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NEW JERSEY'S DISTINCTIVE PUBLIC UNIVERSITY

UPPER TOWNSHIP MUNICIPAL SHORELINE MONITORING

to:

The Township of Upper
PO Box 205
Tuckahoe, New Jersey 08250

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Upper Township, (Resolution No. 161-2022)

2022 ANNUAL REPORT (covering monitoring activities January 2022-December 2022)

January 2023

**FINAL REPORT FOR 2022
ON THE CONDITION OF THE MUNICIPAL BEACHES
IN
THE TOWNSHIP OF UPPER, CAPE MAY COUNTY, NEW JERSEY**



This aerial view of Strathmere, taken October 10, 2022, shows the entirety of Corson's Inlet with the offshore bar systems well defined by breaking waves near the beach and on the shoals off the south side of the inlet. The combination of wave approach and refraction around the nearby offshore bathymetry of Corson's Inlet, generates enhanced transport of sand from the oceanfront near the inlet into the main channel. The bar system is virtually emergent at this stage of the tide, as evident by the people walking on them immediately south of the exposed rock groin. The northernmost developed oceanfront is constantly under erosional stress if large offshore sand supplies are not present as a result of inlet processes. (Photo by Ted Kingston).

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JANUARY 31, 2023**

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**Annual Report for 2022
To
The Township of Upper
On the Condition of the Municipal Beaches in Strathmere**

Introduction

The Stockton University Coastal Research Center (CRC) surveyed the Strathmere beaches quarterly to document changes during 2022. The survey comparisons provide data to evaluate seasonal shoreline and sand volume variations. 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. Seasonal surveys at the six established 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.

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 end of Ocean City and Sea Isle City beaches, all complete by 2016. The US Army Corps dredging contractors returned to Strathmere (added 511,840 cy) and the south end of Ocean City (added 506,159 cy) in 2019 into early 2020 providing maintenance sand to the project derived from the Corson's Inlet borrow zone. Work was complete as of January 2020 and work moved on to Sea Isle City in the spring of 2020 where a total of 895,001 cubic yards of sand were added.

The Army Corps had contractors return to both the south end of Ocean City and 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.

2022 Winter Storm Activity

Storm frequency was sporadic this winter but impactful. January 2022 saw three storms of minor magnitude, then nothing of significance until April. In May, a two-day storm event occurred Mother's Day weekend and eroded the beach into the berm. A week later, a second northeast event worsened the situation as summer began. Data from other locations showed some beach recovery occurred as sand moved back to the beach from the nearshore over the summer. The passage of post-tropical cyclone Ian past the Jersey shore extended that storm's immense impact with two days of 45 MPH winds and high wave action that served to remove summer berm accretion and cut substantially into the beach width seaward of the dune toe.

Engineered Beach Overview

The Corson's Inlet to Townsend's Inlet shore protection project will provide an exceptionally large measure of long-term protection to this segment of the NJ coastline. There is NJ State Aid agreement with the US Army Corps of Engineers to continue maintenance of the project for 44 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 maintained with work in both Strathmere and southern Ocean City during 2019 using Corson's Inlet sand taken from the ebb-tidal delta. In the initial work in 2016, the USACE project provided Ocean City and Strathmere 2.73 million cubic yards of sand derived from two miles offshore, never previously present anywhere within the modern NJ coastal zone either at the inlets or on the barrier island shoreline.

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 NJ State and 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 the 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 83 December 8, 2021
- Survey 84 February 28, 2022
- Survey 85 June 3, 2022
- Survey 86 August 31, 2022
- Survey 87 December 20, 2022

Specific Profile Site Descriptions:

The six cross sections are positioned along the Strathmere oceanfront from Seaview Avenue at the northern extent of residential development, south to the Sea Isle City boundary with Strathmere. The general locations are shown on Figure 1, page 3.

The four surveys completed during 2022 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 February 2022 and December 2022. Photos for each site are included to show the beach conditions during specific time frames throughout the year. Table 1 shows the annual sand volume change at the six monitoring profile locations documented between December 2021 and December 2022.



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

Individual Site Review:

The profile data is summarized in tables 1 through 3 on following pages with the shoreline position change measured in feet landward (-) or seaward (+) and with the sand volume shown in cubic yards of sand per foot of oceanfront shoreline.

**Table 1 - Annual Shoreline & Sand Volume Change at the 6 Monitoring Profiles:
December 2021 to December 2022**

Profile	Shoreline Change (feet)	Volume Change (yds ³ /ft)	Avg. Volume Change (yds ³ /ft)	Distance Between (feet)	Net Volume Change (yds ³)
<i>Southern Township Boundary</i>					
UT-1	1	4.28			
			0.9	1,410	1,325
UT-2	-41	-2.40			
			-11.5	2,938	-33,831
UT-3	-48	-20.63			
			-46.6	2,242	-104,556
UT-4	-131	-72.64			
			-102.1	1,323	-135,118
UT-5	-236	-131.62			
			-102.6	911	-93,482
UT-6	-133	-73.61			
<i>Northern Township Boundary</i>					
Total Volume Change =					-365,662

Sand continued to erode from the Strathmere shoreline following the early 2020 USACE work effort with 365,662 cubic yards of material either moving into the inlet shoals, further offshore or moving from the southern beaches into Sea Isle City's oceanfront under the influence of the littoral wave-generated currents.



