



## MEMORANDUM

DATE: November 4, 2016

TO: Cliff Ogburn, Town of Nags Head (NC)

FROM: HL Kaczowski, Project Engineer  
TW Kana, Project Director

RE: Nags Head Post-*Matthew* Beach Condition Survey [CSE 2458–Task 2]  
**Preliminary Results**

Hurricane *Matthew* was the thirteenth named storm, fifth hurricane, and second major hurricane of the active 2016 Atlantic hurricane season (Wikipedia). As *Matthew* approached the U.S. East Coast, Governor Pat McCrory declared a state of emergency across North Carolina on Thursday, 6 October 2016. After *Matthew*'s passage, Nags Head officials observed a significant loss of sand in the dune and the visible beach areas (c/o D. Ryan, 17 October). Per the Town's request, CSE conducted a comprehensive beach condition survey from October 26 to November 2 to determine the sand volume within the calculated limits established in the Monitoring and Maintenance Plan (Ogburn 2011).

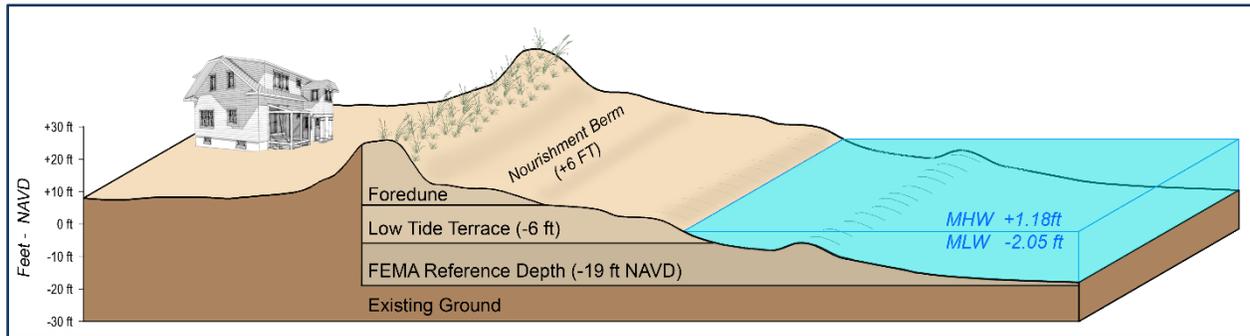
This memorandum offers preliminary results of the October survey. These results are compared to the pre-hurricane season survey results of June 2016, and sand volume changes caused by Hurricane *Matthew* are determined. Toward the end of this memo, CSE gives recommendations to the Town on application for FEMA's post-storm beach restoration funding.

### **SURVEY AND VOLUME ANALYSIS METHODOLOGY**

CSE collected data in October following the same methodology as the previous surveys described in CSE's reports (ie – CSE 2016). We measured profiles at 500 feet (ft) spacing between the foredune and deep water at the same stations used in the previous surveys. The Oct–2016 profiles are compared with corresponding profiles obtained in June 2016 (before the hurricane season). The volume of sand contained between the foredune and three reference depth contours are calculated in three lenses as follows.

- Lens 1 – Foredune – From the face of dune to +6 ft NAVD
- Lens 2 – Beach – Between +6 ft and –6 ft NAVD
- Lens 3 – Underwater – Between –6 ft and –19 ft NAVD (ie – FEMA reference depth limit)

Illustration of these three lenses used in the volume analysis is shown in Figure A.



**Figure A.** Illustration of the three lenses used in the profile volume analysis for Nags Head.

The shoreline was subdivided by the same reaches and subreaches used in the June 2016 volume analysis. We use the volumes from June 2016 as the baseline condition and subtract them from the results of the October survey (post-Matthew). This yields the change in volume with respect to conditions prior to the hurricane season.

