FINAL REPORT FOR 2019
ON THE CONDITION OF THE MUNICIPAL BEACHES
IN
THE TOWNSHIP OF UPPER, CAPE MAY COUNTY, NEW JERSEY

Above is an aerial view of Strathmere, taken December 7, 2019, showing the sand placement operation underway south of Tecumseh Avenue as the maintenance operation proceeded. (Photo by Ted Kingston).

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TABLE OF CONTENTS

Annual Report for 2019
To
The Township of Upper On the
Condition of the Municipal Beaches in Strathmere

Introduction

The Stockton University Coastal Research Center (CRC) surveyed the municipal shoreline quarterly, to document the annual changes for 2019. The survey comparisons provide data to evaluate seasonal shoreline and sand volume changes. Seasonal surveys at the long-established six sites allow the Township to evaluate the performance of the US Army Corps of Engineers (USACE) project conditions following storm events and general changes to the Strathmere beaches independent of the USACE efforts. Data collected at the six oceanfront beach profile locations cover the municipal beaches from Seaview Avenue to 1st Street. This coverage extends the length of the USACE engineered beach in Strathmere.

The USACE Ocean City to Townsends Inlet Shore Protection Project initially placed approximately 1.54 million cubic yards of sand on the Strathmere end of Ludlam Island. An additional 4.09 million cubic yards of sand were placed on the southern Ocean City and Sea Isle City beaches, all complete by 2016. Storm frequency was more or less normal between 2018 and the end of 2019, but the intensity was fortuitously low for all of those that did occur. Wave heights and tidal surges were present, but without marked specific event impact. The cumulative effect was to generate a vertical scarp in the dunes built by 2016 north of Williams Avenue with the greatest impact on the beach at Seaview Avenue. In response to these events, the US Army Corps had contractors return to both the south end of Ocean City and in Strathmere during 2019 to pump additional remedial sand supplies onto both municipal beaches, derived from the Corson's Inlet borrow zone in the ebb-tidal delta.

Winter Storm Activity

Northeasters occurred on December 9th, 16th, and 21st 2018 to start the winter with rain and 20 to 30 MPH wind speeds. January and February were cold, but relatively storm free. There were two mild storms in March and early April, followed by a quiet summer. The 2019 hurricane season saw several storms move through the Atlantic coastal region, but well offshore producing waves, but no local negative wind effects.

Engineered Beach Overview

As of 2016, the USACE project has provided over 3 million cubic yards of sand never previously present anywhere within the modern NJ coastal zone either at the inlets or on the barrier island shoreline. This will provide a very large measure of long-term protection to this segment of the NJ coastline. There is an agreement to continue maintenance of the project for 45 additional years (its inception was in 2015). The maintenance cycle will vary between 4 and 6-year intervals unless impacted by future major storms and was most recently implemented with work in both Strathmere and southern Ocean City during 2019 using Corson's Inlet sand.

Beach Monitoring Program Methodology

The beach monitoring program extends back to June 1995 when the Township of Upper requested that the CRC design and establish a means to provide information on coastal zone management issues within the municipality. Initially, six sites were selected to survey and allow calculations to provide information on beach behavior. In 2009, three additional beach profile stations (UT-21, UT-31, and UT-7) were established in sections that did not have profiles to monitor sediment movement within groin compartments and along Corson's Inlet. In 2009, it was decided to discontinue the 9 existing sites and monitor semi-annually the 200-foot spaced baseline cross sections used during construction of the 2009 Upper Township beach nourishment project to quantify performance and meet monitoring requirements for a FEMA category "G" engineered beach.

This process continued until the USACE took command of the project in 2016. FEMA always steps back from storm disaster reimbursement if the USACE is involved with shore protection projects, so the original six cross sections were resumed to provide the municipal governing body with direct information on beach performance since the USACE only monitors projects annually IF funds are available.

Each site is located in specific regions of the Strathmere shoreline. UT-1 is positioned at the Sea Isle City border on the mid-island straight shoreline. UT-2 is also located on the mid-island portion of Ludlam Island. UT-3 is in a transition zone between straight shoreline orientation and the increasing influence from Corson's Inlet. UT-4 is central in the transition zone, while UT-5 is at a location where inlet processes and offshore waves tend to faithfully deposit sand maintaining a wide beach. UT-6 is located at Seaview Avenue at the northeast corner of development where dramatic shoreline changes, driven by inlet dynamics, frequently produce severe erosion, interspersed with extensive sand deposition creating a wide beach with a broad sandy expanse extending into Corson's Inlet opening as the NJ State park lands. The following is a list of the surveys that are included in this report and the dates they were completed:

- Survey 72 March 13, 2019
- Survey 73 June 11, 2019
- Survey 74 September 16, 2019
- Survey 75 December 12, 2019

Specific Profile Site Descriptions:

Figure 1 below shows the locations of the 6 cross section locations used for this analysis.

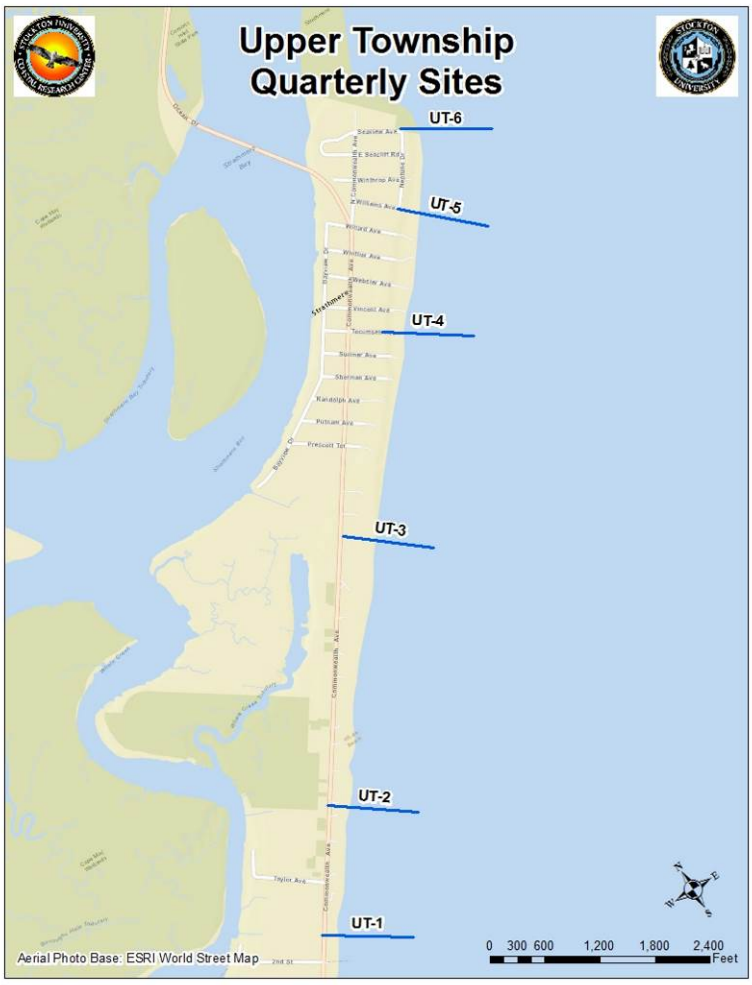

Figure 1. Locations of the 6 beach profile stations for the engineered beach in Upper Township.

