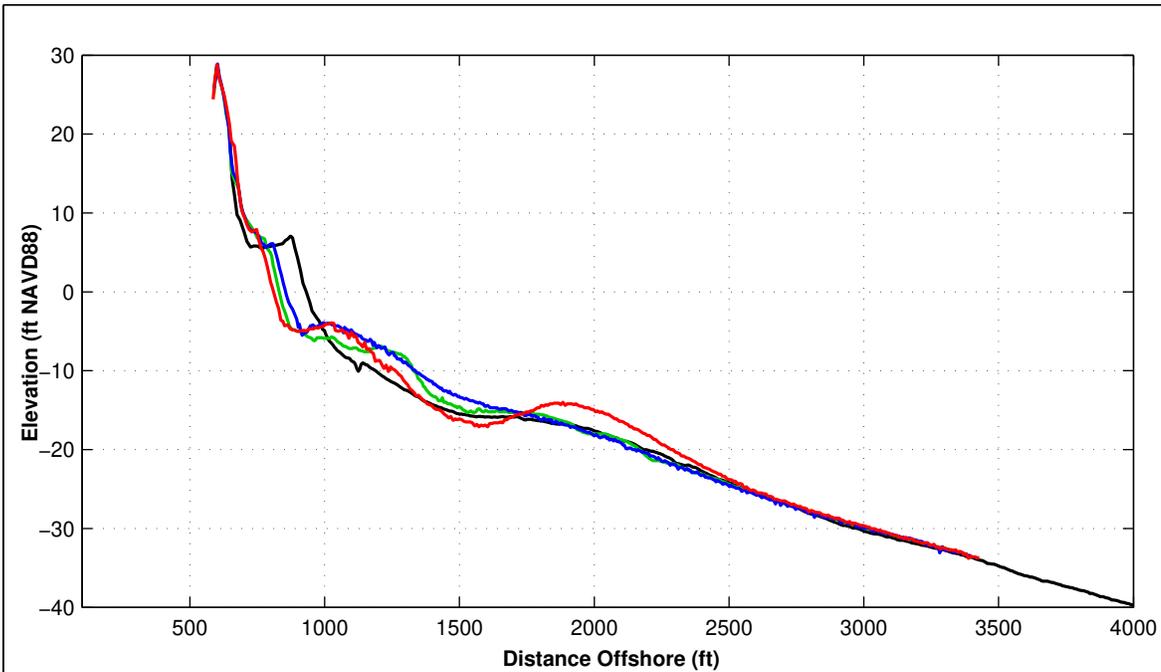
Survey Transect 715+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	89.90 ft	-72.51 ft
Volume Change Above +6 ft NAVD88	5.65 cy/ft	2.86 cy/ft
Volume Change Above 1.18 ft NAVD88	18.81 cy/ft	-5.06 cy/ft
Volume Change Above -6 ft NAVD88	52.11 cy/ft	-20.36 cy/ft
Volume Change Above -14 ft NAVD88	78.72 cy/ft	-43.43 cy/ft
Volume Change Above -19 ft NAVD88	77.83 cy/ft	-28.43 cy/ft
Volume Change Above -30 ft NAVD88	75.65 cy/ft	-2.64 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
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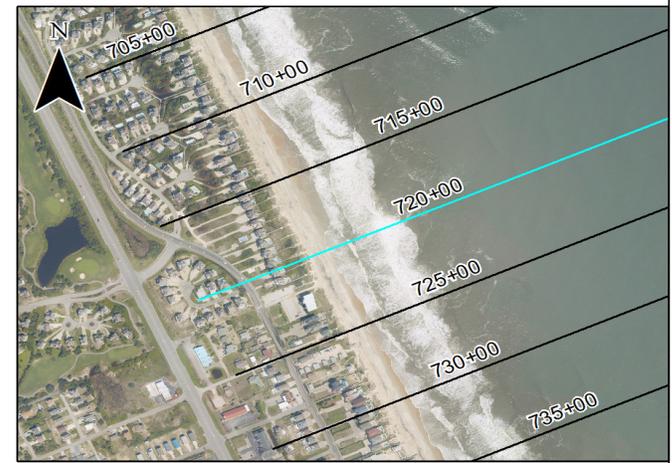


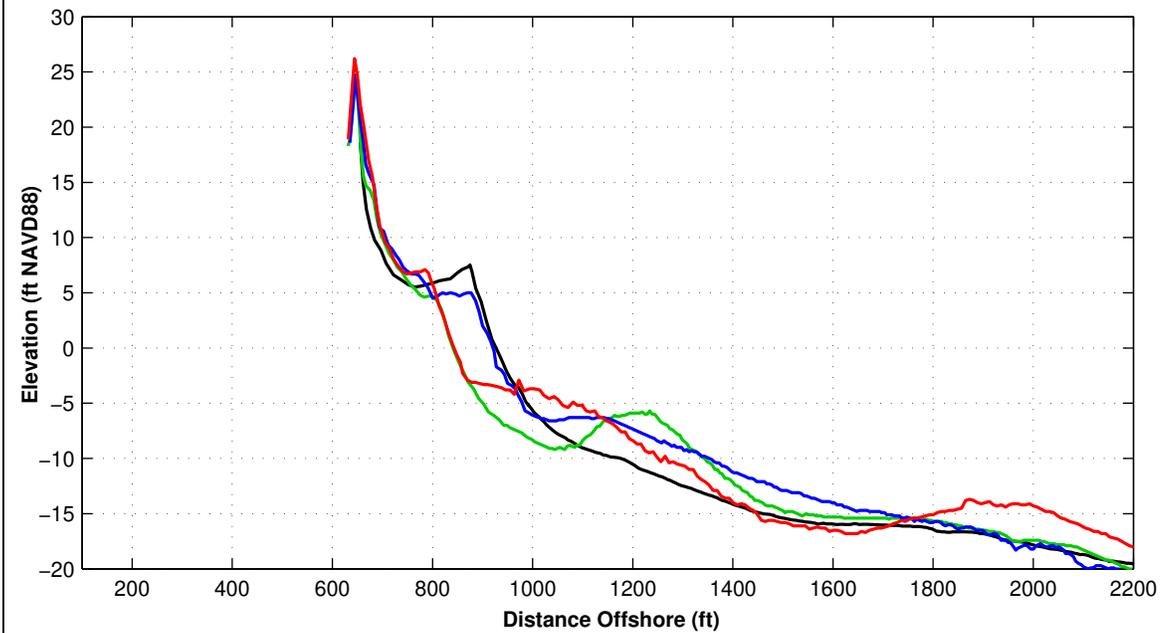
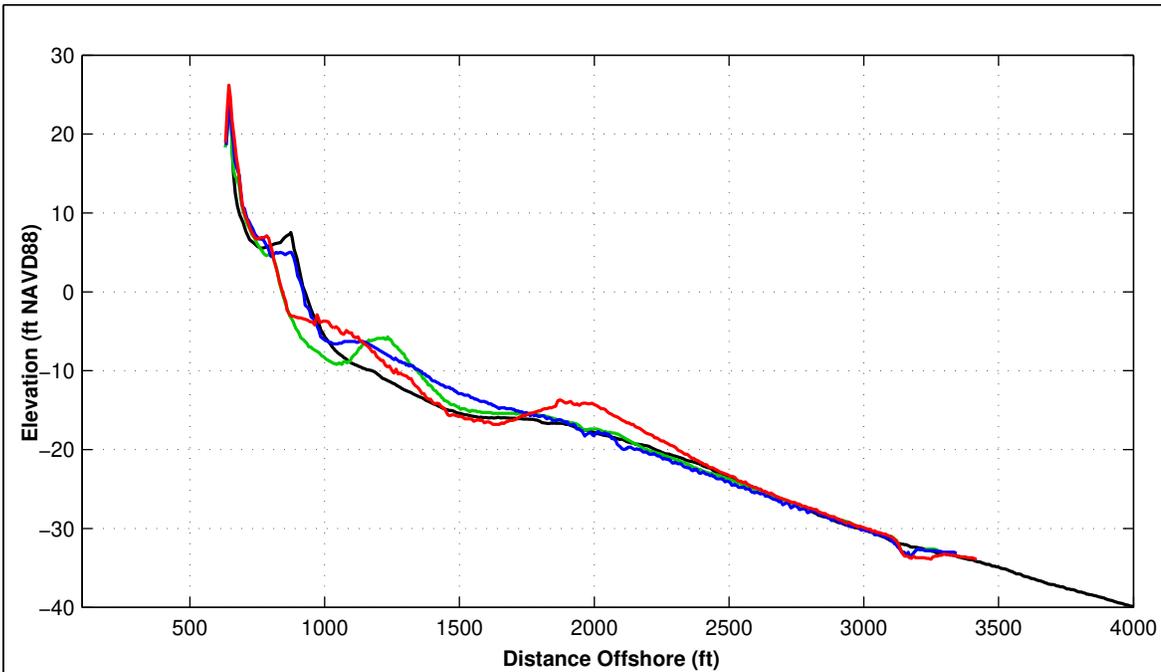
Survey Transect 720+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	23.12 ft	-46.40 ft
Volume Change Above +6 ft NAVD88	0.15 cy/ft	2.93 cy/ft
Volume Change Above 1.18 ft NAVD88	3.91 cy/ft	-5.05 cy/ft
Volume Change Above -6 ft NAVD88	20.64 cy/ft	-17.74 cy/ft
Volume Change Above -14 ft NAVD88	32.96 cy/ft	-45.26 cy/ft
Volume Change Above -19 ft NAVD88	35.11 cy/ft	-28.70 cy/ft
Volume Change Above -30 ft NAVD88	32.93 cy/ft	-2.83 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
1. Station From North To South At Varying Intervals.
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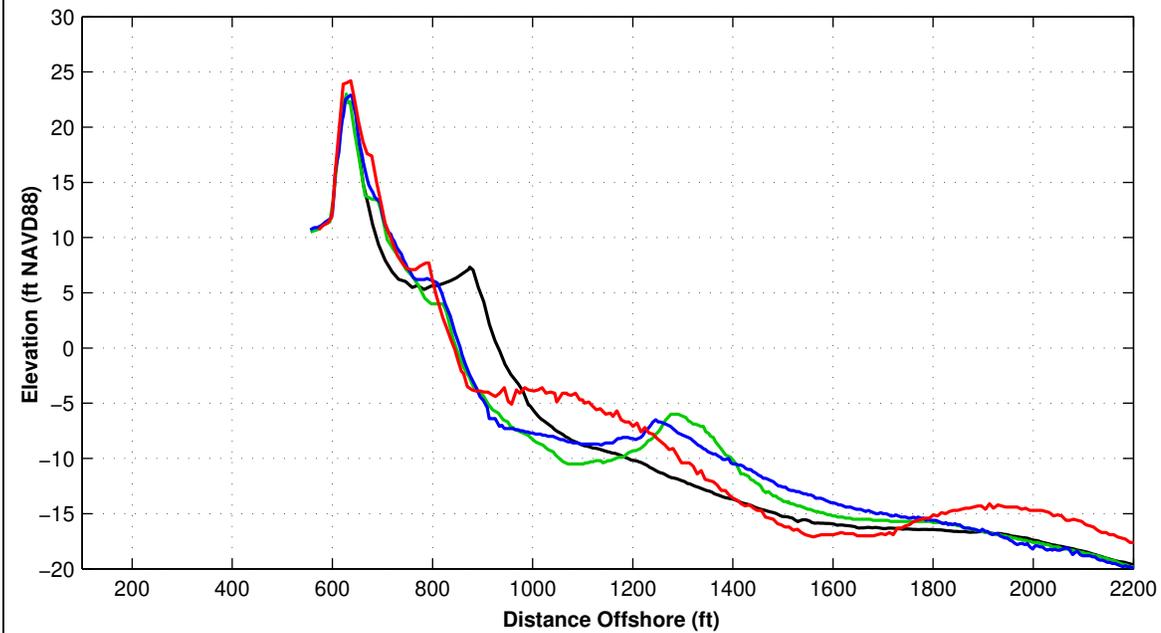
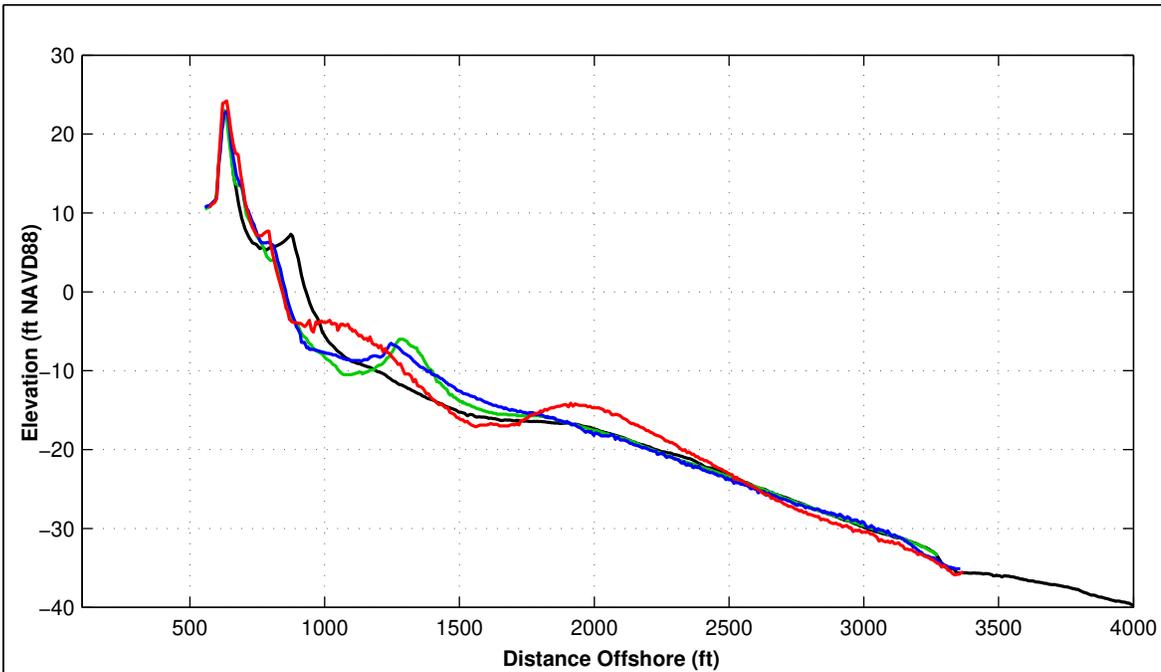
Survey Transect 725+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	79.03 ft	-77.20 ft
Volume Change Above +6 ft NAVD88	4.69 cy/ft	2.66 cy/ft
Volume Change Above 1.18 ft NAVD88	16.27 cy/ft	-6.98 cy/ft
Volume Change Above -6 ft NAVD88	36.93 cy/ft	-12.81 cy/ft
Volume Change Above -14 ft NAVD88	53.15 cy/ft	-34.93 cy/ft
Volume Change Above -19 ft NAVD88	56.35 cy/ft	-16.38 cy/ft
Volume Change Above -30 ft NAVD88	45.03 cy/ft	12.06 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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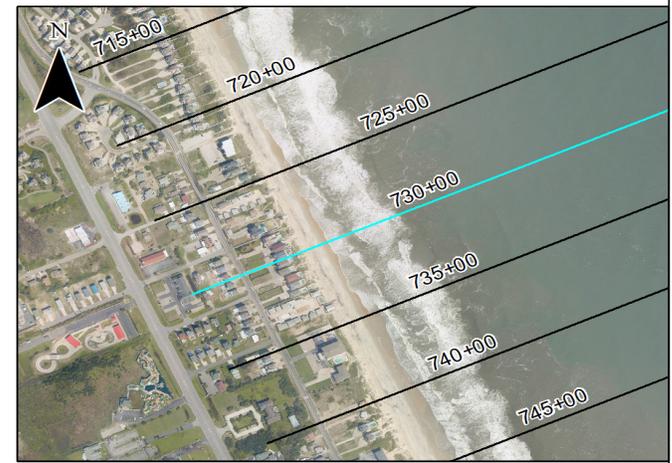


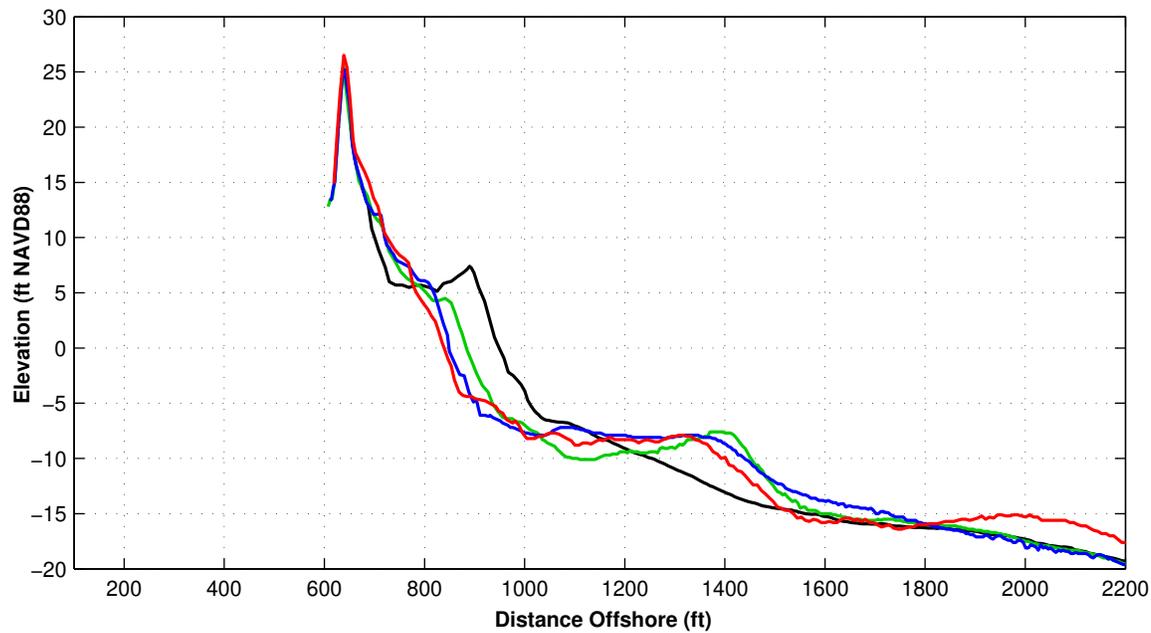
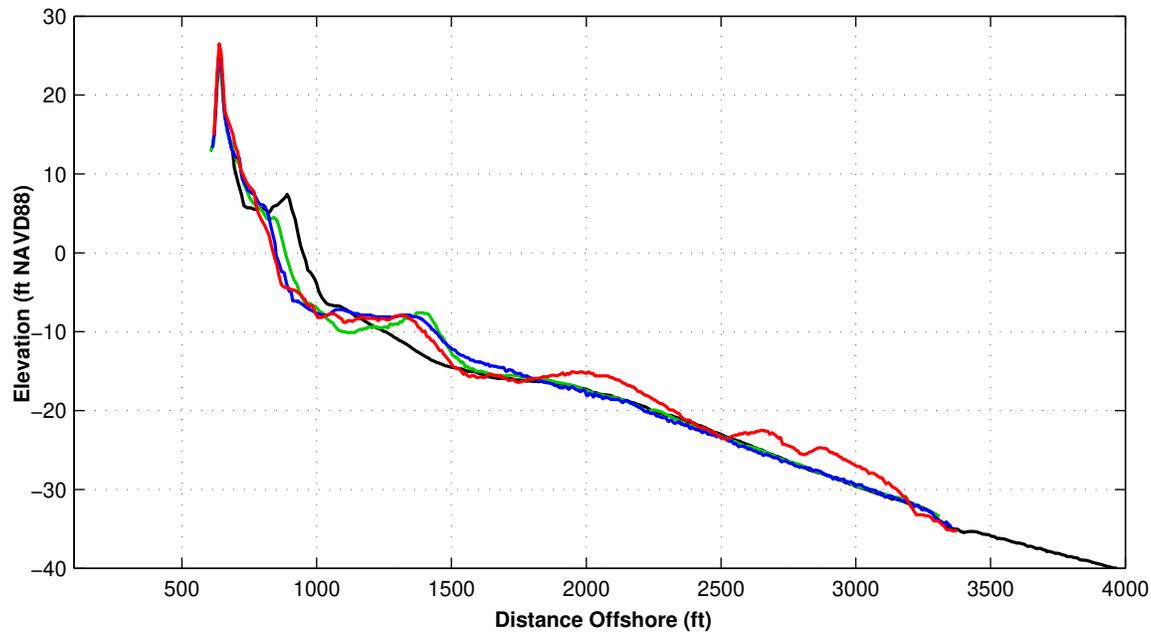
Survey Transect 730+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	7.32 ft	-13.45 ft
Volume Change Above +6 ft NAVD88	4.57 cy/ft	5.43 cy/ft
Volume Change Above 1.18 ft NAVD88	7.92 cy/ft	3.10 cy/ft
Volume Change Above -6 ft NAVD88	8.40 cy/ft	15.50 cy/ft
Volume Change Above -14 ft NAVD88	20.65 cy/ft	10.85 cy/ft
Volume Change Above -19 ft NAVD88	25.69 cy/ft	23.69 cy/ft
Volume Change Above -30 ft NAVD88	21.32 cy/ft	30.57 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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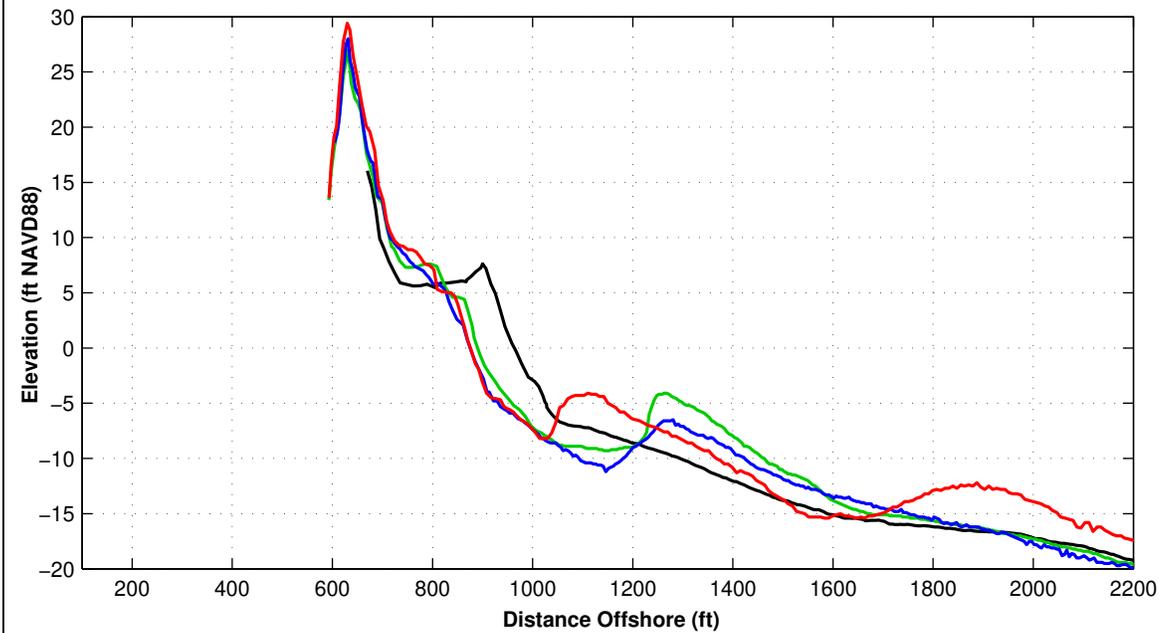
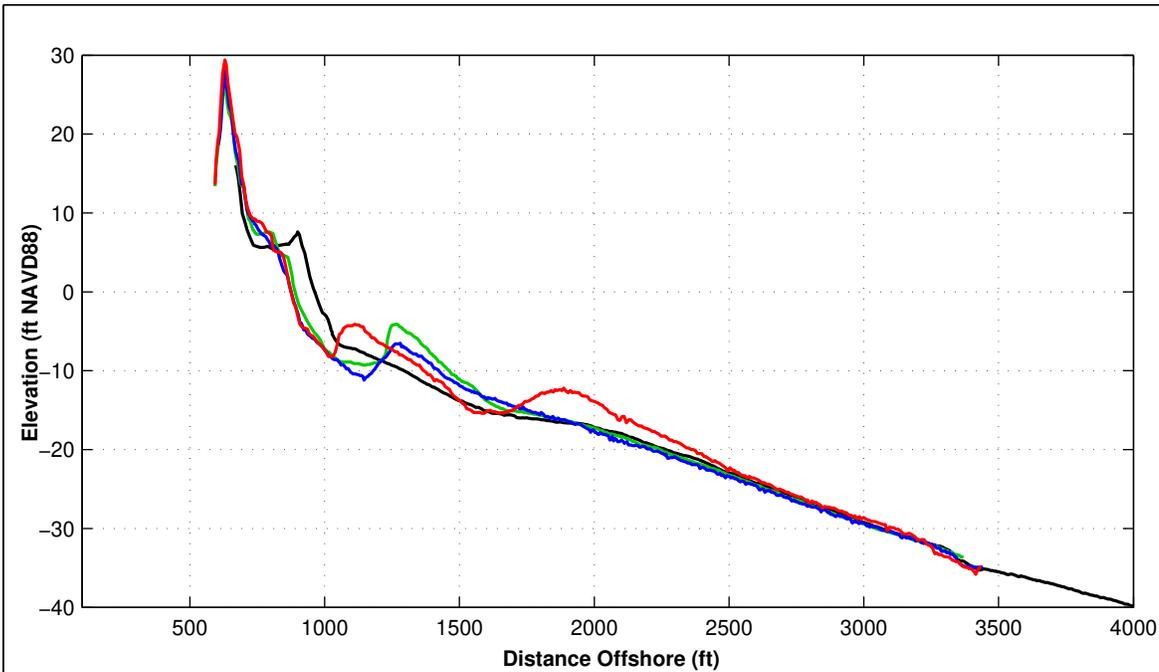


Survey Transect 735+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-29.98 ft	-15.31 ft
Volume Change Above +6 ft NAVD88	2.17 cy/ft	4.12 cy/ft
Volume Change Above 1.18 ft NAVD88	-0.17 cy/ft	-0.23 cy/ft
Volume Change Above -6 ft NAVD88	-9.19 cy/ft	-1.47 cy/ft
Volume Change Above -14 ft NAVD88	6.09 cy/ft	-17.03 cy/ft
Volume Change Above -19 ft NAVD88	9.17 cy/ft	0.38 cy/ft
Volume Change Above -30 ft NAVD88	3.58 cy/ft	61.31 cy/ft

**LEGEND:**  
 JUNE 2022 ———— (red line)  
 JULY 2021 ———— (blue line)  
 JUNE 2020 ———— (green line)  
 AUGUST 2019 ———— (black line)

- Notes:  
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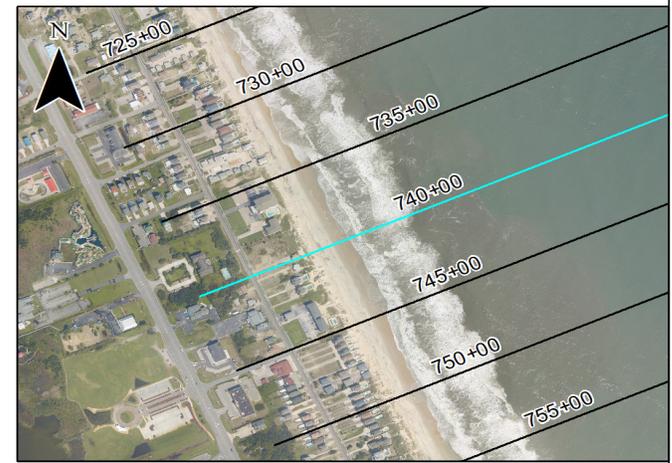


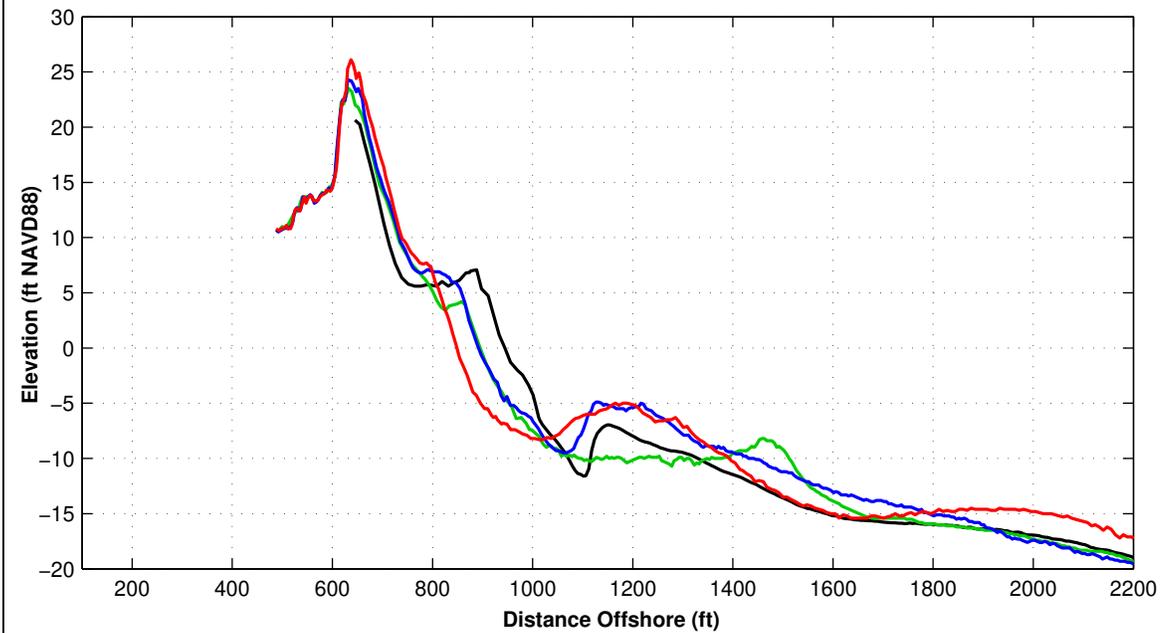
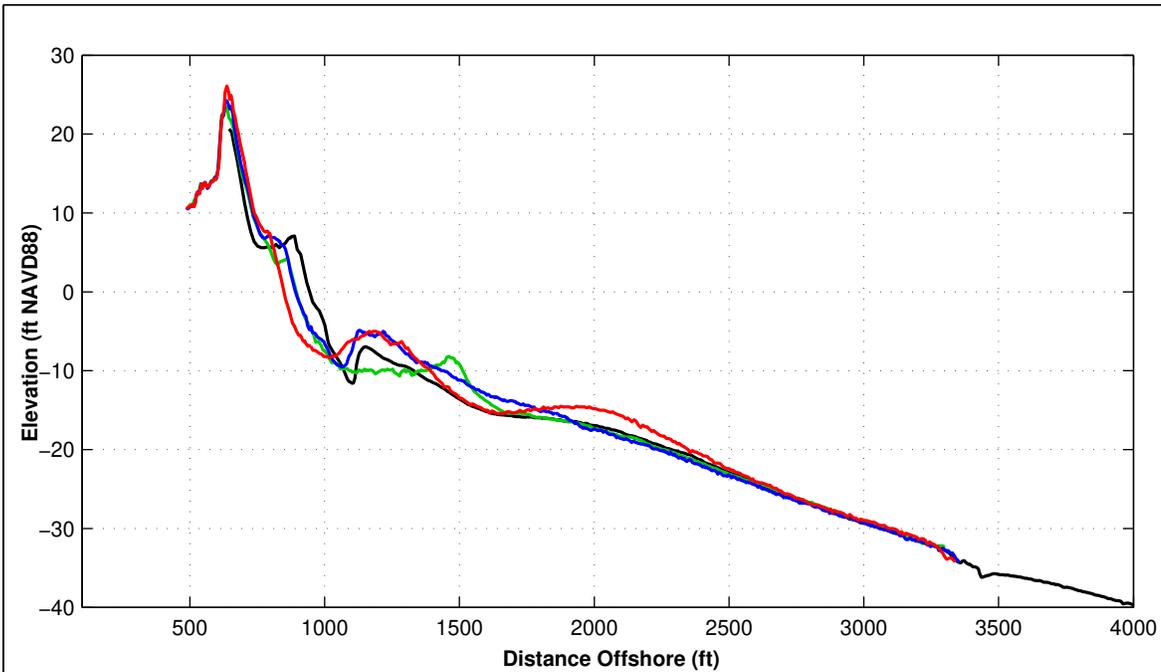
Survey Transect 740+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-15.25 ft	0.79 ft
Volume Change Above +6 ft NAVD88	1.42 cy/ft	6.39 cy/ft
Volume Change Above 1.18 ft NAVD88	-2.21 cy/ft	7.54 cy/ft
Volume Change Above -6 ft NAVD88	-12.22 cy/ft	13.85 cy/ft
Volume Change Above -14 ft NAVD88	-32.90 cy/ft	31.74 cy/ft
Volume Change Above -19 ft NAVD88	-32.57 cy/ft	69.44 cy/ft
Volume Change Above -30 ft NAVD88	-39.85 cy/ft	104.09 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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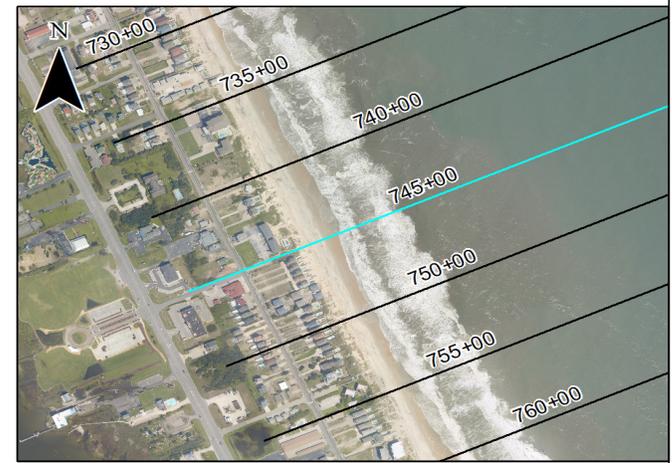


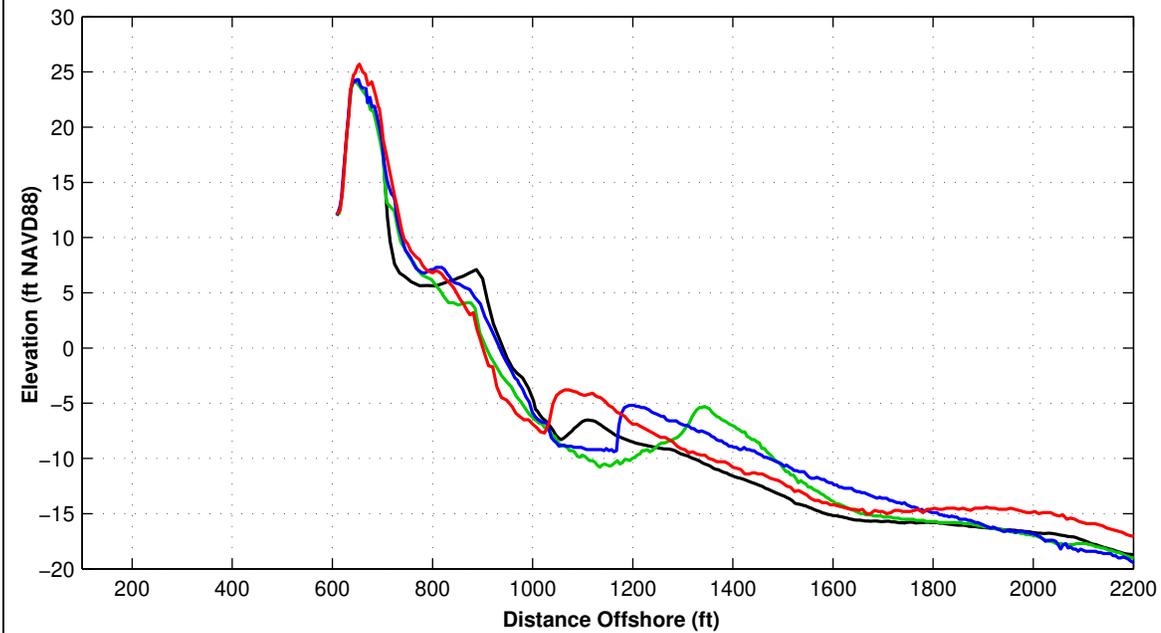
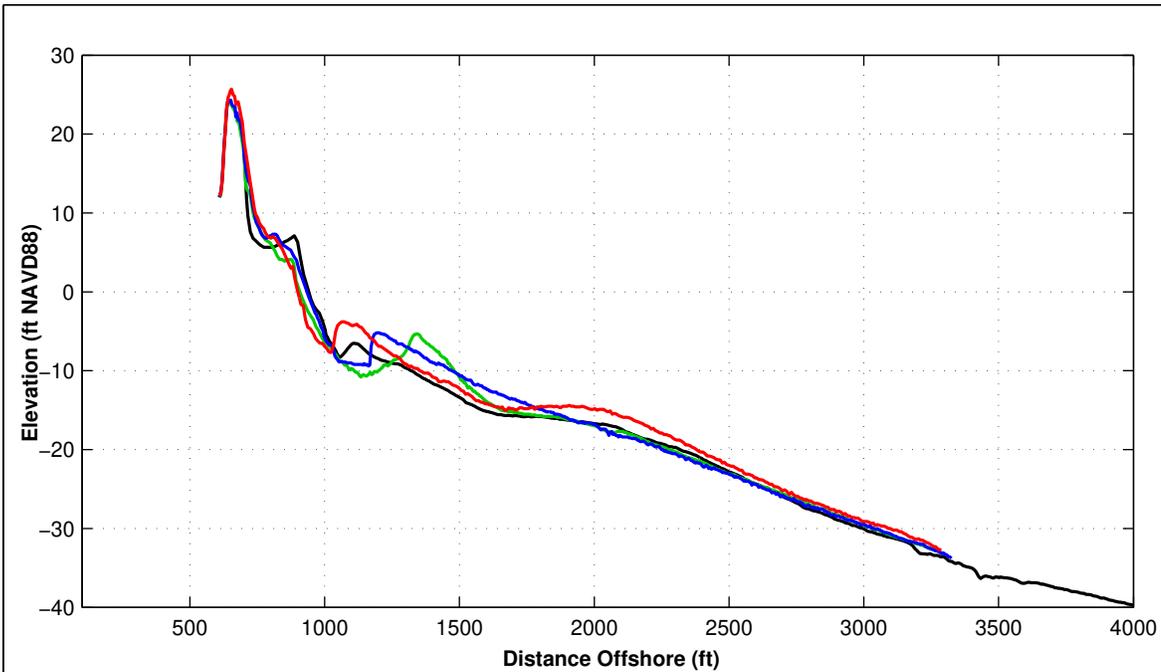
Survey Transect 745+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-3.21 ft	-41.58 ft
Volume Change Above +6 ft NAVD88	4.53 cy/ft	6.87 cy/ft
Volume Change Above 1.18 ft NAVD88	8.72 cy/ft	-0.63 cy/ft
Volume Change Above -6 ft NAVD88	12.02 cy/ft	-14.83 cy/ft
Volume Change Above -14 ft NAVD88	44.36 cy/ft	-28.79 cy/ft
Volume Change Above -19 ft NAVD88	52.20 cy/ft	-3.69 cy/ft
Volume Change Above -30 ft NAVD88	42.97 cy/ft	20.40 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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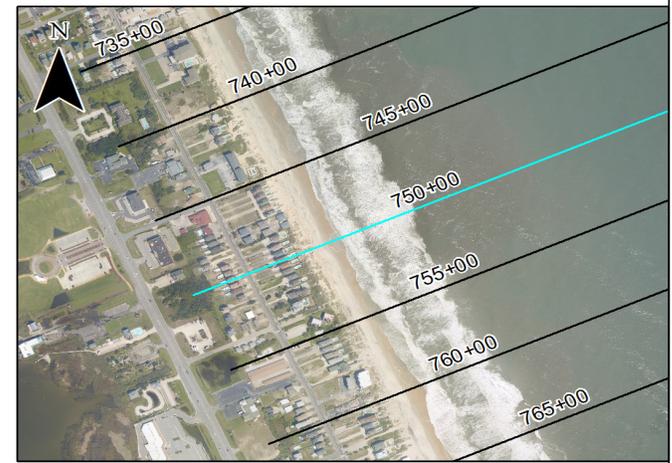


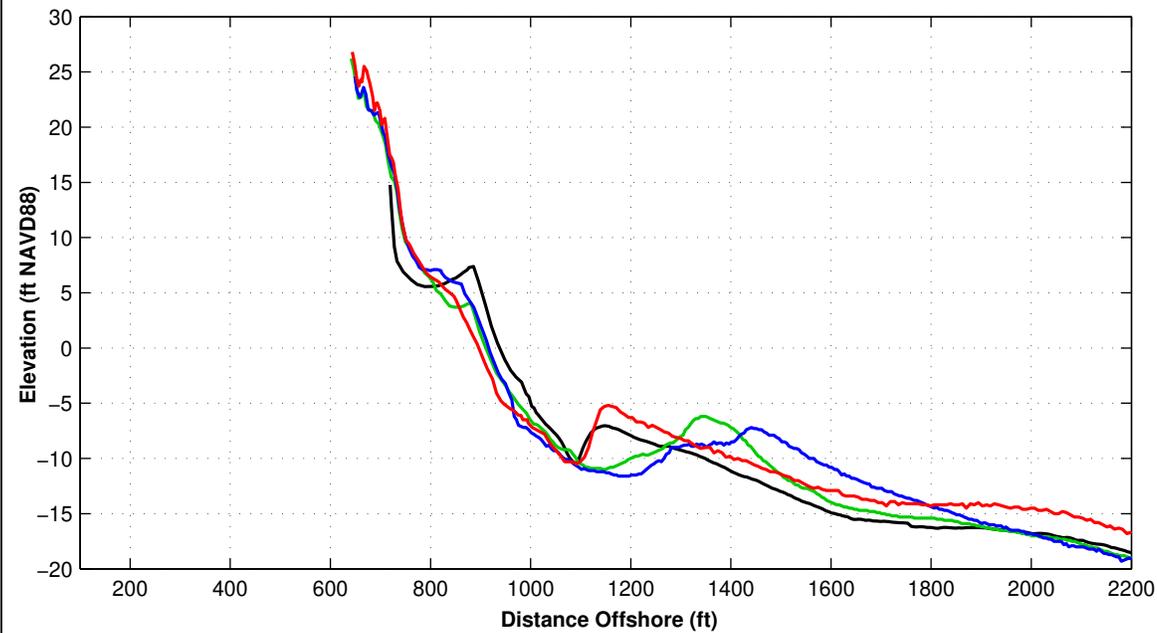
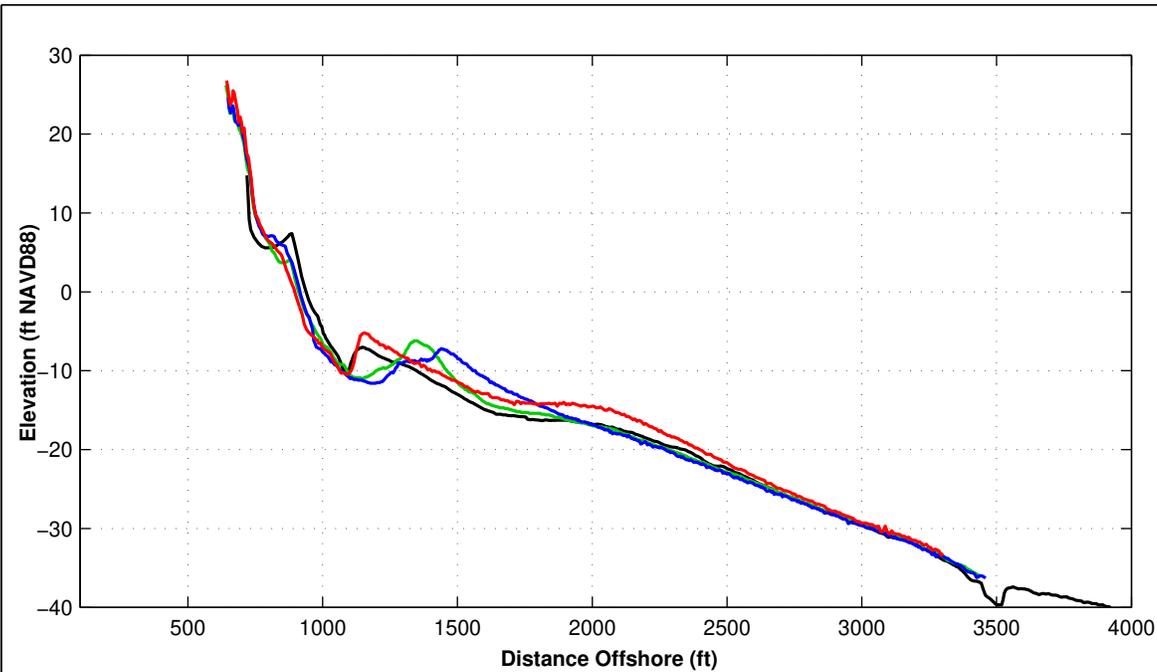


Survey Transect 750+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	26.42 ft	-30.07 ft
Volume Change Above +6 ft NAVD88	4.84 cy/ft	5.40 cy/ft
Volume Change Above 1.18 ft NAVD88	11.00 cy/ft	0.53 cy/ft
Volume Change Above -6 ft NAVD88	17.56 cy/ft	-3.52 cy/ft
Volume Change Above -14 ft NAVD88	34.43 cy/ft	-21.38 cy/ft
Volume Change Above -19 ft NAVD88	41.60 cy/ft	6.84 cy/ft
Volume Change Above -30 ft NAVD88	36.09 cy/ft	37.08 cy/ft

**LEGEND:**  
 JUNE 2022 ———— (red line)  
 JULY 2021 ———— (blue line)  
 JUNE 2020 ———— (green line)  
 AUGUST 2019 ———— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
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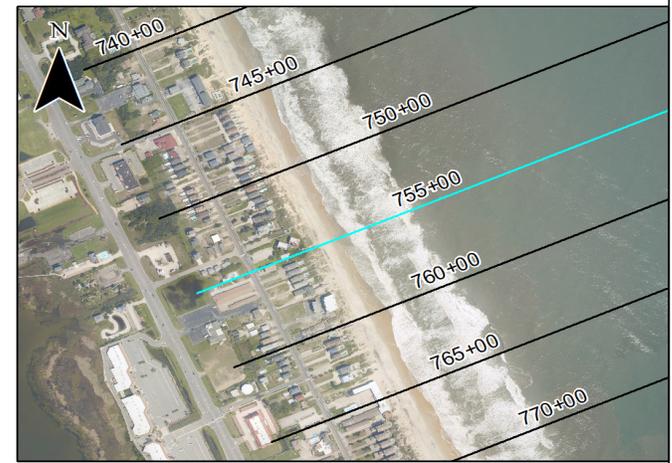


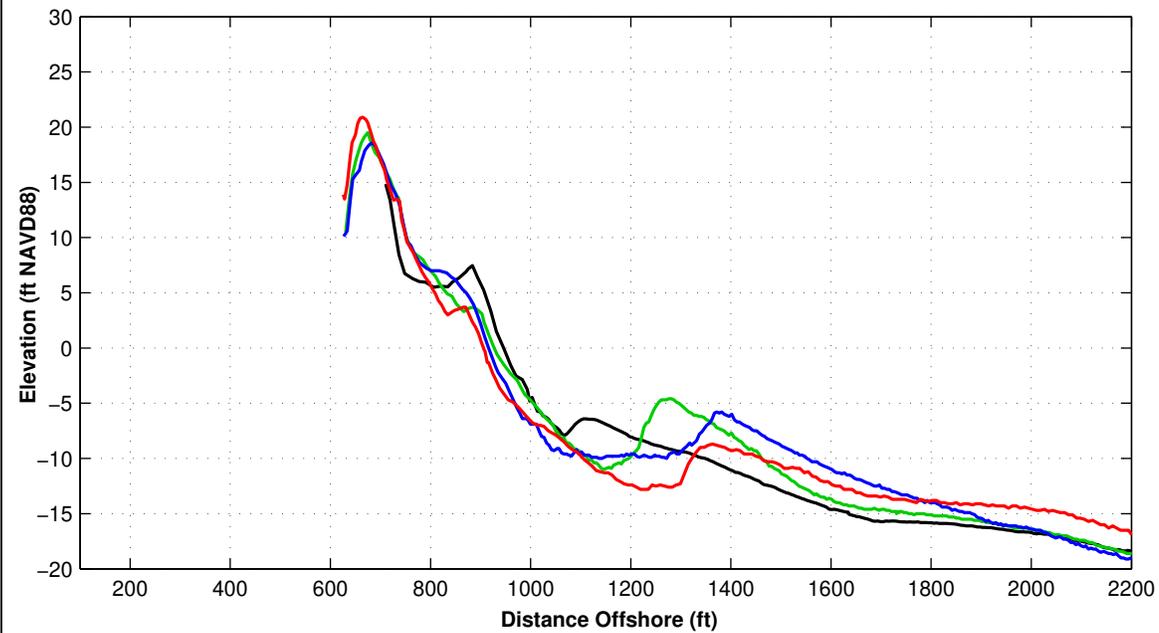
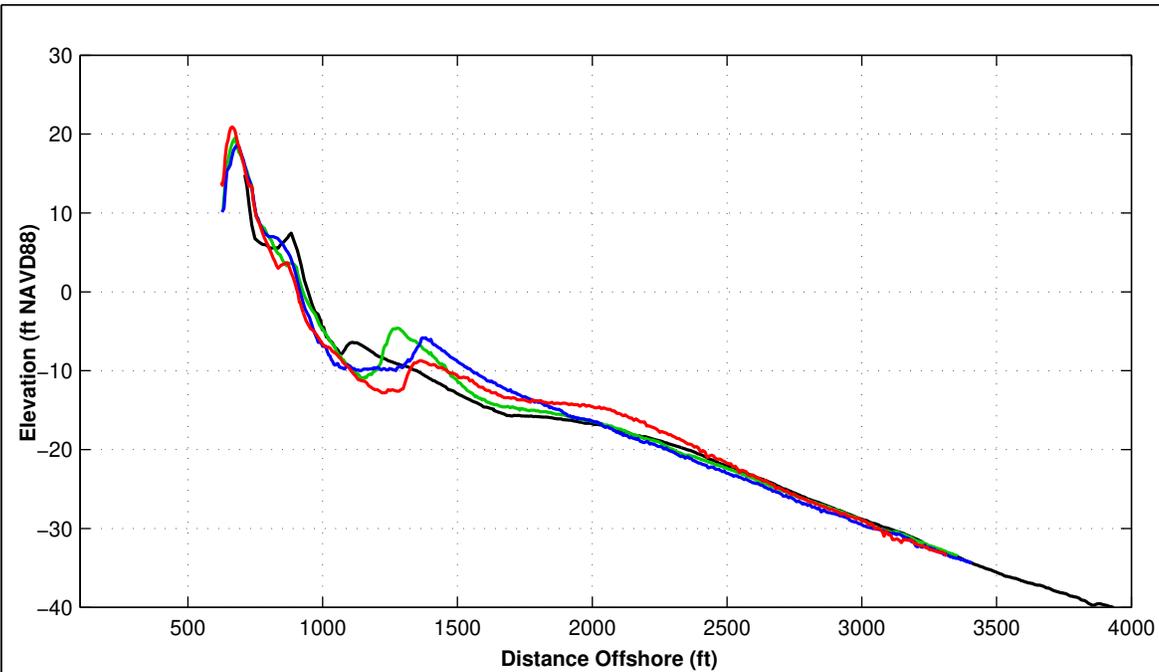
Survey Transect 755+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	6.86 ft	-23.44 ft
Volume Change Above +6 ft NAVD88	2.96 cy/ft	3.24 cy/ft
Volume Change Above 1.18 ft NAVD88	7.52 cy/ft	-1.88 cy/ft
Volume Change Above -6 ft NAVD88	7.37 cy/ft	-5.85 cy/ft
Volume Change Above -14 ft NAVD88	16.48 cy/ft	-5.67 cy/ft
Volume Change Above -19 ft NAVD88	25.15 cy/ft	28.79 cy/ft
Volume Change Above -30 ft NAVD88	17.67 cy/ft	59.94 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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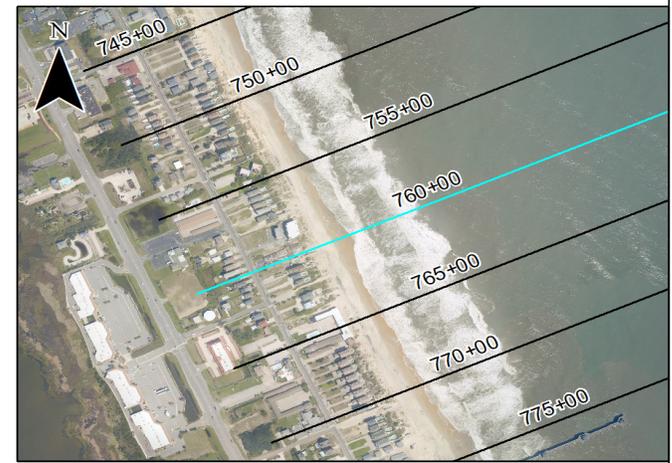


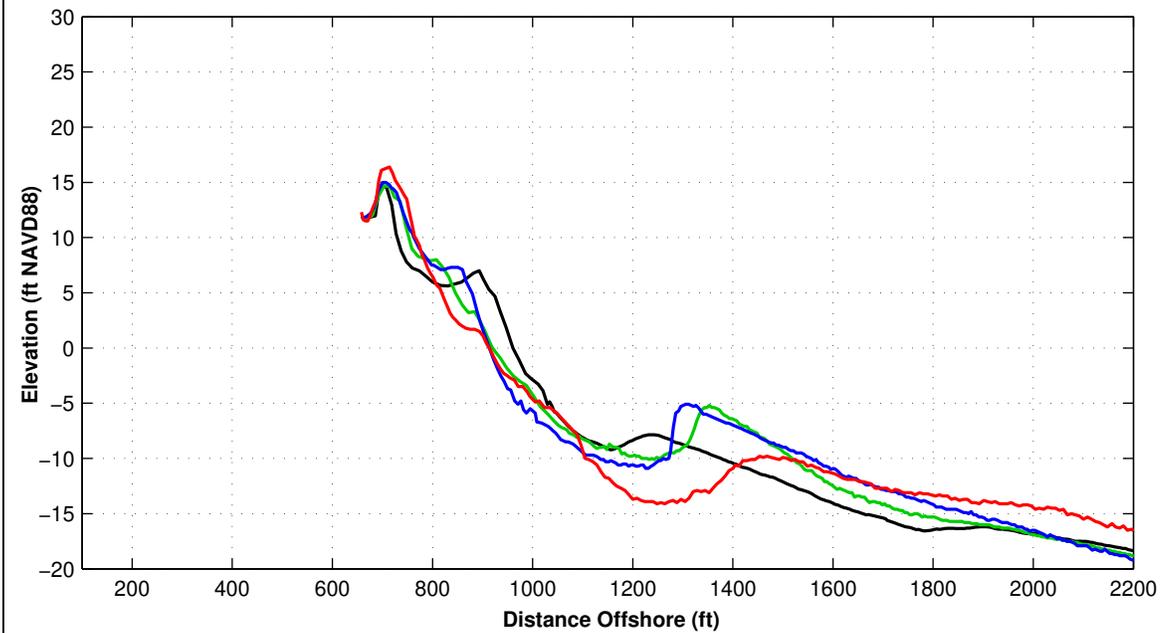
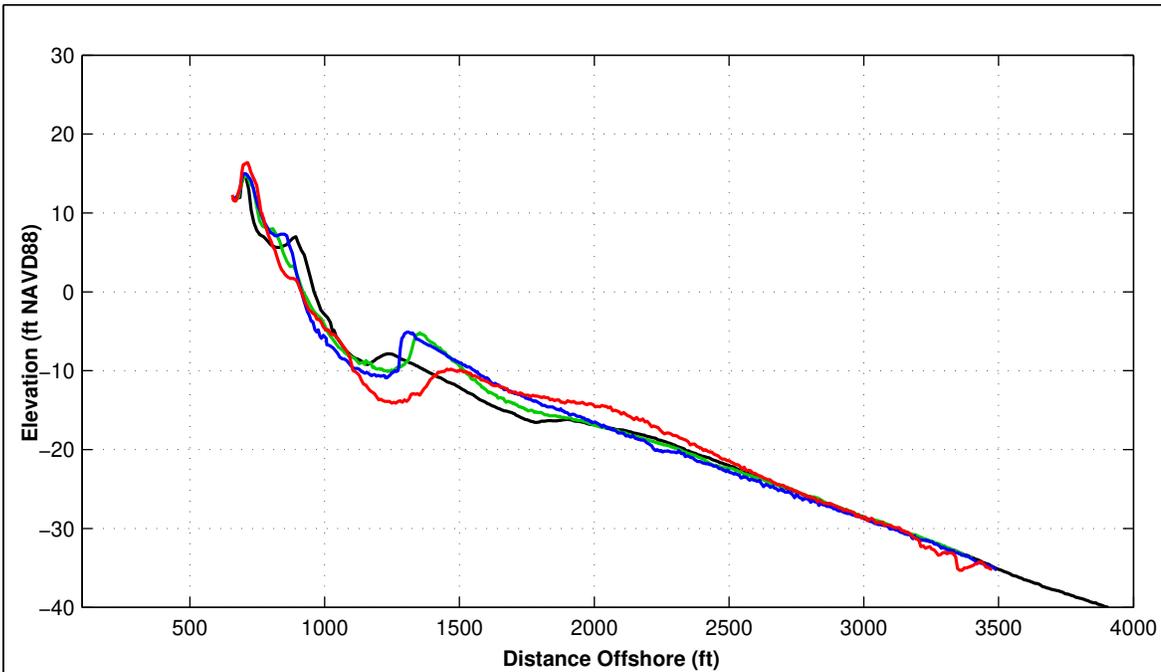
Survey Transect 760+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-9.44 ft	-10.45 ft
Volume Change Above +6 ft NAVD88	-0.70 cy/ft	1.37 cy/ft
Volume Change Above 1.18 ft NAVD88	1.80 cy/ft	-5.77 cy/ft
Volume Change Above -6 ft NAVD88	-6.94 cy/ft	-8.41 cy/ft
Volume Change Above -14 ft NAVD88	5.21 cy/ft	-49.03 cy/ft
Volume Change Above -19 ft NAVD88	9.95 cy/ft	-17.75 cy/ft
Volume Change Above -30 ft NAVD88	-5.77 cy/ft	9.31 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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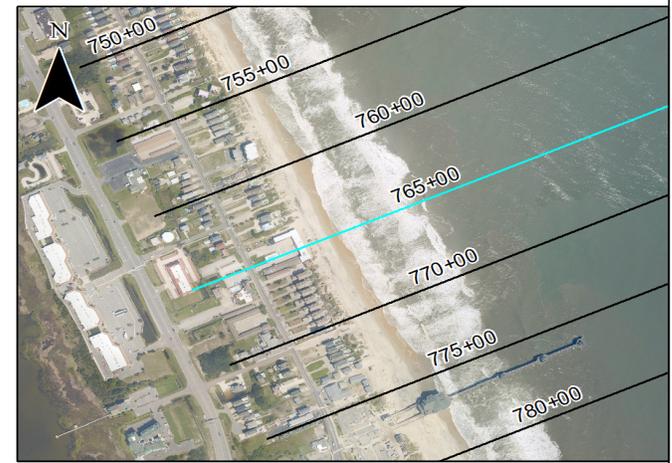


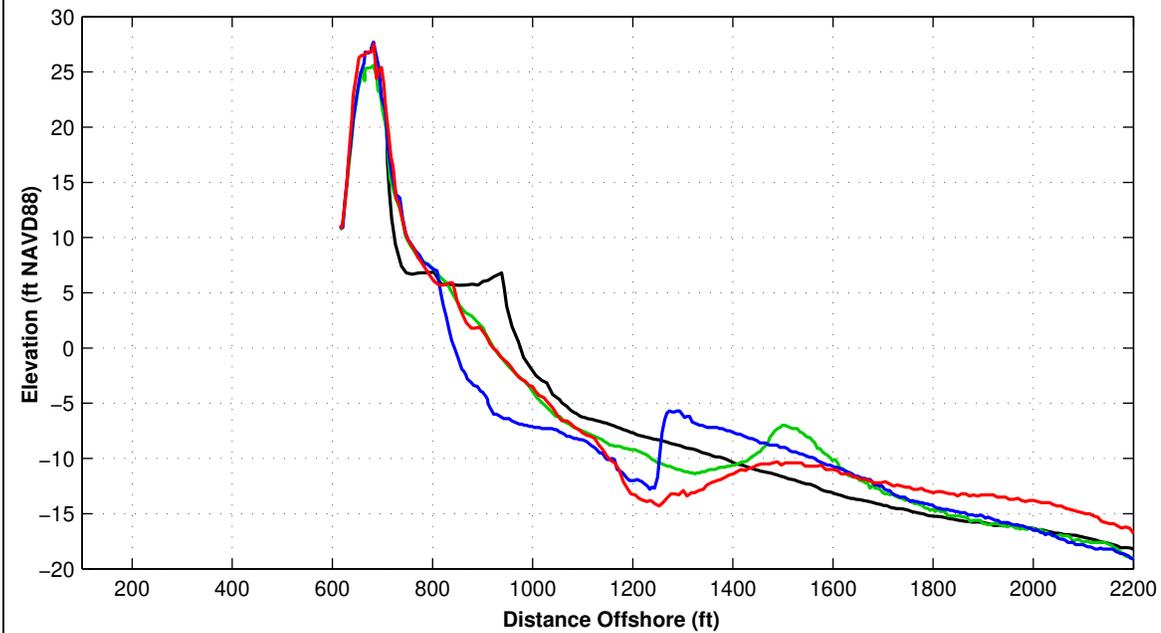
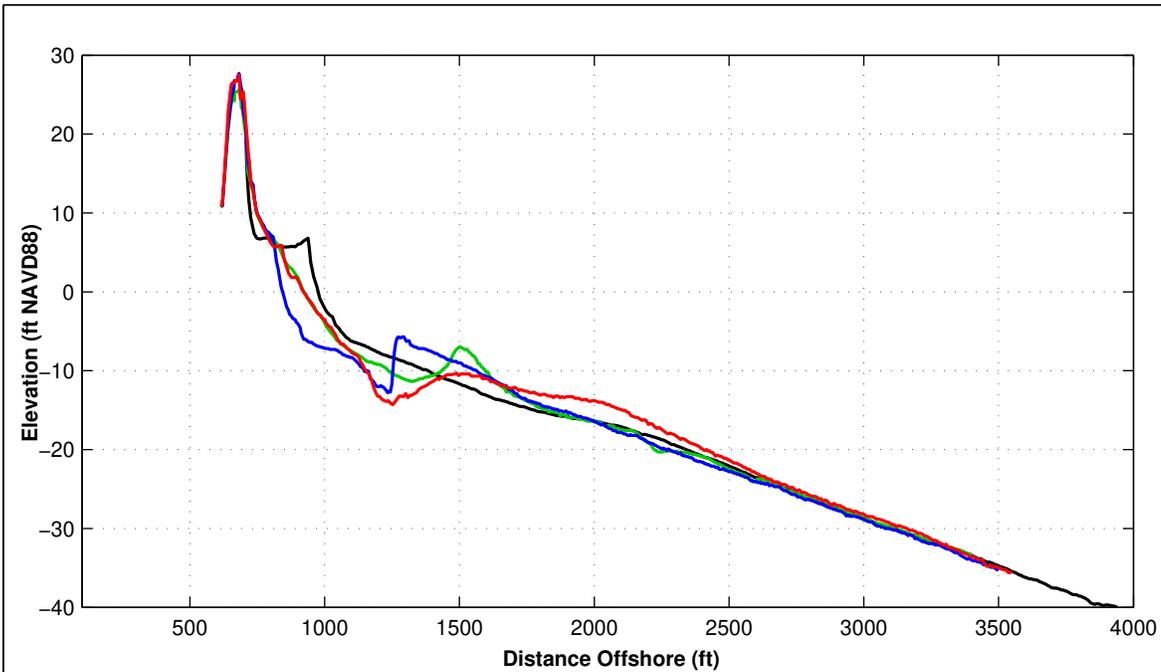
Survey Transect 765+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-3.72 ft	-4.64 ft
Volume Change Above +6 ft NAVD88	2.72 cy/ft	-0.45 cy/ft
Volume Change Above 1.18 ft NAVD88	5.62 cy/ft	-9.27 cy/ft
Volume Change Above -6 ft NAVD88	-0.30 cy/ft	-5.87 cy/ft
Volume Change Above -14 ft NAVD88	5.32 cy/ft	-54.56 cy/ft
Volume Change Above -19 ft NAVD88	13.17 cy/ft	-20.43 cy/ft
Volume Change Above -30 ft NAVD88	-1.68 cy/ft	7.36 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
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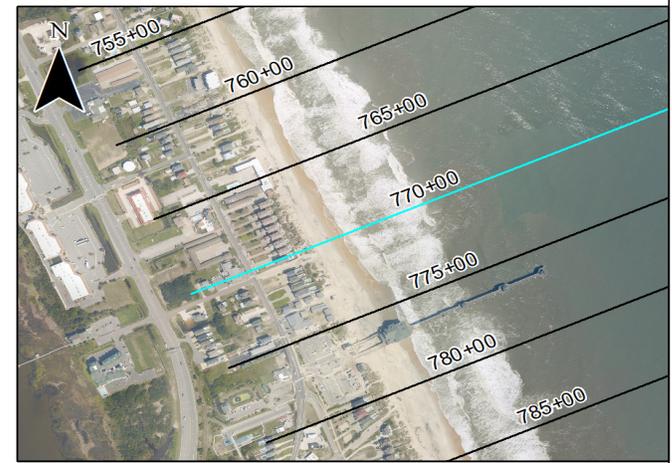


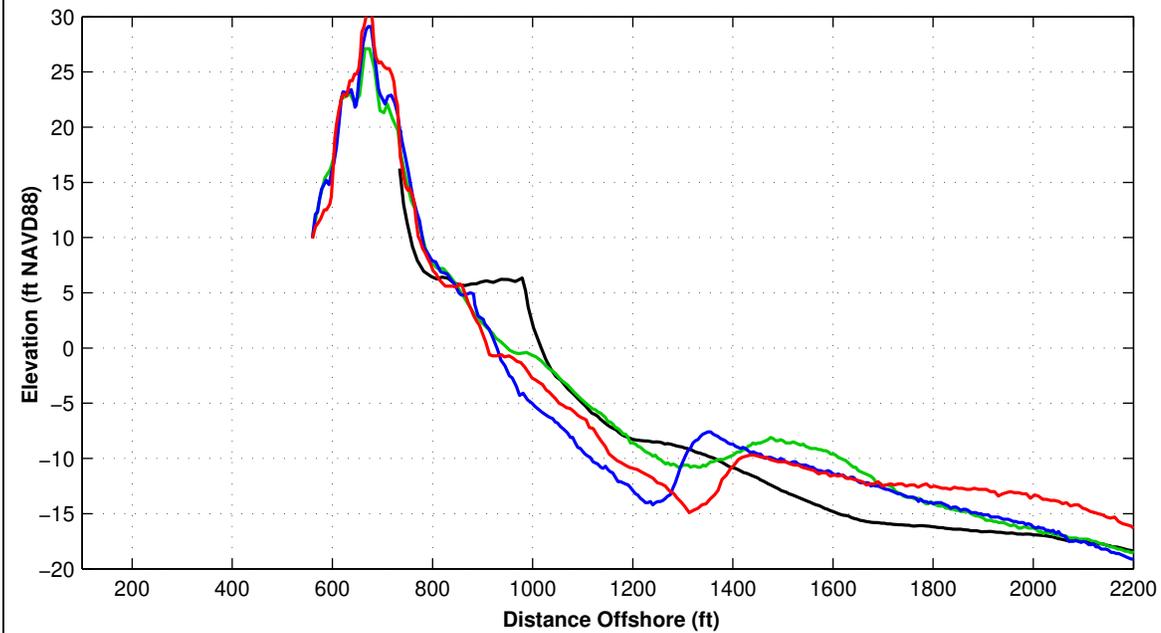
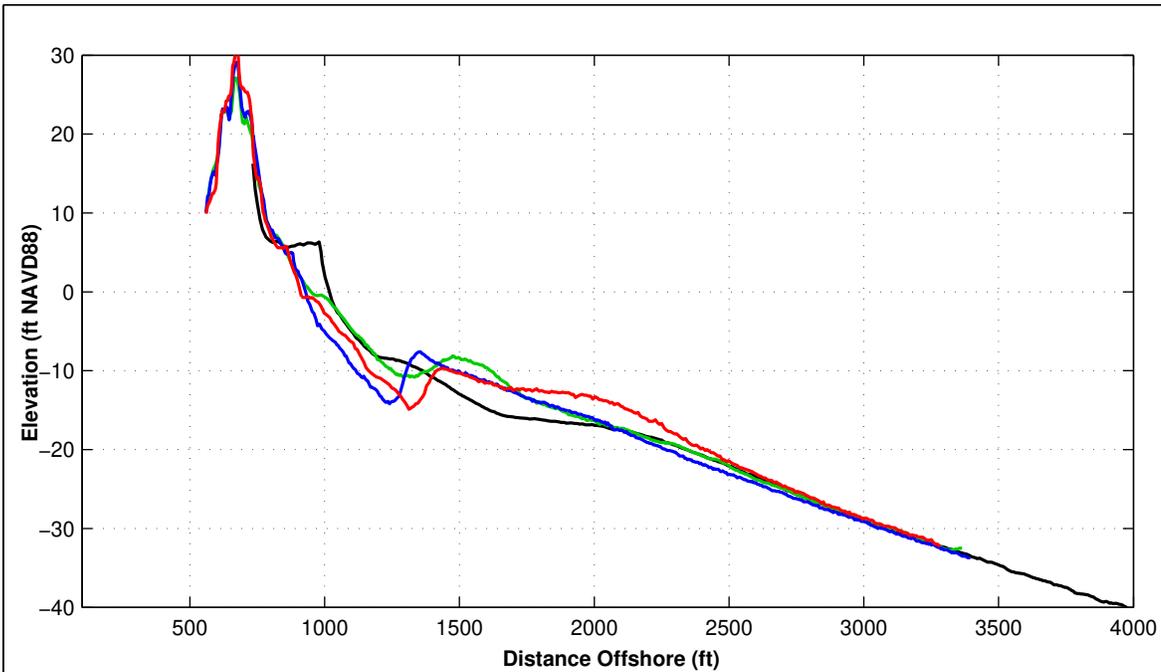
Survey Transect 770+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-72.08 ft	69.98 ft
Volume Change Above +6 ft NAVD88	2.54 cy/ft	-0.13 cy/ft
Volume Change Above 1.18 ft NAVD88	-4.76 cy/ft	6.14 cy/ft
Volume Change Above -6 ft NAVD88	-30.13 cy/ft	32.49 cy/ft
Volume Change Above -14 ft NAVD88	-26.50 cy/ft	-0.04 cy/ft
Volume Change Above -19 ft NAVD88	-25.57 cy/ft	36.37 cy/ft
Volume Change Above -30 ft NAVD88	-34.23 cy/ft	69.84 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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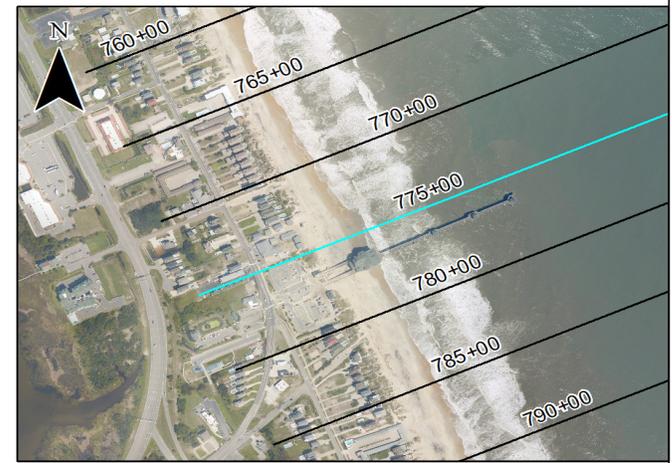


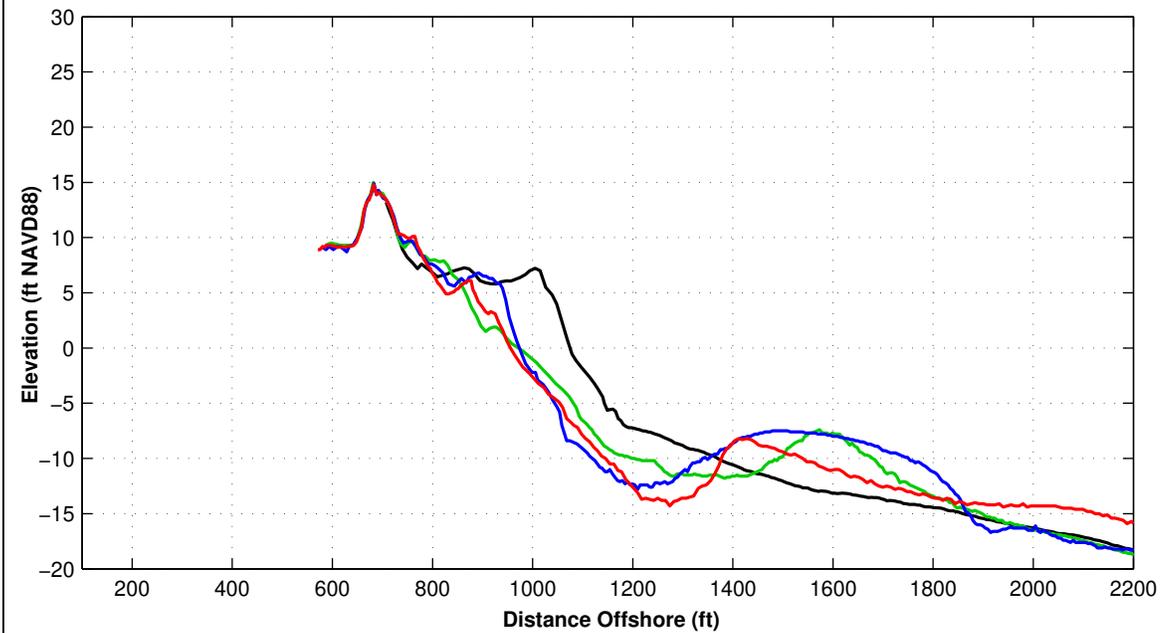
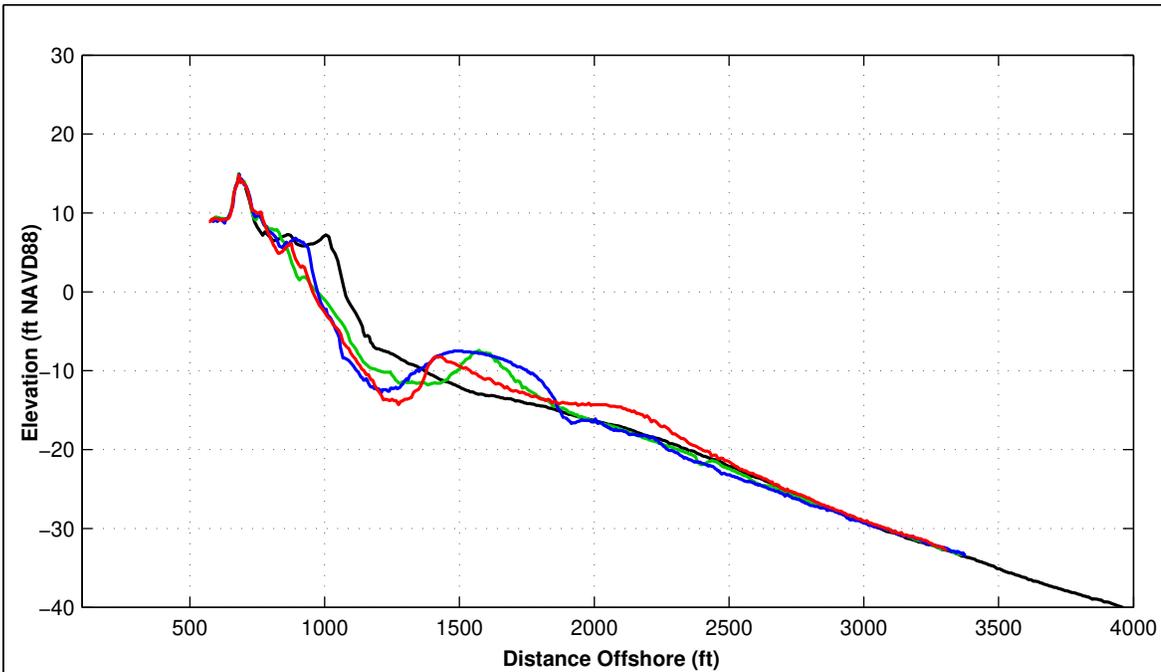
Survey Transect 775+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-4.51 ft	-17.03 ft
Volume Change Above +6 ft NAVD88	4.60 cy/ft	0.18 cy/ft
Volume Change Above 1.18 ft NAVD88	5.59 cy/ft	-1.62 cy/ft
Volume Change Above -6 ft NAVD88	-15.27 cy/ft	6.70 cy/ft
Volume Change Above -14 ft NAVD88	-54.18 cy/ft	14.78 cy/ft
Volume Change Above -19 ft NAVD88	-53.67 cy/ft	51.29 cy/ft
Volume Change Above -30 ft NAVD88	-75.31 cy/ft	86.49 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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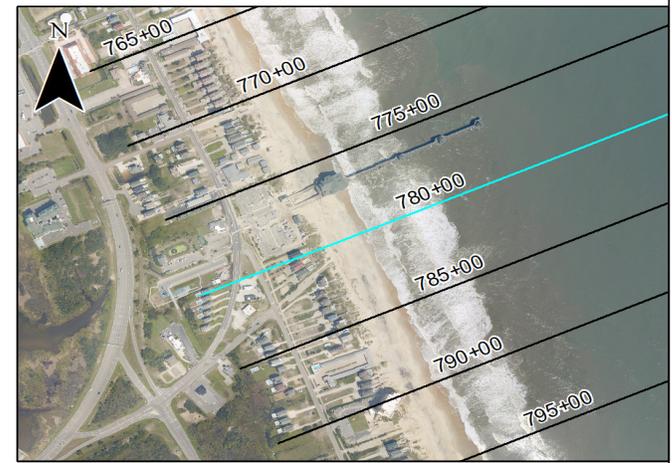


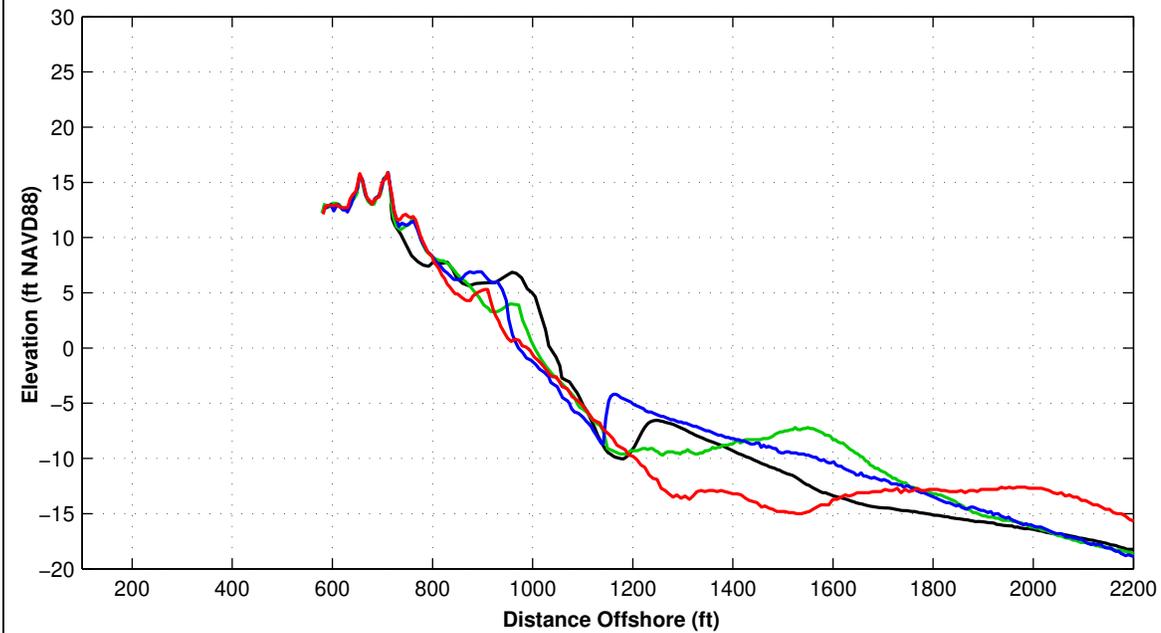
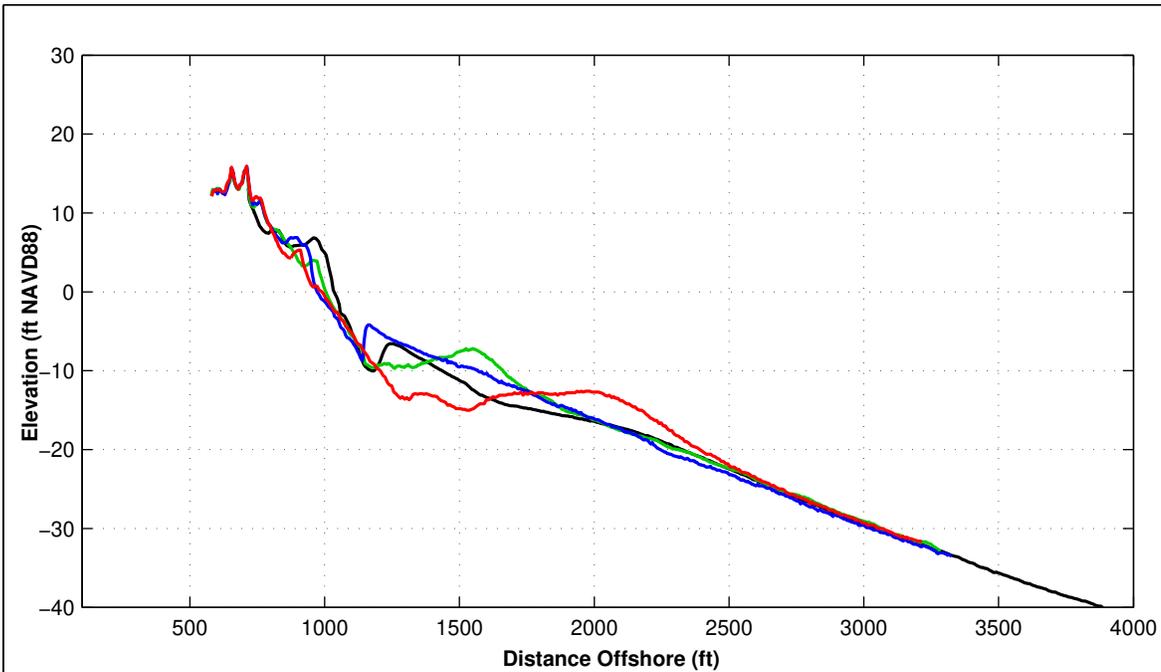


Survey Transect 780+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	21.51 ft	-20.72 ft
Volume Change Above +6 ft NAVD88	-0.26 cy/ft	-1.69 cy/ft
Volume Change Above 1.18 ft NAVD88	11.18 cy/ft	-10.24 cy/ft
Volume Change Above -6 ft NAVD88	5.82 cy/ft	-12.03 cy/ft
Volume Change Above -14 ft NAVD88	20.94 cy/ft	-56.55 cy/ft
Volume Change Above -19 ft NAVD88	17.84 cy/ft	-18.64 cy/ft
Volume Change Above -30 ft NAVD88	7.05 cy/ft	10.69 cy/ft

**LEGEND:**  
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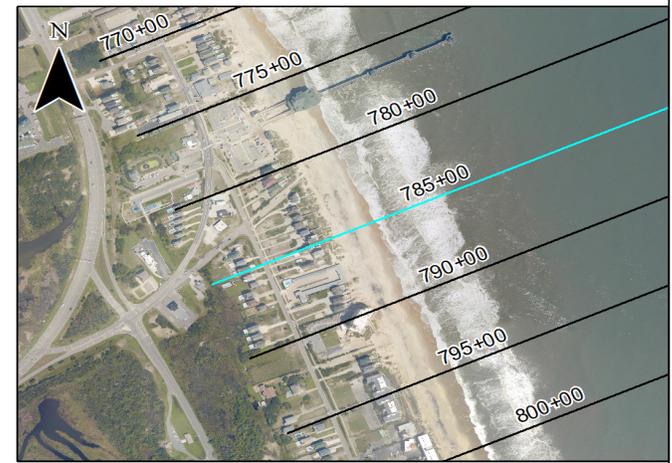


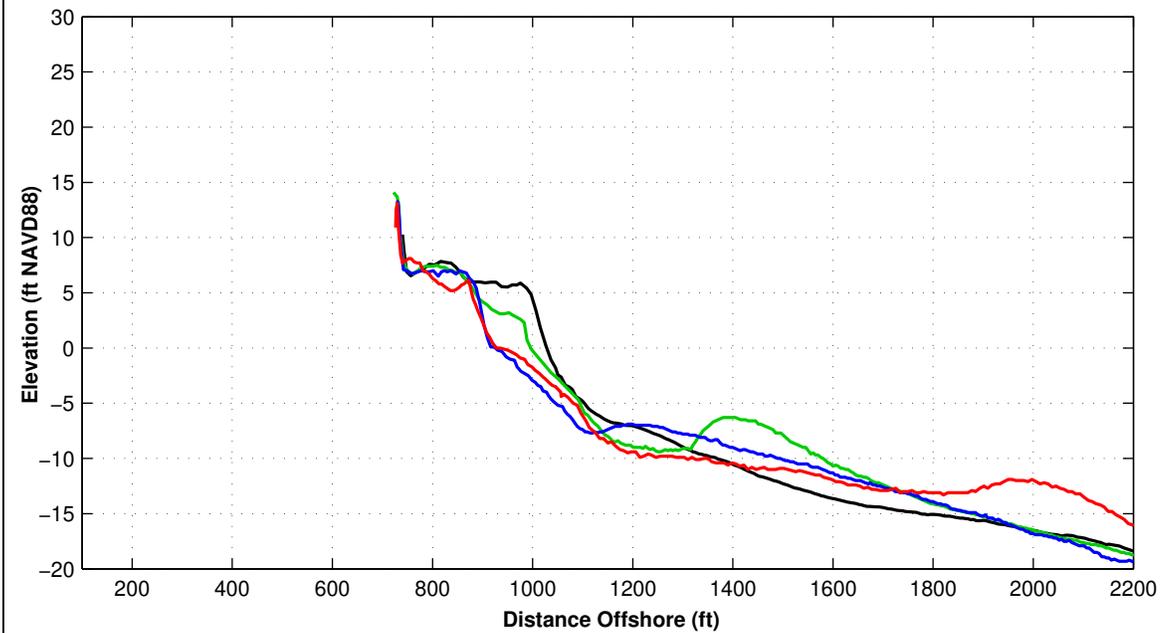
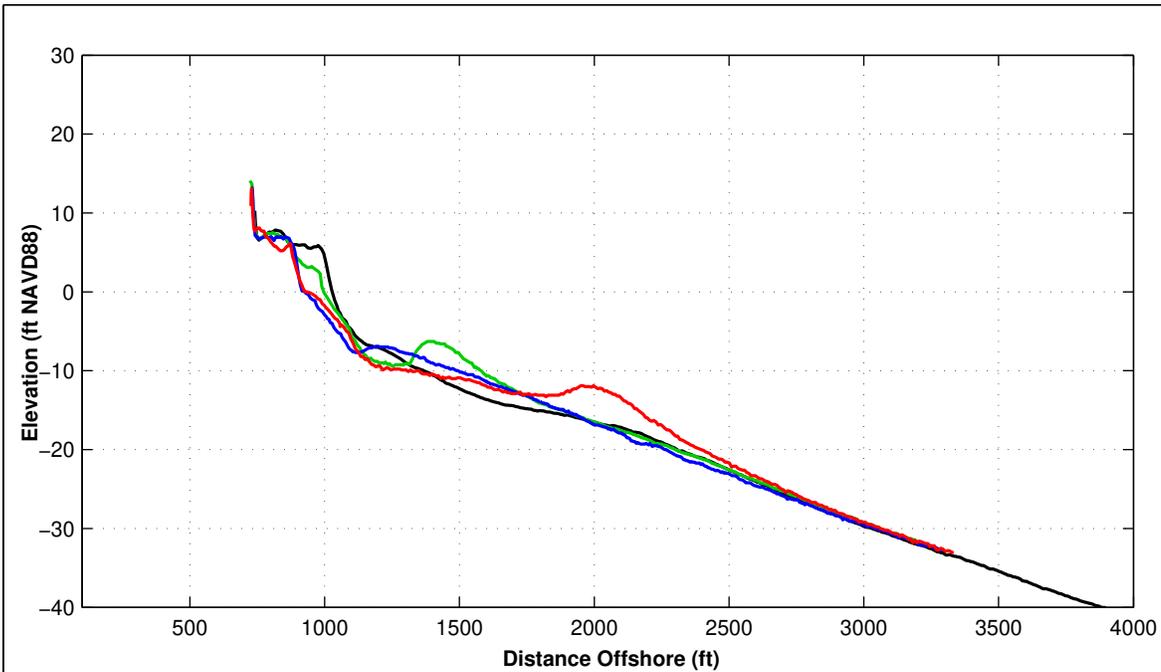
Survey Transect 785+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-32.57 ft	-13.66 ft
Volume Change Above +6 ft NAVD88	0.98 cy/ft	-1.09 cy/ft
Volume Change Above 1.18 ft NAVD88	3.10 cy/ft	-8.79 cy/ft
Volume Change Above -6 ft NAVD88	0.72 cy/ft	-8.40 cy/ft
Volume Change Above -14 ft NAVD88	5.45 cy/ft	-84.82 cy/ft
Volume Change Above -19 ft NAVD88	6.47 cy/ft	-49.90 cy/ft
Volume Change Above -30 ft NAVD88	-15.07 cy/ft	-20.91 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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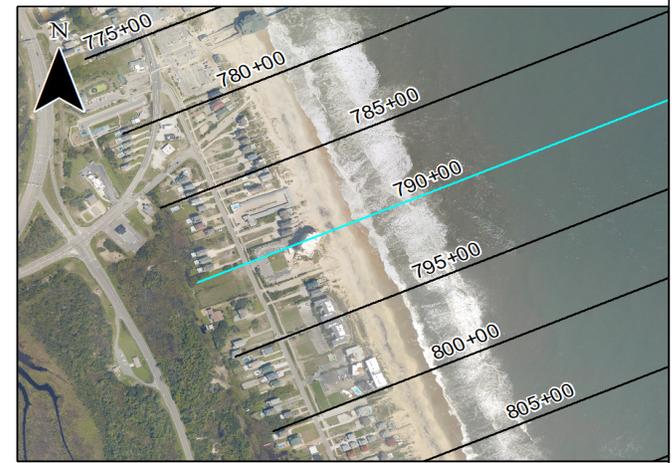


