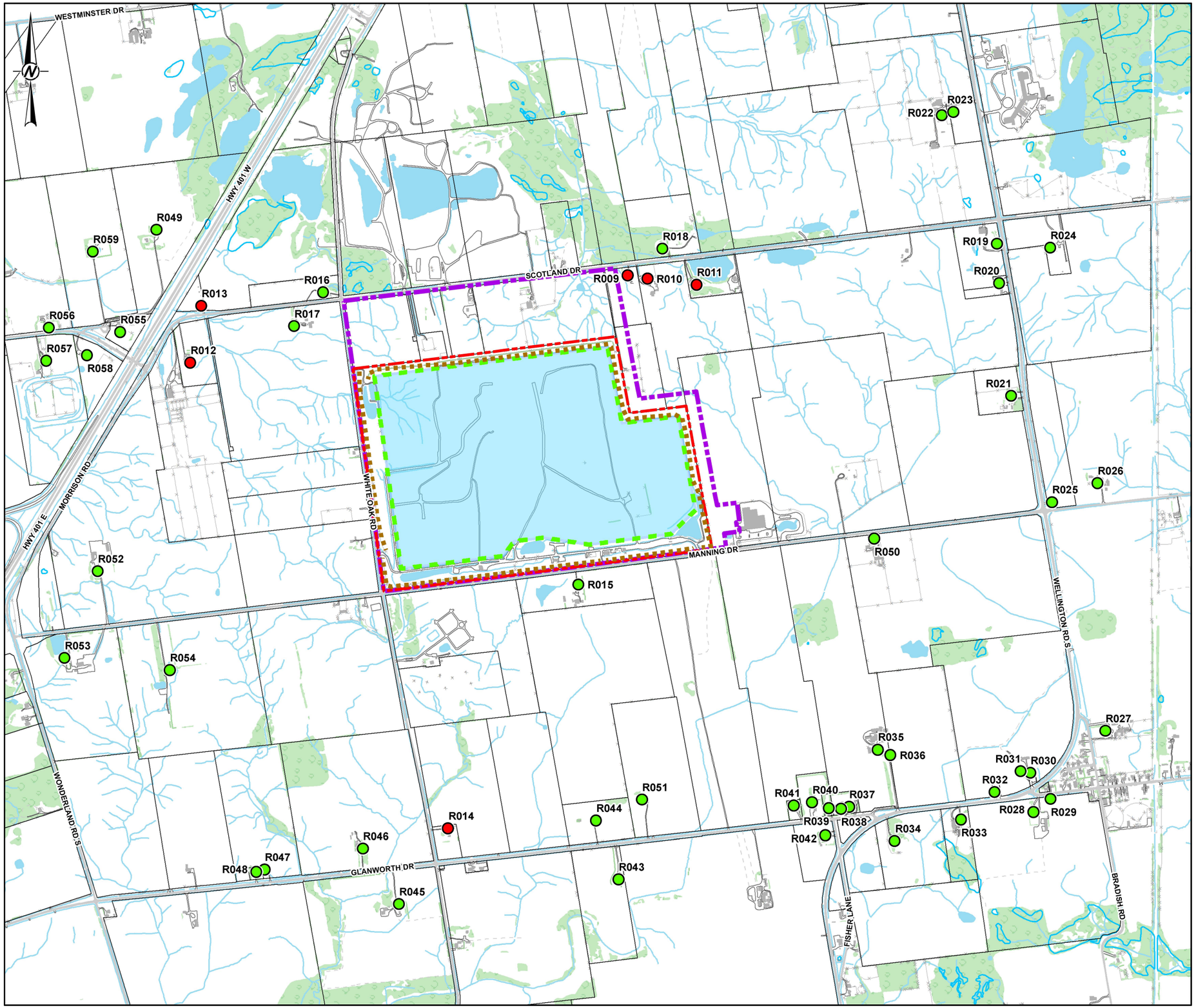
**Table 5.2-1: NAPS Air Quality Monitoring Stations**

| City | Station ID | Distance to Site (km) | Direction | Comments |
|---|---|---|---|---|
| London | 60904 | 12 | northeast | Expected that the Project will experience similar wind patterns and impacts from regional transport of compounds as this station.<br>This station has most relevant air quality indicator compounds except carbon monoxide (CO) and sulphur dioxide ($SO_2$). |
| Kitchener | 61502 | 87 | northeast | Similar to London due to Kitchener's similar size, industry and proximity to Highway 401.<br>This station has all relevant air quality indicator compounds except CO and $SO_2$. |
| Hamilton | 60512 | ~110 | northeast | The Hamilton station was selected for the CO and $SO_2$ data as it was the most representative station that monitors these compounds |

Existing approved on-site sources of air emissions include:

- Landfill gas generated from waste decomposition;
- By-products from combustion of landfill gas in the flare;
- Traffic, loading and unloading, on-site vehicle emissions, and landfill waste receipt activities; and
- Landfill daily and final cover activities.

The AERMOD-PRIME (AERMOD) dispersion model (Version 19191) was used to predict existing ground-level concentrations for the indicator compounds. The AERMOD modelling system was developed by the United States Environmental Protection Agency (U.S. EPA) and has been adopted in Ontario as the regulatory model recommended by the MECP. The AERMOD model (Version 19191) was used to predict concentrations at a series of off-site locations, referred to as points of reception (PORs). These off-site PORs included a series of PORs placed at nearby residences (referred to as sensitive PORs and illustrated on Figure 5.2-2). Model predictions for most of the indicator compounds are presented as the highest value from any modelled POR.




**LEGEND**

- CITY OWNED PROPERTY - EXISTING
- NON-CITY OWNED PROPERTY - EXISTING
- WATERCOURSE
- DRIVEWAY
- FENCELINE
- TRAIL
- APPROXIMATE BERM LOCATION
- BUILDING FOOTPRINT
- WOODED AREA
- WATERBODY
- EXISTING PROPERTY BOUNDARY
- PROPOSED PROPERTY BOUNDARY
- EXISTING APPROVED LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE

**REFERENCE(S)**

1. DATA PROVIDED BY THE CITY OF LONDON.
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

0 175 350 700
1:17,500 METRES

CLIENT
CORPORATION OF THE CITY OF LONDON

PROJECT
INDIVIDUAL EA OF THE PROPOSED W12A LANDFILL EXPANSION

TITLE
**SENSITIVE RECEPTOR LOCATIONS**

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2020-08-19 |
| DESIGNED | ---- |
| PREPARED | JEM |
| REVIEWED | ---- |
| APPROVED | ---- |

| PROJECT NO. | PHASE | REV. | FIGURE |
|---|---|---|---|
| 1648176 | 0020 | A | 5.2-2 |

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More details regarding the development of emission calculations and additional details regarding the dispersion modelling set-up are provided in Volume IV Appendix D.01.

Table 5.2-2 lists the emission rates from the W12A Landfill that were used to characterize the air quality in the Site-vicinity Study Area from currently approved sources, based on the emission rate calculations described in Volume IV Appendix D.01.

