# HALIFAX

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**Item No. 3**
**Committee of the Whole**
**December 9, 2014**

**TO:** Mayor Savage and Members of Halifax Regional Council

**SUBMITTED BY:** Original signed by

Richard Butts, Chief Administrative Officer

Original Signed by

Mike Labrecque, Deputy Chief Administrative Officer

**DATE:** November 24, 2014

**SUBJECT:** Integrated Solid Waste Resource Management Strategy Review – Consultations with Halifax Waste Resource Society Board of Directors with respect to Recommendations #7, 8 and 9.

## SUPPLEMENTARY REPORT

**ORIGIN**

Regional Council directed staff to conduct a review to assess Integrated Solid Waste Resource Management Strategy (the "Review") to enhance system, environmental and fiscal performance.

The Review resulted in a Final Report dated January 8, 2014 (the "Report") which was presented to Committee of the Whole and Regional Council on January 14, 2014. Committee of the Whole approved recommendations 1 through 6 contained in the Report and deferred items 7 through 9 to a future Committee of the Whole Meeting. Committee of the Whole met on June 24, 2014 to consider the deferred items. The following motion was put and passed with respect to each of the recommendations #7, 8 and 9:

> (a) Defer consideration of recommendation number [7, 8 & 9] from the January 8, 2014 staff report; and
>
> (b) Direct staff to meet and consult further with the Halifax Waste Resource Society Board of Directors on the technical issues and/or impacts and report back to Committee of the Whole by November 1, 2014 with a summary of recommendations from the Society and recommended changes to staff's report and recommendations, if any. Should the local Councillors not currently belong to the Board of Directors of the Halifax Waste Resource Society, the Councillors for Districts 11 and 12 be included in the consultation if they so choose.

At its meeting of October 7, 2014, Regional Council directed that the timeframe for staff to report back to Committee of the Whole be extended to December 9, 2014.

## LEGISLATIVE AUTHORITY

*Halifax Regional Municipality Charter,* Part XIII, Solid Waste Resource Management

## RECOMMENDATION

In respect of the deferred motions regarding recommendations 7, 8 &9 it is recommended that Committee of the Whole recommend to Halifax Regional Council that:

1. The motion with respect to recommendation #9 be amended to read as follows:

   Direct staff to defer any action with respect to the siting of a new landfill site in order to assess the implications of system changes currently being implemented and direct staff to increase the vertical height of existing and future cells in accordance with the approach as set out in the report of Conestoga – Rovers & Associates dated October 8, 2014, subject to maintaining the visible isolation of the cells as outlined by the SNC Lavalin Environment balloon study findings with notice to the Chair of the Community Monitoring Committee in accordance with Section 6.05 of the Agreement for Community Monitoring of Solid Waste Facilities dated February 16, 1999 once an updated design and operations plan has been prepared.

2. Further, that the motion with respect to recommendation #8 be amended to read as follows:

   Direct staff to take the necessary steps to maintain the current operating model, including front end processor facility, waste stabilization facility and residual disposal facility other than as directed by Regional Council as a consequence of decisions arising out of the ISWMS Review – Final Report dated January 8, 2014 at the Otter Lake Landfill site. Further, to assess the effects of the system changes currently being implemented, returning to Regional Council, with input from the Community Monitoring Committee, no earlier than March, 2019 with a report and recommendation respecting the effectiveness of the front end processor facility and waste stabilization facilities based on system and other changes since conception including diversion outcomes resulting from the changes currently being implemented;

## BACKGROUND

Committee of the Whole deferred deliberation on the following recommendations pending further meetings and discussions with the Halifax Waste Society Board of Directors:

**Deferred Item #7**

> Amend By-law S-600 to allow for the export of ICI Residual Waste (garbage) outside HRM and amend Administration Order No. 16 to provide for an increase in fees for disposal of ICI Residual Waste from $125 per tonne to the assessed system cost of $170 per tonne.

**Deferred Item #8**

> Direct staff to initiate consultation with Mirror Nova Scotia and the Community Monitoring Committee on options for changes in the operating model (front end processor facility, waste stabilization facility, residual disposal facility) at Otter Lake Landfill Site A, returning to Council with a transition plan for landfill operations at the site based on diversion outcomes resulting from the changes outlined in this report.

**Deferred Item #9**

> Extend operations at Otter Lake beyond 2024 and direct staff to increase the vertical height of existing and future cells by 15m and establish an Integrated Solid Waste Management Campus at the site to support new facilities and alternative technologies as they become viable.

## EXECUTIVE SUMMARY

This report and recommendations augments the work done by staff of HRM with respect to the ISWMS system review and provides Committee of the Whole with a recommendations for amendments to deferred recommendations #7, 8 and 9 arising out of (and based on) recommendations resulting from the consultations undertaken with the Halifax Waste Resource Society Board of Directors' representatives on the technical issues and/or impacts arising as a result of recommendations #7, 8 and 9.

Senior staff of the municipality met with a working committee appointed by the Board of Directors of the Society over the past five months. The meetings were co-chaired by Ken Meech, Executive Director of the Society and John Traves, Q.C. Also in attendance have been Councillors Rankin and Adams as members of the CMC working committee as well as Richard Butts, CAO. The discussions have been productive, frank and open.

The working committee has been provided with an opportunity to review a draft of this report and recommendation and the opportunity to have input. The Society has now had an opportunity to meet and its comments are attached as Attachment #1 to this report. Where the working committee and staff have been unable to agree on matters, their position has been noted in this report.

With respect to deferred items #7, 8 and 9, the consultations have primarily focused on the technical feasibility of increasing the vertical height of the existing and future cells. Specifically concerns with respect to environmental impacts off-site and in particular, with respect to odor and/or leachate have been discussed.

The Society's position with respect to the front end processor and waste stabilization facility, was clear from the outset and has not changed – at this point in time the retention of these facilities, notwithstanding the findings of the ISWMS system review and the costs associated with these facilities is a priority for the Society and the community as a whole. The Society does not object to the export of waste as per recommendation #7, subject to certain expectations as are dealt with below.

The proposal to establish an Integrated Solid Waste Management Campus at the site is premature in the Society's view in the absence of specific proposal(s). The Society has however indicated it is not opposed to HRM considering new facilities and alternative technologies being established at the site, subject to its continued right under the Agreement for a Community Monitoring of Solid Waste Facilities for input with respect to any proposed changes to the specifications for the facility and continued right of monitoring the operations of the facilities.

It is recognized that should Council proceed with the recommendations (whether amended or not) there will be an impact on the expected lifespan of the residual disposal facility. In the circumstances it is premature to begin the siting of a new facility.

The Society has advised, as per attachment #1, that in respect to the recommendations contained in this supplementary report: "The society has reviewed the recommendations from staff and has no objection to the proposal subject to our comments, conditions and ongoing participation by CMC in the process."

