

STOCKTON UNIVERSITY COASTAL RESEARCH CENTER



Survey site #170, Roosevelt Avenue, Deal, NJ. This view from the top of the rock seawall at the profile line shows the Phase III US Army Corps of Engineers Monmouth County shore protection project May 17, 2016 as construction was approaching site #170. The site presently has a 270-foot wide dry beach, 25 times any prior beach width.

New Jersey Beach Profile Network 2017 Annual Report on Shoreline Changes in New Jersey's Four Coastal Counties Raritan Bay to Delaware Bay Spring of 2016 Through Fall of 2017

Prepared for:
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The Stockton University Coastal Research Center



New Jersey Beach Profile Network 2017 Annual Report

On

Shoreline Changes In New Jersey In the Four Coastal Counties Raritan Bay to Delaware Bay

Prepared for:

New Jersey Department of Environmental Protection
Division of Construction and Engineering
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EXECUTIVE SUMMARY

The New Jersey Department of Environmental Protection (NJDEP) collaborated with the Stockton University Coastal Research Center (CRC) in 1986 to create the New Jersey Beach Profile Network (NJBPN). This project commenced as an annual survey in the fall between 1986 and 1993, then switched to a spring and a fall survey at each site in 1994. This allowed the CRC to summarize winter storm damage each spring and review beach accretion following the milder summer season. This annual report is divided into four coastal county segments and provides a summary of beach changes for each county.

Following Hurricane Sandy, the US Army Corps of Engineers (USACE) undertook the restoration of the beaches and dunes to federally authorized design specifications. Funding under Public Law 113-2 allowed 100% federal payment for the restoration of existing storm reduction projects in Monmouth, Ocean, Atlantic, Cape May Counties, and the tidal Delaware Bay/River shoreline. The 2016 report documented completed hurricane restoration work as part of a 30-year review of the program. The report is available at the CRC website at www.stockton.edu/crc.

2017 Shoreline Management:

Most of the post Hurricane Sandy USACE work on authorized coastal storm damage reduction projects was completed by the end of 2015. By the fall of 2017 the USACE Absecon Island project, initially completed for Atlantic City and Ventnor in 2003, was extended through Margate and Longport. Work continued in Margate with the construction of a stormwater management/ocean drainage system to replace the existing process of ocean street-end discharge onto the beach landward of the dunes.

In 2017, work commenced on the Manasquan Inlet to Barnegat Inlet project for the developed portion of Northern Ocean County. This followed years of real estate issues due to individual ownership of the beach to the mean high water line along much of this part of the NJ coastline. Multiple dredges have operated since spring 2017 to carry sand from the offshore borrow sites and place the material on the beach to build the design beach/dune cross section. The project stops at the Island Beach State Park northern boundary in the south, and tapers off to no added material in the northernmost third of Point Pleasant Beach Borough located just south of Manasquan Inlet.

The USACE continues its evaluation of the proposed Wildwoods coastal storm damage reduction project where sand derived from the excess material accumulating on the Wildwood and Wildwood Crest municipal beaches will be excavated and used to restore the losses on the northernmost North Wildwood oceanfront.

This year, following extensive discussions with the New York District US Army Corps of Engineers (NY District), the NJDEP Division of Coastal Engineering (NJDEP DCE) and the CRC, 65 new profile locations were added to the Monmouth County NJBPN workload. Selected from existing NY District survey sites between the present NJBPN survey locations, the CRC installed or upgraded survey markers and backup monumentation at the new locations and completed an initial survey during the fall of 2017. These sites are distributed among the original 34 oceanfront locations. Including the three Raritan Bay sites, the number of

NJBPN sites for Monmouth County is 102 (Figure 1a-d). The 2018 contract will include surveys completed at the old and new Monmouth County locations in the spring and fall of 2018 leading to comparison investigations for changes to the NY District’s Monmouth County coastal storm damage reduction effort between Sandy Hook National Seashore and Manasquan Borough. The number of NJBPN locations totals 171 coast-wide.

All NJBPN survey data were analyzed to show changes in shoreline position and sand volume in each coastal county for an 18-month study interval. The three-month seasonal, annual, and 18-month summaries are provided in the tables below and at the end of the report. Beach nourishment projects in Monmouth, Long Beach Island (Ocean County), and Atlantic Counties produced the extensive sand volume increases previously.

All four counties maintained a positive sand volume gain during the study interval at double digit values for the 18-month evaluation. Two counties lost minor amounts of sand volume during the winter (F 2016 to S 2017 surveys). In the summer of 2017, Atlantic County displayed the greatest sand volume increase due to the work by the USACE on Absecon Island completing the Absecon Inlet to Great Egg Inlet shore protection project (Table 1a).

	Sand Volume Changes at the NJ Oceanfront			
	S 16 – F 16	F 16 – S 17	S 17 – F 17	S 16 – F 17
	Cu. yds./ft.	Cu. yds./ft.	Cu. yds./ft.	Cu. yds./ft.
Monmouth County	22.90	-9.30	1.74	16.17
Ocean County	28.53	-0.42	8.21	34.94
Atlantic County	4.43	1.48	35.30	43.74
Cape May County	7.58	11.51	2.87	22.32

The shoreline change values represent the difference in horizontal distance of the zero elevation position (0.0 ft NAVD88) from the reference monument on the two profiles being compared. Advances seaward are presented as positive integers and retreat landward are negative. Each number shown in the table below is the average change for all the sites in each county. Shoreline positions averaged double digit advances seaward in all four counties over the 18-month period. The two winter loss in sand volume counties (Monmouth and Ocean) also measured shoreline retreat. The summer of 2016 saw a positive sand volume gain but a shoreline retreat in Atlantic County. A similar situation occurred during the summer of 2017 in Cape May County but with single digit averaged values (Table 1b).

	Shoreline Position Shifts Landward (-) or Seaward (+) at the NJ Oceanfront			
	S 16 – F 16	F 16 – S 17	S 17 – F 17	S 16 – F 17
	Feet	Feet	Feet	Feet
Monmouth County	41.23	-23.86	7.05	24.42
Ocean County	36.40	-19.59	32.31	49.12
Atlantic County	-15.10	15.95	42.26	43.11
Cape May County	11.25	20.68	-6.63	25.30

ACKNOWLEDGEMENTS

This research was funded by the State of New Jersey Department of Environmental Protection, Division of Construction and Engineering under the New Jersey Shore Protection Fund (N.J.S.A. 13:19-16.1). This is the final report under contract #4287-17.

INTRODUCTION:

The New Jersey Beach Profile Network (NJBPN) project provides local and regional information on coastal zone changes and is designed to document seasonal and storm-related damage assessments of the New Jersey shoreline. Each site has been visited annually in the fall since 1986. Semi-annual visits, each spring and fall, began in 1994 following the passage of Public Law 93. The program was expanded to take surveys every spring following the winter northeasters and in the fall following summer beach accretion. In addition, new sites were established in the gaps of coverage and at all adjacent tidal inlet shorelines. The information collected consists of photographs of the beach/dune system at each site, a topographic profile of the dune, beach and seafloor to a minimum depth of 15-18 feet, and field notes on significant geologic changes. Also, construction activity is noted and necessary information regarding quantity and duration of such activity is gathered. The field data are used to generate graphical cross section plots, which can be used for comparison across the width of the active coastal zone. The cross section is also used to calculate sand volume and shoreline position changes. The 2017 report is focused on how and where beach recovery has met expectations and what transpired to exceed expectations in terms of beach width and dune recovery.

In 2017 the CRC, NJDEP DCE, and the USACE-New York District coordinated efforts to add 65 new profile sites to Monmouth County and were distributed along the oceanfront coastline south of Sandy Hook National Seashore. The USACE sites were added to provide more continuous coverage of shoreline changes within the recently completed Sea Bright to Manasquan coastal segment. Each of the USACE sites was surveyed during the fall of 2017 and will be re-surveyed twice during 2018 allowing change calculations to be completed for the 2018 annual report. Each new site displays a Google Earth aerial view of the location followed by the initial survey profile cross section plot. Comparison plots and spring 2016 versus Fall 2017 photographs show the changes observable for the original NJDEP sites.

Post-Sandy recovery showed that the hundreds of millions spent by the federal government, augmented by NJ shore protection money and some local enhancements did produce a better set of coastal shore protection conditions than existed prior to Sandy where such restoration work occurred. Since work commenced along the last major segment of the developed NJ coastline this fall, the comparison between beaches under federal jurisdiction versus those not currently covered by the USACE will be the last such focus. The tables of beach volume and shoreline change data are found after the county site descriptions for Cape May County in the appendix. A summary of each county's coastal zone activities follows the county profile site location diagram at the start of each county discussion. Conclusions on the study interval appear at the end of each county section.

STORM RECOVERY AND BEACH PROJECT EFFECTIVENESS:

While a sizable fraction of the sand eroded from the pre-Sandy shoreline was moved offshore into at least 10 feet of water, the rate of return was reassuring that similar results would come to pass similar to the post-1992 northeast storm recovery where now, 5 years after Sandy, much of the lost sand has returned. The combination of extensive work completed by the USACE and natural events have greatly enhanced the storm-damaged beaches.



New Jersey Beach Profile Network

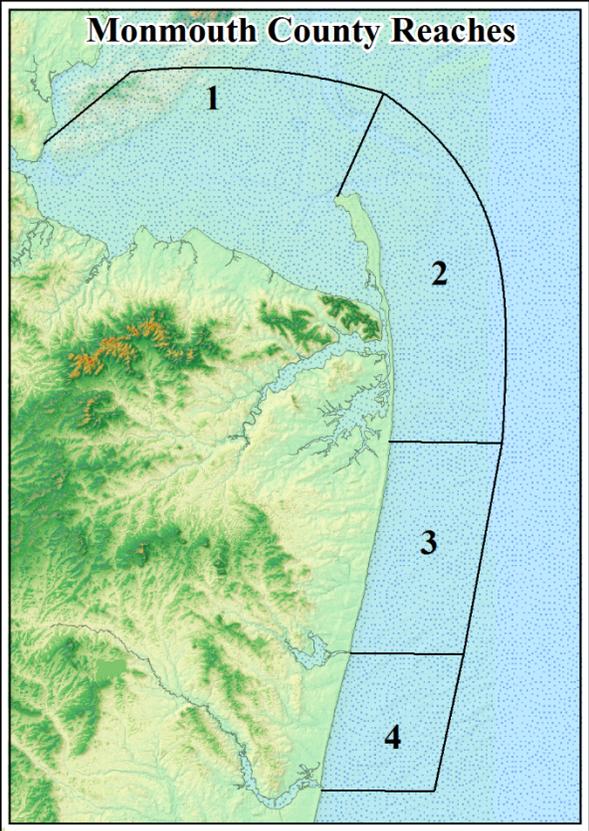
Monmouth County

Raritan Bay and Sandy Hook
to Manasquan Inlet

**NJBPN Profile #'s
187 - 256**

New Jersey Beach Profile Network

Monmouth County Site Locations - Overview and Reach 1



The 102 NJBPN shoreline monitoring sites in Monmouth County extend from three sites along the eastern beaches of the Raritan Bay, to the oceanfront shoreline of Sandy Hook, then south to Manasquan Inlet. Profile sites are located in: Cliffwood Beach in Aberdeen Township, the Borough of Union Beach, Port Monmouth in Middletown Township, Gateway National Seashore, the Borough of Sea Bright, the Borough of Monmouth Beach, the City of Long Branch, the Borough of Deal, the Borough of Allenhurst, the City of Asbury Park, Ocean Grove in Neptune Township, the Borough of Bradley Beach, the Borough of Avon-by-the-Sea, the Borough of Belmar, the Borough of Spring Lake, the Borough of Sea Girt, and the Borough of Manasquan. Monmouth County has the greatest number of beach profile sites due to the complexity of its shoreline. A combination of man-made structures, the natural variety of beach widths and distinct erosional and/or accretional areas made careful site selection a necessity. In the fall of 2017, monitoring efforts were expanded to more fully document current conditions and seasonal changes. This expansion involved adding 65 new monitoring sites throughout the county. Locations of new sites were selected to match those previously occupied by the Army Corps of Engineers.

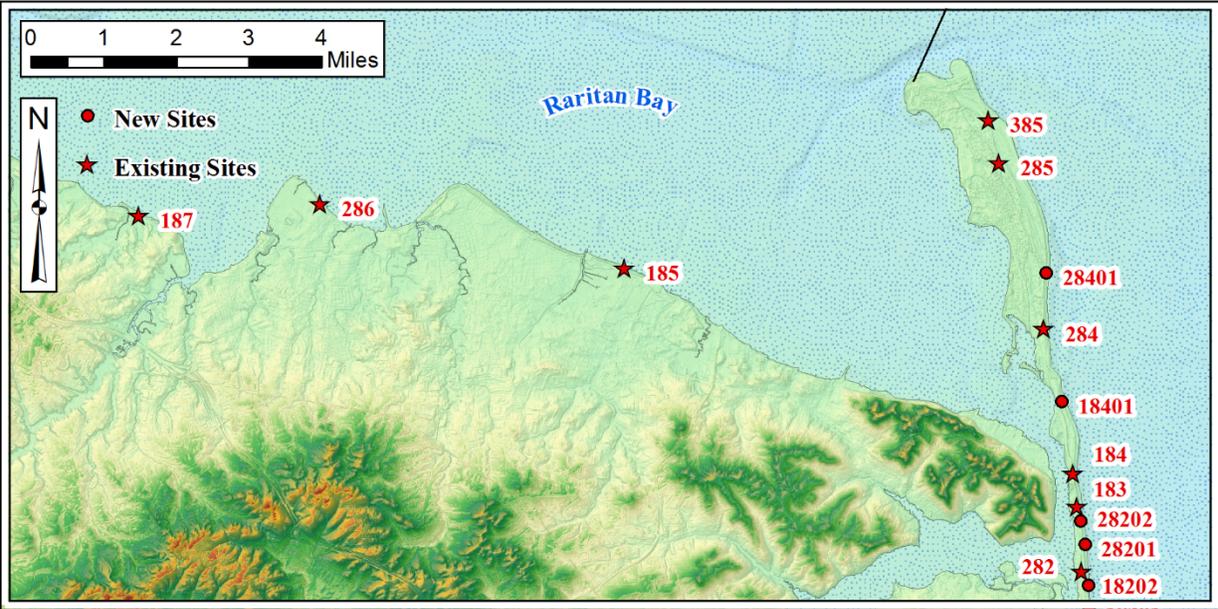


Figure 1a. Location Map for the four Monmouth County coastal reaches where the original and new survey sites are positioned along the Raritan Bay and oceanfront shorelines. The new sites have 5 digit ID numbers. Site #286 was relocated in 2009 to the middle of a public bathing beach to document changes at a non-structural shoreline.

New Jersey Beach Profile Network Monmouth County Site Locations - Reach 2

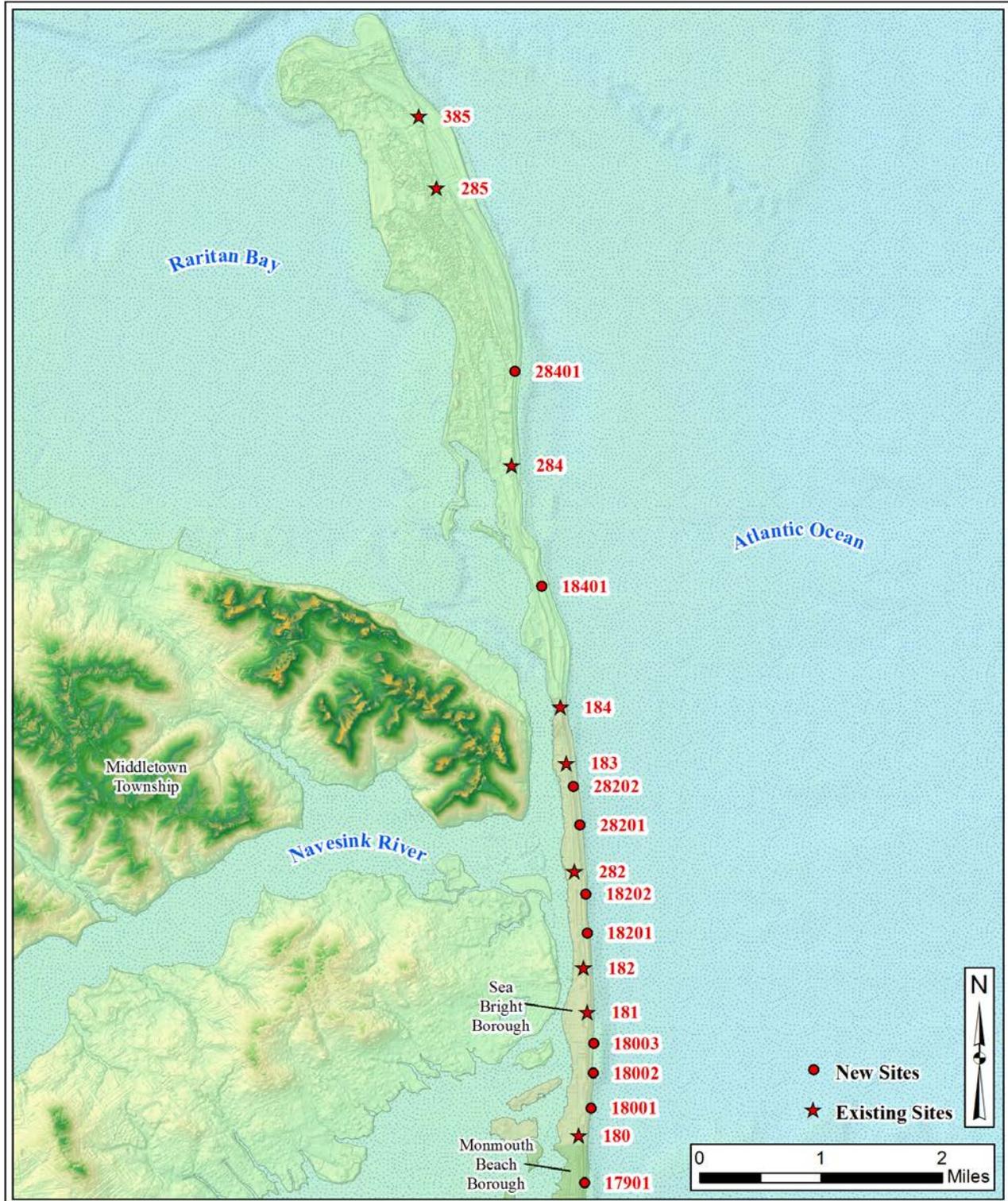


Figure 1b. Reach 2 showing Sandy Hook and Sea Bright survey site locations. The USACE NY District sites added in the fall of 2017 have 5 digits as location numbers. Site #385 was added spring 2017 in increase the extent of the Sandy Hook oceanfront beach coverage to gain better information on sand volumes moving north from the federal project.

New Jersey Beach Profile Network Monmouth County Site Locations - Reach 3

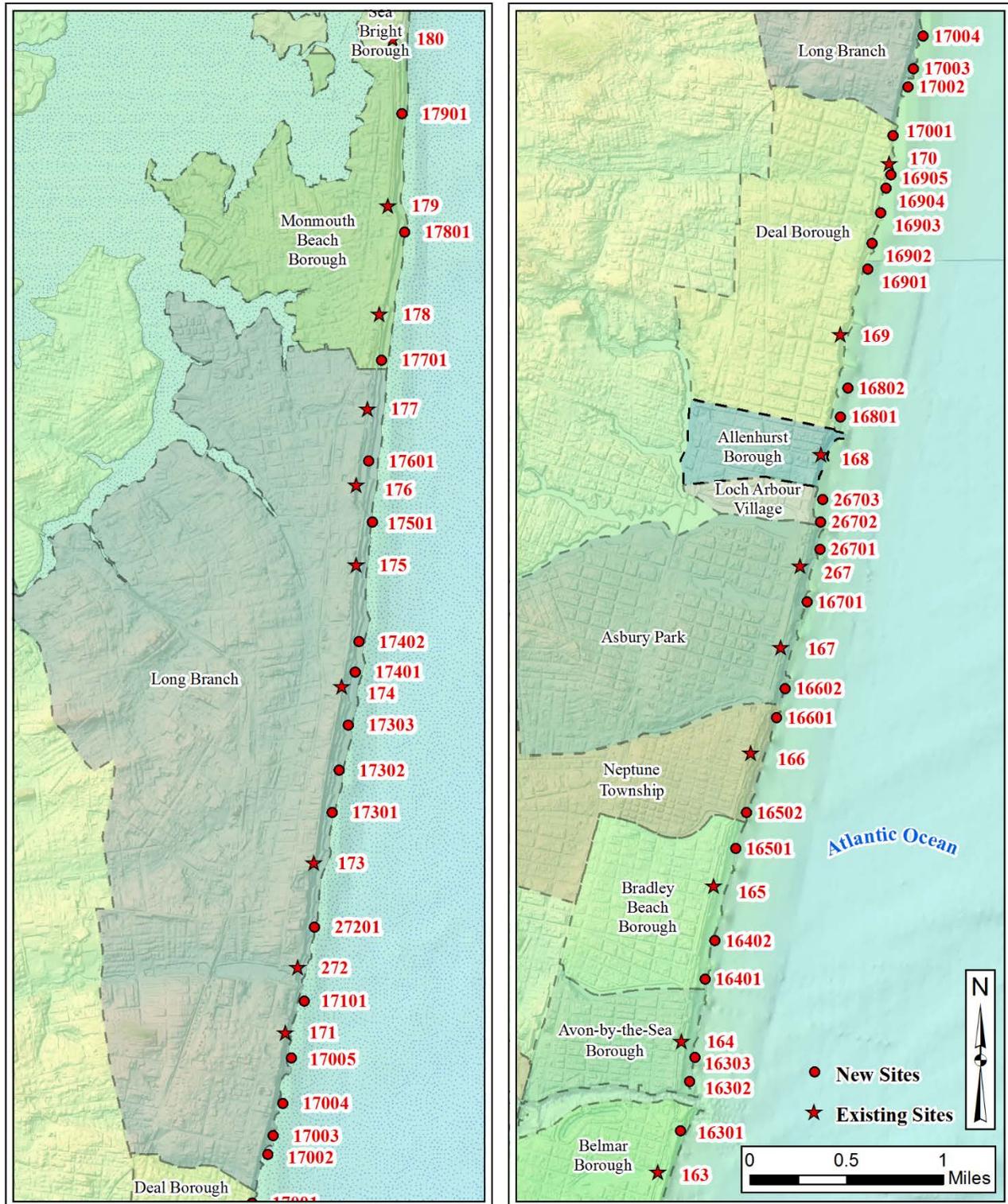


Figure 1c. Reach Three extends from Monmouth Beach south to Belmar Borough along the Monmouth County shoreline. A new location just north of Lake Takanassee was added (#272) in 2010 as Phase III of the federal beach project went to construction to better document the transition between Phase I and Phase III projects.

New Jersey Beach Profile Network Monmouth County Site Locations- Reach 4

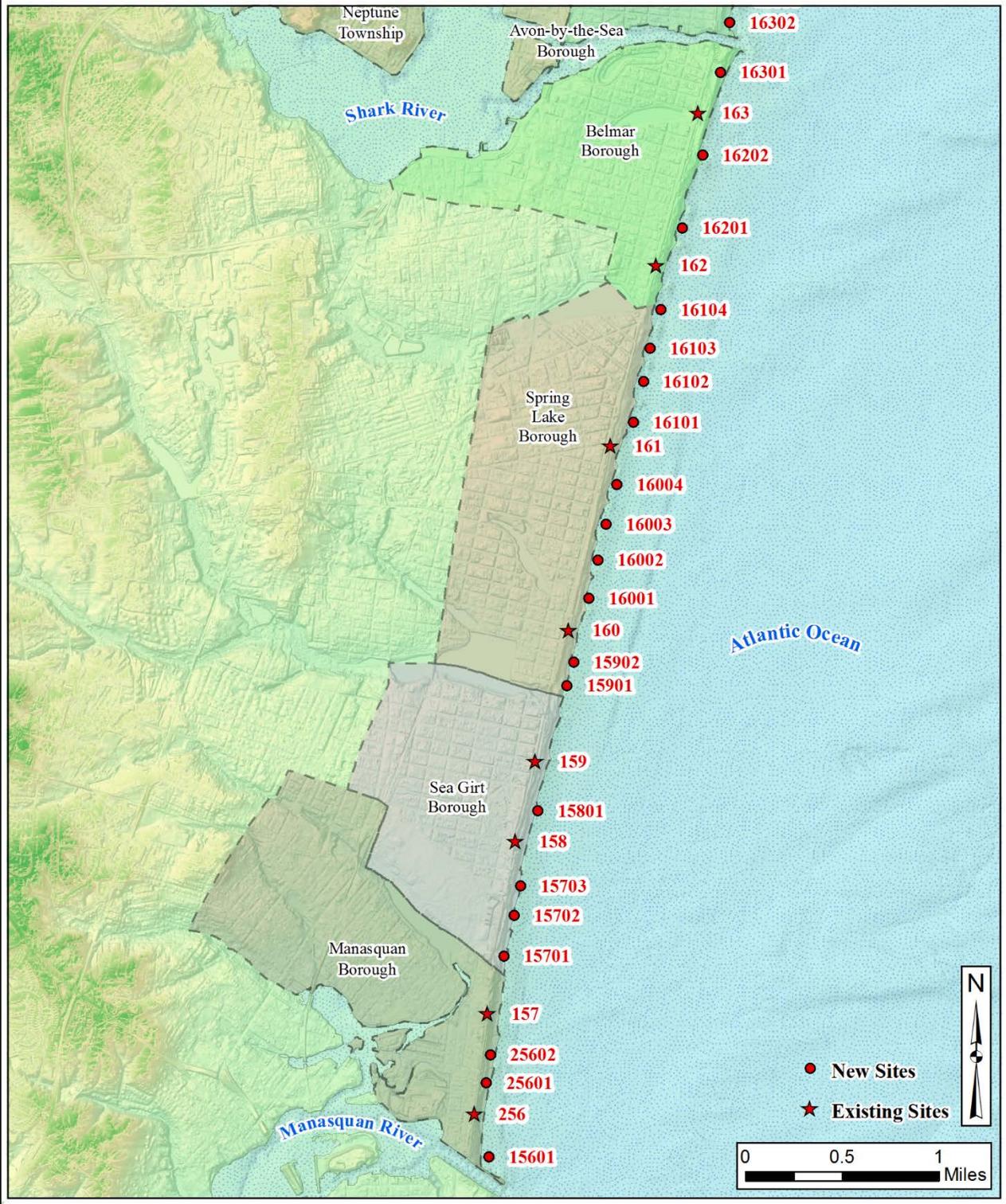


Figure 1d. The fourth reach extends to the Manasquan Inlet, the southern limit of the Monmouth County oceanfront.

Individual Site Descriptions:

The restoration of the Sea Bright shoreline was essentially complete in 2013. The USACE New York District (NY District) returned to the original borrow zone offshore to extract sand for the work. Work continued in 2013 and 2014 to finish all segments originally constructed (2.1 million cu. yds. (\$25.6 million) placed between Sea Bright and Monmouth Beach. Long Branch received 3.3 million cu. yds. (\$40.1 million), Asbury Park to Manasquan was enhanced with the placement of 2.3 million cu. yds. (\$43.6 million). During 2015 the final phase of the Monmouth County shore protection project got underway with the placement of sand along the Loch Arbor, Allenhurst and Deal shoreline. Work was completed into Long Branch through the Elberon section (3.5 miles) leading to Lake Takanassee and the initial project beaches beginning at West End Avenue (4.45 million cu. yds., \$38 million dollars). Work is scheduled to be complete with groin modifications plus storm water system changes by 2018, all funded under PL 113-2 (Disaster Relief Appropriations Act of January 2013)

The beaches along Raritan Bay were badly eroded following Hurricane Sandy, but some recovery was documented since that time. The NY District undertook multiple efforts in restoration, spending \$36.9 million placing 875,000 cu. yds. of new sand along the Keansburg Raritan Bay shoreline in 2014. The 2014 Port Monmouth work involved 3,000 feet of shoreline and about a half-million cubic yards of new sand plus a western groin to hold in the sand and a new, longer fishing pier at the Spy House Museum location. In Union Beach, work in the design phases was reevaluated following Hurricane Sandy via the Limited Re-evaluation Report (HSLRR) that was conducted with non-federal partners, NJDEP and Borough of Union Beach, NJ and published in June 2017. This project includes levees, floodwalls, tide gates, pump stations, and a dune and beach program. All these efforts are 100% federally funded under Public Law 113-2.

In 2017, 65 new profile sites were added to the Monmouth County NJBPN dataset. The new locations are identified by 5-digit numbers (Figure 1a-d). These sites were added to provide more continuous coverage of shoreline changes within the recently completed Sea Bright to Manasquan coastal segment. Each of the USACE sites was surveyed during the fall of 2017 and will be re-surveyed twice during 2018 allowing change calculations to be completed for the 2018 annual report.

Cliffwood Park, Aberdeen; #187

This site is located in a small county park that was established shortly before surveying commenced in 1986. The shoreline faces north-northeast into Raritan Bay and is subject to a significant wave fetch across the bay. Hurricane Sandy transported the entire dune landward into the parking and access areas for the park. During the most recent study period (spring 2016 to fall 2017), minimal changes occurred (sand volume declined just - 0.14 yds³/ft. as the shoreline retreated 6 feet). No specific sediment addition was attempted and the natural changes were very modest.

Union Beach; #286

The Union Beach site is now located in the middle of the municipal bathing beach on Raritan Bay. The site was moved to provide more meaningful data on bay beach changes. Hurricane Sandy pushed sand landward beyond the parking lot, but did not severely affect the shoreline position. During 2013, Union Beach funded sand placement from Amboy Aggregates in the amount of 14,000 cubic yards by truck. On January 3, 2018 a NJ State partnership agreement was signed by the NJDEP and the Corps. Plans and specifications for Phase I, the shoreline component are in development (sand placement, terminal groins, dune cross overs, and outfall extensions). A ridge of sand present in April 2016 was redistributed across the berm, but few other changes were noted. Between spring 2016 and fall 2017, the sand volume decreased by 2.91 yds³/ft. as the shoreline retreated 1.25 feet. At both these first two sites bay floor changes have remained essentially zero in spite of an average depth less than 5 feet over a 500-foot distance offshore.

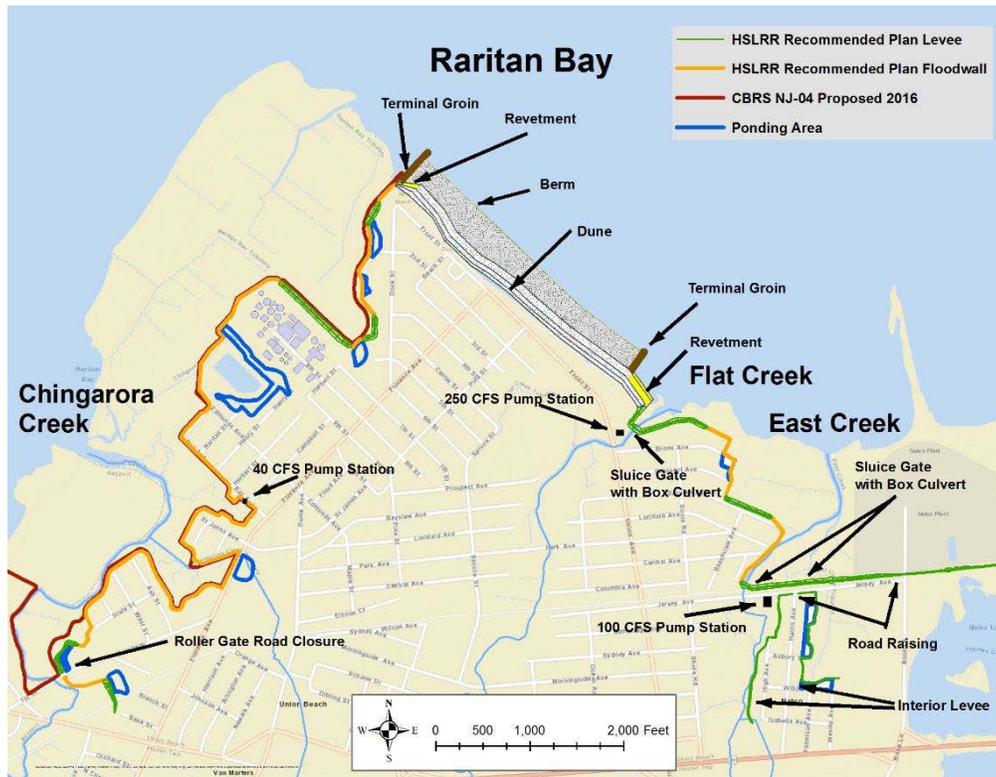


Figure 2. Design plan for Union Beach coastal resilience features reproduced from the January 2017 USACE Union Beach, NJ Hurricane Sandy Limited Reevaluation Report for Coastal Risk Management.

Bay Shore Waterfront Park, Port Monmouth; #185

The easternmost site along the Monmouth County Raritan Bay shoreline is positioned west of Highlands and Atlantic Highlands at a Monmouth County Park site dedicated to an historic building dating to the revolution. Significant shore rehabilitation work preceded Hurricane Sandy and served to absorb some of the impact. The New York District Corps of Engineers concluded pumping approximately a half-million cubic yards of sand onto 3,000 feet of the Port Monmouth shoreline adding a 150 yds³/ft. sand volume addition to the beach in 2014. This project includes a new, longer fishing pier and a rock groin on the west end to retain the bulge in the sand shoreline now present. The 142.11 yds³/ft. sand volume reported as a result of the spring 2014 to fall 2014 survey reflects this project. The site has lost 4.79 yds³/ft. by spring 2015 and 16.67 yds³/ft. by fall 2015. The project shoreline advance of 261 feet saw a 1.7-foot and a 3.7-foot retreat over the next two surveys. This beach is performing very well thus far. The project performed very well over the past 18 months (spring 2016 to fall 2017) losing 5.07 yds³/ft. as the shoreline retreated 14.34 feet. Offshore, this location had no change in the bay floor over a distance of 1,000 feet.

North Beach, Sandy Hook National Seashore; #385

This site was added to NJBPN in 2016 to gain information on the sand volumes accumulating along the National Seashore oceanfront to the vehicular access location. This included an additional 3,500 feet of beach to that previously analyzed between the park entrance (#184) and Gunnison Beach (#285). The tip of the Sandy Hook spit extends an additional 4,000 feet of curving shoreline into Raritan Bay, but ease in profile maintenance and access is difficult. This year the site saw seasonal shifts in the berm position, retreating during the winter of 2017, then advancing beyond the initial survey (F 2016) by 67 feet. Sand did not move landward beyond the berm, but substantial volumes were added to the beachface (34.17 yds³/ft.).

Gunnison Beach, Sandy Hook National Seashore; #285

Gunnison Beach, originally the northernmost site on Sandy Hook National Seashore has gained both sand volume and beach width since establishment in the 1990's. In the past 18 months (spring 2016 to fall 2017) the sand volume declined by 18.01 yds³/ft. accompanied by a shoreline advance of 2.75 feet. For this location, this is a very modest change.

Area F Road, Sandy Hook National Seashore; #28401

This site is the northernmost of the newly added 65 profiles to the original series of 37 NJBPN locations in Monmouth County. The new sites were established in 2017 for the NY District Corps of Engineers to provide greater shoreline coverage density throughout the Monmouth County project. This new profile site was positioned between Gunnison Beach and Parking lot E in the Sandy Hook National Seashore. There is a wide dune with an extended slope seaward to the beach and a significant offshore bar. The coordinates given for the cross section's starting point and alignment put a large concrete relic directly on the survey line. The ruin lies in the intertidal surf zone and presents a danger to the survey crew trying to include it in the profile. Therefore this line was moved 70.2 feet south of the given coordinates for the start point to avoid the obstacle. The ruins are likely related to WW I or WW II military defense installations. None of these new NY USACE profile sites have any comparison data. The spring surveys will occur in 2018.

Parking Lot E, Sandy Hook National Seashore; #284

This public bathing beach was selected because it was located in the middle of Sandy Hook and represented both a public use area and an easy access point to conduct surveys. Growth in the beach and berm width occurred as the site gained 33.57 yds³/ft. in new sand producing a 58.3-foot shoreline advance (spring 2016 to fall 2017).

Parking Lot C, Sandy Hook National Seashore; #18401

A second new site on the Sandy Hook National Seashore oceanfront. There is a 22-foot elevation dune located 225 feet landward of the berm crest on the beach. The profile is quite steep, but offshore there is a bar system extending 350 feet seaward at 7-foot depths prior to dropping into deeper water.

Highlands Beach, Sandy Hook National Seashore; #184

This was initially the northern coastal site, but data supported the need to add sites on Sandy Hook since it was clear that losses south of #184 were being deposited along the National Seashore beaches. Extensive deposition occurred on this site during the past 18 months, (34.88 yds³/ft. in sand volume gain, accompanied by a 57.3-foot shoreline advance) as the berm and beach extended seaward over the summer and fall of 2017.

Via Ripa, Sea Bright; #183

This northern Sea Bright location lies just south of the bridge to Atlantic Highlands across the entrance into the Shrewsbury and Navesink Estuaries. In 2015, the Army Corps project added 43.1 yds³/ft. to the beach producing a shoreline position almost equal to pre-Sandy conditions. A substantial sand volume was added between February 2016 and December 2016 (52.51 yds³/ft. and a 159-foot shoreline advance seaward). The 18-month (S16 to F17) change was a gain in sand of 43.56 yds³/ft. and a 102.5-foot shoreline advance.

300 Ocean Avenue, Sea Bright; #28202

Positioned along the Sea Bright seawall, this site is similar to #183 above with a wide beach, but no dune, a steep berm and a modest offshore bar.

436 Ocean Avenue, Sea Bright; #28201

This new Sea Bright seawall site includes a dune seaward of the wall and a wide beach and a minor offshore bar system.

Shrewsbury Way, Sea Bright; #282

This site was the only northern Monmouth County site along Phase I Federal project that had exceeded the initial sand volume placed on the beach (116%). The Army Corps project restored sand to the beach, but the shoreline fell 156 feet short of the pre-Sandy conditions as of April 2013. This site continued to gain sand since the Corps project concluded by adding 36.20 yds³/ft. with an outstanding 154-foot shoreline advance. This takes the site to a position where the current shoreline lies 96 feet further seaward than prior to Hurricane Sandy. There exists a certain stability to this site that differs from most other Sea Bright locations. During the past 18 months an additional 5.93 yds³/ft. in sand volume was added, but the shoreline retreated (-22 feet). However, the beach berm grew significantly in elevation over the summer of 2017.

678 Ocean Avenue, Sea Bright; #18202

This new site includes a small dune at the base of the seawall, but a 250-foot wide dry beach seaward of the dune. Little material lies offshore as a bar however.

801 Ocean Avenue, Sea Bright; #18201

There is no seawall at this new profile site located between two beach clubs. There is a wide beach rising about 2 feet higher at the berm crest on a multiple ridge beachfront that is 540 feet wide to the water's edge. No offshore bar system is present.

Sea Bright Public Beach, Sea Bright; #182

The next location south was obtained by NJ State purchase 30 years ago and converted into a public bathing area with some off-street parking. There was a modest dune at the toe of the rocks, but the waves ramped up and over the rocks using that sand as a deposit forming the ramp. This beach contained 98% of the initial Federal project's fill material as of fall 2011. No dune existed other than grass growing at the toe of the rock seawall. In 2013 the beach was restored and a new small dune has appeared along with a wide beach that, between spring 2016 and fall 2017, gained 21.13 yds³/ft. in new sand generating a 96-foot shoreline advance. There is no significant offshore bar system.

Sea Bright Municipal Beach; #181

The peninsula widens here to include commercial businesses on both sides of Ocean Avenue plus parking for the beach. However, no rock seawall extended across a gap at the municipal beach. The federal project showed dramatically as a 76.32 yds³/ft. wedge of sand added to the beach by October 2013 advanced the shoreline 104 feet beyond that present prior to Sandy. Following Hurricane Sandy a new hard structure was installed at the seaward edge of the parking lot. Since April 2017 a very large new dune was built on the beach to elevation 19 feet. The beach seaward gained 13.01 yds³/ft. and the shoreline advanced 43 feet.

1201 Ocean Avenue, Sea Bright; #18003

This new profile location includes a pair of dune ridges seaward of the seawall but no horizontal dry beach, just a slope to the water's edge. No offshore bar features exist either.

15 Tradewinds Lane, Sea Bright; #18002

This new profile site has two dune ridges with the larger one seaward, and a similar structure to the beach seaward as seen at site 18003.

1485 Ocean Avenue, Sea Bright; #18001

Positioned at the base of the seawall, this new profile site shows a narrow beach, a developed berm, but no offshore bar system on the initial survey completed in February 2018 due to site access difficulties with private owners.

Sunset Court, Sea Bright; #180

The location north of Cottage Road maintained 45% of the initial sand volume placed in 1999. The repeated deposition of maintenance material at Cottage Road moved north through this location. There was no dune, other than grass here and there among the rocks of the seawall. Sand appeared offshore in quantity as material was pumped onto the beach by the Federal project (82.94 yds³/ft.). Over the past 18 months the sand volume decreased (-8.04 yds³/ft.) and the shoreline advanced 7 feet as the berm developed a large ridge in both summer seasons. The dune increased sand volume, while the net sand loss was attributable to changes well offshore.

122 Ocean Avenue, Monmouth Beach; #17901

This NY USACE site is located north of Cottage Road and contains no dune at the seawall, but a relatively decent width beach sloping into the sea without an offshore bar system.

Cottage Road, Monmouth Beach; #179

The Cottage Road location has been the "Hot Spot" erosion area in an otherwise very successful Federal beach restoration project. Immediately south of this site a massive stone groin was privately built decades ago and acts to restrict sand movement north from the beach fronting a 19th Century private beach club. The groin obviously serves its intended purpose, but to the detriment of the Federal beach project's durability just north of the groin. The Cottage Road site commenced losing sand as soon as it was completed. Losses were replaced in 1997, 1999, 2001, and a modest sand volume was added in 2010 from Shrewsbury River dredging. There was only a narrow, dry beach that gets wet to the rocks under normal wave action at high tide. Just prior to Sandy the construction of a 2012 restoration had started here and was moving northward. The post-storm survey in late March 2013 showed even more loss at the low tide line. By October 2013, restoration had occurred where the berm was regenerated at elevation 10.0 feet and extended 500 feet from the seawall at that elevation. There is no dune at the seawall, but a narrow berm remains in place. Retreat has been consistent over the past 18 months starting with the May 2016 survey. The net loss was -70.31 yds³/ft. accompanied by a 73-foot shoreline retreat at the site.

65 Ocean Avenue, Monmouth Beach; #17801

This new profile location includes a 14-foot elevation dune that lies at the landward edge. The beach is about 150 feet wide to the second berm crest and then slopes into the water without any bar system present. This site is on the up-drift side of the groin producing the serious erosion hot spot at Cottage Road (site #179).

Monmouth Beach Club, Monmouth Beach; #178

The Valentine Street site is located on the premises of the venerable Monmouth Beach Club with the survey starting point in the landward segment of the timber deck overlooking the seawall. Destroyed by Sandy, this site has been rebuilt and the sand replaced to the initial federal project specifications. The dimensions of sand placement between March and October of 2013 is an impressive 181.20 yds³/ft. with a 231-foot shoreline advance seaward. Sand accumulation added to the berm elevation and beach width between April 2016 and January 2018 surveys. The sand volume increased 15.69 yds³/ft. as the shoreline advanced 36 feet seaward.

9 Ocean Avenue, Monmouth Beach; #17701

Positioned half way between #178 and #177, this new profile site includes a seawall with a sand ridge immediately seaward of it, followed by a 270-foot wide dry beach. The beach slope is steep and ends at a very small offshore bar system.

Ocean Avenue Long Branch; #177

This site was once a USO non-commissioned officer's beach recreation area for Fort Monmouth personnel. Presently part of the Seven-Presidents Park system belonging to Monmouth County, this site saw severe erosion during Sandy, followed by further losses offshore as some sand moved landward by March 2013. The federal sand placement project eventually put 123.04 yds³/ft. in new sand at the site producing a shoreline advance of 185 feet. In the past 18 months variation in the berm elevation occurred along with changes to the offshore bar location. The net shoreline change was a 4.3-foot advance seaward with an 8.12 yds³/ft. sand volume increase.

300 Ocean Avenue, North Long Branch; #17601

This new profile location includes a long slope up to the dune crest, a straight line drawn between the reference mark 400 feet landward of the crest and the top of the dune. The beach is about 220 feet wide, but slopes steeply into a trough present during the initial survey. This trough represents a bar system approaching the base of the beachface.

Seven Presidents Park, Long Branch; #176

This site was converted into open parkland space 34 years ago with the purchase of all commercial and private buildings near the waterfront. The area has 25 foot dunes with several prominent gaps to allow public easy access to the beach. The Federal project was completed here in 1999 and 74% of the initial sand placed was still present in October 2011. The restoration effort provided 98.24 yds³/ft. and a 131-foot shoreline advance. Recent variations in the beach and berm positions or elevations provided the most in change seen at this site. The 18-month study period recorded a -12.72 yds³/ft. sand loss volume as the shoreline retreated 7 feet. Little to no change occurred landward of the berm crest.

Ocean Terrace, Long Branch; #17501

Starting at a bulkhead, this new profile site shows a beach with a high seaward berm and a steep slope into the water. A very minor offshore bar exists without a ridge at present.

Broadway Avenue, Long Branch; #175

Here the Corps project beach was at 79% of the as-built sand volume in the fall of 2011. The storm transferred sand offshore between the early October 2012 and March 2013 surveys with 22.72 yds³/ft. deposited on the beach from a loss seen offshore of 28.68 yds³/ft. by the time of the October 2013 survey. The USACE provided

95.55 yds³/ft. in new sand causing a 103-foot shoreline advance here. In the past 18 months the berm position moved significantly landward in two surveyed steps, followed during the last seasonal interval by a return to the December 2016 position. The net sand volume change was -15.96 yds³/ft. accompanied by a 67-foot shoreline retreat from the May 2016 position, but 54 feet seaward of the April 2017 location.

45 Ocean Avenue, Long Branch; #17402

The bluff at this new profile location lies protected behind a decades old vertical steel sheet pile wall. The beach is 175 feet wide with a milder slope into the ocean. No offshore bar system is present.

North Morris Avenue, Long Branch; #17401

At this new profile site the old steel sheet pile wall has a rock revetment protecting it. The beach is about 300 feet wide with a strong break in slope to a more gentle gradient out to sea from the base of the beachface.

Morris Avenue, Long Branch; #174

This site is positioned along the old Long Branch beachfront along the former Ocean Avenue now reduced to a pedestrian walk. Sandy removed the boardwalk from the top of the bluff above the rock seawall. Since then, sand moved landward from offshore regenerated the beach to the position just prior to the hurricane. As of the fall 2014 survey it appeared that the City moved the pedestrian walkway onto the eastern half of the remaining southbound road that once was Ocean Avenue. The boardwalk was rebuilt at the bluff's edge. The USACE work completed by May 2014 placed 167.25 yds³/ft. in new sand at the site and generated a 200-foot shoreline advance as of fall 2014. In the past 18 months the beach lost 4.48 yds³/ft. in sand volume as the shoreline retreated 58 feet. The final beachface position did advance 19 feet seaward as it gained 8.74 yds³/ft. between April and December 2017.

276 Ocean Avenue, Long Branch; #17303

This new profile starts at the top of the bluff and crosses the rock revetment that protects Ocean Avenue in Long Branch. There is a small accumulation of sand at the base of the revetment, but not yet a dune. The beach is 250 feet wide leading to a modest offshore bar system in the initial survey.

378 Ocean Avenue, Long Branch; #17302

This new profile location was established along the uplands bluff, crossing the rock revetment, this site has a similar beach width to site #17303 to the north, with an identical deposit of sand offshore as a bar system.

Wooley Court, Long Branch; #17301

This is the third new site between Morris Avenue and West End Avenue, which starts on the top of the sedimentary bluff, crosses the rock revetment to the beach. The initial survey shows a near identical cross section to the other two new sites in this segment of the Long Branch shoreline.

West End Avenue, Long Branch; #173

Located near the southern end of Phase I within the NY District Corps of Engineers Monmouth County beach restoration project, this site has a rock revetment protecting the base of the bluff, with the boardwalk positioned at the edge of the bluff some 15 feet above the revetment. In 1999 the initial beach replenishment was completed giving this location a 250-foot wide beach, but no dune was included. This site recovered in a similar pattern to the other Long Branch sites. Surveys prior to the storm were completed in October 2012, so

the spring 2013 coverage shows the extensive beach erosion and the transport of sand offshore. The October 2013 survey shows a relatively complete reversal to the pre-Sandy cross section by a year later. Sand did not return to the upper bluff however, the boardwalk position is gone and a replacement has been located on the old roadway, which was the original southbound roadway of a former four-lane Ocean Avenue along this segment. The USACE placed 385.38 yds³/ft. in new sand that generated a 436-foot shoreline advance at the site as of spring 2014. This work suffered 47% loss rates into the fall of 2015, that was followed by restoration work in 2016 and 2017 as the third phase of the Monmouth County project was completed through Deal and Elberon into Long Branch. The past 18 months have seen smaller value changes with the sand volume increasing by 21.9 yds³/ft. during the summer of 2017 accompanied by a 4.5-foot shoreline advance, dominated by accretion during the summer of 2017.

717 Ocean Avenue, Long Branch; #27201

This new profile site is positioned just south of the end of the rock revetment protecting the old Ocean Avenue in Long Branch. There is a bulkhead at the property line and a 300-foot wide beach seaward of the bulkhead. No dune exists at the site, but there is an offshore terrace at the -4-foot elevation of about 200 feet in width. No bar exists on the initial survey. This site essentially re-occupies a site originally established in 1986 (#172) and abandoned due to development.

Lake Takanassee, 805 Ocean Avenue, Long Branch; #272

This profile location was established to replace original site #172 abandoned years ago that was positioned just south of a series of major condominium complexes between West End Avenue and the Lake. This is the northernmost “estuary lake” along the Monmouth County shoreline and, like the others, has a fresh water drainage system constricted at the shoreline by a bay-mouth barrier. It was necessary to relocate the profile to the south, further from the condominium’s parking lot retaining bulkhead. All changes since Hurricane Sandy were variations in cross shore sediment transfers leading to some beach accumulation as of the fall of 2013. The USACE placed sand to this point adding 102.66 yds³/ft. and a shoreline advance of 79 feet. The major sand placement took place between May and December of 2016 as the Phase III portion of the USACE project was completed. That sand volume was 217.10 yds³/ft. with a 322-foot shoreline advance seaward. Some loss occurred during the winter of 2016-2017 (-73.73 yds³/ft., -131ft shoreline change), then stability returned over the summer of 2017 with little additional change (-5.27 yds³/ft.). The net change of the 18 months was a sand volume gain of 147.17 yds³/ft. accompanied by a 184-foot shoreline advance.

Plaza Court, Long Branch; #17101

Located south of Lake Takanassee, this new site was completed under Phase III of the NY District USACE beach nourishment project in 2016. The initial cross section shows a 180-foot wide beach at elevation 10.0 ft (NAVD88) as built by the Corps. The berm shows recent deposition, combined with a steep beachface leading offshore to a substantial bar system.

Pullman Avenue, Elberon; #171

The cross section located in Elberon at Pullman Avenue demonstrated the susceptibility of even the high bluff located here (28 feet NAVD88) to major erosion from the storm surge and waves generated by Hurricane Sandy. The rock revetment and timber wall account for about 40% of the bluff height and were unaffected. Deposition during Sandy occurred offshore where 24.40 yds³/ft. of beach and bluff material was deposited. The scour at the base of the rock revetment protecting this coast was extensive taking sand to -10-foot elevations (as recorded with the Jan 13, 2013 survey 2.5 months later). Since then sand moved back landward, first by the spring 2013 survey back to the pre-Sandy elevations, then by the fall 2013 survey, depositing a dry sand beach over half way up the revetment adding 17.14 yds³/ft. of new material and creating the best “beach” ever

recorded at this location since 1986. The change since 2014 was a loss of 1.41 yds³/ft. and a 33-foot shoreline retreat. Sand moved into this location generating a fall 2014 to 2015 gain of 17.75 yds³/ft. and 26.76 yds³/ft. for the entire study interval. The shoreline advanced 49 feet generating a dry beach at the rock revetment at an elevation of 8.75 feet. This new deposit was 220 feet wide and unprecedented for this site. The bluff erosion during Sandy seems to be the plausible sand source generating the beach present just prior to the federal project reaching this location. The May 2016 survey was the last of this series and is the basis for a dramatic comparison with the Phase III sand placement (271.99 yds³/ft., with a 418-foot shoreline advance). Losses were substantial by May 2017 (-100.86 yds³/ft., and -189 feet of shoreline retreat). Loss continued during the summer of 2017 (-40.66 yds³/ft., and -57 feet of additional retreat). The new profile as of December 2017 shows a substantial offshore bar system with a horizontal trough 3 to 4 feet higher than the offshore surface prior to the fill. The net change since May 2016 was a loss of 137.40 yds³/ft. and a shoreline retreat of 173 feet (41.4% of the placement shoreline advance).

981 Ocean Avenue, Long Branch; #17005

This new profile is situated along the high bluff on private property and starts at the toe of the dune at the bluff. The beach extends seaward at elevation 10.0 for 100 feet before descending on a steep slope to an offshore trough. A substantial offshore bar system is present indicating that similar processes were in progress here as seen with the four surveys completed at site #171 at Pullman Avenue to the north.

1115 Ocean Avenue, Long Branch; #17004

The second of the five new profile locations moving south from Pullman Avenue displays a 90-foot wide beach at elevation 10.0 feet, but a very small bar system that is more of a flat terrace offshore. This is sand redistributed from the beachface since placement.

Ocean Court, Long Branch; #17003

This new profile starts at the toe of either bluff sediments or a small dune. There is a pronounced berm on the beachface crest, different from the two northern sites above. This site has a substantial offshore bar present on the initial survey.

Garfield Road, Long Branch; #17002

This new profile site has a vertical bulkhead as its starting point and sand to the 10.0-foot beach elevation. There is a substantial berm deposited higher in elevation than the 10.0 foot placement elevation. The beachface slopes steeply into the ocean with a small terrace deposited offshore without a bar system present on this initial survey. This beach remains wider than the three to the north at 240 feet to the berm crest.

Jerome Avenue, Deal; #17001

Located just south of the Deal municipal boundary, this new profile starts at a vertical bulkhead and extends for 160 feet at elevation 10.0 to the berm crest. The beach slope is a bit more gentle into the ocean with a more gentle slope seaward without a bar system present.

Roosevelt Avenue, Deal #170;

The Roosevelt Avenue site is located north of the Deal sewage pumping station built in 1906 at the base of the sedimentary bluff. It is essentially a three-story building with just the top story presented at the end of Roosevelt Avenue. South of this street is a series of private homes built on the bluff with a decent sand beach seaward of the dune-mantled bluff edge. North of Roosevelt Avenue there was essentially no dry beach

between closely-spaced groins. Between here and Pullman Avenue, 5 former USACE sites were added to NJBPN to follow changes to the 2016 beach nourishment work completed along the Deal/Long Branch shoreline. Site #170 has a 26-year history of a wet beach against the rocks. Occasional offshore bars have migrated to the shoreline yielding a temporary dry beach less than 25 feet in width. Sandy's waves over-topped the rock wall and scoured deeply into the soil, fill debris (bricks etc.) and bluff sediments. Since Sandy the beach sand excavated at the base of the rock revetment and carried offshore has slowly returned so that the spring 2013 survey found that the sand profile closely matched the pre-Sandy condition. However, more material moved landward so that by October 2013 a dry beach was present at the base of the rocks as sand added to that deposited during the first few months following Hurricane Sandy. This condition slowly deteriorated as sand moved offshore in 2014. The initial survey of this series was completed in May 2016 and shows the final condition as described above, water to the base of the rock seawall. By November 2016 the Phase III deposition amounted to 189.96 yds³/ft. and a 311-foot shoreline advance. This site saw modest adjustments over the next two surveys as the berm retreated providing sand offshore as a terrace by December 2017. The net 18-month change was the addition of 152.11 yds³/ft. and a 238-foot shoreline advance.

South Roosevelt Avenue, Deal; #16905

This new profile site is just situated south of the Roosevelt Avenue street end, but north of Poplar Brook, a unique freshwater stream that still flows across the beach into the sea from headwaters to the west of the Borough of Deal in Monmouth County. This stream channel apparently never achieved an "estuary lake" status at the coastline, but has been flowing across the beach for a long, long time. The new beach is 200 feet wide at elevation 10.0 with a steep beachface and no offshore bar present in this initial survey. A view of the October 2017 Google Earth image for the site appears to show that this stream has been put into an underground culvert extending from Ocean Avenue into the sea, so no longer flows at the surface directly into the ocean.

71 Ocean Avenue, Deal; #16904

Starting at a vertical bulkhead, this new profile location shows an initial trough below elevation 10.0, which rises to elevation 10.0 at the berm crest about 370 feet from the bulkhead. The beach and offshore slope is steep without a bar or terrace present in the initial survey.

Ocean Lane, Deal; #16903

This new profile starts at a rock revetment and reaches the beach at elevation 10.0, which extends seaward for 350 feet to the berm crest. The beachface slope is steep, but there is an offshore bar system present at this site.

Brighton Avenue, Deal; #16902

This new profile location is situated directly in front of a major beach club in Deal and has a new dune between the property development and the open beach. This dune is narrow with a summit elevation of 20 ft (NAVD88). The beach seaward is about 100 feet wider at elevation 9.0 descending steeply to a lower slope terrace offshore.

Wallace Road, Deal; #16901

Positioned at a tall bulkhead and rock revetment that reaches the bluff crest at 30 feet elevation, this new profile location includes a beach that is 200 feet wide at elevation 10.0. The beach slopes to the ocean at similar gradients to others in the area, but has a wide low-gradient terrace offshore. No bar system was present on this initial survey.

Southern Deal, Darlington Avenue #169

The Darlington Avenue site is about a mile north into Deal from Allenhurst and was picked because there was a pocket beach centered at Darlington Avenue extending several blocks in either direction. The sediment bluff, once exposed 25 years ago had been armored by individual property owners over time with timber bulkhead “seawalls”. The beach varied little over time. The spring 2013 survey shows the upper bluff sediment loss with a post-Sandy beach profile far below that seen in October 2012 just prior to the storm. By the fall 2013 survey approximately half the sand present prior to Sandy had returned from offshore. Another year later the site gained 4.72 yds³/ft. and the shoreline moved 4 feet seaward as a modest berm grew on the beach. Individual owners repaired the extensive damage to their bluff protection once again concealing the sedimentary deposits from inspection. This site did gain sand as the federal project got underway with 241.39 yds³/ft. added during the spring to fall 2015 interval. The net change was a sand volume gain of 231.44 yds³/ft. accompanied by a 350-foot shoreline advance. This past 18 months have seen fairly modest adjustments to this location in the Phase III project. The beach is still 350 feet wide from the foot of the bluff with offshore bar adjustment occurring offshore. The net change was a sand volume loss of 8.68 yds³/ft. and a shoreline retreat of 23 feet. The seasonal shoreline shifts were -14, +3, -12 feet for spring 16 to fall 16, fall 16 to spring 17, and spring 17 to fall 17. These are relatively small and may reflect the protected aspect of this shoreline segment between Allenhurst’s groin complex at the Deal boundary and Roseld Avenue to the north.

Monmouth Drive, Deal; #16802

This new profile site has a 160-foot wide beach at elevation 10.0 with a steep slope on the beachface to the zero datum elevation. From that point seaward the slope is less, but no bar system is present at this initial survey.

Neptune Avenue, Deal; #16801

From the bluff elevation, this new profile descends to the beach at the 10.0-foot elevation. This beach is about 100 feet wide at 10 feet, then slopes to elevation 6 at the berm crest. The beachface has the typical steep slope to the water at about -2.0 foot elevation. There is a more gentle slope seaward for an additional 250 feet as a terrace without any bar system present.

Corlies Avenue, Allenhurst; #168

The site #168 at Allenhurst sits on top of an old concrete wall that drops vertically to the sand beach. There is a wooden walk elevated above the road just landward of the concrete wall. The boardwalk is 20 feet above sea level, behind a vertical concrete wall. No Phase II Federal Project sand was deposited along this short segment, but over 13 years some Phase II material has bypassed the large terminal groin in Asbury Park enhancing this small reach. Since the fall 2013 survey, the beach has lost 9.20 yds³/ft. and the shoreline retreated 57 feet. During the winter of 2014 into spring 2015 the site gained 89.54 yds³/ft. as the USACE project got underway. Completed earliest in the Phase III project, this site now has a 225-foot wide beach that the owners choose to push up a winter storm ridge that shows in both the November 2016 and the December 2017 surveys. The 18-month changes amounted to a 37.37 yds³/ft. sand volume gain and a 29-foot shoreline advance.

Euclid Avenue, Loch Arbor; #26703

This new profile site is located at a public beach at the north limit of this tiny community’s shoreline. There is a dune and a narrow beach that slopes steeply into the ocean. There is a low-gradient terrace offshore, but no bar system present.

Edgemont Avenue, Loch Arbor; #26702

This new profile site is situated directly at Deal Lake, the boundary between Loch Arbor and Asbury Park. The Deal Lake flume is the boundary as Loch Arbor has only a two-block shoreline with half a public beach and half in private ownership. There has been a long history of storm waves washing through the private beach club into Deal Lake. This clearly had occurred as the road across the “estuary lake” bay mouth barrier was still

Figure 3. A snippet from an 1867 survey of Monmouth County showing Deal Lake (Great Pond) open to the sea.



closed months after Sandy. Deal Lake is the largest of the now-closed stream estuaries along the Monmouth County shoreline. It was mapped as open to tidal flow repeatedly between 1867 up to as late as 1880, but mapped as closed by 1889. There was no paved road across the bay mouth sand bar until after 1920 according to the earliest aerial photography. There is a sizable weir and boxed flume carrying freshwater

seaward to drain the lake. The profile has a dune and a 120-foot wide beach at elevation 6.0 feet. Offshore there is a terrace extending at a gentle slope for another 220 feet seaward.

1740 Ocean Avenue, Asbury Park; #26701

Positioned on the Asbury Park side of Deal Lake at the north end of the boardwalk, this new profile site has a tiny dune seaward of the boardwalk and a 240-foot wide beach at elevation 10.0 feet. The beachface slope is steep with a lower gradient terrace offshore.

Seventh Avenue, Asbury Park; #267

The Federal project beach in Asbury Park had no dune, but the sand was ramped up to the elevation of the boardwalk. The beach at site 267 lost 39.61 yds³/ft. while 27.56 yds³/ft. were deposited offshore out to 915 feet from the reference. The shoreline retreated 81 feet in the process. By the fall of 2013, the shoreline had advanced 27 feet with 17.79 yds³/ft. returned to the beach. The USACE provided an additional 92.68 yds³/ft. generating a 115-foot shoreline advance. In the past study interval, the site gained 2.95 yds³/ft. in sand volume while the shoreline advanced 19 feet seaward. There was considerable variation in the positions of the offshore bar, but little change on the beach itself.

Sunset Avenue, Asbury Park; #16701

This new profile location starts at the boardwalk and the beach extends 135 feet seaward at a 10.0-foot elevation descending into the ocean at a steep slope. A flat terrace at -3.0 feet extends 200 feet seaward before sloping into deeper water.

Third Avenue, Asbury Park; #167

At site #167 on Third Avenue, there was a storm loss of 29.66 yds³/ft. from the beach, an 84-foot shoreline retreat and sand moved well offshore beyond 17.6-foot depths (NAVD88). By October 2013 26.98 yds³/ft. had returned to the beach as 42.62 yds³/ft. migrated onshore or to the south from the storm deposits seaward. The shoreline advanced 68 feet. By the fall of 2014 the added sand amounted to 60.39 yds³/ft. and the shoreline advanced 35 feet seaward as a result of the USACE project. Over the past 18 months, the site gained 15.20 yds³/ft. as the shoreline position advanced 20 feet seaward. All changes seen on the beach and offshore were minor adjustments between surveys.

Asbury Avenue, Asbury Park; #16602

Located at the southern limit of Asbury Park, this new profile site also starts at the boardwalk with the beach extending 270 feet seaward at a 10.0-foot elevation. The beachface slope is typically steep ending at -1.5-foot elevations in the water. There is a minor terrace extending further offshore without any bars developed.

Spray Avenue, Ocean Grove; #16601

There is a minor dune present seaward of the boardwalk sloping down to the elevation 10.0-foot beach. The steep beachface slope ends at -2.0-foot elevations in the water. A low-gradient terrace extends seaward for 200 feet.

Ocean Grove, Ocean Pathway; #166

Ocean Grove had severe damage to the beach and boardwalk focused to the south of Main Street following Hurricane Sandy. At Ocean Pathway the dune remained as did the large, open, but roofed seating area seaward of the boardwalk. The dune remained with the instrument monument about 1.5 feet from the scarp. The April 2013 survey defined a storm loss of 35.07 yds³/ft. on the beach, dune and near shore with 32.64 yds³/ft. deposited offshore (94 feet of shoreline retreat). By the fall of 2013 22.65 yds³/ft. had recovered on the beach as 28.69 yds³/ft. migrated landward (the shoreline advanced 60 feet in the process). The 2014 activity added 35.79 yds³/ft. in new sand producing a 13-foot shoreline advance. Between spring 2016 and fall 2017, the site gained 35.70 yds³/ft. in sand volume accompanied by a 30-foot shoreline advance, which appear to reflect consistent summer beach accretional processes.

Broadway, Ocean Grove; #16502

This new site has a boardwalk, a dune and a 175-foot wide dry beach seaward of the dune at a 10-foot elevation. The beachface slopes to the water at -3-foot elevation and continues seaward at a gentle slope. Minimal bar activity is present.

Cliff Avenue, Bradley Beach; #16501

At this new profile location, there is a promenade on the bluff edge followed by a dune on the beach. This condition was established prior to the USACE project that followed the 1992 northeast storm when the community elected to abandon the boardwalk over the beach and moved it onto the bluff, thus gaining about 40 feet of badly needed beach space. Today, the beach at elevation 10 continues about 160 feet seaward of the dune before descending into the water at elevation -2.0. A narrow terrace continues seaward before dropping into deeper water.

