DILLON CONSULTING

CITY OF OTTAWA

Trail Road Waste Facility – Review of Landfill Expansion Options

November 2021 – 18-7333

November 22nd, 2021

177 Colonnade Road
Suite 101
Ottawa, Ontario
Canada
K2E 7J4
Telephone
613.745.2213
Fax
613.745.3491

City of Ottawa
Public Works and Environmental Services Department
4475 Trail Road
Ottawa, ON
K1P 1J1

Attention: Brandon Maynard
Compliance Coordinator

Re: Trail Road Waste Facility – Review of Landfill Expansion Options

Dear Mr. Maynard,

Dillon Consulting Limited (Dillon) is pleased to provide the City of Ottawa with the Final Report of the Review of Landfill Expansion Options for the Trail Road Waste Facility.

This Report builds upon the initial review completed by Dillon in 2017 to further describe the specific expansion options that can be considered, along with associated regulatory, operational, and other issues that would need to be addressed.

We trust this meets your requirements at this time. Should you have any questions or comments, please contact the undersigned at (613) 745-2213, ext. 3016.

Sincerely,

DILLON CONSULTING LIMITED

Brent Loney, M.Sc., P.Geo.
Partner

RAD:KNP

Our file: 18-7333

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Acronyms, Abbreviations, Definitions

Environmental Assessment (EA)
Environmental Protection Act (EPA)
Meters above sea level (masl)
Ministry of Environment, Conservation, and Parks (MECP)
Trail Waste Facility (TWF)
West Carleton Environmental Centre (WCEC)
Capital Region Resource Recovery Centre (CRRRC)

Executive Summary

Dillon Consulting Limited (Dillon) was retained by the City of Ottawa (the City) in August 2021 to undertake a feasibility review of potential expansion options for the Trail Waste Facility (TWF). This review builds upon the initial review completed by Dillon in 2017 to provide further discussion on issues that would need to be addressed for each proposed option.

The TWF is located at 4475 Trail Road in Richmond, Ontario, east of Moodie Drive and north of Trail Road. The TWF was opened in 1980 and is expected to remain in operation for approximately 16 more years, closing in 2036 or 2037. Closure year depends on various factors including, but not limited to, landfilling efficiency, potential expansion, and diversion rates.

This review of expansion options only takes into consideration the triangular property currently owned by the City of Ottawa at 4475 Trail Road in Richmond, Ontario. Expansion onto some of the surrounding buffer lands has not been explored, but could be in the future. It is also noted that the expansion options herein assume that development of Stage 5 proceeds as currently planned.

Four options were considered in this report to extend the life of the landfill. All of these options would involve completing a new EA and associated approvals. Public interest would be high considering the significant expansion of urban development to the east of the landfill (i.e., Barrhaven South). The options considered include:

Option 1: involves the extending the crest elevation of Stage 4 across the valley to the crest of Stage 5 ('filling the valley'). The new area of waste would overlap onto existing capped Stage 3B, 4, and 5, requiring cover removal prior to placement of waste. Waste will not be placed atop Stage 3A due to leachate concerns with the adjacent unlined Stages 1&2.

Option 2: involves constructing a new Cell north of the existing Stage 1&2 cells. As per the 2002 Trail Waste Facility Optimization EA, horizontal expansion to the North will be constrained by the geotechnical response of the soft clay deposit to the loading. Although the new cell in this area was previously envisioned as being contiguous with the existing waste mound in the 2002 EA; this is no longer considered feasible due to groundwater compliance considerations (i.e., options that would remove any portions of final cover on the natural attenuation portion of the landfill (existing Stages 1 and 2) are not supported).

Option 3: involves filling in the area southwest of Stage 5. This area was not included in the previous expansion in order to maintain a 100 m buffer from an adjacent aggregate extraction property; however it is felt that there is an opportunity to reduce the buffer in this area to 30 metres and redraw the southwestern portion of Stage 5. It is noted that Option 3 is not considered to be viable as a stand-

alone option given the limited additional capacity gained; however, it would make sense as part of a larger site expansion.

Option 4: combines Options 1 and 3.

The following table provides a comparison of the four options:

	Option 1 (filling the 'valley')	Option 2 (new cell north of Stages 1&2)	Option 3 (adding to SW corner of Stage 5)	Option 4 (combination of 1 and 3)
Additional Volume achieved (m^3)	~ 2.0 M	~ 0.5 M	~ 0.3 M	~ 2.3 M
Additional site life	~ 7.3 years	~ 1.9 years	~ 1 year	~ 8.3 years
Cost per m^3 of capacity gained	$36/$m^3$	$129/$m^3$	$55/$m^3$	$38/$m^3$
Engineering challenges and complexity of design	High	High	Moderate	High
Distance from urban area[1]	~750 m	~200 m	~1.7 km	~750 m

1 – distance from new development on east side of Borrisokane Road

All of these options would involve completing a new EA and associated approvals. Public interest would be high considering the significant expansion of urban development to the east of the landfill (i.e., Barrhaven South).

The least favoured option is considered to be Option 2. This option would involve expansion to the north of the existing waste footprint, and is conceptually similar to some of the options considered in the previous expansion EA. However, the new cell in this area was previously envisioned as being contiguous with the existing waste mound. But this is no longer considered feasible due to groundwater compliance considerations (i.e., options that would remove any portions of final cover on the natural attenuation portion of the landfill (existing Stages 1 and 2) are not supported). Further, a new cell in this area is constrained by soil conditions to the north. As such, a new cell in this area would not offer substantial additional capacity and would be relatively expensive. It would also come with significant engineering challenges given the presence of shallow aquifer groundwater contamination in that area.

Option 3 is not considered to be viable as a stand-alone option given the limited additional capacity gained; however, it would make sense as part of a larger site expansion.

The most favourable expansion options are therefore considered to consist of Options 1 and 4. It is noted that these options also involve significant engineering and logistical challenges, as outlined previously. The costs associated with these options are more reasonable, but are expected to be high relative to costs that would be associated with a new landfill developed at a greenfield site.