## DISCUSSION

**Deferred Item #7**

> **Amend By-law S-600 to allow for the export of ICI Residual Waste (garbage) outside HRM and amend Administration Order No. 16 to provide for an increase in fees for disposal of ICI Residual Waste from $125 per tonne to the assessed system cost of $170 per tonne.**

There are no technical issues identified with respect to recommendation #7. The reduction in the amount of ICI Residual Waste (garbage) received at Otter Lake would, in fact, have a positive impact in terms of reducing the amount of waste handled at Otter Lake and the cost to the system which is currently not being fully recovered.

Although outside the scope of its mandate, the Society has indicated an assumption that Halifax Regional Council would conduct a public hearing on the amendment to By-law S-600. It is recognized that such a decision is within the sole discretion of Regional Council.

Having regard to the Society's position and the discussions on this item, staff is not recommending any changes to recommendation #7.

**Deferred Item #9**

> **Extend operations at Otter Lake beyond 2024 and direct staff to increase the vertical height of existing and future cells by 15m and establish an Integrated Solid Waste Management Campus at the site to support new facilities and alternative technologies as they become viable.**

i) Vertical Expansion

The Society indicated at the outset of discussions a desire to be satisfied with respect to the technical feasibility of any vertical expansion. As a consequence, the parties determined early in their discussions that an independent, high level review of the proposed vertical expansion was needed to satisfy these concerns. Conestoga-Rovers & Associates (CRA) was retained by HRM to conduct this work. CRA's report and supporting presentation to the group are consistent with the conclusions as set out in the Stantec report and SNC Lavalin peer review and are attached as Attachment #2 to this report and recommendation. CRA`s conclusions, in summary, are as follows:

1. They found no technical reason to not consider vertical expansion;
2. The proposed overall height and depth of the landfill is within the range of other North American landfills;
3. Vertical expansion can be implemented while maintaining or enhancing all environmental protection and control measures (e.g., esthetics, odour, ground water);
4. Vertically expanding cells 1-5 represents $68M to $85M of capital costs savings versus the development of new cells.

The Society was provided an opportunity to review both the Terms of Reference for CRA and their report. They were further provided an opportunity to meet with CRA to review CRA`s conclusions and satisfy themselves with respect to the work undertaken.

It is recognized that while technically feasible, should Council direct staff to increase the vertical height as recommended, that the Community Monitoring Committee would continue to have a role with respect to implementation. An updated design and operations plan will be required from the Operator and would need to address such items as cell design and sequencing, slope stability, and landfill gas (LFG) management. CRA has recommended that in order to reduce exposure to more recently placed waste (ie to minimize odors) and to minimize differential settlement that the vertical expansion be started in the oldest cells (i.e. number 1 and 2) first. Proceeding with the implementation will result in changes to the technical specifications for the site and it is recognized that as a consequence of the Agreement for Community Monitoring of Solid Waste Facilities the Community Monitoring Committee will have an opportunity for review and input on any new technical specifications.

The operator (Mirror Nova Scotia) has been provided an opportunity to review all reports and has not raised any concerns with the technical feasibility of the vertical expansion as proposed by CRA that would prevent them from preparing an updated design and operations plan needed for implementation or otherwise.

Vertical expansion, as proposed by CRA, has the advantage of progressing in stages such that portions of the residual disposal facility are re-opened progressively starting with only a portion of the oldest cells for the rationale set out above and thereby minimizing the risk of adverse impacts from the operations. This provides further protections to help ensure the operator proceeds in accordance with the updated design and operations plan and all DOE permitting thereby helping with the goal of maintaining or enhancing all environmental protection and control.

ii) Extension of Operations at Otter Lake beyond 2024

At this point in time, the pre-conditions which would require HRM to permanently close the facilities have not occurred and any decisions with respect to the siting of a new landfill are therefore premature.

Due to the success of diversion programs and other changes to the operating model including those resulting from the most recent strategy review, the Otter Lake facility will not reach capacity as a landfill by 2024. As a result of discussions with the Society, staff and the Society have reviewed this matter and despite the expectations that some people have in the community to the contrary, have been unable to locate any authority for the proposition that the Otter Lake facility operations end in 2024.

As set out in the Report, the Mirror Agreement at Section 24.2 only requires HRM to permanently close the facilities at the end of the operating term: a) if it elects to do so, or b) if the facilities have reached capacity and no additional permits can be obtained to permit further waste to be disposed of at the site. It is not now anticipated that the facility would reach capacity or that additional permits could not be obtained until sometime after 2024.

As a consequence, staff concurs with the Society`s view that discussions with respect to the closure of Otter Lake landfill are premature.

iii) Integrated Solid Waste Management Campus

The proposal to establish an Integrated Solid Waste Management Campus at the site is premature in the Society's view in the absence of specific proposal(s). The Society has however indicated it is not opposed to HRM considering new facilities and alternative technologies being established at the site, subject to its continued right under the Agreement for a Community Monitoring of Solid Waste Facilities for input with respect to any proposed changes to the specifications for the facility and continued right of monitoring the operations of the facilities. Currently there are no proposed new facilities or alternative technologies under active consideration. As a consequence of the discussions to date, staff are satisfied that any proposed future changes can be addressed in the context of the existing CMC agreement.

**Deferred Item #8**

> **Direct staff to initiate consultation with Mirror Nova Scotia and the Community Monitoring Committee on options for changes in the operating model (front end processor facility, waste stabilization facility, residual disposal facility) at Otter Lake Landfill Site A, returning to Council with a transition plan for landfill operations at the site based on diversion outcomes resulting from the changes outlined in this report.**

HRM, the Society and the local community are all too well aware of the failures of the Sackville Landfill. The failures at the Sackville Landfill and the decision in 1999 to locate the successor landfill at Otter Lake led to the formation of the Society and HRM's commitment to ensure that operations at the facilities would be monitored by residents of the communities adjacent to Otter Lake as well as by residents of the Regional Municipality at large. Staff recognizes that it is against this backdrop that the current operating model was developed. Notwithstanding the findings of the Review, the community is not yet satisfied that changes in the operating model, diversion outcomes and other changes resulting from amendments to the ISWMS result or will result in the materials disposed of in the residual disposal facility being substantially free of readily putrescible elements.

