Biggars Lane Landfill Expansion
Environmental Assessment Report

Volume V – Report on Phase 2 Activities

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REPORT ON PHASE 2 ACTIVITIES

Environmental Assessment to Expand the Biggars Lane Landfill
County of Brant

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by the County of Brant (County) to carry out the Phase 2 activities associated with the individual environmental assessment (EA) to secure additional landfill disposal capacity for the County of Brant by expansion of the Biggars Lane landfill site. Phase 1 of the project was the preparation of the Terms of Reference (ToR) (Stantec Consulting Ltd., March 2014), which was approved by the Minister of Environment and Climate Change on May 15, 2016. Phase 2 consisted of activities carried out in accordance with the approved ToR, which comprise the initial portion of the EA, as listed below. The results of these Phase 2 activities provide the basis to proceed with Phase 3 of the project, which consists of completion of the EA and obtaining EA Act approval for the landfill expansion.

Phase 2 consisted of five tasks. This Phase 2 report provides the results and documentation for each of these tasks, with the intent that they can be used in the Phase 3 activities and be modified (as required) to become part of the EA Study Report preparation and submission. The documentation associated with each of these tasks is organized within this report as described below:

- Appendix A - Alternative Methods of Landfill Expansion, consisting of a description of the following in one memorandum:

  1) The rationale for development of the alternative methods, including a predictive assessment of groundwater compliance based on currently available subsurface and hydrogeologic information to determine possible engineered leachate containment and management requirements to demonstrate expanded landfill compliance with the Reasonable Use Guideline (Attachment A-1);

  2) A description of four landfill expansion alternatives, together with plan and cross-section views of each alternative; and,

  3) A description of four leachate management and treatment options, if required depending on the landfill expansion alternative identified as preferred overall.

- Appendix B – Comparative Evaluation Criteria:

  1) Table B-1 - Comparative evaluation criteria to be used to compare the landfill expansion alternatives and identify the preferred alternative, based on the preliminary criteria described in the approved ToR; and,

  2) Table B-2 - Comparative evaluation criteria to be used to compare leachate management and treatment options and identify the preferred option, if required.

- Appendix C - Technical work plans for each of the environmental assessment study components set out in the approved ToR and for leachate management option evaluation (if required), describing the activities to be undertaken in Phase 3 (Attachments C-1 to C-10).

- Appendix D – A Consultation Record of events and activities during Phase 2, consisting of the stakeholder list, the Notice of Commencement and a Summary of Public Information Centre #3, including supporting materials in attachments.
Appendix E – Commitment and Monitoring Strategy/Framework, listing the commitments made by the County during the ToR Phase 1 and to date in the EA Phase 2, and describing the EA monitoring requirements to be fulfilled after EA approval.

- Appendix F – The Phase 2 report and each of the above documents are provided on a CD in PDF and WORD or EXCEL format; the electronic files of the four landfill expansion alternative methods are provided in AutoCAD Civil 3D on the CD.

We trust that provides the required information and documentation on the Phase 2 tasks to serve as the basis to proceed with Phase 3 of the EA. Should there be any questions, please contact us.

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APPENDIX A

Alternative Methods of Landfill Expansion
This memo (which is intended to be subsequently incorporated, with minor modifications as required, to form a chapter of the EA study report) presents the rationale for and description of the ‘Alternative Methods’ for the Biggars Lane landfill Expansion Environmental Assessment (EA). Two types of ‘Alternative Methods’ will be described:

- Alternative Methods of landfill expansion; and,
- Alternative Methods of leachate management.

1.0 RATIONALE FOR AND DESCRIPTION OF ALTERNATIVE METHODS

The approved Terms of Reference (TOR) describes the undertaking as the provision of additional disposal capacity for the County of Brant by expansion of the Biggars Lane landfill site. Section 6.3 of the approved TOR also describes that the ‘Alternative Methods’ to establish additional landfill disposal capacity will be determined during the EA. ‘Alternative Methods’ are different ways that the required additional 1.13 million cubic metres of airspace can be developed within the County-owned property at the Biggars Lane landfill site.

The approved TOR indicates that there are two categories under which Alternative Methods can be considered: “how” and “where”.

“How” refers to the design approach for the expansion, which can range from a natural attenuation design (one that relies on the natural subsurface environment to enable the landfill to operate in compliance with provincial requirements for leachate effects on off-Site groundwater quality and surface water quality), to a site-specific engineered leachate management design, to one of the two generic engineered leachate management designs provided in O.Reg. 232/98 Landfill Standards.

“Where” refers to the physical location and configuration of the expansion, which could range from a vertical expansion above the existing landfill footprint, to a combination of vertical and horizontal expansions of the existing footprint, to a new separate landfill footprint within the County-owned property.
To systematically assess the possible range of “how” and “where” combinations, and thereby determine a number of alternative methods of landfill expansion for subsequent comparison and identification of the overall preferred expansion method, key primary factors and constraints specifically related to the Biggars Land landfill property were applied.

The existing Biggars Lane landfill operates as a natural attenuation landfill. A determination of whether or not the proposed expansion can be shown to perform successfully relying on natural attenuation is a primary factor in determining the alternative methods. If a natural attenuation design is not indicated to be possible, then an engineered design approach will need to be adopted. This engineered design approach would include a low permeability bottom liner and a leachate collection system, which will also necessitate removal of the collected leachate for subsequent treatment prior to its release to the natural environment. This approach would also require the EA to evaluate leachate management and treatment alternatives to demonstrate that such an expansion alternative approach is viable, and identify the preferred method of leachate management and treatment.

1.1 Assessment of Required Design Approach (“How”)

To assess whether or not a proposed expansion can be shown to be expected to perform successfully relying on natural attenuation, i.e., without an engineered base containment liner/leachate collection system and/or an engineered low permeability final cover, a predictive assessment of groundwater compliance was carried out. The predictive assessment was based on a conceptual model of the subsurface and hydrogeological setting at the Biggars Lane landfill property using available investigations and data [Attachment A], and the groundwater and surface water quality data available from ongoing annual Site monitoring reports [Stantec, 2014]. The results of this predictive technical assessment are provided in Attachment A. The groundwater and surface water monitoring network is shown on Figure A-1 in Attachment A.

The subsurface conditions underlying the property are indicated to consist of a variable upper layer of moderately permeable sandy to clayey silt containing zones of sand to silty sand and having a total thickness depth ranging from about 6 to 23 metres (typically about 20 metres thick). This is underlain by 20 to 30 metres of low permeability silty clay soil and then bedrock. The potential migration of leachate in groundwater away from the disposal area will occur in the upper sand and sandy silt deposit. The silty clay is an aquitard and provides natural protection of the underlying bedrock aquifer from leachate effects. The groundwater table at the Site is at shallow depth below ground surface.

To carry out the predictive technical assessment, a preliminary expansion configuration consisting of an expansion by means of the addition of a separate disposal footprint to the west of the current landfill footprint was developed as described in Attachment A and shown on Figures A-2 and A-3. This approach allowed a calibration to the current Site groundwater physical flow and quality conditions in the sand and silty sand to first be made, and then using this calibration a predictive assessment of the expected performance of the proposed expansion configuration to be made without superimposing (overlapping with) the effects of leachate from the existing landfill on groundwater quality. The preliminary expansion configuration was designed to be favourable to natural attenuation by placing the footprint as far upgradient (north) in the County-owned property as possible (since the direction of groundwater flow is known to be generally southward). This provides as much distance as possible between the landfill footprint and the south property boundary for natural attenuation mechanisms in the subsurface to reduce the leachate effects on groundwater quality to that allowable under MOECC Reasonable Use Guideline B-7 (MOE, 1994). In view of the high groundwater table at the Site, as inferred from the available groundwater level monitoring information, the preliminary landfill expansion configuration is expected to be constrained to a limited depth of excavation below ground surface. Using the requirements of O.Reg. 232/98 for side slopes (4 horizontal: 1 vertical) and top area grades (5% minimum slope), this results in a 14.2 hectare footprint to achieve 1.13 million cubic metres of airspace. For the preliminary configuration, a buffer width of 100 m
between the disposal footprint and the north, east and west property boundaries was provided as described in O.Reg. 232/98 (noting that the buffer can be made narrower with justification but cannot be less than 30 metres). This resulted in a separation distance of 230 metres between the south edge of the disposal area and the south property boundary for the leachate effects on groundwater to be naturally attenuated.

The predictive calculations used chloride as the primary leachate indicator parameter, since it is a main leachate characteristic as set out in the O.Reg. 232/98 Landfill Standards and travels at approximately the same rate as groundwater flow. The predictive calculations were used to determine the peak chloride concentrations at the downgradient (south) property boundary (shown on Figure A-2 as 230 m downgradient from the fill area) for the landfill expansion. Results were compared to the Reasonable Use Performance Objectives (RUPO) for the Site (as described under Guideline B-7). Initial calculations showed the expansion as non-compliant when relying completely on natural attenuation at the 230 metre separation distance to the south property boundary, so the separation was increased to 280 metres, thereby moving the expansion footprint 50 metres further north than shown on Figure A-2 and maintaining a buffer width of 50 metres. The reduction of the buffer width remaining on the north side of the expansion from 100 metres to 50 metres is considered approvable for the conditions at this Site in terms of the requirements of O.Reg. 232/98.

Assuming this increased 280 metre separation distance, the predictive calculations were repeated for a natural attenuation approach with no base liner and using a permeable soil final cover. As shown on Figure A-1.7 in Attachment A, the predictive simulations again indicate non-compliance with Guideline B-7 for all conditions simulated.

The same analysis was repeated for a site-specific Engineered Cover design where a low permeability final cover would be placed over the waste progressively as filling in areas of the landfill is completed to the final top of waste contours, thereby significantly limiting infiltration of precipitation into the waste and reducing the generation of leachate available to enter the groundwater flow system. The predictive results shown on Figure A-1.6 from Attachment A indicate that chloride concentrations generally meet the RUPO if a low permeability cover is applied. Sensitivity analysis completed on the calculations indicates that under the lower recharge and lowest hydraulic conductivity condition, calculated chloride concentrations exceed RUPO by 1.3%, although all other sensitivity analyses met the RUPO.

Based on these results, without providing leachate containment with a base liner and leachate collection system, the landfill expansion is technically indicated to comply with Guideline B-7 if a low permeability cover is applied progressively on completion of filling of each phase of the landfill, and with a separation distance between the south edge of the disposal area and the south property boundary of 280 metres. This indicates that the required design approaches (“how”) for expansion of the Biggars Lane landfill require an engineering design. A site-specific design for the expansion is proposed as follows:

1) Engineered Cover - placement of waste on a prepared native soil base (without a low permeability base liner and leachate collection system), with construction of a low permeability final cover system progressively on completion of filling of each phase of the landfill to the final top of waste contours; and,

2) Engineered Base Containment - a low permeability base liner and leachate collection system below the waste. With this approach, based on the Landfill Standards and experience in design on other sites, a permeable soil final cover is typically used to reduce the contaminating lifespan of the landfill. Although it will have to be confirmed for this Site, this design approach typically results in Guideline B-7 being satisfied directly beneath the liner. If this design approach is selected as the overall preferred approach, leachate management and treatment options will have to be evaluated.
1.2 Landfill Expansion Alternative Methods (“Where”)

The range of possible landfill expansion alternatives (“where”) that can be considered are limited by the site property extent and shape, the location of the existing approved landfill footprint and associated stormwater management system components, the geometrical and other requirements of O.Reg. 232/98, the natural subsurface setting and other Site features. The main factors considered in the conceptual development of the Alternative Methods of landfill expansion at the Biggars Lane County-owned property are provided below:

- The seasonally high groundwater level is shown to be close to ground surface. To maintain a minimum of 1 metre separation of the base of the waste from the high groundwater level, the depth of excavation has to be kept relatively shallow;

- On the undeveloped west part of the property, the topography generally declines from northwest to southeast, with an approximately 3 metre high scarp located in the central portion of this area. The implication of this natural feature is that the depth to the groundwater table is indicated to be greater to the north of the scarp than to the south, making positioning of the expansion footprint to the north of the scarp more favourable in terms of Site design and development;

- The presence of the existing stormwater management system components south of the existing disposal area, as well as drainage courses and the Unnamed Creek, present physical constraints and make the portion of the property to the south of the existing disposal area undesirable for locating an expansion. There is also limited area available between the north side of the existing disposal area and the north property boundary. As such, it was concluded that horizontal expansions to the north and south of the existing landfill should not be considered. Also, in view of the requirement to demonstrate overall landfill site compliance in terms of potential long term effects on groundwater and surface water, it is desirable that the expansion area(s) not overlap, or only minimally overlap, with the existing landfill in terms of potential leachate effects on groundwater or surface water. For this reason, as well as the limited additional airspace that would result from raising the existing landfill compared to the total 1.13 million cubic metres of additional airspace required for the 30 year planning period, vertical expansion of the existing footprint should not be considered. Rather, the expansion areas should be on separate footprints to the west or east of the existing disposal area;

- Although geotechnical analyses will have to be carried out on the expansion alternatives, the conditions are considered to be generally geotechnically favourable and are not indicated to present expansion design constraints or limitations in terms of slope stability, height of the expansion or settlement;

- The height of the expansion will be governed by geometrical considerations as well as potential visual impact from off-Site viewpoints; in regard to the latter, if possible the height should be kept similar to that of the existing approved landfill, which is about 9 to 10 metres above original ground surface;

- For the Engineered Cover design approach, a separation of 280 metres between the south limit of the disposal area and the south property boundary has to be provided. For the conceptual design, a flat base elevation was used, since leachate drainage by gravity is not required. For the thickness of the low permeability final cover system, which will likely incorporate a geomembrane, an allowance of 0.75 metres above the top of waste contours was provided, as per the requirements of the Landfill Standards;
For the conceptual design of the Engineered Base Containment, a sloped base was used, noting that this would be optimized in subsequent design in terms of base slope angles and drainage directions to leachate removal points. The low permeability components of the base containment system will be determined through the groundwater modelling predictions; however, for purposes of conceptual design a thickness of 1 metre was provided. For the permeable soil final cover, a thickness of 0.75 metres was provided above the waste as per the requirements of the Landfill Standards;

For the Engineered Base Containment approach, where possible the footprint was oriented west-east such that its long axis was perpendicular to the direction of groundwater flow, since that is advantageous in terms of potential leachate impacts on groundwater quality; and,

It was assumed that the site access and associated infrastructure would remain in its current location. On-Site access roads will be provided as required, including a perimeter access road around the landfill footprints within the buffer area. A stormwater management system for the expansion area(s) will also be provided within the buffer area, as per the requirements of O.Reg. 232/98.

Based on these factors, the following four expansion alternatives were developed to provide the 1.13 million cubic metres of airspace required by the County of Brant for the 2020 to 2050 planning period. Table 1-1 provides a comparative summary of the features of the four alternatives.

**Expansion Alternative 1** – Alternative 1 is shown on Figure 1 (plan view) and Figure 2 (cross-section view). This alternative involves a separate footprint area of 15.1 hectares to the west of the existing landfill, and the engineered low permeability final cover (without a low permeability base liner and leachate collection system) design approach. A separation distance of 280 metres between the south side of the disposal area and the south property boundaries is maintained. The height of this landfill cell is about 12 to 13 metres above existing ground surface. The shallow excavation to form the base of the landfill will involve a combination of cutting and filling, with a net soil surplus of about 92,000 cubic metres available for daily cover and other Site requirements (and noting that this soil quantity will likely change to some degree during subsequent design optimization of the base grade following additional subsurface investigations in this part of the Site, as well as other possible subsequent design refinements).

**Expansion Alternative 2** – Alternative 2 is shown on Figure 3 (plan view) and Figure 4 (cross-section view). This alternative involves a separate footprint area of 14.3 hectares to the west of the existing landfill, and the engineered base containment design approach. The height of this landfill cell is about 14 to 15 metres above existing ground surface. The shallow excavation to form the base of the landfill will involve a combination of cutting and filling, with a net soil surplus of about 66,000 cubic metres available for daily cover and other Site requirements (and noting that this soil quantity will likely change to some degree following additional subsurface investigations in this part of the Site as part of subsequent design optimization of the base grades to provide drainage for the leachate collection system, as well as other possible subsequent design refinements).

**Expansion Alternative 3** – Alternative 3 is shown on Figure 5 (plan view) and Figures 6 and 7 (cross-section views). This alternative involves two separate footprint areas, one on the west side of the existing landfill (10.9 hectare footprint providing approximately 786,000 cubic metres of airspace) and one on the east side (4.7 hectare footprint providing approximately 346,000 cubic metres of airspace), and the engineered low permeability final cover (without a low permeability base liner and leachate collection system) design approach. The intent of this design was to provide a portion of the footprint area and airspace on the east side of the landfill property, thereby allowing some of the future landfilling operations to occur on the part of the property that is most distant from the closest
off-Site receptors. With the engineered final cover design approach, the footprint area on the east side of the existing landfill is limited by having to provide a separation distance of 280 metres between the south side of the disposal areas and the south property boundary. The height of the west and east landfill cells is about 12 to 13 metres and 8 to 9 metres, respectively, above existing ground surface. The shallow excavation to form the base of the landfill cells will involve a combination of cutting and filling, with a net soil surplus of about 41,000 cubic metres available for daily cover and other Site requirements (and noting that this soil quantity will likely change to some degree during subsequent design optimization of the base grade following additional subsurface investigations in these areas of the Site, as well as other possible subsequent design refinements).

Expansion Alternative 4 – Alternative 3 is shown on Figure 8 (plan view) and Figures 9 and 10 (cross-section views). This alternative involves two separate footprint areas, one on the west side of the existing landfill (11.7 hectare footprint providing approximately 660,000 cubic metres of airspace) and one on the east side (8.2 hectare footprint providing approximately 476,000 cubic metres of airspace), and the engineered base containment design approach. The intent of this design was to use the engineered base containment design approach to enlarge the footprint area and maximize the airspace on the east side of the landfill property, thereby allowing as much of the future landfilling operations to occur on the part of the property that is most distant from the closest off-Site receptors. The height of the west and east landfill cells is about 12 metres and 11 to 12 metres, respectively, above existing ground surface. The shallow excavation to form the base of the landfill cells will involve a combination of cutting and filling, with a net soil surplus of about 78,000 cubic metres available for daily cover and other Site requirements (and noting that this soil quantity will likely change to some degree following additional subsurface investigations in these areas of the Site and as part of subsequent design optimization of the base grades to provide drainage for the leachate collection system, as well as other possible subsequent design refinements).

It is noted that once expanded the total landfill airspace on the Site will be approximately 1.86 million cubic metres, which is greater than the 1.5 million cubic metre threshold in O.Reg. 232/98 that requires an active landfill gas collection system. An assessment of the approach to providing landfill gas collection will be provided after identification of the preferred expansion alternative.
Table 1: Summary of Landfill Expansion Alternative Characteristics

<table>
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<tr>
<th>Reference Figures</th>
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<th>Alternative 2</th>
<th>Alternative 3</th>
<th>Alternative 4</th>
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<tr>
<td></td>
<td>1 and 2</td>
<td>3 and 4</td>
<td>5, 6 and 7</td>
<td>8, 9 and 10</td>
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<td>Engineered Base Containment</td>
<td>Engineered Cover</td>
<td>Engineered Base Containment</td>
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<td>East Cell</td>
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</table>

Note: * Likely to change to some degree following additional subsurface investigations in these areas of the Site and as part of subsequent design optimization of the base grades, as well as other possible subsequent design refinements.
1.3 Leachate Management and Treatment Options

For expansion Alternatives 2 and 4 that incorporate the engineered base containment design approach, management and treatment of the collected leachate will be required. This will not be a requirement for expansion Alternatives 1 and 3 that use the engineered cover design approach. The comparative evaluation of landfill expansion alternatives includes consideration of the need for leachate treatment infrastructure, but the selection of the preferred expansion alternative is independent from the selection of a preferred leachate treatment option. As such, selection of the preferred leachate treatment option will be carried out after the overall preferred expansion alternative is decided, but is required only if the preferred landfill expansion alternative is one of Alternatives 2 or 4.

It is most common and desirable, where possible, that landfill leachate treatment is achieved off-Site by co-treating it with municipal sewage at a municipal water pollution control plant (WPCP). The leachate would be conveyed from the landfill Site for treatment, with or without pre-treatment, by tanker truck or pipeline. The possible off-Site leachate treatment options are determined by the number of WPCP’s available, their ability to co-treat the leachate and meet their treated effluent quality requirements, and the available WPCP capacity.

If this approach is not available or otherwise not the preferred approach, then on-site leachate treatment is considered. The range of possible on-site alternatives is determined primarily by treatment technology and the characteristics of potential surface water receivers in the vicinity of the Site to receive the treated effluent, which in turn determines the treated effluent discharge quality.

Based on these factors, the following four leachate treatment options were identified for subsequent evaluation, if required:

- Leachate Treatment Option 1 – leachate treatment using the County-owned Paris WPCP;
- Leachate Treatment Option 2 – leachate treatment using the County-owned St. George WPCP;
- Leachate Treatment Option 3 – leachate treatment using both of the County-owned Paris and St. George WPCPs; and,
- Leachate Treatment Option 4 – on-Site treatment, with effluent discharge to the Unnamed Creek.
NOT FOR CONSTRUCTION
NOT FOR CONSTRUCTION
ATTACHMENT A
Predictive Assessment of Groundwater Compliance
1.0 INTRODUCTION

The Biggars Lane Landfill Site (the Site) has been operating since 1966 as a licensed landfill facility located within the eastern portion of the County of Brant (the County), and is licensed to accept solid non-hazardous waste. The total approved capacity of the Site is 732,225 cubic metres (UEM, 2005). The existing landfill is shown on Figure A-1.1. As it is currently estimated that the Site will reach this capacity in the year 2021 (Stantec, 2014), the County has initiated an Environmental Assessment (EA) process to increase the disposal capacity at the Site and assess the alternatives available to allow them to meet their solid waste disposal needs until 2050.

The EA requires the development of alternative methods of providing the required additional landfill capacity on the County-owned property. The existing landfill uses a natural attenuation approach. From both an operational and financial perspective, the ability to continue this approach for the expansion is favourable to the County. The technical feasibility and regulatory approvability of a natural attenuation approach requires an evaluation of whether or not the effects of landfill leachate on groundwater quality are expected to meet the requirements of the MOECC Reasonable Use Guideline (RUG). To carry out this evaluation, a preliminary site configuration consisting of an expansion of the Site through the addition of a separate disposal footprint to the west of the current fill area was considered. This configuration option was designed to be favorable to natural attenuation by placing the footprint as far north in the County-owned property as possible (since the direction of groundwater flow is generally towards the south). In addition, for the preliminary design the base of the expanded landfill area was set to be 1 m above the interpreted high groundwater elevation and the requirements of O.Reg. 232/98, Landfill Standards were used for side slopes (4H:1V) and top area grades (5%) and for perimeter buffer widths. These parameters were used to develop a preliminary expansion configuration providing a total of 1,130,000 cubic metres of additional airspace on a 14.2 hectare footprint. The preliminary expansion option is shown on Figures A-1.2 and A-1.3.
The technical feasibility for the County to operate this landfill expansion as a natural attenuation landfill site (one in which the natural groundwater setting and land acquisition and/or groundwater easements enables the landfill to remain in compliance with provincial requirements for leachate effects on off-site groundwater quality, without the requirement for engineered liners, leachate collection systems and treatment of collected leachate) is a key determining factor in developing the alternative methods, evaluation criteria and finalizing the EA methodology and workplans.

A natural attenuation expansion is considered feasible if groundwater compliance with the Ministry of the Environment and Climate Change (MOECC) Guideline B-7 (MOE, 1994) can be demonstrated. A series of screening level contaminant transport calculations were completed based on a conceptual model of groundwater flow and contaminant transport at the Site to determine compliance under expanded conditions, based on a calibration to existing conditions. The calculations were completed using GoldSim, a flexible, non-specific modelling code, designed to provide the user with an understanding of the factors that control the performance of an engineered or natural system (as defined by a user-specified mathematical model) and to predict the future behaviour of the defined system. With respect to addressing the Site groundwater quality, GoldSim was used to simulate the passage of contaminants in the landfill leachate from the source area (i.e., the expanded landfill area) through the downstream groundwater flow systems to the downgradient boundary of the Site. GoldSim is fully documented in the Main Users Guide (GTG, 2010a) and the Contaminant Transport Module Users Guide (GTG, 2010b).

This technical memorandum describes the background information and conceptual model development in Section 2, and the screening calculation set-up, calibration to current conditions, adaptation for predictive conditions and assumptions in Section 3. The calculation results are provided in Section 4 and a summary discussion is provided in Section 5.

2.0 CONCEPTUAL MODEL

Site conditions were determined based on subsurface conditions encountered during borehole drilling programs, groundwater level measurements, and groundwater sampling previously conducted at the Site and summarized in the following reports:

- Dames & Moore, Canada, 1993, Hydrogeologic Study of the Biggars Lane Landfill, Township of Brantford.

Based on a review of these reports, the Site conceptual model can be described as follows:

- The surficial geology is described as a discontinuous deposit of sand/silty sand (Unit A), interbedded with a deposit of silt/sandy silt/clayey silt (Unit B) (Stantec, 2014). Based on borehole logs the total thickness of units A and B is inferred to range from 6.2 to 23.4 metres. The hydraulic conductivity of units A and B is estimated to be approximately 7x10^-8 m/s to 1.5x10^-5 m/s (Dames and Moore, 1993), with a geometric mean of 6x10^-7 m/s.
- The upper overburden units are underlain by 20 to 30 metres of clayey silt/silty clay (Unit C), which overlies bedrock of the Salina formation (Stantec, 2014). Unit C has been classified as an aquitard for the purposes of this study based on previous interpretation (Stantec, 2014) and the presence of artesian conditions in the underlying bedrock. Based on this interpretation, it is assumed that transport of leachate impacted groundwater is dominated by advective transport in Units A and B.
Groundwater levels in 2014 ranged from over 231 metres above sea level (masl) to the northeast of the Site (upgradient), to less than 226 masl to the southwest of the Site (downgradient). No leachate mounding within the fill area was noted based on groundwater elevations at OW35-L. It is noted that the water table is at or near ground surface in the southwest part of the Site during certain times of the year.

The interpreted groundwater flow direction across the Site is from the northeast to the southwest towards the Unnamed Creek. Horizontal hydraulic gradients measured at the Site in 2014 were on the order of 0.014 to 0.017 m/m. Horizontal hydraulic gradients appear to be the same in both units A and B. Given the heterogeneous distribution of Units A and B, and the similar gradients noted in both units, they have been grouped into a single unit for the purposes of this analysis.

Based on the hydraulic gradients and hydraulic conductivity values described above, groundwater velocity downgradient of the Site is on the order of 2 metres per year. As the Site has been in operation since 1966, the front or leading edge of the plume can be expected to have reached approximately 100 m downgradient of the existing fill area.

Chloride was chosen as an indicator of leachate impacts for this analysis. Monitoring well OW35-L is located within the Phase I portion of the fill area (currently under final cover). Historically observed chloride concentrations at this location peaked at approximately 1000 mg/L (Stantec, 2014). A summary of approximate observed peak concentrations at shallow monitoring wells downgradient of the fill area is provided in Table 1. Lower concentrations were observed at monitoring wells OW14-S, OW10-S and OW9-S in comparison to other wells located at similar distance from the fill area. This difference may be due to the presence of an increased silt/clayey silt content at the screened interval for these monitoring wells.

**Table 1: Observed Peak Chloride Concentrations Downgradient of Fill Area**

<table>
<thead>
<tr>
<th>Monitoring Well</th>
<th>Distance Downgradient of Fill Area (m)</th>
<th>Observed Peak Chloride Concentration(^1) (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OW2-S</td>
<td>10</td>
<td>520</td>
</tr>
<tr>
<td>OW14-S</td>
<td>28</td>
<td>260</td>
</tr>
<tr>
<td>OW11-S</td>
<td>50</td>
<td>300</td>
</tr>
<tr>
<td>OW10-S</td>
<td>103</td>
<td>45</td>
</tr>
<tr>
<td>OW9-S</td>
<td>167</td>
<td>10</td>
</tr>
<tr>
<td>OW15-S</td>
<td>200</td>
<td>100</td>
</tr>
</tbody>
</table>

Note: 1 Peak concentrations are approximate, and were selected graphically based on plots provided in Appendix J of Stantec (2014).

