Table 9.8-1: Cultural Heritage Impact Assessment of the Proposed Expansion

Resource Type and Civic Address	Analysis of Impact	Conservation/ Mitigation Recommendations
Built heritage resource: 3583 Westminster Drive	The built heritage resource on this listed heritage property is over 60 m (approximately 1.25 km) from the proposed works for the Proposed Expansion and will not be directly impacted through either destruction or alteration, nor indirectly impacted by shadowing, isolation, obstruction, a change in land use, or vibration during construction or operation. The property has design or physical value for its residence, which is a typical vernacular expression of the Gothic Revival style, constructed circa 1865. The property also has potential historical or associative value for the connection between the house that stands today and the property's first patented owner George Mennill or his immediate relatives. It also has historical associations with the early Euro-Canadian settlement of Westminster Township.	No further cultural heritage studies or monitoring is recommended.
Built heritage resource: 5435 White Oak Road	The built heritage resource on this listed heritage property is over 60 m from the proposed works for the Proposed Expansion and will not be directly impacted through either destruction or alteration, nor indirectly impacted by shadowing, isolation, obstruction, a change in land use, or vibration during construction or operation. The property has potential design or physical value for its residence, which dates to circa 1858 and may be a rare example of one of the oldest homes in the southern part of Westminster Township. The house also has design or physical value as a representative example of the Georgian style, still applied for vernacular farmhouses into the Victorian period. The property's historical or associative value is linked to its association with Westminster Township pioneers Peter and John Johnston, and the agricultural development of the Township. The property's contextual value relates to the visual prominence of the house on the landscape and its unusual orientation at an angle to the surrounding roads.	No further cultural heritage studies or monitoring is recommended.

Resource Type and Civic Address	Analysis of Impact	Conservation/ Mitigation Recommendations
Built heritage resource: 4067 Scotland Drive	The built heritage resource on this listed heritage property is over 60 m from the proposed works for the Proposed Expansion and will not be directly impacted through either destruction or alteration, nor indirectly impacted by shadowing, isolation, obstruction, a change in land use, or vibration during construction or operation. The design or physical value of the property is tied to its residence, which is representative of a vernacular expression of the Gothic Revival style. The property's historical or associative value stems from its association with the Westminster Township pioneering family the Johnstons, as well as the agricultural development of the Township during the 19th century. The property has contextual value since it maintains and supports the rural character of the area.	No further cultural heritage studies or monitoring is recommended.
Potential cultural heritage landscape: 6100 White Oak Road	This cultural heritage landscape is over 60 m from the proposed works for the Proposed Expansion and will not be directly impacted through either destruction or alteration, nor will be indirectly impacted by shadowing, isolation, obstruction, a change in land use, or vibration during construction or operation. Since 2006 all cemeteries in the City have been included on the Register of Cultural Heritage Resources.	No further cultural heritage studies or monitoring is recommended.
Built heritage resources: 3691 Manning Drive	The built heritage resources on this listed heritage property are over 60 m distant from the proposed works for the Proposed Expansion and will not be directly impacted through either destruction or alteration, nor will be indirectly impacted by shadowing, isolation, obstruction, a change in land use, or vibration during construction or operation. The property has design or physical value for its farmhouse, which is both representative of a vernacular expression of the Gothic Revival style, and one of few remaining in the area. It also has design or physical value for its large timber-frame barn, which is a typical and well-preserved example of a gable central Ontario type.	No further cultural heritage studies or monitoring is recommended.

Resource Type and Civic Address	Analysis of Impact	Conservation/ Mitigation Recommendations
Potential built heritage resource: 6601/6603 Wellington Road South	The potential built heritage resource on this property is over 60 m (approximately 1 km) from the proposed works for the for Proposed Expansion and will not be directly impacted through either destruction or alteration, nor will be indirectly impacted by shadowing, isolation, obstruction, a change in land use, or vibration during construction or operation. The property has design or physical value for its Gothic arched barn, which is relatively rare in southern Ontario. Usually constructed of laminated trusses, an example of this size may display a high degree of craftsmanship.	No further cultural heritage studies or monitoring is recommended.
Potential built heritage resource: 3243 Manning Drive	The potential built heritage resource on this property is over 60 m (approximately 350 m) from the proposed works for the for Proposed Expansion and will not be directly impacted through either destruction or alteration, nor will be indirectly impacted by shadowing, isolation, obstruction, a change in land use, or vibration during construction or operation. The property has design or physical value as a representative example of a gabled ell vernacular farmhouse. It also has contextual value since it maintains and supports the rural agricultural character of the area.	No further cultural heritage studies or monitoring is recommended.

In summary, no built heritage resources of value or interest were identified within the CH Study Area that could potentially be impacted by the proposed W12A Landfill expansion and no further cultural heritage studies or monitoring of any properties is recommended.

9.9 Socio-economic

This section provides the assessment of socio-economic impacts associated with the proposed expansion of the W12A Landfill as described in Section 8 of this EASR. This assessment was conducted in accordance with the requirements set out in the approved Amended ToR (Volume II). The details of the impact assessment are provided in Volume IV Appendix D.10; a summary is provided below.

The socio-economic environment can be affected both directly and indirectly from both landfill construction work and operational activity. The most common socio-economic effects from landfill operations are nuisance effects such as dust, noise, litter and odour; these can occur during both construction and operations phases and can affect the extent to which residents can use and enjoy their personal property and outdoor spaces. This has

the potential to cause displacement of local residents who may leave the area due to these adverse effects. Vermin is another potential socio-economic concern associated with landfill sites, notably rats and gulls, and can be a concern for local residents and businesses (including farms). The visual appearance of the landfill is also an issue local residents will be aware of. Economically, the landfill contributes to municipal revenues and provides employment opportunities to the community. Costs to the City may be affected by increased heavy truck volume and effects on road surfaces as well as increased maintenance. Additional traffic also has the potential to disturb local residents.

9.9.1 Assessment Methodology

The socio-economic environment is evaluated in a number of different ways and looks at both direct and indirect effects and the level of change that may result to the baseline environment described in Section 5.10 of this EASR.

Direct effects – These are effects to the socio-economic environment that occur as a direct result of a change to a socio-economic feature such as population change or employment effects.

Indirect effects – these are effects to the socio-economic environment that occur indirectly as a result of project related changes on other aspects of the environment (e.g., increased noise, dust or odour creating nuisance effects).

This assessment was completed in collaboration with data collection and analyses undertaken by other disciplines (including noise, air quality, transportation and visual). These data and analyses were used to determine the effects (both beneficial and adverse) associated with the measurable changes in the socio-economic environment resulting from the Project and identify mitigation measures that are technically and economically feasible to prevent, reduce or otherwise ameliorate the adverse environmental effects.

9.9.2 Assessment of Impacts

9.9.2.1 Local Economy

The local economy can be affected through the potential for the creation of new employment opportunities at the site. Effects to local businesses could occur through increased usage of services during construction or effects on operations that may change patronage. Increased capital costs associated with construction and operation may affect municipal finances, e.g., maintenance, equipment replacement, etc. These are evaluated using relevant figures and information provided by the City and findings from applicable discipline studies.

The Project is not expected to create any new jobs in the community during operation, the existing landfill workforce is deemed sufficient. New jobs during construction activities are expected. It is estimated that with the additional infrastructure operations associated with the expansion, the annual operating cost could increase to $5 million. Several stop-controlled approaches along the haul routes are forecast to operate at a poor level of traffic control in the future (2048) conditions. However, traffic signals, if warranted, would be due to the projected increase of background traffic volume and/or movement of this background traffic and not the traffic associated with the landfill expansion. Other businesses (excluding

farms as these are discussed in Section 9.6) in the Site-vicinity Study Area are not anticipated to be affected negatively or positively as a result of the landfill expansion.

In terms of capital costs, the proposed expansion design has an estimated budget of $55 to $90 million, with a midpoint estimate of approximately $72 million (in 2020 dollars). Waste projections by the City show an increase in IC&I and water treatment plant residuals, both of which are charged tipping fees. It is also planned to increase the service area that may result in new waste coming to the landfill, which will be charged a tipping fee. Overall, revenue to the landfill will increase if the waste coming to the landfill matches the waste quantity projections.

9.9.2.2 Residents and Community

The effect of landfill operations on the local population and on the use and enjoyment of residences are typical public concerns. The proximity of the expanded landfill to residences may cause out-migration of local residents or discourage new residents from moving in. The extent to which local residents can use and enjoy their properties and outdoor spaces can be affected by project-related activity that results in, for example, litter, noise, odour, dust and/or vermin or change the visual aspect in an objectionable way. These are evaluated using findings from the respective studies for these components of the environment, as well as qualitative findings from engagement and professional judgement.

There are eight properties that can be considered residential and have existing homes within the Site-vicinity Study Area; there are residences located on farm operations and about half of the residences in the Site-vicinity Study Area are owned by the City. The physical landfill expansion does not require any displacement of residences although the buffer lands identified by the City as being beneficial for on-going landfilling will require the removal of one residence located on a City-owned property north of the landfill expansion. The Islamic Cemetery to the south of the site is the only community feature within the Site-vicinity Study Area. Nuisance effects may affect use of outdoor spaces such as funeral ceremonies or visitors to the cemetery. To date, the City has never received a complaint from the Islamic Cemetery about the operation of the landfill. Current noise, dust and odour sources within the Site-vicinity Study Area will primarily be agricultural and traffic as well as potential noise, dust and odour from the existing site.

Air quality studies identified anticipated measurable air emissions and evaluated them to determine effects. The residual effects were evaluated and concluded that they do not result in adverse effects in terms of air quality, dust or odour for the neighbouring existing residences as they meet appropriate provincial regulatory limits. As such, interference with use and enjoyment of property and other outdoor spaces from air quality, dust or odour are not expected. Appropriate monitoring and best practice measures will control air quality, dust and odour levels such that they do not exceed acceptable levels.

Potential noise impacts were evaluated using existing information and predictive modelling. Ancillary equipment and emergency equipment are expected to operate below provincial sound level limits. The change in traffic noise levels between the existing landfill and the landfill expansion is insignificant to noticeable using the provincial scale to quantify this change; this is considered an acceptable change. On-site noise from the landfill expansion

itself is predicted to require mitigation when the landfill operations are within 330 m of existing residential properties. There is only one residence that presently is located in this proximity and the mitigation is a berm that will act as a sound barrier when landfilling occurs in this limited area along the southern boundary of the expanded landfill. With this berm, the noise is predicted to be within allowable provincial requirements.

Concerns relating to traffic may include changes to access/egress to the site for trucks, increased truck traffic and noise from vehicles during construction and operations. No changes to access and egress are anticipated from the expanded site. As noted above, the anticipated increase in traffic as a result of increasing population and additional communities using the expanded landfill is not forecast to cause any issues with traffic movement along the haul routes. Applicable by-laws will be adhered to for truck traffic and operational hours, and good housekeeping practices will be maintained such that noise and emissions are not above acceptable levels.

Close views of the existing landfill are mainly seen by local residents and truck drivers on the landfill haul routes, but can also be viewed from private residences in areas where individuals may be enjoying their property. Depending on the location from which the W12A Landfill is viewed, features in the immediate landscape such as landscaping and buildings can take visual precedence over the landfill. The landfill expansion will have a high visual impact to three properties and have a moderate-high visual impact on two properties. Three of the five properties with moderate-high to high visual impacts are owned by the City and two properties are privately owned. All other properties will have a moderate visual impact or less. To reduce the visual impact of daily operations, waste would be placed initially to build a berm along the south side of the landfill's waste disposal area and will be covered with final cover soil and seeded to establish vegetation. With the expansion, the landfill property boundary will be moved northward to Scotland Drive and new berms with tree plantings will be constructed along the new property boundary (White Oak Road northward to Scotland Drive, Scotland Drive). The existing Community Enhancement and Mitigative Measures Program will be seeking stakeholder feedback on how the program can be improved including what are appropriate screening measures for private properties.

Vermin such as rats and gulls are concerns associated with landfill sites. No complaints regarding vermin have been noted and continued good site maintenance practices (e.g., application of daily cover, litter control program) will continue.

In summary, the W12A Landfill site is located in a largely agricultural area with few socio-economic features of note. The most likely potential impact to the socio-economic environment is from nuisance effects such as litter, noise, odour or dust, which can affect use and enjoyment of private properties or outdoor spaces. The presence of the landfill and proposed changes to it associated with the expansion are not expected to result in any out-migration of existing residents who are accustomed to living in an area where agricultural and industrial noise is commonplace. Adherence to applicable by-laws and provincial guidelines as well as implementation of best management practices and mitigation will minimize potential effects on the existing environment. In terms of the local economy, no changes to employment or use of local vendors is anticipated and over time the landfill is expected to have increased costs and generate additional revenue for the City. Adherence

to applicable municipal and provincial guidelines and use of best management practices (BMP) at the W12A Landfill site related to control and mitigation of effects such as litter, noise, dust or odour will assist in reducing potential effects to local residents. Continued use of a complaints protocol will be key tools in monitoring socio-economic effects and ensuring good community relations during construction and operations.

9.10 Visual

9.10.1 Methodology

The visual impact of the proposed landfill expansion on existing residential properties within 3,500 m of the site (Site-vicinity Study Area) was assessed. This was done by calculating values for the following factors from each point of interest (viewpoints in private outdoor areas and from public rights of way within the Site-vicinity Study Area):

- The visible area of the proposed landfill (m^2)
- The distance to the nearest visible point on the landfill (m)
- The maximum angle of the cone of view of the visible area of the landfill expansion (in degrees)
- The average slope of the terrain between that viewpoint and the visible proposed landfill area (as a percentage); and
- The amount of tree cover between that viewpoint and the visible landfill expansion area (as a percentage).

These factors represent, from a visual perspective, how much of an observer's view is occupied by the proposed landfill, taking into account the intervening terrain's hilliness and tree cover.

Within the Site-vicinity Study Area, comprehensive topographic information describing the terrain, vegetation, and structures was compiled; private and public viewpoints were identified; and the visual effect of the proposed landfill expansion on those views was calculated.

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.

The report providing additional details of the visual impact assessment is contained in Volume IV Appendix D.11. In this report, the GIS data and algorithms used in the visual impact assessment calculations are listed. The way each of the five above factors was applied in the assessment of visual impact and the qualitative rating of the impact (from very low to very high) and corresponding numerical rating / score for each factor are described.

The impact assessment process started with the identification of outdoor private recreation areas using aerial photography, and significant viewpoints from each were selected. From each of these viewpoints, a viewshed was calculated using the data sets and algorithms.

This calculated viewshed determined what areas of the proposed landfill expansion within the proposed limit of waste would be visible, and what intervening topographic features would mitigate the impact of those visible areas.

Using the numerical rating / score for each factor, each of the factors was then assigned a value from 1 to 5, corresponding to very low impact to very high impact, respectively. The scores were then summed to obtain a rating of the total visual effect of the proposed expansion on each identified viewpoint. The total visual effect rating used scoring system in Table 9.10-1.

Table 9.10-1: Viewpoint Scoring System

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

To check the accuracy of the model, a number of site visits were undertaken to verify the viewshed results. The data used for the viewshed calculations was imported into Google Earth as a 3D model, views of the proposed and existing landfill were generated from that 3D model, and those views were compared with the corresponding views in person.
A more comprehensive assessment was undertaken at one specific residential location, and example photos were taken from chosen views in the private outdoor areas for comparison to the model and its results. This preliminary study confirmed the accuracy of the viewshed ratings and of the real-time views generated by the Google Earth 3D model; the report from this assessment is provided in Volume IV Appendix D.11.

9.10.2 Results

The visual effect of the proposed landfill expansion on the selected viewpoints within the Site-vicinity Study Area is presented on Figure 9.10-1. This figure shows all the viewpoints that were assessed and the total visual effect rating for each viewpoint.

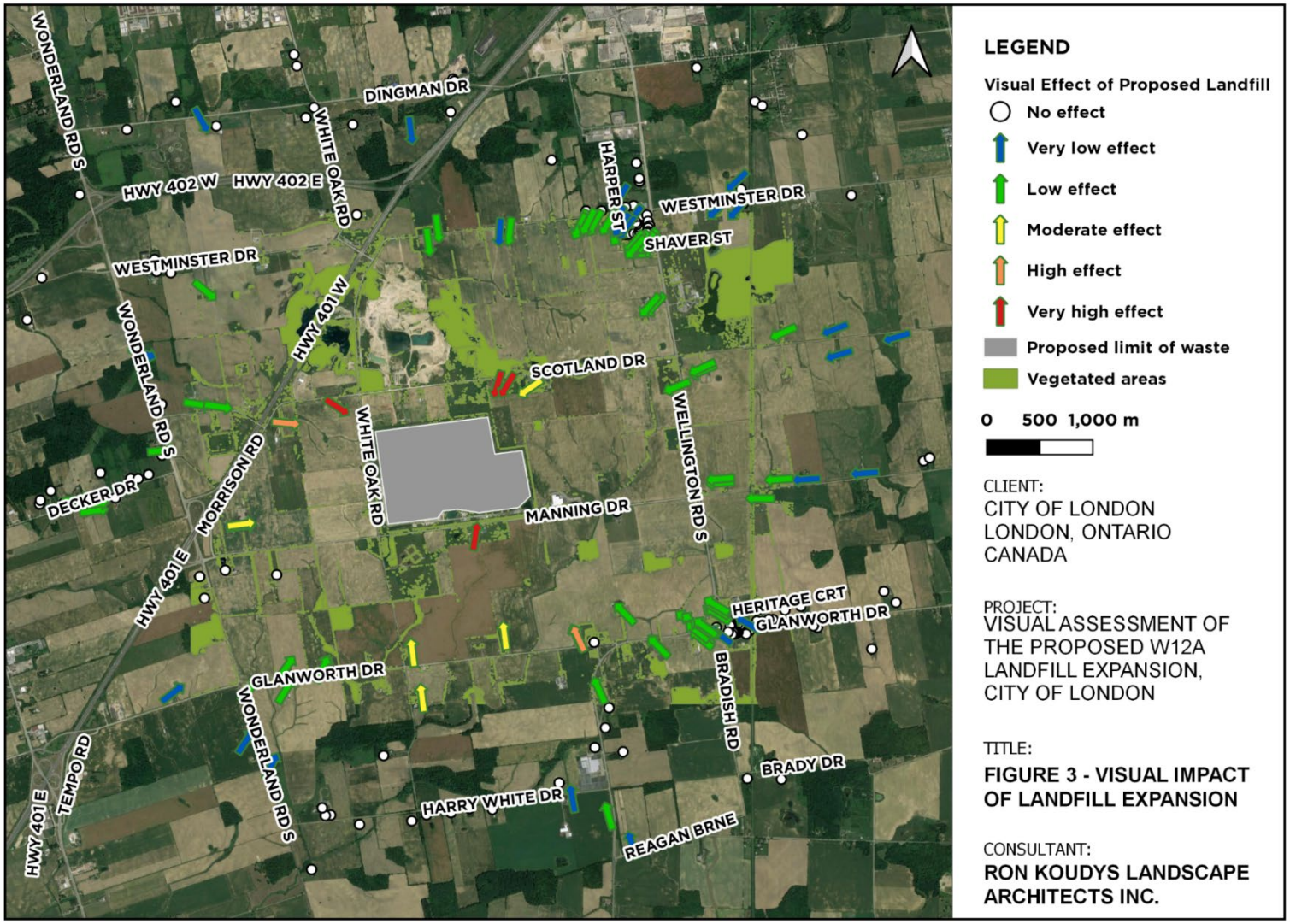


Figure 9.10-1: Visual Impact of Landfill Expansion

For the majority of the viewpoints, the visual effect is moderate to very low (total effect values mostly between 6 and 9). However, the landfill expansion will have a very high visual impact (total effect values of 16 to 18) on four properties (3691 Manning Drive, 3465 Scotland Drive, 3561 Scotland Drive, and 4067 Scotland Drive) and have a high visual impact (total effect values of 12) on two properties (3452 Glanworth Drive and 4233 Scotland Drive). Three of the six properties with high to very high visual impacts are owned by the City (3465 Scotland Drive, 3561 Scotland Drive and 4233 Scotland Drive) and three properties are privately owned (4067 Scotland Drive, 3691 Manning Drive and 3452 Glanworth Drive). The modelled view of the expanded landfill from each of these properties is presented on Figures 9.10-2 to 9.10-7. The expanded landfill is shown in brown-grey to clearly distinguish it from its surroundings. In reality, the expanded landfill will progressively have final cover soil installed and seeded to establish vegetation as the landfill is expanded.