In consideration of the experience at Otter Lake to date and recognizing that there will be impacts to the operations due to the implementation of the recommended changes as set out in the ISWMS - Final Report (as amended), staff is recommending that recommendation #8 be amended as set out above and that measures be implemented to measure the amount of readily putrescible elements being received at Otter Lake prior to bio-stabilization.

iv <u>Role Clarity and Future Opportunities for Improved Relation</u>

Despite best efforts by all parties, there remains a need for greater role clarity with respect to CMC, HRM and the Operator. The consultations with the Society have resulted in a much better appreciation by staff of the role of CMC under the terms of the Community Monitoring Agreement. Further, these discussions have resulted in the recognition of the need for HRM to take a more active role itself in monitoring the operations and activities at Otter Lake. This has resulted in a decision to hire an owner`s engineer with the anticipation that the owner`s engineer will be able to ensure HRM`s responsibilities are met and that the Society's and HRM's expectations with respect to the operator continue to result in operations that achieve the highest environmental outcomes for the protection of HRM and the community.

## FINANCIAL IMPLICATIONS

As set out in the discussion section above, CRA has provided additional confirmation that vertically expanding cells 1-5 represents $68M to $85M of capital costs savings versus the development of new cells. Some of the savings will be immediate. Since cell development is funded over multiple fiscal years there is an estimated $19 million within the Solid Waste Reserve Q123 for fiscal yearend 2014/15. An additional $6 million contribution for cell development is planned for 2015/16. Some portion of this $25 million in projected savings will be required to offset implementation costs.

## COMMUNITY ENGAGEMENT

See the Report.

## ENVIRONMENTAL IMPLICATIONS

See the Report.

## ALTERNATIVES

1. Committee of the Whole could recommend that Regional Council proceed with the deferred recommendations without amendment (either in part or in whole). The proposed amendments to recommendations 8 and 9 reflect a more cautious and staged implementation of changes at Otter Lake although at some cost to HRM. This approach is no longer recommended based on the reasons as set out in this report.

2. Committee of the Whole could recommend to Regional Council not to pass recommendations #7, 8 or 9 in part or in whole. This is not recommended for the reasons set out in the Report.

## ATTACHMENTS

Attachment #1 – Letter from Solid Waste Society
Attachment #2 – CRA Report - Review and Analysis of Increasing Landfill Cell Height, Otter Lake Facility
Attachment #3 – CRA Presentation

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If the report is released to the public, a copy can be obtained by contacting the Office of the Municipal Clerk at 902.490.4210, or Fax 902.490.4208.

Original Signed

Report Prepared by: ______________________________
John Traves Q.C. Municipal Solicitor 902.490.4226

Financial Approval by: ______________________________
Greg Keefe, Director of Finance & ICT/CFO, 902.490.6308

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Halifax Waste-Resource Society
P.O. Box 213
Lakeside, NS
B3T 1M6

December 3, 2014

John Traves, Q.C.
Director
Legal, Insurance And Risk Management Services
Halifax Regional Municipality
PO Box 1749
Halifax, NS
B3J 3A5

Dear Mr. Traves:

**Re: Solid Waste/Resource Strategy Review**

Please find attached the Halifax Waste-Resource Society's position paper on the January 14, 2014 staff recommendations #7, 8 and 9 with respect to the Otter Lake landfill.

Yours sincerely,

Original Signed

Jack Mitchell,
Chair, HWRS

Cc: Ken Meech, Executive Director, HWRS

# Update on Discussions with HRM on Otter Lake Recommendations

## BACKGROUND AT COMMENCEMENT OF DISCUSSIONS

At the outset of these discussions, there were certain understandings and expectations held by the community, and some held by HRM.

### COMMUNITY UNDERSTANDINGS/EXPECTATIONS:

A. Otter Lake Landfill Facility would close by December 31, 2023;

B. There was a predetermined outcome for the community engagement program;

C. The existing agreement between HRM and the HWRS is based on verifiable trust (confidence in commitments);

D. There is a need for more time to monitor (c) before any willingness to support extending life of landfill; and,

E. HRM will honor the commitment by Council that the environmental and community protection standards remain the same or better.

> **Verifiable Trust**
>
> Trust [trust] noun
> 1.reliance on the integrity, strength, ability, surety, etc., of a person or thing; confidence.

### HRM UNDERSTANDINGS/EXPECTATIONS:

A. Based on the solid waste review, there is an opportunity to reduce operational/capital costs; and,

B. There is an ability to extend the operational life of the landfill and eliminate the need to locate a new replacement facility at considerable cost ($100 million).

## POSITION OF HALIFAX WASTE RESOURCE SOCIETY(HWRS)/COMMUNITY MONITORING COMMITTEE(CMC) FOR INPUT TO HRM COUNCIL

Four joint sessions were held to review and discuss recommendations 7, 8, & 9 in the STAFF REPORT dated JANUARY 14, 2014:

A. With respect to ITEM #7 regarding export the HWRS/CMC has no objection. On behalf of the interests of the wider community we suggest due process as it represents changing a principle of the Community Stakeholder Strategy, and export was not included in the waste management public consultation. Accordingly we recommend an additional public hearing to solicit and hear the views from the wider public.

B. In accordance with the CMC agreement we expect that the FEP/WSF facilities will remain in operation.

C. No detail was presented for our review on the proposed integrated waste management campus. It is not recommended that a campus be created in the absence of an opportunity for the HWRS/CMC to view detail of what may be proposed.

D. We recommend the further exploration of alternative technologies.

Based on this starting point the focus of the meetings has been to explore the implications of **vertical expansion to existing cells at the**

**Residual Waste Disposal Facility (RDF)**.

HRM retained Conestoga-Rovers & Associates to complete a high level technical review of the proposed vertical expansion of the RDF at Otter Lake.

The report has concluded that a vertical cell expansion is **technically possible while still maintaining or enhancing environmental protection and control measures** and that it should begin with cells 1 & 2 and continue through to all existing cells.

In the view of the Society an expansion of the landfill by opening closed cells and building higher upon them presents increased environmental risks, including:

- Increased litter;
- Impacts to the Nine Mile River;
- Increased leachate generation; and,
- Potential for significant odour and noise issues.

The report concludes that **design and operational changes** will be **required** to mitigate the risks and meet the objective of vertical cell expansion. As a minimum the report determined the following should be considered in the vertical expansion design:

- Design and Sequencing
- Slope stability
- Leachate and surface water management
- Landfill system components
- Landfill Gas (LFG) management
- Visual impact

The design changes will necessitate the need to develop a **revised operational plan** covering each of these aforementioned elements.

While the report concludes that a vertical extension is technically feasible it confirms that **operational changes** may be necessary to meet environmental objectives and obligations to the community. This represents a risk that is best mitigated by ensuring that the existing operator and its consultant, who are most familiar with the landfill facility, design any required operational modifications subject to review by HRM and CMC.

As design studies and operational changes are completed, HRM should provide opportunities for the local community to view them and understand them.

One of the key issues for the Society remains the **odour standards/outcome**s. It is expected that the operational plan to be developed will address this specific issue consistent with CRA advice that the vertical extension can be implemented while maintaining or enhancing all environmental and community protection.

