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Environmental Assessment of the Proposed W12A Landfill Expansion, City of London

GOLDER

London
CANADA

7.0 Evaluation and Comparison of Landfill Expansion Alternatives

7.1 Methodology

In this section, the predicted effects for each ‘Alternative Method’ are described (Step 3 of the EA process described in Section 3.0 of this EASR), and the ‘Alternative Methods’ compared (Step 4).

As described in Section 6.0 of this EASR, three ‘Alternative Methods’ for expansion of the W12A Landfill were developed. These alternatives are referred to as:

- Alternative 1 – Vertical Expansion Over Existing Footprint (Figure 6.2-1);
- Alternative 2 – Horizontal Expansion to the North and Vertical Expansion Over Part of the Existing Footprint (Figure 6.2-2); and
- Alternative 3 – Horizontal Expansion to the East and Vertical Expansion Over Part of the Existing Footprint (Figure 6.2-3).

In accordance with the approved Amended ToR, there are a total of 12 components (e.g., atmosphere, surface water, biology, etc.) and 18 sub-components (e.g., air quality, noise, surface water quality, etc.) that have been considered in the assessment. For further clarification, the components represent a high level aspect of the environment, each of the sub-components represents a specific aspect of the environment, and the indicators represent a potential effect of the project. A detailed description of the components, sub-components and indicators used for this assessment are provided in Table 3.3-1 of Section 3 of this EASR

Section 7.2 of this EASR discusses the predicted or expected effects for each ‘Alternative Method’ in the context of each component and sub-component using the indicators. The indicators that represent a potential effect of the project were further described by identifying factors that might differentiate between the ‘Alternative Methods’. Subsequently, each expansion alternative was comparatively evaluated using either qualitative, quantitative or a combination of each method, as well an assessment of advantages and disadvantages was completed.

The next step in the EA process was to compile the individual component and sub-component comparative evaluations of ‘Alternative Methods’ and select the overall preferred method of landfill expansion (refer to Section 7.4 of this EASR).

7.2 Assessment of Net Environmental Effects for ‘Alternative Methods’ and Component Comparison of ‘Alternative Methods’

The assessment of net environmental effects for the ‘Alternatives Methods’ is provided below for each component and sub-component. It is noted that this assessment also indicated if additional mitigation measures, beyond those included in the proposed expansion design or normal operating practices at the Site, are required to achieve site compliance with provincial standards. None of these additional mitigation measures were identified as required. Additionally, during this assessment all the ‘Alternative Methods’ were found to be fundamentally approvable under the EPA and hence no changes were proposed to the ‘Alternative Methods’.

During various consultation activities conducted during this EA, stakeholders did not identify any additional ‘Alternative Methods’ for consideration.

Following assessment of net environmental effects of the ‘Alternative Methods’ based on the components and sub-components, the component level comparison of the ‘Alternative Methods’ was completed.

7.2.1 Atmosphere

The Atmosphere environment component comprises two sub-components:

- Air quality (including dust, odour, GHG); and
- Noise.

Landfill expansion and associated operations can produce gases containing contaminants that degrade air quality, lead to levels of particulates (dust) in the air and result in odour effects. Landfill expansion and associated operations will generate noise that will be emitted into the atmosphere and could affect off-site points of reception (PORs).

The atmosphere assessment for each of the environmental sub-components is summarized in the following sections.

7.2.1.1 Air Quality

In accordance with the approved Amended ToR, the indicators to be considered for air quality are:

- Expected concentrations of air quality indicator compounds (selected regulated air contaminants to represent this type of project) at the property area boundary;
- Expected site-related odour at sensitive Points of Reception (PORs); and
- Expected GHG emissions.

The factors considered to differentiate between the 'Alternative Methods' for landfill expansion from the perspective of the air quality indicators were selected because they are most likely to have the potential to result in an adverse effect. The evaluation of each expansion alternative considered the following factors:

- The maximum predicted off-site concentration of vinyl chloride;
- The waste footprint area and height of the expanded landfill in each of the 'Alternative Methods';
- Proximity of PORs in the predominant wind direction; and
- The surface area of the waste footprint for the expansion for each of the 'Alternative Methods', to assess the variation in GHG emissions.

The first factor was assessed quantitatively and the last three factors were assessed qualitatively.

The maximum predicted off-site concentration of vinyl chloride - The maximum predicted off-site concentration of vinyl chloride using US EPA LandGEM and AERMOD models for each alternative was assessed quantitatively. Vinyl chloride was selected for this assessment as it is one of the common LFG constituents and has a relatively low air quality criterion, compared to other volatile organic compounds typical of landfill gas. It is also predominantly released from the waste footprint area, which is the only variable that differs among the alternatives in terms of the release of vinyl chloride.

This 'Alternative Methods' assessment has been carried out as described in Section 4.3 Step 3: Qualitative and Quantitative Evaluation of 'Alternative Methods' of the Atmosphere Work Plan – Revision 2, dated December 2019 (the Workplan) as provided in this EASR in Appendix B (Volume III).

The assessment for vinyl chloride was completed as follows:

1. Vinyl chloride emission rates from the landfill cap from each 'Alternative Method' were calculated using the US EPA LandGEM model. The waste footprint area does not have any other significant sources of vinyl chloride emissions. Vinyl chloride emissions may also be released from the landfill gas flare but, given the high destruction efficiency (~98 to 99%), these are expected to be insignificant. Additionally, emissions from the flare will not vary significantly between the alternatives. The maximum potential waste throughputs (500,000 tonnes per year) were used in calculating the vinyl chloride emission rates.

   LandGEM was run using historic waste tonnage information and future maximum annual waste inputs to obtain the maximum LFG flow rate from the cap, assuming a lifespan of the landfill from 1977 through the end of 2048. The key input parameters for the LandGEM model are the projected annual tonnages of waste disposed of in the waste footprint area, the LFG production potential (L_o) and the LFG generation rate factor (k).

The following MECP default values for L_o and k were used in the LFG generation estimates as described in the MECP Interim Guide to Estimate and Assess Landfill Air Impacts (MECP, 1992):

$$L_o = 125\ m^3/tonne$$

$$K = 0.04\ year^{-1}$$

Historical disposal values were obtained from the 2019 W12A Landfill Status Report, while future disposal rates were conservatively assumed to be 500,000 tonnes per year (the maximum annual tonnage). It is noted that this conservative disposal rate used for modelling purposes would result in more waste being disposed of in the landfill over its lifetime than what is allowed. Emission rates were extracted for the year that results in the highest landfill gas generation (i.e., 2050).

2. A simplified AERMOD air dispersion model, which included the vinyl chloride emissions (i.e., through the landfill cap), was created for each ‘Alternative Method’ and run to obtain estimated vinyl chloride concentrations at the property area boundary.

   Emissions from the landfill cap were modelled using an area source based on the waste footprint area and a release height based on half the maximum height of the landfill to conservatively estimate predicted concentrations of vinyl chloride. This approach is consistent with MECP expectations for modelling landfills and current modelling practices using AERMOD.

   The maximum predicted concentration for each alternative was then compared to the Ontario Ambient Air Quality Criteria (AAQC) of 1 µg/m^3 for vinyl chloride on a 24-hour averaging period and 0.2 µg/m^3 on an annual averaging period. The Ontario Regulation 419/05 Schedule 3 limit for vinyl chloride is also 1 µg/m^3 on a 24-hour averaging period.

Table 7.2-1, below, presents the input parameters that were used in the AERMOD air dispersion models for each ‘Alternative Method’.

Table 7.2-1: Dispersion Modelling Input Parameters per Area Source

‘Alternative Method’ of Landfill Expansion	Source	Release Height (m)	Total Footprint Area (ha)	Maximum Emission Rate (g/s)	Maximum Emission Rate per m^2 (g/s-m^2)
1	Landfill Cap	26	107	0.0153	1.42E-08
2	Landfill Cap	19	134	0.0153	1.14E-08
3	Landfill Cap	21	135	0.0153	1.13E-08

Table 7.2-2, below, summarizes the quantitative results of the dispersion modelling of each ‘Alternative Method’. Concentrations presented below are the maximum off-property concentrations.

Table 7.2-2: Emission Summary– Vinyl Chloride

'Alternative Method' of Landfill Expansion	Landfill Cap Emission Rate [g/s]	Maximum Predicted Concentration [µg/m³]	Averaging Period	Ontario AAQC [µg/m³]	Percentage of AAQC [%]
1	0.0153	1.97E-01	24-hr	1	19.7%
		2.92E-02	Annual	0.2	14.6%
2	0.0153	2.15E-01	24-hr	1	21.5%
		3.99E-02	Annual	0.2	20.0%
3	0.0153	2.27E-01	24-hr	1	22.7%
		3.16E-02	Annual	0.2	15.8%

Vinyl chloride concentrations for all three 'Alternative Methods' are below the relevant AAQC of 1 µg/m³ on a 24-hour averaging period and 0.2 µg/m³ on an annual basis. At 22.7% of the 24-hour AAQC, Alternative 3 has the highest vinyl chloride concentration at or beyond the property area boundary. Alternative 2 has the highest annual concentration at 20% of the annual AAQC. However, the estimated vinyl chloride emissions for each of the alternatives are virtually the same; as such, the three expansion alternatives are considered to be equally preferred.

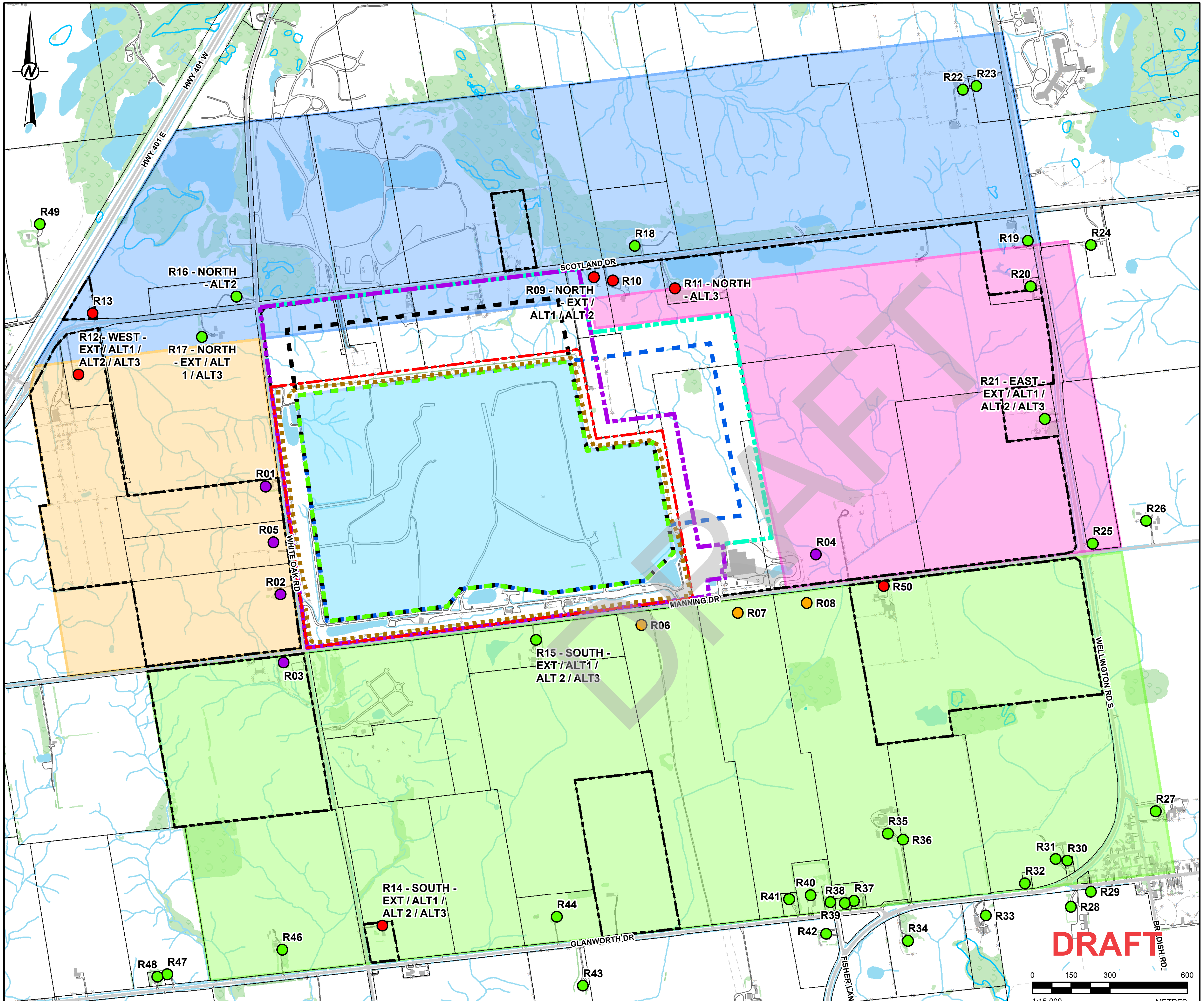
<u>The waste footprint area and height of the expanded landfill in each of the 'Alternative Methods'</u> – Alternative 2 has the lowest vertical extent (height above ground) of the 'Alternative Methods', which is expected to result in the least dispersion of air emissions and consequently higher concentrations at and beyond the property area boundary. Alternative 1 has the highest vertical extent of the 'Alternative Methods' and is anticipated to result in greater dispersion of air emissions and lower off-property concentrations. Comparatively, the surface area of the landfill final cap for each alternative will impact dilution of emissions. As a result, the impact of these two variables (i.e., release height and surface area of the final cap) is best assessed quantitatively. Based on the quantitative assessment in the previous section the three expansion alternatives are considered to be equally preferred.

<u>Proximity of PORs in the predominant wind direction</u> – A figure showing the PORs is provided in Figure 7.2-1. The shortest distance between the waste footprint area and an existing POR is 160 m to the North for Alternative 2. This POR is an existing residence located near the North property boundary along Scotland Drive and is in the predominant wind direction, noted as POR R009 on Figure 7.2-1. There is a cluster of residences at this location that is considered North for all expansion alternatives. As a result, Alternative 2 is the least preferred option when evaluating the proximity of sensitive PORs. The nearest POR distances for each alternative are presented in **Table 7.2-3**.

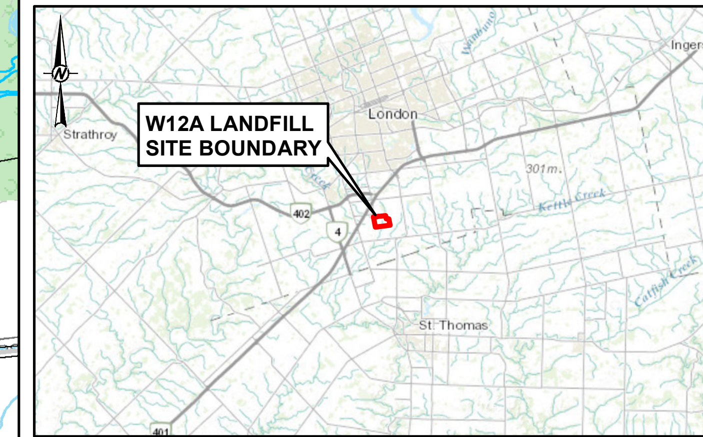
Table 7.2-3: Summary of W12A Landfill Expansion 'Alternative Methods'

Item	Existing Landfill	Alternative 1	Alternative 2	Alternative 3
Total Waste Footprint Area (ha)	107	107	134	135
Peak Waste Elevation (masl)	292	317.7	309.8	311.8
Height of Peak above Average Ground Elevation (m), including final cover	17	43	36	38
Distance to nearest Existing POR (m)*	North: 350 m East: 1520 m South: 190 m West: 860 m	North: 350 m East: 1520 m South: 190 m West: 860 m	**North: 160 m** East: 1520 m South: 190 m **West: 840 m**	North: 240 m **East: 1240 km** South: 190 m West: 860 m
Landfill Expansion Surface Area [ha]	—	109 ha	106 ha	108 ha

Note: *Nearest POR in each direction in bolded font



KEY MAP



SCALE 1:750,000

LEGEND

- CITY OWNED PROPERTY - EXISTING
- CITY OWNED PROPERTY - VACANT
- NON-CITY OWNED PROPERTY - EXISTING
- NON-CITY OWNED PROPERTY - VACANT
- WATERCOURSE
- DRIVEWAY
- FENCELINE
- TRAIL
- APPROXIMATE BERM LOCATION
- BUILDING FOOTPRINT
- WOODED AREA
- WATERBODY
- CITY OWNED PROPERTY
- EXISTING PROPERTY BOUNDARY
- PROPOSED PROPERTY BOUNDARY (ALTERNATIVES 1 & 2)
- PROPOSED PROPERTY BOUNDARY (ALTERNATIVE 3)
- EXISTING APPROVED LIMIT OF WASTE
- PROPOSED LIMIT OF WASTE (ALTERNATIVE 1)
- PROPOSED LIMIT OF WASTE (ALTERNATIVE 2)
- PROPOSED LIMIT OF WASTE (ALTERNATIVE 3)
- EASTERN SECTION
- NORTHERN SECTION
- SOUTHERN SECTION
- WESTERN SECTION

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

CLIENT
CORPORATION OF THE CITY OF LONDON

PROJECT
INDIVIDUAL EA OF THE PROPOSED W12A LANDFILL EXPANSION

TITLE
AIR AND NOISE EVALUATION AND COMPARISON OF LANDFILL EXPANSION ALTERNATIVES

CONSULTANT
GOLDER

YYYY-MM-DD	2020-03-04
DESIGNED	----
PREPARED	JEM
REVIEWED	----
APPROVED	----

PROJECT NO.	PHASE	REV.	FIGURE
1648176	0012	A	7.2-1

25mm
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM

The surface area of the expansion waste footprint – For the purposes of evaluating the greenhouse gas emissions from the 'Alternative Methods', it was assumed that the alternative with the largest surface area within the waste footprint area for placement of expansion waste will contribute to the largest GHGs, and would be the least preferred alternative. As shown in **Table 7.2-3**, since the surface areas of the expansion for each of the alternatives are virtually the same, the three expansion alternatives are considered to be equally preferred from a GHG emissions perspective.

