



**CONESTOGA-ROVERS
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March 13, 2015

Reference No. 088605

Mr. Matthew Keliher MBA, MPS, CHRP, CMA
Manager (Acting)
Solid Waste Resources
Transportation & Public Works
Halifax Regional Municipality
kelihem@halifax.ca

Dear Mr. Keliher:

Re: Scope of Work Requirements for Vertical Expansion Approval
Otter Lake Facility, Halifax Regional Municipality, Nova Scotia

1.0 Introduction

Conestoga-Rovers & Associates (CRA) on behalf of Halifax Regional Municipality (Halifax) has prepared the following requirements for studies, design, and agency consultation for the vertical expansion of the Residual Disposal Facility (RDF) located at the Otter Lake Facility (Site). The requirements have been prepared to facilitate procurement of a Consultant to execute the scope of work; and to outline the data requirements to be collected and provided to the Consultant by the Site Contractor (Mirror NS). The requirements have been divided into the following categories:

- **Section 2.0 Contractor Data Requirements:** This includes all data required to be collected by the Site Contractor in support of assessments to be completed by the Consultant.
- **Section 3.0 Daily Cover Material Options Analysis:** This includes an evaluation of the use of soil based daily cover material to improve RDF odour management practices.
- **Section 4.0 Vertical Expansion Studies, Design, and Agency Consultation:** This includes requirements for studies, design, and agency consultation in support of an application to amend the current Site Approval to Operate (No. 2008-065580-A01) to proceed with vertical expansion.

2.0 Contractor Data Requirements

The purpose of the Contractor data requirements is to provide data and an opinion(s) on the condition of existing infrastructure as it relates to evaluations and designs for the vertical expansion to be completed by the Consultant.



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The Site Contractor is to provide data and an opinion on the condition of the leachate collection and conveyance infrastructure for Cells 1, 2, and 3. The Site Contractor has identified concerns over the operating condition of the leachate collection system (laterals, drainage layer, and sumps) and pumps in these cells as well as the condition of the forcemain used for conveyance of collected leachate to the leachate holding tank, all due to biofouling. The Site Contractor has also raised concerns regarding pump capacity under vertical expansion. Data and opinion provided by the Site Contractor will be used by the Consultant as part the Leachate Collection System Assessment (Section 4.2).

The Site Contractor shall also provide historical and current landfill gas (LFG) generation data and an opinion as to the condition of the LFG collection and flaring system, which will be used in support of the Consultant's evaluation of the condition of the exiting LFG collection system and potential for odours as part of the LFG Management Plan (Section 4.4).

At a minimum, the Site Contractor will complete the following:

- Collect leachate levels and determine leachate elevations from a minimum of 10 LFG wells located in Cell 1, 2, and 3 on two separate occasions. The Consultant will specify which LFG wells will be used for the collection of leachate levels.
- Collect LFG data (pressure and methane, carbon dioxide, and oxygen concentrations) from all LFG wells located in Cells 1-6 and flares on at least two occasions. The flares are to be sampled prior to and post sampling of the LFG wells on each occasion.
- Provide video inspection of the leachate collection system piping in Cells 1, 2, and 3 and provide an opinion as to its condition. Video inspection to include riser pipes and to be detailed in areas of sumps (e.g., rotating camera to maximize all viewing angles).
- Test pumping infrastructure for Cells 1 and 3. Provide results to Consultant along with an opinion on their condition and upgrades required, if any.
- Provide video inspection of the forcemains conveying leachate from Cells 1 and 3 to the leachate holding tank, and provide an opinion as to its conditions and upgrades required, if any.
- Provide additional historical data as requested by the Consultant related to leachate generation and collection, LFG generation, collection and destruction, and filling practices.

Video inspections and LFG data completed within the last year is acceptable in place of supplying new information.



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Key Deliverables: Leachate elevations and LFG data; Video of leachate collection infrastructure; Opinion on condition of existing infrastructure and upgrades required.

3.0 Daily Cover Material Options Analysis

Currently, a shredded (150mm minus) construction and demolition (C&D) matrix is used as daily cover. Daily cover is typically applied in 150 mm lifts at the end of each working day over landfilled waste to reduce nuisance factors (e.g., blown litter, vectors and vermin, and odours). The purpose of the Daily Cover Material Options Analysis is to evaluate the use of soil based daily cover, in conjunction with or in place of the C&D matrix. The use of a soil based daily cover will reduce air space consumed by daily cover soils and assist in the mitigation of odours from the facility, while reducing or minimizing the use of the temporary LFG system.

