Brooks Road Environmental

Air Quality and Odour Assessment Report for the Brooks Road Landfill Site Vertical Capacity Expansion Environmental Assessment

Brooks Road Landfill Site
160 Brooks Road
Haldimand County, Ontario

FEBRUARY 2017
REF. NO. 018235 (66)

Table of Contents

List of Figures

(Following Text)

List of Drawings (Following Text)

List of Tables

List of Appendices

Section 1.0 Introduction

In July 2015 the Minister of the Environment and Climate Change approved the Terms of Reference (ToR) for the Brooks Road Landfill Site Vertical Capacity Expansion Environmental Assessment (EA). This report provides an overview of the alternative conceptual vertical capacity expansion designs (i.e., 'Alternative Methods') for the Brooks Road Landfill Site Vertical Capacity Expansion EA (**Section 2.0**) and documents the following with respect to Air Quality and Odour:

- Describes the Air Quality and Odour Existing Conditions associated with the EA Study Areas (**Section 3.0**)
- Details the mitigation measures to be incorporated into the Alternative Method designs in order to prevent or minimize effects on Air Quality and Odour (**Section 4.0**)
- Documents the net effects analysis for each Alternative Method with respect to Air Quality and Odour (**Section 5.0**)
- Identifies the Preferred Alternative Method from an Air Quality and Odour perspective through a comparative evaluation process (**Section 6.0**)

Section 2.0 Alternative Methods for Vertical Expansion

Three vertical expansion alternatives have been developed for comparative analysis. The alternatives were identified in consideration of the criteria and assumptions outlined in the Conceptual Design Report (CDR) and based on public input received during the ToR.

The following aspects will be identical across all three vertical expansion alternatives, including:

- An expansion capacity of 421,000 m^3, including waste, daily cover, and interim cover
- The limit of waste (i.e., landfill footprint)
- Traffic volume entering and exiting the site, associated with importing waste, daily cover, and interim cover
- The location of the site entrance, scalehouse, and other ancillary supporting features
- The size and location of all buffer areas
- The final cover design (0.6 m of compacted fine-grained soil overlain by a 0.15 m thick vegetative layer)
- The leachate treatment (i.e., batch leachate treatment system)

The three vertical expansion alternatives are illustrated on **Drawings C-02** through **C-07** (following text) and their unique attributes are outlined in **Table 2.1**, below. Further information on the vertical expansion alternatives is found in the CDR.

Table 2.1 Comparison of Vertical Expansion Options			
Attribute	**Alternative 1**	**Alternative 2**	**Alternative 3**
General Description	Expansion capacity with 3H to 1V (33%) side slopes to a crest height of 218.075 m	Expansion capacity with 4H to 1V (25%) side slopes to a crest height of 221.0 m	Expansion capacity with 3H to 1V (33%) side slopes to a crest height of 221.25 m and bench at approx. 210.0 m
Approximate Elevation of Top of Landfill (including final cover)	219.65 m	221.50 m	222.13 m
Approximate Height of Landfill Above Existing Grade of 198.96	20.69 m	22.54 m	23.17 m
Post-Closure Leachate Generation Rate	36 m^3/day	36 m^3/day	36 m^3/day
Number of Vehicles Per Day Associated with Waste and Construction Materials	25 to 50	25 to 50	25 to 50

As can be seen from Table 2.1, the primary differences between the three alternatives are the height of the landfill. From an air quality and odour perspective, the potential emission rates from landfill activities are expected to be very similar since the landfill operations, number of vehicles and on-site road layouts will be very similar. The off-site impacts of the three alternatives are therefore not expected to vary significantly due to the relatively minor differences in elevations of the three alternatives.

Section 3.0 Air Quality and Odour Existing Conditions

The July 2015 Minister-approved ToR includes a preliminary description of the existing environmental conditions within the Study Areas and commits to providing an expanded description of the existing environmental conditions within the Study Areas in the EA. The following section provides a more detailed description and understanding of the Air Quality and Odour Existing Conditions within the Study Areas for use in the assessment and evaluation of Alternative Methods.

3.1 Study Areas

The following two generic study areas were established for preparation of the EA:

- **Site Study Area**, including all lands (i.e., 14.3 hectares (ha)) within the existing, approved boundaries of the Brooks Road Landfill Site (Site), as defined by Environmental Compliance Approval (ECA) No. A110302, dated July 21, 2014, as amended

- **Local Study Area**, including all lands and waters within a 1 kilometre (km) radius of the Site Study Area boundaries

As provided for in the approved ToR, each technical discipline may modify the Local Study Area, as required, during the EA. For Air Quality and Odour both the Site and Local Study Areas are applicable.

Source: MNRF NRVIS, 2014. Produced by GHD under licence from Ontario Ministry of Natural Resources and Forestry, © Queen's Printer 2016;
Aerial: 2006 Grand River Conservation Authority
Coordinate System: NAD 1983 UTM Zone 17N

figure 3.1

STUDY AREAS
AIR QUALITY AND ODOUR ASSESSMENT REPORT
BROOKS ROAD LANDFILL
160 Brooks Road, Cayuga, Ontario

Legend

Site Study Area

Local Study Area (1km Radius)

018235-20(INT004)GIS-WA003 Jul 08/2016

3.2 Methodology

Information on the Air Quality and Odour Existing Conditions within the Local Study Area was gathered from a combination of secondary source research and field investigations.

3.2.1 Available Secondary Source Information Collection and Review

Available secondary sources of information were collected and reviewed by the Air Quality and Odour team to determine existing air quality and odour conditions within the study areas. The following sources of secondary information were collected and reviewed:

- Environment Canada Climate data (2010 to 2014)
- Ambient air quality data obtained from the Ministry of Environment and Climate Change (MOECC) (2009 to 2014). Note that the PM2.5 data available from the closest monitoring station, the MOECC Station #29118 at West Hamilton was used in the net effects assessment for a cumulative particulate evaluation
- Existing Facility Emission Summary and Dispersion Modelling Report, prepared for Brooks Road Environmental by Conestoga-Rovers & Associates (September 14, 2015)
- Odour Monitoring Program, prepared for Brooks Road Environmental by Conestoga-Rovers & Associates (July 28, 2014)
- Odour Monitoring Program, prepared for Brooks Road Environmental by Conestoga-Rovers & Associates (November 3, 2014)
- Odour Monitoring Program, prepared for Brooks Road Environmental by GHD

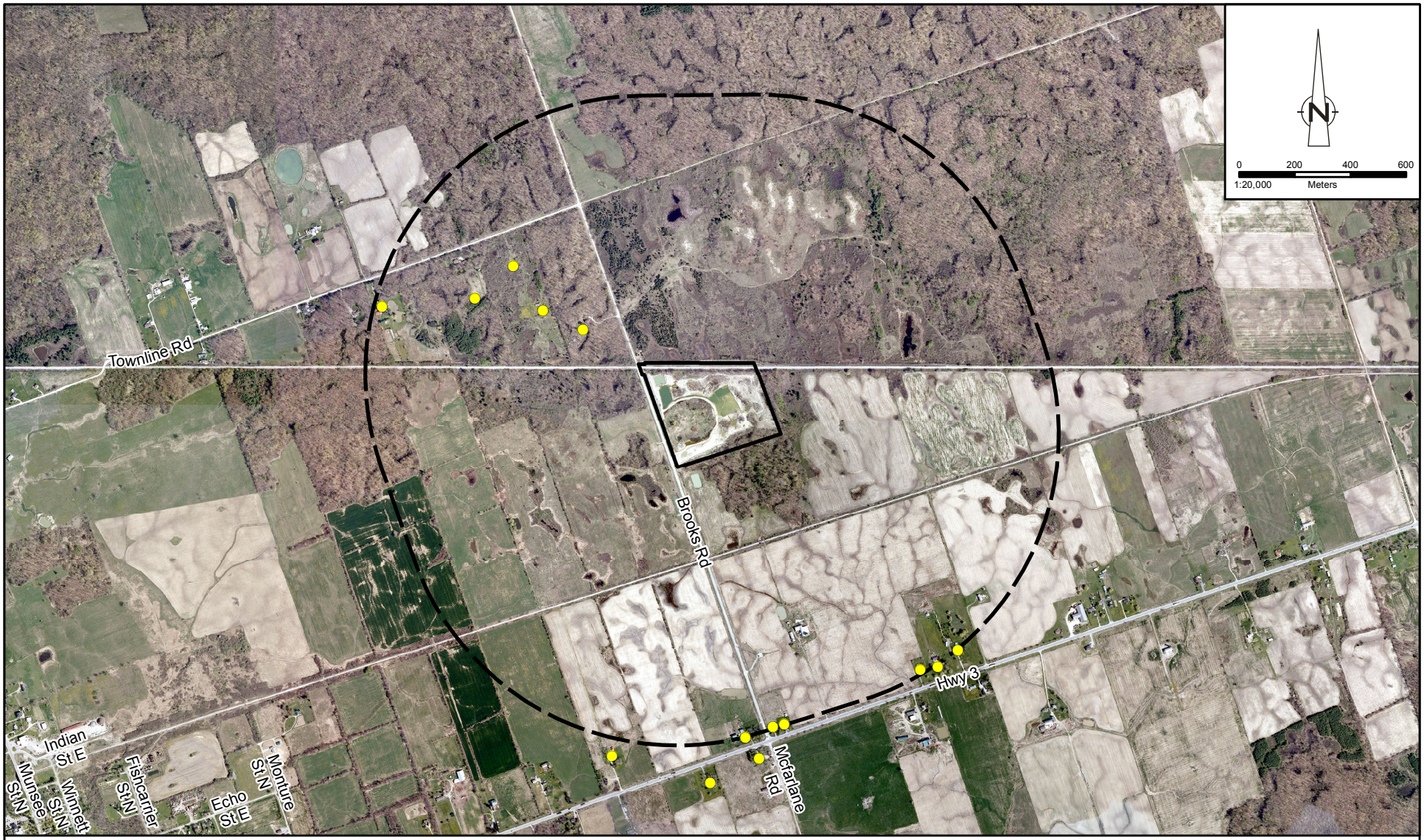
3.2.2 Field Investigations

GHD completed a site visit on September 11, 2015 to review the Site and the conditions within the Local Study Area. The Facility is located just outside of Cayuga, Ontario on a remote road with the nearest residential dwelling approximately 232 metres (m) northwest of the existing property boundary. There are approximately 14 existing one-storey (1.5 m above grade) and two-storey (4.5 m above grade) residential dwellings within the Local Study Area (see **Figure 3.2**). The landfill has a berm that runs along the west property-boundary, and a clay stockpile situated on the north end of the property. While the existing Brooks Road Landfill is currently in operation (i.e., accepting waste), it should be noted that and filling operations at the Site have been slowing down since 2015, as the landfill continues to reach its current approved capacity. At the time of the site visit the landfill liner was being installed and; therefore, minor odours were observed at the Facility entrance and near the leachate processing area.

On-site and off-site odour investigations were completed by GHD in 2014 and 2016. These studies indicated that there was no measurable odour off-site. GHD completed odour measurements during daytime and nighttime periods to try and observe odours in the surrounding community. During all the

odour monitoring events, no odours that could be attributed to the Site were detected off-site. The odour monitoring events are summarized in **Appendix A**.

The GHD Team completed a walk-through of the Site, with focused observations at the location of the proposed vertical expansion and the leachate system. GHD did not identify any fugitive emissions during the walkthrough other than minor particulate emissions generated by small vehicles moving throughout the landfill. The GHD Team also observed the area surrounding the Site to confirm the locations of the nearest sensitive receptors to the Facility.



Source: MNRF NRVIS, 2014. Produced by GHD under licence from Ontario Ministry of Natural Resources and Forestry, © Queen's Printer 2016;
Aerial: 2006 Grand River Conservation Authority
Coordinate System: NAD 1983 UTM Zone 17N

Legend

- Sensitive Receiver Location
- Local Study Area (1km Radius)
- Site Location

figure 3.2

SENSITIVE RECEIVER LOCATIONS
AIR QUALITY AND ODOUR ASSESSMENT REPORT
BROOKS ROAD LANDFILL
160 Brooks Road, Cayuga, Ontario

018235-20(INT004)GIS-WA005 Jul 08/2016

3.3 Climate, Air Quality and Odour

3.3.1 Hamilton Climate Station

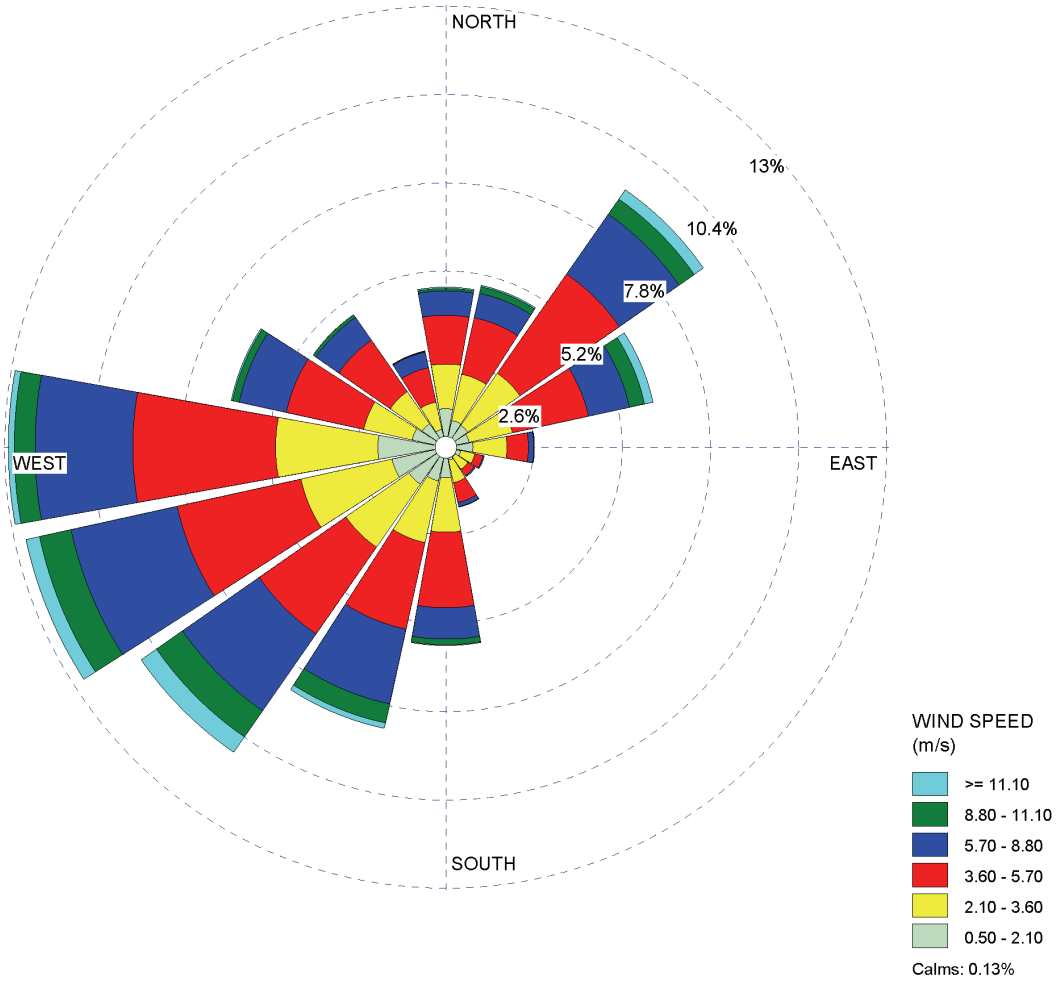
The Hamilton Climate Station is a weather station located at Hamilton's John C. Munro International Airport (43.1N, 79.5W, elevation 237.7 m). The station has been operating since January 15, 1970 under World Meteorological Organization (WMO) ID 71263. The Hamilton Climate Station was selected as it is the closest representative station to the Facility that has hourly documented climate data since 2010. Data from this station is published online at Environment Canada's National Climate Data and Information Archive. Hourly data from the station was analyzed to determine prevalent atmospheric conditions that are considered representative of the Site.

Figure 3.3 presents a five-year wind rose for the Hamilton Climate Station for the period between 2010 and 2014 and **Figure 3.4** presents the wind class frequency distribution. The dominant wind directions, as shown on **Figure 3.3**, are from the southwest, and west.

Figure 3.3 Wind Rose, Hamilton AP 2010 - 2014

WIND ROSE PLOT:
WIND ROSE, HAMILTON AP 2010 - 2014

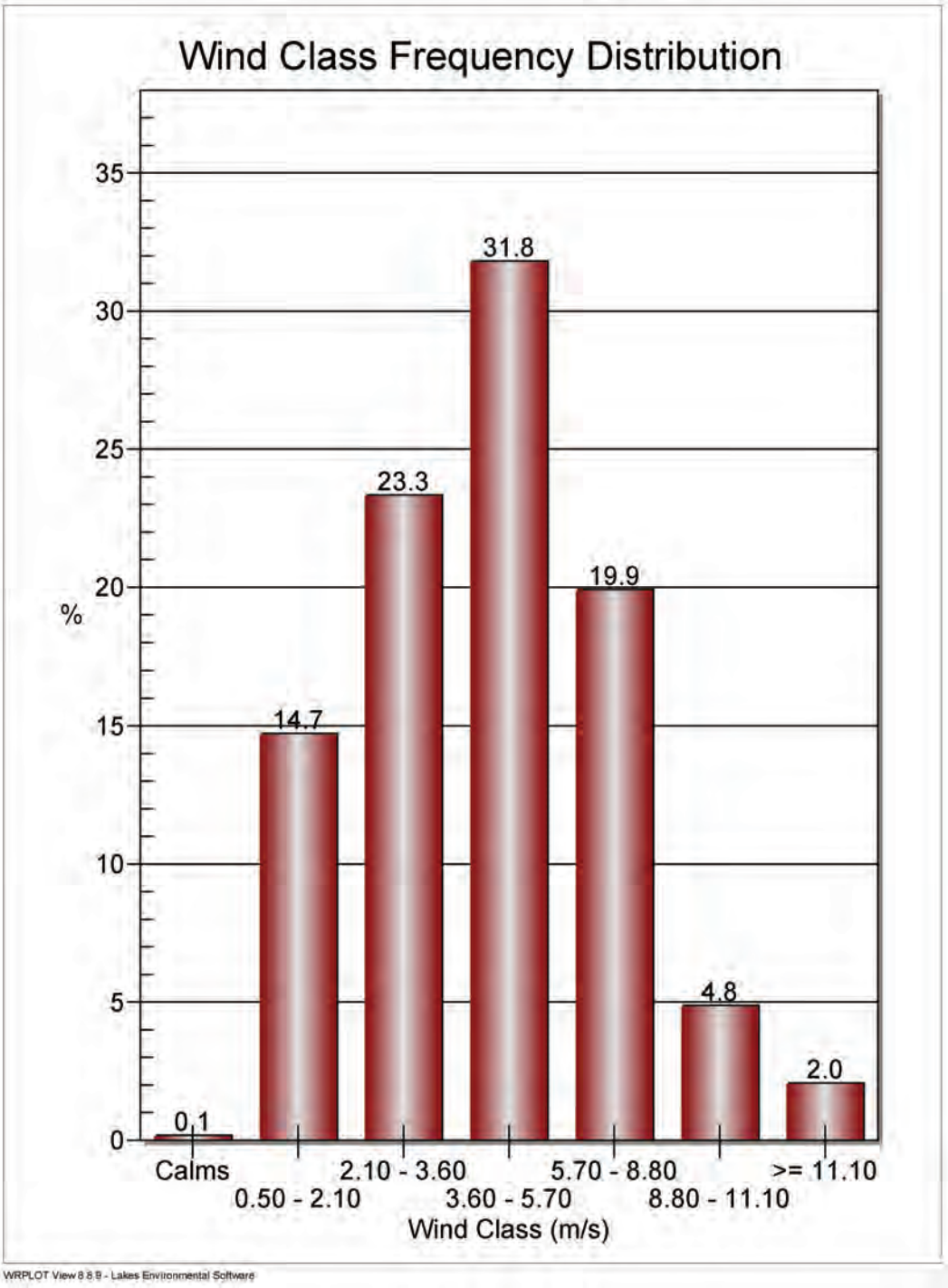
DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 01/Jan/10 - 00:00 **End Date: 31/Dec/14 - 23:00**	**BROOKS ROAD LANDFILL, ONTARIO**	
		MODELER: **GHD**	
	CALM WINDS: **0.13%**	TOTAL COUNT: **42351 hrs.**	
	AVG. WIND SPEED: **4.55 m/s**	DATE: **13/Oct/15**	PROJECT NO.: **018235**

WRPLOT View - Lakes Environmental Software

Figure 3.4 Wind Class Frequency Distribution



3.3.2 Complaint History

Brooks Road Environmental maintains a record of all environmental complaints received at the Site. A review of the complaint records from the past four years indicates that out of the 21 complaints, 20 were related to odour perceived from the Site.

Concerned residents or businesses can call Brooks Road Environmental, the Township of Cayuga, or the MOECC if a nuisance effect is perceived to have occurred because of the Brooks Road Facility. All complaints are recorded and investigated by Brooks Road Environmental. Each complaint is logged and, in many cases, Site staff will go to the location where the nuisance was recorded and conduct on-site investigations. The date and time of the complaint are cross-referenced with data from the Facility in order to determine if any adjustments to operations need to be made at the Site. Each complaint received at the Facility is reported to the MOECC.

Table 3.1 provides a summary of complaint records from either residents or businesses, as recorded by Brooks Road Environmental for the period from 2012 to 2015.

Since 2014 Brooks Road has investigated each odour complaint that was logged. During this time Brooks Road Environmental and GHD have not confirmed that the odour complaints were related to Brooks Road Environmental operations.

Table 3.1 Brooks Road Landfill Site Complaint Records 2012 to 2015

Date	Documented to	Description
August 12, 2012	Landfill Site Staff	Mud on Road
December 13, 2012	Landfill Site Staff	Odour
December 03, 2013	Landfill Site Staff	Odour
December 04, 2013	Landfill Site Staff	Odour
February 04, 2014	MOECC	Odour
February 28, 2014	MOECC	Odour
May 05, 2014	MOECC	Odour
May 06, 2014	MOECC	Odour
July 12, 2014	MOECC	Odour
July 13, 2014	MOECC	Odour
July 14, 2014	MOECC	Odour
July 25, 2014	MOECC	Odour
July 28, 2014	MOECC	Odour
July 29, 2014	Richard Weldon	Odour
August 30, 2014	MOECC	Odour
September 08, 2014	MOECC	Odour
September 10, 2014	Paul Zizek	Odour

Date	Documented to	Description
October 22, 2014	Paul Zizek	Odour
October 23, 2014	Paul Zizek	Odour
January 2, 2015	MOECC	Odour
November 3, 2015	MOECC	Odour

3.3.3 Air Quality

The Facility is located approximately 2.8 km northeast of Cayuga and 25 km south of Hamilton and is surrounded by agricultural land. The closest residential building is approximately 232 m from the Site and there are no major industrial sources within the Study Area as indicated in **Figure 3.1**. The Facility has a berm that runs along the west side of the site and a clay stockpile located along the north side that would reduce the line of sight and fugitive particulate matter emissions when the landfill is in operation. All roads on-Site are unpaved and consist of either gravel or sand. Current fugitive emissions of road dust from the Site are minimal as the Site employs dust mitigation measures, such as reduced vehicle speed and roadway watering or covering using wood chips during dry periods, as-needed.

The Brooks Road Landfill Site is a fully integrated landfill that operates leachate processing equipment, a portable shredder and other small on-site equipment. While the existing Brooks Road Landfill is currently in operation (i.e., accepting waste), it should be noted that landfilling operations at the Site have been slowing down since 2015, as the landfill continues to reach its current approved capacity. At the time of the site visit the landfill shredder and other equipment were in operation and minor particulate emissions were observed in the active working face of the landfill.

3.3.3.1 Vehicle Emissions

Particulate emissions related to vehicles operating at the landfill are the primary emissions of concern at the landfill. Particulate may be defined in various particle size categories; including total suspended particulate (TSP), particulate less than 10 microns (PM10) and particulate less than 2.5 microns (PM2.5). All fractions of particulate were assessed for the potential landfill emissions.

The assessment for particulate matter focused on the re-suspension of particulate matter from truck traffic. The air quality assessment used worst-case assumptions to conduct the emissions estimates. The air quality assessment assumed all daily truck traffic to and from the Site to be garbage trucks weighing 40 tonnes when entering the site and 20 tonnes when exiting the site, resulting in an average of 25 trucks per day (500 tonnes) and a maximum of 50 trucks per day (1,000 tonnes).

The total suspended particulate emission factor for trucks traveling on an unpaved road is 2,620 grams per vehicle kilometer traveled (g/VKT). For paved road the emission factor is 708 g/VKT. For heavy duty

vehicles (HDV) the emission factor for PM10 from vehicle exhaust and brake and tire wear the emission factor is 0.264 g/VKT.

The potential emissions from vehicle exhaust and brake and tire wear for HDV is 0.01% of the emission factor for HDV travelling on unpaved roads. The potential emissions from vehicle exhaust and brake and tire wear for HDV is 0.04% of the emission factor for HDV travelling on paved roads. As the potential emissions from the vehicle exhaust and brake and tire wear for the HDV on the proposed trucks routes is less than 0.1% of the total emissions, they have been classified as insignificant and no further assessment has been completed on these potential emission. The potential emissions from the vehicle exhaust and brake and tire wear were calculated using the Mobile6.2 Mobile Emission Factor Model. The potential emissions for PM2.5 are even less than PM10 example provided above and therefore is also not included in this assessment. Therefore, the potential emissions from vehicle exhaust and brake and tire wear can be concluded to be insignificant.

3.3.3.2 Indicator Compounds

As identified above, TSP, PM10, and PM2.5 were included in the assessment as they are the primary emissions of concern at the landfill. Potential TSP, PM10, and PM2.5 emissions from vehicle exhaust and break and tire wear for the on-site vehicles was concluded to be insignificant based on results from Mobile6.2 and are not included in the assessment. Details on the contribution of vehicle exhaust and break and tire wear in comparison to the other landfill activities are provide in Section 3.3.3.1.

Other tailpipe/combustion emissions, such as nitrogen oxides (NOx) and carbon monoxide (CO), can also be concluded to be insignificant based on the small volume of daily traffic at the landfill, and the significant distances to sensitive receptors. The potential concentrations of NOx and CO that a person might be expected to be exposed to near a municipal road would far exceed the concentrations of these compounds at the landfill boundary. Therefore, it may be concluded that NOx and CO emissions from the vehicles at the landfill are insignificant contributors to the background concentrations of these compounds.

Landfill gases, such as hydrogen sulfide (H2S) and vinyl chloride, can also be concluded to be insignificant based on the operations at the landfill. GHD completed a theoretical landfill gas generation rate for the site. Based on the existing and proposed waste to be disposed at the site, it was determined that the maximum amount of landfill gas that will be generated is less than 200 cubic feet per minute. This would be distributed over an area of approximately 14.3 hectares or 143,000 square metres, resulting in a landfill gas exit velocity of only 0.000004 metre per second. This amount of landfill gas generation is anticipated to be insignificant from an overall site profile and therefore landfill gases are not included in any further assessment.

Odours from the operations have not been further assessed. Details on the rationale to identify the potential odour from the site as negligible are provided in Section 3.3.4, below.

3.3.3.3 MOECC Air Monitoring Data

The MOECC has ambient air monitoring stations across Ontario that measure a variety of pollutant concentrations. Typically, the stations monitor criteria air contaminants, such as nitrogen oxides, carbon monoxide, sulphur dioxide, and particulate matter, with the exception of some specialized monitors that measure speciated volatile organic compounds (VOCs) and ammonia. There are no active monitoring stations within the Study Area, therefore, the monitor located in West Hamilton (29118), Ontario was chosen as the closest monitor to the Site.

The West Hamilton station monitors nitrogen oxides, ground-level ozone, and particulate matter 2.5 µm (PM2.5). The West Hamilton station is located in West Hamilton and is expected to be influenced by the industry within the City of Hamilton. The focus of this assessment is on the various size fractions of particulate matter. Although the West Hamilton Station is not representative of the Brooks Road Landfill Site the data from this location has been included for completeness. The focus of this assessment is on the total suspended particulate (TSP), PM10, and PM2.5. These fractions of particulate matter are the main containments that will be released at the Brooks Road Landfill Site.

Hourly readings and 24-hour average values are provided as part of the MOECC hourly results data set for PM2.5. The West Hamilton monitor is located in a predominantly urban area. Therefore, the PM2.5 concentrations around the Brooks Road Landfill Site are expected to be much lower compared to the monitoring station.

The hourly readings for PM2.5 from the West Hamilton station were averaged to obtain an annual average concentration, which is presented in **Table 3.2** along with the average over the six year period (2009 to 2014). A time frame of six years was chosen as it provides an accurate representation of the PM2.5 levels for West Hamilton that is influenced from the industrial activities in Hamilton but is not representative of the PM2.5 levels at the Brooks Road Landfill Site.

As shown in **Table 3.2**, the concentration for PM2.5 is below its respective Ambient Air Quality Criteria (AAQC) and Canada Ambient Air Quality Standard (CAAQS). The monitoring data indicates PM2.5 levels are slowly increasing over time. However, this is a result of an increase in industry in the vicinity of the West Hamilton monitoring station and is not expected to be the trend for the Brooks Road Landfill Site and its surrounding area. Based on the monitored data, the PM2.5 background concentrations in the vicinity of the Site are well below the respective AAQC and CAAQS. It is expected that the levels at the Brooks Road Landfill site are significantly lower as they are not influenced by the industrial and populated areas of Hamilton.

Based on the information from the West Hamilton meteorological station it is expected that the existing ambient particulate matter concentration at the site is negligible. However, cumulative effects have been assessed based on the 98th percentile data from the West Hamilton monitoring station. The 98th percentile data is used as it is referenced in the Ontario Ambient Air Quality Criteria as being the percentile that is required to meet the PM2.5 Canada Wide Standard.

As part of the Brooks Road Landfill commitment to ensuring that particulate matter emissions from the site are minimized from the existing and proposed operations a standard operating procedure (SOP) will be developed. The purpose of the SOP will be to ensure best management practices are implemented at the site to reduce the potential generation of particulate matter results. This includes, but is not limited to, the watering and sweeping of roads that equipment uses to travel the site.

Table 3.2 Annual Particulate Matter 2.5µm Concentration from the Hamilton West MOECC Monitoring Station

Year	2009	2010	2011	2012	2013	2014	Average	AAQC	CAAQS
Concentration (µg/m^3)$^{(1)}$	7.42	6.74	6.99	7.59	9.55	9.94	8.04	30.00	30.00
Concentration (µg/m^3)$^{(1)}$	15.92	23.34	21.17	20.16	23.4	24.92	21.49	30.00	30.00

Notes:
1. Based on MOECC monitoring station located in West Hamilton, average values.
2. Based on MOECC monitoring station located in West Hamilton, 98 percentile values

3.3.4 Odour Quality

During landfill operations the primary odour sources were identified as the landfill leachate system and the landfill working face. These primary odour sources were confirmed by GHD in 2014 when two separate odour analyses were completed as the result of complaints made by neighbouring residents. However it should be noted that these odour sources were not confirmed to have been the source of the complaints.

Additional odour monitoring was completed by GHD at the Brooks Road Landfill Site in 2016 and also confirmed that the leachate system and working face were the primary localized odour sources, with the leachate system being the more significant contributor. Brooks Road Landfill is currently installing a leachate treatment system that is designed to reduce the handling and storage of leachate and the potential for odour impacts.

The previous analyses indicated high odour levels near the leachate tank and lower odour levels near the working face. All of the off-site monitoring did not identify any odours associated with the Brooks Road Landfill operations at the sensitive receptors. With the leachate treatment system that is currently

being installed the potential for odours from the Brooks Road Landfill operations should be significantly reduced. The odour monitoring programs are summarized in **Appendix A**.

As summarized in **Appendix A**, the odour monitoring programs were completed during meteorological conditions when odours complaints have typically been registered. Odour complaints have typically occurred in the late evening or early morning hours with low to no winds and during temperature inversions (hot during the day and cool during the night). During these programs no odours that were associated with the Brooks Road Landfill operations were detected at the sensitive receptors.

In addition to the on-site and off-site odour monitoring that was completed by Brooks Road Landfill, GHD completed a theoretical landfill gas generation rate for the site. Based on the existing and proposed waste to be disposed at the site, it was determined that the maximum amount of landfill gas that will be generated is less than 200 cubic feet per minute. This would be distributed over an area of approximately 14.3 hectares or 143,000 square metres, resulting in a landfill gas exit velocity of only 0.000004 metre per second. This amount of landfill gas generation is anticipated to be insignificant from an overall odour site profile.

As part of Brooks Road Landfill commitment to ensuring that odour complaints are minimized from the existing and proposed operations a standard operating procedure (SOP) will be developed. The purpose of the SOP will be to include odour mitigation measures that would be implemented to ensure that odour complaints are investigated and the condition that resulted in the odour complaint is mitigated.

Section 4.0 Mitigation Measures to be Incorporated into the Alternative Method Designs

Based on the description of the Alternative Methods provided in **Section 2.0** and the characterization of the Air Quality and Odour Existing Conditions within the Study Areas described in **Section 3.0**, **Table 4.1** presents the mitigation measures recommended to be incorporated into the Alternative Methods designs in order to avoid or minimize impacts on Air Quality and Odour.

Table 4.1 Mitigation Measures to be Incorporated into the Design		
	Recommended Design Mitigation Measure	***Resulting Net Effect***
Alternative Method 1	Pave the road from the landfill entrance up to the point the trucks enter the main part of the landfill (~224 meters)	Reduced particulate matter emissions due to road traffic
Alternative Method 2	Pave the road from the landfill entrance up to the point the trucks enter the main part of the landfill (~224 meters)	Reduced particulate matter emissions due to road traffic
Alternative Method 3	Pave the road from the landfill entrance up to the point the trucks enter the main part of the landfill (~224 meters)	Reduced particulate matter emissions due to road traffic

Section 5.0 Net Effects Assessment

This section documents the net effects assessment for the Alternative Methods for the Brooks Road Landfill Site Vertical Capacity Expansion EA from an Air Quality and Odour perspective.

5.1 Net Effects Assessment Methodology

The assessment of the Alternative Methods was conducted in two steps:

- **Step 1: Confirm Evaluation Criteria and Indicators/Measures**
  Prior to undertaking the net effects assessment, the Air Quality and Odour evaluation criteria and indicators developed in the Minister-approved ToR were reviewed and confirmed for application to each of the Alternative Methods.
- **Step 2: Undertake the Net Effects Analysis**
  With the evaluation criteria, indicators and measures confirmed through the preceding step, a net effects analysis of the Alternative Methods was carried out consisting of the following activities:
  - Identify potential effects (based on measures) on Air Quality and Odour
  - Develop and apply avoidance/mitigation/compensation/enhancement measures
  - Determine net effects on the environment

5.2 General Assumptions

The Site activity and modelling assumptions are summarized in the Sections above. The three Site development Alternative Methods assumptions are documented in **Section 2.0**. The worst-case equipment locations were selected based on proximity and elevated line-of-sight to the property boundary. The worst-case elevation was selected based on Landfill cell development and the corresponding topography detail.

5.3 Criteria/Indicators

The evaluation of the Alternative Methods focused on alternative Site cell configurations. The alternative Site cell configurations were developed based on criteria such as air quality and odour and were evaluated using a simple comparison process to identify the preferred alternative method from an air quality and odour perspective. The development and consideration of alternative Site cell configurations utilized historical data developed at the Site during the past 40+ years, as well as available secondary source information detailed in **Section 3.2.1** and **Section 3.3.1**.

As discussed previously, particulate matter is the only compound of concern in terms of Air Quality and, therefore, only particulate emissions were assessed.

	Environmental Component	Evaluation Criteria	Study Area	Indicators	Rationale	Data Sources
NATURAL	**Atmospheric Environment**	Air quality	Site & Local Study Areas	• Predicted off-Site point of impingement concentrations (µg/m3) of indicator compounds • Number of off-Site receptors potentially affected (residential properties, public facilities, businesses, and institutions)	Waste disposal facilities and associated operations can produce gases containing contaminants that degrade air quality if they are emitted to the atmosphere. Construction and operation activities at a waste disposal facility may also result in changes to the levels of particulates (dust) in the air.	• Environment Canada or Ontario Ministry of the Environment hourly meteorological data and climate normals • Site ambient air monitoring, continuous emissions monitoring data • Applicable MOECC guidelines and technical standards (i.e., ambient air quality criteria) • Aerial photographic mapping and field reconnaissance • Off-Site receptors confirmed on recent mapping • Emissions Summary and Dispersion Modelling (ESDM) reports • Available background ambient air data • Waste materials and leachate characterization and sampling data • Proposed facility characteristics • Landfill design and operation data

	Environmental Component	Evaluation Criteria	Study Area	Indicators	Rationale	Data Sources
		Odour	Site & Local Study Areas	• Predicted off-Site odour concentrations (odour units[OU]) • Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions).	The proposed vertical expansion may result in changes in the degree and frequency of odours from the Site.	• Published odour studies for similar source types • Site specific odour source data and/or ambient odour monitoring data • Environment Canada or MOECC hourly meteorological data and climate normals • Applicable MOECC guidelines and technical standards • Site odour complaints history • Aerial photographic mapping and field reconnaissance • Off-site receptors confirmed on recent mapping • Odour assessment reports • Waste materials and leachate characterization and sampling data • Proposed facility characteristics • Landfill design and operation data

5.4 Potential Environmental Effects

Fourteen off-site residential dwellings will be potentially impacted from the existing Landfill activities. Air quality and odour impacts from the Site are evaluated at the property boundary and at the closest residential dwellings. All residential dwellings are expected to be below the applicable air quality and odour criteria.

From a potential air quality impact exposure perspective, Alternative Methods 1, 2 and 3 are nearly identical because the landfill operations and number of vehicles operating at the site are identical. The only difference between the alternatives is the landfill elevation and the difference in elevation is not significant enough to make a material change in the air quality effects.

5.4.1 Potential Odour Effects

Ontario does not have an odour standard. However, a value of one odour unit (OU) is sometimes used by the MOECC as a limit for odour impacts at sensitive receptors such as residences. Based on the existing conditions odour studies, it has been shown that odour levels at the nearest sensitive receptors will not exceed one OU.

Odour was not modelled for the alternatives within this EA as odour impacts from the vertical expansion of the Site are expected to remain the same or lower than the existing conditions. This is due to the fact that the Site will still be receiving a maximum of 151, 000 tonnes per year and will continue to accept the same type of waste resulting in an unchanged odour profile. Additionally, the area of the active face

will remain relatively unchanged and will occur further from the property boundary to allow for proper landfilling slopes to occur. This will reduce and/or maintain any odours present along the property boundary of the Site. Furthermore, operations will occur within the Site's existing waste footprint and Site boundaries.

As discussed previously, the estimated landfill gas production for the site is extremely small and is not expected to result in any off-site odour impacts.

Additionally, GHD conducted numerous odour analyses in 2014 and 2016 and concluded that there were high odour levels near the leachate tank and the working face, but did not identify any odour at the neighbouring residences. The limited odour detected around the Site boundary was attributed to the historical leachate management system. With the leachate management system currently being implemented by Brooks Road Landfill it is expected that any off-site odour impacts will be reduced. Odours at the concentration currently observed at the site typically do not result in complaints at off-Site sensitive receptor locations. This has been investigated through numerous odour monitoring programs that did not identify any on-site odours being observed at off-site locations. Odour monitoring results from 2014 and 2016 are provided in **Appendix A**.

Lastly, the Site currently implements several operational measures in order to reduce and/or mitigate odour impacts from the Site and they will continue to implement these throughout the vertical expansion. These include:

- Continuing with the daily odour monitoring program carried out by the Site Operator.
- If odours are evident on the property boundary, increase the amount of daily cover applied on the waste.
- Minimize the active working face. Apply interim cover at a minimum thickness of 300 mm on areas of the landfill where landfilling has ceased for 6 months or more.
- Limit exposed areas of the leachate collection system.
- When not in use, ensure blind flanges are placed on leachate collection system cleanouts and sump risers.
- Continue with the use of odour control granules for odour mitigation. Assess areas of placement and their effect on odour mitigation.

5.4.2 Potential Air Quality Effects

The air contaminant of concern for this Site is particulate matter. Other air contaminants are expected to be insignificant. As previously discussed, potential tailpipe and brake and tire wear emissions from vehicles operating at the landfill are insignificant. Also, the estimated landfill gas production of only 200 cfm confirms that any potential off-site impacts of compounds in the gas, such as methane, would be insignificant.

Particulate is primarily produced by vehicle traffic on the landfill roads. The particulate matter that is of concern is based on the re-suspension of particulate matter from traffic on the roads. The tailpipe and brake and tire wear has been determined to be insignificant sources of particulate matter. The Ontario ambient air quality criterion for TSP is 120 µg/m^3 on a 24-hour basis. There are other particulate provincial and federal criteria for particulate less than 10 microns (PM-10) and particulate less than 2.5 microns (PM-2.5). These particulate emissions would also occur from vehicle traffic on the landfill roads.

It is GHD's experience that if one can show compliance with the TSP standard, a site with road traffic being the major source, then the PM10 and PM2.5 concentrations will also be below criteria. However, for completeness, GHD has modeled the TSP, PM10 and PM2.5 emissions in the assessment of the alternatives.

The TSP, PM10 and PM2.5 emissions from the on-site roads were estimated based on truck traffic and emissions factors from the United States Environmental Protection Agency (USEPA). Particulate off-site concentrations were estimated using the AERMOD air dispersion model which is an approved dispersion model under Ontario Regulation 419/05. The AERMOD model incorporates 5 years of meteorological data to determine the worst case air concentration. Therefore, the modeling results can be considered to be conservative. Four potential road layouts for different phases of the landfill were modeled.

GHD modelled four internal potential on-site haul road routes for each Alternative. Routes were modelled with the working face located in the four corners of the landfill (northeast, northwest, southeast, and southwest). These locations represent the worst case positions of the working face for potential receptors in the various directions, and results in the longest possible haul routes. Figures 3.5.1 to 3.5.8 provide examples of the four haul routes and working faces that were modelled for the alternative 1 model for 25 and 50 trucks. The other alternatives are identical, other than different landfill elevations and are provided in Figures 3.6.1 to 3.6.8 (Alternative 2) and 3.7.1 to 3.7.8 (Alternative 3).

Based on preliminary models it was determined that the Site should pave the on-site roadway from the site gate to the entrance to the landfill. This would significantly reduce particulate emissions and potential impacts to the south and west of the Site. Therefore, the evaluation of the alternatives assumed that this section of on-site road would be paved.

The particulate modelling considered the average and maximum number of trucks that would be operating at the landfill under the requested waste approval volume. An average of 25 trucks per day would equate to the annual waste volume requested. The site indicated that a peak of approximately 50 trucks per day could operate at the landfill on a busy day. Therefore, GHD conducted particulate

emission estimates and dispersion modelling assessments for both 25 trucks per day and 50 trucks per day for the three landfill expansion options.

5.4.2.1 Alternative Method 1

TSP, PM10 and PM2.5 from the Site were evaluated at the property boundary and all residential dwellings. The predicted worst case particulate impact at the property boundary for alternative 1 is as follows:

- TSP – 25 trucks per day – 61.49 µg/m^3
- PM10 – 25 trucks per day – 32.28 µg/m^3
- PM2.5 – 25 trucks per day – 4.64 µg/m^3
- TSP – 50 trucks per day - 122.4 µg/m^3
- PM10 – 50 trucks per day – 64.18 µg/m^3
- PM2.5 – 50 trucks per day – 8.8 µg/m^3

The predicted maximum worst case particulate impact at the sensitive receptors for alternative 1 is as follows:

- TSP – 25 trucks per day – 2.91 µg/m^3
- PM10 – 25 trucks per day – 2.31 µg/m^3
- PM2.5 – 25 trucks per day – 0.38 µg/m^3
- TSP – 50 trucks per day - 5.78 µg/m^3
- PM10 – 50 trucks per day – 4.56 µg/m^3
- PM2.5 – 50 trucks per day – 0.61 µg/m^3

The MOECC AAQC for TSP is 120 µg/m^3, 50 µg/m^3 for PM10, and 30 µg/m^3 for PM2.5. The 25 trucks per day scenario is the expected normal operations from the site. During peak times there may be up to 50 trucks per day.

The modelled concentration at the sensitive receptors during the normal and peak operations are all well below the MOECC AAQC for all particulate matter fractions. The modelled concentration at the property boundary for the normal operations of 25 trucks per day is well below the MOECC AAQC for all particulate matter fractions.

The modelled concentration at the property boundary for the peak operations, 50 trucks per day, is right at the AAQC for TSP and PM10. PM2.5 remains well below the MOECC AAQC. The air dispersion modelling for the peak scenario is a worst case scenario based on the worst case day during a five-year period and the truck routes, dumping, and shredding occurring at the worst case location on-Site.

The TSP worst case air quality contours for alternative 1 are presented on **Figures 3.5.1 – 3.5.8** following text. The air quality contours for PM10 and PM2.5 are similar to the TSP air quality contours and have not been included.

5.4.2.2 Alternative Method 2

TSP, PM10 and PM2.5 from the Site were evaluated at the property boundary for alternative 2. It was determined during the air dispersion modelling that alternative 1 is the worst case scenario at the sensitive receptors. Therefore no additional sensitive receptor modelling was completed for alternative 2 or alternative 3 as the particulate matter concentration at the sensitive receptors would be less than alternative 1. The predicted worst case particulate impact at the property boundary for alternative 2 is as follows:

- TSP – 25 trucks per day – 61.01 µg/m^3
- PM10 – 25 trucks per day – 32.06 µg/m^3
- PM2.5 – 25 trucks per day – 4.79 µg/m^3
- TSP – 50 trucks per day - 121.59 µg/m^3
- PM10 – 50 trucks per day – 63.74 µg/m^3
- PM2.5 – 50 trucks per day – 9.13 µg/m^3

The modelled concentration at the property boundary for the normal operations of 25 trucks per day is well below the MOECC AAQC for all particulate matter fractions.

The modelled concentration at the property boundary for the peak operations, 50 trucks per day, is right at the AAQC for TSP and PM10. PM2.5 remains well below the MOECC AAQC. The air dispersion modelling for the peak scenario is a worst case scenario based on the worst case day during a five-year period and the truck routes, dumping, and shredding occurring at the worst case location on-Site.

The TSP worst case air quality contours for alternative 2 are presented on **Figures 3.6.1 – 3.6.8** following text. The air quality contours for PM10 and PM2.5 are similar to the TSP air quality contours and have not been included.

5.4.2.3 Alternative Method 3

TSP, PM10 and PM2.5 from the Site were evaluated at the property boundary for alternative 3. It was determined during the air dispersion modelling that alternative 1 is the worst case scenario at the sensitive receptors. Therefore no additional sensitive receptor modelling was completed for alternative 2 or alternative 3 as the particulate matter concentration at the sensitive receptors would be less than alternative 1. The predicted worst case particulate impact at the property boundary for alternative 3 is as follows:

- TSP – 25 trucks per day – 61.13 µg/m^3
- PM10 – 25 trucks per day – 32.13 µg/m^3
- PM2.5 – 25 trucks per day – 4.80 µg/m^3
- TSP – 50 trucks per day - 122.00 µg/m^3
- PM10 – 50 trucks per day – 63.81 µg/m^3
- PM2.5 – 50 trucks per day – 9.14 µg/m^3

The modelled concentration at the property boundary for the normal operations of 25 trucks per day is well below the MOECC AAQC for all particulate matter fractions.