1.0 Introduction

1.1 Background

The Trail Waste Facility (TWF) is located east of Moodie Drive and north of Trail Road in the City of Ottawa (the Site). The City of Ottawa operates the Trail Road Landfill as its primary disposal facility for municipal solid waste. The landfill was opened in 1980 and was initially comprised of four stages. Stages 1 and 2 were designed as natural attenuation fill areas. Stages 3 and 4 are contained with a clay and geomembrane bottom liner and a leachate collection system. Filling of the initially approved landfill capacity within Stages 1 to 4 proceeded progressively until mid-2007. The site was granted approval in 2005 for a vertical expansion over Stages 1 through 4, as well as the development of a new engineered cell (future Stage 5). Filling was transferred to the vertical expansion area over Stages 1 through 4 after mid-2007, and will transition within the next few years to Stage 5. Detailed design work for Stage 5 is currently underway, and the first phase of construction is expected to be tendered in 2022. It is noted that the expansion options considered herein all assume that development of Stage 5 proceeds as currently planned.

The remaining airspace at the site is currently estimated to provide sufficient waste disposal capacity until approximately 2036 to 2037 (i.e., approximately 16 years), depending on various factors such as the efficiency of landfilling and rates of waste diversion (Dillon, 2021)[1].

In December 2017, Dillon completed a high level review of potential additional expansion opportunities at the Trail Road Waste Facility (i.e., beyond the currently approved vertical expansion over Stages 1 to 4 and new Stage 5). This report builds on that initial review to more fully explore potential expansion opportunities at the Site and serve as a tool for future planning of site activities (i.e., to minimize potential conflicts with future expansion areas, should such expansion be considered in the future).

1.2 Project Scope

As noted above, this review builds on an earlier evaluation, and considers four specific options in more detail. The options considered are as follows:

Option 1	Expansion to merge the existing waste footprint with future Stage 5 (i.e. the 'valley" between Stages 3B, 4 and future Stage 5 –see **Figure 1**)
Option 2	Expansion extending northwards from the existing waste footprint, (see **Figure 1**) and
Option 3	Filling in the area Southwest of Stage 5
Option 4	Combining Options 1 and 3.

[1] Trail Road Waste Facility Remaining Capacity – February 2021 memorandum to Heidi Scott, City of Ottawa.

These four options are reviewed in more detail below. For each option, a discussion of the following points are included:

- The volume of addi onal airspace provided by the proposed opon, as wel l as the expected addi onal landfill lifespan;
- Any approvals required as part of the proposed opon;
- An esm ated mefr ame and cost esm ate for the design, approval, and construcon proc esses associated with each opon;
- Any risks iden fied in the Environmental Assessment (EA), and/or newly introduced risks from each opon;
- Impact(s) to any of the exisng T rail Waste Facility infrastructure or other site features; and,
- Whether each individual opon is dependent` on other on-site acvie s or infrastructure, or if it is a standalone opon.

The scope of this review is limited to an evaluation of the feasibility of landfill expansion options from a technical and regulatory perspective. Whether or not any such expansion should proceed will need to be evaluated as part of the City's overall waste management planning process.

This review of expansion options only takes into consideration the triangular property currently owned by the City of Ottawa at 4475 Trail Road in Richmond, Ontario. Expansion onto some of the surrounding buffer lands has not been explored, but could be in the future.

1.3 Site Constraints

A number of site constraints need to be taken into consideration, including constraints related to soil conditions (geotechnical), natural environment considerations, neighbouring land uses, groundwater impacts, and infrastructure conflicts. Most of these constraints remain common to those considered during the previous expansion EA, although conditions have changed in some cases. The main constraints are outlined below, but also flagged within the discussions pertaining to each potential expansion option.

The Trail Waste Facility Optimization EA was developed from 2000 to 2002. The study area included all property within three (3) kilometers of the landfill site boundary which, at the time, was predominantly agricultural and mineral extraction lands. The public was invited to comment on the EA and the Ministry Review over 12 weeks in 2002 (https://www.ontario.ca/page/trail-waste-facility-landfill-optimization-project). No comments of significance were received from the public, as noted in the Ministry Approval of the EA, which is highly unusual for a landfill EA. This in part reflects the extensive public consultation activities undertaken during the conduct of the EA, wherein public concerns were addressed and in some cases additional mitigation measures incorporated into the proposed undertaking. This included

concerns relating to potential groundwater impacts, impacts to the on-site woodlot, and nuisance issues such as odour and dust control.

Geotechnical

As noted in the 2017 review, the most significant constraint to development at the property occurs within the north-eastern portion of the property where soft clays occur at the flanks of the sand and gravel esker that dominates the site and surrounding area. The soft clays present a geotechnical constraint that significantly limits the development potential in this portion of the site (i.e., while waste placement within a new cell in this area would be possible, the cell would be significantly constrained in terms of base elevation and thickness, such that a relatively low additional capacity would be achieved). This area is represented by geotechnical planning zones A1-A3, as illustrated in the attached figure extracted from the EA report (**Appendix A**). As such, the utility of developing this area was considered to be low at the time, and the same conclusion would hold today. It is noted that area A1 is now largely occupied by the site's stormwater management pond, and the southern forebay of this facility also extends along the eastern portion of area A2. Area B represents an area with more favourable soil conditions for potential development.

Natural Environment

A woodlot is also present in the north-eastern portion of the site, covering portions of area A3 (described above), and south into area B (including the intervening transition area).

Neighbouring Land Uses

Since the EA was approved by the Ministry of Environment, Conservation, and Parks (MECP) in 2005, significant portions of the study area has been rezoned to accommodate high density urban development and other light industrial uses (i.e., Barrhaven South). This is a significant variance from the original EA, and will have the effect of greatly increasing the number of potentially affected residents and other stakeholders proximal to the landfill.

Groundwater Impacts

In recent years, leachate impacted groundwater migration has occurred in areas proximal to the east and south of Stages 1 and 2 of the landfill. While this was expected to be a temporary condition and was showing signs of improvement after the placement of the final low permeability cover on Stages 1 and 2, new aquifer dewatering influences related to development in Barrhaven South are expected to exacerbate the problem. As a result, the City is planning to implement a purge well system at the Site to mitigate these concerns. Groundwater compliance concerns will however effectively eliminate any potential for further landfill expansion without full leachate containment. In addition, shallow aquifer groundwater impacts occur to the north of the existing landfill footprint within the woodlot area.

