## APPENDIX B:
## POTENTIAL PHYSICAL IMPACTS OF ARTIFICIAL BEACH-DUNE CONSTRUCTION TO THE COASTAL ECOSYSTEM

**Table 1.** Potential direct, indirect and cumulative geologic impacts of oceanfront nourishment to the sound side of a barrier island.

| Direct impacts | Indirect impacts | Cumulative impacts |
|---|---|---|
| | Reduced sediment input due to reduced overwash; | Decreased island migration capabilities; |
| | Increased erosion rates; | Modified feedback loops of coastal processes[§] |
| | Increased fringing marsh loss during rising sea level; | |
| | Island narrowing; | |
| | Altered likelihood of storm breach/inlet formation; | |
| | Altered saltwater input from storm overwash | |

[§] An example of a coastal processes feedback loop would be the relationship between grain size, wave energy and sediment transport. Heavier and larger grains require more wave or current energy for entrainment, or to be picked up off the substrate and moved. These heavier and larger grains would not travel as far as lighter or smaller grains, but would only be transported as far as the wave or current energy was high enough to sustain movement. Thus sediment transport volumes, rates and distances are related to wave and current energy as well as grain size. Artificial alteration of the grain size distribution, mineral content, wave energy or current energy will alter the sediment transport dynamics. Modified sediment transport dynamics will then alter the distribution of grain sizes across the substrate as grains are either entrained or deposited. This in turn modifies the wave or current energy required to move the grains. Artificially manipulating any of these variables will influence the others as they are all linked in a dynamic loop of processes.

**Table 2.** Potential direct, indirect and cumulative geologic impacts of oceanfront nourishment to the dune system and barrier island uplands.

| Direct impacts | Indirect impacts | Cumulative impacts |
|---|---|---|
| If dunes are constructed as part of project:<br>• Altered sedimentology (see Table 3);<br>• Altered stratigraphy (see Table 3);<br>• Decreased stability that increases sediment loss to both wind and swash | Increased sediment supply to aeolian transport if fine-grained sediments; | Interrupted island migration capabilities; |
| | Decreased sediment supply to aeolian transport if coarse-grained sediments;<br><br>Possible increased dune building if fine-grained sediments and proper fetch;<br><br>Possible dune starvation and loss if coarse-grained sediments;<br><br>Prevention of natural overwash by artificially plugging dune gaps;<br><br>Prevention or reduction of dune migration if dunes are stabilized | Modified feedback loops of coastal processes |

**Table 3.** Potential direct, indirect and cumulative geologic impacts of oceanfront nourishment to the recreational beach system of a barrier island. This area extends from the dune toe through the intertidal zone to mean low water, or the region of the beach that is available to recreational users for walking, sunbathing, etc.

| Direct impacts | Indirect impacts | Cumulative impacts |
|---|---|---|
| Altered sedimentology:<br>• Grain size<br>• Mineralogy<br>• Carbonate content<br>• Compaction<br>• Grain shape<br>• Sediment cohesion<br>• Mud/clay content<br>• Organic content<br>• Toxicant content<br>• Sediment sorting (i.e., poorly sorted versus well sorted) | Modified sedimentology:<br>• Cementation<br>• Heat capacity<br>• Geochemistry<br>• Nutrient cycles | Semi-permanent to permanent changes to:<br>• Grain size<br>• Mineralogy<br>• Compaction<br>• Nutrient cycles<br>• Geochemistry<br>• Sediment cohesion<br>• Carbonate content<br>• Lithification rate<br>• Hydrologic cycles and pathways<br>• Geologic stratigraphic record |
| Altered stratigraphy:<br>• Lack of sedimentary strata;<br>• Increased homogeneity of sediments | Modified stratigraphy:<br>• Modified water table position;<br>• Modified saltwater interface;<br>• Modified infiltration capacity and efficiency;<br>• Modified effluent capacity and efficiency | Modified storm response functions of the island (e.g., the island-wide volume and location of sediments available to dissipate storm surge waves and currents); |
| Modified beach slope;<br><br>Modified beach width:<br>• Increased sediment supply for aeolian transport if fine grained;<br>• Decreased sediment supply for aeolian transport if coarse-grained;<br>• Altered buffer capacity in storms | Increased wave energy in swash reaching back-beach;<br>Increased overwash volumes from higher sediment supply | Modified island migration capabilities;<br>Modified island response to rising sea level |

