EXECUTIVE SUMMARY

Under the Disposal Area Monitoring System (DAMOS) Program for the U.S. Army Corps of Engineers, New England Division, Science Applications International Corporation (SAIC) conducted an Oceanographic Measurement Program at the Portland Disposal Site (PDS) located 13 km east of Cape Elizabeth in the Gulf of Maine. A single instrumented tripod was deployed from February 27 to May 14, 1996, in order to acquire site-specific data on tides and near-bottom currents, water temperature, and turbidity. The tripod was deployed in the southwest corner of the PDS, in a region of relatively rough topography having a water depth of approximately 60 m. Overall, the 78-day measurement program provided excellent data from which to characterize near-bottom currents and turbidity, and evaluate the physical processes governing bottom sediment resuspension within the PDS.

Vertical profiles of temperature, salinity, and density were acquired at a single location in the PDS during February, April, and May 1996, respectively. The February profile revealed a water column that was very weakly stratified, as is typical for the coastal Gulf of Maine in winter. Water property characteristics during late April and mid-May illustrated that relatively fresh and warm water had been introduced to the surface layer, presumably as a result of river discharge. Beneath a moderate thermocline and pycnocline, water properties were nearly constant throughout the lower half of the water column during late spring. With regard to the vertical density stratification, it is apparent that the entire water column to a depth of 60 m is very weakly stratified throughout winter and early spring, whereas the introduction of relatively fresh/warm waters at the surface during mid-spring causes considerable stratification that may tend to decouple horizontal currents and other transport processes within a two-layer water column.

Time series observations of winds, waves, atmospheric pressure, and surface water temperatures were acquired from NOAA buoy 44007, located 6 km southwest of the PDS, to assess the seasonal and inter-annual variability in meteorological conditions from 1993 through 1995, as well as meteorological conditions during the 1996 measurement program. Analysis of the annual wave statistics revealed that wave characteristics were very similar for the 3.4 years of wave records. Significant wave heights less than 2 m occurred from 90 to 95% of the time during each year. The maximum significant wave height observed in each of the four measurement years ranged from 5.6 to 7.3 m. Overall, wave characteristics during the first half of 1996 were typical of other recent years at this location.

Analysis of the seasonal variability in wave conditions at the PDS revealed that mean significant wave heights were 1.2 m in winter (December through February) and approximately 1 m or less for the other three seasons. Maximum significant wave heights were roughly 3 m in summer, compared to 6 m in winter, and 7 m in spring and fall.

Quantitative analysis of storm waves revealed 72 events during the 3.4-year analysis period that had significant wave heights between 3 and 4 m; average durations for these wave events were only 6 to 8 hrs. Wave heights in the range of 5 to 6 m were observed only 22 times with average durations of less than 3 hrs.

The wave records from March through May 1996 exhibited nine storm events attaining significant wave heights greater than 2 m, with one reaching 5.8 m. This storm activity was similar to that during other recent years, and sufficient for analysis of storm-generated currents as they affect bottom sediment resuspension.

The three consecutive deployments of moored instrumentation at the PDS yielded nearly complete records of near-bottom currents, water temperature, pressure, and relative turbidity over the period from late February to mid-May 1996. Hourly averaged near-bottom current speeds during the measurement period ranged from 0 to approximately 0.4 knots (~20 $cm{\cdot}s^{-1}$), with the majority of the variability occurring at periods of approximately 12 hr in association with the semi-diurnal tide. Tidal harmonic analysis of the current velocity data revealed that the amplitude of the M_2 semi-diurnal tidal current is weak (approximately 3 $cm{\cdot}s^{-1}$), but significantly stronger than all other tidal constituents.

The mean current speed for each of the three deployments was very consistent (7.0 ± 0.4 $cm{\cdot}s^{-1}$), but the mean direction varied greatly among the deployments, presumably due to rough topography (e.g., boulders and rock ledges) in close proximity to the moored instrumentation. Analysis of residual currents (after the mean current and the tidal currents had been removed from the observed records) revealed that storms had almost no effect on hourly averaged near-bottom currents at the PDS.

Time-series measurements of near-bottom turbidity during the 78-day measurement period were acquired using optical sensors at levels of 33 and 81 cm above the seafloor. Both sensors provided excellent quality data (with no appreciable biofouling) such that small turbidity fluctuations above a consistently low background level could be distinguished. Near-bottom turbidity data acquired during the nine storm events having significant wave heights greater than 2 m (from late February through mid-May 1996) revealed that substantial quantities of ambient bottom sediments were resuspended during two storms having maximum significant wave heights in excess of 3 m. However, sediment resuspension was minimal or nonexistent for seven other storms having maximum significant wave heights in the range of 2 to 4 m. This result illustrated that bottom sediment resuspension at the PDS was not simply a function of surface wave height.

Detailed analysis of the near-bottom current data during the nine storms revealed that high-frequency oscillatory currents could be induced by large-amplitude surface waves, resulting in relatively high bottom stress and sediment resuspension as confirmed by elevated near-bottom turbidity levels. The field observations of near-bottom turbidity were useful for documenting that sediment resuspension had occurred during a subset of the storms, but the measurement program was not designed to quantify the depth of erosion nor the volume (per unit area) of sediment that had been eroded during the storms. Furthermore, additional analysis and numerical modeling of the data to determine the complex interactions between wave height, period, and duration, the speed and direction of background currents, and the availability of fine-grained bottom sediments on sediment resuspension at the PDS was beyond the scope of this project.