It is noted that there has been limited subsurface investigation in the portion of the County-owned property west of the present disposal area. For the purposes of this assessment it was assumed that the subsurface and hydrogeological conditions are similar to those in the eastern portion of the property.
3.0 SCREENING LEVEL CALCULATIONS

One-dimensional contaminant transport calculations were completed to provide a screening level assessment of contaminant transport with a reasonable degree of confidence given the available data for the Site. The calculation setup is illustrated on Figure A-1.4 for a calibration to current conditions and Figure A-1.5 for predictive calculations. The following assumptions were made for the calculations:

- One-dimensional contaminant transport was represented. This representation assumes that the flow path is linear between points.
- No retardation or decay of chloride in the downgradient flow path was accounted for.
- As the transport calculations are one-dimensional, any transverse dispersion or spreading of the plume is not explicitly accounted for. To account for these processes, along with potential recharge of unimpacted water downgradient, the calculations were adjusted by “mixing” additional volumes of groundwater, at background concentrations, between the landfill source area and the downgradient boundary.
- The expansion of the landfill is not expected to affect existing groundwater flow directions or gradients.
- As the landfill expansion option is positioned on a separate footprint to the west of the current Site, no cumulative impacts or overlaps between groundwater impacts from the existing footprint and expansion footprint are expected or accounted for in the calculations.

Additional details of the calculation set-up are provided below.

3.1 Calibration Set-up

Screening calculations were calibrated to current conditions for the existing fill area using the peak chloride concentrations listed in Table 1. Input parameters for the calibration condition are summarized as follows:

- The leachate source term for chloride was calculated based on the empirical waste volume versus chloride regression equation presented in Gehrels and Puumala (2000). For current conditions, a leachate chloride concentration of 990 mg/L was applied (based on the volume of waste at the Site at the end of 2014).
- Using the Hydrologic Evaluation of Landfill Performance (HELP) model, leachate generation rates for the existing landfill were set at 195 mm/year and 179 mm/year for open and closed conditions, respectively, assuming a permeable final cover.
- Leachate generated at the landfill was mixed with background groundwater flow. The chloride concentration of the background flow was set at 17 mg/L based on average observed background concentrations in 2014. The hydraulic conductivity of Units A and B was adjusted to 1x10^{-6} m/s to better match observed concentrations.
- Leachate impacted groundwater was assumed to travel in the upper overburden units (Units A and B) only. The vertical spreading of the plume to the underlying clay unit (through diffusion) would result in lower concentrations relative to what is represented in the one-dimensional calculations.
- The calibration is considered at steady-state (long term) conditions; monitoring locations more the 100 m from the fill area will not have reached steady-state conditions; as such, calibration results will exceed the observed peak concentrations at these locations.
- Through calibration to current conditions, a recharge rate of 400 mm/year was applied to the flow path downgradient of the fill area. This value represents approximately half of the annual average precipitation and was assigned as it provides a reasonable match to observed concentrations from the existing landfill, and is meant to represent any transverse dispersion or spreading of the plume in addition to recharge through precipitation.
3.2 Predictive Set-up

Input parameters for the predictive calculation of conditions related to the landfill expansion are summarized as follows:

- A chloride concentration of 1500 mg/L was applied (as per O. Reg. 232/98 (Ministry of the Environment, 2012)). For the closure period, chloride source depletion curves were generated using POLLUTEv7 (Rowe and Booker, 2005);

- Chloride concentrations were predicted at the downgradient property boundary. On Figure A-1.2, this boundary is shown as 230 m downgradient (south) of the southern limit of the fill area;

- The sensitivity of the results was assessed by completing the calculations for downgradient recharge values of both 400 mm/yr (as per calibration) and a lower, more conservative value of 250 mm/yr and hydraulic conductivity values ranging from $3 \times 10^{-7}$ m/s to $1 \times 10^{-6}$ m/s (a range of +/- 60% of the geometric mean hydraulic conductivity for units A and B);

- A leachate generation rate of 195 mm/year was applied over the 29 year period of operation; and,

- Two closure conditions considered:
  1) Application of a low permeability final cover at completion of each phase of the landfill (limiting the leachate generation rate to 50 mm/year); and,
  2) Application of a permeable final cover (with a leachate generation rate of 179 mm/year).

4.0 RESULTS

4.1 Calibration to Current Conditions

As described above, screening calculations were calibrated to existing conditions by adding recharge volumes of water (at background groundwater concentrations) to the downgradient flow path until calculated steady-state concentrations were similar to the observed data. As shown on Figure A-1.4, mixing volumes equivalent to 400 mm per year were added to each portion of the flow path. Sensitivity of the calibration to this parameter was assessed by lowering the recharge to 250 mm/year. Calibration results are shown in Table 2.

<table>
<thead>
<tr>
<th>Monitoring Well</th>
<th>Distance Downgradient of Fill Area (m)</th>
<th>Observed Peak Chloride Concentration(^1) (mg/L)</th>
<th>Calculated Chloride Concentration (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Recharge = 400 mm/year</td>
</tr>
<tr>
<td>OW2-S</td>
<td>10</td>
<td>520</td>
<td>647</td>
</tr>
<tr>
<td>OW14-S</td>
<td>28</td>
<td>260</td>
<td>575</td>
</tr>
<tr>
<td>OW11-S</td>
<td>50</td>
<td>300</td>
<td>506</td>
</tr>
<tr>
<td>OW10-S</td>
<td>103</td>
<td>45</td>
<td>392</td>
</tr>
<tr>
<td>OW9-S</td>
<td>167</td>
<td>10</td>
<td>308</td>
</tr>
<tr>
<td>OW15-S</td>
<td>200</td>
<td>100</td>
<td>277</td>
</tr>
</tbody>
</table>

Note: \(^1\) Approximate peak concentration based on plots provided in Appendix J of Stantec (2014).
As shown above, the calibration results consistently overestimate the observed peak concentrations. Given the low groundwater velocity at the Site, it is possible that only OW2-S and OW14-S could be considered to have reached steady-state. Additionally, wells screened in the silt/clayey silt tend to show lower observed concentrations than those screened in silty sand. The homogeneous aquifer represented in the calculations would not account for this variability. Further, given the high groundwater table and the inferred current leachate effects on the nearby stormwater management ponds, it is possible that a portion of the leachate generated is discharging as leachate impacted groundwater to the ponds. This could partially explain the higher calculated chloride concentrations.

4.2 Predictive Calculations

Predictive calculations were used to determine the peak chloride concentrations at the downgradient property boundary (shown on Figure A-1.2 as 230 m downgradient from the fill area) for the landfill expansion. Results were compared to the Reasonable Use Performance objectives (RUPO) for the Site (as described under Guideline B-7 (MOE, 1994). Initial calculations showed the expansion as non-compliant at 230 m separation distance, so the separation was increased to 280 m, thereby moving the expansion footprint 50 m further north than shown on Figure A-1.2. The reduction of the buffer width remaining on the north side of the expansion from 100 m to 50 m is considered approvable for the conditions at this site in terms of the requirements of O.Reg. 232/98. Results of the predictive simulations are provided in Figure A-1.6 for the low permeability cover and Figure A-1.7 for the permeable cover, assuming a 280 m separation distance. As shown, predictive results indicate that chloride concentrations generally meet the RUPO if a low permeability cover is applied. Sensitivity analysis indicates that under the lower recharge and lowest hydraulic conductivity condition, calculated chloride concentrations exceed RUPO by 1.3%, although all other sensitivity analyses met the RUPO. Application of a permeable cover at closure (as shown in Figure A-1.7) would result in exceedance of the RUPO for chloride for all conditions simulated.

It is noted that the calculation results show a relatively low sensitivity to hydraulic conductivity variations. Given the higher magnitude of the leachate generation rate relative to the lower background groundwater flow, changes to the rate of background groundwater flow within the range of observed hydraulic conductivity values will not have a significant impact on downgradient concentrations.

5.0 DISCUSSION

The analysis presented above was completed to provide an estimate of landfill contaminant concentrations in groundwater at the downgradient property boundary for a preliminary landfill expansion design. Based on these results, without providing a bottom liner and leachate collection system, the landfill expansion is technically indicated to comply with Guideline B-7 if a low permeability cover is applied progressively on completion of filling of each phase of the landfill. Without providing a bottom liner and leachate collection system, the landfill expansion is not expected to demonstrate compliance with Guideline B-7 if a permeable cover is applied at closure.

The results of this predictive assessment, together with the subsurface conditions on areas of the site and the requirements of O.Reg. 232/98 Landfill Standards, provide the basis on which to develop Alternative Methods to provide an additional 1.13 million cubic metres of landfill airspace on the County-owned property at the Biggars Lane Landfill Site.
6.0 LIMITATIONS

This memo was prepared for the exclusive use of the County of Brant. The memo, which specifically includes all tables, figures and appendices, is based on subsurface data and information collected by others and is based solely on the conditions of the property at the time of the work. The factual information, descriptions, interpretations, comments, conclusions and recommendations contained herein are specific to the project described in this memo and do not apply to any other project or site. Under no circumstances may this information be used for any other purposes than those specified in the scope of work unless explicitly stipulated in the text of this memo or formally authorized by Golder Associates Ltd.

The assessment of existing environmental conditions and possible hazards and subsurface conditions at this Site has been made using the results of physical measurements and chemical analyses of liquids from a number of locations. The Site conditions between sampling locations have been inferred based on conditions observed at borehole and monitoring well locations. Subsurface conditions may vary from these sampled locations.

The services performed, as described in this memo, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practising under similar conditions, subject to the time limits and financial and physical constraints applicable to the services. The calculations provide a predictive scientific tool to evaluate the impacts on a real groundwater system. However, and despite the professional care taken during the calculation process, its accuracy is bound to the normal uncertainty associated to groundwater studies and no warranty, express or implied, is made.

Any use which a third party makes of this memo, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this memo.

The findings and conclusions of this memo are valid only as of the date of this memo. If new information is discovered in future work, including excavations, borings, or other studies, Golder Associates Ltd. should be requested to re-evaluate the conclusions of this memo, and to provide amendments as required.

Prepared by: Melissa Bunn, Ph.D; and Trish Edmond, M.E.Sc.

Attachments: Figures A-1.1 to A-1.7
7.0 REFERENCES


NOT FOR CONSTRUCTION
Existing Landfill
(Time Variable Concentration and Leachate Generation)

Chloride Concentration
Peak at 48 Years: 990 mg/L
48+ Years: Chloride Source Depletion Curve (POLLUTE)

Leachate Generation
0 to 48 years: 57 m³/day
48+ Years: 52 m³/day

Notes:
OW – Observation Well
Mixing Rates based on a recharge rate of 400 mm/yr
Landfill Expansion (Time Variable Concentration and Leachate Generation)

Chloride Concentration
Peak at 29 Years: 1500 mg/L
29+ Years: Chloride Source Depletion Curve (POLLUTE)

Leachate Generation
0 to 29 years: 57 m³/day
Low Permeability Cover: 15 m³/day
Permeable Cover: 52 m³/day

Notes:

OW – Observation Well
Mixing Rates based on a recharge rate of 400 mm/yr (and 250 mm/yr)
Note: Distance from fill area to downgradient (south) property boundary of 280 m.
Recharge = 400 mm/year

Recharge = 250 mm/year

Note: Distance from fill area to downgradient (south) property boundary of 280 m.
APPENDIX B
Comparative Evaluation Criteria
Criteria for Comparative Evaluation of Alternative Methods of Landfill Expansion

The comparative assessment criteria and associated rationale, indicators and data sources within the approved Terms of Reference (ToR) Appendix D were identified as preliminary in nature. Early in the Phase 2 Environmental Assessment (EA) process the criteria, rationale, indicators and data sources for evaluation of alternative methods of landfill expansion were discussed with the Ministry of the Environment and Climate Change (MOECC) and modified according to current EA practice and in consideration of commitments made in the ToR. Several of the criteria described in the ToR were re-grouped under different component headings. As a result of the commitments made in the ToR, the potential impact on agriculture from an economic and technical perspective was added as a criteria under the land use component.

Based on experience with other waste EA projects, the components for evaluation of landfill alternative methods were grouped in an order of typical perceived importance and presented at public information centre (PIC) #3. The public was invited to provide their thoughts on the importance of the components and criteria and the order presented. Limited feedback on the order of perceived importance was received as discussed in Appendix D. Table B-1 attached to this memo provides the criteria for comparative evaluation of alternative methods of landfill expansion in the order of typical perceived importance.

Criteria for Comparative Evaluation of Leachate Treatment Options

Appendix A described alternative methods of leachate management. The comparative evaluation of landfill expansion alternatives includes consideration of the need for leachate treatment infrastructure, but the selection of the preferred expansion alternative is independent from the selection of a preferred leachate treatment option. As such, selection of the preferred leachate treatment option will be carried out after the overall preferred expansion alternative is decided, and will be required only if the preferred landfill expansion alternative is one of Alternatives 2 or 4 as presented in Appendix A. Criteria for evaluation of leachate management options were not included in the ToR, but have been developed as part of the EA based on approaches used for this purpose on other landfill expansion EA’s. Table B-2 attached to this memo provides the criteria to be used for comparative evaluation of leachate treatment options.

PLE/PAS/sg

Attachments: Table B-1 and B-2
Table B-1: Criteria for Comparative Evaluation of Alternative Methods of Landfill Expansion

Typical Very Important Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology and Hydrogeology</td>
<td>Which alternative expansion design is preferred for protection of groundwater quality?</td>
<td>The landfill expansion has the potential to affect off-Site groundwater quality.</td>
<td>• Predicted changes in groundwater quality for indicator compounds at the property boundary.</td>
<td>• Landfill expansion alternative methods&lt;br&gt;• Annual landfill monitoring reports and other Site-specific reports&lt;br&gt;• Ministry of the Environment and Climate Change (MOECC) water well records&lt;br&gt;• Environment Canada climate normal&lt;br&gt;• Leachate generation assessment&lt;br&gt;• Predictive modelling as per O.Reg. 232/98&lt;brierten by applicable Source Water Protection plans and related studies/reports (i.e., MOECC, Ministry of Natural Resources and Forestry [MNRF], Conservation Authority)&lt;br&gt;• Municipal Official Plan, specifically any groundwater protection zones, recharge areas, etc.</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Which alternative expansion design is preferred for protection of surface water quality?</td>
<td>The landfill expansion has the potential to affect surface water quality.</td>
<td>• Predicted changes in surface water quality on-Site and off-Site.</td>
<td>• Landfill expansion alternative methods&lt;br&gt;• Annual landfill monitoring reports and other Site reports related to surface water&lt;br&gt;• Site-specific stormwater design reports and assessments&lt;br&gt;• Topographic maps&lt;br&gt;• Facility layout, drainage maps and figures&lt;br&gt;• Published surface water quality information from the MOECC and Conservation Authority&lt;br&gt;• Proposed leachate control concept designs for landfill Site expansion alternatives</td>
</tr>
<tr>
<td></td>
<td>Which alternative expansion design is preferred with regard to change to surface water quantity?</td>
<td>The landfill expansion has the potential to change on-Site surface drainage patterns and alter runoff and peak flows.</td>
<td>• Predict the need for existing SWM infrastructure upgrades to meet O.Reg. 232/98&lt;br&gt;• Predicted occurrence and degree of off-Site effects on surface water flows</td>
<td>• Landfill expansion alternative methods&lt;br&gt;• Topographic maps&lt;br&gt;• Existing Site-specific studies, stormwater design reports and assessments&lt;br&gt;• Air photos&lt;br&gt;• Site surveys and assessments&lt;br&gt;• Published water quantity and flow information from the MOECC, Environment Canada and Conservation Authority&lt;br&gt;• Site reconnaissance&lt;br&gt;• Concept design&lt;br&gt;• Predictive SWM modelling</td>
</tr>
<tr>
<td>Component</td>
<td>Criteria</td>
<td>Rationale</td>
<td>Indicators</td>
<td>Potential Data Sources</td>
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</tr>
<tr>
<td>Natural Environment</td>
<td>Which alternative expansion design is preferred with regard to protection of aquatic ecosystems?</td>
<td>Establishment of additional landfill capacity could alter the functioning of natural aquatic habitats and species.</td>
<td>• Predicted changes in baseflow and surface water quality</td>
<td>• Landfill expansion alternative methods</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Predicted effect on aquatic habitat</td>
<td>• Site reconnaissance and field surveys</td>
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<td></td>
<td></td>
<td></td>
<td>• Predicted effect on aquatic biota including rare, threatened or endangered species</td>
<td>• Grand River Conservation Authority (GRCA), studies such as ESAs, watershed/subwatershed plans</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• Existing Site surveys</td>
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<td></td>
<td></td>
<td>• Other published data sources (i.e., MOECC, MNRF, Conservation Authority, Environment Canada)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Results of surface water assessments</td>
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<td></td>
<td>• Municipal Official Plan</td>
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<td></td>
<td></td>
<td></td>
<td>• Aerial photographic mapping</td>
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<tr>
<td></td>
<td>Which alternative expansion design is preferred with regard to protection of terrestrial ecosystems?</td>
<td>Establishment of additional landfill capacity could alter the functioning of natural terrestrial habitats and vegetation.</td>
<td>• Predicted effect on vegetation communities</td>
<td>• Landfill expansion alternative methods</td>
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<td>• Predicted effect on wildlife and wildlife habitat</td>
<td>• Site reconnaissance and field surveys</td>
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<td>• Identification of any sensitive or significant species or their habitat potentially affected (direct or indirect)</td>
<td>• Air photos</td>
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<td>• GRCA Terrestrial Natural Heritage System Study</td>
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<td></td>
<td></td>
<td>• Existing Site surveys and assessments</td>
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<td>• Other published data sources (i.e., MOECC, MNRF, Conservation Authority, Environment Canada)</td>
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<td>• Municipal Official Plan</td>
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<td></td>
<td></td>
<td>• Aerial photographic mapping</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Which alternative expansion is preferred regarding potential effects to air quality?</td>
<td>The establishment of a landfill expansion may produce air emissions that may degrade off-Site air quality.</td>
<td>• Predicted concentrations of indicator compounds at the property boundary and at off-Site sensitive receptors</td>
<td>• Landfill expansion alternative methods</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Environment Canada or MOECC’s regional air quality data, hourly meteorological data and Climate Normals</td>
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<td></td>
<td></td>
<td>• Aerial photographic mapping and field reconnaissance</td>
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<td>• Provincial air regulations and standards, and MOECC air guidance documents</td>
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<td>• Published or other accepted emission factors</td>
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<td>• Existing Site-specific studies and reports</td>
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<td></td>
<td>• Predictive modelling</td>
</tr>
<tr>
<td>Which alternative expansion is preferred regarding potential changes to odour?</td>
<td>The establishment of a landfill expansion may result in increased odour emissions.</td>
<td>• Predicted odour emissions at off-Site existing sensitive receptors</td>
<td>• Landfill expansion alternative methods</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Environment Canada or MOECC’s regional air quality data, hourly meteorological data and Climate Normals</td>
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<td>• Aerial photographic mapping and field reconnaissance</td>
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<td>• Published or other accepted odour source data</td>
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<td>• Odour complaints history</td>
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<td></td>
<td></td>
<td>• Existing Site-specific studies and reports</td>
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<td></td>
<td></td>
<td></td>
<td>• Predictive modelling</td>
</tr>
</tbody>
</table>
### Table B-1: Criteria for Comparative Evaluation of Alternative Methods of Landfill Expansion

<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmosphere</td>
<td>Which alternative expansion is preferred regarding potential changes to noise?</td>
<td>The establishment of a landfill expansion may result in noise emissions that may increase off-Site noise levels.</td>
<td>• Predicted noise levels beyond the project property boundary and at the discrete off-Site sensitive Points of Reception (POR) (existing and vacant lots)</td>
<td>• Landfill expansion alternative methods  • Existing Site-specific studies and reports  • Aerial photographic mapping and field reconnaissance  • MOECC’s noise guidance documents  • Site-specific equipment noise measurements  • Consultant’s database of similar noise sources  • Monitoring of existing noise at PORs  • Noise complaints history  • Predictive modelling</td>
</tr>
</tbody>
</table>

**Typical Important Components**

<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>Which alternative expansion design is preferred with respect to potential effects from Site-related truck traffic?</td>
<td>Changes to traffic loads and/or routes during construction and/or operations could alter service.</td>
<td>• Predicted traffic changes and effects on roads and intersections in the area of the Site.</td>
<td>• Landfill expansion alternative methods  • Site surveys and assessments  • Available road and intersection characteristics, and AADT traffic count information on potential haul routes (i.e., MTO, municipality)  • Available historical traffic and collisions data  • Aerial photographic mapping  • Information on future infrastructure projects involving long-term highway/road closures creating diversion of landfill traffic from primary haul routes  • Information on any predicted increases in landfill site-related traffic  • Available information in the County of Brant’s Transportation Master Plan Update (long-range roads planning and specific haul route identification)</td>
</tr>
<tr>
<td></td>
<td>Which alternative expansion design is preferred regarding increased potential for bird attraction?</td>
<td>Birds are attracted to landfills and can pose a risk of bird strikes with aircraft.</td>
<td>• Determination of distance to an airfield and, if required, predicted flight pattern from roosts to the landfill expansion</td>
<td>• Landfill expansion alternative methods  • Discussion with local airport and Transport Canada, if required  • Published data sources (i.e., Transport Canada, MNRF)  • Results of natural environment avian surveys</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
</table>
| Land Use                                                                  | Which alternative expansion design is preferred with respect to compatibility with current and proposed planned future land uses on and off-Site? | Waste management projects are often perceived to be more compatible with certain types of neighbouring land uses. | • Current land use  
  • Certain and probable planned future land use  
  • Proximity to off-Site sensitive land uses (i.e., dwellings, churches, parks) | • Site surveys and assessments  
  • Published data sources (i.e., Official Plans, Zoning plans)  
  • Provincial Policy Statement, 2014  
  • Discussions with municipality and, if required, property owners local to the Site |
|                                                                           | Which alternative expansion design is preferred in terms of the view from off-Site? | Expansion of the landfill can change the visual appearance of the Site from off-Site viewpoints (receptor locations). | • Predicted changes in landscapes and views  
  • Visibility of project features from selected receptor locations  
  • Level of visual contrast of project features from selected receptor locations | • Landfill expansion alternative methods  
  • MNRF digital surface models and terrestrial mapping  
  • Aerial photography and field reconnaissance  
  • Satellite imagery  
  • Google Earth  
  • Web mapping sites  
  • Existing Site-specific studies and reports  
  • Visual impact assessment |
|                                                                           | Which alternative expansion design is preferred with regard to potential for effects on agriculture? | The landfill expansion can adversely affect on-Site agricultural operations and use and may be perceived to have the potential to adversely affect off-Site agricultural operations and use. | • Percentage of on-Site lands with soil capability classes 1 to 3  
  • Amount, type(s) and quality of on-Site improvements for agricultural purposes (i.e., structures, tile drainage)  
  • Percentage of on-Site land being used for agricultural purposes  
  • Types(s) and extent of agricultural operations on-Site and off-Site, (i.e., organic, cash crop, livestock) | • Landfill expansion alternatives  
  • Provincial Policy Statement, 2014  
  • Municipal Official Plans  
  • Aerial photographic and topographic mapping  
  • Available soils mapping, municipal drain mapping, available ownership information based on municipal assessment information and including farm tax credit information  
  • Field reconnaissance  
  • Canada Land Inventory (CLI) mapping  
  • Statistics Canada agriculture profiles  
  • Interviews with farmers |
### Table B-1: Criteria for Comparative Evaluation of Alternative Methods of Landfill Expansion

<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
</table>
| **Economic**                           | Which alternative expansion design is preferred with regard to potential for effects on the local economy? | The expansion of the landfill could have the potential to disrupt or displace existing businesses, while there is also the opportunity for the creation of new jobs through construction and/or operations as well as through provision of products or services. | • Predicated effects to local businesses  
• Employment at Site (number and duration)  
• Opportunities to provide products or services | • Landfill expansion alternative methods  
• Projected employment levels, by skill and duration, during the construction and operations phases  
• Estimated costs for project activities during the construction and operations phases for each alternative method  
• Current use of local businesses and services  
• Statistics Canada 2011 National Household Survey  
• Ontario Ministry of Finance Population Projections  
• County of Brant Community Profile, Business Directory, Key Industries |
|                                        | Which alternative expansion design is preferred regarding the capital, operation and maintenance costs for landfill expansion? | Capital costs will be incurred for establishing the additional landfill disposal capacity and other required infrastructure to support the design. On-going operating and maintenance costs will be required for the landfill. | • Predicted capital costs  
• Predicted operation and monitoring costs for the duration of the active service of the landfill and the on-going post-closure care | • Landfill expansion alternative methods  
• Cost estimates for expansion alternatives  
• Operations and capital costs for existing landfill provided by County of Brant  
• Discussion with County of Brant solid waste staff |
| **Typical Less Important Components**  | Which alternative expansion design is preferred with regard to landfill gas subsurface migration potential? | The landfill expansion will produce gas that can potentially migrate in the subsurface from the disposal area. | • Predicted landfill gas subsurface migration distance from landfill footprint and distance to property boundary | • Landfill expansion alternative methods  
• Annual landfill monitoring reports  
• Additional data collection  
• MOECC guidance documents  
• Site surveys and assessments |
|                                        | Which alternative expansion design is preferred with regard to potential to attract vectors and vermin? | The landfill expansion could attract vectors and vermin. | • Predicted potential for attraction of vectors and vermin | • Landfill expansion alternative methods  
• Data from natural environment surveys  
• Vector and vermin occurrence reports and control measures |
# Table B-1: Criteria for Comparative Evaluation of Alternative Methods of Landfill Expansion

<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical and Operational</td>
<td>Which alternative expansion design is preferred from a geotechnical</td>
<td>Design and construction of the landfill expansion and any associated</td>
<td>• Predicted slope stability, settlement and other geotechnical</td>
<td>• Landfill expansion alternative methods</td>
</tr>
<tr>
<td>Considerations</td>
<td>perspective?</td>
<td>infrastructure needs to account for geotechnical considerations.</td>
<td>considerations</td>
<td>• Geotechnical drilling investigation program</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Published subsurface data sources (i.e., MOECC, Ontario Ministry of</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Transportation [MTO])</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Geotechnical assessments</td>
</tr>
<tr>
<td></td>
<td>Which alternative expansion design is preferred regarding the requirement</td>
<td>The landfill expansion may require establishment of additional</td>
<td>• Predicted need for leachate collection and associated disposal and/or</td>
<td>• Landfill expansion alternative methods</td>
</tr>
<tr>
<td></td>
<td>for operational infrastructure?</td>
<td>infrastructure, such as leachate management and/or landfill gas</td>
<td>treatment</td>
<td>• Site surveys and assessments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>collection.</td>
<td>• Predicted need for landfill gas collection and associated handling</td>
<td>• Existing Design, Operations and Maintenance Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Published data sources (i.e., utility plans)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Landfill gas generation predictions</td>
</tr>
<tr>
<td>Cultural and Heritage</td>
<td>Which alternative expansion design is preferred with regard to heritage</td>
<td>The cultural landscape and heritage resources can be altered by</td>
<td>• Predicted effects to identified cultural landscapes off-Site</td>
<td>• Landfill expansion alternative methods</td>
</tr>
<tr>
<td>Resources</td>
<td>resources and the cultural heritage landscape?</td>
<td>expansion of the landfill, and use of the cultural landscape can be</td>
<td>• Predicted effect to the heritage attributes of identified heritage</td>
<td>• Published data sources (including literature; historic maps, land registry data,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>affected by on-going landfill operations.</td>
<td>resources</td>
<td>assessment rolls and census records; local architectural conservation advisory</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>committee and/or municipal heritage building/district listings)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Site surveys and assessments</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td>• Applicable provincial regulations and Ministry of Tourism, Culture and Sport</td>
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<td></td>
<td></td>
<td></td>
<td>(MTCS) guidance documents</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• Aboriginal communities and organizations</td>
</tr>
<tr>
<td></td>
<td>Which alternative expansion design is preferred with regard to protection</td>
<td>Archaeological resources could be disturbed by construction activities</td>
<td>• Presence of archaeological resources on-Site</td>
<td>• Landfill expansion alternative methods</td>
</tr>
<tr>
<td></td>
<td>to protection of archaeological resources?</td>
<td>at the Site.</td>
<td></td>
<td>• Published data sources (including literature; historic maps, land registry</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>data, assessment rolls and census records)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Review of the MTCS updated database</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• On-Site archaeological studies in accordance with MTCS standards and guidelines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Aboriginal communities and organizations</td>
</tr>
</tbody>
</table>
# Table B-2: Criteria for Comparative Evaluation of Leachate Treatment Options