McCabe Avenue, Bradley Beach; #165

Following Hurricane Sandy, the McCabe Avenue site had some damage, but fared better than most locations. Following the USACE work in 2014, the site gained 75.40 yds³/ft. and the shoreline advanced 34 feet. During the past 18 months of study, this site presented few changes. The net sand volume loss was 0.90 yds³/ft. accompanied by a 5-foot shoreline advance. Adjustments in the positions of offshore bars were the main contributor to these changes.

4th Avenue, Bradley Beach; #16402

This new profile site is situated at the Bradley Beach bluff promenade and dune complex with a 170-foot wide beach seaward of the dune. Offshore a small bar exists at an elevation of -4.0 feet.

2nd Avenue, Bradley Beach; #16401

The new profile at 2nd Avenue begins at the boardwalk that lies landward of the dune by approximately 100 feet. The beach is 200 feet wide at elevation 10.0 feet. There is a low amplitude bar offshore as part of the terrace system.

Sylvania Avenue, Avon-by-the-Sea; #164

The Sylvania Avenue boardwalk and adjacent structures suffered extensive damages during Hurricane Sandy. Sand lost from the beach was carried inland, not deposited offshore. The recovered overwash material was pushed back onto the beach by the June survey date in 2013 producing most of the recovery evidenced. The USACE effort added 99.16 yds³/ft. and a 108-foot shoreline advance seaward. The beach extends 220 feet from the boardwalk at a 10-foot elevation before sloping into the water. There are bars present periodically, but not in the most recent survey. In the recent 18-month comparison, the net change was a sand volume gain of 13.35 yds³/ft. and a shoreline advance of 10 feet with most of these changes occurring offshore.

Garfield Avenue, Avon-By-The-Sea; #16303

This new profile site includes a tiny dune seaward of the boardwalk with the beach extending about 100 feet further seaward at a 10-foot elevation. There is a bar terrace offshore in 4.5 feet of water, but no offshore bar present in this initial survey.

Washington, Avenue, Avon-By-The-Sea; #16302

Located just north of Shark River Inlet, this new profile site has a 160-foot wide beach without a dune seaward of the boardwalk. The beach slope is more gentle than most Monmouth County sites and gradually merges with an offshore bar 400 feet from the reference position.

2nd Avenue, Belmar; #16301

Positioned 3 blocks closer to Shark River Inlet on the Belmar side, this new location has the wide beach retained by the inlet jetty (420 feet wide). There is a steeply sloping beachface with a pronounced trough between the beach and an offshore bar.

5th Avenue, Belmar; #163

Belmar has an original survey site at 5th Avenue near Shark River Inlet. The Belmar beach has a boardwalk between it and Ocean Avenue that suffered damages during Hurricane Sandy but was still largely present. Sand was washed into Ocean Avenue during the storm. Since the 5th Ave. beach is extra wide due to the south jetty to Shark River Inlet, the USACE does not add significant sand to this site. The beach gained just 7.85 yds³/ft. in 2014 with the shoreline position moving 4 feet seaward. In the past 18 months, the site gained 8.88 yds³/ft. with a 15-foot shoreline advance.

8th Avenue, Belmar; #16202

At this new profile site, the boardwalk is just seaward of Ocean Avenue and the beach extends 210 feet further seaward at the 10.0-foot elevation. There is a steep beachface that continues offshore onto a terrace with a generous offshore bar present.

14th Avenue, Belmar; #16201

At this new profile location, the boardwalk appears to have a tiny dune at its seaward base. The 10-foot elevation beach extends 240 feet seaward in includes a pushed up ridge of sand used to help block northeast storms in the winter. The offshore slope is quite gentle with no expressed bars present on this initial survey

18th Avenue, Belmar; #162

The 18th Ave. site was augmented by vertical deposition raising the beach berm 2-3 feet across its entire width. The sand volume added was 66.17 yds³/ft. producing a 76-foot shoreline advance following Hurricane Sandy. Since then the site has varied mostly offshore since there is a significant terrace and bar complex present. The City generates a sand ridge on the beach to protect against northeast storms because there is no dune system. The past 18 months have seen a sand volume loss of 20.78 yds³/ft. and a shoreline retreat of 32 feet with the majority of the changes occurring offshore.

North Boulevard, Belmar; #16104

This new profile site is south of the municipal boardwalk seaward of Lake Como, another of the Monmouth County “estuary lakes”. While, historically, not known to be open to the sea, there is no reason to believe that it never was. Sub-bottom studies for an offshore breakwater system installed in the 1990’s found lagoonal sediments under a 3-foot thick sand layer approximately at the 600-foot horizontal distance seaward residual from past conditions where the shoreline was significantly seaward of today’s location.

Remsen Avenue, Spring Lake; #16103

The new profile at the Spring Lake boardwalk lies seaward of the dune system with a 190-foot wide beach at elevation 10.0 feet. There is a seasonal ridge pushed up to defend against northeast storms. The beach slope ends in 4 feet of water then extends seaward for 340 feet without a bar presently.

Lorraine Avenue, Spring Lake; #16102

A similar situation exists at the next new site south where the dune exists landward of the boardwalk. The practice of pushing up a ridge of sand each winter stems from multiple past losses of the boardwalk, most recently in Hurricane Sandy. Waves rush up, hit the dune, and are forced upward with significant power. This lifts the boardwalk off the supports and has destroyed it completely twice in this decade. There is a terrace offshore without a significant offshore bar presently.

Tuttle Avenue, Spring Lake; #16101

This fourth new profile site in Spring Lake maintains the same configuration as the northern three with the pushed up ridge on the beach, an elevation of the beach of 10.0 feet (NAVD88), and a gradual transition to an offshore terrace without a bar.

Brighton Avenue, Spring Lake; #161

Hurricane Sandy relocated sand along this profile with a volume loss (-36.15 yds³/ft.) from the beach but volume gain (25.40 yds³/ft.) offshore to a point 857 feet from the reference (elevation -16.63 ft NAVD88). By the end of 2014, the boardwalk was rebuilt on its original concrete supports and the USACE provided 40.47 yds³/ft. in new sand at Brighton Ave. with a 76-foot shoreline advance seaward. The site was restored by the end of 2014 and since then the site has been stable. The dune on the profile shows the relationship between it and the boardwalk. The two fall surveys show the pushed up sand ridge on the beach at the USACE specified

elevation of 10.0 feet. Changes offshore represent 95% of the totals seen at the site. The sand volume loss was 10.79 yds³/ft. with a 8.5-foot shoreline retreat over the past 18 months.

Madison Avenue, Spring Lake; #16004

This new profile site includes a dune, then the boardwalk, followed by a pushed up ridge of sand. The offshore contains a significant bar system with a well-defined trough at the 300-foot distance.

Morris Avenue, Spring Lake; #16003

This new profile location includes a dune, boardwalk, and pushed up sand ridge, but has little horizontal beach remaining seaward of the ridge. Offshore, there is a terrace that is flat for almost 200 feet without a bar.

Mercer Avenue, Spring Lake; #16002

This new profile location closely resembles #16003 with a narrower terrace but with a small offshore bar.

Essex Avenue, Spring Lake; #16001

This fourth new site between the two original NJBPN locations in Spring Lake more closely resembles the northern site #16004 with a 100 feet of beach seaward of the pushed up sand ridge. There is a bar offshore on the terrace at the base of the beachface.

Salem Avenue, Spring Lake; #160

The site was restored with just 32.29 yds³/ft. in new sand after Sandy causing the shoreline to advance 42 feet. Salem Avenue gained 31.74 yds³/ft. and the shoreline advanced 5 feet immediately afterward. Over the past 18 months, the site gained a sand volume of 7.76 yds³/ft. and the shoreline advanced 7 feet seaward. For some reason, this site did not show a sand ridge pushed up in the fall of 2017.

Union Avenue, Spring Lake; #15902

At this new profile location, the dune is quite a bit higher than the boardwalk with a 140-foot wide, 10-foot elevation beach. No sand ridge was present. Offshore, there is a pronounced bar system.

Brown Avenue, Spring Lake; #15901

At this new profile site, there is a boardwalk and a dune that is approximately equal to the elevation of the boardwalk. The pushed up sand ridge is present here with about 100 feet of dry beach seaward at elevation 10 feet. There is a limited terrace present and no offshore bar. This site lies just north of Wreck Pond, recently the site of extensive reconstruction of the flume box guiding freshwater from this “estuary lake” to the sea. Sandy opened up Wreck Pond to tidal flow for several years. This “lake” has had the most active modern history of tidal access by the ocean, for reasons unrelated to any tidal prism associated with the stream drainage landward. The new structure is quite robust and does permit tides at storm surge elevations access to Wreck Pond in an effort to permit occasional salt water intrusion to the old “estuary.”

New York Avenue, Sea Girt; #159;

Sea Girt is divided into two parts, each with an original profile site. The New York Avenue site #159, represents northern Sea Girt where a shore-parallel Ocean Avenue allows vehicles to park at the boardwalk with easy public access to the beach. Homes exist across Ocean Avenue. Here there were incipient dunes built since

Hurricane Irene in 2011 and were removed by Hurricane Sandy. The New York Avenue profile lost 69.52 yds³/ft. from the beach and nearshore. By the April 2013 a new dune had been placed on the beach using sand recovered from inland with a wider base, but about the same height (17.5 feet). Deposition offshore amounted to 16.36 yds³/ft. that was documented 936 feet seaward from the reference monument. Clearly the majority of the sand was further seaward because by September 2013, 39.16 yds³/ft. had returned to the beach producing an 86-foot advance in the zero elevation position. During 2014 the USACE provided 23.81 yds³/ft. advancing the shoreline 107 feet as of fall 2014. The berm gradually developed to its largest extent by September 2017 with offshore bar migration filling in the immediate offshore zone. The net growth in sand volume for the 18-month comparison was 4.84 yds³/ft. and the shoreline advanced 13 feet seaward.

Crescent Park, Sea Girt; #15801

Crescent Park is an enclave of major single family homes located starting south of New York Avenue and extending to Trenton Avenue. At this new profile location, there is a dune deposited on top of the sedimentary bluff seaward of the homes, followed by a boardwalk with the post-federal project dune established seaward of the boardwalk. About 100 feet of dry beach at elevation 10.0 extends seaward of the dune. There is a terrace offshore, presently without an offshore bar.

Trenton Avenue, Sea Girt; #158

The southern Sea Girt site at Trenton Avenue typifies the coastal bluff with single family homes and a wide, reasonably high dune landward of the boardwalk deposited on the bluff that minimized Sandy erosion and kept the overwash out of the street ends. The Trenton Avenue site saw similar erosion and deposition offshore (-67.07 yds³ lost from the beach and 44.78 yds³/ft. gained offshore) with recovered sand positioned seaward of the boardwalk as a substantial restoration dune. Recovery saw 35.07 yds³/ft. added to the beach as sand from offshore moved landward. The shoreline advanced 34 feet seaward in the process. The 2014 effort added 94.20 yds³/ft. and pushed the zero elevation shoreline 121 feet further seaward as the shore protection project was restored. In the past 18 months the site gained 12.97 yds³/ft. as the shoreline retreated 9 feet. The 2016 summer berm was more extensive than the version that accreted during summer 2017 in terms of position seaward on the profile. Offshore bars were present in each of the four surveys.

Seaside Place, Sea Girt; #15703

This new site starts at the street end and goes directly to the landward base of the bulkhead defending the street. Seaward lies a dune, the beach with a steep beachface. Offshore is a terrace with a low amplitude bar system present on the initial survey.

National Guard Training Center, North, Sea Girt; #15702

This new profile site is one of two within the oceanfront segment long devoted to NJ State Police and National Guard training. Off limits to the public on the beach, the very impressive dune is also part of the shooting range back stop for bullets. There is a 150-foot wide beach at 10.0-foot elevation leading to an offshore terrace with a bar present on the initial survey.

National Guard Training Center, South, Sea Girt; #15701

This new profile location is situated at the south end of the NGTC beach segment with a tall dune, a small foredune leading into a 220-foot wide beach at 10.0-foot elevation. There is no significant offshore bar present on the terrace, but the potential exists for their development.

Riddle Way, Manasquan; #157;

Manasquan is located at the southern limit of the NY District's massive Monmouth County beach restoration project and positioned just north of the Manasquan Inlet. Developed at the turn of the 20th Century, many small homes populate the former primary dune between the ocean and First Avenue. Prior to the USACE project, the Borough had established a small dune system seaward of the paved promenade that is in front of the oceanfront homes. This was primarily in response to the December 1992 northeast storm that damaged the community. Following Sandy, there were tiny remnant dunes present seaward of the asphalt promenade at Riddle Way (site #157). At Riddle Way the dune was all but removed, but the promenade surface remained intact. The dune provided 11.24 yds³/ft. of sand to the beach during the storm, but the beach lost and additional 13.75 yds³/ft. as the offshore added 59.07 yds³/ft. The shoreline retreated 24 feet. By the fall of 2014 the USACE had added 94.17 yds³/ft. in new sand advancing the shoreline 92 feet seaward. However, there is still only a minimal dune just seaward of a fence line located at the edge of the promenade pavement. This profile over the past 18 months grew slightly wider (43 feet), as 8.87 yds³/ft. in new sand accumulated largely at the base of the beachface filling in the trough present May 2017. As of December 2017, no sand ridge had been pushed up on the beach as seen a year earlier.

Main Street, Manasquan; #25602

This new profile extends across the beach from the asphalt promenade. A small dune lies seaward of the promenade as well as a 270-foot wide sloping beach with a fairly consistent gradient all the way into 17 feet of water. No terrace or offshore bar system has developed.

Brielle Road, Manasquan; #25601

Positioned closer to Manasquan Inlet, this new site also consists of a wide beach extending from the asphalt promenade into the water without significant depositional features such as a berm, dunes or an offshore bar. There is a small ridge of sand pushed up on the mid-beach for the winter in 2017.

Pompano Avenue, Manasquan; #256

At the Pompano Avenue site (#256) the dune was removed by Sandy as well as the entire promenade with most of the sand transported inland. A huge bar appeared offshore (59.36 yds³/ft. deposited). Since April 2013 only 12.80 yds³/ft. returned to the beach, but 32.27 yds³/ft. of that deposit moved elsewhere either landward or toward the Manasquan Inlet. The Army Corps placed 82.26 yds³/ft. at this site generating a 113-foot shoreline advance, but there is no significant dune present along the rebuilt promenade. The current series of profiles show a minimal dune at the promenade location with a beach gradient sloping into deep water. The December 2017 survey closely resembles the initial cross sections taken at the USACE sites added the fall of 2017, in that they have a relatively consistent slope seaward from the mid-beach position to the end of the survey line offshore. The May 2017 survey does display a pronounced offshore bar, so the potential exists for these features to migrate onto the Manasquan shoreline. The net change over the past 18 months was a loss of 21.62 yds³/ft. (largely offshore) as the shoreline actually advanced 41 feet in generating the uniform, gentle seaward slope.

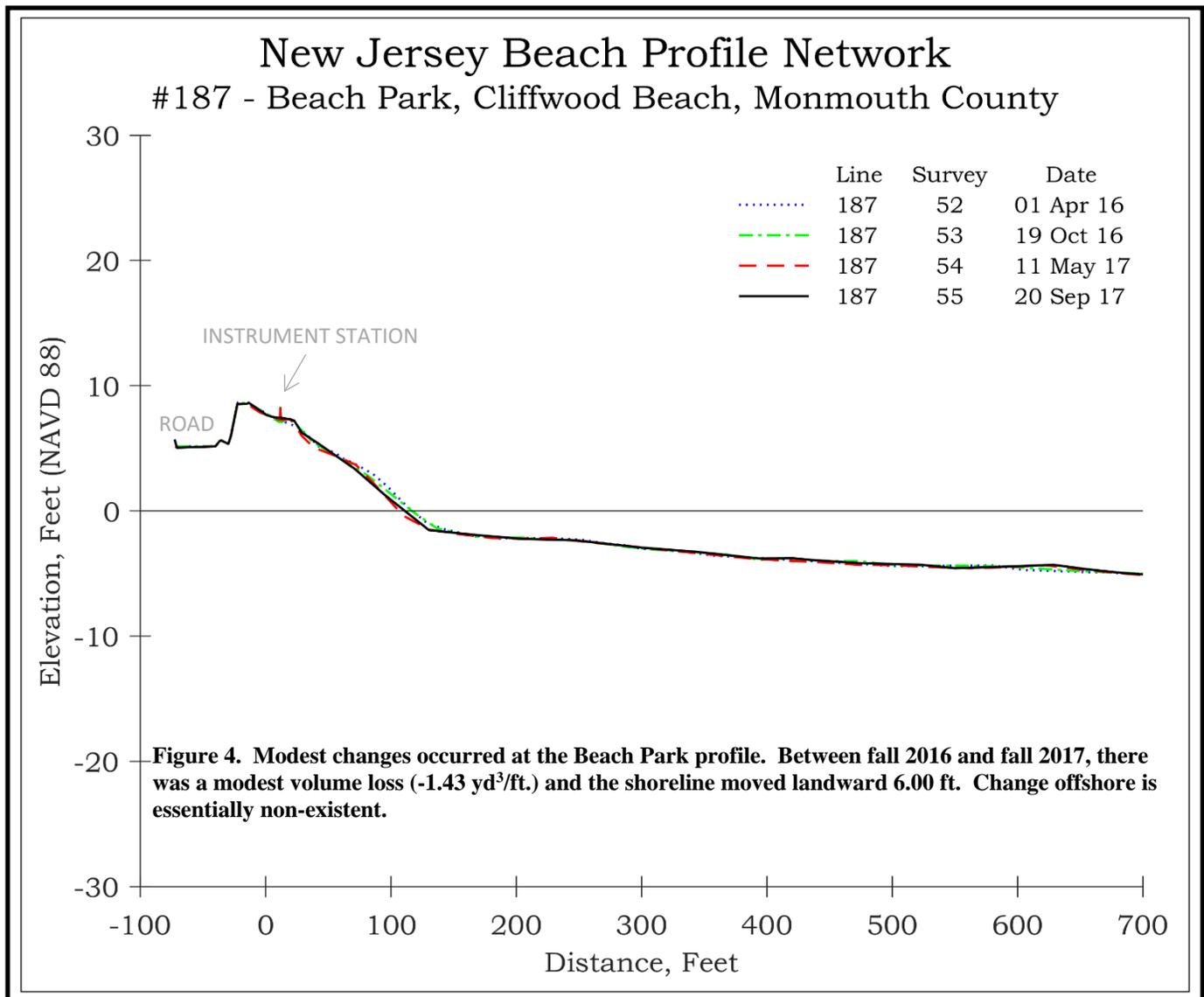
Riverside Drive, Manasquan; #15601

The southernmost new profile site in Monmouth County is positioned just north of the north jetty to Manasquan Inlet. The initial survey reproduces a similar pattern to the other December 2017 Manasquan surveys. The minimal dune at the promenade, followed by a wide beach (200 feet) and a relatively uniform slope seaward without an offshore terrace or bar system.

NJBPN 187 – Beach Park, Cliffwood Beach



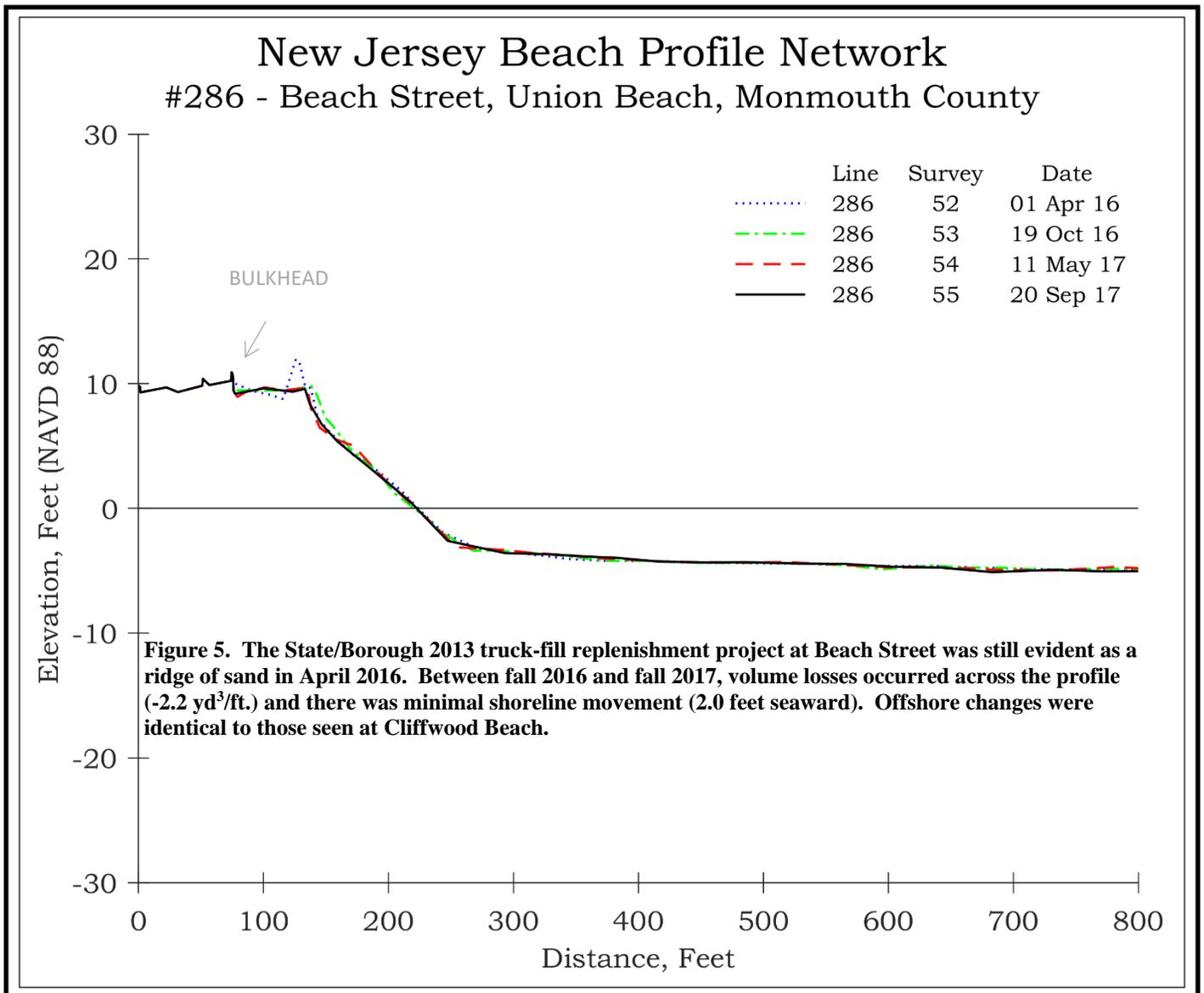
This is the westernmost NJBPN site located on Raritan Bay. The photograph on the left shows the shoreline on April 1, 2016 that still displays residual Sandy damage. The photo on the right shows the beach, the replaced fence and modest dune grass recovery taken on September 20, 2017.



NJBPN 286 – Beach Street, Union Beach



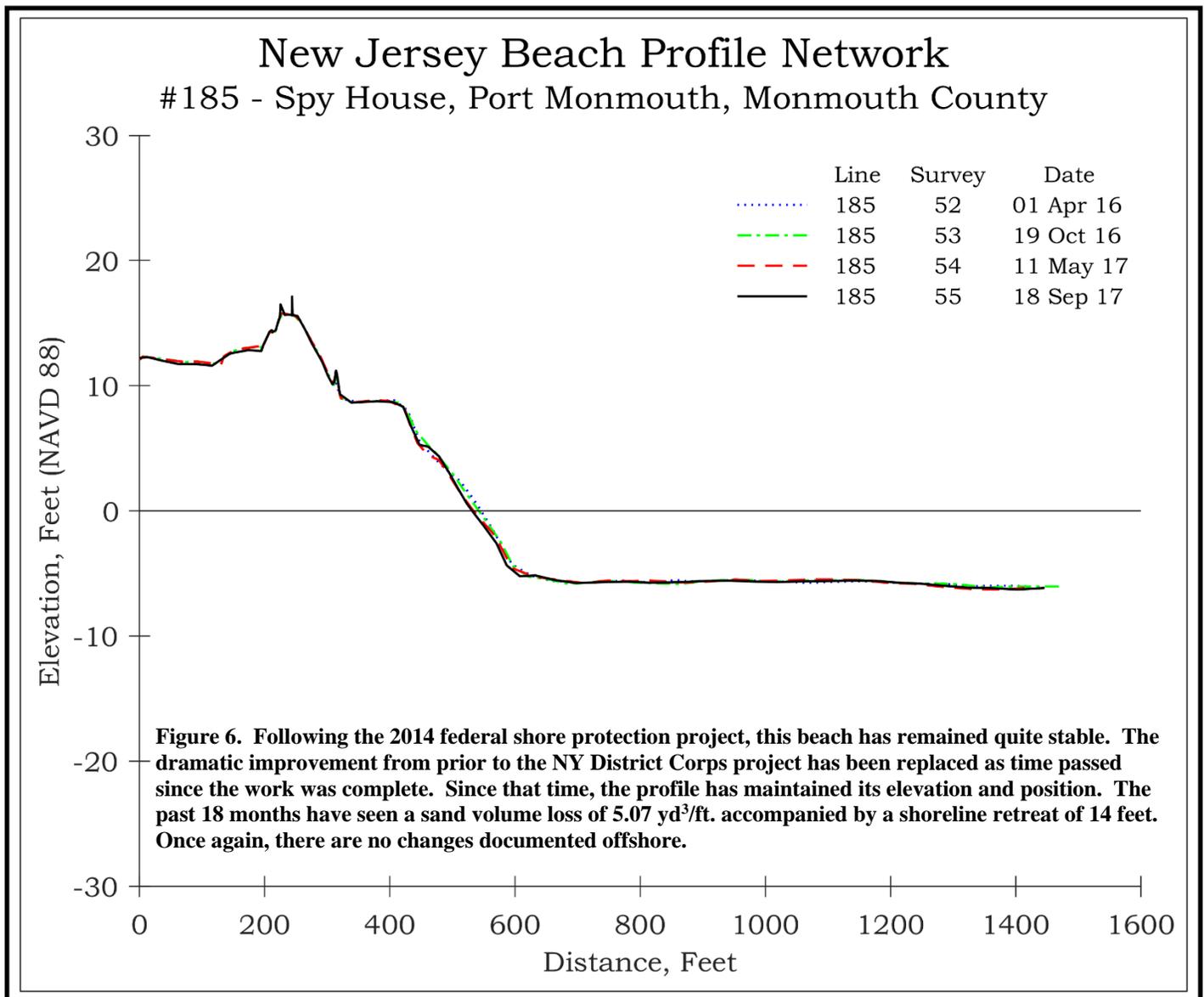
This site was moved to the public bathing beach in 2009. The photograph on the left shows the shoreline on April 1, 2016 with a storm barrier pushed up onto the berm. A truck fill project in 2013 added 14,000 cu. yds. of sand. The photo on the right shows the beach width and berm on September 20, 2017. No ridge was pushed up as of mid-September.



NJBPN 185 – Bay Shore Waterfront Park, Port Monmouth



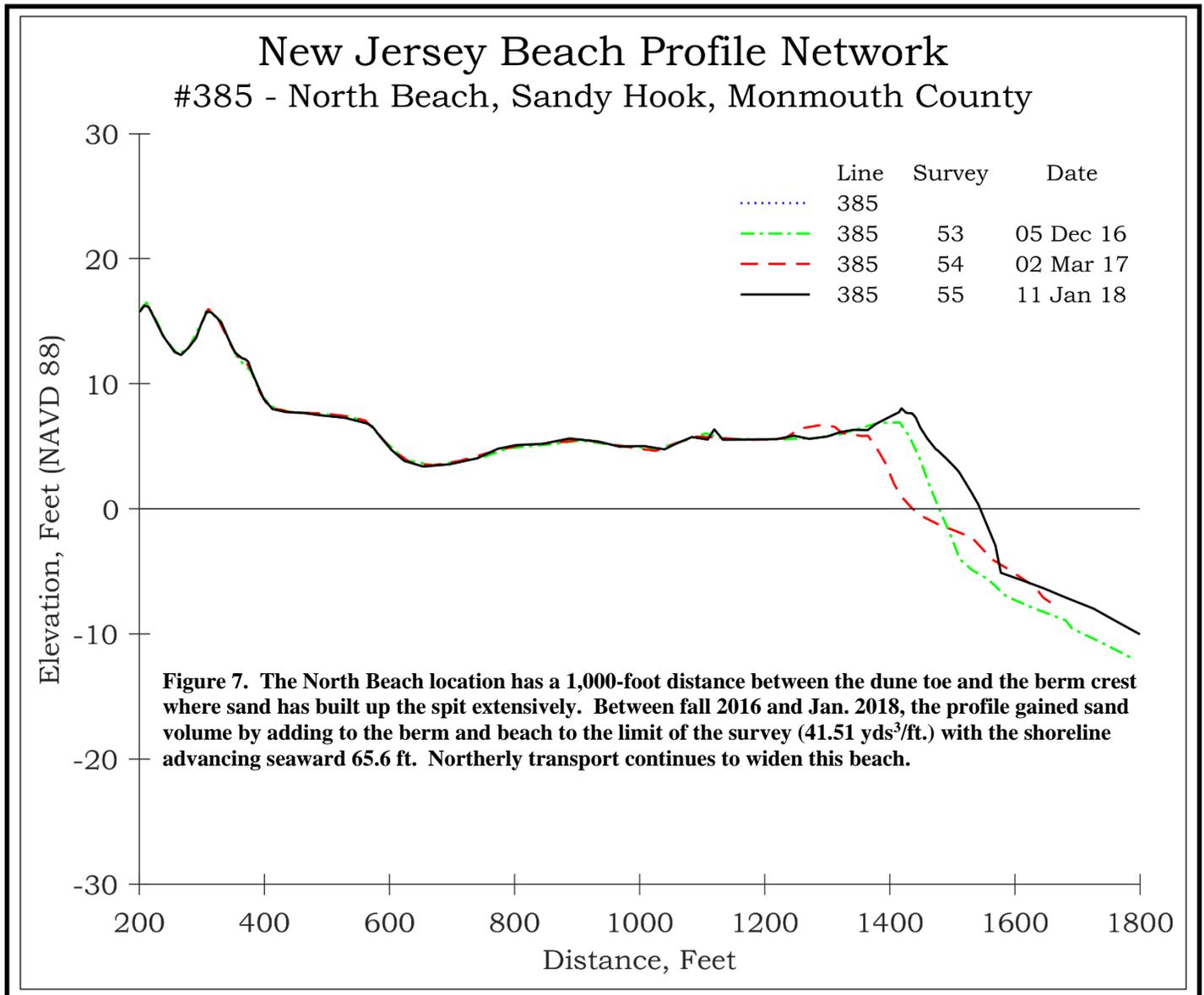
This site was enhanced during 2014 by the NY USACE. The April 1, 2016 view on the left along the beach to the east shows the established profile. The right picture was taken September 18, 2017 confirming the minimal changes documented by the surveys. Sandy Hook lies at the horizon in the distance.



NJBPN 385 - North Beach, Sandy Hook National Seashore



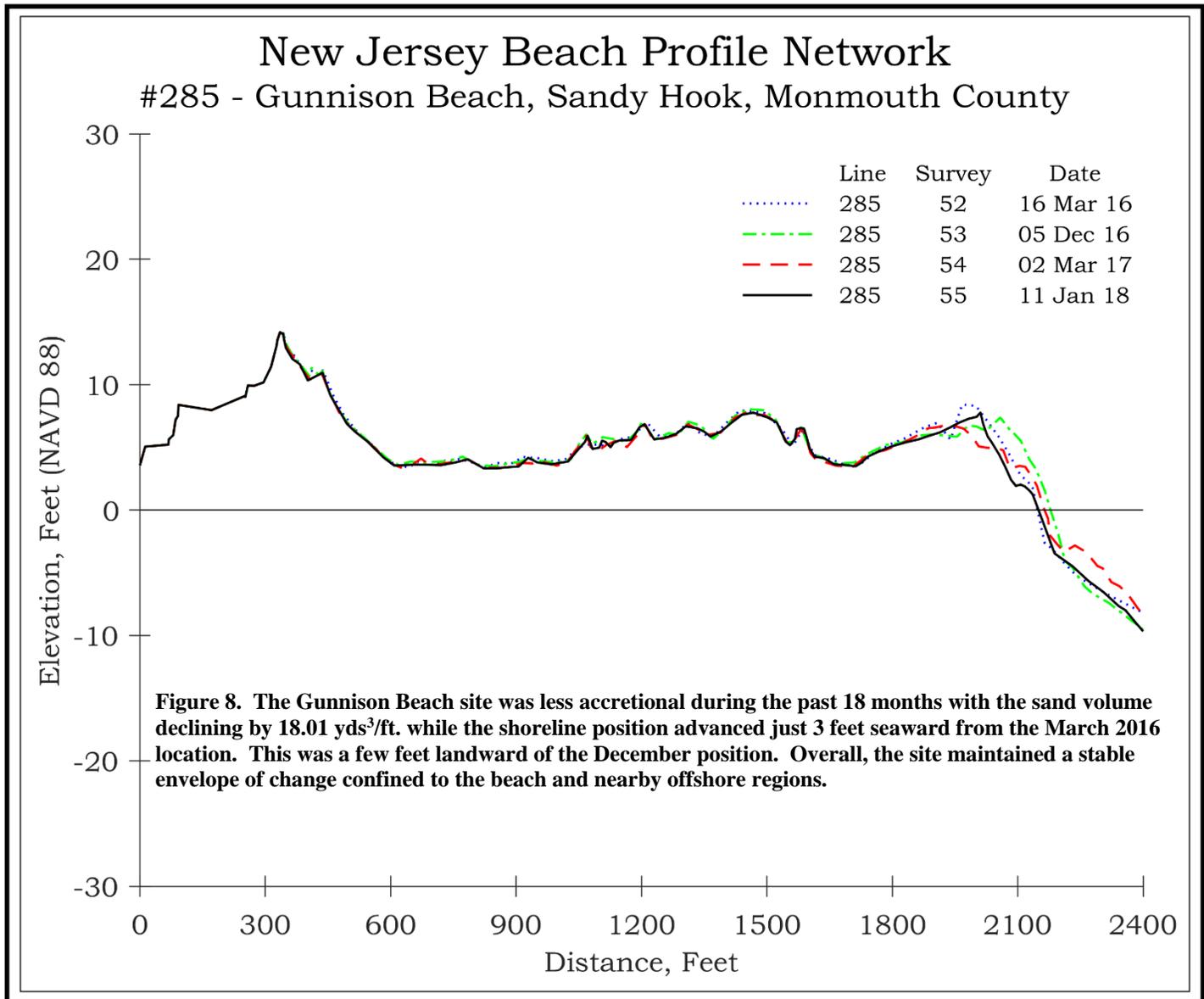
This Sandy Hook location was established in December 2016, then surveyed twice in 2017. The expanse of beach with the view to the left 12/5/2016 looking north toward the tip of Sandy Hook and the view on the right 1/11/2018 looking to the east, is massively impressive within this amazing national treasure.



NJBPN 285 – Gunnison Beach, Sandy Hook National Seashore



This site is difficult to show in still pictures. The photograph on the left shows the March 16, 2016 beach looking north across the partially vegetated back beach; on the right is the view from the back beach east to the water's edge Jan. 11, 2018. Variations in the berm position dominated the past 18 months.



NJBPN 28401 - Area F Road, Sandy Hook

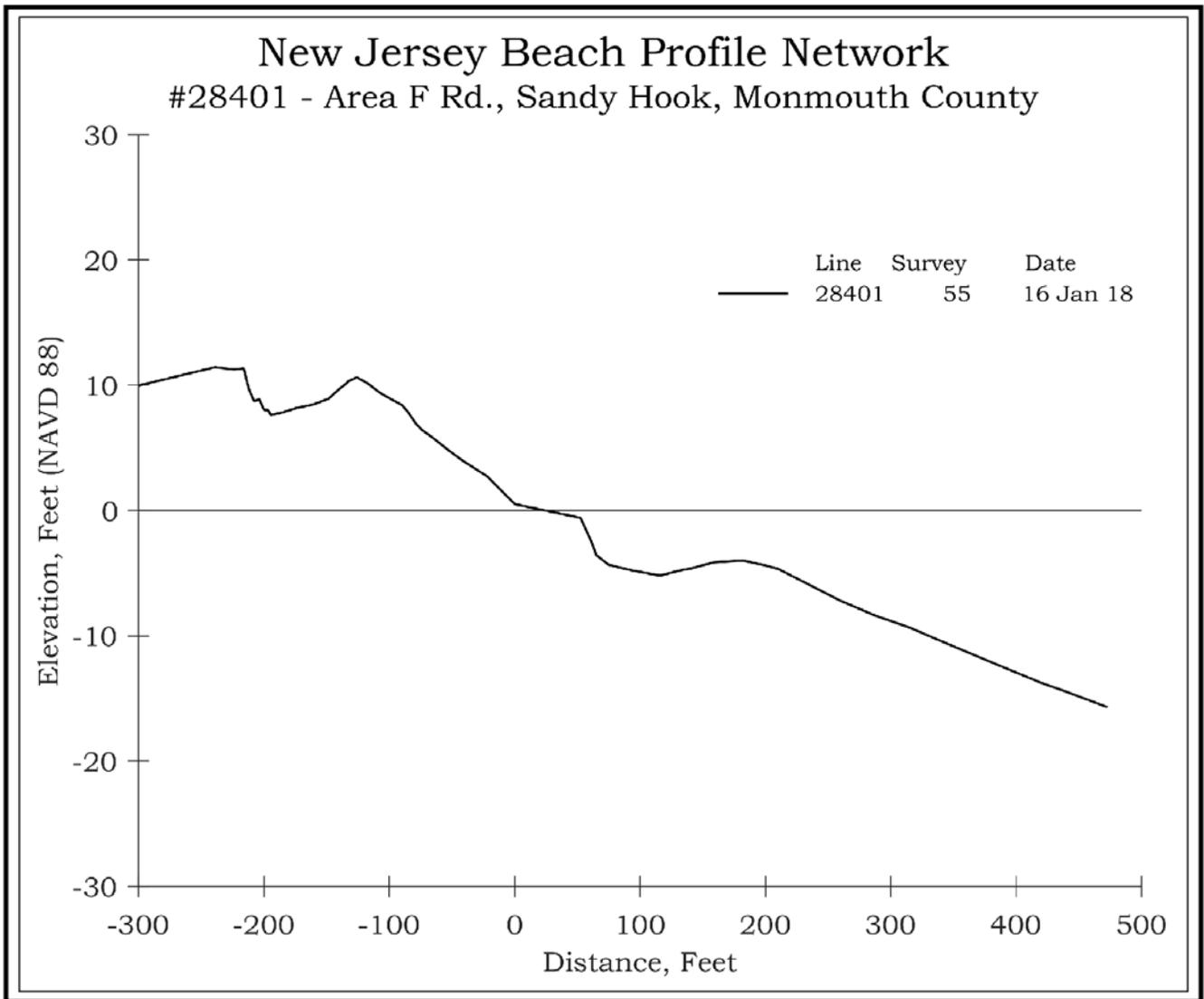
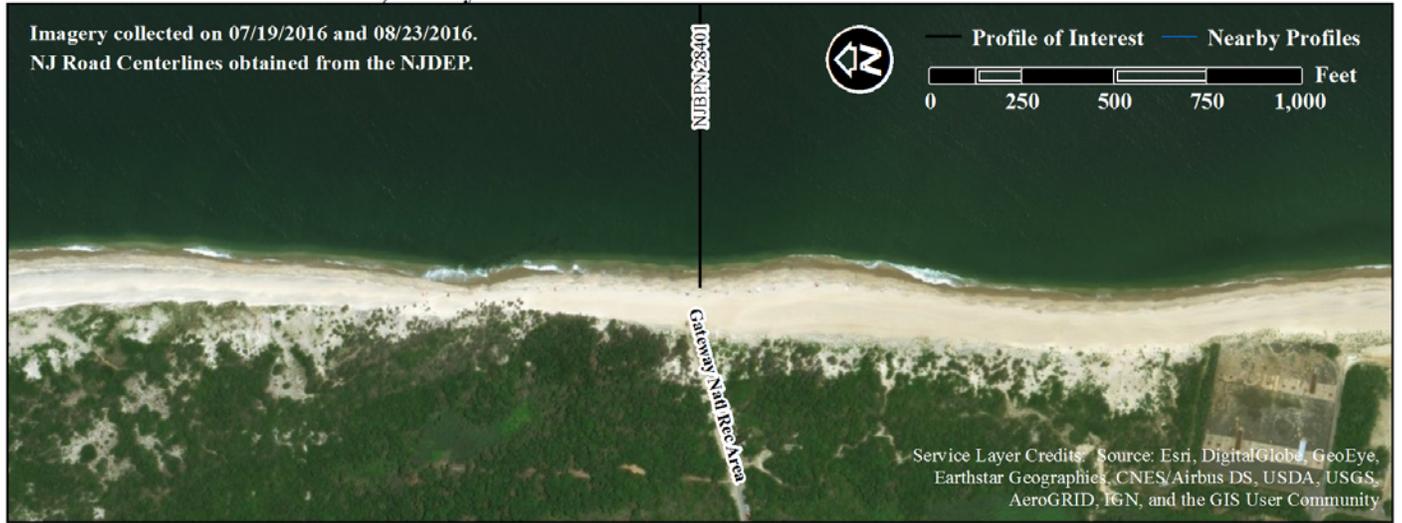
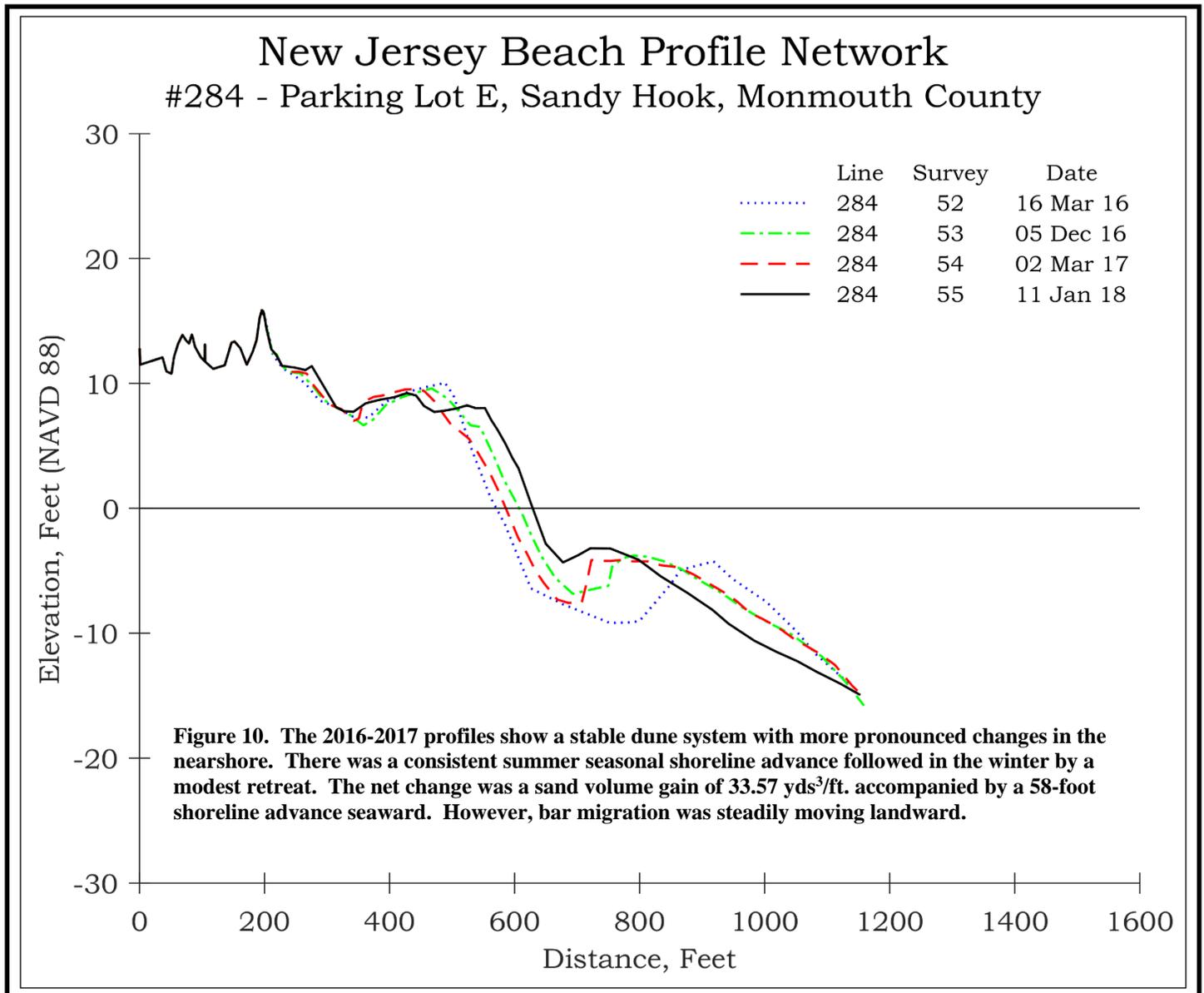


Figure 9. Area F Road is the northernmost new USACE location added in the fall of 2017. This site location contained a concrete relic obstacle located in the surf zone creating a surveying hazard. The site was moved 70.2 feet south of the coordinate start point provided to avoid this obstacle. The beach has a dune, a slope to the base of the beachface with a sand bar located offshore.

NJBPN 284 – Parking Lot E, Sandy Hook National Seashore



On the left is a beach picture from March 16, 2016 looking south along the dune toe. A similar perspective on January 11, 2018 shows the width of the beach from the dune toe looking south from residual winter snow.



NJBPN 18401 - Parking Lot C, Sandy Hook

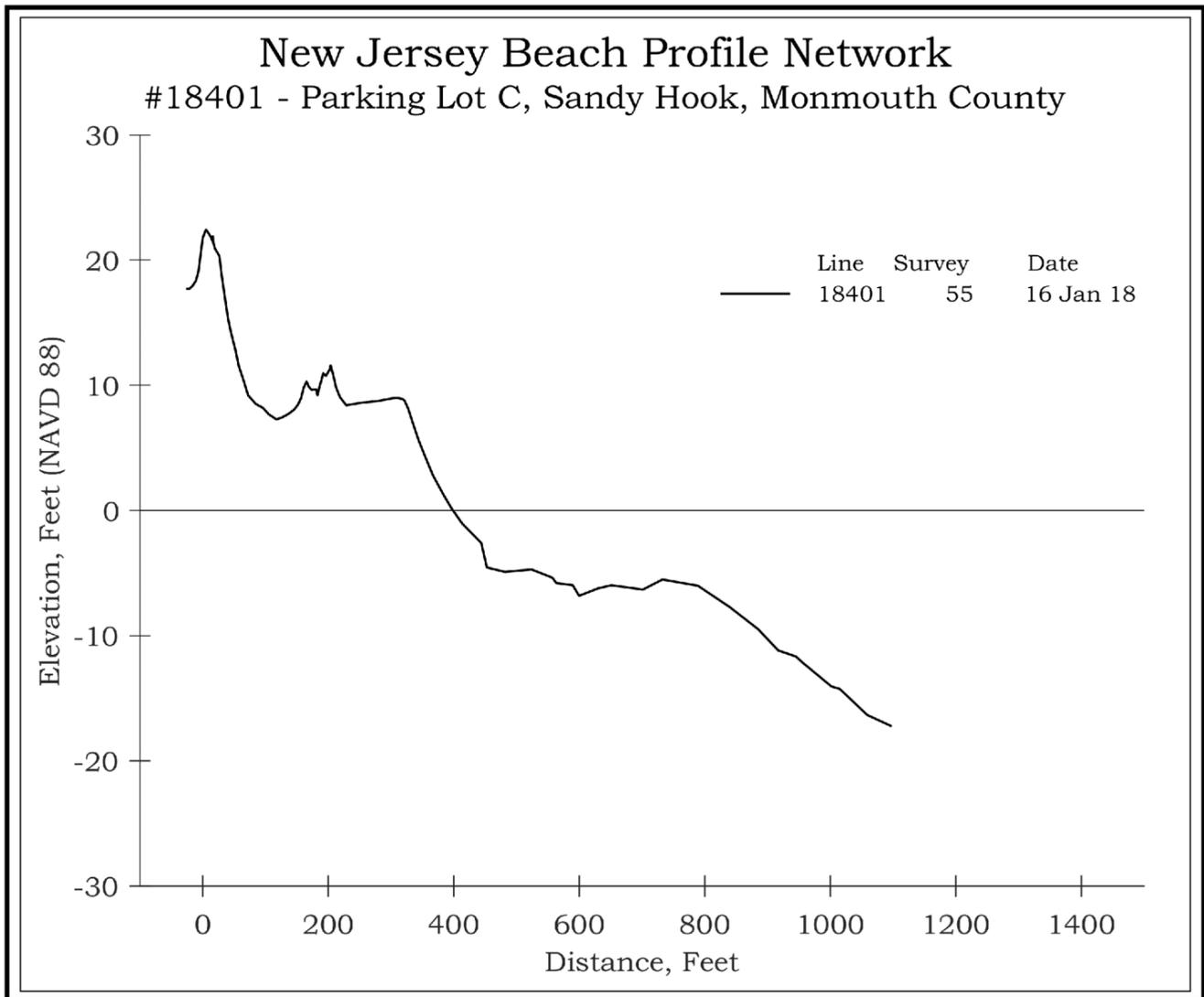
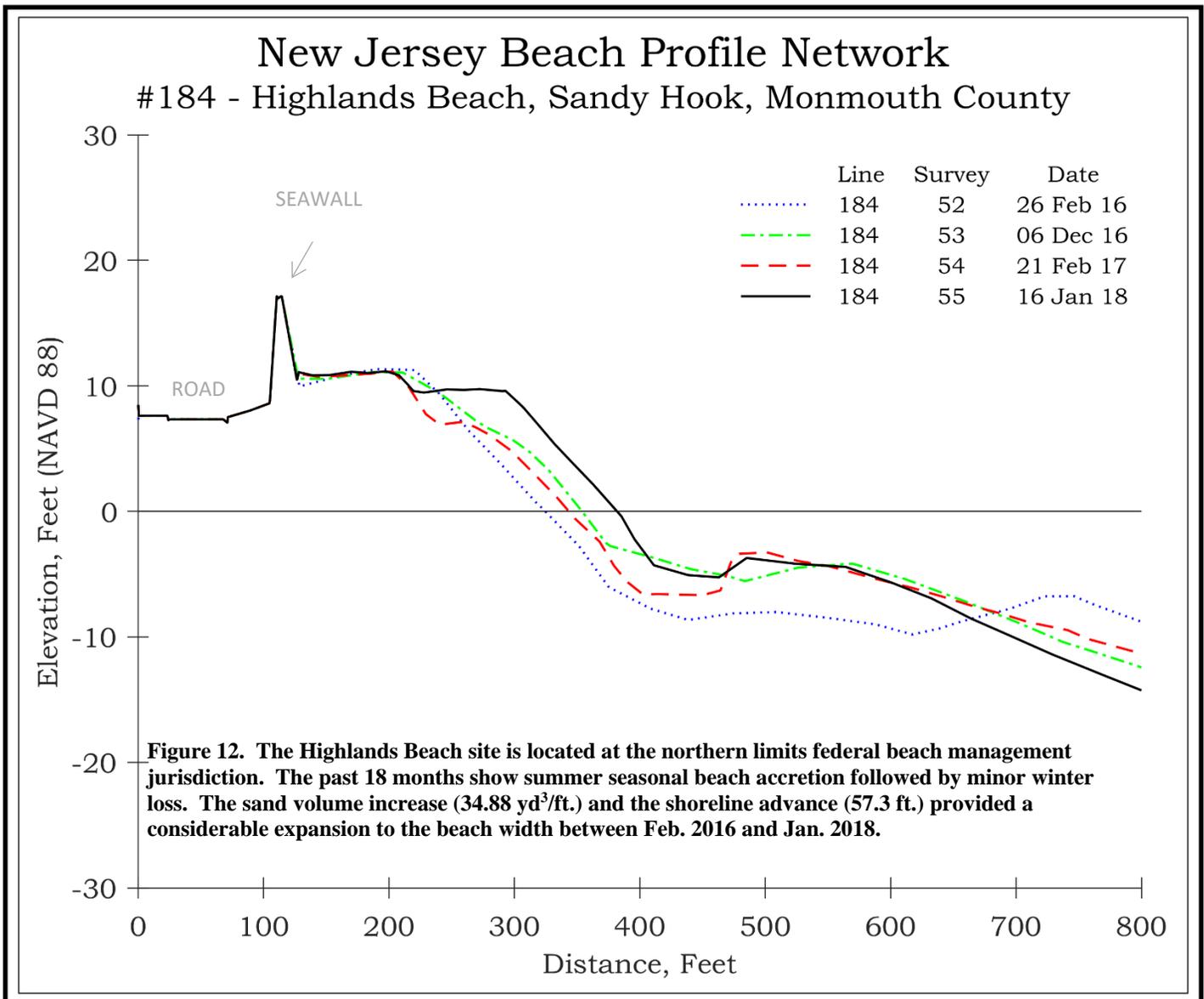


Figure 11. Positioned near the southern end of the Sandy Hook National Seashore, this site contains a large dune, with smaller foredunes seaward of the primary dune, a 80-foot wide dry beach and a uniform slope to water about 4.5 feet in depth offshore. Further seaward is a terrace with a small bar developed at the seaward end.

NJBPN 184 – Highlands Beach, Sandy Hook National Seashore



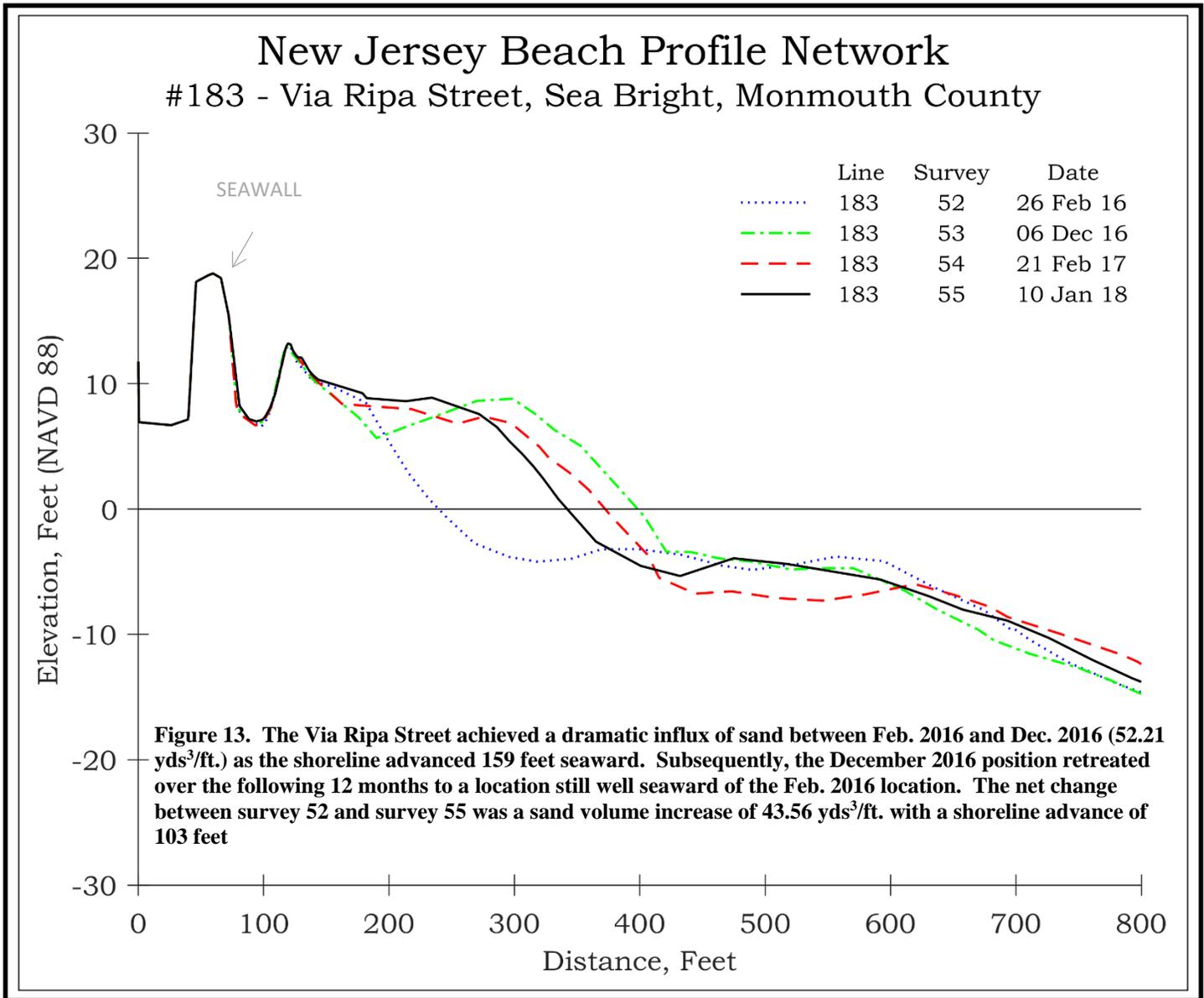
This southern Sandy Hook site is located near the entrance to the park and has gained in volume since the 1995 start of the federal shore protection project. The left view was taken Feb. 26, 2016 during a period of berm retreat. Note the exposed nearshore bar. By January 16, 2018, significant deposition had taken place on the beachface and nearshore regions.



NJBPN 183 – Via Ripa Street, Sea Bright



This site is near the northern limit of the initial Federal shore protection. The left photo shows the seawall and the line of dunes looking south on Feb. 26, 2016, while the right photo (Jan. 10, 2018) shows a southerly view from the dune crest. The rocks on the left side of the 2018 photo were work in progress to improve the condition of the wall and were staged on the beach.



NJBPN 28202 - 300 Ocean Avenue, Sea Bright

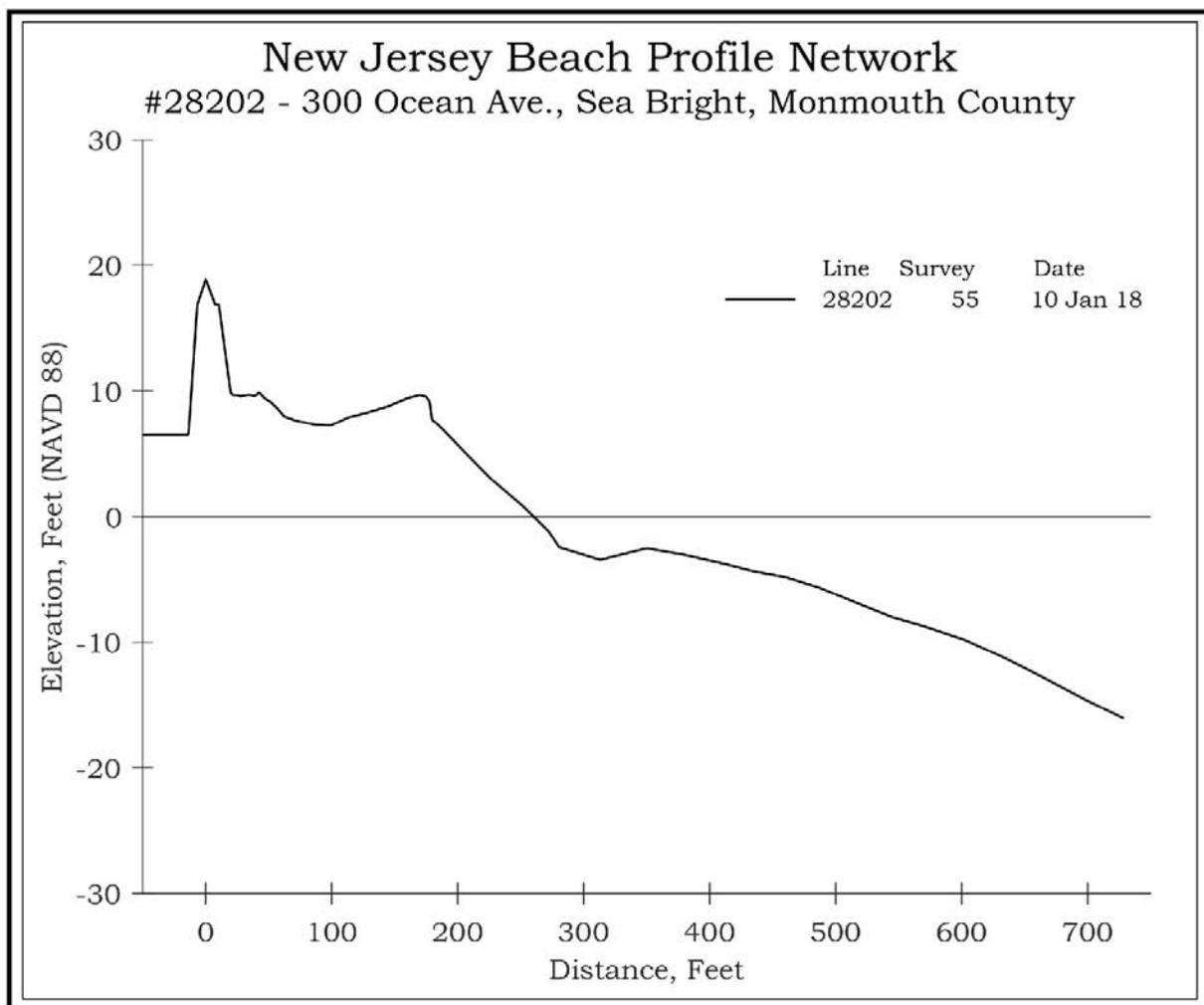


Figure 14. This location starts at the seawall and on its seaward side only minimal dune sand has accumulated. The beach is wide at 150 feet to the berm crest. The beachface slopes to approximately -2.0 feet elevation where a small bar is located offshore.

NJBPN 28201 - 436 Ocean Avenue, Sea Bright

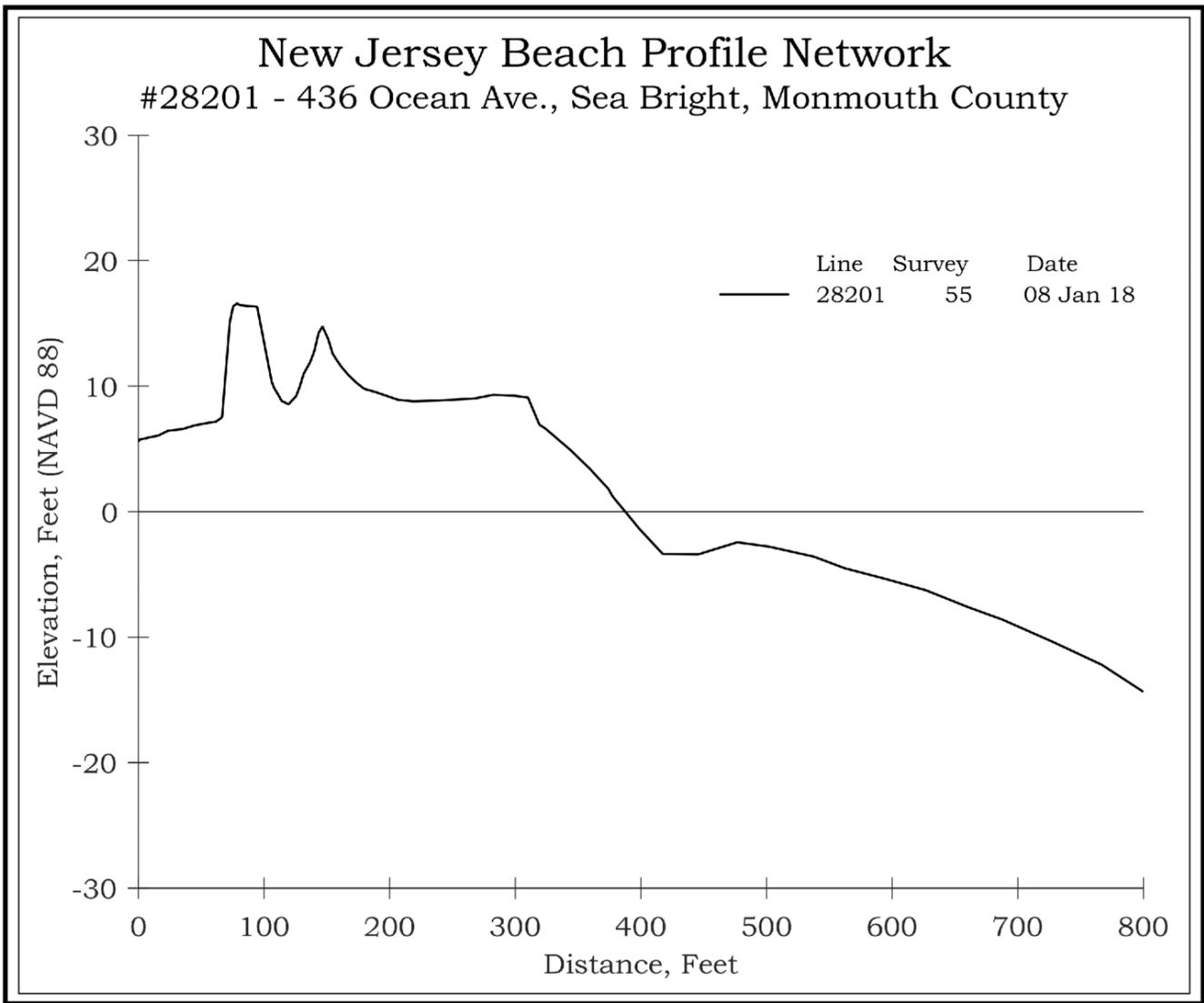
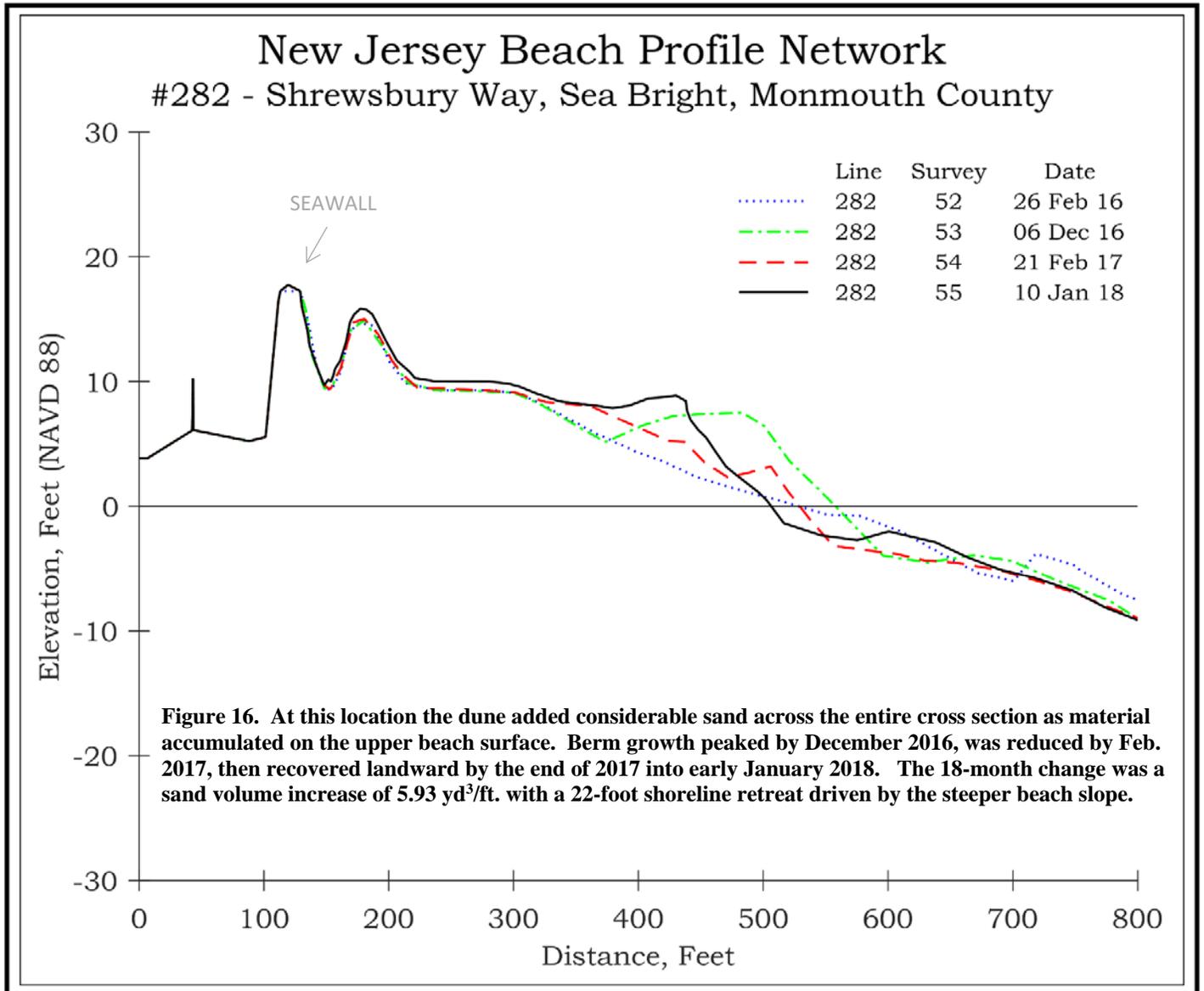


Figure 15. This site has the rock seawall as the initial feature followed by a fairly significant dune. The beach seaward is about 170 feet wide with a uniform beachface slope into 3 feet of water. Offshore, there is a small bar system present.