## **RESULTS**

### *Volume Changes along Nags Head*

Figures B, C, and D show unit volumes station by station in different lenses comparing June 2016 (pre-hurricane season) and October 2016 (post-Matthew). The dashed lines show the trend of data of each survey set. Nearly all stations lost sand in October 2016 in all lenses, and the largest unit volume loss occurred when measured to the FEMA depth limit at -19 ft NAVD (Fig D). There are several sections of the beach where the October lines are above the June lines, meaning those particular localities had more sand after the storm. Such differences are caused mainly by sand migration alongshore during the storm. On average, Nags Head lost ~27 cubic yards per linear foot of shoreline (cy/ft) between the foredune and -19 ft NAVD after Matthew, which is equivalent to a total volume loss of ~1.43 million cubic yards along the 10-mile project area.

### *Volume Changes by Reach and Subreach*

Figure E provides overall results by reach relative to the pre-hurricane season condition. All reaches and subreaches lost a significant amount of sand after Matthew.

To summarize sand losses in all reaches and subreaches, the results show that **the 10-mile Nags Head engineered beach has lost 1,431,653 cy of sand after Hurricane Matthew measured from the foredune to -19 ft NAVD**. This loss represents ~30 percent of the total nourishment volume placed in 2011.



Figures F, G, and H are three sets of orthophotos showing the impact of *Matthew* along the northern and southern ends of Nags Head. The top photos were taken in June 2014 (the most recent orthophotos that the Town has), and the bottom photos were taken by NOAA on 10 October 2016 right after *Matthew*'s passage.

## **RECOMMENDATIONS**

According to the Federal Emergency Management Agency (FEMA) Disaster Assistance Fact Sheet DAP9580.8 – Eligible Sand Replacement on Public Beaches (dated 1 Oct 2009), Nags Head is eligible for assistance in Permanent Work under Category G guidelines because of the following reasons:

- 1) The 10-mile Nags Head beach was constructed by beach nourishment in 2011;
- 2) A maintenance program involving periodic renourishment with imported sand has been established and adhered to by the Town of Nags Head; and
- 3) Approximately 90 percent of nourishment volume remained in the calculation limits as of June 2016, which is above the renourishment threshold established in the maintenance plan.

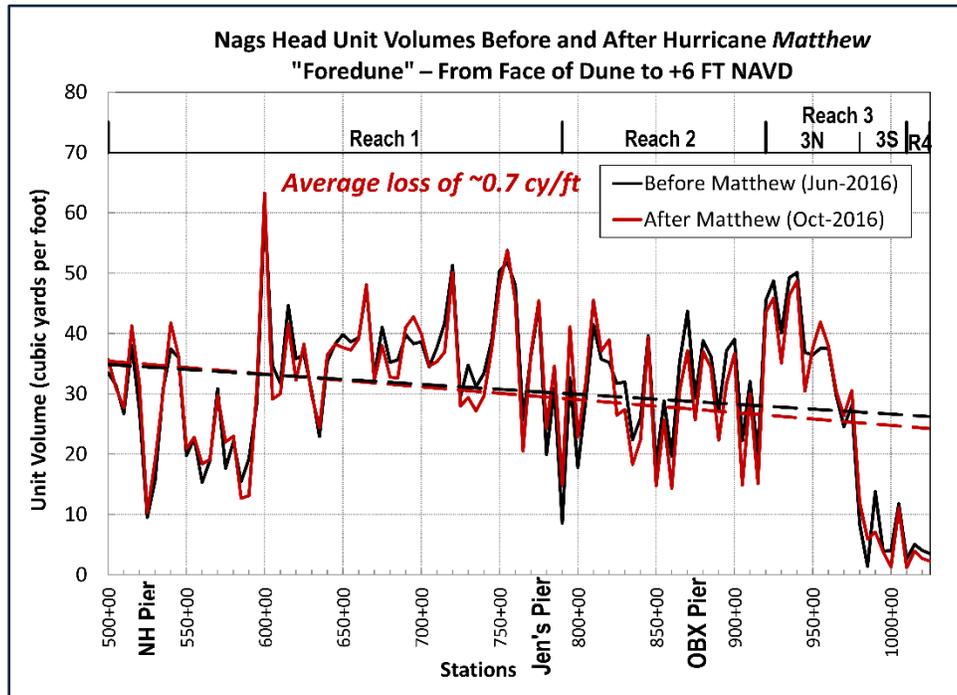
To document eligibility of the beach as a designed and maintained facility, FEMA's Fact Sheet further states that the following documentation should be provided to FEMA:

