# Appendix A

## Draft Conceptual Design Report

# Draft Conceptual Design Report

## Walker South Landfill Phase 2 Environmental Assessment

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# 1. Introduction

## 1.1 Background

Walker's Resource Management Campus (Campus) is located at 2800 Thorold Townline Road in the City of Niagara Falls. The Campus has existed since the 1880s and has provided safe, reliable and affordable waste disposal services for over 40 years.

The South Landfill is a central component of Walker's fully integrated Campus (Figure 1) and has been operating since 2009 under Environmental Compliance Approval (ECA) No. 0084-78RKAM, as amended. It has a total approved site capacity of 17.7 million cubic metres ($m^3$). The South Landfill provides safe, reliable, and affordable disposal capacity for solid, non-hazardous waste from residential and industrial, commercial, and institutional (IC&I) sources. It serves customers from the City of Niagara Falls, the Regional Municipality of Niagara, and the Province of Ontario.

In 2023, Walker Environmental Group (Walker) initiated a Comprehensive Environmental Assessment (EA) under the Ontario *EA Act* seeking approval to expand the capacity of its existing South Landfill as it is expected to reach its current maximum capacity by 2029 to 2031. The South Landfill provides essential resource recovery, renewable energy, and residual waste management infrastructure to the Niagara Region, surrounding communities and Ontario as a whole.

The proposed Phase 2 of the South Landfill would extend its approved capacity by approximately 18 million $m^3$ over a 20-year period, ensuring Walker can continue to provide essential residual waste disposal services to its existing customer base. Walker is proposing to locate the additional disposal capacity (Phase 2) to the east of the existing South Landfill within the area currently occupied by Walker's Southeast Quarry (Figure 1). The proposal would maintain the existing landfill service area, as well as the annual volume of solid, non-hazardous waste from the sources currently accepted.

The Minister-approved Terms of Reference (ToR) committed to providing details on the proposed Alternative Methods of Carrying Out the Undertaking (Alternative Methods) during the EA. This report describes each of the proposed Alternative Methods to a conceptual level of detail for further evaluation in the EA.

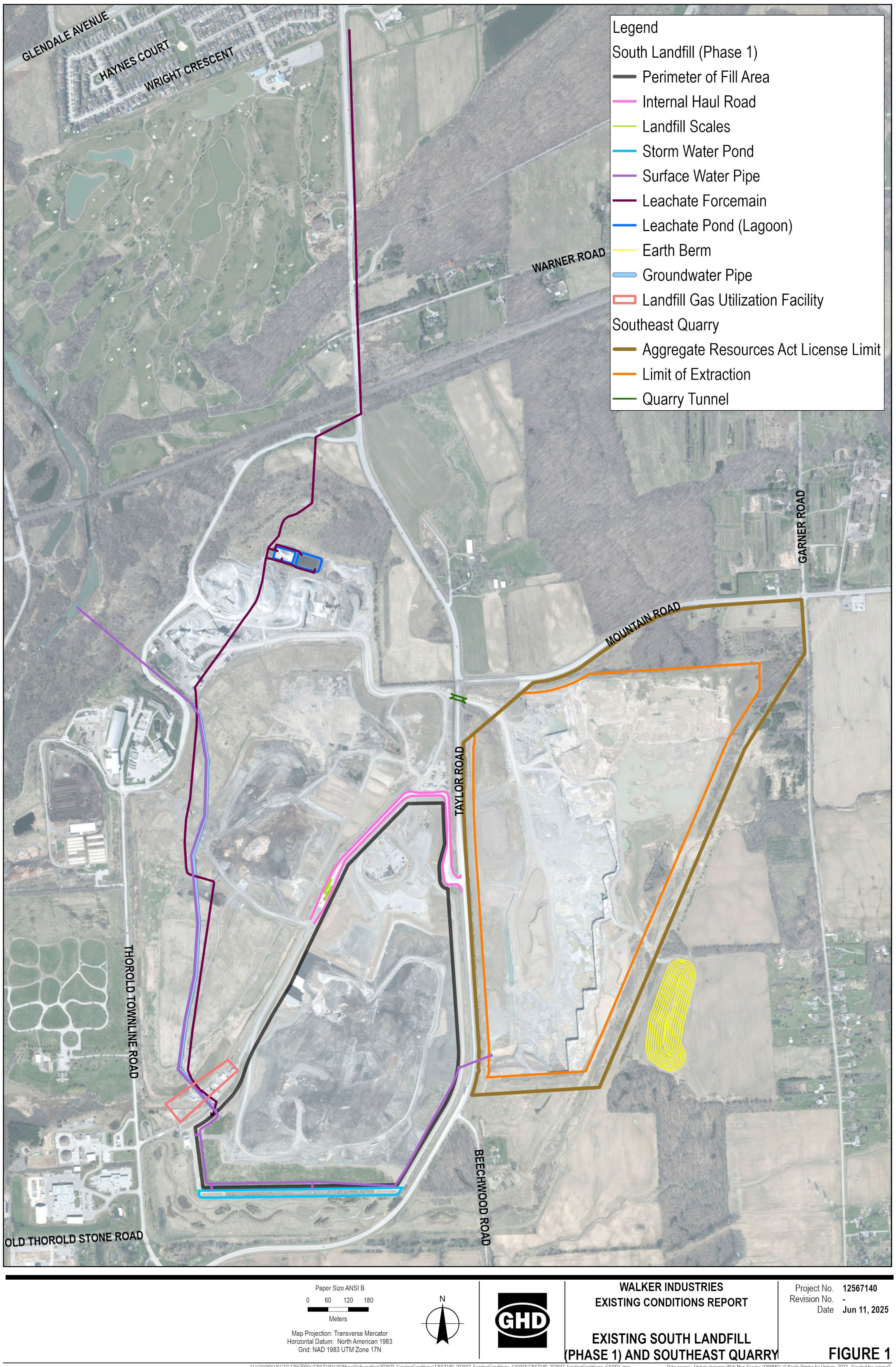


***Figure 1*** ***Existing South Landfill (Phase 1) and Southeast Quarry***

## 1.2 Objectives of the Document

This document is a Conceptual Design Report (CDR) which presents conceptual designs for the proposed Alternative Methods for the South Landfill Phase 2 within the area currently occupied by Walker's Southeast Quarry. The report is intended to form the basis of a comparative analysis of the Alternative Methods by the project team's technical disciplines. The comparative analysis will lead to the identification of a Preferred Alternative, which will be subject to further design development and a detailed impact assessment.

The Alternative Methods presented in this report were developed to a conceptual level of detail based on the following characteristics:

- Site capacity and fill rate
- Footprint size
- Final contours and slopes
- Peak elevation and height relative to the surrounding landscape
- Buffer zones between the proposed South Landfill Phase 2 footprint and the property boundary
- Setbacks to surrounding developments
- Infrastructure requirements
- Leachate management
- Stormwater management
- Landfill Gas management
- Site entrance and weight station
- Operations

Furthermore, the landfill configuration and leachate management alternatives were prepared in consideration of the requirements outlined in the following documents:

- Approved ToR, Walker South Landfill Phase 2 EA, June 2024
- Ontario Regulation [O. Reg.] 243/23 – Waste Management Projects under the *EA Act*
- O. Reg. 50/24: Part II.3 Projects – Designations and Exemptions (the Comprehensive EA Projects Regulation) under the *EA Act*
- O. Reg. 232/98 – Landfilling Sites, under the *Environmental Protection Act* (Last amendment: O. Reg. 268/11, October 31, 2011)
- Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Sites, Ontario Ministry of the Environment (Last revision: January, 2012)
- ECA No. 0084-78RKAM
- Aggregate Resources Act (ARA) licence No. 11175
- ARA licence No. 4437

It should be noted that different approaches may be possible to achieve the same or better design objectives. The conceptual designs for the Alternative Methods presented herein will be further developed during the technical design stage for the Preferred Method.

# 2. Conceptual Design Basis

## 2.1 Overview

A series of criteria and assumptions were established to guide the development of the Alternative Methods. These include Walker's projected continued waste disposal capacity requirements and regulatory requirements relating to site design geometry. In addition, O. Reg. 232/98 and the accompanying Landfilling Standards Guideline specify requirements and/or provide recommendations for key design parameters. Assumptions were also made relating to operational traffic levels, leachate generation rates, and aspects of design and operations. The criteria and assumptions used in the development of the Alternative Methods are discussed in the sections that follow.

## 2.2 Site Capacity and Fill Rate

The South Landfill (Phase 1) has a total approved site capacity of 17.7 million $m^3$ consisting of solid, non-hazardous waste from residential and IC&I sources. It has an annual fill rate of 1.1 million tonnes (a maximum of 850,000 tonnes of residual waste plus an additional 250,000 tonnes of soil used for daily and interim cover per year). The current approved capacity at the South Landfill (Phase 1) is estimated to be reached between 2029 and 2031. The development of Phase 2 proposed under this EA is to increase the site capacity by approximately 18 million $m^3$ over a 20-year operating period and maintain the current annual maximum fill rate of 1.1 million tonnes. The waste type received at the landfill will remain unchanged and the estimated density of waste landfilled will remain at 1:1 (tonne/$m^3$) in-place while the waste-to-daily cover ratio is expected to consist of 30-35% cover material.

## 2.3 Footprint Size

To accommodate the capacity expansion, the proposed footprint, or Fill Area, for all Landfill Configuration Options is 62.6 ha, and is contained within the Extraction Limit of the existing Southeast Quarry. The Waste Disposal Site Boundary Limits, which encompass the Fill Area, a 30 m buffer, and ancillary infrastructures area, is 82.9 ha (see Figure 2, and Section 2.6). The Waste Disposal Site Boundary Limits are fully within the Walker property.

## 2.4 Final Contours and Slope

The South Landfill Phase 2 will follow the regulatory requirements with a maximum final cover slope of four units horizontal to one unit vertical (4H to 1V, or 25%) but the specific slope will vary between the Alternative Methods proposed below.

## 2.5 Peak Elevation and Height

The peak elevation of the South Landfill Phase 2 refers to the highest point of the landfill measured in metres above mean sea level (mAMSL), while the height of the South Landfill Phase 2 is measured relative to the surrounding landscape and is measured in metres above grade. The peak elevation and maximum top of waste (TOW) height for the Alternative Methods was identified based on the goal of minimizing visual impacts to the landscape and will be limited to 212 mAMSL and 31 metres above grade. The height of the landfill is minimized as the proposed designs include an existing excavation of approximately 18 metres below existing grade (i.e., the mined out quarry footprint).

## 2.6 Buffer Areas

The purpose of the buffer is to provide adequate space for vehicle movements and ancillary facilities for maintenance and monitoring, while also serving to avoid or minimize impacts of the site's operations beyond its boundaries. For the South Landfill Phase 2, the proposed buffer zones and setbacks include a 30 metre (m) buffer around the entire perimeter of the site (Figure 2). Additionally, there is extra buffer space at the south end of the proposed Fill Area to accommodate infrastructure such as office facilities, staff parking, and stormwater management systems.

While there is potential that the entire proposed Buffer Area may be disturbed, the extent of this disturbance will be determined as the design is refined. It is possible that not all of the Buffer Area will need to be disturbed to accommodate the necessary infrastructure and monitoring/maintenance access.

## 2.7 Setbacks to Surrounding Developments

In addition to the on-site buffers noted above that will be maintained in relation to the South Landfill Phase 2, additional buffer separation is achieved through road allowances and setbacks for other developments required in accordance with local planning by-laws. The setback between the South Landfill Phase 2 Perimeter of Fill Area and the nearest privately owned land is approximately 235 m (Figure 2).

## 2.8 Infrastructure Requirements

The South Landfill Phase 2 will require various infrastructure components in order to operate the site. The components shall consist of preexisting infrastructure as well as new installations and are as follows:

- 3-phase electrical power access
- Leachate management system
- Landfill gas collection system and utilization facility
- Taylor Road main entrance
- Scale Facility
- Taylor Road underpass/tunnel
- Access roads
- Equipment maintenance facility
- Staff site office facilities
- Stormwater management facilities

The groundwater management system, leachate management system, and stormwater management system will be reconfigured as required to accommodate the Alternative Methods. Further details are provided in the sections that follow.