Individual Site Review

The four surveys completed during 2019 are grouped in order to review the changes observed over the past 12 months. Beach volume and shoreline changes were calculated from each seasonal change between March 2019 and December 2010. Photos for each site are included to show the beach conditions during specific time frames throughout the year. Table 1, below, shows the annual sand volume change at the six monitoring profile locations since December 2018.

Table 1 - Annual Sand Volume Change at the 6 Monitoring Profiles
December 2018 to December 2019

Profile	Shoreline Change (feet)	Volume Change (yds^3/ft)	Avg.Volume Change (yds^3/ft)	Distance Between (feet)	Net Volume Change (yds^3)
Southern Township Boundary					
UT-1	4	-2.54			
			-6.1	1,410	-8,621
UT-2*	-53	-9.69			
			-11.4	2,938	-33,492
UT-3	-17	-13.11			
			-2.7	2,242	-5,970
UT-4	56	7.79			
			57.1	1,323	75,486
UT-5	218	106.33			
			165.6	911	150,820
UT-6	363	224.78			
Northern Township Boundary					
			Total Volume Change =		**178,222**

**UT-2 was not surveyed in December 2018, so March 2019 data substitutes for the year's evaluation.*

**A vehicle access pathway onto the beach was under construction at UT-5 December 2019. Its 13.041 $yds^3/ft.$ sand volume was subtracted from the sand volume change above for UT-5 to reflect regional conditions (see profile plots for the effect of the temporary ramp).*

This annual set of surveys follows last year's highly erosional loss of 453,551 cubic yards of sand focused on UT-5 and UT-6, each with over 130 $yds^3/ft.$ lost from the beach. Loss extended south to UT-4, but in smaller quantities. This year, with the maintenance effort by the USACE, delivered a generous gain as the beach recovered the 2018 losses. Minor losses occurred at UT-3 and UT-2 (March to December 2019), but were more than offset by gains due to the USACE efforts at project maintenance. The photograph below in Figure 3 shows the beach three days prior to the actual fall 2019 CRC beach survey date.

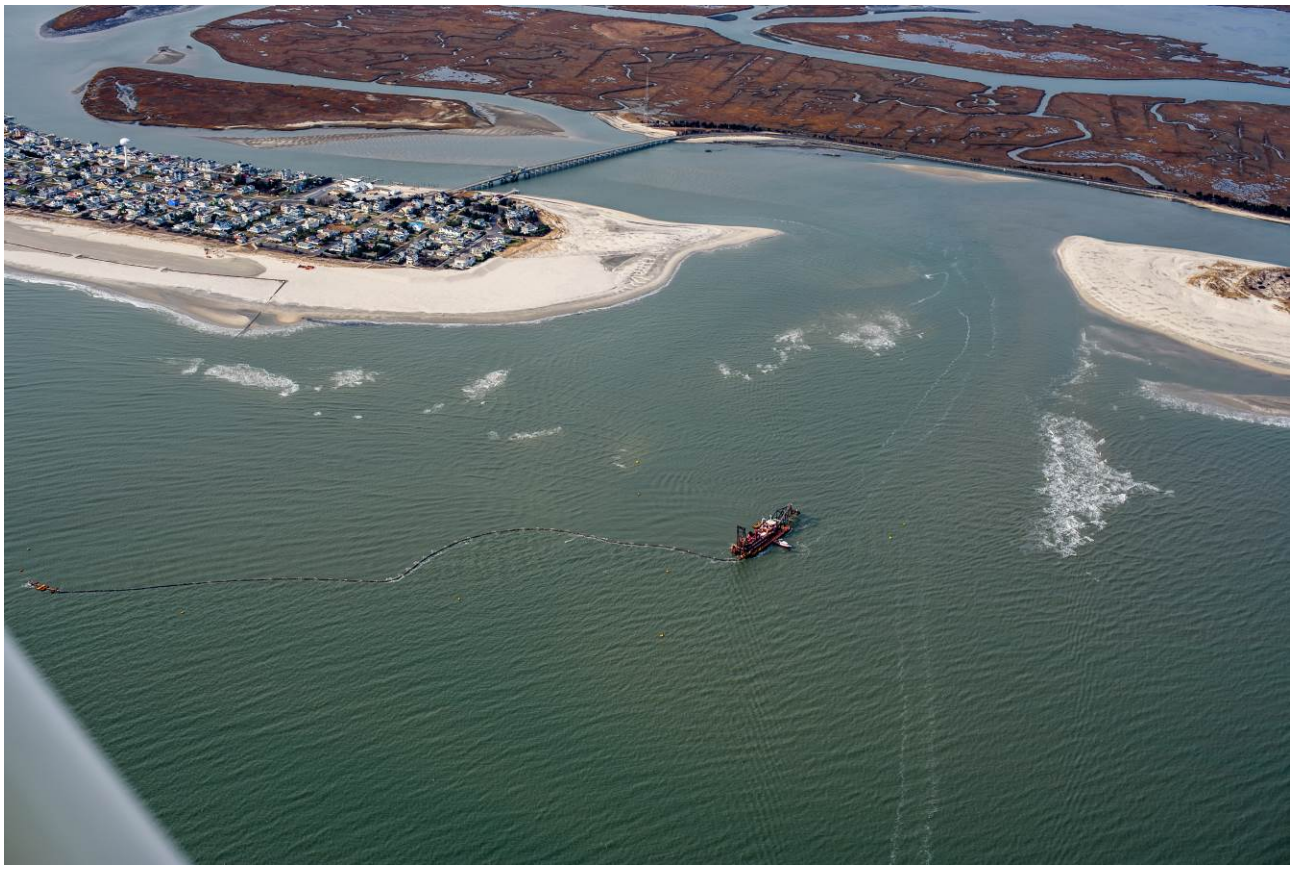

Figure 2. This December 7, 2019 view shows the entirety of the Corson's Inlet ebb-tidal delta, the Great Lakes dredge in position within the borrow zone and the resulting sand deposited on the Strathmere oceanfront. ***(Photo by Ted Kingston)***