- (1) All design studies, plans, construction documents, and as-builts for the original nourishment;*
- (2) Documentation and details of the maintenance plan, including how the need for renourishment is determined and funded; and*
- (3) Pre- and post-storm profiles that extend at least to the seaward edge of the sub-aqueous nearshore zone (closure depth, usually –15 to –20 ft).*

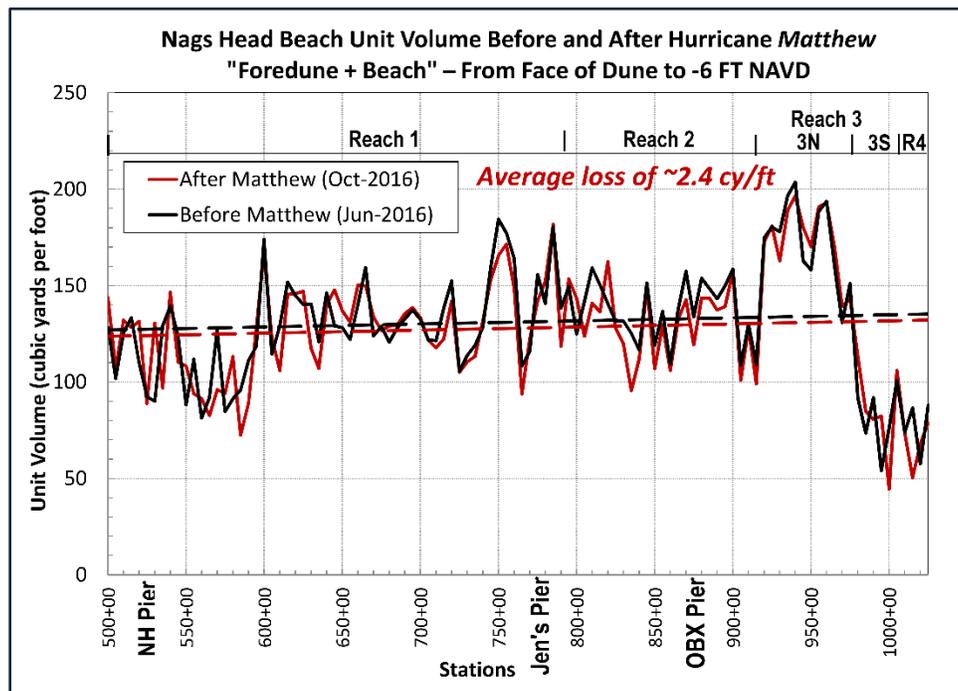
The amount of sand eligible for replacement with Permanent Work funding is limited to the amount lost as a result of the disaster event. For Nags Head, the nearshore measurement limit was set at –19 ft NAVD in the Maintenance Plan. Therefore, the net sand losses to –19 ft NAVD between June 2016 and October 2016 constitute the volume of sand that CSE believes the Town of Nags Head is eligible to claim as a storm loss. We have calculated this volume loss to be 1,431,653 cy. CSE recommends the Town of Nags Head apply for FEMA post-storm beach restoration funding, and CSE will assist the Town with document preparation and other necessary tasks as requested related to this application.