Figure 2. This October 30, 2022 photograph of Corson's Inlet and the north end of Strathmere shows the inlet shoals around the Strathmere island tip with offshore bars extending past UT-6 at Seaview Avenue. (Photo by Ted Kingston)

**Table 2 - 4th Quarter Sand Volume & Shoreline Changes for 2022:
August 2022 to December 2022**

Profile	Shoreline Change (feet)	Volume Change (yds ³ /ft)	Avg. Volume Change (yds ³ /ft)	Distance Between (feet)	Net Volume Change (yds ³)
<i>Southern Township Boundary</i>					
UT-1	-16	-5.27			
			1.4	1,410	2,033
UT-2	-47	8.15			
			3.6	2,938	10,700
UT-3	-31	-0.87			
			-18.3	2,242	-40,950
UT-4	-74	-35.66			
			-29.1	1,323	-38,539
UT-5	-54	-22.60			
			8.9	911	8,117
UT-6	71	40.42			
<i>Northern Township Boundary</i>					
Total Volume Change =					-58,639

The table of values for the final quarter of 2022 show a marked increase in erosion rates distributed across the mid-island survey sites while smaller volume gains were recorded at both the northern and southern ends of the township boundaries. The 58,639 cubic yard sand volume loss was the second greatest amount eroded of the four quarterly evaluations, well behind the losses recorded in the spring.

**Table 3 - Quarterly Sand Volume Changes for 2022:
December 8, 2021 to December 20, 2022**

Profile	Winter 12/21 - 2/22 (yds³/ft)	Spring 2/22 - 6/22 (yds³/ft)	Summer 6/22 - 8/22 (yds³/ft)	Fall 8/22 - 12/22 (yds³/ft)
<i>Southern Township Boundary</i>				
UT-1	0.43	10.31	-2.26	-5.27
UT-2	-2.07	-12.84	2.71	8.15
UT-3	8.92	-25.99	-4.12	-0.87
UT-4	-9.20	-53.74	24.73	-35.66
UT-5	-20.88	-65.02	-21.85	-22.60
UT-6	-22.42	-17.81	-84.92	40.42
<i>Northern Township Boundary</i>				
Quarterly Volume Change (yds³) =	-31,058	-266,664	-24,817	-58,639

Table 3 collects all the sand volume change data into one view with a total sand volume change shown at the bottom of each quarterly column. The beachfront shoreline was the recipient of four quarters of consecutive sand loss for the year. The Mother's Day 2022 storm event brought heavy rains and extraordinarily strong northeast winds (sustained winds 25-30 mph with gusts up to 60 mph) and was the driving force behind severe erosional patterns along much of the New Jersey coastline. The beaches of Upper Twp. were hit particularly hard with cumulative losses for the spring quarter recorded at 266,664 cubic yards along the entire shoreline. The erosion was focused directly in front of the UT-3, UT-4, and UT-5 profiles. The sand loss continued into the summer quarter but was reduced to 24,817 cubic yards. The final fall quarter brought more sand volume losses to the beaches and nearshore regions as post-tropical storm Ian brought with it heavy winds.

♦ 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. The USACE intervened during the fall of 2019 to address the loss with added sand from Corson's Inlet. Inlet dynamics were causing shoreline retreat into the dunes at Seaview Avenue. Continued retreat occurred in 2021 not associated with the northeast storms during the first quarter of 2021. Between the February, June, September, and December 2021 surveys retreat on the beach berm was constant amounting annually to 204 feet measured at the zero-elevation position on the beach.

Following the Mother's Day storm event, the June 2022 survey revealed erosional trends at work in the beachface and nearshore regions at this location. By August the entire beach, nearshore, and substantial portions of the protective dune had been eroded away as inlet tidal dynamics influenced the shifting sands. The final survey in December 2022, displayed continued losses to the dune system as the protective rocks were almost fully exposed (Figure 3c.) however, beach elevation increases took place.



3a. July 14, 2022



3b. August 18, 2022



3c. October 10, 2022

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

Photograph 3a demonstrates just how quickly the shoreline retreats toward the dunes. Wind deposited sand at the fence line has been eroded away with the water's edge along the fencing at Seaspray Ave. as of July 2022.

Photograph 3b shows that by August 2022 the advanced dune loss has reached as far back at the dunecrest.

Photograph 3c shows the severe erosion pattern continued at this location, exposing the rocks that provide the vital street and infrastructure protection. View to the west.



Figure 4. Aerial view of Seaview Avenue profile beach October 30, 2022, looking to the south over Corson's Inlet. The incoming breaking waves and their angle to the shoreline beach combined with the flood-tidal currents moving into Corson's Inlet, generate rapid sand transfer away from this critical region. While shallow wave-like bars still lie just offshore, the beach berm has been cut into a vertical scarp right at the end of Seaview Avenue. That scarp continues into the NJ State Park land to the northwest. Significant volumes of new sand moving north toward the inlet from the southern bar system is required if the erosion is not to move into the 2019-2020 USACE rebuilt dunes this winter.

