

**2018 ANNUAL REPORT - TO THE CITY OF NORTH WILDWOOD
ON THE
CONDITION OF THE CITY BEACHES**



Aerial view of North Wildwood looking southeast from Hereford Inlet on November 18, 2018 showing nearly the entire City plus the rest of the Wildwoods barrier island to Cape May Inlet. The new bulkhead is evident starting at 5th Avenue, the narrow beach seaward of the dunes south to the lifeguard office at 15th Avenue, and the wider beach further south to the three amusement piers. There are two bars, one at the low tide line, the other offshore extending from the inlet south into Wildwood. The accumulation of shoal sand northeast of the inlet jetty is also evident with the expectation of greater accretion to come in 2019. Yes, the vast width of the Wildwood beach is largely due to the fact that Wildwood and Wildwood Crest development is essentially parallel to Surf Avenue in North Wildwood. (Aerial photo taken by Ted Kingston)

**PREPARED FOR: THE CITY OF NORTH WILDWOOD
901 ATLANTIC AVENUE
NORTH WILDWOOD, NJ 08260**

**PREPARED BY: THE STOCKTON UNIVERSITY COASTAL RESEARCH CENTER
30 WILSON AVENUE
PORT REPUBLIC, NJ 08241
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TABLE OF CONTENTS

Introduction	1
2018 Weather Events	1
Figure 1. Comparison of 1995 and 2016 Air Photographs of the Northern No. Wildwood Beach	2
Figure 2. September 2018 Air Photograph of Hereford Inlet Looking at North Wildwood Inlet Shoal Migration Since 2011	3
Figure 3. Series of Air Photographs of Hereford Inlet, 2011 to 2018	4
Figure 4. December 2001 Air Photograph of the Hereford Inlet No. Wildwood Shoreline Engineered Beach Performance	5
Oceanfront Beach Surveys in 2018	5
Figure 5. Representative Profile Locations on the North Wildwood Beach	6
Table 1. Annual Beach Changes at Selected Beach Cross Sections	7
Sand Back-pass Operations	7
Digital Elevation maps for North Wildwood.	8
Figure 6. Spring 2018 Elevation Model of North Wildwood Beach & Bathymetric Data	9
Figure 7. Fall 2018 Elevation Model of North Wildwood Beach & Bathymetric Data	10
Figure 8. Digital Comparison of the Spring 2018 to the Fall 2018 Elevation Data	11
Figure 9. Digital Comparison of the Fall 2017 to Fall 2018 Elevation Data	12
Individual Site Reviews	13
Figures 6-7. Site 00+00 photographs and cross sections	14
Figure 8. Site 02+00 cross sections	16
Figures 9-10. Site 04+00 photographs and cross sections	18
Figures 11-12. Site 06+00 photographs and cross sections	20
Figures 13-14. Site 20+00 photographs and cross sections	22
Figures 15-16. Site 40+00 photographs and cross sections	24
Figures 17-18. Site 52+00 photographs and cross sections	26
Figures 19-20. Site 58+00 photographs and cross sections	28
Figures 21-22. Site 60+00 photograph and cross sections	30
Figures 23-24. Site 64+00 photograph and cross sections	32
Summary/Conclusions	34

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Introduction:

In spite of hauling 191,000 cubic yards of sand from the City of Wildwood's beach and stormwater discharge pipelines in 2017, the multiple northeast events from March to May of 2018 exacted a toll that demanded emergency work reinforcing the bulkhead defense south of 3rd Avenue. The beach width from 2nd to 8th Avenues is zero to 50 feet at high tide with any storm event wave run-up able to continue dune erosion where a dune remains in place. Profiles do show relative stability south of 20th Avenue into Wildwood. The beach elevation is lower, but about as wide as it was a year earlier. Work with sand back-passing continued in the spring of 2018 following the majority of the spring 2018 northeast storms, the last of which occurred on Mother's Day.

The Hereford Inlet shoreline is also eroding back rapidly. The beach is all but absent until just southeast of the Surf Avenue beach access path which ends in the water at high tide making beach entry for vehicles impossible. The pond to the northwest is now open to daily tidal flow and the dune once between the inlet beach and the pond is heavily eroded. Near Central Avenue, the beach remained relatively stable, but narrowed to the point where the main channel produces a very steep drop into deep water.

While North Wildwood maintains a 6,800-foot oceanfront beach and dune system as an engineered beach feature designed back in 2009 with New Jersey Department of Environmental Protection assistance, erosion at the junction between Hereford Inlet and the oceanfront is currently critical. The nourishment history beginning in 2009 has been subject to a series of storms classified as FEMA disaster events and therefore subject to Category "G" reimbursement for losses suffered from a declared storm event. Back passing provided 171,000 cubic yards by mid-May 2016, another 190,000 cubic yards by May 2017, and most recently 153,375 cubic yards by Memorial Day, May 2018. *"The City will harvest from Wildwood through May 11, 2018. The contractor must be finished all work in North Wildwood by May 24, 2018, weather permitting. The contractor is C. Abbonizio Contractor, Inc. from Sewell, NJ"*. A similar arrangement is being considered to commence shortly for spring 2019.

2018 Weather Events:

January and February were cold and dry without storm events, but March, April and May contributed 7 total mild to mild/moderate events with the worst occurring on March 2 & 3 and a repeat March 20 & 21, 2018 with 50 MPH winds. Summer accretion did occur south of 15th Avenue, but nothing appeared on the northern beaches. Offshore a vast area of shallow water dominates the region northeast of the gazebo at 2nd and Kennedy Boulevard. The fall 2018 survey offshore in Hereford Inlet for the NJDEP finds water depths at high tide between 4 and 6 feet over 1,000 feet east and northeast of the City shoreline. However, there is a channel trough immediately seaward of the tip of the rock jetty allowing tidal flow to flush any sand accumulations either offshore from the beach or into the inlet onto the island shoals that exist northeast of Surf Avenue to NJ Avenue.

Presented below are two air photographs showing the northeast corner of the City from March 1995 prior to major oceanfront changes and from August 2016 just prior to the most recent sand losses. In the 1995 view, the beach width at the north end of the City's oceanfront was close to 1,000 feet in width and when retreat commenced in that time frame, the loss rate did not appear to depend on storm frequency or seasonality for loss evaluation. Then the only survey site was the NJ State site at 15th Avenue where work commenced in 1986 and showed that between 1994 and 2004, 1,057 feet of shoreline retreat occurred. This is the data confirming the

visual losses pressed on the staff at the Division of Coastal Engineering by City officials resulting in the 2009 hydraulic restoration of the North Wildwood oceanfront.



Figure 1. The northeast quadrant of the City of North Wildwood between March 1995 and August 2016 shows that oceanfront erosion appears related to large changes in shoal position and exposure at low tide in Hereford Inlet. In 1995, an exposed island sat between Central and Surf Avenues forcing a branch of the main tidal channel against the North Wildwood shoreline. There was no beach at the inlet shore until southeast of Surf Avenue. There was an extensive exposed sand flat system attached to the beach front bar system extending into the inlet. The ebb-tidal currents exited in proximity to the oceanfront beach and deposited sand in transport where wave action could easily move it to the beach bar system, and eventually onto the dry beach. In the mid-1990's the main channel shifted to the northeast, away from North Wildwood allowing the flood-tidal currents to move sand from the oceanfront beach into the inlet along the North Wildwood shoreline depositing the sand spit that has been present since. At its maximum extent (2001), this spit was over 600 feet in average width, with a pond created when the spit tip attached to the inlet shoreline near New Jersey Avenue (extended). As of the August 2016 view, the beach narrowed rapidly starting at 7th Avenue to the inlet, but still showed a dry beach width at the inlet jetty. Sand was continuing to be transported into the inlet generating the new spit reaching almost to Central Avenue. Since then the main tidal channel has shifted more to the northeast and a new island shoal formed by 2011 with a secondary channel between it and the City's inlet shoreline. Since 2011, this shoal has migrated toward the inlet jetty further constricting the channel close to North Wildwood. This channel needs to close considerably before the 1995 conditions are re-established. Then and only then will the oceanfront beaches preferentially receive sand instead of shedding it both south into Wildwood City and northwest into Hereford Inlet.

A recent aerial photograph (Figure 2) on September 22, 2018 from a series of shots by Mr. Ted Kingston for the CRC (Figure 2). It shows the best relationship between the inlet, its beaches and shoal system and the North

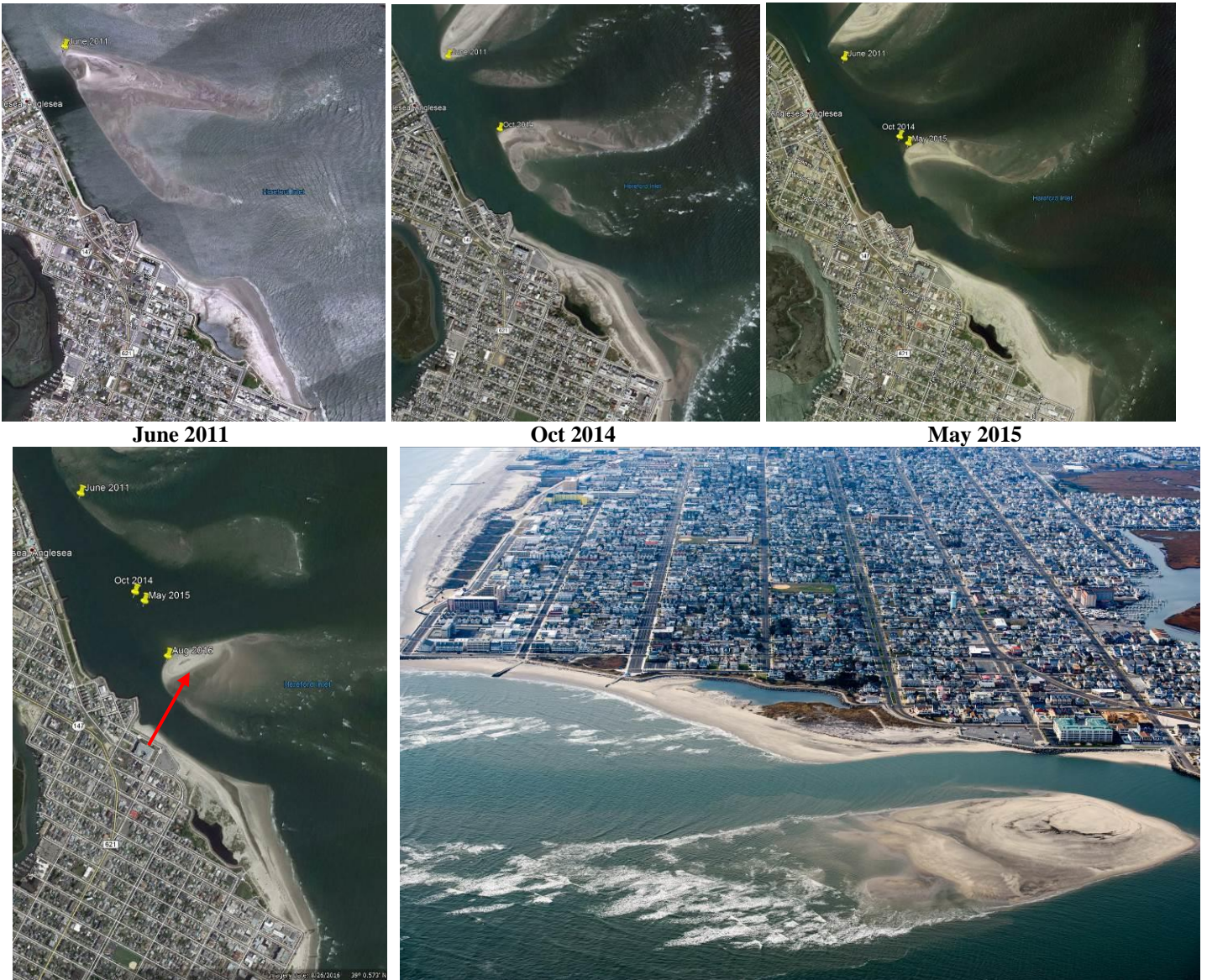
Wildwood inlet and oceanfront shorelines. The changes since August 2016, in spite of almost 500,000 cubic yards of Wildwood City sand hauled back to the northern North Wildwood shoreline demonstrate the intensity of sand movements away from the 2nd Ave. and Kennedy Blvd. corner of the City.