NJBPN 282 – Shrewsbury Way, Sea Bright



The left view shows the federal project from the crest of the dune on Feb. 26, 2016 (view to south). The right photo, also from the dune crest, shows the berm and beach seaward of the rock seawall on January 10, 2018 (view to north).



NJBPN 18202 - 678 Ocean Avenue, Sea Bright

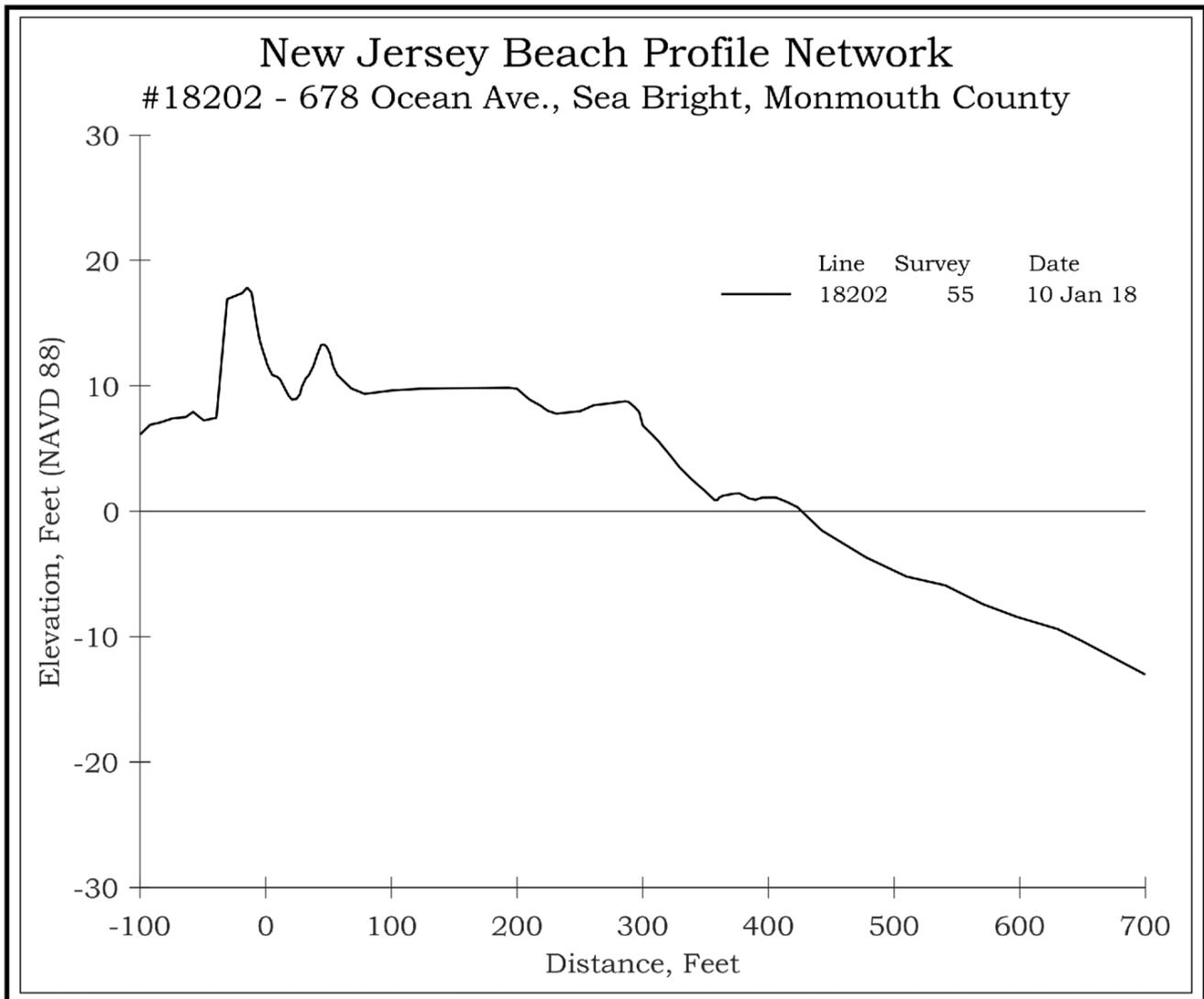


Figure 17. The rock seawall is the initial feature on this profile with a small dune immediately seaward. The beach is 200 feet wide to the berm crest. The beach slopes to the zero elevation position where a bar has merged with the lower beach.

NJBPN 18201 - 801 Ocean Avenue, Sea Bright

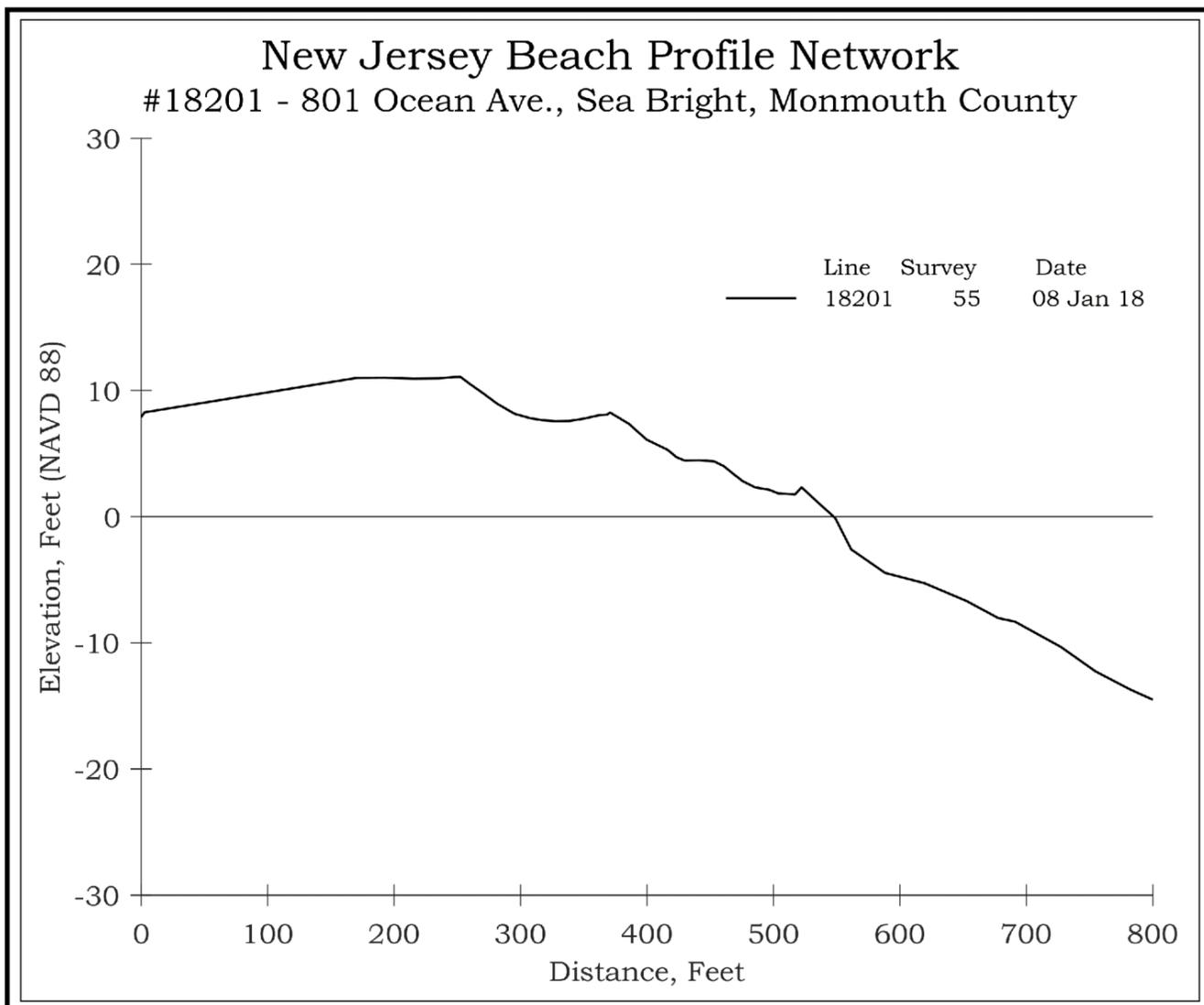
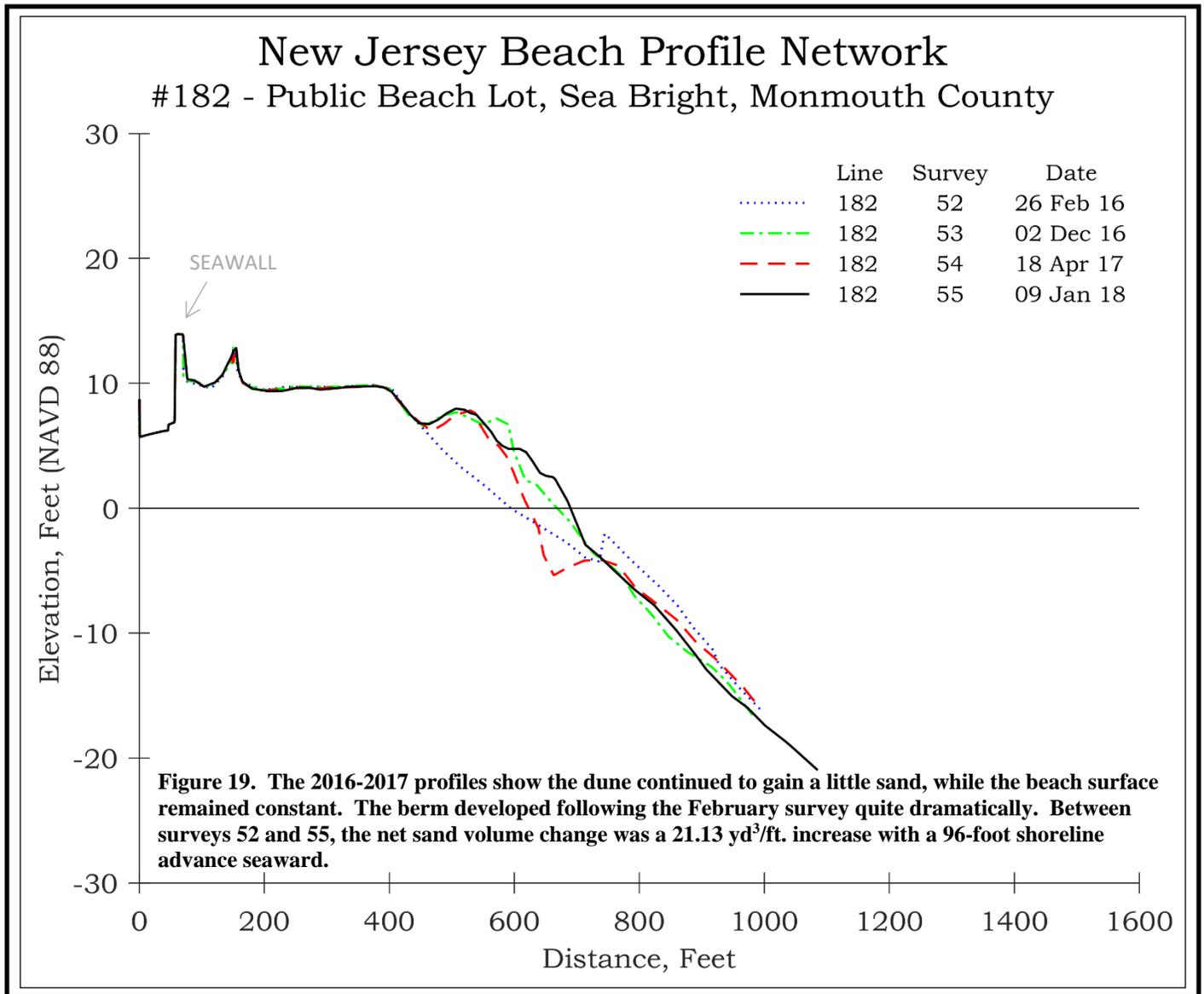


Figure 18. Positioned between two beach clubs, this line starts at the parking lot, ramps up to the dry beach without any dune present. The beach extends 500 feet seaward of the parking lot where a steep beachface drops into the water. There is no terrace or bar system present.

NJBPN 182 – Public Beach, Sea Bright



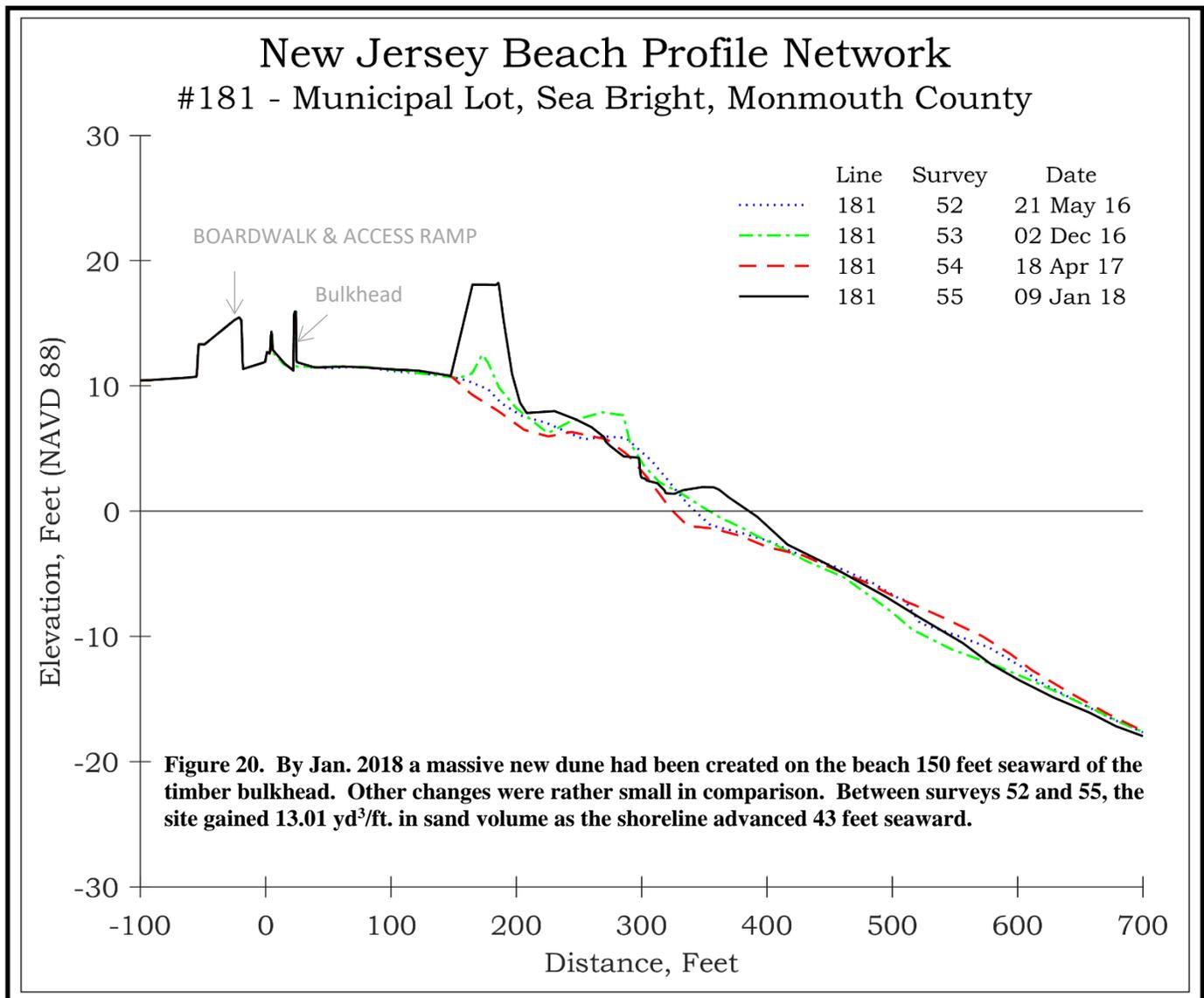
The Feb. 26, 2016 view on the left shows the uniform gradient beach looking north. The right view taken January 9, 2018 shows the berm deposited since early 2016. The dune developed after Sandy and was added to incrementally over time.



NJBPN 181 – Municipal Beach, Sea Bright



The May 16, 2016 view on the left side shows the raked beach in preparation for the summer season looking south. By January 9, 2018 the huge “dune” was in place as a storm barrier on this site.



NJBPN 18003 - 1201 Ocean Ave, Sea Bright

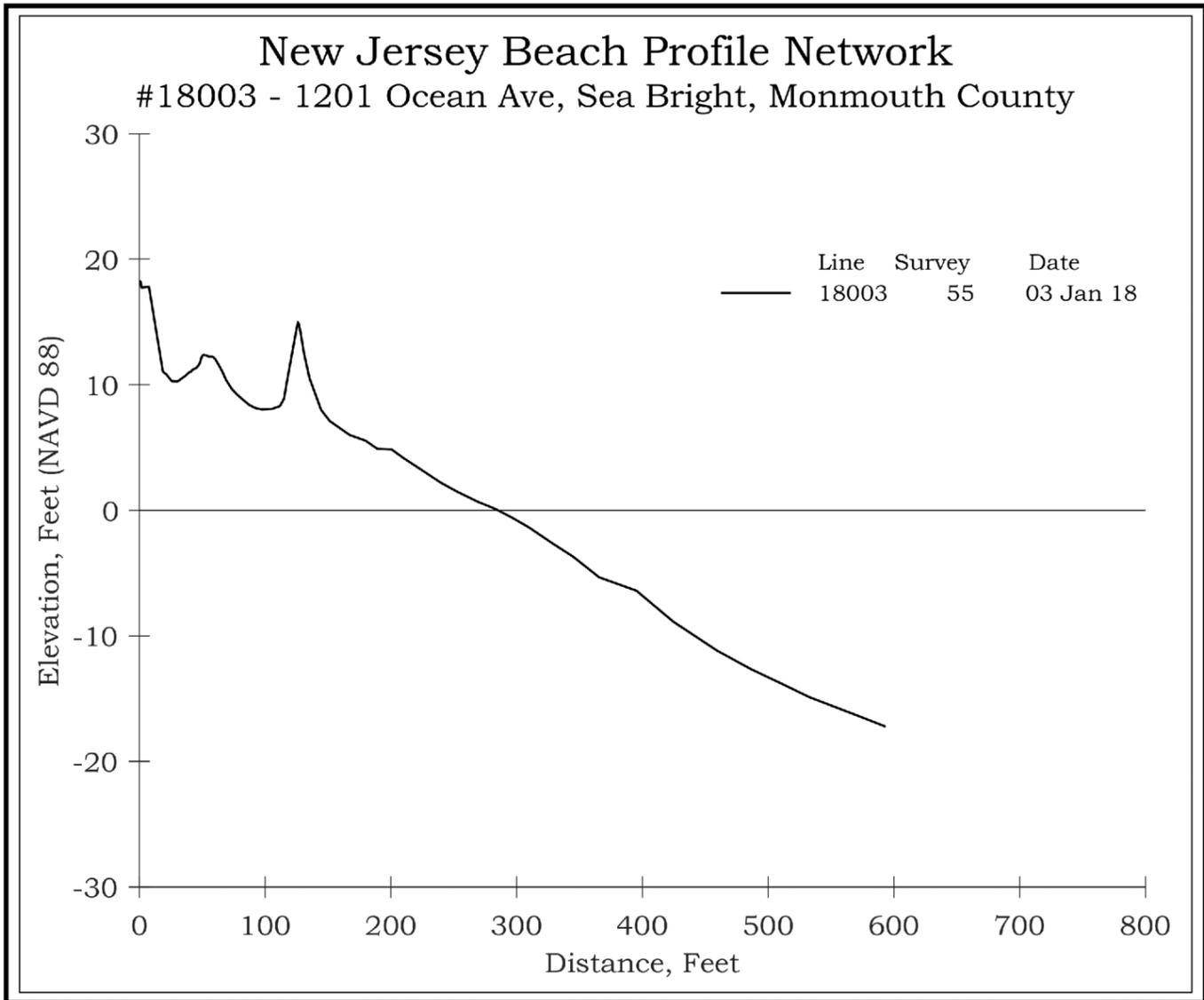


Figure 21. This site starts at the rock seawall and a pair of dunes exist on the landward beach’s first 100 feet of width. From the second dune the slope is quite uniform into the water and beyond. There is no bar system present at this site. This second ridge may be a seasonal barrier to storm waves.

NJBPN 18002 - 15 Tradewinds Ln., Sea Bright

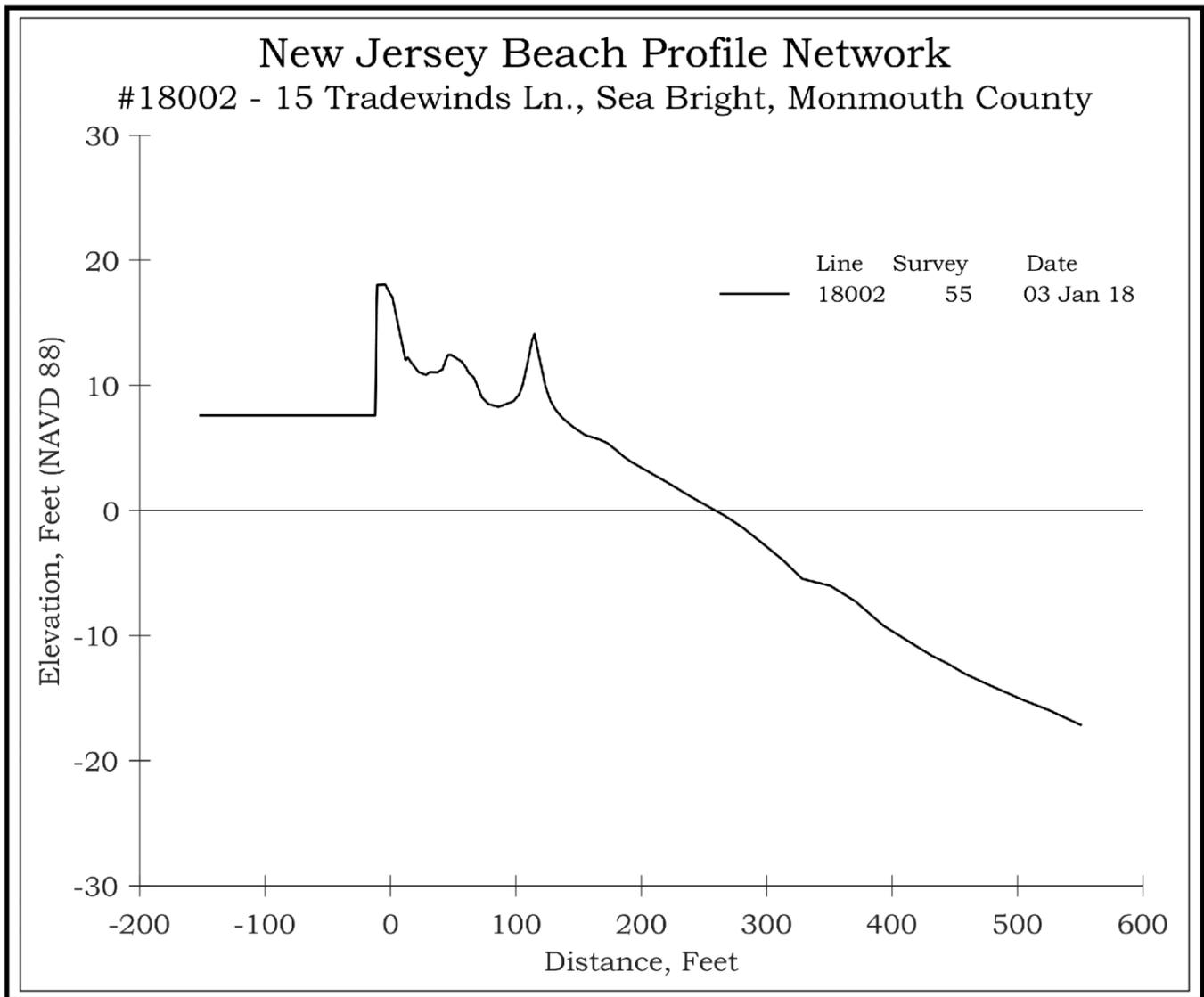


Figure 22. The rock seawall is the initial object on this profile that starts back at the Lane and runs between condominiums. There are dunes present at the seawall and positioned out on the beach by 100 feet. The seaward dune may be a winter ridge of sand pushed up for the winter season.

NJBPN 18001 - 1485 Ocean Avenue, Sea Bright

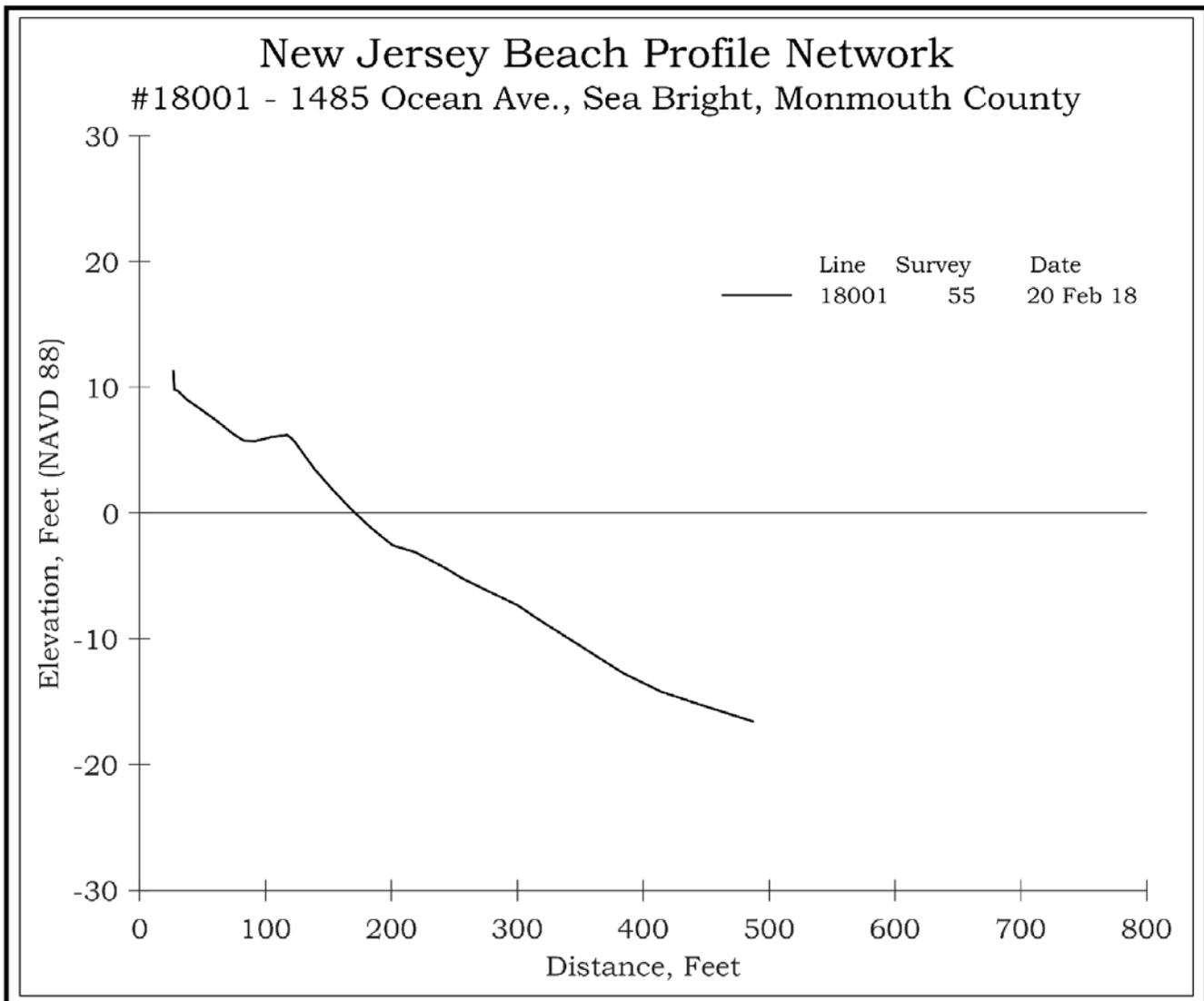
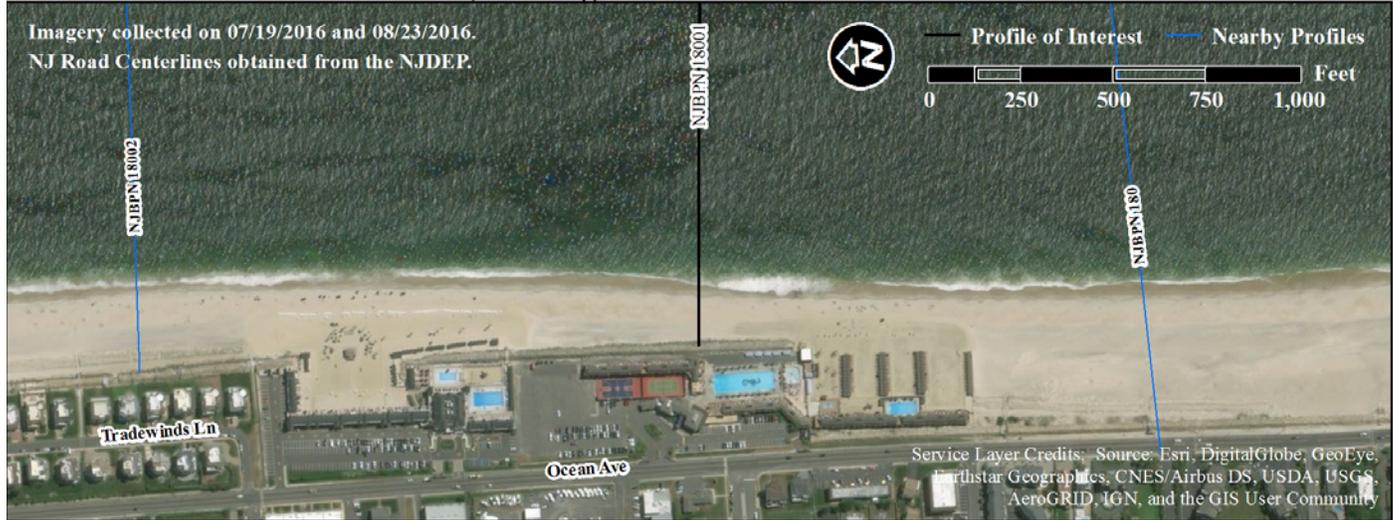
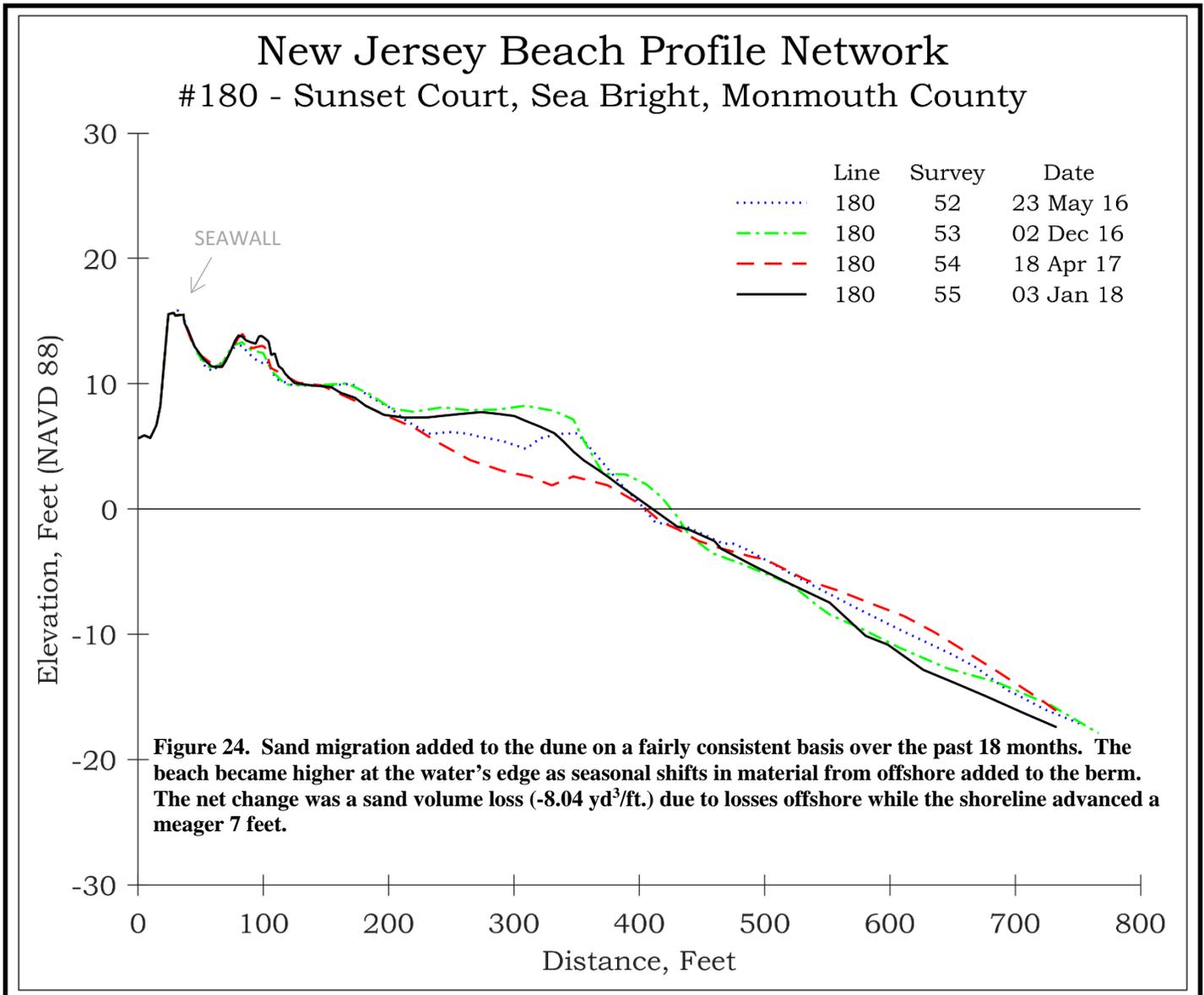


Figure 23. This site starts at a bulkhead and rocks considerably seaward of Ocean Avenue because the structures have been built seaward of the highway. There are no dunes, a fairly narrow beach with a well-defined berm. Offshore there is no terrace or bar system present.

NJBPN 180 – Sunset Court, Sea Bright



The view on the left taken May 23, 2016 shows the sand build-up on the dune into the landward fence. By January 3, 2018 the fence was nearly covered. The site varied in its berm elevation considerably among the four surveys.



NJBPN 17901 - 122 Ocean Avenue, Monmouth Beach

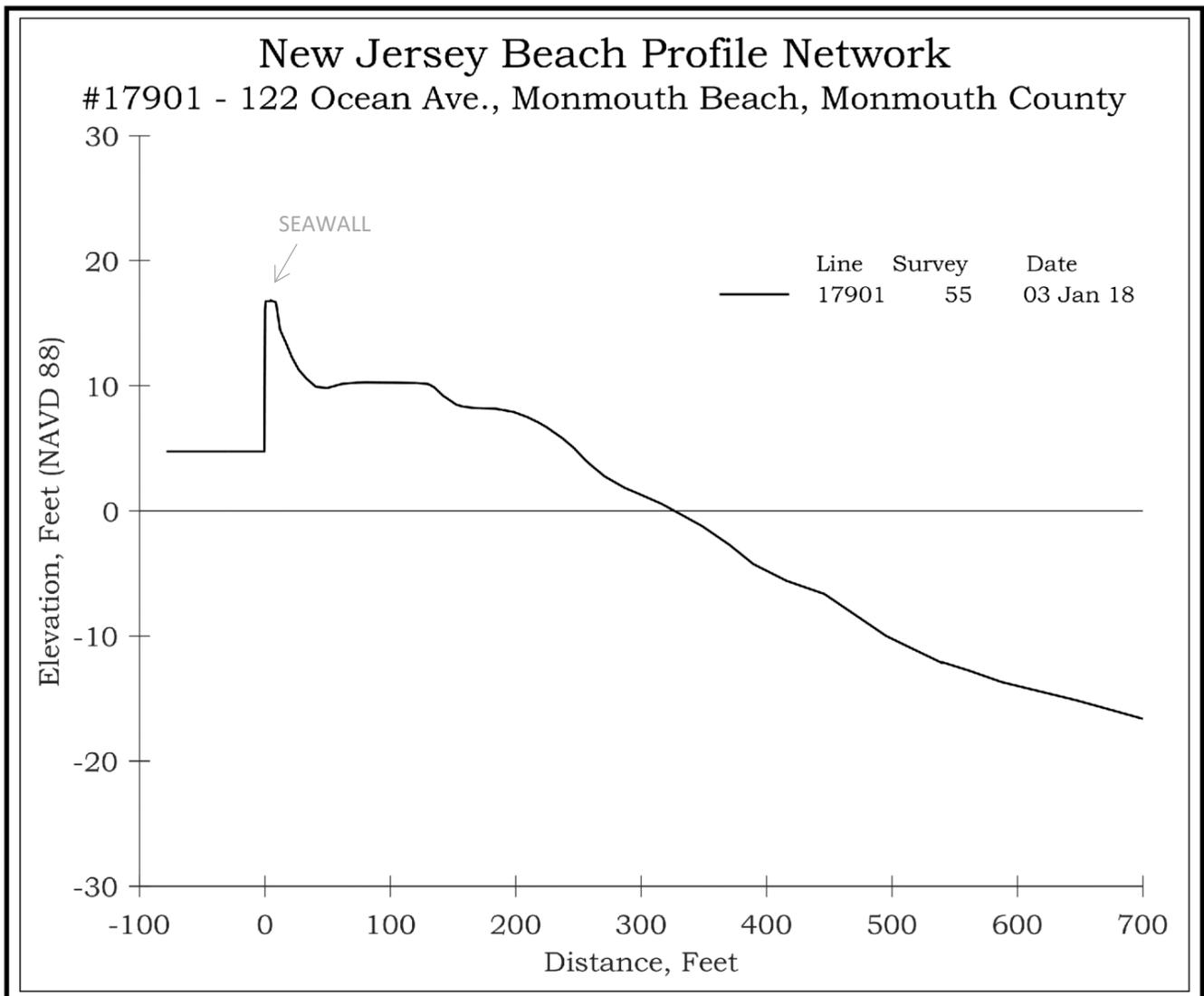
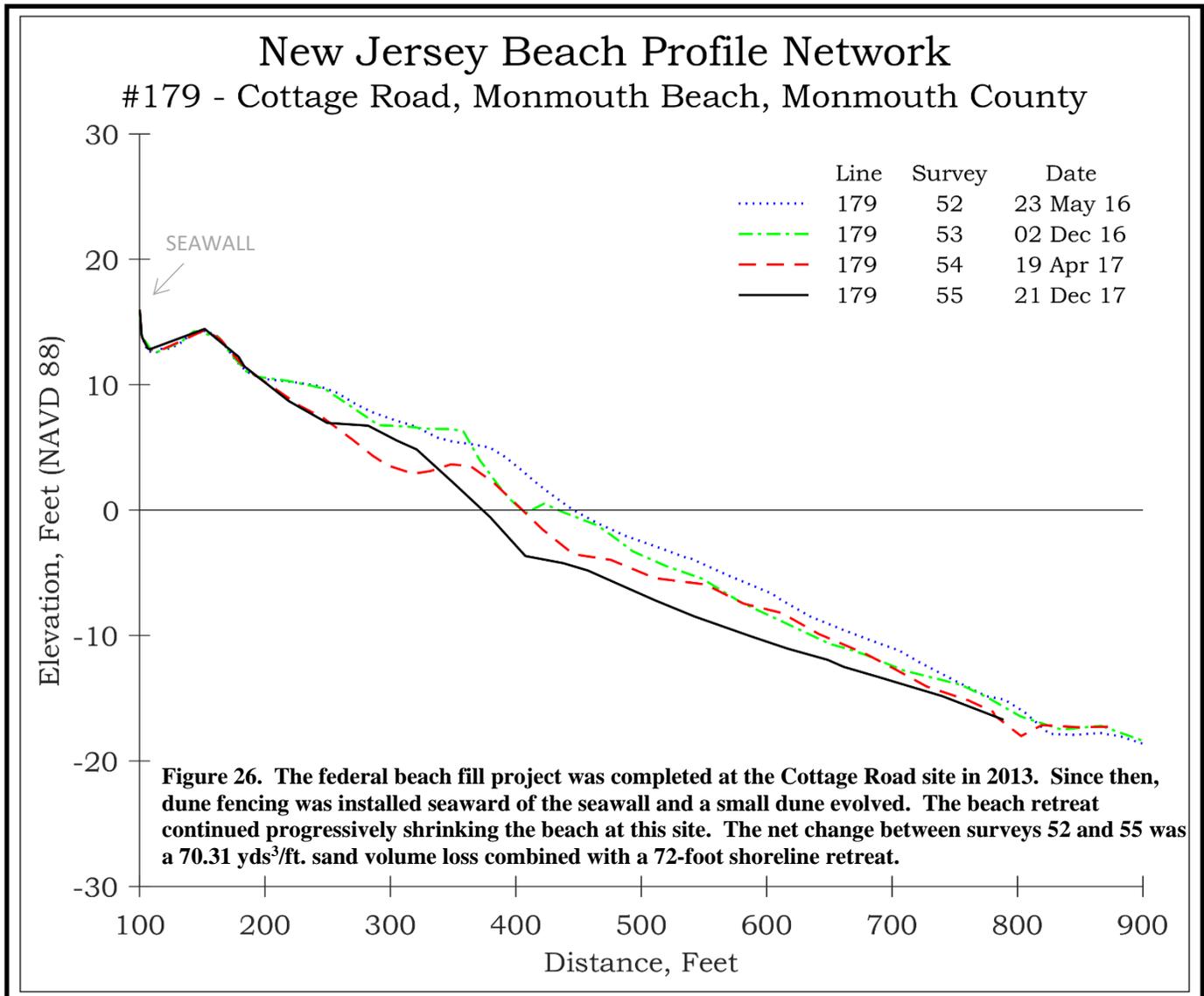


Figure 25. Ocean Avenue lies just west of the rock seawall. There is sand ramped up against the rocks on the seaside, but no dune development. The beach is about 160 feet wide to the berm, where a uniform slope extends into the water to the limit of the survey. No bar system is present.

NJBPN 179 – Cottage Road, Monmouth Beach



This site continues to be the point where the worst erosion occurs in Monmouth County. The left photograph May 23, 2016 shows the newly planted dune from the seaward side of the seawall. On the right the existing beach has narrowed further with the beach and berm about 100 feet wide to the water on December 21, 2017.



NJBPN 17801 - 65 Ocean Avenue, Monmouth Beach

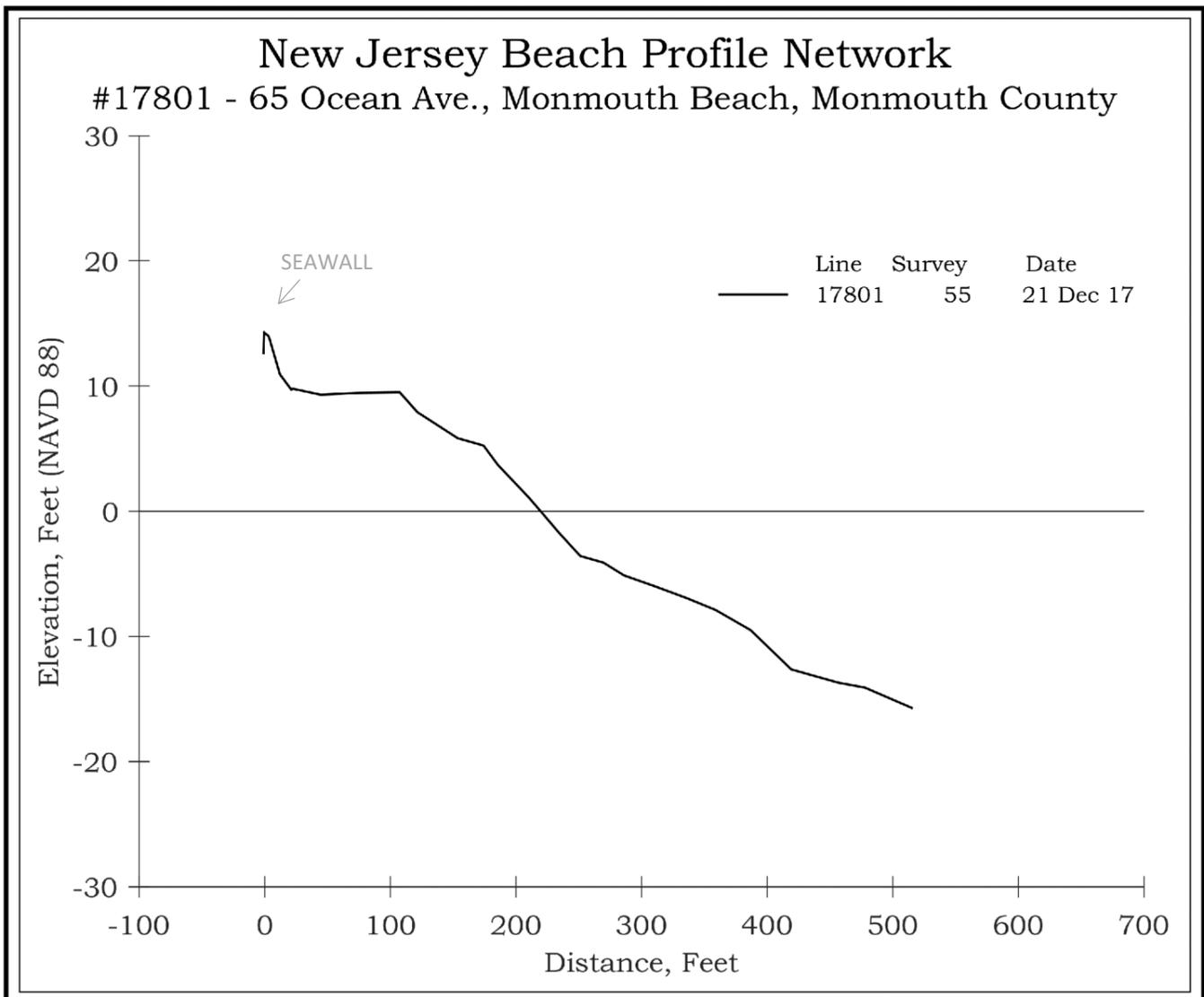
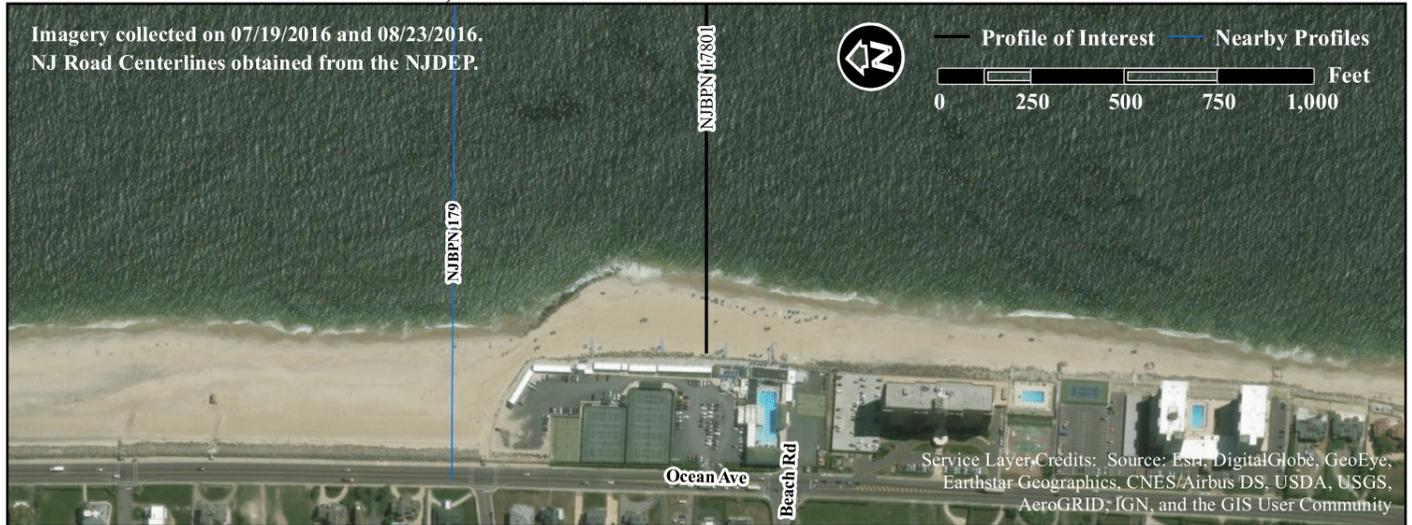
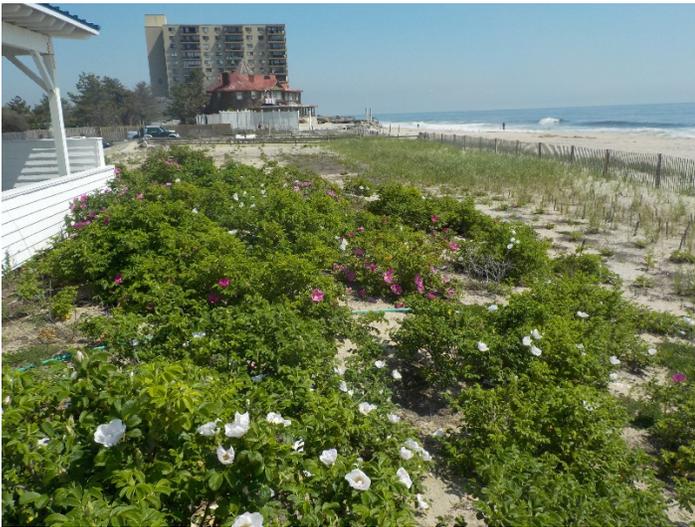
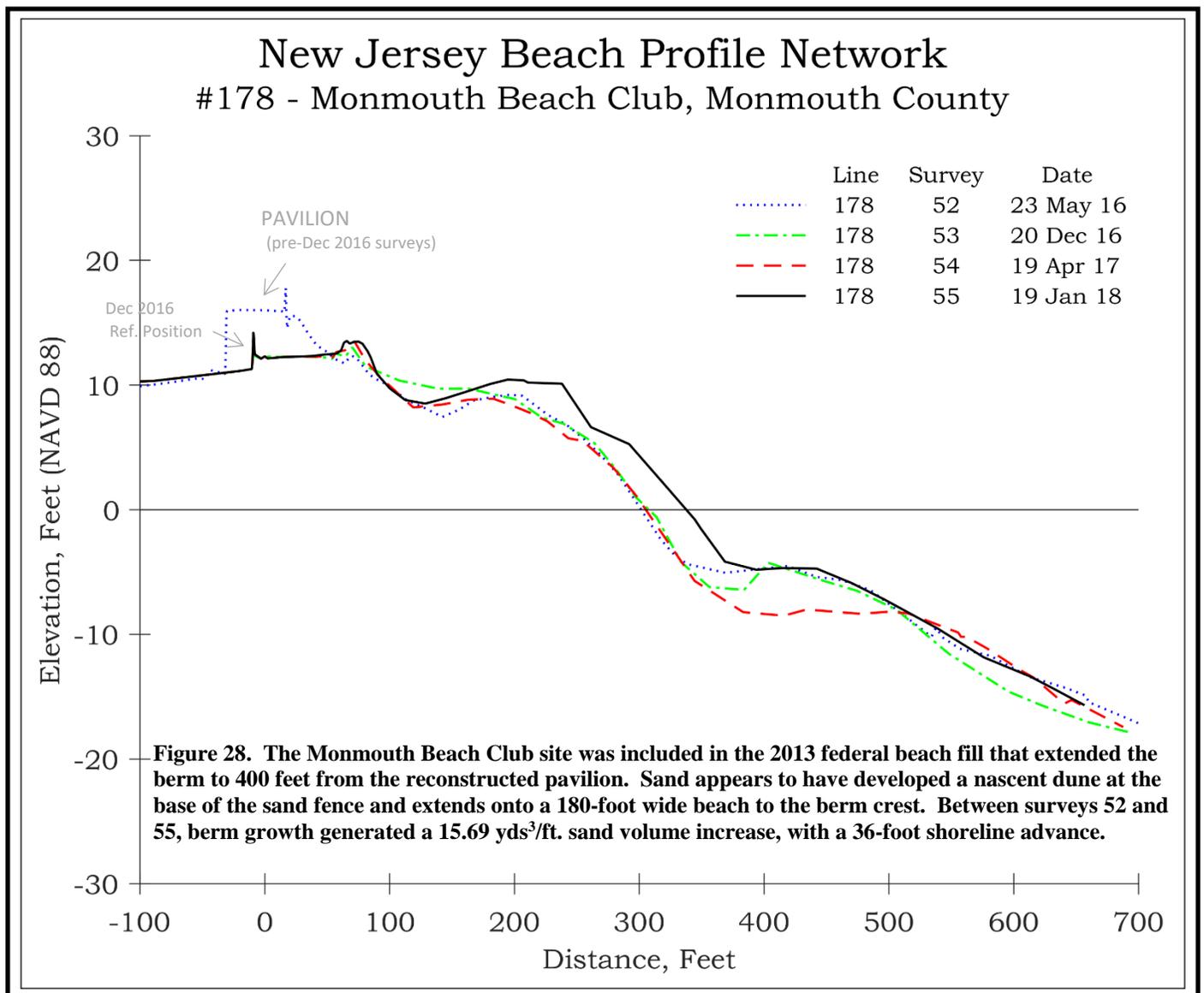


Figure 27. The Monmouth Beach Club is landward of this site where the rock seawall extends seaward around the building. There is no dune system and the beach is about 110 feet wide to the berm crest. The slope is relatively uniform into deeper water with no terrace or offshore bar system present.

NJBPN 178 – Monmouth Beach Club, Monmouth Beach



The left photo taken May 23, 2016 is a view to the north from the dune crest which was planted with *Rosa regosa* at the beach club deck. The right photo taken January 19, 2018 was taken at the sand fence line looking north across the beach berm.



NJBPN 17701 - 9 Ocean Avenue, Monmouth Beach

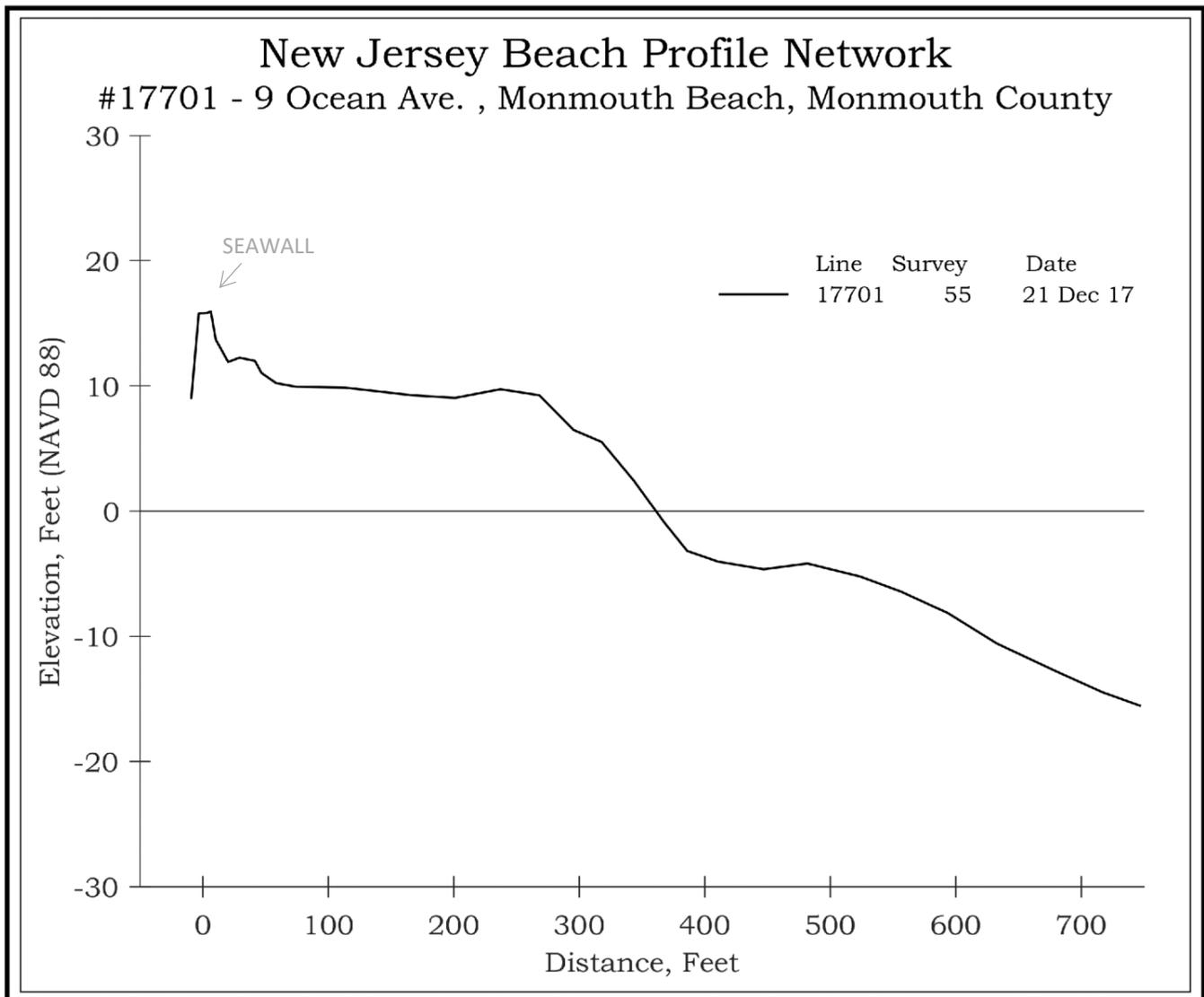
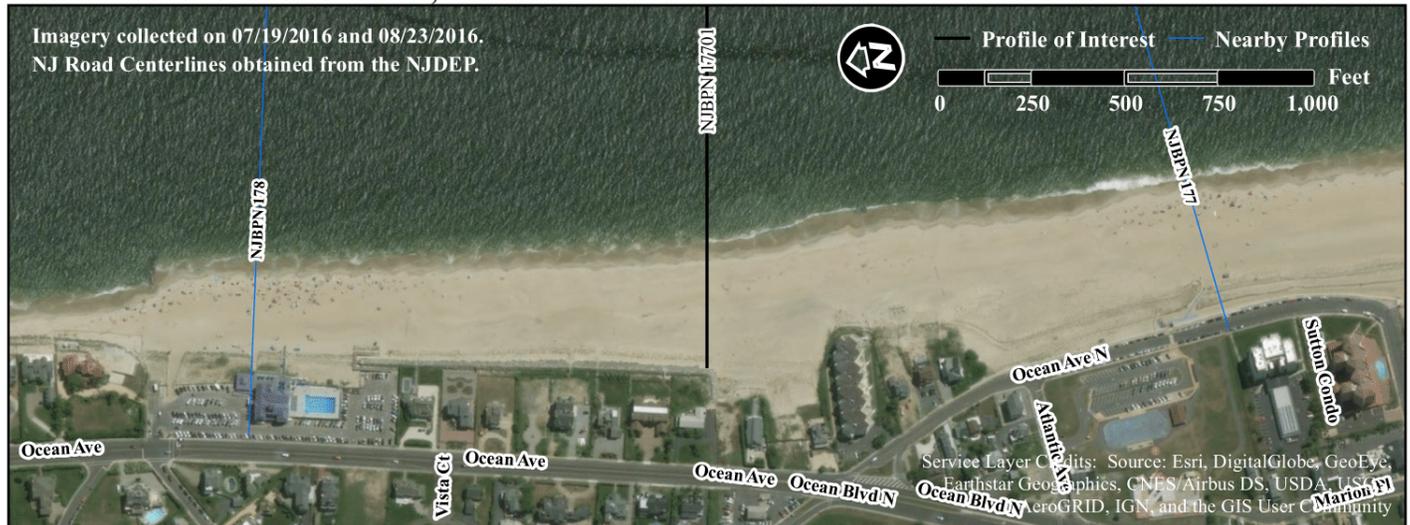
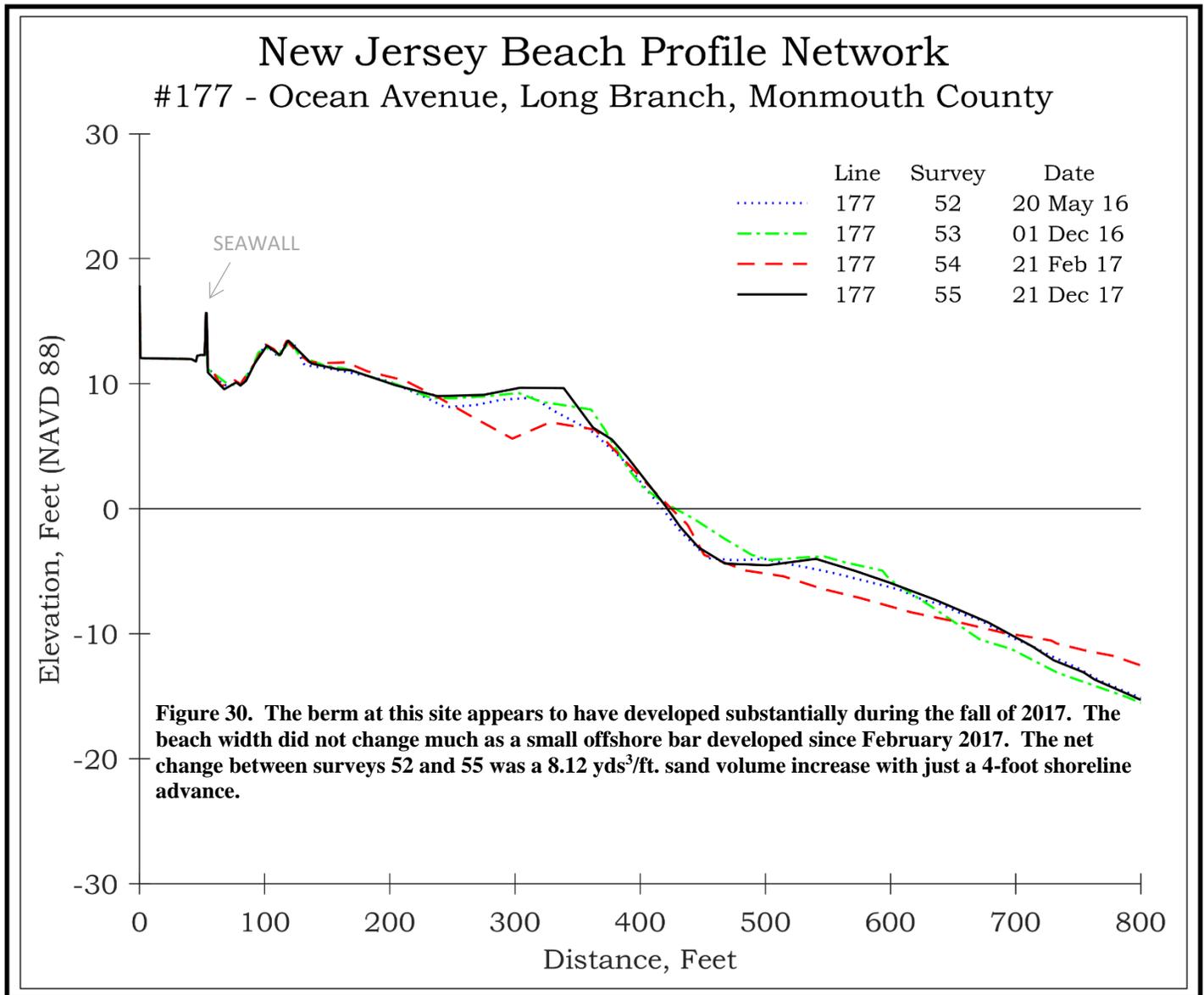


Figure 29. This site is positioned at the southern limit of the “Sea Bright” seawall which extends into Monmouth Beach. There is wind-transported sand at the base of the rocks, but no significant dune. The beach is 250 feet wide to the berm crest, then a beachface slope extends into 3 feet of water. There is a small offshore bar on the terrace seaward of the beach.