The society expects that vertical extension will only proceed in small incremental steps thereby providing the operator, CMC, and HRM the opportunity to bring a halt to the process if unsuccessful. Environmental outcomes will be monitored to ensure compliance.

The society has reviewed the recommendations from staff and has no objection to the proposal subject to our comments, conditions and ongoing participation by CMC in the process.

# Appendix

TECHNICAL REQUIREMENTS AS DETAILED BY HWRS AT COMMENCEMENT OF DISCUSSIONS.

## <u>Otter Lake - Residuals Disposal Facility – Vertical Expansion</u>

With regard to the proposed vertical expansion and the site's current Provincial Approval to Operate, the following two clauses are highlighted:

> *3.p) Pursuant to Section 60 of the Act, the Approval Holder shall submit to the Administrator any new and relevant information respecting any adverse effect that actually results, or may potentially result, from any activity to which the Approval relates and that comes to the attention of the Approval Holder after the issuance of the Approval.*
>
> *3.t) The Approval Holder shall notify the Department prior to any proposed extensions or modifications of the Facility, including the active area, process changes or waste disposal practices which are not granted under this Approval. An amendment to this Approval will be required before implementing any change.*

The Approval to Operate regulates a number of practices and emissions including the following, all of which will need to be dealt with by any change in the RDF cells;

- Air Emissions
- Sound Levels
- Liquid Effluent (Leachate)
- Vector / Litter Control
- Spills or Releases
- Erosion and Sediment Control
- Surface Water Discharge
- Groundwater

### *Topics Needing Review and Assessment Prior to Detailed Design*

### 1) <u>Landfill Cell Development Scope & Sequencing</u>

- What is the most satisfactory height increase and based on what rationale (e.g., is it 15 m versus 10 m, 20 m or some other value?).
- Based on the selected height increase, confirmation of the required fill/long term construction sequence that best deals with vehicle access for waste placement, the original cover and gas collection system, and final cap installation. This evaluation must include selection of a preferred start point (ex., Cell 1 or Cell 6) of the vertical expansion effort.
- closing date and overall fill capacity for the RDF.

### 2) <u>Landfill Stability</u>

- Confirmation that establishing new disposal areas on top of previously completed portions of the landfill will not create issues related to potential sinking of the present ground level of the closed cells and/or side slope failure.

### 3) <u>Area View Planes</u>

- With reference to Dillon's September 2012 conclusion that the top of Cell 5 was visible to area residents, completion of a view plane study to determine the visibility of the RDF during/following vertical expansion including consideration of ongoing/planned area developments.

### 4) <u>Odour Management</u>

- Confirmation of potential odour impacts and approaches for lessoning the potential impact of; a) the removal of the cap system from previously completed cells, and b) excavation/inspection and potential upgrade of the original leachate collection system.
- Identification of a preferred daily/interim cover material to enhance to the control of landfill gas and odours.
- The evaluation of potential odour impacts associated with vertical expansion must acknowledge stipulations included in Section 10 (Air Emissions) of site's Approval to Operate.

### 5) <u>Landfill Gas Management</u>

- Evaluation of landfill gas management needs for the new vertical expansion areas, including connection existing site systems and the potential requirement for new collection and flaring infrastructure.
- Evaluation of potential impacts to surface/sub-surface gas system infrastructure in the closed cells, including buried collection piping.

### 6) <u>Leachate Management</u>

- Confirmation that leachate from the new vertical expansion areas will move down through the closed disposal cells and to the original collection system without flow barriers (including soil cover in Cell 1); blockages; or exceedance of the 300 mm head limit on the RDF liner system.
- Inspection of original cell leachate collection sumps to assess their capability to manage increased quantities of leachate from the new vertical expansion areas. Due to bio-fouling (i.e., material deposits) and design improvements carried out over the years, it is anticipated that some sumps and pumping systems will require excavation and replacement.
- Inspection and possible upgrading of the leachate transmission piping outside of the cells to assess the capability to manage increased quantities of leachate.

### 7) <u>Surface Water Management</u>

- Determining drainage features (including terracing) necessary to accommodate runoff volumes and velocities down extended landfill side slopes.
- Confirmation of upgrade requirements to surface water management infrastructure (e.g., ditching, culverts and ponds) to manage runoff from new vertical expansion areas.

### 8) <u>Litter Management</u>

- Assessment of the adequacy of existing litter management procedures due to the increased elevation/exposure of the working disposal face.

CONESTOGA-ROVERS & ASSOCIATES

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October 8, 2014 Reference No. 088605

Mr. Robert Orr
Coordinator, Collection & Processing
Solid Waste Resources
Transportation & Public Works
Halifax Regional Municipality
orrr@halifax.ca

Dear Mr. Orr:

Re: Review and Analysis of Increasing Landfill Cell Height
Otter Lake Facility, Halifax Regional Municipality, Nova Scotia

## Executive Summary

Conestoga-Rovers & Associates (CRA) was retained by Halifax Regional Municipality (HRM) to complete a high level technical review of the proposed vertical expansion of the Residual Disposal Facility (RDF) located at the Otter Lake Facility (Site). CRA understands that, as part of the Solid Waste Resources Strategy Review, a vertical expansion of the RDF up to a maximum increase of 15 m has been proposed for consideration by HRM.

There is no technical reason to prevent the vertical expansion of the RDF. A vertically expanded RDF will be within the range of waste depths and heights at a number of landfills across North America. To optimize the vertical expansion of the RDF, design and operational changes will be required that address such items as cell design and sequencing, slope stability, and landfill gas (LFG) management. Therefore a revised design and operations plan for the RDF vertical expansion will need to be developed.

A reasonable approach to implement vertical expansion would be to start in Cells 1 and 2, filling from northwest to southeast to final grades and then moving progressively in a southwest direction towards Cell 6. Benefits of this approach include: progressively re-opening portions of the RDF that has older waste and therefore less LFG generation and associated concerns for odours and differential settlement (due to degradation of organics); and easier transition for the Site operator given that Cells 1 and 2 are shallower cells and have a larger footprint when compared to subsequent cells.

From a cost perspective, substantial changes in operational costs are not anticipated, while significant capital costs reductions will be realized through reductions in capital savings on a capital cost per waste tonne basis. As an example, the vertical expansion capacity over Cells 1-5 is approximately 1.8 million to 2.25 million metric tonnes (MT) (based volume calculations completed by Dillon Consulting assuming a density range of 0.8-1.0 MT/cubic metre). This quantity of waste represents the construction of 3.6 to 4.5 new cells (assuming 500,000 MT per cell which is roughly the capacity of Cells 7-9). With the capital cost to develop each cell at roughly $19 million, a vertical expansion in Cells 1-5 represents a $68 to $85 million reduction in capital costs.