Figure 2. September 22, 2018 view from over Hereford Inlet looking southeast at the inlet shoreline, the new island shoal and the depleted oceanfront beaches. The island shoal was present in August 2016, but 350 feet further northwest up channel. The pattern of breaking waves indicate where shallow water exists presently and outlines the main tidal channel in the foreground northeast of the island shoal. The secondary channel lies between the shoal and the North Wildwood shoreline. To the northeast of the 2nd and Kennedy Boulevard jetty there is a narrow, 8-foot deep channel which funnels sand into the inlet from the oceanfront beach, while immediately offshore from this channel there lies 50 acres of shoals less than 5 feet deep at high tide (November 2018 survey data). The inlet beach is eroding to the point where the Surf Avenue vehicle entrance ramp exits into the water, not on the beach sand and the small pond, present since the 1990's is again open to tidal flow across the beach every high tide. This island shoal needs to move two city blocks to the southeast and about 100 yards closer to North Wildwood to re-establish conditions at the inlet replicating those in place in 1995.

Inlet Shoal Migration Since 2011:

Further examination of the Google Earth historical aerial series shows that the shoal island formed sometime prior to 2011 about 2,600 feet northwest of its 2016 position. The set of photographs (Figure 3) show the progression over the past 7 years where the new island shoal has been moving steadily toward the 1995 position shown in Figure 1. There appears to be a cyclic progression between the proximity of an island shoal to the North Wildwood shoreline and ebb-tidal flow dominance generating a sand supply for the oceanfront beach and following the loss of the shoal, a return of flood-tidal flow dominance which transports beach sand into the inlet along the North Wildwood inlet shoreline toward the northwest. Historical mapping has shown such cycles all during the 20th Century, most recently in the 1960's when a very large spit dominated the inlet shore in North Wildwood.



Above are three snapshots from 2011, 2014 and 2015. On the lower left, an Aug 2016 photo - Red Arrow points to the Sept 2018 position, while on right shows the shoal as of Nov 18, 2018.

Figure 3. A series of aerial photographs taken from Google Earth starting in 2011 to show the progressive southeasterly migration of an exposed island shoal in Hereford Inlet which is moving toward the inlet jetty and closer to the North Wildwood inlet shoreline. As it approximates the 1995 position (Figure 1), the impact on the inlet and oceanfront beaches can be expected to cause; a), the inlet beach between the jetty and Central Avenue to virtually disappear, and b), sand to be deposited immediately seaward of the 2nd to 3rd Avenue oceanfront beach where it will move landward adding to the beach width at the jetty. This presumes that the 1995 shoal position scenario will duplicate said conditions in 2019 or 2020. The most recent air photograph is from November 18, 2018 and shows a larger island since Aug. 2016 with a channel between it and North Wildwood exiting about 500 feet north of the inlet jetty.

02+00; 04+00; 06+00; 20+00; 40+00; 52+00; 58+00; 60+00; and 64+00. These sites were chosen for 2018 to show the range of performance changes across the project. The four northern sites document changes in the historically erosional zone, the middle three sites show the changes in the mid-section of the island, and the southern three sites document the changes in around the four pier sites south of 21st Avenue. A discussion of the changes at each of these locations is provided in a later section of this report. The following is a list of the studies included in this report and the respective survey dates are:

- **Survey 30** **March 23, 2017**
- **Survey 31** **April 28, 2017**
- **Survey 32** **October 19, 2017**
- **Survey 33** **June 13, 2018**
- **Survey 34** **October 25, to November 11, 2018**

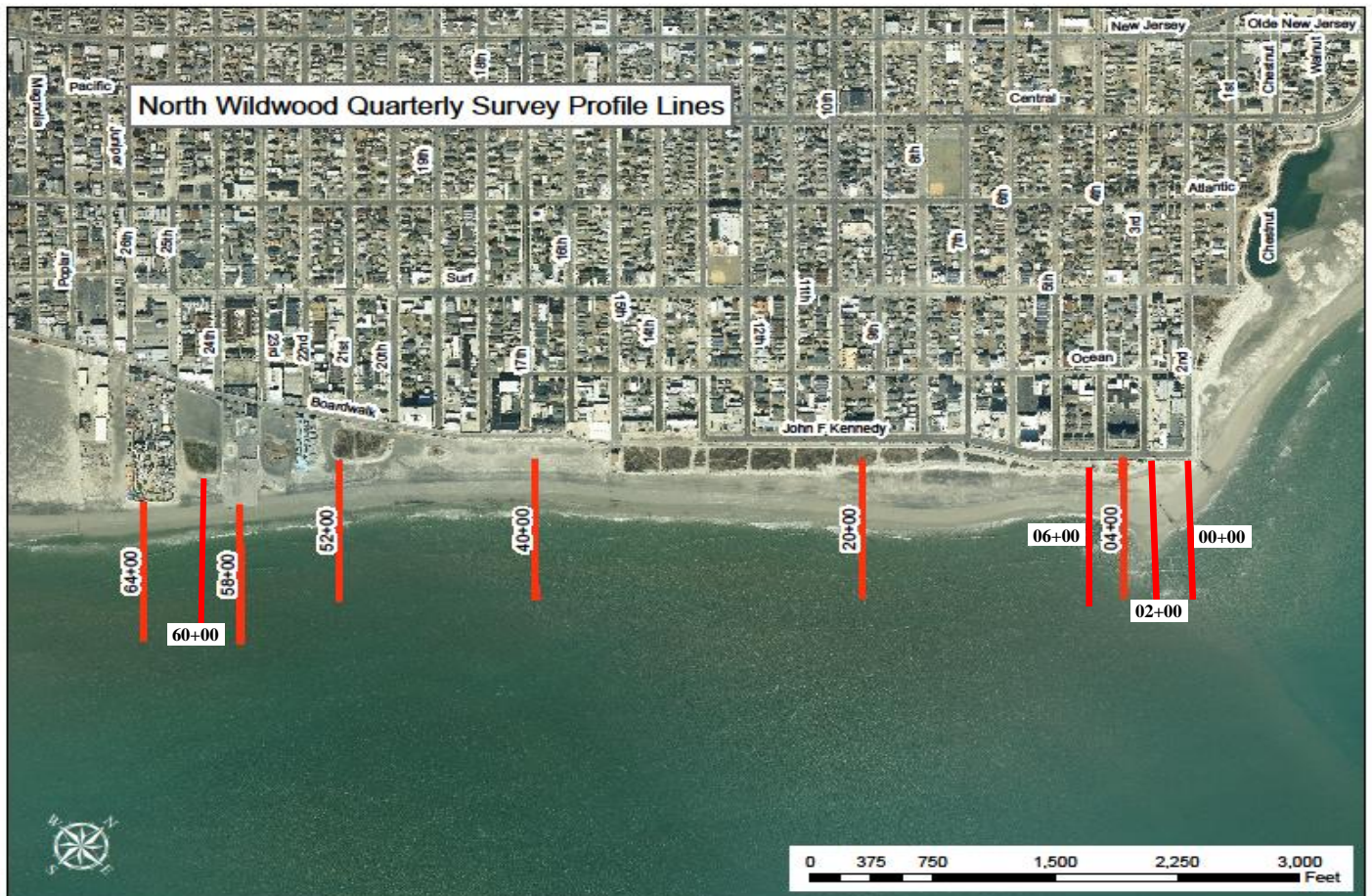


Figure 5. Shown above are locations of ten representative profile sites of the 54 profile stations where shoreline changes were measured on the City’s oceanfront from October 2017 to November 2018. For each of the ten profile stations descriptions and cross sections are provided to show typical changes over the year. This year surveys were included at the jetty, 200 feet, 400 feet, and 600 feet south of the jetty in the set of profiles. In addition, 6 survey lines are completed along the inlet beach in Hereford Inlet. They are spread non-uniformly from the 2nd Avenue jetty to Central Avenue northwest of the jetty. Four go at 200-foot spacing from the jetty to 600 feet northwest, another at 1,200 feet and the final survey line at 2,400 feet northwest at the end of Central Avenue. These survey line data are included in the Digital Elevation Maps (Figure x).

Last year, the comparison between the sand volume on the beach in the fall of 2016 versus the quantity present in October 2017 showed the concentration of losses focused on the northernmost 2,000 feet of oceanfront beach. The sum of losses reached 182,968 cubic yards by site 20+00, located between 9th and 10th Avenues. During the same time interval the southern 4,800 feet of oceanfront beach actually gained 51,846 cubic yards, most likely derived from sand eroded from the northern beach. This year the losses were concentrated between

600 and 2,000 feet south of the inlet jetty and generally decreased to the south. The net loss on the oceanfront based on 10 of the 54 profile lines was -193,426 cubic yards (Table 1).

Table 1
Sand Volume Comparison on the North Wildwood Oceanfront Beach
October 2017 to November 2018

Profile	Shoreline Change (feet)	Volume Change (cu yds/ft.)	Avg. Volume (cu yds./ft.)	Distance Between (feet)	Dune/Beach Changes (cu yds)	Cumulative Changes (cu yds)
<i>Hereford Inlet Shoreline</i>						
			32.50	400	13,000	13,000
0+00	21	32.50				
			12.15	1600	19,446	32,446
02+00	29	-8.19				
			-18.31	400	-7,323	-7,323
04+00	-56	-28.42				
			-39.19	400	-15,676	-15,676
06+00	-76	-49.96				
			-49.84	1600	-79,742	-87,065
20+00	-119	-49.72				
			-33.11	2000	-66,229	-153,294
40+00	-72	-16.51				
			-7.00	1200	-8,395	-161,689
52+00	-8	2.52				
			-2.97	600	-1,780	-163,469
58+00	-43	-8.45				
			-6.04	200	-1,208	-164,677
60+00	-16	-3.62				
			-12.10	400	-4,841	-169,518
64+00	-29	-20.58				
			-20.58	400	-8232	-177,750
<i>Wildwood City Border</i>						
			Total Cubic Yards Vol Change		-193,426	

The one bright spot this year was that the largest gain in sand volume and advances in shoreline position were seen at the jetty and 200 feet south of the inlet jetty. The annual gain at the inlet jetty (00+00) was seen offshore both in the spring and fall surveys (On the beach; *Spring = -0.10 yds³/ft.*, *Fall = 0.67 yds³/ft.*; Offshore; *Spring = 27.01 yds³/ft.*; and *Fall = 32.50 yds³/ft.*). These sand volume increases offshore correspond with the observations made from land and the series of air photos shown above.

The loss numbers on the rest of the beach were larger below the zero elevation datum this year meaning that sand eroded from the ocean beaches from beyond approximately mid-tide levels, while the beaches south of a point 600 feet south of the inlet jetty retained sand during 2018 with minor loss or gains seen.

Back Pass Operations:

The past three years of major sand harvesting effort using Wildwood City sources commenced in the spring of 2016. By Memorial Day 165,000 cubic yards had been placed in a beach berm parallel to the dune toe from 3rd Avenue, south toward 8th Avenue. The dune scarp was augmented with sand pushed up to yield a more natural slope and blend in the beach to the dune’s seaward slope.

Following the March 14, 2017 northeast storm, the City commenced hauling sand from the stormwater discharge points in the City of Wildwood using heavy trucks to move material to the erosion zone at 3rd Avenue. The estimate from truck logs indicated placement of about 190,000 cy of sand by mid-May 2017. The material was deposited at the northern section of the beach and suffered early losses into the inlet around the 2nd Avenue jetty.

In 2018, material was again harvested (153,375 cu. yds.) from the storm water outfall areas and berm between discharge points and truck hauled up to the zone of serious erosion. The distribution was more regional this year with material lasting through the summer season. However, the loss rate was again severe with material moving both into the inlet and south along the North Wildwood shoreline. The beach width between the jetty and the new bulkhead is zero at high tide with dune scarping extending south to 8th Avenue and a narrow beach from there south to 15th Avenue.