Infrastructure Conflicts

Operation of a solid waste landfill requires numerous related infrastructure components. Further to the expansion options considered herein, the following landfill infrastructure elements may have conflicts with the potential expansion:

- *Leachate collection infrastructure* – The leachate collecon pipes under Stages 3 and 4 drain from south to north and connect via a series of manholes on the north side of the landfill and a header running to the leachate pumping staon and the leachate pre-treatment lagoons. It is understood that the leachate collecon pipes f or Stage 5 will drain to the south and thence would also connect via a header to the leachate pumping staon and the pre-treatment lagoons.
- *Landfill gas flaring and utilization infrastructure* – Landfill gas collecon header s, flaring facility and engines are located along the northern perimeter of the exisng w aste footprint.
- *Small Loads drop-off facility* – This facility requires relocaon fr om its current locaon within th e Stage 5 footprint. The new locaon c ould conflict with potenal expansion areas.
- *Future leachate treatment facility* – A proposed full-scale leachate treatment facility to be constructed at the site would opmal ly be placed close to the related leachate infrastructure noted above.

2.0 Option 1: Filling between Stages 3, 4, & 5

2.1 Overview

Option 1 involves the continuation of the crest elevation of Stage 4 [130 meters above sea level (masl)] across the valley to the crest of Stage 5 (128 masl), as depicted in **Figure 1**. The crest of the new area of waste would peak at a 20 horizontal (H): 1 vertical (V) slope. The proposed option would also overlap Stage 3B (roughly the western half of Stage 3). Stage 3A (roughly the eastern half of Stage 3) was prematurely capped in 2020 due to concerns related to lateral leachate movement between Stage 3A and the unlined Stage 2 Cell. Given the leachate concerns, along with the challenges that would come from landfilling on top of a cap (since the cap would not be removed, also for leachate concerns), the proposed new area of waste in Option 1 does not extend into Stage 3A. It is noted that this option assumes that the development of Stage 5 proceeds as currently planned (i.e., the existing Stages would be modified in a 'retrofit' scenario).

The new landfill area would not impact the existing scales or Operations building at the entrance of the Site, and would come down at a 4H:1V slope towards the existing buildings from the crest on the one end of the proposed option. The other side of the new area would encroach onto Stage 3B, and also come down from the crest connecting Stage 3B and 5 at a 4H:1V slope. This side of the new area of Waste would not impact the existing gas flaring building, but would conflict with much of the current leachate management infrastructure in this area (manholes and header, pumping station, pre-treatment lagoons (see Section 2.3.2 below).

This option is further from the developing community compared to Option 2, therefore more buffering of landfill impacts is anticipated.

For Option 1, it is assumed that the existing haul road and the current and future storm water infrastructure in this valley would be removed to create a new base layer for the leachate liner and increase air space for waste. The existing haul road would be relocated.

The area offers approximately 2,019,280 cubic metres of air space. Assuming an annual air space utilization rate of 275,209 m^3/yr ([2]), this Option would provide approximately 7.3 years of additional site life. The annual airspace actually consumed in the future may vary depending on material diversion rates, consumer trends, population of the City, and other factors over the years.

This expansion would require an EA and an amendment to the existing Environmental Protection Act (EPA) Waste, Surface water and Air approvals in addition to the design and construction of the project.

[2] Based on current 5 year average (2016-2020) as outlined in Dillon (2021) – this number is subject to change based on operational considerations, amount of waste diversion, etc.

The timeframe for a waste EA in Ontario has historically taken approximately six (6) years; approvals would be expected to take two (2) years; and design and construction would be expected to take three (3) years, for an estimated 11 year total duration.

2.2 Option 1 Risks

As per the 2002 Trail Waste Facility Optimization EA, there is concern regarding the maximum allowable load on the HDPE piping of the leachate collection system. As such, a detailed investigation and calculations will need to be completed during Detailed Design to determine if the proposed elevations and volume from this report are possible or what additional strategies may be required to mitigate this risk.

The risks associated with this option are as follows:

- With the rela vely new high density urban development being within the three (3) kilometer study area typical for a waste EA, there has been a significant increase in sensi. ve receptors compared to the original EA completed 20 years ago, where the neighbouring properĀes were rural or mineral extracĀon. With this change, it is expected that the EA comment period will warrant more comments, concerns, and potenĀal project revisions based on this feedback.
- An approved EA will include a Property Value Assurance program to protect neighbours typically within one (1) kilometer of the landfill boundary. This is likely to be a very costly program due to the significant number of impacted neighbours and high property values in the area.
- Other local recently approved EA's – West Carleton Environmental Centre (WCEC) and Capital Region Resource Recovery Centre (CRRRC) – have jusĀfied their undertaking based on the need for disposal capacity for residual waste including residenĀal waste generated within the City of Ottawa. This, combined with City's desire to increase waste diversion from the landfill, may create challenges in jusĀfying an expansion at the Site.
  (i.e., hĀp://www.downloads.ene.gov.on.ca/files/eaab/west_carleton_review.pdf)
- A community improvement fund is likely where none exist today, adding to the annual costs.
- The removal of the exisĀng and planned final cover systems on Stage 3B, 4, and 5 will increase leachate and landfill gas impacts. In addiĀon to odour risks, the landfill gas impacts will increase greenhouse gas emissions from the site.
- The Trail AdministraĀon Building would be surrounded on three sides by 4H:1V waste slopes. This may create local air quality issues for staff at this facility, especially during landfill development.

The above list of risks have been developed based on the information that is currently available. Additional risks and considerations may be encountered and lead to design alterations as a result of more detailed investigations completed to support an EA, or during Detailed Design. A detailed

geotechnical investigation will need to be done for all options proposed to determine the real life feasibility and design considerations.

2.3 Option 1: Site Impacts

This option presents the following potential site impacts to existing infrastructure including:

2.3.1 Stormwater Management System

Stage 5 is approved with a permeable cover system, and Stage 4 is approved with an impermeable final cover. It is assumed an impermeable final cover system would be selected to connect Stage 4 and Stage 5. This option is expected to have minor impacts on the site stormwater management system.

Additional impermeable final cover would be placed in the section of the valley between Stages 3B, 4 and 5. Storm water ditching in this area would need to be evaluated to ensure proper grades are achieved and some additional storm flow would occur once the final cover is installed as a result of the increased impermeable surface.