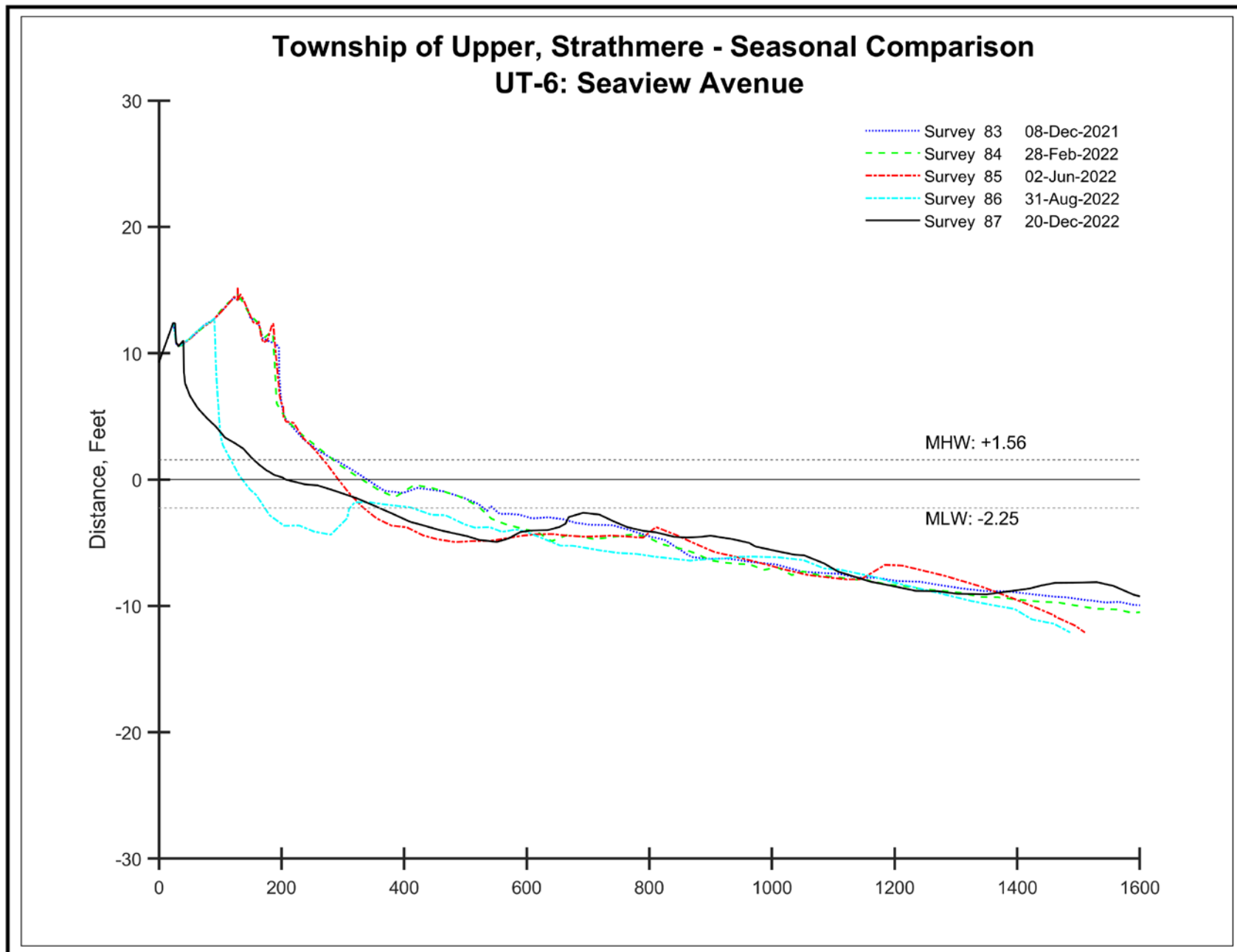


Figure 5. This 2022 sequence of surveys illustrate the rapid shoreline retreat. The August 31, 2022, survey at UT-6 provides a stark view of the dune erosion since June. Previous losses had been relatively minimal, but in the three months, the net loss in sand volume is 84.92 yds³/ft. with a 157-foot shoreline retreat. By December 2022, the nearshore bar approached the shoreline slightly elevating the lower recreational beach, but the sand quantity is insufficient to moderate the situation.

◆ Survey Line UT-5, Williams Avenue, Strathmere

This site was first nourished by the State of New Jersey 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 was included in the municipal monitoring project. Sand is naturally and 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.

The Williams Avenue site was not provided with massive sand volumes initially in the federal project in 2009. However, recent rates of erosion prompted a significant fill in December 2019. The fill volume was 116.67 yds³/ft. which produced a 272-foot shoreline advance. Recreational beach, berm, and nearshore losses occurred throughout all four seasonal surveys the CRC conducted in 2022 due to a combination of storm events and lack of tidal delta sand bar migration onto these beaches. This loss of sand began to impact the dune system as a scarp at the dunetoe emerged by the final December 2022. Over the year, 236 feet of shoreline was recorded with sand losses amounting to 131.615 yds³/ft.



6a. December 8, 2021



6b. June 3, 2022



6c. December 20, 2022

Figures 6a to 6c. UT-5 survey site on Williams Avenue.

Figure 6a. The December 2021 view from the upper beach area shows the decreased width, but no dune damage to date.

Figure 6b was taken in June 2022 looking south across the central region along the berm. Erosion to the beach width berm has taken place.

Figure 6c. View to the south along the upper recreational beach. Severe erosional processes have further cut into the beach and dunetoe, creating a distinct scarp cut into the dune.

