Characterizing Hydrodynamics and Sediment Transport in a Port Facility

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Introduction: As a part of the investigation of the industrial harbor in Augusta Bay, Sicily a study was conducted in the southwestern portion of the industrial harbor to understand hydrodynamic processes (e.g., water currents, tidal flow, and wind-wave forces) and the stability of sediments in the bay. In general, contaminants in the industrial harbor are bound to sediments; an understanding of the extent to which both natural and man-made forces (specifically, shipping activities) might disturb the sediment bed and facilitate the movement of contaminanted sediments is important to evaluating environmental risks and transport of sediments and contaminants in the bay.

Methods: The key to answering the common questions related to contaminanted sediment management is the identification, description, and quantification of the dominant processes involved in moving sediments in Augusta Bay. These processes are (1) erosion of sediments due to currents, waves, and ship movements, (2) movement of sediments in the water column, and (3) deposition of sediments. Although other processes can affect sediment and contaminant transport, an understanding of these fundamental processes is critical.

The approach developed for understanding sediment and contaminant transport in Augusta Bay is to:

- Develop a conceptual site model describing the key site processes
- Compile and collect site data to adequately understand these processes

The Augusta Bay study design included the collection of multiple lines of evidence to support the development of an accurate conceptual site model. The conceptual site model forms the basis for quantifying the processes involved in contaminant transport, and provides the basis for a site risk assessment and remedial evaluation.

A field program was designed in the summer of 2008 to support the development of an accurate understanding of sediment transport in Augusta Bay. The field program included measurements to understand the key sediment transport processes at the site (i.e. sediment erosion, transport, and deposition). The following measurements were conducted to address the sediment and contaminant transport processes:

- Current measurements were conducted to quantify natural background currents and currents generated during ship movements
  - Three bottom mounted platforms were deployed
  - Current profiles were measured from a vessel to capture ship movement currents
- Water quality measurements were collected at various locations in the bay to determine relative quantities of solids in the water column in the bay and during ship movements
- Cores were collected at 6 locations in the bay and analyzed in a Sedflume laboratory to determine erosion rates and the critical shear stress of the sediments. These data quantify how sediments respond to natural processes and ship movements

The data from these and other efforts have been compiled into a conceptual site model describing the general sediment and contaminant transport patterns in the area. The solid understanding of the transport and fate of sediments and contaminants developed here provides a comprehensive description of Augusta Bay.