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A PEER REVIEW OF THE JANUARY 2013 STANTEC REPORT "WASTE RESOURCE STRATEGY UPDATE"

Halifax Regional Municipality - Solid Waste Resources

ENVIRONMENT

17 | April | 13

REPORT
Rev. C04 > Internal ref. 511766-0001-T-EN-REP-0002

A Peer Review of the January 2013 Stantec Report
"Waste Resource Strategy Update"

Version 1.0

<u>Prepared for:</u>

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April 2013

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April 17, 2013

Halifax Regional Municipality
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Attention: Barry Nickerson, P. Eng.
Waste Resources Engineer

Dear Mr. Nickerson:

RE: Peer Review of January 2013 Stantec Report for HRM titled "Waste Resource Strategy Update"

Please accept this as our Peer Review document of the January 2013 "Waste Resource Strategy Update" by Stantec Inc. for the Halifax Regional Municipality (HRM), in response to the August 2012 HRM Request For Proposal (RFP) #12-061 (HRM Solid Waste Resource Strategy System Review, Performance Assessment and Options Analysis).

This document was prepared with contributions from David Haley, Norman Gridley, and other project team members. Please feel free to contact the undersigned about this document at your convenience.

Yours truly,

SNC♦LAVALIN ENVIRONMENT

Cameron Ells, P.Eng.
Regional Director, Atlantic

CE/ap

511766-0001-T-EN-REP-0002, Revision C04

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EXECUTIVE SUMMARY

HRM Council asked HRM staff to have some cost effective, environmentally sustainable options identified for an evolving HRM solid waste resource management strategy.

Stantec was awarded a contract, based on an HRM Request for Proposals (RFP) that resulted in their January 2013 "Waste Resource Strategy Update Report." SNC-Lavalin was later awarded a contract, based on another HRM RFP to prepare a peer review of the Stantec report.

In this peer review project for the Halifax Regional Municipality (HRM), the intent was to include "a comprehensive assessment of the analysis, advice, options, conclusions and recommendation as provided in the report for Section 3.0 Otter Lake Waste Processing and Disposal Facility, and Section 4.0 Landfill Design."

We believe that the HRM system can continue to achieve its environmental performance goals in a more cost effective manner (e.g. implementing option A1 to close the FEP / WSF and A3 to increase the maximum landfill cell elevation for the RDF). For a 21st century stream of wastes intended for the RDF landfill cells, the system requirements for the cost effective and environmentally sustainable separation of materials (e.g. white goods, household hazardous materials, recyclable materials, organic materials having the readily volatile, leachable, and biodegradable potential), could be achieved by other means, processes, and methods within the HRM solid waste management system, than those of the current FEP and WSF infrastructure.

In preparing this Peer Review report, SNC-Lavalin:

- reviewed documents provided by HRM, including the 1997 Operations Plan,
- reviewed the 1995 CSC Strategy - "accepted in its principles" by HRM Council in 1996,
- reviewed applicable legislative and regulatory documents,
- met regularly with HRM staff on this project (e.g. Jan 3, 10, 16, and 17, 2013),
- visited the Otter Lake facility on January 10, 2013,
- reviewed the January 2013 Stantec report,
- focussed on Sections 3 and 4 of the Stantec Report, after consulting with HRM staff,
- considered Options - Community Engagement - HRM Council decision making process,
- considered and described additional performance, financial, and technical information,
- described our varying support for potential options recommended in the Stantec report,
- described our varying support for the conclusions presented in the Stantec report,
- described financial review of some options recommended in Stantec report,
- described additional waste stream laboratory sample results and interpretations,
- described Balloon Study for observing balloons above RDF, from various view planes, and
- conducted the peer review tests sought by HRM in the December 7, 2012 RFP.

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It is understood that HRM is starting a 2013 Community Engagement process. This would help HRM Council establish the social and community boundaries for the HRM Integrated Solid Waste Resource Management program for many years to come. In doing so, HRM will seek the most effective means to achieve the desired environmental performance goals. This may involve considering some of the menu of options presented in the Stantec report. In deciding which options to apply, decision makers may choose to seek what we have indicated as additional information. This summarizes our peer review of the major recommendations.

We support the following recommendations, whose concepts and details, with the indicated additional information, merit serious consideration by the final decision makers:

A1 – Closure of FEP and WSF by the end of 2013

- We support this recommendation because the FEP and WSF have never operated as originally envisioned.

A3 – Extend Life of Otter Lake (RDF) Landfill through Vertical Expansion

- This a proven engineering best practice. Concerns associated with view-planes have been considered during a supplemental assessment.

We expect that with more information, we would agree with these recommendations:

A2 – Request Modification of the Nova Scotia Landfill Liner Specification

- A site-specific risk assessment could be used to prepare a different site specific design that would also achieve the environmental performance goals.

We expect that with more information, we would support these recommended options; the concepts can be supported in principle, as meriting further consideration by decision makers; but we currently lack sufficient information to completely agree or disagree with the following:

B1 – Create a Centralized Waste Resource Campus

B2 – Relocation of MRF to (a centralized) Campus

B3 – Increase Organics Processing Capacity (add an anaerobic digestion capacity to the system)

- The requirement for Recommendation B3 is directly linked to the current policies related to the management of ICI organics, including the HRM By-law restricting cross boundary waste/resource transport.
- Additional analysis is required on the cost / benefit of anaerobic digestion.

C1 – Improve Recovery of Recyclables and Organics:

- We agree with the recommendation as an overall goal,
- We expect that with more information, we would agree with the recommendation to eventually move to collecting a single stream of recyclables at the curbside, due to the collection system efficiencies, and
- We lack sufficient information to either agree or disagree with many of the suggestions put forward in support of this recommended goal.

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C2 – Control Curing and Sale of Finished Compost:

- We expect that with more information, we would disagree with the recommendation (of having HRM operate a new secondary curing area).

C3 – Improve Curbside Collection Frequency:

- We expect that with more modelling information, we would disagree with the recommendation to reduce the number of collection zones, and
- We disagree with the recommendation for doubling the year round collection frequency of the current residential green bin food organic waste stream to a weekly basis.

Based on our review, we believe that the Stantec report provides a wide range of options with which HRM can commence a Community Engagement process in 2013. Recognizing the fundamental importance of the 1995 CSC Strategy and the 1997 HRM Operations Plan in creating the basis of the waste management system now in place, it will be helpful for HRM to start this process with the same underlying principles of maximizing waste diversion, meeting current regulations and standards, and ensuring a cost effective system is in place to serve residents and businesses for the long term.

In our review, we commented on each conclusion and provided a brief discussion. Of the twelve Conclusions in Section 12 of the Stantec report:

- We agreed with Conclusions 1, 2, 3, 4, 5, 6, 7, and 10,
- We somewhat agree with Conclusions 11 and 12, and
- We somewhat disagreed with Conclusions 8, and 9.

An interesting item in the next version or evolution of the HRM waste and resource management strategy will be with respect to a better source separation of the various ICI waste stream components.

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Additional Information

Our February 27, 2013 Balloon Study involved six 600 mm diameter helium filled balloons at the proposed new maximum height for the cells. The topography map figure attached to this document indicates various places where we tested the view planes with respect to the Otter Lake cells. Aside from the bedrock outcrop in the anticipated commercial portion of the Brunello Estates development, we are confident that the increase in height of the landfill cells will not be visible from the other locations visited.

Waste stream samples from the FEP and WSF were taken and analysed to investigate their relative volatilization and leachate potentials. The relative differences were such that we believe the existing gas management and leachate systems have sufficient capacity to continue meeting the groundwater and air quality performance goals for the HRM solid waste system.

Developing the WSF and 2002 "ad-hoc" gas management system capacities, was a response to the more rapid, short term release of high concentration gas from RDF landfill cell destined wastes receiving added mechanical and thermal energy at the FEP / WSF. Without the FEP / WSF, the gas releases to be managed would be expected to be slower, at a lower concentration, and for a longer period of time. This is why be believe the current gas management systems will have more than enough capacity to achieve the HRM community odour incident performance goal of zero incidents per year. If other means, processes, and methods are used to replace what the FEP / WSF was intended to achieve, in a cost effective and environmentally sustainable manner, a reduction can be reasonably anticipated in the annual $750,000 cost to HRM for the "ad hoc" gas management system at the RDF that has been operating since 2002. An unintended consequence of the original FEP / WSF operations would appear to be a contribution to the more rapid, short term, release of the high concentration mass of gas that was responded to by the "ad-hoc" gas management system at the RDF landfill cells since 2002. Aside from the fall of 2011, there have not been very many reported community odour incidents due to the Otter Lake FEP / WSF / RDF activities since 2002. This includes the May – December 2010 seven month period when the WSF was not operating.

The current Otter Lake facility environmental performance goals are based on:

- Minimized average number of annually reported community odour incidents (i.e. Zero),
- Air quality parameters and values indentified in the current Operating Permit, and
- Groundwater and storm water runoff quality parameters and values presented in the annual environmental monitoring report.

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Some highlights from our financial review are summarized in the following:

Financial Review: Relative Change in RDF Material Density if FEP and WSF are closed	
+5 %	Increased volume (decreased density) due to unshredded material +20 % volume for unshredded versus shredded materials <25 % of total 2011 material in RDF was shredded material from WSF (HRM: Section 3.2 graphic incorrect in report. FEP to RDF is unshredded.)
+1 %	Increased volume due to contingency for daily cover materials in response to potential change in odour incident responses
->10 %	Decreased volume (increased density) of unshredded material in RDF from increased mechanical compaction efforts (within manufacturer's range)
< 0 %	No net increase in volume, where change in compaction effort is more significant than the density change from 100% unshredded RDF material.

Financial Review: Reductions to HRM Solid Waste Budget if FEP and WSF are closed	
$7.2 M/year	Front End Processing (FEP) Unit annual operations budget
$1.7 M/year	Waste Stabilization Facility (WSF) annual operations budget
$1.8 M/year	FEP / WSF capital cost and repair budget
$0 / year	No change in cost to repurpose or decommission if done 10 years early
$0 / year	No change in salvage value for FEP / WSF if done 10 years early
$10.7 M/yr	Cumulative reduction to HRM budget if FEP / WSF are closed

Financial Review: Additions to HRM Solid Waste Budget if FEP and WSF are closed	
$100 K/year	Residual Disposal Facility (RDF) additional labour
$100 K/year	RDF area additional annual access road improvements and relocations
$0 /year	RDF infrastructure charge due to change in material density and volume
$100 K/year	RDF area addition to annual mechanical equipment compaction effort
$0 /year	RDF Gas Management Resources change in infrastructure and operations
$0 /year	RDF change in annual odour incident responses, and leachate collection, transportation and treatment budget
$300 K/year	White Goods Program (additional resources)
$150 K/year	Household Hazardous Waste Program (additional resources)
$100 K/year	RDF area additional mechanical compaction efforts and equipment
$100 K/year	Scale house and associated functions salvaged from FEP budget
$950 K/yr	Cumulative additions to HRM budget if FEP / WSF are closed

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Implementing Options A1 and A3 – Financial Results

We have presented a summary of these considerations as tables. The net financial influence on the annual HRM Solid Waste Budget from closing the FEP and WSF is anticipated to be:

- between $9,000,000 – 10,000,000 per year based on FEP / WSF capital and operations, and downstream responses to achieve certain tasks by other means, and
- a potentially substantial reduction in the $750,000 per year budget, for the continued use of the short term "ad hoc" landfill gas control and management system at the RDF.

If it is decided to implement the A1 option on closing the FEP and WSF, there are some financial implications for the HRM solid waste system. They include:

- If filling Cells 6 – 9, to the current design height were to occur over a 15 year period (~11 years x 10/7.5 x $10,000,000), the financial implication for the HRM system could be around $150,000,000.
- If filling Cells 1 – 5 to the proposed additional 15 metres was accomplished over at least 12.5 years; and filling Cells 6 – 9 to the proposed additional 15 metres was accomplished over at least 11 years, the financial implication for the HRM system could be around $230,000,000, as a present worth value.
- 38.5 year fill time = 15+11 (Cells 6-9 current plus 15 m) +12.5 (Cells 1–5 plus 15 m)

If it is decided to implement the A3 option on increasing the landfill cell height, there are some financial implications for the HRM solid waste system. They include:

- If the cost for a new cell is about $15,000,000 to construct, or $25,000,000 for construction and closing, and with the current maximum height an additional cell is constructed about every three years,
- Assuming the cell closure costs would be the same, regardless of the final height, the financial value for the HRM system of increasing the RDF landfill cell heights would be at least $100,000,000 (7 x $15,000,000 > $100,000,000) if not significantly more, based on the seven additional cell liners that did not have to be constructed.

If it is decided to implement both the A1 option on closing the FEP and WSF, and the A3 option on increasing the cell heights:

- The cumulative financial effect of taking an FEP / WSF decision, and an increase in landfill height decision could be on the order of at least $480,000,000 over almost forty (40) years.
- If the current HRM system budget could accomplish the same goals for about $12,000,000 less per year (i.e. $12,000,000 = $480,000,000/40 years), that could reduce the average $170/tonne RDF cost to HRM, to something less than $100/tonne.

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Summary of Peer Review Test Results for Options A1, A2 and A3

We have also prepared a tabulated summary of the results we found in applying tests A, B, and C, to recommendations A1, A2, and A3 in sections 3 and 4 of the January 2013 report, with respect to the methodology and validity of recommendation derivation presented.

Providing a greater focus of our peer review evaluation on the A1, A2, and A3 recommendations in Sections 3 and 4 of the Stantec report reflects our contracted scope of work. The same table was not produced with respect to the B or C group of Stantec recommended options for HRM.

Recommendation A1 - Closure of the FEP (Front End Processing unit) and WSF (Waste Stabilization Facility) by the end of 2013		
Refer to our Section 11.1.5 Methodology of Recommendation Derivation in Stantec Section 3. Refer to our Section 11.1.6 Validity of Recommendation Derivation in Stantec Section 3.		
Test A – System Performance	for Methodology	Yes - Partially
Test A – System Performance	for Validity	Yes - Partially
Test B – Benchmark Analysis and Best Practice	for Methodology	Not comparable
Test B – Benchmark Analysis and Best Practice	for Validity	Not comparable
Test C – Options Analysis and Recommendations	for Methodology	Yes - Partially
Test C – Options Analysis and Recommendations	for Validity	No
Recommendation A2 – Request Modification of the Nova Scotia Landfill Liner Specification		
Refer to our Section 11.2.1.1 Methodology of Recommendation Derivation in Stantec Sec. 4.1. Refer to our Section 11.2.1.2 Validity of Recommendation Derivation in Stantec Section 4.1.		
Test A – System Performance	for Methodology	With more info. - Yes
Test A – System Performance	for Validity	With more info. - Yes
Test B – Benchmark Analysis and Best Practice	for Methodology	Yes
Test B – Benchmark Analysis and Best Practice	for Validity	With more info. - Yes
Test C – Options Analysis and Recommendations	for Methodology	With more info. - Yes
Test C – Options Analysis and Recommendations	for Validity	No
Recommendation A3 – Extend Life of Otter Lake Landfill through Vertical Expansion		
Refer to our Section 11.2.2.1 Methodology of Recommendation Derivation in Stantec Sec. 4.2. Refer to our Section 11.2.2.2 Validity of Recommendation Derivation in Stantec Section 4.2.		
Test A – System Performance	for Methodology	Not applicable
Test A – System Performance	for Validity	Yes
Test B – Benchmark Analysis and Best Practice	for Methodology	Yes
Test B – Benchmark Analysis and Best Practice	for Validity	No
Test C – Options Analysis and Recommendations	for Methodology	Yes
Test C – Options Analysis and Recommendations	for Validity	Yes

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1. INTRODUCTION

1.1. PEER REVIEW GOALS, METHODOLOGY, AND CONTEXT

In this peer review project for the Halifax Regional Municipality (HRM), the intent was to include "a comprehensive assessment of the analysis, advice, options, conclusions and recommendation as provided in the report for Section 3.0 Otter Lake Waste Processing and Disposal Facility, and Section 4.0 Landfill Design."

In following the methodology described in our proposal, we met with HRM staff; visited the Otter Lake facility; reviewed documentation provided electronically by HRM, including files on a Stantec FTP site; tested the recommendations in Stantec Report Sections 3 and 4, and to a lesser degree those in other sections; sought additional information, and prepared our report.

The evolution of the HRM solid waste resource management program included:

- 1995 Community Stakeholder Committee (CSC) "An Integrated Waste Resource Management Strategy"
- 1996 HRM Council motion which had the 1995 CSC Strategy "accepted in its principles"
- 1997 HRM Operations Plan for the Otter Lake facility
- 2002 start of the "ad hoc" gas management system at the RDF landfill cell
- 2013 Stantec report for HRM "Waste Resource Strategy Update Report"

HRM Council asked HRM staff to have some cost effective, environmentally sustainable options identified for an evolving HRM solid waste resource management strategy.

Stantec was awarded a contract, based on an HRM Request for Proposals (RFP) that resulted in their January 2013 "Waste Resource Strategy Update Report." SNC-Lavalin was later awarded a contract, based on another HRM RFP to prepare a peer review of the Stantec report.

The Stantec mandate was described as a high level review and identification of potential options for achieving the HRM solid waste resource management system performance goals in a more cost effective, but still environmentally sustainable manner. Stantec was asked to look at the integrated HRM system as a whole; exemplified by the 1997 HRM Operations Plan for the Otter Lake facility. One response was the "campus" concept in their report, where various components of the HRM system might function more efficiently, if they were in closer proximity, yet still function in an environmentally sustainable manner. The options recommended by Stantec in their report appear as a menu of individual options. As a high level document, these options can start a discussion where additional information is considered; where the 2013 Community Engagement process provides some feedback; and where the HRM Council will make the final decisions about an evolving HRM system (e.g. which options; and in what form).

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This SNC-Lavalin peer review report presents:

- An Executive Summary,
- Information on our contracted scope of work for HRM,
- Our comments with respect to supporting – or not - the major options Stantec recommended and their conclusions; with respect to the merits of each major option they recommend; and for that option continuing to be in an ongoing process involving further considerations, additional information, community engagement, and HRM Council decision making,
- Our discussions on technical items of interest to HRM, and some of our additional performance, financial and technical information with respect to the Stantec options A1 on closing the FEP / WSF (e.g. Waste Sample Investigation; and Financial Review), and option A3 on increasing the maximum height elevation for the Otter Lake residual disposal facility (RDF) landfill cell (e.g. Balloon Study), and
- Our peer review of the process being demonstrated in the Stantec report, with respect to tests sought by HRM (i.e. Test A - System Performance Assessment, Test B - Industry Bench Mark Analysis and Best Practices, and Test C – Options Analysis and Recommendations) and the methodology used in identifying the major option, and to testing their validity. The results of our validity testing of an option being recommended by Stantec, is not of itself an endorsement or a criticism.

In preparing this Peer Review report, SNC-Lavalin:

- reviewed documents provided by HRM, including the 1997 Operations Plan,
- reviewed the 1995 CSC Strategy "adopted in principles" for use by HRM Council in 1996,
- reviewed applicable legislative and regulatory documents,
- met regularly with HRM staff on this project (e.g. Jan 3, 10, 16, and 17, 2013),
- visited the Otter Lake facility on January 10, 2013,
- reviewed the January 2013 Stantec report,
- focussed on Sections 3 and 4 of the Stantec Report, after consulting with HRM staff,
- considered Options - Community Engagement - HRM Council decision making process,
- considered and described additional performance, financial, and technical information,
- described our varying support for potential options recommended in the Stantec report,
- described our varying support for the conclusions presented in the Stantec report,
- described financial review of some options recommended in Stantec report,
- described additional waste stream laboratory sample results and interpretations,
- described Balloon Study for observing balloons above RDF, from various view planes, and
- conducted the peer review tests sought by HRM in the December 7, 2012 RFP.

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1.2. CONTRACT AND PROJECT DOCUMENTS

The most relevant documents associated with this Peer Review project are:

- HRM RFP December 7, 2012;
- SNC-Lavalin proposal December 18, 2012;
- January 2013 "Waste Resource Strategy Update Report" by Stantec Inc.;
- August 2012 HRM Request For Proposal (RFP) #12-061 (HRM Solid Waste Resource Strategy System Review, Performance Assessment and Options Analysis);
- other relevant files provided by HRM, and on a temporary Stantec FTP site;
- the 1995 CSC Strategy as adopted "in its principles" by HRM Council in 1996;
- the 1997 HRM Operations Plan for the Otter Lake facility with Mirror; and
- applicable legislative and regulatory documents.

1.3. PROJECT MEETINGS AND SITE VISIT

In preparing this Peer Review report, we met with HRM staff at four scheduled times (Jan 3, 10, 16, and 17, 2013), and visited the Otter Lake facility on January 10, 2013. We also met with HRM representatives afterwards, which were more impromptu or at short notice.

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2. DOCUMENT REVIEW

The documents reviewed and referred to most often during this project included:

- The 132 page HRM RFP #12-061 (August 2012);
- The 187 page January 2013 Stantec report (Waste Resource Strategy Update Report);
- The 1995 Community Stakeholder Committee document "in its principles" adopted for use by HRM Council in February 1996 (An Integrated Waste Resource Management Strategy for Halifax County / Halifax / Dartmouth / Bedford); and
- The 1997 HRM Operations Plan for the Otter Lake facility, which presents the commitments and desired outcomes, and which deviate considerably from some items in the 1995 CSC Strategy.

The HRM Waste Strategy Reference Document list provided by HRM included:

- 5-year breakdown of organic tonnages (both commercial and residential).
- Diagram of Otter Lake Cell #6 liner in comparison to US EPA Subtitle D Liner System.
- Dillion Density Memo 2011
- Dillion-Otter Lake-RDF Elevation Change Impacts
- Historic Operating Cost Review and Tonnage for Otter Lake.
- CCME Composting Guidelines (2005)
- HRM Collection Contract (2008). Includes costing for collection in the 8 areas of HRM.
- HRM Number of Collection Services Areas from 2008-2011.
- HRM Solid Waste Characterization Study (2003) by SNC-Lavalin.
- HRM Solid Waste Characterization Study (2009) by SNC-Lavalin.
- HRM Solid Waste Characterization Study (2010) by SNC-Lavalin.
- HRM Solid Waste Characterization Study (May, 2004) by SNC-Lavalin.
- HRM Solid Waste Strategy Transportation October 11, 2012
- Lab results from composting samples taken from the Miller Composting Plant, New Era Plant and the Elmsdale curing area
- Materials Recovery Facility Operation Agreement between HRM and Miller.
- Miller 2011 Annual Report
- Municipal Solid Waste Conversion Technology: Waste Characterization Study (prepared by CBCL). (2011)
- New Era 2011 Annual Report
- Nova Scotia Composting Guidelines 2006
- Nova Scotia Municipal Waste Diversion Calculations and Per Capital Disposal.
- NS Municipal Solid Waste Landfill Design Guidelines.
- Otter Lake Cell 6 Final Budget
- Otter Lake RDF 2011 Annual Report April 2012
- Provincially Banned Materials

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- Q123 Construction Reserve. Summary of total funding and balance for Otter Lake.
- Refuse Tonnage: Summary of total waste tonnage for HRM from 1999/2000 to 2011/2012.
- Revised Regional Solid Waste/Resource Management Plan Framework (1996).
- RFP for the Operation of the MRF (2008).
- RFP for the Operation of the MRF Addenda's 1&2 (2008).
- Solid Waste Tonnage Reports 2001 to 2011.
- Summary of collection costs (curbside and condo) for 2008-2011.
- Summary of residential tonnages (all streams).
- HRM Solid Waste Resource Collection and Disposal By-Law.
- Summary of MRF tonnages from 1997 to 2012.
- Summary of materials recovered at the MRF (in terms of sales) from 2005 to 2012.
- Table of Expenditures & Revenues and Net Costs per Tonne for the MRF.
- Table of Monthly Tonnages and Market Price of Recyclable Materials.
- Tip Fees History. Tipping fees for HRM's previous transfer station, the landfill, and organics from 1990 to 2010.
- Integrated Resource Management Strategy (CSC1995).
- Tonnages of Waste Received at Otter Lake from 2006-2011.
- Types of materials processed at the MRF. A comparison of 1992, 2007/2008, and 2011.
- Waste Management 2012 Municipal Tipping Fee Survey
- Waste Resource System Mass Balance for residential and commercial waste from 2007-2011
- Waste Resource System Mass Balance for total waste from 2006-2010.
- Weekly Organics Collections Council Reports

Regulatory and legislative documents that were reviewed included:

- HRM By-Law S-600 "Solid Waste Resource Collection and Disposal By-Law"
- Nova Scotia Composting Guidelines 2006
- NS Municipal Solid Waste Landfill Design Guidelines
- Nova Scotia Environment Act
- Nova Scotia Environmental Goals and Sustainable Prosperity Act (EGSPA)
- CCME Guidelines for Compost Quality (2005)

Additional documents were also provided by HRM during our review. Examples include:

- Otter Lake WSF Materials Characterization and Testing (Dec 2012 – Jan 2013)
- February 16, 1999 Agreement for Community Monitoring of Solid Waste Facilities

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3. LEGISLATIVE, REGULATORY AND INFORMATION REVIEW

3.1. HALIFAX REGIONAL MUNICIPALITY (HRM)

We expect that in years to come, there will be no change to Section 16.3 of the HRM By-Law S-600 "Solid Waste Resource Collection and Disposal By-Law". Under this section, no person shall export or remove solid waste outside of HRM, that has been generated inside of HRM. The industrial, commercial, institutional (ICI) tipping fee revenues support a significant component of the HRM program. General tax revenue supports the residential portion. The incentive ratio of the ICI waste tip fee being greater than the ICI organic tip fee supports the ICI program. If ICI waste and revenues leave HRM, so would their associated financial support for the current program, or similar one

The underlying principle of stewardship, in the 1995 CSC Strategy, and in the 1997 Operations Plan, will continue to underpin the integrated Waste Resource Management System of HRM as it evolves, the community engagement process, and the decision making of the HRM Council.

3.2. PROVINCE OF NOVA SCOTIA (NS)

We do not expect that the integrated HRM solid waste / resource system in the years to come will be influenced by reasonably anticipated changes to these provincial documents:

- The NS Environmental Goals and Sustainable Prosperity Act (EGSPA) which includes the 300 kg/person goal of residential and ICI waste going to a landfill
- The NS Environment Act, whose 2011 amendments includes increasing to ten years from five years, the time between which regular reviews and amendments occur
- The NS Solid Waste Resource Management Regulations - Schedule B - which bans compostable organic material from landfills, and the landfill design guidelines, and
- The Halifax Regional Municipality Charter

3.3. OTHER DOCUMENTS

The 2005 CCME Guidelines for Compost Quality (PN 1340) are among the environmental performance goals for the HRM program. These guidelines discuss measurable recommended targets for several parameters including: relative temperature difference to ambient air, curing time, oxygen respiration rate, carbon dioxide evolution rate, temperature duration (due to pathogens), PAH, PCB, pesticides, herbicides, fecal coliforms, or Salmonella sp.

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4. COMMENTS ON REPORT RECOMMENDATIONS

Comments are provided on the main recommendations in the January 2013 report.

The subsection title identifies the option recommended in the report. We state the degree to which we either agree or disagree with bringing the option forward for consideration by HRM decision makers; or if we support in principle the bringing of the option forward with more available information. In those cases, we have summarized our description of that additional information. We then provide our brief discussion on topics of specific interest to HRM in the RFP we responded to, that are relevant to the recommendation in question.

4.1. COMMENT ON STANTEC REPORT SECTION 12 RECOMMENDATION A1 – CLOSURE OF FEP AND WSF BY THE END OF 2013

With respect to closing the FEP and WSF, this is a recommendation that we support; and whose concepts and details, with the indicated additional information, merit serious consideration by the final decision makers.

We understand that HRM Council will make the final decision, after consulting with staff, 2013 community engagement participants, and others. After reviewing the report, we sought additional performance, financial, and technical information in forming our opinion.

Would implementing these recommendations, with the corresponding changes to infrastructure and operations, significantly change the capacity of the HRM solid waste resource management system to achieve its overall performance goals? After reviewing the report, we sought additional information. Operating the Otter Lake facility includes meeting air quality and groundwater quality performance goals (e.g. air quality guidelines with the facility operating permit, which apply whether or not the FEP or WSF is operating). There is now about a fifteen year environmental monitoring track record for the facility. In our opinion, implementing this recommendation can be done in such a manner that the demonstrated environmental performance trends of the overall system would continue (e.g. the environmental effects as indicated in the results presented in the annual environmental effects monitoring reports).

Would implementing these recommendations, and taking into account the net effect of the resulting positive and negative financial implications, significantly change the potential financial performance of the overall solid waste system in meeting its performance goals? After reviewing the report, we sought additional information. We reviewed and considered the cumulative net effect of several variables. For the FEP and WSF, their cumulative annual operating, capital and repair costs are on the order of $10,700,000. FEP and WSF decommissioning or repurposing charges - now or later - are unlikely to be a significant financial

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factor in a time of low interest rates. To segregate materials by other means may involve additional labour at the RDF; improved access roads to the cell itself; an alternative white goods program; a stronger household hazardous waste program, and more. The cumulative financial impact of implementing these system changes on the annual operating, capital and repair budgets may be in the order of $950,000.

Would there be a financial implication on the lifecycle of a new $15,000,000 landfill cell? Would implementing the recommendation significantly change how often this investment would be made? Another way of asking that question is: Would the final density of waste material in the cell substantially change? In 2011, about 25% of material entering the RDF was first "stabilized" at the WSF (i.e. the material is mechanically shredded, and the volatilization, the biodegradation, and the leachate potentials are reduced through a mechanical air drying process, that also reduces the moisture content). The final density of shredded material is expected to be about 20% greater or more, compared to unshredded material. Without the FEP, the WSF and their mechanical shredding of materials, the same total mass of material entering the RDF could take up 5% (i.e. 20% of 25%) more volume. Additional daily cover materials could take up 1% more volume. We reviewed technical information about the mechanical compaction equipment used at Otter Lake, and other equipment and operational options available to HRM. There is a very plausible scenario, where greater compaction efforts would increase density in the RDF by more than 6%. The incremental increase in compaction efforts, may involve an average annual financial increase on the order of $50,000 – 100,000. Implementing the recommendations, with additional compaction efforts for materials being placed in the RDF, is not expected to change the rate at which new landfill cells are budgeted and constructed. In our opinion, implementing this recommendation can be done in such a manner that there is an annual financial benefit to the HRM solid waste system on the order of almost $10,000,000 / year.

In 2011, the WSF processed about 25% of the waste material being placed in the RDF. The WSF stabilization process reduces the moisture content, and to some extent reduces the volatilization and leachate potential of the waste material. If there was no WSF to stabilize materials, would the resulting RDF infrastructure and operations be such that the overall solid waste system performance goals for groundwater and air quality still be achieved? Performance goal examples include what HRM chose to include in its operating permit, and not having a trend of unacceptable operational incidents or environmental impacts, as demonstrated by the trend in groundwater and air quality monitoring results in the annual reports. After reviewing the report, we sought additional information. We took four waste samples and had a laboratory analyze them for volatile and leachate potential. Sample A is from material just off the truck, as if there was no FEP or WSF, and it was going to the RDF. Sample B material had passed through the FEP, was unshredded, and was going to the RDF. Sample C material was shredded in the FEP / WSF but not yet stabilized. Sample D was shredded stabilized material leaving the WSF for the RDF. We were interested in the relative differences in the volatile and leaching

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potential between the samples, and not so much in the absolute concentrations. One sample is not a demonstrated population, or representative of the full waste stream. HRM has detailed waste audit characterization reports. There is also a recent CBCL report, for considering the potential of the material for biological breakdown and methane generation.

For about seven months - from May to December 2010 - when the WSF was not operating, the infrastructure and operations at Otter Lake facility adapted to this circumstance, with no reported operational issues. In the RDF, this involved using the same "ad hoc" gas management infrastructure and operations that had been used for partially filled cells since 2002. These resources include labour, pipe, and equipment to control, capture, and convey the volatiles to the more permanent gas management systems. Our financial review assumed that the future use and costs of these resources from May to December 2010 would be similar in the future.

Our sample results indicated some relative differences in volatile and leachate potential. From anecdotal field experience, the combination of a high moisture content for loose, handled material (e.g. rainwater on exposed uncovered loose material in the RDF) seems to be the greatest indicator of the potential for a community odour reporting incident. Leachate is currently collected and treated off site. If future RDF waste material has a higher moisture content, and a greater leachate potential or concentration, we believe the existing infrastructure and flexible operational capacity is such that the current documented trends in groundwater and air quality performance at Otter Lake would continue. The operating and monitoring results during and after a seven month period when the WSF was not operating – similar to if there was no operating FEP and WSF - indicated that monitored groundwater and air quality goals were met. In our opinion, if there was no FEP or WSF (e.g. May – December 2010), there is sufficient infrastructure and a demonstrated operational capacity at Otter Lake, such that the trend in environmental groundwater and air quality performance would continue.

Stantec's mandate may have been to bring some potentially useful ideas to the table, and not necessarily to present the detailed arguments and background information, for taking multi-million dollar implementation and municipal budget decisions. The report did not seem to consider future flexibility in waste stream composition in the development of its FEP and WSF recommendations, as per the HRM RFP.

In our opinion, there is sufficient available information to support the A1 recommendations, and that it merits serious consideration by the final decision makers.

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4.2. COMMENT ON STANTEC REPORT SECTION 12 RECOMMENDATION A2 – REQUEST MODIFICATION OF THE NOVA SCOTIA LANDFILL LINER SPECIFICATION

In response to a changing waste stream arriving at the landfill, different infrastructure – including a different liner specification - could be used to achieve the same current environmental performance goals. Where a desired environmental performance can still be achieved, the economic basis for the removal of the leak detection layer is compelling. An HRM site specific technical analysis would necessarily include a risk based assessment that incorporates information on the historic performance of liner systems (that do not have leak detection), site specific physical conditions, the sensitivity of adjacent receptors and some consideration of potential offsite impacts in the event of failure or partial of the liner system. Without this technical analysis, we believe that efforts to influence a near term change in current provincial requirements regarding liner specifications, are unlikely to succeed. They may not be necessary, as the option exists to submit an alternative design to NS Environment.

With respect to requesting a modification in the NS guidelines to the default landfill liner specification, we believe that HRM should instead develop a site specific design alternative, as per existing guideline options, to meet the same environmental performance goals.

With respect to developing an Otter Lake specific landfill design, this is an equivalent alternative recommendation that we can support in principle; and whose concept merits bringing additional information and details to the final decision makers.

Conducting a site specific design is not immediately necessary, although it would be useful. If the A3 option that Stantec recommended is implemented, this may not happen for many years.

Additional information or technical testing with analysis, may show that the cumulative influence of changes to the characteristics of materials entering the landfill in 2013, and a liner design change; for the site specific soil, groundwater, and related characteristics of Otter Lake, and the other HRM system infrastructure and operations; continue to provide an acceptable level of protection. If so demonstrated, and when considering some precedents with projects under the provincial contaminated sites guidelines, the regulator would have a technical basis for considering an acceptable change to the applicable landfill liner cell design.

The leak detection system was part of the 1995 Community Stakeholder Committee (CSC) strategy, and is a component of default provincial landfill design and operation. It was intended to raise public confidence in long term landfill performance. There is now about 15 years of operational experience at Otter Lake that can be a basis for such confidence.

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The report recommends the removal of the protective cushion layer and the leachate detection system. The report is not explicit, but we believe this involves not including a secondary HDPE impermeable liner in future designs. This would make a significant difference to the potential construction costs. The report notes that the wastes in 2012 no longer include the hazardous material found in previous wastes, and the current liner design being used does not reflect this reduced level of risk. While this is true, the justification for reducing the level of containment provided by the existing design criteria would require a site-specific risk assessment. A contingency scenario to be modelled would be the impact of a liner failure and response plan actions, on the adjacent receptors.

Achieving an acceptable risk or hazard to human health and the environment, would involve evaluating the cumulative effect of the physical and chemical characteristics of the materials in the landfill; the cap; the leaching characteristics; the leachate collection and treatment systems; the liner; the soil geology and groundwater characteristics; and the parameter values used to describe the potential human and ecological receptors. A different 2013 liner specification, in response to different characteristics in the materials being placed in the landfill in 2013, could continue to provide an acceptable level of protection. We expect that in this context, an acceptable liner design for Otter Lake involving changes from the current design (e.g. the "cushion" gravel layer over the liner, and leak detection system) could influence the construction budget of the next new cell, by 10% or more.

4.3. COMMENT ON STANTEC REPORT SECTION 12 RECOMMENDATION A3 – EXTEND LIFE OF OTTER LAKE LANDFILL THROUGH VERTICAL EXPANSION

Raising the maximum landfill height, and thus extending the landfill cell life span offers technical and economic efficiencies on a strict dollar per tonne basis of material placed in the landfill. In raising the landfill height, the multimillion dollar investment in the liner, base, groundwater quality monitoring and their wells, and more can be paid for by the tipping fees associated with more tonnes and cubic metres of waste material. An operation plan could describe how this would be accomplished for new cells, and also retroactively applied to already closed cells, if desired by HRM decision makers.

