

Town of Colonial Beach State of the Beach Data Summary Report



Shoreline Studies Program
Virginia Institute of Marine Science
College of William and Mary
Gloucester Point, VA

December 2016

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Introduction

The Town of Colonial Beach occupies a peninsula between the Potomac River and Monroe Bay (Figure 1). Approximately 2.5 miles of the shoreline is publicly-owned. Two areas on the Potomac River have been enhanced as recreational beaches for swimming and sunbathing. Central Beach extends about 1,650 feet south of the Town Pier and is the main recreational beach. North Central Beach extends about 1,450 feet north of the Town Pier Colonial Avenue. Castlewood Beach is south of Central Beach near the entrance to Monroe Bay. It has about 1,150 feet of sandy beach.

In 1982, breakwater and beach fill systems were completed to abate erosion and restore the beach along the Town's shoreline. Four gapped breakwaters were constructed at Central Beach, and 50,000 cubic yards (cy) of sand was placed as part of an U.S. Army Corps of Engineers shore project. At Castlewood Beach, three gapped breakwaters and 16,000 cubic yards of sand were placed, and a terminal groin was constructed to reduce shoaling in the entrance channel to Monroe Bay. Between the two beaches, a rock revetment was placed along the shoreline in 1986 to protect Irving Avenue. A project in 1989 called for 1,250 cubic yards of sand, breakwater maintenance, and cleanup and removal of small rocks from the river bed at the toe of the beach at Central Beach. In the fall of 1992, the Town, in conjunction with the U.S. Army Corps of Engineers replenished Central Beach with 11,200 cy of sand. In the mid-1990s, the Virginia Department of Transportation put in additional riprap revetment along a large section of Colonial Beach's shoreline. Prior to that, a mix of different types of materials had been placed along the shore to abate erosion. In 1998, approximately 2,100 cubic yards of sand was placed primarily on Central Beach with some on Castlewood. Again in the winter of 1999, more sand was placed on Central and Castlewood Beaches. In September 2003, Hurricane Isabel severely impacted Colonial Beach (Milligan *et al.*, 2002). In May 2011, approximately 10,000 cy of beach fill was placed on Central Beach (Milligan *et al.*, 2011).

Specific shore change is addressed at Central Beach and Castlewood Beach through recent beach profiles. Beach profiles taken in June 2016 were compared to previous profiles. Change in beach volume and distance to mean high water (MHW) was quantified.

2 Methods

Central Beach at Colonial Beach was surveyed on 13 June 2016, and Castlewood was surveyed on 30 June 2016. For both Central (Figure 2) and Castlewood Beaches (Figure 3), the previous baseline was re-occupied and surveyed with a total station. In addition, profiles were taken to the north of the existing Central Beach profiles (Figure 4). Profile dates for Central Beach are shown in Table 1 and for Castlewood in Table 2. Profiles were taken with a total station, and vertical control for the survey data was set with a real-time kinematic global positioning system. The profile data were converted to mean low water (MLW), feet (1983-2001 tidal epoch). Accepted datums are listed in Table 3.

The profile cross-sections are plotted in Appendix A. For Central Beach, the profile cross-sections are shown for June/October 2000 (black), October 2011 (red), and June 2016 (blue). For Castlewood, profile cross-sections are shown for February 2004 (black), January 2011 (red), and

June 2016 (blue). Volume change (in cubic yards per foot) was calculated along each profile from the top of bank to the -2 feet MLW contour between October 2011 and June 2016 for Central Beach. Castlewood Beach was analyzed for the time period January 2011 to June 2016. The change in distance to MHW also was calculated. Both are shown on the profile cross-sections in Appendix A and B. The profile data was input to Esri ArcMap to generate contours for the shoreline. In addition to the labeled index contours, MHW and mean low water (MLW) are labeled.



Figure 1. Location of Central Beach and Castlewood Beaches in Colonial Beach, Virginia.

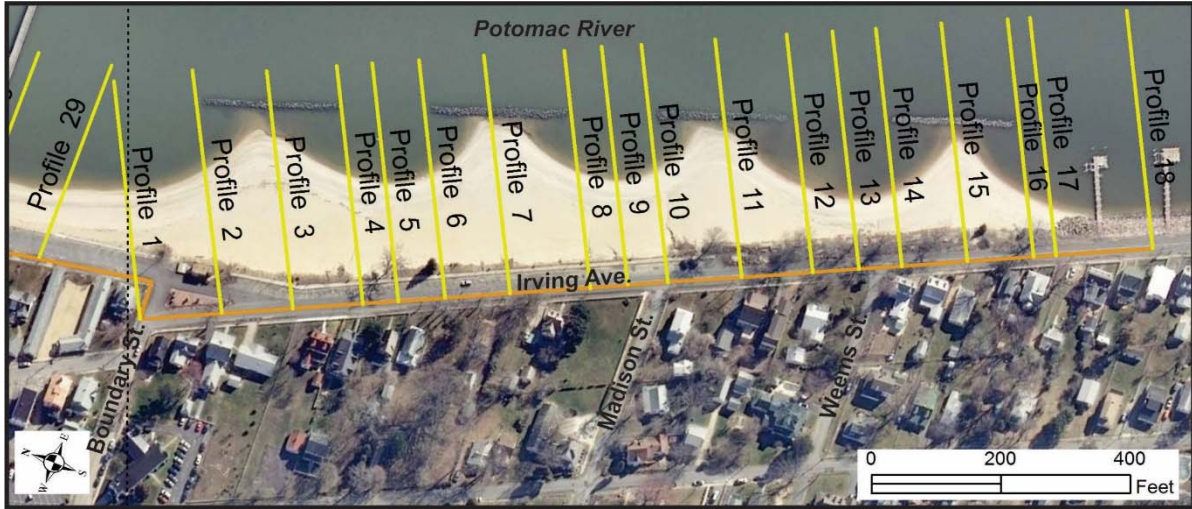


Figure 2. Profile location along Central Beach.



Figure 3. Profile locations along Castlewood Beach, Virginia.

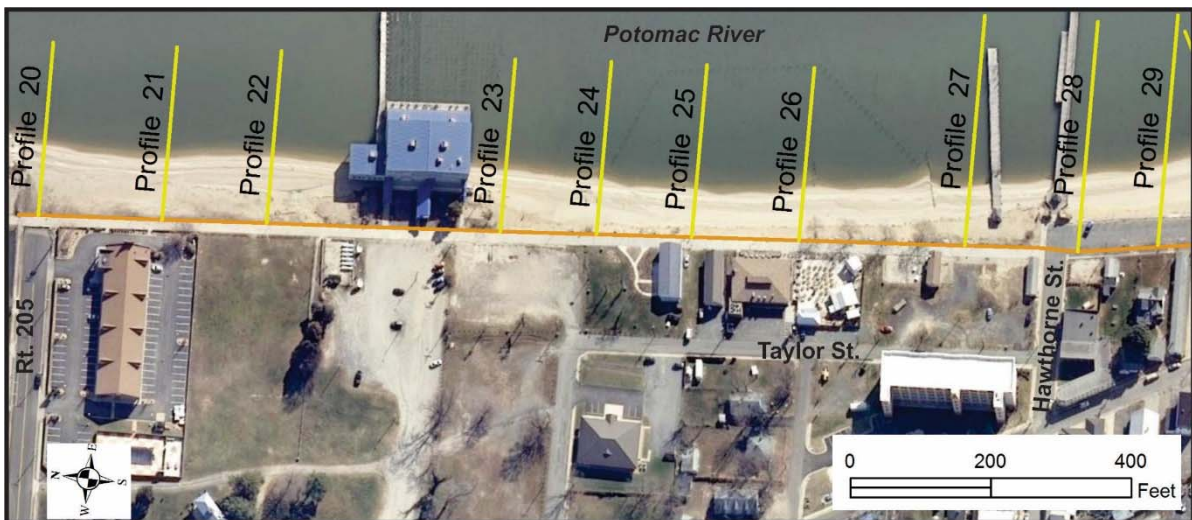


Figure 4. Profile locations along Central Beach North.

Table 1. Beach profile data available for Central Beach in Colonial Beach.

| Date | Survey Number | Profile Number | Comments |
|-------------------|---------------|-----------------------------|-----------------------|
| 30 April 1998 | 100 | 1,3,5,7,9,11,13,15,17 | Post-Twin Northeaster |
| 26 May 1998 | 101 | 1,3,5,7,9,11,13,15,17,18 | |
| 28 October 1998 | 102 | 1,3,5,7,9,11,13,15,17,18 | Post-Hurricane Dennis |
| 23 April 1999 | 103 | 1,3,5,7,9,11,13,15,16,17,18 | |
| 23 September 1999 | 104 | 1,3,5,7,9,11,13,15,17,18 | |
| 2 June 2000 | 105 | 1,3,5,7,9,11,13,15,17,18 | |
| 3 October 2000 | 106 | 1-18 | |
| 25 June 2001 | 107 | 1-18 | Baseline Reset |
| 19 November 2001 | 108 | 1-18 | |
| 12 June 2002 | 109 | 1-18 | Baseline Reset |
| 1 October 2003 | 110 | 2-9,18 | Post-Hurricane Isabel |
| 21 September 2004 | 111 | 1-18 | |
| 25 January 2011 | 112 | 1-18 | |
| 5 July 2011 | 113 | 1-18 | |
| 18 October 2011 | 114 | 1-18 | |
| 13 June 2016 | 115 | 1-18, 20-29 | |

Table 2. Beach Profile data available for Castlewood Beach in Colonial Beach.

| Date | Survey Number | Profile Number |
|------------------|---------------|----------------|
| 25 February 2004 | 100 | 1-10, 5.5, 8.5 |
| 13 January 2005 | 101 | 1-10, 5.5, 8.5 |
| 25 January 2011 | 102 | 1-10, 5.5, 8.5 |
| 30 June 2016 | 103 | 1-10, 5.5, 8.5 |

Table 3. Accepted datums for Colonial Beach in feet for the 1983-2001 tidal epoch from the National Ocean Service website (NOAA, 2011). Values are relative to the station datum.

| Datum | Value (ft) | Description |
|--------|------------|---------------------------------------|
| MHHW | 4.58 | Mean higher-high water |
| MHW | 4.42 | Mean high water |
| NAVD88 | 3.63 | North American Vertical Datum of 1988 |
| MSL | 3.61 | Mean sea level |
| MLW | 2.78 | Mean low water |
| MLLW | 2.64 | Mean lower-low water |
| STND | 0.00 | Station datum |

3 Beach Status Summary

3.1 Central Beach

The cross-sectional profiles taken along Central Beach in 2000, 2011, and 2016 are shown in Appendix A. The 2011 survey was taken after the May 2011 beach fill project. Between 2011 and 2016, Central Beach has been stable. Overall, most profiles have had relatively small changes in volume and in the distance to MHW during this time period. Some change naturally occurs along the profiles because sand within the embayments behind breakwaters can shift due to changes in wave climate. Since wave climate can change throughout the year, minor adjustments are expected. Most noticeable on the profiles is the beach fill that was placed on the beach in 2011. The wedge of sand along the upper beach is shown along most profiles in the large upward change between 2000 and 2011. Overall, little change occurred in this wedge of sand between 2011 and 2016.

Only profile 2 on the northern section of the breakwater system had a significant amount of change. Some sand shifted landward to the upper beach, but it had a net loss of over -6 cy/ft of volume along the profile. Profile 3 only gained about 2.6 cy/ft of sand so some of the sand lost from Profile 2 was lost to the system.

Behind the breakwaters and in Bay A, the shoreline has been stable with some net accretion behind the Breakwaters 1, 2, and 4. Slight loss of sand has occurred in Bay B and Bay C. No change occurs south of the project between BW 4 and the revetment.

Central Beach has a wide backshore that provides both recreational opportunities as well as storm protection (Figure 5). The sand along the northern section of the beach is wider and higher than the southern section primarily because BW 1 is placed farther offshore. The upland along the entire beach is at least 10 feet high at the sidewalk providing a high barrier for storm waters. The nearshore is relatively shallow with the depth being 3-4 feet at MLW at the breakwaters. Breakwaters 1 and 4 have subaerial sand attachments.

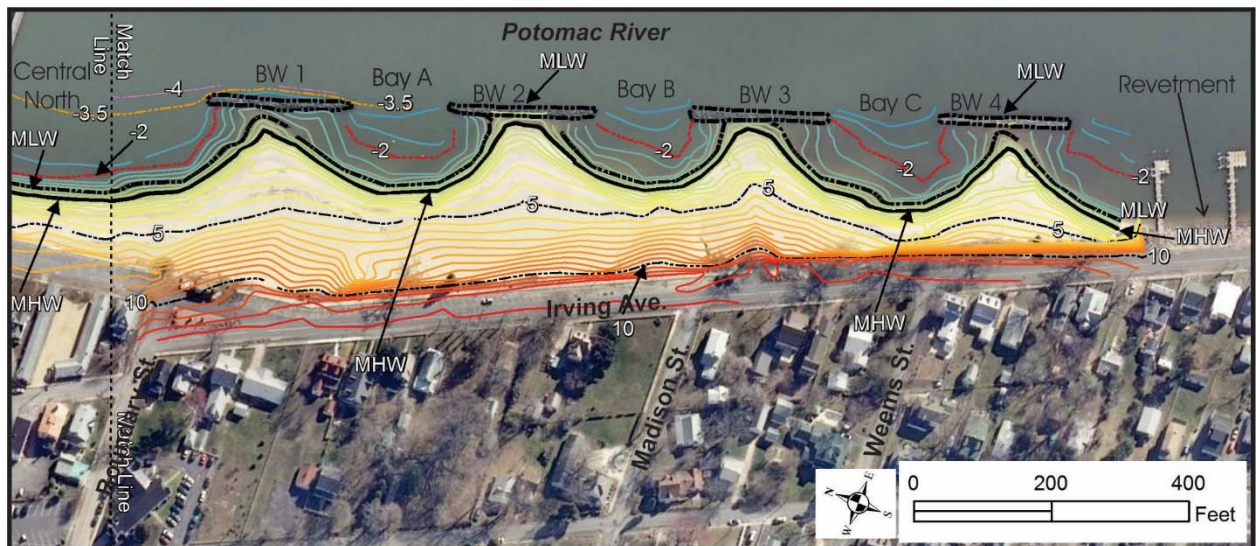


Figure 5. Contour map of profile data at Central Beach. Several index elevations are labeled as are mean high water (MHW) and mean low water (MLW). Survey date 13 June 2016.

Central Beach North only has one survey so no comparisons can be made using the cross-sectional profiles shown in Appendix A. However, the contour map (Figure 6) shows that the beach is relatively narrow with a backshore that is between 5 and 8 feet high, a function of upland topography. The nearshore is deeper north of the Riverboat on the Potomac to -4 feet MLW. The nearshore just north of the Town's pier is relatively flat between 3 and 3.5 feet.

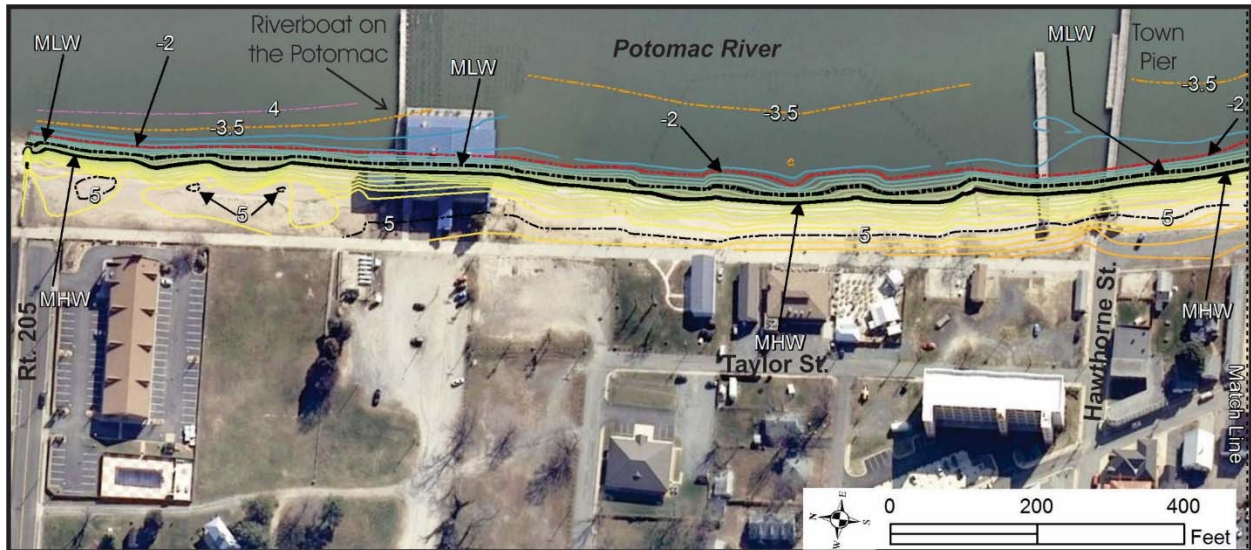


Figure 6. Contour map of profile data at Central Beach North. Several index elevations are labeled as are MHW and MLW. Survey date 13 June 2016.