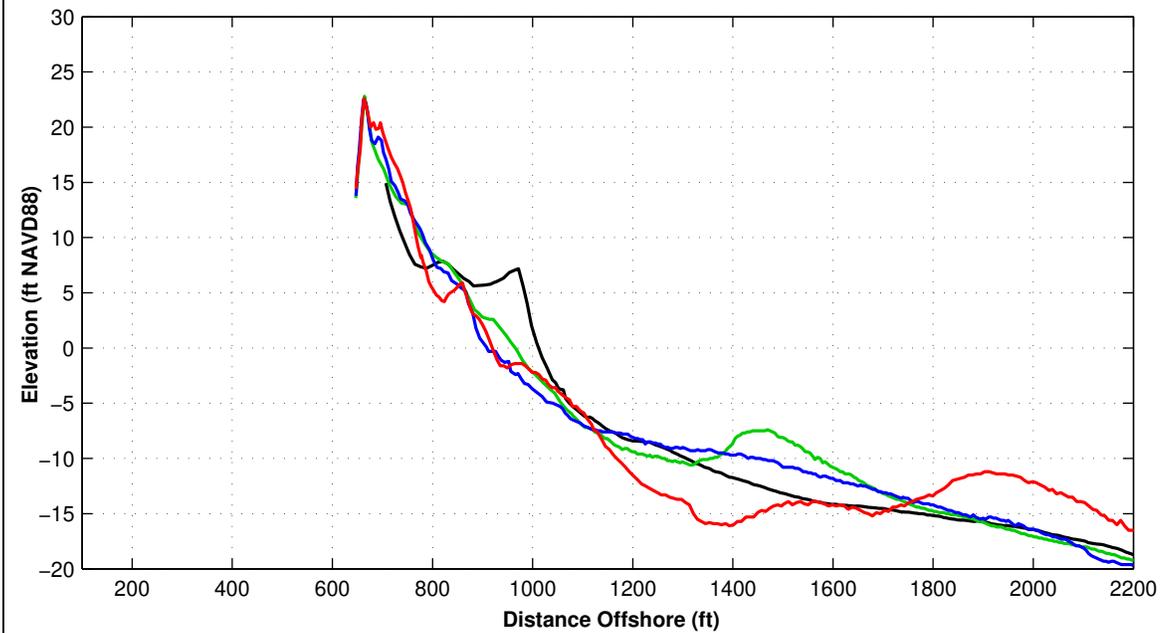
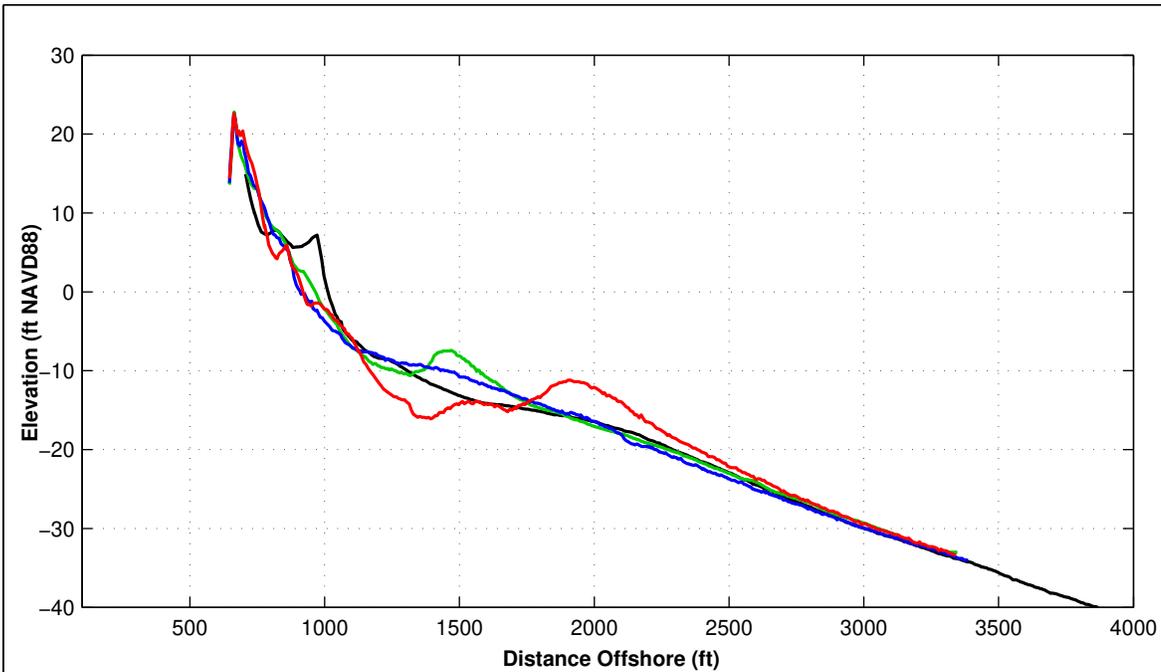
Survey Transect 790+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-79.37 ft	3.16 ft
Volume Change Above +6 ft NAVD88	-1.01 cy/ft	-1.18 cy/ft
Volume Change Above 1.18 ft NAVD88	-6.94 cy/ft	-3.29 cy/ft
Volume Change Above -6 ft NAVD88	-22.09 cy/ft	3.26 cy/ft
Volume Change Above -14 ft NAVD88	-34.34 cy/ft	-8.61 cy/ft
Volume Change Above -19 ft NAVD88	-37.52 cy/ft	35.71 cy/ft
Volume Change Above -30 ft NAVD88	-54.71 cy/ft	67.53 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
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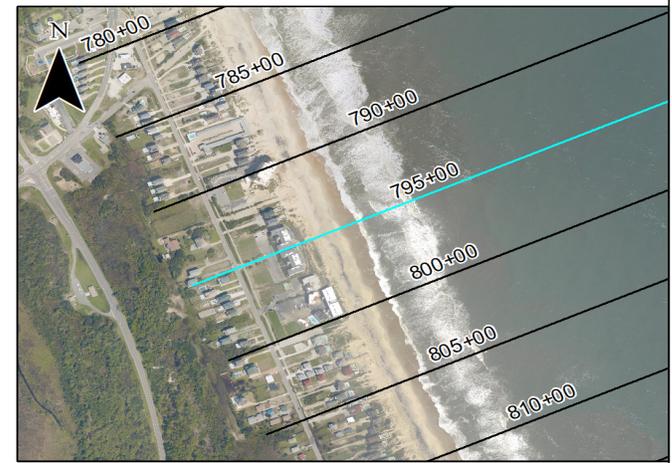


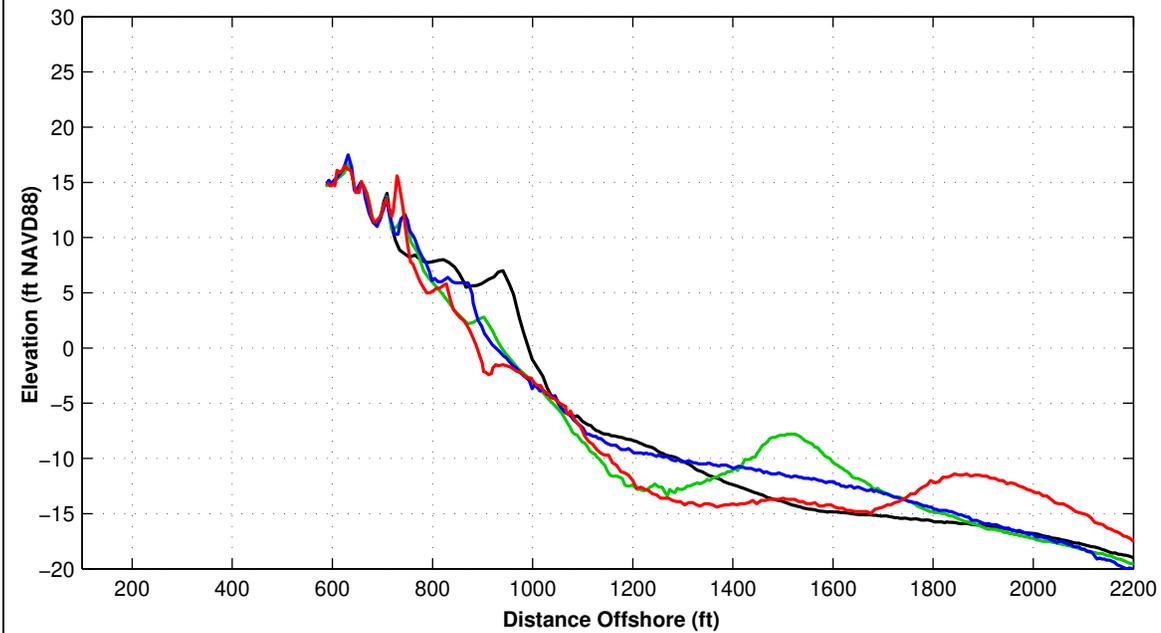
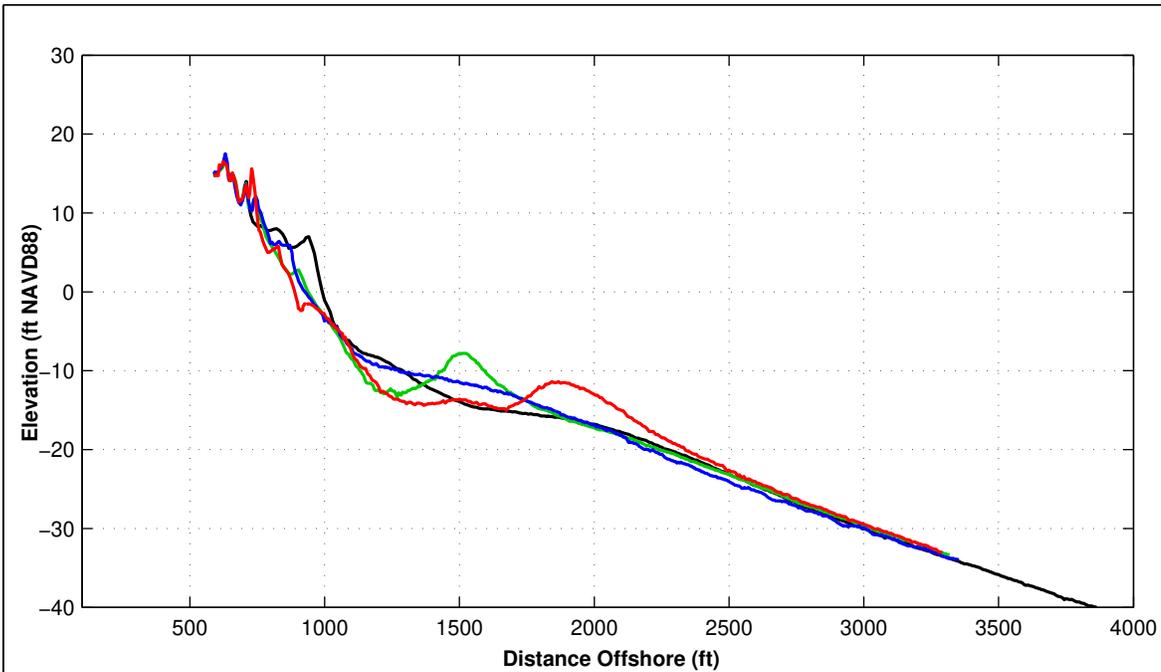
Survey Transect 795+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-54.25 ft	17.34 ft
Volume Change Above +6 ft NAVD88	1.62 cy/ft	-0.27 cy/ft
Volume Change Above 1.18 ft NAVD88	-1.83 cy/ft	-1.45 cy/ft
Volume Change Above -6 ft NAVD88	-11.48 cy/ft	5.64 cy/ft
Volume Change Above -14 ft NAVD88	-18.85 cy/ft	-43.02 cy/ft
Volume Change Above -19 ft NAVD88	-14.61 cy/ft	-15.20 cy/ft
Volume Change Above -30 ft NAVD88	-35.71 cy/ft	25.16 cy/ft

**LEGEND:**

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JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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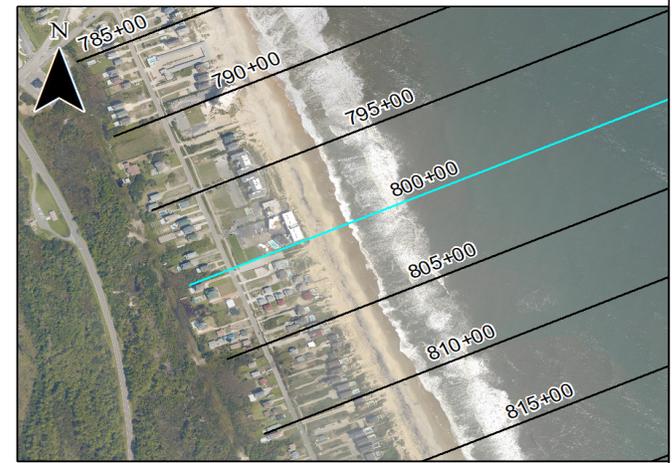


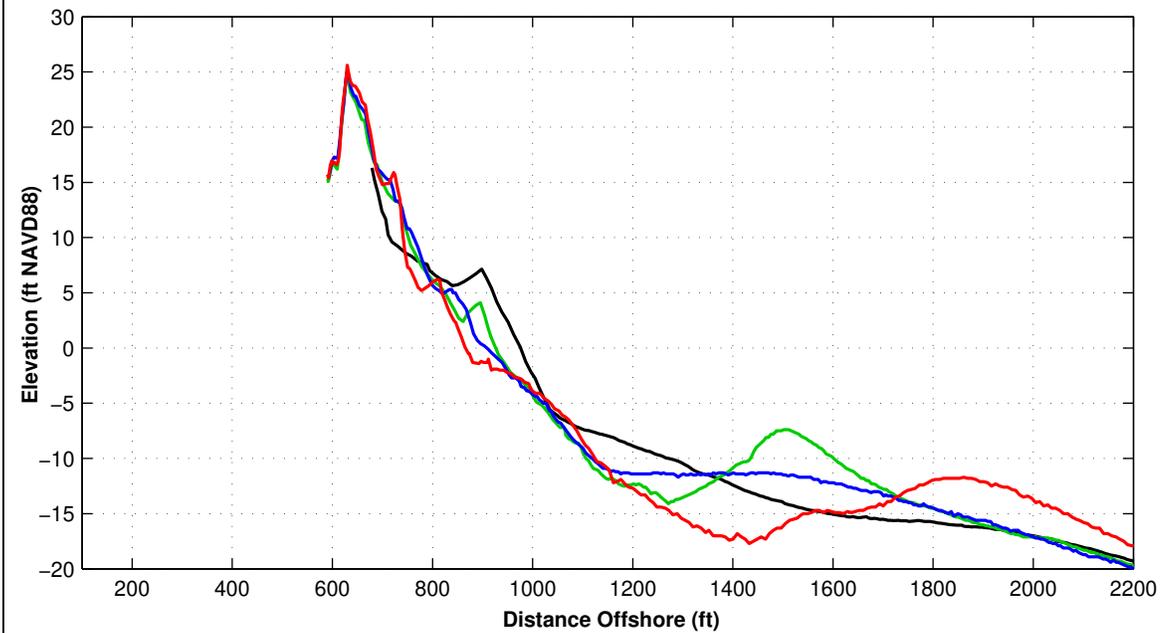
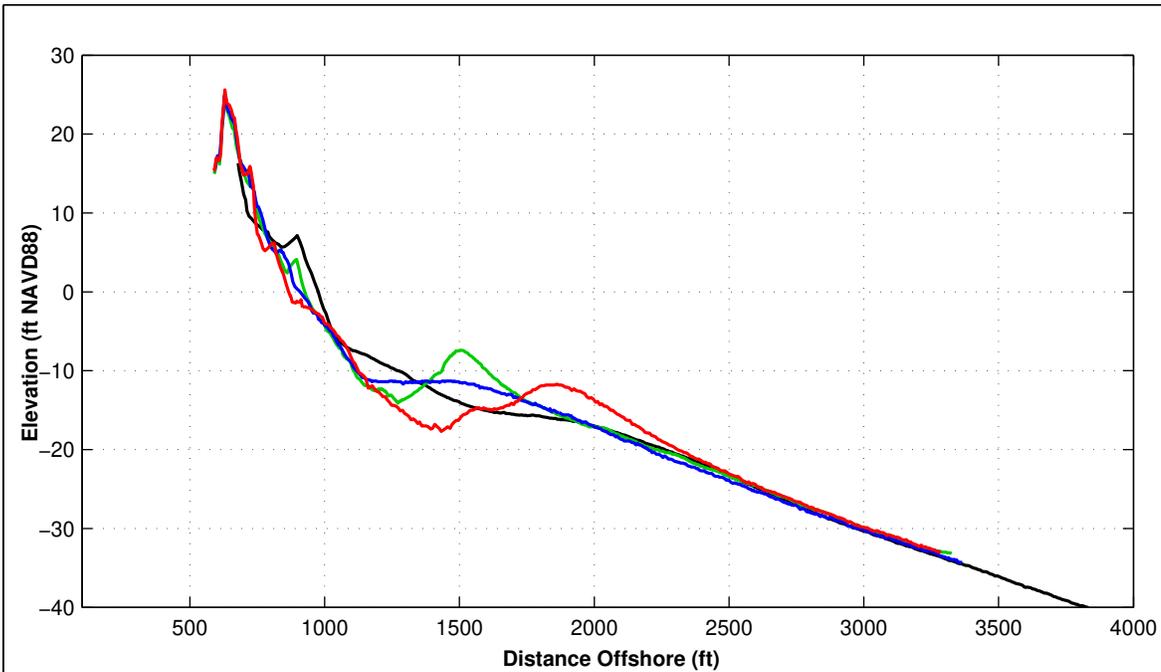
Survey Transect 800+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-17.76 ft	-27.49 ft
Volume Change Above +6 ft NAVD88	1.05 cy/ft	-1.26 cy/ft
Volume Change Above 1.18 ft NAVD88	6.73 cy/ft	-9.22 cy/ft
Volume Change Above -6 ft NAVD88	6.09 cy/ft	-13.49 cy/ft
Volume Change Above -14 ft NAVD88	10.86 cy/ft	-49.35 cy/ft
Volume Change Above -19 ft NAVD88	14.30 cy/ft	-15.94 cy/ft
Volume Change Above -30 ft NAVD88	-7.81 cy/ft	23.67 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
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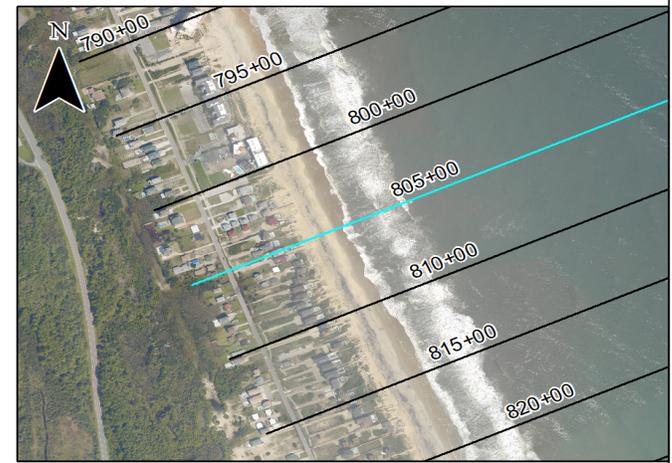


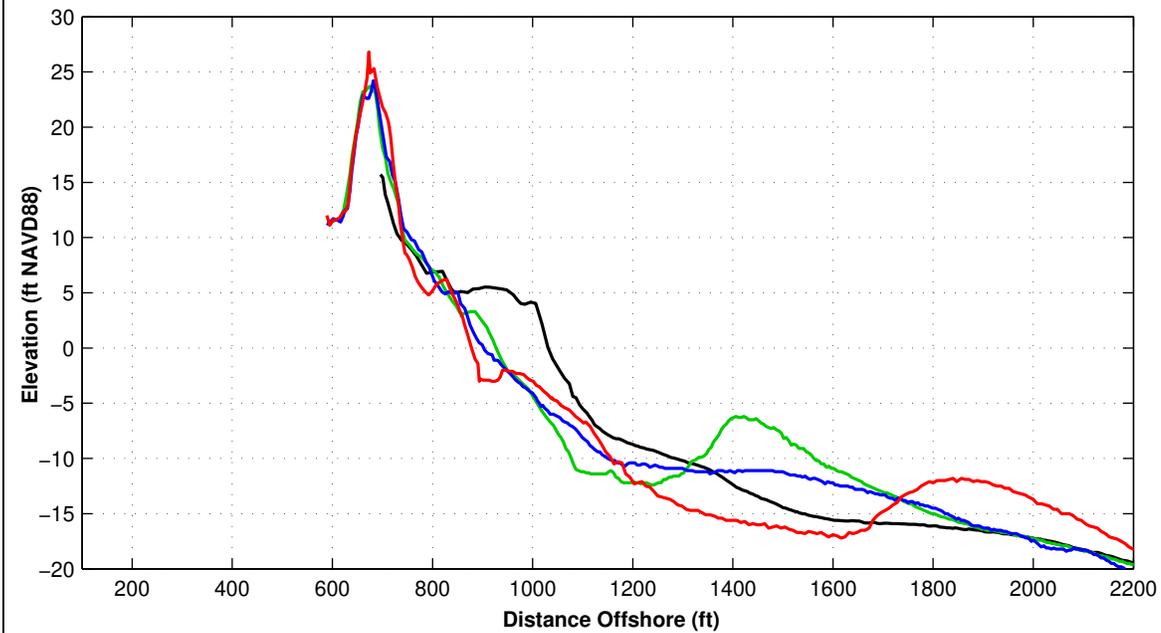
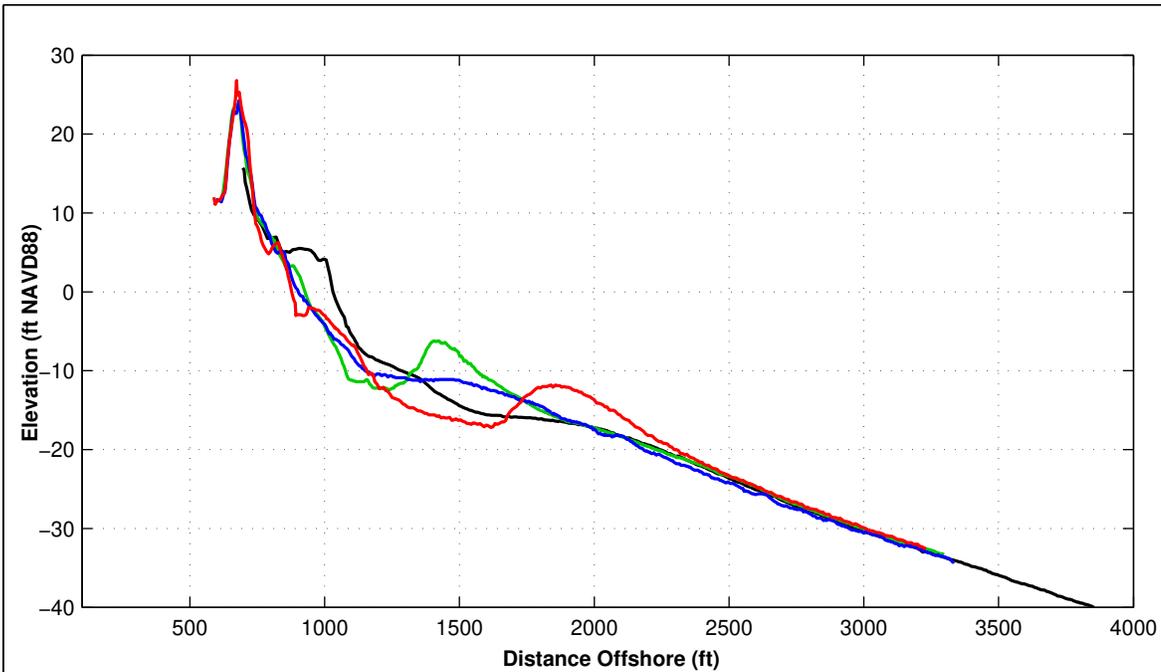
Survey Transect 805+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-32.28 ft	-27.45 ft
Volume Change Above +6 ft NAVD88	3.42 cy/ft	-3.92 cy/ft
Volume Change Above 1.18 ft NAVD88	2.04 cy/ft	-8.53 cy/ft
Volume Change Above -6 ft NAVD88	0.30 cy/ft	-11.37 cy/ft
Volume Change Above -14 ft NAVD88	-12.41 cy/ft	-35.47 cy/ft
Volume Change Above -19 ft NAVD88	-12.37 cy/ft	-30.60 cy/ft
Volume Change Above -30 ft NAVD88	-28.77 cy/ft	-3.32 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

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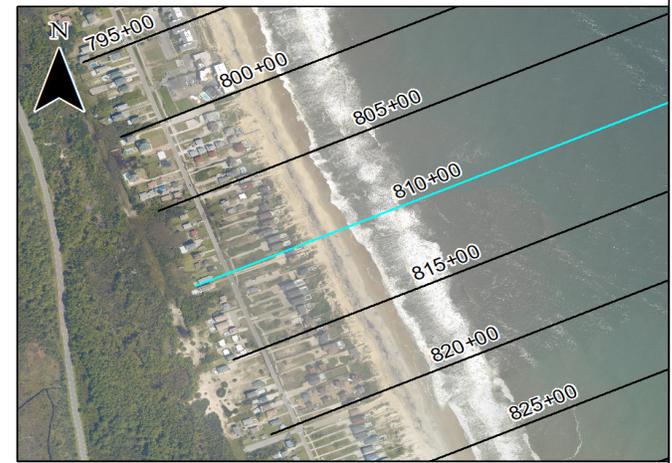


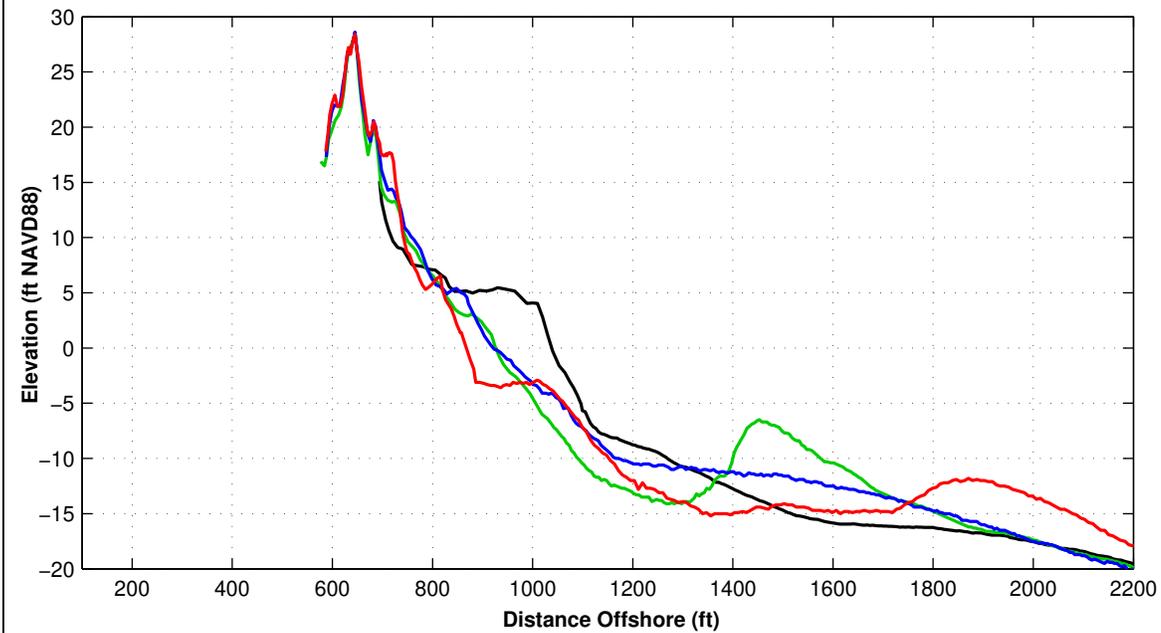
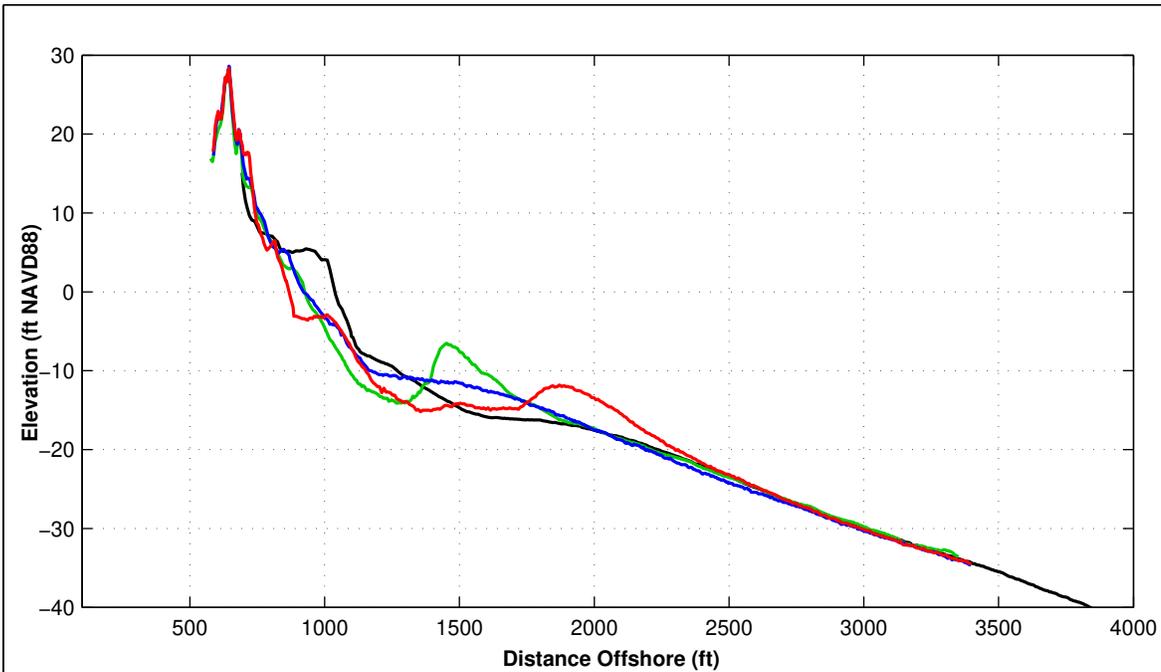
Survey Transect 810+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-31.19 ft	-14.07 ft
Volume Change Above +6 ft NAVD88	1.83 cy/ft	-0.41 cy/ft
Volume Change Above 1.18 ft NAVD88	0.41 cy/ft	-2.17 cy/ft
Volume Change Above -6 ft NAVD88	-1.61 cy/ft	-2.75 cy/ft
Volume Change Above -14 ft NAVD88	-20.15 cy/ft	-27.84 cy/ft
Volume Change Above -19 ft NAVD88	-19.40 cy/ft	-22.41 cy/ft
Volume Change Above -30 ft NAVD88	-40.97 cy/ft	8.94 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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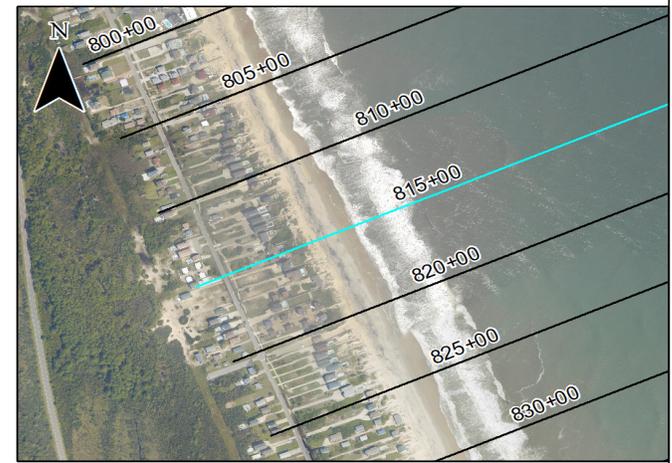


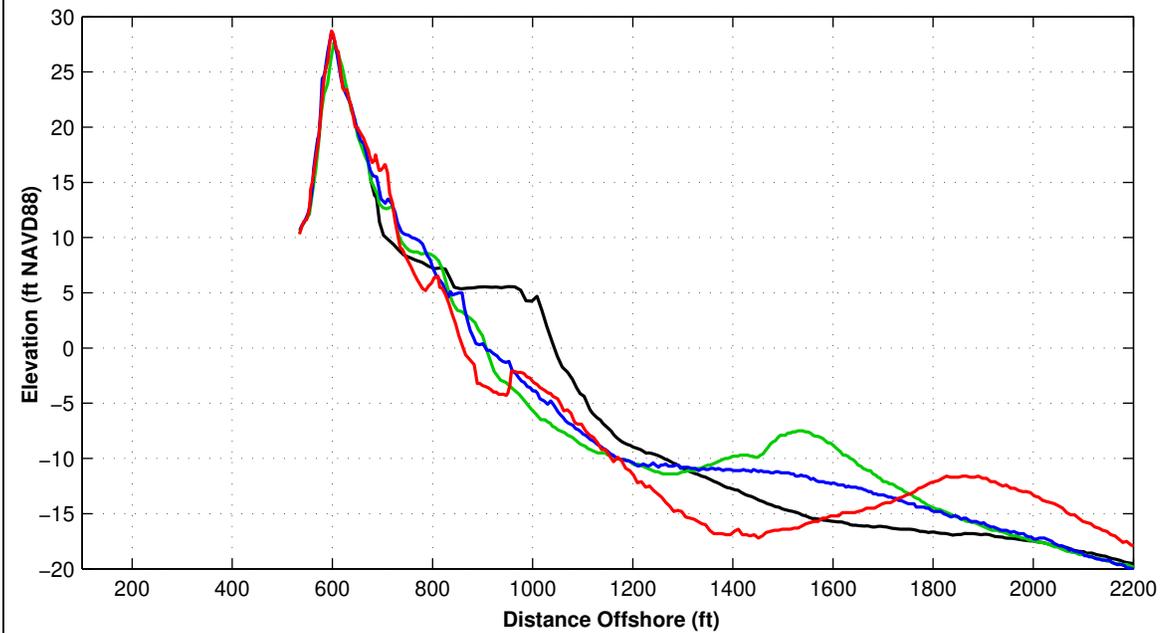
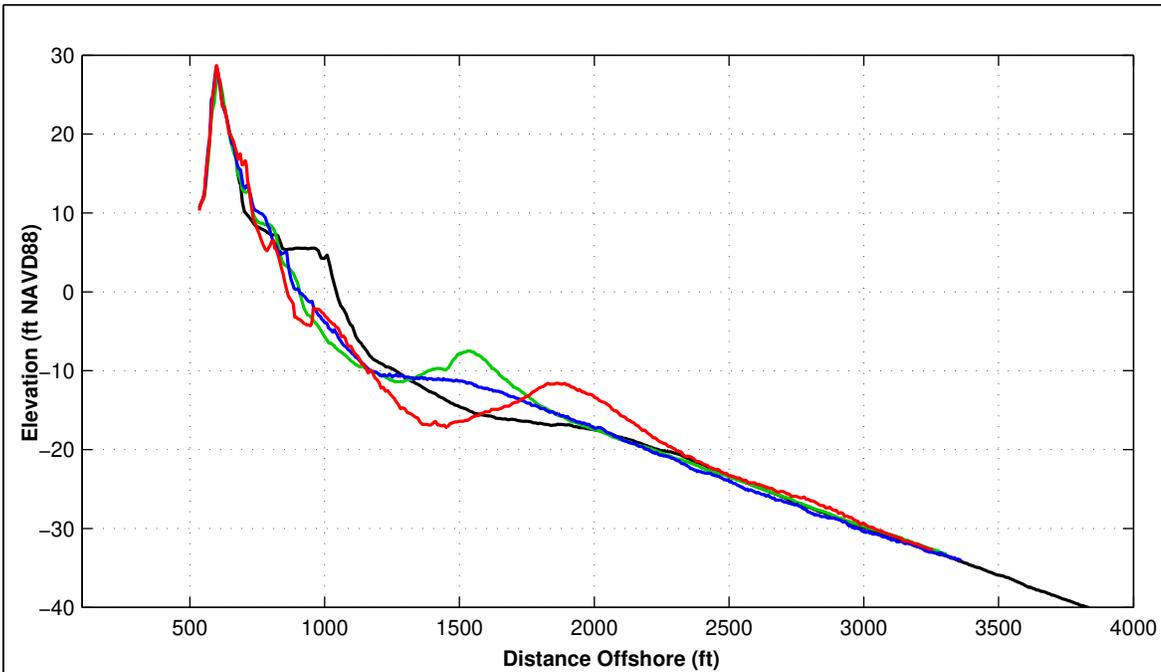
Survey Transect 815+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-14.99 ft	-43.71 ft
Volume Change Above +6 ft NAVD88	4.32 cy/ft	-0.49 cy/ft
Volume Change Above 1.18 ft NAVD88	6.41 cy/ft	-6.87 cy/ft
Volume Change Above -6 ft NAVD88	12.30 cy/ft	-18.12 cy/ft
Volume Change Above -14 ft NAVD88	15.03 cy/ft	-48.08 cy/ft
Volume Change Above -19 ft NAVD88	16.72 cy/ft	-20.44 cy/ft
Volume Change Above -30 ft NAVD88	0.67 cy/ft	3.48 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



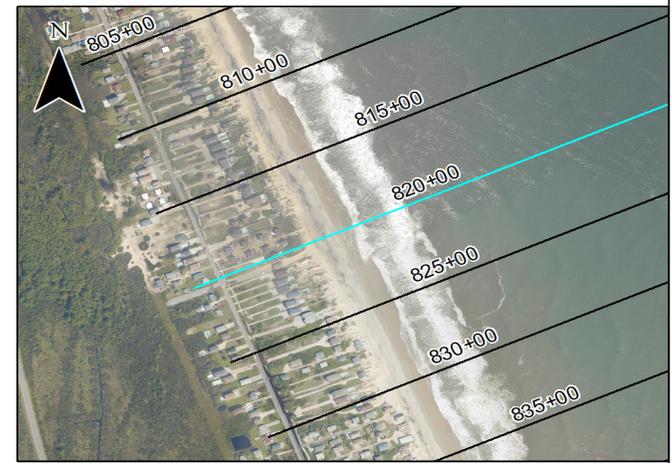


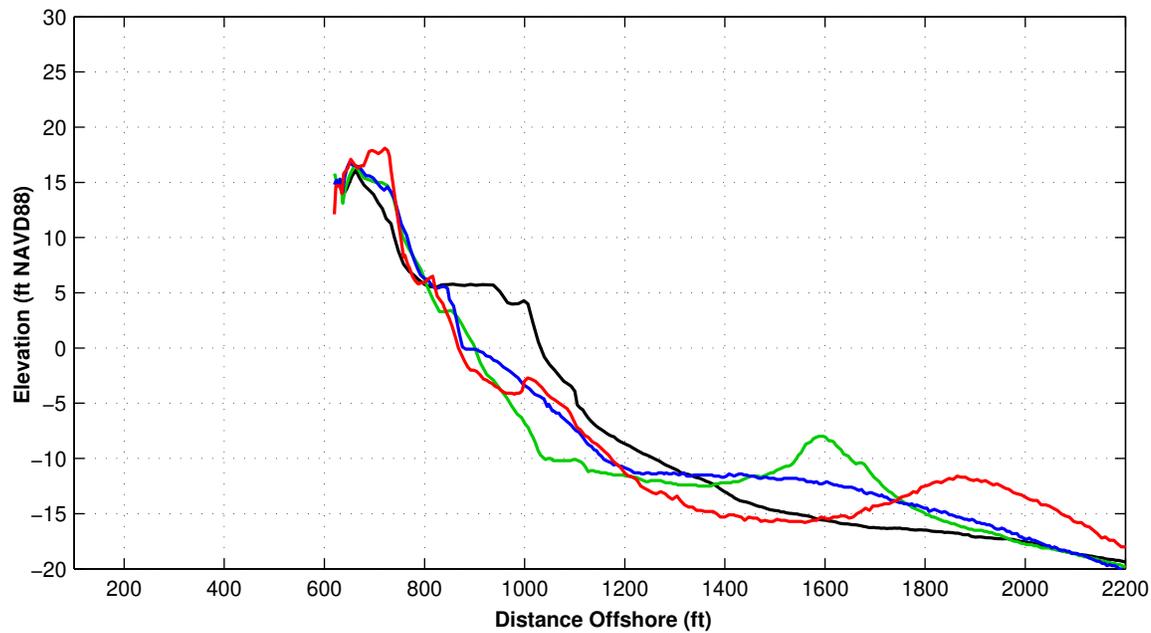
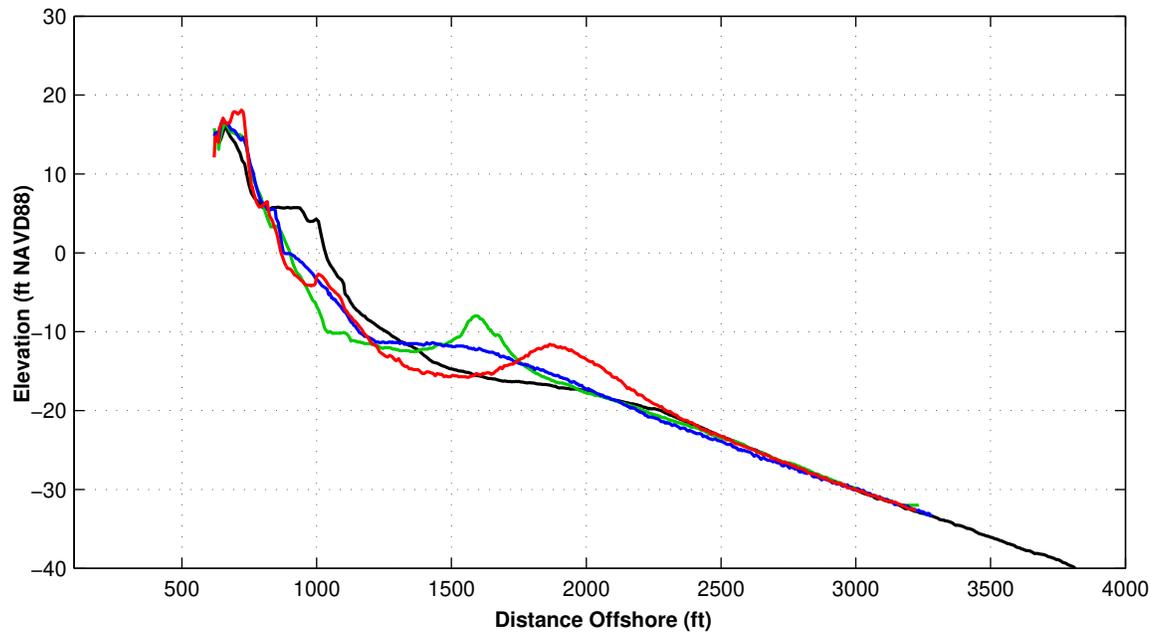
Survey Transect 820+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-19.34 ft	-27.13 ft
Volume Change Above +6 ft NAVD88	2.77 cy/ft	-3.34 cy/ft
Volume Change Above 1.18 ft NAVD88	2.89 cy/ft	-7.87 cy/ft
Volume Change Above -6 ft NAVD88	9.94 cy/ft	-15.40 cy/ft
Volume Change Above -14 ft NAVD88	-17.02 cy/ft	-42.39 cy/ft
Volume Change Above -19 ft NAVD88	-15.60 cy/ft	-34.86 cy/ft
Volume Change Above -30 ft NAVD88	-30.89 cy/ft	0.21 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.

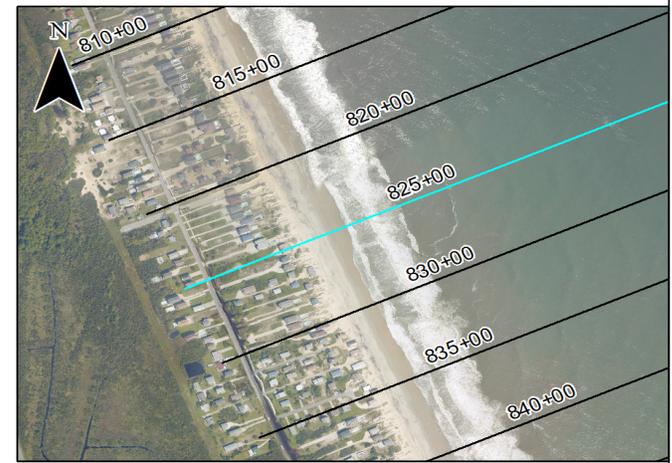


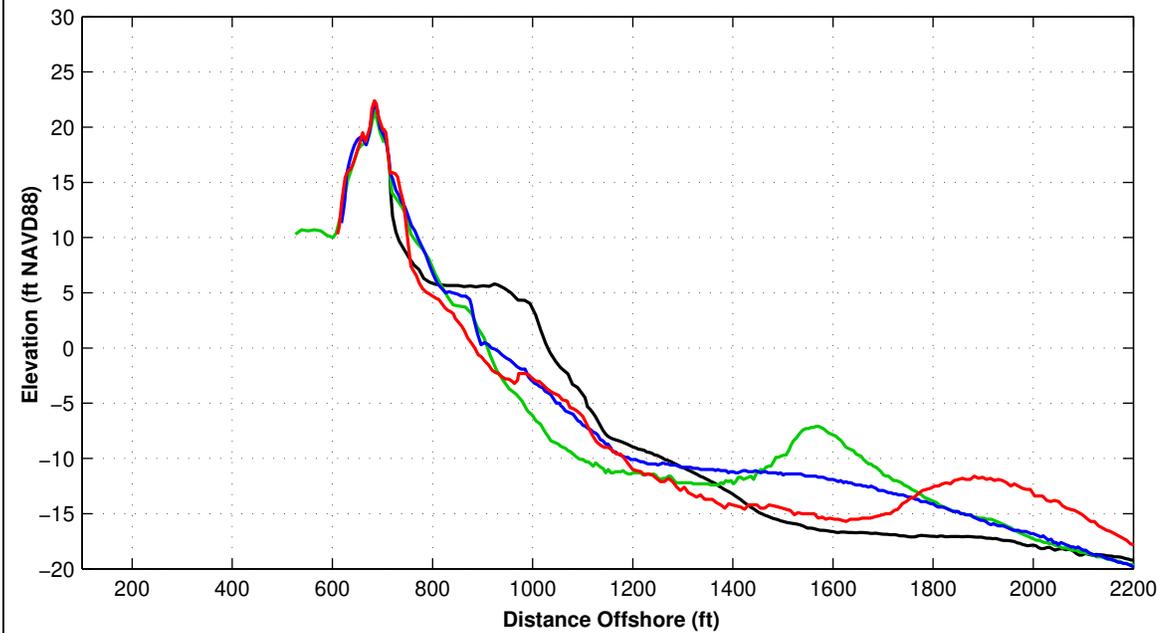
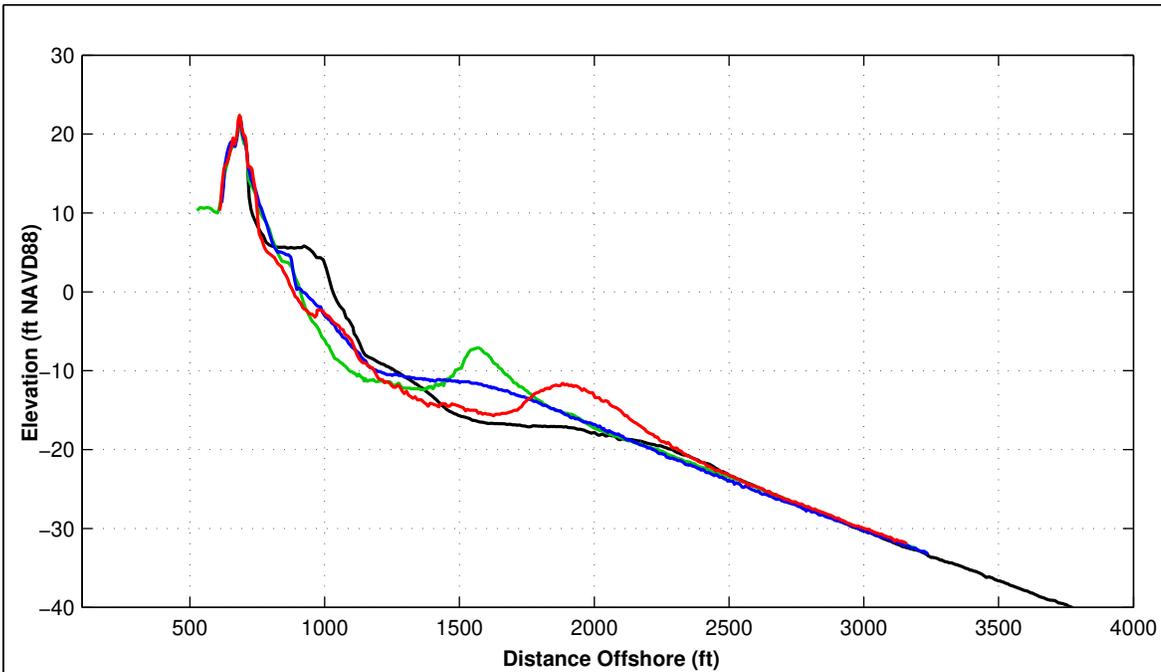


Survey Transect 825+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-16.22 ft	-9.86 ft
Volume Change Above +6 ft NAVD88	0.71 cy/ft	2.86 cy/ft
Volume Change Above 1.18 ft NAVD88	3.09 cy/ft	0.18 cy/ft
Volume Change Above -6 ft NAVD88	13.41 cy/ft	-5.91 cy/ft
Volume Change Above -14 ft NAVD88	16.97 cy/ft	-25.02 cy/ft
Volume Change Above -19 ft NAVD88	23.35 cy/ft	-8.48 cy/ft
Volume Change Above -30 ft NAVD88	8.77 cy/ft	12.87 cy/ft

**LEGEND:**  
 JUNE 2022 ———— (red line)  
 JULY 2021 ———— (blue line)  
 JUNE 2020 ———— (green line)  
 AUGUST 2019 ———— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.



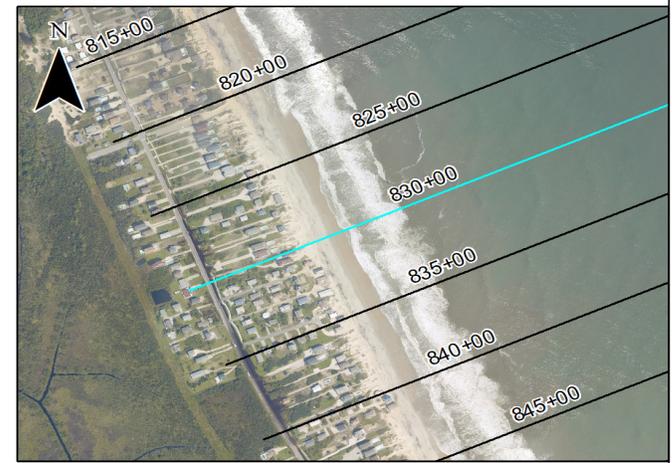


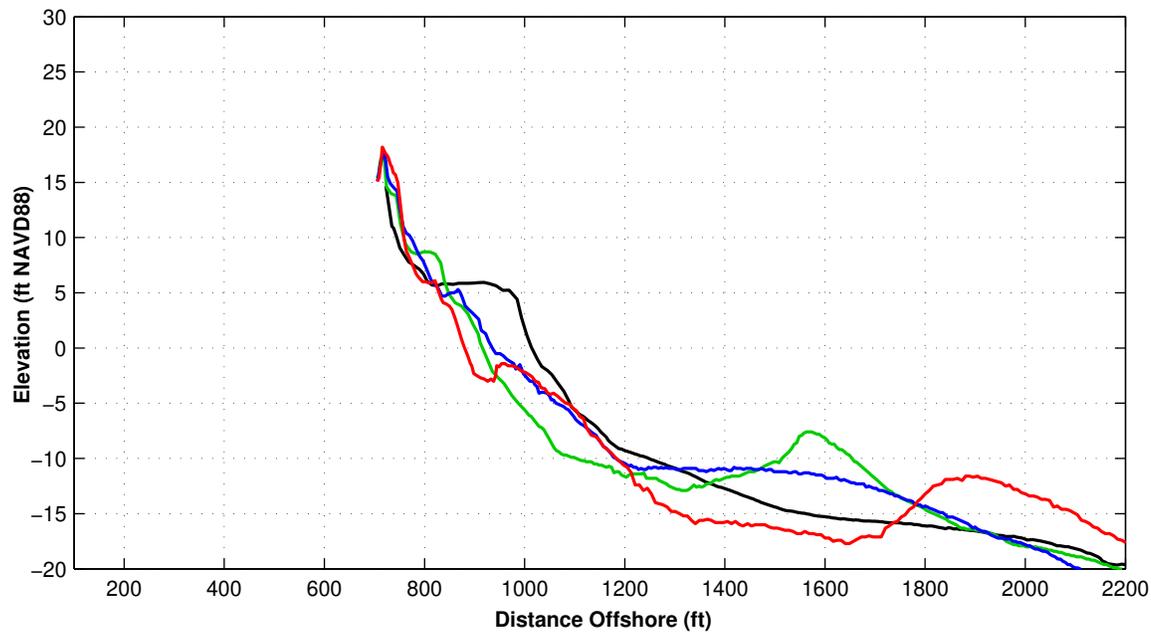
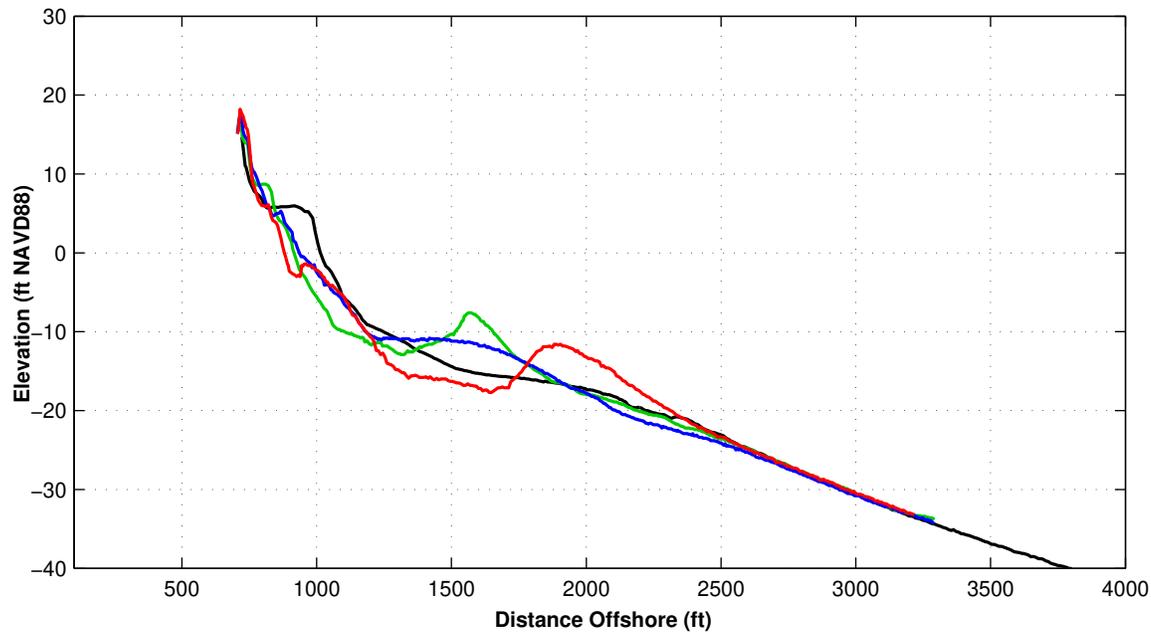
Survey Transect 830+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-8.40 ft	-23.36 ft
Volume Change Above +6 ft NAVD88	1.89 cy/ft	-4.38 cy/ft
Volume Change Above 1.18 ft NAVD88	3.36 cy/ft	-11.85 cy/ft
Volume Change Above -6 ft NAVD88	15.29 cy/ft	-16.32 cy/ft
Volume Change Above -14 ft NAVD88	13.92 cy/ft	-42.38 cy/ft
Volume Change Above -19 ft NAVD88	14.86 cy/ft	-20.53 cy/ft
Volume Change Above -30 ft NAVD88	5.65 cy/ft	-0.34 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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Survey Transect 835+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	15.60 ft	-51.78 ft
Volume Change Above +6 ft NAVD88	-0.69 cy/ft	-1.83 cy/ft
Volume Change Above 1.18 ft NAVD88	0.54 cy/ft	-7.73 cy/ft
Volume Change Above -6 ft NAVD88	14.41 cy/ft	-14.30 cy/ft
Volume Change Above -14 ft NAVD88	21.35 cy/ft	-48.38 cy/ft
Volume Change Above -19 ft NAVD88	22.37 cy/ft	-45.86 cy/ft
Volume Change Above -30 ft NAVD88	0.57 cy/ft	-11.70 cy/ft

**LEGEND:**

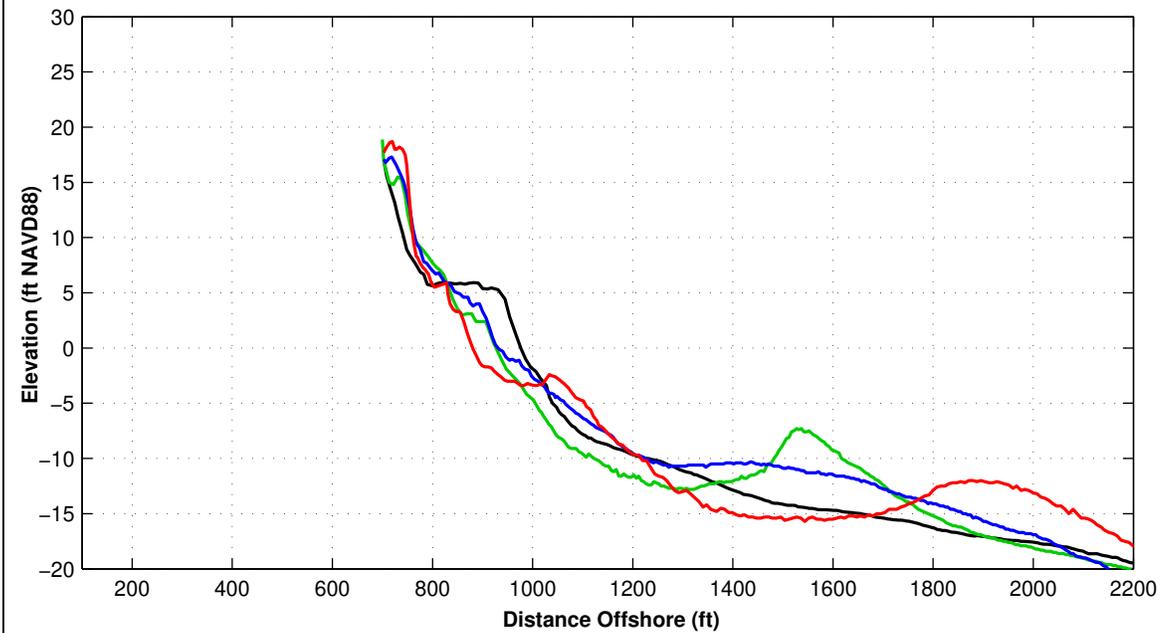
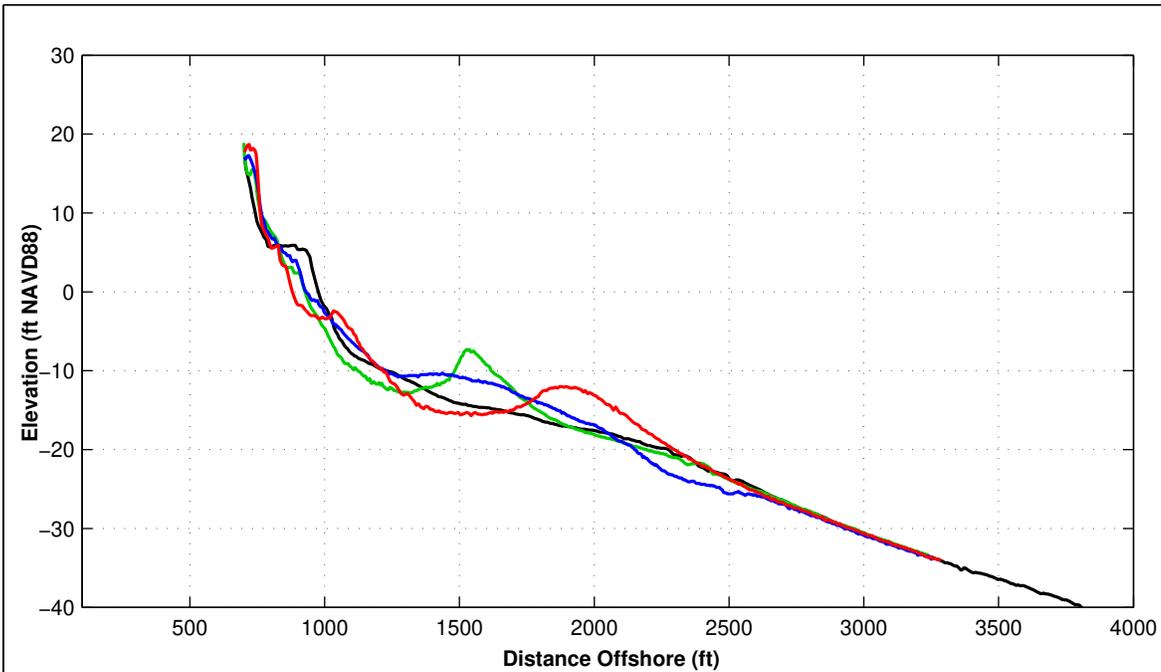
JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

**Notes:**

1. Station From North To South At Varying Intervals.
2. All Survey Elevations In Feet Referenced to NAVD88.



**Town of Nags Head Periodic Surveying Data Analysis**



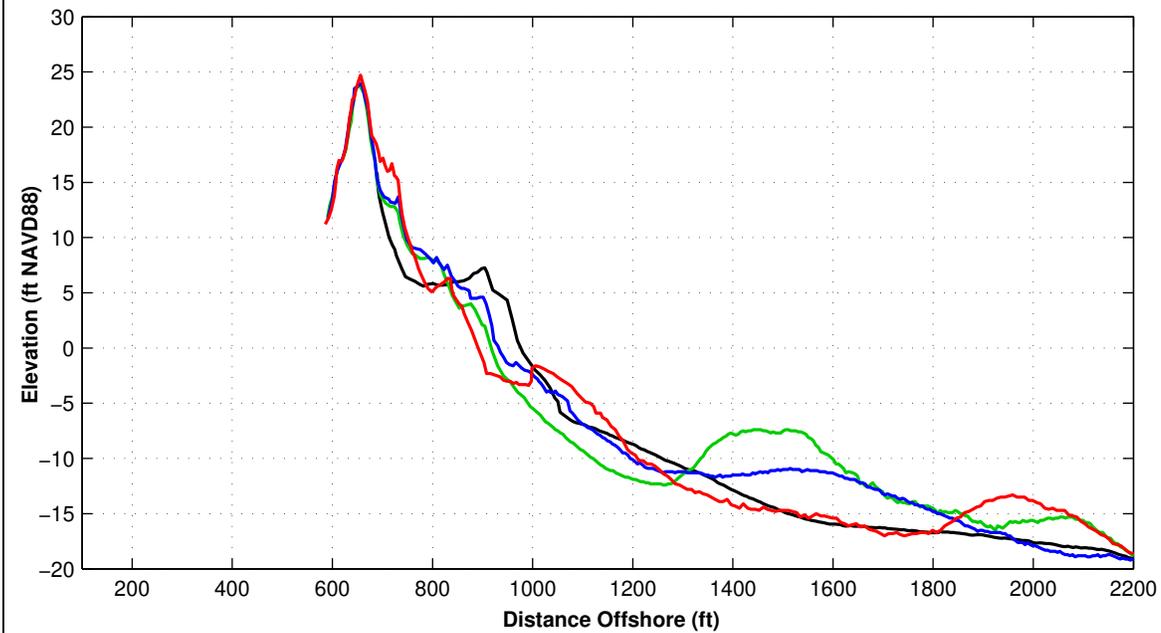
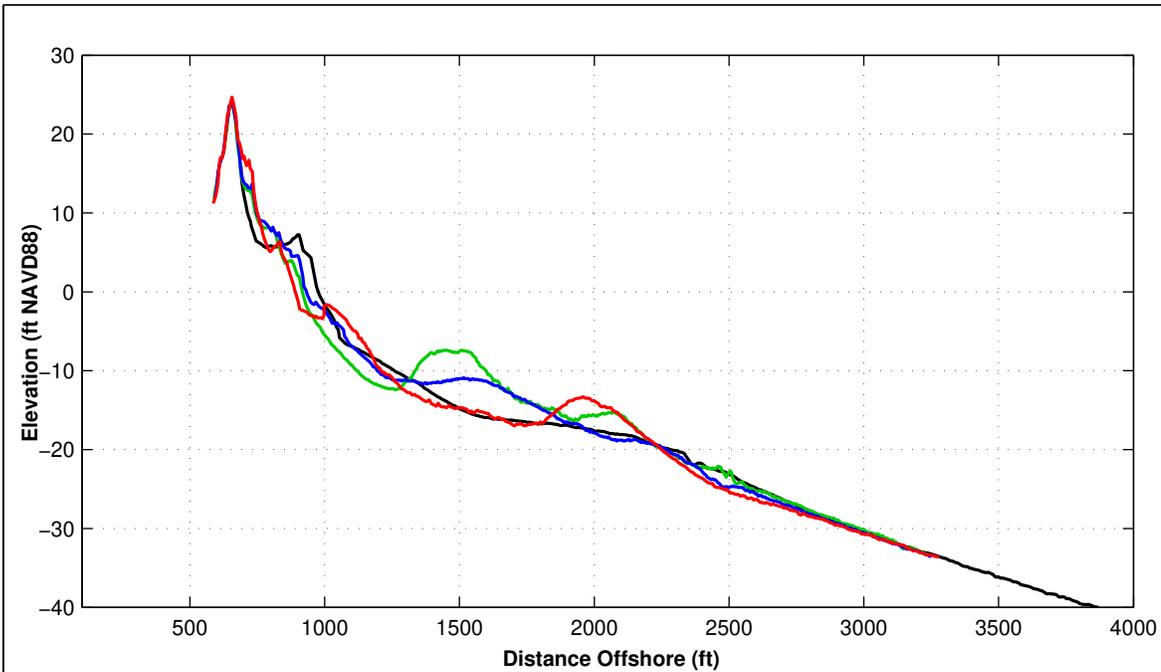
Survey Transect 840+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	2.25 ft	-47.59 ft
Volume Change Above +6 ft NAVD88	1.37 cy/ft	1.42 cy/ft
Volume Change Above 1.18 ft NAVD88	4.88 cy/ft	-5.64 cy/ft
Volume Change Above -6 ft NAVD88	14.05 cy/ft	-10.72 cy/ft
Volume Change Above -14 ft NAVD88	31.86 cy/ft	-44.88 cy/ft
Volume Change Above -19 ft NAVD88	44.93 cy/ft	-27.36 cy/ft
Volume Change Above -30 ft NAVD88	10.82 cy/ft	12.86 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.





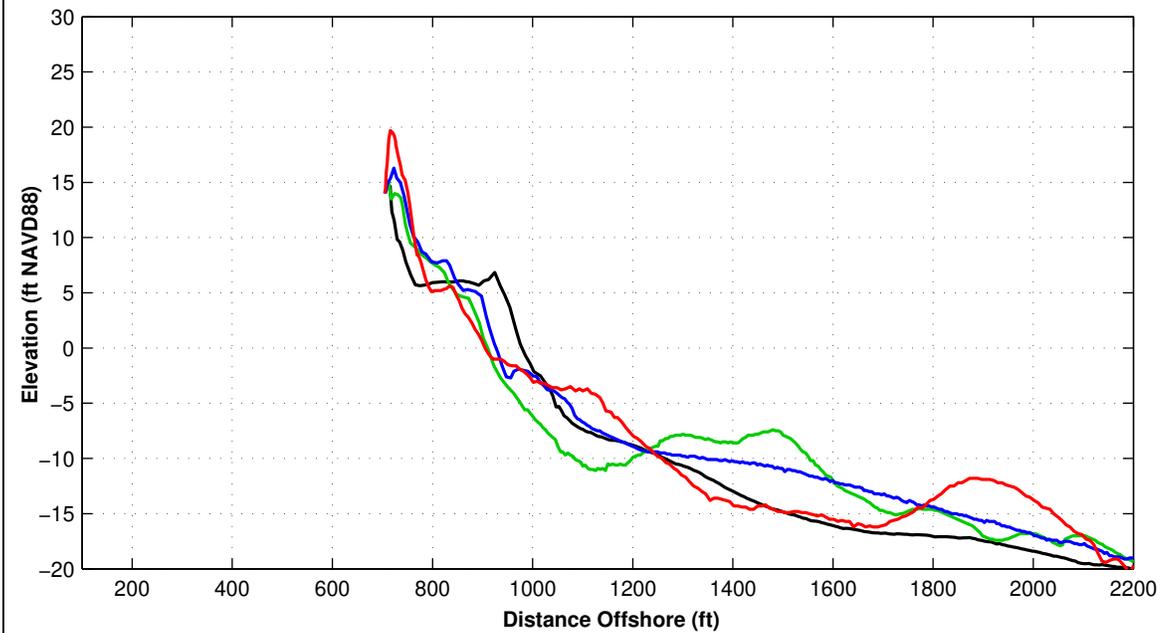
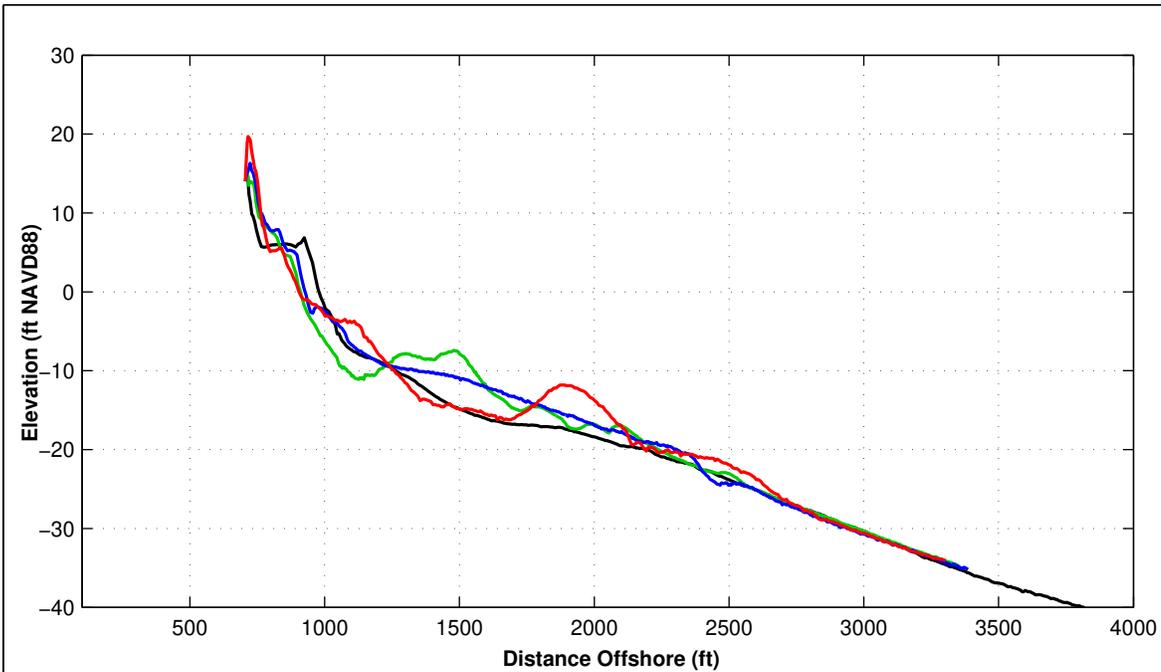
Survey Transect 845+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	11.47 ft	-39.74 ft
Volume Change Above +6 ft NAVD88	3.47 cy/ft	1.07 cy/ft
Volume Change Above 1.18 ft NAVD88	8.48 cy/ft	-6.89 cy/ft
Volume Change Above -6 ft NAVD88	20.84 cy/ft	-8.25 cy/ft
Volume Change Above -14 ft NAVD88	6.58 cy/ft	-37.51 cy/ft
Volume Change Above -19 ft NAVD88	-17.56 cy/ft	-28.71 cy/ft
Volume Change Above -30 ft NAVD88	-31.51 cy/ft	-42.81 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



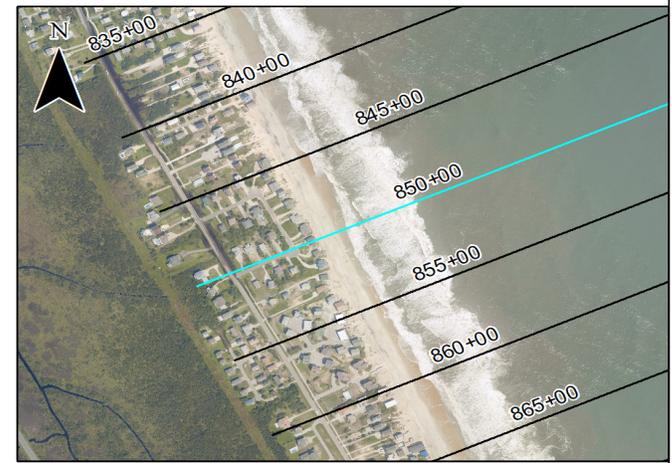


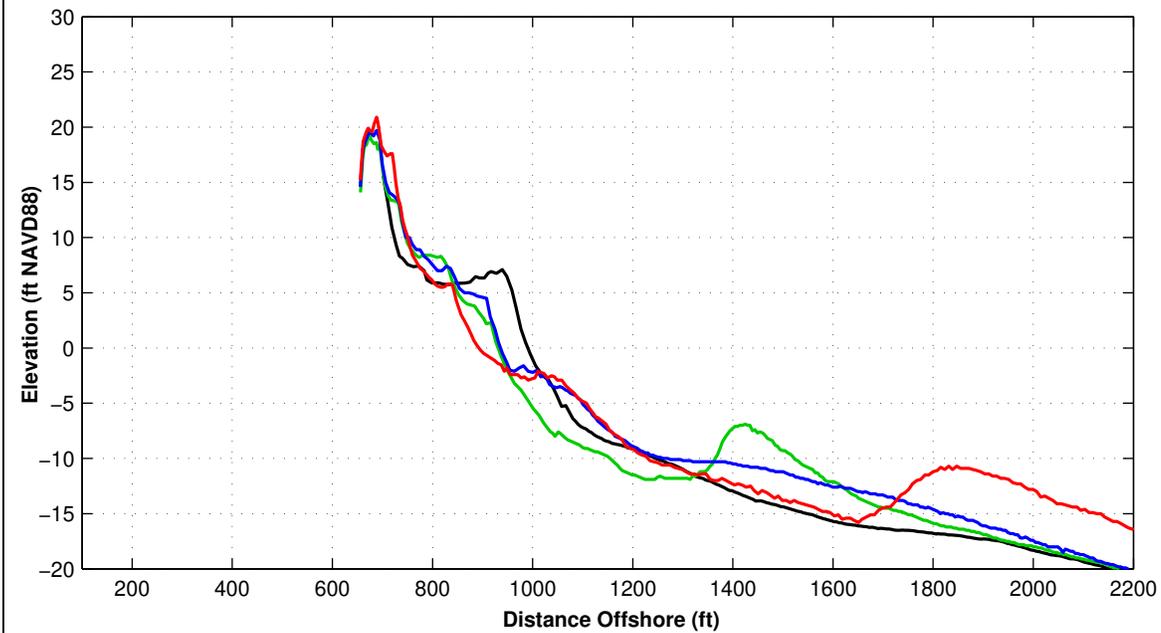
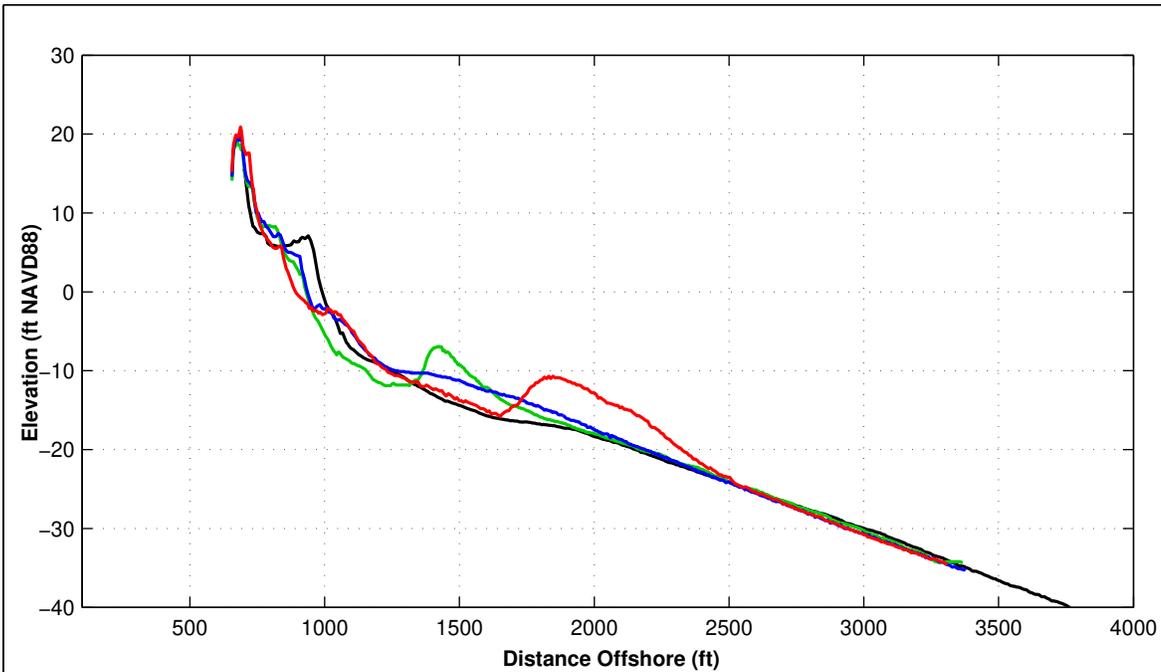
Survey Transect 850+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	18.27 ft	-25.36 ft
Volume Change Above +6 ft NAVD88	4.55 cy/ft	-1.64 cy/ft
Volume Change Above 1.18 ft NAVD88	8.64 cy/ft	-9.10 cy/ft
Volume Change Above -6 ft NAVD88	22.43 cy/ft	-4.04 cy/ft
Volume Change Above -14 ft NAVD88	20.28 cy/ft	-27.08 cy/ft
Volume Change Above -19 ft NAVD88	26.10 cy/ft	-23.65 cy/ft
Volume Change Above -30 ft NAVD88	21.94 cy/ft	-4.62 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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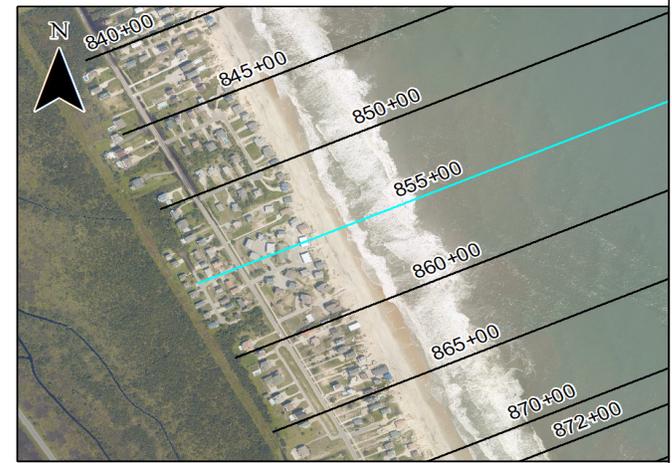


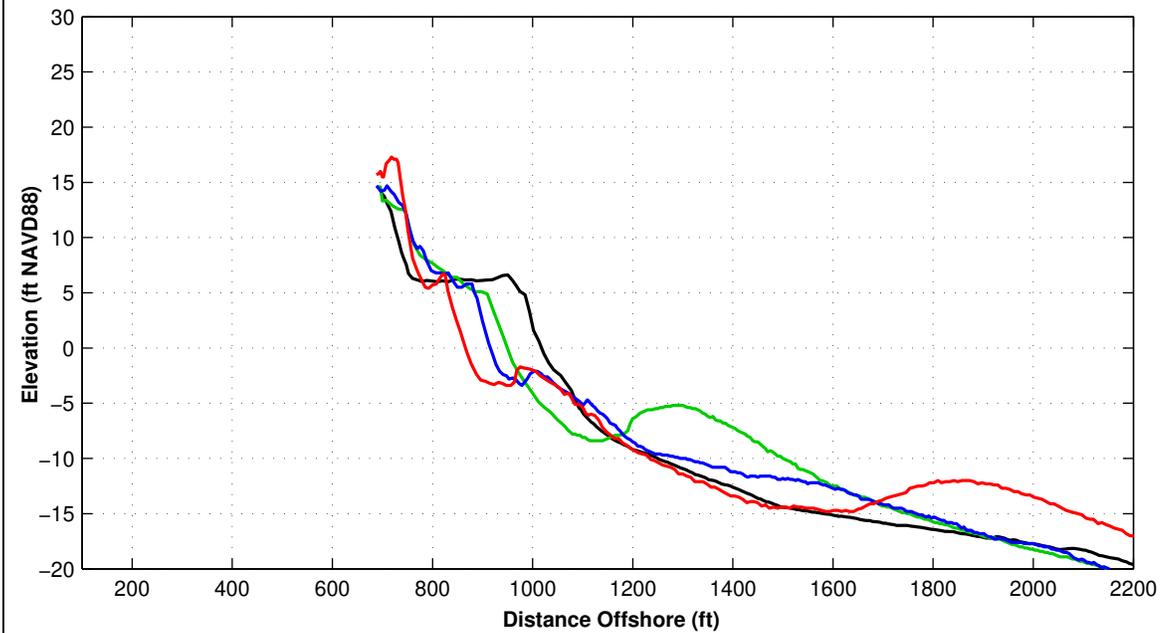
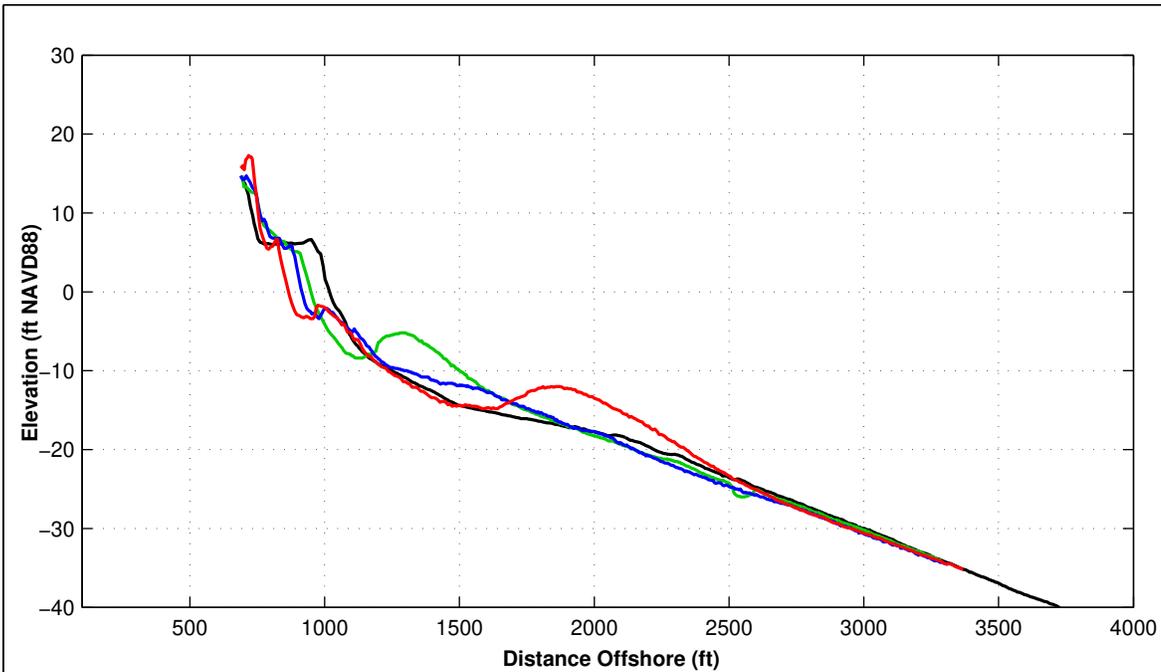
Survey Transect 855+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	4.88 ft	-50.23 ft
Volume Change Above +6 ft NAVD88	1.29 cy/ft	-0.07 cy/ft
Volume Change Above 1.18 ft NAVD88	4.65 cy/ft	-8.75 cy/ft
Volume Change Above -6 ft NAVD88	18.35 cy/ft	-12.51 cy/ft
Volume Change Above -14 ft NAVD88	28.64 cy/ft	-15.14 cy/ft
Volume Change Above -19 ft NAVD88	40.71 cy/ft	25.60 cy/ft
Volume Change Above -30 ft NAVD88	33.04 cy/ft	44.67 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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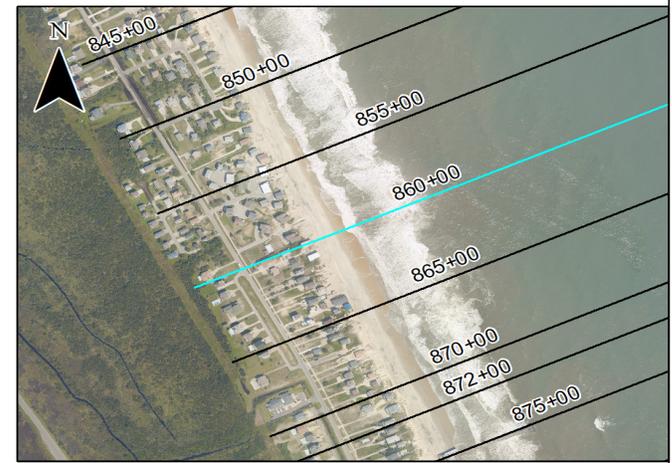