Based on the above quantitative evaluation of vinyl chloride emissions and the rationale provided above for each of the differentiating factors, the alternative assessment as summarized in Table 7.2-4 results in Alternative 1 being identified as the most preferred from an air quality perspective.

Table 7.2-4: Air Quality Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Predicted concentrations of air quality indicator compounds at the property area boundary	The maximum predicted off-site concentration of vinyl chloride	19.7% or 14.6% of the 24-hr or annual AAQC Equally preferred	21.5% or 20.0% of the 24-hr or annual AAQC Equally preferred	22.7% or 15.8% of the 24-hr or annual AAQC Equally preferred
	The footprint area and height of the landfill in each of the 'Alternative Methods'	Area = 107 ha and elevation = 317.7 masl; see quantitative assessment for vinyl chloride Equally preferred	Area = 134 ha and elevation = 309.8 masl; see quantitative assessment for vinyl chloride Equally preferred	Area = 135 ha and elevation = 311.8 masl; see quantitative assessment for vinyl chloride Equally preferred
Expected site-related odour at sensitive PORs	Proximity of existing PORs in the predominant wind direction	Equal or farthest distance to PORs Most Preferred	Equal or closest distance to PORs Least Preferred	Equal or slightly closer distance to PORs Less Preferred
Expected GHG emissions	Surface Area for placement of waste in the expansion (m^2)	109 ha Equally Preferred	106 ha Equally Preferred	108 ha Equally Preferred
Preferred Alternative for Air Quality		**Most Preferred**	**Least Preferred**	**Less Preferred**

In addition to the comparative evaluation using the indicators and factors of differentiation, the advantages and disadvantages identified by the comparative evaluation are shown in **Table 7.2-5**.

Table 7.2-5: Evaluation of Advantages and Disadvantages for Air Quality

Air Quality	Advantages	Disadvantages
Alternative 1	Results in the lowest predicted off-site concentrations of air quality contaminants, although only small differences among alternatives. This alternative is the least likely to impact sensitive PORs from an odour nuisance perspective.	None
Alternative 2	None.	This alternative is the most likely to impact off-site sensitive PORs from an odour nuisance perspective.
Alternative 3	This alternative is less likely than Alternative 2, but more likely than Alternative 1 to impact sensitive off-site PORs from an odour nuisance perspective.	None

7.2.1.2 Noise

In accordance with the approved Amended ToR, the indicator to be considered for Noise is:

- Noise Levels at off-site noise sensitive land uses with POR(s) where human activity is expected to occur.

The factors considered to differentiate between the 'Alternative Methods' for landfill expansion from the perspective of the noise indicator were selected because they are most likely to have the potential to result in an adverse effect. The evaluation of each expansion alternative considered the following factors that were assessed quantitatively:

- Increase of maximum height of the landfill above grade elevation;
- Shortest potential distance of landfill activities to any POR;
- Direction of the nearest POR from the landfill;
- Maximum potential change in noise level (dB); and
- Compliance with Noise Level Limits.

Identification of PORS – The PORs will be identified in accordance with Ontario Ministry of the Environment, Conservation and Parks (MECP) *Environmental Noise Guideline – Stationary and Transportation Sources – Approval and Planning Publication NPC-300* (NPC-300) dated August 2013 (NPC-300). Noise impacts will be assessed in accordance with NPC-300 and the MECP *Noise Guidelines for Landfill Sites, October 1998* (Landfill Guideline). The Landfill Guideline specifically deals with landfilling activities and specifies the respective sound level limits, while NPC-300 covers other noise sources that could operate at the landfill (i.e., stationary noise sources and ancillary activities) and defines PORs. The Landfill

Guideline and NPC-300 each provide definitions for a POR. Based on previous experience with similar projects it is expected the MECP will apply the definition in NPC-300 to this project.

Existing PORs are located in all directions from the landfill with the greatest concentration of existing PORs directly adjacent to the landfill located to the west, north and south; to the east, PORs are located greater than 1 kilometre from the east limit of the area being considered to accommodate the landfill expansion. The POR layout is presented in the attached site plan Figure 7.2-1 and each POR has been assigned a number. This figure was prepared using information provided by the City, including the City figure *W12A Landfill 2019 Annual Report – Map 4*. The following are key aspects regarding the land use and PORs:

- The lands bounded by White Oak Road (west), Scotland Drive (north), Manning Drive (south) and Wellington Road South (east) are primarily City-owned lands and extend eastward beyond the defined Waste Management Resource Recovery Area (WMRRA);
- The existing POR north of the Landfill and south of Scotland Drive is within the proposed property boundary for each landfill expansion alternative and is proposed to be demolished and the land will remain vacant and re-zoned to allow waste management. The other PORs owned by the City are proposed to remain unless there are technical reasons for them to be removed; and
- City-owned lands west of the Landfill along White Oak Road are vacant and will no longer include residential dwellings or other noise sensitive uses.

In NPC-300, it states "*A land use that would normally be considered noise sensitive, such as a dwelling, but is located within the property boundaries of the stationary source is not considered a noise sensitive land use*". Therefore, any PORs within the landfill expansion proposed property boundary will not be assessed. The MECP confirmed the following regarding POR(s) for the noise assessment in June 2020 after a pre-consultation meeting in May 2020:

1) For existing sensitive properties (houses): These properties need to be assessed for noise emissions, and appropriate control measures (if warranted) should be recommended and installed;
2) For future sensitive properties (vacant lots): These properties need to be assessed for noise emissions, and appropriate control measures (if warranted) should be recommended. The installation of these control measures (if warranted) can be deferred to future dates following the development of sensitive buildings on these vacant lots; and
3) For existing sensitive properties (houses) that will be made vacant by the City: These properties need to be assessed for noise, and appropriate control measures (if warranted) should be recommended. The installation of these control measures (if warranted) can be deferred to future dates when these sensitive buildings will be re-occupied.

For the purposes of this 'Alternative Methods' comparison, the following existing PORs were considered: those on: 1) non-City owned lands, and 2) City-owned lands outside the landfill expansion proposed property boundary. In addition, only existing PORs were assessed and the potential noise impact on vacant lots that can accommodate noise sensitive uses were not directly considered, whether on City-owned or non-City owned lands. The review of vacant lots will be completed during the detailed impact assessment for the preferred expansion alternative.

A semi-quantitative assessment of the three 'Alternative Methods' was completed to evaluate the potential impacts on noise levels. The assessment was completed in relation to MECP noise guidelines: NPC-300 and the Landfill Guidelines, and focused on the landfilling operations as this activity differed among the alternatives. The assessment of ancillary facilities and off-site vehicles will be carried out in the assessment of the preferred alternative. The factors considered to differentiate between the 'Alternative Methods' for the landfill expansion, from the perspective of noise, were selected because they have the greatest potential to result in an adverse effect. These consist of: the potential acoustic exposure and the proximity of the landfilling activities to the existing POR(s), the potential change in noise levels in relation to the existing landfill activities, and compliance of the alternatives in relation to applicable noise limits. These factors are further discussed below.

<u>Increase of maximum height of the landfill above grade elevation</u> – The height of the currently approved landfill peak above ground is 17 m. All three alternatives will increase the maximum height of the landfill above grade elevation; Alternative 1 has the greatest increase of 26 m, then Alternative 3 with an increase of 21 m and Alternative 2 with an increase of 19 m. The increase in height is expected to have minimal potential effect on the maximum expected noise levels at PORs to the east and west that are located more than 500 m from the landfill, but could affect the maximum noise levels at the PORs that are closer to the north and south boundary due to greater exposure over the existing landfill perimeter berms. The PORs closest to the north and south have the potential for the greatest change in the maximum noise levels, although noting that distance is the more dominating factor in assessing potential for this change rather than line-of-sight.

<u>Shortest potential distance of Landfill activities to any POR and direction of the nearest POR from the Landfill</u> – Table 7.2 6, below, presents the minimum distances to existing PORs from the landfill activities, which were considered to predict the potential increases in noise levels.

Table 7.2-6: Minimum Distances (m) to Existing PORs from Landfill Activities

Direction [1]	Type of POR	Current	Alternative 1	Alternative 2	Alternative 3
North	City owned	~ 350	~ 350	~ 160	**~ 240** [3]
	Non-City owned	~ 440	~ 440	**~ 240** [3]	~ 440
East	City owned	~ N/A [2]	~ N/A [2]	~ N/A [2]	~ N/A [2]
	Non-City owned	~ 1520	~ 1520	~ 1520	**~ 1240**
South	City owned	~ 1200	~ 1200	~ 1200	~ 1200
	Non-City owned	~ 190	~ 190	~ 190	~ 190
West	City owned	~ 860	~ 860	**~ 840**	~ 860
	Non-City owned	~ N/A [2]	~ N/A [2]	~ N/A [2]	~ N/A [2]

Notes: [1] Relative to the future landfill waste footprint limits.

[2] There are no existing PORs located in this direction relative to the landfill waste limits or were considered in another direction.

[3] This POR is different than the POR identified for the other alternatives.

Where distances to PORs have decreased when compared to the current landfill activities, the values are presented in **bold** text in Table 7.2 6. Alternative 1 results in no change in distance to any of the PORs, but for Alternative 2 and Alternative 3 the landfill activities can move closer to the PORs with Alternative 2 resulting in a greater number of PORs being approached. The changes in distances and the potential change in noise levels are further analyzed below.

Maximum potential change in noise level (dB) – Based on information about the existing landfill, a berm is currently located along the northern, western, southern and part of the eastern property lines of the landfill; however, it is not expected to provide noise mitigation as it is too low to reduce the line-of-sight of any of the PORs to the landfill expansion 'Alternative Methods'. Any increase in maximum landfill height over the existing approved maximum height is expected to have a potential impact on the exposure to noise to any of the PORs. This is an important consideration as noise levels at a POR can be impacted by the line-of-sight to a noise generating activity; this will be considered through the quantitative noise assessment completed in support of the assessment of the preferred alternative.

Although direct line-of-sight exposure to a source is an important factor, in the outdoor environment, other than altering the noise emissions of the activities, the distance of the noise generating activity to a POR is one of the most dominant factors in determining the potential noise levels at the POR. As distance increases, noise levels typically decrease. At the distances applicable to the landfill, the activities act like point sources, and the predicted noise levels at increased/decreased distances can be estimated using the following formula.

$$dBA_{(X_1)} = dBA_{(X_{ref})} - 20 \times \log\left(\frac{X_i}{X_{ref}}\right) \quad \boxed{\text{Equation}}$$

In the Landfill Guideline, the MECP provides guidance for a qualitative assessment of expected changes in noise levels when assessing “off-site vehicles”. This qualitative assessment criterion has been considered appropriate for the purposes of this assessment of alternatives. Table 7.2-7 summarizes the qualitative rating of an increase in sound level.

Table 7.2-7: Landfill Guideline Qualitative Rating of Increases in Sound Levels

Sound Level Increase (dB)	Qualitative Rating
1 to 3 inclusive	Insignificant
3 to 5 inclusive	Noticeable
5 to 10 inclusive	Significant
10 and over	Very significant

As discussed above, for a given operating scenario the distance between the source and POR has the greatest influence on potential noise levels. The potential acoustic performance of topographical features such as property line berms generally have less of a noise impact. Accordingly, the noise assessment focused on the respective changes in distances between the existing and proposed landfilling activities, and the identified existing PORs.

Using Equation 1, the potential increases in noise levels when compared with the current worst-case landfilling activities for each of the ‘Alternative Methods’, due to distance alone, was predicted. These potential increases, without noise mitigation measures, are presented in Table 7.2-8.

Table 7.2-8: Potential Increases in Noise Levels (dB)

Direction	Type of POR	Current	Alternative 1	Alternative 2	Alternative 3
North	City owned	-	0	7	3
	Non-City owned	-	0	5	0
East	City owned	-	N/A[1]	N/A[1]	N/A[1]
	Non-City owned	-	0	0	2
South	City owned	-	0	0	0
	Non-City owned	-	0	0	0
West	City owned	-	0	0	0
	Non-City owned	-	N/A[1]	N/A[1]	N/A[1]

Note: [1] There are no existing PORs located in this direction relative to the landfill waste limits or were considered in another direction.

Considering distance alone, Alternative 1 is not expected to increase the worst-case noise impact at any PORs when compared to the current landfill activities. Alternative 2 could result in increases of up to 7 dB at PORs to the north. According to the Landfill Guideline, this would result in a qualitative rating of 'significant'. At all remaining PORs, no increase in worst-case noise impact from Alternative 2 is expected when compared to the current landfill activities and considering distance alone. Alternative 3 could result in increases of up to 3 and 2 dB at PORs to the north and east, respectively. According to the Landfill Guideline, this would result in a qualitative rating of 'insignificant'. At all remaining PORs, no increase in worst-case noise impact from Alternative 3 is expected when compared to the current landfill activities and considering distance alone.

Compliance with Noise Level Limits – As discussed above, the Landfill Guideline specifically deals with landfilling activities and specifies the respective sound level limits. It is expected that with the use of appropriate noise mitigation measures each of the expansion alternatives can be designed and operated to comply with the applicable noise level limits.

The comparative evaluation of the 'Alternative Methods' using the identified factors is presented in Table 7.2-9. Based on the evaluation, Alternative 1 is the preferred alternative for noise.

Table 7.2-9: Noise Evaluation of the 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Noise Levels and Change in Noise Levels at PORs	Increase of maximum height of the landfill above grade elevation	26 m Least Preferred	19 m Most Preferred	21 m Less Preferred
	Shortest potential distance of landfill activities to any POR	~ 190 m Most Preferred	~ 160 m Least Preferred	~ 190 m Most Preferred
	Direction of the nearest POR from the landfill	South Equally Preferred	North Equally Preferred	North Equally Preferred
	Maximum potential change in noise level (dB)	0 Most Preferred	7 Least Preferred	3 Less Preferred
	Compliance with Noise Level Limits	Can be designed and operated to comply Equally Preferred	Can be designed and operated to comply Equally Preferred	Can be designed and operated to comply Equally Preferred
Preferred Alternative for Noise [1]		**Most Preferred**	**Least Preferred**	**Less Preferred**

Note: [1] As further discussed below, it is expected each 'Alternative Method' could be designed and operated in a manner to comply with MECP noise limits and address potential nuisance concerns.

In addition to the comparative evaluation using the indicators and factors of differentiation, an assessment based on advantages and disadvantages identified by the comparative evaluation was also completed (refer to **Table 7.2-10**).

Table 7.2-10: Evaluation of Advantages and Disadvantages for Noise

Noise	Advantages	Disadvantages
Alternative 1	Potential increase and change in noise levels expected to be minimal in all directions	Potential increase and change in noise levels at PORs expected in all directions although lowest change of three alternatives
Alternative 2	Potential increase and change in noise levels at PORs is expected, but not in all directions	Greatest potential increases and change in noise levels expected in some directions
Alternative 3	Potential increase and change in noise levels at PORs is expected, but not in all directions	Potential increase and change in noise levels are expected to be greater than Alternative 1 in some directions

Although all of these 'Alternative Methods' could result in an increase in the maximum noise levels at some PORs, based on previous experience with similar sites across Ontario, it is expected each 'Alternative Method' could be operated with administrative and/or physical noise controls in a manner to ensure the MECP noise limits are met and the potential nuisance concerns are minimized.

Through a detailed noise assessment of the preferred expansion alternative, the detailed noise modelling will provide information for planning of any required noise mitigation measures for the preferred expansion alternative.

7.2.2 Biology

The Biology component comprises two sub-components:

- Aquatic ecosystems; and,
- Terrestrial ecosystems.

The biology assessment for each of the environmental sub-components is summarized in the following sections.

