# The Application of a Multivariate Statistical Analysis to Identify Potential Ongoing Contaminant Sources to an Urban River

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**Background/Objectives.** A multivariate statistical analysis (MVA) was performed to support the Anacostia River Sediment Project (ARSP) Feasibility Study (FS) being conducted to evaluate potential cleanup options for the tidal Anacostia River located in Washington, D.C. The objective of the MVA was to identify active, ongoing sources of contamination to the tidal river by systematically comparing forensic data sets from three groups of contaminant sources to a tidal river dataset consisting of the same forensics compounds. The MVA focused on polychlorinated biphenyl (PCB) Aroclors, parent and alkylated polycyclic aromatic hydrocarbons (PAHs), and metals. The three contaminant source groups considered by the MVA included potential environmental cleanup sites (PECS) that border the river, nine tributary streams, and 38 municipal outfalls. The results of the MVA indicated that, although tributaries are the dominant ongoing sources to the river, several of the PECSes were also identified as current, unabated sources that locally overprint the tributary forensic signature in tidal river surface sediment.

**Approach/Activities.** The tidal Anacostia River is a 9-mile water body and with the associated water bodies Kingman Lake and Washington Channel, receives sediment inputs from 119 municipal outfalls and 14 named tributaries. In addition, 14 PECSes border the tidal river, four of which include media that have been characterized forensically. Bottom sediment samples from 67 manholes intersecting upstream sewer pipes were used to characterize the inputs from the 38 outfalls. The nine tributaries included are the primary sources of water and sediment to the tidal river and were characterized through the collection of suspended sediment and bottom sediment samples. The surface river bottom data set included 472 surface sediment (top 6 inches) samples. For all four datasets, samples were analyzed for 209 PCB congeners, 34 alkylated PAHs, and 21 metals. All samples with the exception of the tributary suspended sediment were also analyzed for PCB Aroclors.

These data were evaluated using a principal component analysis (PCA) with Varimax Rotation of the chemical variables. The approach identifies chemicals that group together spatially and can be used to explain spatial patterns in the chemical groups in tidal river surface sediment. From an initial, larger number of chemicals, five were identified as primary factors describing approximately 90 percent of the variation in the underlying data. These five are dominated by three main factors (PAHs, PCB congeners, and metals). A second PCA of the transposed data matrix was conducted to identify correlations between locations across the chemicals to confirm the results of the initially performed PCA.

**Results/Lessons Learned.** Results of the MVA confirmed previous “lines of evidence” evaluations for source identification including proximate elevated concentrations observed in environmental media and high level qualitative comparisons of PCB and PAH patterns in manhole bottom and tributary sediments to the tidal river. This analysis indicated that largest tributaries are the most significant ongoing sources while runoff from the former PECS site

operations also appear to be locally impacting recently deposited surface sediment. The MVA results were used to refine the source tracking investigations to support the ARSP FS.