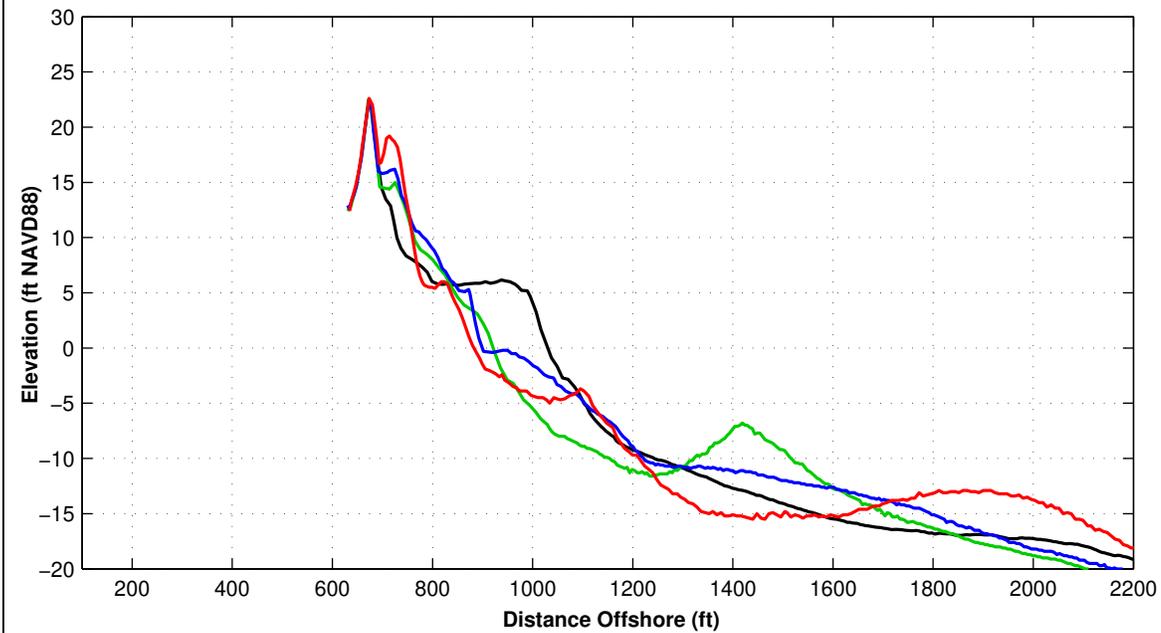
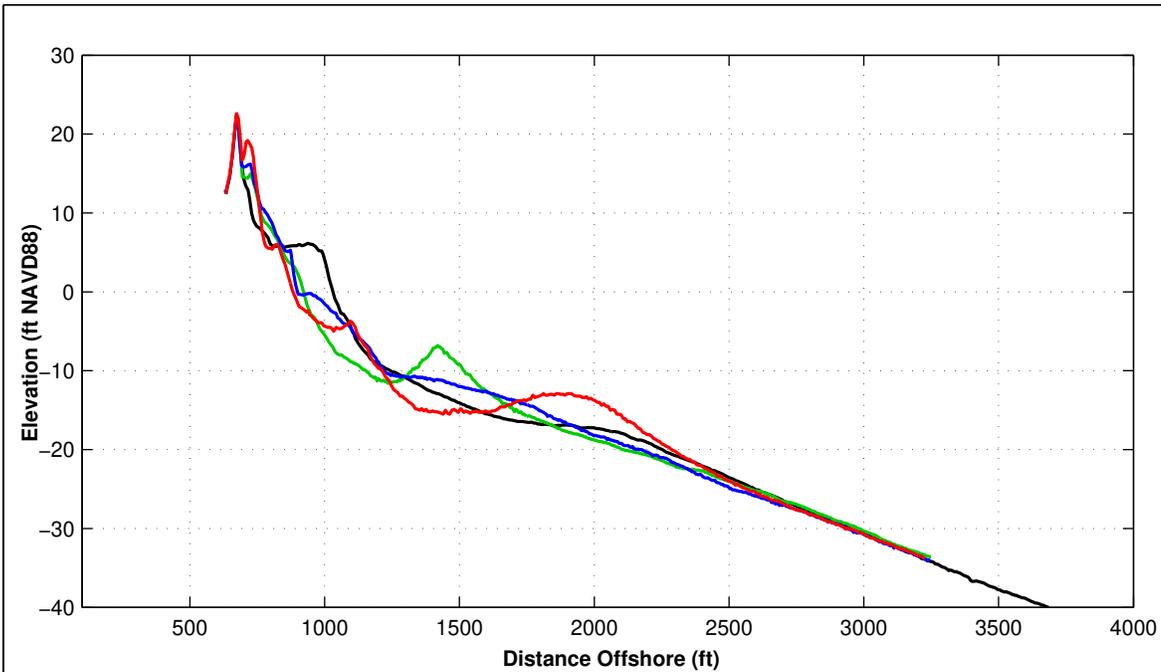
Survey Transect 860+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-32.52 ft	-49.97 ft
Volume Change Above +6 ft NAVD88	1.01 cy/ft	0.16 cy/ft
Volume Change Above 1.18 ft NAVD88	-3.02 cy/ft	-9.10 cy/ft
Volume Change Above -6 ft NAVD88	-0.92 cy/ft	-17.83 cy/ft
Volume Change Above -14 ft NAVD88	-36.66 cy/ft	-31.95 cy/ft
Volume Change Above -19 ft NAVD88	-32.70 cy/ft	15.59 cy/ft
Volume Change Above -30 ft NAVD88	-42.40 cy/ft	49.51 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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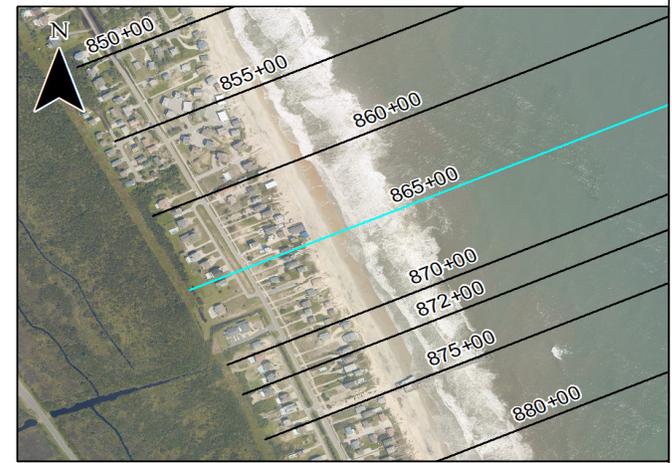


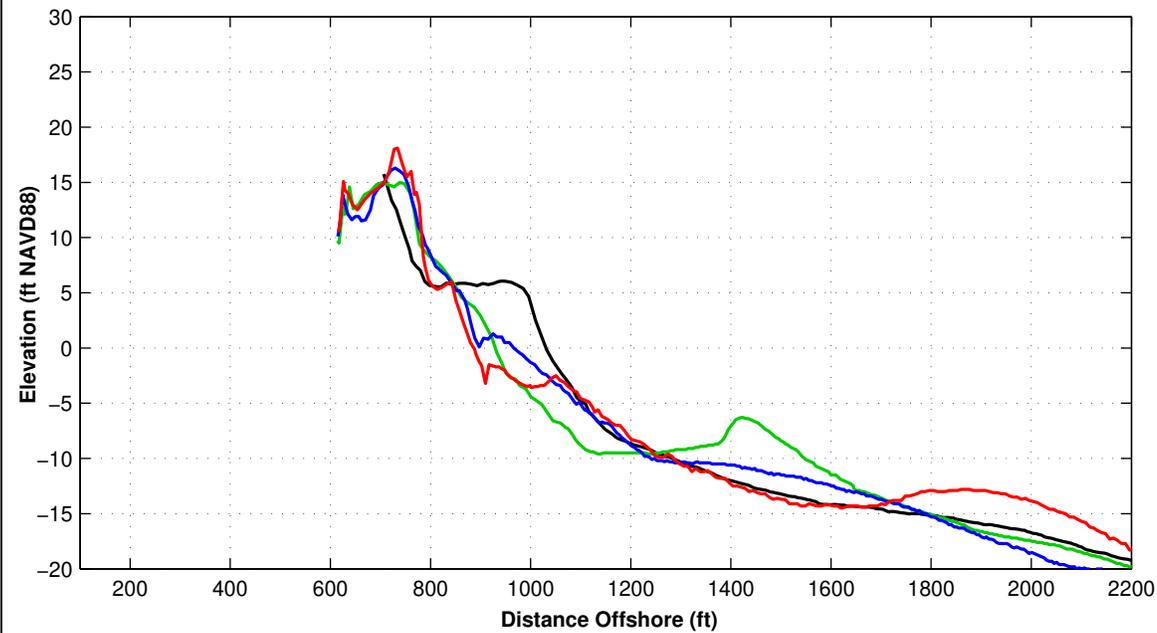
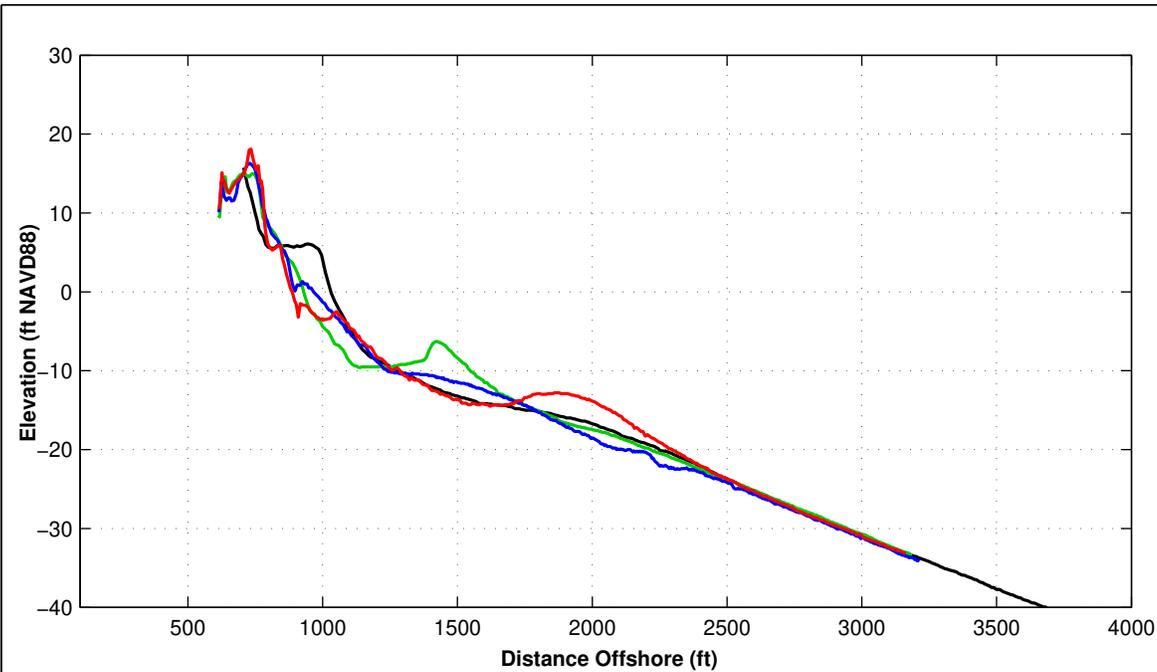
Survey Transect 865+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-21.23 ft	-19.41 ft
Volume Change Above +6 ft NAVD88	5.01 cy/ft	-1.68 cy/ft
Volume Change Above 1.18 ft NAVD88	5.48 cy/ft	-6.77 cy/ft
Volume Change Above -6 ft NAVD88	22.83 cy/ft	-21.08 cy/ft
Volume Change Above -14 ft NAVD88	20.80 cy/ft	-49.88 cy/ft
Volume Change Above -19 ft NAVD88	34.32 cy/ft	-19.82 cy/ft
Volume Change Above -30 ft NAVD88	25.23 cy/ft	1.25 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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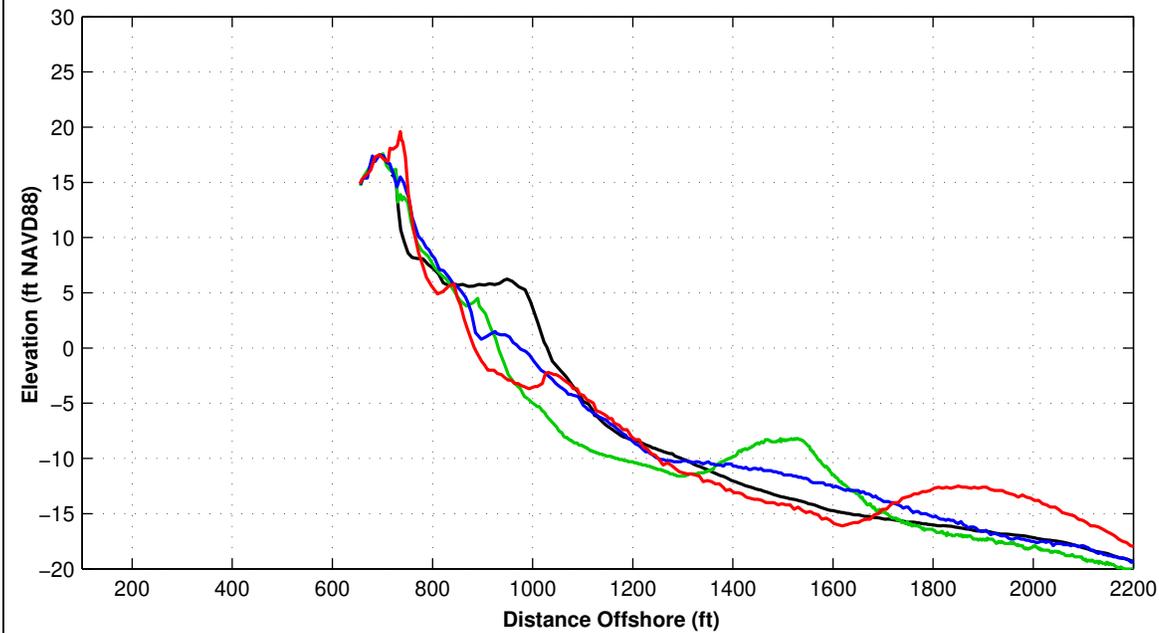
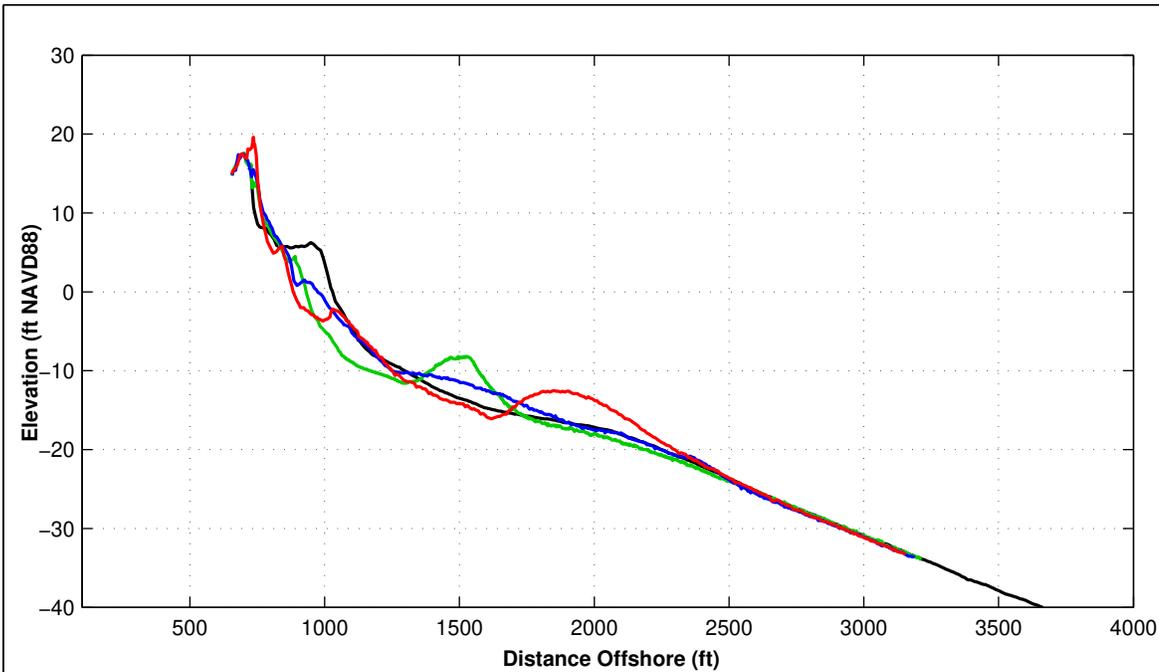
Survey Transect 870+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	7.98 ft	-53.47 ft
Volume Change Above +6 ft NAVD88	1.52 cy/ft	0.81 cy/ft
Volume Change Above 1.18 ft NAVD88	-0.99 cy/ft	-2.15 cy/ft
Volume Change Above -6 ft NAVD88	14.80 cy/ft	-12.86 cy/ft
Volume Change Above -14 ft NAVD88	-5.49 cy/ft	-22.47 cy/ft
Volume Change Above -19 ft NAVD88	-13.55 cy/ft	23.21 cy/ft
Volume Change Above -30 ft NAVD88	-35.20 cy/ft	50.47 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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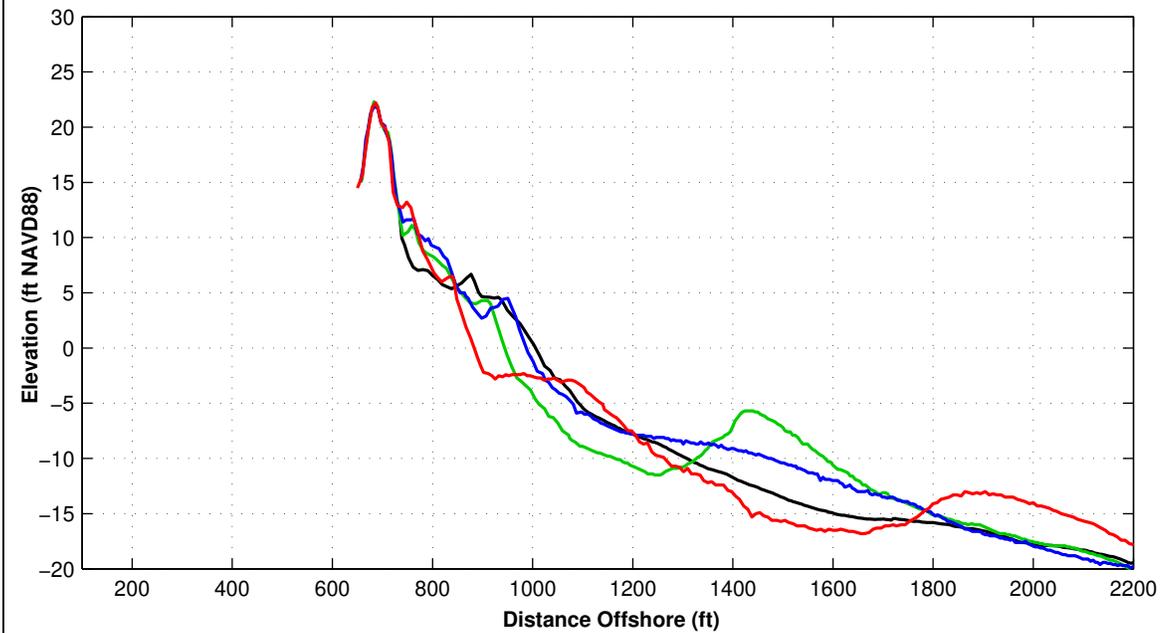
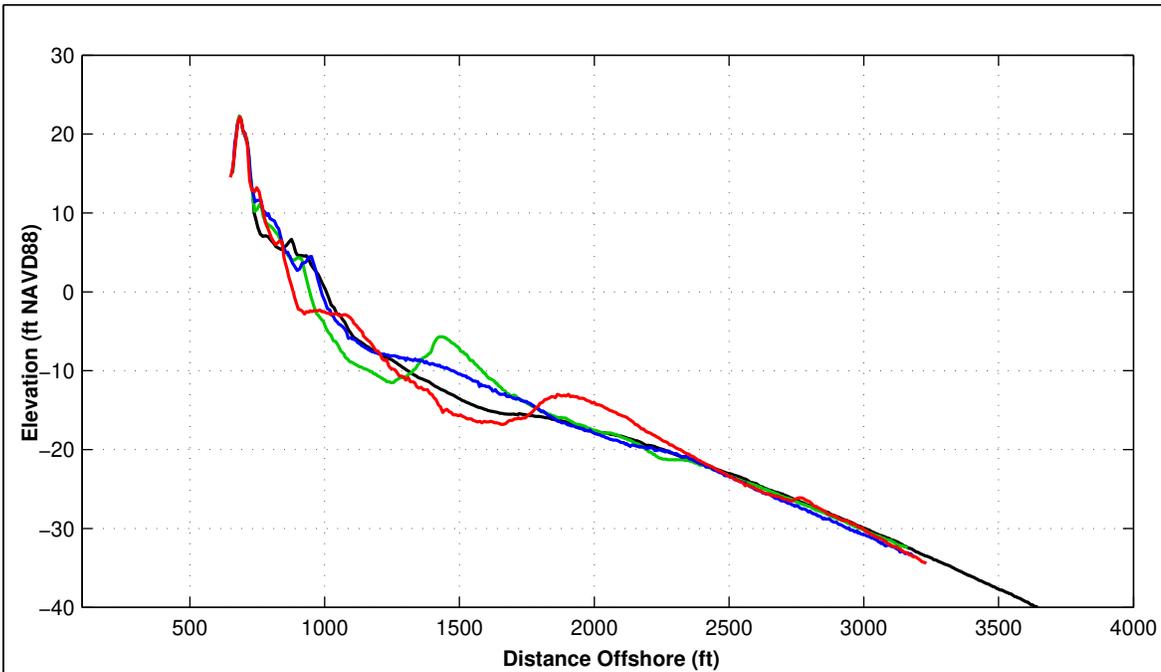
Survey Transect 872+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	23.68 ft	-72.31 ft
Volume Change Above +6 ft NAVD88	3.26 cy/ft	-0.49 cy/ft
Volume Change Above 1.18 ft NAVD88	1.28 cy/ft	-4.26 cy/ft
Volume Change Above -6 ft NAVD88	20.09 cy/ft	-16.50 cy/ft
Volume Change Above -14 ft NAVD88	24.47 cy/ft	-32.56 cy/ft
Volume Change Above -19 ft NAVD88	40.34 cy/ft	-2.49 cy/ft
Volume Change Above -30 ft NAVD88	46.64 cy/ft	4.12 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
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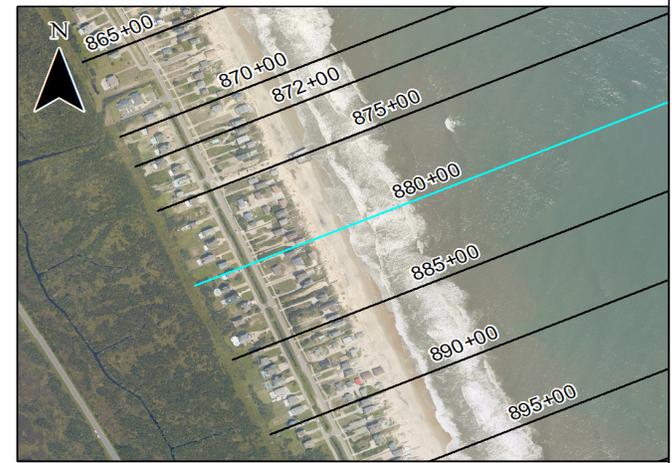


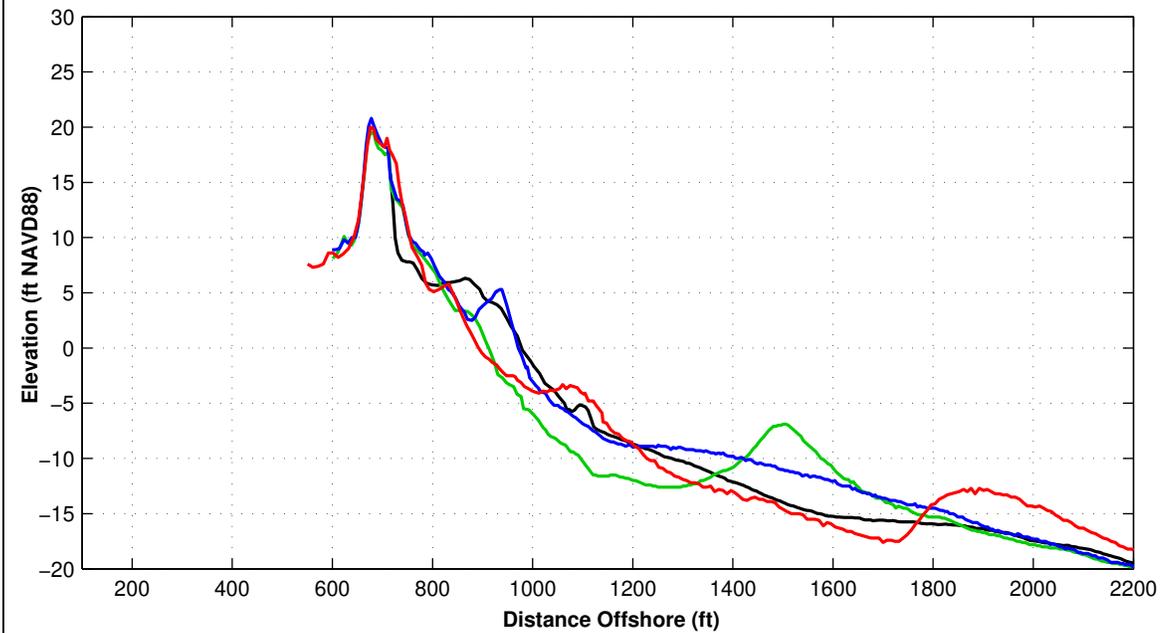
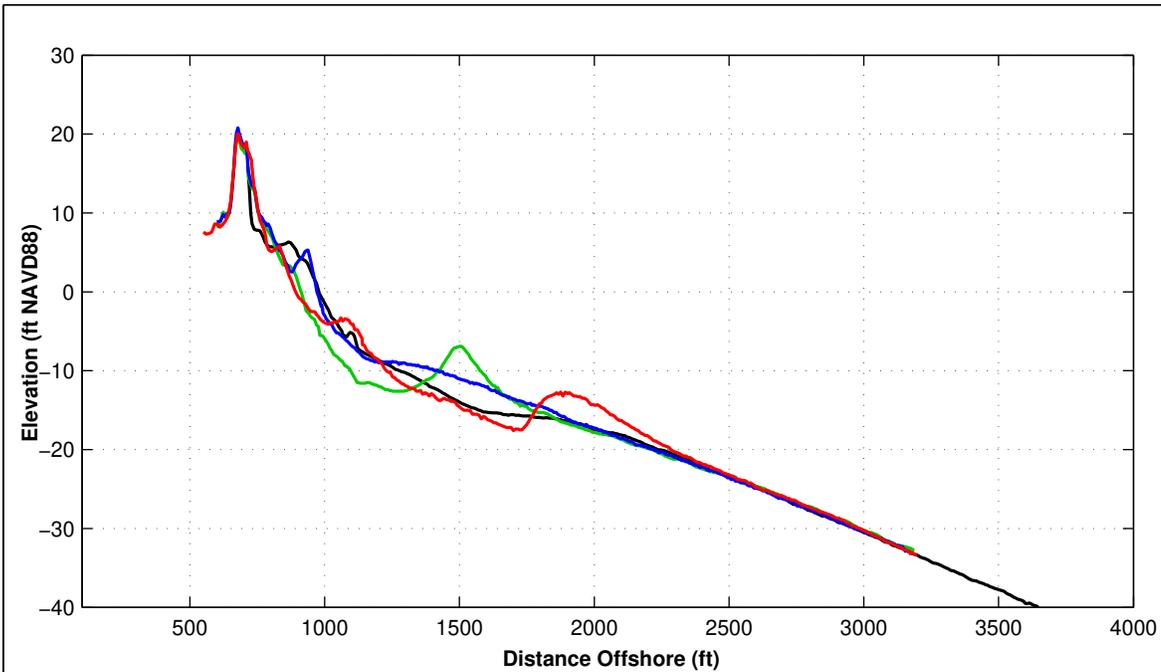
Survey Transect 880+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	42.21 ft	-104.18 ft
Volume Change Above +6 ft NAVD88	3.45 cy/ft	-3.79 cy/ft
Volume Change Above 1.18 ft NAVD88	6.54 cy/ft	-14.57 cy/ft
Volume Change Above -6 ft NAVD88	20.01 cy/ft	-22.49 cy/ft
Volume Change Above -14 ft NAVD88	22.58 cy/ft	-64.45 cy/ft
Volume Change Above -19 ft NAVD88	17.36 cy/ft	-47.07 cy/ft
Volume Change Above -30 ft NAVD88	12.43 cy/ft	-29.92 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
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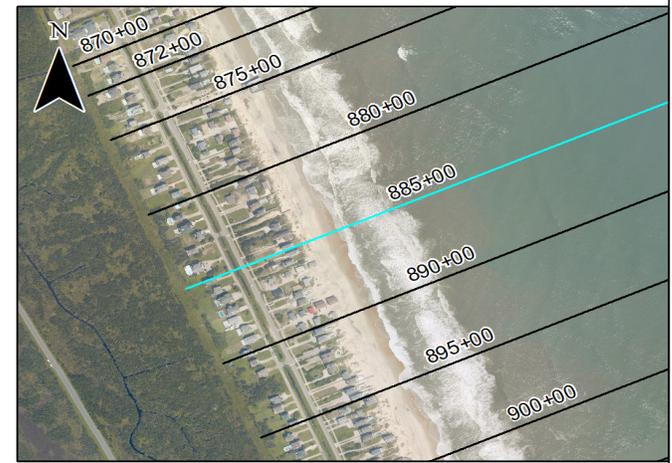


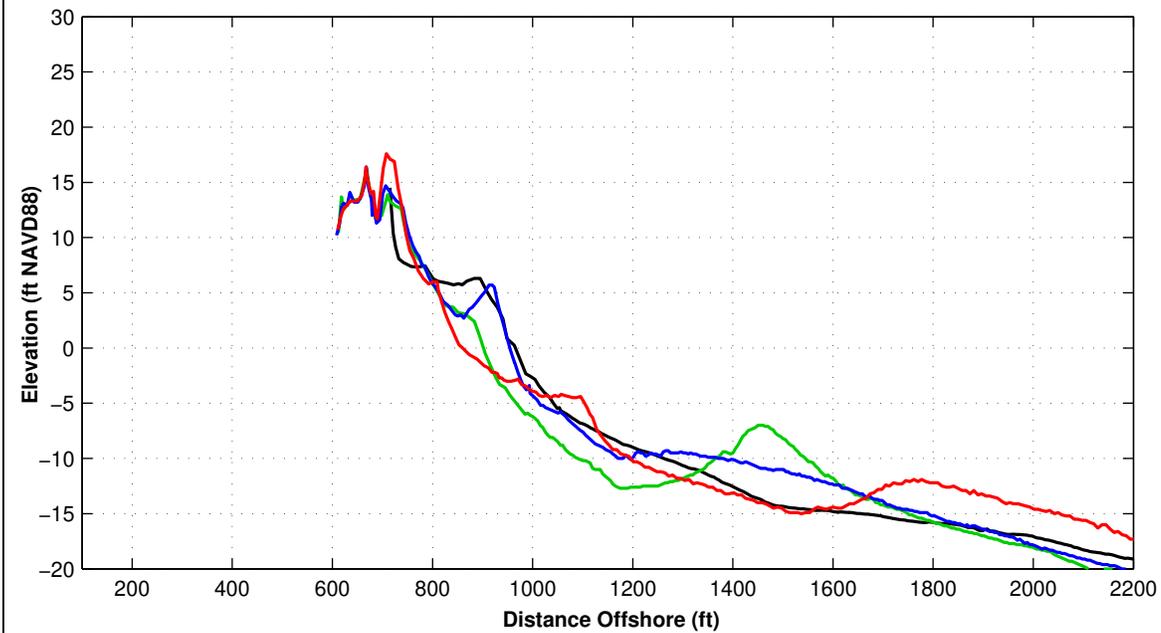
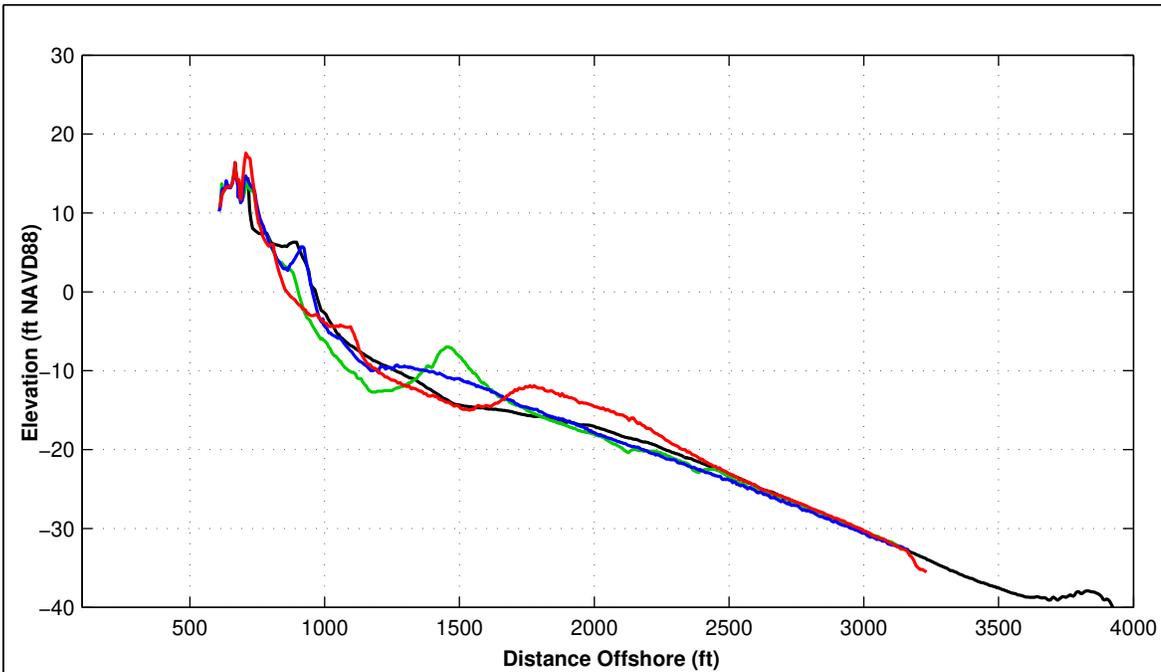
Survey Transect 885+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	63.67 ft	-85.84 ft
Volume Change Above +6 ft NAVD88	2.85 cy/ft	-1.52 cy/ft
Volume Change Above 1.18 ft NAVD88	11.52 cy/ft	-11.53 cy/ft
Volume Change Above -6 ft NAVD88	27.35 cy/ft	-15.93 cy/ft
Volume Change Above -14 ft NAVD88	51.46 cy/ft	-49.58 cy/ft
Volume Change Above -19 ft NAVD88	58.95 cy/ft	-42.90 cy/ft
Volume Change Above -30 ft NAVD88	56.28 cy/ft	-29.74 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



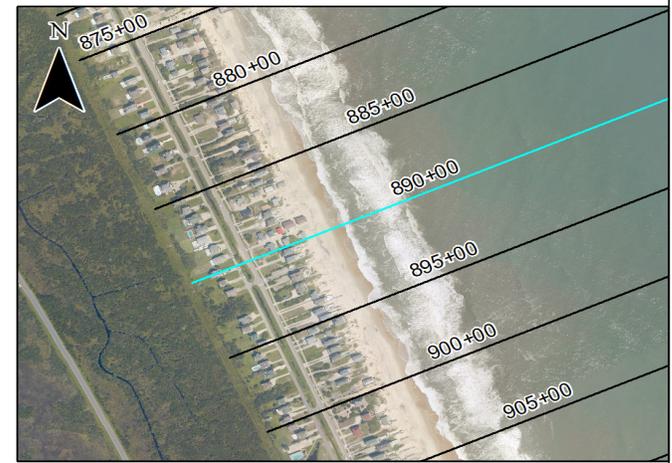


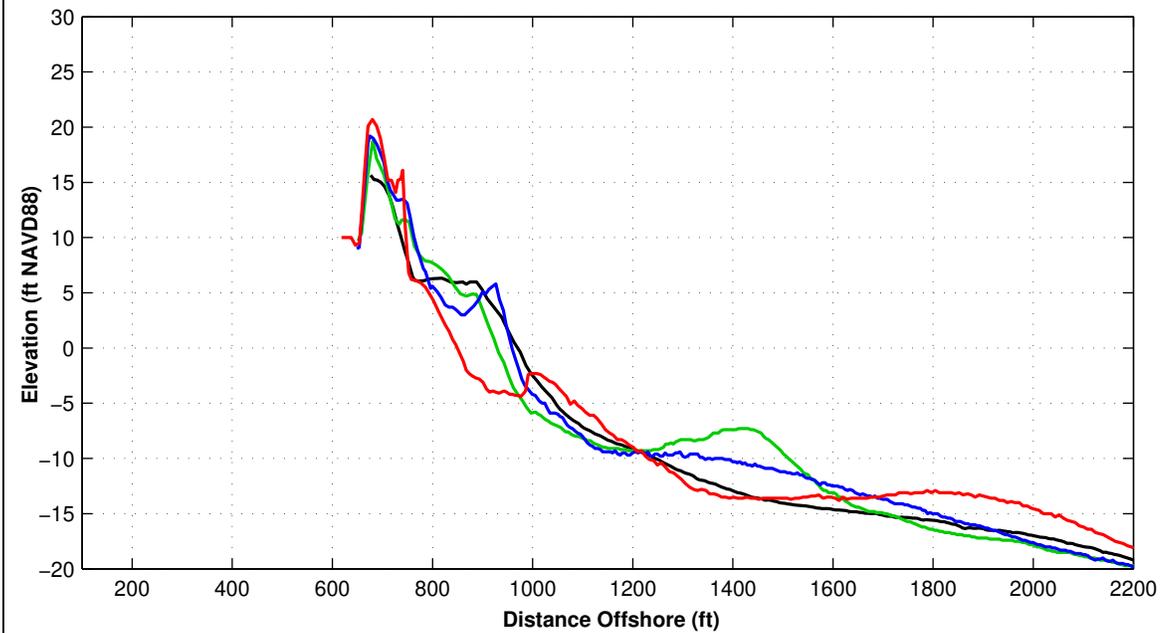
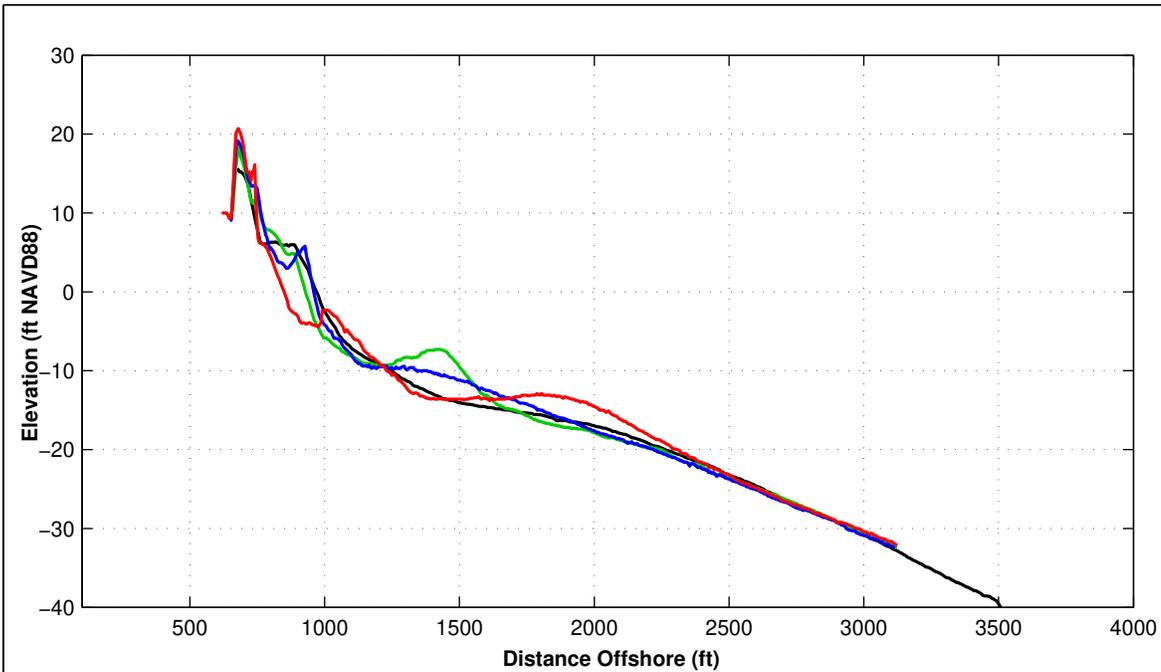
Survey Transect 890+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	53.93 ft	-103.29 ft
Volume Change Above +6 ft NAVD88	1.81 cy/ft	2.38 cy/ft
Volume Change Above 1.18 ft NAVD88	9.24 cy/ft	-9.03 cy/ft
Volume Change Above -6 ft NAVD88	22.58 cy/ft	-15.26 cy/ft
Volume Change Above -14 ft NAVD88	36.09 cy/ft	-36.29 cy/ft
Volume Change Above -19 ft NAVD88	42.07 cy/ft	5.19 cy/ft
Volume Change Above -30 ft NAVD88	35.28 cy/ft	34.89 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



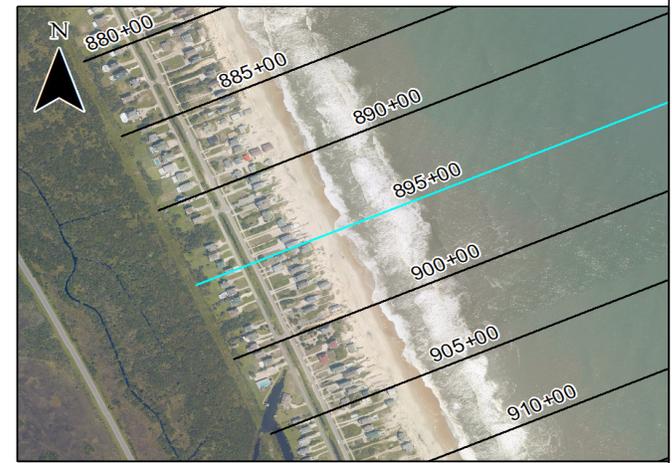


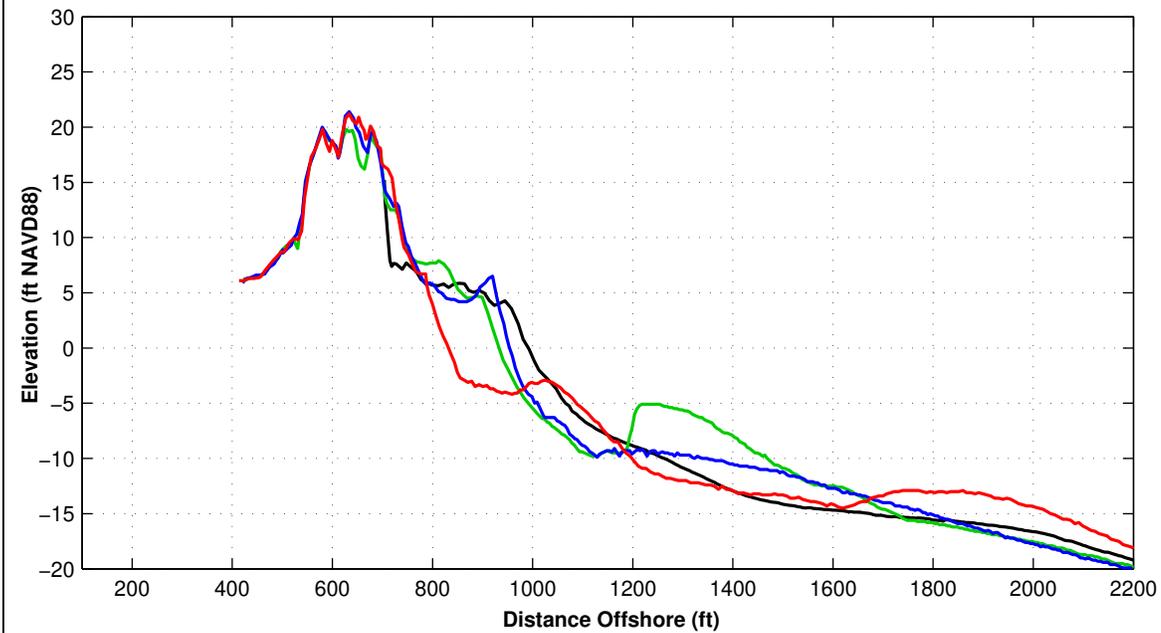
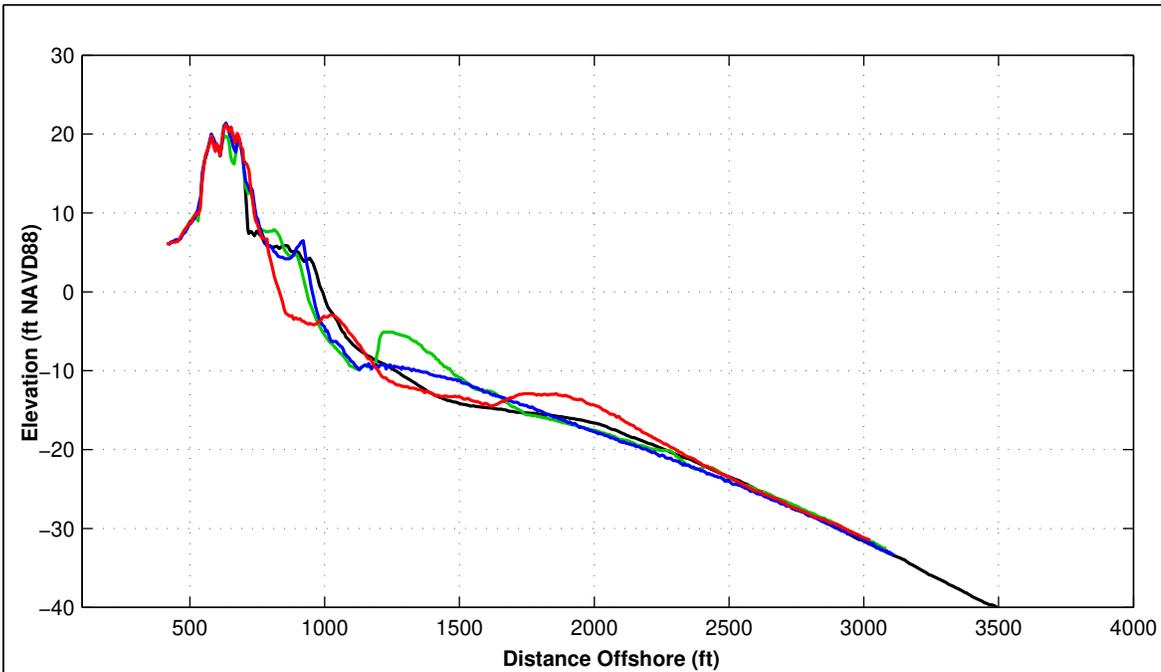
Survey Transect 895+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	32.62 ft	-116.05 ft
Volume Change Above +6 ft NAVD88	2.81 cy/ft	-1.39 cy/ft
Volume Change Above 1.18 ft NAVD88	3.23 cy/ft	-16.35 cy/ft
Volume Change Above -6 ft NAVD88	11.11 cy/ft	-28.13 cy/ft
Volume Change Above -14 ft NAVD88	-5.99 cy/ft	-46.19 cy/ft
Volume Change Above -19 ft NAVD88	7.85 cy/ft	-10.05 cy/ft
Volume Change Above -30 ft NAVD88	0.94 cy/ft	5.60 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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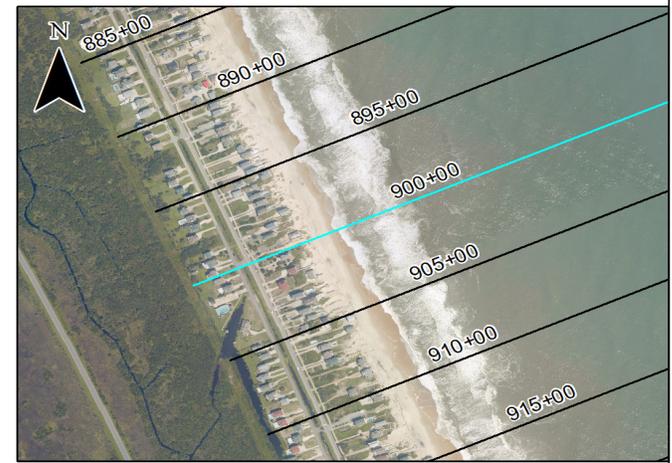


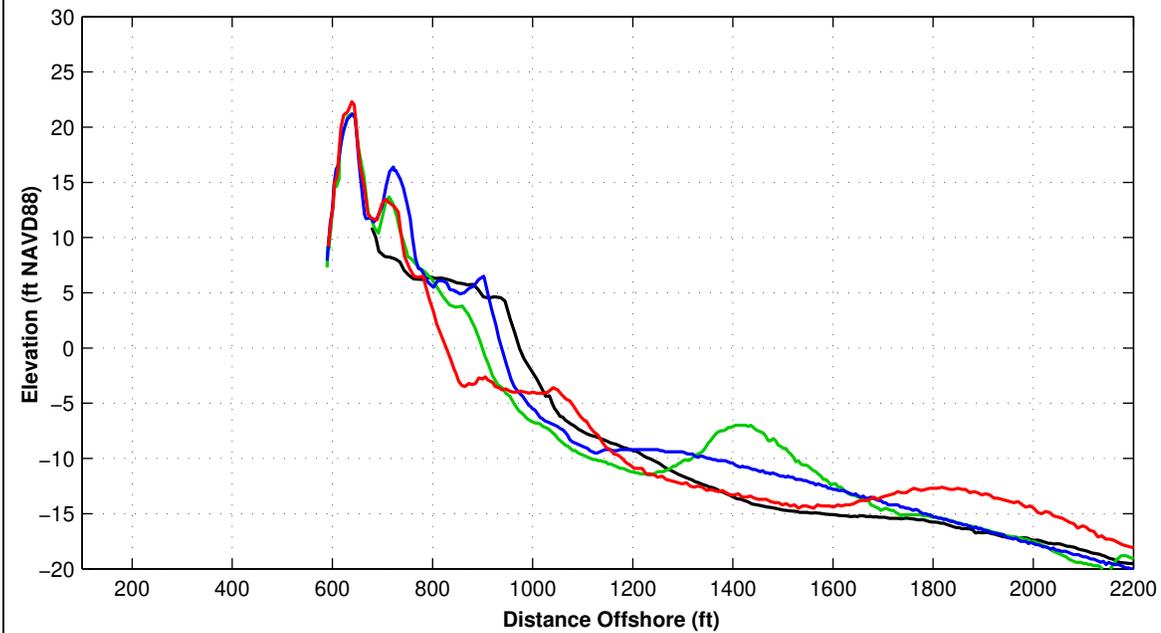
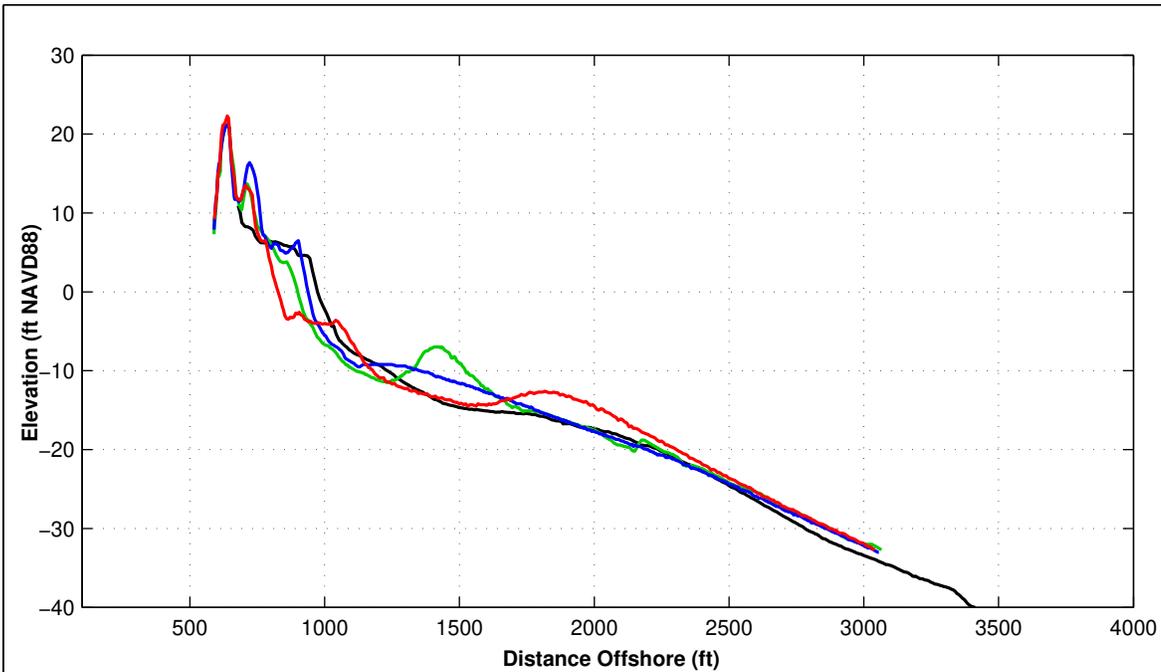
Survey Transect 900+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	22.65 ft	-126.94 ft
Volume Change Above +6 ft NAVD88	0.04 cy/ft	2.18 cy/ft
Volume Change Above 1.18 ft NAVD88	2.04 cy/ft	-16.37 cy/ft
Volume Change Above -6 ft NAVD88	3.83 cy/ft	-29.65 cy/ft
Volume Change Above -14 ft NAVD88	-24.61 cy/ft	-44.78 cy/ft
Volume Change Above -19 ft NAVD88	-20.38 cy/ft	-6.51 cy/ft
Volume Change Above -30 ft NAVD88	-33.72 cy/ft	11.94 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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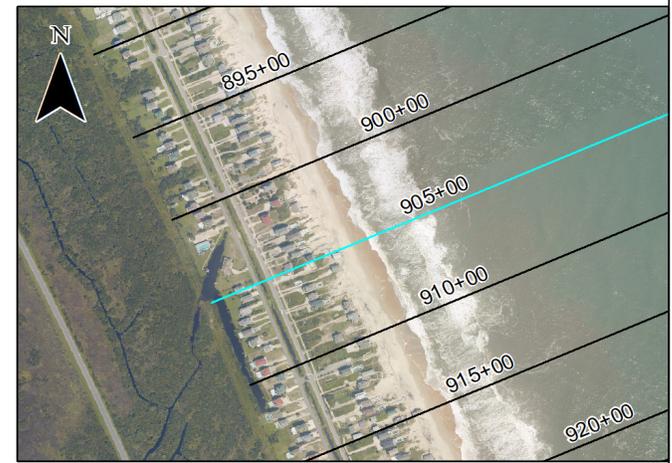


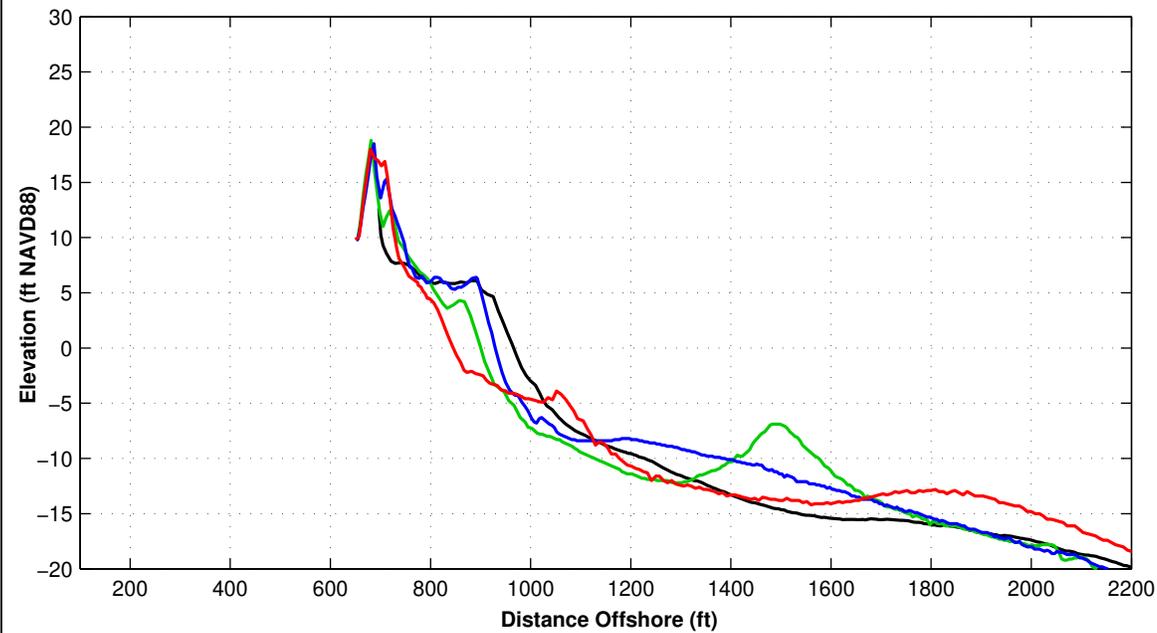
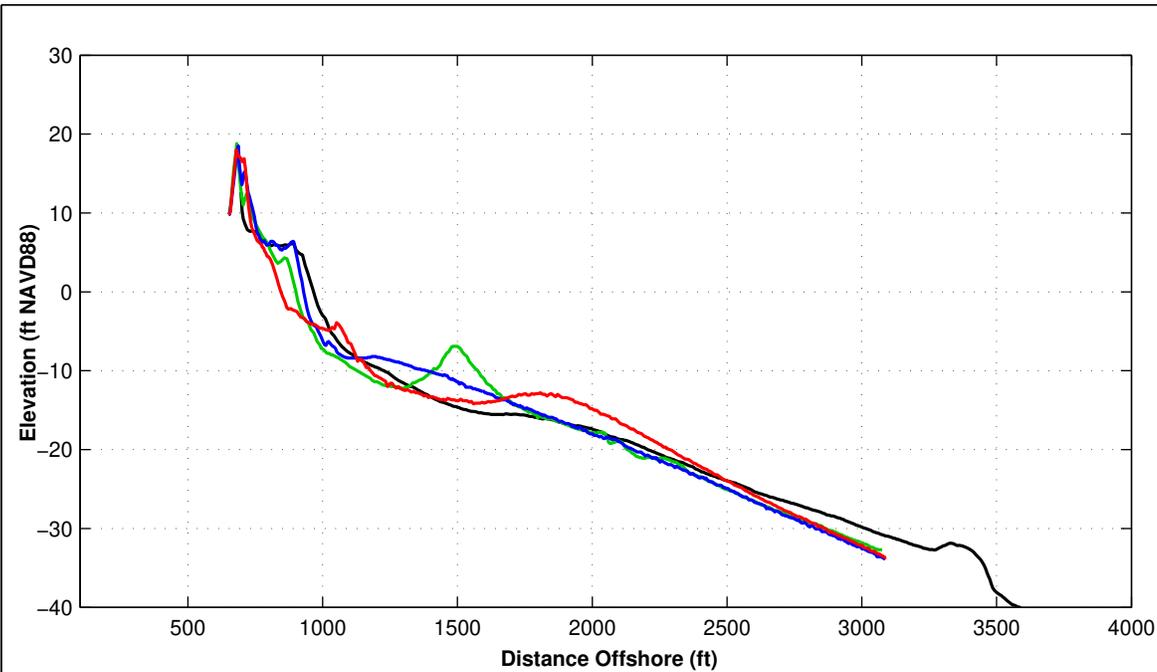
Survey Transect 905+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	40.68 ft	-113.86 ft
Volume Change Above +6 ft NAVD88	7.71 cy/ft	-9.27 cy/ft
Volume Change Above 1.18 ft NAVD88	18.10 cy/ft	-28.63 cy/ft
Volume Change Above -6 ft NAVD88	26.99 cy/ft	-40.54 cy/ft
Volume Change Above -14 ft NAVD88	19.50 cy/ft	-62.46 cy/ft
Volume Change Above -19 ft NAVD88	21.57 cy/ft	-25.79 cy/ft
Volume Change Above -30 ft NAVD88	13.58 cy/ft	-4.70 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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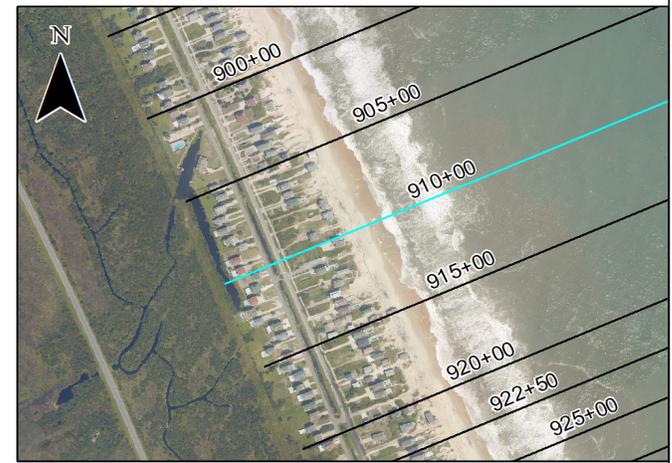


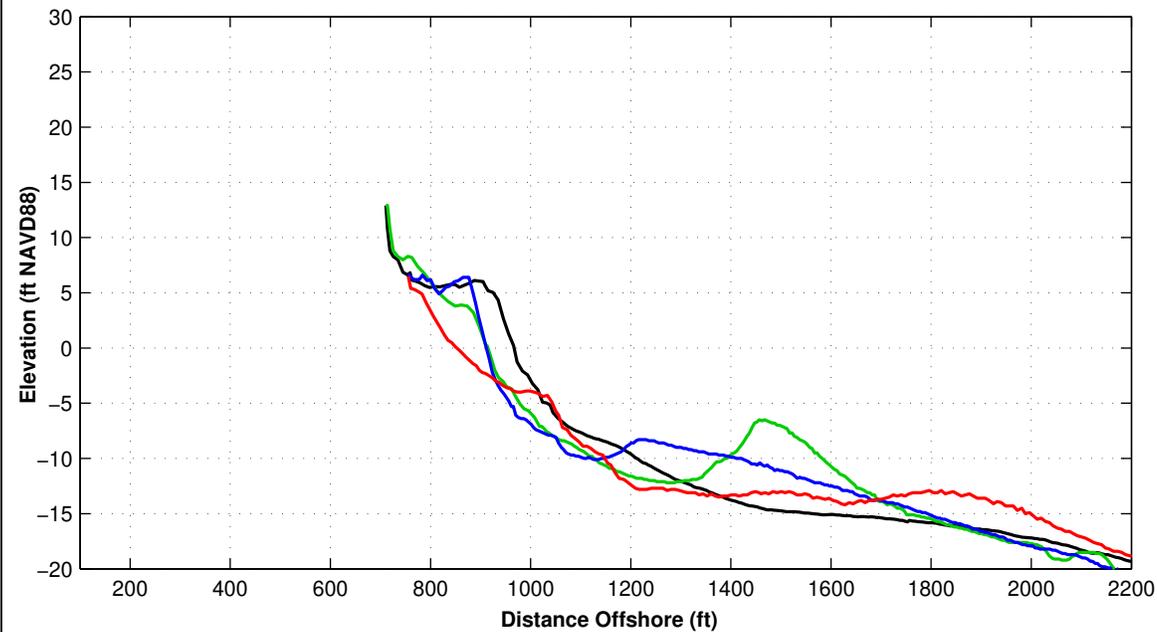
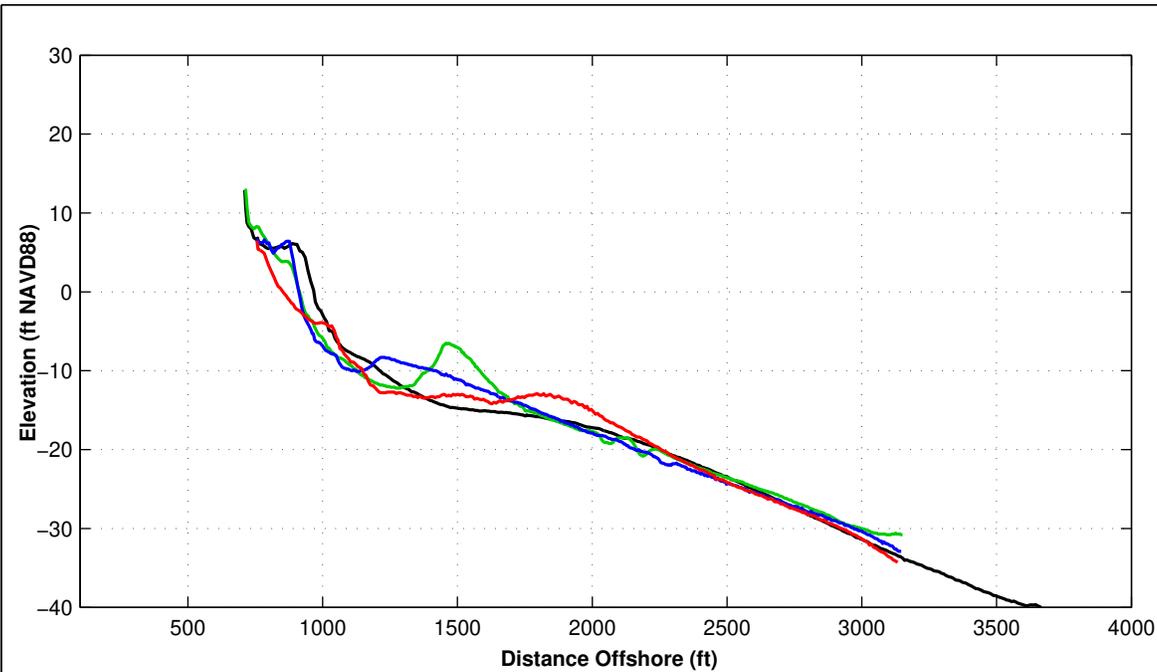
Survey Transect 910+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	30.91 ft	-89.18 ft
Volume Change Above +6 ft NAVD88	2.73 cy/ft	-1.82 cy/ft
Volume Change Above 1.18 ft NAVD88	12.15 cy/ft	-19.11 cy/ft
Volume Change Above -6 ft NAVD88	18.82 cy/ft	-26.38 cy/ft
Volume Change Above -14 ft NAVD88	26.41 cy/ft	-57.45 cy/ft
Volume Change Above -19 ft NAVD88	27.80 cy/ft	-19.42 cy/ft
Volume Change Above -30 ft NAVD88	25.93 cy/ft	10.46 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

- Notes:
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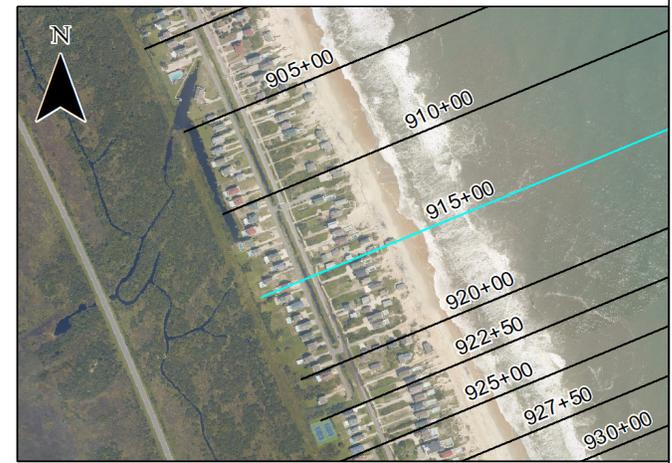


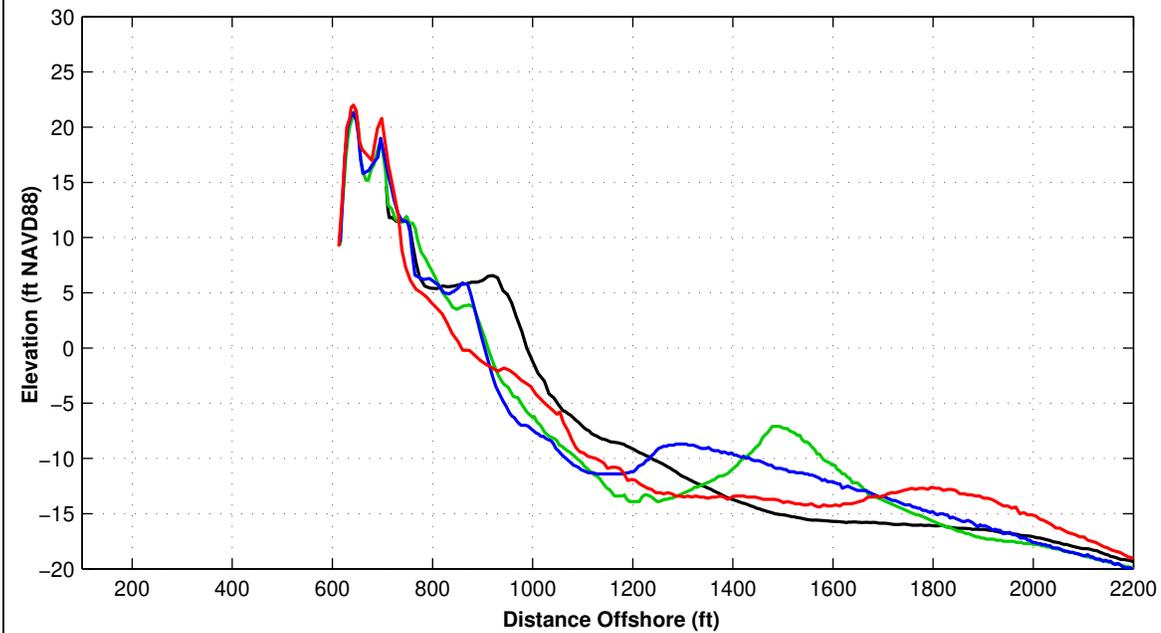
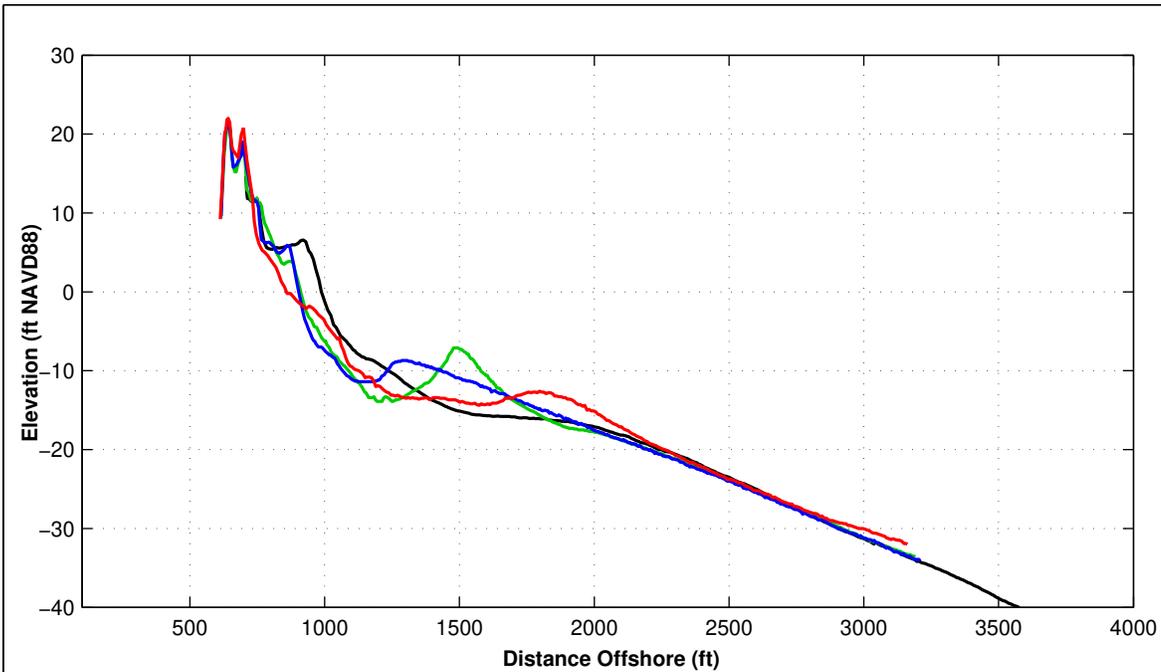
Survey Transect 915+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	1.70 ft	-77.02 ft
Volume Change Above +6 ft NAVD88	-1.58 cy/ft	-0.81 cy/ft
Volume Change Above 1.18 ft NAVD88	3.33 cy/ft	-17.11 cy/ft
Volume Change Above -6 ft NAVD88	0.40 cy/ft	-16.98 cy/ft
Volume Change Above -14 ft NAVD88	-5.52 cy/ft	-54.11 cy/ft
Volume Change Above -19 ft NAVD88	-2.81 cy/ft	-22.74 cy/ft
Volume Change Above -30 ft NAVD88	-20.72 cy/ft	-16.14 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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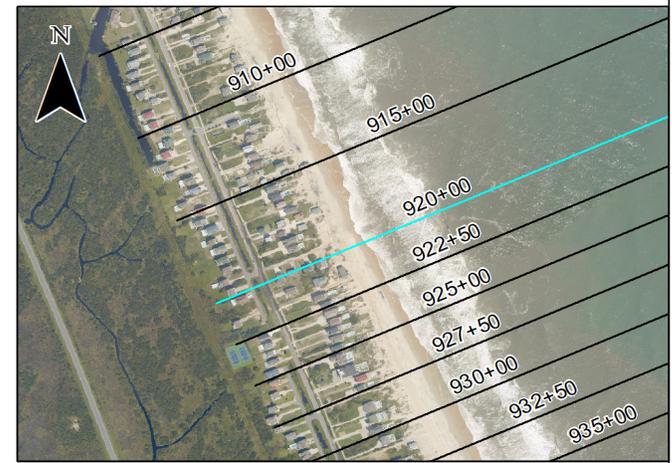


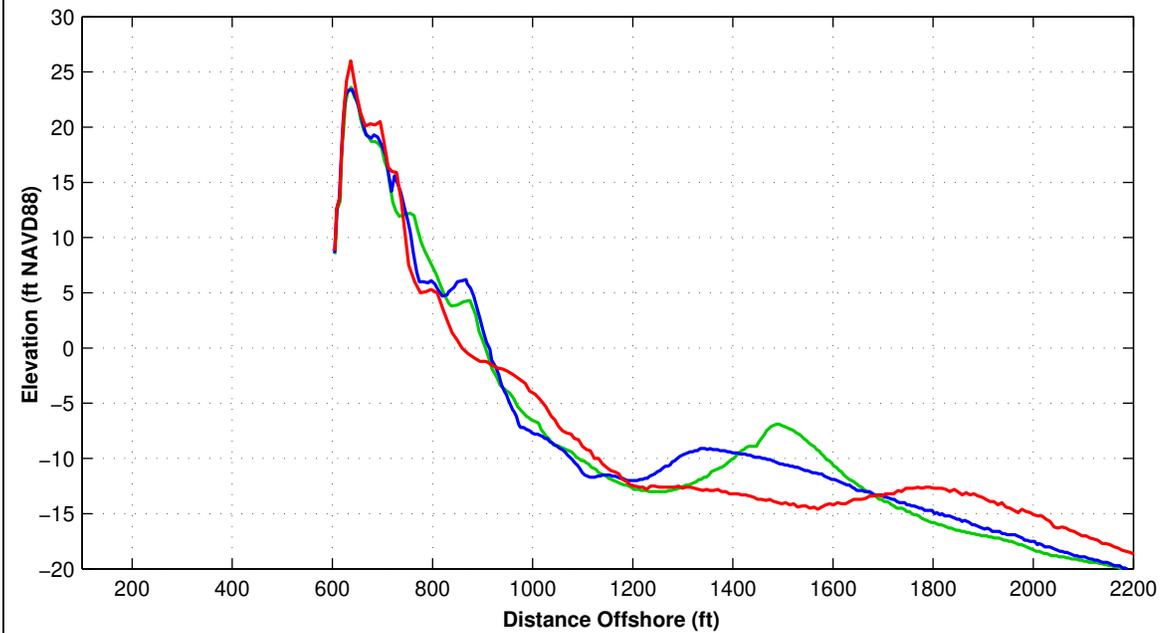
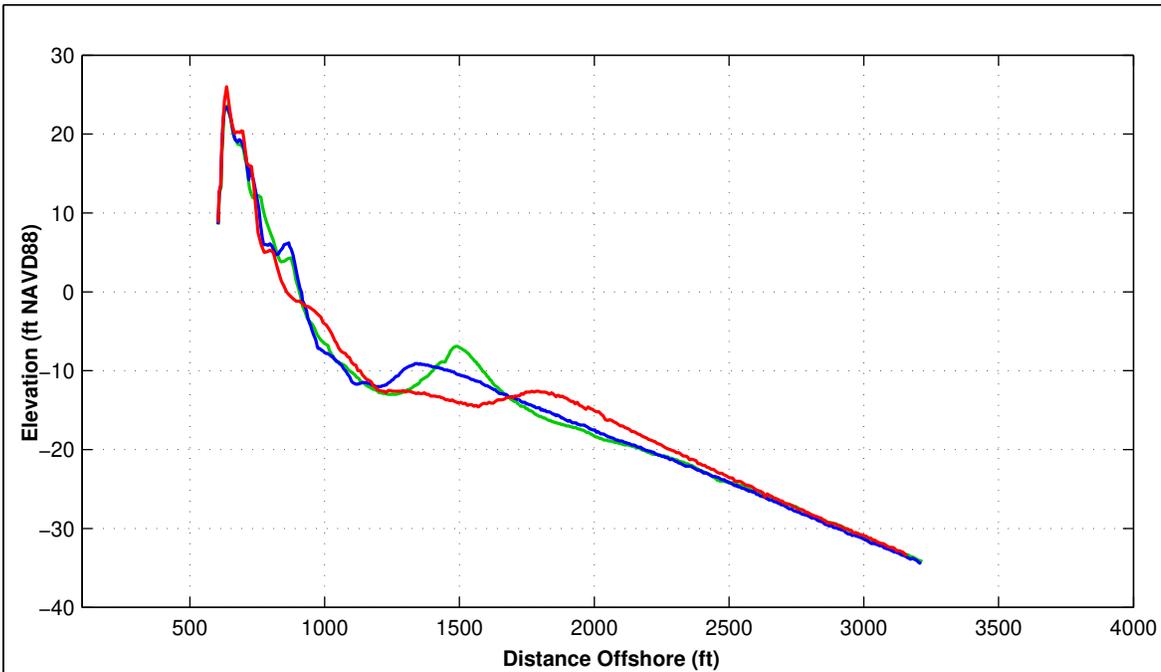
Survey Transect 920+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-5.40 ft	-55.54 ft
Volume Change Above +6 ft NAVD88	-1.80 cy/ft	0.35 cy/ft
Volume Change Above 1.18 ft NAVD88	0.95 cy/ft	-12.25 cy/ft
Volume Change Above -6 ft NAVD88	-3.62 cy/ft	-5.25 cy/ft
Volume Change Above -14 ft NAVD88	5.35 cy/ft	-38.78 cy/ft
Volume Change Above -19 ft NAVD88	13.71 cy/ft	-14.00 cy/ft
Volume Change Above -30 ft NAVD88	9.42 cy/ft	0.81 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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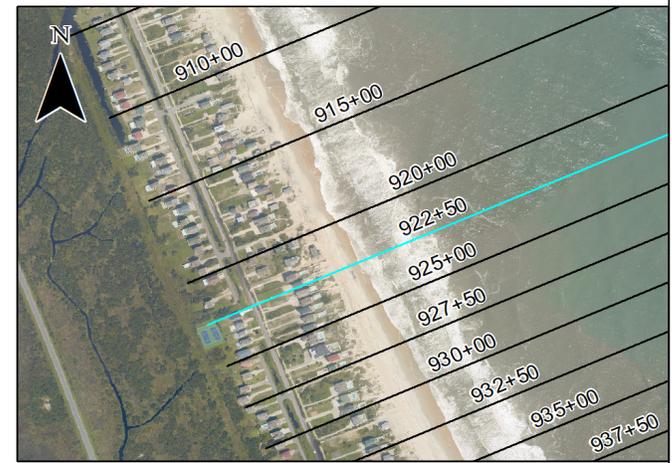


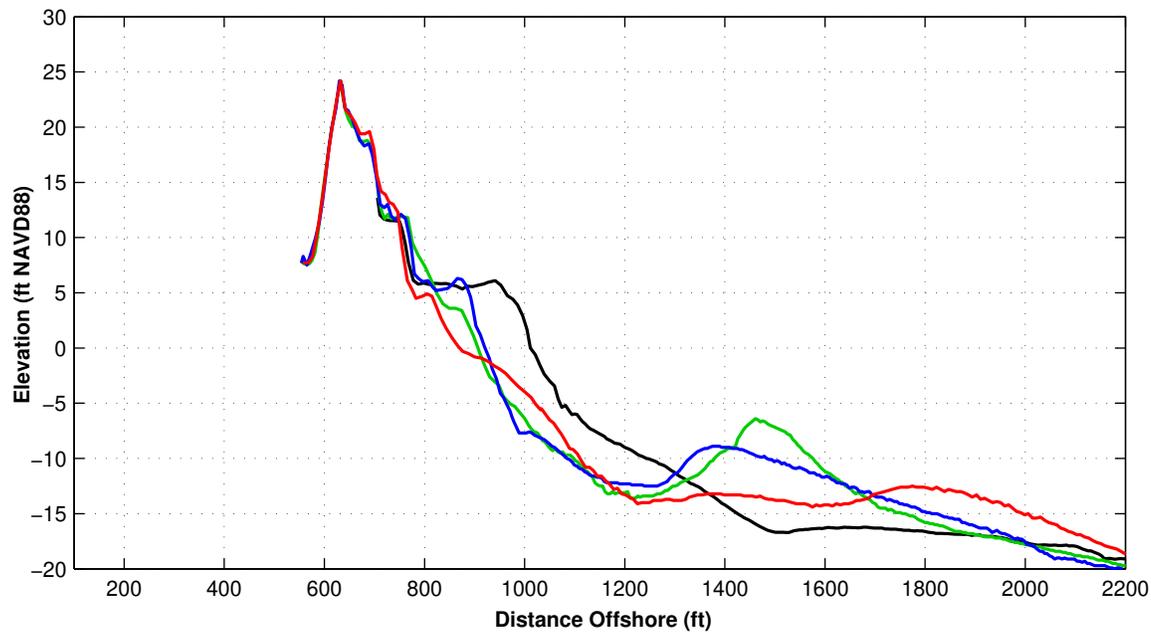
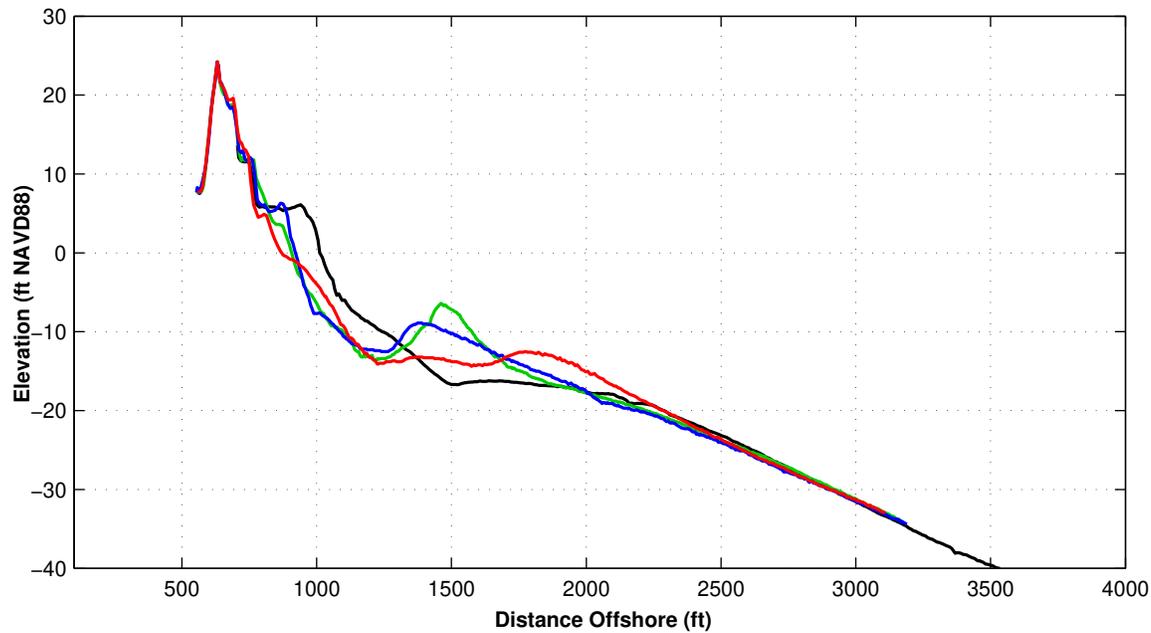
Survey Transect 922+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	7.64 ft	-61.14 ft
Volume Change Above +6 ft NAVD88	-2.57 cy/ft	0.85 cy/ft
Volume Change Above 1.18 ft NAVD88	0.94 cy/ft	-10.96 cy/ft
Volume Change Above -6 ft NAVD88	1.06 cy/ft	-7.56 cy/ft
Volume Change Above -14 ft NAVD88	-4.15 cy/ft	-33.80 cy/ft
Volume Change Above -19 ft NAVD88	5.63 cy/ft	-6.39 cy/ft
Volume Change Above -30 ft NAVD88	0.80 cy/ft	14.49 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
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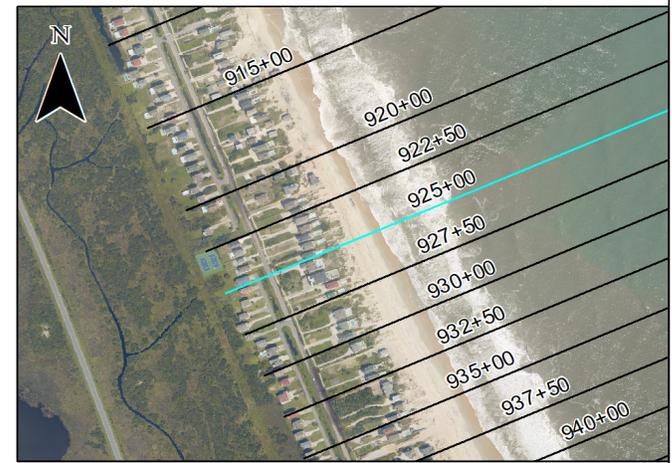