Table 2 - 4th Quarter Sand Volume & Shoreline Changes for 2019
September 16th to December 12th 2019

Profile	Shoreline Change (feet)	Volume Change (yds^3/ft)	Avg.Volume Change (yds^3/ft)	Distance Between (feet)	Net Volume Change (yds^3)
Southern Township Boundary					
UT-1	2	-15.10			
			-16.7	1,410	-23,603
UT-2	-58	-18.38			
			-8.5	2,938	-25,113
UT-3	4	1.29			
			36.8	2,242	82,564
UT-4	153	72.36			
			94.5	1,323	125,049
UT-5	272	116.67			
			173.8	911	158,342
UT-6	432	230.95			
Northern Township Boundary					
			Total Volume Change =		**317,238**

The fourth quarter of 2019 survey followed the work in Strathmere by the US Army Corps maintenance effort on the community oceanfront. The sand was obtained from the authorized borrow zones within Corson's Inlet. This material is replaced largely from sand migrating south from Ocean City's project, first into the State Park,

then onto the ebb shoals of the inlet where it becomes available again for maintenance work on the oceanfront beaches. UT-4, -5 and -6 were all subject to added sand with the most cubic yards per foot added at Seaview Avenue, where it is most needed. The volume added was 365,955 cubic yards based on the closed end average for the three affected profiles and the next one nearest to the south. The net volume shows in Table 2 above. The distribution of the new sand on the affected profiles was relatively evenly spread between the upper beach and the offshore area close to elevation zero. Sand will be redistributed to the south and offshore over time.

UT-3 (+2.87 yds^3/ft. above; - 1.58 yds^3/ft. below)
UT-4 (+41.65 yds^3/ft. above; +30.71 yds^3/ft. below)
UT-5 (+55.83 yds^3/ft. above; +60.841 yds^3/ft. below)
UT-6 (+115.41 yds^3/ft. above; +115.54 yds^3/ft. below)

The nearest profile cross section to the south (UT-3) did not receive additional sand, so displays normal fall into winter patterns of sand transport onto the beach from offshore in modest quantities. The first quarter survey in 2020 should show that sand migrated onto the site from the north.

- **Seaview Avenue, UT-6**

This site is located adjacent to Corson's Inlet making it highly vulnerable to rapid beach changes from inlet dynamics and northeast storms. Serious erosion was threatening the seaward end of Seaview Avenue and its associated private residences. The US Army Corps stepped in with a maintenance effort that extended from southern Ocean City and included Strathmere to a point somewhat north of the Jasper Avenue site (UT-3). The restoration of this beach is outstanding with the dune back to design width and a generous beach width to the water's edge. The key to longer term stability has always been the tendency for secondary tidal channels to form along the back of the beachface and rapidly drag sand either into Corson's Inlet or to the south with usual deposition at and south of the Williams Avenue site. There is no easy and cheap self-help option available to intervene as the local entity at this location because the channel appears rather suddenly, with a sizeable magnitude of action demanded to alter the channel size or location. Careful monitoring of the issue did allow for USACE intervention during the fall of 2019.

3a. June 8, 2018

3c. December 12, 2019

3b. December 7, 2018

Figures 3a to 3c. Seaview Avenue survey site. View to the north.

Photograph 3a in June 2018, the beach and dune were undamaged with a substantial width to the high tide line.

Photograph 3b shows that by December 2018, major damage had happened to erode the dune as the beach's high tide line had moved to the dune toe in 6 months.

Photograph 3c was taken on December 12, 2019 following completion of project maintenance by the USACE. The restored dune has not been vegetated or fenced, but the beach width has been restored to the design specifications.