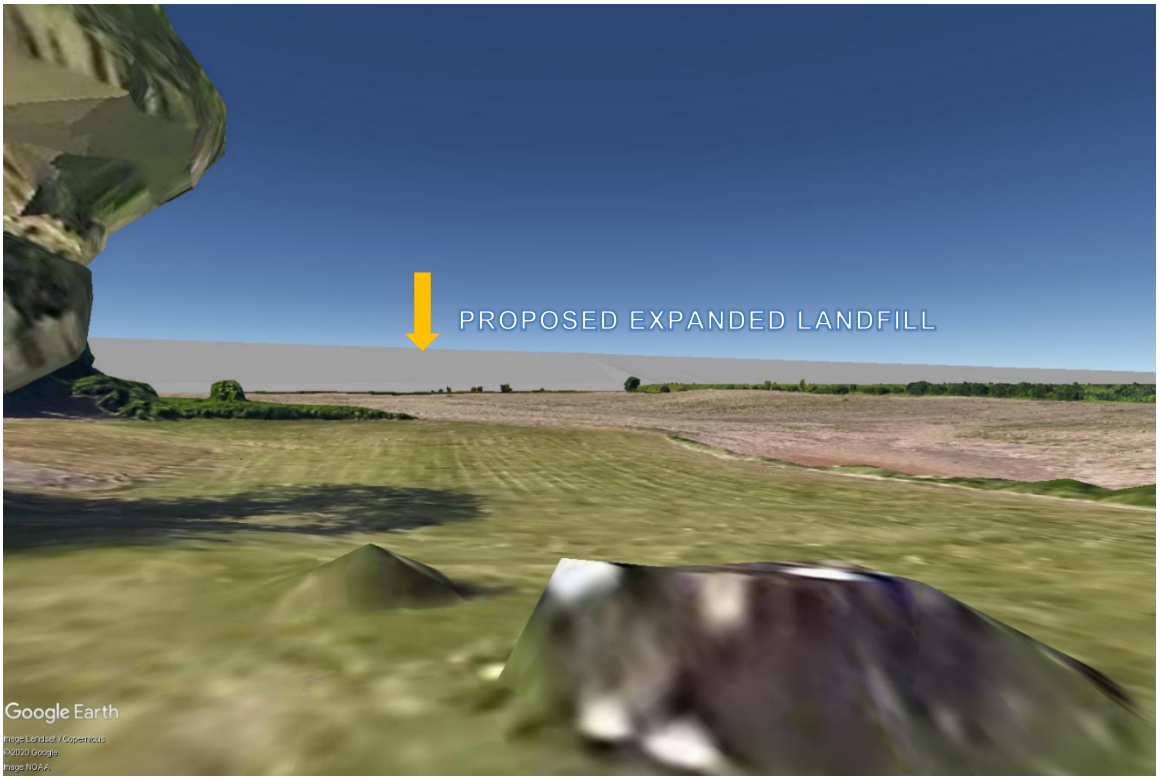


Figure 9.10-2: View of Expanded Landfill from 3465 Scotland Drive

Figure 9.10-3: View of Expanded Landfill from 3561 Scotland Drive

Figure 9.10-4: View of Expanded Landfill from 4067 Scotland Drive

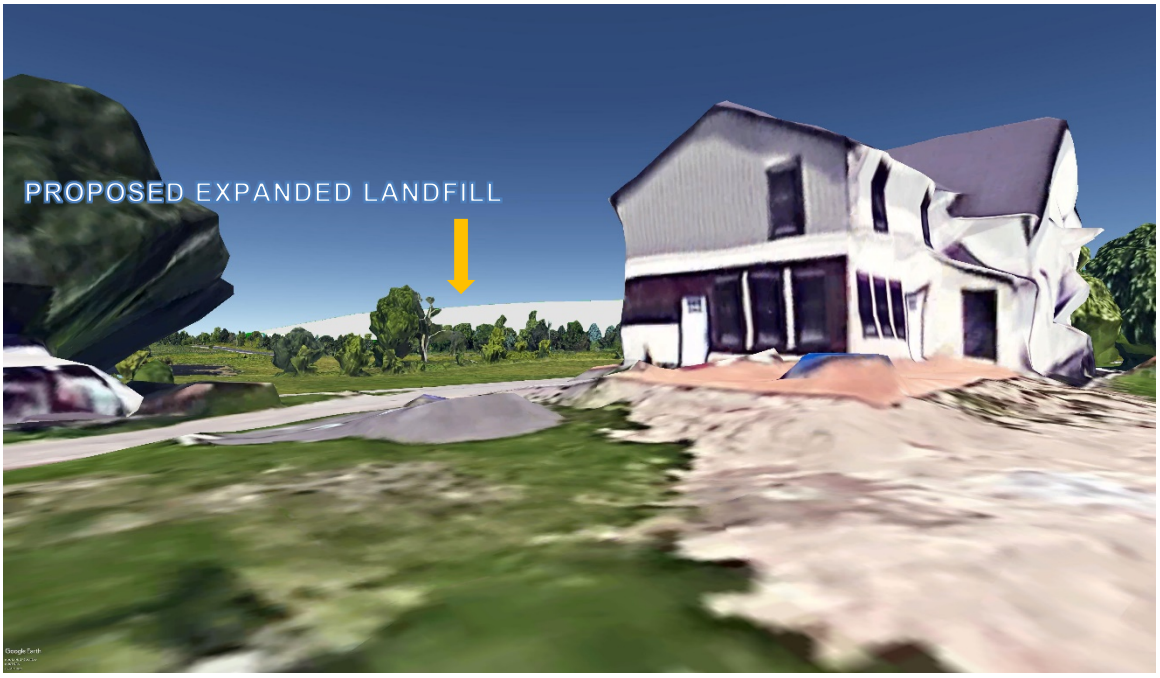


Figure 9.10-5: View of Expanded Landfill from 3691 Manning Drive

Figure 9.10-6: View of Expanded Landfill from 3452 Glanworth Drive

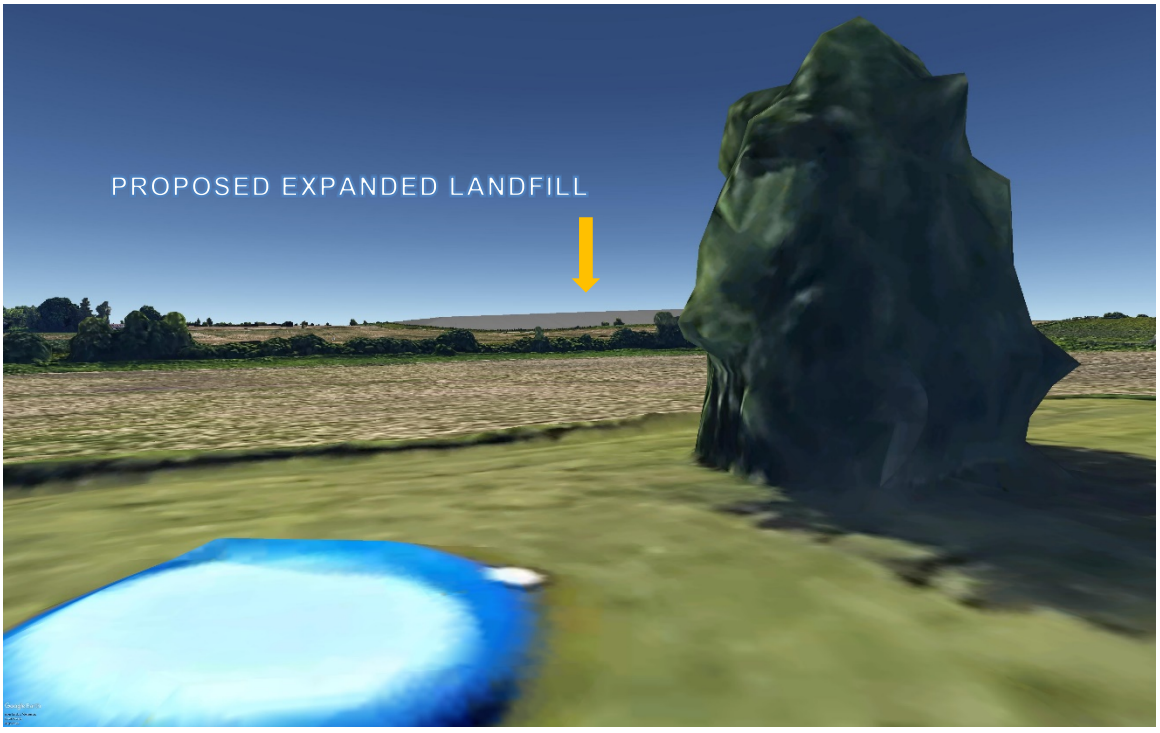


Figure 9.10-7: View of Expanded Landfill from 4233 Scotland Drive

9.10.3 Visual Mitigation

General: To reduce the visual impact of the proposed landfill expansion, topographic and vegetative elements between potentially-affected views and the landfill should be preserved and, where possible, introduced. Using the viewshed model, the views most impacted can be identified and locations for the most effective interventions determined. Fundamentally, these measures will either reduce the area of the landfill visible (the perceived area or cone of view) or increase the visual-absorption capability of the landscape.

The closer these mitigative measures are placed to an impacted viewpoint, the more effective they will be at reducing that visual effect, but the less likely they will be to ameliorate other views. Conversely, mitigation closer to the target of these views (the expanded landfill) will be less effective at mitigating any particular view but will mitigate more views in total.

The most effective measure at reducing visual impact is screening; physically interrupting a line of site to reduce or remove entirely a view of the proposed landfill. Where that is not feasible, measures such as distraction or a combination of measures can be used. By strategically placing a landscape feature that catches the eye or attracts attention within the sight lines of an impacted view, such as an attractive sign along a right-of-way that has views of the proposed landfill, the perceived visual effect can be reduced by distracting the eye away from the landfill and towards the sign. If landscape elements are introduced within a viewshed to be mitigated that are visually similar to the landfill, establish a pattern that incorporates it, frames the view of it, etc., then the combination of visual impacts may be less than just the expanded landfill on its own.

This planned mitigation can be grouped into phases, addressing immediate impacts first. Screening to be provided by tree plantings can be planned to grow as the landfill expands.

Site Operations: The most obvious views of the proposed landfill expansion are from the south. To reduce the visual impact of daily operations, the site development plan proposes that waste would be placed initially to build a berm along the south side of the landfill's waste disposal area and will be covered with final cover soil and seeded to establish vegetation. This berm will screen the view of subsequent filling operations north of the berm from off-site vantage points to the south. The south side perimeter waste berm would be raised sequentially and filled in behind until the peak elevation is reached.

Roadways: The existing perimeter berms with trees on the south, west, north and a portion of the east sides of the landfill are effective at visually screening the existing landfill and expected to continue to screen the view of the expanded landfill from traffic beside the landfill on Manning Drive and White Oak Road, but not from Scotland Drive or Wellington Road South.

With the proposed expansion, the landfill property boundary will be moved northward to Scotland Drive and new berms with tree plantings will be constructed along the new property boundary (White Oak Road northward to Scotland Drive, Scotland Drive). This will visually screen the landfill expansion from traffic beside the landfill on Scotland Drive.

Drivers on Wellington Road South east of the landfill will continue to see the site if they look in the direction of the landfill. However, the landfill expansion is not in the direct line of sight for the driver and is over 1.5 km away. These factors help to mitigate views from Wellington Road South.

There are other roads near the landfill from which the expanded landfill will be visible (e.g., Glanworth Drive). In many cases, these roads are not in the direct line of sight for the driver and are far enough away, which will help to mitigate the visual impact. In some locations, specific view-mitigation measures may be warranted.

The City will seek feedback on appropriate roadside view-mitigation measures from area residents when it updates its Community Enhancement and Mitigative Measure Program as discussed further below. The effectiveness of each mitigation measure can be assessed using the viewshed model to "see" what the impact will be over time.

Residential Properties: As described above, the landfill expansion will have a high to very high visual impact on six properties. Three of these properties are owned by the City and three properties are privately owned. Many other properties have a very low to moderate visual impact.

The City currently has a W12A Landfill CEMMP. The CEMMP is part of the City's overall efforts to reduce and address the negative effects of the W12A Landfill on neighbouring properties. Work on developing the CEMMP began in 2006 and was approved by Council in 2009. The Program was updated in 2010 and again in 2014. The current CEMMP consists of five programs or actions:

- Property Value Protection Plan
- "Right of First Refusal" Program
- Community Mitigative Measures Fund
- No Charge Waste Disposal
- PLC

The City will be updating the CEMMP in consideration of the proposed expansion of the landfill. The first step in updating the CEMMP will be seeking stakeholder feedback on how the program can be improved, including what are appropriate visual screening measures for individual residential properties. The project to update the CEMMP started in November 2020.

9.11 Transportation

The proposed landfill expansion for the W12A Landfill is planned to be operational through 2048. For transportation analysis purposes, 2048 has been identified as the horizon year. Also, a new ancillary waste facility is proposed between the W12A Landfill and the MRF, with its access coming off the staff access at the MRF. This is anticipated to replace the existing Public Drop-off Depot and HSW Depot located at the W12A Landfill.

The emergency driveway accesses to White Oak Road will be retained and a new emergency driveway access to Scotland Drive will be created. All of these emergency

driveway accesses will connect to a new roadway which will surround the entirety of the W12A Landfill expansion limits.

By the 2048 horizon year, two anticipated changes will increase the number of vehicles and the total amount of waste being delivered to the W12A Landfill.

These include:

- An increase in the total amount of waste generated within the City and disposed at the W12A Landfill; and
- An increase in the total amount of waste due to an increase in the overall service area and coverage.

As presented in Table 5.12-1 within Section 5.12, the W12A Landfill received 380,990 tonnes of waste and other materials in 2018. The waste was delivered by 71,220 vehicles.

Table 9.11-1 shows the projected waste quantities and the projected number of vehicles associated with the W12A Landfill in 2048. This information has been provided by the City.

Table 9.11-1: Projected 2048 Data for the W12A Landfill

Type of Vehicle	Tonnage - Landfill	Tonnage - % by Vehicle Type	# of Vehicles - Landfill	# of Vehicles -% by Vehicle Type
Municipal Waste Collection Vehicles	163,000	34.7%	17,430	20.3%
Private Waste Collection Vehicles	250,900	53.5%	22,820	26.5%
Inbound Operating Supplies	51,400	11.0%	2,400	2.8%
Outbound Materials	600	0.1%	120	0.1%
Small Vehicle - Staff	0	0.0%	6,960	8.1%
Small Vehicle - Public	3,230	0.7%	36,260	42.2%
Total	469,130	100%	85,990	100%

By the 2048 horizon year, the City collected waste received at the W12A Landfill is forecast to slightly increase by 600 tonnes to 163,000. An additional 77,200 tonnes of waste are projected to be received by 2048 by private waste collection vehicles. In summary, the total amount of waste disposed at the W12A landfill is projected to increase by 23% to 469,130 tonnes of waste by 2048.

Also, the number of vehicles accessing the W12A Landfill is forecast to increase by 21% to 85,990 vehicles per year. To capture these increases within the future analysis, the peak hour traffic volumes at the two W12A Landfill site accesses have been inflated by a growth factor of 21%. Within the future analysis, 60% of these additional vehicle trips have been

assigned via the Wellington Road Haul Route, while the remaining 40% of these additional vehicle trips have been assigned via the Wonderland Road (Highway 4) Haul Route.

In addition to the increased traffic generated directly by the W12A Landfill expansion, all traffic volumes as seen within the existing (2019) traffic volumes have been inflated by a common 1.00% annual growth factor. This growth factor has been applied at all intersections, ramp terminals and driveway accesses within the Site-vicinity Study Area.

9.11.1 Transportation Impact Assessment

Taking into account the additional vehicles generated by the W12A Landfill as discussed above, as well as applying the projected 1.0% annual growth rate across the Site-vicinity Study Area, operational analyses along the haul routes were assessed in the same manner as the existing traffic operations and assessment as described in Section 5.12.

The future (2048) intersection operations on the transportation network within the Site-vicinity Study Area are presented in Table 9.11-2.

The two signalized intersections, found along Wellington Road at both Dingman Drive and Manning Drive, continue to operate with minor increases reported to the v/c ratio, delays, and 95th percentile queues. All movements at these two intersections, as well as the overall intersection performance, are forecast to remain at a good to reasonable LOS (LOS A to LOS D). Critical movements are not expected to occur by the 2048 horizon year at either of these intersections.

The remaining intersections and site accesses within the Site-vicinity Study Area operate under a stop-control condition. Compared to the existing conditions analyses, most stop-controlled intersections are not anticipated to see any significant changes to operations with a few notable exceptions:

- Wonderland Road (Highway 4) at both ramp terminals from Highway 401:
    - The westbound approach at Wonderland Road and the westbound Highway 401 Ramp Terminal is forecast to operate at LOS F in the p.m. peak hour.
    - The eastbound approach at the Wonderland Road and the eastbound Highway 401 Ramp Terminal/Manning Drive intersection is forecast to operate at a critical level during both the AM and PM peak hours (v/c = 1.21 and LOS F in the a.m. peak hour, and v/c = 1.05 and LOS F in the p.m. peak hour).
- Wellington Road at Scotland Drive:
- During both the a.m. and p.m. peak hours, the eastbound and westbound approaches are forecast to operate up to LOS F. However, all approaches are forecast to remain well below capacity, with a maximum v/c ratio of 0.36.
- Wellington Road at Westminster Drive.

During both the a.m. and p.m. peak hours, the eastbound and westbound approaches are forecast to operate at LOS F. All approaches are forecast to remain below capacity, with a maximum v/c ratio of 0.67.

Table 9.11-2: Future (2048) Intersection Operations along the Haul Routes

Intersection	Movement	a.m. peak hour - v/c	LOS	Delay (s/veh)	95th %ile queue (m)	p.m. peak hour - v/c	LOS	Delay (s/veh)	95th %ile queue (m)
Wonderland Road (Hwy 4) and Decker Drive	EB approach	0.22	C	24.8	7	0.32	D	31.2	11
	NB left	0.01	A	8.4	0	0.06	A	9.5	2
Wonderland Road (Hwy 4) and WB Highway 401 Ramps	WB approach	0.10	C	23.6	3	0.85	F	122	43
	SB left	0.13	A	9.9	4	0.21	A	9.9	6
Wonderland Road (Hwy 4) and EB Highway 401 Ramps / Manning Drive	EB approach	1.21	F	171	105	1.05	F	156	62
	WB approach	0.07	B	12.9	2	0.06	B	13.4	2
	NB left	0.01	A	8.6	0	0.08	A	9.3	2
	SB left	0.03	A	8.9	1	0.01	A	9.7	0
Manning Drive and Morrison Road	SB approach	0.01	A	9.3	0	0.02	A	8.9	0
Manning Drive and White Oak Road	EB approach	0.03	A	7.7	-[1]	0.04	A	7.7	-
	WB approach	0.04	A	7.5	-	0.04	A	7.4	-
	NB approach	0.12	A	7.6	-	0.07	A	7.7	-
	SB approach	0.05	A	7.6	-	0.15	A	7.8	-
-	Overall	—	A	7.6	—	—	A	7.7	—

		a.m.	peak	hour	-	p.m.	peak	hour	-
Manning Drive and W12A Landfill Secondary Access	SB approach	0.01	A	8.9	0	0.00	A	8.6	0
Manning Drive and W12A Landfill Primary Access	SB approach	0.01	A	9.8	0	0.03	A	9.5	0
Manning Drive and MRF Staff/Visitor Access	SB approach	0.00	A	8.9	0	0.01	A	8.9	0
Manning Drive and MRF Primary Access	SB approach	0.05	A	9.9	1	0.06	A	9.7	1
Manning Drive and Wellington Road	EB left								
	EB	0.20	C	31.3	11	0.25	D	36.6	11
	through/right	0.05	C	24.4	5	0.14	C	21.8	8
	WB left[2]	0.00	C	27.0	1	-	-	-	-
	WB	0.15	C	22.6	8	0.08	C	26.8	6
	through/right	0.65	A	8.3	209	0.43	A	4.9	62
	NB through/left	0.00	A	0.0	0	0.00	A	0.0	0
	NB right	0.24	A	3.2	32	0.71	B	10.1	212
	SB through/left	0.04	A	1.2	2	0.02	A	0.5	0.7
	SB right								
-	Overall	-	A	7.7	-	-	A	8.8	-

		a.m.	peak	hour	-	p.m.	peak	hour	-
Wellington Road and Scotland Drive	EB approach	0.10	E	49.2	3	0.36	F	86.9	11
	WB approach	0.18	D	28.7	5	0.11	E	43.3	3
Wellington Road and Westminster Drive	EB approach	0.67	F	79.4	28	0.63	F	116	22
	WB approach	0.65	F	101	25	0.44	F	51	16
	NB left	0.02	A	9.3	1	0.04	B	11	1
	SB left	0.05	B	12.1	1	0.06	A	9	2
Wellington Road and Dingman Drive	EB through/left	0.70	D	52.5	49	0.69	D	53.5	50
	EB right	0.28	B	18.9	17	0.32	B	19.4	21
	WB through/left	0.12	C	32.3	13	0.28	D	36.6	26
	WB right	0.16	B	11.4	9	0.15	B	10.7	9
	NB left	0.16	A	7.8	12	0.22	A	9.6	11
	NB through/right	0.51	A	9.0	83	0.29	A	6.5	41
	SB left	0.09	A	7.7	5	0.14	A	7.0	11
	SB through/right	0.33	A	7.0	42	0.51	A	8.2	84
-	Overall	-	B	12.4	-	-	B	12.3	-

Notes:

1 Synchro analyses for all-way stop conditions did not provide queue lengths for the all way stop-controlled intersection at Manning Drive and White Oak Road. During both peak hours, all approaches are operating at LOS A.

