

## **W12A Landfill Groundwater, Leachate, Water Well, Landfill Gas and Surface Water Quality Monitoring Program**

The groundwater, leachate, water well, landfill gas and surface water monitoring programs are detailed in the attached tables 1 to 6. Additional details on the rationale for the selection of the parameters in the monitoring programs are presented below.

### ***Background***

The W12A Landfill has had groundwater, leachate, water well and surface water monitoring programs since it opened in 1976. Over the years the frequency, locations sampled and parameters tested for have changed as the program has evolved.

### **Groundwater, Leachate and Water Wells**

In 1999, the MOE and the City agreed that six parameters (chlorides, sodium, iron, dissolved organic carbon, cadmium and nickel) would be used in assessing impacts to groundwater with respect to the Reasonable Use Guideline. These parameters were chosen as they were found at high levels in the leachate and not elevated in the upgradient groundwater.

In 2000 and 2001, leachate from the W12A Landfill site was characterized to confirm no contaminants are overlooked in assessing future groundwater impacts or leachate treatment requirements.

The leachate characterization consisted of:

- reviewing historical monitoring results of leachate collected from on-site leachate storage tanks (general chemistry and trace metals)
- testing of leachate in the on-site storage tanks for a wide range of parameters not included in the historical monitoring program (Carbamates, Chlorinated Phenols, Dioxins & Furans, Herbicides & Phenoxy Acid Herbicides, Organochlorine & Organophosphorus Pesticides, Total PCBs, Volatile Organic Compounds)
- testing of leachate collected from the leachate monitoring wells for general chemistry and VOC's

The leachate characterization study found the leachate to be typical of what would be expected for a mid-size Ontario landfill. The only parameters tested that exceeded the Ontario Drinking Water Standards were some general chemistry parameters, some trace metals and some VOC's.

In 2002, Dillon Consulting completed a groundwater impact assessment of Phase 2 of the W12A Landfill. Contaminant transport modeling was completed following procedures recommended in

*Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Sites* (MOE, 1998). These standards designate a list of assessment contaminants for landfill leachate which include selected trace metals, VOC's and general chemistry parameters. These parameters are appropriate for the groundwater impact

assessment of Phase 2 of the W12A Landfill given the findings of the early leachate characterization.

Modeling by Dillon Consulting showed that the concentration of health related parameters will be reduced as they migrate from the landfill and will be within allowable concentrations within a few metres beneath the landfill. Modeling also suggests that chlorides are the critical contaminant for the landfill. Chloride levels will increase with time, at the property boundary, reaching a peak concentration just below the RUG in approximately 500 to 600 years.

#### Landfill Gas

In accordance with amended CoA Waste Disposal Site Number A042102, dated December 23, 2010 the City will undertake continuous monitoring of all permanent on-site buildings for concentrations of methane, oxygen and hydrogen sulphide. In addition two dedicated perimeter landfill gas monitoring wells were installed on June 22, 2011. The results from the aforementioned monitoring locations (i.e. on-site buildings and perimeter wells) will be reviewed and compared to the concentration limits outlined in O.Reg 232/98. Each year an assessment of whether additional monitoring locations are required to provide adequate protection against potential landfill gas migration.

#### Surface Water

A review of the surface water data shows four parameters (ammonia, BOD, chlorides and sulphates) that should be focused on in any monitoring program. All four parameters are found in the leachate at concentrations many times greater than what would typically be expected in surface water and have been found occasionally at levels above background in the surface water discharging from the stormwater management ponds. These four parameters are included in aforementioned Landfill Standards (MOE, 1998) as parameters to be included in surface water monitoring programs.

**Rationale for Parameters to be Tested**

Table 1 lists the recommended parameters to be tested for in the groundwater, leachate, water well and surface water monitoring programs. Each monitoring program has an “indicator” list of parameters that are tested for each sampling event and a “comprehensive” list of parameters that are tested for on specific sampling events.

