

ATTACHMENT 4

PHYSICAL MONITORING METHODOLOGY

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The Nags Head Beach Nourishment Project will be monitored by semi-annual and annual surveys over the life of the project. During Year 1 after construction, semi-annual surveys will be performed. In subsequent years, annual surveys will be performed and supplemented as necessary with post-storm surveys after major storm events.

Physical condition surveys will include the following:

- 1) **Beach and Inshore profiles at minimum 500 ft spacing** at USACE/CSE stations via RTK-GPS (eg – Trimble R8 GNSS, or equivalent) between the foredune and (~)–30 ft NAVD depth contour. Profile azimuths will match pre-project surveys by USACE and CSE to the extent practicable. Surf zone areas will be surveyed to wading depth at low tide. Over-water data will be collected via survey-grade fathometer (eg – ODUM Hydrotrac, or equivalent, linked to the RTK-GPS) with daily bar checks and corrections for water temperature, etc. Offshore portions of lines will be surveyed at high tide stages to provide overlap in the inner surf zone for at least 50% of the lines. High wave energy conditions characteristic of the Nags Head area sometimes preclude full overlap of all lines. A total of ~100 lines will be surveyed during each monitoring event.
- 2) **Data analysis to determine nourishment volumes remaining by reach and the volumes remaining with respect to the renourishment threshold.** Offshore and subareal portions of each profile will be processed using Hypack™ (or equivalent), merged, and filtered for data spikes in the record. Each profile will be added to archived data files (historical profiles by station) and analyzed via appropriate software for computing volumetric changes, unit-width volumes, reach volumes (via average-end-area method) and contour movement.
- 3) **Sediment sample collection to check the as-built sediment quality on the visible beach each year.** Samples will be collected at 5,000 ft spacing at a minimum of five (5) discrete localities across the nourished beach between the toe of the foredune and low-tide terrace. Sediment samples will be analyzed for grain size distribution, percent coarse material, and percent shell using standard dry-sieving at 0.25-phi intervals. Data will be reported in tabular form and compared graphically with pre-project data.
- 4) **Aerial photography of the project area will be conducted yearly to document general conditions along the shoreline.** A video of oceanfront development will be obtained via low altitude photography upon project completion and updated periodically as conditions change. Controlled vertical aerial photography will be obtained at least once every three years after project completion and used for project planning and performance review.
- 5) **Contour movement analysis for selected elevation contours along the beach.** Certain reference contours will be determined via surveys over the length of the project area each year for purposes of comparing beach width with preproject conditions. The local mean high water (MHW) shoreline will be surveyed and plotted on maps for comparison with preproject conditions. Other contours will be plotted for measures of dry beach width (eg – the approximate +5 ft NAVD contour which represents the seaward edge of the constructed berm).