**Table 5.2-2: Existing Emissions from W12A Landfill**

| Compound | Units | Emission Rate |
|---|---|---|
| SPM | g/s | 1.828 |
| $PM_{10}$ | g/s | 0.494 |
| $PM_{2.5}$ | g/s | 0.198 |
| $NO_X$ | g/s | 0.959 |
| $SO_2$ | g/s | 0.078 |
| CO | g/s | 1.612 |
| $H_2S$ | g/s | 0.020 |
| $C_2H_3Cl$ | g/s | 0.002 |
| Odour | OU/s | 5779.037 |

**Notes:**
SPM – suspended particulate matter
$PM_{10}$ – particulate matter with diameter of 10 microns or less
$PM_{2.5}$ – particulate matter with diameter of 2.5 microns or less
NOx – Nitrogen oxides
$SO_2$ – Sulfur dioxide
CO – Carbon monoxide
$H_2S$ – hydrogen sulphide
$C_2H_3CL$ – vinyl chloride
OU – odour unit

The existing air quality conditions against which the Project will be evaluated are a combination of background air quality for the region and the modelled air quality resulting from the emissions of currently approved sources at the existing site. Table 5.2-3 provides a summary of the existing conditions for each of the indicator compounds.

**Table 5.2-3: Existing Air Quality (background plus currently approved activities)**

| Indicator | Averaging Period | Maximum Predicted Concentration from Currently Approved Activities (µg/m³) | Background Air Quality (µg/m³) | Existing Air Quality (µg/m³) |
|---|---|---|---|---|
| SPM | 24-hour | 12.01 | 45.83 | 57.84 |
| | Annual | 2.15 | 26.85 | 29.00 |
| $PM_{10}$ | 24-hour | 5.35 | 25.46 | 30.81 |
| $PM_{2.5}$ | 24-hour | 1.57 | 13.75 | 15.32 |
| | Annual | 0.23 | 8.06 | 8.29 |
| $NO_2$ | 1-hour | 119.32 | 22.57 | 141.89 |
| | 24-hour | 84.60 | 19.87 | 104.47 |
| | Annual | 2.87 | 11.70 | 14.57 |
| $SO_2$ | 10-minute | 0.39 | 56.19 | 56.58 |
| | 1-hour | 0.24 | 34.05 | 34.29 |
| | 24-hour | 0.07 | 32.36 | 32.43 |
| | Annual | 0.0035 | 9.08 | 9.08 |
| CO | ½-hour | 789.52 | 549.72 | 1,339.24 |
| | 1-hour | 657.93 | 458.10 | 1,116.03 |
| | 8-hour | 97.09 | 572.62 | 669.71 |
| $H_2S$ | 10-min | 2.58 | 0.84 | 3.42 |
| | 24-hour | 0.41 | 0.21 | 0.62 |
| $C_2H_3Cl$ | 24-hour | 0.0335 | 0.00382 | 0.037 |
| | Annual | 0.0057 | 0.00147 | 0.007 |
| Odour [1] | 10-min | 0.59 | — | 0.55 |

**Note:** [1] Values are in OU/m³ and presented at the 95%ile

#### *5.2.1.2 Review of Existing Odour Complaints Data*

A review of the odour complaint records for the landfill in 2019 was conducted to identify the likelihood that the landfill may have contributed to each odour complaint. This was undertaken through a review of the location from which the complaint was made and corresponding wind direction at the time the complaint was logged. If the area of the complaint did not appear to be reasonably downwind of the W12A Landfill at the time the complaint was logged, it was deemed unlikely that W12A Landfill was a significant contributor to the complaint and thus the corresponding data was not used for further analysis.

In 2019, a total of 58 odour complaints were received by the City in relation to W12A Landfill. This value is similar to the number of complaints received in 2018 (62 complaints) but higher than in previous years (19 in 2014, 21 in 2015, 17 in 2016, 34 in 2017).

Of the 58 odour complaints received in 2019, eight complaints were excluded based on wind direction, leaving 50 complaints that may reasonably be attributed, in whole or in part, to the W12A Landfill. These 50 “verified” complaints were received from 30 different reported addresses surrounding the site with the majority recorded at addresses along the western end of Manning Drive. It is recognized that one complaint may represent more than one person experiencing an odour episode.

Prior to 2020, the LFG collection system relied mainly on vertical extraction wells to capture LFG being generated in the waste. In the spring of 2020, the latest LFG collection system expansion was completed. This expansion included horizontal collection pipes as well as additional vertical collection wells. This is the type of LFG collection system that is proposed for the landfill expansion and is expected to be able to capture a higher percentage of LFG in the areas where it is installed.

By June 2020 the amount of LFG being collected increased to approximately 1,500 scfm. By October 2020 the amount of LFG being collected increased to approximately 1,700 scfm, which is the maximum capacity of the existing flare. In total the amount of LFG being collected increased almost 50% (500 scfm) in one year.

The increase in the amount of landfill gas being collected appears to have had a direct effect on reducing odours. Verified complaints in 2020 were 19, with only 3 in the second half of the year. There have been no complaints since October 2020.

Figure 5.2-3 below shows the frequency of complaints received for each wind direction in 2019. The majority of odour complaints have historically been recorded during times when winds are blowing from the east.

