South Padre Island Beach and Dune Assessment Project

April 2021 Progress Update

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Summary Overview:

Subcontracts

- The work order with BIO-West fully processed and approved
- Naismith Marine is tracking weather and actively looking for a survey window

Task 1

- Shorelines and shoreline change results received from BEG
- Shoreline change – initial analysis of time series from 1930s-2020 and 2000-2019
- Dune crest and toe morphologic change analysis
- Beach volumes – began initial analysis
- Analyzed lidar surface subtraction for entire study area
- ASBPA abstract

Progress Narrative: Shoreline Change

Long-term shoreline change data that were generated as part of an updated shoreline change assessment for the entire Texas coast were obtained from GLO-BEG. The analysis for this project refines the previous study by focusing in on patterns and trends of change only within the boundaries of the study area (the City of SPI). It also assesses changes of the shoreline in conjunction with the time series of beach profiles from which dune crest and toe elevations, beach width and beach volumes were extracted.

The initial findings of the long-term (1930s-2019) shoreline change analysis identify a distinct pattern, previously described by Morton (1993), of high rates of erosion in the northern portion of the study area (CBI profiles 17-25), generally stable in the central portion (CBI profiles 13-16), and the southern section primarily accretional (Figure 1).

In the most recent decade (2000-2019) the rates of change vary more along coast, which correspond to beach nourishment or offshore sand placement (Figure 3). The pattern is variable along coast, with erosion hotspots in the very northern portion of the study area (beyond the extent of the CBI profiles), accretion or low erosion rates (< 0.9 ft/yr) along much of the central portion of the island (CBI 9-25) and an area of moderate erosion (-0.4 - -1.4 ft/yr) along the coast from CBI 5-9. South of this erosional zone, the shoreline becomes accretional to the inlet jetty.