<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Water</td>
<td>Which leachate treatment method is preferred for the protection of surface water quality?</td>
<td>Leachate management and treatment options have the potential to impact off-Site surface water quality and quantity.</td>
<td>• Anticipated effects on off-Site surface water quality</td>
<td>• Estimated leachate volume and quality&lt;br&gt;• Total and available capacity of potential municipal treatment facilities, treatment facility capability and discharge criteria&lt;br&gt;• Results of background studies including:&lt;br&gt;  • Characteristics of potential receiving waters&lt;br&gt;  • Identification of required treatment facility modifications and/or on-Site pre-treatment&lt;br&gt;  • Prediction of treatment facility performance</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Which leachate treatment method is preferred with regard to surface water quantity?</td>
<td></td>
<td>• Anticipated effects on off-Site surface water quantity</td>
<td>• Estimated leachate volume and quality&lt;br&gt;• Total and available capacity of potential municipal treatment facilities, treatment facility capability and discharge criteria&lt;br&gt;• Results of background studies including:&lt;br&gt;  • Characteristics of potential receiving waters&lt;br&gt;  • Identification of required treatment facility modifications and/or on-Site pre-treatment</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Which leachate treatment method is preferred with regard to odour emissions?</td>
<td>Leachate management (loading, haulage and discharge) and treatment options can produce air emissions, which may degrade off-Site air quality. Similarly, they can result in increased noise levels and odour emissions.</td>
<td>• Anticipated odour emissions</td>
<td>• Estimated leachate volume and quality&lt;br&gt;• Results of background studies including:&lt;br&gt;  • Results of quantitative or qualitative predictive assessments for environmental components</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Which leachate treatment method is preferred with regard to air quality?</td>
<td></td>
<td>• Anticipated air emissions</td>
<td>• Estimated leachate volume and quality&lt;br&gt;• Results of background studies including:&lt;br&gt;  • Results of quantitative or qualitative predictive assessments for environmental components</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Which leachate treatment method is preferred with regard to noise levels?</td>
<td></td>
<td>• Anticipated noise levels</td>
<td>• Estimated leachate volume and quality&lt;br&gt;• Results of background studies including:&lt;br&gt;  • Results of quantitative or qualitative predictive assessments for environmental components</td>
</tr>
<tr>
<td>Component</td>
<td>Criteria</td>
<td>Rationale</td>
<td>Indicators</td>
<td>Potential Data Sources</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Economic       | Which leachate treatment method is preferred with regard to practicality and economic viability? | The capital costs depend largely on the amount of modifications/upgrade required to the off-Site treatment facility, and/or the need for on-Site pre-treatment, as well as the leachate conveyance method, i.e., haulage by tanker or pipeline. The operational costs to treat leachate would be incremental and depend on the increased treatment associated with leachate loading and any additional treatment processes. | • Requirement for capital costs for modifications and upgrades of existing facilities or addition of new facilities  
• Incremental operational costs | • Estimated leachate volume and quality  
• Total and available capacity of potential municipal treatment facilities, treatment facility capability and discharge criteria  
• Results of background studies including:  
  • Identification of required treatment facility modifications and/or on-Site pre-treatment  
  • Anticipated capital and operating cost |
| Technical Effectiveness | Which leachate treatment method is preferred with regard to technical feasibility and proven ability to meet treated effluent quality requirements? | The technical effectiveness depends on the quantity and associated chemical loading associated with the leachate and characteristics of the watercourse that will receive the treated effluent, and the expected ability of the treatment system to provide the required treatment of leachate. | • Incremental increase in quantity and chemical loading on treatment facility by accepting leachate  
• Expected ability of treatment facility to meet treated effluent quality requirements | • Estimated leachate volume and quality  
• Total and available capacity of potential municipal treatment facilities, treatment facility capability and discharge criteria  
• Results of background studies including:  
  • Identification of required treatment facility modifications and/or on-Site pre-treatment  
  • Prediction of treatment facility performance |
| Technical Effectiveness | Which leachate treatment method is preferred with regard to ability to handle the estimated leachate volume? | Existing waste water treatment plants have a licensed capacity in terms of how much wastewater they can receive. On-Site leachate treatment will require adequate space for construction of the treatment facility to handle the estimated quantity of leachate. | • Leachate percentage in comparison to approved rated capacity of wastewater treatment plants  
• Availability of sufficient land area for leachate treatment facility | |
| Traffic        | Which leachate treatment method is preferred with regard to traffic? | Leachate management and treatment options have the potential to impact traffic due to haulage of leachate. | • Amount and type of traffic associated with leachate haulage  
• Type(s) and usage of routes along which leachate will be transported | |
APPENDIX C
Technical Work Plans for Environmental Assessment Study Components
APPENDIX C

Work Plans
Biggars Lane Landfill Expansion EA

Submitted to:
Matthew D'Hondt
Corporation of the County of Brant
26 Park Avenue, PO Box 160
Burford, ON N0E 1A0

Report Number: 1408408 / 3000
OVERVIEW

This document presents the proposed work plans for each environmental assessment study component of the environmental assessment (EA) to secure additional landfill disposal capacity for the County of Brant by means of an expansion at the Biggars Lane landfill site (the undertaking). This EA has a Ministry of Environment and Climate Change (MOECC) approved Terms of Reference (ToR) that sets out the overall framework and work plan for addressing the Ontario Environmental Assessment Act (EAA) requirements when preparing the EA. The enclosed work plans provide component-specific details (including consideration of commitments made in the ToR) in advance of commencing the assessment framework, and include the following environmental components:

- Attachment C-1 – Geology and Hydrogeology Work Plan;
- Attachment C-2 – Surface Water/Stormwater Work Plan;
- Attachment C-3 – Natural Environment Work Plan;
- Attachment C-4 – Atmosphere Work Plan;
- Attachment C-5 – Culture and Heritage Resources Work Plan;
- Attachment C-6 – Land Use/Agricultural/Visual Work Plan;
- Attachment C-7 – Economic Work Plan;
- Attachment C-8 – Technical and Operational Considerations Work Plan;
- Attachment C-9 – Transportation Work Plan; and,
- Attachment C-10 – Methodology for Evaluation of Leachate Management and Treatment Options.

Each of the components will collect and analyze data for the EA based on three generic study areas, as presented in the ToR. The generic study areas are shown on Figures C-1 through C-3 and are described as follows:

- The Regional Study Area – encompasses the County of Brant and does not include the City of Brantford, Six Nations of the Grand River Territory, or the Mississaugas of the New Credit First Nation;
- The Local Study Area – Extends approximately 500 metres in all directions beyond the County-owned lands at the Biggars Lane landfill; and,
- The Site Study Area – Includes the County-owned lands at the Biggars Lane landfill located in the south part of Lot 1, 2nd Range East of Mount Pleasant Road in the County of Brant (former Township of Brantford).

The generic study areas noted above may be modified during the EA to suit the requirements of each component; this is described on a component-specific basis in the individual work plans.

These work plans will form the basis for preparing a cost estimate for completion of each of the component studies and for the other activities associated with completion of the EA documentation and overall study process.
ATTACHMENT C-1
Geology and Hydrogeology Work Plan
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FIGURES
  Figure C-1.1: Proposed Borehole and Monitoring Well Locations
1.0 INTRODUCTION

This document presents the proposed work plan for the geology and hydrogeology component of the environmental assessment (EA) to secure additional landfill disposal capacity for the County of Brant by means of an expansion at the Biggars Lane landfill site (the undertaking). This EA has a Ministry of Environment and Climate Change (MOECC) approved Terms of Reference (ToR) that sets out the overall framework and work plan for addressing the Ontario Environmental Assessment Act (EAA) requirements when preparing the EA. This work plan provides additional component-specific details in advance of commencing the assessment framework.

2.0 ASSESSMENT FRAMEWORK

2.1 Overall Approach

The proposed EA consists of the following steps:

- Step 1 – Describe the service area waste disposal needs for the minimum planning period ending in 2050;
- Step 2 – Develop criteria to be used in the evaluation of the alternative methods;
- Step 3 – Develop design concepts for alternative methods for expanding the existing Biggars Lane landfill site;
- Step 4 – Carry out the studies required to address the evaluation criteria;
- Step 5 – Describe the environment(s) potentially affected by the proposed undertaking;
- Step 6 – Using the evaluation criteria identified in Step 2, carry out an evaluation of the alternative methods for the proposed undertaking and identify the effects to the environment;
- Step 7 – Identify the preferred alternative method of landfill expansion; if the overall preferred alternative method of landfill expansion involves a base liner and leachate collection system (i.e., one of Alternatives 2 or 4), then carry out a comparative evaluation of alternative leachate management and treatment options using the methodology and criteria provided in Attachment C-10;
- Step 8 – Identify measures that may be necessary to prevent, change or mitigate possible environmental effects of the preferred alternative method;
- Step 9 – Prepare a description of the environmental advantages and disadvantages of the preferred alternative method based on net effects that will result following mitigation. The assessment of net effects include effects associated with the construction, operations and any closure/post closure periods of the preferred alternative method; and,
- Step 10 – Prepare monitoring and contingency plans to monitor for environmental effects.

Of these steps, the geology and hydrogeology component will participate in the development of Steps 4 through 10 as they pertain to this component.
2.2 Study Areas

Data for the EA will be collected and analyzed for three generic study areas presented in the ToR. The generic study areas are shown on Figures C-1 through C-3 and are described as follows:

- The Regional Study Area – encompasses the County of Brant and does not include the City of Brantford, Six Nations of the Grand River Territory, or the Mississaugas of the New Credit First Nation;

- The Local Study Area – Extends approximately 500 metres in all directions beyond the County-owned lands at the Biggars Lane landfill; and,

- The Site Study Area – Includes the County-owned lands at the Biggars Lane landfill located in the south part of Lot 1, 2nd Range East of Mount Pleasant Road in the County of Brant (former Township of Brantford).

The generic study areas noted above may be modified during the EA to suit the requirements of the geology and hydrogeology component. It is envisioned that the geology and hydrogeology component will consider all three study areas with regard to the existing conditions and the Site Study Area with regard to the predicted effects.

2.3 Time Frame

The EA will consider potential effects on the environment at three project life cycle stages as follows:

- Construction Phase – This would include clearing, grading, construction of access roads, and initial construction of the landfill expansion cell(s);

- Operations (up to 2050) – This would include regular disposal activities over the course of the operating life of the Site, which is proposed as up to 2050. Ongoing, progressive construction of new disposal cells will also occur through this period; and,

- Closure/Post-closure (post 2050) – Site Closure and Post-closure activities (e.g., leachate management, landfill gas management, monitoring and maintenance) will occur over the contaminating lifespan of the landfill.
3.0 ASSESSMENT CRITERIA AND INDICATORS

Draft environmental components, criteria, rationale, indicators and potential data sources were provided in the approved ToR and have been updated as part of proceeding into the EA stage. They are provided below related to the geology and hydrogeology component.

Table C-1.1: Assessment Criteria for Geology and Hydrogeology

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
</table>
| Which alternative expansion design is preferred for protection of groundwater quality? | The landfill expansion has the potential to affect off-Site groundwater quality. | Predicted changes in groundwater quality for indicator compounds at the property boundary. | • Landfill expansion alternative methods  
• Annual landfill monitoring reports and other Site-specific reports  
• MOECC water well records  
• Environment Canada climate normal  
• Leachate generation assessment  
• Predictive modelling as per O. Reg. 232/98  
• Additional groundwater sample collection programs from existing and new monitors  
• Published geological, hydrogeological and geotechnical maps and reports including applicable Source Water Protection plans and related studies/reports (i.e., MOECC, Ministry of Natural Resources and Forestry, Conservation Authority)  
• Municipal Official Plan, specifically any groundwater protection zones, recharge areas, etc. |

4.0 DETAILED WORK PLAN

4.1 Step 4 – Carry Out Studies

The proposed geology and hydrogeology work plan described herein was developed to gather information required to understand the Biggars Lane landfill site to a level of detail suitable for the purpose of supporting an EA submission.

The geology and hydrogeology component includes the consideration of groundwater quality, groundwater flow and groundwater/surface water interaction. The following tasks will be undertaken to characterize existing subsurface conditions across the Site, supplementing the information available from previous investigations and groundwater and surface water monitoring programs.

- Review conceptual components of the proposed Biggars Lane landfill site expansion;
- Review annual monitoring reports, Site-specific reports, MOECC water well records, and the Municipal Official Plan;
- Acquire and review published Source Protection Plans for the Regional Study Area to determine the location of the Site in relation to any defined Wellhead Protections Areas under the Source Water Protection Act;
Conduct subsurface investigations as described below to characterize the overburden geology at the Site, to determine the depth to bedrock, and to assess the hydrogeological properties of the subsurface materials (program described below);

Carry out routine geotechnical laboratory testing (grain size distribution, moisture content, Atterberg limits) on selected representative samples to validate the soil classifications and descriptions, and assist in interpretation of the hydraulic conductivity;

Characterize the hydraulic conductivity of the overburden deposits (i.e., using rising or falling head tests in monitoring wells or laboratory analysis for low hydraulic conductivity deposits, if necessary);

Determine seasonal variation in groundwater levels and flow orientations using multi-level monitoring well nests;

Collect groundwater samples from newly installed monitoring wells, as described below, on at least two occasions (to coincide with the annual monitoring program for the existing landfill) to characterize baseline groundwater quality for typical organic and inorganic landfill leachate parameters. Groundwater samples collected at existing wells as part of the annual monitoring program will also be used to characterize baseline groundwater quality, and should be analysed for the regular suite of parameters plus boron and iron during both monitoring events;

Determine soil characteristics across the Site that relate to transport of organic and inorganic landfill leachate parameters (i.e., Fraction of Organic Carbon [FOC] to parameterize predictive models of contaminant transport); and,

Determine “linkages” with other components and data generation/transfer requirements.

Based on the current understanding of the Site from previous investigations, a proposed geology and hydrogeology field program has been developed. The investigation consists of 19 borehole locations and 3 staff gauge locations. These 22 test locations have been identified as ‘A’ through ‘V’ and are shown on Figure C-1.1. The components of the field program are described below, and details on the objectives or rationale of the field program along with the proposed drilling techniques, borehole depths, testing, monitoring, etc. presented in Table C-1.1 (for each of the proposed borehole locations).

The proposed field program includes the following components:

At three (3) of the 19 borehole locations, boreholes will be augered through the overburden units and cored into the upper portion of the underlying bedrock to allow determination of bedrock groundwater levels. It is noted that artesian conditions may be encountered in the bedrock at some borehole locations. Depending on the number of subsurface units encountered at each borehole location, additional boreholes may be completed at this location to allow for the installation of monitoring wells in the geologic unit encountered (i.e., sand/silty sand [referred to as Unit A], silt/sandy silt/clayey silt [referred to as Unit B], silty clay [referred to as Unit C], or bedrock). Data collected at these boreholes will be used to establish the thickness of the silty clay unit, which offers a degree of separation/isolation between the upper Units A and B and the underlying bedrock aquifer. Up to three (3) monitors may be installed in the overburden deposits (Units A through C) to determine the groundwater pressure profile and vertical hydraulic gradient within these units. Vertical
pressure profiles through the overburden will be used to verify whether upward vertical gradients are present in Units A and B (as is indicated from monitoring data in a limited number of well installations in parts of the Site). Split spoon sampling will be completed for the full depth of Units A and B to obtain samples for grain size analysis to further delineate the Unit A and Unit B zones at the borehole locations.

- At three (3) of the 19 borehole locations, boreholes will be augered through the upper overburden Units A and B to the base of the silty clay (Unit C). Depending on the number of subsurface units encountered at each borehole location, additional boreholes may be completed at the location to allow for the installation of monitoring wells in the geologic unit encountered (i.e., Units A through C). Up to three monitors may be installed in the overburden deposits (Units A through C) to determine the pressure profile and vertical hydraulic gradient within these units. Split spoon sampling will be completed for the full depth of Units A and B to obtain samples for grain size analysis.

- At nine (9) of the borehole locations, shallow boreholes will be completed to assess the distribution and thickness of Units A and B. Depending on the presence/absence and thickness of each unit encountered, groundwater monitors will be installed in each unit to provide additional information on the water table and shallow groundwater flow system at the Site.

- At the remaining four (4) borehole locations, shallow boreholes will be completed to determine the depth to the water table under the proposed landfill expansion areas. This information will enable the elevation of the base of the waste to be determined, such that it is at least 1 m above the high water table elevation.

- In-situ rising or falling head tests will be completed in monitoring wells installed in Units A and B. Where conditions permit, in-situ rising or falling head tests should also be completed in the silty clay (if possible given the expected low hydraulic conductivity), and the bedrock (where pressures are non-artesian). This information will be used to parameterize the quantitative predictive models.

- Staff gauges will be installed in the Unnamed Creek at three (3) locations. These staff gauges will be used in combination with nearby monitoring wells to estimate the contribution that groundwater from the Site makes to baseflow in the Creek, to assist in assessing Site compliance with provincial requirements.

- As part of the subsurface investigation, representative overburden samples will be collected to determine the FOC. The exact number of samples will be determined based on the results of the field investigation, but is expected that there could be 5 to 10 samples. This information will be used to parameterize the quantitative predictive models.

The locations and critical elevations for all proposed boreholes/monitoring wells and staff gauges would be surveyed to Geodetic datum.

Following completion of the field drilling and testing program, the in-situ rising or falling head test data would be analyzed to develop hydraulic conductivity estimates for the soil (and bedrock) at the Site. In boreholes extended through the silty clay, undisturbed soil sample(s) collected from this layer could be used for laboratory determination of hydraulic conductivity, if necessary.
Following the completion of the in-situ rising or falling head tests, a groundwater level monitoring program would be implemented. At a minimum, the groundwater levels would be measured in all existing monitoring wells on a monthly basis over a period of time to obtain coverage over the seasons. Selected groundwater monitoring wells would be outfitted with data loggers that would measure groundwater levels on a daily basis. The selected monitoring wells are listed in Table C-1.2. Data loggers would be installed at monitors D, E, F, and Q to determine the seasonal high water table elevation. Data loggers would be installed at monitors J and K to allow verification of the presence and/or persistence of upwards vertical gradients in the overburden. These groundwater level measurements would also be used to assess the daily and seasonal variations in groundwater levels, and would permit an assessment of the groundwater level changes in relationship to precipitation events. The groundwater level data would be used to characterize the horizontal and vertical groundwater flow regime at the Site.
Table C-1.2: Summary of Proposed Geology and Hydrogeology Work Plan

<table>
<thead>
<tr>
<th>Borehole Identifier</th>
<th>Proposed Borehole Location (See Figure C-1.1)</th>
<th>Rationale for Borehole</th>
<th>Proposed Drilling Technique</th>
<th>Proposed Borehole Depth Below Ground Surface (metres)</th>
<th>Number of Monitoring Wells to be Installed</th>
<th>In-situ Rising or Falling Head Tests in Monitoring Wells</th>
<th>Data Logger Installations</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Northwest corner of Property. Northwest of existing landfill</td>
<td>Assess the distribution and thickness of Units A and B; determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>Up to 2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>B</td>
<td>Northwest part of Property. Northwest of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; investigate the thickness of the silty clay unit; determine depth to water table in shallow flow system; assess groundwater levels in bedrock aquifer.</td>
<td>Power auger through overburden followed by rotary drill with HQ core recovery</td>
<td>To be drilled approximately 5 metres into bedrock (approx. 38 m to 46 m)</td>
<td>Up to 4</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>C</td>
<td>Northwest part of Property. Northwest of existing landfill</td>
<td>Assess the distribution and thickness of Units A and B; determine depth to water table in shallow flow system</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>Up to 2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>D</td>
<td>Northwest part of Property. Northwest of existing landfill</td>
<td>Determine depth to water table in shallow flow system</td>
<td>Power auger</td>
<td>To be drilled approximately 5 metres into bedrock (approx. 38 m to 46 m)</td>
<td>Up to 4</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>E</td>
<td>Northwest part of Property. Northwest of existing landfill</td>
<td>Determine depth to water table in shallow flow system</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>Up to 2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>F</td>
<td>Northwest part of Property. Northwest of existing landfill</td>
<td>Determine depth to water table in shallow flow system</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>Up to 2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>G</td>
<td>Northwest part of Property. West of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; determine depth to water table in shallow flow system</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>Up to 2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>H</td>
<td>Northwest part of Property. West of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; investigate the thickness of the silty clay unit; determine depth to water table in shallow flow system; assess vertical gradients between silty clay and overlying silt and silty sand.</td>
<td>Power auger</td>
<td>To be completed to top of bedrock (approx. 33 to 41 m)</td>
<td>Up to 3</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>I</td>
<td>Northwest part of Property. West of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>Up to 2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>J</td>
<td>Southwest corner of property. West of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; investigate the thickness of the silty clay unit; assess vertical gradients between silty clay and overlying silt and silty sand; assess potential for upward gradients within overburden units</td>
<td>Power auger</td>
<td>To be completed to top of bedrock (approx. 33 to 41 m)</td>
<td>Up to 3</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>K</td>
<td>Southwest of existing landfill, along Hagan Road. North of Unnamed Creek</td>
<td>Assess the distribution and thickness in Units A and B; investigate the thickness of the silty clay unit; assess groundwater levels in bedrock aquifer; assess potential for upward gradients within overburden units</td>
<td>Power auger through overburden followed by rotary drill with HQ core recovery</td>
<td>To be drilled approximately 5 metres into bedrock (approx. 38 m to 46 m)</td>
<td>Up to 4</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>L</td>
<td>Between existing landfill and South Pond</td>
<td>Determine the extent of leachate impacted groundwater potentially influencing water quality in the South Pond to evaluate existing Site performance</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>Up to 2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>M</td>
<td>South of existing landfill. North of Unnamed Creek</td>
<td>Assess the distribution and thickness in Units A and B; to be used to determine groundwater contribution to baseflow in Unnamed Creek.</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>Up to 2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>N</td>
<td>Southeast of existing landfill. North of Unnamed Creek</td>
<td>Assess the distribution and thickness in Units A and B; to be used to determine groundwater contribution to baseflow in Unnamed Creek.</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>Up to 2</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
**Table C.1.2: Summary of Proposed Geology and Hydrogeology Work Plan**

<table>
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<th>Data Logger Installations</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>Eastern portion of property. Northeast of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; investigate the thickness of the silty clay unit; determine depth to water table in shallow flow system; assess groundwater levels in bedrock aquifer.</td>
<td>Power auger through overburden followed by rotary drill with HQ core recovery</td>
<td>To be drilled approximately 5 metres into bedrock (approx. 38 m to 46 m)</td>
<td>Up to 4</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>P</td>
<td>Eastern portion of property. Northeast of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>Up to 2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Q</td>
<td>Eastern portion of property. East of existing landfill</td>
<td>Determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To 2 m below existing water table (approx. 3 m)</td>
<td>1</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>R</td>
<td>Eastern portion of property. East of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>Up to 2</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>S</td>
<td>Southeastern corner of property. East of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; investigate the thickness of the silty clay unit; assess vertical gradients between silty clay and overlying silt and silty sand; determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To be completed to top of bedrock (approx. 33 to 41 m)</td>
<td>Up to 3</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
4.2 Step 5 – Describe Environment Potentially Affected

Upon completion of the field program and data analysis associated with the geology and hydrogeology work plan (and collection of sufficient representative groundwater level data over a period of time to cover annual fluctuations, as a minimum over the spring, summer and fall seasons), the data would be utilized to develop the final conceptual model of the geological and hydrogeological conditions in the area of the Site. The conceptual model would include subsurface geologic units, local aquifers, aquitards, recharge areas, groundwater flow directions, and groundwater velocities. Compliance of the existing landfill would be evaluated in relation to the Reasonable Use Guideline B-7 and the degree of groundwater-surface water interaction observed at the Unnamed Creek and the South Pond.

4.3 Step 6 – Predict Environmental Effects of Each Landfill Expansion Alternative Method

Leachate generation will be quantitatively estimated using Environment Canada climatic data. Considering “in-design” mitigation measures\(^1\), quantitative predictive modelling of each expansion alternative method (contaminant modelling and if necessary flow modelling) and contaminating lifespan as per Ontario Regulation (O. Reg.) 232/98 using key parameters of concern (selected from the indicator parameters in Table 4 of O.Reg. 232/98) will be conducted. Chloride will be assessed as a selected parameter of concern, and if required other parameters may be selected and assessed based on model calibration results. An organic parameter of concern may also be selected based on landfill liner considerations for some alternatives. The final conceptual model and predictive modelling results will also be used to assess the expected long-term performance of the existing landfill.

Using the evaluation criteria identified, an evaluation of the potential effects to the groundwater environment from each of the alternative landfill expansion methods will be completed.

The geology and hydrogeology component will generate predictions for use by other components where there are linkages.

4.4 Step 7 – Compare Alternative Expansion Methods and Identify the Preferred Alternative Expansion Method

The geology and hydrogeology component will quantitatively compare the degree of potential effects using the criteria and indicators for the geology and hydrogeology component. The alternative expansion methods will be ranked using the terminology of most preferred, equally preferred, moderately preferred and least preferred), and the preferred alternative expansion method will be identified from a geology and hydrogeology perspective.

The alternative which has the smallest predicted negative effect is ranked ‘Most Preferred’. The alternative that has the greatest predicted negative environmental effect is ranked ‘Least Preferred’. The remaining alternative(s) is ranked ‘Moderately Preferred’. If there are no measurable differences among the predicted effects of alternatives, they are ranked ‘Equally Preferred’. This information will be used to identify and describe the justification for selection of the ‘Most Preferred’ option from a geology and hydrogeology component perspective.

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\(^1\) Mitigation measures are actions taken to avoid or reduce potential adverse effects. Mitigation measures incorporated into the design of the project works and activities before the assessment takes place are referred to as ‘in-design’ mitigation measures.
The EA team will then collect the component preferred alternative expansion method and determine the overall preferred alternative expansion method.

If, depending on the preferred landfill expansion alternative identified, there is a need to assess and compare alternative methods of leachate management and treatment as described in Attachment C-10, the geology and hydrogeology-related potential effects will be described qualitatively as input to the comparative evaluation of leachate management and treatment options.

4.5 Step 8 – Identify Mitigation Measures Included in the Preferred Method

As part of Step 6, the geology and hydrogeology component assessed the potential effects from each of the alternative expansion methods. “In-design”1 mitigation measures that were incorporated into the alternatives will be documented.

Following Step 7 and selection of the preferred alternative expansion method, additional mitigation measures, if required, will be identified and refined as necessary.

The prediction of future environmental effects on the geology and hydrogeology component will be carried out, assuming all mitigation measures are in place. The remaining effects or “net effects” will be documented.

4.6 Step 9 – Advantages and Disadvantages of the Preferred Method

A description of the environmental advantages and disadvantages of the preferred alternative expansion method based on net effects will be prepared for the geology and hydrogeology component.

4.7 Step 10 – Monitoring and Contingency Plans

The geology and hydrogeology component will prepare a monitoring program appropriate for the preferred landfill expansion alternative, and a conceptual contingency plan approach. This monitoring and contingency planning process will confirm the effectiveness of the mitigation measures. Contingency planning will outline the steps necessary to address unforeseen events of ineffective or defective mitigation measures that pose risk to the elements of the geology and hydrogeology environment.

The results of Steps 4 to 10 of the assessment will be documented in a geology and hydrogeology report.
FIGURE C-1.1
Proposed Borehole and Monitoring Well Locations
ATTACHMENT C-2
Surface Water/Stormwater Work Plan
ATTACHMENT C-2

Surface Water/Stormwater Work Plan
Biggars Lane Landfill Expansion EA
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1.0 INTRODUCTION

This document presents the proposed work plan for the surface water component of the environmental assessment (EA) to secure additional landfill disposal capacity for the County of Brant by means of an expansion at the Biggars Lane landfill site (the undertaking). This EA has a Ministry of Environment and Climate Change (MOECC) approved Terms of Reference (ToR) that sets out the overall framework and work plan for addressing the Ontario Environmental Assessment Act (EAA) requirements when preparing the EA. This work plan provides additional component-specific details in advance of commencing the assessment framework.

