



Shoreline Change at Padre Island National Seashore, Texas

2017–2019 Data Summary

Natural Resource Data Series NPS/GULN/NRDS—2019/1238



ON THE COVER

Photo of high tide swash line near Port Mansfield Channel taken before shoreline position survey on April 14, 2019.
NPS photo / GULN

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Summary and Key Findings

In May and June 2017 and April 2019 the Gulf Coast Network collected shoreline data at Padre Island National Seashore as a part of the NPS Vital Signs Monitoring Program. Monitoring was conducted following methods detailed in *Monitoring Shoreline Position at Gulf Coast Network Parks: Protocol Implementation Plan* (PIP; Bracewell 2017). Shoreline change was calculated using the Digital Shoreline Analysis System developed by USGS (Theiler et al. 2008).

Key findings from this effort are as follows:

- Shoreline position was recorded for the entire Gulf-side shore, a 105 kilometer (65.2 mile [mi]) extent.
- Overall, 94.5% of transects exhibited landward retreat and only 5.5% of transects were static or advanced seaward.
- The mean shoreline change rate change from 2017 to 2019 was -3.68 meters per year (-12.07 feet [ft] per year) with a standard deviation of 2.3 meters (7.5 ft). The shoreline change rate ranged from -12.11 meters per year to +4.83 meters per year (-39.73 ft/yr to +15.84 ft/yr).

This project is in the early phases of implementation and will benefit from future surveys to better understand the influence of slight changes in survey timing and other environmental variations.

Introduction

As stated by Psuty et al. (2010)

Changes in shoreline position are recognized as interacting with many other elements of the ocean beach-dune ecosystem and are thus both driving and responding to the variety of natural and cultural factors active at the coast at a variety of temporal and spatial scales. The direction and magnitude of shoreline change can be monitored through the application of a protocol that tracks the spatial position of the neap-tide, high tide swash line under conditions of temporal sampling.

The Gulf Coast Network monitors shoreline position at Gulf Islands National Seashore and Padre Island National Seashore (PAIS) using modified procedures developed for

the Northeast Coast Network (NCBN). Handheld and utility task vehicle (UTV)-mounted Global Positioning Systems (GPS) or Global Navigation Satellite Systems (GNSS) are used to record shoreline position by walking or driving the high tide swash line. The Gulf Coast Network's (GULN) monitoring objective is to identify the biennial and long-term trends and variability of shoreline position in network seashore parks.

This report provides a summary of shoreline monitoring data collected to address this objective at Padre Island NS from May 2017 through April 2019.

Study Area

Padre Island National Seashore was established in 1962, and consists of approximately 130,000 acres (52,609 hectares [ha]) of land and water. At 113 kilometers (70 mi), it is the longest stretch of undeveloped barrier island in the world, and ranges in width from 0.8 to 4.8 kilometers (0.5 to 3 miles; Cooper et al. 2005). The authorized boundary of the seashore includes not only the barrier island itself, but also portions of the Gulf of Mexico and the Laguna Madre.

There are a number of aquatic and terrestrial ecosystems in Padre Island National Seashore. Beginning on the Gulf-side and going west to the Gulf Intracoastal Waterway, the park includes the nearshore waters, the foreshore (swash zone) and backshore (from high-tide line to dunes) on the beach, foredunes, vegetated flats behind the dunes with shallow fresh- or brackish-water ponds and marshes, back-island dunes in some areas, wind-tidal flats, and shallow, hypersaline seagrass beds in the lagoon. The interplay of climate, physiography, and geomorphology results in a landscape that is largely shaped by wind (Withers et al. 2004).

The purpose of this document is to report the most recently collected data from within the park as part of an ongoing long-term shoreline-change monitoring program. Other data collected during this survey are available at the [Gulf Coast Network Shoreline Monitoring Project](#).

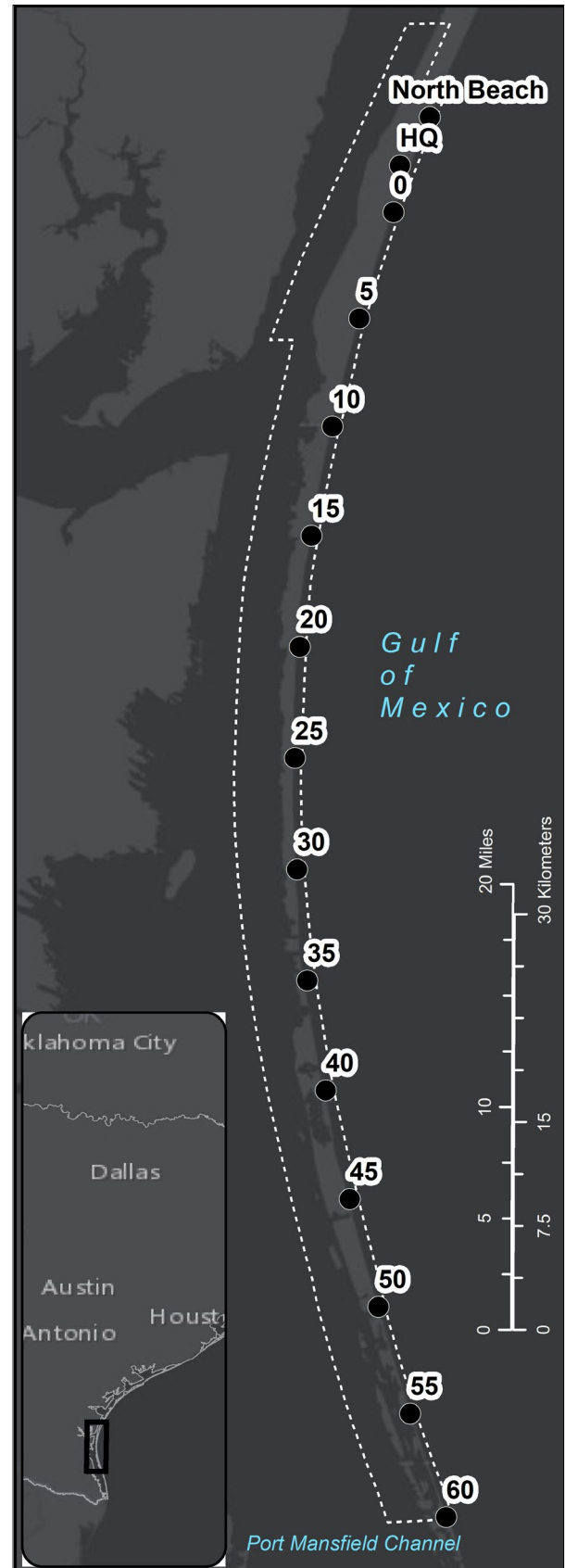


Figure 1. (Right) Extent of shoreline mapping at Padre Island NS. Dashed line indicates the park boundary and numbered black dots represent the park's mile marker system.

Methods

The position of the entire Gulf-side shoreline is mapped in the spring of every other year using methods developed by National Park Service Northeast Coast Barrier Network (Psuty et al. 2010) and adapted by the Gulf Coast Network (Bracewell 2017). Figure 1 shows the extent of the shoreline mapping effort at Padre Island NS from the northern Gulf-side boundary at North Beach to Port Mansfield Channel, near mile marker 60. The high tide swash line is mapped using a GNSS (GPS) unit, then differentially corrected results are exported into a standard GIS format. Digital Shoreline Analysis System (DSAS; Theiler et al. 2008) is used to analyze the shoreline change along spatially fixed cross-shore transects distributed every 50 meters (164 ft). Annual shoreline change rates are calculated using the End Point Rate method, which addresses the change in shoreline by determining the distance between two shorelines and dividing the distance by the time between the shoreline surveys (Figure 2). This report addressed shoreline change between spring 2017 and spring 2019.

Standard Operating Procedure

Table 1 presents the Standard Operation Procedures that are considered critical to maintaining continuity between data sets across many surveys so that the results are comparable. No significant changes were made to SOPs between 2017 and 2019, and version numbers in the table apply to both datasets

Timing of the Shoreline Position Survey

Shoreline surveys of the high tide swash line are conducted during neap tides in April and May of every other year. Neap tides are the two periods per month when high and low tides are least different. For a given survey season, these neap tide periods are determined based on predicted water levels using the closest NOAA monitoring station at Bob Hall Pier (National Ocean and Atmospheric Administration 2018). The verified water levels occurring before the 2017 and 2019 surveys are listed in Table 2. Graphs of verified vs. predicted water levels for the survey periods and the prior week are presented in Figures 3 and 4.