<u>With respect to raising the maximum landfill elevation, this is a recommendation that we support; and whose concepts and details, with the indicated additional information, merit serious consideration by the final decision makers.</u>

We understand that HRM Council will make the final decision, after consulting with staff, 2013 community engagement participants, and others. After reviewing the report, we sought additional visual information in coming to our opinion.

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Would increasing the maximum elevation of the cells by 15 metres, unduly intrude into the view planes of the area around the Otter Lake facility? A Dillon Consulting document for HRM outlined a scenario for a 15 metre cell height extension. HRM decision making has been based on considering the view planes of the cells from residential locations, as per their community commitment. We conducted a balloon study to see if balloons flying at the proposed elevation would be visible from local residential locations.

Balloon Study (February 27, 2013)

Section 8 of this document presents information and elaborates on our February 2013 Balloon Study. We set up six bright helium filled balloons at the proposed new maximum elevation over an Otter Lake facility cell. We then drove to a variety of locations in the area to test if we could observe the balloons, and took some pictures. A map figure attached to this document presents our view planes. Based on this evaluation, we conclude that the increase in height of the landfill cells will not be visible from the residential locations we visited. The cells are visible from a bedrock outcrop in the anticipated commercial area, not the residential area, of the Brunello Estates commercial / residential / golf course development close to Exist 3 of Highway 103.

We understand the existing landfill cells are visible from a portion of the Bluff walking trail located west of the Otter Lake Landfill facility. We interpret this to be a sightline along the Lower Marsh Lake Brook system.

Other Considerations

Increasing the cell heights, will also increase the bearing pressure of the cells on the soil below, and tend to increase the groundwater elevations under the liner. This capillary action is similar as to why fluid stays higher in a narrow straw compared to a wide one. The current program for monitoring, assessment, contingency response planning, and follow up actions, could be adjusted to test if in response to higher cell heights, the groundwater elevation rises to come into contact with the lower drainage layer under the cell liner.

There is no provincial regulation or requirement about the heights of landfill cells in Nova Scotia. If HRM Council approves an increase in height, appropriate engineering design and operations planning would then have to take place. These would follow the same approval process as was used for the existing landfill cells. There are no engineering impediments to developing and preparing an operational plan or specification changes, for both the additional height for future cells, and retroactively for existing cells.

4.4. COMMENT ON STANTEC REPORT SECTION 12 RECOMMENDATION B1 – CREATE A CENTRALIZED WASTE RESOURCE CAMPUS

Developing this recommendation was outside of the scope of work, of the 2012 HRM Request for Proposals to which Stantec responded. Based on some experiences in other jurisdictions,

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and on a conceptual level, it may have some economic and technical merits. This significantly differs from the current operations, the 1997 HRM Operations Plan, and the 1995 Community Stakeholder Committee (CSC) Strategy. The Otter Lake Operations Plan was written by the site operator – MIRROR – and not by HRM.

Consolidating some or most of the waste infrastructure geographically, can be technically viable and may be an economically superior option, to be developed and used in future HRM consultations. The cost estimates presented in the Stantec report are useful for concept level discussions, but are not considered to be suitable for budget decision making purposes.

With respect to a potential "campus" construction somewhere, this is a recommendation that we can support in principle; and whose concept merits bringing additional information and details to the final decision makers.

We lack sufficient information to either agree or disagree with the immediate implementation of this recommendation.

Additional information should demonstrate the existence of a financially viable campus option, for an acceptable site, and with good quality cost estimates, compared to a viable multi-site approach, not unlike the current system.

4.5. COMMENT ON STANTEC REPORT SECTION 12 RECOMMENDATION B2 – RELOCATION OF MRF TO CAMPUS

It appears that sorting recyclables arriving as a single stream at a common facility is more economically efficient than using a multiple stream of sorted materials at the curbside; because the work crews and trucks can be even more efficiently used in their curbside collection efforts. Changing to a one stream collection process would involve a new MRF.

The Stantec report does not explicitly address if the current MRF could be reconfigured and used for processing and segregating a single stream of recyclables being delivered to it. We understand that it would be impractical to convert the current multi-stream MRF to a single stream one, due to the required technology, equipment, age, and space considerations. Some additional capacity might be possible through extra shifts to the current MRF.

One would reasonably anticipate some economic and technical efficiencies if a new MRF were at a campus location. One would anticipate some technical necessities of having a new MRF at a new location, if a single stream collection system is used for recyclables.

The final decision makers of HRM Council can determine in the future if HRM will choose to build a new MRF at a different location or not. The upcoming discussions in the HRM decision

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making process may find that there are probably potential location options for a new MRF - that do and do not include a campus setting - and perhaps do not include the current location, due to the additional material storage requirements.

With respect to moving the MRF to a different location recommendation; this is a recommendation that we can support in principle; and whose concepts merit bringing additional information and details to the final decision makers.

We lack sufficient information to either agree or disagree with a decision on whether or not to implement this recommendation.

Additional information would include an objective siting study, with reasonable financial information, that recommended a preferred location for a new MRF – be it at a campus location or elsewhere. How long HRM continues with the current multiple stream of curbside recyclable collections, or when or if it changes it, will also influence MRF decision making.

4.6. COMMENT ON STANTEC REPORT SECTION 12 RECOMMENDATION B3 – INCREASE ORGANICS PROCESSING CAPACITY

From a technical perspective, a mix of a new anaerobic digestion facility (for the wet and larger, harder to digest organics), and the aerobic facility capacity (for the smaller, easier to digest organics), would provide a stronger opportunity for HRM to meet its 2005 Canadian Council of Ministers of Environment (CCME) treatment guidelines for organics. The processed treated organic material can then be used off site for other purposes in a controlled manner.

The current process and infrastructure from before 2005, are not consistently meeting the current environmental performance guidelines. The report did not present a business case for adding an anaerobic digestion capacity to the HRM system, as a preferred option. It read as a comment or suggestion – be it one with some technical merit - but without demonstrating that it followed a stated methodology for deriving this recommendation.

With respect to adding an anaerobic digestion capacity to the HRM system, this is a recommendation that we can support in principle; and whose concepts merit bringing additional information and details to the final decision makers.

We lack sufficient information to either agree or disagree with deciding to implement this recommendation as presented at this time.

Additional information or technical testing could show that using anaerobic infrastructure for the "wet ICI" wastes, and aerobic infrastructure for the "drier residential" green bin type source separated organic materials, would consistently meet the applicable CCME guidelines. It may be

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worthwhile to compare the value anaerobic digestion to alternative measures – public or private sector based - for adequately treating the "wet ICI" wastes.

4.7. COMMENT ON STANTEC REPORT SECTION 12 RECOMMENDATION C1 – IMPROVE RECOVERY OF RECYCLABLES AND ORGANICS

Removing a greater portion of the industrial, commercial, and institutional (ICI) organic materials from the ICI waste stream is an understandable aspiration.

Can the ICI organics be diverted to a new anaerobic (without oxygen) digestion facility, and the current aerobic (with oxygen) digestion facilities be used to treat the residential organic wastes, that both waste streams consistently meet the applicable 2005 CCME guidelines? The answer may be "yes" but the Stantec report itself did not provide a sufficient cause to conclude this. The report alone does not provide us with a confident sense of what might be the required capital and operating costs, to consistently meet the applicable CCME goals.

The Stantec report presents logical suggestions about modelling and assessing the benefits of truck based automated versus manual collection; separate collection of leaf and yard waste (LYW); single stream versus dual or multiple stream recyclables processing; and to determine collection re-zoning. Modelling was not always discussed in the report, but was included in the recommendations.

The Stantec report presents some recommendations, including: ". . . continuing to carefully evaluate the results of waste characterization studies….encouraging ICI diversion through continued education programs….all new development should be required to implement a compliant source separation program…potentially increasing ICI diversion through enhanced enforcement."

The recommendation regarding new developments is solid and can be readily implemented. These recommendations would be stronger or more compelling if they were presented with corresponding business analysis for HRM to proceed. Private sector business investment or ICI operations would be influenced by such requirements and enforcement.

<u>We agree with the C1 recommendation as an overall goal.</u>

<u>We lack sufficient information to either agree or disagree with many of the suggestions put forward in support of this recommended goal.</u>

<u>We support the "single stream" recommendation in principle, to eventually move to collecting a single stream of recyclables at the curbside, due to the collection system efficiencies. This concept merits bringing additional information and details to the final decision makers.</u>

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Current curbside habits of HRM residents need not change if all recyclables are collected in one area of the same truck, in the future. This recommendation has significant implications for future MRF operations, equipment, location, and the HRM program.

4.8. COMMENT ON STANTEC REPORT SECTION 12 RECOMMENDATION C2 – CONTROL CURING AND SALE OF FINISHED COMPOST

An environmental performance goal for the HRM system is to have the processed organics meet the 2005 CCME guidelines. Processed HRM organics from the composting facilities have not shown themselves so far, to be an economic resource. At Otter Lake, the quality of the WSF processed waste is such that it is then deposited in the RDF landfill cell as waste.

Operating a secondary curing area for processing composted organics is an idea with some technical merit for meeting the applicable guidelines maturity standard. The Stantec report does not demonstrate that it followed a stated methodology for deriving this recommendation. The economic merits have not been demonstrated. The text is conditional, making comments on several options, without presenting a basis for this recommendation.

<u>We expect that with more information, we would disagree with the recommendation. Still, developing this option further, for a later "go" or "no go" decision may be useful for the long term HRM decision making process.</u>

Additional information would a) by providing additional curing, in a study or preferably a lab bench test, evaluate the incremental technical improvement to the HRM composted material, to meet the desired CCME quality guideline and maturity goal; and b) test the recommendation, by means of a financial review of the high quality potential capital and operational costs, to provide sufficient additional capacity at an identified location. The curing pad could be privately or publicly owned but operated under a contract for HRM.

4.9. COMMENT ON STANTEC REPORT SECTION 12 RECOMMENDATION C3 – IMPROVE CURBSIDE COLLECTION FREQUENCY

While plausible in theory, we have not read a compelling business case for reducing in practice, from eight (8) HRM curbside collection zones to about 4 – 6. HRM policy and decision makers are well placed to determine when the benefits of greater regionalization efforts are worthwhile, and when they are not.

<u>We expect that with more modelling information, we would disagree with the recommendation to reduce the number of collection zones.</u>

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Additional information may be available or could be developed with HRM staff, who already have some collection model data that could be used or reworked.

We have not read a compelling business case for doubling the urban organics collection frequency to a weekly basis. Recyclables are already collected weekly in urban and some suburban areas of HRM. The additional "investment" in human and equipment resources used, would have to be "paid for" in the system costs. Residents are not charged a direct tipping fee rate of $/tonne for materials and waste left on their curbside. For HRM, how much of a change in the organic diversion rate, would then be considered a "success" operationally?

<u>We disagree with the recommendation.</u>

This is based on our perception that the recommendation was intended to apply to all current urban organic "green bin" collections. We do not expect that an increased frequency would significantly increase the already higher than average diversion rate compared to other jurisdictions, and if it did so, that such an increase would be sufficient to economically justify the additional capital and operating costs to do so.

The collection of ICI organics is organized and executed by the ICI sector and not by HRM, or using HRM trucks and labour. A case may exist for the ICI sector to increase the frequency with which it collects organics from ICI locations.

Additional information to support this "modified" or "clarified" recommendation would include a financial review of the additional capital and operational costs for implementing a weekly green bin style source separated system, or functional equivalent; and the net ripple effects - technical, financial, or otherwise - on the balance of the HRM solids waste system.

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5. COMMENTS ON SPECIFIC TOPICS OF INTEREST TO HRM

5.1. SEPARATING AND MATERIAL SHREDDING

Residential green bin organic food wastes do not go to the FEP / WSF at the Otter Lake facility. The industrial, commercial, institutional (ICI) waste (e.g. from a food court) arriving at the FEP / WSF does include some relatively wet, heavy, material, with a relatively greater volatilization, biological breakdown, and leachate potential.

For materials perceived with the greatest of these potentials, the rationale for separating and shredding them into two sizes (coarse and fine particles) was that the smaller material would contain the greater total organic content, while the coarse material would contain less. Our observations and additional laboratory results for samples we took at the FEP / WSF support this assumption. We are uncertain as to how 150 mm screen size came to be selected for the screening and separating of the finer from coarser materials.

The finer material is directed to the Waste Stabilization Facility for processing prior to being disposed of in the RDF. The shredding process facilitates a more rapid processing of the mixed waste containing the organic fraction of material. This process is intended to reduce the volatilization, biological breakdown, and leachate potential of the material. The WSF stabilization process includes partially drying the material, and reducing the moisture content of the material. This alone would reduce the volatilization and leachate potential of the material, until the next rain or wetting event. The waste from the WSF, after entering the RDF, then has opportunities to increase its moisture content again, and to become saturated with water.

The report did not identify cost effective, alternative approaches for the continued use of the WSF process infrastructure and operations, perhaps because it recommended the option to close the WSF. The most cost effective alternative appears to be to conclude the use of the WSF process, and to use other infrastructure and operations at the Otter Lake facility to continue to achieve the applicable facility environmental performance goals.

Paper and plastic are examples of hydrocarbon based organic materials arriving at the FEP that do not have a relatively high volatilization, biological breakdown, and leachate potential, compared to say the food portion of organics originating from food court waste.

The FEP / WSF waste stream samples A, B, C, and D, discussed earlier in this Section, indicated differences in volatilization and leachate potential, for materials that were shredded and not shredded; and stabilized and not stabilized. We considered these differences, in the context that the relative portion of WSF stabilized materials is about ~25% of the total quantity of materials being placed in the RDF. The differences were such that we believe that if shredding and biostabilization were not happening, that the RDF infrastructure and operational capacity is

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such, that the overall performance goals regarding groundwater and air quality would continue to be achieved. This is consistent with the seven month experience in 2010, when shredding and stabilization did not occur.

Material shredding was also mentioned in the Stantec report as a contributing factor to landfill gas production and in-place landfill material density. These relationships are discussed in other Sections.

Some less than 150 mm / 6 inch size material is currently shredded before being placed in the WSF and later the RDF. Shredding prior to the RDF, results in a short term release of some landfill gas which is then directed by fans through a biofilter outside of the WSF.

Landfill gas released by materials – shredded through the WSF or unshredded - placed in the landfill cell while it is being filled, is for the most part being currently captured and controlled by gas control measures used since 2002, involving labour, fans and piping systems. For HRM, the acceptable target number of annually reported community odour incidents is zero. After 2002, with an exception in the fall of 2011, this target or performance goal of minimizing odour incidents has been achieved.

After each cell is filled and capped, the permanent landfill gas capture and management system is used to control the landfill gas resulting from biological activity.

Unshredded materials handled in the FEP and placed in the landfill release biodegradation gas more slowly, compared to shredded materials passing through the WSF and also then placed in the landfill cell. In either case, the off gas can be similarly addressed in the short term with the "ad hoc" gas management system used since 2002 for cells where material is being placed; and by the permanent gas management system for covered landfill cells where no more waste is being placed.

The extra 2002 "ad hoc" system is in response to odour incidents in 2001. Suppose the mass of potentially volatile gas or off gas resulting from biological breakdown of material is the same for identical samples of waste stream arriving at the Otter Lake facility. The more a sample is mechanically handled (e.g. modestly by bag breaking in the FEP; or significantly by shredding for the WSF process), or the more it is heated, or the more it is neither completely saturated or completely dry; the more rapidly volatiles enter the air and at a greater concentration.

So the mass to be released from the waste sample that went from the truck to the RDF (i.e. no to low added energy), without any handling in the FEP or WSF, will do so relatively slowly and over a relatively long time. The design and operation of the permanent gas management system has sufficiently controlled the long term potential for community off gas odour incidents.

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The mass to be released from the "bag broken at the FEP waste sample" (i.e. medium added energy) that arrives at the RDF, initially releases its gas a little quicker, at a greater concentration, for a shorter period of time. The permanent gas management system plus a medium sized extra "ad hoc" system controls for the potential community off gas incidents.

The mass to be released from the "shredded, heated, and processed at the WSF sample" (i.e. high added energy) initially releases its gas much quicker, at a higher concentration in the air, for a relatively short period of time. Beside the WSF, an additional set of blowers, pipes, and biofilter system is used to control for the potential community off gas incidents.

The observation made is that the more mechanical or thermal earlier energy that is added to the waste stream sample, the earlier and greater will be the gas management resources, required capacity and costs to control for the threshold condition of the relatively highest concentration of volatile gas being released.

Would the "ad hoc" system at the landfill cell have sufficient capacity to manage the off gas potential of materials that historically have been perceived as having a relatively high off gas potential, and as such were shredded for the WSF process? The demonstrated answer to this question is yes, based on the seven month experience from May – December 2010, when during some roof repair work, the WSF was not operating.

Would the "ad hoc" system at the landfill cell have sufficient capacity to manage the off gas potential of materials that have historically been mechanically handled at the FEP and WSF? Yes, because the volatile concentrations being released by the materials would generally be lower, the release rate would be slower, but it would be happening for a longer period of time.

Is the "ad hoc" system a response to the mechanical and thermal energy added to the waste materials at the FEP and WSF before it arrived at the RDF? Was the "ad hoc" system being used during the seven month period when the WSF was not operating? If no, then the system would appear to be a response to an active FEP and WSF. If yes, then perhaps the "ad hoc" system is not just in response to FEP and WSF activities. However, the maximum or threshold size or capacity of the equipment, pipe, labour, and more of the "ad hoc" system was a result of the thermal and mechanical energy added to waste materials at the FEP and WSF.

Without the FEP and WSF, the landfill cell "ad hoc" gas management system requirements and operations would lessen, for managing against potential community odour incidents. It is reasonable to anticipate that the annual $750,000 expense of this "ad hoc" system would also be less, possibly significantly less, if materials arriving at the RDF had not received additional mechanical or thermal energy at the FEP and WSF.

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Unshredded material may have less available surface area that is subject to leaching, which may have been the model for the current leachate collection, treatment and disposal system. The combined current operational FEP / WSF material shredding, leachate and off gas system costs, are greater than the expected incremental increased RDF costs would be in responding to the potential combination of unshredded materials, and associated leachate, and off gas management efforts. Shredding also allows for a greater long term density of material to be placed in the landfill. We sought additional information and believe that the shredding costs are greater than the value of the volume efficiencies gained; and that additional compaction efforts would also more than financially compensate for this.

The incremental cost of shredding material in the FEP / WSF is greater than what might be the extra leachate handling costs at the RDF, on the order of millions of dollars each year.

From pages the *Decision-Maker's Guide to Solid-Waste Management* (USEPA, 1995):

> "After compaction, shredded refuse has a greater density than compacted unprocessed MSW. This can result in preserving landfill space and reducing the amount of required cover material. In addition, landfill settlement and stabilization may be more uniform over time in the landfilled area. "

In a research paper entitled *Technical and Economic Analysis of Pre-Shredding Municipal Solid Wastes Prior to Disposal* (Garrett C. Fitzgerald, 2009), the author presents data showing that the in-place density of shredded MSW is approximately 20% greater than for non-shredded waste.

There is a cumulative net multimillion dollar benefit to the HRM system from eliminating the cost of shredding material in the FEP / WSF, and accounting for what might be the increased volume of the cell occupied by unshredded materials (5% = 20% x 25%) – whether or not there is a relatively greater mechanical compaction effort applied against the materials in the future.

5.2. LANDFILL GAS GENERATION

Landfill gas is generated by the decomposition of organic materials. A typical landfill gas is primarily methane (40%), with the rest mainly carbon dioxide. An efficient composting process consumes the bi-products of decomposition and little methane gas is generated. The vast majority of waste delivered to the Otter Lake landfill FEP is sent to the landfill (135,000 tonnes in 2011). A portion of this waste (25,100 tonnes in 2011), perceived as having a relatively greater potential for volatilization, leaching, and biodegradation, is segregated and shredded in the WSF process. This waste is intended to be partially composted (biostabilzed) and then deposited in the landfill. It may be more accurate to describe the waste leaving the WSF as

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being drier, rather than being more physically or chemically stabilized. When wetted again in the RDF landfill cell, some of this waste will release more gas. The 2011 primary landfill gas contributor is the decomposition of the organic content of the 73,500 tonnes of mixed waste sent directly to the landfill from the FEP, plus the 22,600 tonnes of WSF processed waste.

The production of gas in the RDF landfill cell will continue as long as organics remain in the wastes placed in it. The report discusses shredding as a contributing factor to the gas production. Shredding results in both an accelerated volatilization process and decomposition process. However the same mass of gas will eventually be released as from non-shredded material, it will just take longer. Most mixed waste landfills generate landfill gas for up to 30 years beyond the last deposit of waste.

For wastes being processed in the WSF, some gas is rapidly released as a result of volatilization and the accelerated bio-decomposition process due to the shredding of material, and curing. A portion of these gases are piped through a large outdoor biofilter at the WSF. If the same waste was not processed in the WSF, the same gas would be released at a slower rate in the landfill cell, and managed by the gas management systems' piping and controlled handling system.

The existing short term "ad hoc" and long term permanent landfill off gas control and management systems have shown themselves capable of addressing shredded and unshredded wastes from the FEP / WSF placed in the RDF cells. With or without waste from the shredded WSF process, the HRM target of zero community odour incidents per year has been achieved for the last ten years, with the exception of the fall of 2011. If there was no WSF process, the landfill gas would be released more slowly, but the gas release would still be within the capacity of both the current "ad hoc" and permanent systems.

The mechanical and thermal energy added to the wastes at the FEP / WSF, may well be why there now exists the short term "ad hoc" gas management to control against potential community odour incidents, and what the required capacity has been. Closing the FEP / WSF would not reduce the long term potential gas mass released, but it would reduce the maximum or threshold short term concentration at which the organic mass is being volatilized. The required capacity for the short term "ad hoc" gas management infrastructure and operations, and the associated annual operating budget of $750,000 per year, would also both be reduced.

We believe that the current trend in achieving the off gas performance goals can be more cost effectively accomplished without the FEP / WSF waste processing, and associated shredding.

Without shredding materials, a steadier off gas release rate, over both the short and the long term, may make for a more efficient use of gas management equipment and infrastructure.

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5.3. LANDFILL COMPACTION

The greater the density of waste materials; the longer each multi-million dollar disposal cell will last. However, are all actions that result in a greater final density of materials in the disposal cells necessarily cost effective?

Currently the shredding at the FEP / WSF of about ~25% of materials entering the RDF cell is one influence on the final compacted waste density. The mechanical compaction effort applied to the other materials placed in the RDF cell is another influence.

Suppose a tonne of unshredded material entering the RDF occupies 20% more volume, compared to a tonne of shredded material leaving the WSF for the RDF. The cumulative influence on the total volume of the cell is about 5% (5% = 20% x 25%).

If the cost for a new cell is about $15,000,000 to construct, or $25,000,000 for construction and closing, and with the current maximum height it needs to be replaced approximately every forty months or between three to five years, then that 5% difference in volume might be valued at about $250,000 – 400,000 per year. Where mechanical compaction efforts more than offset this, and result in no net change in volume, the value of that successful effort would be about $250,000 – 400,000 per year. Financially for the HRM system, the effects of additional mechanical compaction efforts would balance out the density difference in waste arriving at the RDF that was not processed at the FEP / WSF.

If the current maximum height of the landfill cells is increased by the proposed 15 metres, the total additional volume capacity of the Cells 1 – 5 could be at least 80%; and for Cells 6 – 9, it could be at least an additional 75%. Cells 1 – 5 were substantially filled over the last 15 years or 180 months. The Dillon Consulting memo in Appendix A of the report offered the opinion that there could be 152 months – or 12.5 years - of additional capacity for Cells 1 – 5 (152 /~180 is more than 0.8 or 80%). For Cells 6 – 9, the scaled figure in the memo is about an average of 10 squares across the four cells, and the additional elevation is at least an additional 7.5 squares (7.5 / 10 is at least 0.75 or 75%). The memo offered the opinion that for Cells 6 – 9, the increased height could be the equivalent of an additional 134 months – or about 11 years - of capacity. An additional 80% capacity of Cells 1 – 5, could be the equivalent of four (4) replacement cells. An additional 75% capacity of Cells 6 – 9, could be the equivalent of three (3) replacement cells. It seems reasonable that if seven (7 = 4 + 3) replacement were being constructed, their cost would be at least the costs of the current Cells 1 – 5, and perhaps significantly more if that included the development of a new site location for them. Assuming the cell closure costs would be the same, regardless of the final height, the financial value for the HRM system of increasing the RDF landfill cell heights would be at least $100,000,000 (7 x $15,000,000 > $100,000,000) if not significantly more, based on the seven additional cell liners that did not have to be constructed.

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We calculate the net combined capital, repair, and operating costs of the FEP / WSF where the shredding occurs, after accounting for other additional costs if the FEP / WSF was not there, is in the range of $9,000,000 - $10,000,000 per year. If filling Cells 6 – 9, to the current design height were to occur over a 15 year period (~11 years x 10/7.5), the financial implication for the HRM system of not operating the FEP / WSF could be around $150,000,000. If filling Cells 1 – 5 to the proposed additional 15 metres was accomplished over at least 12.5 years; and filling Cells 6 – 9 to the proposed additional 15 metres was accomplished over at least 11 years, the financial implication for the HRM system of not operating the FEP / WSF could be around $230,000,000, as a present worth value.

The cumulative financial effect of taking an FEP / WSF decision, and an increase in landfill height decision, could be on the order of at least $480,000,000 over almost forty (40) years. $480,000,000 = $100,000,000 (7 cells) + $380,000,000 (FEP / WSF).

If the current HRM system budget could accomplish the same goals for about $12,000,000 less per year (i.e. $12,000,000/year = $480,000,000/40 years), that could reduce the average $170/tonne RDF cost to HRM, to something less than $100 / tonne.

The density of waste in the Otter Lake RDF cell, prior to the start of the GPS program for mechanical compaction was about 765 kg/m^3. After the GPS program began, the field densities being achieved increased to almost 800 kg/m^3.

However, for the compaction equipment used at Otter Lake, this density is within the mid-range of the manufacturer's specifications and information. There is reasonable cause to think that additional mechanical compaction efforts with the current equipment, or possibly larger equipment, could more than offset a 5% volume change for unshredded materials.

A GPS based system has now started to be used by HRM equipment such that its compaction and daily cell cover material activities at Otter Lake are more efficient and effective. The final density of waste in the landfill cell is anticipated to increase by about 15 – 20%. This is also contributing to an increased final density of materials placed in a landfill cell.

The methods to increase compaction mentioned in the report are all well understood and applicable.

Some additional compaction of materials in the landfill cell would result if the maximum cell height were increased for future operations.

We expect that the volume reduction financial benefits to the HRM Solid Waste program from compaction of unshredded materials in the future, would more than offset any incremental cost increases from running the permanent landfill cell gas collection system, for a longer time.

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5.4. UTILIZATION OF DAILY COVER MATERIALS

The suggestions in the report reviewed are standard ones. Construction and demolition debris are currently being used as daily cover materials. We support this approach. If unshredded materials are being placed in the cells in the future, the suggestion of using the larger compaction equipment may be a useful cost effective way to keep the material in the cell as dense as is practical.

5.5. LANDFILL CELL LINER DESIGN

The landfill liner represents a significant portion of the overall cell capital cost. The report has compared the Nova Scotia design guidelines with other jurisdictions and United States based regulatory criteria. The report concludes that the default Nova Scotia design criteria requires a significantly greater level of containment than the other systems and it may be possible to modify the existing criteria to remove several components of the liner systems.

The leak detection system was part of the 1995 Community Stakeholder Committee (CSC) strategy, and is a component of default provincial landfill design and operation. It was intended to raise public confidence in long term landfill performance. There is now about 15 years of operational experience at Otter Lake that can be a basis for such confidence.

The report recommends the removal of the protective cushion layer and the leachate leak detection system. The report is not explicit, but we believe this involves not including a secondary HDPE impermeable liner in future designs. This would make a significant difference to the future cell construction costs. The report notes that the wastes in 2012 no longer include the hazardous material found in previous waste streams, and the current liner design being used does not reflect this reduced level of risk. While this is true, the justification for reducing the level of containment provided by the existing design criteria would require a site-specific risk assessment. A contingency scenario to be modelled would be the impact of a liner failure and response plan actions, on the adjacent receptors.

Achieving an acceptable risk or hazard to human health and the environment, would involve evaluating the cumulative effect of the physical and chemical characteristics of the materials in the landfill; the cap; the leaching characteristics; the leachate collection and treatment systems; the liner; the soil geology and groundwater characteristics; and the parameter values used to describe the potential human and ecological receptors. A different 2013 liner specification, in response to different characteristics in the materials being placed in the landfill in 2013, could continue to provide an acceptable level of protection. We expect that in this context, an acceptable liner design for Otter Lake involving changes from the current design (e.g. the "cushion" gravel layer over the liner, and leak detection system) could decrease the construction costs of the next new cell, by 10% or more.

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5.6. FINAL CELL DESIGN HEIGHT

There would be technical and economic efficiencies for the HRM Solid Waste program if the future landfill cell height elevation were increased. This would differ from the current operating parameters. Our evaluation sought to test the visual significance of changing these heights, with respect to the view planes already used in HRM decision making.

The original design accommodated restrictions related to view planes. Our February 2013 Balloon Study tested how visible the proposed additional cell elevation would be from residential view planes in the area. Aside from a bedrock outcrop in the anticipated commercial area of the Brunello Estates commercial / residential / golf course (Exist 3, Highway 103), we are confident that the increase in height of the landfill cells will not be visible from the other locations we visited for the study.

We agree that increasing cell height is a practical way to increase the landfill capacity and reduce overall capital and operating costs. There are no engineering restrictions on re-designing the cell development plan to make effective use of available height.

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6. PEER REVIEW OF CONCLUSIONS

Section 12 of the Stantec report presented twelve conclusions.

Stantec Conclusion 1: *"The total diversion rate is high in HRM compared to other municipalities, but realistic opportunities exist to improve the recovery of residential and ICI recyclables and organics in accordance with provincial legislation."*

(SNC-Lavalin: There are relatively more opportunities with respect to the ICI wastes)

<u>We agree with this conclusion.</u>

How much of an improvement in a total diversion rate is realistic? The residential component of the program is a demonstrated success. As noted in the report, with respect to performance as it relates to other municipal jurisdictions and the provincial target of reducing waste disposal to the target of 300 kg/capita by 2015 HRM is in the middle of the group compared to other regions. A source separation solution for some of the ICI waste streams, especially the organics, would be a challenging and useful outcome for future efforts.

Stantec Conclusion 2: *"The front-end processing (FEP) and waste stabilization facility (WSF) at Otter Lake do not provide a useful function compared to their stated purpose in the 1995 Strategy."*

(SNC-Lavalin: A "useful function" in this case, such as for example the white goods program, should be one that can be executed within a reasonable economic rationale)

<u>We agree with this conclusion.</u>

The FEP and WSF in 2013 provide some functions that can be accomplished by other means (e.g. household hazardous goods; white goods). The FEP and WSF in 2013 provide some functions where a compelling business case for doing so does not exist (e.g. physical separation in 2011 of 250 tonnes of paper, and 50 tonnes of plastic, from over 140,000 tonnes of waste received by the FEP, at a multimillion dollar cost). The FEP and WSF in 2013 provide some functions that do not appear to be positive for the HRM system (e.g. adding mechanical and thermal energy to waste by shredding, such that a resulting more rapid release gas at the RDF was controlled and managed by a new $750,000 per year "ad hoc" system that has been operating since 2002). Compared to the purpose in the 1997 Operations Plan, and the very different waste stream arriving at the facilities in 2013 compared to 1998, due to the now very successful diversion rates, change involving the FEP and WSF is recommended.

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Stantec Conclusion 3: *"The landfill liner design specification in Nova Scotia is more stringent than most comparable state and provincial jurisdictions, and potential modifications could significantly reduce future capital costs."*

(SNC-Lavalin: The default design for various provincial or state jurisdictions, varies with the desired envelope of possibilities associated with their various provincial or state site conditions)

We agree with this conclusion.

That the NS liner specification differs from other jurisdictions, and its modification could reduce future capital costs of cell development, is not in itself, a compelling reason to change the specification. Would a liner design change result in an unacceptable risk or hazard to human health or the environment? Would a liner design change mean that there is an unacceptable level of environmental protection? Where the answers to these questions are no, there would exist a reasonable case for proposing a different and site specific liner specification.

Stantec Conclusion 4: *"An opportunity exists to significantly extend the life of the landfill at Otter Lake, and reduce the site per tonne capital costs by increasing the finished grade by 10-15 metres."*

We agree with this conclusion.

There are technical and economic advantages to increasing the maximum height, and the corresponding option A3 recommended in the Stantec report, merits consideration by those involved in the HRM decision making process. In the February 2013 SNC-Lavalin Balloon Study, the only location where we observed balloons was from the top of a bedrock outcrop, in the anticipated commercial area of the Brunello Estates development, just off of Exist 3 of Highway 103. Two balloons were visible from this location, as was the crest of the existing finished cells. We are unsure of status of view planes from hiking trails, new subdivisions, the upper floor of a school, etc. After the 2013 Community Engagement process, the HRM Council will make the final decision with respect to potentially increasing the maximum landfill height elevation.

Stantec Conclusion 5: *"The two composting operations in Halifax and Dartmouth do not provide a sufficiently finished product to meet applicable guidelines which become effective in the near future."*

We agree with this conclusion.

The 2005 CCME Compost Quality Guidelines are among the current day performance goals for the HRM system. It is helpful to acknowledge, as the Stantec report does, that these guidelines did not exist when the facilities were first designed and permitted.

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Stantec Conclusion 6: *"Composting facilities are at capacity and additional processing capacity is required in the short and longer term."*

We agree with this conclusion.

This will become increasingly urgent if the ICI diversion program evolves.

Stantec Conclusion 7: *"Alternative composting technologies may improve the processing of ICI organics."*

We agree with this conclusion.

Alternative approaches may improve the processing of ICI organics. An alternative approach for treating a mixed waste stream, may or may not be more useful to an HRM program, than – if one existed - an effective, practical, and affordable source separation program. Alternative technologies may improve the processing of ICI organics. Alternative approaches must be first evaluated and demonstrated, before making major capital budget decisions.

Stantec Conclusion 8: *"Collection programs are cost effective and meet most customer needs however there are opportunities to improve diversion by increasing the frequency of collection."*

We somewhat disagree with this conclusion.

Collection programs are relatively cost effective, and do meet the needs of most residents. Given the current diversion rate in the HRM program, we do not believe that doubling the organics collection frequency to a weekly basis for most people in HRM would necessarily be a cost effective way to increase the diversion rate. Pilot testing potential changes in frequency and source separation to collection programs would be a worthwhile effort in seeking an increase in diversion rates.

Stantec Conclusion 9: *"Opportunities exist for more collaborative use of resources with other waste management regions in Nova Scotia."*

We somewhat disagree with this conclusion.

While exporting ICI waste out of HRM may be a potentially economically preferred option for the responsible individual property owners, it is not currently an economically preferred option for the HRM program. We do not anticipate a change in the HRM By law S 600, banning the export of ICI waste from HRM to other jurisdictions (except perhaps by HRM itself).

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While there may be some economically useful options for recyclables from outside of HRM to be processed within HRM, there is no financial or waste flow information presented in the Stantec report to justify this type of activity.

We expect that there will be no change in the foreseeable future to Section 16.3 of the HRM By-Law S-600 "Solid Waste Resource Collection and Disposal By-Law". On a political level, HRM prefers to control the flow of waste and materials entering and leaving its jurisdiction, and pay for having this ability. On an economic level, this is also because the ICI tipping fee revenues entering the HRM general coffers, provide some financial economies of scale that support a full HRM program, even if the tipping fees paid by the ICI sector do not cover their unit costs to HRM. If ICI waste and revenues leave HRM, the unit costs for just the residential wastes and materials would rise significantly, and perhaps prohibitively. There would be significant reductions in the total number of tonnes being processed, and insufficient financial resources to operate the current HRM program.

If the overall HRM integrated solid waste resource management program costs were significantly less, and the program relied less on keeping all of the ICI waste and associated tipping fees within HRM, then perhaps the S 600 By-law might change, and – possibly – there may be some outside-of-HRM waste processing options to consider.

Stantec Conclusion 10: *"Energy-from-Waste and developing waste reduction technologies are not considered appropriate investments for HRM at this time."*

<u>We agree with this conclusion.</u>

Stantec Conclusion 11: *"Overall program costs in HRM are high and represent a higher financial burden on both the private and public sectors compared to similar communities."*

<u>We somewhat agree with this conclusion.</u>

The performance goals for the HRM system are unlike other Canadian jurisdictions, so comparing costs for achieving different outcomes is not an "apples to apples" effort.