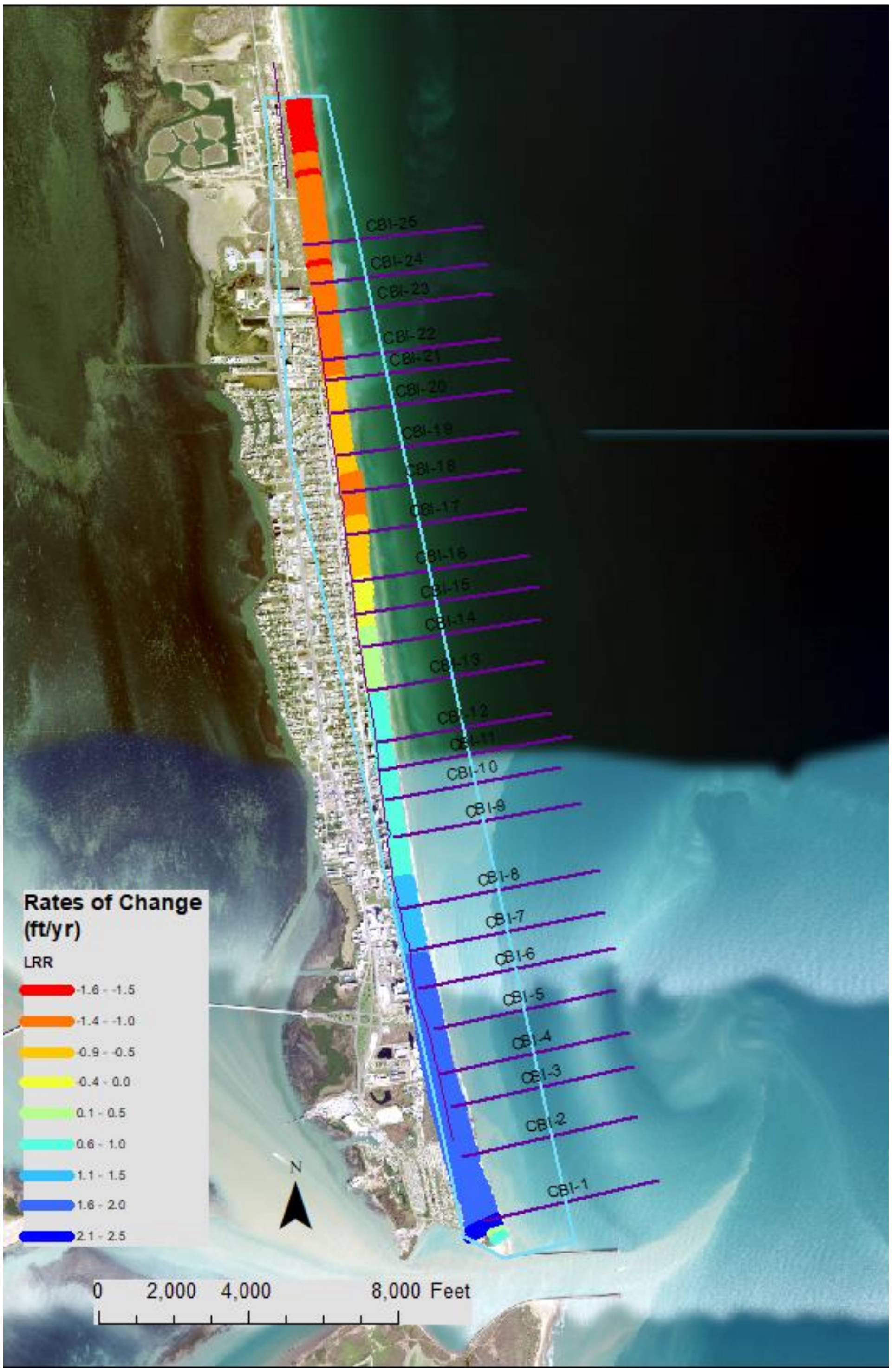

Figure 1. Long-term rates of shoreline change in feet/year from the 1930s to 2019.