## 1.0 Introduction

Conestoga-Rovers & Associates (CRA) was retained by Halifax Regional Municipality (HRM) to complete a high level technical review of the proposed vertical expansion of the Residual Disposal Facility (RDF) located at the Otter Lake Facility (Site). CRA understands that, as part of the Solid Waste Resources Strategy Review, a vertical expansion of the RDF up to a maximum increase of 15 m has been proposed for consideration by HRM. The recommendations are presented and discussed in the following reports:

- Waste Resource Strategy Update (Stantec, 2013)
- A Peer Review of the January 2013 Stantec Report "Waste Resource Strategy Update" (SNC Lavalin, 2013)
- Integrated Solid-Waste Resource Management Strategy Review – Final Report (HRM, 2014)

The Stantec 2013 report concluded that:

- The main benefits for vertical expansion include increasing the RDF capacity by 4.28 million cubic metres and approximately 23-years of capacity, and reducing landfill capital cost substantially on a cost per tonne basis.
- There were no technical issues in expanding the RDF by 10-15 m.
- The vertical expansion should be subject to meaningful stakeholder consultation.

The peer review documented by SNC Lavalin concurred with Stantec's recommendation. SNC Lavalin's 2013 report also documented the findings from a visual impact assessment completed in support of the vertical expansion. The visual assessment utilized six balloons positioned at the proposed maximum elevation in the RDF; and concluded that the balloons were not visible from residential areas visited. SNC Lavalin also noted that increasing the height of the RDF could potentially increase groundwater elevations causing groundwater to come in contact with the cell liner.

Dillon Consulting (Dillon), on behalf of the Site operator Mirror Nova Scotia (Mirror NS), also completed a review of the recommendations with respect to technical, operational, and environmental challenges with vertical expansion of the RDF. Dillon's comments are presented in Memorandums dated September 2012 and May 2013; and are the subject of this review.

CRA's review provides a high level technical review and opinion on components of increasing the height of the RDF for the closed and active cells. Section 2.0 provides an overview of considerations for vertical expansion of the RDF, and Section 3.0 provides CRA's comments on the specific challenges identified by Dillon.

### 1.1 Background

The RDF has approval for nine cells. Cells 1 to 5 have been filled and capped, while Cell 6 is in operation. The RDF blends into the local topography with the final cover design elevation nominally at 113 m AMSL. The base of the landfill also follows the topography resulting in a depth of waste that increases as landfill development is advanced to the southwest. The final depth of refuse at the crest of the landfill ranges from 12 to 27 m based on the original design (Design Drawings Mirror NS, 1998). A 15 m vertical expansion of the RDF would increase the final cover elevation to a nominal elevation of 128 m AMSL and increase the depth of waste at the crest of the landfill to 27 to 42 m, depending on the final design contours.

## 2.0 Increasing Landfill Cell Height Overview

### 2.1 Overview

Landfill design takes into account a number of technical components including site setting (e.g., topography, site size, geologic and hydrogeologic conditions), system components (e.g., leachate, surface water, landfill gas), and operational requirements (e.g., access, waste placement, fill rate, maintenance). The optimal landfill height can be best determined with all of the above considered. The following are several examples of sites that CRA has recently been involved with that demonstrate landfill design solutions that can be applied, as needed, to the RDF to facilitate vertical expansion:

- Lloydminster Waste Disposal Facility (AB): 46 m above grade vertical expansion over existing waste for a total depth of waste of approximately 60 m. Footprint and capacity requirements permitted the use of 4:1 side slopes with terracing for slope stability, site access, and progressive capping.

- Atlantic Waste Facility (BC): 35 m above grade depth of waste. Site size required 3:1 side slopes to accommodate the volume of waste. Textured geomembrane and drainage net with side slope swales were required for slope stability and site maintenance.
- New York State Area Landfill: Approximately 30 m vertical expansion over existing waste for a total depth of waste of 85 m. Horizontal landfill gas (LFG) collection system used at site to facilitate early collection of LFG. As part of vertical expansion, depth of pipe bedding and cover used for horizontal LFG collection pipe increased to minimize the impact of differential settlement on the LFG collection system.

## 2.2 Vertical Expansion of the RDF

The proposed depth of waste at the RDF, including a 15 m vertical expansion, is well within the range of waste depths at a number of landfills, noting the reference sites above. However, to optimize the vertical expansion of the RDF, design and operational changes will be required. At a minimum, the following should be considered in the vertical expansion design:

- Design and sequencing
- Slope stability
- Leachate and surface water management
- Landfill system components
- LFG management
- Visual impact

### 2.2.1 Design and Sequencing

A design and sequencing plan needs to be developed as part of a revised operational plan for the RDF. Design considerations should include, but are not limited to:

- Sizing new cells to accommodate progressive capping thus minimizing operational concerns (e.g., leachate generation, LFG collection).
- Sizing new cells to accommodate landfill operations (e.g., haul roads, safe access and use by site personnel and other entities that require access to the active landfill area).
- Balancing capital and operational costs as well as nuisance factors (e.g., construction mobilization, use of interim cover and temporary LFG collection system, relocation of haul roads, and leachate management).

A practical approach would be to implement vertical expansion starting in Cells 1 and 2 filling from northwest to southeast to final grades and then moving progressively in a southeast direction towards Cell 6. The width of each cell does not necessarily need to be aligned with the current cell limit but rather should be sized to suit operational considerations.

Starting in the northwest end of Cell 1 would:

- Minimize odours generated from previously placed waste: Mirror NS has reported that only small quantities of LFG are generated in older cells, therefore minimizing any potential odour issues from the previously landfilled waste as portions of the final cover are removed.
- Minimize differential settlement: A substantial amount landfill settlement occurs as a result of degradation of organics. The potential for differential settlement in the older cells would be lower given the reported low generation of LFG.
- Cells 1 and 2 are shallower cells and have a larger footprint when compared to subsequent cells, which will allow for an easier transition for the Site operator.
- Realize cost saving from use of existing haul roads and shorter haul distance.

Increasing the height of Cells 7-9 will require a review of the cell layout and modifications to optimize the footprint for each sub-cell, facilitate progressive closure, and minimize leachate generation. Cell 6, which is currently being filled, should continue to be filled and completed with an enhanced interim cover to existing design elevations prior to commencing the vertical expansion. An enhanced interim cover would consist of a minimum 0.3 m low permeable soil completed with 0.15 m vegetative cover. The interim cover would need to be graded to promote drainage and maintained until the vertical expansion progresses to Cell 6.