Natural and Anthropogenic Events Affecting Shoreline Position

On August 26, 2017 Hurricane Harvey made landfall just north of Port Aransas, approximately 48 kilometers (30 miles) north of the seashore, as a Category 4 hurricane. The tide at Bob Hall Pier peaked at about 1.33 meters (4.36 ft; North American Vertical Datum [NAVD]) above predicted water levels in advance of the storm. Although the storm caused extensive damage at Port Aransas and areas to the north and east, impacts at the seashore were relatively minimal.



Figure 2. End Point Rate calculation for transect at Padre Island NS. In this case the shoreline retreated 16.11 meters (52.85 ft) over 683 days, or 8.6 meters (28.2 ft) of retreat per year.

Table 1. Standard operating procedures used for shoreline position data collection, processing, and reporting.

SOP number	SOP title	SOP version
SHR03	Survey Timing and GPS Mission Planning	1.0
SHR04	Basic GPS Settings for Position Collection	1.0
SHR05	Conducting the Survey	1.0
SHR06	Initial Post Survey Processing	1.0
SHR07	Change Calculation, Data Analysis and Reporting	1.0

Table 2. List of verified high tide water levels occurring before shoreline position surveys were conducted [m—meters; *— NAVD 88].

Season	Survey Collection Date and Time	Survey Area	Previous high-tide height* (m)	Previous high-tide Local Time
Spring	05/31/2017 15:31 to 18:36	Mansfield Channel thru Malaquite Beach	0.554	05/31/2017 10:12
Spring	06/01/2017 17:12 to 17:20	North Beach	0.495	06/01/2017 11:18
Spring	04/14/2019 14:15 to 19:15	Mansfield Channel thru North Beach	0.417	04/14/2019 13:30

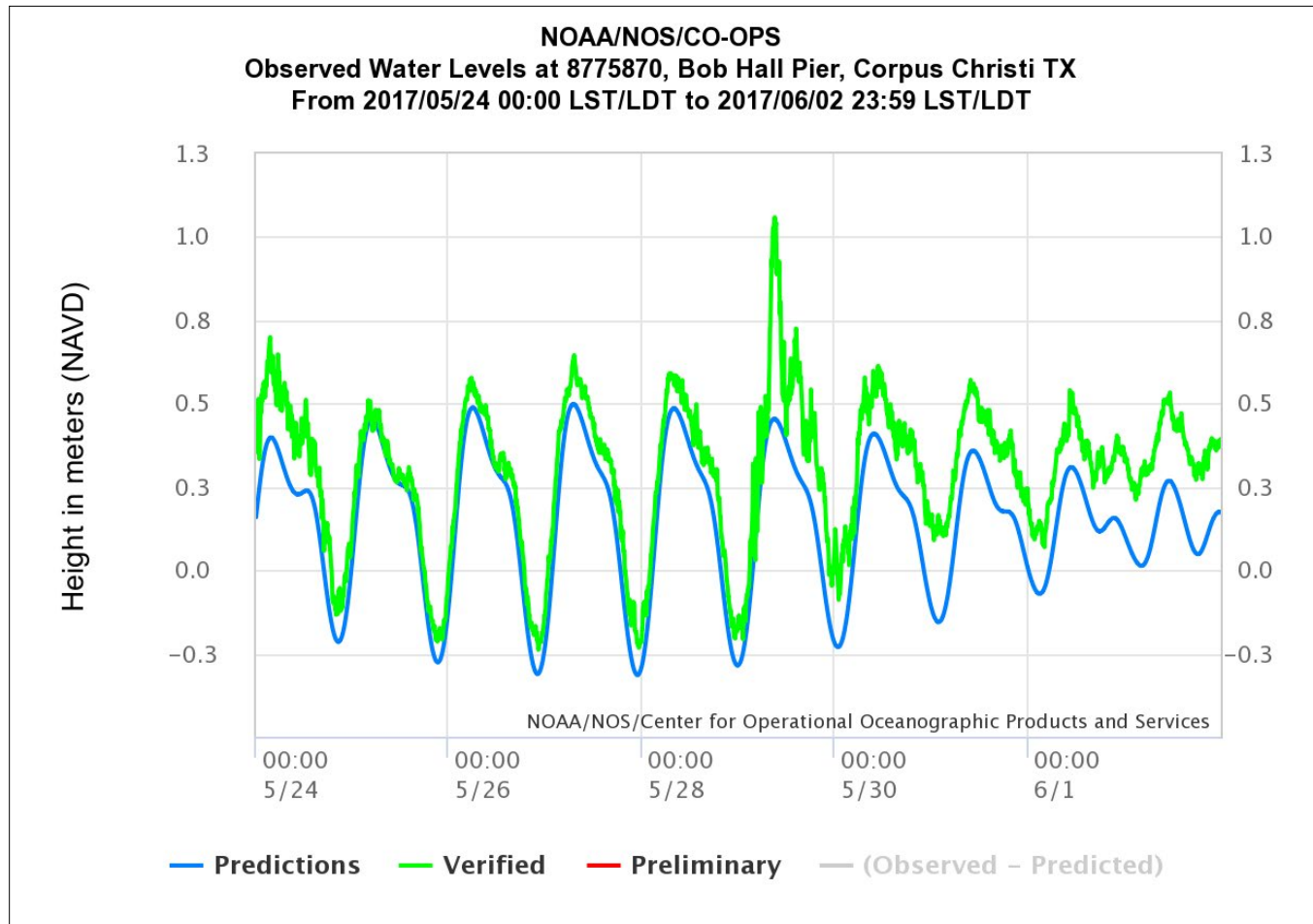


Figure 3. Water levels at Bob Hall Pier for 2017 shoreline position survey period.

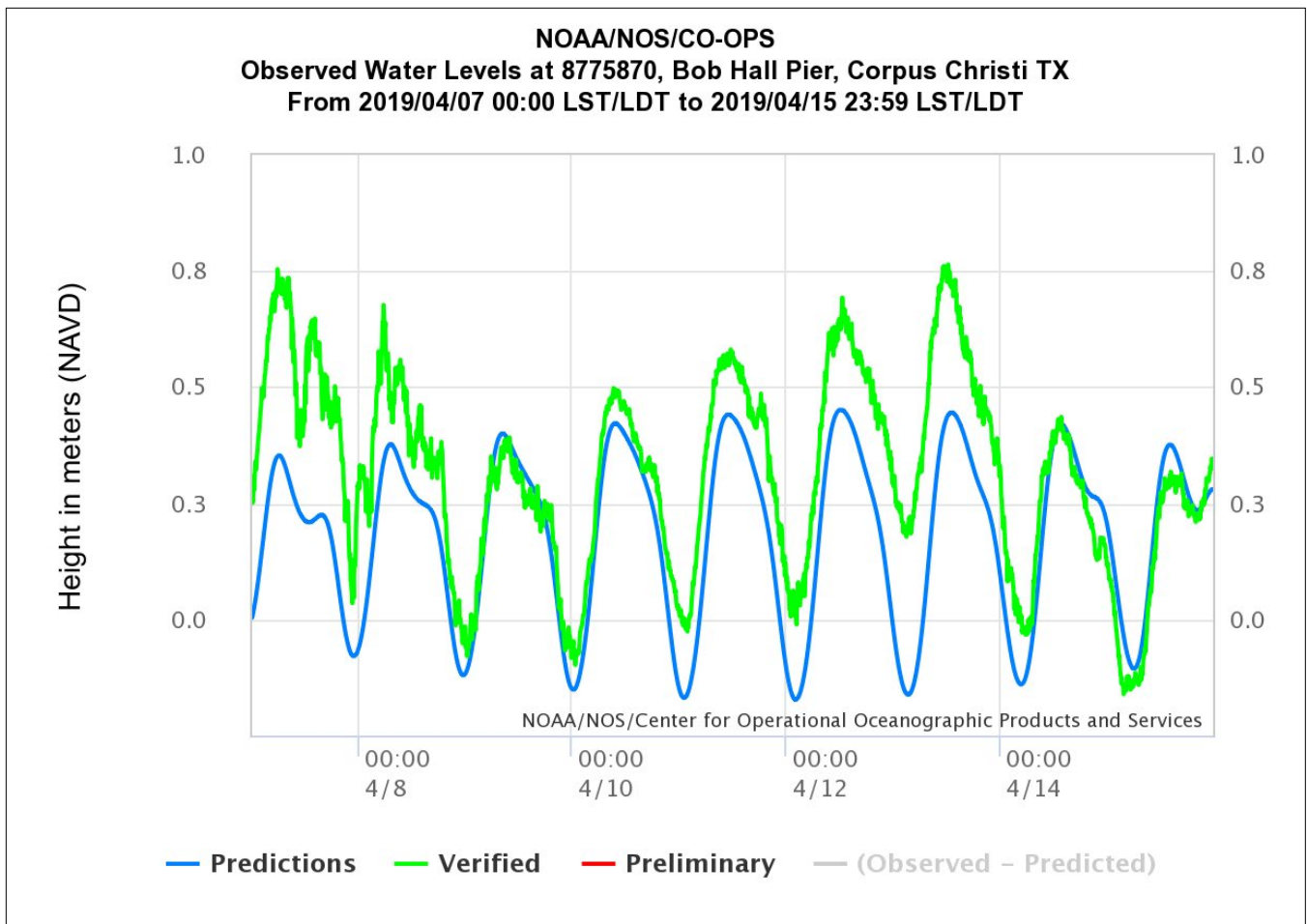


Figure 4. Water levels at Bob Hall Pier for 2019 shoreline position survey period.