2 Within the available traffic count data, no westbound vehicles on Manning Drive were recorded making the left turn during the p.m. peak hour.

EB = East Bound SB = South Bound WB = West Bound NB = North Bound

9.11.2 Emergency Detour Route and Road Closure Assessment

An assessment was carried out on the effects of major road closures and resultant use of Emergency Detour Routes (EDR) as related to the W12A Landfill traffic.

Since the Wonderland Road (Highway 4) and Highway 401 interchange has been completed, the EDR for Highway 401 between the Wonderland Road (Highway 4) and Wellington Road interchanges has been signed along the W12A Landfill haul route (via Manning Drive and Wellington Road). Between the Wonderland Road (Highway 4) and Wellington Road interchanges, Highway 402 connects to Highway 401 at a partial interchange. Wonderland Road (Highway 4) also meets Highway 402 at a full-movement interchange to the north of the Site-vicinity Study Area.

The Highway 402 EDR is located to the north of the corridor, via Wonderland Road (Highway 4), Exeter Road and Wellington Road.

Figure 9.11-1 shows the locations of the Highway 401 and Highway 402 corridors and interchanges, the associated EDRs and the W12A landfill haul routes.

Should an incident occur on Highway 401 west of the Highway 402 interchange compared to the east, there would be different traffic patterns generated by the associated closures for both eastbound and westbound directions. In both scenarios, it has been assumed that Highway 401 would be closed in both directions and all mainline traffic would need to be detoured. Both situations are described below.

Traffic volume data along Highway 401 and Highway 402 through the London region was provided by the MTO.

Figure 9.11-1: Emergency Detour Routes and Highway Interchanges

Table 9.11-3 provides the AADT along the various segments of Highway 401 and Highway 402 through the London region. Note the original 2016 values have been inflated by a 1.0% annual growth factor to better reflect future conditions in the 2048 horizon year. The design hourly volume (DHV) is based on the percentage of traffic along the corridor found during the busiest hour of the day and is provided as a percentage of the AADT.

Table 9.11-3: Daily Traffic Volumes on Highway 401 and Highway 402

Highway #	Segment Start	Segment End	2016 AADT	2048 AADT	Traffic Pattern Type	2048 DHV (%)
Highway 401	Colonel Talbot Road (Highway 4 SOUTH)	Wonderland Road (Highway 4 NORTH)	28,500	39,200	Urban Commuter	10.2
Highway 401	Wonderland Road (Highway 4 NORTH)	Highway 402	28,500[1]	39,200	Urban Commuter	10.2
Highway 401	Highway 402	Wellington Road	58,200	80,000	Urban Commuter	10.2
Highway 401	Wellington Road	Highbury Avenue	62,600	86,100	Intermediate Commuter	10.0
Highway 402	Colonel Talbot Road	Wonderland Road (Highway 4)	24,700	34,000	Intermediate Commuter	10.0
Highway 402	Wonderland Road (Highway 4)	Highway 401	28,500	39,200	Intermediate Commuter	10.0

Note: 1 MTO AADT data for 2016 was collected before the Wonderland Road (Highway 4) interchange was collected in the field. As a result, there is no change in traffic volumes between the east and west legs of this interchange.

In 2048, should Highway 401 be closed between Highway 402 and Wellington Road for a full 24-hour period, approximately 80,000 vehicles would end up being diverted off Highway 401 (and Highway 402). However, should only Highway 401 be closed between Wonderland Road (Highway 4) and Highway 402, then only 39,200 vehicles would be diverted off Highway 401, while Highway 402 would not be impacted.

Based on the DHV, and assuming there is a 50/50 split for directional volume during the design hour, the maximum hourly volume can be seen in Table 9.11-4.

Table 9.11-4: 2048 Design Hourly Volume

Highway #	Segment Start	Segment End	2048 AADT	2048 DHV (%)	DHV	Directional DHV
Highway 401	Colonel Talbot Road (Highway 4 SOUTH)	Wonderland Road (Highway 4 NORTH)	39,200	10.2	3,998	1,999
Highway 401	Wonderland Road (Highway 4 NORTH)	Highway 402	39,200	10.2	3,998	1,999
Highway 401	Highway 402	Wellington Road	80,000	10.2	8,160	4,080
Highway 401	Wellington Road	Highbury Avenue	86,100	10.0	8,610	4,305
Highway 402	Colonel Talbot Road	Wonderland Road (Highway 4)	34,000	10.0	3,400	1,700
Highway 402	Wonderland Road (Highway 4)	Highway 401	39,200	10.0	3,920	1,960

9.11.2.1 Scenario #1 – Full Closure of Highway 401 east of the Highway 402 Interchange

A full closure of Highway 401 between the partial interchange of Highway 402 and Wellington Road would impact traffic volumes on Highway 401 and Highway 402.

Between Wellington Road and Wonderland Road (Highway 4), Highway 402 runs generally in an east-west manner while Highway 401 runs in a northeast-southwest manner. The general road network surrounding these corridors runs in an east-west and north-south arrangement.

Should there be a closure on this portion of Highway 401, eastbound traffic on both Highway 401 and Highway 402 would be diverted at Wonderland Road (Highway 4), while westbound traffic on Highway 401, including traffic destined to Highway 402, would be diverted at Wellington Road. Over 24 hours, up to 80,000 vehicles may be impacted and during the busiest hour, approximately 4,100 vehicles per hour per direction may be impacted.

The Highway 402 EDR between Highway 401 and Wonderland Road (Highway 4) is signed to the north of the Highway 402 corridor via Wonderland Road (Highway 4), Exeter Road and Wellington Road to Highway 401.

The Highway 401 EDR between Wellington Road and Wonderland Road (Highway 4) is signed to the south of the Highway 401 corridor via Manning Drive and Wellington Road.

It is anticipated that the majority of traffic associated with the closure along Highway 402 would rely on Exeter Road between Wonderland Road (Highway 4) and Wellington Road and would not travel or utilize any parts of the W12A Landfill haul routes.

The majority of eastbound traffic associated with Highway 401 would rely on the signed EDR and would follow both Manning Drive and Wellington Road. However, westbound traffic may be split and would rely on Exeter Road and Wonderland Road (Highway 4) to the north of Highway 401, or the signed EDR route along Wellington Road and Manning Drive to the south of Highway 401. This would especially be the case as westbound queues on Highway 401 from Wellington Road would likely extend back to the Exeter Road off-ramp from westbound Highway 401.

Also, given the nature of drivers' habits and/or reliance on tools such as GPS and mobile apps, a portion of traffic will travel along completely different routes, departing and entering the Highway 401 corridor at points well in advance and/or after the actual detour.

9.11.2.2 Scenario #2 – Full Closure of Highway 401 west of the Highway 402 Interchange

A full closure of Highway 401 between the partial interchange of Highway 402 and Wonderland Road (Highway 4) would have an impact on traffic volumes for both Highway 401 and Highway 402.

However, in this case, Highway 401 would remain open between Highway 402 and Wellington Road and traffic on Highway 401 would be diverted onto Highway 402, particularly in the westbound direction.

It is anticipated there would be relatively different travel patterns for eastbound and westbound traffic on Highway 401 with this closure. Eastbound traffic would likely follow two routes from the interchange of Highway 401 and Wonderland Road (Highway 4):

- Eastbound on Manning Drive and northbound on Wellington Road to eastbound Highway 401 (as per the EDR); and
- Northbound on Wonderland Road (Highway 4) and eastbound on Highway 402 which links back to eastbound Highway 401.

Westbound traffic would primarily be diverted along Highway 402 to Wonderland Road (Highway 4) or Colonel Talbot Road, where it would travel southbound to connect back to Highway 401.

Similar to Scenario #1 above, given the nature of drivers' habits and/or reliance on tools such as GPS and mobile apps, a portion of diverted traffic will travel along completely different routes, departing and entering the Highway 401 corridor at points well in advance and/or after the actual EDR.

9.11.2.3 Temporary Closure of Manning Drive

Presently, both the W12A Landfill and MRF have access to/from Manning Drive. The haul routes travel to both the east and west of the sites. As a result, if Manning Drive is closed to either the west or east of the site accesses, alternative access via the other haul route is feasible.

However, if Manning Drive between White Oak Road and Wellington Road is fully closed, alternate emergency access to White Oak Road at the southeast quadrant of the W12A Landfill is currently present. No alternate access is available for the MRF.

As per the proposed W12A Landfill expansion plan, there will be a continuous road corridor that encircles the entire landfill. The emergency access to White Oak Road found towards the southeast quadrant of the landfill site will be retained. Separately, a new emergency access road is planned to link directly to Scotland Drive to the north of the W12A Landfill.

As a result, should Manning Drive be closed in front of the W12A Landfill, alternate driveway access to both White Oak Road and Scotland Drive would be readily available.

As per the City truck route bylaw, both Scotland Drive and White Oak Road are classified as 24-hour truck routes, so heavy vehicles associated with the W12A Landfill and MRF would be able to use White Oak Road or Scotland Drive as an alternate access to the W12A Landfill should access to Manning Drive be blocked on an “as and when needed” basis.

It is recognized that a full closure of Manning Drive between White Oak Road and Wellington Road would occur in extremely limited frequencies. However, the retention of these secondary accesses would allow trucks to use either White Oak Road or Scotland Road to access the haul routes on Wonderland Road (Highway 4) or Wellington Road as and when necessary.

9.11.3 Traffic Mitigation Measures Assessment

Within the Site-vicinity Study Area, several stop-controlled approaches are forecast to operate at LOS E or LOS F under future (2048) conditions, with several of these stop-controlled approaches forecast to near or exceed the available capacity. These include both ramp terminals at the Highway 401 and Wonderland Road (Highway 4) interchange, as well as the two unsignalized intersections on Wellington Road at Scotland Drive and Westminster Drive, respectively.

9.11.3.1 Wellington Road at Scotland Drive and at Westminster Drive

Given the two intersections along Wellington Road have stop-controlled approaches that are forecast to operate at LOS F but are well below capacity, no additional mitigation analysis has been undertaken. In the future, the City may need to collect new TMC data at these intersections to determine if traffic signals are warranted. Given the nature of the Wellington Road haul route, traffic signals at these two intersections would not benefit or assist with the operation of any vehicles associated with the W12A Landfill or MRF as they are currently proceeding straight through these two intersections on Wellington Road in a free-flow manner.

9.11.3.2 Highway 401 and Wonderland Road (Highway 4) Ramp Terminals

Under future (2048) conditions, the two ramp terminals at the Highway 401 and Wonderland Road (Highway 4) are forecast to operate at LOS F. The eastbound Highway 401 Ramp Terminal is forecast to operate at or above capacity during both peak periods, while the westbound Highway 401 Ramp Terminal is forecast to approach capacity during the PM peak hour.

At this interchange, additional analysis was conducted to determine how these two ramp terminal intersections would operate with traffic signals under the current geometric arrangement.

At these two potential signalized intersections, the following items were coded into the Synchro analyses and reporting:

- Signal timing parameters for the yellow and all-red intervals were considered as per the MTO's Traffic Signal Operating and Timing Policy #2010-02;
- No pedestrian phases or signals would be present given the rural context of the interchange;
- The two intersections would operate with 100-second cycle lengths in a fully-actuated manner, with the signals remaining green on Wonderland Road (Highway 4) until a vehicle would approach from the off-ramps or Manning Drive;
- Protected/permissive left-turn signals and phases were included for all left-turn movements on Wonderland Road (Highway 4) to both the Highway 401 on-ramps as well as to Manning Drive;
- Separate split phasing for the eastbound (off-ramp) and westbound (Manning Drive) approaches at the intersection of Wonderland Road (Highway 4) and the Eastbound Ramp Terminal. This split phasing was introduced for the following three reasons:
- Both the eastbound and westbound approaches operate with a single lane;
- There are notable differences in the existing and projected traffic volumes for the east leg (Manning Drive) when compared to the west leg (eastbound off-ramp); as a result, some cycles can likely skip over the signal phase for this leg (westbound Manning Drive); and
- Given the present layout and geometry of the intersection, the eastbound and westbound left-turn movements would physically conflict with one another if permitted simultaneously.

Table 9.11-5 summarizes the projected operations of these two intersections at the Highway 401 and Wonderland Road (Highway 4) interchange when operating under traffic signal control.

With both intersections at the Highway 401 and Wonderland Road (Highway 4) interchange signalized, the northerly intersection is forecast to operate at LOS A during the a.m. peak hour and at LOS B during the p.m. peak hour. The southerly intersection is forecast to operate at an overall LOS C during both peak hours. At both intersections, all movements would be forecast to operate at LOS C or better, with minimal delay or interruptions for any approach, including the ramp terminals from Highway 401.

In the future, the MTO or City may need to collect new TMC data at this interchange to determine if traffic signals would be warranted by the 2048 horizon year. Traffic signals, if warranted, would be due to the projected increase of background traffic volume along the Highway 401 and/or Wonderland Road (Highway 4) corridors, and not be due to traffic associated with the W12A Landfill and/or MRF.

Table 9.11-5: Mitigated Intersection Operations (2048) – Highway 401 and Wonderland Road (Highway 4) Interchange

Intersection -	Movement -	a.m. peak hour v/c	LOS	Delay (s/veh)	95th %ile queue (m)	p.m. peak hour v/c	LOS	Delay (s/veh)	95th %ile queue (m)
Wonderland Road (Highway 4) and WB Highway 401 Ramps	WB approach	0.06	C	21.2	8	0.31	C	26.5	28
	NB thru	0.64	B	12.5	116	0.77	C	21.2	122
	NB right	0.01	A	0.0	0	0.01	A	0.0	0
	SB left	0.22	A	2.8	6	0.41	A	5.9	13
	SB thru	0.25	A	2.7	27	0.42	A	6.1	50
-	Overall	-	A	8.8	-	-	B	14.0	-
Wonderland Road (Highway 4) and EB Highway 401 Ramps / Manning Drive	EB approach	0.59	C	34.3	70	0.44	C	31.1	39
	WB approach	0.12	A	0.8	0	0.10	B	16.6	8
	NB left	0.02	B	13.3	3	0.23	B	10.4	13
	NB thru	0.65	C	26.7	114	0.62	B	18.9	165
	NB right	0.01	A	0.0	0	0.01	A	0.0	0
	SB left	0.10	B	14.0	8	0.02	A	9.5	2
	SB thru	0.49	C	21.1	86	0.72	C	25.6	153
	SB right	0.00	A	0.0	0	0.01	A	0.0	0
-	Overall	-	C	25.1	-	-	C	22.0	-

9.12 Design and Operations

This section provides the assessment of impacts associated with the design and operations of the proposed expansion of the W12A Landfill as described in Section 8 of this EASR. The details of the impact assessment are provided in Volume IV Appendix D.13; a summary is provided below.

The development and description of a number of design and operations aspects of the expansion, which provide the basis for the impact assessment, have been provided in Section 8.0 of this EASR, as follows:

- Proposed expanded landfill phasing and development – Section 8.1.1;
- Estimated leachate generation and on-site leachate management – Section 8.1.2;
- Estimated LFG generation and on-site management – Section 8.1.4; and
- Geotechnical assessment – Section 8.1.3.

Two other design and operations aspects of the proposed expansion that are described in Volume IV Appendix D.13 but have not been provided in Section 8.0 are the soil balance and the estimate of probable capital and operational costs. Each of these is provided below.

9.12.1 Soil Balance

A soil balance estimates the volume of soil materials available on site for potential use in constructing various components of the expansion compared to the types and volumes of soil materials required for their construction. If the volume available exceeds the requirements, then the site has a net soil surplus. Conversely, the site could have a net soil deficit and there will be a need to import soil materials from off-site sources.

The City has completed a soil balance for the existing landfill site and reported the results in the 2019 W12A Landfill Annual Status Report, prepared by the City dated March 2020. The soil balance concludes that at the end of the currently approved landfill operations the site will have a soil surplus of an estimated 361,000 m^3 of topsoil and clay soil. This material is and will be stockpiled at the site and available for future uses associated with the expansion.

Because the proposed expansion involves a vertical expansion above the existing waste footprint, there will be no excavation of new landfill cells to provide a volume of additional soil. There will be small volumes of soil generated from excavations associated with upgrading and replacement of site infrastructure, but these will not be significant amounts and have not been included in the soil balance.

The soil volumes associated with landfill operations and closure are provided in Table 9.12-1 below.

Table 9.12-1: Soil Balance

Item #	Item Name	Description	Volume (m^3) Soil	Volume (m^3) Topsoil
A	Soil Excavation	Vertical expansion, so no excavation.	0	0
B	Existing Final Cover to be removed prior to vertical expansion	All of the landfill will have received final cover. Corresponding area above existing sideslopes is 77 ha. Existing final cover consists of 0.85 m clay soil and 0.15 m topsoil. Assumes all this material can be stripped off prior to placing additional waste, and topsoil is separated for re-use in final cover.	+654,500	+115,500
C	Estimated Soil Surplus at end of current approved landfill operations	Estimated Soil Surplus at end of current approved landfill operations. Existing soil stockpiles plus soil remaining to be excavated less remaining soil needed for existing approved W12A Landfill.	+335,300	+25,700
D	Soil Surplus available for use in the expansion	Use mainly for daily and final cover: Items B + C	+989,800	+141,200
E	Soil Required for final cover of the expansion	Surface area of expanded landfill above existing sideslopes is 78 ha. Proposed final cover consists of 0.6 m of soil and 0.15 m of topsoil.	-468,000	-117,000
F	Daily Soil Cover Requirements	Airspace for waste and daily cover (less the 1 million m^3 in the Dedicated Non-decomposable Waste Cell) is 12.8 millionm^3. Assumes 4:1 waste:daily cover ratio and that alternative cover materials are not used.	-2,560,000	0
G	Soil requirements for expansion	Items E + F	-3,028,000	-117,000
H	Soil Balance	Items D - G	-2,038,200 (Deficit)	+24,200 (surplus)

Note: + indicates soil available for use; - indicates soil required for the expansion

Over the 25 year operational planning period for the expansion, approximately 2,000,000 m^3 of fill material will be required to be imported to the site from off-site sources. This

represents approximately 80% of the daily cover material requirements for the expansion. Imported daily cover will continue to consist of clean street sweepings (primarily sand), clean water treatment plant residuals (primarily sand), select contaminated soil (e.g., no adverse odours) and wood chip residuals from local CR&D recycling facilities. In 2019, these off-site sources provided 85% (by volume) of the cover material used, with only about 15% coming from on-site stockpiles. As such, during the 25 year expansion period, about 15,350 m^3 per year, or 384,000 m^3 total will be required from the soil stockpiles, leaving approximately 605,800 m^3 of surplus. Therefore, there is expected to be enough on-site stockpiled soil to construct the final cover, leaving a surplus of approximately 137,800 m^3 of soil and 24,200 m^3 of topsoil, or a total soil surplus of approximately 162,000 m^3, which can readily be accommodated within the expanded landfill site property limits.

9.12.2 Estimates of Probable Cost

As described in Section 8.0 of this EASR, there are components of the existing site infrastructure that are to be replaced or upgraded / modified, and some new components to be added.

An estimate of capital costs for implementation of the expansion was prepared. It is considered appropriate to consider a range of probable costs, including contingency allowances, to account for components that may or may not be required as the result of the approvals process, the final engineering design and potential variations in both construction materials and contractor costs over time. There will also be costs associated with the approvals process and engineering services during design and construction.

It is estimated that the capital costs of implementing the expansion (including engineering and contingencies) are in the range of $55 to $90 million, with a midpoint estimate of approximately $72 million (in 2020 dollars). The main components of the capital costs can be broken down as follows:

- Replacement of the Phase 1 LCS and installation of finger drains; other possible leachate controls (including the leachate mound control in Phase 1); installation of component to manage leachate during large storm events; replacement of the main leachate pump station; SWMS modifications; site roads, landscaping and fencing – range of $11.6 to $25.6 million, midpoint estimate of $18 million to be carried out in 2023/2024 during initial expansion period.
- Replacement/upgrading of ancillary facilities – range of $10.8 to $16 million, likely to be carried out during the first half of the expansion period.
- Additional LFG flare – $1.5 to $2 million, anticipated to be required around 2022.
- Annual costs of stripping and management of existing final cover soil; progressive placement of final cover and installation of LFG collection system – approximately $1.2 to $1.8 million per year over a 25 year period, total estimated cost in the range of $31 to $46 million.