Existing final cover should be removed to the extent required to accommodate the active fill area. Soil material removed from the existing final cover can be reused in support of landfill operations (e.g., interim or daily cover) or as final cover. Layers stripped below the existing final cover geomembrane should only be reused under the future final cover geomembrane layer (whether to support landfill operations or to be reused in final cover construction). Salvaging of the geomembrane and geotextile materials for reuse as final cover is not practical, however it may be suitable to use the recovered material for temporary uses.

With the progressive removal of final cover, the permanent LFG system that has been installed in the existing cells could be modified[1] to allow for the continued recovery of LFG without extending the vertical LFG wells. While such an approach will reduce the ability to spatially

[1] This could be accomplished by capping the wellhead below the existing waste and by constructing a permanent connection between the wellhead and the sub-header. Control of vacuum applied at each well will be accomplished through a single valve for each sub-header.

control and optimize the quality of LFG collected, it will provide temporary LFG collection until a permanent LFG collection system with new vertical extraction wells is constructed with the placement of final cover (or possibly horizontal LFG collections trenches are installed and operational).

### 2.2.2 Slope Stability

A slope stability analysis will need to be completed in support of vertical expansion to determine the need for design modifications or implementation of slope stability controls. Slope stability concerns are typically readily addressed through the use of slope flattening, terraced slope design, toe of landfill slope armoring with heavy rock, and surface water management controls (e.g., landfill side slope interceptor swales).

### 2.2.3 Leachate and Surface Water Management

Given that the landfill footprint will not increase, the quantity of leachate and surface water to be managed should not increase with vertical expansion and implementation of an optimized cell design and sequencing plan.

Leachate is generated as a result of precipitation infiltration into the waste. In order to minimize leachate generation, the cell design and sequencing plan should include the use of soil berms and/or grading to divert clean surface water from coming in contact with waste, minimize the active face, and encourage surface water runoff from areas completed with final and or interim cover through grading.

Surface water is collected from runoff from areas of the landfill completed with final or interim cover or diverted from the active waste disposal area. Enhanced vegetation on the final and interim cover systems and over bare soil areas around the Site (if any), as well as ditch controls, will reduce erosion and will increase evapotranspiration and infiltration (outside of the lined landfill footprint), reducing the volume of surface water to be managed while improving the quality of the surface water collected.

### 2.2.4 Landfill System Components

The current landfill base liner and leachate collection system are adequate to support a 15 m vertical expansion. The vertical expansion will not adversely impact the performance of the base liner system including the leachate collection piping (150 mm HDPE DR11). The perforated leachate collection pipe is a redundant means of leachate transport should the drainage media clog due to biofouling or other chemical reactions (e.g., calcium).

The final cover over the vertical expansion area may need to be modified to include a stronger geomembrane and side slope swales. If needed, these modifications can be readily incorporated into the final cover over the vertical expansion area.

#### 2.2.5 Landfill Gas Management

There are no technical challenges due to vertical expansion for LFG collection that cannot be readily addressed. A LFG collection system within the vertical expansion area should consider the benefits and drawbacks of both vertical extraction wells and horizontal collection trench components. The advantage of horizontal collection trenches is that they permit nearly immediate collection of LFG from active areas and provide long term collection once the area is closed, however, present operational challenges for waste placement and construction. The use of vertical collection wells only may not be sufficient to adequately control odours, without the addition of temporary wells and/or use of soil based daily cover on a regular basis.

#### 2.2.6 Visual Impact

Based on the visual assessment completed by SNC Lavalin, it does not appear that the proposed vertical expansion will cause a visual impact to the local communities. In the event of any visual concerns, practical options exist to mitigate visual impacts such as the installation of planting beds or visual screening berms on top of the landfill or the side slopes to break-up the skyline view in select areas. Planting beds consist of a topsoil layer sufficiently thick enough (minimum 0.45 m) to allow for the growth of vegetation such as shrubs while not impacting the performance of the landfill final cover. A visual screening berm would consist of a soil berm sized sufficiently based on its purpose and could also be vegetated with shrubs or small trees.

## 3.0 Items Raised by Dillon on Behalf of Mirror NS

### 3.1 The Assessed Potential Lift Capacity and Duration of Operations in Each Cell and Anticipated Duration between Capping Events

A carefully planned and implemented design and sequencing plan would minimize the active area and facilitate the installation of operational controls to minimize leachate generation and facilitate LFG collection. The optimized cell area needs to balance the cost and safety of operations, including waste placement and temporary facilities (daily/interim cover, LFG collection, surface water controls, and haul roads), verses nuisance factors (odour, dust, vector and vermin) and costs for leachate management. At a minimum, the design should accommodate progressive capping and expansion of the LFG collection system. Therefore the duration to fill each cell and duration between capping events should not change substantially from current site practices.

### 3.2 Based on Balloon Study Conducted by SNC Lavalin, Assess the Practical Cell Lift Operation Limits Achievable While Maintaining the Site's Isolation and Visual Impacts

SNC Lavalin completed a visual assessment utilizing six balloons setup at the proposed 15 m vertical expansion elevation of RDF (i.e., 128 m AMSL). The balloons were not visible from nine residential areas visited, however, the balloons and current landfill mound were visible from a bedrock outcrop near the commercial area of the Brunello Estates commercial / residential / golf course (Exist 3, Highway 103). The SNC Lavalin assessment demonstrates that visual impact from the proposed vertical expansion would likely be minimal.

Based on information provide a 15 m vertical expansion is achievable while maintaining the site's limited visual impacts. In the event of any visual concerns, cost effective mitigation measures that could be implemented to break-up the skyline view in select areas include the use of planting beds or visual screening berms on top or along the side slopes of the landfill closest to any receptors. As an example, currently the Waterloo Landfill uses planting beds established with small trees and shrubs on top of the landfill to break-up the skyline view.

### 3.3 Provide Brief Overview of Best Practices for Phased Removal of the Existing Cap in Cells 1 to 5, Corresponding Operational Issues to be Dealt With, and the Degree to which any Salvage of Cap Construction Materials Would/Should be Available for Re-Use

As noted in Section 2.2.1, a reasonable approach would be to implement vertical expansion starting in Cells 1 and 2 filling from northwest to southeast to final grades and then moving progressively in a northwest direction towards Cell 6. Benefits of this approach include: progressively re-opening portions of the RDF that has older waste and therefore less LFG generation and associated concerns for odours and differential settlement (due to degradation of organics); and easier transition for the Site operator given that Cells 1 and 2 are shallower cells and have a larger footprint when compared to subsequent cells.

Existing final cover should only be progressively removed to the extent required to accommodate the active area. As noted in Section 2.2.1, soil material removed from the existing final cover could be reused in support of landfill operations or as final cover. Use of the cover soils in daily operations verses obtaining material from the borrow area would reduce borrow area operations and minimize the effort for stockpile management of the salvaged soils.