## **REFERENCES**

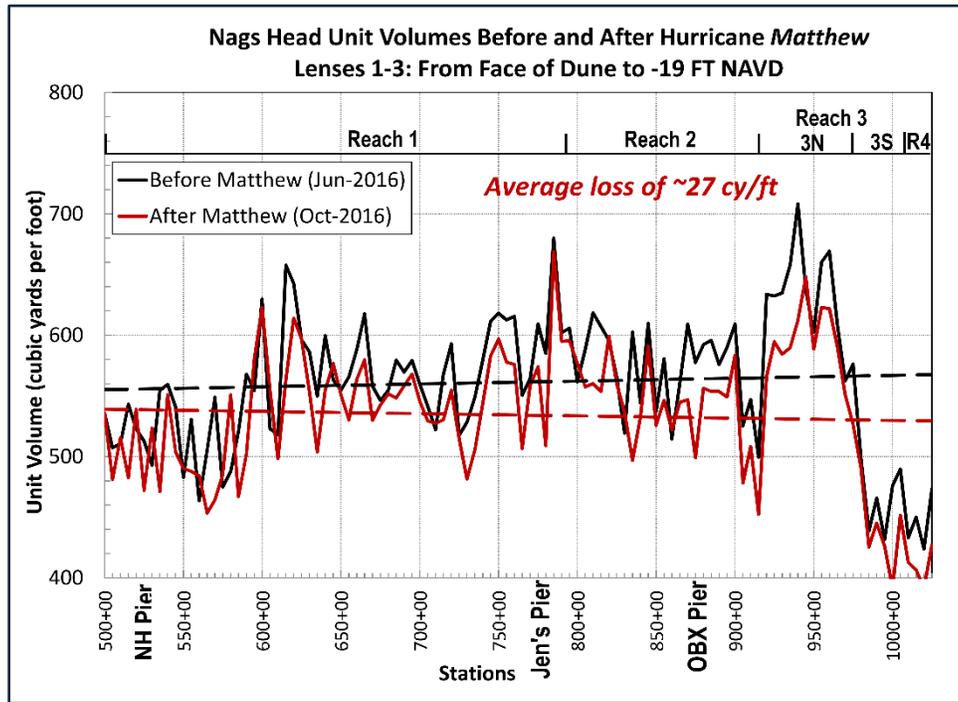
- CSE. 2016. Monitoring and analyses of the 2011 Nags Head beach nourishment project. Year 5 (2016) beach monitoring report for Town of Nags Head, NC. CSE, Columbia (SC), 75 pp + appendices (2387).
- FEMA. 2009. Disaster Assistance Fact Sheet DAP9580.8 – Eligible Sand Replacement on Public Beaches, 4 pages.
- Ogburn, C. 2011. Beach monitoring and maintenance plan for Town of Nags Head, Dare County, North Carolina. Adopted by Town of Nags Head Board of Commissioners, August 2011, 6 pp plus 4 attachments.



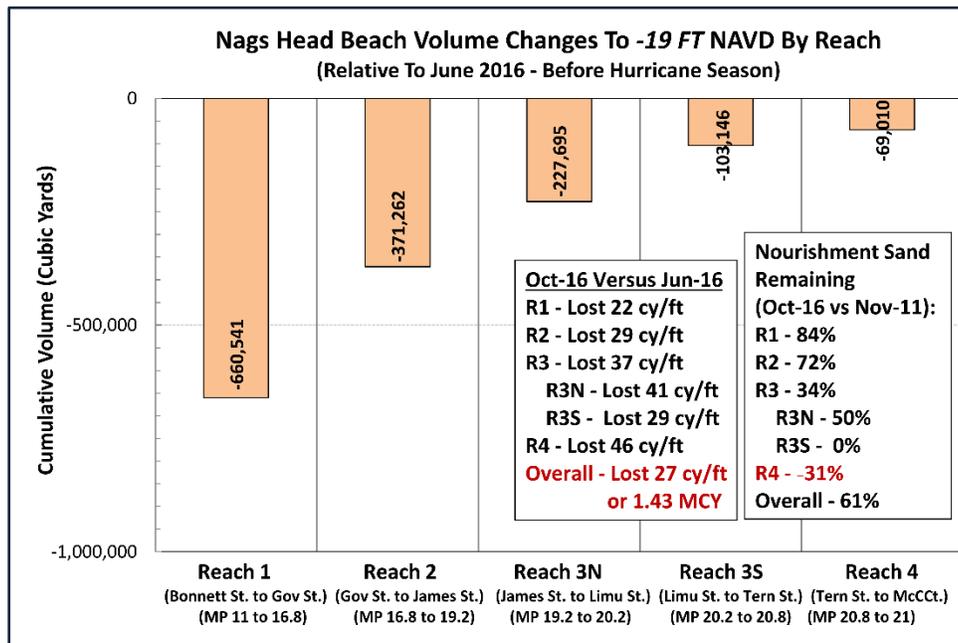
**FIGURE B.** Comparison of unit volumes by station in the foredune areas (Lens 1) before and after Hurricane *Matthew*.