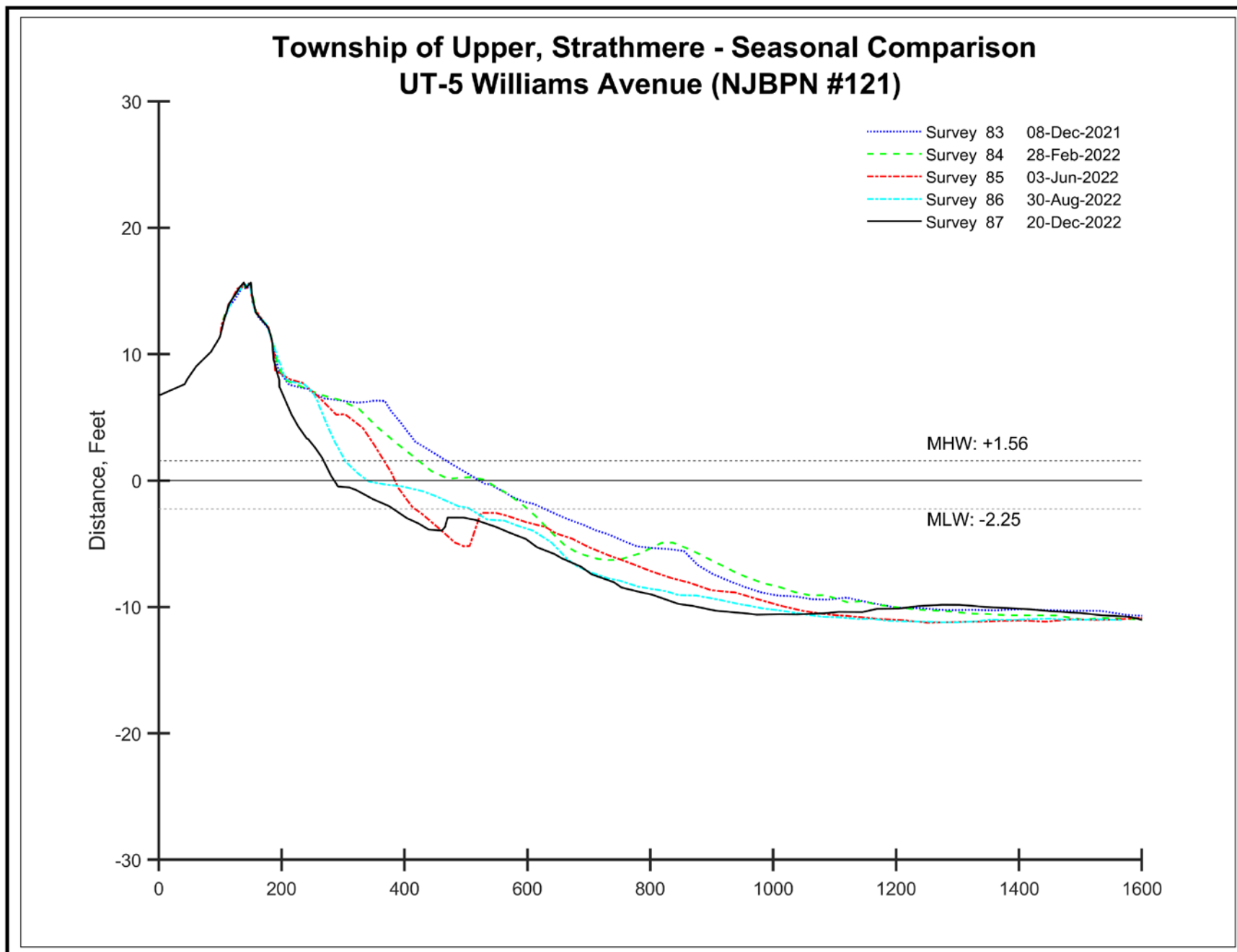


Figure 7. At Williams Avenue, beach retreat over the summer lost 45 feet of shoreline landward as the beachface eroded. Sand was deposited immediately offshore filling in the June trough. The last quarter of 2022 displayed continued losses to the beachface and nearshore regions. Overall losses for the annual comparison amounted to the largest of the 6 profiles with 236 feet of shoreline and 131.05 yds³/ft. of sand.

◆ Survey Location UT-4, Tecumseh Avenue, Strathmere

This profile location was established because the shoreline dynamics are vastly 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 more like a mid-island beach where losses are 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 an obsolete array of timber bulkheads and timber groins. These structures were installed decades previously and are currently 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 most recent 2019 maintenance effort provided 72.36 yds³/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).

Similar to the site at Williams Avenue located immediately to the north, the Tecumseh Avenue site recorded losses from the recreational beach through the shallow nearshore regions throughout all four quarters in the 2022 survey seasons. By June 2022, the beginning of a dune scarp can be seen, and as the erosional progression continued along the upper beach area, this scarp became significantly more pronounced by December. The nearshore trough, which was present in the summer survey, had begun to fill in by the final 2022 survey. The recreational beaches remain at their most vulnerable elevations.



Figure 8a. December 8, 2021



Figure 8b. June 3, 2022



Figure 8c. December 20, 2022

Figure 8a. The December 2021 view to the north along the mid-beach foredune system shows a developing array of dunes normally expected to become a primary dune field.

Figure 8b. The June 2022 photograph shows recreational and berm losses have taken place leaving only a narrow area of dry beach at high tide.

Figure 8c. View to the south in December 2022. The entire beach remains wet while significant erosion into the dune has occurred, revealing a 3-to-5-foot scarp into the dunetoe. Notice the exposed timber pilings from the formerly buried wooden groin.

