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Divert NS, on behalf of Municipal-Provincial Priorities Group

Efficiency and Effectiveness of the Solid Waste Resource Management System

Prepared by:

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Date: September 9, 2019
Project #: 60568061 (440)

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Revision History

Rev #	Date	Revised By:	Revision Description
0	July 11, 2018	Steve Johnson	Draft – Governance section
	March 6, 2019	Jodi Tomchyshyn	Draft – Governance Section edits client comments
	April 11, 2019	Arnold Paintsil	Draft – Best Management Practices updates
	August 27, 2019	Ahmad Younes, Steve Johnson, Jodi Tomchyshyn, Andy Keir	Draft – update governance section, benchmarking, and best management practices based on review comments, draft of financial section
	September 9, 2019	Steve Johnson	Final based on Priority Group comments, NSE comments, Keir Corp updated tables for formatting, and add cover letter and Executive Summary

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Stephen Rayworth, CET
General Manager
Cumberland Joint Services Management Authority
PO Box 549, Amherst NS, B4H 4A1

September 9, 2019

Dear Mr. Rayworth

Subject: **Efficiency and Effectiveness of the Solid Waste Resource Management System**
AECOM File: **60568061 (440)**

AECOM Canada Ltd. (AECOM) was retained by Divert Nova Scotia (Divert) to complete a review of the efficiency and effectiveness of the Nova Scotia Solid Waste Resources Management System.

This final report has been prepared to provide information on Nova Scotia's key solid waste management system including governance, community profiles, and financial modelling with an overview of best management practices from other jurisdictions.

Thank you for choosing the AECOM Canada Ltd. team for this critical project.

Sincerely,
AECOM Canada Ltd.

Steve Johnson, M.Eng., P.Eng.
Waste Services Manager,
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AECOM: 2015-04-13

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Executive Summary

Nova Scotia has long been recognized as a Canadian leader in solid waste minimization, having achieved the lowest per capita disposal rate in Canada. This result is largely due to the innovative mix of regulations; policies; funding; promotion & education; and the combined, inter-related and individual efforts of key stakeholders. However, this success has come at the cost of Nova Scotians bearing the highest gross waste management operating costs in Canada.

With a reduction in diversion credits from Divert Nova Scotia, the Minister of Environment requested an Efficiency Study. This study, administered through the Steering Committee, is to identify opportunities to streamline Nova Scotia's waste resource management system by identifying opportunities for improved efficiency, productivity, and cost effectiveness while maintaining the environmental benefits of diversion, and meeting regulatory requirements.

This study is developed in four distinct sections; governance, best management practices, financial analysis, and community profiles. A summary of each section and its respective conclusions and recommendations is as follows:

Governance

1. Nova Scotia's Waste-Resource Strategy is more than 20 years old and should be revised to enable additional change.
   - The lack of a clear, shared provincial vision on the future of Nova Scotia's waste-resource management system has contributed to the current over capacity and high-cost system.
   - Regulated provincial triple bottom line goals and targets would assist planning, including service, accessibility, cost, jobs, etc. Goals and targets should be achievable, clear, and enforceable, and the responsible parties must be clearly identified.
2. The absence of a provincial requirement to consider the cumulative effect of proposed municipal solid-waste resource infrastructure on the whole of Nova Scotia has contributed to the over-supply of landfills, material recycling facilities (MRFs) and compost facilities.
   - Looking forward, if Nova Scotia implements Extended Producer Responsibility (EPR) for packaging and printed paper the regulated industry (i.e., the producer responsibility organizations or PROs) would define the optimal number of MRFs as the PRO(s) seeks to implement the most cost-effective means of achieving regulated recycling targets. These recycling facilities would be funded by producers and would cease to be a taxpayer funded cost.
   - For landfills and compost facilities, an arm's length from government organization, like Prince Edward Island's crown corporation the Island Waste Management Corporation, might be useful to regulate and/or manage the complement of publicly funded landfills and compost facilities in Nova Scotia to ensure the cumulative effect of public infrastructure investment is considered from a triple-bottom line perspective on the average Nova Scotia taxpayer. Given that waste management is an essential public service, key principles could be established as to guide decisions (e.g., fairness of access, equitability of costs across Nova Scotia taxpayers) in an updated Nova Scotia Waste-Resource Strategy.
3. Municipalities are not obligated to plan regionally or supra-regionally and have little incentive to do so. In the absence of guidance, municipalities are acting rationally when they make decisions they believe to be in the best triple-bottom line interests of their local public (e.g., jobs, environment, cost), as opposed to the best interests of Nova Scotia.

4. Elected municipal councils and Chief Administration Officers (CAOs) are the key decision-makers affecting short and long-term solid waste-resource planning and investment.
    - Yet, by and large, these groups are not regularly targeted with provincial education and outreach on the costs and benefits of Nova Scotia achieving its provincial disposal target.
    - There is a lack of best practice guidance to assist municipally elected officials, CAOs, and solid waste operators on the range of information that should be considered and assessed when considering investment in new infrastructure or setting municipal waste-resource budgets. Guidance would be helpful so that decision-makers can have confidence in making informed decisions on the full costs of solid-waste-resource infrastructure investments.
    - It would help decision-makers to compare costs between jurisdictions, as part of their regular practice.
    - A solid waste management basics education program for new Councillors appointed to serve on a board in needed
5. The purpose and role of the Regional Chairs Committee should be reconsidered.
    - There is a lack of clarity on the roles of the Regional Chairs Committee and the Nova Scotia Federation of Municipalities: both have advocacy roles with the provincial government on behalf of local municipalities on solid waste-resource management.
    - This lack clarity is causing duplication of work, delays, and confusion about 'who speaks for municipalities' on waste-resource issues. It may be beneficial to clarify their respective roles to enable a clear pathway for advocacy and decision-making on solid waste-resource issues to capitalize on the strengths of both entities.
6. There is little publicly available information or direct education on the overall costs of Nova Scotia's solid waste-resource management system, its over-capacity of infrastructure, or how local decision-making is contributing to this problem. The absence of this information is contributing to local confusion on the need for system-wide change.
7. The Fund administered by Divert NS would not exist without the revenues created by the beverage container recycling program. Before considering whether to change this system, a full triple bottom line assessment should be completed to assess the value of the current system compared to any savings and costs that would be accrued through curbside recycling. The relative recovery rates, the value of the material generated by each system relative to their cost of collection, and their relative contribution to the circular economy, may be important strategic considerations.
8. Divert NS collects the bulk of their funding through their operation of the beverage container and tire recycling programs. This funding becomes part of the regulated Resource Recovery Fund. Divert NS redistributes these funds as guided by the regulations and the provincial government. In part, this fund is used to encourage and contribute financially to municipal promotion and education on solid waste-resources issues and opportunities. This creates a duplication of role and mandate between Divert NS and regions/municipalities -i.e., both entities are assessing needs to achieve regulated targets and developing education material.
    - To reduce the duplication, it might beneficial to narrow Divert NS' role in decision-making regarding promotion and education funding to provincial or province-wide opportunities, or topics unrelated to municipal recycling.
    - i.e., Financially contributing to 7 or 50 individual promotion and education programs is less efficient than subsidizing a single common platform with common messages.
    - i.e., providing individual subsidization of municipal and regional promotion and education programs might discourage or reduce the incentive for municipal/regional/cross regional cooperation on promotion and education.

- For example, it might be more cost-effective for either the province to establish or municipal units to collectively agree on a common list of materials that all will be collected and recycled across the province. This would enable the development a province-wide campaign on 'what is recyclable in which waste stream' (i.e., blue box, organics, depot), reducing the need for each municipal unit to investment in individual promotion and education campaigns, and making it easier for Nova Scotians to understand what they can recycle (and where) as they cross borders or move between locations as they live, work and play.

9. Intermunicipal Agreements are a tool to enable municipalities to plan at a sub-regional, regional or supra-regional level and share costs of services. Shared costs, services, and best practices are an important tool to deliver effective and efficient services to the public.
    - Current on-the-ground disputes are putting existing agreements at risk and threaten the success of regional planning and implementation.
    - Standard dispute resolution clauses should be added the agreements that enable collaborative solutions through discussion, negotiation, and if necessary, mediation. Binding arbitration should be a last resort that is used only in exceptional circumstances.
    - Likely points of conflict should be considered, including scenarios to resolve issues prior to those issues becoming disputes (e.g., dissolution of a party to the agreement due to annexation, setting annual or three-year rolling budgets, the desire for additional service or accessibility, management of customer complaints).
    - Dispute resolution training may benefit parties to the agreement.
    - Reporting to the public on the benefits of the agreement, and the results achieved could encourage a greater willingness to resolve issues and disputes.

Best Management Practices

The best management practices section overviews summaries of best practices for the following categories:

1) Planning, Governance, and Administration
2) Waste Collection
3) Recycling
4) Landfill
5) Compost
6) International best management practices Europe and Asia

These practices should be reviewed by Nova Scotia Environment, the regional authorities, Nova Scotia Federation of Municipalities, local municipalities, and Divert NS to determine which practices can be applied in the updates to the solid waste management system.

Practices for Planning, Governance, and Administration, Recycling, and Landfill are provided as follows.

Planning, Governance, and Administration

The following best management practices have been identified for potential in reducing costs:

- Form financially viable regional waste management systems. Managing waste on an optimized waste shed allows for economies of scale which reduces cost with more available waste or diversion tonnage.

- Develop regional solid waste management plan. The plans should use full cost accounting or triple bottom line analysis to meet a provincial diversion mandate or to obtain grant funding.
- Develop an arms-length government organization (i.e. Crown Corporation, Delegated Administrative Organization) responsible for waste planning and operation
- Evaluate and potentially implement policy instruments such as flow control, single-use item reduction, and PAYT
- Develop standardized waste services procurement contracts to reduce administration between regions

Recycling

The following best management practices have been useful in reducing cost in the recycling stream:

- Multi-municipal planning approach to collection and processing of recyclables.
- Optimization of operations in collection and processing.
- Training of key program staff in core competencies.
- Following generally accepted principles for effective procurement and contract management.
- Appropriately planned, designed, and funded promotion and education programs
- Consider using trucks with compaction capability to save on shipping fees
- Implementation of Pay-as-you-throw systems
- Reducing the number of MRFs reduces overall processing and transferring costs. Savings vary depending on number of MRFs and transfer stations in the system
- Utilise transfer stations/depot in smaller communities
- Study collection costs to fully understand savings potential
- MRF process optimisation and energy efficiency – Only run equipment when there is material to process
- Compare costs with other jurisdictions and adopt best practices/adjust cost accordingly

Landfill

The following best management practices have been useful in reducing cost for landfills:

- Planning
  - Limit the number of Regional solid waste facilities to optimize the amount of waste received – reduce staff and administration
  - For a municipality with multiple landfills, temporarily close a number of landfills and divert waste to a one facility to reduce operational costs
- Administrative
  - Set Staffing and operational hours to manage the waste (i.e. control hauler schedules and when waste placed in landfill)
  - Appropriate equipment selection (i.e. right size landfill equipment)
  - Implement a preventative maintenance program
  - Appropriate annual budgeting using full cost accounting
- Landfill Operations
  - Manage airspace utilization (i.e. monitor compaction, cover practices, grade control, have a fill plan)
  - Use of alternative daily cover

  - Use of synthetic covers to reduce leachate generation and associated management costs
- Landfill Engineering
  - Alternative cap designs to reduce post-closure care costs (reduce leachate generation and obtain better landfill gas capture)
  - Progressive capping to reduce leachate generation
  - Master Development Plans for capital and operational cost estimates
  - Design for feedstock and capacity

Financial Analysis

The objective of the financial analysis is to provide a model in which potential recommended changes to Nova Scotia's waste-resource management can be evaluated. The model developed is based on the major waste management infrastructure including transfer stations, landfills, MRFs, and composting facilities.

The steps to develop the Quantrix model included:

- March 3, 2018 project initiation meeting with the Steering Committee. The Datacall system was discussed. It was determined that reports, such as Solid Waste Management Plans and Landfill Master Plans were not available.
- March 8, 2018 Meeting with Nova Scotia Environment on background and type of information available in Datacall.
- May 7, 2018 Steering Committee meeting. Preliminary review of Datacall information online determined system was not easily understood to mine data for project.
- May 29 and 31, 2018 regional coordinators meeting on community profiles and waste flows overview on the forms provided for regional coordinators to complete and the verification process. The community profile information is to clarify waste flows and develop waste flow module for financial model as provided by regional coordinators. The submissions were requested to be completed by June 22, 2018.
- February 20, 2019 – Steering Committee meeting to discuss completed community profiles and waste flows and move forward with financial model development. Direction provided is to use Datacall financials from 2016 versus obtaining information directly from regions.
- March to July 2019, develop model with assistance from Nova Scotia Environment in supplying annualized costs per region including operating costs and amortized capital costs and waste flow quantities. As modules completed coordinated meetings and discussions with regional coordinators to overview modules for their region, verify information, and rationalize gaps or errors within the data. Regional Coordinators were provided access to the Model for online verification or given spreadsheets for regional coordinators to update and verify data.
- July 25, 2019 Meeting with Steering Group which included direction to finalize the model and present current findings, develop recommendations for further analysis and changes to the Datacall system, and prepare a presentation. The project is to be complete by September 12.

From model development the following observations and recommendations were made:

<u>Background Data</u>

An extensive amount of data is collected through the Provincial waste management data call, but, it was found that there are gaps in the data and that the consistency of data among regions and municipalities is variable.

Although considerable effort is expended in the data call to collect a prodigious amount of data, the question looms - Is it all useful? A large portion of the data assembled had to be aggregated to make it usable for system modelling.

It became apparent during the model build that there is misalignment in how people record their waste flow data and cost information. Consistency across the seven regions and constituent municipalities is required.

Recommendation:

a) **It is recommended that Nova Scotia review its approach to data management with particular attention to what is needed, how it is assembled, how it will be used.**

b) **It is recommended that Nova Scotia get alignment among the various providers of information about the data needed and when it is required.**

Data Analysis

The data collected in the provincial data call is assembled in Excel spread sheets, but these are static. They are not interconnected and do not permit interactive analysis, forecasting or what-if analysis. Essentially the Excel Data Call workbook as it currently stands is a data base. In order to make use of the data it needs to be activated.

This study has produced a system model that is fully linked top to bottom. A change in input data or assumptions ripples through the entire model. The model is designed to enable what-if analysis.

Recommendation

c) **Data is an asset. It needs to be analyzed to create value**

d) **The model is a tool for data analysis. It needs to be annually calibrated to be useful for planning.**

e) **As considerable effort was involved in developing the Quantrix model, Nova Scotia should consider replacing the Datacall system with the information needed to calibrate the Quantrix Model. If the Quantrix model is used, then the following should be implemented:**

- **Develop forms and common definitions for data input based on what information to be tracked for facility user and government programs**
- **Develop similar accounting practices for facilities for standardized data entry**
- **Training of regional coordinators and applicable government staff in Quantrix**
- **Set up the Quantrix model for multiple user access in the Quantrix Qloud**
- **Regional coordinators or other trained staff to update model with full cost accounting data from standardized forms from (a)**

The Waste Management System

The model reveals that there are cost inefficiencies in the system. This may require system reconfiguration and consolidation to take advantage of economies of scale.

The spread of per tonne costs in many instances for activities and facilities appears to be fairly broad across the Regions and constituent municipalities. Attention needs to be given as to whether these costs are accounted for in the same way. Have some municipalities accounted for costs one way and other municipalities another?

Nova Scotia needs to look at its waste system and decision adjustments if it feels they are needed.

Recommendation:

f) Carefully look at the waste flow and cost information generated by the model to assess commonality of results.

g) Look at the cost outputs to determine if per tonne dollar costs spreads across regions and municipalities can be tightened either through negotiation or system reconfiguration.

h) Nova Scotia should develop a Provincial Solid Waste Management Plan, or have the seven Regions prepare their own plans which would include:

- **An assessment of system facilities using full cost accounting with respect to potential expansion, capacity thresholds, and financial viability.**
- **Determine potential facility expansions and closures taking into account associated transportation costs**
- **Determine EPR implementation scheduling and changes to the waste facility network with associated costs.**
- **Update the Quantrix model to assess facility network modification(s) and impacts to the Provincial system.**

Please note that for EPR implementation, producers will decide what infrastructure is needed as they design their system. Producers may choose an 'all Atlantic system' plan. It's is likely that producers will consolidate processing into a single MRF, as they have in BC, and use transfer stations to move materials through the province. The timeframe to transition to EPR can range from 2 years, as being proposed in Alberta, to up to 5 year as proposed in Ontario, taking into account the management of stranded assets. Producers will want to assess the status of the waste transfer station and MRF assets.

Community Profiles

Community profiles are essentially a resume which provides:

- A material flow diagram (waste type, tonnage);
- system costs;
- A municipality caption (community data, collection and diversion program information, processing and disposal information, public education programs, challenges and future considerations); and
- A facility summary (capacity, capital and operational cost, facility assessment, performance metric)

This information was compiled and summarized draft waste shed information verified by the regional coordinators and used to develop the financial model. This information should be updated by the regional coordinators for use in future studies. The profiles are provided in Appendix 8.

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Appendices

1. Governance

1.1 Approach

As a first step, an extensive literature review was undertaken to gather information on Nova Scotia's key waste-resource stakeholder groups, including identifying their roles and responsibilities in waste-resource management and efforts to improve the cost efficiency and effectiveness of Nova's Scotia's waste-resource system. The key stakeholder groups included:

- Nova Scotia Environment
- Department of Municipal Affairs
- Waste-Resource Regions -including the Regional Chairs Committee, Regional Coordinators Committee, and the Municipal Priorities Group
- Nova Scotia Federation of Municipalities

The inter-relationship between these stakeholder groups was then mapped and further explored through key informant interviews. Each interviewee was guaranteed anonymity to ensure they provided their best input. Questions were sent to interviewees before each interview to provide each interviewee the time to reflect on their responses (Appendix 1). Each conversation was free flowing; the question template was used as a guide for each category of inquiry.

In total, 21 one-hour interviews were conducted and the content of the interviews was then assessed for both trends and unique responses. Information provided during the interviews was verified, as much as possible, with further literature review. The interviewees brought the perspectives of the following stakeholder groups (the number of interviewees per group is indicated in brackets):

- Regional coordinators (11)
- Solid waste managers (4)
- Nova Scotia Environment (1)
- Department of Municipal Affairs (1)
- Nova Scotia Federation of Municipalities (1)
- Divert NS
- Regional Chairs Committee member (1)
- Independent consultant working in Nova Scotia (1)

This section of the project was completed February to August 2018. Information and research may not be current at the time of publishing.