2.3.2 Leachate Management System

A leachate liner would be required beneath the new waste air space over the unlined portions of the site between the existing Stage 3B, Stage 4, and Stage 5 leachate collection systems. Final cover over the connected slopes of Stage 3B, 4, and 5 would need to be removed to allow landfill operations and ensure leachate from the expansion is collected in these Stages.

All leachate sumps on Stage 4 and most of the sumps on Stage 5 would be buried under waste presenting significant engineering challenges with buried infrastructure. Relocation of much of the above grade infrastructure will also be required (pumping station, pre-treatment lagoons). In addition, the MH9 leachate pumping station is connected to SCADA intranet through cabling buried along the footprint of the landfill. This cable would need to be relocated or abandoned.

Leachate management volumes would increase and result in additional long term management costs.

2.3.3 Final Cover

Affected areas of Stage 3B, 4, and Stage 5 final cover would need to be stripped to prepare for waste filling activities. The final cover stripped from these Stages could be stored for potential beneficial reuse at the Site or elsewhere.

From a leachate management perspective, there is no concern with stripping Stage 4 & 5 covers, as they are both lined Cells with leachate collection systems.

2.3.4 Site Access

This option would result in the termination of the access road to the current leachate pre-treatment system and landfill gas utilization facility between Stages 3, 4 and 5. By the time the approval would likely be received, Stage 5 is expected to be mostly full. It is assumed that an alternate site entrance would be required, likely on Cambrian Road, to facilitate site activities. Cambrian Road is an unpaved local road which would require paving and maintenance to ensure appropriate safe access is maintained year round for the size of vehicles that would be using the road, and to control the dust that would be produced on an unpaved road.

2.3.5 Landfill Gas

The main perimeter landfill gas header located to the east of the current haul road between Stages 4 and 5 would be buried and would require evaluation to ensure continued operation beneath the waste mound much like the current Nepean collector under Stage 4.

2.3.6 Other Facility Impacts

The relocation of the main site access to Cambrian Road would likely require the relocation of the existing main site scales, possibly to the east of Stage 5. The expected location of the relocated scales may interfere with the proposed future small loads facility. In addition, the current fueling station just northeast of the Administration building would need to be relocated as it would interfere with the new waste expansion and associated footprint.

2.4 Option 1 Cost Estimate

The Option 1, Class D Cost Estimate includes costs for the following:

- The EA process;
- RelocaĀon of the service road;
- Bulk excavaĀon;
- Stripping of some exisĀng cover;
- A new liner;
- Leachate collecĀon for the new area;
- Expansion of the landfill gas system;
- Infrastructure relocaĀon; and,
- Final cover.

The estimated cost for the above items is approximately $73 million. This works out to approximately $36 per m^3 of additional airspace. A detailed breakdown of all costs considered can be found in **Appendix B**.

Please note that these are high level cost estimates. Costs are anticipated to differ based on information that comes from future geotechnical investigations and detailed design work and analysis.

3.0 Option 2: Building a new Cell to the North of Exisng Stage 1&2` Cells

3.1 Overview

Option 2 is a new proposed Cell to the North of the existing Stage 1&2 Cells (See **Figure 1**). The new proposed stage would cover an approximately 8.4 hectare footprint.

The 2002 Trail Waste Facility Optimization EA included a similar option to this; however, it was a ten (10) hectare Cell directly connected to Stages 1&2. The new Cell being proposed in this report would need to be completely separate from Stages 1&2 to ensure no leachate from the new stage enters the unlined Stage 1&2.

The area offers approximately 525,083 cubic metres of air space which is equivalent to 1.9 years of additional site life assuming an annual air space utilization rate of 275,209 m3/yr.

As per the 2002 Trail Waste Facility Optimization EA, horizontal expansion to the North will be constrained by the geotechnical response of the soft clay deposit to the loading. Further geotechnical investigations and review will need to be completed to verify the practicality of this option, and to determine the size and elevation that is acceptable in this area. The cell geometry depicted in Figure 1 is believed to be achievable based on current information, but would be subject to change.

This option would require an EA and an amendment to the existing EPA Waste, Surface water and Air approvals. The timeframe for a waste EA in Ontario is typically six (6) years with approvals expected to take two years and design and construction three years, for an estimated 11 year total (as outlined for Option 1).

3.2 Option 2 Risks

The risks associated with this option are as follows:

- This footprint is in closest proximity to the developing community and therefore poses the greatest risks for offsite impact. It is worth noĀng that in 2005 the City reversed the filling sequence of the verĀcal landfill expansion over Stages 1-4 to move landfill operaĀons away from the community as it progressed.
- High density urban development is within the three (3) kilometer study area that is typical for a waste EA. This is a significant influx of sensiĀve receptors and a variance from the original EA, as neighbouring properĀes were rural or mineral extracĀon 20 years ago. The footprint of this opĀon is adjacent to the site boundary, offering the least buffer to miĀgate waste impacts, especially odour.

An increase in local community concerns is therefore expected if this OpĀon is selected. With this change, it is expected that the EA comment period will warrant more comments, concerns, and potenĀal project revisions based on this feedback.

- This OpĀon is in full view of the developed community. Vegetated screening berms would need to be established along the property boundary toward Highway 416 to reduce the risk of blowing liĀer, dust impacts, and views of the waste operaĀon.
- An increase in bird control efforts (e.g. seagull) would be required miĀgate the visual concerns.
- Approximately eight hectares of the exisĀng woodlot would be removed. This may be subject to restricĀons due to natural environment consideraĀons.
- The original EA limited the maximum height for this geotechnical zone to 125 masl.
- The footprint for this OpĀon is built within an area of shallow aquifer groundwater impacts. In addiĀon to the groundwater management concerns that would arise during construcĀon, the area in quesĀon represents part of the aĀenuaĀon zone for the shallow aquifer and would be compromised by the new cell development. This would likely require that acĀve groundwater miĀgaĀon measures (e.g., groundwater collecĀon trench) be introduced for the shallow aquifer (i.e., in addiĀon to the planned purge wells for the deep aquifer).
- An approved EA will include a Property Value Assurance program to protect neighbours typically within one (1) kilometer of the landfill boundary. This is likely to be a very costly program due to the significant number of impacted neighbours and high property values in the area.
- Other local recently approved EA's – WCEC and CRRRC – have jusĀfied their undertaking based on the need for disposal capacity for residual waste including residenĀal waste generated within the City of Ottawa reducing the need for proceeding with an expansion to provide addiĀonal capacity. (i.e., hĀp://www.downloads.ene.gov.on.ca/files/eaab/west_carleton_review.pdf)
- A community improvement fund is likely where none exist today, adding to the annual costs.