The parameters to be tested for in the groundwater, leachate and surface water monitoring programs are the same as the parameters suggested in the Landfill Standards (MOE, 1998) except for;

Parameter	Monitoring Program/List	Comment
<i>Additions</i>		
cadmium	groundwater - indicator leachate - indicator	City and MOE previously agreed to use cadmium in assessing groundwater impacts
hardness	surface water – indicator surface water - comprehensive	MOE, London Region, requested addition of hardness to the surface water program
nickel	groundwater - indicator/ comprehensive leachate - indicator/ comprehensive	City and MOE previously agreed to use nickel in assessing groundwater impacts
phenols	groundwater - indicator leachate - indicator	Certificate of Approval includes these parameters on the indicator list for water wells
potassium	groundwater - indicator leachate - indicator	Certificate of Approval includes these parameters on the indicator list for water wells
selenium	leachate – comprehensive	Tested for in water wells
EPA 624 VOC Scan	groundwater - comprehensive leachate - comprehensive	recommendation from leachate characterization study
<i>Removal</i>		
Nitrate	groundwater - indicator leachate - indicator	on comprehensive list, will add to indicator list in future if testing indicates need
Suspended Solids	leachate - indicator leachate - comprehensive	not considered necessary to evaluate leachate quality
Total Phosphorous	groundwater - comprehensive	tested for in leachate monitors, will test in groundwater monitors if testing indicates need
TKN	surface water - indicator	on comprehensive list, will add to indicator list in future if testing indicates need
TDS	groundwater - indicator/ comprehensive leachate - indicator/ comprehensive surface water - indicator/ comprehensive	not considered necessary to evaluate leachate, surface water or groundwater quality

**Table 1  
Parameters Monitored**

Parameter	Groundwater Monitoring Wells		Leachate Monitoring		Water Wells		Surface Water Sampling Stations	
	Comp.	Indicator	Comp.	Indicator	Comp.	Indicator	Comp.	Indicator
<i>General</i>								
Alkalinity	X	X	X	X	X	X	X	X
BOD <sub>5</sub>			X	X			X	X
COD	X		X	X			X	X
Conductivity	X	X	X	X	X	X	X	X
DOC	X	X	X	X	X	X		
Hardness					X	X	X	X
pH	X	X	X	X	X	X	X	X
Phenols	X	X	X	X	X	X	X	X
Sulphate	X	X	X	X	X	X	X	X
Suspended Solids			X	X			X	X
<i>General - Nutrients</i>								
Ammonia	X	X	X	X			X	X
Nitrate	X		X		X	X	X	X
Nitrite	X		X				X	X
TKN	X		X				X	
Total Phosphorus			X				X	X
<i>General - Major Ions</i>								
Chloride	X	X	X	X	X	X	X	X
Calcium	X	X	X	X	X	X		
Iron	X	X	X	X	X	X	X	X
Magnesium	X	X	X	X	X	X		
Manganese	X		X	X				
Potassium	X	X	X	X	X	X		
Sodium	X	X	X	X	X	X		

**Table 1  
Parameters Monitored**

Parameter	Groundwater Monitoring Wells		Leachate Monitoring		Water Wells		Surface Water Sampling Stations	
	Comp.	Indicator	Comp.	Indicator	Comp.	Indicator	Comp.	Indicator
<i>Trace Metals</i>								
Arsenic	X		X		X		X	
Barium	X		X		X		X	
Boron	X		X		X		X	
Cadmium	X	X	X	X	X	X	X	
Chromium	X		X		X		X	
Copper	X		X		X		X	
Lead	X		X		X		X	
Mercury			X				X	
Nickel	X	X	X	X	X	X		
Selenium			X		X			
Silver					X			
Strontium					X			
Zinc	X		X		X		X	
<i>Volatiles</i>								
EPA 624 Scan	X		X					
<i>Field<sup>a</sup></i>								
Conductivity	X	X	X	X	X	X	X	X
Dissolved Oxygen							X	X
Flow <sup>a</sup>							X	X
pH	X	X	X	X	X	X	X	X
Temperature	X	X					X	X

Notes

- a) Flows from each stormwater management pond will be measured quantitatively (e.g. using weirs). Flows at other surface water sampling locations will be measured qualitatively.