1.1.1 Objective

The Nova Scotia waste-resource management system has been extensively studied over the 10 years to identify and define improvements to Nova Scotia's system that would reduce costs, improve effectiveness and help Nova Scotia reach its waste disposal target of 300 kilograms (kg) per capita. Several rounds of government consultation have resulted in two separate proposals to update and improve its 1995 Waste Strategy; yet barriers have affected Nova Scotia's ability to move forward and implement the needed changes. Key barriers identified include:

- Concerns about the potential for additional costs to implement the proposed changes when the current system is already the most expensive in the country according to Statistics Canada data.
- Unanswered questions about whether efficiencies could be found in the existing system that could negate the need for changes.
- Unanswered questions about whether a lack of clear roles and responsibilities in the governance system are the real barriers hindering Nova Scotia's ability to improve the cost efficiency and effectiveness of its system.

The objective of this task was to analyse the existing governance approach, including the roles and responsibilities of the various decision-making entities involved in the waste-resource governance system: i.e., municipal, regional, and provincial (Divert NS and NSE). In completing this task, special attention was focussed on:

- Governance and administrative efficiency
- Barriers to effective decision-making
- Overlapping roles and responsibilities or a lack of clear role and responsibilities

The key questions included:

1. Are changes in governance required to improve waste management programs and services?
2. Are changes in governance required to achieve cost reductions?

1.2 Background

Nova Scotia has long been recognized as a Canadian leader in solid waste minimization, having achieved the lowest per capita disposal rate in Canada. This result is largely due to the innovative mix of laws; policies; funding; promotion & education; and the combined, inter-related and individual efforts of key stakeholders, including:

- Nova Scotia Environment
- Seven regional authorities
- Nova Scotia Federation of Municipalities
- Local municipalities
- Divert NS
- Stewardship program operators
- Facility operators
- Individual Nova Scotians and Nova Scotia businesses

However, this success has come at the cost of Nova Scotians bearing the highest gross waste management operating costs in Canada (Statistics Canada, 2012). The following is a description and assessment of the roles, responsibilities and activities of the key stakeholder groups as they relate to solid waste-resource management in Nova Scotia.

1.2.1 The Role of Nova Scotia Environment

Nova Scotia Environment is responsible for developing, implementing, and enforcing the legal framework for solid waste-resource management in Nova Scotia.

Nova Scotia Environment's efforts began in 1995 when it took steps to enable a framework for an effective solid-waste resource management system, including a commitment to achieve 50 per cent waste diversion by 2000. A brief chronology of the government's efforts to improve and effect waste minimization is below.

Table 1: Chronology of Nova Scotia Environment Policy Interventions to Encourage Waste Minimization

Year	Action Taken by the Government of Nova Scotia
1995	Established a target of 50 per cent solid waste diversion in the *Environment Act* (1995), which the Province was required to achieve.
1995	Released its first Solid-Waste Resource Management Strategy (Waste Strategy) (Department of Nova Scotia, 1995).
1996	Implemented the *Solid-Waste Resource Management Regulations* (NS Reg. 25/96), which included nine key actions to encourage waste minimization and better waste management: 1. Established seven regions to act as waste sheds for the planning and implementation of solid waste-resource management. 2. Required each region to develop and implement a solid waste-resource management plan to achieve 50 per cent waste diversion. 3. Enabled a Resource Recovery Fund (the Fund), owned by the provincial government, operated by Divert NS. 4. Enabled Divert NS (formerly operated as Resource Recover Fund Board), to administer the Fund and foster waste minimization. 5. Established Nova Scotia's first disposal bans for organics, some paper and plastics, beverage containers, and tires. 6. Enabled Industry Product Stewardship (now commonly Extended Producer Responsibility or EPR). 7. Established a deposit-refund program for ready-to-serve beverage containers (excluding milk products), operated by Divert NS. This is product stewardship program operated by a non-industry, delegated authority -i.e., not EPR. 8. Established a product stewardship program select used tires (passenger, light truck, medium truck), operated by Divert NS. This is product stewardship program operated by a non-industry, delegated authority -i.e., not EPR. 9. Required landfills to meet "second generation" requirements.
1996	Established the *Used Oil Regulations (N.S. Reg. 51/95)*, to enable return to retail for this material.
1997	Released *Construction and Demolition Debris Disposal Site Guidelines (*Nova Scotia Environment and Labour, 1997a)*; Municipal Solid Waste Landfill Guidelines (*Nova Scotia Environment and Labour, 1997b)., and *Guidelines for Grease Trap Waste (*Nova Scotia Environment and Labour, 1997c).
2000	Achieved 50 per waste diversion target (Nova Scotia Environment, 2008).
2000	Established the *Nova Scotia Milk Packaging Stewardship Agreement*, which established the Atlantic Dairy Council's voluntary agreement to fund the costs of recycling milk packaging in Nova Scotia (Nova Scotia Environment and Labour, 2000).

Year	Action Taken by the Government of Nova Scotia
2002	Established an EPR requirement for a Consumer Paint Products Stewardship Program and added disposal bans to these materials (Solid Waste-Resource Management Regulations, 1996).
2006	Established a target of no more than 300 kg/capita/year waste disposed in the *Environment Act (1995)* , and in 2007 confirmed this goal in their *Environmental Goals and Sustainable Prosperity Act (2007).* Neither Act clarified the regulated party (i.e., whether the responsible party is the provincial government, the regions, or local municipalities.)
2006	Released *Guidelines for the Siting and Operation of Waste Transfer Stations* (Nova Scotia Environment and Labour, 2006).
2007	Established an EPR requirements for an Electronic Products Stewardship Program and added disposal bans for this material (Solid Waste-Resource Management Regulations, 1996).
2008	Released *Final Report on Nova Scotia's Solid Waste Resource Management Strategy* (Nova Scotia Environment, 2008a), and released consultation document entitled *Thinking Outside the Landfill (*Nova Scotia Environment, 2008b) to update its Waste Strategy.
2009	Released a consultation summary report entitled: *Renewal of Nova Scotia's Solid Waste Resource Management Strategy: Consultation Summary Report (*Nova Scotia Environment, 2009).
2011	Stemming from the 2008 consultation and 2009 consultation summary, released a proposal update to the Waste Strategy entitled: *Our Path Forward: Building on the Success of Nova Scotia's Solid Waste Resource Management Strategy* (Nova Scotia Environment, 2011). In this Strategy, Nova Scotia Environment committed to • A reinvigoration of Regional Plans (i.e., requiring regions update the plans) • Developing an action plan on EPR • Improving collaboration and education on waste reduction • Developing options for improving C&D waste diversion
2014	Released a new consultation document, entitled: *Revising Our Path Forward: A public discussion paper about solid waste regulation in Nova Scotia* (Nova Scotia Environment, 2014).

2015	Released a consultation summary report entitled: *What we heard: solid waste regulation public discussion* (Nova Scotia Environment, 2015). Key commitments:
	• Develop new solid waste management strategy;
	• Move forward with EPR for packaging and printed paper (PPP), used oil material (including containers and filters), mercury containing products, and household hazardous waste (HHW);
	  ○ Allow de minimus level exemption for PPP EPR;
	  ○ Work with stakeholders to guide stewardship in the development of stewardship plans;
	• Study and report on the financial effects of the proposals on four municipalities, by 2015; and
	• Further define the role of Divert NS (formerly RRFB).

2015	Target deadline for Nova Scotia to achieve the regulated 300 kg/capita waste disposal target. The target was not achieved.
Various	Established voluntary EPR agreements between Nova Scotia Environment and the producers of Newspapers, Expired Medications, Sharps, and Yellow pages.

Nova Scotia's waste-resource approach and framework is extensive, includes using the broadest range of policy instruments at the provincial level anywhere in Canada, has fostered collaboration and innovation among stakeholder groups, and has been incredibly successful. Over the first 22 years, Nova Scotia:

- Achieved 50 per cent diversion of the amount of waste disposed/person from that disposed in 1989 (Nova Scotia Environment, 2011)
- Decreased its overall waste disposed from 743 kg/person/year in 1990 to 384 kg/person in 2017 (Divert NS, 2017)
- Increased materials recycled and marketed from 11,000 tonnes per year in 1992 to over 55,000 tonnes in 2017 (Datacall 2017)
- Increased organics collected from 3,000 tonnes in 1994 to over 105,000, tonnes in 2017 (Datacall 2017)
- Expanded curbside recycling to 100% of households (Divert NS, 2018a)
- Expanded curbside collection of organics to 90% of households s (Divert NS, 2018b); established 78 Enviro-depots across the province (Divert NS, 2017)
- Recycled over 5.2 billion beverage containers since 1996 (Divert NS, 2011-2018)[1]
- Began reusing and recycling tires and now diverts over 1.1 million tires each year (Divert NS, 2018c)
- Began recycling leftover paint and now diverts over 450,000 litres each year (Product Care, 2017)
- Began recycling Waste Electrical and Electronic Equipment (WEEE), commonly known as e-waste, and now diverts over 3500 tonnes of each year (EPRA, 2017)

The framework developed by Nova Scotia Environment to reduce and better manage waste is impressive. Nova Scotia is the only province to ban materials from disposal (landfill and incineration) on a province-wide level. However, while Nova Scotia Environment sets the framework to achieve waste diversion by establishing and enforcing its laws (legislation, regulation and guidelines) and other policies, it ultimately does not manage waste or directly affect its diversion. Ultimately, it is the leadership, local investment, and combined on-the-ground efforts of the seven regional authorities, local municipalities, Divert NS, stewardship program operators, facility operators, Nova Scotia businesses and individual Nova Scotians that have established the on-the-ground infrastructure, plans, promotion and education, and local enforcement that have enabled Nova Scotia to undertake the activities necessary to achieve its waste diversion targets and lower waste disposal rates.

1.2.2 The Role of the Department of Municipal Affairs

The Department of Municipal Affairs (the Department) is responsible for developing, implementing, and enforcing the legal framework enabling municipal government to act locally and govern. The key piece of legislation administered by the Department is the *Municipal Government Act*, *1998* which outlines what municipal governments must provide and have the option of providing. Key components of the Act include:

- s. 49 (1)(b), which enables municipalities to regulate the use of solid-waste management facilities, providing for times and conditions under which they may be used and setting charges for the use of solid-waste management facilities operated by the municipality

[1] Total containers recycled was calculated by adding the number of containers reported as recycled since the program's inception by Nova Scotia Environment in 'Our Path Forward, 2011' (which was 2.6 billion) plus the number of containers reported as recycled annually by Divert NS in its 2011-2018 Annual Reports.

- s. 60, which enables municipalities and villages to enter into service agreements with one or more municipalities, villages, service commissions, the Government of the Province or of Canada or a department or agency of either of them or a band council
- s. 65 (q) and (am), which enables municipalities with the power to expend money to collect, remove, manage and dispose solid waste and on establishing solid-waste management facilities
- s. 81 (1) (ba), which enables municipalities to establish by-laws imposing, fixing and providing methods of enforcing payment of charges for solid-waste management facilities
- s. 220 (5)(f), which enables municipalities to establish a land-use by-law, where a municipal planning strategy so provides, that regulate the location of disposal sites for any waste material
- s. 231 (4)(h) which enables municipalities to establish by-laws, where a municipal planning strategy so provides, requiring site approval for the location of facilities for the storage of solid waste
- s. 274 (2) (da) which enables municipalities to require the inclusion of provisions for infrastructure charges for new or expanded solid-waste management facilities
- s. 325 which enables municipalities to establish by-laws respecting solid waste
- s. 326 (1) which enables municipalities to provide compensation to an area, to the property owners in an area or to the residents of an area in which a solid-waste management facility is located
- s. 326 (2) which enables municipalities to contract with other municipalities or persons for the use of any component of its solid-waste management program

The provisions for municipalities relating to solid waste in this Act are enabling only, and as such do not require municipalities to take any mandatory action to enable solid waste-resource collection or management.

In addition to overseeing the implementation of the Act, the Department also provides advice and mentoring on best practices for implementing intermunicipal partnerships and agreements, including advice on dispute resolution practices to resolve disputes that occur during the course of the agreement (Service Nova Scotia and Municipal Relations, 2004; Service Nova Scotia and Municipal Relations, 2006).

1.2.3 The Role of the Office of Regulatory Affairs and Service Effectiveness

The Office of Regulatory Affairs and Service Effectiveness aims to reduce regulatory burden to business and make service improvements to support economic growth in Nova Scotia and across Atlantic Canada. The Office has two functions: 1) to reduce undue provincial burden on Nova Scotia businesses, and 2) align regulatory systems across the four provinces of the Atlantic region. To that end, the Government of Nova Scotia, along with the governments of the other Atlantic provinces have signed an MOU that describes their collaboration. Key elements of the Premiers' Charter of governing principles for regulation include:

1. The Government will regulate to achieve its policy objectives only
2. Regulation should not impose costs and obligations on business, social enterprises, individuals and community groups unless a robust and compelling case has been made to do so
3. The policy need should be clearly articulated at the outset
4. Regulation should be the only effective and necessary way to meet the policy need
5. Regulation should be a tempered response
6. Regulation should be accountable
7. Regulation should be accessible and easy to comply with
8. Regulation should consider economic impact

9. Good regulatory governance (Office of Regulatory Affairs and Service Effectiveness, 2018)

New proposed regulation for Nova Scotia would be reviewed with these principles in mind.

The Role of Municipalities

Nova Scotia's municipal units are enabled by the *Municipal Government Act, 1998* [s. 325-326] to implement by-laws and services to manage solid waste in their jurisdictions.

Nova Scotia has 50 municipal units, including: nine municipal counties, 12 municipal districts, three regional municipalities, 26 incorporated towns (Figure 1). The geographical boundaries of municipal counties, districts, and regional municipalities do not overlap; incorporated towns exist within the boundaries of municipal districts and counties. Each of Nova Scotia's 50 municipal units have their own municipal government, tax base, municipal budget, and vote at the Nova Scotia Federation of Municipalities. The cultural relevance of each of the 50 municipal units is steeped in more than 140 years of history, since the first municipal county was incorporated in 1874 (Figure 2, Appendix 2).

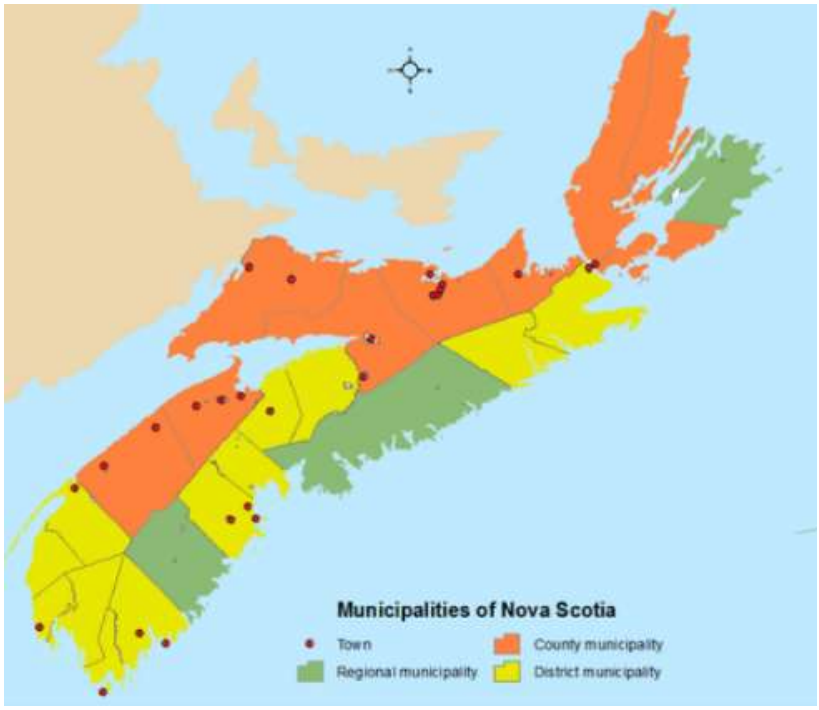


Figure 1: Municipalities of Nova Scotia (Wikipedia, 2018b).

Figure 2: Historical Map of Nova Scotia Municipal Districts, Counties, and Regional Municipalities (Wikipedia, 2018b)

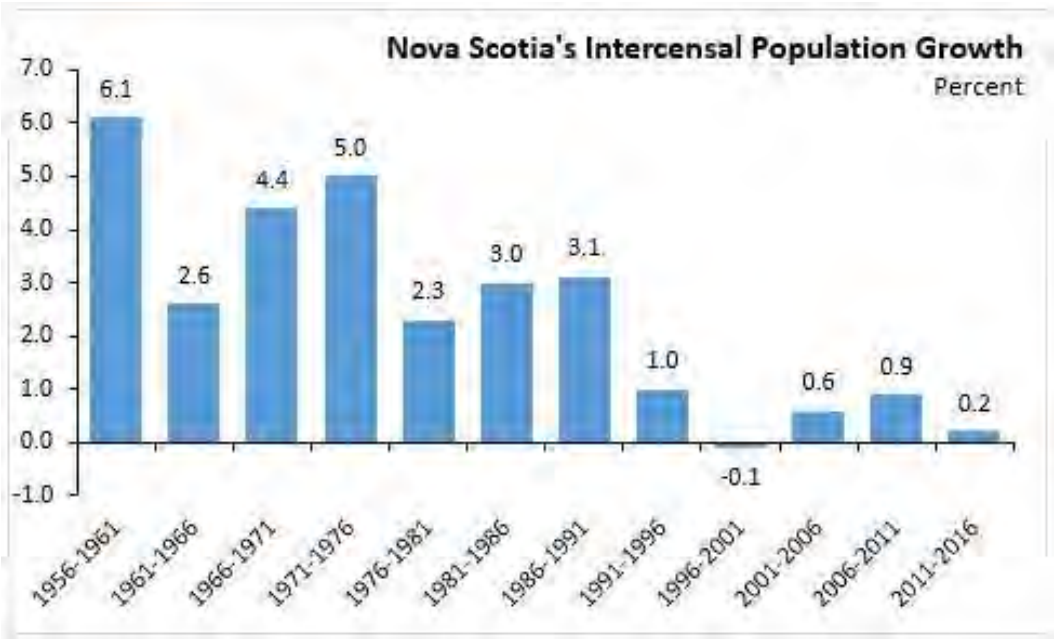


Figure 3: Population Growth in Nova Scotia (Nova Scotia Finance and Treasury Board, 2017)

In general, the population growth of Nova Scotia is flat (i.e., 0.2 per cent growth between 2011-2016), but most municipal units across Nova Scotia are facing a declining population as the population redistributes to larger urban centres and oceanside communities (Appendix 2). Of the 50 municipal units, 40 faced declining populations, and only 10 are experiencing population growth including: Halifax (Region 4); East Hants (Region 3); Annapolis Royal, Berwick, Kentville, and Middleton (Region 5); and Mahone Bay, Bridgewater and West Hants (Region 6) (Appendix 2). As population declines, so does the tax base to fund municipal operations, including solid waste-resource management. Of the seven municipal units with second generation landfills within their borders (i.e., Colchester, Cumberland, Guysborough, Chester, Queens, West Hants and Halifax), all face declining populations except Halifax and West Hants (Appendix 2).