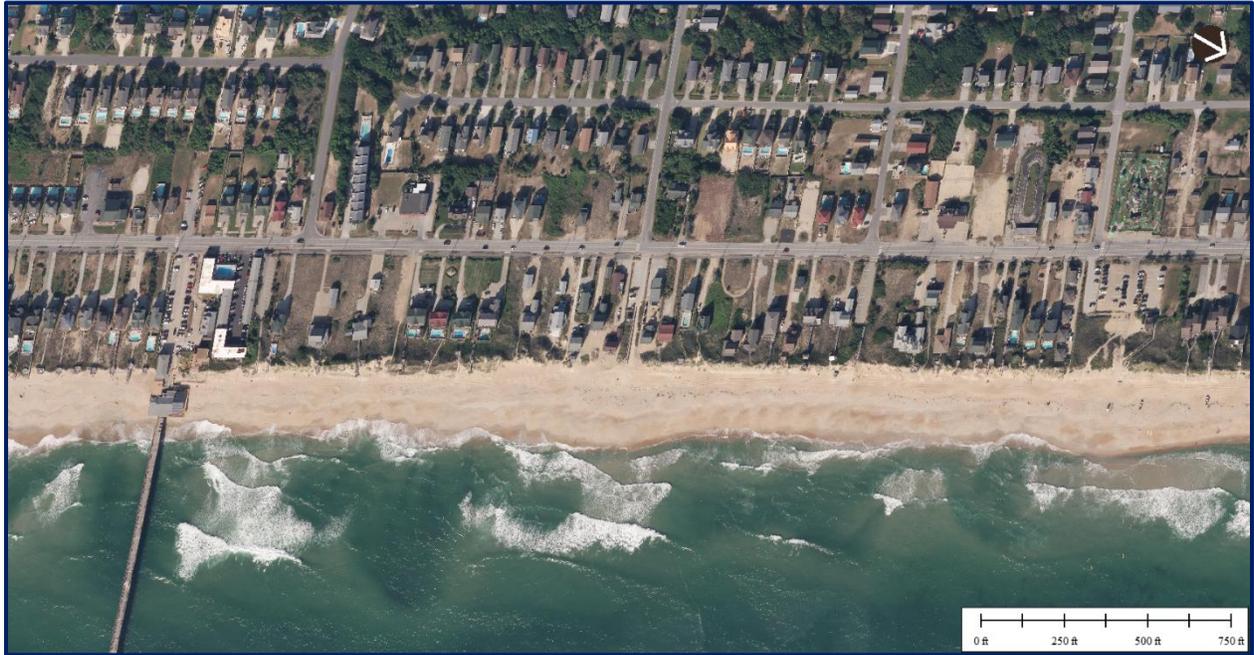
**FIGURE C.** Comparison of cumulative unit volumes by station in the foredune and beach areas (Lenses 1 and 2) before and after Hurricane *Matthew*.



