RECEIVED
JUN 14 2010
WETLANDS

KELLY ISLAND BENEFICIAL USE DISPOSAL SITE -
SUMMARY OF CONTAINMENT DIKE DESIGN ANALYSIS BY CERC.

1. CERC has completed its design analysis of the sand containment dike for the Kelly Island beneficial use dredged material disposal area. This effort was conducted to address the interest of Delaware DNREC for a "substantial sand barrier beach" rather than the original geotube dike design.

2. The CERC analysis evaluated the two primary mechanisms that would contribute to erosion of the sand dike: "long-term" erosion due to normal wave and tidal action, and "short-term" erosion associated with storm events. Although these phenomena are not really separable in terms of the real world behavior of the structure, it is necessary to address them separately in terms of modeling or predicting their effects on the structure. Therefore, CERC's design analysis approached the probable contribution of long-term and storm associated erosion separately.

3. Long-term Erosion. Long-term erosion losses were based on the OCTI-computed longshore sediment transport analysis. The OCTI analysis utilized a 6 year "normal" condition wave hindcast to predict longshore sediment transport. This analysis concluded that the "normal" condition net longshore transport was to the north at a rate on the order of 25,000 to 50,000 cy/yr. The CERC analysis assumed that the net transport rate was equivalent to the rate at which sediment would be eroded from the exposed face of the dike. Given a dike crest elevation of +10 ft MLW (approx equal to +8 ft NGVD), and an assumed slope of 1:20 which ties into existing bottom at -6 ft MLW, the 50,000 cy/yr net transport rate corresponds to a maximum annual "shoreline retreat rate" of 18 ft/yr. This is the conservatively high shoreline retreat rate computed from this procedure. The retreat corresponding to the lower (25,000 cy/yr) value of net longshore transport is 9 ft/yr.

4. Storm-induced Erosion. Storm-induced erosion losses were computed using SBEACH. This model requires the specification of a pre-storm profile and a time history of water level and wave data for the duration of the storm. The pre-storm profile was based on the geometry used in the long-term erosion analysis with a +10 ft MLW crest elevation. The crest width was specified as an extending landward infinitely, in order to provide a sufficient buffer of material in the profile to supply the model-computed volumetric demand of sediment. The water level and wave boundary conditions were developed in two ways. First, a set of time-varying boundary conditions was created from the OCTI hindcast data for the 2- through 25-year storm events. These parameters were run through SBEACH simulations, and results in terms of "berm retreat" were tabulated. Next, a more conservative set of assumptions was used, leading to a "worst case" storm simulation. In these runs, the wave and water level values were held constant for the storm duration. The results comparing the time-varying versus constant wave and water level simulations are shown in Figure XX. It can be seen that there is a large difference between these two conditions for the 2-year event, and proportionately smaller differences for larger (less frequent) storm events. For the 10-year event with the conservative assumption

of constant waves and water level, the corresponding berm retreat is approximately 120 feet.

5. Dike Cross-section Design. The dike design was based on an initial performance standard that the structure should be sufficiently large (recall DNREC's request for a "substantial sand barrier beach") to survive intact through a 10 year period. This was simplistically assumed to be represented by a dike cross-section that was sufficiently large to withstand 10 years of long-term shoreline retreat and a 10-year storm event. The berm width would then be the sum of the shoreline retreat over 10 years plus the shoreline retreat from a 10-year storm event. Based on the conservative assumptions of 18 ft/yr of long-term erosion plus the approximately 120 feet of berm recession from the 10-yr event, the minimum crest width would be approximately 300 feet. With 1:20 front and back slopes, the cross-section of this structure is equivalent to approximately **330 cy/lineal ft**. For a structure length of 6,000 feet, the resulting volume of sand required for construction is **2.0 Mcy**. It should be recalled that this cross-section is based on making the most conservative assumptions with regard to both long-term erosion losses (50,000 cy/yr versus 25,000 cy/yr) and storm erosion losses (based on constant versus time-varying waves and water level.)

6. Alternate Dike Cross-sections. The above assumptions result in a cross-section which is "overdesigned" to a degree, rather than one which has been cost-optimized and reflects the risk and uncertainty inherent in this analysis. For example, if the lower (25,000 cy/yr) estimate of net longshore transport losses had been adopted, the resulting berm crest width would be smaller by 90 feet, for a total width of approximately 210 feet. The corresponding cross-section would a volume equivalent to about **275 cy/lineal ft**, and a total construction quantity of **1.7 Mcy**. Further, if the 10-yr event erosion based on time-varying waves and water levels had been used, the berm crest would be smaller by an additional 40 feet. Thus the berm crest width based on "best case" rather than "worst case" assumptions would be 170 ft, with a volume equivalent to about **250 cy/ft**, and a total structure construction quantity of about **1.5 Mcy**.

7. Use of Groins to Reduce Longshore Transport Losses. In order to reduce the longshore sand transport rate from the dike into areas adjacent to Kelly Island, particularly the mouth of the Mahon River, a plan was developed that included groins. It was initially assumed that the groins would have the effect of reducing the net longshore transport losses to zero. The dike crest width would then be based solely on the width required to withstand the recession associated with the 10-year storm event. The recession from the constant wave and water level (vs time varying) 10 yr event is 120 feet (vs 80 feet). A sand dike with a crest width of 120 feet would require approximately **230 cy/ft**, and a total construction quantity of **1.4 Mcy**. A total of 8 to 12 groins, each 275 ft long, would be required along the 6,000 ft length of the structure, depending on whether a 2:1 or 3:1 ratio of groin spacing-to-length was used.

RECEIVED
JUN 14 2010
WETLANDS

Shoreline retreated, no sand 20-30 miles either side. residual beach always down

No good prototype - sand

Sand on beaches - imported anyway

.6 - .8 mm .3 ≈ .7 not perfect

- Sand will migrate -
  - Octi longshore transport rate - max rate + 10 year
  - CERC sized Berm
  - Loss due to major storm then groins.
  - super conservative
  - 6000' ft of Habitat -
  - concentrated fill + fine

RECEIVED
JUN 14 2010
WETLANDS

Works Cited:

McGee, R.G. (1996). "Geoacoustic study of Delaware main channel," Technical Report HL-96-9, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Smith, David, Nancy Jackson, Susan Love, Karl Nordstrom, Richard Weber and David Carter. Beach Nourishment on Delaware Bay Beaches to Restore Habitat for Horseshoe Crab Spawning and Shorebird Foraging. December, 2002a. Report prepared for the Nature Conservancy.

Smith, D.R., Pooler P.S., Loveland, R.E., Botton M.L., Michels, S.F., Weber, R.G., Carter, D.B. Horseshoe Crab Reproductive Activity on Delaware Beaches: Interactions with Beach Characteristics. 2002b. Journal of Coastal Research. 18:4. 730-740.

USACE, 2009. Incorporating Sea-Level Change Considerations in Civil Programs. Circular No. 1165-2-211. Dept of the Army, U.S. Army Corps of Engineers, Washington, DC.