The current annual operating cost, including both staff and the operations, is approximately $4.5 million (in 2020 dollars). It is estimated that with the additional infrastructure operations associated with the expansion, the annual operating cost could increase to $5 million.

9.12.3 Impact Assessment

The proposed W12A expansion incorporates many mitigation measures in its design and operational procedures to control emissions of leachate and LFG to the natural environment, control potential off-site nuisance effects and operate in compliance with provincial regulations and standards. A discussion of potential impacts associated with site design and operations is provided below.

Phasing and Development: The design of the expansion phasing and the approach to development of each phase will reduce potential visual impacts (i.e., view of ongoing site landfilling operations) from off-site vantage points to the south, from where the site operations are most visible for the greatest number of existing residences. In terms of landfilling, the area from which the existing final cover will be stripped in advance of placement of waste, as well as the active area used for waste disposal will be kept as small as practical to minimize the potential for odours and blowing litter.

Management of Leachate: The management of leachate will continue to rely on the same LCS approaches that have proven effective in preventing impacts on groundwater and surface water quality. These provide control on leachate migration away from the waste footprint in the shallow subsurface and, together with the natural hydrogeological setting, prevent adverse effects on off-site groundwater resources (aquifers) used by water supply wells. The current Phase 2 LCS below the waste will continue to be used below the portion of the expansion above the Phase 2 landfill area. For the Phase 1 area, it is proposed to improve the effectiveness of the current perimeter LCS by replacing it with a new perimeter system, and control potential perimeter leachate seeps associated with the leachate mound in Phase 1 by installing finger drains connected into the replacement perimeter LCS. In addition, the proposed leachate management system design will provide sufficient temporary leachate storage to minimize the potential for untreated leachate release due to storm events that are sufficiently large to cause overflows from the off-site pumping station and WWTP.

Management of LFG: The expansion will continue to utilize an active LFG collection system (installed progressively with the final cover as expansion phases are completed) to capture and flare LFG and thereby control odour and greenhouse gas releases. The expansion will also utilize horizontal LFG collectors installed in the waste to further control LFG (including odour) release during the landfilling operations.

Geotechnical Considerations: Geotechnical analysis demonstrates that the proposed expansion will be stable in terms of overall stability of the waste, and that settlement of the underlying clay till deposit due to the weight of the vertical expansion of waste will not adversely affect the operation and performance of the underdrain LCS below the Phase 2 area.

Soil Balance: To satisfy its need for soils for daily and final cover purposes, the expansion is expected to use a combination of available on-site stockpiled soil and alternative daily cover consisting of off-site waste materials. It is anticipated that there will be an overall soil surplus at the end of the expansion period. The expansion will require aggregates and asphalt for infrastructure construction and maintenance. However, besides these imported materials, the expansion is not expected to consume off-site soil resources from licensed pits or other borrow sources.

Capital and Operational Costs: The capital costs associated with the expansion can be planned within the municipality's annual capital expenditures budgeting process. The operating costs are comparable to but somewhat higher than the current operating costs. These cost components are not expected to impact municipal finances.

9.13 Comparison of Do-Nothing

For the City, the Do-Nothing alternative would be to allow the W12A Landfill to reach its approved capacity and not pursue any other solution for residual waste management for the City. The predicted effects of the preferred alternative were compared to the Do-Nothing scenario to better understand and appreciate the magnitude of any predicted effects of the proposed expansion design. Considering the environmental, socio-economic and technical components and indicators, a discussion of this comparison is provided in Table 9.13-1.

Not all effects of vertical expansion noted above in Table 9.13-1 were negative, a few were positive, and some effects were similar whether considering Do-Nothing or vertical landfill expansion. However, when considering the identified preferred undertaking and the discussion in Table 9.13-1, it is shown that all negative effects are mitigatable to within regulatory limits, as vertical landfill expansion is a well-known and well understood type of approach in terms of landfill development, operations and performance.

One of the City's basic requirements as a municipality is to provide municipal services and infrastructure for its ratepayers including waste management. As such, the Do-Nothing Alterative would not be practical to implement. If the City actually did nothing, individual residents would be responsible for finding their own solution to waste management such as hiring a private waste management company or disposing of waste on their own property. The comparison of the Do Nothing alternative does not include the potential actual impacts of the Do Nothing alternative.

Table 9.13-1: Comparison of Do-Nothing to the Preferred Undertaking

Component	Sub-component	Indicator(s)	Do-Nothing Versus Preferred Undertaking
Environmental			
Atmosphere	Air quality (including dust, odour, GHG)	Expected concentrations of air quality indicator compounds (selected regulated air contaminants to represent this type of project) at the property boundary. Expected site-related odour at POR. Expected GHG emissions.	Under Do-Nothing conditions, the landfill would close and air quality indicators, odour and GHG would reduce over time from current conditions as the site would not be operational. The site will still have the potential for air quality, odour and GHG impacts, just at lower thresholds. The proposed landfill expansion design would see continued air quality indicators, odour and GHG from the operational site at levels greater than Do-Nothing, but in compliance with regulatory limits.
	Noise	Noise Levels at off-site PORs, or vacant lots that accommodate the future construction of PORs.	The closure of the existing landfill under the Do-Nothing scenario would see noise from the site activities reduce to zero. There would still be noise in the area due to other businesses nearby including the MRF, and the proximity of Highway 401. The landfill expansion proposed is predicted to have noise effects in compliance with regulatory limits provided mitigation measures are adopted.
Geology and Hydrogeology	Groundwater quality	Expected effect on groundwater quality at the property boundary.	The existing landfill, if closed in a Do-Nothing scenario, would continue to have impacts to groundwater quality at the property boundary for 100s of years, at concentrations below regulatory limits. The proposed expansion of the landfill will increase the potential impacts to groundwater quality at the property boundary beyond the Do-Nothing scenario, but with the use of mitigation measures still at concentrations below regulatory limits.
Surface Water	Surface water quality	Expected effect on surface water quality in the SWMS and within the Site-vicinity.	The closure of the existing landfill will all but remove any possibility of surface water quality impacts to the SWMS and off-site water bodies. With the proposed expansion of the landfill as designed, the possibility of impacts to the SWMS and other water bodies is very limited as a result of operational practices. These operational practices are the same as currently used and have worked favourably. Therefore, there is not much difference between Do-Nothing and the expanded landfill design with respect to surface water quality.
	Surface water quantity	Expected change in peak flows (within the on-site SWMS and at the property boundary). Expected degree of off-site effects on surface water within the Site-vicinity.	Surface water quantity peak flows are based on landfill final design parameters (e.g., slope steepness, length, etc.). Under the Do-Nothing scenario a pre-existing peak flow is anticipated for the closed landfill. The regulatory requirements for landfill expansion require the matching of peak flow by using stormwater management tools (e.g., ponds, orifices, etc.). As such, the peak flow in Do-Nothing and landfill expansion is the same. The only difference is the peak flow may be sustained for a longer duration with the landfill expansion in some drainage areas, and for a shorter duration in other areas, compared to the Do-Nothing scenario.
Biology	Aquatic ecosystems	Expected change in surface water quality on-site and within the Site-vicinity. Expected impact on aquatic habitat and biota, including rare, threatened or endangered species on-site and within the Site-vicinity.	As noted for surface water, there is no anticipated difference between the Do-Nothing scenario and the landfill expansion as related to surface water quality or peak flow on or off-site. As noted, under landfill expansion conditions there may be a longer or shorter duration of peak flow that could impact aquatic habit (although there are no rare, threatened or endangered species). It should be noted that some aquatic habitat may be positively impacted, while other aquatic habitat may be negatively impacted.
	Terrestrial ecosystems	Expected impact on terrestrial vegetation communities, wildlife habitat, and wildlife, including rare, threatened or endangered species on-site and within the Site-vicinity.	The closure of the landfill under the Do-Nothing scenario is likely to not affect habitat for Monarch and SAR grassland birds (Bobolink and Eastern Meadowlark). The landfill expansion will directly negatively impact the habitat of Monarch, Bobolink and Eastern Meadowlark through the construction of the vertical expansion. A detailed EMMP and observation protocols can minimize impacts during construction and operation. Compensation for habitat loss will be developed in consultation with the MECP for Bobolink and Eastern Meadowlark. In the longer term, the re-vegetated final cover for the expansion will reinstate the habitat available on the existing areas of the closed landfill.

Component	Sub-component	Indicator(s)	Do-Nothing Versus Preferred Undertaking
Socio-Economic			
Land Use	Current and planned future land uses	Expected impact on sensitive land uses (i.e., dwellings, churches, and parks within the Site-vicinity).	Under Do-Nothing conditions there is no expected displacement of residents. The landfill expansion will displace one resident from a City-owned rental property. As noted from other components (noise, air quality, visual and traffic), the expectation is that neither the landfill expansion nor the Do-Nothing scenario will interfere with the use and enjoyment of residential properties. The preferred undertaking is consistent with the Provincial Policy Statement and conforms with the Official Plan.
Agriculture	Agriculture	Expected effect on agricultural land base and agricultural operations within the site and Site-vicinity.	The Do-Nothing scenario would see no change or effect regarding agricultural operations in the area. The landfill expansion design, although vertical, requires some land to the North and a little to the East of the existing landfill for ancillary facilities that will reduce some existing agricultural operations on City-owned lands.
Archaeology	Archaeology	Expected archaeological resources potentially affected on-site.	The closure of the existing landfill under the Do-Nothing scenario will have no effect on expected archaeological resources in the area. The landfill expansion lands required to the North will be in the area of an archaeological resource that must be avoided. This can be easily accomplished with the design and the negative effect is considered negligible or minimal.
Culture	Built Heritage Resources	Expected impact on the heritage attributes of identified built heritage resources on-site and within the Site-vicinity Study Area.	The landfill expansion will not impact built heritage resources and neither will the Do-Nothing scenario.
	Cultural Heritage Landscapes	Expected impact on identified cultural heritage landscapes on-site and within the Site-vicinity Study Area.	The landfill expansion will not impact cultural heritage landscapes and neither will the Do-Nothing scenario.
Socio-economic	Local Economic	Expected effect on local employment. Expected effects on local businesses and commercial activity. Expected effects on municipal finances.	The Do-Nothing scenario causes a negative effect with regard to local employment while the landfill expansion should have a positive effect on local employment during construction and continued operation. Neither the Do-Nothing nor the landfill expansion are expected to cause effects to local businesses or commercial activity. The Do-Nothing scenario will cost the City less than expanding the site.
	Residents and Community	Displacement of residents. Expected interference with use and enjoyment of residential properties (nuisance effects).	Under Do-Nothing conditions there is no expected displacement of residents. The landfill expansion will displace one resident from a City-owned rental property. As noted from other components (noise, air quality, visual and traffic), the expectation is that neither the landfill expansion nor the Do-Nothing scenario will interfere with the use and enjoyment of residential properties.
Visual	Visual	Expected changes in landscape views from off-site.	The closure of the existing landfill under the Do-Nothing scenario will continue to have areas where the landfill is visible from off-site. With the proposed vertical landfill expansion it is expected that the landfill will have greater visibility from off-site locations, although individual mitigation could be offered through the community in the future.
Technical			
Design and Operations	Engineered Containment	Expected degree of engineered containment and/or controls required.	With the Do-Nothing scenario the landfill would close and any required engineering (final cover and LFG collection) would need to be constructed. The landfill expansion will need this same engineering, although it would be deferred for 25 years. Additionally, the landfill expansion will require improvements to the perimeter LCS around Phase 1 of the landfill and inclusion of leachate collection from the lateral LFG collectors.
	Financial	Estimated costs associated with implementation of expansion alternatives.	The costs for the Do-Nothing scenario are not zero as on-going monitoring and maintenance will be required for decades post-closure of the existing landfill. To expand the landfill has some significant operational costs, although comparatively lower because a vertical expansion is proposed. During operation of the landfill and post-closure, on-going monitoring will be required.
Transportation	Traffic	Expected effect on traffic along the haul routes in the vicinity of the site.	The proposed expansion is predicted to have no impact to traffic that will require the upgrade of any intersection over the life of the landfill. If the landfill were to close (Do-Nothing), this would also have no impact to traffic requiring upgrades to any intersections.

10.0 Climate Change Considerations

The document entitled “Considering Climate Change in the Environmental Assessment Process” (MECP, 2019) was used as a guide for incorporating measures in the landfill expansion design that reduce both the potential impact of climate change on the landfill (i.e., climate change adaptation) and its potential impact on climate change (i.e., climate change mitigation).

10.1 Potential Impacts of Climate Change on the Landfill Expansion

It is expected that the planned 25 year operational period of the landfill expansion, i.e., through 2048, will be too short to be significantly affected by impacts from climate change. However, during the post-closure period, longer term changes in precipitation and temperature could possibly affect the vegetative cover growth on the closed landfill and/or runoff of surface water from the landfill final cover and the performance of the components that comprise the SWMS. For example, an increase in precipitation and/or an increase in storm intensity or duration compared to historical design storms would increase the amount of runoff, potentially resulting in surface erosion of the vegetated landfill final cover surface and exceedance of the capacity of the SWMS.

As described in more detail in Volume IV Appendix D.04, climate change adaptation was incorporated into the design of the landfill expansion as follows:

- The SWM ponds have been designed to provide 80% total suspended solids removal (Enhanced level of treatment). In the event that larger storms result in an increased amount of surface erosion and a corresponding increased amount of suspended solids in the runoff, the ponds will be better able to remove suspended solids and thereby reduce potential effects on the off-site downstream receiving watercourses.
- In addition to the design of the SWMS components, i.e., ditches and SWM ponds, to accommodate the runoff associated with the storm events corresponding to the 1:5 and 1:100 year return period storm intensities and durations (as required by O. Reg. 232/98), the stormwater ponds were assessed to predict conditions during the 1:250 year return period storm event and the Regional Design storm (Hurricane Hazel) to evaluate potential climate change effects.

  The assessment indicates that once the proposed modifications to the SWM ponds are complete, under expansion conditions:

- the 1:250 year return period design storm event peak discharge from the site will be about 11% less than the pre-development peak for the area of the landfill draining to Dodd Creek and less than the 1:100 pre-development peak; and,
- the 1:250 year return period design storm event peak discharge from the site will be about 56% more than the pre-development peak for the area of the landfill draining to Dingman Creek; however, the 1:100 year design storm event peak will be about 34% less than the 1:100 pre-development peak.

Landfill operations may also have to adapt to climate change effects. For example:

- Changing climate patterns may result in extremes of heat or cold for extended periods of time. This will require site operations staff working outdoors to use applicable operational procedures that are reviewed and periodically updated to reflect these changing conditions. Landfill vehicles and equipment will continue to have heaters and air conditioners to provide climate-controlled conditions for the operators.
- If there are stronger winds for extended periods of time that reduce the effectiveness of the litter control fences, fences that are more strongly anchored, higher and/or longer would be designed and installed. Additional resources to pick up litter from strong wind events, both on and off the site, may also be required.

A gradual increase in annual precipitation in future could result in a gradual increase in the annual infiltration through the landfill final cover and an increase in leachate generation. This would result in a larger volume of leachate having to be collected by the LCSs and conveyed for treatment off-site. However, because not all of the increase in precipitation would infiltrate, i.e., the runoff and evapotranspiration components of the site water balance would also increase, it is considered reasonable to expect that there would only be a marginal increase in leachate generation compared to what is currently being collected from the landfill footprint and conveyed for treatment.

The design of the proposed replacement perimeter LCS for the Phase 1 area of the landfill, as well as the design of the proposed system of temporary leachate storage on the W12A Landfill site during storm events of significant magnitude that could result in discharge of the mixed leachate/sewage to Dingman Creek or the Thames River if the WWTP is in a by-pass situation temporarily, will take the possibility of increased leachate generation into account. This will also be considered in the design of the replacement for the main leachate pump station on the W12A Landfill site. These designs will be completed during the EPA approval stage.

The current LCS beneath the Phase 2 area has capacity to convey a much larger volume of leachate than is currently being generated. As described in Section 8.1.2.2, the forcemain that connects the landfill site to the Dingman Pump Station has sufficient capacity to handle increased leachate generation, and there is adequate capacity at the Dingman Pump Station and the Greenway WWTP to accommodate these leachate flows.

In summary, the potential impacts from climate change related to precipitation have been considered in terms of design of the SWMS for the expanded landfill, and will be taken into account in the final design of site infrastructure components related to leachate collection and temporary storage on-site. Adjustments to landfill operations can be made, as required, in future to mitigate potential effects from climate change.

10.2 Impacts of the Landfill Expansion on Climate Change

The potential effects of the landfill expansion on climate change have been assessed to quantify potential climate change effects. Ways that the project could reduce GHG emissions or remove GHGs from the atmosphere have also been considered.

The two main ways that a landfill expansion could affect climate change are the generation of GHG that enters the atmosphere, and reduction of GHG sequestration by removal of forested areas. For the proposed vertical expansion of the W12A Landfill above the existing footprint, there will not be any clearing of forested areas, and therefore no associated adverse effects related to GHG sequestration.

The activities at the site that will produce GHGs consist of the following:

- Landfill gas;
- Stationary combustion emissions from the flare(s);
- On-site transportation fuel combustion emissions; and
- Stationary combustion emissions from natural gas used for comfort heating in the buildings.

The GHG emission estimates, where applicable, have followed quantification guidelines for both provincial and federal reporting:

- Federal reporting under Section 46 of the *Canadian Environmental Protection Act*, (CEPA), SC 1999: Greenhouse Gas Emissions Reporting Program (GHGRP).
- Provincial reporting under Ontario's Greenhouse Gas Emissions: Quantification, Reporting, and Verification Regulation, Ontario Regulation 390/18 (O. Reg 390/18).

The following is taken from Volume IV Appendix D.01.

GHG emissions from on-site transportation have been estimated using emission factors from Tables 2-2 and 2-6 of Canada's ECCC Document "2019 Canada's Greenhouse Gas Quantification Requirements" dated December 2019 (GHGRP Guidance Document) (ECCC, 2019a) (Table 10.2-1). Fuel consumption for the on-site transportation equipment was estimated using methods in the document titled 'Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling – Compression Ignition NR-009d' dated July 2010 (Crankcase Document) (US EPA, 2010). Stationary combustion emissions from natural gas used for comfort heating were estimated using Equation 2-19 and emission factors from Table 2-4 of the GHGRP Guidance Document. Emissions from the fugitive release and combustion of landfill gas are categorized as "Waste Emissions" under the 2019 GHGRP Guidance Document. There is no prescribed method in the 2019 GHGRP Guidance Document for estimating fugitive methane emitted through the landfill cap or emissions from biomass combustion through the flare and therefore GHG emissions from these sources were estimated using engineering calculations. Fugitive methane that is oxidized in the atmosphere once emitted through the cap has not been taken into consideration for this assessment; however, it is commonly assumed that approximately 10% of the methane from landfill gas oxidizes.

Table 10.2-1: GHG Emissions Sources and Methods

Source Category	Emission Sources	Emissions Methodology	GHG
Stationary Combustion	Natural Gas	2019 GHGRP Guidance Document s.2.A.2.c Equation 2-9 2019 GHGRP Guidance Document s.2.B Equation 2-13	Carbon Dioxide (CO_2) Methane (CH_4) Nitrous Oxide (N_20)
On-site Transportation	Diesel Gasoline	2019 GHGRP Guidance Document s.2.A.1 Equation 2-2 Crankcase Document (Fuel Consumption) 2019 GHGRP Guidance Document s.2.B Equation 2-13	CO_2 CH_4 N_20
Waste (Landfill Gas)	Fugitive LFG	Not prescribed in 2019 GHGRP Guidance Document Engineering Estimate (EE) – Carbon Dioxide/Methane composition of LFG and the amount of LFG lost fugitively	CO_2 CH_4
Waste (Landfill Gas Flare)	LFG Combustion	Not prescribed in 2019 GHGRP Guidance Document EE – Methane composition of LFG, Flare destruction efficiency, conversion of methane to carbon dioxide. N_2O estimated from Western Climate Initiative (WCI) method for LFG Flares	CO_2 CH_4 N_20

Table 10.2-2 and Table 10.2-3 summarize all estimated annual GHG emission rates in tonnes per year for each activity at the Project for the existing landfill and the proposed expanded landfill, respectively. These are not to be confused with reportable GHG emissions that exclude CO_2 from biomass/combustion of biomass and are reported in Tables 10.2-4 and 10.2-5 for the existing landfill and the proposed expanded landfill, respectively.

