

EXECUTIVE SUMMARY

The Halifax Harbour Water Quality Monitoring Program (HHWQMP) has been an integral part of the Halifax Harbour Solutions Project (HHSP). Prior to the development of the Halifax Harbour Solutions Project two sewage treatment plants had been operating at Mill Cove in Bedford Basin and in Eastern Passage. However about 80% of Halifax Harbour sewershed still entered Halifax Harbour untreated. In 1989 the Halifax Harbour Task Force (HHTF) was commissioned to develop environmental quality guidelines and objectives for uses of Halifax Harbour. The Halifax Regional Municipality (HRM) proposed a regional approach to treat raw sewage before discharge in the Harbour which encompassed three wastewater treatment facilities (WWTFs) with UV disinfection to be located in Halifax, Dartmouth and Herring Cove, a sewage collection system, combined sewage overflows (CSOs), three outfalls and diffusers, and a sewage sludge (biosolids) management facility. The HHSP was designed to meet the water quality objectives set by the HHTF. A condition of Environmental Assessment approval included the following requirement under the heading **3.6 Follow-up**:

“Under the CEAA, a follow-up program:

- verifies the accuracy of the assessment; and*
- determines the effectiveness of any mitigation measures that have been implemented.*

The primary objective of the project is to meet the water quality objectives for Halifax Harbour as set by the Halifax Harbour Task Force (HHTF 1990) based on intended end use. Upon completion of the project, the proponent will verify that these water quality objectives have been attained.”

The above-noted condition of approval and requirement for project follow-up has therefore stipulated the objectives and framework for the Halifax Harbour Water Quality Monitoring Program.

Water quality monitoring commenced in June 2004, before any of the three proposed sewage treatment facilities were constructed, and ended several months after the re-commissioning of the Halifax Wastewater Treatment Facility in 2010. The monitoring program was based on water quality surveys that include over 30 sites distributed from the Bedford Basin to the Outer Halifax Harbour. Water samples taken at 1-m and 10-m depths below the water surface were analyzed for a set of water quality parameters. In addition, continuous vertical profiles with depth of basic hydrographic properties (salinity, temperature and depth), dissolved oxygen and fluorescence were collected. From June 2004 to June 2006 the surveys were conducted weekly and from July 2006 onward, slightly modified surveys were conducted biweekly. Regular sampling stopped in June 2009 with the Halifax plant out of commission, with two additional surveys in the fall of that year. Six additional surveys were conducted between May and September 2010 following re-commissioning of the Halifax plant.

The primary indicator of water quality and the one with the highest potential impact for human health is fecal coliform bacteria concentration, with the amounts measured in

CFU (coliform forming units) per 100 mL of volume. The guideline is expressed in terms of the geometric mean of at least 5 samples taken within 30 days in a given location. Two limits were considered in the analysis: the recreational or swimming limit of 200 CFU/100 mL, and the shellfish harvesting limit of 14 CFU/100 mL. The shellfish harvesting limit applies to the Outer Harbour, while the swimming limit applies to the Middle Harbour and Bedford Basin. The Inner Harbour was classified as an area intended for industrial use, therefore no guidelines apply to that area. During the baseline period before the WWTFs began operating (June 2004 to July 2007), there were frequent exceedances of the guidelines at individual sites, with the highest mean levels in the fall and winter seasons, and the lowest values in the spring and summer. The Inner Harbour was the most polluted area, with mean levels consistently above all guidelines. Measurements in the Middle Harbour and Bedford Basin routinely exceeded the applicable swimming guideline year-round at individual sites, and the mean levels for both sections were high with exceedances of the swimming limit in the fall and winter months. The Outer Harbour mean levels were relatively lower, but consistently above the applicable shellfishing guideline during all seasons in the baseline period.

The year 2008 represents a transitional period when the WWTFs gradually came online. Full effluent treatment began in Halifax in March, in Dartmouth in August, and in the Herring Cove WWTF in December 2008. Significant improvements were measured during this transitional period in all areas of the harbour, except for the Outer Harbour where no apparent effect was observed as the Herring Cove plant was not functional for most of 2008. The Dingle Park and Black Rock beaches were opened for public swimming in August 2008, for the first time in decades. In January 2009 the Halifax WWTF experienced a failure, resulting in elevated bacteria levels, but not to the baseline levels seen before the cleanup began. Full operation of the Halifax WWTF was restored in June 2010. The surveys conducted between June and September 2010 after all three WWTFs were operating in full capacity have shown vast improvements in all areas of the Harbour, on average meeting or exceeding the goals set by HHTF. The mean fecal coliform levels were below all applicable guidelines in all areas of the Harbour. Compared to the baseline fecal coliform concentrations, the levels in Bedford Basin were reduced by 87.5%; in the Inner Harbour where the baseline concentrations were highest, the mean levels were reduced by 97%; in the Middle Harbour by 90.5%; and in the Outer Harbour where the baseline concentrations were lowest, there was a reduction of 85%. There were a few localized guideline exceedances at individual sites, likely related to storm events that can cause overflows in the combined sewage overflow system, resulting in temporary untreated effluent discharges into the harbour.

The analysis of chemistry data shows that the guidelines for metals concentrations have been met on average, however intermittent exceedances of copper and mercury guidelines still occur. The spatial and temporal distribution of these exceedances does not allow for the identification of a single source of contamination.

The analysis of ammonia nitrogen levels shows an increase in the mean levels in 2010, up to twice the baseline values in the Inner Harbour area. This is not unexpected, as the effluent outfalls in 2010 were consolidated to the Inner Harbour area, while they were

more widely dispersed through the harbour during the baseline period. Furthermore, the primary treatment process is not expected to diminish the ammonia nitrogen levels in the treated effluent. There are no guidelines set by HHTF for ammonia nitrogen, however there is the potential that elevated values may create the conditions for more frequent algal blooms in the Harbour, which may temporarily and locally reduce dissolved oxygen levels below the applicable guidelines. The measured dissolved oxygen levels in 2010 have been high and satisfying all applicable criteria in all areas of the Harbour, with local exceptions likely related to the observed elevated phytoplankton activity. The Bedford Basin deep water is prone to natural depression of dissolved oxygen, as it represents a deep fjord with a shallow sill that prevents intrusions of oxygenated continental shelf water through most of the year.

The mean levels of total suspended solids in the Harbour have been reduced to approximately 60% of the baseline levels, with a tendency for higher values in the Inner Harbour where the outfalls of the Halifax and Dartmouth WWTFs are located. This is an expected effect of the concentration of the TSS sources in the Inner Harbour by the placement of the Halifax and Dartmouth WWTF outfalls in this area. Due to the fact that the ambient TSS level is not explicitly defined, it is unclear whether the current TSS levels meet the HHTF guideline of 10% above ambient level. Furthermore, the available data for Halifax Harbour do not allow for the estimation of the purely anthropogenic contribution toward the observed TSS concentrations. Given the fact that the values are relatively low above the detection limit and natural plankton activity in the Harbour can contribute significantly, there is no indication that the current levels are abnormal or that they can be reduced further.