NJBPN 177 – 404 Ocean Avenue, Long Branch



The left photo was taken May 20, 2016. The berm position relative to the rock groin to the north is a reference. By December 21, 2017 the beach view on the right shows near identical rock exposure from 18 months earlier as those two surveys show.



NJBPN 17601 - 300 Ocean Ave North, Long Branch

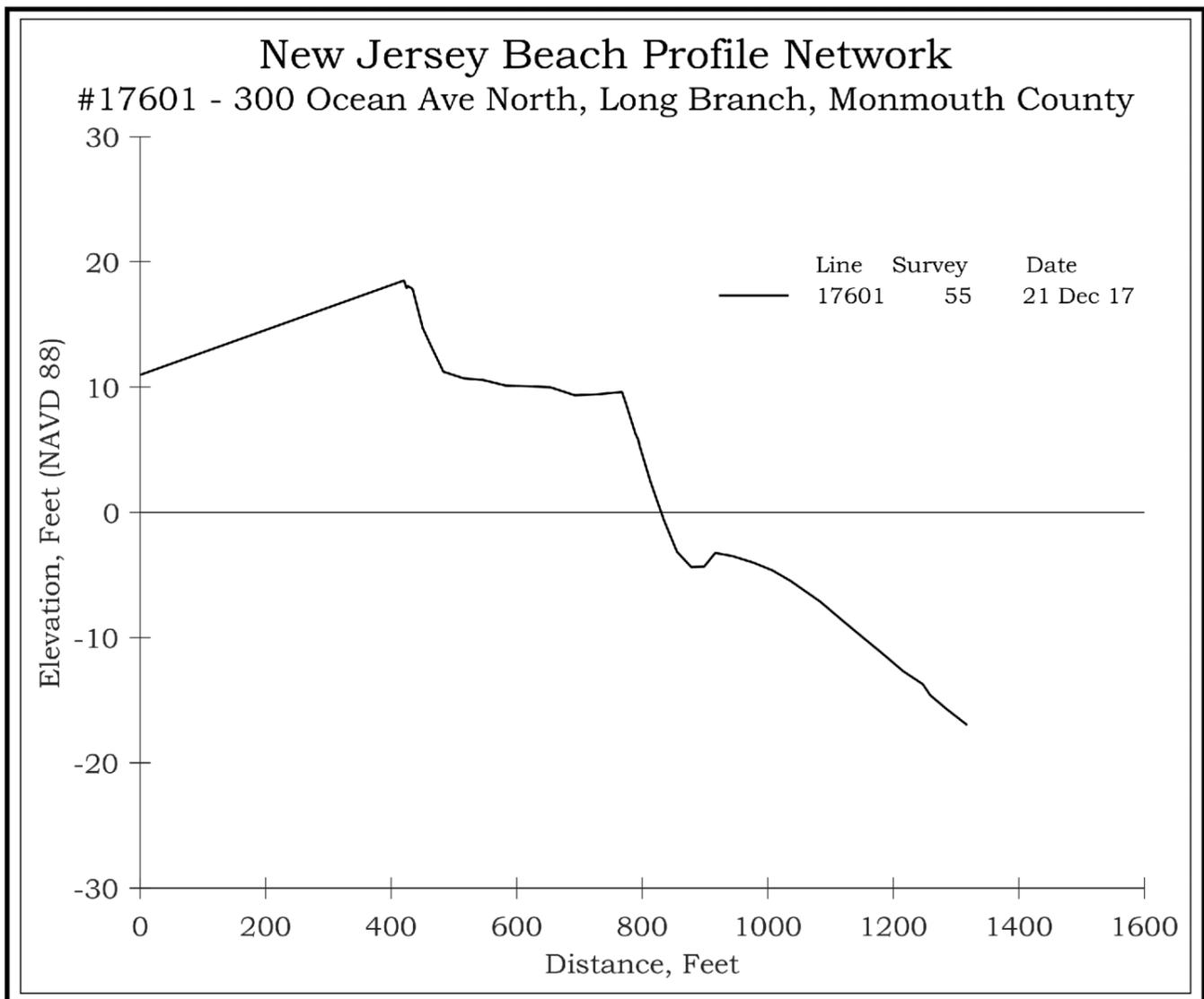
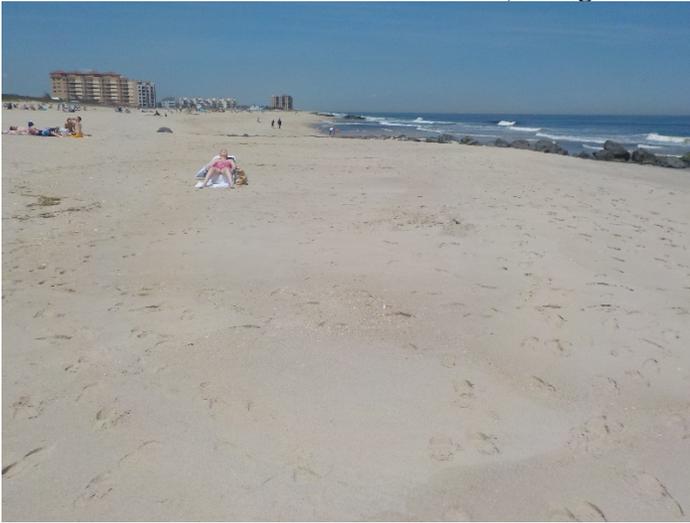
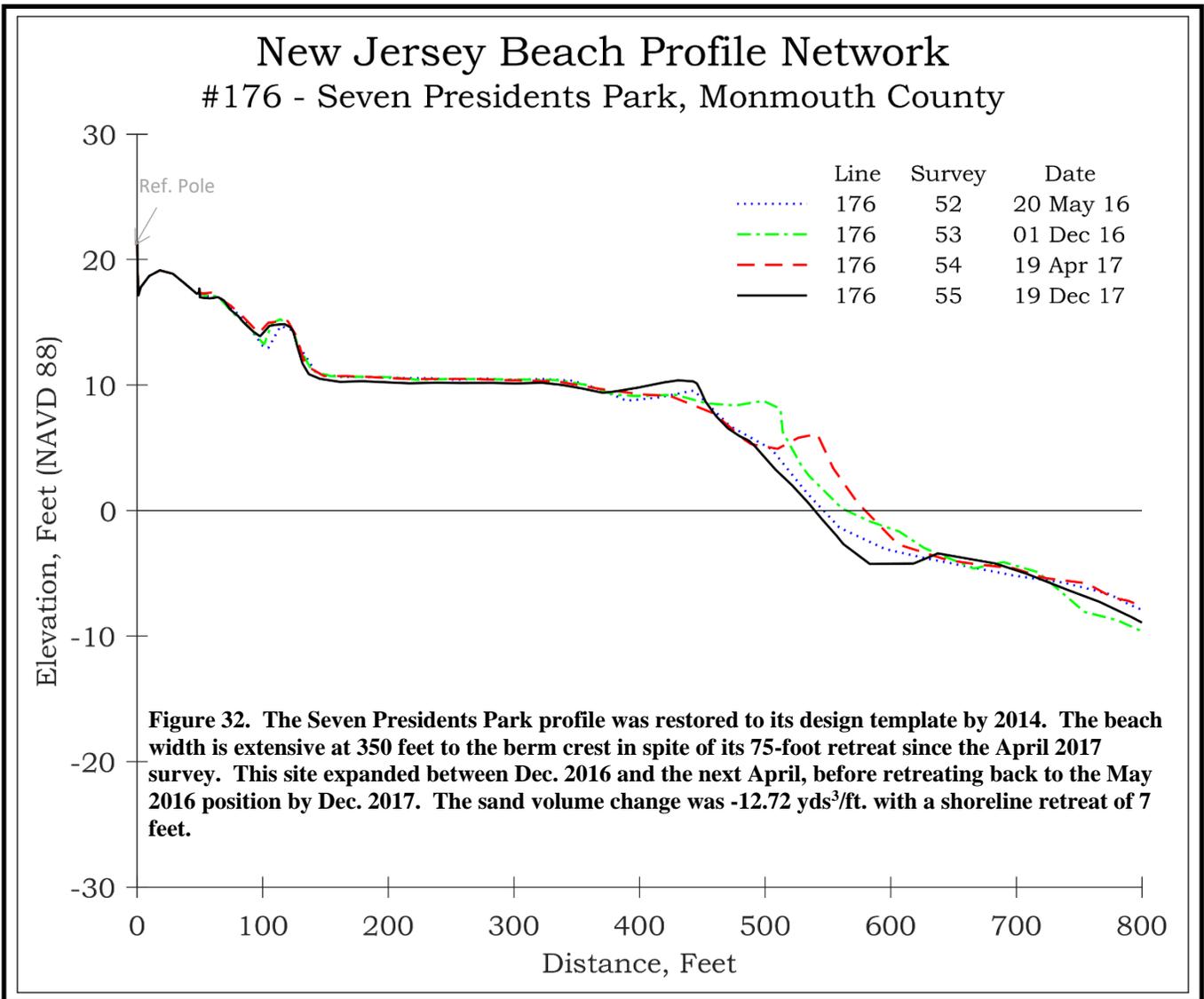


Figure 31. The long ramp up to the dune crest is a straight line between the reference point and the IS station on the dune crest. The beach is 250 feet wide with a uniform slope on the beachface leading offshore to a decent sized bar system.

NJBPN 176 – Seven President’s Park, Long Branch



This site maintained a pronounced berm partially retained by the rock groin showing in this May 20, 2016 view to the north. By December 19, 2017 (right photo) the rocks were covered in sand as the summer berm remained in place.



NJBPN 17501 - Ocean Terr., Long Branch

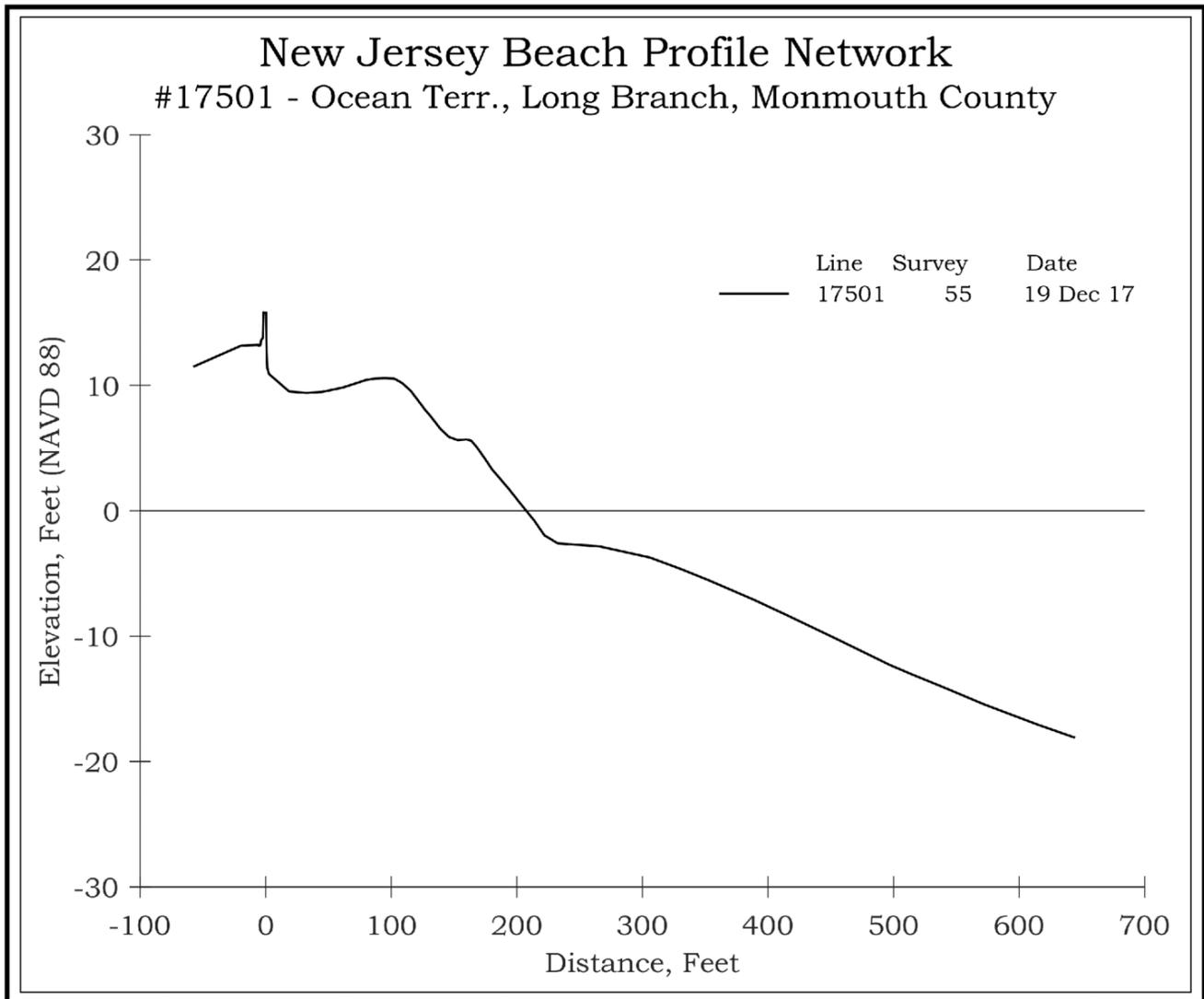
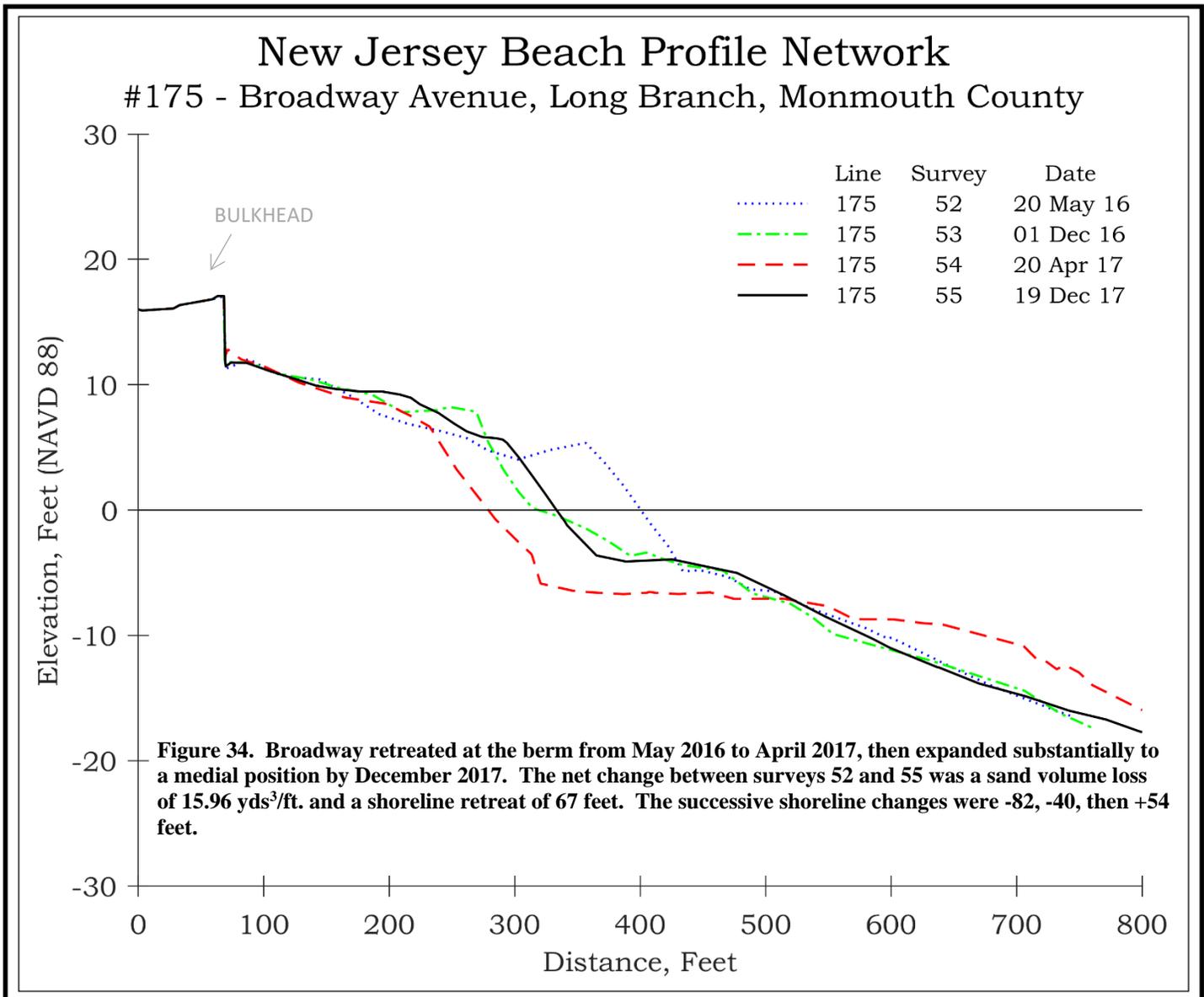


Figure 33. This location is at the very northern end of the old steel sheet pile wall at the Long Branch uplands bluff edge. There are multiple survey sites south along this shore protection feature. There is no dune established here, but sand is ramped up against the wall. There is a 120-foot wide beach, a uniform beach slope and a narrow offshore terrace developed.

NJBPN 175 – Broadway Avenue, Long Branch



The left photograph taken May 20, 2016 shows the beach as the summer was beginning with a wide pronounced berm present. By December 19, 2017 (right photo) the beach is a little narrower, but still wider than it was April 2017 (survey 54).



NJBPN 17402 - 45 Ocean Avenue, Long Branch

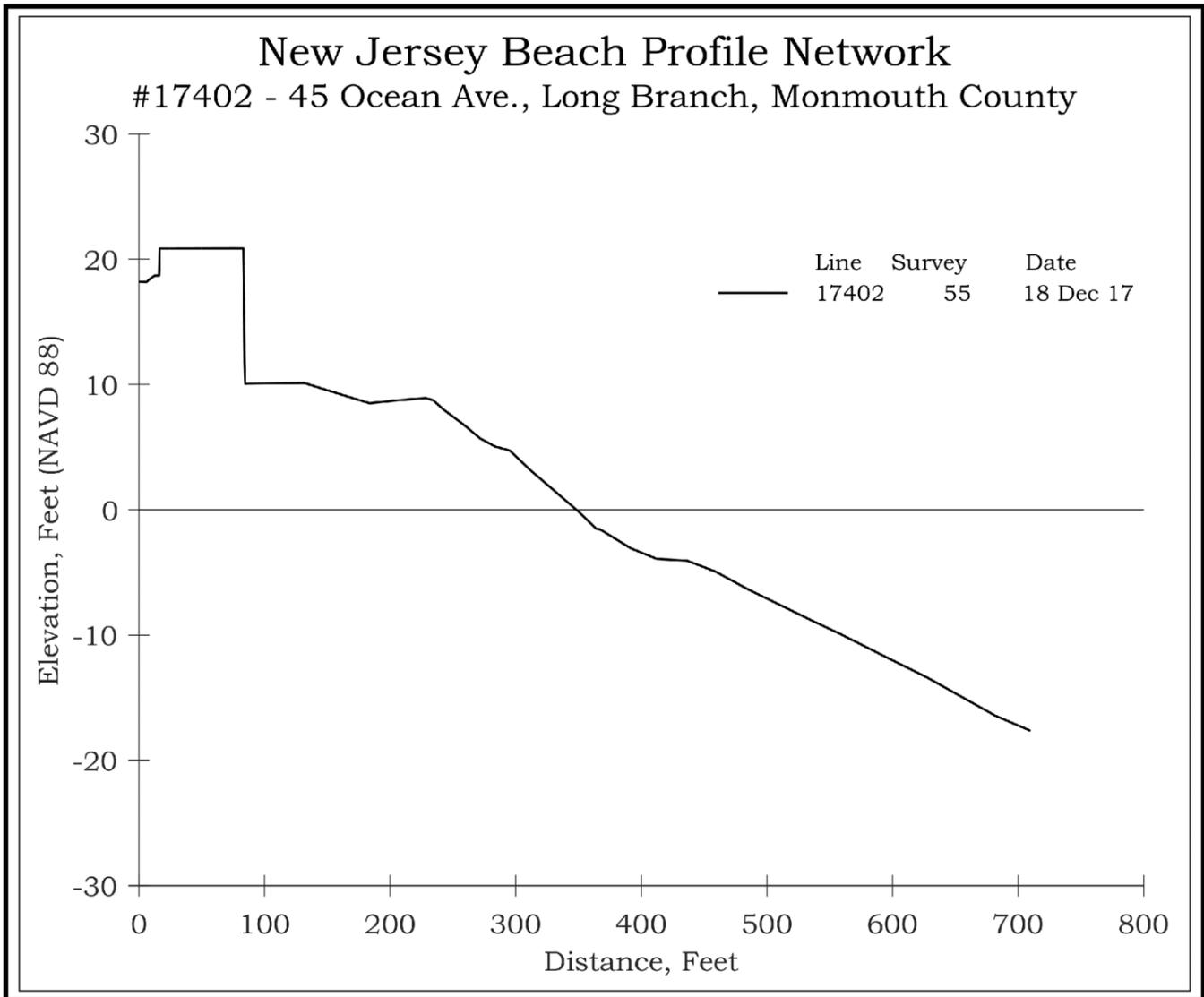


Figure 35. Moving south along Ocean Avenue in Long Branch, the beach narrows to 150 feet with a uniform beachface and offshore slope without any bar system present.

NJBPN 17401 - N. Morris Avenue, Long Branch

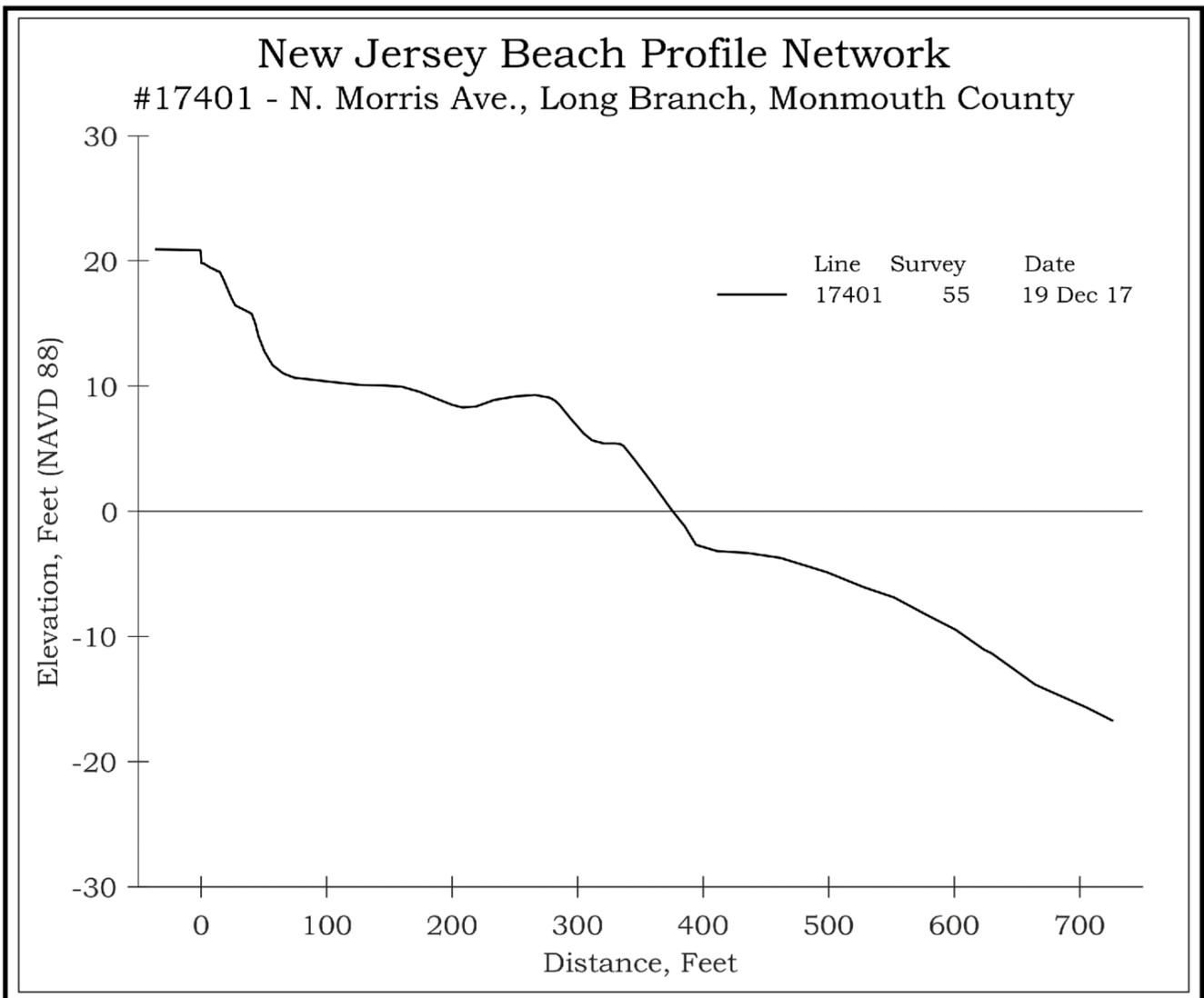
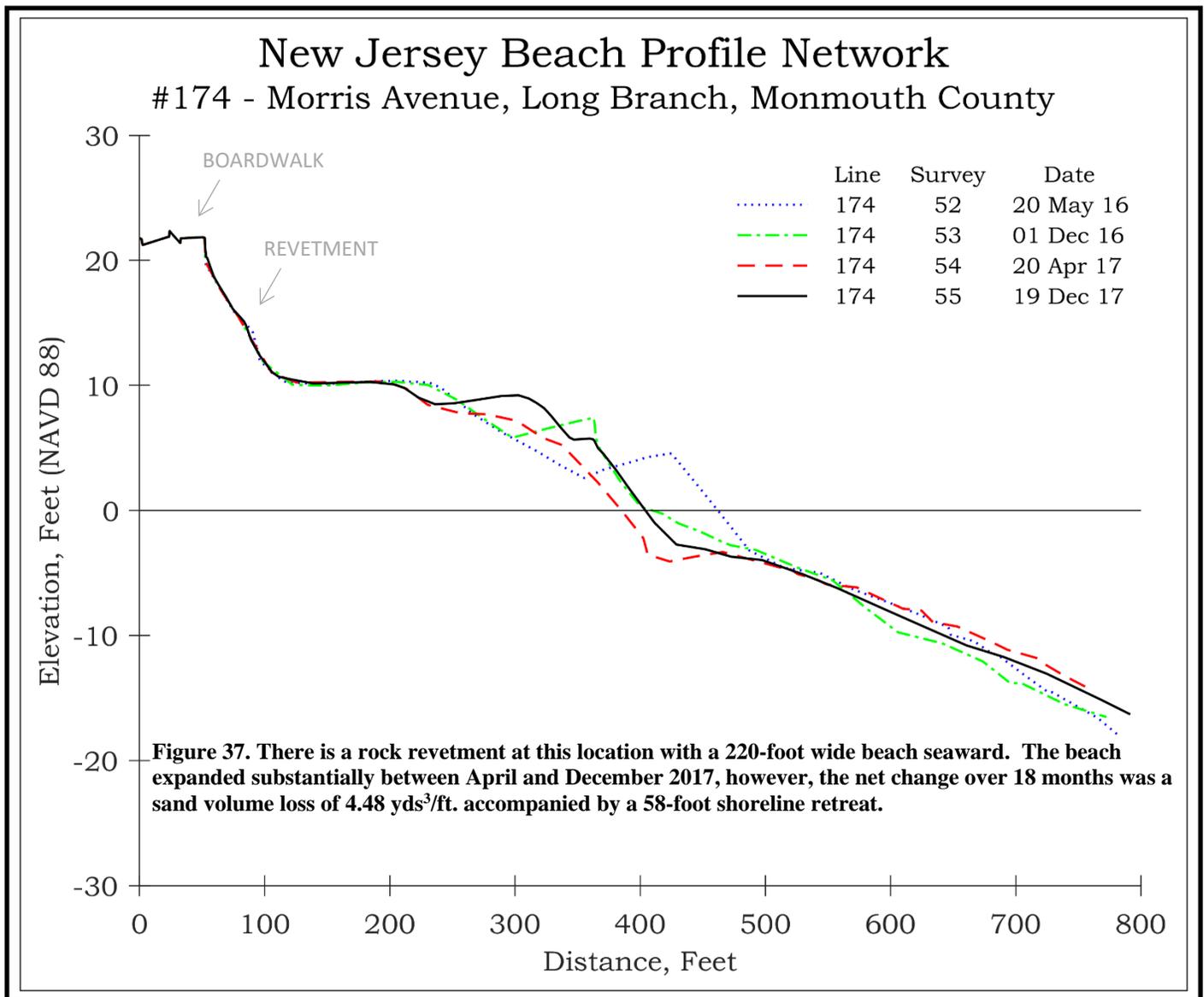


Figure 36. The steel wall was augmented a decade or two ago with a rock revetment because of deterioration. The beach extends 250 feet further seaward to a beachface slope ending in 3.5 feet of water. There is a narrow terrace offshore without a bar present.

NJBPN 174 – Morris Avenue, Long Branch



The May 20, 2016 view on the left side shows the beach in good condition with newly planted grass between the rock revetment and the new boardwalk. The right side view, taken December 19, 2017 shows some grass growth and a similar width beach after 18 months.



NJBPN 17303 - 276 Ocean Avenue, Long Branch

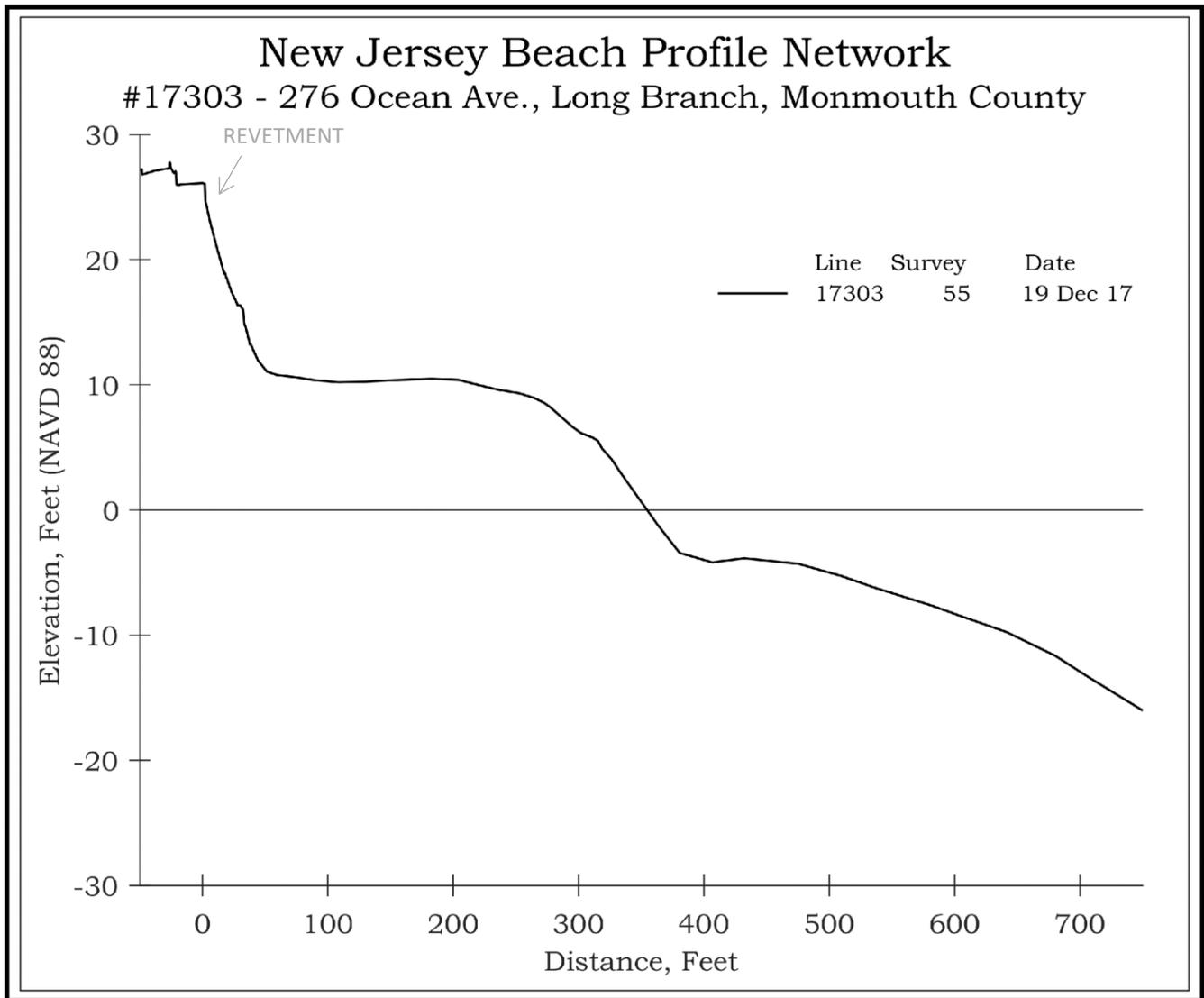


Figure 38. South of Morris Avenue the rock revetment continues with a 240-foot wide beach, no dune system and a horizontal terrace about 75 feet wide offshore, but no bar system present.

NJBPN 17302 - 378 Ocean Avenue, Long Branch

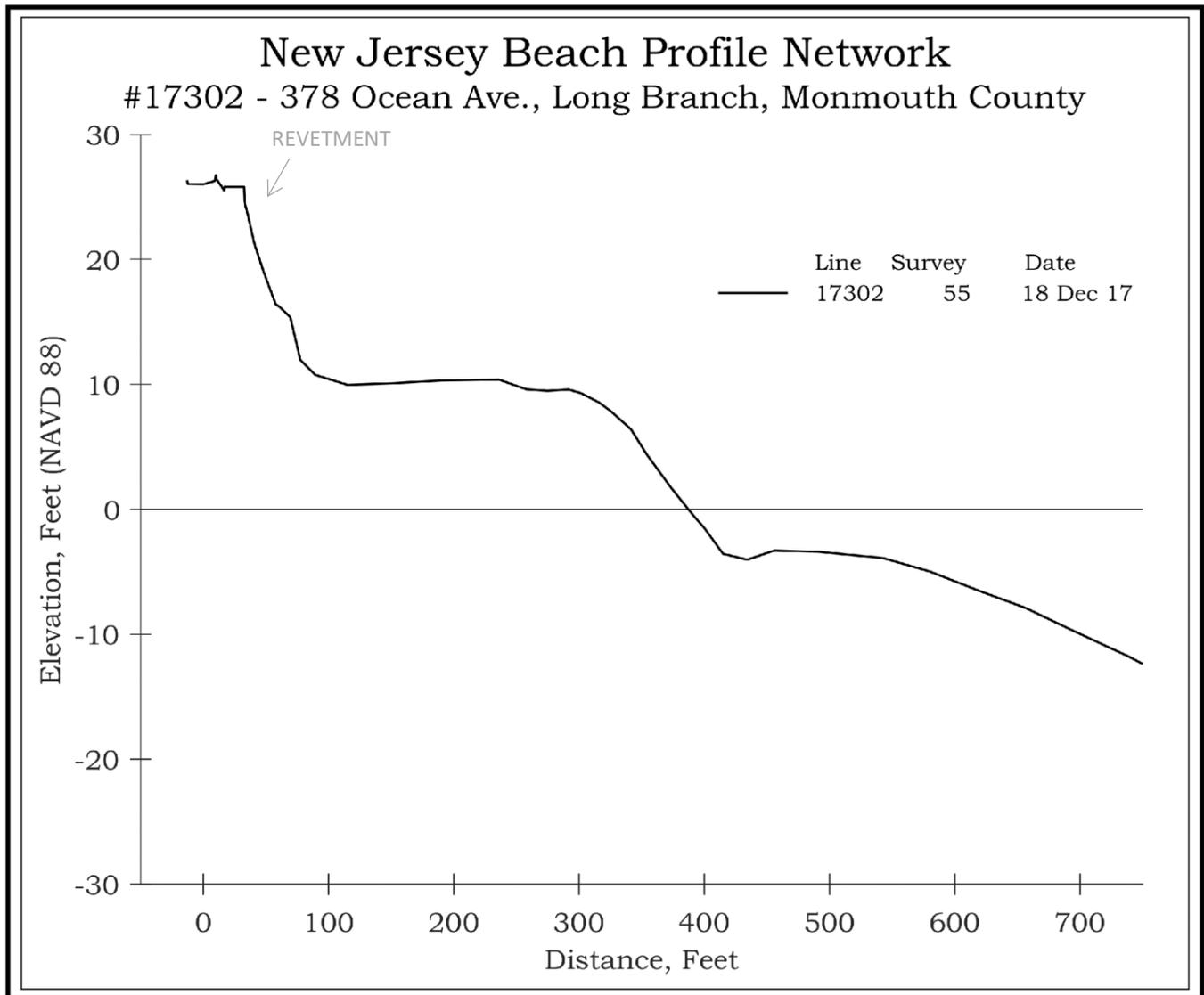


Figure 39. The bluff revetment is the first element in the survey with a 230-foot wide beach to the berm. Here there is an offshore bar present on the terrace about 3 feet below the zero datum.

NJBPN 17301 - Wooley Ct., Long Branch

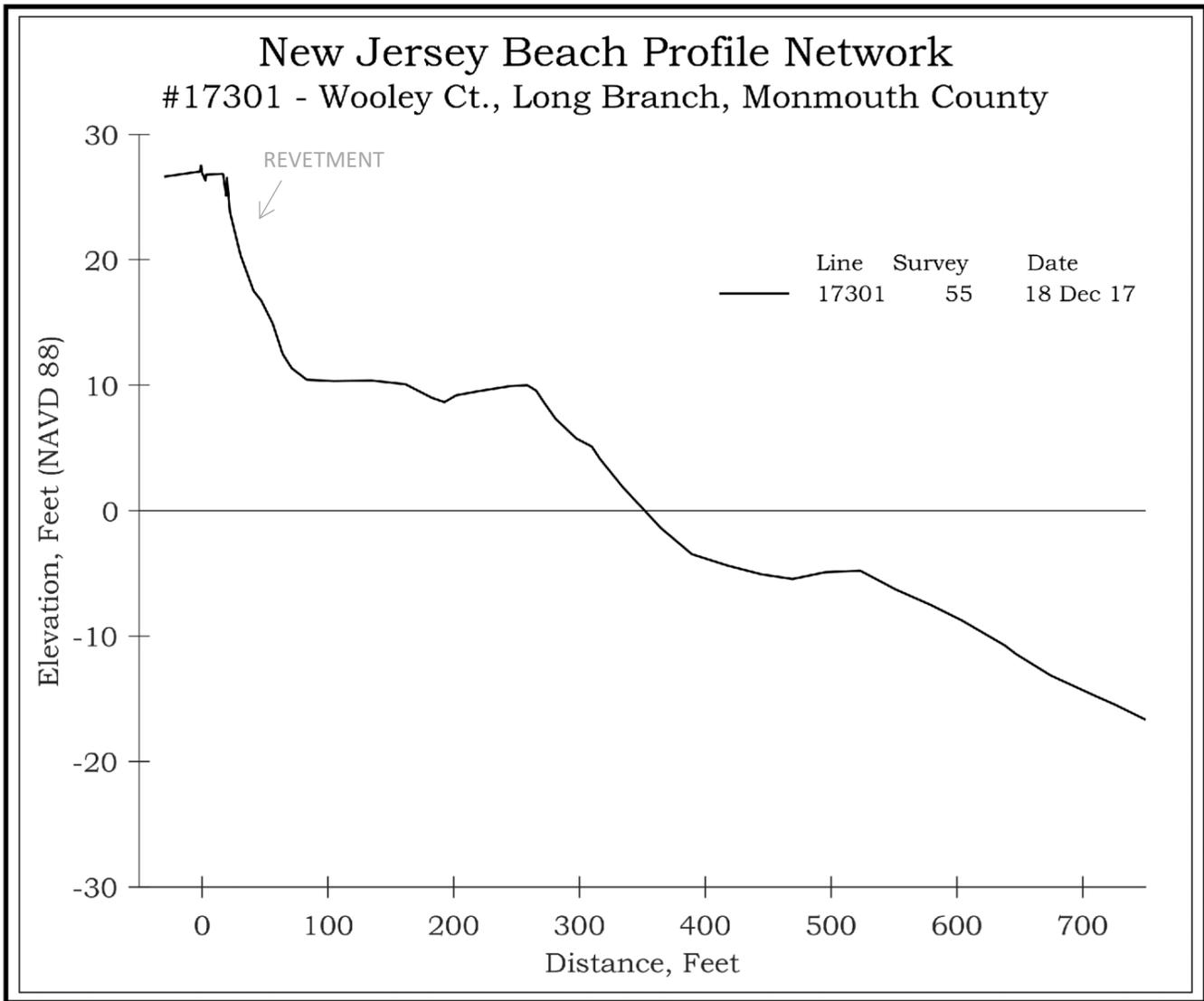
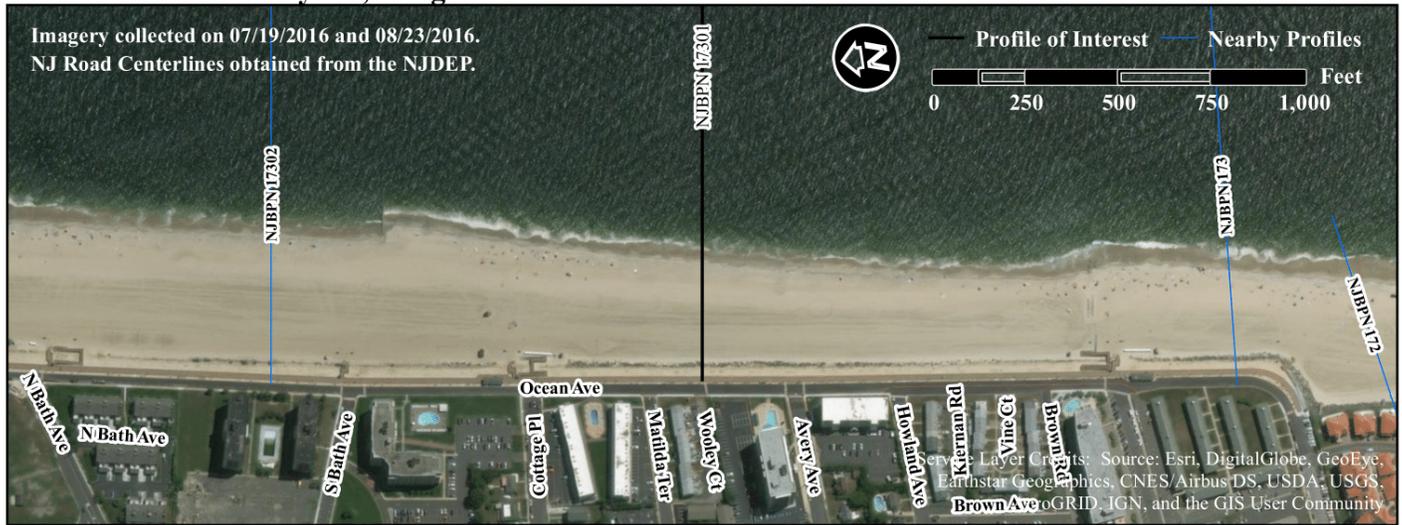
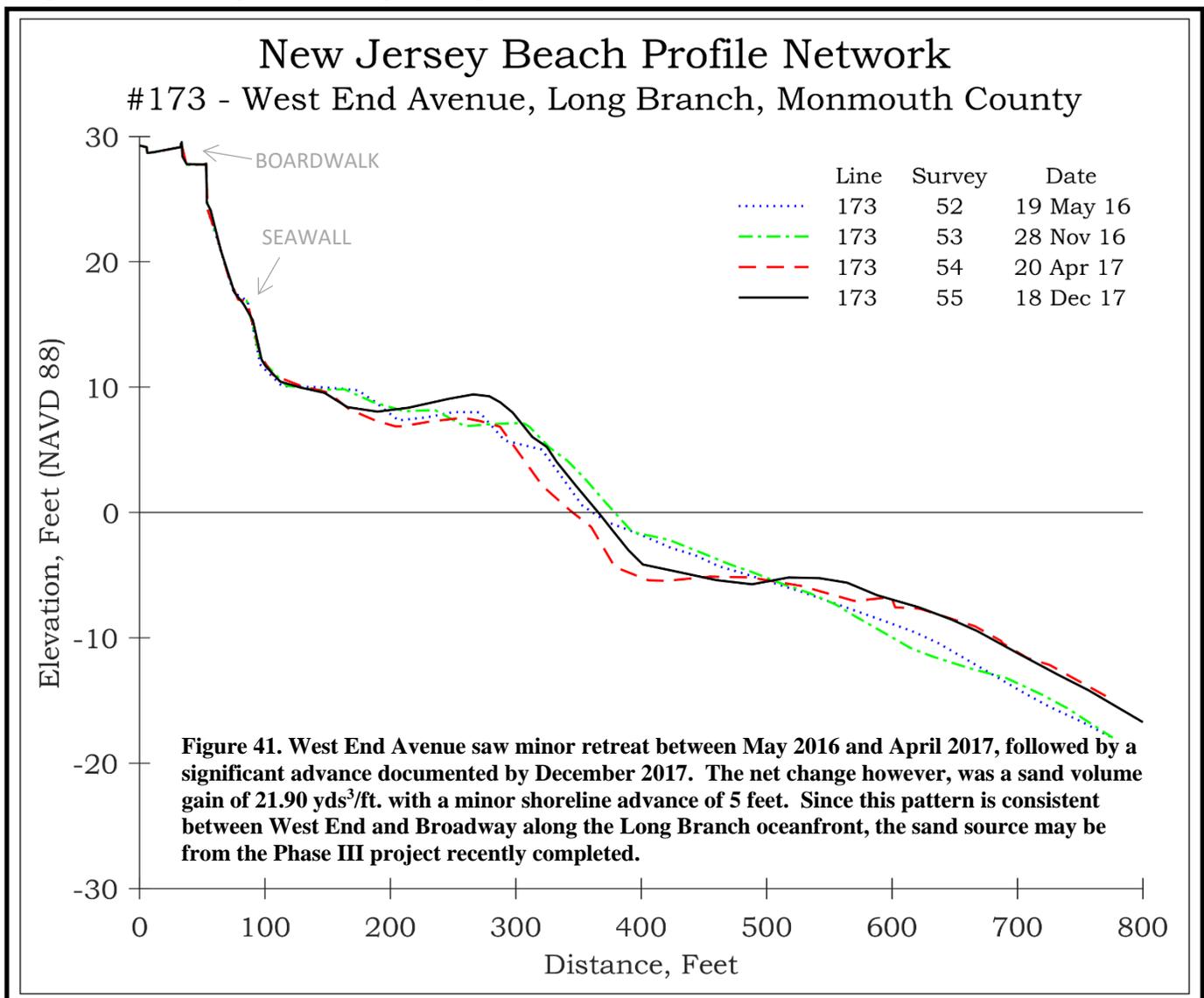


Figure 40. Rock revetment followed by a 170-foot wide beach to the berm and a beachface slope to a terrace about 4 feet below the datum with a small bar present.

NJBPN 173 – West End Avenue, Long Branch



This site is the southern location within Phase I of the federal project. The left view precedes the arrival of the Phase III construction and shows that the beach narrows to the south (May 19, 2016). By December 18, 2017 the scope of the additional sand placed as the third phase was completed is quite dramatic.



NJBPN 27201 - 717 Ocean Avenue, Long Branch

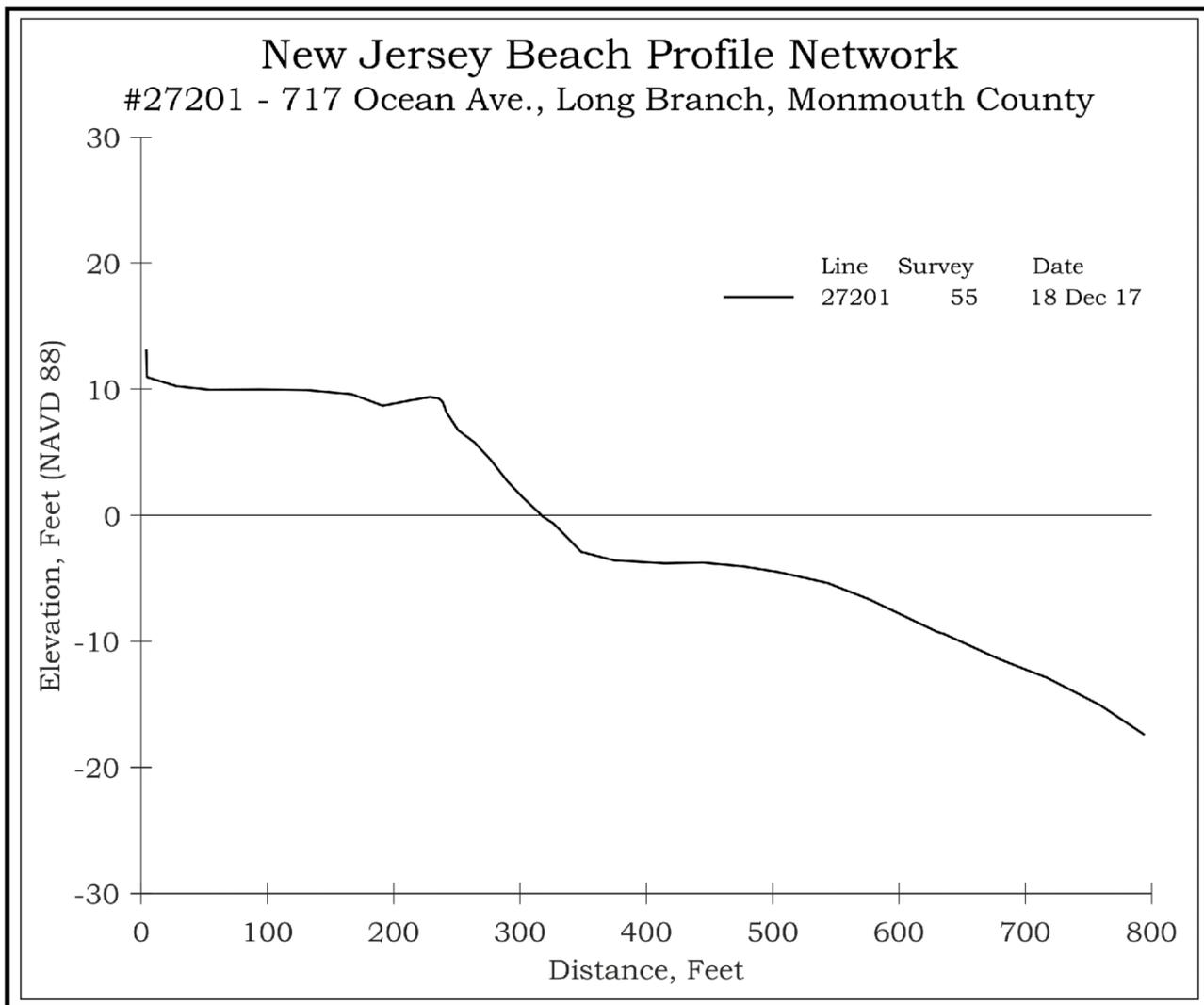
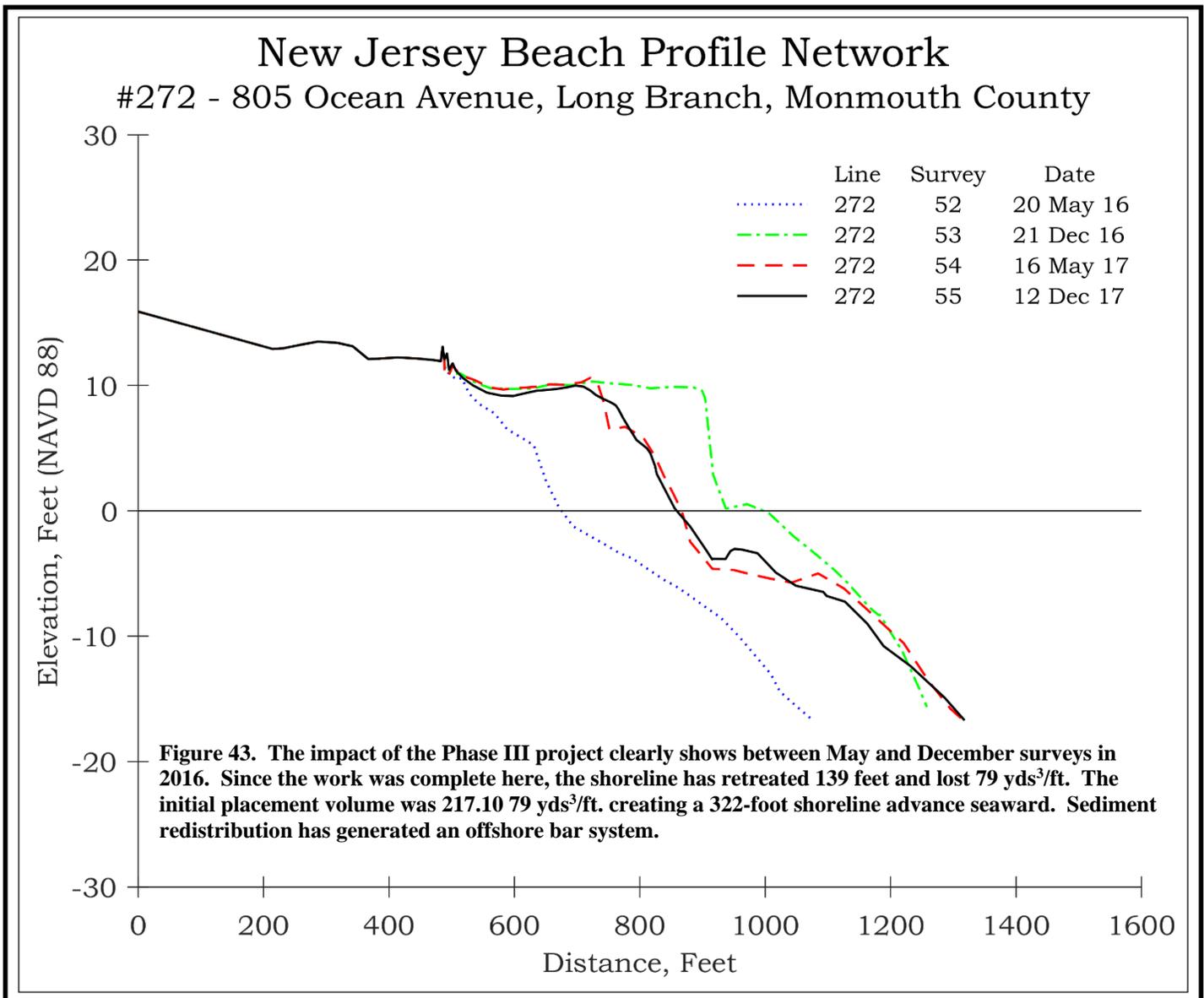


Figure 42. Located in the northern limit for the Phase III USACE beach restoration project, this location starts at a bulkhead, then extends across 250 feet of elevation 10.0 beach to the berm crest. The 10.0-foot elevation represents the project design elevation for the berm. The beachface has a uniform slope into 3.0 feet of water where a terrace exists offshore, but no offshore bar system has developed.

NJBPN 272 – 805 Ocean Ave, Long Branch



This site, established in 2010, is located on the northeastern edge of Lake Takanassee. The view to the left, taken May 20, 2016 pre-dates the federal project, a contractor dredge is shown at the horizon on the left side. By December 12, 2017, the project was complete and the rock groin was buried in new material from offshore.



NJBPN 17101 - Plaza Ct., Long Branch

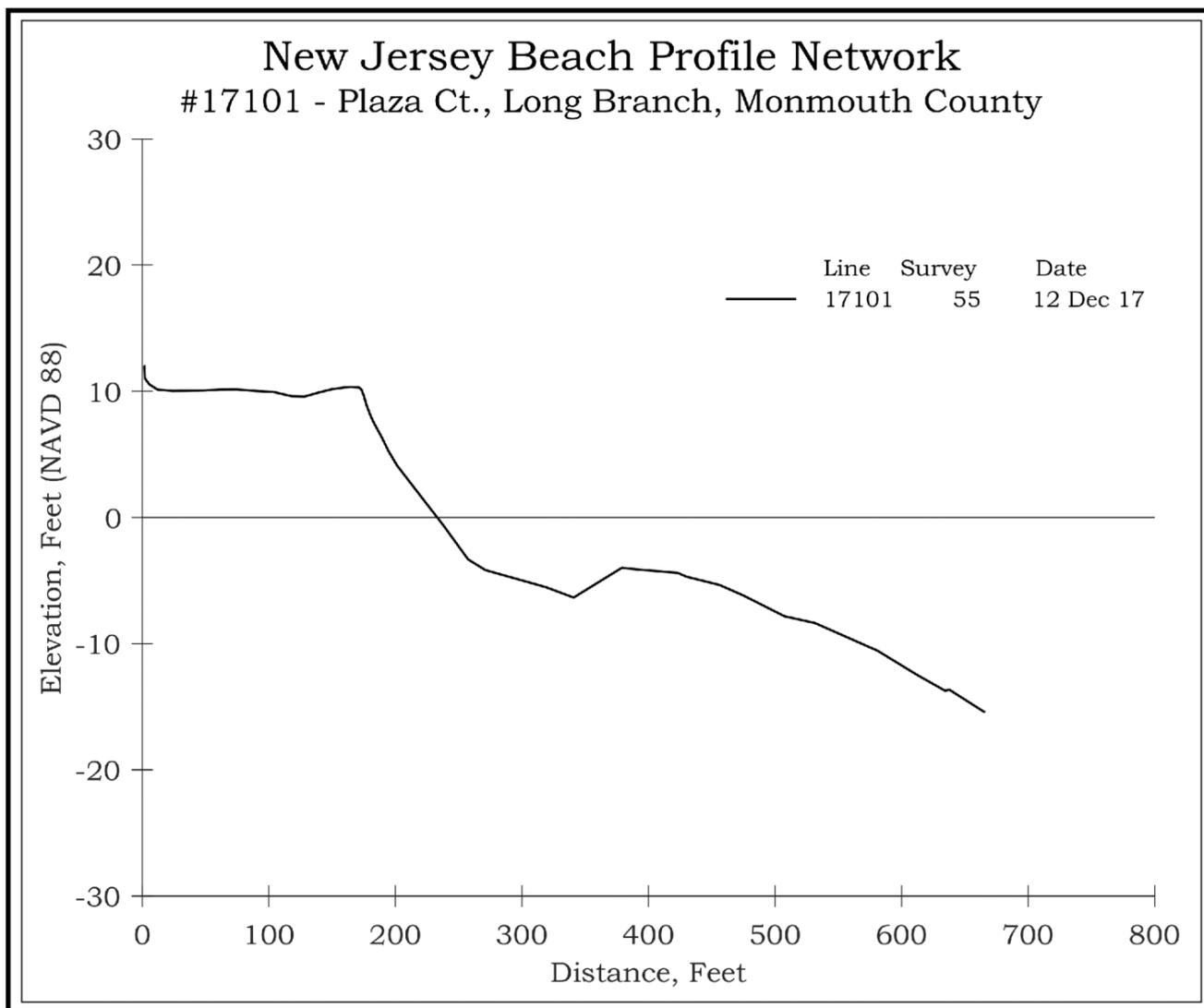
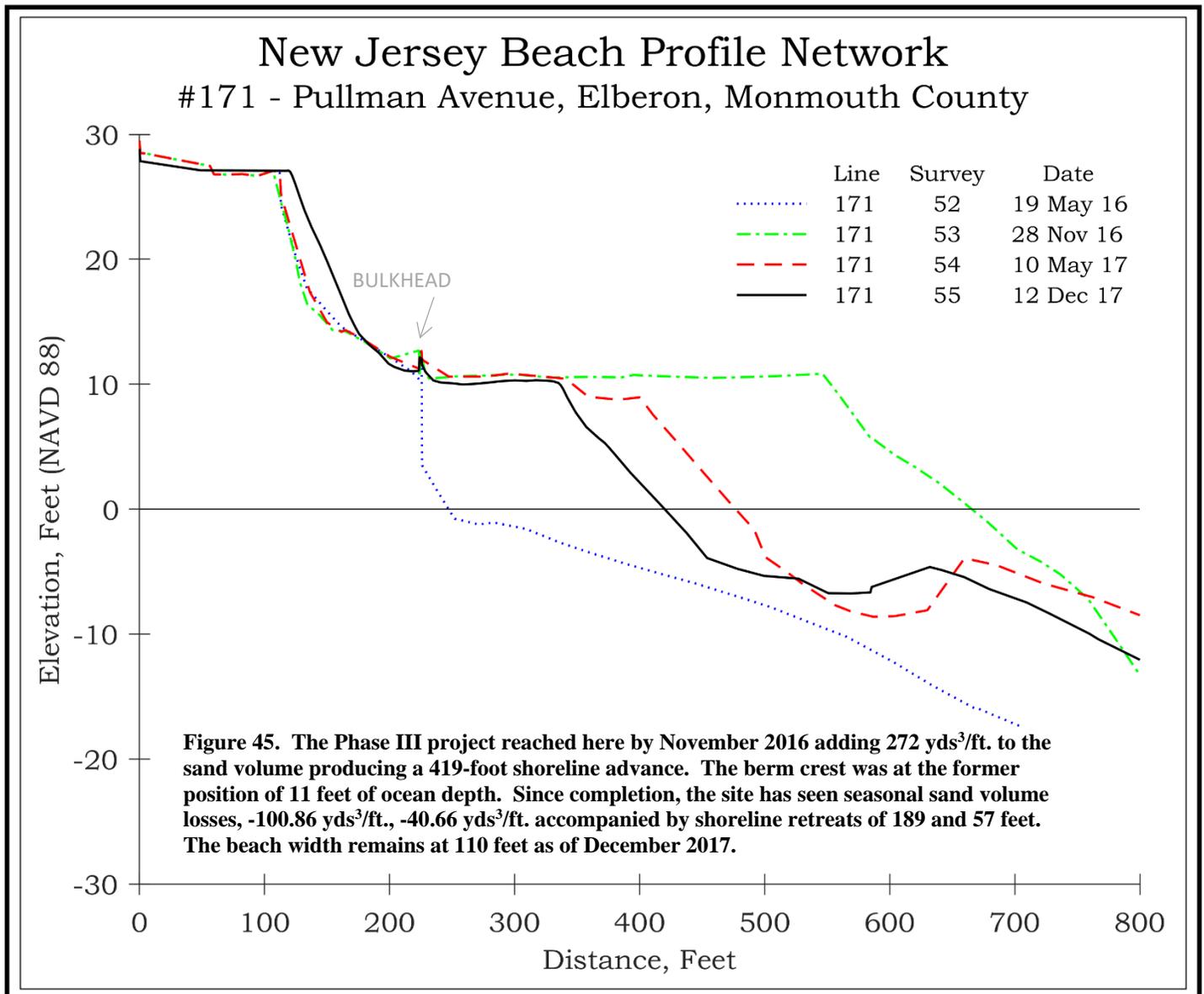


Figure 44. This site is located south of Lake Takanassee at a wide beach position south of the lake freshwater exit flume structure. The beach is 190 feet wide at elevation 10.0 to the berm crest. The beachface slope into the water reaches 5.5-foot depths at the toe of a substantial offshore bar system.

NJBPN 171 – Pullman Avenue, Elberon



This site is located on the highest point along the bluff shoreline. The May 19, 2016 view on the left pre-dated the USACE beach project and shows what is left of the post-Sandy sand beach derived from bluff erosion. The photo on the right (taken December 12, 2017) shows the new beach after some adjustment. The vertical bulkhead just shows to the right side.