## 2.9 Groundwater Management

The South Landfill is a modern and highly engineered site consisting of a double composite liner system designed in accordance with O. Reg. 232/98: Landfilling Sites. Additionally, the hydrogeologic setting at the site provides an inward groundwater gradient (i.e., hydraulic trap design) that offers a robust groundwater protection contingency measure.

The South Landfill Phase 2 will feature a double composite Compact Clay Liner (CCL) and Geosynthetic Clay Liner (GCL) liner system that meets or exceeds O. Reg. 232/98 with a maximum slope of 3H to 1V as per O. Reg. 232/98. The hydrogeologic setting of Phase 2 is similar to Phase 1, with an inward groundwater gradient for contingency purposes, supported by groundwater monitoring wells to ensure compliance.

## 2.10 Leachate Management

Within the East and South Landfills, leachate is primarily produced by the percolation of precipitation through the refuse. Moisture present in the refuse upon arrival at the landfills also contributes to the production of leachate. An engineered clay liner and double composite liner system was constructed within the East and South Landfills, respectively, to contain and isolate the leachate from the natural environment. A leachate collection system (LCS) constructed on the liner systems collects the leachate and discharges it to two on-site lagoons where it is aerated and eventually discharged to the sanitary sewer for treatment at the Port Weller, Wastewater Treatment plant in St. Catharines.

The estimated maximum leachate generation rate for the South Landfill Phase 2 is approximately 104,500 $m^3$/year (supporting calculations are presented in **Appendix A**). It should be noted that the leachate generation rate will vary over the operational and post-closure period of the landfill, and is influenced by factors including precipitation, degree of landfill development (e.g., area of landfill that is actively undergoing development versus areas where interim/final cover has been placed), final cover design, and other factors. Detailed modeling of the leachate generation will be carried out using the Hydrologic Evaluation of Landfill Performance (HELP) model following the selection of a preferred alternative.

The alternative methods of leachate management being considered for the South Landfill Phase 2 are continued use and expansion of the existing leachate management system (Section 3.2.1), and development of an on-site wastewater treatment system (Section 3.2.2). A new pump station and forcemain would be common to both options. It is assumed the forcemain would be installed in open cut.

## 2.11 Stormwater Management

Drainage at the Campus operations is managed such that surface water that has the potential to contact waste materials is isolated and directed to the LCS, prior to treatment and discharge to the Municipal Sanitary Sewer under an existing agreement with the Town of Niagara-on-the-Lake. Non-contact (precipitation that does not come in to contact with waste) runoff within the Campus is collected in the Southeast Quarry sump, East Quarry stormwater management structure, and in a series of stormwater management ponds around the South and East Landfills. These ponds are operated with the discharge valve normally closed and are batch discharged if they meet their applicable discharge criteria. If the accumulated runoff in the stormwater management ponds does not meet discharge criteria, the water can be pumped to the LCS as a contingency.

The South Landfill Phase 2 designs will include additional stormwater management ponds surrounding the development and the associated conveyance infrastructure (Figure 2). The design of the cap will include 600 mm of low permeability final cover soil and 150 mm of topsoil meeting the requirements of O. Reg. 232/98.

## 2.12 Gas Management

Dating back to 2002 when landfill gas was provided to a local papermill to offset its use of fuel oil and natural gas, Walker pioneered the utilization of landfill gas from the landfill to provide reliable, low cost and renewable sources of energy within the local community. In 2020, Walker and GM developed a cogeneration project using landfill gas to power and heat GM’s St. Catharines Propulsion Plant helping reduce its greenhouse gas (GHG) emissions by 70 percent and protecting it from rising electricity and carbon costs. Most recently, in 2023, Walker and Enbridge built Ontario’s largest renewable natural gas (RNG) project, where landfill gas is cleaned and transformed into RNG which is used interchangeably with natural gas. In total, the landfill gas from the Walker Campus can power the equivalent of approximately 16,000 homes.

The landfill gas collection and control system for South Landfill Phase 2 will follow or exceed the applicable regulations.

## 2.13 Traffic

Vehicle traffic associated with the development of the site is important in assessing the potential impacts of the site on various receptors. The total vehicle traffic volumes were calculated based on assumed vehicle types and average capacities and are estimated at an average of approximately 250 trucks per day with a potential peak of approximately 425 trucks per day (supporting data is presented in **Appendix B**). The traffic associated with staff vehicles or other site operations is assumed to be negligible. It is noted that operation of the Southeast Quarry is expected to cease in 5-7 years and would result in a decrease in background traffic.

The vehicle traffic to the site during the operations phase of the development will remain the same as current landfill operations:

– Current haul routes and site entrance for South Landfill (Phase 1) will remain unchanged for Phase 2.
– A maximum daily receipt limit of 10,000 tonnes per day will continue.
– Phase 2 will have the same operational hours as Phase 1:
  - Waste will only be accepted between 7:00 am to 7:00 pm – Monday to Friday (except statutory holidays), and 7:00 am to 1:00 pm on Saturdays.
  - Site preparation activities (road maintenance, snow removal, etc.) will permit on-site equipment operation between:
    – 6:00 am to 9:00 pm – Monday to Friday (except statutory holidays)
    – 6:00 am to 3:00 pm on Saturdays
    – 24 hours a day and on Sundays during emergency events such as large snow events, large melt events, large rain events and fire emergencies.

The longest possible haul distance for internal traffic within the Site is estimated at 3,100 m.

# 2.14 Construction

The development and construction of the project will include two main components. The first component is the construction of key infrastructure required to operate the landfill. This includes the construction of new and/or upgrade of existing infrastructure such as scales and weigh station, primary internal haul roads, Taylor Road underpass/tunnel, electrical servicing, leachate pump station, force mains, site offices and general civil works. This infrastructure will be developed prior to, or during the development of the first stage (Stage 1) of the landfill.

The second component is the development of the landfill fill area which primarily includes the liner system. The landfill fill area will be developed in four main stages (Figure 2). Each stage will accommodate approximately four cells. It is generally anticipated that cells will be developed on an annual basis. Stage and cell development is expected to occur as follows and will be the same for all Landfill Configuration Options being considered. Construction of the Stages and cells generally consists of earthmoving, placement of granular materials and construction of the liner and leachate collection system.

– Stage 1 will begin in the southern end of the site and will progress in a northerly direction. The capacity of Stage 1 is approximately 4,500,000 $m^3$ and will last about 5 years at maximum filling rates.
– Stage 2 is in the middle of the site and will progress in a northerly direction. The capacity of Stage 2 is approximately 4,500,000 $m^3$ and will last about 5 years at maximum filling rates.
– Stage 3 is in the northeastern corner of the site. It will begin at the northeastern limit of Stage 2 and progress in a northerly direction. The capacity of Stage 3 is approximately 4,500,000 $m^3$ and will last about 5 years at maximum filling rates.
– Stage 4 is in the northwestern corner of the site. It will begin at the western limit of Stage 3 and progress in a westerly direction. The capacity of Stage 4 is approximately 4,500,000 $m^3$ and will last about 5 years at maximum filling rates.
– Note that footprints for the stages, although not equal in area, are approximately equal in volume due to the effect of temporary waste side slopes required during the operation of the landfill.
– Within each of these stages, new landfill liner (referred to as cell) will be constructed yearly, or as needed, to provide sufficient space for waste placement and landfill operations. All aspects of each new cell are connected to existing cells, and new stages to existing stages to form one continuous landfill liner system.

## 2.15 Operations

The following operating practices, based on current operation of the South Landfill (Phase 1), will be common to all Alternative Methods. While these would not significantly influence the comparative analysis, they should nevertheless be considered in reviewing the Alternative Methods. Any modifications to the design and operations will be outlined during the detailed impact assessment of the Preferred Method.

### Receiving and Placement of Waste

- All materials received at the site are verified, recorded and weighed to ensure compliance with regulatory conditions.
- Waste trucks will be directed to offload in the designated working area (active face).
- Daily working areas (active face) will generally be limited to no more than 2,000 $m^2$ in size.
- Waste will be placed, graded with a bulldozer and compactor in lifts ranging from 1 to 5 m thickness.
- Burning or scavenging will not be permitted.

### Daily and Intermediate Cover

- Daily cover will be applied following each day's landfilling operations to control potential nuisance effects, to facilitate vehicle access on the site, and to ensure an acceptable site appearance is maintained.
- Suitable solid, non-hazardous wastes (e.g., wood chips, soil, sand, fill materials) will be segregated from the incoming waste streams for use as daily cover. Alternative daily cover may also be used.
- Intermediate cover will be applied to landfill areas that are not yet brought up to final grade, but will be inactive for more than several months, consistent with O. Reg. 232/98.
- Soil suitable for the establishment of temporary vegetation in order to control water and wind erosion will be used for intermediate cover (or other equivalent surface treatments that achieve the same purpose), obtained from suitable solid, non-hazardous waste soils that are segregated from the incoming waste streams, or an alternative source.

### Nuisance Controls

O. Reg. 232/98 requires that landfills be designed and operated to ensure that nuisance impacts are minimized, and the regulation requires that the proponent prepare a report describing all aspects of the operation, as well as maintenance procedures that will be followed.

A key objective in planning operations is to ensure the facility is operated in accordance with relevant permits and approvals while minimizing nuisance impacts including noise, litter, vectors, dust, and odour. Typical operating practices relating to these issues include:

- Approximately 750 m of paved internal roads allow mud to dislodge from truck wheels before exiting the site, minimizing mud and dust on public roads.
- Road sweepers will be used regularly on internal paved roads, parking areas, and adjacent external roadways to remove dirt and dust.
- Dust control such as watering will be used to minimize dust on unpaved traffic surfaces.
- Traffic speeds will be limited to control dust and noise.
- Trucks with open tops will require tarping while moving. Once inside the site, tarps will be removed prior to unloading.
- Permanent and temporary/mobile litter fencing will be erected at key locations around the working areas to catch blowing litter.

- Litter collection will be regularly carried out on-site and in the vicinity of the site to remove any fugitive blowing litter.
- Birds of prey, noisemakers and other industry standard bird control methodologies will be used daily during operating hours to discourage birds from gathering and scavenging at the landfill.
- Pest control measures will be employed if vermin are found at the site.
- Odour control measures will include, but are not limited to, the adaptive application of a small working face, daily cover, and ongoing refinements to the operation of the gas collection and leachate treatment systems.
- A formal public hotline, reporting and response procedure will be in place to identify and correct any nuisance issues (currently in place for Walker's Niagara operations).

## Monitoring

Routine monitoring programs and reporting systems will be established through the EA and subsequent approvals process. These may could include the following:

- Functional and operational equipment (pumps, flares, etc.)
- Leachate quantity and quality
- Groundwater levels and quality
- Surface water flows and quality
- Treated leachate quantity and quality
- Air emissions
- Landfill gas collection and perimeter monitoring
- Noise levels
- Particulates (dust)

## Personnel Requirements

The site is generally anticipated to require the following full-time personnel for the landfill operations:

- 1 operator for each piece of heavy equipment (see Sec. 3.10 below)
- 2 scale operator
- 1 landfill traffic coordinator
- 1 waste inspector
- 1 sweeper operator
- 2 litter control technicians
- 1 landfill superintendent
- 1 landfill gas control/utilization plant operator
- 1 landfill gas wellfield technician
- 1 wildlife control technician
- 1 leachate treatment plant operator (if on-site leachate treatment plant is required)
- Various subcontracted personnel as required for construction, operation, daily / intermediate cover supply and application, closure, and maintenance activities

## Equipment Requirements

The site is anticipated to require the following landfilling equipment:

- 5 compactors for waste spreading/compaction

– 2 tippers for truck unloading
– 1 water truck for dust control
– 1 fuel truck for refueling
– 1 sweeper truck for dust control
– 1 loader for miscellaneous operations
– 1 skidsteer for miscellaneous operations
– 10 site pick-up trucks for site staff
– 2 excavators for loading of soils and miscellaneous operations
– 6 haul trucks for transport of soils
– 1 grader
– 1 bulldozer for miscellaneous operations
– 1 bulldozer for maintaining inbound cover material (25% utility)

Additional equipment will be required during construction and closure phases which are expected to occur up to 8 months per year.

