

In the 1920s, a partially dug section of Love Canal, located in the southeast corner of Niagara Falls, New York, became a chemical and municipal disposal site for several chemical companies and the city of Niagara Falls (NYSDOH 1978). An unknown array and quantity of chemicals were buried on-site until the waste site was capped in 1953. Estimates of hazardous waste in this landfill range from 22,000 tons (19,954 tonnes) (U.S. EPA 1996) to 176,000 tons (159,632 tonnes) (Online Ethics Center 1999). In the late 1950s, homebuilding began adjacent to the Love Canal landfill, subsequently breaching the cap. By 1978, compounds identified at this site included: benzene, toluene, benzoic acid, lindane, trichloroethylene (TCE), dibromoethane, benzaldehydes, methyl chloride, carbon tetrachloride, and chloroform (NYSDOH 1978).

The Occidental Chemical-Hyde Park (then Hooker Chemicals and Plastics) site, from 1953 to 1975, received approximately 80,000 tons (72,560 tonnes) of chemical waste (U.S. EPA and NYSDEC 1999). This included approximately 0.7 tons (.6 tonnes) to 1.6 tons (1.5 tonnes) of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). The former drainage stream of the landfill, Bloody Run, which flows into the Niagara River, was historically contaminated with organic chemicals including 2,3,7,8-TCDD. Compounds from this site, including 2,3,7,8-TCDD, were previously detected approximately 1,600 feet (488 meters) away in contaminated groundwater seeping from the Niagara River gorge face (U.S. EPA and NYSDEC 1999). After remediation, which included purge wells to capture aqueous-phase liquids at the gorge face, concentrations of 2,3,7,8-TCDD in the gorge face seepage are below the 10 micrograms per liter specified in the Record of Decision.

These and other waste sites contributed to extensive groundwater contamination problems that have adversely affected beneficial uses (see Table 1) in the Niagara River AOC. For example, the 102nd Street Landfill, a 22.4 acre (9 hectares) site, received about 23,500 tons (21,315 tonnes) of mixed organic solvents, organic and inorganic phosphates, and related chemicals in the period 1943 until 1971 (U.S. EPA and NYSDEC 2000). The presence of groundwater contamination is complicated by complex intersecting network of fractures and tectonic faults in the bedrock of the Niagara Frontier and the Western Lake Ontario basin (Yager and Kappel 1987). The deeply fractured bedrock that underlies the Niagara Region provides a direct pathway for groundwater contaminated by dense non-aqueous-phase liquids (DNAPL) to migrate from hazardous waste sites to the Niagara River and Lake Ontario (IJC 1993). Typical DNAPL components include: tetrachloroethylene, TCE, 1,2-dichloroethylene, trichloroethane, and carbon tetrachloride (NRC 1999). Substances, such as 2,3,7,8-TCDD and polychlorinated biphenyls (PCBs), also may be present. In addition, metabolites of carbon tetrachloride and TCE can be expected in dissolved-phase plumes emanating from certain DNAPL source zones (NRC 1999). For example, when TCE is not fully degraded, vinyl chloride is formed (NRC 2000). Vinyl chloride is more carcinogenic than TCE (NRC 2000).

Transport of contaminants by the Niagara River has resulted in downstream effects. Contaminant-related impacts of mirex and 2,3,7,8-TCDD, derived from Niagara River sources, to Lake Ontario fish and wildlife were noted as a concern by Environment Canada and Ontario Ministry of the Environment (1981). Contaminants from the Niagara River AOC, which previously migrated into the Niagara River, have been conveyed downstream to Lake Ontario. For example, the inventory of polychlorinated dibenzo-p-dioxins and dibenzofurans sequestered in Lake Ontario sediment has been estimated at 5,800 kilograms (12,787 pounds) (Pearson *et al.* 1997). Impacts to commercial fishing in specific areas within Lake Ontario due to Niagara River sources of mirex and PCBs were also identified.

In September 1976, the New York State Department of Environmental Conservation (NYSDEC) began investigation of issues related to Love Canal (NYSDOH 1978). By September 1978, scientific analyses had identified 82 chemical compounds in the landfill (NYSDOH 1978). In 1979, 215 chemical waste sites were identified in the Niagara and Erie counties area of New York. Of these, at least four are known to have leaked contaminants into the Niagara River (Environment Canada and Ontario Ministry of