

Mass Flux and Forensic Assessment: Informed Remediation Decision Making at One of Canada's Most Polluted Sites

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Abstract : Sydney Harbour, Nova Scotia, Canada has long been subject to effluent and atmospheric inputs of contaminants, including thousands of tons of PAHs from a large coking and steel plant which operated in Sydney for nearly a century. Contaminants comprised of coal tar residues which were discharged from coking ovens into a small tidal tributary, which became known as the Sydney Tar Ponds (STPs), and subsequently discharged into Sydney Harbour. An Environmental Impact Statement concluded that mobilization of contaminated sediments posed unacceptable ecological risks, therefore immobilizing contaminants in the STPs using solidification and stabilization was identified as a primary source control remediation option to mitigate against continued transport of contaminated sediments from the STPs into Sydney Harbour. Recent developments in contaminant mass flux techniques focus on understanding "mobile" vs. "immobile" contaminants at remediation sites. Forensic source evaluations are also increasingly used for understanding origins of PAH contaminants in soils or sediments. Flux and forensic source evaluation-informed remediation decision-making uses this information to develop remediation end point goals aimed at reducing off-site exposure and managing potential ecological risk. This study included reviews of previous flux studies, calculating current mass flux estimates and a forensic assessment using PAH fingerprint techniques, during remediation of one of Canada's most polluted sites at the STPs. Historically, the STPs was thought to be the major source of PAH contamination in Sydney Harbour with estimated discharges of nearly 800 kg/year of PAHs. However, during three years of remediation monitoring only 17-97 kg/year of PAHs were discharged from the STPs, which was also corroborated by an independent PAH flux study during the first year of remediation which estimated 119 kg/year. The estimated mass efflux of PAHs from the STPs during remediation was in stark contrast to ~2000 kg loading thought necessary to cause a short term increase in harbour sediment PAH concentrations. These mass flux estimates during remediation were also between three to eight times lower than PAHs discharged from the STPs a decade prior to remediation, when at the same time, government studies demonstrated on-going reduction in PAH concentrations in harbour sediments. Flux results were also corroborated using forensic source evaluations using PAH fingerprint techniques which found a common source of PAHs for urban soils, marine and aquatic sediments in and around Sydney. Coal combustion (from historical coking) and coal dust transshipment (from current coal transshipment facilities), are likely the principal source of PAHs in these media and not migration of PAH laden sediments from the STPs during a large scale remediation project.

Keywords : contaminated sediment, mass flux, forensic source evaluations, remediation

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