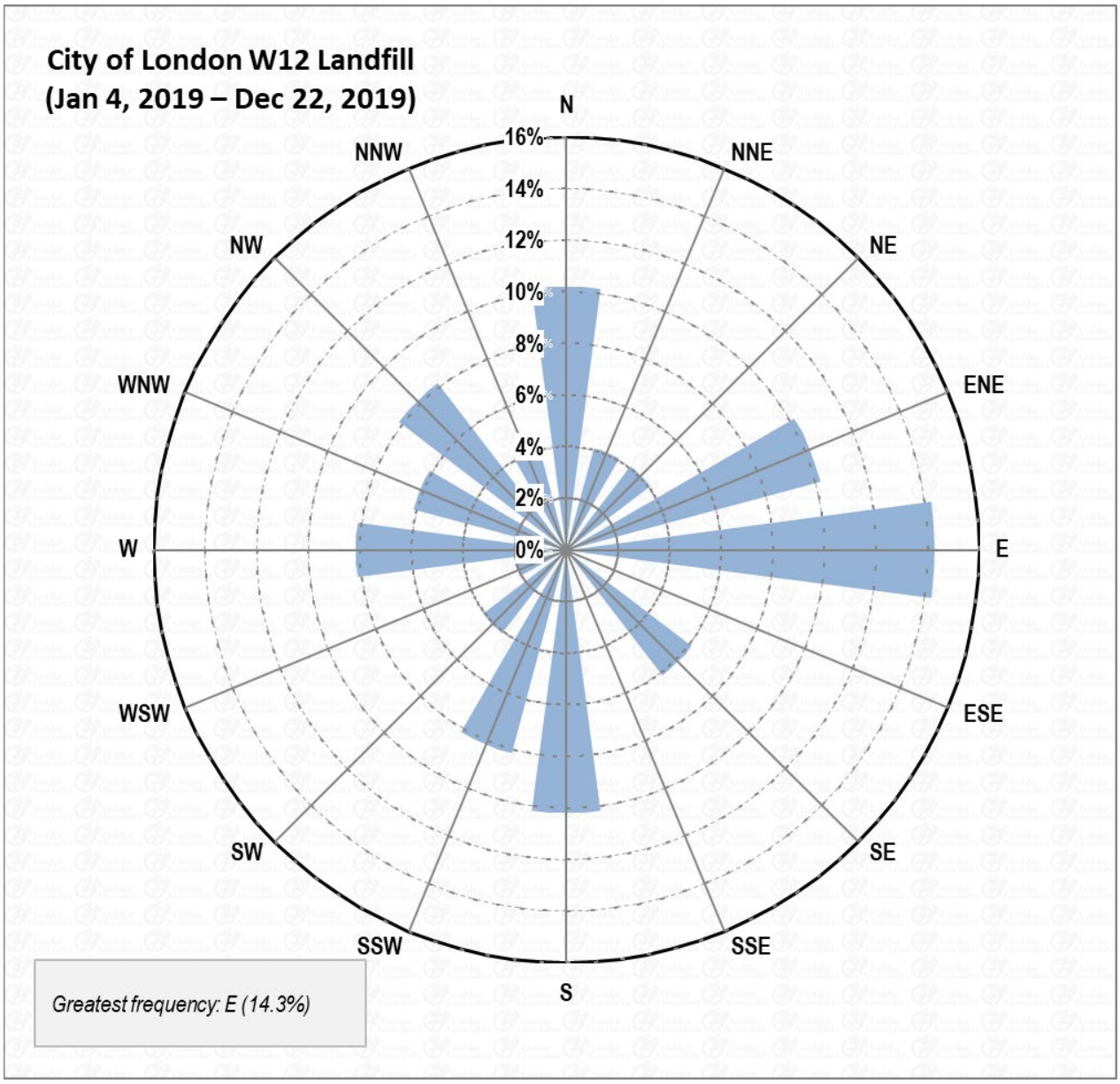



**Figure 5.2-3: Odour Rose for 2019 Odour Complaints Potentially Attributed to W12A Landfill**

### 5.2.2 Noise

This sub-section presents a characterization of the existing acoustic environment.

Much of the lands within the Site-vicinity Study Area, near the current landfill property, are owned by the City, as shown in Figure 5.2-4, and do not contain any existing noise-sensitive buildings (i.e., vacant lands). Figure 5.2-4 presents all of the PORs, a total of 81, that were identified within the Site-vicinity Study Area. The most sensitive of these PORs, in all directions, from the Project were carried forward in the assessment to capture the greatest potential impacts. A total of 11 of the identified PORs were selected as being representative of the most sensitive PORs in the Site-vicinity Study Area with respect to the Project for further assessment, which include R01, R02, R04, R06, R10, R15, R16, R19, R23, R25 and, R50.

An assessment was completed to establish the existing conditions in the acoustic environment Site-vicinity Study Area, and to be subsequently used to assess the potential impacts due to the Project. Existing noise levels in the Site-vicinity Study Area are influenced by vehicle traffic, existing landfill operations and operations of other facilities within the Site-vicinity Study Area, such as the aggregate pits to the north and the MRF to the east of the landfill. In completing a conservative assessment, these other facilities were not assessed in quantifying existing noise levels.

The noise assessment, in Section 9.1.2, was carried out in accordance with MECP guidelines to meet MECP requirements and an assessment to determine change from existing noise levels was completed to support the EA. The methodology used for the MECP noise assessment was based on the MECP publications *"Noise Guidelines for Landfill Sites"* (Landfill Guidelines) (MECP 1998) and *Environmental Noise Guideline – Stationary and Transportation Sources – Approval and Planning Publication NPC-300* (NPC-300) dated August 2013 (NPC-300). These documents are further described in Section 9.1.2.1.

For the noise assessment in accordance with MECP guidelines, existing conditions were determined only for the haul route as required by the MECP. When assessing change from existing noise levels, vehicle traffic and existing landfill activities were considered to establish existing conditions. The following landfilling activities were considered in the noise assessment, when appropriate:

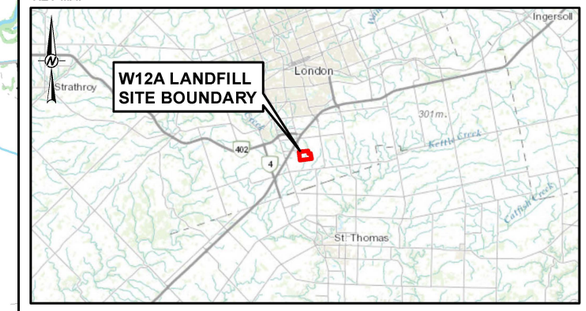
- Landfilling operations, which are comprised of the following scenarios:
- Normal operations (7 a.m. to 5 p.m.);
- Site preparation (6 a.m. to 7 a.m.);
- Building a berm (daytime only);
- Placement of daily cover (5 p.m. to 6 p.m.); and
- Disposal of dewatered biosolids (24-hour operations).
- Landfill ancillary equipment, including emergency diesel generator testing; and
- Landfill traffic along off-site haul routes.

The landfill does not use pest control devices that generate noise and there are no plans to use them in the future; therefore, no assessment was carried out.

BLAKIE RD
RANEY CRES
ROXBURGH RD
WELLINGTON RD
HWY 401 W
DINGMAN DR
AVENUE RD
HWY 402 W
HWY 402 E
WESTMINSTER DR
SHAVER ST
HWY 401 E
WONDERLAND RD S
SCOTLAND DR
MORRISON RD
WHITE OAK RD
MANNING DR
DECKER DR
GLANWORTH DR
FISHER LANE
BRADISH RD
WELLINGTON RD S

R01 R02 R03 R04 R05 R06 R07 R08 R09 R10 R11 R12 R13 R14 R15 R16 R17 R18 R19 R20 R21 R22 R23 R24 R25 R26 R27 R28 R29 R30 R31 R32 R33 R34 R35 R36 R37 R38 R39 R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57 R58 R59 R60 R61 R62 R63 R64 R65 R66 R67 R68 R69 R70 R71 R72 R73 R74 R75 R76 R77 R78 R79 R80 R81 R82

KEY MAP

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LEGEND

- CITY OWNED PROPERTY - EXISTING
- CITY OWNED PROPERTY - VACANT
- NON-CITY OWNED PROPERTY - EXISTING
- NON-CITY OWNED PROPERTY - EXISTING (RURAL SUBDIVISION OF APPROXIMATELY 40 HOUSES)
- NON-CITY OWNED PROPERTY - VACANT
- WATERCOURSE
- DRIVEWAY
- FENCELINE
- TRAIL
- APPROXIMATE EXISTING BERM LOCATION
- HAUL ROUTES
- BUILDING FOOTPRINT
- WOODED AREA
- WATERBODY
- CITY OWNED PROPERTY
- EXISTING PROPERTY BOUNDARY
- PROPOSED PROPERTY / SITE STUDY AREA
- EXISTING APPROVED LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE
- SITE-VICINITY STUDY AREA

REFERENCE(S)
1. DATA PROVIDED BY THE CITY OF LONDON.
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

0 250 500 1,000
1:25,000 METRES

CLIENT
CORPORATION OF THE CITY OF LONDON

PROJECT
INDIVIDUAL EA OF THE PROPOSED W12A LANDFILL EXPANSION

TITLE
**NOISE STUDY AREAS AND POINTS OF RECEPTION**

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2020-09-18 |
| DESIGNED | --- |
| PREPARED | JEM |
| REVIEWED | --- |
| APPROVED | --- |

| PROJECT NO. | PHASE | REV. | FIGURE |
|---|---|---|---|
| 1648176 | 0023 | A | **5.2-4** |

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Landfill operations noise sources and ancillary facilities noise sources are outlined in detail in Volume IV Appendix D.02.