7.2.2.1 Aquatic Ecosystem

In accordance with the approved Amended ToR, the indicators to be considered for aquatic ecosystems are:

- Expected change in surface water quality on-site and within the Site-Vicinity Study Area; and
- Expected impact on aquatic habitat and biota, including rare, threatened or endangered species on-site and within the Site-vicinity Study Area.

The factors considered to differentiate between 'Alternative Methods' for landfill expansion, from the perspective of the aquatic ecosystems indicators, were selected because they are most likely to result in an adverse effect. The factors considered were:

- Change in the Site Development Area of the landfill;
- Change in the Waste Footprint Area of the landfill;
- Change in discharge rate from SWM ponds;
- Change in discharge volume from SWM ponds;
- Change in water quality to receiving watercourses;
- Change in discharge area to SWM ponds;
- Impact to aquatic SAR or sensitive species; and
- Loss of potential fish habitat.

The comparative evaluation of 'Alternative Methods' using these factors is presented in Table 7.2-11. Impacts to aquatic habitat and biota were determined using the constraints identified and the proposed waste footprints for each of the three alternatives. Figure 7.2-2 to Figure 7.2-4 display both the constraints mapping and the location of the three alternatives.

All aquatic habitat that falls within the proposed waste footprint for each alternative was included in the area totals provided in Table 7.2-11. Additionally, the 100 m closest to the landfill in the buffer that has been provided between the proposed property limits and the expanded limits of waste for the Alternatives was considered as an impact area to account for possible temporary impacts of construction activities related to the landfill expansion or the location of landfill infrastructure within the buffer. Impacts related to changes in surface water quality and quantity derived from the factors and impacts presented in the comparison of alternatives tables for surface water, Section 7.2.7, were also considered.

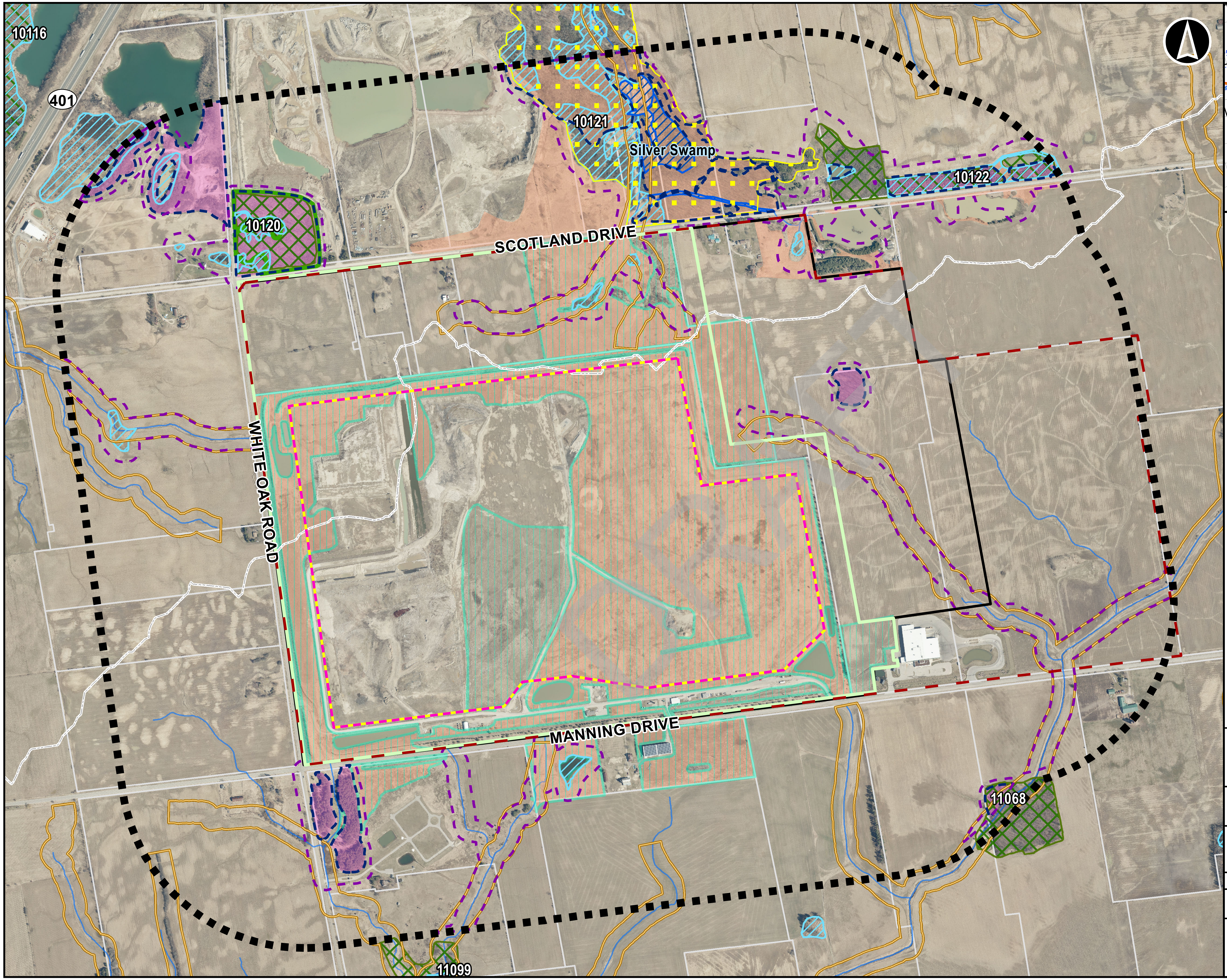
Table 7.2-11: Aquatic Ecosystem Evaluation of 'Alternative Methods'

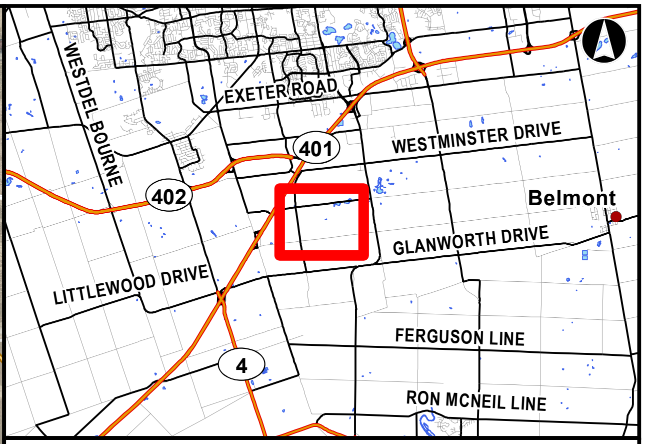
Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected change in surface water quality on-site and within the site-vicinity	Site Development Area	Minor increase in surface area of landfill (~9 ha) Most Preferred	Significant increase in surface area of landfill (~47 ha) Less Preferred	Significant increase in surface area of landfill (~43 ha) Less Preferred
	Waste Footprint area of landfill	107 ha Most Preferred	134 ha Less Preferred	135 ha Less Preferred
	Change in discharge rate from SWM ponds	Peak flow similar to existing proposed landfill design Equally Preferred	Peak flow earlier and for longer duration Equally Preferred	Peak flow earlier and for longer duration Equally Preferred
	Change in discharge volume from SWM ponds	Minor increase in total volume of runoff leaving the Site Study Area Most Preferred	Larger increase in total volume of runoff leaving the Site Study Area (minor on a full watershed scale) Less Preferred	Larger increase in total volume of runoff leaving the Site Study Area (minor on a full watershed scale) Less Preferred
	Change in water quality to receiving watercourses	SWMPs will be upgraded as required and designed to achieve 80% TSS removal Equally Preferred	SWMPs will be upgraded as required and designed to achieve 80% TSS removal Equally Preferred	SWMPs will be upgraded as required and designed to achieve 80% TSS removal Equally Preferred
	Change in drainage area to SWM ponds	Remains same Most Preferred	Increased Less Preferred	Increased Less Preferred
	Ranking	**Most Preferred**	**Less Preferred**	**Less Preferred**

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected impact on aquatic habitat and biota, including rare, threatened or endangered species within on-site and within the site-vicinity	Impact to aquatic SAR or sensitive species	No important or exceptional fish habitat was observed within the Study Area. Equally preferred	No important or exceptional fish habitat was observed within the Study Area. Equally preferred	No important or exceptional fish habitat was observed within the Study Area. Equally preferred
	Loss of potential fish habitat[1]	None Most Preferred	~659 m (~2132 m^2) Least Preferred	~106 m (~212 m^2) Less Preferred
	Ranking	**Most Preferred**	**Least Preferred**	**Less Preferred**
Preferred Alternative for Aquatic Ecosystems		**Most Preferred**	**Least Preferred**	**Less Preferred**

Note: [1] For agricultural drains, a bank full width of 2 m was used to calculate the available area of fish habitat

In addition to the comparative evaluation using the indicators and factors of differentiation, an assessment based on advantages and disadvantages identified by the comparative evaluation is shown in Table 7.2-12. Only those advantages or disadvantages that are unique to each alternative have been presented in Table 7.2-12 (e.g., impacts to SAR or sensitive species are not listed as they are the same across the alternatives).





Legend

- Watercourse
- Parcel Fabric
- Site Study Area
- Site-vicinity Study Area
- Waste Management Resource Recovery Area Boundary
- Proposed Property Boundary
- Existing Limits of Waste
- Proposed Limits of Waste

Natural Heritage Features

- 11068 Woodlot or Wetland Patch ID
- Conservation Authority Boundary
- Valleyland
- Potential ESA
- Locally Significant Wetland
- Unevaluated Wetland
- Significant Woodland
- Significant Woodland
- Species At Risk (SAR) Habitat
- Candidate Species at Risk (SAR) Habitat
- Confirmed Significant Wildlife Habitat (SWH)
- Candidate Significant Wildlife Habitat (SWH)
- Preliminary Buffer

0 50 100 200 300 400 500
Metres

W12A Landfill Expansion
Environmental Assessment

Comparison of Alternative Methods
- Alternative 1

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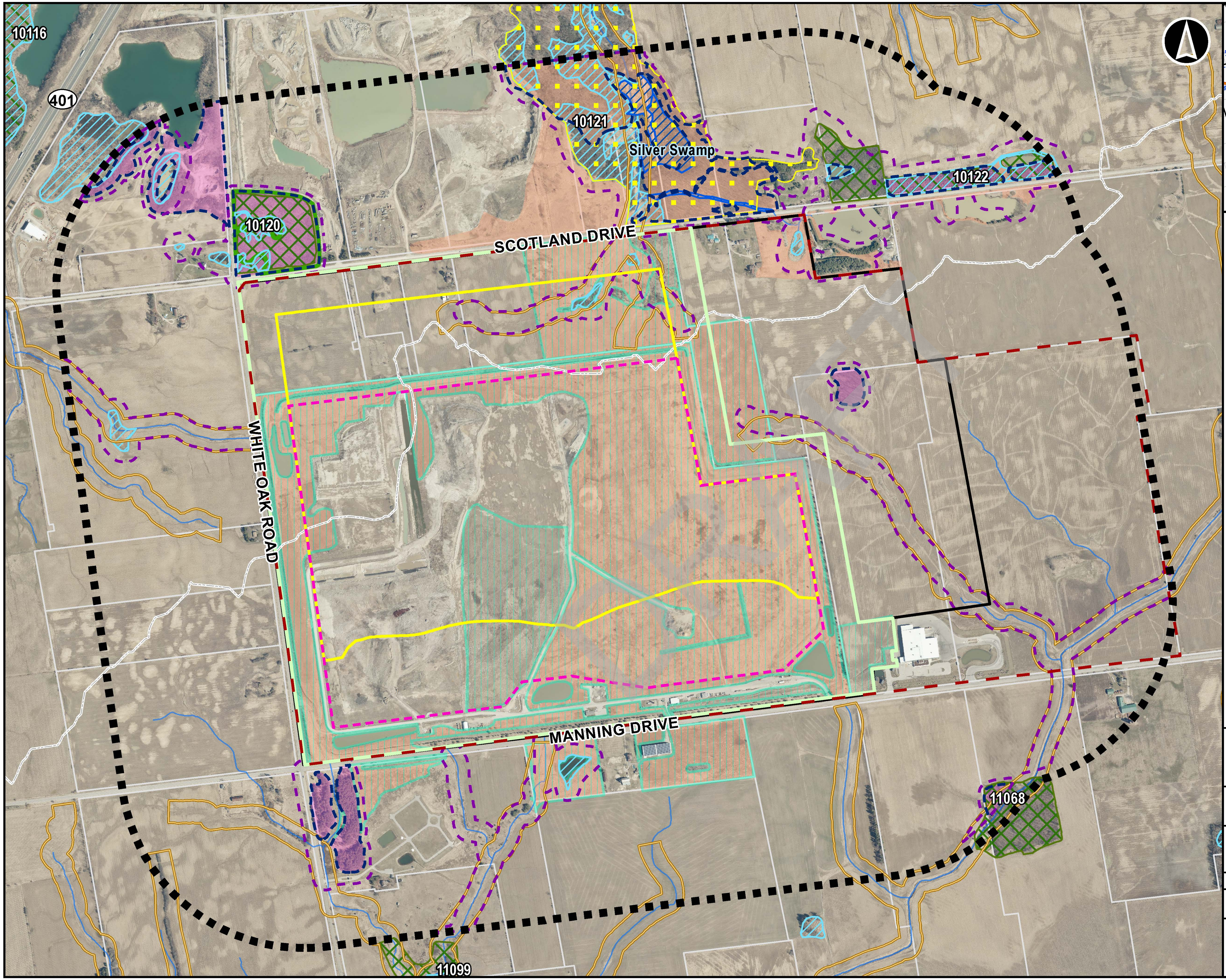

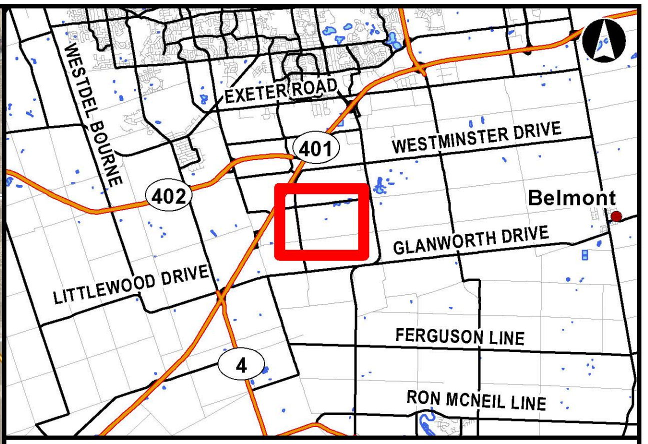

Legend

- Watercourse
- Parcel Fabric
- Site Study
- Site-vicinity Study Area
- Waste Management Resource Recovery Area Boundary
- Proposed Property Boundary
- Existing Limits of Waste
- Proposed Limits of Waste

Natural Heritage Features

- 11068 Woodlot or Wetland Patch ID
- Conservation Authority Boundary
- Valleyland
- Potential ESA
- Locally Significant Wetland
- Unevaluated Wetland
- Significant Woodland
- Significant Woodland
- Species At Risk (SAR) Habitat
- Candidate Species at Risk (SAR) Habitat
- Confirmed Significant Wildlife Habitat (SWH)
- Candidate Significant Wildlife Habitat (SWH)
- Preliminary Buffer