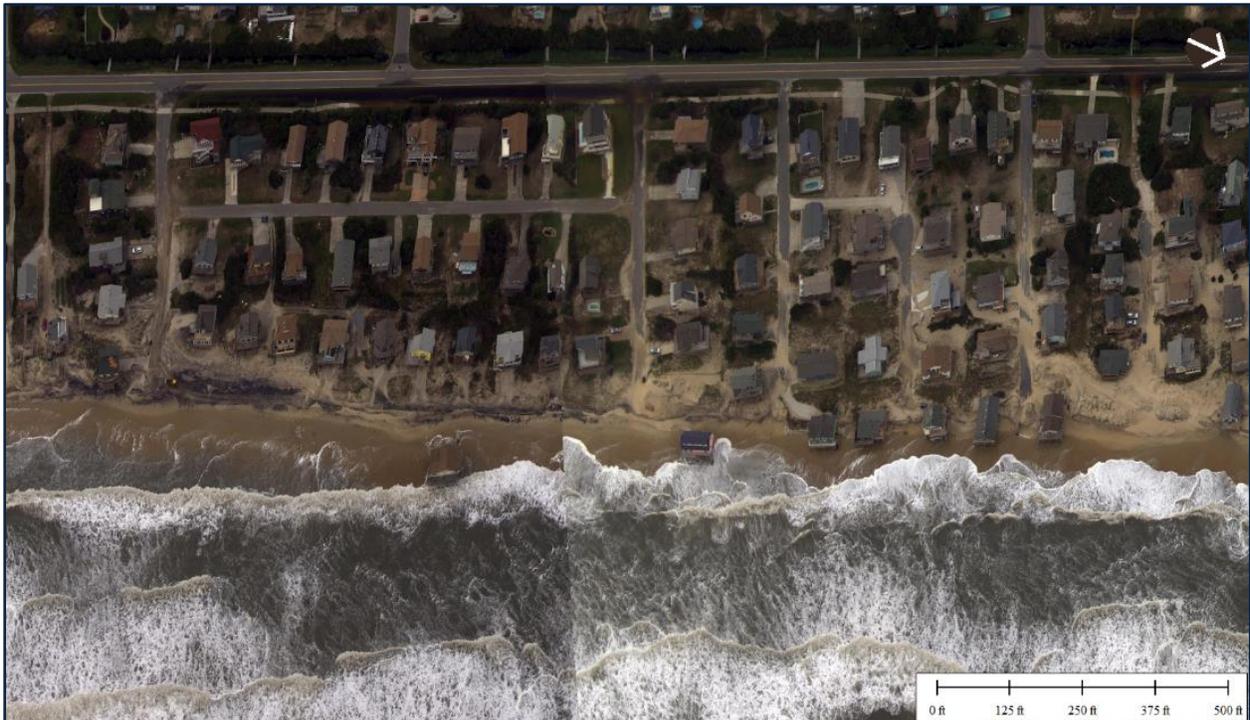
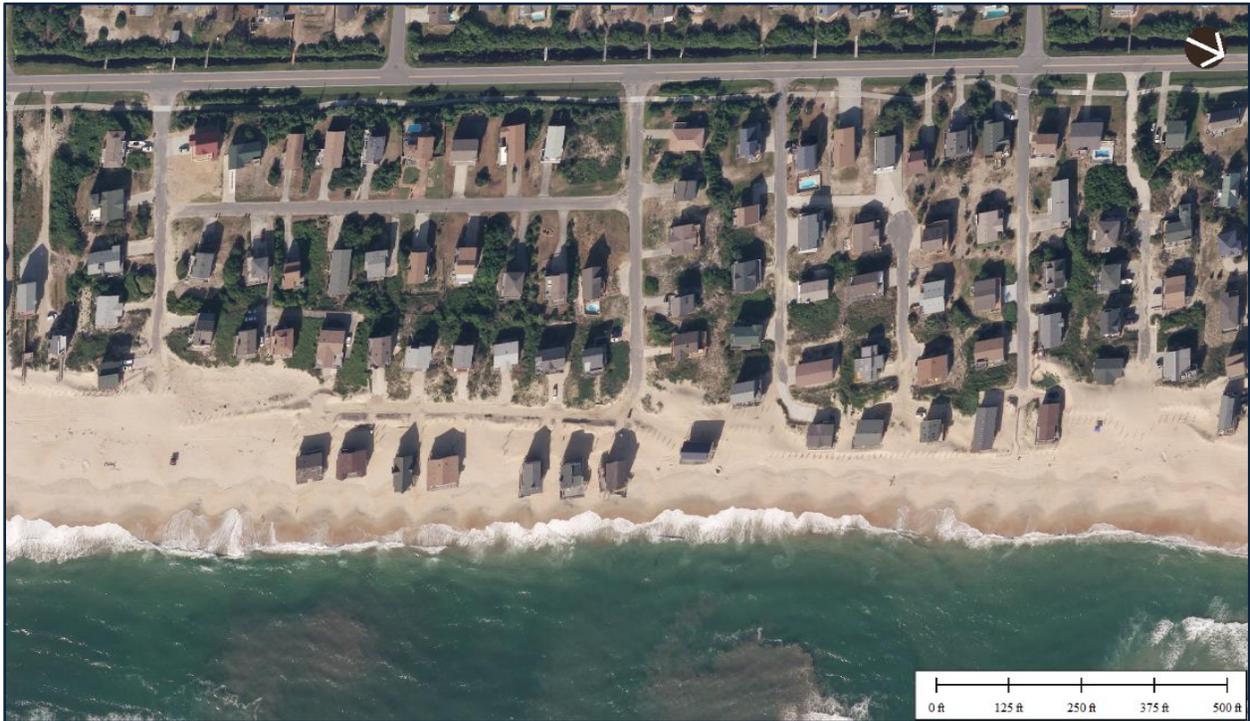
**FIGURE D.** Comparison of cumulative unit volumes by station between the foredune and –19 ft NAVD (Lenses 1, 2, and 3) before and after Hurricane *Matthew*.