Project-specific on-site and off-site noise measurements were completed to support the noise assessment. The noise measurements conducted to characterize the primary noise sources associated with existing landfill activities, and the modelling completed to establish existing noise levels is described below.

#### *5.2.2.1 Short-term Monitoring and Landfill Equipment Sound Level Measurements*

A noise field study was carried out to characterize existing noise levels in the Site-vicinity Study Area. This noise field study was completed on 15 July 2020 and involved short-term noise monitoring at ten off-site locations shown in Figure 5.2-4 to collect existing noise levels during the daytime period. The noise field study focused on understanding how the vehicle traffic, existing landfill operations and operations of other facilities within the Site-vicinity Study Area, such as the aggregate pits to the north and the MRF to the east of the Project, influenced the existing acoustic environment. The short-term monitoring locations were carried out on readily accessible public areas near the identified representative PORs, which were generally along the edge of the roads.

Source sound level measurements were carried out at the existing landfill to establish noise emissions of the existing sources of noise to support the characterization of existing noise levels (and subsequent assessment for potential landfill expansion noise impacts in the Site-vicinity Study Area) on 24 August 2020.

The existing acoustic environment in the Site-vicinity Study Area is dominated primarily by road traffic along the local roads and, at certain PORs, existing landfill operations and other facilities in the Site-vicinity Study Area.  Table  summarizes the locations (shown in Figure 5.2-4) and measured noise levels at each of the 10 monitoring locations.

**Table 5.2-4: Summary of Short-term Noise Monitoring Results**

| Noise Measurement ID | Noise Monitoring Location | UTM Coordinates (NAD83 17T) | Measured $L_{eq}$ (dBA)[1] | Measured $L_{90}$ (dBA)[2] |
|---|---|---|---|---|
| M01 | Scotland Drive east of R11 | 482081 mE 4748407 mN | 64 | 37 |
| M02 | Scotland Drive west of R09 | 481151 mE 4748286 mN | 68 | 42 |
| M03 | White Oak Road adjacent to R02 | 480603 mE 4747115 mN | 55 | 49 |
| M04 | Manning Drive between R06 and R07 | 482168 mE 4747050 mN | 66 | 43 |
| M05 | Wellington Road north of R25 | 483644 mE 4747509 mN | 75 | 55 |
| M06 | Wellington Road across from R20 | 483510 mE 4748342 mN | 75 | 59 |
| M07 | Scotland Drive between R12 and R17 | 480016 mE 4748166 mN | 67 | 48 |
| M08 | Manning Drive west of R03 | 480171 mE 4746808 mN | 55 | 36 |
| M09 | Manning Drive between R08 and R50 | 482690 mE 4747110 mN | 60 | 40 |
| M10 | Glanworth Drive between R42 and R43 | 482097 mE 4745785 mN | 75 | 45 |

**Notes:**

[1] $L_{eq}$ – Equivalent (average) sound pressure level

[2] $L_{90}$ – Average sound pressure level exceeded 90% of the time

#### *5.2.2.2 Noise Prediction Modelling*

Noise prediction modelling was carried out for the noise assessment. Landfilling equipment and road traffic were modelled to support the assessment of compliance with MECP guidelines and the assessment of change from existing noise levels.

***Landfill Operations and Ancillary Equipment***

Landfill operations and ancillary equipment were modelled to support the characterization of Project impacts for the assessment of compliance with MECP guidelines and existing conditions and of Project impacts for the assessment of change from existing noise levels. The noise predictions were carried out using the Computer Aided Noise Attenuation (CadnaA) model. The CadnaA noise modelling software (version 2020 MR 1), developed by DataKustik GmbH, is widely accepted for evaluating environmental noise. CadnaA model input parameters are provided in Volume IV Appendix D.02. The prediction method used is

conservative as it assumes that all PORs are downwind from the noise source or that a moderate ground-based temperature inversion exists. In addition, ground cover and physical barriers, either natural (terrain-based) or constructed and atmospheric absorption are included as related specifically to the site. Noise sources for the landfill equipment were characterized by entering the sound power and/or sound pressure octave band spectrum associated with each source. Other parameters including building dimensions, frequency of use, hours of operation, and enclosure attenuation ratings also define the nature of sound emissions.

All landfill operation sources operating within the active area were modelled as a 25 m by 40 m area source, based on the active area of exposed waste. For all landfill operations except for building a berm, it was assumed the active area will be located a minimum of 20 m from the edge of the area of new waste placement to allow for the building of a working berm.

***Road Traffic***

Road traffic was modelled to support the characterization of existing conditions and Project impacts for both the assessment of compliance with MECP guidelines and the assessment of change from existing noise levels. The noise predictions for road traffic were carried out using the MECP's Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT), which is the basis of the DOS-based STAMSON modelling software provided by the MECP.

Existing noise levels due to road traffic were established using Annual Average Daily Traffic (AADT) provided by the City or, for Highway 401 and Highway 402, from published data from the Ontario Ministry of Transportation (MTO) (MTO 2016). The daytime and nighttime period percentages and total truck percentages for local roadways were provided by the City. Speed limits were provided by the City/MTO or determined from readily available public imagery.

#### *5.2.2.3 Existing Noise Levels*

The following presents the existing conditions considered in both the assessment of compliance with MECP guidelines and the change due to the Project relative to existing noise levels.

##### 5.2.2.3.1 MECP Guidelines Assessment

All representative PORs identified in this noise assessment are conservatively described as being located in a Class 3 area, as defined in NPC-300 as a rural area with an acoustical environment that is dominated by natural sounds. Existing conditions in the Site-vicinity Study Area are generally consistent with a Class 3 area; however, based on the existing traffic volumes on specific roads in the area, it is expected that existing noise conditions near some roads may be elevated.

For the noise assessment in accordance with MECP requirements, existing conditions were determined only for the haul route without existing landfill traffic as required by the MECP. Predicted road traffic noise levels for the predictable worst case hour (i.e., the hour when Project impacts are predicted to be the greatest) are presented in Table 5.2-5.

**Table 5.2-5: Predicted Existing Noise Levels Along Haul Route**

| Receptor | Existing One-Hour Road Traffic Noise Level – without Existing Landfill Traffic (dBA) |
|---|---|
| R02 | 48 |
| R04 | 45 |
| R06 | 46 |
| R15 | 46 |
| R19 | 62 |
| R23 | 51 |
| R25 | 59 |
| R50 | 56 |

**Note:** Hour with worst case predicted noise impact due to the Project is the 10:00 to 11:00 hour, as described in Section 9.1.2.1.

#### 5.2.2.3.2 Assessment of Change from Existing Noise Levels

The following section presents the assessment of existing noise levels related to the noise impact assessment to support the EASR for consideration for other disciplines. It does not address any MECP requirements.

To establish existing conditions, the assessment of existing landfill operations considered daily landfilling operations and existing landfill traffic along the off-site haul routes. It was assumed that daily landfilling operations occurred in the western portion of the landfill (i.e., Phase 2 of landfill area).