Nova Scotia's Seven Solid Waste-Resource Regions

The 1996 *Solid Waste-Resource Management Regulations* divided Nova Scotia's 50 municipal units into seven regions and required each region to develop and implement a solid waste plan to enable effective waste management and minimization. The regions include:

- Region 1. Cape Breton
- Region 2. Eastern
- Region 3. Northern
- Region 4. Halifax
- Region 5. Valley
- Region 6. South Shore / West Hants
- Region 7. Western.

Each region was contemplated as a waste-shed for the development and implementation of waste-resource management plans. Each region was required by regulation to report on its progress towards achieving 50 per cent waste diversion by 2000. In implementing the regional system, Region 2 petitioned the government to be further subdivided into two sub-regions (2A and 2B) and the government agreed, which effectively created eight recognized waste-sheds. Each Region had the opportunity to create a 'regional committee' (Board, Authority, etc.), where appropriate, to oversee the development and implementation of the regional solid waste-resource plans.

Regional Planning

The regulations did not require that all municipal units within each region share infrastructure, collection services, by-laws, or otherwise collaborate on the implementation of waste minimization practices (e.g., by entering into intermunicipal arrangements). Further, the regulations only required that regions report on progress towards the 50 percent waste diversion target, which was achieved by Nova Scotia by 2000. As a result, once this target was achieved, the legal requirement to jointly plan for waste minimization effectively ended. Nova Scotia Environment approved (and continues to approve) requests to construct additional landfill space and other disposal infrastructure (i.e., energy from waste) despite regional plans, and despite articulated concerns by the government about the provincial overabundance and cost of existing waste-resource management infrastructure.

The regional boundaries of the seven waste-sheds vary in comparison to other government planning 'sheds' across the province (Figures 5-8). Given that all municipal unit boundaries touch other municipal units, it is likely that individual citizens could live in one municipality while working or cottaging in another. Confusing regional boundaries could affect whether individual citizens know whom to contact to identify options to participate in local waste-resource programming.

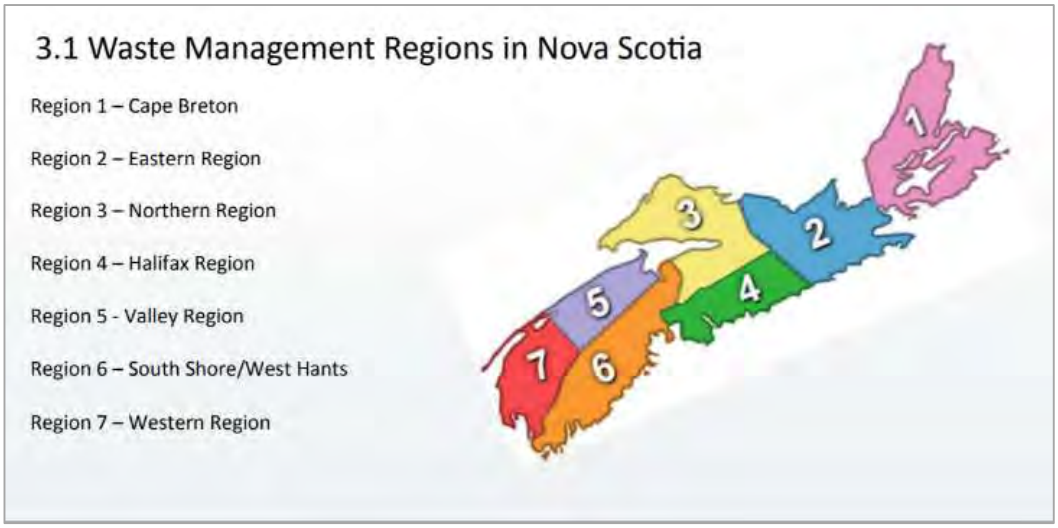


Figure 4: Nova Scotia's Seven Regional Waste-Sheds (Divert NS, 2013)

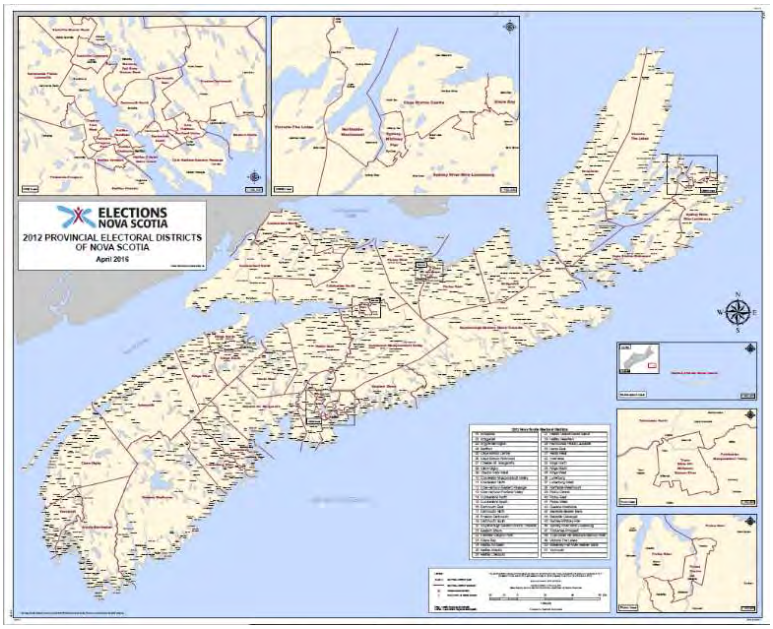


Figure 5: Nova Scotia's Provincial Elections Boundaries (Elections Nova Scotia, 2016)

Figure 6: Nova Scotia's Seven Regional Education Centres (Nova Scotia Education and Early Childhood Development, 2018)

Figure 7: Nova Scotia Federal Elections Boundaries (Elections Canada, 2018)

There is no regulated requirement for the seven regions to update their regional waste solid waste-resource management plans at any regular interval. As a result, the plans have generally remained unchanged since they were first submitted to the province in the late 1990s. The regions original solid waste-resource plans are not publicly available and only one region has published updated plan information: i.e., Halifax (Stantec, 2013). The province has indicated its intent to remove the requirement for regional plans in the regulations (Honourable Andrew Younger, 2015).

Interestingly, the regulations seem to have set up the regional system to be a competitive system between regions rather than a collaborative system across municipal units to encourage cost-effective and efficient solid waste-resource management across the province. Specifically, the regulations:

1. Require regional plans while allowing individual municipal implementation.
2. Require Divert NS (formerly RRFB) to provide a minimum of 50 per cent of the net revenues of the provincial Resource Recovery Fund (the Fund) to municipalities or regions [s. 8(1)(a)], and an agreement between the provincial government and Divert NS further requires that Divert NS divide this funding between the regions based on their relative diversion rate.

The total value of the Fund available to regions in any given year is a fixed amount comprised of Divert NS's net revenues from operating the beverage container deposit refund program, the tire program, other profits resulting from the oversight of stewardship programs, and interest. Therefore, since the net revenues are divided amongst the seven regions based their relative diversion, the seven regions are essentially competitors seeking to achieve more of the divided profits instead of collaborators in achieving cost-effective waste-resource management.

Municipal units have the authority to plan and implement solid waste-resource management infrastructure and services in isolation or through cooperation with other municipal units. If a cooperative approach is desired, they can do so either by direct contract [s. 326(2)] or by entering into an Intermunicipal Services Agreement [s. 60] under the Municipal Government Act, 1998. However, since each municipal unit is directed by a local government that is responsible to its own taxpayers, decisions taken by municipal units on waste-resource management can be reasonably made in the local interest irrespective of the overall cost effectiveness or efficiency of Nova Scotia's waste-resource management. As a consequence, most of Nova Scotia's municipal units operate individual or sub-regional collection contracts (as opposed to regional contracts), and Nova Scotia does not have a harmonized province-wide material collection list (i.e., what goes where in the garbage, recycling, and organics streams) despite its small land area. There are some exceptions: regions 4 & 5 have regional collection contracts, and regions 4, 5 & 7 have common collection lists (Appendix 2). Regardless of these efforts, the lack of province-wide collaboration between municipal units to determine the province's overall infrastructure needs has likely led to Nova Scotia's current state: i.e., having seven approved second-generation landfills, nine material recycling facilities and 15 composting facilities servicing a total population of less than one million people at the highest gross waste management operating costs in Canada.

1.2.4 The Role of the Regional Chairs Committee & its Sub-Committees

Regional Chairs Committee

The Solid-Waste Regional Chairs Committee (the Committee) is comprised of eight elected officials, each of which acts as the Chair of their local regional planning committee or otherwise represents (in the case of Halifax) a region. The eight members to the Committee include: one representative of Regions 1 and 3 to 7, plus two representatives for Region 2 (2A and 2B). The two members for Region 2 share one vote on the Committee. The Nova Scotia Federation of Municipalities sits on the Committee in a non-voting, advisory capacity.

The Committee was established in 1998 to provide a communication channel for elected officials to discuss cross-regional matters and to communicate regional issues to the provincial bodies, including:

- Government (Nova Scotia Environment, Department of Municipal Affairs)
- The Nova Scotia Federation of Municipalities
- Divert NS

The role of the Committee is to provide an ongoing forum for the discussion of solid waste-resource management in Nova Scotia, regular opportunities to meet and exchange information from a municipal/regional perspective with each other and with key provincial stakeholders, and to enable a pathway to carry direct information back to the elected officials representing local municipal units in each Chair's region (Appendix 3). The Committee's meetings are funded by Divert NS.

Regional Coordinators Committee

The Regional Coordinators Committee was established in 1998 and is made up of 11 members including: one each for Regions 4 to 7, two for Regions 1 to 2, and three members for Region 3. There are multiple members for some regions to enable this Committee to directly engage with coordinators operating on-the-ground from all regional and sub-regional groups: i.e., the government-recognized sub-division of Region 2 (2A and 2b) and the on-the-ground (but not government-recognized) sub-divisions of Regions 1 and 3.

The Committee is a non-voting, non-decision-making entity that:

- Provides staff-level technical and administrative support to the Regional Chairs Committee
- Establishes a pathway to liaise information to the seven regional committees
- Creates a forum for sharing information between regional coordinators and key stakeholders
- Enables a forum for direct, annual negotiation of contracts between the regional coordinators and Divert NS

The Divert NS contracts and funding supports the regional coordinator's job functions and specific project work (Appendix 4).

Municipal-Provincial Solid Waste Resource Priorities Group

The Municipal-Provincial Solid Waste Resource Priorities Group (Group) is a sub-committee of the Regional Chairs Committee. The Group was formed in November 2014 after a resolution recommending its formation by the Nova Scotia Federation of Municipalities (Appendix 5).

The Group's role is to discuss the next steps for the Nova Scotia Environment's 2015 proposal to amend the Solid Waste-Resource Regulations, including implementing new stewardship programs for select materials. The Group's ultimate goal is to recommend amendments to the regulations and stewardship program initiatives for the benefit of all Nova Scotians (Appendix 6). The Group is comprised of 12 members, including those representing:

- Regional Chairs Committee (2 members)
- Regional Coordinators Committee (2 members)
- Solid Waste Managers & Directors Committee (2 members)
- Nova Scotia Environment (2 members)
- Divert NS (2 members)
- Nova Scotia Federation of Municipalities (1 member)
- Municipal Affairs (1 member).

1.2.5 The Role of Nova Scotia Federation of Municipalities

The Nova Scotia Federation of Municipalities or NFSM (formerly the Union of Nova Scotia Municipalities or UNSM), represents the provincial interests of the 50 municipal governments across Nova Scotia. Each member municipality has one equal vote in the federation.

The Federation operates under a Memorandum of Understanding with the provincial government, called a Partnership Framework, which was signed December 1, 2016 by the Federation and the Department of Municipal Affairs. The Partnership Framework establishes the government's commitment to make it a priority to consult with the Federation on potential changes to legislation and regulation. The agreement enshrines the Federation as the voice of municipalities on all provincial legislation and regulation. Each year, the Federation provides the government with its list of top priorities for consultation.

1.2.6 The Role of Divert NS

Divert NS is a non-crown, not-for-profit association enabled under the Solid Waste-Resource Regulations to:

- Operate a deposit-refund system for beverage containers
- Support municipal waste diversion programs across the province
- Develop and implement voluntary industry stewardship agreements
- Develop education and awareness programs
- Promote the development of value-added manufacturing
- Administer Nova Scotia's Resource Recovery Fund, under an agreement with the Government of Nova Scotia (Divert NS, 2018e)

The Divert NS Board is a multi-stakeholder group whose membership is defined in the *Solid Waste-Resource Regulations* as: three government-appointed members and two Board-appointed members, including one Regional Waste Coordinator and the Union of Nova Scotia Municipalities (now Nova Scotia Federation of Municipalities). The Board currently has 10 members, including one representative of the Regional Chairs Committee, one representative from the Nova Scotia Federation of Municipalities, and other members employed in the fields of private industry, academia, local government, and environmental sustainability.

Divert NS does not have direct authority over municipal decision-making on solid waste-resource management. Instead, Divert NS affects Nova' Scotia's solid waste-resource planning and waste minimization through the funding of programs, including:

- Collecting funding for and operating two product stewardship programs (beverage container and tires)
- Divvying out 50 per cent or more of their annual revenues to regions in diversion credits, which varies based on their relative diversion rates
- Offering funding contracts to regions and Regional Coordinators for the delivery of eligible services
- Providing a stipend to support meetings of the Regional Chairs and Regional Coordinators Committees
- Funding provincial education activities, including Summits
- Funding innovative research
- Other activities as directed by the provincial government

In 2017, Divert NS provided "$8.1 million in funding to Nova Scotia's 50 municipalities for diversion credits and funding for local recycling, composting, and other programs; $1.3 million (includes allocation to regions) to educate Nova Scotians and build ongoing support for environmental action; and $196 thousand approved for new research projects that support entrepreneurs and encourage innovation in waste reduction (Divert NS, 2017)".

1.3 Analysis of Nova Scotia Solid Waste-Resource Management System

1.3.1 Overview of the Decision-Making Pathway

The Nova Scotia waste-resource decision-making pathway is multi-layered with numerous actors, most of whom act in advisory roles. Information flow is generally strong between advisory groups, which meet regularly (e.g., Regional Chairs Committee and Regional Coordinators Committee meet every six weeks) but could be improved between those with decision-making authority (i.e., ability to create laws or by-laws, set budgets and invest). The only entities in Nova Scotia with the ability to make decisions that directly and tangibly affect local waste-resource management investment and outcomes include the provincial government, the 50 municipalities, and the public (Figure 8).

- The Regional Chairs Committee has no legal authority to impose decisions on municipal units.
- The regions have no legal authority to impose decisions on municipal units, but their municipal units may agree to joint terms or decision-making processes through an intermunicipal agreement (i.e., a contract). However, even when an intermunicipal agreement is in place, those agreements can be disputed and exited as per contract law (e.g., Valley -Region 5 is an example).
- The sub-regions have no legal authority to impose decisions on municipal units, but their municipal units may agree to joint terms or decision-making processes through an intermunicipal agreement (i.e., a contract). However, even when an intermunicipal agreement is in place, those contracts can be disputed and existed as per contract law and/or the terms of the agreement.
- The regional coordinators and solid waste managers are resources for their local municipalities, regional committees, and the Regional Chairs Committee. They are also communicators and educators for their local public.

Figure 8: Governance Framework of Current Nova Scotia Solid Waste Management System

The green arrow represents the decision-making hierarchy. The grey arrow represents the flow of information between NSFM and Regional Chairs Committee. The green boxes are the decision-makers on waste and recycling matters, and the grey boxes are advisory groups positioned to assist the decision-makers in making an informed decision. The regional coordinators act provincially (to inform the Regional Chairs Committee) and locally (to inform regional and local decision-making and often work directly with the public).

1.3.2 Effectiveness of Decision-Making

Almost universally, interviewees expressed great pride in the accomplishments Nova Scotia has made on waste diversion -i.e., the lowest disposal rate in Canada- and pointed to this as evidence that the system is achieving results despite not being perfect.

There was also almost universal dissatisfaction with the effectiveness of decision-making processes in Nova Scotia related to solid-waste resource management. As an example, most interviewees pointed to the fact that Nova Scotia Environment has extensively studied and consulted on proposed opportunities to update and improve Nova Scotia's waste-resource system over the past decade, but has not implemented new actions despite widespread support for the proposed changes.

Key among the frustrations is the lack of a decision on implementing 100 per cent EPR for packaging and paper products. Most interviewees expressed the belief that the 100 per cent EPR proposal had received nearly unanimous support from Nova Scotia's 50 municipalities, and that minor (but expected) lobbying from a few stakeholder groups had stalled the decision resulting in a loss of millions of dollars in new revenue to fund municipal recycling. This is supported by Kenney's estimate of the value a 100 per cent EPR-based system for packaging and paper products (PPP) would provide municipalities in Nova Scotia. In 2015, Kenney estimated a full EPR system would provide $14-$17 million per year in value (i.e., revenues and removed municipal costs) based on the value received by municipalities in other provinces with regulated EPR for PPP. This means that every year of delay on a decision to move forward on 100 per cent EPR costs Nova Scotia municipalities an estimated $14 to 17 million in lost revenue, and more in

potentially avoided costs (investments in landfills, MRFs, fleets, promotion & education for packaging). The gross annual cost of Nova Scotia's waste-resource management system in 2017 was $140.9 million; the net total cost was $102 million (McQueen, personal communication[2])

.

Interviewees identified several other areas of concern regarding the effectiveness of decision-making. The following table summarizes the key findings from the interviewees.