2.0 ASSESSMENT FRAMEWORK

2.1 Overall Approach

The proposed EA consists of the following steps:

- Step 1 – Describe the service area waste disposal needs for the minimum planning period ending in 2050;
- Step 2 – Develop criteria to be used in the evaluation of the alternative methods;
- Step 3 – Develop design concepts for alternative methods for expanding the existing Biggars Lane landfill site;
- Step 4 – Carry out the studies required to address the evaluation criteria;
- Step 5 – Describe the environment(s) potentially affected by the proposed undertaking;
- Step 6 – Using the evaluation criteria identified in Step 2, carry out an evaluation of the alternative methods for the proposed undertaking and identify the effects to the environment;
- Step 7 – Identify the preferred alternative method of landfill expansion; if the overall preferred alternative method of landfill expansion involves a base liner and leachate collection system (i.e., one of Alternatives 2 or 4), then carry out a comparative evaluation of alternative leachate management and treatment options using the methodology and criteria provided in Attachment C-10;
- Step 8 – Identify measures that may be necessary to prevent, change or mitigate possible environmental effects of the preferred alternative method;
- Step 9 – Prepare a description of the environmental advantages and disadvantages of the preferred alternative method based on net effects that will result following mitigation. The assessment of net effects include effects associated with the construction, operations and any closure/post closure periods of the preferred alternative method; and,
- Step 10 – Prepare monitoring and contingency plans to monitor for environmental effects.

Of these steps, the surface water component will participate in the development of Steps 4 through 10 as they pertain to this component.
2.2 Study Areas

Data for the EA will be collected and analyzed for three generic study areas presented in the ToR. The generic study areas are shown in Figures C-1 through C-3 and are described as follows:

- The Regional Study Area – encompasses the County of Brant and does not include the City of Brantford, Six Nations of the Grand River Territory, or the Mississaugas of the New Credit First Nation;
- The Local Study Area – Extends approximately 500 metres in all directions beyond the County-owned lands at the Biggars Lane landfill; and,
- The Site Study Area – Includes the County-owned lands at the Biggars Lane landfill located in the south part of Lot 1, 2nd Range East of Mount Pleasant Road in the County of Brant (former Township of Brantford).

For the surface water component, the generic study areas noted above will be modified to study the sub-watershed within which the Unnamed Creek is located.

2.3 Time Frame

The EA will consider potential effects on the environment at three project life cycle stages as follows:

- Construction Phase – This would include clearing, grading, construction of access roads, and initial construction of the landfill expansion cell(s);
- Operations (up to 2050) – This would include regular disposal activities over the course of the operating life of the Site, which is proposed as up to 2050. Ongoing, progressive construction of new disposal cells will also occur through this period; and,
- Closure/Post-closure (post 2050) – Site Closure and Post-closure activities (e.g., leachate management, landfill gas management, monitoring and maintenance) will occur over the contaminating lifespan of the landfill.

For the surface water component, the design and operational requirements for the surface water management system at full build out of the Site, i.e., closure and post-closure governs in terms of potential effects on the surface water environment.
3.0 ASSESSMENT CRITERIA AND INDICATORS

Draft environmental components, criteria, rationale, indicators and potential data sources were provided in the approved ToR and have been updated as part of proceeding into the EA stage. They are provided below related to the surface water component.

Table C-2.1: Assessment Criteria for Surface Water

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which alternative expansion design is preferred for protection of surface water quality?</td>
<td>The landfill expansion has the potential to affect surface water quality.</td>
<td>• Predicted changes in surface water quality on-Site and off-Site.</td>
<td>• Landfill expansion alternative methods&lt;br&gt;• Annual landfill monitoring reports and other Site reports related to surface water&lt;br&gt;• Site-specific stormwater design reports and assessments&lt;br&gt;• Topographic maps&lt;br&gt;• Facility layout, drainage maps and figures&lt;br&gt;• Published surface water quality information from the MOECC and Conservation Authority&lt;br&gt;• Proposed leachate control concept designs for landfill site expansion alternatives</td>
</tr>
<tr>
<td>Which alternative expansion design is preferred with regard to change to surface water quantity?</td>
<td>The landfill expansion has the potential to change on-Site surface drainage patterns and alter runoff and peak flows.</td>
<td>• Predict the need for existing stormwater management infrastructure upgrades to meet O.Reg. 232/98&lt;br&gt;• Predicted occurrence and degree of off-Site effects on surface water flows</td>
<td>• Landfill expansion alternative methods&lt;br&gt;• Topographic maps&lt;br&gt;• Existing Site specific stormwater design reports and assessments&lt;br&gt;• Air photos&lt;br&gt;• Site surveys and assessments&lt;br&gt;• Published water quantity and flow information from the MOECC, Environment Canada and Conservation Authority&lt;br&gt;• Site reconnaissance&lt;br&gt;• Concept design&lt;br&gt;• Predictive stormwater management modelling</td>
</tr>
</tbody>
</table>
4.0  DETAILED WORK PLAN

4.1  Step 4 – Carry Out Studies

The following tasks will be undertaken to characterize existing environmental conditions and/or provide information to assist with the assessment:

- Review surface water quality data and other Site reports related to surface water and stormwater management; and,
- Conduct surface water flow monitoring within the Unnamed Creek to assist with the evaluation of leachate treatment options, if required, based on the selected alternative expansion method (as described in Section 4.4).

4.2  Step 5 – Describe Environment Potentially Affected

The following tasks will be undertaken to further characterize existing environmental conditions:

- Review and summarize surface water quality data;
- Review and summarize existing surface water flow data;
- Review of Site topography to delineate sub-watersheds;
- Using an event based hydrologic model, calculate surface water runoff peak flow rates in the area of the Site under existing pre-development conditions, using 2, 5, 25 and 100 year design storms as set out in O.Reg. 232/98; and,
- Review existing stormwater management infrastructure against O.Reg. 232/98 requirements.

4.3  Step 6 – Predict Environmental Effects of Each Landfill Expansion Alternative Method

Using the evaluation criteria identified, an evaluation of the potential effects to the surface water environment from each of the alternative landfill expansion methods will be completed. The following activities will be carried out to predict the environmental effects on surface water for the alternative landfill expansion methods:

- Develop Site stormwater management concepts designs for the proposed alternatives to evaluate potential effects to surface water quantity and quality;
- Assess future surface water runoff and peak flows and quality conditions for a range of storm events (e.g., 2-, 5-, 25- and 100-year);
- Compare these predictions to the existing pre-development conditions; determine changes and potential adverse effects on downstream water courses;
- Determine if mitigation measures are required (Step 8), and if so develop conceptual mitigation, (e.g., engineered stormwater management measures/facilities); and,
- Document the factual information and analysis in a Surface Water Supporting Document that will form an appendix to the EA report.
The surface water component will generate predictions for use by other components where there are linkages. Predicted effects to surface water will be linked with the natural environment component for the assessment of potential effects to fish habitat.

4.4 Step 7 – Compare Alternative Expansion Methods and Identify the Preferred Alternative Expansion Method

The surface water discipline will compare the degree of potential effects quantitatively using the criteria and indicators for the surface water component. The alternative expansion methods will be ranked using the terminology of most preferred, equally preferred, moderately preferred and least preferred), and the preferred alternative expansion method will be identified from a surface water perspective.

The alternative which has the smallest predicted negative effect is ranked ‘Most Preferred’. The alternative that has the greatest predicted negative environmental effect is ranked ‘Least Preferred’. The remaining alternative(s) is ranked ‘Moderately Preferred’. If there are no measurable differences among the predicted effects of alternatives, they are ranked ‘Equally Preferred’. This information will be used to identify and describe the justification for selection of the ‘Most Preferred’ option from a surface water component perspective.

The EA team will then collect the component preferred alternative expansion methods and determine the overall preferred alternative expansion method.

If, depending on the preferred landfill expansion alternative identified, there is a need to assess and compare alternative methods of leachate management and treatment as described in Attachment C-10, the surface water discipline will provide input to the evaluation to assist in completion of the comparative evaluation. The input on surface water related to the Site is anticipated primarily to consist of: 1) the surface water quality and flow quantity characteristics of the Unnamed Creek as the potential receiver of treated effluent from the on-Site treatment plant option; and 2) the relative potential for the off-Site and on-Site leachate treatment options to adversely affect surface water resources in the Site Study Area and Local Study Area.

4.5 Step 8 – Identify Mitigation Measures Included in the Preferred Method

As part of Step 6, the surface water component will assess the potential effects from each of the alternative expansion methods. “In-design” mitigation measures¹ that were incorporated into the alternatives will be documented.

Following Step 7 and selection of the preferred alternative expansion method, additional mitigation measures, if required, will be identified and refined as necessary.

The prediction of future environmental effects on the surface water component will be carried out, assuming all mitigation measures are in place. The remaining effects or “net effects” will be documented.

¹ Mitigation measures are actions taken to avoid or reduce potential adverse effects. Mitigation measures incorporated into the design of the project works and activities before the assessment takes place are referred to as ‘in-design’ mitigation measures.
4.6 Step 9 – Advantages and Disadvantages of the Preferred Method

A description of the environmental advantages and disadvantages of the preferred alternative expansion method based on net effects will be prepared for the surface water component.

4.7 Step 10 – Monitoring and Contingency Plans

The surface water component will prepare a monitoring program appropriate for the preferred landfill expansion alternative, and a conceptual contingency plan approach. This monitoring and contingency planning process will confirm the effectiveness of mitigation measures. Contingency planning will outline the steps necessary to address unforeseen events or ineffective mitigation measures that pose risk to the elements of the surface water environment.

The results of Steps 7 to 10 of the assessment will complete the Surface Water Supporting Document.
ATTACHMENT C-3
Natural Environment Work Plan
ATTACHMENT C-3

Natural Environment (Biology) Work Plan
Biggars Lane Landfill Expansion EA
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1.0 INTRODUCTION

This document presents the proposed work plan for the natural environment (biology) component of the environmental assessment (EA) to secure additional landfill disposal capacity for the County of Brant by means of an expansion at the Biggars Lane landfill site (the undertaking). This EA has a Ministry of Environment and Climate Change (MOECC) approved Terms of Reference (ToR) that sets out the overall framework and work plan for addressing the Ontario Environmental Assessment Act (EAA) requirements when preparing the EA. This work plan provides additional component-specific details in advance of commencing the assessment framework.

2.0 ASSESSMENT FRAMEWORK

2.1 Overall Approach

The proposed EA consists of the following steps:

- Step 1 – Describe the service area waste disposal needs for the minimum planning period ending in 2050;
- Step 2 – Develop criteria to be used in the evaluation of the alternative methods;
- Step 3 – Develop design concepts for alternative methods for expanding the existing Biggars Lane landfill site;
- Step 4 – Carry out the studies required to address the evaluation criteria;
- Step 5 – Describe the environment(s) potentially affected by the proposed undertaking;
- Step 6 – Using the evaluation criteria identified in Step 2, carry out an evaluation of the alternative methods for the proposed undertaking and identify the effects to the environment;
- Step 7 – Identify the preferred alternative method of landfill expansion; if the overall preferred alternative method of landfill expansion involves a base liner and leachate collection system (i.e., on of Alternatives 2 or 4), then carry out a comparative evaluation of alternative leachate management and treatment options using the methodology and criteria provided in Attachment C-10;
- Step 8 – Identify measures that may be necessary to prevent, change or mitigate possible environmental effects of the preferred alternative method;
- Step 9 – Prepare a description of the environmental advantages and disadvantages of the preferred alternative method based on net effects that will result following mitigation. The assessment of net effects include effects associated with the construction, operations and any closure/post closure periods of the preferred alternative method; and,
- Step 10 – Prepare monitoring and contingency plans to monitor for environmental effects.

Of these steps, the natural environment component will participate in the development of Steps 4 through 10 as they pertain to this component.
2.2 Study Areas

Data for the EA will be collected and analyzed for three generic study areas presented in the ToR. The generic study areas are shown on Figures C-1 through C-3 and are described as follows:

- The Regional Study Area – encompasses the County of Brant and does not include the City of Brantford, Six Nations of the Grand River Territory, or the Mississaugas of the New Credit First Nation;
- The Local Study Area – Extends approximately 500 metres in all directions beyond the County-owned lands at the Biggars Lane landfill; and,
- The Site Study Area – Includes the County-owned lands at the Biggars Lane landfill located in the south part of Lot 1, 2nd Range East of Mount Pleasant Road in the County of Brant (former Township of Brantford).

The generic study areas noted above may be modified during the EA to suit the requirements of the natural environment component.

2.3 Time Frame

The EA will consider potential project effects on the environment at three project life cycle stages as follows:

- Construction Phase – This would include clearing, grading, construction of access roads, and initial construction of the landfill expansion cell(s);
- Operations (up to 2050) – This would include regular disposal activities over the course of the operating life of the Site, which is proposed as up to 2050. Ongoing, progressive construction of new disposal cells will also occur through this period; and,
- Closure/Post-closure (post 2050) – Site Closure and Post-closure activities (e.g., leachate management, landfill gas management, monitoring and maintenance) will occur over the contaminating lifespan of the landfill.
### 3.0 ASSESSMENT CRITERIA AND INDICATORS

Draft environmental components, criteria, rationale, indicators and potential data sources were provided in the MOECC approved ToR and have been updated as part of proceeding into the EA stage. They are provided below related to the natural environment component.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
</table>
| **Which alternative expansion design is preferred with regard to protection of aquatic ecosystems?** | Establishment of additional landfill capacity could alter the functioning of natural aquatic habitats and species. | • Predicted changes in baseflow and surface water quality  
• Predicted effect on aquatic habitat  
• Predicted effect on aquatic biota including rare, threatened or endangered species | • Landfill expansion alternative methods  
• Site reconnaissance and field surveys  
• Grand River Conservation Authority (GRCA) studies, such as ESAs, watershed/subwatershed plans  
• Existing Site surveys  
• Other published data sources (i.e., MOECC, Ministry of Natural Resources and Forestry (MNRF), Conservation Authority, Environment Canada)  
• Results of surface water assessments  
• Municipal Official Plan  
• Aerial photographic mapping |
| **Which alternative expansion design is preferred with regard to protection of terrestrial ecosystems?** | Establishment of additional landfill capacity could alter the functioning of natural terrestrial habitats and vegetation. | • Predicted effect on vegetation communities  
• Predicted effect on wildlife and wildlife habitat  
• Identification of any sensitive or significant species or their habitat potentially affected (direct or indirect) | • Landfill expansion alternative methods  
• Site reconnaissance and field surveys  
• Air photos  
• GRCA Terrestrial Natural Heritage System Study  
• Existing Site surveys and assessments  
• Other published data sources (i.e., MOECC, MNRF, Conservation Authority, Environment Canada)  
• Municipal Official Plan  
• Aerial photographic mapping |
4.0 DETAILED WORK PLAN

4.1 Step 4 – Carry Out Studies

Natural environment studies completed for the EA will include a desktop review as well as detailed field surveys. The Ontario MNRF will be consulted prior to conducting the field program, to ensure Species at Risk (SAR), rare wildlife species, or rare plant communities are appropriately addressed and that the most recent survey protocols are used. If any of these are found to be present or likely to be affected by the proposed project, the appropriate measures will have to be taken to obtain approvals for the project to proceed. The study results will be documented and provided in a report supporting the EA.

4.1.1 Desktop Review

A desktop review of data and information available for the Site Study Area and the Local Study Area will be completed to identify significant natural heritage features, or functions, that occur or have the potential to occur. The desktop review will use information available from sources, including, but not limited to:

- MNRF Natural Heritage Information Centre (NHIC) Biodiversity Explorer geographic, species and natural areas information (including Areas of Natural and Scientific Interest [ANSI] and Provincially Significant Wetlands [PSW]);
- Readily available MNRF mapping and existing studies. A data request will be submitted to MNRF to obtain any additional information that they hold, including the location of significant deer yarding areas;
- Information (including any watershed studies and wetland mapping) and mapping available through the GRCA;
- Species at Risk (SAR) mapping to determine if the project is located within the range for species regulated under the Ontario Endangered Species Act, 2007;
- Atlas of Breeding Birds of Ontario (Cadman; et al. 2007);
- Atlas of the Mammals of Ontario (Dobbyn 1994);
- Reptiles and Amphibians of Ontario (Ontario Nature 2013);
- Bat Conservation International (BCI) range maps (BCI 2013);
- County of Brant Official Plan (2012);
- Information contained in natural heritage related map layers from Ontario Base Map series, Natural Resource Values Information System (NRVIS) mapping and Land Information Ontario; and,
- Existing aerial photography.
Species at Risk Screening

Species at Risk (SAR) considered for the assessment will include those species listed in the Ontario Endangered Species Act (ESA; 2007), the federal Species at Risk Act (SARA; 2002), and species of provincial concern (i.e., ranked S1 to S3 in the NHIC). A screening of all SAR that have the potential to be found in the Local Study Area will be conducted first as a desktop exercise, using the sources listed above. Species with ranges overlapping the Site Study Area, or recent occurrence records in the vicinity, will be screened by comparing their habitat requirements to habitat conditions in the vicinity of the Site Study Area, based on aerial photography. During the field surveys, suitable habitats for all SAR identified through the desktop screening will be searched for, and signs of individuals will be recorded.

4.1.2 Field Data Collection and Characterization

A natural environment field program will be undertaken to characterize existing terrestrial and aquatic environmental baseline conditions, including the temporal and spatial distribution of natural features on the Site Study Area. Examples of natural heritage features with potential to occur on the Site Study Area include plant communities and wetland communities, wildlife, SAR, significant portions of the habitat of endangered and threatened species, species of conservation concern, and designated natural areas (including but not limited to ANSI, PSW, significant woodlands, and significant valleylands). The natural environment field program will be separated into terrestrial and aquatic environment components as described in the following sections. It is noted that for the findings to be considered valid, the studies necessarily have to occur during specific seasons of the year and cover the spring, summer and fall periods as described below.

Aquatic Environment

Aquatic environment component surveys will consist of fisheries, aquatic habitat and benthic components and will be completed over a three season period, as described below.

Spring Survey

A reconnaissance of the surface water features, including watercourses and waterbodies, within the Site Study Area and Local Study Area where there is connectivity to the watercourses within the Site Study Area (where access is available) will be undertaken to select aquatic sampling stations. Stations will be selected based on similarity of habitat to allow for the comparison of fish and benthic communities among stations. Locations of sampling stations will also depend on road access, land access and logistical constraints. Two reference sampling stations beyond the influence of the existing landfill will also be sited.

Detailed habitat mapping and incidental wildlife observations will be recorded on standardized datasheets. Descriptions and mapping of aquatic habitats will include measurements of wetted channel width, depth, flow, velocity, substrate composition, and in-stream cover. Typically, a 150 m (minimum) section of representative habitat will be mapped within a stream section to show the distribution and relative abundance of distinct habitat types (e.g., cascades, riffles, runs, pools). Representative photos of stream and other open water body habitat will be taken from the upstream and downstream locations at each station, where applicable. Standard in situ water quality parameters (temperature, dissolved oxygen, pH, turbidity and conductivity) will be collected in the watercourses and waterbodies within the Site Study Area and at the reference stations during the spring survey.
Summer Survey
An application for a scientific fish collection permit will be prepared and submitted to the MNRF to support a fish community survey.

A fish community inventory will be conducted during the permissible in water working period (i.e., summer) by a two-person crew using a backpack electrofisher. Survey stations identified in the spring survey will be sampled (i.e., shocked) for a minimum of 150 m or 40 times the wetted width to ensure reliable estimates of species occurrences and that rare habitats are encountered. All captured fish will be identified to species level and measured.

If the timing of the work is such that field surveys commence in the spring of the year, the fish habitat mapping completed during the spring survey will be confirmed and supplemented with new data, as appropriate. However, if the project timing is such that the field surveys commence in the summer, the stations will be selected during the summer survey and the work described above will be completed. This will be confirmed during subsequent surveys in the fall and spring. Basic in-situ water quality data will be collected and photos of the surface water features will be taken at the same stations that were selected during the spring survey.

Fall Survey
During the fall, a two-person crew will sample fish and macroinvertebrates at the established stations.

During the fall survey, benthic macroinvertebrate sampling will be conducted using a 0.72 m² fixed-area sample from a standard habitat unit according to methods described in the Ontario Benthos Biomonitoring Network: Protocol Manual (Jones, et al. 2007). A 500 µm mesh D-framed dipnet will be jabbed into the substrate to a depth of 5 cm, and swept forward until the net is filled with disturbed materials. A minimum of three jabs will be pooled to create one sample. The number of jab and sweep samples pooled per replicate will be recorded, as well as depth. All benthic samples will be submitted to an accredited benthic laboratory for sorting and identification of the organisms.

If, during the spring and/or summer survey an alternative benthic sampling technique is deemed necessary, the work plan will identify this adjustment and describe the chosen technique.

Sediment samples will be collected using a standard Ekman grab (6 x 6) at each station. Samples will be sent to a private analytical laboratory for metals analyses including particle size to aid in Site description, and for analysis of the benthic community.

Terrestrial Environment
The overall objective of the terrestrial environment component will be to characterize existing terrestrial environmental baseline conditions in the area of the proposed project expansion within the Site Study Area vicinity.

Ecological Land Classification, Wetland, and Vegetation Surveys
Following accepted protocols (Lee et al. 1998), plant communities within the Site Study Area will be delineated using Ecological Land Classification (ELC) by provincially recognized staff. A plant inventory and rare plant survey will be carried out. Habitats where plant SAR could occur will be investigated and any rare, threatened, or endangered plants (e.g., butternut) will be identified. The location(s) of identified species with special conservation status will be mapped using hand-held Global Positioning System (GPS) units. Three ELC/plant surveys will be conducted between late spring and late summer/early fall to cover the blooming season of various species.
(e.g., spring for forest flowering plants such as *Trillium* spp. and *Viola* spp. [violet species], mid-summer for *Juncus* spp. [rush species] and *Carex* spp [sedge species], late summer for *Aster* spp. and *Solidago* spp. [goldenrod species]). Results from the ELC surveys will be used to determine whether additional taxa-specific surveys, including SAR searches, will be required.

**Avian Surveys**

Based on the results of the desktop review and Site observations, several different avian survey methods may be required to sample bird species that may be found in the Site Study Area, including the following:

- **Breeding Raptor Surveys** – One breeding raptor survey is planned in spring. An area search will be used to search for breeding adults, nests or other breeding evidence. Observations of raptors will also be made during Breeding Bird Surveys (BBS) and other survey types. Depending on the species identified as potentially occurring within the Site Study Area during the desktop review, species-specific playback may be utilized to detect those species that are known to respond (e.g., red-shouldered hawk *Buteo lineatus*);

- **Owl Surveys** – One breeding owl survey is planned in spring, in conjunction with nocturnal amphibian surveys (described below). Surveys may include silent listening as well as playback for species such as the eastern screech owl (*Megascops asio*). All species of owls and other nocturnal wildlife that are encountered will be identified during these surveys. Incidental observations of wildlife will be noted during other field surveys;

- **Breeding Bird Surveys (BBS)** – Two BBS will be conducted on the Site Study Area, planned for between May and July. The surveys will consist of point count stations distributed throughout all natural habitats within the Site Study Area (including SAR habitat). BBS will begin one-half hour before sunrise and will generally be completed by 10:00 a.m. The surveys will be conducted when weather conditions (i.e., precipitation and wind) are within the parameters required by monitoring programs such as the Canadian Wildlife Service (CWS) Breeding Bird Survey. Each survey station will be visited for ten minutes and all species heard or seen will be identified. Other data collected will include, but not be limited to, distance of birds from observer, notable behaviours, sex and age (where possible); and,

- **Eastern Whip-poor-will, Common Nighthawk and Chimney Swift Surveys** – These species are crepuscular and nocturnal by nature and require their own survey protocol. Therefore, nocturnal point count surveys at several stations are planned during May or June, when these species are most vocal, if there is suitable habitat within the Site Study Area. An effort will be made to conduct this survey within one week of the full moon, when the eastern whip-poor-will is most active. If it is determined through the desktop review, or previous field surveys that there is no suitable habitat for these species within the Site Study Area, these surveys will be curtailed. All other nocturnal wildlife observed will be identified during this survey.

**Mammal Surveys**

Track/sign/scat surveys and visual encounter surveys will be conducted, concurrently with other field surveys from April to October, to identify mammal activity within the Site Study Area.
Amphibian Surveys

Three nocturnal amphibian (frogs and toads) surveys will be conducted between late April and July, following standardized protocols that are consistent with the Marsh Monitoring Program (Konze and McLaren 1997). The surveys will be conducted at stations within, and adjacent to, appropriate habitats within the Site Study Area including wetlands and waterbodies. The surveys will be completed by listening for calling frogs and toads starting a half hour after local sunset. At each station, three minute surveys will be completed and amphibians will be identified by their unique vocalization. Abundance will be estimated based upon the intensity of the calling activity.

Reptile Surveys

During spring, an area search will be conducted to search for emerging or basking snakes, including SAR. Areas of high potential for use as hibernacula or basking sites, such as rock piles and building foundations, will be searched.

Five turtle basking surveys, including for SAR turtles, will be conducted, in May and June using MNRF survey protocols (2012). Two turtle nesting surveys will be conducted during the appropriate nesting season of each species with a potential to occur within the Site Study Area. Surveys will take place at the edge of wetlands, ponds, or other waterbodies, or adjacent potential nesting areas. Basking survey stations will be approached quietly and carefully, using existing vegetation as a blind. High power binoculars (10 x magnification) and/or spotting scopes will be used to conduct the surveys. Turtle nesting surveys will include modified area searches following procedures recommended by MNRF SAR biologists. If it is determined through the desktop review or previous field surveys that there is not suitable habitat within the Site Study Area for turtle basking or nesting, these surveys will be curtailed.

Reptiles and amphibians will also be surveyed through visual encounter surveys in all potential suitable habitats within the Site Study Area concurrent with other spring and summer surveys following recommended protocols (MNR 2013a, MNR 2013b, McDiarmid 2012). Potential hiding areas, such as logs and debris, will be searched as well.

Butterfly and Dragonfly Surveys

Area searches in suitable habitat and incidental observations of butterflies and dragonflies will be conducted. Close focus binoculars and butterfly nets will be used to identify species, where necessary. In addition, habitat for rare and/or listed species (e.g., Monarch) will be identified during ELC surveys. In addition, opportunistic surveys for butterflies and dragonflies will be conducted concurrently with all other surveys.

Other Species (including Species at Risk)

Based on the desktop review and the preliminary SAR screening, a list of SAR species that have moderate or high potential to occur within the Site Study Area, based on habitat conditions, will be compiled. Most SAR will be covered by the previously mentioned surveys (e.g., BBS surveys for Cerulean Warbler, Basking Counts and Area Search for Blanding’s Turtle, Butterfly surveys for Monarch, Vegetation Surveys for Butternut, Fish Community Surveys).

If the data collected under the current study approach does not confirm the presence/absence of a SAR, then additional species-specific surveys will be scoped, costed and conducted, based upon consultation with the MNRF to provide this confirmation.
4.2 Step 5 – Describe Environment Potentially Affected

A report will be prepared to provide a current assessment of terrestrial and aquatic resources to assist with the development of the EA. It will include a description of key natural environment features within the Site Study Area and Local Study Area.

The report will include a description of the plant communities and vascular plants within the Site Study Area, as well as wildlife and wildlife habitat use, including SAR. The report will also include descriptions of fish, habitat and macroinvertebrate assemblages per each watercourse section. Assemblages will be described using standard metrics measuring functional and structural attributes of the community, for example, fish abundance, macroinvertebrate density and diversity, and relative abundance of EPT taxa (Ephemeroptera, Plecoptera, and Trichoptera).

To aid with the interpretation of biological summaries, data on the physical-chemical environment, watercourse size and surrounding land use will also be provided per sampling location. The report will include descriptions of habitat of fish species (e.g., locations, availability, important spawning areas) and this information will be incorporated with the surface water component to describe the potential effects of the proposed Project on this aspect of the natural environment.