It was assumed that the landfilling operations scenarios do not occur concurrently. Other activities associated with the landfill may occur but are expected to result in lower noise impacts when compared with the activities listed above and therefore were not further assessed.

Existing landfill operations were predicted over the entire daytime (7 a.m. to 11 p.m.) and nighttime (11 p.m. to 7 a.m.) periods, considering normal operations, site preparation, placement of daily cover, and ancillary equipment. These landfill operating scenarios were time-weighted accordingly, based on operating hours specified above. Predicted existing landfill operations noise levels at representative PORs are presented in Table 5.2-6.

The overall existing noise levels, shown in Table 5.2-6, were calculated by combining the existing road traffic noise levels and the existing landfill operations noise levels.

**Table 5.2-6: Predicted Existing Noise Levels**

| Receptor | Existing Average Road Traffic Noise Level (dBA) - Day | Existing Average Road Traffic Noise Level (dBA) - Night | Existing Average Landfill Operations Noise Level (dBA)- Day | Existing Average Landfill Operations Noise Level (dBA) - Night | Existing Overall Average Noise Level (dBA) - Day | Existing Overall Average Noise Level (dBA) - Night |
|---|---|---|---|---|---|---|
| R01 | 48 | 41 | 50 | 34 | 52 | 42 |
| R02 | 49 | 41 | 50 | 35 | 53 | 42 |
| R04 | 50 | 34 | 35 | 20 | 50 | 34 |
| R06 | 51 | 35 | 46 | 30 | 52 | 36 |
| R10 | 48 | 41 | 43 | 27 | 49 | 41 |
| R15 | 50 | 34 | 51 | 37 | 53 | 39 |
| R16 | 55 | 48 | 40 | 25 | 55 | 48 |
| R19 | 64 | 57 | 30 | 14 | 64 | 57 |
| R23 | 53 | 46 | 31 | 15 | 53 | 46 |
| R25 | 62 | 54 | 31 | 14 | 62 | 54 |
| R50 | 60 | 44 | 36 | 20 | 60 | 44 |

In general, the noise levels from the short-term monitoring exceeded the predicted overall existing noise levels shown in Table 5.2-6, by an average of 5 dB and up to 14 dB.
The largest differences were observed when measurements were taken near other facilities in the Site-vicinity Study Area (i.e., the aggregate pits north of the landfill and the MRF to the east). Site observations indicated these other facilities were major sources of noise for some receptors. Therefore, it is expected that the predicted overall existing noise levels shown in Table 5.2-6 are generally underestimated. This will subsequently result in a conservative assessment for landfill expansion related changes relative to existing noise levels as the predicted relative changes will be greater than what will be experienced.

## 5.3 Geology and Hydrogeology

This section of the EASR provides a summary of the existing hydrogeological conditions in the area underlying and surrounding the W12A Landfill site. The work to characterize existing hydrogeological conditions was carried out as described in the approved Amended ToR (Volume II) and following the Groundwater work plan (provided in Volume III Appendix B.02). The summary includes descriptions and accompanying illustrations of the geological and hydrogeological setting, overburden materials and site hydrogeology. The detailed report is contained in Volume IV Appendix D.03.

The description of existing geological and hydrogeological conditions is based on numerous previous hydrogeological investigations and groundwater monitoring programs completed for

the W12A Landfill area and a supplemental investigation completed in 2019 and 2020 that focused on obtaining additional hydrogeological information related to the expansion alternatives for the W12A Landfill. In addition, to evaluate the nature of the fractures in the upper portion of the Surficial Aquitard and their potential to create a preferred pathway for leachate migration from the landfill expansion, a benched test pit measuring approximately 12 m x 12 m in plan and 5.4 m in depth was completed in November 2019 in the area between the landfill and the MRF. The test pit allowed the fracture characteristics and fracture frequency to be assessed with depth. The work plan for the supplemental investigations is detailed in the Groundwater Work Plan, dated November 2019 (refer to Volume III Appendix B.02).

The location of historical and current boreholes and the test pit at the existing landfill are shown on Figure 5.3-1.

### 5.3.1 Geological and Hydrogeological Setting

In terms of geological setting, the landfill is located on part of the Westminster Moraine, which consists of low permeability till soils identified as the Port Stanley Till. Immediately north of the landfill site, gravel and gravelly sand were formed from the older Catfish Creek drift (located under the Port Stanley Till) or were deposited underneath the Port Stanley Till by subglacial streams.

Major hydrostratigraphic units are divided into aquitards and aquifers. An aquitard consists of low permeability soils that inhibit groundwater flow. An aquifer consists of permeable soils that can transmit large enough quantities of water such that when water wells are installed, they produce usable quantities of water.

In terms of the hydrogeological setting, the Site Study Area is underlain by low permeability Port Stanley Till, which comprises most of the Westminster Moraine. The next major regional hydrogeological feature is an aquifer found beneath the Port Stanley Till, consisting of stratified sand and gravel soils, most likely part of the Catfish Creek Drift. These soil deposits comprise the White Oak Aquifer. The White Oak Aquifer extends as far north as Lambeth and extends southeast to Kettle Creek. The aquifer has an irregular vertical distribution with a maximum thickness of approximately 45 m just north of the landfill along Scotland Drive.

Some local aquifers consisting of sand and gravel soil layers occur in the Port Stanley Till and were probably formed by subglacial processes at the time that the till soils were deposited. These local aquifers are not regionally extensive and generally thinner than the White Oak Aquifer. One such local aquifer is present underneath the landfill (referred to as the Upper Aquifer) and separates the Port Stanley Till into the Surficial Aquitard and a Lower Aquitard, both of which are above the White Oak Aquifer. The Upper Aquifer has not been identified north of Scotland Drive, but is present below the W12A Landfill site and extends south of Manning Drive. The thickness of the Upper Aquifer is variable, ranging from less than 2 m to more than 8 m thick.