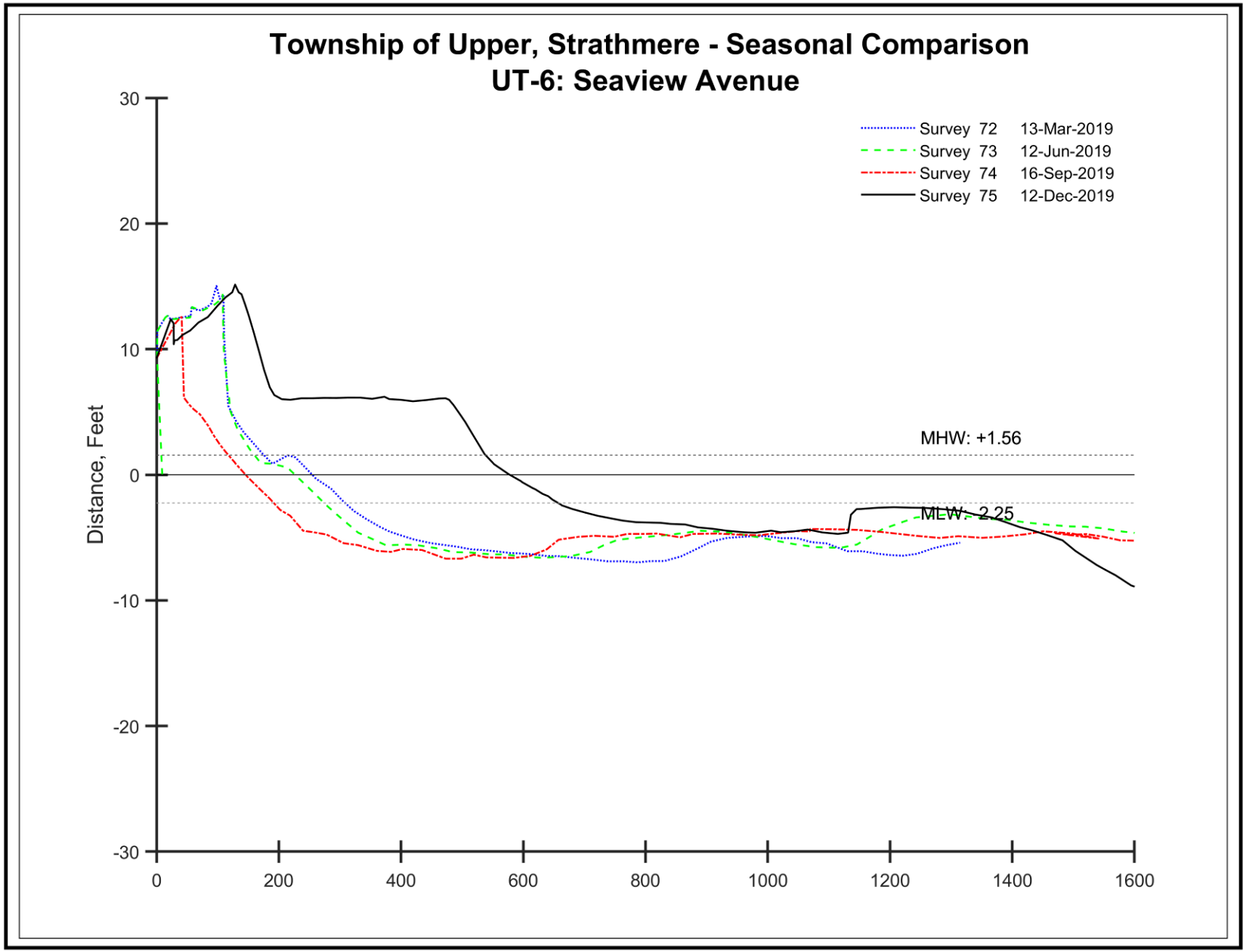

Figure 4. Between March and June of 2019, the beach retreated nearly 70 feet by September compromising the dune as protection from storms. The massive sand volume placed by the USACE shows in the December survey as a volume of 230.95 yds^3/ft. added across the extent of the profile line producing a shoreline advance of 432 feet. The offshore bar volume amounted to 19.34 yds^3/ft. of that total added by wave action within the ebb-tidal delta.

♦ **Survey Line UT-5, Williams Avenue, Strathmere**

This site was initially nourished in 1984 and is located near the southern limit for direct inlet influences. The site has been monitored since 1986 as part of the NJBPN program and included in the municipal monitoring project. Sand is intermittently added to the beach in this region as tidal delta bars accumulate off adjacent ebb shoals and migrate landward under favorable conditions to attach themselves to the shoreline providing influxes of sand periodically.

The Williams Avenue site was not provided massive sand volumes initially in the federal project. However, recent rates of erosion prompted a significant fill by December 2019. The fill volume was 116.67 yds^3/ft. which produced a 272-foot shoreline advance. The fill shows a wider dune* on the plot along with replaced beach sand lost since 2018.

*The survey in December 2019 encountered a substantial sand push added to the seaward edge of the dune to create the vehicle beach access path at Williams Avenue. This sand volume does not represent a regional addition of 15.50 yds^3/ft. to the entire foredune slope, so was subtracted from the comparisons shown in the two tables above for UT-5.

5a. December 10, 2018

5b. June 12, 2019

5c. December 12, 2019

Figures 5a to 5c. UT-5 survey site on Williams Avenue.

Figure 5a shows the beach in December following 200 feet of shoreline retreat.

Figure 5b was taken in June 2019 looking south from the dune across the vehicle access pathway onto the beach.

Figure 5c is a view of the beach after the federal maintenance widened the beach and added sand to the dune area seaward of the existing grass.

