



MEMORANDUM

TO Sandra Brunet, B.Sc., City of Barrie

DATE May 29, 2017

CC

FROM Christi Groves, B.Sc., Senior Environmental
Scientist, Shawn Lytle, P.Geo., Principal

PROJECT No. 11-1170-0043

**SUMMARY OF WORK PROGRAMS CONDUCTED AT THE BUNKER'S CREEK LANDFILLS, CITY OF
BARRIE**

Golder Associates Ltd. ("Golder") has been retained by the City of Barrie ("City") to provide a summary of the work programs conducted at the Bunker's Creek Landfills between 2011 and 2016. The desktop and initial field portions of the investigations were initiated in 2011 and have been ongoing since. This memorandum summarizes the main findings of the following reports:

- Golder Associates Ltd., 2013. *D-4 Study and Environmental Assessment – Final Report, Bunker's Creek Landfills – City of Barrie*. Report prepared for the City of Barrie and dated April 2013 (**2013 D-4 Study and Environmental Assessment Report**).
- Golder, 2014. *Supplemental Environmental Investigations – Final Report, City of Barrie's Bunker's Creek Historical Landfills*. Report prepared for the City and dated September 2014 (**2014 Supplemental Environmental Investigations**).
- Golder Associates Ltd., 2015. *2014 Annual Monitoring Report – Final Report, Bunker's Creek Landfills – City of Barrie*. Report prepared for the City of Barrie and dated September 24, 2015 (**2014 Annual Monitoring Report**).
- Golder Associates Ltd., 2016. *2015 Annual Monitoring Report – Final Report, Bunker's Creek Landfills – City of Barrie*. Report prepared for the City of Barrie and dated June 6, 2015 (**2015 Annual Monitoring Report**).
- Golder Associates Ltd., 2017. *2016 Annual Monitoring Report – Final Report, Bunker's Creek Landfills – City of Barrie*. Report prepared for the City of Barrie and dated April 2017 (**2016 Annual Monitoring Report**).

Background

The Ministry of the Environment and Climate Change (MOECC, Ministry) identified nine possible closed waste disposal sites within the City on the basis of information collected largely in 1979, supplemented with information available up to 1994 when the Ministry Waste Inventory was finalized. Two of these landfills were investigated and concluded that they were reported in error and were removed from the Ministry inventory. The remaining landfills were operated from approximately 1930 to 1964, following which the City commenced the use of the Sandy Hollow Landfill (now known as the Barrie Landfill). The exact limits of the sites were not known, however it was expected that they were largely completed by filling of low lying lands, in most cases next to Bunker's and Dymont's Creeks, including the areas known as Milligan's Pond, Brock Park, and the west end of Frederick Street. Residential, commercial, and industrial development has occurred on parts of the waste sites; the remainder is public parkland.

The Bunker's Creek landfills are present on both sides of Bunker's Creek, and are bounded by Anne Street to the west, Bradford Street to the east, Perry Street to the north, and Victoria Street to the south. The landfills operated



MEMORANDUM

from approximately 1930 to 1964, and are expected to have largely operated as infilling within the low lying areas along Bunker's Creek.

These investigations were initially completed to assess and reduce the area required to have specialized studies (i.e. D-4 Studies) completed prior to planning approvals for proposed development. MOECC guidelines state that D-4 Studies are required to be completed within 500 m of any operating or closed landfill unless a reduction in this 500 m limit can be supported by additional investigations

2013 D-4 Study and Environmental Assessment Report and the 2014 Supplemental Environmental Investigations

Summary of Work

- Historical investigation
 - A limited historical information study was conducted to determine if historical information could be used to confirm or refute the presence of landfills at properties identified in the Ministry Waste Disposal Site Inventory (MOECC, 1991). It was determined that seven sites could be combined into two essentially contiguous waste disposal sites located along parts of Bunker's Creek (Sites 1, 2, 3 and 7) and Dymont's Creek (Sites 4, 5 and 6) between Anne Street and Bradford Street.
- Subsurface Investigation
 - Drilling of six boreholes in 2011 and four boreholes in 2013 to characterize the limits of waste. Locations were chosen inside and outside the anticipated waste disposal area footprint;
 - Installation of seven monitoring wells in 2011 and one additional monitoring well in 2013 to allow for the assessment of groundwater quality in the vicinity of the waste. The deepest wells were installed at the base of waste, if present. A shallow landfill gas probe was installed above the water table at these same locations, where possible;
 - Installation of an additional 12 landfill gas probes in 2011 and three in 2013 to assess landfill gas;
 - Collection of soil samples during drilling for visual characterization, headspace screening of volatile organic compounds and submission to the analytical laboratory where warranted;
 - Collection of groundwater samples from the monitoring wells;
 - A minimum of one soil sample was submitted for each borehole where waste was encountered during drilling and was analyzed for typical landfill parameters (i.e., common for similar historical landfill sites in Ontario) and waste classification;
 - Groundwater samples were collected from each monitoring well at least twice and submitted for analysis of typical landfill parameters; and,
 - Measurement of landfill gas (methane, carbon dioxide and oxygen) concentrations at the gas probes using a GEM 2000 gas meter.