As part of the options analysis, a cost-benefit evaluation will be completed for three scenarios:

1. Scenario 1: Continued use of the shredded C&D matrix as daily cover (in 150 mm lifts). Cost considerations will include the continued use of temporary LFG system.
2. Scenario 2: Continued use of the shredded C&D matrix on a daily basis (in 150 mm lifts), with use of soil based daily cover (in 150 mm lifts) periodically based on the fill sequencing plan (e.g., for every 5, 10, or 15 m lift of residuals landfilled). Two sub-scenarios will be considered: utilizing soil from an on-Site borrow area; and importing soil from an off-Site location within 100 km of the Site. Cost considerations will include the reduction in the use of the temporary LFG system and the cost to supply, stockpile, place, and remove soil based daily cover.
3. Scenario 3: Soil based cover is used on a daily basis (in 150 mm lifts). Two sub-scenarios will be considered: utilizing soil from an on-Site borrow area; and importing soil from an off-Site location within 100 km of the Site. Cost considerations will include the minimization of the temporary LFG system and optimization of the permanent LFG system and the cost to supply, stockpile, place, and remove soil based daily cover.

As part of the Daily Cover Material Options Analysis, a material balance will need to be completed for each scenario for vertical expansion that details demand quantities for soil and shredded C&D matrix materials while considering reuse quantities of salvageable final cover materials. Additional cost consideration will include the consumption of landfill air space and leachate generation rates. The options analysis is to recommend the preferred scenario based on costing and technical considerations, including maintaining or improving the current level of environmental protection.



Key Deliverables: Daily Cover Material Options Analysis

4.0 Vertical Expansion Studies, Design, and Agency Consultation

4.1 Geotechnical Assessment

The purpose of the geotechnical assessment is to evaluate the slope stability of the proposed vertically expanded waste mound and provide design recommendations. Specifically, the geotechnical assessment must address the following:

- 1) Evaluate slope stability and foundation stability and settlement estimates for the proposed vertical expansion.
- 2) Assess the cause of settlement within Cell 4 and identify corrective actions, if needed.

A geotechnical investigation is required to confirm conditions in Cells 1 to 5. The Consultant is to select the borehole locations and sampling requirements while considering the following:

- Age of waste within each cell.
- Characteristics of materials placed in the RDF including shredded and stabilized waste and shredded C&D matrix daily cover.
- Differential settlement in Cell 4.
- Cells 1 and 3 sump assessment as part of the Leachate Collection System Assessment (Section 4.2).

All fieldwork and tests will be completed as per ASTM/ CSA methods. Boreholes must not penetrate the base liner system and should be planned to be terminated 3.0 m above the base liner.

Based on the results of the field program, a geotechnical assessment will be completed and will consist of:

- Evaluation of the stability of the final slopes, recommendations should include options to improve slope stability as needed.
- Evaluation and recommendations regarding the consolidation/settlement of new and existing residual material, and the foundation of Cells 1 to 6.
- Evaluation stability of Cell 4 and rehabilitation recommendations, as required.
- Verification that native subgrade is able to support new loading of expanding landfill.
- Discussion of impacts to structures and pipe cover.



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A Geotechnical Report will be prepared for the proposed vertical expansion. This report will provide a summary of activities, results, and recommendations. The report will present all data collected, borehole logs, laboratory analysis results, slope stability assessment, consolidation/settlement assessment, and provide recommendations on other geotechnical related aspects.

Key Deliverable: Geotechnical Report

4.2 Leachate Collection System Assessment

The purpose of the leachate collection system assessment is to evaluate the condition of leachate collection infrastructure in Cells 1, 2, and 3. As mentioned in Section 2.0, the Contractor operating the Site has raised concerns over the condition of the leachate collection and conveyance systems. The leachate collection system assessment will include:

- An evaluation of the sumps in Cells 1 and 3 thru:
 - The installation of a monitoring well in each sump and evaluation of water levels on a minimum of three occasions
 - Review of leachate elevations provided by the Contractor
 - Review of video inspection and opinions provide by the Contractor
 - Review of actual leachate generation rates from Cells 1, 2, and 3 since closure (if available) verses projected values calculated as part of the original RDF design
- An evaluation of corrective actions/upgrades required to leachate pumping and conveyance infrastructure for Cells 1 and 3.
- Recommendations for further actions, as needed, which may include further field investigations and/or detailed design to upgrade current infrastructure.