An assessment of potential effects (Step 6) of the project on the natural environment will be included as well as recommended mitigation measures (Step 8).

4.3 Step 6 – Predict Environmental Effects of Each Landfill Expansion Alternative Method

Using the evaluation criteria identified, an evaluation of the potential effects to the natural environment from each of the alternative landfill expansion methods will be completed. Based on the conceptual landfill design and in-design mitigation measures, potential effects of the proposed landfill expansion will be assessed. Where project-environment interactions are identified, the natural environment component team will work closely with the Design and Operations (D&O) discipline team to understand the development plan and the associated effects to the terrestrial and aquatic environment. Qualitative assessment methods will be employed where the development plan is detailed enough to allow numerical calculation of changes to the Site Study Area over time. For example, this may apply to a change in water balance for the Site Study Area, which would drive any potential changes to water quality. Qualitative analysis, based on the experience and professional opinion of the biologists, will be applied to evaluate effects to the natural environment for ecosystem components that are not as easily quantified, such as noise and airborne contaminants.

The natural environment component will generate predictions for use by other components where there are linkages. Similarly, in order to assess potential effects, the natural environment component will require predictions from other disciplines, including, but not limited to, the atmospheric, surface water and hydrogeology environment components.

4.4 Step 7 – Compare Alternative Expansion Methods and Identify the Preferred Alternative Expansion Method

The natural environment component discipline will compare the degree of potential effects qualitatively using the criteria and indicators for the natural environment component. The alternative expansion methods will be ranked using the terminology of most preferred, equally preferred, moderately preferred and least preferred), and the preferred alternative expansion method will be identified from a natural environment component perspective.
The alternative which has the smallest predicted negative effect is ranked ‘Most Preferred’. The alternative that has the greatest predicted negative environmental effect is ranked ‘Least Preferred’. The remaining alternative(s) is ranked ‘Moderately Preferred’. If there are no measurable differences among the predicted effects of alternatives, they are ranked ‘Equally Preferred’. This information will be used to identify and describe the justification for selection of the ‘Most Preferred’ option from a natural environment component perspective.

The EA team will then collect the component preferred alternative expansion method and determine the overall preferred alternative expansion method.

If, depending on the preferred landfill expansion alternative identified, there is a need to assess and compare alternative methods of leachate management and treatment as described in Attachment C-10, the natural environment-related potential effects will be described qualitatively as input to the comparative evaluation of leachate management and treatment options.

4.5 Step 8 – Identify Mitigation Measures Included in the Preferred Method

As part of Step 6, the natural environment component assessed the potential effects from each of the alternative expansion methods. “In-design” mitigation measures¹ that were incorporated into the alternatives will be documented.

Following Step 7 and selection of the preferred alternative expansion method, additional mitigation measures, if required, will be identified and refined as necessary.

The prediction of future environmental effects on the natural environment component will be carried out, assuming all mitigation measures are in place. The remaining effects or “net effects” will be documented.

4.6 Step 9 – Advantages and Disadvantages of the Preferred Method

A description of the environmental advantages and disadvantages of the preferred alternative expansion method based on net effects will be prepared for the natural environment component.

4.7 Step 10 – Monitoring and Contingency Plans

The natural environment component will prepare a monitoring program appropriate for the preferred landfill expansion alternative, and a conceptual contingency plan approach. This monitoring and contingency planning process will confirm the effectiveness of the mitigation measures. Contingency planning will outline the steps necessary to address unforeseen events or ineffective or defective mitigation measures that pose risk to natural environment elements.

The results of Steps 6 to 10 of the assessment will be documented in the natural environment report.

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¹ Mitigation measures are actions taken to avoid or reduce potential adverse effects. Mitigation measures incorporated into the design of the project works and activities before the assessment takes place are referred to as ‘in-design’ mitigation measures.
5.0 REFERENCES


ATTACHMENT C-4
Atmosphere Work Plan
ATTACHMENT C-4

Atmosphere Work Plan
Biggers Lane Landfill Expansion EA

May 2016
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1.0 INTRODUCTION

This document presents the proposed work plan for the atmosphere component of the environmental assessment (EA) to secure additional landfill disposal capacity for the County of Brant by means of an expansion at the Biggars Lane landfill site (the undertaking). This EA has a Ministry of Environment and Climate Change (MOECC) approved Terms of Reference (ToR) that sets out the overall framework and work plan for addressing the Ontario Environmental Assessment Act (EAA) requirements when preparing the EA. This work plan provides additional component-specific details in advance of commencing the assessment framework.

2.0 ASSESSMENT FRAMEWORK

2.1 Overall Approach

The proposed EA consists of the following steps:

- Step 1 – Describe the service area waste disposal needs for the minimum planning period ending in 2050;
- Step 2 – Develop criteria to be used in the evaluation of the alternative methods;
- Step 3 – Develop design concepts for alternative methods for expanding the existing Biggars Lane landfill site;
- Step 4 – Carry out the studies required to address the evaluation criteria;
- Step 5 – Describe the environment(s) potentially affected by the proposed undertaking;
- Step 6 – Using the evaluation criteria identified in Step 2, carry out an evaluation of the alternative methods for the proposed undertaking and identify the effects to the environment;
- Step 7 – Identify the preferred alternative method of landfill expansion. If the overall preferred alternative method of landfill expansion involves a base liner and leachate collection system (i.e., one of Alternatives 2 or 4), then carry out a comparative evaluation of alternative leachate management and treatment options using the methodology and criteria provided in Attachment C-10;
- Step 8 – Identify measures that may be necessary to prevent, change or mitigate possible environmental effects of the preferred alternative method;
- Step 9 – Prepare a description of the environmental advantages and disadvantages of the preferred alternative method based on net effects that will result following mitigation. The assessment of net effects include effects associated with the construction, operations and any closure/post closure periods of the preferred alternative method; and,
- Step 10 – Prepare monitoring and contingency plans to monitor for environmental effects.

Of these steps, the atmosphere component will participate in the development of Steps 4 through 10 as they pertain to this component.
2.2 Study Areas

Data for the EA will be collected and analyzed for three generic study areas presented in the ToR. The generic study areas are shown on Figures C-1 through C-3 and are described as follows:

- The Regional Study Area – encompasses the County of Brant and does not include the City of Brantford, Six Nations of the Grand River Territory, or the Mississaugas of the New Credit First Nation;
- The Local Study Area – Extends approximately 500 metres in all directions beyond the County-owned lands at the Biggars Lane landfill; and,
- The Site Study Area – Includes the County-owned lands at the Biggars Lane landfill located in the south part of Lot 1, 2nd Range East of Mount Pleasant Road in the County of Brant (former Township of Brantford).

The generic study areas noted above may be modified during the EA to suit the requirements of the atmosphere component. The Local Study Area may be expanded to approximately 1500 m in all directions beyond the County-owned lands at the Biggars Lane landfill site for the noise criterion of the atmosphere component. This Local Study Area is expected to encompass all Point(s) of Reception (POR[s]) where noise effects from project activities, within the Site Study Area, could affect humans.

2.3 Time Frame

The EA will consider potential effects on the environment at three project life cycle stages as follows:

- Construction Phase – This would include clearing, grading, construction of access roads, and initial construction of the landfill expansion cell(s);
- Operations (up to 2050) – This would include regular disposal activities over the course of the operating life of the Site, which is proposed as up to 2050. Ongoing, progressive construction of new disposal cells will also occur through this period; and,
- Closure/Post-closure (post 2050) – Site Closure and Post-closure activities (e.g., leachate management, landfill gas management, monitoring and maintenance) will occur over the contaminating lifespan of the landfill.
3.0 ASSESSMENT CRITERIA AND INDICATORS

Draft environmental components, criteria, rationale, indicators and potential data sources were provided in the approved ToR and have been updated as part of proceeding into the EA stage. They are provided below related to the atmosphere component.

Table C-4.1: Atmospheric Assessment Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which alternative expansion is preferred regarding potential effects to air quality?</td>
<td>The establishment of a landfill expansion may produce air emissions that may degrade off-Site air quality.</td>
<td>• Predicted concentrations of indicator compounds at the property boundary and at off-Site sensitive receptors</td>
<td>• Landfill expansion alternative methods&lt;br&gt; • Environment Canada or MOECC’s regional air quality data, hourly meteorological data and Climate Normals&lt;br&gt; • Aerial photographic mapping and field reconnaissance&lt;br&gt; • Published or other accepted emission factors&lt;br&gt; • Existing Site-specific studies and reports&lt;br&gt; • Predictive modelling</td>
</tr>
<tr>
<td>Which alternative expansion is preferred regarding potential changes to odour?</td>
<td>The establishment of a landfill expansion may result in increased odour emissions.</td>
<td>• Predicted odour concentrations at off-Site existing sensitive receptors</td>
<td>• Landfill expansion alternative methods&lt;br&gt; • Environment Canada or MOECC’s regional air quality data, hourly meteorological data and Climate Normals&lt;br&gt; • Aerial photographic mapping and field reconnaissance&lt;br&gt; • Provincial air regulations and standards, and MOECC air guidance documents&lt;br&gt; • Published or other accepted odour source data&lt;br&gt; • Odour complaints history&lt;br&gt; • Existing Site-specific studies and reports&lt;br&gt; • Predictive modelling</td>
</tr>
<tr>
<td>Which alternative expansion is preferred regarding potential changes to noise?</td>
<td>The establishment of a landfill expansion may result in noise emissions that may increase off-Site noise levels.</td>
<td>• Predicted noise levels beyond the project property boundary and at the discrete off-Site sensitive Points of Reception (PORs) (existing and vacant lots)</td>
<td>• Landfill expansion alternative methods&lt;br&gt; • Existing Site-specific studies and reports&lt;br&gt; • Aerial photographic mapping and field reconnaissance&lt;br&gt; • MOECC’s noise guidance documents&lt;br&gt; • Site-specific equipment noise measurements&lt;br&gt; • Consultant’s database of similar noise sources&lt;br&gt; • Monitoring of existing noise at PORs&lt;br&gt; • Noise complaints history&lt;br&gt; • Predictive modelling</td>
</tr>
</tbody>
</table>
4.0 DETAILED WORK PLAN

4.1 Step 4 – Carry Out Studies

The atmosphere component comprises two subcomponents for the purposes of the EA: air quality (which includes air quality and odour) and noise.

The air quality and odour study will be conducted in accordance with a methodology approved by the MOECC. It will include a desktop study using predictive modelling to assess potential air quality and odour emissions associated with the expanded landfill operations at the property boundary and/or off-Site sensitive receptors (as applicable), and comparison of the predictions to provincial standards and regulations.

A noise assessment of the alternative expansion methods will be prepared in accordance with the MOECC guidance documents. The noise assessment will be completed through a literature review of previously prepared studies and available aerial imagery, a field program to supplement the literature review, and predictive modelling. The assessment will consider on-Site and off-Site project activities. The noise emissions from the Site at sensitive POR(s) (existing and vacant lots) will be predicted in accordance with MOECC publication “Noise Guidelines for Landfill Sites” and NPC-300 “Environmental Noise Guideline – Stationary and Transportation Sources – Approval and Planning” (as applicable) for the worst-case hour of operation. The assessment of potential vacant lot noise will be carried out for the preferred expansion alternative only.

4.2 Step 5 – Describe Environment Potentially Affected

4.2.1 Air Quality

The following tasks will be undertaken to characterize existing environmental conditions:

- Review conceptual components of the proposed Biggars Lane landfill expansion;
- Compile and interpret information from existing data sources, including information available from Environment Canada and the MOECC air quality monitoring data from local stations;
- Based on consultation with the MOECC, the review of existing information and the project description, identify information gaps and data needs;
- Conduct a Site reconnaissance to confirm Site information compiled from existing documentation and finalize the location and nature of potential off-Site receptors;
- Compile and document climate normals for the Site, and document the existing climatic conditions;
- Define existing (baseline) conditions; and,
- Determine "linkages" with other components and data generation/transfer requirements (e.g., link with natural environment, land use and economic components).

The existing conditions will be documented as part of a technical document in support of the EA.
4.2.2 Noise

The existing noise environment at off-Site POR(s), in the vicinity of the Site, will be documented through the literature review and field program, where existing noise levels at a number of representative POR(s) will be measured by monitoring. The established baseline noise levels will be compared to MOECC expected levels based on the MOECC guidance documents, and used to assess the potential effects of the project. An Acoustic Assessment Report will be developed in accordance with the MOECC Publication NPC-233.

4.3 Step 6 – Predict Environmental Effects of Each Landfill Expansion Alternative Method

The Province of Ontario has regulations and standards for air quality and noise, which set limits protective of the surrounding environment and the use and enjoyment of property. A facility such as the Biggars Lane Landfill will not be approved or permitted to operate unless it is demonstrated to the MOECC that it can be designed and operated to meet the provincial air quality and noise standards. Prior to commencing the studies the atmospheric component will:

- Consult with the MOECC to decide on the air dispersion/noise modelling approach and protocols to be used in the assessment;
- Use existing Site information and published information (and, only if required, conduct noise measurements at other sites with similar equipment to determine the expected noise emissions from Site operations); and,
- Gather published odour data at sites with similar activities.

4.3.1 Air Quality

Upon collection of data required for the assessment of air quality and odour, the following study will be completed:

An initial semi-quantitative assessment of predicted air quality and odour emissions for each landfill expansion alternative method will be conducted. Air emissions from the landfill expansion alternative methods (e.g., on-Site haul roads, excavation operations, the landfill) will be estimated. This will be followed by the execution of an atmospheric dispersion model. A unitized dispersion modelling approach will be conducted to assess the air quality dispersion factors for each of the landfill expansion scenarios. The result will be predicted dispersion factors for air quality and odour effects that will subsequently be used to select the preferred alternative method. The dispersion factors will focus on property line (for air quality) and off-Site sensitive receptors for odour that were identified during the site reconnaissance. In support of the air quality and odour assessment described above, the following will be completed:

- The development of an AERMOD atmospheric dispersion model protocol for the Site that will be developed in consultation with the MOECC to agree on the dispersion modelling approach and input parameters; and,
- The approved protocol will be used to conduct the modelling for the Site, which will be used to predict effects of the proposed operations. Based on the complexity (or simplicity) of local conditions, changes to the selected atmospheric dispersion model may be made. Changes to the dispersion model will be done in consultation with the MOECC.
The appropriate meteorological dataset will be obtained from the MOECC for use in the AERMOD model. Using the evaluation criteria identified, an evaluation of the potential effect to the environment from each of the alternative landfill expansion methods will be completed.

4.3.2 Noise

A detailed noise prediction model will be developed in accordance with the International Standards Organization (ISO) 9613 Acoustics: Attenuation of Sound during Propagation Outdoors, an internationally accepted prediction algorithm used to predict the propagation of noise levels in the outdoor environment. The noise modelling will take ground cover and physical barriers, either natural (terrain based) or constructed, and atmospheric absorption into consideration as they relate specifically to the undertaking. In developing the quantitative predictive noise model, source-specific data from on-Site measurements, and data from the consultant’s database of similar sources to predict project-specific noise levels will be used. The predicted project noise levels will be compared to existing levels and MOECC established noise limits to assess the potential effects.

Using the evaluation criteria identified, an evaluation of the potential effects to the atmosphere environment from each of the alternative landfill expansion methods will be completed.

4.3.3 Linkages

The atmosphere component will generate predictions for use by other components where there are linkages.

4.4 Step 7 – Compare Alternative Expansion Methods and Identify the Preferred Alternative Expansion Method

4.4.1 Air Quality

The atmosphere component discipline will compare the degree of potential effects semi-quantitatively using the emission dispersion factors as they relate to criteria and indicators for air quality.

The preferred alternative will be assessed for air quality and odour in a similar matter but will include a full quantitative assessment and the results of the dispersion modelling will be compared to existing regulatory limits to determine the effect of the preferred alternative. In addition, the dispersion modelling results will be provided to other disciplines for further assessment. The air quality assessment will be conducted using MOECC approved methodology. Odour effect will be determined using published odour data and following the guidance in the MOE Technical Bulletin Methods for Modeling Assessments of Contaminants with 10-minute average standards for odours and guidelines under O.Reg. 419/05.

4.4.2 Noise

The atmosphere component discipline will also compare the degree of potential effects quantitatively using the criteria and indicators for noise.
4.4.3 Overall Component and Project Preferred Alternative Expansion Method

The alternative expansion methods will be ranked using the terminology of most preferred, equally preferred, moderately preferred and least preferred, and the preferred alternative expansion method will be identified from an atmosphere perspective.

The alternative that has the smallest predicted negative effect is ranked 'Most Preferred'. The alternative that has the greatest predicted negative environmental effect is ranked 'Least Preferred'. The remaining alternative(s) is ranked 'Moderately Preferred'. If there are no measurable differences among the predicted effects of alternatives, they are ranked 'Equally Preferred'. This information will be used to identify and describe the justification for selection of the 'Most Preferred' option from an atmosphere component perspective.

When each component preferred alternative expansion method is available, the EA team will determine the overall preferred alternative expansion method.

If, depending on the preferred landfill expansion alternative identified, there is a need to assess and compare alternative methods of leachate management and treatment as described in Attachment C-10, the atmosphere-related potential effects will be described qualitatively as input to the comparative evaluation of leachate management and treatment options.

4.5 Step 8 – Identify Mitigation Measures Included in the Preferred Method

As part of Step 6, the atmosphere component assessed the potential effects from each of the alternative expansion methods. “In-design” mitigation measures1 that were incorporated into the alternatives will be documented.

Following Step 7 and selection of the preferred alternative expansion method, additional mitigation measures, if required, will be identified and refined as necessary.

The prediction of future environmental effects on the atmosphere component will be carried out, assuming all mitigation measures are in place. The remaining effects or “net effects” will be documented.

As described above in Step 7, once the preferred alternative method is selected, additional predictive modelling will be performed to complete the quantitative assessment and include the assessment of the conceptual design of the landfill gas collection system on air quality and odour effects. The results from this additional modelling will be assessed against the Ontario regulations and standards for air quality such as Regulation 419/05 and the Ambient Air Quality Criteria. Similarly, an assessment of potential noise effects at vacant lots in the Local Study Area will be completed. The assessments will be reported in the technical document in support of the EA. If the modelling of the selected preferred alternative expansion scenario suggests that the standards may not be achieved, modifications to the sources and/or additional mitigation measures will be required. Best management plans to control air emissions, i.e., dust, odours and noise, will be provided, together with an appropriate monitoring program and applicable conceptual contingency plans.

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1 Mitigation measures are actions taken to avoid or reduce potential adverse effects. Mitigation measures incorporated into the design of the project works and activities before the assessment takes place are referred to as ‘in-design’ mitigation measures.
4.6  **Step 9 – Advantages and Disadvantages of the Preferred Method**

A description of the environmental advantages and disadvantages of the preferred alternative expansion method based on net effects will be prepared for the atmosphere component.

4.7  **Step 10 – Monitoring and Contingency Plans**

A monitoring and verification program will be prepared for the atmosphere component, appropriate for the preferred landfill expansion alternative, and a conceptual contingency plan approach. This monitoring, verification and contingency planning process will confirm the effectiveness of the mitigation measures. Contingency planning will outline the steps necessary to address unforeseen events or ineffective or defective mitigation measures that pose risk to the elements of the atmosphere environment. A complaints procedure to address complaints received regarding atmospheric emissions from the Site will be outlined.

The results of Steps 6 to 10 of the assessment will be documented in air quality and noise reports.
ATTACHMENT C-5
Culture and Heritage Resources Work Plan
ATTACHMENT C-5

Cultural and Heritage Resources Work Plan
Biggars Lane Landfill Expansion EA
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1.0 INTRODUCTION

This document presents the proposed work plan for the cultural and heritage resources component of the environmental assessment (EA) to secure additional landfill disposal capacity for the County of Brant by means of an expansion at the Biggars Lane landfill site (the undertaking). This EA has a Ministry of Environment and Climate Change (MOECC) approved Terms of Reference (ToR) that sets out the overall framework and work plan for addressing the Ontario Environmental Assessment Act (EAA) requirements when preparing the EA. This work plan provides additional component-specific details in advance of commencing the assessment framework.

2.0 ASSESSMENT FRAMEWORK

2.1 Overall Approach

The proposed EA consists of the following steps:

- Step 1 – Describe the service area waste disposal needs for the minimum planning period ending in 2050;
- Step 2 – Develop criteria to be used in the evaluation of the alternative methods;
- Step 3 – Develop design concepts for alternative methods for expanding the existing Biggars Lane landfill site;
- Step 4 – Carry out the studies required to address the evaluation criteria;
- Step 5 – Describe the environment(s) potentially affected by the proposed undertaking;
- Step 6 – Using the evaluation criteria identified in Step 2, carry out an evaluation of the alternative methods for the proposed undertaking and identify the effects to the environment;
- Step 7 – Identify the preferred alternative method of landfill expansion; if the overall preferred alternative method of landfill expansion involves a base liner and leachate collection system (i.e., one of Alternatives 2 or 4), then carry out a comparative evaluation of alternative leachate management and treatment options using the methodology and criteria provided in Attachment C-10;
- Step 8 – Identify measures that may be necessary to prevent, change or mitigate possible environmental effects of the preferred alternative method;
- Step 9 – Prepare a description of the environmental advantages and disadvantages of the preferred alternative method based on net effects that will result following mitigation. The assessment of net effects include effects associated with the construction, operations and any closure/post closure periods of the preferred alternative method; and,
- Step 10 – Prepare monitoring and contingency plans to monitor for environmental effects.

Of these steps, the cultural and heritage resources component will participate in the development of Steps 4 through 10 as they pertain to this component.
2.2 Study Areas

Data for the EA will be collected and analyzed for three generic study areas presented in the ToR. The generic study areas are shown on Figures C-1 through C-3 and are described as follows:

- The Regional Study Area – encompasses the County of Brant and does not include the City of Brantford, Six Nations of the Grand River Territory, or the Mississaugas of the New Credit First Nation;

- The Local Study Area – Extends approximately 500 metres in all directions beyond the County-owned lands at the Biggars Lane landfill; and,

- The Site Study Area – Includes the County-owned lands at the Biggars Lane landfill located in the south part of Lot 1, 2nd Range East of Mount Pleasant Road in the County of Brant (former Township of Brantford).

The generic study areas noted above may be modified during the EA to suit the requirements of the Built cultural and heritage resources component and it is envisioned that the assessment for this component will focus on the Site Study Area.

2.3 Time Frame

The EA will consider potential effects on the environment at three project life cycle stages as follows:

- Construction Phase – This would include clearing, grading, construction of access roads, and initial construction of the landfill expansion cell(s);

- Operations (up to 2050) – This would include regular disposal activities over the course of the operating life of the Site, which is proposed as up to 2050. Ongoing, progressive construction of new disposal cells will also occur through this period; and,

- Closure/Post-closure (post 2050) – Site Closure and Post-closure activities (e.g., leachate management, landfill gas management, monitoring and maintenance) will occur over the contaminating lifespan of the landfill.
3.0 ASSESSMENT CRITERIA AND INDICATORS

Draft environmental components, criteria, rationale, indicators and potential data sources were provided in the approved ToR and have been updated as part of proceeding into the EA stage. Provided below are those related to the cultural and heritage resources component.

Table C-5.1: Assessment Criteria for Cultural and Heritage Resources

<table>
<thead>
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<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which alternative expansion design is preferred with regard to heritage resources and the cultural heritage landscape?</td>
<td>The cultural landscape and heritage resources can be altered by expansion of the landfill, and use of the cultural landscape can be affected by ongoing landfill operations.</td>
<td>• Predicted effects to identified cultural landscapes off-Site&lt;br&gt;• Predicted effect to the heritage attributes of identified heritage resources</td>
<td>• Landfill expansion alternative methods&lt;br&gt;• Published data sources (including literature; historic maps, land registry data, assessment rolls and census records; local architectural conservation advisory committee and/or municipal heritage building/district listings)&lt;br&gt;• Site surveys and assessments&lt;br&gt;• Applicable provincial regulations and Ministry of Tourism, Culture and Sport (MTCS) guidance documents&lt;br&gt;• Aboriginal communities and organizations</td>
</tr>
<tr>
<td>Which alternative expansion design is preferred with regard to conservation of archaeological resources?</td>
<td>Archaeological resources could be disturbed by construction activities at the Site.</td>
<td>• Presence of archaeological resources on-Site</td>
<td>• Landfill expansion alternatives&lt;br&gt;• Published data sources (including literature; historic maps, land registry data, assessment rolls and census records)&lt;br&gt;• Review of the MTCS updated database&lt;br&gt;• On-Site archaeological studies in accordance with MTCS standards and guidelines&lt;br&gt;• Aboriginal communities and organizations</td>
</tr>
</tbody>
</table>

4.0 DETAILED WORK PLAN

All work conducted by the cultural and heritage resources component will follow guidance provided in the Ministry of Tourism, Culture and Sport (MTCS) Ontario Heritage Tool Kit series as well as other relevant publications such as the Parks Canada Standards and Guidelines for the Conservation of Historic Places in Canada for the built heritage and cultural landscape criterion. Similarly, guidance provided in the MTCS’s Standards and Guidelines for Consultant Archaeologists (MTCS 2011) and the County of Brant Official Plan 2012 will be followed for the archaeology criterion.

4.1 Step 4 – Carry Out Studies

Prior to initiating these studies, pre-consultation will be carried out with MTCS to confirm the proposed work plan approach and, if required, make any modifications. Also, the County will consult with the First Nation and Métis communities and seek their input specifically regarding their knowledge regarding archaeology and heritage resources within the Site Study Area and Local Study Area.
4.1.1 Built Heritage and Cultural Heritage Landscapes

Task 1 – Desktop Review

A desktop review will be carried out to determine the potential for cultural heritage resources within the Local Study Area and Site Study Area. Information will be gathered from aerial imagery as well as consultation with knowledgeable individuals and organizations such as municipal planners and/or heritage officers.

Task 2 – Field Reconnaissance

A field reconnaissance will confirm whether potential heritage structures and cultural heritage landscapes are present in the Local Study Area and Site Study Area. Features within the Site Study Area will be surveyed by accessing the property, while those in the Local Study Area will be documented from publically accessible rights-of-way.

4.1.2 Archaeology

Task 1 – Archaeological Potential Checklist

The first task of the archaeological study will be to complete the MTCS Criteria for Evaluating Archaeological Potential Checklist. Depending on the results of the Checklist evaluation, a decision will be made to either:

1) Draft a technical memorandum summarizing the results of the Checklist evaluation stating that no further archaeological assessment is required within the Site Study Area that will be submitted as part of the EA report; or,

2) Proceed with a Stage 1 Archaeological Assessment.

Task 2 – Stage 1 Archaeological Assessment

A Stage 1 Archaeological Assessment will be undertaken if the results of the Checklist evaluation indicate that it is required. The objective of a Stage 1 Archaeological Assessment is to gather information about the Site Study Area’s geography, land use history and current condition as well as any previous archaeological research within the vicinity, to evaluate the Site Study Area’s archaeological potential and recommend whether further archaeological assessment is required (Stage 2). If required, the Stage 1 archaeological assessment will include the following tasks:

- Query of the Ontario Archaeological Sites Database, maintained by the MTCS, to determine whether any archaeological sites have been registered within a 1 km radius of the Site Study Area;
- Query of the Ontario Public Register of Archaeological Reports, maintained by the MTCS, to determine whether any archaeological fieldwork has been conducted within a 50 m radius of the Site Study Area;
- Review of relevant historic and environmental literature pertaining to the Site Study Area;
- Review of relevant recent and historical mapping of the Site Study Area; and,
- A property inspection to confirm existing conditions on the Site Study Area.

Research carried out for the Stage 1 Archaeological Assessment will provide the required data to determine whether further archaeological assessment of the Site Study Area is required. If further assessment is required, a Stage 2 Archaeological Assessment will be undertaken.
Task 3 – Stage 2 Archaeological Assessment

The objective of a Stage 2 archaeological assessment is to determine if there are archaeological resources present within the Site Study Area and to assess whether any identified archaeological resources are of sufficient cultural heritage value or interest to require further archaeological assessment (Stage 3).