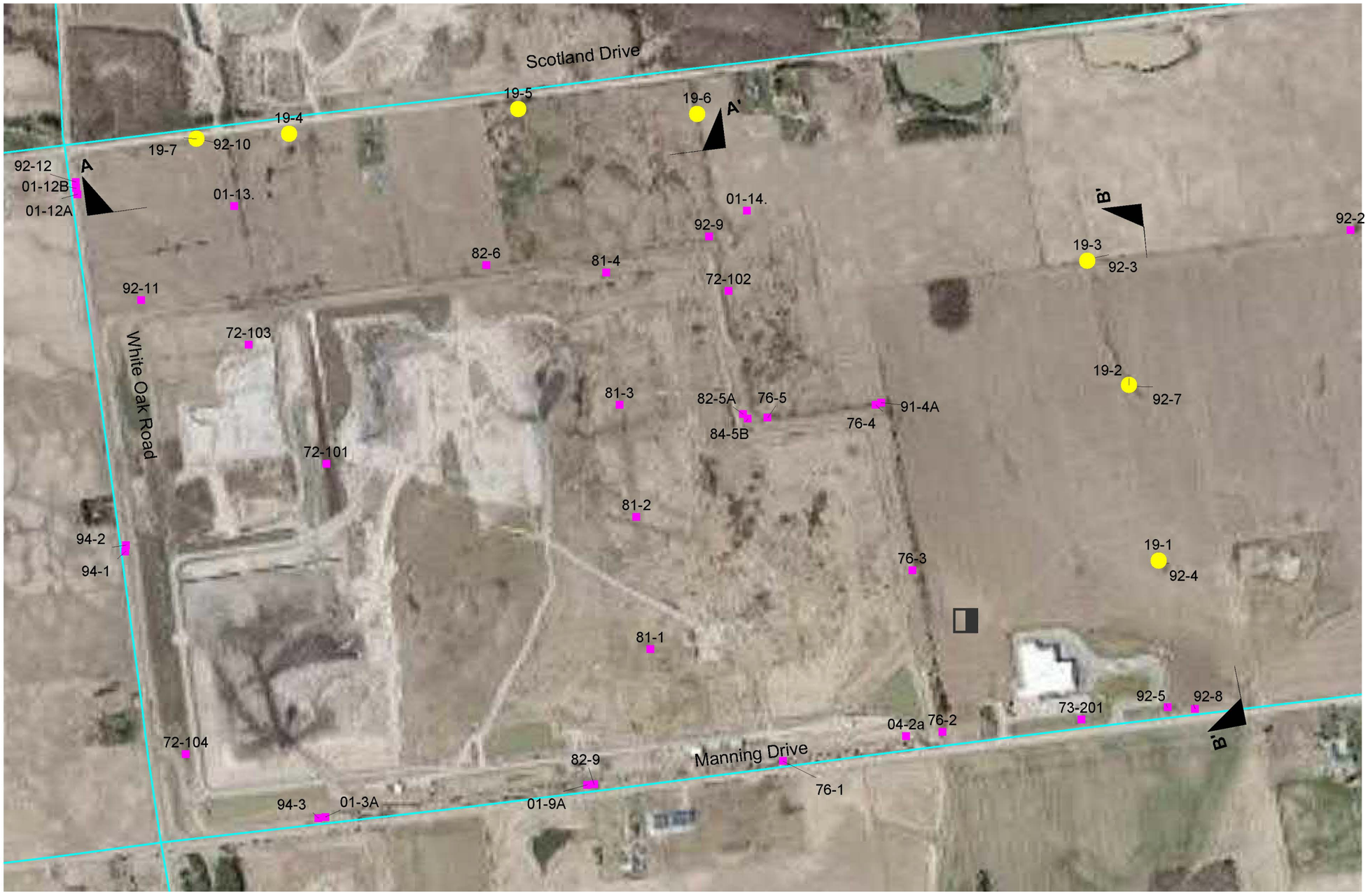
Geological cross-sections illustrating this sequence of overburden deposits are provided on Figure 5.3-2.

The thickness of the Surficial Aquitard varies from as much as 20 m at the northwest corner of the existing W12A Landfill site, to 15 m or greater below much of the existing landfill, and to about 8 m at the southeast corner of the landfill property along Manning Drive. A plan showing the interpreted elevation of the contact between the Surficial Aquitard and the Upper Aquifer beneath the W12A Landfill site is provided on Figure 5.3-3, while a plan showing the distribution of thickness of the Surficial Aquitard is provided on Figure 5.3-4. As illustrated on Figure 5.3-3, the elevation of the contact between the Surficial Aquitard and the underlying Upper Aquifer is relatively consistent below the landfill and adjacent area; as such, the variations in the Surficial Aquitard thickness are more related to surface topography changes than variations in the elevation of the base of the aquitard unit.

Limestone bedrock is found approximately 80 to 90 m below the landfill and slopes downwards from north-northeast.

Municipal water is available to residences near the landfill on Manning Drive, White Oak Road, Scotland Drive and Wellington Road South; however, some of the homeowners have not connected to the available municipal services. These residences, as well as residences and farms further away from the landfill area, rely on individual water supply wells, installed in either the Upper Aquifer or the White Oak Aquifer for their water supply. The annual monitoring program for the W12A Landfill includes sampling and analysis of domestic wells in the area of the landfill site. Monitoring does not indicate any effect from the landfill on the water quality in these wells.

Source water protection studies were carried out for the watersheds in which the City is located. The resulting Source Water Protection Plans delineate source protection areas with respect to municipal drinking water supplies (Wellhead Protection Areas – WHPAs and Intake Protection Zones – IPZs) as well as groundwater recharge areas, assign vulnerability to these source protection areas and describe appropriate land use planning for their protection. There are two Source Protection Regions in the area of and surrounding the W12A Landfill - the Thames-Sydenham and Region (the Upper Thames River Source Protection Area) and the Lake Erie Region Drinking Water Source Protection Region (Kettle Creek Source Protection Area). The primary source of drinking water for the City is surface water from Lake Huron and Lake Erie, with a stand-by backup supply from groundwater from the Hyde Park and Fanshawe well fields located in the northeast and west parts of the City.