The modelled concentration at the property boundary for the peak operations, 50 trucks per day, is right at the AAQC for TSP and PM10. PM2.5 remains well below the MOECC AAQC. The air dispersion modelling for the peak scenario is a worst case scenario based on the worst case day during a five-year period and the truck routes, dumping, and shredding occurring at the worst case location on-Site.

The TSP worst case air quality contours for alternative 3 are presented on **Figures 3.7.1 – 3.7.8** following text. The air quality contours for PM10 and PM2.5 are similar to the TSP air quality contours and have not been included.

5.4.3 Cumulative Effects

A cumulative effects assessment considers other sources of air emissions in the area of the site and background ambient air quality. There are no significant off-site sources of air emissions within the study area, other than local road traffic.

As discussed in Section 3.3.3.2, there is no MOECC or Environment Canada air monitoring station located near the site. However, GHD used the MOECC West Hamilton air monitoring station as a source of local particulate ambient air data. This station is approximately 40 km from the landfill and is impacted by many other sources in Hamilton and is likely providing much higher particulate ambient air quality data than would be representative near the landfill.

The West Hamilton air monitoring station has an average PM2.5 concentration of 8.04 µg/m^{3}and a 98 percentile concentration of 21.49 µg/m^3, from 2009 to 2014. The West Hamilton air monitoring station does not report PM10 or TSP concentrations. The predicted PM2.5 concentrations at the residential receptors from the proposed landfill operations, when added to the background PM2.5 concentrations, would not result in an exceedance of the PM2.5 AAQC of 30 µg/m^3. The maximum cumulative effect from site activities and the West Hamilton air data is 22.10 µg/m^3 during the peak operation scenario (50 trucks). This is below the MOECC AAQC of 30 µg/m^3.

The cumulative effects at the property line for PM2.5 was also completed based on the 2009 to 2014 PM2.5 data from the West Hamilton air monitoring station. During normal operations (25 trucks) the maximum predicted PM2.5 concentration at the property boundary is 26.29 µg/m^3, or 87.6% of the MOECC AAQC. During the peak operating scenario (50 trucks) the maximum predicted PM2.5 concentration at the property boundary is 30.63 µg/m^3. This value is equal to the MOECC AAQC. Using the average PM2.5 concentration from the West Hamilton monitoring station for the peak operating scenario (50 trucks) the maximum predicted PM2.5 concentration at the property boundary is 17.18 µg/m^3. It should be noted that the use of the West Hamilton air monitoring station, the use of the 98th percentile value, and the modelling parameters (meteorological data, route length, location of drop operations) are all worst case scenarios that are not expected to occur simultaneously and provide a conservative estimate of the cumulative effects at the property boundary and sensitive receptors.

5.5 Mitigation Measures Beyond Those Incorporated into the Design

5.5.1 Alternative Method 1

A Fugitive Dust Best Management Plan will be developed and implemented to reduce roadway emission by a minimum of 90 percent. Controls capable of achieving this include watering and sweeping of roadways. This will reduce the particulate matter emissions on-site to within the MOECC property boundary emission limit and all residential dwellings will be within the applicable air quality and odour emission limits.

Additionally, the Site currently implements several operational measures in order to reduce and/or mitigate odour impacts from the Site and they will continue to implement these throughout the vertical expansion. These efforts have proven to be successful as illustrated in the odour analyses conducted by GHD in 2014 and 2016 provided in **Appendix A**.

5.5.2 Alternative Method 2

A Fugitive Dust Best Management Plan will be developed and implemented to reduce roadway emission by a minimum of 90 percent. Controls capable of achieving this include watering and sweeping of roadways. This will reduce the particulate matter emissions on-site to within the MOECC property boundary emission limit and all residential dwellings will be within the applicable air quality and odour emission limits.

Additionally, the Site currently implements several operational measures in order to reduce and/or mitigate odour impacts from the Site and they will continue to implement these throughout the vertical expansion. These efforts have proven to be successful as illustrated in the odour analyses conducted by GHD in 2014 and 2016 provided in **Appendix A**.

5.5.3 Alternative Method 3

A Fugitive Dust Best Management Plan will be developed and implemented to reduce roadway emission by a minimum of 90 percent. Controls capable of achieving this include watering and sweeping of roadways. This will reduce the particulate matter emissions on-site to within the MOECC property boundary emission limit and all residential dwellings will be within the applicable air quality and odour emission limits.

Additionally, the Site currently implements several operational measures in order to reduce and/or mitigate odour impacts from the Site and they will continue to implement these throughout the vertical expansion. These efforts have proven to be successful as illustrated in the odour analyses conducted by GHD in 2014 and 2016 provided in **Appendix A**.

5.6 Net Environmental Effects

5.6.1 Alternative Method 1

As indicated by the results of the air quality and odour potential effects discussed in Section 5.4, there is no potential for an air quality and odour impact at the local residential receptors due to the + 20.69 m elevation change associated with Alternative Method 1. The air quality and odour offsite impacts from the expanded landfill are expected to be lower than the existing potential impacts. Furthermore, mitigation measures have been proposed in order to reduce and/or mitigate these impacts off-site. It is anticipated that with these controls in place, the odour and particulate concentrations at or past the property boundary of the Site will be well within the applicable emission limits.

5.6.2 Alternative Method 2

As indicated by the results of the air quality and odour potential effects discussed in Section 5.4, there is no potential for an air quality and odour impact at the local residential receptors due to the + 22.54 m elevation change associated with Alternative Method 2. The air quality and odour offsite impacts from the expanded landfill are expected to be lower than the existing potential impacts. Furthermore, mitigation measures have been proposed in order to reduce and/or mitigate these impacts off-site. It is anticipated that with these controls in place, the odour and particulate concentrations at or past the property boundary of the Site will be well within the applicable emission limits.

5.6.3 Alternative Method 3

As indicated by the results of the air quality and odour potential effects discussed in Section 5.4, there is no potential for an air quality and odour impact at the local residential receptors due to the + 23.17 m elevation change associated with Alternative Method 3. The air quality and odour offsite impacts from the expanded landfill are expected to be lower than the existing potential impacts. Furthermore, mitigation measures have been proposed in order to reduce and/or mitigate these impacts off-site. It is

anticipated that with these controls in place, the odour and particulate concentrations at or past the property boundary of the Site will be well within the applicable emission limits.

Table 5.1 Alternative Method 1 Air Quality and Odour Potential Environmental Effects, Mitigation Measures & Net Effects

	Environmental Component	Evaluation Criteria	Indicator	Potential Effects	Mitigation Measures	Net Effects
NATURAL	Atmospheric Environment	Air Quality	Predicted off-Site concentrations (µg/m^3) of indicator compounds	Potential air quality impact change due to increased elevation of + 20.69 m above the Existing Conditions.	• Implement Fugitive Dust Best Management Plan to include controls such as watering and sweeping of roadways to allow for a minimum of 90% emission reduction	• Reduced particulate matter emissions due to on-site road traffic by a minimum of 90% • Air quality property boundary maximum exposure less than ambient air quality criteria for TSP, PM10 and PM2.5
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses, and institutions)	Up to 14 existing off-site residential dwellings affected by the proposed Landfill expansion.		• No residences are expected to experience a change in the predicted off-site air quality impact due to the Landfill expansion based on the Existing Conditions.
		Odour	Predicted off-Site odour concentrations (OU)	Potential odour impact change due to increased elevation of + 20.69 m above the Existing Conditions.	• Maintain the operational measures currently in place to reduce/mitigate odour impacts from the Site during the vertical expansion	• Reduced/maintained Site boundary odour concentrations and reduced odour complaints at off-Site locations
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	Up to 14 existing off-site residential dwellings affected by the proposed Landfill expansion.		• No residences are expected to experience a change in the predicted off-site odour impact due to the Landfill expansion based on the Existing Conditions.

Table 5.2 Alternative Method 2 Air Quality and Odour Potential Environmental Effects, Mitigation Measures & Net Effects

	Environmental Component	Evaluation Criteria	Indicator	Potential Effects	Mitigation Measures	Net Effects
NATURAL	Atmospheric Environment	Air Quality	Predicted off-Site concentrations (µg/m^3) of indicator compounds	Potential air quality impact change due to increased elevation of + 22.54 m above the Existing Conditions.	• Implement Fugitive Dust Best Management Plan to include controls such as watering and sweeping of roadways to allow for a minimum of 90% emission reduction	• Reduced particulate matter emissions due to on-site road traffic by a minimum of 90%
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses, and institutions)	Up to 14 existing off-site residential dwellings affected by the proposed Landfill expansion.		• No residences are expected to experience a change in the predicted off-site air quality impact due to the Landfill expansion based on the Existing Conditions.
		Odour	Predicted off-Site odour concentrations (OU)	Potential odour impact change due to increased elevation of + 22.54 m above the Existing Conditions.	• Maintain the operational measures currently in place to reduce/mitigate odour impacts from the Site during the vertical expansion	• Reduced/maintained Site boundary odour concentrations and reduced odour complaints at off-Site locations
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	Up to 14 existing off-site residential dwellings affected by the proposed Landfill expansion.		• No residences are expected to experience a change in the predicted off-site odour impact due to the Landfill expansion based on the Existing Conditions.

Table 5.3 Alternative Method 3 Air Quality and Odour Potential Environmental Effects, Mitigation Measures & Net Effects

	Environmental Component	Evaluation Criteria	Indicator	Potential Effects	Mitigation Measures	Net Effects
NATURAL	Atmospheric Environment	Air Quality	Predicted off-Site concentrations (µg/m^3) of indicator compounds	Potential air quality impact change due to increased elevation of + 23.17 m above the Existing Conditions.	• Implement Fugitive Dust Best Management Plan to include controls such as watering and sweeping of roadways to allow for a minimum of 90% emission reduction	• Reduced particulate matter emissions due to on-site road traffic by a minimum of 90% • Air quality property boundary maximum exposure less than ambient air quality criteria for TSP, PM10 and PM2.5
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses, and institutions)	Up to 14 existing off-site residential dwellings affected by the proposed Landfill expansion.		• No residences are expected to experience a change in the predicted off-site air quality impact due to the Landfill expansion based on the Existing Conditions.
		Odour	Predicted off-Site odour concentrations (OU)	Potential odour impact change due to increased elevation of + 23.17 m above the Existing Conditions.	• Maintain the operational measures currently in place to reduce/mitigate odour impacts from the Site during the vertical expansion	• Reduced/maintained Site boundary odour concentrations and reduced odour complaints at off-Site locations
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	Up to 14 existing off-site residential dwellings affected by the proposed Landfill expansion.		• No residences are expected to experience a change in the predicted off-site odour impact due to the Landfill expansion based on the Existing Conditions.

Section 6.0 Comparative Evaluation

This section documents the comparative evaluation of the Alternative Methods from an Air Quality and Odour perspective based on the net environmental effects identified in **Section 5.0**.

6.1 Comparative Evaluation Methodology

The Minister approved ToR states that the comparative evaluation of the Alternative Methods will be carried out using a Reasoned Argument (or Trade-off) method, with evaluation criteria as the basis for comparison. Under the Reasoned Argument approach, the differences in the net effects associated with each Alternative Method are highlighted. Based on these differences, the advantages and disadvantages of each alternative can be identified according to the evaluation of trade-offs between the various evaluation criteria and indicators. The relative significance of potential impacts is then examined to provide a clear rationale for the selection of a preferred alternative from an Air Quality and Odour perspective. The term *trade-offs* is defined as "*things of value given up in order to gain different things of value*." Each Alternative Method will be compared against the others to distinguish relative differences in impacts to the environment, taking into account possible mitigation measures.

6.2 Comparative Evaluation Results

Air quality and odour impact predictions are within applicable limits for all three alternatives for normal operations at the sensitive receptors. Although the off-site air quality impact predictions are near identical for all three alternatives, Alternative Method 2 has the lowest property boundary concentration followed by Alternative Method 3 then Alternative Method 1. Therefore, from a potential air quality and odour perspective, Alternative Method 2 ranks 1st, Alternative Method 3 ranks 2nd, and Alternative Method 1 ranks 3rd.

Table 6.1 Air Quality and Odour Comparative Evaluation

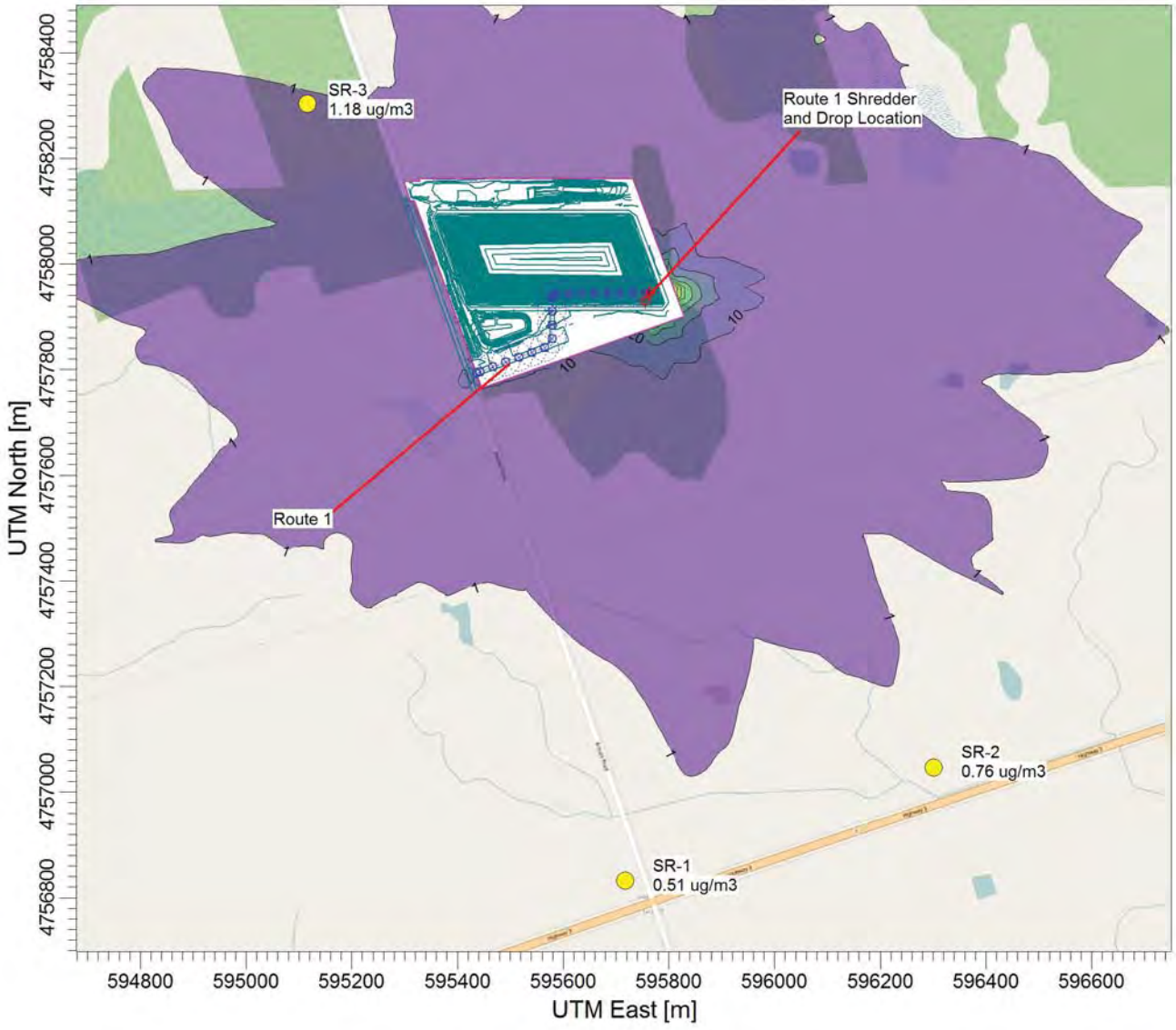
	Env. Component	Evaluation Criteria	Indicator	Alternative Method 1 Net Effects	Alternative Method 2 Net Effects	Alternative Method 3 Net Effects
NATURAL	Atmospheric Environment	Air Quality	Predicted off-Site point of impingement concentrations ($\mu g/m^3$) of indicator compounds	Air quality property boundary maximum exposure of 61.49 $\mu g/m^3$ for TSP for normal operations **LOW NET EFFECTS**	Air quality property boundary maximum exposure of 61.01 $\mu g/m^3$ for TSP during normal operations **LOW NET EFFECTS**	Air quality property boundary maximum exposure of 61.13 $\mu g/m^3$ for TSP during normal operations **LOW NET EFFECTS**
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses, and institutions)	Up to 14 residences may experience a change in the predicted off-site air quality impact due to the Landfill expansion based on the Existing Conditions **LOW NET EFFECTS**	Up to 14 residences may experience a change in the predicted off-site air quality impact due to the Landfill expansion based on the Existing Conditions **LOW NET EFFECTS**	Up to 14 residences may experience a change in the predicted off-site air quality impact due to the Landfill expansion based on the Existing Conditions **LOW NET EFFECTS**
			Criteria Ranking:	**3rd**	**1st**	**2nd**
			Criteria Rationale:	From a potential air quality TSP impact exposure perspective, Alternative Methods 1, 2 and 3 are nearly identical. However, Alternative Method 2 has the lowest property boundary concentration.		
		Odour	Predicted off-Site odour concentrations (OU)	Reduced/maintained Site boundary and off-Site odour concentrations **LOW NET EFFECTS**	Reduced/maintained Site boundary and off-Site odour concentrations **LOW NET EFFECTS**	Reduced/maintained Site boundary and off-Site odour concentrations **LOW NET EFFECTS**
			Number of off-Site receptors potentially affected (residential properties, public facilities, businesses and institutions)	Up to 14 residences may experience a change in the predicted off-site odour impact due to the Landfill expansion based on the Existing Conditions **LOW NET EFFECTS**	Up to 14 residences may experience a change in the predicted off-site odour impact due to the Landfill expansion based on the Existing Conditions **LOW NET EFFECTS**	Up to 14 residences may experience a change in the predicted off-site odour impact due to the Landfill expansion based on the Existing Conditions **LOW NET EFFECTS**
			Criteria Ranking:	**Tied for 1st**	**Tied for 1st**	**Tied for 1st**
			Criteria Rationale:	From a potential odour impact exposure perspective, Alternative Methods 1, 2 and 3 are identical.		
		Env. Component Ranking:		**3rd**	**1st**	**2nd**
	RATIONALE			From a potential air quality and odour impact exposure perspective, Alternative Methods 1, 2 and 3 are nearly identical. However, Alternative Method 2 has the lowest property boundary TSP concentration followed by Alternative Method 3, then Alternative Method 1.		

Section 7.0 Conclusion

The Brooks Road Landfill Vertical Capacity Expansion considers three vertical developments: Alternative Methods 1 to 3. All three alternatives will maintain the existing Landfill footprint. Alternative Methods 1 to 3 are only different by up to 2.5 m based on the proposed final height. The net effect analysis determined that the change in elevation resulted in an environmentally insignificant change to the off-site air quality and odour impact at the fourteen residential dwellings of concern, meaning that the air quality and odour impact predictions were within applicable limits. Further, the off-site air quality impact predictions were near identical for Alternative Methods 1 to 3; however, Alternative Method 2 has the lowest property boundary concentration followed by Alternative Method 3 then Alternative Method 1. All three Alternative Methods were below the AAQC for TSP, PM10, and PM2.5 at the property boundary for normal operations. All three alternative methods were below the AAQC for TSP, PM10, and PM2.5 at the sensitive receptors for the peak operations. The cumulative effect for PM2.5 was below the PM2.5 AAQC at the sensitive receptors for normal and peak operations. Therefore, from a potential air quality and odour perspective, despite Alternative Methods 1, 2 and 3 being nearly identical, Alternative Method 2 ranks 1st, Alternative Method 3 ranks 2nd, and Alternative Method 1 ranks 3rd.

PROJECT TITLE:

Figure 3.5.1 - Air Quality Contours - Vertical Expansion Alternative 1 - 25 Trucks per Day - Truck Route 1□ 24-Hour Total Particulate Matter



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: LF1E1RT1 ug/m^3

1.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0

COMMENTS:	SOURCES: **6**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,034 (0 — 0.4 km)	
	MAX: **61.5 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.5.2 - Air Quality Contours - Vertical Expansion Alternative 1 - 25 Trucks per Day - Truck Route 2
24-Hour Total Particulate Matter

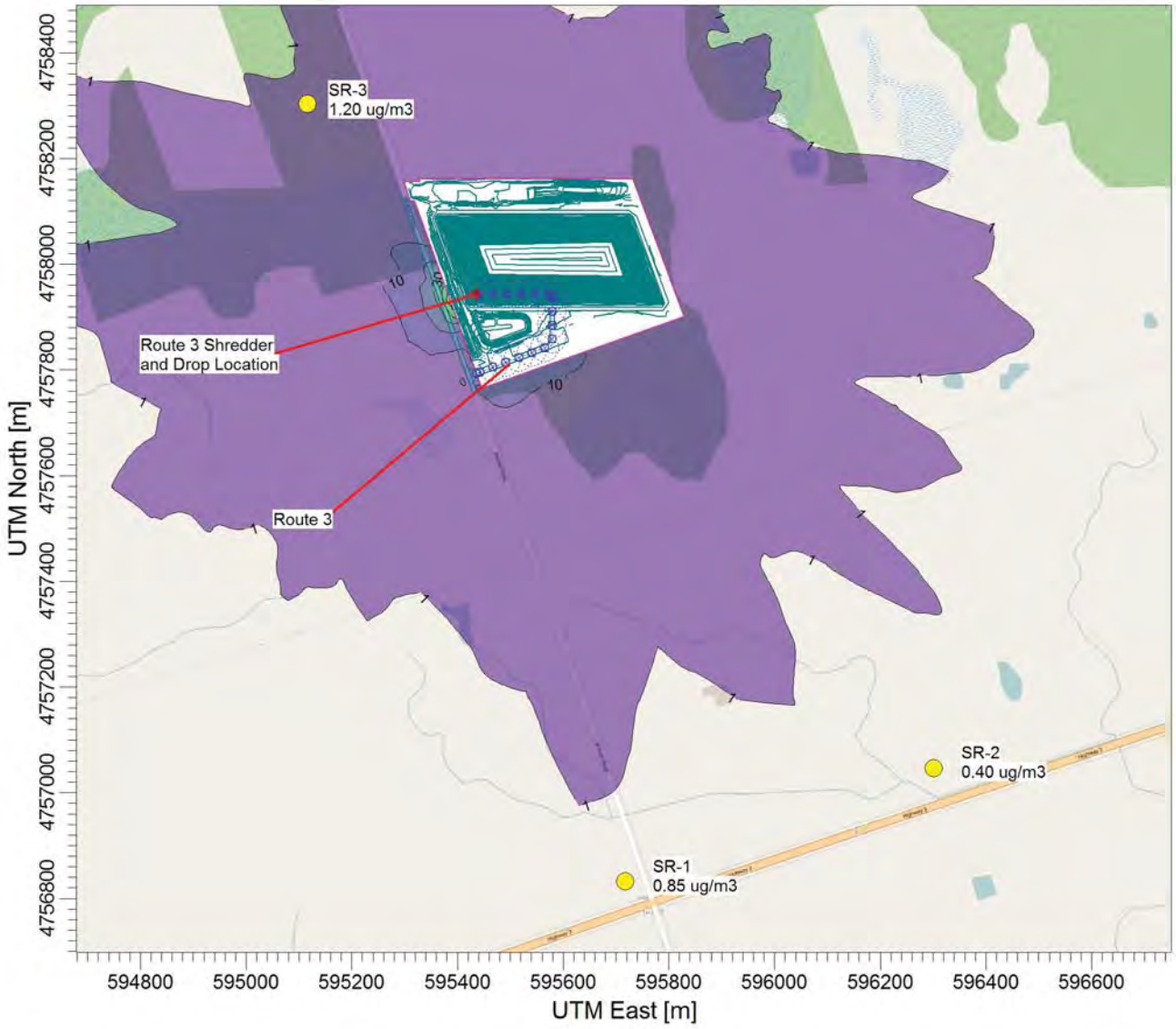
PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: LF1E1RT2 ug/m^3

1.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0

COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,034 (0 — 0.4 km)	
	MAX: **54.5 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.5.3 - Air Quality Contours - Vertical Expansion Alternative 1 - 25 Trucks per Day - Truck Route 3
24-Hour Total Particulate Matter



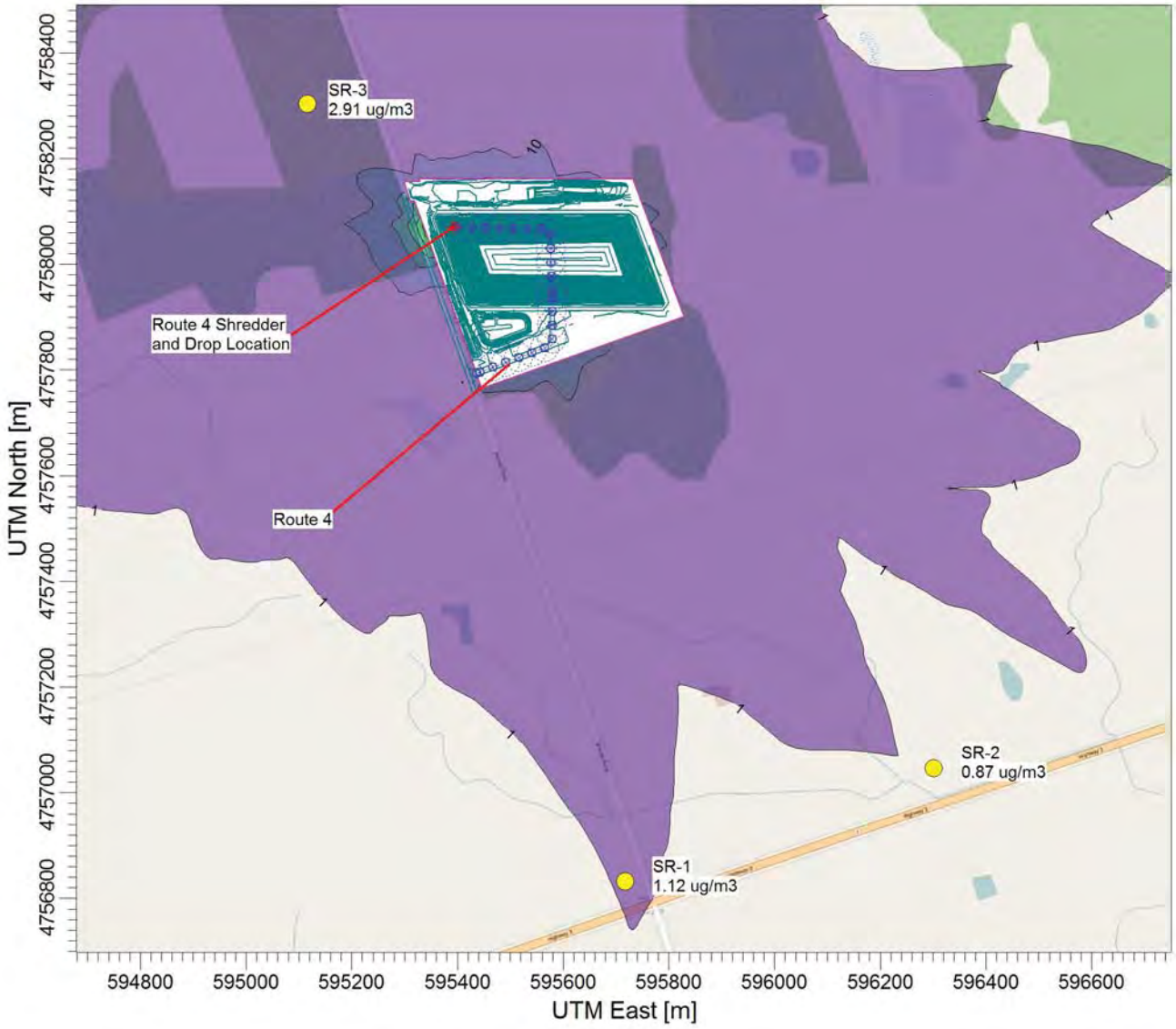
PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: LF1E1RT3 ug/m^3

1.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0

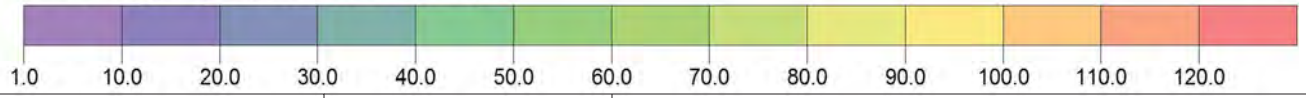
COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,034 (0 — 0.4 km)	
	MAX: **51.2 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.5.4 - Air Quality Contours - Vertical Expansion Alternative 1 - 25 Trucks per Day - Truck Route 4
24-Hour Total Particulate Matter



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: LF1E1RT4 ug/m^3

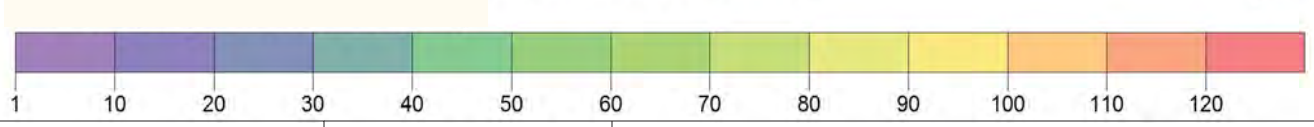


COMMENTS:	SOURCES:	COMPANY NAME:	
	5	**Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS:	MODELER:	
	3392	**GHD**	
	OUTPUT TYPE:	SCALE: 1:13,034	
	Concentration	0 0.4 km	
	MAX:	DATE:	PROJECT NO.:
	47.5 ug/m^3	**12/5/2016**	**018235**

PROJECT TITLE:

Figure 3.5.5 - Air Quality Contours - Vertical Expansion Alternative 1 - 50 Trucks per Day - Truck Route 1
24-Hour Total Particulate Matter

PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: LF1E1RT1 ug/m^3

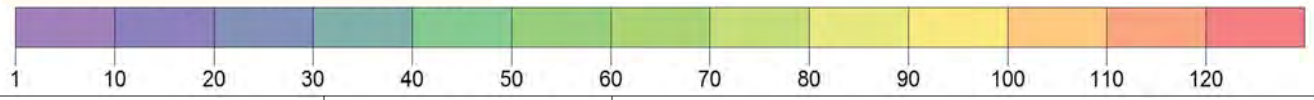


COMMENTS:	SOURCES: **6**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,174 — 0 — 0.5 km	
	MAX: **122.4 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.5.6 - Air Quality Contours - Vertical Expansion Alternative 1 - 50 Trucks per Day - Truck Route 2
24-Hour Total Particulate Matter

PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: LF1E1RT2 ug/m^3

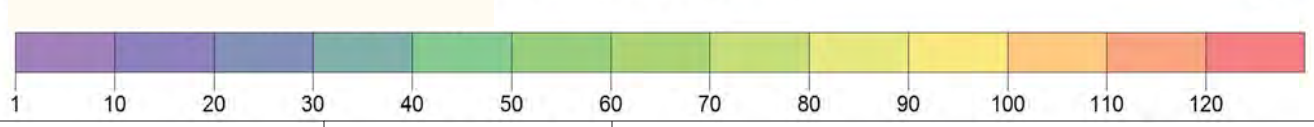


COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,174 — 0 — 0.5 km	
	MAX: **108.2 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.5.7 - Air Quality Contours - Vertical Expansion Alternative 1 - 50 Trucks per Day - Truck Route 3
24-Hour Total Particulate Matter

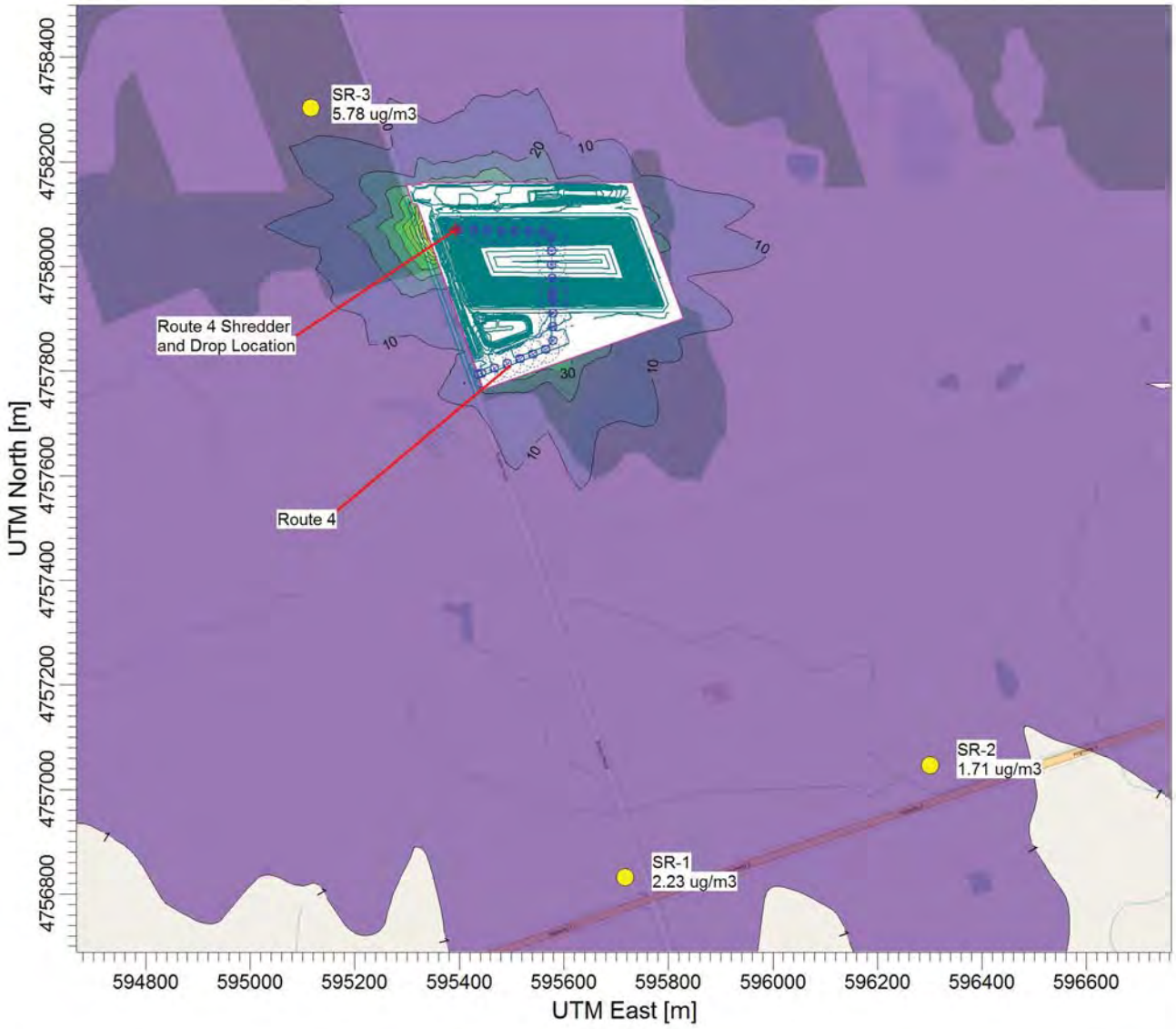
PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: LF1E1RT3 ug/m^3



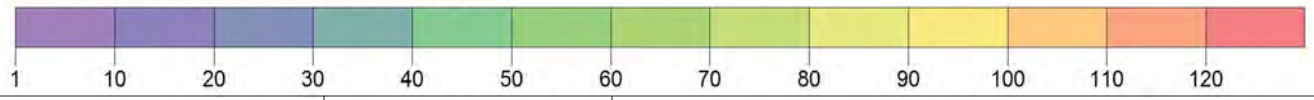
COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,174 (0 — 0.5 km)	
	MAX: **102.3 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.5.8 - Air Quality Contours - Vertical Expansion Alternative 1 - 50 Trucks per Day - Truck Route 4
24-Hour Total Particulate Matter



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: LF1E1RT4 ug/m^3



COMMENTS:	SOURCES:	COMPANY NAME:	
	5	**Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS:	MODELER:	
	3392	**GHD**	
	OUTPUT TYPE:	SCALE: 1:13,174	
	Concentration	0 0.5 km	
	MAX:	DATE:	PROJECT NO.:
	95.1 ug/m^3	**12/5/2016**	**018235**

PROJECT TITLE:

Figure 3.6.1 - Air Quality Contours - Vertical Expansion Alternative 2 - 25 Trucks per Day - Truck Route 1
24-Hour Total Particulate Matter

PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT2RT1 ug/m^3

1.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0

COMMENTS:	SOURCES: **6**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,034 (0 — 0.4 km)	
	MAX: **61.0 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

AERMOD View - Lakes Environmental Software

E:\18235_BrooksRoadLF\2016_12_December_figures\route4.isc

PROJECT TITLE:

Figure 3.6.2 - Air Quality Contours - Vertical Expansion Alternative 2 - 25 Trucks per Day - Truck Route 2
24-Hour Total Particulate Matter

PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT2RT2 ug/m^3

1.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0

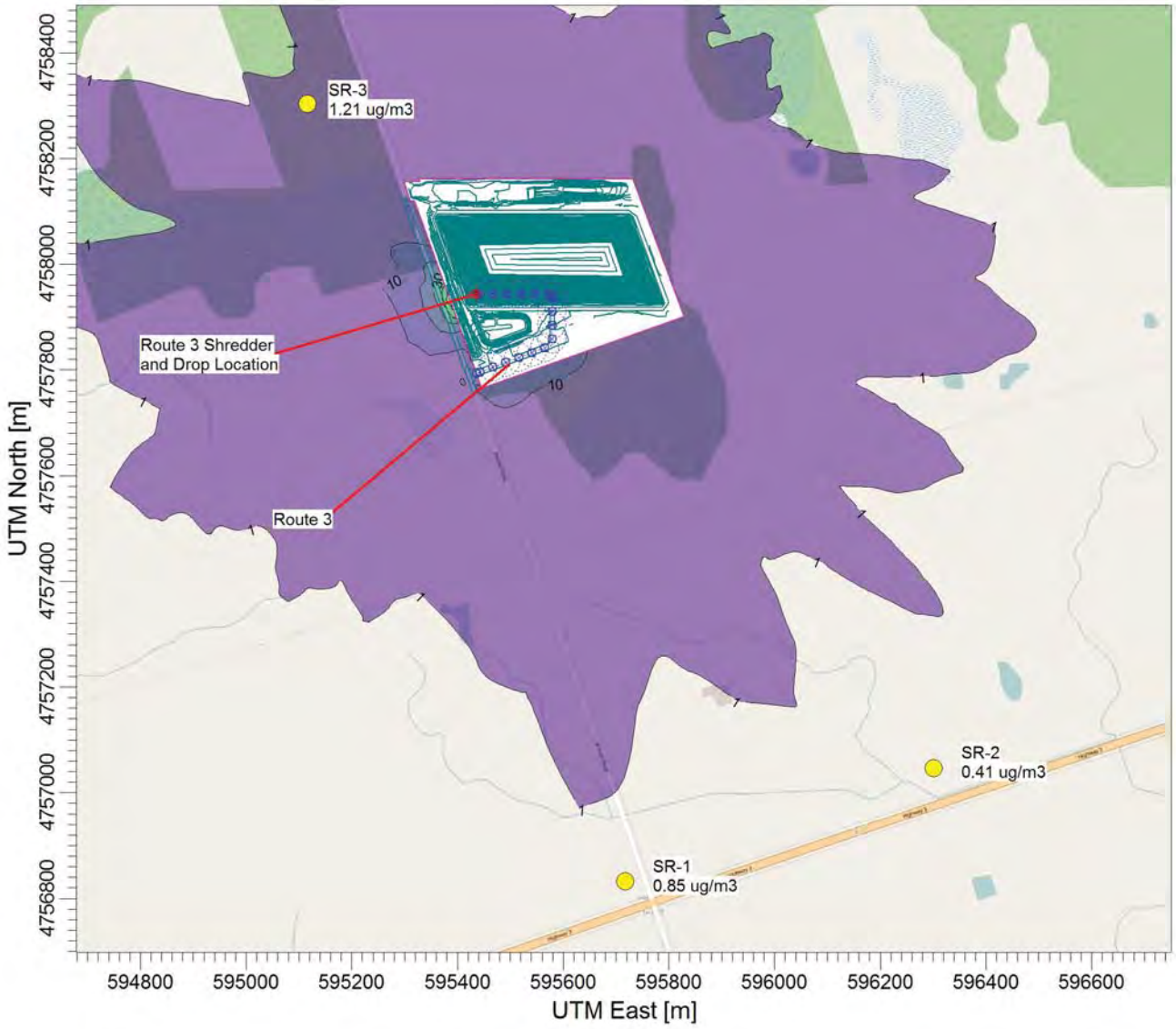
COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,034 (0 — 0.4 km)	
	MAX: **54.4 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

AERMOD View - Lakes Environmental Software

E:\18235_BrooksRoadLF\2016_12_December_figures\route2.isc

PROJECT TITLE:

Figure 3.6.3 - Air Quality Contours - Vertical Expansion Alternative 2 - 25 Trucks per Day - Truck Route 3
24-Hour Total Particulate Matter



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT2RT3 ug/m^3

1.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0

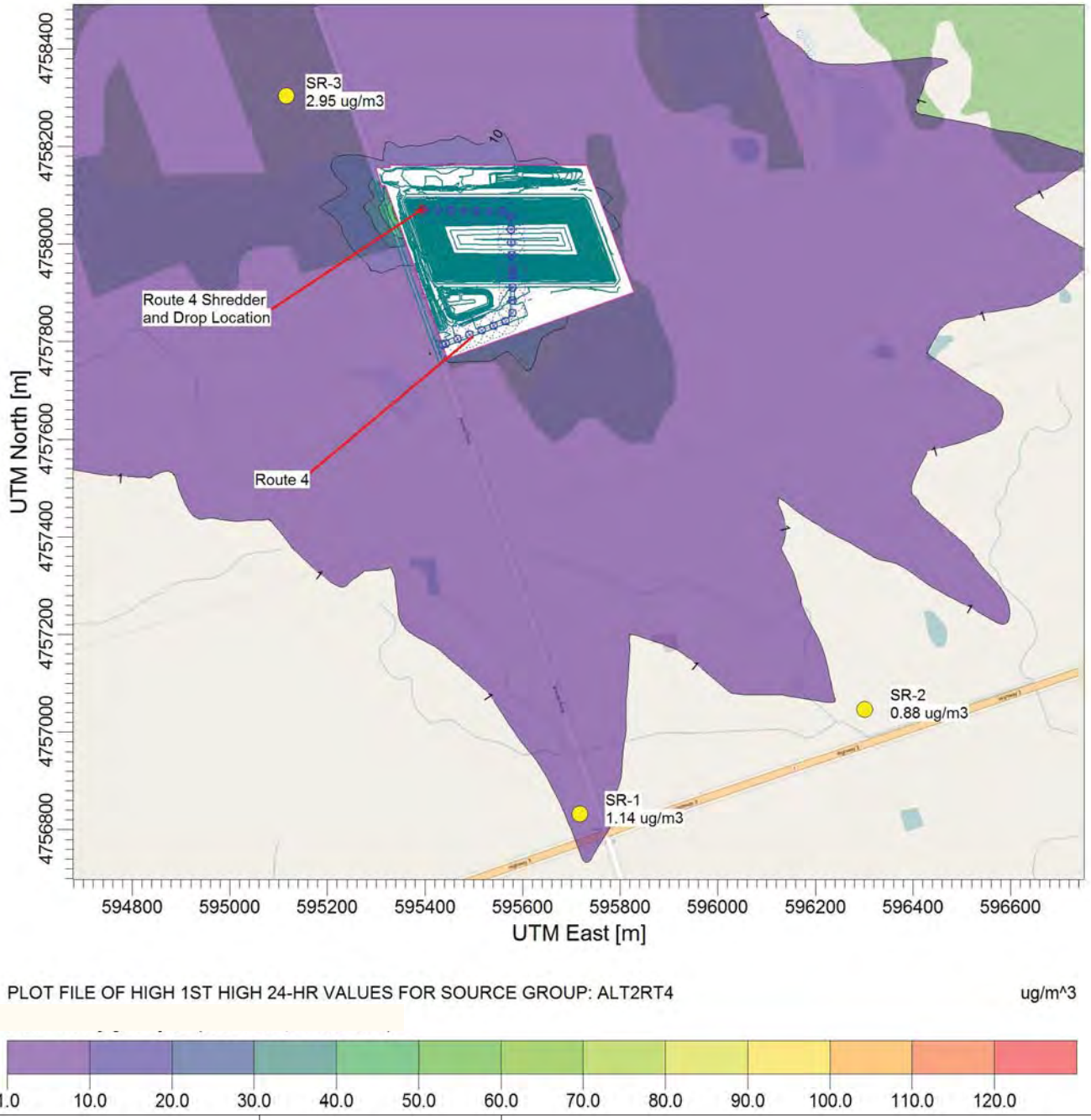
COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,034 (0 — 0.4 km)	
	MAX: **51.4 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

AERMOD View - Lakes Environmental Software

E:\18235_BrooksRoadLF\2016_12_December_figures\route3.isc

PROJECT TITLE:

Figure 3.6.4 - Air Quality Contours - Vertical Expansion Alternative 2 - 25 Trucks per Day - Truck Route 4
24-Hour Total Particulate Matter



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT2RT4 ug/m^3

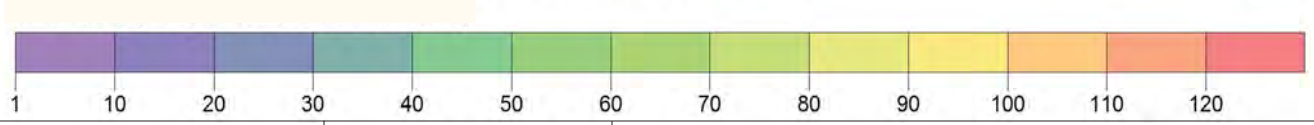
1.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0

COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,034 — 0 — 0.4 km	
	MAX: **47.9 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.6.5 - Air Quality Contours - Vertical Expansion Alternative 2 - 50 Trucks per Day - Truck Route 1
24-Hour Total Particulate Matter