If required, a Stage 2 archaeological survey of the Site Study Area will occur through pedestrian survey on all lands that are ploughable, and through test pit survey on all lands that cannot be ploughed. In the event that archaeological resources are identified, their location will be recorded using a sub-metre accuracy hand-held Global Positioning System (GPS) unit and they will be systematically inventoried and collected for further processing, including washing, identification, cataloguing and analysis.

Poorly drained areas, areas of steep slope and areas of previous disturbance within the Site Study Area will be mapped and photo-documented but, as per the Standards and Guidelines for Consultant Archaeologists (MTCS 2011), these areas will not be subject to intensive Stage 2 archaeological survey as they possess low to no archaeological potential.

Fieldwork and analysis carried out for the Stage 2 Archaeological Assessment will provide the required data to determine whether further archaeological assessment of the Site Study Area is required. If further assessment is required, a Stage 3 Archaeological Assessment, and potentially Stage 4 Archaeological Mitigation will be required prior to land disturbance.

4.2 Step 5 – Describe Environment Potentially Affected

4.2.1 Built Heritage and Cultural Heritage Landscapes

The first task to be undertaken as part of Step 5 is to complete the MTCS Check Sheet for Environmental Assessments: Screening for Impacts to Built Heritage and Cultural Heritage Landscapes. Depending on the results of the Check Sheet evaluation, a decision will be made to either:

1) Draft a technical memorandum summarizing the results of the desktop review, field investigation and the Check Sheet assessment, and stating that no further cultural heritage assessment is required; or,

2) Proceed with a Heritage Impact Assessment.

If the decision is made to proceed with a Heritage Impact Assessment, the procedure will follow guidance provided in the MTCS Ontario Heritage Tool Kit: Heritage Resources in the Land Use Planning Process, and involve the following tasks:

Task 1 – Collect Historical Data

A historical overview is required to identify past land use and the wider regional and provincial context of the Local Study Area and Site Study Area. Information will be gathered from archival and secondary sources as well as historical aerial photography.

Task 2 – Consult with Stakeholders

Knowledgeable individuals and organizations such as municipal planners or heritage officers will be consulted as appropriate to ensure concerns or issues are identified early in the process.
**Task 3 – Determine Heritage Value or Interest**

Based on the historical data and field reconnaissance, the built resource or landscape will be evaluated using the criteria for determining culture heritage value or interest as prescribed in the *Ontario Heritage Act Regulation 09/06*.

**Task 4 – Report**

A Heritage Impact Assessment report summarizing the results of Tasks 1 to 3 will be provided as part of the EA report.

### 4.2.2 Archaeology

The results of the Step 4 studies will determine the archaeology reporting requirements that will be necessary. If the Checklist evaluation indicates that no further archaeological work is required, a technical memorandum summarizing the results of the evaluation will be produced to be included for submission with the EA report. If the Checklist evaluation indicates a Stage 1 Archaeological Assessment is required, a short technical memorandum will be produced indicating such, and a Stage 1 Archaeological Assessment will commence. Much of the research undertaken for the Checklist evaluation is applicable, and will be applied to the Stage 1 Archaeological Assessment. If it becomes clear early in the Stage 1 process that the Site Study Area contains archaeological potential necessitating a Stage 2 Archaeological Assessment, it will be recommended that a combined Stage 1-2 Archaeological Assessment report be produced. A combined Stage 1-2 report will provide cost savings through reporting efficiencies and will eliminate the additional time required for the MTCS to independently review both a Stage 1 and Stage 2 archaeological report. At the completion of the Stage 2 Archaeological Assessment, if required, the report will indicate whether any archaeological resources are located within the Site Study Area, and, if so, whether they possess sufficient cultural heritage value or interest to require further archaeological assessment (Stage 3). All archaeological assessment reports produced will be provided as part of the EA report.

### 4.3 Step 6 – Predict Environmental Effects of Each Landfill Expansion Alternative Method

#### 4.3.1 Built Heritage and Cultural Heritage Landscapes

The landfill expansion alternatives will be assessed for the potential direct and indirect effects to resources of cultural heritage value or interest. Effect identification will follow guidance provided in the MTCS *Ontario Heritage Tool Kit: Heritage Resources in the Land Use Planning Process*.

A qualitative evaluation of the potential effects resulting from each of the alternative landfill expansion methods will follow the guidance provided in the MTCS *Heritage Resources in the Land Use Planning Process*, which identifies six potential direct or indirect effects that a development or site alteration may have on a built heritage resource or cultural heritage landscape. These are:

- **Destruction** of any, or part of any, significant heritage attributes, or features;
- **Alteration** that is not sympathetic or is incompatible, with the historic fabric and appearance;
- **Shadows** created that alter the appearance of a heritage attribute or change the viability of a natural feature or plantings, such as a garden;
CULTURAL AND HERITAGE RESOURCES WORK PLAN
BIGGARS LANE LANDFILL EXPANSION EA

- **Isolation** of a heritage attribute from its surrounding environment, context or a significant relationship;
- **Direct or indirect obstruction** of significant views or vistas within, from, or of built and natural features; or,
- **A change in land use** such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces.

### 4.3.2 Archaeology

Using the evaluation criterion identified for archaeology under the cultural and heritage resources component, both a quantitative and qualitative evaluation of the potential effects resulting from each of the alternative landfill expansion methods will be completed. The quantitative evaluation will examine the number of archaeological resources that will be affected by each alternative landfill expansion method, while the qualitative evaluation will examine the type of archaeological resources that will be affected.

### 4.3.3 Linkages

The cultural and heritage resources component will generate predictions for use by other components where there are linkages.

### 4.4 Step 7 – Compare Alternative Expansion Methods and Identify the Preferred Alternative Expansion Method

#### 4.4.1 Built Heritage and Cultural Heritage Landscapes

Built heritage and cultural heritage landscapes will be compared using the criteria and indicators for the cultural and heritage resources component.

#### 4.4.2 Archaeology

Archaeological conditions will be compared using the criteria and indicators for the cultural and heritage resources component.

#### 4.4.3 Overall Component and Project Preferred Alternative Expansion Method

The alternative expansion methods will be ranked using the terminology of most preferred, equally preferred, moderately preferred and least preferred, and the preferred alternative expansion method will be identified from a cultural and heritage perspective.

The alternative which has the smallest predicted negative effect is ranked ‘Most Preferred’. The alternative that has the greatest predicted negative environmental effect is ranked ‘Least Preferred’. The remaining alternative(s) is ranked ‘Moderately Preferred’. If there are no measurable differences among the predicted effects of alternatives, they are ranked ‘Equally Preferred’. This information will be used to identify and describe the justification for selection of the ‘Most Preferred’ option from a heritage component perspective.

When each component preferred alternative expansion method is available, the EA team will determine the overall preferred alternative expansion method.

If, depending on the preferred landfill expansion alternative identified, there is a need to assess and compare alternative methods of leachate management and treatment as described in Attachment C-10, the heritage-related potential effects (i.e., hauling of leachate for treatment at County-owned treatment facilities) will be described qualitatively as input to the comparative evaluation of leachate management and treatment options.
4.5 Step 8 – Identify Mitigation Measures Included in the Preferred Method

As part of Step 6, the cultural and heritage resources component assessed the potential effects from each of the alternative expansion methods. "In-design” mitigation measures¹ that were incorporated into the alternatives will be documented.

Following Step 7 and selection of the preferred alternative expansion method, additional mitigation measures, if required, will be identified and refined as necessary. The appropriate mitigation measures will depend on the significance of the identified resources and mitigation strategies will be prepared that avoid or minimize adverse effects to these resources.

The prediction of future environmental effects on the cultural and heritage resources component will be carried out, assuming all mitigation measures are in place. The remaining effects or “net effects” will also be documented.

4.6 Step 9 – Advantages and Disadvantages of the Preferred Method

A description of the environmental advantages and disadvantages of the preferred alternative expansion method based on net effects will be prepared for the cultural and heritage resources component.

4.7 Step 10 – Monitoring and Contingency Plans

The cultural and heritage resources component will prepare a monitoring program appropriate for the preferred landfill expansion alternative, and a conceptual contingency plan approach. This monitoring and contingency planning process will confirm the effectiveness of mitigation measures. Contingency planning will outline the steps necessary to address unforeseen events or ineffective or defective mitigation measures that pose risk to the elements of the heritage environment.

The results of Steps 6 to 10 of the assessment will be documented in the archaeology report(s) and Heritage Impact Assessment, if required.

¹ Mitigation measures are actions taken to avoid or reduce potential adverse effects. Mitigation measures incorporated into the design of the project works and activities before the assessment takes place are referred to as ‘in-design’ mitigation measures.
ATTACHMENT C-6
Land Use/Agricultural/Visual Work Plan
ATTACHMENT C-6

Land Use/Agricultural/Visual Work Plan
Biggars Lane Landfill Expansion EA
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1.0 INTRODUCTION

This document presents the proposed work plan for the land use component of the environmental assessment (EA) to secure additional landfill disposal capacity for the County of Brant by means of an expansion at the Biggars Lane landfill site (the undertaking). This EA has a Ministry of Environment and Climate Change (MOECC) approved Terms of Reference (ToR) that sets out the overall framework and work plan for addressing the Ontario Environmental Assessment Act (EAA) requirements when preparing the EA. This work plan provides additional component-specific details in advance of commencing the assessment framework.

2.0 ASSESSMENT FRAMEWORK

2.1 Overall Approach

The proposed EA consists of the following steps:

- Step 1 – Describe the service area waste disposal needs for the minimum planning period ending in 2050;
- Step 2 – Develop criteria to be used in the evaluation of the alternative methods;
- Step 3 – Develop design concepts for alternative methods for expanding the existing Biggars Lane landfill site;
- Step 4 – Carry out the studies required to address the evaluation criteria;
- Step 5 – Describe the environment(s) potentially affected by the proposed undertaking;
- Step 6 – Using the evaluation criteria identified in Step 2, carry out an evaluation of the alternative methods for the proposed undertaking and identify the effects to the environment;
- Step 7 – Identify the preferred alternative method of landfill expansion; if the overall preferred alternative method of landfill expansion involves a base liner and leachate collection system (i.e., one of Alternatives 2 or 4), then carry out a comparative evaluation of alternative leachate management and treatment options using the methodology and criteria provided in Attachment C-10;
- Step 8 – Identify measures that may be necessary to prevent, change or mitigate possible environmental effects of the preferred alternative method;
- Step 9 – Prepare a description of the environmental advantages and disadvantages of the preferred alternative method based on net effects that will result following mitigation. The assessment of net effects include effects associated with the construction, operations and any closure/post closure periods of the preferred alternative method; and,
- Step 10 – Prepare monitoring and contingency plans to monitor for environmental effects.

Of these steps, the land use component will participate in the development of Steps 4 through 10 as they pertain to this component.
2.2 Study Areas

Data for the EA will be collected and analyzed for three generic study areas presented in the ToR. The generic study areas are shown on Figures C-1 through C-3 and are described as follows:

- The Regional Study Area – encompasses the County of Brant and does not include the City of Brantford, Six Nations of the Grand River Territory, or the Mississaugas of the New Credit First Nation;

- The Local Study Area – Extends approximately 500 metres in all directions beyond the County-owned lands at the Biggars Lane landfill; and,

- The Site Study Area – Includes the County-owned lands at the Biggars Lane landfill located in the south part of Lot 1, 2nd Range East of Mount Pleasant Road in the County of Brant (former Township of Brantford).

The generic study areas noted above may be modified during the EA to suit the requirements of the land use component.

2.3 Time Frame

The EA will consider potential effects on the environment at three project life cycle stages as follows:

- Construction Phase – This would include clearing, grading, construction of access roads, and initial construction of the landfill expansion cell(s);

- Operations (up to 2050) – This would include regular disposal activities over the course of the operating life of the Site, which is proposed as up to 2050. Ongoing, progressive construction of new disposal cells will also occur through this period; and,

- Closure/Post-closure (post 2050) – Site Closure and Post-closure activities (e.g., leachate management, landfill gas management, monitoring and maintenance) will occur over the contaminating lifespan of the landfill.
### 3.0 ASSESSMENT CRITERIA AND INDICATORS

Draft environmental components, criteria, rationale, indicators and potential data sources were provided in the approved ToR and have been updated as part of proceeding into the EA stage. They are provided below related to the land use component.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Which alternative expansion design is preferred with respect to compatibility with current and proposed planned future land uses on and off-Site?</strong></td>
<td>Waste management projects are often perceived to be more compatible with certain types of neighbouring land uses.</td>
<td>• Current land use • Certain and probable planned future land use • Proximity to off-Site sensitive land uses (i.e., dwellings, churches, parks)</td>
<td>• Site surveys and assessments • Published data sources (i.e., Official Plans, Zoning By-laws) • Provincial Policy Statement, 2014 • Discussions with municipality and, if required, property owners local to the Site</td>
</tr>
<tr>
<td><strong>Which alternative expansion design is preferred in terms of the view from off-Site?</strong></td>
<td>Expansion of the landfill can change the visual appearance of the Site from off-Site viewpoints (receptor locations).</td>
<td>• Predicted changes in landscapes and views • Visibility of project features from selected receptor locations • Level of visual contrast of project features from selected receptor locations</td>
<td>• Landfill expansion alternative methods • Ministry of Natural Resources and Forestry (MNRF) digital surface models (DSMs) and terrestrial mapping • Aerial photography and field reconnaissance • Satellite imagery • Google Earth • Web mapping sites • Existing Site-specific studies and reports • Visual impact assessment</td>
</tr>
<tr>
<td><strong>Which alternative expansion design is preferred with regard to potential for effects on agriculture?</strong></td>
<td>The landfill expansion can adversely affect on-Site agricultural operations and use and may be perceived to have the potential to adversely affect off-Site agricultural operations and use.</td>
<td>• Percentage of on-Site lands with soil capability classes 1 to 3 • Amount, type(s) and quality of on-Site improvements for agricultural purposes (i.e., structures, tile drainage) • Percentage of on-Site land being used for agricultural purposes • Types(s) and extent of agricultural operations on-Site and off-Site (i.e., organic, cash crop, livestock)</td>
<td>• Landfill expansion alternative methods • Provincial Policy Statement, 2014 • Municipal Official Plans • Aerial photographic and topographic mapping • Available soils mapping, municipal drain mapping, available ownership information based on municipal assessment information and including farm tax credit information • Field reconnaissance • Canada Land Inventory (CLI) mapping • Statistics Canada agriculture profiles • Interviews with farmers</td>
</tr>
</tbody>
</table>
4.0  DETAILED WORK PLAN

4.1  Step 4 – Carry Out Studies

4.1.1  Land Uses and Agriculture

The land use discipline team will undertake a review of municipal planning documents to determine the policy and regulatory context related to the Study Areas. The Local Study Area will be the focus of the baseline characterization because the Biggars Lane Landfill is an active site, whose land use designation is not proposed to change. Information will be collected to understand and clearly document the characteristics of existing land uses within the Local Study Area. Existing land use information will be derived from field surveys and aerial photography interpretation. Particular attention will be given to the identification of land uses potentially sensitive to landfilling activities, as defined in the Provincial guidelines and municipal policies. The land use component includes field surveys to document existing agricultural conditions (i.e., soil capability, types and extent of agricultural operations, cropping patterns, farm structures, etc.) and an evaluation of the effect of the project on the agricultural operations in the Local Study Area.

4.1.2  Visual Environment

An assessment of the visual effects of the Biggars Lane Landfill expansion on the area around the Site (anticipated to be larger than the Local Study Area) will be undertaken; with the extent of the area from the landfill property to be determined once the Site visibility from off-Site locations is assessed as part of this work. The visual effects assessment will be based on the selection of up to six representative viewpoints (receptor locations). Viewpoints for visual simulations are typically selected to be representative views of the proposed undertaking and at receptor locations where a person’s visual amenity might be affected by the view of the landfill site and the overall effect of visible project features.

4.2  Step 5 – Describe Environment Potentially Affected

4.2.1  Land Uses and Agriculture

The following tasks will be undertaken to further characterize existing land use and agricultural conditions:

- A field survey of the Local Study Area to collect the following data:
  - Existing land uses;
  - Number, type and proximity of sensitive land uses;
  - Document agricultural operations (cropping patterns, farm buildings, structures etc.)
  - Photo log depicting the general land uses; and,
  - Identification of any planning approvals notice signage.

- The following digital data sources will be used to support the existing conditions research:
  - Parcel fabric mapping provided by County of Brant;
  - Aerial photography provided by County of Brant; and,
  - Google Earth imagery.
The following provincial legislation, guidelines, and County of Brant regulatory documents will be reviewed:

- *Planning Act*;
- Provincial Policy Statement 2014;
- Ontario Ministry of Environment Guidelines:
  - Land Use Compatibility, Guideline D-1;
  - Land Use On or Near Landfills and Dumps, Guideline D-4;
- County of Brant Official Plan (2012);
- County of Brant Zoning By-law 110-01 (2012); and,
- Canada Land Inventory (CLI) / Soil Capability for Agriculture mapping.

- Review background documentation regarding the operations existing Biggars Lane Landfill;
- Review conceptual components of the proposed Biggars Lane Landfill expansion;
- Review of local development activity and potential planning issues; and,
- Meet with farmers to obtain information they are willing to share about their agricultural operations within the Local Study Area.

Based on this information, a description of the land use and planning designations for the Local Study Area and Site Study Area will be prepared.

### 4.2.2 Visual Environment

Landforms within the Site Study Area include the landfill expansion design alternative methods, the buildings, equipment and stockpiles, as well as any berms, trees or other mitigation measures that may be put into place to mitigate the visual effects of the landfill on receptors in the vicinity. The Local Study Area and Regional Study Area topography can be characterized as flat or undulating. The visible landscape includes farms, private residences, public roads/highways, a golf course and other areas with potential visual sensitivity. This can also be described as the zone of visual influence or area within which the undertaking may have an effect on visual aesthetics. As a result of these factors, visual aesthetic effects will be assessed carefully and potential effects mitigated to minimize the net visual effects.
4.3 Step 6 – Predict Environmental Effects of Each Landfill Expansion Alternative Method

4.3.1 Land Uses and Agriculture

Using the evaluation criteria identified, an evaluation of the potential effects to the land use and agricultural environment from each of the alternative landfill expansion methods will be completed. For consideration of land use and agriculture:

- Based on the proposed operational practices and/or results of predictive assessments of potential nuisance effects as carried out by other components (e.g. atmosphere) and the technical and operational considerations component, and visual considerations, the potential effects of each alternative method on existing surrounding land use will be assessed; and,

- The potential effect of the proposed project on the existing and potential agricultural use of off-Site lands will be assessed. Based on the proposed operational practices and/or results of predictive assessments of potential nuisance effects as carried out by other components (e.g. atmosphere) and the technical and operational considerations component, and groundwater and surface water considerations, the potential effects of each alternative method on existing and proposed off-Site agricultural use will be assessed.

4.3.2 Visual Environment

Using the evaluation criteria identified, an evaluation of the potential effects to the visual environment from each of the alternative landfill expansion methods will be completed.

An evaluation of the visual change relative to the existing baseline conditions will be determined based on guidance from the Landscape Institute and Institute of Environmental Management and Assessment Guidelines for Landscape and Visual Impact Assessment. These guidelines present a widely recognized set of best practices and techniques for landscape and visual impact assessment. Mitigation measures to avoid or minimize the potential effects of the project will be identified (Step 8) and selected from common best practices and based on their feasibility and effectiveness within the context of the existing landscape.

Before commencing a field assessment, a digital surface model (DSM) with surface features such as buildings and trees will be acquired from the MNRF for an area to be determined (between the Local Study Area and Regional Study Area) and a viewshed analysis will be completed with ArcGIS software for an area that is expected to be within 1 to 3 km from the Site. The viewshed analysis will create a colour coded map that shows areas that are potentially visible and not visible from each landfill expansion design alternative. This will help to locate optimal off-Site viewpoint locations from which the landfill site will be photographed, as described in Section 4.4.2 below.

Two-dimensional line-of-site profile figures will be created as a quick qualitative way to compare the expansion alternatives. These figures will have a line drawn from the eyes of a ‘stick person’ positioned at the critical viewing locations to the top of the proposed landfill, along with any obstacles such as trees or buildings that may be in the way of that person’s line of sight. These figures will be used to illustrate the critical off-Site vantage points, will be used to compare the landfill expansion alternatives, and will also be available for illustration during public consultation.

4.3.3 Linkages

The land use component will generate predictions for use by other components where there are linkages.
4.4 Step 7 – Compare Alternative Expansion Methods and Identify the Preferred Alternative Expansion Method

4.4.1 Land Uses and Agriculture

The land use component discipline will compare the degree of potential effects using the criteria and indicators for the land use component.

4.4.2 Visual Environment

The visual site reconnaissance will be a qualitative assessment of the landscape from up to 6 off-Site viewpoint locations chosen during the viewshed analysis. Photographs of the Biggars Lane landfill site will be taken from these viewpoint locations with the final number depending on the assessor’s observations. Photographs will be taken in the spring or late fall when the leaves are off the trees to provide a worst case scenario. Photographs of the Site will be taken with approximately 50% overlap from some viewpoints that are closer to the landfill site in order to create panoramic images that incorporate the full length of the Site Study Area. It may be sufficient to take single photographs that cover the full length of the Site Study Area from viewpoints that are farther away. These photos will provide a baseline to compare with the preferred landfill expansion design visual simulations.

The ground coordinates directly below the camera will be collected with a high accuracy (+/-1m) Global Positioning System (GPS) unit. The distance will be measured from the ground to the camera lens with a tape measure and added to the camera elevation value. Additional GPS coordinates will be collected for reference features such as telephone poles or fence posts that can be seen in the photographs. Pylons may be used as reference points in some cases when there is a lack of suitable reference features. These reference points will later be used to superimpose the overall preferred alternative visualization images onto the photographs in order to create the visual simulations. A location map will be created to show the location of the viewpoints in relation to the proposed landfill expansion alternatives and property boundary.

The visual environment component discipline will compare the degree of potential effects quantitatively and qualitatively using the criteria and indicators for the visual component. Following the completion of the viewshed analysis in Step 6, GIS software tools will be used to perform landscape calculations for the evaluation and quantitative comparison of the total visible landscape area for each expansion alternative, and the preferred expansion alternative from the perspective of visual effect will be identified.

A 3D model of the overall preferred landfill expansion design will be created with Visual Nature Studio (VNS) 3D visualisation software from the 3D AutoCAD facility design and the surrounding digital terrain model provided by J.H. Cohoon Engineering Ltd. Mitigation features such as proposed screening berms and trees will be added to the 3D model along with any proposed buildings, equipment or stockpiles. Coordinates from the GPS will be imported into the 3D model for any reference features such telephone poles or fence posts. Cameras will be placed in the model at the same GPS coordinate location and elevation as that of the digital camera used in the field. Images will be rendered in VNS at each viewpoint using the same focal length, heading and horizontal field of view as that of the digital photographs. Panoramic images will then be created from the VNS images for each viewpoint by following the same procedure used to create the panoramic photographs. The reference points collected in the field will be used to align and superimpose the VNS images into the photographs in Adobe Photoshop. The landfill expansion design and any mitigation features will be extracted from the VNS image and various selection methods will be used to pull layers of vegetation or existing buildings into the foreground.
Lines will be drawn at the top of the landfill design and any screening berms and labelled in order to differentiate one from the other. The assessment will result in the production of at least six visual simulation or photo-composite figures that will illustrate how the proposed Biggars Lane landfill site will appear in comparison with the baseline images (existing photos) from each viewpoint. This work will lead to the development of a conceptual landscape plan.

4.4.3 Overall Component and Project Preferred Alternative Expansion Method

The alternative expansion methods will be ranked using the terminology of most preferred, equally preferred, moderately preferred and least preferred, and the preferred alternative expansion method will be identified from a land use perspective.

The alternative which has the smallest predicted negative effect is ranked ‘Most Preferred’. The alternative that has the greatest predicted negative environmental effect is ranked ‘Least Preferred’. The remaining alternative(s) is ranked ‘Moderately Preferred’. If there are no measurable differences among the predicted effects of alternatives, they are ranked ‘Equally Preferred’. This information will be used to identify and describe the justification for selection of the ‘Most Preferred’ option from a land use component perspective.

When each component preferred alternative expansion method is available, the EA team will determine the overall preferred alternative expansion method.

If, depending on the preferred landfill expansion alternative identified, there is a need to assess and compare alternative methods of leachate management and treatment as described in Attachment C-10, the land use-related potential effects will be described qualitatively as input to the comparative evaluation of leachate management and treatment options.

4.5 Step 8 – Identify Mitigation Measures Included in the Preferred Method

As part of Step 6, the land use component assessed the potential effects from each of the alternative expansion methods. “In-design mitigation measures\(^1\) that were incorporated into the alternatives will be documented.

Following Step 7 and selection of the preferred alternative expansion method, additional mitigation measures, if required, will be identified and refined as necessary. The prediction of future environmental effects on the land use component will be carried out, assuming all mitigation measures are in place. The remaining effects or “net effects” will be documented.

4.6 Step 9 – Advantages and Disadvantages of the Preferred Method

A description of the environmental advantages and disadvantages of the preferred alternative expansion method based on net effects will be prepared for the land use component. For the visual environment, a table rating the preferred method based on the net effects will be prepared and include the advantages and disadvantages of the visibility and visual amenity for each viewpoint.

\(^1\) Mitigation measures are actions taken to avoid or reduce potential adverse effects. Mitigation measures incorporated into the design of the project works and activities before the assessment takes place are referred to as ‘in-design’ mitigation measures.
4.7 Step 10 – Monitoring and Contingency Plans

The land use component will prepare a monitoring program appropriate for the preferred landfill expansion alternative, and a conceptual contingency plan approach. This monitoring and contingency planning process will confirm the effectiveness of mitigation measures. It is not anticipated that contingency planning will be required for the land use component.

The results of Steps 6 to 10 of the assessment will be documented in a land use report.
ATTACHMENT C-7
Economic Work Plan
May 2016

ATTACHMENT C-7

Economic Work Plan
Biggars Lane Landfill Expansion EA
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1.0 INTRODUCTION

This document presents the proposed work plan for the economic component of the environmental assessment (EA) to secure additional landfill disposal capacity for the County of Brant by means of an expansion at the Biggars Lane landfill site (the undertaking). This EA has a Ministry of Environment and Climate Change (MOECC) approved Terms of Reference (ToR) that sets out the overall framework and work plan for addressing the Ontario Environmental Assessment Act (EAA) requirements when preparing the EA. This work plan provides additional component-specific details in advance of commencing the assessment framework.

2.0 ASSESSMENT FRAMEWORK

2.1 Overall Approach

The proposed EA consists of the following steps:

- Step 1 – Describe the service area waste disposal needs for the minimum planning period ending in 2050;
- Step 2 – Develop criteria to be used in the evaluation of the alternative methods;
- Step 3 – Develop design concepts for alternative methods for expanding the existing Biggars Lane landfill site;
- Step 4 – Carry out the studies required to address the evaluation criteria;
- Step 5 – Describe the environment(s) potentially affected by the proposed undertaking;
- Step 6 – Using the evaluation criteria identified in Step 2, carry out an evaluation of the alternative methods for the proposed undertaking and identify the effects to the environment;
- Step 7 – Identify the preferred alternative method of landfill expansion; if the overall preferred alternative method of landfill expansion involves a base liner and leachate collection system (i.e., one of Alternatives 2 or 4), then carry out a comparative evaluation of alternative leachate management and treatment options using the methodology and criteria provided in Attachment C-10;
- Step 8 – Identify measures that may be necessary to prevent, change or mitigate possible environmental effects of the preferred alternative method;
- Step 9 – Prepare a description of the environmental advantages and disadvantages of the preferred alternative method based on net effects that will result following mitigation. The assessment of net effects include effects associated with the construction, operations and any closure/post closure periods of the preferred alternative method; and,
- Step 10 – Prepare monitoring and contingency plans to monitor for environmental effects.

Of these steps, the economic component will participate in the development of Steps 4 through 9 as they pertain to this component.
2.2 Study Areas

Data for the EA will be collected and analyzed for three generic study areas presented in the ToR. The generic study areas are shown on Figures C-1 through C-3 and are described as follows:

- The Regional Study Area – encompasses the County of Brant and does not include the City of Brantford, Six Nations of the Grand River Territory, or the Mississaugas of the New Credit First Nation;
- The Local Study Area – Extends approximately 500 metres in all directions beyond the County-owned lands at the Biggars Lane landfill; and,
- The Site Study Area – Includes the County-owned lands at the Biggars Lane landfill located in the south part of Lot 1, 2nd Range East of Mount Pleasant Road in the County of Brant (former Township of Brantford).