# 2.16 Closure, Post-closure, and End Use

Closure and post closure (or decommissioning) of the South Landfill Phase 2 will take place in accordance with O. Reg. 232/98, which includes the future requirement to develop a closure plan. Walker is required to prepare a closure plan when the South Landfill Phase 2 has reached 90 percent of its approved capacity or two years of remaining capacity (whichever comes first).

In concert with developing conceptual designs for the Alternative Methods, per the approved ToR, broad closure and post closure frameworks relating to infrastructure, monitoring, and end use have been generated for assessment and comparative evaluation purposes.

## Infrastructure

*Table 1 Potential Outcome of Infrastructure at Closure*

| Retain/Modify for continued operation post-closure | Repurpose, or remove and rehabilitate | Remove and rehabilitate |
|---|---|---|
| Leachate management system | Entrance, tunnel, and internal access roads | Scale facility |
| Landfill gas collection system and utilization facility | Maintenance and site office facilities | |
| Stormwater management facilities | Site security fencing as determined | |
| Groundwater management system | | |
| Water Monitoring Program | | |
| Site security fencing as determined | | |

## Post-closure Monitoring Requirements

Post-closure monitoring is expected to include the following:

– Monitoring of the final cover system
– Landfill gas and landfill gas collection system monitoring
– Leachate and leachate collection system monitoring

– Groundwater and surface water monitoring

An annual Post-Closure Care Report will be prepared, which will summarize results from monitoring programs.

# Post-closure Use

The proposed end use associated with the existing quarry is progressive rehabilitation to agricultural land usage. With consideration given to pre-development land use and ecological conditions, Walker is currently considering the following as possible end-uses for the proposed South Landfill Phase 2:

– Agricultural use (e.g., similar to the rehabilitated portion of the East Landfill)
– Naturalization (e.g., planting with regionally native species, and improving wildlife corridors/connectivity)
– Recreational (e.g., trails for hiking or mountain biking, and sports fields)
– A combination of the above.

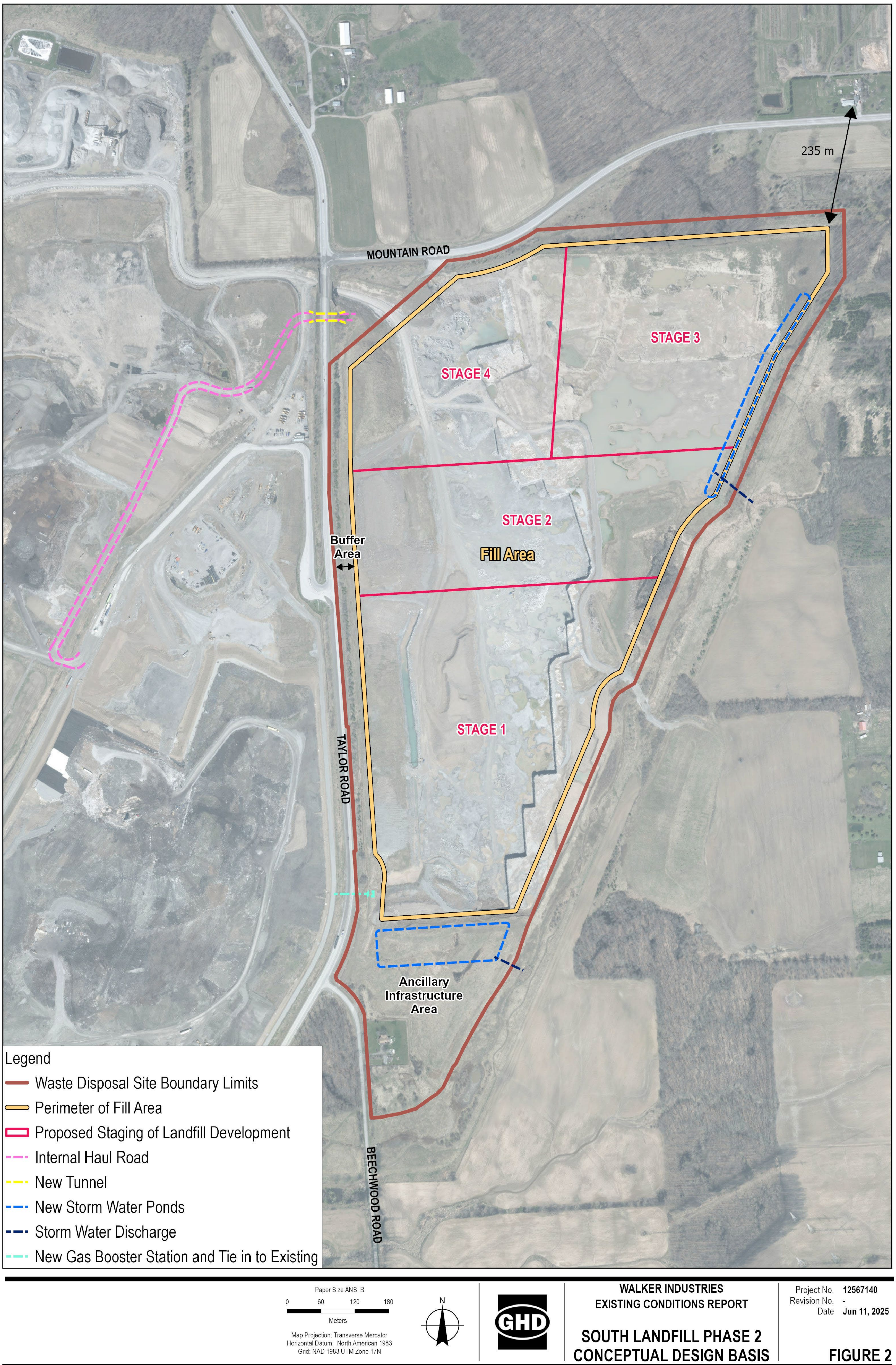


***Figure 2 South Landfill Phase 2 Conceptual Design Basis***

# 3. Alternative Methods

## 3.1 Landfill Configuration Options

Three landfill configuration options have been developed, each with the same proposed Perimeter of Fill area and Waste Disposal Site Boundary Limits. Additionally, all three options share identical infrastructure requirements; groundwater management, stormwater management, and gas management design elements; annual and daily maximum fill rate, site development staging, and operations. The three options differ in capacity, maximum height, and final contour slopes.

### 3.1.1 Option A – Same height and final contours as current South Landfill

Landfill Configuration Option A is shown in Figure 3 and has the following general attributes:

- Option A has the highest peak elevation of the three options of 212 mAMSL (TOW).
- An approximate height above grade of 31 m.
- The slope from existing grade to 202 mAMSL will be four units horizontal to one unit vertical (4H to 1V, or 25%) and the slope from 202 mAMSL to 212 mAMSL will be twenty units horizontal to one unit vertical (20H to 1V, or 5%).
- A landfill capacity of 20,205,000 $m^3$.
- The area available for agricultural end use will be 36.7 ha.

### 3.1.2 Option B

Landfill Configuration Option B is shown in Figure 4 and has the following general attributes:

- Option B has a slightly lower peak elevation than Option A of 211 mAMSL (TOW).
- An approximate height above grade of 30 m.
- The slope from existing grade to 194 mAMSL will be four units horizontal to one unit vertical (4H to 1V, or 25%) and the slope from 194 mAMSL to 211 mAMSL will be fifteen units horizontal to one unit vertical (15H to 1V, or 6.7%).
- A landfill capacity of 18,277,400 $m^3$.
- The area available for agricultural end use will be 51.4 ha.

### 3.1.3 Option C

Landfill Configuration Option C is shown in Figure 5 and has the following general attributes:

- Option C is the lowest of the three options with a peak elevation of 205 mAMSL (TOW).
- An approximate height above grade of 24 m.
- The slope from existing grade to 195 mAMSL will be four units horizontal to one unit vertical (4H to 1V, or 25%) and the slope from 195 mAMSL to 205 mAMSL will be 20 units horizontal to one unit vertical (20H to 1V, or 5%).
- A landfill capacity of 17,893,000 $m^3$.
- The area available for agricultural end use will be 45.0 ha.