The above list of risks have been developed based on the information that is currently available. Additional risks and considerations may be encountered and lead to design alterations as a result of more detailed investigations completed to support an EA, or during Detailed Design. A detailed geotechnical investigation will need to be done for all options proposed to determine the real life feasibility and design considerations.

3.3 Option 2: Site Impacts

This option presents the following potential site impacts to existing infrastructure including:

3.3.1 Stormwater Management System

This option is expected to have minor impacts on the site stormwater management system. Storm water ditching is this area would need to be evaluated to ensure proper grades are achieved and some additional storm flow would occur once the final cover is installed as a result of the increased impermeable surface.

3.3.2 Leachate Management System

A leachate liner would be required beneath the new waste air space. A new leachate pumping station and pipeline would be required to deliver leachate to the pre-treatment system. Leachate management volumes would increase and result in additional long term management costs.

3.3.3 Groundwater Impacts

As noted above, this proposed cell would be located in an area of shallow aquifer groundwater impacts (with this area currently serving an important contaminant attenuation function). Reducing the capacity for groundwater contaminant attenuation in this area would be highly likely to prompt the need for the installation of an active shallow aquifer groundwater mitigation system (e.g., horizontal groundwater collector) which would result in the need to manage additional wastewater (i.e., contaminated groundwater). This would need to be accounted for with the wastewater already to be generated from the future operation of deep aquifer purge wells at the Site.

3.3.4 Site Access

It is assumed the existing haul road would be utilized to serve this expansion footprint. Truck traffic impacts on the existing landfill gas and leachate pre-treatment facility would need to be managed and the perimeter road would require improvement.

3.3.5 Landfill Gas

The existing gas flaring building would potentially need to be relocated for the development of this area (depending on the final footprint selected after more detailed review and optimization). The main perimeter landfill gas header located to the south of the current Stage 1 and 2 footprint may be buried and would require evaluation to ensure continued operation.

3.3.6 Other Facility Impacts

This option would require a significant removal of a portion of the woodlot that is located to the north of the existing landfill cells. Environmental concerns and potential mitigation measures would need to be investigated if this Option is selected.

3.4 Option 2 Cost Estimate

The Option 2, Class D Cost Estimate includes costs for the following:

- The EA process;
- Base grade preparaĀon;
- Clearing of woodlot;
- A new liner;
- A new leachate collecĀon system;
- A new leachate pump staĀon;
- A new landfill gas system;
- Infrastructure relocaĀon; and,
- Final cover.

The estimated cost for the above items is approximately $68 million. This works out to approximately $129 per m^3 of additional airspace. A detailed breakdown of all costs considered can be found in **Appendix B**.

Please note that these are high level cost estimates. Costs are anticipated to differ based on information that comes from future geotechnical investigations and detailed design work and analysis.

4.0 Option 3: Filling in the corner Southwest of Stage 5

4.1 Overview

The southwest corner of Stage 5 has a buffer of 100 metres to Cambrian Road to the north as established in the 2002 TWF EA. This buffer was set due to private property ownership north of Cambrian Road and the potential for impacts to end uses for aggregate (sand) extracted from this property. Since the time of the EA, additional work has been completed to assess leachate impacted groundwater contamination of aggregate and its effect on concrete product strength, a common end use of aggregate from area pits. Dillon completed sampling over several years at the nearby Howe Ross pit contaminated with Nepean landfill leachate and determined that the leachate did not contribute significant organic impurities to the aggregate (and hence would have no impact on concrete strength). As a result we feel there is an opportunity to reduce the buffer in this area to 30 metres and redraw the south western portion of Stage 5.

It is assumed this area would be excavated to match the adjacent Stage 5 base grades. The area offers approximately 263,937 cubic metres of air space which is equivalent to approximately one year of additional site life assuming an annual air space utilization rate of 275,209 m^3/yr.

This option assumes that the development of Stage 5 would proceed as planned, and that the proposed option would require an EA and an amendment to the existing EPA Waste, Surface water and Air approvals. The timeframe for a waste EA in Ontario is typically six (6) years with approvals expected to take two years and design and construction three years, for an estimated 11 year total.

4.2 Option 3 Risks

The risks associated with this option are as follows:

- High density urban development is within the three (3) kilometer study area typical for a waste EA. This is a significant influx of sensiĀve receptors and a variance from the original EA as neighbouring properĀes were rural or mineral extracĀon 20 years ago. The footprint of this opĀon is adjacent to the site boundary offering the least buffer to miĀgate waste impacts especially odour, exacerbaĀng local community concerns. With this change, it is expected that the EA comment period will warrant more comments, concerns, and potenĀal project revisions based on this feedback.
- An approved EA will include a Property Value Assurance program to protect neighbours typically within one (1) kilometer of the landfill boundary. This is likely to be a very costly program due to the significant number of impacted neighbours and high property values in the area.

- Other local recently approved EA's – WCEC and CRRRC – have jusĀfied their undertaking based on the need for disposal capacity for residual waste including residenĀal waste generated within the City of Ottawa reducing the need for proceeding with an expansion to provide addiĀonal capacity. (i.e., hĀp://www.downloads.ene.gov.on.ca/files/eaab/west_carleton_review.pdf)
- A community improvement fund is likely where none exist today, adding to the annual costs.
- This opĀon does not provide sufficient air space as a standalone opĀon in an EA process.
- The proximity to Moodie Drive may create addiĀonal visual and odour related impacts.
- A legal agreement including compensaĀon with the neighbouring property owner may be required to manage concerns related to the proximity of the waste footprint.

The above list of risks have been developed based on the information that is currently available. Additional risks and considerations may be encountered and lead to design alterations as a result of more detailed investigations completed to support an EA, or during Detailed Design. A detailed geotechnical investigation will need to be done for all options proposed to determine the real life feasibility and design considerations.