[2] *In 2017, approximately 15% of the reported net cost included costs were related to Halifax's front end processor/ waste stabilization facility. This facility was a Halifax community requirement to site the landfill and was subsequently recorded as part of government's approval for the landfill*

Reviewer Observation	Commentary
A. The current municipal decision-making framework is flawed because it discourages provincial planning. There is no entity responsible for provincial planning despite Nova Scotia's small geography and small population.	
1. There is a disconnect between the ultimate decision makers on local investment (i.e., municipal units -local councils and local CAOs), and those targeted by provincial consultation, communications and education on the opportunities and consequences of decisions respecting solid-waste resource management (i.e., Regional Chairs and Coordinators).	Local municipalities' councils are made up of an ever-changing group of politicians that are required to make decisions on a range of topics. They are not waste resource management experts, and are not versed in: • Nova Scotia's solid-waste resource history, targets or why those targets are important; • The differences in environmental benefit or long-term economic consequences recycling vs. forms of disposal (like energy from waste); or • The consequences of local decisions on the overall solid-waste resource management system for Nova Scotia. Most of the provincial interaction with municipalities on solid waste-resources occurs at the Regional Chairs Committee (and its sub-committees). However, only eight elected officials (eight of the 50 municipalities) sit on this committee at any given time. Information is expected to flow from the province down through the eight members of the Regional Chairs Committee to the 50 local municipalities. Interviewees reported that this works well for some communities, and yet is ineffective for others. Ultimately, consensus and recommendations formed at the Regional Chairs Committee cannot be assumed to equate to 100 per cent municipal support.

2. The current legal framework for solid waste-resources creates competition between municipalities (i.e., jobs, funding, sources of revenue) and discourages cross-border collaboration or consideration of provincial planning.	• Provincial funding for waste-resource management is provided through Divert NS to the regions, including diversion credits. While this funding model could foster cooperation regionally, it discourages other cross border collaboration to seek the most efficient options.
	  ○ Higher diversion in another region equates to less diversion credit funding locally.
	• The provincial framework enables and encourages local, place-based decision-making, which provides great autonomy and little accountability to report on the provincial effects of local decision-making. A place-based approach to solid-waste resource infrastructure planning can discourage municipalities from allowing local infrastructure to be used for the provincial good (e.g., lower costs overall).
	  ○ The Colchester landfill is not open to receive waste from outside its sub-region to protect local space for local waste, despite its high cost of operations.
	  ○ The nine municipalities with MRFs generate revenues and jobs not available to other municipalities, as they can charge tipping fees on recyclables sent for processing. Under good market conditions, communities with revenue-generating MRFs may have incentive to discourage a provincial EPR solution for PPP if the revenue from the MRF can be used to cross-subsidize other municipal costs (e.g., organics processing).

Reviewer Observation	Commentary

3. Provincial decision-making seems inconsistent with provincial solid waste-resource goals. There currently isn't a body responsible for assessing the benefits, costs, and other consequences of local infrastructure investment decisions on the province as a whole.	Ultimately, the province has the authority to approve waste-resource infrastructure. Yet, that approval process does not seem to take into account government's concerns over cost effectiveness of the solid waste-resource system, the lack of municipal collaboration, or the need to achieve its 300 kg / capita diversion target.
	• Government has stated a concern that Nova Scotia's costs are higher than the rest of Canada, yet it does not require local municipalities or private companies to account for provincial costs or capacity in local infrastructure investment decisions, nor report the consequences of those decisions publicly.
	• For example, the government has suggested there is a local overabundance of landfill disposal capacity, yet it approved:
	  ○ Each of the existing seven second generation landfills;
	  ○ Has recently approved an expansion of the Cumberland landfill;
	  ○ Has recently approved the energy from waste (EfW) pilot in Chester, i.e., Sustane Technologies. Sustane Technologies will process municipal solid waste into refuse derived fuel pellets, which will ultimately provide fuel for combustion.
	• Each of these decisions created new disposal capacity in a province that is already over-capacity. Further diversion efforts to reach 300 kg / capita will be at the expense of tipping fee profits needed to operate disposal sites cost effectively.

4. From a municipal-political perspective, there is no apparent benefit or requirement to municipal collaboration on waste-resource decision-making. As a result, decisions are made based on local benefits, instead of longer term or provincial consequences.	There is no legal requirement for municipalities to assess the consequences of their local decisions on the greater Nova Scotia, nor is there any requirement to implement regional plans or share costs. Each municipal unit in Nova Scotia is empowered to develop and implement its own plans and budgets, irrespective of other communities in its region or across the province. • As a result, local councils are predictably and logically making waste-resource decisions considering their local triple bottom line effects (budget, local jobs, ability to effectively manage the material, local satisfaction with service) instead of how their local decisions affect Nova Scotia as a whole. • There is no guidebook to outline the range of information local municipalities should consider as a best practice to enable informed decision-making on local solid waste-resource services and infrastructure. • There is no public pressure to consider the effects of the decisions on the greater Nova Scotia -i.e., Nova Scotia's public and businesses are generally unaware that the province's waste-resource management costs are the highest in Canada and equally unaware of the root cause of those costs. • Local municipalities' first priority is to meet local citizen's expectations, which can be counterproductive to achieving the benefits of cross-border collaboration. For example, one municipality might choose to expand their collection lists instead of harmonizing collection with nearby municipalities.

Reviewer Observation	Commentary
	• There is no requirement for municipalities to cooperate on issues such as harmonizing collection lists, co-tendering collection, or implementing harmonized by-laws.

5. The diversion credit system seems intended to encourage regional collaboration, but the amount provided is an insignificant amount compared to overall costs, and therefore is insufficient to achieve that purpose. Additionally, the calculation of diversion rate seems unfair and arbitrary and is therefore ineffective for this task.	The diversion credits are calculated on a base data year of 1989. The data from this base year was largely estimated because weigh scales were not used at the time, and as a result the data was based on all the waste streams disposed in a region. Some regions believe this is unfair or counter-productive because:
	• They believe their estimated 1989 estimate is incorrect.
	• They believe that the 1989 estimate is irrelevant given the goal it relates to was achieved by 2000.
	• They believe that calculation of reduced disposal to 300 / kg / capita on 1989 values is unfair as:
	  ○ It creates an unlevel competitive playing field (i.e., between those municipal units that invested early vs later), and
	  ○ It creates a performance gap that is insurmountable; and
	  ○ A new base year was not established when the province adopted a new target.
	• They believe regions are punished if their municipalities are investing in revitalization. Growth and renewal is a public good. However, in a province as old as Nova Scotia, this often requires tearing down old or delict buildings. Demolition waste is generally not recyclable given current technologies. As a result, regions end up "being punished" with lower diversion credits if they are going through a period of renewal and growth.

B. There is an overall lack of clarity on the roles and responsibilities in the decision-making process.	
6. Government decision-making processes for making changes to the legal framework are unclear, seem to vary, and that variation is causing uncertainty and frustration.	Nova Scotia's government has a history of implementing decisions without fully consulting on some topics and over-consulting on others. There is no clear pathway (information gathering, consultation or clarity in the support needed to encourage decisions). For example: • There was little consultation by NSE before the government set the 300 kg/capita target in 2006. • At the time of these interviews, there was wide-spread, but unconfirmed, reports that NSE was actively drafting changes to the regulations regarding used oil materials and construction and demolition (C&D) waste. Yet at the time of these interviews, municipalities had not been consulted on a proposal. In comparison, there has been extensive consultation on changes to update Nova Scotia's waste strategy, and extensive and widespread support for EPR for PPP, yet the province remains uncommitted to enact change.

Reviewer Observation	Commentary
	There is general agreement among the interviewees that it is unreasonable for the NSE to expect unanimous municipal support on any issue because the decisions will inevitably create winners and losers. The province should make decisions based on the best interest of the majority and mitigate the effects on the minority. There is also general agreement among the interviewees that the province should be clear and define the threshold of municipal support to make a decision. This could be based on the number of municipalities out of 50 or based on population.

7. There is confusion over the difference in the roles of the Regional Chairs and the Nova Scotia Federation of Municipalities	The Regional Chairs Committee (which receives funding from the province) and the Nova Scotia Federation of Municipalities seem to have overlapping roles, or at least a lack of clarity on the difference between their roles.
	• Regional Chairs Committee was created in 1998 and has led solid-waste resource advocacy on behalf on the municipalities with the province since that time.
	  ○ The Committee's role has been politically oriented over the last 20 years and has acted as the conduit between municipalities and the province on municipal solid waste-resource issues.
	  ○ This is a logical role for a Committee made up of elected officials, as opposed to operational staff / CAOs (which would be more focused on advocating for best practices and collaboration across municipalities, harmonization, and operational issues).
	• The Nova Scotia Federation of Municipalities has a mandate through a signed agreement with the Department of Municipal Affairs (Partnership Framework) to be the voice of municipalities on issues with the province. Its membership includes all 50 municipalities.
	  ○ Annually, the Federation creates a top five priority list of municipal issues, which is endorsed by its members, to present to the province. Issues range from removing property tax caps, to internet access, to physician recruitment, to roads, to municipal finances. The goal is to focus the province's attention on the most urgent municipal priorities.

8. There is confusion about the role of Divert NS as it relates to municipal decision-making on solid-waste resource infrastructure.	Divert NS's role is clearly defined in regulation and through an MOU with the province. Its mandate extends far beyond encouraging local municipal diversion. • They are the operator of the beverage container and tire recycling programs; • They administrate the provincial Fund; • They are obligated to spend at least 50 per cent of the Fund on municipal diversion credits; • They are responsible for fostering education on diversion opportunities; and • They are responsible encouraging innovation and new stewardship programs.

Reviewer Observation	Commentary
	What is unclear is their mandate to determine the promotion and education needs of local regions on specific topics. • Divert NS requires that municipalities sign contracts that are fee for service agreements on topics such as local education and promotion. While the contracts are signed with the regions /Regional Coordinators, the outcomes and activities required by Divert NS might not line up with regional/local needs towards encouraging better diversion overall. There is also curiosity about the apparent duplication of service between the local municipal curbside programs and the Divert NS beverage container return program. Local knowledge about the benefit a deposit refund program provides compared to curbside collection seems to be lacking. For example, there seems to be a lack of understanding regarding: • The comparative value of the resources managed curbside vs through a source separated recycling program like deposit refund program, especially for glass, PET, HPDE and aluminum. For example, materials from deposit refund programs are still being marketed at a significant value, where as the same materials collected via curbside have been more difficult to market, if a market can be found at all. • Divert NS efforts to co-market materials with Canada's other deposit refund programs to ensure Nova Scotia gains the economies of scale and a price advantage for the materials collected and marketed. • The comparatively high collection rates for beverage containers in deposit refund programs across Canada vs lower rates in curbside programs.
C. Other Issues	
9. A lack of understanding of the potential value for shared planning and implementation of waste-resource management, is impeding informed decision-making.	The Valley has long been held as the model for an effective regional plan implementation. This region is supported by an Intermunicipal Agreement that has been working effectively and providing common service across the region for more than 19 years. Recently, disputes have arisen that threaten the future of the intermunicipal agreement, and the benefit of shared planning for the public and taxpayers in that region.
10. Regions and often sub-regions (2A and 2B) see themselves as cultural and/or geographically unique.	There seems to be a general belief held by most regions that their local conditions are so inherently unique that it would make regional or provincial planning inherently difficult. Key factors mentioned include cultural preferences, norms, distance, geography, and local infrastructure.

1.3.3 Decision-Making in Other Jurisdictions

By and large, the decision-making process for solid waste-resource planning and implementation in Nova Scotia is reasonably similar to other Canadian provinces. Local municipal governments retain the right to make decisions on solid-waste resource planning and implementation, including infrastructure investment, subject to provincial approvals. The provincial governments set the legal framework for provincial diversion programs. None of the provinces have a published a step-by-step decision-making guide to implementing new regulations, and in each province the respective municipal associations (like the Nova Scotia Federation of Municipalities) are strong advocates for the municipal voice in advocating for or against new legislation or regulation. The one key difference is that Nova Scotia seems to be the only province with a government-supported 'advisory layer' -i.e., Regional Chairs Committee (and its sub-committees), which are subsidized through the government Fund (administered by Divert NS).

- In BC, like Nova Scotia, the regions are required to develop solid waste management plans, however unlike Nova Scotia, each plan must be approved by the Minister, reviewed every five years, and updated every 10 years (Ministry of Environment, British Columbia, 2016). Regions are enabled to make by-laws to implement the plans, however, municipal governments retain decision-making authority within their jurisdictions. There is no regulated consequence for failing to implement the plans, except the potential for the province to deny the approval of new proposed disposal infrastructure until the plan is implemented (Conner, personal communication). In addition to solid waste management planning, BC has regulated extended producer responsibility (EPR) programs for a range of materials to encourage their collection and diversion, including a 100 per cent EPR program for residential packaging and paper.
- Alberta, Saskatchewan, and Manitoba provide municipalities with the right to make local decisions on waste planning and do not have regulations requiring regional plans. Though, Saskatchewan encourages regional systems and regional plans. In each province, the governments set the overarching regulated framework for solid waste-resource management in each of these provinces (Giroux Environmental Consulting, 2014). Saskatchewan and Manitoba committed to implementing EPR for a range of materials and have implemented shared responsibility for curbside recycling programs -i.e., shared responsibility programs are municipally-operated packaging and printed paper recycling programs that are partially producer funded. Alberta does not have any regulated EPR programs operating and does not have a provincial packaging program in place.
- In Quebec, regional municipalities must develop regional solid waste management plans for residential and IC&I waste in their communities and have their plans approved by the Minister. The Minister may refuse a plan if the performance measures, activities and targets are not sufficient. Municipalities that do not have an approved plan, or do not report as required on implementation, are not eligible to receive funds from a Quebec program that redistributes ~$70 million in funds collected from the province's disposal levy to municipalities (Ministère du Développement durable, de l'Environnement et des Parcs, no date; Dussault, personal communication). This program redistributes funds collected based municipalities waste diversion performance.
- In Ontario, municipalities may implement a regional solid waste management plan (as an upper tier municipality) and/or a local plan (as a lower tier municipality). Communities are encouraged to implement a recycling plan or strategy as one step towards maximizing the funding they are eligible to receive through the provincially regulated Blue Box Program. Failure to have a recycling plan or strategy decreases the funding they are eligible to receive (CIF, 2018).
- In PEI, where the system is managed province-wide, decision-making is streamlined through direct communication between the province and its crown corporation the Island Waste Management Corporation (IWMC). The province sets the legal framework, and the Corporation operates the PEI's integrated solid waste management system, called the Waste Watch Program, including its landfills, its MRF, compost facility, energy recovery facility, and its curbside/depot collection program (Island Waste Management Corporation, 2018). The system is supported by disposal bans on designated materials, and mandatory sorting requirements for packing and paper recyclables, organics, and waste that apply to both the residential and commercial sector. The Corporation sets a common list of packaging and paper materials collected in its residential curbside stream and at depots and rejects contaminated streams at

curb (Island Waste Management Corporation, 2016). Commercial entitles are required to hire their own waste haulers. The collection of packaging and printed paper is not supported by producer responsibility funding.

- In New Brunswick, municipalities are responsible for waste collection within their boundaries. Regional Solid Waste Commissions are responsible for managing unincorporated community collection and waste disposal. In total, 13 regional waste commissions exist, covering the province. Each commission develops and implements its regional plans for solid waste-resource management (Environment and Local Government, New Brunswick, 2001). The collection and recycling of packaging and printed paper is not supported by producer responsibility funding.

1.4 Analysis of Municipal Role in Waste Management with Implementation of Extended Producer Responsibility Programs

1.4.1 Objective

The objectives of this task are to analyze how the municipal role in waste management could be affected by the increasing trend for industry to run their own waste management programs for their end-of-life products. How would the regional/municipal role change to accommodate this? What steps should the regions and municipalities take to play an optimal role?

The key questions include:

- How could municipalities' current roles and responsibilities (and the costs associated with those roles and responsibilities) change with the trend towards industry-operated recycling programs?
- How could municipalities best position themselves to play an optimal role in this future system?

This section of the project was completed February to August 2018. Information and research may not be current at the time of publishing.

1.4.2 Background

Industry-operated recycling programs, called Extended Producer Responsibility (EPR) programs, are being implemented in Canada. The uptake in EPR programs stems from the Canadian Council of Ministers of the Environment (CCME) 2009 Canada-wide Action Plan on Extended Producer Responsibility (CAP-EPR), in which all of Canada's provinces and territories committed to work towards implementing EPR programs for a range of materials. All provinces, except Alberta, have implemented several EPR programs since that time.

1.4.2.1 Definitions

Product Stewardship

From a waste-resource management perspective, product stewardship can be defined as the stewarding of a material at-end-life to final disposition (recycling facility, composter, landfill, etc.). For product stewardship, the entity undertaking the act of stewarding can be any entity or combination of entities (e.g., government, retailer, municipality, producer, or consumer) (Product Stewardship Institute, 2016). The product stewardship spectrum includes: consumer stewardship, government stewardship, retail stewardship, shared responsibility, extended producer responsibility, etc. For example, a municipality is acting as a government steward when it accepts financial and/or physical responsibility for the management of end-of-life materials, such as when it funds and operates a municipal curbside recycling program (EPR Canada, 2017).

Shared responsibility

Shared responsibility is a type of product stewardship where more than one entity (e.g., a municipality and a producer) share the costs and / or operational responsibility for managing a material at end-of-life, and also share the liabilities and risks of funding and operating a program (Valiante, 2015).

Extended Producer Responsibility (EPR)

Full Extended Producer Responsibility (EPR) is a distinct form of product stewardship that shifts all financial and operational responsibility of recycling programs from municipalities and taxpayers to producers and consumers (Product Stewardship Institute, 2016). Under full EPR, producers have full self-determinacy and accept all the costs, risks, and liabilities of managing a material at end-of-life (Valiante, 2015).

EPR is consistent with the polluter pays principle, which assigns the costs of managing an environmental effect to the entity causing the effect (the polluter), instead of to a secondary entity responsible for cleaning up the effect (the receiver) (OECD, 2001). The polluter pays principle provides the entity with the greatest ability to prevent the pollution (the polluter) with a legal, financial and / or business incentive to make a different choice to prevent the pollution or reduce the costs of managing the pollution. For EPR, this means the producer (who designs and markets the product) and the consumer (who makes the choice to buy the product) pay for the cost of managing that product when it reaches end of life, instead of the municipality and taxpayer who have little ability to make choices that would prevent the product's impacts at the source (e.g., product redesign, product avoidance). It's important to note that while all consumers are taxpayers, all taxpayers are not consumers of all products.

