



December 6, 2011

Mr. Cliff Ogburn, Town Manager
Town of Nags Head
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RE: Nags Head Beach Nourishment Project (CSE 2203)
Final Report – Preliminary Results

Dear Cliff:

This letter summarizes the condition of the beach along Nags Head after nourishment.

Between 24 May and 27 October, the contractor (Great Lakes Dredge & Dock Company) placed 4,615,126 cubic yards (cy) along the ten-mile project area. Seventy (70) percent of the sand was placed above mean low water (MLW), and 30 percent was placed below MLW. CSE completed a detailed survey of the beach and inshore zone in November 2011 and compared present conditions against the November 2010 condition (same-season comparison). We confirm herein there are 4,713,927 ($\pm 3\%$) cubic yards more sand volume in the ten-mile project area after nourishment. Following normal adjustment and fall storms, 52 percent of the nourishment sand remains on the visible beach above MLW and 48 percent is contained between MLW and the 12-foot (ft) depth contour (~800 ft offshore). Sand losses out of the project area to date have been negligible.

Figure A shows typical cross-sections (“profiles”) of the beach before and after nourishment. The upper diagram shows the initial shape of the nourished beach as sand was pumped into place. The constructed beach averaged more than 200 ft wide, and nearly all the new sand was contained within 400 ft of the foredune. This beach shape allowed the contractor to control the volume placed with the expectation that waves would soon reshape the nourishment into a natural profile.

The middle diagram of Figure A shows the profile of the beach after Hurricane *Irene* (27 August) and several fall northeasters. Storm waves pushed some sand higher on the dry-sand beach (note yellow wedge) while at the same time the wet-sand beach receded landward. Thus, the dry beach narrowed by about 25-33 percent. Some sand from the wet beach shifted offshore and formed a bar 400-600 ft from the foredune (note the underwater sand buildup). We determined the limit of significant sand movement since nourishment was the 12-ft depth contour (~800 ft from the foredune).

The lower diagram of Figure A compares the nourishment profile (referred to as “fill template”) and the adjusted profile. The red zone shows the portion of the nourishment profile that shifted onshore (to build the dry beach higher) and offshore (to form a new bar in shallow water). The green zone shows the net buildup of the beach and underwater area following nourishment and natural adjustments.

Figure B illustrates conditions before and after nourishment. Prior to nourishment, condemned houses along Seagull Drive were sitting in the surf. Regulations precluded nourishment over exposed sandbags, so the project had to work around the Seagull houses, leaving a pond (see middle photo). Fall northeasters washed over the nourished beach and pushed sand into the pond (see bottom photo).

The landward and offshore shift of sand had the important effect of forming a more natural profile with new sand bars forming in shallow water. Prior to the adjustment of the nourishment project, surf conditions were unfavorable and dangerous in some areas because of the steep slope of the wet beach. However, after storms impacted Nags Head, the resulting underwater bars produced more favorable surfing conditions.

Surveys during construction confirmed that ~94 percent of the nourishment sand (~4.3 million cubic yards) was placed above low-tide wading depth (-6 ft NAVD) and only ~6 percent settled in deeper water. After Hurricane *Irene* and the fall storms, ~70 percent of the nourishment sand (~3.2 million cubic yards) remains above low-tide wading depth. The remainder is found between the 6-ft and 12-ft depth contours, which are about 400-800 ft from the foredune. Figure C (upper) shows the sand volumes contained in particular slices of the beach. (See Figure A for a representation of various slices of the beach.) Note that after adjustment, 52 percent of the nourishment sand is in the visible beach above MLW, and ~48 percent is close to shore between MLW and the 12-ft depth contour (~800 ft from the foredune). We expected at least half of the nourishment sand to end up below low water where it serves as a foundation for the dry-sand beach.

CSE’s measurements in November 2011 detected over 4.7 million cubic yards more sand along Nags Head beach (calculated to -12 ft contour) compared with conditions in November 2010. This result is better than expected and suggests there has been no loss of sand by natural processes over the past year and a gain of at least 4.6 million cubic yards via nourishment. Little or no sand has shifted out of the project area into deep water (>12 ft). Figure C (lower) shows the accumulated total volumes between the foredune and indicated depth contour. Project losses have been negligible to date within the boundaries set forth for the FEMA post-storm restoration criteria (-19 ft NAVD). Our measurements detected ~4.45 million cubic yards more sand between the foredune and the -19 ft contour. The difference between this volume and the nourishment volume (~150,000 cy) is about 3 percent which is considered within the limits of accuracy of underwater surveys for projects of this type.