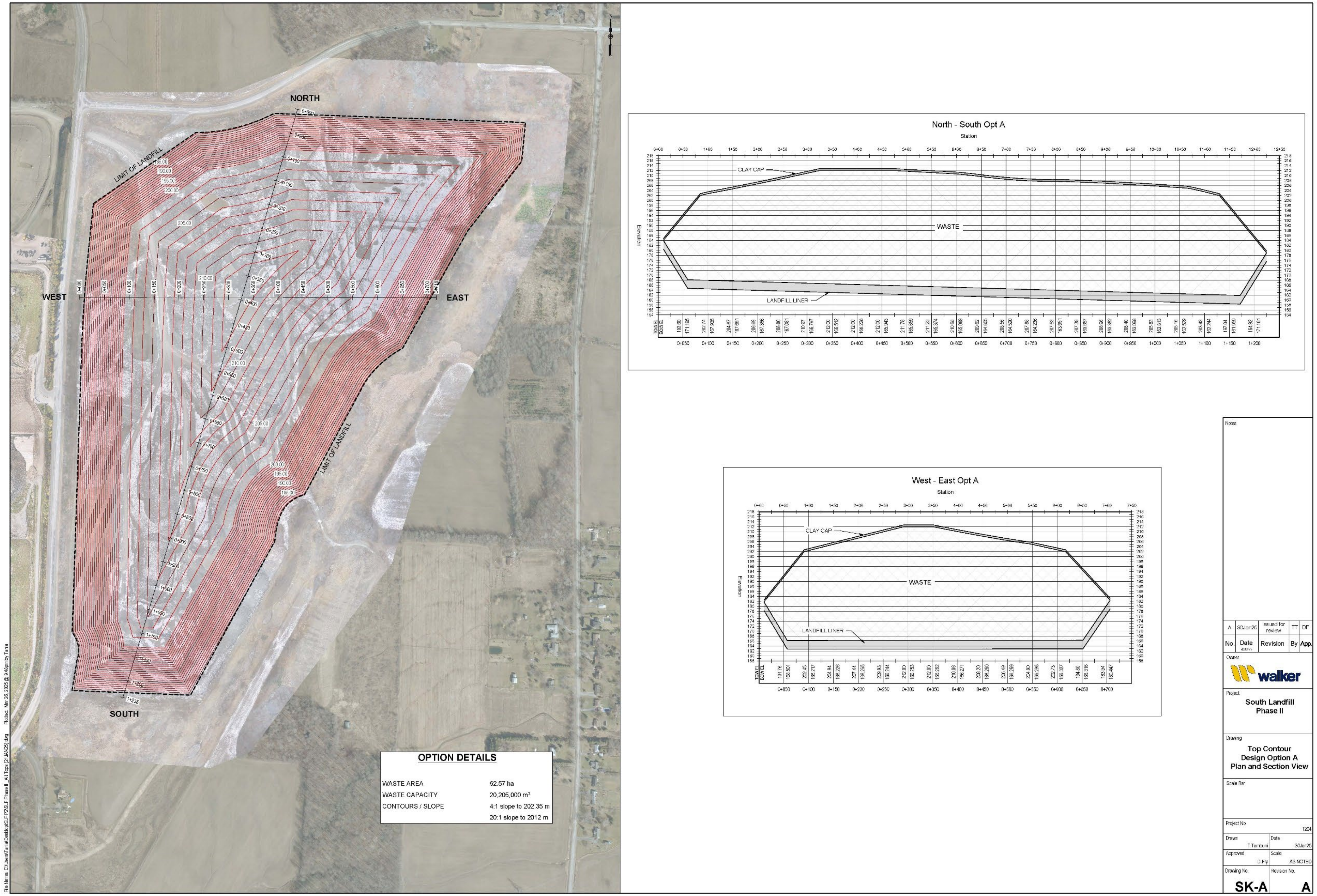


*Figure 3 Landfill Configuration Option A*

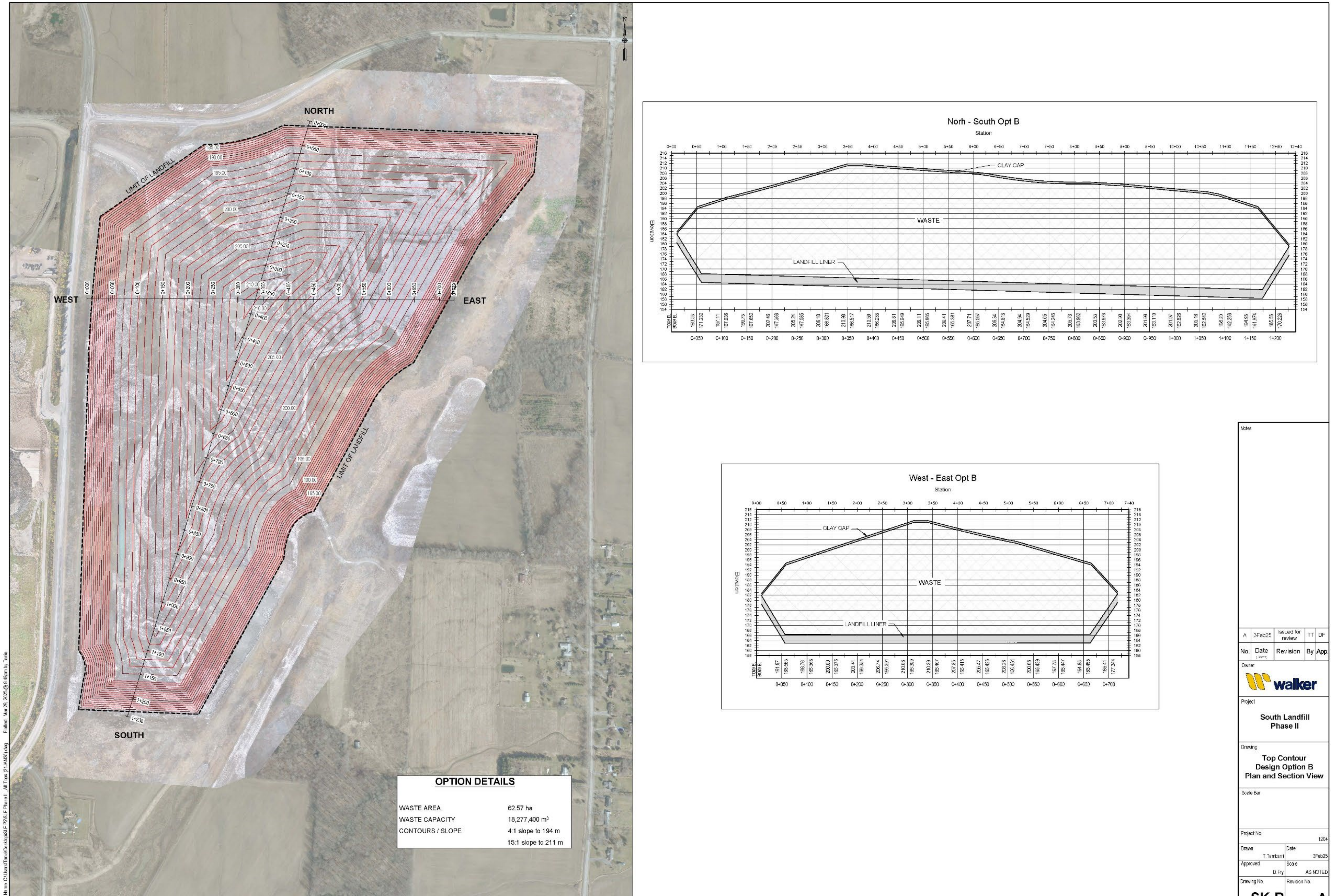


*Figure 4 Landfill Configuration Option B*

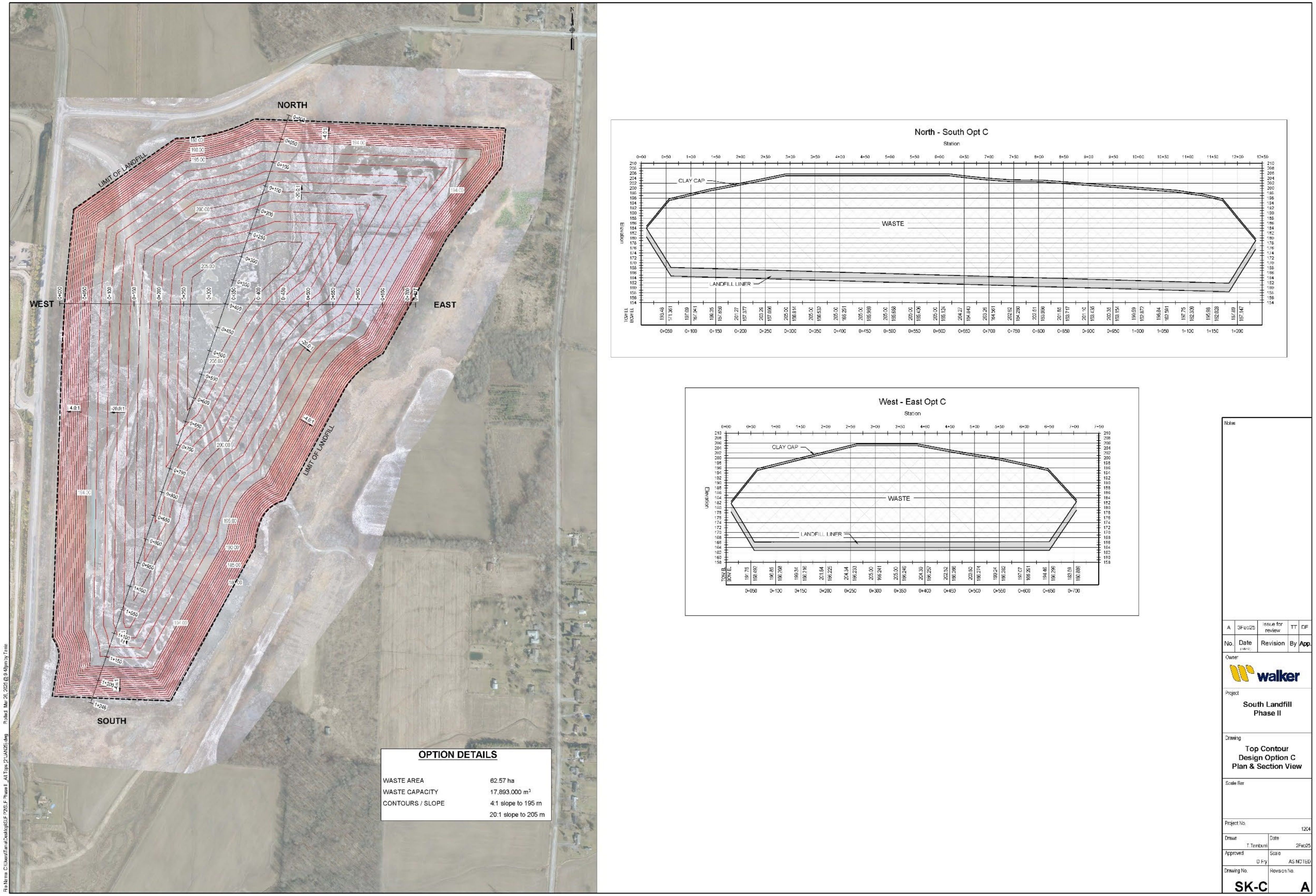


*Figure 5 Landfill Configuration Option C*

## 3.2 Leachate Management Options

In accordance with the approved ToR, an assessment of the existing leachate treatment system relative to the Alternative Methods will be carried out as part of the EA to determine if any modifications or additions are required to support the continuation of disposal capacity at Walker's Resource Management Campus. Any modifications or additions to the existing leachate treatment system that are required for the preferred Alternative Method will be identified and assessed as part of the EA. Additionally, development of an on-site wastewater treatment plant is being evaluated as an alternative method for leachate management.

### 3.2.1 Option A – Continued Use of the Municipal Wastewater Treatment System

Leachate Management Option A would build upon the pre-existing leachate management system and approach but would include the necessary expansion of the system capacity as the new development is expected to generate a maximum of 104,500 $m^3$ per year. The expansion would include a leachate sump, including a pump station equipped with the needed metering equipment and controls for monitoring and contingency purposes, a forcemain to transport the leachate from the pump station to the lagoon area, a third on-site lagoon (located adjacent the existing two lagoons) for aeration and eventual discharge (Figure 6).

Once treated at the on-site lagoons, leachate will be conveyed via an existing force/gravity main to the Niagara-on-the-Lake sanitary sewer system for final treatment at the Region of Niagara's Port Weller Wastewater Treatment Plant.


*Figure 6 Expansion of Existing Leachate Management System*

### 3.2.2 Option B – Development of an On-Site Wastewater Treatment Plant

Leachate Management Option B consists of developing an on-site wastewater treatment plant located within the Campus boundary. A facility design basis was developed and a preliminary siting exercise was undertaken to examine options for locating the facility. The following factors were considered in establishing the design basis for the on-site wastewater treatment plant option:

- Estimated leachate volumes
- Potential discharge location
- Leachate quality

The proposed treatment configuration is illustrated in Figure 7. Approximately 6.5 hectares (ha) would be required to accommodate the plant.

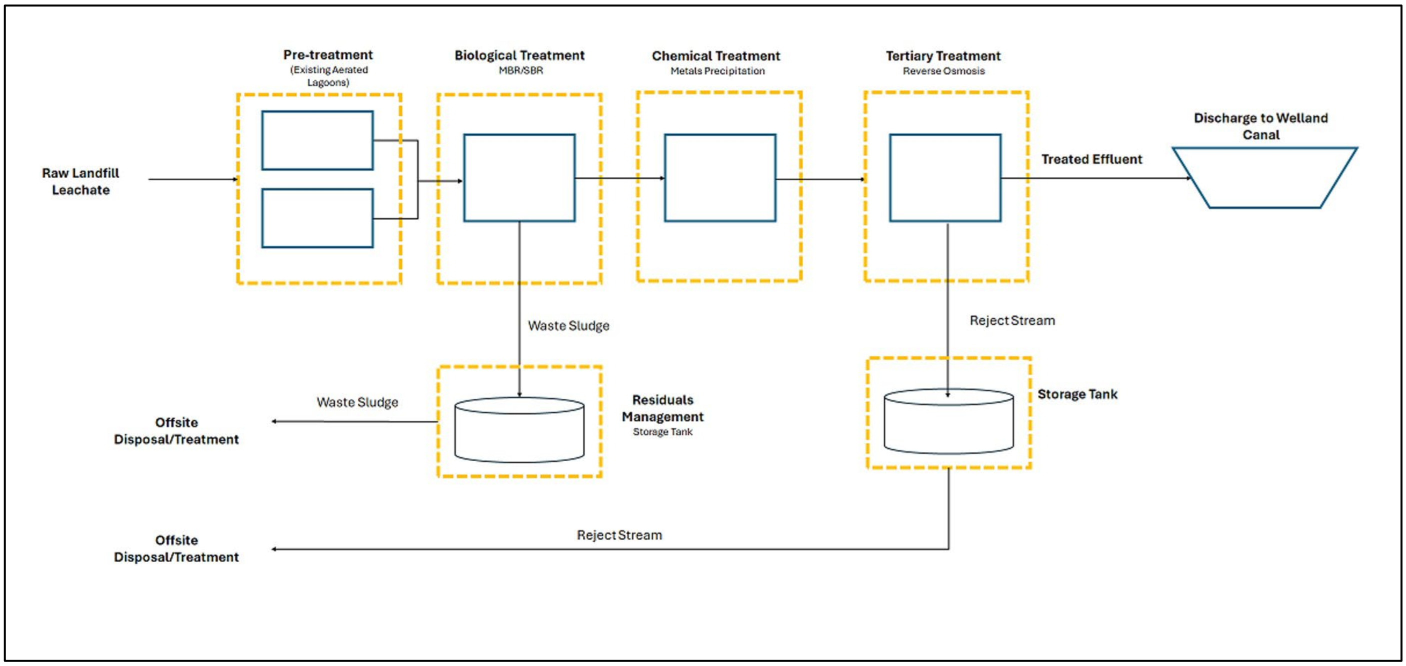


*Figure 7 Proposed on-site Wastewater Treatment Process Configuration*

Subsequently, a high-level screening was undertaken to identify and evaluate potential locations for the on-site wastewater treatment plant option. Criteria that were considered in the evaluation process included the following:

- Natural Environment
- Socio-Cultural Environment
- Financial
- Technical

Figure 8 shows the location and proposed footprint of the preferred location, adjacent the existing treatment lagoons.