3.2 Castlewood Beach

Some change has occurred at Castlewood Beach since 2004. Cross-sectional beach profiles (Appendix B) show the change between 2004, 2011, and 2016. Change was variable with little change occurring along Profile 1 or 2. However, along Profile 3 behind Breakwater 1, sand was lost between 2004 and 2011. Some sand returned between 2011 and 2016. In addition, a large section of *Phragmites australis* has grown up in this area. Along Profiles 4, 5, and 6, sand has been lost between 2004 and 2016. Little change has occurred at Profile 7; however, at Profiles 8, 9, and 10 sand has been removed from the lower beach, but the upper beach is higher.

Figure 7 shows the contours developed from the profile data. Bay A has been eroding and Breakwaters 1 and 2 may be detaching. Breakwater 2, in particular, has a subaerial sand attachment along its entire length. Breakwater 3 is fully attached. Bay B and the small bay between Breakwater 3 and the spur are small because of the narrow gap between structures. The wider gap between Breakwater 1 and 2 allow more wave energy into Bay A. Overall, the site is very shallow with the -2 feet MLW contour outside of the breakwaters.

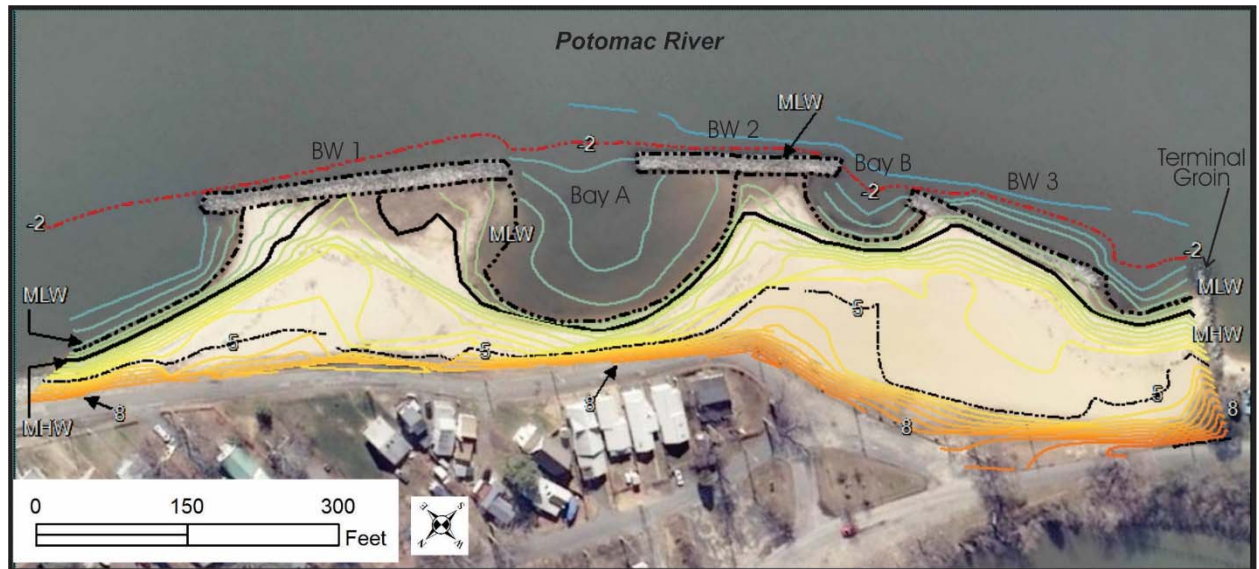


Figure 7. Contour map of profile data at Castlewood Beach 30 June 2016.

4 Summary

Table 4 shows a summary table for the calculated volume and shoreline change along each profile at Central and Castlewood Beaches. Overall, very little change occurred at Central Beach between 2011 and 2016. Much of the fill that was placed on the beach in May 2011 seems to have remained. Several profiles had large changes in the distance to MHW; however, the net volume change usually was not correspondingly large. This indicates that sand may have shifted into other sections of the profile from MHW.

The shoreline along Central Beach North appears stable, but without additional profiles, the change cannot be quantified. No additional sand is needed to maintain beach stability at this time.

At Castlewood, beach fill in Bay A and behind Breakwaters 1 and 2 will help maintain the backshore and beach regions. The shoreline here retreated over 2 feet between 2011 and 2016 and likely was not shifted to other areas of the profile because the shoreline has been eroding since 2004.

Table 4. Summary table for the calculated volume and shoreline change along each profile at Central and Castlewood Beaches.

| Central Beach 2011-2016 | | | Castlewood Beach 2011-2016 | | |
|-------------------------|---------------------------|----------------------------------|----------------------------|---------------------------|----------------------------------|
| Profile Number | Net Volume Change (cy/ft) | Net Shoreline Change at MHW (ft) | Profile Number | Net Volume Change (cy/ft) | Net Shoreline Change at MHW (ft) |
| 2 | -6.4 | -26.8 | 1 | 1.4 | 6.9 |
| 3 | 2.6 | 8.2 | 2 | -0.8 | -23.5 |
| 4 | 0.1 | -7.0 | 3 | 3.0 | 33.0 |
| 5 | 0.1 | -0.4 | 4 | 0.2 | -2.4 |
| 6 | 0.3 | -2.1 | 5 | -0.6 | 23.6 |
| 7 | 2.2 | 33.7 | 5.5 | -4.9 | -17.4 |
| 8 | 2.1 | -7.3 | 6 | 5.6 | 19.7 |
| 9 | -1.3 | -8.1 | 7 | -1.7 | -4.0 |
| 10 | 0.6 | -7.7 | 8 | 3.2 | -17.5 |
| 11 | -1.2 | 4.5 | 9 | 1.1 | 0.2 |
| 12 | 0.0 | -7.4 | 10 | -0.7 | -1.9 |
| 13 | 1.0 | -4.6 | | | |
| 14 | 0.0 | -0.8 | | | |
| 15 | 1.9 | 63.9 | | | |
| 16 | 0.8 | 0.5 | | | |
| 17 | 0.5 | -1.7 | | | |
| Average | 0.2 | | | 0.5 | |

5 References

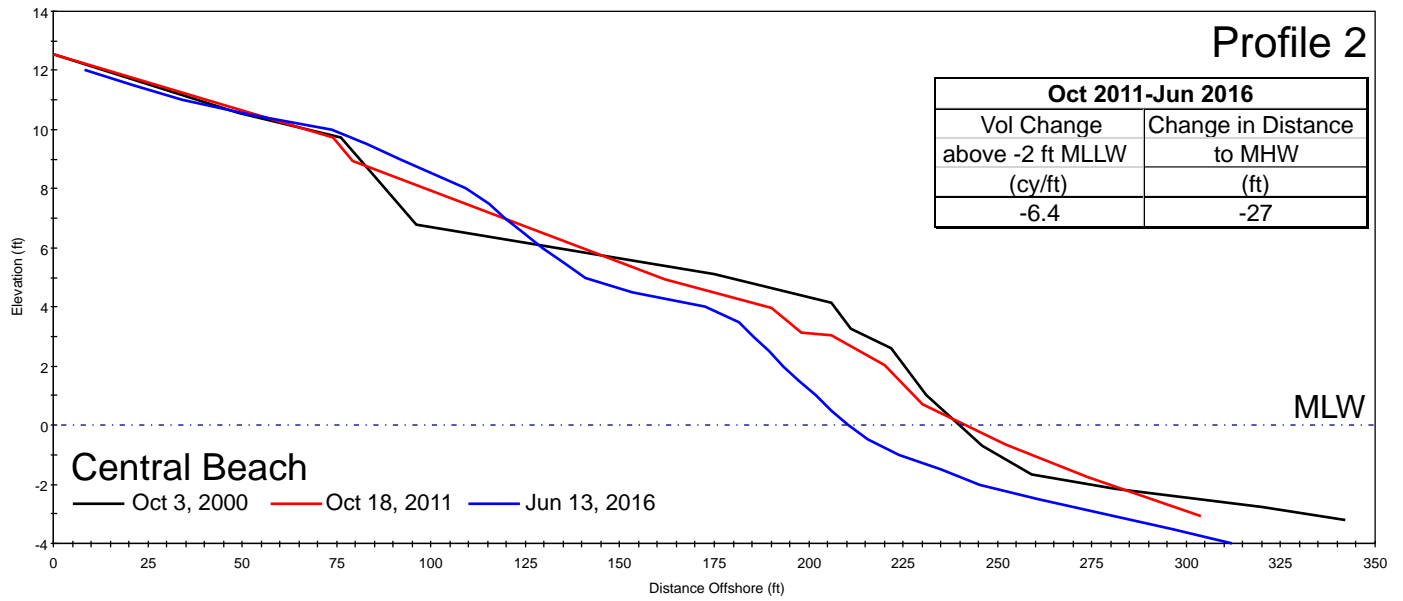
- Milligan, D.A., C.S. Hardaway, Jr., R.H. Brindley, G.R. Thomas, & L.M. Meneghini, 2002. Public Beach Assessment Report: Central Beach and Castlewood Park Beach, Colonial Beach, Virginia. Technical Report prepared for the Board on Conservation and Development of Public Beaches. Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, Virginia.
http://web.vims.edu/physical/research/shoreline/docs/Public_Beaches/Final_Report-Central%20Beach.pdf
- Milligan, D.A., C.S. Hardaway, Jr., & C. Wilcox, 2011. Colonial Beach State of the Beach Report: 2011. Data summary report prepared for the Town of Colonial Beach. Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, Virginia.
- NOAA, 2011. http://tidesandcurrents.noaa.gov/data_menu.shtml?stn=8635150 Colonial Beach, Potomac River, VA&type=Datums

Appendix A

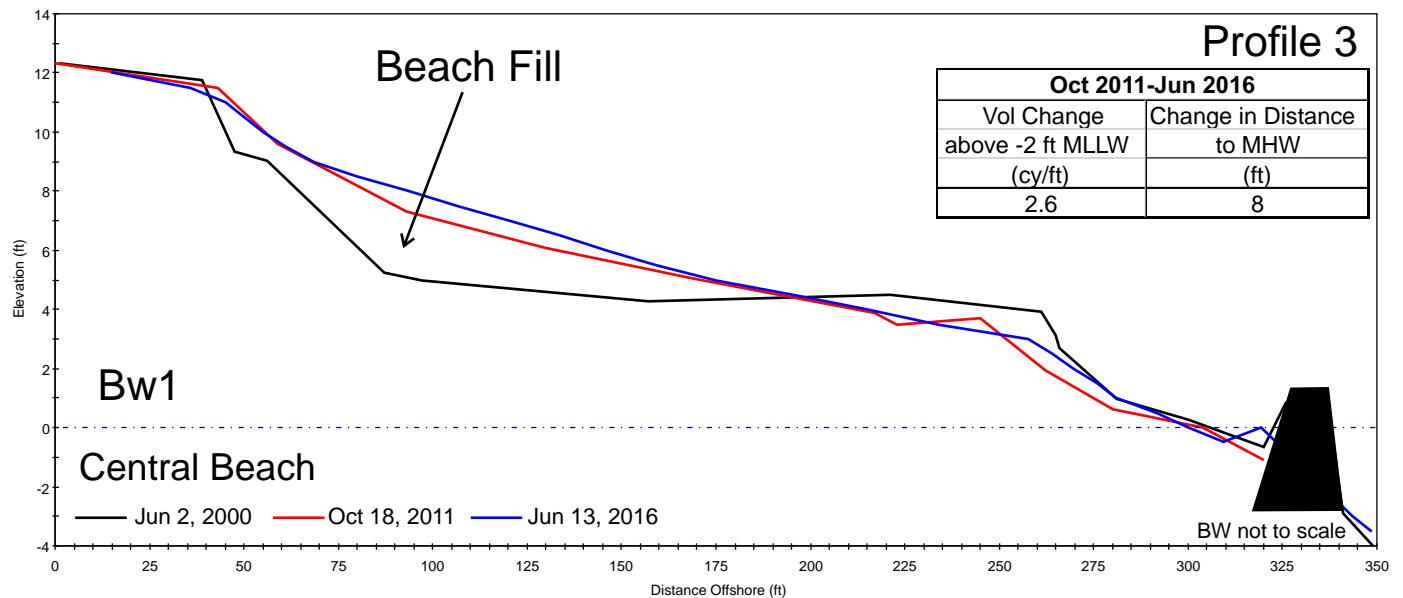
Survey data from June/October 2000, October 2011, and June 2016 for Central in the Town of Colonial Beach, Virginia. Also shown are cross-sections taken along North Central for the first time in June 2016.