A Leachate Collection System Assessment Report will be prepared presenting all data collected and reviewed, evaluation results, and recommendations.

Key Deliverable: Leachate Collection System Assessment Report



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4.3 Cell Design and Sequencing Plan

The Cell Design and Sequencing Plan will provide an overview of the vertically expanded RDF including details on landfill development. Key considerations will include:

- Maintaining or improving current levels of environmental protection
- Sizing new cells to accommodate progressive capping and minimizing the landfill working face thus lessening operational concerns (e.g., leachate generation, odours, and vector and vermin)
- Sizing new cells to accommodate landfill operations
- Minimizing areas of landfill final cover to be removed with each sequence
- Geotechnical assessment findings
- Capital and operating costs

The plan will include details with regards to landfill design including daily and interim cover use, landfill volumes including site life estimates for all new proposed cells, and landfill development. The Cell Design and Sequencing Plan will include the following drawings:

- Existing Conditions Drawing
- Final Conditions Drawing (i.e., grading plan) for vertically expanded Cells 1-6 including a minimum of two cross-sections
- Cell Layout Drawing
- Cell Sequencing Drawings showing landfill development, including final cover removal area, interim and final cover, surface water works, LFG infrastructure, roads, etc.

Key Deliverable: Cell Design and Sequencing Plan

4.4 Landfill Gas (LFG) Management Plan

The purpose of the LFG Management Plan is to determine the best option(s) for LFG management at the RDF during vertical expansion from both a technical and financial perspective, while maintaining or improving the current level of environmental protection at the Site with regards to LFG emissions including odours. The LFG Management Plan shall consist of the following components:

- LFG Production Assessment
- LFG Collection and Flaring System Assessment
- Recommended LFG Management Components



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LFG Production Assessment

A LFG Production Assessment will be completed to verify current and future LFG production rates at the RDF using available background information. An industry approved method will be used for estimating LFG production rates.

The LFG Production Assessment shall include a written summary that includes at a minimum the methodology, input data, assumptions, estimates for LFG production and LFG recovery throughout the life of the RDF, recommendations, and conclusions. In addition, the potential impacts on LFG production by the stabilized waste disposed at the RDF, as well as the processed shredded C&D matrix used as an alternative daily cover material, will be discussed.

LFG Collection and Flaring System Assessment

An assessment of the existing permanent and temporary LFG Collection and Flaring Systems will be completed to determine current efficiencies, future compatibility with a progressively expanding landfill, and future needs as it relates to LFG collection and destruction.

The LFG Collection and Flaring System Assessment will include:

- A summary of the existing permanent and temporary LFG collection system infrastructure
- A summary of the existing permanent and temporary LFG flaring systems
- A discussion on the performance of the existing permanent LFG Collection and Flaring System and its compatibility with long-term LFG collection and destruction at the Site
- A discussion on the performance of the existing temporary LFG Collection and Flaring System and its compatibility and need for long-term LFG collection and destruction at the Site

LFG Management Plan

Based on the recommendations and conclusions of the LFG Production Assessment and the LFG Collection and Flaring System Assessment, a LFG Management Plan will be developed that details the means by which the LFG resource will be managed, including the progressive expansion of LFG collection and destruction controls. The LFG Management Plan will include:

- A summary of the LFG Production Assessment
- A summary of the LFG Collection and Flaring System Assessment
- A summary of any associated field investigations



- A conceptual design for LFG collection
- Details on how the existing permanent LFG collection system will be managed during vertical expansion
- Details on any changes to current practices (i.e., use of a temporary LFG system)

The conceptual design for LFG collection shall follow the proposed progressive vertical expansion and the approved cell design and sequencing plan, and be able to support future LFG production rates.

A discussion on the conceptual design for LFG collection and preliminary capital cost estimates will be presented. The discussion will also include any recommendations or conclusions identified in the LFG Production Assessment and LFG Collection and Flaring System Assessment as they pertain to the vertical expansion and the approved cell design and sequencing plan, LFG collection system capacity, LFG flaring system capacity, condensate management, and projected LFG collection system efficiencies.

Key Deliverables: LFG Management Plan with LFG Gas Production Assessment and LFG Collection and Flaring System Assessment as appendices.