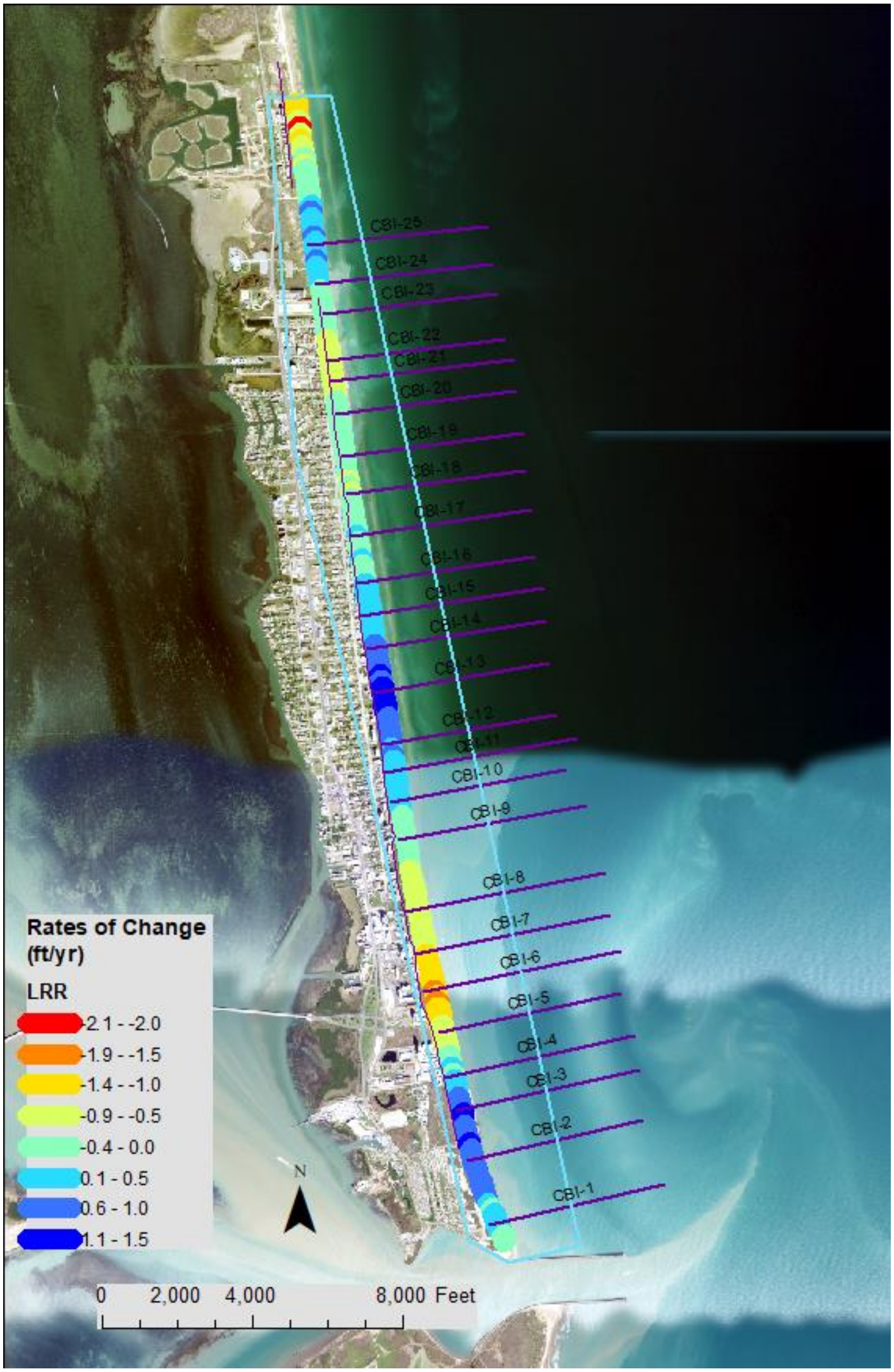

Figure 2. Short-term rates of shoreline change from 2000-2019

Progress Narrative: Dune Crest and Toe Time Series

Continued analysis of the beach-dune metrics examined the time series and explored possible reasons for particular pattern of change. From 1995 to 2006, the dune crest elevation was variable alongshore but stable through time with the exception of noticeable gains in elevation in the northern portion of the study area (CBI 16-25) and significant loss at CBI-1 and 2 occurring after 1995 (Figure 3). The elevation increase from the earlier dates (1995, 2002) to the 2005 and 2006 surveys is attributable to beach nourishment projects and dune reconstruction that took place in 2002, 2005, and 2006. The loss at the southern end of the study area is associated with removal of the dunes for public access and other recreational uses.

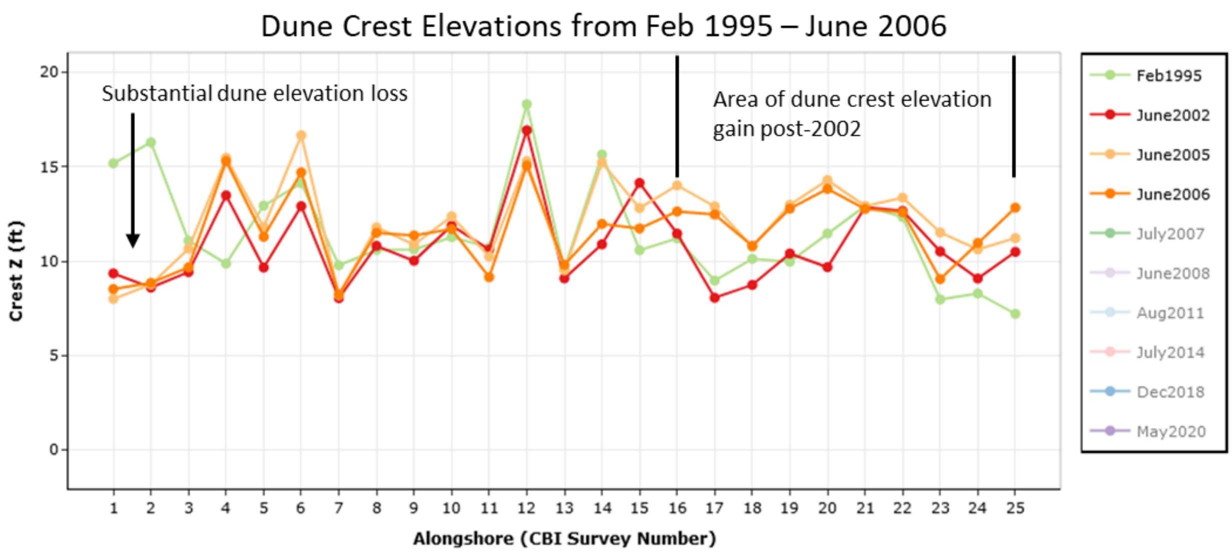

Figure 3. Alongshore dune crest elevations in the earlier time period of the study. Note that the dunes are relatively stable (not changing a lot through time) with the exception of elevation gains in the northern section post-2002 and substantial early loss after 1995 at CBI-1.

The time period with the greatest consistent change in dune crest elevation is a period of substantial loss between 2006 and 2011 (Figure 4).The average dune crest elevation in 2011 was lower than any other period of time, at 9.4 ft. Although there were beach nourishment projects in the years between 2006 and 2011, two hurricanes impacted SPI in that time period (Hurricanes Dolly and Ike in 2008) resulting in extensive erosion of the beach and dunes.

After 2011, regular beach nourishment projects, both on the beach and dunes, and in the offshore area resulted in consistent and sustained increase and stabilization of the dunes (Figure 5). The dune crest elevations did approach 2011 levels at a few specific locations (i.e. CBI-2, 11 and 13), but overall the dunes remained robust.