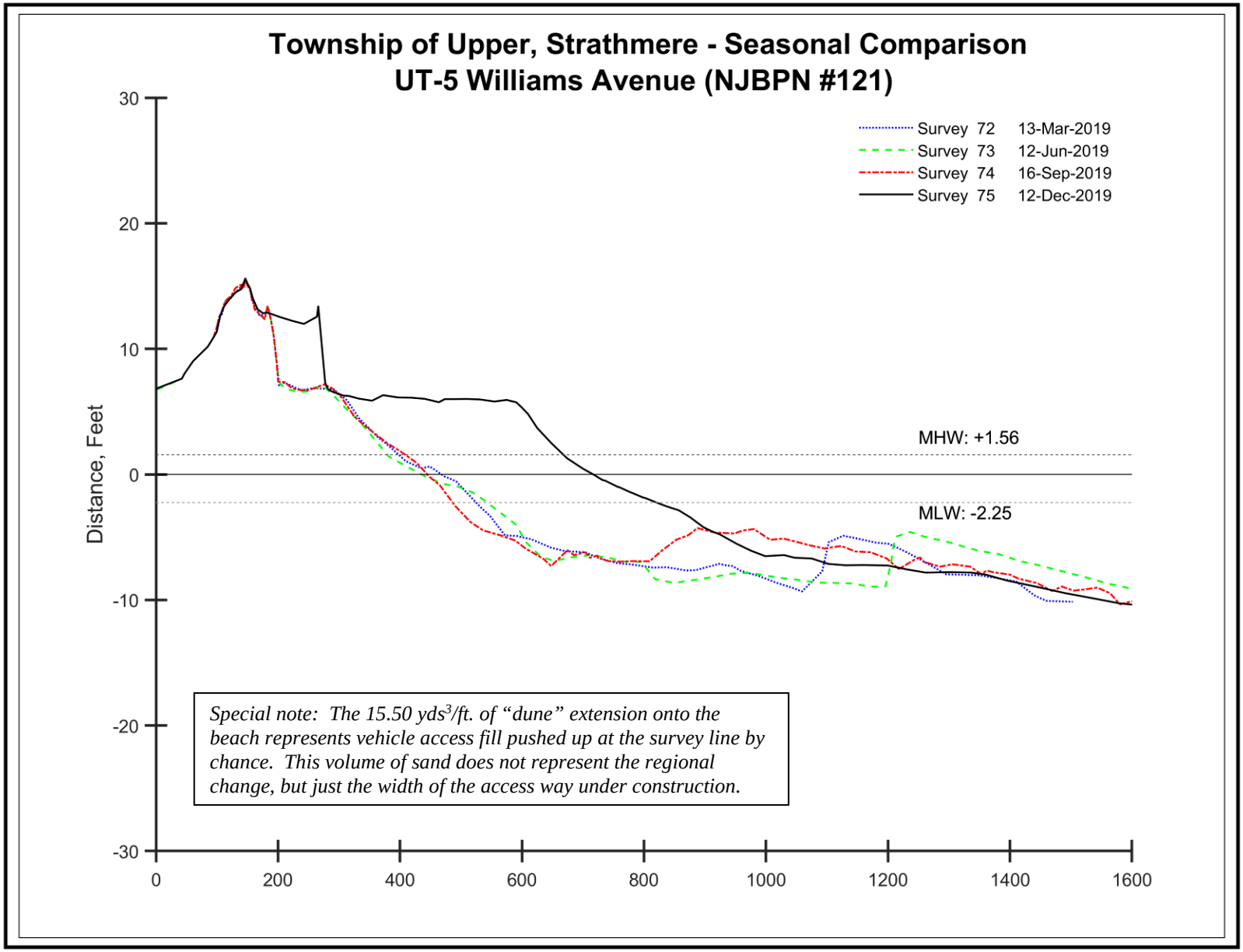

Figure 6. This site lies just south of the influence of the ebb-tidal delta for Corson's Inlet, but still within the influence of major offshore bar formation. Surveys 72, 73, and 74 show progressive bar creation and landward migration by September. The maintenance fill provided a 272-foot shoreline advance and a beachface toe of slope intersecting the offshore bar from September. The added "dune" volume for the vehicle access was 15.50 yds^3/ft. and the beach volume added was 136.23 yds^3/ft. Further seaward there were minor additions and losses as the offshore surface changed with sand movements due to breaking waves.

- **Survey Location UT-4, Tecumseh Avenue, Strathmere;**

This profile location was established because the shoreline dynamics are very different between the Williams Avenue (UT-5) and Jasper Avenue (UT-3) sites related to the influence of the ebb-tidal shoals of Corson's Inlet. Jasper Avenue performs like a mid-island beach usually does with losses mainly directed toward the south with cross-shore sand redistributions the major component of change. Tecumseh Avenue lies mid-way between the two different beach configurations and was surrounded by obsolete timber bulkhead and timber groin arrays. These structures had been installed during a past period of shoreline retreat that demanded their installation. Today, these decayed structures are basically buried in the beach project sand.

The USACE sponsored beachfill was completed by July 2015 which significantly extended and elevated the dune and beachface seaward. The berm and upper beachface began to show signs of erosion by November 2015. The USACE's return to pump sand following NE Storm Jonas was documented as a 106-foot advance in the berm position seaward due to the addition of 61.39 yds^3/ft. in sand volume in 2016. The most recent maintenance effort provided 72.36 yds^3/ft. in new sand on the beach yielding a 153-foot shoreline advance seaward. The project tapered off further south with no new sand added at Jasper Avenue (UT-3).

Figure 7a. December 10, 2018

Figure 7c. December 12, 2019

Figure 7b. June 12, 2019

Figure 10a is a view to the north along the dune crest taken during the winter of 2018.

Figure 10b shows the summer beach in June of 2019.

Figure 10c shows the same perspective by December 2019. The federal project was completed generating a wider beach, with some sand wind-transported into the dunes and onto the upper dry beach. The direct comparison of the December 2018 (7a) with this beach's width is evidence for the federal project enhancement of the site.

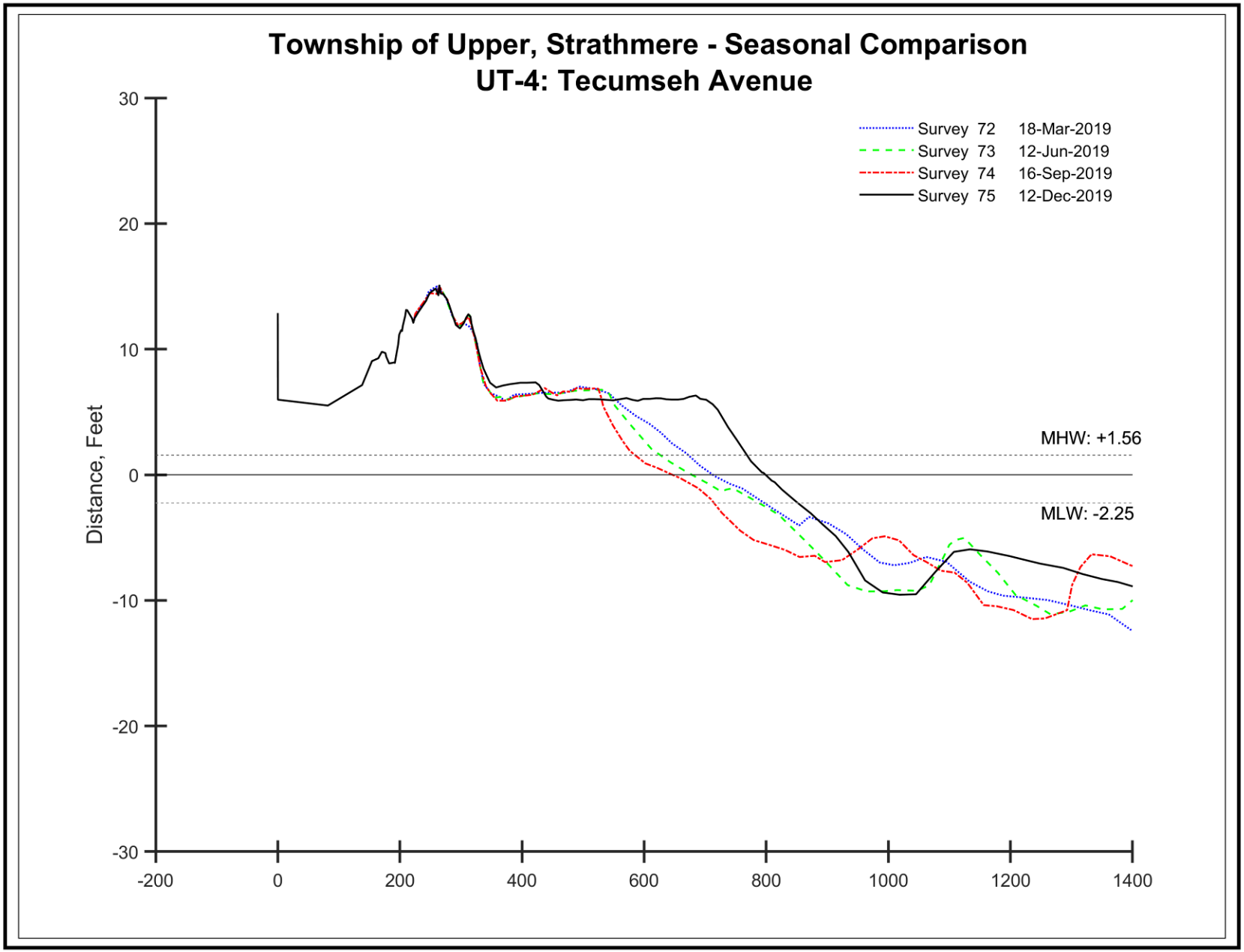

Figure 8. The dune and recreational beaches remained relatively consistent through 2019 with sand added to the upper dry beach by December 2019. Also, large scale offshore bars formed and moved landward with a major trough showing as of December 2019 within 200 feet of the zero-elevation position. The federal maintenance effort added 72.36 yds^3/ft. with a 153-foot shoreline advance. 73.61 yds^3/ft. were deposited on the beach with 28.05 yds^3/ft. added offshore in the large bar system that has appeared. Other loss areas offshore equaled most of that accretion in the new bar.