The results also indicate that negligible quantities of nourishment sand have shifted downcoast to the National Seashore. This is better than expected at this stage of the project because the southern end has had a few months to adjust and spread southward under northeast storms. Sand is expected to shift downcoast over time. The measurements in November 2011 suggest that if any sand has shifted to south Bodie Island since nourishment, an equal volume has shifted to Nags Head from Kill Devil Hills. Otherwise, the volume change detected in the project area would be less than the nourishment volume. We conclude from this that nourishment sand has not reached Oregon Inlet in any measurable quantity or has not increased the rate of shoaling in the channel.

In summary, the Nags Head nourishment project is performing better than expected, and the profile is adjusting to a shape and configuration which is indistinguishable from a natural beach. We expect the higher dry beach (formed by storm overwash) will remain dry most of the time and will serve as a feeder for dune growth. Areas where the dry beach is wide are also likely to sprout vegetation in spring.

Thank you for your attention and your support of this project. Please let us know if you have any questions, or if you need any additional information.

Sincerely,

Coastal Science & Engineering (CSE)

A handwritten signature in black ink, appearing to read 'Timothy W Kana', written over a light blue horizontal line.

Timothy W Kana (Project Director)

A handwritten signature in black ink, appearing to read 'Haiqing L Kaczowski', written over a light blue horizontal line.

Haiqing L Kaczowski (Project Engineer)

cc: Cliff Ogburn (Town of Nags Head)
Raleigh Bland (USACE)
Lynn Mathis (NCDCM)
John Cece (NCDCM)
Steven Traynum (CSE)
Philip McKee (CSE)
Trey Hair (CSE)

Enclosures

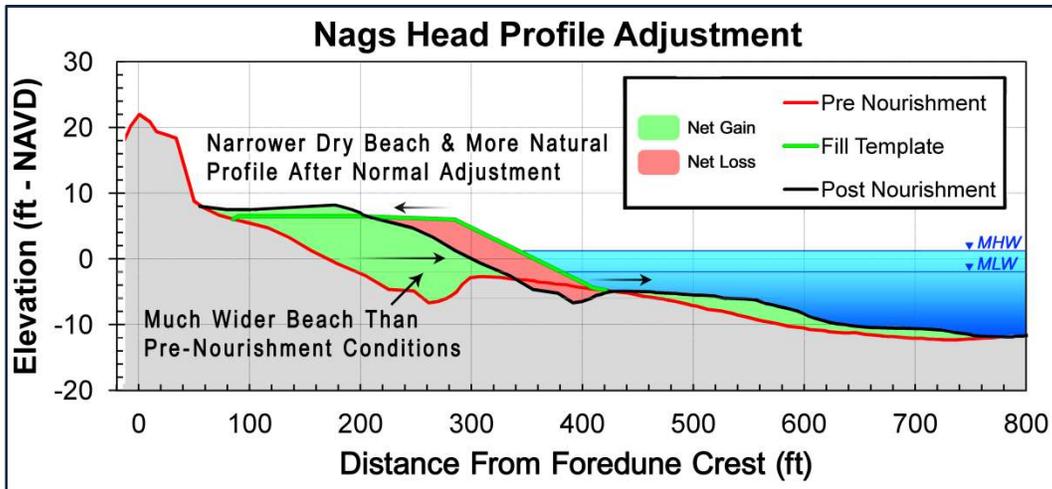
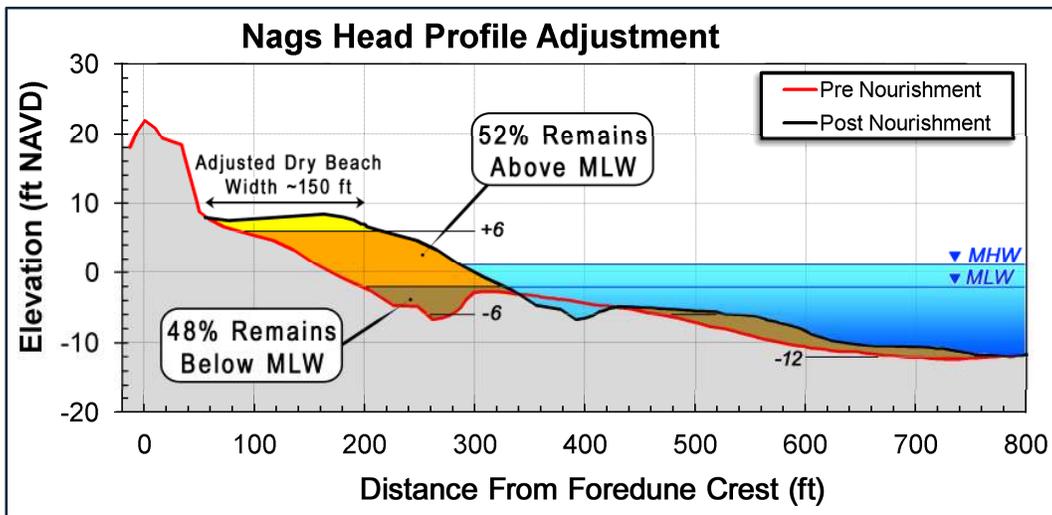
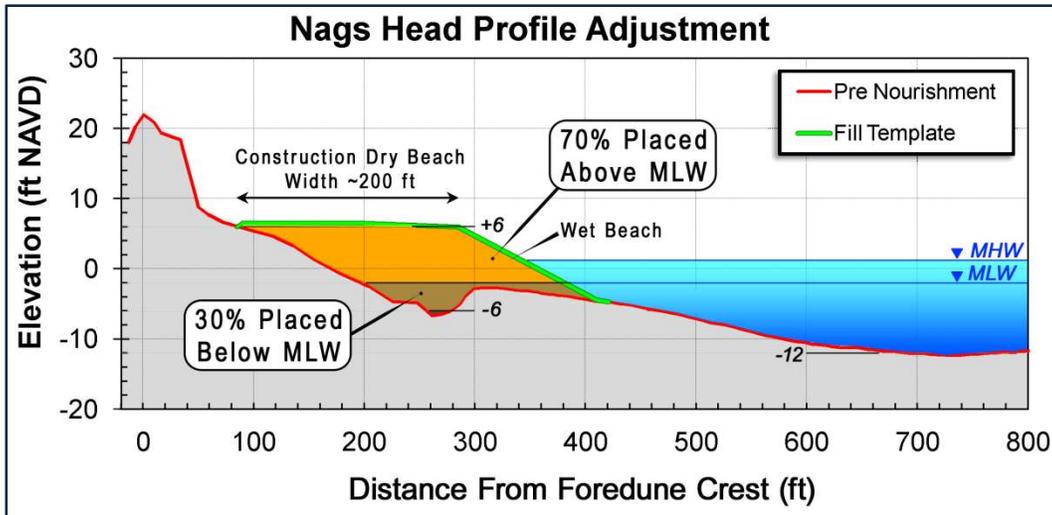