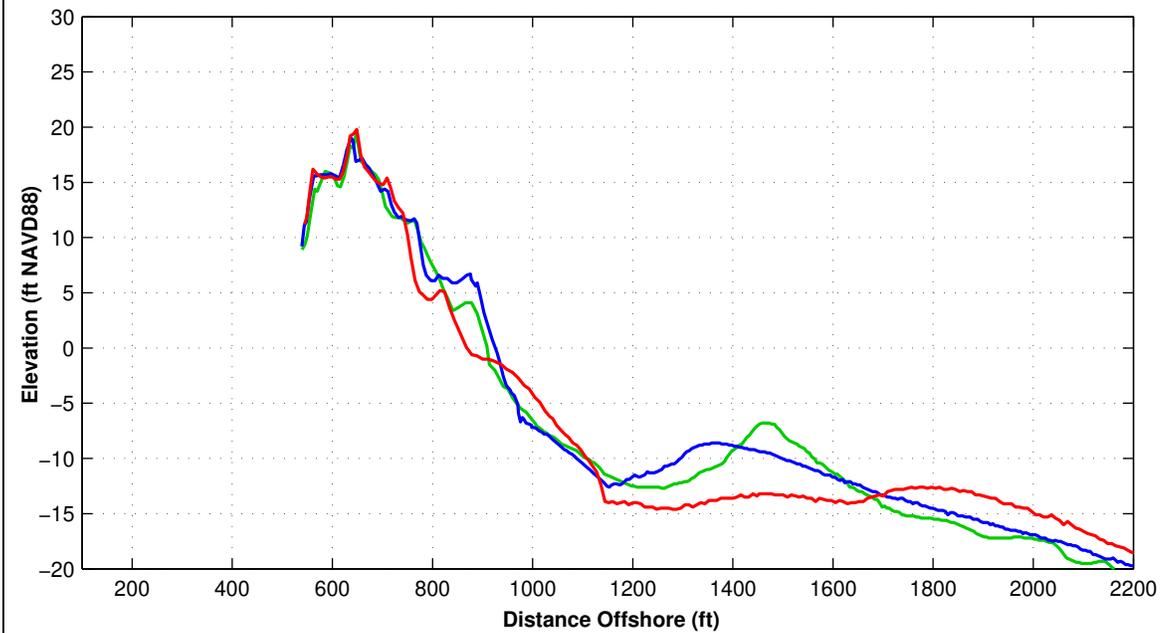
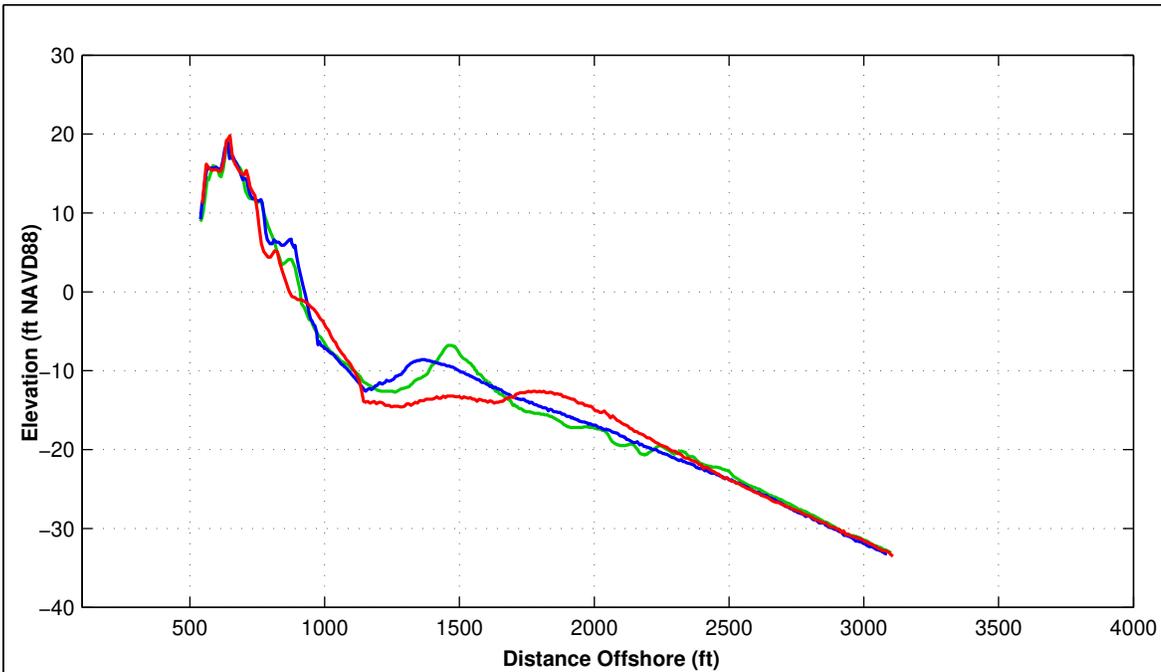


Survey Transect 925+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	14.80 ft	-60.35 ft
Volume Change Above +6 ft NAVD88	-1.75 cy/ft	-0.99 cy/ft
Volume Change Above 1.18 ft NAVD88	4.31 cy/ft	-14.21 cy/ft
Volume Change Above -6 ft NAVD88	5.70 cy/ft	-11.14 cy/ft
Volume Change Above -14 ft NAVD88	0.37 cy/ft	-44.21 cy/ft
Volume Change Above -19 ft NAVD88	7.13 cy/ft	-14.49 cy/ft
Volume Change Above -30 ft NAVD88	-5.73 cy/ft	0.40 cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
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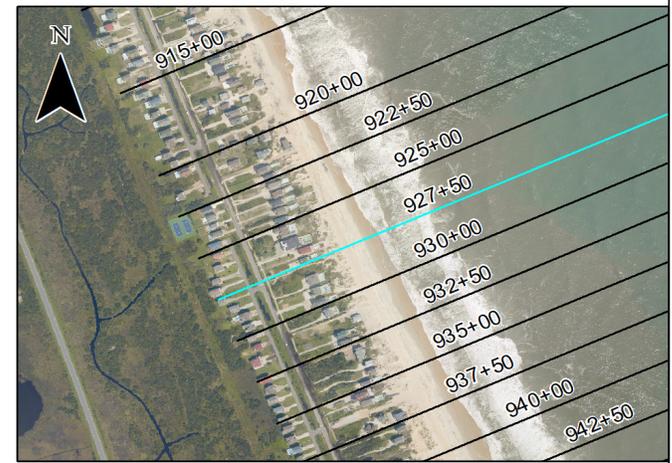


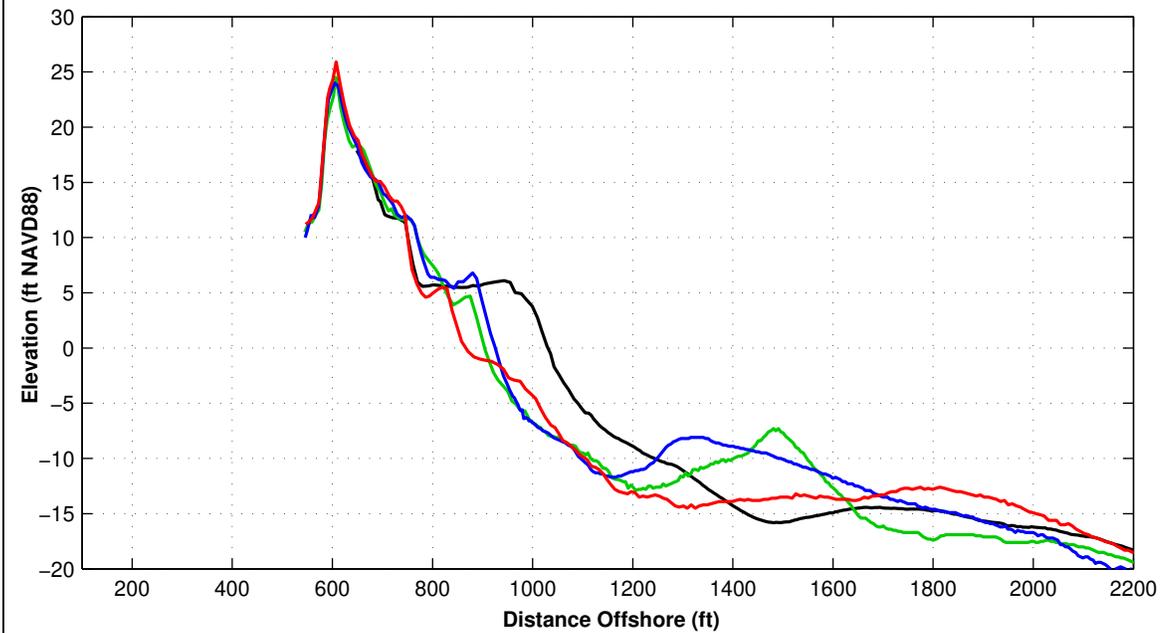
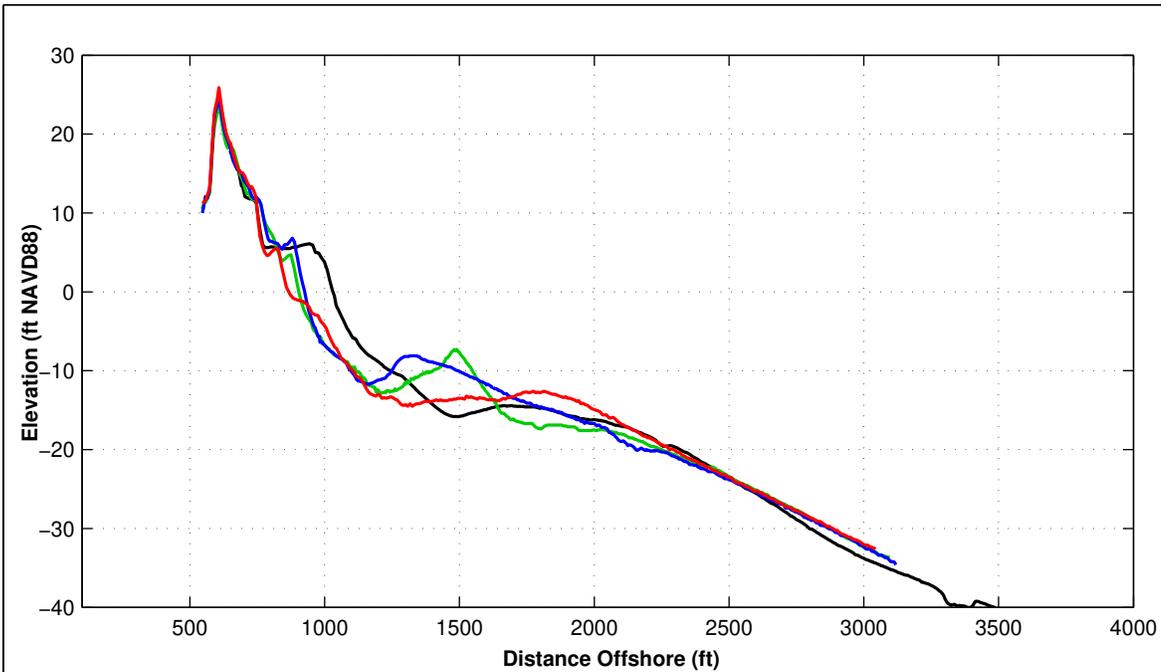
Survey Transect 927+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	14.74 ft	-59.68 ft
Volume Change Above +6 ft NAVD88	-0.67 cy/ft	-3.22 cy/ft
Volume Change Above 1.18 ft NAVD88	6.16 cy/ft	-17.17 cy/ft
Volume Change Above -6 ft NAVD88	8.75 cy/ft	-15.80 cy/ft
Volume Change Above -14 ft NAVD88	9.13 cy/ft	-63.85 cy/ft
Volume Change Above -19 ft NAVD88	22.21 cy/ft	-41.28 cy/ft
Volume Change Above -30 ft NAVD88	10.32 cy/ft	-34.24 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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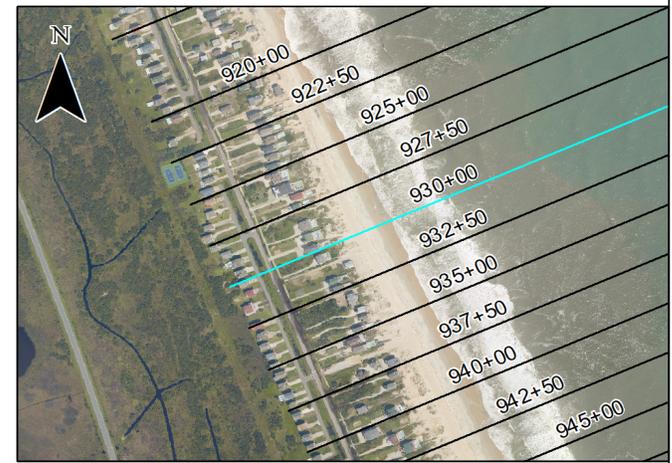


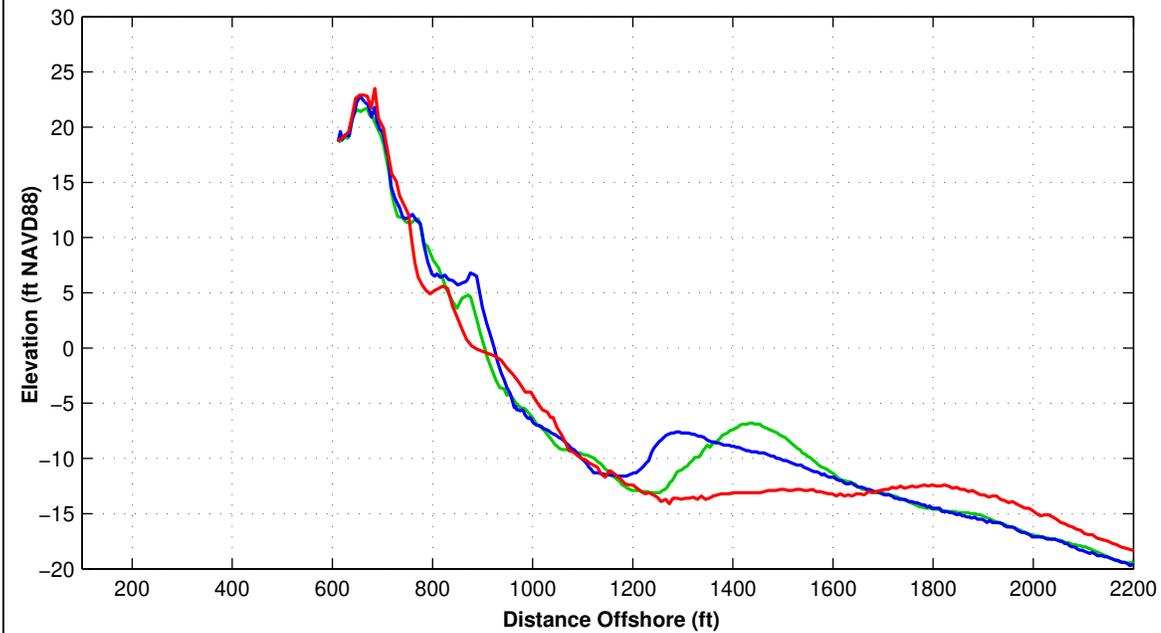
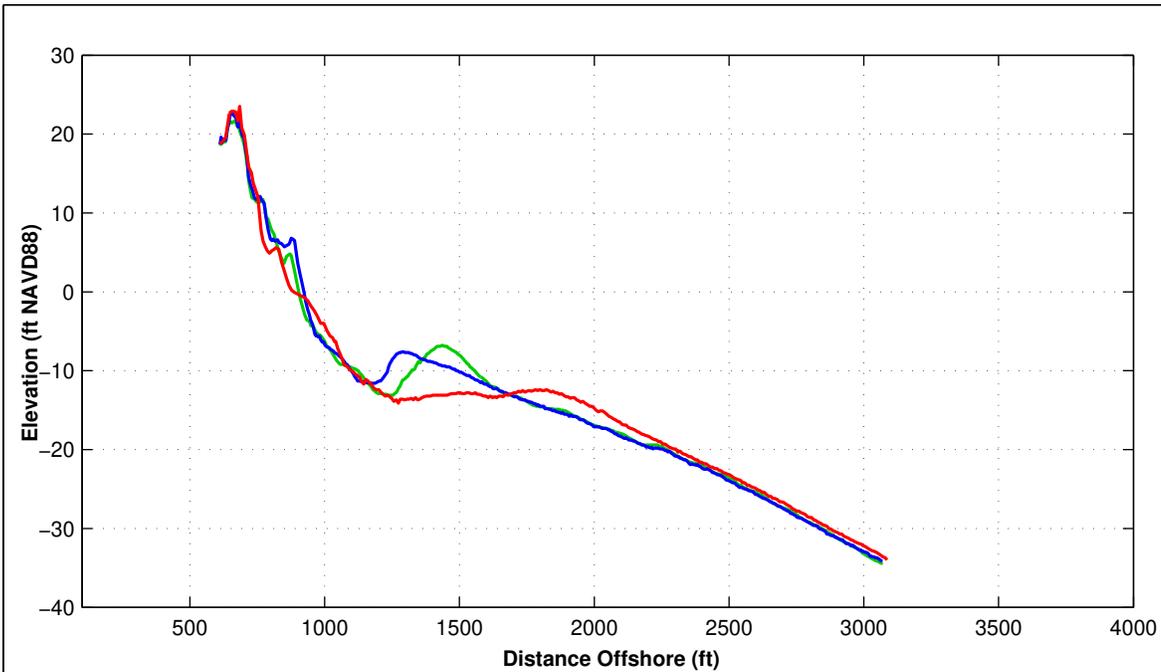
Survey Transect 930+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	19.94 ft	-62.85 ft
Volume Change Above +6 ft NAVD88	-0.40 cy/ft	-3.46 cy/ft
Volume Change Above 1.18 ft NAVD88	5.82 cy/ft	-16.50 cy/ft
Volume Change Above -6 ft NAVD88	9.36 cy/ft	-16.87 cy/ft
Volume Change Above -14 ft NAVD88	25.70 cy/ft	-71.86 cy/ft
Volume Change Above -19 ft NAVD88	48.61 cy/ft	-47.97 cy/ft
Volume Change Above -30 ft NAVD88	38.73 cy/ft	-35.68 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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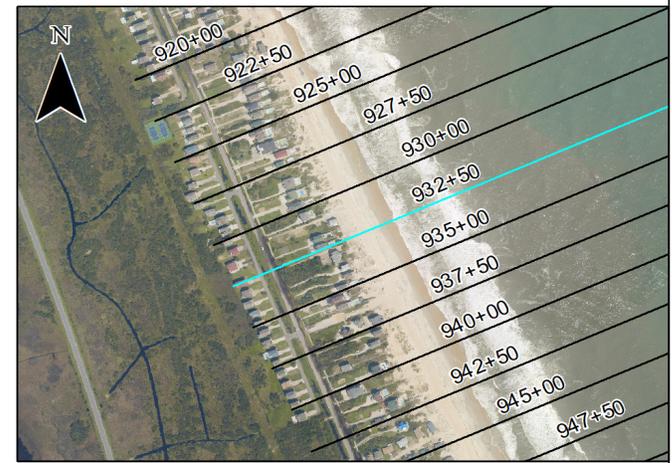


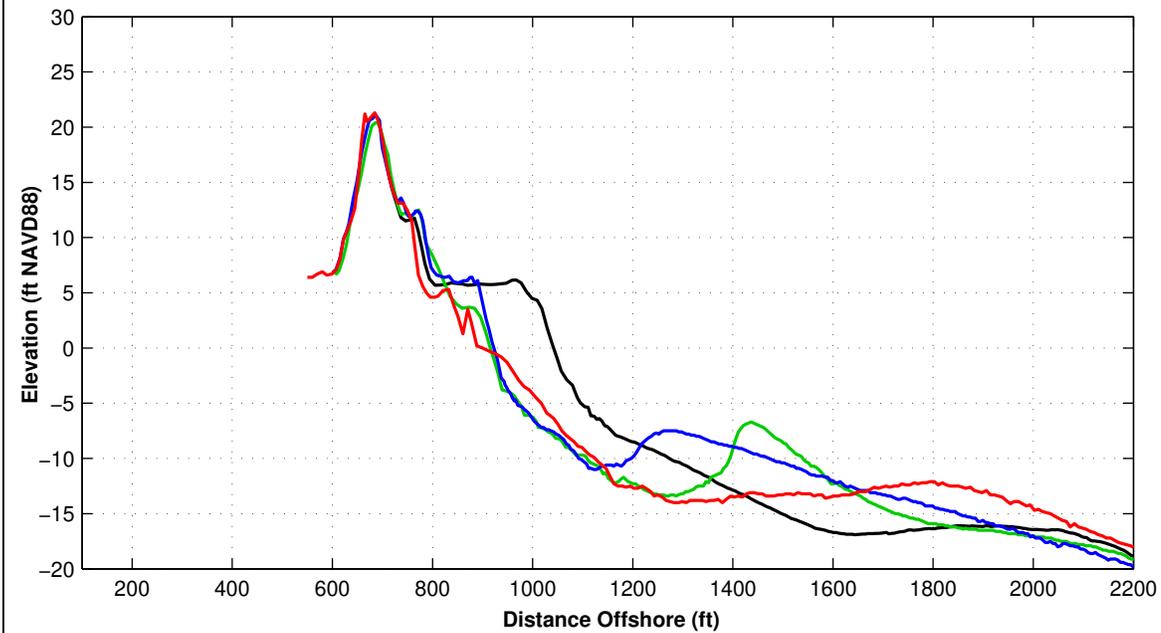
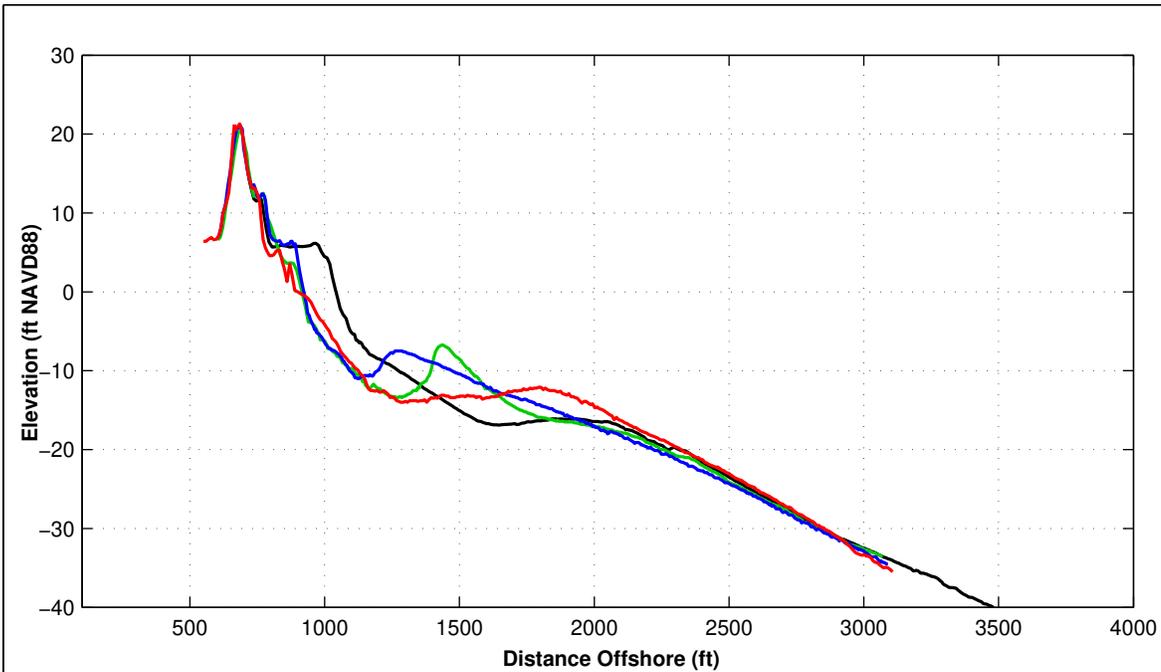
Survey Transect 932+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	19.02 ft	-51.69 ft
Volume Change Above +6 ft NAVD88	1.90 cy/ft	-2.91 cy/ft
Volume Change Above 1.18 ft NAVD88	7.83 cy/ft	-14.42 cy/ft
Volume Change Above -6 ft NAVD88	10.67 cy/ft	-11.15 cy/ft
Volume Change Above -14 ft NAVD88	13.92 cy/ft	-57.18 cy/ft
Volume Change Above -19 ft NAVD88	12.18 cy/ft	-32.98 cy/ft
Volume Change Above -30 ft NAVD88	8.14 cy/ft	-15.15 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

- Notes:
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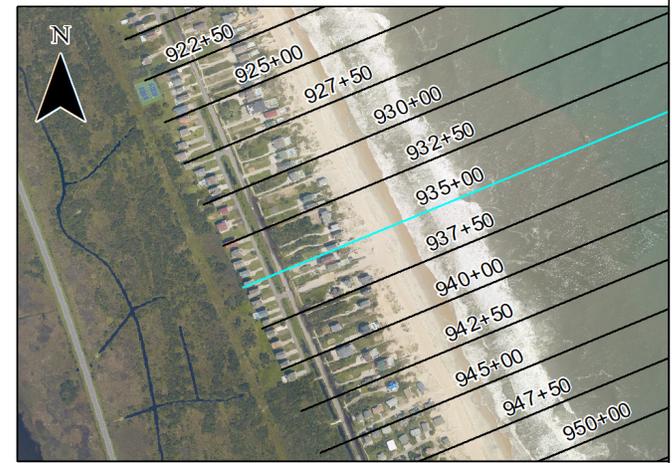


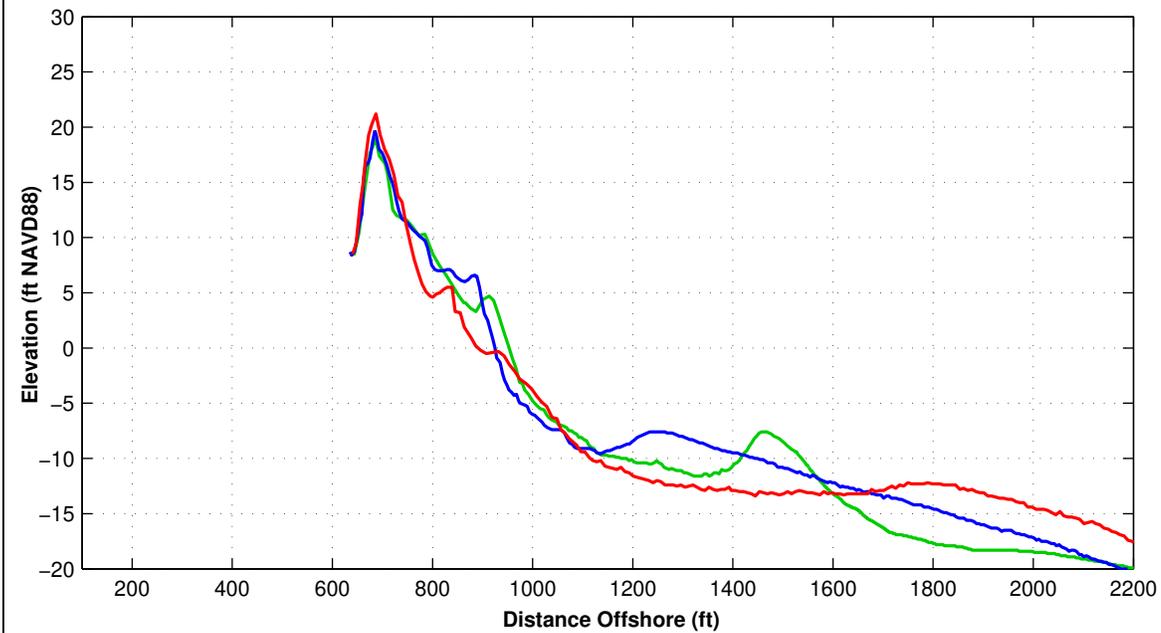
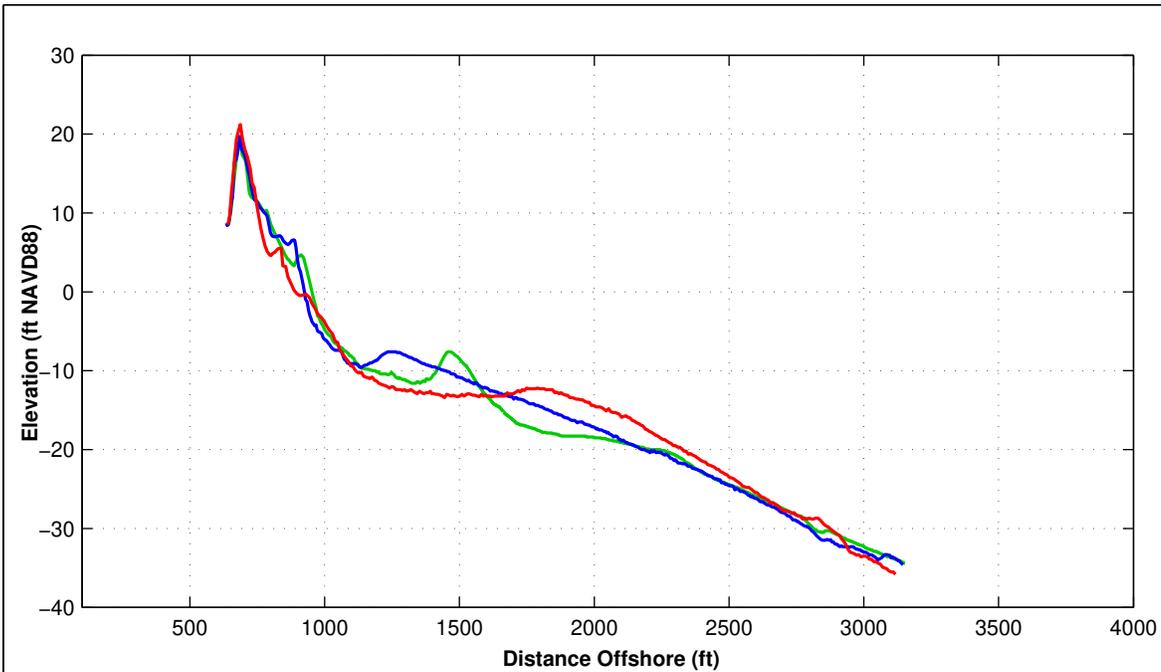
Survey Transect 935+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	7.56 ft	-31.79 ft
Volume Change Above +6 ft NAVD88	2.43 cy/ft	-6.34 cy/ft
Volume Change Above 1.18 ft NAVD88	8.63 cy/ft	-17.57 cy/ft
Volume Change Above -6 ft NAVD88	9.85 cy/ft	-12.55 cy/ft
Volume Change Above -14 ft NAVD88	36.50 cy/ft	-61.50 cy/ft
Volume Change Above -19 ft NAVD88	44.47 cy/ft	-33.34 cy/ft
Volume Change Above -30 ft NAVD88	34.41 cy/ft	-6.23 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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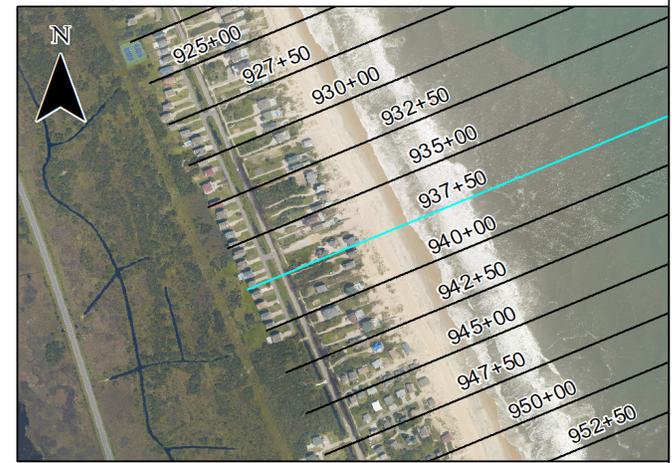


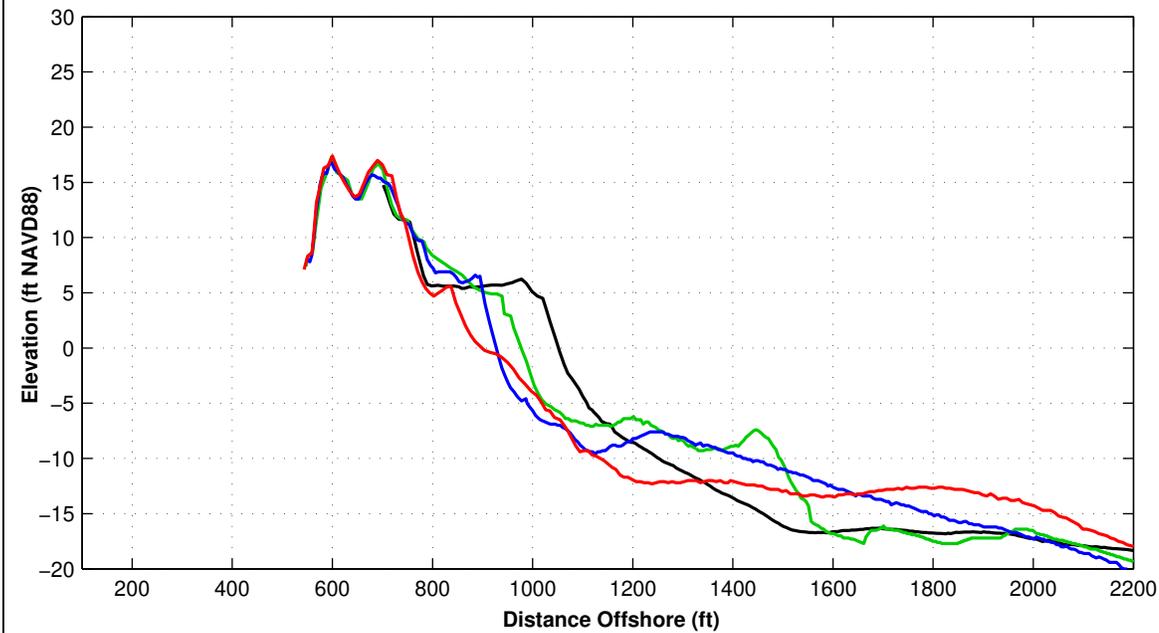
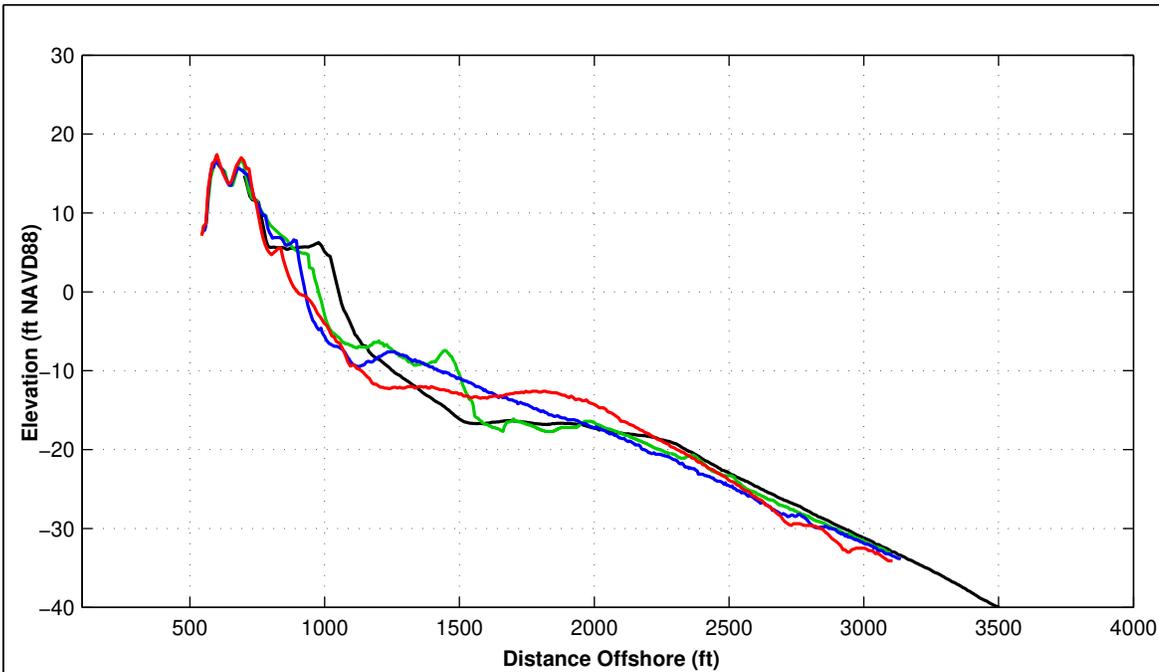
Survey Transect 937+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-26.25 ft	-44.87 ft
Volume Change Above +6 ft NAVD88	1.60 cy/ft	-4.52 cy/ft
Volume Change Above 1.18 ft NAVD88	2.23 cy/ft	-15.87 cy/ft
Volume Change Above -6 ft NAVD88	-5.36 cy/ft	-11.33 cy/ft
Volume Change Above -14 ft NAVD88	9.47 cy/ft	-52.09 cy/ft
Volume Change Above -19 ft NAVD88	43.13 cy/ft	-15.47 cy/ft
Volume Change Above -30 ft NAVD88	35.27 cy/ft	13.75 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.



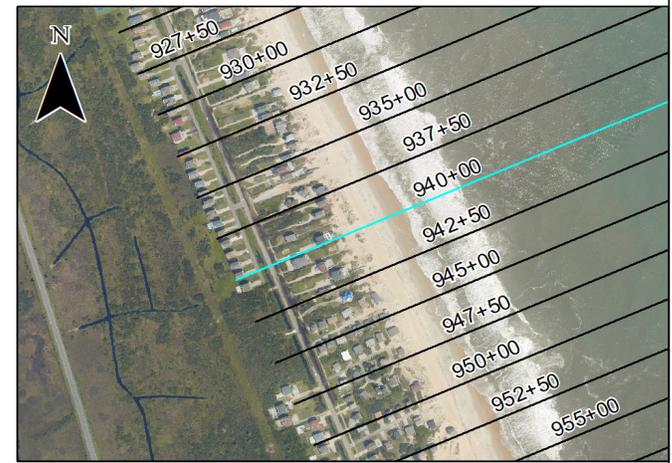


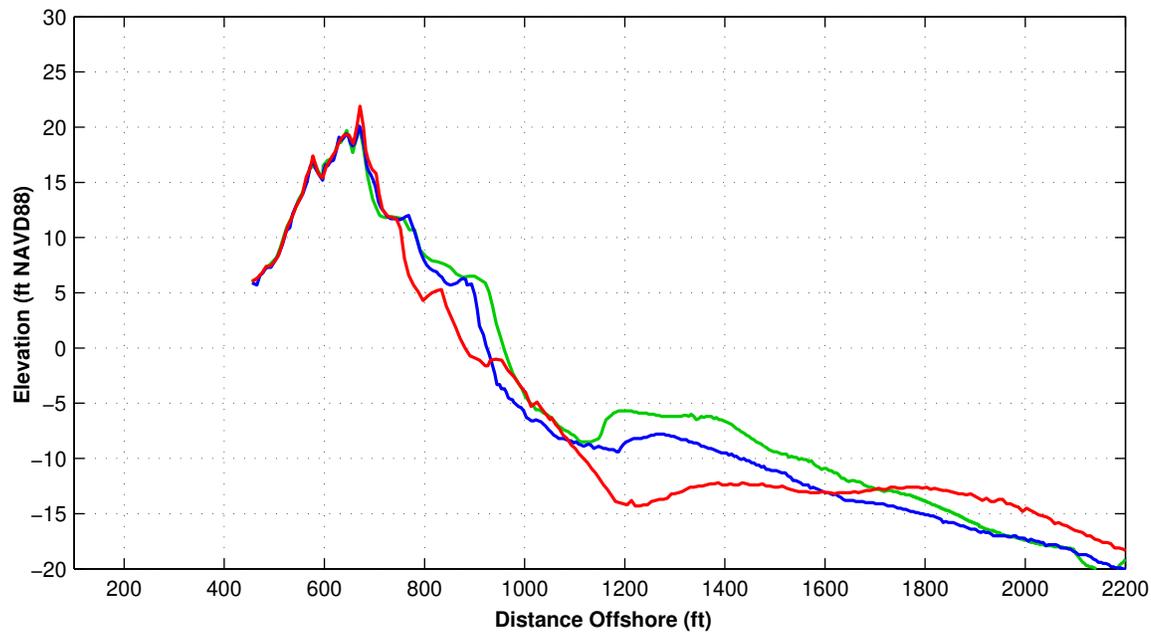
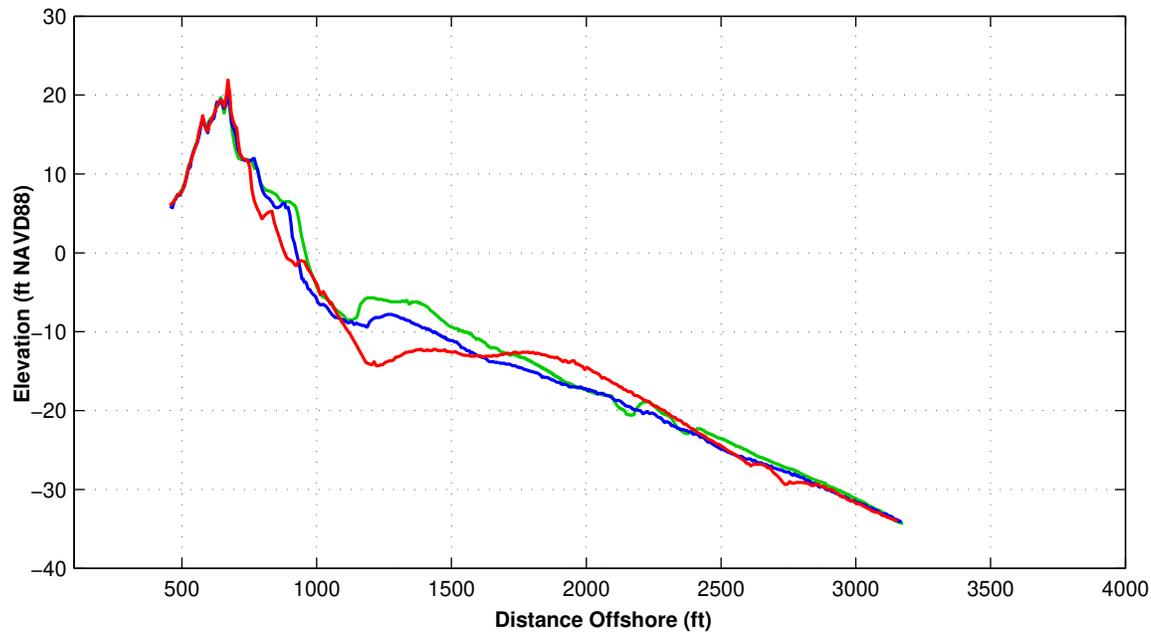
Survey Transect 940+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-47.17 ft	-44.47 ft
Volume Change Above +6 ft NAVD88	-1.92 cy/ft	-3.54 cy/ft
Volume Change Above 1.18 ft NAVD88	-7.09 cy/ft	-14.99 cy/ft
Volume Change Above -6 ft NAVD88	-19.99 cy/ft	-11.68 cy/ft
Volume Change Above -14 ft NAVD88	-31.24 cy/ft	-47.66 cy/ft
Volume Change Above -19 ft NAVD88	-2.72 cy/ft	-13.12 cy/ft
Volume Change Above -30 ft NAVD88	-26.39 cy/ft	1.34 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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  2. All Survey Elevations In Feet Referenced to NAVD88.

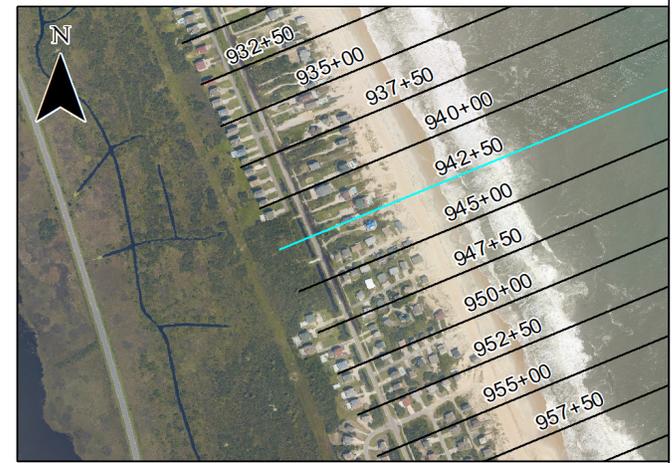


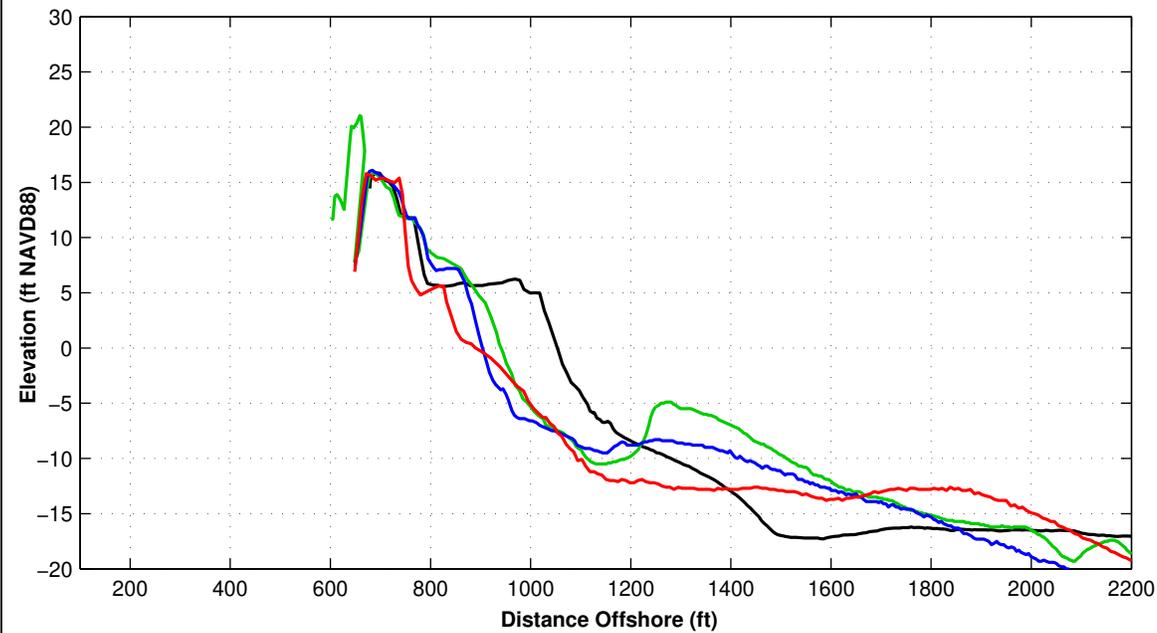
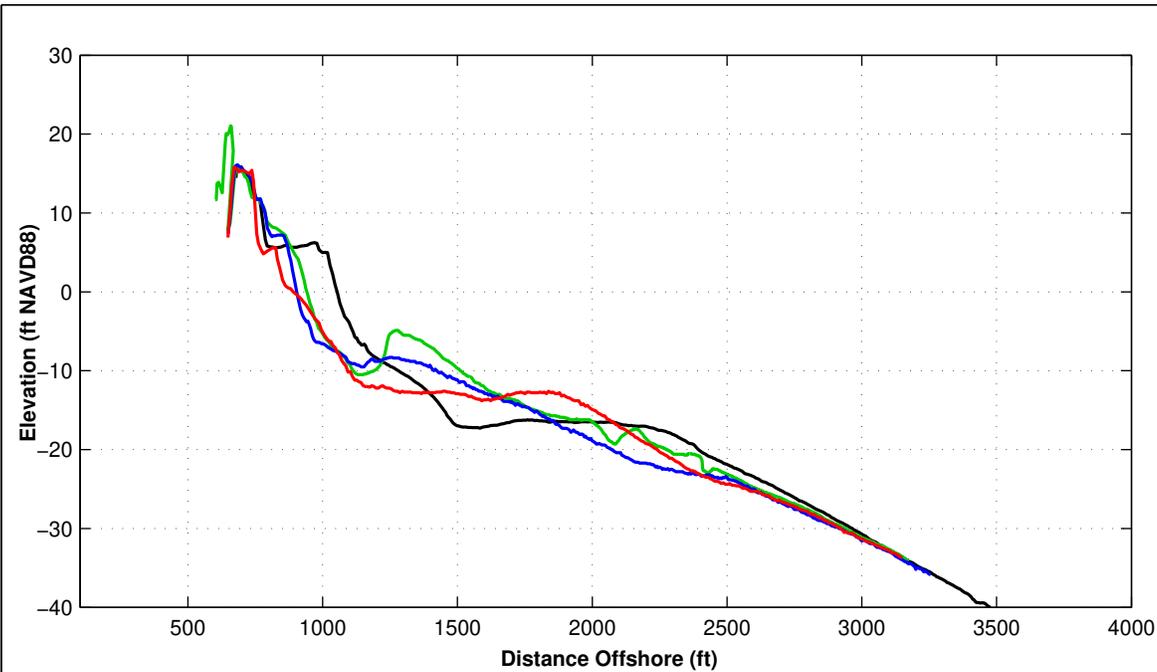


Survey Transect 942+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-32.41 ft	-49.50 ft
Volume Change Above +6 ft NAVD88	-1.15 cy/ft	-5.87 cy/ft
Volume Change Above 1.18 ft NAVD88	-7.06 cy/ft	-17.97 cy/ft
Volume Change Above -6 ft NAVD88	-16.88 cy/ft	-15.31 cy/ft
Volume Change Above -14 ft NAVD88	-67.94 cy/ft	-58.13 cy/ft
Volume Change Above -19 ft NAVD88	-73.50 cy/ft	-25.21 cy/ft
Volume Change Above -30 ft NAVD88	-91.57 cy/ft	-20.54 cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
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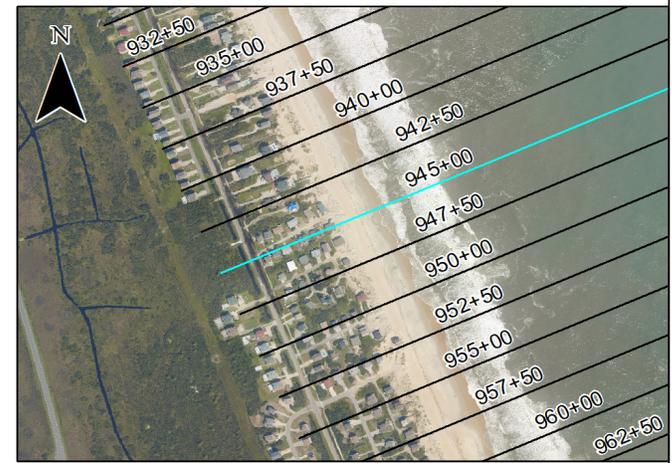


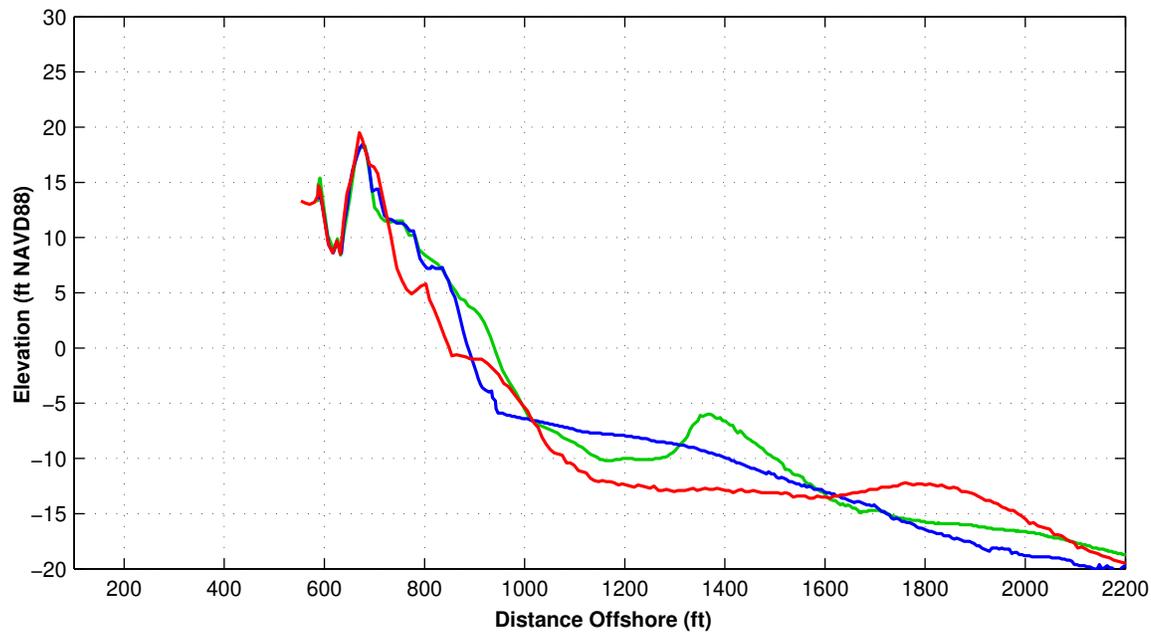
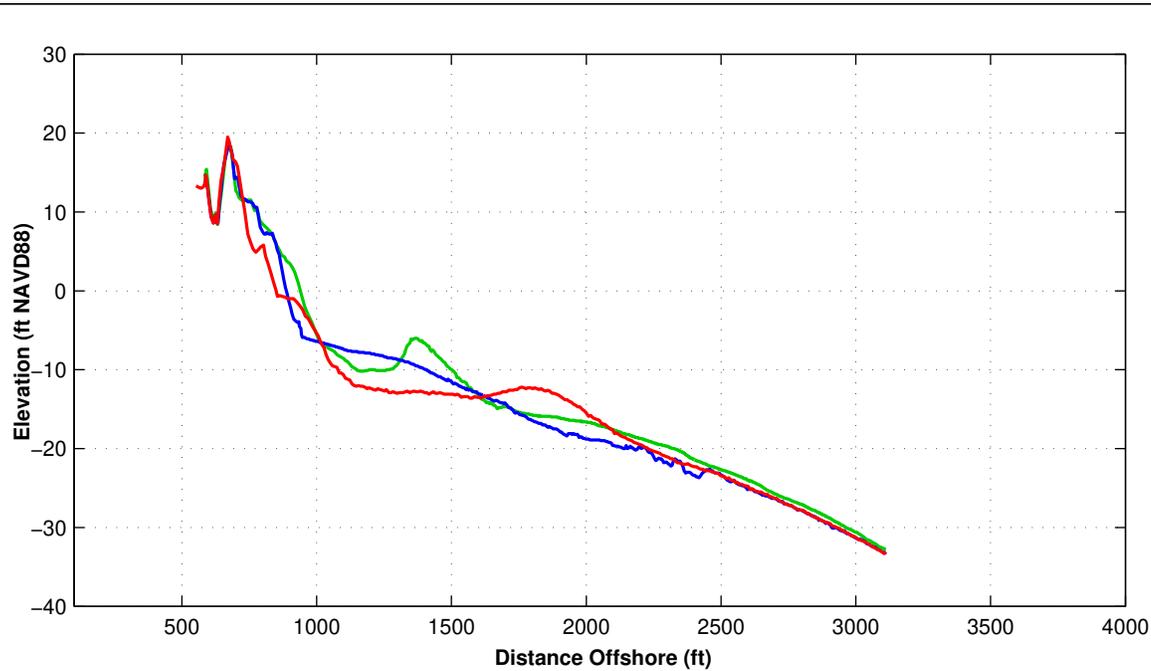


Survey Transect 945+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-36.10 ft	-41.04 ft
Volume Change Above +6 ft NAVD88	0.74 cy/ft	-9.83 cy/ft
Volume Change Above 1.18 ft NAVD88	-4.12 cy/ft	-19.51 cy/ft
Volume Change Above -6 ft NAVD88	-16.59 cy/ft	-14.19 cy/ft
Volume Change Above -14 ft NAVD88	-43.08 cy/ft	-54.91 cy/ft
Volume Change Above -19 ft NAVD88	-60.75 cy/ft	-15.18 cy/ft
Volume Change Above -30 ft NAVD88	-100.23 cy/ft	4.67 cy/ft

**LEGEND:**  
 JUNE 2022 ———— (red line)  
 JULY 2021 ———— (blue line)  
 JUNE 2020 ———— (green line)  
 AUGUST 2019 ———— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.

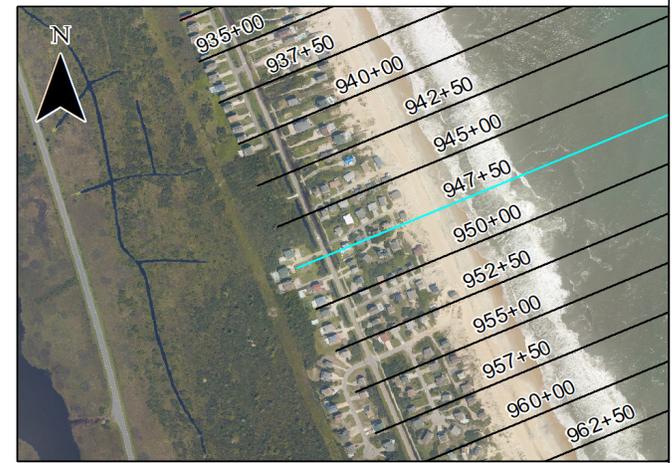


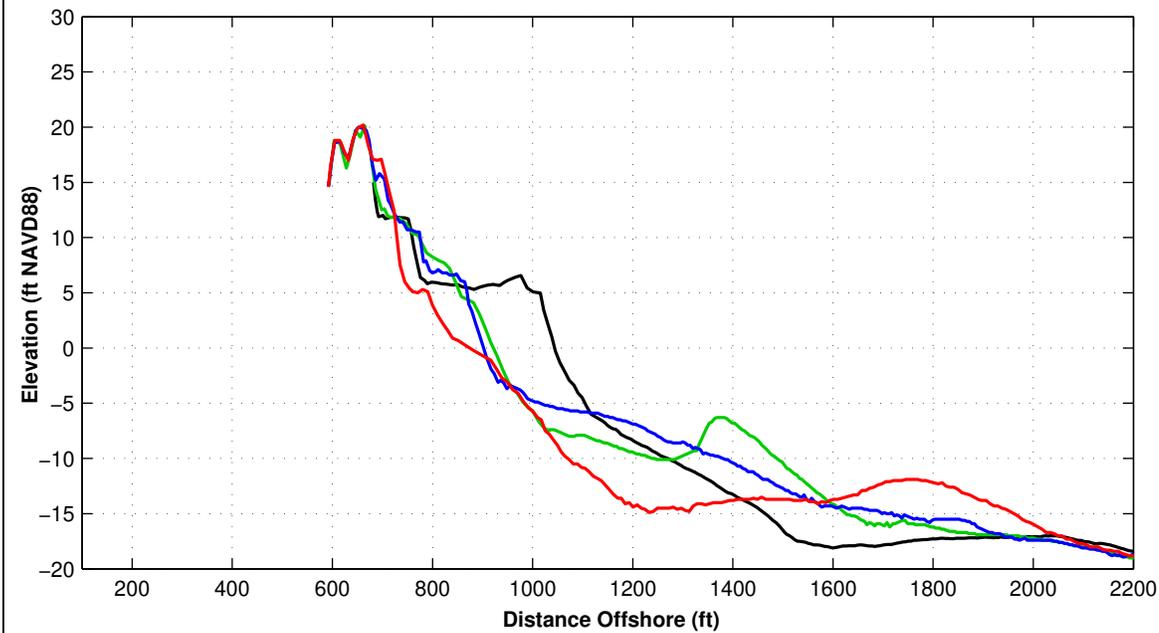
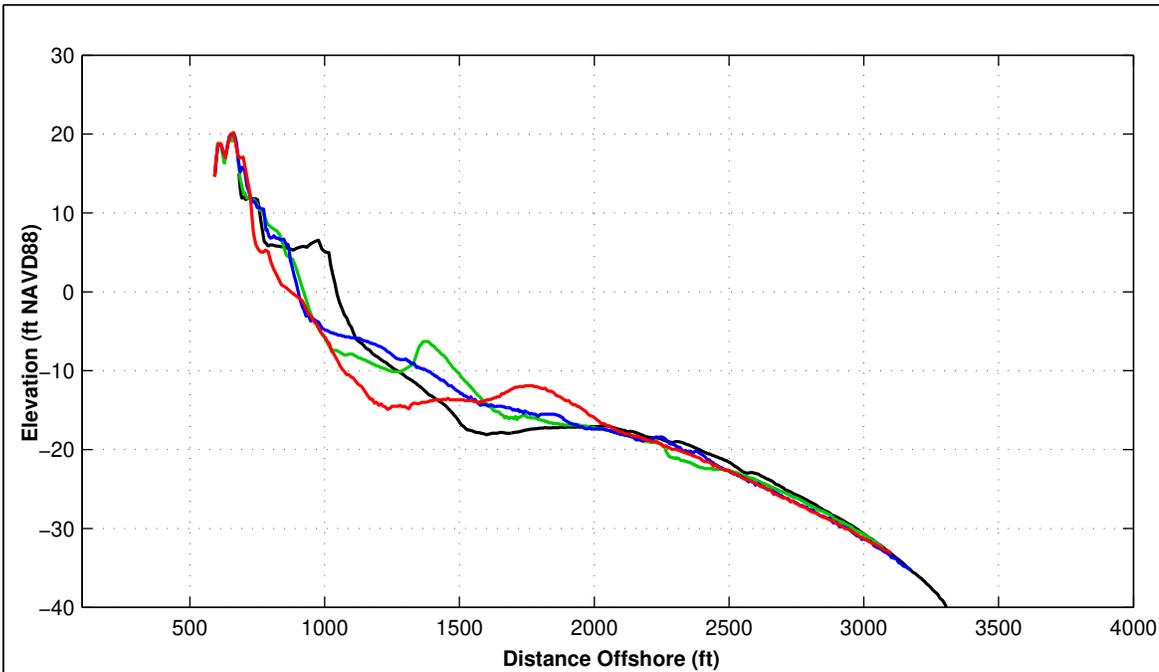


Survey Transect 947+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-50.51 ft	-40.59 ft
Volume Change Above +6 ft NAVD88	0.50 cy/ft	-9.75 cy/ft
Volume Change Above 1.18 ft NAVD88	-4.42 cy/ft	-19.14 cy/ft
Volume Change Above -6 ft NAVD88	-18.71 cy/ft	-13.53 cy/ft
Volume Change Above -14 ft NAVD88	-22.45 cy/ft	-63.41 cy/ft
Volume Change Above -19 ft NAVD88	-43.45 cy/ft	-21.77 cy/ft
Volume Change Above -30 ft NAVD88	-77.29 cy/ft	-12.39 cy/ft

**LEGEND:**  
 JUNE 2022 ——— (Red line)  
 JULY 2021 ——— (Blue line)  
 JUNE 2020 ——— (Green line)  
 AUGUST 2019 ——— (Black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.



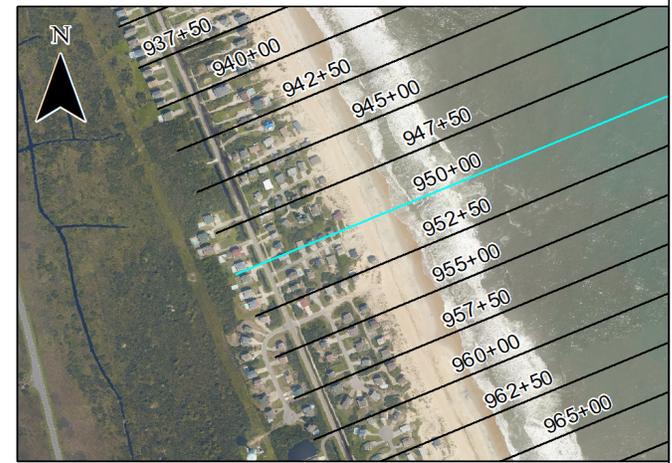


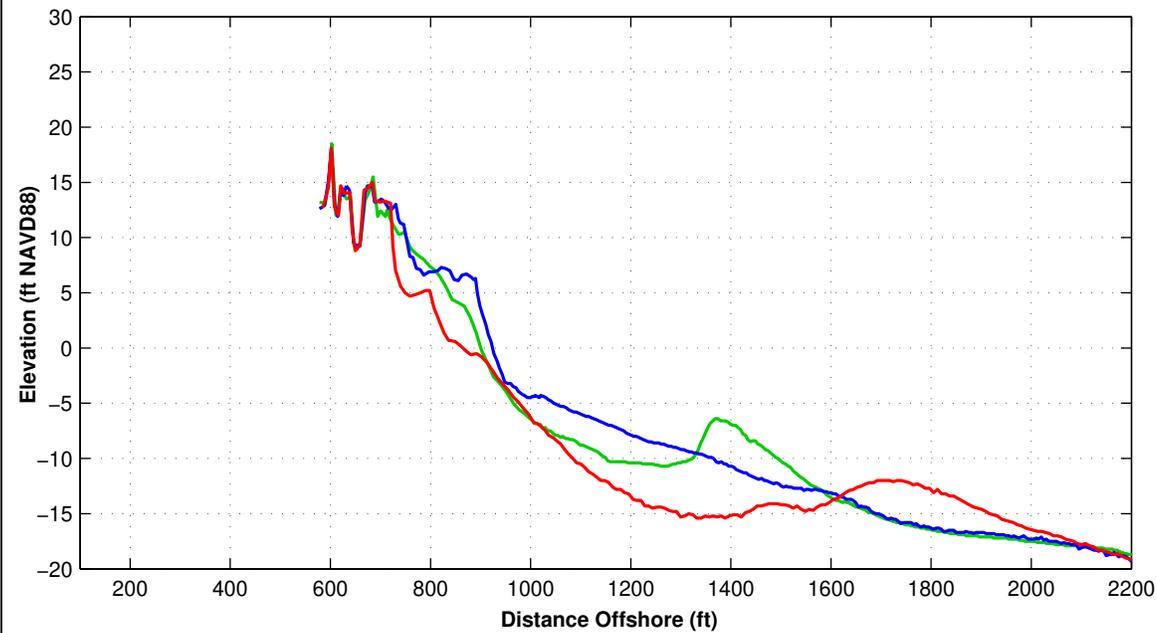
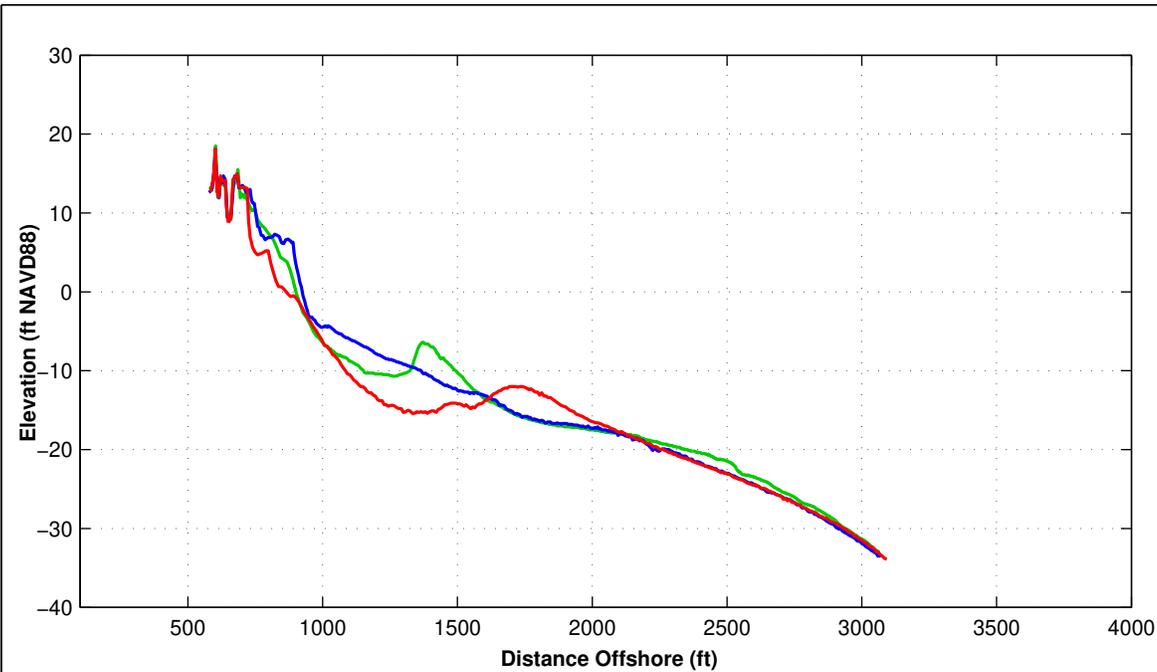
Survey Transect 950+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-16.91 ft	-57.80 ft
Volume Change Above +6 ft NAVD88	1.68 cy/ft	-9.33 cy/ft
Volume Change Above 1.18 ft NAVD88	0.97 cy/ft	-23.24 cy/ft
Volume Change Above -6 ft NAVD88	0.93 cy/ft	-28.02 cy/ft
Volume Change Above -14 ft NAVD88	0.22 cy/ft	-94.52 cy/ft
Volume Change Above -19 ft NAVD88	9.37 cy/ft	-73.34 cy/ft
Volume Change Above -30 ft NAVD88	11.78 cy/ft	-77.58 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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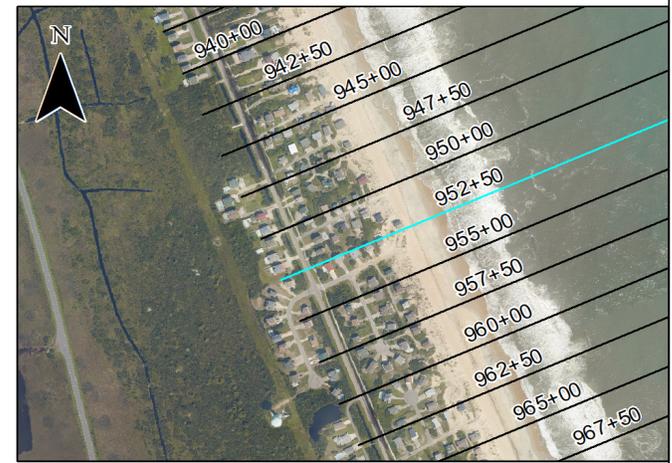


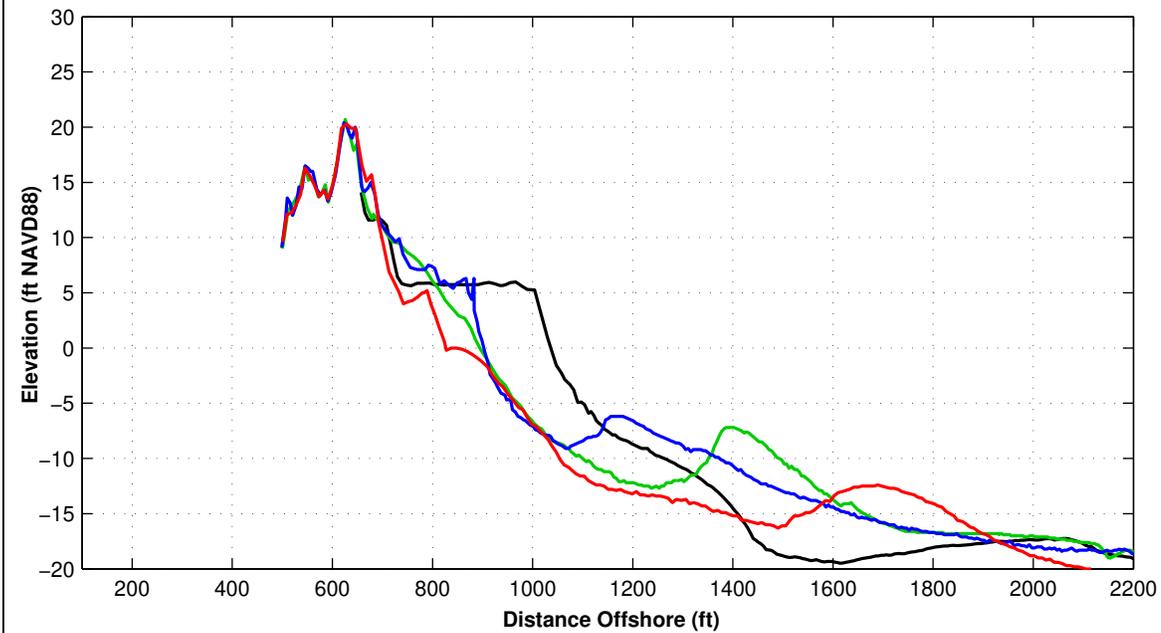
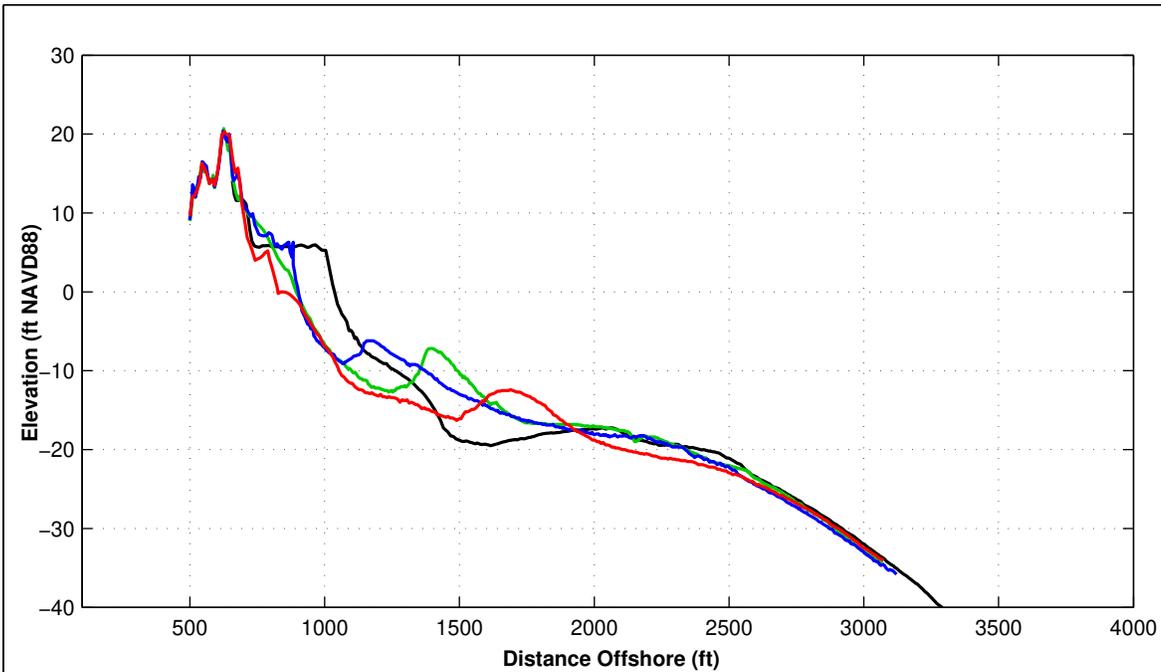


Survey Transect 952+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	23.28 ft	-86.08 ft
Volume Change Above +6 ft NAVD88	2.55 cy/ft	-10.30 cy/ft
Volume Change Above 1.18 ft NAVD88	9.53 cy/ft	-28.83 cy/ft
Volume Change Above -6 ft NAVD88	19.28 cy/ft	-40.44 cy/ft
Volume Change Above -14 ft NAVD88	23.39 cy/ft	-105.29 cy/ft
Volume Change Above -19 ft NAVD88	25.93 cy/ft	-90.54 cy/ft
Volume Change Above -30 ft NAVD88	0.89 cy/ft	-90.25 cy/ft

**LEGEND:**  
 JUNE 2022 ———— (red line)  
 JULY 2021 ———— (blue line)  
 JUNE 2020 ———— (green line)  
 AUGUST 2019 ———— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
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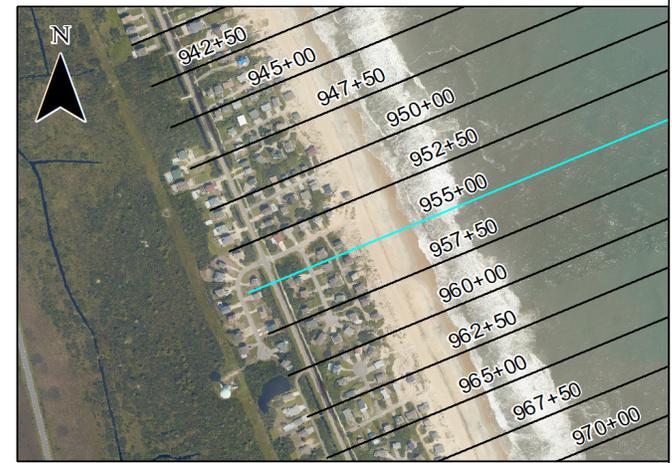


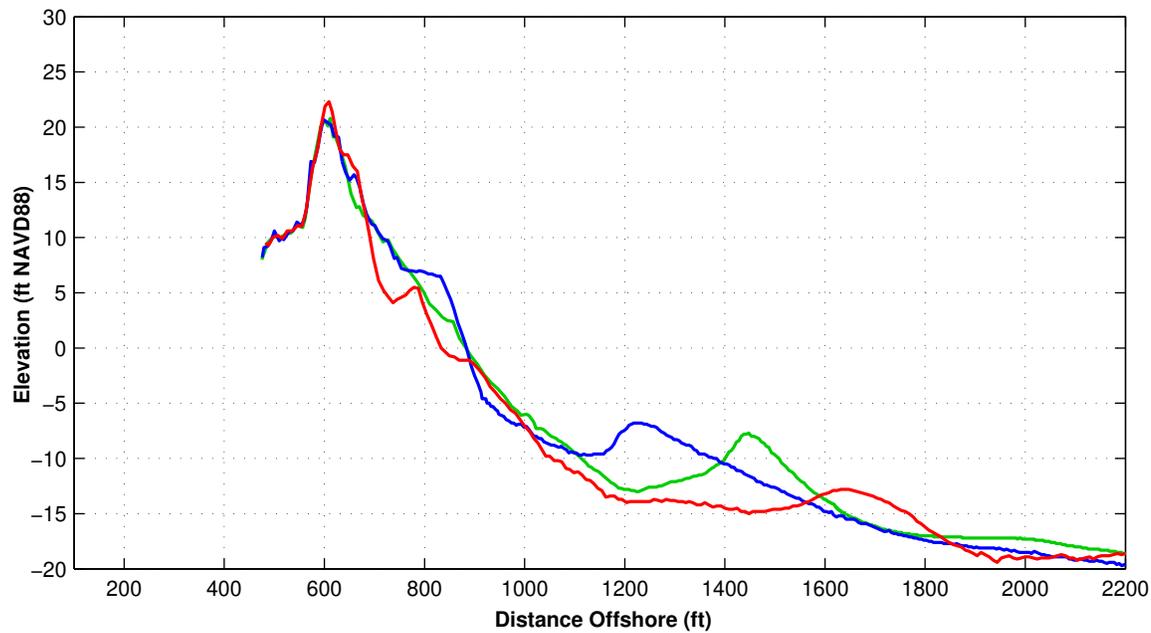
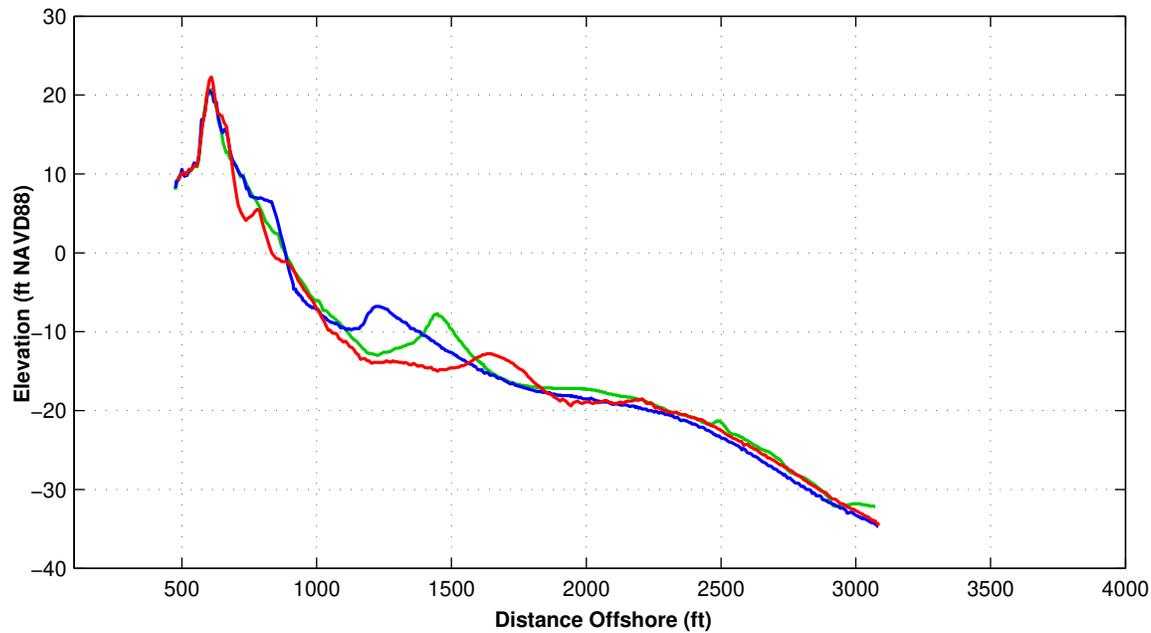
Survey Transect 955+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	12.81 ft	-75.95 ft
Volume Change Above +6 ft NAVD88	2.75 cy/ft	-7.01 cy/ft
Volume Change Above 1.18 ft NAVD88	9.77 cy/ft	-24.57 cy/ft
Volume Change Above -6 ft NAVD88	8.11 cy/ft	-27.96 cy/ft
Volume Change Above -14 ft NAVD88	22.04 cy/ft	-90.53 cy/ft
Volume Change Above -19 ft NAVD88	12.55 cy/ft	-89.56 cy/ft
Volume Change Above -30 ft NAVD88	1.09 cy/ft	-105.11 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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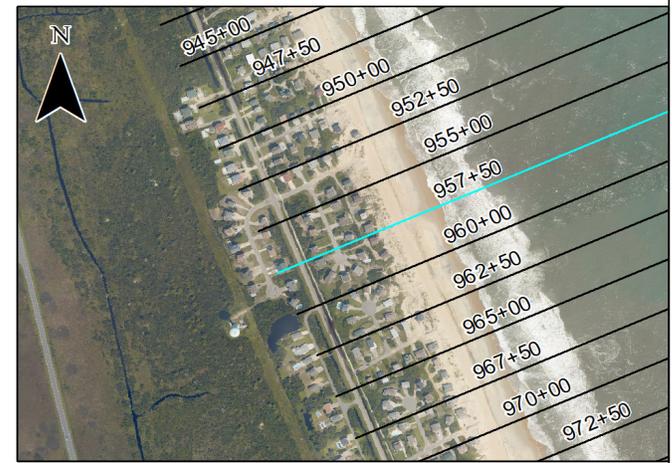


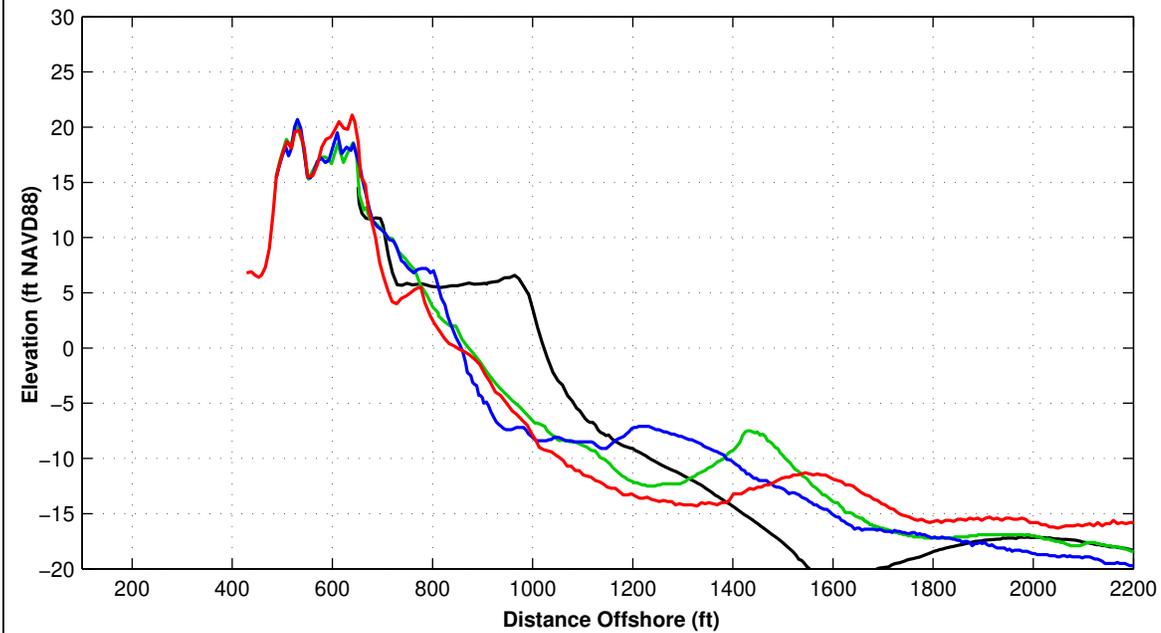
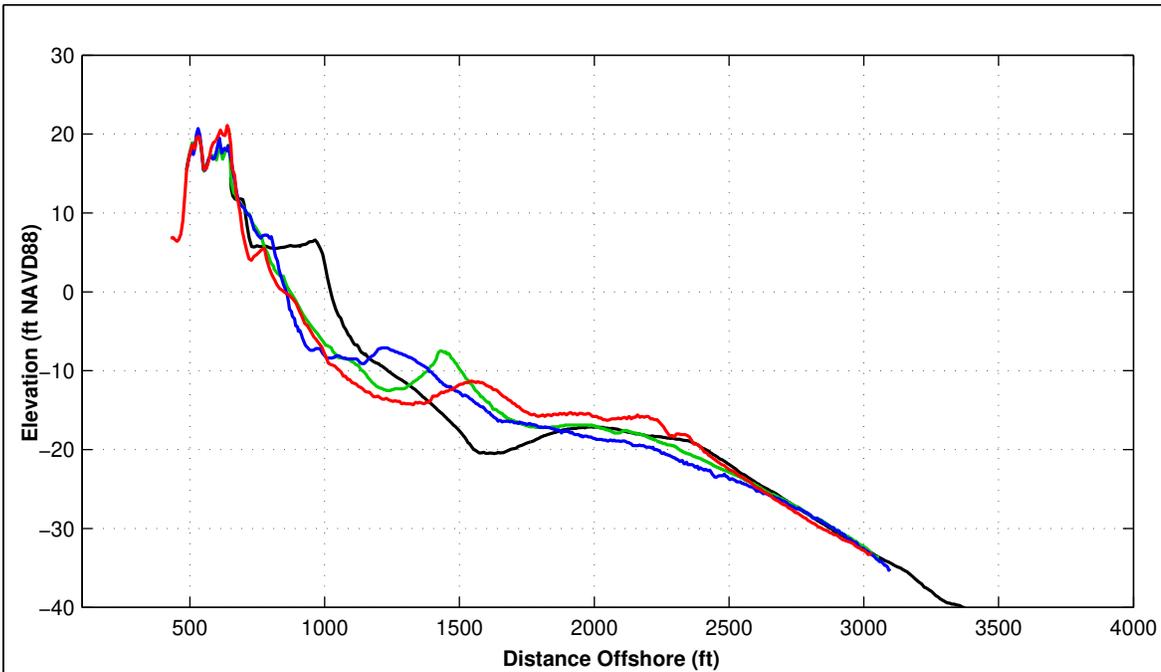