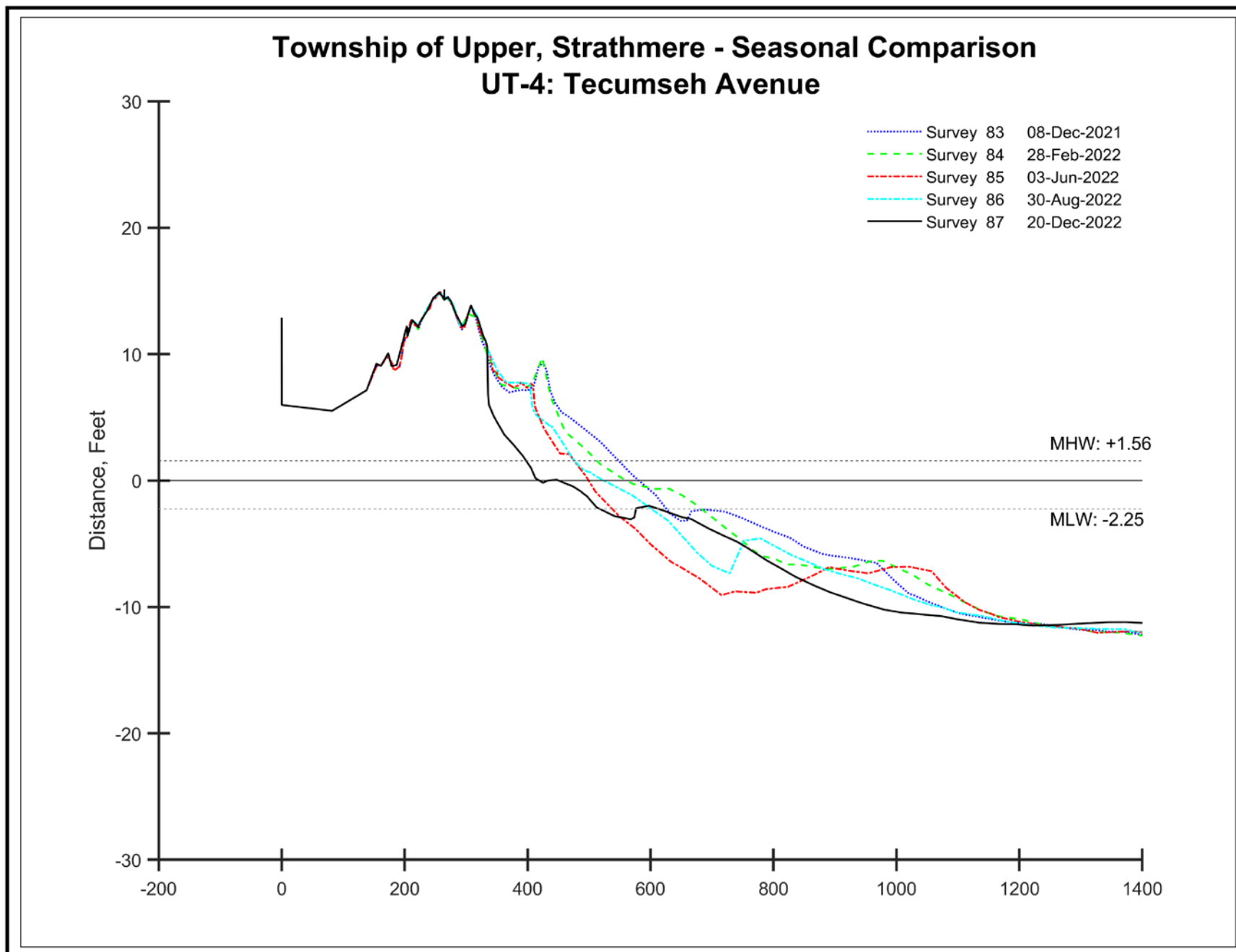


Figure 9. This location suffered beach retreat up to the December 2022 survey. Over 130 feet of shoreline retreat with 72.64 yds³/ft. of sand volume losses were recorded when comparing the annual December surveys. A significant offshore bar displayed in previous surveys has shifted outside the profile limits.

◆ 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 1990s breached the dune here four times resulting in severe damage to 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. This project elevated and extended the berm position seaward nearly 250 feet. In June of 2016, the USACE had completed the northeast storm “Jonas” (January 24, 2016) restoration. No maintenance sand from the 2019 USACE project was directly placed at this location, but the site saw four quarterly sand volume increases totaling 32 yds³/ft. during 2020.

The erosional trends occurring in the recreation beach through the nearshore in the three northern UT profile sites had little influence on the Jasper Avenue location. Here, the typical beach berm had formed by the August 2022 survey, with relatively healthy recreational beaches and no damage to the protective dune. By the final December survey, traditional fall sand migration patterns shifted some of the berm material to a nearshore bar located about 1,000 feet from the profile’s origin. If history repeats itself, the anticipated migration of these bar sands back to the beach and berm regions should take place in time for the upcoming summer months.



10a. December 8, 2021



10b. June 3, 2022

Photo 10a. The valley between the old primary dune and its buried fencing is between a vibrant new foredune system rapidly becoming the main area where new sand is added.

Photograph 10b View to the north in June displaying the wide healthy primary and foredune system.

Photograph 10c. The December 2022 view looking to the north, shows that the entire dune system remained unscathed by erosional forces and continues to flourish.