FIGURE A. Sequence of profiles. [UPPER] Before and fill template. [MIDDLE] Before and post-nourishment. [LOWER] All three profiles with red and green erosion/accretion zones.



FIGURE B.
Aerial views of south Nags Head at
Seagull Drive.

[UPPER]
23 February 2011 – before nourishment.

[MIDDLE]
2 September 2011 – after nourishment
and Hurricane *Irene* (note pond).

[LOWER]
21 November 2011 – after nourishment
and fall northeasters.

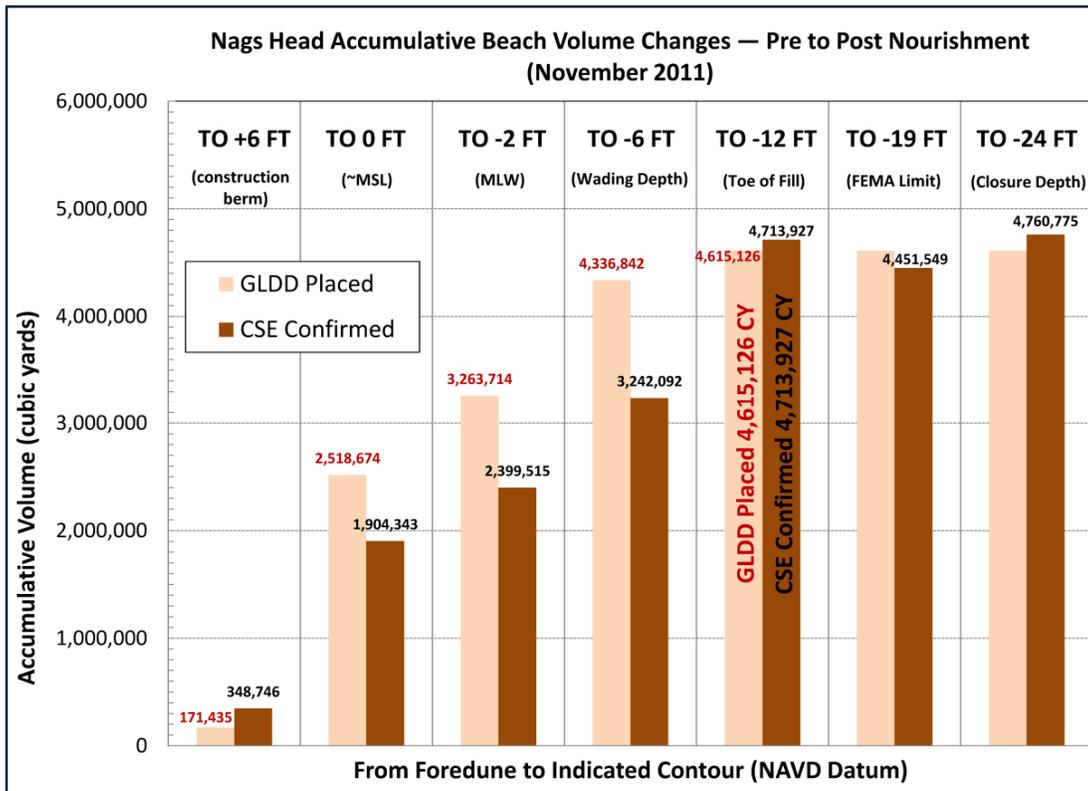
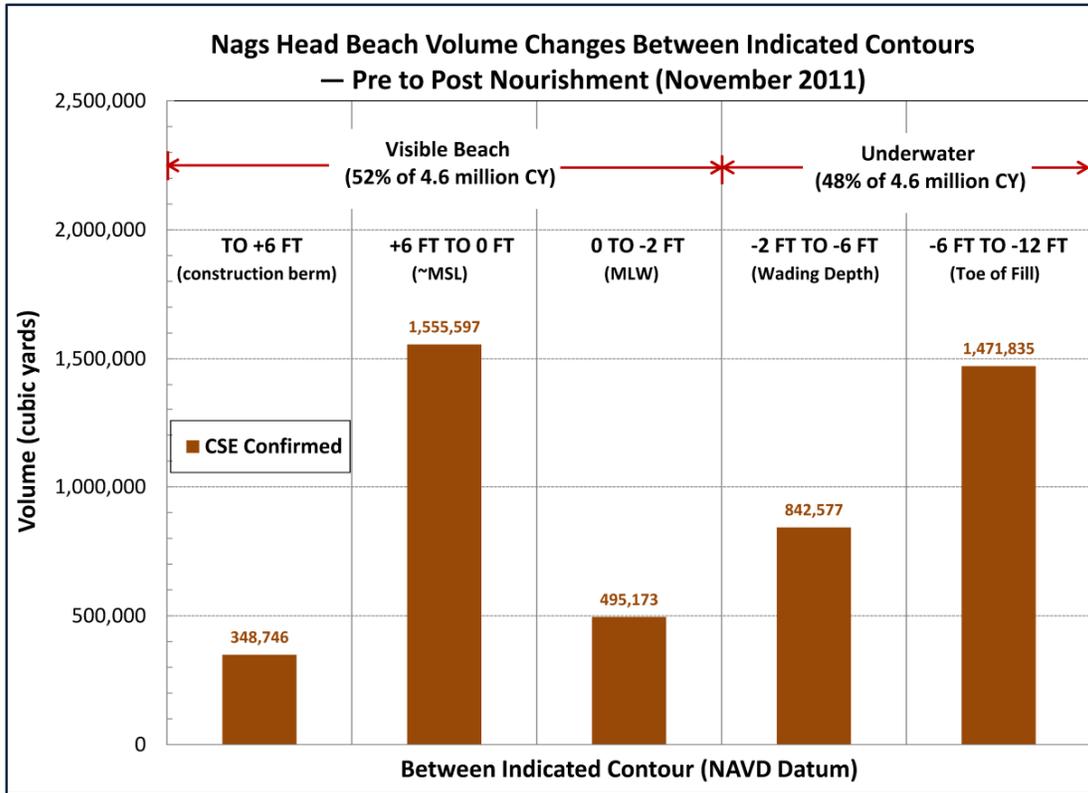


FIGURE C. Beach volume changes between November 2010 and November 2011. [UPPER] Sand volume changes between representative contours. [LOWER] Accumulated volume changes between the foredune crest and the indicated contour.