Photos taken in June 2016

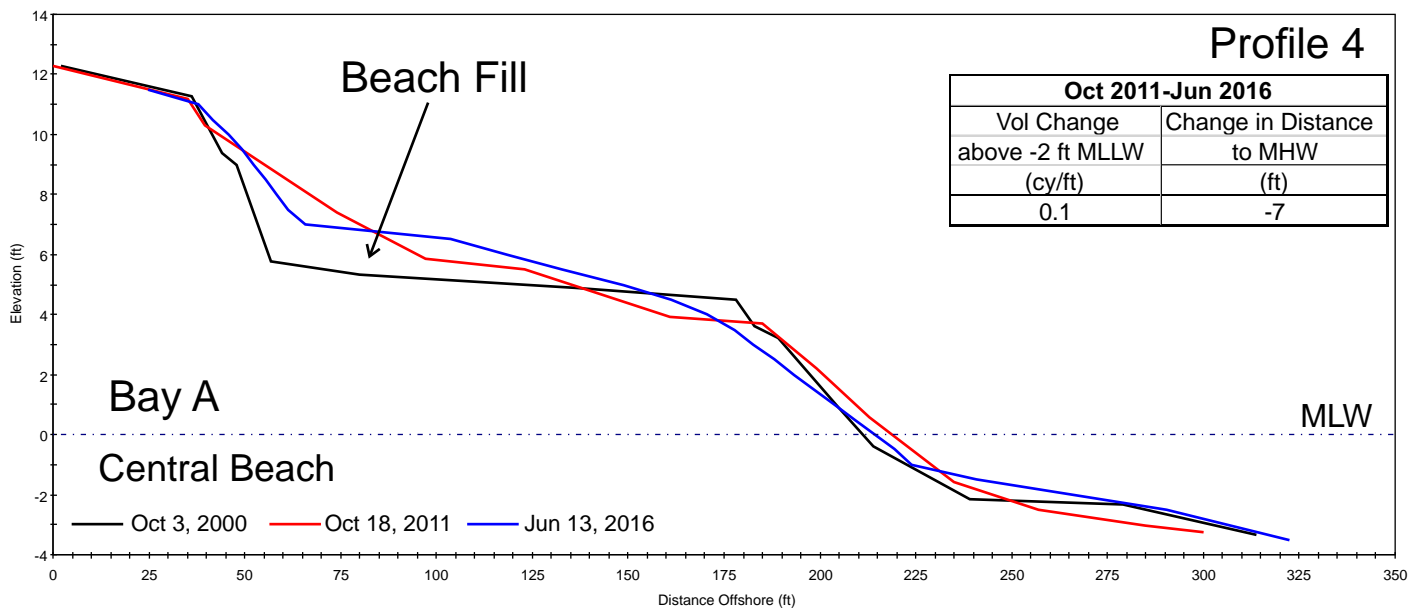
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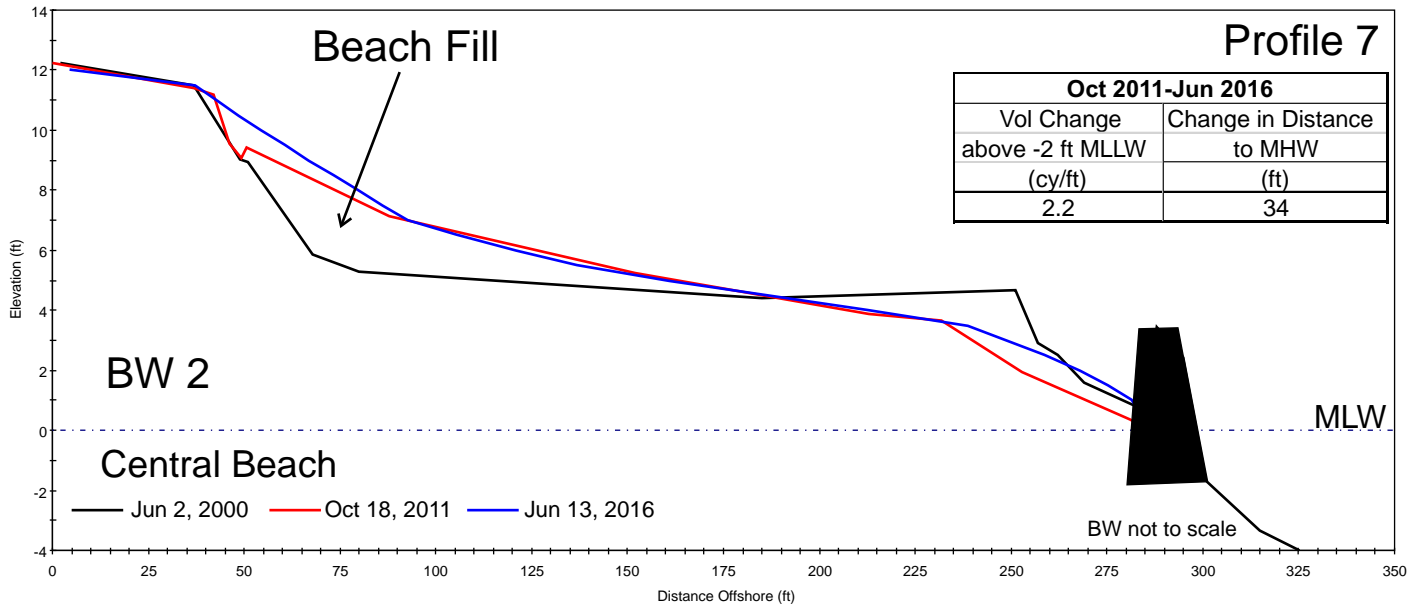
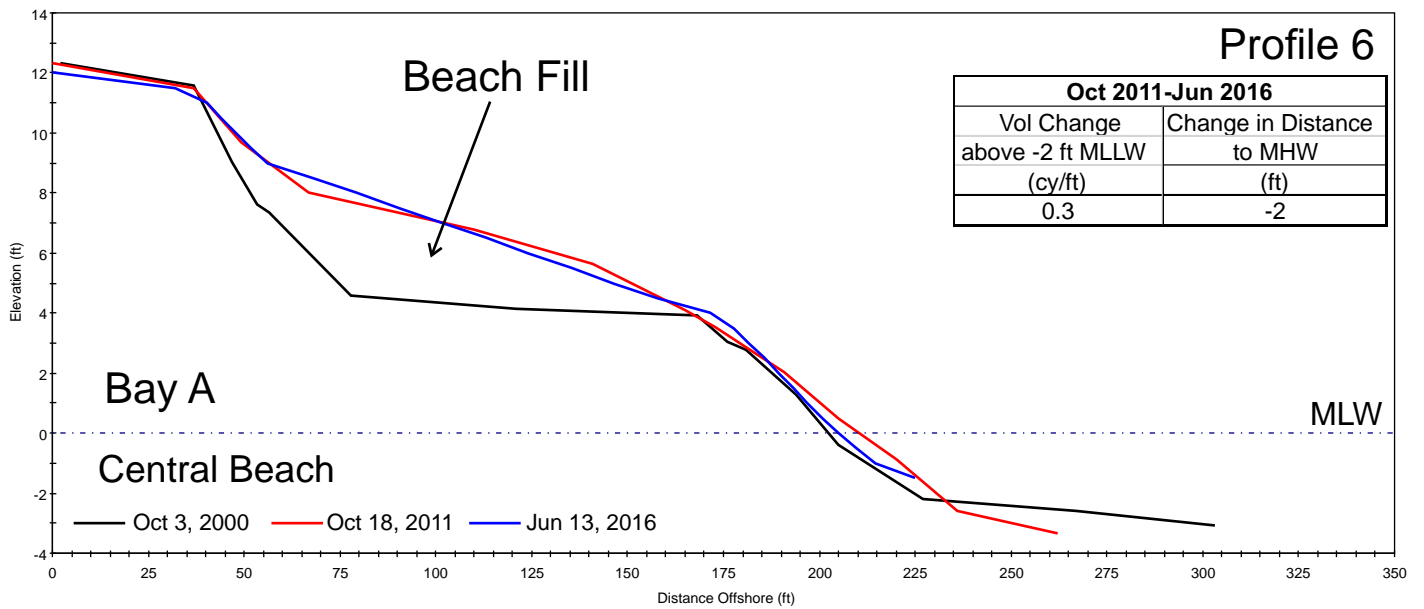
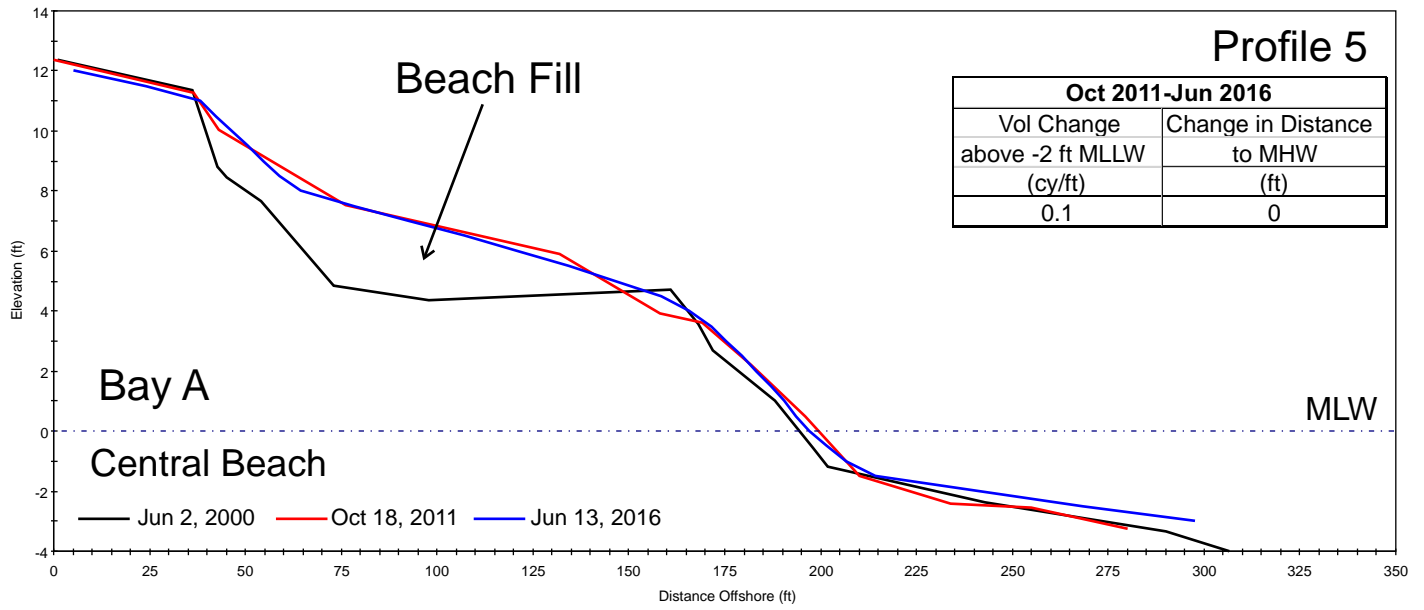