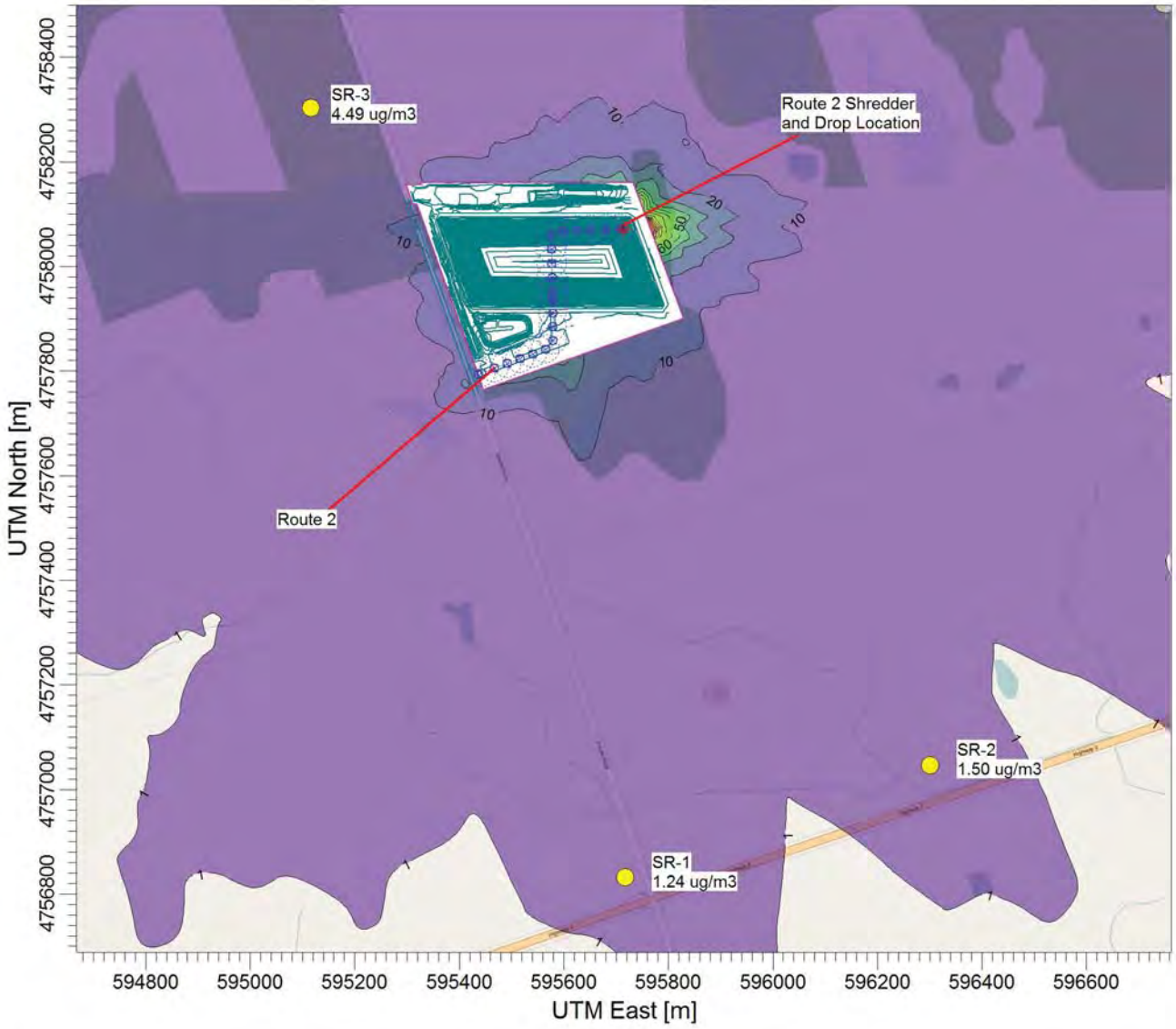
PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT2RT1 ug/m^3



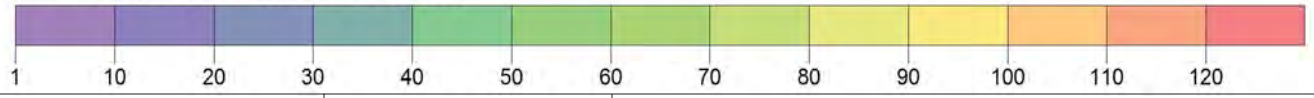
COMMENTS:	SOURCES: **6**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,174 — 0 — 0.5 km	
	MAX: **121.6 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.6.6 - Air Quality Contours - Vertical Expansion Alternative 2 - 50 Trucks per Day - Truck Route 2
24-Hour Total Particulate Matter



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT2RT2 ug/m^3

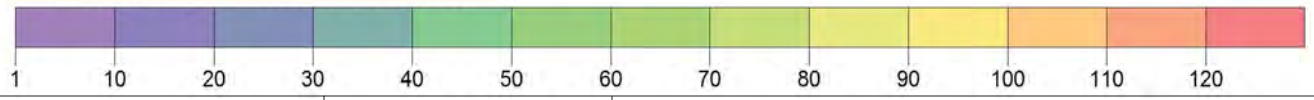


COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,174 — 0 — 0.5 km	
	MAX: **108.2 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.6.7 - Air Quality Contours - Vertical Expansion Alternative 2 - 50 Trucks per Day - Truck Route 3
24-Hour Total Particulate Matter

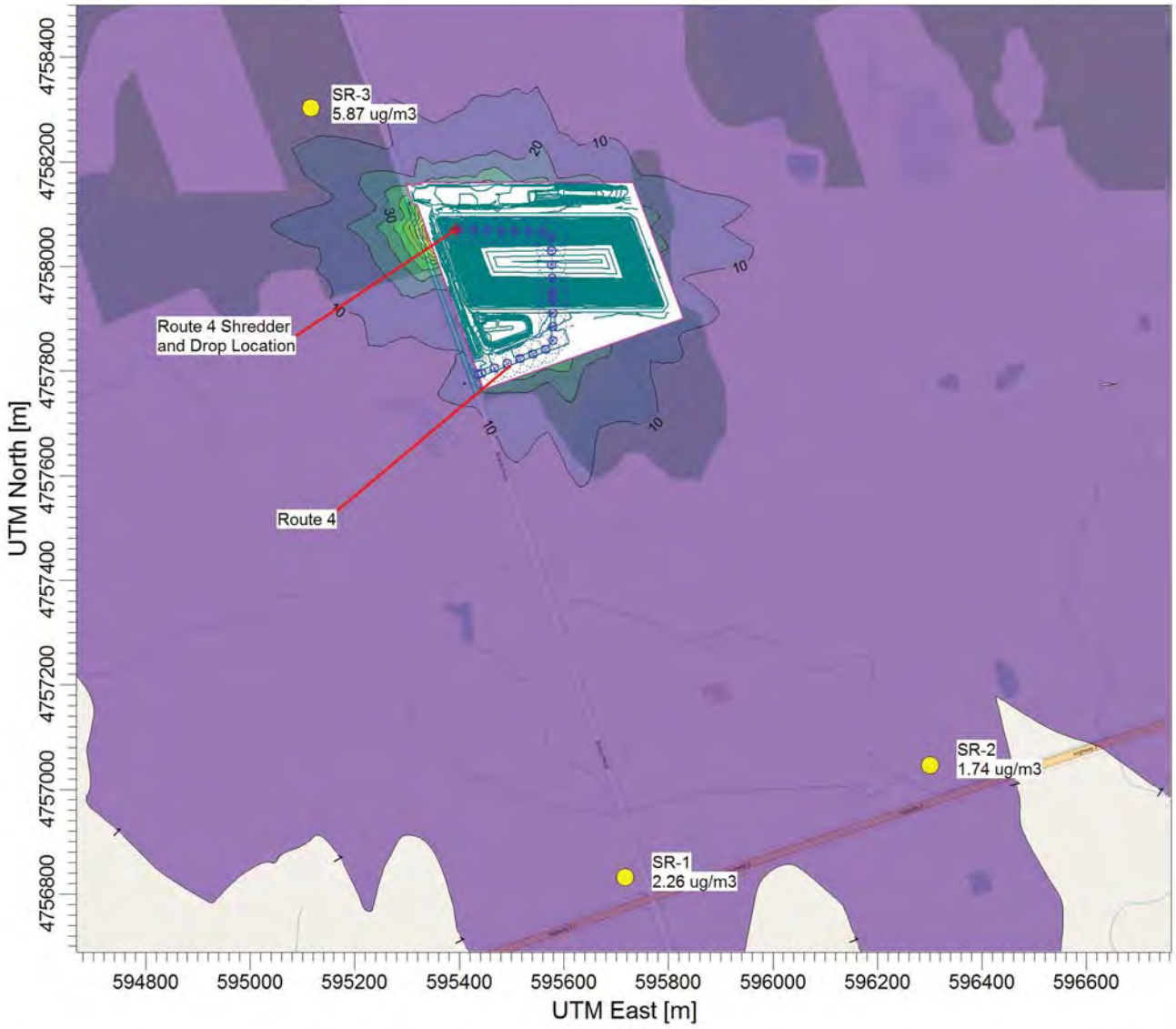
PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT2RT3 ug/m^3



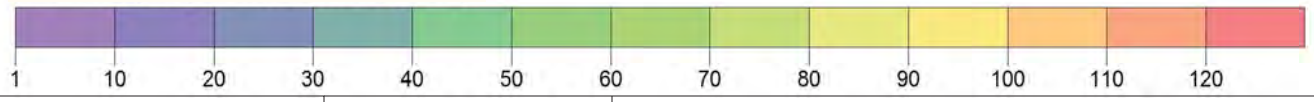
COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,174 (0 — 0.5 km)	
	MAX: **102.7 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.6.8 - Air Quality Contours - Vertical Expansion Alternative 2 - 50 Trucks per Day - Truck Route 4
24-Hour Total Particulate Matter



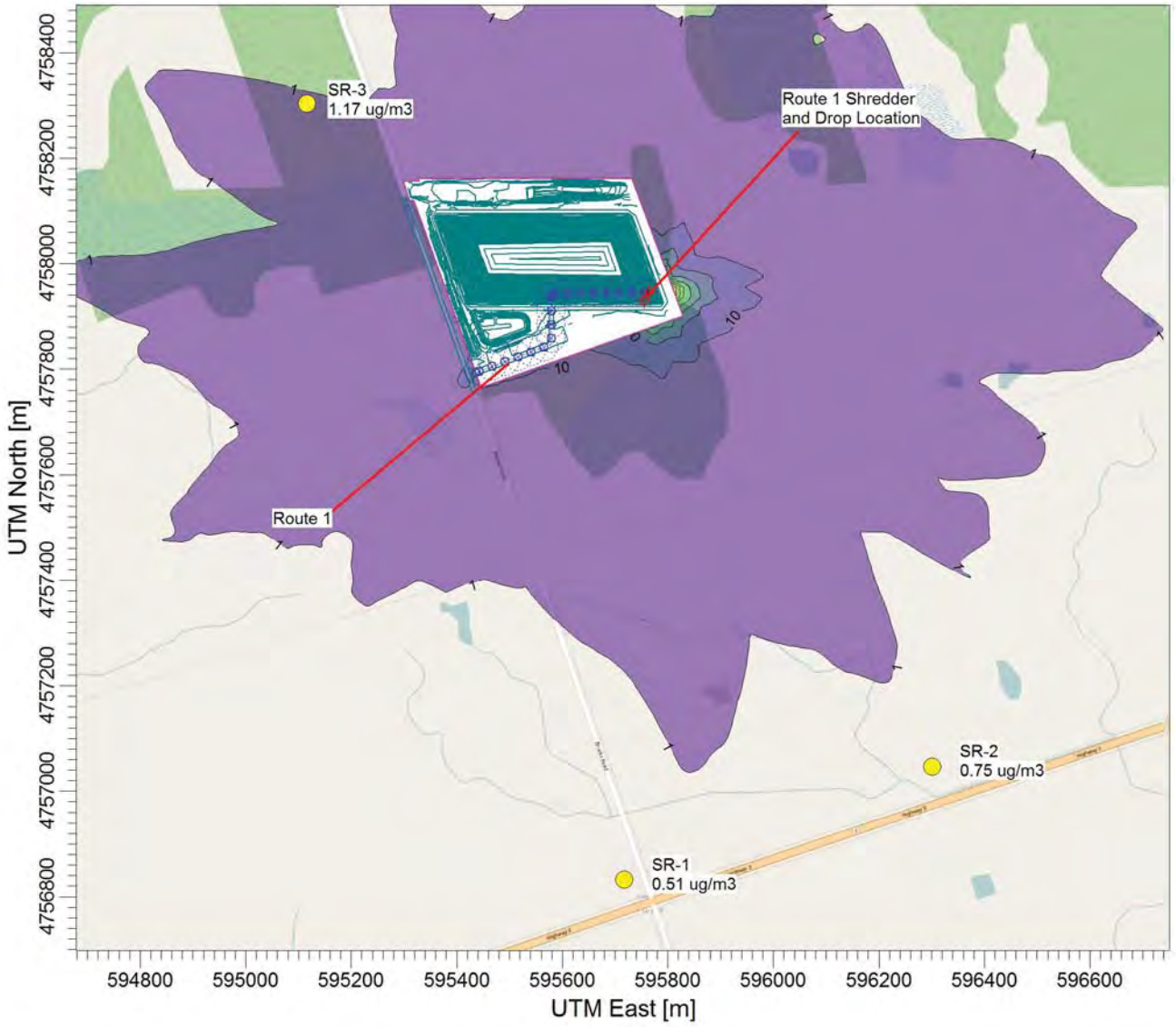
PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT2RT4 ug/m^3



COMMENTS:	SOURCES:	COMPANY NAME:	
	5	**Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS:	MODELER:	
	3392	**GHD**	
	OUTPUT TYPE:	SCALE: 1:13,174	
	Concentration	0 0.5 km	
	MAX:	DATE:	PROJECT NO.:
	95.9 ug/m^3	**12/5/2016**	**018235**

PROJECT TITLE:

Figure 3.7.1 - Air Quality Contours - Vertical Expansion Alternative 3 - 25 Trucks per Day - Truck Route 1
24-Hour Total Particulate Matter



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT3RT1 ug/m^3

1.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0

COMMENTS:	SOURCES: **6**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,034 (0 — 0.4 km)	
	MAX: **61.1 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

AERMOD View - Lakes Environmental Software

E:\18235_BrooksRoadLF\2016_12_December_figures\route1.isc

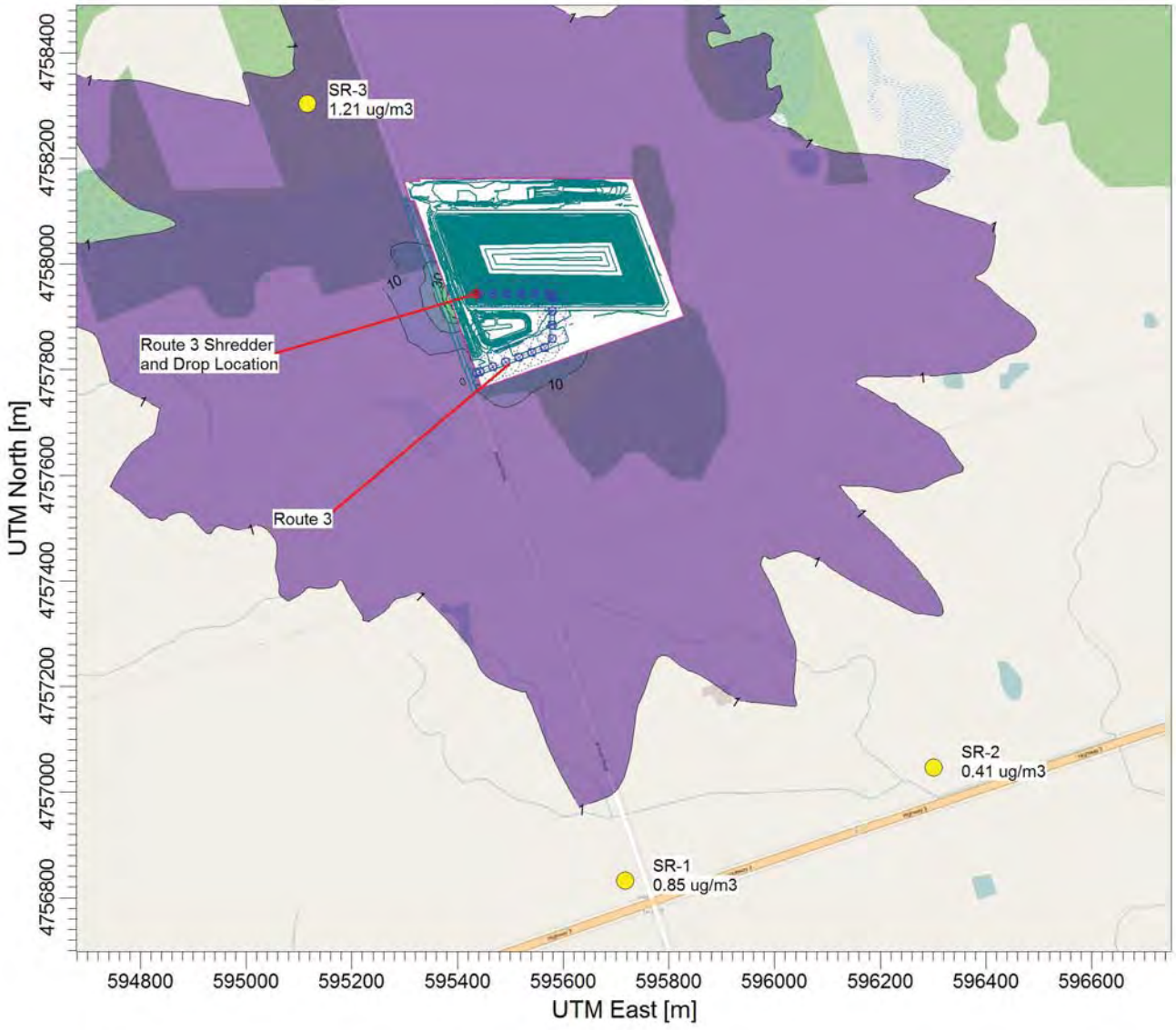
PROJECT TITLE:

Figure 3.7.2 - Air Quality Contours - Vertical Expansion Alternative 3 - 25 Trucks per Day - Truck Route 2
24-Hour Total Particulate Matter

COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,034 (0 — 0.4 km)	
	MAX: **54.0 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.7.3 - Air Quality Contours - Vertical Expansion Alternative 3 - 25 Trucks per Day - Truck Route 3
24-Hour Total Particulate Matter



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT3RT3 ug/m^3

1.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0

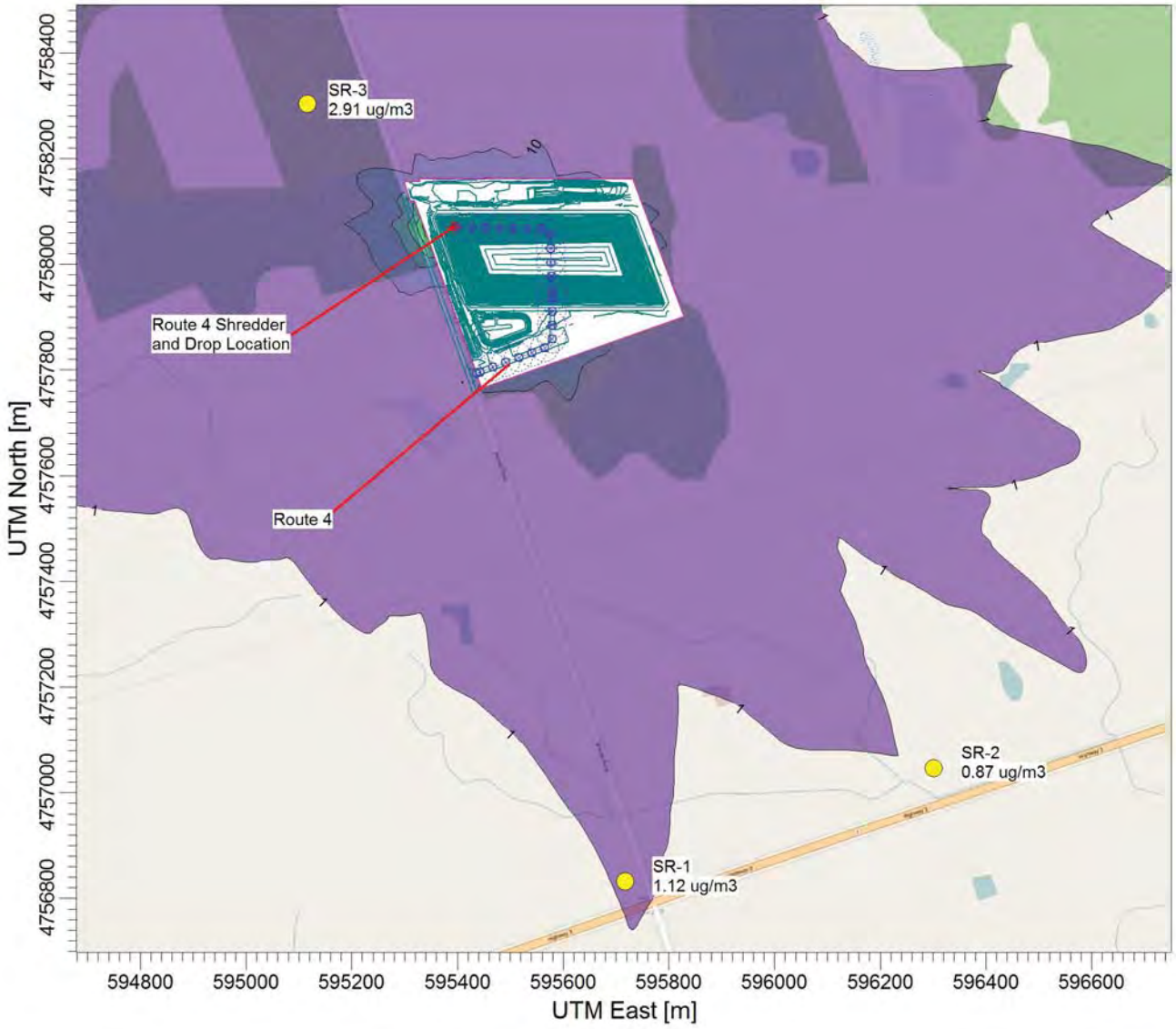
COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,034 (0 — 0.4 km)	
	MAX: **51.4 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

AERMOD View - Lakes Environmental Software

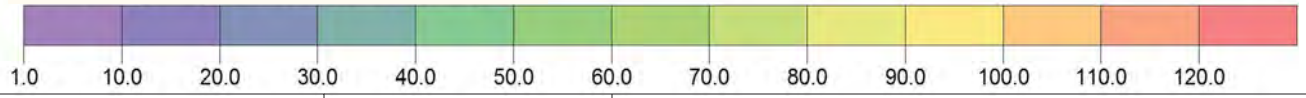
E:\18235_BrooksRoadLF\2016_12_December_figures\route3.isc

PROJECT TITLE:

Figure 3.7.4 - Air Quality Contours - Vertical Expansion Alternative 3 - 25 Trucks per Day - Truck Route 4
24-Hour Total Particulate Matter



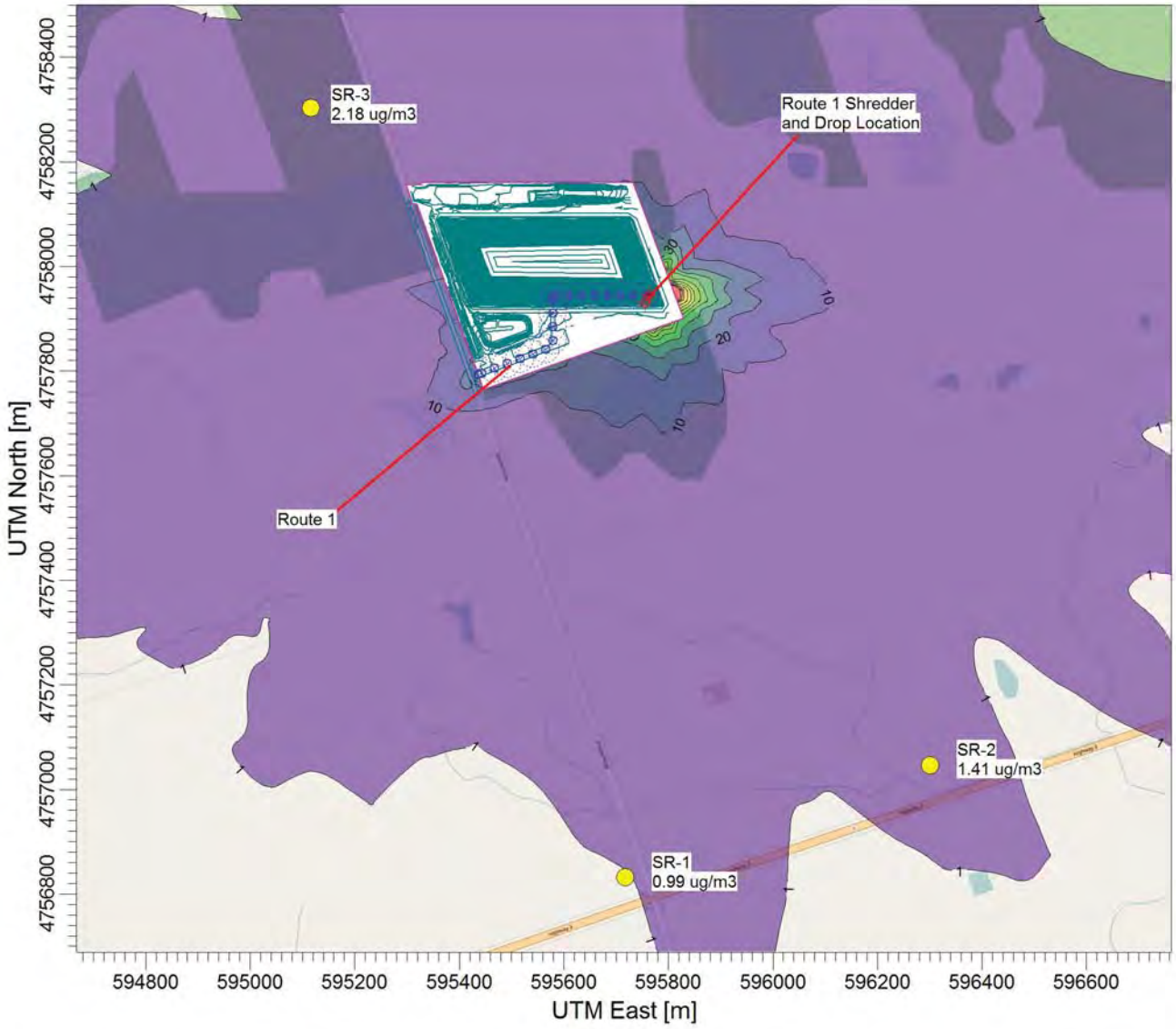
PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT3RT4 ug/m^3



COMMENTS:	SOURCES:	COMPANY NAME:	
	5	**Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS:	MODELER:	
	3392	**GHD**	
	OUTPUT TYPE:	SCALE: 1:13,034	
	Concentration	0 0.4 km	
	MAX:	DATE:	PROJECT NO.:
	47.5 ug/m^3	**12/5/2016**	**018235**

PROJECT TITLE:

Figure 3.7.5 - Air Quality Contours - Vertical Expansion Alternative 3 - 50 Trucks per Day - Truck Route 1
24-Hour Total Particulate Matter



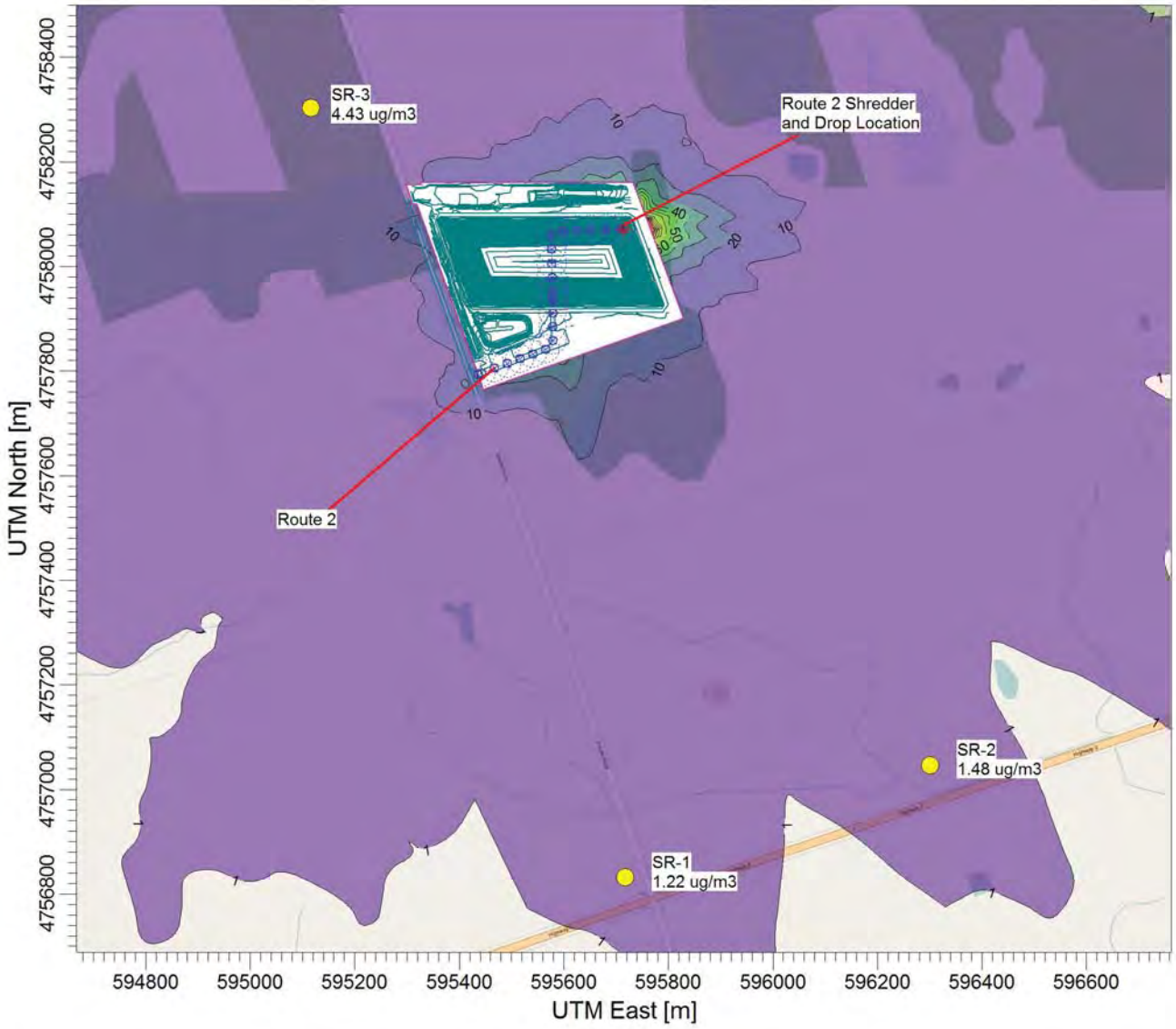
PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT3RT1 ug/m^3

1 10 20 30 40 50 60 70 80 90 100 110 120

COMMENTS:	SOURCES: **6**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,174 — 0 — 0.5 km	
	MAX: **122.0 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.7.6 - Air Quality Contours - Vertical Expansion Alternative 3 - 50 Trucks per Day - Truck Route 2
24-Hour Total Particulate Matter



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT3RT2 ug/m^3

1 10 20 30 40 50 60 70 80 90 100 110 120

COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,174 (0 — 0.5 km)	
	MAX: **107.4 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

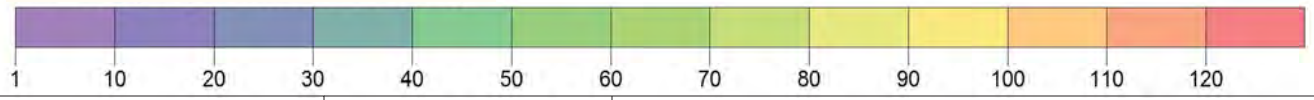
AERMOD View - Lakes Environmental Software

E:\18235_BrooksRoadLF\2016_12_December_figures\route2.isc

PROJECT TITLE:

Figure 3.7.7 - Air Quality Contours - Vertical Expansion Alternative 3 - 50 Trucks per Day - Truck Route 3
24-Hour Total Particulate Matter

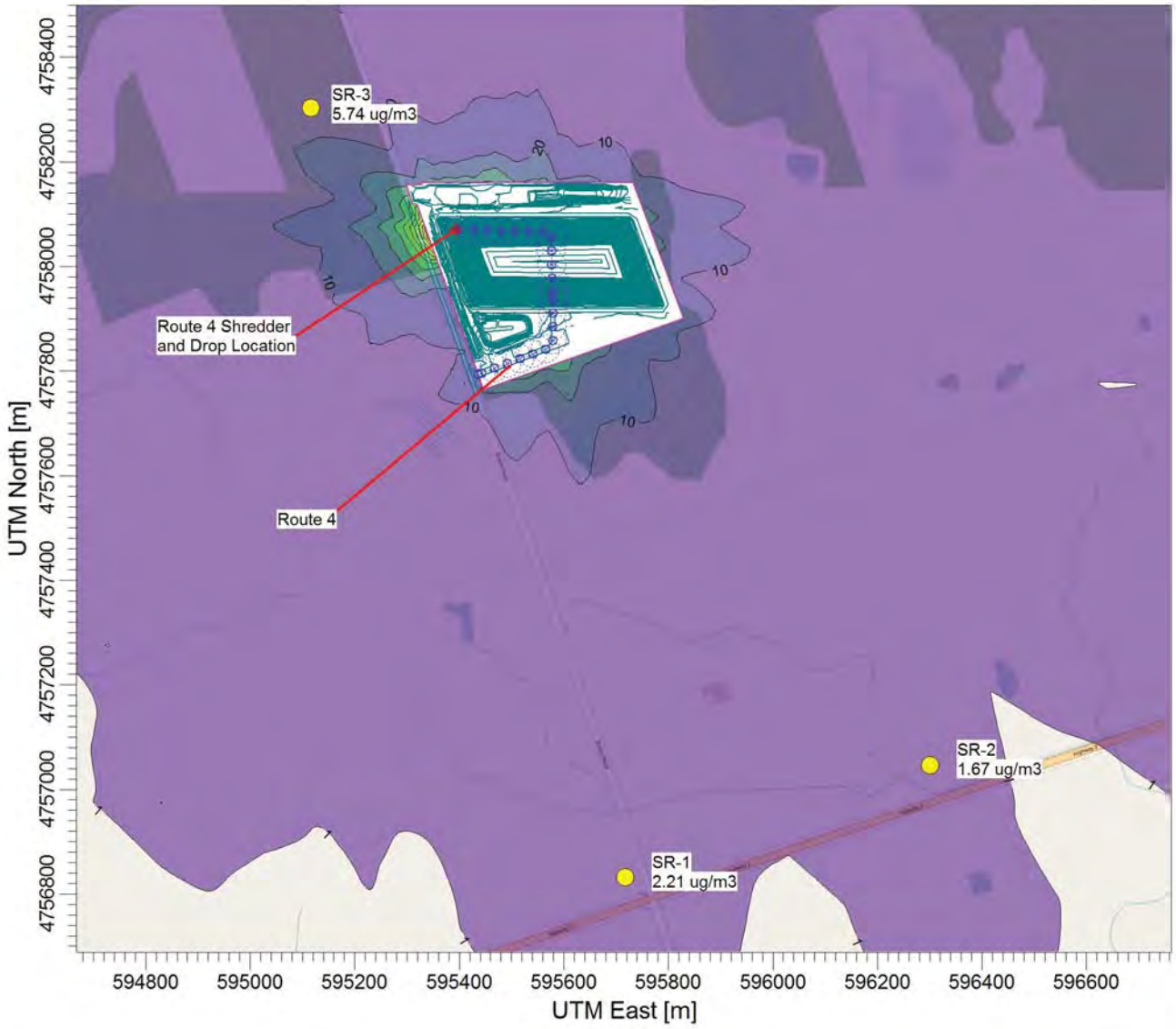
PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT3RT3 ug/m^3



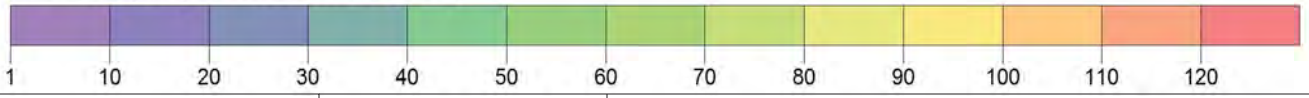
COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,174 (0 — 0.5 km)	
	MAX: **102.7 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

PROJECT TITLE:

Figure 3.7.8 - Air Quality Contours - Vertical Expansion Alternative 3 - 50 Trucks per Day - Truck Route 4
24-Hour Total Particulate Matter

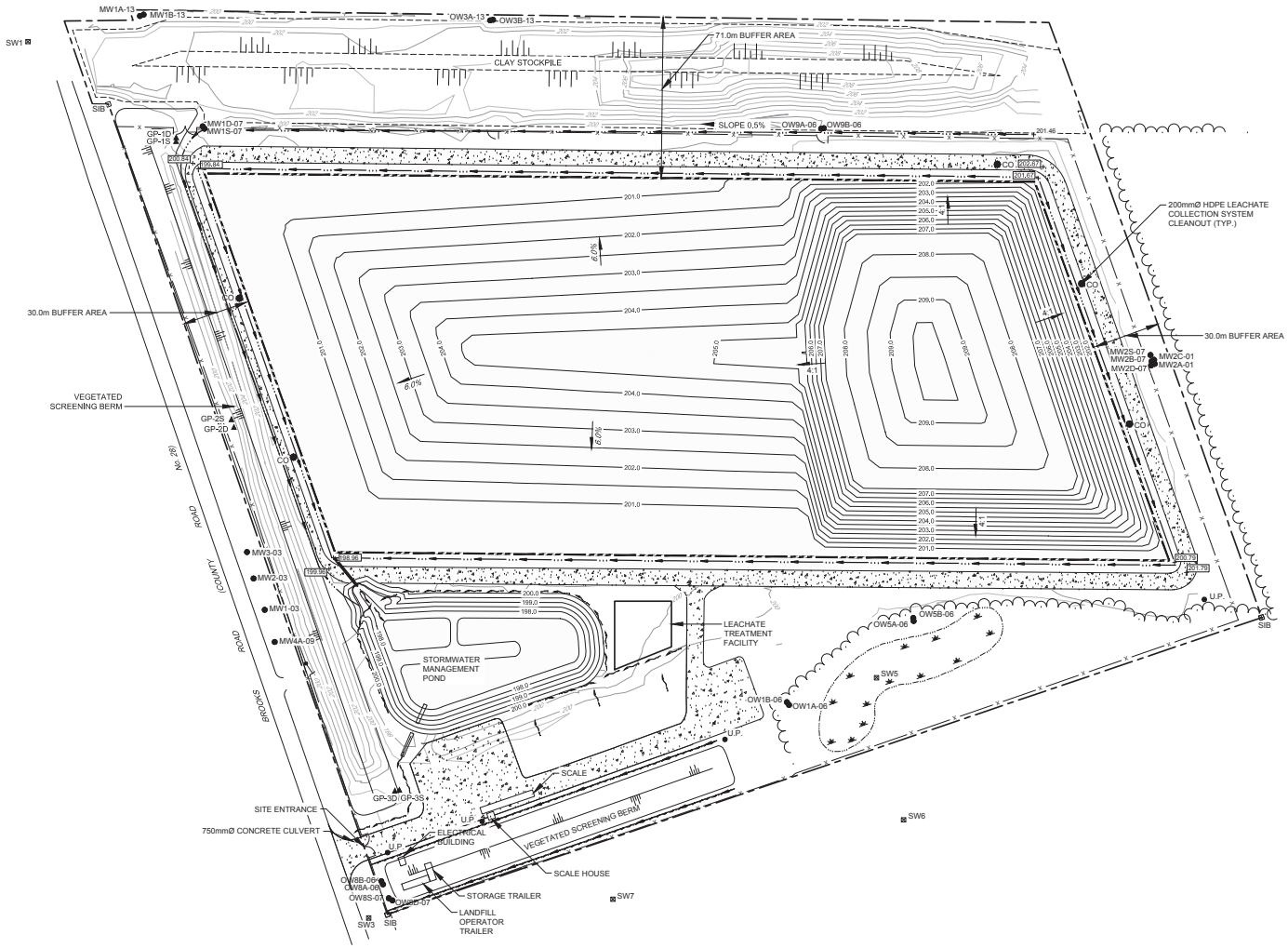


PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALT3RT4 ug/m^3



COMMENTS:	SOURCES: **5**	COMPANY NAME: **Brooks Road Landfill, Haldimand County, Ontario**	
	RECEPTORS: **3392**	MODELER: **GHD**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:13,174 — 0 — 0.5 km	
	MAX: **94.8 ug/m^3**	DATE: **12/5/2016**	PROJECT NO.: **018235**

Drawings



No.	Revision	Date	Initial

LEGEND

- 202.0 — FINAL CONTOURS BEFORE VERTICAL EXPANSION (1.0m INTERVAL (m AMSL))
- FINAL CONTOURS BEFORE VERTICAL EXPANSION (0.5m INTERVAL (m AMSL))
- GROUND CONTOUR (2.0m INTERVAL)
- GROUND CONTOUR (1.0m INTERVAL)
- PROPERTY LINE
- APPROVED LIMIT OF WASTE
- EXISTING FENCELINE
- CLAY STOCKPILE AREA
- PERIMETER DITCH
- TREELINE
- GRANULAR SURFACE ACCESS ROAD
- SWAMPY AREA
- 201.67 — SPOT ELEVATION (m AMSL)
- CO — LEACHATE COLLECTION SYSTEM CLEAN OUT
- SIB — STANDARD IRON BAR
- OW1B-06 — OBSERVATION WELL
- MW2A-01 — MONITORING WELL
- SW6 — SURFACE WATER MONITORING
- GP-3S — GAS PROBE
- U.P. — UTILITY POLE
- DOUBLE GATE
- SINGLE GATE

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

BROOKS ROAD LANDFILL SITE
HALDIMAND COUNTRY, ONTARIO

CONCEPTUAL DESIGN REPORT

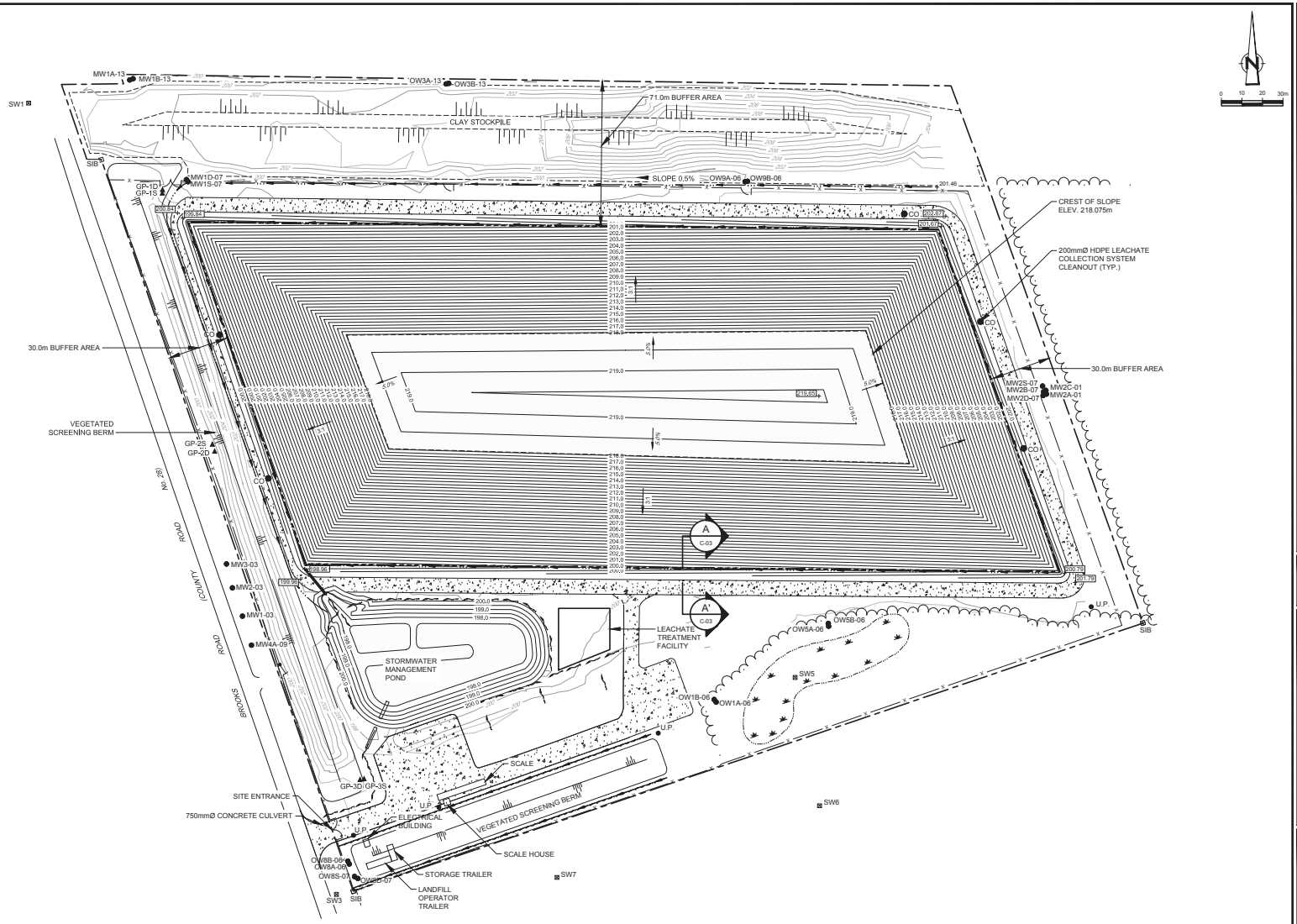
EXISTING CONDITIONS INTERIM CLOSURE

GHD

Source Reference:
EXISTING GROUND CONTOURS AND TOPOGRAPHIC FEATURES SHOWN ARE BASED ON TERVITA AS-BUILT FOR FINAL CONDITIONS FOR STAGE 2A, 2B AND STAGE 3A, AND NORTH CLAY STOCKPILE SURVEY BY VAN NOSTRAND AND GIBSON SURVEYED JULY 17 2013

Project Manager:	Reviewed By:	Date:	
G.FERRARO	P.KEMP	DECEMBER 2015	
Scale: 1:1000	Project N#: 18235-20	Report N#: 051	Drawing N#: C-01

18235-20(051)CI-WA001 DEC 4/2015



No.	Revision	Date	Initial

LEGEND

- 202.0 — TOP OF FINAL CONTOUR (1.0m INTERVAL (m AMSL))
- TOP OF FINAL COVER CONTOUR (0.5m INTERVAL (m AMSL))
- GROUND CONTOUR (2.0m INTERVAL)
- GROUND CONTOUR (1.0m INTERVAL)
- PROPERTY LINE
- APPROVED LIMIT OF WASTE
- EXISTING FENCELINE
- CLAY STOCKPILE AREA
- PERIMETER DITCH
- TREELINE
- GRANULAR SURFACE ACCESS ROAD
- SWAMPY AREA
- 201.67 — SPOT ELEVATION (m AMSL)
- CO — LEACHATE COLLECTION SYSTEM CLEAN OUT
- SIB — STANDARD IRON BAR
- OW1B-06 — OBSERVATION WELL
- MW2A-01 — MONITORING WELL
- SW6 — SURFACE WATER MONITORING
- GP-3S — GAS PROBE
- U.P. — UTILITY POLE
- DOUBLE GATE
- SINGLE GATE