0 50 100 200 300 400 500
Metres

W12A Landfill Expansion
Environmental Assessment

Comparison of Alternative Methods
- Alternative 2

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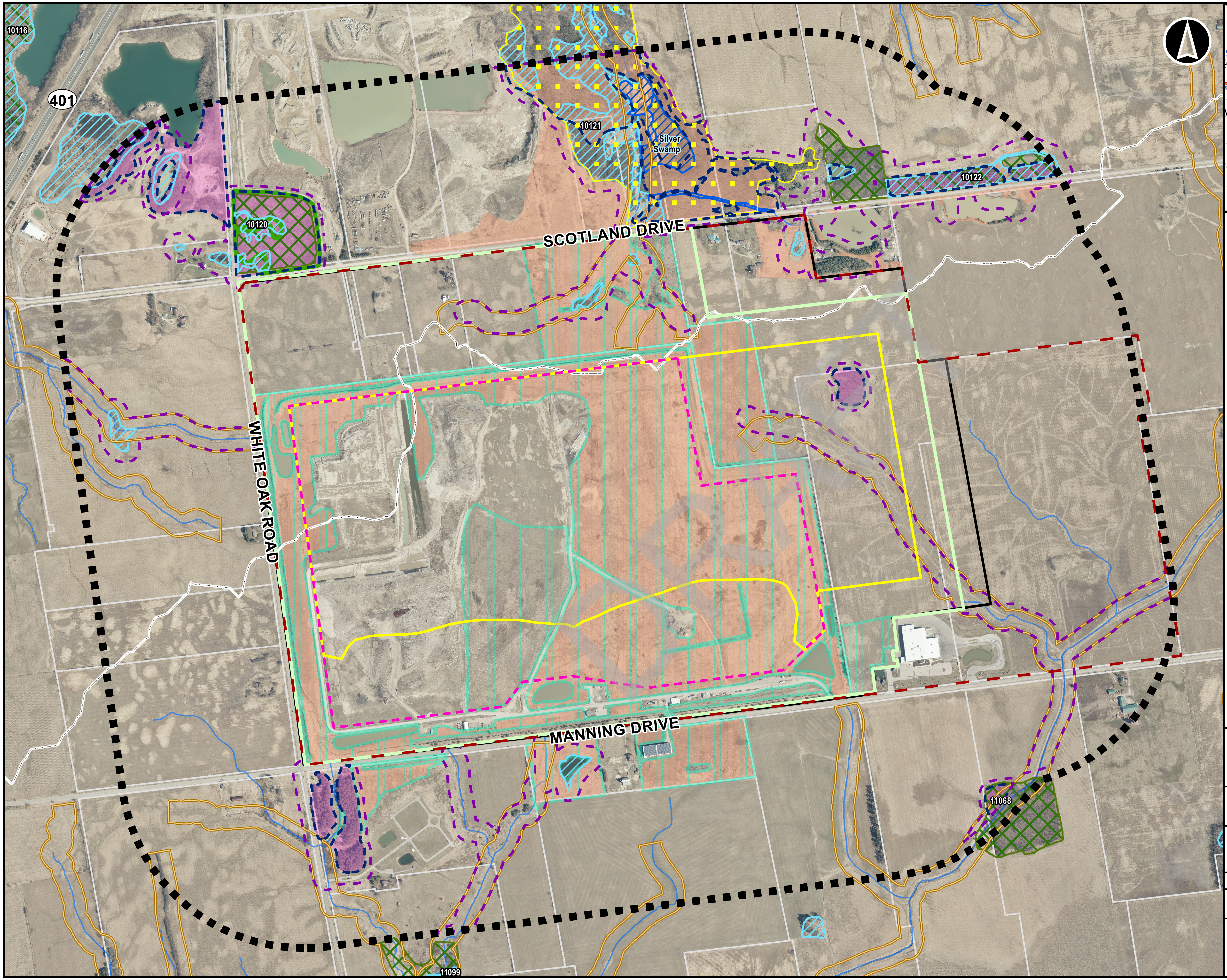

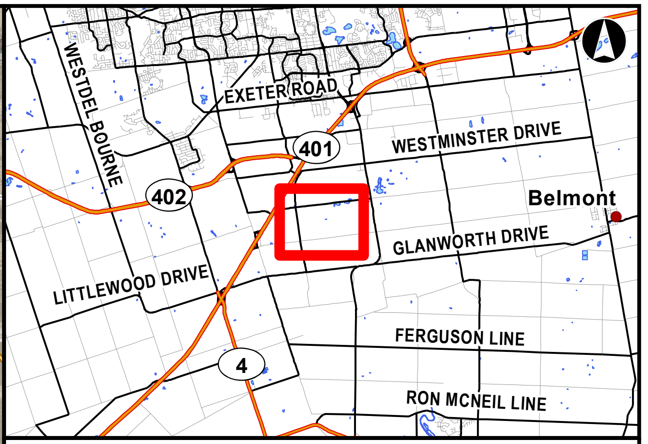

Legend

- Watercourse
- Parcel Fabric
- Site Study Area
- Site-vicinity Study Area
- Waste Management Resource Recovery Area Boundary
- Proposed Property Boundary
- Existing Limits of Waste
- Proposed Limits of Waste

Natural Heritage Features

- 11088 Woodlot or Wetland Patch ID
- Conservation Authority Boundary
- Valleyland
- Potential ESA
- Locally Significant Wetland
- Unevaluated Wetland
- Significant Woodland
- Significant Woodland
- Species At Risk (SAR) Habitat
- Candidate Species at Risk (SAR) Habitat
- Confirmed Significant Wildlife Habitat (SWH)
- Candidate Significant Wildlife Habitat (SWH)
- Preliminary Buffer

0 50 100 200 300 400 500
Meters

W12A Landfill Expansion
Environmental Assessment

Comparison of Alternative Methods
- Alternative 3

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AECOM

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Table 7.2-12: Evaluation of Advantages and Disadvantages for Aquatic Ecosystems

Aquatic Ecosystems	Advantages	Disadvantages
Alternative 1	Majority of impacts restricted to the current Site Development Area. No expected impacts to adjacent watercourses that would result in a loss of potential fish habitat	None
Alternative 2	None	Removal of the entire portion of the Bannister-Johnson Drain south of Scotland Drive will likely result in a decrease of inputs (e.g. natural sediment transport processes) to the downstream portions of the Drain. Greatest loss of potential fish habitat. Increase in surface water runoff being directed to on-site SWM ponds. Increase in total volume of runoff leaving the subject site.
Alternative 3	None	Removal of a portion of an un-named tributary will likely result in a decrease of inputs (e.g., natural sediment transport processes) to the Shore Creek Drain. Small loss of potential fish habitat. Increase in surface water runoff being directed to on-site SWM ponds. Increase in total volume of runoff leaving the subject site.

After reviewing the impacts of the three alternatives it was determined that Alternative 1 was the most preferred option from an aquatic ecosystem perspective while Alternative 3 was a less preferred option and Alternative 2 was the least preferred option.

Alternative 1 was chosen as the most preferred option as the majority of potential impacts are restricted to the existing Site Development Area, limiting its potential impact to surrounding watercourses and fish habitat.

Alternative 2 was chosen as the least preferred option as it accounts for the greatest potential loss of potential fish habitat. Both Alternative 2 and 3 were found to have similar disadvantages regarding the quantity and quality of surface water conditions on-site and within the vicinity of the landfill compared to Alternative 1.

7.2.2.2 Terrestrial Ecosystems

In accordance with the approved Amended ToR, the indicator to be considered for terrestrial ecosystems is:

- Expected impact on terrestrial vegetation communities, wildlife habitat, and wildlife, including rare, threatened or endangered species on-site and within the Site-vicinity Study Area.

The factors considered to differentiate between ‘Alternative Methods’ for landfill expansion, from the perspective of the terrestrial ecosystems indicator, were selected because they are most likely to result in an adverse effect. These consist of:

- Change in the Site Development Area of the landfill;
- Change in the Waste Footprint Area of the landfill;
- Impact to SAR;
- Impact to Significant Wildlife Habitat (SWH);
- Removal of natural vegetation;
- Impacts to natural features identified on MAP 5 of the London Plan; and,
- Potential for off-site impacts to wildlife habitat.

The comparative evaluation of ‘Alternative Methods’ using these factors is presented in Table 7.2-13. Impacts were determined using the constraints identified and the proposed footprints for each of the three expansion alternatives. Figure 7.2-1 to Figure 7.2-3 display both the constraints mapping and the location of the three expansion alternatives.

All vegetation communities, habitat and natural features that fall within the proposed Waste Footprint Area for each alternative were included in the area totals provided in Table 7.2-13**.** Additionally, the 100 m closest to the landfill in the buffer that has been provided between the proposed property limits and the proposed Waste Footprint Areas for the Alternatives was considered as impact area to account for possible temporary impacts of construction actives related to the landfill expansion or the location of landfill infrastructure within the buffer.

Table 7.2-13: Terrestrial Ecosystems Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected impact on terrestrial vegetation communities, wildlife habitat, and wildlife, including rare, threatened or endangered species on-Site and within the Site-vicinity	Site Development Area	Minor increase in surface area of landfill (~9 ha) <u>Most Preferred</u>	Significant increase in surface area of landfill (~47 ha) <u>Less Preferred</u>	Significant increase in surface area of landfill (~43 ha) <u>Less Preferred</u>
	Waste Footprint area of landfill	107 ha <u>Most Preferred</u>	134 ha <u>Less Preferred</u>	135 ha <u>Less Preferred</u>
	Impact to SAR habitat – Bobolink	63.19 ha <u>Less Preferred</u>	60.39 ha <u>Less Preferred</u>	53.4 ha <u>Most Preferred</u>
	Impact to SAR habitat – Eastern Meadowlark	114 ha <u>Less Preferred</u>	114 ha <u>Less Preferred</u>	118.4 ha <u>Most Preferred</u>
	Impact to Candidate SAR Bat Habitat	0 ha <u>Most Preferred</u>	0 ha <u>Most Preferred</u>	0.69 ha <u>Less Preferred</u>
	Impact to Candidate significant wildlife habitat (SWH) – Bat Maternity Colonies	0 ha <u>Most Preferred</u>	0 ha <u>Most Preferred</u>	0.69 ha <u>Less Preferred</u>
	Impact to Candidate SWH – Turtle Overwintering	0 ha <u>Equally Preferred</u>	0 ha <u>Equally Preferred</u>	0 ha <u>Equally Preferred</u>
	Impact to Confirmed SWH – Amphibian Breeding	0 ha <u>Equally Preferred</u>	0 ha <u>Equally Preferred</u>	0 ha <u>Equally Preferred</u>
	Impact to Confirmed SWH – Species of Special Concern and Rare Species – Eastern Wood-Pewee	0 ha <u>Equally Preferred</u>	0 ha <u>Equally Preferred</u>	0 ha <u>Equally Preferred</u>
	Impact to Confirmed SWH – Species of Special Concern and Rare Species - Monarch	84.8 ha <u>Less Preferred</u>	84.8 ha <u>Less Preferred</u>	89.2 ha <u>Most Preferred</u>
	Impact to Confirmed SWH – Terrestrial Crayfish	0 ha <u>Equally Preferred</u>	0 ha <u>Equally Preferred</u>	0 ha <u>Equally Preferred</u>

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
	Removal of Natural Vegetation Communities	Total: 63.42 ha (CUM: 63.17 ha CUH: 0.25 ha) Most Preferred	Total: 82.26 ha (CUM: 59.4 ha CUH: 0.88 ha CUT: 2.05 ha MAM: 0.06 ha MAS: 0.01 ha SAS: 0.03 ha) Least Preferred	Total: 75.11 ha (CUM: 54.55 ha CUH: 0.74 ha FOD: 0.69 ha) Less Preferred
	Removal of Natural Heritage Features (City of London) - Valleylands	0 ha Most Preferred	6.72 ha Least Preferred	5.18 ha Less Preferred
	Removal of Natural Heritage Features (City of London) – Potential ESA	0 ha Equally Preferred	0 ha Equally Preferred	0 ha Equally Preferred
	Removal of Natural Heritage Features (City of London) – Locally Significant Wetlands	0 ha Equally Preferred	0 ha Equally Preferred	0 ha Equally Preferred
	Removal of Natural Heritage Features (City of London) – Unevaluated Wetlands	0 ha Most Preferred	0.33 ha Less Preferred	0 ha Most Preferred
	Potential for off-Site impacts to wildlife habitat	Impact to off-site wildlife habitat will be avoided through the implementation of 100 m buffer areas around the proposed limits of waste. Equally Preferred	Impact to off-site wildlife habitat will be avoided through the implementation of 100 m buffer areas around the proposed limits of waste. Equally Preferred	Impact to off-site wildlife habitat will be avoided through the implementation of 100 m buffer areas around the proposed limits of waste. Equally Preferred
Preferred Alternative for Terrestrial Ecosystems		**Most preferred**	**Least preferred**	**Less preferred**

In addition to the comparative evaluation using the indicators and factors of differentiation, an assessment based on advantages and disadvantages identified by the comparative evaluation is shown in Table 7.2-14.

Table 7.2-14: Evaluation of Advantages and Disadvantages for Terrestrial Ecosystems

Terrestrial Ecosystems	Advantages	Disadvantages
Alternative 1	Disturbance limited to the existing landfill footprint. No impact to candidate SAR bat habitat and Bat Maternity Colonies SWH. No impacts to natural features adjacent to the landfill site (watercourses, unevaluated wetlands and valleylands). Opportunity to revegetate agricultural fields within the 300 m buffer area proposed on the north side of the existing landfill footprint. Doing so will help to offset the loss of SAR and SWH habitat. Opportunity to revegetate the 107 ha proposed waste footprint during site closure.	Greatest loss of SAR (Bobolink and Eastern Meadowlark) and confirmed SWH (Monarch) within the existing landfill footprint.
Alternative 2	Opportunity to revegetate the 134 ha proposed waste footprint during site closure. No impact to candidate SAR bat habitat and Bat Maternity Colonies SWH.	Loss of SAR (Bobolink and Eastern Meadowlark) and confirmed SWH (Monarch) habitat. Largest loss of natural vegetation communities of all three expansion alternatives. Loss of natural features as per the City of London Plan Map 5 including unevaluated wetlands and valleylands.
Alternative 3	Opportunity to revegetate agricultural fields within the 300 m buffer area proposed on the north side of the existing landfill footprint. Doing so will help to offset the loss of SAR and SWH habitat. Opportunity to revegetate the 135 ha proposed waste footprint during site closure.	Loss of SAR (Bobolink and Eastern Meadowlark) and confirmed SWH (Monarch) habitat. Loss of candidate SWH and SAR Bat habitat. Loss of natural features as per the City of London Plan Map 5 including valleylands.

After reviewing the impacts of the three alternatives it was determined that Alternative 1 was the most preferred option from a terrestrial ecosystem perspective while Alternative 3 was the less preferred option and Alternative 2 was the least preferred option.

Alternative 1 was chosen as the most preferred option as the majority of potential impacts are restricted to the existing Site Development Area. Alternative 1 preserves the mature shagbark hickory woodlot that is considered candidate SWH and SAR bat habitat. It is also anticipated that Alternative 1 will not have an impact to any of the surrounding Natural Heritage features.

Alternative 3 presents a lower impact to grassland habitat for SAR and SOCC and provides the same 300m buffer area to the north of the existing landfill footprint. However, the required removal of the shagbark hickory woodlot was determined to be a more significant loss as it is typically more difficult to replace mature wooded areas than grassland habitat.

Alternative 2 was chosen as the least preferred option as it creates the most impact to the surrounding natural environment and does not provide an additional area within the proposed property limits that could be left to naturalize.

7.2.3 Geology and Hydrogeology

In accordance with the approved Amended ToR, the indicator to be considered for groundwater quality is:

- Expected effect on groundwater quality at the property area boundary.

The factors considered to differentiate between 'Alternative Methods' for landfill expansion, from the perspective of the groundwater quality indicator, were selected because they are most likely to potentially result in an adverse effect. These factors are:

- the thickness of Surficial Aquitard below the base elevation of the waste footprint area for placement of expansion waste to protect Upper Aquifer groundwater quality;
- waste footprint area configuration for placement of expansion waste relative to groundwater flow direction; and
- maximum thickness of waste.

The factors were selected for the reasons described below.

<u>Thickness of Surficial Aquitard below the base elevation of the waste footprint area for placement of expansion waste to protect Upper Aquifer groundwater quality</u> – Based on historical and current subsurface investigations at the W12A Landfill expansion Site Study Area, it is known that the conditions underlying the current landfill footprint and proposed alternative expansion areas consist of a variable thickness of continuous low permeability Surficial Aquitard (Port Stanley Till) followed by a granular Upper Aquifer layer. The Upper Aquifer is used off-site for domestic water supply and represents the layer in which potential leachate effects from the W12A Landfill are and will be assessed in terms of Reasonable Use Guideline compliance. Based on borehole and other information, the thickness of the

Surficial Aquitard below existing ground surface is variable; however, the interpreted elevation of the contact zone between the base of the Surficial Aquitard and the underlying Upper Aquifer across the Site Study Area is fairly consistent between about elevation 262 masl and 258 masl, with the decline in surface elevation generally from north to south/southwest. That is, the difference in Surficial Aquitard thickness mostly reflects the variation in ground surface elevation. Therefore, the thickness and variation in thickness of the protective Surficial Aquitard unit below the base elevation of each of the landfill expansion alternatives indicates the relative degree of natural protection for the Upper Aquifer. This is most relevant to the Phase 1 area of the existing landfill that does not have an underdrain leachate collection system and a leachate mound develops within this portion of the landfill. Of the three comparative evaluation factors, this factor has the greatest effect on Upper Aquifer groundwater protection at this Site Study Area.

<u>Waste footprint area configuration relative to groundwater flow direction</u> – It is known that the direction of groundwater flow in the Upper Aquifer is from northeast to southwest. To minimize potential magnitude of leachate effects on groundwater in the Upper Aquifer, it is preferable to orient the long dimension of the waste footprint area perpendicular to the direction of groundwater flow, i.e., the east-west (E-W) dimension of the footprint.

<u>Maximum thickness of waste</u> – the greater the total thickness of waste, the greater the potential leachate source strength and the longer the contaminating lifespan of the landfill (which is defined as the length of time for the contaminant concentrations in the leachate to decline over time to the allowable Reasonable Use Guideline concentration in the Upper Aquifer).

The comparative evaluation of 'Alternative Methods' using these factors is presented in Table 7.2-15.

Based on the evaluation, Alternatives 2 and 3 are least and less preferred, respectively, from a groundwater quality perspective. Alternative 1 is most preferred.