# Existing Groundwater Conditions

CORPORATION OF THE CITY OF LONDON

INDIVIDUAL EA OF THE PROPOSED W12A LANDFILL EXPANSION

**HISTORICAL AND CURRENT BOREHOLES AND TEST PITS**

Figure 5.3-1

**LEGEND**

- 2019 Drilling Location
- Historical Borehole Location
- Test Pit Location

Note: See Figure 5.3-2 for Geologic Sections

0 100 200 300 400 m

Scale 1 : 8 000

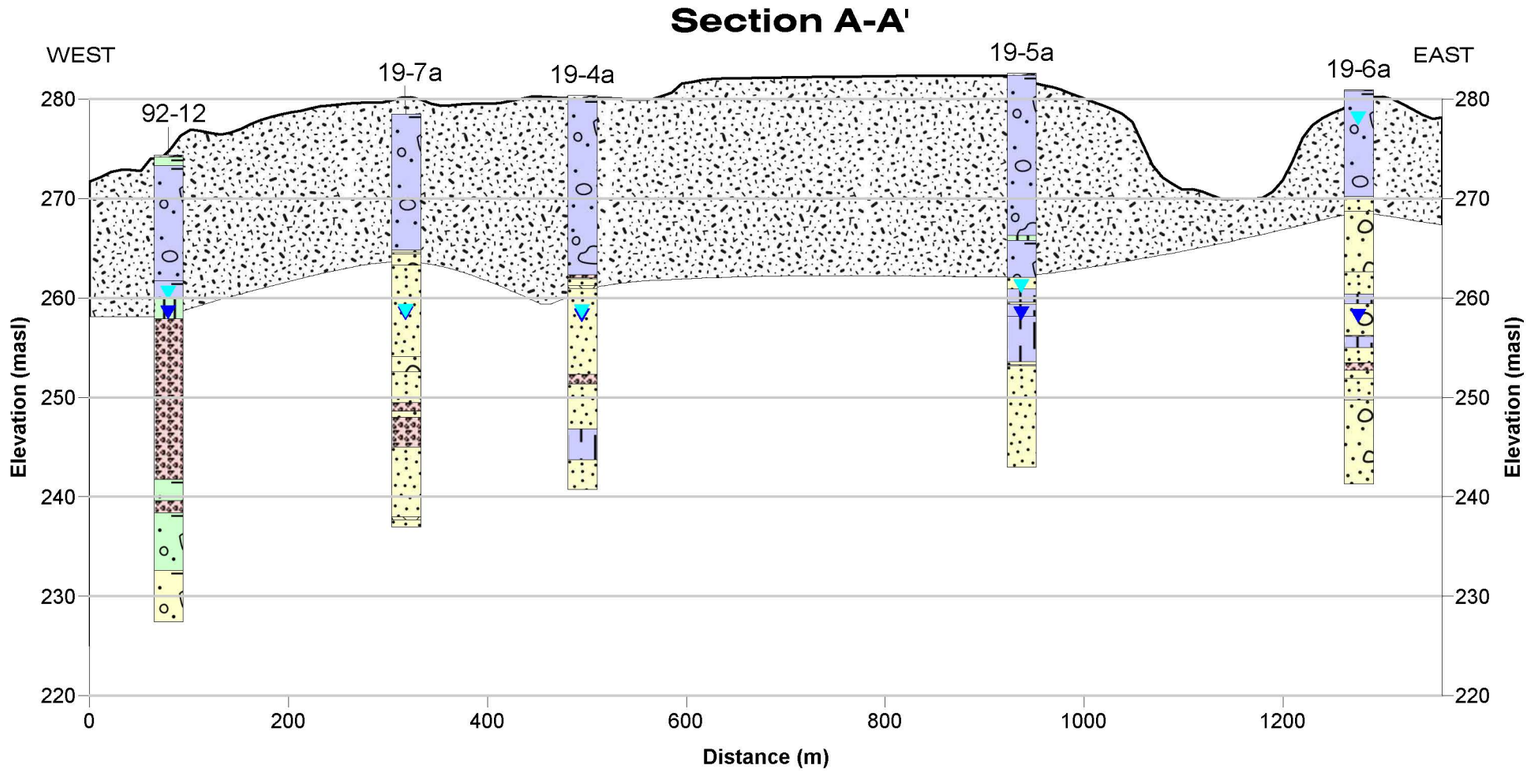
MAP CREATED BY : LOM
MAP CHECKED BY: RFK
MAP PROJECTION: NAD 1983 UTM Zone 18N
2017 AIR PHOTO

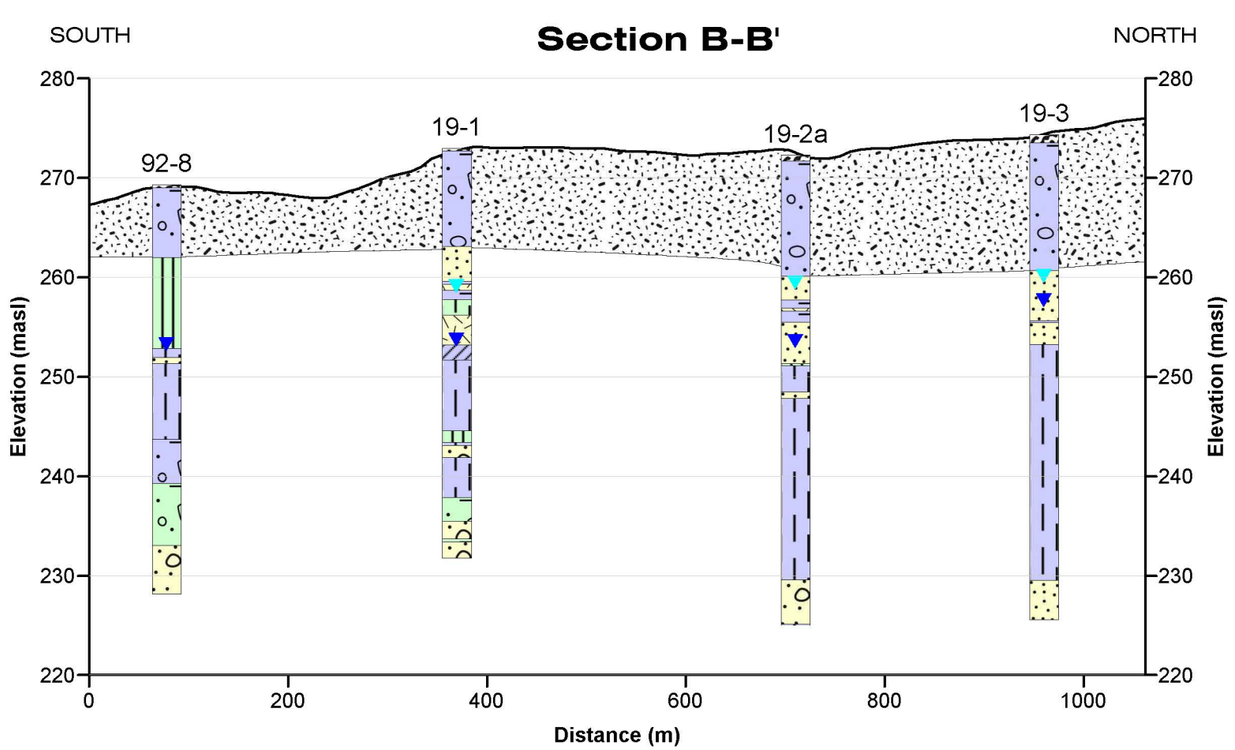
DILLON CONSULTING

PROJECT: 19-1230

STATUS: FINAL

DATE: AUGUST 2020




# Existing Groundwater Conditions

CORPORATION OF THE CITY OF LONDON

INDIVIDUAL EA OF THE PROPOSED W12A LANDFILL EXPANSION

## GEOLOGIC CROSS SECTIONS

Figure 5.3-2

**LEGEND**

- Surficial Aquitard
- Groundwater Level Upper Aquifer
- Groundwater Level White Oak Aquifer
- topsoil
- clay
- silty clay
- silty clay till
- clayey silt
- clayey silt till
- sandy silt
- sandy silt till
- silty sand
- silty sand till
- sand
- sand and gravel
- gravel