NJBPN 17005 - 981 Ocean Avenue, Long Branch

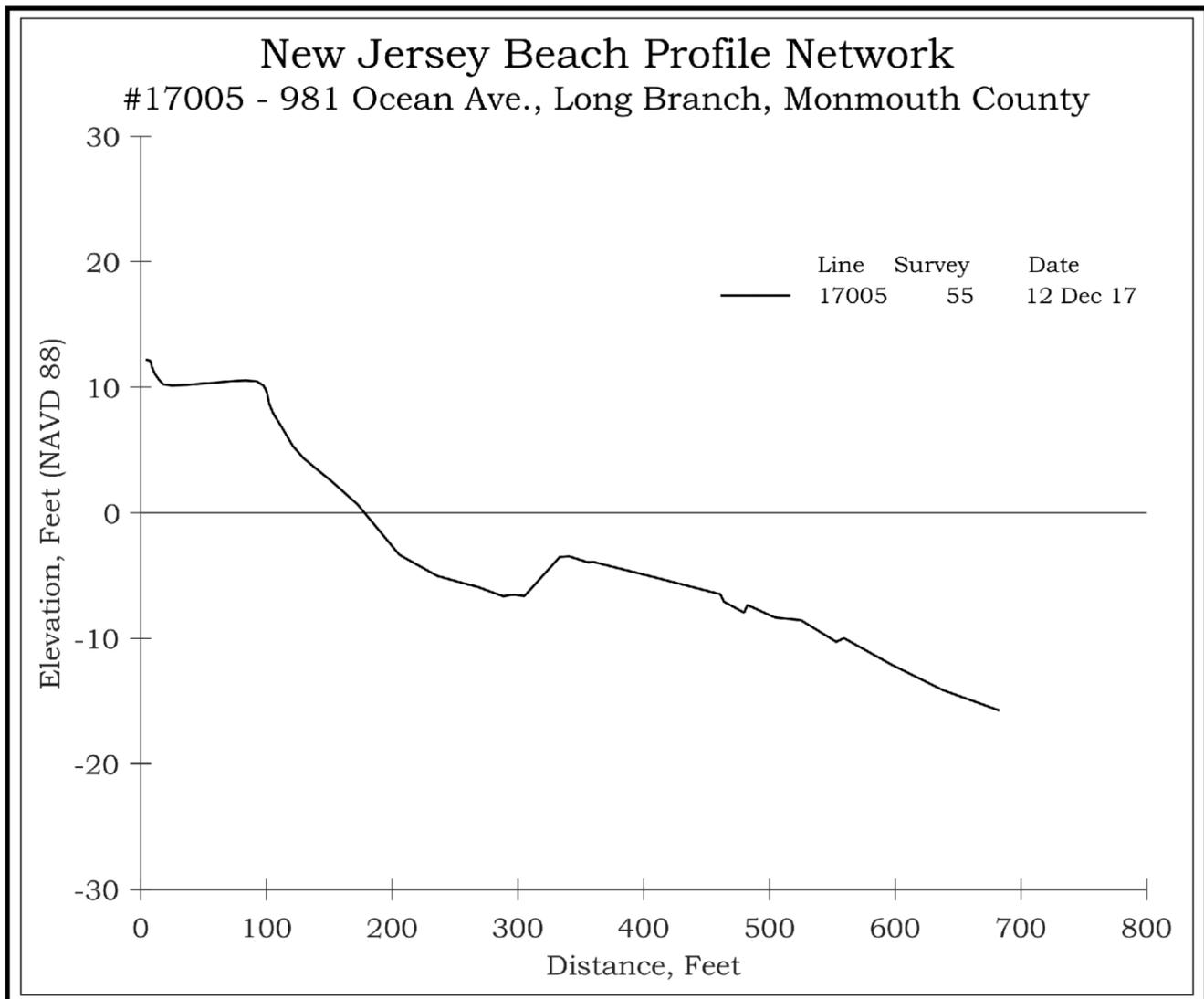


Figure 46. Located in the Elberon groin field, this location was completed during 2016 and clearly has adjusted with beach width reduction and sand deposited offshore in a very large bar system.

NJBPN 17004 - 1115 Ocean Avenue, Long Branch

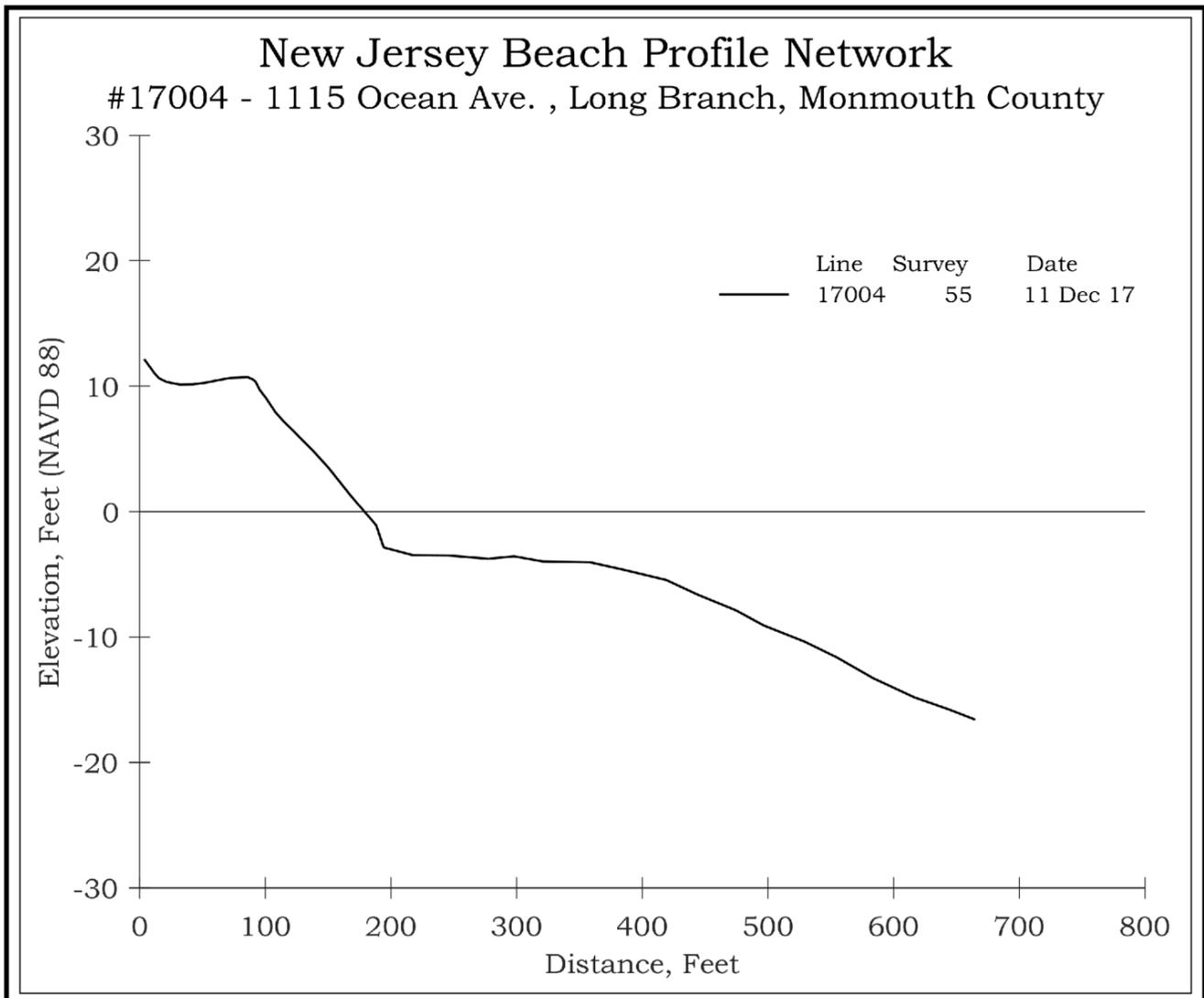


Figure 47. This location is also within the Elberon groin field. The beach is under 100 feet wide to the berm crest. The offshore terrace is 200 feet wide indicating considerable profile adjustment since 2016.

NJBPN 17003 - Ocean Ct., Long Branch

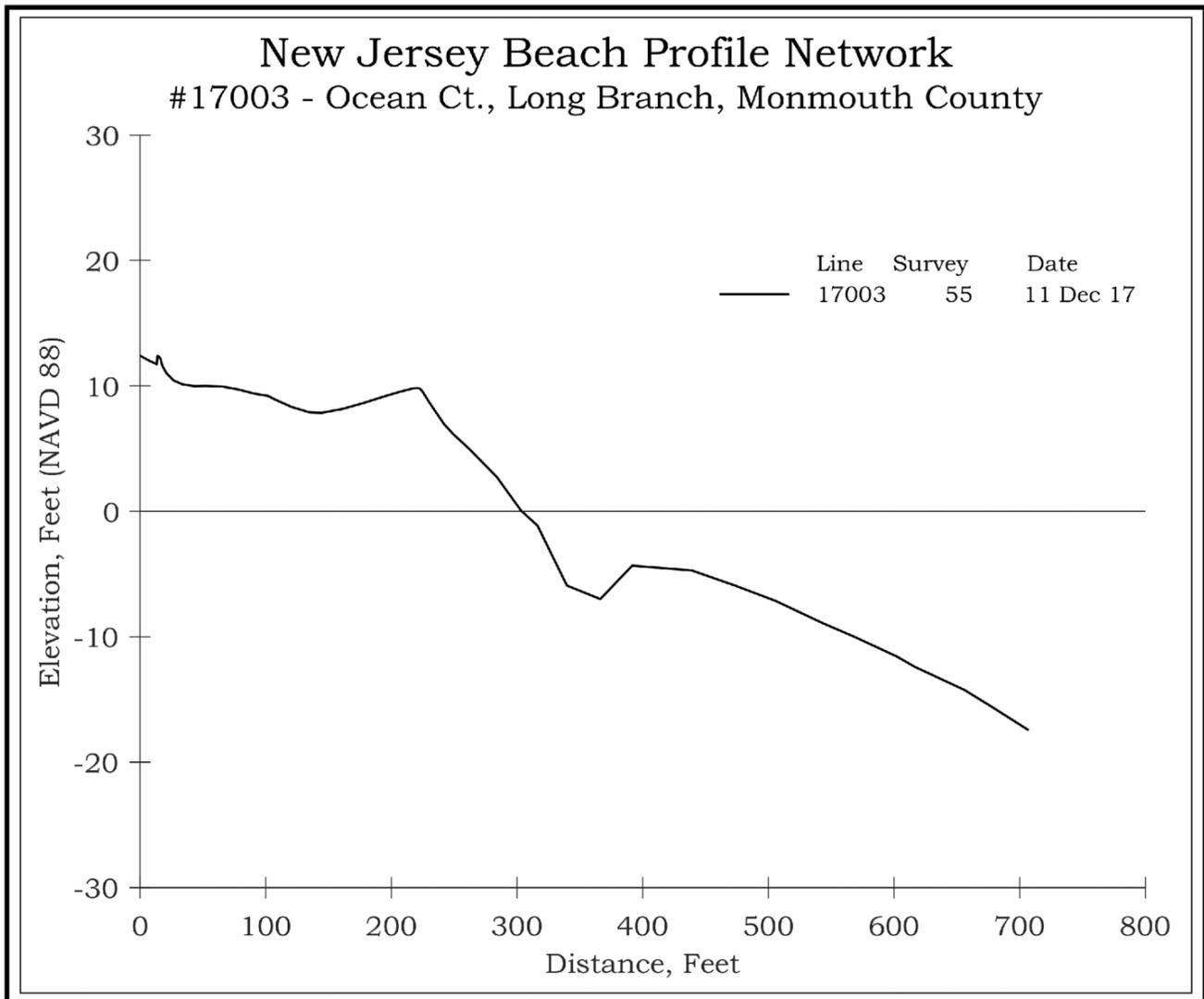


Figure 48. This site retains a wide beach with a significantly built up berm leaving 260 feet of elevation 10.0-foot beach remaining. The bar system offshore is extensive in width and elevation. There are no dunes along this Elberon bluff segment.

NJBPN 17002 - Garfield Road, Long Branch

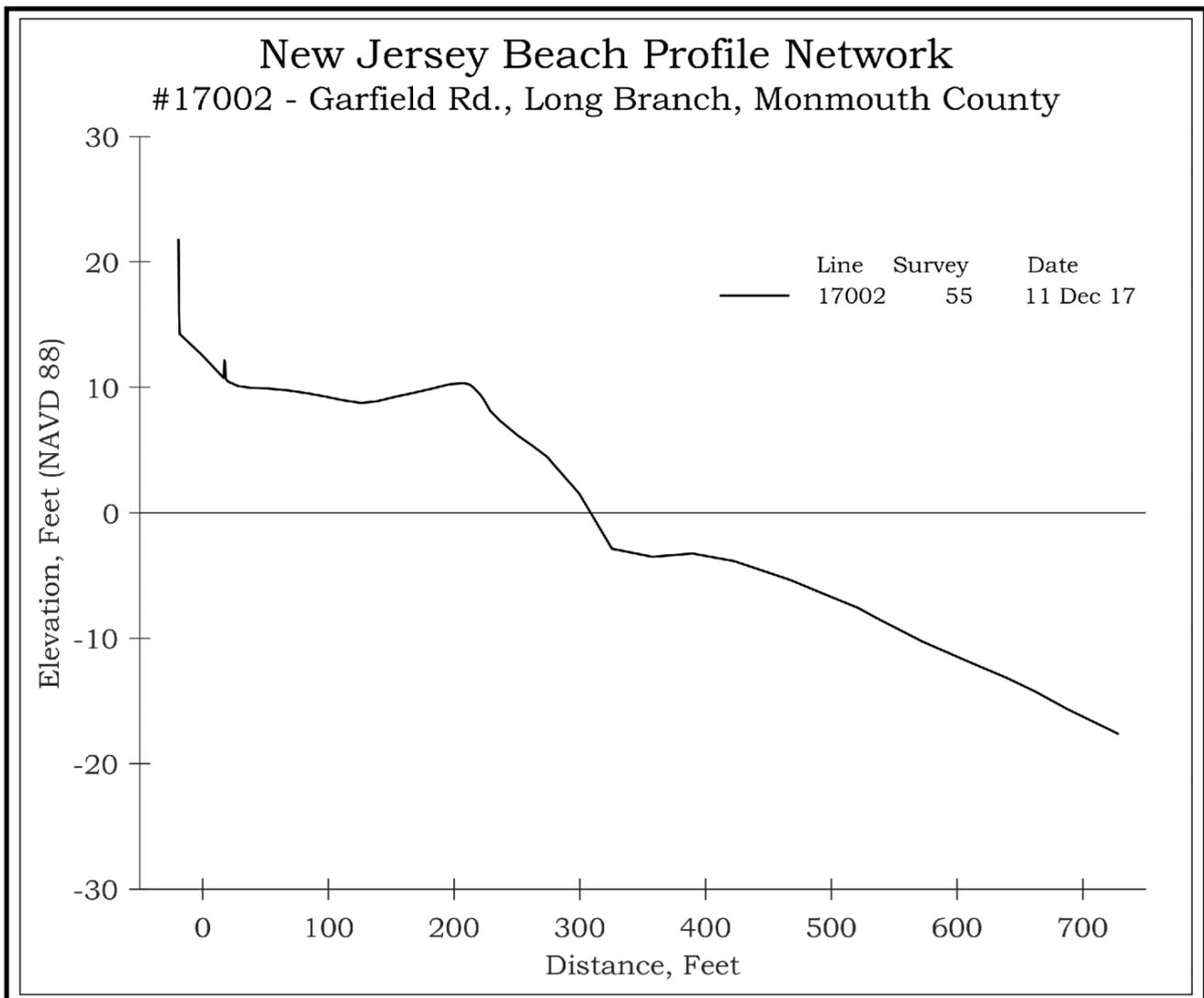


Figure 49. The beach width is just over 200 feet at elevation 10.0 with a build up on the berm crest from wave up-rush. Offshore there is a terrace with a small bar present.

NJBPN 17001 - Jerome Avenue, Deal

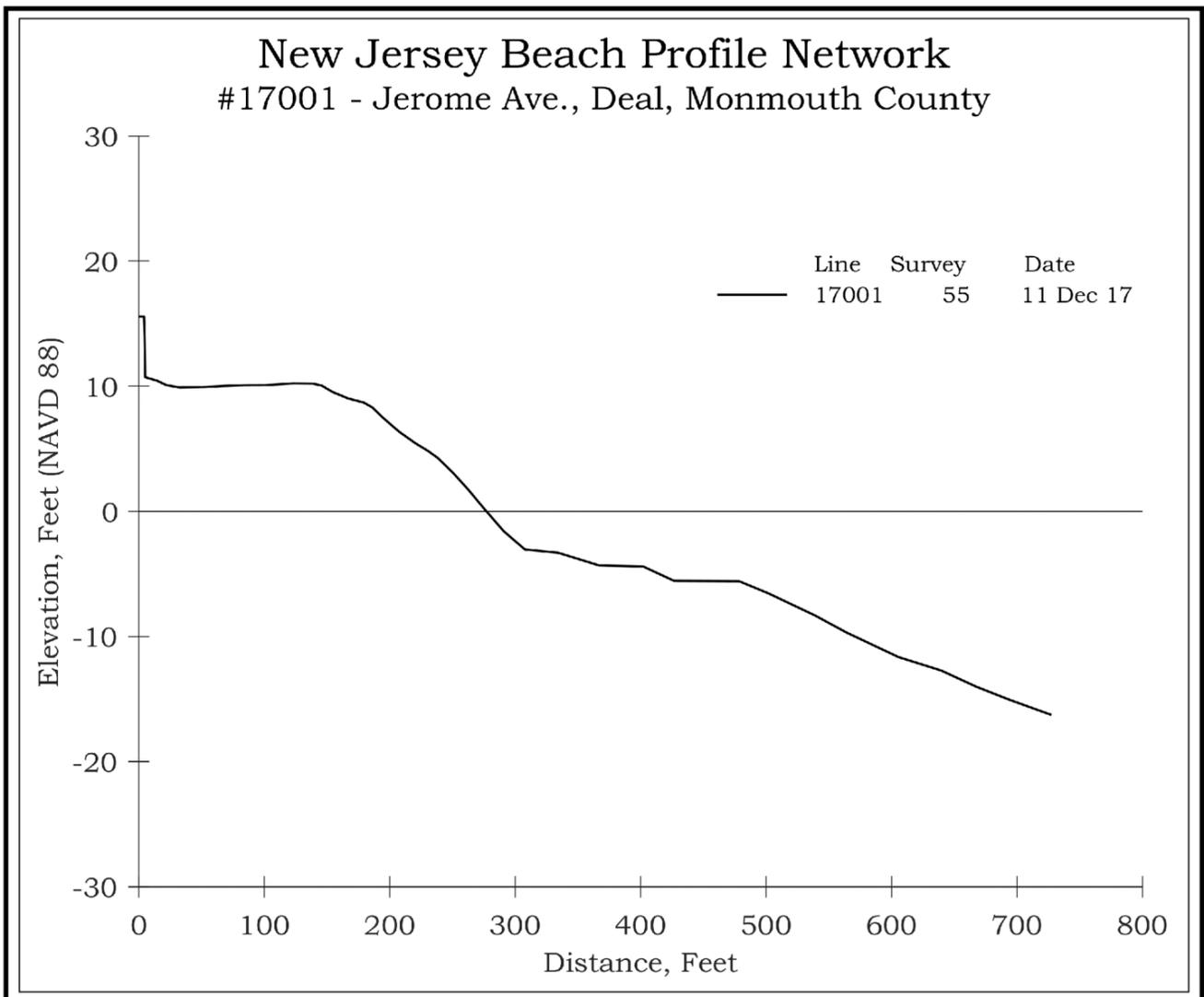
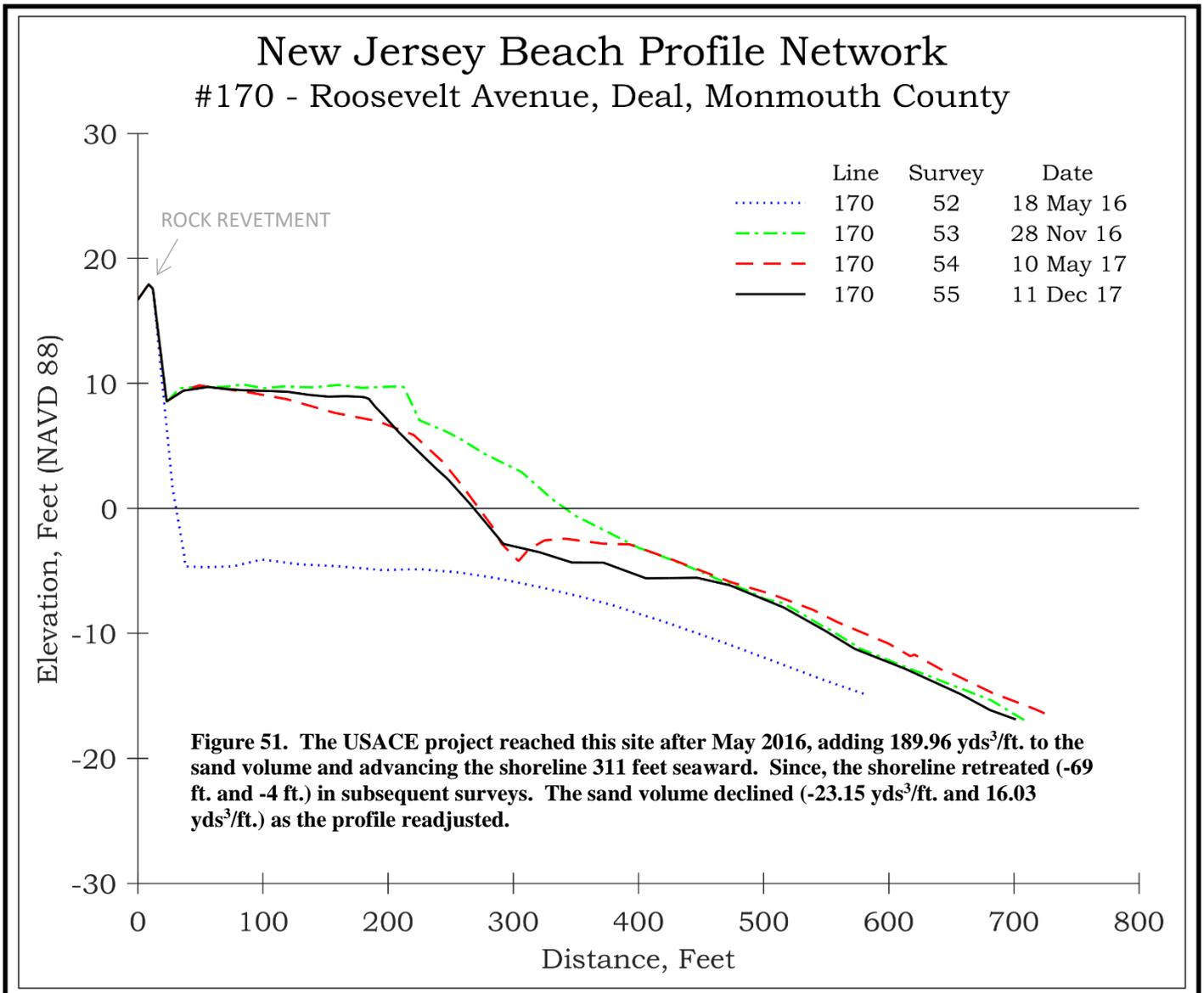


Figure 50. The imagery was collected in the summer of 2016 while the Phase III project was at this point in its progress toward Long Branch. The survey shows a 200-foot wide beach with a small terrace offshore, no dune and some readjustment in the cross section since the fill was complete.

NJBPN 170 – Roosevelt Avenue, Deal



By May 18, 2016 the USACE construction project was working just south of Roosevelt Avenue in Deal. The right photo (view to the north) shows the condition of the former tiny sand pocket beach. By December 11, 2017, the project was complete and the beach had adjusted to the configuration shown below in the plots. The entire groin is buried.



NJBPN 16905 - S. Roosevelt Avenue, Deal

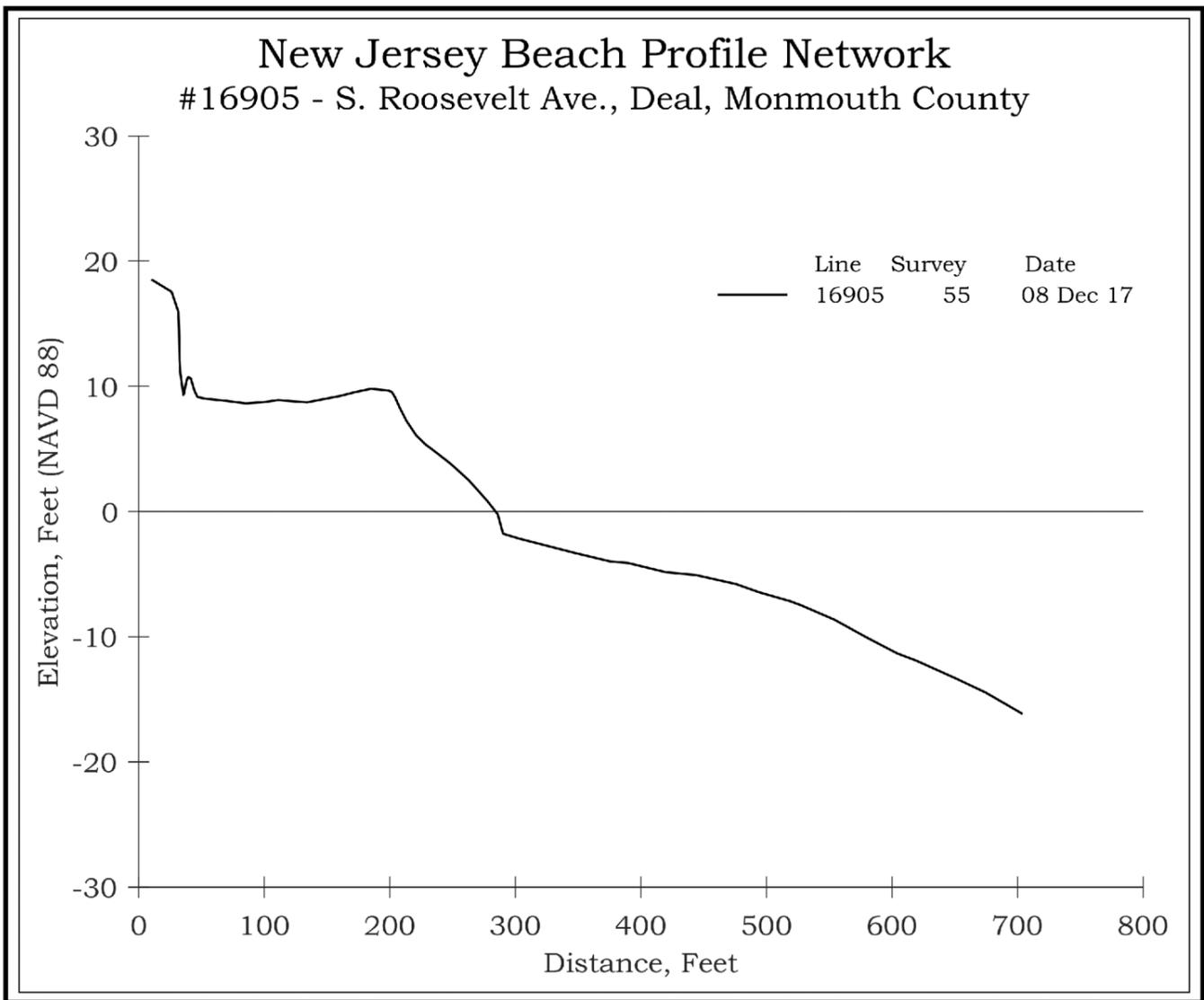


Figure 52. This new site is just south of Roosevelt Avenue in Deal, where Poplar Brook flows across the beach to the sea. Unique to Monmouth County, this freshwater stream appears to be confined within a culvert following Phase III beach construction. The beach is 200 feet wide without any offshore terrace or bar system. There is an old dune ridge present.

NJBPN 16904 - 71 Ocean Avenue, Deal

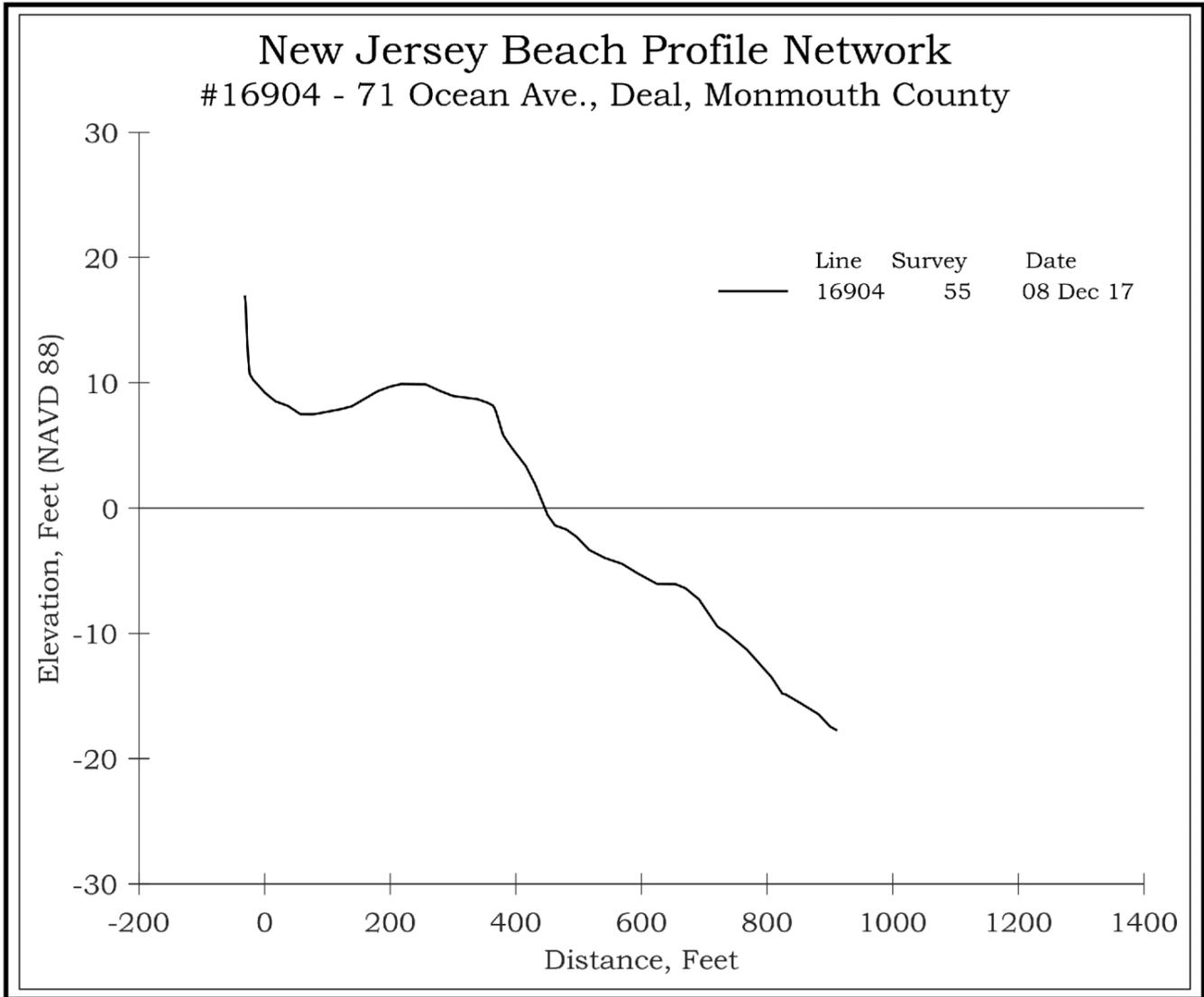


Figure 53. Located south of Poplar Brook, this site has a mounded berm indicating post-construction adjustment. The offshore section has a very small bar system, but little accumulation of material

NJBPN 16903 - Ocean Ln., Deal

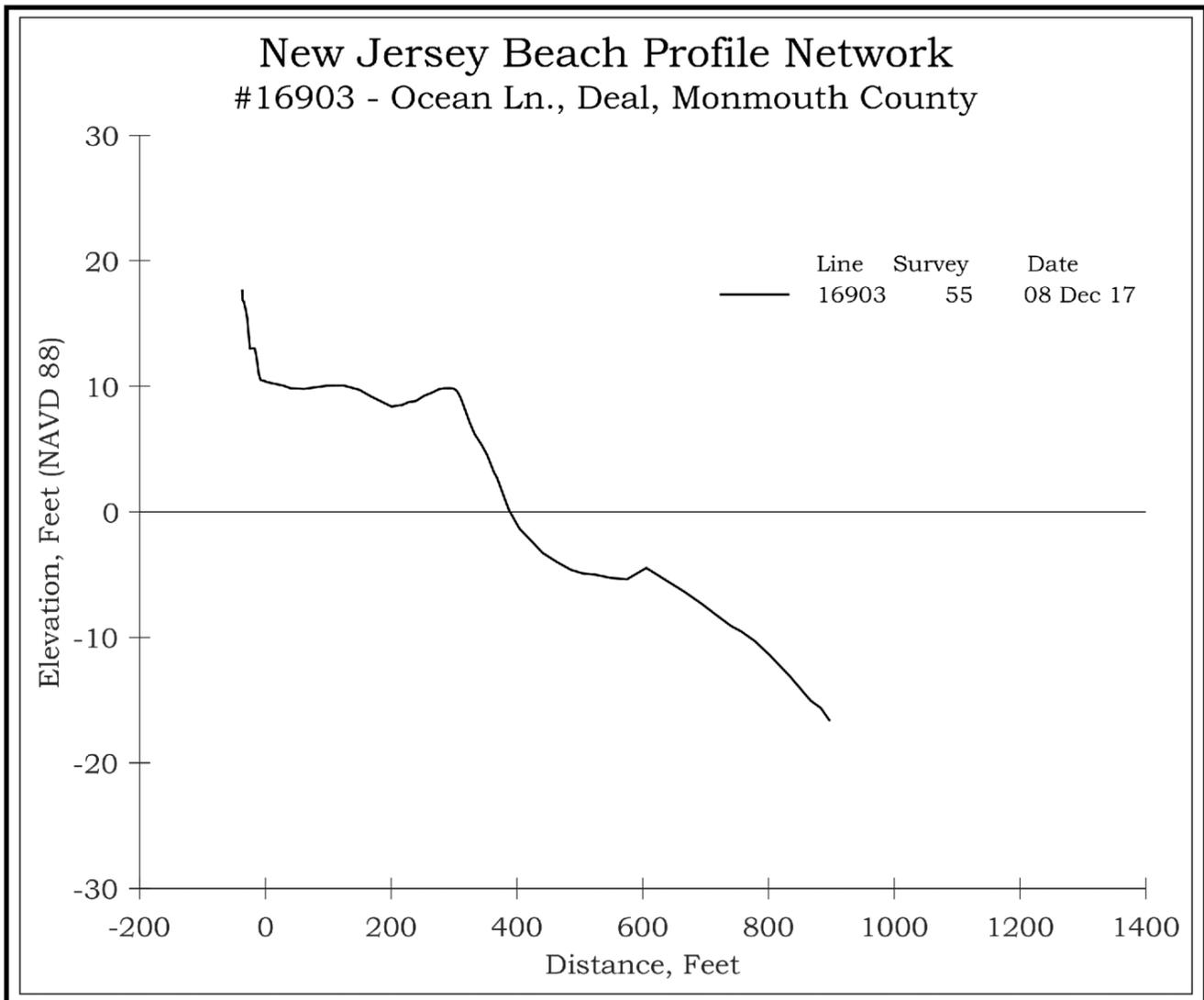


Figure 54. This site is in proximity to Phillips Avenue bathing pavillion, severely damaged by Hurricane Sandy. The site has a 240-foot wide beach and a bar system offshore. An old dune system dating back to the 19th Century is the profile starting point.

NJBPN 16902 - Brighton Avenue, Deal

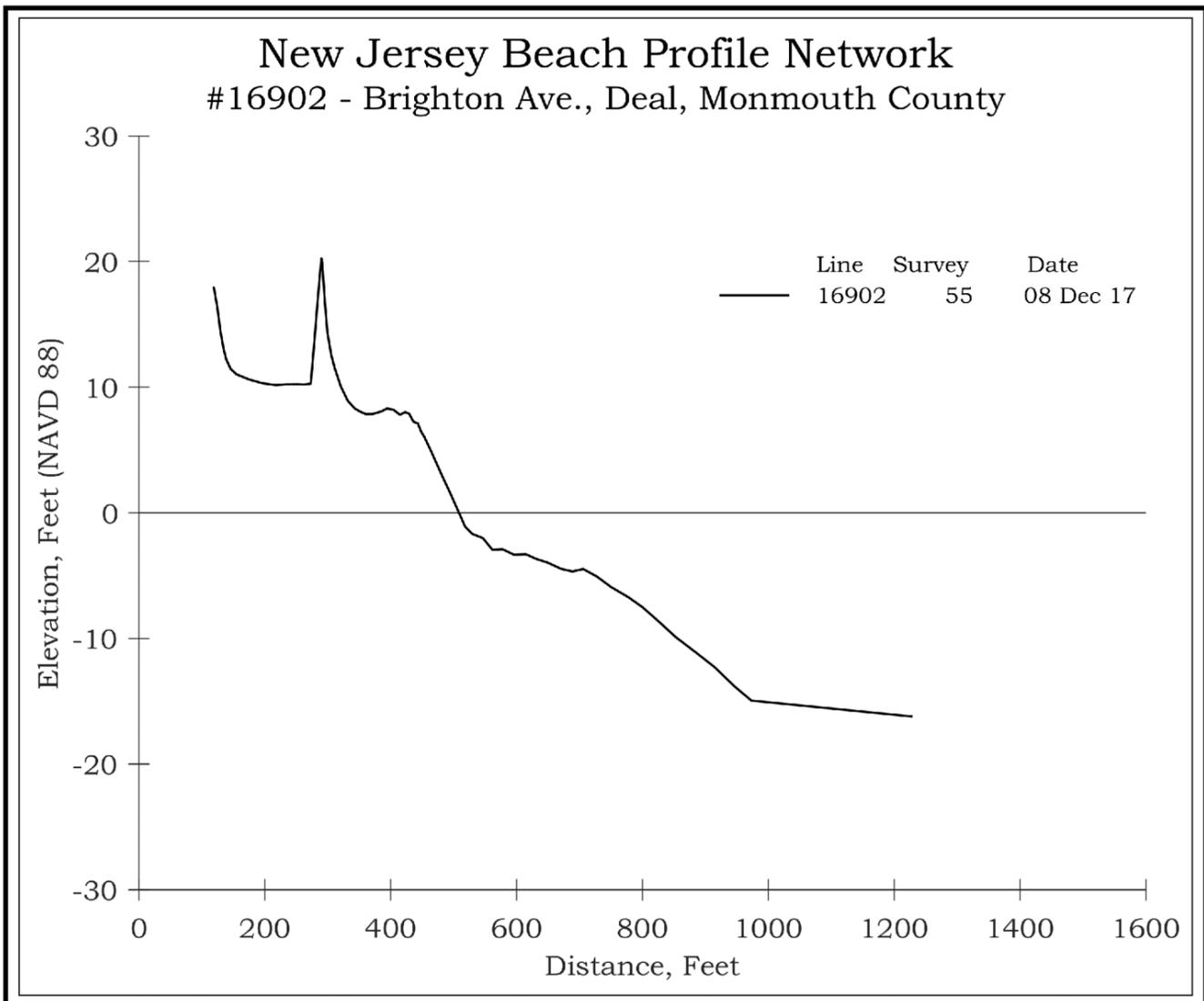


Figure 55. The Deal Casino bathing complex is the site of this cross section. The sand ridge on the beach is the result of storm defense for the winter. A small dune is present near the property fenceline as well as an offshore bar as a minor feature.

NJBPN 16901 - Wallace Road, Deal

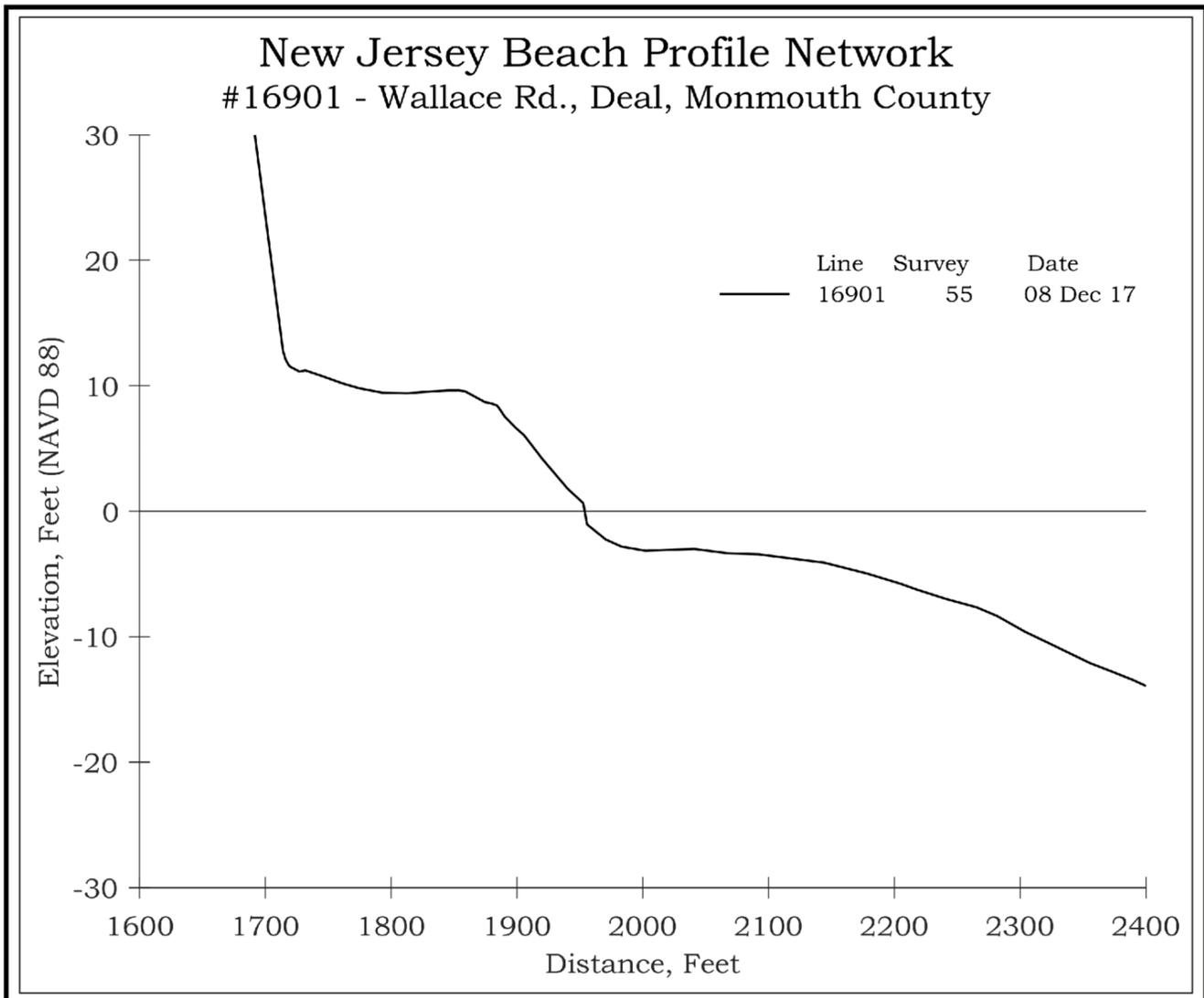
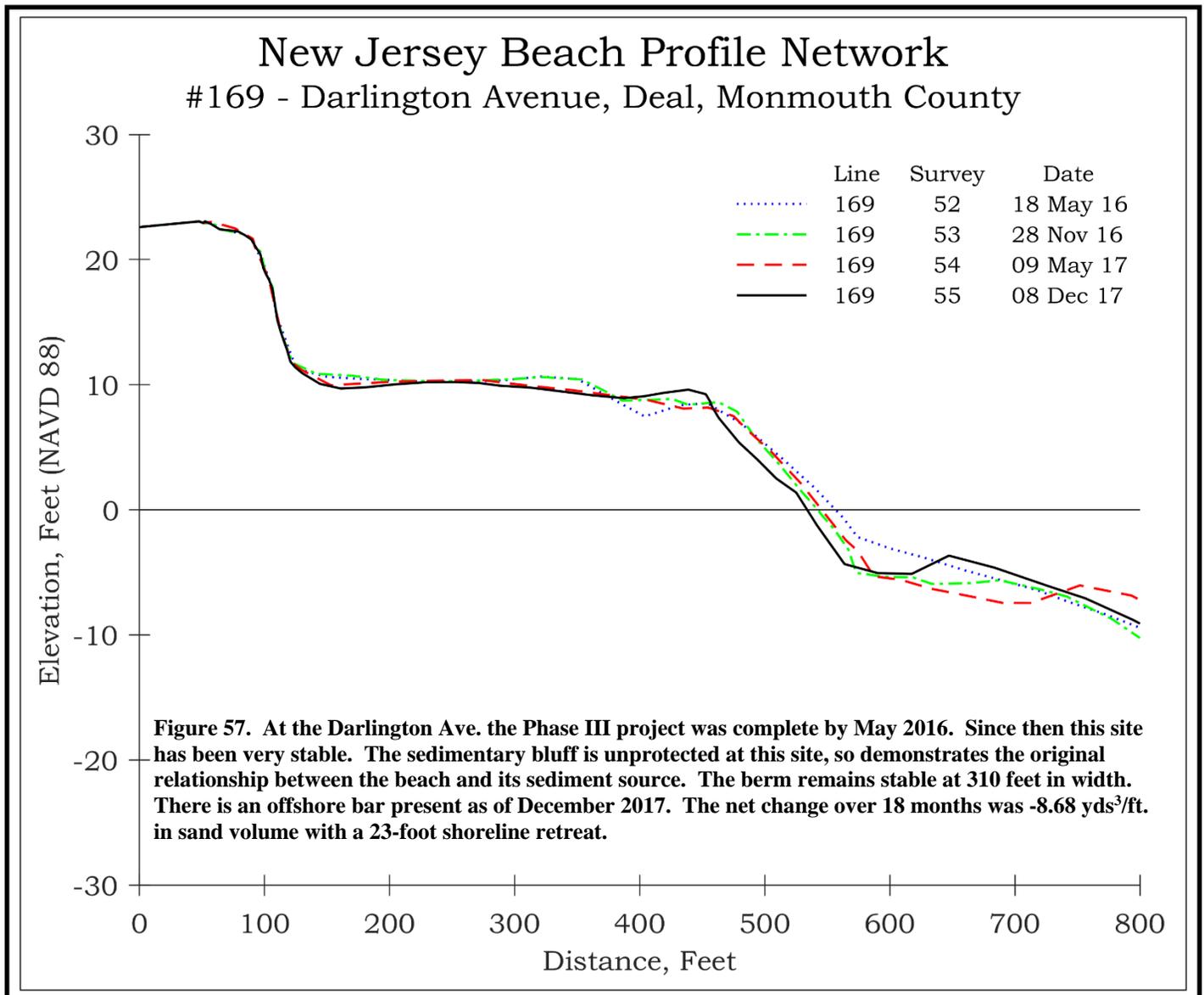


Figure 56. This site is located on the boundary between the bathing complex and private homes which extend south of the location. This beach abuts the sedimentary bluff without a dune present. The Phase III beach remains 200 feet wide with a terrace offshore, but no bar complex present.

NJBPN 169 – Darlington Avenue, Deal



The Darlington site has maintained the as-built width quite well. Completed earlier than May 18, 2016, the bluff is once again protected behind new timber bulkheads. By December 8, 2017, the beach was essentially the same width with few changes discernable in photographs.



NJBPN 16802 - Monmouth Drive, Deal

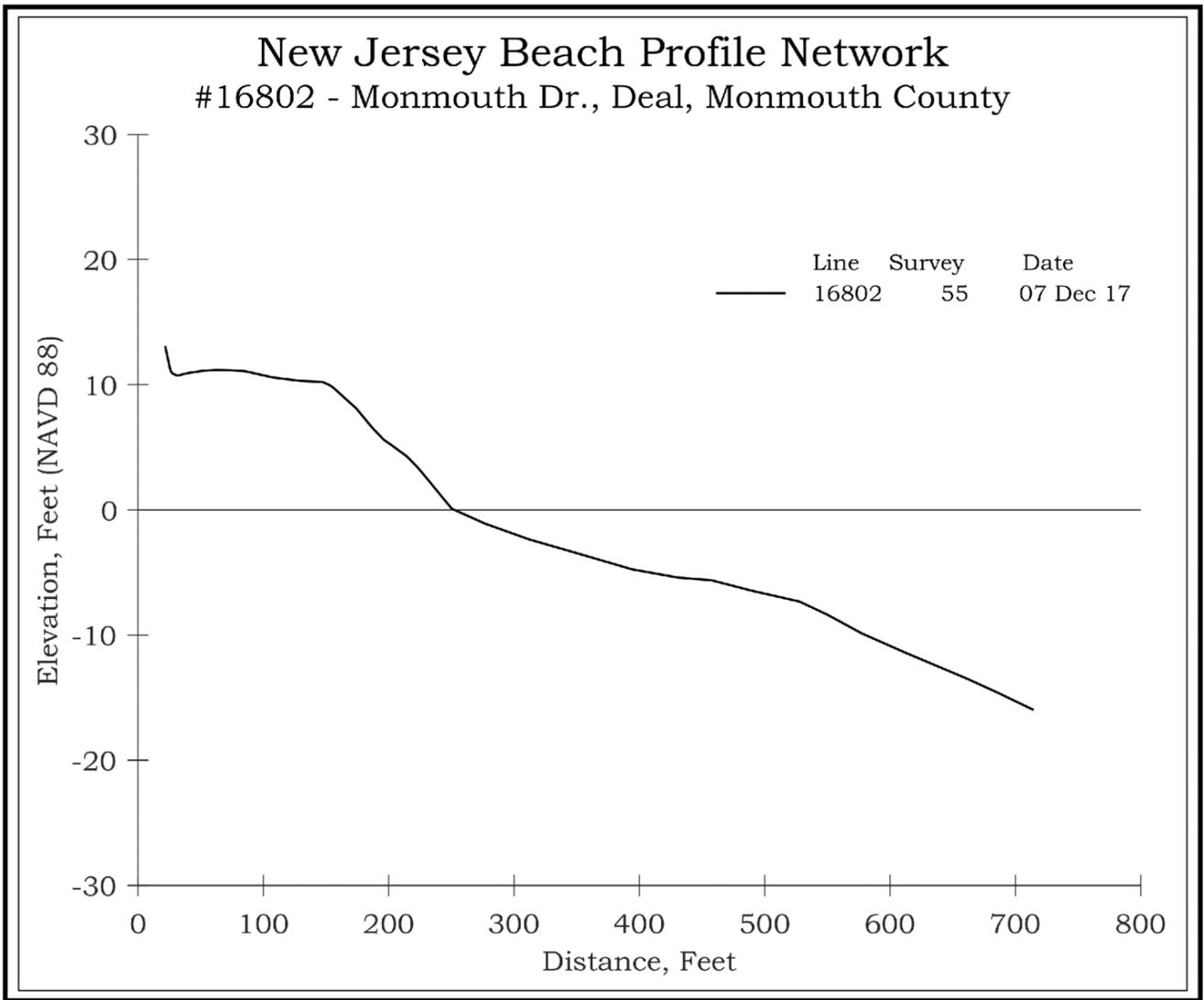


Figure 58. This site fronts a private home at the bluff. No dune exists and the beach measured 150 feet wide. There is no offshore terrace or bar system developed.

NJBPN 16801 - Neptune Avenue, Deal

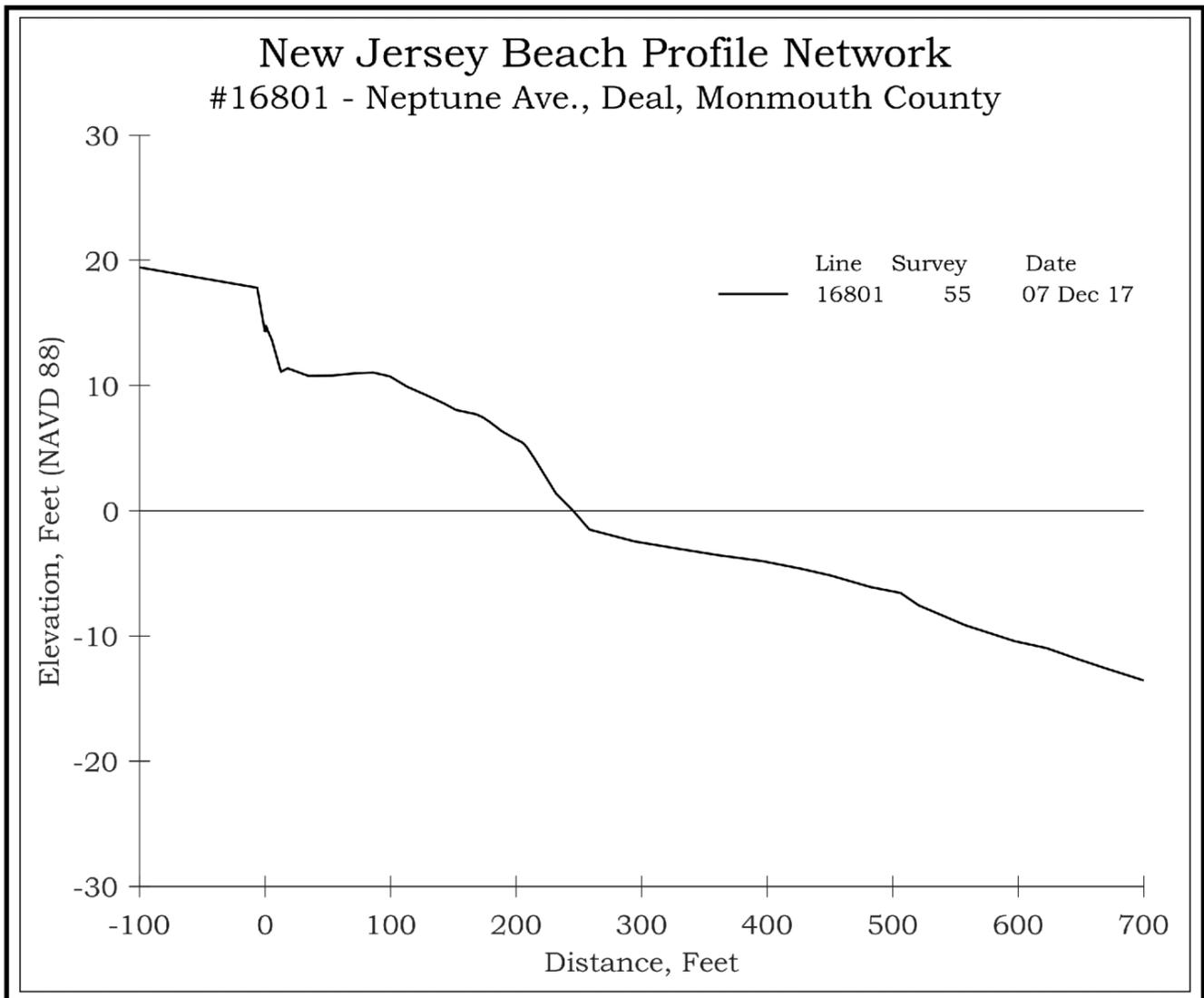
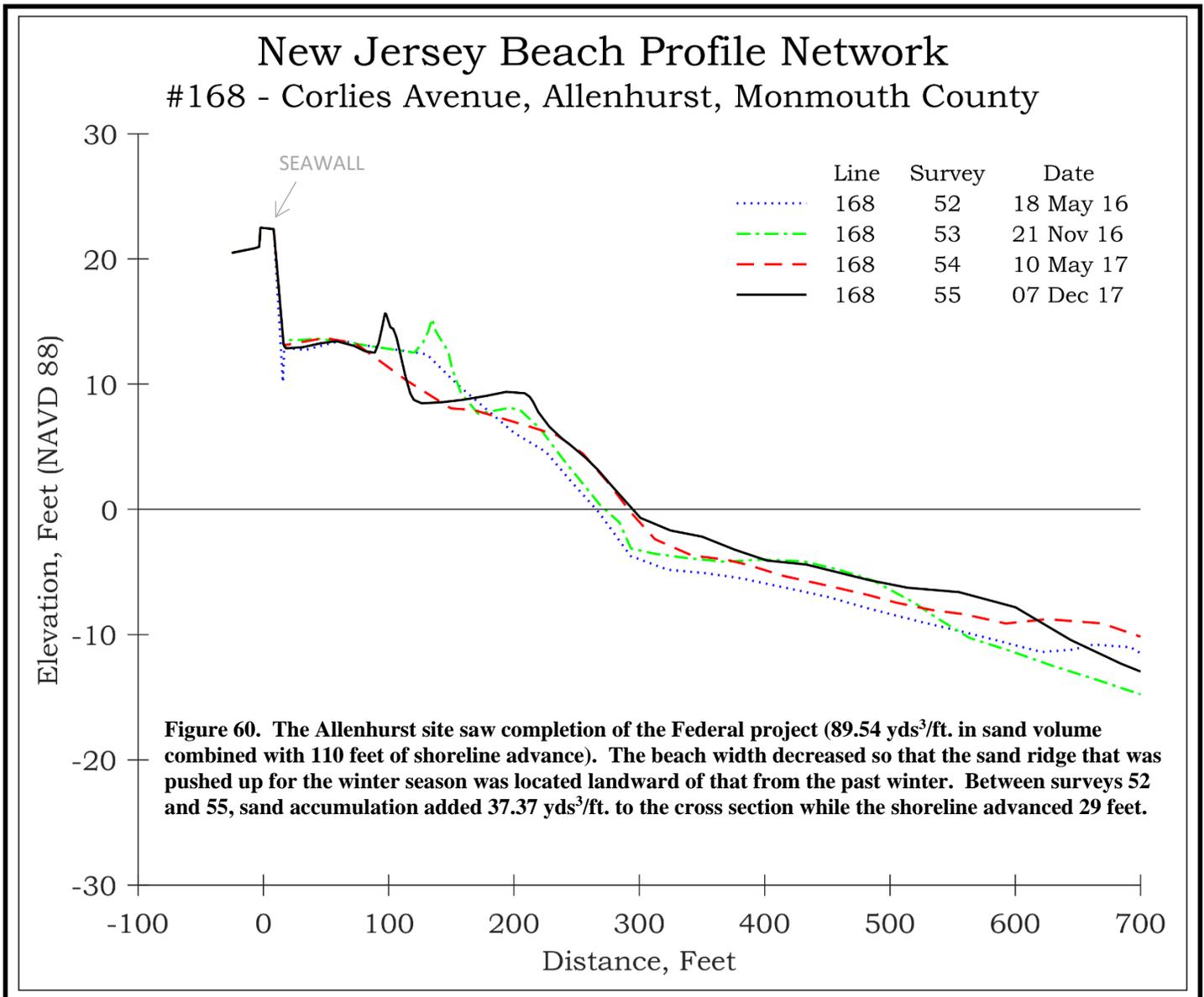


Figure 59. This is the first site in Deal with the bluff protected by armor stone. The beach has been modified post project with about 80 feet of the 10.0-foot elevation berm remaining. The beachface slopes seaward and intersects a low gradient terrace offshore.

NJBPN 168 – Corlies Avenue, Allenhurst



This site in Allenhurst was the starting point for Phase III USACE work in 2015. The left side view (May 18, 2016) to the south includes Loch Arbor and in the distance, Asbury Park. The right side view from the top of the old concrete seawall shows the storm ridge pushed up to mitigate wave damage as of December 7, 2017.



NJBPN 26702 - Edgemont Avenue, Loch Arbour

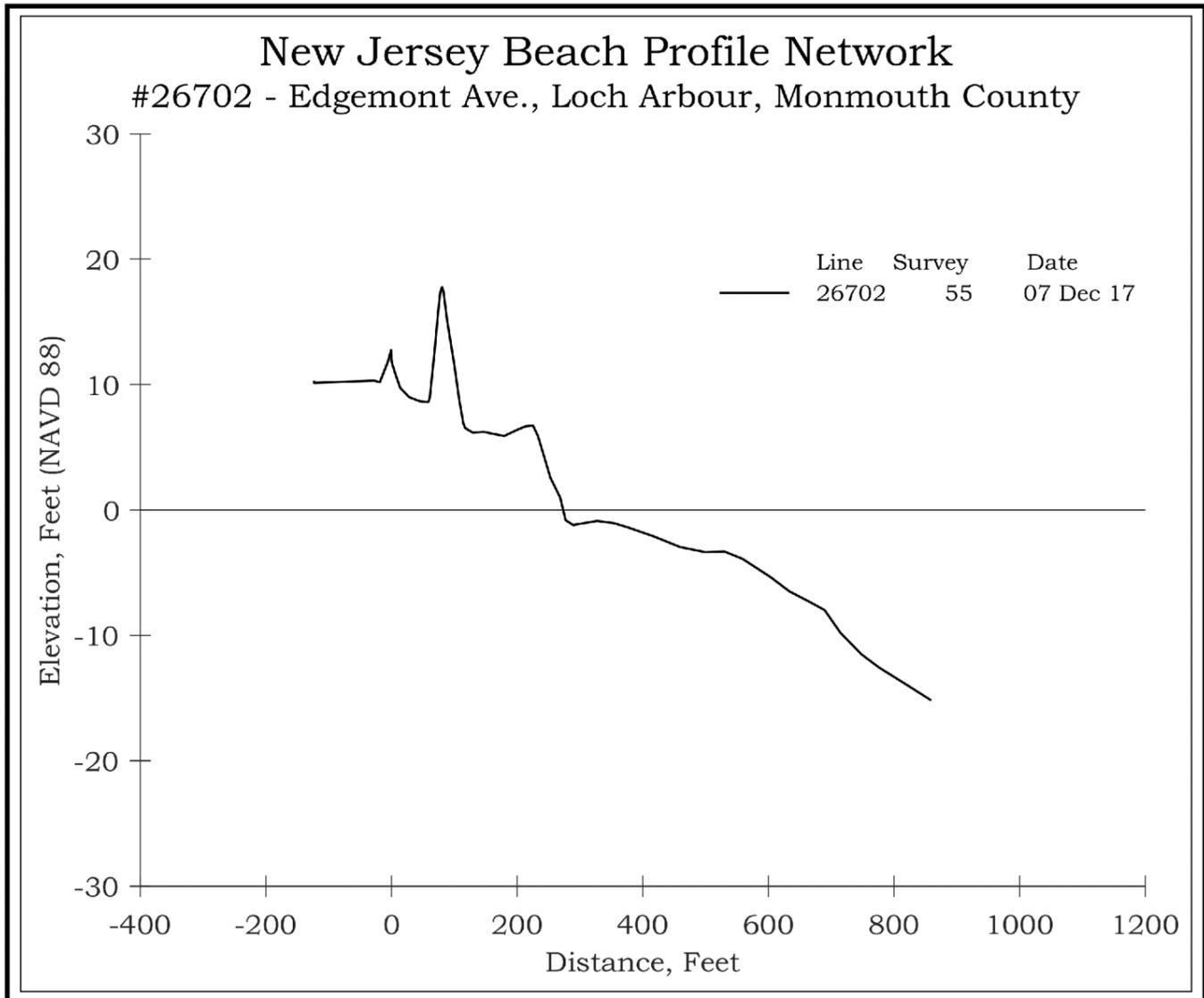


Figure 62. This site is located on the private half of the Loch Arbour shoreline, adjacent to the Deal Lake exit flume. This lake is the largest of the now-closed estuary lakes in Monmouth County. The sand ridge represents a winter season push-up storm protection. There is a minor dune, with a small offshore bar.