Results

Shoreline Position Data Quality

Shoreline position was recorded in May and June 2017 and April 2019. In both survey years, 105.5 kilometers (65.5 miles) of shoreline position was recorded. The average post-processed horizontal precision remained near or below 10 centimeters (3.9 inches [in]; Table 3).

Table 4 presents grouped and total summary statistics for the 2017 to 2019 shoreline position change rates and includes: transect count, minimum, maximum, average, standard

deviation and percentile ranks. All groups showed overall landward retreat. Retreat was generally least toward the center of the island's north/south extent, around mile marker 30, and increased toward both northern and southern reaches of the seashore. End Point Rate maps are presented in Appendix A.

Table 3. Table listing the average horizontal positional precision of the shoreline features collected during 2017 and 2019 [m—meters].

Collection Date	Average Horizontal Precision (m)
05/31/2017	0.096
06/01/2017	0.037
04/14/2019	0.128

Table 4. Summarization of End Point Rates for sections of Padre Island NS [EPR—End Point Rate (in meters per year)].

Transect	Count of EPR	Minimum of EPR	Maximum of EPR	Average of EPR	Standard Deviation of EPR	5 th Percentile of EPR	95 th Percentile of EPR
Closed Beach	146	-8.12	-2.78	-5.96	0.99	-7.47	-4.30
MM 0–5	160	-7.50	-3.28	-5.26	1.04	-6.99	-3.77
MM 10–15	161	-7.80	-1.24	-4.10	1.38	-7.14	-2.26
MM 15–20	160	-8.94	-1.74	-5.31	1.66	-8.30	-2.56
MM 20–25	161	-4.90	0.00	-2.10	0.79	-3.39	-0.87
MM 25–30	161	-3.98	0.63	-1.70	0.95	-3.31	-0.05
MM 30–35	160	-5.93	4.83	-1.66	2.43	-5.01	3.08
MM 35–40	161	-8.67	3.15	-2.37	2.43	-6.65	1.72
MM 40–45	161	-7.90	2.86	-2.78	2.29	-6.04	1.33
MM 45–50	160	-7.18	2.97	-3.09	2.28	-6.77	1.19
MM 5–0	160	-6.61	-1.59	-3.73	1.11	-5.70	-2.06
MM 50–5	161	-8.78	1.70	-4.32	2.08	-7.58	-0.84
MM 55–60	157	-12.11	3.45	-5.65	2.45	-9.90	-1.20
North Beach	35	-6.10	-1.67	-3.97	0.93	-5.76	-1.98
Grand Total	2104	-12.11	4.83	-3.68	2.30	-7.30	0.12

Annual Shoreline Change Analysis

The average End Point Rate (EPR) for the entire seashore between 2017 and 2019 is -3.68 meters/year (-12.07 ft/yr), with a standard deviation of 2.30 meters/year (7.5 ft/yr; Figure 5). The historical rate of change for North Padre Island between the 1930s and 2012 is 0.82 meters/year (2.69 ft/yr), with a standard deviation of 0.98 meters/year (3.22 ft/yr), which increases for the more recent period between 2000 and 2012 to -1.14 meters/year (-3.74 ft/yr) with a standard deviation of 1.19 meters (3.9 ft/yr; Paine 2014). It is important to note that a linear regression model was used to calculate the historical annual change rate. A similar method will be used to calculate change rates for GULN trend reports, which occur after each five shoreline surveys.

Areas of Special Interest

During scoping meetings for this project, PAIS Resource Management staff expressed special interest in Closed Beach and the area north of Mansfield Channel (mile marker 55 to 60). Both of these areas exhibited a higher than average End Point Rate retreat, -5.96 meters/year and -5.65 meters/year respectively (-19.55 and -18.54 ft/yr), compared with a seashore-wide average of -3.68 meters/year (-12.07 ft/yr; Table 4).

Problems and Concerns

The high tide occurring before the 2019 survey was around 15 centimeters (5.9 in) higher than in 2017. Although this seems like a relatively insignificant difference, where beach slope is slight, the impacts on horizontal displacement of the swash line can be surprising. From a limited number of transects where the network conducts monitoring of topographic elevation, we find that beach slope at Padre Island NS can vary at least between 2.86% and 8.25%. Using these slope estimates and 15-centimeter (5.9-in) vertical

change, the horizontal displacement of the swash line ranges between 5.24 meters and 1.82 meters (17.19 and 5.97 ft) respectively. A technical report summarizing this influence of slope and tidal variation can be found in Appendix B. It is important to keep in mind that what may seem like a dramatic change in shoreline position could be attributed to a slight beach slope and tidal variation between surveys. It is anticipated that linear regression models used in trend analyses will lessen the impact from tidal variation.

Survey timing for the spring 2017 survey was delayed because of the Protocol Implementation Plan publication review process. As a result, the survey spanned just over the prescribed April to May sample window to June 1. However, no major seasonal, weather, or tidal impacts occurred prior to the survey that prohibits the June 1, 2017 survey from being compared with the 2019 survey and/or subsequent shoreline surveys.

As mentioned in the introduction of this document, the measurement noise attributed to geomorphic differences (e.g., slope), as well as weather, seasonal and tidal differences, will be put in context after several shoreline surveys have been conducted.

Protocol Changes

No major changes occurred to the GULN PIP (Bracewell, 2017) between its initial publication in 2017 and composition of this report (August, 2019).

Additional Information

For data and information related to this report please visit the [Gulf Coast Network Shoreline Monitoring Project](#). For information about the GULN's complementary coastal dynamics project on topographic change, see the [Gulf Coast Network Coastal Topography Monitoring Project](#).