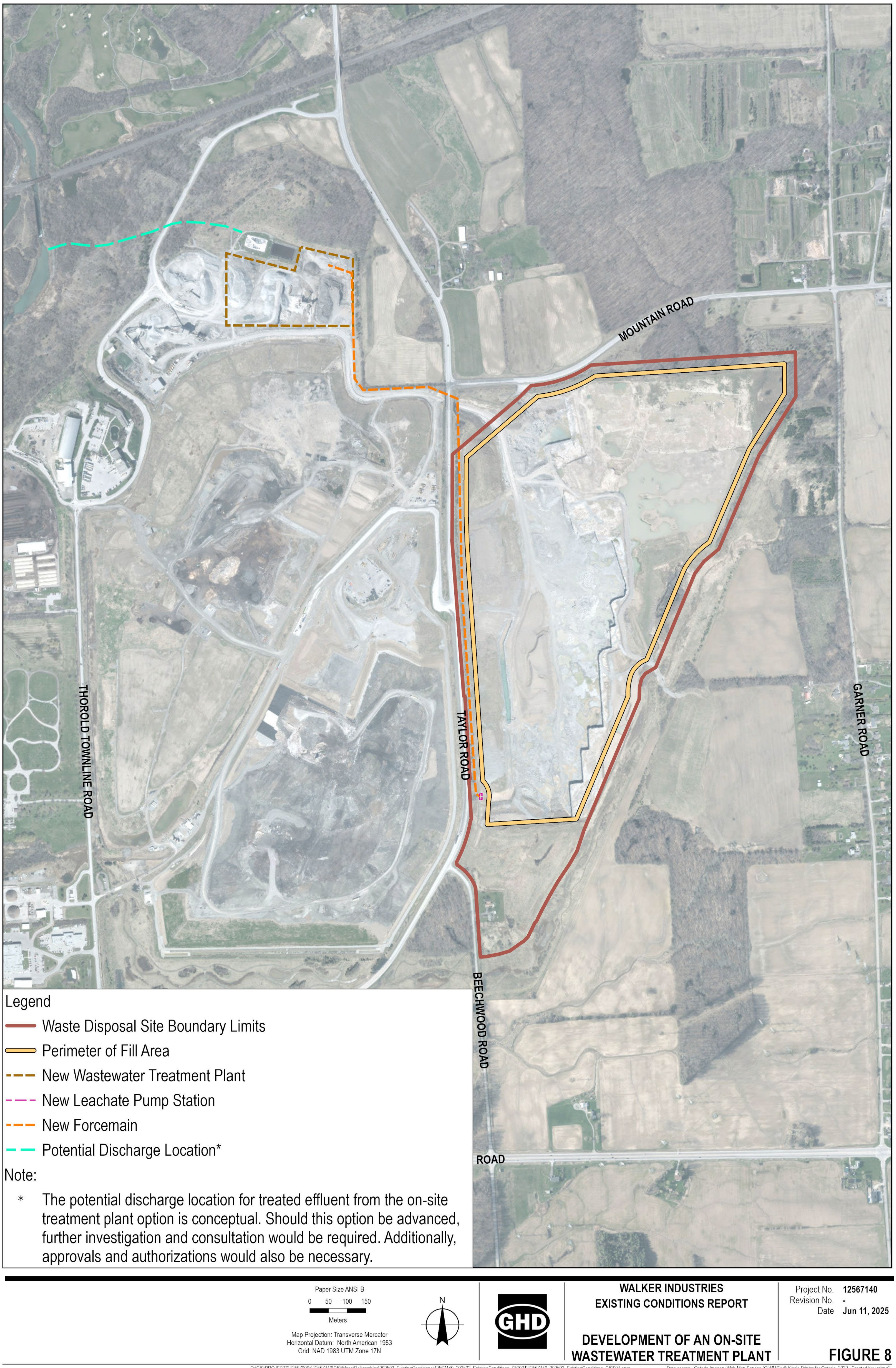


***Figure 8 Proposed Location and Footprint of On-site Wastewater Treatment Plant***

## 3.3 Landfill Gas Collection System

In accordance with the approved ToR, an assessment of the existing landfill gas collection and utilization system relative to the Alternative Methods will be carried out as part of the EA to determine if any modifications or additions are required to support the continuation of disposal capacity at Walker's Resource Management Campus. Any modifications or additions to the existing landfill gas collection and utilization system that are required for the Preferred Alternative Method will be identified and assessed as part of the EA.

At a minimum, a landfill gas extraction wellfield will be developed in accordance with O. Reg. 232/98. Landfill gas collected from the site will be conveyed to the existing Landfill Gas Utilization Facility (shown on Figure 1) where it will be flared or utilized to generate renewable energy.

Generally, system upgrades will include a landfill gas control booster station to extract landfill gas from the landfill and convey it across Taylor Rd. to the existing Landfill Gas Utilization Facility where it will be used to generate renewable energy. The landfill gas management approach will seek to maximize the use of the existing facilities within the Walker Campus and may be utilized within Walker's existing landfill gas projects or potentially explore additional venues for landfill gas utilization.

# 4. Summary

A summary of the details associated with the Landfill Configuration Options and Leachate Management Options is presented in Table 1 and Table 2, respectively.

*Table 2* *Comparison of Alternative Landfill Configuration Options*

| Option | Figure No. | Description | Location | Volume ($m^3$) | Footprint area (ha) | Approx. elevation (mAMSL; Top of Waste) | Approx. height above grade (m; Tope of Waste) | Slope | Area available for agricultural end use (ha) | Minimum Distance to Privately Owned Lands (m) | Longest Internal Haul Distance (m) | Leachate Generation Rate (max, $m^3$/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | Figure 3 | Same Height & Slope as Current South Landfill Phase A | Quarry footprint | 20,205,000 | 62.6 | 212 | 31 | E.G. to 202 @ 4:1<br>202 to 212 @ 20:1 | 36.7 | ~235 | ~3,100 | ~104,500 |
| B | Figure 4 | Maximized Agricultural End Use | Quarry footprint | 18,277,400 | 62.6 | 211 | 30 | E.G. to 194 @ 4:1<br>194 to 211 @15:1 | 51.4 | ~235 | ~3,100 | ~104,500 |
| C | Figure 5 | Average Agricultural End Use | Quarry footprint | 17,893,000 | 62.6 | 205 | 24 | E.G. to 195 @ 4:1<br>195 to 205 @ 20:1 | 45.0 | ~235 | ~3,100 | ~104,500 |

*Table 3* *Comparison of Alternative Leachate Management Options*

| Option | Figure No. | Description | Location | Approximate footprint area (ha) | Potential discharge location | Associated infrastructure requirements |
|---|---|---|---|---|---|---|
| A | Figure 6 | Municipal Wastewater Treatment System | Northwest portion of Campus, adjacent existing lagoons | 0.3 | Welland Canal via municipal wastewater treatment plant | Leachate pump station; new forcemain |
| B | Figure 8 | On-site Wastewater Treatment Plant | Northwest portion of Campus, adjacent existing lagoons | 6.5 | Old Welland Canal | Leachate pump station; new forcemain |

# Appendices

# Appendix A

## Leachate Generation

# TECHNICAL MEMORANDUM

**DATE** November 4, 2024 **Project No.** CA-WSP-131-22826-25

**TO** Darren Fry, A.Sc.T.
Project Director, Environmental Division
Walker Environmental Group Inc.

**FROM** Frank Barone, Ph.D., P.Eng. **EMAIL frank.barone@wsp.com**

**PREDICTED ANNUAL LEACHATE VOLUMES - PROPOSED SOUTH (PHASE II) LANDFILL**

This Technical Memorandum provides initial predictions of annual leachate generation volumes for the proposed South (Phase II) Landfill at Walker Environmental Group's Thorold Campus. The leachate volumes are intended to inform the Environmental Assessment studies for the proposed landfill.

As shown in Figure 1 (attached), the initial conceptual design for the South (Phase II) Landfill has sixteen cells within a 63-hectare fill area. The cells will be landfilled over a fifteen-year period from Years 2030 to 2045, with final cover applied progressively as final waste fill contours are reached. Figure 1 and Table 1 show the progression of landfill cell development, filling and final cover placement (i.e., capping).

For each year of the landfilling period, the leachate volume generated from areas without final cover was estimated taking into consideration leachate volumes pumped from the existing South Landfill prior to the start of final cover construction in 2020. As shown in Table A.1 (Appendix A, attached), the leachate volume pumped each year from the South Landfill from the start of landfilling in Year 2010 to Year 2019, was divided by the corresponding waste fill area to obtain a leachate generation rate in millimeters per year (mm/y) for that year. The resulting leachate generation rates range from 400 to 450 mm/y for the first two years of the landfilling period and then follow a decreasing trend to a stable range between 200 and 300 mm/y after year six of operation (Figure A.1). The decreasing trend reflects moisture uptake by the waste fill as the average thickness of waste across the landfill increases. This trend was applied to the progression of cell development and capping for the proposed South (Phase II) landfill to estimate annual leachate volumes from waste fill areas without final cover. For areas with final cover, the leachate generation rate was estimated using the HELP Model considering climate change (Appendix B). The modelling gave a leachate generation rate of 188 mm/y to Year 2040 followed by an increasing trend to 232 mm/y at Year 2070. Year 2070 represents the end of the second period of climate change projections given in the Ministry of Natural Resources and Forestry Climate Change Research Report CCRR-44 (2015).

Based on the above approach, the predicted annual leachate volumes for the South (Phase II) from the start of landfilling in Year 2030 to Year 2070 are shown in Table 2 and Figure 2. The annual leachate volumes increase from approximately 30,000 $m^3$ in Year 2030 to 131,000 $m^3$ at the end of the operating period in Year 2045, followed by a decreasing trend to 128,000 $m^3$ at completion of final cover construction in Year 2050. From Year 2050 to 2070, annual leachate volumes gradually increase due to climate change to 147,000 $m^3$.

**WSP Canada Inc.**

***DRAFT***

Frank Barone, Ph.D., P.Eng.
*Senior Geo-Environmental Engineer*

FSB/al

Attachments: Table 1: Progression of Landfill Cell Development, Filling and Capping – Proposed South (Phase II) Landfill
Table 2: Estimated Annual Leachate Generation Rates and Volumes – Proposed South (Phase II) Landfill
Figure 1: Cell Development Plan - Proposed South (Phase II) Landfill
Figure 2: Estimated Annual Leachate Volumes – Proposed South (Phase II) Landfill
Appendix A – Leachate Generation Rates from Uncapped Waste Fill Areas (Existing South Landfill)
Appendix B – HELP Modelling for Leachate Generation Rate from Capped Waste Fill Areas – Proposed South (Phase II) Landfill