10c. December 20, 2022

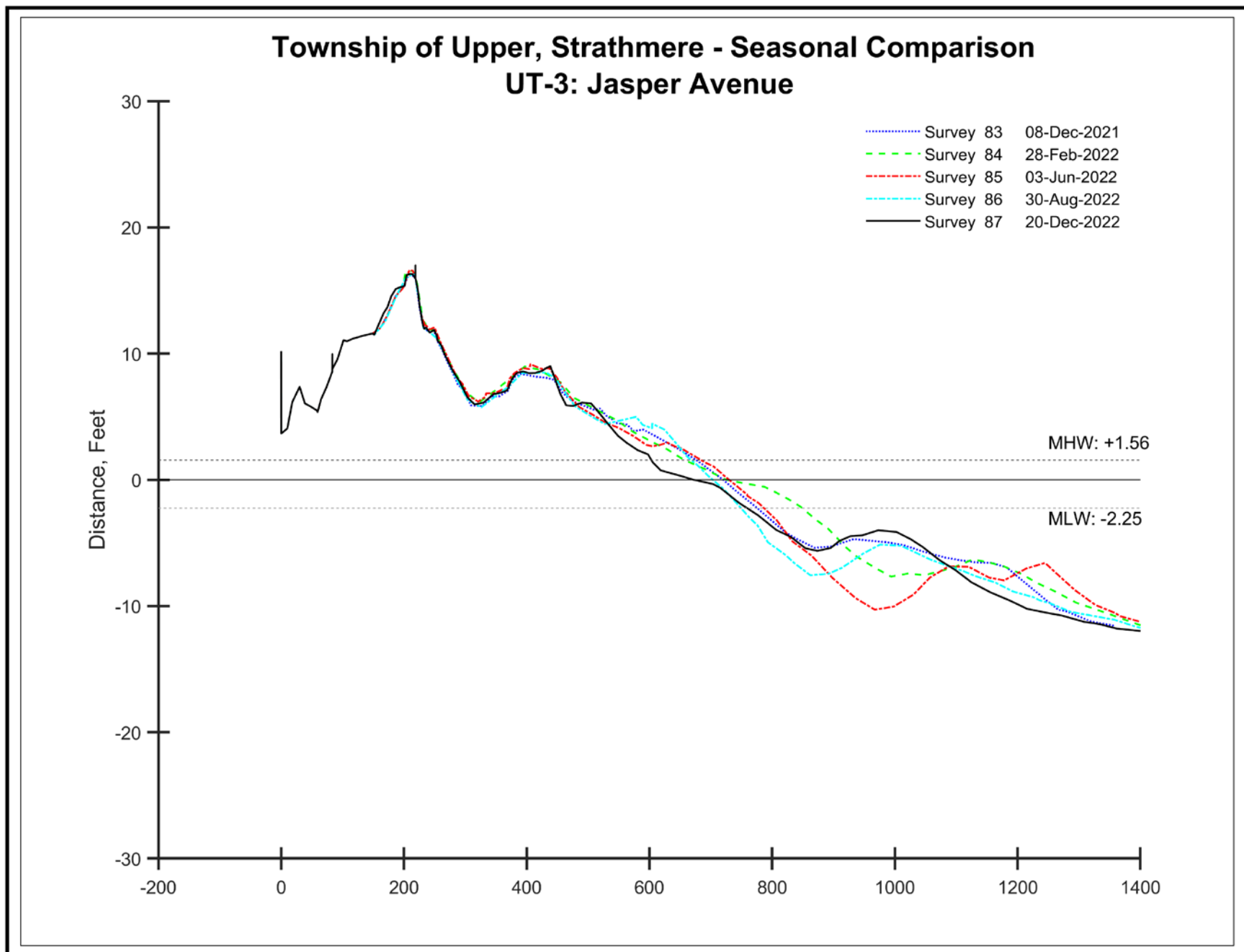


Figure 11. The berm position that was present through August 2022 had eroded by December as sand shifted to the offshore bar, in the process filling in the nearshore trough. Both the primary and the foredune remained intact throughout this study interval. For the annual comparison, the sand volume declined by 20.63 yds³/ft. across the entire transect line coupled with a shoreline retreat of 48 feet.

◆ 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 starting in 1984. The most effective non-federal project was completed by the NJDEP and Upper Township at a 75% state cost and 25% local cost in 2009.

Following initial USACE project construction, the post-Jonas northeast storm restoration was complete by June 2016 with a wider beach due to an added 56.01 yds³/ft. placed at the site. No new sand was directly added to this location during the 2019 USACE efforts.

The winter of 2021 into 2022 slightly eroded the berm and flattened the beach slope generating a larger than normal nearshore bar. By June 2022, that berm continued to lose elevation and position as material shifted to the offshore bar. As of August 2022, the sands from the offshore bar began to migrate landward and elevating the nearshore and berm areas. The bar attached to the beach by December 2022 adding to the berm and widening the recreational beach.



12a. September 12, 2021



12b. June 2, 2022



12c. December 20, 2022

Figure 12a. This view in September depicts wind deposition into the new grass at the dune toe with minor change obvious in the general beach condition.

Photograph 12b taken on a bright sunny day looking south along the foredune toe.

Photograph 12c. This view in December displays continued wind deposition into the grass at the dune toe with increases to the berm width and elevation since the summer survey.