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

BROOKS ROAD LANDFILL SITE
HALDIMAND COUNTRY, ONTARIO

CONCEPTUAL DESIGN REPORT

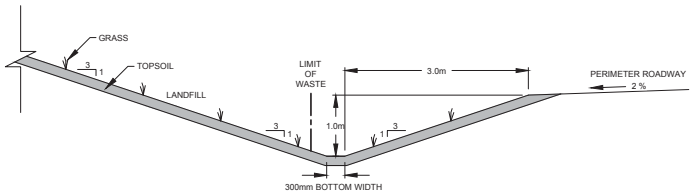
VERTICAL EXPANSION ALTERNATIVE 1

GHD

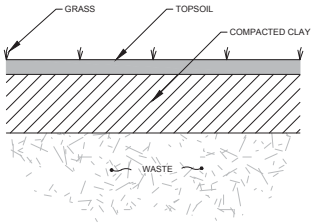
Source Reference:
EXISTING GROUND CONTOURS AND TOPOGRAPHIC FEATURES SHOWN ARE BASED ON TERVITA AS-BUILT FOR FINAL CONDITIONS FOR STAGE 2A, 2B AND STAGE 3A, AND NORTH CLAY STOCKPILE SURVEY BY VAN NOSTRAND AND GIBSON SURVEYED JULY 17 2013

Project Manager:	Reviewed By:	Date:	
G.FERRARO	P.KEMP	DECEMBER 2015	
Scale: 1:1000	Project N#: 18235-20	Report N#: 051	Drawing N#: C-02

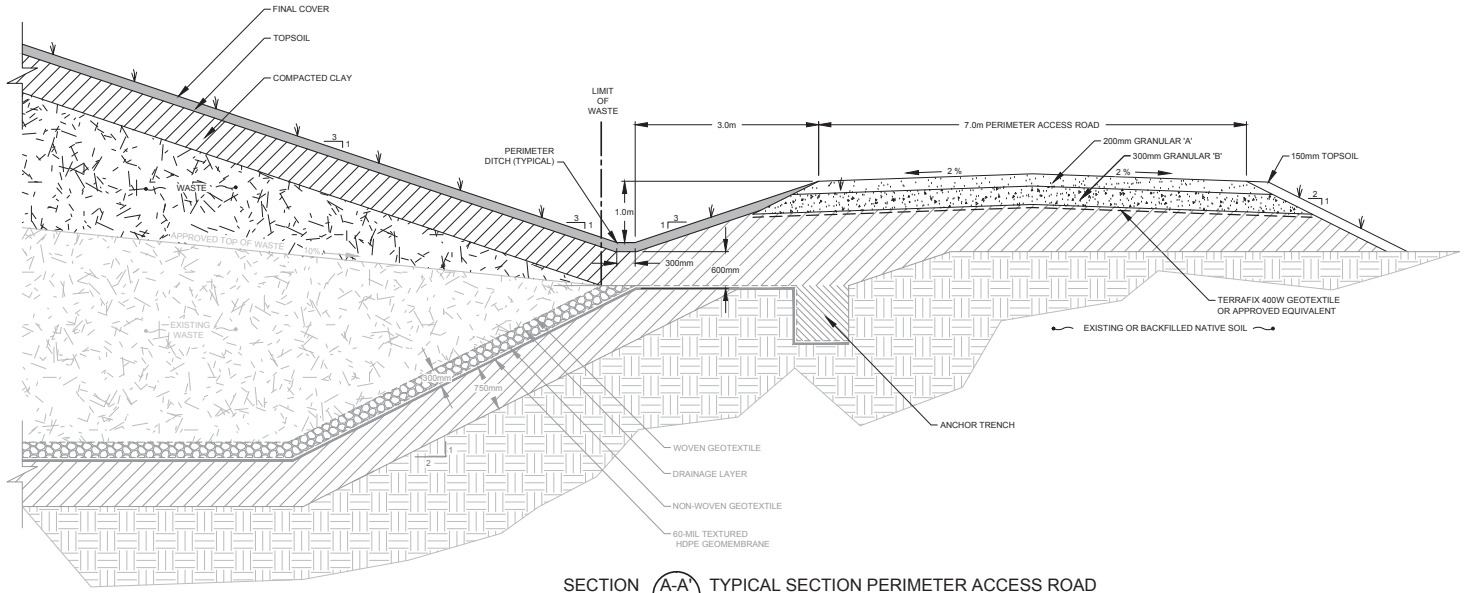
18235-20(051)CI-WA002 JAN 19/2016



DETAIL 1 (C-03) PERIMETER DITCH (TYPICAL)
1:40



DETAIL 2 (C-03) FINAL COVER
1:40



SECTION A-A' (C-02) TYPICAL SECTION PERIMETER ACCESS ROAD
1:40

No.	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

BROOKS ROAD LANDFILL SITE
HALDIMAND COUNTRY, ONTARIO

CONCEPTUAL DESIGN REPORT

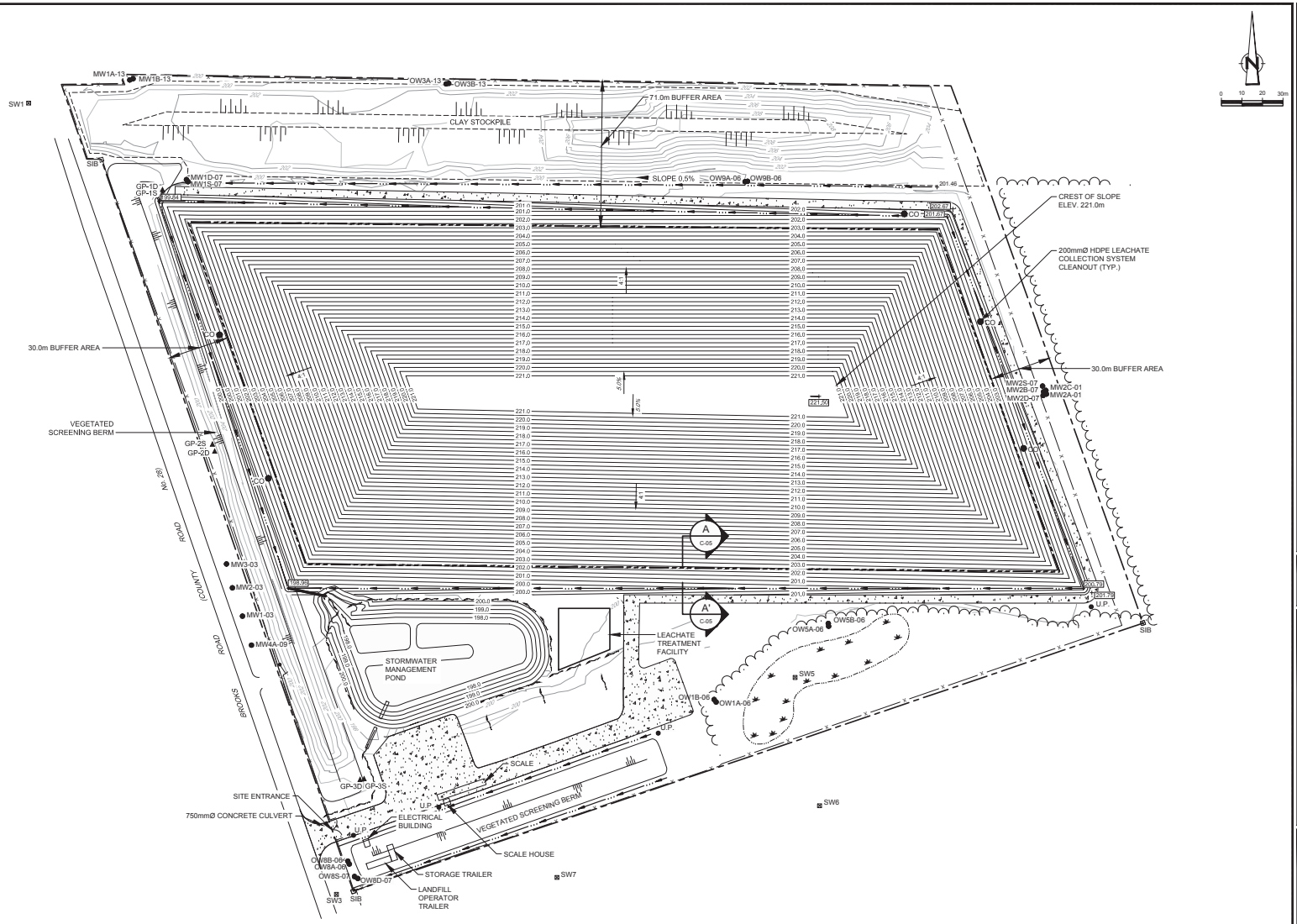
VERTICAL EXPANSION
ALTERNATIVE 1 DETAILS

GHD

Source Reference:

Project Manager:	Reviewed By:	Date:	
G.FERRARO	P.KEMP	DECEMBER 2015	
Scale: 1:1000	Project N#: 18235-20	Report N#: 051	Drawing N#: C-03

18235-20(051)CI-WA003 DEC 4/2015



No.	Revision	Date	Initial

LEGEND

- 202.0 — TOP OF FINAL COVER CONTOUR (1.0m INTERVAL (m AMSL))
- TOP OF FINAL COVER CONTOUR (0.5m INTERVAL (m AMSL))
- 202 — GROUND CONTOUR (2.0m INTERVAL)
- GROUND CONTOUR (1.0m INTERVAL)
- PROPERTY LINE
- APPROVED LIMIT OF WASTE
- x — EXISTING FENCELINE
- CLAY STOCKPILE AREA
- PERIMETER DITCH
- TREELINE
- GRANULAR SURFACE ACCESS ROAD
- SWAMPY AREA
- 201.67 — SPOT ELEVATION (m AMSL)
- CO — LEACHATE COLLECTION SYSTEM CLEAN OUT
- SIB — STANDARD IRON BAR
- OW1B-06 — OBSERVATION WELL
- MW2A-01 — MONITORING WELL
- SW6 — SURFACE WATER MONITORING
- GP-3S — GAS PROBE
- U.P. — UTILITY POLE
- DOUBLE GATE
- SINGLE GATE

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

BROOKS ROAD LANDFILL SITE
HALDIMAND COUNTRY, ONTARIO

CONCEPTUAL DESIGN REPORT

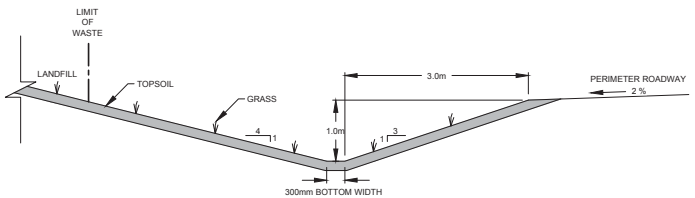
VERTICAL EXPANSION ALTERNATIVE 2

GHD

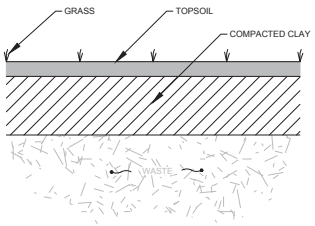
Source Reference:
EXISTING GROUND CONTOURS AND TOPOGRAPHIC FEATURES SHOWN ARE BASED ON TERVITA AS-BUILT FOR FINAL CONDITIONS FOR STAGE 2A, 2B AND STAGE 3A, AND NORTH CLAY STOCKPILE SURVEY BY VAN NOSTRAND AND GIBSON SURVEYED JULY 17 2013

Project Manager:	Reviewed By:	Date:	
G.FERRARO	P.KEMP	DECEMBER 2015	
Scale: 1:1000	Project N#: 18235-20	Report N#: 051	Drawing N#: C-04

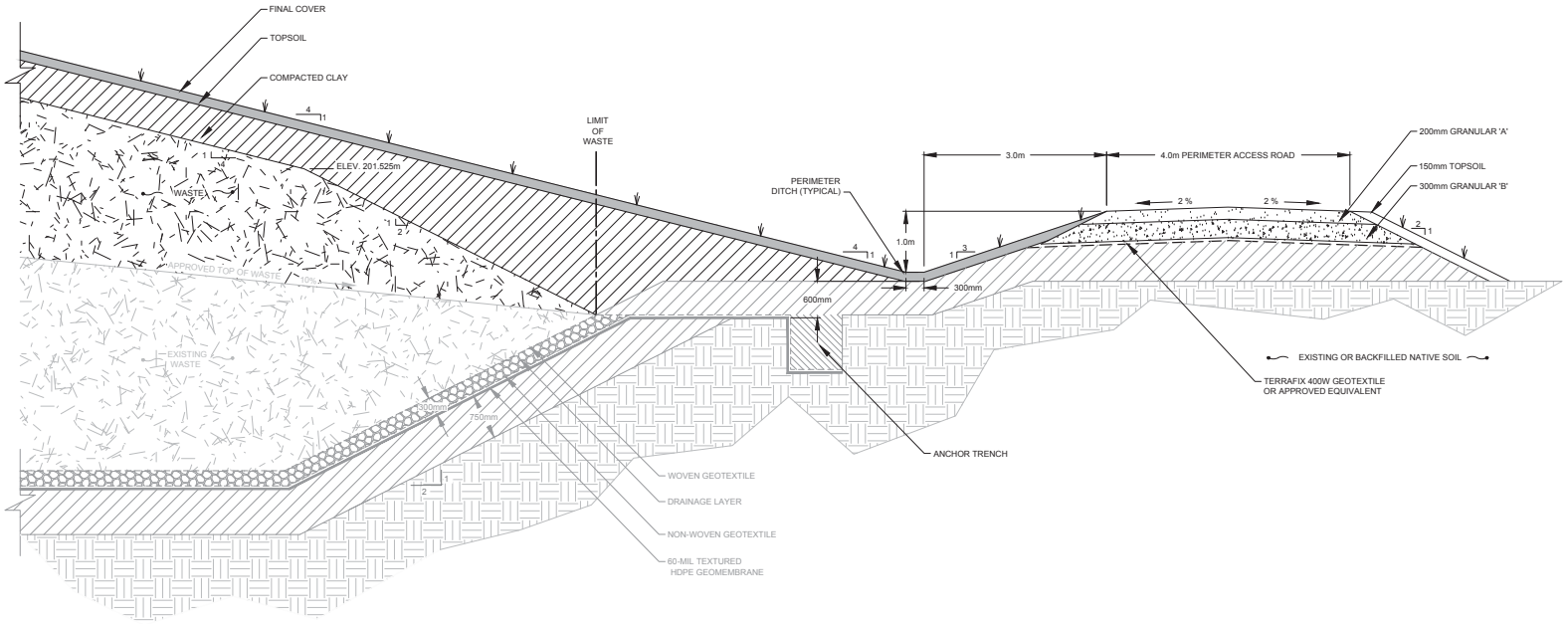
18235-20(051)CI-WA004 JAN 19/2016



DETAIL 1 (C-05) PERIMETER DITCH (TYPICAL)
1:40



DETAIL 2 (C-05) FINAL COVER
1:40



SECTION A-A' (C-04) TYPICAL SECTION PERIMETER ACCESS ROAD
1:40

No.	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

BROOKS ROAD LANDFILL SITE
HALDIMAND COUNTRY, ONTARIO

CONCEPTUAL DESIGN REPORT

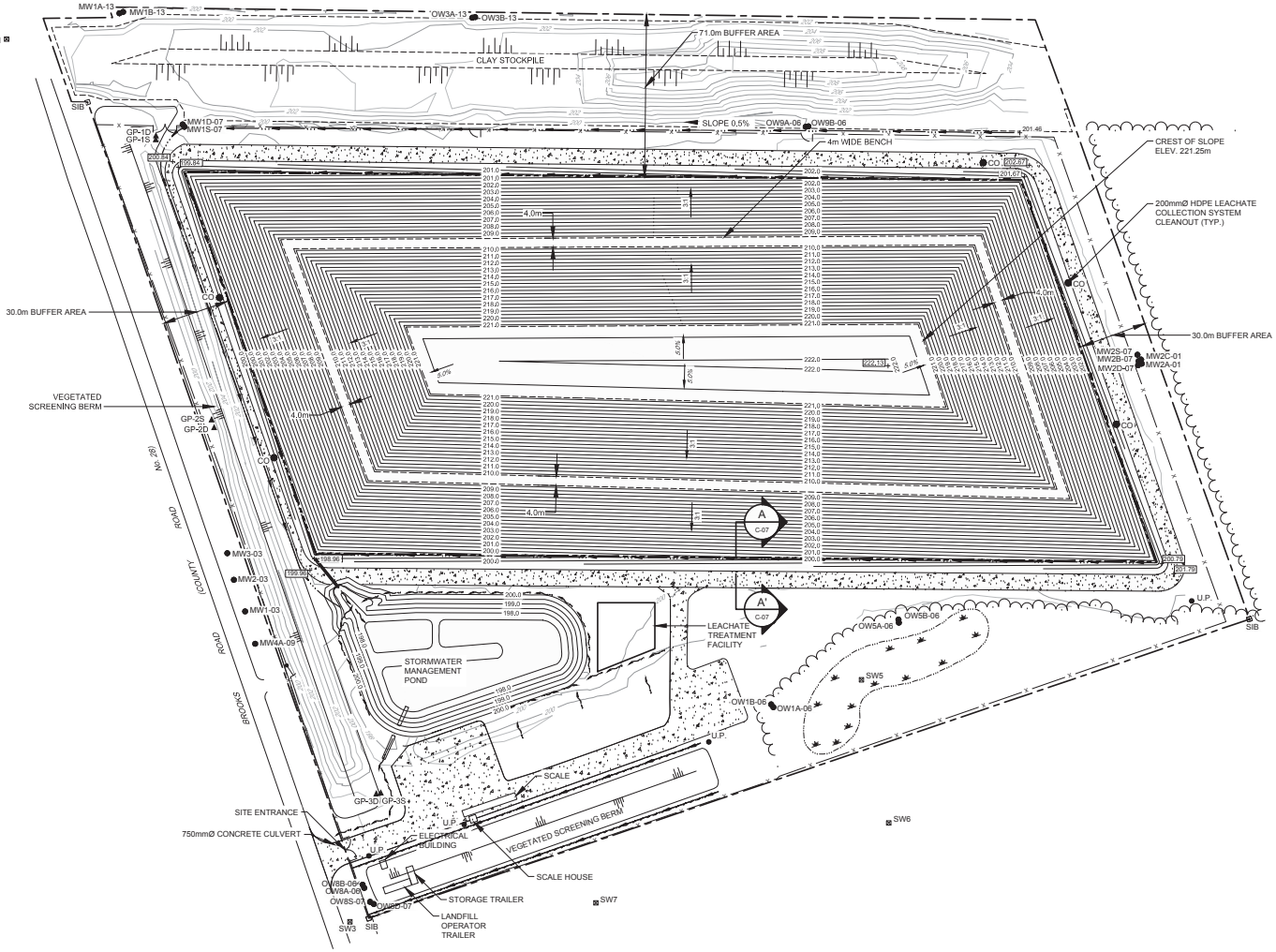
VERTICAL EXPANSION
ALTERNATIVE 2 DETAILS

GHD

Source Reference:

Project Manager:	Reviewed By:	Date:	
G.FERRARO	P.KEMP	DECEMBER 2015	
Scale: 1:1000	Project N#: 18235-20	Report N#: 051	Drawing N#: C-05

18235-20(051)CI-WA005 DEC 11/2015



No.	Revision	Date	Initial

LEGEND

- 202.0 — TOP OF FINAL COVER CONTOUR (1.0m INTERVAL (m AMSL))
- TOP OF FINAL COVER CONTOUR (0.5m INTERVAL (m AMSL))
- 202 — GROUND CONTOUR (2.0m INTERVAL)
- GROUND CONTOUR (1.0m INTERVAL)
- PROPERTY LINE
- APPROVED LIMIT OF WASTE
- x — EXISTING FENCELINE
- CLAY STOCKPILE AREA
- PERIMETER DITCH
- TREELINE
- GRANULAR SURFACE ACCESS ROAD
- SWAMPY AREA
- 201.67 — SPOT ELEVATION (m AMSL)
- CO — LEACHATE COLLECTION SYSTEM CLEAN OUT
- SIB — STANDARD IRON BAR
- OW1B-06 — OBSERVATION WELL
- MW2A-01 — MONITORING WELL
- SW6 — SURFACE WATER MONITORING
- GP-3S — GAS PROBE
- U.P. — UTILITY POLE
- DOUBLE GATE
- SINGLE GATE

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

BROOKS ROAD LANDFILL SITE
HALDIMAND COUNTRY, ONTARIO

CONCEPTUAL DESIGN REPORT

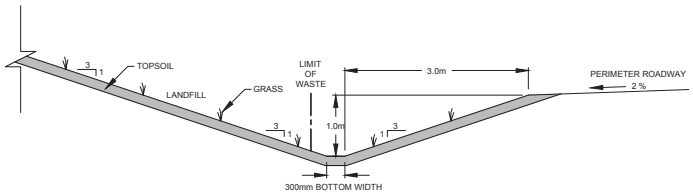
VERTICAL EXPANSION ALTERNATIVE 3

GHD

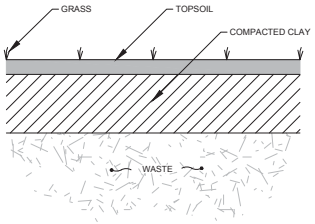
Source Reference:
EXISTING GROUND CONTOURS AND TOPOGRAPHIC FEATURES SHOWN ARE BASED ON TERVITA AS-BUILT FOR FINAL CONDITIONS FOR STAGE 2A, 2B AND STAGE 3A, AND NORTH CLAY STOCKPILE SURVEY BY VAN NOSTRAND AND GIBSON SURVEYED JULY 17 2013

Project Manager:	Reviewed By:	Date:	
G.FERRARO	P.KEMP	DECEMBER 2015	
Scale: 1:1000	Project N#: 18235-20	Report N#: 051	Drawing N#: C-06

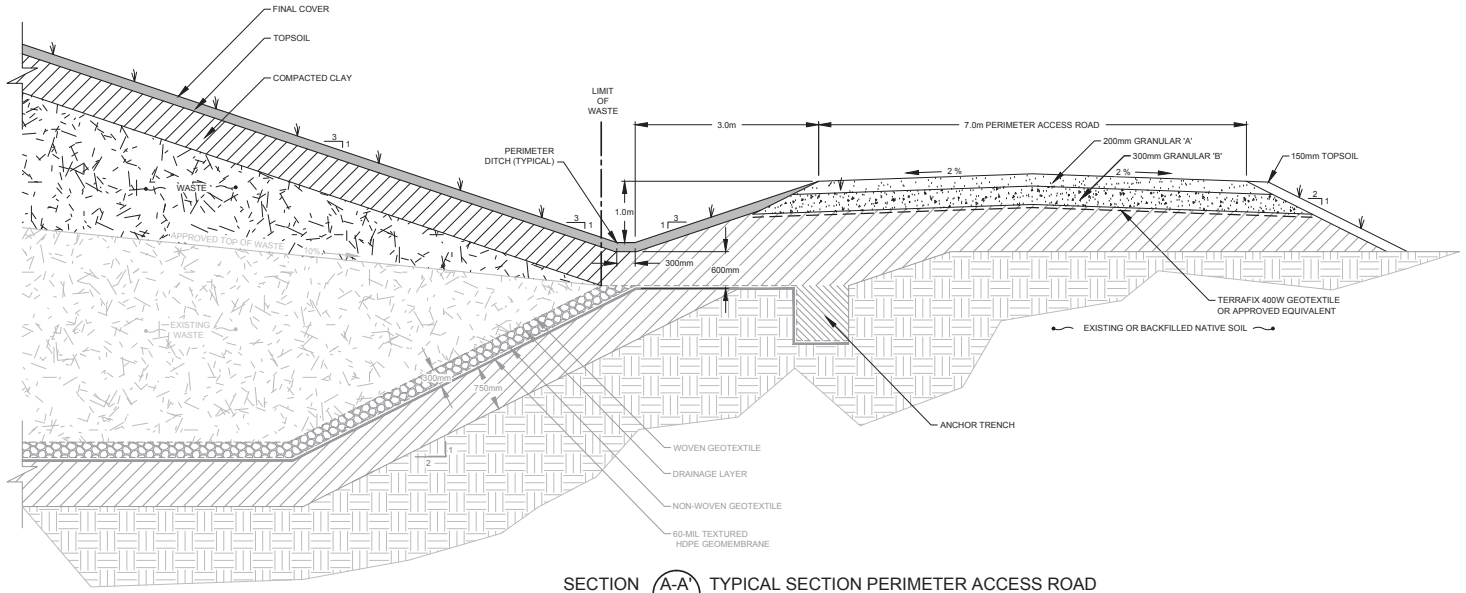
18235-20(051)CI-WA006 JAN 19/2016



DETAIL 1 (C-07) PERIMETER DITCH (TYPICAL)
1:40



DETAIL 2 (C-07) FINAL COVER
1:40



SECTION A-A' (C-06) TYPICAL SECTION PERIMETER ACCESS ROAD
1:40

No.	Revision	Date	Initial

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

BROOKS ROAD LANDFILL SITE
HALDIMAND COUNTRY, ONTARIO

CONCEPTUAL DESIGN REPORT

VERTICAL EXPANSION
ALTERNATIVE 3 DETAILS

GHD

Source Reference:

Project Manager:	Reviewed By:	Date:	
G.FERRARO	P.KEMP	DECEMBER 2015	
Scale: 1:1000	Project N#: 18235-20	Report N#: 051	Drawing N#: C-07

18235-20(051)CI-WA007 DEC 4/2015

Appendix A

GHD Odour Monitoring Program Summary Letters

CONESTOGA-ROVERS & ASSOCIATES

651 Colby Drive, Waterloo, Ontario, Canada N2V 1C2
Telephone: (519) 884-0510 Facsimile: (519) 884-0525
www.CRAworld.com

July 28, 2014 Reference No. 018235-72

Mr. Richard Weldon
Brooks Road Environmental
c/o 2270386 Ontario Limited
160 Brooks Road, R.R. #5
Cayuga, Ontario
N0A 1E0

Dear Mr. Weldon:

Re: Odour Monitoring Program
Brooks Road Landfill Site, Cayuga, Ontario

1.0 Introduction

Conestoga-Rovers & Associates (CRA) was retained by Brooks Road Environmental c/o 2270386 Ontario Limited (BRE) to complete an ambient odour monitoring program (OMP) at the Brooks Road Landfill Site (Site) located in Cayuga, Ontario.

The OMP collected odour data in an effort to identify areas in the community potentially impacted by the Site and to determine conditions that may contribute to a potential odour impact.

This program was developed to assist BRE in determining the following information:

- Identification of potential odour sources at the Site
- Qualification and quantification of the odour from identified sources
- Odour monitoring at off-Site locations

The OMP was conducted by an Air Quality Expert on three days (April 1, May 9, and June 3, 2014) over approximately two months.

2.0 Site Description

The Site is located at 160 Brooks Road in Cayuga, Ontario approximately one kilometre north of Kings Highway No. 3 (Talbot Road). The Site is legally described as Part of Lot 24, Concession I-N.T.R., Haldimand County.

The total Site area is approximately 12.4 hectares (ha) (30.6 acres) of which 6 ha (15 acres) is approved for landfilling.

The Site is bounded to the north by the former Canada Southern Railway right-of-way. The former Canada Southern Railway section between Brooks Road and east to Windecker Road is owned by BRE. To the north of the former rail right-of–way there is a rural property consisting of undeveloped fields (i.e., long-term inactive agricultural crop production lands) and forested areas are present.

To the south and east of the Site is undeveloped rural property consisting of a combination of fields and forested areas.

The Site is bounded to the west by Brooks Road. On the west side of Brooks Road is an undeveloped rural property. The property itself is characterized primarily by undeveloped fields with occasional bush lots.

3.0 Odour Monitoring Program

Odour monitoring was completed during the Site visits using a Nasal Ranger™ field olfactometer. The Nasal Ranger has eight (8) settings that allow the user to quantify odour concentrations ranging from two (2) odour units (ou) to greater than 60 ou. The olfactometer mixes a known volume of carbon filtered air with a known volume of ambient air to produce a dilution-to-threshold (D/T) ratio. The D/T ratio is defined as follows:

D T = Volume of Carbon Filtered Air/volume of odorous air

It should be noted that the odour unit value as measured by a field olfactometer, like the Nasal Ranger, are not directly comparable to odour data provided by an odour panel. The data from the Nasal Ranger does provide a good relative gauge to evaluate various odour concentrations.

4.0 Odour Collection

On-Site monitoring locations were identified and selected based on an evaluation of the current Site activities. The on-Site locations monitored during the OMP are expected to be locations that may contribute to any potential off-Site impact. Off-Site monitoring locations have been selected based on sensitive receptors in the community.

The monitoring locations provided in Table 1 are shown in Figure 1A (on-Site locations) and Figure 1B (off-Site locations).

Monitoring occurred over a number of different weather conditions, wind speeds, wind directions, and time periods. Due to this variability, monitoring was conducted three times to give an accurate assessment of the potential odour impacts during Site operation. The field data sheets for each Site visit are provided in Attachment A. The field data sheets provide the meteorological conditions, odour intensities, and qualifying descriptors.

5.0 Results & Observations

The Air Quality Expert detected odour related to BRE's operations at various locations on-Site. Over the three field collection days at the Site, odour ranged from <2 ou to 30 ou, as summarized on Table 1 and detailed in Figures 2A, 3A, and 4A. The most intense odours were detected around the leachate storage tanks and around the north-east corner of the Stage 2A landfill cell. All the odours were either described as waste or landfill leachate by the Air Quality Expert.

During the OMP no on-Site odours were detected at any off-Site locations.

6.0 Conclusions and Recommendations

The highest odour concentration detected on-Site was 30 ou. This concentration was detected adjacent to the leachate storage tanks within the Stage 2A landfill cell. The limited odour detected around the perimeter of the Site was a maximum of 15 ou. Odours at this concentration typically do not result in complaints, and this odour concentration is an on-Site concentration.

All odour monitoring completed at the off-Site locations, as presented in Figures 2B, 3B, and 4B, were below detection limits. Based on the findings of the OMP it is not expected that on-Site odours are impacting off-Site receptors.

The highest odour detected at the Site was described by the Air Quality Expert as landfill leachate. This would indicate that the odours during these observations are being emitted from exposed areas of the leachate collection system and from the leachate storage tanks during loading and unloading of leachate.

In order to limit the potential for off-Site odour impacts, the following operational measures are recommended:

- Continue with the daily odour monitoring program established by BRE and carried out by the Site Operator
- If odours are noted at the property boundary, increase the amount of daily cover applied on the waste
- Minimize the active working face. Apply interim cover at a minimum thickness of 300 mm on areas of the landfill where landfilling has ceased for 6 months or more.
- Limit exposed areas of the leachate collection system
- When not in use, ensure blind flanges are placed on leachate collection system cleanouts and sump risers
- Make every effort to limit spilled leachate within the leachate storage tank (Baker tank) containment area and immediately clean up any spills when they occur

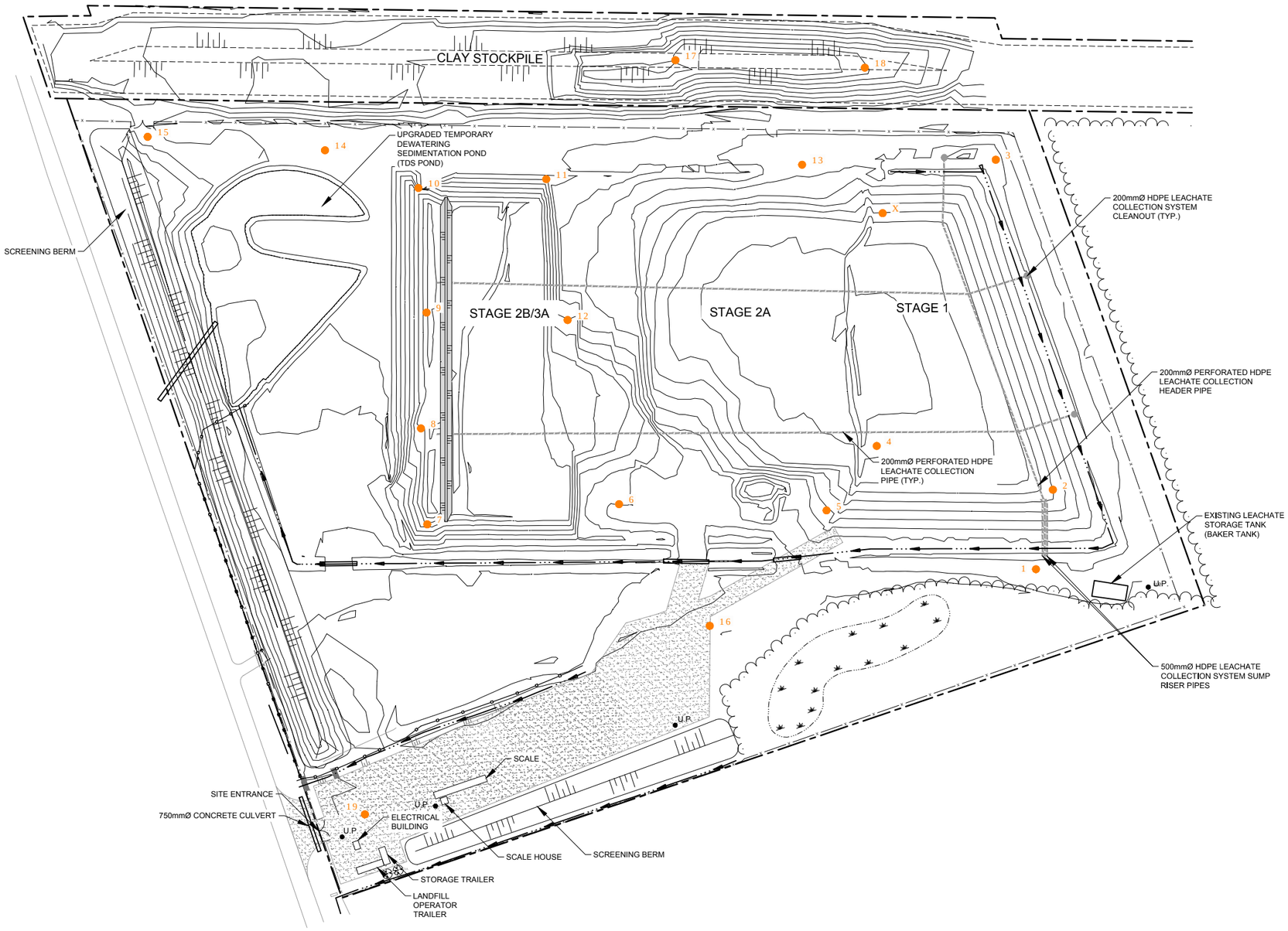
Should you have any questions on the above, please do not hesitate to contact us.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

Matthew Griffin P. Eng.

RM/mg/35
Encl.



0 10 20 30m

LEGEND:

- GROUND CONTOUR AT 1.0m INTERVAL
- 192.0 GROUND CONTOUR AT 2.0m INTERVAL
- PROPERTY LINE
- FENCELINE
- EDGE OF PONDED WATER
- CLAY STOCKPILE AREA
- SILT FENCE
- LEACHATE COLLECTION SYSTEM PIPING
- DRAINAGE DITCH
- SWAMPY AREA
- TEMPORARY DIVIDER BERM
- ROADWAY
- TREELINE
- U.P. UTILITY POLE
- CULVERT
- CHECK DAM
- DOUBLE GATE
- SINGLE GATE
- 1 MONITORING LOCATION

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

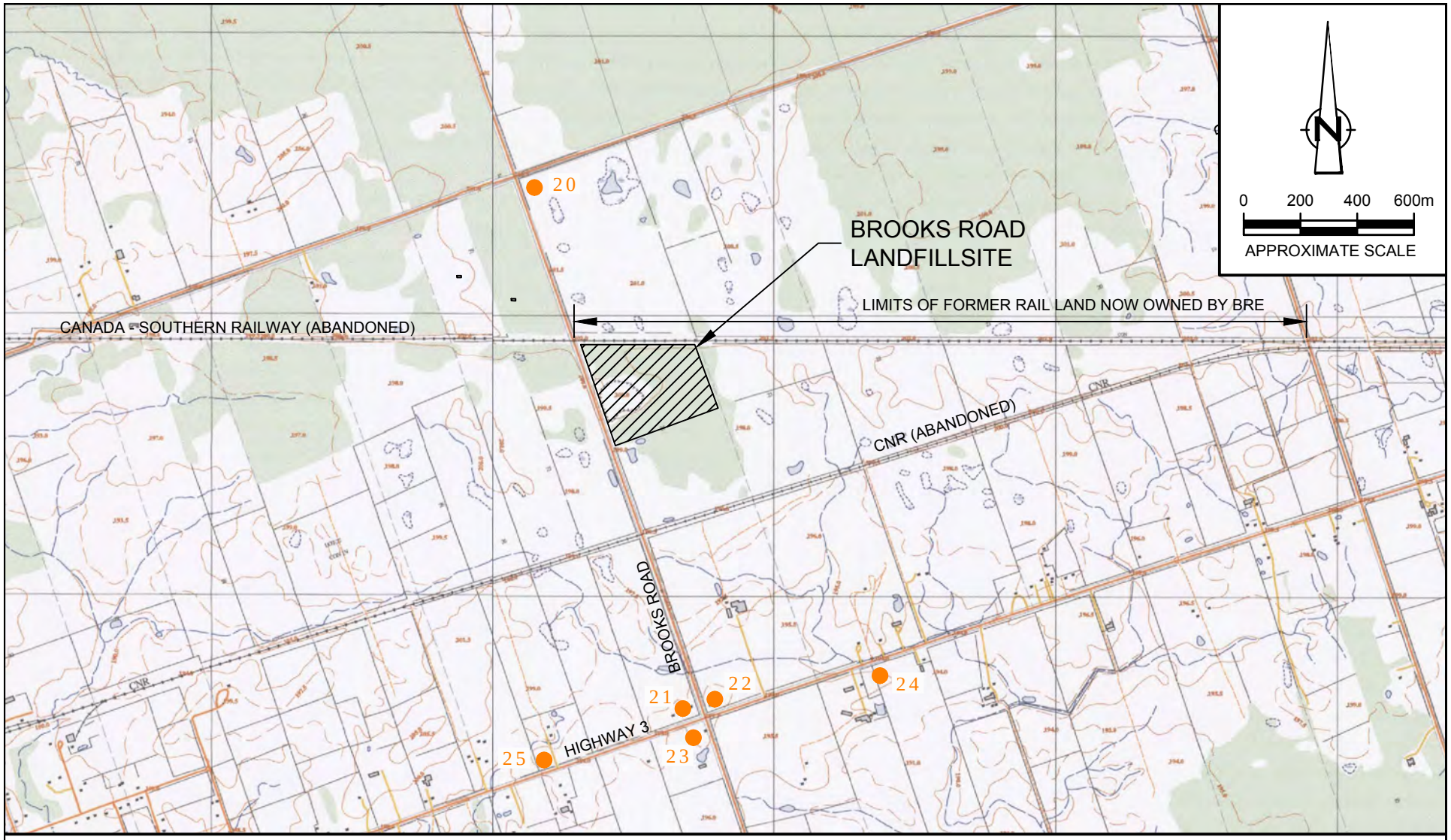
BROOKS ROAD LANDFILL SITE
CAYUGA, ONTARIO

ON-SITE MONITORING LOCATIONS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:
EXISTING GROUND CONTOURS AND TOPOGRAPHIC FEATURES SHOWN ARE BASED ON TERVITA AS-BUILT FOR FINAL CONDITIONS FOR STAGE 2A, 2B AND STAGE 3A, AND NORTH CLAY STOCKPILE SURVEY BY VAN NOSTRAND AND GIBSON SURVEYED JULY-17-2013

Project Manager:	Reviewed By:	Date:	
G. FERRARO	R. MORGAN	JULY 2014	
Scale: 1:1000	Project №: 18235-72	Report №: WELD035	Drawing №: figure 1A



SOURCE: MINISTRY OF NATURAL RESOURCES
SHEETS: 10 17 5900 47550 & 10 17 5950 47550

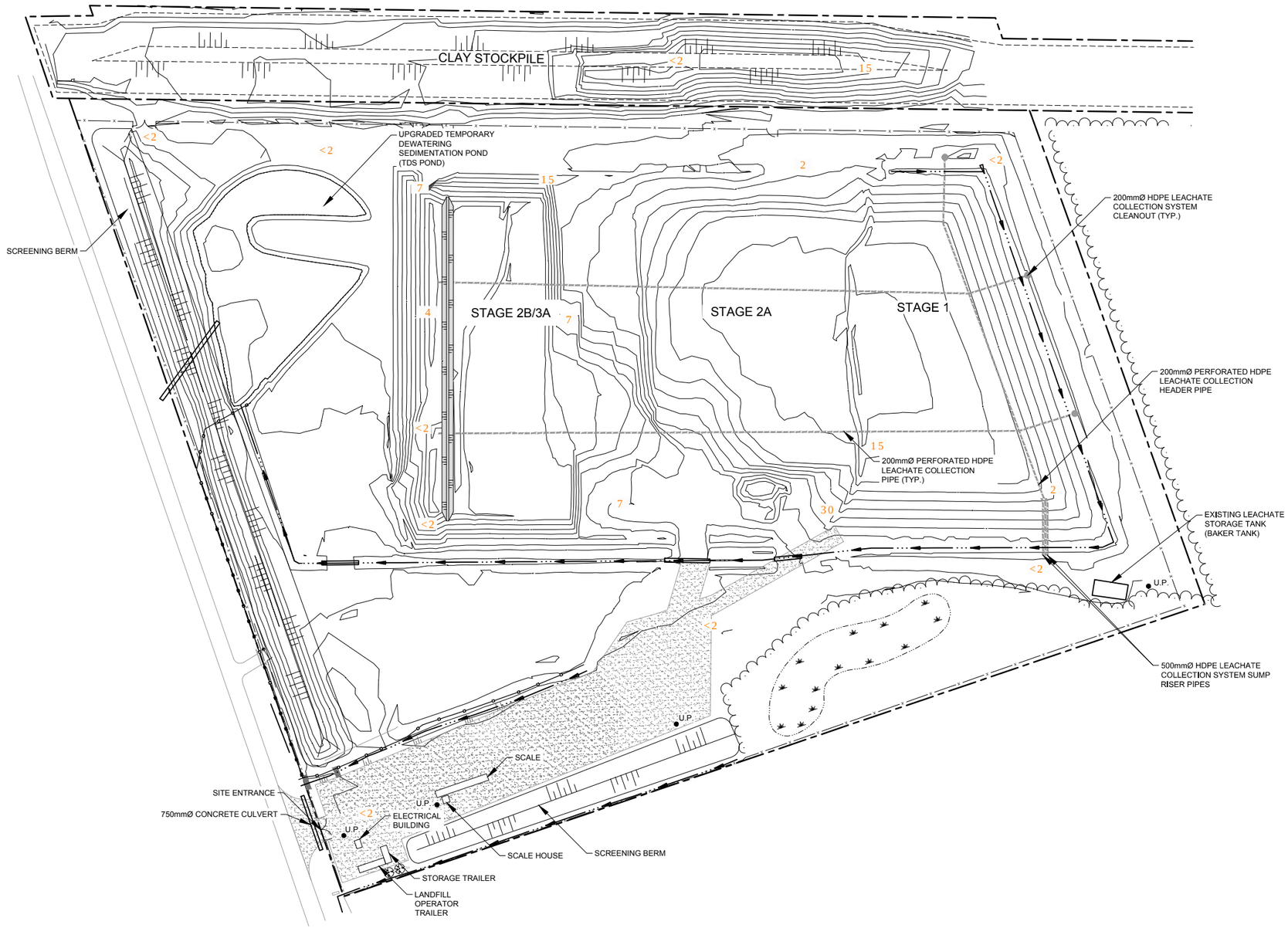
figure 1B

LEGEND

20 OFF-SITE MONITORING LOCATION

OFF-SITE MONITORING LOCATIONS
BROOKS ROAD LANDFILL
Cayuga, Ontario

18235-72(WELD035)GN-WA008 JUL 8/2014



0 10 20 30m

LEGEND:

- GROUND CONTOUR AT 1.0m INTERVAL
- 192.0 GROUND CONTOUR AT 2.0m INTERVAL
- PROPERTY LINE
- FENCELINE
- EDGE OF PONDED WATER
- CLAY STOCKPILE AREA
- SILT FENCE
- LEACHATE COLLECTION SYSTEM PIPING
- DRAINAGE DITCH
- SWAMPY AREA
- TEMPORARY DIVIDER BERM
- ROADWAY
- TREELINE
- U.P. UTILITY POLE
- CULVERT
- CHECK DAM
- DOUBLE GATE
- SINGLE GATE
- 15 ODOUR MONITORING RESULT (OU)

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

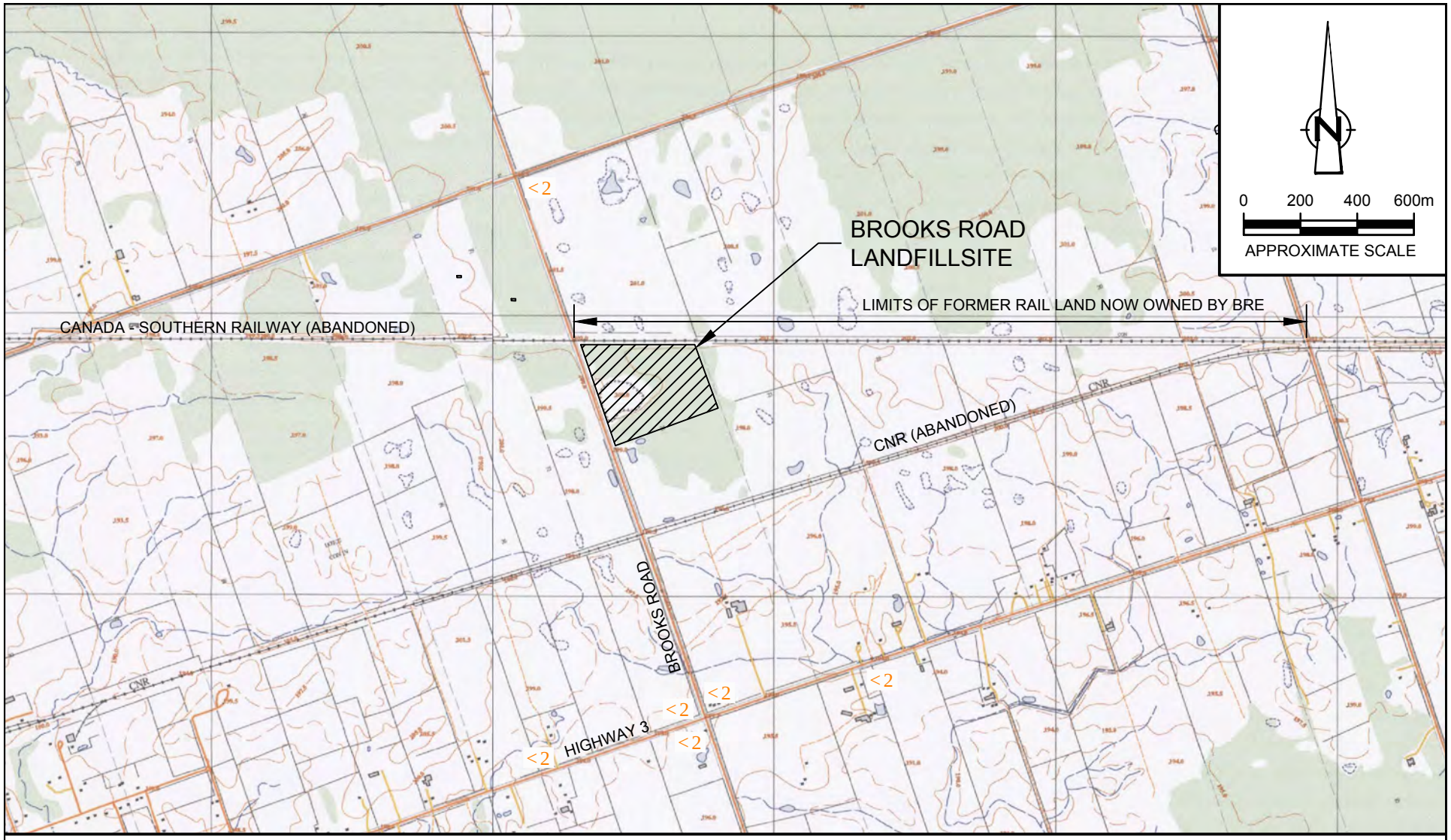
BROOKS ROAD LANDFILL SITE
CAYUGA, ONTARIO