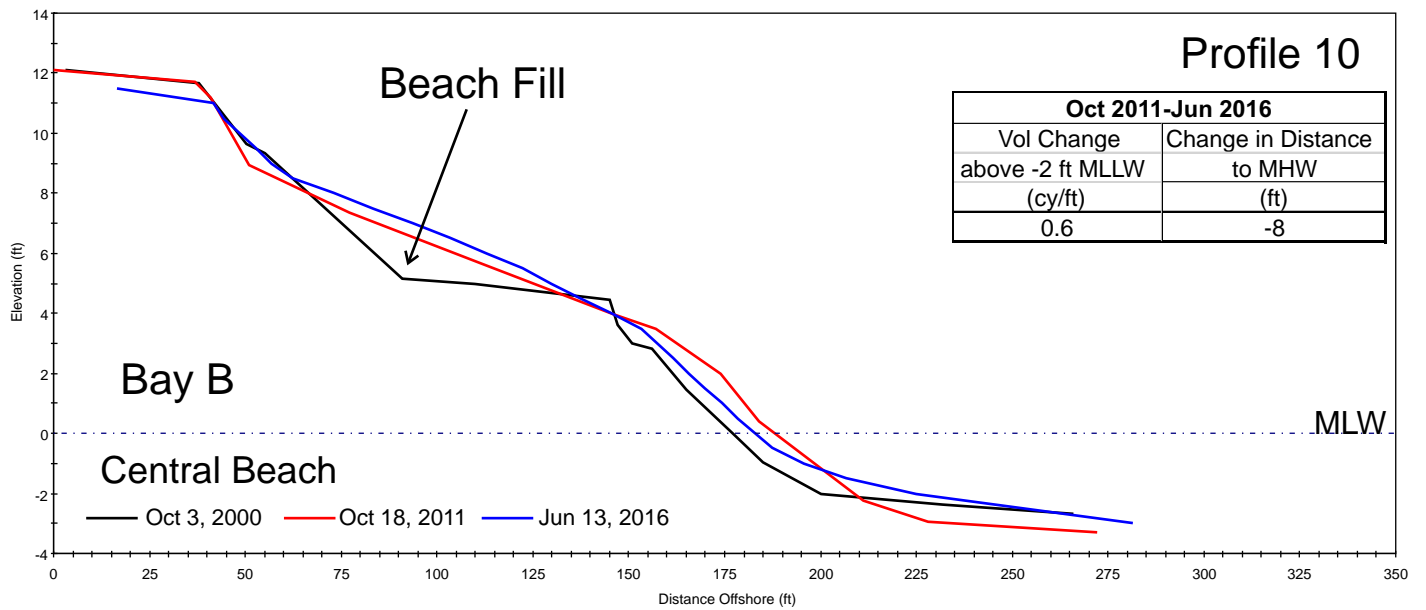
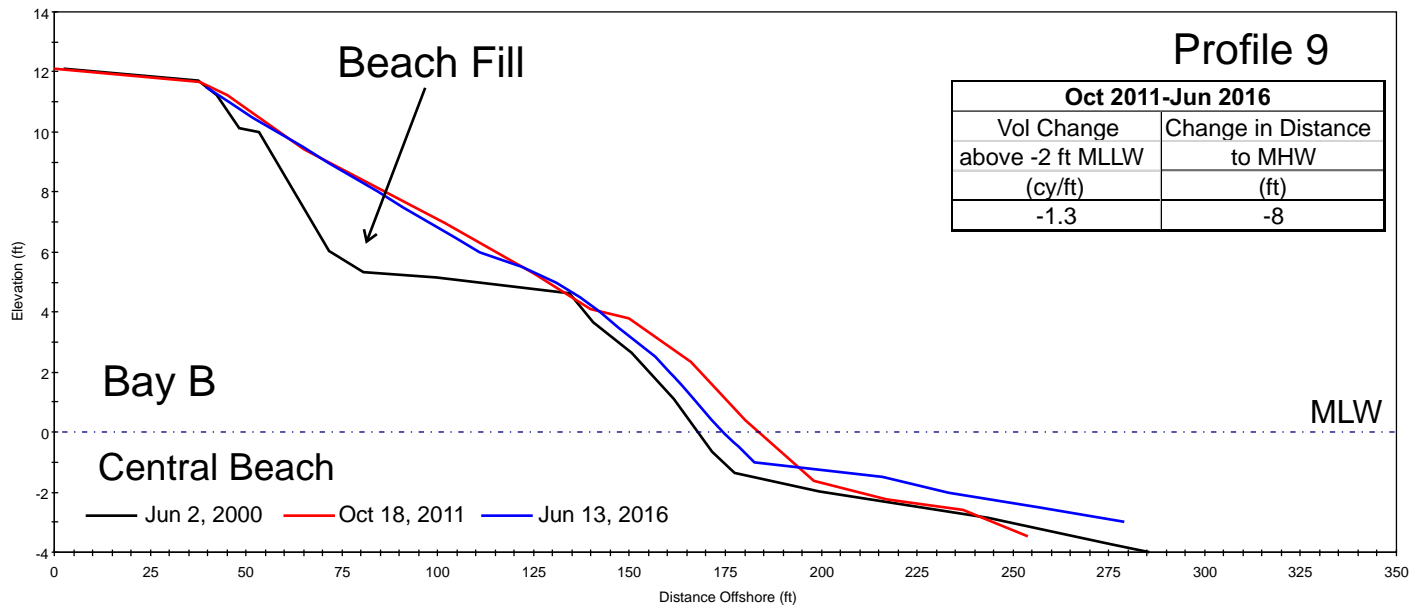
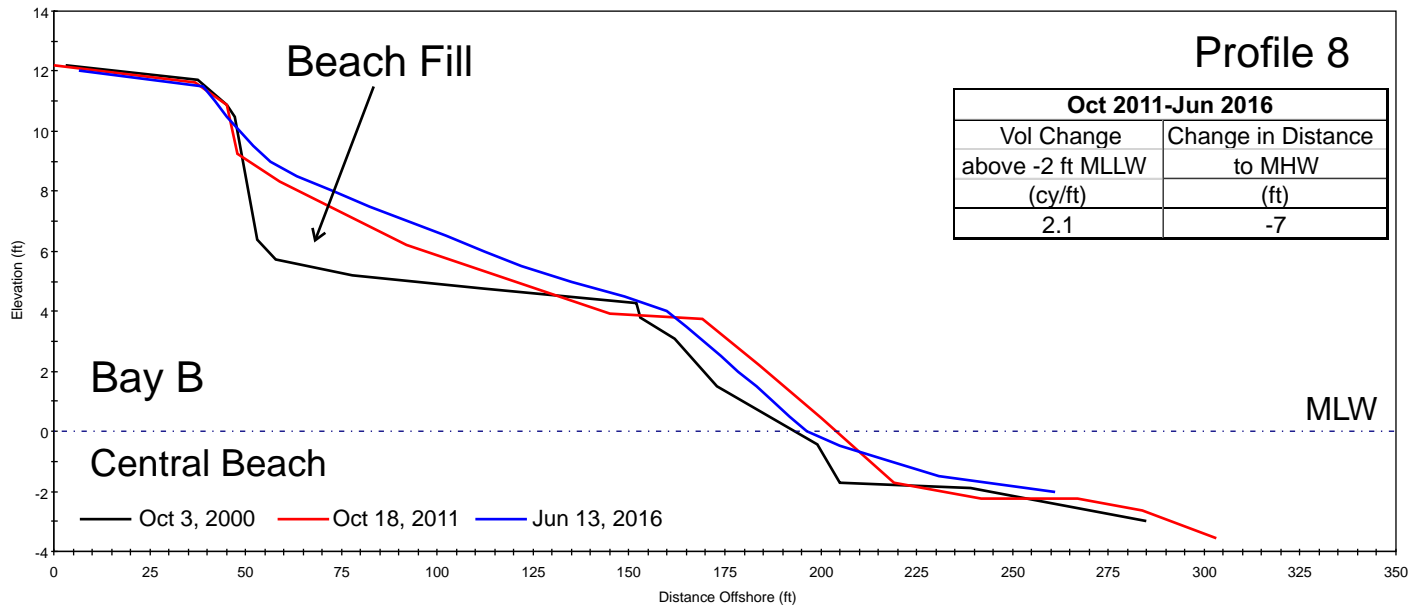
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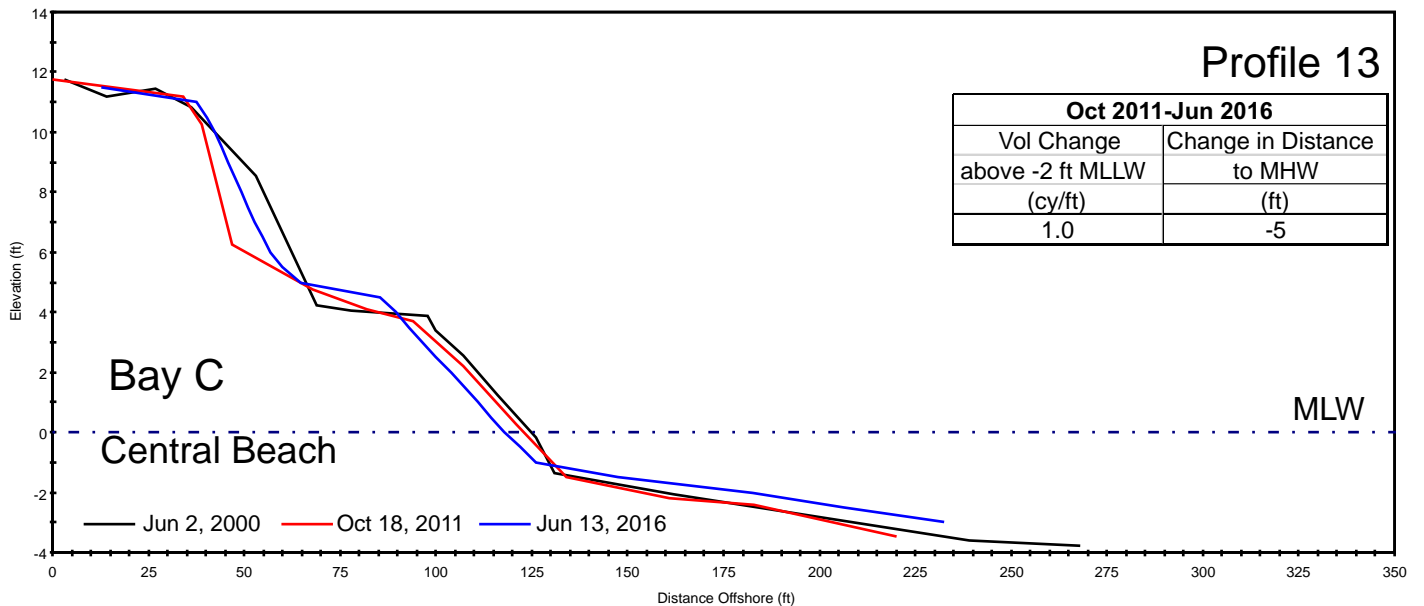
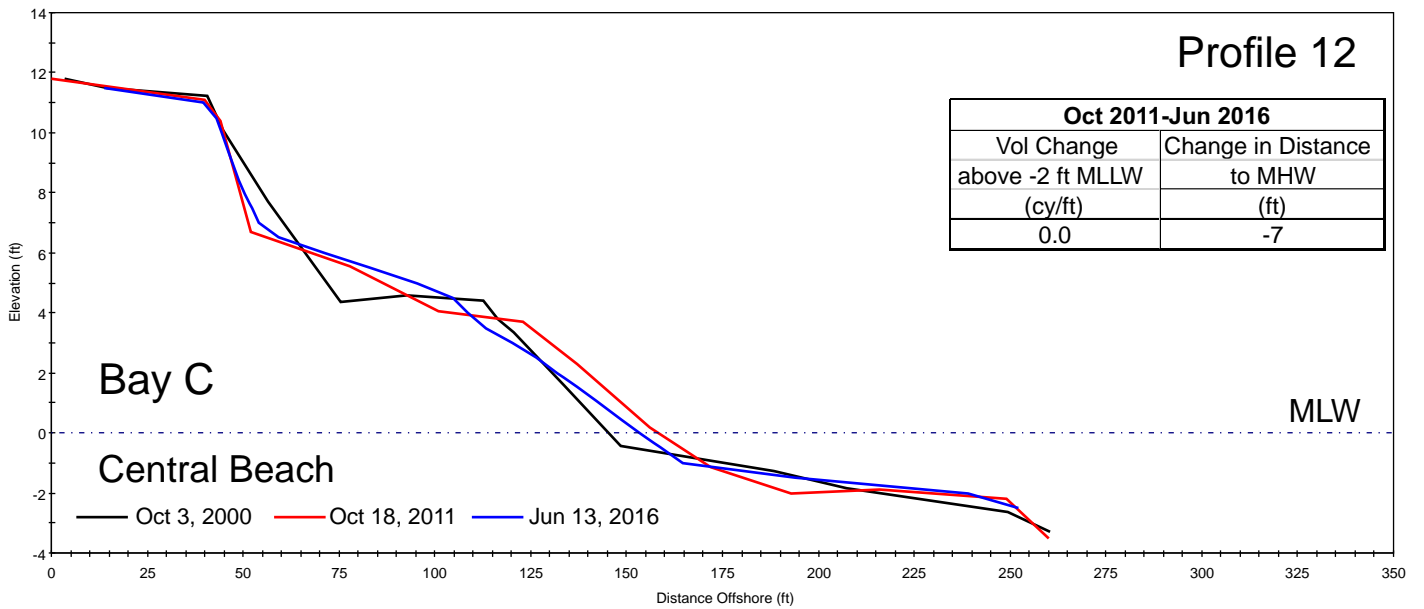
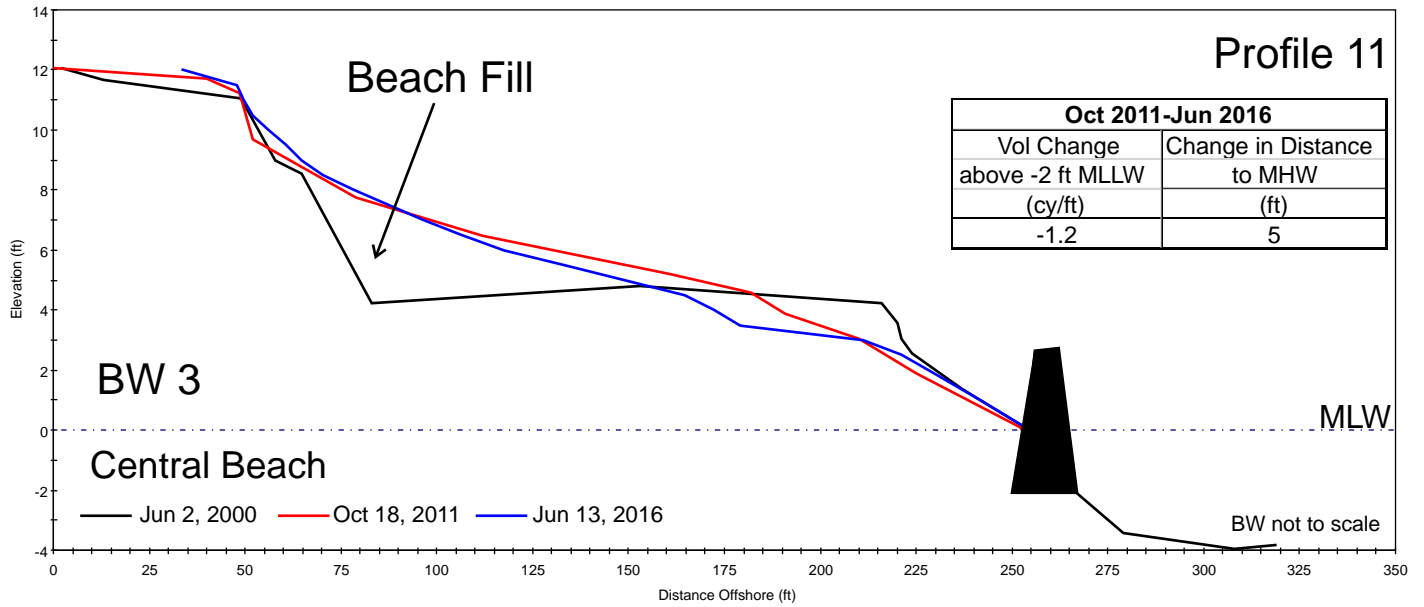


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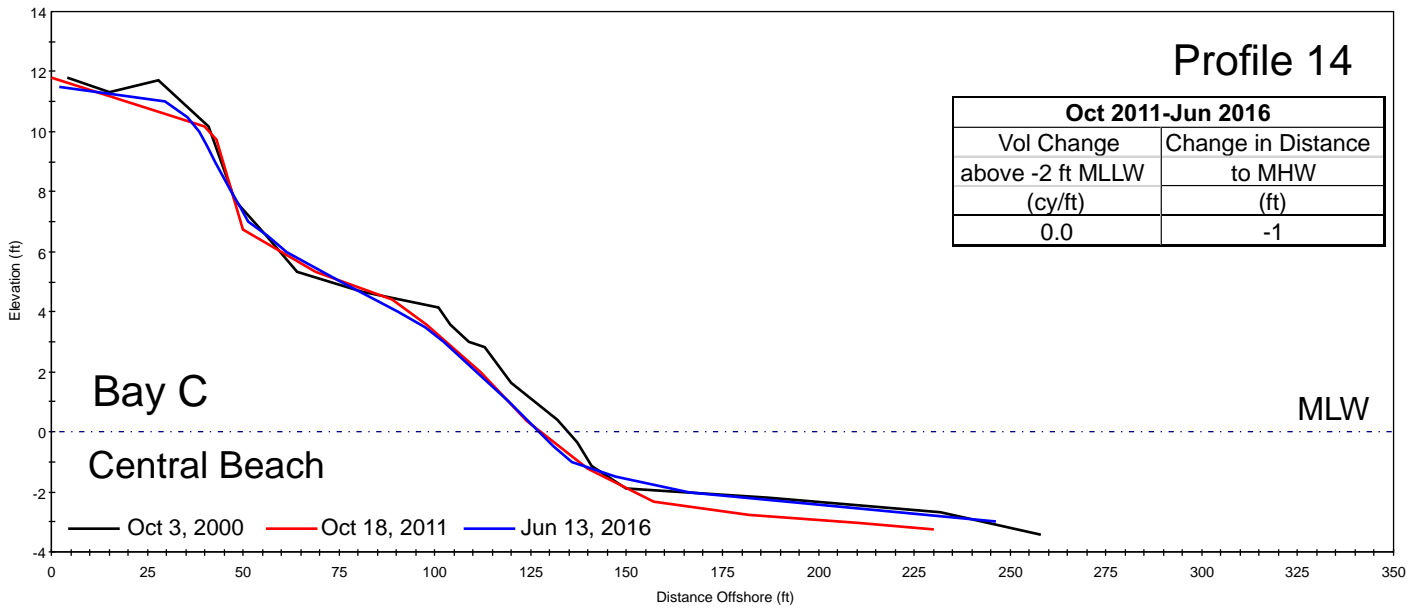