The generic study areas noted above may be modified during the EA to suit the requirements of the economic component. For economic data, the Local Study Area will need to be the smallest relevant census division for which demographic data exists to describe potentially-affected communities. The capital, operational and maintenance costs of the landfill expansion criteria will utilize the Site Study Area.

2.3 Time Frame

The EA will consider potential effects on the environment at three project life cycle stages as follows:

- Construction Phase – This would include clearing, grading, construction of access roads, and initial construction of the landfill expansion cell(s);
- Operations (up to 2050) – This would include regular disposal activities over the course of the operating life of the Site, which is proposed as up to 2050. Ongoing, progressive construction of new disposal cells will also occur through this period; and,
- Closure/Post-closure (post 2050) – Site Closure and Post-closure activities (e.g., leachate management, landfill gas management, monitoring and maintenance) will occur over the contaminating lifespan of the landfill.
3.0 **ASSESSMENT CRITERIA AND INDICATORS**

Draft environmental components, criteria, rationale, indicators and potential data sources were provided in the approved ToR and have been updated as part of proceeding with the EA stage. They are provided below related to the economic component.

Table C-7.1: Economic Component Criteria and Indicators

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
</table>
| Which alternative expansion design is preferred with regard to potential for effects on the local economy? | The expansion of the landfill could have the potential to disrupt or displace existing businesses, while there is also the opportunity for the creation of new jobs through construction and/or operations as well as through provision of products or services. | - Predicated effects to local businesses  
- Employment at Site (number and duration)  
- Opportunities to provide products or services | - Landfill expansion alternative methods  
- Projected employment levels, by skill and duration, during the construction and operations phases  
- Estimated costs for project activities during the construction and operations phases for each alternative method  
- Current use of local businesses and services  
- Statistics Canada 2011 National Household Survey  
- Ontario Ministry of Finance Population Projections  
- County of Brant Community Profile, Business Directory, Key Industries |
| Which alternative expansion design is preferred regarding the capital, operation and maintenance costs for landfill expansion? | Capital costs will be incurred for establishing the additional landfill disposal capacity and other required infrastructure to support the design. On-going operating and maintenance costs will be required for the landfill. | - Predicted capital costs  
- Predicted operation and monitoring costs for the duration of the active service of the landfill and the ongoing post-closure care | - Landfill expansion alternative methods  
- Cost estimates for expansion alternatives  
- Operations and capital costs for existing landfill provided by County of Brant  
- Discussion with County of Brant solid waste staff |
4.0 DETAILED WORK PLAN

4.1 Step 4 – Carry Out Studies

The economic component comprises two subcomponents for the purposes of the EA: local economy and landfill expansion capital, operation and maintenance costs. A desktop review and County interviews will be completed to support Step 5 and will be documented in the appropriate chapter(s) of the EA report.

4.2 Step 5 – Describe Environment Potentially Affected

4.2.1 Local Economy

The following tasks will be undertaken to characterize existing economic conditions:

- Review conceptual components (including all alternative methods) of the proposed project;
- Review the “County of Brant Solid Waste Disposal Future Needs Study” (Stantec, 2011) and other associated waste management strategies for the County of Brant;
- Request and review data on anticipated opportunities for employment and local procurement of goods and services for the construction and operation of the proposed project expansion; and,
- Compile information from Statistics Canada census data, and municipal and regional economic development data, studies and reports on economic conditions in the study areas, including:
  - Population and demographics;
  - Labour force distribution;
  - Key employment sectors and employers;
  - Employment, unemployment and participation rates;
  - Average household and personal incomes; and,
  - Economic development trends and plans.

4.2.2 Landfill Expansion Capital, Operation and Maintenance Costs

The County will be interviewed to understand existing operational and maintenance costs for the existing landfill.
4.3  Step 6 – Predict Environmental Effects of Each Landfill Expansion Alternative Method

4.3.1  Local Economy
Using the evaluation criteria, an evaluation of the potential effects to the environment from each of the alternative landfill expansion methods will be completed. The evaluation will assess and compare the economic effects and will estimate:

- Business effects (positive or negative) on nearby commercial activities;
- Person hours of employment for the construction and operation of each alternative method; and,
- Value of goods and services required for construction and operation of the project.

The evaluation of economic effects will use both quantitative data and qualitative information to predict likely and net effects of the project alternative methods.

4.3.2  Landfill Expansion Capital, Operation and Maintenance Costs
Using the existing operational and maintenance costs and considering the landfill expansion alternatives, the potential capital, operational and maintenance costs for the expansion alternatives will be described quantitatively. This quantitative assessment will require quantity estimates of materials (i.e., geosynthetic materials, earthworks, etc.) and will rely on experience with cost estimating for other waste management facilities, including unit rates for select materials for the capital costs. The operational and maintenance costs will be based on the County’s experience as well as experience and observations at other waste management facilities of a similar size.

4.3.3  Linkages
The economic component will generate predictions for use by other components where there are linkages.

4.4  Step 7 – Compare Alternative Expansion Methods and Identify the Preferred Alternative Expansion Method

4.4.1  Local Economy
The local economy for the landfill expansion options will be compared quantitatively and qualitatively using the criteria and indicators for the economic component.

4.4.2  Landfill Expansion Capital, Operation and Maintenance Costs
The capital, operational and maintenance costs for the landfill expansion options will be compared quantitatively using the criteria and indicators for the economic component.

4.4.3  Overall Component and Project Preferred Alternative Expansion Method
The alternative expansion methods will be ranked using the terminology of most preferred, equally preferred, moderately preferred and least preferred, and the preferred alternative expansion method will be identified from an economic perspective.

The alternative which has the smallest predicted negative effect is ranked ‘Most Preferred’. The alternative that has the greatest predicted negative environmental effect is ranked ‘Least Preferred’. The remaining alternative(s)
is ranked ‘Moderately Preferred’. If there are no measurable differences among the predicted effects of alternatives, they are ranked ‘Equally Preferred’. This information will be used to identify and describe the justification for selection of the ‘Most Preferred’ option from an economic component perspective.

When each component preferred alternative expansion method is available, the EA team will determine the overall preferred alternative expansion method.

If, depending on the preferred landfill expansion alternative identified, there is a need to assess and compare alternative methods of leachate management and treatment as described in Attachment C-10, the economic-related potential effects (i.e., hauling of leachate for treatment at County-owned treatment facilities) will be described qualitatively as input to the comparative evaluation of leachate management and treatment options.

4.5 Step 8 – Identify Mitigation Measures Included in the Preferred Method

As part of Step 6, the economic component assessed the potential effects from each of the alternative expansion methods. “In-design” mitigation measures\(^1\) that were incorporated into the alternatives will be documented.

Following Step 7 and selection of the preferred alternative expansion method, additional mitigation measures, if required, will be identified and refined as necessary.

The prediction of future environmental effects on the economic component will be carried out, assuming all mitigation measures are in place. The remaining effects or “net effects” will be documented.

4.6 Step 9 – Advantages and Disadvantages of the Preferred Method

A description of the environmental advantages and disadvantages of the preferred alternative expansion method based on net effects will be prepared for the economic component.

The results of Steps 6 to 10 of the assessment will be documented in the appropriate chapter(s) of the EA report.

5.0 REFERENCES


\(^1\) Mitigation measures are actions taken to avoid or reduce potential adverse effects. Mitigation measures incorporated into the design of the project works and activities before the assessment takes place are referred to as ‘in-design’ mitigation measures.
ATTACHMENT C-8
Technical and Operational Considerations Work Plan
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1.0 INTRODUCTION
This document presents the proposed work plan for the technical and operational considerations component of the environmental assessment (EA) to secure additional landfill disposal capacity for the County of Brant by means of an expansion at the Biggars Lane landfill site (the undertaking). This EA has a Ministry of Environment and Climate Change (MOECC) approved Terms of Reference (ToR) that sets out the overall framework and work plan for addressing the Ontario Environmental Assessment Act (EAA) requirements when preparing the EA. This work plan provides additional component-specific details in advance of commencing the assessment framework.

2.0 ASSESSMENT FRAMEWORK
2.1 Overall Approach
The proposed EA consists of the following steps:

- Step 1 – Describe the service area waste disposal needs for the minimum planning period ending in 2050;
- Step 2 – Develop criteria to be used in the evaluation of the alternative methods;
- Step 3 – Develop design concepts for alternative methods for expanding the existing Biggars Lane landfill site;
- Step 4 – Carry out the studies required to address the evaluation criteria;
- Step 5 – Describe the environment(s) potentially affected by the proposed undertaking;
- Step 6 – Using the evaluation criteria identified in Step 2, carry out an evaluation of the alternative methods for the proposed undertaking and identify the effects to the environment;
- Step 7 – Identify the preferred alternative method of landfill expansion; if the overall preferred alternative method of landfill expansion involves a base liner and leachate collection system (i.e., on of Alternatives 2 or 4), then carry out a comparative evaluation of alternative leachate management and treatment options using the methodology and criteria provided in Attachment C-10;
- Step 8 – Identify measures that may be necessary to prevent, change or mitigate possible environmental effects of the preferred alternative method;
- Step 9 – Prepare a description of the environmental advantages and disadvantages of the preferred alternative method based on net effects that will result following mitigation. The assessment of net effects include effects associated with the construction, operations and any closure/post closure periods of the preferred alternative method; and,
- Step 10 – Prepare monitoring and contingency plans to monitor for environmental effects.

Of these steps, the technical and operational considerations component will participate in the development of Steps 4 through 10 as they pertain to this component.
2.2 Study Areas

Data for the EA will be collected and analyzed for three generic study areas presented in the ToR. The generic study areas are shown on Figures C-1 through C-3 and are described as follows:

- The Regional Study Area – encompasses the County of Brant and does not include the City of Brantford, Six Nations of the Grand River Territory, or the Mississaugas of the New Credit First Nation;
- The Local Study Area – Extends approximately 500 metres in all directions beyond the County-owned lands at the Biggars Lane landfill; and,
- The Site Study Area – Includes the County-owned lands at the Biggars Lane landfill located in the south part of Lot 1, 2nd Range East of Mount Pleasant Road in the County of Brant (former Township of Brantford).

The generic study areas noted above may be modified during the EA to suit the requirements of the technical and operational considerations component and it is envisioned that the assessment required for this component will focus on the Site Study Area.

2.3 Time Frame

The EA will consider potential effects on the environment at three project life cycle stages as follows:

- Construction Phase – This would include clearing, grading, construction of access roads, and initial construction of the landfill expansion cell(s);
- Operations (up to 2050) – This would include regular disposal activities over the course of the operating life of the Site, which is proposed as up to 2050. Ongoing, progressive construction of new disposal cells will also occur through this period; and,
- Closure/Post-closure (post 2050) – Site Closure and Post-closure activities (e.g., leachate management, landfill gas management, monitoring and maintenance) will occur over the contaminating lifespan of the landfill.
### 3.0 ASSESSMENT CRITERIA AND INDICATORS

Draft environmental components, criteria, rationale, indicators and potential data sources were provided in the approved ToR and have been updated as part of proceeding into the EA stage. They are provided below related to the technical and operational considerations component.

#### Table C-8.1: Technical and Operational Assessment Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which alternative expansion design is preferred with regard to landfill gas subsurface migration potential?</td>
<td>The landfill expansion will produce gas that can potentially migrate in the subsurface from the disposal area.</td>
<td>• Predicted landfill gas subsurface migration distance from landfill footprint and distance to property boundary</td>
<td>• Landfill expansion alternative methods&lt;br&gt;• Annual landfill monitoring reports&lt;br&gt;• Additional data collection&lt;br&gt;• MOECC guidance documents&lt;br&gt;• Site surveys and assessments</td>
</tr>
<tr>
<td>Which alternative expansion design is preferred with regard to potential to attract vectors and vermin?</td>
<td>The landfill expansion could attract vectors and vermin.</td>
<td>• Predicted potential for attraction of vectors and vermin</td>
<td>• Landfill expansion alternative methods&lt;br&gt;• Data from natural environment surveys&lt;br&gt;• Vector and vermin occurrence reports and control measures</td>
</tr>
<tr>
<td>Which alternative expansion design is preferred from a geotechnical perspective?</td>
<td>Design and construction of the landfill expansion and any associated infrastructure needs to account for geotechnical considerations.</td>
<td>• Predicted slope stability, settlement and other geotechnical considerations</td>
<td>• Landfill expansion alternative methods&lt;br&gt;• Geotechnical drilling investigation program&lt;br&gt;• Published data sources (i.e., MOECC, Ontario Ministry of Transportation)&lt;br&gt;• Geotechnical assessments</td>
</tr>
<tr>
<td>Which alternative expansion design is preferred regarding the requirement for operational infrastructure?</td>
<td>The landfill expansion may require establishment of additional infrastructure, such as leachate management and/or landfill gas collection.</td>
<td>• Predicted need for leachate collection and associated disposal and/or treatment&lt;br&gt;• Predicted need for landfill gas collection and associated handling</td>
<td>• Landfill expansion alternative methods&lt;br&gt;• Site surveys and assessments&lt;br&gt;• Existing Design, Operations and Maintenance Plan&lt;br&gt;• Published data sources (i.e., utility plans)&lt;br&gt;• Landfill gas generation predictions</td>
</tr>
</tbody>
</table>
4.0 DETAILED WORK PLAN

4.1 Step 4 – Carry Out Studies

4.1.1 Landfill Gas Migration

A landfill gas subsurface lateral migration study will be conducted as a desktop study. The existing design and operations report, annual monitoring reports and other available data sources will be reviewed with respect to subsurface stratigraphy, groundwater levels, potential subsurface pathways, location of stormwater ditching, and existing waste disposal areas/features in order to understand the potential for landfill gas subsurface lateral migration at the Site.

The landfill gas probe construction logs and the methane concentrations recorded at existing landfill gas probes located on-Site and near the existing landfill property boundary will be reviewed. Depending on the results of this review, a field component consisting of the inspection of existing landfill gas probes and the installation and monitoring of additional shallow landfill gas probes along the property boundary may be considered, if warranted.

It is noted that, as described in Section 4.3.1, an active landfill gas collection system will be required at the expanded landfill, which will assist in mitigating the potential for lateral gas migration in the subsurface.

4.1.2 Vectors and Vermin

The existing landfill site operations include retaining the services of a certified pest control company to regularly assess the site and report on their findings and control activities. The results from the proposed natural environment surveys will be evaluated to provide data on what species are present in the area that could be related to vectors and vermin.

4.1.3 Geotechnical

The studies as described herein to describe the geotechnical environment were developed to gather information required to understand the Site to a level of detail suitable for the purpose of supporting a submission for EA approval for the Site expansion.

The geotechnical component includes soil geotechnical properties. The following tasks will be undertaken to characterize existing subsurface conditions:

- Acquire and review existing geotechnical, geophysical or geological reports for previous studies carried out within the Site Study Area. Carry out a review of available literature, air photos, topographic and geologic mapping, and soil and land-use surveys within the Local Study Area;

- On the basis of the background data, prepare a conceptual model of geotechnical conditions beneath and in the area of the Site to further refine the scope of the subsurface investigation;

- Conduct subsurface investigation to characterize the overburden soils at the Site, and to assess the geotechnical properties of the materials (program described below); and,

- Develop the final conceptual model of geotechnical conditions in the area of the Site, including groundwater and surface water interaction.
Based on the current understanding of the Site, a proposed integrated geology, hydrogeology and geotechnical field program has been developed. The overall investigation consists of 19 test locations that have been identified as ‘A’ through ‘V’ and are shown on Figure C-1.1 in Attachment C-1. Of the 19 test locations, 10 locations have been selected for geotechnical testing, in addition to the geology and hydrogeology testing. As described in Attachment C-1, the geotechnical components of the field program are described below, and details on the geotechnical objectives of the drilling program along with the proposed drilling techniques, borehole depths, testing, etc. are presented in Table C-8.2.

The proposed geotechnical field program includes the following components:

- At two (2) of the testing locations, boreholes will be augered through the overburden units and cored into the upper portion of the underlying bedrock to prove the presence of bedrock and determine the thickness of the overlying soil units at these locations. Standard Penetration Test (SPT) sampling should be completed at 1.5 m intervals over the full depth of the borehole to confirm its compactness (for strength correlations) and to obtain samples for classification and index testing;

- At two (2) of the testing locations, boreholes will be augered through the overburden units and terminated upon auger refusal on the underlying bedrock to determine the thickness of the overlying soil units at these locations. SPT sampling should be completed at 1.5 m intervals over the full depth of the borehole to confirm its compactness (for strength correlations) and to obtain samples for classification and index testing;

- At the remaining six (6) testing locations, boreholes will be augered to the top of the clay deposit (Unit C) to assess the distribution and thickness of the surficial sand and silt units. SPT sampling should be completed at 1.5 m intervals over the full depth of the borehole to obtain samples for classification and index testing;

- In-situ vane testing should be completed within the clayey deposits (where the shear strength allows) to investigate the shear strength profile of the full thickness of the deposit; and,

- Undisturbed Shelby tube samples should be collected from representative intervals within the clay deposits for laboratory consolidation and/or triaxial testing.

Following completion of the geotechnical field investigation program, geotechnical laboratory testing would be carried out on selected representative soil samples. That testing would include index/classification testing (e.g., water content, Atterberg limit/plasticity, and grain size distribution), as well as more sophisticated testing relating to the strength and compressibility of the underlying soils, with a focus on the clay deposit. The testing would likely include laboratory oedometer consolidation testing to evaluate the consolidation characteristics of the deposit, and may also include triaxial testing to evaluate the shear strength of the deposit.

Upon completion of the field program and data analysis, the data would be utilized to develop the final conceptual model of the geotechnical conditions in the area of the Site.
<table>
<thead>
<tr>
<th>Borehole Identifier</th>
<th>Proposed Borehole Location (See Figure C-1.1)</th>
<th>Rationale for Borehole</th>
<th>Proposed Drilling Technique</th>
<th>Proposed Borehole Depth Below Ground Surface (metres)</th>
<th>Geotechnical sampling and testing requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Northwest corner of Property. Northwest of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To be drilled approximately 5 metres into bedrock (approx. 38 m to 46 m)</td>
<td>SPT sampling at 1.5 m intervals over the full depth of the borehole. In-situ vane testing within the clayey deposits (where the shear strength allows).</td>
</tr>
<tr>
<td>B</td>
<td>Northwest part of Property. Northwest of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; investigate the thickness of the silty clay unit; determine depth to water table in shallow flow system; assess groundwater levels in bedrock aquifer.</td>
<td>Power auger through overburden followed by rotary drill with HQ core recovery</td>
<td>To be drilled approximately 5 metres into bedrock (approx. 38 m to 46 m)</td>
<td>SPT sampling at 1.5 m intervals over the full depth of the borehole. In-situ vane testing within the clayey deposits (where the shear strength allows). Undisturbed Shelby tube samples within clayey deposits for consolidation / triaxial testing.</td>
</tr>
<tr>
<td>C</td>
<td>Northwest corner of Property. Northwest of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>SPT sampling at 1.5 m intervals over the full depth of the borehole. In-situ vane testing within the clayey deposits (where the shear strength allows).</td>
</tr>
<tr>
<td>G</td>
<td>Northwest part of Property. West of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>SPT sampling at 1.5 m intervals over the full depth of the borehole. In-situ vane testing within the clayey deposits (where the shear strength allows).</td>
</tr>
<tr>
<td>H</td>
<td>Northwest part of Property. West of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; investigate the thickness of the silty clay unit; determine depth to water table in shallow flow system; assess vertical gradients between silty clay and overlying silt and silty sand.</td>
<td>Power auger</td>
<td>To be completed to top of bedrock (approx. 33 to 41 m)</td>
<td>SPT sampling at 1.5 m intervals over the full depth of the borehole. Undisturbed Shelby tube samples within clayey deposits for consolidation / triaxial testing. In-situ vane testing within the clayey deposits (where the shear strength allows).</td>
</tr>
<tr>
<td>I</td>
<td>Northwest part of Property. West of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>SPT sampling at 1.5 m intervals over the full depth of the borehole. In-situ vane testing within the clayey deposits (where the shear strength allows).</td>
</tr>
<tr>
<td>O</td>
<td>Eastern portion of property. Northeast of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; investigate the thickness of the silty clay unit; determine depth to water table in shallow flow system; assess groundwater levels in bedrock aquifer.</td>
<td>Power auger through overburden followed by rotary drill with HQ core recovery</td>
<td>To be drilled approximately 5 metres into bedrock (approx. 38 m to 46 m)</td>
<td>SPT sampling at 1.5 m intervals over the full depth of the borehole. Undisturbed Shelby tube samples within clayey deposits for consolidation / triaxial testing. In-situ vane testing within the clayey deposits (where the shear strength allows).</td>
</tr>
<tr>
<td>P</td>
<td>Eastern portion of property. Northeast of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>SPT sampling at 1.5 m intervals over the full depth of the borehole. In-situ vane testing within the clayey deposits (where the shear strength allows).</td>
</tr>
<tr>
<td>R</td>
<td>Eastern portion of property. East of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To be completed to top of silty clay (approx. 18 to 23 m)</td>
<td>SPT sampling at 1.5 m intervals over the full depth of the borehole. In-situ vane testing within the clayey deposits (where the shear strength allows).</td>
</tr>
<tr>
<td>S</td>
<td>Southeast corner of property. East of existing landfill</td>
<td>Assess the distribution and thickness in Units A and B; investigate the thickness of the silty clay unit; assess vertical gradients between silty clay and overlying silt and silty sand; determine depth to water table in shallow flow system.</td>
<td>Power auger</td>
<td>To be completed to top of bedrock (approx. 33 to 41 m)</td>
<td>SPT sampling at 1.5 m intervals over the full depth of the borehole. In-situ vane testing within the clayey deposits (where the shear strength allows).</td>
</tr>
</tbody>
</table>
4.1.4 Operational Infrastructure
The existing Site infrastructure and any currently proposed infrastructure will be determined by conducting a Site inspection and reviewing published data sources, Site surveys and assessments, reviewing the existing design and operation report and discussions with County solid waste staff.

4.2 Step 5 – Describe Environment Potentially Affected

4.2.1 Landfill Gas Migration
The existing conditions with respect to the potential for landfill gas subsurface lateral migration will be summarized using the data collected from Step 4 and reported in a technical document in support of the EA report.

4.2.2 Vectors and Vermin
Data collected from Step 4 will be summarized for the vectors and vermin existing conditions.

4.2.3 Geotechnical
Information on the geotechnical environment will be provided in a technical document in support of the EA report, based on the literature review and results of the subsurface investigation program.

4.2.4 Operational Infrastructure
The existing operational infrastructure will be summarized using the data collected from Step 4.

4.3 Step 6 – Predict Environmental Effects of Each Landfill Expansion Alternative Method

4.3.1 Landfill Gas Migration
The Province of Ontario has regulations and standards applicable to landfill sites with respect to the subsurface migration of landfill gas. Ontario Regulation 232/98, which applies to new and expanding landfill sites in Ontario, specifies that the design of a landfill must ensure that the subsurface migration of landfill gas meets several conditions including:

- The concentration of methane gas below the surface of the land at the boundary of the Site must be less than 2.5 percent by volume;
- The concentration of methane gas must be less than 1.0 percent by volume in any on-Site building or enclosed structure; and,
- The concentration of methane gas must be less than 0.05 percent by volume in any on-Site building or enclosed structure on an adjacent property.

A facility such as the Biggars Lane landfill will not be permitted to operate if it is demonstrated not to meet these criteria. In addition, the Biggars Lane landfill will be required to install a landfill gas management system under O.Reg. 216/08 and 217/08, which require the installation of a landfill gas management system for landfills with greater than 1.5 million cubic metres of waste.
Using the evaluation criteria identified, a qualitative evaluation of the potential effects to the environment from each of the alternative landfill expansion methods will be completed and will consist of the following:

- Landfill gas production assessment: An estimate of the current and future landfill gas generation will be completed using the LandGEM model developed by the United States Environmental Protection Agency (USEPA), which is a model approved by the MOECC. The estimated landfill gas generation, together with the physical setting of the Site (Tasks 4 and 5), will provide an estimate of the rate of landfill gas that can be expected to be generated that is available to potentially migrate from the expanded landfill site.

- Landfill gas subsurface lateral migration assessment: Using the evaluation criteria identified, a qualitative comparative evaluation of the potential effects from each of the alternative landfill expansion methods will be completed based on the distance from the landfill footprint to the property boundary, to the nearest building, and to the closest stormwater ditch; type of landfill cover and rate/method of landfill cover application; presence of engineered landfill base containment; and, other factors that are applicable.

4.3.2 Vectors and Vermin

Using the known existing issues with regard to vectors and vermin, and considering the landfill expansion alternative methods, the potential for vectors and vermin will be described qualitatively. This qualitative assessment will also rely on experience in developing operations and management plans for other waste management facilities including landfills, transfer sites and waste processing sites. The assessment will consider the findings of the natural environment surveys in relation to the spatial location of the landfill expansion alternatives.

4.3.3 Geotechnical

Using the evaluation criteria identified, a quantitative evaluation of the potential effects in terms of the geotechnical aspects based on slope stability and settlement considerations of each of the alternative landfill expansion methods will be completed.

4.3.4 Operational Infrastructure

The landfill expansion alternative methods will be reviewed along with the landfill gas generation predictions to assess what infrastructure is likely required for each landfill expansion alternative. At a high level, the design requirements associated with leachate collection and treatment and landfill gas collection will be qualitatively described for each landfill expansion alternative.

4.3.5 Linkages

The technical and operation considerations component will generate predictions for use by other components where there are linkages.
4.4 Step 7 – Compare Alternative Expansion Methods and Identify the Preferred Alternative Expansion Method

4.4.1 Landfill Gas Migration
Landfill gas will be compared considering the degree of potential effects qualitatively using the criteria and indicators for the technical and operational considerations component.

4.4.2 Vectors and Vermin
Vectors and vermin will be compared considering the degree of potential effects qualitatively using the criteria and indicators for the technical and operational considerations component.

4.4.3 Geotechnical
The geotechnical environment will be compared considering the degree of potential effects quantitatively using the criteria and indicators for the technical and operational considerations component.

4.4.4 Operational Infrastructure
The operational infrastructure required for each landfill expansion alternative method will be compared qualitatively using the criteria and indicators for the technical and operational considerations component.

4.4.5 Overall Component and Project Preferred Alternative Expansion Method
The alternative expansion methods will be ranked for each of the four criteria that comprise the technical and operational component using the terminology of most preferred, equally preferred, moderately preferred and least preferred. Using this combined ranking, the preferred alternative expansion method will be identified from a technical and operational component perspective.

The alternative which has the smallest predicted negative effect is ranked ‘Most Preferred’. The alternative that has the greatest predicted negative environmental effect is ranked ‘Least Preferred’. The remaining alternative(s) is ranked ‘Moderately Preferred’. If there are no measurable differences among the predicted effects of alternatives, they are ranked ‘Equally Preferred’. This information will be used to identify and describe the justification for selection of the ‘Most Preferred’ option from a technical and operational considerations component perspective.

When each component preferred alternative expansion method is available, the EA team will determine the overall preferred alternative expansion method.

If, depending on the preferred landfill expansion alternative identified, there is a need to assess and compare alternative methods of leachate management and treatment as described in Attachment C-10, the technical and operational-related potential effects will be described qualitatively as input to the comparative evaluation of leachate management and treatment options.
4.5 Step 8 – Identify Mitigation Measures Included in the Preferred Method

As part of Step 6, the technical and operational considerations component assessed the potential effects from each of the alternative expansion methods. “In-design” mitigation measures\(^1\) that were incorporated into the alternatives will be documented.

Following Step 7 and selection of the preferred alternative expansion method, additional mitigation measures, if required, will be identified and refined as necessary.

The prediction of future environmental effects on the technical and operational considerations component will be carried out, assuming all mitigation measures are in place. The remaining effects or “net effects” will be documented.