- **Survey Line UT-3, Jasper Avenue, Strathmere;**

Jasper Avenue is the first of three sites located along the central part of the island known as “Whale Beach”. This segment has been notoriously narrow and subject to repeated overwash to the bay. Storms through the 1990’s breached the dune here four times resulting in serious damage to a group of homes built east of Commonwealth Avenue immediately north and south of Jasper Avenue. Since the 2001 NJ State and local beach project, the situation has improved dramatically. Hurricane Sandy did not penetrate the dunes largely because of a final NJ State/local project completed in 2009.

By July 2015, the USACE sponsored beachfill was completed which elevated and extended the berm position seaward nearly 250 feet. Following June of 2016, the USACE had completed the northeast storm “Jonas” (January 24, 2016) restoration.

Seasonal and annual beach/dune changes were very minimal at this site during 2019. No maintenance sand from the USACE was directly placed at this location, but past performance data would expect some sand to migrate to this zone relatively quickly. The fall seasonal changes amounted to a net gain of 1.29 yds^3/ft. in sand volume accompanied by a 4-foot shoreline advance. The annual change was a loss of 13.11 yds^3/ft. and a 17-foot shoreline retreat.

9a. June 8, 2018

9b. June 12, 2019

9c. December 12, 2019

Photo 9a is a view to the north along the dune's seaward slope during the summer of 2018. The tops of the old foredune fence are barely exposed at this time as a result of wind-generated sand transport into the dunes. New fencing was installed.

Photograph 9b shows the view to the north taken from the foredune perspective a year later with extensive grass growth and spread seaward of the fence line.

Photograph 9c shows the development of dune grass on the dry beach surface since the initial federal work was completed in 2016. Each summer this area expands and acts as a sand trap for wind transported material.

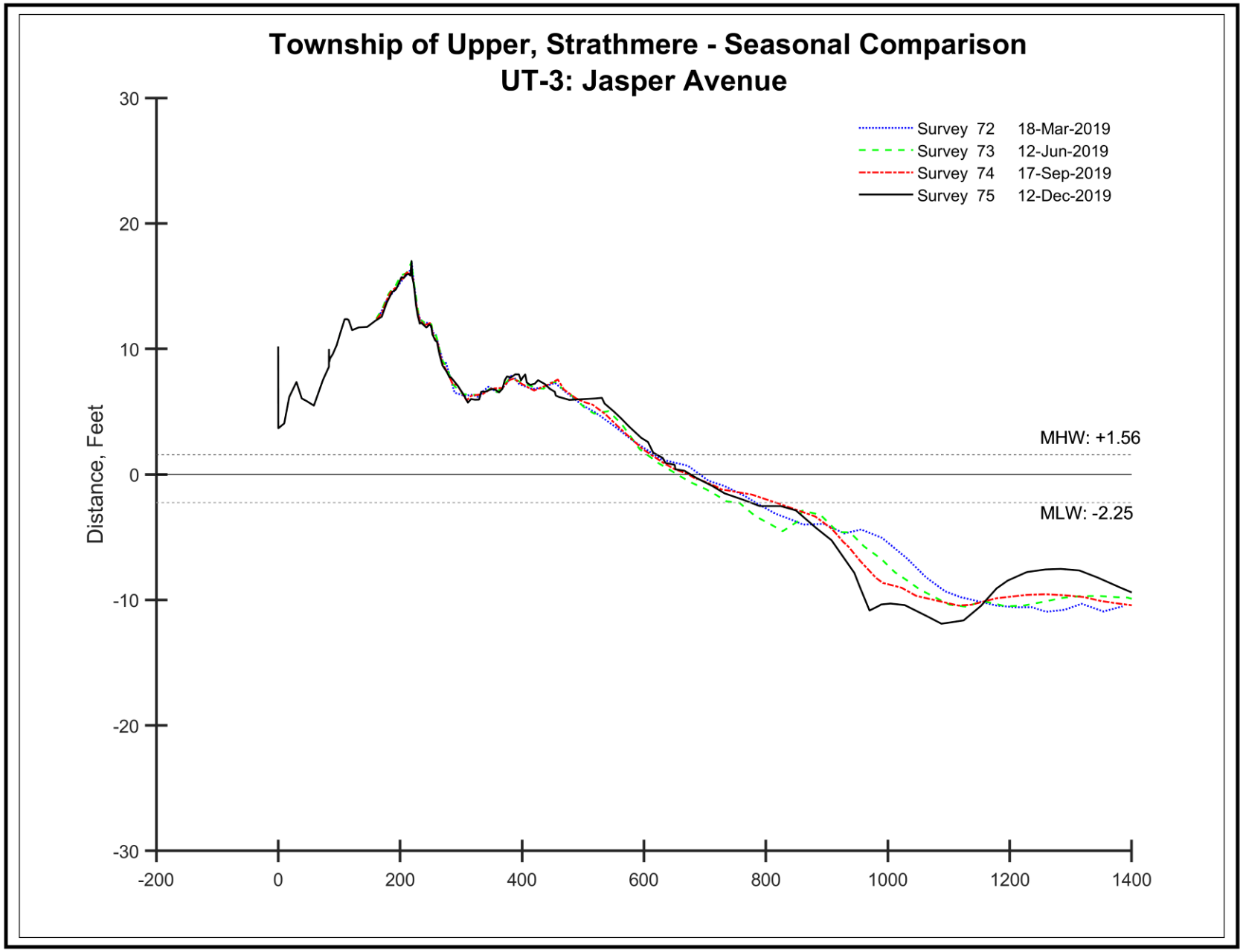

Figure 10. At Jasper Avenue the dunes and back beach areas did not change much over the past year. The beach added sand on the berm by December, while a substantially deeper trough offshore paired with a massive bar situated between 1,200 and 1,400 feet from the reference position was the primary cause for the sand volume changes reported above. Just the trough produced 34.16 yds^3/ft. in sand loss quantity, while the bar gained 20.48 yds^3/ft.