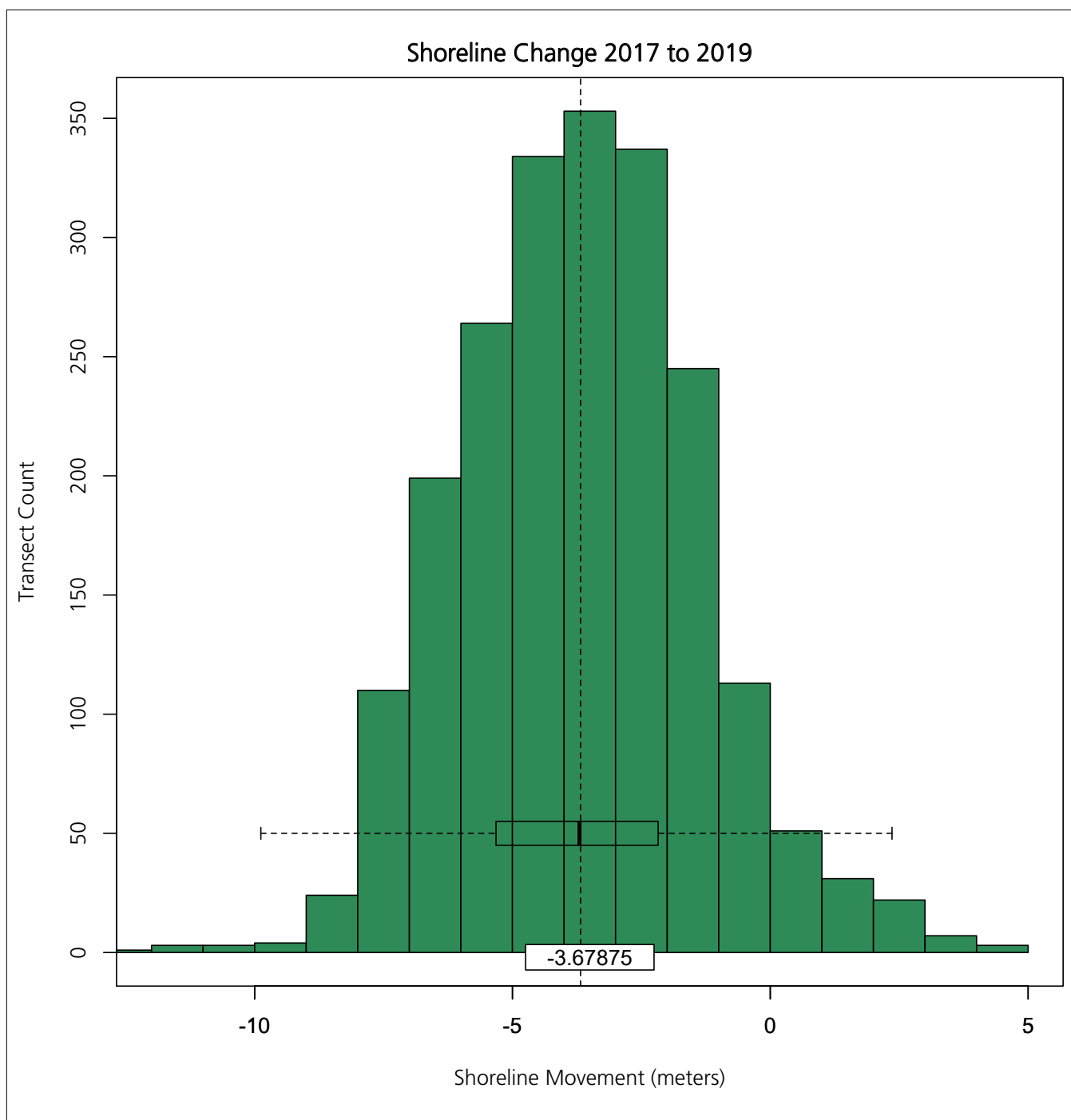


Figure 5. Histogram and boxplot of shoreline position change. Dashed vertical line shows mean retreat.

Literature Cited

- Bracewell, J. 2017. Monitoring shoreline position at Gulf Coast Network parks: Protocol implementation plan. Natural Resource Report NPS/GULN/NRR—2017/1501. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2243708> (last accessed September 2019).
- Cooper, R. J., G. Sundin, S. B. Cederbaum, and J. J. Gannon. 2005. Natural resource summary for Padre Island National Seashore (PAIS). Final report to National Park Service Gulf Coast Network
- National Oceanic and Atmospheric Administration (NOAA). 2018. The Center for Operational Oceanographic Products and Services. Available at: tidesandcurrents.noaa.gov (last accessed August 2019).
- Paine, J., T. Caudle, J. Andrews. 2014. Shoreline movement along the Texas Gulf Coast, 1930's to 2012. Final Report Prepared for the General Land Office under Contract No. 09-074-000, Work Order No. 7776. Bureau of Economic Geology, University of Texas at Austin.
- Psuty, N. P., T. M. Silveira, M. Duffy, J. P. Pace, and D. E. Skidds. 2010. Northeast Coastal and Barrier Network geomorphological monitoring protocol: Part I—ocean shoreline position. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/664308> (last accessed August 2019).
- Thieler, E. R., E. A. Himmelstoss, J. L. Zichichi, and A. Ergul. 2008. The digital shoreline analysis system (DSAS) version 4.0—an ArcGIS extension for calculating shoreline change. Open-File Report 2008-1278. U.S. Geological Survey. Available at: <https://cmgds.marine.usgs.gov/publications/DSAS/of2008-1278/> (last accessed August 2019).
- Withers, K., E. H. Smith, O. Gomez, and J. Wood. 2004. Assessment of coastal water resources and watershed conditions at Padre Island National Seashore, Texas. Technical report NPS/NRWRD/NRTR-2004/323.

Appendix A. End Point Rate Maps

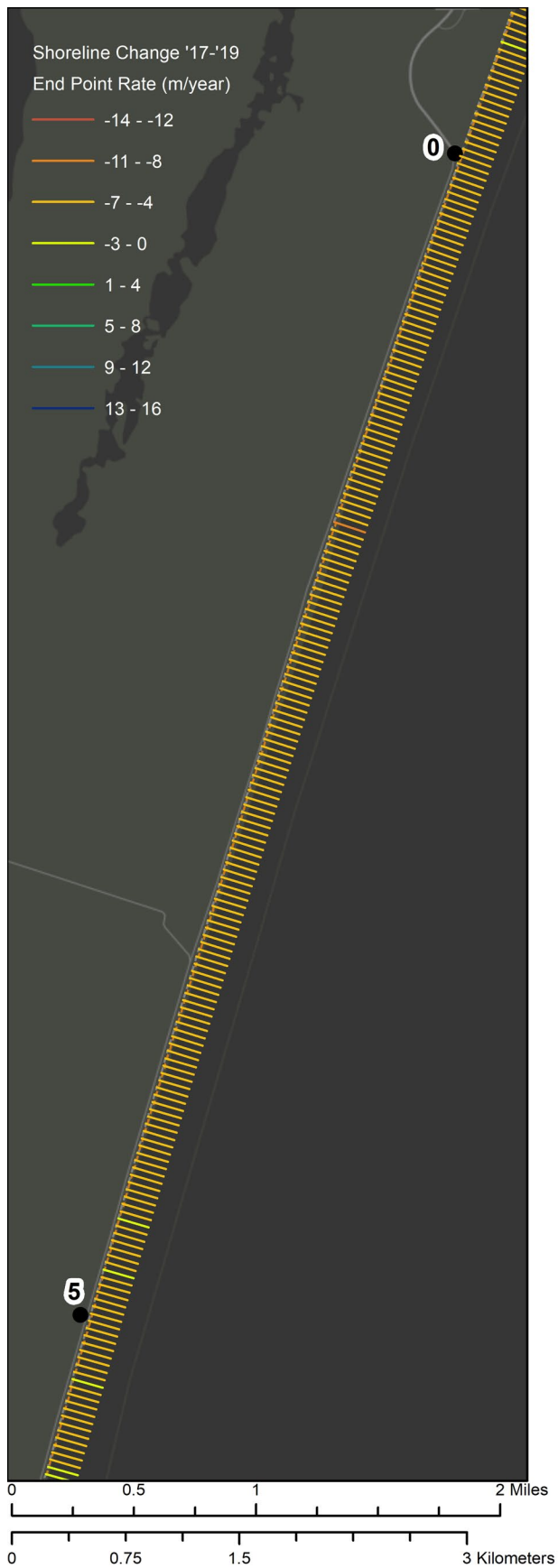


Figure A-2. Shoreline position change in meters per year. Mile Marker 0 thru Mile Marker 10.