**Table 2  
Groundwater Monitoring Program**

Monitoring Wells		Parameters	Sampling Dates
Description	Identification #		
<b>Shallow Aquifer - On-site<sup>a</sup></b> All monitoring wells located at or near the property boundary that are screened in the shallow aquifer	13-1a, 13-3a, 91-4a, 84-5b, 82-6, 92-11, 941, 94-3, 01-9a, 04-2a, 06-1, 06-2	Comprehensive List Indicator List	June April, October
<b>Shallow Aquifer - Off-site</b> Representative monitoring wells located in adjacent City owned properties that are screened in the shallow aquifer	01-12b, 01-14, 04-6a, 05-1, 05-2, 05-3	Indicator List	June
<b>White Oaks Aquifer</b> Representative monitoring wells (on-site and off-site) that are screened in the White Oaks Aquifer	92-8, 92-9, 92-10, 92-12, 94-2, 01-3a	Indicator List	June
<b>Till</b> Till monitor below garbage	00-7a	Comprehensive List	June
<b>All Monitoring Wells</b>	Monitoring wells listed above plus, 92-1, 92-2, 92 -3, 92-4, 92-7, 01-12a, 01-13, 00-3a, 00-3b, 05-4, 05-5	Water levels	April, June, October

Notes

- b) Two inactive monitoring wells (72-101, 72-103) were decommissioned in 2006 in accordance with Ontario Regulation 903, as amended to Ontario Regulation 128/03, under the Ontario Water Resources Act.
- c) Two deteriorating monitoring wells were decommissioned (76-1, 76-3) and replaced (13-1a, 133a) in 2013 in accordance with Ontario Regulation 903, as amended to Ontario Regulation 128/03, under the Ontario Water Resources Act.

**Table 3  
Leachate Monitoring Program**

Location	Parameters	Sampling Dates
<b>Representative Leachate Monitoring Wells</b> Monitoring wells 97-2, 97-5 and 97-7	Comprehensive List Indicator List	June April, October
<b>Leachate Loading Station</b> Leachate loading station #1	Comprehensive List Indicator List	June April, September, November
<b>All Leachate Monitoring Wells</b> Monitoring wells 97-2, 97-3, 97-4, 97-5, and 97-7	Water Levels	June

Notes

- d) Completed construction of a leachate pumping station and forcemain at leachate loading station #1 in January of 2012. Following this, sampling at leachate loading station #2 was concluded.

**Table 4  
Water Well Monitoring Program**

Location	Parameters	Sampling Dates
<b>Water Wells - On-site</b> 14	Comprehensive List Indicator List	June April, October
<b>Water Wells - Off-site</b> 12, 13, 16, 17, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33, 36	Comprehensive List Indicator List	June 2014, 2017, etc. June

Notes

- e) Three private residences (10, 11, 5) have connected to municipal water.

**Table 5  
Landfill Gas Monitoring Program**

Location	Parameters	Sampling Dates
<b>Methane Monitoring Wells - On-site</b> G1-11, G2-11	Methane gas	Annual sampling events in the winter, spring, and fall. Two other events during periods of landfill gas collection system shut down.

**Table 6**  
**Surface Water Monitoring Program**

Location	Parameters	Sampling Dates
<b><i>On-site Surface Water Sampling Stations</i></b> Stations 1, 2, 3, 5 and 7	Comprehensive List  Indicator List	One spring and one fall sampling event Two other sampling events
<b><i>Off-site Surface Water Sampling Stations</i></b> Station 10	Comprehensive List  Indicator List	One spring and one fall sampling event Two other sampling events