The Otter Lake facility processing costs of about $170 per tonne is high compared to other landfills; while the per tonne cost of the collection system is less than in other jurisdictions.

The HRM system seeks to achieve a higher diversion rate, with fewer tonnes of waste material per person entering the RDF landfill cell, and that contributed to the $170 / tonne experience in HRM. In our opinion, the opportunity exists to take advantage of some potential infrastructure and operations options such that the $170 / tonne average cost to HRM could be reduced, while maintaining or improving on the current trend in diversion rates. Is a high landfill unit cost

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where high diversion rates result in fewer deposited tonnes due to diversion, automatically better or worse than a lower unit cost for more tonnes per person being deposited in a landfill cell? A high diversion rate may well be reflected in a higher unit cost for the program, but options exist to lower the $170/tonne unit rate without compromising diversion effectiveness, and possibly encouraging more diversion by allocating system budgets to different priorities. Perhaps a more interesting comparison between jurisdictions would be the total program budget, per person, divided by the number of tonnes placed in the landfill.

If the costs in HRM compared to other jurisdictions are truly relatively high, for achieving similar goals, then yes this is a financial burden. If HRM costs are greater, to achieve an HRM specific set of goals that are different from elsewhere, then this may not be a relative financial burden. It is part of the package of pros and cons for choosing to live and work in HRM.

Where there may be technical and financially more effective ways to meet the desired performance goals with the HRM system, they must be pursued within social and community expectations. Within this context, seeking ways to reduce the $170 / tonne landfilling cost to HRM, and still achieve goals, is desirable. Is this a relative financial burden in HRM compared to other jurisdictions? If the snow clearing budget per person might be more in Quebec City, or Moncton, would that be a relative financial burden for people there?

Stantec Conclusion 12: *"HRM would benefit from the creation of a centralized waste resource campus, rather than having facilities at four different locations in Halifax and Dartmouth. Development can be staged over time to match the end-of-useful-life of current infrastructure and incorporate new elements for HRM such as outdoor windrow compost curing pads; permanent educational and household special waste facilities; and the development of a materials transfer capability."*

<u>We somewhat agree with this conclusion.</u>

With economies of scale, and with transportation and logistical efficiencies, including the use of transfer stations in the system, this infrastructure approach may offer technical and financial long term benefits for the HRM program. Conceptually, and perhaps with the Ontario examples provided, there is cause to think this would be the case for HRM as well. The information in the report reviewed did not prove that this would be the case for HRM, but it is an idea whose merits could be tested, and could be positive.

The concept is worthy of discussion. It would be a significant difference from what is part of the 1997 HRM Operations Plan, and other foundation documents.

The financial numbers in the report reviewed that are associated with this concept, should be further developed, before being relied upon as a basis for HRM budget decision making.

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7. WASTE SAMPLE INVESTIGATION

7.1. INTRODUCTION

While preparing our Peer Review of the January 2013 Stantec Report for the Halifax Regional Municipality (HRM) titled "Waste Resource Strategy Update" report, we conducted a relative volatilization and leachate potential investigation of waste streams in the FEP and WSF area of the Otter Lake Facility.

This section presents a summary of our purpose and methodology in conducting this investigation; and our interpretation of the results. The laboratory sample results are presented as tables attached to this document. Also attached is a figure indicating the relative locations of our samples. The Stantec report presents a menu of options; some of which may be considered in the future, within the boundaries of the applicable solid waste strategy, approved by HRM Council. The results influenced our option A1 opinion.

7.2. PURPOSE AND METHODOLOGY

7.2.1. PURPOSE

In preparing our Peer Review report, consideration was made of the relative volatilization, biodegradation, and leachate potential of materials in the FEP, WSF and RDF. If materials were being shredded or not shredded before going to the RDF; and if materials were being stabilized or not stabilized at the WSF before going to the RDF; what is their relative volatilization, biodegradation for producing off gas, and leachate potential?

This is significant in part because changes to these potentials may influence a changing potential in consistently meeting the facility groundwater and air quality performance goals.

The HRM RFP specifically asked for comments to be included in our report with respect to landfill off gas characteristics. How these might change if there was no FEP and WSF?

In 2011, the WSF processed about 25% of the waste material being placed in the RDF. The WSF stabilization process reduces the moisture content, and to some extent reduces the volatilization and leachate potential of the waste material. If there was no WSF to stabilize materials, would the resulting RDF infrastructure and operations be such that the overall solid waste system performance goals for groundwater and air quality still be achieved? Performance goal examples include the operating permit requirements, and not having a trend of unacceptable operational incidents or environmental impacts, as demonstrated by the trend in groundwater and air quality monitoring results in the annual reports. After reviewing the report, we sought additional information.

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7.2.2. METHODOLOGY

We were interested in the relative differences in the volatile and leaching potential between the samples, and not so much in the absolute concentrations. One sample is not a demonstrated population. HRM has detailed waste audit characterization reports.

There is also a recent CBCL report, for considering the potential of the material for biological breakdown and methane generation. We did not perceive that the long term biodegradation potential for producing landfill off gasses significantly differed if the materials were shredded or not; or stabilized or not. We contemplated that the short term volatilization and leachate potential could change among those four waste streams.

We discussed a potential analytical program with a local laboratory, and then with HRM.

At the Otter Lake facility, we took four samples while in the presence of a representative of HRM Solid Waste. Photos were taken and kept for future reference.

We took four waste samples and had a laboratory analyze them for volatile and leachate potential. We were not focussed on absolute concentrations, but relative ones between shredded and unshredded materials; between stabilized and unstabilized materials.

Figure 1 attached to this letter, indicates the relative location of our four samples:

- Sample A (FEP) is from material just off the truck, as if there was no FEP or WSF, and it was going to the RDF. This is similar to option A1 in the report we reviewed.
- Sample B (RDA) material had passed through the FEP, was unshredded, and was going to the RDF. This is similar to the majority of material now entering the cells.
- Sample C (WSF) material was shredded in the FEP / WSF but not yet stabilized.
- Sample D (RDF) was shredded stabilized material leaving the WSF for the RDF.

Each sample (2 x 1 litre) contained sufficient material to perform our desired analytical tests. Some results of the laboratory program are presented in tables attached to this investigative report:

- Table 1 – BTEX / TPH in mg/kg, and as leachate mg / litre
- Table 2 – Leachable metals in ug / litre
- Table 3 – Volatile Organic Compounds (# of distinct compounds detected)

We also had the laboratory test for moisture content, pH, and percent loss on ignition.

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Our expectation was that since Sample A (FEP) had received the least mechanical agitation, it would have the least volatilization and leaching potential. This would rise with Sample B (RDA) for unshredded material from broken bags, and rise still further as Sample C (WSF) for materials judged in the field to merit being processed at the WSF. The potential would then fall in Sample D (RDF) for material that had been processed and leaving the WSF for the RDF.

7.2.3. INTERPRETATION OF RESULTS

The moisture content was greatest in Sample A (FEP), least in Sample B (RDA), and similar in Samples C (WSF) and D (RDF). The pH values were consistently in the 5.1 – 5.3 range.

The loss on ignition indicated the greatest relative carbon content with Sample A (FEP) at 95%. The relative difference with the 72% result for Sample B (RDA) reflects the loss through volatilization of material that has now been handled and is going to the RDF. The relative difference with the 78% result for Sample C (WSF) reflects that materials chosen to be stabilized are perceived to have a greater organic content than the Sample B material. The 52% result for Sample D (RDF) reflects material that has been handled and heated.

The BTEX / TPH analysis provided an opportunity for the relative volatilization and leachability of hydrocarbons, including volatile organic hydrocarbons and polyaromatic hydrocarbons that are part of the TPH mix. Only Sample C (WSF) had detectable concentrations of BTEX solvents and BTEX leachate. Samples A (FEP) and B (RDA) had comparable TPH concentrations and leachate potential. The sample results or instrument readings were such that this screening effort was sufficient. There were no additional analysis for concentrations of volatile organic compounds or polyaromatic hydrocarbons.

The metal leaching results seemed to indicate that the potential for some metals associated with Sample A (FEP) was similar to the weighted average of 75% of the Sample B (RDA) value plus 25% of the Sample C (WSF) or D (RDF).

The relative potential of volatile organic compounds to be released into the air, was indirectly indicated by the number of distinct VOC compounds that were detected on a carbon tube placed in the sample. The relative number of VOC compounds detected was consistent with the pattern of energy applied to each waste stream. Sample A (FEP) had not been shredded or stabilized, and had 3 detectable VOC compounds. Sample B (RDA) from the waste stream that had been handled and was leaving the FEP for the RDF, had 5 detectable VOC compounds. Materials to be stabilized at the WSF were perceived in the field as having a greater volatilization and leachate potential. That is effectively why they were selected to be stabilized at the WSF. Sample C (WSF) had 15 detectable VOC compounds. Stabilized materials leaving the WSF for the RDF, as represented by Sample D (RDF) had 7 detectable VOC compounds.

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In 2011, the WSF processed about 25% of the waste material being placed in the RDF. The balance of the material entering the RDF was not shredded or stabilized, although some handling and agitation in the FEP and on the conveyor belts would reasonably have had some influence on the volatilization potential of the waste stream materials.

The sample program in this investigation is not sufficient in size to claim the results as being representative of the conditions of these inherently heterogeneous waste streams, as a whole. However we find that the results provide an interesting relative measure of volatilization and leachate potential for the waste streams as represented by:

- Sample A (FEP) is from material just off the truck, as if there was no FEP or WSF, and it was going to the RDF. This is similar to option A1 in the report we reviewed.
- Sample B (RDA) material had passed through the FEP, was unshredded, and was going to the RDF. This is similar to the majority of material now entering the cells.
- Sample C (WSF) material was shredded in the FEP / WSF but not yet stabilized.
- Sample D (RDF) was shredded stabilized material leaving the WSF for the RDF.

There are volatilization and leachate potential results where the Sample A (FEP) results are similar to a blend of 75% Sample B (RDA) plus 25% Sample C (WSF) or D (RDF) for the total mass of material entering the RDF.

Our sample results indicated some relative differences in volatile and leachate potential. We believe that the moisture content of the material is a greater indicator of the potential for a community odour reporting incident. Leachate is currently collected and treated off site. If future RDF waste material has a higher moisture content, and a greater leachate potential or concentration, we believe the existing infrastructure and flexible operational capacity is such that the current documented trends in groundwater and air quality performance at Otter Lake would continue.

In our opinion, when considering the short term volatilization and leachate potential of the waste stream materials – with or without shredding; with or without stabilization - the difference in this potential for the full mix of materials, does not significantly change enough to compromise or overwhelm the capacity of the current gas management and leachate collection, transportation and treatment systems, to achieve the desired groundwater and air quality performance goals.

In our opinion, if there was no FEP or WSF, there is sufficient infrastructure and a demonstrated operational capacity at Otter Lake, such that the trend in environmental groundwater and air quality performance would continue.

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8. BALLOON STUDY

8.1. INTRODUCTION

While preparing our Peer Review of the January 2013 Stantec Report for the Halifax Regional Municipality (HRM) titled "Waste Resource Strategy Update" report, we have also prepared this Balloon Study.

The Stantec report option A3 involved taking actions to raise the maximum height or elevation of the Otter Lake facility RDF cells.

Would increasing the maximum elevation of the cells by 15 metres, unduly intrude into the view planes of the area around the Otter Lake facility? A Dillon Consulting document for HRM outlined a scenario for a 15 metre cell height extension. HRM decision making has been based on considering the view planes of the cells from residential locations.

We conducted a "Balloon Study" where helium filled balloons were placed on the cell area. We then drove to different view planes in the area to see if the balloons could be observed.

8.2. COMMENTS ON FEBRUARY 27, 2013 BALLOON STUDY

Raising the maximum landfill height, and thus extending the landfill cell life span offers technical and economic efficiencies on a strict dollar per tonne basis of material placed in the landfill. An operation plan could describe how this would be accomplished for new cells, and also retroactively applied to already closed cells, if desired by HRM decision makers.

With respect to raising the maximum landfill elevation, this is an option that we support; and whose concepts and details, with the indicated additional information, merit serious consideration by the final decision makers.

We understand that HRM Council will make the final decision, after consulting with staff, 2013 community engagement participants, and others. After reviewing the report, we sought additional visual information in coming to our opinion.

On February 27, 2013, we set up six bright helium filled balloons at the proposed new maximum elevation over an Otter Lake facility cell. From the top of the cell we observed residential areas beside the Beechville-Lakeside-Timberlea Elementary school in Glengary Estates, and in the Maplewood subdivision. We could also see high rise apartment buildings from Clayton Park, and commercial buildings in the Bayers Lake Industrial Park.

Figure 1 attached to this letter indicates our observation locations, and their relative location with respect to the Otter Lake facility:

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- Silver Birch Drive, Hubley
- Beechville, Lakeside, Timberlea Trail south of highway 103 and east of Exist 4
- James St., Glengary Estates, Timberlea
- Johnston Ave., Greenwood Heights, Timberlea
- Brunello Estates, Exit 3, Highway 103
- Greenhead Road, Lakeside
- States Lanes, Beechville Estates
- Old Coach Road, Hatchet Lake
- Prospect River Court, Prospect

The only location where balloons were visible was from the top of a bedrock outcrop, just off HWY 103 Exit 3 in the anticipated commercial area of the proposed Brunello Estates commercial/residential/golf course community. Two balloons were visible from this location as was the crest of the existing finished cells. Due to the tree line at street level obstructing the view, the increase in height of the landfill cells may be visible from the third floor windows at the west extremity of Beechville Estates, the Timberlea-Beechville-Lakeside Elementary school and adjoining residences in Glengary Estates, and a few houses in Maplewood Subdivision.

We understand the existing landfill cells are visible from a portion of the Bluff walking trail located west of the Otter Lake Landfill facility. We interpret this to be a sightline along the Lower Marsh Lake Brook system.

We are confident that the increase in height of the landfill cells will not be visible from the other locations visited. We were told by the Indian Lake Golf Course owner that on occasion, vehicles backing up at the landfill can be heard at the golf course.

At the end of the day, the balloons were still afloat, however, they were deflated the following morning. All balloons and strings were removed from the site on February 28th.

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9. COMMENTS ON STANTEC REPORT RESPONSES TO SOME HRM RFP QUESTIONS AS PART OF THE SCOPE OF WORK

Our comments are presented on the Stantec Report Responses, to some August 2012 HRM RFP Questions as part of the scope of work.

Has the system resulted in the expected diversion and at what cost?

Some diversion rates in the integrated ~~waste~~ / resource management strategy has been a success. The residential organics diversion rate is the most notable success; while the ICI organics diversion rate is the greatest area for improvement in the overall system. The diversion rates for white goods, household hazardous goods, consumer electronics, and other items have been better as expected. In some cases, materials have not so much diverted, but are not so commonly used now (e.g. types of paint). The Stantec report notes that diversion rates have generally met expectations, and places HRM diversion statistics in the middle of the range of those reported in similar jurisdictions. The cost of the diversion rates achieved is reflected in the overall average cost to HRM of $170 / tonne of waste in the RDF. The system is seen to be more expensive when compared to other systems, however those systems do not provide the front end processing that the HRM system provides. Other Nova Scotia jurisdictions meet the applicable Nova Scotia regulations, permits, and goals without an FEP or WSF. Compared to other jurisdictions, the HRM system may be seeking to accomplish a little more with respect to diversion, but the $170 / tonne HRM cost is significantly more. Could the HRM solid waste resource management infrastructure and operations systems continue to accomplish a little more with respect to diversion, at something less than $170 / tonne? Yes, it could do so with some changes to the current HRM infrastructure and operations.

How does the HRM system compare to the National GAP statistics?

In the Stantec report, a table in Section 6.4 Comparison of Current Operations to Industry Best Practice, presents diversion statistics for Halifax and other jurisdictions. Their report states that they used the GAP methodology that is also used by Waste Diversion Ontario (WDO) for equitably measuring performance for Ontario municipalities. The Stantec diversion calculations for HRM are in a similar range as those calculated by HRM.

Compared to six Ontario municipalities, HRM has:

- A higher than average processing cost ($/tonne) for recycling processing costs
- A lower than average revenue to the system per tonne of recycled material collected
- The lowest waste generation per person rate of all municipalities in the table
- Below average all in processing costs($) / waste generation per capita (Tonne / person)

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Are the system components doing what the Strategy envisioned?

The report provided sufficient analysis to allow a conclusion that yes, the integrated waste / resource management plan has been implemented in accordance with the original strategy. The analysis supports a conclusion that some components of the system are more effective than others, and that the diversion rates for some waste streams (e.g. residential green bin organics) has been more successful than others (e.g. ICI food based organics). The report notes several challenges involving the system components and operations (e.g. quality of the compost in meeting or exceeding CCME criteria). The experienced operation of the FEP differs from what was envisaged in the 1997 Operations Plan; which in turn differed from the aspirations in the 1995 CSC Strategy.

Meeting CCME quality standards has been difficult; this has primarily been a result of the poor quality IC & I material affecting the operation of the compost facilities. The original strategy assumed the final compost material would be marketable and result in revenue for the system, which has not been the case. The operation of the FEP differs from the original strategy in that organics are not diverted from landfill disposal. However, what is perceived as being the waste arriving at the FEP having the more volatile organic component, is separated and processed at the WSF, and then deposited in the RDF landfill cell.

The WSF process is intended to be a stabilizing one that reduces the potential – among other things - for the material to cause reportable community odour incidents. That reduction in this potential by the current WSF process, may be more of a function of the reduced moisture content, than from more physical or chemical bonding that is stabilized regardless of the moisture content of the material. When the material is unsaturated – or does not have the void spaces within it flooded with water - a greater moisture content better enables the transfer of organics from the material into the air. HRM field experience leaves the perception that the potential of the material leaving the WSF to contribute to a community odour incident, increases with a rise in the moisture content of the material from when, for example, the material leaving the WSF is wetted by rainwater when it is soon deposited in the RDF.

What are the conditions of the existing assets?

The report has not provided a condition assessment of existing assets. The report does however mention several system components (MRF, FEP) are nearing their useful design life; however building and equipment inspection results are not provided.

Are there flawed assumptions in the integrated strategy?

The report does not directly address this question; however the analysis clearly identifies factors that have required changes to the original integrated strategy. As mentioned previously, the assumed revenue from compost operations has not proven to be correct. The strategy also assumed technologies would be available to efficiently remove organics and recyclables during the FEP process, however this has not been proven to be the case. An earlier vision assumed

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the RDF would be operated as a dry system, and this is also not the case. While the residential green bin organics do not go into the RDF landfill cell, some stabilized and un-stabilized ICI organics are being deposited in the RDF. Relative to other waste in the RDF landfill cell, gas released from these ICI organics happens quicker, at a higher concentration, and for a shorter period of time. The strategy envisioned an evolving system (e.g. the role of the FEP / WSF infrastructure and operations), with diversion success based primarily on the stewardship model. The assumption has proved correct for the residential sector, but not so accurate for the IC & I sector. The "system components" discussion above cautioned about describing the reduced potential of waste leaving the WSF as being the result of chemical stabilization, or essentially being the result of a sometimes temporary reduction in moisture content.

The 1995 CSC Strategy, which was adopted in its principles by HRM for their operations, noted that (for infrastructure components such as the FEP and WSF) "these sites will operate to maximum potential and be scaled down in a planned manner as source-separated centralized composting scales up." The composting capacity of the system has scaled up from the 1990's, and will increase in the future, by one means or another. HRM decision making about this evolution in infrastructure and operations would be such that HRM will "provide systems which manage the collected residues in a cost effective and environmentally sustainable manner."

Is the ICI model optimized and at who's benefit?

The report does not provide a detailed analysis of the ICI waste management model. The report provides an overview of the constraints imposed on the commercial sector as a result of the by-law provisions, and discusses the overall impact of the ICI materials on the system capacity and operations. The original Strategy assumed Commercial tipping fees would be an important revenue stream used to offset the costs of processing the ICI waste materials. The report does not provide a business case analysis of the revenues and costs associated with the management of ICI mixed wastes and organics. For the ICI organic materials at the composting facilities, the $75/tonne tipping fee is less than the $160/tonne cost to HRM. For the ICI waste sent to the RDF landfill cells, the $125/tonne tipping fee is less than the $170/tonne cost to HRM. The ICI tipping fees provide some useful economies of scale revenue to the HRM system.

What is the impact of changing the existing model and separating ICI from the residential waste management system?

The report identifies problems in achieving compost quality guidelines and attributes this to the poor quality, wet, saturated ICI organic material at the compost facilities. Based upon the analysis presented in the report, the removal of the ICI organics from the residential organics would have a positive impact on compost quality. The report discusses anaerobic digestion as a potential treatment alternative for ICI organic materials at the composting facilities, given the constraints of the By-law to limit cross municipal boundary movement of materials. The removal of ICI material would also impact tipping fee revenues.

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Are there Provincial legislative or regulatory implications?

Several of the options recommended in the Stantec report may have potential technical or economic merit. While they differ from current infrastructure and operations, they can be considered to be within the context of an evolving system that meets overall goals in a cost effective and environmentally sustainable manner. The infrastructure and operational response can evolve from what was the 1990's waste streams, to what is and can be reasonably anticipated as being the evolved waste streams of today and tomorrow. HRM Council will decide the next evolution of the HRM Integrated Solid Waste Management System (ISWMS).

The Stantec report states that they conducted their work on the assumption that there would be no change to Section 16.3 of the HRM By law S-600 (i.e. causing much of the ICI waste streams to be processed in HRM system facilities). Some speculation about potential arrangements with other jurisdictions might imply a change in this By law.

The Stantec recommendation regarding changes to the landfill liner design specification, seeks to change the provincial Municipal Solid Waste Landfill Guidelines. In reading Section III 1 b) of the guidelines, perhaps a site specific proposal would instead best meet HRM's interests.

Section III 1 b) "In the event that a proponent advocates an alternative design to the minimum standard, it will be the responsibility of the proponent to demonstrate to the satisfaction of the Department that the proposed alternate design is capable of achieving an equivalent or higher level of protection than the minimum standards. Any proposal for an alternate design will be assessed on the technical merits of the design and will be evaluated on a case by case basis."

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10. TESTING STANTEC RECOMMENDATIONS AGAINST THE 1995 STRATEGY

10.1. DEVELOPMENT AND CONTEXT OF THE 1995 CSC STRATEGY

The Community Stakeholder Committee was created in the context of a municipal waste management crisis. In the early 1990s the Upper Sackville Landfill was nearing its maximum capacity, and was known for environmental issues, including leachate generation and odour. The agency responsible for solid waste management on behalf of the four participating municipalities had proposed an Energy from Waste (EfW) project (i.e. Incineration) as a solution to the existing system. In accordance with regulatory requirements, the EfW project was subject to an Environmental Impact Assessment (EIA) process. As an outcome of the EIA process, the decision of the Minister of the Environment was to reject the incineration project.

This situation led to the County of Halifax, acknowledging that any future landfill site serving the four member municipalities would be located on property within its administrative boundaries, accepting responsibility for developing a new municipal waste management strategy on behalf of those four municipalities.

Over a 15 month period, under this framework of commitment, the Community Stakeholder Committee was established, and through an extensive series of meetings of both the CSC and subcommittees (termed working groups at the time) created by it, the Integrated Waste Resource Management Strategy was developed. A consensus based process was applied in all meetings. The strategy which was created was then voted on and "accepted in its principles" by the new HRM Council in 1996. The fundamental premise of the strategy was stewardship: that waste was to be considered as a resource, and that through a series of aggressive diversion and recycling programs, valuable materials would be recovered, and the residual waste stream requiring landfilling would thereby be minimized. An associated concept was the processing of the residual waste stream (to stabilize the organics) before placement in the landfill. This concept was also a foundation principle for the site selection process of the new landfill.

In 1996 the amalgamated Halifax Regional Municipality was created, encompassing the four municipal units. The HRM developed its 1997 Operations Plan which reflected the CSC Strategy, which was then the basis for financing and implementing the components of the integrated waste management system, which is in place today.

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10.2. TESTING RECOMMENDATIONS AGAINST THE 1995 CSC STRATEGY

The Stantec recommendations are guided by the Scope of Work objectives. The objective is to ensure that the integrated solid waste resource management system can be flexible, and can evolve to meet changing capacity requirements; to achieve diversion objectives; to satisfy regulatory requirements; to be consistent with HRM environmental stewardship requirements; and to promote program efficiencies.

The Stantec recommendations do relate to what changes to the Integrated HRM Solid Waste / Resource Management System, might be financially more efficient, while still maintaining the underlying principles of the 1995 CSC Strategy. Several of the options that Stantec recommends would benefit from additional information than what is presented in the report itself, in the process by which they may be considered by HRM Council. We have suggested what that additional information could include in our specific comments on each option recommended by Stantec. The Stantec report appears to have been consistent with the 1995 CSC Strategy "in its principles." Any potential program changes involving the options Stantec has recommended would be expected to happen after feedback has been provided from the Community Engagement process to HRM Council, which would then make the final decisions in an open public manner.

It was recognized in the 1995 CSC Strategy that the system would evolve. One overriding principle of the 1995 CSC Strategy was Stewardship. For the most part, the recommendations are consistent with this principle; one specific area that may require further evolution, and application of the principles of stewardship, is the management of IC & I waste streams.

The following is from the 1995 CSC Strategy. "To ensure the maximum diversion of organic content is achieved prior to the opening of new residuals disposal facilities, the Strategy includes front end processing facilities to divert the remaining "third stream" mixed wastes. At these facilities, residual organic material will be separated and processed. Beginning with the approved opening of new residuals disposal facilities, these sites will operate to maximum potential and be scaled down in a planned manner as source-separated centralized composting scales up.

To achieve the Strategy's waste diversion goals, the following is required:

- Encourage waste reduction at source for all sectors of society, supported by independently funded programs and personnel.
- Provide source-separated multi-stream collection and handling and a household hazardous waste (HHW) depot for all residential generators by January 1, 1997. This refers to all residential generators now served by municipally-sponsored collection contracts.

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- Establish incentive-based means of achieving stewardship and source separation for all IC&I generators.
- Provide systems which manage the collected residues in a cost effective and environmentally sustainable manner."

Source separated centralized composting has scaled up, and since 1995, the success in this particular program - where the residential green bin materials are composted and do not go the residuals disposal facility at Otter Lake - has significantly changed the composition of the waste stream arriving at the RDF.

It would seem that scaling back on facilities such as the FEP and WSF infrastructure and operations, would be consistent with the 1995 CSC Strategy if a significant portion of organics with relatively high volatilization and leaching potential (e.g. residential green bin organics) are no longer going to RDF landfill cells; and if this was a cost effective change that is managed in an environmentally sustainable manner.

Within this context, we note that the following major options recommended in the Section 12 Stantec Report, are changes to current infrastructure and operations, that could be cost effective and managed in an environmentally sustainable manner, and in that sense be consistent with the 1995 CSC Strategy:

- Stantec A1 – Closure of FEP and WSF by the end of 2013
- Stantec A2 – Request Modification of the Nova Scotia Landfill Liner Specification
- Stantec A3 – Extend Life of Otter Lake Landfill Through Vertical Expansion
- Stantec B1 – Create a Centralized Waste Resource Campus
- Stantec B2 – Relocation of MRF to Campus

Additional information, especially for Options A2, B1 and B2, would be useful before HRM Council makes any final decision making. Still the potential in these options to be cost effective and managed in an environmentally sustainable manner, merits some consideration, preferably with some additional information. We have suggested such additional information, along with some potential budget estimates, in a separate letter to HRM.

10.3. 2013 COMMUNITY ENGAGEMENT PROCESS

Any potential HRM solid waste resource management program changes involving the options Stantec has recommended would be expected to happen after feedback has been provided from the Community Engagement process to HRM Council, which would then make the final decisions in an open public manner.

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The Stantec report and this peer review are part of a process that started when HRM Council voted to have staff look into ways by which the infrastructure and operations might evolve in response to the changes in the waste streams. The options subsequently identified, this peer review, the community engagement, the additional information, and more are steps in the same process where HRM Council will make the final decisions about what will change.

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11. RESULTS OF THE PEER REVIEW

Section 4 reviews specific sections of the January 2013 Stantec report "Waste Resource Strategy Update Report." The corresponding sections of the August 2012 HRM RFP and the Stantec report are identified. The applicable conclusions and recommendations are stated. We have then typically identified portions or quotes from the section being reviewed, and offered comments. Section 7 presents our opinions on the recommendations.

As per our HRM RFP, the focus of the peer review is on the Stantec report Section 3 - Otter Lake Waste Processing and Disposal Facility, and the Stantec report Section 4 - Landfill Design. The peer review tested both the methodology and validity in accordance with the RFP. Descriptions of the peer review tests are summarized below.

Peer Review Tests

The indicated Stantec report Sections, conclusions and recommendations were reviewed and tested, based on the test descriptions in the HRM RFP for:

- Test A – System Performance
- Test B – Benchmark Analysis and Best Practices
- Test C – Options Analysis and Recommendations

For each test, we made consideration with respect to:

- (Methodology) The extent to which there was a declared or identified methodology that was demonstrated to have been followed in the report, that resulted in the conclusions and recommendations.
- (Validity) How compelling was the report text in supporting or proving the validity of the conclusions, recommendations, and cost estimates provided.

Summary of Peer Review Tests

We have also prepared a tabulated summary of the results we found in applying tests A, B, and C, to recommendations A1, A2, and A3 in sections 3 and 4 of the January 2013 report, with respect to the methodology and validity of recommendation derivation presented.

Providing a greater focus of our peer review evaluation on the A1, A2, and A3 recommendations in Sections 3 and 4 of the Stantec report reflects our contracted scope of work. The same table was not produced with respect to the B or C group of Stantec recommended options for HRM.

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Table 1: Summary of Peer Review Test Results for Options A1, A2 and A3

Recommendation A1 - Closure of the FEP (Front End Processing unit) and WSF (Waste Stabilization Facility) by the end of 2013		
Refer to our Section 11.1.5 Methodology of Recommendation Derivation in Stantec Section 3. Refer to our Section 11.1.6 Validity of Recommendation Derivation in Stantec Section 3.		
Test A – System Performance	for Methodology	Yes - Partially
Test A – System Performance	for Validity	Yes - Partially
Test B – Benchmark Analysis and Best Practice	for Methodology	Not comparable
Test B – Benchmark Analysis and Best Practice	for Validity	Not comparable
Test C – Options Analysis and Recommendations	for Methodology	Yes - Partially
Test C – Options Analysis and Recommendations	for Validity	No
Recommendation A2 – Request Modification of the Nova Scotia Landfill Liner Specification		
Refer to our Section 11.2.1.1 Methodology of Recommendation Derivation in Stantec Sec. 4.1. Refer to our Section 11.2.1.2 Validity of Recommendation Derivation in Stantec Section 4.1.		
Test A – System Performance	for Methodology	With more info. – Yes
Test A – System Performance	for Validity	With more info. - Yes
Test B – Benchmark Analysis and Best Practice	for Methodology	Yes
Test B – Benchmark Analysis and Best Practice	for Validity	With more info. - Yes
Test C – Options Analysis and Recommendations	for Methodology	With more info. - Yes
Test C – Options Analysis and Recommendations	for Validity	No
Recommendation A3 – Extend Life of Otter Lake Landfill through Vertical Expansion		
Refer to our Section 11.2.2.1 Methodology of Recommendation Derivation in Stantec Sec. 4.2. Refer to our Section 11.2.2.2 Validity of Recommendation Derivation in Stantec Section 4.2.		
Test A – System Performance	for Methodology	Not applicable
Test A – System Performance	for Validity	Yes
Test B – Benchmark Analysis and Best Practice	for Methodology	Yes
Test B – Benchmark Analysis and Best Practice	for Validity	No
Test C – Options Analysis and Recommendations	for Methodology	Yes
Test C – Options Analysis and Recommendations	for Validity	Yes

We also considered and made comments with respect to the completeness of the section. How completely did the Stantec report respond to the deliverables being sought for in the HRM RFP. What, if any, were highly significant deliverables sought by HRM that were not in the January 2013 report.

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11.1. OTTER LAKE WASTE PROCESSING AND DISPOSAL FACILITY

What Was Sought and What Was Delivered

In the HRM RFP dated July 2012, three (3) key objectives were established with respect to the waste processing and landfill operating model. The objectives listed in Section 5.1.1 of the RFP are included below:

a. Review the current landfill operating model which includes waste processing and provide a performance assessment in comparison to other municipal systems. Complete a system assessment to validate the operating models outcomes in terms of the original 1997 Operations Plan objectives. Make recommendations on evolving the existing model to recognize the changes in the waste stream that have occurred over the past 15 years from the original content.

b. Provide a comprehensive examination of the strategy components related to the Waste Processing & Landfill Operating Model, processes, practices, costs and a bench mark industry analysis to provide a detailed recommendations report on evolving the strategy with options to meet diversion objectives and achieve efficiencies in order to deliver a more fiscally sustainable solid waste program for HRM. This assessment shall include a cost benefit analysis of the current landfill cell height criteria and the corresponding financial implications in terms of cost per tonne for increasing the cell height/volume in increments of 5 meters.

c. Provide recommended changes to the existing operating model and policies, and assess their impacts on the existing program in terms of environmental stewardship, community impacts, facility operations and program costs.

The *Waste Resource Strategy Update* report reviews the front end processing and waste stabilization facility in Section 3.0 Otter Lake Waste Processing and Disposal Facility. The following conclusions related to the landfill operating model are from Section 12.1 of the report.

> "1) *The total diversion rate is high in HRM compared to other municipalities, but realistic opportunities exist to improve the recovery of residential and ICI recyclables and organics in accordance with provincial legislation."*
>
> 2) *The front-end processing (FEP) and waste stabilization facility (WSF) at Otter Lake no longer provide a useful function compared to their stated purpose in the 1995 Strategy.*"

The following landfill options were recommended in Section 12.2 of the January 2013 report.

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"A1 – Closure of the FEP and WSF by the end of 2013

The FEP and WSF do not function in a manner envisaged in the 1995 CSC Strategy, or when the 1997 Operations Plan was prepared. These facilities were intended to stabilize organic wastes and produce a low grade compost product. Few organics are now actually processed, and the multiple shredding of the waste prior to disposal may actually increase the generation of landfill gas over the short term in the period before gas collection systems can be installed. Implementation of this recommendation is contingent on HRM implementing a separate collection for white goods (stoves; refrigerators) rather than the current practice of loading these items in with the regular curbside waste and then removing the appliances from the waste at the FEP. The annual cost to operate the FEP and WSF is reported to be $8.9 million per year. Most of this amount could be recognized as sustainable savings less any contractual commitments."

11.1.1. COMMENT ON STANTEC REPORT 3.1 EXISTING OPERATIONS

11.1.1.1. Comment on Stantec Report 3.1.1 Front End Processing (FEP)

The report states that "no significant effort is made to remove compostable materials such as wet paper, cardboard, or other recyclables from the conveyor lines." During our January 10, 2013 visit to the Otter Lake facility, the observed bales of cardboard, and large pieces of paper may have been from what had accumulated over several months. The 250 tonnes of baled cardboard and paper products diverted from the RDF landfill cell at the FEP in 2011, were an insignificant portion (< 1%) of the 140,500 tonnes of materials that arrived at the FEP in 2011. Paper and other wastes too small to be baled continued along the FEP line to the WSF / RDF.

The Stantec assessment provides some discussion on the removal of white goods and scrap metals but does not describe how this process works. This separation of materials happens on the tip floor.

In fact, the Waste Resource Strategy Update Report (WRSU) provides little explanation why "no significant effort" is being made to recover organics and recyclables at the FEP.

"The rationale for sending smaller particles to the WSF was the assumption that most compostable organics would be smaller than most non-compostable materials after coarse shredding". This statement is unsupported by waste characterization information. It is also unclear how the size of the material particles (coarse) was selected, and if the equipment successfully shreds' the material to this particle size.

The summary diagram provided on the Stantec Report Page 3.2 indicates that 73,500 tonnes of mixed waste material, with their black bags broken open, were sent to the landfill in 2011. Residential green bin food wastes do not go to the FEP or end up in the RDF. Some organics

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are in the waste streams, especially in some mixed ICI waste. The WSF dries some small sized, typically non food organics like paper before it goes to the RDF (e.g. 22,600 tonnes in 2011). The FEP / WSF processes reduce but do not eliminate the potential volatilization, biological breakdown, and leaching potential of these organics entering the RDF. Could an acceptable level of environmental protection be the result of different infrastructure and operations? Yes.