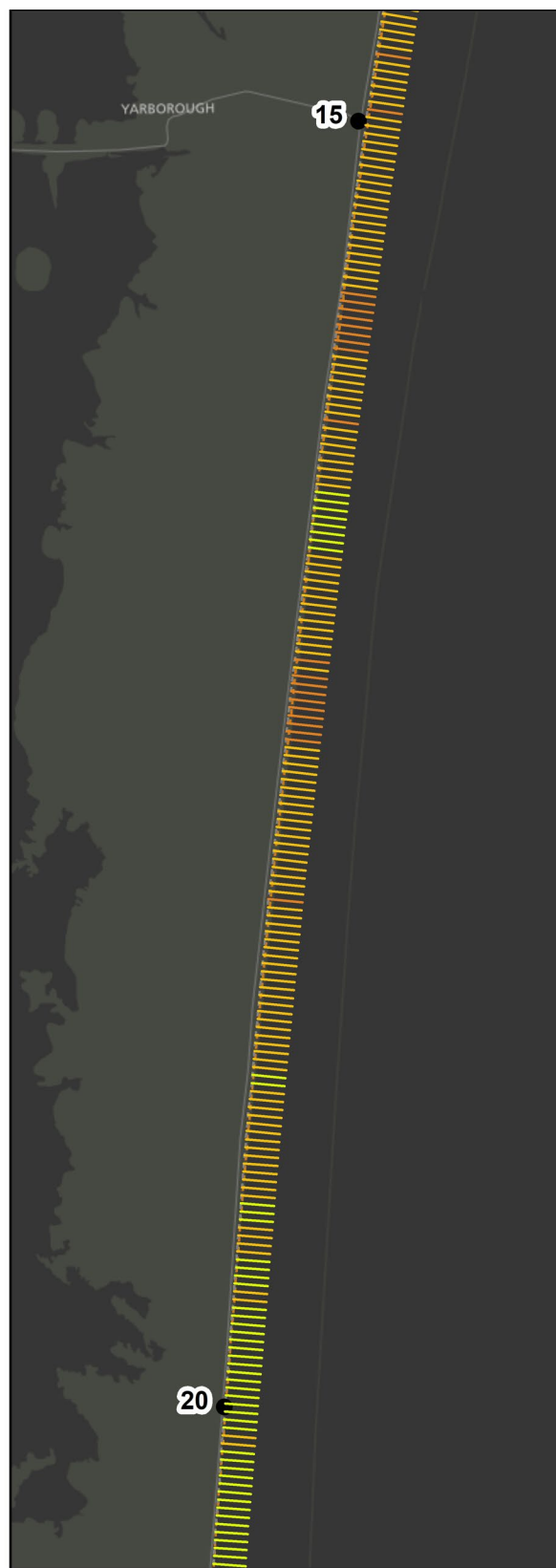
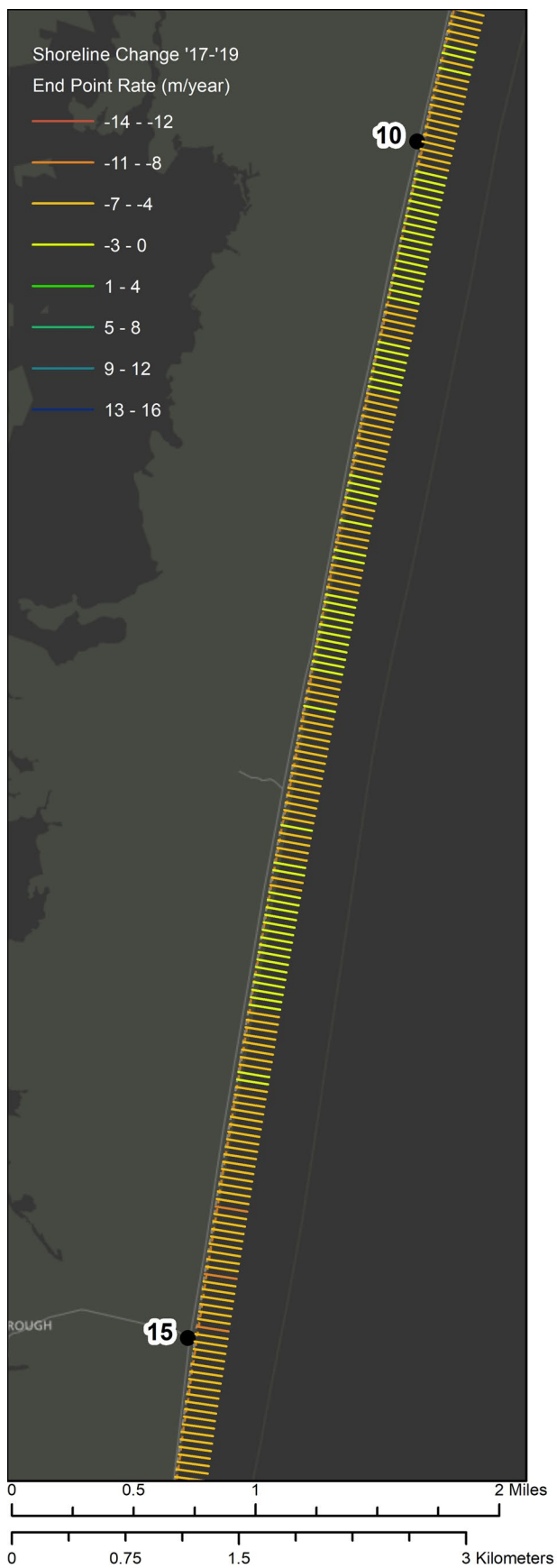


Figure A-3. Shoreline position change in meters per year. Mile Marker 10 thru Mile Marker 20.

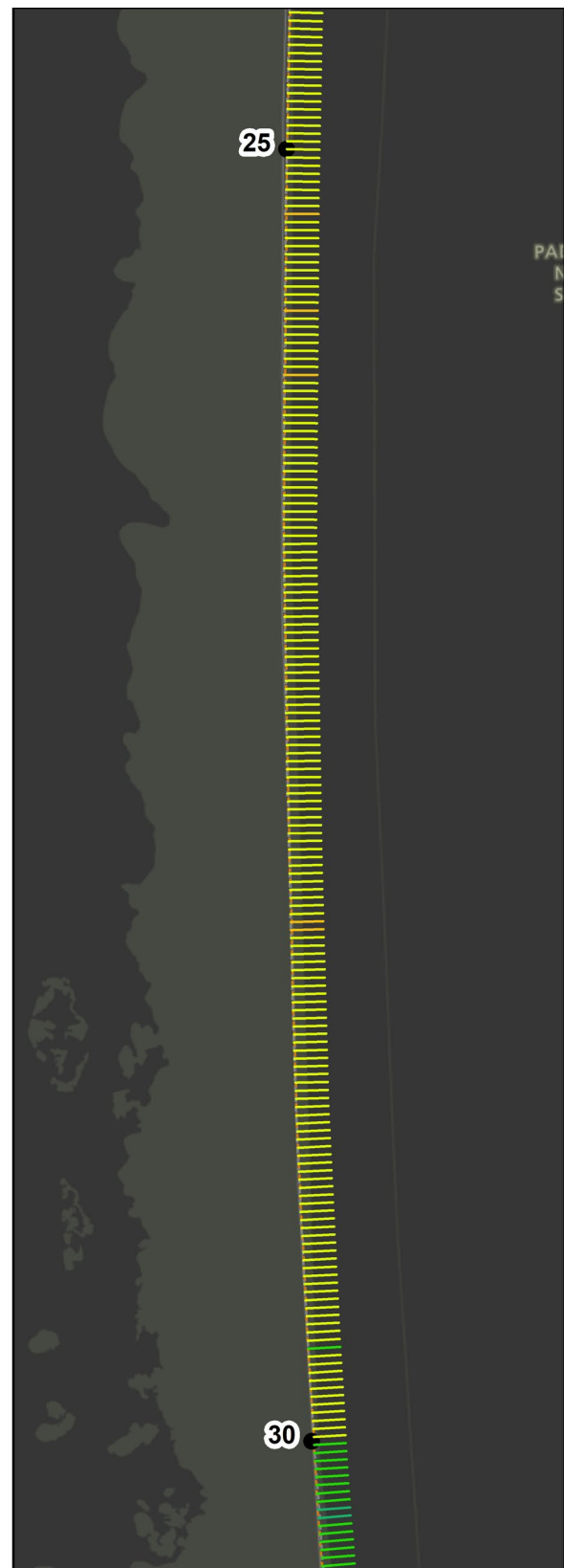
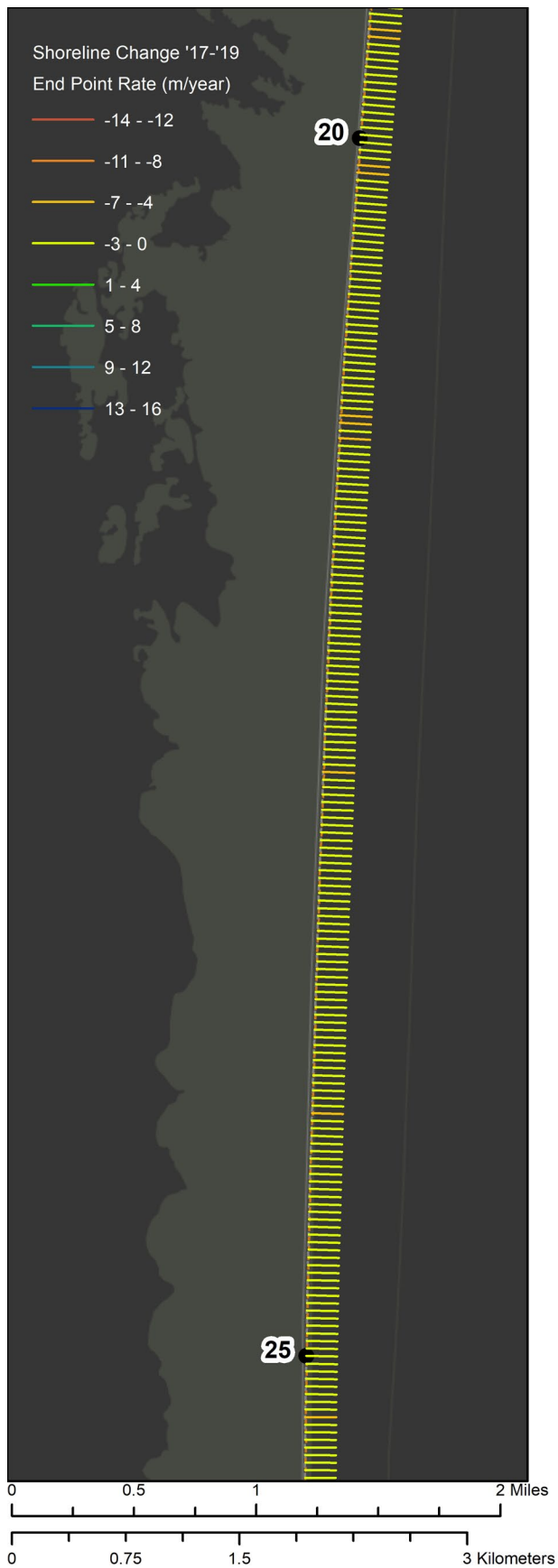