Based on these investigations, the combined area requiring D-4 Assessment was reduced from approximately 219 hectares (i.e. a 500 m radius from the limits of the landfills) to 23.2 hectares with some areas reduced to the



MEMORANDUM

limits of waste. This reduction was reviewed and approved by the MOECC. Monitoring of conditions in the Landfills was recommended following the completion of the 2013 investigations.

2014 Annual Monitoring Report

Summary of Work

In 2014, the following monitoring program was conducted:

- Collection of groundwater samples from seven monitoring wells (MW-B1 through MW-B7);
- Measurement of landfill gas (methane, carbon dioxide and oxygen) concentrations at nineteen landfill gas monitors (GP-B1 through GP-B19) using a GEM 2000 gas meter;
- Collection of surface water samples from five locations along Bunker's Creek upstream, adjacent to and downstream of the Bunker's Creek Landfills (SWB-1 through SWB-5); and,
- Submission of groundwater and surface water samples for chemical analysis of typical landfill parameters.

2015 Annual Monitoring Report

Summary of Work

In 2015, the following monitoring program was conducted:

- Collection of groundwater samples from the seven existing monitoring wells (MW-B1 through MW-B7);
- Measurement of landfill gas (methane, carbon dioxide and oxygen) concentrations at nineteen existing landfill gas monitors (GP-B1 through GP-B19) using a GEM 2000 gas meter;
- Collection of surface water samples from five locations along Bunker's Creek upstream, adjacent to and downstream of the Bunker's Creek Landfills (SWB-1 through SWB-5); and,
- Submission of groundwater and surface water samples for chemical analysis of typical landfill parameters.

2016 Report

Summary of Work

In 2016, the following monitoring program was conducted:

- Decommissioning of monitoring well MW-B2 and gas probe GP-B2;
- Drilling of one monitoring well and landfill gas probe (CB16-1) east of the landfills along Bradford Street, north of Vespra Street to assess the landfill limits and to further characterize impacts identified in monitoring wells to the west of this location;
 - Collection of soil samples during drilling;
 - Submission of one soil sample from borehole CB16-1 for laboratory analysis of typical landfill related parameter and for waste classification; and,
- Groundwater and landfill gas monitoring, including:



MEMORANDUM

- Collection of groundwater samples from the seven existing monitoring wells (MW-B1 through MW-B7), as well as CB16-1;
- Collection of surface water samples from five locations along Bunker's Creek upstream, adjacent to and downstream of the Bunker's Creek Landfills (SWB-1 through SWB-5);
- Analysis of collected groundwater and surface water samples for typical landfill related parameters; and,
- Measurement of landfill gas (methane, carbon dioxide and oxygen) concentrations at fourteen existing landfill gas monitors (GP-B1 through GP-B6, GP-B8 through GP-B13, and GP-B15 and GP-B16) located within the waste fill area in March 2016 (frozen ground).

Findings

Golder has carried out monitoring of groundwater, surface water and landfill gas in the area of the Bunker's Creek Landfill since 2011. Based on the overall findings of the monitoring program completed to date, the following information is of note:

- **Soil** – soil impacts, where present, are limited to materials within the waste fill limits.
- **Groundwater** – there have been no significant changes in groundwater quality during the completion of the Annual Monitoring Programs. Wells located within the waste fill area are impacted by the presence of waste, however the results are not significantly changing over time.
- **Surface Water** – Surface water quality in the vicinity of the landfills does not appear to be significantly impacted by the landfills. Chemical concentrations above the Provincial Water Quality Objectives are typical of surface water quality throughout the City and are not considered to indicate landfill related impacts.
- **Landfill Gas** - Concentrations of landfill gas in gas probes located within the waste fill areas are below a level of 5% of the Lower Explosive Limit of methane, with the exceptions of three locations in the central or southern portions of the former landfills. Monitoring of landfill gas in areas outside of the waste fill indicate that there is no migration of landfill gas beyond the waste fill limits or to residential properties. Whereas continued monitoring is warranted to ensure conditions do not change, methane concentrations are not expected to increase.

Recommendations

Based on the findings of the most recent Annual Monitoring Reports, the following recommendations were provided:

- Monitoring of landfill gas should continue on an annual basis at existing probes both inside and outside the waste limits;
- Due to consistent results since 2011 which do not show that groundwater is impacted by the landfills, further groundwater monitoring is not recommended;
- The surface water quality should be monitored annually at the established locations; and,

The samples should be analyzed for typical landfill related parameters, consistent with previous sampling events.