- **Survey Line UT-2, 2400 Commonwealth Avenue, Strathmere;**

This site is located directly seaward of the residence at 2400 Commonwealth Avenue in the southern segment of the Strathmere shoreline. This region has been more resilient than First Avenue with no documented episodes of dune breaching or overwash during the CRC monitoring for the Township. The state, local and federal beach nourishment efforts have significantly enhanced the beach and dune.

The USACE sponsored beachfill was completed by July 2015 which significantly extended and elevated the dune and beachface seaward. The berm and upper beachface showed signs of erosion by November 2015. The post-Jonas northeast storm restoration was complete by June 2016 with a wider beach due to an added 56.01 yds^3/ft. placed at the site.

This past year the beach retreated fairly dramatically from the September position losing 35.53 yds^3/ft. from the berm. The shoreline retreated 58 feet in the process between September and December 2019. The net loss for the entire site in the fall was -18.38 yds^3/ft., so the beachface into the offshore region was where all the changes occurred. No new sand was added at this location by the federal maintenance effort, but material will eventually arrive on site in the future.

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11a. December 1, 2017

Figure 14b. June 12, 2019

Figure 14a is a view to the south from the instrument position on the foredune crest.

Photograph 14b shows the dune toe in June with a substantial deposit of wind transported sand completely burying the line of fence. The plants are doing well as they expand seaward down the dune's seaward slope.

Photograph 14c view from December a year later shows the grass becoming distributed more naturally as the planted plugs spread out.

14c. December 12, 2019

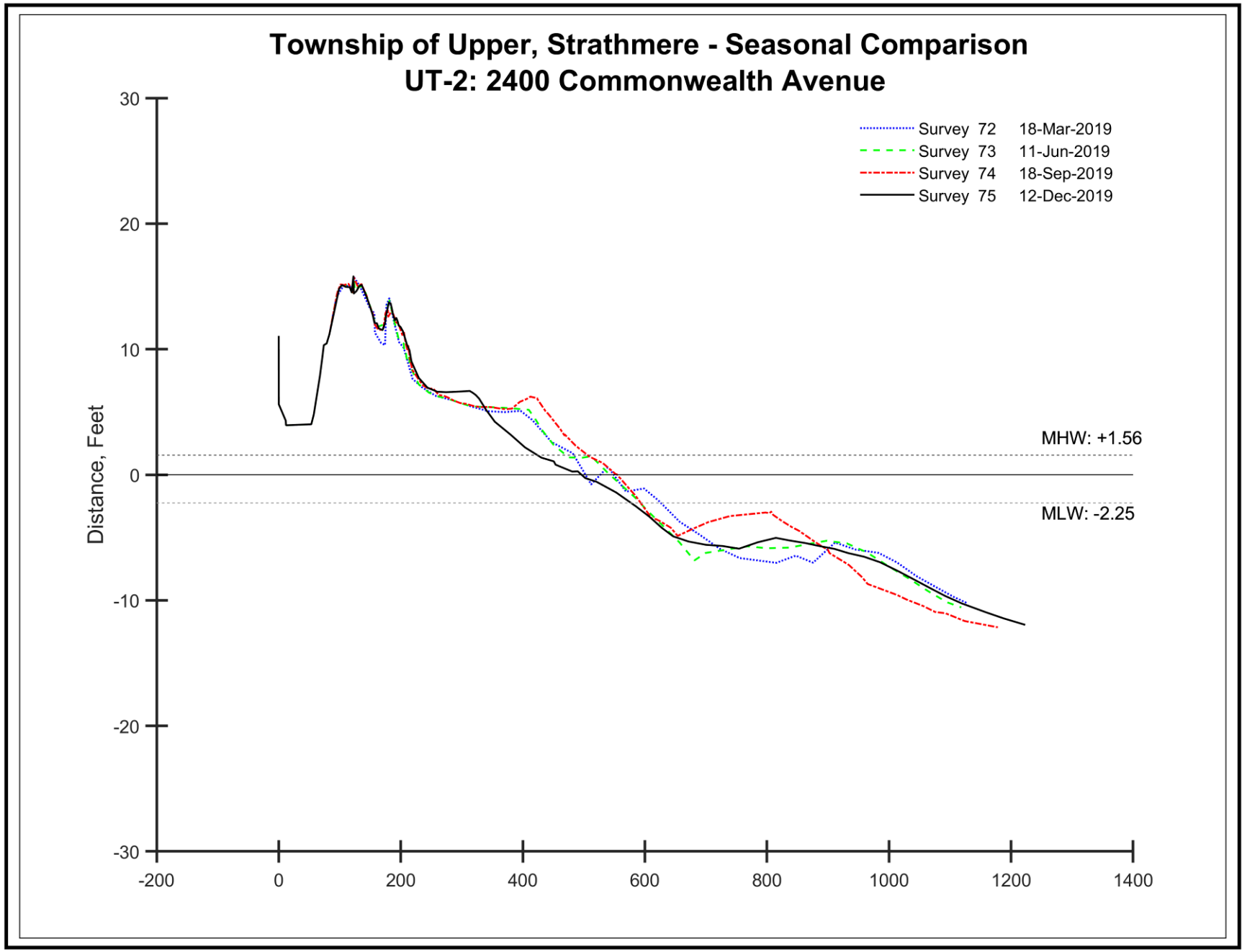

Figure 12. Sand did migrate into the dunes adding sub-cubic yard per foot sand quantities here and there (+1.93 yds^3/ft. as the largest amount added before the berm loss quantity). Offshore, the large September bar diminished in size generating the entire loss volume (-33.47 yds^3/ft. starting on the berm at elevation 5.40 feet, with the most distant segment of the profile line reducing that loss by 15.09 yds^3/ft.)

- **Survey Line UT-1, First Street (NJBPN #120), Strathmere;**

This profile site is actually a few yards inside Sea Isle City but was established in 1986 for a NJ State beach monitoring program. Acting as the southernmost site in Upper Township, this location suffered from overwash during any moderate northeaster. In fact, the segment to the south of the site was so persistently over-washed, that the County undertook the installation of 10-foot diameter geo-textile tubes as dune core along 2,400 feet of the beach into Sea Isle City in 1996.