11.1.1.2. Comment on Stantec Report 3.1.2 Waste Stabilization Facility (WSF)

The result of the WSF process reduces the volatility, leaching, and biodegradation potential, of some compostable materials (i.e. stabilizes them). These materials are more apt to be small paper, and typically are not food, lawn or yard waste. Conventional aerobic composting is a suitable stabilization process. The effectiveness of the compost process could be further defined with additional characterization information as measured at the end of the compost cycle. The short term off-gas being volatilized by the FEP - WSF stabilization process is being effectively addressed by piping it through the WSF bark bio-filter. We do not perceive that the WSF process results in a significant change in the long term methane off-gas potential from the biological breakdown of organic hydrocarbons. Could an acceptable level of environmental protection be the result of different infrastructure and operations? Yes. Could the HRM system benefit by using some WSF infrastructure in an alternative but cost effective way, to compost source separated organic materials that are not to be placed in the RDF landfill cell? Yes.

The report does not provide comment on the condition of the system and the remaining useful life of these facilities. The compostable quality of the WSF stabilized material is such that it is effectively "garbage." It is not an economic resource, and it is not suitable for further processing and re-use.

11.1.1.3. Comment on Stantec Report 3.1.3 Residual Disposal Facility (RDF)

The report was to provide a performance assessment of the RDF in comparison to other municipal systems. The report concluded "Stantec is of the opinion that the RDF is generally well designed and operated". While we agree with this statement, it would be appropriate to support this conclusion with references to regulatory inspection results, HRM operational reviews, and compliance monitoring data. The design and operation of the RDF meets the provincial regulations as evidenced by the regulatory approval. There is no assessment of the RDF operational performance (in comparison to other municipal systems) or if the infrastructure (roads, scales, daily and final cover systems, surface water drainage etc.) is in good repair.

The impact of the use of shredded mixed waste on the RDF capacity, verses typical non-processed waste would also provide information necessary to assess the overall cumulative effect of the FEP, WSF, RDF, collection systems, composting facilities, and recycling programs. Changes to any one of these variables, may be offset by changes elsewhere. Could an

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acceptable level of environmental protection be the result of different RDF infrastructure and operations? Yes.

11.1.2. COMMENT ON STANTEC REPORT 3.2 COMPARISON OF CURRENT OPERATIONS TO THE 1995 STRATEGY

11.1.2.1. Comment on Stantec Report 3.2.1 Front End Processing (FEP)

The 1995 Strategy states that "The processing of mixed residues from both residential and IC & I sectors is required to ensure that usable and/or inappropriate materials are removed before delivery to the residuals disposal facility". In addition "recyclable materials will be processed . . . and routed to markets" and "compostable materials that are recovered from the mixed waste stream will be processed in composting facilities separate from the source separated compostable facilities."

From the 1995 Integrated Waste/Resource Management Strategy (IWRMS): "To ensure the maximum diversion of organic content is achieved prior to the opening of the new residuals disposal facilities, the Strategy includes front-end processing facilities to divert the remaining "third stream" mixed wastes. At these facilities, residual organic material will be separated and processed. Beginning with the approved opening of new residuals disposal facilities, these sites will operate to maximum potential and be scaled down in a planned manner as source-separated centralized composting scales up."

Given the reasonably successful curb side diversion rate of residential green bin organics, the planned expansion of centralized composting facilities, the operational and the covered RDF cells, and the intended HRM effort to better separate organics from within the ICI waste streams, the low percentage of "third stream" wastes to be separated from what is being conveyed to the RDF, the maximum potential for the FEP operations has already passed, and consideration of scaling back FEP operations is consistent under these circumstances with the 1995 CSC Strategy.

The report states that "the waste stream in 1995 contained large amounts of both recyclable and compostable materials which the FEP was intended to remove". This statement is correct, and in the context of the broader integrated strategy, expected. The compostable material arriving at the FEP is not the green bin food organics and the lawn and yard waste that is typically composted elsewhere. The ICI waste arriving at the FEP includes sometimes significant portions of compostable material such as food organics.

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"The FEP does indeed process all waste received, but there is little benefit gained from this activity as few recyclables are recovered and no useful or valuable compost is produced." The FEP processes all of the waste it receives. Organics received at the FEP go to the RDF either directly or indirectly through the WSF.

Significant portions of materials collected through the HRM solid waste resources management program, do not arrive at the FEP as they are successfully diverted elsewhere (e.g. blue bag / cardboard program, and compost facilities) by the system collection methods (e.g. green bins). Some wastes arriving at the FEP are diverted away from the RDF landfill cells, such as those under the white goods, and household hazardous materials programs.

The technical design and contracted operational requirements of the FEP (e.g. between HRM and MIRROR) are based on the HRM Council supported 1997 Operations Plan, and the implementation agreements. These came after the 1995 CSC Strategy or IWRMS.

The figure on page 3.2 of the reviewed report graphically shows that FEP functions include the diversion of household / special wastes (e.g. paints and solvents), paper fibres (e.g. large cardboard and paper), large items, bottles, white goods and scrap. Small sized compostable materials (e.g. smaller than 150 mm / 6 inch) are diverted to the WSF. From the WSF, after reducing but not eliminating the volatilization, leaching, and the methane producing biodigestable potential of these materials, the small sized compostable materials (22,600 tonnes in 2011) are conveyed to the RDF. The same figure indentifies the 73,500 tonnes of mixed waste, including (>150 mm / 6" sized) compostable materials, that is sent directly to the RDF. The total amount of materials directed to the RDF in 2011 was 135,600 tonnes.

Some material at the FEP has a relatively low potential to result in an immediate odour release through volatilization, leaching, and the methane producing biodegradation process. This material goes directly to the RDF. The report did not note apparent community odour incident issues, but our later discussions with HRM staff confirmed that in the fall of 2001, there were community odour incidents from earlier than expected landfill gas production. The "ad hoc" gas management system was the response to the 2001 incidents, and it continues to operate in 2013. This manages gas in the short term being released from the RDF landfill cell waste, but before the cell is capped and the long term gas management infrastructure is put in place. The fall 2011 community odour incidents are associated with heavy rainfall while capping Cell 5.

Shredded material at the FEP with a relatively high volatilization and biodegradation potential, (<150 mm / 6" size) goes to the WSF first for the stabilization process. A high percentage of this includes organics from the mixed ICI waste stream. The result is a waste product, not a compostable material additive, and is not an economic resource. The residential green bin food waste produces - not sent to the FEP / WSF but to the dedicated compost facilities elsewhere in HRM – does produce a compost product.

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The Stantec report also makes no reference to how the current HRM operation conforms to the Provincial Solid Waste Management Regulations and the related provision that bans organics and some other materials from landfills. Other jurisdictions in Nova Scotia meet the same provincial guidelines with different infrastructure and operations (i.e. without an FEP or WSF). The municipal source separated composting programs are the responses by HRM and other jurisdictions to the applicable provincial requirements banning organics from landfills. The provincial operating permit for the Otter Lake facility reflects the infrastructure and operations being used. Where there is different infrastructure and operations, such as in other jurisdictions in Nova Scotia, or possibly with Otter Lake in the future, a different provincial operating permit would be prepared.

Could the targeted level of environmental protection continue to be achieved with different infrastructure and operations? Yes.

11.1.2.2. Comment on Stantec Report 3.2.2 Waste Stabilization Facility (WSF)

"The 1995 Strategy recognized that the output from the WSF would be low quality compost, but it was anticipated that it would still be a valuable and useful resource. In contrast, the 1997 agreement between HRM and MIRROR specifically identifies that all WSF output is to be placed directly in the RDF." The perceived or desired usefulness of the processed WSF waste differed between the 1995 CSC Strategy and 1997 HRM Operations Plan documents.

In the context of the HRM operations plan and agreements with MIRROR, it may be that the WSF is achieving something less than stabilization. For some small sized compostable shredded material from the FEP, the WSF may be reducing but not eliminating the potential for an immediate odour release through volatilization, leaching, and the methane producing biodegradation process. The WSF process may be somewhat reducing the moisture content of the waste leaving it on a temporary basis, but which then increases after arriving in the RDF.

The WSF process reduces the moisture and organic content of the waste. Water and carbon dioxide result from the biological breakdown of hydrocarbons. The captured off-gas – volatilized hydrocarbons, carbon dioxide, and more - is effectively addressed environmentally by piping it through a WSF bark bio-filter. That the economic potential of the compost material is negligible, owes much to the success of collection programs that divert green bin residential food waste away from the Otter Lake FEP / WSF / RDF facilities. The quality of the ICI mixed waste stream is such that while compost is not produced, there remains some volatilization, leaching, and biodegradation potential. From the FEP and WSF processes, this waste ends up in the RDF.

Could the targeted level of environmental protection continue to be achieved with different infrastructure and operations? Yes.

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11.1.2.3. Comment on Stantec Report 3.2.3 Residual Disposal Facility (RDF)

"The environmental performance of the landfill has also been acceptable compared to the expectations in the 1995 strategy" The Stantec report provides little supporting information on the condition of the existing landfill (See Section 3.1.3) or on the effectiveness of the RDF operations. However, the RDF is a permitted facility which conforms to the provincial design and operating requirements, as evidenced by the regulatory approval.

A primary consideration is reviewing the actual cell life versus projected cell life, and if discrepancies exist, to explore these. The Stantec report states that a "significant deviation from the 1995 Strategy is that all output from the WSF is sent to the landfill." Instead of being a resource, the material leaving the WSF process is effectively garbage; albeit, drier and less likely to have volatilization or short term odour producing characteristics. Attempting to mix the loose, dry, light WSF material with compost facility material, would lower the quality of the compost and present some technical challenges. The material leaving the WSF is not suitable as cover material in the RDF, as it is too light, so it is deposited as waste or garbage in the RDF.

If those materials currently being stabilized in the WSF were instead sent directly to the RDF, would the environmental performance goals with respect to gas release and leachate potential still be achieved? In considering the experiences in other jurisdictions; what happened at Otter Lake when the WSF was not operating for a seven month period from May to December 2010; and our interpretations of the February 2013 waste stream sample laboratory results for relative volatilization and leachate characteristics, we find the answer to that last question to be yes. If so, is the long term incremental improvement in gas release and leaching potential for materials through the WSF stabilization process, a worthwhile investment? We find the answer to be no. If the materials were not stabilized through the WSF process, we believe there is sufficient capacity in the current Otter Lake facility infrastructure, capacity, and operations, to meet its environmental performance goals, and to do so in a more resource efficient manner.

About half of the waste entering the RDF (in 2011, 73,500 tonnes of 135,600 tonnes) is a mixed waste stream from the FEP that includes some compostable organics from the ICI waste and residential waste streams. Does the shredding provide a net economic benefit, when considering the downstream impacts on gas release and collection, and similarly for leachate?

HRM's analysis presented in the Next Steps Paper No. 2A identifies 29,805 tonnes/year of organics and recyclables, that could be potentially diverted from this waste stream. Typically it is some of the organics from the mixed ICI waste stream that is being processed at the WSF. Approximately 250 tonnes of paper fibre and 50 tonnes of recyclables were diverted from the 2011 waste stream arriving at the FEP. That 300 tonnes of material diverted from the RDF landfill cell is about 1% of 29,805 tonnes.

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The impact of shredded mixed waste on the rate of landfill gas generation is discussed. This rate increase is a combined result of the mechanical and thermal energy applied to the waste during the FEP / WSF process, and the physical, chemical, and biological characteristics of the organics that are not removed or stabilized before they arrive at the RDF. The Stantec report concludes that the shredded organic waste in the FEP/WSF increases the potential for community odour impacts compared to a scenario where the FEP/WSF did not exist.

We understand that in the RDF since 2002, whatever is the currently uncapped cell receiving waste, is where the short term "ad hoc" gas management measures are being used. During the seven month period from May – December 2010 when the WSF was closed for repairs, this "ad hoc" system has controlled the landfill gas being released such that there were no reported community odour incidents except for the fall of 2011. In the fall of 2011, significant rain events contributed to delays in placing clay for capping the cell that was just filled. Since 2002, with the exception of the fall of 2011, the HRM performance goal of minimizing the number of reported community odour incidents has been achieved. The additional cost to HRM for maintaining the "ad hoc" gas management system is approximately $750,000 per year.

The mechanical and thermal energy received by the waste entering the FEP / WSF is understood to result in the relatively more rapid, short term release of gas at greater concentrations, but ultimately being released for a shorter period of time. After 2002, the new "ad hoc" short term gas management infrastructure and operations at the RDF landfill cell have resulted in there being limited reported community odour incidents, except for in the fall of 2011. If the current FEP and WSF actions were not happening, and the waste was not receiving the extra mechanical and thermal energy, the volatilization and release of gas from wastes entering the RDF landfill cell, would occur for a longer period of time, but at a slower rate, and at a reduced gas mass in air concentration.

Materials that have been sent directly from the FEP to the RDF have a relatively low potential for short term volatilization, leaching and biodegradation. That potential is greater for the materials selected, shredded, and entering the WSF stabilization process. That potential in the WSF materials is somewhat reduced when the processed materials are then sent for disposal in the RDF. Those materials collected by the HRM system, with the highest volatilization and leachate potential, are not in the waste materials at the Otter Lake FEP / WSF / RDF facilities, but the potential resources resulting from treatment at the compost facilities elsewhere in HRM.

There have been community odour impacts, and these are more typically associated with the partially filled RDF cells, when rain increases the moisture content of exposed waste in the RDF.

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A capacity now exists in the partially filled RDF cell, to intercept and capture the gas that might otherwise lead to potential community based odour incidents. This involves a group of full time staff, temporary piping, air blowers, and the permanent gas control measures for the completed cells.

Shredded materials in the RDF, given their relative particle size and homogeneous mixing, are likely to more rapidly release volatilized gas, and methane from biodegradation in the short term, compared to unshredded materials. Moisture content and oxygen are also critical factors. The reviewed report did not note that removing the FEP/WSF will not eliminate the production of landfill gases; it would just occur over more years, in a more controlled setting.

There would be a decrease in density of mixed waste placed in the landfill cell if the current shredding process is discontinued. The cumulative influence of this and changing compaction efforts on the landfill capacity and program financial efficiency, was not evaluated in the report. After reviewing the report we sought additional information, presented elsewhere in this document, to respond to these questions.

11.1.3. COMMENT ON STANTEC REPORT 3.3 COMPARISON OF CURRENT OPERATIONS TO INDUSTRY BEST PRACTICES

11.1.3.1. Comment on Stantec Report 3.3.1 Front End Processing (FEP)

The Stantec report indicates they could find no direct comparisons to HRM FEP process. This makes a comparison to industry best practices difficult.

The report would benefit from a discussion on effective ways to better separate the more volatile and leachable food based organics from the mixes encountered in the ICI waste stream. Either doing so economically at the curb side source, or at central location, or both, is a desirable practice for the HRM system. Of the ICI waste entering the HRM system, some is sufficiently organic to go to the compost facilities and not the RDF. What goes to the FEP – WSF infrastructure sometimes is a mix of organic and other wastes. This waste does go to the RDF.

The FEP – WSF infrastructure and operations do not provide a value added outcome with respect to off-gas volatilization, and the potential for community odour incident potential, because of the demonstrated performance of the gas management infrastructure and operations at the RDF.

However, based on the existing operation of the FEP there is little bench-marking to report.

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11.1.3.2. Comment on Stantec Report 3.3.2 Residual Disposal Facility (RDF)

The Stantec report confirms the design and operational standards for the RDF are stringent compared to landfills operated in most comparable jurisdictions. This is supported by information presented in the Liner Design Section.

11.1.4. COMMENT ON STANTEC REPORT 3.4 OPPORTUNITIES FOR OPERATIONAL IMPROVEMENTS

11.1.4.1. Comment on Stantec Report 3.4.1 Front End Processing / Waste Stabilization

The report considers four (4) options for consideration by HRM. The following option was recommended:

"Option A1 – Closure of the FEP and WSF by the end of 2013

"The FEP and WSF do not function in a manner envisaged in the 1995 Strategy. These facilities were intended to stabilize organic wastes and produce a low grade compost product. Few organics are now actually processed, and the multiple shredding of the waste prior to disposal may actually increase the generation of landfill gas over the short term in the period before gas collection systems can be installed. Implementation of this recommendation is contingent on HRM implementing a separate collection for white goods (stoves; refrigerators) rather than the current practice of loading these items in with the regular curbside waste and then removing the appliances from the waste at the FEP. The annual cost to operate the FEP and WSF is reported to be $8.9 million per year. Most of this amount could be recognized as sustainable savings less any contractual commitments."

With respect to continuing to achieve the annual goal of minimizing community odour incidents associated with the Otter Lake facility, does the current FEP – WSF infrastructure and operations make a technical contribution at an economic cost? A relatively minor contribution is made in that the total mass of potentially released organic gas mass underwent a minor reduction in the WSF. This minor reduction in the total long term gas release potential is achieved at a net cost to HRM of approximately 9 – 10 million dollars a year, plus the extra short term "ad hoc" gas management infrastructure at the RDF for the short term, rapid release of high concentration gas mass into the air. Can the RDF infrastructure and operations adequately address this in a more cost effective manner? Yes, as demonstrated when the WSF was not operational for a seven month period.

Perhaps a different way of looking at this is if the intended environmental goals are being achieved. The environmental goals include minimizing the number of community odour incidents; and no releases to the air or groundwater that result in an unacceptable human

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health or environmental risk or hazard. Performance goals are also in the operating permit. The 1995 CSC Strategy had a vision for achieving this. The follow-up 1997 facility operations plan, influenced the design and operation of the infrastructure and operations to achieve this, but with some differences, or more detailed clarifications from what was in the 1995 CSC Strategy. In 2012, the FEP, WSF, RDF, collection systems, composting facilities, and the balance of the HRM solid waste program, together act in a way to achieve those same environmental performance goals.

Could an acceptable level of environmental protection be the result of different infrastructure and operations? Yes.

Would a changing mix of waste arriving at Otter Lake, mean that different infrastructure and operations could continue to provide acceptable environmental protection? Yes.

Does the reviewed report provide a compelling case in support of the recommendation to close the FEP and WSF? After reviewing the report, we sought additional performance, financial, and technical information. We agree with the option recommended in the report, and that it merits detailed consideration by the final HRM decision makers.

The report provides some discussion and rationale as to why or why not a particular option is worth considering as a recommendation. The report seems unclear as to if the environmental performance goals are systemic (i.e. the cumulative result of the FEP, WSF, RDF, collection systems, compost facilities) or - for this Section – are the goals specific to just the FEP/WSF? Is the FEP/WSF to be considered a success - or not - in achieving a specific goal or benchmark? Or is the FEP/WSF making - or not making - a cost effective contribution to achieving system wide goals or benchmarks? In looking more broadly than just the report being reviewed, we find that the current FEP/WSF infrastructure and operations are not making a cost effective contribution to maintaining the achievement of the groundwater and air quality goals for the HRM system as a whole.

Most organics (i.e. the residential green bin types and yard waste) do not come to the FEP / WSF / RDF. For those organics that do, some are diverted (i.e. compostable cardboard); some with relatively high volatilization, leaching and biodigesting potential (i.e. from some ICI mixed waste), are processed in the WSF and then go to the RDF; and some with relatively low potentials (i.e. small pieces of paper) are sent to the RDF. In our opinion, the WSF process contribution to minimizing the number of reported annual community odour incidents is such that if it did not exist, it would not be missed, due to the demonstrated gas management infrastructure, capacity, and operations at the RDF.

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Presenting additional information in the report could clarify what HRM is or is not seeking to achieve with the FEP. We sought additional information from HRM and understand that the cumulative influence of the FEP, WSF and RDF are to meet the groundwater and air quality goals of the Operating Permit, the 1997 HRM Operations Plan, and minimizing the annual number of reported community odour incidents while aspiring for no incidents. We then could better assess its effectiveness, and therefore support the recommendation for removal.

That difference in potential performance goals leads to different evaluation results and recommendations. If aspiring to maximize the diversion of compostable materials away from the RDF – regardless of the waste materials' physical, chemical, and biological characteristics – involves one set of recommendations. If aspiring to minimize the leaching characteristics of materials in the RDF – regardless of the landfill design and operations – involves another set of recommendations. If aspiring to achieve systemic environmental performance - the cumulative effect of the infrastructure and operations of the FEP, WSF, RDF, collection system, and composting facilities – involves a different set of recommendations. In our opinion, the current FEP/WSF infrastructure and operations are not necessary for the HRM system as a whole to achieve the desired groundwater and air quality goals and to minimize the annual number of reported community odour incidents.

From the report, it is inferred that the removal of the FEP will benefit the downstream RDF. Some functions (e.g. the white goods waste stream) would presumably be accomplished by other means, and at a cost. Without the WSF process, there would be an incremental change in volatilization, leaching and methane producing biodegradation potential, of material entering the RDF cell. If so, and with the current RDF cell design and operations, would the systemic environmental goals still be achieved (e.g. community odour impacts, and acceptable human health and environmental risks and hazards)? Would those goals still be met for unshredded materials that did not go through the WSF process? Would those goals still be met if the recommended RDF cell design changes occurred? If yes then from a technical perspective, and if yes the changes are a net financial plus for the HRM system, then that would justify the recommended changes. In our opinion, the answer to both of those questions is yes, and that the recommended changes are justified.

After reviewing the report, we sought additional technical and financial information. Some of this is presented in Sections 5, 7 and 12. Essentially, we find that after accounting for downstream costs there is a significant financial benefit to closing the FEP and WSF; and the changing volatilization and leaching potential is such that the existing gas management and leachate systems would continue to meet the groundwater and air quality performance goals.

Our analysis took account of many changes, including changes in landfill capacity from the portion of unshredded instead of shredded waste, and changes in compaction efforts.

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11.1.4.2. Comment on Stantec Report 3.4.2 Residual Disposal Facility (RDF)

The report concludes the RDF is "generally well designed and operated". While this may be accurate, the report does not provide a supporting operational assessment of the RDF.

Opportunities for operation improvements could have been identified as a result of observations made during regulatory inspections, HRM operational reviews, and compliance monitoring data. The report identifies three (3) opportunities to increase the density of the in-place residuals, resulting in additional RDF capacity. There is a qualitative discussion on relative cost concluding there would be no short-term financial gain. The long-term financial gains have been discussed in the context of capital costs associated with delaying the construction of the next cells. What is missing is the business case costing related to the three (3) presented options. Following the recommendation and having unshredded materials in the RDF, may result in an incremental decrease in the density of the in-place residuals. The cumulative influence of these density changes – technical and economic – may support the recommendation made, but this was not shown.

In several of the previous Sections the review focuses on the operation of the FEP and the current practice of shredding mixed waste material. This is relevant to the discussion on density and is addressed in Section 4 - Landfill Liner. This analysis (of density) is pertinent to the discussion regarding the landfill design and Otter Lake operations sections.

11.1.5. METHODOLOGY FOR RECOMMENDATION DERIVATION IN STANTEC REPORT SECTION 3

Test A – System Performance

The FEP and WSF facilities were reviewed in the field by Stantec personnel to observe the process. In addition, a desk top review of supporting data and literature related to actual tonnage through these facilities and associated costs was undertaken. Specifically, the following can be noted regarding actual methodology employed to evaluate the FEP and WSF facilities.

Reference to the 1995 strategy intent and objective was clear as the report re-iterates the intentions developed in the original strategy, being that these facilities were intended to remove recoverable resources including recyclable and compostable materials.

The RFP states that the purpose of the WSF is to reduce the potential of the material to produce odour, gases and attract vectors and to reduce the leachate strength after placement in the RDF. It also states that this outcome is a primary objective of the operational performance system assessment. The WSF reduces that potential at a significant cost, and in our opinion, the current RDF infrastructure, capacity and operations would meet the desired performance goals, even if the WSF did not reduce the waste materials volatilization potential.

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The Stantec report provides a general statement on system performance indicating that materials are recovered, however in low volumes due to the fact that curb side collection of organics and recyclables has significantly reduced the volumes delivered to the Otter Lake facility. It is stated that the system no longer performs as intended due to the significant reduction in organics and recyclables that are collected and transported elsewhere (e.g. green bin and blue bag materials). The site review did indicate that some materials containing compostable organics (22,600 tonnes in 2011) were stabilized in the WSF before placement in the RDF. Recoverable materials (1200 tonnes per year of white goods in 2011, and 300 tonnes per year of bottles and paper) are being separated from the total waste stream at the FEP (140,600 tonnes per year in 2011). Some waste characterization information from different years was available in preparing our peer review of the Stantec report.

While data was not presented in the report, it is reasonable to conclude that the WSF process does reduce the potential for volatilized odour, leachate, and biodegradation methane production from the low quality compostable materials.

We sought additional information, collected four waste stream samples in February 2013, and had them analyzed at a laboratory. This additional information is useful in understanding some of the relative concentrations and associated physical and chemical characteristics, for materials in the RDF cell; and the relative concentrations and characteristics before and after the WSF process. The WSF process does influence the characteristics for a minority portion of materials in the RDF, but in our opinion, it is not necessary in achieving the HRM solid waste system goals (e.g. to minimize the annual number of community odour incidents).

A condition assessment of FEP and WSF structures and their components was not provided within the document. This might have suggested remaining useful life of these facilities and actual O&M costs, or whether those costs have been increasing or decreasing, or simply they are in good repair or require regular repairs.

There is no reference in the report to historical tonnage of waste received at the FEP and WSF facilities for each year since operation prior to 2011. Detail for 2011 was provided which yields a recent picture of what is occurring. HRM has historical data for this which was available to Stantec and to ourselves. Environmental monitoring report information was also available.

In considering the demonstrated methodology used, Test A was met partially.

Test B – Bench Mark Analysis and Best Practice

Stantec attempted to compare the FEP operations and procedures at Otter Lake to other facilities in Canada and North America, however did not find a suitable comparison. The City of Edmonton was referenced as having a similar operation, however details were not provided. Alternatively, comparison to European facilities may have shed some worthwhile information.

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HRM provided FEP waste information to Stantec on more years than just the 2011based year presented on page 3.2 figure of their report. That the facility in 2011 separated about 300 tonnes of recoverable paper and plastic material from the incoming 140,600 tonnes, underscores that the FEP is not achieving its original purpose. The separation or diversion of white goods, household hazardous materials, and other materials from the RDF can be accomplished by other means. The waste stream today significantly differs from the late 1990's when the facility opened. From 2002 / 03 to 2007 / 08 there was a decrease in organics, recyclables, and paper in both residential and ICI waste streams.

In considering the demonstrated methodology used, Test B did not apply as the infrastructure and operations in HRM are sufficiently different from other places, as to not be comparable.

Test C – Options Analysis and Recommendations

Stantec presents four (4) options for the Otter Lake FEP and WSF facilities that might be considered from this day forward. They are:

Option 1 – Maintain Current operations
Option 2 – Improve recovery of recyclables in the FEP
Option 3 – Close and decommission the FEP and WSF.
Option 4 – Repurpose the FEP and WSF to process source separated organics

Each option is described and rationalized with text with subsequent recommendations. Option 3 is recommended by Stantec as the FEP and WSF are reported as requiring $8.9 million in annual operating costs. Those preparing the report had access to relevant financial, budget, and annual cost information, from HRM.

After reviewing the report, we reviewed some cost information with HRM, took into account additional factors (e.g. annual capital repair and replacement; additional labour and material compaction, achieving the separation of white goods and additional household hazardous materials by other means) and calculated a similarly significant financial saving for the HRM system of between $9 – 10 million on an annual basis.

The cost per tonne with the reduction is not provided in the report; nor is the cost per person as requested in RFP. Test C was partially met.

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11.1.6. VALIDITY OF RECOMMENDATION DERIVATION FOR STANTEC REPORT SECTION 3

Test A – System Performance

The document discusses the original strategy, identifies current costs, provides information on recent tonnage at the FEP and WSF facilities and references a number of staff that work at the site. The argument for decommissioning appears to be based on the annual operating costs.

There is some discussion on the benefits, including white goods, some recyclables that are currently recovered, and also a discussion on the potential for collecting these product streams at the source. Costs for 2011 are indicated, and Stantec had access to HRM historical costs since 1995 and original estimates to run these facilities. There is some reference to current contracts for managing the FEP and WSF facilities. We later reviewed one of these contracts.

The report is compelling in its assertion that the FEP and WSF is not functioning and is not providing enough benefits to justify the ongoing costs. We subsequently reviewed additional information and accounted for that in our financial calculations. We found that our support for the recommendation increased.

In considering the validity of the recommendation, Test A was met partially.

Test B – Bench Mark Analysis and Best Practice

The report describes only the intent to compare the operations to other sites. The report states that they were unable to find similar comparable sites in North America. As such there is no comparison analysis or discussion with outcomes provided. The report also states that the FEP and WSF are unusual when compared to other jurisdictions. Report states that the HRM method of pre-processing wastes is simply not done elsewhere.

In considering the demonstrated methodology used, Test B did not apply as the infrastructure and operations in HRM are sufficiently different from other places, as to not be comparable.

Test C – Options Analysis and Recommendations

The report considers four (4) options for consideration by HRM. However it does not detail the components or detailed changes within Options 2- 4. The report provides a strong rationale as to why or why not a particular option is worth considering as a recommendation. A cost benefit analysis on each option is not provided.

A cost benefit analysis was not presented on the relative benefits of placing and compacting shredded WSF waste in the RDF versus a direct end-dump into the cell followed by compaction.

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We sought additional information and tabulated some of the results in this document. We find that plausible changes in the mechanical compaction equipment and operations at Otter Lake are reasonably expected to more than offset a difference in material density if all materials arriving at the RDF were unshredded.

With respect to closing the FEP and WSF, this is a recommendation that we support; and whose concepts and details, with the indicated additional information, merit serious consideration by the final decision makers.

After reviewing the Stantec report, we sought additional performance, financial, and technical information in forming our opinion about the option being recommended by Stantec. This is discussed in another section of this document on our opinion on the A1 option itself, not this section on how that A1 option on the closing the FEP / WSF was derived or validated by Stantec.

Stantec's mandate may have been to bring some potentially useful ideas to the table, and not necessarily to present the detailed arguments and background information, for supporting multi-million dollar municipal budget decisions.

In our opinion, Test C was not met.

11.1.7. COMPLETENESS OF HRM RFP SECTION 5.1.1 IN STANTEC REPORT SECTION 3

The RFP identified that highly sought deliverables/objectives related to the FEP and WSF Assessment shall include:

1. A performance assessment in comparison to other municipal systems
2. Complete a system Assessment to validate the operating model outcomes in terms of original strategy objectives
3. Make recommendations in recognition of changes to waste stream which have occurred in the last 15 years
4. Provide a comprehensive examination of the strategy components related to waste processing, practices, costs and bench mark industry analysis with recommendations and options to achieve efficiencies and diversion objectives.

In consideration of the objectives as identified in the RFP the January 2013 report did not provide a stated methodology for evaluating performance of these facilities.

A system assessment was conducted through the use of site inspections, operating information related to historical tonnage data, historical annual costs, environmental benefits (negative or

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positive) at the RDF, and staffing requirements. A building condition assessment was not provided. The operational assessment was based on the HRM Operations Plan for the facility.

Recommendations are provided for decommissioning of the FEP and WSF facilities. Some economic considerations are demonstrated. Some associated environmental, social, and operational considerations have been taken into account, but generally as qualitative support.

A systemic benchmark detailed analysis was not provided. The report addressed the RFP requirement to identify objectives by relating the potential to divert savings from the closed front end facilities towards more public education, in an effort to further reduce waste volumes which are received by the Otter Lake facilities.

While the report has not completely provided all that was asked for in the HRM RFP, we sought additional information, and support the recommended closure of the FEP and WSF facilities, in the context of some of their activities (e.g. white goods program) being accomplished by other means, infrastructure, operations, and investments.

11.1.8. ADDITIONAL COMMENTS

Our mainly positive additional comments about the current FEP, WSF, and RDF operations are:

- We toured the Otter Lake facility on January 10, 2013 and met with Barry Nickerson of HRM and Steve Copp from Mirror. We observed the FEP and WSF facilities as well as the remaining components of the Otter Lake Facility. We found that the FEP was well managed and that some segregation of recoverables had happened, including the observed bales of cardboard and newsprint, and metal objects.
- The FEP facility was producing mainly dry product in various sizes for further processing at either the WSF facility or direct placement into the current open landfill cell. Approximately 30% of received product goes through the WSF.
- The current active cell receives and places waste material from the FEP and from the WSF, and mechanically compacts this mix of materials.
- There were no odours at the open cell nor at the FEP. There was high humidity at the WSF with a slight odour.
- The bark biofilter for gases from the WSF was functioning and was understood to require product replacement every few years.
- The closed portion of the RDF was vegetated and fitted with over 150 methane gas wells that are collecting and thereby directing methane to a flare stack at the lower elevation of the RDF for burning and managing the off gas being produced.
- The landfill produces between 60 - 90 Million Litres of leachate per year.
- Current capped cells may drop 20% in height over a seven year period.
- A clear methodology for the evaluation and assessment of the FEP and WSF facilities has not been presented, but we sought additional information and were satisfied.

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- Historical data on annual costs, volumes received since 1999, staffing levels, recoverable materials received and actual cell construction costs over the last 15 years are available.
- A bench mark analysis did not provide a good comparison, however there may not be a comparable facility in Canada for reference.
- Options were not detailed enough to show what might remain or be reused for alternate applications if the FEP and WSF were re-purposed or decommissioned or what would be the economic, social and environmental gains of such options. A compost operation is discussed however an analysis of each option might better support the recommendations.

It has been presented by Stantec that the cost of running these two facilities is in the range of $9 million per year (2011) and that little recoverable product is generated. Some items raised in this review and requested in the RFP have not been presented. We then sought additional information and calculated a net financial benefit of closing the FEP/WSF that accounts for the resulting downstream costs, while still achieving the HRM environmental performance goals.

This additional information and evaluation increased our level of support for the A1 option (FEP/WSF closure) recommended in the report. This is discussed in another section of this document on our opinion on the A1 option itself, not this section on how that A1 option on the closing the FEP / WSF was derived or validated by Stantec.

11.2. LANDFILL DESIGN

What Was Sought and What Was Delivered

HRM identified four (4) key objectives with respect to the landfill design. The objectives listed in section 5.1.2 of the RFP are summarized below:

1. Conduct industry benchmarking assessment of regulated landfill cell liner design and specifications of no less than ten separate and distinct jurisdictions. Conduct a comparative analysis of the liner specifications considering cost, unit cost, permeability, and environmental protection level.
2. Develop a recommended specification schematic to meet legislative requirements and environmental protection requirements in light of the variation in the waste stream's composition between 1999 (diversion guidelines implemented) and current day (63% diversion achieved in HRM). Develop a second schematic considering that other landfills throughout the province do not necessarily achieve the same degree of waste diversion.
3. Develop a cost estimate comparison for the development of a 500,000 tonne landfill cell in Nova Scotia considering the current specifications and the proposed specifications.
4. Develop an independent report and presentation on the benchmark assessment findings and new recommended cell liner design and specifications for distribution to the NS Landfill Operators Working Group and NS Environment Solid Waste Division.

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The Stantec report addresses the landfill design and capacity issues in Section 4 Landfill Design. The following conclusions related to landfill design were identified by Stantec in Section 12.1.

"3) The landfill liner design specification in Nova Scotia is more stringent than most comparable state and provincial jurisdictions, and potential modifications could significantly reduce future capital costs.

4) An opportunity exists to significantly extend the life of the landfill at Otter Lake, and reduce the site per tonne capital costs by increasing the finished grade by 10-15 metres."

The following landfill recommendations were issued by Stantec in Section 12.2 of their report.

"A2 – Request Modification of the Nova Scotia Landfill Liner Specification
The current landfill liner specification is more stringent than most comparable state and provincial jurisdictions. Given the context in HRM and Nova Scotia in the 1990s, this conservative specification was considered prudent at the time. However, the current specification results in relatively high capital construction costs which in turn lead to increased expenses for the ICI sector and HRM. Based on examples from other jurisdictions, HRM capital costs for liner construction could be reduced by approximately $3.4 million for a typical cell ($10.2 million over the remaining life of the site) if Nova Scotia were to adopt a specification consistent with most similar jurisdictions.

A3 – Extend Life of Otter Lake Landfill through Vertical Expansion
The current design for the finished elevation of the landfill will result in a landform that will be consistent with surrounding topography. While this approach has merit, an extension of approximately 17-23 years to the life of the landfill can be achieved by a 10-15 metre increase in the finished grade of the site. Given the potential benefit to the broader community and the remote locale of the site, Stantec recommends that HRM consider a vertical expansion of the landfill subject to input from the immediate neighbours of the landfill."