Survey Transect 957+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	8.35 ft	-53.66 ft
Volume Change Above +6 ft NAVD88	3.40 cy/ft	-7.17 cy/ft
Volume Change Above 1.18 ft NAVD88	9.27 cy/ft	-20.31 cy/ft
Volume Change Above -6 ft NAVD88	3.80 cy/ft	-20.02 cy/ft
Volume Change Above -14 ft NAVD88	17.20 cy/ft	-82.98 cy/ft
Volume Change Above -19 ft NAVD88	1.15 cy/ft	-74.63 cy/ft
Volume Change Above -30 ft NAVD88	-26.77 cy/ft	-53.92 cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
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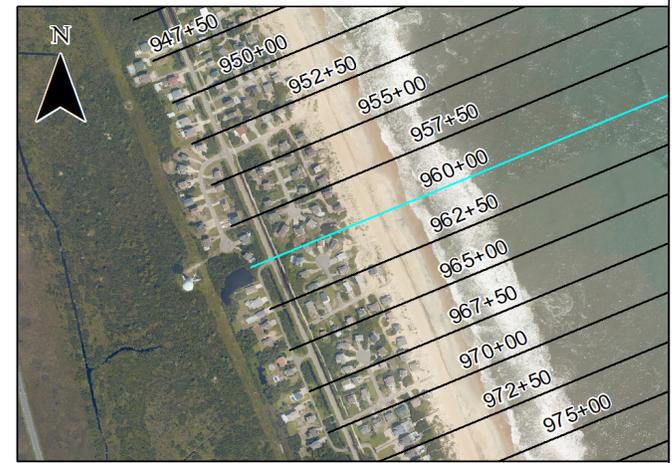


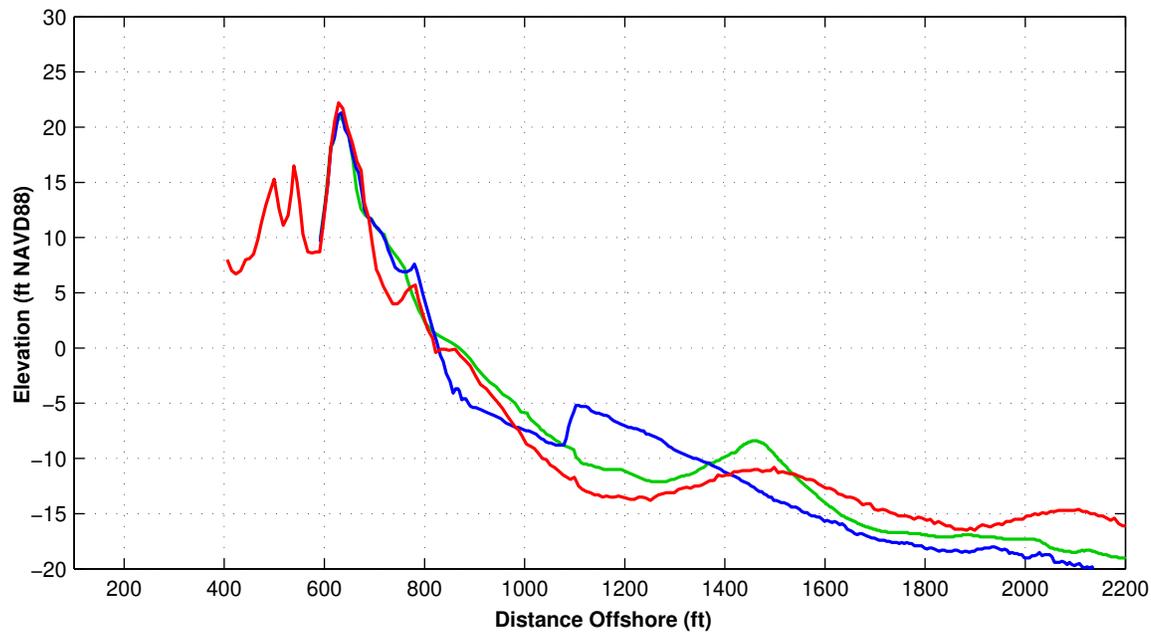
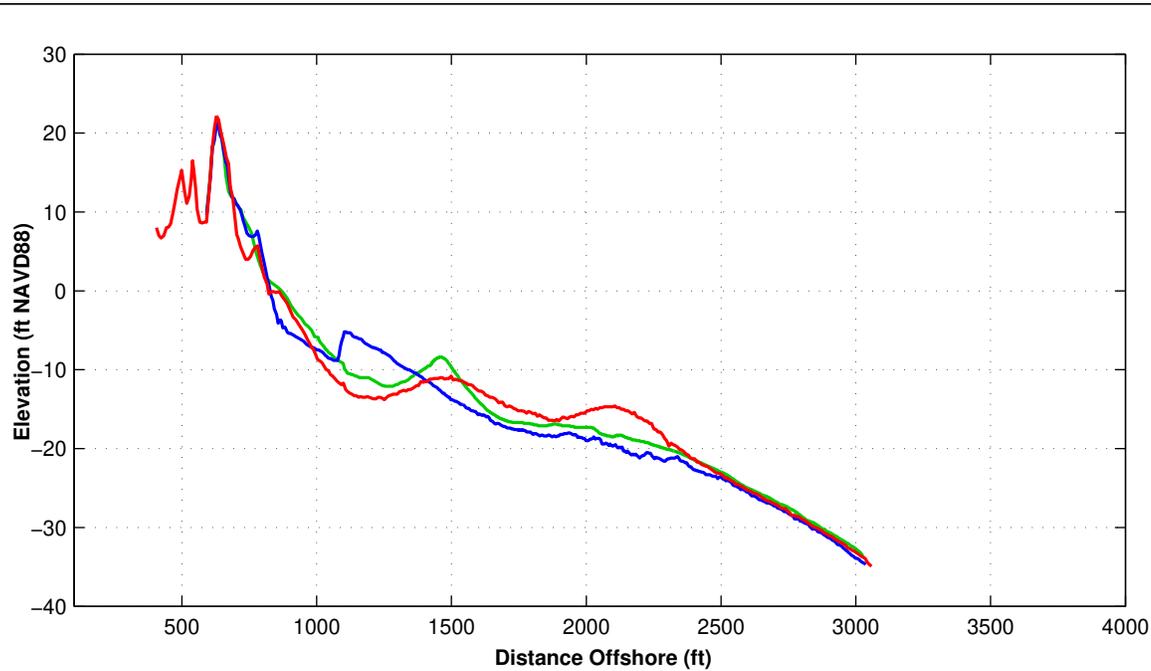
Survey Transect 960+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-9.78 ft	-25.86 ft
Volume Change Above +6 ft NAVD88	3.23 cy/ft	-4.15 cy/ft
Volume Change Above 1.18 ft NAVD88	6.39 cy/ft	-13.33 cy/ft
Volume Change Above -6 ft NAVD88	-3.59 cy/ft	-7.43 cy/ft
Volume Change Above -14 ft NAVD88	4.43 cy/ft	-58.24 cy/ft
Volume Change Above -19 ft NAVD88	-13.99 cy/ft	3.24 cy/ft
Volume Change Above -30 ft NAVD88	-32.24 cy/ft	24.47 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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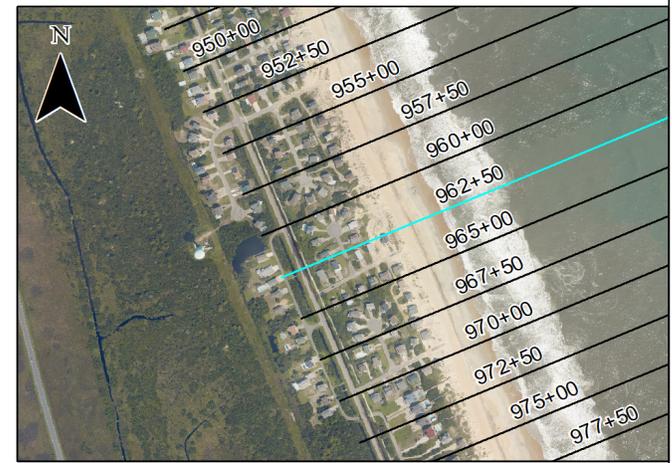


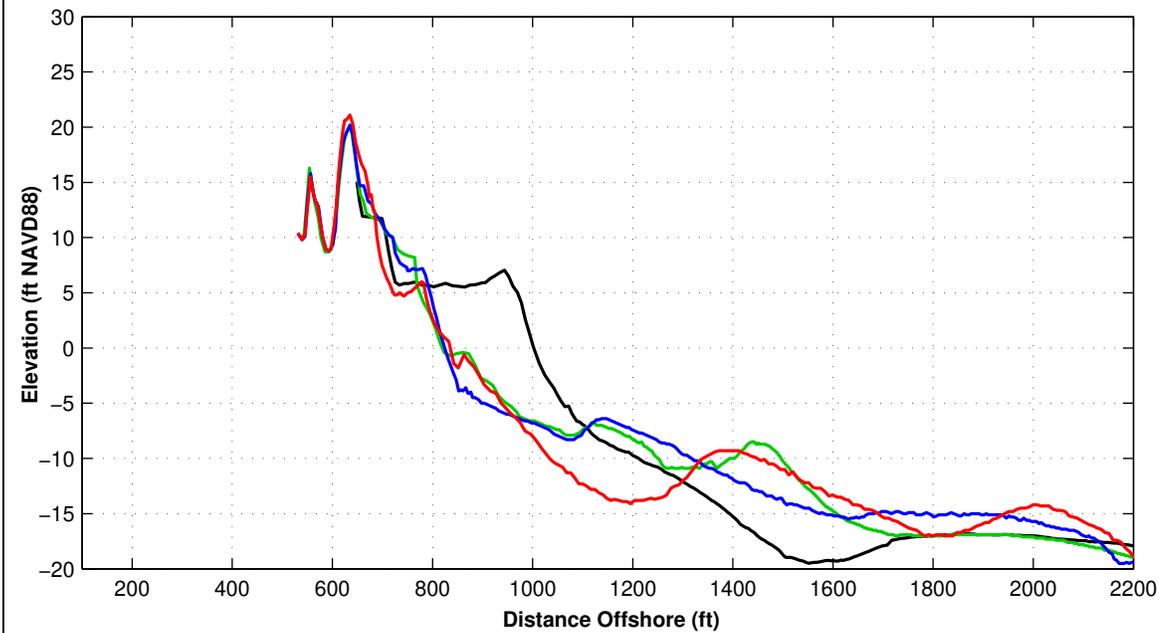
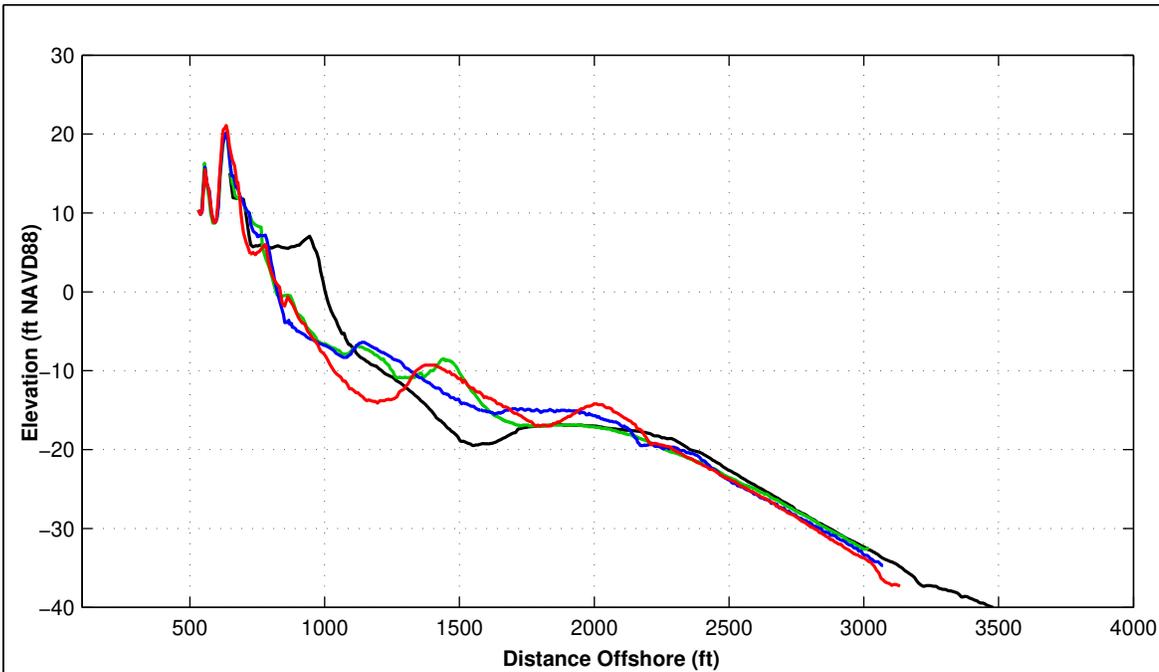


Survey Transect 962+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-6.55 ft	-7.52 ft
Volume Change Above +6 ft NAVD88	1.40 cy/ft	-5.76 cy/ft
Volume Change Above 1.18 ft NAVD88	4.12 cy/ft	-10.62 cy/ft
Volume Change Above -6 ft NAVD88	-12.34 cy/ft	-0.48 cy/ft
Volume Change Above -14 ft NAVD88	-1.34 cy/ft	-47.78 cy/ft
Volume Change Above -19 ft NAVD88	-25.04 cy/ft	25.18 cy/ft
Volume Change Above -30 ft NAVD88	-52.49 cy/ft	50.95 cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
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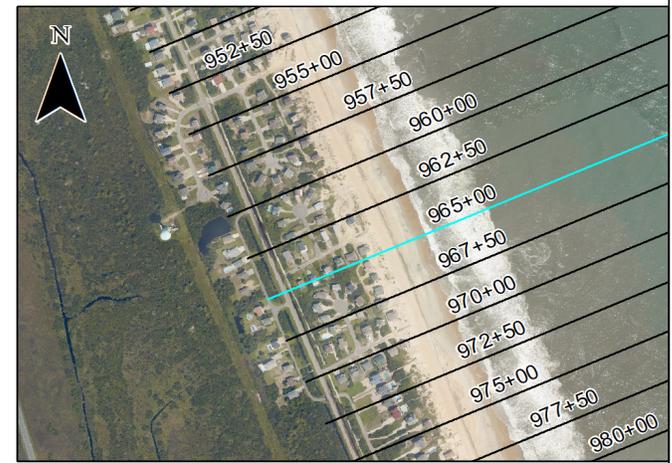


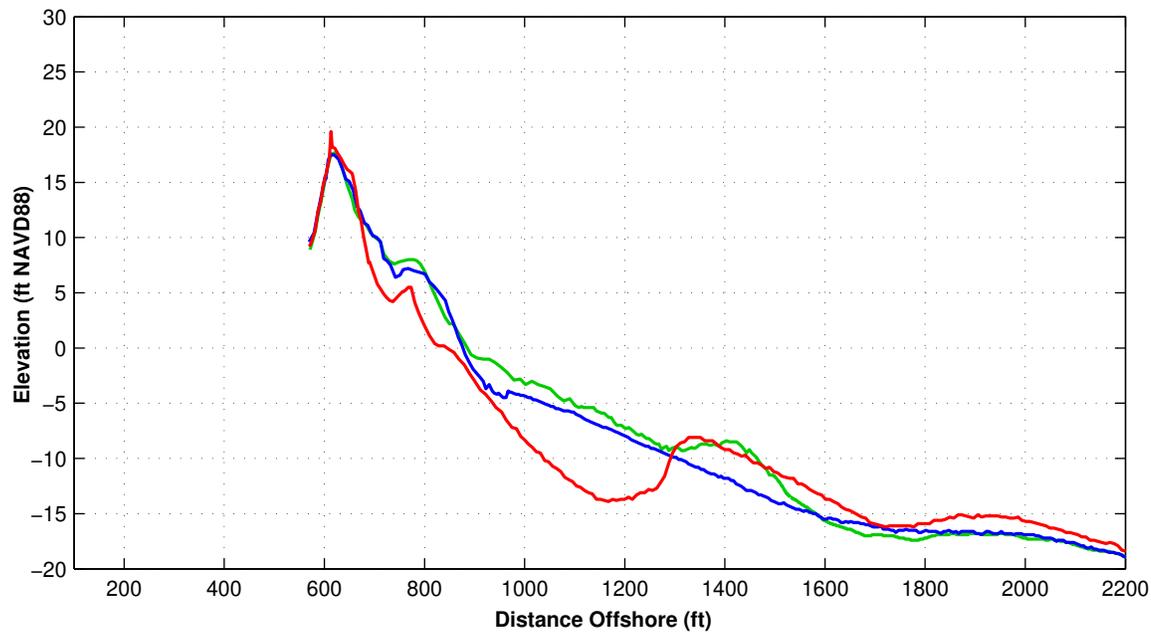
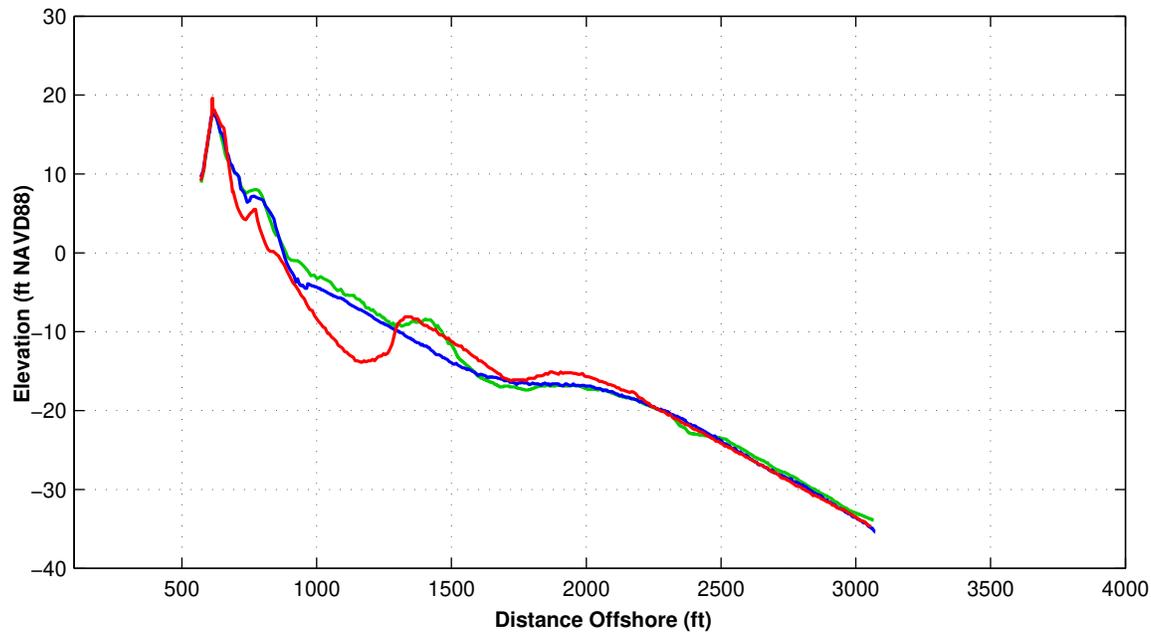
Survey Transect 965+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	6.39 ft	2.51 ft
Volume Change Above +6 ft NAVD88	1.84 cy/ft	-4.60 cy/ft
Volume Change Above 1.18 ft NAVD88	4.41 cy/ft	-7.94 cy/ft
Volume Change Above -6 ft NAVD88	-5.47 cy/ft	0.50 cy/ft
Volume Change Above -14 ft NAVD88	-19.51 cy/ft	-32.78 cy/ft
Volume Change Above -19 ft NAVD88	6.67 cy/ft	-26.88 cy/ft
Volume Change Above -30 ft NAVD88	1.38 cy/ft	-29.25 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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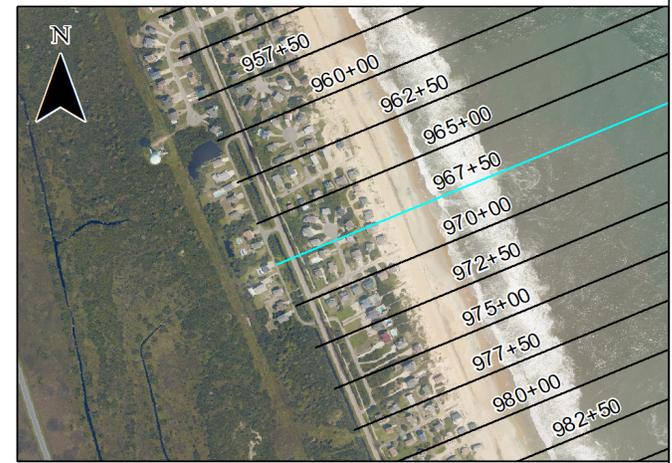


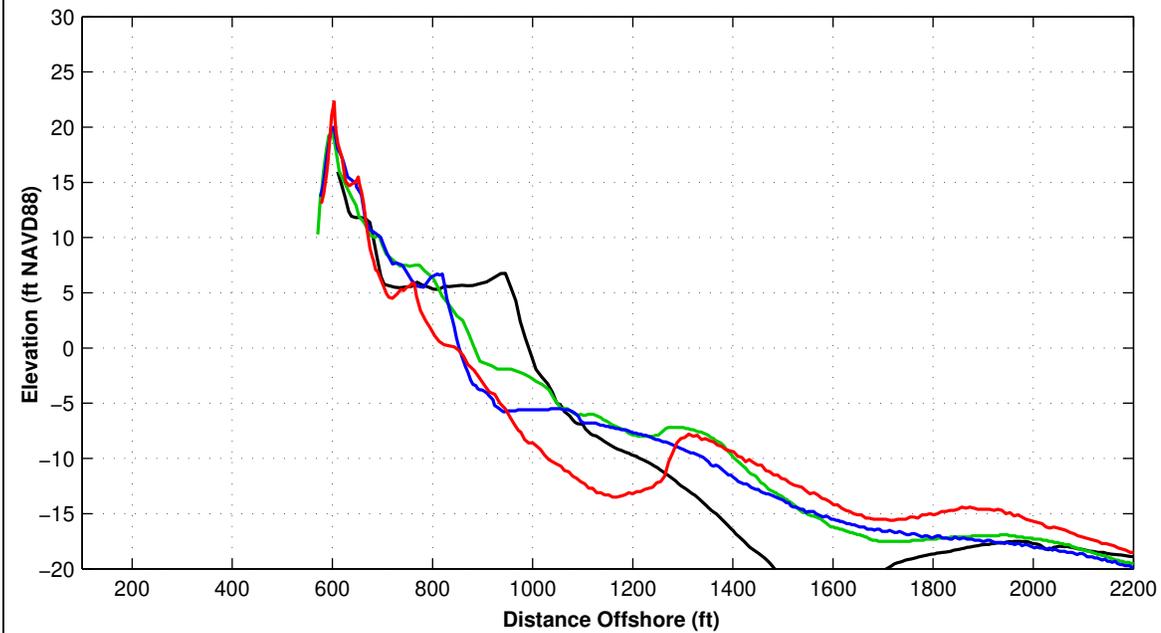
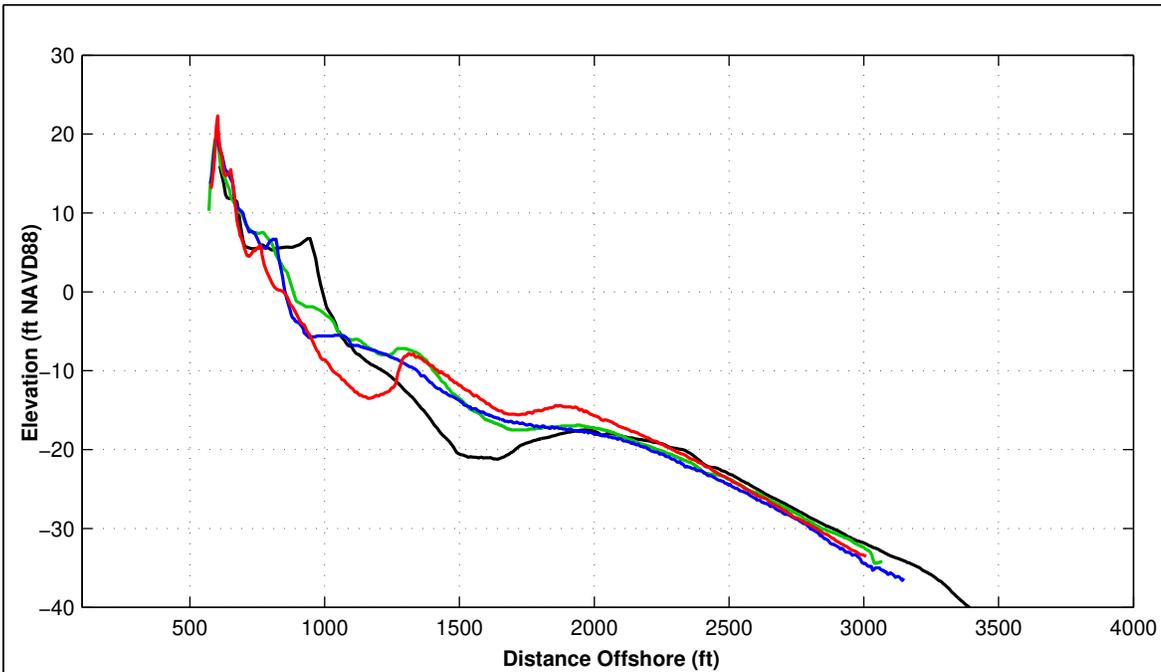


Survey Transect 967+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-4.26 ft	-56.49 ft
Volume Change Above +6 ft NAVD88	-1.45 cy/ft	-6.60 cy/ft
Volume Change Above 1.18 ft NAVD88	0.05 cy/ft	-19.51 cy/ft
Volume Change Above -6 ft NAVD88	-14.15 cy/ft	-31.50 cy/ft
Volume Change Above -14 ft NAVD88	-40.27 cy/ft	-60.79 cy/ft
Volume Change Above -19 ft NAVD88	-33.65 cy/ft	-36.65 cy/ft
Volume Change Above -30 ft NAVD88	-35.91 cy/ft	-41.32 cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
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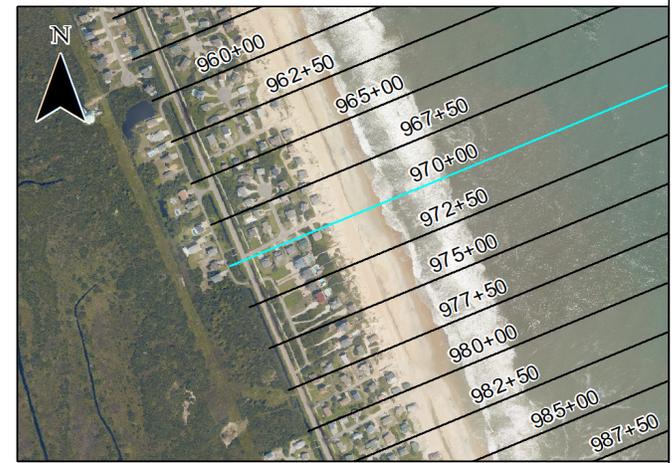


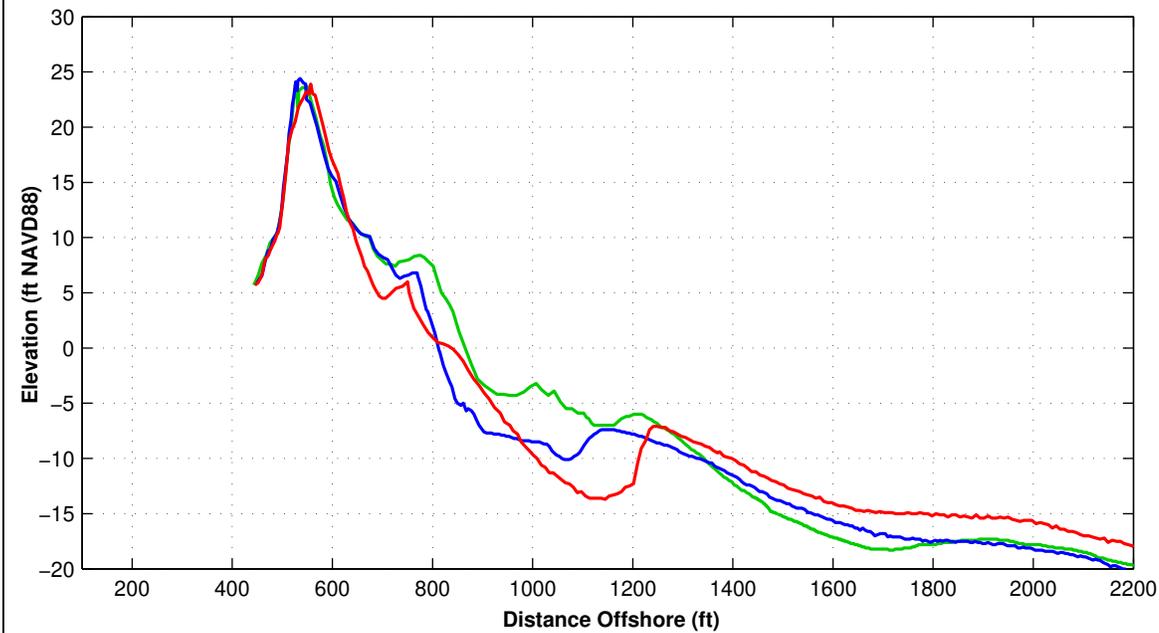
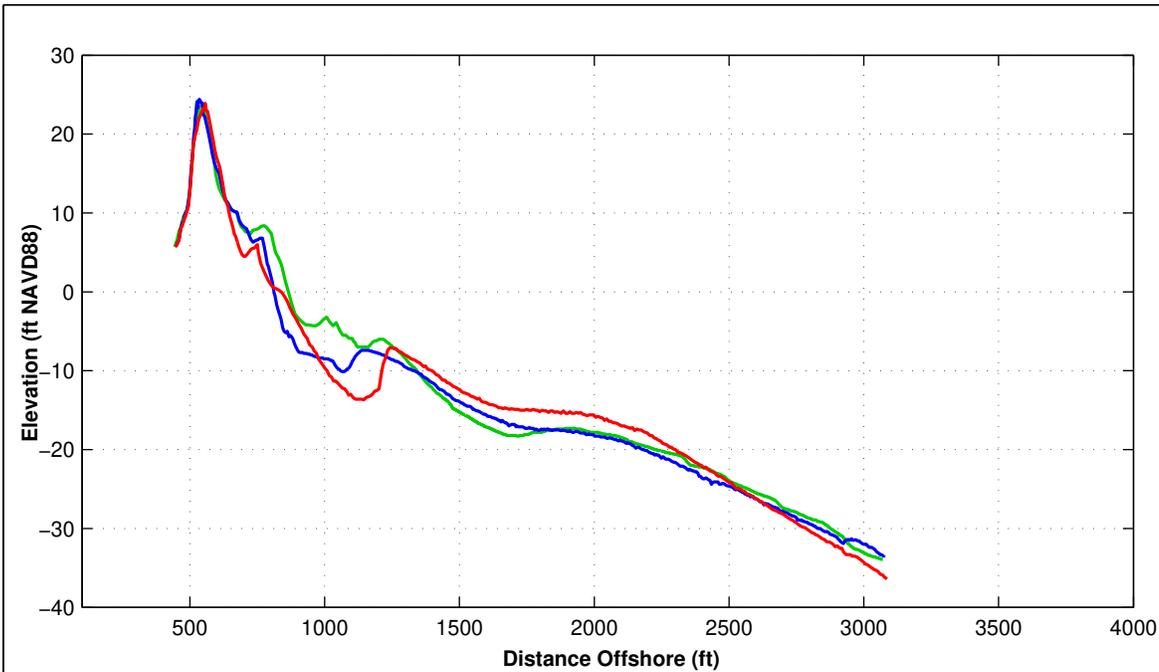
Survey Transect 970+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-26.41 ft	-43.19 ft
Volume Change Above +6 ft NAVD88	2.08 cy/ft	-7.46 cy/ft
Volume Change Above 1.18 ft NAVD88	0.88 cy/ft	-19.08 cy/ft
Volume Change Above -6 ft NAVD88	-20.18 cy/ft	-20.04 cy/ft
Volume Change Above -14 ft NAVD88	-36.10 cy/ft	-54.53 cy/ft
Volume Change Above -19 ft NAVD88	-35.85 cy/ft	-11.04 cy/ft
Volume Change Above -30 ft NAVD88	-50.18 cy/ft	7.08 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
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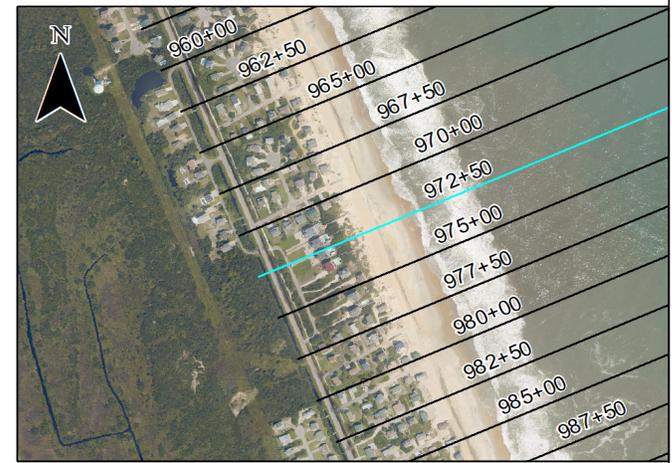


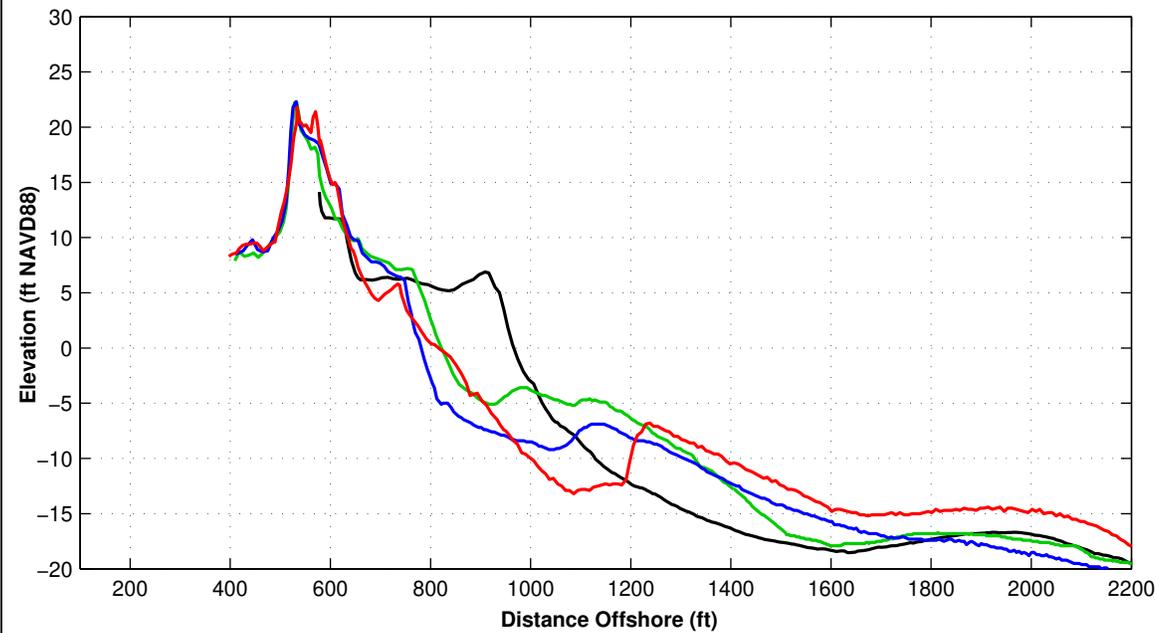
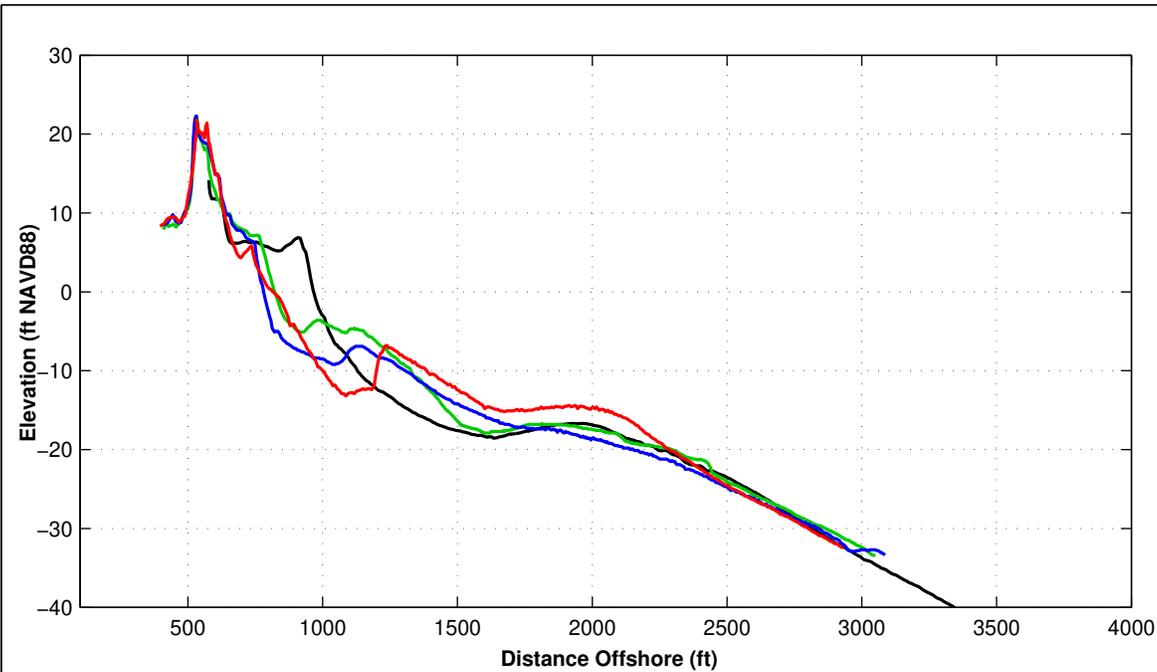
Survey Transect 972+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-49.91 ft	-9.87 ft
Volume Change Above +6 ft NAVD88	-3.25 cy/ft	-4.88 cy/ft
Volume Change Above 1.18 ft NAVD88	-11.43 cy/ft	-11.02 cy/ft
Volume Change Above -6 ft NAVD88	-37.83 cy/ft	0.53 cy/ft
Volume Change Above -14 ft NAVD88	-65.93 cy/ft	-9.73 cy/ft
Volume Change Above -19 ft NAVD88	-54.56 cy/ft	40.63 cy/ft
Volume Change Above -30 ft NAVD88	-76.57 cy/ft	55.71 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
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  2. All Survey Elevations In Feet Referenced to NAVD88.



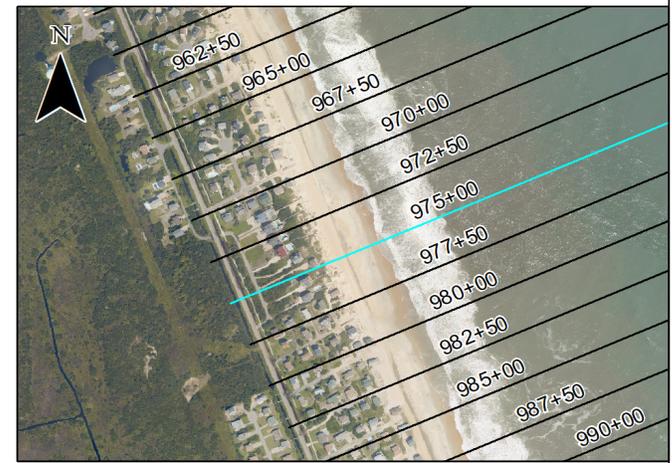


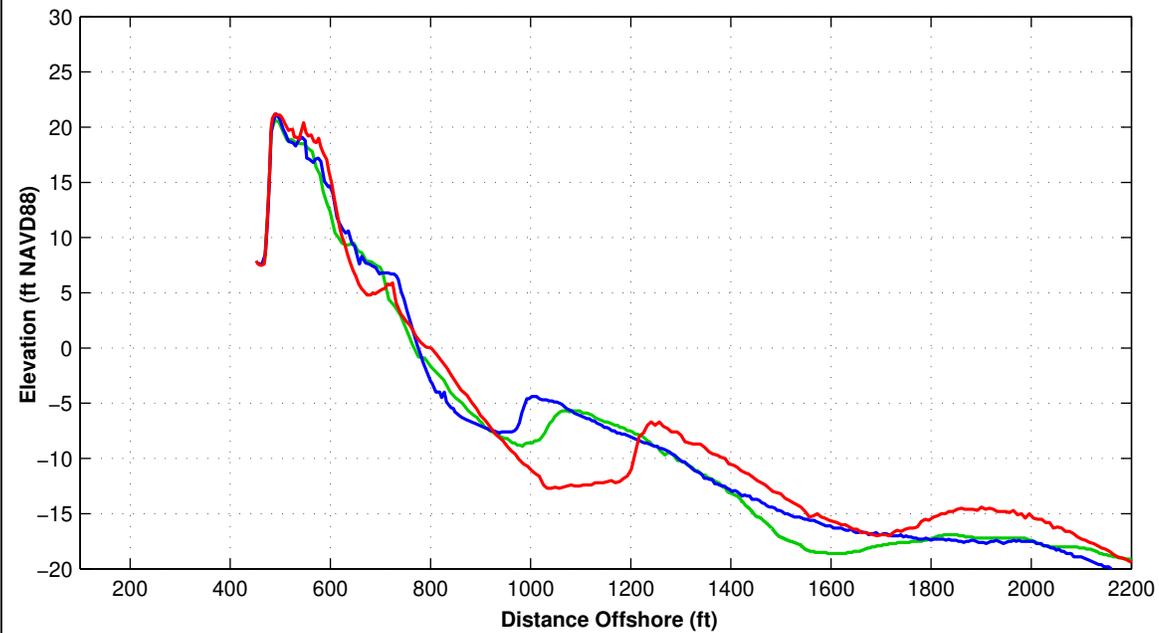
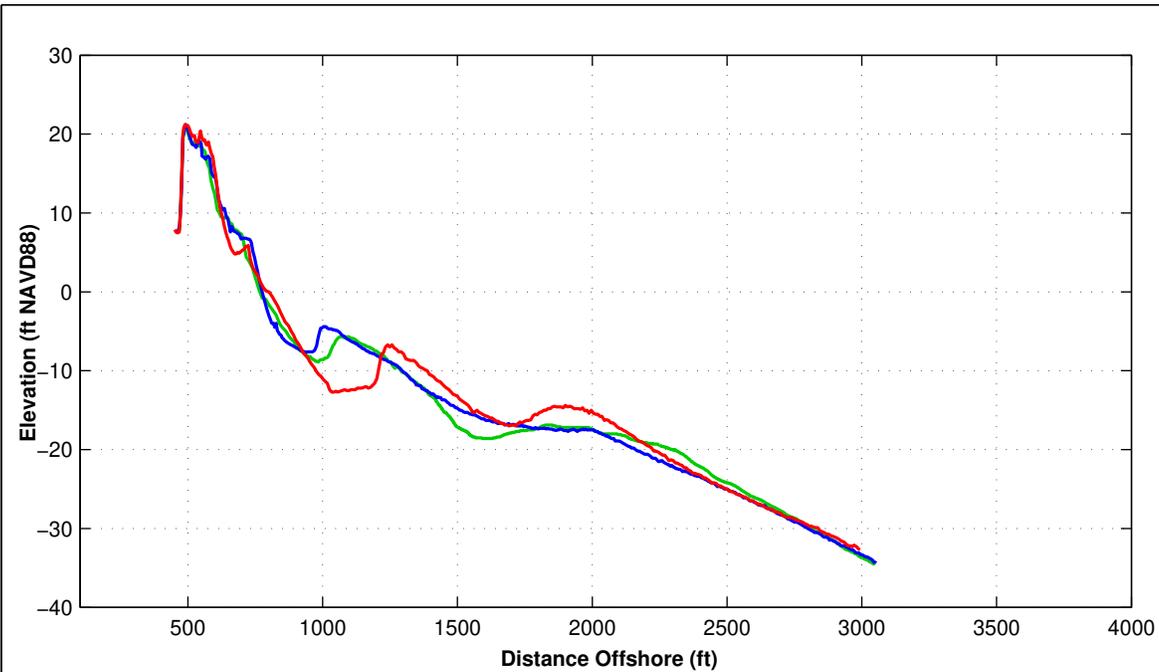
Survey Transect 975+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-38.72 ft	14.19 ft
Volume Change Above +6 ft NAVD88	3.19 cy/ft	-4.44 cy/ft
Volume Change Above 1.18 ft NAVD88	-2.82 cy/ft	-7.42 cy/ft
Volume Change Above -6 ft NAVD88	-31.00 cy/ft	8.14 cy/ft
Volume Change Above -14 ft NAVD88	-57.38 cy/ft	0.72 cy/ft
Volume Change Above -19 ft NAVD88	-53.33 cy/ft	65.76 cy/ft
Volume Change Above -30 ft NAVD88	-79.50 cy/ft	79.48 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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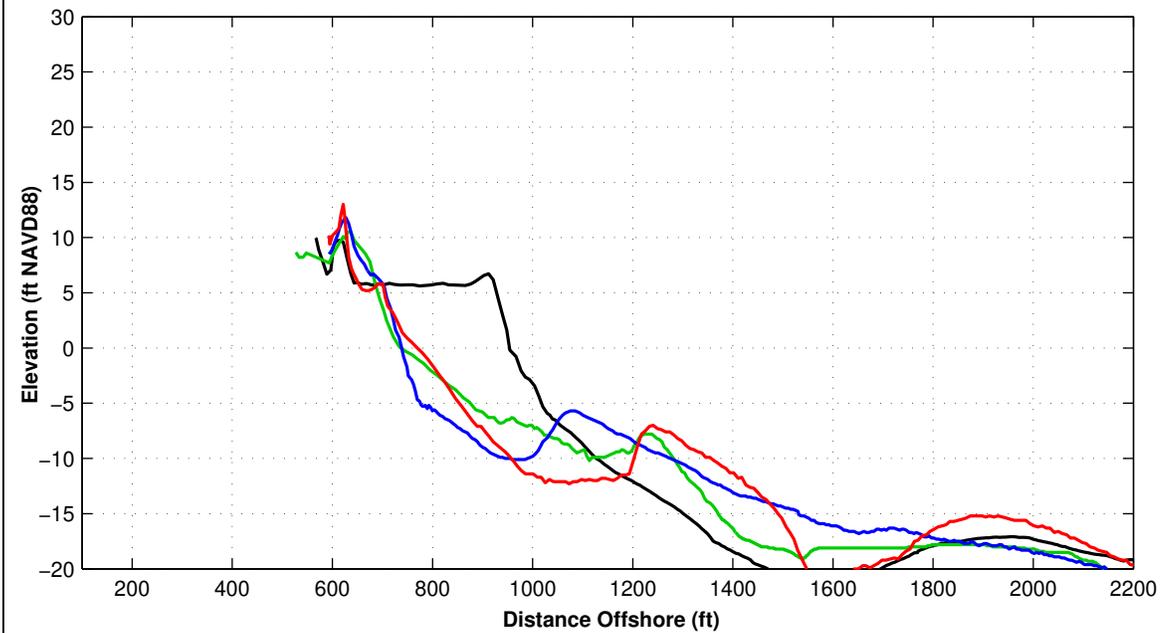
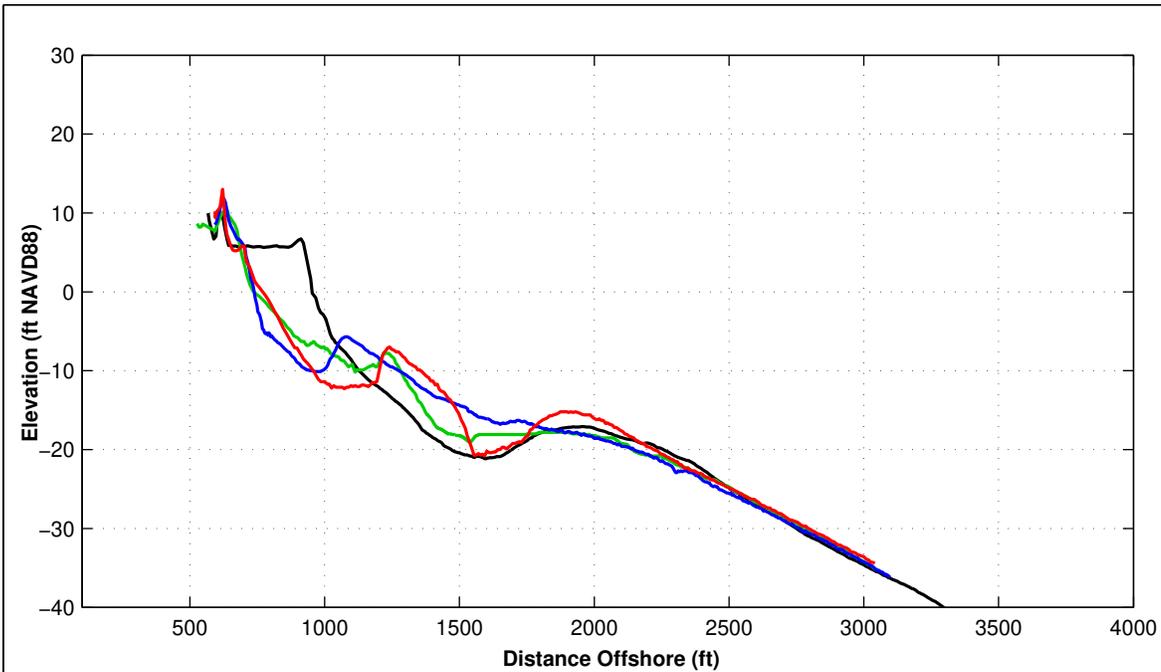
Survey Transect 977+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	11.30 ft	2.34 ft
Volume Change Above +6 ft NAVD88	3.99 cy/ft	-0.64 cy/ft
Volume Change Above 1.18 ft NAVD88	7.76 cy/ft	-4.51 cy/ft
Volume Change Above -6 ft NAVD88	7.80 cy/ft	1.59 cy/ft
Volume Change Above -14 ft NAVD88	12.29 cy/ft	-24.37 cy/ft
Volume Change Above -19 ft NAVD88	28.84 cy/ft	12.44 cy/ft
Volume Change Above -30 ft NAVD88	2.05 cy/ft	22.24 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
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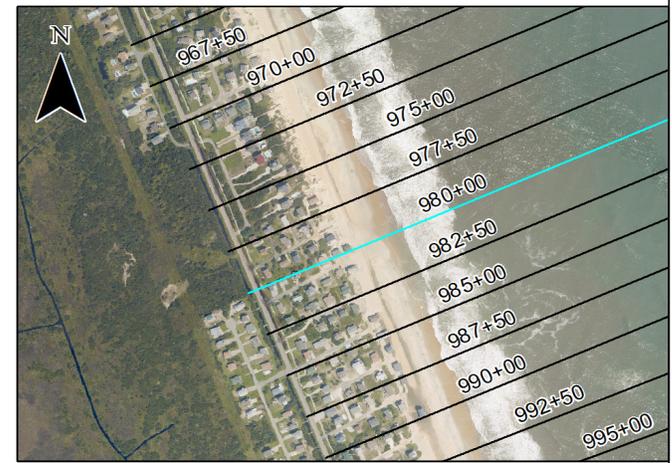


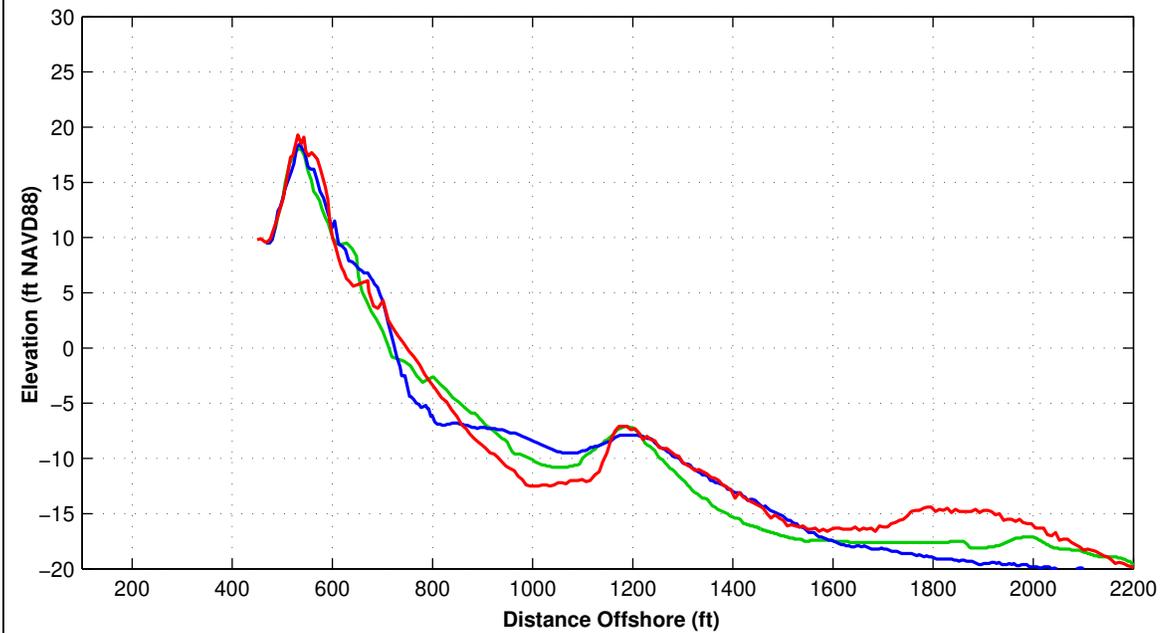
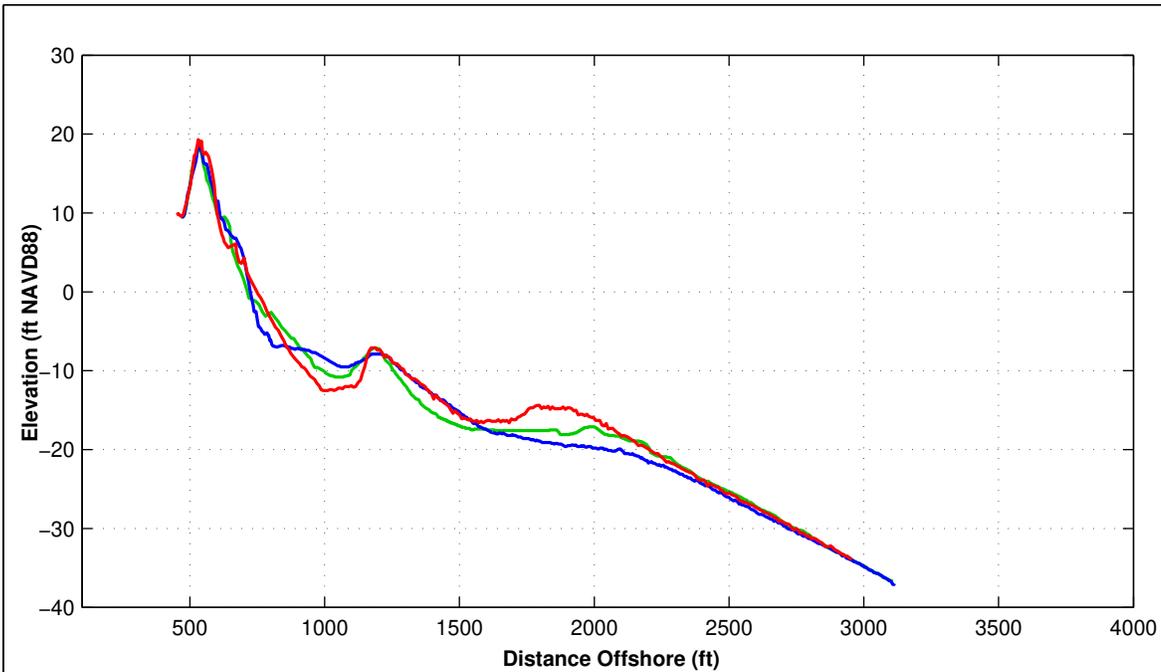
Survey Transect 980+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	10.86 ft	12.95 ft
Volume Change Above +6 ft NAVD88	1.85 cy/ft	-2.91 cy/ft
Volume Change Above 1.18 ft NAVD88	4.34 cy/ft	-3.47 cy/ft
Volume Change Above -6 ft NAVD88	-8.57 cy/ft	10.60 cy/ft
Volume Change Above -14 ft NAVD88	-7.74 cy/ft	-4.08 cy/ft
Volume Change Above -19 ft NAVD88	30.10 cy/ft	-4.02 cy/ft
Volume Change Above -30 ft NAVD88	19.27 cy/ft	7.61 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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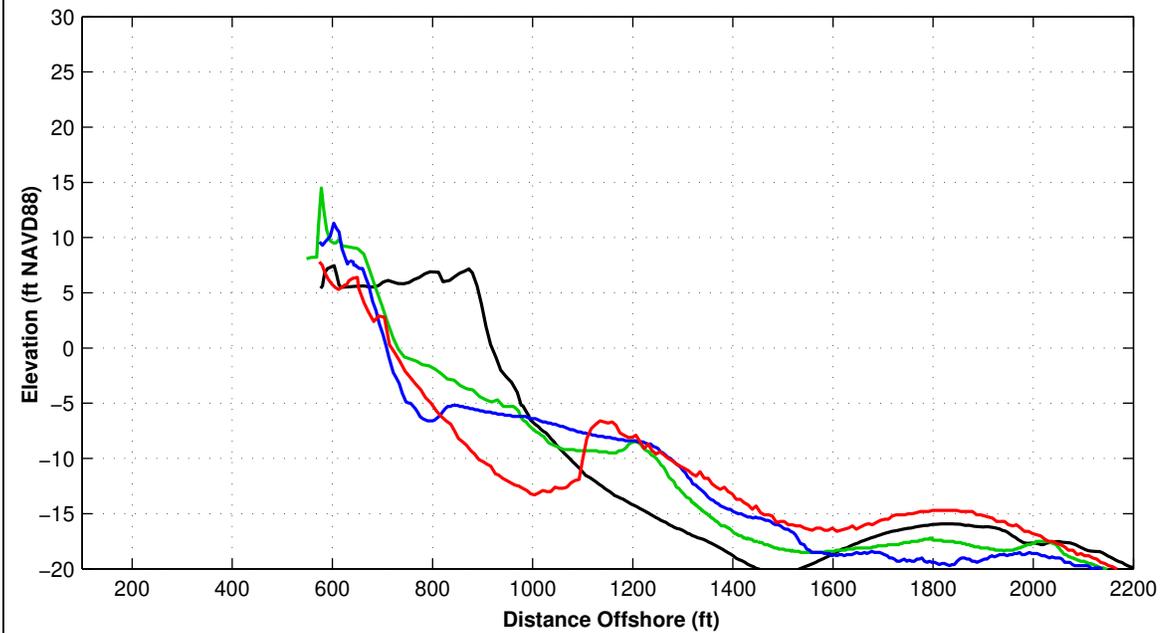
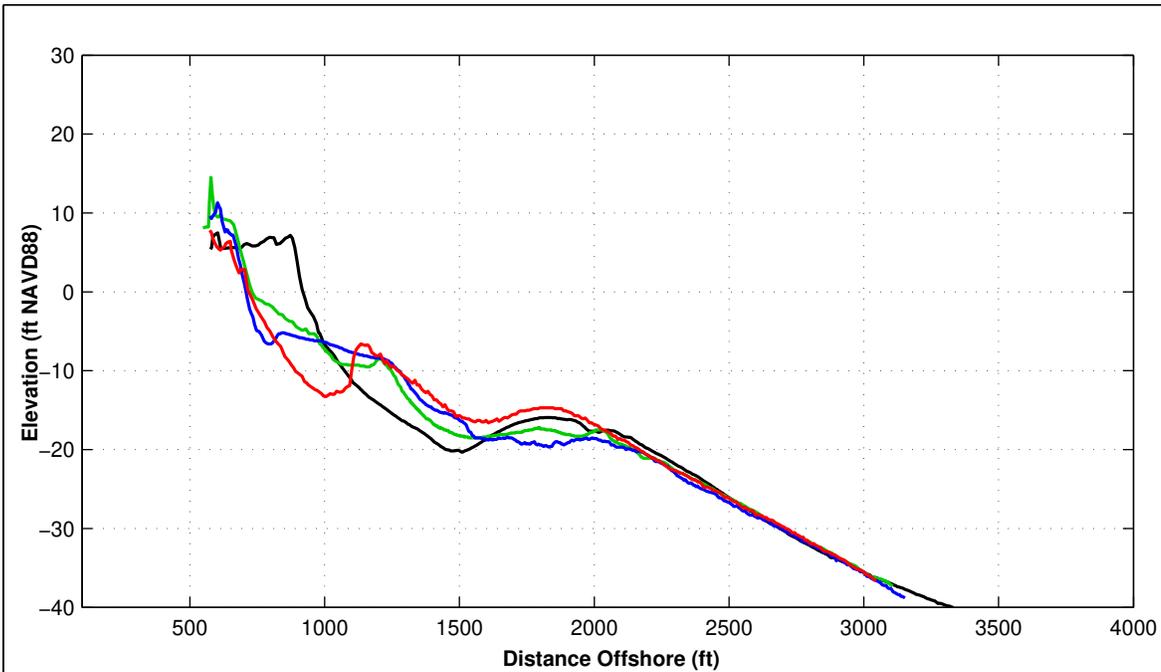
Survey Transect 982+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	14.64 ft	12.35 ft
Volume Change Above +6 ft NAVD88	2.58 cy/ft	-1.19 cy/ft
Volume Change Above 1.18 ft NAVD88	7.33 cy/ft	-2.56 cy/ft
Volume Change Above -6 ft NAVD88	-2.32 cy/ft	8.55 cy/ft
Volume Change Above -14 ft NAVD88	13.03 cy/ft	-16.66 cy/ft
Volume Change Above -19 ft NAVD88	5.00 cy/ft	39.14 cy/ft
Volume Change Above -30 ft NAVD88	-23.62 cy/ft	63.64 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

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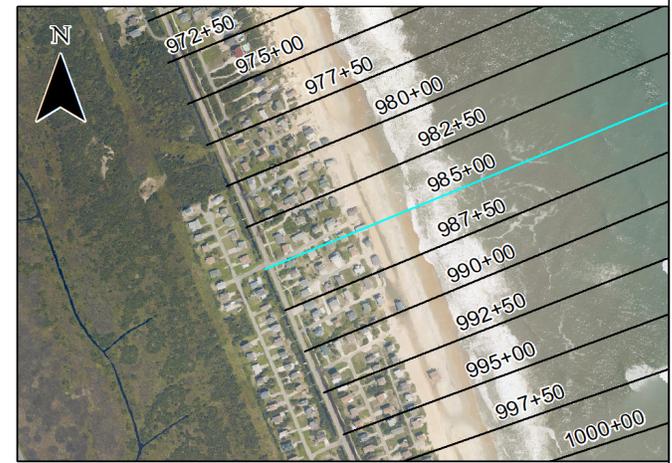


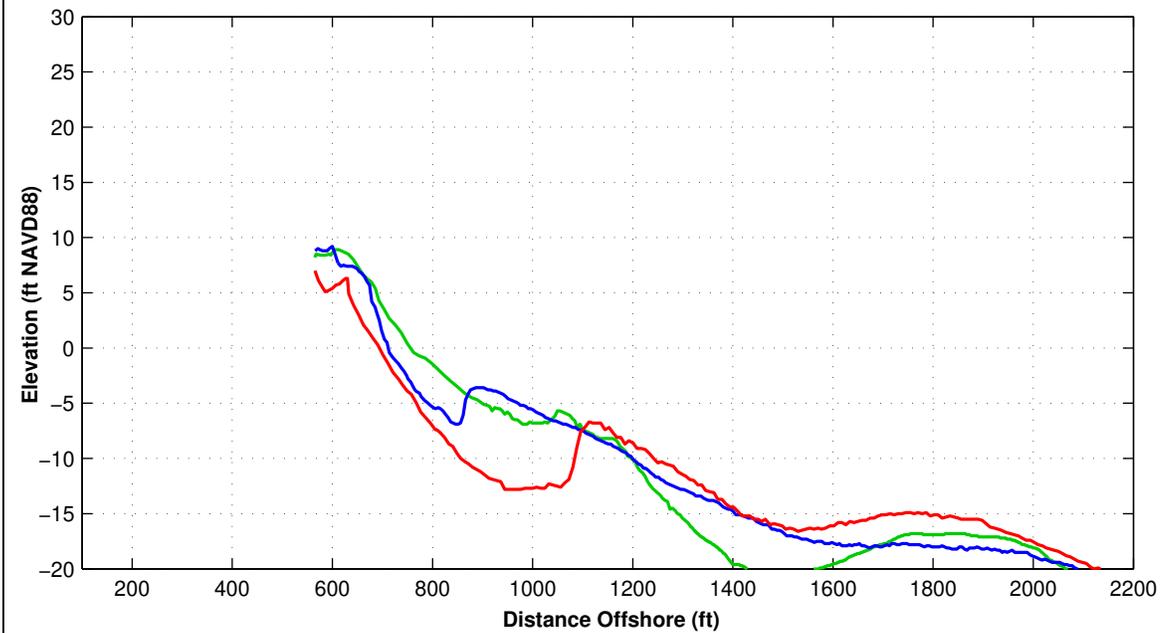
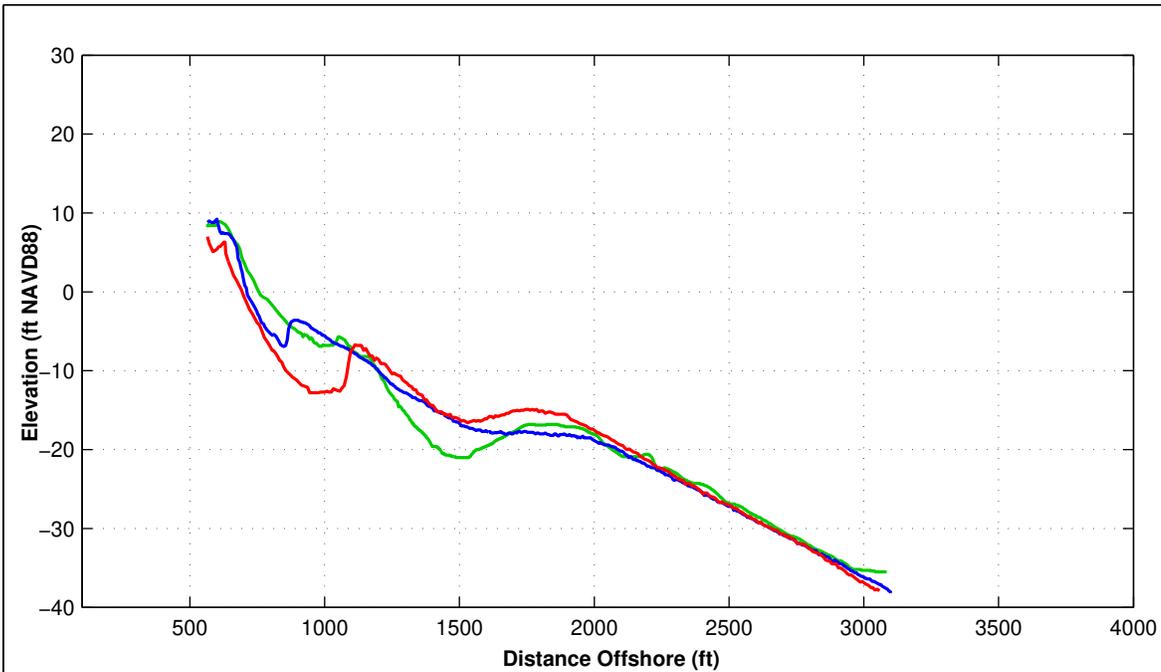
Survey Transect 985+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-18.00 ft	9.03 ft
Volume Change Above +6 ft NAVD88	-4.17 cy/ft	-8.96 cy/ft
Volume Change Above 1.18 ft NAVD88	-6.93 cy/ft	-11.03 cy/ft
Volume Change Above -6 ft NAVD88	-30.91 cy/ft	-5.85 cy/ft
Volume Change Above -14 ft NAVD88	-13.77 cy/ft	-47.65 cy/ft
Volume Change Above -19 ft NAVD88	-16.84 cy/ft	15.24 cy/ft
Volume Change Above -30 ft NAVD88	-27.95 cy/ft	27.43 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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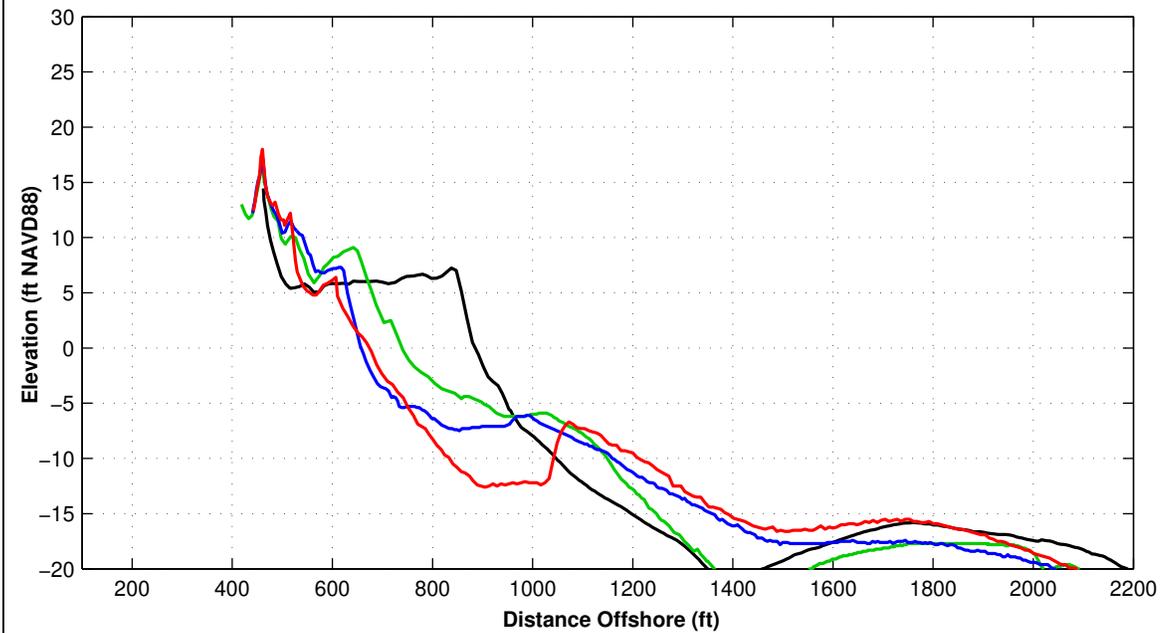
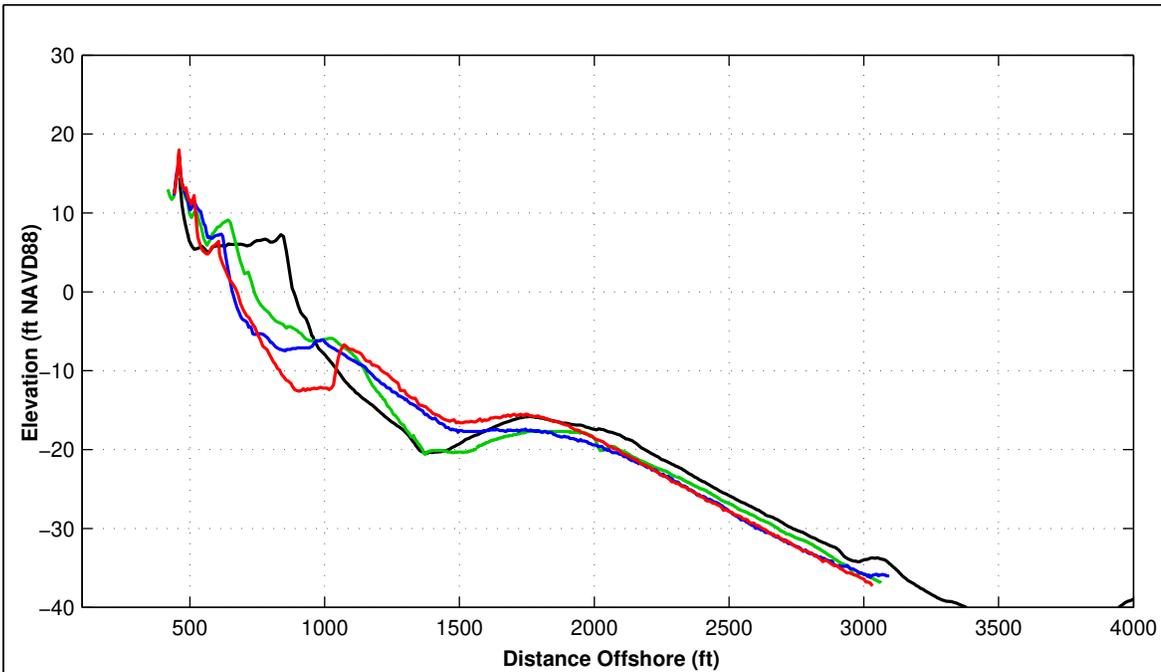
Survey Transect 987+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-39.07 ft	-24.34 ft
Volume Change Above +6 ft NAVD88	-1.73 cy/ft	-3.41 cy/ft
Volume Change Above 1.18 ft NAVD88	-5.17 cy/ft	-10.36 cy/ft
Volume Change Above -6 ft NAVD88	-17.18 cy/ft	-24.61 cy/ft
Volume Change Above -14 ft NAVD88	-12.78 cy/ft	-66.21 cy/ft
Volume Change Above -19 ft NAVD88	9.42 cy/ft	-24.16 cy/ft
Volume Change Above -30 ft NAVD88	7.81 cy/ft	-16.31 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

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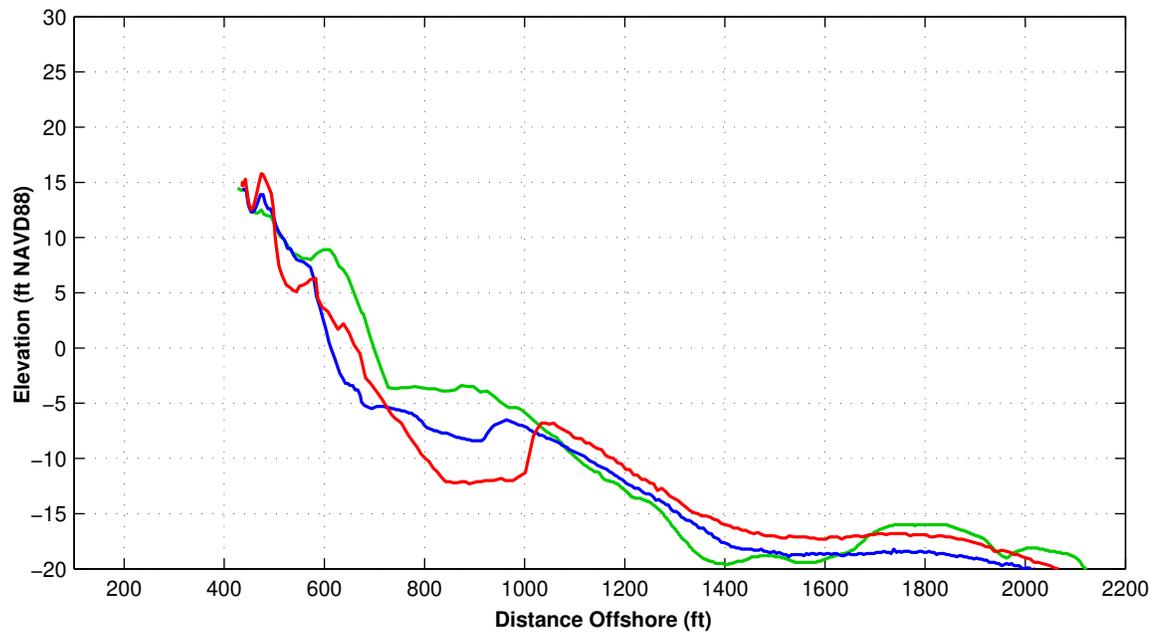
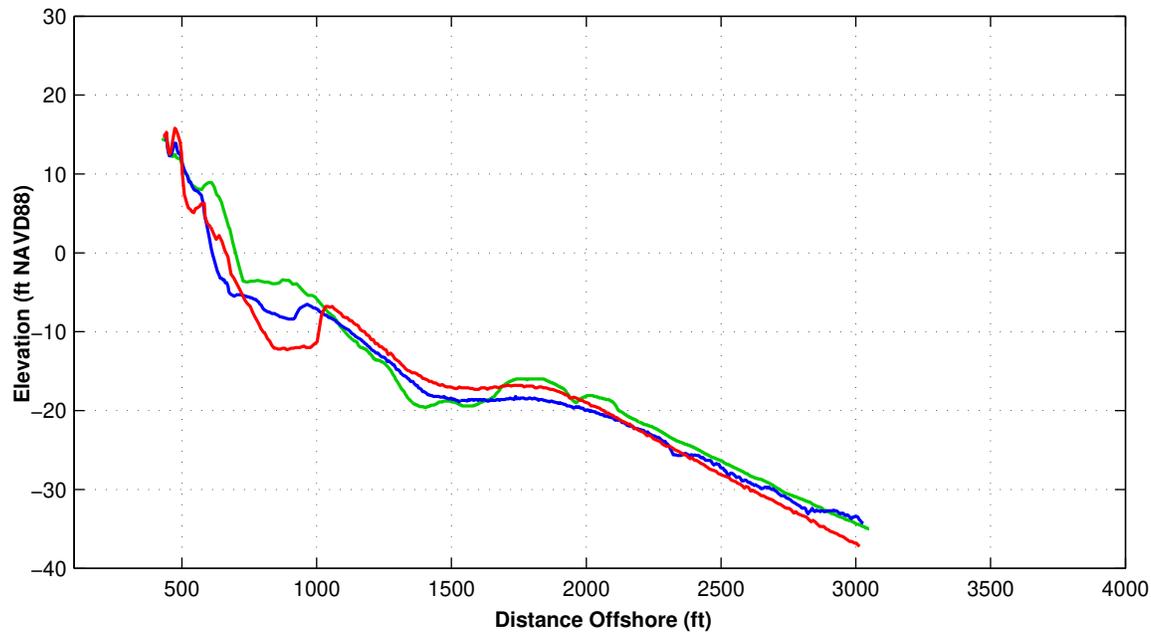


Survey Transect 990+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-78.58 ft	5.22 ft
Volume Change Above +6 ft NAVD88	-1.71 cy/ft	-6.31 cy/ft
Volume Change Above 1.18 ft NAVD88	-11.99 cy/ft	-10.09 cy/ft
Volume Change Above -6 ft NAVD88	-41.28 cy/ft	-6.39 cy/ft
Volume Change Above -14 ft NAVD88	-44.68 cy/ft	-37.50 cy/ft
Volume Change Above -19 ft NAVD88	-13.75 cy/ft	-3.72 cy/ft
Volume Change Above -30 ft NAVD88	-21.21 cy/ft	-1.12 cy/ft

**LEGEND:**  
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 JUNE 2020 ———— (green line)  
 AUGUST 2019 ———— (black line)

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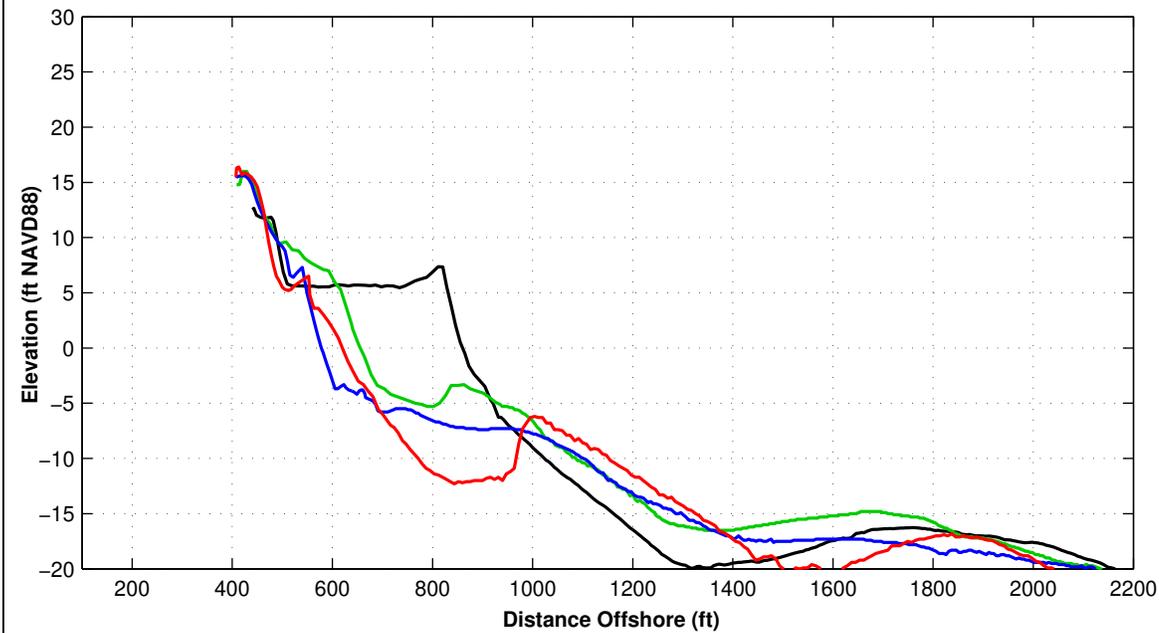
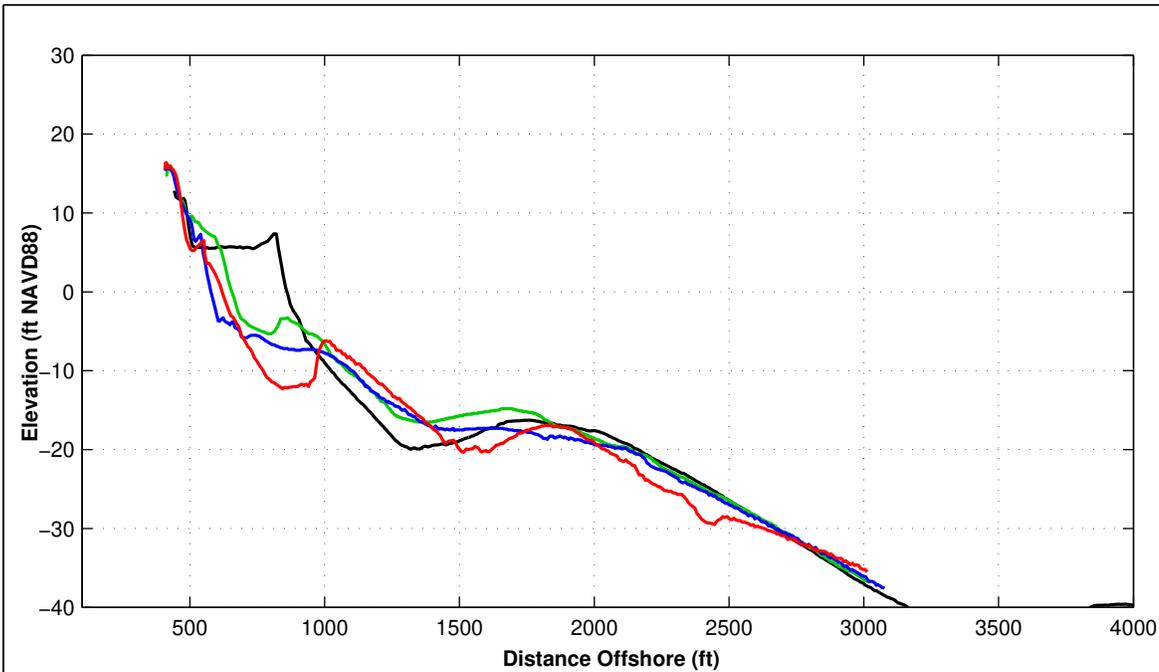


Survey Transect 992+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-84.46 ft	45.55 ft
Volume Change Above +6 ft NAVD88	-4.89 cy/ft	-4.12 cy/ft
Volume Change Above 1.18 ft NAVD88	-19.07 cy/ft	-2.41 cy/ft
Volume Change Above -6 ft NAVD88	-56.69 cy/ft	8.38 cy/ft
Volume Change Above -14 ft NAVD88	-65.74 cy/ft	-16.02 cy/ft
Volume Change Above -19 ft NAVD88	-77.78 cy/ft	20.50 cy/ft
Volume Change Above -30 ft NAVD88	-105.69 cy/ft	17.00 cy/ft

**LEGEND:**  
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 JUNE 2020 ———— (green line)  
 AUGUST 2019 ———— (black line)

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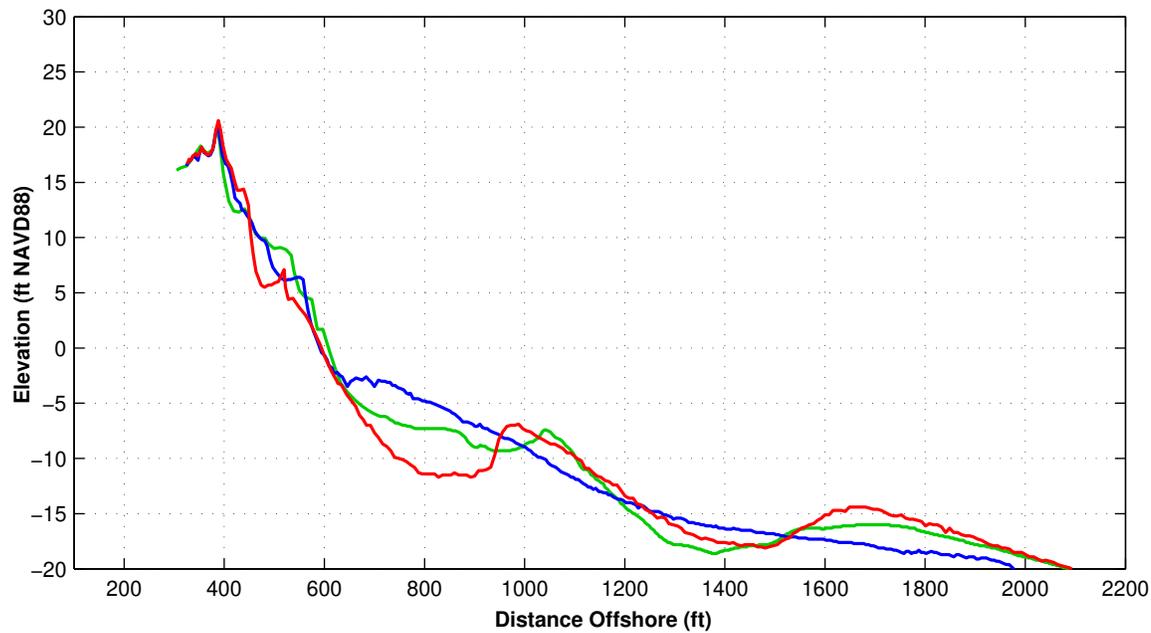
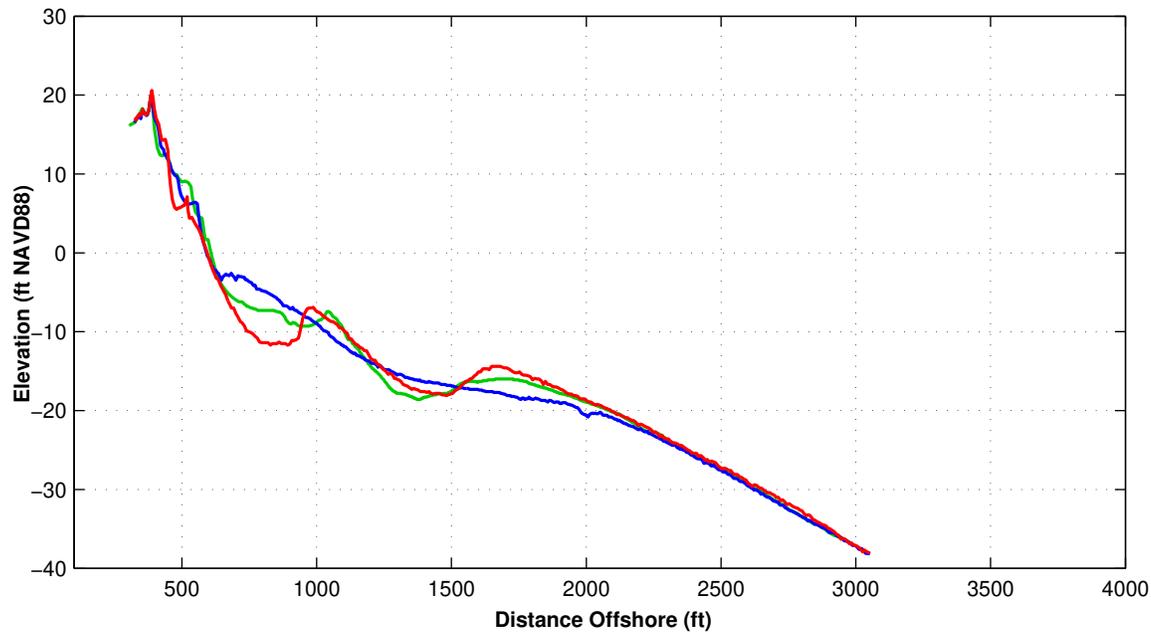
Survey Transect 995+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-74.46 ft	37.67 ft
Volume Change Above +6 ft NAVD88	-5.68 cy/ft	-4.14 cy/ft
Volume Change Above 1.18 ft NAVD88	-18.27 cy/ft	-1.85 cy/ft
Volume Change Above -6 ft NAVD88	-48.90 cy/ft	6.18 cy/ft
Volume Change Above -14 ft NAVD88	-57.48 cy/ft	-17.06 cy/ft
Volume Change Above -19 ft NAVD88	-94.65 cy/ft	-21.69 cy/ft
Volume Change Above -30 ft NAVD88	-103.97 cy/ft	-71.39 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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Survey Transect 997+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-19.13 ft	1.57 ft
Volume Change Above +6 ft NAVD88	-1.47 cy/ft	-3.15 cy/ft
Volume Change Above 1.18 ft NAVD88	-2.56 cy/ft	-6.60 cy/ft
Volume Change Above -6 ft NAVD88	10.37 cy/ft	-22.50 cy/ft
Volume Change Above -14 ft NAVD88	12.32 cy/ft	-48.49 cy/ft
Volume Change Above -19 ft NAVD88	7.81 cy/ft	-21.07 cy/ft
Volume Change Above -30 ft NAVD88	-4.71 cy/ft	-4.67 cy/ft