APRIL 1, 2014 ODOUR MONITORING

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:
EXISTING GROUND CONTOURS AND TOPOGRAPHIC FEATURES SHOWN ARE BASED ON TERVITA AS-BUILT FOR FINAL CONDITIONS FOR STAGE 2A, 2B AND STAGE 3A, AND NORTH CLAY STOCKPILE SURVEY BY VAN NOSTRAND AND GIBSON SURVEYED JULY-17-2013

Project Manager:	Reviewed By:	Date:	
G. FERRARO	R. MORGAN	JULY 2014	
Scale: 1:1000	Project N°: 18235-72	Report N°: WELD035	Drawing N°: figure 2A



SOURCE: MINISTRY OF NATURAL RESOURCES
SHEETS: 10 17 5900 47550 & 10 17 5950 47550

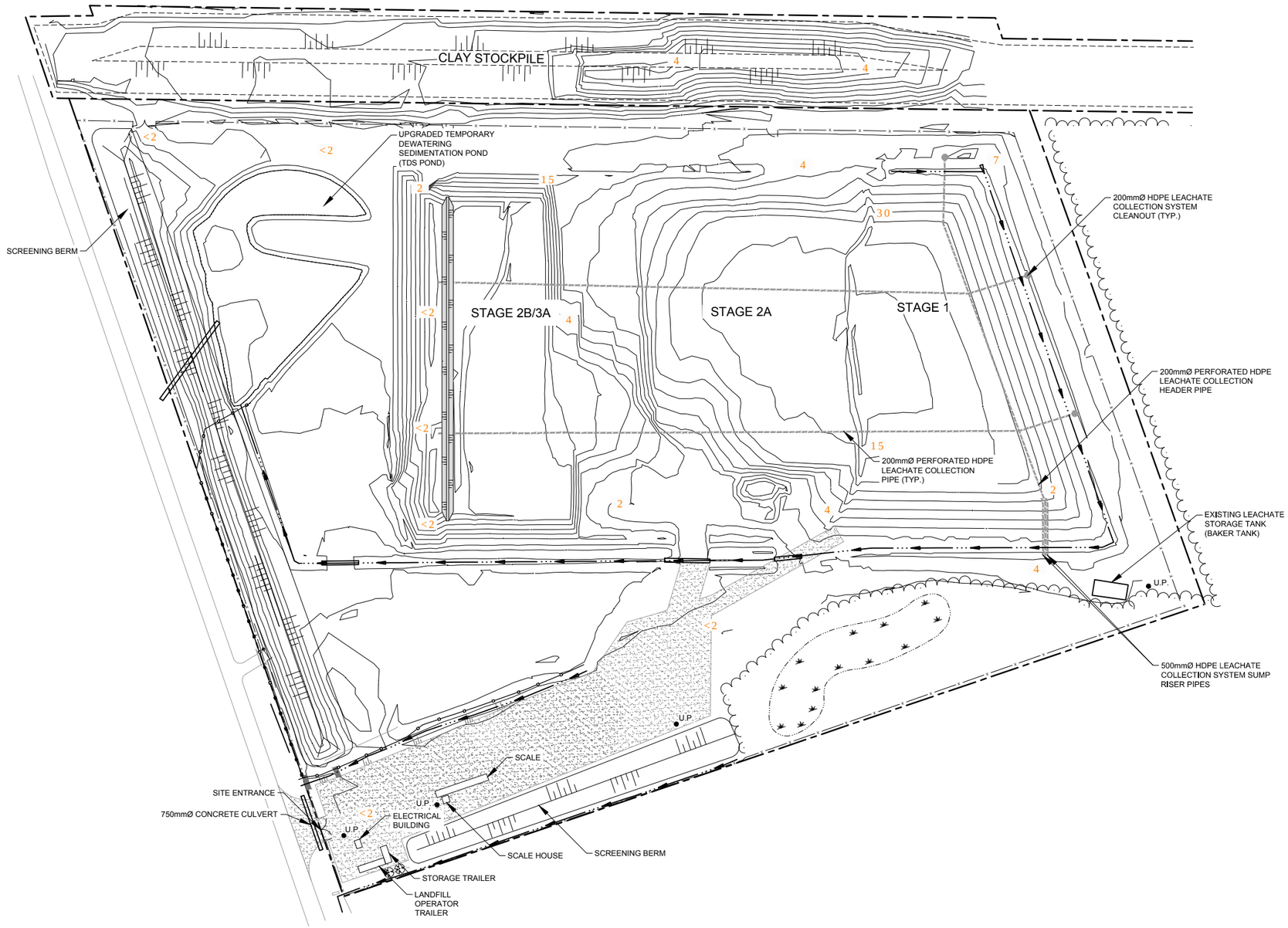
figure 2B

APRIL 1, 2014 ODOUR MONITORING
BROOKS ROAD LANDFILL
Cayuga, Ontario

LEGEND

<2 ODOUR MONITORING RESULT (OU)

18235-72(WELD035)GN-WA002 JUL 8/2014



0 10 20 30m

LEGEND:

- GROUND CONTOUR AT 1.0m INTERVAL
- 192.0 GROUND CONTOUR AT 2.0m INTERVAL
- PROPERTY LINE
- FENCELINE
- EDGE OF PONDED WATER
- CLAY STOCKPILE AREA
- SILT FENCE
- LEACHATE COLLECTION SYSTEM PIPING
- DRAINAGE DITCH
- SWAMPY AREA
- TEMPORARY DIVIDER BERM
- ROADWAY
- TREELINE
- U.P. UTILITY POLE
- CULVERT
- CHECK DAM
- DOUBLE GATE
- SINGLE GATE
- 15 ODOUR MONITORING RESULT (OU)

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

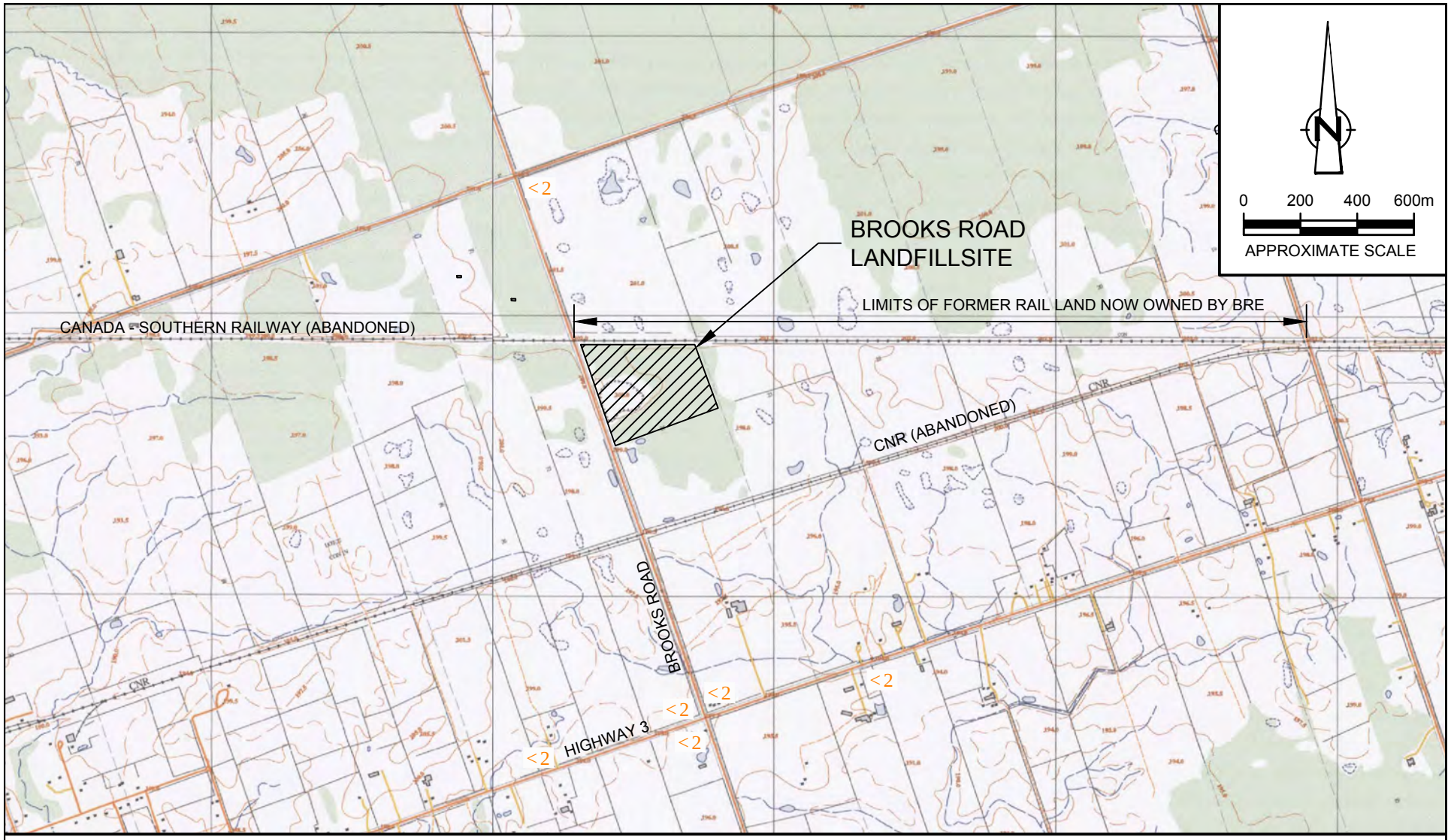
BROOKS ROAD LANDFILL SITE
CAYUGA, ONTARIO

MAY 9, 2014 ODOUR MONITORING

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:
EXISTING GROUND CONTOURS AND TOPOGRAPHIC FEATURES SHOWN ARE BASED ON TERVITA AS-BUILT FOR FINAL CONDITIONS FOR STAGE 2A, 2B AND STAGE 3A, AND NORTH CLAY STOCKPILE SURVEY BY VAN NOSTRAND AND GIBSON SURVEYED JULY-17-2013

Project Manager:	Reviewed By:	Date:	
G. FERRARO	R. MORGAN	JULY 2014	
Scale: 1:1000	Project N°: 18235-72	Report N°: WELD035	Drawing N°: figure 3A



SOURCE: MINISTRY OF NATURAL RESOURCES
SHEETS: 10 17 5900 47550 & 10 17 5950 47550

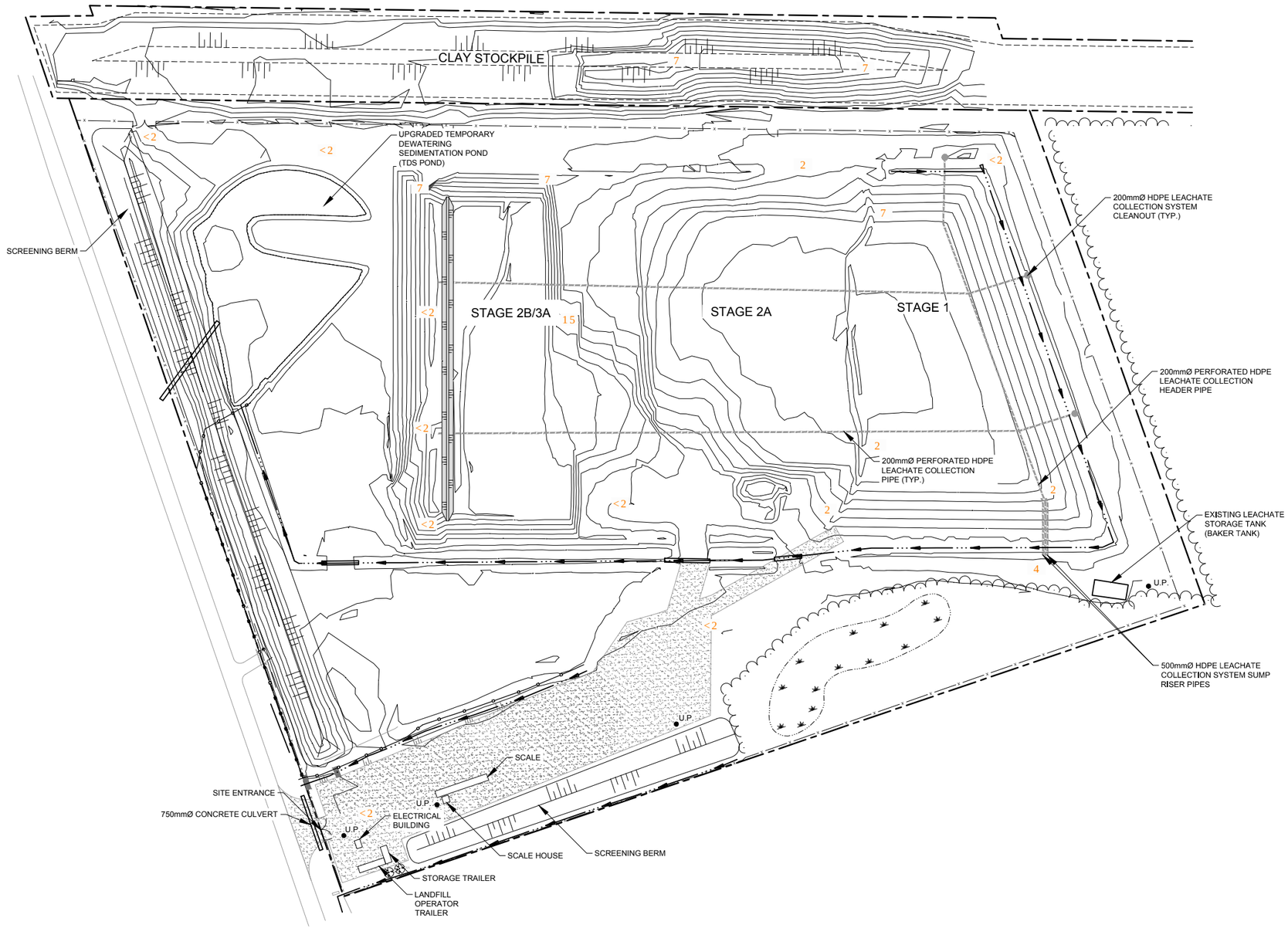
figure 3B

MAY 9, 2014 ODOUR MONITORING
BROOKS ROAD LANDFILL
Cayuga, Ontario

LEGEND

<2 ODOUR MONITORING RESULT (OU)

18235-72(WELD035)GN-WA004 JUL 8/2014



0 10 20 30m

LEGEND:

- GROUND CONTOUR AT 1.0m INTERVAL
- 192.0 GROUND CONTOUR AT 2.0m INTERVAL
- PROPERTY LINE
- FENCELINE
- EDGE OF PONDED WATER
- CLAY STOCKPILE AREA
- SILT FENCE
- LEACHATE COLLECTION SYSTEM PIPING
- DRAINAGE DITCH
- SWAMPY AREA
- TEMPORARY DIVIDER BERM
- ROADWAY
- TREELINE
- U.P. UTILITY POLE
- CULVERT
- CHECK DAM
- DOUBLE GATE
- SINGLE GATE
- 15 ODOUR MONITORING RESULT (OU)

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

BROOKS ROAD LANDFILL SITE
CAYUGA, ONTARIO

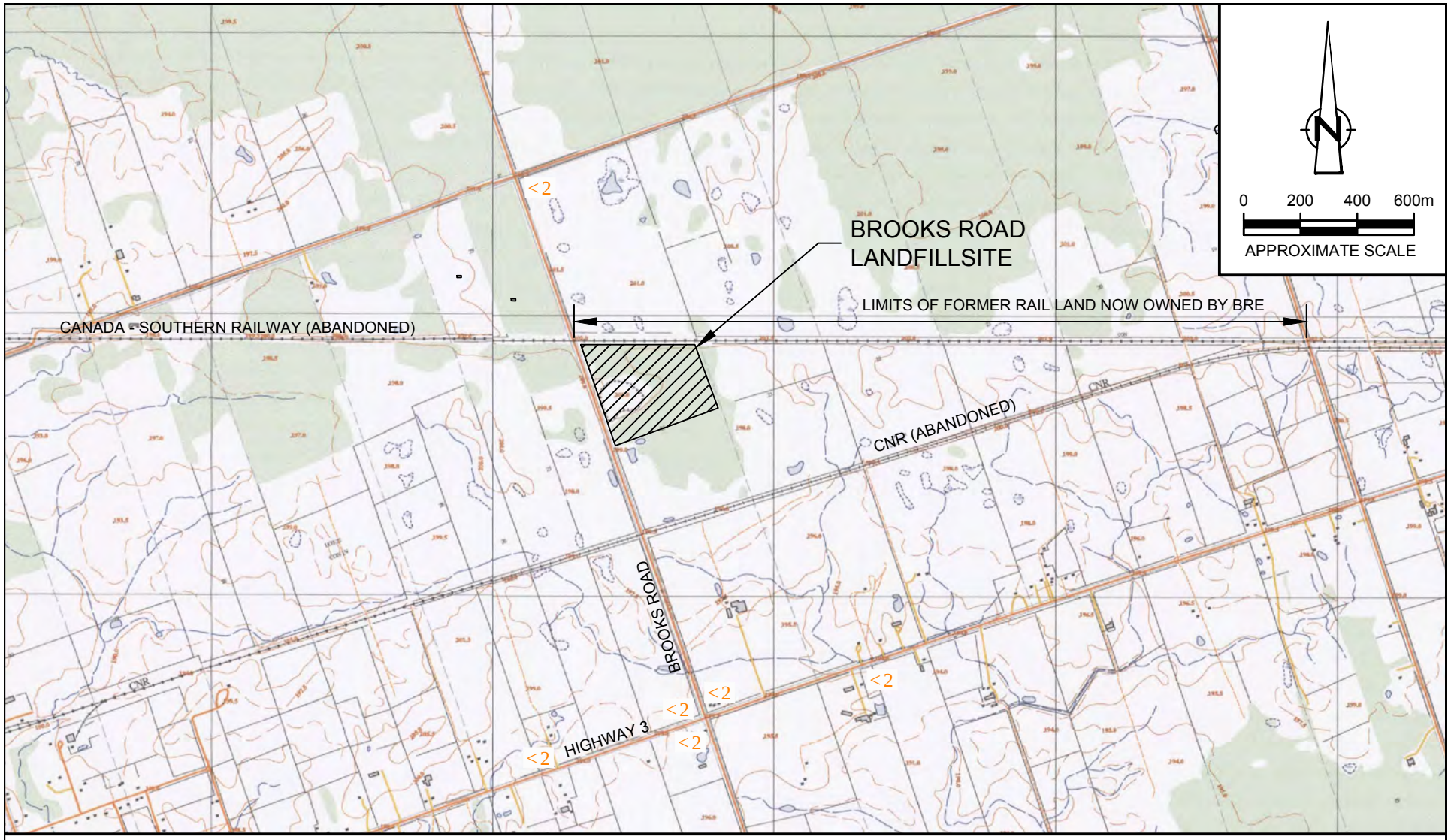
JUNE 3, 2014 ODOUR MONITORING

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:
EXISTING GROUND CONTOURS AND TOPOGRAPHIC FEATURES SHOWN ARE BASED ON TERVITA AS-BUILT FOR FINAL CONDITIONS FOR STAGE 2A, 2B AND STAGE 3A, AND NORTH CLAY STOCKPILE SURVEY BY VAN NOSTRAND AND GIBSON SURVEYED JULY-17-2013

Project Manager:	Reviewed By:	Date:	
G. FERRARO	R. MORGAN	JULY 2014	
Scale: 1:1000	Project N°: 18235-72	Report N°: WELD035	Drawing N°: figure 4A

18235-72(WELD035)GN-WA005 JUL 8/2014



SOURCE: MINISTRY OF NATURAL RESOURCES
SHEETS: 10 17 5900 47550 & 10 17 5950 47550

figure 4B

JUNE 3, 2014 ODOUR MONITORING
BROOKS ROAD LANDFILL
Cayuga, Ontario

LEGEND

<2 ODOUR MONITORING RESULT (OU)

18235-72(WELD035)GN-WA006 JUL 8/2014

TABLE 1

SUMMARY OF ODOUR MONITORING
BROOKS ROAD LANDFILL
CAYUGA, ONTARIO

Sample Location		*1-Apr-14 (ou)*	*9-May-14 (ou)*	*3-Jun-14 (ou)*
On-Site	1	< 2	4	4
On-Site	2	2	2	2
On-Site	3	< 2	7	< 2
On-Site	X	-	30	7
On-Site	4	15	15	2
On-Site	5	30	4	2
On-Site	6	7	2	< 2
On-Site	7	< 2	< 2	< 2
On-Site	8	< 2	< 2	< 2
On-Site	9	4	< 2	< 2
On-Site	10	7	2	7
On-Site	11	15	15	7
On-Site	12	7	4	15
On-Site	13	2	4	2
On-Site	14	< 2	< 2	< 2
On-Site	15	< 2	< 2	< 2
On-Site	16	< 2	< 2	< 2
On-Site	17	< 2	4	7
On-Site	18	15	4	7
On-Site	19	< 2	< 2	< 2
Off-Site	20	< 2	< 2	< 2
Off-Site	21	< 2	< 2	< 2
Off-Site	22	< 2	< 2	< 2
Off-Site	23	< 2	< 2	< 2
Off-Site	24	< 2	< 2	< 2
Off-Site	25	< 2	< 2	< 2
Average On-Site		6	6	4
Minimum On-Site		< 2	< 2	< 2
Maximum On-Site		30	30	15
Average Off-Site		< 2	< 2	< 2
Minimum Off-Site		< 2	< 2	< 2
Maximum Off-Site		< 2	< 2	< 2

Notes:

ou - odour units
'-' no data could be collected due to open asbestos dumping.

Attachment A

Field Data Sheets

#018235

NASAL RANGER

Date: April 1, 2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
10:40	1							X	S07	capped
10:45	2						X		S07	
10:50	3							X	S06	old garbage pile
11:00	4			X					S07	
11:05	5		X						S07	leachate tanks
11:10	6				X				S06	above open stage 2B
11:15	7							X	S06	above open stage 2B
11:20	8							X	S06	Base of stage 2B
11:23	9					X			S06	Top of stage 2B
11:27	10				X				S06/S07	T.O of stage 2B
11:41	11			X					S06/S07	Top of stage 2B
11:45	12				X				S06	middle of 2A/2B
11:50	13						X		S06/S07	
11:55	14							X	S06	
12:00	15							X	S06	
12:06	16							X	S06/S07	
12:25	17							X	S06	
12:30	18			X	X				S07	
12:45	19							X	S06/S07	
13:00	20							X	—	No smell

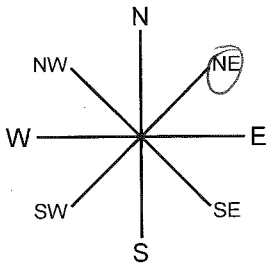
Weather Conditions

- [X] Sunny
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [X] Calm
- [X] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 5 °F/(°C) Relative Humidity: 45 % Barometric Pressure: 102.39

Comments: _____

Code _____ Name Rob Morgan Signature _____

#018235

NASAL RANGER

Date: April 1, 2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
13:05	21							x	406	No odour
13:10	22							x	406	No odour
13:15	23							x	406	No odour
13:25	24							x	406	No odour
13:30	25									

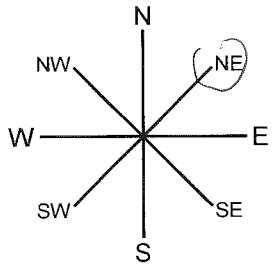
Weather Conditions

Precipitation:

- ☐ Sunny
- ☐ Partly Cloudy
- ☐ Mostly Cloudy
- ☐ Overcast
- ☐ Hazy

- ☐ None
- ☐ Fog
- ☐ Rain
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☒ Calm
- ☒ Light Breeze (1-5 mph)
- ☐ Moderate Wind (5-15 mph)
- ☐ Strong Winds (15 or higher mph)

Temperature:_____°F/°C Relative Humidity:_____% Barometric Pressure:_____

Comments:_____

_____

_____

Code Name Signature

#018235

NASAL RANGER

Date: May 9, 2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
9:47	1					X			507	capped/pumping a little
9:50	2						X		507	
9:53	3				X				506	garbage bags
	X		X						506/507	Big garbage pile
	4			X					507	some odor from pooled water
	5					X			507	leachate tanks
	6						X		507	
	7							X	507	
	8							X	507	
	9							X	507	
	10						X		507	
	11			X					506	
	12					X			506	
	13					X			506	
	14							X	506	
	15							X	506	
	16							X	506	
	17					X			506/507	
	18					X			506/507	
10:50	19							X	506	

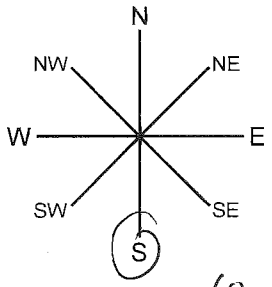
Weather Conditions

- [ ] Sunny
- [X] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [ ] Calm
- [ ] Light Breeze (1-5 mph)
- [X] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 20 °F/(°C) Relative Humidity: 60 % Barometric Pressure: 101.3 kPa

Comments: _____

Code _____ Name RC Morgan Signature _____

018235

NASAL RANGER

Date: May 9, 2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
10:56	20							X	406	No odour
	21							X	406	No odour
	22							X	406	No odour
	23							X	406	No odour
	24							X	406	No odour
11:10	25							X	406	No odour

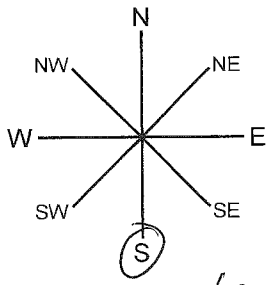
Weather Conditions

- ☐ Sunny
- ☒ Partly Cloudy
- ☐ Mostly Cloudy
- ☐ Overcast
- ☐ Hazy

Precipitation:

- ☒ None
- ☐ Fog
- ☐ Rain
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☐ Calm
- ☐ Light Breeze (1-5 mph)
- ☒ Moderate Wind (5-15 mph)
- ☐ Strong Winds (15 or higher mph)

Temperature: 20 °F (°C)

Relative Humidity: 60 %

Barometric Pressure: 101.3 kPa

Comments: _____

Code	Name	Signature
	Rob Morgan	

018235

NASAL RANGER

Date: June 3, 2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
9:50	1					X	X		507	
9:58	2						X		507	
10:01	3							X	506	
10:05	X				X				506	
10:09	4						X		506	
10:13	5						X		507	
10:16	6							X	506	
10:19	7							X	506	
10:22	8							X	506	
10:25	9							X	506	
10:28	10				X		X		506/507	
10:31	11				X				506/507	
10:34	12			X					506	
10:37	13						X		506	
10:48	14							X	506	
10:51	15							X	706	
10:56	16							X	506	
10:42	17				X				506/507	
10:45	18				X				506/507	
10:59	19							X	506	

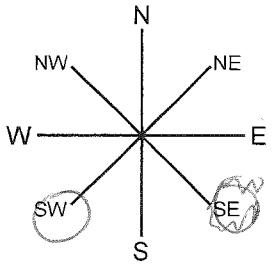
Weather Conditions

- [ ] Sunny
- [ ] Partly Cloudy
- [X] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [ ] Calm
- [ ] Light Breeze (1-5 mph)
- [X] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 21 °F/(°C) Relative Humidity: 98 % Barometric Pressure: 101.0 kpa

Comments: _____

Code	Name	Signature
	Rob Morgan	

#018235

NASAL RANGER

Date: June 3, 2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
11:05	20							X	406	
	21									
	22									
	23									
	24									
	25									

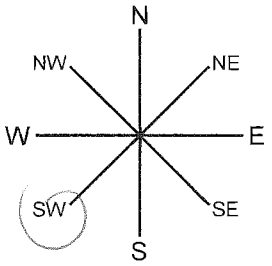
Weather Conditions

- ☐ Sunny
- ☐ Partly Cloudy
- ☒ Mostly Cloudy
- ☐ Overcast
- ☐ Hazy

Precipitation:

- ☒ None
- ☐ Fog
- ☐ Rain
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☐ Calm
- ☐ Light Breeze (1-5 mph)
- ☒ Moderate Wind (5-15 mph)
- ☐ Strong Winds (15 or higher mph)

Temperature: 21 °F/°C Relative Humidity: 98 % Barometric Pressure: 101.0 Kpa

Comments: _____

Code	Name	Signature
	Rob Morgan	

CONESTOGA-ROVERS & ASSOCIATES

651 Colby Drive, Waterloo, Ontario, Canada N2V 1C2
Telephone: (519) 884-0510 Facsimile: (519) 884-0525
www.CRAworld.com

November 3, 2014 Reference No. 018235-72

Mr. Richard Weldon
Brooks Road Environmental
c/o 2270386 Ontario Limited
160 Brooks Road, R.R. #5
Cayuga, Ontario
N0A 1E0

Dear Mr. Weldon:

Re: Odour Monitoring Program
Brooks Road Landfill Site, Cayuga, Ontario

1.0 Introduction

Conestoga-Rovers & Associates (CRA) was retained by Brooks Road Environmental c/o 2270386 Ontario Limited (BRE) to complete an ambient odour monitoring program (OMP) at the Brooks Road Landfill Site (Site) located in Cayuga, Ontario.

The OMP collected odour data in an effort to identify areas in the community potentially impacted by the Site and to determine conditions that may contribute to a potential odour impact.

This program was developed to assist BRE in determining the following information:

- Identification of potential odour sources at the Site
- Qualification and quantification of the odour from identified sources
- Odour monitoring at off-Site locations

The OMP was conducted by an Air Quality Expert on three consecutive days (August 7, August 8, and August 9, 2014) in response to odour complaints received during the month of July 2014 from the resident located at 5319 Highway 3, Cayuga (Dave Glenney). Additional odour monitoring was also conducted on September 10, 2014 in response to an odour complaint received by the resident at 225 Brooks Road, Cayuga (Rosanne Belliveau) on September 10, 2014.

2.0 Site Description

The Site is located at 160 Brooks Road in Cayuga, Ontario approximately one kilometre north of Kings Highway No. 3 (Talbot Road). The Site is legally described as Part of Lot 24, Concession I-N.T.R., Haldimand County.

The total Site area is approximately 14.3 hectares (ha) (35.3 acres) of which 6 ha (15 acres) is approved for landfilling.

The Site is bounded to the north by a rural property consisting of undeveloped fields (i.e., long-term inactive agricultural crop production lands) and forested areas. To the south and east of the Site is undeveloped rural property consisting of a combination of fields and forested areas. The Site is bounded to the west by Brooks Road. On the west side of Brooks Road is an undeveloped rural property which is characterized primarily by undeveloped fields with occasional bush lots.

3.0 Odour Monitoring Program

Odour monitoring was completed during the Site visits using a Nasal Ranger™ field olfactometer. The Nasal Ranger has eight settings that allow the user to quantify odour concentrations ranging from two odour units (ou) to greater than 60 ou. The olfactometer mixes a known volume of carbon filtered air with a known volume of ambient air to produce a dilution-to-threshold (D/T) ratio. The D/T ratio is defined as follows:

D T = Volume of Carbon Filtered Air/volume of odorous air

It should be noted that the odour unit value as measured by a field olfactometer, like the Nasal Ranger, are not directly comparable to odour data provided by an odour panel. The data from the Nasal Ranger does provide a good relative gauge to evaluate various odour concentrations.

4.0 Odour Collection

On-Site monitoring locations were identified and selected based on an evaluation of the current Site activities. The on-Site locations monitored during the OMP are expected to be locations

that may contribute to any potential off-Site impact. Off-Site monitoring locations have been selected based on sensitive receptors in the community.

The monitoring locations provided in Table 1 and Table 2 are shown in Figure 1A (off-Site locations) and Figure 1B (on-Site locations), respectively.

Monitoring occurred over different temperature, wind speeds, and wind directions in the morning hours. Monitoring was conducted over three consecutive days (August 7, August 8, and August 9, 2014) to give an accurate assessment of the potential odour impacts during Site operation. On September 10, 2014, odour monitoring was focused around Ms. Belliveau's residence.

The field data sheets for each Site visit are provided in Attachment A. The field data sheets provide the meteorological conditions, odour intensities, and qualifying descriptors.

5.0 Results & Observations

The Thursday August 7, 2014 monitoring event took place between 4:45 a.m. to 8:50 a.m. During this monitoring event the temperature ranged from 13^{o}C to 20^{o}C with wind speeds of 5 km/hr to 12 km/hr blowing predominantly from the northwest. Since the wind was blowing predominantly from the northwest the off-Site monitoring locations were predominantly south and southeast of the landfill. During the monitoring event no odours were detected by the Air Quality Expert at any off-Site monitoring locations as provided in Table 1 and Figure 2A.

On-Site odour monitoring was conducted during the August 7, 2014 monitoring event. The Air Quality Expert detected odour related to BRE's operations at various locations on-Site. Odour ranged from <2 ou to 30 ou, as summarized on Table 2 and detailed in Figure 2B. The most intense odours were detected around the leachate storage tanks within the Stage 2A landfill cell and around the center (north to south) of the Stage 2B/3A active landfill face. All the odours were either described as waste or landfill leachate by the Air Quality Expert.

The Friday August 8, 2014 monitoring event took place between 5:01 a.m. to 12:44 p.m. During this monitoring event the temperature ranged from 13^{o}C to 22^{o}C with wind speeds of 0 km/hr to 8 km/hr blowing predominantly from the north and northeast. Since the wind was blowing predominantly from the north and northeast the off-Site monitoring locations were predominantly south and southwest of the landfill. During the monitoring event odours with a

similar characteristic to on-Site odours were detected by the Air Quality Expert at the end of the driveway at 5345 Highway 3, Cayuga and in the southeast corner and southeast to southwest boundary of the property owned by BRE west of the Site. The odours were described as faint (<2 ou) and dissipated within 0.5-1 seconds of detection. During this monitoring event a burnt wood odour was detected halfway up the driveway at 5319 Highway 3, Cayuga. The odour was described as faint (<2 ou) and dissipated within 0.5-1 seconds of detection. Off-Site monitoring locations during this monitoring event are provided in Table 1 and Figure 3A.

On-Site odour monitoring was conducted during the August 8, 2014 monitoring event. The Air Quality Expert detected odour related to BRE's operations at various locations on-Site. Odour ranged from <2 ou to 30 ou, as summarized on Table 2 and detailed in Figure 3B. The most intense odours were detected around the leachate storage tanks within the Stage 2A landfill cell and around the center (north to south) of the Stage 2B/3A active landfill face. All the odours were either described as waste or landfill leachate by the Air Quality Expert.

The Saturday August 9, 2014 monitoring event took place between 5:12 a.m. to 9:12 a.m. During this monitoring event the temperature ranged from 14^{o}C to 21^{o}C with wind speeds of 9 km/hr to 13 km/hr blowing predominantly from the east. Since the wind was blowing predominantly from the east the off-Site monitoring locations were predominantly south and southwest of the landfill. During the monitoring event odours with a similar characteristic to on-Site odours were detected by the Air Quality Expert at the end of the driveway at 5345 Highway 3, Cayuga and in the southeast corner of the property owned by BRE west of the Site. The odours were described as faint (<2 ou) and dissipated within 0.5-1 seconds of detection. During this monitoring event a burnt wood odour was detected halfway up the driveway at 5319 Highway 3, Cayuga. The odour was described as faint (<2 ou) and dissipated within 0.5-1 seconds of detection. Off-Site monitoring locations during this monitoring event are provided in Table 1 and Figure 4.

The Wednesday September 10, 2014 monitoring even took place between 11:00 a.m. and 12:45 p.m. During this monitoring event the temperature ranged from 22.5^{o}C to 23.1^{o}C with wind speeds of 19 km/hr to 22 km/hr blowing predominantly from the south. Since the wind was blowing predominantly from the south and Ms. Belliveau's residence is located slightly northwest of the landfill, monitoring locations were only considered on Brooks Road between the landfill and the residence. During the monitoring event odours with a similar characteristic to on-Site odours were not detected by the Air Quality Expert at the monitoring locations off-Site. Odours described as Tar/Asphalt and very faint (<2 ou) were detected along the road

at the off-Site monitoring locations and dissipated within 0.5-1 seconds of detection. Off-Site monitoring locations during this monitoring event are provided in Table 1 and Figure 5A.

On-Site odour monitoring was conducted during the September 10, 2014 monitoring event. The Air Quality Expert detected odour related to BRE's operations at various locations on-Site. Odour ranged from <2 ou to 30 ou, as summarized on Table 2 and detailed in Figure 5B. The most intense odours were detected directly south of the Stage 2A landfill cell and at the northeast corner of the Stage 2B/3A landfill cell. All the odours were either described as waste or landfill leachate by the Air Quality Expert.

6.0 Conclusions and Recommendations

The highest odour concentration detected on-Site was 30 ou. This concentration was detected adjacent to the leachate storage tanks within the Stage 2A landfill cell and in the center (north to south) of the Stage 2B/3A active landfill face. The limited odour detected around the perimeter of the Site was a maximum of 15 ou. Odours at this concentration typically do not result in complaints at off-Site locations, and this odour concentration is an on-Site concentration.

All odour monitoring results at the off-Site locations, as presented in Figures 2A, 3A, 4, and 5A showed low concentrations (<2 ou) and dissipated quickly (0.5-1 seconds). Due to the short duration of odours quantification could not be completed.

The highest odour detected at the Site was described by the Air Quality Expert as landfill leachate. This would indicate that the odours during these observations are being emitted from exposed areas of the leachate collection system and from the leachate storage tanks during loading and unloading of leachate.

At a few locations odours that were briefly detected off-Site had the same characteristics as the on-Site odours, while at other locations odour was briefly detected off-Site that did not have the same characteristics as the on-Site odours.

In order to limit the potential for off-Site odour impacts, the following operational measures are recommended:

- Continue with the daily odour monitoring program established by BRE and carried out by the Site Operator
- If odours are noted at the property boundary, increase the amount of daily cover applied on the waste
- Minimize the active working face. Apply interim cover at a minimum thickness of 300 mm on areas of the landfill where landfilling has ceased for 6 months or more
- Limit exposed areas of the leachate collection system
- When not in use, ensure blind flanges are placed on leachate collection system cleanouts and sump risers
- Make every effort to limit spilled leachate within the leachate storage tank (Baker tank) containment area and immediately clean up any spills when they occur
- Continue with use of odour control granules for odour mitigation. Assess areas of placement and their effect on odour mitigation.

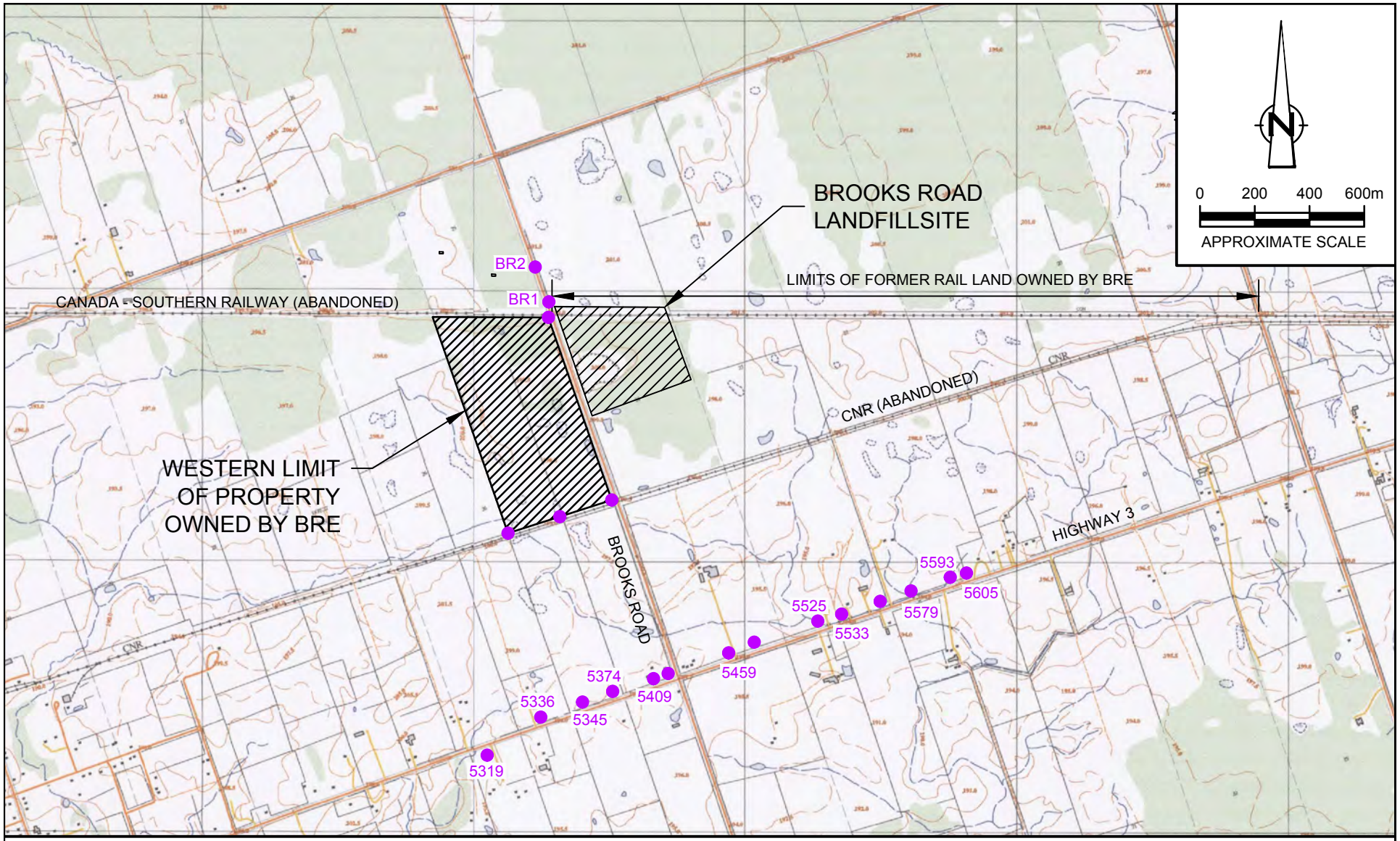
Should you have any questions on the above, please do not hesitate to contact us.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

Matthew Griffin P. Eng.

RM/cb/37
Encl.