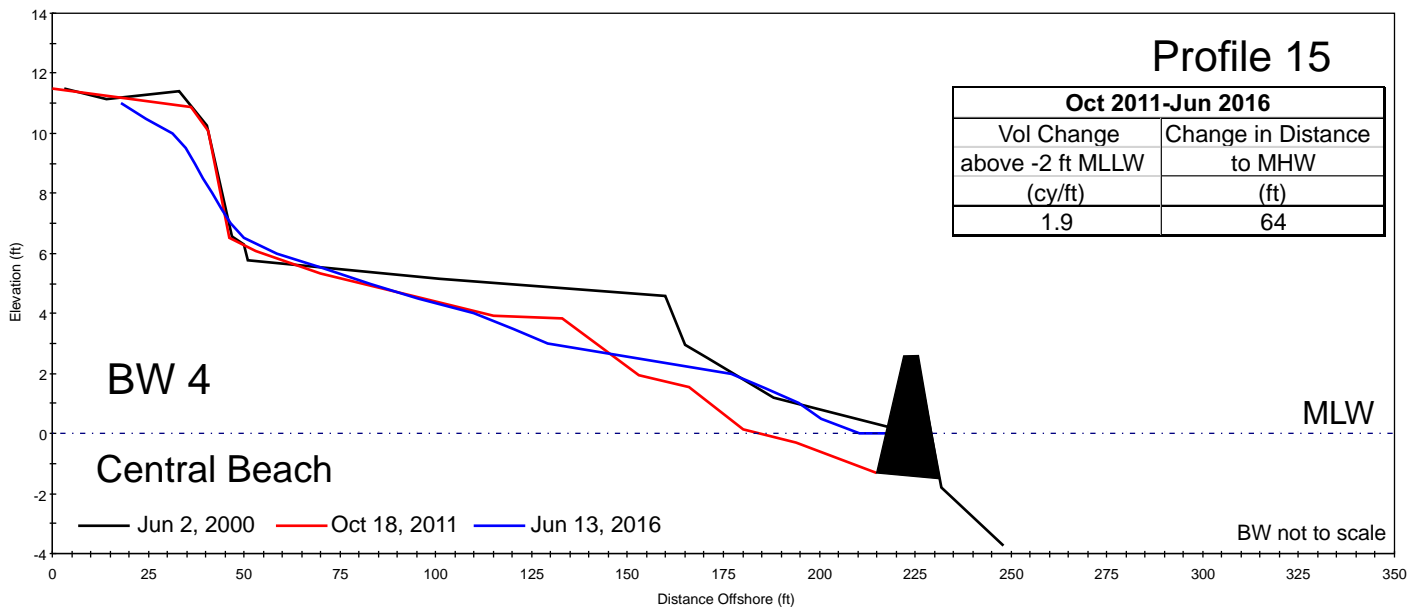




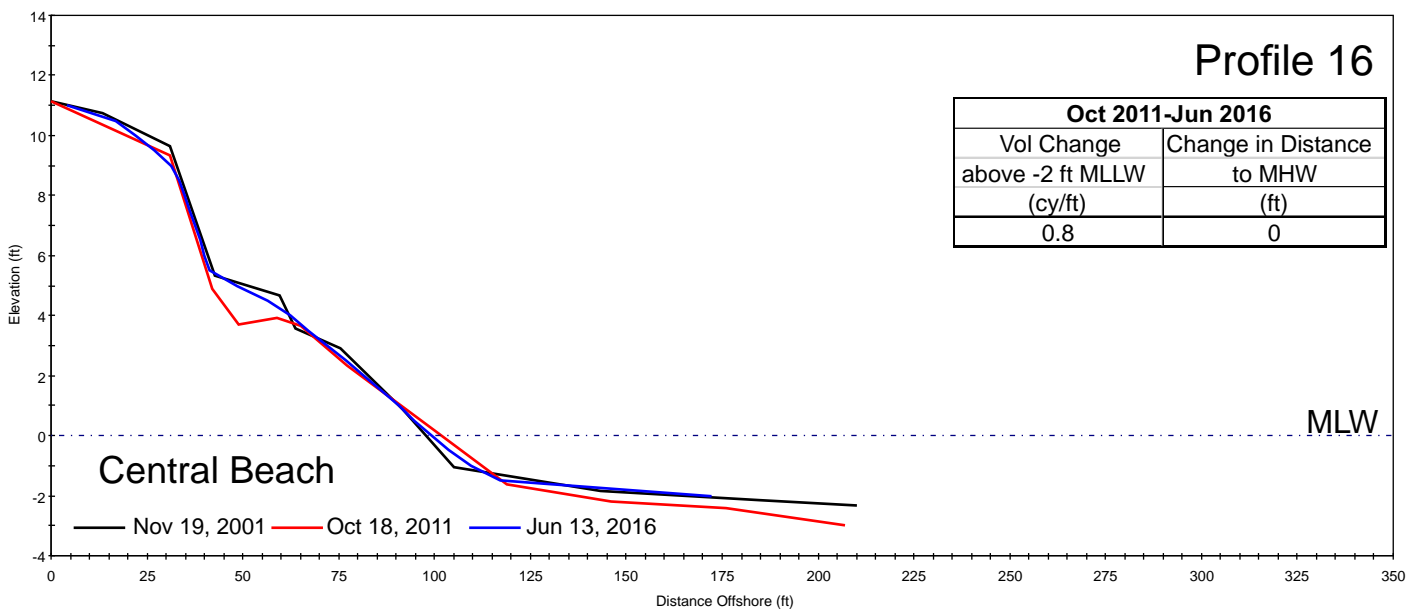
Profile 14



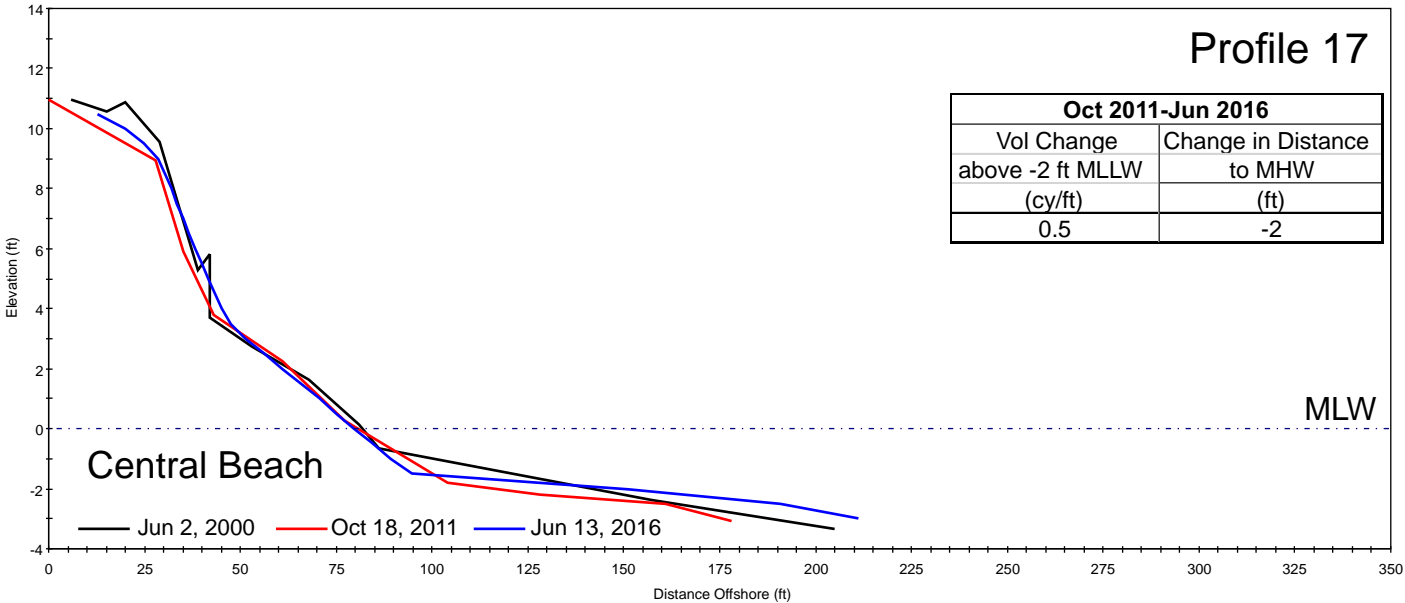
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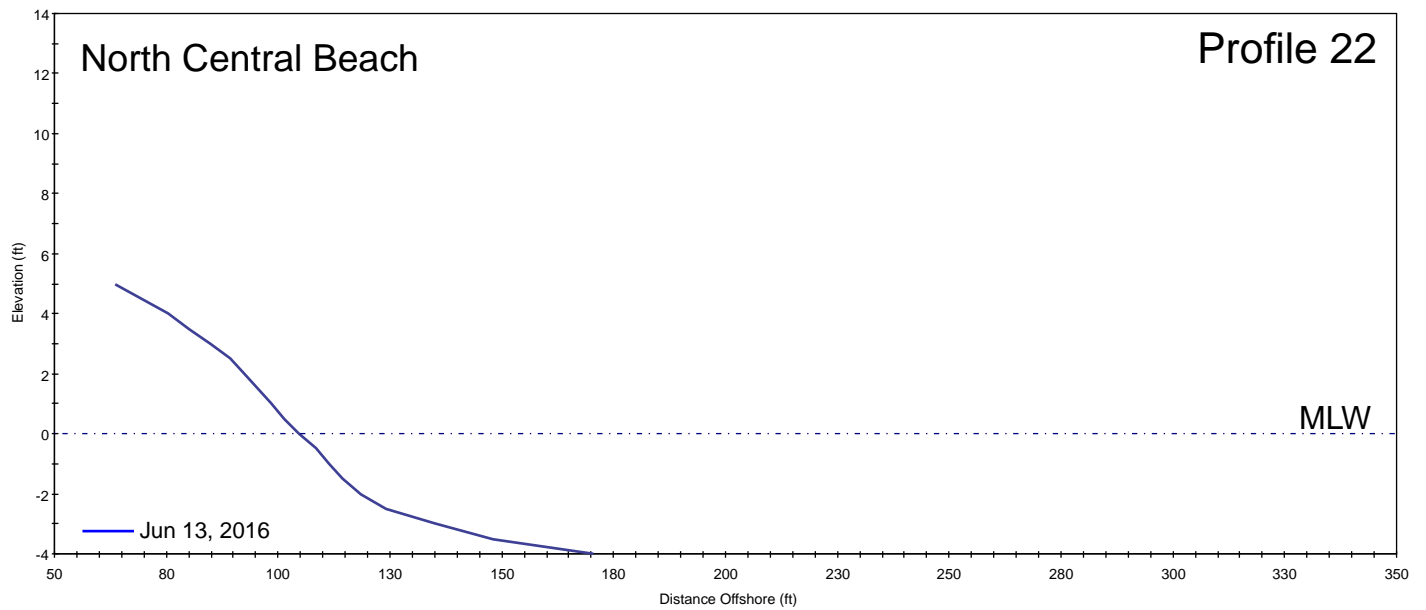
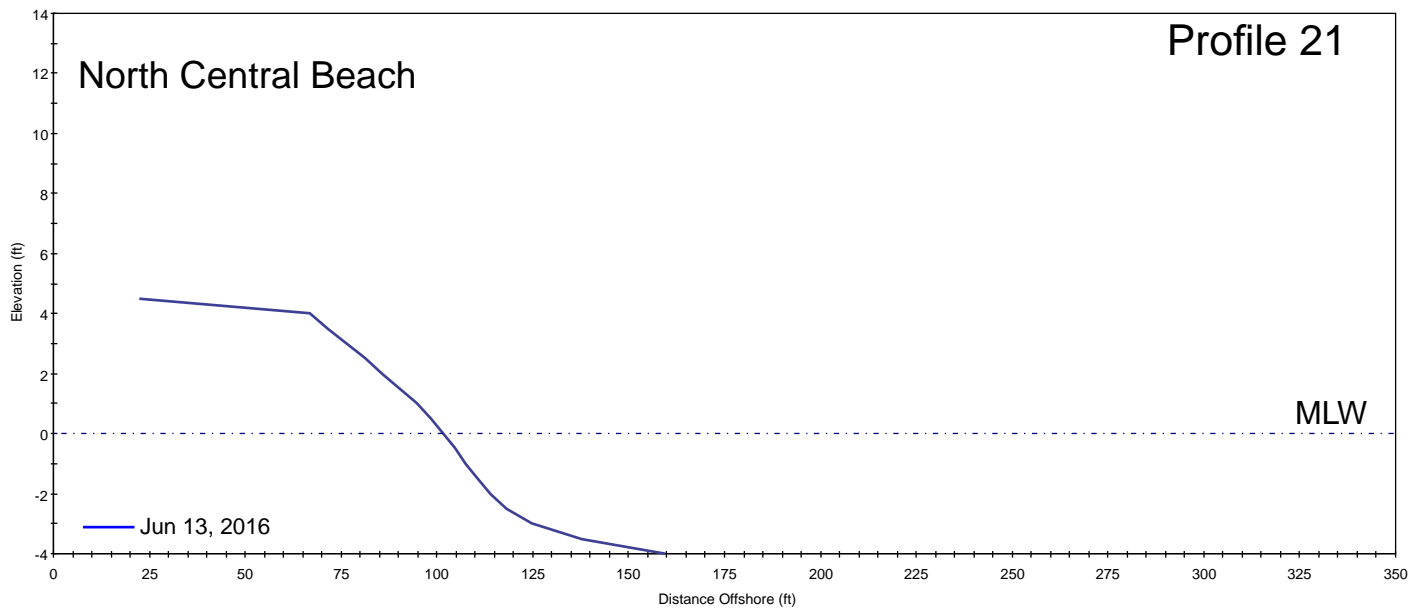
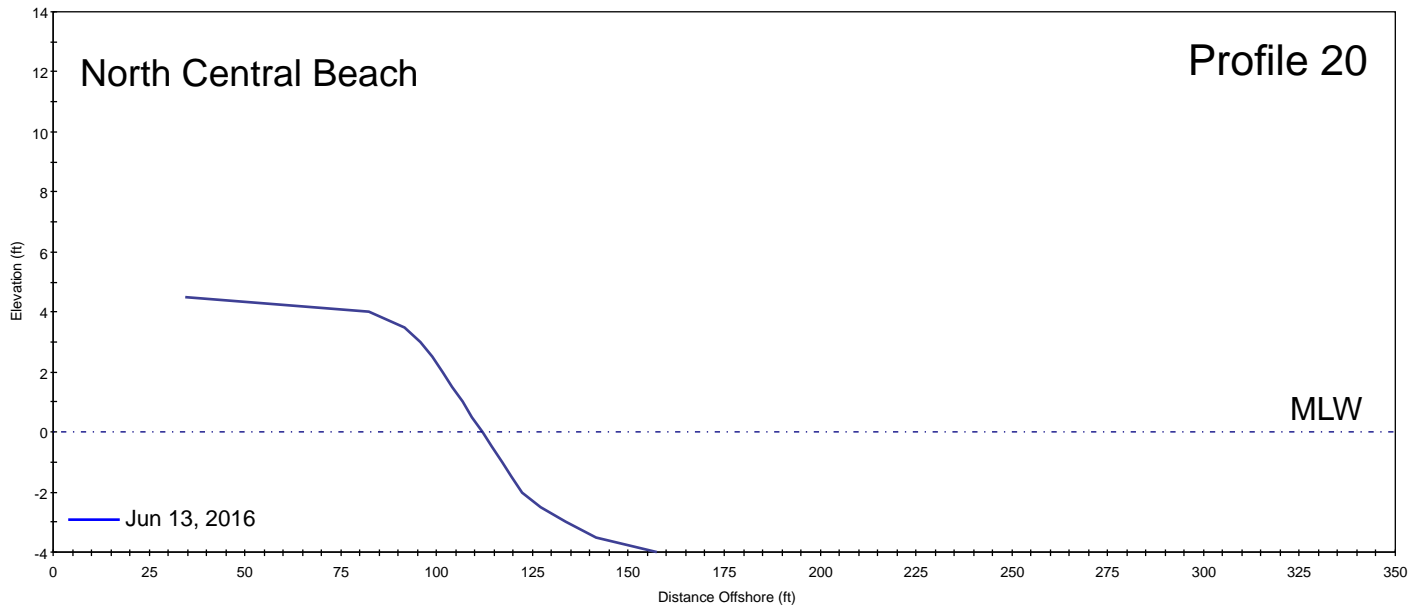