The USACE sponsored beachfill was completed by July 2015 which significantly extended and elevated the dune and beachface seaward. The berm and upper beachface showed signs of erosion by November 2015. The post-Jonas disaster declaration USACE restoration was complete by June 2016 with a wider beach and an added 26.86 yds^3/ft. placed at the site.

This beach berm also retreated between September and December 2019. The offshore bar also diminished dramatically as well. The net change in the last quarter was a 15.10 yds^3/ft. sand volume loss with a very minor 2-foot shoreline advance. This fourth quarter loss was entirely offshore. At the zero elevation position the site had a 1.91 yds^3/ft. net gain. The berm and offshore dominated the changes seen.

The annual change was a 2.54 yds^3/ft. sand volume loss but a 4-foot shoreline advance.

13a. June 8, 2018

13b. June 11, 2019

13c. December 12, 2019

Photograph 13a shows the dune growth as of the summer of 2018.

Photograph 13b shows the dune with grass plants and the deposition of wind transported sand added a year later in June 2019. Luxuriant growth has enhanced the dune habitat.

Photograph 13c provides the winter view to the north across the dune and onto the beach. The decrease in beach berm width is evident in the picture.

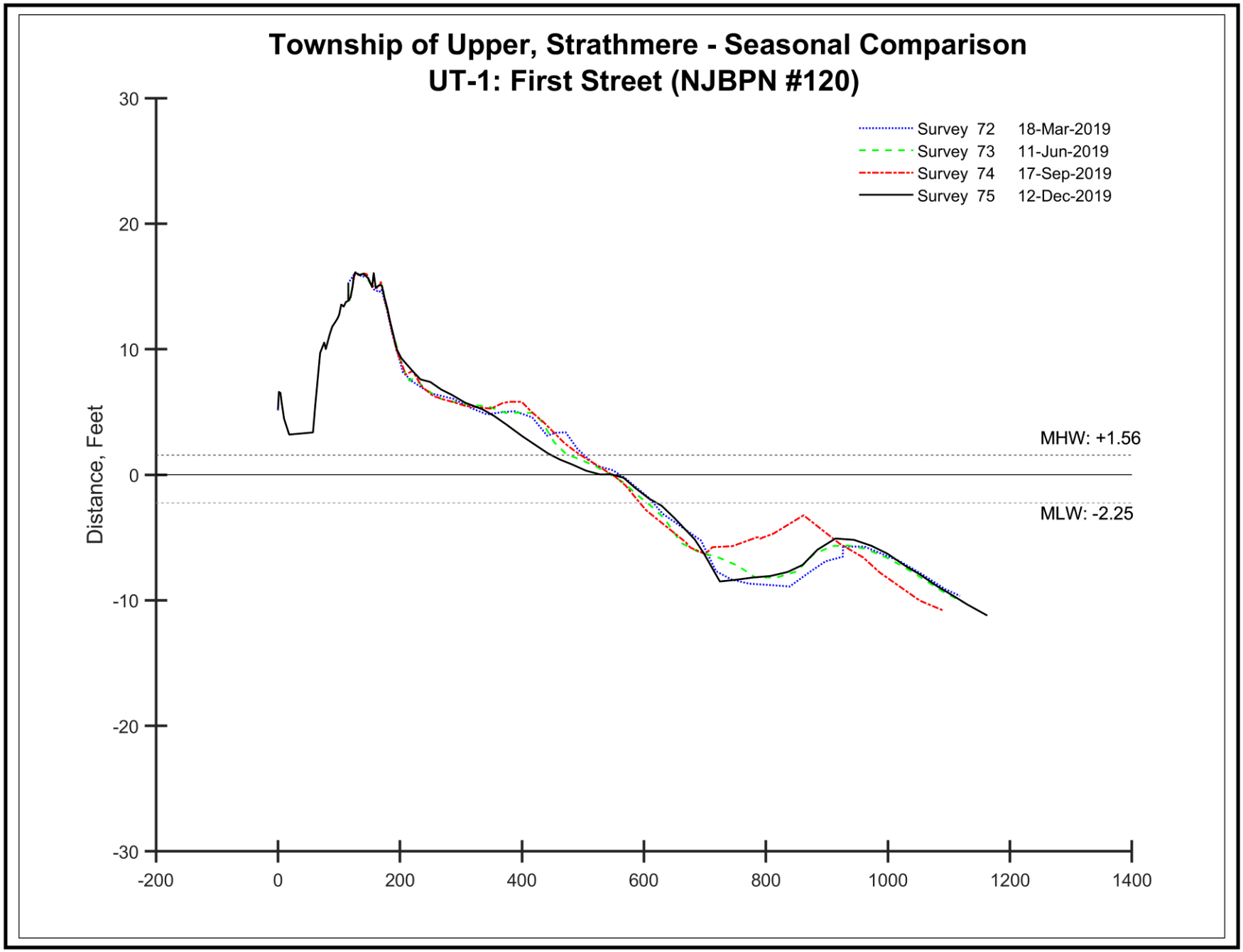

Figure 14. Overall, this site gained sand on the upper beach surface, but lost the beach berm developed as of the September survey. The offshore bar virtually collapsed at the 840-foot distance but remained positioned where earlier versions were located at the 950-foot distance seaward by December 2019.

Summary & Conclusions

The 2015 federal project placed approximately 1.54 million cubic yards of sand on the north end of Ludlam Island, including the Strathmere oceanfront beaches. The USACE returned (following the 2015 federally sponsored US Army Corps of Engineers beach nourishment projects completion in Strathmere) to repair the storm damage from Northeast Storm Jonas under a Federal Disaster Declaration with sand derived from Corson's Inlet ebb-tidal delta borrow zone.

During 2018, serious erosion problems cropped up between Williams Avenue and the State Park, taking away the beach and slicing into the dune at Seaview Avenue. The Township moved sand by truck from south of Williams Avenue to the scarp in the Seaview dune, but the losses continued. The Great Lakes Dredge and Dock dredge returned to Corson's Inlet borrow zone in 2019 funded by USACE maintenance dollars for work both in southern Ocean City as well as northern Strathmere. The six survey profiles document the addition of 365,955 cubic yards of new sand from the inlet source. This does not count any sand placed into the State Park north of Seaview Avenue site since the CRC does not survey in the park. The average between UT-4 that received sand and UT-3 which did not is a linear interpolation with no data taken in between the two sites. The USACE most likely tapered the new material gradually to blend into the existing profile making the closed end computation reasonably accurate.

As 2020 gets underway, the CRC will keep careful watch on wave and secondary tidal channel development at Seaview Avenue.