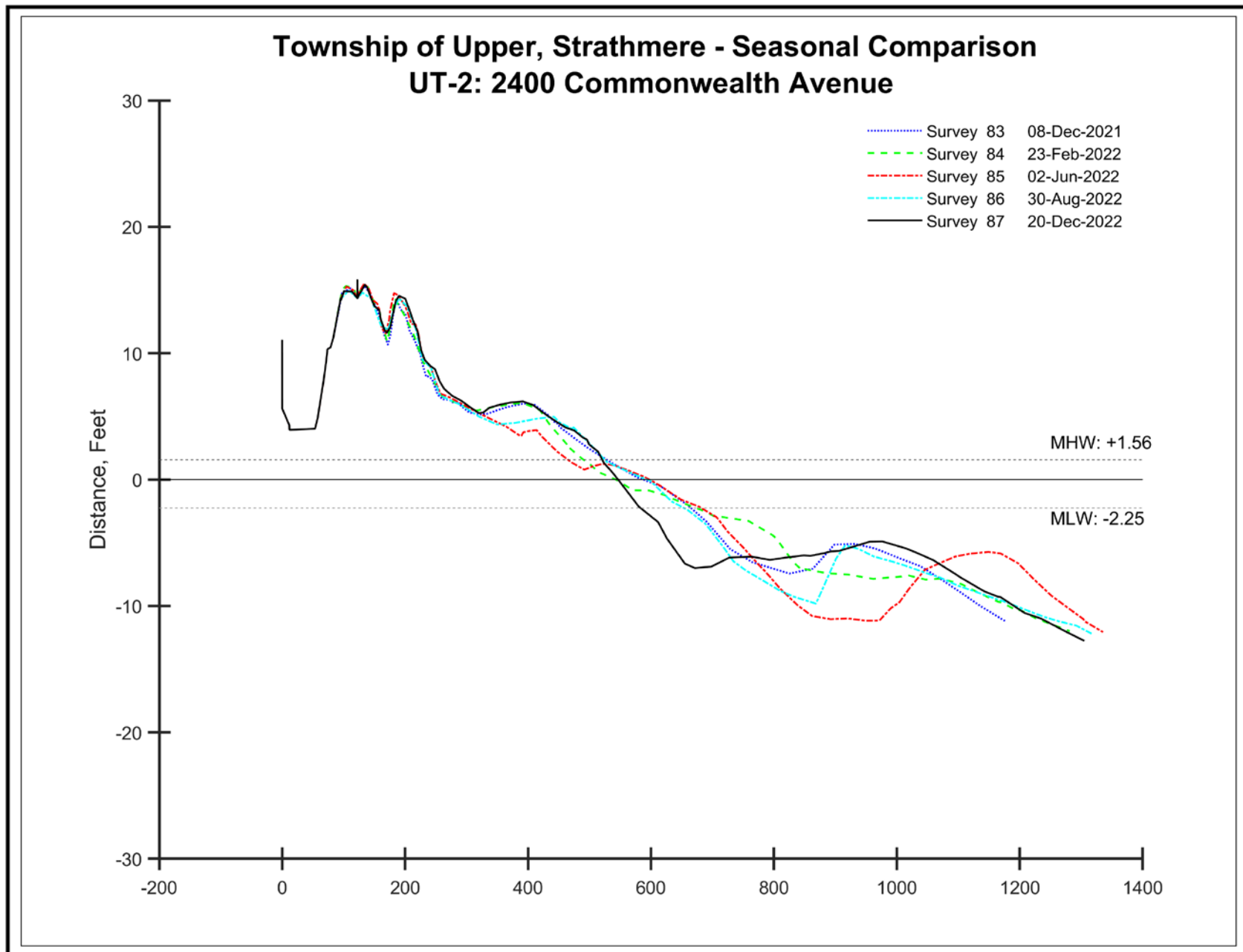


Figure 13. The primary dune developed a significant foredune nearly at the same elevation as the reference position on the original dune. Berm growth did not reach the 2021 proportions by December 2022 as the nearshore sand welded to the beachface. Significant offshore bar advancement can be seen since the August survey. Between surveys 86 and 87, the seasonal loss was 47 feet of shoreline with 8.15 yds³/ft. net gain in sand volume.

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

This profile site is located 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 once suffered from overwash during any moderate northeaster. In fact, the segment to the south of the site was so persistently overwashed, 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 geo-textiles replaced the use of I-5 gravel used as road grade base in the core of the primary dune. Another failed attempt was the placement of the first generation of “Beachsaver Reefs” in the proximal nearshore sub-tidal zone to mitigate wave energy striking the beach. These were removed shortly after they subsided into the sand and marsh mat under the sand by order of the NJDEP.

In 1984, a New Jersey co-sponsored beach nourishment project introduced Corson’s Inlet sand to this location as part of the original Strathmere beach nourishment project. This work was accompanied with three timber base and rock toe offshore groins spaced widely between the Tecumseh Avenue site and this location. The NJDEP 2009 beach project added material here as well.

The USACE sponsored beachfill was completed by July 2015. This project significantly extended and elevated the dune and beachface seaward. The post-Jonas disaster declaration USACE restoration was complete by June 2016 with a wider beach and an added 26.86 yds³/ft. placed at the site. This site lies well south of the 2019 maintenance effort focused on the northern half mile of the oceanfront.

The recreational beach and berm decreased in position and elevation between the December 2021 and the June 2022 surveys conducted by the CRC. These materials shifted offshore, enhancing the offshore bar to its most significant elevation at this time. Landward migration of the offshore bar began over the summer months and August, the survey data captured the formation of a double-tired berm. Recreational beach elevation increased by the final December survey while the lower berm reset its position seaward. For the annual comparison at this site, the shoreline position remained unchanged at the sand volume across the profile increase by 4.28 yds³/ft.



14a. September 13, 2021



14b. June 2, 2022



14c. December 20, 2022

Photograph 14a. This early fall view shows the beach width re-established since the summer after the offshore bar moved onto the beach.

Photograph 14b. View to the north along the dunetoe in June 2022. Slight accretion can be seen in the seaward foredune slope.

Photograph 14c. This December 2022 view shows the beach width and dune system remains in-tact.