Table 7.2-15: Groundwater Quality Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected effect on groundwater quality at the property area boundary.	Thickness of Surficial Aquitard beneath base elevation of expansion footprint	No horizontal expansion; thickness below existing footprint approximately 14 m Most Preferred	Thickness below existing footprint approximately 14 m; below northern expansion area 10 m to 12 m (average 11 m), indicated to be reduced to about 5 to 6 m in northeast corner area Less Preferred	Thickness below existing footprint approximately 14 m; below eastern expansion area 13 m at north side to 8 m south side (average 10.5 m) Less Preferred
	Configuration of the waste footprint area for placement of waste in the expansion	Footprint dimensions 900 m N-S by 1,200 m avg. E-W Less Preferred	Footprint dimensions 1,100 m N-S by 1,200 m avg. E-W Less Preferred	Footprint dimensions 900 m N-S by 1,600 m avg. E-W Most Preferred
	Thickness of waste	42 m Less Preferred	35 m Most Preferred	36.8 Most Preferred
Preferred Alternative for Groundwater Quality		**Most Preferred**	**Least Preferred**	**Less Preferred**

Alternative 1 is the overall most preferred because it has the greatest and most consistent thickness of Surficial Aquitard below the base elevation of the landfill, which is the most important groundwater quality protection factor and more important than the other two factors combined.

Alternative 3 is preferable compared to Alternative 2 because of its equal ranking for Surficial Aquitard thickness below the base elevation and higher ranking in terms of the expansion configuration. Based on preliminary analysis, it is expected that with the combination of engineered controls and natural protection, the performance of all three alternatives is likely to meet the requirements of the Reasonable Use Guideline and O.Reg. 232/98.

In addition to the comparative evaluation using the indicators and factors of differentiation, the advantages and disadvantages identified by the comparative evaluation are as shown in Table 7.2-16.

Table 7.2-16: Evaluation of Advantages and Disadvantages for Groundwater Quality

Groundwater Quality	Advantages	Disadvantages
Alternative 1	Surficial Aquitard thickest and least variable in thickness below this footprint, thereby providing greatest degree of natural protection.	Greatest thickness of waste. Roughly square shape.
Alternative 2	Least thickness of waste.	Roughly square shape. Reduced thickness of Surficial Aquitard beneath northeast corner portion of northern expansion area.
Alternative 3	Similar thickness of waste to Alternative 2. Rectangular shape with long dimension E-W perpendicular to groundwater flow direction.	A larger portion of the waste footprint area, i.e., southern portion of eastern expansion area, overlies reduced thickness of Surficial Aquitard.

7.2.4 Surface Water

The Surface Water environment component comprises two sub-components:

- Surface water quality; and
- Surface water quantity.

Contaminants associated with the landfill expansion and associated operations could seep or runoff into surface water and adversely affect water quality and aquatic life. Operations associated with the landfill expansion could alter runoff and peak flows. The surface water assessment for each of the environmental sub-components is summarized in the following sections.

7.2.4.1 Surface Water Quality

In accordance with the approved Amended ToR, the indicator to be considered for surface water quality is:

- Expected effect on surface water quality in the SWMS and within the Site-vicinity Area.

The factors considered to differentiate between ‘Alternative Methods’ for landfill expansion, from the perspective of the surface water quality indicator, were selected because they are most likely to result in an adverse effect. These factors are:

- Expected changes in total drainage area to SWM ponds;
- Waste footprint area;
- Sediment loading on ponds; and,
- Existing pond treatment capacity (permanent volume).

The factors were selected for the reasons described below.

Expected Changes in total drainage area to SWM ponds – An increase or decrease in the proposed waste footprint area and total Site development area discharging to each of the existing SWM ponds will impact the sizing of treatment volumes and outlet mechanisms required for each pond. Each of the alternative proposed landfill expansion designs were compared to the existing landfill design to compare the changes in total drainage area to the SWM facilities.

Waste Footprint Area – The waste footprint area of each of the proposed landfill expansion alternatives was compared to the existing landfill design. An increase in landfill surface area indicates that there will be an increase in loading on the SWMS.

Sediment loading on ponds – The expected sediment loading in each pond will impact the required treatment volumes within the SWMS to ensure that the stormwater treatment objectives are met. Each of the alternative proposed landfill expansion designs were compared to the existing landfill design to compare the changes in expected sediment loading to the SWM facilities.

Existing pond treatment capacity (permanent volume) – The capacity of the treatment volume of the existing ponds was assessed to determine if they are likely to be sufficient to provide treatment for the alternative expansion design options.

The runoff catchments were determined for each pond based on the design surfaces:

- 55% Imperviousness was used for the calculations, based on the assessment of modelling results in Section 4.3.1 of the Stormwater Management Masterplan for the W12A Site (Earth Tech Canada Inc, 2002);
- Enhanced (80%) long-term suspended solids (SS) removal was adopted based on Section 2.4 of the W12A Landfill Area Plan Study Surface Water Background Study (Dillon Consulting Limited, 2005), which indicates that the SWM ponds provide the “highest level” of quality control of stormwater;
- Water quality storage requirements were determined based on Table 3.2 of the Ontario Stormwater Management Planning and Design Manual (Ministry of the Environment, Conservation and Parks, 2003); and,
- Permanent water volumes were compared to those given for each of the SWM ponds in the W12A Landfill Amended Certificate of Approval, Municipal and Private Sewage Works Number 4175-8C4SD5 (2011).

The comparative evaluation of ‘Alternative Methods’ using these factors is presented in Table 7.2-17.

Based on the evaluation, it is considered that Alternative 1 is the most preferred option from a surface water quality perspective.

Table 7.2-17: Surface Water Quality Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected effect on surface water quality in the SWMS and within the Site-vicinity Study Area	Expected changes in total drainage area to SWM ponds	Approximately the same Most Preferred	Increased Less Preferred	Increased Less Preferred
	Waste footprint area	Minor increase in surface area of landfill (~1.8 ha) Most Preferred	Large increase in surface area of landfill (~28 ha) Less Preferred	Large increase in surface area of landfill (~30 ha) Less Preferred
	Sediment loading on ponds	Potential increase due to increased slope length and reworking existing landfill areas Most Preferred	Probable increase due to increased slope length and new expanded landfill areas Less Preferred	Probable increase due to increased slope length and new expanded landfill areas Less Preferred
	Existing pond treatment capacity (permanent volume)	Three of four ponds expected to require upgrading Most Preferred	All ponds expected to require upgrading Less Preferred	All ponds expected to require upgrading Less Preferred
Preferred Alternative for Surface Water Quality		**Most preferred**	**Less Preferred**	**Less Preferred**

Note: ~ means approximately

In addition to the comparative evaluation using the indicators and factors of differentiation, an assessment based on advantages and disadvantages identified by the comparative evaluation was also completed (refer to Table 7.2-18). Alternative 1 is most preferred because it offers the lowest increase in stormwater catchment area needing to be captured and treated and is expected to require the fewest modifications to the existing SWMS.

Table 7.2-18: Evaluation of Advantages and Disadvantages for Surface Water Quality

Surface Water Quality	Advantages	Disadvantages
Alternative 1	Overall area of the landfill waste footprint for placement of expansion waste remains approximately the same. Least amount of modification to the existing SWMS required. Total Site development area managed as part of the landfill operation will remain approximately the same (increases by 9 ha).	Potential for increased peak flows conveyed to existing/upgraded SWM ponds.
Alternative 2	None	Increase in surface area of landfill waste footprint for placement of expansion waste means that the overall volume of runoff requiring treatment is increased Area to the north of the existing landfill will be converted from unmanaged to managed state Stormwater infrastructure will need to be constructed in new locations Larger overall Site development area (increases by 47 ha) will result in a more complicated SWMS.
Alternative 3	None	Increase in surface area of landfill waste footprint for placement of expansion waste means that the overall volume of runoff requiring treatment is increased Area to the east of the existing landfill will be converted from unmanaged to managed state Stormwater infrastructure will need to be constructed in new locations Larger overall Site development area (increases by 43 ha) will result in a more complicated SWMS.

7.2.4.2 *Surface Water Quantity*

In accordance with the approved Amended ToR, the indicators to be considered for surface water quantity are:

- Expected change in peak flows (within the on-site SWMS and at the property area boundary); and
- Expected degree of change to off-site effects on surface water quantity within the Site Study Area and off-site within the Site-vicinity Study Area.

The on-site effects, the factors considered to differentiate between 'Alternative Methods' for landfill expansion, from the perspective of the surface water quantity indicators, were selected because they are most likely to result in an adverse effect. These factors are:

- Maximum slope angle;
- Diversion of runoff between subwatersheds;
- Estimated total stormwater catchment; and
- Existing pond capacity for active storage.

The factors were selected for the reasons described below.

<u>Maximum slope angle</u>: Increased slope angle will have an overall effect on the peak flow entering the SWM facilities. The alternative proposed landfill expansion developments were compared to the existing design to check the effect that the slope angle would likely have on stormwater runoff.

<u>Diversion of runoff between subwatersheds</u>: The landfill falls on the divide between the Dingman Creek and Dodd Creek Subwatersheds. Based on the overall stormwater strategy for the W12A Landfill site, peak flow attenuation to pre-development flows should be provided for rainfall events up to the 100-year Annual Recurrence Interval (ARI) event. The proposed expansion designs will move the location of the subwatershed divide within the Site Study Area boundary, increasing the catchment area flowing in a northerly direction toward Dingman Creek. The resulting peak flow attenuation volume required in the northern catchment to achieve pre-development flow rates will be larger as a result of an increased catchment area. The increase in catchment area to Dingman Creek from the proposed expansion development is considered to be minor in all scenarios as the area of the landfill site (waste footprint area or property area) compared to the full watershed is less than 1%.

<u>Estimated total stormwater catchment</u>: The total stormwater catchment will impact the total runoff expected from the landfill. It will be captured and attenuated for flow control.

<u>Existing pond capacity for active storage volume</u>: The capacity of the extended detention/erosion control volume of the existing ponds was assessed to determine if they were likely to be sufficient to provide capacity for the alternative expansion design options. The assessment of the active capacity of the existing ponds was undertaken based on the following methodology:

The runoff catchments were determined for each pond, the design surface geometry of 55% Imperviousness was used for the calculations, based on the assessment of modelling results in Section 4.3.1 of the Stormwater Management Masterplan for the W12A Site (Earth Tech Canada Inc, 2002)

Extended detention and erosion control:

- Extended detention volume of 40 m^3/ha was adopted based on Section 3.3.2 of the Ontario Stormwater Management planning and Design Manual (Ministry of the Environment, Conservation and Parks, 2003);
- Erosion control volume for ponds within both catchments was determined by calculating the 25 mm storm volume, which is approximately 275 m^3/ha for 55% Imperviousness; and
- The larger of the extended detention and erosion control volumes was adopted for the sizing of the slow release portion of the ponds.

Flood attenuation (100 year 24 hr):

- A rational method calculation was undertaken to determine a conservative estimate of the required storage volumes to attenuate the 100 year ARI rainfall event to pre-development flows; and
- Rainfall intensity was determined based on Table 6.3 of the Design Specifications & Requirements Manual (City of London, 2019) for the 100 year rainfall event.

The total active storage volume is the sum of the extended detention/erosion control volume and the 100-year flood attenuation volume.

The off-Site effects (the factors considered to differentiate between 'Alternative Methods' for landfill expansion) from the perspective of the surface water quantity indicators, were selected because they are most likely to result in an adverse effect. These factors are:

- Off-site volume; and
- Peak flow at site study area boundary.

The factors were selected for the reasons described below.

<u>Off-site volume:</u> SWM controls within the Site Study Area are proposed to control the peak flow of stormwater runoff. However, the overall volume of discharge from the Site will increase as a result of any new development as infiltration is not available on the Site (pre- and post-development ground conditions are not favourable to stormwater infiltration). A comparison of the likely overall increase in volume of stormwater runoff from each of the proposed expansion alternatives was undertaken to compare the effect of each on the surrounding area and downstream catchment.

Peak flow at Site Study Area boundary: As the impervious area is increased within a catchment area, the change in impervious area will cause an earlier and higher peak flow of stormwater runoff. The SWMS at the landfill will provide peak flow attenuation to meet pre-development peak flows, and this will result in changes to the hydrograph at the Site Study Area boundary. Commentary is provided on the expected differences between the hydrograph at the Site Study Area boundary for the existing approved landfill development, and the proposed expansion alternatives.

The comparative evaluation of 'Alternative Methods' using these factors is presented in Table 7.2-19.

Based on the evaluation, it is considered that Alternative 1 is the most preferred option from a surface water quantity perspective.

Table 7.2-19: Surface Water Quantity Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected change in peak flows (within the on-site SWMS and at the property area boundary)	Maximum slope angle	~25% (4H:1V) Decrease in time of concentration, increase in peak runoff from waste footprint area Equally Preferred	~25% (4H:1V) Decrease in time of concentration, increase in peak runoff from waste footprint area Equally Preferred	~25% (4H:1V) Decrease in time of concentration, increase in peak runoff from waste footprint area Equally Preferred
	Diversion of runoff between subwatersheds	Increase in landfill catchment area to Dingman Creek of ~14.1 ha Less Preferred	Increase in landfill catchment area to Dingman Creek of ~3.5 ha Most Preferred	Increase in landfill catchment area to Dingman Creek of ~1 ha Most Preferred
	Estimated total stormwater catchment (ha)	151 Most Preferred	189 Less Preferred	185 Less Preferred
	Existing pond capacity for active storage volume	3 of 4 ponds expected to require upgrading Most Preferred	All ponds expected to require upgrading Less Preferred	All ponds expected to require upgrading Less Preferred
	Ranking	**Most Preferred**	**Less Preferred**	**Less Preferred**

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected degree of off-site effects on surface water quantity within the Site Study Area and off-site within the Site-vicinity Study Area	Off-site volume	Minor increase in total volume of runoff leaving the Site Study Area Most Preferred	Larger increase in total volume of runoff leaving the Site Study Area (minor on a full watershed scale) Less Preferred	Larger increase in total volume of runoff leaving the Site Study Area (minor on a full watershed scale) Less Preferred
	Peak flows at Site Study Area boundary	Peak flow similar to existing landfill design Most Preferred	Peak flow similar to existing landfill design but earlier and for longer duration Less Preferred	Peak flow similar to existing landfill design but earlier and for longer duration Less Preferred
	Ranking	**Most Preferred**	**Less Preferred**	**Less Preferred**
Preferred Alternative for Surface Water Quantity		**Most Preferred**	**Less Preferred**	**Less Preferred**

In addition to the comparative evaluation using the indicators and factors of differentiation, an assessment based on advantages and disadvantages identified by the comparative evaluation was also completed (refer to Table 7.2-20). Alternative 1 is most preferred because it offers the lowest increase in stormwater catchment area needing to be captured and attenuated and is expected to require the least modification to the existing SWMS.

Table 7.2-20: Evaluation of Advantages and Disadvantages for Surface Water Quantity

Surface Water Quantity	Advantages	Disadvantages
Alternative 1	Overall landfill Site development area remains approximately the same (increases by 9 ha) Least amount of modification to the existing SWM infrastructure required.	Increase in diversion of landfill catchment from Dodd Creek to Dingman Creek of ~14.1 ha (resulting in the need for more attenuation in the northern catchment area – on-site effect).
Alternative 2	Increase in diversion of landfill catchment from Dodd Creek to Dingman Creek (~3.5 ha) (less attenuation required in northern catchment area).	Total landfill Site development area increase by ~47 ha Upgrades to the existing SWM infrastructure expected to be of larger magnitude than Alternative 1. Some new SWM infrastructure expected to be required.

Surface Water Quantity	Advantages	Disadvantages
Alternative 3	Increase in diversion of landfill catchment from Dodd Creek to Dingman Creek (~1 ha) (less attenuation required in northern catchment area).	Total landfill Site development area increase by ~43 ha. Upgrades to the existing SWM infrastructure expected to be of larger magnitude than Alternative 1. Some new SWM infrastructure expected to be required.

7.2.5 Agriculture

In accordance with the approved Amended ToR, the indicator to be considered for current and planned future use is:

- Expected effect on agricultural land base and agricultural operations within the Site and Site-vicinity Study Areas.

The agricultural system is comprised of a group of inter-connected elements that collectively create a viable, thriving agricultural sector. The agricultural system includes the agricultural land base, comprised of prime agricultural areas, and the agri-food network that includes infrastructure, services and assets important to the viability of the agri-food sector[1].

The factors considered to differentiate between 'Alternative Methods' for landfill expansion, from the perspective of the agriculture component, were selected based on the Province's draft *Agricultural Impact Assessment Guidelines* (released March 2018). The differentiating factors assessed consisted of the following:

- The degree of investment and agricultural infrastructure (e.g. tile drainage and fencing);
- Soil capability;
- Potential impacts on agricultural land within the Site Study Area;
- Potential impacts on agricultural land within the Site-vicinity Study Area; and
- Potential Impact on agricultural system (e.g., fragmentation).

