

**SUMMARY FINDINGS REPORT
PAGO PAGO HARBOR
SEDIMENT TOXICITY STUDY**

Prepared by:

CH2M HILL

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EXECUTIVE SUMMARY

Recent toxicity studies indicate elevated levels of some contaminants of concern (COCs) in the fish, macro-invertebrates, and sediments within the Inner and Middle Harbor portions of Pago Pago Harbor on the Island of Tutuila in American Samoa. The American Samoa Environmental Protection Agency (ASEPA) conducted the study reported here to determine the concentrations, distribution, probable origins, and expected fate of COCs. This report provides an overall summary of the findings of the Sediment Toxicity Study which consisted of four phased and interrelated elements: Study Element 1 - Sediment Screening; Study Element 2 - Seabed Characterization and Mapping; Study Element 3 - Detailed Sediment Analysis; and Study Element 4 - Sediment Fate and Transport Analysis. Each study element corresponds to a separate, but not independent, part of the overall study. Each subsequent phase was planned based in part on the results of earlier study elements. Detailed reports were prepared for each study element.

Study Element 1 – Sediment Screening Study: This study element provided sediment sampling and analysis to: define the surficial distribution of sediment types and COCs on the seabed; develop, define, and verify the list of COCs; and, provide data and guidance for subsequent study elements. Field work was conducted in February 2004. Grab samples from 48 stations distributed throughout Pago Pago Harbor were collected. Distribution of the samples consisted of 24 from the Inner Harbor, 9 from the Middle Harbor, and 15 from the Outer Harbor. All samples were analyzed for grain size, percent solids, total organic carbon (TOC), total volatile solids (TVS), calcium, and sulfide. Samples from selected stations were analyzed for nutrients (total nitrogen and total phosphorus), selected metals, polychlorinated biphenyls (PCBs), organotins, pesticides, and semi-volatiles and volatiles. The focus of Study Element 1 was on the Inner Harbor because it was expected that the highest level of contamination would be found there. Outer Harbor samples were taken as reference samples, to verify expected minimal contamination, and to occupy a few historic sampling stations.

Study Element 2 – Seabed Characterization and Mapping: This study element included geophysical mapping to provide a detailed description of the seabed characteristics within the Harbor. The data were collected in February/March 2004 and used a combination of geophysical methods to provide detailed characterization of the seabed and subsurface sediment. These methods included: precision echo-sounding to obtain the bathymetry of the harbor; sidescan sonar to obtain acoustic images of the seafloor to characterize the sediment and map surface debris; and, sub-bottom profiling to determine the nature and thickness of seafloor sediment. The study produced bathymetric maps of the Harbor, maps of the areal extent and thickness of the fine-grained shallow marine sediment, and identified small-scale natural and artificial (for example, sunken ships) features on the seabed.

Study Element 3 – Detailed Sediment Analysis: This study element was based on the results of the first two elements and a review of other available data. The study included sampling and analyses to better define the vertical and horizontal extent of selected COCs. The sampling was conducted in March 2005. Sediment cores were collected from 18 locations in the Harbor. Most of the cores were collected in the Inner Harbor. Samples were collected from these cores at selected depth intervals in the sediment. Selected samples were analyzed for a

variety of COCs from the various cores based on the results of the two previous study elements and in consultation with ASEPA. Analyses included: grain size, percent solids, TOC, and calcium, TKN, total phosphorus, selected metals (including arsenic, chromium copper, lead, mercury, nickel, selenium, and zinc), PCBs, tributyltin, dioxins, pesticides, and selected semi-volatile compounds. The majority of the samples analyzed were from cores in the Inner Harbor taken in sediment pools identified by the seabed mapping study. Samples from a sediment pool near the head of the Inner Harbor (Harbor Head Sediment Pool; HHSP) received particular attention, as did samples from cores near the marine shipyard, the power plant, and the location of abandoned outfalls previously used by the tuna canneries.

Study Element 4 – Sediment Fate and Transport Analysis: The fourth and final study element was conducted in May 2006 and consisted of collecting and analyzing samples to better define the sources, sinks, and transport paths of particular COCs (those identified as being of principal concern). Surficial sediment samples were collected from four sites in the Harbor for pore water analysis (three in the Inner Harbor and one in the Outer Harbor). Sediment samples were also collected from five perennial streams which flow into the Harbor. The particular sample locations and media were considered potentially outstanding data gaps that needed to be addressed to evaluate the origins, transport, and fate of the Harbor sediments and associated COCs. Analyses were limited to specific parameters including grain size, nutrients (for stream samples only), selected metals, PCBs, and pesticides.

Harbor sediments display characteristics indicating two primary sources: terrigenous sediments from the watershed derived from relatively recent volcanic soils, and marine biogenous sediments derived from the fringing coral reefs and shells of marine organisms. Terrigenous sediments were found in highest concentration the Inner Harbor, with higher fractions in the upper portion of sediment cores. The fraction of marine sediments increased from the Inner Harbor to the Outer Harbor where sediments are essentially all from marine sources.

The studies indicated the contaminants are derived from both natural processes and anthropogenic watershed activities. Higher concentrations of all COCs are typically associated with the terrigenous sediment fraction. The concentrations of all COCs analyzed are reflected in the apparent sources with higher values consistently in the upper layers of the sediments from the Inner Harbor. The suite of COCs analyzed show only sporadic values of potential concern compared to available evaluation criteria such as the apparent effects threshold developed by the National Oceanic and Atmospheric Administration.

Metals in Inner Harbor sediments are a combination of general watershed contributions with likely point source contributions from industrial facilities, but are generally not of sufficient concern to warrant any additional action other than future monitoring. DDT contributions appear to be generally from watershed sources that may still be active. PCB concentrations high enough to be of concern appear to occur in a very limited area with a single source. Contaminated sediments, once deposited throughout the Harbor, tend to remain in place. Only in areas of large ship operations on the north shore of the Inner Harbor does it appear that sediments might be remobilized by propeller scour. These remobilized sediments do not appear to migrate throughout the Harbor, but re-deposit fairly close to the source and remain in place.

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