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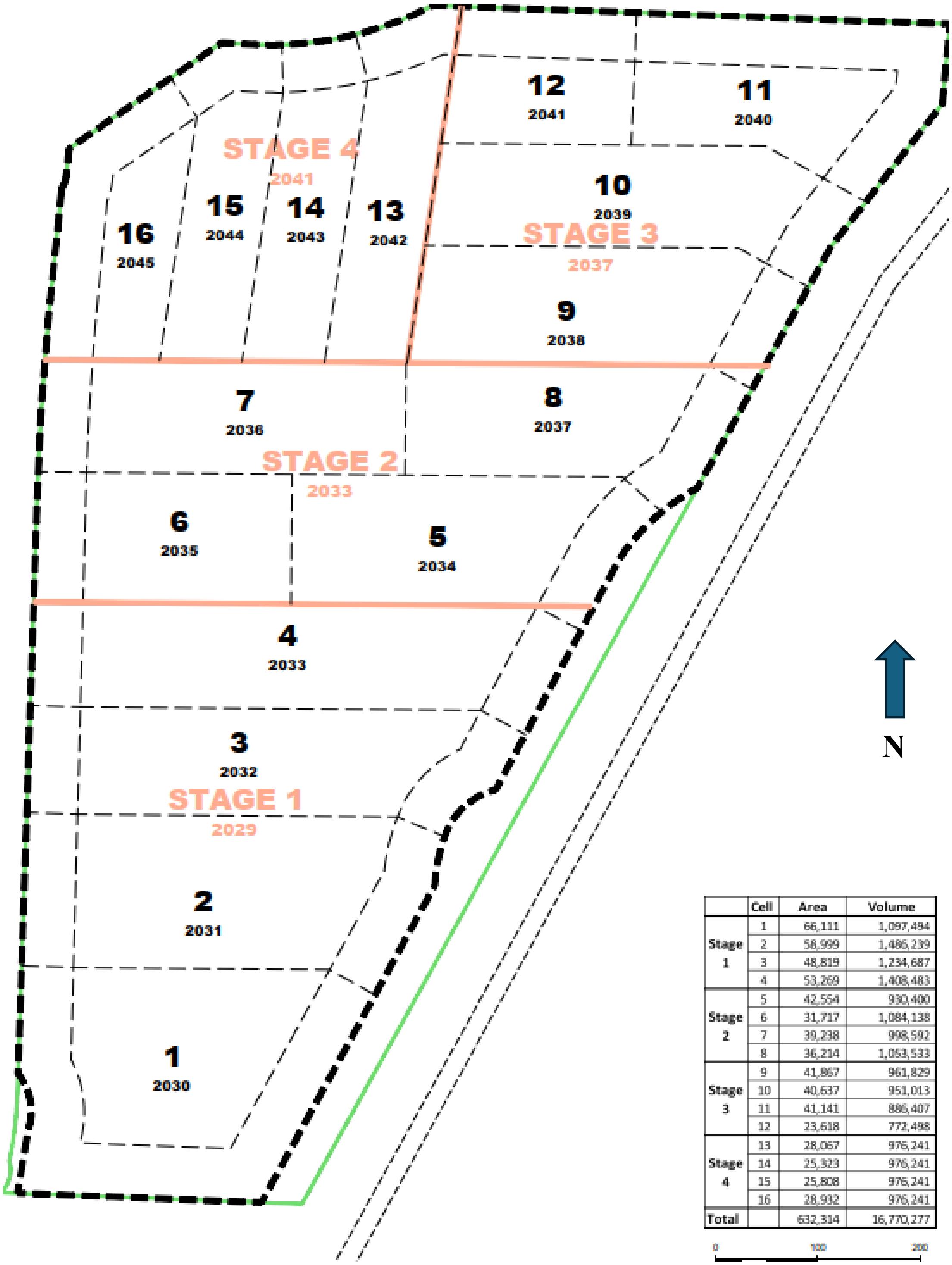
Table 1. Progression of Landfill Cell Development, Filling and Capping – Proposed South (Phase II) Landfill

| Landfill Timing | | | | |
|---|---|---|---|---|
| **Year** | **Licence Surrender Year** | **Cell Construction (Spring Start)** | **Waste Placement (Jan 1st)** | **Capped** |
| **2028** | Stage 1 | | | |
| **2029** | | Cell 1 | | |
| **2030** | | Cell 2 | Cell 1 | |
| **2031** | | Cell 3 | Cell 2 | |
| **2032** | Stage 2 | Cell 4 | Cell 3 | |
| **2033** | | Cell 5 | Cell 4 | |
| **2034** | | Cell 6 | Cell 5 | |
| **2035** | | Cell 7 | Cell 6 | Cell 1 |
| **2036** | Stage 3 | Cell 8 | Cell 7 | Cell 2 |
| **2037** | | Cell 9 | Cell 8 | Cell 3 |
| **2038** | | Cell 10 | Cell 9 | Cell 4 |
| **2039** | | Cell 11 | Cell 10 | Cell 5 |
| **2040** | Stage 4 | Cell 12 | Cell 11 | Cell 6 |
| **2041** | | Cell 13 | Cell 12 | Cell 7 |
| **2042** | | Cell 14 | Cell 13 | Cell 8 |
| **2043** | | Cell 15 | Cell 14 | Cell 9 |
| **2044** | | Cell 16 | Cell 15 | Cell 10 |
| **2045** | | | Cell 16 | Cell 11 |
| **2046** | | | | Cell 12 |
| **2047** | | | | Cell 13 |
| **2048** | | | | Cell 14 |
| **2049** | | | | Cell 15 |
| **2050** | | | | Cell 16 |

**Stage 1**
**Stage 2**
**Stage 3**
**Stage 4**

Table 2. Estimated Annual Leachate Generation Rates and Volumes – Proposed South (Phase II) Landfill

| Year | Area Without Final Cover at Start of Year ($m^2$) | Area With Final Cover at Start of Year ($m^2$) | Leachate Generation from Area Without Final Cover | | Leachate Generation from Area With Final Cover | | Total Leachate Generation from Landfill ($m^3$) |
|---|---|---|---|---|---|---|---|
| | | | (mm/y) | $m^3$ | (mm/y) | $m^3$ | |
| **2030** | 66,111 | | 450 | 29,750 | | | 29,750 |
| **2031** | 125,110 | | 420 | 52,546 | | | 52,546 |
| **2032** | 173,929 | | 380 | 66,093 | | | 66,093 |
| **2033** | 227,198 | | 340 | 77,247 | | | 77,247 |
| **2034** | 269,752 | | 295 | 79,577 | | | 79,577 |
| **2035** | 235,358 | 66,111 | 250 | 58,840 | 188 | 12,429 | 71,268 |
| **2036** | 215,597 | 125,110 | 250 | 53,899 | 188 | 23,521 | 77,420 |
| **2037** | 202,992 | 173,929 | 250 | 50,748 | 188 | 32,699 | 83,447 |
| **2038** | 191,590 | 227,198 | 250 | 47,898 | 188 | 42,713 | 90,611 |
| **2039** | 189,673 | 269,752 | 250 | 47,418 | 188 | 50,713 | 98,132 |
| **2040** | 199,097 | 301,469 | 250 | 49,774 | 188 | 56,676 | 106,450 |
| **2041** | 183,477 | 340,707 | 250 | 45,869 | 189 | 64,553 | 110,422 |
| **2042** | 175,330 | 376,921 | 250 | 43,833 | 191 | 71,967 | 115,799 |
| **2043** | 158,786 | 418,788 | 250 | 39,697 | 192 | 80,575 | 120,271 |
| **2044** | 143,957 | 459,425 | 250 | 35,989 | 194 | 89,067 | 125,056 |
| **2045** | 131,748 | 500,566 | 250 | 32,937 | 195 | 97,777 | 130,714 |
| **2046** | 108,130 | 524,184 | 250 | 27,033 | 197 | 103,159 | 130,192 |
| **2047** | 80,063 | 552,251 | 250 | 20,016 | 198 | 109,493 | 129,509 |
| **2048** | 54,740 | 577,574 | 250 | 13,685 | 200 | 115,361 | 129,046 |
| **2049** | 28,932 | 603,382 | 250 | 7,233 | 201 | 121,400 | 128,633 |
| **2050** | 0 | 632,314 | 250 | 0 | 203 | 128,149 | 128,149 |
| **2051** | 0 | 632,314 | 250 | 0 | 204 | 129,076 | 129,076 |
| **2052** | 0 | 632,314 | 250 | 0 | 206 | 130,004 | 130,004 |
| **2053** | 0 | 632,314 | 250 | 0 | 207 | 130,931 | 130,931 |
| **2054** | 0 | 632,314 | 250 | 0 | 209 | 131,859 | 131,859 |
| **2055** | 0 | 632,314 | 250 | 0 | 210 | 132,786 | 132,786 |
| **2056** | 0 | 632,314 | 250 | 0 | 211 | 133,713 | 133,713 |
| **2057** | 0 | 632,314 | 250 | 0 | 213 | 134,641 | 134,641 |
| **2058** | 0 | 632,314 | 250 | 0 | 214 | 135,568 | 135,568 |
| **2059** | 0 | 632,314 | 250 | 0 | 216 | 136,496 | 136,496 |
| **2060** | 0 | 632,314 | 250 | 0 | 217 | 137,423 | 137,423 |
| **2061** | 0 | 632,314 | 250 | 0 | 219 | 138,350 | 138,350 |
| **2062** | 0 | 632,314 | 250 | 0 | 220 | 139,278 | 139,278 |
| **2063** | 0 | 632,314 | 250 | 0 | 222 | 140,205 | 140,205 |
| **2064** | 0 | 632,314 | 250 | 0 | 223 | 141,132 | 141,132 |
| **2065** | 0 | 632,314 | 250 | 0 | 225 | 142,060 | 142,060 |
| **2066** | 0 | 632,314 | 250 | 0 | 226 | 142,987 | 142,987 |
| **2067** | 0 | 632,314 | 250 | 0 | 228 | 143,915 | 143,915 |
| **2068** | 0 | 632,314 | 250 | 0 | 229 | 144,842 | 144,842 |
| **2069** | 0 | 632,314 | 250 | 0 | 231 | 145,769 | 145,769 |
| **2070** | 0 | 632,314 | 250 | 0 | 232 | 146,697 | 146,697 |




| | Cell | Area | Volume |
|---|---|---|---|
| Stage 1 | 1 | 66,111 | 1,097,494 |
| | 2 | 58,999 | 1,486,239 |
| | 3 | 48,819 | 1,234,687 |
| | 4 | 53,269 | 1,408,483 |
| Stage 2 | 5 | 42,554 | 930,400 |
| | 6 | 31,717 | 1,084,138 |
| | 7 | 39,238 | 998,592 |
| | 8 | 36,214 | 1,053,533 |
| Stage 3 | 9 | 41,867 | 961,829 |
| | 10 | 40,637 | 951,013 |
| | 11 | 41,141 | 886,407 |
| | 12 | 23,618 | 772,498 |
| Stage 4 | 13 | 28,067 | 976,241 |
| | 14 | 25,323 | 976,241 |
| | 15 | 25,808 | 976,241 |
| | 16 | 28,932 | 976,241 |
| Total | | 632,314 | 16,770,277 |