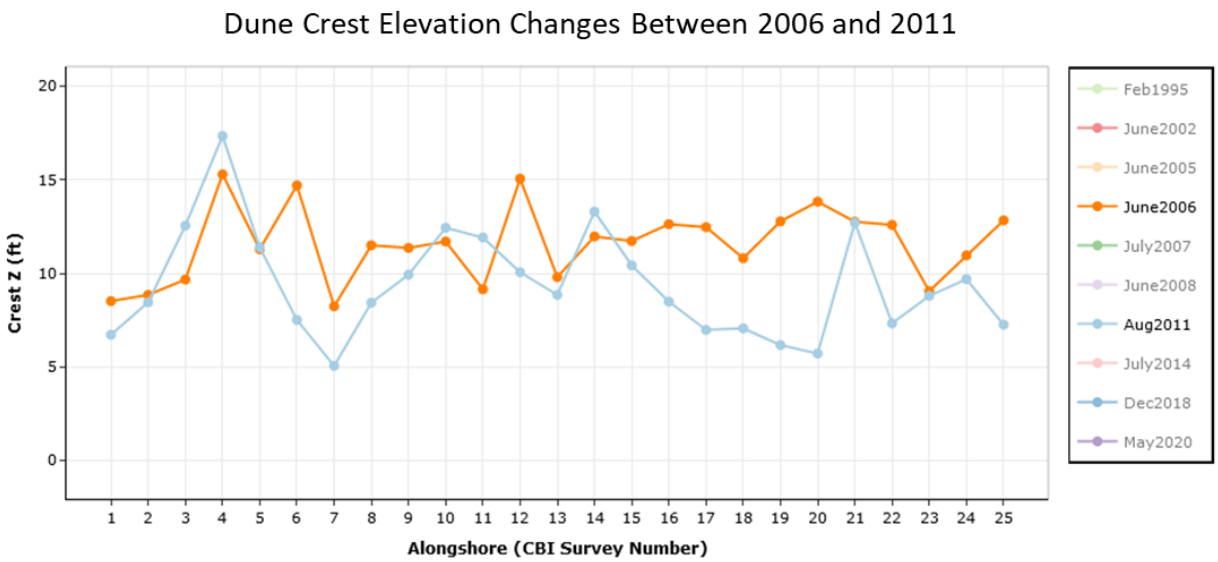

Figure 4. Alongshore dune crest elevation changes between 2006 and 2011 showing the highest dune losses for any period of time over the study time series.

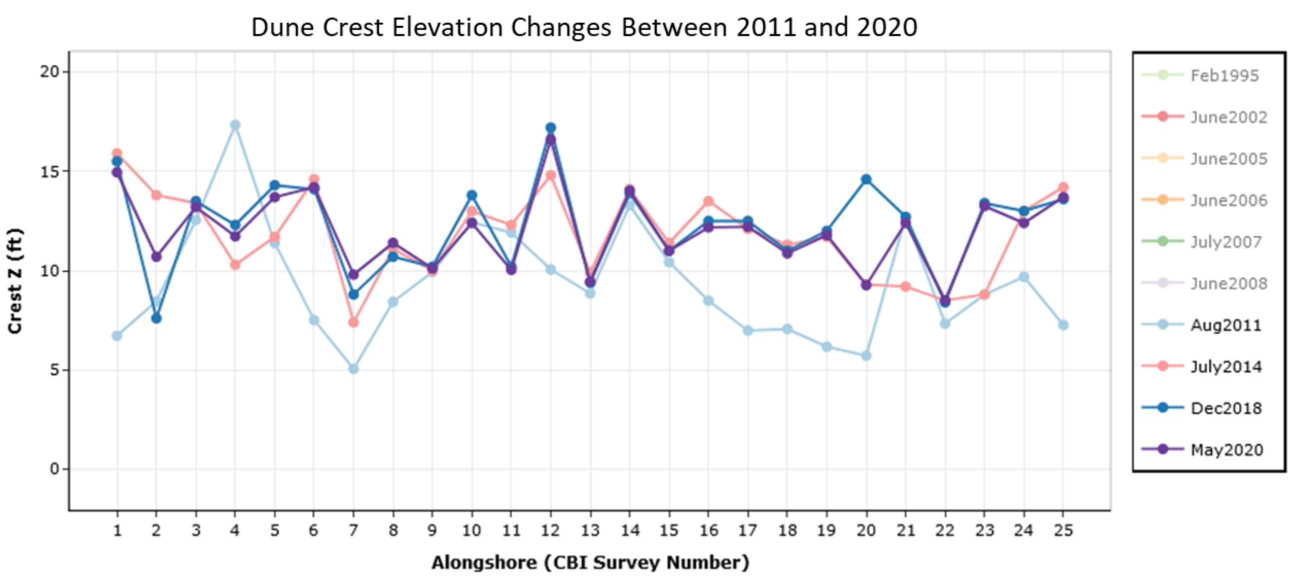

Figure 5. Alongshore dune crest elevation changes between 2011 and 2020 showing consistent, sustained gains in the dune crest elevations along the majority of SPI.

An initial evaluation of the dune toe elevations has similarities to the dune crest, as is expected, although the toe of the dune is more likely to be subjected to erosion from more minor storm events than the dune crest, especially if the beach is lowered from previous storms. Prior to 2011, there is no distinct or consistent temporal or spatial pattern in the dune toe elevation. However, between 2006 and 2011, as with the dune crest, there is more sustained lowering of the dune toe (Figure 6). As with the dune crests, this is likely attributable to the impacts from Hurricanes Dolly and Ike.