11.2.1. LANDFILL LINER ASSESSMENT

11.2.1.1. Methodology for Recommendation Derivation in Stantec Report Section 4.2

Test A – System Performance

The report reviewed the original liner design detail, which was based on the Nova Scotia Municipal Solid Waste Guidelines. In order to verify system performance, Stantec consulted the site operator and the monitoring results for the samples collected from the leak detection

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collection system. The operator indicated that leak detection sumps are pumped out on a regular basis. The water in the leak detection sumps may not be from the leak detection system itself, but from condensate and surface water intrusion. While the analytical results reportedly tend to support this interpretation, Stantec could not conclude this without further investigation. Stantec suggested that HRM review the design and operation of the collection sumps to isolate these sumps from surface water and other sources. If the leak detection system is not contributing to the water in the sumps, Stantec suggested that the leak detection layer requirement could be removed from the Nova Scotia Environment (NSE) guidelines pending NSE's review. It is important that the components of the leachate detection layer are defined in the report. Normally the leachate detection system includes the collection piping bedded in a pervious media and the underlying confinement layer, in this case HDPE. It is unclear if the Stantec recommendation (and cost savings estimate) includes the secondary HDPE confining liner below the leachate collection piping. We have assumed it does.

Analytical results were not presented in the report to test an assumption that the water in the leak detection layer is not contributing to the water that accumulates in the sumps. The guidelines or criteria against which these sample results were compared were not identified in the report. Evaluating the monitoring information would help in testing this assumption.

In suggesting that the secondary geomembrane liner be removed, it would be helpful to discuss the reason secondary containment was adopted as the Provincial default standard, and why the type of liner specified accounts for provincial variations in the local hydrogeology and environmental requirements. The report did not provide a risk based assessment of potential receptors to support the removal of the leak detection layer and secondary geomembrane. We understand from HRM that no liner leaks have been detected since the Otter Lake operations began in the late 1990's. No additional information was referenced to complete the condition assessment of the landfill containment liner system.

The report also reviewed the reason for the cushion layer located above the leachate collection layer. This layer is typically provided to protect the leachate collection system against potential damage that could be caused by the placement and compaction of the initial lifts of waste. The report suggested that this layer could be substituted by careful placement of a 5 m layer of loosely compacted waste.

Design calculations and cost comparisons are not included in the report to support this recommendation. What would be the net financial benefit to the HRM system of not having a cushion layer, while taking additional measures to reasonably protect the liner? What would be the net financial benefit to the HRM system of having a potentially higher cell elevation? These could be calculated, and would be useful for HRM decision makers.

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The Nova Scotia Solid Waste Guidelines standard liner system design provides multiple contingency measures. The liner has been developed to contain municipal solid waste. Although residential green bin food waste organics does not enter the RDF, similar organic material does, that is mixed in with the industrial, commercial, institutional (ICI) waste streams. The residential black bag material may not be 100% free of green bin type organic materials, but the trend is satisfactory.

The guidelines anticipate that alternative site specific liner designs could be presented and technically justified; and be approved if the result is appropriate environmental protection.

The cost savings estimated for the removal of the cushion layer and the leak detection layer cannot be validated from the report itself, since the unit costs and estimated quantities were not provided. A risk assessment cost was not provided, and the results of one are not yet known with any certainty. We sought additional information from HRM, and found that changes from the current design (e.g. the "cushion" gravel layer over the liner, and leak detection system) could influence the construction budget of the next new cell, by 10% or more.

Additional information that provided some expected results, would meet Test A.

Test B – Industry Bench Mark Analysis and Best Practices

Stantec conducted the industry bench mark analysis by reviewing landfill containment liner specification data from several jurisdictions, i.e. ten provinces and states and the USEPA. The jurisdictions in question are presented in the referenced Drawing 01, which indicates that most of these jurisdictions specify a minimum single composite liner (e.g. a geo-membrane overlying a layer of low-permeability clay).

The methodology followed in the bench marking analysis considers liner composition only and does not include a review of liner performance (monitoring data), costs, site-specific receptors, or the waste composition. Compared to some other jurisdictions, the diversion rate in HRM results in a significantly different waste stream for the liner to contain. Due to the diversion rate, the 2013 waste arriving at the FEP / WSF / RDF has a significantly reduced volatilization and leachate potential compared to the waste arriving when the facility was designed and opened in the 1990's.

While more information on more variables should be accounted for in the more detailed HRM decision making to come, we find that this Section meets the intent of Test B.

Test C – Options Analysis and Recommendations

The review of the landfill containment liner generated two (2) options that would require NSE acceptance: 1) removal of the cushion layer and 2) removal of the leak detection layer and secondary liner.

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Stantec provides a figure that presents default liner specifications for a group of North American jurisdictions. Compared to these, constructing the default Nova Scotia specification is relatively expensive. Different jurisdictions have different site conditions to account for, and possibly different waste stream assumptions and environmental performance goals, and these can result in different default designs for their different circumstances. A review of the rationale for the Nova Scotia default design would be useful.

Stantec has stated that the cushion layer is not required in some jurisdictions. There is no indication as to whether the landfills in those jurisdictions have been assessed for damage to the leachate collection system. The alternate placement methodology suggested is not supported in the report by case studies or prior experience. The option recommended does not appear to reconcile the value of volume gained in the cell by the removal of the cushion, against the cost or lost revenue opportunity if five (5) meters of more loosely compacted mixed waste will be in the landfill cell volume. This can be calculated and presented in the future. We do not yet see a strong case for implementing this cushion layer option.

The methodology used to compare the liner cross-sections for the removal of the leak detection appears to be solely based on a desktop review of specifications in other jurisdictions, not their performance, or the potential impact liner failure may have on site-specific receptors. Stantec also stated that aside from ensuring that the leachate collection liner is working effectively, the "leak detection layer does not enhance the environmental performance of the site". This may be the case as long as the primary containment liner is intact, however the leak detection layer forms part of the secondary containment should the first layer be compromised. This would have a direct impact of the environmental performance of the site. Ultimately the selection of a suitable liner system will depend upon Regulatory requirements, the material being contained and the risks associated with these materials entering the environment.

The relatively common use of double liners for hazardous waste sites, is not in itself a justification for their use at a typical municipal waste landfill, and is not a strong argument to be used in support of the recommendation to remove this requirement from the NSE guidelines.

The methodology used to evaluate the removal or ongoing use of the two liner components, does not discuss the relevance of site-specific conditions, historic performance of single liner systems in other jurisdictions, industry and regulatory trends, service life assessment, a review of scholarly articles, or a regulatory opinion. The volatilization and leaching potential of the wastes - and where this has changed due to diversion rates – could also be a relevant factor or consideration in the liner design for a landfill.

Additional supporting analysis would be required to fully satisfy Test C.

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An alternative to changing the default specification in the guidelines is to propose a site specific design, which provides acceptable environmental protection and meets the applicable environmental goals. This option exists in the guidelines. The provincial guidelines would not have to be changed to implement this alternative option.

11.2.1.2. Validity of Recommendation Derivation in Stantec Report Section 4.2

Test A – System Performance

In our view the report lacks sufficient information to conclude that the system is performing in accordance with the original intent. The lack of referenced leak detection analytical data is an example of where this could be easily corrected. The lack of data makes it unclear which parameters were analyzed and which guidelines were used as a basis for comparison. If the source of water in the leak detection layer is unknown, it is difficult to confirm whether the primary liner is working adequately. A technical service assessment of the liner would also have provided suitable comfort in the performance assessment. The report does not confirm whether the liner is functioning as expected. Available supporting information would result in Test A being achieved.

Test B – Industry Bench Mark Analysis and Best Practices

The bench marking analysis compares the minimum required liner compositions for ten (10) jurisdictions but does not consider any other parameters in the analysis. The effect of potential contaminant migration, should the primary liner fail, was not addressed in the report, which makes it difficult to fully understand whether these recommended changes would adversely affect the surrounding environment. As mentioned above, a review of the performance of liner systems without secondary leak detection layers would be appropriate. Anticipating the usefulness of the expected results if additional information was provided, the intent of Test B is met.

Test C – Options Analysis and Recommendations

As previously mentioned, the recommendations were based on liner specifications used in other jurisdictions. On an economic basis, the removal of the leak detection layer is a compelling argument; however, the analysis should also include a risk based assessment that incorporates information on the historic performance of liner systems (that do not have leak detection), site specific physical conditions, and the sensitivity of adjacent receptors should a failure occur.

The recommendation to remove the cushion layer increases the risk of liner damage, and would require specific placement protocols and quality control measures to be applied. Some Ontario jurisdictions would have useful examples. In order to remove the cushion layer but protect the leachate collection system against damage, Stantec recommends loosely compacting the first five (5) metres of waste. Additional analysis is required to determine the difference in the

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tonnage (and system costs) between the existing cushion layer and highly compacted material scenario, versus no cushion layer and a less dense, but somewhat compacted material?

A qualitative estimate of savings incurred by these proposed changes was included in the Stantec report. The cost estimate could not be validated since no engineering details or unit prices were included. Test C was not met.

11.2.1.3. Completeness of HRM RFP Deliverables in Stantec Report Section 4.2

SNC-Lavalin reviewed the report with consideration made of the deliverables identified in HRM's RFP. The specific deliverables presented in section 5.1.2.7 of the RFP, were generally to:

1. conduct industry benchmarking analysis of standard environmental protection landfill cell liner design and specification from other jurisdictions in comparison to NS;
2. conduct expected content analysis comparison between NS/HRM MSW current waste stream to the same jurisdictions where cell liner specifications were reviewed;
3. complete cost benefit analysis per tonne of cell cost for the jurisdictions reviewed in comparison to NS/HRM;
4. develop cost comparison assessment for the development of a 500,000 tonne landfill cell in HRM using both current and recommended cell liner specifications and draft a preliminary assessment report outlining findings and providing a recommended new specification with cost and assessed environmental protection variance; and,
5. draft a separate final report for submission to NSE.

Based on our review of the Stantec report, it appears that the first deliverable was partially complete. Although industry benchmarking of the landfill liner was completed with respect to overall composition, the jurisdictions were not compared in terms of performance cost, permeability and comparable environmental protection levels.

Finally, it appears that the final four deliverables were not included in the report. With respect to the second deliverable, a review of leachate strength from 1999 to present day would have been useful in assessing the environmental impact of the current waste composition in light of recommended liner modifications. We understand from HRM that items 4 and 5 are being provided separately by Stantec.

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11.2.2. LANDFILL CAPACITY ASSESSMENT

11.2.2.1. Methodology in Recommendation Derivation for Stantec Report Section 4.3

Test A – System Performance

The report indicates that the current maximum elevation of the RDF is 113 m above mean sea level and that this elevation was selected during site development to create a landform that blends with the local environment. It is not stated, but it would be assumed that the current landfill is meeting the originally stated objectives for maximum elevation. The report indicates that this design criterion is rare in modern landfill design but does not state whether this is perceived to be a flaw in the original strategy. The report does not provide the reader with background information on how and why this maximum elevation criterion was implemented for this site and relevance these criteria would have on any recommended modification. It is our understanding that this criteria was developed in consultation with community stakeholders. No methodology was given for evaluating the performance of the landfill height and how it compares. Test A is not relevant in this case.

Test B – Bench Mark Analysis and Best Practice

No methodology was declared for comparing what other jurisdictions are doing with respect to landfill height. The report mentions that this design criteria is rare in modern landfills but does not state what other jurisdictions were consulted and what the actual maximum heights are at other landfills. Do we know how satisfied the local residents are with the view planes at these other landfills of greater height? The report states that the setback and visual buffering is rare in other jurisdictions but does not expand on this to state what jurisdictions were consulted and what the typical setback distances are and what, if any, visual buffering achieved. The report states that other jurisdictions typically have landfill heights 20 m to 30 m above the surrounding topography. Our February 2013 balloon study investigated the visual implications of a 15 metre increase in the finished cell height elevation. The HRM landfill design and construction costs are influenced by the cell height elevation decision making by HRM council. Test B is met.

Test C – Options Analysis and Recommendations

The report provides an incremental capacity increase with each 5 meter increase in elevation as well as a capital cost per tonne with each 5 meter increment in elevation.

The referenced Dillon Consulting reports provide a solid supporting reference and methodology.

Proceeding with a new cell height elevation will involve preparing an updated cell development plan based upon general constraints including maximum side slopes, lift height, progressive cell closure, road access, and final cover requirements. The cell development plan would reference and confirm the maximum height available based on site constraints. Incremental heights are

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then applied to the model to establish development cost estimates. Other operation factors would also contribute to the cell development model, such as time required for the consolidation of previous cells, gas management, and expansion of the leachate collection system. This would also allow the designers to maximize the use of air space and minimize development costs. An updated or new cell development plan is not a requirement in making a cell height elevation change decision, but is a result in making that decision. Test C is met.

11.2.2.2. Validity for Recommendation Derivation in Stantec Report Section 4.3

Test A – System Performance

The report concludes there are "no engineering impediments to increasing the elevation of the landfill" and in our view, this is accurate. The report also suggests correctly that an increase in height may be considered a negative visual impact in the community. Regarding the validity of landfill height in the original strategy, the report is neutral in this regard, neither convincing the reader that the maximum elevation is a flaw in the strategy nor that in other jurisdictions the higher elevation is acceptable to the community. The report correctly acknowledges that an opinion on the potential visual impacts will be required.

We conducted a February 2013 Balloon Study for an increased cell height elevation of 15 metres. We raised the balloons and then from several residential locations, we tried to observe the balloons. The balloons were not visible, in late February, with snow on the ground, and no leaves on the trees, except for one location - the anticipated commercial area of the proposed Brunello Estates development – where one could already see the landfill cells. Test A is met.

Test B – Bench Mark Analysis and Best Practice

The report indicates that the Otter Lake landfill design height and profile is rare and/or unusual. The current cell height decision was made by HRM as the owner, and not by a regulatory requirement. The 1997 Operations Plan by HRM for the Otter Lake facility reflects the decision made by HRM. There is a buffer distance required by the province with respect to potable water supply wells. The report did not present comparisons with other jurisdictions. Test B is not met.

Test C – Options Analysis and Recommendations

The report describes the process to modify the vertical height and has two letter reports that were generated by Dillon Consulting to show what the additional height would achieve in terms of additional landfill life. The reports also looked at the sight lines of the facility. The conclusion to raise the landfill height (in the absence of all other factors including social costs) makes sense from an engineering standpoint and is a compelling argument for cost savings on a strict per tonne basis and in extending the life of the landfill. They have recommended their A3 option. Test C is met.

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After reviewing the Stantec report, we sought additional performance, financial, and technical information in forming our opinion about the option being recommended by Stantec. This is discussed in another section of this document on our opinion on the A3 option itself, not this section on how that A3 option for raising the landfill height was derived or validated by Stantec. In our balloon study, we placed balloons on the cell at the higher elevation being discussed. We then went to several residential vantage points in the area, and the balloons were only observed in one of these locations – one where the landfill cells could already be seen. These vantage points and distances are presented in a map figure attached to this document.

11.3. OPPORTUNITY TO CREATE A REGIONAL WASTE RESOURCE CAMPUS

In the subsequent Sections of this report, the Peer Review Tests A, B, and C discussed previously were not applied. We comment on many of the Stantec report sub-Sections.

What Was Sought and What Was Delivered

There is no corresponding HRM RFP Section on a Campus concept that corresponds with the Stantec Report Section 5 Opportunity to Create a Regional Waste Resource Campus.

The Stantec report evaluates the opportunity to create a regional waste resource campus in Section 5.3. The following conclusion related to centralized waste management - a campus concept - was identified in Section 12.1.

12) HRM would benefit from the creation of a centralized waste resource campus, rather than having facilities at four different locations in Halifax and Dartmouth. Development can be staged over time to match the end-of-useful-life of current infrastructure and incorporate new elements for HRM such as outdoor windrow compost curing pads; permanent educational and household hazardous waste facilities; and the development of a materials transfer capability.

The following campus recommendation was made in by Stantec in Section 12.2 of their report.

"B1 – Create a Centralized Waste Resource Campus

Current infrastructure is located at four different properties in Dartmouth and Halifax. With the exception of the Otter Lake facility, sites are of limited size and prevent the consideration of co-collection of materials at the curb in a single truck. Stantec recommends HRM establish a large acreage waste resource campus (Campus) in a location of sufficient size to meet changing infrastructure needs (excluding landfill disposal) for on the order of 50 years. The benefits would include the potential to optimize collection routing and fleet size, lands for compost curing, a common location for infrastructure replacements when needed, and a location for contingency waste transfer. Possible components and timing are presented below.

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- Secure lands, obtain approvals and complete site servicing 2013 / 2014
- Construct and operate compost curing pads 2014 / 2015
- Construct scales, offices and educational centre 2015
- Construct multi-use transfer facility for white goods/waste/HHW 2015
- Construct anaerobic composter for ICI organics 2015 / 2016
- Construct replacement MRF 2017 / 2018
- Optional aerobic composting processing capacity 2018+
- Optional advanced waste reduction(gasification or other) 2020+
- Other long-term waste reduction infrastructure needs 2020+

11.3.1. PEER REVIEW OF REGIONAL WASTE RESOURCE CAMPUS EVALUATION

11.3.1.1. Comment on Stantec Report 5.1 CHALLENGES OF CURRENT DECENTRALIZED MODEL

"The current decentralized model is challenging..." In the 1990's, the decentralized locations of the infrastructure was intended to increase public support for the system from all four (4) member communities that composed HRM. In 2013, this political sentiment may have diminished.

"A possible future need for HRM is outdoor windrow composting pads..." HRM is required by 2014 to have a plan for compost to meet CCME guidelines that can be implemented in 2015.

11.3.1.2. Comment on Stantec Report 5.2 FLEXIBILITY OFFERED BY WASTE TRANSFER FACILITY

"Suspension of service at Otter Lake has occurred only once in 15 years and is unlikely to become a regular occurrence." This is a logical enough statement. However, the HRM RFP sought comment on what might happen with a "catastrophic failure" of the Otter Lake landfill.

"An order of magnitude capital cost estimate to establish a standalone transfer capability is $5 million..." This estimate should be substantiated. However, the reliance on the West Hants facility and system seems reasonable. That reliance is more broadly based, since HRM has had emergency agreements in place for years now with the West Hants, the Chester, and the Queens landfills.

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11.3.1.3. Comment on Stantec Report 5.3 OPPORTUNITY TO CO LOCATE INFRASTRUCTURE OVER THE LONG TERM

The report notes that "...a decision regarding maintaining the current decentralized model or transitioning to a campus concept is a critical first step..." This is logical but it requires HRM Council confirmation of an evolution in the system model, and initiating planning activities at an early enough stage, to allow the development of related recommendations.

11.3.1.4. Comment on Stantec Report 5.4 20 YEAR CONCEPT PLAN FOR REGIONAL WASTE RESOURCE CAMPUS

"Possible components for a new green field campus and timing are presented below..." This list does not include site selection, community consultation, environmental permitting, approvals, and other related activities. These activities are critical to the timing of the implementation for such a facility.

11.3.1.5. Comment on Stantec Report 5.4.2 Siting Considerations

The report reviewed noted that "...especially if the recommendation to close the FEP and WSF is adopted..." The Stantec report does not present an analysis that provides a full technical support for their recommended option. After considering additional performance, financial and technical information as noted in our document, we support the FEP / WSF closure option, and its consideration by HRM Council decision makers.

The report reviewed noted that "...a transportation study has been completed..." A study reference in the report would be useful. HRM staff had provided this to Stantec, and later provided us with an opportunity to read the indicated transportation study.

The report reviewed noted that "...while 40 hectares is considered as a minimum...." Ideally a concept sketch would have been provided, or at least an estimate of land required for each component.

11.3.1.6. Comment on Stantec Report 5.5 DEVELOPMENT COSTS

The costs in this section require justification, perhaps with supporting concept sketch and some preliminary engineering cost estimates. Presumably they are at a conceptual level.

The Stantec report offers a generalized breakdown of costs to implement a Centralized Waste Resource Campus on a green field site. Perhaps the order of magnitude is +/- 50%. To validate the cost breakdown it would be necessary to see a concept plan to scale outlining the following:

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- Extent of area to be developed and limits of grading
- Location of buildings, footprint, and vehicle assembly areas
- Location and extent of roads and typical cross Sections
- Location of outside composting areas
- Location and extent on other storage areas, white goods, ICI, construction materials etc.
- General site topography and drainage patterns

Given that the report identifies that a site would require as a minimum a 40 hectare parcel with a campus layout we have initially looked at disturbing approximately half to achieve acceptable grades.

In consideration of item 1 on page 5.5 Site Preparation and Earthworks we have considered the 20 hectares with a minimum of 300 mm of overburden having to be removed to accommodate parking areas and building footprints at grade. This would equate to approximately 60,000 cubic metres of material to be excavated and relocated. Using a unit price of approximately $\$25/m^3$ to move soil, this would result in an item worth approximately $1.5 million. If the unit price was half this value, i.e. $\$12.50/m^3$, then the item would cost approximately $750,000. These values are much higher than stated in the Stantec report. They are based on our considered assumptions. As such a common known quantity for this item, and the other items identified would assist in validation of the costs presented.

Alternatively, we were involved in the design and contract administration for a 18,000 sq. ft recycling facility and office complex with three bay garage in Nova Scotia which was constructed for $1.6 million in 2006. On this basis it would be expected that the office/education facility might be somewhat high, once again depending on footprint, building type, and interior requirements and use.

Given that little information is presented on the Centralized Campus layout and location, a cost verification exercise cannot be conducted at this time. If half of the 40 hectare site is to be disturbed, than the cost estimate provided by Stantec is considered to be low. Based on this rationale, it can be suggested that the cost estimates offered in the report for a campus setting should be used for initial discussion purposes only, and not considered for budgeting purposes.

11.3.1.7. Comment on Stantec Report 5.6 REGIONAL WASTE RESOURCE CAMPUS AS CORNERSTONE FOR 20 YEAR STRATEGY

The report notes that "....The decentralized location of infrastructure in Dartmouth and Halifax, combined with the complications of bridge crossings, makes the evaluation of all possible scenarios onerous." This statement could be more positive, in suggesting the evaluation of various scenarios, selected based on alternative site locations. An analysis of transportation aspects should be recommended based on alternative sites.

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The report noted that "…The benefits of a campus concept cannot be fully quantified financially at this time." While true, some reference to collection costs, and benchmarking of those costs, might help this discussion.

11.4. MATERIALS RECYCLING FACILITY (MRF)

What was Sought and What was Delivered

HRM RFP Section 5.1.4 Materials Recycling Facility (MRF) Capacity, Technology and Location, included a group of deliverables being sought. Stantec Report Section 6 Materials Recycling Facility, was the response delivered.

An excerpt from Stantec Report Section 12 Recommendations:

B2 – Relocation of MRF to Campus

The existing MRF in Halifax is operating satisfactorily and equipment is suitable for current needs and until the expiry of a contract extension to 2019. As identified above, it is recommended that this activity be relocated to the Campus in anticipation of a 2019 contract start date.

11.4.1.1. Comment on Stantec Report 6.1 EXISTING MRF OPERATIONS

The report concludes that "The MRF is operating in a manner envisaged by the 1995 Strategy." We agree with this technical assessment.

"Material from the ICI sector is also received and processed at the MRF." This was anticipated in the 1995 CSC Strategy. If the opportunity existed, the ICI sector is considered to have the ability to develop a private sector based materials recycling capacity.

11.4.1.2. Comment on Stantec Report 6.2 OPERTIONAL LIMITATIONS

The report notes that the MRF will be beyond its current one-shift processing capacity as a result of population growth and more diversion of recyclables from the ICI sector.

"While operating hours can be extended to accommodate additional tonnage to the MRF, there is insufficient storage capacity to accommodate the same and the site is not suitable for expansion of the MRF to any significant extent." This is a critical statement which leads to future recommendations for possible relocation. We suggest a sketch showing the MRF on its site, and some reference to adjacent property limitations or restrictions. The wholesale rejection of additional working hours is incomplete. It might be possible to add weekend shifts and

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operation, for example, to increase capacity incrementally. We find the conclusion is insufficiently founded.

11.4.1.3. Comment on Stantec Report 6.3 COMPARISON OF OPERATIONS TO 1995 WASTE RESOURCE STRATEGY

The report notes that "HRM has fulfilled these objectives with respect to its MRF operation." We agree.

11.4.1.4. Comment on Stantec Report 6.4 COMPARISON OF CURRENT OPERATIONS TO INDUSTRY BEST PRACTICE

In general this is a very thorough and complete review. However, some areas where additional comments or recommendations could be made are noted below.

"HRM's processing fee is in line with the industry but in the case of revenue only 75% comes back to HRM." Is a different revenue sharing model suggested here? If so, what should it be?

"The residue rate of 9.26% is high for a two-stream program." This may be within a <10% performance standard, with a 5% target. The report could have suggested a target, supported by examples.

"The rebate that HRM provides the contractor for residue disposal is not a common feature for similar programs..." What is being suggested, that this rebate be eliminated?

11.4.1.5. Comment on Stantec Report 6.5 TWO STREAM VERSUS SINGLE STREAM PROCESSING

The report notes that "Single stream recycling can also attract greater participation in multi residential and commercial sectors where there may be storage and space limitations for sorting containers, especially in the context of mandatory organics separation." It would be helpful to have some comparative comments, or some estimates of effects, which could use this finding as a basis for recommending single stream in HRM.

"Single stream processing is a viable option for HRM..." "HRM's current capture rate for recyclable materials is in the order of 63% which when compared to other municipal jurisdictions is low." The other jurisdictions referrenced, all from Ontario, are presented in a Section 6.4 table. The report does not suggest an achievable target for HRM.

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11.4.1.6. Comment on Stantec Report 6.6 REGIONALIZATION

The report notes that "There is a particular benefit in regionalized single stream processing operations..." This is a good finding and can be used to support a recommendation for single stream processing.

The operating cost curve on page 6.10 is useful but needs explanations of the parameters as well as some sources of information.

"HRM could adopt a similar approach in this regard however discussions with other municipalities should ensue...." This is a good recommendation.

11.4.1.7. Comment on Stantec Report 6.7 OPPORTINITIES FOR OPERATIONAL IMPROVEMENTS

Short Term Addition of Boxboard

This recommendation is reasonable, and the savings has been documented ($117,000 per year). We agree with the recommendation.

Construction and Operation of a New MRF – New Location in Mid to Long Term

This recommendation is not sufficiently assessed considering the disadvantages listed (of continuing to operate the existing MRF):

- Limited space – this has not yet been documented fully enough
- Potential value of the sale of the property – this is not a reason to abandon a facility that is operating well
- Greater maintenance required... - this is not documented fully enough, and has been stated elsewhere, the MRF is operating well with equipment being upgraded regularly
- Limited opportunities for regionalization – why because of limited capacity? This rationale is not explained
- Limited if any opportunity for co-locating with other waste management operations – this is correct, although the rationale for doing so is not supported in the text
- Site may not accommodate additional traffic – while stated, and inferred to be true, no technical information is provided to support this statement

Flexibility in Operations in the Mid to Long Term

"A new MRF should be appropriately designed to accommodate HRM's long term processing needs but another consideration is that a new MRF should have flexibility in processing operations to adjust to the ever changing recyclable materials make up." This statement is consistent with the original CSC Strategy. From the work provided by the report, there is no indication that the existing MRF did not achieve this goal. In fact, the statement earlier that the

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MRF is achieving what was desired in the strategy is already noted. The final statement in this section, that "single stream recycling can support this need for flexibility", is clear, and is given to support the change to single stream recycling.

In our discussions with HRM staff, it is understood that it would be impractical to change the existing MRF to accommodate a potential change to a single stream system. The equipment would be significantly different, and would require replacement. If the collection stream is changing, then a new MRF would be required.

11.4.1.8. Comment on Stantec Report 6.8 CONCLUSIONS

The report notes that "The MRF is nearing the end of its operational life expectancy, both building and the majority of the equipment in the MRF." This conclusion is not drawn from the earlier text. Nothing has been stated about the building nearing the end of its life, nor the majority of the equipment at the end of its life. As a conclusion, it should have supporting information. It is recommended this part be strengthened as it is fundamental to the recommendation of building a new MRF.

"There is capacity to handle the short term growth for recyclable material processing by expanding the operating hours." Earlier, the report rejects this change. There should be a clear discussion of shift modifications.

11.4.1.9. Comment on Stantec Report 6.9 RECOMMENDATIONS

"Between 2013 and 2016 determine to implement single stream or dual stream processing option…" This recommendation is very important. The benefits stated earlier in this section strongly support single stream processing. The information from other jurisdictions is also supportive. Would other information change this perspective? Based on what was presented in the report, the recommendation could, be more strongly worded.

"In 2016 commence with formal procurement process for new MRF." The need for the new MRF is not strongly enough supported in the findings, as noted earlier. However, if single stream processing is selected by HRM, then a new MRF (it appears) will be essential to that decision.

11.5. ORGANICS WASTE PROCESSING FACILITIES

What was Sought and What was Delivered

HRM RFP Section 5.1.3 Compost Processing, Capacity and Regulatory Compliance, noted the group of deliverables being sought. The Stantec Report Section 7 Organics Waste Processing Facilities, was the response.

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The following is an excerpt from the Stantec Report Section 12 Conclusions (5th, 6th, and 7th):

1. The two composting operations in Halifax and Dartmouth do not provide a sufficiently finished product to meet applicable guidelines which become effective in the near future.
2. Composting facilities are at capacity and additional processing capacity is required in the short and longer term.
3. Alternative composting technologies may improve the processing of ICI organics.

The following is an excerpt from the Stantec Report Section 12 Recommendations:

B3 – Increase Organics Processing Capacity

The aerobic composting facility south of Halifax is not considered a strategic asset and could be decommissioned at the end of the current contract in 2019. Equivalent organics processing capacity for the Halifax collection zone is recommended to be realized at Otter Lake by repurposing the WSF. The Dartmouth organics processing facility can meet Dartmouth area needs until at least 2030 by constructing an anaerobic processing facility by 2015/2016 at either the current site or at an alternative location.

C2 – Control Curing and Sale of Finished Compost

Once organics are processed at facilities in Dartmouth and Halifax, the unfinished product is sold at a nominal fee of $1/tonne at both facilities. HRM has no control over the final maturation process and foregoes the potential for an increase in net revenue generation. The final maturation (also termed "curing") process typically requires a period of up to one year in outdoor open windrows to meet CCME guidelines and become a saleable product. It is recommended that HRM control the final curing process to ensure guidelines are being met with its compost, and also to gain the benefit of enhanced product value at final maturation.

11.5.1.1. Comment on Stantec Report 7.1 EXISTING OPERATIONS

This section is complete. The reference to the strategy is made. These compostable organic materials are not being received by the Otter Lake facility as waste materials. The intended diversion rate target has been achieved. The intended target for the quality of the resulting compost process has not been achieved. No reference is made in the report to the inability of residents to use the currently resulting composted material.

11.5.1.2. Comment on Stantec Report 7.2 OPERATIONAL LIMITATIONS

Lack of Capacity

"The two organics processing facilities…are at full capacity." We agree.

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Compliance with CCME Guidelines

"The HRM compost program is currently non-compliant in terms of consistently meeting newly adopted CCME guidelines for compost maturity prior to transfer to unmonitored open windrow sites for final curing." We agree.

"The results of the tests indicated that the compost leaving the phase one facilities had greater respiration rates than that allowed under the 2005 CCME guidelines." We agree.

"Both facilities can continue to meet the 1996 requirements but neither facility can consistently meet the requirements of the 2005 CCME guidelines." We agree.

11.5.1.3. Comment on Stantec Report 7.3 COMPARISON OF CURRENT OPERATIONS TO 1995 WASTE RESOURCE STRATEGY

The report notes that the charging system adopted for ICI wastes will be designed to encourage separation. The report states that "HRM implemented a differential tipping fee structure for this sector." While not elaborated on in the report, the HRM tipping fee structure financially encourages compostable organic material to not go to the Otter Lake RDF landfill cell. Other actions are also needed that result in a better source separation of organics in what is collected from the ICI sector.

The reviewed report notes that "…both facilities have experienced nuisance issues…." Can this be elaborated on? How often, how serious, reported by whom, and what action(s) were taken?

The reviewed report notes that "overall, the program has fulfilled the intent of the Strategy having implemented all original recommendations and having diverted a significant amount of organics from the landfill from both residential and ICI sectors." We agree that the organic diversion target has been achieved – principally through the residential green bin program - but the resulting compost quality target, and intended usefulness of the material, has not been achieved.

11.5.1.4. Comment on Stantec Report 7.4 COMPARISON OF CURRENT OPERATIONS TO INDUSTRY BENCHMARKS

Organics Waste Program Performance Comparison to other Municipal Jurisdictions

The table "Key Performance Indicators for Various Municipalities" in the Stantec report, notes that the residential organics diversion is indicated as 27.01%. It would be helpful to the reader to have a reference as to how this number was derived. In this same table, the header "organics processing fees" is misleading, as the item indicated is the costs, not the fees.

"HRM's program compares quite favourably to other municipal programs." We agree.

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"During fiscal 2011 / 2012, 51,238 tonnes of SSO were diverted from landfill, of which 16,615 tonnes, or 32%, consisted of waste from the ICI (and some multi-family) sector." This data needs to be clarified in terms of data source.

"In summary, it is evident that no municipality is providing the level of service that HRM provides to the ICI sector." The discussion addresses two Canadian cities, so the conclusion is not fully supported.
We understand from HRM staff that the tipping fee is $75 per tonne for ICI organic materials going to the composting facilities. In the table on page 7.8, the "fee" (at almost $160 / tonne as the organic facility processing cost to HRM) is much higher than the $75/tonne tipping fee paid to HRM when collecting ICI materials. While the tipping fee is less than the current cost to HRM for processing materials at these composting facilities, it helps to divert some ICI organics away from the Otter Lake landfill. ICI mixed waste, which includes compostable organics and a portion that cannot be composted, goes to the more expensive Otter Lake facility for disposal in the RDF landfill. The processing cost per tonne of material to HRM is currently greater for what enters the RDF landfill at Otter Lake, than for what is processed at the composting facilities.

The FEP does not effectively separate most of the compostable organics included in the mixed ICI waste that arrives at the Otter Lake facility. Those relatively high volatile or leachable organic materials that arrive at the FEP, and are separated and processed in the WSF, are not so much stabilized, as they are somewhat dried out. The WSF material that goes to the RDF, and becomes wetted again, or has a rise in their moisture content, also has the potential – again - to release volatile gas. The mass - or number of volatile gas molecules - may be released more slowly, at a smaller concentration, and over a longer period of time, but that potential to release gas still exists.

Where a portion of collected ICI material is sufficiently organic that it can be composted, it is in the interest of both HRM and the ICI sector, to have it composted and to not have it placed in the Otter Lake RDF. Those compostable organics are arriving at the RDF, while being banned and should not be included in what is sent to the RDF. This circumstance strengthens the resolve to improve the ICI and curb side source separation of wastes and materials.

LYW Programs

"In summary, there is really no 'best practice' as it relates to the management of LYW waste as part of a Green bin/Cart program." We agree.

Compost Material Marketing

This section comments on activity elsewhere in Canada but does not draw any conclusions about HRM.

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11.5.1.5. Comment on Stantec Report 7.5 OPPORTUNITIES FOR OPERATIONAL IMPROVEMENTS

General

"HRM has already made substantial capital investment in existing facilities, in some cases quite recently, and where deemed feasible the continued operation of this infrastructure is recommended as part of the long term system…" This is a solid conclusion. However, in another part of the report the closure of the Goodwood compost facility is recommended as it is referred to as "not a strategic asset." Is there a contradiction between these two statements?

Options to Meet both Short and Long Term Capacity Needs

The financial information / arguments presented are not balanced. The basis of cost estimating between options is not the same, and incomplete information is available. The selection of a preferred option is more difficult for the user of the report. Perhaps this was beyond the Stantec scope of work.

Continued Operation of Miller and New Era

"These facilities are operating reasonably well…" Although this sounds positive, where is the supporting information for this conclusion? And there is reference to "fairly significant" capital upgrades that have been made and are being paid for (or capitalized) by HRM, but these upgrades are not listed. One has to make the presumption that the costs for these upgrades have been incorporated in the fees charged by the private facilities, but it would be helpful for this to be clarified.

"HRM has an opportunity to ensure sufficient processing capacity over the planning period with the combined use of a new anaerobic digestion facility and the use/repurposing of existing aerobic composting facilities." This is correct. The conclusions drawn indicate a range of options, which is the best that can be developed at this stage of a study.

Repurpose the WSF

"The existing WSF is no longer an asset to HRM's landfill operation." This statement is not fully enough supported. In the fashion the WSF is being employed now, this may be true, but it does not allow for or suggest a potential alternative use for some of the WSF infrastructure. The WSF was a fundamental aspect in the original landfill siting efforts, as it was intended to stabilize residual waste before being placed in the landfill. The actual experience at the Otter Lake facility is that the WSF has neither fulfilled that earlier vision, nor has a reasonable prospect for doing so in the future. The value of what the WSF is currently accomplishing, does not justify the current multimillion dollar annual WSF budget.

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Compost Curing Pads

The recommendation for compost curing pads is conditional, not direct, as noted below…
"As part of a Regional Waste Resource Campus concept, compost curing pads could be constructed and operated to provide HRM with greater control over the process, finished product and marketing." This statement is more limiting than it needs to be. The bottom line is that curing of compost is needed and whether or not a regional waste resource campus were implemented, this should be considered.