NJBPN 26701 - 1740 Ocean Avenue, Asbury Park

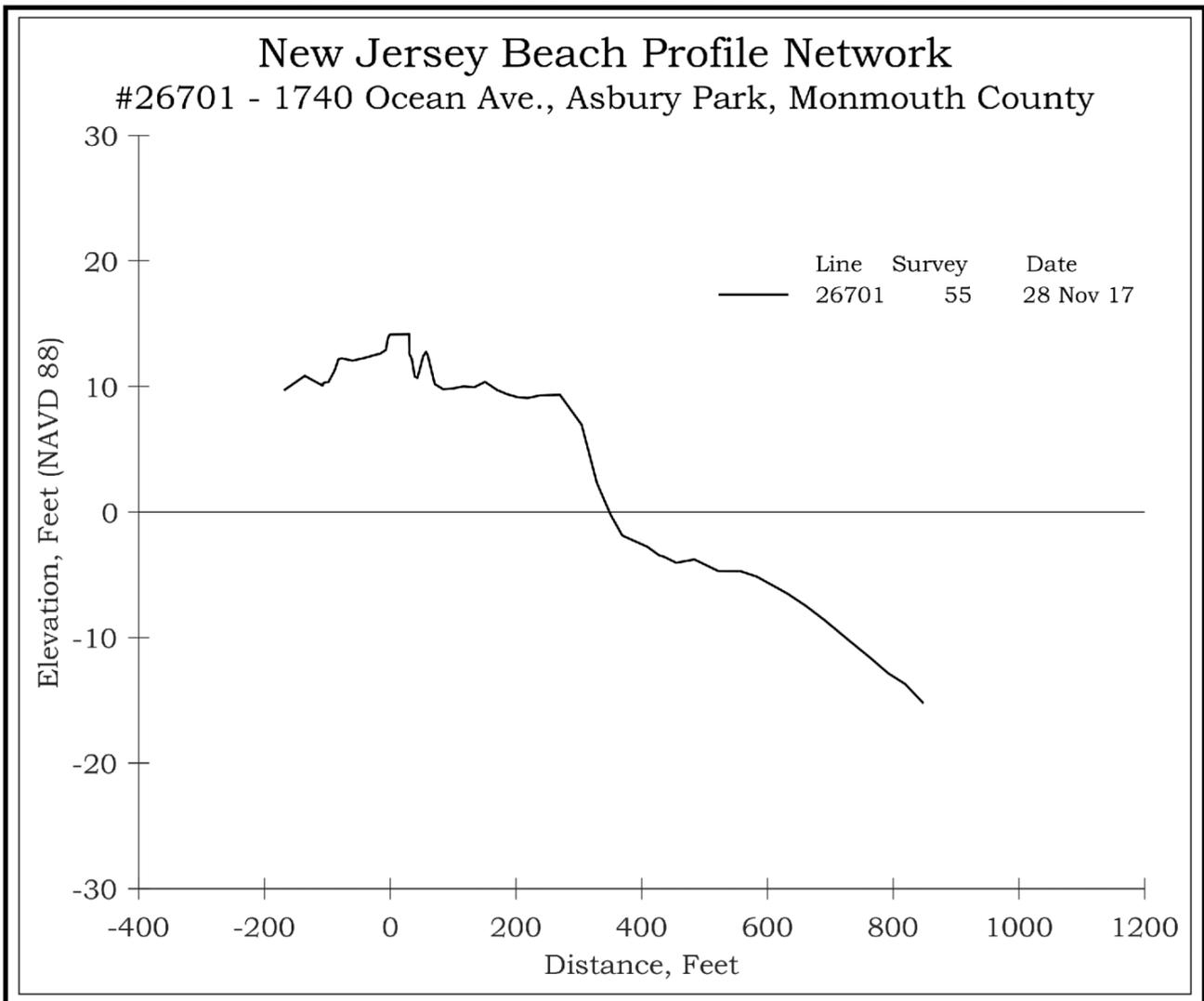
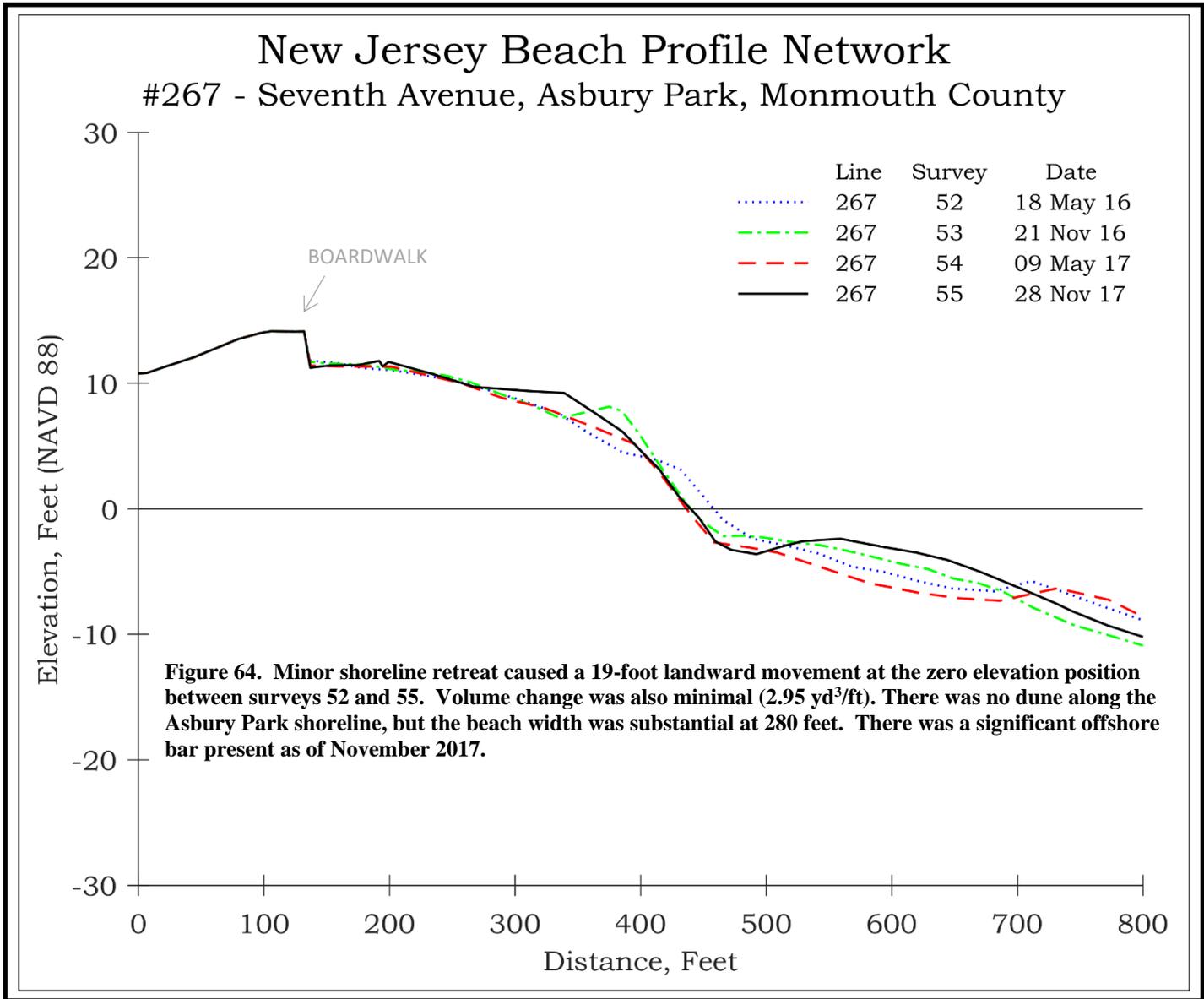


Figure 63. Positioned at the northern limit of the Asbury Park shoreline, this site sits at the boardwalk with a tiny dune seaward of the walk. The beach is about 200 feet wide following Sandy restoration of Phase II from Asbury south to the Manasquan Inlet. There is a terrace offshore.

NJBPN 267 – 7th Avenue, Asbury Park



This site is the northernmost in Phase II of the Monmouth County project. The left photo was taken May 18, 2016 and illustrates variation in the beach alignment south of the profile line. The right photo (taken November 28, 2017) shows the winter sand fence. No storm wave barrier was pushed up on this heavy use beach.



NJBPN 16701 - Sunset Avenue, Asbury Park

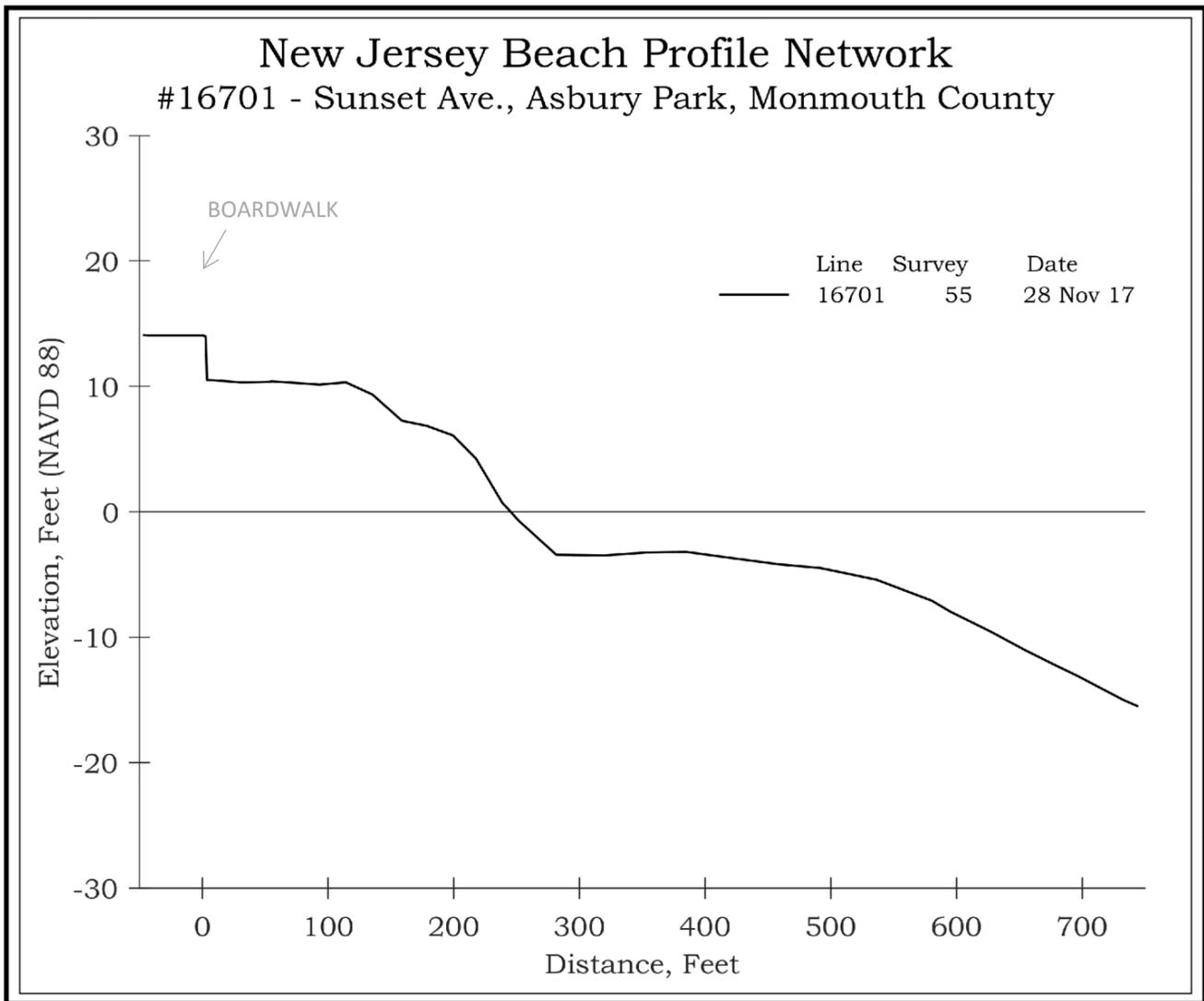
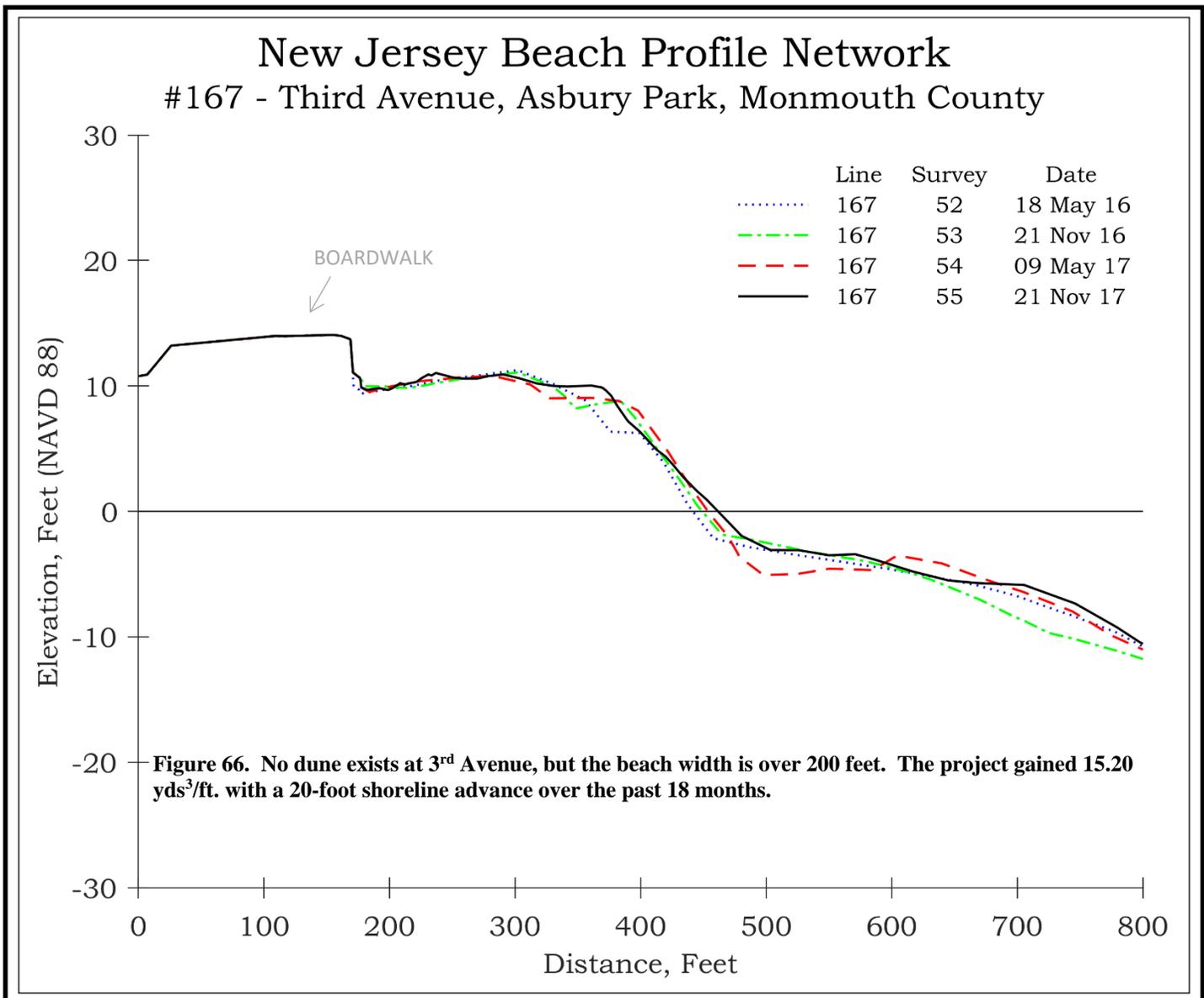


Figure 65. This site starts at the boardwalk and extends across 200 feet of dry beach largely remaining at the 10.0-foot elevation. There is a wide terrace offshore without a bar present as of November 2017.

NJBPN 167 – 3rd Avenue, Asbury Park



The site remained in good shape with the May 18, 2016 view (left), not significantly different from that (right) taken November 21, 2017. The berm has advanced somewhat by accretion. No dune is present.



NJBPN 16602 - Asbury Avenue, Asbury Park

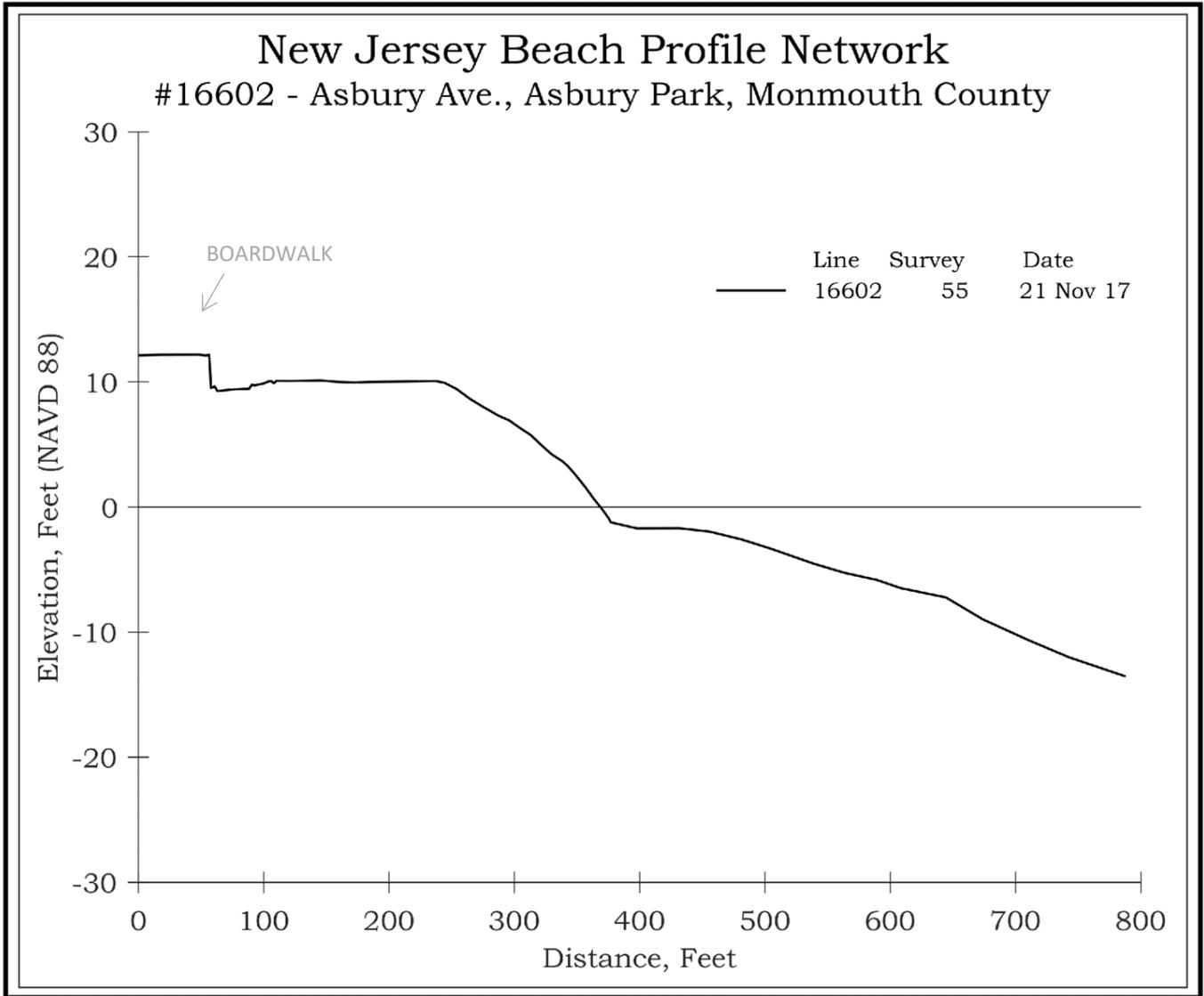


Figure 67. This southern Asbury Park beach is 270 feet in width with a shallow terrace offshore, but no bar present as of November 2017.

NJBPN 16601 - Spray Avenue, Ocean Grove

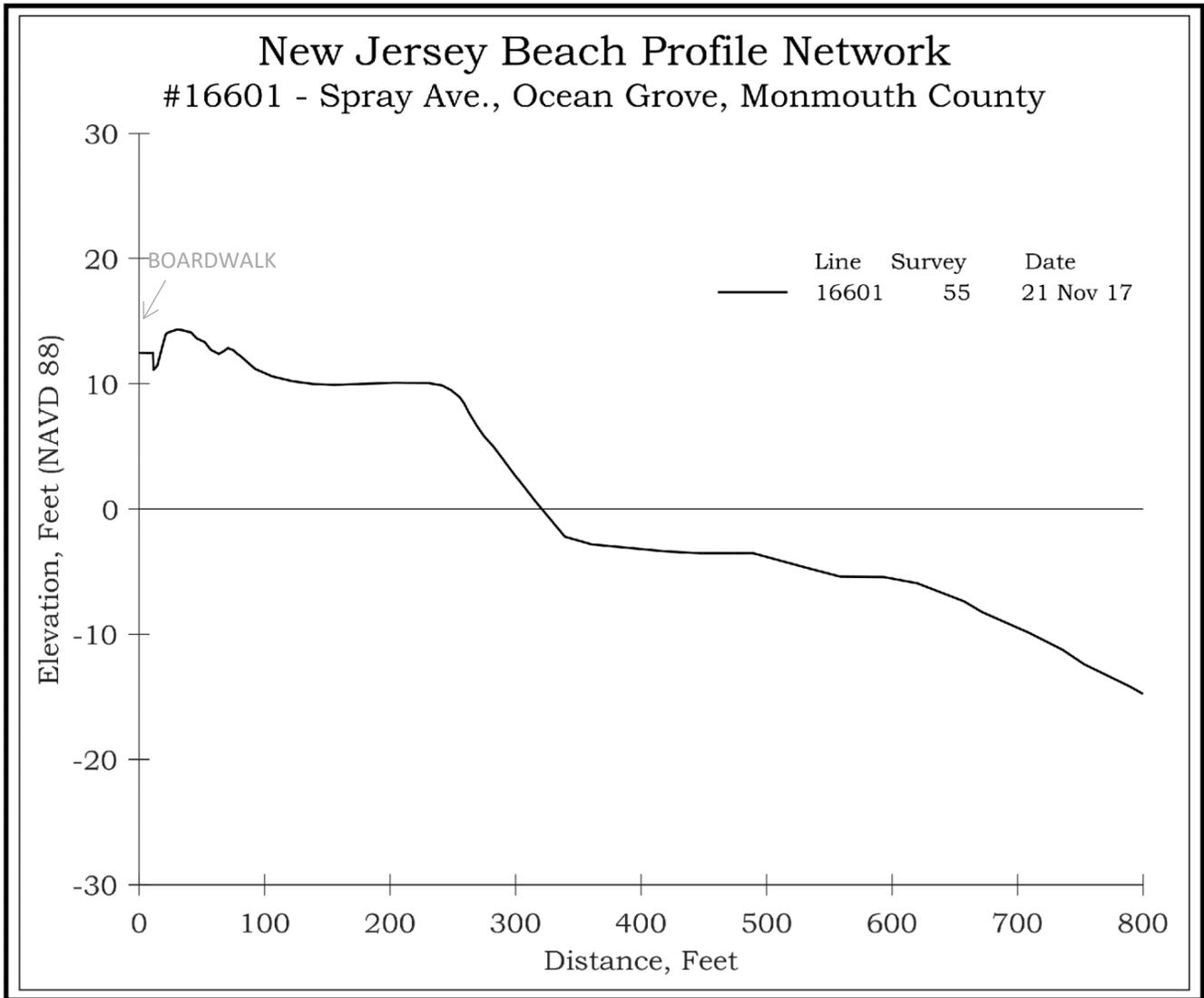
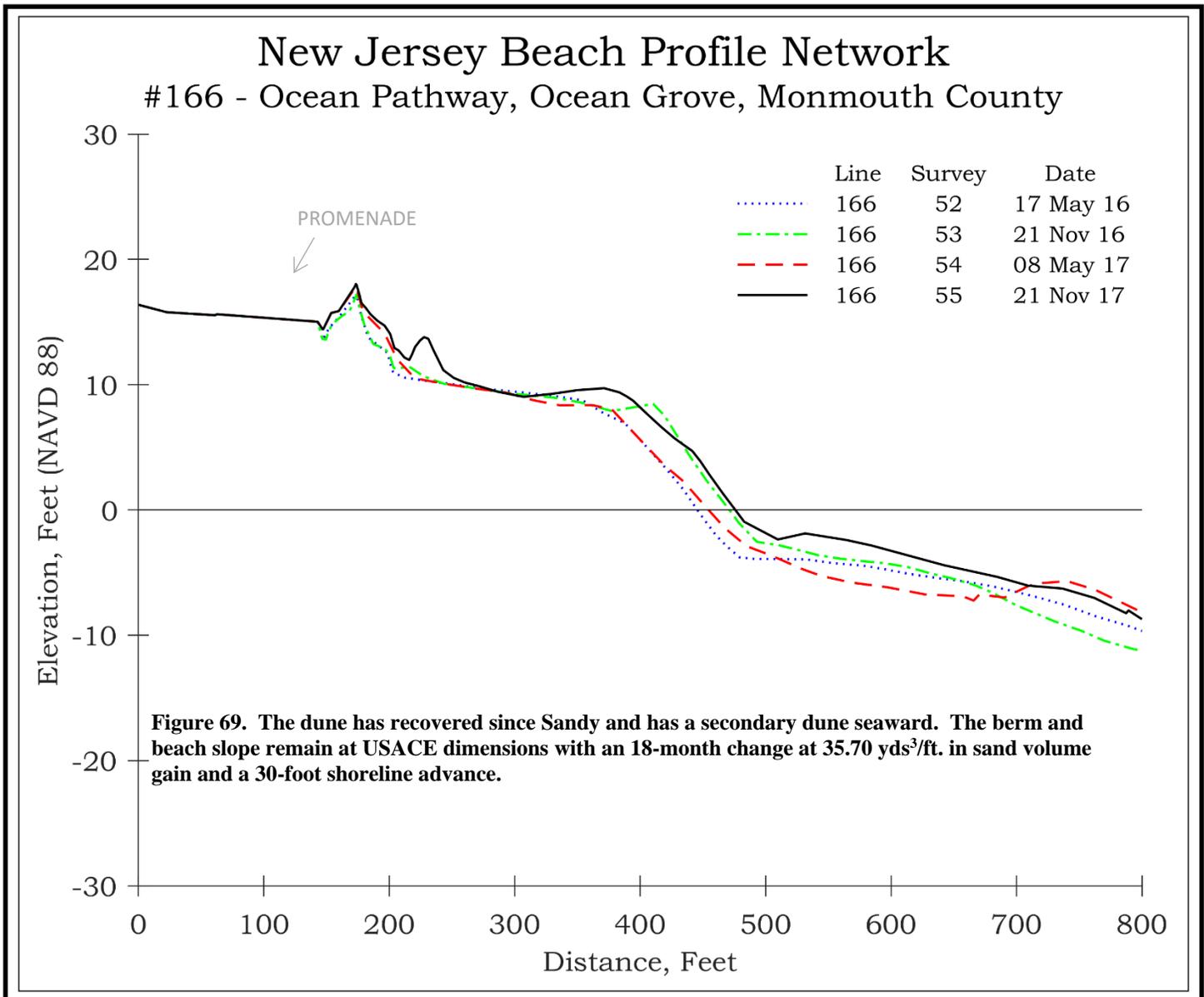


Figure 68. The northern Ocean Grove cross section starts at the boardwalk, with a small dune immediately seaward. The beach is 210 feet wide with a generously wide terrace offshore, but no bar system present.

NJBPN 166 – Ocean Pathway, Ocean Grove



The sand volume added during 2014 remains in place (May 17, 2016) with minor variations leaving the berm virtually unchanged on November 21, 2017 (right).



NJBPN 16502 - Broadway, Ocean Grove

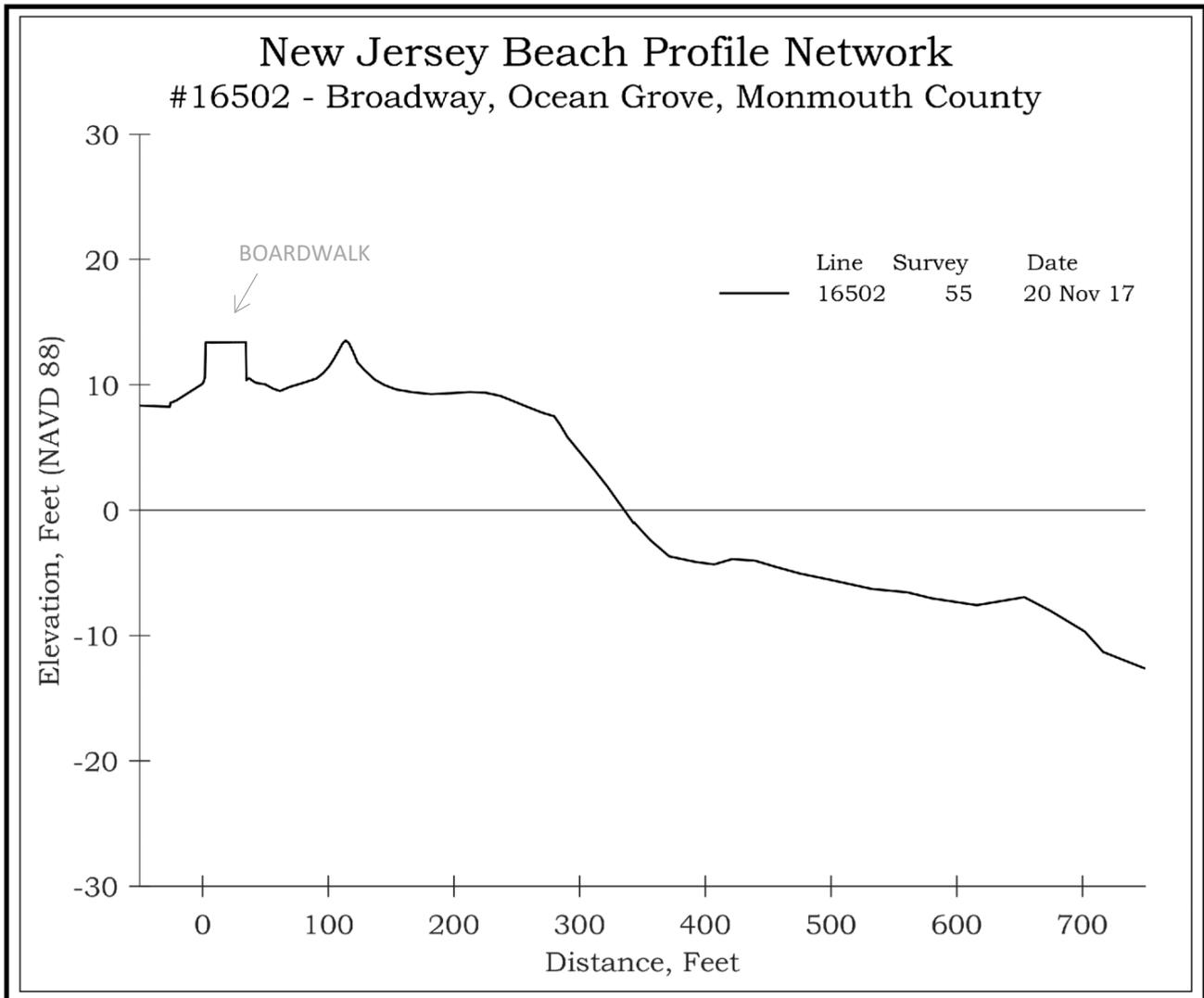


Figure 70. Positioned at the south end of Ocean Grove, this site has a low dune seaward of the boardwalk with 150 feet of 10.0-foot elevation beach beyond that. The offshore has a tiny bar on the shallow gradient terrace seaward of the beachface.

NJBPN 16501 - Cliff Avenue, Bradley Beach

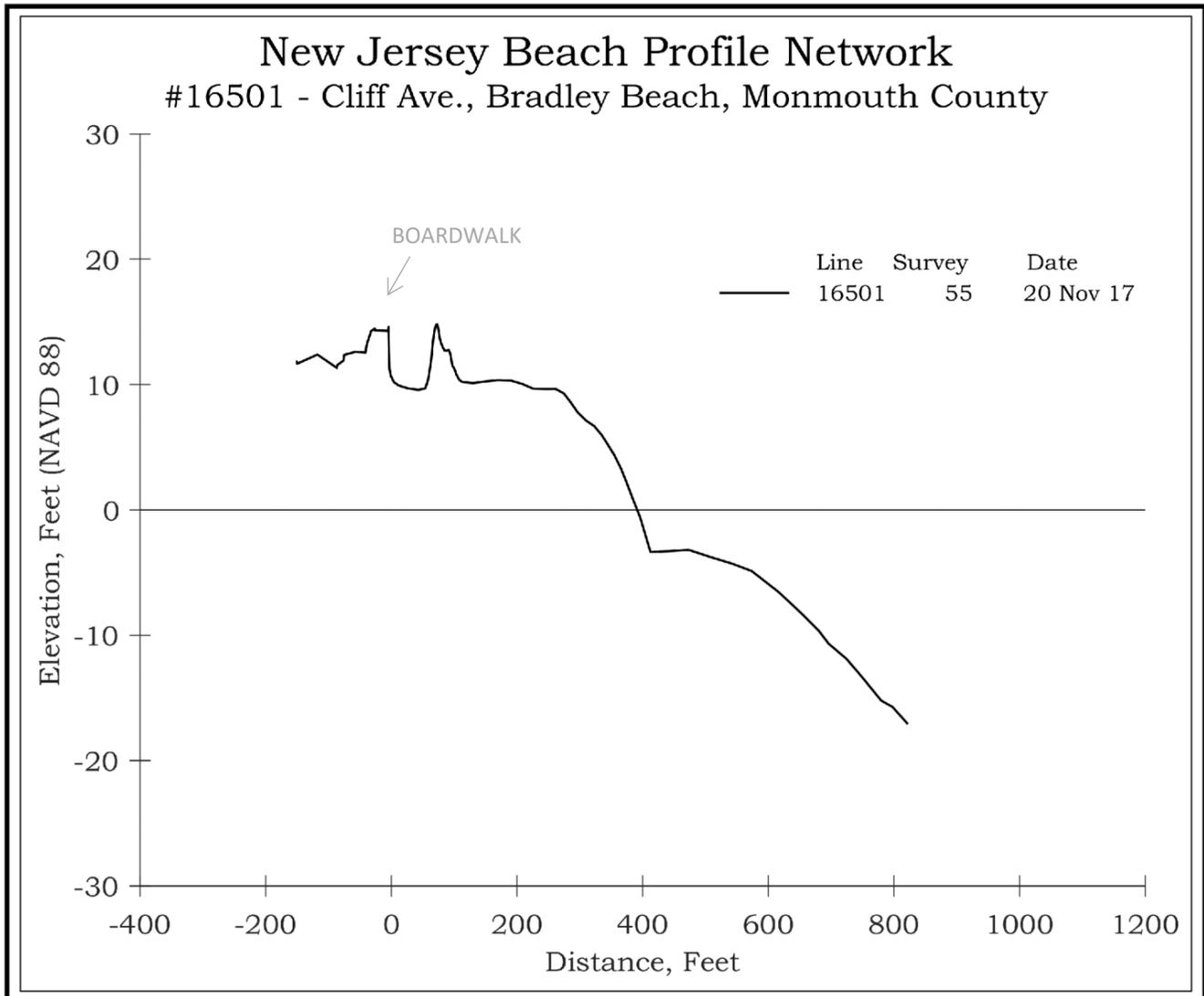
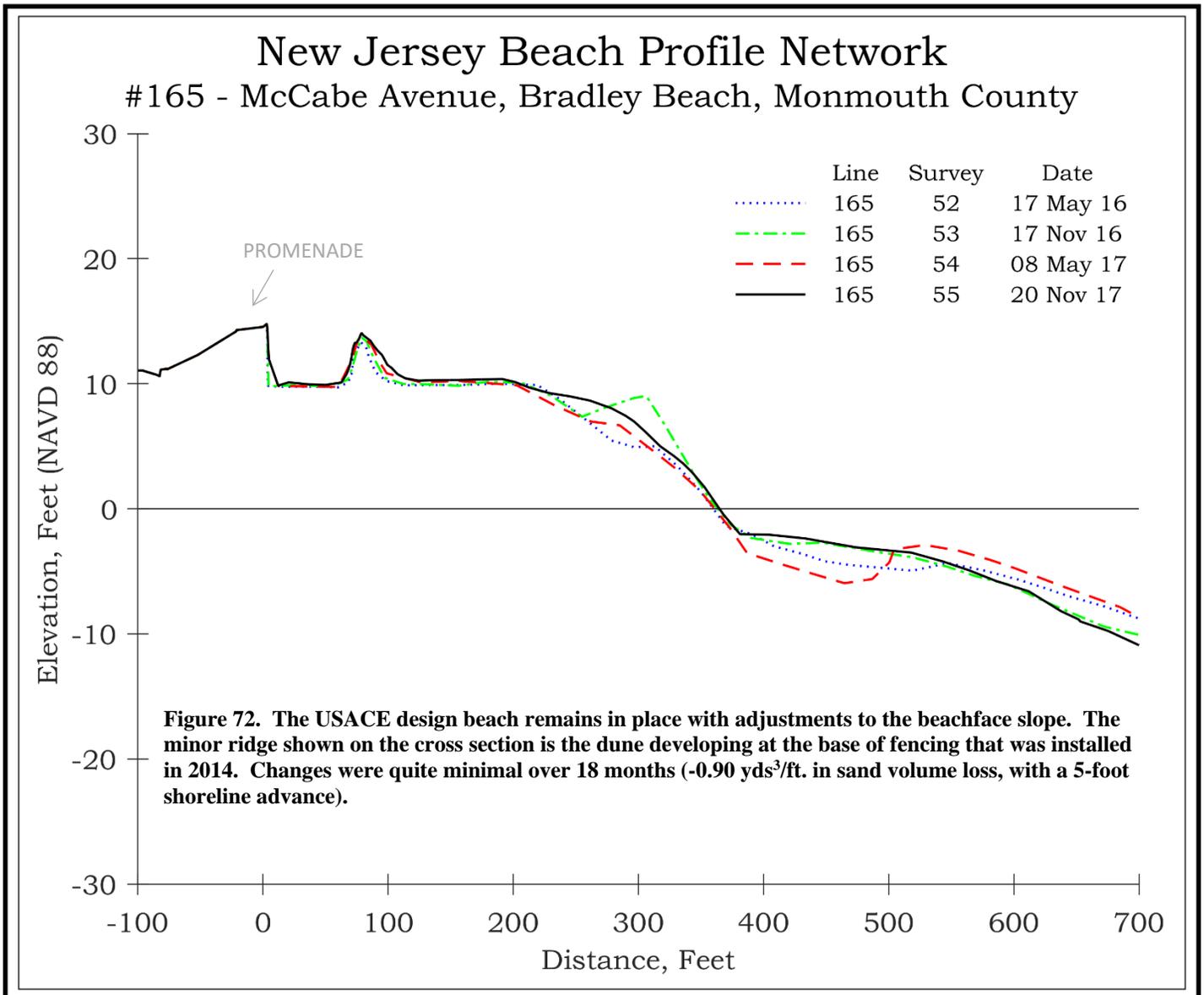


Figure 71. There is a dune between the boardwalk and the beachfront with about 200 feet of dry beach seaward at the USACE design elevation. There is a terrace offshore without a bar present.

NJBPN 165 – McCabe Avenue, Bradley Beach



The May 17, 2016 view to the south shows the beach width following the Sandy restoration that occurred in 2014. The November 20, 2017 view to the south (right photo) was taken from the dune crest and, definitely the best example of a man-generated dune in southern Monmouth County.



NJBPN 16402 - 4th Avenue, Bradley Beach

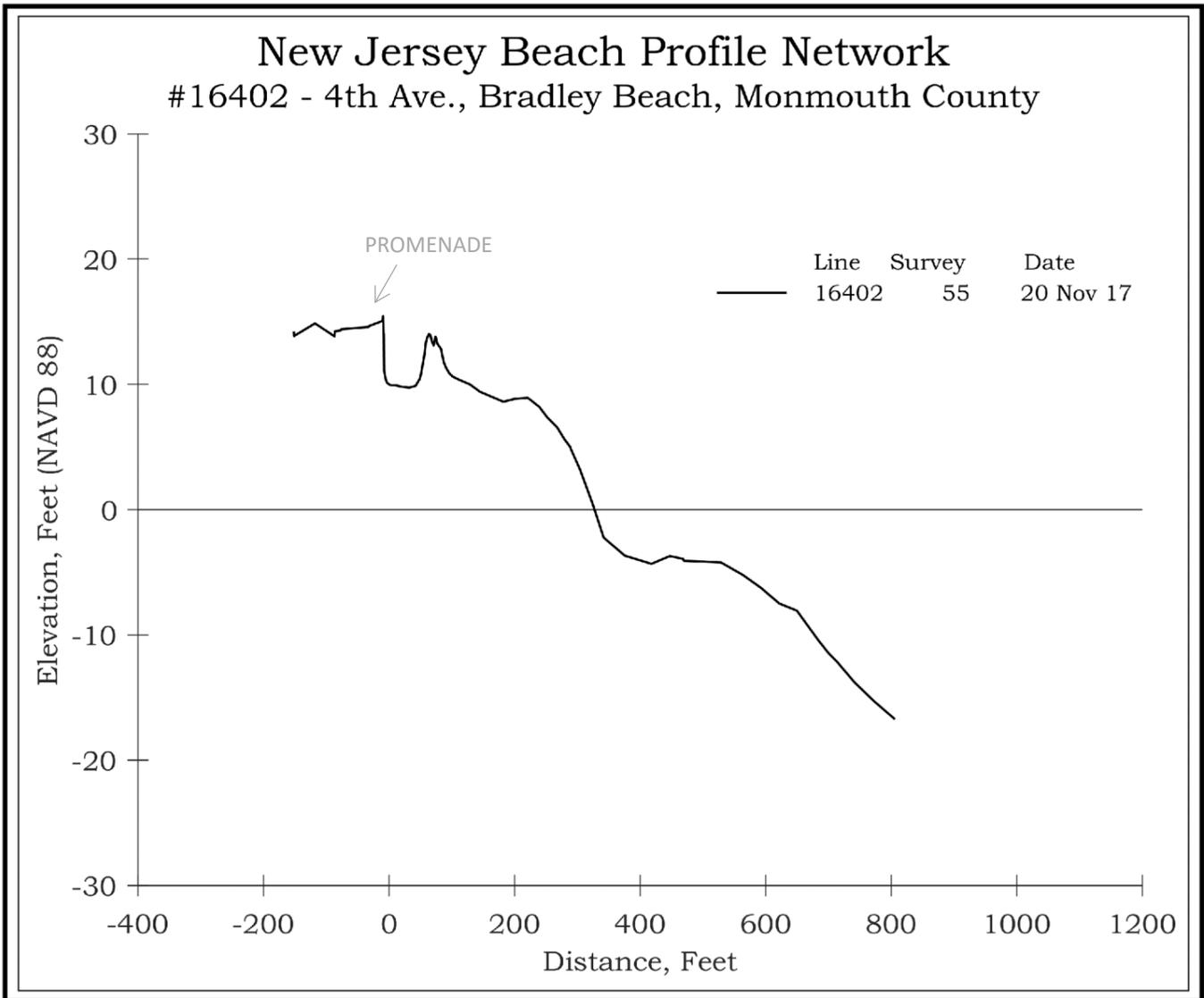


Figure 73. A dune lies seaward of the promenade with a 170-foot wide beach seaward from it. Offshore the terrace has a modest bar system present.

NJBPN 16401 - 2nd Avenue, Bradley Beach

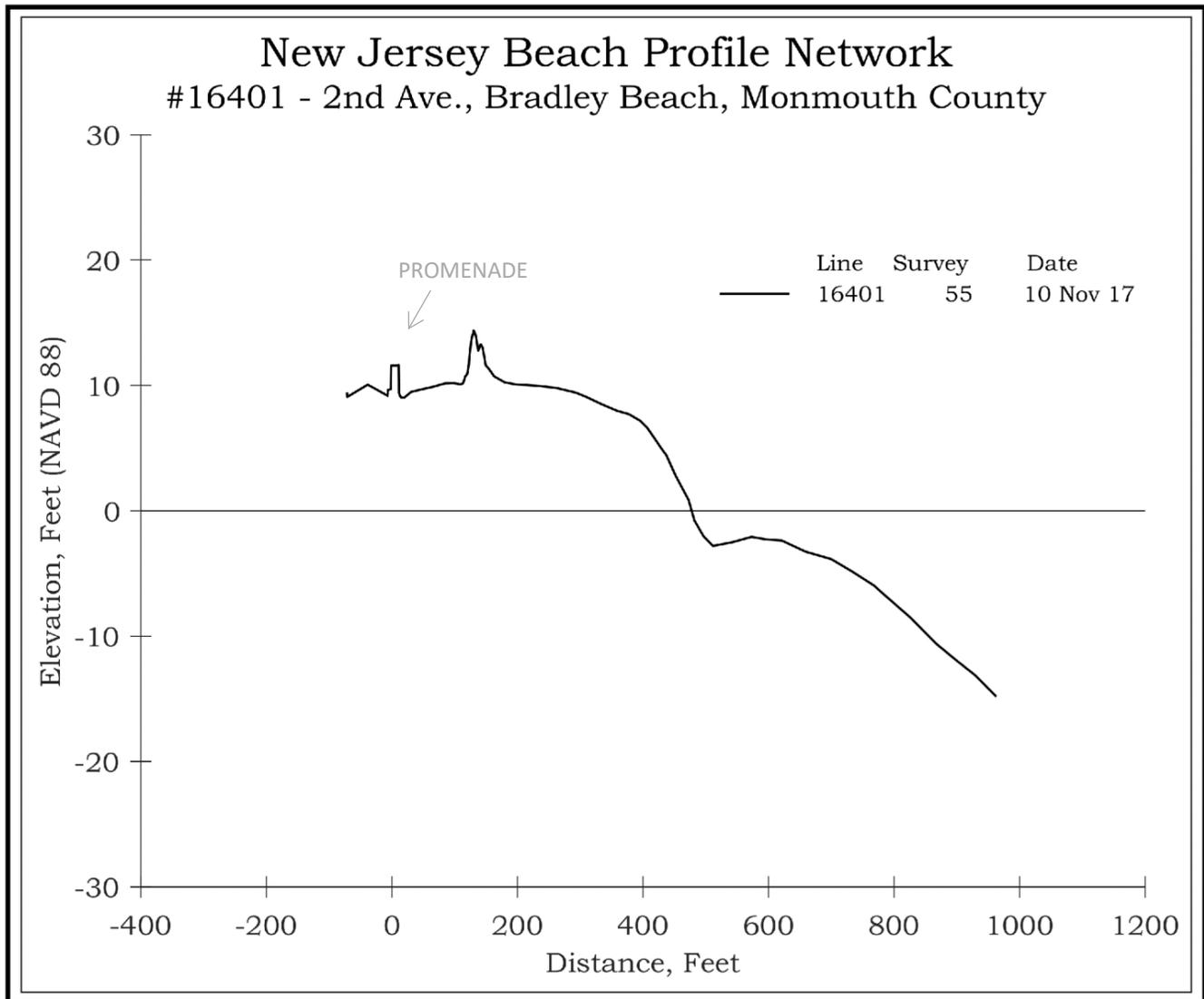
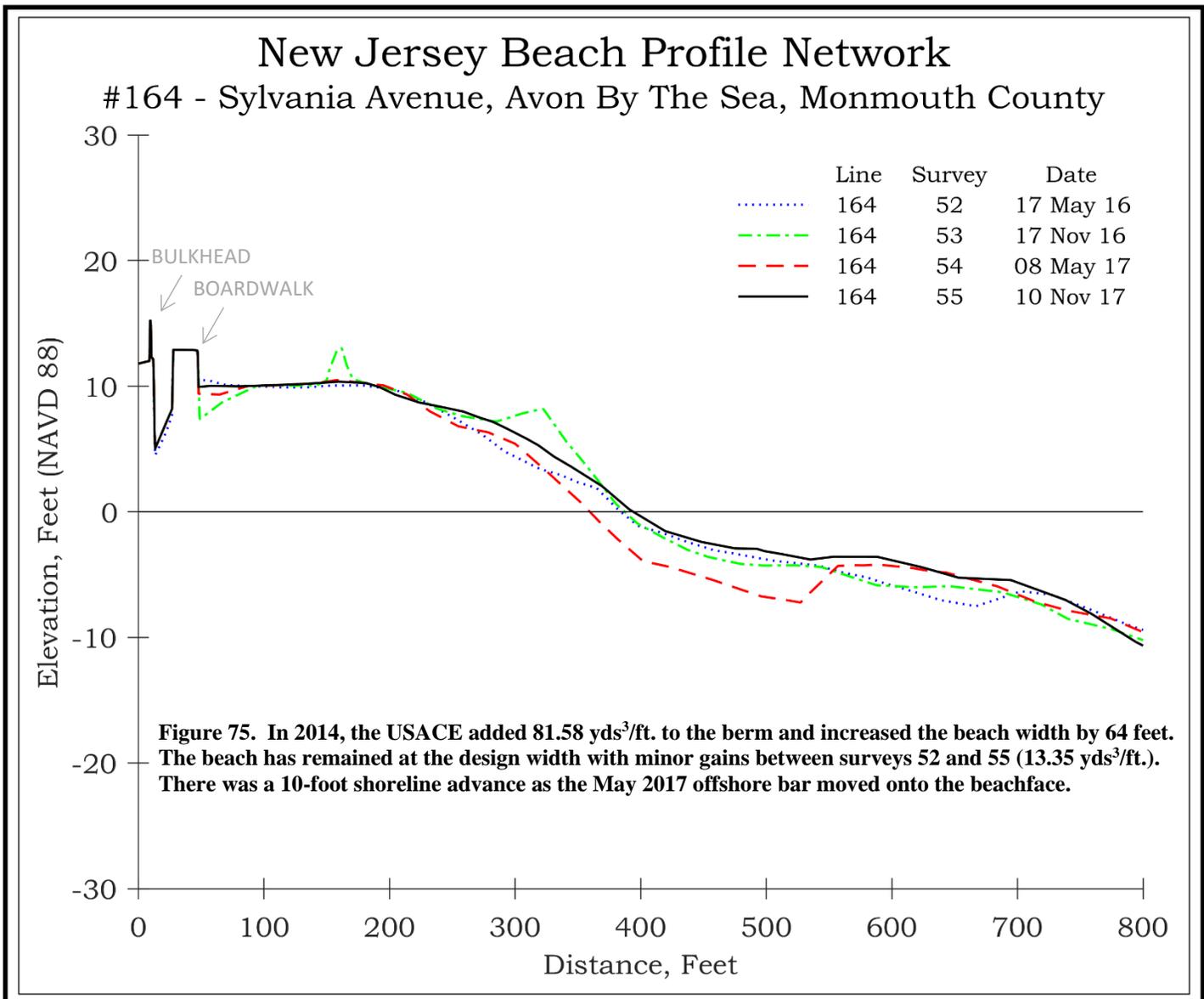


Figure 74. There is a dune present seaward of the walkway and a 270-foot wide beach leading offshore to a small bar system present on the terrace.

NJBPN 164 – Sylvania Avenue, Avon-by-the Sea



This site is located north of the Shark River Inlet. The left view shows the beach looking south toward the inlet on May 17, 2016. On November 10, 2017 (right photo), the beach was about the same with berm elevation variations over the 18-month period.



NJBPN 16303 - Garfield Avenue, Avon-By-The-Sea

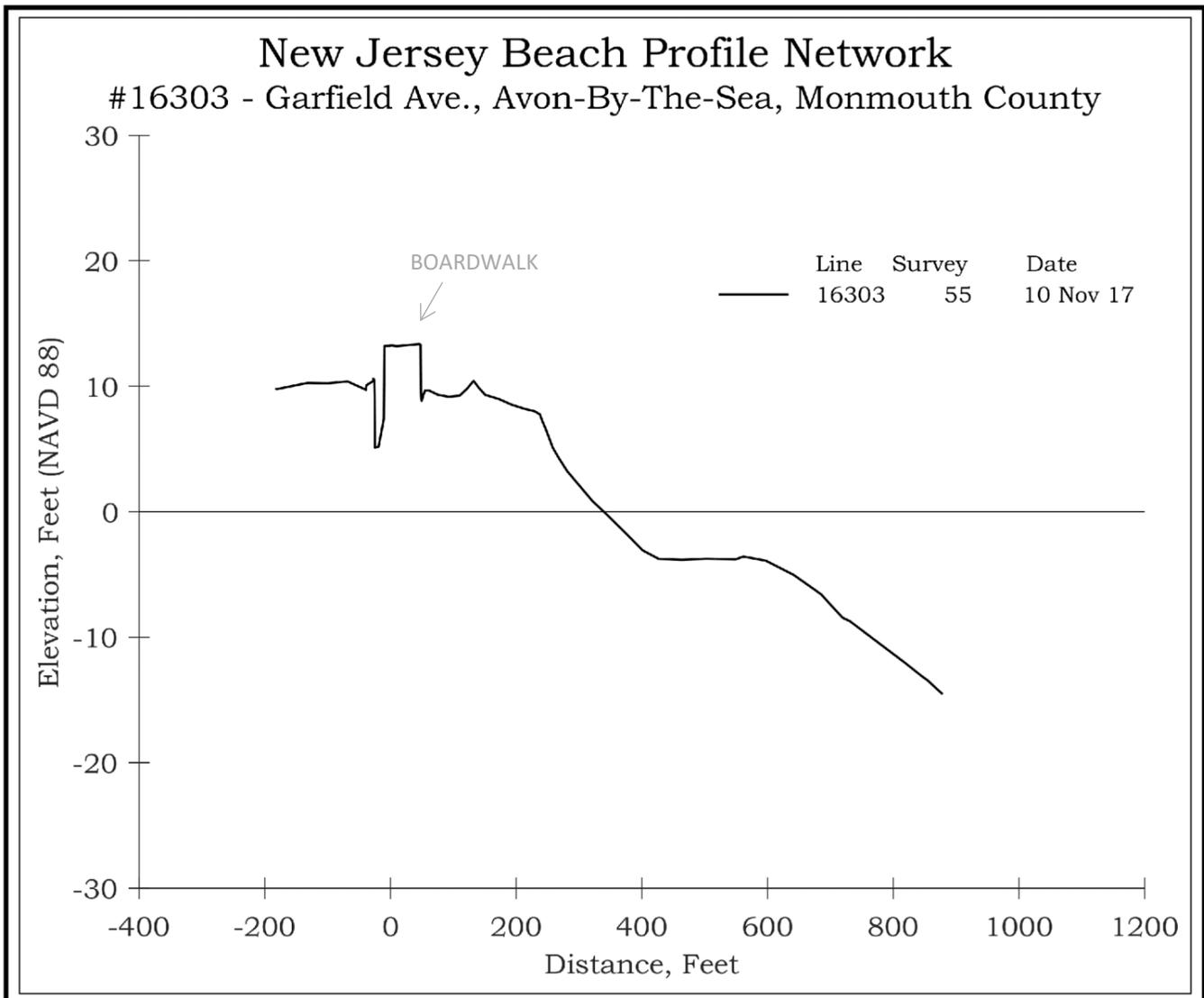
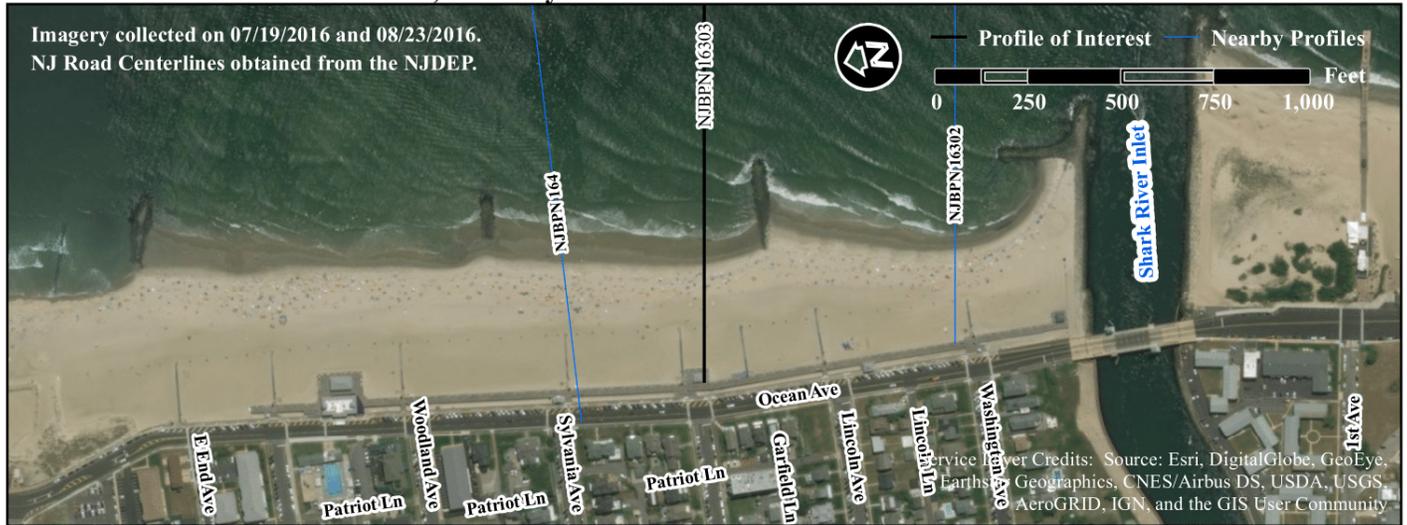


Figure 76. Seaward of the boardwalk, sand accumulated at the base of the sand fence and a 200-foot wide beach. The offshore shows a terrace/bar at -5 ft elevation.

NJBPN 16302 - Washington Avenue, Avon-By-The-Sea

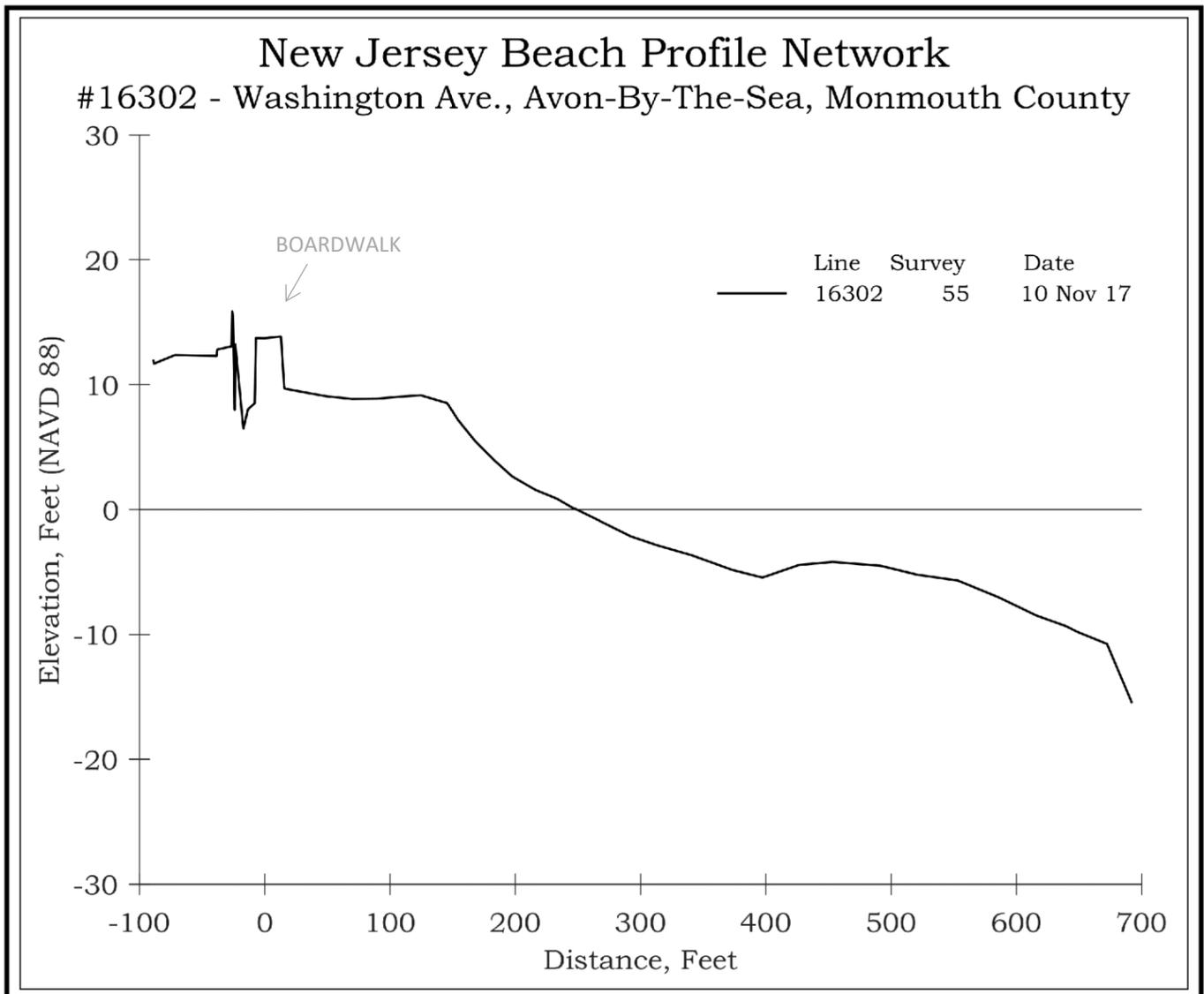
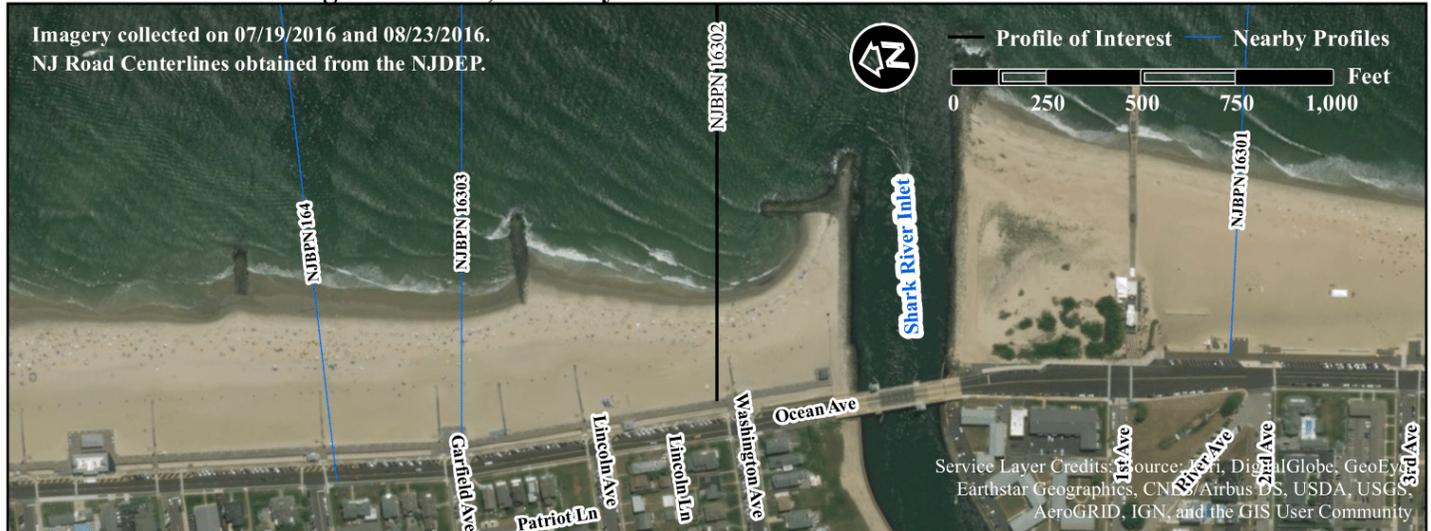


Figure 77. This new site is located approximately 300 ft. north of the Shark River Inlet north jetty. The elevation 10ft berm extends seaward from the boardwalk by 160 feet. A bar lies offshore in about -4 ft. water depth.