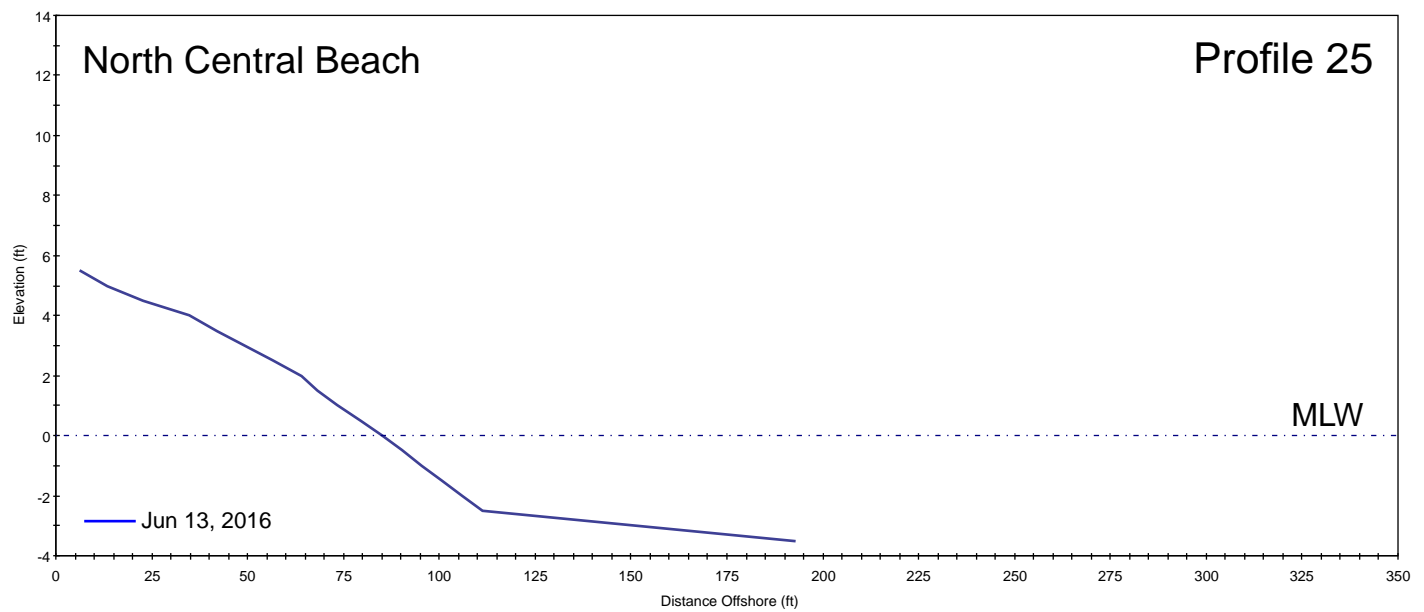
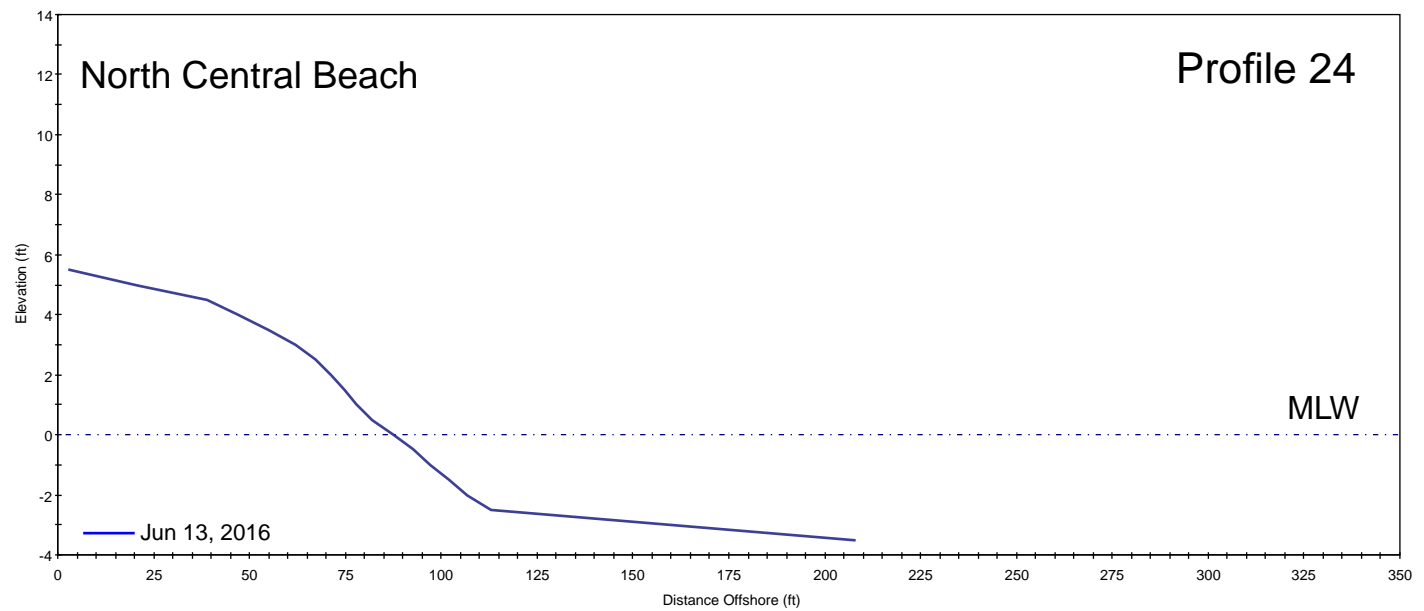
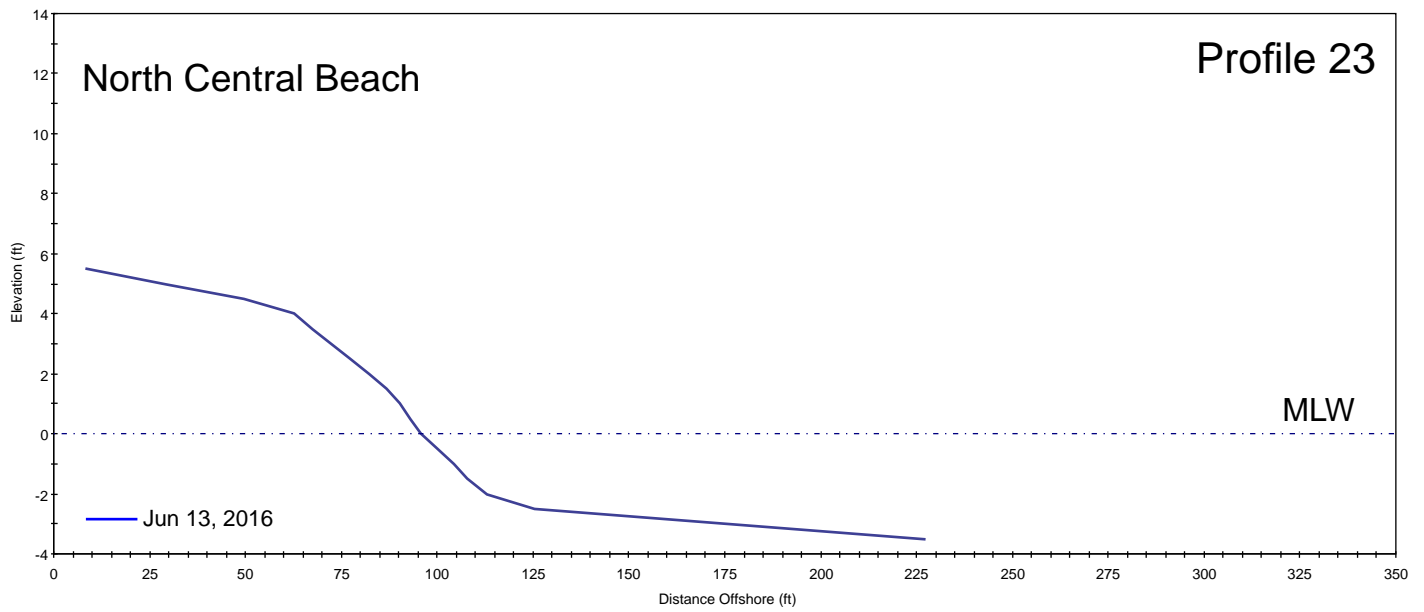
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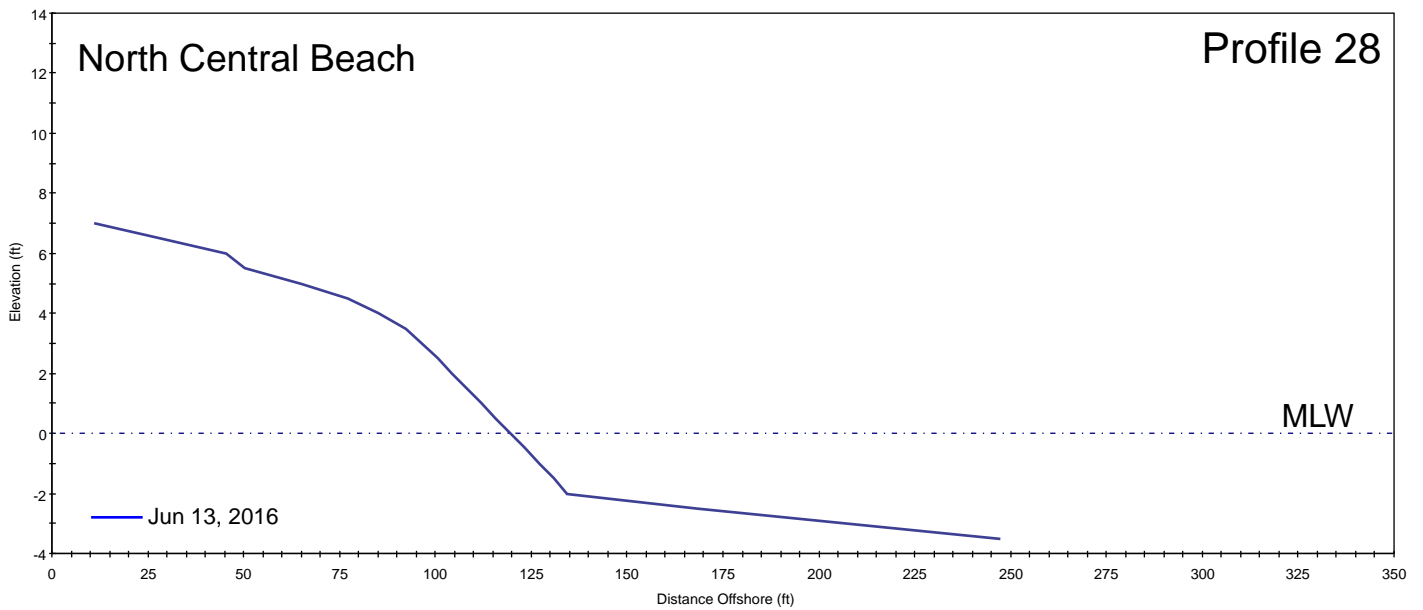
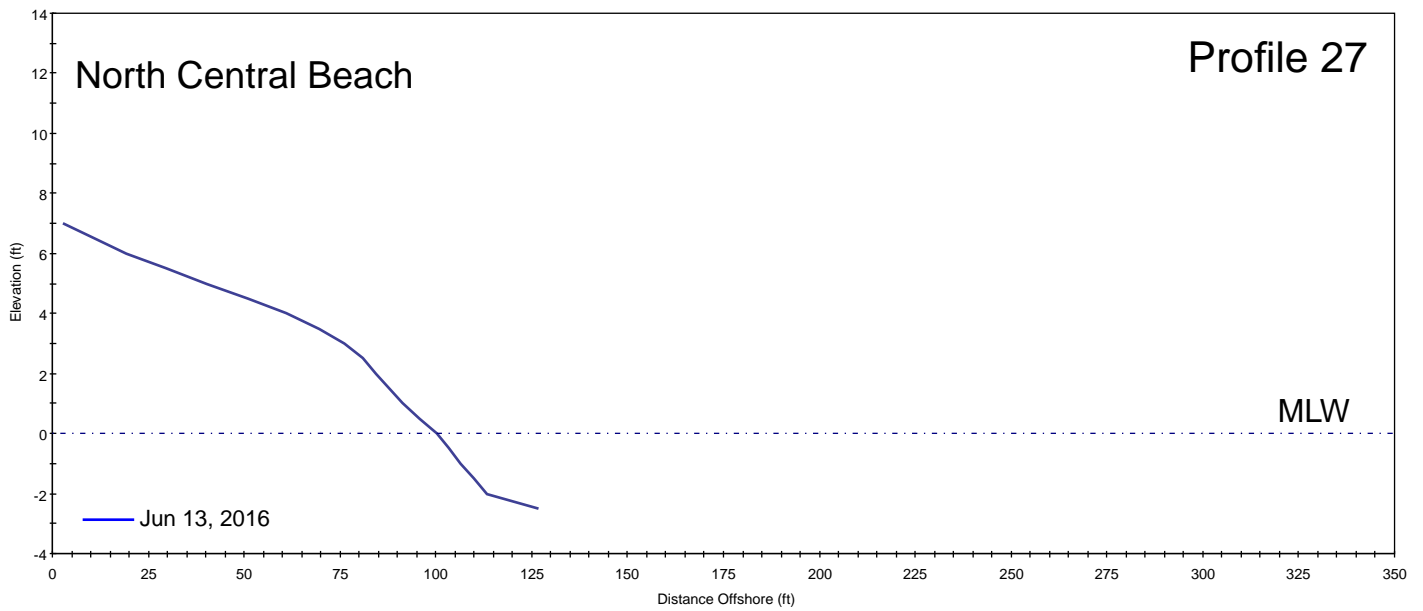
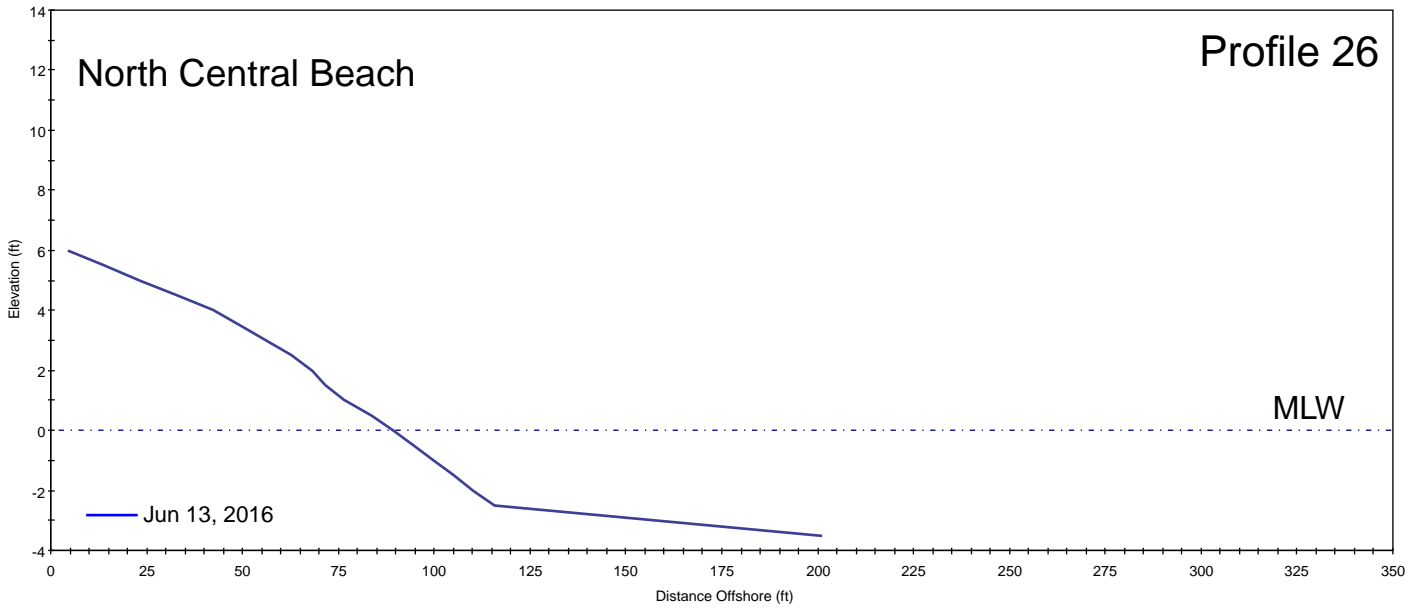


Profile 17



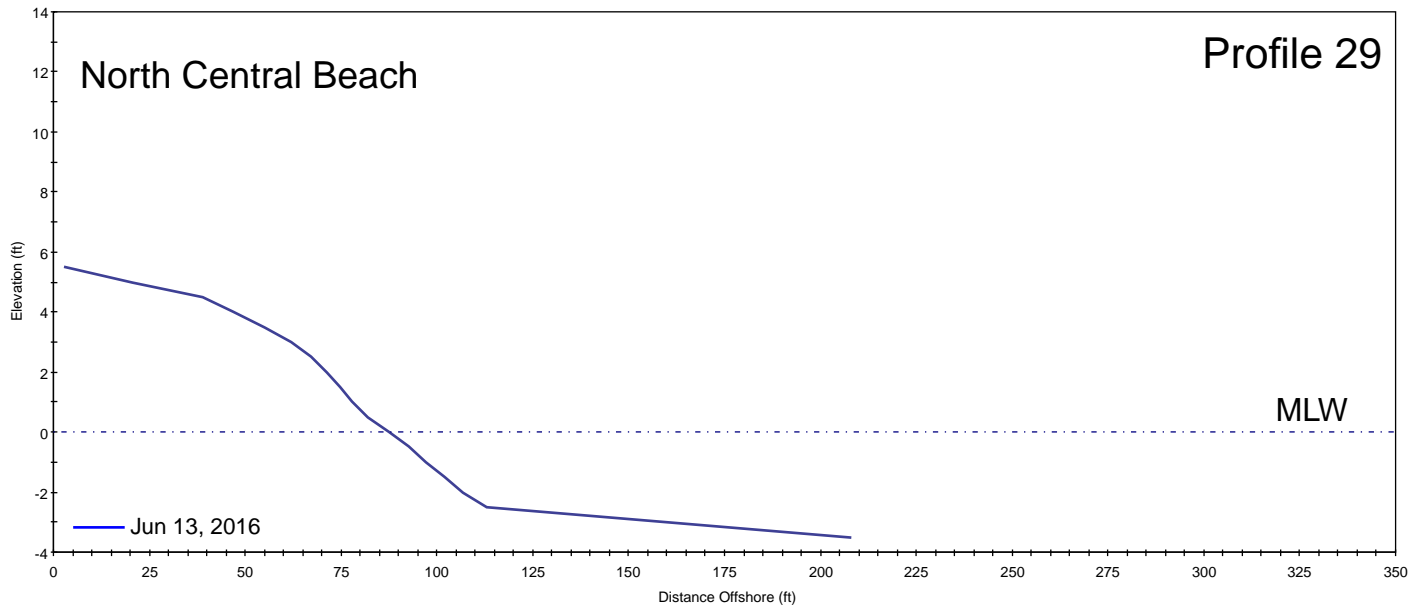






North Central Beach

Profile 29



Central Beach 13 June 2016



Looking south toward BW 1.



Beach and backshore north of
BW 1



Looking south along Central
Beach toward BW 1.

Central Beach 13 June 2016



Sand tombolo behind BW 2.



Bay C between BW 2 and BW 3.



Looking north along Central Beach toward Bay C and BW 3.

Central Beach
13 June 2016



BW 4



Looking north toward Bay C
and BW 3.

Central Beach North 13 June 2016



Looking south along Central Beach North. The grain size is very large along this section of beach.



A rock groin extends into the water at the northern boundary of Central Beach North.



The shoreline sediment along the northern section is very large-grained.

Central Beach North 13 June 2016



Old pilings in the water offshore.



Sand backshore extends landward to the sidewalk.