These factors were selected based on the need to assess loss of agricultural lands and production, as well as evaluating the impacts of each alternative on the broader agricultural system and takes into consideration the draft Agricultural Impact Assessment Guidelines released by the Province in March 2018. The comparative evaluation below adopts a number of the indicators recommended in the Province's draft guidelines[2].

[1] Note, this definition is based on the Province's definition of agricultural system in the Greenbelt Plan, 2017. While the lands are outside of the Greenbelt area, the definition provides a useful framework to assess land use change impacts from an agricultural perspective.

[2] OMAFRA: Agricultural Impact Assessments, 2018.

The comparative evaluation of 'Alternative Methods' using these factors is presented in Table 7.2-21, below.

Based on the evaluation, it is expected that both Alternative 1 and 2 provide some advantages from an agricultural perspective, with Alternative 3 being the least preferred approach. An analysis of each 'Alternative Method' is provided in Table 7.2-21, below. Alternative 1 is considered to be the most preferred option.

Table 7.2-21: Agriculture Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected effect on agricultural land base and agricultural operations within the Site and Site-vicinity Study Area	Degree of investment/ infrastructure	N/A – Vertical expansion of existing landfill footprint. <u>Most Preferred</u>	There is some closed/tiled drainage found on the northeastern portion of the lands. It is not considered to be a significant agricultural asset. There are no livestock facilities/ infrastructure visible and limited agricultural production. No indication of significant investments into the northern lands (fencing, agricultural buildings/storage, etc.) <u>Less Preferred</u>	The area proposed for expansion is tile drained and includes constructed drainage (Shore Creek Drain). The tile drainage on the lands is considered to represent a significant degree of agricultural investment. <u>Least Preferred</u>
	Soil Capability (Canada Land Inventory rating)	N/A – Lands are presently used for waste facility and unavailable for agriculture. <u>Most Preferred</u>	The north expansion lands are comprised of Class 2 and 3 soils (prime agricultural lands). <u>Less Preferred</u>	The eastern expansion lands are comprised of Class 2 soils with small portion of Class 3 soils (prime agricultural lands). <u>Less Preferred</u>

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
	Potential impacts on agricultural land within Site Study Area	Limited impacts on agricultural land base as no expansion onto agricultural lands is proposed. Some agricultural land may be used for stockpiling soil or berming purposes. Lands east of 3801 Scotland Drive will continued to be farmed (cash crop). Most Preferred Most Preferred	27 ha/67 acres of land to be removed. Note, only a small amount of this is in agricultural production. The remaining lands are considered fallow. Less Preferred	28 ha/69 acres of prime agricultural lands to be removed from active agricultural production. Additional loss of non-productive lands along proposed northern boundary due to visual berms and soil stock piles. Least Preferred
	Potential impacts on agricultural land uses within Site-vicinity Study Area	Crop production located immediately east of subject lands. Livestock operation (beef) located approximately 800 m from southeast portion of the landfill footprint; no impact expected. Equally Preferred	Crop production located immediately east of subject lands. Livestock operation (beef) located approximately 800 m from southeast portion of the landfill footprint; no impact expected. Some cash crop production was observed near intersection of Scotland Drive and White Oaks Road. There are no active livestock facilities adjacent to the northern expansion area. Equally Preferred	Crop production located immediately east of subject lands. There is a livestock operation (beef) located approximately 600 m from southeast portion of the landfill footprint; no impact expected. Equally Preferred

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
	Impact on agricultural system (e.g., fragmentation)	No loss of agricultural lands. No impacts on agricultural system expected. Most Preferred	Negligible loss of agricultural lands. These lands are already considered to be fragmented by the existing landfill and associated berms. No significant impacts on broader agricultural system as these lands do not include agricultural amenities or assets that support the agri-food network. It is further noted that the northern lands are adjacent to an existing aggregate operation, which may be considered to limit livestock operations in this area. Most Preferred	A larger portion of productive agricultural land would be removed. This area is comprised of land that has experienced a higher degree of investment than Alterative 2, due to the presence of tile drainage and constructed drainage. The proximity of the livestock facility at 3242 Manning Drive could also be considered a sensitive use due to the presence of cattle but noting the 600 m separation distance. Least Preferred
Preferred Alternative for Agriculture		**Most Preferred**	**Less Preferred**	**Least Preferred**

In addition to the comparative evaluation, an assessment based on advantages and disadvantages identified by the comparative evaluation was also completed as shown in Table 7.2-22 below. In summary, Alternative 1 is the most preferred option as it does not result in any loss of prime agricultural lands.

While less preferred due to the loss of designated prime agricultural lands, Alternative 2 does not include an expansion onto lands that have existing agricultural amenities (e.g., tile drainage). Alternative 2 is considered to be a negligible loss of land as the lands are not actively in production and are already considered to be fragmented by the existing landfill and non-agricultural uses to the north (aggregate). The loss of these lands from production will not impact the long-term viability of farming in the surrounding area. There are no livestock operations in proximity to the northern expansion lands proposed for Alternative 2.

Alternative 3 is the least preferred as expansion into the eastern area results in a loss of 28 ha of productive prime agricultural land. Furthermore, a significant degree of investment has been made into the eastern lands in the form of tile and constructed drainage.

Table 7.2-22: Evaluation of Advantages and Disadvantages for Agriculture

Agriculture	Advantages	Disadvantages
Alternative 1	No loss of agricultural land. Utilize existing land base.	N/A
Alternative 2	Majority of lands are considered to be fallow. Small amount of lands used for cash crop production. There are no significant agricultural infrastructure/amenities.	Loss of 27 ha of prime agricultural land (although a majority of the lands is not in agricultural production).
Alternative 3	N/A	Loss of 28ha of prime agricultural land. Existing agricultural infrastructure would need to be modified (tile drainage system) to accommodate the horizontal expansion area.

7.2.6 Archaeology

In accordance with the approved Amended ToR, the indicator to be considered for archaeology is:

- Expected archaeological resources potentially affected on-site.

The factors considered to differentiate between 'Alternative Methods' for landfill expansion, from the perspective of the archaeology component, were selected because they are most likely to result in an adverse effect. These factors are.

- Archaeological sites in the site development area;
- Proximity to known areas of archaeological significance or potential in the site development area; and,
- Proposed extent of horizontal expansion of landfill footprint.

The factors were selected for the reasons described below.

<u>Archaeological sites in the site development area</u> – There are known archaeological sites to the north of the existing W12A Landfill site that require further assessment. If these sites are located within the proposed site development area of one of the three 'Alternative Methods', then they could be affected by the new landfill-related infrastructure constructed within the buffer areas around the perimeter.

Proximity to known areas of archaeological significance or potential in the site development area – Based on the previous Stage 1 Archaeological Assessment completed for the W12A Landfill Area Study in 2006 and the City of London's current Archaeological Management Plan, there are areas of archaeological significance or potential within the existing W12A Landfill Site Study Area that have not been previously assessed and require further work (Stage 2 assessment) to identify potential archaeological sites and/or document previous disturbance.

Proposed extent of horizontal expansion of landfill footprint – There are known archaeological sites to the north of the existing W12A Landfill site that require further assessment. To minimize affects to these sites it is preferable if they are not located in proposed areas of horizontal expansion of the waste footprint area.

The archaeological information used to complete this comparative assessment was the findings of Stage 1 and Stage 2 archaeological studies carried out in the Site Study Area, which identified the areas of archaeological significance.

The comparative evaluation of 'Alternative Methods' using these factors is presented in Table 7.2-23.

Based on the evaluation, Alternatives 1 and 3 are most preferred from the archaeology perspective.

Table 7.2-23: Archaeology Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected archaeological resources potentially affected on-site.	Archaeological sites in the site development area	Proposed development area will include known archaeological sites requiring further work. Equally preferred	Proposed development area will include known archaeological sites requiring further work. Equally preferred	Proposed development area will include known archaeological sites requiring further work. Equally preferred
	Proximity to known areas of archaeological significance or potential in the site development area	Includes areas of archaeological significance or potential that require further assessment to identify potential archaeological sites and/or document previous disturbance. Equally preferred	Includes areas of archaeological significance or potential that require further assessment to identify potential archaeological sites and/or document previous disturbance. Equally preferred	Includes areas of archaeological significance or potential that require further assessment to identify potential archaeological sites and/or document previous disturbance. Equally preferred

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
	Proposed extent of horizontal expansion of landfill footprint	No horizontal expansion of landfill footprint, therefore there will be no impact to known archaeological sites requiring further assessment. Most preferred	Horizontal expansion of landfill footprint to the north will impact known archaeological sites requiring further assessment. Least preferred	Horizontal expansion of landfill footprint to the east will not impact known archaeological sites requiring further assessment. Most preferred
Preferred Alternative for Archaeology		**Most preferred**	**Less preferred**	**Most preferred**

In addition to the comparative evaluation using the indicators and factors of differentiation, an assessment based on advantages and disadvantages identified by the comparative evaluation was also completed (refer to Table 7.2-24). Alternatives 1 and 3 are most preferred because they could potentially avoid impacting known areas of archaeological significance.

Table 7.2-24: Evaluation of Advantages and Disadvantages for Archaeology

Archaeology	Advantages	Disadvantages
Alternative 1	No horizontal expansion that could impact known archaeological sites requiring further assessment.	New landfill-related infrastructure in the site development area could impact known archaeological sites to the north of the existing W12A landfill site that require further assessment.
Alternative 2	None.	Proposed horizontal expansion of landfill footprint will impact known archaeological resources in northern buffer zone.
Alternative 3	Horizontal expansion to the east will not impact known archaeological sites requiring further assessment.	New landfill-related infrastructure in the Site development area could impact known archaeological sites to the north of the existing W12A landfill site that require further assessment.

7.2.7 Cultural Heritage

In the approved Amended ToR under the Cultural Heritage component there were two sub-components; cultural heritage landscapes and built heritage resources. After completion of the assessment of existing conditions it was determined that the Site-vicinity Study area did not contain any cultural heritage landscapes and as such the 'Alternative Methods' are not compared considering this sub-component.

In accordance with the approved Amended ToR, the indicator to be considered for built heritage resources is:

- Expected impact on identified built heritage resources on-site and within the Site-vicinity Study Area

The factors considered to differentiate between 'Alternative Methods' for landfill expansion, from the perspective of the built heritage resources component, were selected because they are most likely to result in an adverse effect. These are:

- Alteration that is not sympathetic, or is incompatible, with the historic fabric and appearance;
- Destruction of any, or part of any, significant heritage attribute or feature;
- Shadow impacts on the appearance of a heritage attribute or an associated natural feature;
- Isolation of a heritage attribute from its surrounding environment, context, or a significant relationship;
- Impact on significant views or vistas within, from, or of built and natural features;
- A change in land use where the change in use may impact the cultural heritage value or interest of the property area; and
- Land disturbances such as a change in grades that alters soils and drainage patterns that may affect a built heritage resource.

Each of these factors was evaluated for expected impact on identified built heritage resources within the Site-vicinity Study Area based on the following successive considerations:

- Whether there is an expected impact to identified cultural heritage resources.
- The likely degree of expected impact to identified cultural heritage resources.
- The potential to ameliorate or mitigate the expected impact to identified cultural heritage resources.

The comparative evaluation of 'Alternative Methods' using these factors is presented in Table 7.2-25.

Based on the evaluation, it is expected that none of the landfill alternatives provides a significant advantage, resulting in the equal ranking of each alternative from the perspective of built heritage resources.

Table 7.2-25: Built Heritage Resources Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected impact on identified cultural heritage resources within the Site-vicinity Study Area	Alteration that is not sympathetic, or is incompatible, with the historic fabric and appearance	No expected impacts	No expected impacts	No expected impacts
	Destruction of any, or part of any, significant heritage attribute or feature	No expected impacts	No expected impacts	No expected impacts
	Shadow impacts on the appearance of a heritage attribute or an associated natural feature	No expected impacts	No expected impacts	No expected impacts
	Isolation of a heritage attribute from its surrounding environment, context, or a significant relationship	No expected impacts	No expected impacts	No expected impacts
	Impact on significant views or vistas within, from, or of built and natural features	No expected impacts	No expected impacts	No expected impacts
	A change in land use where the change in use may impact the cultural heritage value or interest of the property area	No expected impacts	No expected impacts	No expected impacts
	Land disturbances such as a change in grades that alters soils and drainage patterns that may affect a built heritage resource	No expected impacts	No expected impacts	No expected impacts
Preferred Alternative for Built Heritage Resources		**Equally Preferred**	**Equally Preferred**	**Equally Preferred**

In addition to the comparative evaluation using the indicators and factors of differentiation, an assessment based on advantages and disadvantages identified by the comparative evaluation was also completed (refer to Table 7.2-26). None of the alternatives provides a notable advantage or disadvantage over another.

Table 7.2-26: Evaluation of Advantages and Disadvantages for Built Heritage Resources

Cultural Heritage Resources	Advantages	Disadvantages
Alternative 1	There are no expected impacts to identified built heritage resources from this alternative	None
Alternative 2	There are no expected impacts to identified built heritage resources from this alternative	None
Alternative 3	There are no expected impacts to identified built heritage resources from this alternative	None

7.2.8 Land Use

In accordance with the approved Amended ToR, the indicator to be considered for current and planned future land uses is:

- Expected impact on sensitive land uses (i.e., dwellings, churches, and parks within the Site-vicinity).

To evaluate this indicator, two factors were identified that were used to differentiate between the 'Alternative Methods' for landfill expansion from the perspective of the land use indicator. These factors are:

- Compatibility with municipal land use policy framework; and
- Proximity to sensitive land use (and type), and potential impact on sensitive land uses.

<u>Compatibility with municipal land use policy framework</u> - This factor examines the compatibility of the landfill expansion with City of London Official Plan designations (1989 Official Plan, and The London Plan) and City of London Zoning By-law regulations within the Site-vicinity Study Area. It was selected as the proposed landfill expansion may not be consistent with certain land use permissions, resulting in the need for approvals under the Planning Act (e.g., Official Plan amendment and/or Zoning By-law amendment).

The current limit of waste is within an area zoned Waste and Resource Management (WRM1) that permits: agricultural uses; municipal waste disposal facility; leachate pre-treatment / hauled liquid waste facility; public drop-off for municipal hazardous and special waste; community recycling and drop-off depot; yard waste composting facility; and material recovery facility. Under all three scenarios, a Zoning By-law Amendment would be required to re-zone either the area to the north or east to the WRM1 zone from the Agricultural (AG2) Zone. Accordingly, one expansion alternative does not provide a benefit over another from a zoning perspective.

Based on the evaluation, it is expected that no landfill expansion alternative provides a significant advantage, relative to the other, resulting in the equal ranking of each alternative from the perspective of compatibility with municipal land use policy framework.

Based on proximity to and potential impacts on the sensitive land uses – This factor was selected as waste disposal facilities can potentially affect the use and enjoyment of sensitive uses in the Site-vicinity Study Area. This factor is evaluated through an assessment of potential nuisances that are identified under the provincial land use Guideline D-1 (Land Use and Compatibility) including noise and vibration; visual impact; odours and air emissions; litter, dust and other particulates; and other contaminants.

Alternative 1 is the most preferred alternative from a land use planning perspective. This alternative was selected on the basis that it does not result in the limits of the waste footprint area being extended towards a sensitive land use. Alternatives 2 and 3 would result in the limit of the waste footprint area extending towards residential dwellings to the north, northwest and northeast along Scotland Drive and White Oak Road. In addition, Alternative 3 would result in encroachment towards a cattle farm located on the south side of Manning Drive to the southeast of the Site Study Area.

The comparative evaluation of 'Alternative Methods' using these factors is presented in Table 7.2-27.

Table 7.2-27: Current and Planned Future Land Use Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected impact on sensitive land uses (i.e., dwellings, churches, and parks within the Site-vicinity Study Area)	Compatibility with municipal land use policy framework	Equally Preferred	Equally Preferred	Equally Preferred
	Proximity to sensitive land use (and type) and potential impacts on sensitive land uses	Most Preferred	Less Preferred	Least Preferred
Preferred Alternative for Current and Planned Future Land Uses		**Most Preferred**	**Less Preferred**	**Least Preferred**

In addition to the comparative evaluation using the indicators and factors of differentiation, an assessment based on advantages and disadvantages identified by the comparative evaluation is shown in Table 7.2-28. Based on this analysis, Alternative 1 is most preferred because it is the only alternative that does not encroach towards any sensitive land uses.