NJBPN 16301 - 2nd Avenue, Belmar

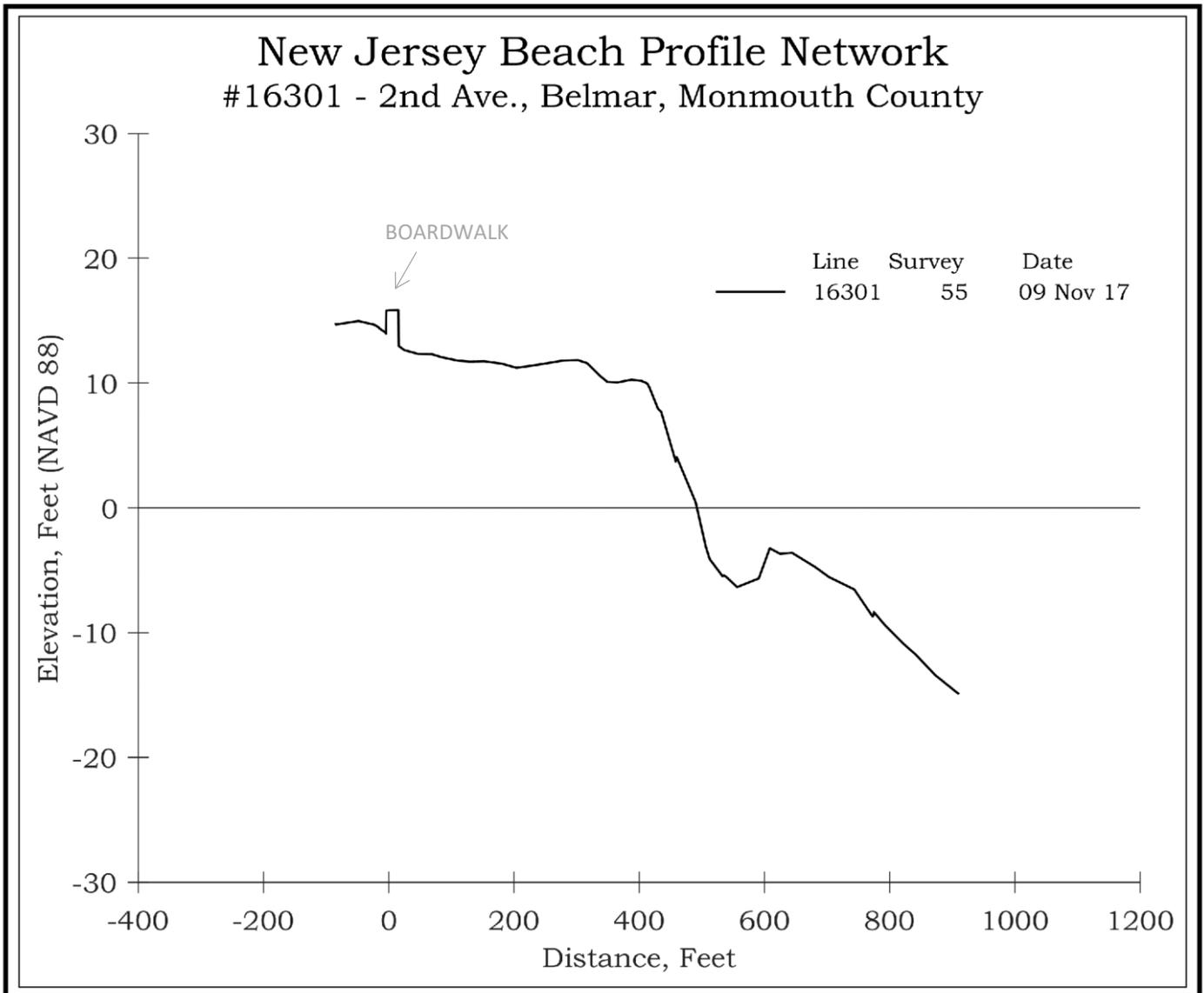
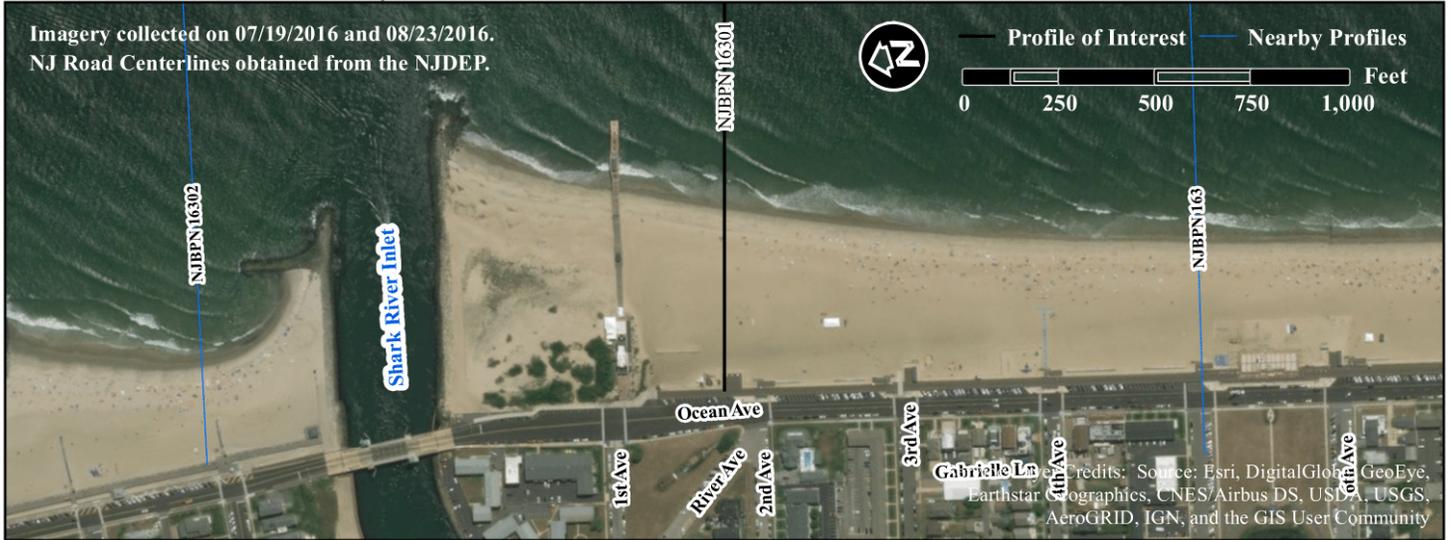
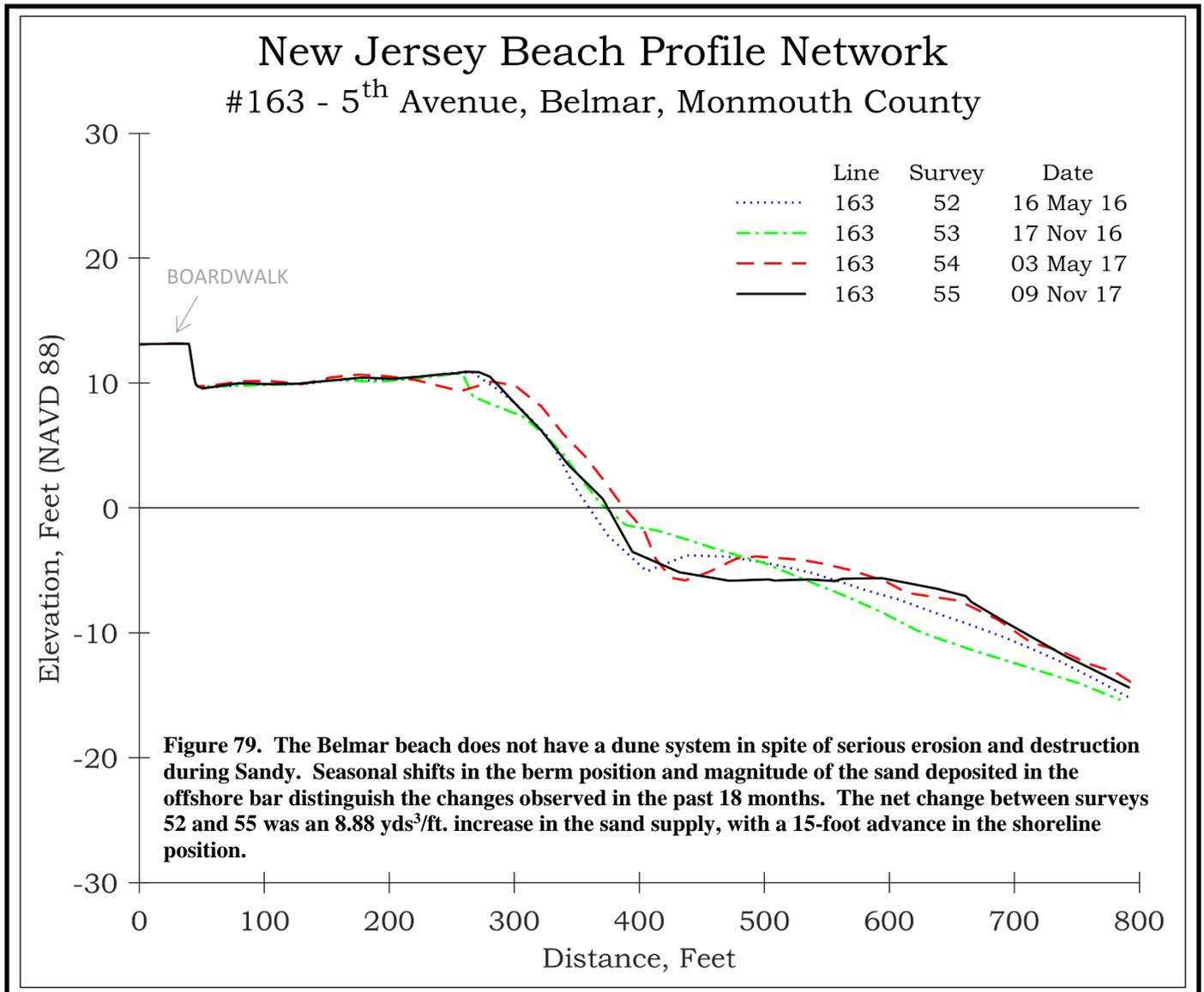


Figure 78. The new site in Belmar includes a 400-ft wide beach with no dune. There is minimal accumulation of sand at the fencing sites. Offshore, a bar was measured in -3 ft. water depth.

NJBPN 163 – 5th Avenue, Belmar



This site did not have a dune prior to Sandy but had a wide, dry beach. The north view on May 16, 2016 (left photo) shows this wider than normal beach due to sand trapping by the Shark River Inlet jetty. By November 9, 2017 (right photo) the position of the shoreline was located midway between the 18-month variations.



NJBPN 16202 - 8th Avenue, Belmar

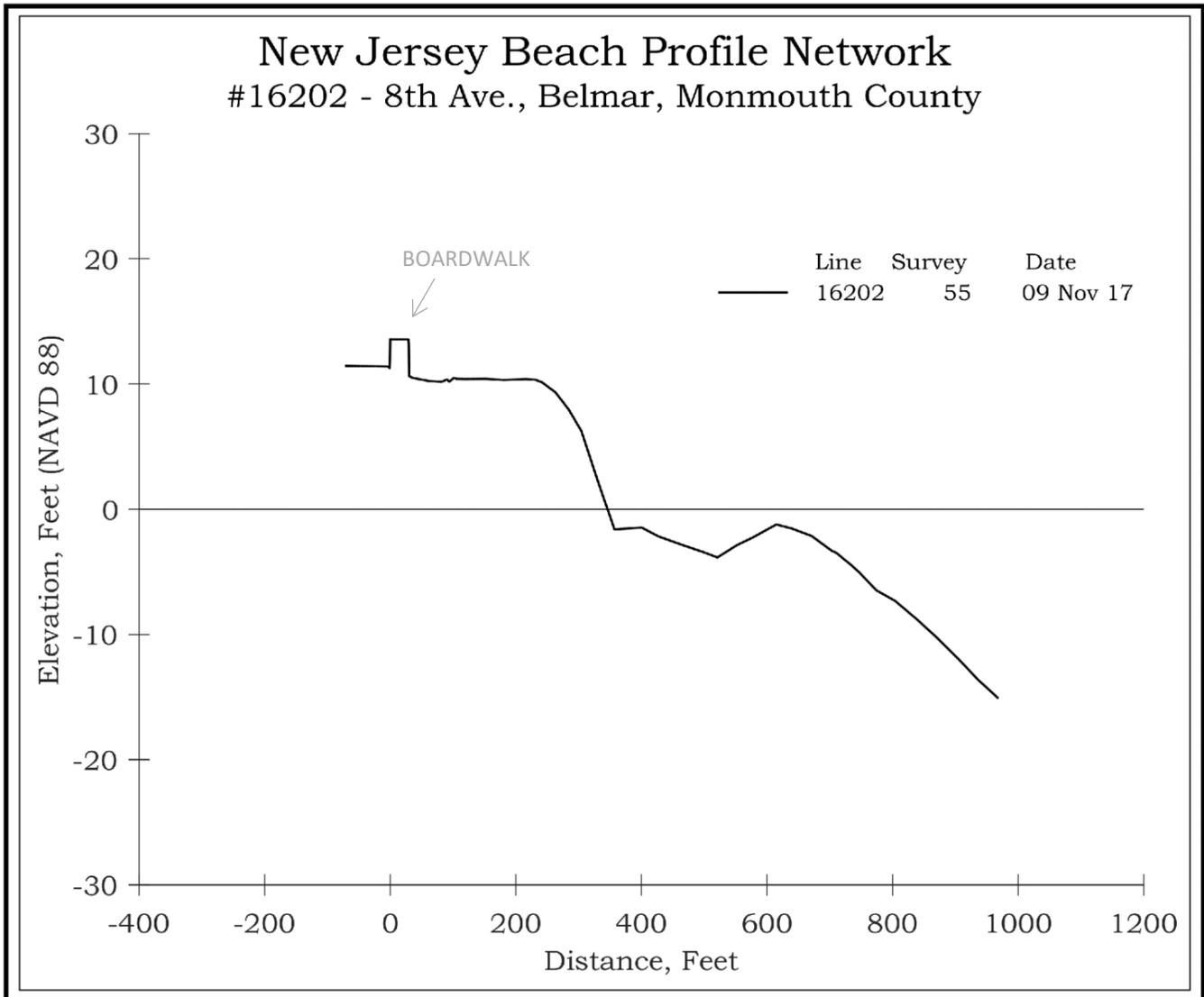


Figure 80. The boardwalk is the backstop for the beach, since there is no dune system. The beach is over 200 feet wide at elevation 10.0 feet leading into a steep beachface and a significant offshore bar, the crest of which reaches nearly to the zero elevation datum.

NJBPN 16201 - 14th Avenue, Belmar

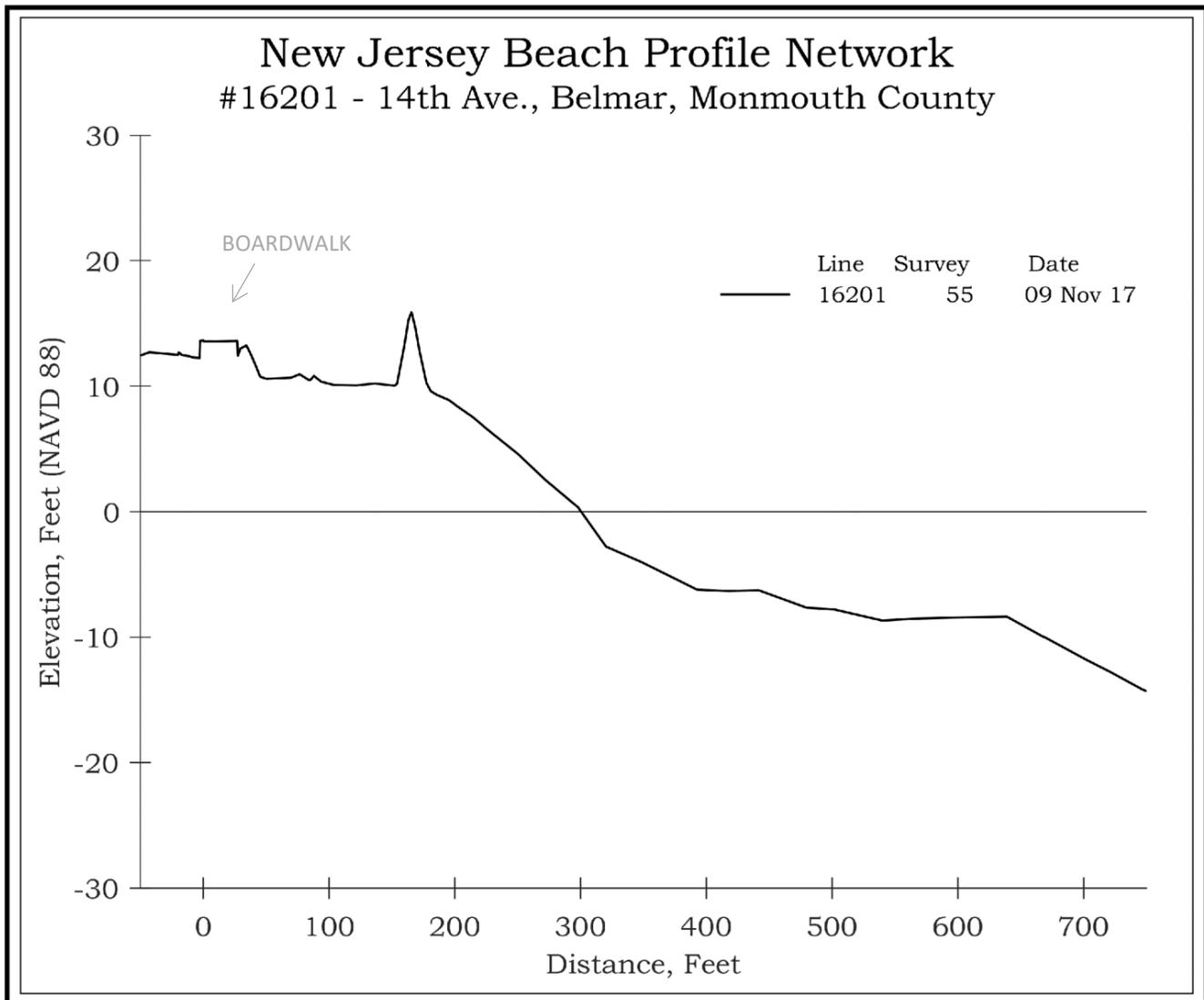
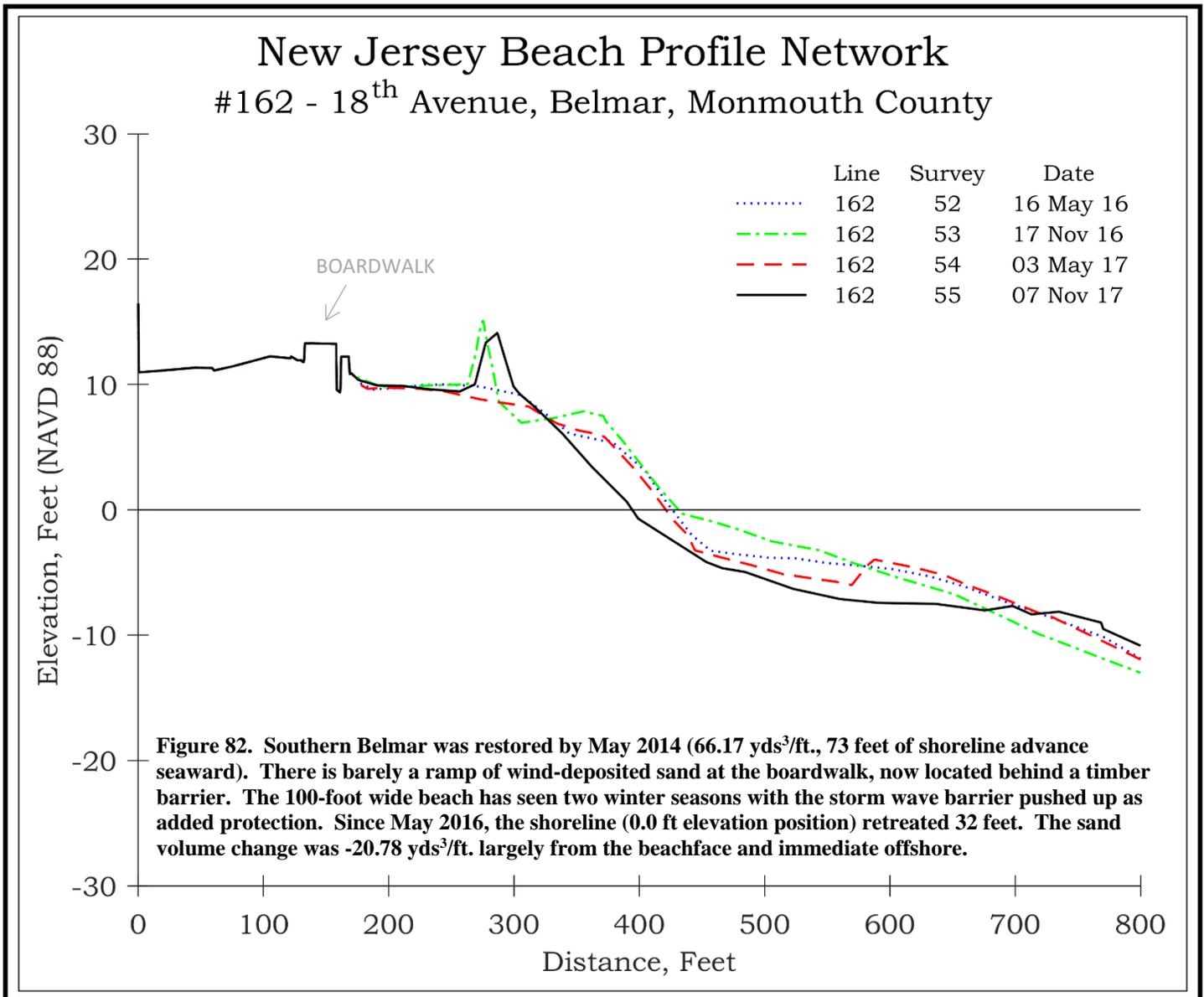


Figure 81. The 14th Avenue site does have a tiny dune feature immediately seaward of the boardwalk. The beach extends 125 feet to a ridge of sand likely a seasonal barrier to storm waves. Not present further north up the beach, these features are not uniformly created in the southern Monmouth County communities. Offshore, a tiny bar on a terrace is present.

NJBPN 162 – 18th Avenue, Belmar



The May 16, 2016 view on the left shows the new boardwalk and facilities built since Sandy. The right PHOTO shows the storm barrier pushed up by November 7, 2017 to help defend the boardwalk from winter events. No dune was created along the Belmar waterfront.



NJBPN 16104 - North Blvd., Belmar

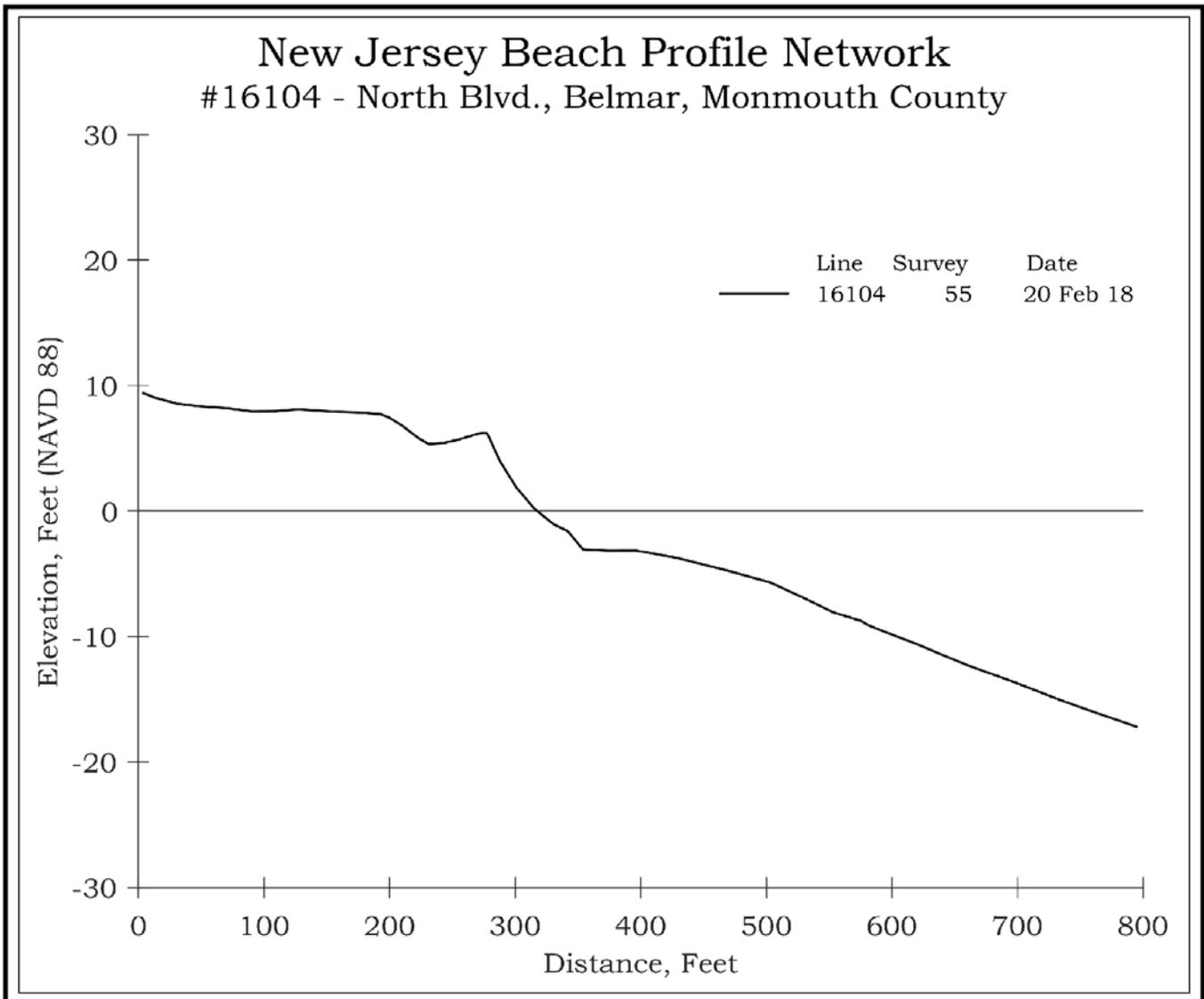


Figure 83. This site is located on the north side of Lake Como, the estuary lake between Belmar and Spring Lake. The beach is 300 feet wide without a dune system present. The berm developed a pronounced peak with a small terrace offshore.

NJBPN 16103 - Remsen Avenue, Spring Lake

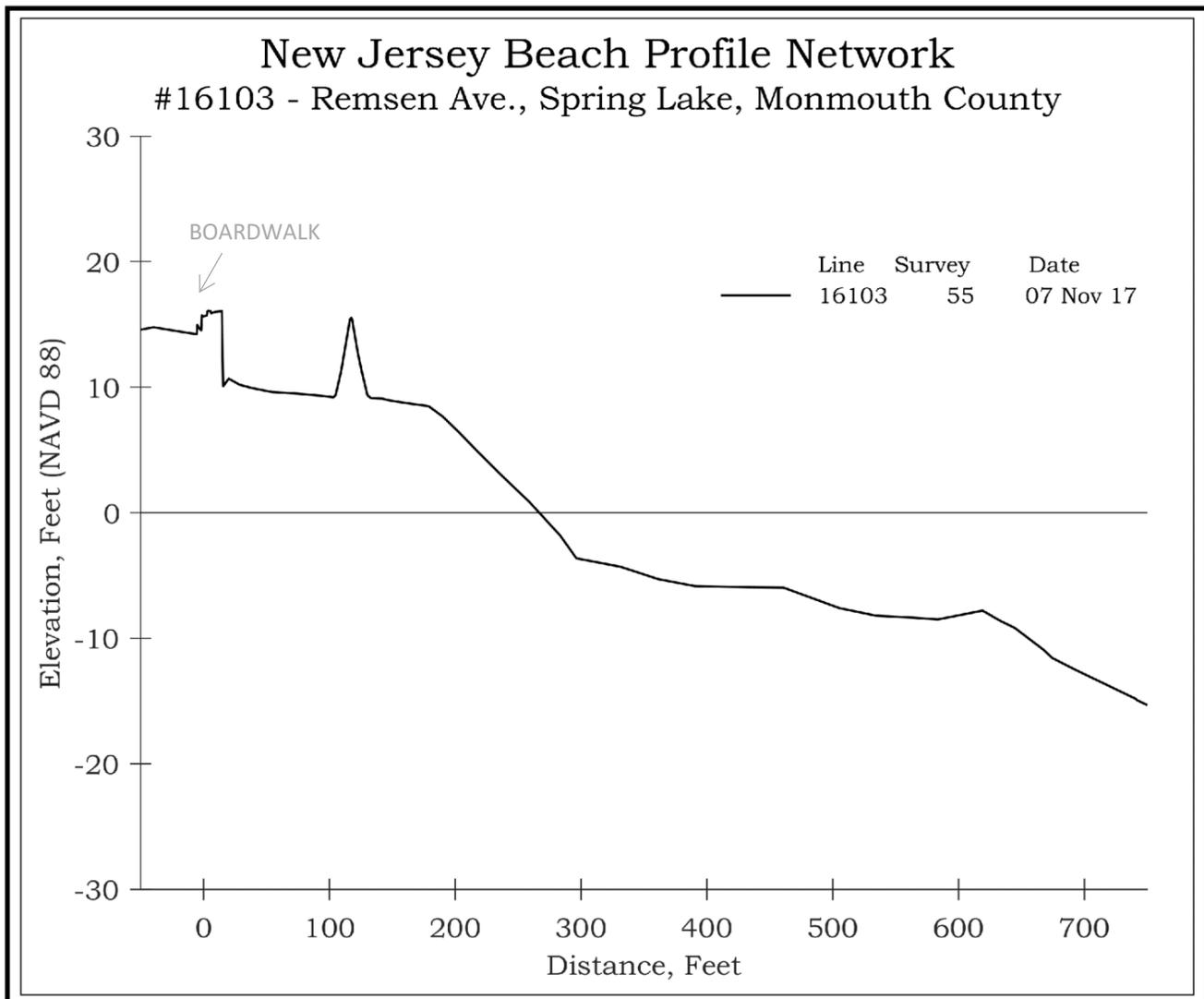


Figure 84. A grass strip separates Ocean Avenue and the boardwalk. The municipality pushed up a storm wave barrier on the outer dry beach on the USACE fill. The beachface slope is quite uniform and leads to a gently sloped terrace with two small bars deposited on it.

NJBPN 16102 - Lorraine Avenue, Spring Lake

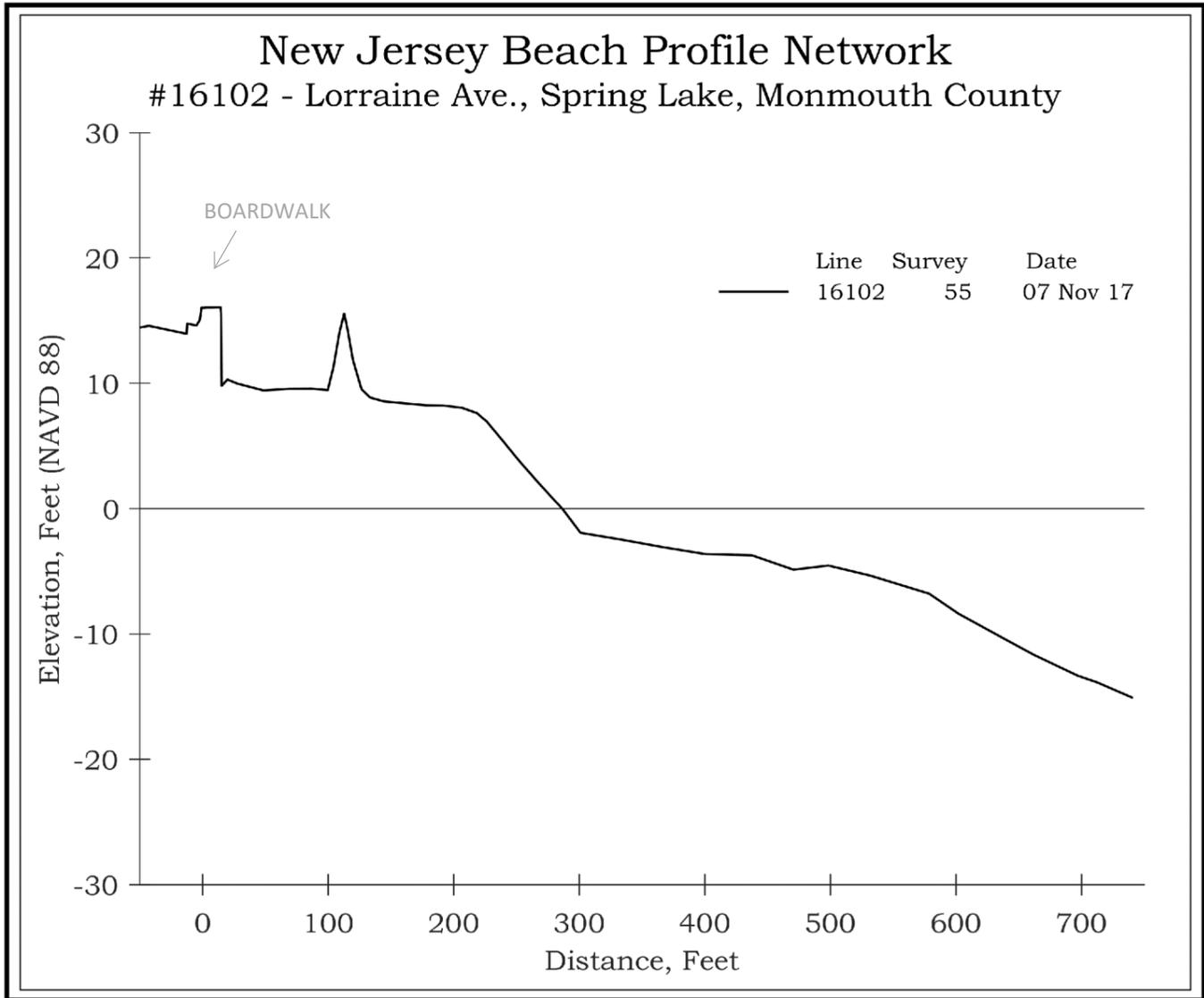


Figure 85. This site follows the same pattern as the site to the north with a boardwalk followed 80 feet further seaward with the storm wave barrier pushed up for the winter. There is a terrace offshore and no bar development.

NJBPN 16101 - Tuttle Avenue, Spring Lake

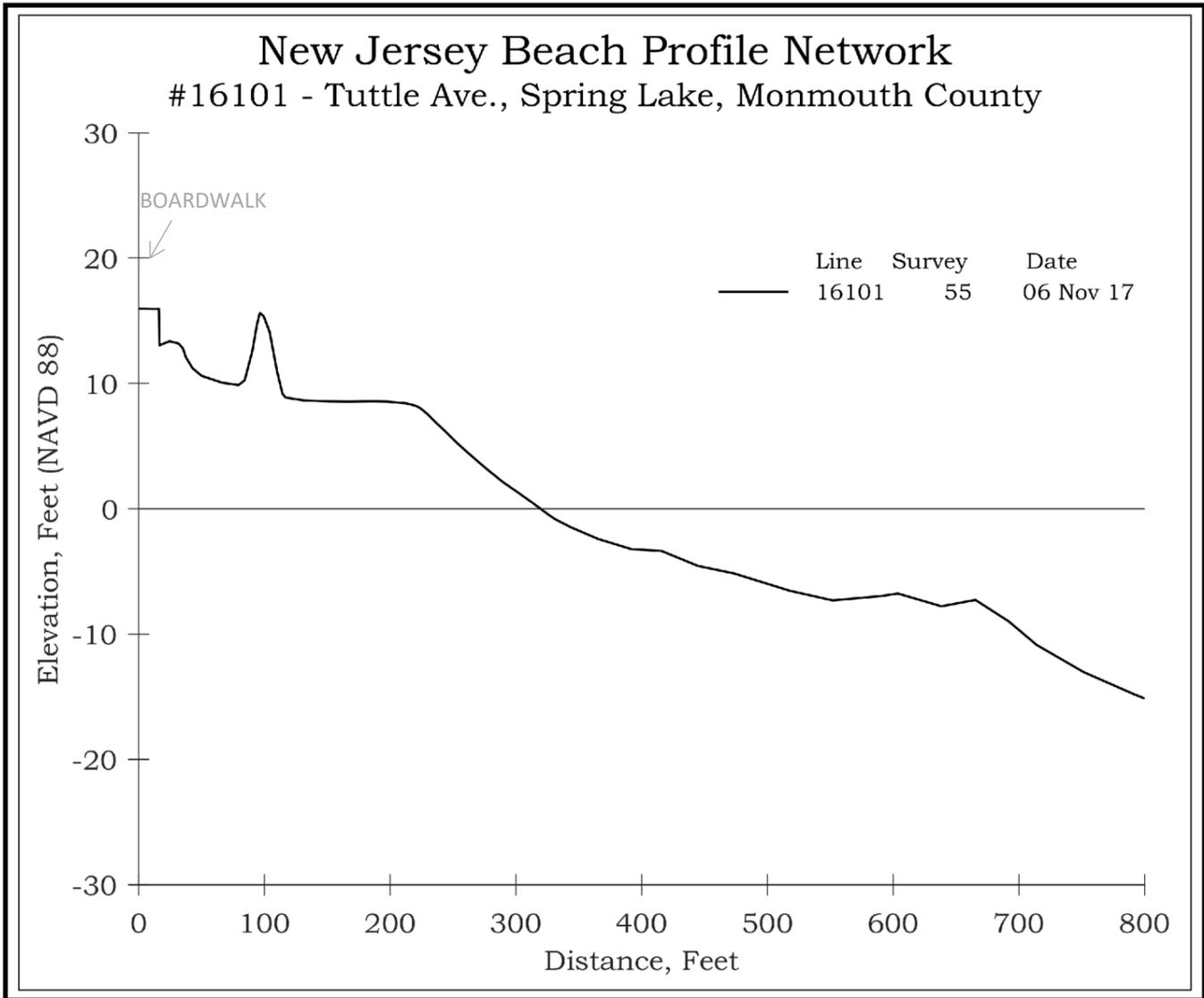
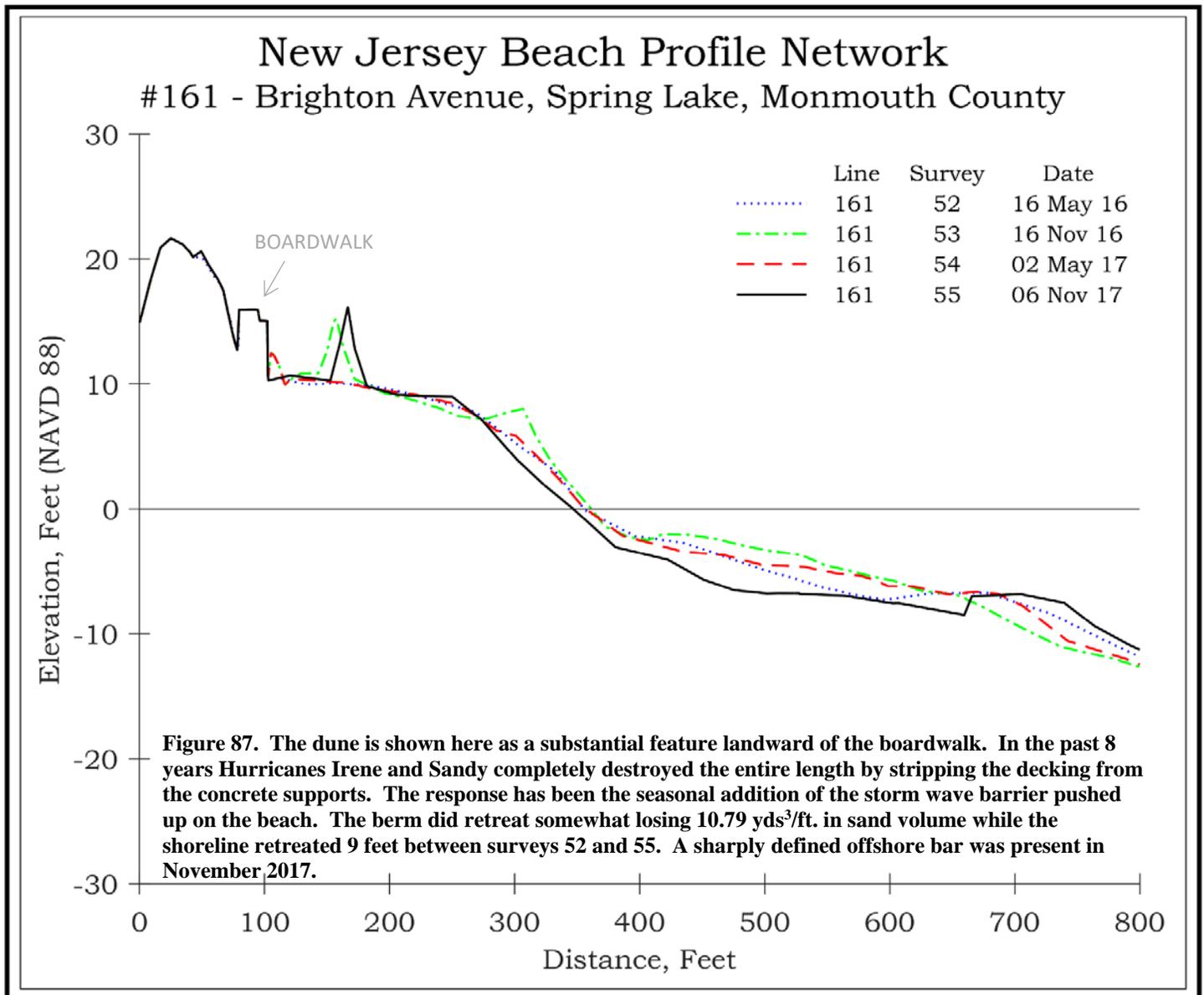


Figure 86. At this site the dune deposit has appeared seaward of the boardwalk installation and the storm wave barrier lies just 60 feet from the boardwalk. There is another 100 feet of beach nearly at elevation 10.0 seaward of the sand ridge. Offshore there is a modest bar well offshore.

NJBPN 161 – Brighton Avenue, Spring Lake



The left photo shows the beach as of May 16, 2016 looking north in Spring Lake. The right photo was taken from the crest of the storm barrier pushed up each winter for added storm protection (Nov. 6, 2017).



NJBPN 16004 - Madison Avenue, Spring Lake

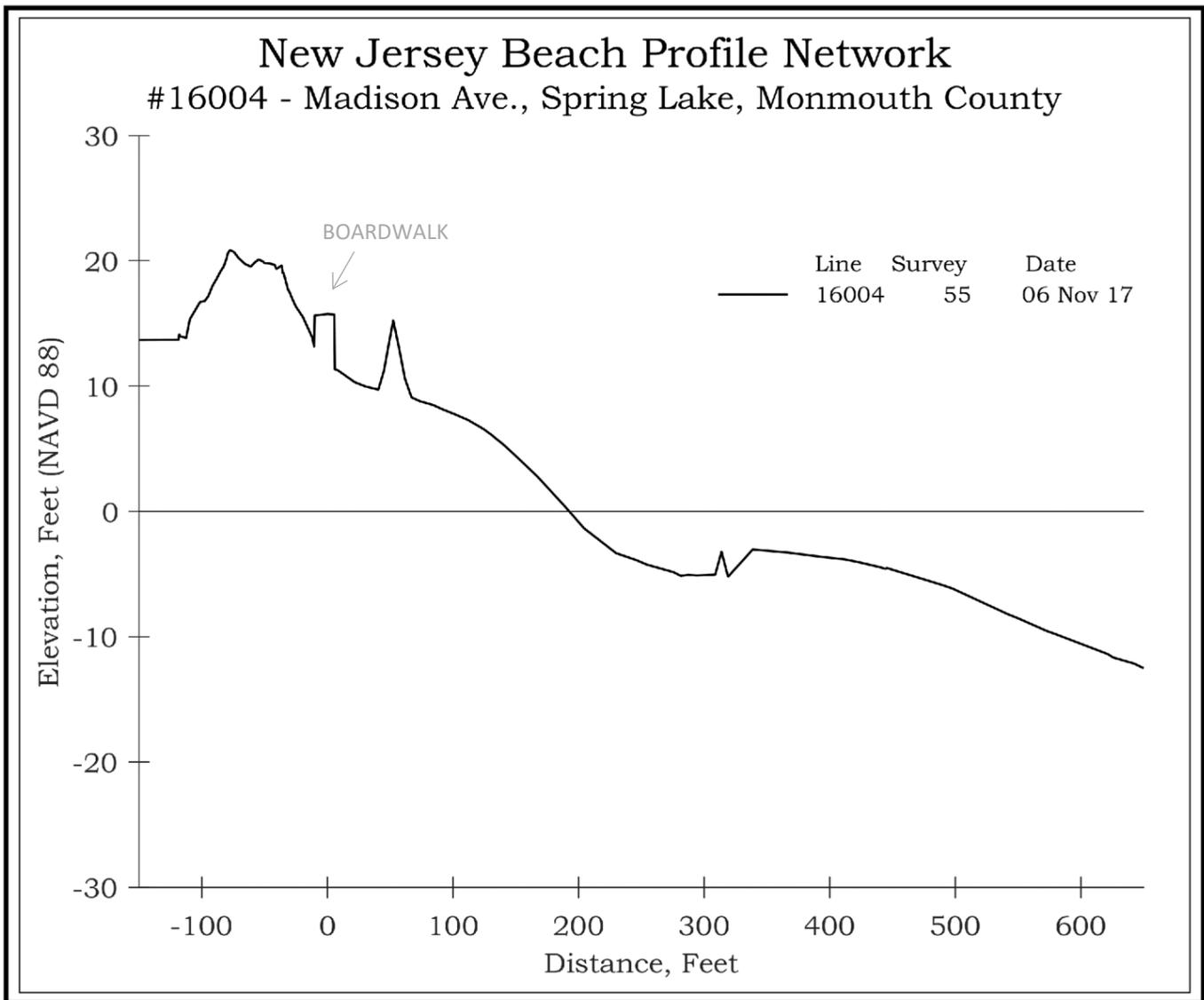


Figure 88. The dune is robust between Ocean Avenue and the boardwalk. The space between the storm barrier and the boardwalk is about 50 feet with a gradual slope into 5 feet of water for the beachface. A substantial bar resides offshore.

NJBPN 16003 - Morris Avenue, Spring Lake

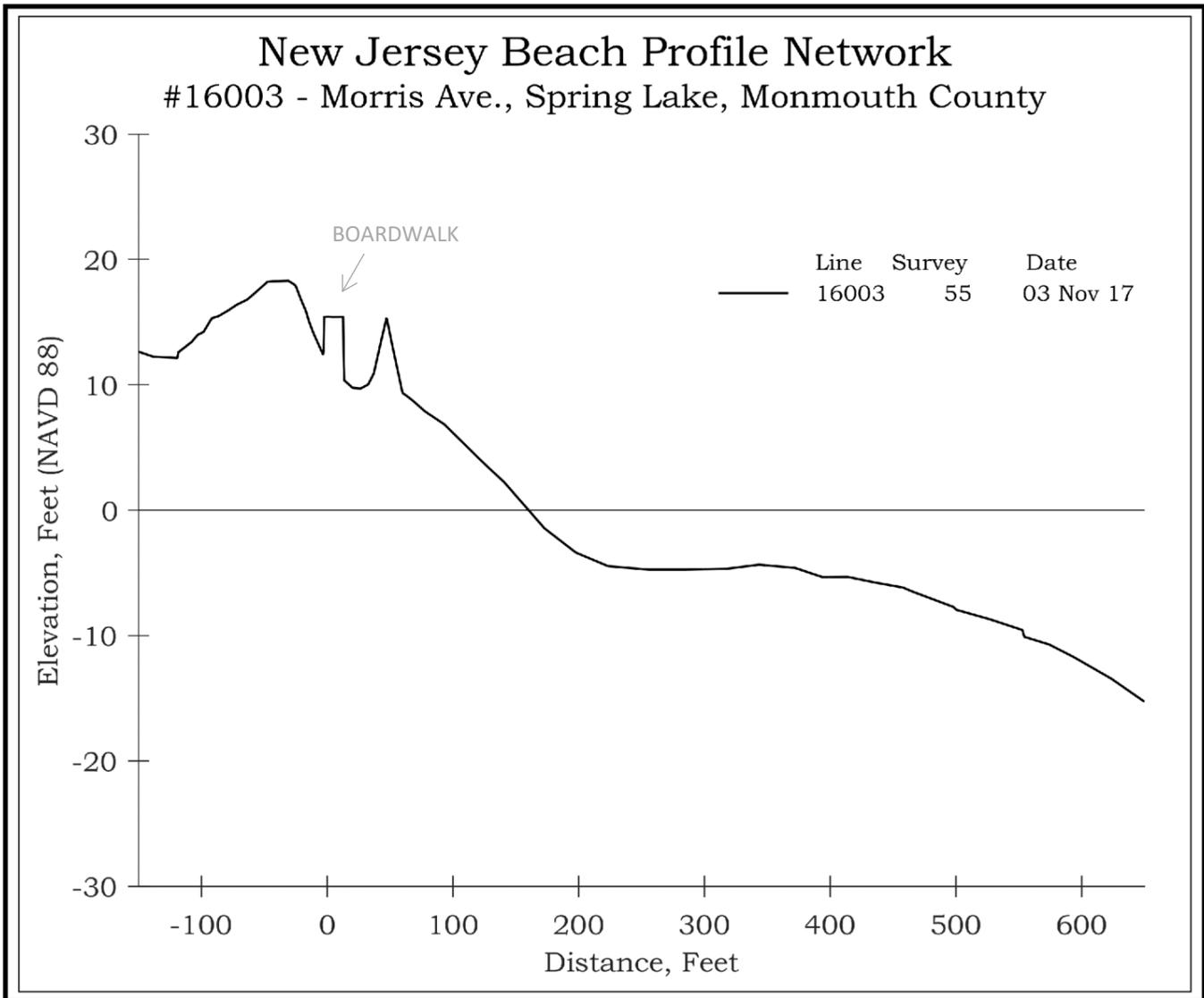


Figure 89. The dune and boardwalk continue south with the storm barrier pushed closer to the boardwalk, at a 30-foot distance. There is a 200-foot wide terrace offshore without a bar present.

NJBPN 16002 - Mercer Avenue, Spring Lake

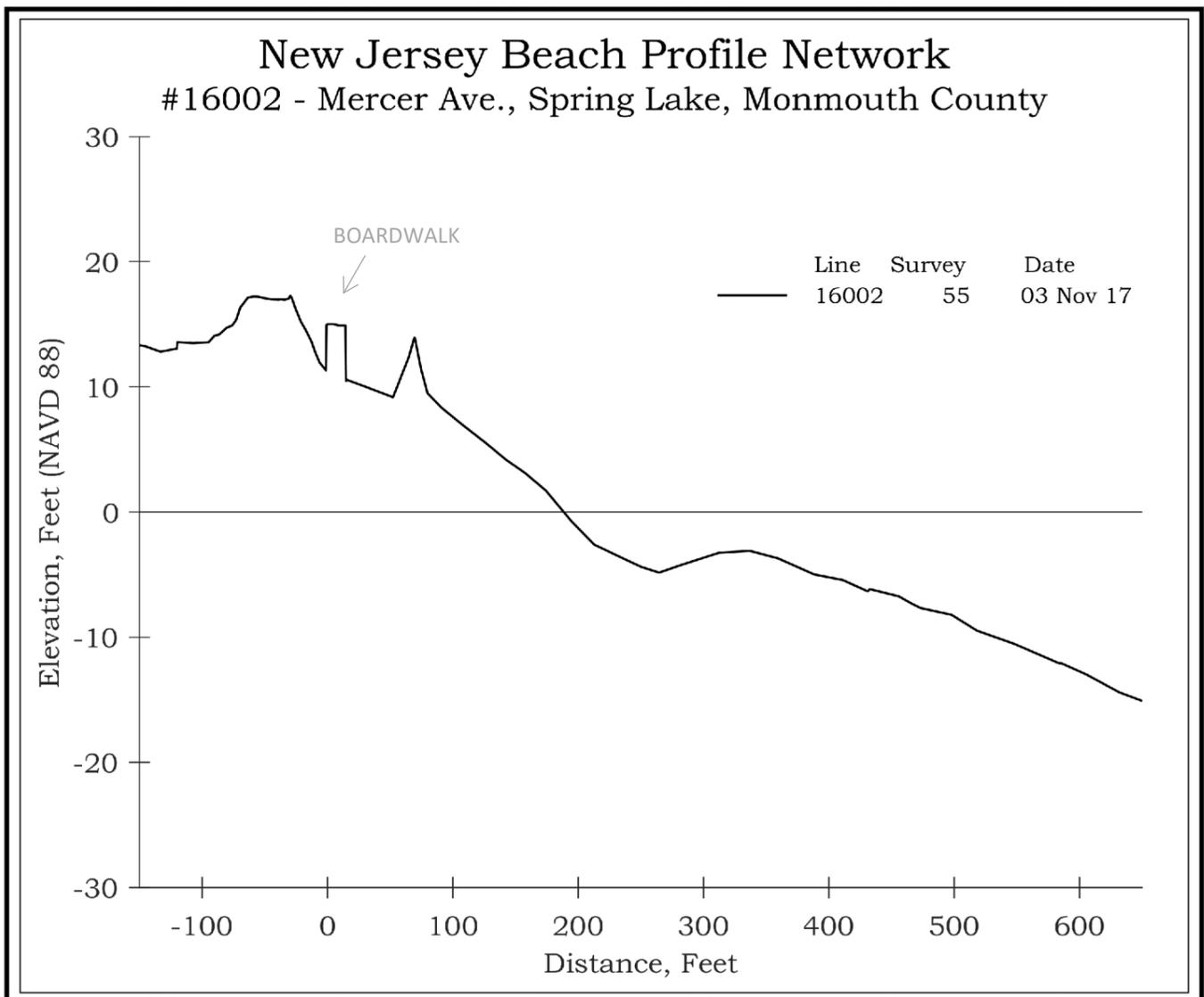
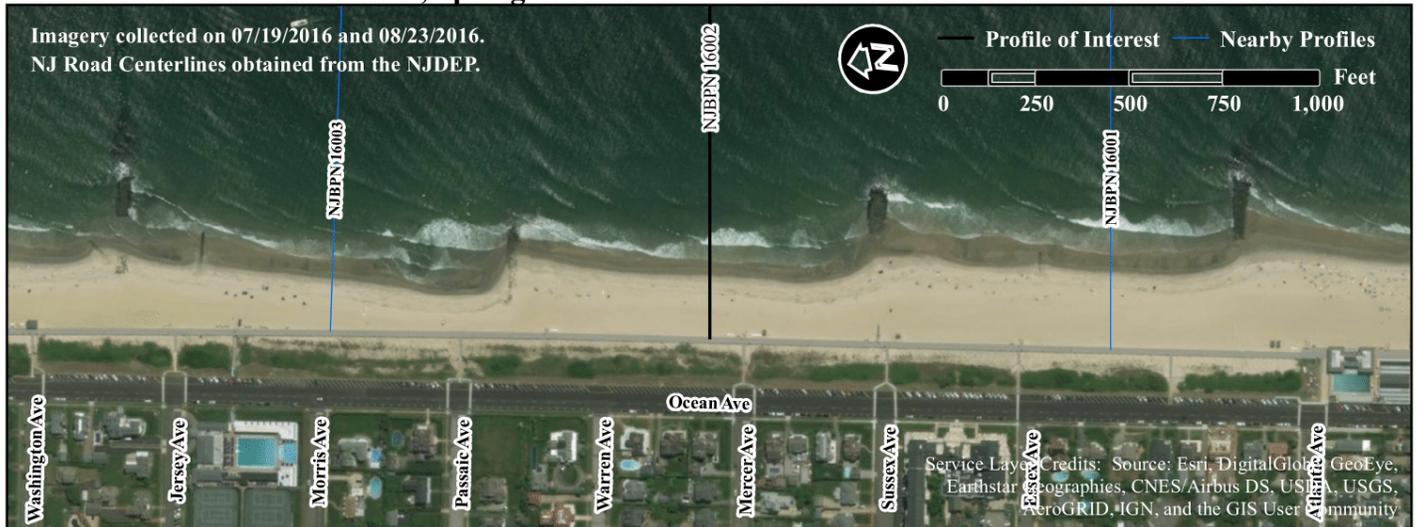


Figure 90. The dune is slightly lower and narrower at Mercer Avenue with a distinct separation from the boardwalk. The storm barrier is about 50 feet further seaward. However, the beachface slope ending in 4 feet of water begins at the seaward toe of the barrier. Offshore a substantial bar system exists.

NJBPN 16001 - Essex Avenue, Spring Lake

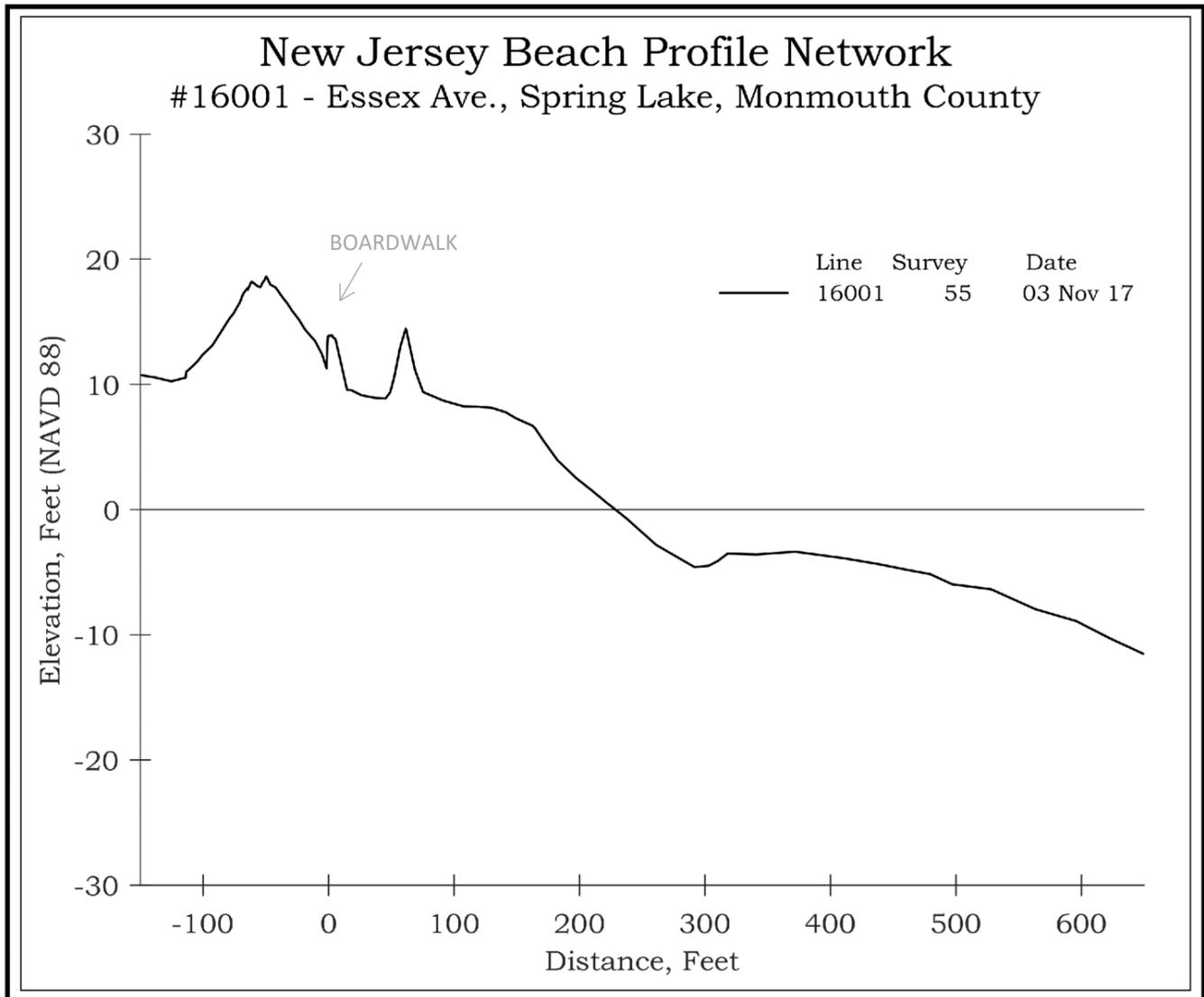
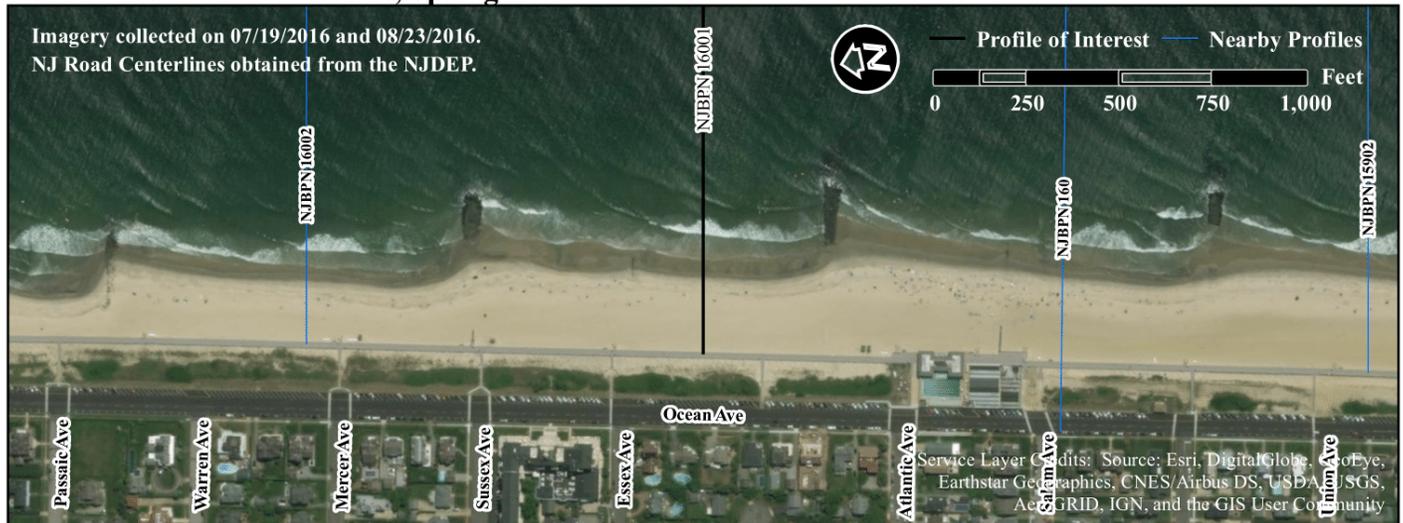
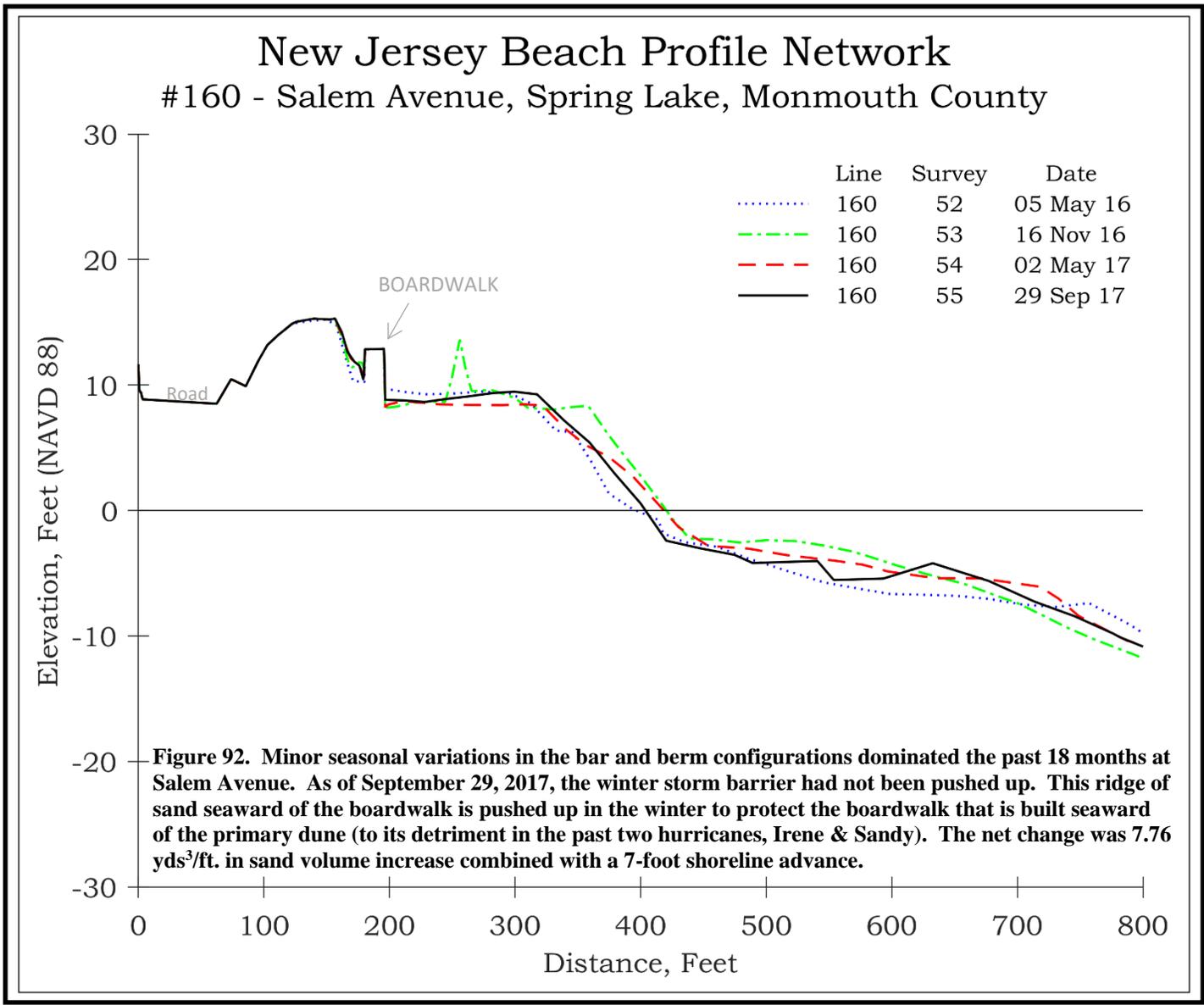


Figure 91. The dune/boardwalk combination are in close proximity with the storm barrier about 40 feet seaward of the boardwalk. The beach width is about 100 feet wide from the seaward toe of the storm barrier. The beachface ends at the landward edge of an offshore bar present on the offshore low-gradient terrace.

NJBPN 160 – Salem Avenue, Spring Lake



The Salem Avenue beach site lies just south of one of the municipal beach facilities. The left photo was taken May 5, 2016 after the 2015 wave barrier was graded flat. The right side view was taken Sept. 29, 2017, perhaps prior to recreating the same feature for the 2016-2017 season.



NJBPN 15902 - Union Avenue, Spring Lake

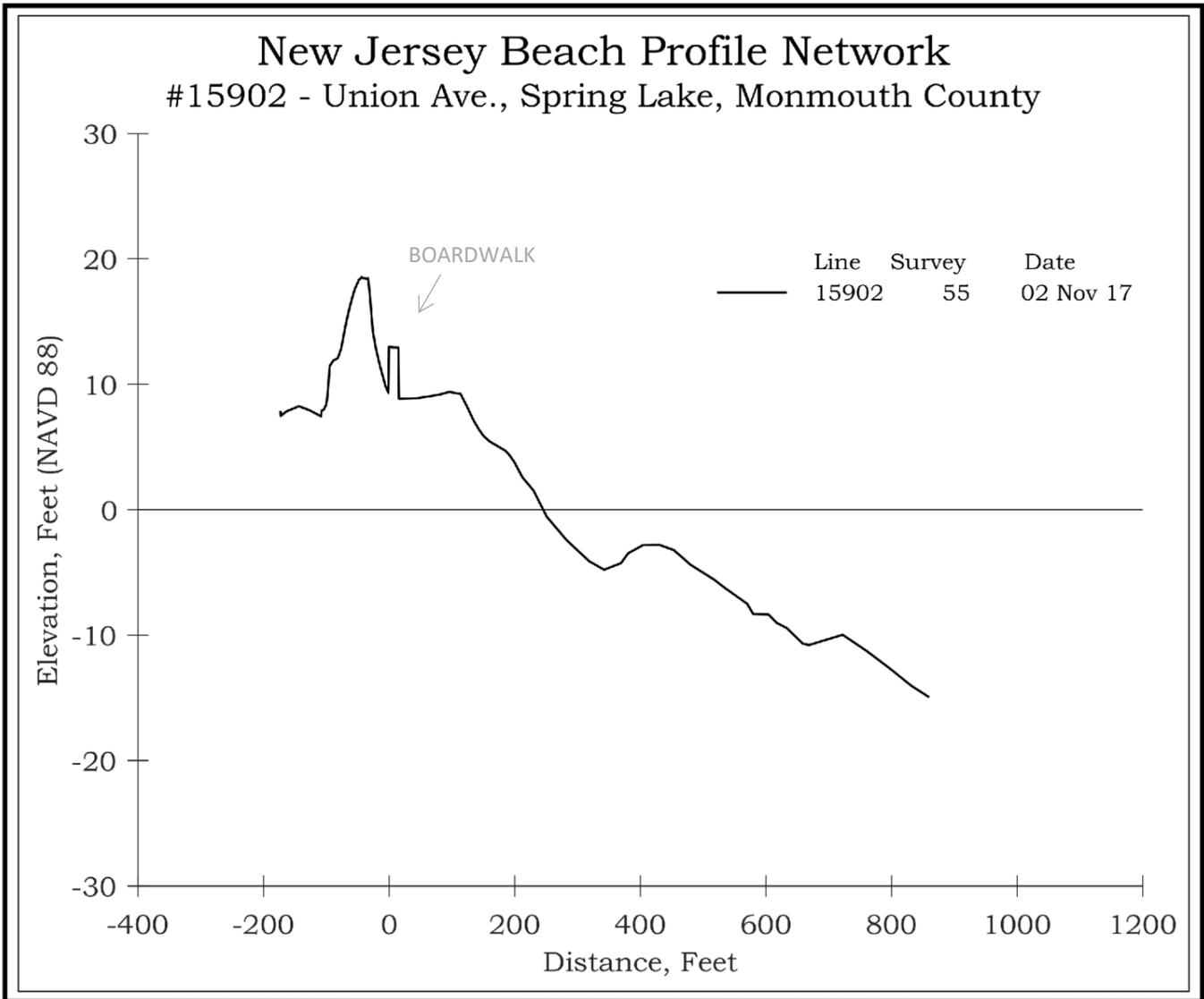
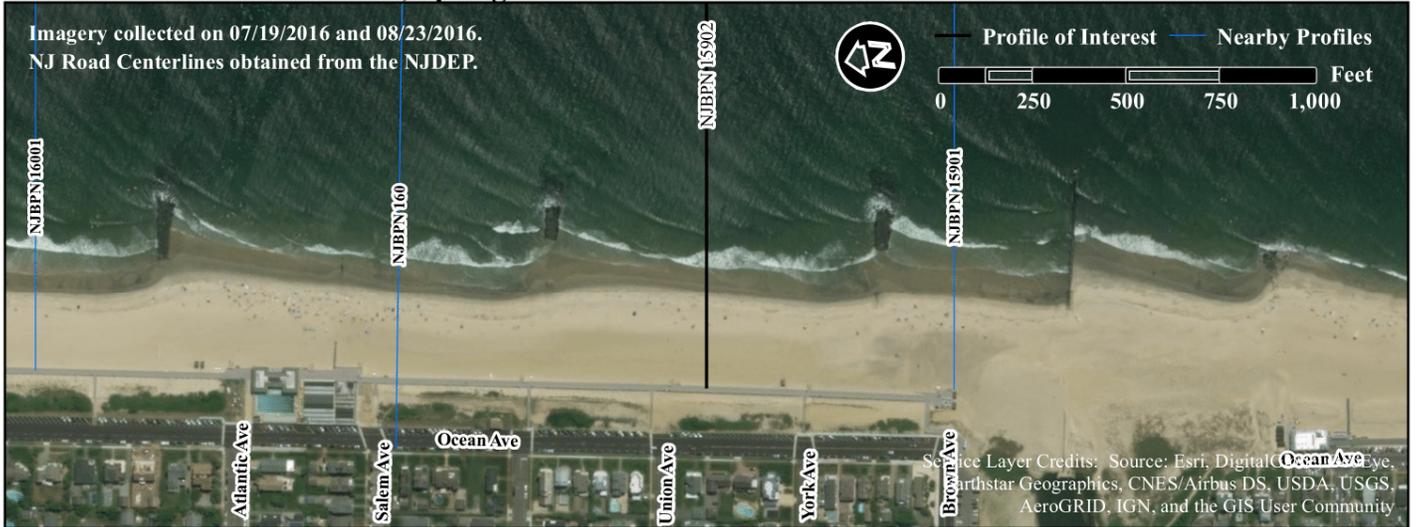


Figure 93. This site has a narrow dune with the boardwalk seaward of it without the storm barrier sand ridge (as of Nov. 2nd). There is a 100-foot wide, 10.0-foot elevation beach seaward of the boardwalk with a significant offshore bar system present.