**LEGEND:**

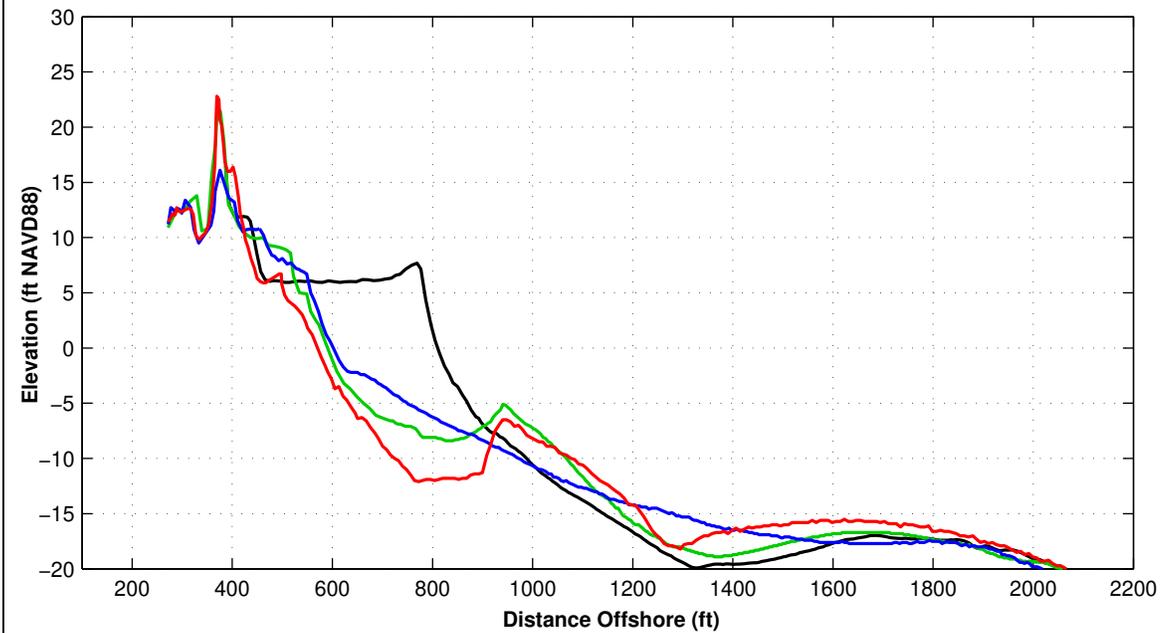
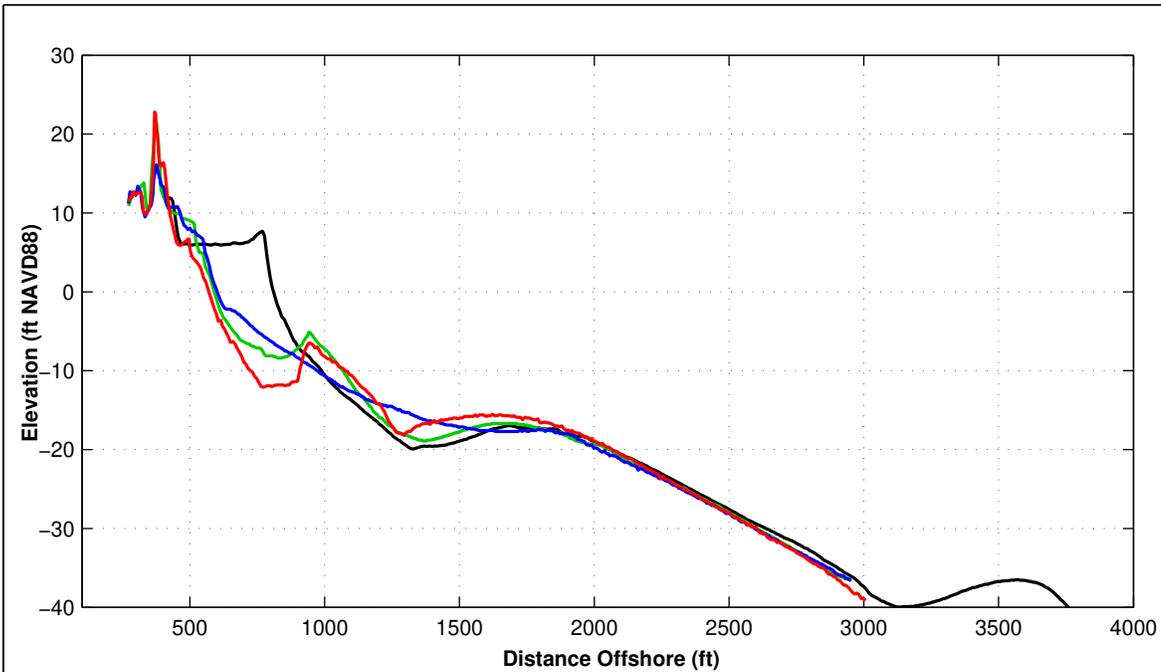
JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

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**Town of Nags Head Periodic Surveying Data Analysis**



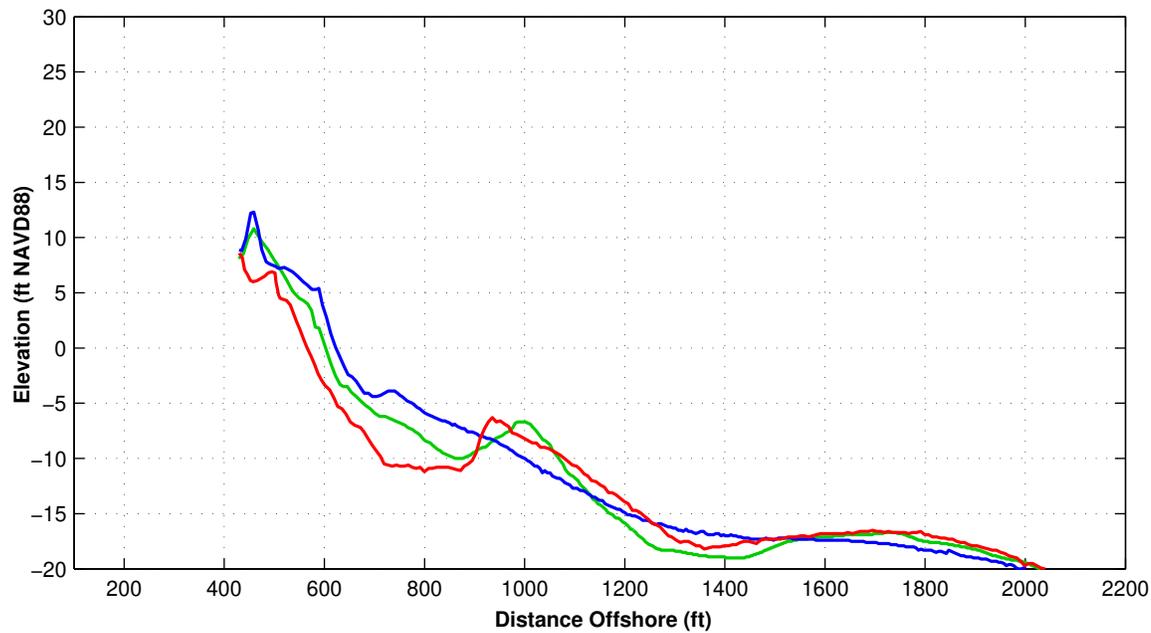
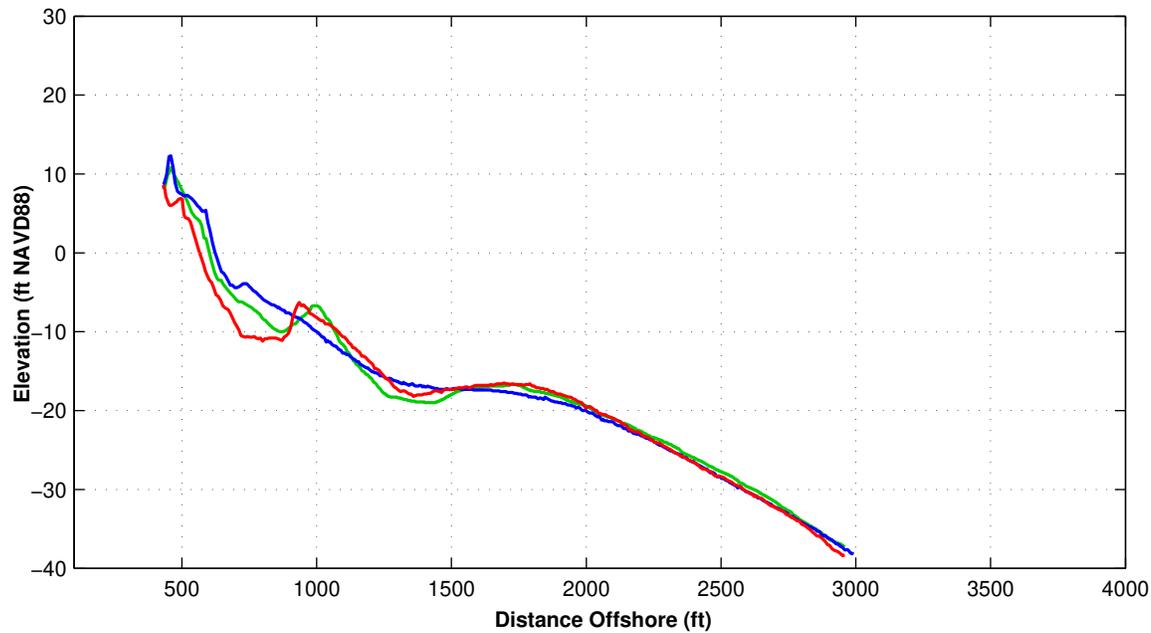
Survey Transect 1000+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	7.31 ft	-28.26 ft
Volume Change Above +6 ft NAVD88	0.38 cy/ft	-10.16 cy/ft
Volume Change Above 1.18 ft NAVD88	2.82 cy/ft	-17.73 cy/ft
Volume Change Above -6 ft NAVD88	14.67 cy/ft	-36.39 cy/ft
Volume Change Above -14 ft NAVD88	1.36 cy/ft	-53.81 cy/ft
Volume Change Above -19 ft NAVD88	21.63 cy/ft	-39.01 cy/ft
Volume Change Above -30 ft NAVD88	15.61 cy/ft	-31.02 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

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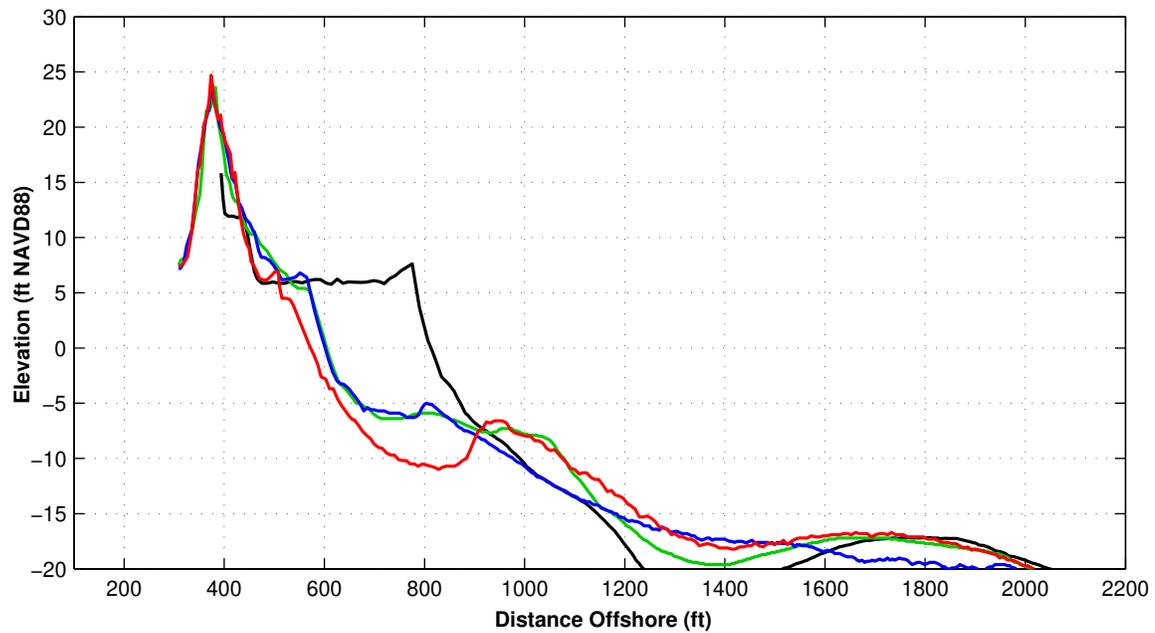
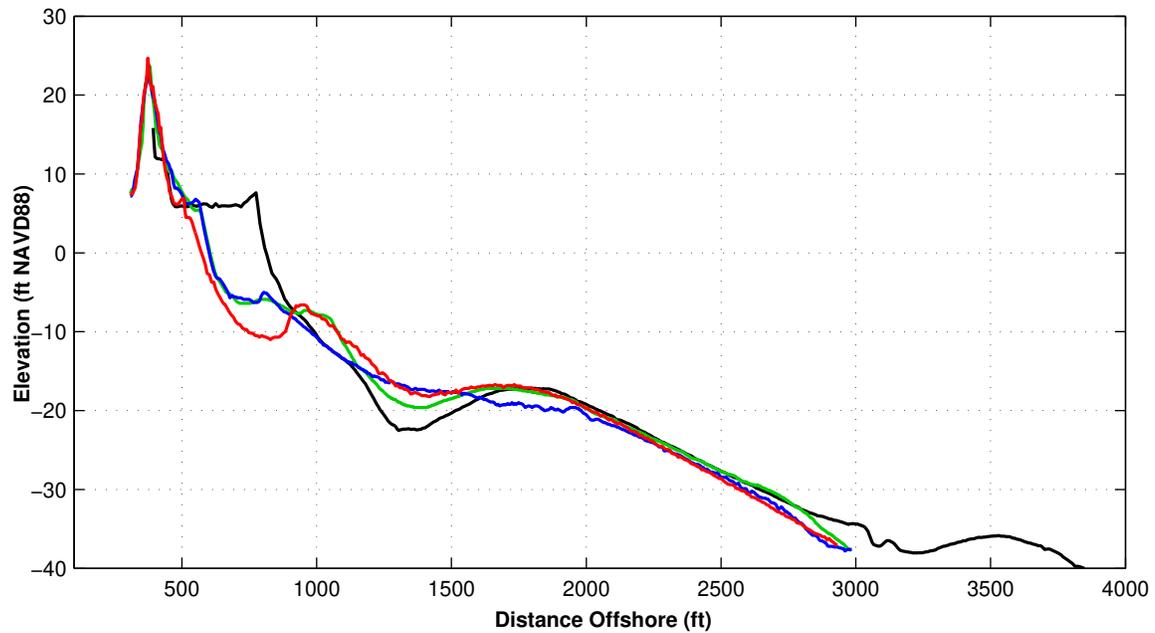


Survey Transect 1002+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	19.91 ft	-58.70 ft
Volume Change Above +6 ft NAVD88	0.78 cy/ft	-7.08 cy/ft
Volume Change Above 1.18 ft NAVD88	6.49 cy/ft	-18.92 cy/ft
Volume Change Above -6 ft NAVD88	18.04 cy/ft	-41.09 cy/ft
Volume Change Above -14 ft NAVD88	19.36 cy/ft	-58.43 cy/ft
Volume Change Above -19 ft NAVD88	31.85 cy/ft	-48.56 cy/ft
Volume Change Above -30 ft NAVD88	16.71 cy/ft	-42.72 cy/ft

**LEGEND:**  
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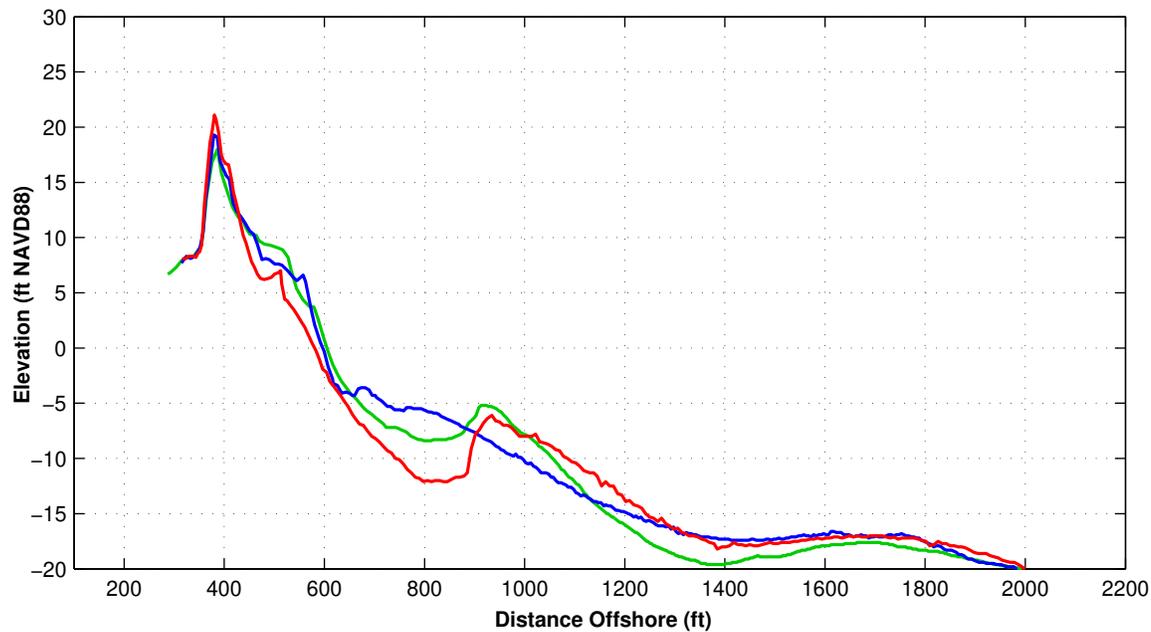
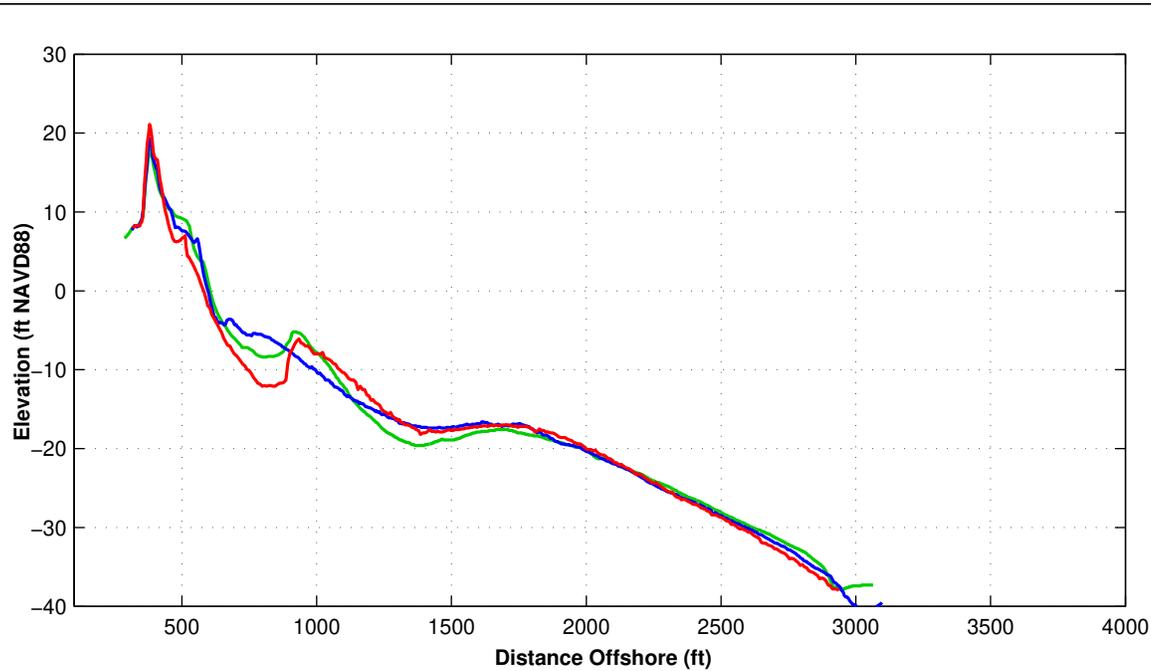


Survey Transect 1005+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-3.29 ft	-31.88 ft
Volume Change Above +6 ft NAVD88	1.25 cy/ft	-5.66 cy/ft
Volume Change Above 1.18 ft NAVD88	1.62 cy/ft	-13.48 cy/ft
Volume Change Above -6 ft NAVD88	2.88 cy/ft	-23.39 cy/ft
Volume Change Above -14 ft NAVD88	-17.60 cy/ft	-29.38 cy/ft
Volume Change Above -19 ft NAVD88	-16.96 cy/ft	-5.82 cy/ft
Volume Change Above -30 ft NAVD88	-37.67 cy/ft	3.48 cy/ft

**LEGEND:**  
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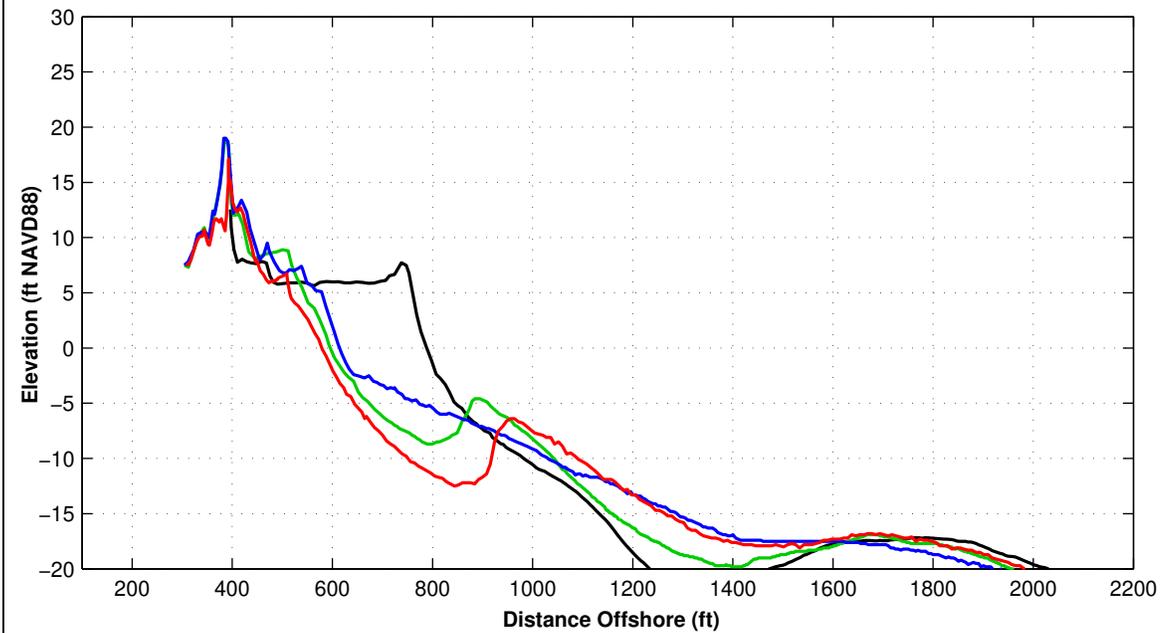
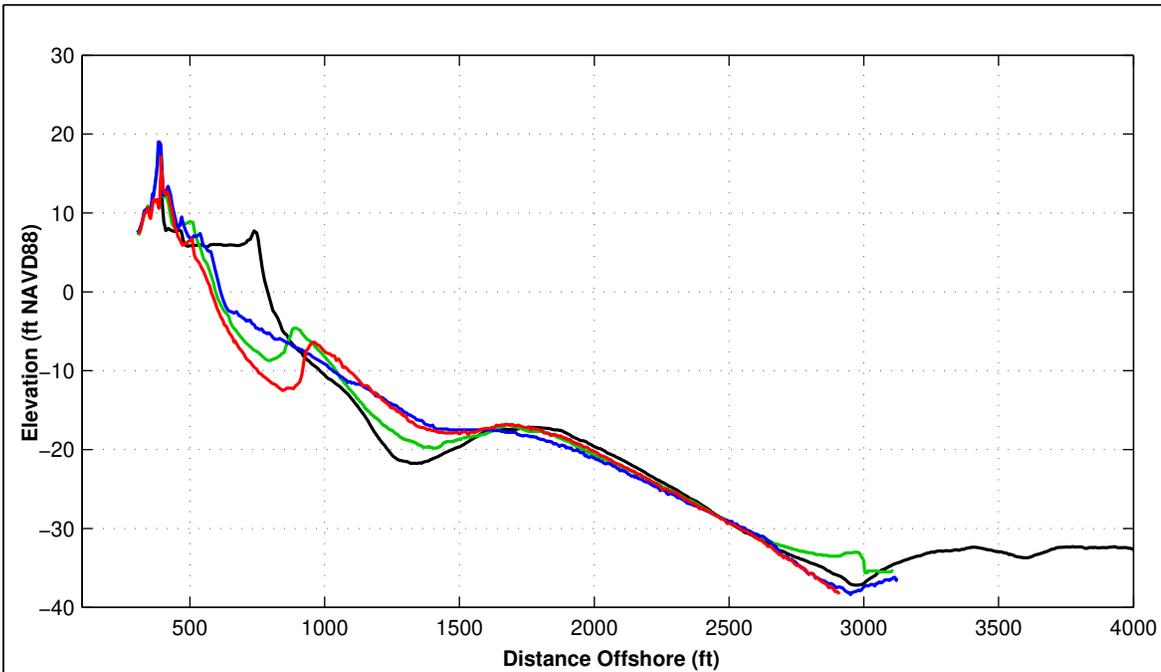


Survey Transect 1007+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-9.72 ft	-19.29 ft
Volume Change Above +6 ft NAVD88	-1.18 cy/ft	-4.46 cy/ft
Volume Change Above 1.18 ft NAVD88	-0.76 cy/ft	-10.91 cy/ft
Volume Change Above -6 ft NAVD88	0.86 cy/ft	-20.33 cy/ft
Volume Change Above -14 ft NAVD88	-5.37 cy/ft	-32.43 cy/ft
Volume Change Above -19 ft NAVD88	28.68 cy/ft	-32.36 cy/ft
Volume Change Above -30 ft NAVD88	22.93 cy/ft	-29.69 cy/ft

**LEGEND:**  
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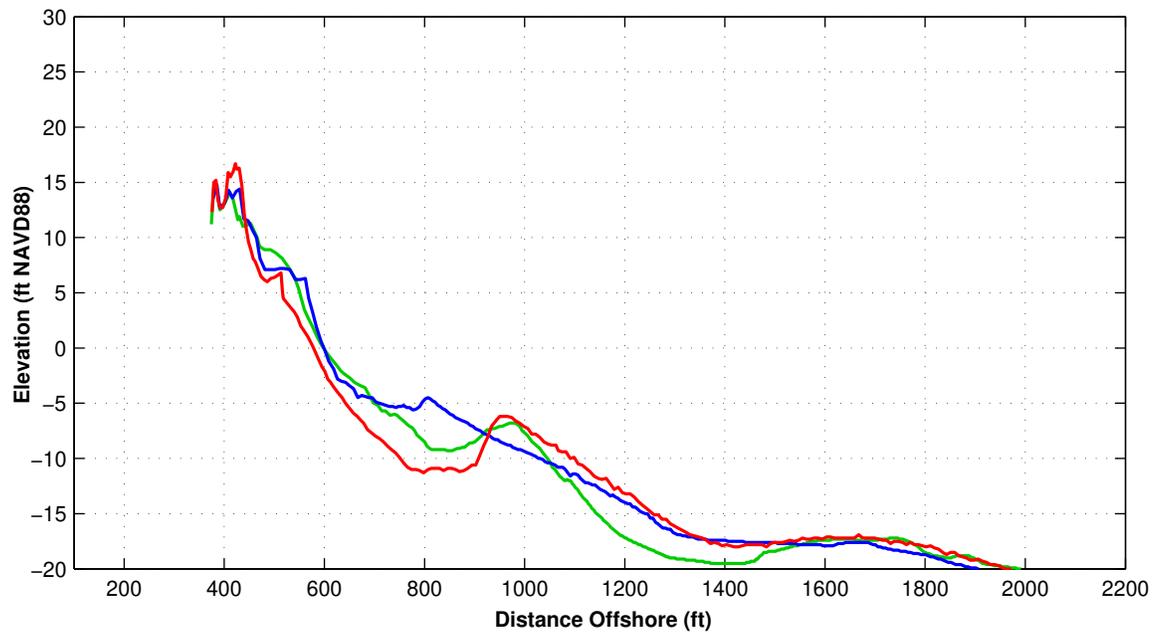
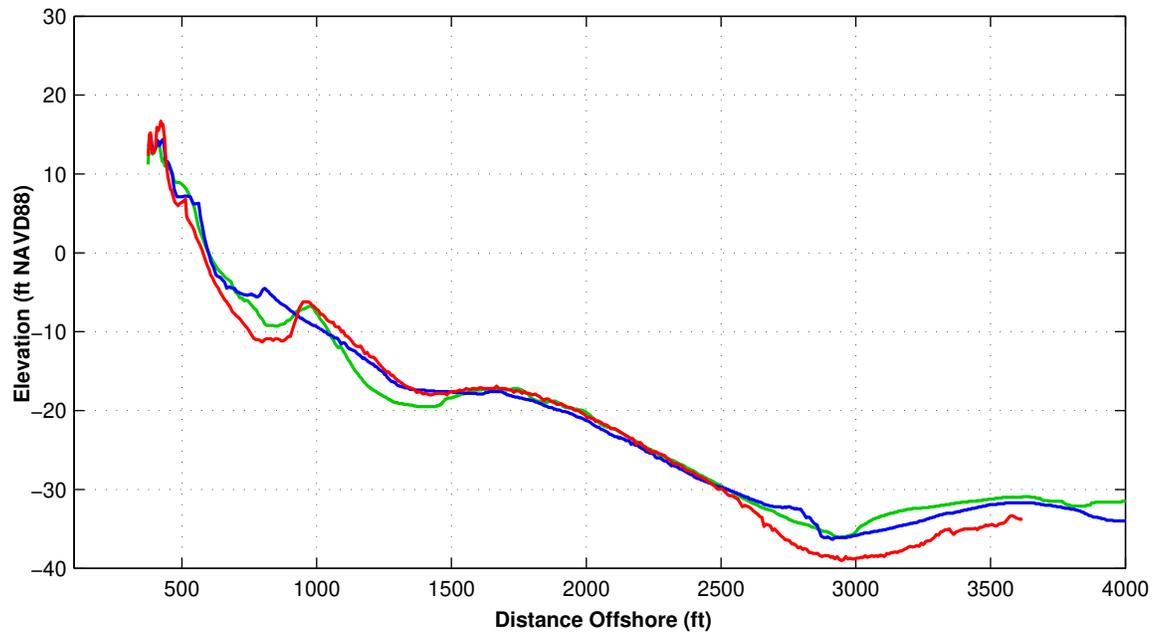
Survey Transect 1010+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	18.33 ft	-38.45 ft
Volume Change Above +6 ft NAVD88	0.69 cy/ft	-5.80 cy/ft
Volume Change Above 1.18 ft NAVD88	5.12 cy/ft	-14.78 cy/ft
Volume Change Above -6 ft NAVD88	15.78 cy/ft	-33.59 cy/ft
Volume Change Above -14 ft NAVD88	26.09 cy/ft	-62.21 cy/ft
Volume Change Above -19 ft NAVD88	53.15 cy/ft	-58.82 cy/ft
Volume Change Above -30 ft NAVD88	46.38 cy/ft	-48.47 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.





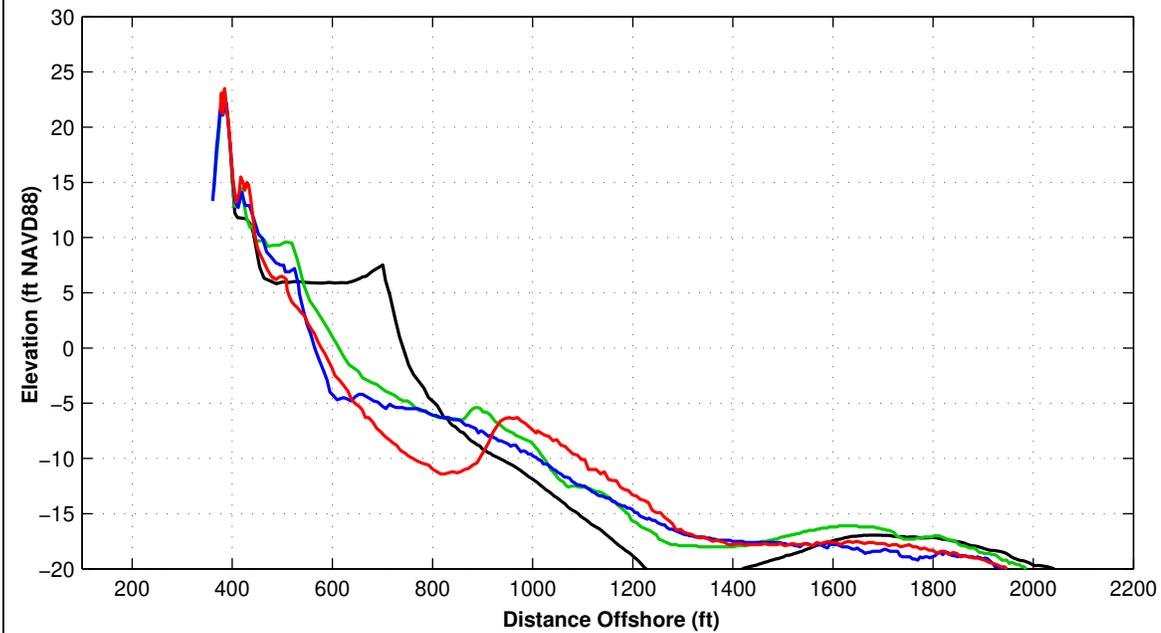
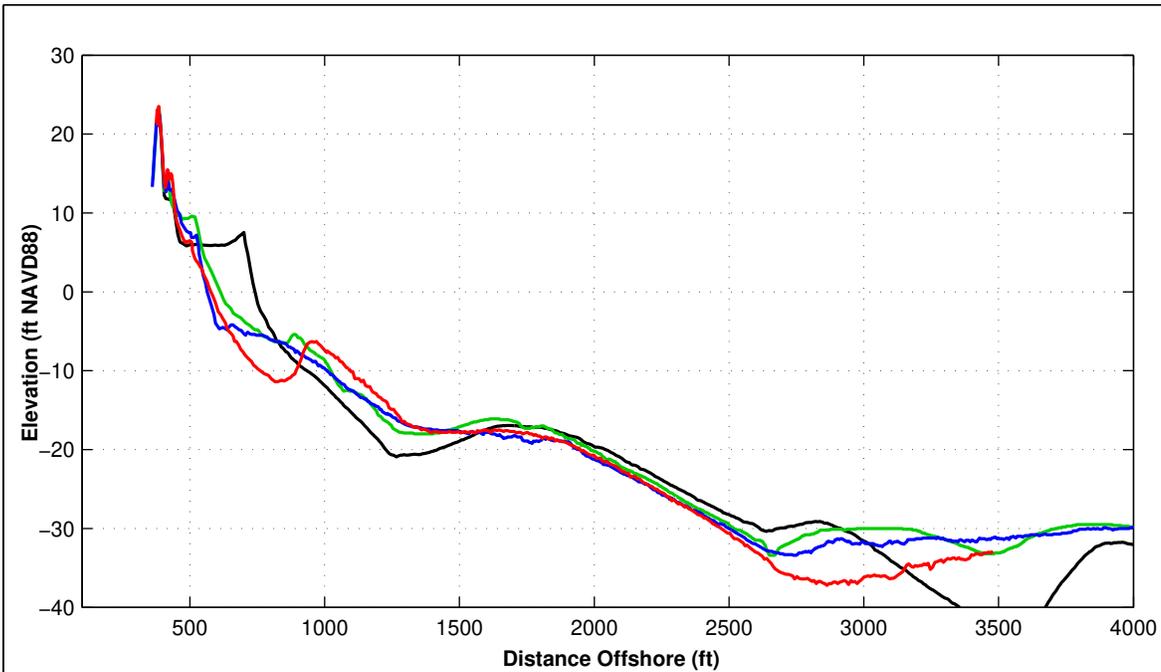
Survey Transect 1012+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	5.64 ft	-24.65 ft
Volume Change Above +6 ft NAVD88	-1.13 cy/ft	-2.16 cy/ft
Volume Change Above 1.18 ft NAVD88	1.25 cy/ft	-9.31 cy/ft
Volume Change Above -6 ft NAVD88	2.91 cy/ft	-21.77 cy/ft
Volume Change Above -14 ft NAVD88	15.13 cy/ft	-39.94 cy/ft
Volume Change Above -19 ft NAVD88	37.34 cy/ft	-30.97 cy/ft
Volume Change Above -30 ft NAVD88	24.32 cy/ft	-18.42 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

- Notes:
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  2. All Survey Elevations In Feet Referenced to NAVD88.



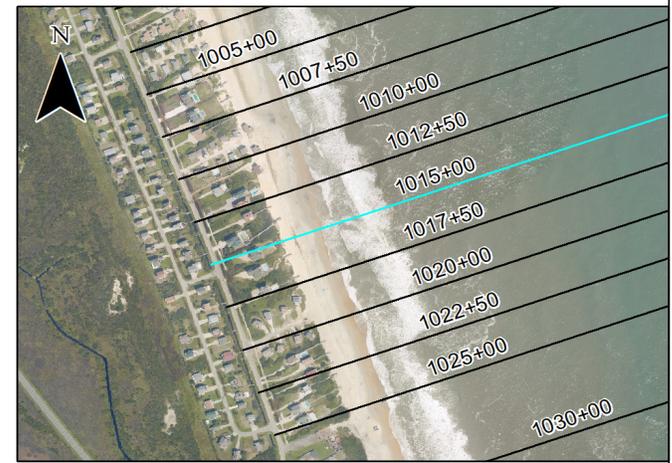


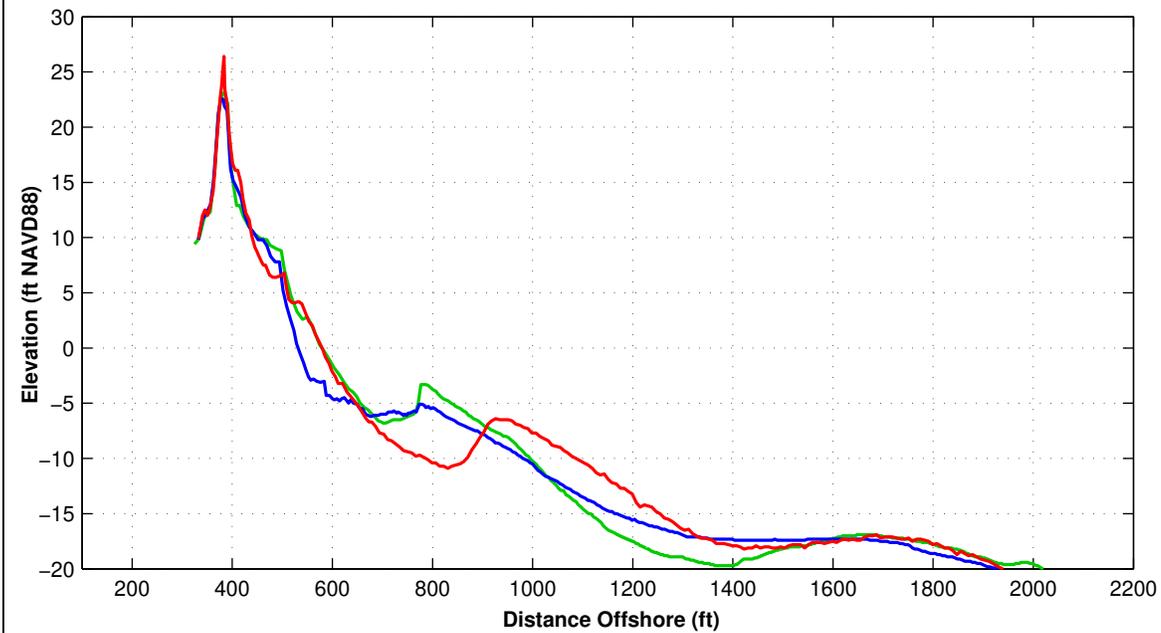
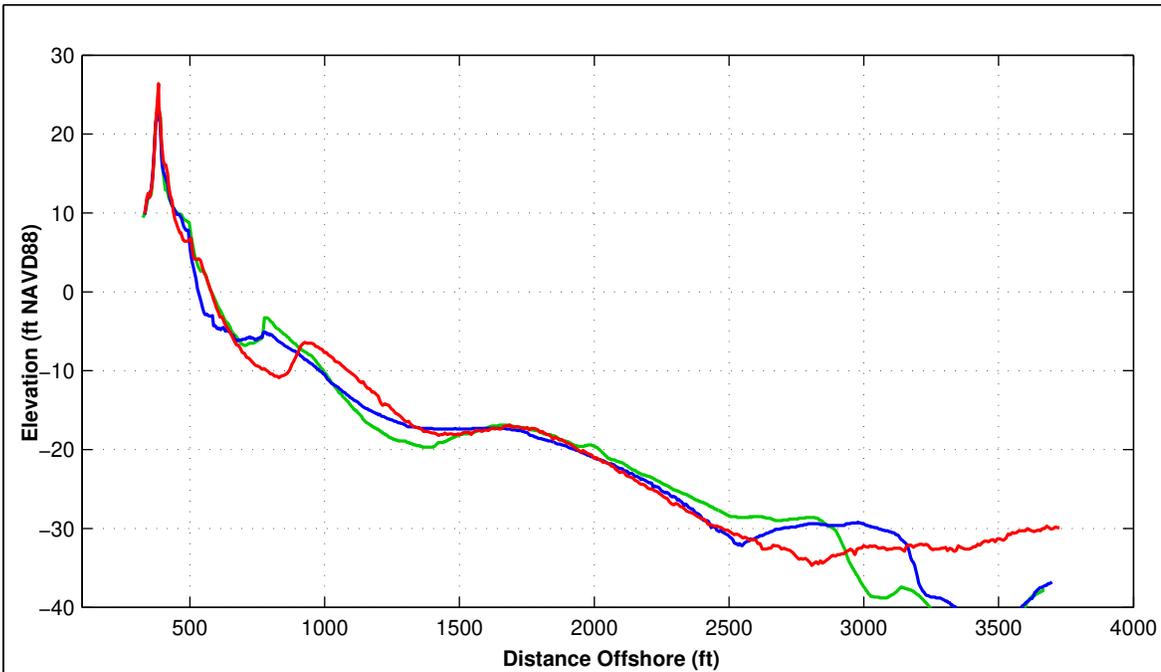
Survey Transect 1015+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-40.76 ft	7.99 ft
Volume Change Above +6 ft NAVD88	-3.28 cy/ft	-2.61 cy/ft
Volume Change Above 1.18 ft NAVD88	-7.71 cy/ft	-4.33 cy/ft
Volume Change Above -6 ft NAVD88	-24.87 cy/ft	-4.26 cy/ft
Volume Change Above -14 ft NAVD88	-31.60 cy/ft	-12.04 cy/ft
Volume Change Above -19 ft NAVD88	-46.69 cy/ft	-3.81 cy/ft
Volume Change Above -30 ft NAVD88	-58.23 cy/ft	-10.98 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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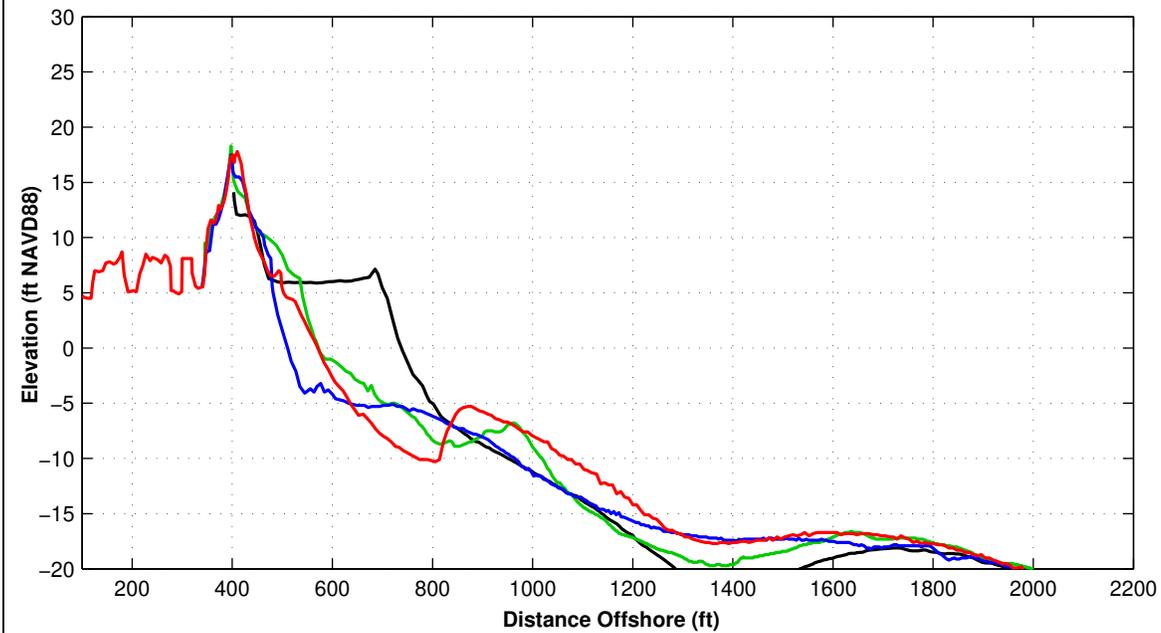
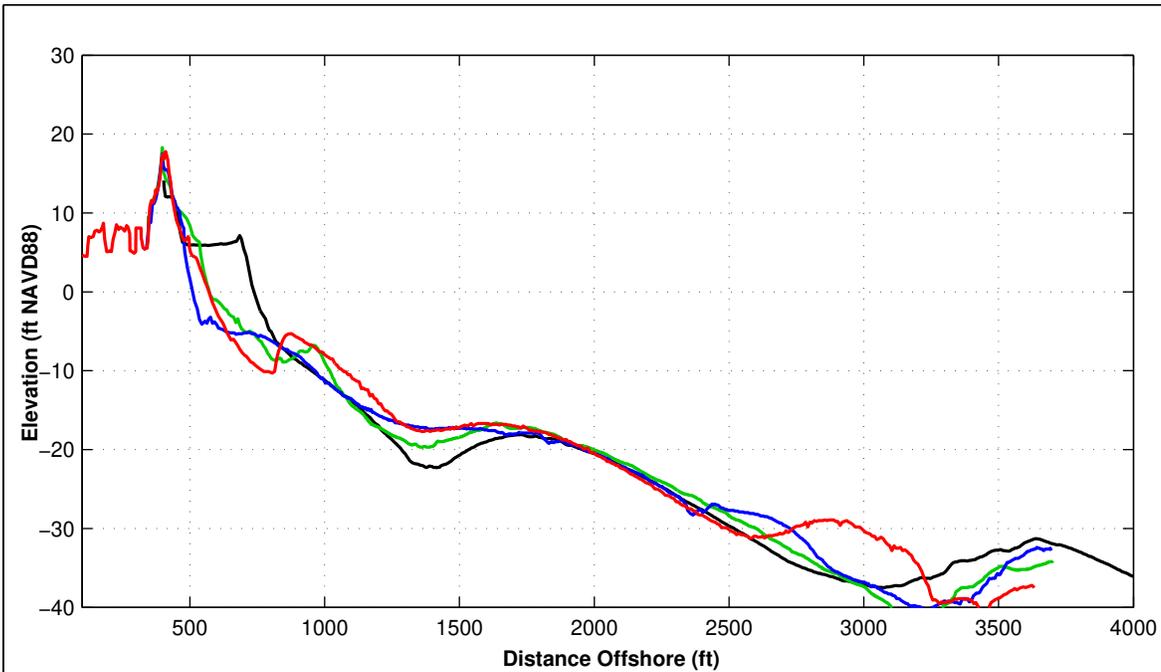
Survey Transect 1017+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-41.69 ft	41.85 ft
Volume Change Above +6 ft NAVD88	-1.46 cy/ft	-0.38 cy/ft
Volume Change Above 1.18 ft NAVD88	-5.50 cy/ft	4.10 cy/ft
Volume Change Above -6 ft NAVD88	-21.52 cy/ft	12.70 cy/ft
Volume Change Above -14 ft NAVD88	-24.19 cy/ft	15.44 cy/ft
Volume Change Above -19 ft NAVD88	-2.51 cy/ft	23.01 cy/ft
Volume Change Above -30 ft NAVD88	-38.40 cy/ft	11.96 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

- Notes:
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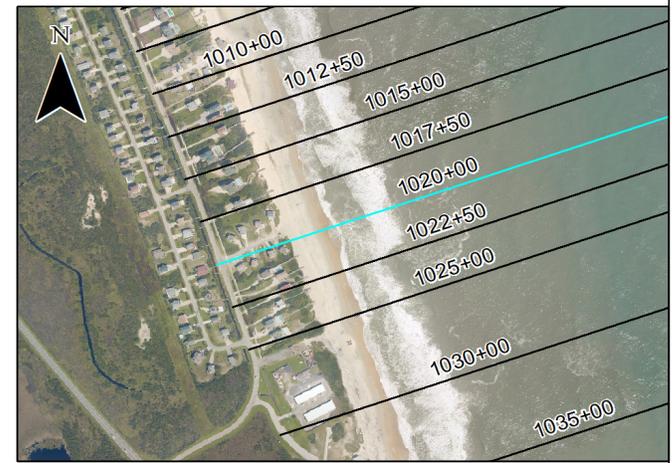


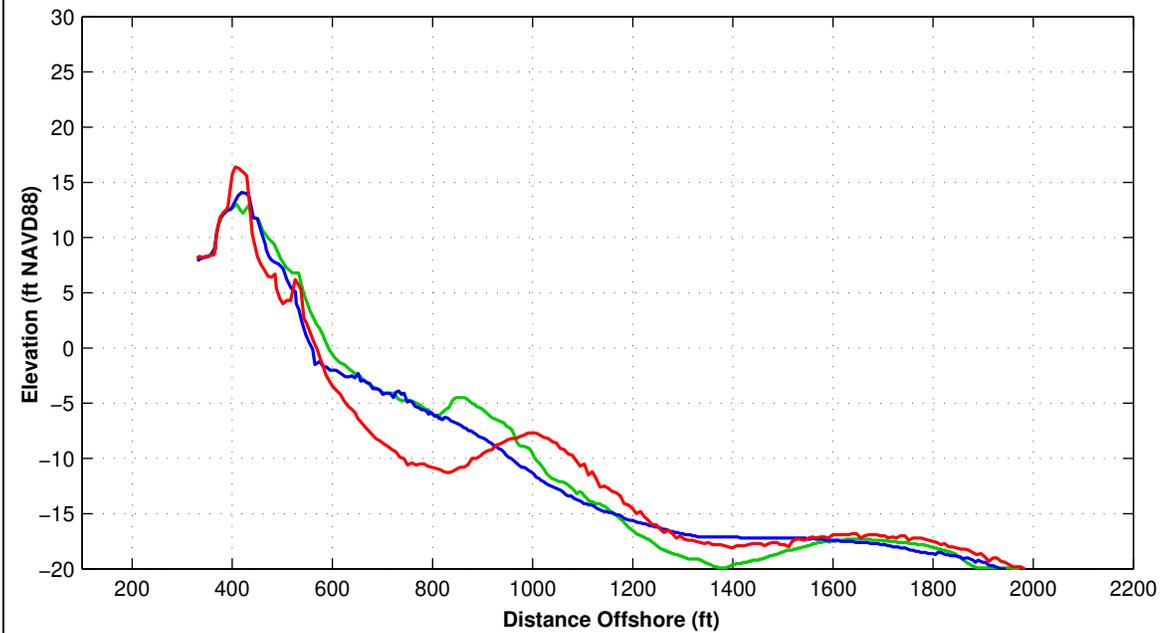
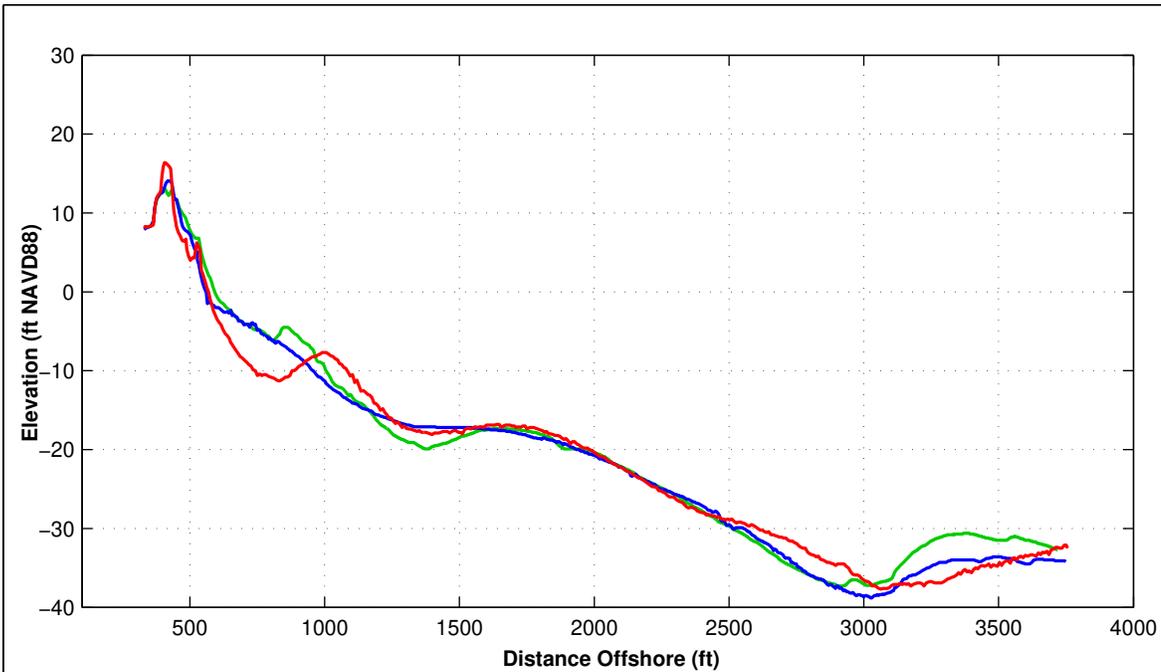


Survey Transect 1020+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-59.58 ft	55.01 ft
Volume Change Above +6 ft NAVD88	-4.35 cy/ft	-1.89 cy/ft
Volume Change Above 1.18 ft NAVD88	-14.75 cy/ft	5.07 cy/ft
Volume Change Above -6 ft NAVD88	-34.94 cy/ft	15.69 cy/ft
Volume Change Above -14 ft NAVD88	-38.41 cy/ft	30.10 cy/ft
Volume Change Above -19 ft NAVD88	-21.96 cy/ft	43.61 cy/ft
Volume Change Above -30 ft NAVD88	-22.95 cy/ft	26.18 cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
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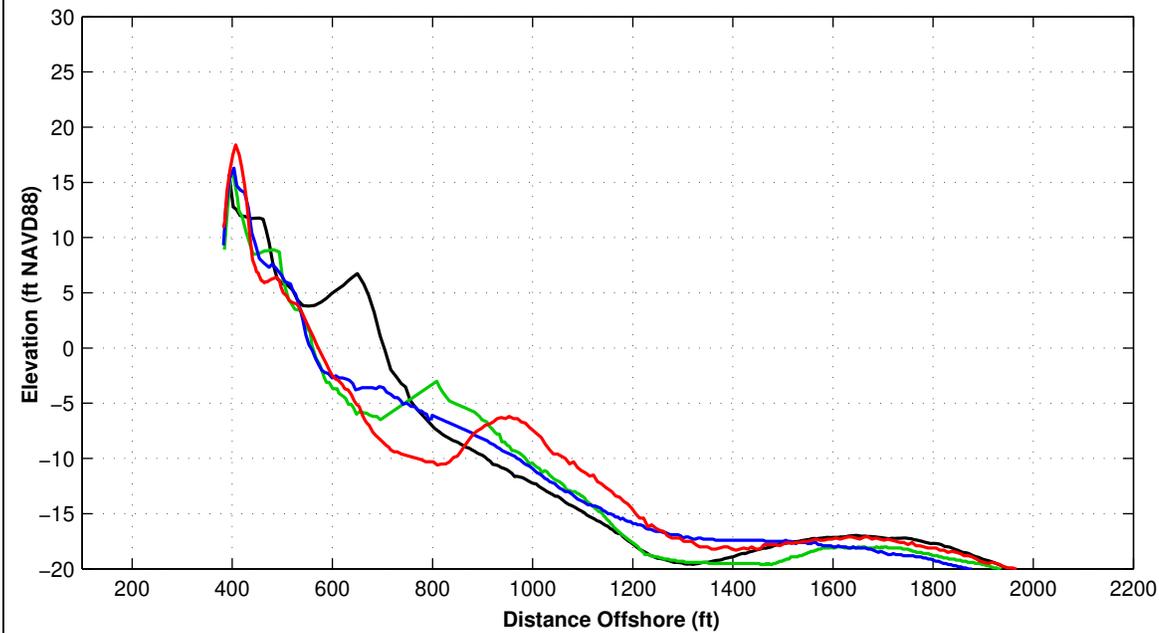
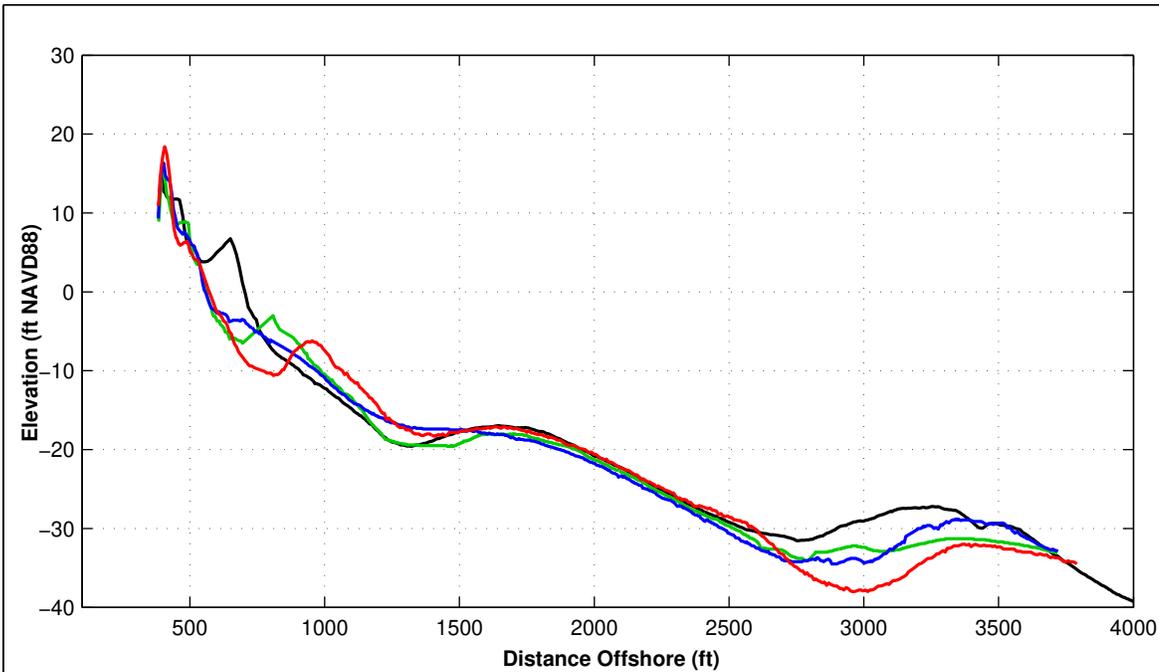
Survey Transect 1022+50	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-33.80 ft	10.22 ft
Volume Change Above +6 ft NAVD88	-1.38 cy/ft	-2.35 cy/ft
Volume Change Above 1.18 ft NAVD88	-5.66 cy/ft	-2.34 cy/ft
Volume Change Above -6 ft NAVD88	-13.93 cy/ft	-15.79 cy/ft
Volume Change Above -14 ft NAVD88	-29.71 cy/ft	-23.36 cy/ft
Volume Change Above -19 ft NAVD88	-11.36 cy/ft	-15.61 cy/ft
Volume Change Above -30 ft NAVD88	-6.44 cy/ft	-15.91 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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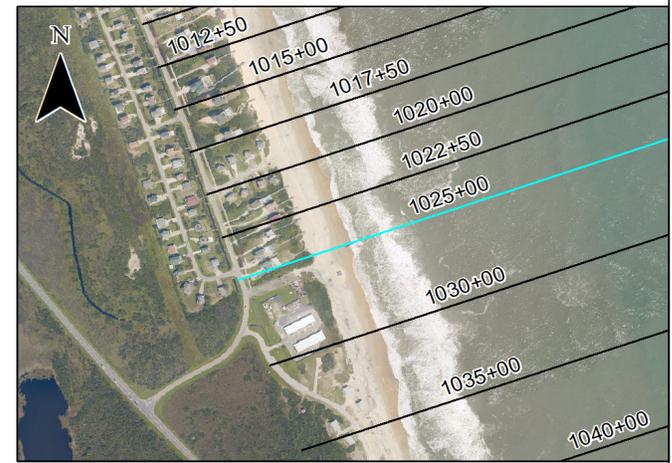


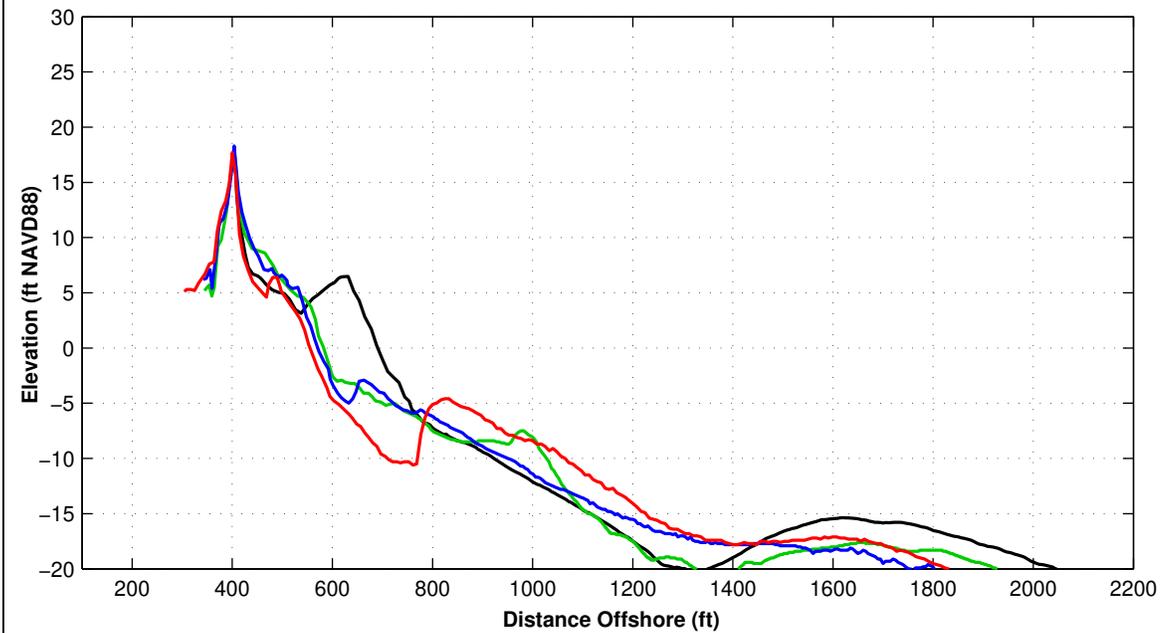
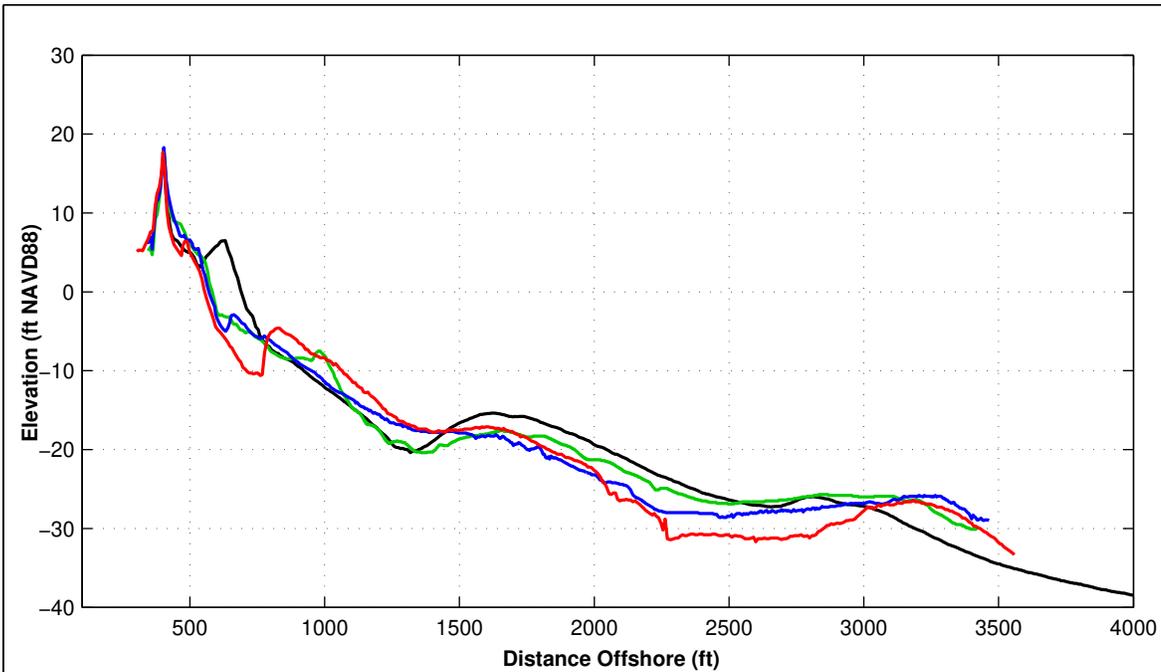
Survey Transect 1025+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-9.60 ft	13.06 ft
Volume Change Above +6 ft NAVD88	-1.39 cy/ft	-3.50 cy/ft
Volume Change Above 1.18 ft NAVD88	-0.43 cy/ft	-4.37 cy/ft
Volume Change Above -6 ft NAVD88	2.15 cy/ft	-11.60 cy/ft
Volume Change Above -14 ft NAVD88	-6.78 cy/ft	-8.81 cy/ft
Volume Change Above -19 ft NAVD88	17.15 cy/ft	0.34 cy/ft
Volume Change Above -30 ft NAVD88	14.74 cy/ft	24.34 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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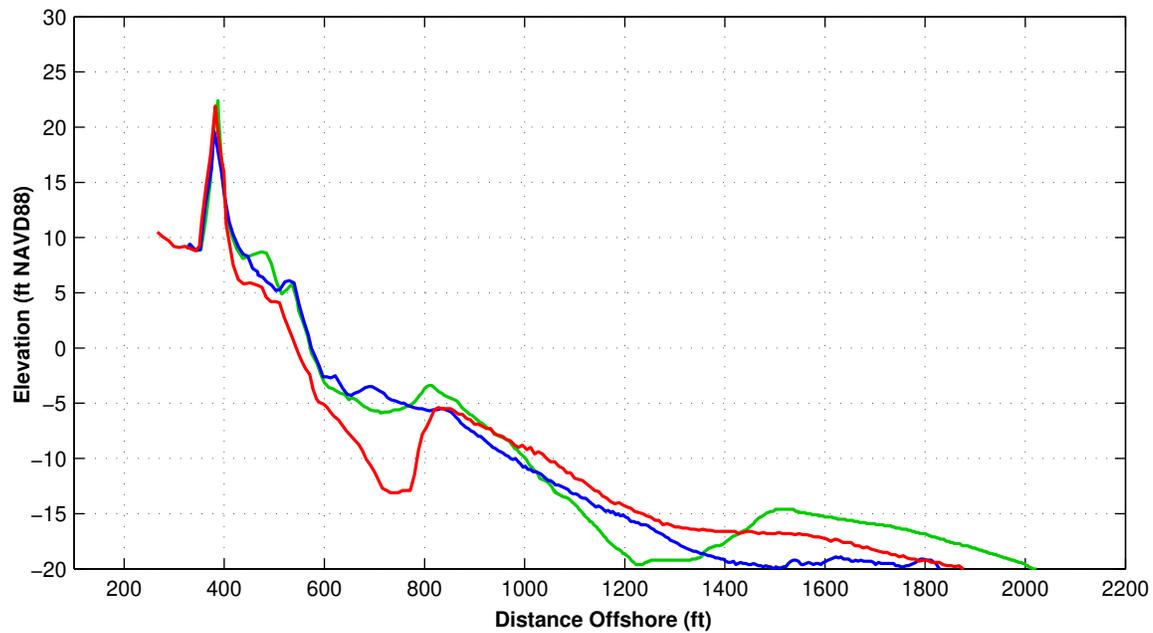
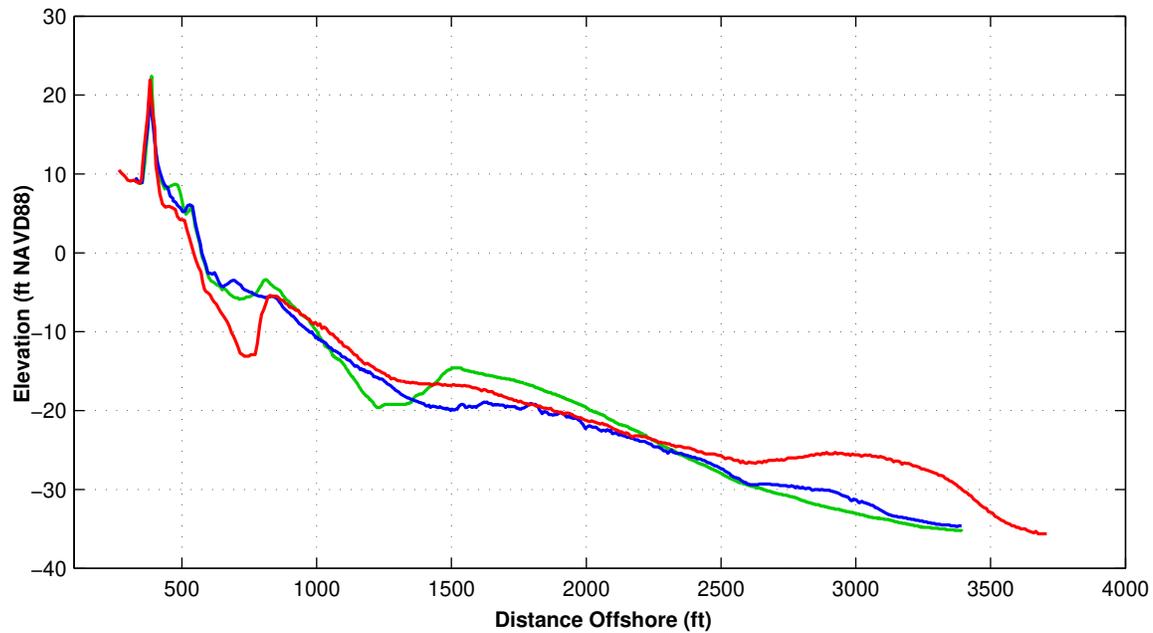
Survey Transect 1030+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-10.01 ft	-14.54 ft
Volume Change Above +6 ft NAVD88	-0.14 cy/ft	-6.98 cy/ft
Volume Change Above 1.18 ft NAVD88	-1.29 cy/ft	-11.71 cy/ft
Volume Change Above -6 ft NAVD88	-2.54 cy/ft	-20.81 cy/ft
Volume Change Above -14 ft NAVD88	-9.71 cy/ft	-6.67 cy/ft
Volume Change Above -19 ft NAVD88	8.00 cy/ft	9.83 cy/ft
Volume Change Above -30 ft NAVD88	-54.82 cy/ft	-61.34 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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Survey Transect 1035+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	2.22 ft	-34.24 ft
Volume Change Above +6 ft NAVD88	-4.05 cy/ft	-4.08 cy/ft
Volume Change Above 1.18 ft NAVD88	-3.38 cy/ft	-12.12 cy/ft
Volume Change Above -6 ft NAVD88	-1.71 cy/ft	-31.67 cy/ft
Volume Change Above -14 ft NAVD88	-6.04 cy/ft	-46.05 cy/ft
Volume Change Above -19 ft NAVD88	-43.26 cy/ft	-11.07 cy/ft
Volume Change Above -30 ft NAVD88	-66.42 cy/ft	119.74 cy/ft

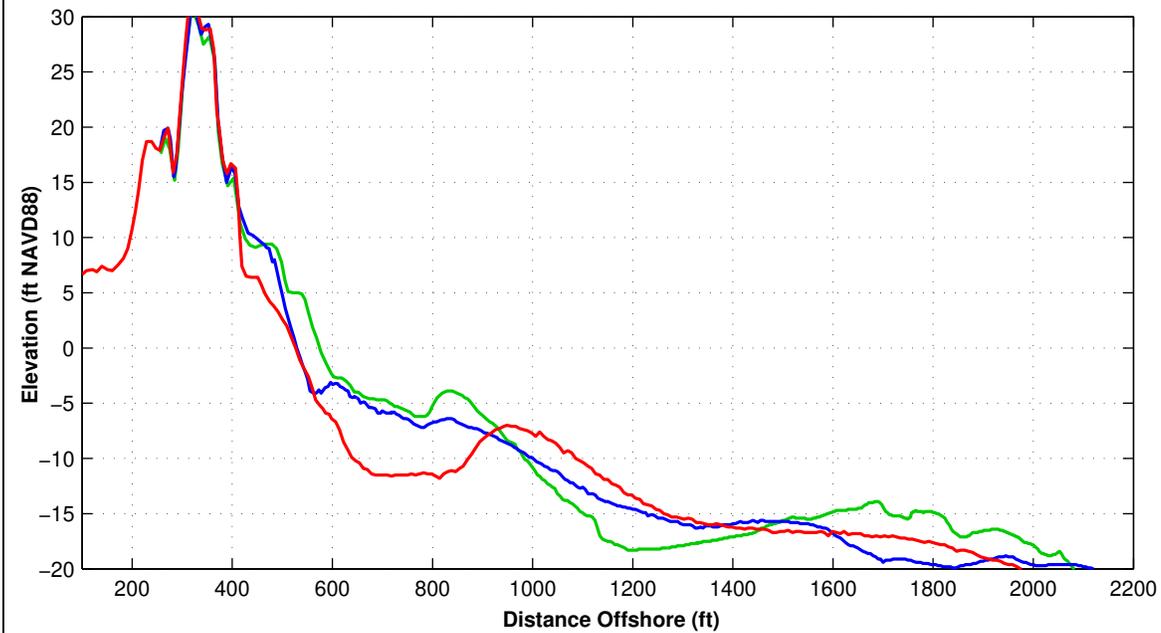
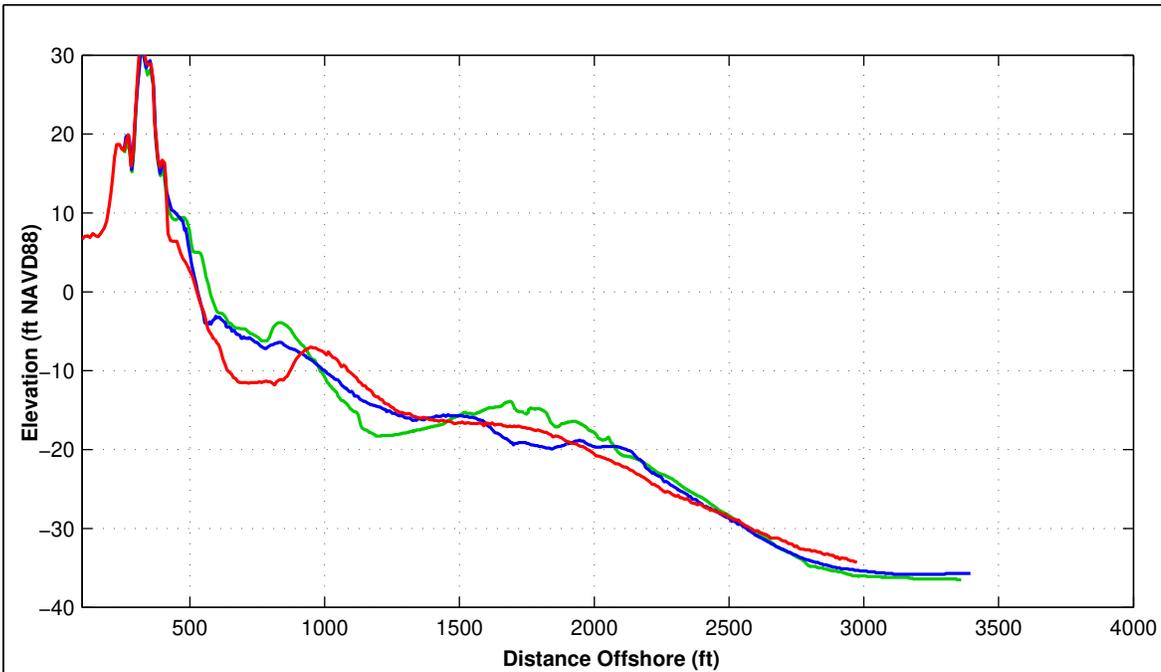
**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

**Notes:**

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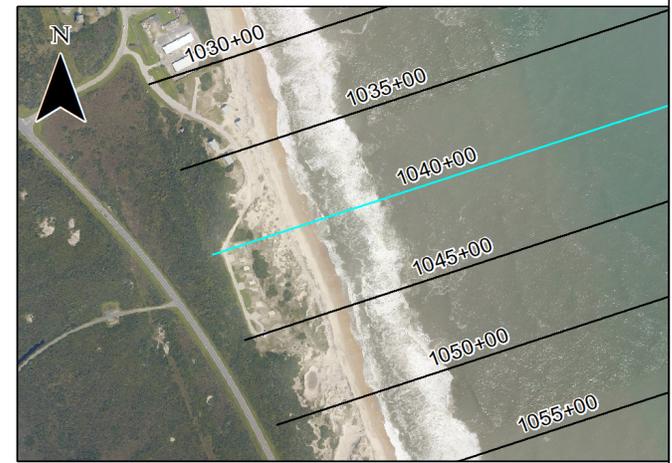


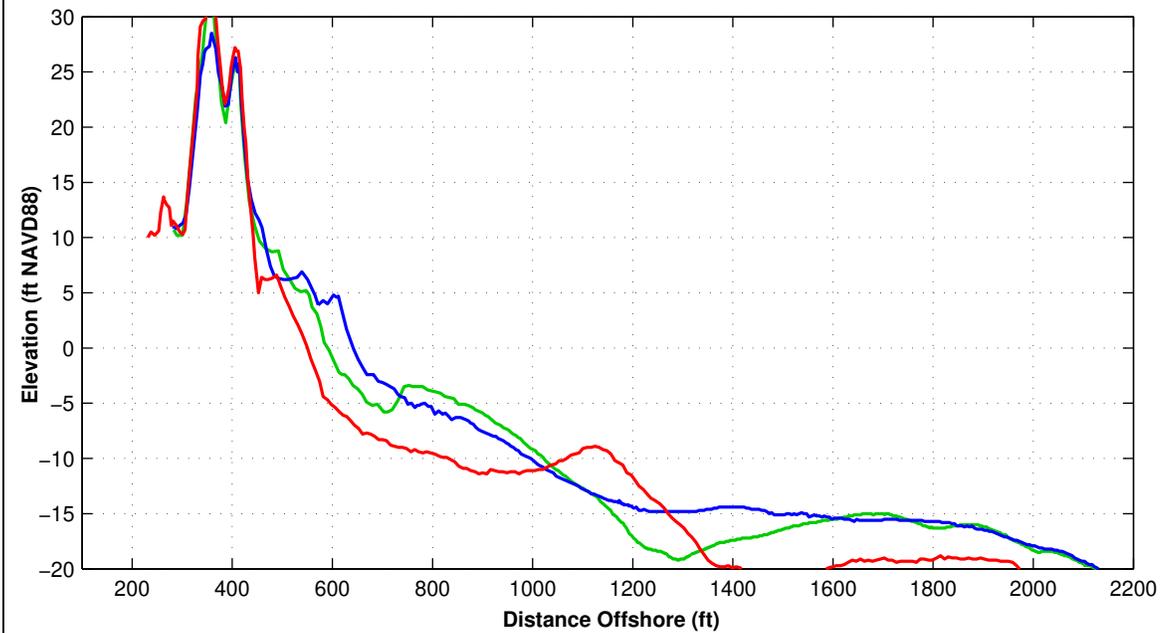
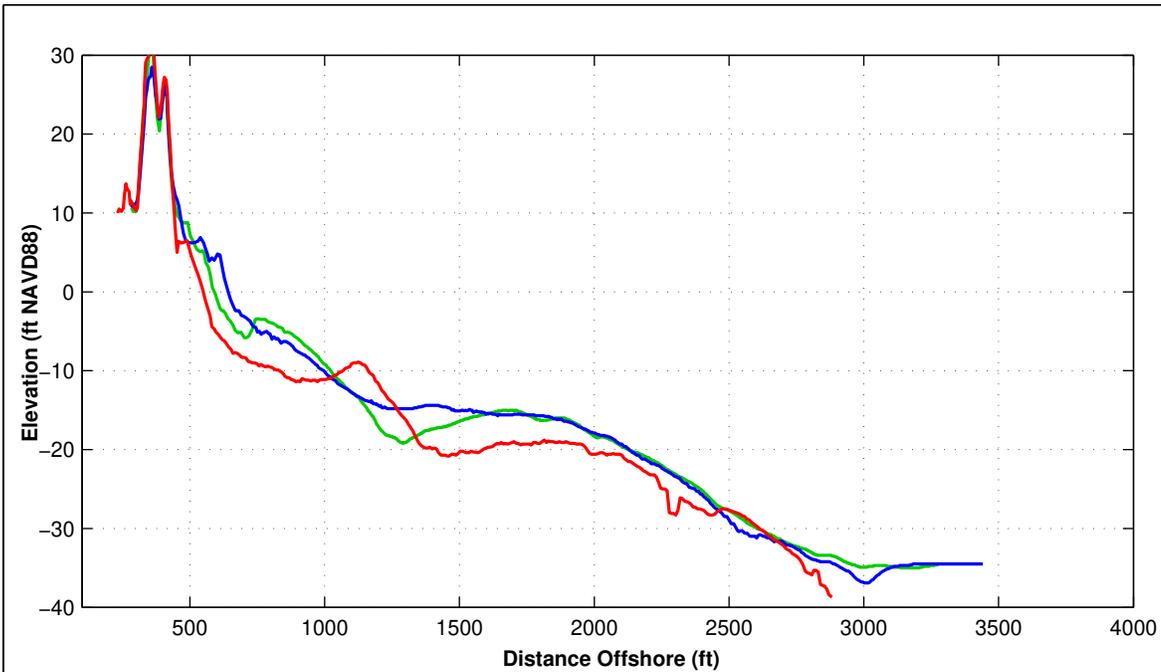


Survey Transect 1040+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-44.71 ft	-5.24 ft
Volume Change Above +6 ft NAVD88	1.93 cy/ft	-8.53 cy/ft
Volume Change Above 1.18 ft NAVD88	-4.66 cy/ft	-12.32 cy/ft
Volume Change Above -6 ft NAVD88	-22.89 cy/ft	-20.14 cy/ft
Volume Change Above -14 ft NAVD88	-22.41 cy/ft	-45.78 cy/ft
Volume Change Above -19 ft NAVD88	-42.77 cy/ft	-33.48 cy/ft
Volume Change Above -30 ft NAVD88	-54.25 cy/ft	-51.43 cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

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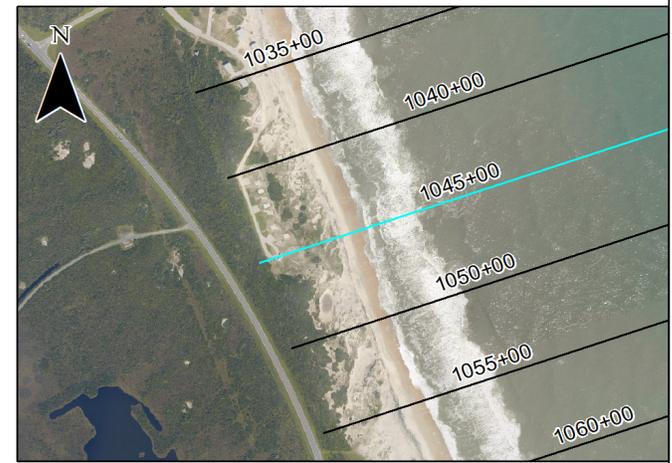