SOURCE: MINISTRY OF NATURAL RESOURCES
SHEETS: 10 17 5900 47550 & 10 17 5950 47550

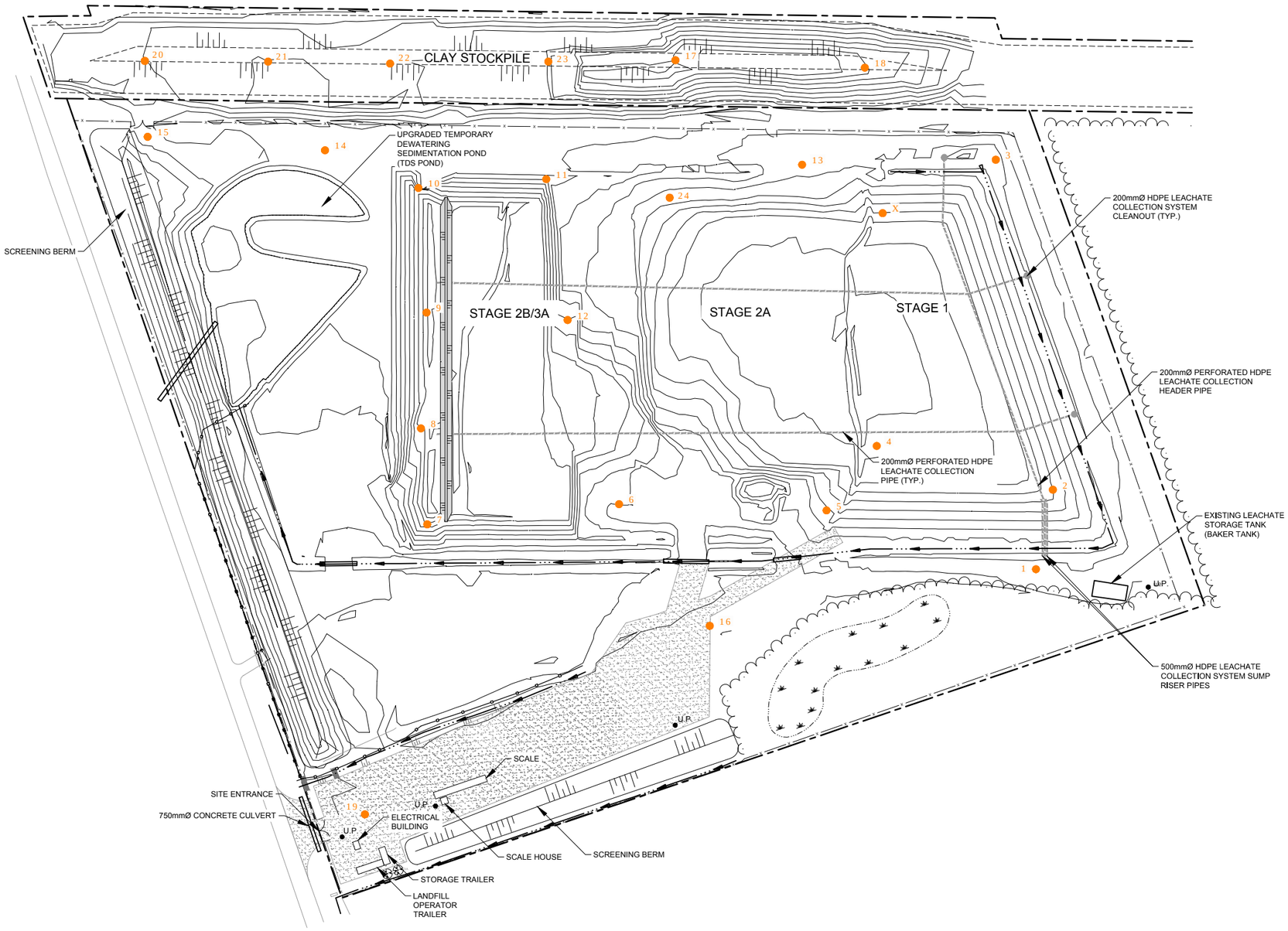
LEGEND

5533 MONITORING LOCATION

figure 1A

OFF-SITE MONITORING LOCATIONS
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

18235-72(WELD037)GN-WA001 SEP 23/2014



N

0 10 20 30m

LEGEND:

- GROUND CONTOUR AT 1.0m INTERVAL
- 192.0 GROUND CONTOUR AT 2.0m INTERVAL
- PROPERTY LINE
- FENCELINE
- EDGE OF PONDED WATER
- CLAY STOCKPILE AREA
- SILT FENCE
- LEACHATE COLLECTION SYSTEM PIPING
- DRAINAGE DITCH
- SWAMPY AREA
- TEMPORARY DIVIDER BERM
- ROADWAY
- TREELINE
- U.P. UTILITY POLE
- CULVERT
- CHECK DAM
- DOUBLE GATE
- SINGLE GATE
- 1 MONITORING LOCATION

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

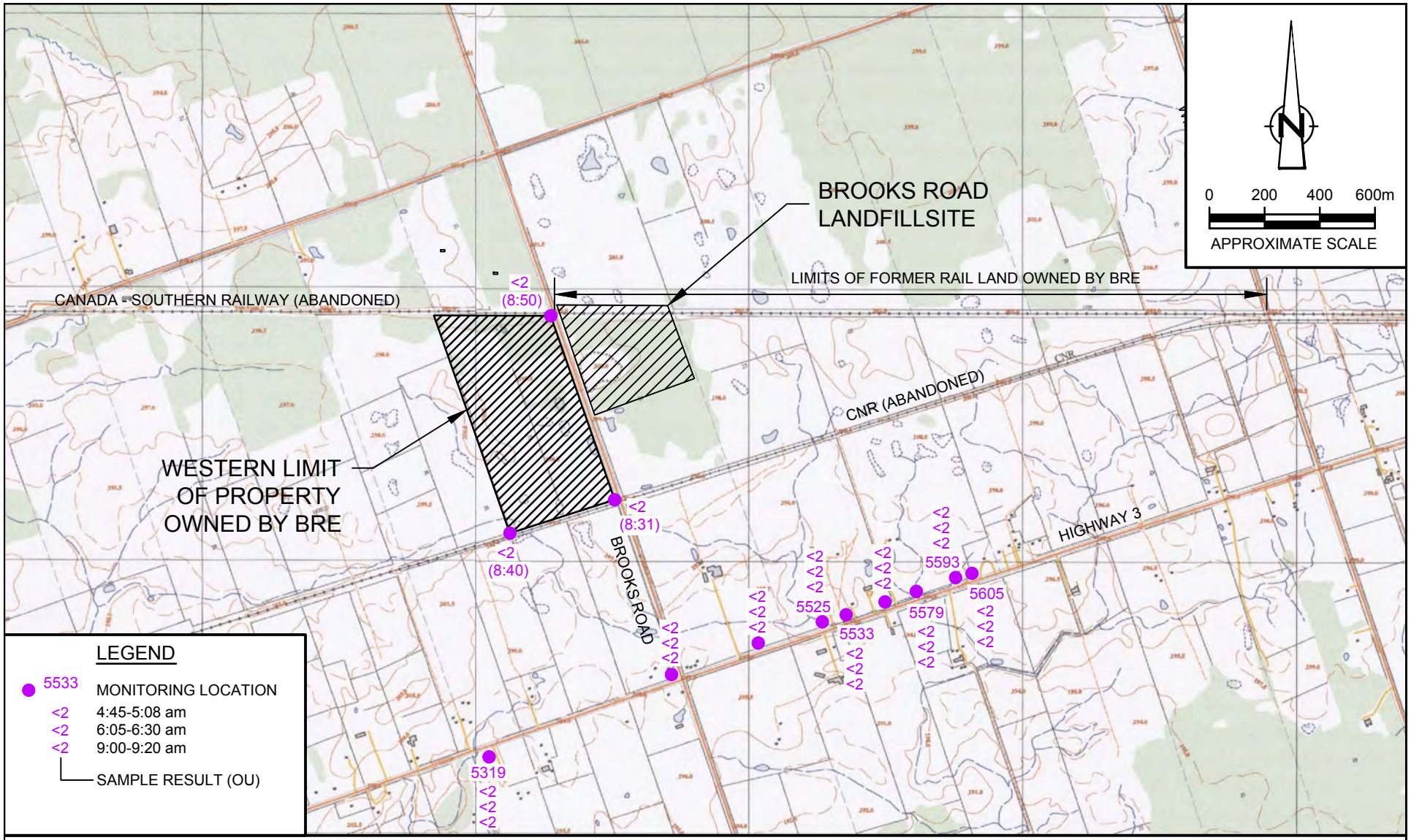
BROOKS ROAD LANDFILL SITE
CAYUGA, ONTARIO

ON-SITE MONITORING LOCATIONS

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:
EXISTING GROUND CONTOURS AND TOPOGRAPHIC FEATURES SHOWN ARE BASED ON TERVITA AS-BUILT FOR FINAL CONDITIONS FOR STAGE 2A, 2B AND STAGE 3A, AND NORTH CLAY STOCKPILE SURVEY BY VAN NOSTRAND AND GIBSON SURVEYED JULY-17-2013

Project Manager:	Reviewed By:	Date:	
G. FERRARO	R. MORGAN	AUGUST 2014	
Scale: 1:1000	Project №: 18235-72	Report №: WELD037	Drawing №: figure 1B

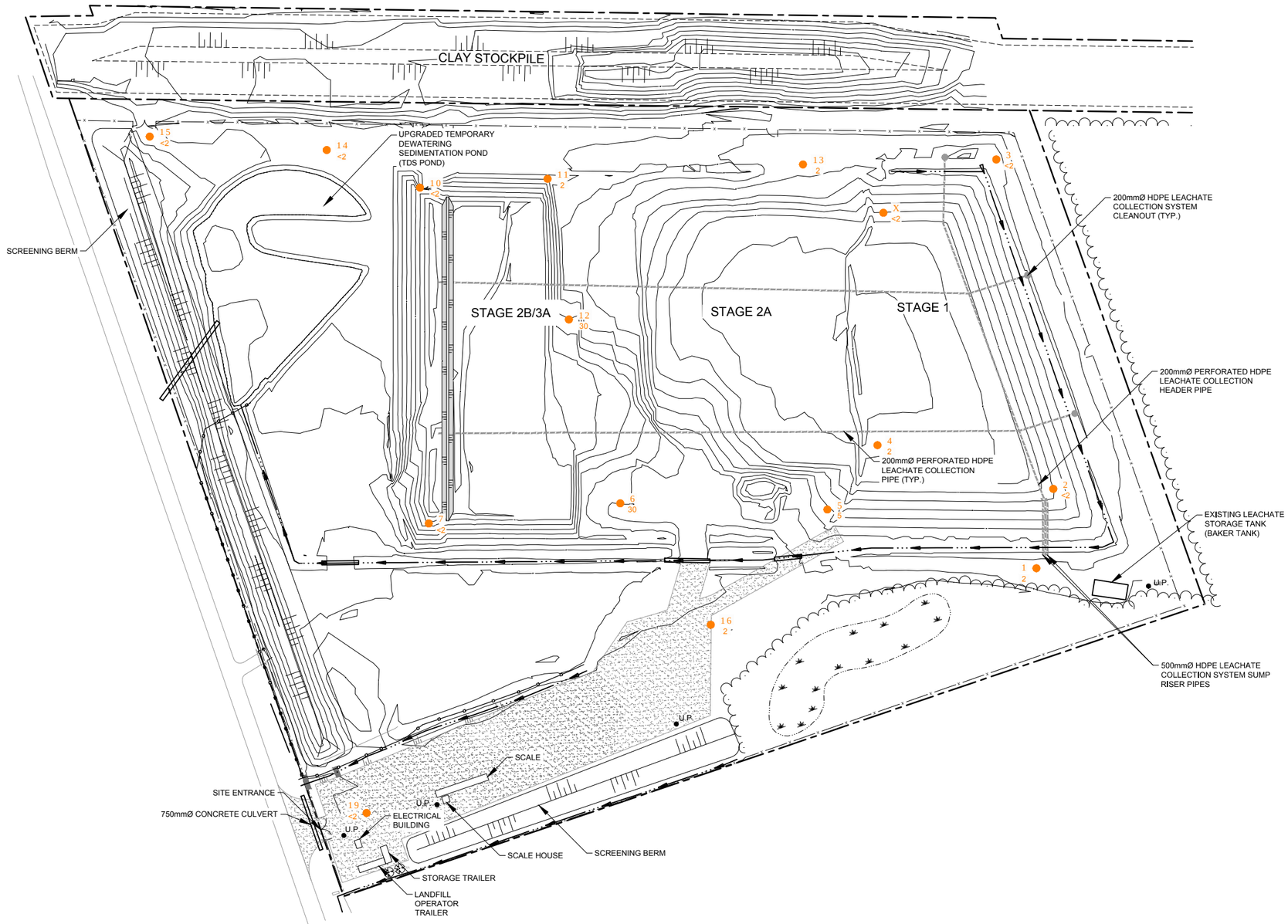


SOURCE: MINISTRY OF NATURAL RESOURCES
SHEETS: 10 17 5900 47550 & 10 17 5950 47550

figure 2A

AUGUST 7, 2014 ODOUR MONITORING (OFF-SITE)
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

18235-72(WELD037)GN-WA003 AUG 12/2014



0 10 20 30m

LEGEND:

- GROUND CONTOUR AT 1.0m INTERVAL
- 192.0 GROUND CONTOUR AT 2.0m INTERVAL
- PROPERTY LINE
- FENCELINE
- EDGE OF PONDED WATER
- CLAY STOCKPILE AREA
- SILT FENCE
- LEACHATE COLLECTION SYSTEM PIPING
- DRAINAGE DITCH
- SWAMPY AREA
- TEMPORARY DIVIDER BERM
- ROADWAY
- TREELINE
- U.P. UTILITY POLE
- CULVERT
- CHECK DAM
- DOUBLE GATE
- SINGLE GATE
- 1 / <2 MONITORING LOCATION 6:35-8:00 am / SAMPLE RESULT (OU)

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

BROOKS ROAD LANDFILL SITE
CAYUGA, ONTARIO

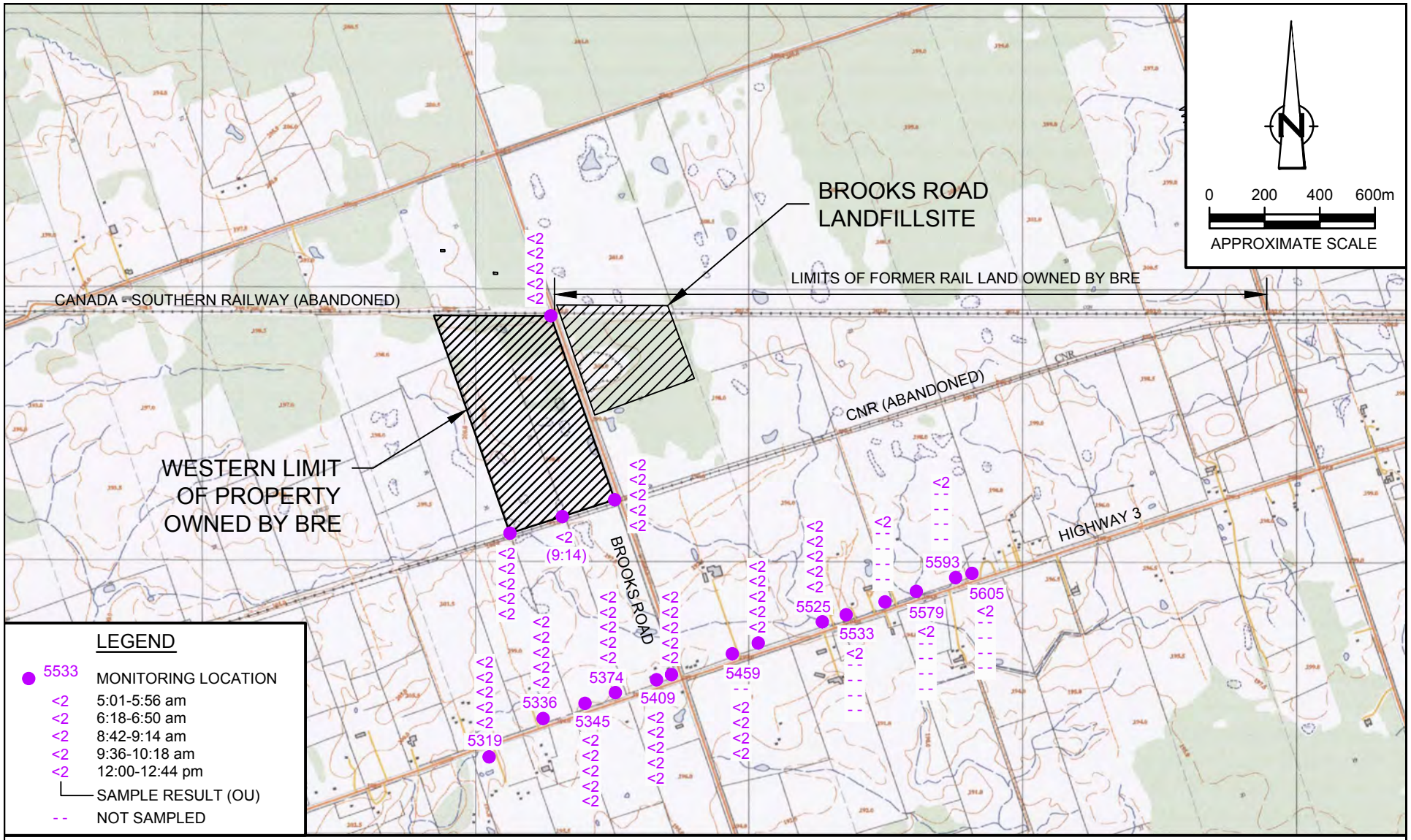
AUGUST 7, 2014 ODOUR MONITORING (ON-SITE)

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:
EXISTING GROUND CONTOURS AND TOPOGRAPHIC FEATURES SHOWN ARE BASED ON TERVITA AS-BUILT FOR FINAL CONDITIONS FOR STAGE 2A, 2B AND STAGE 3A, AND NORTH CLAY STOCKPILE SURVEY BY VAN NOSTRAND AND GIBSON SURVEYED JULY-17-2013

Project Manager:	Reviewed By:	Date:	
G. FERRARO	R. MORGAN	AUGUST 2014	
Scale: 1:1000	Project N°: 18235-72	Report N°: WELD037	Drawing N°: figure 2B

18235-72(WELD037)GN-WA004 AUG 12/2014

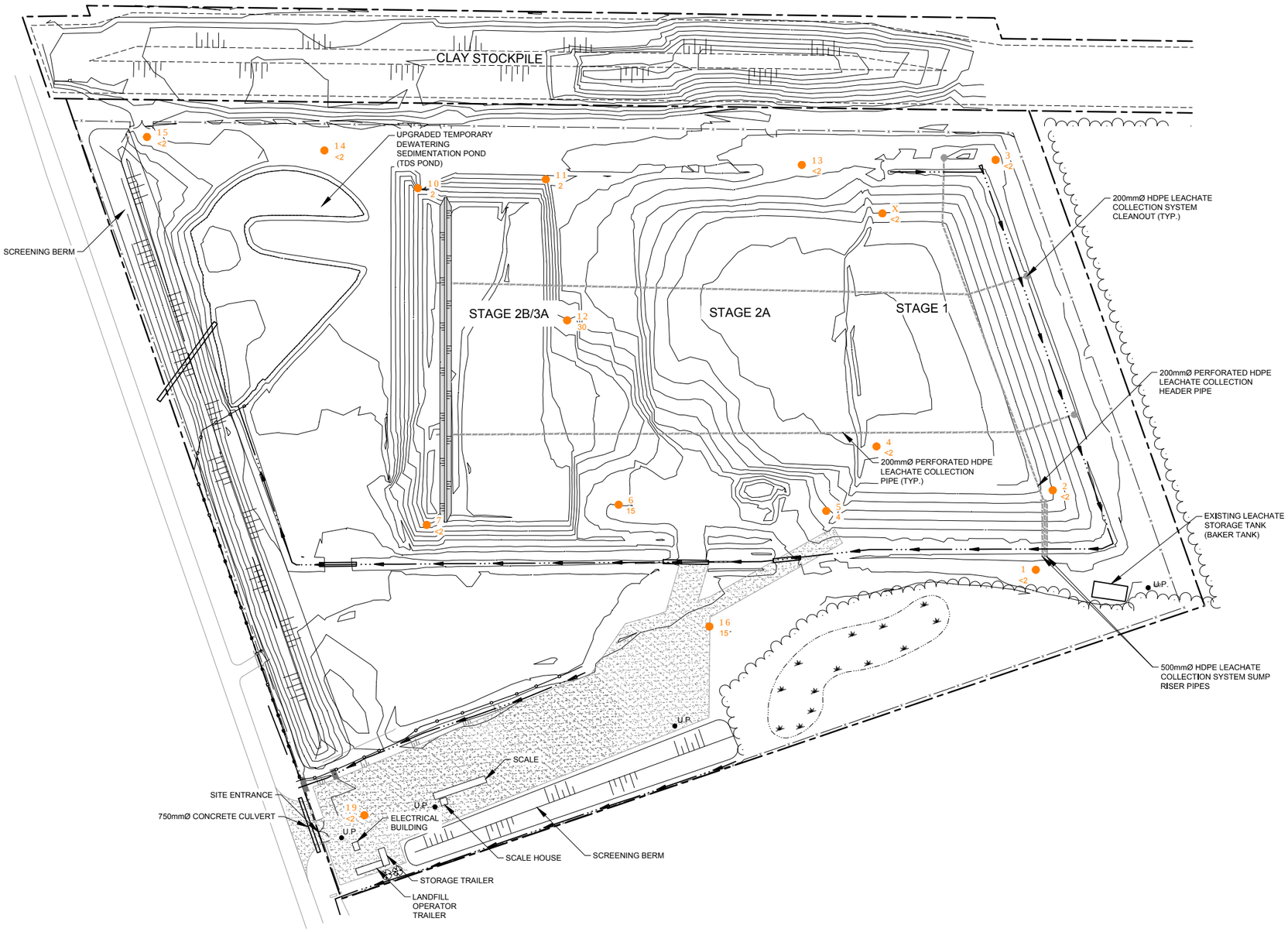


SOURCE: MINISTRY OF NATURAL RESOURCES
SHEETS: 10 17 5900 47550 & 10 17 5950 47550

figure 3A

AUGUST 8, 2014 ODOUR MONITORING (OFF-SITE)
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

18235-72(WELD037)GN-WA005 AUG 12/2014



0 10 20 30m

LEGEND:

- GROUND CONTOUR AT 1.0m INTERVAL
- 192.0 GROUND CONTOUR AT 2.0m INTERVAL
- PROPERTY LINE
- FENCELINE
- EDGE OF PONDED WATER
- CLAY STOCKPILE AREA
- SILT FENCE
- LEACHATE COLLECTION SYSTEM PIPING
- DRAINAGE DITCH
- SWAMPY AREA
- TEMPORARY DIVIDER BERM
- ROADWAY
- TREELINE
- U.P. UTILITY POLE
- CULVERT
- CHECK DAM
- DOUBLE GATE
- SINGLE GATE
- 1 <2 MONITORING LOCATION 7:12-8:15 am / SAMPLE RESULT (OU)

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

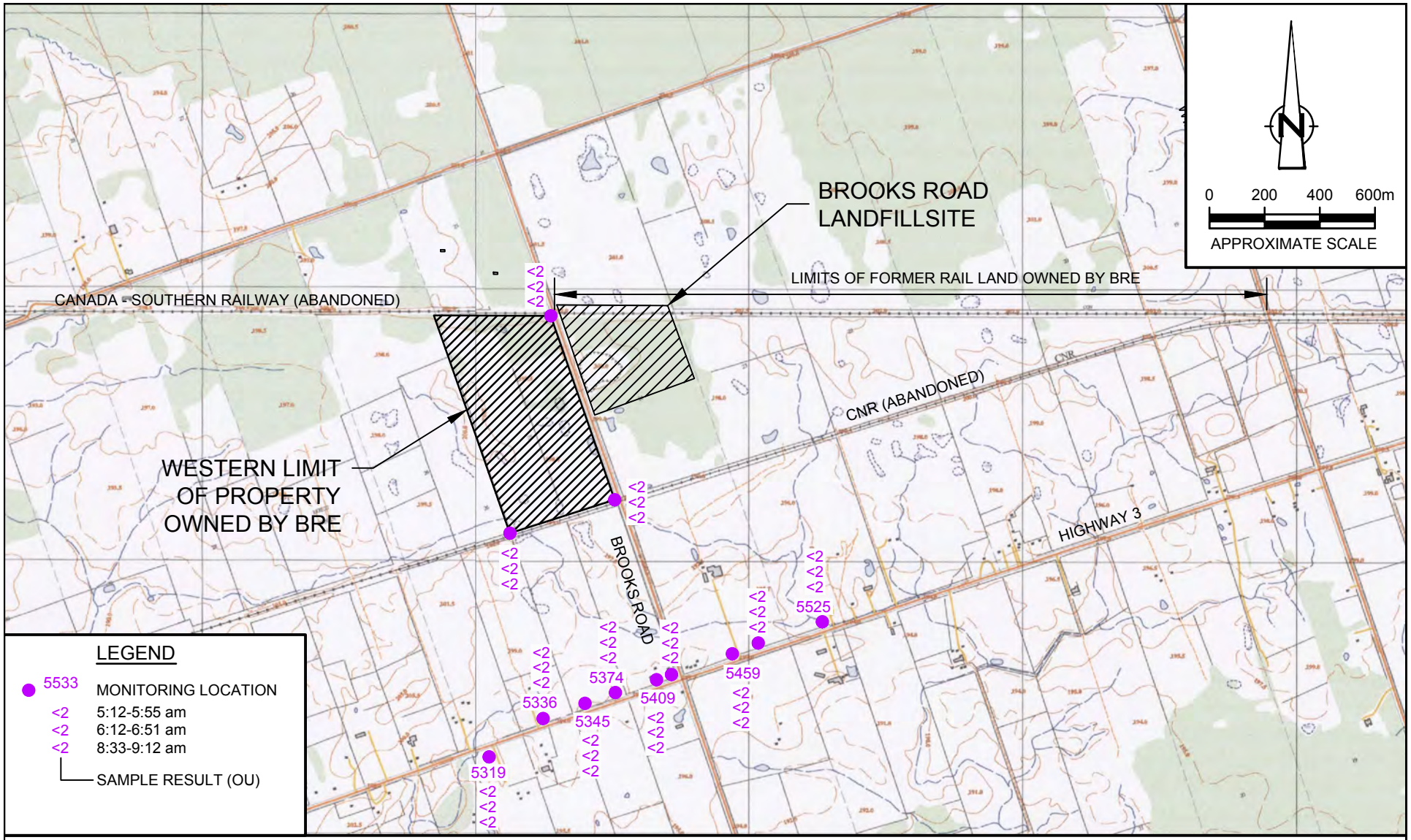
BROOKS ROAD LANDFILL SITE
CAYUGA, ONTARIO

AUGUST 8, 2014 ODOUR MONITORING (ON-SITE)

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:
EXISTING GROUND CONTOURS AND TOPOGRAPHIC FEATURES SHOWN ARE BASED ON TERVITA AS-BUILT FOR FINAL CONDITIONS FOR STAGE 2A, 2B AND STAGE 3A, AND NORTH CLAY STOCKPILE SURVEY BY VAN NOSTRAND AND GIBSON SURVEYED JULY-17-2013.

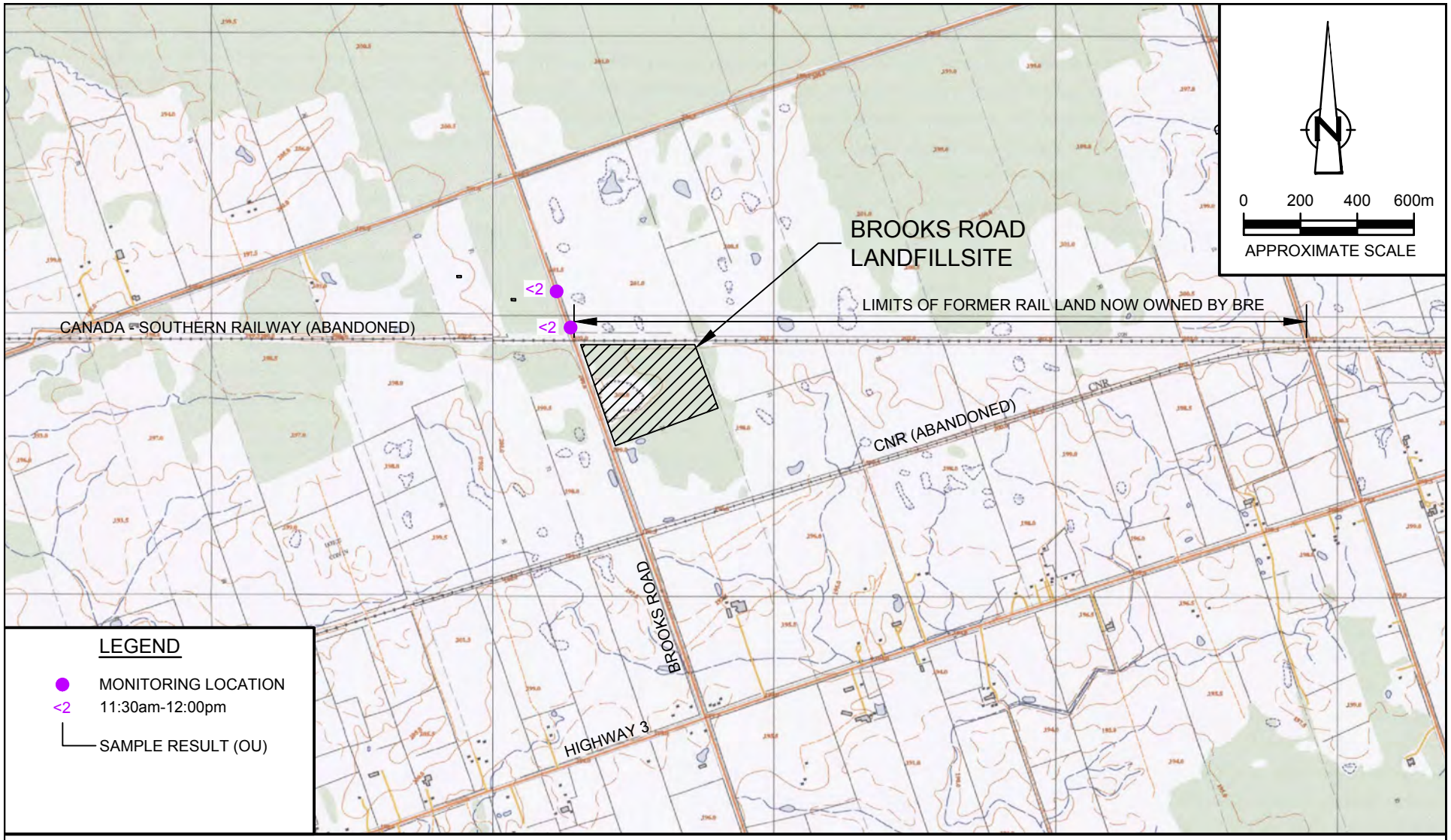
Project Manager:	Reviewed By:	Date:	
G. FERRARO	R. MORGAN	AUGUST 2014	
Scale: 1:1000	Project N°: 18235-72	Report N°: WELD037	Drawing N°: figure 3B



SOURCE: MINISTRY OF NATURAL RESOURCES
SHEETS: 10 17 5900 47550 & 10 17 5950 47550

figure 4

AUGUST 9, 2014 ODOUR MONITORING (OFF-SITE)
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

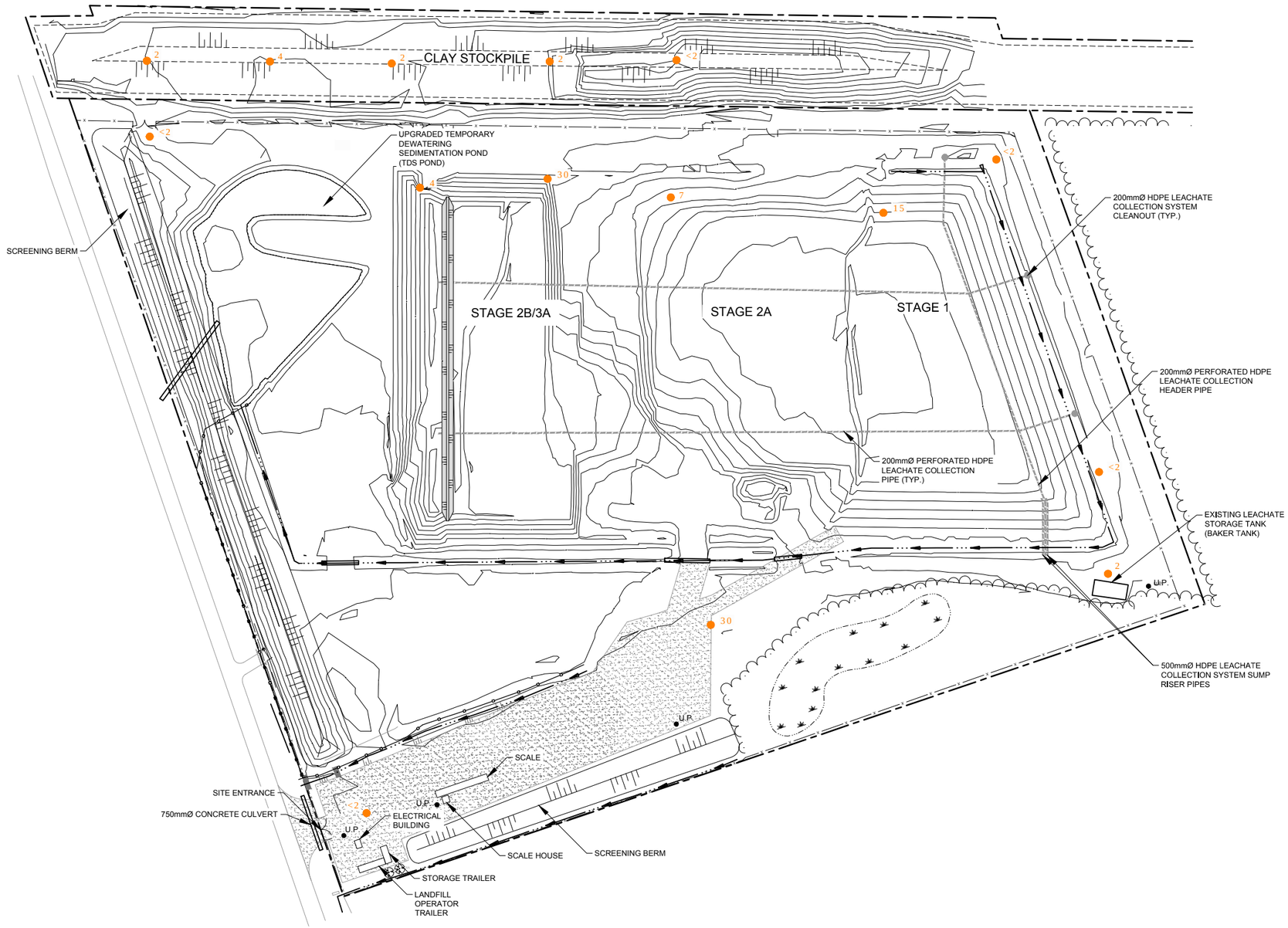


SOURCE: MINISTRY OF NATURAL RESOURCES
SHEETS: 10 17 5900 47550 & 10 17 5950 47550

figure 5A

SEPTEMBER 10, 2014 ODOUR MONITORING (OFF-SITE)
BROOKS ROAD LANDFILL
Cayuga, Ontario

18235-72(WELD037)GN-WA009 OCT 22/2014



0 10 20 30m

LEGEND:

- GROUND CONTOUR AT 1.0m INTERVAL
- 192.0 GROUND CONTOUR AT 2.0m INTERVAL
- PROPERTY LINE
- FENCELINE
- EDGE OF PONDED WATER
- CLAY STOCKPILE AREA
- SILT FENCE
- LEACHATE COLLECTION SYSTEM PIPING
- DRAINAGE DITCH
- SWAMPY AREA
- TEMPORARY DIVIDER BERM
- ROADWAY
- TREELINE
- U.P. UTILITY POLE
- CULVERT
- CHECK DAM
- DOUBLE GATE
- SINGLE GATE
- 1 MONITORING LOCATION

SCALE VERIFICATION

THIS BAR MEASURES 50mm ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

Status	Date	Initial

BROOKS ROAD LANDFILL SITE
CAYUGA, ONTARIO

SEPT. 10, 2014 ODOUR MONITORING (ON-SITE)

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:
EXISTING GROUND CONTOURS AND TOPOGRAPHIC FEATURES SHOWN ARE BASED ON TERVITA AS-BUILT FOR FINAL CONDITIONS FOR STAGE 2A, 2B AND STAGE 3A, AND NORTH CLAY STOCKPILE SURVEY BY VAN NOSTRAND AND GIBSON SURVEYED JULY-17-2013

Project Manager:	Reviewed By:	Date:	
G. FERRARO	R. MORGAN	SEPTEMBER 2014	
Scale: 1:1000	Project N°: 18235-72	Report N°: WELD037	Drawing N°: figure 5B

TABLE 1

SUMMARY OF OFF-SITE ODOUR MONITORING
BROOKS ROAD LANDFILL
CAYUGA, ONTARIO

Sample Location		*7-Aug-14 (ou)*			*8-Aug-14 (ou)*					*9-Aug-14 (ou)*			*10-Sep-14 (ou)*
		4:45-5:08	*6:05-6:30*	*9:00-8:50*	*5:01-5:56*	*6:18-6:50*	*8:42-9:14*	*9:36-10:18*	*12:00-12:44*	*5:12-5:55*	*6:12-6:57*	*8:33-9:12*	*11:30-12:00*
Highway 3 - Addresses													
Off-Site	5605	< 2	< 2	< 2	< 2	-	-	-	-	-	-	-	-
Off-Site	5593	< 2	< 2	< 2	< 2	-	-	-	-	-	-	-	-
Off-Site	5579	< 2	< 2	< 2	< 2	-	-	-	-	-	-	-	-
Off-Site	5579-5533	< 2	< 2	< 2	< 2	-	-	-	-	-	-	-	-
Off-Site	5533	< 2	< 2	< 2	< 2	-	-	-	-	-	-	-	-
Off-Site	5525	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-
Off-Site	5525-5459	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-
Off-Site	Highway 3 & Brooks Rd	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-
Off-Site	5409	-	-	-	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-
Off-Site	5374	-	-	-	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-
Off-Site	5345	-	-	-	< 2	< 2	< 2 (1)	< 2	< 2	< 2 (1)	< 2	< 2	-
Off-Site	5336	-	-	-	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-
Off-Site	5319	< 2	< 2	< 2	< 2	< 2	< 2	< 2 (2)	< 2 (2)	< 2 (2)	< 2 (2)	< 2	-
Property West of BRE													
Off-Site	Southeast Corner	-	-	< 2	< 2	< 2	< 2 (1)	< 2	< 2	< 2 (1)	< 2	< 2	-
Off-Site	Southwest Corner	-	-	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-
Off-Site	Northeast Corner	-	-	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-
Off-Site	Southeast-Southwest Boundary	-	-	-	-	-	< 2 (1)	-	-	-	-	-	-
Brooks Road North West of BRE													
Off-Site	BR1	-	-	-	-	-	-	-	-	-	-	-	< 2
Off-Site	BR2	-	-	-	-	-	-	-	-	-	-	-	< 2

Notes:

ou - odour units
'-' no data monitored at these locations due to unfavourable wind conditions.
(1) Odour with a similar characteristic to BRE detected very briefly in low concentrations.
(2) 'Burnt wood' odour with detected very briefly in low concentrations.

TABLE 2

SUMMARY OF ON-SITE ODOUR MONITORING
BROOKS ROAD LANDFILL
CAYUGA, ONTARIO

Sample Location		*7-Aug-14 (ou)*	*8-Aug-14 (ou)*	*10-Sep-14 (ou)*
On-Site	1	2	< 2	2
On-Site	2	< 2	< 2	< 2
On-Site	3	< 2	< 2	< 2
On-Site	X	< 2	< 2	15
On-Site	4	2	< 2	-
On-Site	5	2	4	-
On-Site	6	30	15	-
On-Site	7	< 2	< 2	-
On-Site	8	-	-	-
On-Site	9	-	-	-
On-Site	10	< 2	2	4
On-Site	11	2	2	30
On-Site	12	30	30	-
On-Site	13	2	< 2	-
On-Site	14	< 2	< 2	-
On-Site	15	< 2	< 2	< 2
On-Site	16	2	15	30
On-Site	17	-	-	< 2
On-Site	18	-	-	-
On-Site	19	< 2	< 2	< 2
On-Site	20	-	-	2
On-Site	21	-	-	4
On-Site	22	-	-	2
On-Site	23	-	-	2
On-Site	24	-	-	7
Average On-Site		6	6	7
Minimum On-Site		< 2	< 2	< 2
Maximum On-Site		30	30	30

Notes:

ou - odour units
'-' no data could be collected due to current operations at the landfill.

Attachment A

018235

NASAL RANGER

On-Site

Date: 8/7/2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
6:35	1						X		507	
6:39	2							X	506/507	
6:42	3							X	506	
6:47	4						X		506	
6:48	5						X		506	
6:50	6		X						507	
7:29	7							X	506	
—	~~8~~									
—	~~9~~									
7:43	10							X		
7:45	11						X		506/507	
7:32	12		X						507	
7:48	13						X		506/507	
7:42	14							X		
7:40	15							X		
7:52	16						X		507	
—	~~17~~									
—	~~18~~									
8:00	19							X		
6:45	~~20~~ X							X	506	

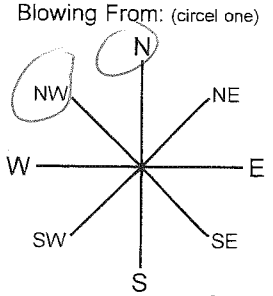
Weather Conditions

Precipitation:

- ☐ Sunny
- ☒ Partly Cloudy
- ☐ Mostly Cloudy
- ☐ Overcast
- ☐ Hazy

- ☐ None
- ☐ Fog
- ☐ Rain
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☒ Calm
- ☐ Light Breeze (1-5 mph)
- ☐ Moderate Wind (5-15 mph)
- ☐ Strong Winds (15 or higher mph)

Temperature: 12 °F/°C

Relative Humidity: 82 %

Barometric Pressure: 101.7 kPa

Comments: _____

Code

Rob Morgan
Name

Signature

018235

Highway 3 Locations

NASAL RANGER

Date: 8/7/2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
4:45	5605							X		No odour
	5593							X		"
	5579							X		"
4:50										
	Between 5579-5533							X		"
	5533							X		"
4:59	5525							X		"
	Directly SE of landfill							X		"
5:06	Corner Highway 3 + Brooks Rd.							X		"
5:08	5319							X		"
6:05	5605							X		No odour
	5593							X		"
	5579							X		"
6:11	Between 5579-5533							X		"
	5533							X		"
6:14	5525							X		"
	Directly SE of landfill							X		"
6:19	Corner Highway 3 + Brooks Rd							X		"
6:30	5319							X		"

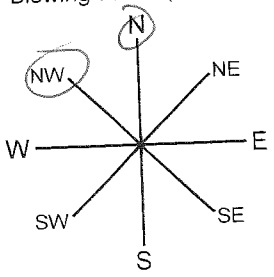
Weather Conditions

- ☐ Sunny
- ☒ Partly Cloudy
- ☐ Mostly Cloudy
- ☐ Overcast
- ☐ Hazy

Precipitation:

- ☐ None
- ☐ Fog
- ☐ Rain
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☒ Calm
- ☐ Light Breeze (1-5 mph)
- ☐ Moderate Wind (5-15 mph)
- ☐ Strong Winds (15 or higher mph)

Temperature: 12 °F/(°C)

Relative Humidity: 82 %

Barometric Pressure: 101.7 kpa

Comments:

Code

Rob Morgan
Name

Signature

016235

NASAL RANGER

Date: 8/7/2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
9:00	5605							X		No Odour
	5593							X		"
	5579							X		"
	Between 5579-5533							X		"
	5533							X		"
	5525							X		"
	Directly SE of Landfill							X		"
	Corner Highway 3 & Brooks Rd							X		"
9:20	5319							X		"
	Western BRC Property									
8:51	SE Corner							X		No Odour
8:40	SW Corner							X		"
8:50	NE Corner							X		"

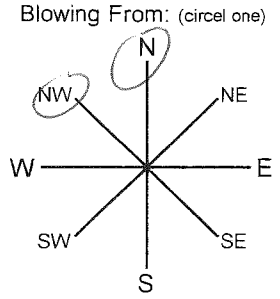
Weather Conditions

- [ ] Sunny
- [X] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [ ] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [X] Calm
- [ ] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 15 °F/°C Relative Humidity: 87 % Barometric Pressure: 101.8 Kpa

Comments: _____

Code	Name	Signature
	Rob Morgan	

018235

NASAL RANGER

OFF-Site

Date: 8/8/2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
5:01	5605							X		No odour
5:05	5593							X		"
	5579							X		"
	Between 5579 - 5533							X		"
5:16	5533							X		"
	5525							X		"
5:20	Directly SE of landfill							X		"
5:23	Corner Highway 3 + Brooks							X		"
	5409							X		"
5:26	5374 (North side)							X		"
	5345							X		"
5:30	5336 (north side)							X		"
5:34	5319							X		"
	Property West of RAE									
5:38	SE corner							X		No odour
5:51	SW corner							X		"
5:56	NE corner							X		"

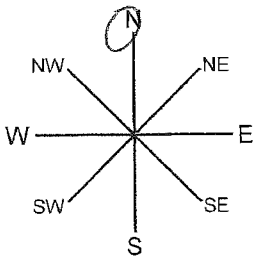
Weather Conditions

- ☐ Sunny
- ☐ Partly Cloudy
- ☐ Mostly Cloudy
- ☐ Overcast
- ☐ Hazy

Precipitation:

- ☒ None
- ☐ Fog
- ☐ Rain
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☒ Calm
- ☐ Light Breeze (1-5 mph)
- ☐ Moderate Wind (5-15 mph)
- ☐ Strong Winds (15 or higher mph)

Temperature: 16 °F/(°C) Relative Humidity: ____% Barometric Pressure: ____

Comments: _____

Code _____ Name Rob Morgan Signature _____

0182235

NASAL RANGER

Off-site

Date: 8/8/2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
6:18	5525							X		No odour
	~~Dorothy Schoolfield~~									"
6:25	Corner Highway 3 + Brooks							X		"
6:26	5409							X		"
	5374 (north side)							X		"
	5345							X		"
	5336 (north side)							X		"
6:34	5319							X		"
6:21	Between 5525 - 5459							X		"
6:22	5459							X		"
	Property west of BRE									
6:38	SE Corner							X		No Odour
	SW corner							X		"
6:50	NE corner									"

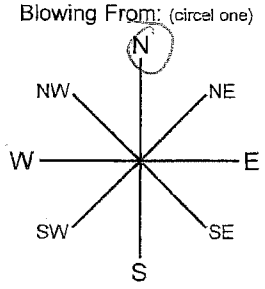
Weather Conditions

- ☐ Sunny
- ☒ Partly Cloudy
- ☐ Mostly Cloudy
- ☐ Overcast
- ☐ Hazy

Precipitation:

- ☒ None
- ☐ Fog
- ☐ Rain
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☐ Calm
- ☒ Light Breeze (1-5 mph)
- ☐ Moderate Wind (5-15 mph)
- ☐ Strong Winds (15 or higher mph)

Temperature: 16 °F/(C) Relative Humidity: ____% Barometric Pressure: ____

Comments: _____

Code _____ Name Rob Morgan Signature _____

NASAL RANGER

On-site

Date: 8/8/2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
7:12	1							X	507/506	
7:17	2							X	507 (mild)	
7:21	3							X	506	
7:24	4							X	506 (mild)	
7:29	5					X		X	506/507	
7:34	6			X					506/507	
7:40	7							X	506	
	8									
	X									
7:50	10						X		506/507	
7:52	11						X		506/507	
7:58	12		X					X	506/507	
7:55	13							X		
7:48	14							X		
7:45	15							X		
8:11	16			X					507	
	17									
	18									
8:15	19							X	506/507	
7:22	X							X	506 (mild)	

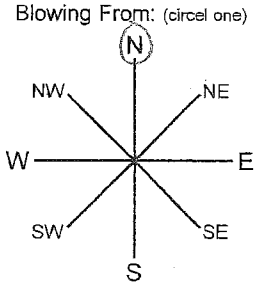
Weather Conditions

- [X] Sunny
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [X] Calm
- [X] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 18 °F/°C Relative Humidity: ____% Barometric Pressure: ____

Comments: _____

Code _____ Name Rob Morgan Signature _____

NASAL RANGER

OFF-Site

Date: 8/8/2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
8:42	5525							X		No Odour
8:44	Between 5525 - 5459							X		"
	5459							X		"
	Corner Highway 3 + Banks							X		"
8:48	5409							X		"
	5374 (north side)							X		"
8:54	5345							X	~507	very briefly caught odour & gone within a minute
8:55	5336 (north side)							X		No Odour
9:00	5319							X		No odour
	Property West of BRC									
9:05	SE Corner							X	~507	*
9:12	SW Corner							X		No Odour
9:24	NE Corner							X		"
9:14	Between SE + SW							X	~507	*

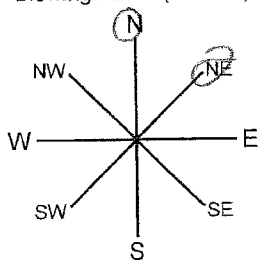
Weather Conditions

- ☐ Sunny
- ☐ Partly Cloudy
- ☐ Mostly Cloudy
- ☐ Overcast
- ☐ Hazy

Precipitation:

- ☐ None
- ☐ Fog
- ☐ Rain
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☐ Calm
- ☐ Light Breeze (1-5 mph)
- ☐ Moderate Wind (5-15 mph)
- ☐ Strong Winds (15 or higher mph)

Temperature:____°F/°C Relative Humidity:____% Barometric Pressure:____

Comments: _____

Code _____ Name Rob Morgan Signature _____

NASAL RANGER

Off-Site

Date: August 9 2004

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
5:12	5525							X		No odour
5:15	Between 5525 - 5549							X		No odour
	5459							X		"
5:20	Corner highway 3 and Bridge							X		"
	5409							X		"
5:23	5379 (North Side)							X		"
	5345							X		Very faint sewage odour
5:29	5336 (North side)							X		No odour
5:32	5319							X	~40	Not landfill
	Property West of 5319									
5:40	SE Corner							X	~50?	Briefly faint odour
5:47	SW Corner							X		No odour
5:55	NE Corner							X		"

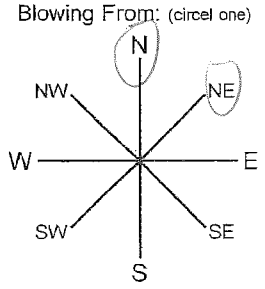
Weather Conditions

- [X] Sunny
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [X] Calm
- [ ] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: _____ °F/°C Relative Humidity: _____ % Barometric Pressure: _____

Comments: _____

Code _____ Name _____ Signature _____

NASAL RANGER

Off-Site

Date: August 9/04

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
8:33	5525							X		No odour
	Between 5525-5459							X		"
8:38	5459							X		"
	Corner Highway 3 and Rocky							X		"
8:42	5409							X		"
	5374 (North Side)							X		"
8:46	5345							X		"
	5330 (North Side)							X		"
8:52	5319							X		"
	Property West of BPE									
8:56	SE corner							X		No odour
9:03	SW corner							X		"
9:12	NE corner							X		"

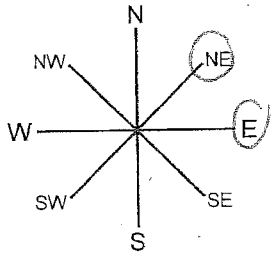
Weather Conditions

- [X] Sunny
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [ ] Calm
- [X] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature:____°F/°C Relative Humidity:____% Barometric Pressure:____

Comments: _____

Code Name Signature

NASAL RANGER

OFF - Site

Date: August 8th

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
9:36	5525							X		No odour
9:38	Between 5525 - 5459							X		No odour
9:40	5459							X		"
9:42	Corner Highway 3 & Brooks							X		"
9:43	5409							X		"
	5374 (north side)							X		"
	5345							X		"
9:55	5336 (north side)							X		
9:50	5319							X	~40	Not landfill
	Property West of BRE									
10:00	SE corner							X		No odour
10:10	SW corner							X		"
10:18	NE corner							X		"

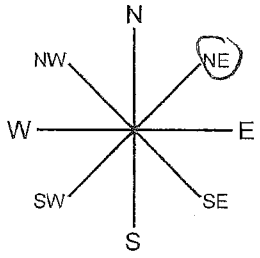
Weather Conditions

- [ ] Sunny
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [X] Calm
- [ ] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature:____°F/°C Relative Humidity:____% Barometric Pressure:____

Comments: _____

Code Name Signature

NASAL RANGER

Off-Site

Date: August 8 2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
12:00	5525							X		None odor
	Between 5525-5459							X		~~None~~ No odor
12:06	5459							X		"
	Corner Highway 3 and Oaks							X		"
12:10	5409							X		"
	5374 (North side)							X		"
12:15	5345							X		"
	5336 (North side)							X	~~NW~~ SW	"
12:23	5319							X	~NW	Nat Landfill
	Property West of BRB									
12:28	SE corner							X		No odor
12:36	SW corner							X		"
12:44	NE corner							X		"

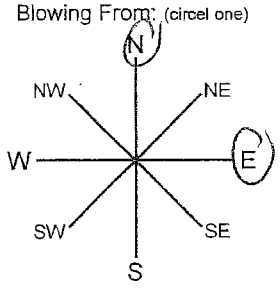
Weather Conditions

- [X] Sunny
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circle one)



Wind Speed:

- [X] Calm
- [X] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: ____ °F/°C Relative Humidity: ____ % Barometric Pressure: ____

Comments: _____

Code _____ Name _____ Signature _____

NASAL RANGER

Date: August 9th 04

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
6:12	5525							X		W. odour
	Between 5525-5549							X		"
6:16	5459							X		"
	Corner Halkway 3 and Brooks							X		"
6:20	5409							X		"
~~6:30~~	5374 (North side)							X		"
6:24	5345							X		"
	5336 (North side)							X		"
6:30	5319							X	-40	Wet land area
	Property West of BRE									
6:36	SE Corner							X		No odour
6:43	SW Corner							X		"
6:57	NE Corner							X		"

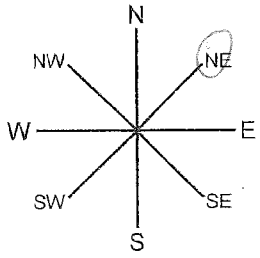
Weather Conditions

- [X] Sunny
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [X] Calm
- [ ] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature:____°F/°C Relative Humidity:____% Barometric Pressure:____

Comments: _____

Code Name Signature

98235

NASAL RANGER

On-Site

Date: 9/10/2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
11:00	1						X		S06/S07	
	2							X	"	
	3							X	"	
	X			X					"	
	10					X			"	
	11		X						"	
	15							X	"	
	16		X						"	
	17							X	"	
	19							X	"	
	20						X		"	
	21					X			"	
	22						X		"	
	23						X		"	
11:55	24				X				"	

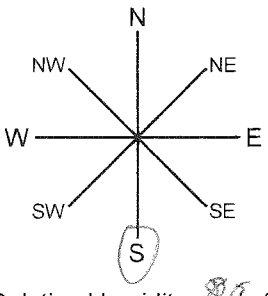
Weather Conditions

- ☐ Sunny
- ☐ Partly Cloudy
- ☐ Mostly Cloudy
- ☒ Overcast
- ☐ Hazy

Precipitation:

- ☐ None
- ☐ Fog
- ☐ Rain
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☐ Calm
- ☐ Light Breeze (1-5 mph)
- ☒ Moderate Wind (5-15 mph)
- ☐ Strong Winds (15 or higher mph)

Temperature: 22 °F/(°C) Relative Humidity: 80 % Barometric Pressure: 98.5

Comments: _____

Code: _____ Name: Rick Morgan Signature: _____

018235

NASAL RANGER

Off-Site

Date: 9/10/2014

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
12:15	BR1							X	727	
12:30	BR2							X	722	

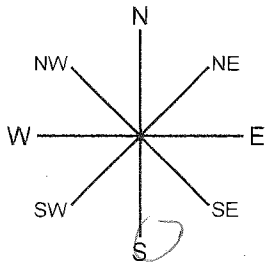
Weather Conditions

Precipitation:

- ☐ Sunny
- ☐ Partly Cloudy
- ☐ Mostly Cloudy
- ☒ Overcast
- ☐ Hazy

- ☐ None
- ☐ Fog
- ☐ Rain
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☐ Calm
- ☐ Light Breeze (1-5 mph)
- ☒ Moderate Wind (5-15 mph)
- ☐ Strong Winds (15 or higher mph)

Temperature: 22 °F/°C Relative Humidity: 50 % Barometric Pressure: 98.5

Comments: _____

Code	Name	Signature
	Rob Morgan	

December 9, 2016 Reference No. 018235

Mr. Richard Weldon
Brooks Road Environmental
c/o 2270386 Ontario Limited
160 Brooks Road, R.R. #5
Cayuga, Ontario
N0A 1E0

Dear Mr. Weldon:

Re: Odour Monitoring Program
Brooks Road Landfill Site, Cayuga, Ontario

1. Introduction

GHD Limited (GHD) was retained by Brooks Road Environmental c/o 2270386 Ontario Limited (BRE) to complete an ambient odour monitoring program (OMP) at the Brooks Road Landfill Site (Site) located in Cayuga, Ontario.

