EXECUTIVE SUMMARY

Oceanographic conditions at the New London Disposal Site (NLDS) are dominated by twice daily tidal currents. These currents appear to be sufficiently strong near the seafloor to winnow unconsolidated fine sediments. The site is protected from many storm-generated wave disturbances with the result that tidal currents are likely to determine the surface characteristics of ambient sediments and dredged material disposal mounds. These results are consistent with twenty years of observation of the formation and persistence of stable disposal mounds armored with shell and coarse sand in surface sediments.

NLDS, located in the eastern portion of Long Island Sound approximately 5.38 km south of Eastern Point, CT, is the focus of a continuing monitoring program conducted by the Disposal Area Monitoring System (DAMOS) of the New England District, U.S. Army Corps of Engineers with funding provided by the U.S. Navy. In 1995–96, the U.S. Navy placed approximately 863,000 m^3 of dredged material (based on scow estimates) at a temporary disposal buoy to form a capped mound known as the Seawolf mound. Permit conditions for this activity required a comprehensive monitoring program of the Seawolf mound. One goal of this program is to develop an understanding of those oceanographic processes which govern the fate and transport of dredged material placed at this site.

Toward this goal, two sets of seasonal measurements were made of physical oceanographic variables that may affect sediment dynamics at the Seawolf disposal site. These observations also provide a basis for a preliminary quantitative description of how dynamic conditions may vary within NLDS.

By design, the specific measurements made during the two seasons were different. In late summer (September and October 1997), current velocity was measured 1 m off the local bottom. Bottom-mounted pressure measurements were used to characterize pressure conditions generated by local wind-wave conditions. Optical backscatter (OBS) observations were made 20 and 75 cm above the local bottom to estimate near-bottom suspended material concentrations and profiles. During the winter season (January and February), when material disposal is expected to take place, this suite of instruments was supplemented with an acoustic doppler current profiler (ADCP) placed on the bottom in the NW corner of NLDS, in approximately 18 m of water and adjacent to the near-bottom current meter. The ADCP provided detailed current profiles between approximately 3 m and 14 m below the water surface. During a two-day cruise at the end of January 1998, a ship-based ADCP provided vertical velocity profiles along E-W and N-S transects across NLDS. During winter and summer deployments wind velocity and atmospheric pressure measurements were obtained from a meteorological station maintained by the University of Connecticut at Avery Point located approximately 5 km north of NLDS.

Currents in three frequency bands were identified: low frequency background currents with variations in magnitude and direction at periods of greater than a day; tidal or

higher frequency currents with periods between approximately 3 and 24 hours; and wind-wave induced currents which varied over a wave period as well as in response to longer term changes in the local wave field. In general, observations showed the background near-bottom current speeds to be in the range of 2–15 $cm \cdot s^{-1}$, depending on the conditions. During the occasional larger wave events at NLDS, the maximum (instantaneous) wind-wave induced bottom current speeds would be expected to be in the range of 10–20 $cm \cdot s^{-1}$, depending on wave height and period. In contrast, approximately one meter off the bottom, currents associated with the semidiurnal lunar (M_2) tidal constituent varied regularly between 8 and 25 $cm \cdot s^{-1}$ over the 12 hr, 25 min tidal period. Three meters below the water surface the M_2 tidal current speeds varied between 8 $cm \cdot s^{-1}$ and 45 $cm \cdot s^{-1}$. Due to its magnitude and consistent and regular presence, the M_2 tidal currents would appear to be the more important factor affecting sediment transport and deposition. It is pertinent to remember, however, that the cumulative effects of all the forcing mechanisms active at a given time governs transport and deposition of suspended and bottom sediments.

During the late summer measurements, significant wind and wave events were limited in magnitude. Wind speeds were generally $< m \cdot s^{-1}$. Similarly, local wind wave events (those that clearly stood out over the background) could be defined as intervals when significant wave heights exceeded ~60 cm, a relatively low wave. While several such events occurred, significant wave heights were generally less than 1 m with short periods. Available Optical Backscatter (OBS) observations showed no substantial suspended material events, although there was some question concerning the operation of the lower instrument during this deployment.

During the winter deployment, significant wind speed events were well correlated with decreasing local atmospheric pressure and passage of fronts. Maximum wind speeds were seldom over 15 $m \cdot s^{-1}$. Episodes when the significant wave height rose above the background were weak, but generally correlated with local wind events associated with migrating atmospheric low-pressure systems. Generally, the quality controlled OBS records did not show significant resuspension or local backscattering maxima in conjunction with local wave height increases. Approximately semidiurnal variations in the absolute value of the OBS signal correlated well over the 55 cm vertical sensor separation. Typically the sensor closest to the bottom had slightly higher OBS values which might be expected if a bottom gradient existed.

Profiles of low frequency currents showed that the current directions rotated counterclockwise with increasing depth below the water surface. A similar pattern was seen for the profile of average velocity vectors. Maximum current speed measured by the bottom-mounted ADCP (~85 $cm \cdot s^{-1}$) was recorded near the water surface. One meter above the bottom, maximum measured speed was ~55 $cm \cdot s^{-1}$, representing a strong low frequency current close to the water-sediment boundary.

Ship-based surveys and *in-situ* current measurements point to changes in the near-bottom velocity fields at different locations within NLDS. This variation is not unexpected given the location of Fishers Island to the east and the variations in relative water depth over the disposal site. After recovery and redeployment of *in-situ* instrumentation (to retrieve data and install additional equipment) minor changes in location of the near-bottom current meter caused a change, primarily in direction, in low frequency currents. This could reflect the influence of local bottom bathymetry on current direction. Ship-based current profiles, which provided observations within one to two meters of the local bottom, showed variations in current speed and direction over the site. However, horizontal variation in velocity was weak compared to some of the vertical gradients and, at times, horizontal gradients higher in the water column.

Transects of current profiles taken by ship showed the apparent impact that blocking by Fishers Island of eastward directed currents can have, particularly on the locally dominant M_2 tidal currents. At various times, currents over NLDS could have currents at one depth directed toward Fishers Sound, while at another depth currents were directed southeast toward the Race. At times, a bifurcation or divergence of currents was observed such that currents on the northern half of a N/S transect had a slight northerly component while currents on the southern portion of that transect had a southerly component.

Spatial (vertical and horizontal) and temporal variations in currents could impact the bottom distribution of sediments released at a disposal site (ADDAMS, DAMOS capping model). These data will improve significantly the accuracy of models used for site evaluation. Additional numerical schemes are available to evaluate the potential transport and bottom deposition of sediment released in the water column. These numerical models incorporate spatial and temporal variations in the vertical velocity profiles as well as using actual bathymetry to more accurately resolve predictions of the location, quantity and size of dredged material deposited on the bottom.

Given the regularity and magnitude of the near-bottom M_2 tidal currents, it is possible that the surface of any sediment placed on the bottom could be winnowed so that the coarser and shell fractions would eventually armor the surface and decrease the frequency of sediment movement. Numerical schemes are presently available to evaluate the potential for given bottom sediments to be resuspended and hence transported due to the combined influence of waves and currents. With the actual estimates of current and wave conditions, these schemes can more accurately reflect the actual conditions. In conjunction with these numerical models, the current and wave measurements could be used to evaluate the sediment size classes that might be expected to be resuspended and transported or to remain essentially in place. Field evidence suggests small-scale winnowing does occur, but over time the material remains stable.