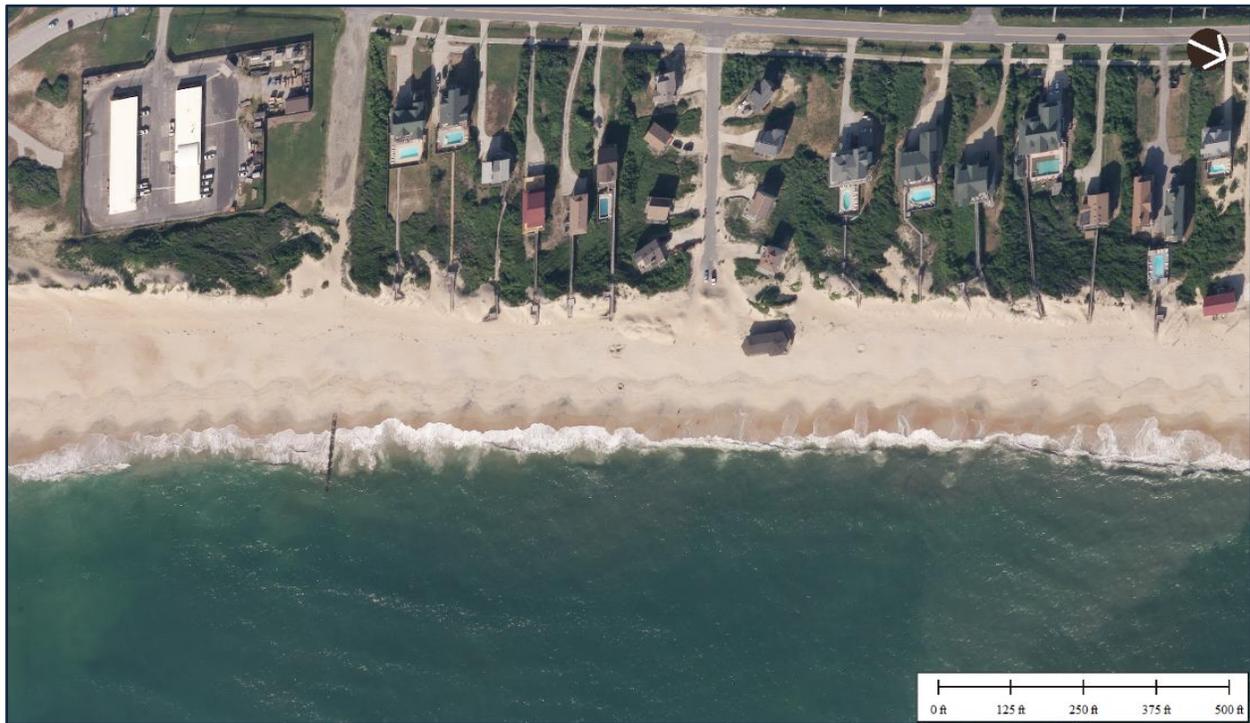
**FIGURE E.** Beach volume changes by reach and subreach relative to June 2016 survey results from the foredune to –19 ft NAVD.



**FIGURE F.** Orthophotos of project’s north limit near Nags Head Pier and Bonnett Street) before (7 June 2014) and after (10 October 2016) Hurricane *Matthew*.



**FIGURE G.** Orthophotos of Seagull Drive before (7 June 2014) and after (10 October 2016) Hurricane *Matthew*.



**FIGURE H.** Orthophotos of Town’s south limit before (7 June 2014) and after (10 October 2016) Hurricane *Matthew*.