Figure A-4. Shoreline position change in meters per year. Mile Marker 20 thru Mile Marker 30.

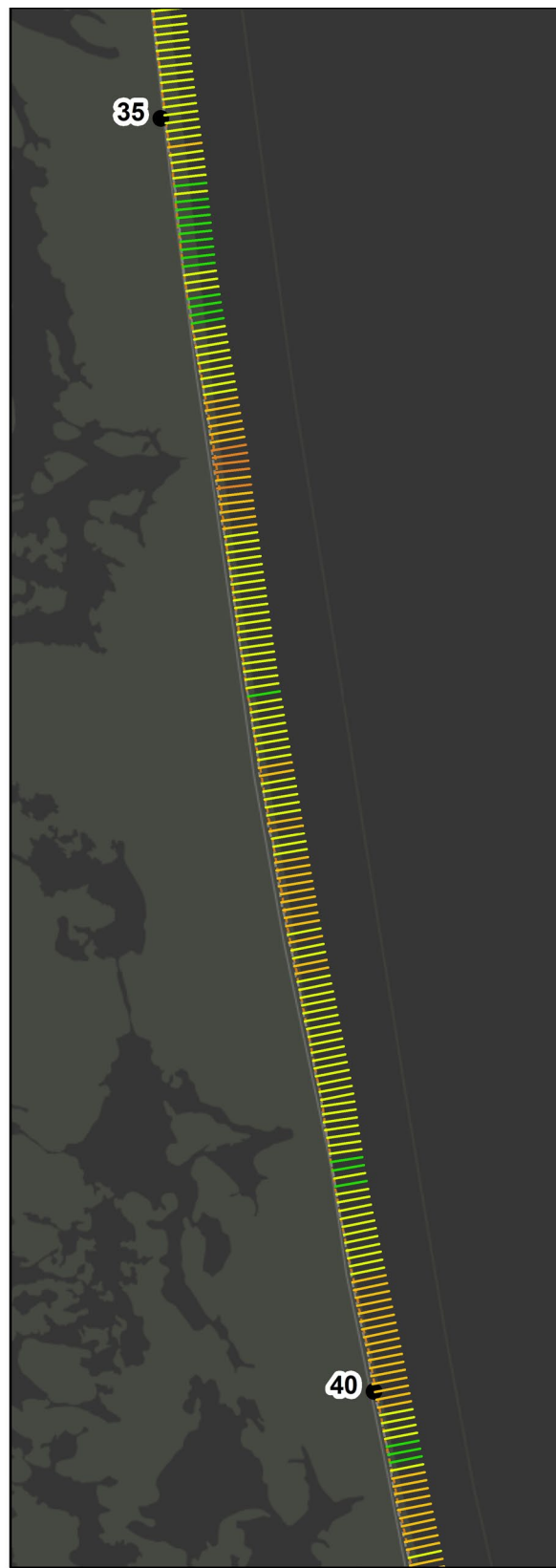
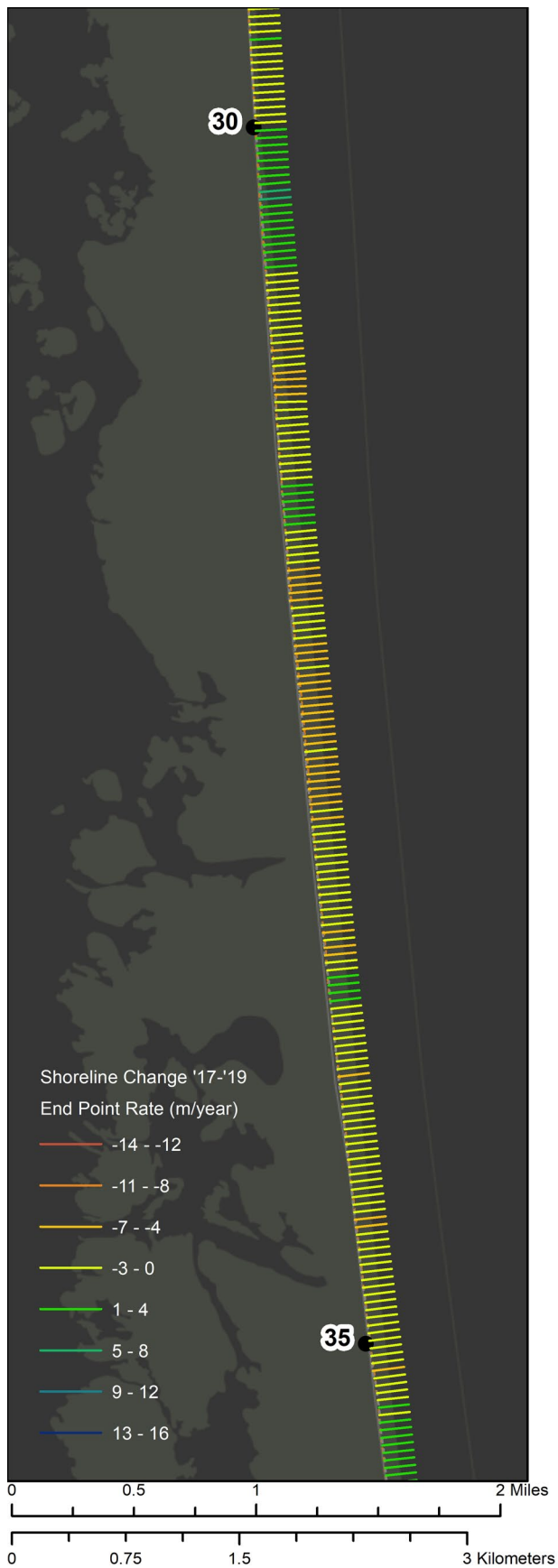


Figure A-5. Shoreline position change in meters per year. Mile Marker 30 thru Mile Marker 40.