While a major hydraulic beach restoration project might serve the City's immediate future needs, this prospect has the issue that Hereford Inlet is part of the Coastal Barrier Resources System NJ-09, that has definite restrictions on spending federal funds to move sand outside the CBRS to North Wildwood. Unless Congress actually changes this 1982 Act, there will be no future federal funds for moving sand from the inlet borrow zone to the beach. The USACE has elected to focus its project for the Wildwoods on sand back-passing in a larger scale because of this restriction on available sand supplies. Mining the very southern extent of this barrier island is also off limits due to the fact that the undeveloped beach section at Cape May Inlet is now part of the Cape May Wildlife Refuge. This agency has no interest in allowing sand acquisition either on the beach or offshore related to fears for habitat disturbance by doing so.

The State of NJ and any local or county entity is free to take sand from the CBRS area in Hereford Inlet with appropriate state and federal permits, but the cost to North Wildwood is fixed at 25% of the project cost instead of 8.75% if federal money was involved with a USACE effort and a NJ State partnership. The 2009 initial beach restoration effort was a State and local partnership without federal funding. FEMA reimbursed the City at 75% of expenses for repair efforts made following a number of federal storm disaster declarations starting with the Veteran's Day storm of 2009.

Digital Elevation Models for 2017 & 2018:

The CRC has been surveying both the oceanfront beach for the City and Hereford Inlet bathymetry for the State of NJ, DEP since 2009. The annual review took place twice on the North Wildwood beaches (June and October/November 2018 and once in November for Hereford Inlet. There are 54 survey lines positioned 200 feet apart on the oceanfront and along the inlet shoreline in North Wildwood. The line spacing increases to the northwest along the inlet beach in proximity with Central Avenue.

A series of four maps were prepared to show potentially important changes during 2018 which were confirmed by the beach profile transect comparisons. The maps focus on the central beach losses seen, but also show the large volume of new sand deposited around the inlet jetty and to the nearby region to the northeast in the inlet. Figures 6 and 7 depict the existing conditions found in June (Figure 6) and in November (Figure 7), while Figures 8 and 9 depict the direct comparison differences (gains and losses). Figure 8 shows regions of gain v. loss between spring and fall 2018. Figure 9 shows the comparison between fall 2017 and fall 2018.

The November survey shows a narrow oceanfront beach with a large area of shoaling immediately northeast of the 2nd Avenue jetty. This sand was not entirely derived from sand hauled back from the City of Wildwood over the past two years. Some did move into the inlet, but most appears to have been transported south to the beaches between 15th Avenue and the Wildwood boundary where summer accumulation seems to have occurred in volumes approximating the losses seen on the beach to the north.

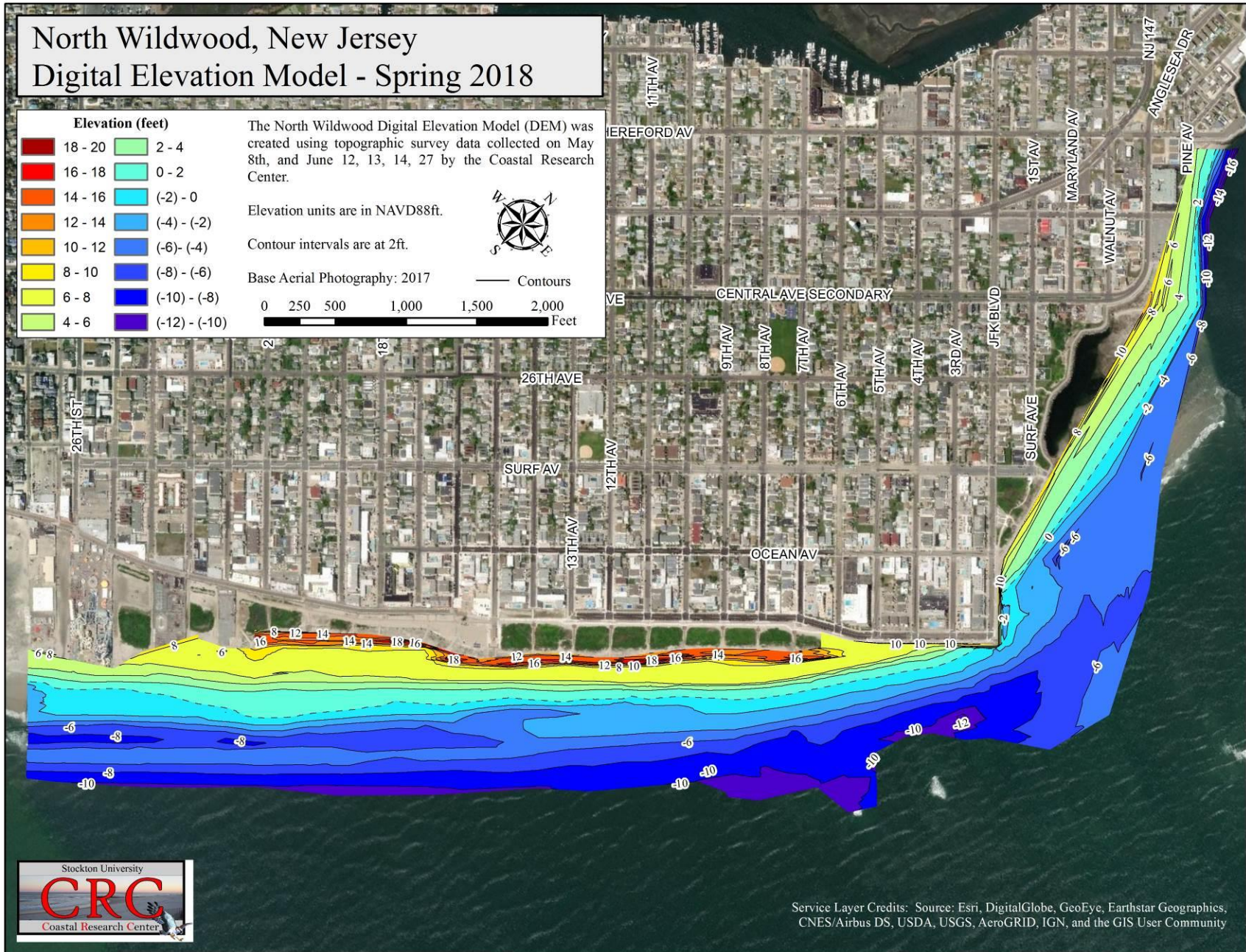


Figure 6. Digital elevation map for North Wildwood’s ocean and inlet beaches for the spring of 2018. Most areas show a gradual deepening moving seaward.

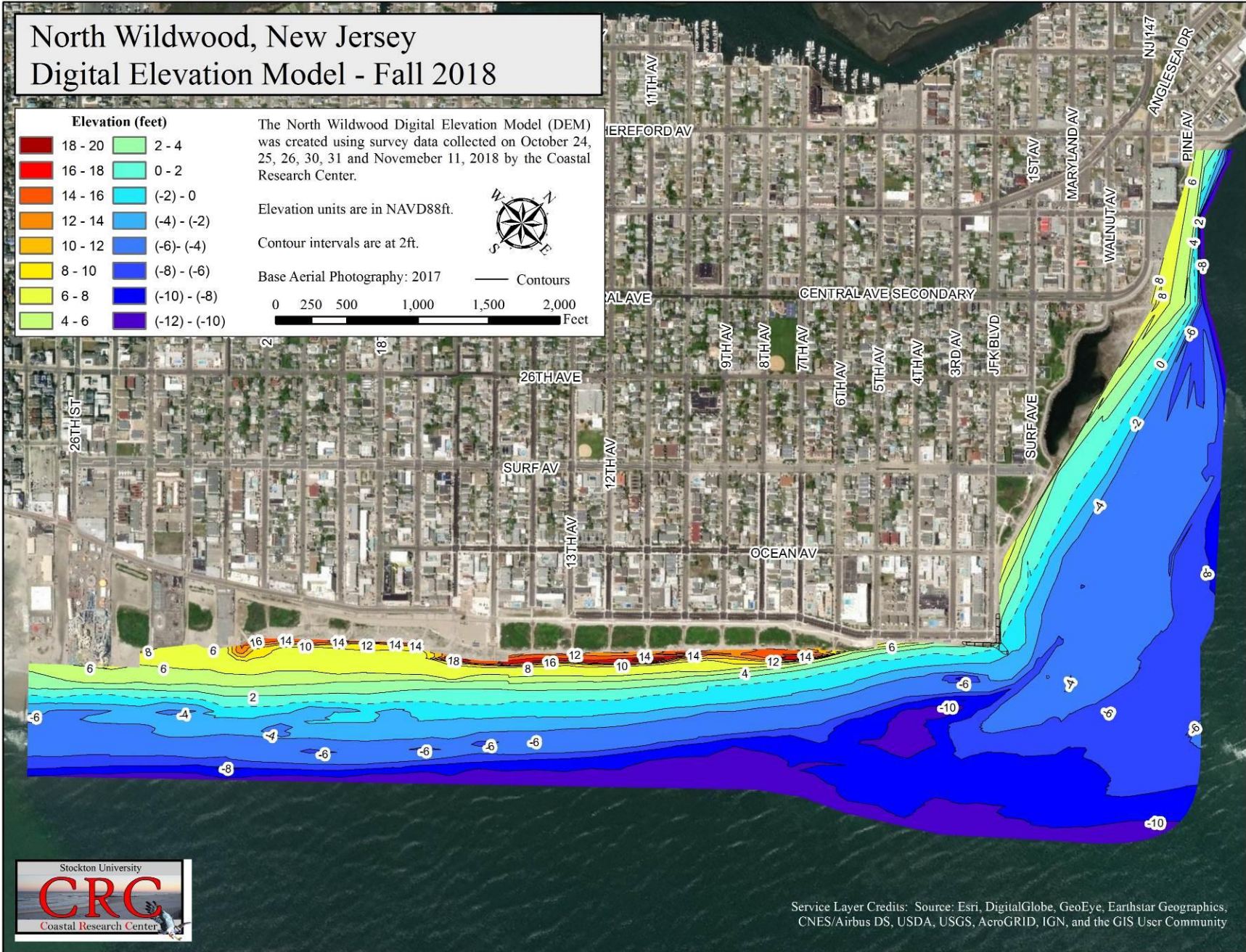


Figure 7. The elevation data from November 2018 shows a narrower oceanfront beach combined with an expanded area of shoals to the northeast of 2nd Avenue.