There are some indications of dune toe recovery post-2011 but it is not as consistent as the dune crest (Figure 7). As mentioned above, this is likely because the dune toe is a more dynamic portion of the beach-dune system, and even with regular nourishments, more minor storms waves can reach the base of the dune, especially if the beach is narrow or low.

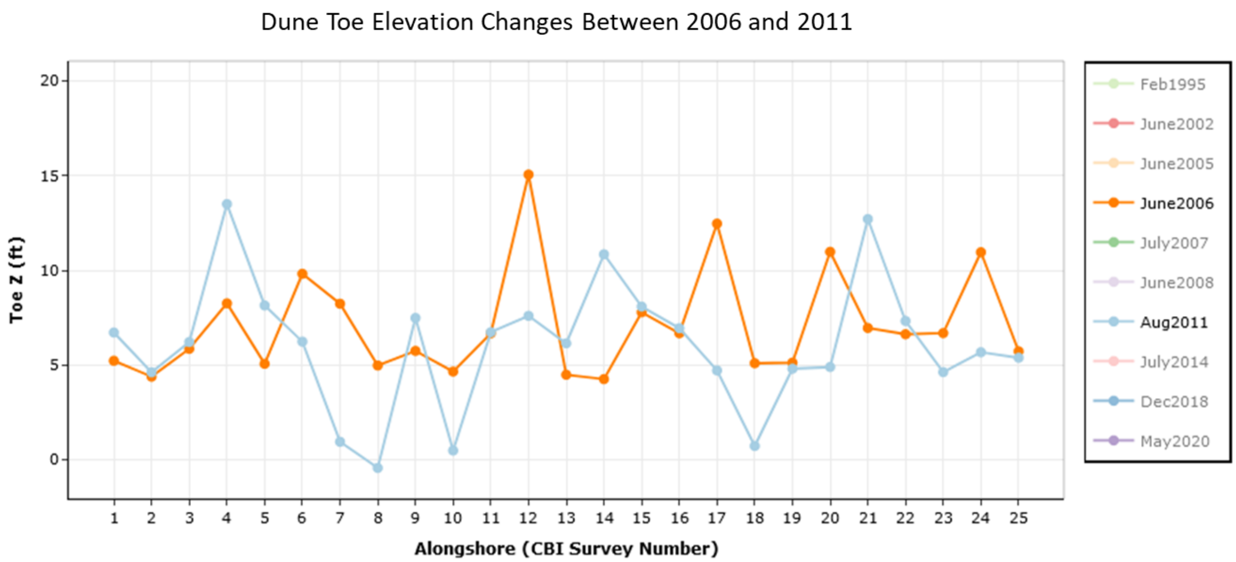

Figure 6. Alongshore dune toe elevation changes between 2006 and 2011 showing substantial losses in this time period.

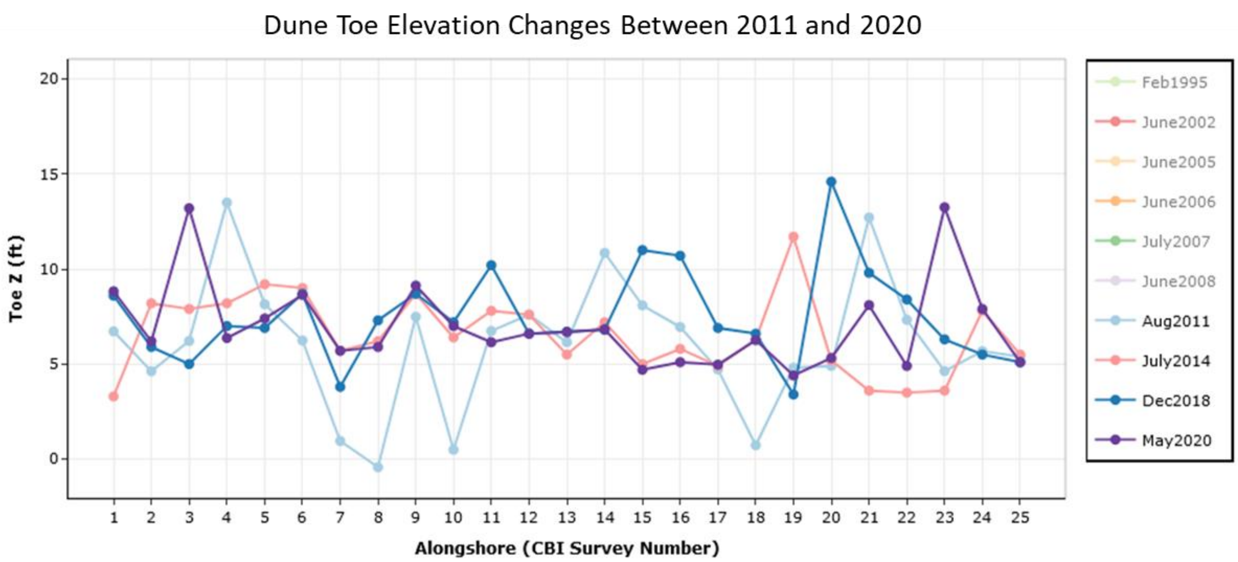

Figure 7. Alongshore dune toe elevation changes between 2011 and 2020 showing sustained recovery in some locations, but less consistently as compared to the dune crest.