4.5 Stormwater Management and Erosion and Sediment Control Plan

The Stormwater Management and Erosion and Sediment Control Plan will include a general review of the current stormwater management system and determine the stormwater management requirements for vertical expansion. The Stormwater Management and Erosion and Sediment Control Plan will, at a minimum, include:

- Evaluation of the possible impacts of vertical expansion on the existing stormwater management system
- Provide recommendations for upgrades to the existing stormwater management system required as a result of vertical expansion
- Analysis of the pre and post development RDF runoff using an existing and proposed condition hydrologic/hydraulic model to simulate the 2-year through the 100 year storm events using local IDF precipitation data
- Review the current sizing/configuration of the two sedimentation ponds
- Prepare preliminary design drawings of the minor and major drainage systems to meet applicable quantity and quality control guidelines
- Assess potential permitting or construction related constraints that may be imposed by modifications of the final grading plan



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- Develop a temporary erosion and sediment control plan in accordance with the Nova Scotia Environment's Erosion and Sedimentation Control Handbook for Construction Sites
- Develop a permanent erosion and sediment control plan in accordance with the Nova Scotia Environment's Erosion and Sedimentation Control Handbook for Construction Sites

Key Deliverables: Stormwater Management and Erosion and Sediment Control Plan

4.6 Updated Design and Operations Plan

The Updated Design and Operations Plan will provide a summary of the following:

- Cell Design and Sequencing Plan
- Geotechnical Assessment
- Leachate Collection System Assessment
- LFG Management Plan
- Stormwater and Erosion and Sediment Control Plan

In addition, operational procedures will be updated and will include:

- Site Supervision
- Hours of Operations
- Site Security and Access
- Inspections, Complaints, and Record Keeping
- Dust Control
- Noise Control
- Odour Control
- Traffic Control and Impact
- Vector and Vermin Control
- Litter Control
- Landfill Cover Removal Procedures (including liner anchoring details)
- Lift Placement, Lift Height, and Waste Compaction
- Surface Water Management
- Landfill Gas Management
- Leachate Management
- Monitoring and Reporting
- Contingency Plans



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The revised odour control procedures will be prepared in accordance with Section 10 of the Approval to Operate (2008-065580-A01). As part of the revised procedures, detailed odour inspection procedures will be developed including on and off site monitoring to ensure early detection of any odour issues. The Consultant is to evaluate the use of a field olfactometer (e.g., Nasal Ranger) as part of revised odour inspection procedures. In addition as part of the contingency plans, detailed contingencies for odour management will be prepared for during landfill cover removal operations and during normal operations and will include such items as modifying operations, utilizing cover soils, utilizing oxidizing misting agents, and installing temporary LFG infrastructure.

The Operations Plan for the RDF prepared in August 2012 will form the basis of revised operational plan.

Key Deliverables: Updated Design and Operations Plan

4.7 Nova Scotia Environment Consultation and Permit Application

The above noted studies and design plans form the basis of supporting information to be used in obtaining an amendment to the Otter Lake Facility Approval to Operate (2008-065580-A01) to proceed with vertical expansion. Nova Scotia Environment (NSE) will need to be consulted to confirm whether there are additional requirements (e.g., additional studies or design plans) and to address any concerns. As part of NSE Consultation and Permit Application, the following will need to be completed:

- Meet with NSE a minimum of three occasions to review vertical expansion plans
- Prepare draft and final Municipal Approval Application and supporting information for Halifax's review
- Prepare final Municipal Approval Application and supporting information and submit to NSE.

Application fees will be paid by Halifax.

Key Deliverables: NSE Consultation and Municipal Approval Application



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4.8 Project Meetings

The Consultant is to assume that five meeting with Halifax will be required throughout the duration of the project. The Consultant will be responsible for preparing meeting agendas and minutes.

Key Deliverables: Meeting Agendas and Minutes

5.0 Potential Additional Requirements

Based on executing the above noted work, several other items may be required to be completed in order to successfully obtain an amendment to the Approval to Operate, including:

- Detailed Design and Specifications: Given that there will be no new cell construction as part of vertical expansion, detailed design and specifications are not required at this time. Depending on the outcome of the above noted studies and design plans, it is possible that as part of the first phase of vertical expansion detailed design and specifications will be required for items such as slope modifications (e.g., toe of landfill slope armoring), LFG infrastructure (e.g., horizontal collection design), and leachate management infrastructure repairs and upgrades. Detailed design and specifications will be required as part of cell closure and will include design of final cover, landfill gas infrastructure, and surface water works.
- Other requirements as identified by NSE.

We trust that the required studies, design plans, and agency consultation for vertical expansion of RDF have been clearly identified as requested by Halifax. Should you have any questions please do not hesitate to contact us.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES



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