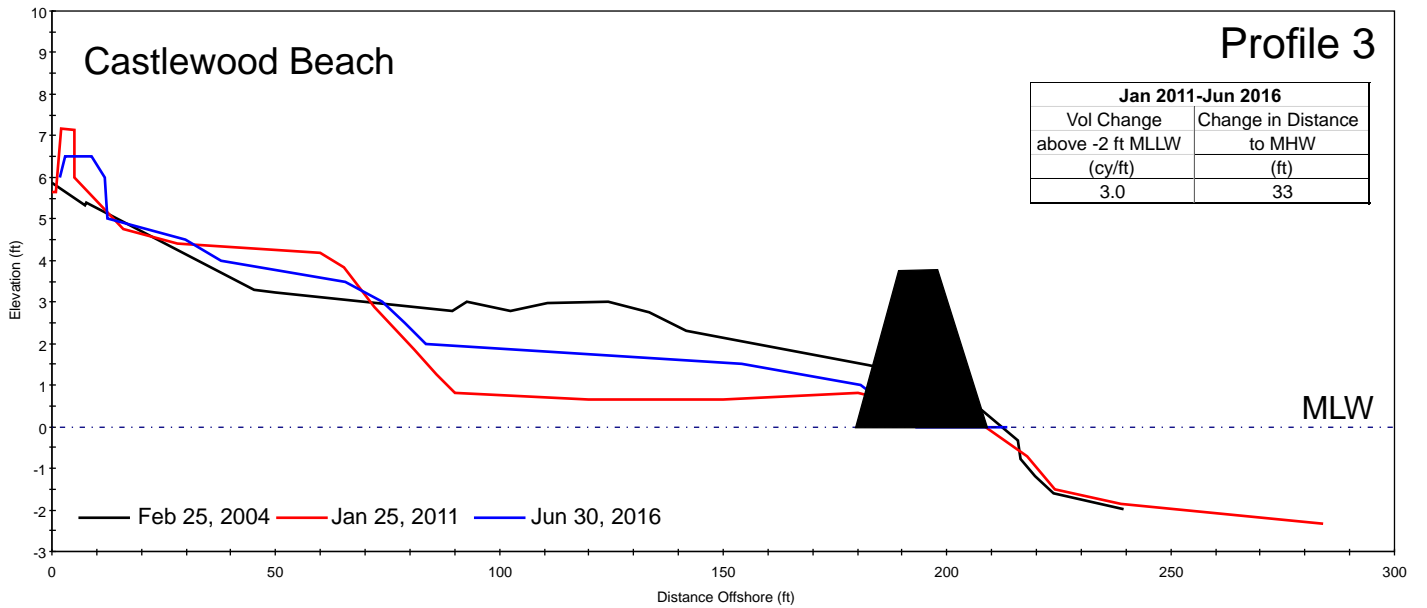
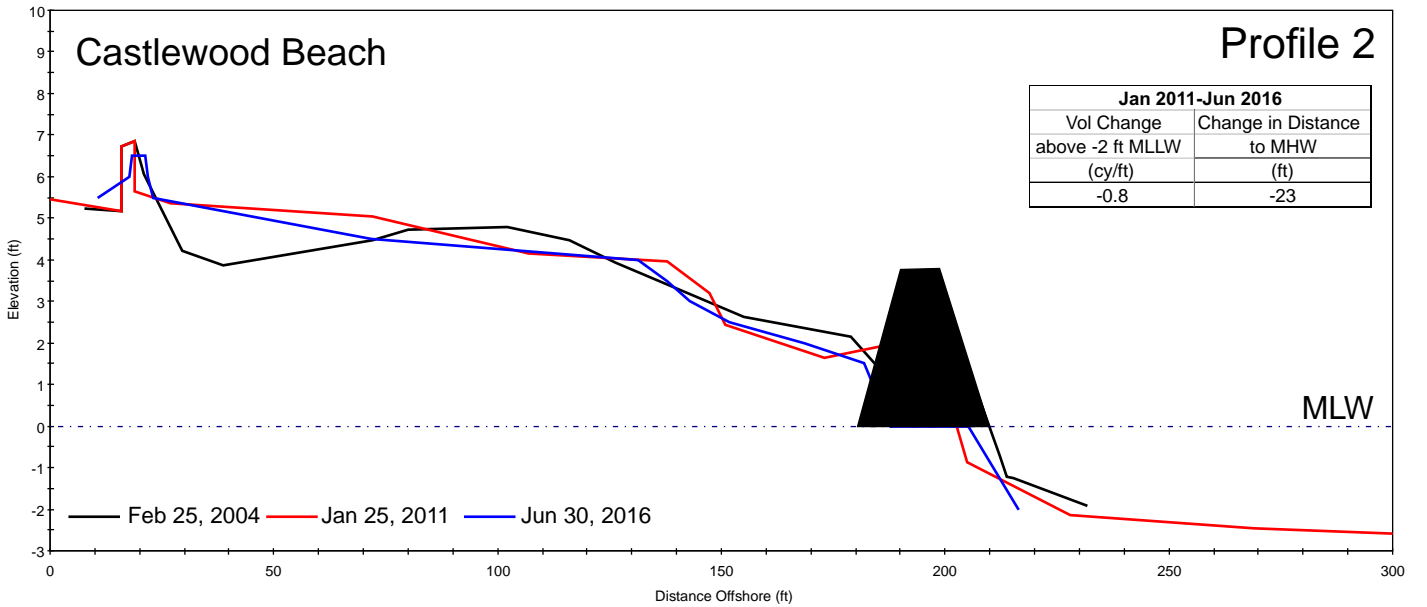
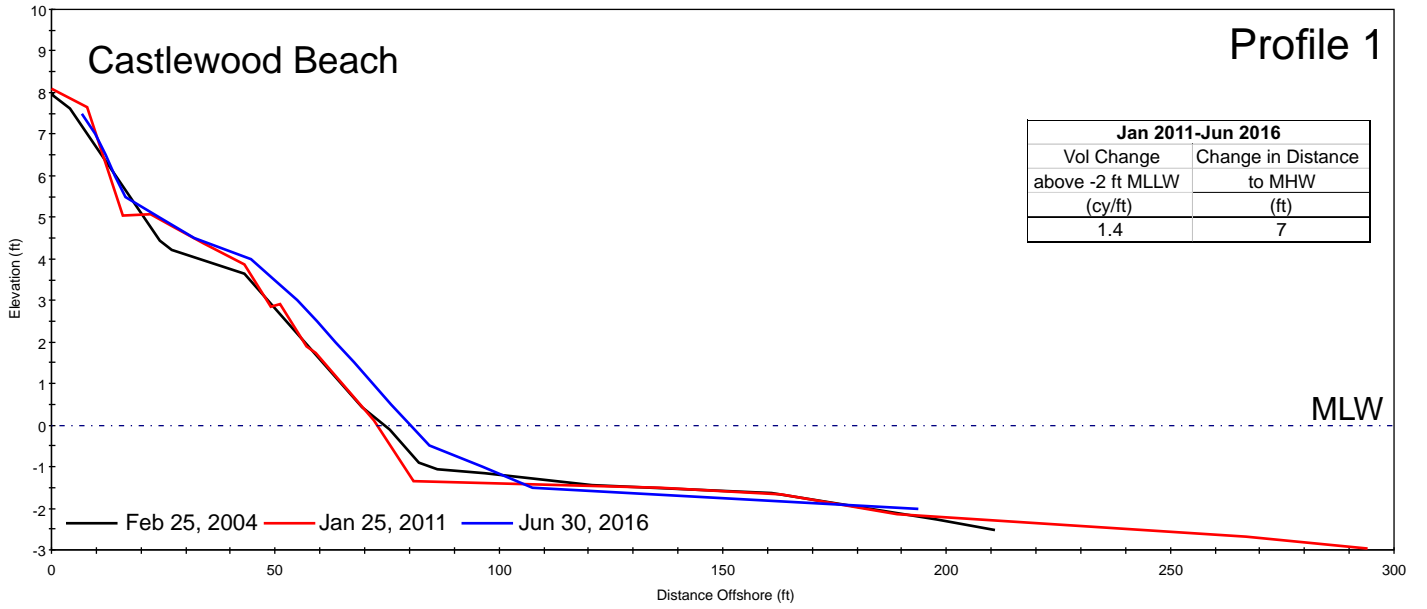


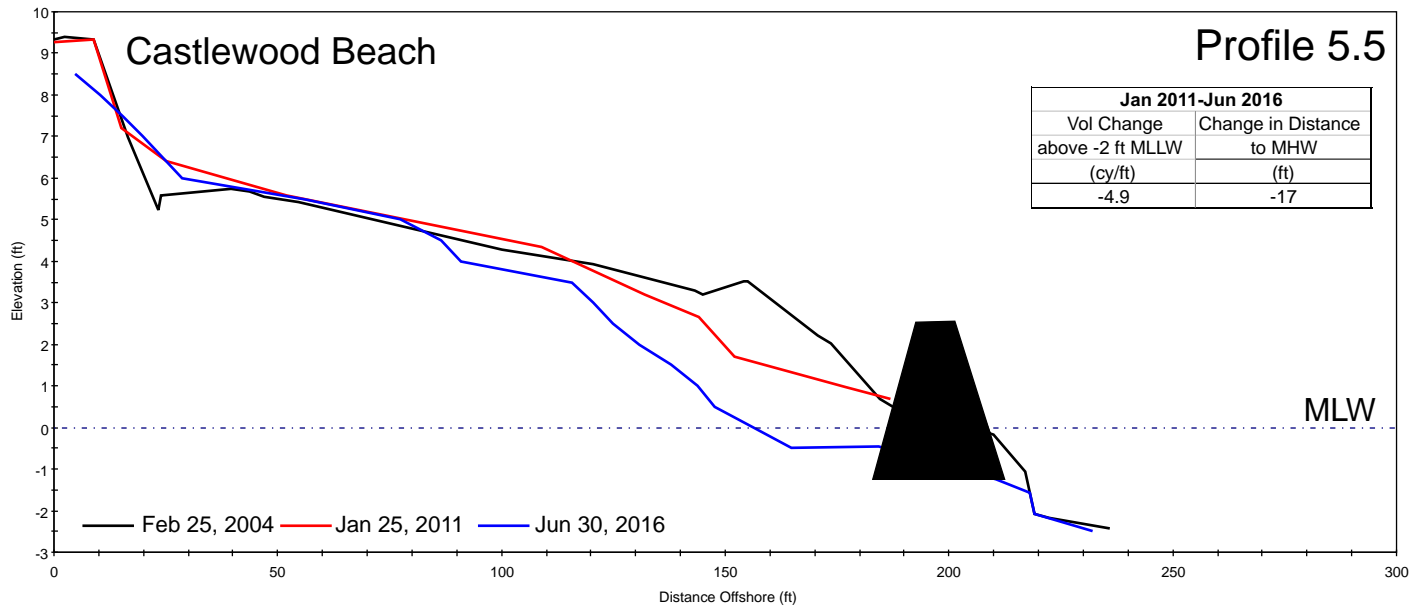
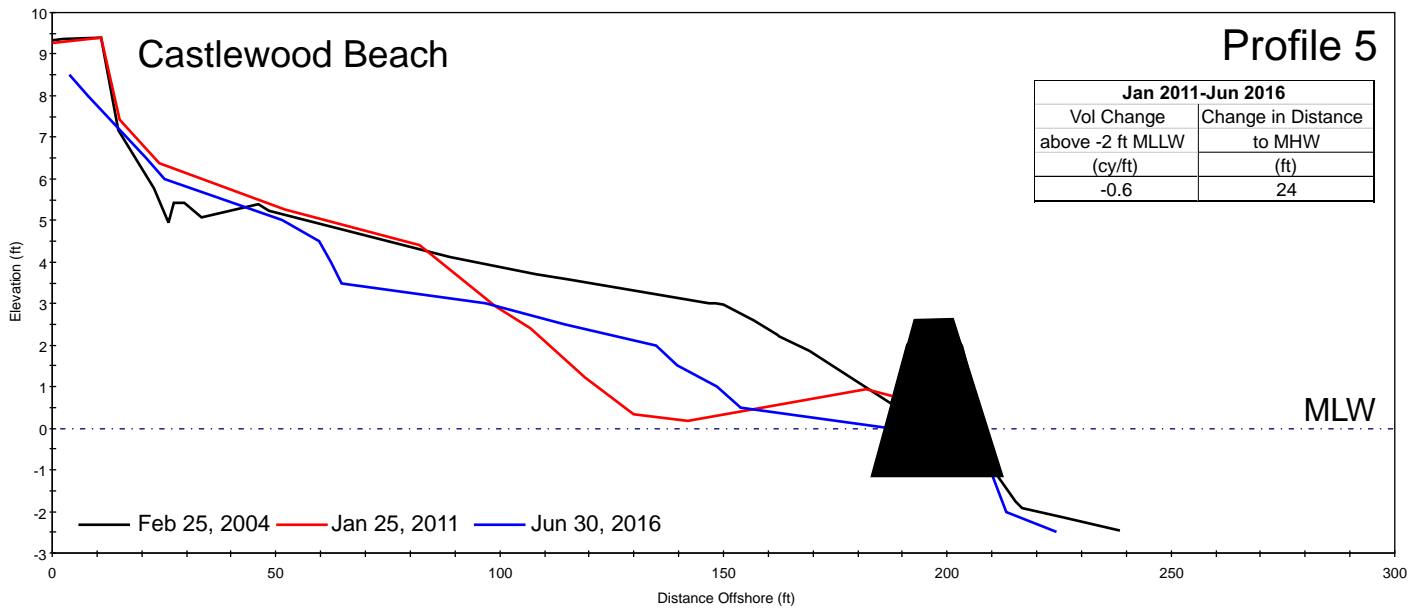
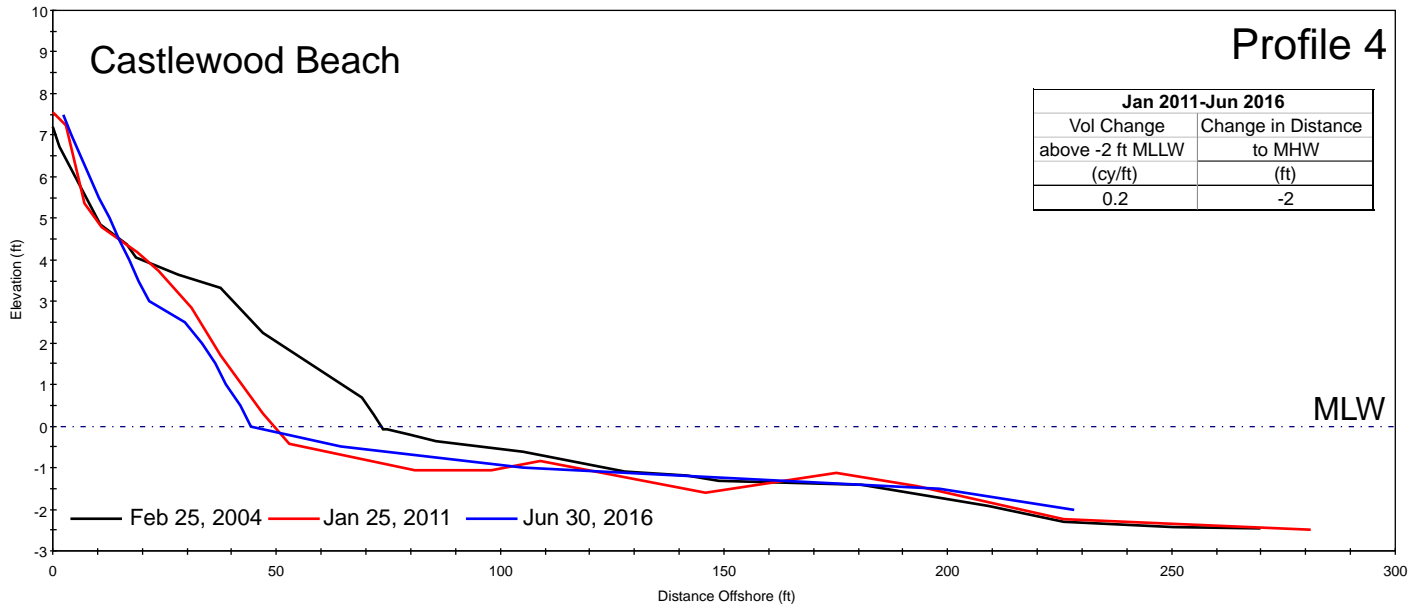
Looking north along Central Beach North toward the County pier.