Progress Narrative: Near-term Topographic Change

To analyze very short-term changes to the topography of the entire beach-dune system, we obtained two lidar datasets from 2016 and 2018. Both raster data sets have a cell size resolution of 1 meter (3.28 ft), and were obtained from NOAA's Digital Coast website (https://coast.noaa.gov/digitalcoast/data/). The 2016 data were collected by the U.S. Army Corp of Engineers as part of their National Coastal Mapping Program, and the 2018 were contracted by the USGS as part of the 3DEP Program.

Along the length of the island, the pattern of change is generally vertical accretion of the dunes, especially at the seaward edge of the dune field, and appears to be related dune construction associated with beach nourishment. There was onshore placement of sand in October of 2016, several months following the lidar data collection. A 2018 offshore nourishment occurred after the 2018 lidar was collected, so could not influence the beach-dune morphology for this topographic analysis. The fact that the constructed dunes are still largely intact is testament that nourishment is successful in maintaining a health dune system.

Also persistent along almost the entire length of the study area is elevation loss of the beach, with evidence of scarping at or near the swash zone (Figures 8-10). The beach erosion is persistently higher in the northern section of the island (Figure 8) from CBI profiles 21-25 and the area north of CBI-25. The severity of the beach erosion decreases to the south (Figures 9 and10), and there are a few locations where the beach experienced some accretion, such as CBI-2 and 5 (Figure 10), and CBI profiles 13-15, and 19 (Figure 9). The extreme values of some of the high erosion areas, > 6 feet of vertical loss is suggestive of storm erosion, and may be reflecting erosion and slow recovery caused by Hurricane Harvey in the years between the lidar surveys.