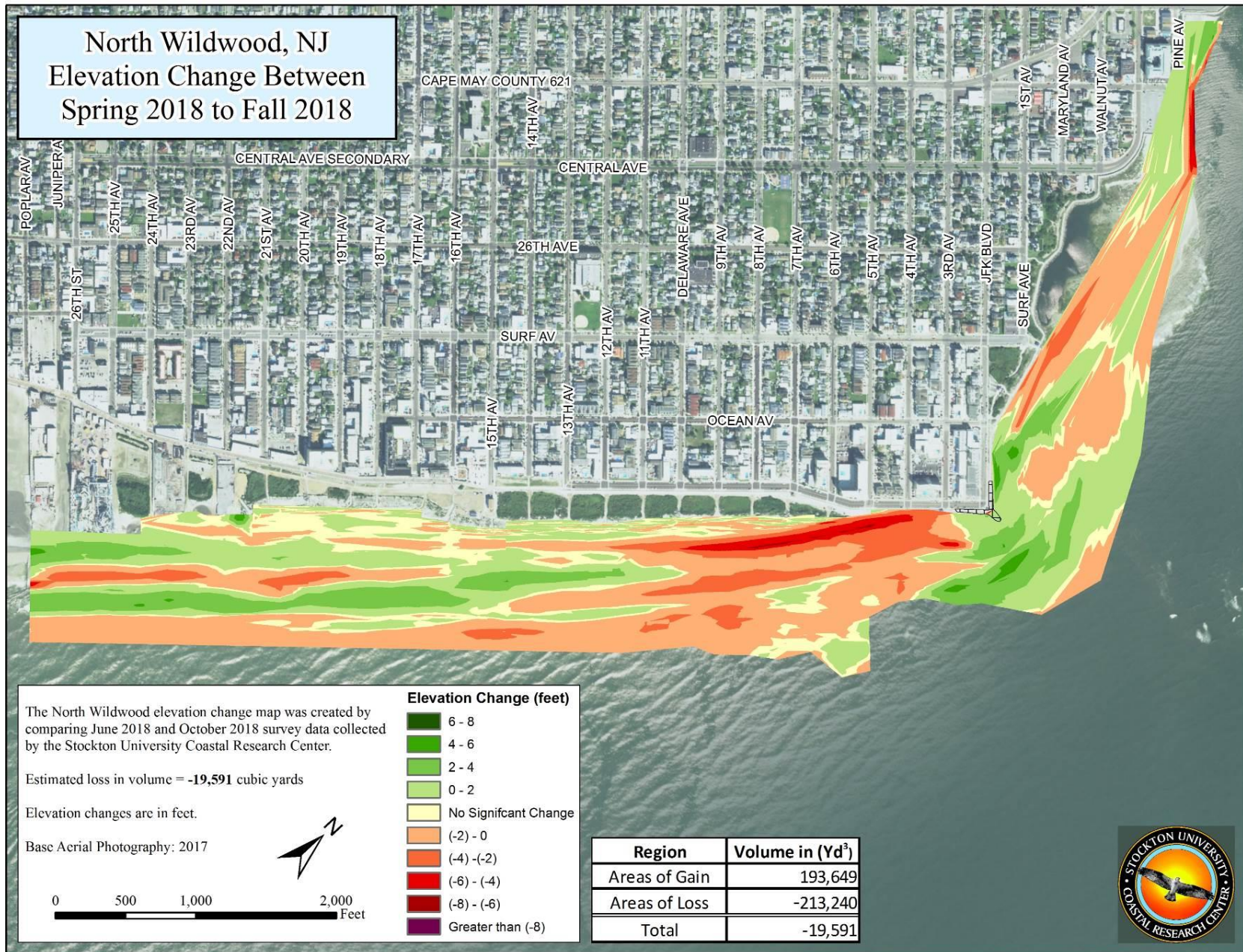


Figure 8. Between the spring and fall 2018 surveys, the oceanfront beaches lost sand offshore and suffered regional loss between 3rd and 12th Avenues with the dunes suffering the worst in total thickness of sand taken away. However, the summer saw substantial accumulation of sand around the 2nd Ave. jetty. The beachfront sand loss appears as deposition in long ridges south of 10th Avenue.

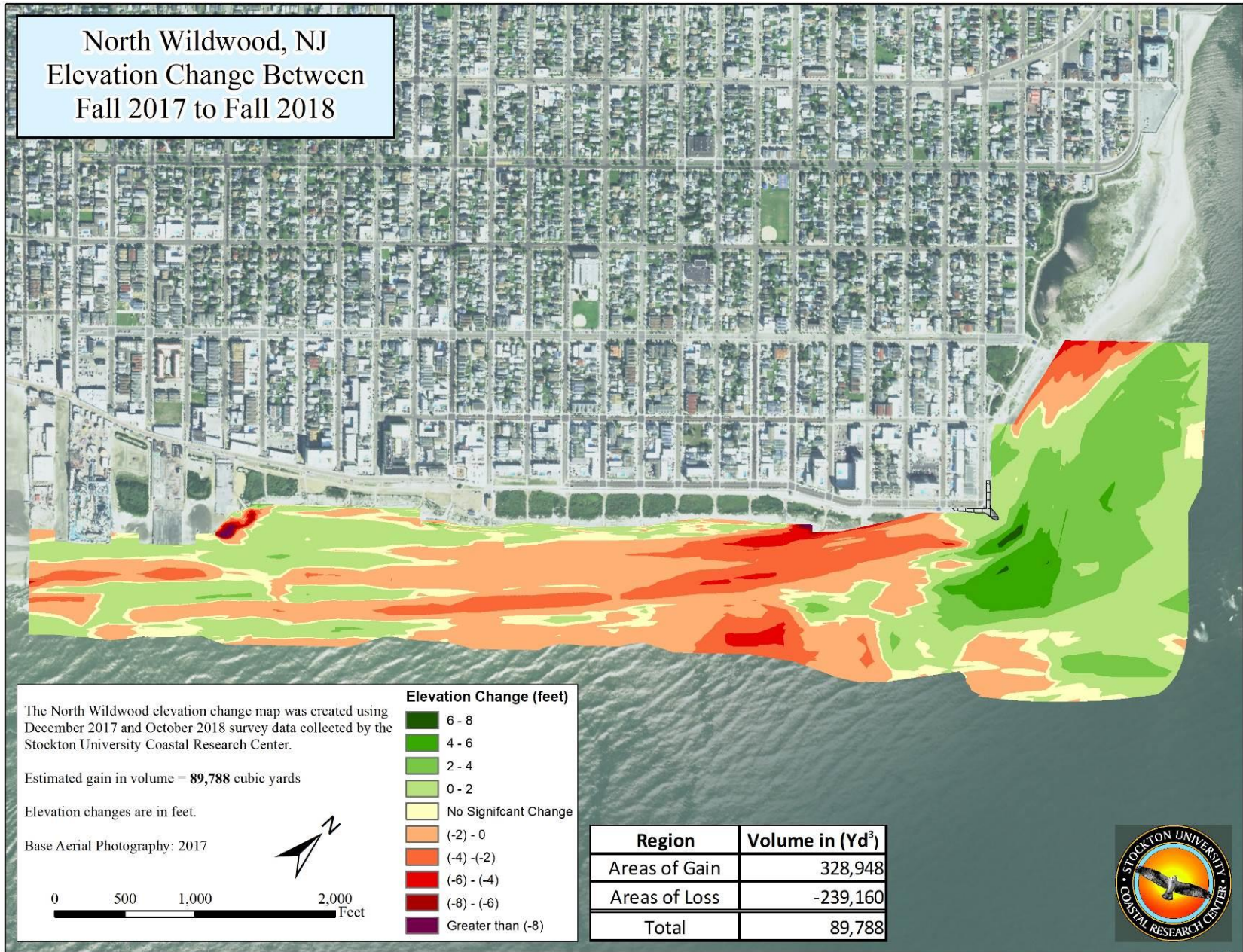


Figure 9. The fall 2017 comparison to November 2018 dramatically illustrates the changes seen in the individual beach transects. The oceanfront lost material in vertical amounts approaching 6.0 feet while to the northeast of the 2nd Ave jetty, the gains resulted in up to 8.0 feet vertically resulting in a digitally calculated sand volume gain of 328,948 cubic yards the vast majority of which is under water near the 2nd Avenue beaches.

The deposition seems concentrated at the seaward end of the 2nd Avenue jetty with the 8.0-foot dark green contour about 150 feet seaward of the jetty. The fall bathymetric survey was done under ideal conditions with no waves, so reflects good coverage from both the beach transects which go into water 700 feet or more from the water's edge to overlap the boat lines that continue seaward for 2,000 feet. The sand volume added is concentrated in this area and is being augmented by the ebb tidal flow moving Hereford Inlet material into this position as a result of the sand shoal island moving to the southeast toward the 1995 position seen in Figure 1. The large volume of gain exceeds the sand back-passed from Wildwood over the past two years, some of which did move to the Hereford Inlet shoreline beaches, but not to the extent shown in Figure 9. The back-pass sand is likely the source of the accretion seen in the green-colored ridges on the beach south of 15th Avenue.

The beach losses are also evident in the annual comparison where between 3rd and 16th Avenues moderate loss occurred across the transect line and severe loss occurred at the dunes with a deep spot seen offshore from 8th Avenue. However, as previously stated, sand shed from these beaches appears to have accumulated in ridges parallel to the shoreline south of 16 Avenue to the Wildwood border.

The final notable place where change occurred lies seaward and northwest of Surf Avenue where erosion claimed considerable width of the inlet shoreline associated with the pond that formed here in 2001 (Figure 4). Figure 8 shows that this was problematic even during the past summer where erosion was dominant in this segment.

Individual Site Review:

This section describes the shoreline and volume changes documented at selected profile locations to show general trends in sediment movement along the City's beaches for 2018. Annual beach volume and shoreline changes were calculated from October 2017 to November 2018.

Site 00+00 (at the inlet jetty)

This year the first profile line was included to show the additions to the offshore region in the immediate vicinity of the Hereford Inlet jetty. This line starts at the oceanfront side of the jetty and extends perpendicular to the seawall into the ocean. There is no high tide beach present, with the first data points as of October 2018 presently just above zero elevation NAVD 88. This represents a substantial improvement since June 2018 when the beach points started a -1.5 feet elevation (approximately low tide).

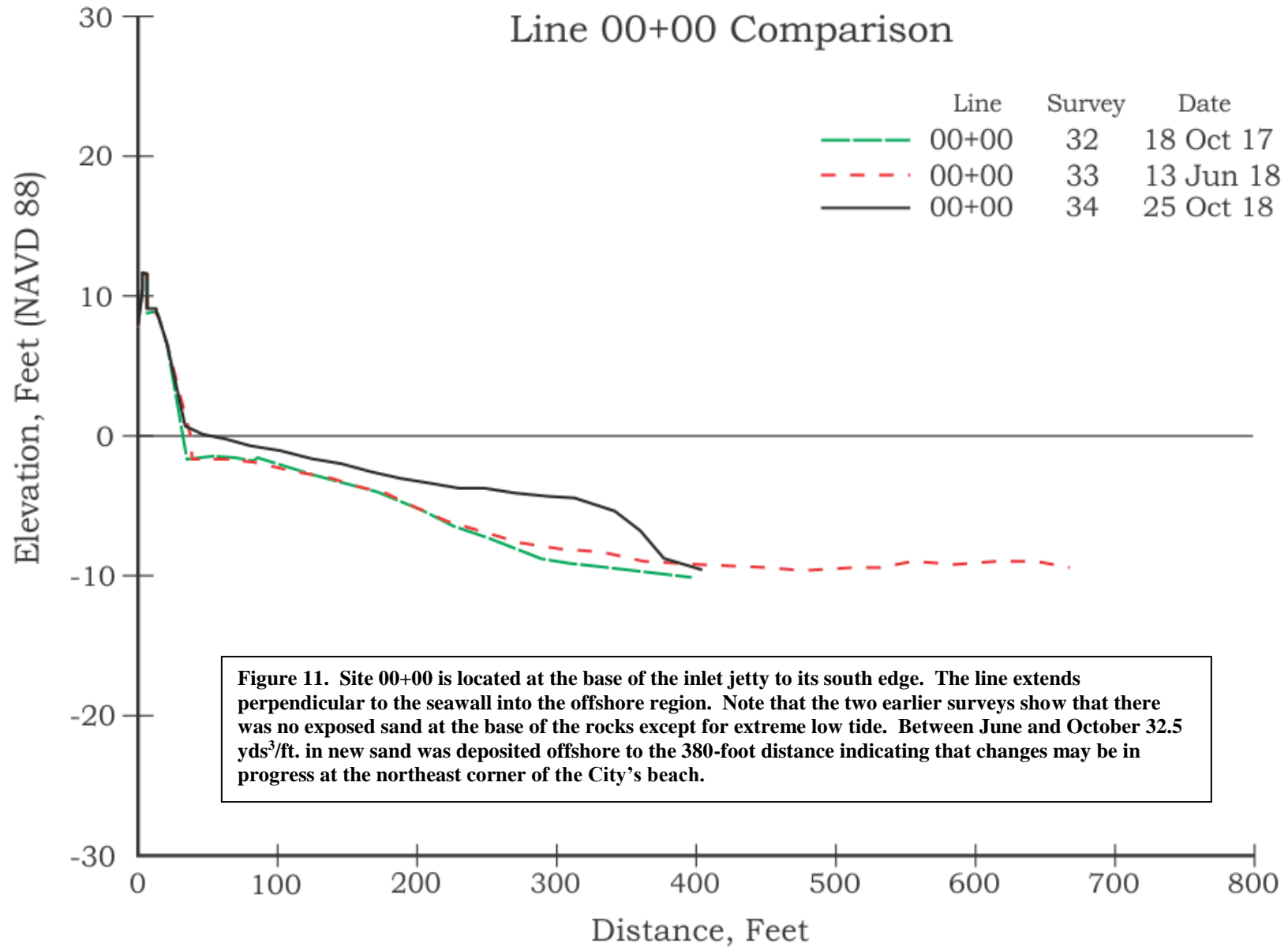


Figure 10. View to the north taken November 11, 2018 showing the inlet gazebo and inlet jetty beach. This position approximates 02+00 station with site 00+00 located on the other side of the pipeline.