**Table 3.** (continued)

| Direct impacts | Indirect impacts | Cumulative impacts |
|---|---|---|
| Increased sediment supply to nearshore system | Increased adjacent inlet shoaling;<br>Increased resuspension and transport if finer-grained ;<br>Increased turbidity levels as very fine-grained sediments are winnowed away;<br>Decreased sediment transport if coarser-grained;<br>Increased probability of scarp formation and perpetuation;<br>Modified geomorphology, including formation and maintenance of beach cusps, berms and berm crests, ridges and runnels, and berm welding | Modified inlet migration rates;<br>Modified sediment transport pathways and volumes;<br>Artificial geomorphic patterns and evolution<br>Modified feedback loops of coastal processes |

**Table 4.** Potential direct, indirect and cumulative geologic impacts of oceanfront nourishment to the forebeach fill area of a barrier island. This area includes the subaqueous portion of the fill profile and the shoreface, extending from mean low water to tens of feet of water depth.

| Direct impacts | Indirect impacts | Cumulative impacts |
|---|---|---|
| Altered sedimentology (see Table 3); | Altered longshore sediment transport rates and volumes; | Modified erosion/accretion rates; |
| Altered stratigraphy (see Table 3); | Altered cross-shore sediment transport rates and volumes; | Modified sediment transport pathways; |
| Altered beach slope:<br>• Scarp formation<br>• Elevated wave swash penetration landward | Altered wave refraction and reflection patterns; | Modified island migration capabilities; |
| Altered beach profile; | Altered wave energy and distribution pattems; | Modified island response to rising sea level; |
| Increased turbidity from slurry de-watering during placement | Modified shoreface profile, position and accommodation space; | Modified inlet migration rates; |
| | Modified stratigraphy:<br>• Modified water table position<br>• Modified saltwater interface<br>• Modified infiltration capacity and efficiency<br>• Modified effluent capacity and efficiency | Semi-permanent to permanent changes to:<br>• Grain size<br>• Mineralogy<br>• Compaction<br>• Nutrient cycles<br>• Geochemistry<br>• Sediment cohesion<br>• Carbonate content<br>• Lithification rate<br>• Hydrologic cycles and pathways<br>• Geologic stratigraphic record |
| | Modified sedimentology:<br>• Nutrient cycles<br>• Geochemistry | Modified current pathways and magnitudes; |
| | Modified sandbar evolution and dynamics (e.g., migration, welding, shape changes); | Modified nearshore and continental shelf bathymetry; |
| | Modified ability to form or maintain sandbars; | Modified feedback loops of coastal processes |
| | Increased inlet shoaling; | |

**Table 4.** (continued)

| Direct impacts | Indirect impacts | Cumulative impacts |
|---|---|---|
| | Increased sediment supply for storm response; Increased turbidity as very fine-grained sediments are resuspended and transported | |

**Table 5.** Potential direct, indirect and cumulative geologic impacts of oceanfront nourishment to the intermediate nearshore area of a barrier island. This area does not include the fill profile, but extends from the foreshore beach area to the borrow area. Transportation of the dredged material from the borrow area to the fill placement area occurs across this region, but no direct dredging or fill placement occurs here.

| Direct impacts | Indirect impacts | Cumulative impacts |
|---|---|---|
| Increased turbidity from crater | Increased turbidity levels from re-suspended sediments from crater and fill | Altered sediment supply for island and coastal compartment |
| Increased turbidity from fill placement | Settling out of fine sediments from increased turbidity levels | Modified feedback loops of coastal processes |
| | | Modified current pathways and magnitudes |
| | | Modified wave energy magnitudes and distribution |

**Table 6.** Potential direct, indirect and cumulative geologic impacts of oceanfront nourishment to the offshore borrow area. This area includes the borrow pit and its immediate surroundings. Dredging occurs in this region and the dredged material is transferred from this offshore borrow area through the intermediate nearshore region to the fill placement area. Areas seaward of the borrow pit, which is typically on the continental shelf, are included in this region.

| Direct impacts | Indirect impacts | Cumulative impacts |
|---|---|---|
| Increased turbidity | Settling and accumulation of fine sediments in crater | Permanent changes to the geologic stratigraphic record |
| Turbidity or density currents radiating out from borrow area | Deposition of sediments from turbidity/density currents | Modified bathymetry patterns and depths |
| Crater excavation | Altered wave energy | |
| Modified bathymetry | Altered wave refraction patterns | |
| | Altered benthic sediment substrate in and near crater | |
| | Possible release of gas hydrates in substrate | |
| | Modified sediment-water interface dynamics | |