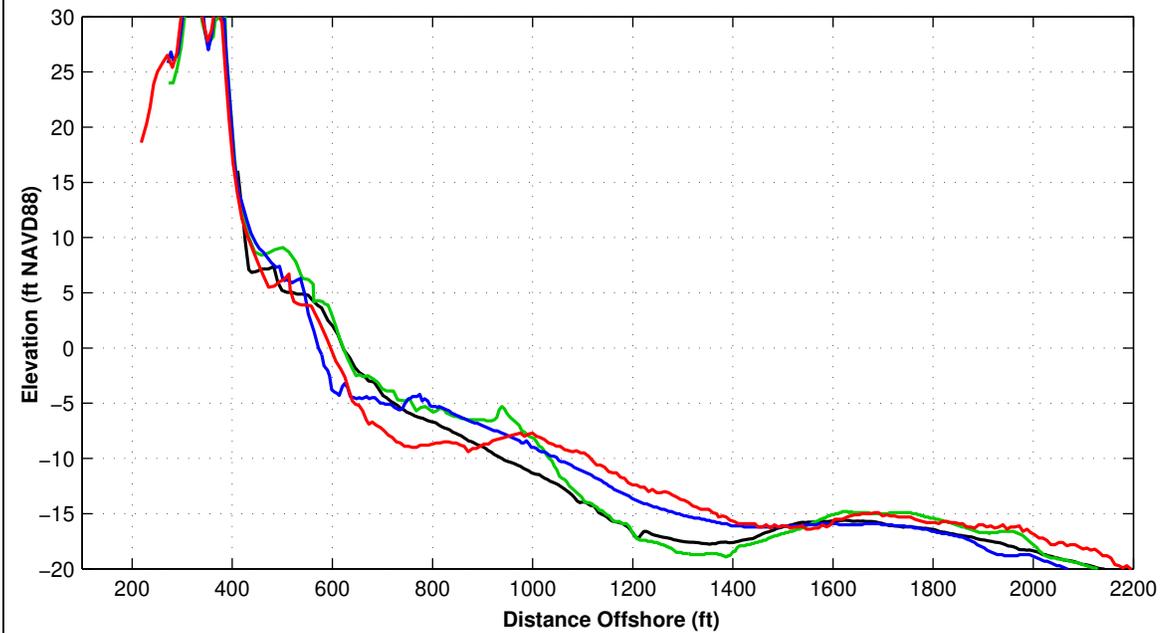
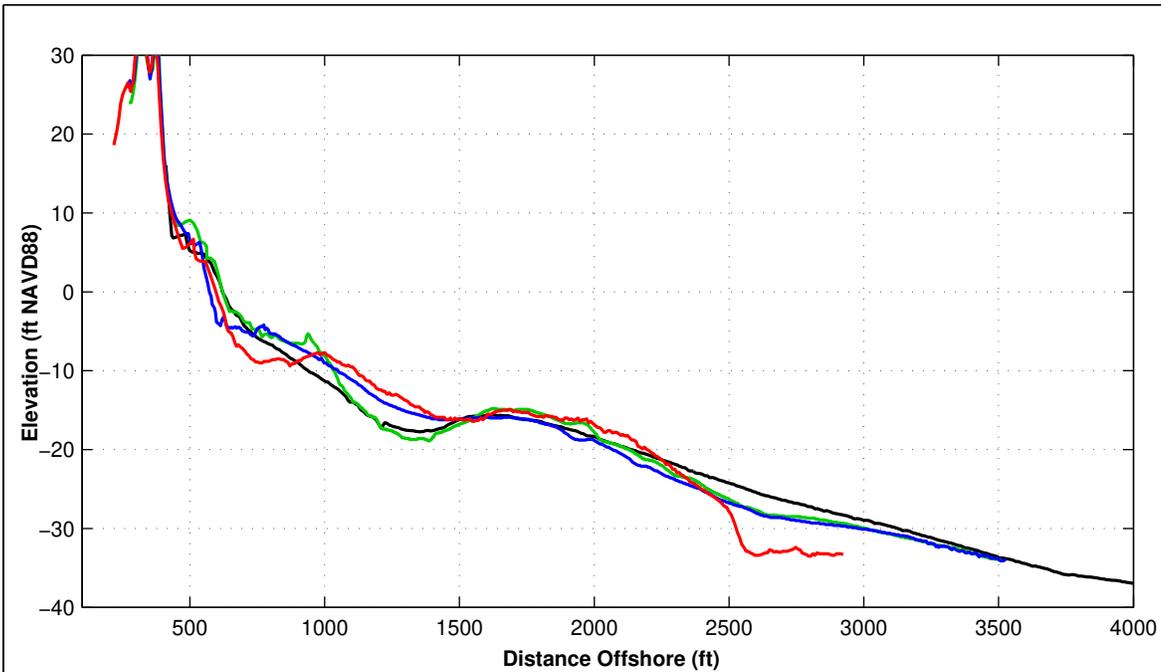


Survey Transect 1045+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	51.69 ft	-92.30 ft
Volume Change Above +6 ft NAVD88	0.28 cy/ft	-2.19 cy/ft
Volume Change Above 1.18 ft NAVD88	7.86 cy/ft	-17.58 cy/ft
Volume Change Above -6 ft NAVD88	14.35 cy/ft	-50.35 cy/ft
Volume Change Above -14 ft NAVD88	6.46 cy/ft	-69.38 cy/ft
Volume Change Above -19 ft NAVD88	46.95 cy/ft	-157.68 cy/ft
Volume Change Above -30 ft NAVD88	37.57 cy/ft	-201.06 cy/ft

**LEGEND:**  
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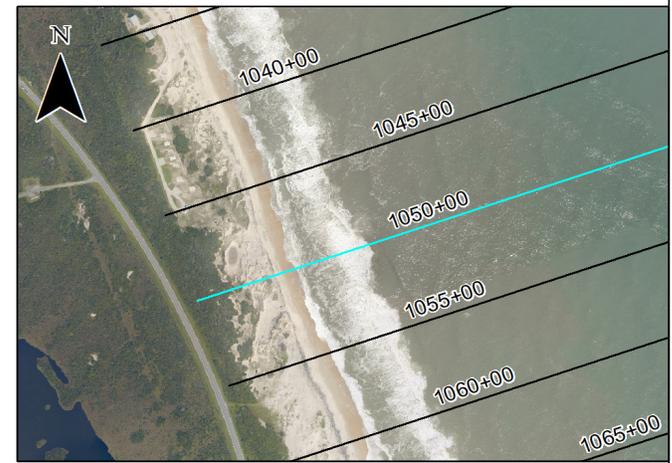


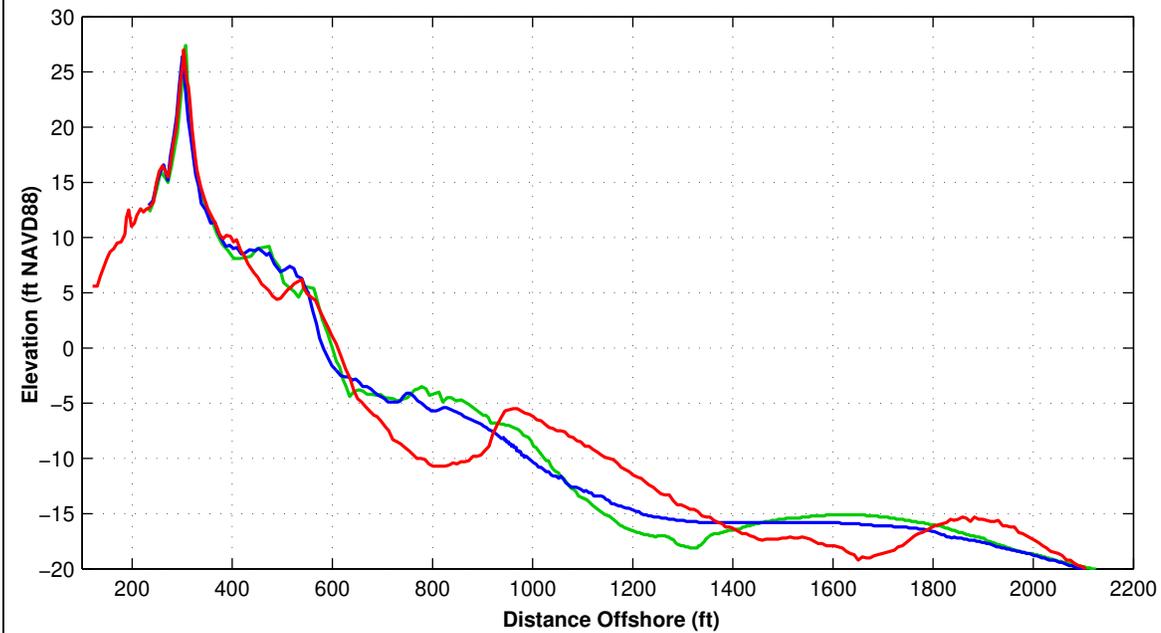
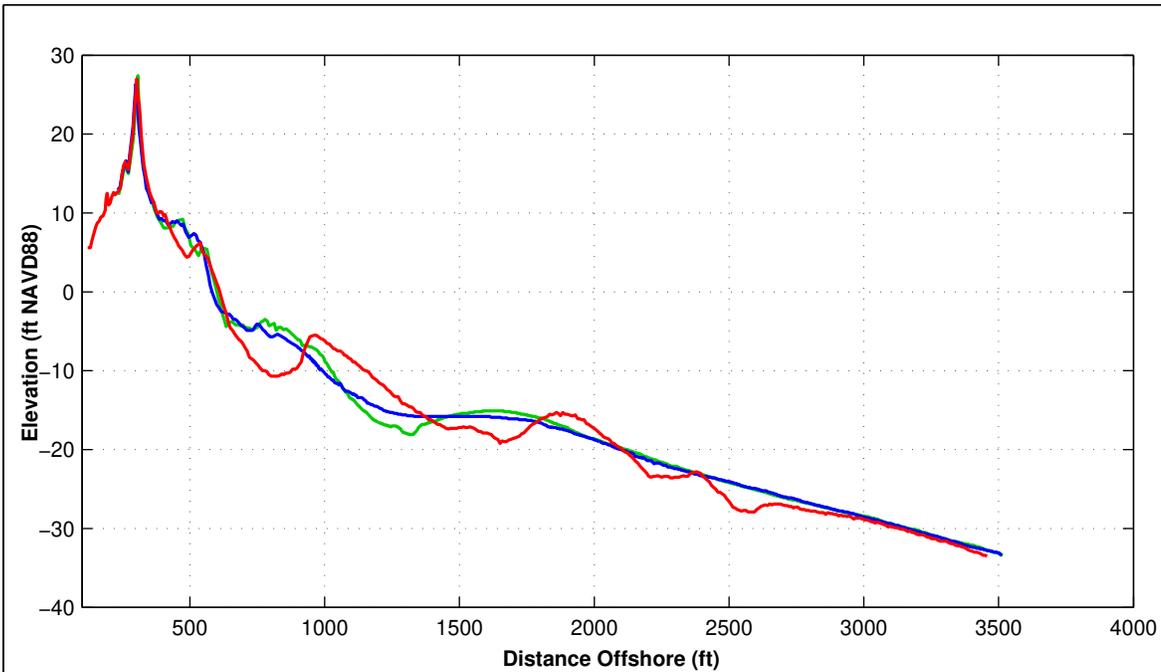
Survey Transect 1050+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-47.07 ft	20.29 ft
Volume Change Above +6 ft NAVD88	-3.49 cy/ft	-4.27 cy/ft
Volume Change Above 1.18 ft NAVD88	-9.80 cy/ft	-4.96 cy/ft
Volume Change Above -6 ft NAVD88	-23.41 cy/ft	-7.19 cy/ft
Volume Change Above -14 ft NAVD88	-18.48 cy/ft	-14.30 cy/ft
Volume Change Above -19 ft NAVD88	-5.46 cy/ft	15.85 cy/ft
Volume Change Above -30 ft NAVD88	-25.92 cy/ft	13.61 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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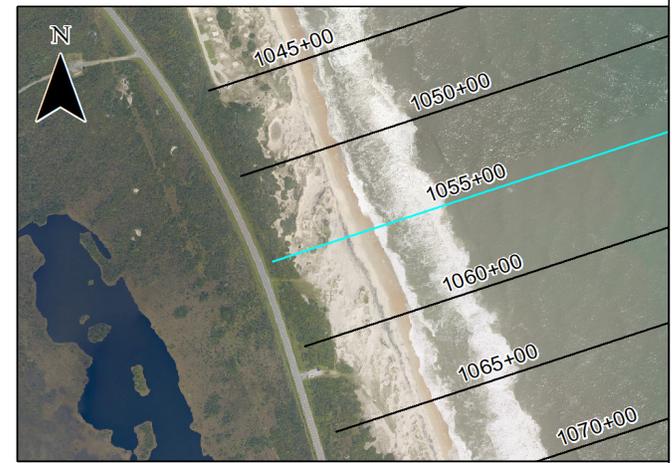


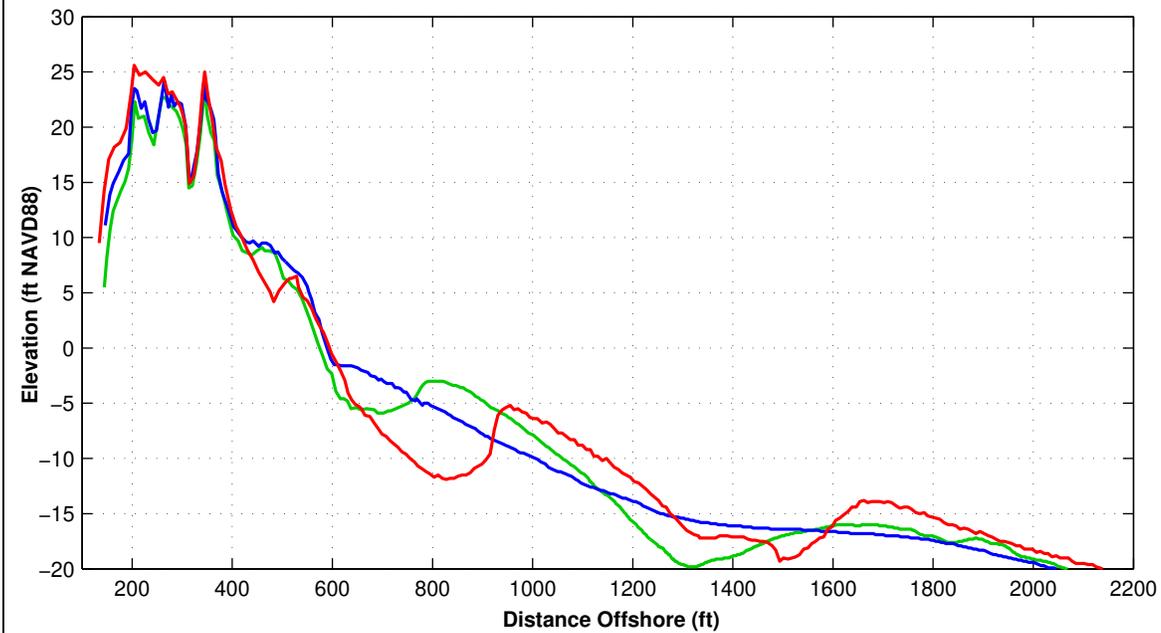
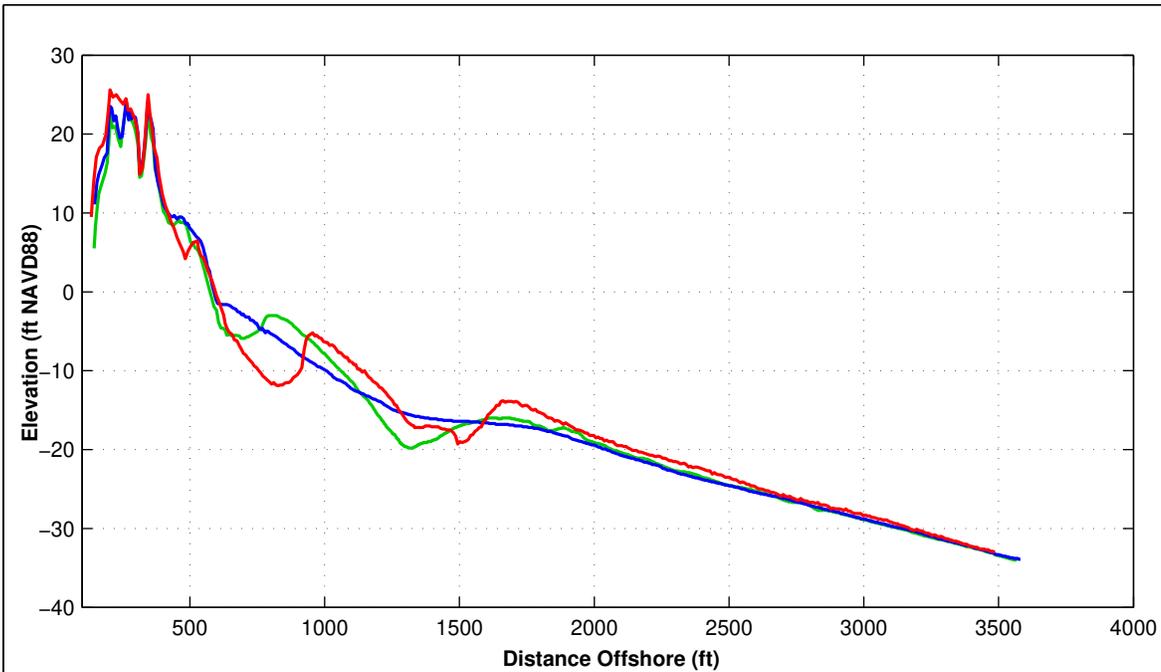
Survey Transect 1055+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-18.38 ft	25.23 ft
Volume Change Above +6 ft NAVD88	0.40 cy/ft	-2.64 cy/ft
Volume Change Above 1.18 ft NAVD88	-0.85 cy/ft	-2.91 cy/ft
Volume Change Above -6 ft NAVD88	-6.40 cy/ft	-7.83 cy/ft
Volume Change Above -14 ft NAVD88	-12.91 cy/ft	5.53 cy/ft
Volume Change Above -19 ft NAVD88	-6.11 cy/ft	2.26 cy/ft
Volume Change Above -30 ft NAVD88	-8.24 cy/ft	-38.73 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

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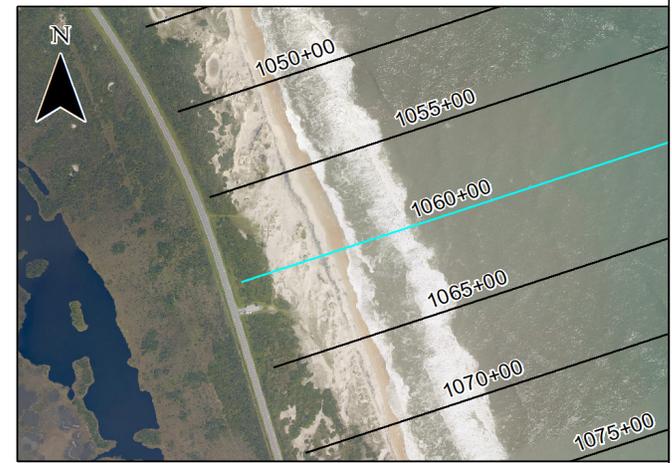


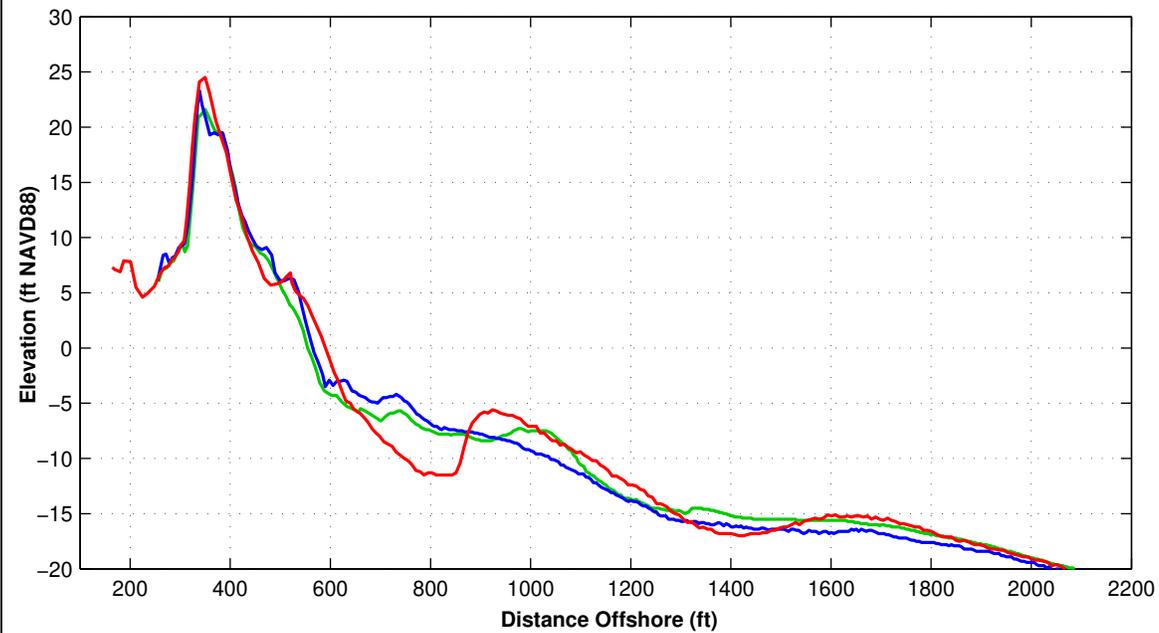
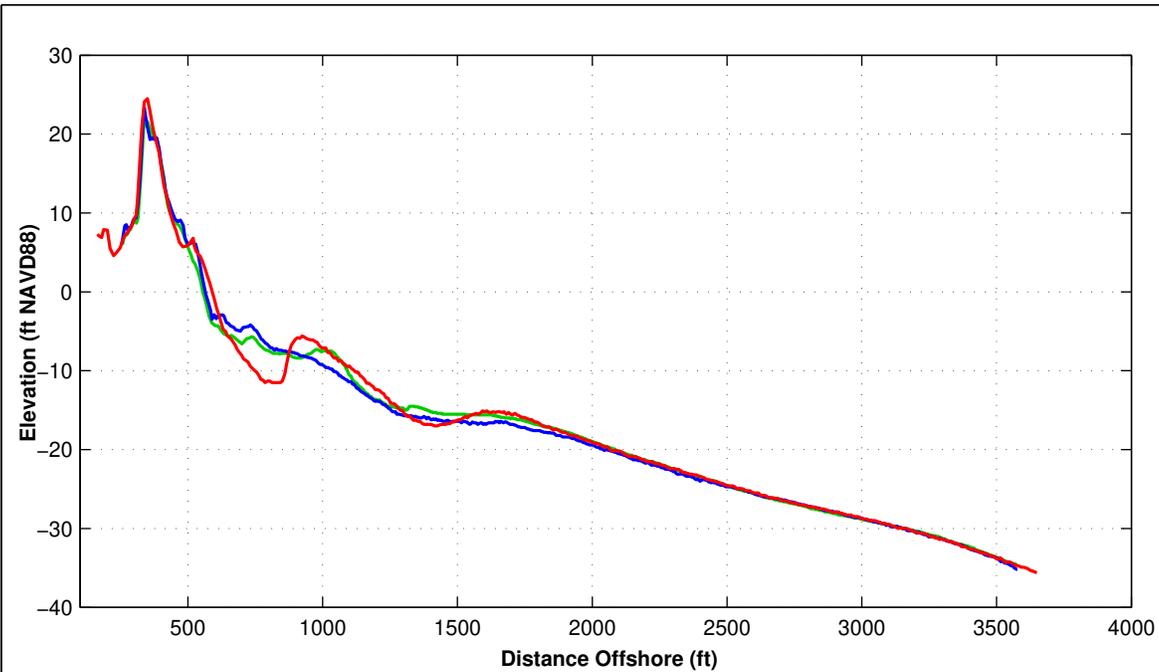
Survey Transect 1060+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	15.54 ft	3.26 ft
Volume Change Above +6 ft NAVD88	11.24 cy/ft	0.92 cy/ft
Volume Change Above 1.18 ft NAVD88	14.65 cy/ft	-1.73 cy/ft
Volume Change Above -6 ft NAVD88	20.64 cy/ft	-16.93 cy/ft
Volume Change Above -14 ft NAVD88	4.75 cy/ft	-16.79 cy/ft
Volume Change Above -19 ft NAVD88	25.66 cy/ft	-0.69 cy/ft
Volume Change Above -30 ft NAVD88	22.99 cy/ft	33.46 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

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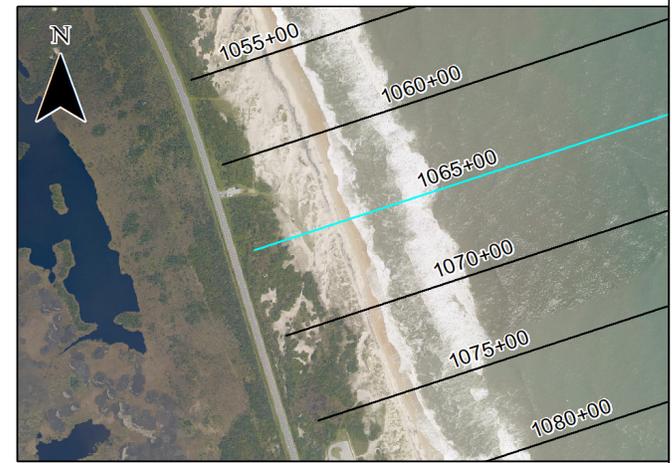


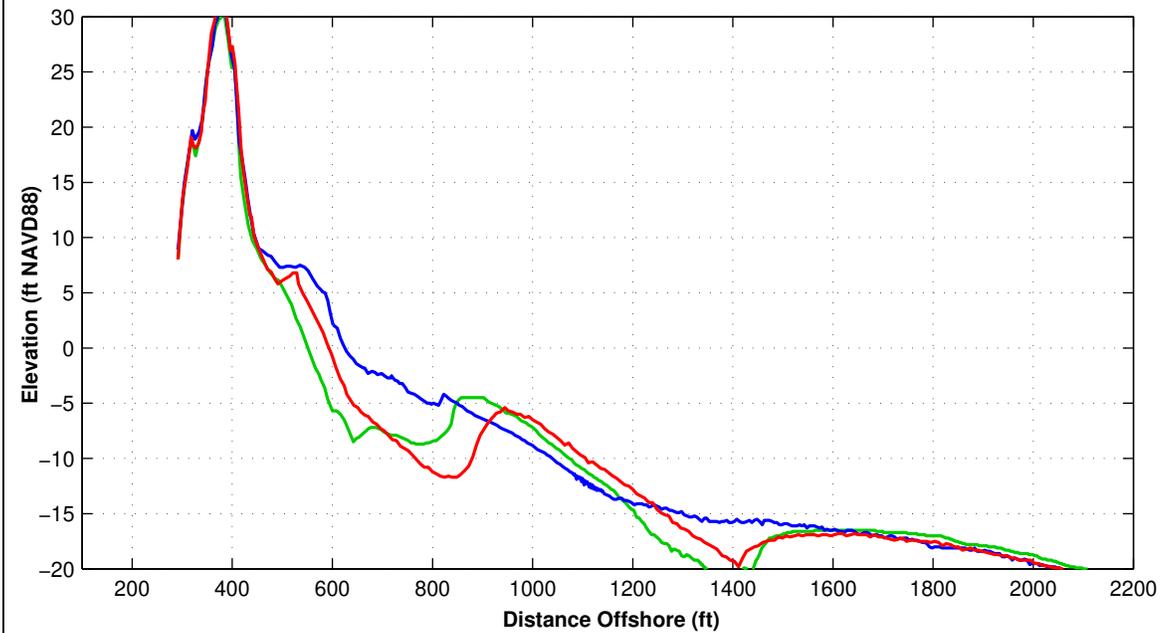
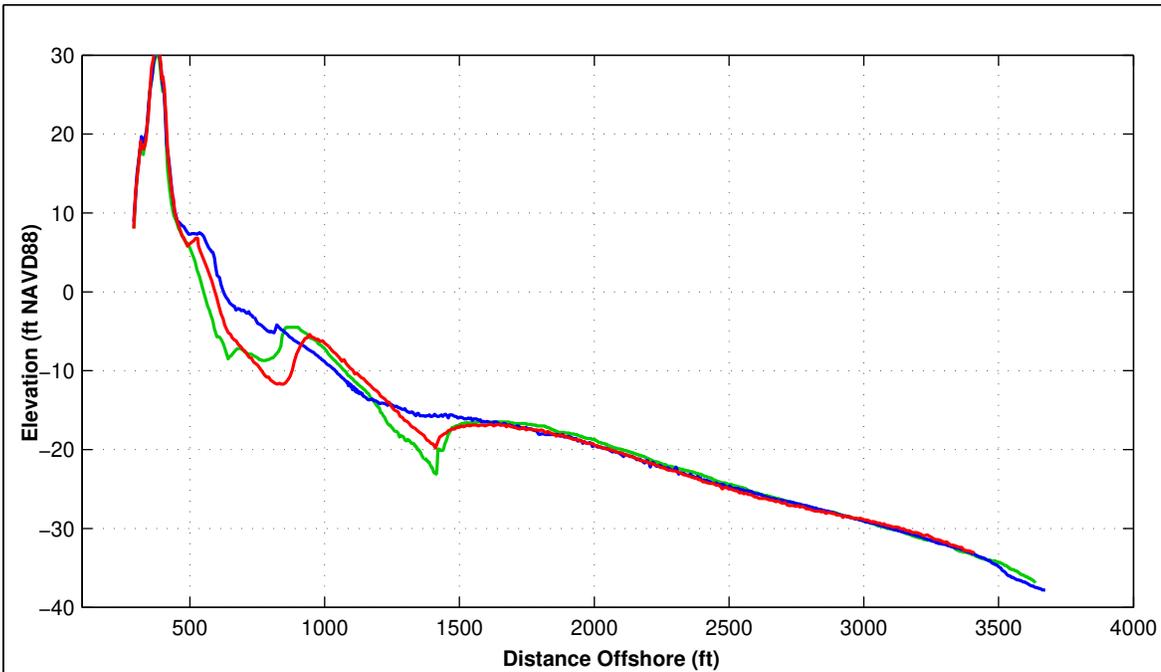


Survey Transect 1065+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	9.67 ft	22.99 ft
Volume Change Above +6 ft NAVD88	1.65 cy/ft	-1.12 cy/ft
Volume Change Above 1.18 ft NAVD88	5.20 cy/ft	0.49 cy/ft
Volume Change Above -6 ft NAVD88	15.76 cy/ft	-2.60 cy/ft
Volume Change Above -14 ft NAVD88	8.55 cy/ft	-3.88 cy/ft
Volume Change Above -19 ft NAVD88	-14.40 cy/ft	11.46 cy/ft
Volume Change Above -30 ft NAVD88	-18.18 cy/ft	18.29 cy/ft

**LEGEND:**  
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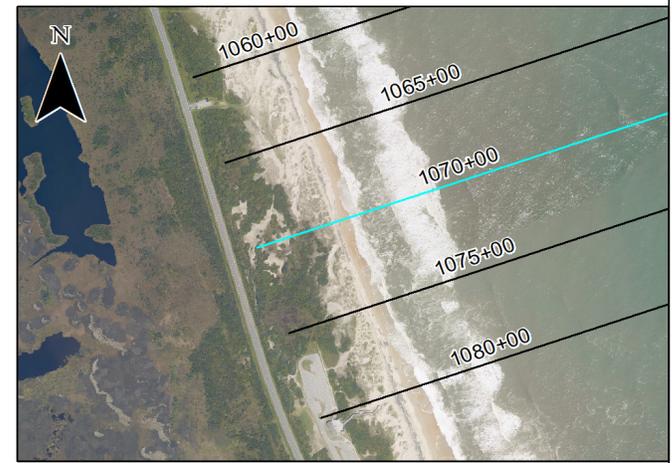


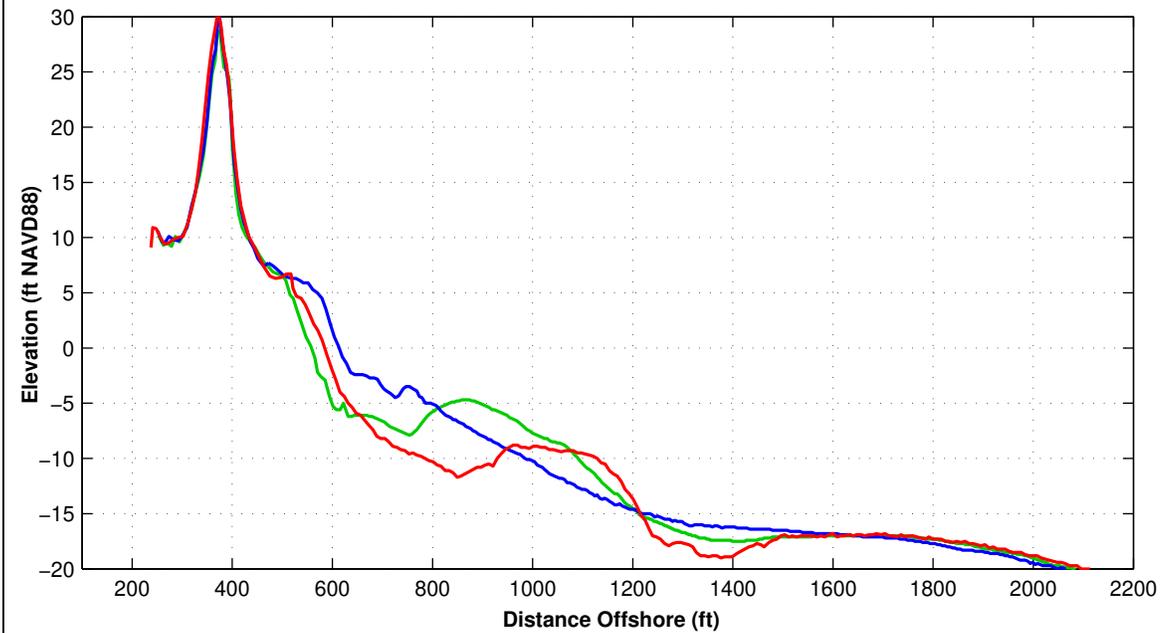
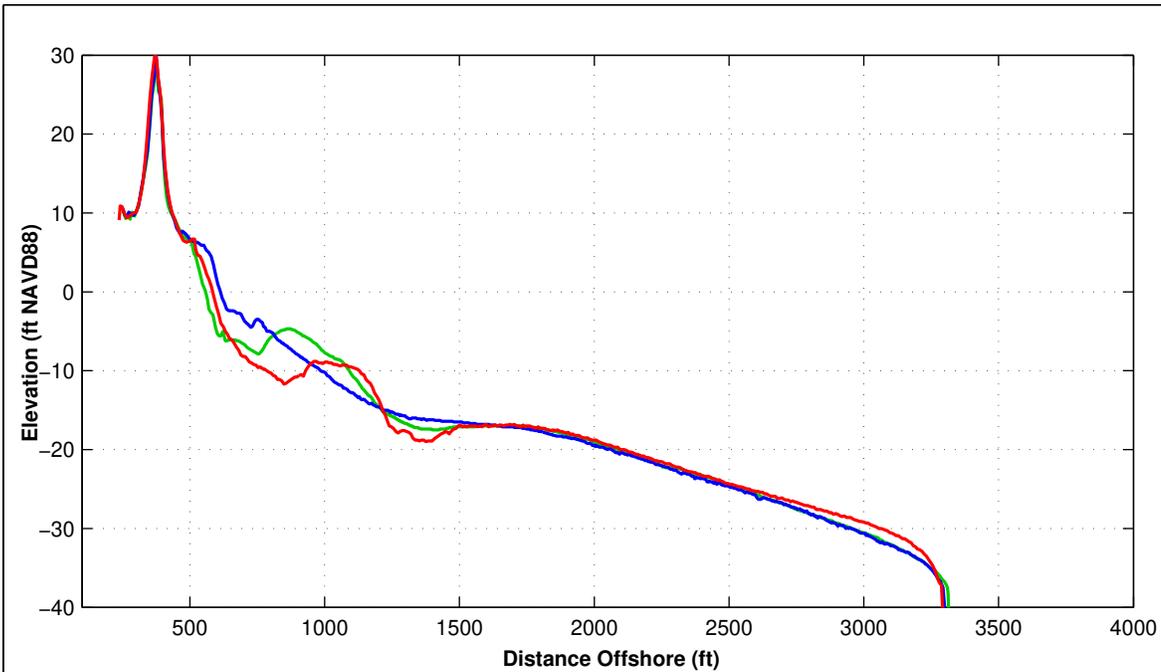
Survey Transect 1070+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	72.17 ft	-30.70 ft
Volume Change Above +6 ft NAVD88	8.12 cy/ft	-2.74 cy/ft
Volume Change Above 1.18 ft NAVD88	21.13 cy/ft	-9.12 cy/ft
Volume Change Above -6 ft NAVD88	53.52 cy/ft	-34.28 cy/ft
Volume Change Above -14 ft NAVD88	57.32 cy/ft	-44.27 cy/ft
Volume Change Above -19 ft NAVD88	83.58 cy/ft	-65.63 cy/ft
Volume Change Above -30 ft NAVD88	81.63 cy/ft	-70.47 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

- Notes:
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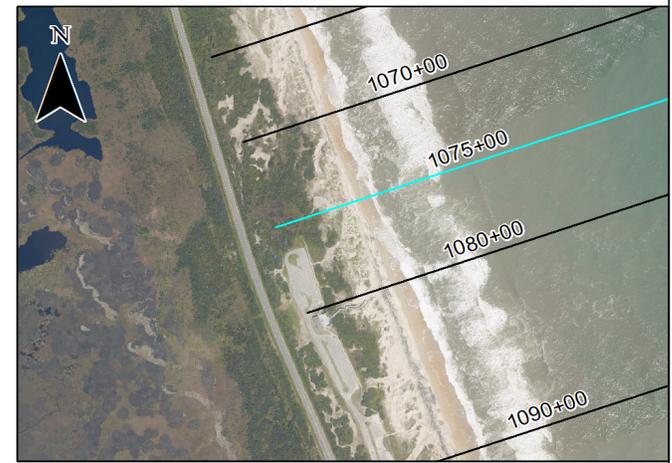


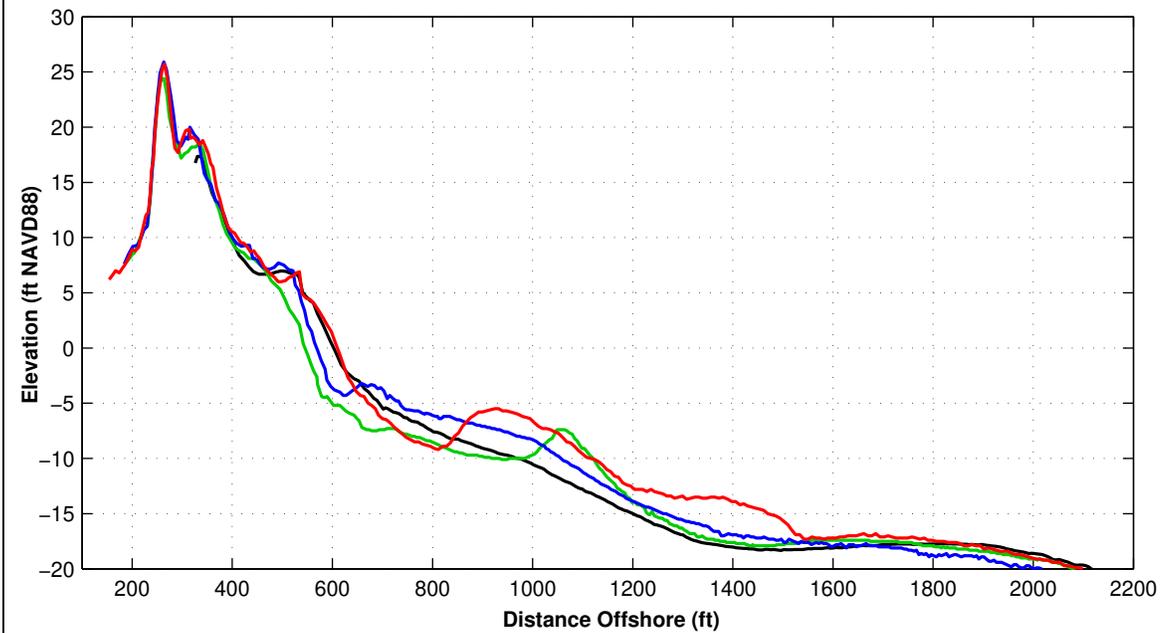
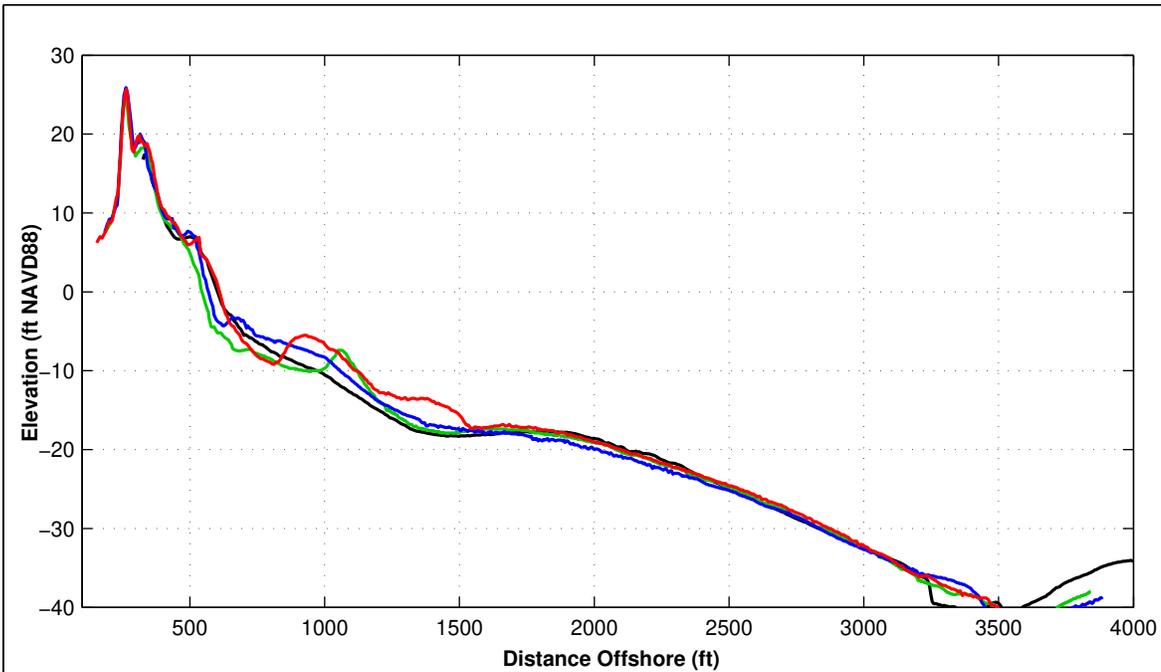
Survey Transect 1075+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	56.69 ft	-27.54 ft
Volume Change Above +6 ft NAVD88	2.25 cy/ft	0.02 cy/ft
Volume Change Above 1.18 ft NAVD88	12.10 cy/ft	-6.39 cy/ft
Volume Change Above -6 ft NAVD88	35.95 cy/ft	-27.54 cy/ft
Volume Change Above -14 ft NAVD88	13.20 cy/ft	-40.96 cy/ft
Volume Change Above -19 ft NAVD88	19.90 cy/ft	-56.18 cy/ft
Volume Change Above -30 ft NAVD88	13.25 cy/ft	-31.19 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
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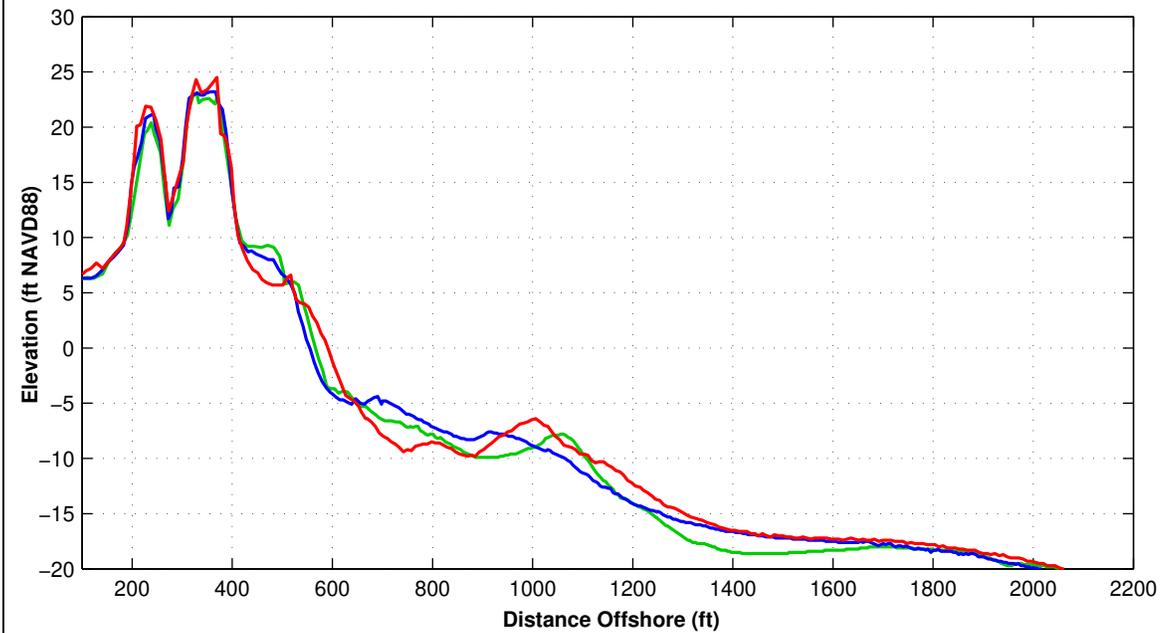
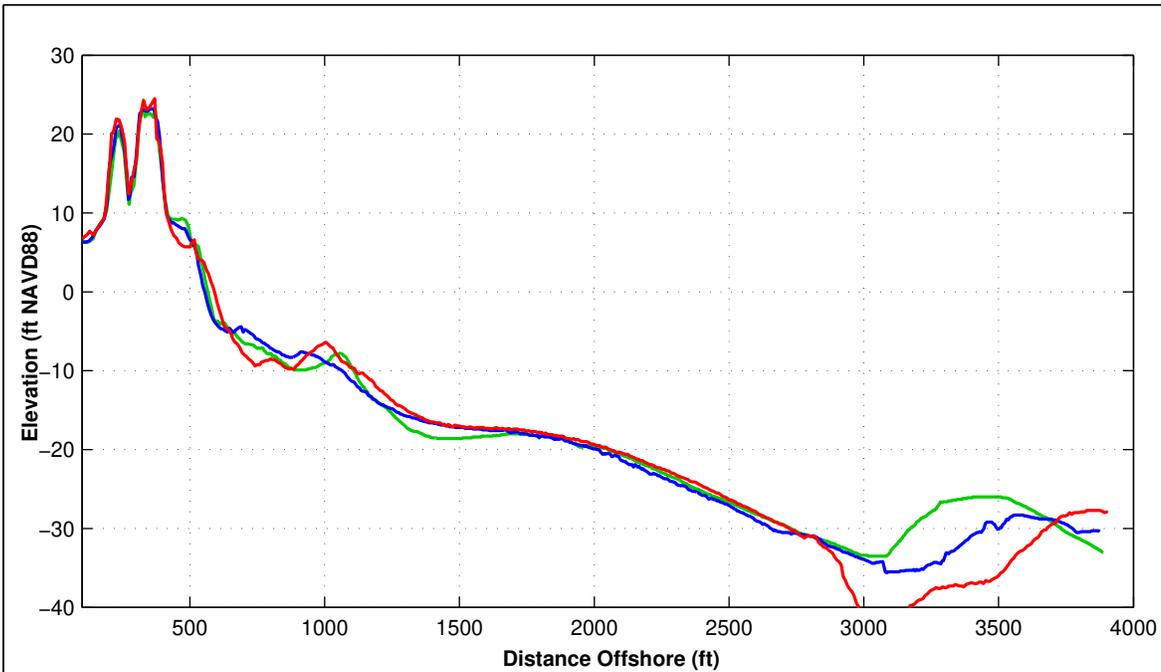
Survey Transect 1080+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	22.19 ft	40.14 ft
Volume Change Above +6 ft NAVD88	5.44 cy/ft	2.02 cy/ft
Volume Change Above 1.18 ft NAVD88	10.48 cy/ft	6.41 cy/ft
Volume Change Above -6 ft NAVD88	25.77 cy/ft	9.67 cy/ft
Volume Change Above -14 ft NAVD88	44.70 cy/ft	21.48 cy/ft
Volume Change Above -19 ft NAVD88	44.34 cy/ft	58.04 cy/ft
Volume Change Above -30 ft NAVD88	27.74 cy/ft	83.27 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

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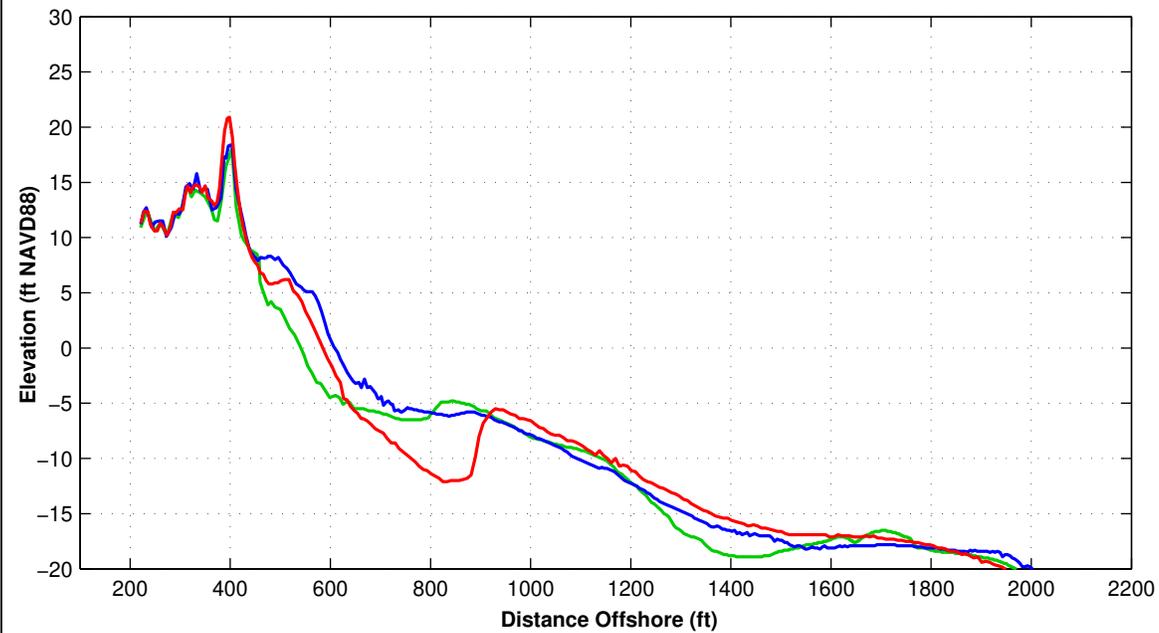
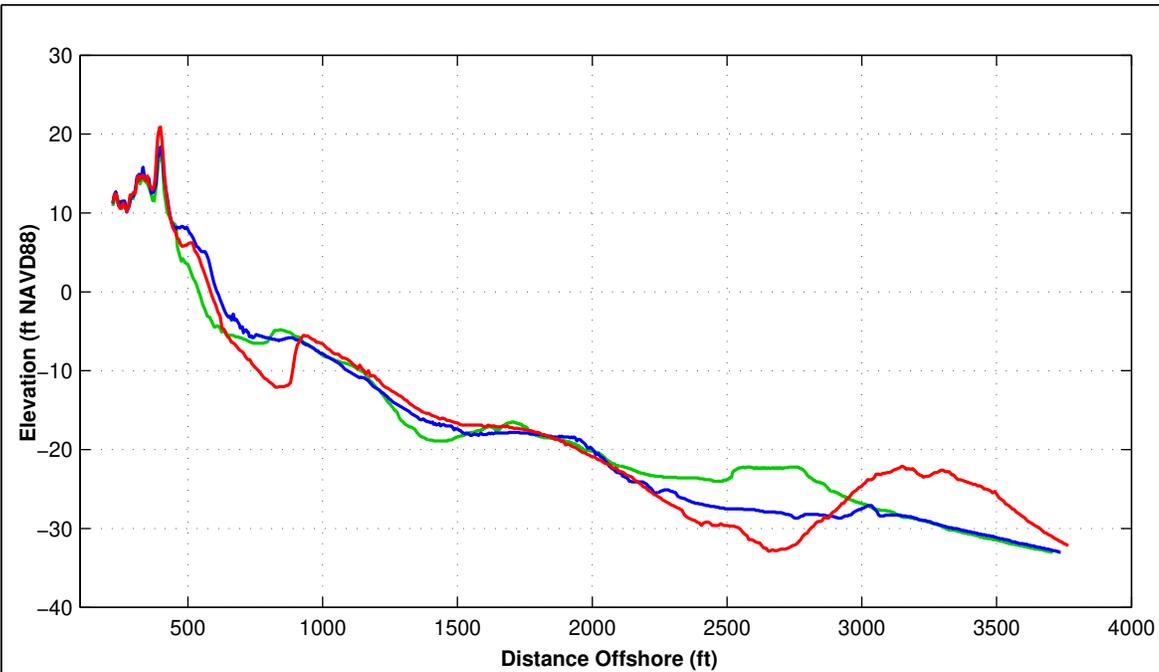
Survey Transect 1090+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-12.97 ft	33.37 ft
Volume Change Above +6 ft NAVD88	2.26 cy/ft	-3.04 cy/ft
Volume Change Above 1.18 ft NAVD88	-0.03 cy/ft	-0.41 cy/ft
Volume Change Above -6 ft NAVD88	-0.16 cy/ft	3.80 cy/ft
Volume Change Above -14 ft NAVD88	5.78 cy/ft	5.09 cy/ft
Volume Change Above -19 ft NAVD88	26.03 cy/ft	14.92 cy/ft
Volume Change Above -30 ft NAVD88	-34.45 cy/ft	41.19 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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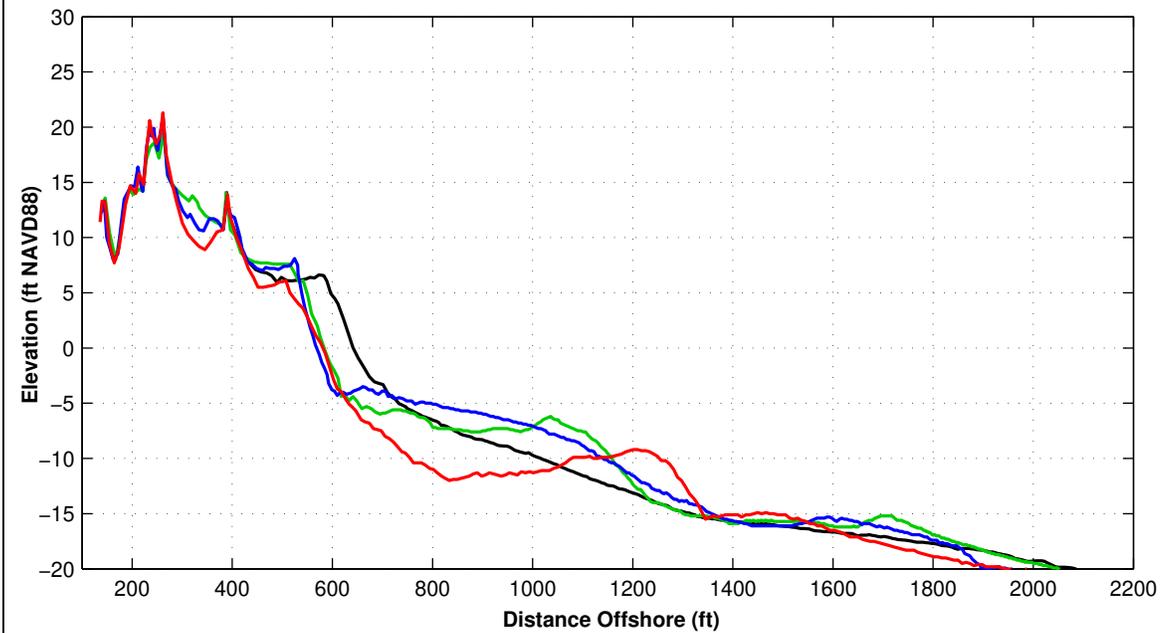
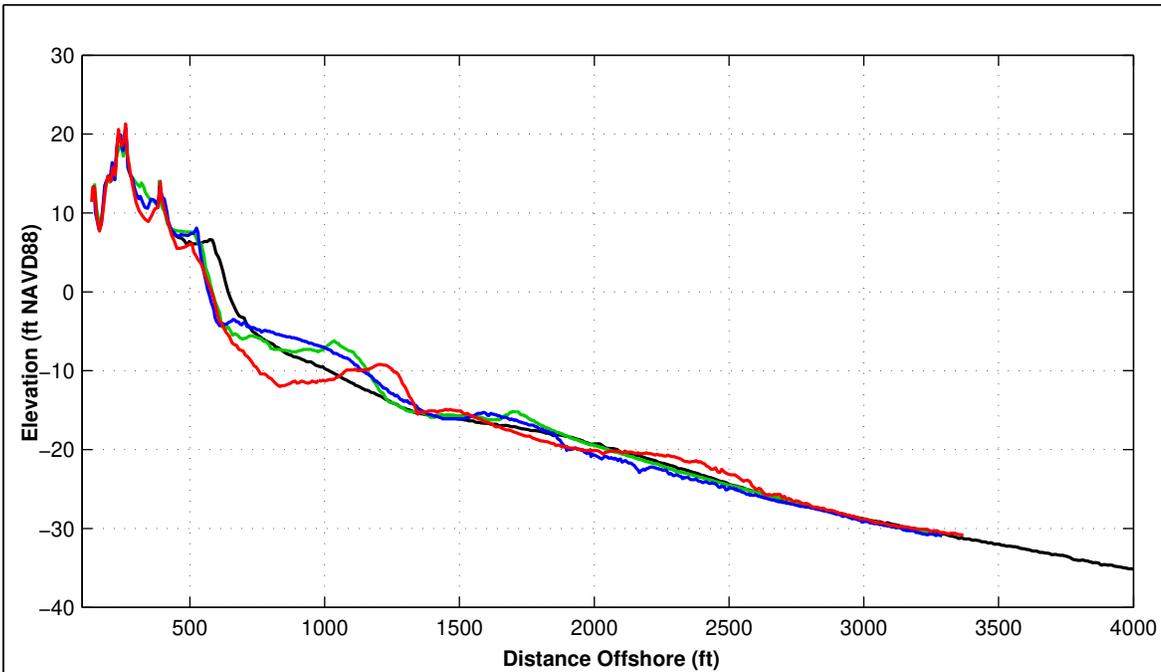
Survey Transect 1100+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	67.73 ft	-23.13 ft
Volume Change Above +6 ft NAVD88	6.11 cy/ft	-3.01 cy/ft
Volume Change Above 1.18 ft NAVD88	20.89 cy/ft	-8.01 cy/ft
Volume Change Above -6 ft NAVD88	38.32 cy/ft	-19.97 cy/ft
Volume Change Above -14 ft NAVD88	36.42 cy/ft	-39.47 cy/ft
Volume Change Above -19 ft NAVD88	49.22 cy/ft	-25.02 cy/ft
Volume Change Above -30 ft NAVD88	-68.43 cy/ft	50.14 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
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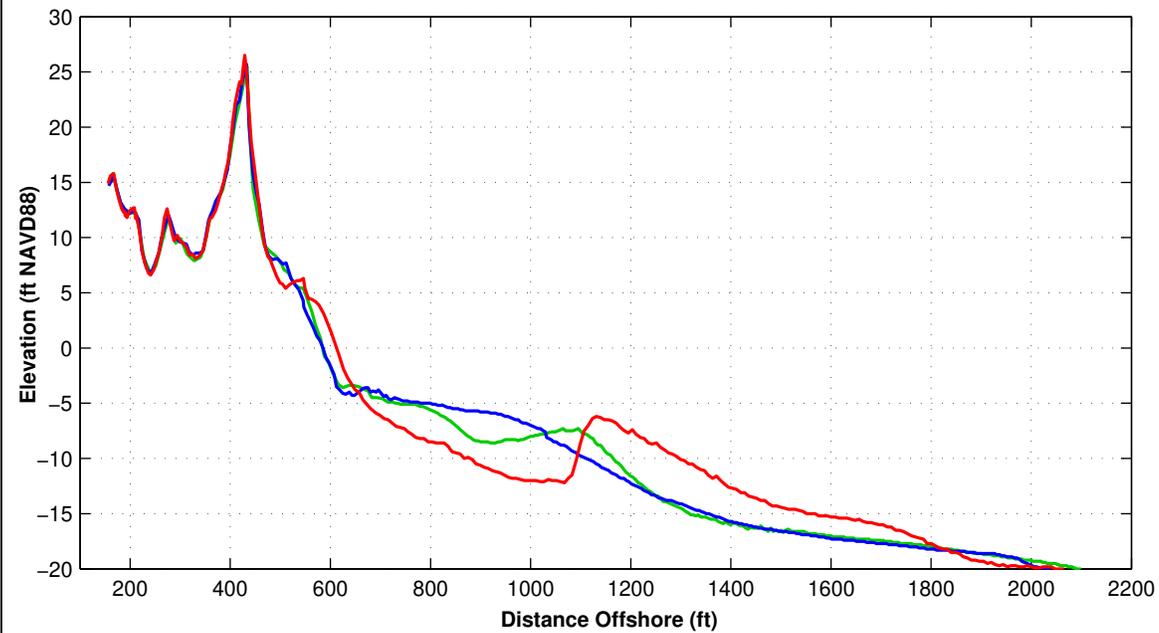
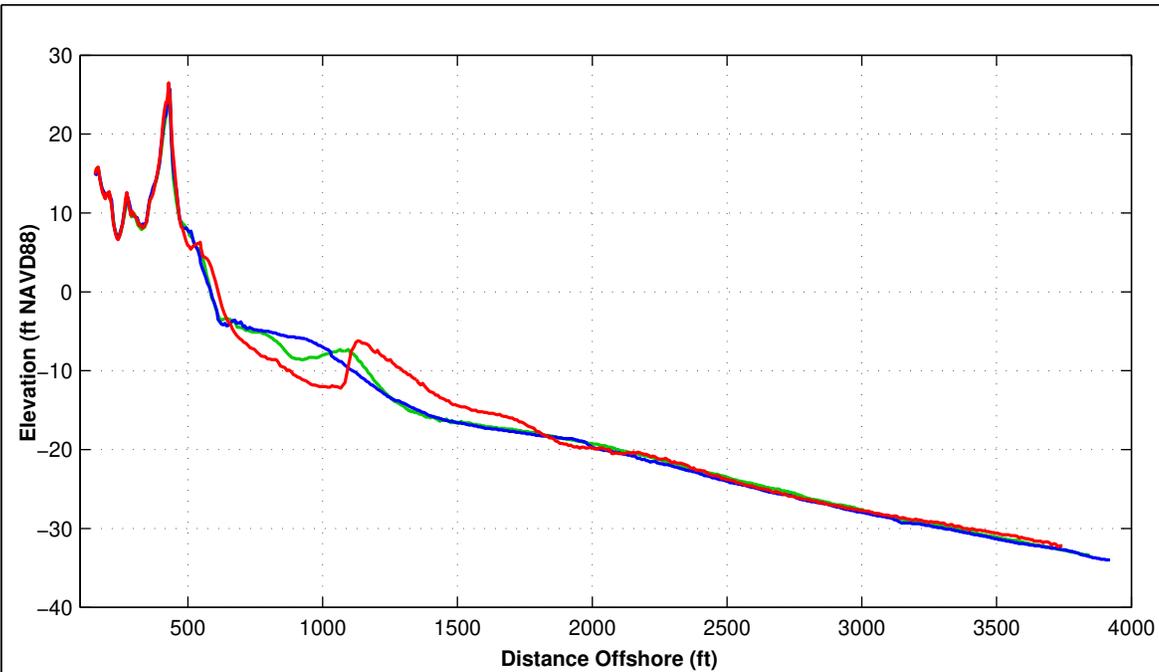
Survey Transect 1110+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-14.43 ft	6.01 ft
Volume Change Above +6 ft NAVD88	0.45 cy/ft	-5.80 cy/ft
Volume Change Above 1.18 ft NAVD88	-1.64 cy/ft	-7.97 cy/ft
Volume Change Above -6 ft NAVD88	4.84 cy/ft	-17.43 cy/ft
Volume Change Above -14 ft NAVD88	11.06 cy/ft	-68.61 cy/ft
Volume Change Above -19 ft NAVD88	7.65 cy/ft	-79.09 cy/ft
Volume Change Above -30 ft NAVD88	-16.28 cy/ft	-33.84 cy/ft

**LEGEND:**

JUNE 2022	<span style="color: red;">—</span>	JUNE 2020	<span style="color: green;">—</span>
JULY 2021	<span style="color: blue;">—</span>	AUGUST 2019	<span style="color: black;">—</span>

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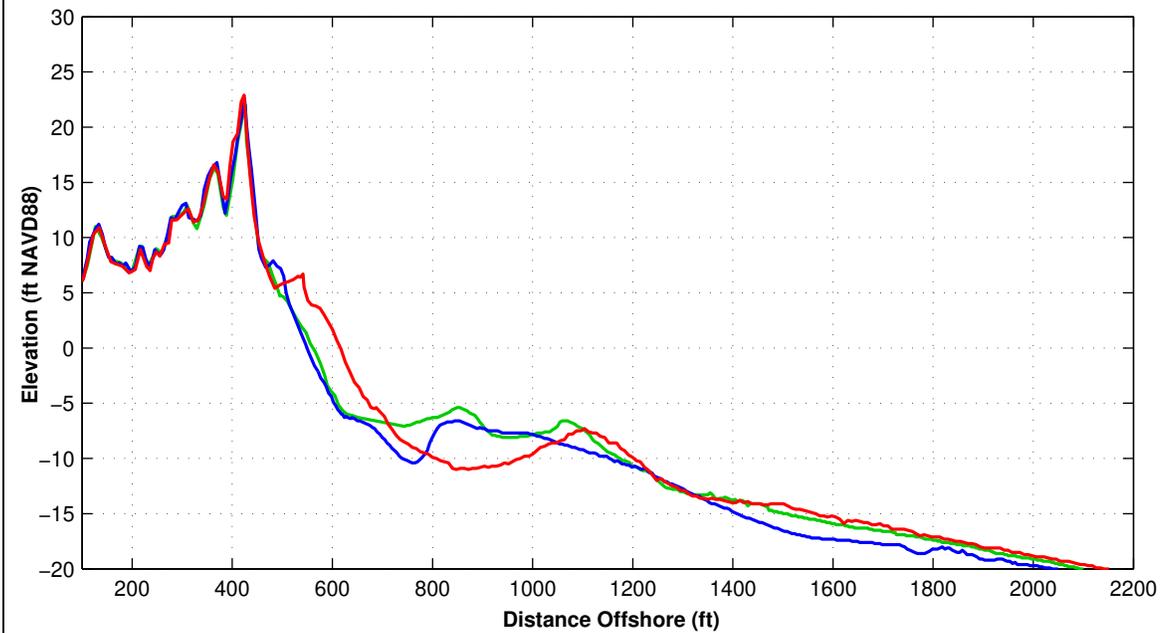
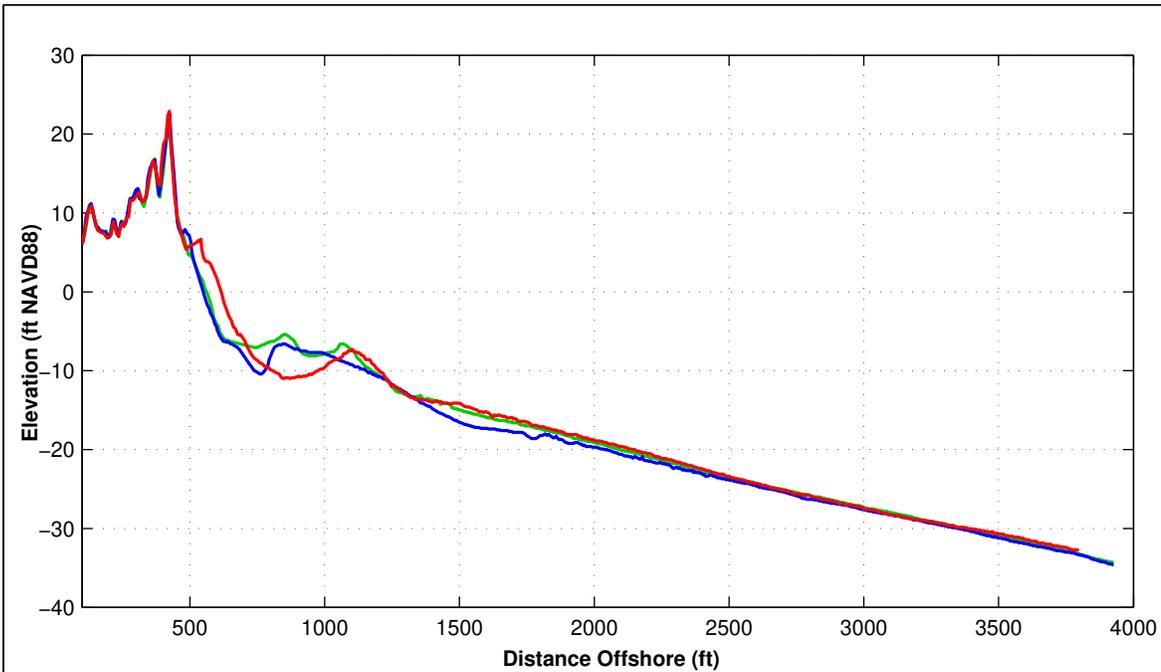
Survey Transect 1120+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-5.78 ft	31.57 ft
Volume Change Above +6 ft NAVD88	0.85 cy/ft	-1.25 cy/ft
Volume Change Above 1.18 ft NAVD88	-0.66 cy/ft	3.09 cy/ft
Volume Change Above -6 ft NAVD88	2.06 cy/ft	-0.62 cy/ft
Volume Change Above -14 ft NAVD88	4.77 cy/ft	-6.32 cy/ft
Volume Change Above -19 ft NAVD88	4.42 cy/ft	22.49 cy/ft
Volume Change Above -30 ft NAVD88	-14.31 cy/ft	35.70 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

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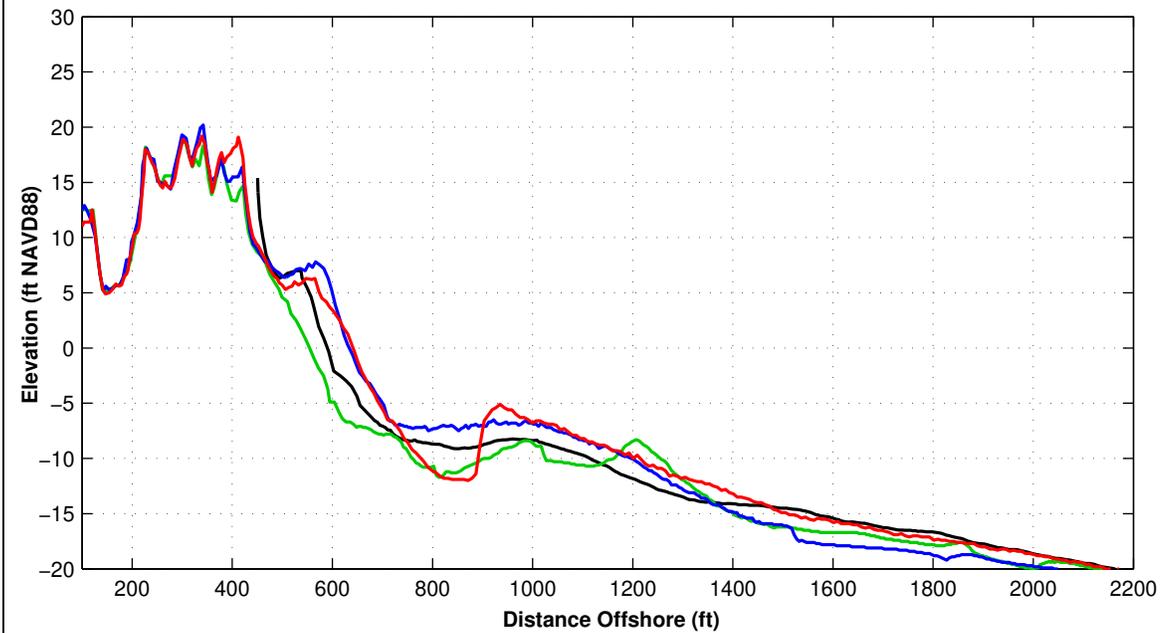
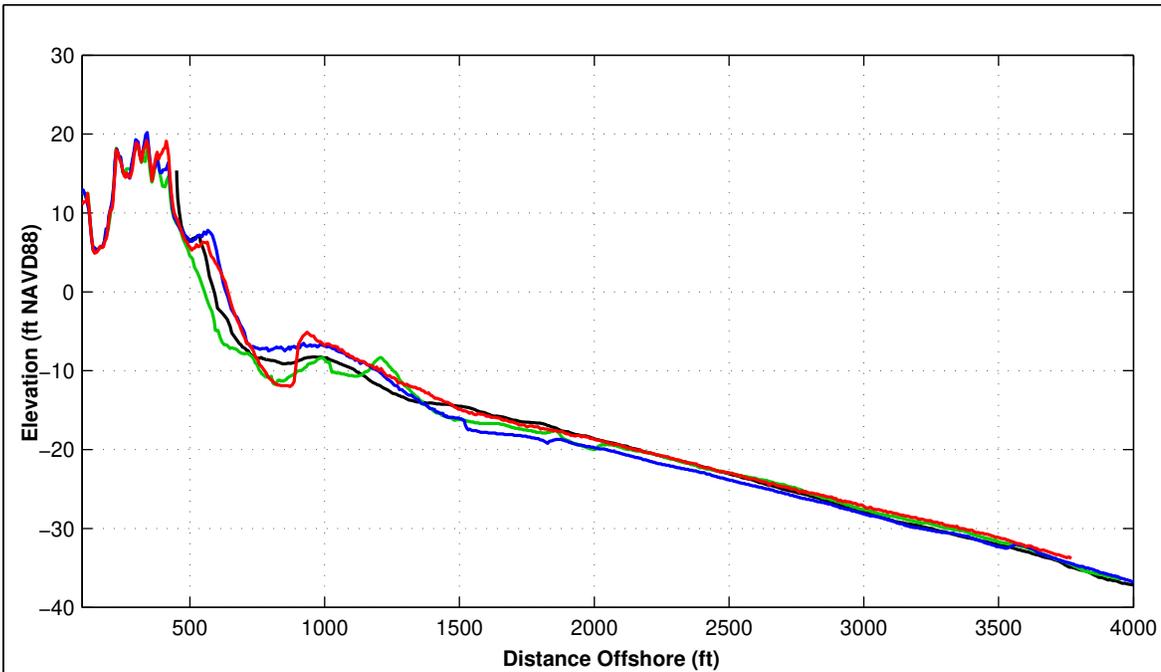
Survey Transect 1130+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-10.39 ft	65.83 ft
Volume Change Above +6 ft NAVD88	2.07 cy/ft	-2.07 cy/ft
Volume Change Above 1.18 ft NAVD88	2.55 cy/ft	6.87 cy/ft
Volume Change Above -6 ft NAVD88	-0.69 cy/ft	24.54 cy/ft
Volume Change Above -14 ft NAVD88	-22.43 cy/ft	14.30 cy/ft
Volume Change Above -19 ft NAVD88	-46.89 cy/ft	47.65 cy/ft
Volume Change Above -30 ft NAVD88	-66.27 cy/ft	70.13 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

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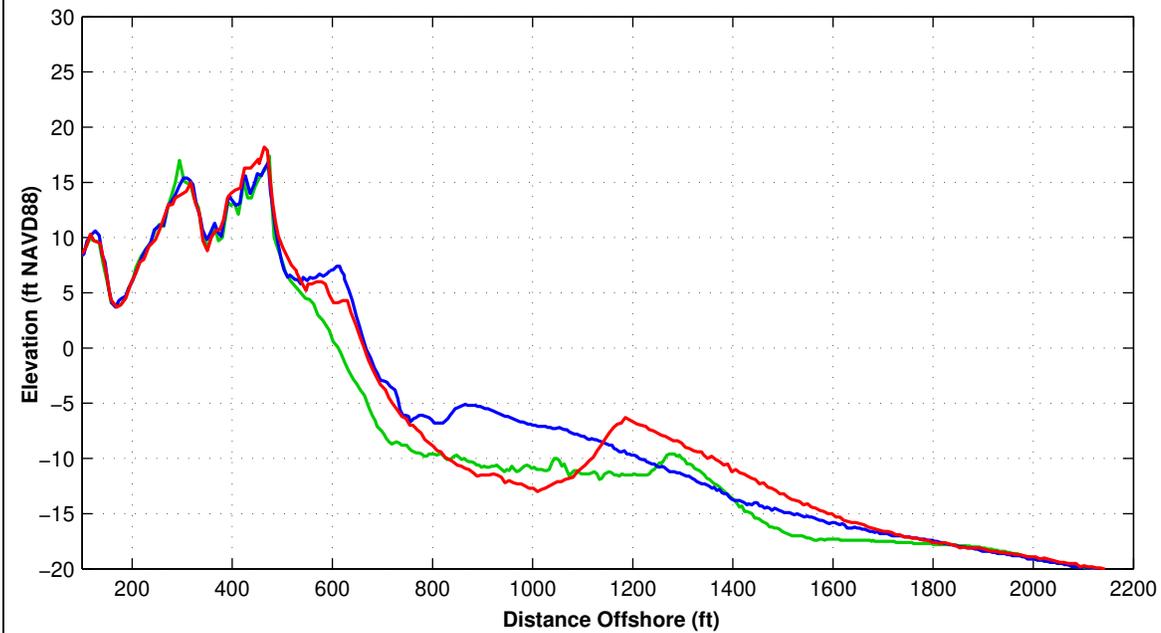
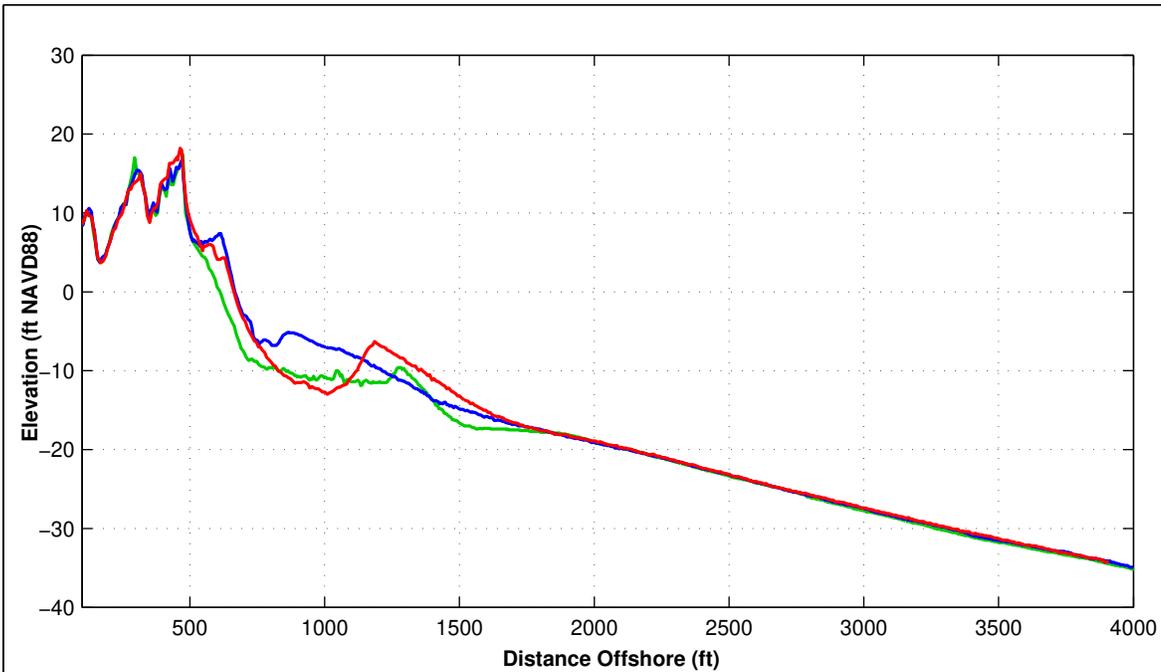
Survey Transect 1140+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	80.78 ft	8.35 ft
Volume Change Above +6 ft NAVD88	4.68 cy/ft	-0.10 cy/ft
Volume Change Above 1.18 ft NAVD88	21.57 cy/ft	-2.69 cy/ft
Volume Change Above -6 ft NAVD88	23.02 cy/ft	-1.35 cy/ft
Volume Change Above -14 ft NAVD88	63.58 cy/ft	-11.38 cy/ft
Volume Change Above -19 ft NAVD88	50.53 cy/ft	21.44 cy/ft
Volume Change Above -30 ft NAVD88	14.35 cy/ft	68.04 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

- Notes:
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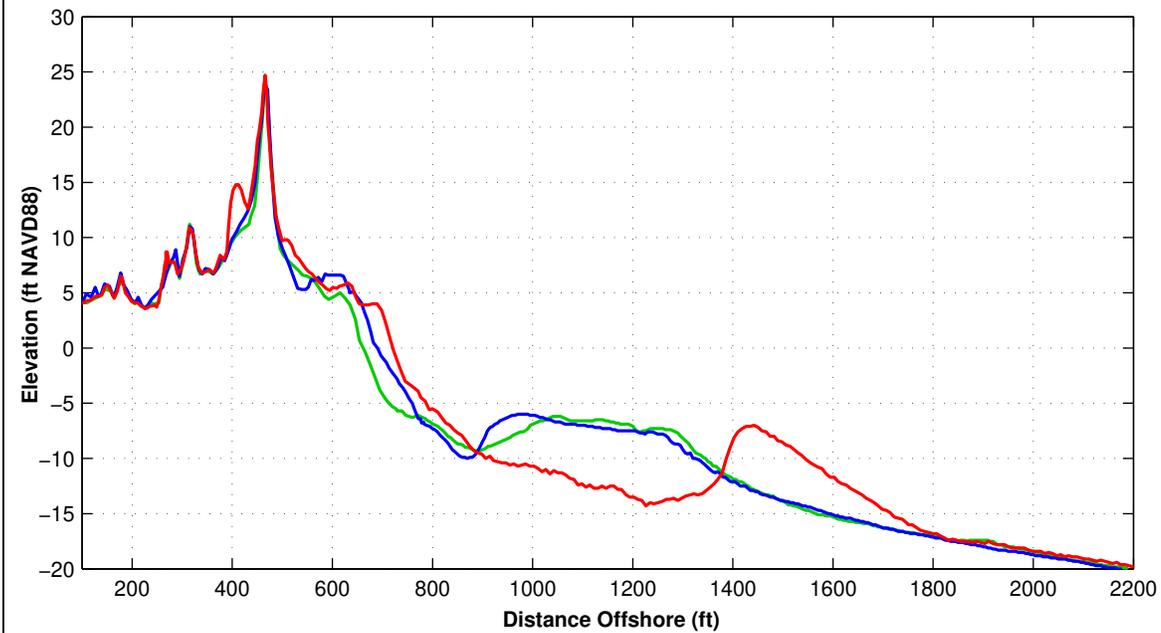
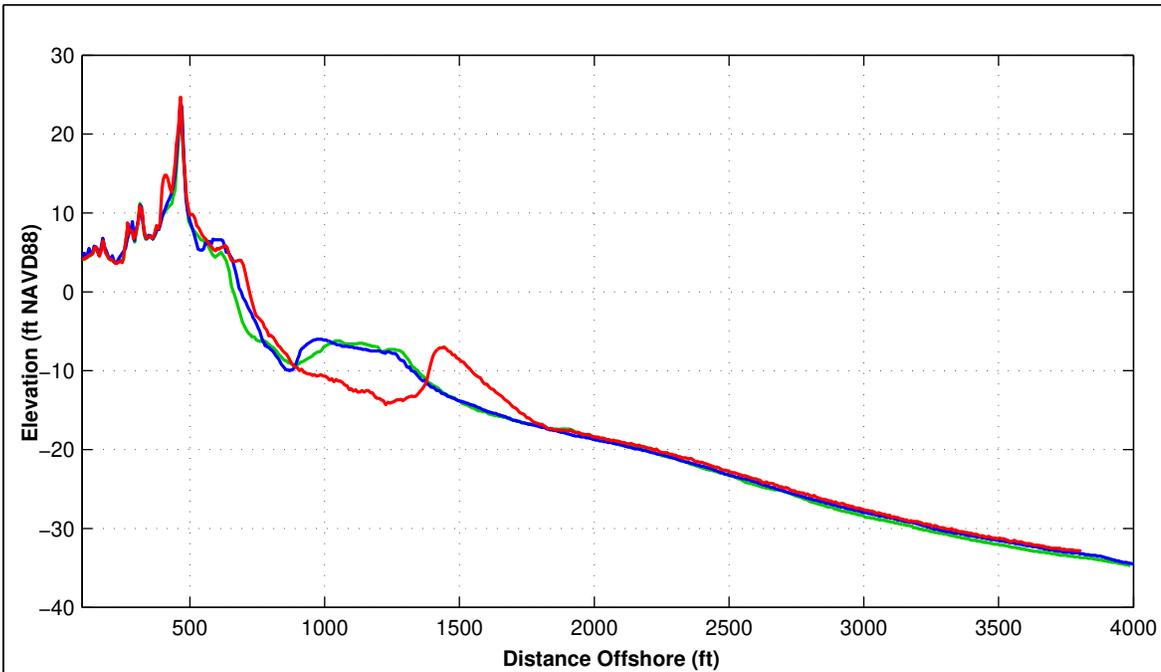
Survey Transect 1150+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	62.01 ft	-5.11 ft
Volume Change Above +6 ft NAVD88	5.09 cy/ft	2.46 cy/ft
Volume Change Above 1.18 ft NAVD88	19.58 cy/ft	-1.47 cy/ft
Volume Change Above -6 ft NAVD88	37.34 cy/ft	-5.76 cy/ft
Volume Change Above -14 ft NAVD88	99.71 cy/ft	-32.33 cy/ft
Volume Change Above -19 ft NAVD88	115.60 cy/ft	-25.48 cy/ft
Volume Change Above -30 ft NAVD88	121.32 cy/ft	-20.90 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