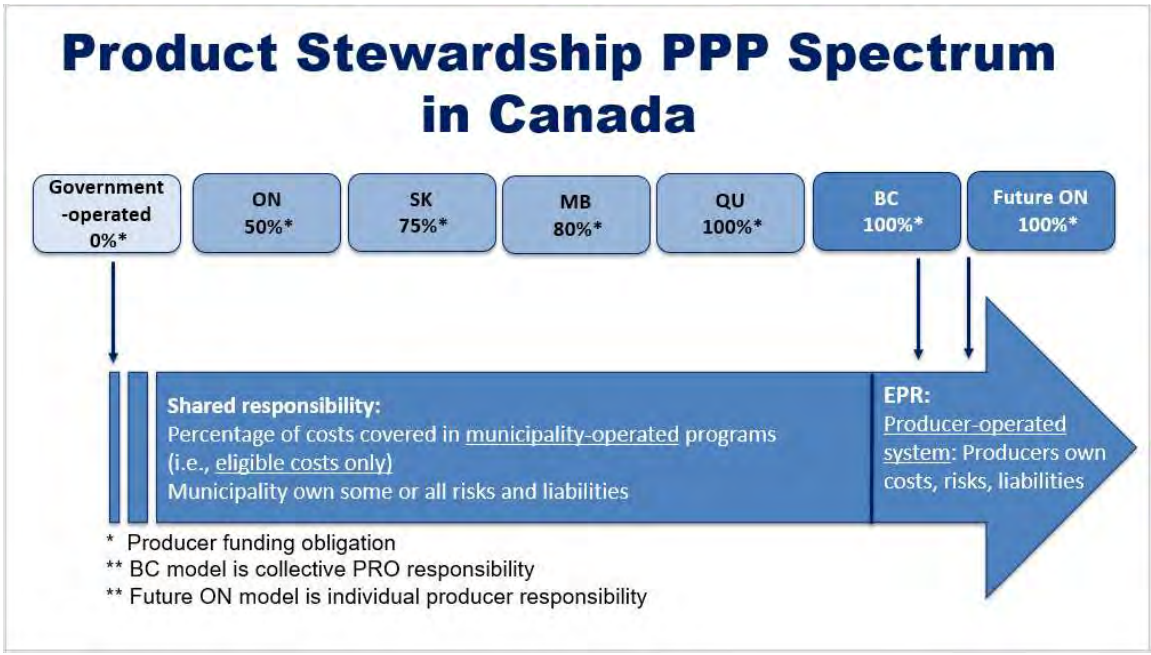


Figure 9: Canada's Product Stewardship Spectrum for the Management of Packaging and Paper (Source: Tomchyshyn London, 2017).

1.4.2.2 Implementation of EPR in Canada

EPR and shared responsibility programs have been implemented across Canada for a range of materials in every province except Alberta, including programs for tires, electronic waste, paint and paint containers, household hazardous waste, pharmaceuticals and sharps, beverage containers, used oil and antifreeze materials, batteries, and packaging and printed paper (PPP) / packaging and paper product (PPP).

Shared responsibility PPP programs exist in Saskatchewan, Manitoba, Ontario, and Quebec where municipalities operate the programs and accept the risks and liabilities of marketing the materials they generate, and producers provide varying degrees of funding – i.e., a percentage of municipal costs that are discounted by an efficiency factor (Table 1). The risk and liabilities that accompany program operations should not be underestimated. Programs in Quebec receive 100 per cent producer funding of efficient municipal costs, and yet many of the municipally-operated MRFs are facing significant financial difficulty due to China's National Sword policy and an inability to market their material (Dussault, personal communication, 2018)[3].

British Columbia is the first, and to date only, province in Canada to implement a full EPR program for residential PP. In BC, producers are responsible for 100 per cent of the costs, risks and liabilities associated with collecting and recycling residential and streetscape packaging and paper to meet regulated outcomes. The risks and liabilities include those associated with the marketing of recyclables.

However, it should be noted that while the regulation in BC has assigned full EPR responsibility in principle, municipalities in BC are noting on-the-ground exceptions to full responsibility in-practice (Recycle BC, 2018b). Briefly, these include:

- Producers are not required to provide universal access to all BC communities regardless of size. Specifically, Section 5(1)(c) of the Recycling Regulation requires producers to provide "reasonable and free access to collection facilities", but it does not define "reasonable". Producers have been able to meet their targets without servicing some small and rural communities (Recycle BC, 2018b). As a result, a small number of communities in BC remain without local EPR service, including those that have been:
    - Waitlisted for EPR service (Recycle BC has agreed to onboard services as finances allow).
    - Deemed too small to receive service.
    - Deemed to receive service if they are within a 45-minute drive of a drop-off depot (which some communities have identified as unfair and unreasonable).
- Municipalities have the option of 'first right of refusal' to operate as the local collection agent in a fee-for-service arrangement with the EPR program operator. Local conditions play a role in the value of the fee-for-service relationship. In some cases, the fee provided exceeds the municipality's costs (and provides a source of revenue), and in others it does not cover the municipality's costs. In cases where the fee does not cover all costs, the program continues to be subsidized by the local municipality (Macdonald, personal communication).

3 For an overview China's National Sword and its effect on Canada's recyclers see Recycling Council of Ontario's Special Webinar: China's Environmental Measures Affecting Trade in Waste, Scrap, and Recycled Materials. Environment and Climate Change Canada and Global Affairs Canada provided overviews of the legal consequences to Canadian recyclers. Retrieved from: https://rco.on.ca/Our-Work/chinas-environmental-measures-affecting-trade-in-waste-scrap-and-recycled-materials/. Accessed: October 5, 2018.

Table 2: Range of Municipal-Producer PPP Funding Arrangements in Canada

Province	Muni Role (Material Management)	Producer Obligation (% of eligible costs)
BC	Municipality choice: 1) Opt out –no Recycle BC service 2) Opt in – collect at offered $ rate 3) Opt in – no role (i.e.., Recycle BC collects, processes and markets)	Up to 100% (All costs, risks, and liabilities)
SK	Collect, process, and market (Some cost, all risks, liabilities)	Up to 75% (Eligible costs)
MB	Collect, process, and market (Some cost, all risks, liabilities)	Up to 80% (Eligible costs)
ON current	Collect, process, and market (Some cost, all risks, liabilities)	Up to 50% (Eligible costs)
QU	Collect, process, and market (Some cost, all risks, liabilities)	Up to 100% (Eligible costs)

1.4.3 How Could Nova Scotia's Municipalities' Role Change under EPR?

1.4.3.1 Current Role -Municipally-Operated Systems

Nova Scotia's 50 municipalities have more than 20 years' experience implementing local packaging and printed paper recycling programs.

Nova Scotia's municipalities' current role is one of complete autonomy: i.e., they design, plan, implement, educate, communicate, assess performance, purchase services, market materials, and are the ultimate funder of their programs. Municipalities are also the first point of contact for their public.

Some municipalities, such as those in Region 5: The Valley, have chosen to implement a jointly operated, harmonized program across their region, enabling a regional operator to provide these functions for all communities in the region. This has enabled the benefit of consistent communication to all Valley residents about what is and what is not recyclable, and what should be separated into the recycling, composting, and garbage streams.

Outside the Valley, there is little wide-spread harmonization of programs between municipalities across Nova Scotia. Residents moving from one community to another, as they move between work and play, must be educated on multiple programs to participate effectively. Almost all communities in Nova Scotia operate curbside collection programs, and all programs are funded by the municipal taxpayer.

In the absence of regulation that requires otherwise, Nova Scotia's municipalities have 100 per cent autonomy to make waste-resource management decisions, and local interests have tended to prevail in designing local programs. Municipalities in Nova Scotia have almost 150 years' experience in waste management, 20 years in recycling program management, and excel at providing the level of high-quality service their public expects. See Section 1 for an overview on the current state of waste-resource management and decision making in Nova Scotia.

1.4.3.2 Potential Future Role -If Shared Responsibility

Shared responsibility PPP programs have been implemented in Saskatchewan, Manitoba, Ontario, and Quebec.

In shared responsibility systems, the municipal role remains one of complete autonomy: i.e., they design, plan, implement, educate, communicate, assess performance, purchase services, market materials, and are the ultimate funder of their programs. Municipalities are also the first point of contact for their public.

Little would change for Nova Scotia municipalities operationally, or in terms of risks and liabilities. Municipalities would continue to have complete autonomy over the on-the-ground operations of their programs and would continue to face the risks and liabilities of program operation. Producers would be "no more than ratepayers", having little incentive to consider product and packaging design efficiencies (Valiante & Gies, 2015). Under a shared responsibility system, the only tangible differences would be:

1. Producers would be required by law to subsidize the cost of local municipally-operated PPP programs by paying a percentage of municipal costs.
2. Municipalities would be required to report on performance and costs to receive funding.

Historically, the value of the municipal subsidy assigned in regulation (i.e., 50, 75, 80, 100 per cent of actual municipal costs) has been reduced by an assessment of whether costs are "reasonable" and "eligible", and results in subtracting costs related to:

- The inefficiency of having multiple municipal systems, which duplicates services and functions across municipalities, compared to a seamless jurisdiction-wide system -i.e., reduced economies of scale;
- The cost of processing any non-program materials -i.e., waste or other contamination, non-target recyclable products, excluded packaging -e.g., newspapers; non-printed paper; packaging-like products (such as tin pie plates sold as a product); and
- The cost of processing any additional non-program materials the municipality may intentionally collect in its mixed recyclables streams -e.g., textiles (Quebec Regulation respecting compensation for municipal services provided to recover and reclaim residual materials; Armstrong, 2014; Valiante, 2015).

There could be significant debate and even dispute on the verification of whether municipally reported costs are accurate, eligible, and reasonable. Municipalities generally believe all or most of their reported costs should be eligible for producer funding, whereas producers argue those costs are inflated due to inefficiency or inaccurate reporting. As Valiante (2014) noted, in shared responsibility systems conflict arises on the determination of producer obligated funding because: "*Municipalities can't anticipate and plan for the myriad, lightweight, complex packages that enter blue boxes. In turn, producers have no say on how the province-wide consolidation, processing and marketing of PPP could be improved to minimize costs and improve market revenue for the materials collected".* As a result, in shared responsibility PPP systems, the adjusted eligible municipal costs (of which producers pay a share equal to 50, 75, 80 or 100 per cent) are often far less that the municipal reported costs is.

1.4.3.3 Potential Future Role -If EPR

As discussed above, under an EPR system producers accept the full costs, risks, liabilities, and opportunities of implementing a program for designated materials. Government may designate EPR for some or all of a material stream: e.g., for packaging and paper products category across all sectors or just for residentially generated paper and packaging products.

Producers may meet their legal obligations collectively through a Producer Responsibility Organization (PRO) or individually, unless otherwise restricted by law. Producers must meet targets and performance requirements set out in regulation, such as accessibility, collection service, proof of recycling, recycling rates, recovery rates, reporting, and any other criteria that might be regulated -e.g., adherence to a 3Rs hierarchy, requirements for third party audits. The decision on which criteria to regulate is important for governments to carefully consider because those are the only outcomes governments may legally hold producers accountable to. Aside from meeting regulated outcomes, producers have complete autonomy to design an efficient and effective system. For example, if accessibility in rural areas is a desired outcome, then it may be prudent to regulate a rural accessibility requirement; otherwise producers may choose to meet their targets without providing rural accessibility.

Because producers can plan a provincial or even cross-provincial system, and not just a municipal system, they will be able to capitalize on efficiencies that municipalities cannot, including economies of scale, strategic investment in high-efficiency MRFs, and large-scale system design. In planning a system for Nova Scotia, producers may also consider pre-planning for an Atlantic Canada, cross-provincial system to capitalize on future, greater economies of scale. If this is the case, then it might be prudent for Nova Scotia to be an early EPR system adopter to ensure it has the ability to provide early and ongoing influence on system design and the greater potential for local investment.

Producers excel at the business of selling their commodities for the highest value and providing services for the least cost. In an EPR system, producers' primary goal is meeting regulated targets with the least cost, risk, and liability. They aim to retain the highest value for the collected resources (future commodities) to maximize commodity profits, reduce overall system costs, and obtain better access to markets. As a result, in transitioning from a municipality-operated program to an EPR system, producers may change local service options for residents to ensure the commodities can be collected and processed in a manner that retains their highest value.

For example, it's widely known that broken glass from glass packaging contaminates other materials when co-collected with those other materials, and this reduces the market opportunities for the comingled material. To retain the highest value for the glass and for the other materials, experts agree that glass should be collected separately to avoid cross contamination. It's also widely accepted that keeping paper separate from container packaging best protects the value of paper. Upon planning an EPR program, producers will consider lessons learned in other jurisdictions, and will be able to apply improvements to their new programs.

In transitioning from a municipally-operated system to an EPR system, municipalities are absolved of the risks and liabilities of managed the designated material unless they choose otherwise. Producers manage all collection, processing, and marketing of materials, and accept all the costs and consequences of their management.

Given how EPR for PPP has been implemented/proposed in BC/Ontario, upon transitioning Nova Scotia's municipalities can expect to be offered three options to receive service from the new system:

1. To halt management of the local recycling program and turn all program operations over to producers at producers' cost, risk, and liability.
2. To accept 'first right of refusal' if they wish to retain their position as the local collection agent and point-of-first-contact for their residents. With this option, municipalities are offered a fee-for-service rate to perform specific deliverables (collection, service frequency, contamination rates, etc.). The rate offered may not cover all the municipalities' costs, risks, or liabilities (Recycle BC, 2018b).
3. To opt out of the program altogether if they wish to retain complete control of their local municipal recycling program, and retain all the costs, risks and liabilities that choice entails.

Under Option 1, the role of municipalities is one of being a client. Their role will be to assess service resulting from the EPR program (e.g., through waste stream audits, public complaints) and communicate their review to the regulator to inform updated regulations.

Under Option 2, the role of municipalities is one of being a service provider. Their role shifts to one of providing service to meet the producer's required deliverables.

Under Option 3, municipalities retain their traditional role, continue to pay 100 per cent of program operating costs, and face all program liabilities and risks.

It will be important for municipalities to consider the implications if Nova Scotia were to designate only packaging and paper products (PPP) in the residential sector for EPR, as is currently the practice in other provinces. Nova Scotia municipalities that currently offer recycling services to their IC&I sector may need to consider whether they will be able to continue to provide these services (if the new infrastructure is owned and operated by PROs) or whether they will require their IC&I clients to seek privately contracted services. If Nova Scotia designates all PPP (regardless of sector) for EPR, then this issue is moot. Nova Scotia may wish to consider designating all PPP for EPR and phasing in implementation beginning with the residential sector. This would make it clear that any PRO decisions on establishing infrastructure and capacity should consider the eventual collection and recycling of IC&I PPP volumes.

1.4.4 Municipal Planning for a Transition to EPR for PPP

The transition from the status quo (i.e., municipally-operated programs) to an EPR system is one that requires careful planning, both for producers and for municipalities. Municipalities can glean lessons on what municipal planning should entail from how EPR has been implemented in Canada to date. Specifically,

- British Columbia transitioned from a traditional, municipally-operated system to EPR in 2014. Their transition took three years from the point of first regulation.
- Ontario is currently planning a transition from a 50 per cent shared responsibility system to EPR and is expected to take seven or more years to complete from the point of first regulation.

Since these are the only two provinces in Canada that have taken the steps to implement a full EPR approach (as opposed to a shared responsibility approach), they are most illustrative of what Nova Scotia could expect if it transitioned its PPP management from municipalities to EPR. The BC and Ontario systems are explained in further detail below. The transition plans for these two provinces look very different.

1.4.4.1 British Columbia's Transition to EPR

In British Columbia, at the time of transition, there were virtually no municipally-owned MRFs. The province had consulted on an EPR framework directly with producers and stakeholders for several years prior to passing a regulation for PPP in 2011, and the regulation's effective date was an additional three years later in 2014. This provided municipalities with a lengthy opportunity to consider the possibility of EPR in making capital investment decisions (Conner, personal communication; Government of British Columbia, 2018).

The regulation required producers to submit a stewardship plan and have it approved by government by 2012, and then implement the plan by 2014 (Multi-Material BC, 2012; Recycling Regulation: BC Reg 449/2004). The plan had to explain how producers would achieve regulated outcomes, including achieving 75 per cent diversion and providing province-wide coverage. Producers submitted their first plan November 19, 2012, an updated version on February 25, 2013, and a final version on April 8, 2013. In 2017, BC amended the definition of paper in its regulation to remove the word 'printed' from 'packaging and printed paper' to ensure the all types of residentially generated paper are an obligated material (Recycling Regulation: BC Reg 449/2004).

This is a key distinction between BC's and Ontario's legal frameworks. BC's system requires producers to submit a stewardship plan to government for approval (including updated plans every five years), and the BC government has the authority to withhold approval of the plan if it does not meet its requirements. Ontario's system does not require stewardship plans to be prepared or to be reviewed and approved by government.

To date, BC has only approved a single Producer Responsibility Organization (PRO), called Recycle BC, to implement a province-wide, comprehensive PPP system on behalf of producers despite two submissions being received. The department argued that approving additional stewardship plans could have unintended consequences including making stewardship agencies less viable and reducing recovery rates (Auditor General of British Columbia, 2016). The consequence of this has been controversial:

- The approval of a single PRO has enabled a harmonized provincial system to exist, which has provided the benefits of a single point of contact for the public; municipalities, and government; system wide planning and implementation; and economies of scale for large investments needed for high-efficiency processing.
- It has prevented producers seeking the services of a competing PRO, which might provide better service to producers and encourage greater innovation.

According to Valiante et al (2017), this single approved-PRO model is a form of monopoly that unduly restricts market competition, and he states, "competition between competing PROs should be enabled" (Valiante, Geis & Busuttil, 2017). BC's Auditor General has identified this as an issue that needs to be resolved (Auditor General of British Columbia, 2016).

BC's program operates using market-based incentives and competitive tendering practices. Recycle BC provides a financial incentive to local governments, First Nations, and private collectors to deliver recycling collection services and education under contract. Recycle BC also procures post-collection management of PPP through a competitive process for material transfer, sorting and processing.

Recycle BC offered to maintain curbside collection of recycling in those communities whose local governments provided residential curbside recycling or garbage collection as of November 2012 (Recycle BC, 2018a). Recycle BC was required to ensure province-wide coverage (though not universal service to every community), and service for multi-family units (five units or more), and streetscapes.

1.4.4.2 Municipalities' role in BC's system

Recycle BC submitted its plan for government approval November 2012 and its final plan in April 2013. Upon roll out of the program, municipalities were given the choice to:

1. Turn local program implementation over to the Recycle BC. Curbside service would be continued where it existed on November 2012. If this option was chosen, Recycle BC could contract with private service providers directly.
2. Accept a contract with Recycle BC at a "market-clearing" rate to continue to act as the local collection agent and provide local promotion and education. If this option was chosen, a municipality would agree to sign a Master Services Agreement and a Statement of Work and deliver services as contracted including meeting a contamination rate.
3. Decline inclusion in the program -i.e., opt out and continue the status quo.