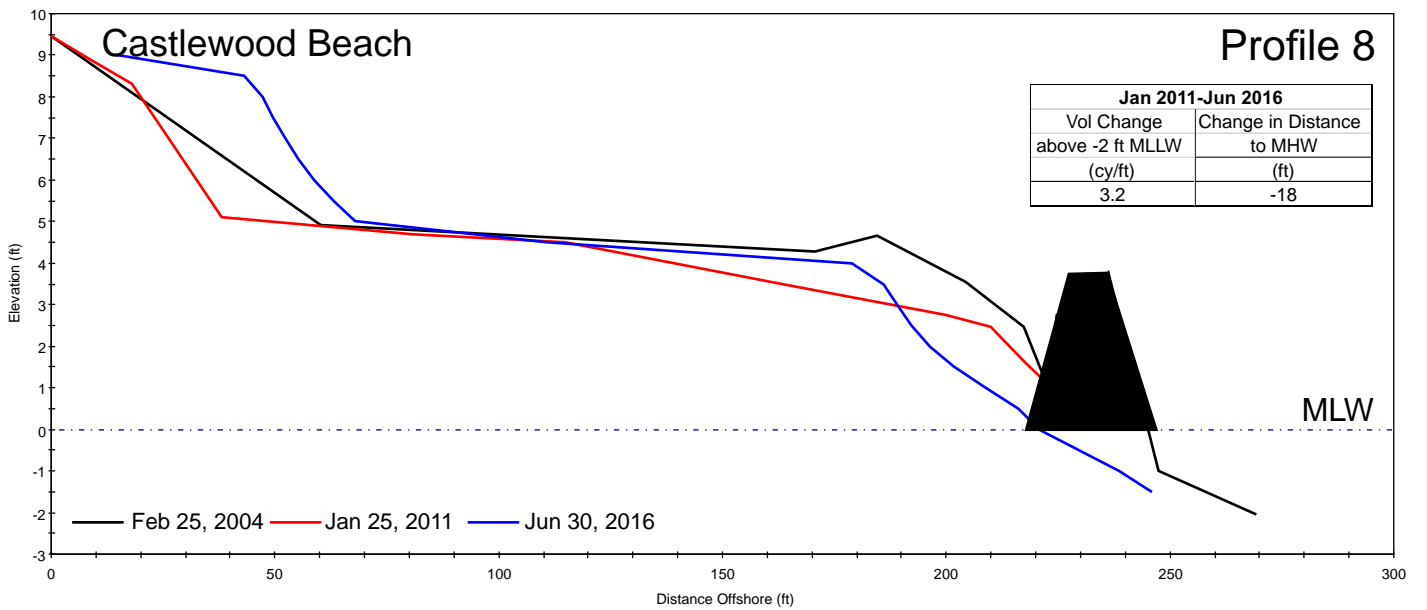
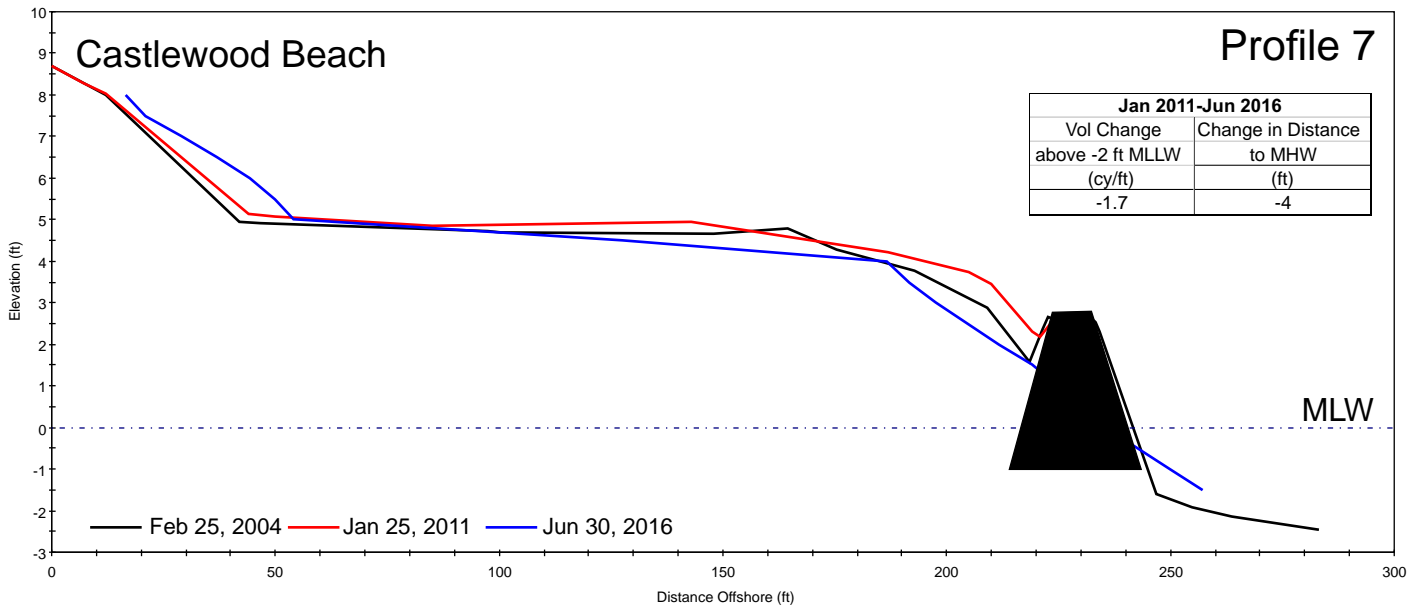
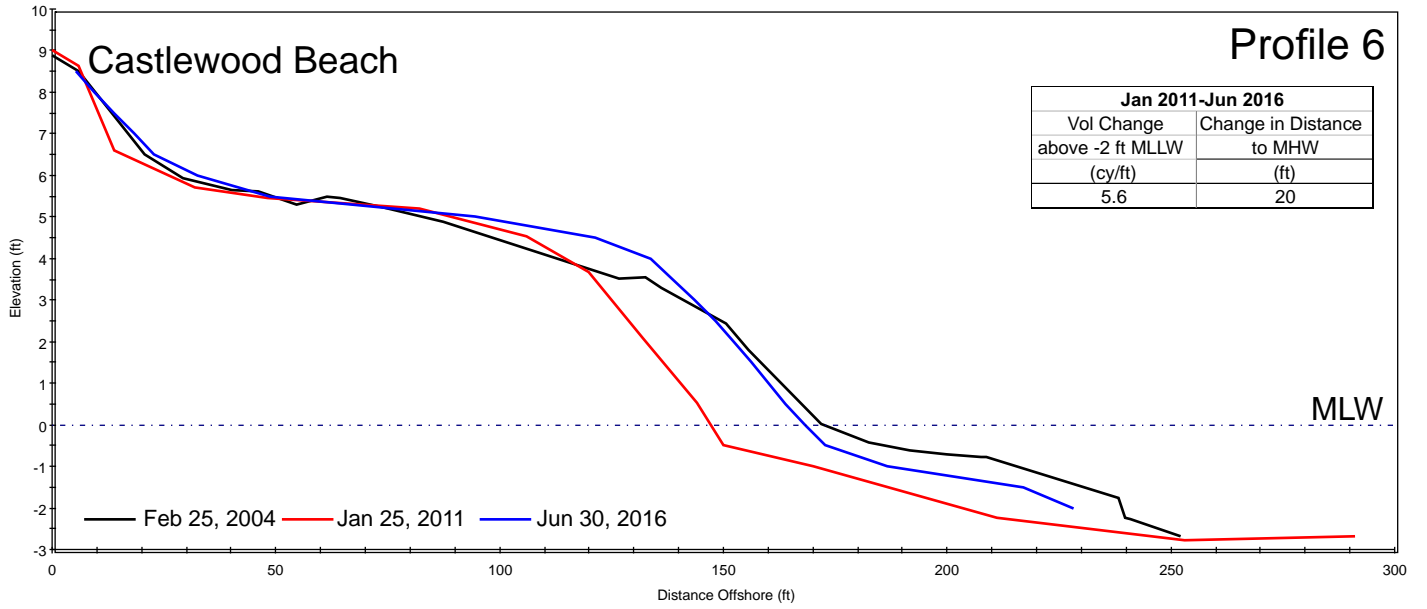
Appendix B

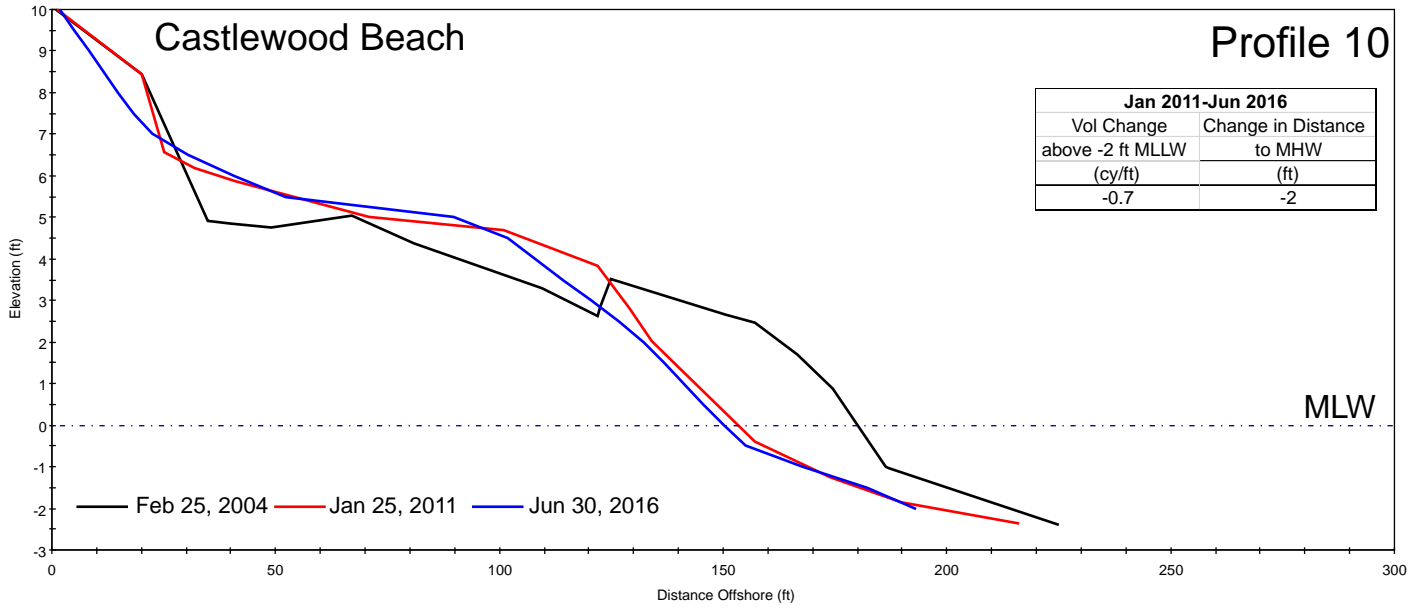
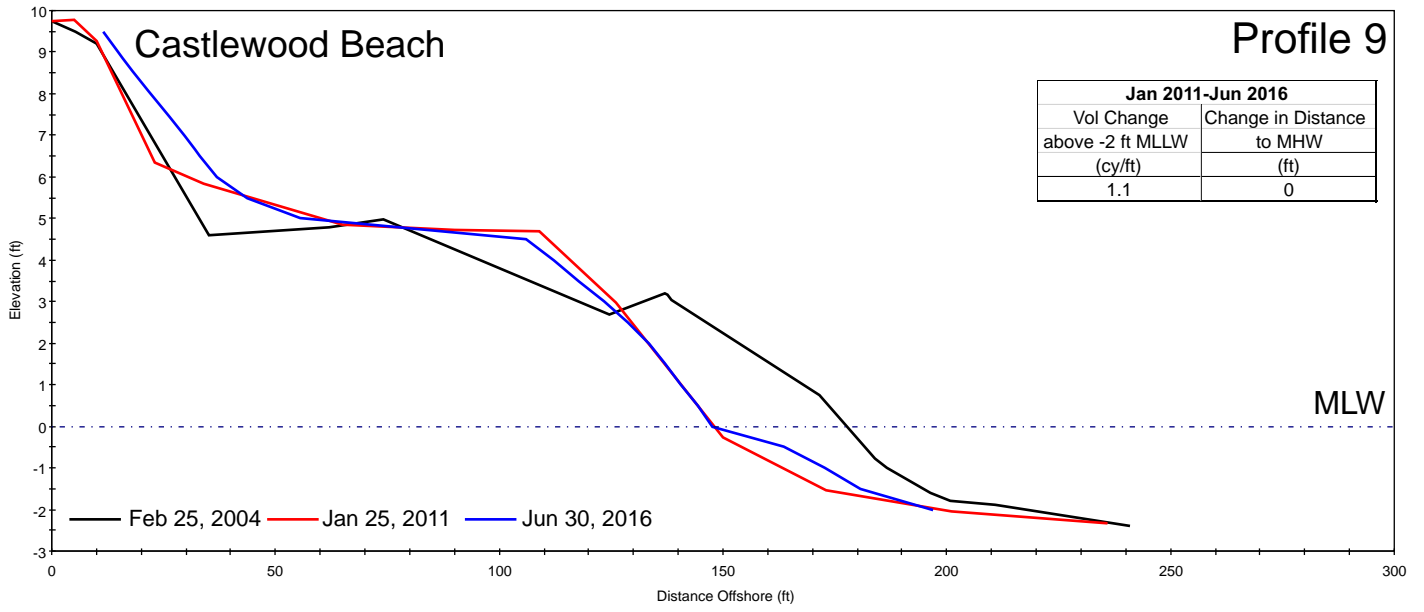
**Survey data from February 2004, January 2011, and June 2016 for Castlewood Beaches in the
Town of Colonial Beach, Virginia**

Photos taken in June 2016









Castlewood Beach 30 June 2016

Looking south along the wide backshore on the southern end of Castlewood.



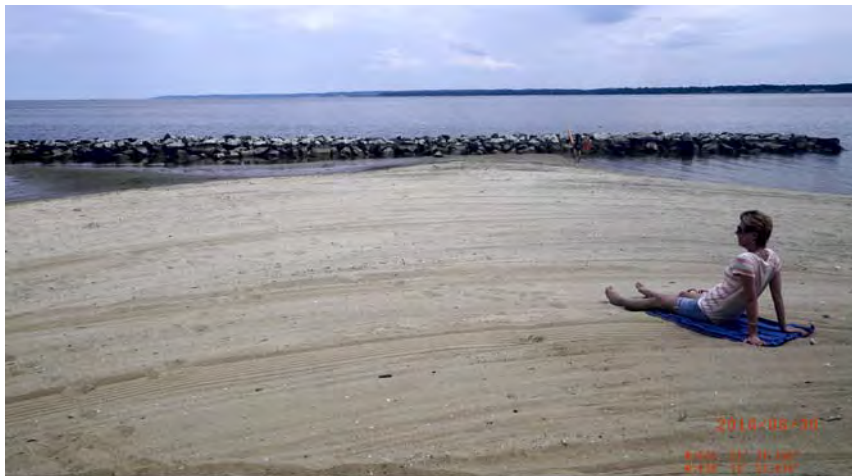
Looking north toward Bay A.



Small Bay B and BW 3.



Castlewood Beach 30 June 2016



Sand tombolo and the subaerial sand attachment behind BW 2.



Bay A



The beach along the center-most section of Bay A is narrow.

Castlewood Beach 30 June 2016



Gabion basket wall along the road behind BW 1.



Vegetation behind BW 1 and in the backshore along the road and gabion basket wall.



Northern end of Castlewood Beach north of BW 1

Castlewood Beach 30 June 2016



Looking south along the road and backshore from the northern end of the beach.



Northern end of Castlewood Beach where the sand tapers into a stone revetment.