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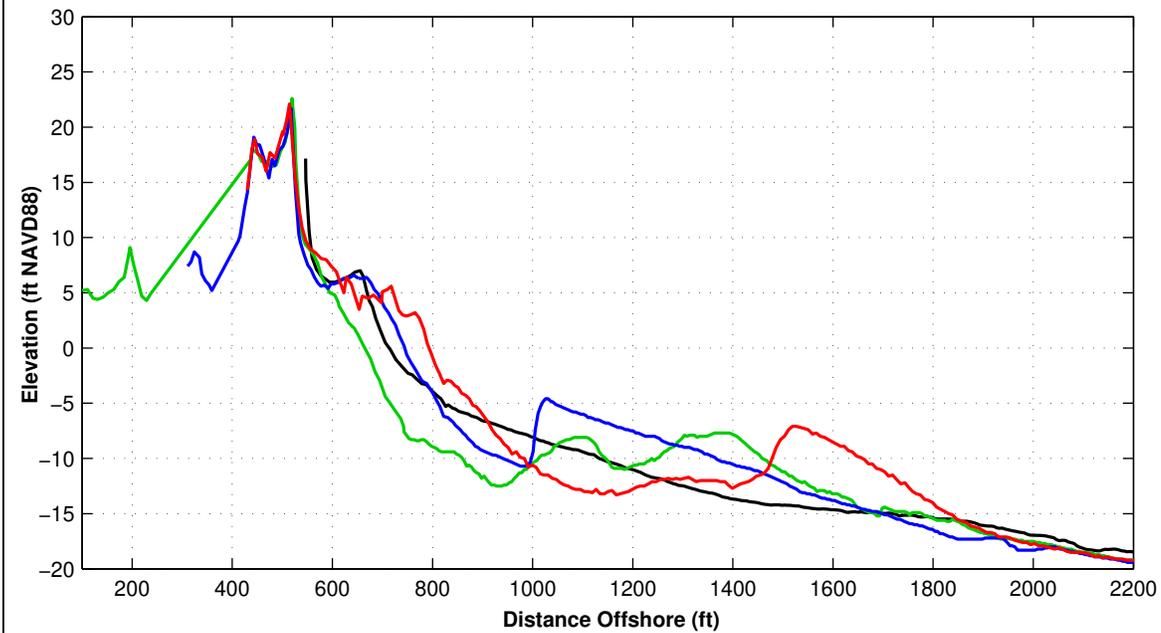
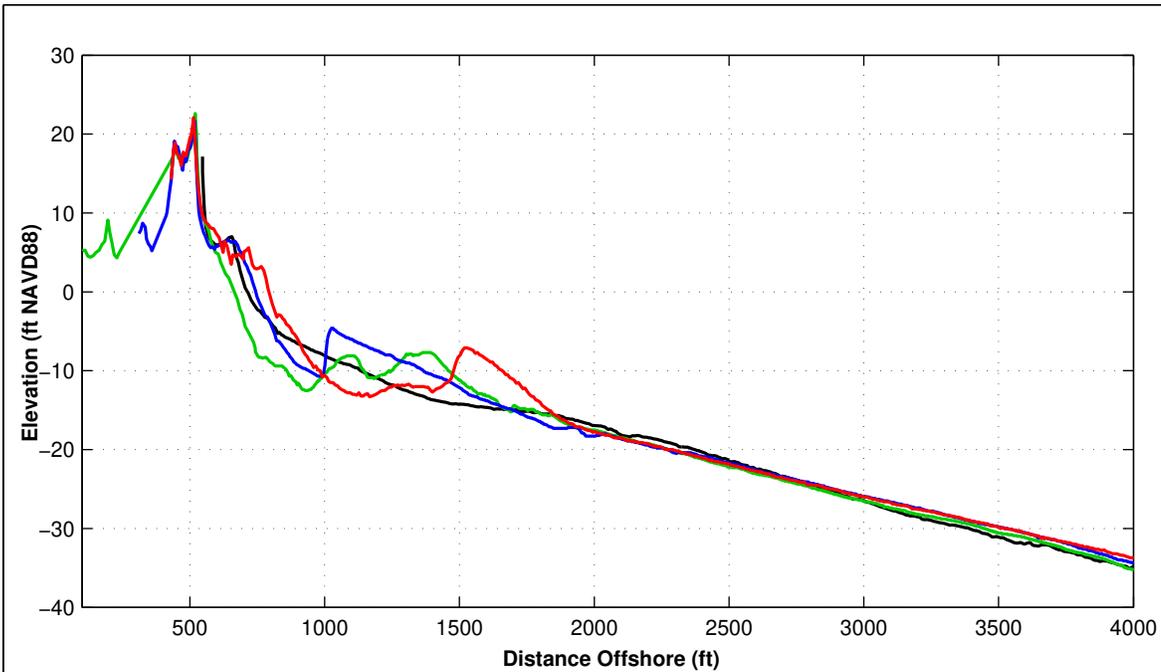
Survey Transect 1160+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	26.29 ft	34.98 ft
Volume Change Above +6 ft NAVD88	-0.22 cy/ft	2.80 cy/ft
Volume Change Above 1.18 ft NAVD88	5.30 cy/ft	6.16 cy/ft
Volume Change Above -6 ft NAVD88	15.15 cy/ft	13.24 cy/ft
Volume Change Above -14 ft NAVD88	11.15 cy/ft	-22.27 cy/ft
Volume Change Above -19 ft NAVD88	9.77 cy/ft	-8.45 cy/ft
Volume Change Above -30 ft NAVD88	19.68 cy/ft	8.53 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
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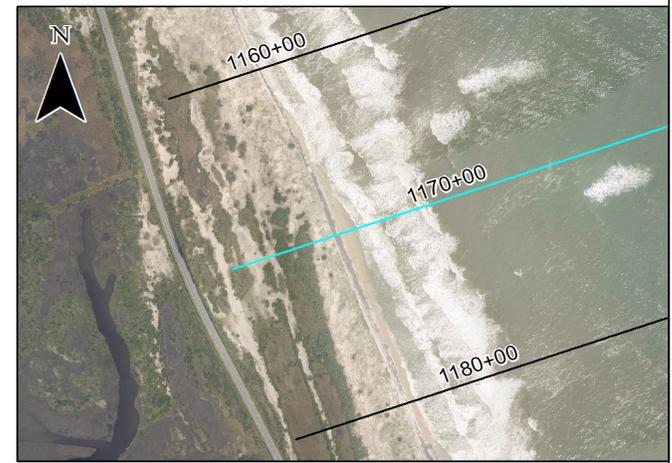


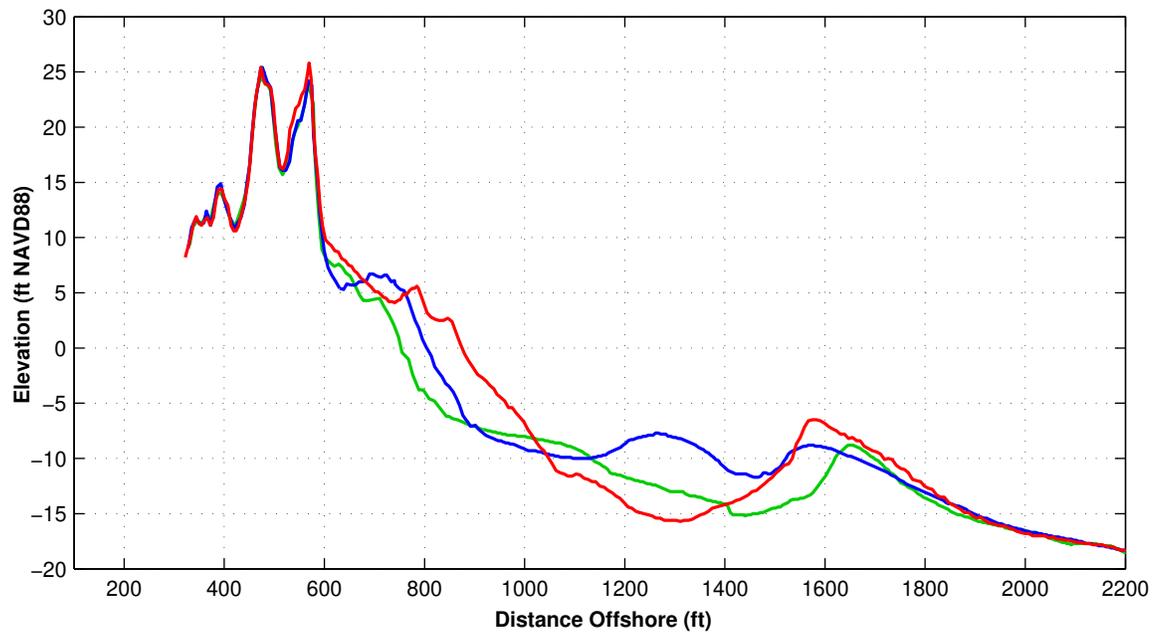
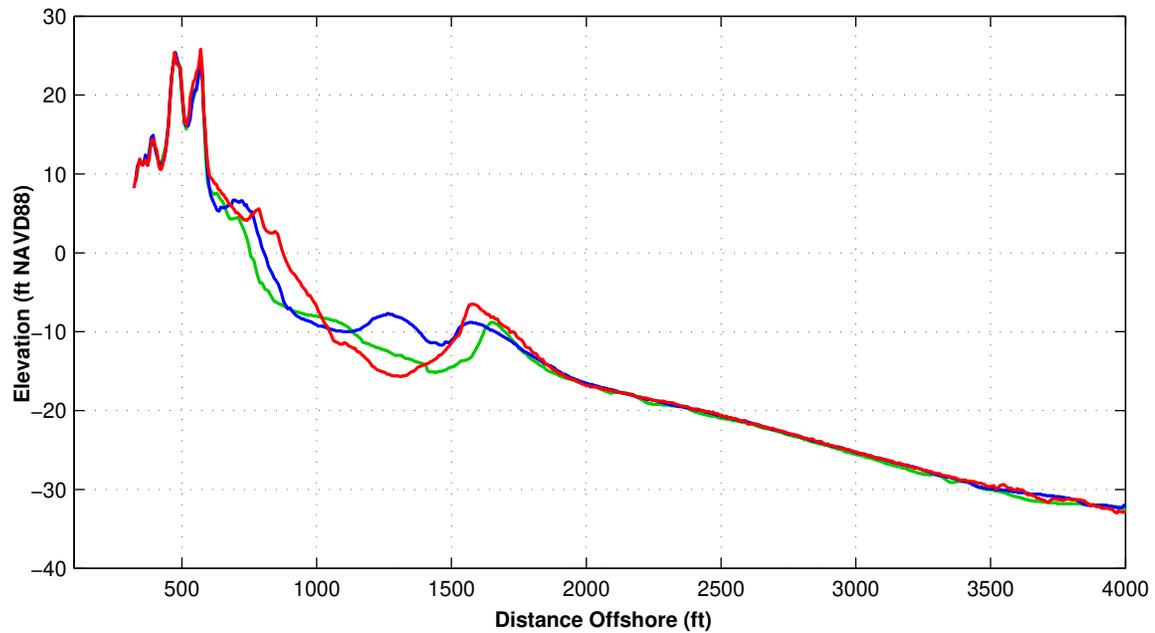
Survey Transect 1170+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	81.82 ft	52.02 ft
Volume Change Above +6 ft NAVD88	0.10 cy/ft	5.02 cy/ft
Volume Change Above 1.18 ft NAVD88	7.43 cy/ft	8.49 cy/ft
Volume Change Above -6 ft NAVD88	32.27 cy/ft	20.77 cy/ft
Volume Change Above -14 ft NAVD88	64.14 cy/ft	4.21 cy/ft
Volume Change Above -19 ft NAVD88	53.53 cy/ft	20.90 cy/ft
Volume Change Above -30 ft NAVD88	75.59 cy/ft	18.30 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
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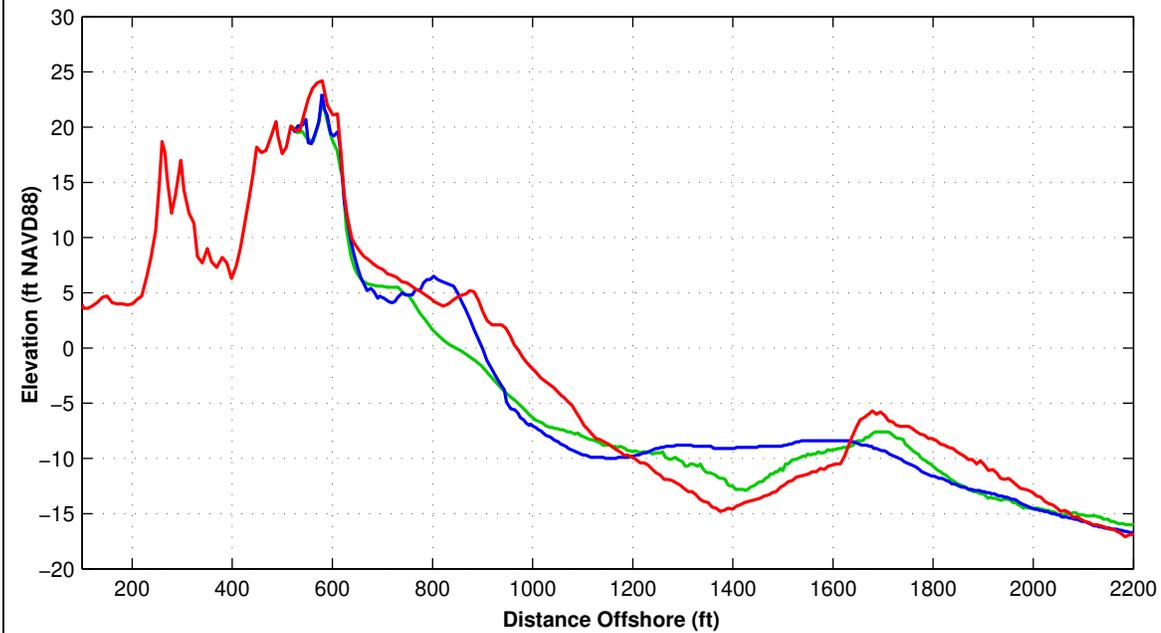
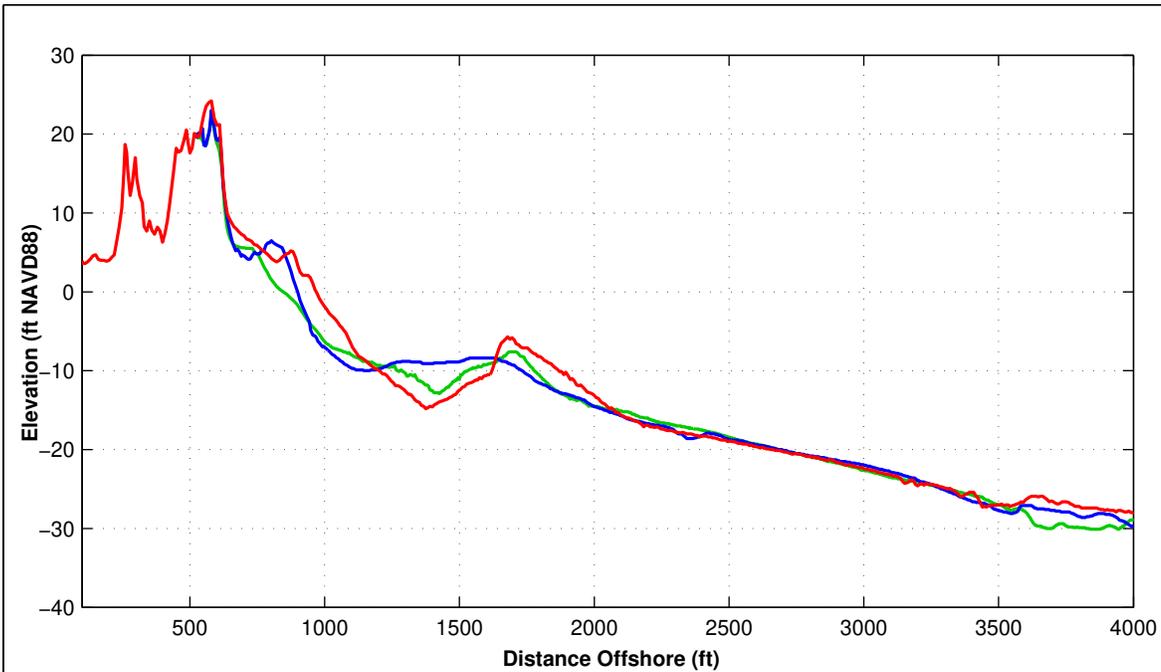
Survey Transect 1180+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	46.37 ft	71.89 ft
Volume Change Above +6 ft NAVD88	0.78 cy/ft	7.65 cy/ft
Volume Change Above 1.18 ft NAVD88	11.34 cy/ft	11.86 cy/ft
Volume Change Above -6 ft NAVD88	24.93 cy/ft	33.36 cy/ft
Volume Change Above -14 ft NAVD88	78.59 cy/ft	-1.27 cy/ft
Volume Change Above -19 ft NAVD88	86.39 cy/ft	-10.81 cy/ft
Volume Change Above -30 ft NAVD88	97.31 cy/ft	-6.94 cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

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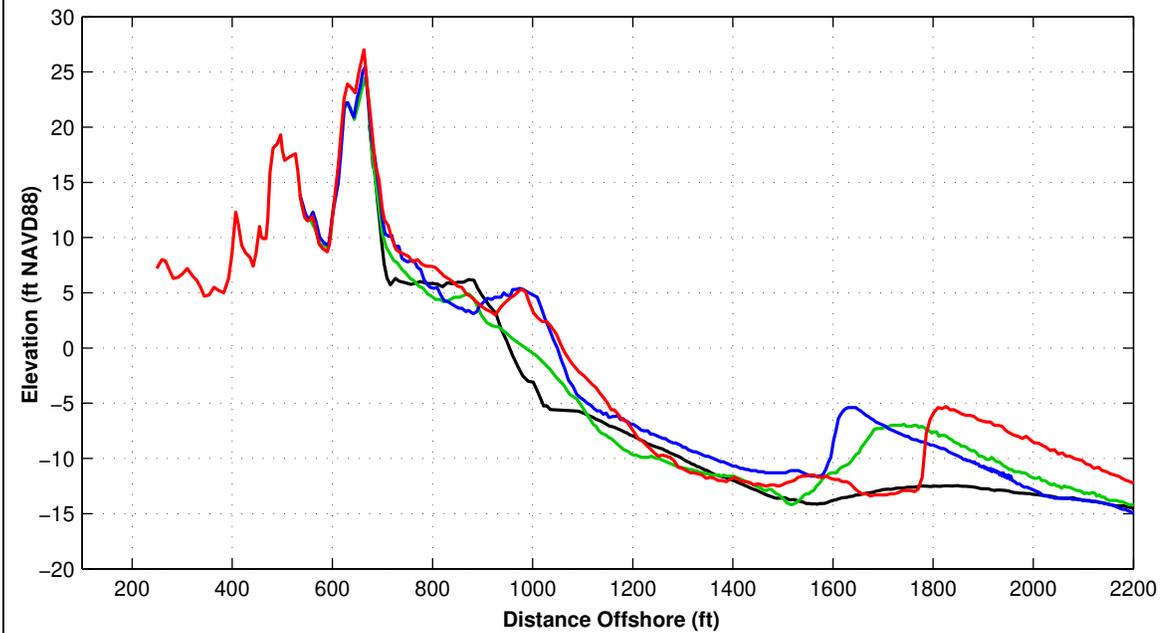
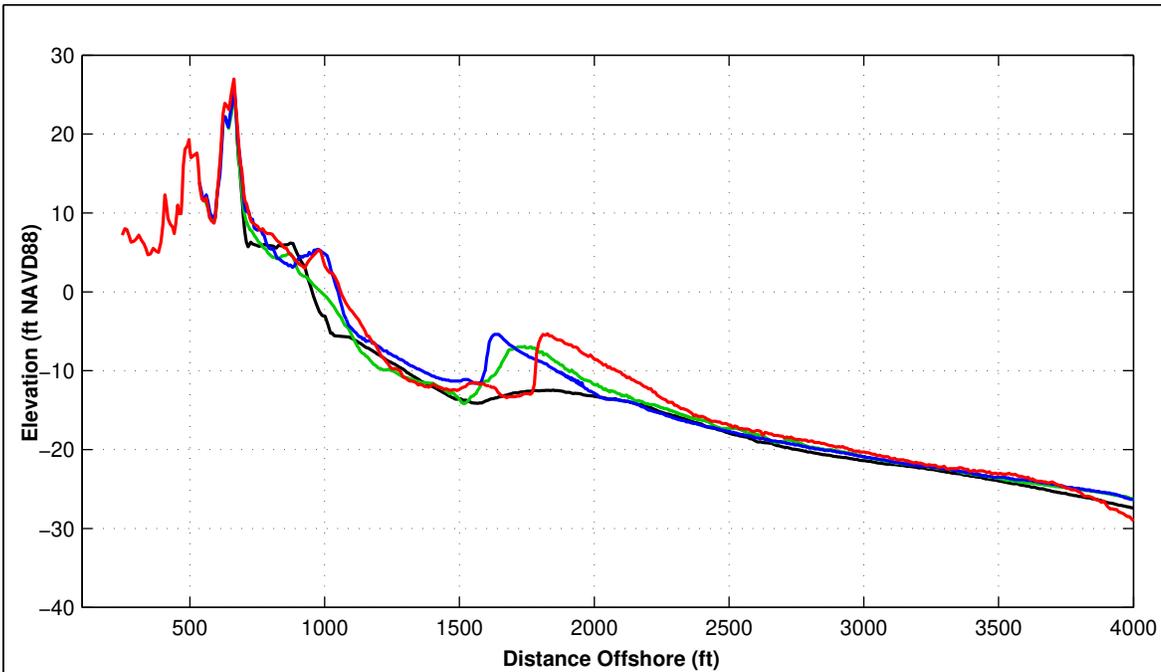


Survey Transect 1190+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	77.21 ft	66.44 ft
Volume Change Above +6 ft NAVD88	2.61 cy/ft	6.69 cy/ft
Volume Change Above 1.18 ft NAVD88	15.43 cy/ft	12.76 cy/ft
Volume Change Above -6 ft NAVD88	19.85 cy/ft	37.18 cy/ft
Volume Change Above -14 ft NAVD88	30.88 cy/ft	31.30 cy/ft
Volume Change Above -19 ft NAVD88	20.50 cy/ft	30.18 cy/ft
Volume Change Above -30 ft NAVD88	44.41 cy/ft	58.72 cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

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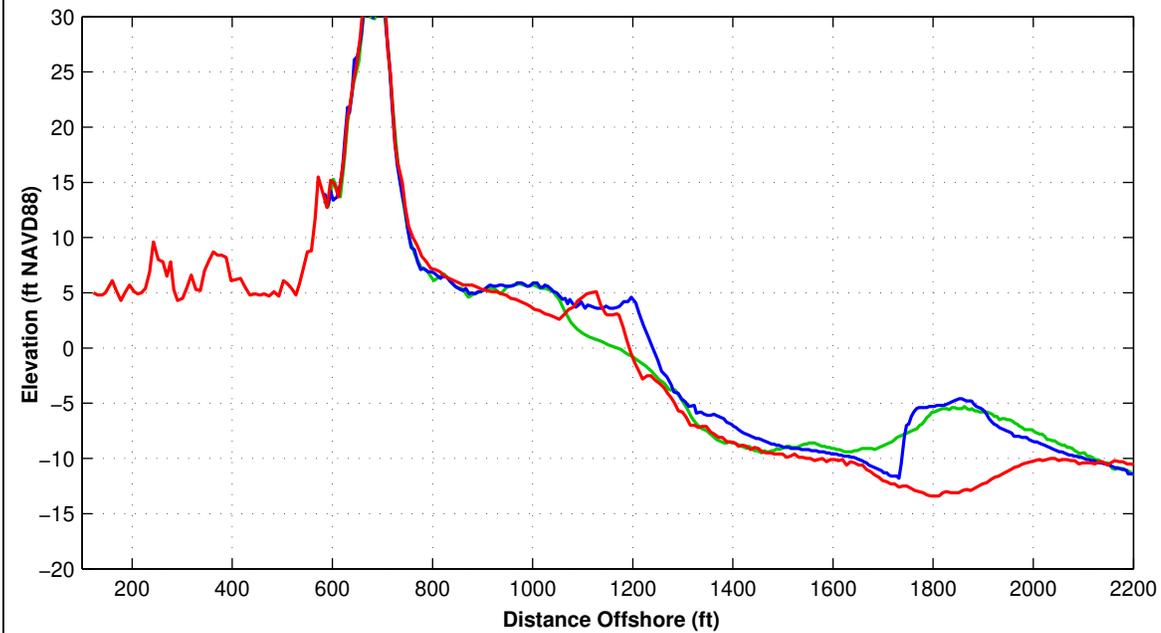
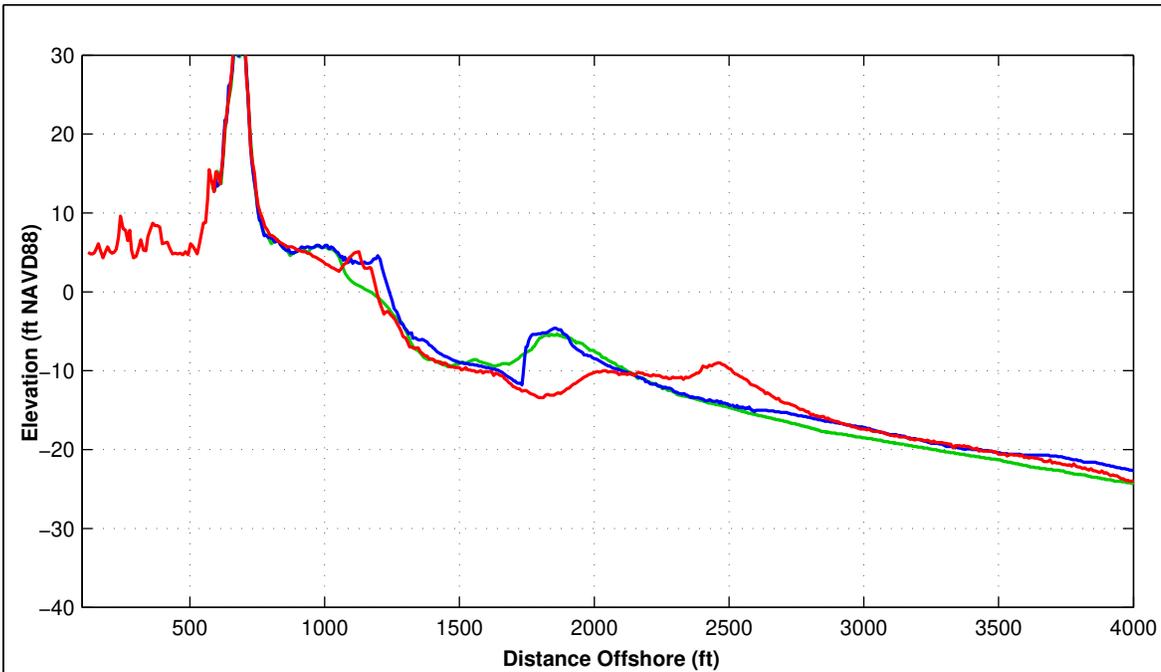
Survey Transect 1200+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	86.41 ft	10.64 ft
Volume Change Above +6 ft NAVD88	2.02 cy/ft	2.66 cy/ft
Volume Change Above 1.18 ft NAVD88	16.47 cy/ft	4.20 cy/ft
Volume Change Above -6 ft NAVD88	26.59 cy/ft	11.76 cy/ft
Volume Change Above -14 ft NAVD88	53.08 cy/ft	12.27 cy/ft
Volume Change Above -19 ft NAVD88	42.92 cy/ft	34.03 cy/ft
Volume Change Above -30 ft NAVD88	45.94 cy/ft	4.98 cy/ft

**LEGEND:**

JUNE 2022 —      JUNE 2020 —  
 JULY 2021 —      AUGUST 2019 —

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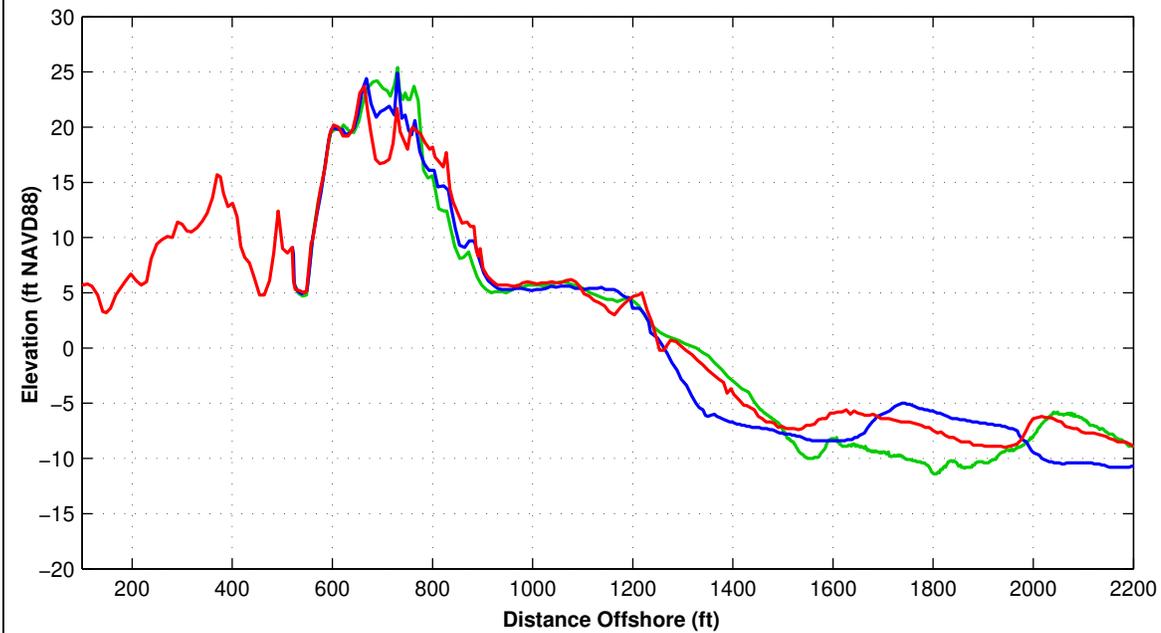
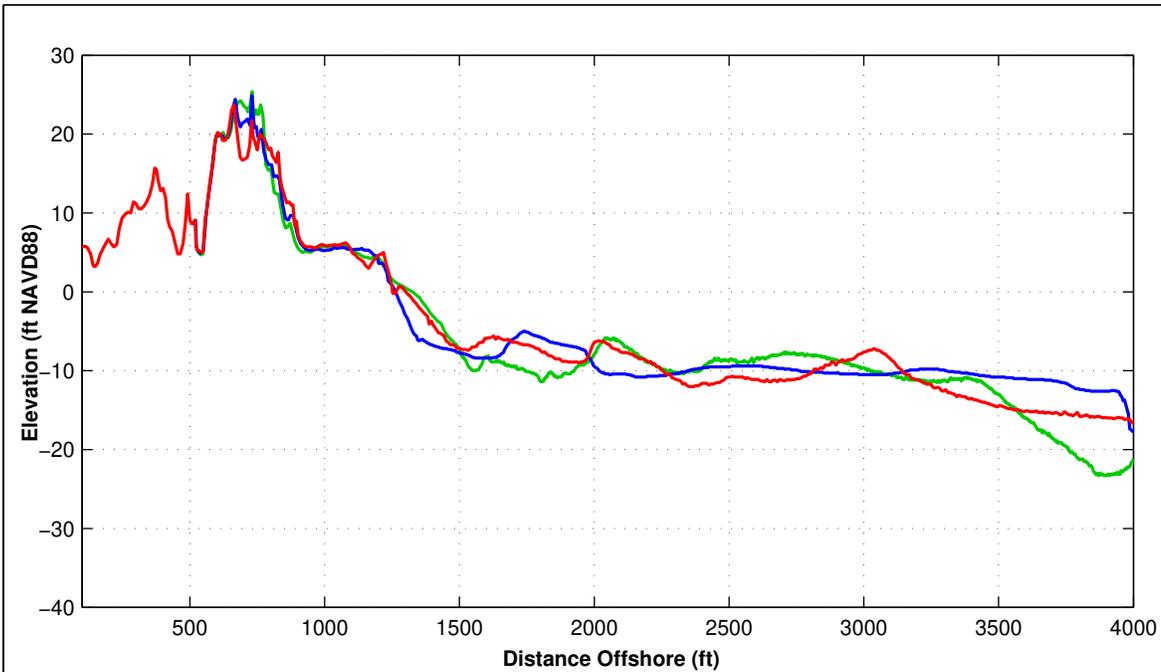
Survey Transect 1210+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	123.34 ft	-44.14 ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

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  2. All Survey Elevations In Feet Referenced to NAVD88.





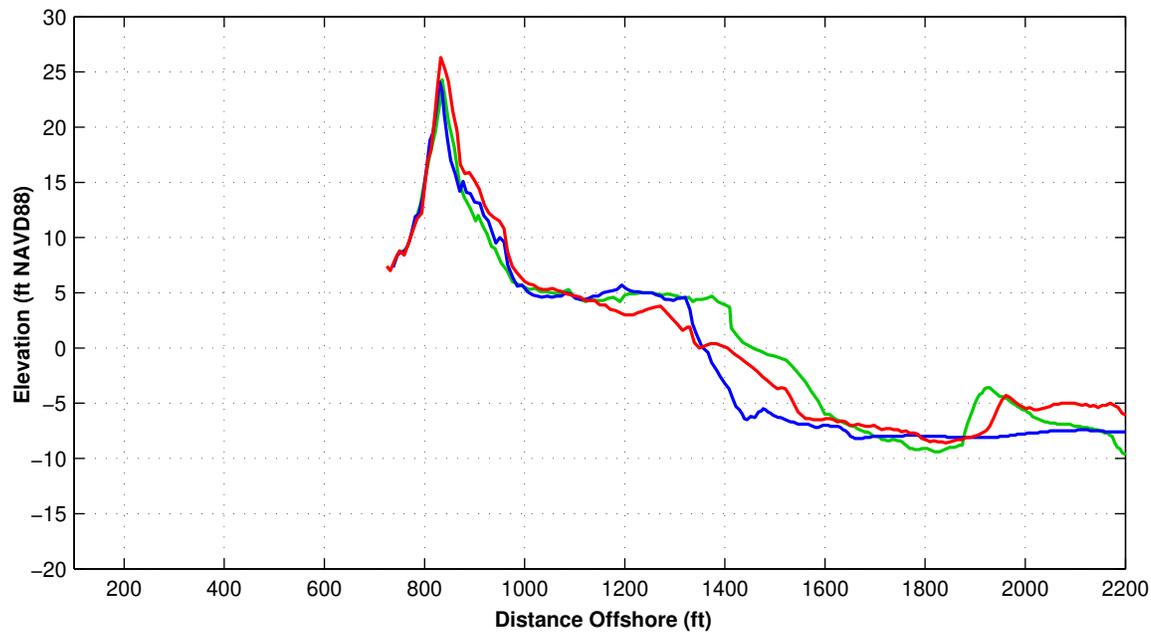
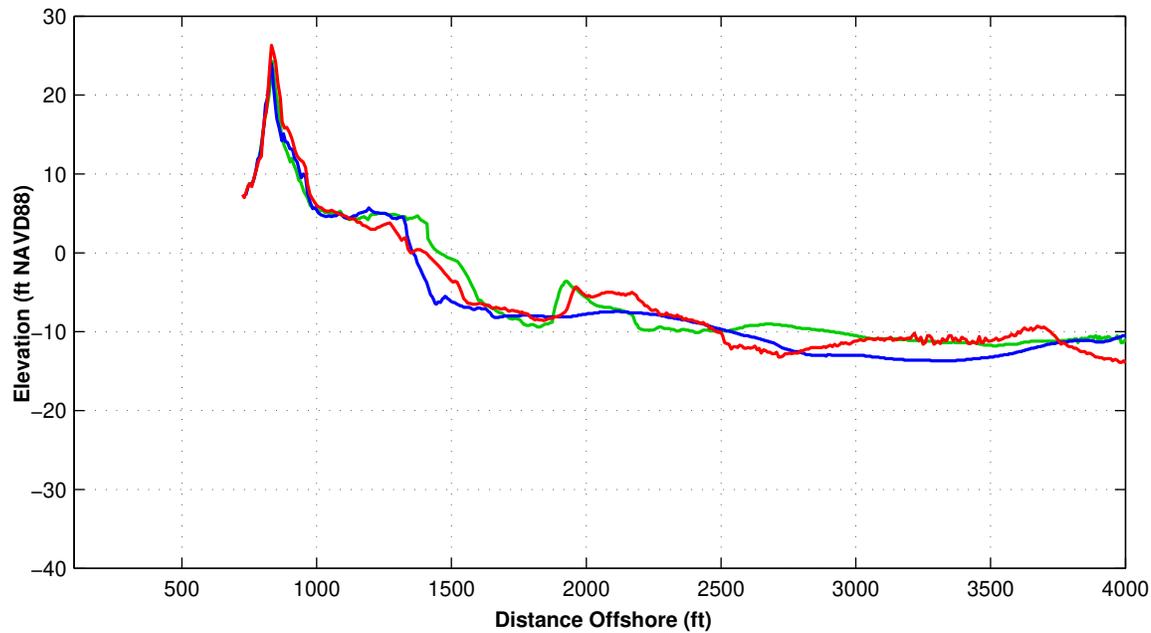
Survey Transect 1220+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-22.32 ft	4.09 ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

**LEGEND:**

JUNE 2022		JUNE 2020	
JULY 2021		AUGUST 2019	

- Notes:
1. Station From North To South At Varying Intervals.
  2. All Survey Elevations In Feet Referenced to NAVD88.

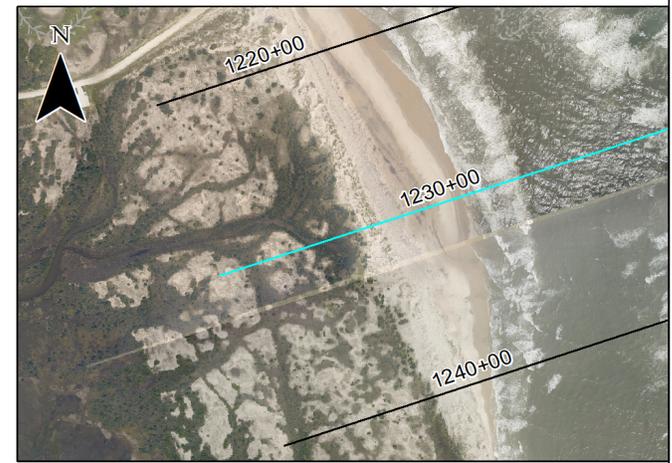


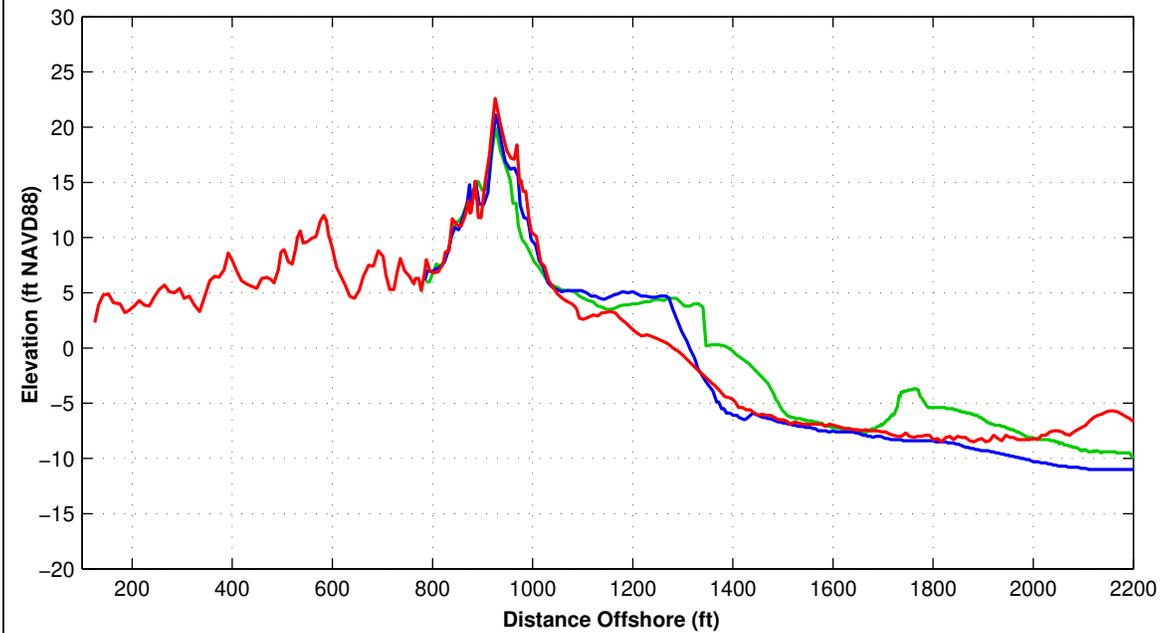
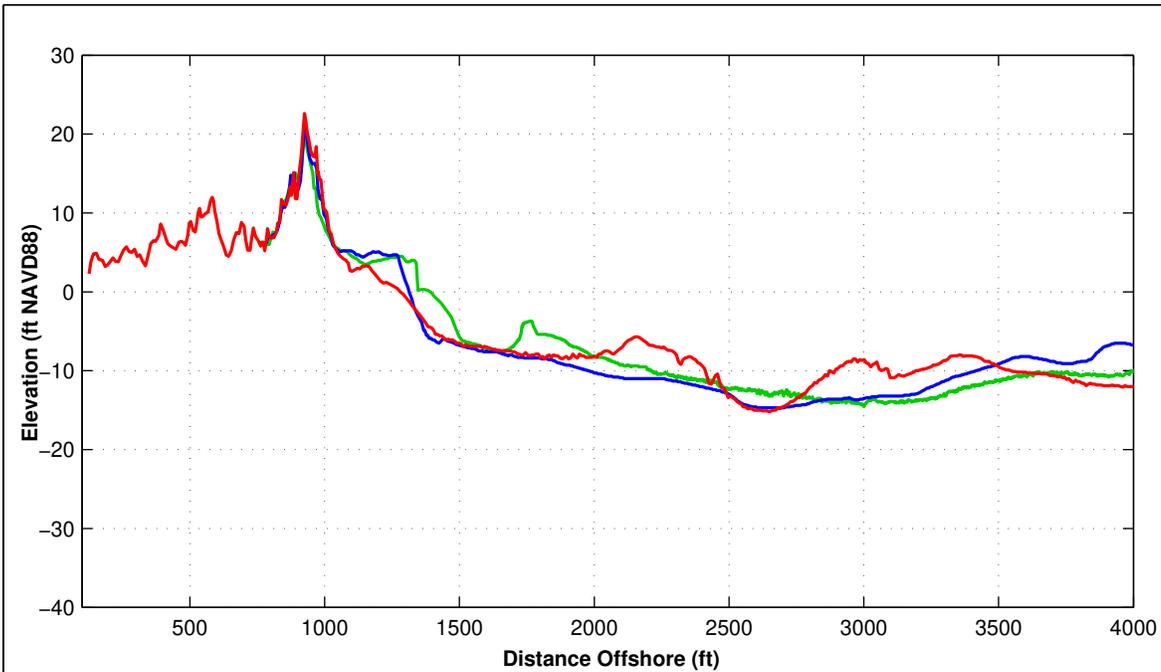


Survey Transect 1230+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-79.14 ft	-9.42 ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.



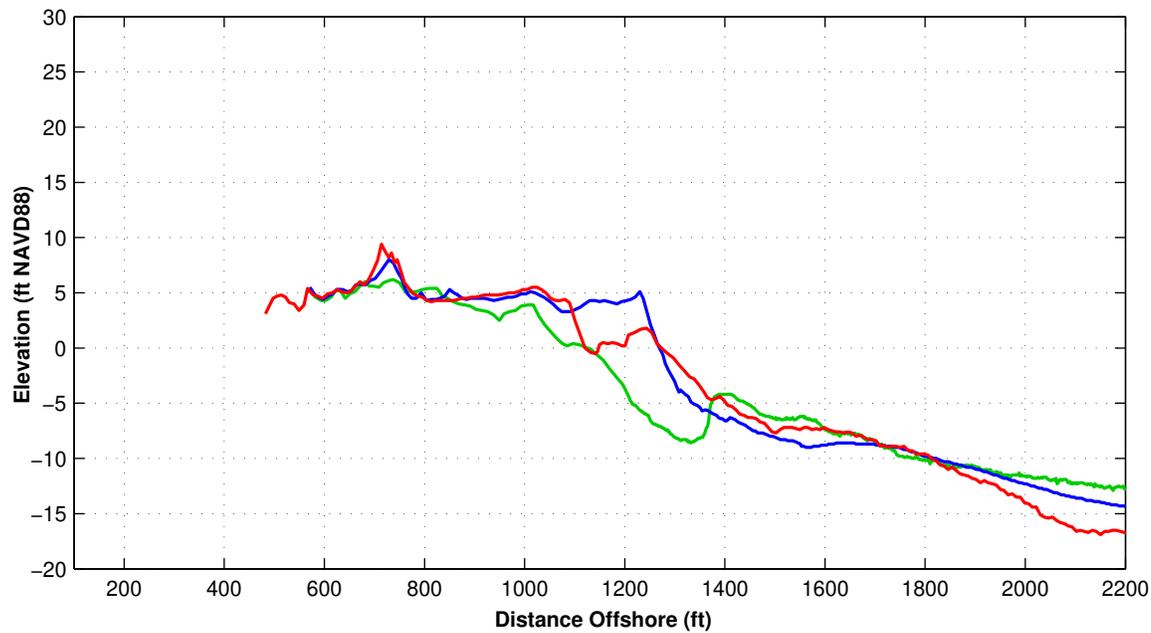
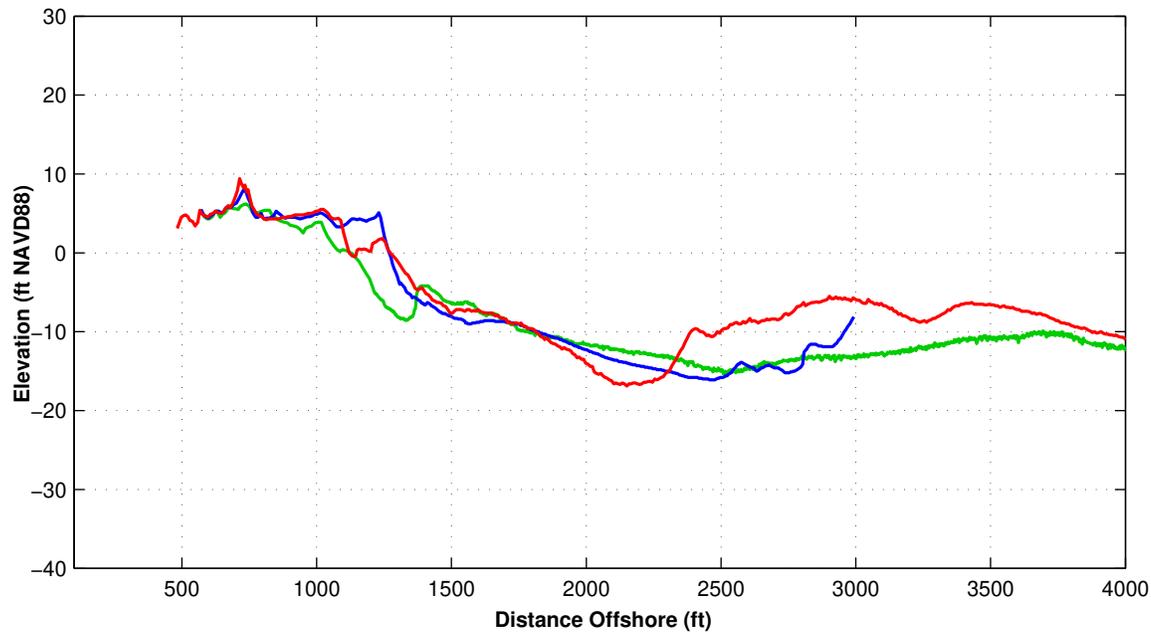


Survey Transect 1240+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-42.91 ft	-71.08 ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JUNE 2020 ——— (green line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.



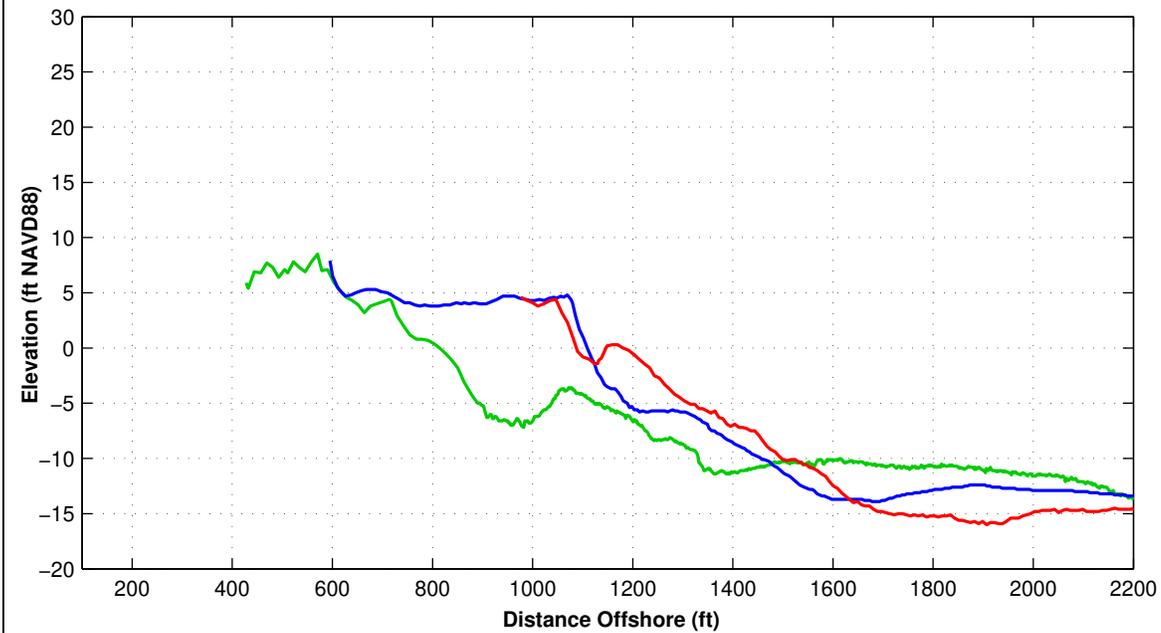
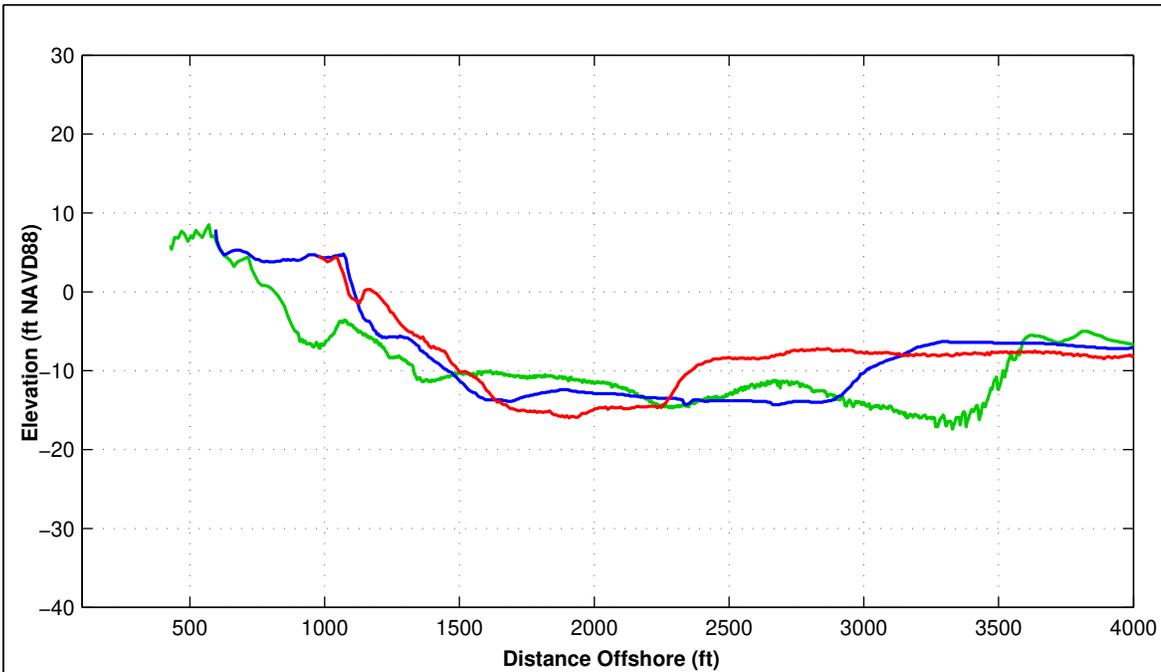


Survey Transect 1250+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	200.90 ft	-2.67 ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.



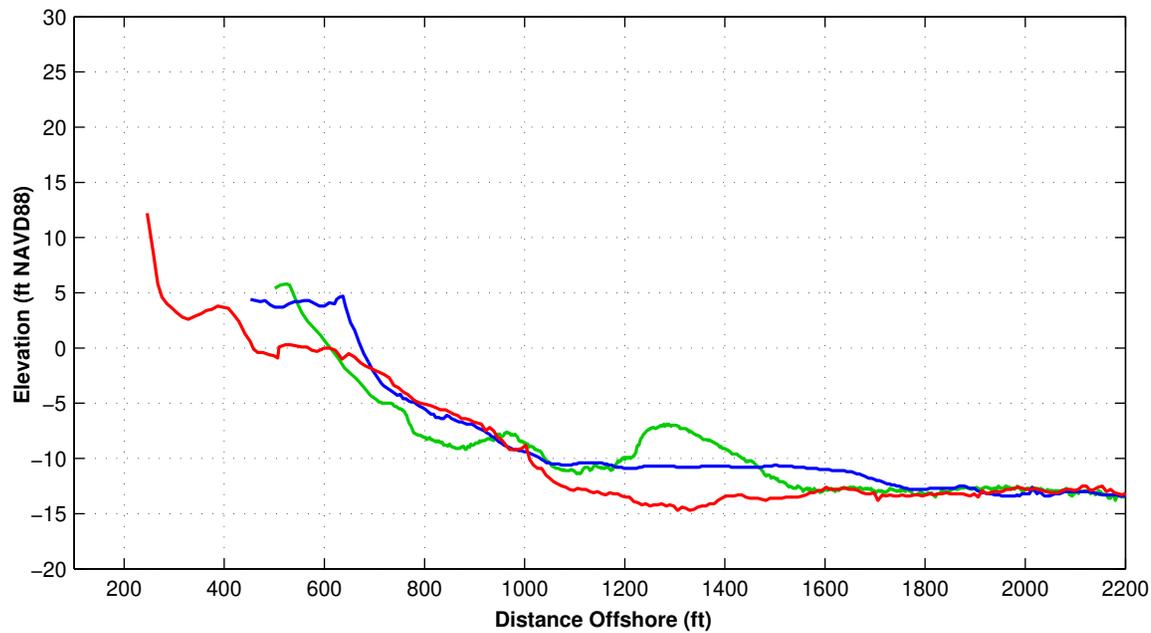
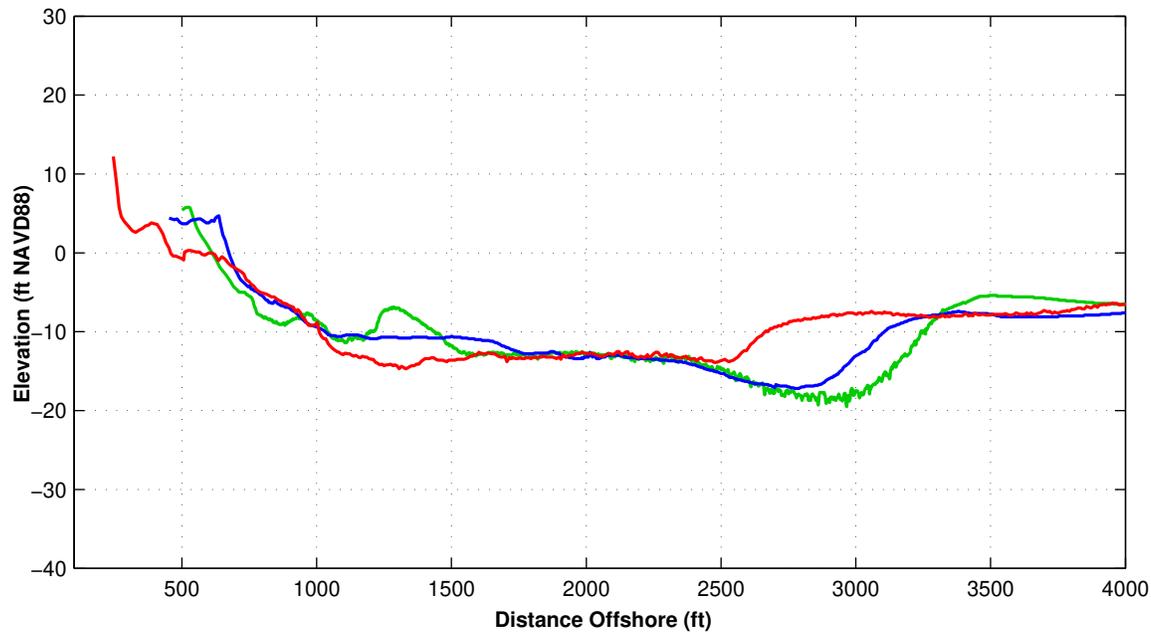


Survey Transect 1260+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	343.36 ft	-20.24 ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.



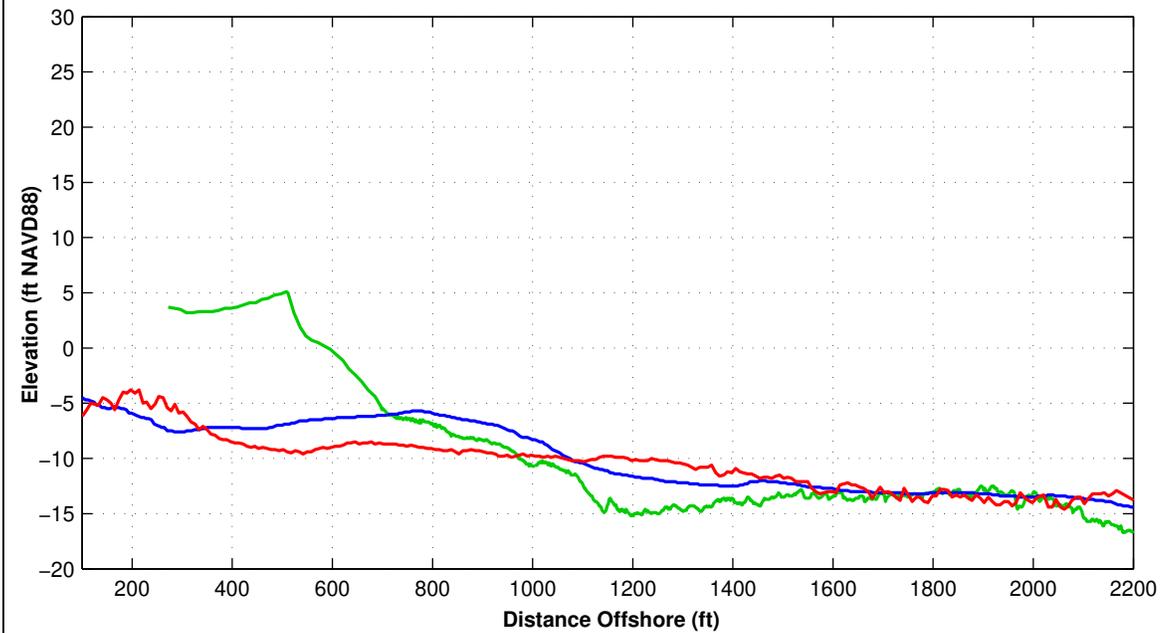
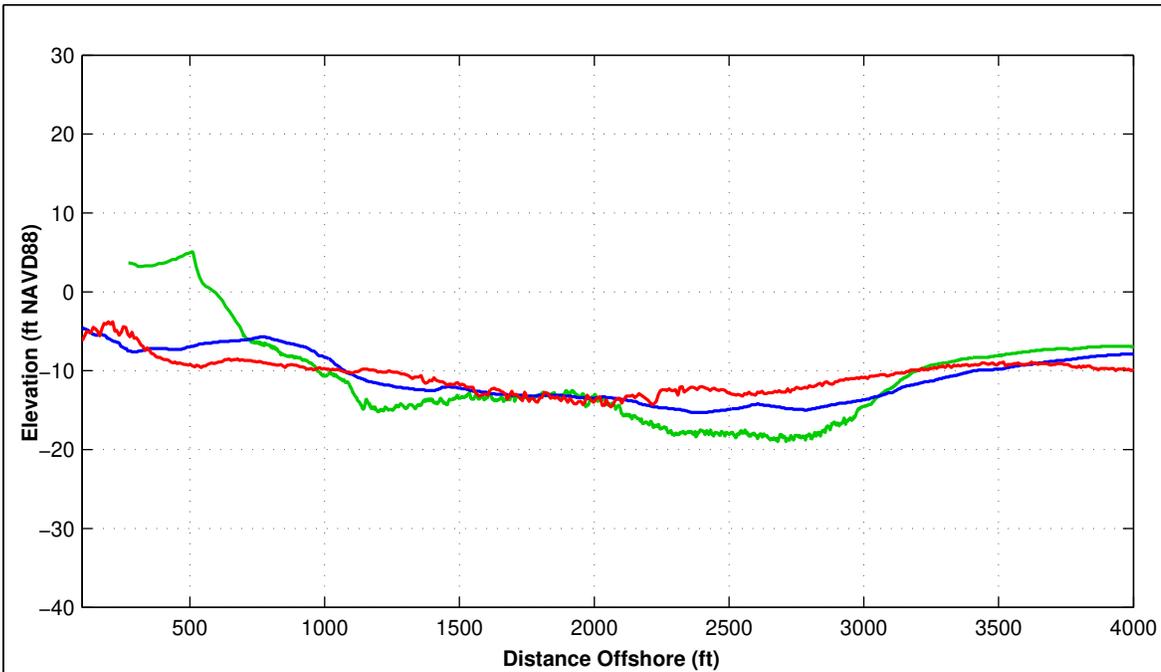


Survey Transect 1270+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	72.34 ft	-220.93 ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.



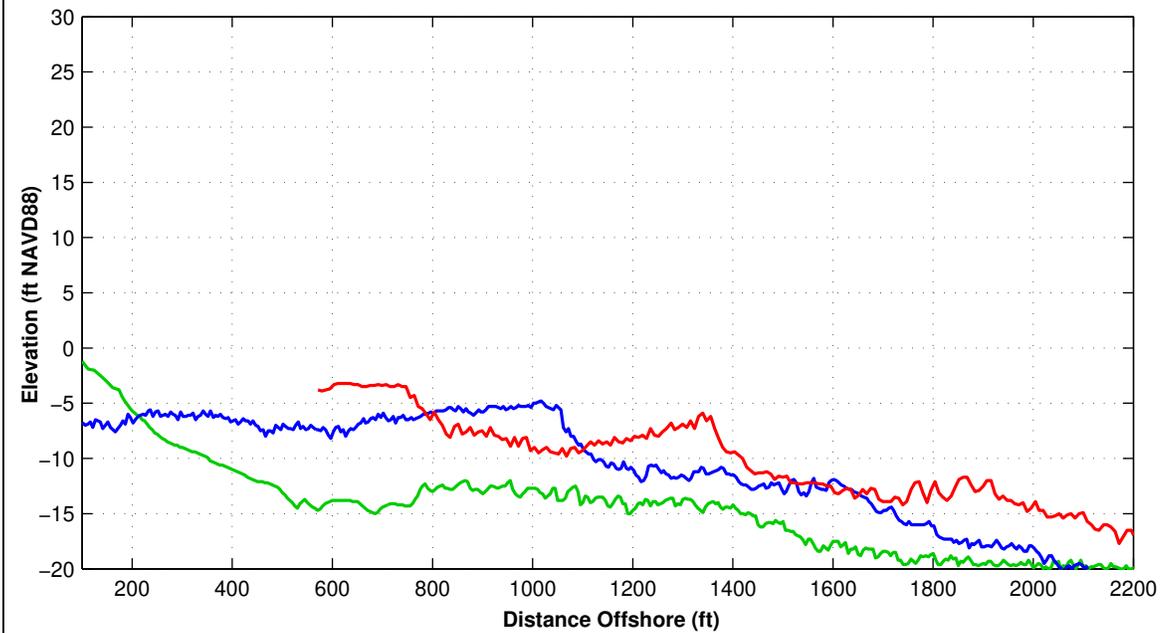
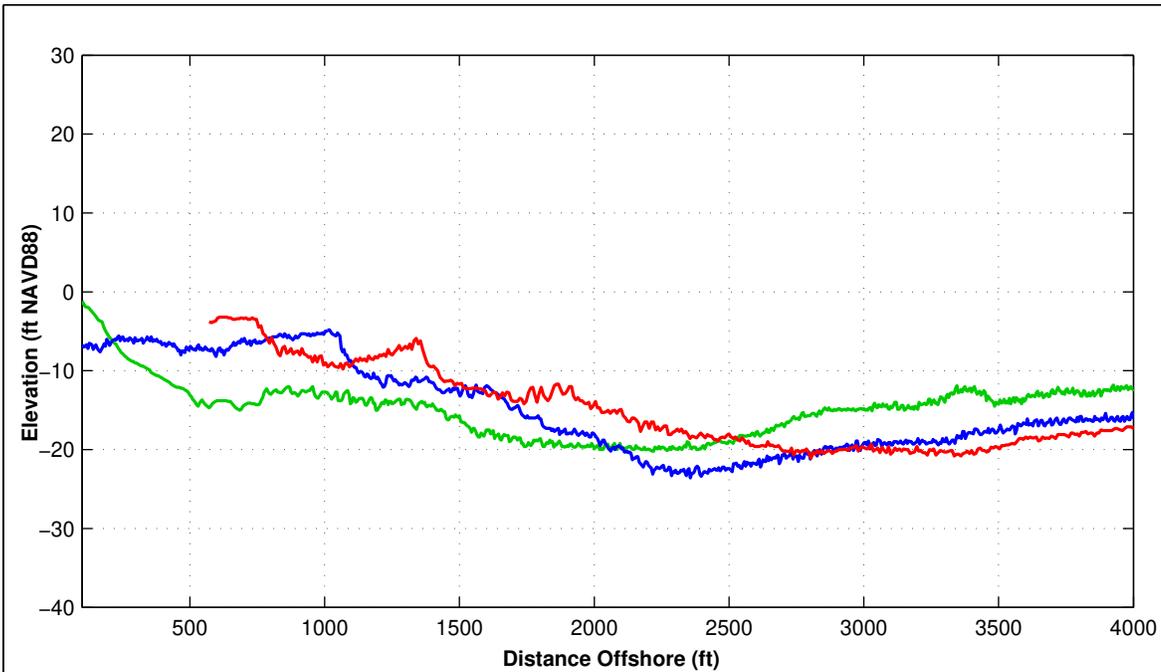


Survey Transect 1280+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-528.15 ft	- ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

**LEGEND:**  
 JUNE 2022 ——— (red line)  
 JULY 2021 ——— (blue line)  
 JUNE 2020 ——— (green line)  
 AUGUST 2019 ——— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.





Survey Transect 1290+00	JULY 2021 – JUNE 2020	JUNE 2022 – JULY 2021
Shoreline Change at MHW (1.18 ft NAVD88)	-589.44 ft	- ft
Volume Change Above +6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above 1.18 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -6 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -14 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -19 ft NAVD88	99999.00 cy/ft	- cy/ft
Volume Change Above -30 ft NAVD88	99999.00 cy/ft	- cy/ft

**LEGEND:**  
 JUNE 2022 ———— (red line)  
 JULY 2021 ———— (blue line)  
 JUNE 2020 ———— (green line)  
 AUGUST 2019 ———— (black line)

- Notes:  
 1. Station From North To South At Varying Intervals.  
 2. All Survey Elevations In Feet Referenced to NAVD88.



# APPENDIX C

## TABULATED SHORELINE AND VOLUME CHANGE DATA



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. Shoreline Change and Volume Change is calculated for the period between surveys from July 20, 2021 to June 29, 2022.

Reach	Transect Number	Station	Shoreline Change @ MHW (+1.18 ft NAVD)	Above Berm (+6 ft NAVD88)		Above MHW (+1.18 ft NAVD88)		Above -6 ft NAVD88		Above -14 ft NAVD88		Above -19 ft NAVD88		Above -30 ft NAVD88			
				2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)	2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)	2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)	2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)	2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)	2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)	2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)
				Nags Head - North	1	430+00	-16.09	84.88	4.30	118.70	0.79	197.67	1.96	389.01	19.84	618.04	10.29
2	435+00	-16.76	19.26		-0.65	40.28	-4.73	98.46	-3.30	260.62	15.07	460.73	-11.70	1293.84	6.92		
3	440+00	-17.31	31.98		0.37	58.64	-4.19	123.62	-6.99	288.25	3.76	522.31	3.69	1363.03	27.27		
4	445+00	-51.15	18.87		-2.61	35.05	-12.05	77.38	-29.66	239.78	-26.98	472.15	-27.16	1305.80	-6.23		
5	450+00	-39.03	27.44		-1.34	45.89	-9.16	89.67	-27.77	242.44	-14.58	473.31	-17.14	1309.79	7.47		
6	455+00	9.26	38.74		0.81	66.67	2.25	130.70	4.11	294.41	15.98	497.12	-16.80	1333.62	2.01		
7	460+00	-50.40	40.53		-0.42	63.43	-7.99	112.37	-31.30	278.17	-16.31	529.25	1.75	1373.55	34.93		
8	465+00	-18.38	33.68		0.97	56.79	-1.88	104.20	-18.33	278.62	-1.49	510.98	-4.65	1346.94	25.75		
9	470+00	-57.78	41.33		-0.55	64.43	-11.29	110.26	-31.18	271.56	-33.16	506.18	-34.04	1355.06	-1.71		
10	475+00	-31.14	50.36		0.80	80.14	-6.21	151.33	-6.10	329.44	0.26	566.29	1.20	1419.69	30.26		
11	480+00	26.48	36.45		-1.21	67.72	2.80	138.21	7.96	314.05	18.12	546.77	19.72	1396.11	47.23		
12	485+00	-80.84	55.56		-1.62	83.59	-12.44	136.56	-43.78	312.89	-42.08	552.73	-39.62	1413.95	-11.06		
13	490+00	-37.30	55.58		1.36	85.47	-5.56	146.43	-17.93	338.90	-0.67	587.95	16.12	1450.75	45.56		
Reach 1	14	495+00	52.49	47.89	0.74	81.28	9.02	151.61	12.56	335.13	15.31	573.96	20.42	1434.95	48.30		
	15	500+00	-74.31	36.12	2.26	60.36	-10.15	108.07	-37.78	281.62	-39.01	514.59	-35.12	1369.43	-8.23		
	16	505+00	-33.62	41.42	4.86	67.54	1.13	120.37	-20.21	302.13	-6.03	538.70	6.80	1392.75	32.04		
	17	510+00	6.58	33.70	6.12	66.87	6.17	133.24	5.97	324.49	15.21	553.84	60.19	1383.17	77.45		
	18	515+00	47.07	48.31	6.31	82.38	13.55	148.03	5.88	327.11	-1.96	547.89	2.60	1406.67	36.30		
	19	520+00	-13.56	42.98	6.72	76.52	6.01	141.13	-8.21	343.60	-20.06	603.12	5.53	1457.61	44.33		
	20	525+00	-7.95	22.99	3.68	53.64	3.29	117.41	-14.12	280.87	-66.31	544.65	-21.65	1392.45	13.94		
	21	530+00	46.31	28.78	3.38	61.62	10.47	124.48	13.00	318.36	2.30	581.57	42.49	1427.71	74.47		
	22	535+00	-23.83	36.80	8.20	72.01	5.53	141.72	-3.65	317.12	-39.23	589.35	5.18	1444.82	43.05		
	23	540+00	6.18	45.79	8.38	81.76	9.12	152.82	11.15	326.83	-16.56	599.80	30.07	1459.98	63.50		
	24	545+00	18.48	46.29	9.19	81.54	10.03	151.22	8.53	328.04	-13.37	589.57	22.99	1445.51	56.55		
	25	550+00	-21.72	28.80	9.92	58.42	4.28	118.80	-7.72	299.95	-31.54	550.08	-2.16	1384.66	31.89		
	26	555+00	-14.10	32.45	6.13	63.69	3.56	128.77	-2.17	304.12	-22.15	550.27	-2.05	1379.61	32.94		
	27	560+00	-25.05	19.38	3.24	46.26	-2.75	105.68	-7.78	270.22	-43.02	513.44	-27.32	1335.10	-3.10		
	28	565+00	-29.27	24.86	2.99	50.19	-3.57	107.93	-8.07	269.29	-30.84	519.37	-6.34	1348.87	26.17		
	29	570+00	-21.88	29.14	2.57	55.63	-3.09	116.40	-5.73	275.73	-39.46	527.20	-11.67	1366.87	14.29		
	30	575+00	-42.59	18.89	-0.30	39.92	-9.86	94.71	-16.03	245.18	-62.72	490.98	-41.74	1321.86	-16.51		
	31	580+00	-36.43	19.21	-3.11	40.49	-12.44	100.97	-13.59	252.16	-52.11	500.10	-31.10	1329.60	-5.53		
	32	585+00	-46.34	15.78	-1.86	38.49	-12.71	101.93	-15.10	264.54	-64.07	521.31	-41.58	1346.24	-18.68		
	33	590+00	-3.48	8.62	-6.07	32.77	-10.18	100.08	-0.96	270.04	-22.69	529.89	0.67	1351.86	22.62		
	34	595+00	3.96	17.27	-3.56	43.02	-2.89	107.72	7.17	280.64	-4.49	540.71	15.95	1364.16	34.64		
	35	600+00	-19.21	62.46	-7.47	98.32	-11.62	177.33	-9.19	360.87	-48.24	627.53	-33.84	1477.38	-14.89		
	36	605+00	-29.13	24.51	-5.10	54.07	-9.66	126.64	-8.37	295.79	-22.01	551.97	-12.43	1383.21	8.06		
	37	610+00	16.02	29.41	-1.26	57.98	-1.02	131.52	8.82	294.10	-44.84	548.43	-37.50	1371.14	-18.63		
	38	615+00	-16.20	32.62	-2.34	64.85	-1.72	149.81	4.06	325.04	-13.54	591.49	0.37	1417.56	20.79		
	39	620+00	1.05	27.18	0.91	59.06	2.38	137.99	11.44	319.72	9.43	583.40	19.77	1409.79	39.38		
	40	625+00	-59.02	37.32	-1.93	69.99	-8.59	149.74	-16.34	332.16	-7.52	586.62	-6.92	1410.42	11.24		
	41	630+00	-41.47	44.57	0.66	80.24	-5.24	162.36	-12.90	353.22	-41.78	598.02	-60.50	1425.61	-44.74		
	42	635+00	-39.27	27.22	-0.59	57.83	-7.44	134.28	-15.34	322.21	-37.68	552.58	-67.69	1362.32	-32.24		
	43	640+00	-31.45	51.84	2.23	88.96	-2.90	177.43	-5.55	388.89	-3.96	642.61	-13.82	1426.37	39.97		
	44	645+00	-44.70	48.55	-1.98	87.46	-9.05	183.96	-11.98	389.77	-28.40	644.99	-29.28	1396.84	-160.69		
	45	650+00	-21.28	45.97	2.27	80.67	-1.79	170.42	1.73	371.02	-6.06	613.14	-13.29	1516.30	105.98		
	46	655+00	-27.66	32.16	2.18	60.25	-2.90	137.66	-2.81	334.07	10.06	596.54	22.73	1377.59	36.10		
	47	660+00	-50.27	43.39	0.86	75.50	-7.35	158.65	-18.07	354.78	-8.45	603.42	-12.90	1395.43	8.94		
	48	665+00	-44.85	52.79	-0.67	85.10	-9.22	161.41	-18.32	352.28	-3.23	607.53	2.36	1409.58	35.17		
	49	670+00	-38.10	37.27	4.26	67.98	-0.36	142.75	-9.10	323.03	-12.97	553.13	-25.35	1342.42	3.06		
	50	675+00	-53.68	1.73	-2.94	12.63	-13.81	54.21	-29.69	210.72	-30.76	413.26	-54.61	1166.31	-40.17		
	51	680+00	1.59	43.39	-0.13	76.68	-1.05	158.73	2.51	347.38	1.76	572.63	-14.52	1381.09	-5.83		
	52	685+00	-19.62	40.60	0.24	71.98	-3.40	148.66	-1.70	333.92	-5.38	573.21	-5.79	1396.30	11.79		
	53	690+00	-65.77	47.45	2.34	77.64	-7.86	144.11	-31.19	317.87	-43.47	545.72	-56.17	1363.15	-33.73		
54	695+00	-31.39	49.04	0.67	84.28	-4.56	163.90	-5.66	342.72	-15.55	575.42	-22.14	1387.61	-5.07			
55	700+00	-50.38	54.46	4.11	84.60	-4.90	150.73	-25.49	338.54	-27.42	565.61	-36.59	1367.47	-25.28			
56	705+00	-16.02	44.90	1.36	75.17	-1.08	140.54	-17.79	333.87	-16.21	584.55	1.88	1392.45	22.67			
57	710+00	-9.27	43.72	1.41	66.47	-1.77	113.92	-32.83	299.03	-41.44	559.67	-10.64	1363.50	13.21			
58	715+00	-72.51	50.71	2.86	86.16	-5.06	165.23	-20.36	351.88	-43.43	595.13	-28.43	1399.26	-2.64			
59	720+00	-46.40	54.95	2.93	87.40	-5.05	160.65	-17.74	352.19	-45.26	598.19	-28.70	1403.53	-2.83			
60	725+00	-77.20	35.28	2.66	67.59	-6.98	144.53	-12.81	331.31	-34.93	576.86	-16.38	1376.15	12.06			
61	730+00	-13.45	44.00	5.43	77.88	3.10	157.04	15.50	355.50	10.85	598.70	23.69	1396.94	30.57			
62	735+00	-15.31	33.93	4.12	62.47	-0.23	122.50	-1.47	317.47	-17.03	562.41	0.38	1414.77	61.31			
63	740+00	0.79	44.20	6.39	81.22	7.54	157.00	13.85	376.77	31.74	646.49	69.44	1472.96	104.09			
64	745+00	-41.58	56.15	6.87	90.50	-0.63	156.37	-14.83	370.77	-28.79	635.50	-3.69	1460.66	20.40			
65	750+00	-30.07	67.18	5.40	110.57	0.53	197.92	-3.52	415.52	-21.38	688.97	6.84	1524.51	37.08			
66	755+00	-23.44	61.50	3.24	99.65	-1.88	174.61	-5.85	388.74	-5.67	669.35	28.79	1500.61	59.94			
67	760+00	-10.45	45.46	1.37	81.28	-5.77	157.36	-8.41	346.56	-49.03	627.80	-17.75	1458.08	9.31			
68	765+00	-4.64	19.61	-0.45	42.61	-9.27	108.82	-5.87	275.51	-54.56	547.12	-20.43	1361.73	7.36			
69	770+00	69.98	36.42	-0.13	68.32	6.14	146.40	32.49	333.91	-0.04	613.94	36.37	1446.40	69.84			
70	775+00	-17.03	57.09	0.18	92.73	-1.62	176.49	6.70	378.62	14.78	663.17	51.29	1490.04	86.49			
71	780+00	-20.72	21.62	-1.69	60.97	-10.24	146.00	-12.03	339.21	-56.55	621.65	-18.64	1440.46	10.69			
72	785+00	-13.66	41.30	-1.09	89.11	-8.79	195.56	-8.40	386.26	-84.82	678.64	-49.90	1507.48	-20.91			

Reach	Transect Number	Station	Shoreline Change @ MHW (+1.18 ft NAVD)	Above Berm (+6 ft NAVD88)		Above MHW (+1.18 ft NAVD88)		Above -6 ft NAVD88		Above -14 ft NAVD88		Above -19 ft NAVD88		Above -30 ft NAVD88			
				2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)	2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)	2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)	2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)	2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)	2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)	2022 Measured Volume (cy/ft)	2021-2022 Volume Change (cy/ft)
Reach 2	73	790+00	3.16	3.75	-1.18	30.41	-3.29	103.87	3.26	309.09	-8.61	585.33	35.71	1376.97	67.53		
	74	795+00	17.34	51.61	-0.27	90.48	-1.45	183.17	5.64	359.74	-43.02	634.47	-15.20	1455.34	25.16		
	75	800+00	-27.49	19.68	-1.26	49.29	-9.22	127.24	-13.49	290.10	-49.35	561.69	-15.94	1361.39	23.67		
	76	805+00	-27.46	39.11	-3.92	71.16	-8.53	150.84	-11.37	311.00	-35.47	556.98	-30.60	1355.82	-3.32		
	77	810+00	-14.07	55.32	-0.41	92.08	-2.17	175.94	-2.75	347.51	-27.84	592.90	-22.41	1391.26	8.94		
	78	815+00	-43.71	45.48	-0.49	78.44	-6.87	156.78	-18.12	321.94	-48.08	587.37	-20.44	1379.89	3.48		
	79	820+00	-27.13	42.77	-3.34	78.14	-7.87	159.27	-15.40	334.15	-42.39	584.08	-34.86	1396.45	0.21		
	80	825+00	-9.86	38.44	2.86	70.74	0.18	147.79	-5.91	316.87	-25.02	572.84	-8.48	1362.25	12.87		
	81	830+00	-23.36	36.10	-4.38	63.83	-11.85	143.44	-16.32	315.49	-42.38	577.88	-20.53	1364.64	-0.34		
	82	835+00	-51.78	16.72	-1.83	40.06	-7.73	108.85	-14.30	261.45	-48.38	486.68	-45.86	1248.80	-11.70		
	83	840+00	-47.59	27.16	1.42	52.97	-5.64	126.75	-10.72	292.89	-44.88	543.40	-27.36	1303.34	12.86		
	84	845+00	-39.74	49.27	1.07	86.53	-6.89	178.48	-8.25	353.48	-37.51	597.11	-28.71	1354.27	-42.81		
	85	850+00	-25.36	17.32	-1.64	41.63	-9.10	118.94	-4.04	290.47	-27.08	526.08	-23.65	1292.64	-4.62		
	86	855+00	-50.23	39.11	-0.07	73.26	-8.75	162.49	-12.51	368.00	-15.14	644.55	25.60	1422.28	44.67		
	87	860+00	-49.97	23.24	0.16	49.48	-9.10	121.79	-17.83	302.76	-31.95	571.56	15.59	1342.42	49.51		
	88	865+00	-19.41	40.30	-1.68	72.17	-6.77	150.27	-21.08	319.05	-49.88	575.59	-19.82	1344.03	1.25		
	89	870+00	-53.47	37.61	0.81	69.29	-2.15	151.73	-12.86	343.98	-22.47	611.45	23.21	1379.73	50.47		
	90	872+00	-72.31	25.58	-0.49	51.79	-4.26	126.76	-16.50	305.77	-32.56	561.41	-2.49	1319.06	4.12		
	91	880+00	-104.18	39.54	-3.79	71.83	-14.57	157.29	-22.49	339.63	-64.45	583.62	-47.07	1370.21	-29.92		
	92	885+00	-85.84	37.60	-1.52	69.97	-11.53	154.69	-15.93	333.15	-49.58	575.55	-42.90	1362.22	-29.74		
93	890+00	-103.29	31.63	2.38	61.33	-9.03	141.16	-15.26	323.96	-36.29	595.41	5.19	1390.93	34.89			
94	895+00	-116.05	35.53	-1.39	61.86	-16.35	135.82	-28.13	318.69	-46.19	587.65	-10.05	1372.79	5.60			
95	900+00	-126.94	48.19	2.18	78.25	-16.37	155.97	-29.65	345.11	-44.78	618.72	-6.51	1406.99	11.94			
96	905+00	-113.87	11.41	-9.27	29.19	-28.63	86.42	-40.54	248.37	-62.46	508.01	-25.79	1263.80	-4.70			
97	910+00	-89.18	23.17	-1.82	47.82	-19.11	115.36	-26.38	284.70	-57.45	548.60	-19.42	1308.68	10.46			
98	915+00	-77.02	4.95	-0.81	20.06	-17.11	78.74	-16.98	223.89	-54.11	475.50	-22.74	1221.88	-16.14			
Reach 3 - North	99	920+00	-55.54	49.74	0.35	81.46	-12.25	166.76	-5.25	332.00	-38.78	597.22	-14.00	1386.30	0.81		
	100	922+50	-61.14	57.09	0.85	89.83	-10.96	173.32	-7.56	340.62	-33.80	606.91	-6.39	1395.90	14.49		
	101	925+00	-60.35	55.36	-0.99	89.14	-14.21	175.66	-11.14	335.85	-44.21	605.04	-14.49	1391.01	0.40		
	102	927+50	-59.68	40.01	-3.22	73.21	-17.17	156.24	-15.80	308.22	-63.85	575.86	-41.28	1355.47	-34.24		
	103	930+00	-62.85	38.40	-3.46	72.00	-16.50	152.62	-16.87	305.51	-71.86	573.03	-47.97	1353.65	-35.68		
	104	932+50	-51.69	47.84	-2.91	80.39	-14.42	160.08	-11.15	321.80	-57.18	588.79	-32.98	1368.10	-15.16		
	105	935+00	-31.79	51.43	-6.34	91.53	-17.57	183.67	-12.55	358.08	-61.50	635.46	-33.34	1431.25	-6.23		
	106	937+50	-44.87	27.23	-4.52	55.03	-15.87	129.51	-11.33	294.71	-52.09	564.20	-15.47	1328.10	13.75		
	107	940+00	-44.47	50.98	-3.54	94.06	-14.99	190.23	-11.68	382.30	-47.66	663.22	-13.12	1446.28	1.34		
	108	942+50	-49.50	46.10	-5.87	82.24	-17.97	168.68	-15.31	340.67	-58.14	612.15	-25.21	1379.02	-20.54		
	109	945+00	-41.04	39.80	-9.83	80.29	-19.51	171.99	-14.19	352.00	-54.91	624.67	-15.18	1412.98	4.67		
	110	947+50	-40.59	21.11	-9.75	45.71	-19.14	113.90	-13.53	267.63	-63.41	521.76	-21.77	1289.60	-12.39		
	111	950+00	-57.80	47.15	-9.33	79.74	-23.24	163.32	-28.02	318.34	-94.52	578.87	-73.34	1386.80	-77.58		
	112	952+50	-86.08	32.19	-10.30	67.12	-28.83	152.65	-40.44	311.25	-105.29	563.65	-90.54	1371.82	-90.25		
	113	955+00	-75.95	55.03	-7.01	95.76	-24.57	190.48	-27.96	353.91	-90.53	590.09	-89.56	1405.17	-105.11		
	114	957+50	-53.66	40.64	-7.17	73.99	-20.31	155.70	-20.02	301.27	-82.98	524.12	-74.63	1334.34	-53.92		
	115	960+00	-25.86	59.79	-4.15	100.23	-13.33	193.98	-7.43	367.21	-58.24	651.39	3.24	1485.18	24.47		
	116	962+50	-7.52	28.65	-5.76	55.35	-10.62	126.44	-0.48	280.81	-47.78	551.24	25.18	1340.87	50.95		
	117	965+00	2.51	42.83	-4.60	82.70	-7.94	169.39	0.50	352.10	-32.78	618.63	-26.88	1422.84	-29.25		
	118	967+50	-56.49	25.07	-6.60	53.42	-19.51	126.74	-31.50	302.01	-60.79	554.12	-36.65	1330.20	-41.32		
119	970+00	-43.19	37.55	-7.46	72.59	-19.08	156.44	-20.04	343.07	-54.53	607.14	-11.04	1407.55	7.08			
Reach 3 - South	120	972+50	-9.87	57.02	-4.88	97.82	-11.02	190.70	0.53	390.93	-9.74	665.04	40.63	1476.25	55.71		
	121	975+00	14.19	46.09	-4.44	84.03	-7.42	171.73	8.14	372.01	0.72	656.29	65.76	1462.70	79.48		
	122	977+50	2.34	64.09	-0.64	107.68	-4.51	201.61	1.59	406.50	-24.37	673.69	12.44	1486.48	22.24		
	123	980+00	12.95	13.69	-2.91	44.94	-3.47	117.87	10.60	297.85	-4.08	517.03	-4.02	1300.79	7.61		
	124	982+50	12.35	30.57	-1.19	60.65	-2.56	129.73	8.55	301.82	-16.66	551.27	39.14	1331.39	63.64		
	125	985+00	9.03	2.81	-8.96	24.89	-11.03	79.41	-5.85	237.97	-47.65	478.15	15.24	1234.59	27.43		
	126	987+50	-24.34	0.09	-3.41	8.43	-10.36	42.42	-24.61	175.56	-66.21	397.60	-24.16	1115.37	-16.31		
	127	990+00	5.22	6.76	-6.31	28.81	-10.09	85.56	-6.39	242.93	-37.50	468.50	-3.72	1213.74	-1.12		
	128	992+50	45.55	14.59	-4.12	40.18	-2.41	101.35	8.38	261.93	-16.02	472.71	20.50	1225.47	17.00		
	129	995+00	37.67	0.54	-4.14	16.44	-1.85	61.38	6.18	210.89	-17.06	392.02	-21.69	1107.23	-71.40		
	130	997+50	1.57	26.19	-3.15	55.32	-6.60	118.43	-22.50	283.86	-48.49	514.14	-21.07	1314.49	-4.67		
	131	1000+00	-28.26	2.82	-10.16	21.32	-17.73	67.82	-36.39	213.85	-53.81	430.01	-39.01	1197.75	-31.02		
	132	1002+50	-58.70	0.82	-7.08	14.52	-18.92	51.77	-41.09	194.52	-58.43	387.15	-48.56	1133.45	-42.72		
	133	1005+00	-31.88	14.19	-5.66	37.59	-13.48	89.29	-23.39	251.81	-29.38	448.67	-5.82	1209.20	3.48		
Reach 4	134	1007+50	-19.29	24.79	-4.46	53.11	-10.91	114.03	-20.33	282.35	-32.43	483.83	-32.36	1250.07	-29.69		
	135	1010+00	-38.45	4.65	-5.80	24.72	-14.78	74.17	-33.59	227.65	-62.21	421.61	-58.82	1160.71	-48.47		
	136	1012+50	-24.65	23.55	-2.16	51.36	-9.31	112.05	-21.77	285.82	-39.94	484.29	-30.97	1230.96	-18.42		
	137	1015+00	7.99	14.05	-2.61	36.41	-4.33	90.38	-4.26	257.95	-12.04	445.24	-3.81	1173.36	-10.98		
	138	1017+50	41.85	27.84	-0.38	56.03	4.10	117.47	12.70	297.01	15.44	493.54	23.01	1228.31	11.96		
139	1020+00	55.01	7.50	-1.89	25.86	5.07	73.57	15.69	245.94	30.10	438.01	43.61	1169.72	26.18			
140	1022+50	10.22	17.29	-2.35	41.32	-2.34	93.68	-15.79	251.86	-23.36	444.51	-15.61					