Note: See Figure 5.3-1 for Geologic Section Locations

0 100 200 300 m

Scale 1 : 6 000

NOTE: VERTICAL SCALE EXAGGERATED 10x

MAP CREATED BY : LOM
MAP CHECKED BY: RFK

DILLON CONSULTING

PROJECT: 19-1230

STATUS: FINAL

DATE: JULY 2020

# Existing Groundwater Conditions

CORPORATION OF THE CITY OF LONDON

INDIVIDUAL EA OF THE PROPOSED W12A LANDFILL EXPANSION

**UPPER AQUIFER SURFACE ELEVATION**
Figure 5.3-3

**LEGEND**

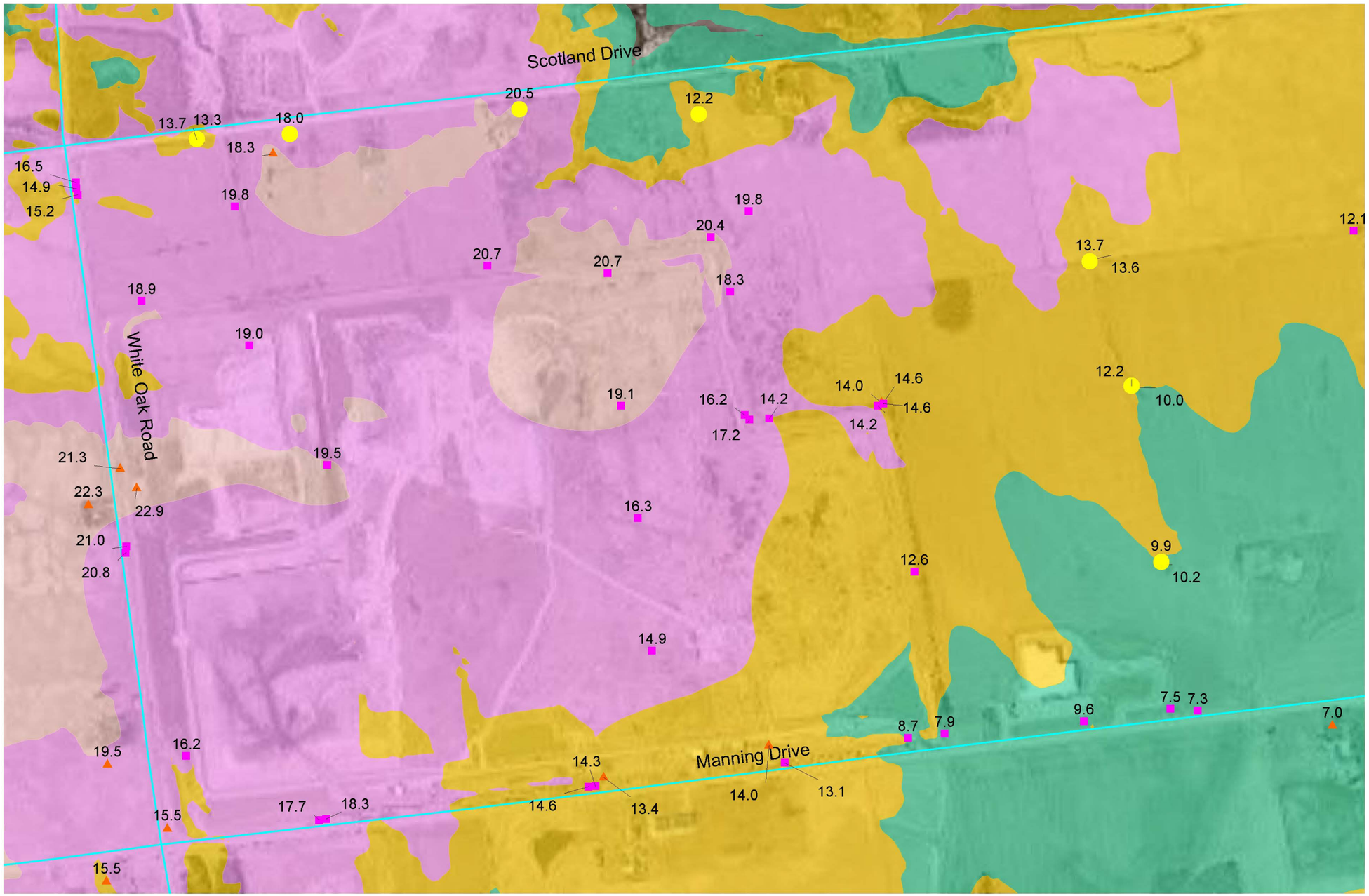
- 2019 Drilling Location
- Historical Borehole Data
- Water Well Record Data
- 260.1 Elevation of Upper Aquifer (masl)
- 260 Upper Aquifer Surface Contour (masl)

0 100 200 300 400 m
Scale 1 : 8 000

MAP CREATED BY : LOM
MAP CHECKED BY: RFK
MAP PROJECTION: NAD 1983 UTM Zone 18N
2017 AIR PHOTO

DILLON CONSULTING

PROJECT: 19-1230
STATUS: FINAL
DATE: AUGUST 2020




## Existing Groundwater Conditions

CORPORATION OF THE CITY OF LONDON

INDIVIDUAL EA OF THE PROPOSED W12A LANDFILL EXPANSION

### SURFICIAL AQUITARD THICKNESS

Figure 5.3-4

**LEGEND**

20
Thickness of Surficial Aquitard (m)
15
10
5

2019 Drilling Location

Historical Borehole Data

Water Well Record Data

12.6
Surficial Aquitard Thickness (m)

0 100 200 300 400 m

Scale 1 : 8 000

MAP CREATED BY : LOM
MAP CHECKED BY: RFK
MAP PROJECTION: NAD 1983 UTM Zone 18N
2017 AIR PHOTO

DILLON CONSULTING

PROJECT: 19-1230

STATUS: FINAL

DATE: AUGUST 2020

All of these sources are distant from the W12A Landfill. The closest municipal well field to the W12A Landfill is the Belmont well field (Kettle Creek Source Protection Area) located 10 km east of the landfill. The capture area for the Belmont well field extends to the north of Belmont and not in the direction of the landfill. There are no source water protection areas identified on or in the area of the W12A Landfill. As such, neither the existing landfill nor the proposed expansion are influenced by planning considerations or requirements related to source water protection.

### 5.3.2 W12A Landfill Site Hydrogeology

Groundwater flow in the Surficial Aquitard is principally vertically downward under a high vertical hydraulic gradient. The water level in the underlying Upper Aquifer is below the surface of the aquifer, which results in the high vertical gradient. The significantly weathered and fractured clay that occurs at surface and extends within the first 5 m will have a horizontal component of groundwater flow. The upper portion of the Surficial Aquitard is weathered and fractured. The degree of significant fracturing decreases with depth such that the shallower fractured till zone is more hydraulically active than the lower less fractured till soil. Generally, regional studies have indicated that the tills are highly fractured to a depth of 3-4 m, a transitional zone occurs beneath the highly weathered and fractured soil with isolated vertical fractures occurring to depths of approximately 6 m. The occurrence and pattern of fractures observed in the test pit put down in 2019 were consistent with this general description. Studies completed by the University of Western Ontario and Dillon in 2000 on Phase 1 of the landfill (where excavation depths of landfill cells were less than those in Phase 2) indicated that the depth of active fractures beneath the waste fill is less than 2 m and that desiccation fractures in till soils occurring during landfill cell construction are “self-healing” and do not create a preferential pathway for groundwater flow.

Groundwater moves downward at an estimated velocity of 1 to 2 centimetres (cm) per year in the Surficial Aquitard. The estimated travel time through the Surficial Aquitard has been estimated to be in the order of 700 years. The Surficial Aquitard provides physical separation between the base of the landfill and the Upper Aquifer and natural hydrogeologic protection of the groundwater in the Upper Aquifer from landfill leachate effects. The ongoing landfill site groundwater monitoring program shows that the Upper Aquifer groundwater has not been affected by landfill leachate.

Groundwater flow in the Upper Aquifer is shown on Figure 5.3-5. As indicated on the figure, groundwater flows from the northeast to the southwest.

Figure 5.3-6 illustrates the water level in the White Oak Aquifer. Groundwater elevations are highest in the northwest near Scotland Drive and White Oak Road and decrease to the southeast. Based on previous assessments (Dillon, 2015), the ponds in the gravel pits north of Scotland Drive are directly hydraulically connected to the White Oak Aquifer and cause an elevated groundwater elevation in this area. Groundwater elevations decrease to the southeast. Groundwater flow in the White Oak Aquifer in the area of the landfill is in a general north to south/southeast direction.