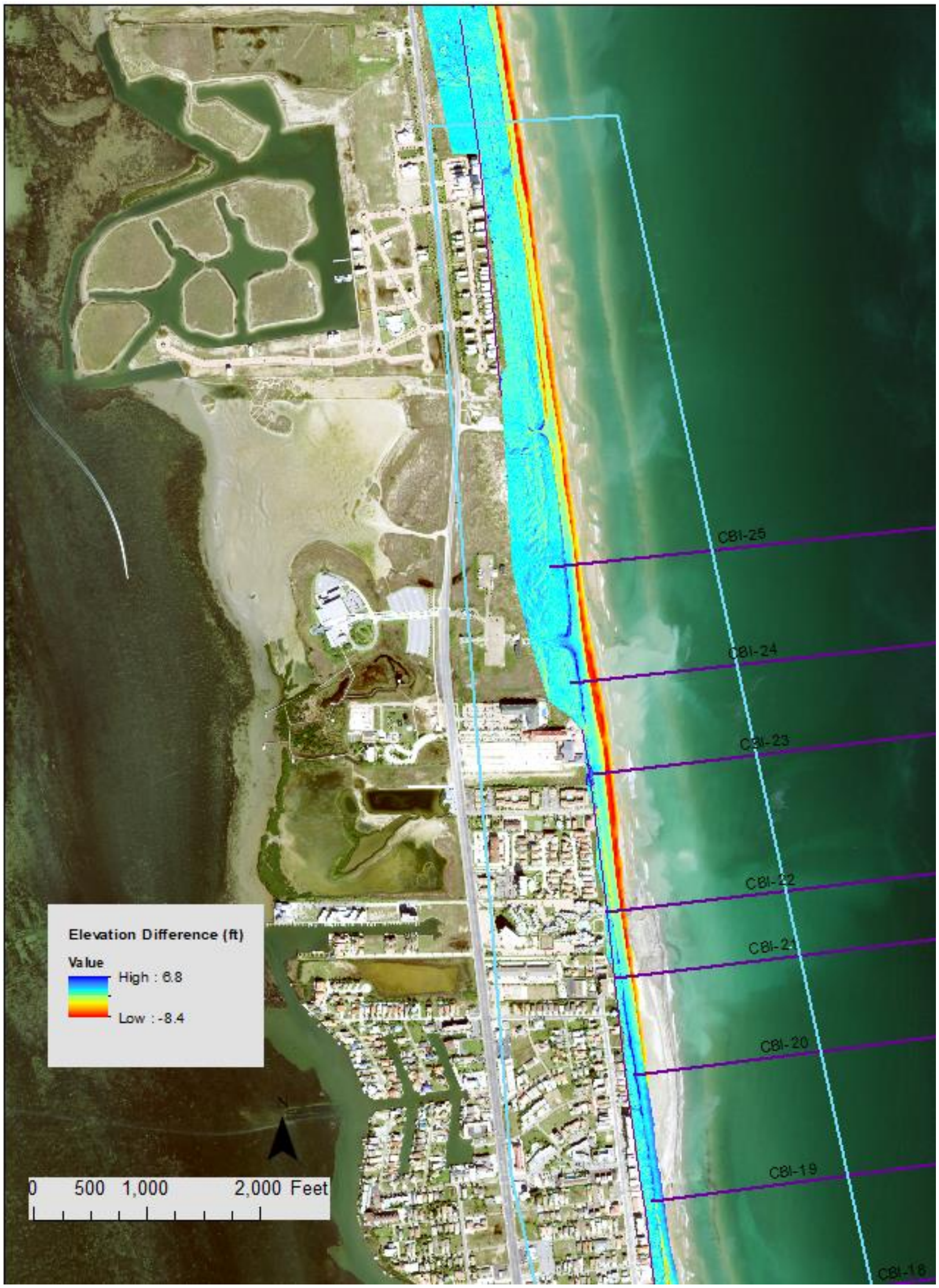

Figure 8. Topographic difference map of the northern portion of the study area including the locations of the CBI profiles for reference.