Table 10.2-2: Summary of Estimated GHG Annual Emissions from the Existing (early 2020) W12A Landfill

Source	Estimated Annual Emissions [tonnes/yr]	Estimated Annual Emissions [tonnes/yr]	Estimated Annual Emissions [tonnes/yr]	Annual Total [tonnes/yr]
	CO_2	CH_4	N_2O	CO_2e
Landfill Gas	12,635	4,584	0	127,245
LFG Flare	20,346	151	0.039	24,141
Mobile Combustion Emissions (road and non-road vehicles)	8,310	0.240	0.697	8,523
Comfort Heating	169	0.003	0.003	170

Note: CO_{2e} equals carbon dioxide equivalence, which is the summation of multiplying the emissions of CO_2, CH_4, N_2O by their respective global warming potential of 1, 25, and 298, respectively (IPCC, 2012)

The existing annual emissions were estimated to represent the 2020 year.

Table 10.2-3: Summary of Estimated GHG Annual Emissions from the Proposed Expansion of the W12A Landfill in Year 2049

Source	Estimated Annual Emissions [tonnes/yr]	Estimated Annual Emissions [tonnes/yr]	Estimated Annual Emissions [tonnes/yr]	Annual Total [tonnes/yr]
	CO_2	CH_4	N_2O	CO_2e
Landfill	8,870	3,219	0	89,337
LFG Flare	49,043	365	0.095	58,191
Mobile Combustion Emissions (road and non-road vehicles)	10,032	0.290	0.840	10,291
Comfort Heating	169	0.003	0.003	170

The peak annual LFG generation from the landfill expansion were predicted to occur in 2049. When comparing Tables 10.2-2 and 10.2-3 it is apparent that there is more LFG emitted from the landfill in 2020 than in 2049 while conversely there is more LFG flared in 2049 than in 2020.This is mostly a factor of the LFG collection efficiency that is expected to significantly improve by 2049 in comparison to 2020.

The tables below summarize the reportable GHG emissions under the GHGRP and O. Reg 390/18. Table 10.2-4 and Table 10.2-5 present the annual GHG emission rates in tonnes per year for each activity at the Project for the existing landfill and the proposed expanded landfill, respectively. Carbon dioxide from the combustion of biomass is excluded from GHGRP per Schedule 3 s.2(b) of the Notice with respect to reporting of greenhouse gases for 2019 and it is not included in the Reporting Amount per s.6(2) of O. Reg 390/18. Carbon dioxide from the decomposition of biomass is excluded from GHGRP per Schedule 3 s.2(c) of the Notice with respect to reporting of greenhouse gases for 2019 and from O. Reg 390/18 per ON.191 of the MECP Guideline for QRV of GHG Emissions, Feb 2020.

Table 10.2-4: Summary of Reportable Annual GHG Emissions from the Existing (early 2020) W12A Landfill

Source	Estimated Annual Emissions [tonnes/yr]	Estimated Annual Emissions [tonnes/yr]	Estimated Annual Emissions [tonnes/yr]	Annual Total [tonnes/yr]
	CO_2	CH_4	N_2O	CO_2e
Landfill	—	4,584	0	114,610
LFG Flare	—	151	0.039	3,795
Mobile Combustion Emissions (road and non-road vehicles)	8,310	0.240	0.697	8,523
Comfort Heating	169	0.003	0.003	170

The existing annual emissions were estimated to represent the 2020 year.

Table 10.2-5: Summary of Reportable Annual GHG Emissions from the Proposed Expansion of the W12A Landfill in Year 2049

Source	Estimated Annual Emissions [tonnes/yr]	Estimated Annual Emissions [tonnes/yr]	Estimated Annual Emissions [tonnes/yr]	Annual Total [tonnes/yr]
	CO_2	CH_4	N_2O	CO_2e
Landfill	—	3,219	0	80,466
LFG Flare	—	365	0.095	9,148
Mobile Combustion Emissions (road and non-road vehicles)	10,032	0.290	0.840	10,291
Comfort Heating	169	0.003	0.003	170

The peak LFG generation were predicted to occur in 2049.Table 10.2-6 presents a comparison of the W12A Landfill's existing and proposed expansion GHG emissions to the provincial and Canadian totals. As indicated, the increase in emissions from the existing case to the proposed expansion would have a negligible contribution of less than 0.04% to the Ontario emissions and less than 0.01% to the Canadian emissions; therefore, the Project will have a negligible effect on climate change.

Table 10.2-6: Comparison of GHG Emissions from the Project to Ontario and Canadian Emission Totals

Source	Existing Emissions [kt/year CO_2e]	Expansion Emissions [kt/year CO_2e]	Increase in Emissions [kt/year CO_2e]
Project GHG Emissions	160	158	-2
Comparison to Ontario Total	0.10%	0.10%	-0.0013%
Comparison to Canada-wide Total	0.02%	0.02%	-0.0003%
Ontario GHG Emissions (2018)	**165,000**	**165,000**	**165,000**
Canada-wide GHG Emissions (2018)	**729,000**	**729,000**	**729,000**

In summary, GHG generated from the landfill expansion will be controlled by an active LFG collection and flaring system, such that the resulting GHG emissions would have a negligible contribution to the provincial GHG emissions.

11.0 Cumulative Impact Assessment

11.1 Approach

In the ToR, the City proposed to undertake a cumulative impact assessment of the potential effects of the proposed landfill expansion in combination with past, present and reasonably foreseeable future activities, where possible, as briefly outlined in the Code of Practice for Preparing and Reviewing Environmental Assessments in Ontario (MOECC, 2014). To carry out this assessment, a framework often used in federal EA processes was considered (Assessing Cumulative Environmental Effects under the Canadian *Environmental Assessment Act*, March 2018, Version 2 (Government of Canada (2012)), noting that the *Canadian Environmental Assessment Act* has been replaced by the *Impact Assessment Act* (2019). Cumulative effects guidance documents under the new act have not been prepared.

An assessment of cumulative effects provides a more complete understanding of what might happen to environmental, socio-economic and technical components beyond the influence of the Project alone. This is useful for regulatory decision-makers and authorities as they review and plan future developments.

This cumulative impact assessment corresponds to Step 8 of the methodology described in Section 3.0.

11.1.1 General

This analysis considers the residual, negative effects of the W12A Landfill expansion and the potential for these residual effects to interact with other projects or activities, which when combined may result in a greater and in particular adverse effect to an environmental, socio-economic or technical component.

11.1.2 Assessment Methodology

The cumulative effects analysis involved a scoping phase and an analysis of effects phase. For the scoping phase, the components that had residual negative effects (after mitigation) from the proposed landfill expansion were identified. After this, other projects or activities in the area that may affect the same components were identified.

During the analysis of effects phase, the other projects or activities were evaluated to assess if their effects would overlap in timing or spatial extent with the effects of the Project, accounting for and including the proposed landfill expansion mitigation. The nature and extent of the possible cumulative effects were then identified along with any possible mitigation and/or monitoring strategies.

11.2 Scope

11.2.1 Identified Components

The identified environmental, socio-economic and technical components from the proposed landfill expansion with identified residual, negative effects are: atmosphere (air/odour and noise); hydrogeology; surface water (quantity); biology; land use; agriculture; socio-economic, transportation and visual. Excluded are surface water (quality), archaeology

and cultural heritage landscapes and built heritage resources, as there were no residual effects identified for these components. Also excluded is design and operations, as the effects are not anticipated to overlap in timing or spatial extent with other projects or activities in the area.

Table 11.2-1 summarizes the predicted residual effects of the W12A Landfill expansion on the selected components where mitigation measures may not be sufficient to completely eliminate the potential effects, even when regulatory standards are being met.

Table 11.2-1: Summary of Landfill Expansion Residual Effects

Component	Potential Effects of W12A Landfill Expansion	Location of Residual Effect from W12A Landfill Expansion
Atmosphere*	Odour	Site, Site-vicinity
	Dust emissions	Site, Site-vicinity
	Air quality	Site, Site-vicinity
	Noise emissions	Site, Site-vicinity (including haul routes)
	GHG	Site, Site-vicinity (including haul routes)
Hydrogeology	Groundwater quality impacts	Site
Surface Water	Surface water quantity impacts	Site-vicinity
Biology	Change in habitat as a result of alteration of flows (aquatic biological resources)	Site-vicinity
	Removal of vegetation and disruption to wildlife (terrestrial biological resources)	Site
Land Use	Nuisance (dust, odour, noise)	Site-vicinity (including haul routes)
Agriculture	Loss of productive land on or off-site	Site
Socio-economic	Nuisance (dust, odour, noise), visual, traffic	Site-vicinity
Transportation	Traffic along the haul routes	Site-vicinity (including haul routes)
Visual	Change in views of the landfill	Site-vicinity

Notes: * A quantitative cumulative impact assessment is a component of the air quality assessment described in Section 9.1.1 whereby the background air quality expected for the area obtained from a combination of background air quality for the region and the modelled air quality resulting from the emissions of currently approved sources at the existing W12A Landfill Site is added to the predicted impact from the landfill expansion. This is a different

qualitative cumulative impact assessment following the framework often used in federal EA processes. These are different cumulative impact assessments.

11.2.2 Spatial Extent

All predicted negative, residual effects of the W12A Landfill expansion are located on the Site and in the Site-vicinity (including along the haul routes); therefore, this is the area for primary consideration in the cumulative impact assessment.

11.2.3 Timing

The residual effects of the W12A Landfill expansion will arise primarily during the construction and operations phases of the Project.

11.2.4 Other Projects and Activities

The existing zoning and land use in the vicinity of the site was considered in determining the other projects and activities to include in this cumulative assessment:

- To the north: agriculture, rural residential, two aggregate pits, a concrete plant and Highway 401 corridor;
- To the west: large agriculture parcels, rural residential and Highway 401 corridor; further southwest approximately 14 km is another landfill;
- To the south: livestock operation, agriculture, rural residential and the Islamic Cemetery of London;
- To the east: the City's MRF, agriculture, rural residential; to the northeast along the haul route a driving range, Shaver subdivision, school board office, Catholic College, agriculture and rural residential; and
- Outside of the Site-vicinity area approximately 5 and 7 km to the northeast of the Site are two waste processing facilities.

There are no known new future planned land uses in the Site-vicinity.

11.2.5 Potential Impacts Due to Other Projects and Activities

It has been assumed in the absence of information to the contrary that the non waste related off-site activities and projects described above operate and perform in compliance with relevant regulatory standards, such as those established by the MECP. There is no indication to the contrary from the work undertaken for this EA. It is known that the landfill located 14 km to the south and the two waste processing facilities located to the northeast have each had multiple odour complaints and some have received MECP orders and charges related to odour issues.

A residual effects interaction matrix shown in Table 11.2-2 was completed to identify potential overlaps in terms of types of effect between negative, residual effects of the W12A Landfill expansion and potential residual effects of other projects and activities on each component.

Table 11.2-2: Interactions Matrix – Type of Effect

Component[1]	Potential Effects of W12A Landfill Expansion	Farming Operations	Aggregate Pits	Concrete Plant	Highway	MRF	Additional Small Commercial Operations	Waste Disposal and Waste Processing Facilities
Atmosphere	Odour	yes	no	no	no	yes	no	yes
	Dust emissions	yes	yes	yes	no	no	no	no[2]
	Air quality	yes	no	no	yes	no	no	no[2]
	Noise emissions	yes	yes	yes	yes	yes	no	no[2]
	GHG	yes	no	no	yes	no	no	yes
Hydrogeology	Groundwater quality impacts	no	no	no	no	no	no	no[2]
Surface Water	Surface water quantity impacts	no	no	no	no	no	no	no
Biology	Change in habitat as a result of alteration of flows (aquatic biological resources)	no	no	no	no	no	no	no
	Removal of vegetation and disruption to wildlife (terrestrial biological resources)	yes	no	no	no	no	no	no
Land Use	Nuisance (dust, odour, noise)	yes	yes	yes	yes	yes	no	yes
Agriculture	Loss of productive land on or off-site	no	no	no	no	no	no	no

Component[1]	Potential Effects of W12A Landfill Expansion	Farming Operations	Aggregate Pits	Concrete Plant	Highway	MRF	Additional Small Commercial Operations	Waste Disposal and Waste Processing Facilities
Socio-economic	Nuisance (dust, odour, noise), visual, traffic	yes	yes	yes	yes	yes	no	yes
Transportation	Traffic along the haul routes	no	yes	yes	no	yes	yes	no
Visual	Change in views of the landfill	no	no	no	no	no	no	no[2]

Notes:
[1] Only those components with negative, residual effects are listed.
[2] Due to distance of these facilities, many of the potential effects from this activity are not expected to overlap spatially.

11.3 Analysis of Effects

Overlaps in terms of components in timing or space of effect between the negative, residual effects of the W12A Landfill expansion and the potential residual effects of the other existing activities in the vicinity of the landfill were identified in Table 11.2-2.

Table 11.3-1 below provides a further discussion of the identified overlaps of potential cumulative effects results from the proposed W12A Landfill expansion and other projects and activities in the area. Additional mitigation and/or monitoring strategies are identified where applicable and possible.

Table 11.3-1: Potential Cumulative Effects

Component / Indicators	Potential Effects of the W12A Landfill Expansion	Existing or Proposed Activities that Overlap in Time or Space	Proposed Mitigation or Monitoring	Potential Remaining Cumulative Effects
Atmosphere • Expected concentrations of air quality indicator compounds (selected regulated air contaminants to represent this type of project) at the property boundary. • Expected site-related odour at PORs. • Expected GHG emissions.	Expansion will result in an increase in concentrations of most air quality indicator compounds and odour, noting that GHG emissions are expected to be lower due to better collection efficiency of the LFG collection system. Air quality and odour associated with the expansion are predicted to meet relevant Ontario Regulations at PORs.	The ongoing active farming, aggregate pits, concrete plant, and Highway all have the potential to contribute to reduced air quality. The MRF, farming operations and distant waste disposal and waste processing facilities can contribute to odours. The ongoing active farming, Highway and waste disposal and processing facilities contribute to GHG emissions.	General best management practices and operations as part of the design are anticipated to mitigate the W12A Landfill expansion air quality and odour effects to within regulatory limits. A one-time monitoring event is suggested. Regular reporting of GHG.	The air quality assessment completed includes the contribution to predicted effects from similar existing background conditions with the exception of perhaps other waste management facilities, and concludes the effects will be within the compliance limits. Despite the fact that the model predicts that odour and longer distance odour impacts should not be an issue, there is a precedent of impact experienced in this area. This will require more stringent controls around operational plans and mitigation measures.

Component / Indicators	Potential Effects of the W12A Landfill Expansion	Existing or Proposed Activities that Overlap in Time or Space	Proposed Mitigation or Monitoring	Potential Remaining Cumulative Effects
Atmosphere • Noise Levels at off-site PORs, or vacant lots that accommodate the future construction of PORs.	Additional on-site noise mitigation required for landfill operations within 330 m of an off-site noise POR. Ancillary equipment and emergency equipment are expected to operate below the sound level limits. Change in traffic noise levels between the existing landfill and proposed landfill expansion is insignificant to noticeable; this is considered an acceptable change.	The ongoing active farming, aggregate pits, concrete plant, MRF, Highway and additional small commercial operations all have the potential to have noise effects.	General best management practices and operations as part of the design will mitigate most of the noise effects. Additional mitigation in the form of working behind a berm when landfilling near one particular POR will be required. Noise monitoring when working in this area will be required if the POR exists when landfilling in that specific area is occurring in future.	The short term background noise data collected is a direct measurement of existing cumulative effects around the landfill and the predictions of existing conditions and landfill expansion have been shown to be below and above the short term background noise data, respectively. Therefore, it is possible to consider the expansion predictions to be conservative and possibly commensurate with cumulative noise.

Component / Indicators	Potential Effects of the W12A Landfill Expansion	Existing or Proposed Activities that Overlap in Time or Space	Proposed Mitigation or Monitoring	Potential Remaining Cumulative Effects
Biology • Expected impact on terrestrial vegetation communities, wildlife habitat, and wildlife, including rare, threatened or endangered species on-site and within the Site-vicinity.	Direct impacts to habitat for monarch butterflies and SAR grassland birds (Bobolink and Eastern Meadowlark) as a result of preparing areas of the existing landfill for vertical expansion.	The on-going farming operations have the potential to decrease terrestrial habitat during normal operations.	A detailed EMMP, Construction Monitoring Plan, and Species at Risk and Wildlife Observation Protocol will be developed to minimize impacts during construction and operation. Compensation for habitat loss will be developed in consultation with the MECP for Bobolink and Eastern Meadowlark.	It is difficult to determine exact effects possible from farming operations; the W12A Landfill expansion residual effects can be fully mitigated.

Component / Indicators	Potential Effects of the W12A Landfill Expansion	Existing or Proposed Activities that Overlap in Time or Space	Proposed Mitigation or Monitoring	Potential Remaining Cumulative Effects
Land Use • Expected impact on sensitive land uses (i.e., dwellings, churches, and parks within the Site-vicinity).	See odour, dust, noise residual effects above.	The ongoing active farming, aggregate pits, concrete plant, MRF, Highway, additional small commercial operations and distant waste disposal and waste processing facilities all have the potential to contribute to nuisance effects.	See odour, dust, and noise mitigation above.	See odour, dust, and noise cumulative effects above. In light of the existing zoning and the associated Official Plan policy framework, it is considered unlikely that new sensitive land uses would be introduced in close proximity to the landfill.
Socio-economic • Displacement of residents. • Expected interference with use and enjoyment of residential properties (nuisance effects).	See odour, dust, noise residual effects above. Visual and traffic are also items that can interfere with use and enjoyment of residential properties. Direct displacement of one City-owned rental property will occur as a result of the Project.	The ongoing active farming, aggregate pits, concrete plant, MRF, Highway, additional small commercial operations and distant waste disposal and waste processing facilities all have the potential to contribute to nuisance effects. These existing activities have potential traffic effects (particularly the new concrete plant). None of the activities in the area have measurable	See odour, dust, air quality and noise mitigation above.	See odour, dust and noise cumulative effects above and transportation noted below. In light of the existing zoning and the associated Official Plan policy framework, it is considered unlikely that new sensitive land uses would be introduced in close proximity to the landfill.

Component / Indicators	Potential Effects of the W12A Landfill Expansion	Existing or Proposed Activities that Overlap in Time or Space	Proposed Mitigation or Monitoring	Potential Remaining Cumulative Effects
		effects related to views (visual) compared to those associated with the proposed vertical landfill expansion.		
Transportation • Expected effect on traffic along the haul routes in the vicinity of the site.	Traffic is predicted to increase as a result of the W12A Landfill expansion, although not to the extent that any modifications to roadways or intersections are expected as a result of the landfill.	The aggregate pits, concrete plant, MRF, additional small commercial operations all contribute to traffic in the area. It is noted that traffic with some of these projects and activities in the area has been characterized by the public to be traffic that is speeding and possibly causing a safety risk. While this cannot be quantified in a cumulative impact assessment as it is assumed that vehicles are being operated legally.	Under future (2048) conditions, the two ramp terminals at Highway 401 and Wonderland Road (Highway 4) are forecast to operate at a poor level of service and likely require upgrade in the future. It was determined that this upgrade is more a result of a general area projected traffic increase and not the Project wholly.	The traffic assessment completed includes the contribution to predicted effects from similar existing background conditions, with the exception that the effects of the concrete plant may not be included as it is a new facility (2020). The effects predicted from the assessment will be within the compliance limits. The concrete plant would have had to demonstrate to the City that their expected traffic would be compatible with other activities in the area.

Note: [1] Only those components with negative, residual effects for the landfill expansion and negative effects for other projects and activities are listed.

12.0 Monitoring and Contingency

The following sections present the monitoring plans for each of the disciplines, where relevant (Section 12.1), followed by contingency plans (Section 12.2). Efforts have been made to conservatively estimate potential impacts associated with the proposed W12A Landfill expansion; however, there is always some potential for variability between predicted and actual conditions. Effective monitoring and contingency measures are intended to address this potential variability and confirm the assumptions used in this assessment.

12.1 Monitoring

The proposed expansion of the W12A Landfill has been designed to incorporate mitigation measures to minimize the potential for unacceptable environmental effects. An effective monitoring program provides results to: indicate whether the facility is working as expected and that the assumptions used in the assessment were correct; assess on an ongoing basis whether mitigation measures as designed and operated are effective; and identify unforeseen problems so they can be addressed in a timely manner.

Effects monitoring programs are presented in relation to the components used in the assessment. For the proposed W12A Landfill expansion, the conceptual effects monitoring programs are described below. The final details (i.e., frequency of monitoring, monitoring parameters, possible changes over time depending on the results of the specific monitoring program, etc.) of effects monitoring for the Atmosphere, Hydrogeology/Geotechnical, Surface Water and Biology components will be determined in consultation with the MECP and incorporated in the ECA amendments for the proposed expansion.

12.1.1 Atmosphere

12.1.1.1 Air

Table 12.1-1 summarizes the conceptual follow-up air quality verification program for the air quality (including odour) component.

