PAH Source Evaluation of Sediments in the Vicinity of Pier 39, San Francisco Bay

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Background/Objectives. A forensic evaluation was undertaken to determine the apparent source and nature of PAHs in sediments from a study area in the vicinity of Pier 39 in San Francisco Bay. Study focus was PAH composition in sediments relative to ambient total PAH concentrations, based on the San Francisco Estuary Institute Regional Monitoring Program list of 25 PAHs. Study objectives related to the presence of total PAHs greater than ambient concentrations in sediments, and potential pyrogenic (combustion, coal/oil carbonization process) source relationships with respect to PAH compounds typically associated with point and nonpoint pyrogenic source types. PAHs potentially associated with manufactured gas plant (MGP) operations were of consideration, due to the historical presence of MGP facilities in the general vicinity. Study objectives included identification of potential nonpoint pyrogenic source signatures that may suggest significant contribution to “nonpoint urban influence”, which is distinguished from identified high-concentration point source pyrogenic signatures.

Approach/Activities. The forensic evaluation considered sediment sample data generated from multiple sampling events during 2016-2017, from over 130 station locations. This evaluation also included subsurface soil samples taken during 2017 from locations along the shoreline between Pier 39 and Pier 45, and from upland areas adjacent to the former Beach Street MGP facility footprint. Additional information included creosote-treated piling samples taken during 2017 at various locations within the vicinity of Pier 39 to Pier 45.

The forensic approach used diagnostic source ratio analysis for determination of potential source relationships for PAHs. Specific PAH ratios were selected on the basis of being representative of a potential source material and exhibiting environmental stability with respect to weathering influences on relative PAH concentrations. The forensic approach used a two-step process to: (1) identify potential source signatures and define a source model(s); and (2) apply the source model(s) to sediment samples in order to identify the presence of these signatures, and to characterize nonpoint urban influence with respect to PAH composition. In addition, samples from creosote pilings, shoreline soils, and upland soil samples were evaluated with respect to the potential source signatures for sediments.

Results/Lessons Learned. Initial evaluations of higher PAH concentration sediments supported the use of a two-model approach, consisting of benzo(b+k)fluoranthene/benzo(a)pyrene versus fluoranthene/pyrene and C1-chrysenes/C1-fluoranthenes+pyrenes versus fluoranthene/pyrene. Application of the two models indicated the presence of distinct potential source signatures, as identified from the distributions of the higher PAH concentration sediments. Some signatures exhibited pyrogenic character potentially consistent with historical MGP sources and one signature was related to a creosote source, such as creosote-treated pilings. A fifth source of PAHs to the study area sediment consists of ubiquitous nonpoint and potential unidentified point sources, which is distinguished from the point source signatures and is termed “urban influence”.