Table 7.2-28: Evaluation of Advantages and Disadvantages for Current and Planned Future Land Uses

Current and Planned Future Land Uses	Advantages	Disadvantages
Alternative 1	Does not encroach towards any sensitive land uses within the Site-vicinity Study Area.	Additional height may create visual impacts to surrounding uses including Islamic Cemetery of London, immediately south of the landfill at the southeast corner of Manning Drive and White Oak Road.
Alternative 2	Does not encroach towards sensitive land uses to the southwest (cattle farm along south side of Manning Drive).	Locates facility in closer proximity to sensitive land uses to the north, northwest, and northeast (residences along Scotland Drive and White Oak Road), which could intensify odour, noise and dust impacts.
Alternative 3	Does not encroach towards sensitive land uses to the northwest (residences along Scotland Drive and White Oak Road).	Locates facility in closer proximity to sensitive land uses to the north, and northeast (residences along Scotland Drive) as well as southeast (cattle farm along south side of Manning Drive) which could intensify odour, noise and dust impacts, and could have impacts on the cattle.

7.2.9 Socio-economic

The Socio-economic component comprises two sub-components:

- Local economy; and
- Residents and community.

The assessment for each of the Socio-economic sub-components is summarized in the following sections.

7.2.9.1 Local Economy

In accordance with the approved Amended ToR, the indicators to be considered for local economy are:

- Expected effect on local employment;
- Expected effects on local businesses and commercial activity; and
- Expected effects on municipal finances.

The factors considered to differentiate between 'Alternative Methods' for landfill expansion, from the perspective of the local economy indicators were selected because they are most likely to result in an adverse effect. These consist of:

- Employment opportunities during landfill expansion construction and operation;
- Potential impacts to local commercial businesses in the Site-vicinity Study Area (excludes agriculture, which is evaluated in Section 7.2.5 of this EASR; and
- Capital costs associated with construction and operational costs.

The comparative evaluation of 'Alternative Methods' using these factors is presented in Table 7.2-29. Landfill expansion can provide economic benefits to the local community in the form of new employment opportunities during expansion activities and day-to-day operation. This also has the potential for increased employment opportunities for local firms supplying products or services directly, or as secondary suppliers, during expansion activities. Although a similar potential for employment positions are predicted to be required at the Site for ongoing operations regardless of the alternative selected, there is expected to be additional employment opportunities during construction associated with each of the expansion alternatives. The capital costs associated with Alternatives 2 and 3 are expected to be greater than Alternative 1.

Table 7.2-29: Local Economy Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected effect on local employment.	Consideration of temporary employment positions generated during construction.	No horizontal expansion and associated construction required. Greatest length of construction of perimeter collector and finger drains. <u>Least Preferred</u>	Similar potential for employment positions generated during construction of horizontal expansion and perimeter collector and finger drains compared to Alternative 3. Length of perimeter system approximately 80% of that for Alternative 1. <u>Most Preferred</u>	Similar potential for employment positions generated during construction of horizontal expansion and perimeter collector and finger drains compared to Alternative 2. Length of perimeter system approximately 72% of that for Alternative 1. <u>Most Preferred</u>
	Consideration of new permanent employment positions generated during operation.	No expected change to existing employment numbers. <u>Equally Preferred</u>	No expected change to existing employment numbers. <u>Equally Preferred</u>	No expected change to existing employment numbers. <u>Equally Preferred</u>
	Ranking	**Least Preferred**	**Most Preferred**	**Most Preferred**
Expected effects on local businesses and commercial activity.	Consideration of businesses in the area who may experience disruption.	No impacts to local business operations, as the proposed expansion is located within the existing landfill footprint. <u>Equally Preferred</u>	No impacts from the horizontal expansion to local business operations anticipated. <u>Equally Preferred</u>	No impacts from the horizontal expansion to local business operations anticipated. <u>Equally Preferred</u>

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
	Consideration of potential revenue to businesses whose services may be required during landfill construction	No excavation for horizontal expansion and associated underdrain leachate collection system construction required. Greatest length of construction of perimeter collector and finger drains, but perimeter collectors required less resources than underdrain leachate collection system. <u>Less Preferred</u>	Similar potential for employment positions and revenue generated during construction of horizontal expansion (excavation and underdrain leachate collection system) and perimeter collector and finger drains compared to Alternative 3. Length of perimeter system approximately 80% of that for Alternative 1. <u>Most Preferred</u>	Similar potential for employment positions generated during construction of horizontal expansion and perimeter collector and finger drains compared to Alternative 2. Length of perimeter system approximately 72% of that for Alternative 1. <u>Most Preferred</u>
	Ranking	**Less Preferred**	**Most Preferred**	**Most Preferred**
Expected effects on municipal finances.	Relative cost of facility expansion.	Lowest overall capital and additional operational costs. <u>Most Preferred</u>	Largest capital cost to implement expansion. <u>Less Preferred</u>	Lower capital costs to implement expansion compared to Alternative 2. <u>Less Preferred</u>
	Anticipated increase in revenue.	All alternatives will receive the same amount of incoming waste <u>Equally Preferred</u>	All alternatives will receive the same amount of incoming waste <u>Equally Preferred</u>	All alternatives will receive the same amount of incoming waste <u>Equally Preferred</u>
	Ranking	**Most Preferred**	**Less Preferred**	**Less Preferred**
Preferred Alternative for Local Economy		**Least Preferred**	**Most Preferred**	**Most Preferred**

Alternatives 2 and 3 were ranked highest for employment and local business opportunities during construction. Although there will be construction required for Alternative 1, Alternative 1 was less preferred for these two factors than Alternatives 2 and 3. Alternative 1 has the lowest capital cost for construction, followed by Alternative 3 and Alternative 2. Overall, it is considered that Alternatives 2 and 3 rank as preferred in terms of the local economy.

In addition to the comparative evaluation using the indicators and factors of differentiation, an assessment based on advantages and disadvantages identified by the comparative evaluation was also completed (refer to Table 7.2-30).

Table 7.2-30: Evaluation of Advantages and Disadvantages for Local Economy

Local Economy	Advantages	Disadvantages
Alternative 1	No impacts to local business operations. Lowest overall capital and additional operational costs.	Smallest potential for employment opportunities associated with construction.
Alternative 2	No impacts to local business operations. Largest potential for employment opportunities associated with construction.	Largest capital cost to implement expansion.
Alternative 3	No impacts to local business operations. Potential for employment opportunities associated with construction comparable to Alternative 2.	Higher capital costs compared to Alterative 1, but lower than Alternative 2.

7.2.9.2 Residents and Community

In accordance with the approved Amended ToR, the indicators to be considered for residents and community are:

- Displacement of residents; and
- Expected interference with use and enjoyment of residential properties (nuisance effects).

The factors considered to differentiate between ‘Alternative Methods’ for landfill expansion, from the perspective of the residents and community indicators were selected because they are most likely to result in an adverse effect. These consist of:

- Proximity to nearby residences; and
- Biophysical and social interactions with nearby residential PORs (i.e., noise, odour, and nuisance wildlife/pests). Potential visual impacts are considered in Section 7.2.10 of this EASR.

The comparative evaluation of ‘Alternative Methods’ using these factors is presented in Table 7.2-31.

There are four residential-rental properties, located north of the existing landfill, that are owned by the City of London. The buildings associated with 3801 Scotland Drive are proposed to be removed for landfill expansion, while the three other residential buildings, located at 3561, 3465 and 3405 Scotland Drive, will remain for each of the three alternatives. In each of the three alternatives, the landfill will be designed to MECP regulations and required to perform in accordance with accepted standards for potential off-site nuisance impacts. Although adverse effects are not anticipated at nearby residences, the alternatives with closer residences have a higher potential for adverse effects.

Based on the evaluation, it is expected that Alternative 1 is preferred from the perspective of local residents and community.

Table 7.2-31: Residents and Community Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Displacement of residents.	Displacement of residents during landfill expansion, construction and/or operation.	One City rental property proposed for demolition. No change to private residences. Equally Preferred	One City rental property proposed for demolition. No change to private residences. Equally Preferred	One City rental property proposed for demolition. No change to private residences. Equally Preferred
Expected interference with use and enjoyment of residential properties (nuisance effects).	Potential nuisance effects from air quality, noise, odour, and nuisance wildlife species and pests on nearby residential PORs.	With vertical expansion, the distance to residential PORs does not change from existing conditions. This alternative is the least likely to potentially impact sensitive PORs from an odour or noise nuisance perspective. Comparable rate of fill and type of waste is predicted to result in a comparable level of attraction for nuisance wildlife species and pests. Most Preferred	Less separation from a larger number of residential properties located to the north along Scotland Drive. This alternative is the most likely to potentially impact sensitive PORs from an odour or noise nuisance perspective. Comparable rate of fill and type of waste is predicted to result in a comparable level of attraction for nuisance wildlife species and pests. Least Preferred	Greater separation than Alternative 2 but less separation than Alternative 1 from residential properties located to the north along Scotland Drive. This alternative is less likely than Alternative 2, but more likely than Alternative 1 to potentially impact sensitive PORs from an odour or noise nuisance perspective. Comparable rate of fill and type of waste is predicted to result in a comparable level of attraction for nuisance wildlife species and pests. Less Preferred
Preferred Alternative for Residents and Community		**Most Preferred**	**Least Preferred**	**Less Preferred**

In addition to the comparative evaluation using the indicators and factors of differentiation, an assessment based on advantages and disadvantages identified by the comparative evaluation was also completed (refer to Table 7.2-32).

Table 7.2-32: Evaluation of Advantages and Disadvantages for Residents and Community

Residents and Community	Advantages	Disadvantages
Alternative 1	This alternative is considered the least likely to impact sensitive PORs from an odour or noise nuisance perspective.	None
Alternative 2	None	This alternative is considered the most likely to potentially impact sensitive PORs from an odour or noise nuisance perspective.
Alternative 3	None	This alternative is less likely than Alternative 2, but more likely than Alternative 1, to impact sensitive PORs from an odour or noise nuisance perspective.

7.2.10 Visual

In accordance with the approved Amended ToR, the indicator to be considered for visual is:

- Expected changes in landscape views from off-Site.

The factor considered to differentiate between 'Alternative Methods' for landfill expansion, from the visual perspective was:

- Number of landscape views impacted.

This factor was considered for public rights of way and significant outdoor residential areas within 3500 m of the Site.

Calculation of Visual Impact – A quantitative assessment was undertaken to consistently quantify the visual impact of the proposed expansion alternatives, which involved the calculation of the following values from each point of interest (viewpoints in private outdoor areas and from public rights of way within the Site-vicinity Study Area boundary):

- The visible area of the proposed landfill (in m^2);
- The distance to the nearest visible point (in m);
- The maximum angle between the visible area of the landfill (in degrees);

- The average slope of the terrain between that viewpoint and the visible landfill area (as a percentage); and
- The amount of tree cover between that viewpoint and the visible landfill area (as a percentage).

The following data and algorithms were used in the calculation of the above-mentioned values:

a) City of London 2019 Aerial Photography;

b) Contours, parcel boundary, and existing limit of waste, taken from the City of London's AutoCAD drawing file project no. 1648176, project title "Individual EA of the proposed W12A Expansion";

c) Significant vegetation (trees and hedges) from the City of London Open Data Catalogue and digitized from aerial photography and site visits;

d) Structures (houses, silos, etc.) from the City of London Open Data Catalogue and digitized from aerial photography and site visits;

e) Surface and terrain data from Natural Resources Canada High Resolution Digital Elevation Model - CanElevation Series; and

f) Viewshed calculation r.viewshed by Laura Toma (Bowdoin College), Yi Zhuang (Carnegie-Mellon University), William Richard (Bowdoin College), and Markus Metz.

Viewpoints within the Site-vicinity Study Area were selected from private outdoor areas using aerial photography to determine where people would normally gather on their property for outdoor experiences during the summer months (pools, patios, fire pits, etc.). In the absence of amenities identifiable from the aerial photographs, locations near the house within the backyard were selected.

From each of these viewpoints, a viewshed was calculated using the aforementioned data sets and algorithms to determine what areas of each proposed W12A Landfill expansion alternative within the zone denoted as "proposed limit of waste" would be visible, as well as factors that would mitigate the visual impact of those visible areas. Each of these factors was then assigned a score, ranging from very low impact to very high impact, and the scores summed to obtain a rating of the total visual effect of each expansion design alternative on each identified viewpoint. The specific visual factors assessed and the scores assigned to each are as follows:

<u>Area of Landfill Visible</u> – A score is given based on how much of the landfill is visible; the more of the landfill that is visible, the higher the visual impact rating will be. Given that an object's visual mass decreases as it gets further from its viewer, the distance to the visible areas is taken into account in assessing the visual impact of these areas.

The height and width of each visible portion of the landfill were multiplied to determine the area visible, and then were summed to get the total area of visible landfill. This sum was then divided by the distance to the landfill to get a "Perceived Area Index", and assigned a rating as shown in Table 7.2-33.

Table 7.2-33 Perceived Area Index Values

Perceived Area Index	Effect Level	Value
0 – 7.5	Very Low	1
7.51 – 13.0	Low	2
13.1 – 18.0	Moderate	3
18.1 – 23.0	High	4
> 23.0	Very High	5

Cone of View – The angle of an observer's cone of vision that has the greatest clarity is approximately 124 degrees. If the visible portions of the landfill occupy greater than 50% of this cone of vision the impact was determined to be high; if it occupies between 31% and 50%, it was determined to be moderate; if it was 30% or less the impact was low.

To calculate the visual impact of the landfill on the cone of view, the angle between the leftmost and rightmost edges of the visible portions of the landfill were determined and assigned a rating as shown in Table 7.2-34.

Table 7.2-34 Cone of View Values

Cone of View	Effect Level	Value
0 degrees to 15 degrees	Very Low	1
16 degrees to 30 degrees	Low	2
31 degrees to 50 degrees	Moderate	3
51 degrees to 90 degrees	High	4
> 90 degrees	Very High	5

Distance from the Landfill – As the distance between an observer and an object increases, the visual impact decreases, as determined by the nature of focal perception. Impact ratings were assigned based on whether the areas of landfill visible from each viewpoint fall into the foreground, middleground, or background of an observer's vision.

The distance from the viewpoint to the nearest point of the landfill was determined in metres, and assigned a rating as shown in Table 7.2-35

Table 7.2-35 Distance to Landfill

Distance In Metres	Effect Level	Value
2201 – 3500	Very Low	1
1501 – 2200	Low	2
801 – 1500	Moderate	3
601 – 800	High	4
0 – 600	Very High	5

Visual Absorption Capability Factor – Finally, the nature of the landscape between the viewpoint and the landfill site was taken into account. The visual impact of an object on a viewpoint is mitigated by significant masses of vegetation and changes of grade that occupy the space between it and an observer.

The capability of the terrain in the cone of view to absorb visual impact was calculated based on the mean slope of the terrain and the percent coverage of existing significant vegetation within the previously calculated cone of view, as shown in Table 7.2-36.

Table 7.2-36 Visual Absorption Capability Factor Values (VACF)

Factor	Range	Value	Description
Slope	0 percent	0	Water
	0.1 – 5 percent	1	Flat
	5.1 – 20 percent	2	Rolling
	> 20 percent	3	Rugged
Vegatation (% coverage)	<1 percent	0	Open
	1 – 10 percent	1	Sparse
	11 – 40 percent	2	Moderate
	> 40 percent	3	Dense

These values were then summed to obtain a VACF rating as shown in Table 7.2-37.

Table 7.2-37 Visual Absorption Capability Factor Value Ratings

Range	Description	Effect Level	Value
6	Very high visual absorption	Very Low	1
4 – 5	High visual absorption	Low	2
2 – 3	Moderate visual absorption	Moderate	3
1	Very high visual absorption	High	4
0	Very low visual absorption	Very High	5

Total Visual Effect – All of the above values were then summed to determine the overall visual effect of the expanded landfill alternative on each particular viewpoint, as described in Table 7.2-38.

Table 7.2-38 Combined Effect Value Scale

Combined Effect Value Scale	Visual Effect Ranking
4-6	Very Low Effect
7-9	Low Effect
10-11	Moderate Effect
12-15	High Effect
16-20	Very High Effect

Overall Visual Impact – The overall visual effect was calculated for the existing landfill design and for each of the landfill expansion alternatives for each of the selected viewpoints within the Site-vicinity Study Area. The location of the viewpoint was deemed to be impacted if the overall visual effect ranking for a landfill expansion alternative was higher than the overall visual effect ranking for the existing landfill.

Based on the results of the evaluation, which is summarized in Table 7.2-39, it is expected that Alternative 3 is the most preferred from a visual perspective.

Table 7.2-39: Visual Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected changes in landscape views from off-Site areas	Number of landscape views impacted	64 Least Preferred	49 Less Preferred	31 Most Preferred
Preferred Alternative for Visual		**Least Preferred**	**Less Preferred**	**Most Preferred**

In addition to the comparative evaluation using the indicators and factors of differentiation, an assessment based on advantages and disadvantages identified by the comparative evaluation was also completed (refer to Table 7.2-40). Alternative 3 is most preferred because it is expected to have the least visual effect on public rights of way and private outdoor areas.