This recommendation is based on several factors, including a revenue estimate, however the authors leave the final recommendation uncertain.

If the existing aerobic composting facilities continue to operate and they do not meet CCME guidelines, some potential responses could include diverting the ICI materials arriving at the current composting facilities, to another dedicated facility. It may be that separated residential materials arriving and being treated at the current facilities would meet the CCME guidelines. This could be considered in the context of relative the capital and operating costs.

The second to last paragraph in this Section, ending with "at 6000 finished tonnes per year this would equate to somewhere in the order of $324,000/year if all material could be sold." The financial basis in this paragraph, as a support for a business case, is incomplete. While not stated in the report, we understand that the "originally envisaged" $7.50/tonne figure was from the 1995 CSC Strategy. A different figure of $54/tonne is derived from local compost sales reports, but we are uncertain if local in this case refers to HRM. This is a significant amount of revenue against which selection of compost curing options needs to be evaluated.

"A curing and storage area would be an ideal addition to HRM's system particularly in the context of a new Waste Resource Campus and if at Otter Lake even more ideal if the WSF is repurposed as discussed above. If the WSF is repurposed for aerobic composting then all composting, curing and storage could occur on one site with no secondary transfer necessary." The WSF is currently used for garbage waste going to the RDF. Perhaps the WSF infrastructure and operations could be used differently in the future to aerobic compost materials that are not going to the RDF. A review of aerobic composting and curing in the HRM system, and some additional information, may result in a plan and justification for implementing this statement.

Anaerobic Digestion (AD) Processing Facility for ICI Sector Organics

Anaerobic digestion processing is addressed here for ICI organics. The intent is to divert ICI organics such that they are no longer being mixed with residential organics for treatment. The more challenging ICI organics would be treated anaerobically, while the easier to treat residential organics would be treated aerobically. This approach may provide a better opportunity to meet the applicable CCME guidelines. Proponent demonstrations could test if

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treated HRM waste materials meet the applicable CCME guideline values before decisions are made.

This subsection has extensive discussion on AD composting, then focuses on one technology, and leads to a cost estimate "in the order of $25,600,000 with $4,400,000 of that dedicated to aerobic composting and curing." The basis of the cost estimate is unclear. The reference is to "low rate composting and curing of digestrate" but this could be clarified with respect to the technologies discussed in the Section.

"At a minimum if HRM intends to pursue this option they should conduct their own due diligence review of the technology intending to be applied through site visits and the determination of suitability..." This is an appropriate recommendation.

"Alternatively HRM could engage in a more formal request for Expression of Interest and then if more suitable a Request for Proposal process for a new anaerobic digestion facility at a new Waste Resource Campus or at another HRM owned site if more appropriate." This is an appropriate recommendation.

11.5.1.6. Comment on Stantec Report 7.6 CHANGES TO FEEDSTOCK TO AEROBIC COMPOSTING FACILITIES

Removal of LYW

The reviewed report notes that "...if the WSF is re purposed it would be ideal to have an adjacent/near composting pad for LYW.." This is a logical suggestion, though not a recommendation. If the WSF is not repurposed, this could still be done at the Otter Lake site.

"The benefit of freeing up capacity at New Era and Miller is the opportunity in the shorter term to make more practical use of these facilities through increased household organic waste capture..." This is a logical statement, though not a recommendation.

Removal of ICI Organics

"Removal of this material....from the existing aerobic composting facilities to anaerobic digesters (discussed above) would leave a lighter and more homogeneous feedstock which would positively contribute to meeting compost maturity requirements per CCME guidelines." This is not presented as a recommendation because the earlier discussion on AD processing was inconclusive. In other words it is a consideration only. It appears there is insufficient information to determine if removal of the ICI organics from the aerobic digesters would allow those existing private operations to consistently meet CCME guidelines, thereby reducing the estimated capital upgrading.

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Removal of Boxboard

"Removal of boxboard from the organics waste stream would therefore likely contribute to the ability of these processing facilities to meet CCME Guidelines…additional benefits of removing boxboard…with respect to potential cost savings and diversion." This is a logical recommendation.

There appears to be no mention of the challenge of removing boxboard from the ICI organics stream. Perhaps this is considered too minimal to be important in this discussion, but there is no mention of the challenges involved.

11.5.1.7. Comment on Stantec Report 7.7 REGIONAL PARTNERSHIPS

The report notes that "It appears that a regional partnership with another municipality is not a feasible option…however partnership operations with these facilities for processing should continue to be an option for excess capacity…" This is a logical recommendation.

11.5.1.8. Comment on Stantec Report 7.8 CONCLUSIONS AND RECOMMENDATIONS

We present our comments on the Stantec Recommendations in Section 4 of this document, and on the Conclusions, in Section 6.

11.6. COLLECTION PROGRAMS AND CONTAINER CONSIDERATIONS

What was Sought and What was Delivered

The HRM RFP Section 5.1.7 Collection System and 5.1.8 Curbside Collection Container Analysis, noted the group of deliverables being sought. The Stantec Report Section 8 Collection Programs and Container Considerations, was the response.

An excerpt from the Stantec Report Section 12 Conclusions:

8) Collection programs are cost effective and meet most customer needs however there are opportunities to improve diversion by increasing the frequency of collection.

An excerpt from the Stantec Report Section 12 Recommendations.

C1 – Improve Recovery of Recyclables and Organics

Based on the results of annual waste composition studies completed recently by SNC-Lavalin and CBCL, 30% of residential and up to 50% of ICI materials currently sent to landfill could be

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recovered as recyclables or compostable organics. This is an opportunity for HRM to optimize existing programs and increase diversion.

C3 – Improve Curbside Collection Frequency

Challenges with recovery of divertible materials at the curb are often linked to the frequency of collection. Whether the entire collection system is weekly or every 2 weeks, this does not change the amount of material to be collected on a monthly basis. Residents are far more likely to divert organics and recyclables if collection is performed on a weekly basis so that odour and storage constraints do not affect participation.

11.6.1. COMMENT ON STANTEC REPORT 8.2 CURBSIDE COLLECTION CONTRACTS, ZONES AND COSTS

11.6.1.1. Comment on Stantec Report 8.2.1 Residential Collection Contracts

The report notes that "All collection services are provided every two weeks except for weekly recyclable collection in the urban and suburban areas, and weekly organic collection in urban and some suburban areas in July and August."

"The current collection contracts commenced on July 1, 2008 and expire June 30, 2013."

The residential material collection system is a real success story in the HRM system. Still, that level is at a plateau, and for the HRM system as a whole to improve, some change is needed. The most positive change would be an improved and more effective source separation of ICI materials when they are collected, such that more – and preferably substantially all - ICI compostable organics are diverted from the waste stream that concludes with the RDF.

11.6.1.2. Comment on Stantec Report 8.2.2 Condominium Collection Contract

The report notes that "HRM services 8,333 condominium units (larger than 6 units)." Payment for HRM services is based on the number of condo units involved. As more condominiums are constructed over the contract period, more service will be provided and paid for.

11.6.1.3. Comment on Stantec Report 8.2.3 Garbage Collection

There is a useful graphic illustrating Diversion and Disposal Trends, covering the period 2001 to 2012. Even better would be a graphic showing these figures per person over the period.

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11.6.1.4. Comment on Stantec Report 8.2.4 Source Separation

Green Cart Program – The report references from another consultant report that for the residential waste stream "the performance of the system has exceeded the original strategy goal of 21.9% under the mature system, indicating that the organics program has exceeded expectations in performance." The system performance is adequately presented.

11.6.1.5. Comment on Stantec Report 8.2.5 Recycling

"HRM currently provides curbside collection to eligible residences using a blue bag system. Residents are currently able to place unlimited quantities of recycling at the curb, however they are required to separate the material into three streams."
"The performance of the recycling program has not increased significantly over the past decade."

The system performance is adequately presented.

11.6.2. CURRENT PERFORMANCE COMPARED TO INDUSTRY BENCHMARKS

11.6.2.1. Comment on Stantec Report 8.3.1 Single vs. Two Stream Recycling Collection

"Many of the larger municipalities in Ontario… and in the US ...have switched from dual stream systems to single stream systems over the past ten years, as they encourage residential participation and improve capture rates." The report provided a good discussion, with appropriate examples.

11.6.2.2. Comment on Stantec Report 8.3.2 Recycling Collection Containers

"The performance of the system results in a 15.9% residential curbside diversion rate for recyclables which is low in comparison to other municipalities shown in the table below." What is the source of the reference for the 15.9 percent figure for HRM?

11.6.2.3. Comment on Stantec Report 8.3.3 Automated Garbage Collection

A description of the automated truck system would be useful for those who have not seen one.

The reviewed report notes that "...automated waste collection is considered to be an emerging best practice in waste management where efficiencies can be gained in collection of any waste stream." As a comparison of HRM to other jurisdictions this is helpful information but nothing is provided regarding quantitative costs or benefits.

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11.6.2.4. Comment on Stantec Report 8.3.4 Co-collection of Materials

"Many municipalities are utilizing a co-collection model to achieve efficiencies in collection." "HRM's processing facilities are not geographically located in such a way that co-collection would appear to be able to drive greater efficiencies in its current collection system." This statement indicates that at present co-collection is not recommended. "Co-collection however becomes a real opportunity for HRM in the context of a Waste Resource Campus with multiple processing facilities located on one site." In other words it is suggested this be considered depending on the Campus concept. As with Section 8.3.3, it would be helpful to enhance this with some financial commentary, perhaps related to collection contract costs and changes that could ensue.

11.6.2.5. Comment on Stantec Report 8.3.5 User Pay Programs and RFID

No comment.

11.6.2.6. Comment on Stantec Report 8.3.6 Level of Service

"Some municipalities in Canada have recently begun switching their collection systems to provide a uniform level of service..." This is not quantitative. It would be useful to have a reference and add that this applies to other municipalities with a similar size.

11.6.2.7. Comment on Stantec Report 8.3.7 Bag Limits

"The current HRM bag limit is higher than other Nova Scotia municipalities. HRM could consider gradually reducing their residential bag limit..." This statement could be substantiated with actual data.

11.6.2.8. Comment on Stantec Report 8.3.8 Leaf and Yard Waste Management

The reviewed report notes that "...there are no prescribed 'best practices' with respect to the management of LYW in concert with a household organics collection program..." No comments.

"Residents in HRM are permitted to use kraft paper bags but the elimination of the plastics should be considered further." This is not a recommendation per se, but it could be.

11.6.2.9. Comment on Stantec Report 8.3.9 Expanded Multi-Residential Sector Collection

"Typically, the diversion rate in this sector is 20%, however that would be expected to increase with the implementation of various initiatives mentioned above, and with program maturation."

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The reference to 20% is not substantiated and should be. The associated recommendations are reasonable.

"HRM already employs these best practices with existing multi-family curb side collection and condominium property collection programming and would simply extend these practices to the balance of the multi-family sector." This is a recommendation and it seems reasonable, although no business case information has been provided. Neither the costs nor the benefits are quantified.

11.6.3. OPPORTUNITIES FOR IMPROVEMENT

11.6.3.1. Comment on Stantec Report 8.4.1 Impact of Decisions Regarding Campus Concept and Recyclables Processing

The report notes that "Clear direction as to whether HRM will maintain a de-centralized infrastructure model, or transition to a campus concept, is required before collection contracts can be re-organized." As stated in earlier comments, the Campus Concept has not been fully supported with a business case analysis. As a result there is insufficient information for HRM to take this decision. This statement in the report is not a recommendation, however.

"Another factor which will impact the collection program is the decision to either maintain a two stream recyclables program, or convert to single stream processing and collection." This statement is clear, however, no business case analysis was presented to support staying with two stream or converting to the single stream.

11.6.3.2. Comment on Stantec Report 8.4.2 Contract Timing and Duration

This subsection does not provide clear recommendations. No comment.

11.6.3.3. Comment on Stantec Report 8.4.3 Short Term Collection Program Changes

Three recommendations are provided in this subsection. These are supported by previous analysis.

11.6.3.4. Comment on Stantec Report 8.4.4 Collection Zones

"Stantec recommends that HRM consider reducing the number of collection zones...Stantec suggests that a total of 4-6 zones would be satisfactory." The basis of this recommendation seems to be the benefit to reducing the administrative burden on HRM staff. There is no

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financial analysis or business case presented to support this statement. There may be social and local business benefits for keeping the current number of collection zone contracts.

11.6.3.5. Comment on Stantec Report 8.4.5 Frequency of Collection

"Stantec does however recommend that urban areas receive weekly organics and recyclables collection throughout the year with a maintained bi-weekly garbage collection cycle." There is no business case presented. It is based on a "best practice" argument. It is expected that the estimate of the incremental cost of making this change for everyone would not be worth the corresponding change in material diversion from residential locations. Weekly organics collection may make sense in expanding these services for the ICI locations. In that case, this would increase diversion for the system as a whole (Residential + ICI), even as the diversion rate for the residential portion has trended to stay at about the same value.

11.6.4. COMMENT ON STANTEC REPORT 8.5 CONCLUSIONS AND RECOMMENDATIONS

Some recommendations do not have support in the text.

"More detailed collection modelling could be undertaken to assess the benefits of automated versus manual collection, separate collection of LYW, single stream versus dual stream collection." This is a logical recommendation, though it was not stated in the previous text.

"Modelling should also be undertaken to determine collection area re-zoning once long term processing facility location(s) are determined." As in the previous recommendation, this makes sense, but was not stated in the text. In the text a reduction of number of collection zones was recommended, but here, modelling is suggested.

11.7. REVIEW OF ENERGY FROM WASTE OPPORTUNITIES

What was Sought and What was Delivered

The HRM RFP Section 5.1.6 Conversion Technology – Energy from Waste Technology Analysis noted what deliverables are sought, and the Stantec Report Section 9 Review of Energy from Waste Opportunities, presents the response.

An excerpt from Stantec Report Section 12 Conclusions:

10) Energy-from-Waste and developing waste reduction technologies are not considered appropriate investments for HRM at this time.

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11.7.1. COMMENT ON ENERGY FROM WASTE CONSIDERATIONS IN 1995

"Many EFW technologies, including gasification and pyrolysis, were in the early stages of development when the 1995 Strategy was developed and therefore, were not considered in the analysis."

This is not why they were not considered in the analysis. EFW had been rejected as an option for long term MSW management in the four municipalities. An EA for an EFW (i.e. incineration only) based municipal solid waste management system, presented for review by the Regional Authority, was formally rejected by the Minister of the Environment. This outcome was a significant driver for the development of the Waste Resource Strategy. It was one of the motivations for public involvement and the activity of the community stakeholders group. We think that to infer that EFW (i.e. as incineration) was an "option" at that time is not correct.

11.7.2. COMMENT ON STANTEC REPORT 9.2 COMBUSTION

11.7.2.1. Comment on Stantec Report 9.2.2 Benchmark Analysis

"Energy production via combustion or incineration is much more widespread in Europe. A recent projection…estimates that over 550 plants with a combined capacity of 80 million TPY will be in operation by 2016." The relative nature of this statement should be corrected. The population of Europe is hundreds of millions, and limitations on space as well as high energy costs are also likely drivers for the greater number of incineration facilities. Some European jurisdictions accept incineration of municipal solid waste and EFW (energy from waste) applications, but not Nova Scotia.

11.7.3. COMMENT ON STANTEC REPORT 9.7 RECOMMENDED FUTURE DIRECTION

The report notes that "EFW is considered as a mid to long-term waste management alternative for HRM to be considered in more detail in the 5-10 year range after local efforts to improve current facilities and operations are well under way."

The basis for this statement is unclear. Why is it an alternative? If the HRM system operates well, and diversion can be enhanced in future, the only reason to consider EFW would be to reduce landfilling requirements. If this is the case, it should be clarified as a landfilling alternative only. As well, this would merit some comment about the energy content of the waste stream that would be directed to an EFW unit after such significant diversion. This recommendation does not have a business case and is improperly technically founded.

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11.8. LOCAL INDUSTRIAL / COMMERCIAL WASTE NEEDS AND OPPORTUNITIES

What was Sought and What was Delivered

The HRM RFP Section 5.1.9 Options for ICI Processing Capacity identified desired deliverables being sought. The Stantec Report Section 10 Local Industrial / Commercial Waste Needs and Opportunities, was the response.

11.8.1. COMMENT ON STANTEC REPORT 10.1 EXISTING OPERATIONS

This Section states that "50% of ICI materials sent to landfill could be recovered as recyclables or compostable organics....this represents a significant opportunity to increase diversion in the HRM." This aspirational goal may have practical expectations, that are something less.

From our discussions with HRM staff, there is a 65 (ICI) / 35 (residential) split in the 140,000 tonnes of material collected annually by the HRM solid waste program. If 50% or half of the 80,000 tonnes (80,000 = 65% of 140,000) collected from ICI (40,000 tonnes), or even a 25% quarter (20,000 tonnes) were not mixed waste, but could be accepted at HRM compost facilities, this would be a significant benefit to the HRM solid waste resource management system. Encouraging more source separation and collection of ICI organic material that is acceptable for aerobic or possibly anaerobic treatment, as opposed to a central facility separation, is a better way to accomplish this.

11.8.2. COMMENT ON STANTEC REPORT 10.2 COMPARISON OF CURRENT OPERATIONS TO 1995 STRATEGY

11.8.2.1. Comment on Stantec Report 10.2.1 By Law S-600

"The current HRM by-law No. S-600 discourages and prohibits in some ways the ICI sector from developing their own parallel system as encouraged in the 1995 strategy." The word "prohibit" seems too strong here. There is no prohibition to developing waste management systems within HRM, although the financial benefits to the private sector of doing so may be limited. There is simply a restriction to moving the ICI waste outside of HRM.

11.8.2.2. Comment on Stantec Report 10.2.2 Waste Characterization Studies

"...the percentage of acceptable material for disposal at HRM facilities has increased steadily since 2003. However, despite this increase, there is still contamination of ICI loads." We agree.

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11.8.2.3. Comment on Stantec Report 10.2.3 Tipping Fees

"Based on observations of the current program, the ICI tipping fee structure has not been encouraging further source separation. By applying a higher fee for mixed loads, there would be a great incentive for source separation." The observations referred to in this statement are not clear. How has the ICI tipping fee structure changed over time, and is it possible to examine the Source Separation as a function of this tipping fee escalation? How much more could the fee be raised to? What is best practice in charging for ICI loads? None of this is mentioned.

As we understand it, $170/tonne is the cost to HRM for processing waste at the Otter Lake facility, while the tipping fee for ICI waste is $125/tonne, and the charge for residential waste is covered by municipal taxes. The ICI tipping fee for organics at the compost facilities is $75/tonne, while the charge for residential organic materials is covered by municipal taxes. This $75/tonne rate differential encourages the diversion of ICI organic materials away from the FEP / WSF / RDF and towards the compost production facilities, but this is not always the successful result. Contrary to the applicable bylaw, and for many years now, some of the ICI waste has not been properly source separated, and as such is not suitable for treatment at the compost facilities. This has resulted in an organic component of some ICI wastes being received at the FEP/ WSF / RDF Otter Lake facility.

11.8.2.4. Comment on Stantec Report 10.2.4 Diversion Targets

"Since 1990, tipping fees for waste have increased from $27.50 to $125 per tonne. Since the introduction of the source separated organics program in 1999, tipping fees for organics have only increased by 10.5% from $68 to $75 per tonne." The trend in how these tipping fees have changed is such that there is an economic incentive for organics to go to the composting facilities and not in a waste stream that ends up in the Otter Lake RDF landfill cells.

11.8.3. COMMENT ON STANTEC REPORT 10.3 BENCHMARK ANALYSIS

"In order to fully assess the current performance of the HRM Waste Resource System, a comparison to similar jurisdictions in Canada was conducted. Jurisdictions used were chosen primarily based on similarities in population and geography to HRM…the results of the analysis showed that most jurisdictions do not provide waste management collection services to the ICI sector." This benchmark analysis is incomplete in terms of documentation. At a minimum, a table of jurisdictions, populations, and collection provision methods should be given, to support the statement. Is this the table with comparisons between Halifax and six Ontario communities? Potentially interesting comparisons could be other coastal communities such as Victoria, St. John's, Saint John, and Quebec City.

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11.8.4. COMMENT ON STANTEC REPORT 10.4 RECOMMENDATIONS

The recommendations in this Section are fairly soft.

"The effectiveness of that By-law change should be assessed and re-evaluated. Consideration to further amend By-law S-600 to require waste haulers to provide services that support HRM's waste management strategy throughout the entire collection process will help increase waste diversion." The benefits and costs of this recommendation should be mentioned. What is the potential to discourage commercial investment, for example, as a result of increased restrictions on waste management? In one form or another, there will continue to be some locally available waste hauling capacity available. The results of regulations or HRM direction will ultimately be reflected in the unit fees paid to these haulers.

"Consideration should also be given to allow a cash transaction payment option for ICI organics customers delivering to the composting facilities that are currently not on account." This makes sense, although it would have a marginal effect on ICI waste diversion.

The reviewed report notes that "continuing to carefully evaluate the results of waste characterization studies….encouraging ICI diversion through continued education programs….all new development should be required to implement a compliant source separation program…potentially increasing ICI diversion through enhanced enforcement." Some of these recommendations are soft, but the requirement for new developments is solid and can be readily implemented. In no case has a business analysis been presented. For example, there is no way to estimate the influence of such requirements or enforcement could adversely affect business investment. These recommendations should be accompanied by additional analysis to support them.

"Revising By-law S-600 to include proper communication and utilization of commercial bins to support source separation." This recommendation seems logical, however, does it go on to suggest that commercial bins would be provided by HRM? No.

The discussion in this Section of the report is fairly light, considering the importance of ICI waste source separation to the success of the HRM system. Could there be more creative suggestions? For example, could there be some creation or utilization of a discussion or working group of ICI collectors to explore how to improve separation without creating undue financial burden? Are there examples of such collaboration elsewhere in Canada or in the US?

Community engagement, focus groups, informed discussion, and more have been used in developing the HRM solid waste resource management program. That trend will continue.

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11.9. WASTE RESOURCE PARTNERSHIP OPPORTUNITIES IN NS BEYOND HRM

What was Sought and What was Delivered

The HRM RFP Section 5.1.10 NS Waste System Regional Overview of Materials and Facilities, noted the deliverables being sought. The Stantec Report Section 11 Waste Resource Partnership Opportunities in Nova Scotia Beyond HRM, was the response.

An excerpt from Stantec Report Section 12 Conclusions:

9) Opportunities exist for more collaborative use of resources with other waste management regions in Nova Scotia.

While exporting ICI waste out of HRM may be a potentially economically preferred option for the responsible individual property owners, it is not currently an economically preferred option for the HRM program. We do not anticipate a change in the HRM By law S 600, banning the export of ICI waste from HRM to other jurisdictions (except perhaps by HRM itself).

While there may be some economically useful options for recyclables from outside of HRM to be processed within HRM, there is no financial or waste flow information presented in the Stantec report to justify this type of activity.

We expect that there will be no change in the foreseeable future to Section 16.3 of the HRM By-Law S-600 "Solid Waste Resource Collection and Disposal By-Law". This is because the ICI tipping fee revenues support a significant component of the full HRM program. If ICI waste and revenues leave HRM, there would be insufficient financial resources for the HRM program.

If the overall HRM integrated solid waste resource management program costs were significantly less, and the program relied less on keeping all of the ICI waste and associated tipping fees within HRM, then perhaps the S 600 By-law might change, and – possibly – there may be some options outside of HRM to consider.

11.10. DEVELOPMENT OF A TRANSFER STATION CAPACITY

What was Sought and What was Delivered

The HRM RFP Section 5.1.5 Development of a Transfer Station Capacity is what was responded to by the Stantec Report Section 5.2 Flexibility Offered by Waste Transfer Capability.

An excerpt from Stantec Report Section 12 Conclusions:

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11) Overall program costs in HRM are high and represent a greater financial burden on both the private and public sectors compared to similar communities.

This conclusion applies to more than one section of the Stantec report.

Due to the agreement and proximity to the West Hants landfill, Stantec "does not recommend any further consideration of a standalone transfer facility." Agreements exist for emergency circumstances between HRM and other jurisdictions as well. The report further states "If HRM at some point chooses to revisit its waste disposal strategy and export waste to other jurisdictions on a long-term or permanent basis, then a transfer facility would likely become a key component of that revised strategy." We agree, especially if HRM Bylaw S-600 was amended, and waste or materials originating from eastern HRM were being transported to the Eastern Region (Pictou, Antigonish, and Guysborough counties) instead of to the Otter Lake facility.

12. LIMITATIONS ON CONTRACTED SCOPE OF PEER REVIEW REPORT

SNC-Lavalin Inc. was retained by the Halifax Regional Municipality to conduct a peer review of the document entitled Waste Resource Strategy Update, dated January 2013 by Stantec Consulting Limited. The Peer Review analysis reflects our best judgement on the report content and recommendations. The report is the property of SNC-Lavalin Inc. and the Halifax Regional Municipality. SNC-Lavalin Inc. accepts no responsibility for any decision made by a third party based on the content of this report. Should new information become available that is pertinent to the subject matter of this report, SNC-Lavalin Inc. reserves the right to modify our opinions, conclusions, and recommendations accordingly.

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13. SUMMARY OF FINDINGS

In preparing this Peer Review report, SNC-Lavalin:

- reviewed documents provided by HRM, including the 1997 Operations Plan,
- reviewed the 1995 CSC Strategy - "accepted in its principles" by HRM Council in 1996,
- reviewed applicable legislative and regulatory documents,
- met regularly with HRM staff on this project (e.g. Jan 3, 10, 16, and 17, 2013),
- visited the Otter Lake facility on January 10, 2013,
- reviewed the January 2013 Stantec report,
- focussed on Sections 3 and 4 of the Stantec Report, after consulting with HRM staff,
- considered Options - Community Engagement - HRM Council decision making process,
- considered and described additional performance, financial, and technical information,
- described our varying support for potential options recommended in the Stantec report,
- described our varying support for the conclusions presented in the Stantec report,
- described financial review of some options recommended in Stantec report,
- described additional waste stream laboratory sample results and interpretations,
- described Balloon Study for observing balloons above RDF, from various view planes and
- conducted the peer review tests sought by HRM in the December 7, 2012 RFP.

Some general finding from our peer review can be summarized as follows:

- The 132 page HRM RFP #12-061 called for many deliverables for the Stantec report,
- The 187 page Stantec January 2013 "Waste Resource Strategy Update" was reviewed,
- Some Sections of the Stantec report met the peer review tests sought by HRM on
    - A - System Performance Assessment,
    - B - Industry Bench Mark Analysis and Best Practices, and
    - C – Options Analysis and Recommendations,
- Not all recommendations were shown to be the derived result of a stated methodology,
- Not all recommendations were shown to be validated by information in the same report,
- We commented on questions and topics of particular interest as noted in our HRM RFP,
- Since the waste stream in 2013 so differs from that of 1995, Stantec has identified some options for consideration by HRM decision makers, where continuing to achieve the community, environmental, stewardship, waste and resource program goals for the system, might be met more efficiently, using a different mix of infrastructure and operations in the future.

It is understood that HRM is starting a 2013 Community Engagement process. This would help HRM Council establish the social and community boundaries for the HRM Integrated Solid Waste Resource Management program for many years to come. In doing so, HRM will seek the most effective means to achieve the desired environmental performance goals. This may involve some of the menu of options presented in the Stantec report. In deciding which options to apply, decision makers may choose to seek what we have indicated as additional information.

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This is our summary of our agreement with the major Stantec recommendations.

We support the following recommendations, whose concepts and details, with the indicated additional information, merit serious consideration by the final decision makers:
A1 – Closure of FEP and WSF by the end of 2013
A3 – Extend Life of Otter Lake (RDF) Landfill through Vertical Expansion

We expect that with more information, we would agree with these recommendations:
A2 – Request Modification of the Nova Scotia Landfill Liner Specification

We expect that with more information, we would agree with these recommended options; the concepts can be supported in principle, as meriting further consideration by decision makers; but we currently lack sufficient information to completely agree or disagree with the following:
B1 – Create a Centralized Waste Resource Campus
B2 – Relocation of MRF to (a centralized) Campus
B3 – Increase Organics Processing Capacity (add an anaerobic digestion capacity to the system)

C1 – Improve Recovery of Recyclables and Organics:

- We agree with the recommendation as an overall goal,
- We expect that with more information, we would agree with the recommendation to eventually move to collecting a single stream of recyclables at the curbside, due to the collection system efficiencies, and
- We lack sufficient information to either agree or disagree with many of the suggestions put forward in support of this recommended goal.

C2 – Control Curing and Sale of Finished Compost:

- We expect that with more information, we would disagree with the recommendation (of having HRM operate a new secondary curing area).

C3 – Improve Curbside Collection Frequency:

- We expect that with more modelling information, we would disagree with the recommendation to reduce the number of collection zones, and
- We disagree with the recommendation for doubling the year round collection frequency of the current residential green bin food organic waste stream to a weekly basis.

We believe that the HRM system can continue to achieve its environmental performance goals in a more cost effective manner (e.g. changing the operations that now take place at the FEP and WSF portions of the Otter Lake facility). The volume and density impacts of having no materials shredded at the WSF, should be balanced by the mix of greater and more efficient (e.g. the new GPS system) mechanical compaction efforts on wastes placed in the RDF landfill cell. For a 21st century stream of wastes intended for the RDF landfill cells, the system

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requirements for the cost effective and environmentally sustainable separation of materials (e.g. white goods, household hazardous materials, recyclable materials, organic materials having the readily volatile, leachable, and biodegradable potential), could be achieved by other means, processes, and methods within the HRM solid waste management system, than the current FEP and WSF infrastructure and operations.

Based on our review, we believe that the Stantec report provides a wide range of options with which HRM can commence a Community Engagement process in 2013. Recognizing the fundamental importance of the 1995 CSC Strategy and the 1997 HRM Operations Plan in creating the basis of the waste management system now in place, it will be helpful for HRM to start this process with the same underlying principles of maximizing waste diversion, meeting current regulations and standards, and ensuring a cost effective system is in place to serve residents and businesses for the long term.

In our review, we commented on each of the twelve (12) Conclusions in Section 12 of the Stantec report and provided a brief discussion.

- We agreed with Conclusions 1, 2, 3, 4, 5, 6, 7, and 10,
- We somewhat agreed with Conclusions 11 and 12, and
- We somewhat disagreed with Conclusions 8, and 9.

We agree with Conclusions 1, 2, 3, 4, 5, 6, 7, and 10.

Stantec Conclusion 1: *"The total diversion rate is relatively high in HRM compared to other municipalities, but realistic opportunities exist to improve the recovery of residential and ICI recyclables and organics in accordance with provincial legislation."*

(SNC-Lavalin: There are relatively much more opportunities with respect to the ICI wastes)

Stantec Conclusion 2: *"The front-end processing (FEP) and waste stabilization facility (WSF) at Otter Lake no longer provide a useful function compared to their stated purpose in the 1995 Strategy."*

(SNC-Lavalin: A "useful function" in this case, such as for example the white goods program, should be one that can be executed within a reasonable economic rationale)

Stantec Conclusion 3: *"The landfill liner design specification in Nova Scotia is more stringent than most comparable state and provincial jurisdictions, and potential modifications could significantly reduce future capital costs."*

(SNC-Lavalin: The default design for various provincial or state jurisdictions, varies with the desired envelope of possibilities associated with their various provincial or state site conditions)

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Stantec Conclusion 4: *"An opportunity exists to significantly extend the life of the landfill at Otter Lake, and reduce the site per tonne capital costs by increasing the finished grade by 10-15 metres."*

Stantec Conclusion 5: *"The two composting operations in Halifax and Dartmouth do not provide a sufficiently finished product to meet applicable guidelines which become effective in the near future."*

Stantec Conclusion 6: *"Composting facilities are at capacity and additional processing capacity is required in the short and longer term."*

Stantec Conclusion 7: *"Alternative composting technologies may improve the processing of ICI organics."*

Stantec Conclusion 10: *"Energy-from-Waste and developing waste reduction technologies are not considered appropriate investments for HRM at this time."*

We somewhat agree with conclusions 11 and 12

Stantec Conclusion 11: *"Overall program costs in HRM are relatively high and represent a higher financial burden on both the private and public sectors compared to similar communities."*

Stantec Conclusion 12: *"HRM would benefit from the creation of a centralized waste resource campus, rather than having facilities at four different locations in Halifax and Dartmouth. Development can be staged over time to match the end-of-useful-life of current infrastructure and incorporate new elements for HRM such as outdoor windrow compost curing pads; permanent educational and household special waste facilities; and the development of a materials transfer capability."*

We somewhat disagree with Conclusions 8 and 9.

Stantec Conclusion 8: *"Collection programs are relatively cost effective and meet most customer needs however there are opportunities to improve diversion by increasing the frequency of collection."*

Stantec Conclusion 9: *"Opportunities exist for more collaborative use of resources with other waste management regions in Nova Scotia."*

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Our February 27, 2013 Balloon Study involved six 600 mm diameter helium filled balloons at the proposed new maximum height for the cells. The topography map figure attached to this document indicates various places where we tested the view planes with respect to the Otter Lake cells. Aside from the bedrock outcrop in the anticipated commercial portion of the Brunello Estates development, we are confident that the increase in height of the landfill cells will not be visible from the other locations visited.

Waste stream samples from the FEP and WSF were taken and analysed to investigate their relative volatilization and leachate potentials. The relative differences were such that we believe the existing gas management and leachate systems have sufficient capacity to continue meeting the groundwater and air quality performance goals for the HRM solid waste system.

The current Otter Lake facility environmental performance goals are based on:

- Minimized average number of annually reported community odour incidents (i.e. Zero),
- Air quality parameters and values indentified in the current Operating Permit, and
- Groundwater and storm water runoff quality parameters and values presented in the annual environmental monitoring report.

Developing the WSF and 2002 "ad-hoc" gas management system capacities, was a response to the more rapid, short term release of high concentration gas from RDF landfill cell destined wastes receiving added mechanical and thermal energy at the FEP / WSF. Without the FEP / WSF, the gas releases to be managed would be expected to be slower, at a lower concentration, and for a longer period of time. This is why be believe the current gas management systems will have more than enough capacity to achieve the HRM community odour incident performance goal of zero incidents per year. If other means, processes, and methods are used to replace what the FEP / WSF was intended to achieve, in a cost effective and environmentally sustainable manner, a reduction can be reasonably anticipated in the annual $750,000 cost to HRM for the "ad hoc" gas management system at the RDF that has been operating since 2002. An unintended consequence of the original FEP / WSF operations would appear to be a contribution to the more rapid, short term, release of the high concentration mass of gas that was responded to by the "ad-hoc" gas management system at the RDF landfill cells since 2002. Aside from the fall of 2011, there have not been very many reported community odour incidents due to the Otter Lake FEP / WSF / RDF activities since 2002. This includes the May – December 2010 seven month period when the WSF was not operating.

An interesting item in the next version or evolution of the HRM waste and resource management strategy will be with respect to a better source separation of the various ICI waste stream components.

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We noted that we also sought additional information regarding the financial implications with respect to the option A1 recommendation made in the report reviewed. We reviewed some internal HRM documents, and discussed them with HRM staff.

For closing the FEP and WSF, we considered the annual operational costs, as well as the capital costs and repairs. If the FEP and WSF are closed, there are downstream ripple effects and activities to be accounted for in achieving the program performance goals by other means. In this case we anticipated additional resources for some programs (e.g. White Goods, and Household Hazardous Waste), along with additional labour and annual access road work. We also considered the cumulative relative influence on the unshredded material volume and density in the RDF if the FEP and WSF are closed.

We have presented a summary of these considerations as tables. The net financial influence on the annual HRM Solid Waste Budget from closing the FEP and WSF is anticipated to be:

- between $9,000,000 – 10,000,000 per year based on FEP / WSF capital and operations, and downstream responses to achieve certain tasks by other means, and
- a potentially substantial reduction in the $750,000 per year budget, for the continued use of the short term "ad hoc" landfill gas control and management system at the RDF.

If it is decided to implement the A1 option on closing the FEP and WSF, there are some financial implications for the HRM solid waste system. They include:

- If filling Cells 6 – 9, to the current design height were to occur over a 15 year period (~11 years x 10/7.5 x $10,000,000), the financial implication for the HRM system could be around $150,000,000.
- If filling Cells 1 – 5 to the proposed additional 15 metres was accomplished over at least 12.5 years; and filling Cells 6 – 9 to the proposed additional 15 metres was accomplished over at least 11 years, the financial implication for the HRM system could be around $230,000,000, as a present worth value.
- 38.5 year fill time = 15+11 (Cells 6-9 current plus 15 m) +12.5 (Cells 1–5 plus 15 m)

If it is decided to implement the A3 option on increasing the landfill cell height, there are some financial implications for the HRM solid waste system. They include:

- If the cost for a new cell is about $15,000,000 to construct, or $25,000,000 for construction and closing, and with the current maximum height an additional cell is constructed about every three years,
- Assuming the cell closure costs would be the same, regardless of the final height, the financial value for the HRM system of increasing the RDF landfill cell heights would be at least $100,000,000 (7 x $15,000,000 > $100,000,000) if not significantly more, based on the seven additional cell liners that did not have to be constructed.