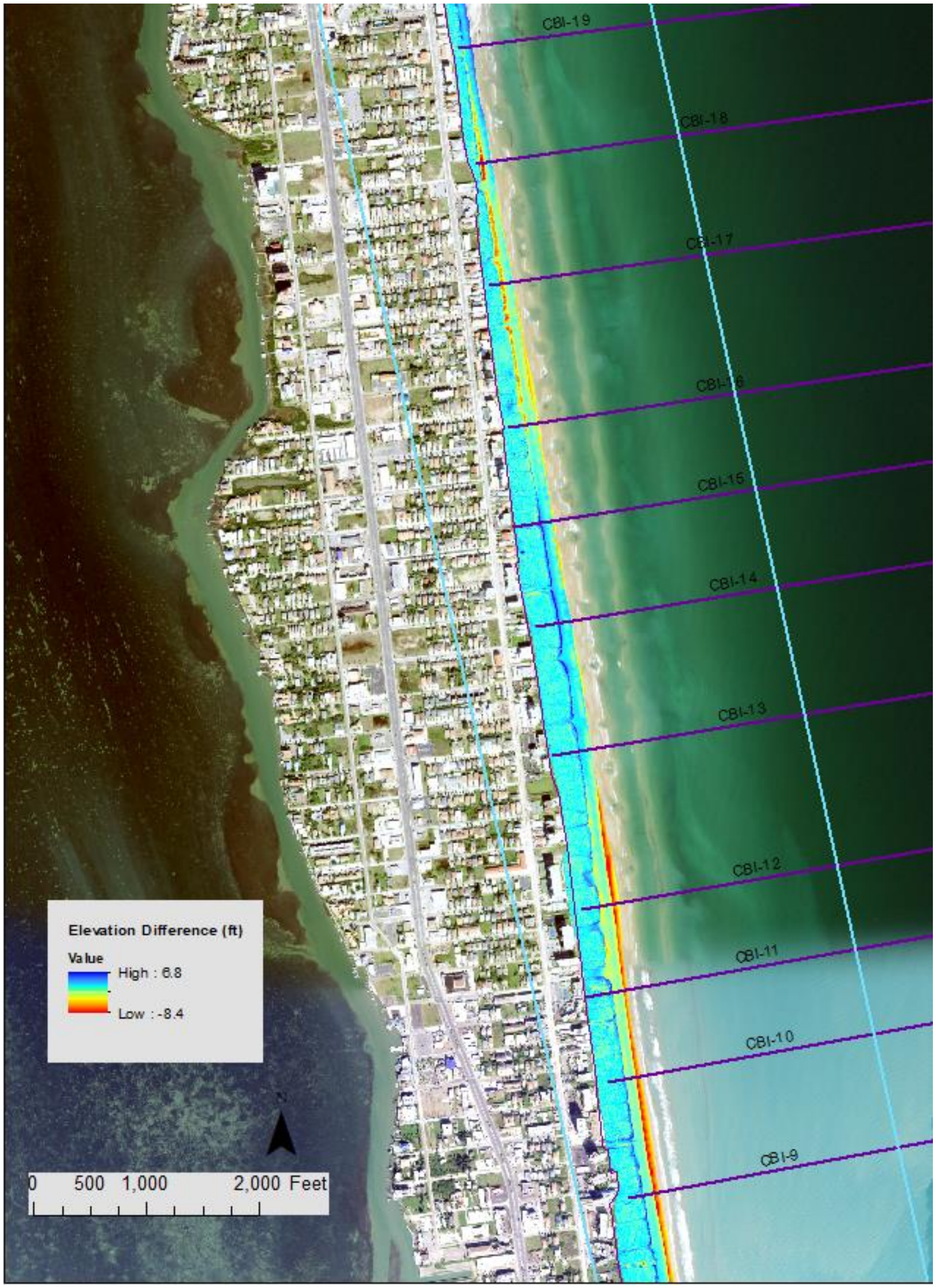

Figure 9. Topographic difference map of the central portion of the study area including the locations of the CBI profiles for reference.

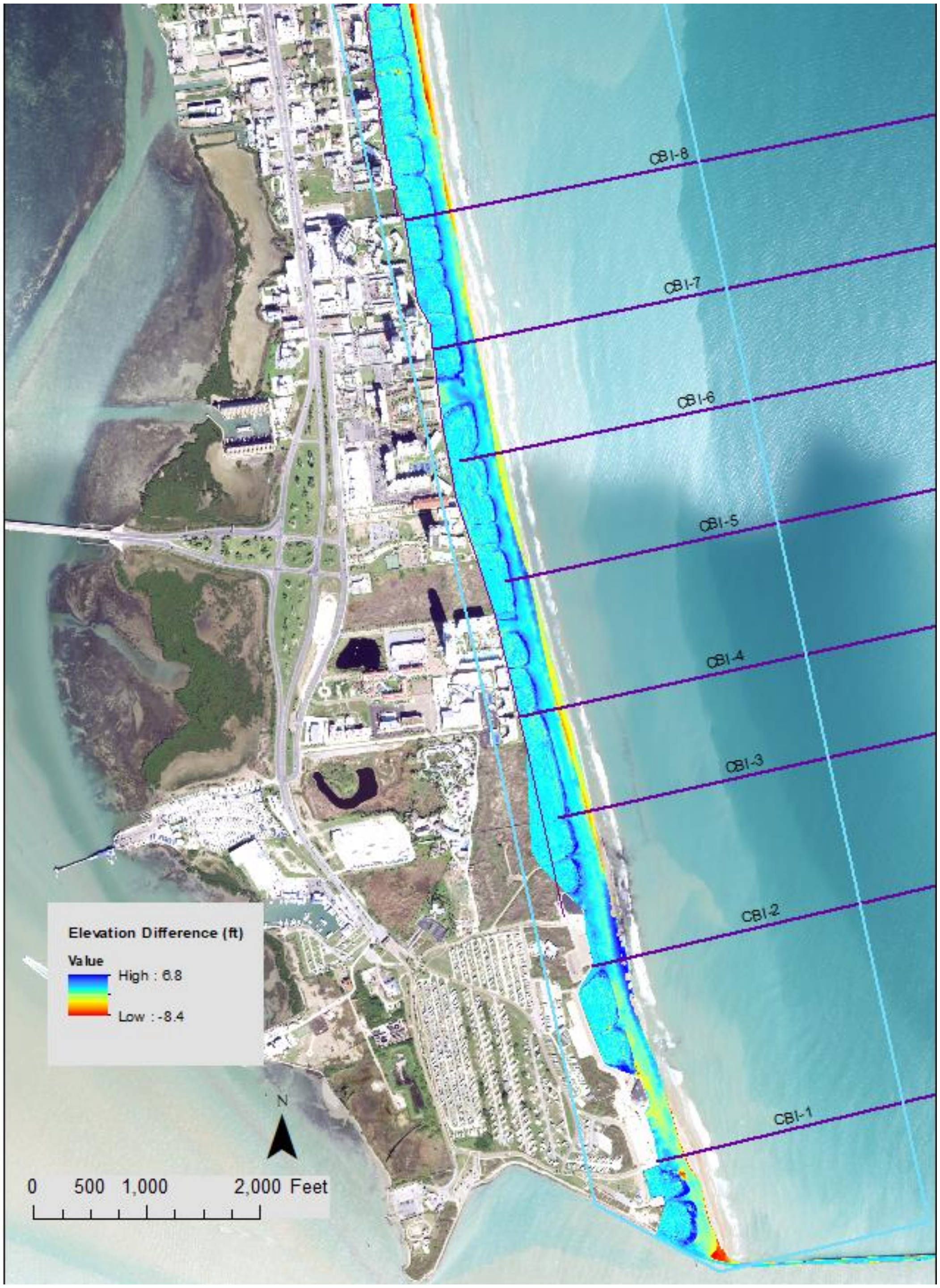

Figure 10. Topographic difference map of the southern portion of the study area including the locations of the CBI profiles for reference.