Table 12.1-1: Proposed Follow-Up Activities for Air Quality and Odour

Project Phase	Objective	Suggested Program Activity
Operations Phase	• To verify the predicted concentrations of SPM, PM_{10} and $PM_{2.5}$. • To verify that the mitigation measures considered integral to the Project are being incorporated as planned and are effective.	• One time only sampling of unpaved and paved road silt loadings to confirm emission estimates. • Review and update of existing fugitive dust management plan and complaints response protocol.
Operations Phase	• To verify that the Odour emission rates used in the assessment were reasonable, but conservative. • To verify the predicted concentrations of Odour. • To verify that the mitigation measures considered integral to the Project are being incorporated as planned, and are effective.	• One time landfill gas sampling early in the expansion to determine actual emission rates from the site of indicator compounds. • Sampling analysis to include odourous compounds, Vinyl Chloride and Hydrogen sulphide. • Review and update the odour management plan and complaints response protocol.

Landfills that generate over 10,000kt CO_2 equivalent of GHG are required to report GHG to the following as noted in Section 10:

- Federal reporting under Section 46 of the Canadian Environmental Protection Act, (CEPA), SC 1999: Greenhouse Gas Emissions Reporting Program (GHGRP).
- Provincial reporting under Ontario's Greenhouse Gas Emissions: Quantification, Reporting, and Verification Regulation, Ontario Regulation 390/18 (O. Reg 390/18).

The W12A Landfill has been and will continue to report its GHG generation.

12.1.1.2 Noise

A follow-up noise monitoring program is proposed for the expanded landfill when landfill operations are within 330 m of the existing residence to the south (i.e., POR R15 on Figure 5.2-4 in Section 5.2) and if the residence is present when landfilling operations occur in the southern areas of Phase 5E and Phase 7E. Since the other identified

representative PORs that are within the distances that trigger the requirement for noise mitigation specified in Section 9.1.2 are currently vacant, it is proposed that any noise mitigation requirements related to these locations be deferred until such time that they become occupied with a noise sensitive use (if this actually occurs in future).

It is proposed the specifics of the methodology of the noise monitoring program related to R15, i.e., the frequency, timing, duration and selection of noise data to be collected, be determined prior to landfilling operations occurring in the southern areas of Phase 5E and Phase 7E, as it is expected there may be updated information at that time or a noise sensitive use will no longer be present at R15.

12.1.2 Geology and Hydrogeology

The City has an existing comprehensive groundwater monitoring program for the existing landfill that has been updated to reflect current site information and the proposed landfill expansion. A summary of the proposed groundwater, leachate and neighbouring water wells monitoring program for the proposed landfill expansion is provided in Table 12.1-2, Table 12.1-3 and Table 12.1-4, respectively. The monitoring locations are shown on Figure 12.1-1. The monitoring program parameters are generally consistent with the requirements set out in O. Reg 232/98 with exceptions noted in Table 12.1-5.

Table 12.1-2: Groundwater Monitoring Program

Monitoring Wells / Description	Identification #	Parameters	Sampling Dates
Shallow Aquifer – On-site All monitoring wells located at or near the property boundary that are screened in the Shallow Aquifer	01-12b, 01-14, 13-1a, 13-3a, 91-4a, 84-5b, 82-6, 92-11, 94-1, 94-3, 01-9a, 04-2a, 06-1, 06-2, 92-7a, 19-4b, 19-5b	Comprehensive List Indicator List	June April, October
Shallow Aquifer – Off-site representative monitoring wells located in adjacent City-owned properties that are screened in the Shallow Aquifer	04-6a, 05-1, 05-2, 05-3	Indicator List	June
White Oak Aquifer Representative monitoring wells (on-site and off-site) that are screened in the White Oak Aquifer	92-8, 92-9, 92-10, 92-12, 94-2, 01-3a, 14	Indicator List	June

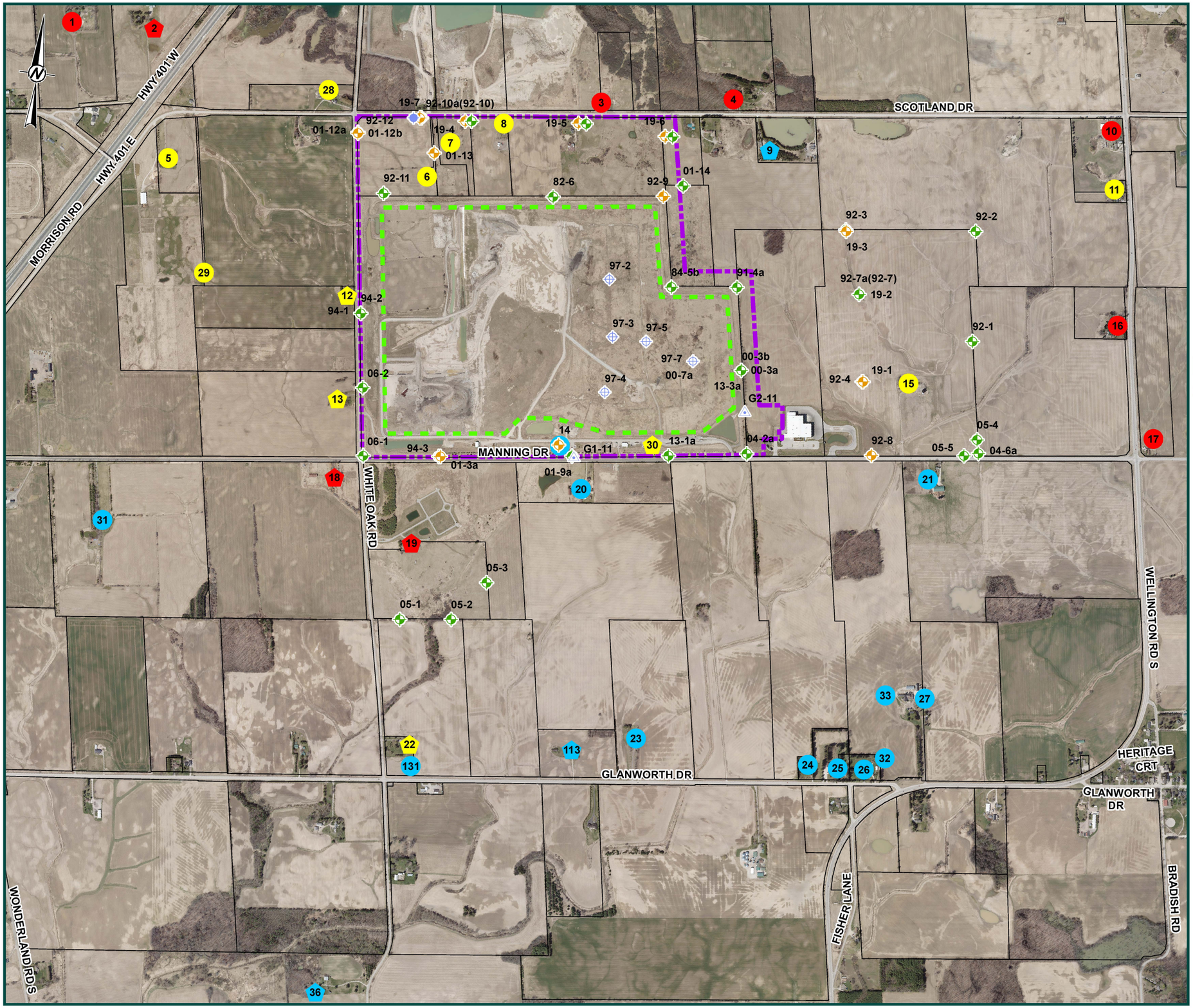
Monitoring Wells / Description	Identification #	Parameters	Sampling Dates
Till	00-7a (Till monitor below garbage) Additional monitoring wells will be installed in the upper fractured clay till zones at key locations on the east and/or south sides of the Phase 1 area, with the details to be determined as part of the subsequent EPA approvals process for the expansion.	Comprehensive List	June
All Monitoring Wells	Monitoring wells listed above plus 92-1, 92-2, 92-3, 92-4, 92-7, 01-12a, 01-13, 00-3a, 00-3b, 05-4, 05-5, 19-1, 19-2, 19-3, 19-4a, 19-5a, 19-6a, 19-6b, 19-7a, 19-7b, 19-7c, 92-10a	Water levels	April, June, October

Table 12.1-3: Leachate Monitoring Program

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

Table 12.1-4: Water Well Monitoring Program

Location	Parameters	Sampling Dates
Water Wells – Off-site Upgradient and Downgradient Wells if access granted by owner and if not destroyed/decommissioned by owner. These water wells could change over time – currently this includes 9, 20, 21, 23, 24, 25, 26, 27, 31, 32, 33, 36, 113, 131	Comprehensive List Indicator List	Every 3 years; June 2020 is most recent event Annually in June



LEGEND

ACTIVE MONITORING WELLS

- GROUNDWATER, UPPER AQUIFER
- GROUNDWATER, WHITE OAK AQUIFER
- LEACHATE
- METHANE GAS
- TILL

CURRENT WATER WELL MONITORING PROGRAM

- UPPER AQUIFER
- WHITE OAK AQUIFER

DECOMMISSIONED WATER WELLS

- UPPER AQUIFER
- WHITE OAK AQUIFER

HISTORIC WATER WELLS

- UPPER AQUIFER
- WHITE OAK AQUIFER
- PROPERTY FABRIC
- PROPOSED PROPERTY BOUNDARY
- PROPOSED LIMIT OF WASTE

REFERENCE(S)

1. DATA PROVIDED BY THE CITY OF LONDON
2. CITY OF LONDON AERIAL PHOTOGRAPHY, APRIL 2016
3. SITE FEATURES PREPARED BY CALLON DIETZ INC. LTD., OCTOBER 19, 2016.
4. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 17 VERTICAL DATUM: CGVD28

0 190 380 760

1:15,000 METRES

CLIENT
CORPORATION OF THE CITY OF LONDON

PROJECT
INDIVIDUAL EA OF THE PROPOSED W12A LANDFILL EXPANSION

TITLE
PROPOSED GROUNDWATER MONITORING

CONSULTANT
GOLDER

YYYY-MM-DD	2020-11-06
DESIGNED	----
PREPARED	JEM
REVIEWED	PLE
APPROVED	PAS

PROJECT NO.	CONTROL	REV.	FIGURE
1648176	0026	0	**12.1-1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

Table 12.1-5: Groundwater Parameters Monitored

Parameter	Groundwater Monitoring Wells	Groundwater Monitoring Wells	Leachate Monitoring	Leachate Monitoring	Water Wells	Water Wells
	Comp.*	Indicator	Comp.*	Indicator	Comp.*	Indicator
General						
Alkalinity	✓	✓	✓	✓	✓	✓
Biological Oxygen Demand$_5$			✓	✓		
Chemical Oxygen Demand	✓	✓	✓	✓		
Conductivity	✓	✓	✓	✓	✓	✓
Dissolved Organic Carbon	✓	✓	✓	✓	✓	✓
pH	✓	✓	✓	✓	✓	✓
Phenols	✓		✓		✓	
Sulphate	✓	✓	✓	✓	✓	✓
Suspended Solids			✓	✓		
General – Nutrients						
Ammonia	✓	✓	✓	✓		
Nitrate	✓		✓		✓	✓
Nitrite	✓		✓			
Total Kjeldahl Nitrogen	✓		✓			
Total Phosphorus			✓			

Parameter	Groundwater Monitoring Wells	Groundwater Monitoring Wells	Leachate Monitoring	Leachate Monitoring	Water Wells	Water Wells
	Comp.*	Indicator	Comp.*	Indicator	Comp.*	Indicator
General – Major Ions						
Chloride	✓	✓	✓	✓	✓	✓
Calcium	✓	✓	✓	✓	✓	✓
Iron	✓	✓	✓	✓	✓	✓
Magnesium	✓	✓	✓	✓	✓	✓
Manganese	✓		✓			
Potassium	✓	✓	✓	✓	✓	✓
Sodium	✓	✓	✓	✓	✓	✓
Trace Metals						
Arsenic	✓		✓		✓	
Barium	✓		✓		✓	
Boron	✓		✓		✓	
Cadmium	✓		✓		✓	
Chromium	✓		✓		✓	
Copper	✓		✓		✓	
Lead	✓		✓		✓	
Mercury	✓		✓			
Nickel	✓		✓		✓	
Selenium			✓		✓	
Silver					✓	
Strontium					✓	
Zinc	✓		✓		✓	

Parameter	Groundwater Monitoring Wells	Groundwater Monitoring Wells	Leachate Monitoring	Leachate Monitoring	Water Wells	Water Wells
	Comp.*	Indicator	Comp.*	Indicator	Comp.*	Indicator
Volatiles						
EPA 624 Scan	✓		✓			
Field						
Conductivity	✓	✓	✓	✓	✓	✓
pH	✓	✓	✓	✓	✓	✓
Temperature	✓	✓				

Notes:
The parameters to be tested for in the groundwater and leachate are the same as the parameters suggested in the Landfill Standards (MECP, 1998) except for:

- Potassium – added to groundwater and leachate indicator and included in Environmental Compliance Approval (ECA)
- Selenium – added to leachate comprehensive and tested for in water wells
- EPA 624 VOC Scan – added to groundwater and leachate comprehensive as recommended from leachate characterization study but not included on water wells
- Temperature – added to groundwater comprehensive and indicator lists
- Nitrate – removed from groundwater and leachate indicator lists and will add based on results of groundwater and leachate comprehensive list analysis
- Total Phosphorus – removed from groundwater comprehensive list and will be added if leachate testing shows a need
- Total Dissolved Solids – removed from groundwater and leachate indicator and comprehensive lists as not considered necessary to evaluate water quality.

* comp. means the comprehensive list of monitoring parameters

As described in the Existing Conditions and Impact Assessment Report for the Design and Operations component (Volume IV, Appendix D.13), a leachate mound monitoring component in the Phase 1 area of the landfill is required to assess groundwater predictions and future performance. The mound monitoring wells would be installed in the central part (not necessarily on the peak but in the higher parts of the waste) of the Phase 1 area after completion of each of Phases 5E through 8E. These mound monitoring wells would be monitored for leachate levels following the same schedule for leachate levels outlined in Table 12.1-3.

12.1.3 Surface Water

12.1.3.1 Site Surface Water Quality Monitoring

Since the points of discharge from the stormwater management system (ponds) for the proposed expansion are the same as the existing site, it is proposed that the current monitoring locations for surface water as related to the overall W12A Landfill site be continued for the proposed expansion. The program is provided in Tables 12.1-6 and 12.1-7.

Table 12.1-6: Surface Water Monitoring Program

Location	Parameters	Sampling Dates
Surface Water Sampling Stations Stations 1, 2, 3, 5, 7 and 10	Comprehensive List	One spring and one fall sampling event
	Indicator List	Two other sampling events

Table 12.1-7: Surface Water Monitoring Parameters

Parameter	Surface Water Comp.*	Surface Water Indicator	Parameter	Surface Water Comp.*	Surface Water Indicator
General			***General - Nutrients***		
Alkalinity	✓	✓	Ammonia	✓	✓
Biological Oxygen Demand$_5$	✓	✓	Nitrate	✓	✓
Chemical Oxygen Demand	✓	✓	Nitrite	✓	✓
Conductivity	✓	✓	Total Kjeldahl Nitrogen	✓	✓
Hardness	✓	✓	Total Phosphorus	✓	✓
pH	✓	✓	***Trace Metals***		
Phenols	✓	✓	Arsenic	✓	
Sulphate	✓	✓	Barium	✓	
Suspended Solids	✓	✓	Boron	✓	
Total Dissolved Solids	✓	✓	Cadmium	✓	
Major Ions			Chromium	✓	
Chloride	✓	✓	Copper	✓	
Iron	✓	✓	Lead	✓	
Field			Mercury	✓	
Conductivity	✓	✓	Zinc	✓	
Dissolved Oxygen	✓	✓			
Flow [(a)]	✓	✓			
pH	✓	✓			
Temperature	✓	✓			

Notes:

[(a)] Flows conditions (i.e., stagnation, qualitative description of flow rate, etc.) in water discharged from each stormwater management pond will be noted.

* comp. means the comprehensive list of monitoring parameters

12.1.3.2 Stormwater Management System Monitoring

It is proposed that the current monitoring program for monitoring of surface water quality in the stormwater management pond discharge be continued for the proposed expansion and the proposed modifications to the stormwater management system.

Sampling from all stormwater management ponds will be undertaken four times per year after significant rainfall events at the outfall of Pond 1, Pond 2/3, Pond 4 and Pond 5 in spring and fall and two other sampling events. The samples collected in the spring and fall will be analyzed for the comprehensive list of parameters and the samples from the other two events will be analyzed for the indicator parameter list as prescribed in existing ECA 1828-9CKRMK (i.e., nutrients, major ions, trace metals, volatiles, and field test parameters) and summarized in Table 12.1-8.

Table 12.1-8: Surface Water Monitoring Parameters

Parameter	Surface Water Comp.	Surface Water Indicator	Parameter	Surface Water Comp.	Surface Water Indicator
General			***General - Nutrients***		
Alkalinity	✓	✓	Ammonia	✓	✓
Biological Oxygen Demand$_5$	✓	✓	Nitrate	✓	✓
Chemical Oxygen Demand	✓	✓	Nitrite	✓	✓
Conductivity	✓	✓	Total Kjeldahl Nitrogen	✓	
Hardness	✓	✓	Total Phosphorus	✓	✓
pH	✓	✓	***Trace Metals***		
Phenols	✓	✓	Arsenic	✓	
Sulphate	✓	✓	Barium	✓	
Suspended Solids	✓	✓	Boron	✓	
Major Ions			Cadmium	✓	
Chloride	✓	✓	Chromium	✓	
Iron	✓	✓	Copper	✓	
Field			Lead	✓	
Conductivity	✓	✓	Mercury	✓	
Dissolved Oxygen	✓	✓	Zinc	✓	
pH	✓	✓			
Temperature	✓	✓			

12.1.4 Biology

The following monitoring activities are proposed for the landfill expansion.

Construction Phase

As described in Section 9.4.4.1, an EMMP will be developed and will include a Construction Monitoring Plan that will outline monitoring activities to be completed during construction. These activities will include, but are not limited to, the following:

- Pre-construction inspection to confirm proper installation of Erosion and Sediment Control (ESC) and any recommended wildlife exclusionary measures;
- Regular ESC fencing monitoring and any exclusionary fencing measures;
- Employ mitigation measures such as grading stockpiles and other exposed faces to prevent nesting of bank swallows as noted in Best Management Practices for the Protection, Creation and Maintenance of Bank Swallow Habitat in Ontario (MNRF, 2017); and
- Training session for on-site personnel which summarizes mitigation measures.

Operations Stage

Monitoring during operations may include monitoring of any compensation measures necessary to meet MECP permitting or approval requirements for Bobolink and Eastern Meadowlark, as well as groundwater and surface water quality and quantity monitoring required to meet relevant provincial permitting and approvals. Monitoring requirements for Operations will be determined at the detailed design stage.

Closure and Post-closure Stage

Monitoring of compensation plantings and SAR habitat will likely be required to meet requirements under the ESA (*O. Reg. 242/08*). The closure and post-closure monitoring efforts will be determined at the detailed design stage.

12.1.5 Landfill Gas Monitoring

It is proposed that the current monitoring program for the presence and concentration of landfill gas be continued for the proposed expansion. Continuous monitoring in all permanent on-site buildings for concentrations of methane, oxygen, and hydrogen sulphide will be undertaken. In addition, the two existing dedicated perimeter landfill gas monitoring wells will be sampled three times per year (April, June and October). The results from the aforementioned monitoring locations (i.e. on-site buildings and perimeter wells) will be reviewed and compared to the concentration limits set out in *O. Reg. 232/98*.

12.2 Contingency Measures

In the event that the ongoing groundwater or surface water monitoring programs detect unexpected problems, it may be necessary to implement contingency measures to further reduce the potential for any adverse environmental effects associated with the proposed expansion of W12A Landfill. The current ECA for the W12A Landfill has a trigger mechanism that requires prescribed actions to be taken should the monitoring results indicate that certain thresholds are reached, whereby additional investigations and assessments are undertaken to confirm the monitoring results and determine if it is necessary to implement contingency measures to prevent non-compliance with the Reasonable Use Guideline for groundwater, or to prevent leachate-impacted waters from accessing the stormwater management ponds. The supporting documents to the current ECA also contains contingency measures. As part of the ECA amendment application process for the expanded landfill, the trigger mechanisms and contingency measures will be reviewed and modified, if required.

The following describes contingency measures that could be put into effect.

12.2.1 Groundwater

There are two mechanisms by which leachate could potentially adversely affect off-site groundwater and require contingency measures to be implemented.

1. Horizontal migration of leachate or leachate-impacted groundwater through the upper fractured clay till zone. This situation could arise if the perimeter leachate collection system around the Phase 1 area of the landfill is not effective enough to capture the leachate. It is noted that leachate not captured by the leachate collection system would have to first travel across the approximately 100 m wide buffer zone to reach the landfill property boundary. If this occurs, the contingency measure could consist of a leachate-impacted groundwater collection trench on the landfill property, from which the collected water would be transferred to the main leachate management system for subsequent treatment. Alternatively, the City could obtain control of the use of the off-site shallow groundwater in the affected area by establishing a Contaminant Attenuation Zone; this could take the form of acquiring additional land or obtaining a groundwater easement on the additional land.

