

Brake Pad Partnership Technical Studies Modeling the Fate of Copper in the San Francisco Bay

Summary of Findings

The Brake Pad Partnership commissioned a bay modeling study to obtain estimates of the effect of copper from brake pads on copper levels in the bay. URS Corp. conducted the hydrodynamic modeling using MIKE 21 HD, a two-dimensional, free-surface flow modeling system that simulates hydraulics in estuaries, coastal waters, and seas where vertical stratification can be neglected. A module called ECO Lab was used in conjunction with the hydrodynamic model to assess the fate and transport of copper in the bay.

The copper source estimates used directly in the bay modeling were developed for the Brake Pad Partnership by Process Profiles. Estimates of the air deposition of copper, which are primarily due to brake pad wear debris, were modeled for the Partnership by Atmospheric and Environmental Research, Inc. Watershed modeling to determine estimates of copper in runoff to the bay was performed for the Partnership by AQUA TERRA Consultants. All of these supporting studies, which in turn relied on Partnership monitoring and characterization studies, are described elsewhere. Key bay modeling procedures include:

- The model was run with and without copper contributions from brake pads.
- The bay was modeled using 990-m grids except in the South Bay and the Carquinez Strait, which were modeled using 330-m grids.
- The simulation was conducted for two sets of water years 1981 to 2020 in sequence, for a total of 40 modeled years. This ensured that a range of weather conditions was considered and that the model ran for long enough to produce finished results.
- Copper sources that were modeled included copper in runoff, copper from publicly-owned treatment works and industrial point sources, copper entering the bay from the San Joaquin Delta, copper released from anti-fouling paints on boats and pressure-treated wood used in marine construction, and air deposition of copper.
- Model runs were performed to analyze the sensitivity of dissolved and benthic copper concentrations to copper loads, initial benthic copper conditions, and temperature and salinity forcings.

Key findings include:

- Over the course of a year, brake pad wear debris contributes less than 1 percent to the dissolved copper concentrations at the North Bay sites, while brake pad wear debris contributions are approximately 6 percent in the South Bay and 9 percent in the Lower South Bay.
- The proportion of dissolved copper in bay waters due to brake pads is higher during the wet season than during the dry season.
- In the southernmost portions of the bay, the contribution of copper from brake pads to copper in benthic sediments reaches up to 3.5 percent after 40 years of simulation.