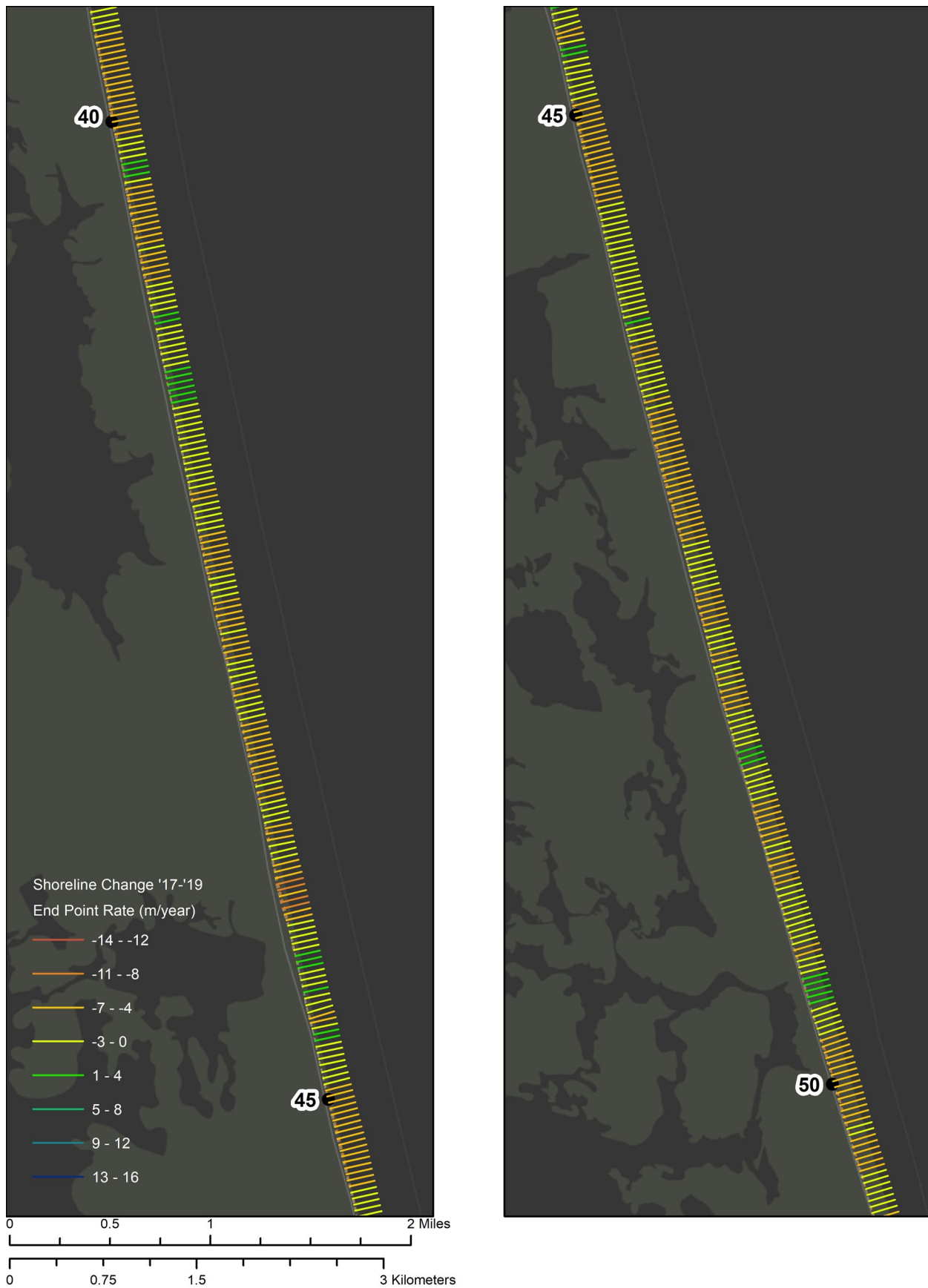


Figure A-6. Shoreline position change in meters per year. Mile Marker 40 thru Mile Marker 50.

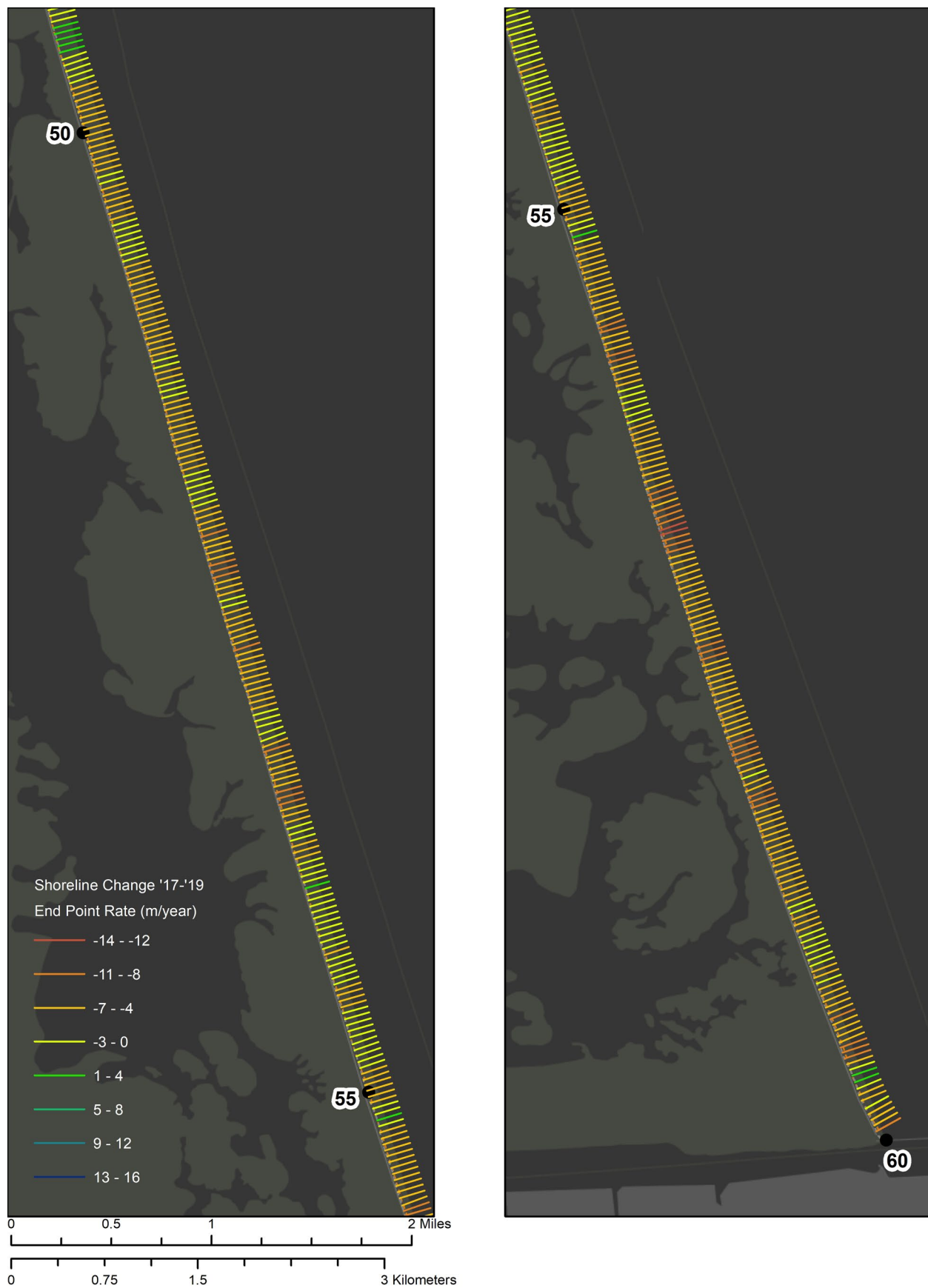


Figure A-7. Shoreline position change in meters per year. Mile Marker 50 thru Mile Marker 60.

Appendix B: Determining the Impact of Beach Slope on Shoreline Displacement

In addition to shoreline position, the Gulf Coast Network conducts a coastal topography survey concurrently with the shoreline position survey. The topographic survey collects elevation data along fixed cross-shore transects. From these points, elevation profiles of the beach/dune system are created and analyzed over time. Through examination of elevation points that were within 3 horizontal meters (9.8 ft) of the shoreline feature, it was determined that the high tide swash line was approximately 20 centimeters (7.9 in; NAVD 88) higher in the 2019 survey than in the 2017 survey. As implementation of this shoreline position project is relatively recent and at present there are only two shoreline features to compare, it is not yet clear how much meaningful impact this variation will have on comparisons made between many surveys, or if this amount of vertical displacement is within what is a normal and expected range from any one survey event to the next. What is clear, however, is that a vertical change in the mapped shoreline feature will result in greater

horizontal displacement on slightly sloped beaches than it will on steeper beaches. This scenario can be thought of as similar to contour lines on a topographic map; where lines are far apart, slope is slight and where lines are close together, slope is steep. Park Resource Managers and others who interpret the reported results from the GULN shoreline position project need to be aware of the role that beach slope plays on horizontal displacement. To better understand the relationship between changes in elevation and horizontal displacement, a basic geometry calculation can be used to solve for horizontal distance (HD) using beach slope, converted to an angle (A), and vertical displacement (VD) in a tangent function ($VD/\text{Tangent}(A)$; Figure B-1). This function is graphed in Figure B-2 and depicts two scenarios, one where the vertical change of the high tide swash line is 10 centimeters and another with a 20-centimeter vertical change.