2. Vertical migration of leachate through the Surficial Aquitard to the Upper Aquifer. If monitoring indicated these leachate effects, the contingency measure would be the installation of purge wells in the Upper Aquifer to intercept the leachate-impacted groundwater prior to it leaving the W12A Landfill property and transferring the collected water to the main leachate management system for subsequent treatment. It is noted that the predictive modelling indicates that with the proposed leachate control measures to be included in the expansion design, the site is expected to meet the Reasonable Use Guideline in the Upper Aquifer, with peak impacts not occurring until approximately 700 years.

12.2.2 Surface Water

The valves on the stormwater management ponds are normally open. The results of the stormwater pond discharge quality sampling will be compared to trigger values listed in Table 2 of the current ECA 1828-9CKRMK, as shown in Table 12.2-1.

Table 12.2-1: Stormwater Pond Trigger Values

Parameter	Trigger Concentration (mg/L)
Ammonia (un-ionized)	> 0.3
Biological Oxygen Demand$_5$	> 10.0
Chloride	> 800
Sulphate	> 1000

In the event of an exceedance of a trigger parameter, additional surface water sampling would be conducted at the location of the exceedance to confirm the result. If the second sample results in an exceedance, then the associated stormwater management pond will be operated in batch discharge mode with the gate valve normally closed.

During batch discharge mode operation surface sampling will occur prior to the discharge of any surface water. The surface water from the pond will be discharged to the leachate management system and conveyed with leachate for off-site treatment if the trigger concentration is exceeded for any trigger parameter. If the concentration for each trigger parameter is less than the corresponding trigger concentration, the surface water will be released to the downstream water course.

Three consecutive surface water sampling events for each trigger parameter exceeded are required to be less than the corresponding trigger concentration for each parameter before the pond can be returned to normal operation (valve open).

13.0 Summary of Commitments and Other Approvals

Compliance monitoring of the W12A Landfill expansion will be carried out to confirm that it has been constructed, implemented and operated in accordance with the commitments made by the City during the preparation of the EA and any conditions of EA approval. This section lists the commitments made by the City during the ToR (Table 13-1) and during the EA study process (Table 13-2). This list does not include items that will be legally required according to existing provincial regulations.

The following table (Table 13-1) summarizes the commitments made by the City during the ToR and the status of fulfilling each of the commitments.

Table 13-1: List of Commitments made by the City during the Development and Approval of the ToR

ID	Commitment (Location where Commitment was made in ToR)	Status
1	The EA will be prepared in accordance with subsections 6(2)(c) and 6.1(3) of the *EA Act. (ToR Section 2.4)*	Completed Refer to Sections 2.2 and 2.7.1 of this EASR.

ID	Commitment (Location where Commitment was made in ToR)	Status
2	The City has committed to a target of 60% residential waste diversion by the end of 2022. *(ToR Section 3.1)*	Completed On March 2, 2020, London Municipal Council approved the budget to fund actions to increase waste diversion from 45% (current level) to 60% waste diversion by the end of 2022. This includes funding the implementation of the Green Bin Program as part of the 60% Waste Diversion Action Plan. The City's Resource Recovery Strategy, an even broader, more long term look at waste diversion and resource recovery, will be completed in 2022 (refer to Section 2.3 of this EASR). The projected residual waste requiring disposal over the 25 year planning period for the expansion is based on the City achieving 60% residential waste diversion by end of 2022 (refer to Volume III Appendix C: 2019 Updated Residual Waste Projections and Landfill Capacity Assessment). Based on the COVID-19 pandemic, the City will now have its 60% Waste Diversion Action Plan programs operational by the end of 2022 as 9 to 12 months have been lost from the original timeframe.
3	When requested, the City will meet with individuals or groups at their convenience to assist them with understanding the project information and providing input; for example, if they are unable to participate in planned public consultation events or require more information.	Ongoing As described in Section 4.0 of this EASR, the City offered to meet and met with individuals or groups at their convenience during the EA process. The offer to meet with individual and groups was included on the Project Website and the Notice for Open House 4. One business who uses the landfill and one resident living near the landfill requested meetings.

ID	Commitment (Location where Commitment was made in ToR)	Status
4	The City will contact Indigenous groups to discuss their consultation needs and continue to involve them in the EA process. *(ToR Section 8.3)*	Ongoing Refer to Indigenous Community subsections within Section 4.0 of this EASR and materials related to Indigenous Community consultation in Volume V Appendix E.
5	Where described in the ToR for the environmental components, detailed work plans for the technical studies will be prepared and provided to the appropriate GRT agency for review and concurrence. *(ToR section 7.6)*	Completed Refer to work plans in Volume III Appendix B.
6	The City will share work plans with Indigenous Communities and post work plans on the project website. *(ToR section 7.6)*	Completed A workshop was held for Indigenous Communities to review the detailed work plans on August 26, 2019. Feedback from this workshop resulted in changes to the Groundwater work plan. The work plans were posted on the project website.
7	The City will consider the stated purpose of this EA during the EA process and will refine the purpose if required. The final purpose statement will be provided in the EA study report. *(ToR Section 1.2)*	Completed Refer to Section 2.1 of this EASR.
8	During the EA, assumptions used in determining the projected residual waste from the existing service area will be refined and assessed. This will be described in the EA study report. *(ToR Section 3.3.6)*	Completed Refer to Volume III Appendix C: 2019 Updated Residual Waste Projections and Landfill Capacity Assessment and Section 2.4 of the EASR.

ID	Commitment (Location where Commitment was made in ToR)	Status
9	During the EA the proposed regional service area will be confirmed and further assessed. This will be described in the EA study report. *(ToR Section 3.3.7)*	Completed Refer to Section 2.4 of this EASR and Volume III Appendix C: 2019 Updated Residual Waste Projections and Landfill Capacity Assessment.
10	During the EA, the preliminary criteria and indicators for each of the environmental, socio-economic and technical components will be refined and described in the EA study report. *(ToR Section 7.3)*	Completed Refer to Section 3.3 of this EASR.
11	The preliminary Study Areas will be reviewed and confirmed during the EA and described in the EA study report. *(ToR Section 7.2)*	Completed Refer to Section 5.1 of this EASR.
12	A more detailed description of the environmental conditions will be prepared during the EA to reflect the confirmed Study Areas using a combination of sources of existing information and site-specific investigations and studies and provided in the EA study report. *(ToR Section 5)*	Completed Refer to Section 5.0 of this EASR and to the individual component reports in Volume IV.
13	The individual Alternative Methods of expanding the W12A Landfill will be identified, refined and confirmed during the EA, and described in the EA study report. *(ToR Section 6)*	Completed Refer to Section 6.0 of this EASR
14	Further input on the relative importance of the assessment indicators will be obtained during the initial stages of the EA. *(ToR Section 7.5.4)*	Completed Additional input on the importance of the assessment indicators was sought during Open House #3. Refer to Section 4.0 of this EASR and Volume V Appendix F.05.

ID	Commitment (Location where Commitment was made in ToR)	Status
15	During the EA, the capability of the WWTP to continue to receive the leachate generated from the preferred landfill expansion alternative will be evaluated. This will be described in the EA study report. *(ToR Section 7.5.2)*	Completed Refer to Section 8.1.2 of this EASR.
16	The preferred expansion alternative will be assessed from the perspective of climate change. *(ToR Section 7.5.7)*	Completed Refer to Section 10.0 of this EASR.
17	A cumulative impact assessment will be completed and described in the EA study report. *(ToR Section 7.5.9)*	Completed Refer to Section 11.0 of this EASR.
18	Post-closure commitments will be described in the EA study report.	Completed Refer to Section 13.0 in this EASR.
19	The list of ToR commitments will be provided in the EA study report together with the way in which these commitments were addressed during the EA and the location of the information within the EA documents. The EASR will also include a list of commitments made by the City during the preparation of the EA studies and during consultation throughout the EA process. *(ToR Section 11)*	Completed Refer to Tables 13-1 and 13-2 in Section 13.0 of the EASR.
20	The City commits to developing a monitoring framework during the preparation of the EA. *(ToR Section 11.2)*	Completed Refer to Section 12.0 of this EASR.

The following table (Table 13-2) summarizes the commitments made by the City during the EA.

Table 13-2: Table of Commitments made by the City during the EA

ID	Component (*if applicable*)	Commitment (*Location of Where Commitment was Made in the EA Document Package*)	Project Phase
A	-	Implementation of all required Site effects monitoring and reporting programs. (EASR – Section 12)	Construction, operations and post-closure
B	-	The City has committed to implementing its 60% Waste Diversion Action Plan. (EASR – Section 2.3)	Operations
C	-	Forward the KCCA and EAPWSS the landfill's Annual Status Report each year. The Annual Status report contains all environmental monitoring data for the year.	Construction, operations and post-closure
D	Atmosphere	Application of dust suppressant on unpaved roads on a routine basis. (EASR –Volume IV – Appendix D.01)	Construction and operations
E	Atmosphere	Sweep/clean the roads as required to prevent mud track out on vehicles. (EASR –Volume IV – Appendix D.01)	Construction and operations
F	Atmosphere	On-site vehicles and equipment engines will meet Tier 3 emission standards and be maintained in good working order. (EASR –Volume IV – Appendix D.01)	Construction and operations
G	Atmosphere	Minimize idling of vehicles on-site. (EASR – Volume IV – Appendix D.01)	Construction and operations
H	Atmosphere	Site will operate with approx.1,500 m^2 maximum working face. (EASR – Volume IV – Appendix D.01)	Operations
I	Atmosphere	Landfill will be capped and LFG collection system installed and put into operations progressively as Phases of landfilling are completed. (EASR – Volume IV – Appendix D.01)	Operations and post-closure
J	Atmosphere	Prepare a fugitive dust management plan and complaints response protocol. (EASR – Section 12.1.1.1 and Volume IV – Appendix D.01)	Pre-construction
K	Atmosphere	Review and update the odour management plan and complaints response protocol. (EASR – Section 12.1.1.1 and Volume IV – Appendix D.01)	Pre-construction

ID	Component (*if applicable*)	Commitment (*Location of Where Commitment was Made in the EA Document Package*)	Project Phase
L	Atmosphere	Design and implement a follow-up noise monitoring program for the expanded landfill when landfill operations are within 330 m of POR R15 on Figure 5.2-4 in Section 5.2. Requirements for nearby vacant lots will be developed if a noise-sensitive building is constructed. (EASR – Section 9.1.2.3 and Volume IV – Appendix D.02)	Operations
M	Groundwater	Design horizontal landfill gas collectors for dual purpose as gas collection and leachate mound control, in the north-south direction at 30 m spacing and to a depth of 3 m into the existing waste fill over the top surface of the Phase 1 area. (EASR – Section 9.2 and Volume IV – Appendix D.03)	Pre-construction
N	Groundwater	Monitoring wells will be installed in the upper fractured clay till zones at key locations on the east and/or south sides of the Phase 1 area, with the details to be determined as part of the subsequent EPA approvals process for the expansion	Pre-construction
O	Surface Water	Design post-expansion outlet of surface water flows to corresponding pre-expansion flows to convey design storm flows. (EASR – Section 8.5.5 and Volume IV – Appendix D.04)	Pre-construction
P	Surface Water	Provide Enhanced Level Protection (80% TSS removal) as defined by the MECP SWM Planning and Design Manual (MECP, 2003). (EASR – Section 8.5.5 and Volume IV – Appendix D.04)	Pre-construction
Q	Surface Water	Engineer surface drainage from potentially contaminated areas to be contained locally within berms and discharge into the waste and eventually into the leachate management system, and separate from surface drainage from non-contaminated areas. (EASR – Section 8.5.5 and Volume IV – Appendix D.04)	Pre-construction
R	Surface Water	Design ditch sizes to convey the 1:100 year return period design storm and culverts sized to convey a 1:25 year return period design storm as per *O. Reg. 232/98*. (EASR – Section 8.5.5 and Volume IV – Appendix D.04)	Pre-construction

ID	Component (*if applicable*)	Commitment (*Location of Where Commitment was Made in the EA Document Package*)	Project Phase
S	Surface Water	Inspect ESC measures during construction on a weekly basis, and after significant rainfall events (e.g. greater than approximately 10 mm). Inspection reporting, highlighting any ESC deficiencies, will be prepared for each inspection, and kept on-Site for reference and reported to MECP, if needed. (EASR – Volume IV – Appendix D.04)	Construction
T	Biology	A detailed EMMP will be developed, including a construction monitoring program. (EASR Section 9.4 and Volume IV Appendix D.05)	Pre-construction
U	Biology	Conduct all vegetation clearing activities outside the breeding bird season. (EASR Section 9.4 and Volume IV Appendix D.05)	Construction and operations
V	Biology	No vegetation clearing between April 1 to August 31 unless a nest search is completed by a qualified ecologist. (EASR Section 9.4 and Volume IV Appendix D.05)	Construction and operations
W	Biology	Prepare and implement a Species at Risk and Wildlife Observation Protocol to outline the steps to take in the event of an encounter with wildlife, including SAR, during the construction stage. (EASR Section 9.4 and Volume IV Appendix D.05)	Pre-construction, construction, and operations
X	Biology	Consult MECP to determine appropriate compensation for habitat loss of SAR grassland birds, specifically for Bobolink and Eastern Meadowlark, as regulated under the ESA (*O. Reg. 242/08*). (EASR Section 9.4 and Volume IV Appendix D.05)	Pre-construction
Y	Biology	Progressively re-vegetate as landfilling is completed in the expansion phases. Plantings should include native species that are known to occur within the region and may include compensation plantings as determined through consultation with the MECP for Bobolink and Eastern Meadowlark habitat compensation. (EASR Section 9.4 and Volume IV Appendix D.05)	Operations
Z	Archaeology	EMMP (EASR Section 9.7 and Volume IV Appendix D.08)	Construction and operations

ID	Component (*if applicable*)	Commitment (*Location of Where Commitment was Made in the EA Document Package*)	Project Phase
AA	Archaeology	Install a temporary fencing barrier to clearly delineate a 10-metre protective buffer around White Oak 1 site (AfHh-926). The protected area and the location of the temporary barrier will be shown on all contract drawings and be labeled as a “no-go” zone where construction activities will not be permitted. (EASR Section 9.7 and Volume IV Appendix D.08)	Construction and operations
AB	Archaeology	Provide instructions to all construction staff to stay outside of the 10 m protected area and ensure appropriate monitoring by a licensed archaeologist during any construction which takes place within. (EASR Section 9.7 and Volume IV Appendix D.08)	Construction and operations
AC	Archaeology	Implement a construction monitoring program whereby a licensed archaeologist would be present to monitor any construction activities (excavation or stockpile placement) that extend to the edge of the protected area, if these activities occur. (EASR Section 9.7 and Volume IV Appendix D.08)	Construction and operations
AD	Archaeology	Implement a post-construction monitoring program on the effectiveness of the monitoring and avoidance strategy for reporting to MHSTCI by the licensed consultant archaeologist, if construction monitoring occurs. (EASR Section 9.7 and Volume IV Appendix D.08)	Operations

ID	Component (*if applicable*)	Commitment (*Location of Where Commitment was Made in the EA Document Package*)	Project Phase
AE	Archaeology	If archaeological resources are unexpectedly encountered, all activities impacting archaeological resources must cease immediately, MHSTCI should be notified, and a licensed archaeologist is to be engaged to carry out an archaeological assessment in accordance with the Ontario Heritage Act and the Standards and Guidelines for Consultant Archaeologists. If human remains are encountered, all activities must cease immediately and the local police as well as the Registrar, Burials of the Ministry of Government and Consumer Services (416-326-8800) must be contacted. In situations where human remains are associated with archaeological resources, MHSTCI should also be notified to ensure that the site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act. (Volume IV Appendix D.08)	Construction
AF	Land Use	Confirm if the intended uses of the Site Area comply with existing Zoning By-law permissions. (EASR Sections 9.5.1.4 and 13.2 and Volume IV Appendix D.06)	Pre-construction
AG	Visual	Waste will be placed initially to build a berm along the south side of the landfill's waste disposal area and will be covered with final cover soil and seeded to establish vegetation. This berm will screen the view of subsequent filling operations north of the berm from off-site vantage points to the south. The south side perimeter waste berm would be raised sequentially and filled in behind until the peak elevation is reached. (EASR Section 8.1.1 and 9.10.3 and Volume IV D.11)	Operations
AH	Visual	Construct new berms with tree plantings along the new property boundary (White Oak Road northward to Scotland Drive, Scotland Drive). (EASR Section 9.9 and Volume IV Appendix D.10)	Operations
AI	Visual	The City will seek feedback on appropriate roadside view-mitigation measures from area residents when it updates its CEMMP. (EASR Section 9.10.3)	Pre-construction

ID	Component (*if applicable*)	Commitment (*Location of Where Commitment was Made in the EA Document Package*)	Project Phase
AJ	Visual	City will seek feedback from the public on possible improvements to the CEMMP and on appropriate visual screening measures for affected individual residential properties. (EASR Section 9.10.3)	Pre-construction
AK	Climate Change	Include the possibility of increased leachate generation from climate change into the design of the proposed replacement perimeter LCS for the Phase 1 area of the landfill, as well as the design of the proposed system of temporary leachate storage on the W12A Landfill site during storm events of significant magnitude that could result in discharge of the mixed leachate/sewage to Dingman Creek or the Thames River if the WWTP is in a by-pass situation temporarily. (EASR Section 10.1)	Pre-construction
AL	Climate Change	Include the possibility of increased leachate generation from climate change in the design of the replacement for the main leachate pump station on the W12A Landfill site. (EASR Section 10.1)	Pre-construction

13.1 Potential Project Modifications

In accordance with section 4.2.5 of the MECP Code of Practice for Preparing and Reviewing Environmental Assessments in Ontario, January 2014, and subject to O. Reg. 101/07, minor modifications to the undertaking may be made following approval, subject to consultation with the MECP Environmental Assessment Branch to confirm any requirements with respect to such modifications under the *Environmental Assessment Act*.

13.2 Other Approvals

The following section describes the additional approvals that will or may be required for the expansion of the W12A Landfill site, in addition to the EA approval process.

Environmental Compliance Approval Amendments

The W12A Landfill expansion will require approval under the *Environmental Protection Act* (EPA) and the *Ontario Water Resources Act* (OWRA).

The EPA, Section 27 stipulates that *"…no person shall use, operate, establish, alter, enlarge or extend a waste management system or a waste disposal site except under and in accordance with an environmental compliance approval [ECA]*." The application for the waste ECA under Part 5 of the EPA must be supported by a detailed report that complies with *O. Reg. 232/98* Landfilling Sites and describes the proposed design and operations of the expanded W12A Landfill site. In addition, the site will require an air and noise ECA under Part 9 of the EPA.

The OWRA, Section 53 states *"…no person shall use, operate, establish, alter, extend or replace new or existing sewage works except under and in accordance with an environmental compliance approval."* Sewage works in this context refer to collecting, transmitting, treating and/or disposing of stormwater. An ECA amendment from the MECP for 'sewage works' will be required for the proposed modifications to the stormwater management works associated with the expanded landfill. The application must be supported by a document assessing potential impacts to the environment and relevant environmental standards that must be met.

Ontario Heritage Act

The expansion of the W12A Landfill will require review letters from the Ministry of Heritage, Sport, Tourism and Culture Industries for the archaeological assessment reports indicating that the reports have been found to be compliant with the Standards and Guidelines for Consultant Archaeologists and entered into the Ontario Public Register of Archaeological Reports. Construction should not proceed until such letters have been received regarding archaeological assessment reports that recommend no further concern throughout the footprint of the landfill expansion..

Planning Act
It is expected that re-zoning of the lands required for the expansion of the on-site buffer may be required. Zoning review will occur after EA.

Approvals Related to the Natural Environment
Based on the layout, design and operation of the proposed expansion, approvals related to the natural environment may be required under several pieces of legislation as described below.

Endangered Species Act (Provincial)
The confirmed presence and breeding of two Species at Risk birds, Bobolink and Eastern Meadowlark, in the cultural meadow habitats (Patch P02) within the proposed expansion area of the W12A Landfill will require review and determination of permitting requirements under the *Endangered Species Act* (ESA). Direct loss and/or damage of Bobolink and Eastern Meadowlark habitat is likely to occur during site preparation (e.g., vegetation stripping and site grading), construction of temporary stockpile areas, transportation of equipment and materials, and excavation. It is possible that mitigation can be put into place to avoid or minimize the effects to the species. Consultation with the MECP will be required to determine whether the proposed works require a Notice of Activity or Overall Benefit Permit.