Figure 1. Cell Development Plan - Proposed South (Phase II) Landfill

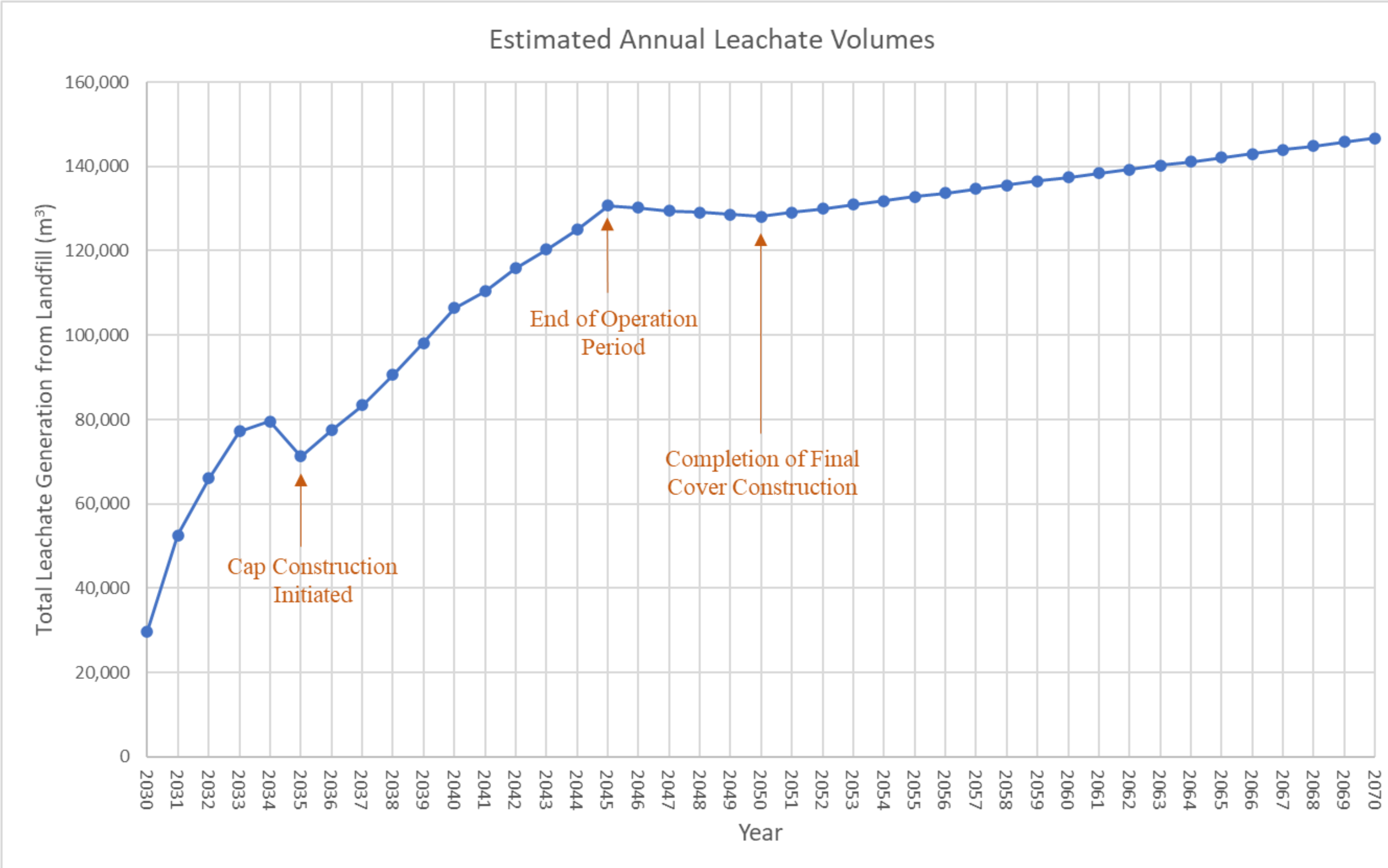



Figure 2. Estimated Annual Leachate Volumes – Proposed South (Phase II) Landfill

**APPENDIX A**

# Leachate Generation Rates from Uncapped Waste Fill Areas (Existing South Landfill)

Table A.1. South Landfill Measured Annual Leachate Pumping Volumes and Equivalent Leachate Generation Rate Without Final Cover

| **Year** | **Area of Waste Fill Placement ($m^2$)** | **Total Annual Leachate Pumping Volume ($m^3$)** | **Equivalent Leachate Generation Rate (mm/y)** |
|---|---|---|---|
| **2010** | 75,222 | 31,179 | 414.5 |
| **2011** | 121,075 | 53,205 | 439.4 |
| **2012** | 144,686 | 55,242 | 381.8 |
| **2013** | 184,032 | 66,722 | 362.6 |
| **2014** | 228,183 | 74,138 | 324.9 |
| **2015** | 262,118 | 49,661 | 189.5 |
| **2016** | 316,388 | 57,633 | 182.2 |
| **2017** | 360,294 | 101,355 | 281.3 |
| **2018** | 384,638 | 73,673 | 191.5 |
| **2019** | 384,638 | 88,828 | 230.9 |

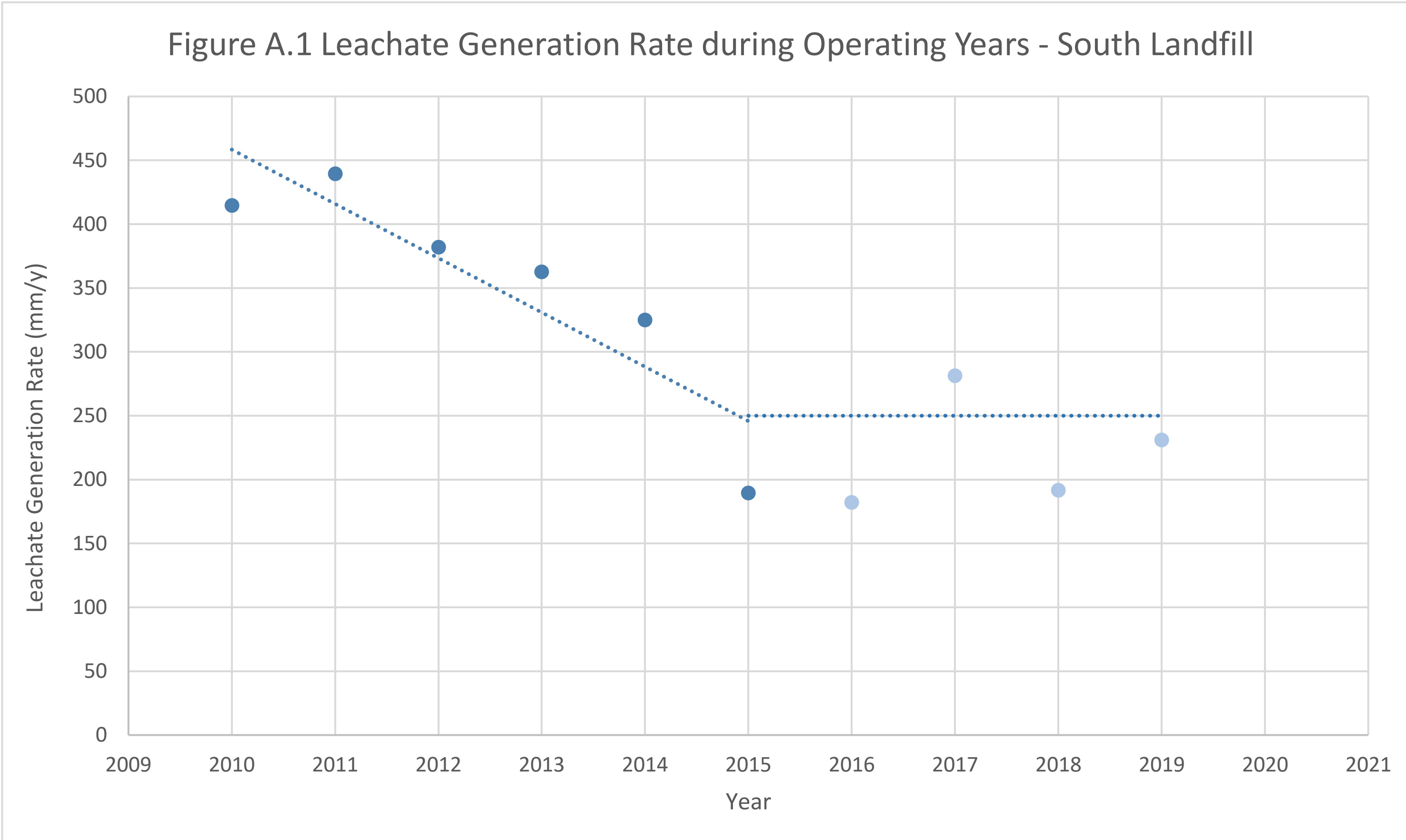


Figure A.1 Leachate Generation Rate during Operating Years - South Landfill
Leachate Generation Rate (mm/y)
500
450
400
350
300
250
200
150
100
50
0
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year

**APPENDIX B**

# HELP Modelling for Leachate Generation Rate from Capped Waste Fill Areas - Proposed South (Phase II) Landfill

| Calculation of Leachate Generation Rates for Areas with Final Cover, Proposed Walker South (Phase 2) Landfill, Thorold, Ontario | | |
|---|---|---|
| Project No.: CA-WSP-131-22826-27 | Prepared by: S. Rimal<br>Reviewed by: F. Barone | Date: November 2024 |

## 1.0 INTRODUCTION

The leachate generation rates due to atmospheric water infiltration through the final cover of the proposed South (Phase 2) Landfill at the Walker Environmental Group Thorold Campus was estimated using the Hydrologic Evaluation of Landfill Performance (HELP) Model Version 3.07 (Ref.-1).

The HELP model is a quasi-two-dimensional water-balance model for water movement in the landfill (Ref-2.). The model accepts the weather data and landfill design data and uses solution techniques that account for the effect of different processes such as surface storage, snowmelt, runoff, infiltration, evapotranspiration, vegetation growth, soil moisture storage, lateral subsurface drainage, leachate recirculation, unsaturated vertical drainage, and leakage through liners (Ref-2. and Ref-3). The site-specific runoff, evapotranspiration, infiltration, drainage, leachate collection and liner leakage can be determined, as needed, using the HELP model.

## 2.0 CLIMATOLOGICAL INPUT PARAMETERS

Two different climatological scenarios were evaluated.

1. Without climate change; and
2. With climate change.

For the scenario without climate change, daily precipitation and temperature input data for the Site were synthetically generated using the HELP model (Ref. 1). This involved taking 30 years of continuous precipitation and temperature data for Buffalo, New York, USA (nearest reference station included in the HELP model database) and then adjusting the data with mean monthly precipitation and temperature values based on the average values for the St. Catherines Airport meteorological station as shown in the attached Table 1. Daily solar radiation data was synthetically generated using the HELP model by taking the Buffalo, New York solar radiation data (included in the HELP model database) and correcting the latitude for the Site. Average quarterly relative humidity and average annual wind speed for the Sarnia Airport meteorological station were used (refer to attached Table 2).

For the scenarios with climate change, the potential change in precipitation and temperature input data were based on Table 5 of Climate Change Research Report CCRR-44, Lake Erie Basin, reference periods 2011-2040 and 2040-2071 and representative concentration pathway (RCP) of 4.5 $W/m^2$ (Ref. - 4). The precipitation and temperature input in for the climate change scenarios are presented in attached Table 3.

## 3.0 WASTE ONLY, DAILY COVER, AND FINAL COVER INPUT PARAMETERS

The HELP model input parameters for the final cover are summarized in Table 4. The values used in the HELP model for total porosity, field capacity, wilting point are according to the HELP model default values as shown in the attached Table 3. For the soil cover layers and waste fill the initial water content was taken as equal to or greater than the field capacity water content, which is the water content at which the soil can no longer absorb/retain additional moisture under free drainage. With respect to modelling the leachate generation rate, this is a conservative assumption as it reduces the time to reach peak leachate generation.

The model for the final cover was run with a final cover slope of 5% and runoff path length of 200 m based on the final contours for the landfill.

## 4.0 VEGETATION INPUT PARAMETERS

The HELP model requires input data for the type and extent of vegetation growing on the cover, as well as input data for the evaporative zone depth. The leaf area index is defined as the dimensionless ratio of the leaf area of actively transpiring vegetation to the nominal surface area of the final cover. For the final cover, a ground with good stand of grass with a maximum leaf are index of 4 was used.

The evaporative zone depth is defined as the maximum depth from which water may be removed by evapotranspiration. For the final cover an evaporative zone depth of 50 cm was assumed for the sandy loam topsoil / clayey cover soil with good stand of grass.

## 5.0 RESULTS

The leachate generation rates obtained from the HELP modelling are provided in Table 5. The average annual leachate generation rate for the scenario without climate change is 178 mm/y. For the climate change scenarios, average annual leachate generation rates of 188 mm/y for Reference Period 2011-2040 and 232 mm/y for Reference Period 2041-2070.

## REFERENCES


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

Ref 2. – Schroeder, P.R., Dozier, T.S., Zappi, P.A., McEnroe, B.M., Sjostrom, J.W., and Peyton, R.L. (1994). "The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3," EPA/600/R-94/168b, September 1994, U.S. Environmental Protection Agency, Office of Research and Development, Washington DC.

Ref 3. – Sharma, H.P. and Lewis, S.P. (1994). Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation, John Wiley and Sons, Inc. New York, 588p.

Ref 4. - MNRF (2015). Climate Change Projects for Ontario: An Updated Synethesis for Policymakers and Planners, Ministry of Natural Resources and Forestry , Science and Research, Climate Change Research Report CCRR-44.

## TABLE 1: NORMAL MEAN MONTHLY PRECIPITATION AND TEMPERATURE AT ST. CATHARINES AIRPORT METEOROLOGICAL STATION [1981-2010 DATA]

**Climate ID:** 6137287
**Elevation:** 97.8 masl
**Latitude:** 43°12'00.000" N
**Longitude:** 79°10'00.000" W

| | Units | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total Precipitation** | mm | 65.2 | 54.9 | 61.7 | 77 | 76.8 | 85.9 | 77.8 | 70.3 | 90.6 | 67 | 81.6 | 71.5 |
| **Temperature** | $^{o}C$ | -3.8 | -2.9 | 1.1 | 7.4 | 13.7 | 19 | 21.9 | 20.8 | 16.6 | 10.4 | 4.6 | -0.9 |

Source: Canadian Climate Normals 1981-2010 (Environment Canada).