Consistent with the requirements of O.Reg. 216/08 and 217/08, an EA level landfill gas management system design will be prepared for the overall alternative expansion method (Step 7). The design components will be specific to the overall preferred alternative expansion method (e.g., type and layout of landfill gas wells/collectors, phasing of installation, location of flare, etc.).

4.6 Step 9 – Advantages and Disadvantages of the Preferred Method

A description of the environmental advantages and disadvantages of the preferred alternative expansion method based on net effects will be prepared for the technical and operational considerations component.

4.7 Step 10 – Monitoring and Contingency Plans

The technical and operational considerations component will prepare a monitoring program appropriate for the preferred landfill expansion alternative, and a conceptual contingency plan approach related to landfill gas, vectors and vermin and, if appropriate, the geotechnical aspect. This monitoring and contingency planning process will confirm the effectiveness of mitigation measures. Contingency planning will outline the steps necessary to address unforeseen events or ineffective or defective mitigation measures that pose a risk to the elements of the technical and operational considerations.

The results of this assessment will be documented in support documents to the EA or directly within section of the EASR.

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\(^1\) Mitigation measures are actions taken to avoid or reduce potential adverse effects. Mitigation measures incorporated into the design of the project works and activities before the assessment takes place are referred to as ‘in-design’ mitigation measures.
ATTACHMENT C-9
Transportation Work Plan
May 2016

ATTACHMENT C-9

Transportation Work Plan
Biggars Lane Landfill Expansion EA
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1.0 INTRODUCTION

This document presents the proposed work plan for the transportation component of the environmental assessment (EA) to secure additional landfill disposal capacity for the County of Brant by means of an expansion at the Biggars Lane landfill site (the undertaking). This EA has a Ministry of Environment and Climate Change (MOECC) approved Terms of Reference (ToR) that sets out the overall framework and work plan for addressing the Ontario Environmental Assessment Act (EAA) requirements when preparing the EA. This work plan provides additional component-specific details in advance of commencing the assessment framework, and has been prepared with input from County of Brant Engineering and the Ministry of Transportation of Ontario (MTO) staff.

2.0 ASSESSMENT FRAMEWORK

2.1 Overall Approach

The proposed EA consists of the following steps:

- Step 1 – Describe the service area waste disposal needs for the minimum planning period ending in 2050;
- Step 2 – Develop criteria to be used in the evaluation of the alternative methods;
- Step 3 – Develop design concepts for alternative methods for expanding the existing Biggars Lane landfill site;
- Step 4 – Carry out the studies required to address the evaluation criteria;
- Step 5 – Describe the environment(s) potentially affected by the proposed undertaking;
- Step 6 – Using the evaluation criteria identified in Step 2, carry out an evaluation of the alternative methods for the proposed undertaking and identify the effects to the environment;
- Step 7 – Identify the preferred alternative method of landfill expansion; if the overall preferred alternative method of landfill expansion involves a base liner and leachate collection system (i.e., one of Alternatives 2 or 4), then carry out a comparative evaluation of alternative leachate management and treatment options using the methodology and criteria provided in Attachment C-10;
- Step 8 – Identify measures that may be necessary to prevent, change or mitigate possible environmental effects of the preferred alternative method;
- Step 9 – Prepare a description of the environmental advantages and disadvantages of the preferred alternative method based on net effects that will result following mitigation. The assessment of net effects include effects associated with the construction, operations and any closure/post closure periods of the preferred alternative method; and,
- Step 10 – Prepare monitoring and contingency plans to monitor for environmental effects.

Of these steps, the transportation component will participate in the development of Steps 4 through 10 as they pertain to this component.
2.2 Study Areas

Data for the EA will be collected and analyzed for three generic study areas presented in the ToR. The generic study areas are shown on Figures C-1 through C-3 and are described as follows:

- The Regional Study Area – encompasses the County of Brant and does not include the City of Brantford, Six Nations of the Grand River Territory, or the Mississaugas of the New Credit First Nation;
- The Local Study Area – Extends approximately 500 metres in all directions beyond the County-owned lands at the Biggars Lane landfill; and,
- The Site Study Area – Includes the County-owned lands at the Biggars Lane landfill located in the south part of Lot 1, 2nd Range East of Mount Pleasant Road in the County of Brant (former Township of Brantford).

The generic study areas noted above may be modified during the EA to suit the requirements of the transportation component and it is envisioned that the assessment required for this component will focus on the Local and Regional Study Areas.

2.3 Time Frame

The EA will consider potential effects on the environment at three project life cycle stages as follows:

- Construction Phase – This would include clearing, grading, construction of access roads, and initial construction of the landfill expansion cell(s);
- Operations (up to 2050) – This would include regular disposal activities over the course of the operating life of the Site, which is proposed as up to 2050. Ongoing, progressive construction of new disposal cells will also occur through this period; and,
- Closure/Post-closure (post 2050) – Site Closure and Post-closure activities (e.g., leachate management, landfill gas management, monitoring and maintenance) will occur over the contaminating lifespan of the landfill.
### 3.0 ASSESSMENT CRITERIA AND INDICATORS

Draft environmental components, criteria, rationale, indicators and potential data sources were provided in the approved ToR and have been updated as part of proceeding into the EA stage. They are provided below related to the transportation component.

**Table C-9.1: Assessment Criteria for Transportation**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
</table>
| Which alternative expansion design is preferred with respect to potential effects from Site-related truck traffic? | Changes to traffic loads and/or routes during construction and/or operations could alter service. | Predicted traffic changes and effects on roads and intersections in the area of the Site. | • Landfill expansion alternatives  
• Site surveys and assessments  
• Available road and intersection characteristics, and AADT traffic count information on potential haul routes (i.e., MTO, municipality)  
• Available historical traffic and collisions data  
• Aerial photographic mapping  
• Information on future infrastructure projects involving long-term highway/road closures creating diversion of landfill traffic from primary haul route  
• Information on any predicted increases in haul traffic if an engineered containment design is required  
• Available information contained in the County of Brant’s Transportation Master Plan Update, with regards to long-range roads planning and specific haul route identification |

| Which alternative expansion design is preferred regarding increased potential for bird attraction? | Birds are attracted to landfills and can pose a risk of bird strikes with aircraft. | Determination of distance to an airfield and, if required, predicted flight pattern from roosts to the landfill expansion. | • Landfill expansion alternative methods  
• Discussion with local airport and Transport Canada, if required  
• Published data sources (i.e., Transport Canada, Ministry of Natural Resources and Forestry [MNRF])  
• Results of natural environment avian surveys |
4.0 DETAILED WORK PLAN

4.1 Step 4 – Carry Out Studies

4.1.1 Traffic

Although an effect from traffic is not anticipated to be a discriminator in the evaluation of alternative landfill expansion methods (since the expansion is a continuation of existing operations with the same service area), project-specific analytical issues will be confirmed during Step 4 of the overall EA approach to verify that the transportation component is assessing the relevant effects that may relate to existing and future traffic generated by the undertaking.

The Biggars Lane landfill site is located outside the MTO’s permit control area as defined in the Public Transportation and Highway Improvement Act (PTHIA). Therefore MTO permits (i.e., Building and Land Use permit) are not required for the actual expansion of the Biggars Land landfill site. However, MTO does note that the approved EA ToR requires that individual technical studies be undertaken as part of the EA, which includes a ‘Transportation/Traffic Assessment Study’. Furthermore, MTO has an interest in a Transportation/Traffic Assessment Study and the effects the continued operation, expansion and additional traffic generated by the Biggars Lane landfill will have on the provincial highway network.

Equally important will be consultation with County of Brant staff in confirming the existing/future haul routes through the County for regular collection of waste, as well as any long-range waste transfer trucking. The County has also embarked on an update to their Transportation Master Plan, during which haul route roads will be identified through a County-Wide Truck Management Plan. The transportation assessment will consider the County’s draft designated heavy truck routes in the traffic assessment for the proposed landfill expansion alternatives.

The transportation assessment will identify and analyze waste vehicle effects for the Biggars Lane landfill site. The study will include the following elements:

- Review and confirm haul routes;
- Estimate vehicular traffic generation (by vehicle classification);
- Distribute and assign landfill-generated traffic to local/provincial road network in the area of the Site;
- Assess effects along prescribed haul route(s), including:
  - Level of service (delay), volume to capacity, queuing;
  - Collision risk assessment; and,
  - Road/intersection deficiency identification.

The route currently used for waste transfer haulage primarily involves Highway 24, County Road 4, Hagan Road, and Biggars Lane. The study will confirm that this haul route strategy will continue into the future, as a basis for the transportation assessment.
4.1.2 Bird Attraction

The results of the bird survey aspect of the natural environment field program will be reviewed. Transport Canada will be contacted to confirm the number of certified airports within 15 km of the Site and any available published data sources from Transport Canada or MNRF will be reviewed. It is known that the Brantford Municipal Airport is approximately 10 kilometres from the Site.

4.2 Step 5 – Describe Environment Potentially Affected

4.2.1 Traffic

The roadways directly affected by the transportation of waste (and other materials delivered and/or removed) at the Biggars Lane landfill site could include the following:

- Site Access Road to Biggars Lane;
- Biggars Lane;
- Burtch Road (Brant County Road 26);
- Elliott Road;
- Wetmores Road;
- Hagan Road;
- Oakland Road (Brant County Road 4);
- Cockshutt Road (Brant County Road 4); and,
- Highway 24.

The key intersections that will be examined in the assessment of operational/safety effects will include (at a minimum):

- Biggars Lane Landfill access to Biggars Lane;
- Biggars Lane/Hagan Road;
- Biggars Lane/Elliott Road;
- Biggars Lane/Wetmores Road;
- Biggars Lane/Burtch Road;
- Burtch Road/Cockshutt Road;
- Burtch Road/Mount Pleasant Road;
- Hagan Road/County Road 4; and,
- County Road 4/Highway 24.
The study will document the baseline conditions for the existing transportation environment, including:

- Daily and AM/PM peak hour traffic flows on haul route roadways and intersections (traffic flows will be classified by vehicle type);
- Collision history along links and at intersections; and,
- Operational deficiencies and/or any at-capacity conditions.

4.2.2 Bird Attraction
Data collected from Step 4 will be summarized for the nuisance bird existing conditions.

4.3 Step 6 – Predict Environmental Effects of Each Landfill Expansion Alternative Method

4.3.1 Traffic
Using the evaluation criteria, and the identified roadway/intersection deficiencies, an evaluation of the potential effects on transportation from each of the alternative landfill expansion methods will be completed (noting that these are expected to be the same for all alternatives.

The transportation assessment will also identify potential effects on, and contingency plans for, temporary alternate haul route(s) in the event that road authorities need to undertake maintenance, repairs, or improvements. This evaluation will consider:

- Capital works planned for the County or provincial highways(s) in the area, which would prevent the waste vehicles from using the roads and/or associated intersection(s) and accessing the Site; and,
- Short-term emergency road closures, and effects associated with long-term closure due to County/MTO construction plans, and/or ongoing maintenance activities.

The contingency haul route(s) will be examined in sufficient detail that they can be identified for temporary use.

4.3.2 Bird Attraction
Using the known existing issues with regard to bird attraction and considering the landfill expansion alternatives, the potential for future bird attraction will be described qualitatively. This qualitative assessment will also rely on experience in developing operations and management plans for other waste management facilities including landfills, transfer sites and waste processing sites. The assessment will consider the findings of the natural environment surveys in relation to the spatial location of the landfill expansion alternatives. The location of certified airports will dictate the extent of any mitigation measures proposed.

4.3.3 Linkages
The transportation component will generate truck and passenger car traffic predictions for potential use by other components where there are linkages (e.g., atmospheric component).
4.4 Step 7 – Compare Alternative Expansion Methods and Identify the Preferred Alternative Expansion Method

4.4.1 Traffic
The transportation component will compare the degree of potential effects using the criteria and indicators for the transportation component.

The evaluation of alternatives from a transportation component perspective will be quantifiably assessed using standard operational metrics (delay to vehicles, Level of Service, volume to capacity ratios and queuing). As mentioned, an effect from traffic is likely not a discriminator for selecting the preferred method of landfill expansion, but the study is nonetheless required to identify and quantify traffic effects, identify road deficiencies along the primary haul route, and identify contingent haul routes.

4.4.2 Bird Attraction
Bird attraction will be compared qualitatively considering the degree of potential effects using the criteria and indicators for the transportation component.

4.4.3 Overall Component and Project Preferred Alternative Expansion Method
The alternative expansion methods will be ranked using the terminology of most preferred, equally preferred, moderately preferred and least preferred, and the preferred alternative expansion method will be identified from a transportation perspective.

The alternative which has the smallest predicted negative effect is ranked ‘Most Preferred’. The alternative that has the greatest predicted negative environmental effect is ranked ‘Least Preferred’. The remaining alternative(s) is ranked ‘Moderately Preferred’. If there are no measurable differences among the predicted effects of alternatives, they are ranked ‘Equally Preferred’. This information will be used to identify and describe the justification for selection of the ‘Most Preferred’ option from a transportation component perspective.

When each component preferred alternative expansion method is available, the EA team will determine the overall preferred alternative expansion method.

If, depending on the preferred landfill expansion alternative identified, there is a need to assess and compare alternative methods of leachate management and treatment as described in Attachment C-10, the transportation-related potential effects (i.e., hauling of leachate for treatment at County-owned treatment facilities) will be described qualitatively as input to the comparative evaluation of leachate management and treatment options.
4.5 Step 8 – Identify Mitigation Measures Included in the Preferred Method

As part of Step 6, the transportation component will have assessed the potential effects of the landfill expansion. "In-design" mitigation measures (i.e., bird controls) that were incorporated into the alternatives will be documented.

Following Step 7 and selection of the preferred alternative expansion method, additional mitigation measures, if required, will be identified and refined as necessary.

The prediction of future environmental effects on the transportation component will be carried out, assuming all mitigation measures are in place. The remaining effects or “net effects” will be documented. This shall include a prioritization of any road upgrades/improvements deemed necessary to support the preferred alternative, including functional concept designs for such road works.

4.6 Step 9 – Advantages and Disadvantages of the Preferred Method

A description of the environmental advantages and disadvantages of the preferred alternative expansion method based on net effects will be prepared for the transportation component.

4.7 Step 10 – Monitoring and Contingency Plans

The transportation component will prepare a monitoring program appropriate for the preferred landfill expansion alternative, and a conceptual contingency plan approach. This monitoring and contingency planning process will confirm the effectiveness of mitigation measures. Contingency planning will outline the steps necessary to address unforeseen events of ineffective or defective mitigation measures that pose risk to the elements of the transportation environment. This may include coordination with other planning and monitoring efforts, such as emergency spill response protocols (along public roadways) and driver complaint/resolution procedures.

The result of Steps 6 to 10 of the transportation assessment will be documented in a transportation report.

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1 Mitigation measures are actions taken to avoid or reduce potential adverse effects. Mitigation measures incorporated into the design of the project works and activities before the assessment takes place are referred to as ‘in-design’ mitigation measures.
ATTACHMENT C-10
Methodology for Evaluation of Leachate Management and Treatment Options
ATTACHMENT C-10

Methodology for Evaluation of Leachate Management and Treatment Options
Biggars Lane Landfill Expansion EA
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Table C-10.1: Comparative Evaluation Criteria for Leachate Management and Treatment Options ........................................ 2
1.0 DETAILED WORK PLAN

Expansion Alternatives 2 and 4 incorporate an engineered base containment design approach (with a low permeability base liner and leachate collection system). The collected leachate will be removed from the landfill for treatment. If one of Alternatives 2 or 4 is identified through the comparative evaluation process as the overall preferred landfill expansion alternative, then a comparative evaluation of alternative leachate management and treatment options will be required. Conversely, if one of Alternatives 1 or 3 is identified as preferred, leachate management and treatment will not be required.

The following four leachate treatment options were identified for evaluation, if one of Alternatives 2 or 4 is the preferred expansion alternative:

- Leachate Treatment Option 1 – leachate treatment using the County-owned Paris Water Pollution Control Plant (WPCP);
- Leachate Treatment Option 2 – leachate treatment using the County-owned St. George WPCP;
- Leachate Treatment Option 3 – leachate treatment using both of the County-owned Paris and St. George WPCPs; and,
- Leachate Treatment Option 4 – on-Site treatment, with effluent discharge to the Unnamed Creek.

The methodology to assess these leachate management and treatment options will consist of the following activities:

1) estimate the leachate volume and quality associated with the preferred landfill expansion alternative;
2) describe each leachate management and treatment option at a conceptual level of detail;
3) compare the leachate management and treatment options using the evaluation criteria provided in Table C-10.1; and,
4) identify the preferred leachate management and treatment option for the Biggars Lane landfill expansion.
Table C-10.1: Comparative Evaluation Criteria for Leachate Management and Treatment Options

<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
</table>
| Surface Water | Which leachate treatment method is preferred for the protection of surface water quality? | Leachate management and treatment options have the potential to impact off-Site surface water quality and quantity. | • Anticipated effects on off-Site surface water quality | • Estimated leachate volume and quality  
• Total and available capacity of potential municipal treatment facilities, treatment facility capability and discharge criteria |
|               | Which leachate treatment method is preferred with regard to surface water quantity? |                                                                           | • Anticipated effects on off-Site surface water quantity |                                                                                |
| Atmosphere    | Which leachate treatment method is preferred with regard to odour emissions? | Leachate management (loading, haulage and discharge) and treatment options can produce air emissions, which may degrade off-Site air quality. Similarly, they can result in increased noise levels and odour emissions. | • Anticipated odour emissions | • Results of background studies including:  
• Characteristics of potential receiving waters  
• Identification of required treatment facility modifications and/or on-Site pre-treatment |
|               | Which leachate treatment method is preferred with regard to air quality?    |                                                                           | • Anticipated air emissions |                                                                                |
|               | Which leachate treatment method is preferred with regard to noise levels?   |                                                                           | • Anticipated noise levels |                                                                                |
Table C-10.1: Comparative Evaluation Criteria for Leachate Management and Treatment Options

<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
</table>
| Economic                   | Which leachate treatment method is preferred with regard to practicality and economic viability? | The capital costs depend largely on the amount of modifications/upgrade required to the off-Site treatment facility, and/or the need for on-Site pre-treatment, as well as the leachate conveyance method, i.e., haulage by tanker or pipeline. The operational costs to treat leachate would be incremental and depend on the increased treatment associated with leachate loading and any additional treatment processes. | • Requirement for capital costs for modifications and upgrades of existing facilities or addition of new facilities  
• Incremental operational costs | • Results of quantitative or qualitative predictive assessments for other components  
• Prediction of treatment facility performance  
• Anticipated capital and operating cost |
| Technical Effectiveness    | Which leachate treatment method is preferred with regard to technical feasibility and proven ability to meet treated effluent quality requirements? | The technical effectiveness depends on the quantity and associated chemical loading associated with the leachate and characteristics of the watercourse that will receive the treated effluent, and the expected ability of the treatment system to provide the required treatment of leachate. | • Incremental increase in quantity and chemical loading on treatment facility by accepting leachate  
• Expected ability of treatment facility to meet treated effluent quality requirements |
## Table C-10.1: Comparative Evaluation Criteria for Leachate Management and Treatment Options

<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria</th>
<th>Rationale</th>
<th>Indicators</th>
<th>Potential Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Which leachate treatment method is preferred with regard to ability to handle the estimated leachate volume?</td>
<td>Existing waste water treatment plants have a licensed capacity in terms of how much wastewater they can receive. On-Site leachate treatment will require adequate space for construction of the treatment facility to handle the estimated quantity of leachate.</td>
<td>• Leachate percentage in comparison to approved rated capacity of wastewater treatment plants&lt;br&gt;• Availability of sufficient land area for leachate treatment facility</td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td>Which leachate treatment method is preferred with regard to traffic?</td>
<td>Leachate management and treatment options have the potential to impact traffic due to haulage of leachate.</td>
<td>• Amount and type of traffic associated with leachate haulage&lt;br&gt;• Type(s) and usage of routes along which leachate will be transported</td>
<td></td>
</tr>
</tbody>
</table>
This Appendix has been moved to
*Volume VI – Record of Consultation* of the
Biggars Lane Landfill Expansion Environmental Assessment Report
APPENDIX E
Commitment and Monitoring Strategy/Framework
SUMMARY OF COMMITMENTS

Compliance monitoring of the Biggars Lane landfill site will be undertaken to confirm that it has been constructed, implemented and/or operated in accordance with the commitments made during the preparation of the EA and the conditions of the EAA. This section lists the commitments made by the County of Brant during development of the TOR (Table E-1) and during the EA study process (Table E-2). The EA study commitments will include in-design mitigation measures and best management practices and will be described in a section of the EASR. The list provided in Table E-2 include items related to both compliance monitoring and effects monitoring, where effects monitoring refers to monitoring carried out after the EA to assess the effects of the project on the environment on an ongoing basis during project phases from construction through post-closure.

Table E-1: List of Commitments made by the County of Brant during Development of the TOR

<table>
<thead>
<tr>
<th>ID</th>
<th>Commitment (Location of Where Commitment was Made)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The County will continue to implement, and aim to increase, their waste diversion strategies. (TOR Section 6.1.1)</td>
<td>Ongoing. Outside the scope of the EA.</td>
</tr>
<tr>
<td>B</td>
<td>The alternative methods for providing additional landfill disposal capacity at the Biggars Lane landfill will be identified, refined and confirmed during the EA. (TOR Section 6.3)</td>
<td>will be completed. Alternative methods provided in Appendix A of the Phase 2 Report and to be refined in Phase 3 of the EA project.</td>
</tr>
<tr>
<td>C</td>
<td>The assessment criteria presented in the TOR are preliminary in nature only. The assessment criteria will be reviewed and finalized early in the EA process. (TOR Section 8.2 and Appendix D)</td>
<td>will be completed. Final assessment criteria provided in Appendix B of the Phase 2 Report.</td>
</tr>
<tr>
<td>D</td>
<td>The consultation plan for the EA will be implemented to maintain channels of communication with government agencies, the public, other interested stakeholders, and Aboriginal communities. (TOR Section 11.0)</td>
<td>will be completed. Report on EA consultation program provided in Appendix D of the Phase 2 Report and to be updated as Phase 3 of the EA progresses.</td>
</tr>
<tr>
<td>E</td>
<td>In regard to consultation with Aboriginal communities, an Accommodation Strategy to address how the proposed undertaking can avoid or mitigate potential adverse effects on the exercise of constitutionally protected rights will be developed with input from the communities. (TOR Section 11.5)</td>
<td>will be completed. To be completed early in Phase 3 of the EA.</td>
</tr>
<tr>
<td>ID</td>
<td>Commitment (Location of Where Commitment was Made)</td>
<td>Status</td>
</tr>
<tr>
<td>----</td>
<td>--------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>F</td>
<td>A conflict resolution process will be developed in the early stages of the EA, to be applied when appropriate to resolve conflicts that may arise during the EA. <em>(TOR Section 11.6)</em></td>
<td>will be completed. To be completed early in Phase 3 of the EA.</td>
</tr>
<tr>
<td>G</td>
<td>Air and water quality assessments will be carried out as part of the EA. <em>(TOR, Appendix B, Section 3.3)</em></td>
<td>will be completed. Attachments C-4 and C-1 of the Phase 2 Report, respectively.</td>
</tr>
<tr>
<td>H</td>
<td>General impacts due to traffic, noise and odours will be assessed during the EA. <em>(TOR, Appendix B, Section 3.3)</em></td>
<td>will be completed. Attachments C-9 and C-4 of the Phase 2 Report, respectively.</td>
</tr>
<tr>
<td>I</td>
<td>The impact on agriculture from an economic and technical perspective will be assessed during the EA. <em>(TOR, Appendix B, Section 3.3)</em></td>
<td>will be completed. Attachment C-6 of the Phase 2 Report.</td>
</tr>
<tr>
<td>J</td>
<td>The County is following the Grand River Notification Agreement and is working in cooperation with all potentially affected Aboriginal communities. <em>(TOR, Appendix B, Section 4.3)</em></td>
<td>will be completed. Appendix D of the Phase 2 Report.</td>
</tr>
<tr>
<td>K</td>
<td>The transportation assessment study will include an analysis of contingency plans in case of provincial highway closure along haul routes to the landfill site. <em>(TOR Agency Response Summary Table)</em></td>
<td>will be completed. Attachment C-9 of the Phase 2 Report.</td>
</tr>
<tr>
<td>L</td>
<td>Technical studies completed as part of the EA will be carried out in accordance with O.Reg. 232/98 and the Landfill Standards. <em>(TOR Agency Response Summary Table)</em></td>
<td>will be completed. Appendix C of the Phase 2 Report.</td>
</tr>
<tr>
<td>M</td>
<td>The evaluation of potential effects on groundwater will consider Source Water Protection Plans. <em>(TOR Agency Response Summary Table)</em></td>
<td>will be completed. Attachment C-1 of the Phase 2 Report.</td>
</tr>
<tr>
<td>N</td>
<td>The evaluation of potential impacts on surface water will be completed to a level of detail appropriate for a future ECA application associated with wastewater (stormwater and leachate). <em>(TOR Agency Response Summary Table)</em></td>
<td>will be completed. Attachment C-2 of the Phase 2 Report.</td>
</tr>
<tr>
<td>ID</td>
<td>Commitment (Location of Where Commitment was Made)</td>
<td>Status</td>
</tr>
<tr>
<td>----</td>
<td>---------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>O</td>
<td>Cultural heritage and archaeological assessments will be carried out as part of the EA in accordance with MTCS guidance and requirements. (TOR Agency Response Summary Table)</td>
<td>will be completed. Attachment C-5 of the Phase 2 Report.</td>
</tr>
<tr>
<td>P</td>
<td>The EA will include assessment of potential impacts on the Unnamed Creek southwest of the existing landfill. (TOR Agency Response Summary Table)</td>
<td>will be completed. Attachment C-2 of the Phase 2 Report.</td>
</tr>
<tr>
<td>Q</td>
<td>The County will continue to engage the GRCA during the EA process. (TOR Agency Response Summary Table)</td>
<td>will be completed. Attachment C-1 of the Phase 2 Report.</td>
</tr>
<tr>
<td>R</td>
<td>The County will continue to engage with the Six Nations during the EA process. (TOR Agency Response Summary Table)</td>
<td>will be completed. Appendix D of the Phase 2 Report.</td>
</tr>
<tr>
<td>S</td>
<td>The noise assessment completed as part of the EA will consider zoning that allows future sensitive receptors on vacant lots. (TOR Agency Response Summary Table)</td>
<td>will be completed. Attachment C-4 of the Phase 2 Report.</td>
</tr>
<tr>
<td>T</td>
<td>When the County applies to the MOECC for a revision to the ECA for the expansion to the Biggars Lane landfill, they will simultaneously apply to the MOECC for a revision to the Paris landfill site to revoke the existing approval for additional landfill capacity at that site. (Terms of Reference Notice of Approval)</td>
<td>Subsequent to EA approval for expansion of the Biggars Lane landfill, when submitting the application for ECA revision.</td>
</tr>
<tr>
<td>U</td>
<td>In addition to assessing alternative expansions and footprints to accommodate the increase of landfill capacity, the County will also assess landfill gas collection options for each alternative method. (Terms of Reference Notice of Approval)</td>
<td>will be completed. Attachment C-8 of the Phase 2 Report.</td>
</tr>
</tbody>
</table>
Table E-2: List of Commitments made by the County of Brant during the EA

[to be completed during preparation of the EA report]

<table>
<thead>
<tr>
<th>ID</th>
<th>Component (if applicable)</th>
<th>Commitment (Location of where commitment was made in the EA Document Package)</th>
<th>Project Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Archaeology</td>
<td>The County will notify the Huron-Wendat Nation of archaeology studies to be carried out on the site as part of the EA.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hydrogeology; archaeology; cultural heritage; natural environment; surface water and stormwater; land use, agricultural and visual</td>
<td>The County will provide copies of the archaeology report(s) and notify the Mississaugas of the New Credit First Nation of archaeology, borehole drilling, groundwater sampling, surface water sampling, aquatic and terrestrial ecosystem field studies, agricultural surveys, and cultural heritage landscape surveys to be carried out on the site as part of the EA.</td>
<td></td>
</tr>
</tbody>
</table>

The County of Brant will report compliance monitoring to the MOECC annually regarding the status of these commitments until such time as all commitments are completed or addressed in EPA/OWRA conditions of approval.
APPENDIX F
Data CD