The site is currently not useable for recreational purposes other than watching the sea from the gazebo or fishing. However, the most recent survey finds that offshore 32.50 yds³/ft. of new sand has been added extending in a berm-like deposit closing out with the June 2018 profile at a 380-foot distance from the seawall. The prospect of the island shoal, now located between Central and Atlantic Avenues (extended into the inlet) to further enhance sand deposition in this vicinity appears better than previously noted.

City of North Wildwood - Semi-Annual Comparison

Line 00+00 Comparison

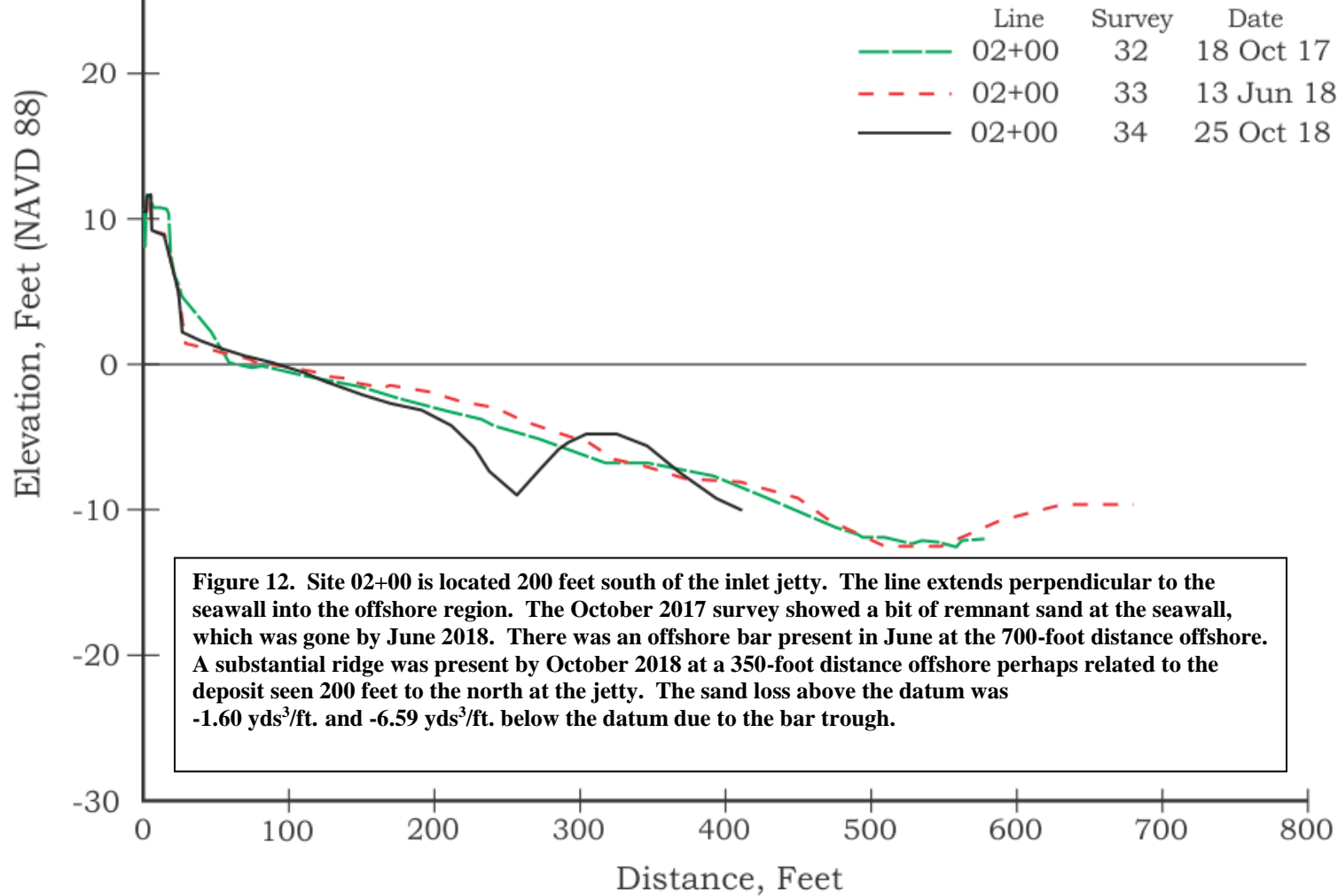


Site 02+00 (about 100 feet south of the inlet gazebo)

The photograph above for site 00+00 (Figure 6) also serves to illustrate conditions 200 feet south of the inlet jetty. Here, sand also appears on the beach in November 2018, but in a much smaller volume. The beach starts at approximately the elevation of mean high tide at the rocks and slopes quickly below the zero datum elevation. The late October 2018 survey showed that offshore, a sizeable bar had formed with a trough between the beach and the bar. This trough essentially produced the small negative sand volume change seen (-6.59 yds³/ft. below the zero datum).

City of North Wildwood - Semi-Annual Comparison

Line 02+00 Comparison



Site 04+00 (between 3th and 4th Avenues)

The site is located in the northern portion of the island adjacent to Hereford Inlet 400 feet south of the 2nd Avenue jetty. This area has typically been an erosional shoreline due to its proximity to the inlet and the direct impact from northeast storms. Sand placed here during episodes of back-passing show in the October 2017 and June 2018 survey data, but the beach was eroded to a narrow strip by October 2018. An offshore bar was present in the fall of 2018 indicating sand accumulation offshore related to inlet geomorphic changes which may prove positive to the north end beach.



Figure 13. View to the south taken from directly in front of the cap on the new bulkhead that starts just south of the 3rd Avenue gazebo on November 5, 2018. The beach is wet almost to the bulkhead as the fall 2018 survey indicates in figure 10 and the sand loss extends 320 feet offshore totaling 28.42 yds³/ft. Clearly the sand that has appeared at the inlet jetty at site 00+00 did not arrive by transport north along the shoreline. Sand from this location has moved south generating the losses documented. The 5-foot remnant of the sand back-passed from Wildwood during the late spring of 2018 is all that is left in place from that effort.

City of North Wildwood - Semi-Annual Comparison

Line 04+00 Comparison

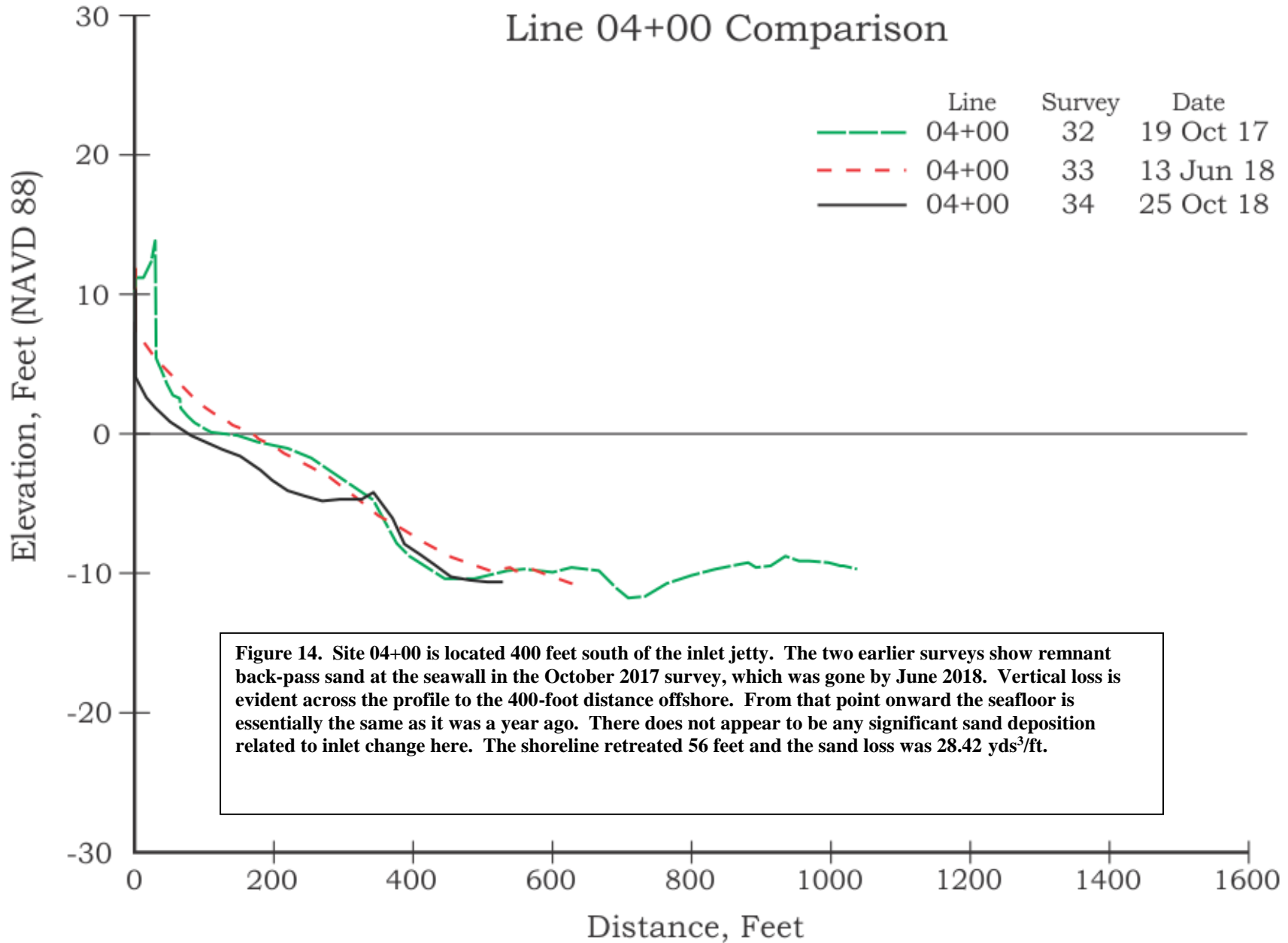


Figure 14. Site 04+00 is located 400 feet south of the inlet jetty. The two earlier surveys show remnant back-pass sand at the seawall in the October 2017 survey, which was gone by June 2018. Vertical loss is evident across the profile to the 400-foot distance offshore. From that point onward the seafloor is essentially the same as it was a year ago. There does not appear to be any significant sand deposition related to inlet change here. The shoreline retreated 56 feet and the sand loss was 28.42 yds³/ft.