The OMP collected odour data in an effort to identify areas in the community potentially impacted by the Site and to determine conditions that may contribute to a potential odour impact.

This program was developed to assist BRE in determining the following information:

- Identification of potential odour sources at the Site
- Qualification and quantification of the odour from identified sources
- Odour monitoring at off-Site locations

The OMP was conducted by an Air Quality Expert on three nights in October 2016 (October 19/20, October 20/21, and October 27/28) in response to odour complaints received from residents located in the area surrounding the Site in Cayuga, Ontario.

2. Site Description

The Site is located at 160 Brooks Road in Cayuga, Ontario approximately 1 kilometre north of Kings Highway No. 3 (Talbot Road). The Site is legally described as Part of Lot 24, Concession I-N.T.R., Haldimand County.

The total Site area is approximately 14.3 hectares (ha) (35.3 acres) of which 6 ha (15 acres) is approved for landfilling.

The Site is bounded in the north by a rural property consisting of undeveloped fields (i.e., long-term inactive agricultural crop production lands) and forested areas. To the south and east of the Site is

undeveloped rural property consisting of a combination of fields and forested areas. The Site is bounded to the west by Brooks Road. On the west side of Brooks Road is an undeveloped rural property which is characterized primarily by undeveloped fields with occasional bush lots.

3. Odour Monitoring Program

Odour monitoring was completed during the Site visits using a Nasal Ranger™ field olfactometer. This is a proactive tool used to provide instant readings of odour at various locations. The Nasal Ranger has eight settings that allow the user to quantify odour concentrations ranging from two odour units (ou) to greater than 60 ou. For context, 1 ou is equal to a level of odour that would typically be detected by half of the people who are exposed to it i.e., it is at a very low level of odour.

In terms of operation, the olfactometer mixes a known volume of carbon filtered air with a known volume of ambient air to produce a dilution-to-threshold (D/T) ratio. The D/T ratio is defined as follows:

D T = Volume of Carbon Filtered Air/volume of odorous air

It should be noted that the odour unit value as measured by a field olfactometer, like the Nasal Ranger, are not directly comparable to odour data provided by an odour panel. The data from the Nasal Ranger does provide a good relative gauge to evaluate various odour concentrations.

The odour unit is a unit of measure, where 1 ou is defined as the concentration at which 50% of the population will detect the olfactory stimulus. At 1 ou an odour is detected but is generally not an adverse effect. There is no absolute guidance on odour values, like what is documented for specific chemical compounds, but generally 5 to 10 odour units is considered the annoyance level. The annoyance level is where complaints can occur.

4. Odour Monitoring

A brief walkthrough of the southern portion of the Site was performed each evening prior to off-Site monitoring to determine if on-Site odour could be identified. From previous monitoring studies the southern perimeter near the east above ground leachate storage tank is expected to be the location that may have the greatest contribution to any potential off-Site impact. The leachate treatment system is currently being commissioned and it is expected that continuous treatment capacity in this system will reduce odours from leachate at the Site and thus diminish an obvious odour source.

Off-Site monitoring locations have been selected based on sensitive receptors in the community.

The monitoring locations provided in Table 1 are shown on Figure 1.

Monitoring occurred over different temperature, wind speeds, and wind directions in the evening and morning hours. Monitoring was conducted over three different nights (October 19/20, October 20/21, and

October 27/28) to give an accurate assessment of the potential odour impacts during the nighttime hours while the Site was not operational.

The field data sheets for each Site visit are provided in Attachment A. The field data sheets provide the meteorological conditions, odour intensities, and qualifying descriptors.

5. Results & Observations

The on-Site odour monitoring was conducted at 10:00 p.m. on October 19 along the southern perimeter of the Site. The Air Quality Expert detected odour described as landfill leachate ranging from <2 ou to 15 ou. The odour originated from the east above ground leachate storage tank with the highest concentration detected at the western extent of Stage 2B/3A.

The October 19-20, 2016 monitoring event took place between 10:31 p.m. to 4:44 a.m. During this monitoring event the temperature was 12-14°C with calm wind speeds (4-5 km/hr) blowing predominantly from the southwest during the evening, moving from the east during early morning hours and then from the north-northeast. During the monitoring event no on-Site odour was detected by the Air Quality Expert at any off-Site monitoring locations as provided in Table 1 and on Figure 2.

During this monitoring event an odour complaint was registered from 249 Townline Road East (GHD monitoring location 14) at 11:00 p.m. GHD completed odour monitoring at location 14 at 11:01 p.m. and no odour was detected.

The on-Site odour monitoring was conducted at 10:00 p.m. on October 20 along the southern perimeter of the Site. The Air Quality Expert detected odour described as landfill leachate ranging from <2 ou to 4 ou. The odour originated from the east above ground leachate storage tank with the highest concentration detected at the front gate. It should be noted that 4 ou at the gate is less than the general annoyance level of 5 to 10 ou, which suggests minimal potential for disturbance off-Site.

The October 20-21, 2016 monitoring event took place between 10:24 p.m. to 4:34 a.m. During this monitoring event the temperature was 11°C with moderate wind speeds (16-20 km/hr) blowing predominantly from the north-northeast. During the monitoring event no on-Site odour was detected by the Air Quality Expert at any off-Site monitoring locations as provided in Table 2 and on Figure 3.

The on-Site odour monitoring was conducted at 10:00 p.m. on October 27 along the southern perimeter of the Site. The Air Quality Expert detected odour described as landfill leachate ranging from <2 ou to 2 ou. The odour originated from the east above ground leachate storage tank with the highest concentration detected at the middle of the southern perimeter of the Site. Again, this is lower than the general annoyance level of 5 to 10 ou.

The October 27-28, 2016 monitoring event took place between 10:32 p.m. to 4:26 a.m. During this monitoring event the temperature ranged from -1 to 2°C with moderate wind speeds (8-14 km/hr) blowing predominantly from the northwest. During the monitoring event no on-Site odour was detected by the Air Quality Expert at any off-Site monitoring locations as provided in Table 3 and on Figure 4.

6. Conclusions and Recommendations

The highest odour concentration detected on-Site was 15 ou. This concentration was detected at the western extent of Stage 2B/3A. The limited odour detected around the perimeter of the Site was a maximum of 4 ou. Odours at this concentration typically do not result in complaints at off-Site locations, and this odour concentration is an on-Site concentration. With the distance between the Site and the receptors it is expected that the 4 ou detected at the perimeter of the Site will be less at the receptors. The 4 ou at the Site property boundary is also less than the general annoyance level of 5 to 10 ou.

A 'burnt wood' odour was detected at an off-Site location on October 19, 2016 and October 27, 2016 in low concentrations (<2 ou), as presented in Figures 2 and 4. No on-Site activities would result in this type of off-Site odour.

The highest odour detected at the Site was described by the Air Quality Expert as landfill leachate. This would indicate that the odours during these observations are being emitted from exposed areas of the east above ground leachate storage tank.

In order to limit the potential for off-Site odour impacts, the following operational measures are recommended:

- Fully commission the leachate treatment system in order to reduce leachate storage volumes that may produce odour. Treatment to Environmental Compliance Approval limits will denature odorous compounds in leachate.
- Continue with the daily odour monitoring program established by BRE and carried out by the Site Operator.
- If odours are noted at the property boundary, increase the amount of daily cover applied on the waste.
- Minimize the active working face. Apply interim cover at a minimum thickness of 300 mm on areas of the landfill where landfilling has ceased for 6 months or more.
- Limit exposed areas of the leachate collection system and control passive odour emissions from the east above ground leachate storage tank.
- When not in use, ensure blind flanges are placed on leachate collection system cleanouts and sump risers.
- Investigate the sealing of leachate storage tanks to minimize odours generated during the handling of leachate.
- Continue with use of odour control granules for odour mitigation. Assess areas of placement and their effect on odour mitigation.

Should you have any questions on the above, please do not hesitate to contact us.

Yours truly,

GHD

Matthew Griffin, P. Eng.

RM/cb/46

Encl.

figure 1

ODOUR MONITORING LOCATIONS
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

18235-79(WELD046)GN-WA001 DEC 9, 2016

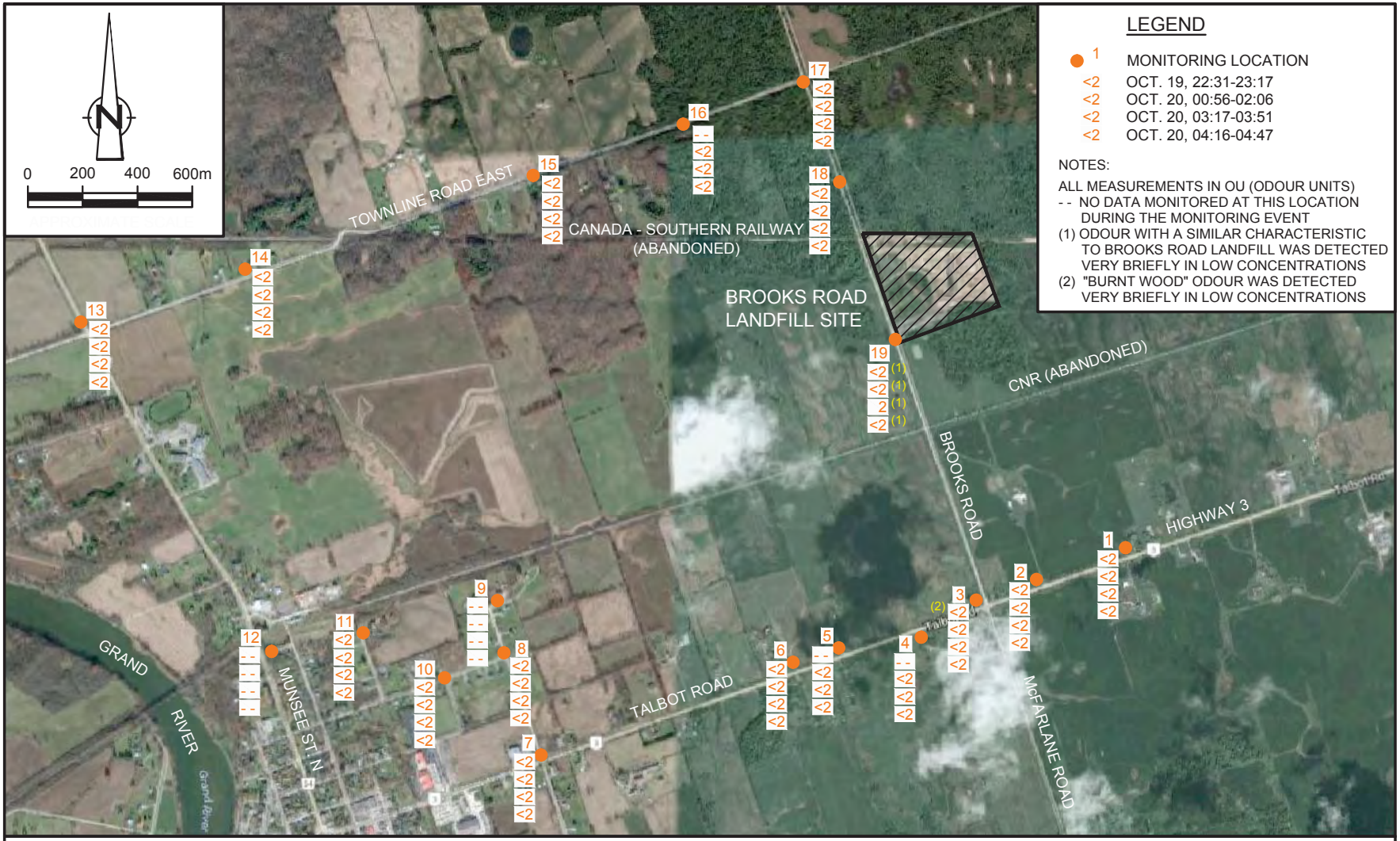


figure 2

OCTOBER 19-20, 2016 (EVENT #1) - ODOUR MONITORING LOCATIONS
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

GHD

18235-79(WELD046)GN-WA002 DEC 9, 2016

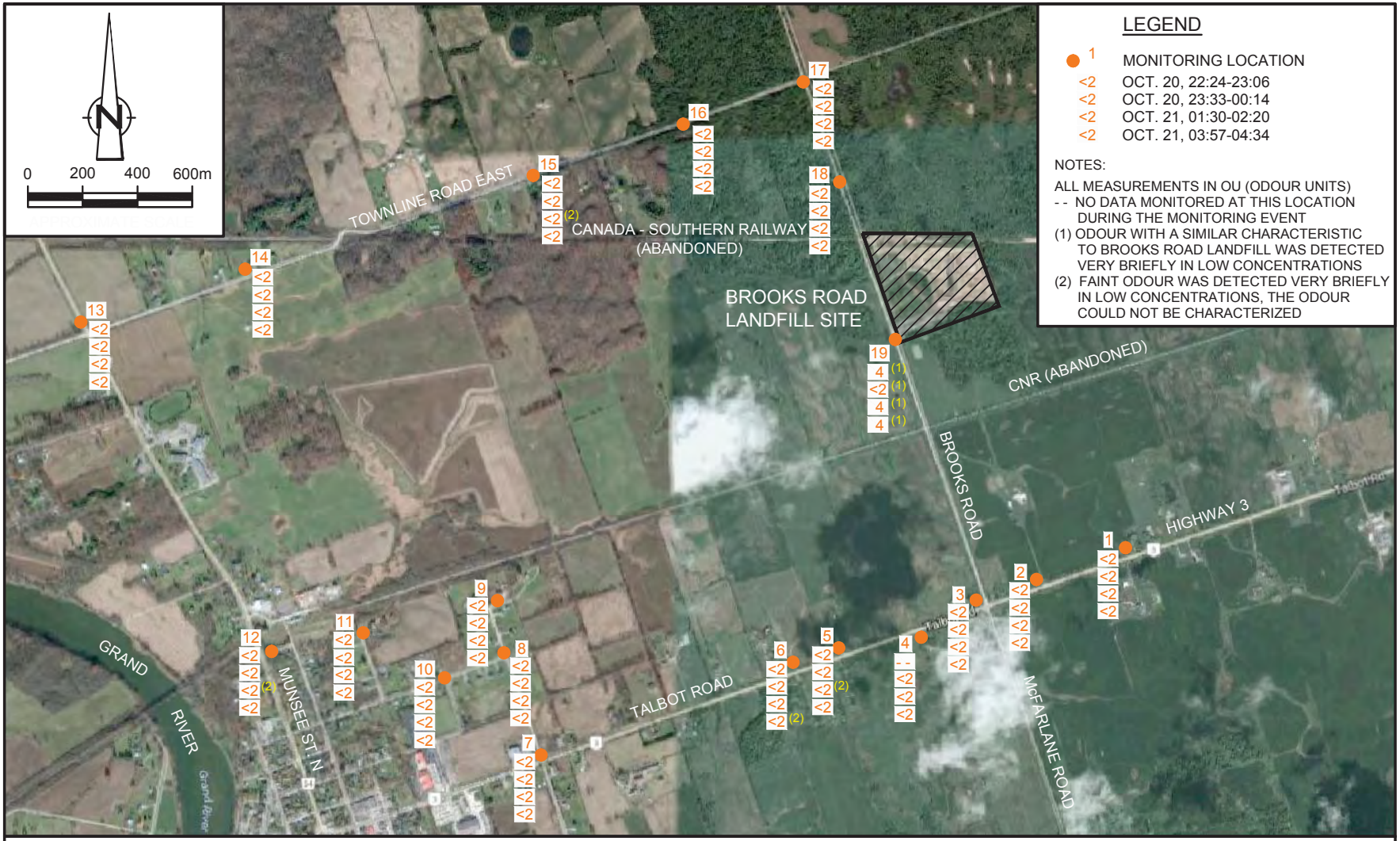


figure 3

OCTOBER 20-21, 2016 (EVENT #2) - ODOUR MONITORING LOCATIONS
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

GHD

18235-79(WELD046)GN-WA003 DEC 9, 2016

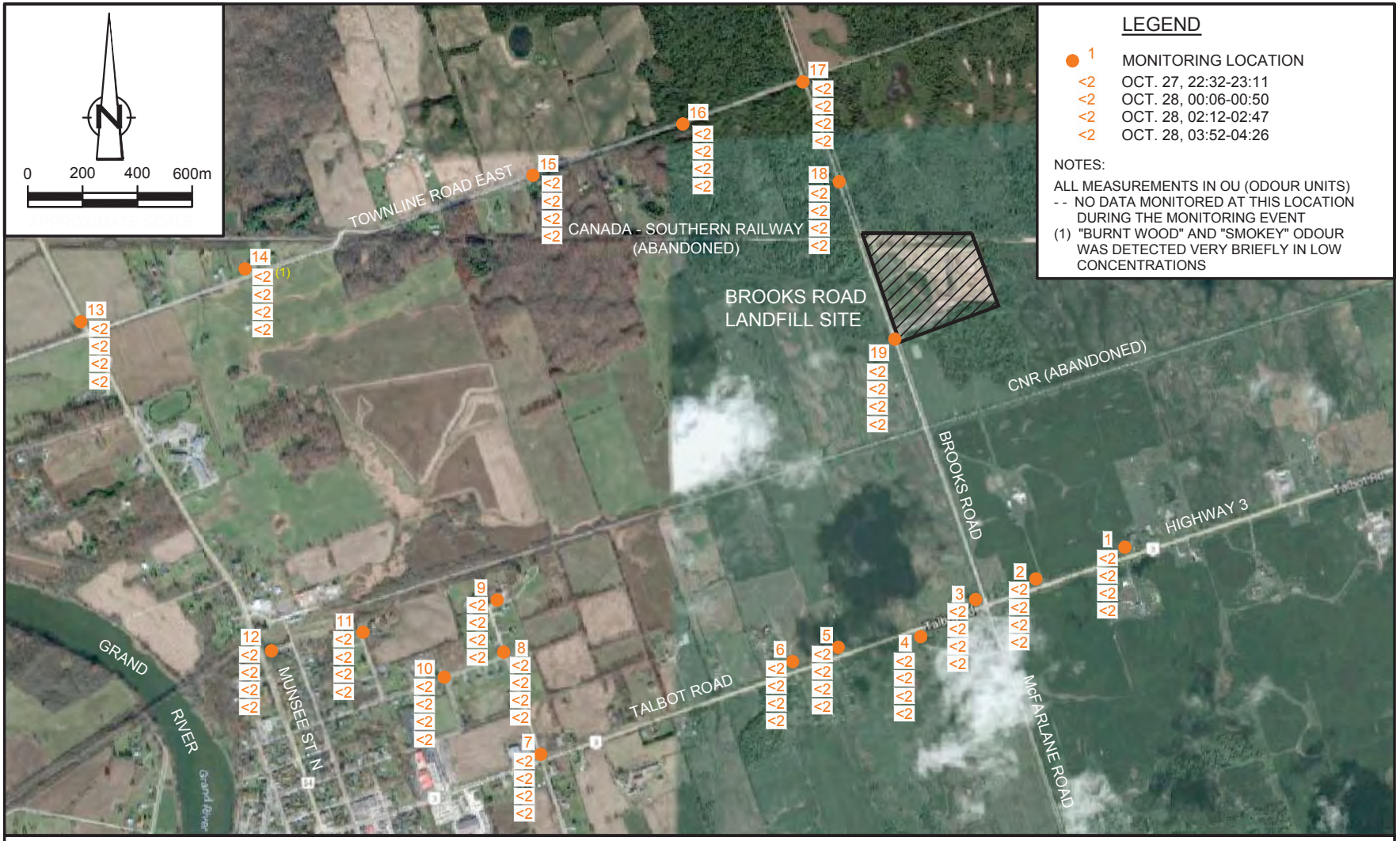


figure 4

OCTOBER 27-28, 2016 (EVENT #3) - ODOUR MONITORING LOCATIONS
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

18235-79(WELD046)GN-WA004 DEC 9, 2016

Table 1

Summary of Off-Site Odour Monitoring Event #1
Brooks Road Landfill
Cayuga, Ontario

Sample Location		19-Oct-16 (ou) 22:31 - 23:17	20-Oct-16 (ou) 00:56 - 02:06	20-Oct-16 (ou) 03:17 - 03:51	20-Oct-16 (ou) 04:16 - 04:47
ID	**Description**				
1	5525 Talbot Rd	< 2	< 2	< 2	< 2
2	5459 Talbot Rd	< 2	< 2	< 2	< 2
3	5409 Talbot Rd	< 2 (2)	< 2	< 2	< 2
4	5374 Talbot Rd	-	< 2	< 2	< 2
5	5345 Talbot Rd	-	< 2	< 2	< 2
6	5319 Talbot Rd	< 2	< 2	< 2	< 2
7	Montour St/Tablot Rd	< 2	< 2	< 2	< 2
8	Echo St E/Montour St	< 2	< 2	< 2	< 2
9	Montour St	-	-	-	-
10	Johnson St/Echo St	< 2	< 2	< 2	< 2
11	Fishcarrier St	< 2	< 2	< 2	< 2
12	Hill St	-	-		
13	Munsee St N/Townline Rd E	< 2	< 2	< 2	< 2
14	249 Townline Rd E	< 2	< 2	< 2	< 2
15	380 Townline Rd E	< 2	< 2	< 2	< 2
16	460 Townline Rd E	-	< 2	< 2	< 2
17	Townline Rd E/Brooks Rd	< 2	< 2	< 2	< 2
18	225 Brooks Rd	< 2	< 2	< 2	< 2
19	Brooks Road Landfill (Front Gate)	< 2 (1)	< 2 (1)	2 (1)	< 2 (1)

Notes:

ou - odour units
- no data monitored at this location during the monitoring event.
(1) Odour with a similar characteristic to Brooks Road Landfill detected very briefly in low concentrations.
(2) "Burnt Wood" odour with detected very briefly in low concentrations.

Table 2

Summary of Off-Site Odour Monitoring Event #2
Brooks Road Landfill
Cayuga, Ontario

Sample Location		20-Oct-16 (ou)	20-Oct-16 (ou)	21-Oct-16 (ou)	21-Oct-16 (ou)
		22:24 - 23:06	23:33 - '00:14	01:30 - '02:20	03:57 - 4:34
ID	Description				
1	5525 Talbot Rd	< 2	< 2	< 2	< 2
2	5459 Talbot Rd	< 2	< 2	< 2	< 2
3	5409 Talbot Rd	< 2	< 2	< 2	< 2
4	5374 Talbot Rd	-	< 2	< 2	< 2
5	5345 Talbot Rd	< 2	< 2	< 2 (2)	< 2
6	5319 Talbot Rd	< 2	< 2	< 2	< 2 (2)
7	Montour St/Talbot Rd	< 2	< 2	< 2	< 2
8	Echo St E/Montour St	< 2	< 2	< 2	< 2
9	Montour St	< 2	< 2	< 2	< 2
10	Johnson St/Echo St	< 2	< 2	< 2	< 2
11	Fishcarrier St	< 2	< 2	< 2	< 2
12	Hill St	< 2	< 2	< 2 (2)	< 2
13	Munsee St N/Townline Rd E	< 2	< 2	< 2	< 2
14	249 Townline Rd E	< 2	< 2	< 2	< 2
15	380 Townline Rd E	< 2	< 2	< 2 (2)	< 2
16	460 Townline Rd E	< 2	< 2	< 2	< 2
17	Townline Rd E/Brooks Rd	< 2	< 2	< 2	< 2
18	225 Brooks Rd	< 2	< 2	< 2	< 2
19	Brooks Road Landfill (Front Gate)	4 (1)	< 2 (1)	4 (1)	4 (1)

Notes:

ou - odour units
- no data monitored at this location during the monitoring event.
(1) Odour with a similar characteristic to Brooks Road Landfill detected very briefly in low concentrations.
(2) Faint odour detected very briefly in low concentrations, the odour could not be characterized.

Table 3

Summary of Off-Site Odour Monitoring Event #3
Brooks Road Landfill
Cayuga, Ontario

Sample Location		27-Oct-16 (ou) 22:32 - 23:11	28-Oct-16 (ou) 00:06 - 00:50	28-Oct-16 (ou) 02:12 - 02:47	28-Oct-16 (ou) 03:52 - 04:26
ID	**Description**				
1	5525 Talbot Rd	< 2	< 2	< 2	< 2
2	5459 Talbot Rd	< 2	< 2	< 2	< 2
3	5409 Talbot Rd	< 2	< 2	< 2	< 2
4	5374 Talbot Rd	< 2	< 2	< 2	< 2
5	5345 Talbot Rd	< 2	< 2	< 2	< 2
6	5319 Talbot Rd	< 2	< 2	< 2	< 2
7	Montour St/Tablot Rd	< 2	< 2	< 2	< 2
8	Echo St E/Montour St	< 2	< 2	< 2	< 2
9	Montour St	< 2	< 2	< 2	< 2
10	Johnson St/Echo St	< 2	< 2	< 2	< 2
11	Fishcarrier St	< 2	< 2	< 2	< 2
12	Hill St	< 2	< 2	< 2	< 2
13	Munsee St N/Townline Rd E	< 2	< 2	< 2	< 2
14	249 Townline Rd E	< 2 (1)	< 2	< 2	< 2
15	380 Townline Rd E	< 2	< 2	< 2	< 2
16	460 Townline Rd E	< 2	< 2	< 2	< 2
17	Townline Rd E/Brooks Rd	< 2	< 2	< 2	< 2
18	225 Brooks Rd	< 2	< 2	< 2	< 2
19	Brooks Road Landfill (Front Gate)	< 2	< 2	< 2	< 2

Notes:

ou - odour units
- no data monitored at this location during the monitoring event.
(2) "Burnt Wood" and "Smokey" odour with detected very briefly in low concentrations.

Attachment A

NASAL RANGER

Date: 10/19/2016

Time(pm)	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
1031	5659							X		
1034	5525							X		
1036	5459							X		
1038	5409							X	402	
1040	5319							X		
1043	Montour/Talbot							X		
1045	Echo/Montour							X		
1047	Johnson/Echo							X		
1049	~~Cattle~~ Fish carrier crt							X		
1057	* Hwy 3 (North of townline)							X		
1101	249 Townline							X		
1105	380 Townline							X		
1110	Townline/Brooks							X		
1113	225 Brooks							X		
1117	front gate							X	507	
1150	front gate							X	507	

Weather Conditions

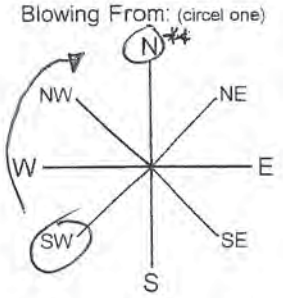
clear

- [X] ~~Sunny~~
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [X] Calm
- [ ] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 14 °F/(°C)

Relative Humidity: 84 %

Barometric Pressure: 102 kPa

Comments: * North of Office

** At beginning of monitoring rain winds were SW then shifted to N by the end

01823S
Code

Rob Morgan
Name

Signature

1/4

NASAL RANGER

Date: 10/20/2016

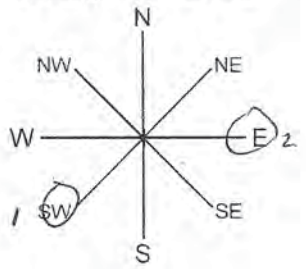
Time (24)	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
0056	~~5655~~ 5525							X		
0057	5459							X		
0100	5409							X		
0102	5374							X		
0104	5345							X		
0106	5319							X		
0107	Montana/Talbot							X		
0109	Echo/Montana							X		
0111	Johnson/Echo							X		
0113	Fish carrier Crt							X		
0117	Hwy 3 (north of Townline)							X		
0119	249 Townline							X		
0122	380 Townline							X		
0127	Townline/Brooks							X		
0129	225 Brooks							X		
0125	460 ~~Brooks~~ Townline							X		
0135	Echo/Montana							X		
0206	Front Gate							X	507	

Weather Conditions

Precipitation:
- [ ] Sunny
- [ ] Partly Cloudy
- [X] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:
- [X] Calm
- [ ] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 12 °F/(C) Relative Humidity: 89 % Barometric Pressure: 101.9 kPa

Comments: _____

Code	Name	Signature
0:8235	Rob Morgan	

NASAL RANGER

Date: 10/20/2016

Time (a.m.)	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
0317	5525							X		
0318	5459							X		
0320	5409							X		
0321	5374							X		
0323	5345							X		
0325	5319							X		
0327	Montour/Talbot							X		
0329	Echo/Montour							X		
0331	Johnson/Echo							X		
0334	Fisherrier Cut							X		
0340	Hwy 3 (northof Townline)							X		
0342	249 Townline							X		
0344	380 Townline							X		
0346	460 Townline							X		
0348	Townline/Brookes							X		
0350	225 Brookes							X		
0351	* Front Gate/West Perimeter						X	X	506/507	

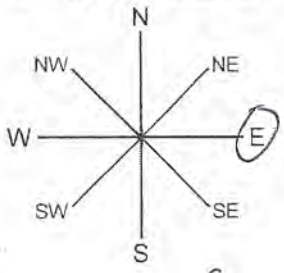
Weather Conditions

- [ ] Sunny
- [ ] Partly Cloudy
- [X] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circle one)



Wind Speed:

- [X] Calm 5 km/hr
- [X] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 13 °F/(C) Relative Humidity: 90 % Barometric Pressure: 101.8 kPa

Comments: * odour of ZOU detected but on and off in potency

018235 (Code) Rob Morgan (Name) (Signature)

3/4

NASAL RANGER

Date: 10/20/2016

Time (am)	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
0416	Montour/Talbot							X		
0418	Echo/Montour							X		
0420	Johnson/Echo							X		
0422	Fishcarrier Crt							X		
0424	Hwy 3 (north of Townline)							X		
0426	249 Townline							X		
0428	380 Townline							X		
0429	460 Townline							X		
0430	Townline/Brooks							X		
0432	255 Brooks							X		
0436	5525							X		
0438	5459							X		
0440	5409							X		
0446	5374							X		
0442	5345							X		
0444	5319							X		
0447	Front Gate							X	507	

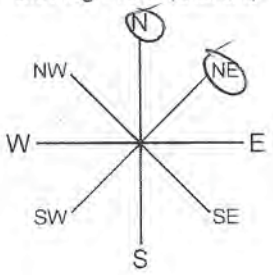
Weather Conditions

- [ ] Sunny
- [X] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [X] Calm 4 km/hr
- [X] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 13 °F/(°C)

Relative Humidity: 91 %

Barometric Pressure: 101.8 kPa

Comments: _____

Code	Name	Signature
018235	Rob Morgan	

4/4

NASAL RANGER

Date: 10/20/2016

Time (pm)	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
1024	5525							X		
1026	5459							X		
1028	5409							X		
1030	5345							X		
1032	5319							X		
1038	Montour/Talbot							X		
1040	Echo/Montour							X		
1041	Montour ~~Echo~~ Bend							X		
1043	Johnson/Echo							X		
1045	Fishcarrier Cut							X		
1053	Hwy 3 (north of Townline)							X		
1048	Hill St (end) near winnet st							X		
1056	249 Townline							X		
1059	380 Townline							X		
1101	460 Townline							X		
1102	Townline/Brooks							X		
1108	Front Gate						X	X	507	
1104	225 Brooks							X		
1106	West Perimeter					X	X	X	507/506	

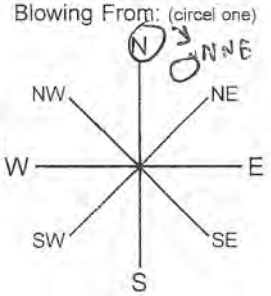
Weather Conditions

Precipitation:

- ☐ Sunny
- ☒ Partly Cloudy
- ☐ Mostly Cloudy
- ☐ Overcast
- ☐ Hazy

- ☐ None
- ☐ Fog
- ☒ Rain (light)
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☐ Calm
- ☐ Light Breeze (1-5 mph)
- ☒ Moderate Wind (5-15 mph) 16-20 Km/h
- ☐ Strong Winds (15 or higher mph)

Temperature: 11 °F/(°C) Relative Humidity: 93 % Barometric Pressure: 101.4 kPa

Comments: _____

Code	Name	Signature
018235	Rob Morgan	RM

3 1/4

NASAL RANGER

Date: 10/20/2016 - 10/21/2016

Time(pm)	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
1133	Tracks (Brooks Rd)							X		
1136	5525							X		
1139	5459							X		
1141	5409							X		
1142	5374							X		
1144	5345							X		
1146	5319							X		
1148	Monteur/Tallout							X		
1149	Echo/Monteur							X		
1150	Monteur Bend							X		
1152	Johnson/Echo							X		
1154	Fish carrier Crt							X		
1156	Hill St (end near Winnett St)							X		
0001	Hwy 3 (north of Townline)							X		
0003	249 Townline							X		
0006	380 Townline							X		
0008	460 Townline							X		
0010	Townline/Brooks							X		
0012	225 Brooks							X		
0014	Front Gate/Well							X	507	

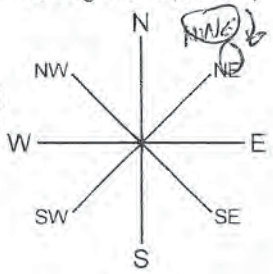
Weather Conditions

- [ ] Sunny
- [X] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [✓] None
- [ ] Fog
- [✓] Rain (light)
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [ ] Calm
- [ ] Light Breeze (1-5 mph)
- [X] Moderate Wind (5-15 mph) 16 km/h
- [ ] Strong Winds (15 or higher mph)

Temperature: 11 °F/(C) Relative Humidity: 92 % Barometric Pressure: 101.3 kPa

Comments:

018235 Code | Rob Morgan Name | Signature

2/4

NASAL RANGER

Date: 10/21/2016

Time (am)	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
0130	Tracks (Brooks Rd)							✗	507 (faint)	
0142	5525							✗		
0144	5459							✗		
0146	5409							✗		
0147	5374							✗		
0149	5345							✗	*	
0150	5319							✗		
0152	Montana / Talbot							✗		
0153	Echo / Montour							✗		
0154	Montour Blvd							✗		
0156	Johnson / Echo							✗		
0158	Fish Carrier Crt							✗		
0202	Hill St (end near wind st)							✗	*	
0206	Hwy 3 (north of Townline)							✗		
0208	249 Townline							✗		
0212	380 Townline							✗	*	
0214	460 Townline							✗		
0215	Townline / Brookes							✗		
0217	225 Brookes							✗		
0220	Front Gate (west side)					✗	✗	✗	507	

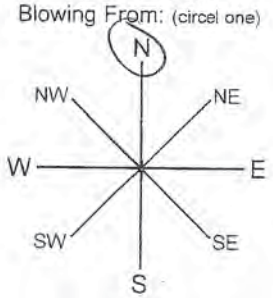
Weather Conditions

Precipitation:

- ☐ Sunny
- ☒ Partly Cloudy
- ☒ Mostly Cloudy
- ☐ Overcast
- ☐ Hazy

- ☐ None
- ☐ Fog
- ☒ Rain
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☐ Calm
- ☐ Light Breeze (1-5 mph)
- ☒ Moderate Wind (5-15 mph) 17 km/h
- ☐ Strong Winds (15 or higher mph)

Temperature: 11 °F/(C) Relative Humidity: 91 % Barometric Pressure: 101.2 kPa

Comments: * faint odour, could not characterize

01235 Code | RL Morgan Name | Signature

3/4

NASAL RANGER

Date: 10/21/2016

Time(AM)	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
0357	Trucks (Brooks Rd)							X		
0400	5525							X		
0402	5459							X		
0404	5409							X		
0405	5374							X		
0407	5345							X		
0409	5319							X		first door - could'nt characterize
0411	Montour / Talbot							X		
0412	Echo / Montour							X		
0414	Montour Blvd							X		
0416	Johnson / Echo							X		
0418	Fishcarrier crk							X		
0420	Hill St (end near Limit)							X		
0423	Hwy 3 (north of Tomlin)							X		
0425	249 Townline							X		
0427	380 Townline							X		
0429	460 Townline							X		
0430	Townline / Brooks							X		
0432	225 Brooks							X		
0434	Front Gate (west side)					X	X	X	507	

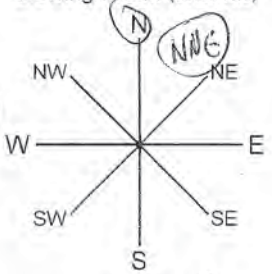
Weather Conditions

- [ ] Sunny
- [X] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [ ] None
- [ ] Fog
- [X] Rain (light)
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circle one)



Wind Speed:

- [ ] Calm
- [ ] Light Breeze (1-5 mph) 19 km/hr
- [X] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 11 °F/(°C) Relative Humidity: 92 % Barometric Pressure: 101.2 kPa

Comments: _____

018235 (Code) Rob Morgan (Name) _____ (Signature)

8 4/4

NASAL RANGER

Date: 10/27/2016

Time(in)	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
1032	Tracks (Brookside)							X		
1035	5525							X		
1036	5459							X		
1037	5409							X		
1039	5374							X		
1041	5345							X		
1042	5319							X		
1044	Monteer/Talbot							X		
1045	Echo/Monteer							X		
1046	Monteer Bend							X		
1048	Johnson/Echo							X		
1050	Firecrest Ct							X		
1052	Hill St							X		
1056	Hwy 3 (northbound line)							X		
1059	249 Townline							X	502/414	
1102	380 Townline							X		
1104	460 Townline							X		
1107	Townline/Brooks							X		
1109	225 Brooks							X		
1111	Front Gate							X		

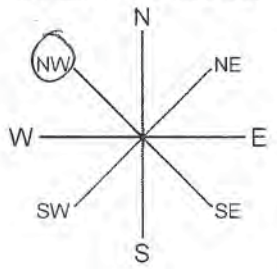
Weather Conditions

- [ ] Sunny
- [X] Partly Cloudy
- [X] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [ ] Calm
- [ ] Light Breeze (1-5 mph)
- [X] Moderate Wind (5-15 mph) (14 Km/h)
- [ ] Strong Winds (15 or higher mph)

Temperature: 2 °F/(C)

Relative Humidity: 84 %

Barometric Pressure: 102.1 kPa

Comments: _____

018235 (Code) | Rob Morgan (Name) | _____ (Signature)

NASAL RANGER

Date: 10/28/2016

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
0006	Tracks / Beckett Rd							X		
0009	5525							X		
0010	5459							X		
0011	5409							X		
0012	5374							X		
0014	5345							X		
0015	5319							X		
0017	Mentor / Tyler H							X		
0018	Echo / Mentor							X		
0020	Mentor Blvd							X		
0021	Johnson / Echo							X		
0022	Fish carrier Cut							X		
0025	Hill St							X		
0029	Hwy 3 (N of Tourline)							X		
0031	249 Tourline							X		
0034	380 Tourline							X		
0036	460 Tourline							X		
0037	Tourline / Brooks							X		
0038	225 Brooks							X		
0050	Front Gate							X		

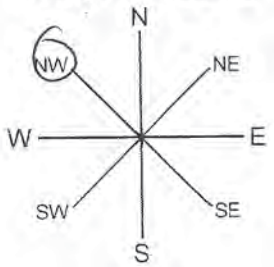
Weather Conditions

- [X] Sunny/clear
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circle one)



Wind Speed:

- [ ] Calm
- [X] Light Breeze (1-5 mph) (9 k-/hr)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 1 °F/(C) Relative Humidity: 82 % Barometric Pressure: 102.2 kpa

Comments: _____

618235 Code | Rob Morgan Name | Signature

NASAL RANGER

Date: 10/28/2016

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
0212	Tracks (Brooks Rd)							X		
0214	5525							X		
0216	5459							X		
0217	5409							X		
0219	5374							X		
0220	5345							X		
0222	5319							X		
0224	Montour/Talbot							X		
0225	Echo/Montour							X		
0226	Montour Bend							X		
0228	Johnson/Echo							X		
0230	Fish carrier Cut							X		
0232	Hill 57							X		
0235	Hwy 3 (N of Townline)							X		
0237	249 Townline							X		
0239	380 Townline							X		
0241	460 Townline							X		
0243	Townline/Brooks							X		
0244	225 Brooks							X		
0247	Front Gate							X		

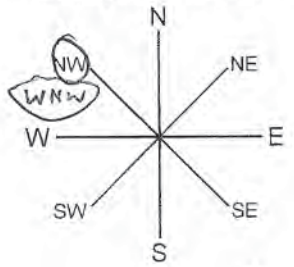
Weather Conditions

- [X] ~~Sunny~~ Clear
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circle one)



Wind Speed:

- [ ] Calm
- [X] Light Breeze (1-5 mph) (8 km/hr)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 0 °F/(°C)

Relative Humidity: 86 %

Barometric Pressure: 102.7 kPa

Comments: _____

018235 (Code) | Rob Morgan (Name) | (Signature)

NASAL RANGER

Date: 10/28/2018

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
0352	Tracks / Brooks Rd							X		
0355	5525							X		
0356	5459							X		
0358	5409							X		
0400	5374							X		
0401	5345							X		
0403	5319							X		
0405	Monitor / Talbot							X		
0406	Echo / Monitor							X		
0408	Monitor Bend							X		
0410	Johnson / Echo							X		
0412	Fish carrier Cut							X		
0413	Hill St							X		
0415	Hwy 3 (N of Townline)							X		
0417	249 Townline							X		
0419	380 Townline							X		
0420	460 Townline							X		
0421	Townline / Brooks							X		
0423	285 Brooks							X		
0426	Front Gate							X		

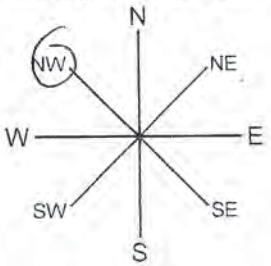
Weather Conditions

- [X] ~~Sunny~~ Clear
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circle one)



Wind Speed:

- [ ] Calm
- [ ] Light Breeze (1-5 mph)
- [X] Moderate Wind (5-15 mph) (13 km/hr)
- [ ] Strong Winds (15 or higher mph)

Temperature: -1 °F/(C) Relative Humidity: 89 % Barometric Pressure: 102.3

Comments: _____

Code	Name	Signature
018235	Rob Morgan	

December 9, 2016 Reference No. 018235

Mr. Richard Weldon
Brooks Road Environmental
c/o 2270386 Ontario Limited
160 Brooks Road, R.R. #5
Cayuga, Ontario
N0A 1E0

Dear Mr. Weldon:

Re: Odour Monitoring Program
Brooks Road Landfill Site, Cayuga, Ontario

1. Introduction

GHD Limited (GHD) was retained by Brooks Road Environmental c/o 2270386 Ontario Limited (BRE) to complete an ambient odour monitoring program (OMP) at the Brooks Road Landfill Site (Site) located in Cayuga, Ontario.