NJBPN 15901 - Brown Avenue, Spring Lake

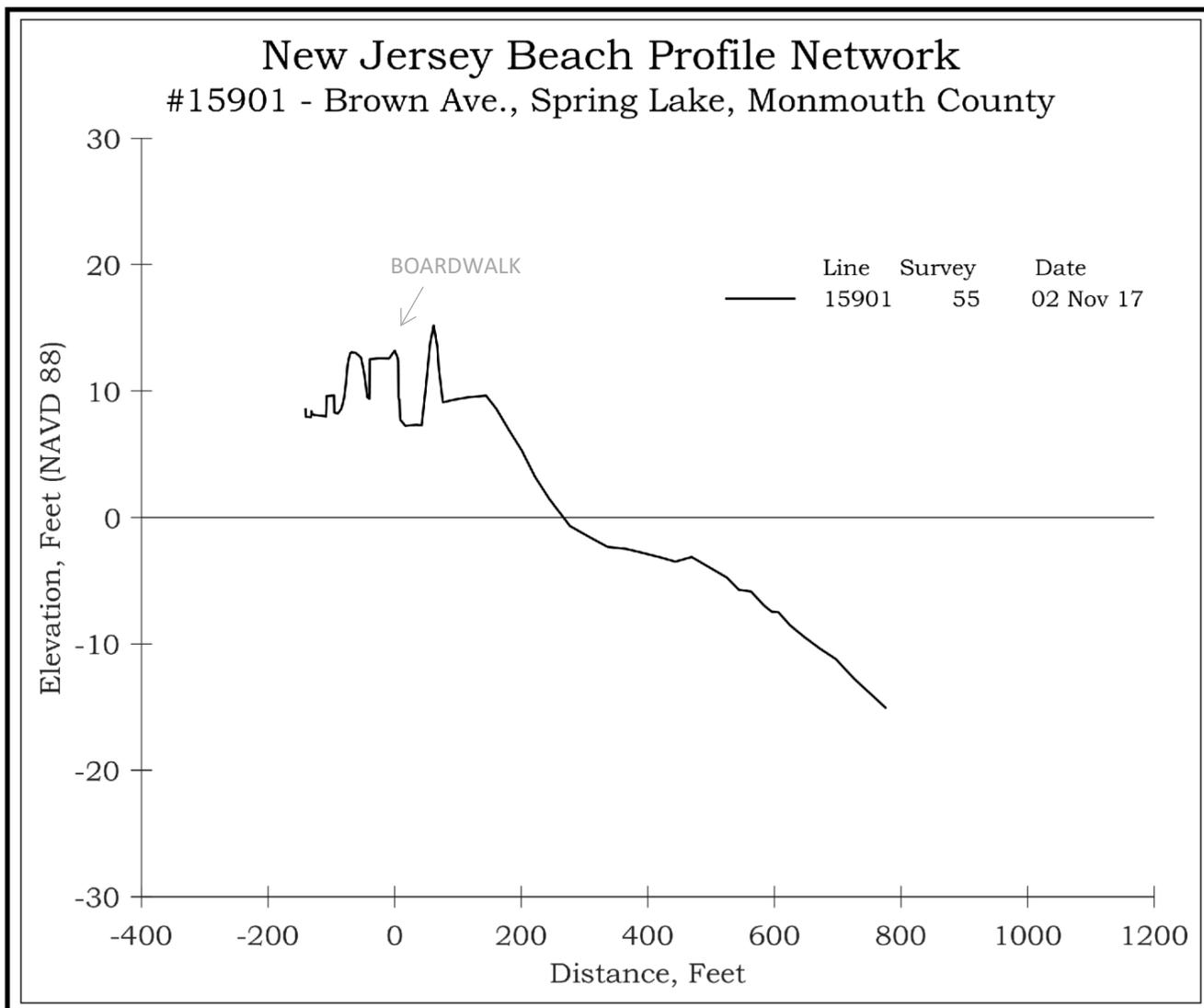
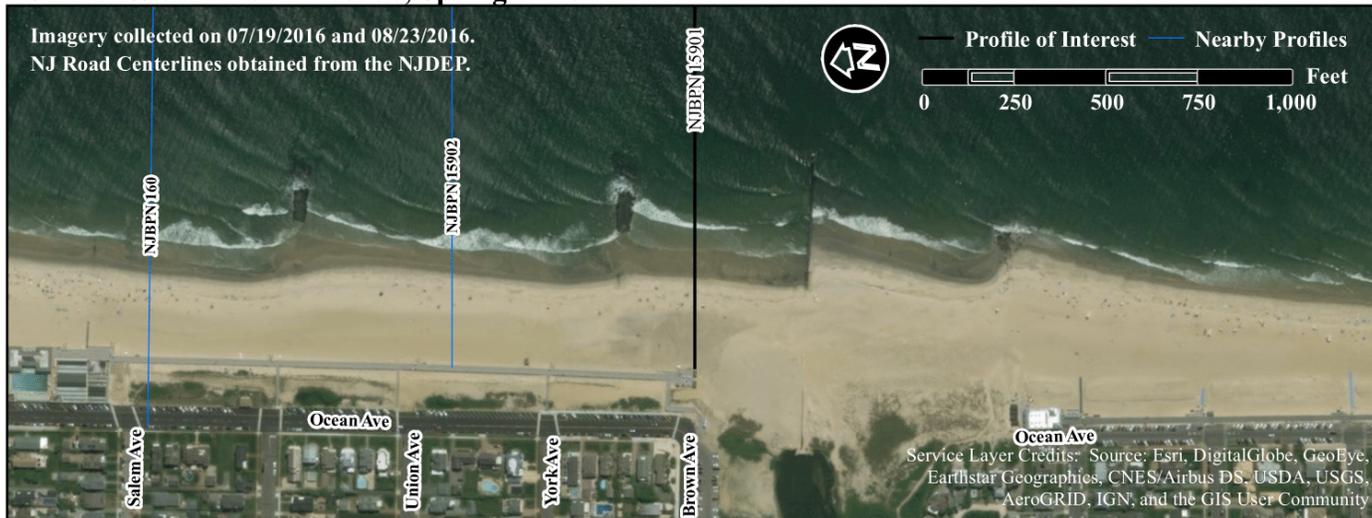
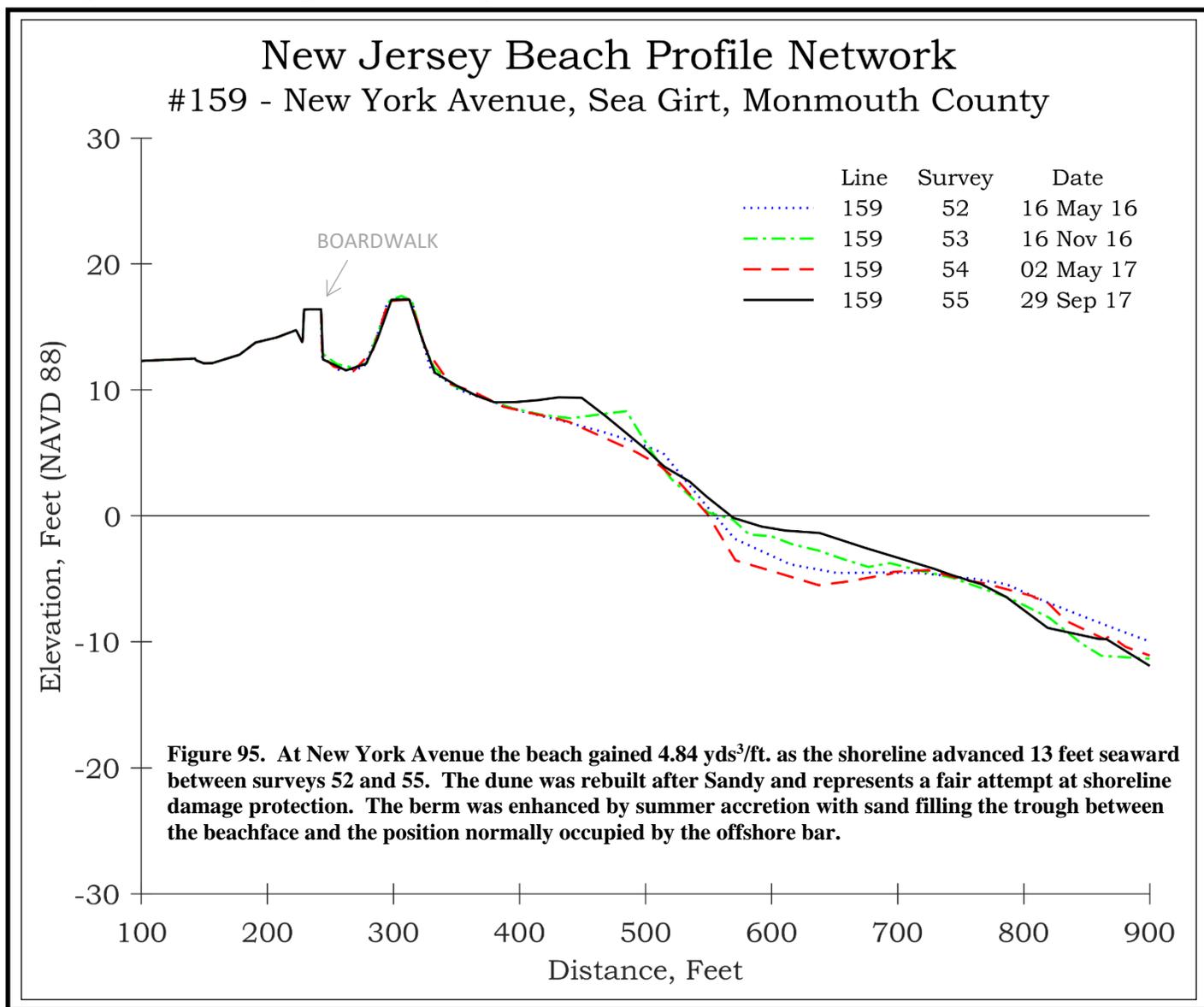


Figure 94. At the south end of Spring Lake, the dune is not significantly higher than the surface of the boardwalk. The storm barrier is present as of Nov 2nd at this location with a 70-foot wide beach seaward of it. There is a small offshore bar present well seaward. The recently rebuilt Wreck Pond flume for fresh water to reach the ocean lies just to the south.

NJBPN 159 – New York Avenue, Sea Girt



The northern site in Sea Girt had the dune restored after Sandy. The May 16, 2016 northerly view was taken from the dune crest (left photo). The Sept. 29, 2017 view (right photo) shows grass growth, but the pedestrian gaps at the beach elevation will direct major storm waves through with dire consequences for the boardwalk.



NJBPN 15801 - Crescent Park, Sea Girt

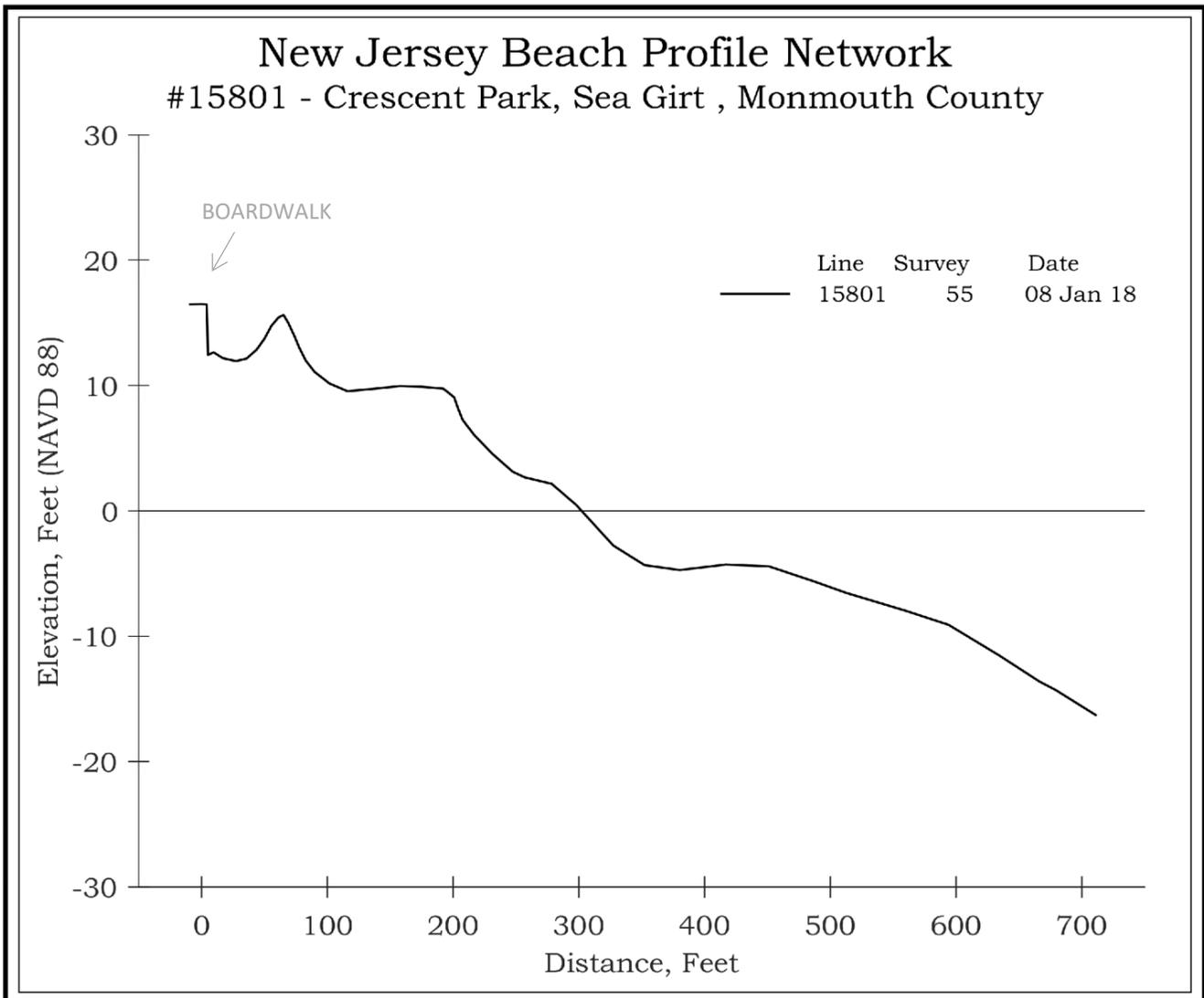
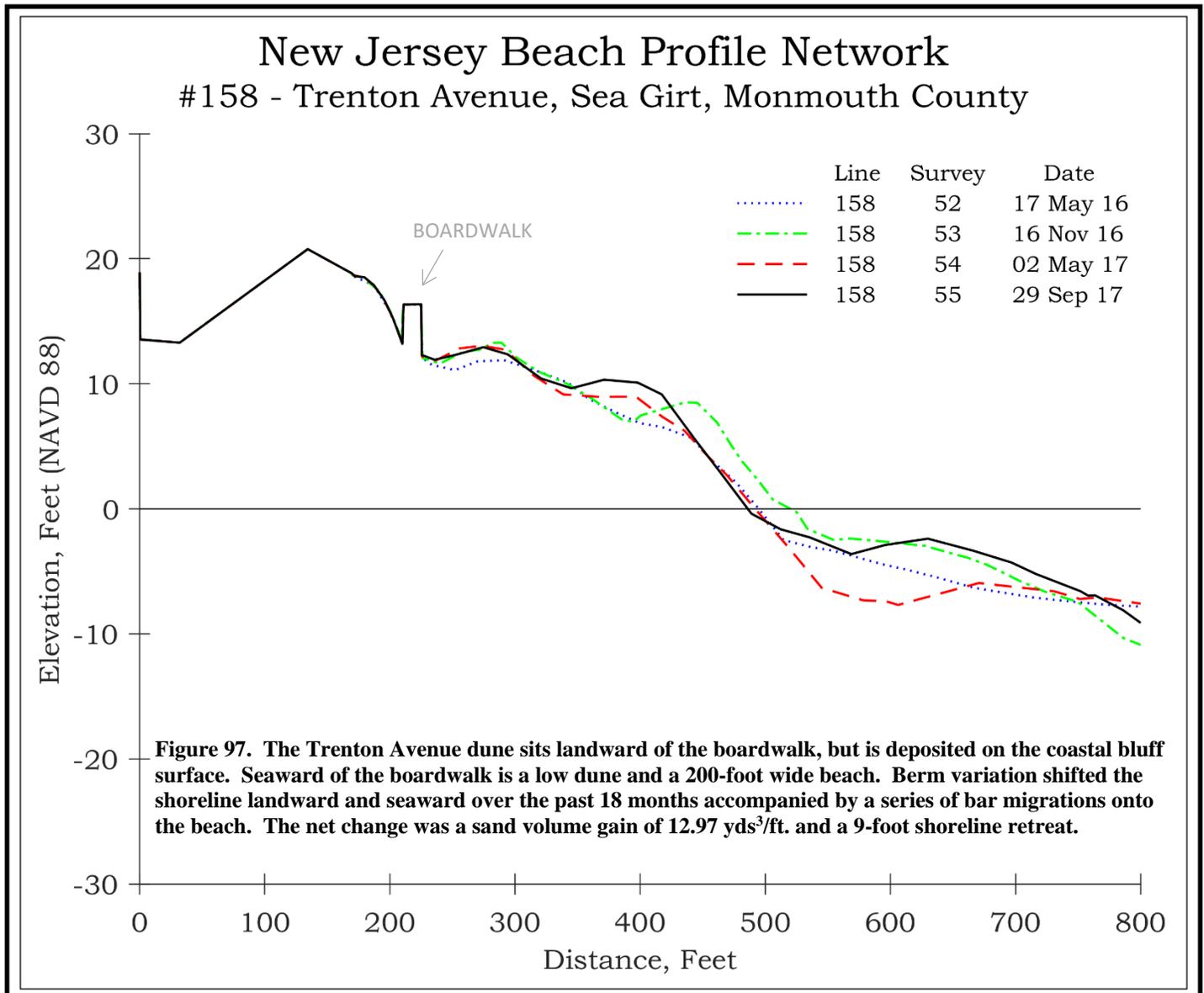


Figure 96. The landward limit of this site corresponds to the last segment of the Monmouth County coastal bluff exposed at the shoreline. Manasquan is built on modern coastal deposits and south of Point Pleasant Beach, the bluff is buried under modern dunes due to its lower elevation. The boardwalk is the starting point for the survey. The dune and beach occupy the first 200 feet of the cross section with a beachface that ends in 4 feet of water. There is a minor bar offshore.

NJBPN 158 – Trenton Avenue, Sea Girt



The May 17, 2016 view on the left shows the mid-beach view to the north seaward both the dune and the boardwalk. The Sept. 28, 2017 view (right photo) is from the seaward toe of the dune looking north.



NJBPN 15703 - Seaside Place, Sea Girt

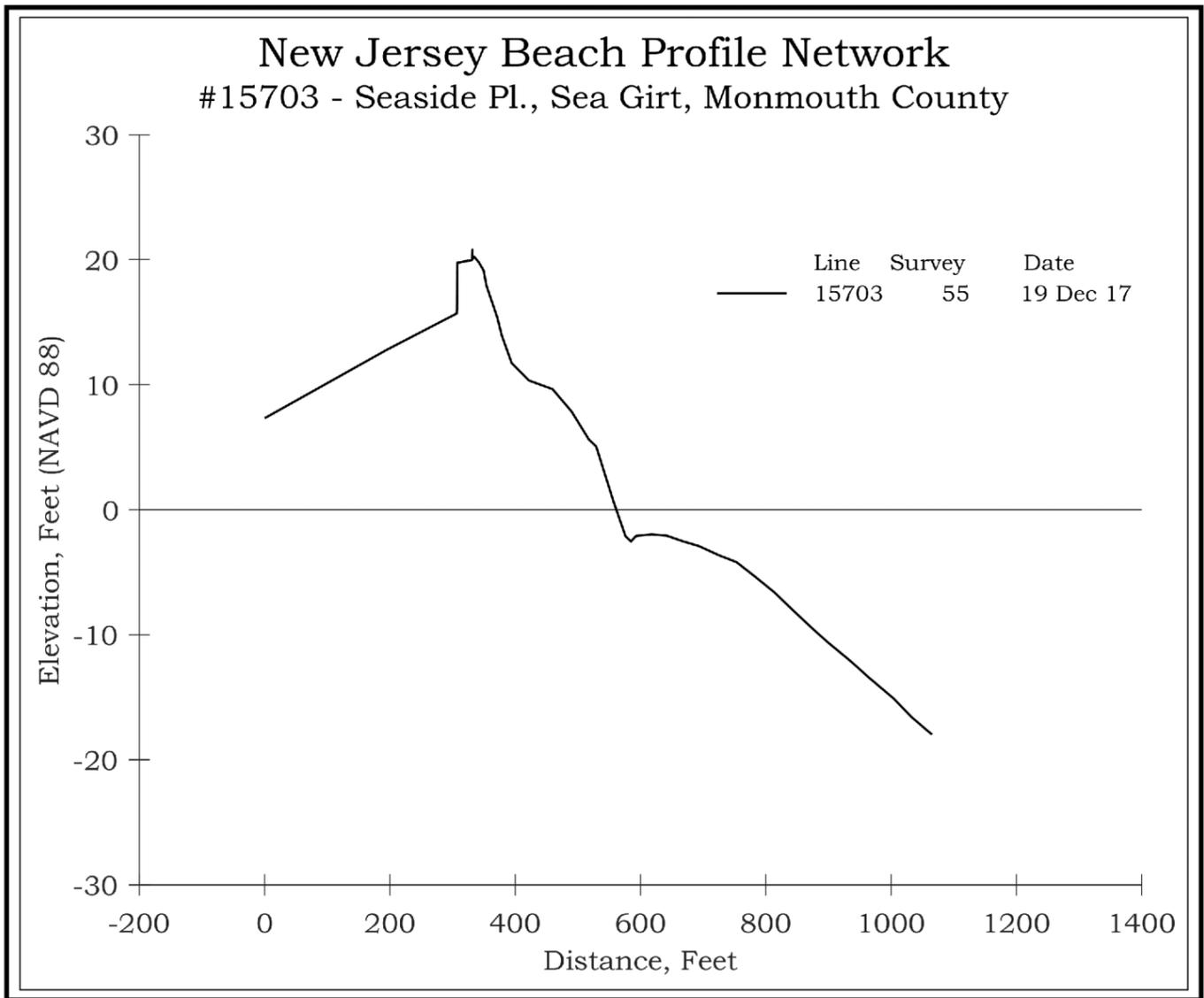
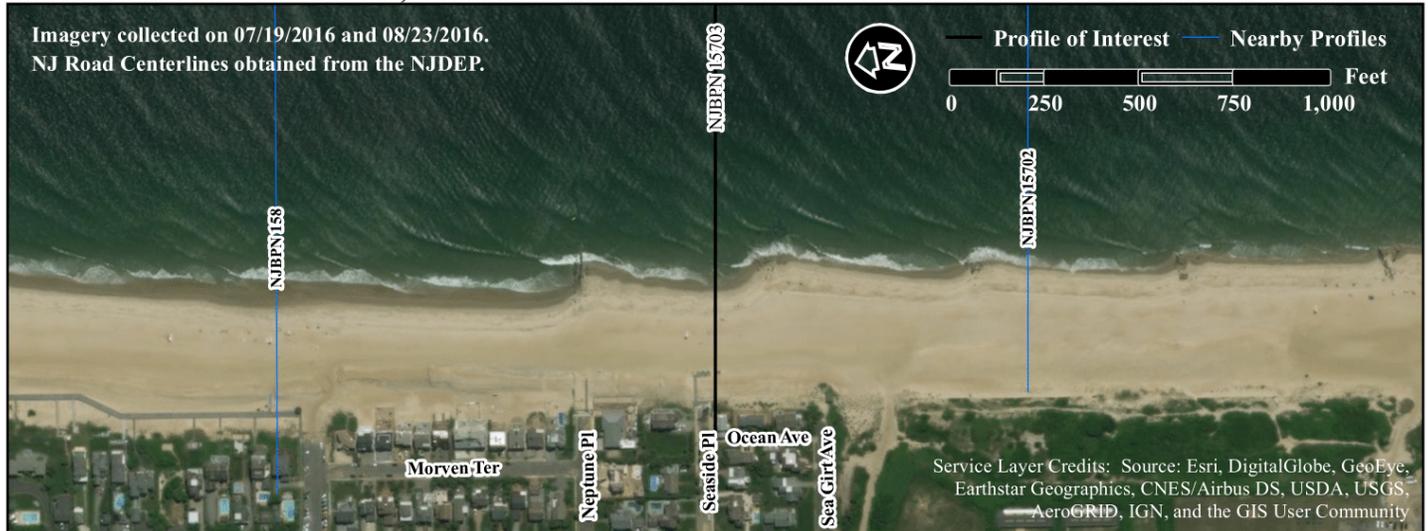


Figure 98. Located at the southern limit of Sea Girt, this site has a dune with a narrow beach which drops steeply into the ocean. There is a modest offshore bar positioned very close to the base of the beachface.

NJBPN 15702 - NGTC - North, Sea Girt

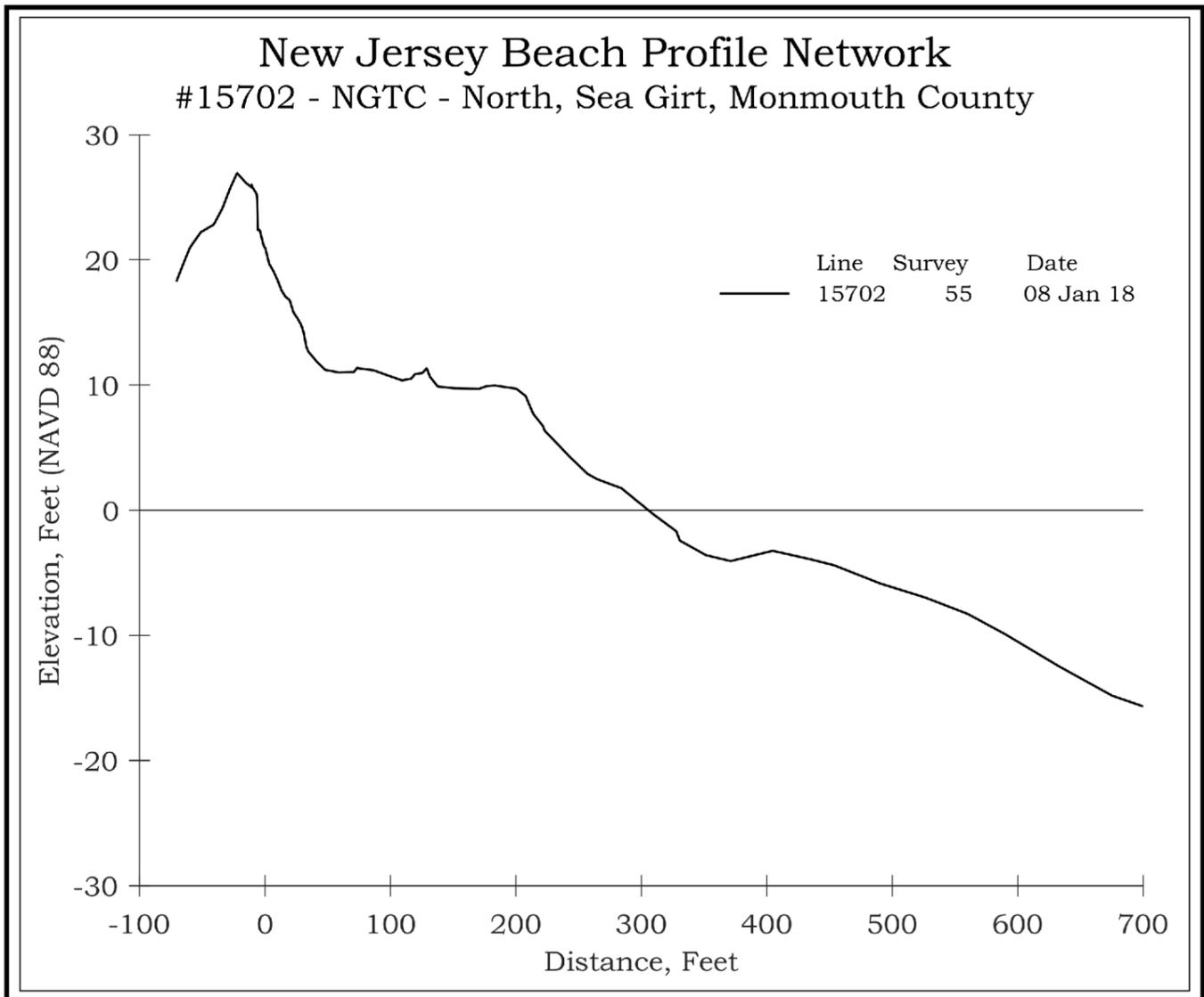


Figure 99. The extraordinary dune elevation is because the National Guard shooting range ends at its landward side, so the added height is to stop bullets. This beach is off limits to the public, about 150 feet wide with an offshore bar.

NJBPN 15701 - NGTC - South, Sea Girt

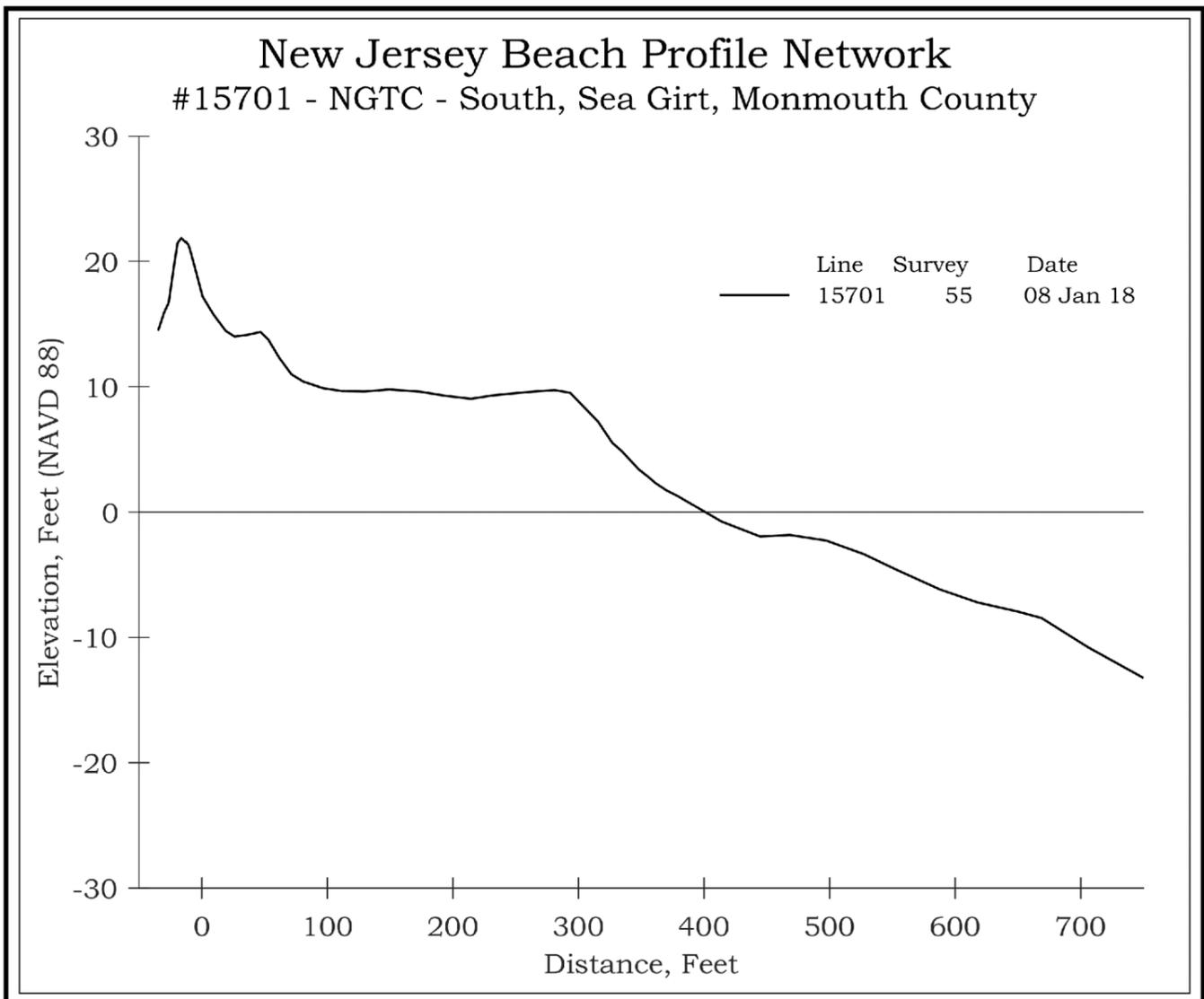
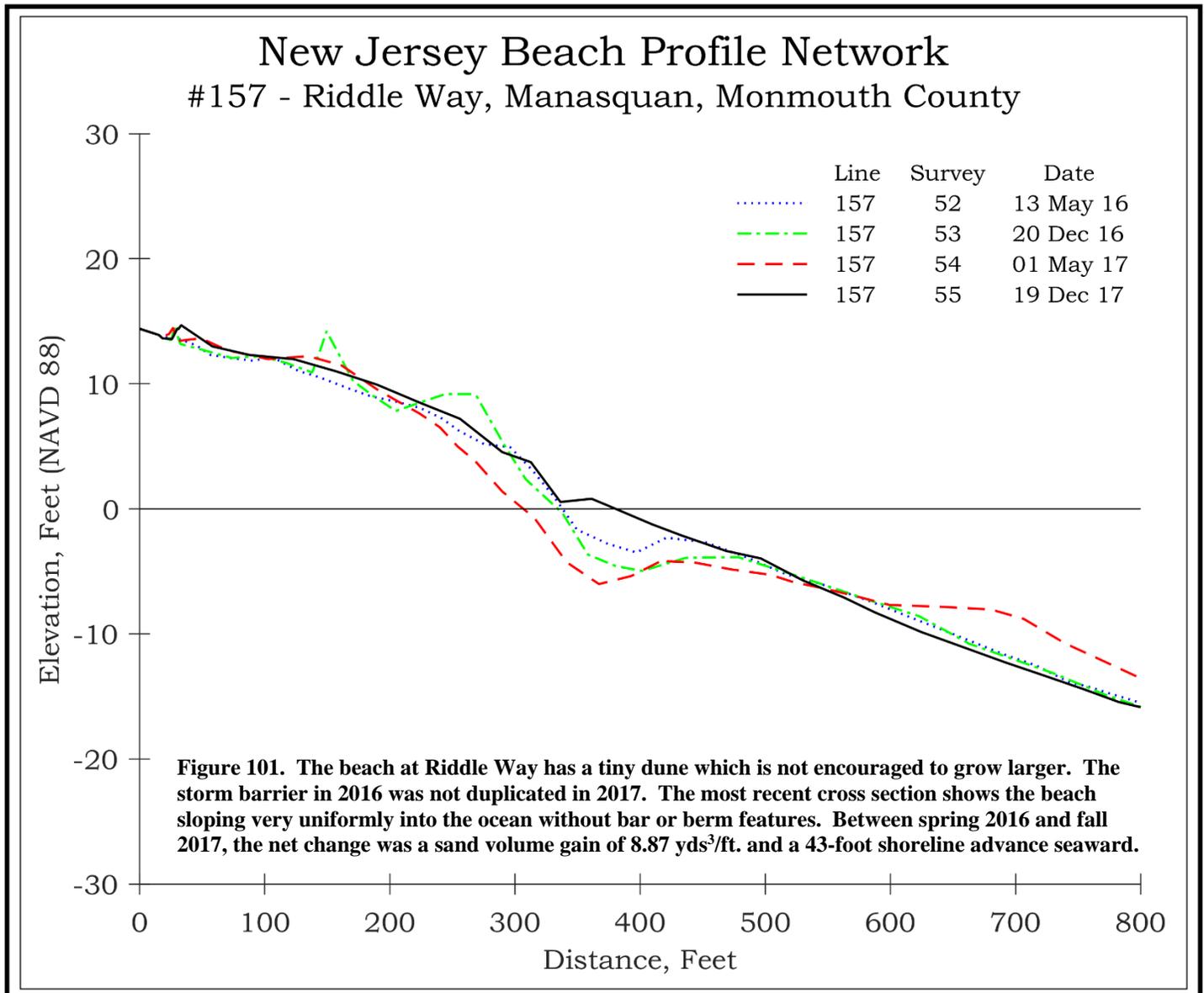


Figure 100. This site is located at the south end of the National Guard training facility beachfront. The dune is lower because it is outside the rifle range aiming area. The beach is 300 feet wide with minimal bar development offshore.

NJBPN 157 – Riddle Way, Manasquan



The May 13, 2016 view to the north in Manasquan (left photo) shows a uniform beach slope into the water, while the Dec. 19, 2017 view (right photo) shows a sizable bar moving onto the beach.



NJBPN 25602 - Main Street, Manasquan

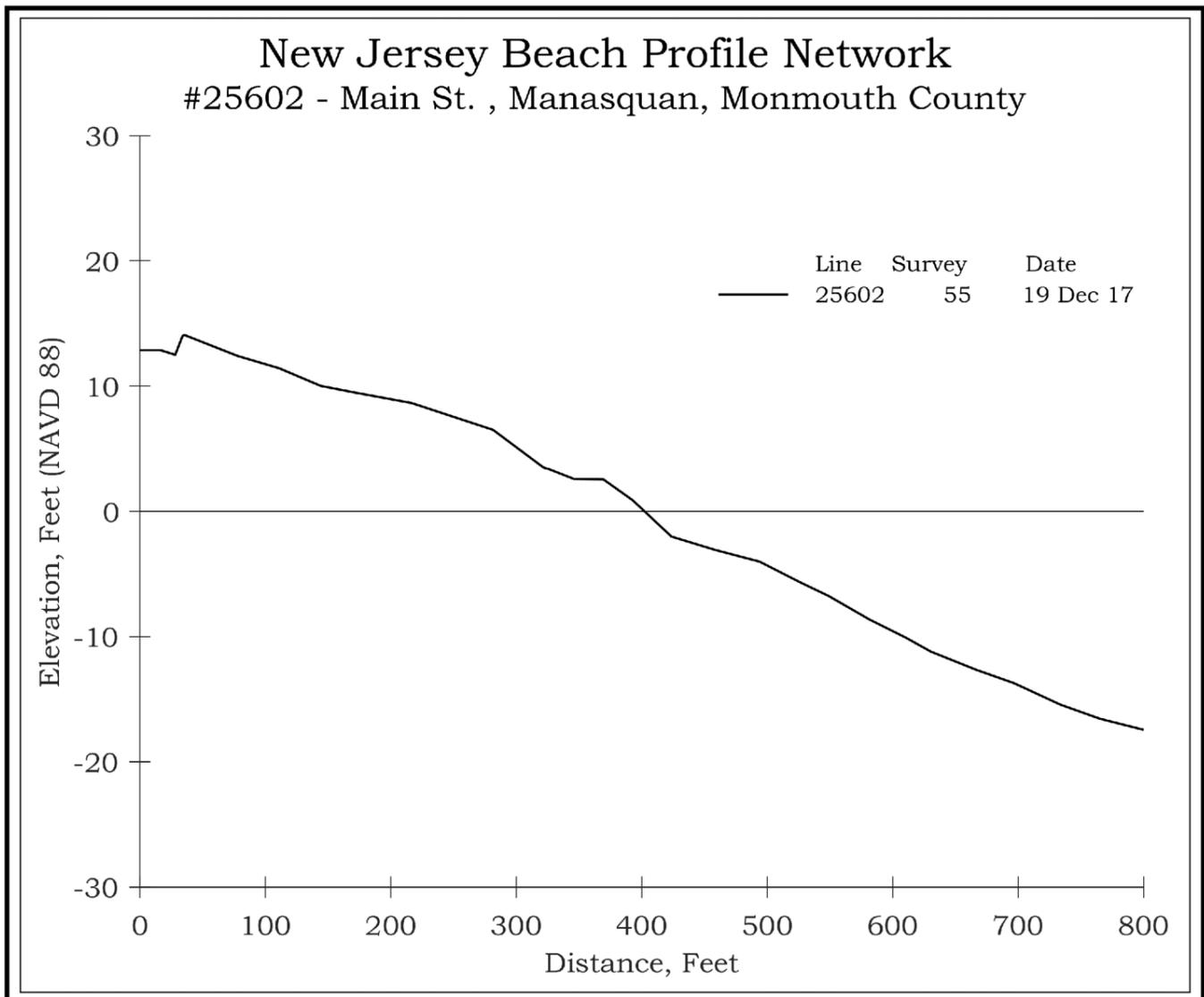
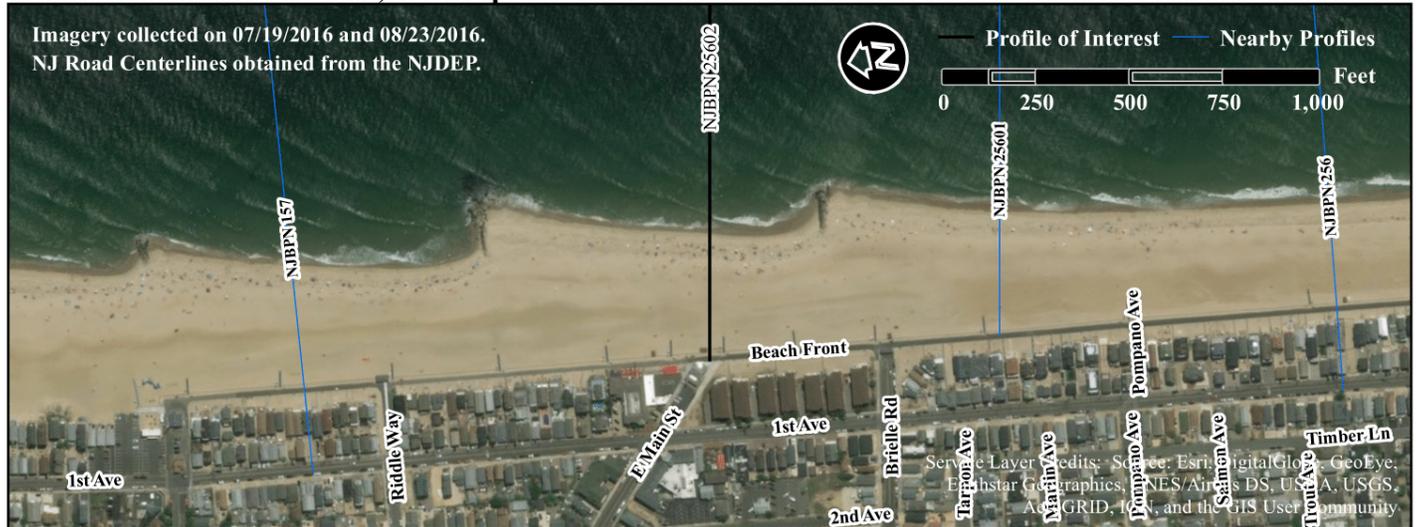


Figure 102. Nearly the identical beach configuration was surveyed at this location as was seen at Riddle Way. The tiny dune lies immediately seaward of an asphalt promenade in front of the private homes.

NJBPN 25601 - Brielle Road, Manasquan

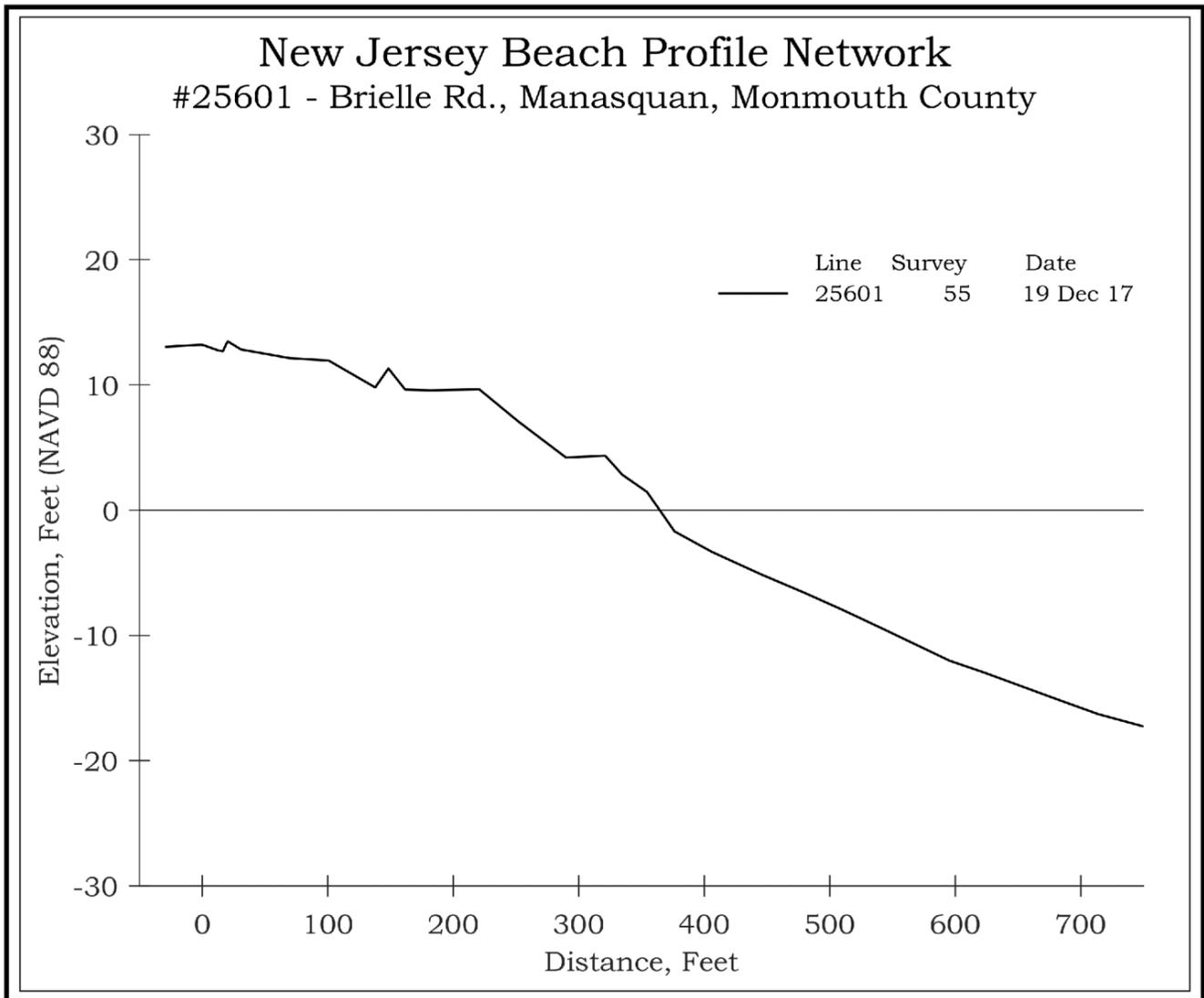
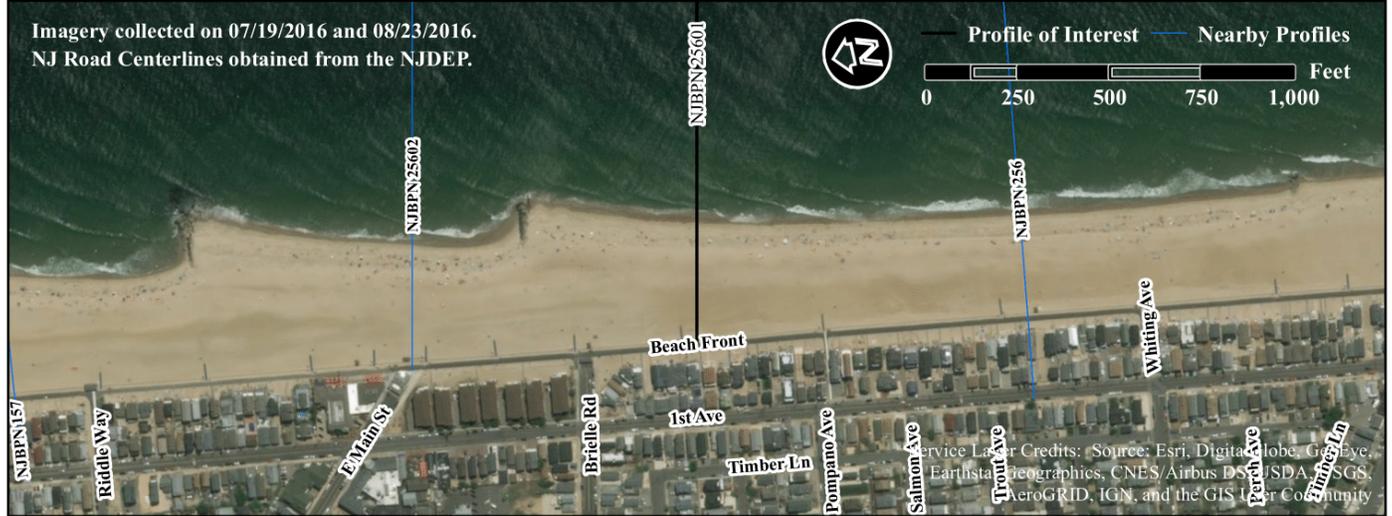
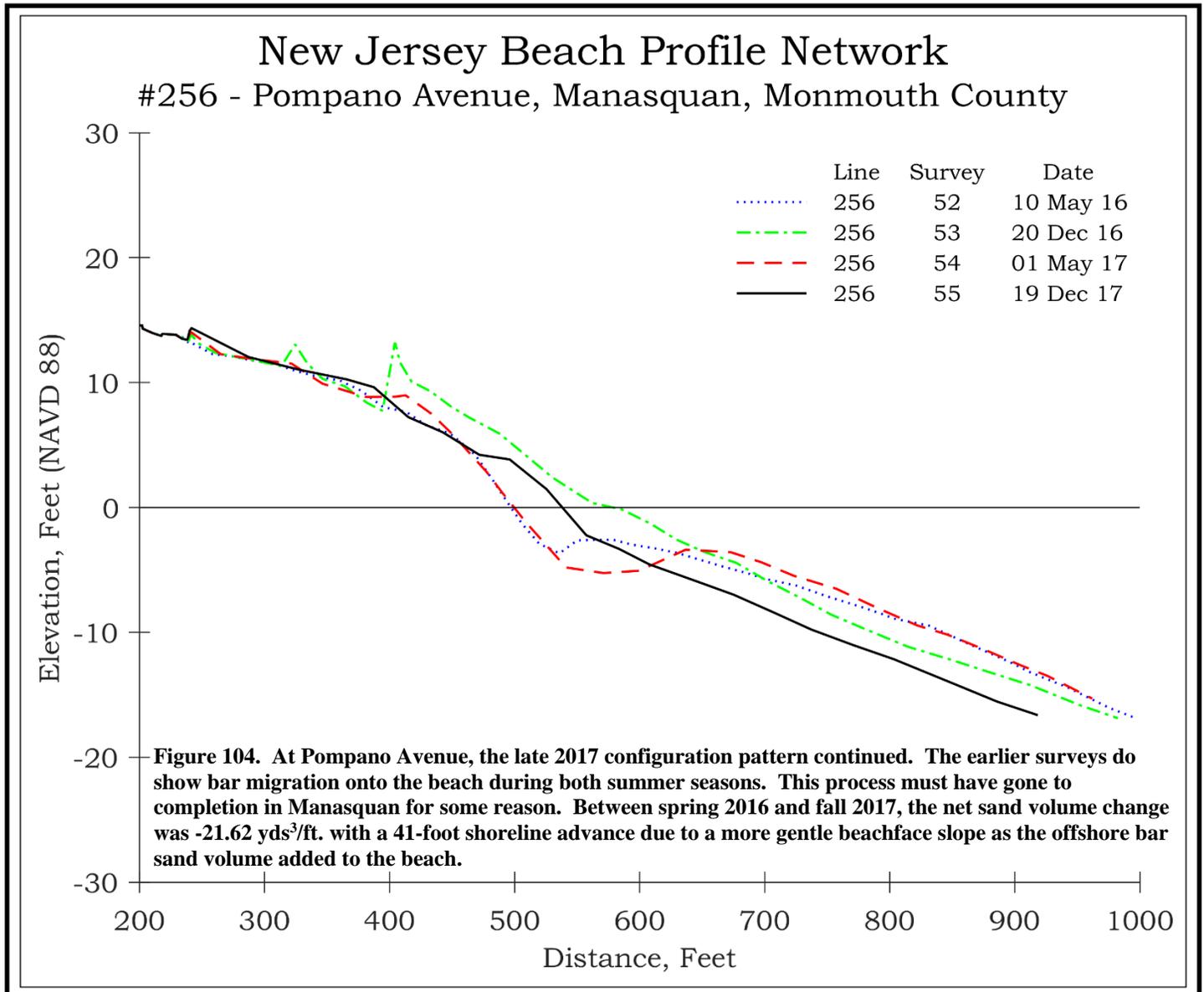


Figure 103. The December 2017 surveys of the Manasquan beach seem to follow a pattern of relatively generalized slopes into the ocean without any offshore features (bar or terrace development).

NJBPN 256 – Pompano Avenue, Manasquan



The May 10, 2016 view to the south (left photo) shows the Manasquan Inlet jetty along the berm. The Dec. 19, 2017 view (right photo) includes the promenade, houses, and the single line fence attempting to collect sand to form a dune.



NJBPN 15601 - Riverside Drive, Manasquan

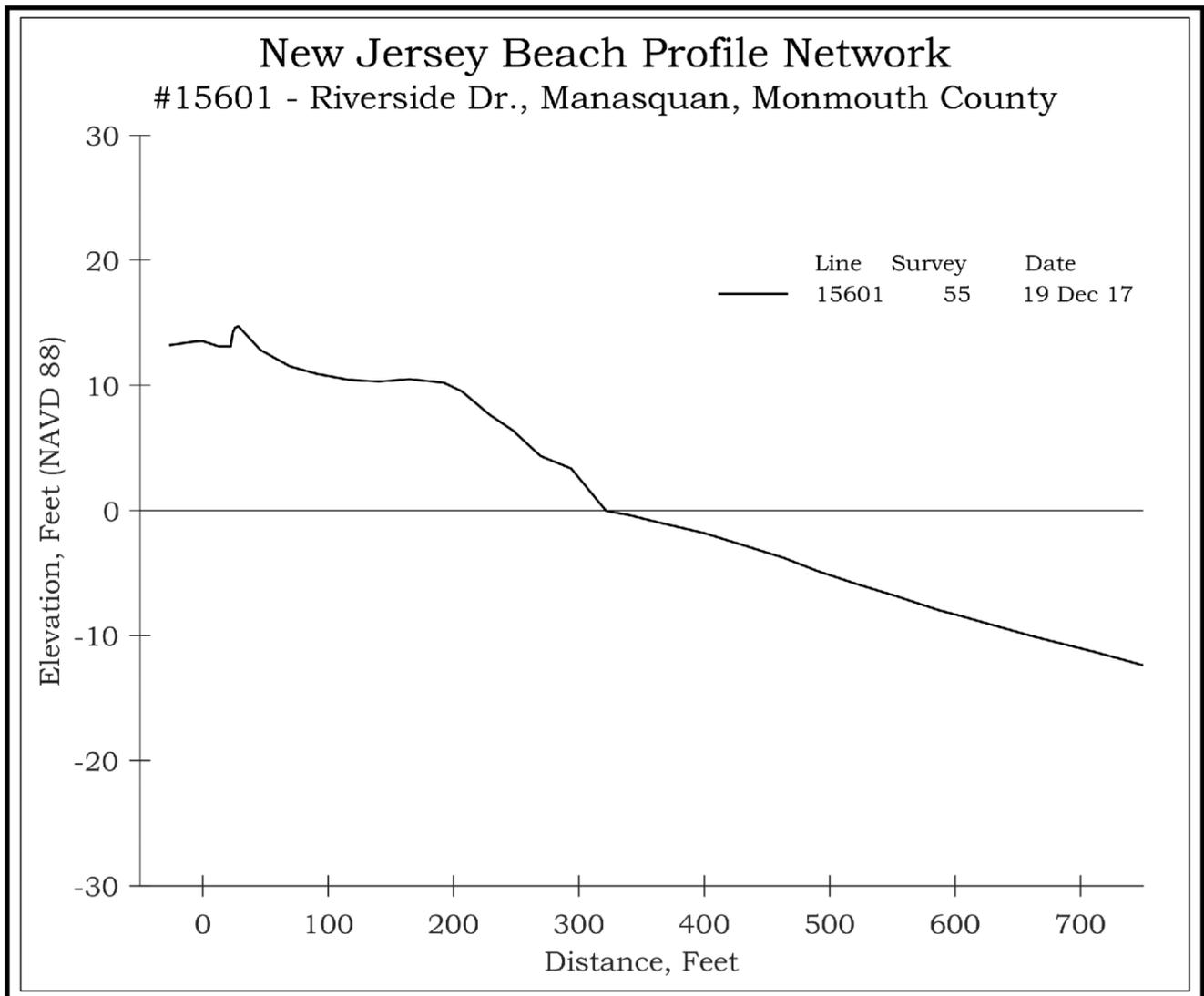
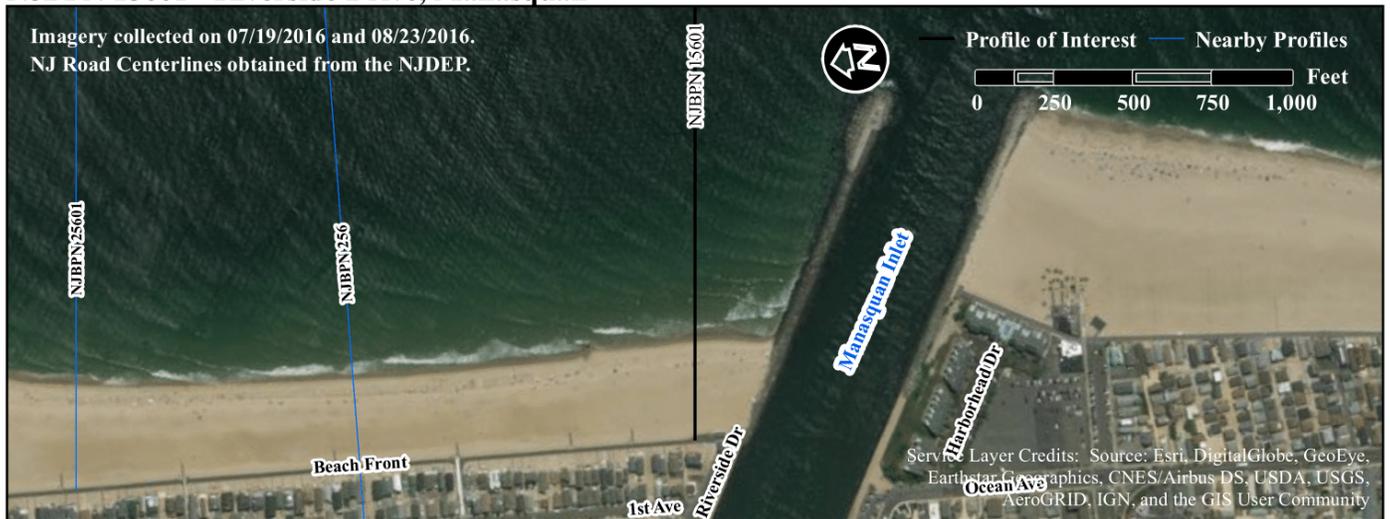


Figure 105. The southernmost survey site in Monmouth County lies a few hundred feet from the north Manasquan Inlet jetty. This site has the largest “tiny” dune seen in Manasquan and shows a mounded berm deposit that eventually slopes seaward to the zero elevation position. The offshore region is a uniform slope seaward minus any bar features.

Summary & Conclusions

The NY District of the US Army Corps of Engineers completed Phase III of the Monmouth County shore protection project in late 2016. This effort followed the post-Sandy restoration of both Phase I and Phase II at an expense of \$109.3 million dollars to pump 7.7 million cubic yards from offshore in order to restore the entire federal Coastal Storm Risk Management and Erosion Control Project to the original design specifications. Sandy Hook has become included in the project, since most project losses are moving onto the hook along the 6-mile reach. The Gunnison Profile site (#285) boasts a 2,500-foot wide dry beach half of which has accumulated since 1998 shortly following the initial work in Sea Bright. The recent addition of a new cross section 3,500 feet north of the Gunnison site will provide added data on sand quantities depositing along the National Seashore coastline.

The Raritan Bay restoration took place at Port Monmouth adding a half-million cubic yards of sand at a site covered by NJBPN site #185. More sand was added at Keansburg and has been surveyed for results since placement under a separate NJDEP contract.

In 2017, the NY District Corps and the Division of Coastal Engineering collaborated with the CRC to establish an additional 65 profile locations between Gunnison Beach and Manasquan Inlet, positioned among the existing 34 NJBPN oceanfront sites, to gather a more dense set of sand volume change and shoreline migration data for the District. The first cross section data was collected during the fall 2017 survey season. Comparison plots will be completed in 2018 to gain insight on beach performance.

Appendix Tables 2 and 3 provide the seasonal and annual profile volume and shoreline changes for Monmouth County. The average sand volume that migrated back to the shoreline as of fall 2015 since Sandy was 33.56 yds³/ft. and represents 92.3% of the sand lost due to Sandy (-36.27 yds³/ft.). This does include the work completed by the USACE in 2014 minus losses up to fall 2015. Work in in Deal and Long Branch contributed 17.88 yds³/ft. to the Monmouth County total by the fall of 2016. Therefore, after the completion of Phase III, the Monmouth County oceanfront shoreline has had a post-Sandy sand volume increase of 51.44 yds³/ft. or 141.8% of the Hurricane Sandy sand volume loss. Using a Google Earth distance measurement between the Sandy Hook National Seashore and Manasquan Inlet, the net sand volume increase above that present prior to Hurricane Sandy is 1.65 million cubic yards {51.44 yds³/ft. minus 36.27 yds³/ft. equals 15.17 yds³/ft. multiplied by the distance along the county shoreline (108,940 feet) generates the 1,652,620 cubic yards of new sand}

Monmouth County averaged 17.88 yds³/ft. of added sand to the 34 oceanfront cross sections producing a 27-foot average shoreline advance between May 2016 and December 2017. The 8 Sea Bright sites averaged a gain of 3.00 yds³/ft., the 6 Long Branch sites averaged a gain of 24.01 yds³/ft., the newly completed Phase III sites gained 107.00 yds³/ft., and the 13 sites between Asbury Park and Manasquan averaged a gain of 6.70 yds³/ft.

The larger gains observed in Long Branch versus Sea Bright to the Sandy Hook seashore may indicate sand movement moving north derived both from the recent restoration efforts in Phase I plus substantial additions from the Phase III construction. The Phase III sites show huge increases in sand volumes accompanied by a 259-foot shoreline advances seaward. The southern segment did better than the Sea Bright section with double the average gain. For now, material can arrive into the newly completed section of Deal to Long Branch from the south, so if sand progresses north along the beach, this process may see a reduction in loss rates now that the Deal to Long Branch section is complete and structural changes are made to the groins in this reach.