   Recycle BC released their Master Services Agreements and Statements of Work for collection services in June 2013 (enabling municipalities to accept Option 2); municipalities were required to respond to the offer by September 16, 2013.

Upon the program's roll out deadline, most municipalities opted to become a collection service provider to MMBC (Option 2); several declined service (Option 3); and a small number chose to turn all program operations over to MMBC (Option 1). Four years later, as of June 2018, a handful of communities have opted for Option 1 (Macdonald, personal communication); most notably the City of Vancouver, which transitioned from Option 2 to Option 1 in 2016 (City of Vancouver, 2018)[4].

Some municipal concerns about Recycle BC's existing system include (Multi-Material BC, 2016a; Recycle BC, 2018a; Recycle BC, 2018b):

- The period between municipalities receiving the Master Services Agreement and Statements of Work did not provide municipalities with the time needed to fully consider the implications of the options. The agreements were delivered in June and a response was required by mid-September. Some communities did not have Council meetings over this time period.
- Communities that declined inclusion in the program (Option 3) upon program launch, and later wanted to opt into either Options 1 or 2 were placed on a waitlist (many for several years).
- The fee-for-service market rate offered does not cover the full cost of some municipalities' operations despite municipalities' best efforts.
- Unstaffed depots are not eligible for funding.
- Municipalities are unable to meet the contamination rates, especially at depots.
- Many rural and unincorporated areas of the province remain un-serviced.
- Driving distance to a depot is too long for rural areas - i.e., Recycle BC measures that 98 per cent of the population has access to service either via curbside or depot, but measures access to depot as a 30-minute drive in an urban area versus a 45-minute drive in a rural area.
- The program does not allow a community to collect and drop material off at a depot on behalf of their residents, even when driving distance is 45 minutes or greater.
- The fee-for-service rates are not indexed annually to the Consumer Price Index.
- Municipalities, not producers, are responsible for any costs above the incentive rates offered by producers -e.g., costs, risks, and liability of operating and marketing materials from unmanned depots.
- The regulated diversion target is for 75 per cent diversion of the aggregate amount of PPP marketed, and not 75 per cent of each grade of packaging, which allows categories of packaging to remain unmanaged by the program and disposed of at municipalities expense.

Recycle BC is currently consulting on their updated five-year stewardship plan. They have proposed several changes, including (Recycle BC, 2018a; Recycle BC, 2018b; Recycle BC 2018c):

- Maintaining eligibility for those local governments that had curbside collection programs in place as of May 2014 to join the Recycle BC program as contracted collectors or as fully serviced municipalities by Recycle BC (Option 2 and Option 1 above), if specific criteria are met.
    - For example; if a municipality had chosen to opt out of the program in 2014 (Option 3 above), they are eligible to opt into Option 2 (municipality operates program as a collection service provider) and may be eligible to opt into Option 1 (Recycle BC fully operated system) if specific criteria are met.
- Adding a requirement that a transition from Options 2&3 to Option 1 is only available to those curbside programs that collected a minimum capture rate of 90 kilograms per curbside household in the previous calendar year;

[4] *For more information on the rationale for the decision for the City of Vancouver to enable Recycle BC to assume full responsibility for the City's recycling program, see 1) the report and presentation to Standing Committee on City Finance and Services, dated November 17, 2015, available at: https://council.vancouver.ca/20151117/documents/cfsc4.pdf, and 2) a presentation to the Committee dated November 17, 2015, available at: https://council.vancouver.ca/20151117/documents/cfsc4presentation.pdf. Accessed: October 5, 2018.*

- Adding a requirement that new curbside collection programs would only be added for communities with 5000 residents or more. Communities under 5000 residents would be ineligible for new curbside service. Depot service would be provided.
- Adding an 18-month notification period for a community that wants to transition from Option 2 (municipality operates program as a collection service agent) to Option 1 (Recycle BC operates program).
- Adding a requirement that transition from Option 2 to Option 1 would only be considered if the transition date falls on or after the original termination date of the applicable local government's curbside collection agreement.
- Increasing their target general recovery rate from 75 per cent to 78 per cent by 2022.
- Adding material-specific targets for plastics, metal, glass, and paper.
- Broadening the scope of obligated material to include packaging-like products and single-use plastic products such as drinking straws, and plastic cutlery.

1.4.4.3 Ontario's Proposed Transition to EPR

In Ontario, municipalities have been operating under a shared responsibility system since 2004 (Stewardship Ontario, 2013). They have a long history of working with an Industry Funding Organization (which is a quasi regulated Producer Responsibility Organization), called Stewardship Ontario, to develop and implement Ontario's Blue Box Program. In 2016, Ontario passed new legislation called the *Waste-Free Ontario Act*, *2016*[5]*,* which created a pathway for the Blue Box Program to be transitioned from a shared responsibility program to EPR. In 2017, Ontario's Minister of the Environment provided a letter of direction to initiate the planning needed to transition Ontario's Blue Box program to EPR in a phased approach (Ministry of Environment and Climate Change, 2017). Full transformation is expected to take eight years or more, and consultation on the transition is now underway (Stewardship Ontario, 2017).

Ontario's legal framework for EPR differs from BC's framework in several key ways. First, it enables an Individual Producer Responsibility (IPR) system. Individual Producer Responsibility is a framework where producers are individually responsible for their own products and packaging at end of life. This means that individual producers cannot discharge their obligations to a collective PRO -i.e., both the individual producers and the collective PRO can be held liable for failing to achieve government regulated outcomes. It also means that even if an individual producer joins a collective PRO, any program financing mechanisms would be subject to Canada's Competition Act and the fees producers pay to fund the program should relate to the actual costs of dealing with their own products and packaging at end of their life. This responsibility creates the business incentive for producers to implement greener design: e.g., reduce materials, make products and packaging easier to recycle, repair, remanufacture, upgrade, reuse (OWMA, 2013).

In comparison, under collective responsibility, the collective PRO assumes responsibility for achieving regulated outcomes, and provides individual producers with a due diligence defence if outcomes are not met - i.e., the producer could argue they did their best to achieve outcomes by joining the government-approved program. In addition, the costs of managing materials under a collective PRO may not reflect the true cost of managing a specific material. BC's regulation does not require material specific targets or outcomes.

Another key difference with Ontario's IPR model, is that it does not require producers to submit a stewardship plan for government's approval. Instead, once the system is fully implemented, producers will be required to meet specific targets and standards or be subject to administrative penalties or other enforcement measures. In theory, the lack of a government-approved, PRO-authored plan will enable a more fluid, dynamic, innovative and competitive marketplace that competes to access the resources producers need to meet their regulated outcomes.

[5] *The Waste-Free Ontario Act, 2016 is omnibus legislation consisting of two Acts: Resource Recovery and Circular Economy Act, 2016 and the Waste Diversion Transition Act, 2016.*

Finally, unlike BC, Ontario is transitioning from a shared responsibility PPP system in which both municipalities and producers have made significant investment in implementing the existing shared responsibility system. Under the existing shared responsibility system:

- Producers have a legal obligation to over 50 per cent of the eligible costs for the municipally-operated program (Waste Diversion Transition Act, 2016)
- Municipalities have legal obligation to operate a local blue box program (Ontario Regulation 101/94: Recycling and Composting of Municipal Waste).

As a consequence of Ontario Regulation 101/94, a greater proportion of Ontario municipalities own collection and post-collection infrastructure than did BC municipalities at the time of BC's transition to full EPR. As a result, Ontario municipalities are more concerned about the potential for stranded assets upon a transition to EPR than were BC municipalities upon their transition.

Ontario's new EPR framework is theoretical at this point, as it is only in the planning phase. The main elements of the municipal role in the proposed Ontario transition plan are outlined in the table below. However, since there was extensive feedback from Ontario stakeholders on this proposal (Association of Ontario Municipalities, et al; 2018), it is likely this transition plan will undergo significant revision. As a result, the elements of this plan are presented at a high-level and are useful for illustrative purposes only.

Table 3: Main Elements of Ontario's Proposed Transition to EPR Relating to the Municipal Role

Ontario Transition Plan Elements (Stewardship Ontario, 2017)
1. Until communities' transition, continue with shared responsibility -i.e., existing PRO continues to provide funding at a rate of 50 per cent of eligible costs. The existing PRO is the government-regulated Industry Funding Organization called Stewardship Ontario.
2. Communities across Ontario are grouped into 'catchments' -i.e., a logical cluster of communities. The operational and financial responsibility for collection and processing would transition from being municipally-organized to PRO-organized, on a catchment by catchment basis. I.e., transition from 50 per cent PRO-funded and municipally-operated to 100 per cent PRO-funded and PRO-organized. The first catchment would be transitioned two years after the transition plan is approved.
3. Once catchments are known, the PRO would consult on the design of supply chain commercial agreements -i.e., the Master Service Agreement and Statements of Work. The agreement would include service standards (e.g., contamination levels) and a standardized uniform list of materials to be collected and processed by service providers province-wide.
4. Communities determine and declare their interest in and ability to transition. Key considerations: – Existence and state of current assets. – Whether commercial contracts will be stranded for collection or processing-i.e., does community self-serve, or have contracts that are expiring or can be terminated? – Whether commercial contracts can be amended to service the PRO. – Whether commercial or union contracts exist that cannot be exited. Communities may be able to divest, lease out, or repurpose their existing infrastructure. A date for declaration is set, and communities would have 90-days to seek approval of their Councils to declare their wish to transition and whether they wish to supply service. Communities that decline to transition would continue to be funded under the shared responsibility system.
5. The PRO would procure collection and post-collection services for the first catchment, and subsequent catchments as per the agreed to schedule. Communities would have the right of first refusal to act as collection agents in their communities, paid at the market-clearing price.
6. Then there would be a systematic transition of communities to EPR on a catchment by catchment basis until all have transitioned.
7. The shared responsibility program would be repealed, and the government-regulated PRO (Stewardship Ontario) would cease to exist. Full transformation into the IPR system would be complete. Producers become individually liable for regulated outcomes and would be free to form a new collective PRO or work directly with the marketplace to access materials (e.g., service providers).

1.4.5 Lessons for Nova Scotia from the BC and Ontario EPR Frameworks

As municipalities in Nova Scotia consider a future EPR PPP program, there are several lessons that can be gleaned from both BC's transition to EPR and Ontario's proposed transition plan.

1. The regulated targets and outcomes are the guiding principles for producer action. Any service beyond achieving regulated outcomes is optional. Nova Scotia municipalities should consider drafting the list of targets and outcomes they would like to see in the future regulation. For example, whether there should be:

2. PROs will aim to achieve maximize efficiency through competitive processes, finding economies of scale, making strategic investments, and producing high-value commodities. This will likely mean building or transforming post-collection processing facilities, transfer facilities and collections systems. In this scenario, municipalities with the least municipally-owned infrastructure and assets will have the easiest transition to EPR. Until the path to EPR is known in Nova Scotia, it would be wise to minimize municipal investment in new post-collection infrastructure and long-term contacts should be minimized.
3. Once a PRO begins consultation on an EPR transition plan, municipalities might only be given 90 days to review the proposal and determine their response. Nova Scotia's municipalities should educate their Councils early and through the consultation and transition processes to ensure they will be prepared to make a decision in short order.
    - For example, if the BC model is chosen, then municipalities would need to decide if they wish to engage their 'first right of refusal' to provide local collection services. Municipalities that decline service at initiation may be wait-listed years prior to obtaining service.
4. It's likely there will be three years or more between an EPR PPP regulation and full implementation. In BC, the regulation was passed in 2011 and implemented in 2014. In Ontario, the transition plan proposes a 2-year transition for the first 'catchment' once the plan is approved.
    - In BC, only those municipalities that had pre-existing curbside programs were eligible for curbside funding or service upon program implementation. If the BC model is to be implemented in Nova Scotia, then it might be prudent for any municipalities that do not have curbside programs to implement curbside prior to the regulation or be prepared to lobby for increased options to add curbside post-regulation.
5. Stranded assets can be managed in a transition to EPR.
    - If the BC model is chosen, municipalities will be offered the 'first right of refusal' to act as a collection service provider. This can help municipalities mitigate the cost of amending existing collection contracts, managing fleet investments, and staff. However, municipalities may want cease providing services as assets age or agreements mature. Regardless of a municipality's choice at the time of implementation, they should be provided with a clear path to full EPR at a later date.
    - Other options to minimize stranded assets: municipalities with post-collection infrastructure may also consider bidding or partnering on a bid offer post-collection service to a PRO, or selling, leasing or repurposing their infrastructure and repositioning staff.
6. If under the future model municipalities accept a contract to become a collection service provider to a PRO, the role of the municipality changes from procurer of services to service provider. Changes to the internal financial and administrative systems may be required to enable this relationship.
7. If the BC model is chosen, the future PRO would standardize the list of materials collected across the province.
    - It might be beneficial for Nova Scotia municipalities to pre-emptively standardize the list of materials collected in all three waste-resource streams prior to EPR to reduce public expectation for unique services.
    - This would also enable a province-wide education program for all three waste-resource streams, reducing the costs associated with duplicating on-the-ground education to meet local needs.
8. If material specific targets will not be regulated, then Nova Scotia municipalities might want to consider the cost and consequences of packaging that continues to be disposed of in municipally-owned landfills.
9. On product definition, Nova Scotia may want to consider:

- BC recently changed the obligated materials in its program from packaging and printed paper to packaging and paper, to ensure it was clear that all paper is obligated (and all paper stewards are responsible for funding the system).
- Quebec's regulation includes packaging-like-products -e.g., pie tins and solo cups -which could be a package or a product and is indistinguishable to the consumer.
- If residential PPP is the only material obligated, producers will make estimates of what they believe will be sold into the residential vs. IC&I streams. This decreases the transparency on the material recovered.

10. The definition of recycling could include Energy from Waste (EfW), unless it's specifically excluded. This will be an important outcome to define in regulation.
11. Newspapers have received an exemption from paying direct fees into all PPP programs in Canada -and are often the biggest free rider in an EPR PPP system. They offer 'in-kind' advertising to municipalities in most shared responsibility provinces. In full EPR, in-kind advertising will not be acceptable to other producers in a collective PRO. For example, the BC government is now paying the newspaper producers' fees to Recycle BC in return for in-kind advertising to be used by government. Without this agreement, the newspapers share of the costs would be at municipalities' cost. Nova Scotia municipalities may want to consider how they wish to manage newspapers

1.5 Conclusions

1. Nova Scotians have achieved incredible waste diversion results and are proud of their accomplishments. 11.
2. Nova Scotia's Waste-Resource Strategy is more than 20 years old and should be revised to enable additional change.
    - The lack of a clear, shared provincial vision on the future of Nova Scotia's waste-resource management system has contributed to the current over capacity and high-cost system.
    - Regulated provincial triple bottom line goals and targets would assist planning, including service, accessibility, cost, jobs, etc. Goals and targets should be achievable, clear, and enforceable, and the responsible parties must be clearly identified.
3. The absence of a provincial requirement to consider the cumulative effect of proposed municipal solidwaste resource infrastructure on the whole of Nova Scotia has contributed to the over-supply of landfills, MRFs and compost facilities.
    - Looking forward, if Nova Scotia implements Extended Producer Responsibility (EPR) for packaging and printed paper (see Section 1.4 for a discussion on EPR) the regulated industry (i.e., the producer responsibility organizations or PROs) would define the optimal number of MRFs as the PRO(s) seeks to implement the most cost-effective means of achieving regulated recycling targets. These recycling facilities would be funded by producers and would cease to be a taxpayer funded cost.
        - For landfills and compost facilities, an arm's length from government organization, like Prince Edward Island's crown corporation the Island Waste Management Corporation, might be useful to regulate and/or manage the complement of publicly funded landfills and compost facilities in Nova Scotia to ensure the cumulative effect of public infrastructure investment is considered from a triple-bottom line perspective on the average Nova Scotia taxpayer. Given that waste management is an essential public service, key principles could be established as to guide decisions (e.g., fairness of access, equitability of costs across Nova Scotia taxpayers) in an updated Nova Scotia Waste-Resource Strategy.
4. Municipalities are not obligated to plan regionally or supra-regionally and have little incentive to do so. In the absence of guidance, municipalities are acting rationally when they make decisions they believe to be

in the best triple-bottom line interests of their local public (e.g., jobs, environment, cost), as opposed to the best interests of Nova Scotia.

5. Elected municipal councils and CAOs are the key decision-makers affecting short and long-term solid waste-resource planning and investment.
    - Yet, by and large, these groups are not regularly targeted with provincial education and outreach on the costs and benefits of Nova Scotia achieving its provincial disposal target.
    - There is a lack of best practice guidance to assist municipally elected officials, CAOs, and solid waste operators on the range of information that should be considered and assessed when considering investment in new infrastructure or setting municipal waste-resource budgets. Guidance would be helpful so that decision-makers can have confidence in making informed decisions on the full costs of solid-waste-resource infrastructure investments.
    - It would help decision-makers to compare costs between jurisdictions, as part of their regular practice.
    - A solid waste management basics education program for new Councillors appointed to serve on a board
6. The purpose and role of the Regional Chairs Committee should be reconsidered.
    - There is a lack of clarity on the roles of the Regional Chairs Committee and the Nova Scotia Federation of Municipalities: both have advocacy roles with the provincial government on behalf of local municipalities on solid waste-resource management.
    - This lack clarity is causing duplication of work, delays, and confusion about 'who speaks for municipalities' on waste-resource issues. It may be beneficial to clarify their respective roles to enable a clear pathway for advocacy and decision-making on solid waste-resource issues to capitalize on the strengths of both entities.
7. There is little publicly available information or direct education on the overall costs of Nova Scotia's solid waste-resource management system, its over-capacity of infrastructure, or how local decision-making is contributing to this problem. The absence of this information is contributing to local confusion on the need for system-wide change.
8. The Fund administered by Divert NS would not exist without the revenues created by the beverage container recycling program. Before considering whether to change this system, a full triple bottom line assessment should be completed to assess the value of the current system compared to any savings and costs that would be accrued through curbside recycling. The relative recovery rates, the value of the material generated by each system relative to their cost of collection, and their relative contribution to the circular economy, may be important strategic considerations.
9. Divert NS collects the bulk of their funding through their operation of the beverage container and tire recycling programs. This funding becomes part of the regulated Resource Recovery Fund. Divert NS redistributes these funds as guided by the regulations and the provincial government. In part, this fund is used to encourage and contribute financially to municipal promotion and education on solid waste-resources issues and opportunities. This creates a duplication of role and mandate between Divert NS and regions/municipalities -i.e., both entities are assessing needs to achieve regulated targets and developing education material.
    - To reduce the duplication, it might beneficial to narrow Divert NS' role in decision-making regarding promotion and education funding to provincial or province-wide opportunities, or topics unrelated to municipal recycling.
    - I.e., Financially contributing to 7 or 50 individual promotion and education programs is less efficient than subsidizing a single common platform with common messages.