## TABLE 2: NORMAL RELATIVE HUMIDITY AND WINDSPEED AT ST. CATHARINES AIRPORT METEOROLOGICAL STATION [1981-2010 DATA]

**Climate ID:** 6137287
**Elevation:** 97.8 masl
**Latitude:** 43°12'00.000" N
**Longitude:** 79°10'00.000" W

| | Units | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Relative Humidity at 15:00** | % | 73 | 67.7 | 62.9 | 57.6 | 55.9 | 58.1 | 57.5 | 59 | 60.5 | 64.5 | 69.1 | 71.9 |
| **Average Quarterly Relative Humidity** | % | 67.9 | | | 57.2 | | | 59.0 | | | 68.5 | | |
| **Windspeed*** | km/h | 21.1 | 19.2 | 18.5 | 17.3 | 14.5 | 13.9 | 13.2 | 12.4 | 13.6 | 15.4 | 18.2 | 19 |
| **Average Annual Windspeed** | km/h | 16.4 | | | | | | | | | | | |

Source: Canadian Climate Normals 1981-2010 (Environment Canada).
*Wind Speed: Canadian Climate Normals 1971-2000 (Environment Canada).

## TABLE 3: MEAN MONTHLY PRECIPITATION AND TEMPERATURE FOR CLIMATE CHANGE SCENARIOS

| | Units | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reference Period 2011-2040** | | | | | | | | | | | | | |
| **Total Precipitation** | mm | 76.1 | 65.8 | 62.9 | 78.2 | 78.0 | 83.1 | 75.0 | 67.5 | 91.8 | 68.2 | 82.8 | 82.4 |
| **Temperature** | °C | -1.7 | -0.80 | 3.5 | 9.8 | 16.1 | 21.0 | 23.9 | 22.8 | 19.0 | 12.8 | 7.0 | 1.2 |
| **Reference Period 2041-2070** | | | | | | | | | | | | | |
| **Total Precipitation** | mm | 75.9 | 65.6 | 70.4 | 85.7 | 85.5 | 85.6 | 77.5 | 70.0 | 99.3 | 75.7 | 90.3 | 82.2 |
| **Temperature** | °C | 0.3 | 1.20 | 4.7 | 11.0 | 17.3 | 22.2 | 25.1 | 24.0 | 20.2 | 14.0 | 8.2 | 3.2 |

Source: Mean monthly precipitation and temperature was modified using Table 5 of Ref-4 to account for climate change.

## TABLE 4: HELP MODEL INPUT PARAMETERS†

| Input Parameters | Units | *Waste* | *Final Cover* | |
|---|---|---|---|---|
| | | | ***Topsoil*** | ***Cover Soil*** |
| HELP Model Soil Texture Class† | [-] | - | 6 | 26 |
| USDA Soil Texture Class / Description | [-] | MSW | Sandy Loam (SL) | Silty Clay (SiCL) (Moderate) |
| Thickness | m | 10 m | 0.15 | 0.60 |
| Total porosity | [-] | 0.671 | 0.453 | 0.445 |
| Field capacity | [-] | 0.292 | 0.190 | 0.393 |
| Wilting point | [-] | 0.077 | 0.085 | 0.277 |
| Initial volumetric water content | [-] | 0.292 | 0.190 | 0.445 |
| Hydraulic Conductivity* | cm/s | $1.0 \times 10^{-3}$ | $7.2 \times 10^{-4}$ | $1.9 \times 10^{-6}$ |

Notes: † HELP model default soil texture class were used together with model default parameters for total porosity, field capacity, wilting point and hydraulic conductivity. HELP model default parameters for total porosity, field capacity, wilting point and hydraulic conductivity are considered representative for the waste fill at the Site. Specified hydraulic conductivity was used for the final cover soil.
* Effective saturated hydraulic conductivity.

## TABLE 5: PREDICTED LEACHATE GENERATION RATES WITH FINAL COVER

| Month | Without Climate Change | | With Climate Change Reference Period (2011-2040) | | With Climate Change Reference Period (2041-2070) | |
|---|---|---|---|---|---|---|
| | Avg. (mm) | Potential Peak (mm) | Avg. (mm) | Potential Peak (mm) | Avg. (mm) | Potential Peak (mm) |
| **January** | 28 | 52 | 40 | 62 | 41 | 59 |
| **February** | 7 | 14 | 28 | 55 | 39 | 65 |
| **March** | 8 | 13 | 13 | 31 | 34 | 61 |
| **April** | 20 | 26 | 39 | 57 | 44 | 62 |
| **May** | 13 | 21 | 23 | 45 | 20 | 42 |
| **June** | 8 | 16 | 1 | 4 | 3 | 10 |
| **July** | 7 | 13 | 0 | 0 | 0 | 0 |
| **August** | 9 | 12 | 0 | 0 | 0 | 0 |
| **September** | 12 | 21 | 0 | 1 | 0 | 1 |
| **October** | 19 | 29 | 6 | 17 | 7 | 19 |
| **November** | 25 | 36 | 13 | 26 | 16 | 30 |
| **December** | 27 | 36 | 25 | 35 | 28 | 38 |
| **Annual Avg.** | **178** | | **188** | | **232** | |

# Appendix B

## Traffic Volumes

# Traffic – Assumptions and Supporting Data

## 1. Assumptions

Traffic data from the existing South Landfill (Phase 1) was used as a proxy as the proposed Phase 2 would maintain the same annual volume and daily limit of solid, non-hazardous waste from residential and industrial, commercial and institutional (IC&I) sources presently accepted at Phase 1. Data from 2023 was used and is assumed to be representative of typical traffic patterns expected for Phase 2.

## 2. Supporting Data

A total of 59,272 trucks were recorded for South Landfill (Phase 1) in 2023. The weekly average was 230 trucks per weekday (Figure 1). Figure 2 illustrates the average number of trucks by hour, while Figure 3 shows the maximum number of trucks per day.

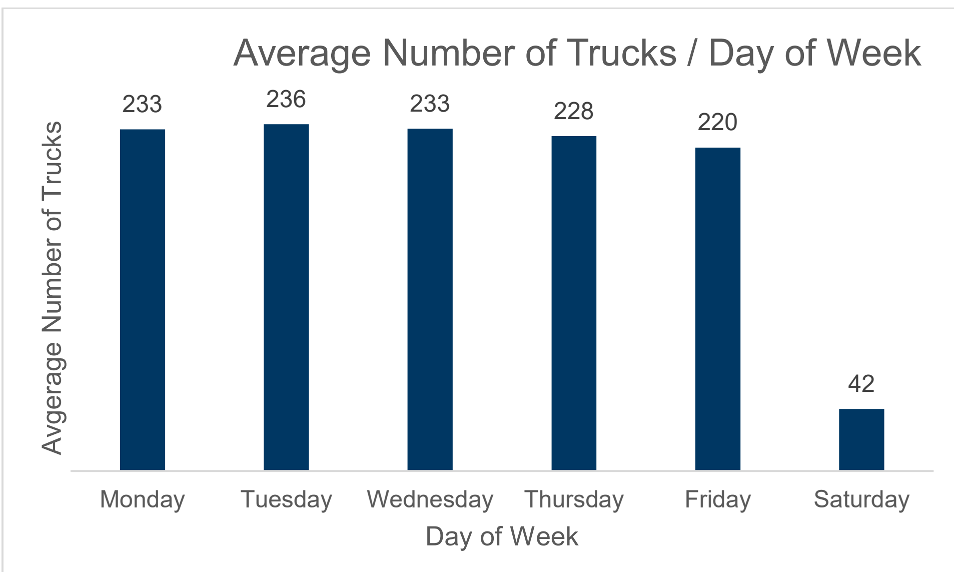



***Figure 1 Average Number of Trucks Per Weekday in 2023 at the South Landfill (Phase 1)***

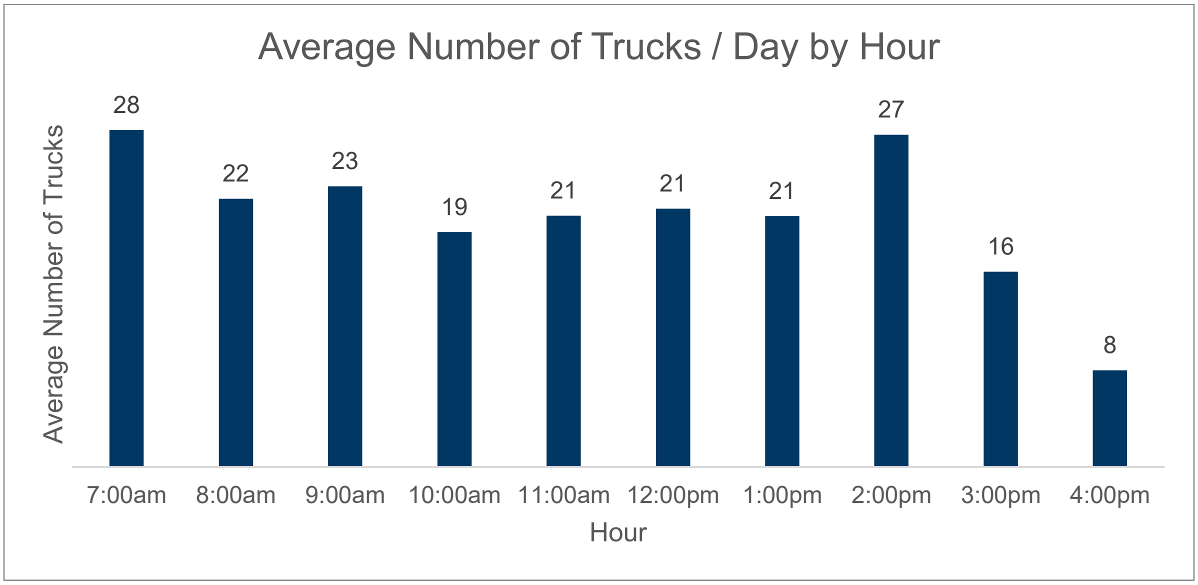



***Figure 2*** ***Average Number of Trucks by Hour in 2023 at the South Landfill (Phase 1)***

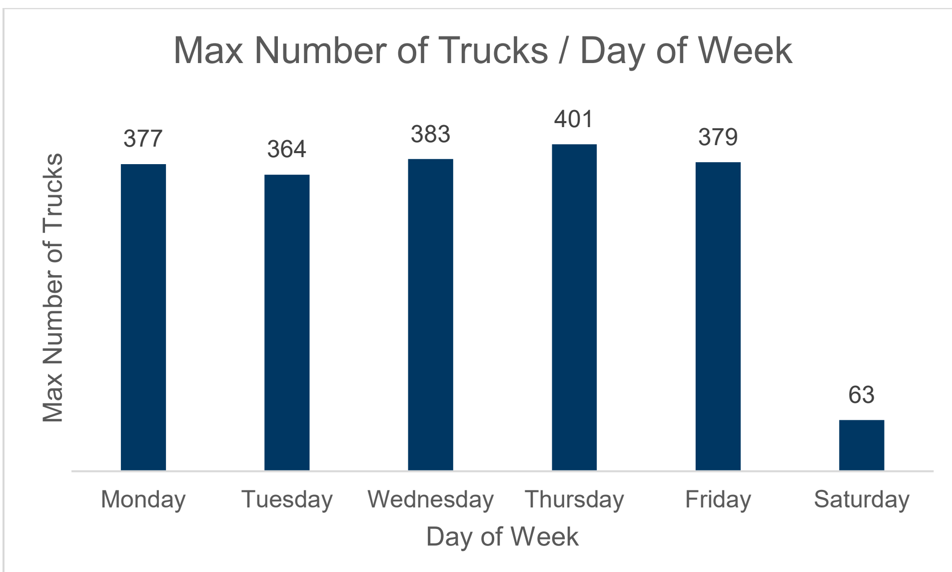



***Figure 3*** ***Maximum Number of Trucks Per Weekday in 2023 at the South Landfill (Phase 1)***