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If it is decided to implement both the A1 option on closing the FEP and WSF, and the A3 option on increasing the cell heights:

- The cumulative financial effect of taking an FEP / WSF decision, and an increase in landfill height decision could be on the order of at least $480,000,000 over almost forty (40) years.
- If the current HRM system budget could accomplish the same goals for about $12,000,000 less per year (i.e. $12,000,000 = $480,000,000/40 years), that could reduce the average $170/tonne RDF cost to HRM, to something less than $100/tonne.

Summary of Peer Review Tests

We have also prepared a tabulated summary of the results we found in applying tests A, B, and C, to recommendations A1, A2, and A3 in sections 3 and 4 of the January 2013 report, with respect to the methodology and validity of recommendation derivation presented.

Providing a greater focus of our peer review evaluation on the A1, A2, and A3 recommendations in Sections 3 and 4 of the Stantec report reflects our contracted scope of work. The same table was not produced with respect to the B or C group of Stantec recommended options for HRM.

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Table 2: Summary of Peer Review Test Results for Options A1, A2 and A3

Recommendation A1 - Closure of the FEP (Front End Processing unit) and WSF (Waste Stabilization Facility) by the end of 2013		
Refer to our Section 11.1.5 Methodology of Recommendation Derivation in Stantec Section 3. Refer to our Section 11.1.6 Validity of Recommendation Derivation in Stantec Section 3.		
Test A – System Performance	for Methodology	Yes - Partially
Test A – System Performance	for Validity	Yes - Partially
Test B – Benchmark Analysis and Best Practice	for Methodology	Not comparable
Test B – Benchmark Analysis and Best Practice	for Validity	Not comparable
Test C – Options Analysis and Recommendations	for Methodology	Yes - Partially
Test C – Options Analysis and Recommendations	for Validity	No
Recommendation A2 – Request Modification of the Nova Scotia Landfill Liner Specification		
Refer to our Section 11.2.1.1 Methodology of Recommendation Derivation in Stantec Sec. 4.1. Refer to our Section 11.2.1.2 Validity of Recommendation Derivation in Stantec Section 4.1.		
Test A – System Performance	for Methodology	With more info. - Yes
Test A – System Performance	for Validity	With more info. - Yes
Test B – Benchmark Analysis and Best Practice	for Methodology	Yes
Test B – Benchmark Analysis and Best Practice	for Validity	With more info. - Yes
Test C – Options Analysis and Recommendations	for Methodology	With more info. - Yes
Test C – Options Analysis and Recommendations	for Validity	No
Recommendation A3 – Extend Life of Otter Lake Landfill through Vertical Expansion		
Refer to our Section 11.2.2.1 Methodology of Recommendation Derivation in Stantec Sec. 4.2. Refer to our Section 11.2.2.2 Validity of Recommendation Derivation in Stantec Section 4.2.		
Test A – System Performance	for Methodology	Not applicable
Test A – System Performance	for Validity	Yes
Test B – Benchmark Analysis and Best Practice	for Methodology	Yes
Test B – Benchmark Analysis and Best Practice	for Validity	No
Test C – Options Analysis and Recommendations	for Methodology	Yes
Test C – Options Analysis and Recommendations	for Validity	Yes

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14. ADDITIONAL INFORMATION

Some highlights from our financial review are summarized in the following:

Financial Review: Relative Change in RDF Material Density if FEP and WSF are closed	
+5 %	Increased volume (decreased density) due to unshredded material +20 % volume for unshredded versus shredded materials <25 % of total 2011 material in RDF was shredded material from WSF (HRM: Section 3.2 graphic incorrect in report. FEP to RDF is unshredded.)
+1 %	Increased volume due to contingency for daily cover materials in response to potential change in odour incident responses
->10 %	Decreased volume (increased density) of unshredded material in RDF from increased mechanical compaction efforts (within manufacturer's range)
< 0 %	No net increase in volume, where change in compaction effort is more significant than the density change from 100% unshredded RDF material.

Financial Review: Reductions to HRM Solid Waste Budget if FEP and WSF are closed	
$7.2 M/year	Front End Processing (FEP) Unit annual operations budget
$1.7 M/year	Waste Stabilization Facility (WSF) annual operations budget
$1.8 M/year	FEP / WSF capital cost and repair budget
$0 / year	No change in cost to repurpose or decommission if done 10 years early
$0 / year	No change in salvage value for FEP / WSF if done 10 years early
$10.7 M/yr	Cumulative reduction to HRM budget if FEP / WSF are closed

Financial Review: Additions to HRM Solid Waste Budget if FEP and WSF are closed	
$100 K/year	Residual Disposal Facility (RDF) additional labour
$100 K/year	RDF area additional annual access road improvements and relocations
$0 /year	RDF infrastructure charge due to change in material density and volume
$100 K/year	RDF area addition to annual mechanical equipment compaction effort
$0 /year	RDF Gas Management Resources change in infrastructure and operations
$0 /year	RDF change in annual odour incident responses, and leachate collection, transportation and treatment budget
$300 K/year	White Goods Program (additional resources)
$150 K/year	Household Hazardous Waste Program (additional resources)
$100 K/year	RDF area additional mechanical compaction efforts and equipment
$100 K/year	Scale house and associated functions salvaged from FEP budget
$950 K/yr	Cumulative additions to HRM budget if FEP / WSF are closed

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APPENDIX A

Figure 1 – Sample Locations

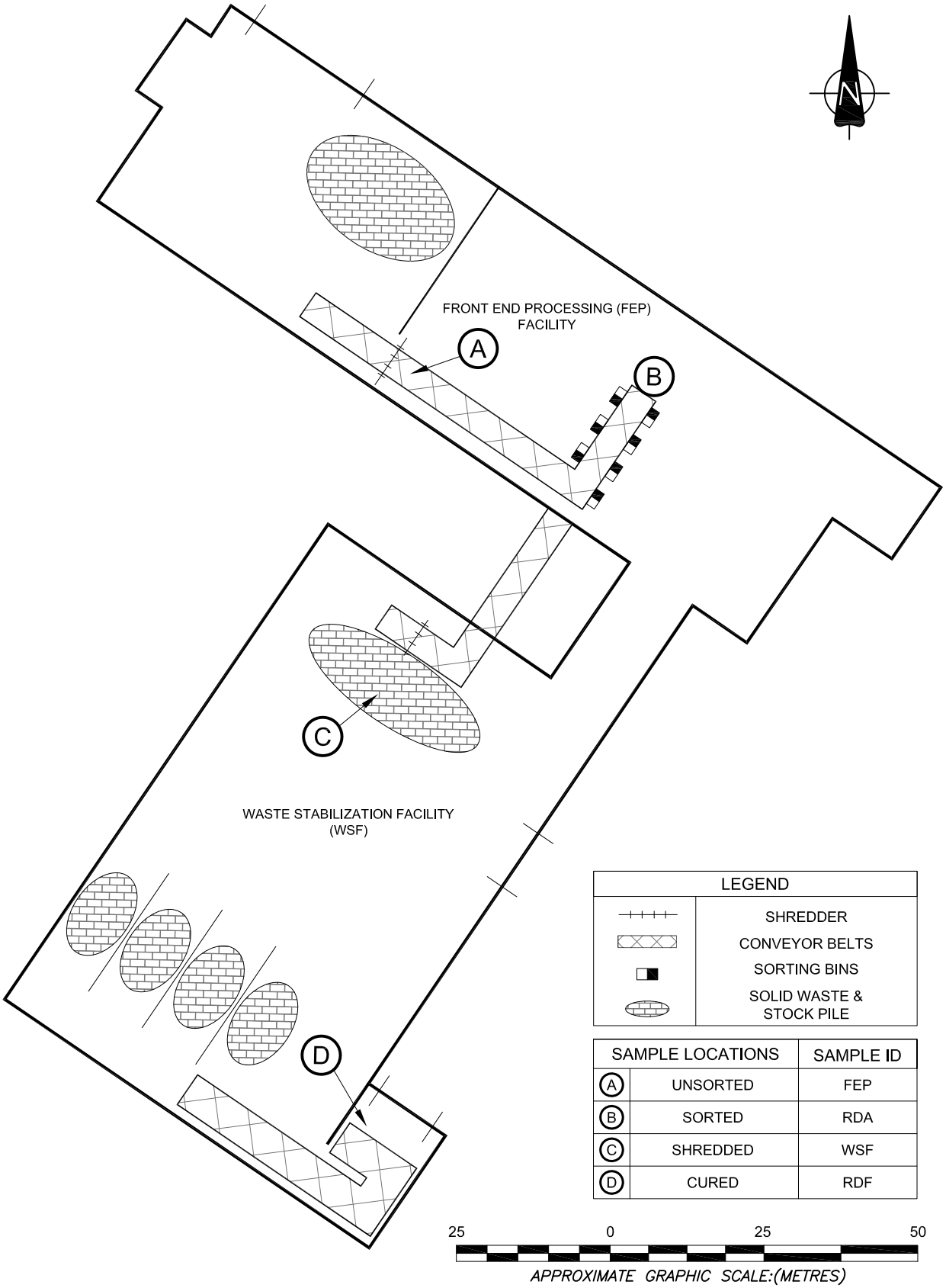
Figure 2 – Topography Map for Balloon Study

Table 1 – Summary of Petroleum Hydrocarbon Analytical Results

Table 2 – Summary of Leachable Metals

Table 3 – Summary of Volatile Organic Compounds

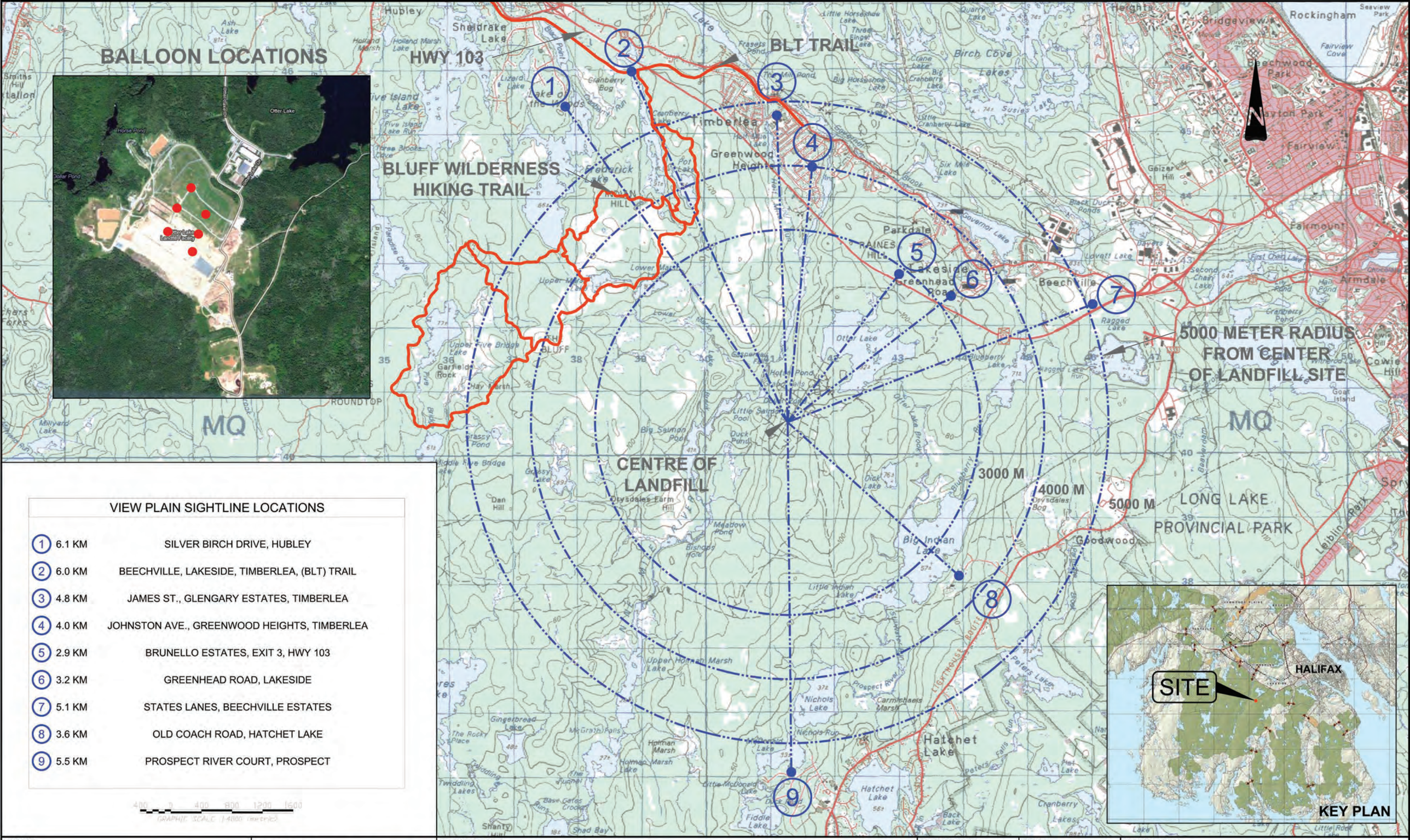
Laboratory Results



LEGEND	
	SHREDDER
	CONVEYOR BELTS
	SORTING BINS
	SOLID WASTE & STOCK PILE

SAMPLE LOCATIONS		SAMPLE ID
A	UNSORTED	FEP
B	SORTED	RDA
C	SHREDDED	WSF
D	CURED	RDF

SNC•LAVALIN SNC•LAVALIN Inc. Halifax, Nova Scotia, Canada Telephone: (902) 492–4544 Fax: (902) 492–4540 Member of the SNC•LAVALIN Group	DESIGNED BY: AT	PROJECT: HRM WASTE RESOURCE STRATEGY PEER REVIEW	DATE: MARCH 2013
	DRAWN BY: BK		PROJECT #: 511766-0001
	CHECKED BY: CE	FIGURE TITLE: **SAMPLE LOCATIONS OTTER LAKE WASTE PROCESSING & DISPOSAL FACILITY LANDFILL**	FIGURE #: 1
CLIENT: HALIFAX REGIONAL MUNICIPALITY	SCALE: NTS		



VIEW PLAIN SIGHTLINE LOCATIONS

1	6.1 KM	SILVER BIRCH DRIVE, HUBLEY
2	6.0 KM	BEECHVILLE, LAKESIDE, TIMBERLEA, (BLT) TRAIL
3	4.8 KM	JAMES ST., GLENGARY ESTATES, TIMBERLEA
4	4.0 KM	JOHNSTON AVE., GREENWOOD HEIGHTS, TIMBERLEA
5	2.9 KM	BRUNELLO ESTATES, EXIT 3, HWY 103
6	3.2 KM	GREENHEAD ROAD, LAKESIDE
7	5.1 KM	STATES LANES, BEECHVILLE ESTATES
8	3.6 KM	OLD COACH ROAD, HATCHET LAKE
9	5.5 KM	PROSPECT RIVER COURT, PROSPECT

400 0 400 800 1200 1600
GRAPHIC SCALE 1:4000 (metres)

CLIENT:
HALIFAX REGIONAL MUNICIPALITY

SNC·LAVALIN
SNC·LAVALIN, Inc.
Halifax, Nova Scotia, Canada
Telephone: (902) 492-4544
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Certified ISO 9001
Member of the SNC·LAVALIN Group

PROJECT TITLE:
HRM WASTE RESOURCE STRATEGY PEER REVIEW

DESIGNED BY: AT	SCALE: AS SHOWN
DRAWN BY: DC	PROJECT #: 511766-0001
CHECKED BY: CE	DATE: MARCH 2013

FIGURE TITLE:
TOPOGRAPHY MAP / VIEW PLANE SIGHTLINE LOCATIONS
OTTER LAKE WASTE PROCESSING & DISPOSAL FACILITY LANDFILL

FIGURE #: 2

Table 1: Summary of Petroleum Hydrocarbon Analytical Results
Otter Lake Waste Proccessing & Disposal Facility Landfill

Sample ID : Sample Date : Lab ID :	FEP 25-Feb-13 QQ6802	RDL	RDA 25-Feb-13 QQ6803	RDL	WSF 25-Feb-13 QQ6804	RDL	RDF 25-Feb-13 QQ6805	RDL	Units
Benzene	<0.13	0.13	<0.13	0.13	<0.075	0.08	<0.13	0.13	mg/kg
Leachable Benzene	<0.010	0.01	<0.010	0.01	<0.010	0.01	<0.010	0.01	mg/L
Toluene	<0.13	0.13	<0.13	0.13	2.3	0.08	<0.13	0.13	mg/kg
Leachable Toluene	<0.010	0.01	<0.010	0.01	0.012	0.01	<0.010	0.01	mg/L
Ethylbenzene	<0.13	0.13	<0.13	0.13	0.33	0.08	<0.13	0.13	mg/kg
Leachable Ethylbenzene	<0.010	0.01	<0.010	0.01	<0.010	0.01	<0.010	0.01	mg/L
Xylene (Total)	<0.25	0.25	<0.25	0.25	1.9	0.15	<0.25	0.25	mg/kg
Leachable Xylene (Total)	<0.020	0.02	<0.020	0.02	<0.020	0.02	<0.020	0.02	mg/L
PHC ARBCA Fraction									
C6 - C10 (less BTEX)	<13	13	<13	13	15	7.5	<13	13	mg/kg
Leachable C6 - C10 (less BTEX)	<0.10	0.1	<0.10	0.1	0.17	0.1	<0.10	0.1	mg/L
>C10-C16 Hydrocarbons	190 *	120	180 *	110	130 **	50	530 **	100	mg/kg
Leachable >C10-C16 Hydrocarbons	0.64	0.2	0.59	0.2	0.25	0.2	0.5	0.2	mg/L
>C16-C21 Hydrocarbons	990 *	120	1100 *	110	1100 **	50	5300 **	100	mg/kg
Leachable >C16-C21 Hydrocarbons	0.4	0.2	<0.20	0.2	<0.20	0.2	0.21	0.2	mg/L
>C21-<C32 Hydrocarbons	3700 *	180	3700 *	170	930 **	75	5000 **	150	mg/kg
Leachable >C21-<C32 Hydrocarbons	<0.50	0.5	<0.50	0.5	<0.50	0.5	<0.50	0.5	mg/L
Modified TPH (Tier1)	4900	180	5000	170	2200	75	11000	150	mg/kg
Leachable Modified TPH (Tier1)	1	0.5	0.59	0.5	<0.50	0.5	0.71	0.5	mg/L
Reached Baseline at C32	No	--	No	--	No	--	No	--	mg/kg
Leachable Reached Baseline at C32	Yes	--	Yes	--	Yes	--	Yes	--	mg/L
Hydrocarbon Resemblance	Unidentified compound(s) in fuel / lube range.	--	One product in fuel / lube range. Unidentified compound(s) in fuel oil	--	Unidentified compound(s) in fuel / lube range.	--	One product in fuel / lube range. Unidentified compound(s) in fuel / lube	--	mg/kg
Leachable Hydrocarbon Resemblance	Unidentified compound(s) in fuel / lube range.	--	Unidentified compound(s) in fuel / lube range.	--	Unidentified compound(s) in fuel / lube range.	--	Unidentified compound(s) in fuel range.	--	mg/L

Notes:

* Elevated TEH RDL(s) due to matrix interference.
** Elevated TEH RDL(s) due to sample dilution.
RDL Reportable Detection Limit.
-- not available / not applicable

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Table 2: Summary of Leachable Metals (ug/L)
Otter Lake Waste Proccessing & Disposal Facility Landfill

Sample ID : Sample Date : Lab ID :	FEP 25-Feb-13 QQ6802	FEP Lab-Dup 25-Feb-13 QQ6802	RDA 25-Feb-13 QQ6803	RDA Lab-Dup 25-Feb-13 QQ6803	WSF 25-Feb-13 QQ6804	WSF Lab-Dup 25-Feb-13 QQ6804	RDF 25-Feb-13 QQ6805	RDF Lab-Dup 25-Feb-13 QQ6805	RDL
Leachable Aluminum (Al)	2200	4100 *	480	230	480	1400 *	4200	890 *	100
Leachable Antimony (Sb)	<20	<20	<20	<20	<20	<20	<20	<20	20
Leachable Arsenic (As)	<20	<20	<20	<20	<20	<20	24	<20	20
Leachable Barium (Ba)	220	250	120	160	290	580 *	430	140 *	50
Leachable Beryllium (Be)	<20	<20	<20	<20	<20	<20	<20	<20	20
Leachable Boron (B)	<500	<500	<500	<500	<500	2100	840	<500	500
Leachable Cadmium (Cd)	<3.0	<3.0	3.3	<3.0	<3.0	<3.0	11	5.3	3
Leachable Calcium (Ca)	390000	240000 *	170000	380000 *	370000	240000 *	500000	380000	1000
Leachable Chromium (Cr)	<20	<20	<20	<20	<20	<20	77	<20	20
Leachable Cobalt (Co)	<10	<10	<10	<10	<10	<10	17	11	10
Leachable Copper (Cu)	63	21	25	30	<20	24	330	100 *	20
Leachable Iron (Fe)	3100	670 *	<500	<500	12000	3100 *	6300	1800 *	500
Leachable Lead (Pb)	10	8.2	9	6.8	5.3	40 *	80	18 *	5
Leachable Lithium (Li)	<20	<20	<20	<20	<20	<20	53	<20	20
Leachable Magnesium (Mg)	11000	5900 *	14000	25000 *	14000	19000	41000	19000 *	1000
Leachable Manganese (Mn)	830	210 *	490	330 *	1700	2500 *	6200	4000 *	20
Leachable Mercury (Hg)	<0.50 **	<0.50	<0.50 **	<0.50	<0.50 **	<0.50	<0.50 **	<0.50	0.5
Leachable Molybdenum (Mo)	<20	<20	<20	<20	<20	<20	30	<20	20
Leachable Nickel (Ni)	<20	<20	<20	23	20	130 *	290	200 *	20
Leachable Potassium (K)	51000	52000	50000	81000 *	69000	70000	120000	55000 *	1000
Leachable Selenium (Se)	<10	<10	<10	<10	<10	<10	<10	<10	10
Leachable Silver (Ag)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5
Leachable Strontium (Sr)	590	440	350	590 *	850	730	1400	980 *	50
Leachable Thallium (Tl)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1
Leachable Tin (Sn)	<20	<20	<20	<20	<20	<20	37	<20	20
Leachable Uranium (U)	1	<1.0	<1.0	<1.0	3.7	2.4	1.5	<1.0	1
Leachable Vanadium (V)	<20	<20	<20	<20	<20	<20	<20	<20	20
Leachable Zinc (Zn)	640	270 *	240	140	580	530	5600	3500 *	50

Notes:

* Poor Relative Percent Difference (RPD) due to sample inhomogeneity.
** Elevated detection limit due to sample matrix.
RDL Reportable Detection Limit.
-- not available / not applicable

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Table 3: Summary of Volatile Organic Compounds
Otter Lake Waste Proccessing & Disposal Facility Landfill

Sample ID : Sample Date : Lab ID :	FEP 25-Feb-13 QQ6802	RDA 25-Feb-13 QQ6803	WSF 25-Feb-13 QQ6804	RDF 25-Feb-13 QQ6805
1,2,4-Trimethylbenzene	--	--	DC	--
1,3,5-Trimethylbenzene	--	--	DC	--
1,4-Dichlorobenzene	--	--	DC	--
3 Ethyltoluene	--	--	DC	--
a-Pinene	--	--	DC	DC
d-Limonene	DC	DC	DC	DC
Decane	DC	DC	DC	--
Dodecane	--	--	--	DC
Ethylbenzene	--	--	DC	DC
m.p-Xylenes	--	DC	DC	DC
Nonane	--	--	DC	--
o-Xylene	--	--	DC	DC
Styrene	--	--	DC	--
Tetrachloroethylene	--	DC	DC	--
Toluene	--	DC	DC	DC
Undecane	DC	--	DC	--
Total Number of Detectable Compounds	**3**	**5**	**15**	**7**

Notes:

DC Detectable Compounds
-- Non-Detect

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Success Through Science®

Your Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Your C.O.C. #: B156094

Attention: Cameron Ells

SNC-Lavalin Inc, Environment Division
5657 Spring Garden Rd
Suite 200
Halifax, NS
B3J 3R4

Report Date: 2013/03/07

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B327722
Received: 2013/02/25, 16:00

Sample Matrix: Soil
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
TEH in Leachate (PIRI)	4	2013/02/28	2013/03/01	ATL SOP-00113	Based on Atl. PIRI
TEH in Soil (PIRI) (1)	3	2013/02/27	2013/03/01	ATL SOP 00111	Based on Atl. PIRI
TEH in Soil (PIRI) (1)	1	2013/02/27	2013/03/04	ATL SOP 00111	Based on Atl. PIRI
Mercury - Total in Leachate (CVAA,LL)	4	2013/03/04	2013/03/04	ATL SOP 00026	Based on EPA245.1
Metals Leach TCLP/CGSB extraction	4	2013/02/27	2013/02/28	ATL SOP-00059	Based on EPA6020A
Loss on Ignition at 600	1	2013/02/27	2013/02/28	In progress	Soil Sampling - MC
Loss on Ignition at 600	3	2013/02/28	2013/02/28	In progress	Soil Sampling - MC
Moisture	4	N/A	2013/02/26	ATL SOP 00001	MOE Handbook 1983
VPH in Leachates (PIRI)	4	2013/03/04	2013/03/05	ATL SOP 00118	Based on Atl. PIRI
VPH in Soil (PIRI)	4	2013/02/26	2013/02/27	ATL SOP 00119	Based on Atl. PIRI
TCLP Inorganic extraction - pH	4	N/A	2013/02/27	ATL SOP-00035	Based on EPA1311
TCLP Inorganic extraction - Weight	4	N/A	2013/02/27	ATL SOP-00035	Based on EPA1311
ModTPH (T1) Calc. for Leachate	4	N/A	2013/03/05		Based on Atl. PIRI
ModTPH (T1) Calc. for Soil	4	2013/02/25	2013/03/04		Based on Atl. PIRI
Volatile Open Characterization in Water	4	N/A	2013/03/01		

Remarks:

Reporting results to two significant figures at the RDL is to permit statistical evaluation and is not intended to be an indication of analytical precision.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Soils are reported on a dry weight basis unless otherwise specified.

Maxxam Analytics International Corporation o/a Maxxam Analytics 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel:902-420-0203 Toll-free:800-565-7227 Fax:902-420-8612 www.maxxamanalytics.com

Your Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Your C.O.C. #: B156094

Attention: Cameron Ells

SNC-Lavalin Inc, Environment Division
5657 Spring Garden Rd
Suite 200
Halifax, NS
B3J 3R4

Report Date: 2013/03/07

CERTIFICATE OF ANALYSIS

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Michelle Hill, Project Manager
Email: MHill@maxxam.ca
Phone# (902) 420-0203 Ext:289

==========

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Total cover pages: 2

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Maxxam Job #: B327722
Report Date: 2013/03/07

SNC-Lavalin Inc, Environment Division
Client Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Sampler Initials: AT

RESULTS OF ANALYSES OF SOIL

Maxxam ID		QQ6802	QQ6802	QQ6803	QQ6803		
Sampling Date		2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30		
COC Number		B156094	B156094	B156094	B156094		
	Units	**FEP**	**FEP Lab-Dup**	**RDA**	**RDA Lab-Dup**	**RDL**	**QC Batch**
Inorganics							
Moisture	%	54		39		1	3134060
Sample Weight (as received)	g	40	49	49	48	N/A	3134627
Initial pH	N/A	NA	NA	NA	NA		3134634
Final pH	N/A	5.2	5.1	5.1	5.3		3134634
Miscellaneous Parameters							
Loss on Ignition	%	95		72		0.30	3136534

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
QC Batch = Quality Control Batch

Maxxam ID		QQ6804	QQ6804	QQ6805	QQ6805		
Sampling Date		2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30		
COC Number		B156094	B156094	B156094	B156094		
	Units	**WSF**	**WSF Lab-Dup**	**RDF**	**RDF Lab-Dup**	**RDL**	**QC Batch**
Inorganics							
Moisture	%	43		44		1	3134060
Sample Weight (as received)	g	48	49	49	47	N/A	3134627
Initial pH	N/A	NA	NA	NA	NA		3134634
Final pH	N/A	5.3	5.2	5.3	5.1		3134634
Miscellaneous Parameters							
Loss on Ignition	%	78		52		0.30	3136534

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
QC Batch = Quality Control Batch

Maxxam Analytics International Corporation o/a Maxxam Analytics 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel:902-420-0203 Toll-free:800-565-7227 Fax:902-420-8612 www.maxxamanalytics.com

Maxxam Job #: B327722
Report Date: 2013/03/07

SNC-Lavalin Inc, Environment Division
Client Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Sampler Initials: AT

MERCURY BY COLD VAPOUR AA (SOIL)

Maxxam ID		QQ6802	QQ6802	QQ6803	QQ6803	QQ6804		
Sampling Date		2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30		
COC Number		B156094	B156094	B156094	B156094	B156094		
	Units	**FEP**	**FEP Lab-Dup**	**RDA**	**RDA Lab-Dup**	**WSF**	**RDL**	**QC Batch**
Metals								
Leachable Mercury (Hg)	ug/L	<0.50 (1)	<0.50	<0.50 (1)	<0.50	<0.50 (1)	0.50	3139951

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
QC Batch = Quality Control Batch
(1) Elevated detection limit due to sample matrix.

Maxxam ID		QQ6804	QQ6805	QQ6805		
Sampling Date		2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30		
COC Number		B156094	B156094	B156094		
	Units	**WSF Lab-Dup**	**RDF**	**RDF Lab-Dup**	**RDL**	**QC Batch**
Metals						
Leachable Mercury (Hg)	ug/L	<0.50	<0.50 (1)	<0.50	0.50	3139951

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
QC Batch = Quality Control Batch
(1) Elevated detection limit due to sample matrix.

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Maxxam Job #: B327722
Report Date: 2013/03/07

SNC-Lavalin Inc, Environment Division
Client Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Sampler Initials: AT

ELEMENTS BY ICP/MS (SOIL)

Maxxam ID		QQ6802	QQ6802	QQ6803	QQ6803		
Sampling Date		2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30		
COC Number		B156094	B156094	B156094	B156094		
	Units	**FEP**	**FEP Lab-Dup**	**RDA**	**RDA Lab-Dup**	**RDL**	**QC Batch**
Metals							
Leachable Aluminum (Al)	ug/L	2200	4100 (1)	480	230	100	3135654
Leachable Antimony (Sb)	ug/L	<20	<20	<20	<20	20	3135654
Leachable Arsenic (As)	ug/L	<20	<20	<20	<20	20	3135654
Leachable Barium (Ba)	ug/L	220	250	120	160	50	3135654
Leachable Beryllium (Be)	ug/L	<20	<20	<20	<20	20	3135654
Leachable Boron (B)	ug/L	<500	<500	<500	<500	500	3135654
Leachable Cadmium (Cd)	ug/L	<3.0	<3.0	3.3	<3.0	3.0	3135654
Leachable Calcium (Ca)	ug/L	390000	240000 (1)	170000	380000 (1)	1000	3135654
Leachable Chromium (Cr)	ug/L	<20	<20	<20	<20	20	3135654
Leachable Cobalt (Co)	ug/L	<10	<10	<10	<10	10	3135654
Leachable Copper (Cu)	ug/L	63	21	25	30	20	3135654
Leachable Iron (Fe)	ug/L	3100	670 (1)	<500	<500	500	3135654
Leachable Lead (Pb)	ug/L	10	8.2	9.0	6.8	5.0	3135654
Leachable Lithium (Li)	ug/L	<20	<20	<20	<20	20	3135654
Leachable Magnesium (Mg)	ug/L	11000	5900 (1)	14000	25000 (1)	1000	3135654
Leachable Manganese (Mn)	ug/L	830	210 (1)	490	330 (1)	20	3135654
Leachable Molybdenum (Mo)	ug/L	<20	<20	<20	<20	20	3135654
Leachable Nickel (Ni)	ug/L	<20	<20	<20	23	20	3135654
Leachable Potassium (K)	ug/L	51000	52000	50000	81000 (1)	1000	3135654
Leachable Selenium (Se)	ug/L	<10	<10	<10	<10	10	3135654
Leachable Silver (Ag)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	3135654
Leachable Strontium (Sr)	ug/L	590	440	350	590 (1)	50	3135654
Leachable Thallium (Tl)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	3135654
Leachable Tin (Sn)	ug/L	<20	<20	<20	<20	20	3135654
Leachable Uranium (U)	ug/L	1.0	<1.0	<1.0	<1.0	1.0	3135654
Leachable Vanadium (V)	ug/L	<20	<20	<20	<20	20	3135654
Leachable Zinc (Zn)	ug/L	640	270 (1)	240	140	50	3135654

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
QC Batch = Quality Control Batch
(1) Poor RPD due to sample inhomogeneity.

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Maxxam Job #: B327722
Report Date: 2013/03/07

SNC-Lavalin Inc, Environment Division
Client Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Sampler Initials: AT

ELEMENTS BY ICP/MS (SOIL)

Maxxam ID		QQ6804	QQ6804	QQ6805	QQ6805		
Sampling Date		2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30		
COC Number		B156094	B156094	B156094	B156094		
	Units	**WSF**	**WSF Lab-Dup**	**RDF**	**RDF Lab-Dup**	**RDL**	**QC Batch**
Metals							
Leachable Aluminum (Al)	ug/L	480	1400 (1)	4200	890 (1)	100	3135654
Leachable Antimony (Sb)	ug/L	<20	<20	<20	<20	20	3135654
Leachable Arsenic (As)	ug/L	<20	<20	24	<20	20	3135654
Leachable Barium (Ba)	ug/L	290	580 (1)	430	140 (1)	50	3135654
Leachable Beryllium (Be)	ug/L	<20	<20	<20	<20	20	3135654
Leachable Boron (B)	ug/L	<500	2100	840	<500	500	3135654
Leachable Cadmium (Cd)	ug/L	<3.0	<3.0	11	5.3	3.0	3135654
Leachable Calcium (Ca)	ug/L	370000	240000 (1)	500000	380000	1000	3135654
Leachable Chromium (Cr)	ug/L	<20	<20	77	<20	20	3135654
Leachable Cobalt (Co)	ug/L	<10	<10	17	11	10	3135654
Leachable Copper (Cu)	ug/L	<20	24	330	100 (1)	20	3135654
Leachable Iron (Fe)	ug/L	12000	3100 (1)	6300	1800 (1)	500	3135654
Leachable Lead (Pb)	ug/L	5.3	40 (1)	80	18 (1)	5.0	3135654
Leachable Lithium (Li)	ug/L	<20	<20	53	<20	20	3135654
Leachable Magnesium (Mg)	ug/L	14000	19000	41000	19000 (1)	1000	3135654
Leachable Manganese (Mn)	ug/L	1700	2500 (1)	6200	4000 (1)	20	3135654
Leachable Molybdenum (Mo)	ug/L	<20	<20	30	<20	20	3135654
Leachable Nickel (Ni)	ug/L	20	130 (1)	290	200 (1)	20	3135654
Leachable Potassium (K)	ug/L	69000	70000	120000	55000 (1)	1000	3135654
Leachable Selenium (Se)	ug/L	<10	<10	<10	<10	10	3135654
Leachable Silver (Ag)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	3135654
Leachable Strontium (Sr)	ug/L	850	730	1400	980 (1)	50	3135654
Leachable Thallium (Tl)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	3135654
Leachable Tin (Sn)	ug/L	<20	<20	37	<20	20	3135654
Leachable Uranium (U)	ug/L	3.7	2.4	1.5	<1.0	1.0	3135654
Leachable Vanadium (V)	ug/L	<20	<20	<20	<20	20	3135654
Leachable Zinc (Zn)	ug/L	580	530	5600	3500 (1)	50	3135654

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
QC Batch = Quality Control Batch
(1) Poor RPD due to sample inhomogeneity.

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Maxxam Job #: B327722
Report Date: 2013/03/07

SNC-Lavalin Inc, Environment Division
Client Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Sampler Initials: AT

VOLATILE ORGANICS BY GC/MS (SOIL)

Maxxam ID		QQ6802	QQ6803	QQ6804	QQ6805	
Sampling Date		2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30	2013/02/25 14:30	
COC Number		B156094	B156094	B156094	B156094	
	Units	**FEP**	**RDA**	**WSF**	**RDF**	**QC Batch**
Volatile Organics						
Characterisation by MS	N/A	COMMENT (1)	COMMENT (2)	COMMENT (3)	COMMENT (4)	3135274

QC Batch = Quality Control Batch

(1) 10.25 g of sample was weighed out in a 250 ml soil jar. The front portion of a large charcoal tube was added to the sample jar via a small plastic continer. The carbon was left in the sample container for a period of 24 hours to absorb vapours. It was then removed from the container, Desorption solvent (CS2) was added allowing it to stand for 30 minutes and the extract vialed. The extract was then analyzed by GC-MSD for VOC-Open analysis.