- I.e., providing individual subsidization of municipal and regional promotion and education programs might discourage or reduce the incentive for municipal/regional/cross regional cooperation on promotion and education.
- For example, it might be more cost-effective for either the province to establish or municipal units to collectively agree on a common list of materials that all will be collected and recycled across the province. This would enable the development a province-wide campaign on 'what is recyclable in which waste stream' (i.e., blue box, organics, depot), reducing the need for each municipal unit to investment in individual promotion and education campaigns, and making it easier for Nova Scotians to understand what they can recycle (and where) as they cross borders or move between locations as they live, work and play..

10. Intermunicipal Agreements are a tool to enable municipalities to plan at a sub-regional, regional or supra-regional level and share costs of services. Shared costs, services, and best practices are an important tool to deliver effective and efficient services to the public.
    - Current on-the-ground disputes are putting existing agreements at risk and threaten the success of regional planning and implementation.
    - Standard dispute resolution clauses should be added the agreements that enable collaborative solutions through discussion, negotiation, and if necessary mediation. Binding arbitration should be a last resort that is used only in exceptional circumstances.
    - Likely points of conflict should be considered, including scenarios to resolve issues prior to those issues becoming disputes (e.g., dissolution of a party to the agreement due to annexation, setting annual or three-year rolling budgets, the desire for additional service or accessibility, management of customer complaints).
    - Dispute resolution training may benefit parties to the agreement.
    - Reporting to the public on the benefits of the agreement, and the results achieved could encourage a greater willingness to resolve issues and disputes.

2. Best Management Practices

2.1 Background

Most Nova Scotia municipalities operate a three-stream, source separated, curbside system to collect recyclables, organics and waste. Rural communities without curbside collection have residents self-haul materials to their local landfills/transfer stations. Most, but not all communities, operate a two-stream recycling system separating paper from containers.

The efforts of Nova Scotia municipalities have resulted in great success, as the province has achieved its 50% diversion target and is working towards its target of 300 kg / capita / year. However, the cost of Nova Scotia's waste management system appears to be high. In 2015, Nova Scotia's then Minister noted Nova Scotia had the highest net cost of disposal per tonne at $387/tonne (Younger, 2015). Younger, also noted that this high cost didn't reflect the value Nova Scotia's waste-resource system provides to Nova Scotia. As a result, the Municipal Priorities Group requested a scan of best practices in other jurisdictions that could reduce costs or increase revenues in Nova Scotia.

To complete this task the work entailed:

- Obtaining existing studies and best practices from AECOM past projects, the National Solid Waste Benchmarking Initiative, Waste Management Associations (SWANA and Ontario's Continuous Improvement Fund), not-for-profit provincial recycling associations, databases, and online research;
- Develop a summarize best practices that reduce waste management cost per cost capita;
- Review of EPR programs and how it's been implemented or initiated in other provinces, especially for packaging and printed materials;
- Review of policy tools have been implemented to support the EPR programs (e.g., disposal bans);

Please note that this literature review does not include confirmation of report/study findings on if they have been implemented.

This section overviews summaries of best practices in the following categories:

1) Planning, Governance, and Administration
2) Waste Collection
3) Recycling
4) Landfill
5) Compost
6) International best management practices Europe and Asia

Please note that each section provides a summary of the best management practices, and a summary and/or excerpt of the conclusions of each of the reports reviewed where the best management practice is shown in red.

2.2 Scan of Best Practices that Reduce Cost- Planning, Governance

The following is a summary of best management practices that may reduce costs for governance, planning, and administration practices.

- Form financially viable regional waste management systems. Managing waste on an optimized waste shed allows for economies of scale which reduces cost with more available waste or diversion tonnage.
- Develop regional solid waste management plan. The plans should use full cost accounting or triple bottom line analysis to meet a provincial diversion mandate or to obtain grant funding. The plan should be developed to:
    - Account for changes in waste flow
    - Site and size solid waste infrastructure accordingly so they are economical
    - Waste collection and transfer optimisation
    - Plan and improve waste infrastructure design and operation
    - Evaluate system infrastructure and financials
- Develop an arms-length government organization (i.e. Crown Corporation, Delegated Administrative Organization) responsible for waste planning and operation
- Evaluate and potentially implement policy instruments such as flow control, single-use item reduction, and PAYT
- Develop standardized waste services procurement contracts to reduce administration between regions

Table 4 summarizes case studies of these best practices reviewed.

Table 4: Scan of Best Practices that Reduce Cost- Planning, Governance, Administration

Case Studies – Planning and Governance Best Practices
Regional Solid Waste Planning - Saskatchewan[6],[7] Saskatchewan waste management system is being revitalized. It currently has 328 operational landfills, 155 transfer stations, 15 industrial landfills, and 356 closed landfills. Saskatchewan has more landfills per capita than any other Canadian province. It is undertaking a program to form regional systems for landfills and waste diversion, inclusive of First Nations, and encouraging full cost accounting practices. The 'Starting a Regional Waste Management System document' includes statements on proper budgeting including "decide on an affordable per capita dollar figure and build your budget around it". It may take longer to put the whole system in place, but it must be affordable. This should result in appropriate planning so that landfills are sited and sized accordingly to be economical.
Regional Solid Waste Planning – Smooth Rock Falls Ontario[8] With loss of its Pulp and Paper Mill, community of 2,400 people reduced to less than 1,400 people. This was a loss of 40% of tax revenue. The community realized it needed to improve and identified opportunities. They developed Vision for Change, Service Delivery Review, and a Solid Waste Management Plan. They also developed an automated curbside collection program to improve efficiency, expanded the landfill, updated design and operations, and established agreements with neighbouring municipalities to improve efficiency and reduce cost. This has resulted in cost savings in residential collection and landfilling fees.
Regional Solid Waste Planning and Governance - Prince Edward Island -Island Waste Management Corporation (2018) PEI developed one waste management program for the whole province. The population of the province is approximately 150,000. Under PEI's Environmental Protection Act, the Island Waste Management Corporation (IWMC) is responsible for planning and implementing an integrated waste management system for PEI. The IWMC is a crown corporation created by an order of the Lieutenant Governor in Council in 1999, under the Environmental Protection Act. The IWMC is responsible for collecting and processing a 3-stream waste-resource system (organics, recycling, and waste), operating PEI's landfill and compost facility. The IWMC has implemented a mandatory sort program for curbside packaging and paper, a clear bag system for waste, and encourages its citizens to use open bins instead of bags for recyclables and organics. The IC&I sector must hire its own haulers for transportation to the landfill. The mandatory 3-sort system is imposed at landfill. Program costs include (Island Waste Management Corporation, 2016): • Residential -Annual fee of $205 (per household) charged on their property tax bill, which covers the cost of carts, collection fees, and disposal costs for the entire year. • Seasonal properties -Annual fee of $95 and receive collection from June through September. • An extended cottage collection -Rate of $120 and is available from mid-May through the end of October. • IC&I - The commercial tipping fee was $100 per metric tonne at IWMC's final disposal facilities.

[6] http://publications.gov.sk.ca/documents/66/97825-Solid%20Waste%20Management%20Strategy%20Discussion%20Paper.pdf. Accessed April 2, 2019

[7] *http://publications.gov.sk.ca/documents/66/86789-Waste%20-%20Regional%20Waste%20Management%20System.pdf. Accessed April 2, 2019*

[8] *Presentation from SWANA Canadian Waste Resource Symposium March 2018.*

Current waste facilities include:

- Six Waste Watch Drop-Off Centers located across PEI
- One Central Compost Facility owned by IWMC and operated under contract by ADI International Ltd
- One landfill -East Prince Waste Management Facility (fully-lined landfill cell)
- One energy from waste (EfW) facility -PEI Energy Systems
- One recycling facility - GreenIsle Environmental Inc.

Regional Solid Waste Planning - Quebec -Mandatory Waste Management Plan
(Regulation Respecting the Charges Payable for the Disposal of Residual Materials Environment Quality Act; Dussault, personal communication).

Quebec has mandatory waste management plans that each region develops and submits for approval by the Minister. Quebec has 90 different regions. The regulation does not dictate what must be in the plans in terms of measures, but the measures must contribute to the Provincial Waste Management Action Plan. If the province deems that measures are not adequate, then the plan won't be approved. If a region does not have its plan approved, municipalities aren't eligible for funding originating from Quebec's disposal levies (~$70 million per year).

Regional Planning - Halifax Regional Municipality Waste Resource Strategy Update (Stantec, 2013)

Updating a regions waste strategy can result in cost saving if a waste system can be optimized.

Halifax Regional Municipality (HRM) commissioned a report to update their Waste-Resource Strategy. The findings are specific to Halifax only. Key best practice findings to reduce costs included:

- Closure of the Front-end Processor (FEP) and Waste Stabilization Facility. Rationale: they do not function as envisioned, do not provide additional environmental benefit, and cost $8.9 million / year to operate.
- Request modification of the Nova Scotia landfill liner specification. Rationale: specifications are more stringent than comparable state and provincial jurisdictions.
- Extend the life of Otter Lake landfill through vertical expansion.
- Create a centralized waste resource campus. Rationale -currently have four properties, and three of are limited size and prevent co-collection of materials at the curb in a single truck.
- Relocate the MRF to the campus.
- Increase organics processing capacity – relocate the aerobic composting facility to Otter Lake. Dartmouth facility by constructing an anaerobic facility at current or alternative location.
- Improve recovery of recyclables and organics – waste audit shows better opportunity to improve capture
- Control curing and sale of finished compost – improve storage capacity for curing so can generate additional revenue from compost that meets CCME guidelines
- **Improve curbside collection frequency – to reduce contamination rates**

Planning - City of Vancouver -Single-use item reduction strategy 2018-2025: Priority Action in Zero Waste 2040 (City of Vancouver, 2018)

The City of Vancouver has developed and approved a single-use item reduction strategy[9] to reduce waste from:

- Plastic and paper shopping bags
- Polystyrene foam cups and take-out containers
- Disposable hot and cold drink cups
- Take-out food containers
- Disposable straws and utensils

Reducing waste from single use items would:

- Reduce the amount of material sent to landfill
- Reduce contamination of recycled and composted materials
- Reduce the amount of these items managed through public waste collection and litter programs
- Reduce litter from these items in the environment
- Support the zero-waste goal

Rationale -it costs Vancouver taxpayers $2.5 million to collect these items from public waste bins and clean-up litter.

State of Waste Management Planning in Canada, CCME 2014[10]

1) Zero Waste Business Case Development by the Province of BC:

With respect to waste reduction, the BC Ministry of Environment commissioned a report in 2013 on the Business Case for Zero Waste in BC. The report makes a comparative evaluation of three MSW diversion scenarios (43%, 62%, and 81%) for waste generated, projecting economic costs and benefits and employment impacts by 2025 for each scenario. The residential, ICI and CRD sectors are the basis for the analysis. Preliminary results indicate a positive business case for moving waste up the pollution prevention hierarchy. This is the only Canadian jurisdiction which has conducted a comprehensive business case analysis for zero waste for the entire province.

2) Municipal Performance Monitoring to Track Waste Disposal / Diversion Linked to Reduction:

Nova Scotia regularly monitors disposal and diversion volumes of every municipality in the province. They have a unique funding formula whereby each municipality can apply for “diversion credits” which means increased funding from the RRFB to use for waste management costs based on the volume they divert from landfill. The province uses a formula that is based on actual disposal volumes, not higher diversion rates, which more accurately measures waste reduction overall (since higher diversion numbers could be associated with higher waste generation). Municipal reporting is required.

3) Regional Waste Planning:

Québec and BC require regional waste plans for designated municipal districts/areas. In those provinces, these plans include material-specific diversion targets (including CRD, and other ICI wastes), along with other traditionally recycled materials. The regional areas must also monitor disposal volumes tonnages and report to the province for aggregate reporting (this is voluntary in BC).

[9] *https://vancouver.ca/green-vancouver/single-use-items.aspx*

[10] *https://www.ccme.ca/files/Resources/waste/wst_mgmt/State_Waste_Mgmt_in_Canada%20April%202015%20revised.pdf. Accessed April 2, 2019.*

Municipal Solid Waste Flow Control, EPA (1994)[11],[12]

Financials for the development and operation of a solid waste management or recycle facility is dependant on the material flow. How the material flow is controlled can be controlled directly or indirectly through Municipal bylaws, Municipal Development permits, Municipal and/or Provincial Policy, Provincial Act, Regulations & Approvals, or local market controls (facility pricing, local contracts).

Full Cost Accounting, Best Management Practices for New Hampshire Solid Waste Facilities (2014)[13] and SWANA Technical Policy T-4.2 Full Cost Accounting for Municipal Solid Waste Management Systems (2012)

Full Cost Accounting provides a systematic approach to reporting the actual costs of solid waste management, i.e., past and future outlays of expenditures, overhead costs and operating costs. With knowledge of your actual costs, you can begin to evaluate where actual cost savings can be obtained and the best options for doing so.

- Accounting for costs rather than outlays
- Accounting for hidden costs
- Accounting for overhead and indirect costs to individual solid waste services
- Accounting for past and future outlays
- Accounting for costs according to activities or paths

SWANA Technical Policy states:

SWANA supports the establishment of full cost accounting for municipal solid waste management system(s) (MSWMS).

a. Full cost accounting should provide to the public, policy makers and managers of MSWMS a clear statement of all the costs of a MSWMS.
b. Costs for various components of a MSWMS should be separately accounted for and disclosed.
c. Users of the MSWMS should know the system costs, and those costs should be reflected either by user fees or on a tax statement.
d. In a MSWMS funded as an enterprise activity, the full costs reported to the users of the systems should be the basis for establishing fees. Such fees must benefit all users of the system and should be equitable in their application.
e. Full cost accounting must include all direct and indirect costs necessary for a MSWMS to deliver all the services identified in the MSWMS plan.

When MSWMS are competitively bid with private sector service providers, the competitive bid (service fee) becomes the cost for purposes of full cost accounting.

Full cost accounting therefore provides an understanding of the various cost components of a MSWMS. Through this understanding, the public, policy makers and managers can make informed decisions, knowing fully what resources are needed to successfully provide MSWMS services.

Note: Technical Policy T-4.2 available for download at **https://swana.org/default.aspx** to members

[11] *https://nepis.epa.gov/Exe/ZyPDF.cgi/10000SH1.PDF?Dockey=10000SH1.PDF. Accessed April 2, 2019*
[12] *https://archive.epa.gov/epawaste/nonhaz/municipal/web/html/flowctrl.html. Accessed April 2, 2019*
[13] *https://www.des.nh.gov/organization/commissioner/pip/publications/wmd/documents/wmd-13-01.pdf. Accessed April 2, 2019*

Implementing PAYT in Large Cities with Existing Automated Collection Systems (SWANA, 2016):

The following conclusions are offered regarding the implementation of PAYT in large U.S. cities based

on this limited investigation:

- To implement PAYT programs, over 75% of the large cities surveyed in a recent study chose to use containers of varying volumes – rather than bags or stickers – to provide the pricing incentives.
- Two thirds of the cities with PAYT programs reported that illegal dumping was a problem of medium to high importance.
- The costs of waste disposal represent 24% of the total costs of waste collection and disposal for single family residents in Charlotte. Therefore, if the City were to implement a PAYT program and 50% of additional residential waste was diverted from disposal as a result, the city could expect to save $0.92 per household per month – or $2.35 million per year in disposal costs. These potential costs savings would be offset by the costs of administration and enforcement of the PAYT program as well as any additional costs (such as the requirement to purchase special plastic bags for waste disposal by the residents and the costs of illegal dumping cleanup).
- If the city of Charlotte were to implement a PAYT program, it is likely that the frequency of recyclables collection would have to be increased from a bi-weekly to weekly basis. If this is the case, any savings achieved in disposal costs would be more than offset by increased collection costs.

Note: SWANA document available for download at **https://swana.org/default.aspx** to members

Municipal Contracts Database (CIF)

Provide an online resource to help increase the quality of contracts (i.e. recycling, MRF, landfill operations, collection) transfer better/best practices into tenders and agreements, reduce contract administration and associated costs, harmonize tender processes and documents for service providers, and potentially provide a training resource for anticipated contract management course. Project to include:

- Gathering, cataloguing, reviewing & annotating a database of municipal contracts
- Developing a searchable index on a website to match user profiles
- Identifying preferred practices and removing municipal ID, not in challenges and opportunities in the documents
- Updating against current events revised practices, new requirements

Note: document available for download at **https://thecif.ca/funded-projects/**

2.2.1 Best Practices - Waste Collection

The following is a summary of best management practices that may reduce costs for waste collection.

Evaluation of Private and Public Collection Services

For regions that do not have experienced private hauling companies locally, it is advisable to compare cost of running private and public waste collection systems and determine which one is economically feasible and will meet the requirements of the community.

The Athabasca Regional Waste Management Services Commission[14]

(http://www.athabascaregionalwaste.com/home.html) developed its own collection services as there wasn't a local hauling company. When collection tendering rates where evaluated the rates obtained from bid evaluations were higher than what the Commission could develop and operate at.

Standardized Hauling Contracts

Standardized hauling contracts between regions may assist with reducing hauling costs. This could allow hauling companies to optimize routes on regional boundaries, implement changes for provincial and local diversion programs, and have a common understanding of what is expected for waste collection (i.e. missed pick up's, contamination rates, accident investigations, payment and administration, waste audits, automated collection, multifamily services, etc.).

From the Implementing Residential Waste Hauling Contracts, the recommendation is to include the following information into the hauling contract.

If a jurisdiction has set lofty recycling or zero waste goals or has an idea for a new circular economic model in the coming decade, this vision should be shared in the request for proposals (RFPs) and in the service contracts.

Residential hauling contracts and programs can also be improved by incorporating public relations tactics early. Stakeholder engagement is often discussed but may be overlooked. Program development, however, may be the difference between success and failure.

The public relations element of a residential hauling program should be incorporated as early as possible and extend beyond the program's release, with multiple iterations of outreach throughout the life of the program.

Instead of writing what materials are expressly accepted for recycling into a hauling contract, the contract should refer to a list of materials issued by the solid waste director or an equivalent representative in a municipality.

Contracts should also be structured to allow for smaller regional firms to respond. Having short-term contracts hinders the ability of a smaller regional firm to finance new equipment, which may be preferred by the issuing agency. Having a term of at least seven years is preferable to open the doors for smaller firms.