Table 7.2-40: Evaluation of Advantages and Disadvantages for Visual

Visual	Advantages	Disadvantages
Alternative 1	None	Expected to have the highest visual effect on surrounding residential private outdoor areas and public rights of way.
Alternative 2	Expected to have a low visual effect on surrounding residential private outdoor areas and public rights of way.	Expected to have a higher visual effect on surrounding residential private outdoor areas and public rights of way than Alternative 3.
Alternative 3	Expected to have the least visual effect on surrounding residential private outdoor areas and public rights of way.	None

7.2.11 Design and Operations

The Design and Operations component comprises two sub-components:

- Engineered containment; and
- Financial.

The Design and Operations assessment for each of the sub-components is summarized in the following sections.

7.2.11.1 Engineered Containment

In accordance with the approved Amended ToR, the indicator to be considered for engineered containment is:

- Expected degree of engineered containment and/or controls required.

In general, alternatives that require less reliance on engineered systems to provide containment and control of potential releases to the environment are preferred. The factors considered to differentiate between 'Alternative Methods' for landfill expansion, from the perspective of the engineered containment indicator, were selected because they are most likely to result in an adverse effect. The factors are:

- Phase 1 perimeter leachate collection system (LCS) and finger drain requirements;
- Underdrain LCS requirements;
- LFG collection system requirements and effectiveness; and
- Provision of temporary leachate storage during storm events.

Phase 1 Perimeter and Underdrain LCS Requirements - For leachate control, consideration is given to the requirement for additional LCS and management infrastructure to implement the expansion alternative. For the Phase 1 landfill area, the components are the replacement of the perimeter LCS and provision of finger drains to control leachate seepage (leachate breakout along the perimeter slopes); the indicator is the length of system required. For the horizontal expansion areas, the component is the provision of the underdrain LCS; the indicator is the area of system required. In terms of effectiveness of leachate control, the Phase 1 area perimeter and finger drain collectors do not reduce the buildup of a leachate mound within the landfill (which potentially causes leachate migration deeper into the subsurface) but rather captures leachate that migrates to the perimeter at the base or towards the sideslopes of the landfill; these systems are accessible and can be maintained, replaced or augmented. The underdrain LCS (beneath the existing Phase 2 area and proposed to be installed below the horizontal expansion areas) prevent the formation of a leachate mound and can be maintained by regular flushing over the functional service life of the system but cannot be accessed for repair or replacement. Overall, an underdrain LCS is considered preferable over a perimeter collector / finger drain system. An underdrain LCS could also be augmented after failure with a perimeter collector / finger drain system.

The factual information relevant to these factors is provided below:

Table 7.2-41: Engineering Containment Considerations for Evaluation of 'Alternative Methods'

	Alternative 1	Alternative 2	Alternative 3
Total Additional Waste Footprint Area (ha)	None	27 ha	28 ha
Phase 1 perimeter LCS and finger drain requirements	2,350 m	1,900 m	1,400 m

LFG collection system requirements and effectiveness – For landfill gas (LFG) control, consideration is given to the requirement to provide an active LFG collection system and associated handling (flaring) of the collected gas. In general, the effectiveness of LFG collection systems increases with increasing thickness of waste.

Provision of temporary leachate storage during storm events – The two main approaches are temporary storage within the landfill where it is underlain by an underdrain LCS or the construction of a storage pond or tank to temporarily contain leachate from the Phase 1 area perimeter LCS. The availability of storage within the underdrain LCS is considered preferable since there will not need to be additional storage infrastructure provided or the potential for odours associated with temporary storage of leachate in a pond.

The comparative evaluation of 'Alternative Methods' using these factors is presented in Table 7.2-42.

Based on the evaluation, Alternative 3 is most preferred in terms of expected degree of engineered containment and/or control requirements, followed by Alternative 2 and then Alternative 1 as least preferred.

Table 7.2-42: Engineered Containment Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected degree of engineered containment and/or controls required.	Phase 1 perimeter LCS and finger drain requirements	Longest length of perimeter LCS / finger drain control Least Preferred	Longer length of perimeter LCS / finger drain control system compared to Alternative 3 Less Preferred	Shortest length of perimeter LCS / finger drain control system Most Preferred
	Underdrain LCS requirements	No additional underdrain LCS Least Preferred	Additional 27 ha Less Preferred	Additional 28 ha Most Preferred
	LFG collection system requirements and effectiveness	All expansion alternatives have the same additional airspace and volume of waste requiring control of LFG emissions, but in terms of effectiveness Alternative 1 has the greatest waste thickness and therefore gas collection will be most effective Most Preferred	All expansion alternatives have the same additional airspace and volume of waste requiring control of LFG emissions. Less Preferred	All expansion alternatives have the same additional airspace and volume of waste requiring control of LFG emissions. Less Preferred
	Provision of temporary leachate storage during storm events	A storage pond (or tank) will be required for temporary storage of leachate from the whole of the Phase 1 perimeter LCS. Least Preferred	The north side portion of the Phase 1 perimeter LCS will be replaced by the underdrain LCS in the northern expansion area. A storage pond (or tank) will be required for	The east side portion of the Phase 1 perimeter LCS will be replaced by the underdrain LCS in the eastern expansion area and the north side portion of the Phase 1

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
			temporary storage of leachate from the Phase 1 perimeter LCS that will remain along the east and south sides. Less Preferred	perimeter LCS will discharge into the east expansion area underdrain LCS. A storage pond (or tank) will be required for temporary storage of leachate from the Phase 1 perimeter LCS that will remain along the south side, although it may be possible to also route leachate from this south side section of perimeter LCS into the east extension underdrain system. Most Preferred
Preferred Alternative for Engineered Containment and/or Controls		**Least Preferred**	**Less Preferred**	**Most Preferred**

Based on the evaluation, it is indicated that Alternative 3 is most preferred from an engineered containment and controls perspective because it ranked highest for all indicators (except for one indicator where it was less preferred).

In addition to the comparative evaluation using the indicators and factors of differentiation, the advantages and disadvantages identified by the comparative evaluation are shown in Table 7.2-43.

Table 7.2-43: Evaluation of Advantages and Disadvantages for Engineered Containment

Engineered Containment	Advantages	Disadvantages
Alternative 1	Most effective at capturing LFG.	Phase 1 area totally reliant on Phase 1 area perimeter LCS and finger drains for leachate control. Pond (or tank) required for temporary leachate storage.
Alternative 2	Northern horizontal expansion area has underdrain collection system.	Pond (or tank) required for temporary leachate storage for east and south side sections of Phase 1 perimeter LCS. Less preferred than Alternative 1 for effective landfill gas collection.
Alternative 3	Shortest length of perimeter LCS / finger drain control system. Eastern horizontal expansion area has underdrain collection system and can be used for temporary storage for most if not all of the leachate collected by remaining sections of the Phase 1 perimeter LCS.	Less preferred than Alternative 1 for effective landfill gas collection.

7.2.11.2 Financial

In accordance with the approved Amended ToR, the indicator to be considered for financial is:

- Costs associated with implementation of expansion alternatives.

The factors considered to differentiate between ‘Alternative Methods’ for landfill expansion, from the perspective of the financial indicator, were selected because they are most likely to result in an adverse effect. These factors are:

- Capital costs for establishing the additional disposal capacity; and
- Additional ongoing operational and maintenance costs associated with the expansion.

Capital Costs – The main components that will have different capital costs between the three alternatives are: 1) the volume of excavation and construction of the underdrain LCS (indicated by the excavation quantity and horizontal expansion area); 2) the construction of finger drains and perimeter LCS for the Phase 1 area (indicated by the length of perimeter); and, 3) LFG collection system extension into horizontal expansion areas (indicated by the horizontal expansion area).

Ongoing Additional Operational and Maintenance Costs – The main components that will have different operating and maintenance (O&M) costs between the three alternatives are: 1) the additional costs for underdrain LCS inspection and flushing (indicated by horizontal expansion area); 2) Phase 1 perimeter LCS and finger drain maintenance and possible replacement (indicated by length of Phase 1 perimeter); 3) LFG system operations (indicated by horizontal expansion area).

The factual information relevant to these factors is provided below:

Table 7.2-44: Financial Considerations for Evaluation of 'Alternative Methods'

	Alternative 1	Alternative 2	Alternative 3
Total Additional Waste Footprint Area (ha)	none	27 ha	28 ha
Phase 1 perimeter LCS and finger drain requirements	2,350 m	1,900 m	1,400 m
Excavation volume	none	2,040,000 m^3	820,000 m^3

The comparative evaluation of 'Alternative Methods' using these factors is presented in Table 7.2-45.

Based on the evaluation, it is indicated that Alternative 1 is most preferred from a financial perspective.

Table 7.2-45: Financial Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Costs associated with implementation of expansion alternatives.	Estimated capital costs for alternative designs.	No costs to construct a horizontal expansion; lowest LFG collection system costs, longest length of Phase 1 perimeter. Most Preferred	Construction of horizontal expansion with largest excavation volume; 20 % less Phase 1 perimeter length than Alternative 1. Least Preferred	Construction of horizontal expansion with smaller excavation volume than Alternative 2; less Phase 1 perimeter length than Alternatives 1 (40% less) or 2 (25% less). Less Preferred

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
	Estimated additional operational and maintenance (O&M) costs	No additional costs for underdrain LCS; largest potential for periodic costs associated with Phase 1 area perimeter leachate collection and finger drains and leachate seeps; no additional costs for LFG system O&M costs. Most Preferred	Additional costs to annually maintain underdrain LCS in horizontal expansion area; lower potential for periodic costs associated with Phase 1 area perimeter leachate collection and finger drains and leachate seeps than Alternative 1; additional LFG system O&M costs for gas well system in horizontal expansion area compared to Alternative 1. Less Preferred	Additional costs to annually maintain underdrain LCS in horizontal expansion area; lower potential for periodic costs associated with Phase 1 area perimeter leachate collection and finger drains and leachate seeps than Alternatives 1 and 2; additional LFG system O&M costs for gas well system in horizontal expansion area similar to Alternative 2. Less Preferred
Preferred Alternative for Financial		**Most Preferred**	**Least Preferred**	**Less Preferred**

In addition to the comparative evaluation using the indicators and factors of differentiation, the advantages and disadvantages identified by the comparative evaluation are shown in Table 7.2-466.

Table 7.2-46: Evaluation of Advantages and Disadvantages for Financial

Financials	Advantages	Disadvantages
Alternative 1	No excavation and management of excavated soil required. Lowest overall capital and additional operational costs.	Longest length of perimeter collector and finger drains to construct.
Alternative 2	None.	Largest volume of excavation and excavated soil to manage. Largest capital cost to implement expansion.
Alternative 3	Less volume of excavation and excavated soil to manage, and lower capital costs to implement expansion compared to Alternative 2.	Greater volume of excavation and excavated soil to manage, and higher capital costs to implement expansion compared to Alternative 1.

7.2.12 Transportation

In accordance with the approved Amended ToR, the indicator to be considered for traffic is:

- Expected effect on traffic along the Haul Route(s).

The factors considered to differentiate between 'Alternative Methods' for landfill expansion, from the perspective of the traffic indicator, were selected because they would be the most likely to result in an adverse effect, from a future traffic operation and safety perspective. These factors are:

- Changes in traffic volume;
- Changes in required haul routes; and
- Changes in type of vehicle expected.

It is noted that with the proposed expansion the annual maximum waste receipt is to be reduced from 650,000 to 500,000 tonnes per year. As such, the maximum waste-related traffic associated with the expansion will be less than what is allowed for the current landfill.

From a traffic/transportation standpoint, all three alternatives are preferred equally. This is largely because additional vehicles generated with the W12A Landfill expansion are expected to remain constant no matter what the selected alternative may be. In addition, the access locations and operations are expected to be the same as existing under all three alternatives.

The comparative evaluation of ‘Alternative Methods using this traffic factor is presented in Table 7.2-47.

Table 7.2-47: Traffic Evaluation of 'Alternative Methods'

Indicator	Differentiating Factors	Alternative 1	Alternative 2	Alternative 3
Expected effect on traffic along the Haul Route	Changes in traffic volume	Same for each alternative <u>Equally Preferred</u>	Same for each alternative <u>Equally Preferred</u>	Same for each alternative <u>Equally Preferred</u>
	Changes in required haul routes	Same for each alternative <u>Equally Preferred</u>	Same for each alternative <u>Equally Preferred</u>	Same for each alternative <u>Equally Preferred</u>
	Changes in type of vehicle expected	Same for each alternative <u>Equally Preferred</u>	Same for each alternative <u>Equally Preferred</u>	Same for each alternative <u>Equally Preferred</u>
Preferred Alternative		**Equally Preferred**	**Equally Preferred**	**Equally Preferred**

As a result, there are no unique advantages or disadvantages when comparing the three alternatives for the W12A Landfill expansion from a transportation perspective.

7.3 Public Input Regarding the Ranking of Alternatives

As described in Section 4.6 of this EASR, throughout the consultation period for the EA process, by way of meetings with PLC, CLC and Indigenous Communities, the open houses and the project website, feedback was solicited from the public. Among other things, feedback regarding the preferential ranking of components and sub-components was solicited from the public. The public was asked to consider if any component or sub-component was more or less important than another. The public was also provided an opportunity to comment on the individual component assessments or the identification of the preferred alternative, and whether they agreed or disagreed.

No feedback was received that conflicted with any of the analysis and ranking of individual components presented in Section 7.2. The ranking of components and sub-components from stakeholders was provided mostly during Open House #2 during the ToR and some more on-line surveys in advance of Open House #3. The rankings of the relative importance of the components by the stakeholders was considered in the overall identification of the preferred alternative, as described in Section 7.4.

7.4 Comparative Evaluation

The ranking of the ‘Alternative Methods’ for each of the components and sub-components and identification of the overall preferred alternative is presented in Table 7.4-1. The public ranking of the relative importance of the components and sub-components is also provided in Table 7.4-1. The comparative evaluation of ‘Alternative Methods’ of expanding the London W12A Landfill clearly identified Alternative 1 as the preferred method of expanding the landfill

Table 7.4-1 Summary of the Components and Sub-components Comparative Evaluation of 'Alternative Methods'

Category	Component / Sub-component	Alternative 1	Alternative 2	Alternative 3	Public Ranking Group
Environmental	**Atmosphere**				
	Air Quality (dust, odour and GHG)	Most Preferred	Least Preferred	Less Preferred	More Important
	Noise	Most Preferred	Least Preferred	Less Preferred	Less Important
	Biology				
	Aquatic ecosystems	Most Preferred	Least Preferred	Less Preferred	More Important
	Terrestrial ecosystems	Most Preferred	Least Preferred	Less Preferred	More Important
	Geology and Hydrology				
	Groundwater quality	Most Preferred	Least Preferred	Less Preferred	More Important
	Surface Water				
	Surface water quality	Most preferred	Less Preferred	Less Preferred	More Important
	Surface water quantity	Most Preferred	Less Preferred	Less Preferred	Important
Social	**Agriculture**				
	Agriculture	Most Preferred	Less Preferred	Least Preferred	Important
	Archaeology				
	Archaeology	Most Preferred	Less Preferred	Most Preferred	Less Important
	Cultural				
	Built Heritage Resources	Equally Preferred	Equally Preferred	Equally Preferred	Less Important
	Land Use				
	Current and planned future land uses	Most Preferred	Less Preferred	Least Preferred	Important
	Socio-economic				
	Local Economy	Least Preferred	Most Preferred	Most Preferred	Important
	Residents and Community	Most Preferred	Least Preferred	Less Preferred	More Important
	Visual				
	Visual	Least Preferred	Less Preferred	Most Preferred	Less Important

Category	Component / Sub-component	Alternative 1	Alternative 2	Alternative 3	Public Ranking Group
Technical	**Design and Operations**				
	Engineered Containment	Least Preferred	Less Preferred	Most Preferred	Important
	Financial	Most Preferred	Least Preferred	Less Preferred	Important
	Transportation				
	Traffic	Equally Preferred	Equally Preferred	Equally Preferred	Less Important
Overall Evaluation of Alternatives		**Most Preferred**	**Least Preferred**	**Less Preferred**	

As shown in Table 7.4-1, there are 12 components and 17 subcomponents.

Alternative 1 was ranked as most preferred for 12 of the sub-components and least preferred for three. Alternative 2 ranked as most preferred for one, less preferred for seven and least preferred for seven sub-components. Alternative 3 ranked as most preferred for four, less preferred for nine and least preferred for two sub-components. All three expansion alternatives were equally preferred for two of the sub-components. For those components/sub-components that were ranked by the public stakeholders as more important, Alternative 3 was ranked more highly than Alternative 2, resulting in Alternative 2 being ranked as least preferred overall.

Alternative 1 was identified as the preferred expansion alternative for the W12A Landfill expansion. This was the case whether the subcomponents were given an equal weighting or a weighting based on stakeholder input. Some key advantages of this expansion alternative are that the same landfill footprint is utilized meaning that proximity to sensitive PORs stays the same and most potential nuisance impacts are indicated to be less than associated with the other expansion alternatives, no aquatic features are destroyed as a result of construction, the thickest aquitard is present offering the most protection to downgradient groundwater quality, the least modifications to the SWMS are required, no loss of agricultural land and least capital cost for construction.