With the progressive removal of final cover, the permanent LFG system that has been installed in the existing cells could be modified to allow for the continued recovery of LFG in the older placed waste as the new waste is being landfilled, as noted in Section 2.2.1. Should the existing system become damaged (e.g., due to landfill operations or differential settlement), vertical replacement wells could be installed, as needed, and incorporated in the LFG collection system.

### 3.4 By Comparison to Existing On-Going Active Cell Temporary Gas Management Techniques and Existing Permanent Gas Management Infrastructure, Provide any Envisioned Operational or System Changes in Terms of Methods and Infrastructure for Gas Control During Landfill Operations Related to Cell Lift Activities on Cells as a Result of Extending the Period When Cells Would be Open

It is CRA's understanding that the use of the temporary LFG system was implemented with the development of Cells 1 and 2 as a result of odour issues. The Stantec 2013 report indicates that an un-intended consequence of the Front End Processor (FEP) and Waste Stabilization Facility (WSF) is that LFG is generated earlier in the RDF than in a typical municipal solid waste landfill as a result of the shredding and mixing of organic waste in the FEP/WSF. CRA also understands that a shredded construction and demolition (C&D) material has been used substantially since 2001 as a daily cover.

There are no technical challenges with vertical expansion for LFG collection that cannot be readily addressed. The vertical expansion design needs to meet both the short term and long term LFG collection requirements, while minimizing capital and operational costs. As noted in Section 3.1, a carefully planned and implemented design and sequencing plan would minimize the active area and facilitate the installation of operational controls to minimize leachate generation and facilitate LFG collection. The use of temporary LFG systems is not ideal and the design should minimize the need of temporary systems. CRA understands that temporary LFG collection wells and above grade piping are installed on an annual basis; and as the landfill reaches final contours, the vertical wells are extended with solid risers to form part of the permanent system. While the temporary system is effective at collecting LFG in the short term to address potential odour issues , as designed is inherently labour intensive with the need to manually drain condensate from the collection piping. In addition, the temporary system does not facilitate placement of additional waste while operational, and does not maximize the collection of LFG post closure as the extended wells are not screened in the upper portion of the waste. Vertical expansion design considerations include the use of horizontal LFG collection trenches in conjunction with vertical collection wells, the use of the temporary LFG collections system (modified as necessary) that promotes gravity condensate drainage, and the use of soil based daily cover soils. The use of soil based daily cover would minimize moisture infiltration and as such leachate generation and potentially slow LFG generation.

### 3.5 Cell Access Operational Considerations to Address Access Road Routing and Slopes, Access Road Section on Top of Existing Cells With the Objective of Minimizing Impact to Permanent Gas Management Infrastructure, Potential for Differential Settlement in the Cover, Effect on Leachate Production (if any), and Operational Issues Related to Associated Cells, Firewalls, Cell Walls And Slopes for Cell Lift Construction and Capping

As noted in Section 2.2.1, a reasonable approach would be to implement vertical expansion starting in Cells 1 and 2 filling from northwest to southeast to final grades and then moving progressively in a northwest to southeast direction towards Cell 6. This would allow for the use of the existing roads over the landfill cover to be utilized as haul roads to the active area. A review of the material types and depths should be completed to determine if improvements are required for landfill traffic, to minimize routine maintenance, to ensure the protection of the cover and LFG collection system, and for safety. The improvements may be as simple as adding an aggregate surface course and routine grading or may involve the widening and buildup of the roads (uniformly or specifically where they cross LFG collection piping), ditching to direct surface water runoff, and protection of above grade LFG components. Long term integrity of the final cover geomembrane is of less importance as it will be removed as landfilling advances to the southeast. Haul road construction within the active area would be similar to the current practice.

Haul traffic on top of the landfill may cause an increase in settlement. The settlement will primarily impact LFG collection piping and efforts should be made to minimize crossing of the pipes. As noted above, additional aggregate (or potentially temporary steel plates) may need to be added over the LFG collection pipe to better distribute the load and to protect the infrastructure. Differential settlement in the landfill may require maintenance to promote drainage and maintain the integrity of the final cover. Though vertical expansion will cause differential settlement due to the additional placed waste, other factors play an important role such as placement techniques, waste characteristics, and landfill design and operation.

As noted in Section 2.2.3, in order to minimize leachate generation the cell design and sequencing plan should include the use of soil berms and or grading to divert clean surface water from coming in contact with waste, minimize the active face, and encourage surface water runoff from areas completed with final and/or interim cover through grading. Overall, leachate generation for the Site should not increase as the landfill footprint is not increasing. As the landfill is vertically expanded, lower layers of previously placed waste will consolidate therefore potentially impeding the collection of leachate and contribute to leachate mounding. The presence of fire breaks used in the RDF may compound this issue by limiting the vertical migration of leachate and lateral/vertical migration of LFG. Potentially operational issues could involve an increased number of leachate seeps (prior to final cap placement) and lower LFG recovery. By only removing the final cover from the top of the cell, leachate seeps from the side slopes should not be a concern and will help minimize the generation of new leachate. Currently Mirror NS has reported that no leachate mounding is occurring in the RDF and seeps have been observed with minimal frequency from un-capped portions of the RDF.

There should be no concerns in applying interim cover, fire breaks, or final cover on an adequately designed vertically expanded RDF. Health and safety considerations should be evaluated by completing a slope stability assessment which may result in design modifications or the implementation of controls in support of vertical expansion, in conjunction with operational procedures.

### 3.6 Cell Lift Operations to Increase Cell Usage Could Have Operational Consequences that may Affect Operational Costs, Including:

- Waste placement/sequencing limitations
- Extended use of temporary landfill gas collection systems
- Modification of existing landfill gas infrastructure
- Staged installation and design modification of future landfill gas management infrastructure
- Increased leachate production
- Modified stormwater management provisions (e.g., terraced construction) to accommodate extended landfill side slopes
- Provide reasonable order of magnitude cost assessment of operational changes and compare to individual cell construction and closure costs (40 months; $25 million)

The vertical expansion design and operation needs to balance the cost and safety of operations, including waste placement and temporary facilities (e.g., daily/interim cover, LFG collection, surface water controls, haul roads), verse the nuisance factors (e.g., odour, dust, vector and vermin) and costs for leachate management. At a minimum, the design should accommodate progressive capping and expansion of the LFG collection system. The duration to fill each cell and duration between capping events should not change substantially from current site practices (i.e., filling Cells 1-6). For Cells 7-9, a revised design and sequencing plan should be developed and consider progressive landfill closure thus minimizing operational concerns (e.g., leachate generation, LFG generation).