Planning Act – Provincial Policy Statement (Provincial)
The presence of Significant Wildlife Habitat (SWH) within and adjacent to the W12A Landfill expansion area triggers the requirement for an Environmental Impact Study (EIS) under the *Planning Act* vis a vis the Provincial Policy Statement (PPS). The requirement for an EIS as it relates to SWH may be met by the similar requirement under municipal policies, as noted below. The natural environment studies completed as part of this EA area considered to meet the requirements for an EIS under the PPS.

Conservation Authorities Act (Provincial)
While the proposed W12A Landfill expansion area does not directly overlap with the Regulation Limits for the UTRCA and the KCCA, it does immediately abut limits for both authorities. It will, therefore, be prudent to engage both the UTRCA and KCCA in discussions to determine the potential requirements for a Section 28 Permit under the Ontario Regulation 157/06 (UTRCA) and Ontario Regulation 181/06 (KCCA) under the *Conservation Authorities Act*.

The London Plan (Municipal)
The London Plan (2016) requires an EIS for any proposed works involving development and site alteration within or adjacent to the Natural Heritage System, such that they will only be permitted after ecological functions have been evaluated and it is demonstrated that there will be no negative impacts to the Natural Heritage System. While not identified on The London Plan Natural Heritage Features mapping, the presence of SAR Habitat and SWH within and adjacent to the proposed landfill expansion area triggers the requirement for an EIS. As noted above, the preparation of an EIS can meet the requirements under the Provincial Policy Statement (2020) and The London Plan. The requirement for any additional work to meet the requirements for an EIS will be determined in consultation with the City of London.

14.0 References

AECOM. 2011. Design Brief- W12A Leachate Pumping Station and Forcemain. Prepared for the City of London.

Anderson, Jacob. 2009. *The Lawson Site: An Early Sixteenth Century Neutral Iroquoian Fortress*. Museum of Ontario Archaeology, Special Publication No. 2. London.

Aquafor Beech Ltd et al. (Aquafor Beech). 1995. *Kettle and Dodds Creek Subwatershed Study*. May 1995.

Archaeologix Inc. 2005. *Archaeological & Built Heritage Assessment (Stage 1), W12A Landfill Area Study, City of London, County of Middlesex, Ontario.* Report on file with the Ontario Ministry of Heritage, Sport, Tourism and Culture Industries, Toronto.

Bird Studies Canada, Environment Canada's Canadian Wildlife Service, Ontario Nature, Ontario Field Ornithologists and Ontario Ministry of Natural Resources. 2006. Ontario Breeding Bird Atlas Website. http://www.birdsontario.org/atlas/index.jsp

Brock, Daniel and Muriel Moon. 1972. *The History of the County of Middlesex, Canada. Mika Studios, Belleville, Ontario*. Revised edition to the Goodspeed and Goodspeed Reference: http://www.ourroots.ca/toc.aspx?id=4506&qryID=03dda9cb-f088-4a56-b36c-da6b5ca9d368

Brunger, Alan G. 2019. “Talbot, Thomas” in *Dictionary of Canadian Biography, Vol. 8*, University of Toronto/Université Laval. Electronic resource: http://www.biographi.ca/en/bio/talbot_thomas_8E.html. Last accessed August 8, 2019.

Canadian Council of Ministers of the Environment (CCME). 2014. *Canada-Wide Standards for Particulate Matter and Ozone, 2012 Final Report.*

Carman, Richard A., Buehler, David, Mikesell, Stephen and Carolyn L. Searls. 2012. Current Practices to Address Construction Vibration and Potential Effects to Historic Buildings Adjacent to Transportation Projects. Wilson, Ihrig and Associates, ICF International, and Simpson, Gumpertz and Heger, Incorporated for the American Association of State Highway and Transportation Officials (AASHTO), Washington, D.C.

Chapman, L.J, and D.F. Putnam.1984. The Physiography of Southern Ontario. Ontario Ministry of Natural Resources. 270 pp.

City of London 2020. W12A Landfill Annual Status Report, January 1 to December 31, 2019. File dated: March 2020.

City of London. March 2020a. Greenway Wastewater Treatment Centre 2019 Annual Report.

City of London. March 2020b. W12A Landfill Annual Status Report January 1 to December 31, 2019. Prepared by the City of London.

City of London. 2019. Environmental Assessment of the Proposed W12A Landfill Expansion - 2019 Updated Residual Waste Projections & Landfill Capacity Assessment.

City of London. 2019a. Design Specifications & Requirements Manual.

City of London. 2019b. The London Plan, Consolidated November 13, 2019 (https://london.ca/sites/default/files/The-London-Plan-Policies-Effect-Nov18-2019.pdf).

City of London. 2016. The London Plan. Available at: https://www.london.ca/business/Planning-Development/Official-Plan/Pages/The-London-Plan.aspx

City of London. 2015. Environmental Screening Process W12A Landfill Service Area Amendment Draft Background Document.

City of London. October. Open Data Catalogue (https://www.london.ca/city-hall/open-data/Pages/Open-Data-Data-Catalogue.aspx).

Comcor Environmental Limited (Comcor). 2009. *Ontario Regulation 347 Exemption and Design Report*. June 23, 2009.

Delcan Corporation (Delcan). 2005. *Dingman Creek Subwatershed Study Update*. April 2005.

Dillon Consulting Limited. 2000. *City of London Hydrogeological Investigation for the W12A Landfill*, in association with the University of Western Ontario, December 2000, 00-7849.

Dillon Consulting Limited. 2015. *Review of Groundwater Quality Upgradient (North) of W12A Landfill,* Letter Report dated February 6, 2015, 14-9782.

Dillon Consulting Limited. 2005. *W12A Landfill Area Plan Study, Surface Water Background Study*, Final Report, December 5, 2005, 05-4556.

Dillon Consulting. 2012. Hydraulic Evaluation of Landfill Performance (HELP) Modeling for the City of London.

Dodd, Christine F., Dana R. Poulton, Paul A. Lennox, David G. Smith and Gary A. Warrick. 1990. The Middle Ontario Iroquoian Stage. In: *The Archaeology of Southern Ontario to A.D. 1650*. Occasional Publication of the London Chapter, Ontario Archaeological Society, Number 5: 321-360.

Earth Tech Canada Inc. (Earth Tech). 2002. *Stormwater Management Master Plan, W12A Landfill, City of London*. January 2002.

Ellis, Chris J., Ian T. Kenyon and Michael W. Spence. 1990. The Archaic. In: *The Archaeology of Southern Ontario to A.D. 1650*. Occasional Publication of the London Chapter, Ontario Archaeological Society, Number 5: 65-124.

Environment Canada – Canadian Wildlife Service (EC-CWS). 2009. Forest Bird Monitoring Program Survey Instructions & Codes. May 2009 Edition.

Environment and Climate Change Canada (ECCC). 2019. National Air Pollution Surveillance Program (NAPS). http://www.ec.gc.ca/rnspa-naps/

ECCC. 2019a. 2019 Canada's Greenhouse Gas Quantification Requirements. Available: http://publications.gc.ca/collections/collection_2020/eccc/En81-28-2019-eng.pdf

Ferris, Neal. 2009. *The Archaeology of Native-Lived Colonialism: Challenging History in the Great Lakes*. University of Arizona Press, Tucson.

Fox, William A.1990. The Middle Woodland to Late Woodland Transition. In: *The Archaeology of Southern Ontario to A.D. 1650*. Occasional Publication of the London Chapter, Ontario Archaeological Society, Number 5: 171-188.

Gentilcore, R. Louis, and Kate Donkin. 1973. *Land Surveys of Southern Ontario: An Introduction and Index to the Field Notebooks of the Ontario Land Surveyors 1784-1859*. Cartographica, Monograph No. 8. Toronto: BV Gutsell, Department of Geography, York University.

Golder Associates Ltd. (Golder). 2010. *Stage 1 and 2 Archaeological Assessment, Proposed Regional Materials Recovery Facility, 3438 and 3290 Manning Drive, City of London, Middlesex County, Ontario.* Report on file with the Ministry of Heritage, Sport, Tourism and Culture Industries, Toronto.

Golder. 2017. *Stage 3 Site Specific Assessment, 1687 Wilton Grove Road, The Baker Site (AfHg-3), Part of Lot 8, Concession 3, Former Township of Westminster, Now City of London, Middlesex County, Ontario.* Report on file with the Ministry of Heritage, Sport, Tourism and Culture Industries, Toronto.

Golder. 2018a. *Stage 1-2 Archaeological Assessment, W12A Landfill Site, Cells 9 and 10, Part of Lot 20, Concession 6, Former Township of Westminster, Middlesex County, Now City of London, Ontario.* Report on file with the Ministry of Heritage, Sport, Tourism and Culture Industries, Toronto.

Golder. 2018b. *Stage 3 Archaeological Assessment, White Oak 1 Site (AfHh-916), W12A Landfill Site, Potential Landfill Expansion Area, Part of Lot 20, Concession 6, Former Township of Westminster, Middlesex County, Now City of London, Ontario.* Report on file with the Ministry of Heritage, Sport, Tourism and Culture Industries, Toronto.

Golder. 2020. *Stage 2 Archaeological Assessment, W12A Landfill Expansion Environmental Assessment, Part of Lots 17, 18, 19, and 20, Concession 6, Former*

Township of Westminster, Middlesex County, Now City of London, Ontario. Report on file with the Ministry of Heritage, Sport, Tourism and Culture Industries, Toronto.

Government of Canada. 2019. *Impact Assessment Act*. S.C. 2019, c.28. s 1.

Government of Canada. 2012. Technical Guide: Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act*, March 2018, Version 2.

Government of Canada. 1999. *Canadian Environmental Protection Act*, 1999 (S.C. 1999, c. 33). Last Amended October 2020.

Government of Canada. 1994. *Migratory Birds Convention Act*, 1994 (S.C. 1994, c. 22). Last Amended December 2017.

Government of Ontario (Ontario). 2020. *Ontario Regulation 390/18:* Greenhouse gas Emissions: Quantification, Reporting and Verification. Last amended May 2020.

Government of Ontario (Ontario). 2017a. *Environmental Protection Act,* R.S.O. 1990, Chapter E.19. Last amended November 2017.

Government of Ontario (Ontario). 2017b. *Ontario Water Resources Act,* R.S.O. 1990, Chapter O.40. Last amended December 2017.

Government of Ontario (Ontario). (2007). *Ontario Regulation 101/07: Waste Management Projects. Environmental Assessment Act*.

Government of Ontario (Ontario). 2014. The Archaeology of Rural Historical Farmsteads: A DRAFT Technical Bulletin for Consultant Archaeologists

Hagerty. T.P., and M.S. Kingston. 1992. The soils of Middlesex County. Ontario Centre for Soil Resource Evaluation Report No. 56. Ontario Ministry of Agriculture and Food, Resource Management Branch, Guelph, ON, Canada.

IBI Group. 2009. Proposed New Land Uses Adjacent to W12A Landfill: Traffic Impact Assessment

IBI Group. 2008. W12A Landfill Area Plan (for the City of London).

Intergovernmental Panel on Climate Change (IPCC). 2012. Climate Change 2007: The Physical Science Basis, Working Group 1 contribution to the IPCC Fourth Assessment Report – Errata http://www.ipcc.ch/report/ar4/wg1/.

Keron, J. 2016. *The Baker Site (AfHg-3): A Fluted Point, Probably Gainey Phase, Site in the City of London.* Draft report prepared for Golder Associates Ltd.

Keron, J. 1979. Site Record Form for AfHg-3, Archaeological Survey of Canada. On file with the Ontario Ministry of Tourism, Culture, and Sport, Toronto.

Lennox, Paul A. and William R. Fitzgerald. 1990. The Culture History and Archaeology of the Neutral Iroquoians. In: *The Archaeology of Southern Ontario to A.D. 1650*. Occasional Publication of the London Chapter, Ontario Archaeological Society, Number 5: 405-456.

MacLaren Limited. (1970). Report on Solid Waste Disposal for the City of London.

MacLeod, Malcolm. 1972. Fortress Ontario or Forlorn Hope? Simcoe and the Defence of Upper Canada. Canadian Historical Review 53(2): 149-78.

Marsh Monitoring Program Participant's Handbook Surveying Amphibians. 2008 Edition. 20 Pages. Published by Bird Studies Canada in cooperation with Environment Canada and the U.S Environmental Protection Agency. February 2008.

Meligrana, John F. 2000. The Politics of Municipal Annexation: The Case of the City of London's Territorial Ambitions during the 1950s and 1960s. *Urban History Review.* Vol. 29 (1): 3-20.

Middlesex County. 2014. Middlesex Natural Heritage Systems Study: A study to identify natural heritage systems in Middlesex County. Project management by Upper Thames River

Conservation Authority in cooperation with Middlesex County Conservation Authorities.

Ministry of Agriculture, Food and Rural Affairs (OMAFRA). 2018. *Guidance Document for Agricultural Impact Assessments* (DRAFT released March 2018)

OMAFRA. 2016. Agricultural Information Atlas: Constructed Drains. Available at: http://www.omafra.gov.on.ca/english/landuse/gis/condrain.htm

OMAFRA. 2016a. Use of Soil and Canada Land Inventory (CLI) Information for Agricultural Land Use Planning in Ontario. Available at: http://www.omafra.gov.on.ca/english/landuse/gis/soil_data/nts.htm

OMAFRA. 2017. Minimum Distance Separation (MDS): Overview and the MDS Document – Publication 853.

Ontario Ministry of Environment (MOE). 1998. Noise Guidelines for Landfill Sites (Draft).

MOE. 1995. Ontario Guideline D-1, Land Use Compatibility. Available: https://www.ontario.ca/page/d-1-land-use-and-compatibility

MOE. 1995a. Ontario Guideline D-4, Land Use On or Near Landfills and Dumps. Available: https://www.ontario.ca/page/d-4-land-use-or-near-landfills-and-dumps

Ministry of Environment and Energy (MOEE). 1994. Water Management: Policies, Guidelines, Provincial Water Quality Objectives. Available: https://atrium.lib.uoguelph.ca/xmlui/bitstream/handle/10214/15816/OME_water_qual_object94.pdf?sequence=1&isAllowed=y

Ministry of Environment and Climate Change (MOECC). 2017. Guide: Consideration of Climate Change in Environmental Assessment in Ontario. December 2017.

Ministry of the Environment and Climate Change (MOECC). (2014) Consultation in Ontario's Environmental Assessment Process. 2014

MOECC. 1990. *Environmental Protection Act*. Available: https://www.ontario.ca/laws/statute/90e19. Last updated: July 2020

Ministry of the Environment, Conservation and Parks (MECP) (2020). Ambient Air Quality Criteria. Technical Assessment and Standards Development Branch, Human Toxicology and Air Standards Section.

MECP. 2020a. Strategy for a Waste-Free Ontario: Building the Circular Economy (2017, updated 2020)

MECP. 2019. Discussion paper on reducing litter and waste in our communities (updated 2021).

MECP. 2018. Food and Organic Waste Policy Statement.

MECP. 2018a. A Made-in-Ontario Environment Plan.

MECP. 2003. *Stormwater Management Planning and Design Manual*. March 2003.

MECP. 1998. *Noise Guidelines for Landfill Sites*. October 1998. Queen's Printer for Ontario: Toronto, Ontario

MECP. 1998a. *Ontario Regulation 232/98* made under Part V of the *Environmental Protection Act*.

MECP. 1994. Guideline B-7: Incorporation of the Reasonable Use Concept into MOE Groundwater Management, (Formerly Policy 15-08): MOE Program Development Branch: Ontario Ministry of Environment, Conservation and Parks, April 1994, 8p.

MECP. Air Resources Branch. 1992. *Interim Guide to Estimate and Assess Landfill Air Impacts.* October 1992.

Ministry of Environment and Climate Change (MOECC). 2013. Environmental Noise Guideline - Stationary and Transportation Sources - Approval and Planning (NPC-300).

MOECC. 2014. Ontario MOECC Code of Practice for Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario. January 2014.

Ministry of Municipal Affairs and Housing (MMAH). 2020. Provincial Policy Statement, 2020. Available at: https://files.ontario.ca/mmah-provincial-policy-statement-2020-accessible-final-en-2020-02-14.pdf

MNRF. 2017. Best Management Practices for the Protection, Creation and Maintenance of Bank Swallow Habitat in Ontario.

Ministry of Transportation (MTO). 2016. Provincial Highways Traffic Volumes 2016.

MMM Group. 2015. Wonderland Road South Municipal Class Environmental Assessment: Environmental Study Report.

Government of Ontario (Ontario). 1998. *Ontario Regulation 232/98 Landfilling Sites*. Last Updated: October 2011. *Environmental Protection Act.*

Government of Ontario. 1990. *Environmental Assessment Act* (EAA). Electronic Document: https://www.ontario.ca/laws/statute/90e18. Last updated: July 2020.

Oldham, M.J., W.D. Bakowsky and D.A. Sutherland. 1995. Floristic quality assessment system for Southern Ontario. Ontario Ministry of Natural Resources, Natural Heritage Information Centre. Peterborough, Ontario.

Ontario Breeding Bird Atlas. 2001. Guide for Participants. Atlas Management Board, Federation of Ontario Naturalists, Don Mills.

Ontario. 1990b. *Ontario Heritage Act,* Government of Ontario. 1990. *Ontario Heritage Act, R.S.O. 1990, c. O.18.* Accessed Online: https://www.ontario.ca/laws/statute/90o18

OMAFRA. 2016. Agricultural Information Atlas: Constructed Drains. Available at: http://www.omafra.gov.on.ca/english/landuse/gis/condrain.htm

OMAFRA. 2016a. Use of Soil and Canada Land Inventory (CLI) Information for Agricultural Land Use Planning in Ontario. Available at: http://www.omafra.gov.on.ca/english/landuse/gis/soil_data/nts.htm

Ontario Ministry of Natural Resources and Forestry (OMNRF). 2017. Survey Protocol for Species at Risk Bats within Treed Habitats. Ministry of Natural Resources and Forestry - Guelph District. April 2017.

Ontario Ministry of Natural Resources and Forestry (OMNRF). 2015. Significant Wildlife Habitat Criteria Schedules for Ecoregion 7E. January 2015.

Ontario Ministry of Natural Resources and Forestry (OMNRF). 2015a. General Habitat Description for the Bank Swallow (*Riparia riparia*). July 2015. Available on the internet at: https://ossga.com/multimedia/0/bank_swallow_ghd_en.pdf

Ontario Ministry of Natural Resources and Forestry (OMNRF). 2015b. General Habitat Description for the Barn Swallow (*Hirundo rustica*). 2015. Available on the internet at: https://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_ghd_brn_swllw_en.pdf

Ontario Ministry of Natural Resources and Forestry (OMNRF). 2014. Species at Risk in Ontario. Accessed March 2019 at: https://www.ontario.ca/environment-and-energy/species-risk-ontario-list

Parsons Corporation. 2016. Dingman Creek Subwatershed Study, Background Study (DRAFT). File dated: February 2016.

Rowe, R.K., Booker, J.R. and Fraser, M.J. 1994. POLLUTE (Version 7); Distributed by GAEA Environmental Engineering Ltd.

Schmalz, Peter S. 1991. *The Ojibwa of Southern Ontario*. University of Toronto Press, Toronto.

Smith, Wm. H. 1846. *Smith's Canadian Gazetteer*. H. & W. Rowsell, Toronto.

Spence, Michael W., Robert H. Pihl and Carl Murphy. 1990. Cultural Complexes of the Early and Middle Woodland Periods. In: The Archaeology of Southern Ontario to A.D. 1650. Occasional Publication of the London Chapter, Ontario Archaeological Society, Number 5: 15-170.

Statistics Canada (StatsCan). 2016. Census of Agriculture: Farms classified by farm type; Table 32-10-0403-01 (formerly Cansim 004-0200). Available at: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210040301

Tourism London. 2019. *A Brief History of London, Ontario*. Tourism London, Ontario, Canada. Electronic resource: https://www.londontourism.ca/A-Brief-History-of-London-Ontario. Last accessed: April 1, 2019.

Troughton, Michael & Cathy Quinlan. 2009. *The Thames River Watershed: A Heritage Landscape Guide*. Carolinian Canada Coalition and Thames Canadian Heritage River Committee, London, Ontario.

United States Environmental Protection Agency (US EPA). 2010. Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling – Compression Ignition NR-009d

US EPA. 2005. *Landfill Gas Emissions Model (LandGEM) Version 3.02 User's Guide*. May 2005.

US EPA. 1997. The Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3.07 (1 November 1997), Developed by Environmental Laboratory, USAE Waterways Experiment Station for U.S. Environmental Protection Agency Risk Reduction Engineering Laboratory, Cincinnati, OH.

Williamson, R. 1990. The Early Iroquoian Period of Southern Ontario. In *The Archaeology of Southern Ontario to A.D. 1650*. Occasional Publication of the London Chapter, Ontario Archaeological Society, Number 5: 291-320.