Site 06+00 (approximately at 4th Avenue)

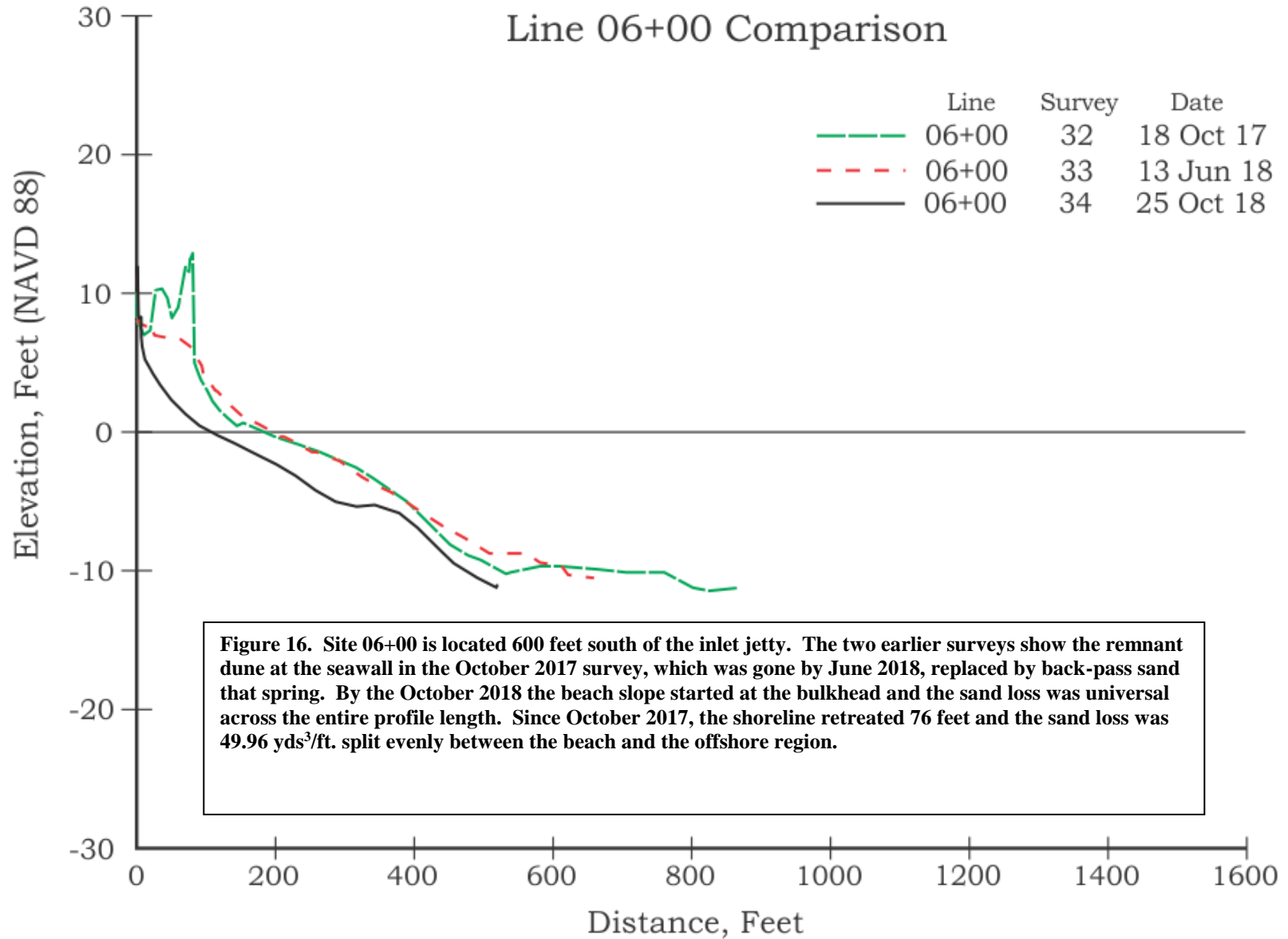
The third of the northern survey sites added to the review this year is located at the end of 4th Avenue where the new bulkhead was completed in early 2018. In 2017 a remnant dune existed at this site, replaced by sand transported from Wildwood City by the time of the June 2018 survey. As of October 25, 2018 the erosion had cut the sand supply back to a starting point for sand elevation at 9.0 feet which rapidly declined to zero elevation within 110 feet of the bulkhead. Erosion dominated the entire cross section to the ending point offshore.



Figure 15. Site 06+00 is on the beach in proximity to where the dune returns to the beach. The view shows the extent of the erosion here and the minimal beach width remaining. The profile plot below paints a grim picture of dune loss and beach retreat reaching nearly 50 cubic yards of sand per foot since October 2017. In fact, the sand loss since June 2018 was 48.61 yds³/ft. meaning that it was the 2018 pattern of northeast storms from March into May that was responsible for the losses in spite of the sand transferred here from Wildwood by Memorial Day 2018.

City of North Wildwood - Semi-Annual Comparison

Line 06+00 Comparison



Site 20+00 (between 9th and 10th Avenues)

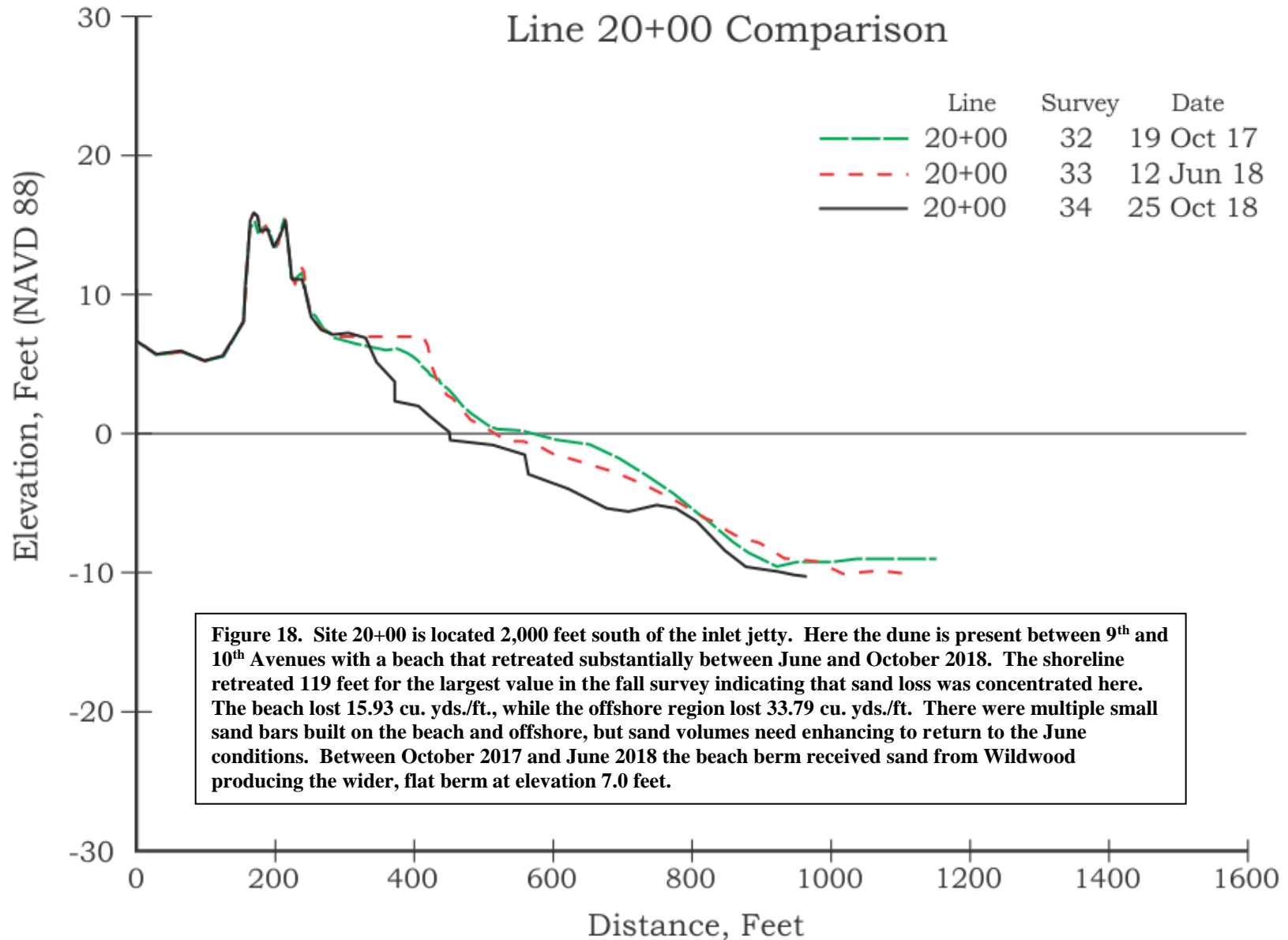
This site is located 2,000 feet south of the inlet jetty and is near the transition from erosion to stability and even accretion from time to time. Dune erosion has occurred here during storms, but frequently has resolved with wind transport and deposition after the storm event. Beach retreat was most dramatic between June and October 2018, after the spring series of northeast events had concluded with a minor event the day prior to Memorial Day 2018. The beach loss has an impact on both the dune stability and the available recreational space between 8th and 15th Streets. The pattern of beach retreat indicates that the transport of sand south toward Wildwood has continued, but the appearance of sand offshore at the Hereford Inlet jetty might show changes at the inlet that could prove beneficial to the oceanfront beach in general.



Figure 17. View to the south taken from the beach at 10th Ave. on June 16, 2018 following sand placement from Wildwood. The erosion seen in the plot of surveys (Figure 14) is evidence that beach loss continued through the summer into the fall because the October 2018 survey plot shows a 67-foot shoreline retreat since the June 2018 survey. The annual retreat of 119 feet does show the storm impact during the spring of 2018.

City of North Wildwood - Semi-Annual Comparison

Line 20+00 Comparison



Site 40+00 (17th Avenue)

Positioned 4,000 feet south of the 2nd Avenue jetty, this site is located two blocks south of the lifeguard station in the mid-section of the City's oceanfront beaches. Following initial construction in 2009 this region has remained relatively stable. The dry sand expanse has diminished over the past decade, leaving the visitor area dependent on wave run-up conditions. The bar offshore must migrate to the shoreline to have any expanse of recreational beach this summer.

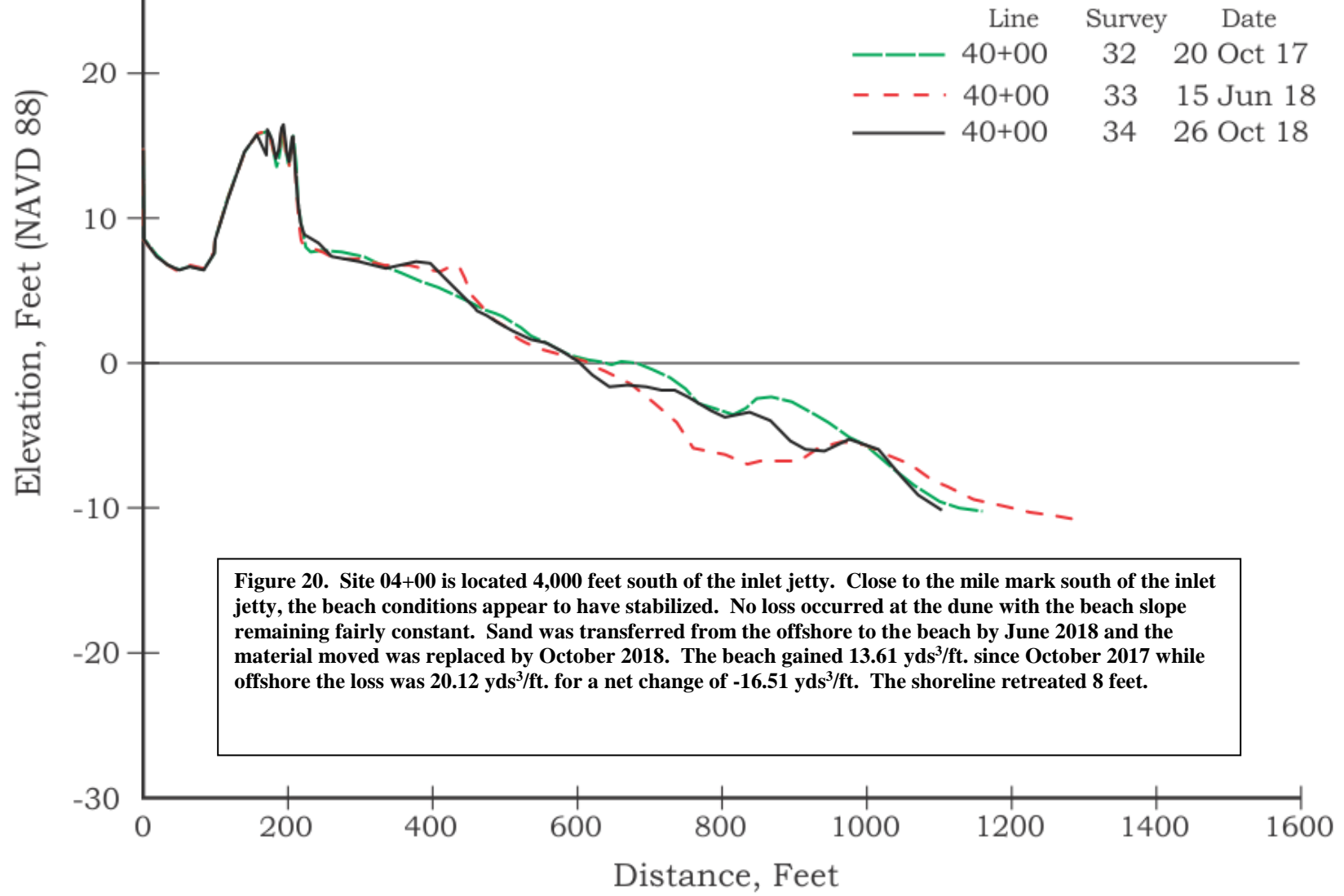
Beach accretion did occur over the entire year from October 2017 to October 2018 adding 13.61 yds³/ft. of sand, but the offshore region lost material leaving the site with a net loss for the year. The shoreline retreated 72 feet.