As discussed in Section 2.2.3, the quantity of leachate and surface water generation should not increase as the landfill footprint will not change with a vertical expansion. In order to minimize leachate generation, the cell design and sequencing plan should include the use of soil berms and/or grading to divert clean surface water from coming in contact with waste, minimize the active face, and encourage surface water runoff from areas completed with final and or interim cover through grading. Enhanced vegetation on the final and interim cover systems and over bare soil areas around the Site (if any), as well as ditch controls, will reduce erosion and will increase evapotranspiration and infiltration (outside of the lined landfill footprint), reducing the volume of surface water to be managed while improving the quality of the surface water collected.

Side slope swales may be required to channel surface water runoff horizontally midway along the side slope. This can readily be incorporated into the final cover design with minimal overall costs and without a decrease in air space available for the disposal of refuse and daily cover. The use of terracing is effective for slope stability and provides ample space for installation of surface water control features, however it reduces landfill air space for waste placement.

As previously noted, a reasonable approach would be to implement vertical expansion starting in Cells 1 and 2 filling from northwest to southeast to final grades and then moving progressively in a northwest to southeast direction towards Cell 6. The width of each cell does not necessarily need to be aligned with the current cell limits and should be sized to suit operational considerations.

A vertical expansion is not expected to increase the overall operational costs at the Site. Minor cost increases are expected for some items but cost reductions can also be realized. Several examples include (assuming vertical expansion progresses as described):

- Removal and management of salvaged cover material will increase operational costs, however, the use of the salvaged material in the daily operations will reduce costs to supply temporary cover soils from the borrow area and will allow the clean borrow supply for final cover works.

- Increased operational costs to modify the existing permanent LFG system (i.e., capping each well head) and install horizontal LFG collection trenches, however, the use of the temporary LFG system will no longer be needed (resulting in operational cost savings). Overall, the operation of the LFG collection system should not increase on a cost per tonne/basis.
- Landfill Access Roads: Construction of the total length of access road will be deferred resulting in a decrease cost for winter maintenance (e.g., snow removal, sanding), road side ditch maintenance (e.g., ditch cleaning, grass cutting), and grading and aggregate for road maintenance/improvements. This will be offset by increases in cost for improving roads to accommodate truck traffic and to protect the LFG collection system.
- Shorter haul time to the active face will reduce cost (less time and less fuel). When filling in Cells 1 and 2 the travel distance per load is reduce by at least 1 km round trip as compared to filling Cell 7.
- Cost to manage windblown litter may increase due to fill height relative to surrounding areas.

Overall, any increases in operational cost, if any, will be substantially lower than capital cost savings association with the construction and closure of new cells at the RDF (i.e., on a cost per waste tonnage basis). In addition, annual capital savings set aside for new cell construction will be greatly reduced given that new cells will not be required for an extended period of time (i.e., > 15 years).

### 3.7 Assess the Potential that Conducting Cell Lift Operations Could Increase the Bearing Pressure of the Cells on the Soil/Bedrock Below to such an Extent to Impact Groundwater Elevations Under the Liner

CRA understands that the geology underlying the base liner at the RDF consists of a thin layer of overburden over bedrock. As part of a revised design plan a geotechnical assessment should be completed to ensure that the integrity of the base liner system is not adversely affected due to differential settlement in the underlying native soils and bedrock as a result of vertical expansion and corresponding increase in landfill bearing pressure. It is not anticipated that this will be a concern due to the depth of overburden, nor is it expected that this would result in an increase groundwater elevations beneath or surrounding the cells.

### 3.8 Assess the Potential Impact of Cell Operations Improving the in Place Density of the Compacted Waste, and the Additional Capacity Realization of this Added Compaction

The vertical expansion will result in further consolidation of previously placed waste in the RDF. This net gain in landfill air space realized from the consolidation of adequately placed waste (modern landfilling practices typically result in an in-place waste density in the range of 0.8-1 MT/$m^3$) however, is minimal (potentially 5 percent), when compared to net gain in air space due to degradation (potentially 20-30 percent depending on the waste characteristics).

### 3.9 Assess the Potential Impact of any Cell Density Increase on the Liner System Itself; Including the Leak Detection Layer, Leachate Collection Layer, and Overall Environmental Protective Resilience

The current landfill base liner and leachate collection system are adequate to support a 15 m vertical expansion. The vertical expansion will not adversely impact the performance of the base liner system including the leachate collection piping (150 mm HDPE DR11). It is noted that the perforated pipe is a redundant means of leachate transport should the drainage media clog due to biofouling or other chemical restrictions (e.g., calcium).

## 4.0 Conclusion

There is no technical reason to prevent the vertical expansion of the RDF. A vertically expanded RDF will be within the range of waste depths and heights at a number of landfills across North America. To optimize the vertical expansion of the RDF, design and operational changes will be required that address such items as cell design and sequencing, slope stability, and landfill gas (LFG) management. Therefore a revised design and operations plan for the RDF vertical expansion will need to be developed.

A reasonable approach to implement vertical expansion would be to start in Cells 1 and 2, filling from northwest to southeast to final grades and then moving progressively in a southwest direction towards Cell 6. Benefits of this approach include: progressively re-opening portions of the RDF that has older waste and therefore less LFG generation and associated concerns for odours and differential settlement (due to degradation of organics); and easier transition for the Site operator given that Cells 1 and 2 are shallower cells and have a larger footprint when compared to subsequent cells.

From a cost perspective, substantial changes in operational costs are not anticipated, while significant capital costs reductions will be realized through reductions in capital savings and on a capital cost per waste tonne basis.

We trust that this technical evaluation provides the relevant information required by HRM regarding the proposed vertical expansion of the RDF. Should you have any questions please do not hesitate to contact us.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

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Encl.

# Increasing Landfill Cell Height Otter Lake Facility – Technical Review

Conestoga-Rovers & Associates

November 21, 2014



## Cell Height Increase – Scope

- To provide a high level independent review of the proposed vertical expansion
- Address a list of technical, operational, and environmental concerns raised by Mirror NS
- Approach:
  - Site Visit
  - Provide background information
  - Internal CRA brainstorming sessions

## Cell Height Increase - Findings

- No technical reason to not consider vertical expansion
- Proposed overall height and depth of landfill within range of other North American landfills
- Vertical expansion can be implemented while maintaining all environmental protection and controls (e.g., aesthetics, odour, groundwater)
- Vertically expanded Cells 1-5 represents $68 to $85 million capital cost savings versus development of new cells



## Cell Height Increase - Implementation

- Revised Design & Operations Plan is needed to address such items as:
  - Cell Design and Sequencing
  - Slope Stability
  - Landfill Gas (LFG) Management
- Starting vertical expansion in oldest cells (i.e., 1 & 2) would provide the following benefits:
  - Reduce exposure to more recently placed waste (less odours)
  - Minimize differential settlement