4.3 Option 3: Site Impacts

This option presents the following potential site impacts to existing infrastructure including:

4.3.1 Stormwater Management System

This option is expected to have minor impacts on the site stormwater management system. Storm water ditching is this area would need to be evaluated to ensure proper grades are achieved and some additional storm flow may occur once the final cover is installed as a result of the increased impermeable surface.

4.3.2 Leachate Management System

A leachate liner would be required beneath the new waste air space. The liner would connect to the adjacent Stage 5 liner system. This option would be easiest to implement if the immediately adjacent Stage 5 leachate liner had yet to be installed making extension of the excavation and liner installation more straightforward.

Leachate management volumes would increase and result in additional long term management costs.

4.3.3 Groundwater Impacts

Concerns related to groundwater compliance or mitigation are not expected for this option, as shallow aquifer impacts do not occur in this area.

4.3.4 Site Access

It is assumed the existing haul road and operational areas would be utilized to serve this expansion footprint.

4.3.5 Landfill Gas

Additional landfill gas would be generated from the waste placed in this area. The gas collection mains around the perimeter of Stage 5 may need to be rerouted around this additional footprint.

4.3.6 Other Facility Impacts

Other than minor perimeter fencing no additional impacts to other site facilities are expected with this option.

4.4 Option 3 Cost Estimate

The Option 3, Class D Cost Estimate includes costs for the following:

- The EA process;
- Bulk excavaĀon;
- Stripping of some exisĀng cover;
- A new liner;
- Leachate collecĀon system for new areas;
- Expansion of landfill gas system; and,
- Final cover.

The estimated cost for the above items is approximately $15 million. This works out to approximately $55 per m^3 of additional airspace. A detailed breakdown of all costs considered can be found in **Appendix B**.

Please note that these are high level cost estimates. Costs are anticipated to differ based on information that comes from future geotechnical investigations and detailed design work and analysis.

5.0 Option 4 – Combining Options 1 and 3

5.1 Overview

Option 4 is a combination of Options 1 and 3. Option 2 has been excluded due to the considerable constraints and minimal air space gains associated with this option. The area offers a total of approximately 2,283,217 cubic metres of air space which is equivalent to 8.3 years of additional site life assuming an annual air space utilization rate of 275,209 m^3/yr.

The advantage this option offers is maximizing potential site air space in one EA process but this does present the most impacts and risks.

This expansion would require an Environmental Assessment and an amendment to the existing EPA Waste, Surface water and Air approvals. The timeframe for a waste EA in Ontario is typically six (6) years with approvals expected to take two (2) years and design and construction three (3) years for an estimated 11 year total.

The risks associated with this option include all of the risks determined for Options 1, 2 and 3.

The site impacts for this option include all of the impacts determined for Options 1, 2 and 3.

5.2 Option 4 Cost Estimate

The Option 4, Class D Cost Estimate includes costs for the following:

- The EA process (assuming the same cost for combining the opĀons);
- Relocation of Service Road (for OpĀon 1);
- Bulk excavaĀon (OpĀons 1+3);
- Stripping of some exisĀng cover (OpĀons 1+3);
- A new liner (OpĀons 1+3);
- Leachate collecĀon system for new areas (OpĀons 1+3);
- Expansion of landfill gas system (OpĀons 1+3);
- Infrastructure relocaĀon (OpĀon 1); and,
- Final cover (OpĀons 1+3).

The estimated cost for the above items is approximately $86 million. This works out to approximately $38/$m^3$ of additional airspace. A detailed breakdown of all costs considered can be found in **Appendix B**.

Please note that these are high level cost estimates. Costs are anticipated to differ based on information that comes from future geotechnical investigations and detailed design work and analysis.

6.0 Discussion

The following table provides a comparison of the four options:

	Option 1 (filling the 'valley')	Option 2 (new cell north of Stages 1&2)	Option 3 (adding to SW corner of Stage 5)	Option 4 (combination of 1 and 3)
Additional Volume achieved (m^3)	~ 2.0 M	~ 0.5 M	~ 0.3 M	~ 2.3 M
Additional site life	~ 7.3 years	~ 1.9 years	~ 1 year	~ 8.3 years
Cost per m^3 of capacity gained	$36/$m^3$	$129/$m^3$	$55/$m^3$	$38/$m^3$
Engineering challenges and complexity of design	High	High	Moderate	High
Distance from urban area[1]	~750 m	~200 m	~1.7 km	~750 m

1 – distance from new development on east side of Borrisokane Road

All of these options would involve completing a new EA and associated approvals. Public interest would be high considering the significant expansion of urban development to the east of the landfill (i.e., Barrhaven South).

The least favoured option is considered to be Option 2. This option would involve expansion to the north of the existing waste footprint, and is conceptually similar to some of the options considered in the previous expansion EA. However, the new cell in this area was previously envisioned as being contiguous with the existing waste mound. But this is no longer considered feasible due to groundwater compliance considerations (i.e., options that would remove any portions of final cover on the natural attenuation portion of the landfill (existing Stages 1 and 2) are not supported). Further, a new cell in this area is constrained by soil conditions to the north. As such, a new cell in this area would not offer substantial additional capacity and would be relatively expensive. It would also come with significant engineering challenges given the presence of shallow aquifer groundwater contamination in that area.

Option 3 is not considered to be viable as a stand-alone option given the limited additional capacity gained; however, it would make sense as part of a larger site expansion.

The most favourable expansion options are therefore considered to consist of Options 1 and 4. It is noted that these options also involve significant engineering and logistical challenges, as outlined

previously. The costs associated with these options are more reasonable, but are expected to be high relative to costs that would be associated with a new landfill developed at a greenfield site.

It should be noted that this review of expansion options only takes into consideration the triangular property currently owned by the City of Ottawa at 4475 Trail Road. Expansion onto some of the surrounding buffer lands has not been explored, but could be in the future. It should also be noted that these options are all preliminary concepts and require further analysis and testing to verify, refine, and optimize.