This sample was detected for the following compounds: Decane, d-Limonene and Undecane.

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(2) 10.15 g of sample was weighed out in a 250 ml soil jar. The front portion of a large charcoal tube was added to the sample jar via a small plastic continer. The carbon was left in the sample container for a period of 24 hours to absorb vapours. It was then removed from the container, Desorption solvent (CS2) was added allowing it to stand for 30 minutes and the extract vialed. The extract was then analyzed by GC-MSD for VOC-Open analysis.

This sample was detected for the following compounds: Toluene, Tetrachloroethylene, m,p-Xylenes, Decane and d-Limonene.

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(3) 9.97 g of sample was weighed out in a 250 ml soil jar. The front portion of a large charcoal tube was added to the sample jar via a small plastic continer. The carbon was left in the sample container for a period of 24 hours to absorb vapours. It was then removed from the container, Desorption solvent (CS2) was added allowing it to stand for 30 minutes and the extract vialed. The extract was then analyzed by GC-MSD for VOC-Open analysis.

This sample was detected for the following compounds: Toluene, Tetrachloroethylene, Ethylbenzene, m,p-Xylenes, o-Xylene, Nonane, Styrene, a-Pinene, 3-Ethyltoluene, 1,3,5-Trimethylbenzene, Decane, 1,2,4-Trimethylbenzene, d-Limonene, 1,4-Dichlorobenzene and Undecane.

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(4) 10.19 g of sample was weighed out in a 250 ml soil jar. The front portion of a large charcoal tube was added to the sample jar via a small plastic continer. The carbon was left in the sample container for a period of 24 hours to absorb vapours. It was then removed from the container, Desorption solvent (CS2) was added allowing it to stand for 30 minutes and the extract vialed. The extract was then analyzed by GC-MSD for VOC-Open analysis.

This sample was detected for the following compounds: Toluene, Ethylbenzene, m,p-Xylenes, o-Xylene, a-Pinene, d-Limonene and Dodecane.

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Maxxam Job #: B327722
Report Date: 2013/03/07

SNC-Lavalin Inc, Environment Division
Client Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Sampler Initials: AT

ATLANTIC RBCA HYDROCARBONS (SOIL)

Maxxam ID		QQ6802	QQ6802		QQ6803		
Sampling Date		2013/02/25 14:30	2013/02/25 14:30		2013/02/25 14:30		
COC Number		B156094	B156094		B156094		
	Units	**FEP**	**FEP Lab-Dup**	**RDL**	**RDA**	**RDL**	**QC Batch**
Petroleum Hydrocarbons							
Benzene	mg/kg	<0.13		0.13	<0.13	0.13	3135275
Leachable Benzene	mg/L	<0.010	<0.010	0.010	<0.010	0.010	3140244
Toluene	mg/kg	<0.13		0.13	<0.13	0.13	3135275
Leachable Toluene	mg/L	<0.010	<0.010	0.010	<0.010	0.010	3140244
Ethylbenzene	mg/kg	<0.13		0.13	<0.13	0.13	3135275
Leachable Ethylbenzene	mg/L	<0.010	<0.010	0.010	<0.010	0.010	3140244
Xylene (Total)	mg/kg	<0.25		0.25	<0.25	0.25	3135275
Leachable Xylene (Total)	mg/L	<0.020	<0.020	0.020	<0.020	0.020	3140244
C6 - C10 (less BTEX)	mg/kg	<13		13	<13	13	3135275
Leachable C6 - C10 (less BTEX)	mg/L	<0.10	<0.10	0.10	<0.10	0.10	3140244
>C10-C16 Hydrocarbons	mg/kg	190 (1)		120	180 (1)	110	3135287
Leachable >C10-C16 Hydrocarbons	mg/L	0.64		0.20	0.59	0.20	3136633
>C16-C21 Hydrocarbons	mg/kg	990 (1)		120	1100 (1)	110	3135287
Leachable >C16-C21 Hydrocarbons	mg/L	0.40		0.20	<0.20	0.20	3136633
>C21-<C32 Hydrocarbons	mg/kg	3700 (1)		180	3700 (1)	170	3135287
Leachable >C21-<C32 Hydrocarbons	mg/L	<0.50		0.50	<0.50	0.50	3136633
Modified TPH (Tier1)	mg/kg	4900		180	5000	170	3132844
Leachable Modified TPH (Tier1)	mg/L	1.0		0.50	0.59	0.50	3133489
Reached Baseline at C32	mg/kg	No		N/A	No	N/A	3135287
Leachable Reached Baseline at C32	mg/L	Yes		N/A	Yes	N/A	3136633
Hydrocarbon Resemblance	mg/kg	COMMENT (2)		N/A	COMMENT (3)	N/A	3135287
Leachable Hydrocarbon Resemblance	mg/L	COMMENT (2)		N/A	COMMENT (2)	N/A	3136633
Surrogate Recovery (%)							
Leachable Isobutylbenzene - Extractable	%	117			114		3136633
Leachable n-Dotriacontane - Extractable	%	100			106		3136633
Isobutylbenzene - Extractable	%	121			114		3135287
n-Dotriacontane - Extractable	%	129			93		3135287
Leachable Isobutylbenzene - Volatile	%	99	99		99		3140244

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
QC Batch = Quality Control Batch
(1) Elevated TEH RDL(s) due to matrix interference.
(2) Unidentified compound(s) in fuel / lube range.
(3) One product in fuel / lube range. Unidentified compound(s) in fuel oil range. Lube oil fraction.

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Maxxam Job #: B327722
Report Date: 2013/03/07

SNC-Lavalin Inc, Environment Division
Client Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Sampler Initials: AT

ATLANTIC RBCA HYDROCARBONS (SOIL)

Maxxam ID		QQ6802	QQ6802		QQ6803		
Sampling Date		2013/02/25 14:30	2013/02/25 14:30		2013/02/25 14:30		
COC Number		B156094	B156094		B156094		
	Units	**FEP**	**FEP Lab-Dup**	**RDL**	**RDA**	**RDL**	**QC Batch**
Isobutylbenzene - Volatile	%	123 (1)			112 (1)		3135275

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
QC Batch = Quality Control Batch
(1) Elevated VPH RDL(s) due to sample dilution / matrix interference.

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Maxxam Job #: B327722
Report Date: 2013/03/07

SNC-Lavalin Inc, Environment Division
Client Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Sampler Initials: AT

ATLANTIC RBCA HYDROCARBONS (SOIL)

Maxxam ID		QQ6803		QQ6804	QQ6804		
Sampling Date		2013/02/25 14:30		2013/02/25 14:30	2013/02/25 14:30		
COC Number		B156094		B156094	B156094		
	Units	**RDA Lab-Dup**	**RDL**	**WSF**	**WSF Lab-Dup**	**RDL**	**QC Batch**
Petroleum Hydrocarbons							
Benzene	mg/kg		0.13	<0.075		0.075	3135275
Leachable Benzene	mg/L	<0.010	0.010	<0.010	<0.010	0.010	3140244
Toluene	mg/kg		0.13	2.3		0.075	3135275
Leachable Toluene	mg/L	<0.010	0.010	0.012	0.012	0.010	3140244
Ethylbenzene	mg/kg		0.13	0.33		0.075	3135275
Leachable Ethylbenzene	mg/L	<0.010	0.010	<0.010	<0.010	0.010	3140244
Xylene (Total)	mg/kg		0.25	1.9		0.15	3135275
Leachable Xylene (Total)	mg/L	<0.020	0.020	<0.020	<0.020	0.020	3140244
C6 - C10 (less BTEX)	mg/kg		13	15		7.5	3135275
Leachable C6 - C10 (less BTEX)	mg/L	0.13	0.10	0.17	<0.10	0.10	3140244
>C10-C16 Hydrocarbons	mg/kg		110	130 (1)		50	3135287
Leachable >C10-C16 Hydrocarbons	mg/L		0.20	0.25		0.20	3136633
>C16-C21 Hydrocarbons	mg/kg		110	1100 (1)		50	3135287
Leachable >C16-C21 Hydrocarbons	mg/L		0.20	<0.20		0.20	3136633
>C21-<C32 Hydrocarbons	mg/kg		170	930 (1)		75	3135287
Leachable >C21-<C32 Hydrocarbons	mg/L		0.50	<0.50		0.50	3136633
Modified TPH (Tier1)	mg/kg		170	2200		75	3132844
Leachable Modified TPH (Tier1)	mg/L		0.50	<0.50		0.50	3133489
Reached Baseline at C32	mg/kg		N/A	No		N/A	3135287
Leachable Reached Baseline at C32	mg/L		N/A	Yes		N/A	3136633
Hydrocarbon Resemblance	mg/kg		N/A	COMMENT (2)		N/A	3135287
Leachable Hydrocarbon Resemblance	mg/L		N/A	COMMENT (2)		N/A	3136633
Surrogate Recovery (%)							
Leachable Isobutylbenzene - Extractable	%			115			3136633
Leachable n-Dotriacontane - Extractable	%			104			3136633
Isobutylbenzene - Extractable	%			109			3135287
n-Dotriacontane - Extractable	%			104 (3)			3135287
Leachable Isobutylbenzene - Volatile	%	99		100	101		3140244

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
QC Batch = Quality Control Batch
(1) Elevated TEH RDL(s) due to sample dilution.
(2) Unidentified compound(s) in fuel / lube range.
(3) TEH samples were extracted using a flat-bed shaker instead of the accelerated mechanical shaker due to matrix incompatibility.

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Maxxam Job #: B327722
Report Date: 2013/03/07

SNC-Lavalin Inc, Environment Division
Client Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Sampler Initials: AT

ATLANTIC RBCA HYDROCARBONS (SOIL)

Maxxam ID		QQ6803		QQ6804	QQ6804		
Sampling Date		2013/02/25 14:30		2013/02/25 14:30	2013/02/25 14:30		
COC Number		B156094		B156094	B156094		
	Units	**RDA Lab-Dup**	**RDL**	**WSF**	**WSF Lab-Dup**	**RDL**	**QC Batch**
Isobutylbenzene - Volatile	%			93 (1)			3135275

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
QC Batch = Quality Control Batch
(1) Elevated VPH RDL(s) due to sample dilution / matrix interference.

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Maxxam Job #: B327722
Report Date: 2013/03/07

SNC-Lavalin Inc, Environment Division
Client Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Sampler Initials: AT

ATLANTIC RBCA HYDROCARBONS (SOIL)

Maxxam ID		QQ6805	QQ6805		
Sampling Date		2013/02/25 14:30	2013/02/25 14:30		
COC Number		B156094	B156094		
	Units	**RDF**	**RDF Lab-Dup**	**RDL**	**QC Batch**
Petroleum Hydrocarbons					
Benzene	mg/kg	<0.13		0.13	3135275
Leachable Benzene	mg/L	<0.010	<0.010	0.010	3140244
Toluene	mg/kg	<0.13		0.13	3135275
Leachable Toluene	mg/L	<0.010	<0.010	0.010	3140244
Ethylbenzene	mg/kg	<0.13		0.13	3135275
Leachable Ethylbenzene	mg/L	<0.010	<0.010	0.010	3140244
Xylene (Total)	mg/kg	<0.25		0.25	3135275
Leachable Xylene (Total)	mg/L	<0.020	<0.020	0.020	3140244
C6 - C10 (less BTEX)	mg/kg	<13		13	3135275
Leachable C6 - C10 (less BTEX)	mg/L	<0.10	<0.10	0.10	3140244
>C10-C16 Hydrocarbons	mg/kg	530 (1)		100	3135287
Leachable >C10-C16 Hydrocarbons	mg/L	0.50		0.20	3136633
>C16-C21 Hydrocarbons	mg/kg	5300 (1)		100	3135287
Leachable >C16-C21 Hydrocarbons	mg/L	0.21		0.20	3136633
>C21-<C32 Hydrocarbons	mg/kg	5000 (1)		150	3135287
Leachable >C21-<C32 Hydrocarbons	mg/L	<0.50		0.50	3136633
Modified TPH (Tier1)	mg/kg	11000		150	3132844
Leachable Modified TPH (Tier1)	mg/L	0.71		0.50	3133489
Reached Baseline at C32	mg/kg	No		N/A	3135287
Leachable Reached Baseline at C32	mg/L	Yes		N/A	3136633
Hydrocarbon Resemblance	mg/kg	COMMENT (2)		N/A	3135287
Leachable Hydrocarbon Resemblance	mg/L	COMMENT (3)		N/A	3136633
Surrogate Recovery (%)					
Leachable Isobutylbenzene - Extractable	%	114			3136633
Leachable n-Dotriacontane - Extractable	%	101			3136633
Isobutylbenzene - Extractable	%	89			3135287
n-Dotriacontane - Extractable	%	75 (4)			3135287

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
QC Batch = Quality Control Batch
(1) Elevated TEH RDL(s) due to sample dilution.
(2) One product in fuel / lube range. Unidentified compound(s) in fuel / lube range.
(3) Unidentified compound(s) in fuel range.
(4) TEH samples were extracted using a flat-bed shaker instead of the accelerated mechanical shaker due to matrix incompatibility.

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Maxxam Job #: B327722
Report Date: 2013/03/07

SNC-Lavalin Inc, Environment Division
Client Project #: 511766-0001
Site Location: SNC CUSTOM LEACHATE
Sampler Initials: AT

ATLANTIC RBCA HYDROCARBONS (SOIL)

Maxxam ID		QQ6805	QQ6805		
Sampling Date		2013/02/25 14:30	2013/02/25 14:30		
COC Number		B156094	B156094		
	Units	**RDF**	**RDF Lab-Dup**	**RDL**	**QC Batch**
Leachable Isobutylbenzene - Volatile	%	102	102		3140244
Isobutylbenzene - Volatile	%	100 (1)			3135275

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
QC Batch = Quality Control Batch
(1) Elevated VPH RDL(s) due to sample dilution / matrix interference.

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Package 1	10.3°C

Each temperature is the average of up to three cooler temperatures taken at receipt

GENERAL COMMENTS

Results relate only to the items tested.

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SNC-Lavalin Inc, Environment Division
Attention: Cameron Ells
Client Project #: 511766-0001
P.O. #:
Site Location: SNC CUSTOM LEACHATE

Quality Assurance Report

Maxxam Job Number: DB327722

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
3134627 KCA	Method Blank	Sample Weight (as received)	2013/02/27	NA		g	
	RPD [QQ6802-02]	Sample Weight (as received)	2013/02/27	19.2		%	N/A
	RPD [QQ6803-02]	Sample Weight (as received)	2013/02/27	2.1		%	N/A
	RPD [QQ6804-02]	Sample Weight (as received)	2013/02/27	1.0		%	N/A
	RPD [QQ6805-02]	Sample Weight (as received)	2013/02/27	4.2		%	N/A
3135275 THL	Matrix Spike	Isobutylbenzene - Volatile	2013/02/27		89	%	60 - 140
		Benzene	2013/02/27		83	%	60 - 140
		Toluene	2013/02/27		122	%	60 - 140
		Ethylbenzene	2013/02/27		107	%	60 - 140
		Xylene (Total)	2013/02/27		118	%	60 - 140
	Spiked Blank	Isobutylbenzene - Volatile	2013/02/27		94	%	60 - 140
		Benzene	2013/02/27		89	%	60 - 140
		Toluene	2013/02/27		91	%	60 - 140
		Ethylbenzene	2013/02/27		93	%	60 - 140
		Xylene (Total)	2013/02/27		93	%	60 - 140
	Method Blank	Isobutylbenzene - Volatile	2013/02/27		91	%	60 - 140
		Benzene	2013/02/27	<0.025		mg/kg	
		Toluene	2013/02/27	<0.025		mg/kg	
		Ethylbenzene	2013/02/27	<0.025		mg/kg	
		Xylene (Total)	2013/02/27	<0.050		mg/kg	
		C6 - C10 (less BTEX)	2013/02/27	<2.5		mg/kg	
	RPD	Benzene	2013/02/27	NC		%	50
		Toluene	2013/02/27	NC		%	50
		Ethylbenzene	2013/02/27	NC		%	50
		Xylene (Total)	2013/02/27	NC		%	50
		C6 - C10 (less BTEX)	2013/02/27	NC		%	50
3135287 JRU	Matrix Spike	Isobutylbenzene - Extractable	2013/03/01		94	%	30 - 130
		n-Dotriacontane - Extractable	2013/03/01		93 (1)	%	30 - 130
		>C10-C16 Hydrocarbons	2013/03/01		NC	%	30 - 130
		>C16-C21 Hydrocarbons	2013/03/01		88	%	30 - 130
		>C21-<C32 Hydrocarbons	2013/03/01		NC	%	30 - 130
	Spiked Blank	Isobutylbenzene - Extractable	2013/02/28		100	%	30 - 130
		n-Dotriacontane - Extractable	2013/02/28		106	%	30 - 130
		>C10-C16 Hydrocarbons	2013/02/28		77	%	30 - 130
		>C16-C21 Hydrocarbons	2013/02/28		87	%	30 - 130
		>C21-<C32 Hydrocarbons	2013/02/28		101	%	30 - 130
	Method Blank	Isobutylbenzene - Extractable	2013/02/28		104	%	30 - 130
		n-Dotriacontane - Extractable	2013/02/28		111	%	30 - 130
		>C10-C16 Hydrocarbons	2013/02/28	<10		mg/kg	
		>C16-C21 Hydrocarbons	2013/02/28	<10		mg/kg	
		>C21-<C32 Hydrocarbons	2013/02/28	<15		mg/kg	
	RPD	>C10-C16 Hydrocarbons	2013/02/28	10.2		%	50
		>C16-C21 Hydrocarbons	2013/02/28	0.1		%	50
		>C21-<C32 Hydrocarbons	2013/02/28	3.8		%	50
3135654 DLB	Spiked Blank	Leachable Aluminum (Al)	2013/02/27		102	%	80 - 120
		Leachable Antimony (Sb)	2013/02/27		106	%	80 - 120
		Leachable Arsenic (As)	2013/02/27		96	%	80 - 120
		Leachable Barium (Ba)	2013/02/27		101	%	80 - 120
		Leachable Beryllium (Be)	2013/02/27		98	%	80 - 120
		Leachable Boron (B)	2013/02/27		98	%	80 - 120
		Leachable Cadmium (Cd)	2013/02/27		97	%	80 - 120
		Leachable Calcium (Ca)	2013/02/27		93	%	80 - 120
		Leachable Chromium (Cr)	2013/02/27		97	%	80 - 120
		Leachable Cobalt (Co)	2013/02/27		98	%	80 - 120
		Leachable Copper (Cu)	2013/02/27		96	%	80 - 120

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Quality Assurance Report (Continued)

Maxxam Job Number: DB327722

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
3135654 DLB	Spiked Blank	Leachable Iron (Fe)	2013/02/27		101	%	80 - 120
		Leachable Lead (Pb)	2013/02/27		101	%	80 - 120
		Leachable Lithium (Li)	2013/02/27		101	%	80 - 120
		Leachable Magnesium (Mg)	2013/02/27		100	%	80 - 120
		Leachable Manganese (Mn)	2013/02/27		97	%	80 - 120
		Leachable Molybdenum (Mo)	2013/02/27		102	%	80 - 120
		Leachable Nickel (Ni)	2013/02/27		95	%	80 - 120
		Leachable Potassium (K)	2013/02/27		97	%	80 - 120
		Leachable Selenium (Se)	2013/02/27		95	%	80 - 120
		Leachable Silver (Ag)	2013/02/27		105	%	80 - 120
		Leachable Strontium (Sr)	2013/02/27		100	%	80 - 120
		Leachable Thallium (Tl)	2013/02/27		102	%	80 - 120
		Leachable Tin (Sn)	2013/02/27		103	%	80 - 120
		Leachable Uranium (U)	2013/02/27		105	%	80 - 120
		Leachable Vanadium (V)	2013/02/27		99	%	80 - 120
		Leachable Zinc (Zn)	2013/02/27		98	%	80 - 120
	Method Blank	Leachable Aluminum (Al)	2013/02/27	<100		ug/L	
		Leachable Antimony (Sb)	2013/02/27	<20		ug/L	
		Leachable Arsenic (As)	2013/02/27	<20		ug/L	
		Leachable Barium (Ba)	2013/02/27	60, RDL=50		ug/L	
		Leachable Beryllium (Be)	2013/02/27	<20		ug/L	
		Leachable Boron (B)	2013/02/27	<500		ug/L	
		Leachable Cadmium (Cd)	2013/02/27	<3.0		ug/L	
		Leachable Calcium (Ca)	2013/02/27	<1000		ug/L	
		Leachable Chromium (Cr)	2013/02/27	<20		ug/L	
		Leachable Cobalt (Co)	2013/02/27	<10		ug/L	
		Leachable Copper (Cu)	2013/02/27	<20		ug/L	
		Leachable Iron (Fe)	2013/02/27	<500		ug/L	
		Leachable Lead (Pb)	2013/02/27	<5.0		ug/L	
		Leachable Lithium (Li)	2013/02/27	<20		ug/L	
		Leachable Magnesium (Mg)	2013/02/27	<1000		ug/L	
		Leachable Manganese (Mn)	2013/02/27	<20		ug/L	
		Leachable Molybdenum (Mo)	2013/02/27	<20		ug/L	
		Leachable Nickel (Ni)	2013/02/27	<20		ug/L	
		Leachable Potassium (K)	2013/02/27	<1000		ug/L	
		Leachable Selenium (Se)	2013/02/27	<10		ug/L	
		Leachable Silver (Ag)	2013/02/27	<5.0		ug/L	
		Leachable Strontium (Sr)	2013/02/27	<50		ug/L	
		Leachable Thallium (Tl)	2013/02/27	<1.0		ug/L	
		Leachable Tin (Sn)	2013/02/27	<20		ug/L	
		Leachable Uranium (U)	2013/02/27	<1.0		ug/L	
		Leachable Vanadium (V)	2013/02/27	<20		ug/L	
		Leachable Zinc (Zn)	2013/02/27	<50		ug/L	
	RPD [QQ6802-02]	Leachable Aluminum (Al)	2013/02/28	60.4 (2)		%	35
		Leachable Antimony (Sb)	2013/02/28	NC		%	35
		Leachable Arsenic (As)	2013/02/28	NC		%	35
		Leachable Barium (Ba)	2013/02/28	NC		%	35
		Leachable Beryllium (Be)	2013/02/28	NC		%	35
		Leachable Boron (B)	2013/02/28	NC		%	35
		Leachable Cadmium (Cd)	2013/02/28	NC		%	35
		Leachable Calcium (Ca)	2013/02/28	45.0 (2)		%	35
		Leachable Chromium (Cr)	2013/02/28	NC		%	35
		Leachable Cobalt (Co)	2013/02/28	NC		%	35
		Leachable Copper (Cu)	2013/02/28	NC		%	35
		Leachable Iron (Fe)	2013/02/28	NC (2)		%	35

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Quality Assurance Report (Continued)

Maxxam Job Number: DB327722

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
3135654 DLB	RPD [QQ6802-02]	Leachable Lead (Pb)	2013/02/28	NC		%	35
		Leachable Lithium (Li)	2013/02/28	NC		%	35
		Leachable Magnesium (Mg)	2013/02/28	58.2 (2)		%	35
		Leachable Manganese (Mn)	2013/02/28	119 (2)		%	35
		Leachable Molybdenum (Mo)	2013/02/28	NC		%	35
		Leachable Nickel (Ni)	2013/02/28	NC		%	35
		Leachable Potassium (K)	2013/02/28	2.7		%	35
		Leachable Selenium (Se)	2013/02/28	NC		%	35
		Leachable Silver (Ag)	2013/02/28	NC		%	35
		Leachable Strontium (Sr)	2013/02/28	30.4		%	35
		Leachable Thallium (Tl)	2013/02/28	NC		%	35
		Leachable Tin (Sn)	2013/02/28	NC		%	35
		Leachable Uranium (U)	2013/02/28	NC		%	35
		Leachable Vanadium (V)	2013/02/28	NC		%	35
		Leachable Zinc (Zn)	2013/02/28	80.8 (2)		%	35
	RPD [QQ6803-02]	Leachable Aluminum (Al)	2013/02/28	NC		%	35
		Leachable Antimony (Sb)	2013/02/28	NC		%	35
		Leachable Arsenic (As)	2013/02/28	NC		%	35
		Leachable Barium (Ba)	2013/02/28	NC		%	35
		Leachable Beryllium (Be)	2013/02/28	NC		%	35
		Leachable Boron (B)	2013/02/28	NC		%	35
		Leachable Cadmium (Cd)	2013/02/28	NC		%	35
		Leachable Calcium (Ca)	2013/02/28	78.1 (2)		%	35
		Leachable Chromium (Cr)	2013/02/28	NC		%	35
		Leachable Cobalt (Co)	2013/02/28	NC		%	35
		Leachable Copper (Cu)	2013/02/28	NC		%	35
		Leachable Iron (Fe)	2013/02/28	NC		%	35
		Leachable Lead (Pb)	2013/02/28	NC		%	35
		Leachable Lithium (Li)	2013/02/28	NC		%	35
		Leachable Magnesium (Mg)	2013/02/28	55.9 (2)		%	35
		Leachable Manganese (Mn)	2013/02/28	38.3 (2)		%	35
		Leachable Molybdenum (Mo)	2013/02/28	NC		%	35
		Leachable Nickel (Ni)	2013/02/28	NC		%	35
		Leachable Potassium (K)	2013/02/28	46.9 (2)		%	35
		Leachable Selenium (Se)	2013/02/28	NC		%	35
		Leachable Silver (Ag)	2013/02/28	NC		%	35
		Leachable Strontium (Sr)	2013/02/28	52.0 (2)		%	35
		Leachable Thallium (Tl)	2013/02/28	NC		%	35
		Leachable Tin (Sn)	2013/02/28	NC		%	35
		Leachable Uranium (U)	2013/02/28	NC		%	35
		Leachable Vanadium (V)	2013/02/28	NC		%	35
		Leachable Zinc (Zn)	2013/02/28	NC		%	35
	RPD [QQ6804-02]	Leachable Aluminum (Al)	2013/02/28	NC (2)		%	35
		Leachable Antimony (Sb)	2013/02/28	NC		%	35
		Leachable Arsenic (As)	2013/02/28	NC		%	35
		Leachable Barium (Ba)	2013/02/28	67.0 (2)		%	35
		Leachable Beryllium (Be)	2013/02/28	NC		%	35
		Leachable Boron (B)	2013/02/28	NC		%	35
		Leachable Cadmium (Cd)	2013/02/28	NC		%	35
		Leachable Calcium (Ca)	2013/02/28	41.7 (2)		%	35
		Leachable Chromium (Cr)	2013/02/28	NC		%	35
		Leachable Cobalt (Co)	2013/02/28	NC		%	35
		Leachable Copper (Cu)	2013/02/28	NC		%	35
		Leachable Iron (Fe)	2013/02/28	116 (2)		%	35
		Leachable Lead (Pb)	2013/02/28	NC (2)		%	35

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Quality Assurance Report (Continued)

Maxxam Job Number: DB327722

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
3135654 DLB	RPD [QQ6804-02]	Leachable Lithium (Li)	2013/02/28	NC		%	35
		Leachable Magnesium (Mg)	2013/02/28	25.9		%	35
		Leachable Manganese (Mn)	2013/02/28	37.5 (2)		%	35
		Leachable Molybdenum (Mo)	2013/02/28	NC		%	35
		Leachable Nickel (Ni)	2013/02/28	NC (2)		%	35
		Leachable Potassium (K)	2013/02/28	0.6		%	35
		Leachable Selenium (Se)	2013/02/28	NC		%	35
		Leachable Silver (Ag)	2013/02/28	NC		%	35
		Leachable Strontium (Sr)	2013/02/28	14.8		%	35
		Leachable Thallium (Tl)	2013/02/28	NC		%	35
		Leachable Tin (Sn)	2013/02/28	NC		%	35
		Leachable Uranium (U)	2013/02/28	NC		%	35
		Leachable Vanadium (V)	2013/02/28	NC		%	35
		Leachable Zinc (Zn)	2013/02/28	7.9		%	35
	RPD [QQ6805-02]	Leachable Aluminum (Al)	2013/02/28	130 (2)		%	35
		Leachable Antimony (Sb)	2013/02/28	NC		%	35
		Leachable Arsenic (As)	2013/02/28	NC		%	35
		Leachable Barium (Ba)	2013/02/28	NC (2)		%	35
		Leachable Beryllium (Be)	2013/02/28	NC		%	35
		Leachable Boron (B)	2013/02/28	NC		%	35
		Leachable Cadmium (Cd)	2013/02/28	NC		%	35
		Leachable Calcium (Ca)	2013/02/28	26.6		%	35
		Leachable Chromium (Cr)	2013/02/28	NC		%	35
		Leachable Cobalt (Co)	2013/02/28	NC		%	35
		Leachable Copper (Cu)	2013/02/28	106 (2)		%	35
		Leachable Iron (Fe)	2013/02/28	NC (2)		%	35
		Leachable Lead (Pb)	2013/02/28	NC (2)		%	35
		Leachable Lithium (Li)	2013/02/28	NC		%	35
		Leachable Magnesium (Mg)	2013/02/28	71.4 (2)		%	35
		Leachable Manganese (Mn)	2013/02/28	42.0 (2)		%	35
		Leachable Molybdenum (Mo)	2013/02/28	NC		%	35
		Leachable Nickel (Ni)	2013/02/28	39.0 (2)		%	35
		Leachable Potassium (K)	2013/02/28	77.2 (2)		%	35
		Leachable Selenium (Se)	2013/02/28	NC		%	35
		Leachable Silver (Ag)	2013/02/28	NC		%	35
		Leachable Strontium (Sr)	2013/02/28	37.5 (2)		%	35
		Leachable Thallium (Tl)	2013/02/28	NC		%	35
		Leachable Tin (Sn)	2013/02/28	NC		%	35
		Leachable Uranium (U)	2013/02/28	NC		%	35
		Leachable Vanadium (V)	2013/02/28	NC		%	35
		Leachable Zinc (Zn)	2013/02/28	45.4 (2)		%	35
3136534 BBD	QC Standard	Loss on Ignition	2013/02/28		100	%	80 - 120
	Method Blank	Loss on Ignition	2013/02/28	<0.30		%	
3136633 JRU	Matrix Spike						
	[QQ6803-02]	Leachable Isobutylbenzene - Extractable	2013/03/01		117	%	30 - 130
		Leachable n-Dotriacontane - Extractable	2013/03/01		110	%	30 - 130
		Leachable >C10-C16 Hydrocarbons	2013/03/01		74	%	30 - 130
		Leachable >C16-C21 Hydrocarbons	2013/03/01		98	%	30 - 130
		Leachable >C21-<C32 Hydrocarbons	2013/03/01		100	%	30 - 130
	Leachate Blank	Leachable Isobutylbenzene - Extractable	2013/03/01		113	%	30 - 130
		Leachable n-Dotriacontane - Extractable	2013/03/01		101	%	30 - 130
		Leachable >C10-C16 Hydrocarbons	2013/03/01	<0.20		mg/L	
		Leachable >C16-C21 Hydrocarbons	2013/03/01	<0.20		mg/L	
		Leachable >C21-<C32 Hydrocarbons	2013/03/01	<0.50		mg/L	
	Spiked Blank	Leachable Isobutylbenzene - Extractable	2013/03/01		112	%	30 - 130

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Quality Assurance Report (Continued)

Maxxam Job Number: DB327722

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
3136633 JRU	Spiked Blank	Leachable n-Dotriacontane - Extractable	2013/03/01		100	%	30 - 130
		Leachable >C10-C16 Hydrocarbons	2013/03/01		83	%	30 - 130
		Leachable >C16-C21 Hydrocarbons	2013/03/01		97	%	30 - 130
		Leachable >C21-<C32 Hydrocarbons	2013/03/01		100	%	30 - 130
	Method Blank	Leachable Isobutylbenzene - Extractable	2013/03/01		110	%	30 - 130
		Leachable n-Dotriacontane - Extractable	2013/03/01		98	%	30 - 130
		Leachable >C10-C16 Hydrocarbons	2013/03/01	<0.20		mg/L	
		Leachable >C16-C21 Hydrocarbons	2013/03/01	<0.20		mg/L	
		Leachable >C21-<C32 Hydrocarbons	2013/03/01	<0.50		mg/L	
3139951 MKH	QC Standard	Leachable Mercury (Hg)	2013/03/04		94	%	80 - 120
	Spiked Blank	Leachable Mercury (Hg)	2013/03/04		102	%	80 - 120
	Method Blank	Leachable Mercury (Hg)	2013/03/04	<0.10		ug/L	
	RPD [QQ6802-02]	Leachable Mercury (Hg)	2013/03/04	NC		%	25
	RPD [QQ6803-02]	Leachable Mercury (Hg)	2013/03/04	NC		%	25
	RPD [QQ6804-02]	Leachable Mercury (Hg)	2013/03/04	NC		%	25
	RPD [QQ6805-02]	Leachable Mercury (Hg)	2013/03/04	NC		%	25
3140244 THL	Matrix Spike [QQ6805-02]	Leachable Isobutylbenzene - Volatile	2013/03/05		102	%	70 - 130
		Leachable Benzene	2013/03/05		100	%	70 - 130
		Leachable Toluene	2013/03/05		104	%	70 - 130
		Leachable Ethylbenzene	2013/03/05		104	%	70 - 130
		Leachable Xylene (Total)	2013/03/05		103	%	70 - 130
	Spiked Blank	Leachable Isobutylbenzene - Volatile	2013/03/05		88	%	70 - 130
		Leachable Benzene	2013/03/05		106	%	70 - 130
		Leachable Toluene	2013/03/05		106	%	70 - 130
		Leachable Ethylbenzene	2013/03/05		104	%	70 - 130
		Leachable Xylene (Total)	2013/03/05		101	%	70 - 130
	Method Blank	Leachable Isobutylbenzene - Volatile	2013/03/05		100	%	70 - 130
		Leachable Benzene	2013/03/05	<0.010		mg/L	
		Leachable Toluene	2013/03/05	<0.010		mg/L	
		Leachable Ethylbenzene	2013/03/05	<0.010		mg/L	
		Leachable Xylene (Total)	2013/03/05	<0.020		mg/L	
		Leachable C6 - C10 (less BTEX)	2013/03/05	<0.10		mg/L	
	RPD [QQ6802-02]	Leachable Benzene	2013/03/05	NC		%	40
		Leachable Toluene	2013/03/05	NC		%	40
		Leachable Ethylbenzene	2013/03/05	NC		%	40
		Leachable Xylene (Total)	2013/03/05	NC		%	40
		Leachable C6 - C10 (less BTEX)	2013/03/05	NC		%	40
	RPD [QQ6803-02]	Leachable Benzene	2013/03/05	NC		%	40
		Leachable Toluene	2013/03/05	NC		%	40
		Leachable Ethylbenzene	2013/03/05	NC		%	40
		Leachable Xylene (Total)	2013/03/05	NC		%	40
		Leachable C6 - C10 (less BTEX)	2013/03/05	NC		%	40
	RPD [QQ6804-02]	Leachable Benzene	2013/03/05	NC		%	40
		Leachable Toluene	2013/03/05	NC		%	40
		Leachable Ethylbenzene	2013/03/05	NC		%	40
		Leachable Xylene (Total)	2013/03/05	NC		%	40
		Leachable C6 - C10 (less BTEX)	2013/03/05	NC		%	40
	RPD [QQ6805-02]	Leachable Benzene	2013/03/05	NC		%	40
		Leachable Toluene	2013/03/05	NC		%	40
		Leachable Ethylbenzene	2013/03/05	NC		%	40
		Leachable Xylene (Total)	2013/03/05	NC		%	40
		Leachable C6 - C10 (less BTEX)	2013/03/05	NC		%	40

N/A = Not Applicable
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

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SNC-Lavalin Inc, Environment Division
Attention: Cameron Ells
Client Project #: 511766-0001
P.O. #:
Site Location: SNC CUSTOM LEACHATE

Quality Assurance Report (Continued)

Maxxam Job Number: DB327722

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Leachate Blank: A blank matrix containing all reagents used in the leaching procedure. Used to determine any process contamination.
QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) TEH samples were extracted using a flat-bed shaker instead of the accelerated mechanical shaker due to matrix incompatibility.
(2) Poor RPD due to sample inhomogeneity.

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Validation Signature Page

Maxxam Job #: B327722

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Alan Stewart, Scientific Specialist (Organics)

Golleen Acker, Supervisor, General Chemistry

Kevin Macdonald, Inorganics Supervisor

Rose Macdonald, Scientific Specialist (Organics)

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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