The OMP collected odour data in an effort to identify areas in the community potentially impacted by the Site and to determine conditions that may contribute to a potential odour impact.

This program was developed to assist BRE in determining the following information:

- Identification of potential odour sources at the Site
- Qualification and quantification of the odour from identified sources
- Odour monitoring at off-Site locations

The OMP was conducted by an Air Quality Expert on two nights in November 2016 (November 23 and November 25) in response to odour complaints received from residents located in the area surrounding the Site in Cayuga, Ontario.

2. Site Description

The Site is located at 160 Brooks Road in Cayuga, Ontario approximately 1 kilometre north of Kings Highway No. 3 (Talbot Road). The Site is legally described as Part of Lot 24, Concession I-N.T.R., Haldimand County.

The total Site area is approximately 14.3 hectares (ha) (35.3 acres) of which 6 ha (15 acres) is approved for landfilling.

The Site is bounded in the north by a rural property consisting of undeveloped fields (i.e., long-term inactive agricultural crop production lands) and forested areas. To the south and east of the Site is

undeveloped rural property consisting of a combination of fields and forested areas. The Site is bounded to the west by Brooks Road. On the west side of Brooks Road is an undeveloped rural property which is characterized primarily by undeveloped fields with occasional bush lots.

3. Odour Monitoring Program

Odour monitoring was completed during the Site visits using a Nasal Ranger™ field olfactometer. This is a proactive tool used to provide instant readings of odour at various locations. The Nasal Ranger has eight settings that allow the user to quantify odour concentrations ranging from two odour units (ou) to greater than 60 ou. For context, 1 ou is equal to a level of odour that would typically be detected by half of the people who are exposed to it i.e., it is at a very low level of odour.

In terms of operation, the olfactometer mixes a known volume of carbon filtered air with a known volume of ambient air to produce a dilution-to-threshold (D/T) ratio. The D/T ratio is defined as follows:

D T = Volume of Carbon Filtered Air/volume of odorous air

It should be noted that the odour unit value as measured by a field olfactometer, like the Nasal Ranger, are not directly comparable to odour data provided by an odour panel. The data from the Nasal Ranger does provide a good relative gauge to evaluate various odour concentrations.

The odour unit is a unit of measure, where 1 ou is defined as the concentration at which 50% of the population will detect the olfactory stimulus. At 1 ou an odour is detected but is generally not an adverse effect. There is no absolute guidance on odour values, like what is documented for specific chemical compounds, but generally 5 to 10 odour units is considered the annoyance level. The annoyance level is where complaints can occur.

4. Odour Monitoring

A brief walkthrough of the southern portion of the Site was performed each evening prior to off-Site monitoring to determine if on-Site odour could be identified. From previous monitoring studies the southern perimeter near the east above ground leachate storage tank is expected to be the location that may have the greatest contribution to any potential off-Site impact. The leachate treatment system is currently being commissioned and it is expected that continuous treatment capacity in this system will reduce odours from leachate at the Site and thus diminish an obvious odour source.

Off-Site monitoring locations have been selected based on sensitive receptors in the community.

The monitoring locations provided in Tables 1 and 2 are shown on Figures 1A and 1B.

Monitoring occurred over different temperature, wind speeds, and wind directions in the evening and morning hours. Monitoring was conducted over two different nights in November 2016 (November 23 and

November 25) to give an accurate assessment of the potential odour impacts during the nighttime hours while the Site was not operational.

The field data sheets for each Site visit are provided in Attachment A. The field data sheets provide the meteorological conditions, odour intensities, and qualifying descriptors.

5. Results & Observations

The November 23, 2016 monitoring event took place between 1:52 a.m. to 5:20 a.m. During this monitoring event the temperature ranged from -7 to -10°C with calm wind speeds (2-6 km/hr) blowing predominantly from the northwest. During the monitoring event no on-Site odour was detected by the Air Quality Expert at any off-Site monitoring locations as provided in Table 1 and on Figures 2A and 2B.

On-Site odour monitoring was conducted at 1:45 a.m. on November 25 along the southern perimeter of the Site. The Air Quality Expert detected odour described as landfill leachate ranging from <2 ou to 30 ou. The odour originated from the east above ground leachate storage tank with the highest concentration detected at the western extent of Stage 2B/3A.

The November 25, 2016 monitoring event took place between 2:01 a.m. to 5:12 a.m. During this monitoring event the temperature ranged from 4 to 5°C with calm wind speeds (4 km/hr) blowing predominantly from the south. During the monitoring event on-Site odour was detected by the Air Quality Expert briefly at two locations north of the Site on Brooks Rd as provided in Table 2 and on Figures 3A and 3B.

6. Conclusions and Recommendations

The highest odour concentration detected on-Site was 30 ou. This concentration was detected at the western extent of Stage 2B/3A. The limited odour detected around the perimeter of the Site was a maximum of 2 ou. Odours at this concentration typically do not result in complaints at off-Site locations, and this odour concentration is an on-Site concentration. With the distance between the Site and the receptors it is expected that the 2 ou detected at the perimeter of the Site will be less at the receptors. The 2 ou at the Site property boundary is also less than the general annoyance level of 5 to 10 ou.

A 'stale' and 'swampy' odour was detected at an off-Site location on November 23, 2016 in low concentrations (<2 ou), as presented in Figure 5. No on-Site activities would result in this type of off-Site odour.

A 'manure' odour was detected at an off-Site location on November 25, 2016 in low concentrations (<2 ou), as presented on Figure 6. No on-Site activities would result in this type off-Site odour.

The highest odour detected at the Site was described by the Air Quality Expert as landfill leachate. This would indicate that the odours during these observations are being emitted from exposed areas of the east above ground leachate storage tank.

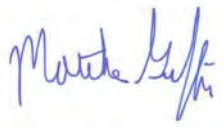
In order to limit the potential for off-Site odour impacts, the following operational measures are recommended:

- Fully commission the leachate treatment system in order to reduce leachate storage volumes that may produce odour. Treatment to Environmental Compliance Approval limits will denature odorous compounds in leachate.
- Continue with the daily odour monitoring program established by BRE and carried out by the Site Operator.
- If odours are noted at the property boundary, increase the amount of daily cover applied on the waste.
- Minimize the active working face. Apply interim cover at a minimum thickness of 300 mm on areas of the landfill where landfilling has ceased for 6 months or more.
- Limit exposed areas of the leachate collection system and control passive odour emissions from the east above ground leachate storage tank. Following the November 23, 2016 odour monitoring event, the east above ground leachate storage tank was drained of leachate and washed during the afternoon that same day, but the tank was not sealed. Following the November 25, 2016 monitoring event, the east above ground leachate storage tank was sealed that same day to eliminate any remaining passive odour emissions.
- When not in use, ensure blind flanges are placed on leachate collection system cleanouts and sump risers.
- Investigate the sealing of leachate storage tanks to minimize odours generated during the handling of leachate.
- Continue with use of odour control granules for odour mitigation. Assess areas of placement and their effect on odour mitigation.

Should you have any questions on the above, please do not hesitate to contact us.

Yours truly,

GHD



Matthew Griffin, P. Eng.

RM/cb/47

Encl.

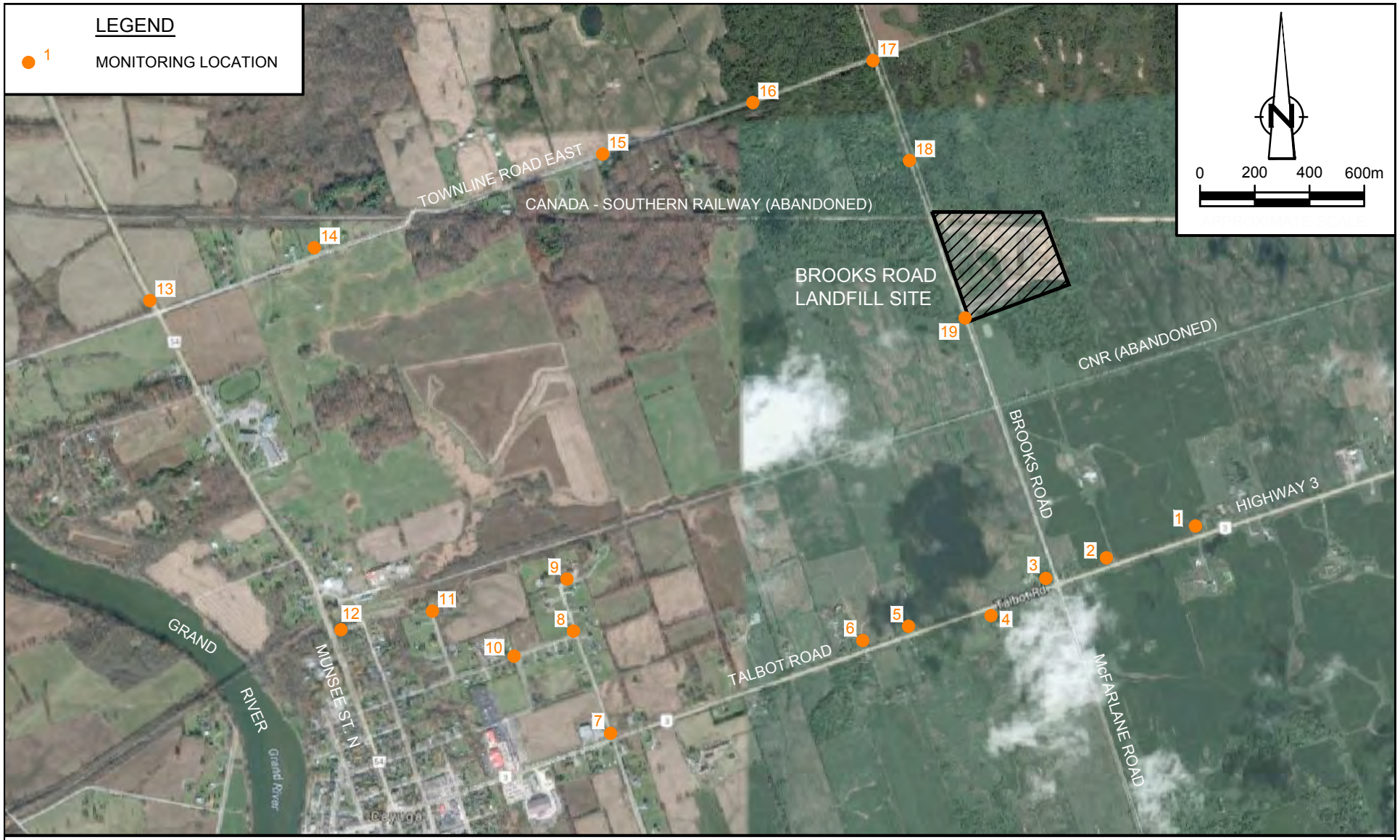


figure 1A

ODOUR MONITORING LOCATIONS #1
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

GHD

18235-79(WELD047)GN-WA001 DEC 9, 2016

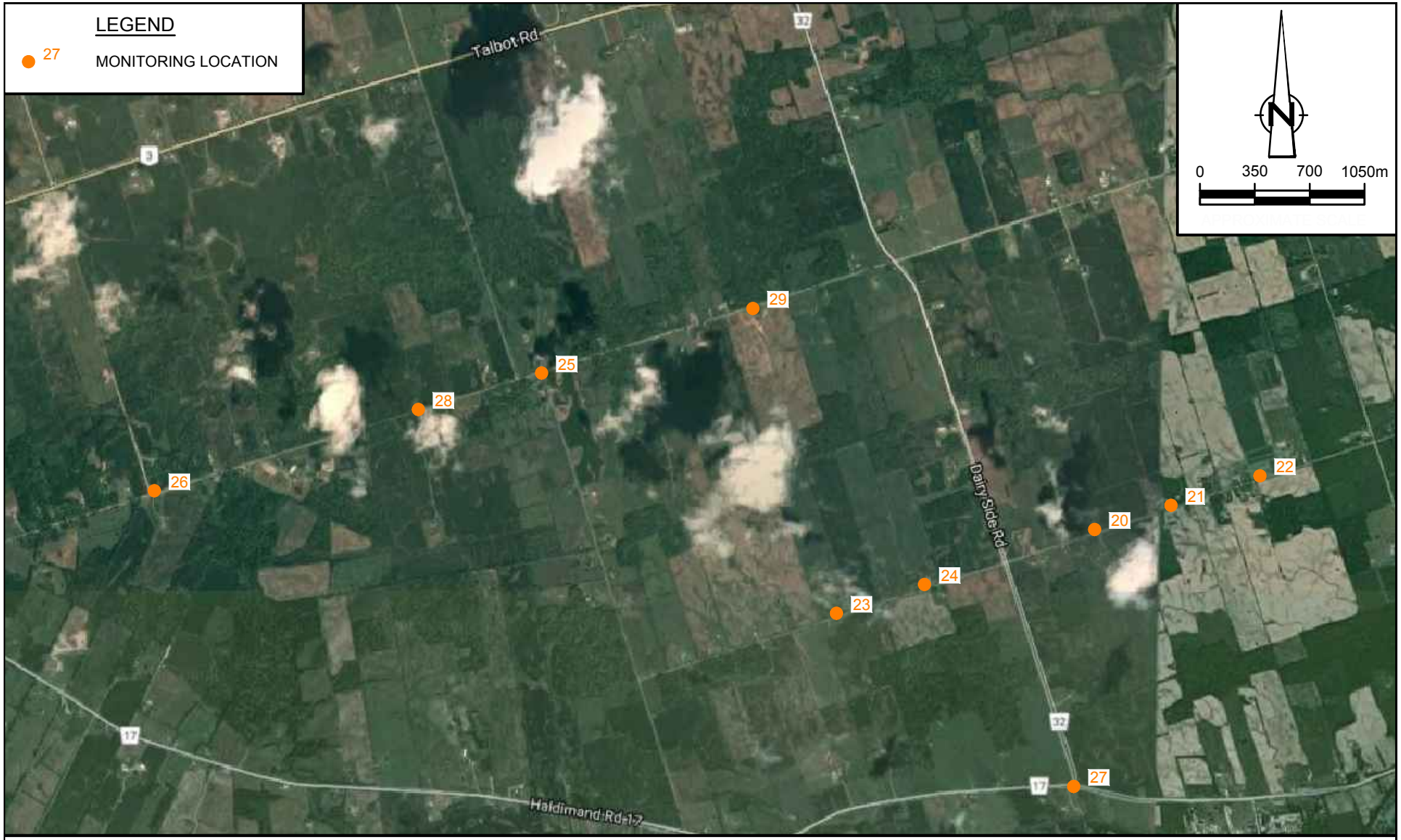


figure 1B

ODOUR MONITORING LOCATIONS #2
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

18235-79(WELD047)GN-WA002 DEC 9, 2016

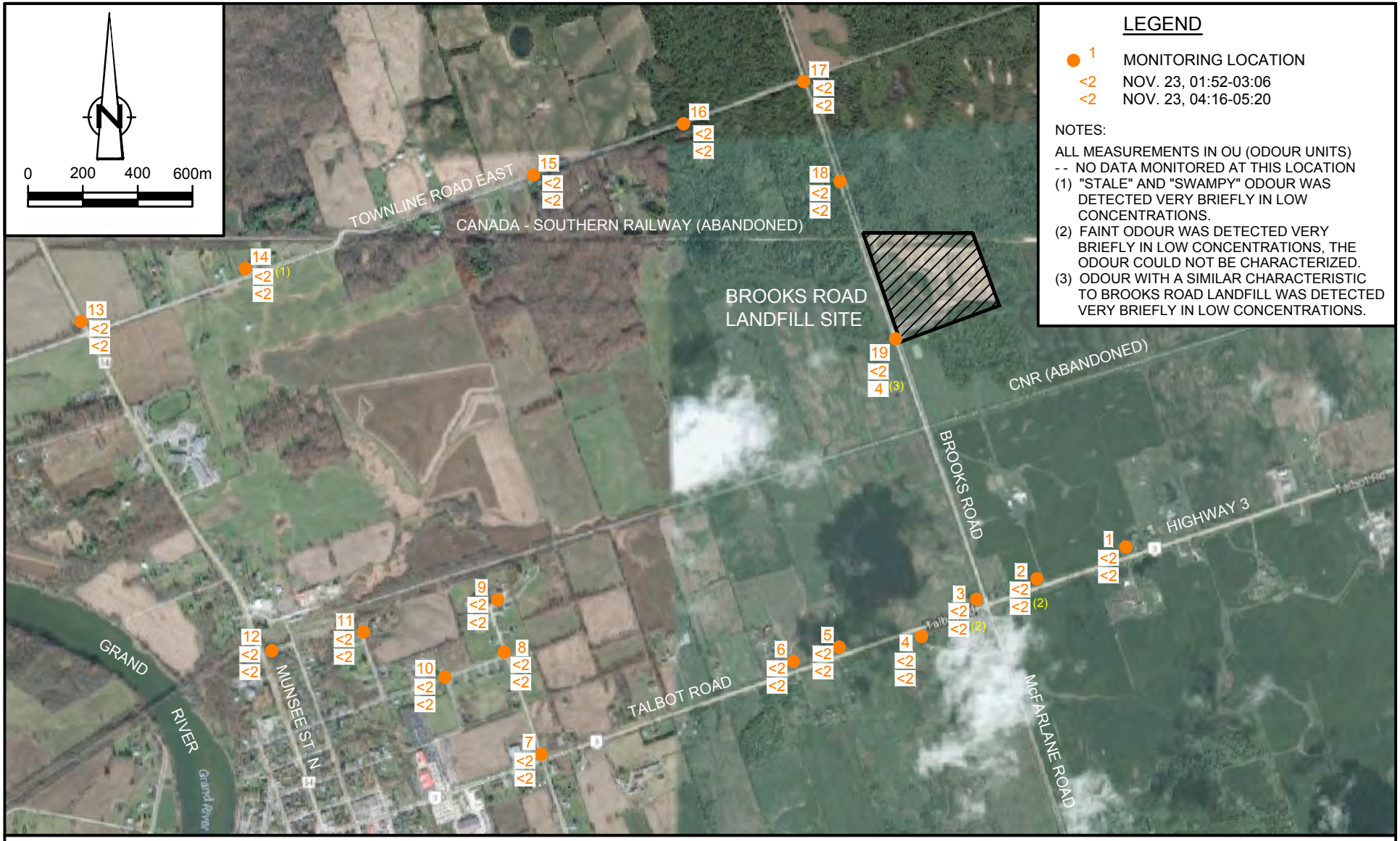


figure 2A

NOVEMBER 23, 2016 (EVENT #4) - ODOUR MONITORING LOCATIONS #1
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

GHD

18235-79(WELD047)GN-WA003 DEC 9, 2016

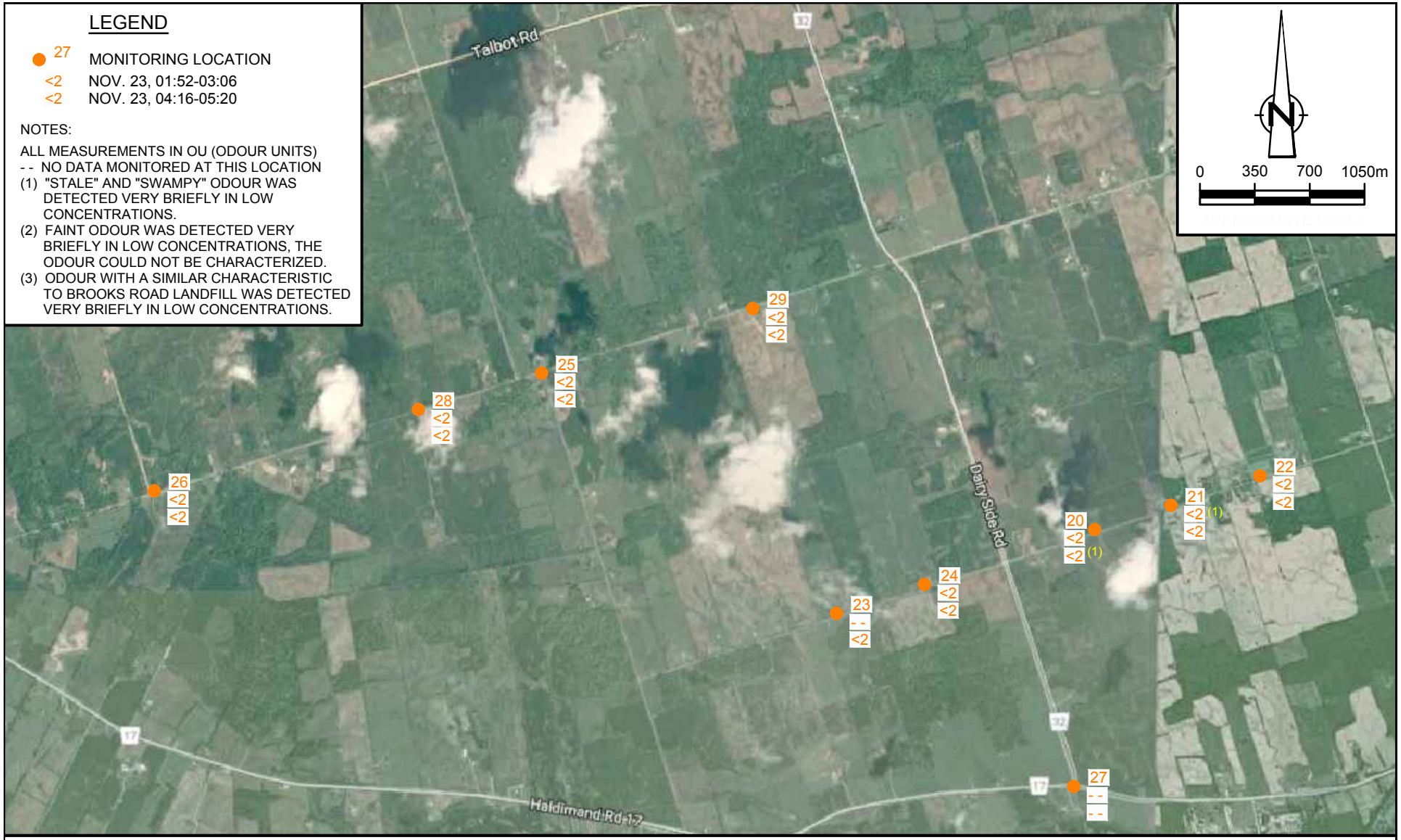


figure 2B

NOVEMBER 23, 2016 - ODOUR MONITORING LOCATIONS #2
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

GHD

18235-79(WELD047)GN-WA004 DEC 9, 2016

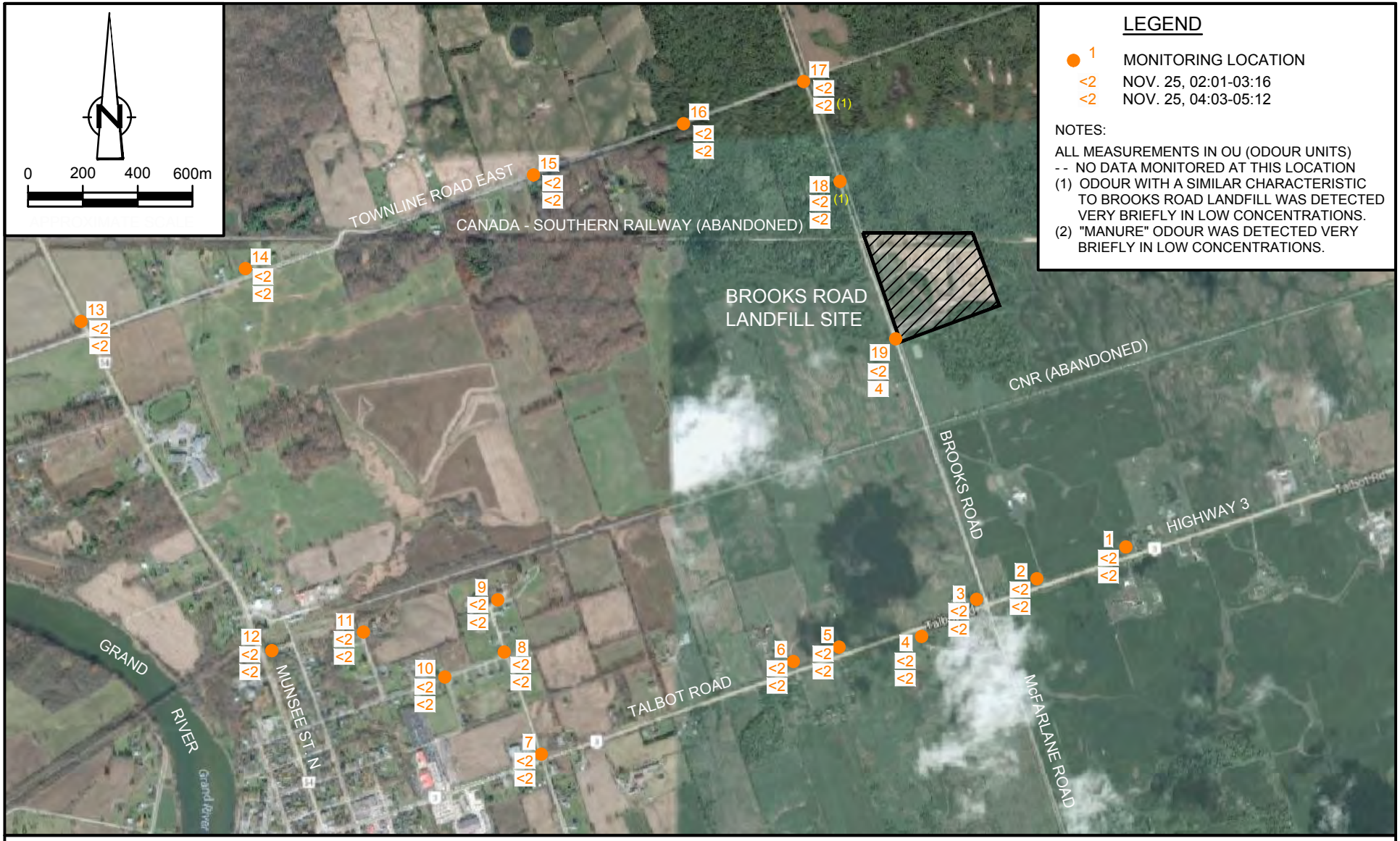


figure 3A

NOVEMBER 25, 2016 (EVENT #4) - ODOUR MONITORING LOCATIONS #1
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

GHD

18235-79(WELD047)GN-WA005 DEC 9, 2016

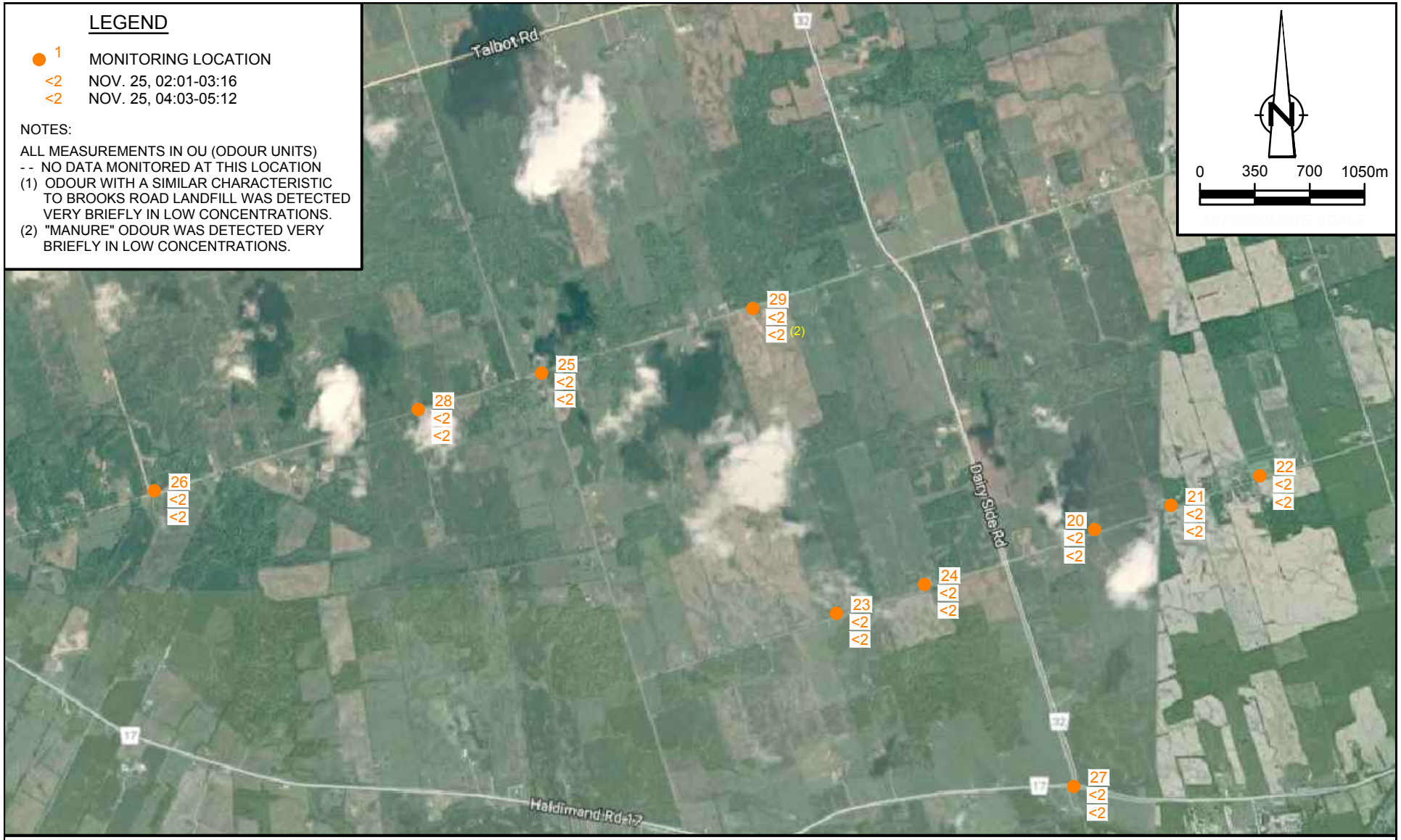


figure 3B

NOVEMBER 25, 2016 - ODOUR MONITORING LOCATIONS #2
BROOKS ROAD LANDFILL SITE
Cayuga, Ontario

GHD

18235-79(WELD047)GN-WA006 DEC 9, 2016

Table 1

Summary of Off-Site Odour Monitoring Event #1
Brooks Road Landfill
Cayuga, Ontario

Sample Location		23-Nov-16 (ou) 01:52 - 03:06	23-Nov-16 (ou) 04:16 - 5:20
ID	Description		
1	5525 Talbot Rd	< 2	< 2
2	5459 Talbot Rd	< 2	< 2 (2)
3	5409 Talbot Rd	< 2	< 2 (2)
4	5374 Talbot Rd	< 2	< 2
5	5345 Talbot Rd	< 2	< 2
6	5319 Talbot Rd	< 2	< 2
7	Montour St/Tablot Rd	< 2	< 2
8	Echo St E/Montour St	< 2	< 2
9	Montour St	< 2	< 2
10	Johnson St/Echo St	< 2	< 2
11	Fishcarrier St	< 2	< 2
12	Hill St	< 2	< 2
13	Munsee St N/Townline Rd E	< 2	< 2
14	249 Townline Rd E	< 2 (1)	< 2
15	380 Townline Rd E	< 2	< 2
16	460 Townline Rd E	< 2	< 2
17	Townline Rd E/Brooks Rd	< 2	< 2
18	225 Brooks Rd	< 2	< 2
19	Brooks Road Landfill (Front Gate)	< 2	4 (3)
20	406 2nd Concession Rd S	< 2	< 2 (1)
21	480 2nd Concession Rd S	< 2 (1)	< 2
22	565 2nd Concession Rd S	< 2	< 2
23	191 2nd Concession Rd S	-	< 2
24	245 2nd Concession Rd S	< 2	< 2
25	Windecker Rd/1st Concession Rd S	< 2	< 2
26	McFarlane Rd/1st Concession Rd S	< 2	< 2
27	Dairy Side Rd/Haldimand Rd 17	-	-
28	447 1st Concession Rd S	< 2	< 2
29	709 1st Concession Rd S	< 2	< 2

Notes:

ou - odour units
- no data monitored at this location during the monitoring event.
(1) "Stale" and "Swampy" odour with detected very briefly in low concentrations.
(2) Faint odour detected very briefly in low concentrations, the odour could not be characterized.
(3) Odour with a similar characteristic to BRE detected very briefly in low concentrations.

Table 2

Summary of Off-Site Odour Monitoring Event #5
Brooks Road Landfill
Cayuga, Ontario

Sample Location		25-Nov-16 (ou) 02:01 - 03:16	25-Nov-16 (ou) 04:03 - 05:12
ID	**Description**		
1	5525 Talbot Rd	< 2	< 2
2	5459 Talbot Rd	< 2	< 2
3	5409 Talbot Rd	< 2	< 2
4	5374 Talbot Rd	< 2	< 2
5	5345 Talbot Rd	< 2	< 2
6	5319 Talbot Rd	< 2	< 2
7	Montour St/Tablot Rd	< 2	< 2
8	Echo St E/Montour St	< 2	< 2
9	Montour St	< 2	< 2
10	Johnson St/Echo St	< 2	< 2
11	Fishcarrier St	< 2	< 2
12	Hill St	< 2	< 2
13	Munsee St N/Townline Rd E	< 2	< 2
14	249 Townline Rd E	< 2	< 2
15	380 Townline Rd E	< 2	< 2
16	460 Townline Rd E	< 2	< 2
17	Townline Rd E/Brooks Rd	< 2	< 2 (1)
18	225 Brooks Rd	< 2 (1)	< 2
19	Brooks Road Landfill (Front Gate)	< 2	< 2
20	406 2nd Concession Rd S	< 2	< 2
21	480 2nd Concession Rd S	< 2	< 2
22	565 2nd Concession Rd S	< 2	< 2
23	191 2nd Concession Rd S	< 2	< 2
24	245 2nd Concession Rd S	< 2	< 2
25	Windecker Rd/1st Concession Rd S	< 2	< 2
26	McFarlane Rd/1st Concession Rd S	< 2	< 2
27	Dairy Side Rd/Haldimand Rd 17	< 2	< 2
28	447 1st Concession Rd S	< 2	< 2
29	709 1st Concession Rd S	< 2	< 2 (2)

Notes:

ou - odour units
- no data monitored at this location during the monitoring event.
(1) Odour with a similar characteristic to BRE detected very briefly in low concentrations.

Attachment A

NASAL RANGER

Date: 11/23/2016

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
01:52	406 2nd Conc.							X		
01:55	480 2nd Conc							X	415/416	Faint/hard to characterize
01:58	565 2nd Conc							X		
02:04	245 2d Conc							X		
02:13	Winchester / 1st Conc							X		
02:15	447 1st Conc							X		
02:18	McFarlane / 1st Conc							X		
02:26	709 1st Conc							X		
02:35	5525							X		
02:36	5459							X		
02:38	5409							X		
02:39	5374							X		
02:40	5345							X		
02:41	5319							X		
02:43	Montour / Talbot							X		
02:44	Echo/Montour							X		
02:45	Montour Blvd							X		
02:47	Johnson/Echo							X		
02:48	Fish counter Crt							X		
02:50	Hill St							X		

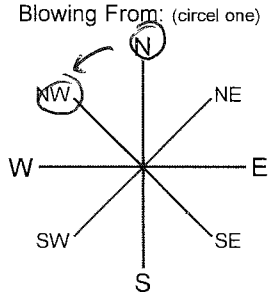
Weather Conditions

- [X] ~~Sunny~~ clear
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [ ] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [X] Calm 4 Km/hr
- [ ] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: -7 °F/(C) Relative Humidity: 83 % Barometric Pressure: 102.7 kPa

Comments: _____

018235 Code | Rob Morgan Name | ~~Signature~~

NASAL RANGER

Date: 11/23/2016

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
02:55	Hwy 3 (North of Townline)							X		
02:58	249 Townline							X		
03:00	380 Townline							X		
03:02	460 Townline							X		
03:03	Townline/Brooks							X		
03:05	225 Brooks							X		
03:06	Front Gate							X		

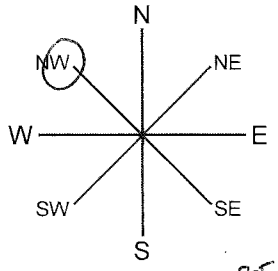
Weather Conditions

- [X] Sunny (Clear)
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [X] Calm 2 km/hr
- [ ] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: -8 °F/°C

Relative Humidity: ~~10~~ 85 %

Barometric Pressure: 102.6 kPa

Comments: _____

Code	Name	Signature
018235	R.L Morgan	R.L

2/4

NASAL RANGER

Date: 11/23/2016

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
04:16	406 2nd Conc							X	415/416	faint / hard to characterize
04:19	480 2nd Conc							X		
04:21	565 2nd Conc							X		
04:25	245 2nd Conc							X		
04:29	Windecker/1st Conc							X		
04:33	447 1st Conc							X		
04:35	McFarlane/1st Conc							X		
04:40	709 1st Conc							X		
04:48	5525							X		
04:49	5459							X		faint odour / no characterize
04:50	5409							X		faint odour / no characterize
04:51	5374							X		
04:53	5345							X		
04:54	5319							X		
04:56	Montour/Talbot							X		
04:57	Echo/Montour							X		
04:58	Montour Bend							X		
04:59	Jenkson/Echo							X		
0503	Fisherrider Crt							X		
0506	Hill St							X		
0425	191 2nd Conc							X		

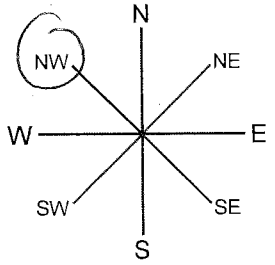
Weather Conditions

- [X] ~~Sunny~~ Clear
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [X] Calm 4 km/hr
- [ ] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: -9 °F/(°C) Relative Humidity: 91 % Barometric Pressure: 102.7 kPa

Comments:

018235 Code | Rob Morgan Name | Signature

NASAL RANGER

Date: 11/23/2016

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
0509	Hwy 3 (north of Tourelle)							X		
0511	249 Tourelle							X		
0513	380 Tourelle							X		
0515	460 Tourelle							X		
0516	Tourelle / Brookes							X		
0518	2250 Brookes							X		
0520	Front Gate						X	X	507	

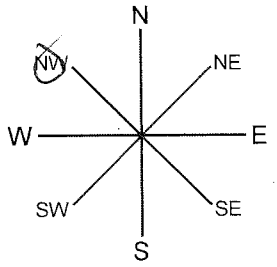
Weather Conditions

- [X] ~~Sunny~~ Clear
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [ ] Overcast
- [ ] Hazy

Precipitation:

- [X] None
- [ ] Fog
- [ ] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [X] Calm 6 km/h
- [ ] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: -10 °F/(C) Relative Humidity: 89 % Barometric Pressure: 102.6 kPa

Comments: _____

018215 (Code) Rob Morgan (Name) _____ (Signature)

Date: 11/25/2016

NASAL RANGER

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
2:01	406 2nd Conc.							X		
2:03	480 2nd Conc							X		
2:05	565 2nd Conc							X		
2:15	245 2nd Conc							X		
2:20	Windecker/1st Conc							X		
2:27	447 1st Conc							X		
2:30	McFarlane/1st Conc.							X		
2:33	709 1st Conc.							X		
2:43	5525							X		
2:44	5459							X		
2:45	5409							X		
2:46	5374							X		
2:47	5345							X		
2:48	5319							X		
2:50	Montour/Talbot							X		
2:51	Echo/Montour							X		
2:53	Montour Bend							X		
2:54	Johnson/Echo							X		
2:56	Fishcarrier Crt							X		
2:58	Hill St							X		

Weather Conditions 2:42 32?? 17 Rd X
2:16 191 2nd Conc X

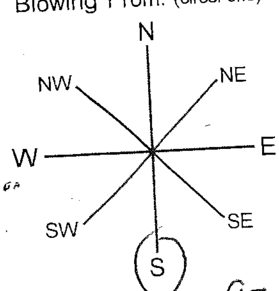
Precipitation:

- [ ] Sunny
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [x] Overcast
- [ ] Hazy

Precipitation:

- [ ] None
- [x] Fog
- [x] Rain (spitting at 2:45 on)
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [x] Calm 4 Km/hr
- [ ] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 4 °F/°C (°C circled)

Relative Humidity: 98 %

Barometric Pressure: 102 kPa

Comments: ______

018235 — Code

R.S Morgan — Name

[signature] — Signature

1/4

NASAL RANGER

Date: 11/25/2016

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
3:03	Hwy 3 (north of Tomline)							X		
3:05	249 Tomline							X		
3:07	380 Tomline							X		
3:10	460 Tomline							X		
3:11	Tomline/Bricks							X		
3:14	225 Bricks							X	507/grenade	
3:16	Front Gate							X		
2:12	32 Rd/17 Rd							X		
2:16	191 2nd Cove							X		

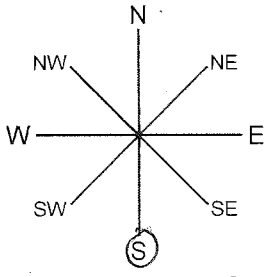
Weather Conditions

Precipitation:

- ☐ Sunny
- ☐ Partly Cloudy
- ☐ Mostly Cloudy
- ☒ Overcast
- ☐ Hazy

- ☐ None
- ☒ Fog
- ☒ Rain (barely)
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☐ Calm
- ☐ Light Breeze (1-5 mph)
- ☐ Moderate Wind (5-15 mph)
- ☐ Strong Winds (15 or higher mph)

Temperature: 4 °F (°C) Relative Humidity: 98 % Barometric Pressure: 102 kPa

Comments: _____

018235 Code | Rob Morgan Name | Signature

2/11

NASAL RANGER

Date: 11/23/2016

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
4:03	406 2nd Conc							X		
4:05	480 2nd Conc							X		
4:06	565 2nd Conc							X		
04:14	245 2nd Conc							X		
04:16	191 2nd Conc							X		
04:18	Winchester / 1st Conc							X		
04:24	McFarlane / 1st Conc							X		
04:31	709 1st Conc.							X	Soft	
04:11	~~5525~~ 32 Rd / 17 Rd							X		
04:38	5525							X		
04:39	5459							X		
04:40	5409							X		
04:41	5374							X		
04:42	5345							X		
04:43	5319							X		
04:45	Montour / Kalbot							X		
04:46	Echo / Montour							X		
04:47	Montour Bend							X		
04:49	Johnson / Ech.							X		
4:27	447 1st Conc							X		

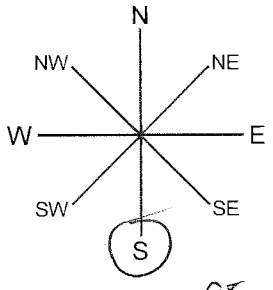
Weather Conditions

- ☐ Sunny
- ☐ Partly Cloudy
- ☐ Mostly Cloudy
- ☒ Overcast
- ☐ Hazy

Precipitation:

- ☐ None
- ☒ Fog
- ☒ Rain (Barely)
- ☐ Sleet
- ☐ Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- ☒ Calm 4 Kn/Hr
- ☐ Light Breeze (1-5 mph)
- ☐ Moderate Wind (5-15 mph)
- ☐ Strong Winds (15 or higher mph)

Temperature: 5 °F/(°C)

Relative Humidity: 98 %

Barometric Pressure: 102 kPa

Comments: _____

Code	Name	Signature
018235	RS Morgan	RS M

3/4

NASAL RANGER

Date: 11/25/2016

Time	Location	D/T 60	30	15	7	4	2	<2	Descriptors	Comments
0451	Fisherrier Crt							X		
	H.11 St									
0455	Hwy 3 (north & Town)							X		
0457	249 Townline							X		
0500	380 Townline							X		
0501	460 Townline							X		
0502	Townline / Brooks							X	507/granny	
0504	225 Brooks							X		
0512	Front Gate							X		

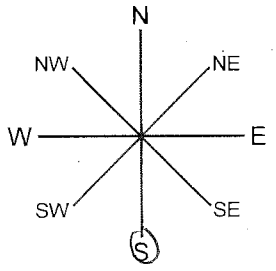
Weather Conditions

- [ ] Sunny
- [ ] Partly Cloudy
- [ ] Mostly Cloudy
- [x] Overcast
- [ ] Hazy

Precipitation:

- [ ] None
- [x] Fog
- [x] Rain
- [ ] Sleet
- [ ] Snow

Wind Direction Blowing From: (circel one)



Wind Speed:

- [x] Calm 4 km/h
- [ ] Light Breeze (1-5 mph)
- [ ] Moderate Wind (5-15 mph)
- [ ] Strong Winds (15 or higher mph)

Temperature: 5 °F (°C)

Relative Humidity: 98 %

Barometric Pressure: 1021 hPa

Comments: _____

Code	Name	Signature
018235	Rob Morgan	

4/4