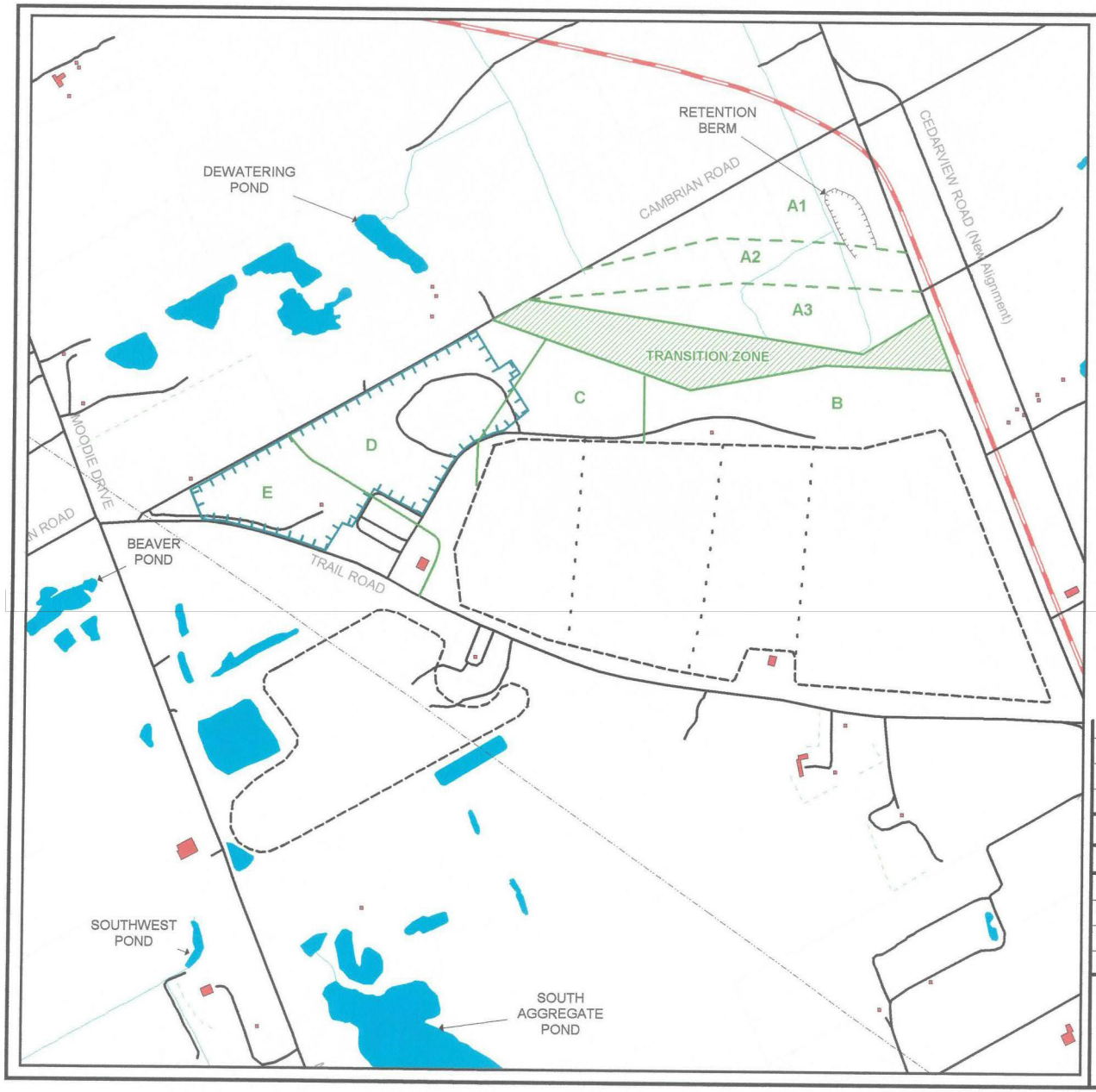
Figures

OPTION 1: FILLING BETWEEN STAGES 3, 4, & 5
Available Airspace: 2,019,280.41 Cu. M.
Excavation Volume: 85,423.35 Cu. M.
Liner Area: 38,308.59 sq. m.
Cap Stripping Area: 171,103.57 sq. m.
Final Cover Area: 211,117.14 sq. m.
OPTION 2: BUILDING A NEW CELL TO THE NORTH OF EXISTING STAGE 1 & 2 CELLS
Available Airspace: 525,083.63 Cu. M.
Woodlot Area: 84,158.64 Cu. M.
Liner Area: 83,985.55 sq. m.
Leachate Pipe: 1250m
Final Cover Area: 85,246.22 sq. m.
OPTION 3: FILLING IN THE CORNER SOUTHWEST OF STAGE 5
Available Airspace: 263,937.30 Cu. M.
Excavation Volume: 72,069.87 Cu. M.
Liner Area: 16,846.93 sq. m.
Leachate Pipe: 160m
Cap Stripping Area: 14,514.74 sq. m.
Final Cover Area: 31,805.03 sq. m.
STAGE 5
STAGE 4
STAGE 3
STAGE 2
STAGE 1
PROPERTY LINE
PROPERTY LINE
CONTOURS SHOWN ARE STAGE 5 APPROVED TOP OF CAP
CONTOURS SHOWN ARE STAGE 2 TO 4 APPROVED TOP OF CAP
N5011328
E362186
N5011250
E362293
N5011138
E362464
N5011023
E362496
N5011400
N5011200
N5011000
N5010800
N5010600
N5010400
E361400
E361600
E361800
E362000
E362200
E362400
E362600
E362800
E363000
E363200
E363400
SITE FEATURES AND CONTOURS PROVIDED BY THE CITY OF OTTAWA
SCALE 1:2,000
METRES
DILLON CONSULTING
DATE SEPTEMBER 2021
PROJECT TRAIL ROAD LANDFILL
TITLE 3 PRELIMINARY EXPANSION OPTIONS
PROJECT NO. 18-7333
FIGURE NO. 1

Appendix A

Geotechnical Constraints

DILLON CONSULTING



LEGEND

GEOTECHNICAL PLANNING ZONE	PROPOSED MAXIMUM SLOPE CREST ELEVATION (m)
A1	100
A2	105
A3	110
B	125
C	125
D	125
E	125

SPECIAL NOTE

THIS DRAWING TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT

REFERENCE

BASE PLAN PRODUCED BY GOLDER ASSOCIATES LTD.
UNDER LICENCE WITH THE ONTARIO MINISTRY
OF NATURAL RESOURCES, QUEENS PRINTER, 1996