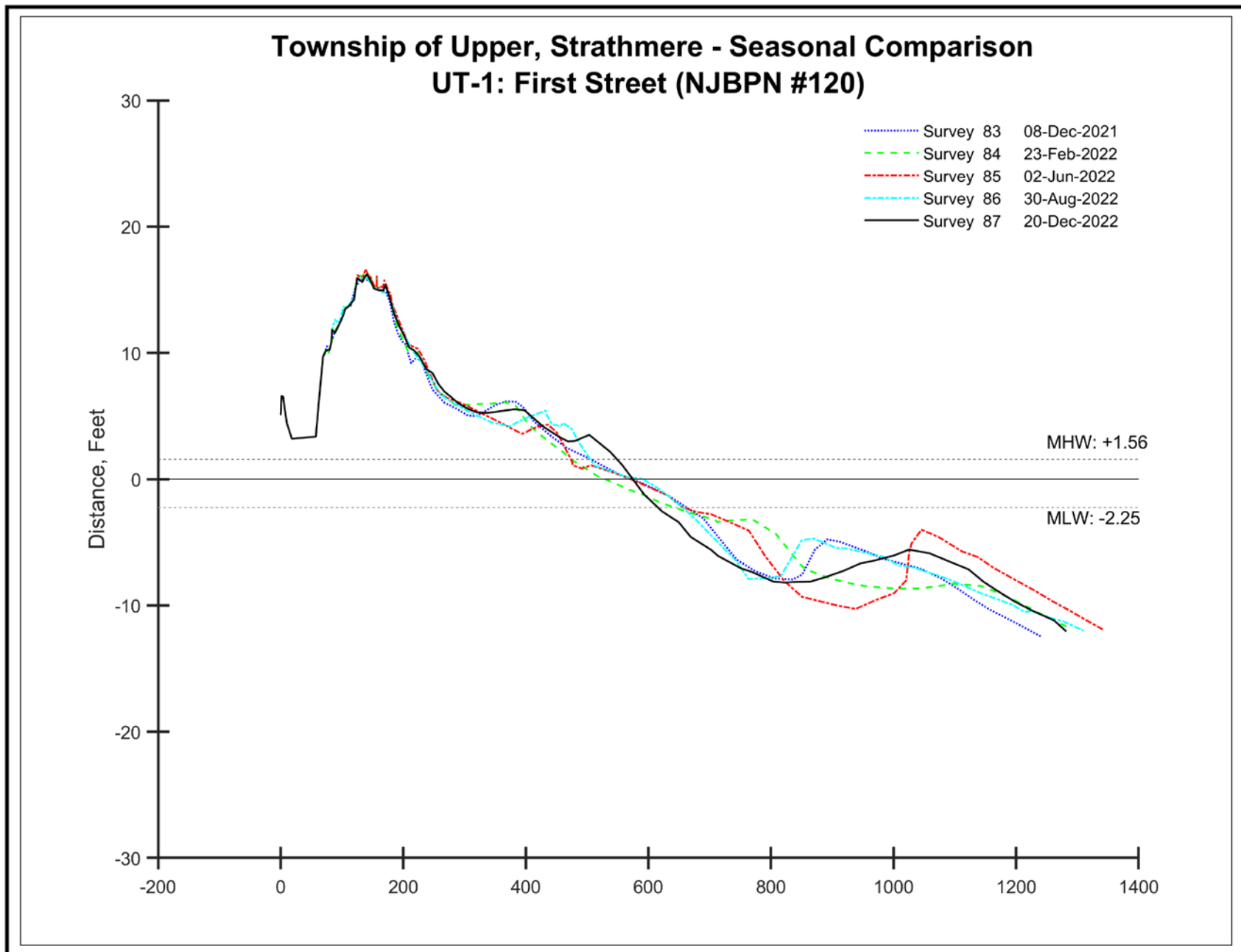


Figure 15. Seasonal variations appear well illustrated in this site's five transects. A double-tiered berm developed by the final survey as nearshore material made its way to the beachface. The pronounced offshore bar that was present in August had returned by December, though not as elevated. The primary dune remained virtually unchanged for the entire study period. Despite the offshore topography changes, this site managed a relative equilibrium with 4.28 yds³/ft. of sand gain recorded over the 12 months.

Summary & Conclusions

A summary sheet provided by Mr. Dwight Pakan, project manager for the USACE Ocean City to Sea Isle City shore protection project presents the following:

1. The 2015 federal project placed approximately 1.224 million cubic yards of sand on the north end of Ludlam Island that included the Strathmere oceanfront beaches. The US Army project also placed 1.516 million yards of sand on the southern end of Ocean City's oceanfront; all sand was derived from offshore sand sources. The work continued into Sea Isle City (1.889 million cy).
2. An emergency repair was sanctioned because of an October 2015 northeast storm. Sand was sourced from Corson's Inlet ebb tidal delta; amounts received by each municipality are:
 - a. Ocean City (317,200 cy)
 - b. Strathmere (312,000 cy)
 - c. Sea Isle City (374,000 cy)
3. The USACE returned after Northeast Storm Jonas, in 2016, to repair the damage under a Federal Disaster Declaration with sand derived from Corson's Inlet ebb-tidal delta borrow zone:
 - a. Ocean City (173,800 cy)
 - b. Strathmere (235,600 cy)
 - c. Sea Isle City (530,800 cy)
4. In August of 2020, the 2nd Cycle Periodic Nourishment was completed:
 - a. Ocean City (506,159 cy)
 - b. Strathmere (511,840 cy)
 - c. Sea Isle City (895,001 cy)Sand used in Ocean City and Strathmere was derived from Corson's Inlet. The Sea Isle sand came from the offshore borrow site.

The year 2022 produced considerable sand loss to the region. There was a special erosional focus on the northern three locations from Tecumseh Avenue to the inlet profile at Williams Avenue. Following the combination of the back-to-back Mother's Day and northeast storm events, the spring losses of -266,664 cubic yards were by far the most critical of this annual report. A staggering -365,662 cubic yards of cumulative sand volume losses calculated for the 12 months between December 2021 and December 2022. The northern three profiles combined to record a 500-foot shoreline retreat with almost half of that linear loss coming from the Williams Avenue site (UT-5). At the northernmost site, Seaview Avenue (UT-6), rock structures that were installed and buried as road and infrastructure protection have been uncovered as the shoreline retreat cut well into the dune system. Sand supplies to the south must move quickly toward the inlet to prevent further dune erosion this winter.

Inlet tidal dynamics continue to play a significant role in shoreline stability in the vicinity of Corson's Inlet and extensively shape the shoreline location. This is attributed to the interplay of positions between the main tidal channel to the north and an ephemeral secondary channel that periodically appears adjacent to the low tide line along the beaches proximal to Corson's Inlet in Upper Township. Historically, this formation of a secondary tidal channel running closer to the Strathmere shoreline acts as a scouring agent at the base of the beach effectively removing large volumes of sand at the very northeastern most point of the barrier island, and even in the absence of storm events can produce extensive shoreline retreat. As evident in Figure 16 below, the submerged shoal configuration has surrounded and restricted the main tidal channel, most likely forcing the inlet channel to swing south in response to the build-up of sand on the northern shoals, almost certainly resulting in the secondary tidal channel formation. Topographic and bathymetric surveys of the entire Corson's Inlet system would verify this premise.



Figure 16. This October 30, 2022 photograph of Corson's Inlet shows the constriction of the main tidal channel by the surrounding ebb-tidal shoal system. Notice the absence of a clear navigable pathway out between Ocean City and northern Ludlam Island to the oceanfront. *(Photo by Ted Kingston)*