Figure 19. View to the south along the upper beach on November 5, 2018. Beach flattening has moved the wet/dry surf line close to the dunes. While no erosion of the dunes has occurred as yet, the narrow beach where the most visitors tend to gather presents a space problem for the coming season. There is a bar offshore, but not in the position to add to the beach in the near future.

City of North Wildwood - Semi-Annual Comparison

Line 40+00 Comparison



Site 52+00 (21st Avenue)

Several hundred feet of dry beach still protected the dune system at this location and to the north, to the south the beach width seaward of the dune was diminished significantly from the initial project design. Immediately south of this location, the engineered dune was initially built with a seaward jog in its alignment from just seaward of the boardwalk to run seaward of the eastern ends of the timber and Morey's piers in North Wildwood.

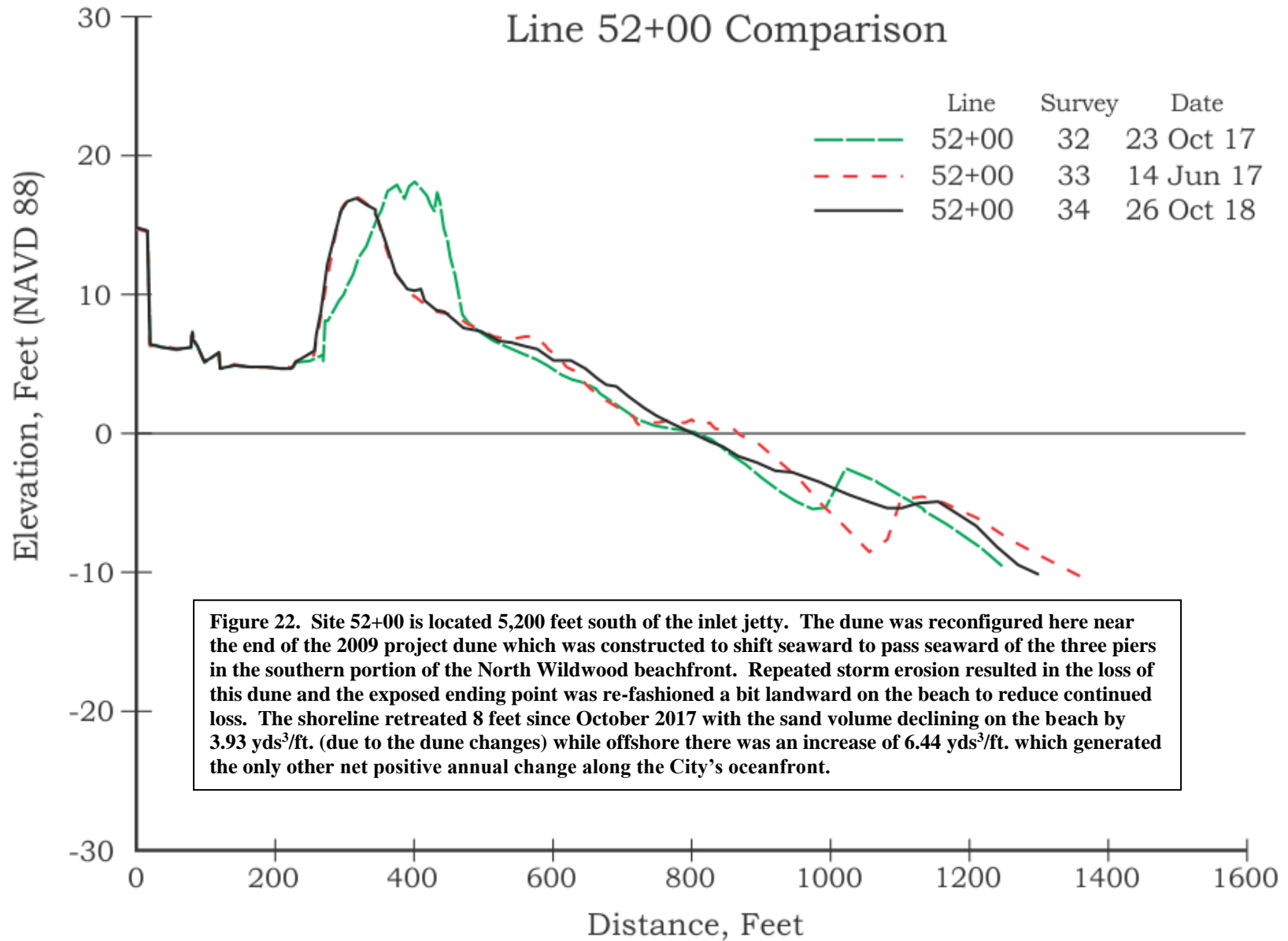
This element of the original 2009 project was abandoned following Hurricane Sandy which wiped out the dune across the zone occupied by the three ocean piers. Morey's Surfside Pier installed a steel bulkhead fronting their pier, extended along the northeast side for about 100 feet. A new dune system was created landward of the pier ends combining an island dune originally present between the Morey's pier and the adjacent timber pier. No dune was replaced south of Morey's Surfside pier.



Figure 21. View to the north taken from the dune toe at 21st Avenue on June 16, 2018. The view along this part of the dune system shows a wider beach extending north from where the project design had the dune shift seaward in order to pass seaward of the three piers and the fourth structure at the Wildwood boundary. The start of the dune shift seaward commences just south of this survey line.

City of North Wildwood - Semi-Annual Comparison

Line 52+00 Comparison



Site 58+00 (Between 23rd & 24th Avenues)

This site is located in the southern section of the City's oceanfront where the engineered dune system was originally constructed seaward of the piers. The original NJDEP project permits mandated a seaward jog in the dune system, which resulted in their vulnerability to the spate of frequent storms since 2009. With limited beach width seaward of the feature to attenuate wave action and absorb the energy before impacting the seaward slope, the dune suffered severe erosion. During Sandy, the proximity of the dunes seaward of the piers to the shoreline made them no match for this event. Dunes were entirely washed away south of 22nd Avenue and the beachface and berm flattened by the storm waves and surge.

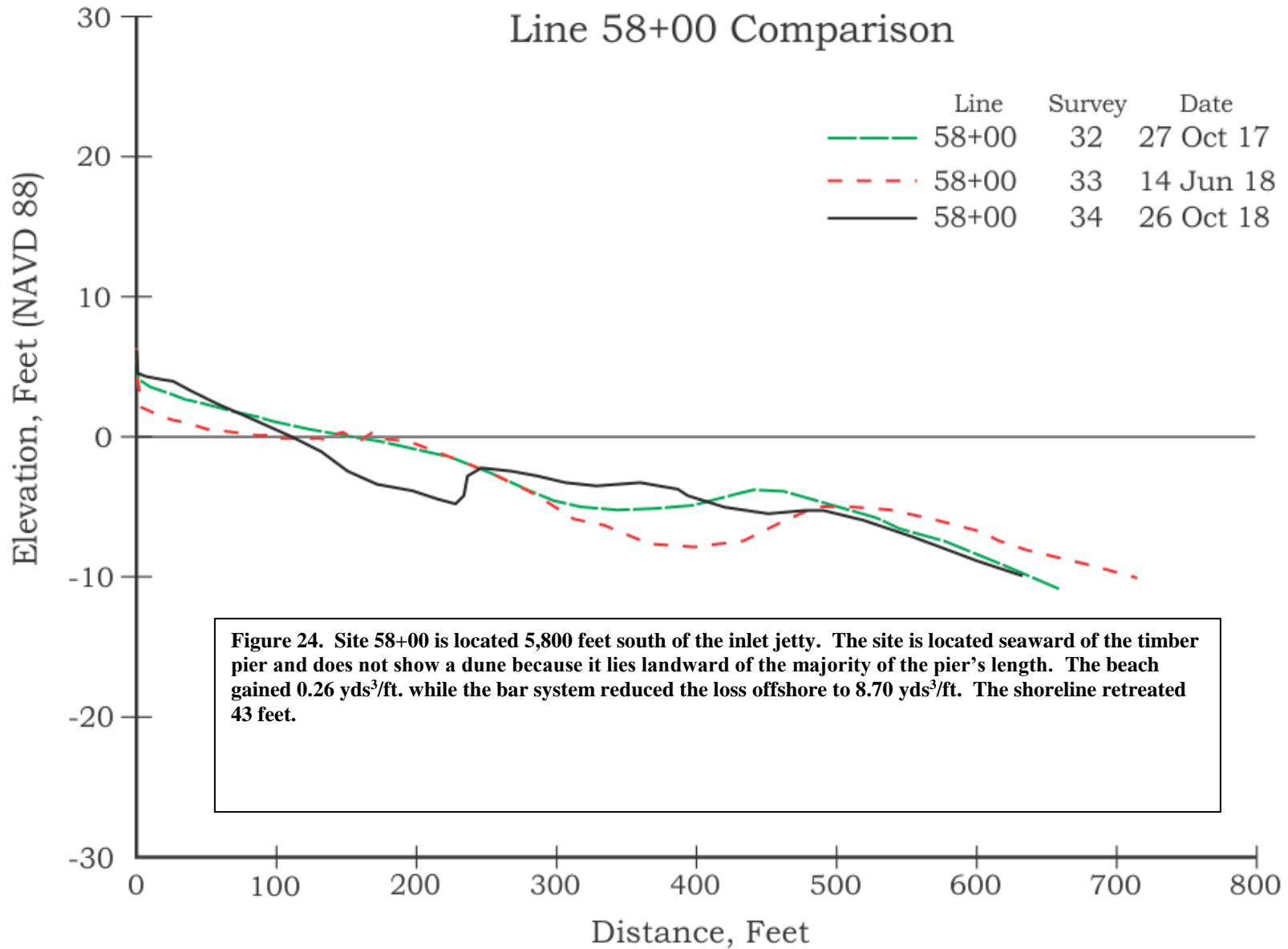
An effort was made in 2013 to restore the dune, but events in 2014 forced re-positioning the dune system landward between the piers and including a large vegetated island dune that had existed between Morey's Surfside Pier and the adjacent timber pier. The dune was merged with the landward end of the northeast side bulkhead wall put in for defense of the seaward end of the Surfside Pier. Sand was placed beside each timber pier as well to mitigate storm waves reaching boardwalk development.



Figure 23. A close up view of the beach at the very seaward end of the timber pier indicating that no dry beach or dune feature remains at the pier's end (November 11, 2018). The dune extends to the pier and in between it and Morey's Surfside pier utilizing an older island dune existing on beach raking debris from years ago. This was essentially the same configuration the beach presented a year ago.

City of North Wildwood - Semi-Annual Comparison

Line 58+00 Comparison



Site 60+00 (24th Avenue)

In an effort to better define the beach zone where piers dominate in North Wildwood, this site was included to show the changes to enhance dune protection since Hurricane Sandy. The main feature is an old dune island likely developed around beach raking debris left in a variety of places when the North Wildwood beach was much wider. In the 1990's multiple island dunes existed from 15th Avenue south to here because sand accumulated among the debris and plant seeds always accompanied the grass stems and other organics washed up onto the shoreline. These germinated, established and trapped more sand enhancing these features. The majority of these features are long eroded away as the beachfront retreated between 1994 and 2009.