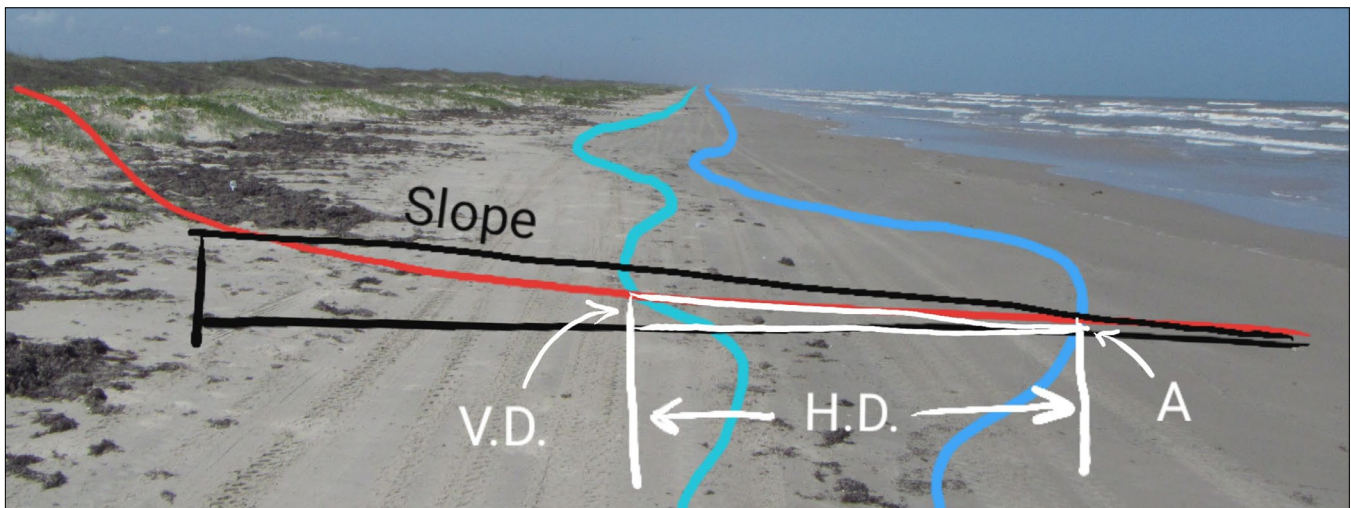


Figure B-1. Illustration of calculation used to illustrate horizontal displacement related to slope. Red line indicates the profile of a cross-shore transect. White lines and text describe the coefficients used to calculate horizontal distance (displacement). Blue lines running along-shore represent two shoreline surveys conducted at different times.

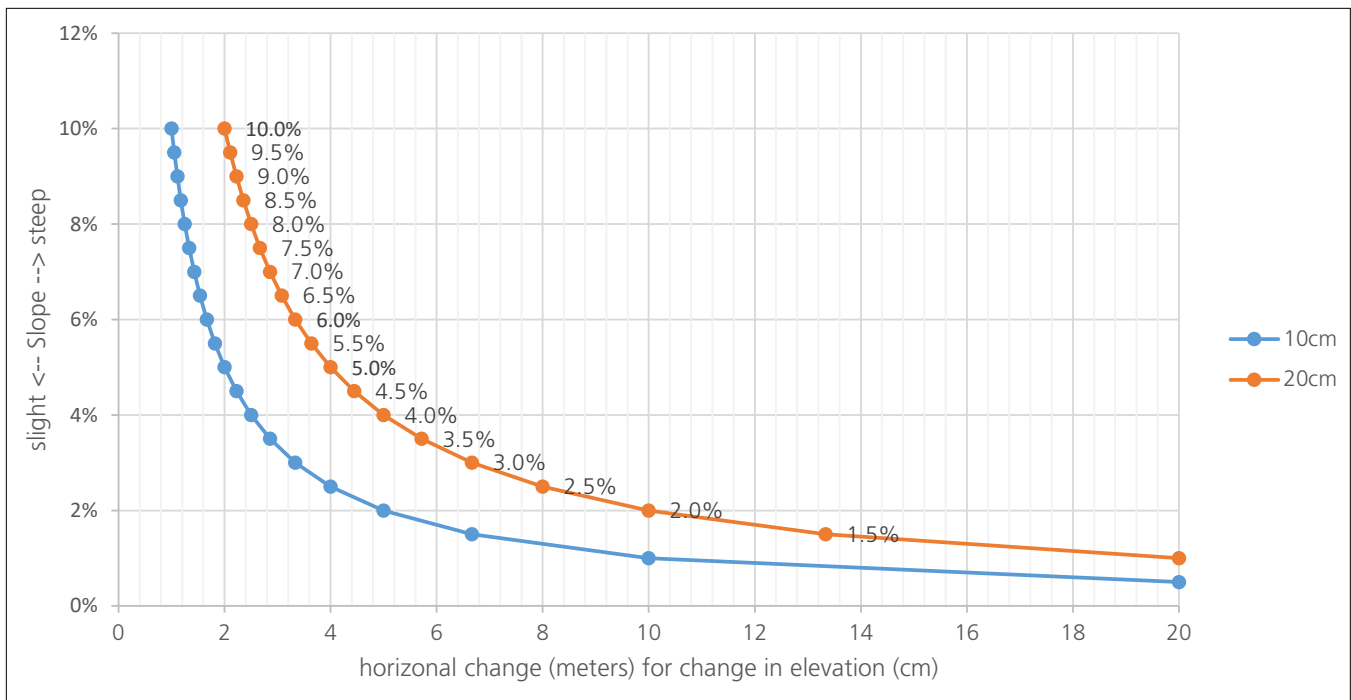


Figure B-2. Graph of horizontal displacement related to slope

All topographic survey points taken along transects that were less than 1 meter NAVD88 were used to calculate beach slope. Least squares regression was then used to fit a slope line to the beach points. In 2017 and 2019 these beach transect slopes varied from 2.87% to 6.51% and 3.65% to 8.25% respectively (Table B-1). When the surveyed feature changes by an elevation of 20 centimeters (7.9 in), a slope of 2.87% produces a horizontal displacement of 6.97 meters (22.86 ft), while a slope of 8.25% produces a horizontal displacement of 2.42 meters (7.9 ft). Of course this function can only be applied soundly in areas where topographic

surveys were conducted coincident to shoreline position surveys. However, the intent of presenting this relationship between slope and displacement is not to provide a mathematical function to correct the shoreline position, but to make readers aware that slight beach slopes can magnify horizontal displacement. Hopefully an awareness of this relationship will provide a point of reference for vertical fluctuations in the high-tide swash line and additional context for the interpretation of GULN shoreline position reports.

Table B-1. Percent slope related to topographic transects surveyed in 2017 and 2019 and the slope change between surveys. The slopes are averaged for adjacent groups of transects.

Transect	2019	2017	Slope Change
'tran(9)'	2.89%	5.32%	-2.43%
'tran(10)'	3.06%	4.87%	-1.81%
'tran(11)'	3.18%	5.08%	-1.89%
'tran(12)'	3.38%	4.51%	-1.13%
'tran(13)'	4.03%	3.88%	0.16%
'tran(14)'	3.08%	4.99%	-1.91%
'tran(15)'	4.35%	3.65%	0.70%
'tran(16)'	3.84%	4.47%	-0.64%
Closed Beach	3.48%	4.60%	-1.12%
'tran(23)'	3.27%	3.84%	-0.57%
'tran(24)'	3.27%	4.03%	-0.76%
'tran(25)'	2.87%	4.77%	-1.91%
MM 5	3.13%	4.21%	-1.08%
'tran(38)'	3.04%	3.84%	-0.80%
'tran(39)'	3.07%	3.81%	-0.74%
'tran(40)'	3.22%	4.61%	-1.39%
MM 15	3.11%	4.09%	-0.98%
'tran(73)'	4.59%	4.32%	0.27%
'tran(75)'	6.51%	4.56%	1.96%
'tran(77)'	6.37%	4.00%	2.38%
MM 35	5.83%	4.29%	1.54%
'tran(101)'	5.21%	8.24%	-3.03%
'tran(103)'	4.37%	8.25%	-3.88%
'tran(105)'	5.37%	4.06%	1.30%
'tran(107)'	5.87%	7.12%	-1.26%
'tran(109)'	4.46%	6.93%	-2.46%
'tran(111)'	4.04%	4.23%	-0.19%
Mansfield Channel	4.886%	6.473%	-1.59%

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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