REVISION	DATE	DESCRIPTION	DRAWN	CHECKED	REVIEW

SCALE	1:10,000	
PROJECT	001-2816	
DESIGN	MIC	FEB/01
DRAWN	MRL	SEP/01
CHECK	PAS	FEB/01
REVIEW	PAS	FEB/01

PROJECT
TRAIL LANDFILL OPTIMIZATION/EXPANSION PROJECT

SHEET TITLE
PROPOSED MAXIMUM SLOPE CREST ELEVATIONS FOR HORIZONTAL EXPANSION

N W E S

Ottawa

FILE NO.
001-2816/GIS_INFO/MAPS

FIGURE NO.
B.31

Appendix B

Cost Estimate

Option 1: Filling between Stages 3, 4, and 5

Item	Estimated Quantity	Unit	Unit Price	Cost	Notes
EA process	1	Lump sum	$1,500,000	$ 1,500,000	Assusming less cost will be incurred for the EA study because of previous and ongoing studies that could be drawn on for this application (ie. Birds, air, etc.)
Relocation of service road	1,500	lin. m.	$1,000	$ 1,500,000	Rebuild Cambrian Road and create new site entrance
Bulk excavation cost	85,504	m^3	$5	$ 427,520	
Stripping of some Stage 3, 4, & 5 cover	171,104	m^2	$5	$ 855,518	
Liner cost	38,309	m^2	$400	$ 15,323,436	
Leachate collection for new area	1	Lump sum	$13,000,000	$ 13,000,000	Relocation of Stage 3 Pump and areation pond
Expansion of LFG system	1	Lump sum	$2,000,000	$ 2,000,000	
Infrastructure relocation	1	Lump sum	$5,000,000	$ 5,000,000	Relocating of pumping station and pre-treatment lagoons
Final cover	211,117	m^2	$100	$ 21,111,714	

Subtotal Cost	$ 60,718,188	
Contingency Cost	$ 12,143,638	Approximately 15% of Subtotal Cost
Total Cost	$ 72,861,825	

Additional airspace (m^3)	2,019,280
$/$m^3$	$ 36.08

Option 2: Building a new Cell to the North of Existing Stage 1 and 2 Cells

Item	Estimated Quantity	Unit	Unit Price	Cost	Notes
EA process	1	Lump sum	$1,500,000	$ 1,500,000	Assusming less cost will be incurred for the EA study because of previous and ongoing studies that could be drawn on for this application (ie. Birds, air, etc.). Assuming same cost as Option 1.
Base grade preparation	1	Lump sum	$750,000	$ 750,000	Assume building on grade (approximately), plus some additional work to prepare the base for construction.
Clearing of woodlot	84,159	m^2	$10	$ 841,586	
Liner cost	83,986	m^2	$400	$ 33,594,220	
New leachate collection system	1250	lin. m.	$120	$ 150,000	
New leachate pump station	1	Lump sum	$3,000,000	$ 3,000,000	
New LFG system	1	Lump sum	$3,000,000	$ 3,000,000	
Infrastructure relocation	1	Lump sum	$5,000,000	$ 5,000,000	Relocating of existing gas flaring building
Final cover	85,246	m^2	$100	$ 8,524,622	

Subtotal Cost	$ 56,360,428	
Contingency Cost	$ 11,272,086	Approximately 15% of Subtotal Cost
Total Cost	$ 67,632,514	

Additional airspace (m^3)	525,083
$/$m^3$	$ 128.80

Option 3: Filling in the corner Southwest of Stage 5

Item	Estimated Quantity	Unit	Unit Price	Cost	Notes
EA process	1	Lump sum	$1,500,000	$ 1,500,000	Assusming less cost will be incurred for the EA study because of previous and ongoing studies that could be drawn on for this application (ie. Birds, air, etc.)
Bulk excavation cost	72,070	m^3	$5	$ 360,349	
Stripping Stage 5 cover in overlapping areas	14,515	m^2	$5	$ 72,574	Stripping of Stage 5 cap only required if this area is complete. Cost would be reduced if the EA is completed prior to this section of landfill is constructed.
Liner cost	16,847	m^2	$400	$ 6,738,772	
Leachate collection system for new areas	1	Lump sum	$100,000	$ 100,000	
Expansion of LFG system	1	Lump sum	$200,000	$ 200,000	
Final cover	31,805	m^2	$100	$ 3,180,503	

Subtotal Cost	$ 12,152,198	
Contingency Cost	$ 2,430,440	Approximately 15% of Subtotal Cost
Total Cost	$ 14,582,638	

Additional airspace (m^3)	263,937
$/$m^3$	$ 55.25

Option 4: Option 1 (Filling between Stages 3, 4, 5) and Option 3 (Filling in the corner Southwest of Stage 5)

Item	Estimated Quantity	Quantity	Unit Price	Cost	Notes
EA process	1	Lump sum	$1,500,000	$ 1,500,000	Assusming less cost will be incurred for the EA study because of previous and ongoing studies that could be drawn on for this application (ie. Birds, air, etc.). Combining both options under one EA will not significantly increase cost.
Relocation of service road	1,500	lin. m.	$1,000	$ 1,500,000	From Option 1
Bulk excavation cost	m^3	157,574	$5	$ 787,869	Option 1 + Option 3
Stripping of some Stage 3, 4, & 5 cover	m^2	185,618	$5	$ 928,092	Option 1 + Option 3
Liner cost	m^2	55,156	$400	$ 22,062,208	Option 1 + Option 3
Leachate collection system for new areas	1	Lump sum	$13,100,000	$ 13,100,000	Option 1 + Option 3
Expansion of LFG system	1	Lump sum	$2,200,000	$ 2,200,000	Option 1 + Option 3
Infrastructure relocation	1	Lump sum	$5,000,000	$ 5,000,000	From Option 1
Final cover	m^2	242,922	$100	$ 24,292,217	Option 1 + Option 3

Subtotal Cost	$ 71,370,386	
Contingency Cost	$ 14,274,077	Approximately 15% of Subtotal Cost
Total Cost	$ 85,644,463	

Additional airspace (m^3)	2,283,217
$/$m^3$	$ 37.51