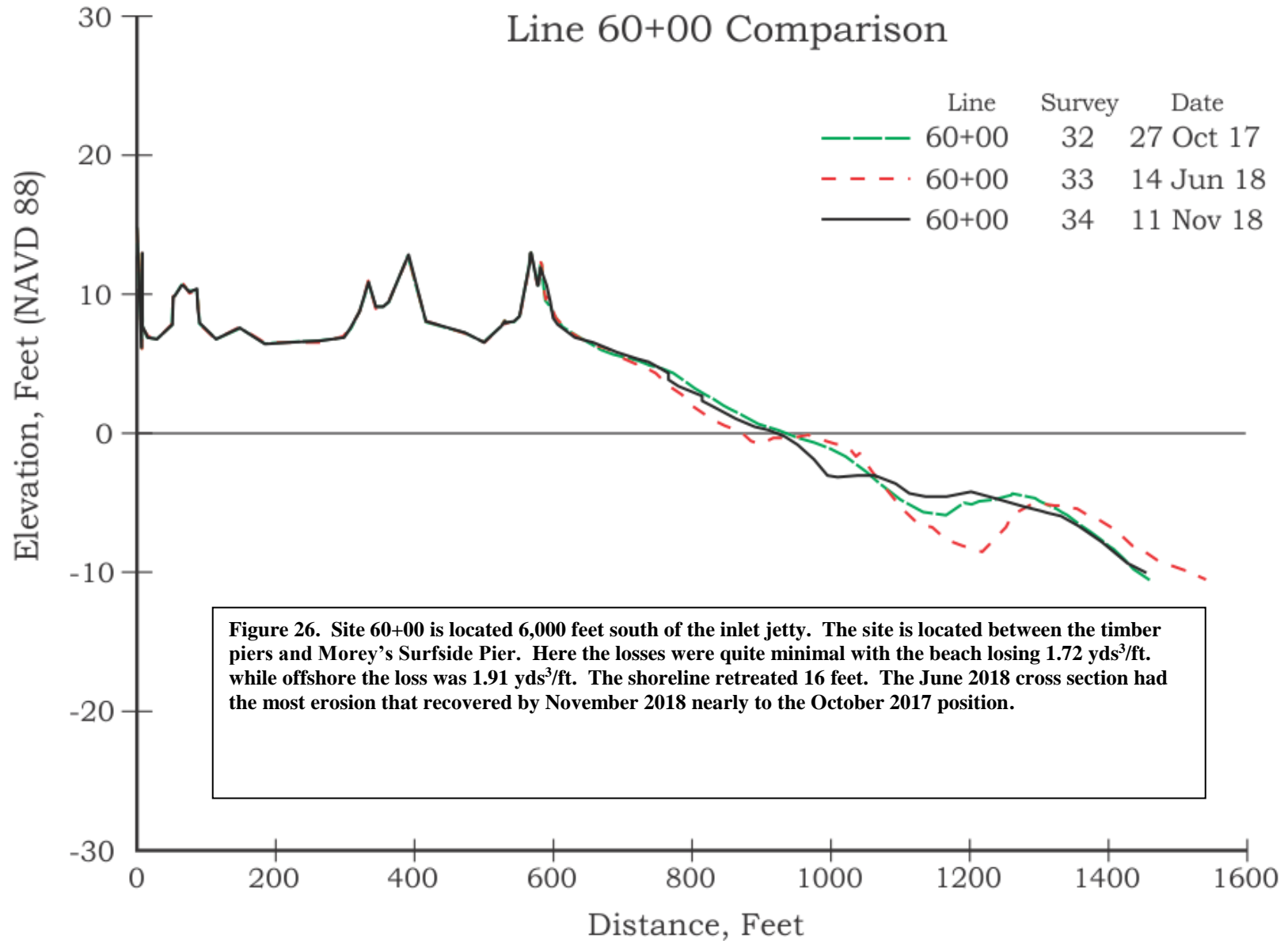
The piers originally had the 2009 dune built seaward of the pier ends on the outer beach, but storm erosion starting November 2009 and climaxing with Hurricane Sandy in October 2012 saw complete loss of the dune seaward of the three piers. The existing situation was completed in 2014 and has established quite well. The beach seaward remained stable with minor annual losses in both shoreline position and sand volume (loss of the berm above the zero datum).



Figure 25. Site 60+00 was included this year in the survey plots presented, with calculations for sand volume and shoreline changes. The view was taken November 11, 2018. This site lies in proximity to 24th Avenue, between the Surfside Pier and the timber pier to the north in the photograph. The dune lies well landward of the end of the pier due to post-2009 erosion. The as-built project dune extended seaward of all three piers and was exposed to wave erosion immediately by the 2009 Veteran's Day northeast storm. Following multiple episodes of dune damage, the dune was moved landward parallel with the dune line to the north.

City of North Wildwood - Semi-Annual Comparison

Line 60+00 Comparison



Site 64+00 (between 25th and 26th Avenues)

This is the southern-most cross section of the selected profiles within the larger database. Located seaward of the Surfside Pier and Ocean Oasis Water Park and Beach Club this site represents conditions at the south end engineered beach and its taper near the Wildwood and North Wildwood border. Initially the engineered beach design template placed the dune feature 30 feet seaward of the pier's steel bulkhead. A series of storm events that followed construction in 2009 resulted in multiple episodes of erosion followed by restoration efforts to maintain this section of dune. The beach seaward of the feature is narrow and prone to storm erosion.

Like the profile at Line 58+00 located to the north of the piers, by the spring 2014 survey (April 25th), the beach and dune had eroded to a point where the City was forced to reposition this feature landward of the easternmost point of the piers. No dune was replaced south of Surfside Pier because the City of Wildwood declined to allow the original design to be re-established. The proximity to Ocean Oasis also mitigated against dune success due to the location in even mild storm wave activity.



Figure 27. View to the south taken on November 11, 2018 near 26th Avenue showing the beach at the Surfside Pier's seaward end steel bulkhead. Waves easily reach the bulkhead making a dry berm unlikely until the shoreline advances about 100 feet further seaward. Little change has occurred at the bulkhead in over a year with summer accumulations allowing minor beach use immediately seaward of the steel wall.

City of North Wildwood - Semi-Annual Comparison

Line 64+00 Comparison

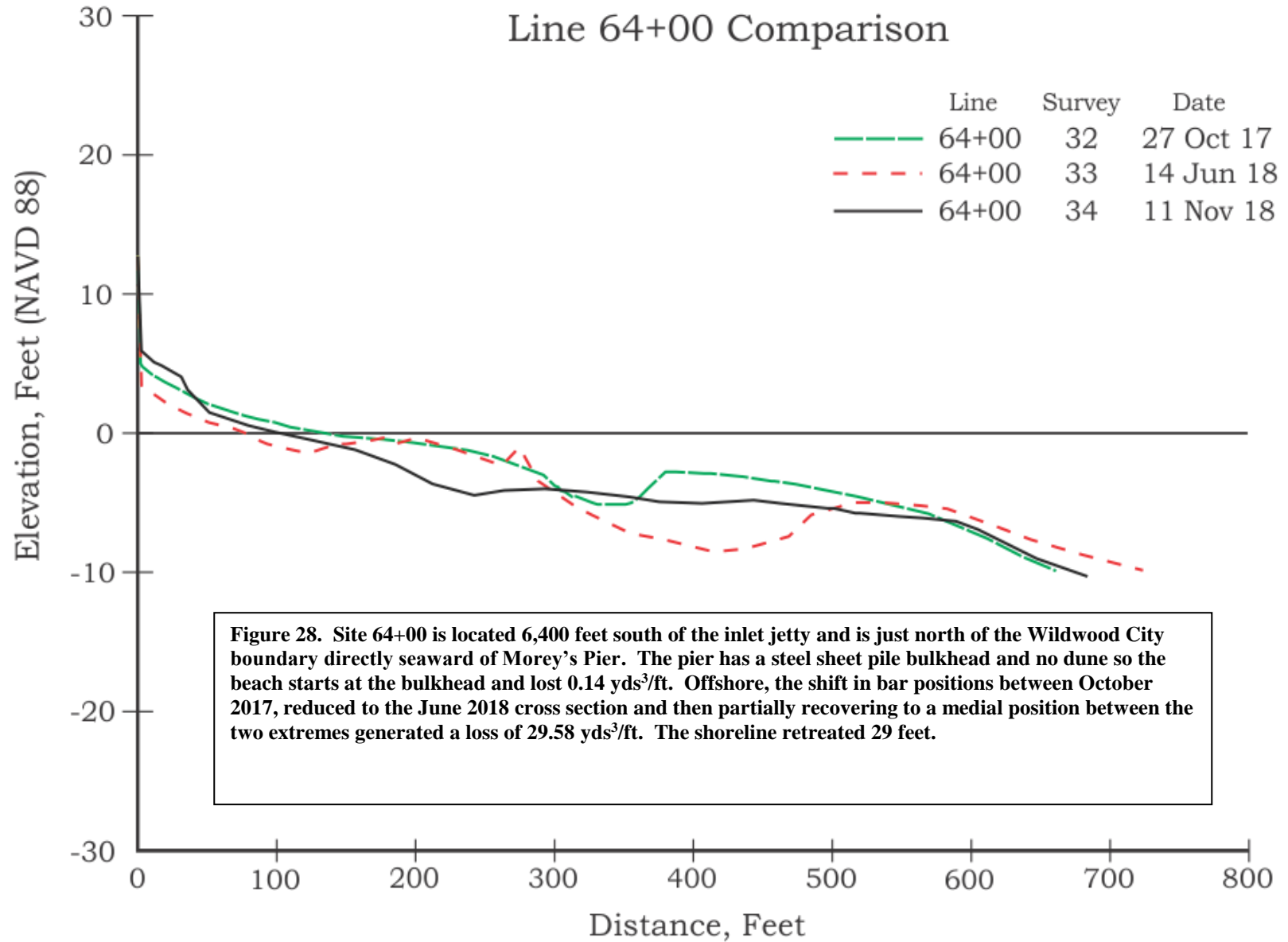


Figure 28. Site 64+00 is located 6,400 feet south of the inlet jetty and is just north of the Wildwood City boundary directly seaward of Morey’s Pier. The pier has a steel sheet pile bulkhead and no dune so the beach starts at the bulkhead and lost 0.14 yds³/ft. Offshore, the shift in bar positions between October 2017, reduced to the June 2018 cross section and then partially recovering to a medial position between the two extremes generated a loss of 29.58 yds³/ft. The shoreline retreated 29 feet.

Summary/Conclusions:

January and February of 2018 were cold and storm free, however, this changed dramatically in March with a weekly series of mild to moderate northeast storms that continued until Mother's Day, May 13, 2018. The City commenced sand back-passing on April 23, 2018 and continued until May 23rd. The northeast events were not quite finished and the Sunday prior to Memorial Day, the winds reached 22 MPH from the northeast all day. The 2018 back-pass resulted in 153,375 cubic yards of sand moved to the region between 3rd and 8th Avenues along the dune toe on the oceanfront. June surveys show that material remained as of June 13th, but was largely gone by October 25th.

At the north end, inlet dynamics, orientation to the northeast and tidal flow exposes this region to near continuous erosional processes associated with its proximity to Hereford Inlet. The inlet beach sand deposit has been shrinking in width for several years with the Surf Avenue vehicle access ramp un-usable unless it is low tide. The pond in the spit is open to high tide inundation at its southeast end and the tidal channel is very close to the rocks at Central Avenue.

However, as shown in the introduction, there are events unfolding which hint at a developing beach sand supply to the northeast off the inlet jetty. This is being fostered by the presence of a shoal island separated from the North Wildwood inlet beach by a secondary ebb-tidal channel. The ebb tidal flow splits around this shoal and sweeps past in the ebb direction effectively dominating the shoal's progress toward the inlet mouth. Sand derived from the shoal appears to be depositing just northeast and seaward of the inlet jetty reducing the water depth to less than 3-4 feet at high tide. If wave action is able to move material toward the beach depositing it on the oceanfront rather than in the inlet, the beach width dilemma may rapidly diminish.

If there is to be additional sand moved north from Wildwood in 2019, the deposition should be restricted to the beach at the dune toe between 4th and 10th Avenues so that spreading will go both directions resulting in longer residence times on the North Wildwood oceanfront shoreline.

The common solutions between Wildwood's need to clear its eight storm drains on the beach and the sand loss erosion problem at the northern oceanfront beach in North Wildwood has made the sand back-passing operation a cost-effective and far easier methodology to accomplish than contracting with a major dredging company to mine sand from Hereford Inlet. However, permits should also be sought to continue hydraulic beach maintenance going forward on a 5-6 year schedule in the absence of either continued large scale sand recycling or the start of the anticipated US Army Corps of Engineers shore protection project. The NJ Div. of Coastal Engineering should be approached to renew the 2009 project scope, that if done to the level of half the initial sand volume (1.45 million CY), would reset the stage so that a stable oceanfront shoreline could be maintained using the sand back-passing methodology to, perhaps, greatly extend the time between hydraulic dredge projects.