Contract writers often focus on defining technical terms in a contract but sometimes overlook the legal terms. In the absence of a definition within the contract for a legal term, a generally accepted definition from courts in that state is most likely to be applied. Always ask for legal review from internal counsel, being sure to ask specifically for counsel to consider terms that should be defined.

[14] *Personal conversation with Steve Johnson, 2017*

2.2.2 Best Management practices for optimizing Waste Collection Routes- CCAC (2015)[15]

Improving the waste collection routes will help reduce labor, operation, and transport costs. In addition, efficient routes will mitigate impacts on public health, safety, and the environment by reducing the need for vehicles on the roads, lessening traffic congestion, increasing public safety, and decreasing atmospheric and noise pollution.

The following best management practices can be implemented:

- Routes should not be fragmented or overlapping. Each route should be compact, consisting of street segments clustered in the same geographical area
- Total collection time plus hauling time should be reasonably constant for each route in the service area, ensuring equalized workloads.
- The collection route should be started as close to the garage or motor pool as possible, considering heavily traveled and one-way streets
- Waste on heavily traveled streets should not be collected during rush hours.
- In neighborhoods with too many one-way streets, it is best to work through it through a series of overlapping loops
- Services on dead end streets can be considered as services on the street segment that they intersect, since they can only be collected by passing down that street segment. To keep left turns to a minimum, collect the dead-end streets when they are to the right of the truck. Depending on the length of the street and turning restrictions, waste on the dead-ends can be collected by either walking down, backing down, or making a U-turn.
- When practical, waste on steep hills should be collected from both sides of the street while the collection vehicle is moving downhill. This practices facilities safety, ease, and speed of collection. It also lessens wear on the collection vehicle and conserves fuel and oil.
- Higher elevations should be at the start of the route.
- For collection from one side of the street at a time, it is generally best to route with many clockwise turns around blocks. This guideline and the following one emphasize the development of a series of clockwise loops to minimize left turns, which generally are more difficult and time-consuming than right turns. Right turns are safer, especially for right-hand-drive collection vehicles.
- For collection from both sides of the street at the same time, it is generally best to route with long, straight paths across the route before looping clockwise.

Curbside Collection of Residential Food Waste (SWANA, 2008)

Note document available for download at https://swana.org/default.aspx to members.

This document overviews the curbside collection and food waste programs. It provides a summary of programs and cost per resident for San Francisco California, Alameda County California, Seattle Washington, and Cedar Rapids Iowa.

For collection of methods of co-collection with yard waste or separate collection of food waste it found that the most popular method was for co-collection. The frequency was weekly for most communities but found some seasonal variation with yard waste programs, with a reduction in the winter months. Lidded roll-out carts were required with plastic biodegradable bags or use of paper bags.

[15] *PDF copy attached*

The compost facility should be in reasonable proximity to the food-waste collection area for two reasons:

- To minimize odors developed during transport and emitted when the RFW is unloaded at the compost site
- To minimize transport costs.

The report concludes that:

- Based on a literature review and investigation of current programs, the following observations and conclusions are offered with respect to the source separation and curbside collection of residential food waste:
- Food waste constituted 12.4% of the municipal solid waste (MSW) stream generated in the United States in 2006, which is roughly equal to yard waste at 12.9%.
- In recent years, a number of North American communities have sought to raise the bar of residential waste stream diversion to levels of 75% or more. One of the principal means of achieving these higher diversion levels involves the curbside collection of residential food waste.
- There are a total of 56 United States communities in four states which collect residential food waste (RFW) at the curb. Most of the RFW curbside collection programs are relatively new, having been initiated within the last decade. In contrast, the curbside collection of RFW in Europe is widespread and has been practiced for over 20 years.
- Most of the curbside RFW collection programs reviewed during this project – including both European and North American programs – utilize rollout containers and automated collection vehicles and co-collect RFW and yard wastes.
- RFW and yard waste can be collected on a weekly or every other week basis. Weekly collection of RFW serves to minimize the generation of odors and vectors.
- The food wastes targeted for collection in RFW programs falls into four categories: fruit and vegetable wastes, bread and cereal wastes, food-soiled paper products, and meat, fish, and dairy wastes. All programs target the first two categories regardless of collection frequency. Meat, fish and dairy food wastes and food-soiled paper are generally targeted only if weekly collection service is provided and if the composting facility receiving the food waste is equipped to handle these wastes.
- None of the reviewed programs include oil and grease in the types of food waste acceptable for collection. In addition, none of the programs collect other organic waste such as soiled diapers or pet litter.
- As with most other curbside recycling programs, participation in curbside RFW programs is voluntary. To encourage participation, some communities have reduced the frequency of their residential waste collection service to an every other week basis. Other communities are considering mandatory participation requirements.
- All of the residential curbside yard waste/food waste co-collection programs reviewed during this project require residents to utilize lidded, roll-out carts for placement of the waste products at the curb for pickup.
- The effective RFW set out rates for these programs ranged from 25% to 37% while the amount of RFW set out per participating residence range from 5 to 10 pounds.
- In general, for YW/RFW co-collection programs, the impact of including RFW in the collection service was reported to be minimal. A key issue with respect to program costs is whether or not a program recommends the use of compostable plastic bags to control odors and vectors. These bags – which cost $5.00 per 25 bags – can significantly add to a resident's cost of participation.
- An important requirement for RFW collection services is the availability of a reasonably close-by composting facility that is permitted to receive household food waste and soiled paper and cardboard.

- Two key issues for RFW collection programs which must be addressed are odors and vectors. Meat and dairy scraps tend to generate odors and attract flies. Keeping these materials out of an RFW collection program may cut back on odor and pest problems. With respect to fruit flies, residents are generally informed that "while they are pesky, they will not harm you."
- In SWANA's opinion, the conclusion that the potential increase in flies and other vectors due to RFW collection programs does not create public health issues may be premature. SWANA recommends that additional research be conducted in this regard to quantitatively assess and characterize this potential problem.

2.3 Scan of Best Practices that Reduce Cost- Recycling Stream

The following best management practices have been useful in reducing cost in the recycling stream. Table 5 summarizes case studies of these best practices reviewed.

- Multi-municipal planning approach to collection and processing of recyclables.
- Optimization of operations in collection and processing.
- Training of key program staff in core competencies.
- Following generally accepted principles for effective procurement and contract management.
- Appropriately planned, designed, and funded promotion and education programs
- Consider using trucks with compaction capability to save on shipping fees
- Implementation of Pay-as-you-throw systems
- Reducing the number of MRFs reduces overall processing and transferring costs. Savings vary depending on number of MRFs and transfer stations in the system
- Utilise transfer stations/depot in smaller communities
- Study collection costs to fully understand savings potential
- MRF process optimisation and energy efficiency – Only run equipment when there is material to process
- Compare costs with other jurisdictions and adopt best practices/adjust cost accordingly
    - Plan waste collection methods and increase collection frequency (where necessary) to increase efficiency and reduce contamination and cost
    - Perform waste audits at regular intervals -information from the audits can be used to improve capture rates of recyclables and organics.

Ontario has the most extensive literature in Canada on best practices that potentially reduce the costs of operating municipal recycling programs for packaging and printed paper (curbside and depot collection). The information can be found at (https://thecif.ca/funded-projects/). Select research from Ontario and other sources is described below.

2.3.1 Best Practices Research-Ontario

Since 2004, Ontario has operated a shared responsibility program for Blue Box recyclables. The Ontario Blue Box program is regulated in two ways:

1) The former Waste Diversion Act, 2002, and now the Waste Diversion Transition Act, 2016 (Part II of the omnibus Waste-Free Ontario Act, 2016) establishes a shared responsibility system for the operation of a provincial Blue Box program, including requiring producers to pay 50 per cent of municipalities eligible costs for operating their local Blue Box recycling programs. Unlike the Waste Diversion Act, 2002, the new Waste Diversion Transition Act, 2016 provides a pathway for the Ontario government to move Ontario's Blue Box program from a shared responsibility system to full extended producer responsibility system through implementation of new regulation.

2) Under Ontario Regulation 101/94: Recycling and Composting of Municipal Waste, municipalities with a population of 5000 or more were required to:
   a. Establish, operate and maintain a blue box program for the curbside collection of recyclables, except for Northern Ontario which allowed for depot collection up to 15,000.
   b. Establish, operate and maintain a leaf and yard waste system.

The shared cost responsibility for Ontario's Blue Box program resulted in disputes relating to the definition of eligible and reasonable costs. In a 2014 arbitration to determine the 2014 producer obligation to fund the municipally-operated Blue Box program, Judge Armstrong described the issue as follows:

> *On the one hand, Municipalities will generally always subjectively assert that they are operating as efficiently and effectively as they are able and that the costs they report must be accepted at face value. On the other hand, Stewards will generally always subjectively assert that Municipalities are not operating as efficiently and effectively as they could and that the reported costs are inflated (*Armstrong, 2014).

As a result, several steps were taken in Ontario to identify and implement best practices that would reduce system costs, including commissioning a 2007 KPMG report entitled "Blue Box Program Enhancement and Best Practices Assessment Project"[16] , and the later development of a Continuous Improvement Fund (CIF) in 2008, which is still active.

2.3.2 Findings from the KPMG Report16

In 2007, KPMG generated a report describing best practices for the operation of municipal Blue Box programs that would improve effectiveness and reduce cost, however, it was not able to predict the specific cost and performance implications of implementing the best practices for individual municipalities.

> *"With respect to the estimation of the cost implications of individual best practices, KPMG was unable to meet the project's objectives. The reason is straightforward: the data available from the WDO datacall combined with additional information from the site visits, while extensive and carefully verified, contain nowhere near enough detail to permit the analysis of individual best practice costs …" (*KPMG, 2007, p.3).

The best practices identified by KPMG are outlined in Table 5 below.

2.3.3 Recommendations of the Continuous Improvement Fund

Ontario's Continuous Improvement Fund (CIF) was formed in 2008 as a partnership between the Association of Municipalities of Ontario, the City of Toronto, Stewardship Ontario, and the Resource Productivity and Recovery Authority (Continuous Improvement Fund, 2018).

> *"The CIF's mandate is to improve the effectiveness and efficiency of Ontario's municipal blue box Programs. This mandate is fulfilled through the provision of funding, technical support and training to aid municipalities and program stakeholders in the identification and development of best practices and technological and market-based solutions that lead to program improvements."*

[16] http://www.stewardshipontario.ca/wp-content/uploads/2013/03/KPMG_final_report_vol1.pdf. *Accessed April 2, 2019*

The CIF is funded from a portion of the producer's annual steward funding obligation for Ontario's Blue Box program. In the first year of the program this equated to 20 per cent of the funding owed to municipalities (Continuous Improvement Fund, 2008). An overview of the best-practices identified by CIF is outlined in Table 5 below.

2.3.4 Recommendations from Resource Recycling Systems and StewardEdge

In 2012, to inform opportunities to improve the cost-efficiency and effectiveness of Ontario's Blue Box system, Waste Diversion Ontario commissioned Resource Recycling Systems and StewardEdge to develop a model to reflect a cost-effective, efficient and successful resource recovery system for Ontario's Blue Box Program. Their recommendations are specific to the Ontario context only but could inform likely best practices in Nova Scotia. The recommendations are listed in Table 5.

2.3.5 Best Practice Research -Other Sources

Additional sources of best practices reviewed include those from:

1) Recycle BC, 2012 - Best practices in multi-residential recycling[17].
2) RRS -MRF Material Flow Study[18]
3) Multi-Material BC, 2016 - Describes efforts to reduce contamination to retain high commodity value and access markets.[19].

The best practices are identified in Table 5.

[17] https://recyclebc.ca/multi-family-building-recycling-programs-best-practices-improve-capture-recyclables/. *Accessed April 3, 2019*

[18] https://www.plasticsrecycling.org/images/pdf/resources/MRF-material-flow-study-FINAL.pdf. *Accessed April 3, 2019*

[19] *The Recycle BC overview is sourced from a Chapter of report entitled "Multi-Family Diversion Program Best Practices", which was delivered to the City of Calgary in 2012, The full report reference is: "Multi-Family Waste Diversion Stakeholder Engagement and Strategy, prepared for: Waste & Recycling Services, The City of Calgary, prepared by Stantec Consulting Ltd., December 6, 2013*

The City of Calgary report is no longer publicly posted but is available upon direct request for limited use. For a copy of the relevant *chapter contact Sharon Howland, Team Lead, Program Management, City of Calgary at sharon.howland@calgary.ca.*

Table 5: Scan of Best Practices Best Practices that Reduce Cost- Recycling Stream

Recycling Best Practices
KPMG (2007) - Blue Box Program Enhancement and Best Practices Assessment Project16 Development and implementation of an up-to-date plan for recycling as part of an integrated waste management system. 1) Multi-municipal planning approach to collection and processing of recyclables. 2) Establishing defined performance measures, including diversion targets, monitoring and a continuous improvement program. 3) Optimization of operations in collection and processing. 4) Training of key program staff in core competencies. 5) Following generally accepted principles for effective procurement and contract management. 6) Appropriately planned, designed, and funded promotion and education programs. **7)** Established and enforced policies that encourage waste diversion.
Continuous Improvement Fund (2009,2018) - Describes 5 Centres of Excellence, each with Best Practices 1) Collection a. Compaction - achieved by front/rear load bins, stationary compactors or by simple packing with available loaders, compaction saves shipping costs. b. Curbside Collection Policies i. Bag Limits - Limiting bags set out for waste collection helps increase generation awareness and Blue Box capture rates. ii. Clear Bags - Waste in clear bags increases collection safety, user awareness, enforcement and participation in recycling programs. iii. Pay-as-you-throw - Homeowners who pay for their waste bags at the curb increase recycling. c. Depots i. Siting -Site selection considers permits, size requirements, infrastructure, services, the environment and customer usability. ii. Design - Depot layout includes considerations such as traffic flow, materials management, signage, and safety. iii. Operations -Optimizing safety, throughput, participation, user/staff satisfaction and reducing costs are part of operating an efficient depot. d. Multi-family Recycling i. Build and maintain a database of all multi-residential properties ii. Benchmark performance and monitor on a regular basis iii. Provide adequate recycling bin capacity iv. Provide promotion & education materials v. Set a minimum threshold for recycling for buildings to be eligible for municipal garbage collection and disposal services vi. Identify buildings that are not recycling and determine the feasibility of extending municipal services vii. Engage in outreach activities including training for stakeholders

viii. Develop design requirements for new building developments that design for increased diversion. Municipal approval for new building developments should be subject to meeting these mandatory requirements.

e. Public Space & Signage

i. Signage - Good signage is key to participation and low contamination. Keep messages clear and simple, use recognized colours, pair graphics with text and make it visible.

ii. Twinning - Place recycling, garbage (and organics) bins side-by-side to avoid making users travel to sort materials.

iii. Location - Place bins in high traffic locations and ensure they are visible with convenient access.

iv. Bin Type- Choose the type and size of bins best suited to local conditions to increase use and reduce weather and vandalism damage. Both function and aesthetics are important.

2) Operations -End markets and transportation issues impact recycling in a variety of ways and both are subject to change.

a. End-markets -improve processing and conduct spot audits to meet market requirements for quality (e.g. moisture, contamination), store bales appropriately (e.g. to avoid moisture and sun).

b. Transportation -ensure you understand the requirements prior to attempting to transport materials across the border to the US or overseas.

3) Promotion & Education - is a fundamental best practice for the blue box program, with a requirement for programs to operate with an appropriately planned, designed, and funded P&E plan. The P&E best practice requires that programs have an up-to-date communications plan with identified goals, measurable objectives, a program to monitor and evaluate the P&E
efforts.

4) Policies -The division of producer funding to Ontario's municipalities is based in part on their relative efficiency and effectiveness. The following are seven objectives that contribute to municipalities relative best practice scores:

a. Complete program performance projections and analysis

b. Complete Blue Box efficiency assessments for collection, depot, transfer station and processing operations

c. Take steps to implement Blue Box System optimization initiatives

d. Assess program performance outcomes - i.e., amount of marketable material collected per household does, costs/tonne relative to your peers

e. Undertake training of key program staff in core competencies -continuing education credits

f. Implement promotion and education achievements and initiatives

g. Implement effective policies that promote waste diversion – to provide adequate recycling capacity, limit waste, incentivize recycling and reduce contamination

5) Procurement -Effective procurement of recycling equipment and services is critical to the success and cost containment of all recycling programs.

a. Use key clauses -for inclusion in any procurement or contract documents

b. Use CIFs annotated RFP as a guide, which includes better practices

Resource Recycling Systems and StewardEdge (2012)

1) Reducing the number of MRFs reduces overall processing and transferring costs.

- Savings vary depending on number of MRFs and transfer stations in the system.

2) The lowest cost modelled system is the one with the fewest MRFs, however regional dynamics will dictate how much savings can be achieved by getting to the minimum number of MRFs.

- Regional dynamics arising from the characteristics of material generation density and geography, the location, capability and condition of the existing infrastructure and current contracts affect the potential savings.

3) The key to the hub-and-spoke system is highly efficient medium and large MRFs running 2-shifts per day.
   - The supply of material from the less dense areas (accessed through hub-and-spoke supply strategies) enables these efficiencies to be realized.
4) Material can be transferred economically on long distances
   - Utilizing transfer stations allows smaller communities to accept a wider variety of materials (the standard suite of materials), while constructing a MRF locally that could separate such a wide variety of materials would be cost prohibitive.
5) Collection costs need to be studied to fully understand savings potential
   - The lowest cost scenarios achieve their efficiencies through consolidation of transfer stations and this can have a significant effect on collection routes, depending on the final location of these transfer stations – and quantifying that impact was not part of this study.
   - Collection impacts vary due to differing equipment utilized, the distances from the end of collection routes or depot locations to these aggregation points and local private infrastructure.

Best Practices to improve participation and reduce contamination in multi-residential units- Recycle BC (2012) [20]

1) Make recycling as convenient as, or more convenient than, garbage disposal.
2) Implement a comprehensive promotion and education campaign involving superintendents and management as well as residents.
3) Develop and deliver training programs to building staff and owners on how to promote and operate the recycling program – supportive and engaged building superintendents and owners are key to the success of the program.
4) Provide incentives to building superintendents to increase recycling.
5) Involve interested and engaged residents as recycling champions – at least one or two champions per building.
6) Provide an in-unit recycling storage container (bags or small boxes) for each household.
7) Provide adequate recycling storage at the central collection point (a general rule is that a 360-litre cart is sufficient for 7 units and a 4 cubic yard bin is sufficient for 60 units).
8) *Establish a central storage area that is indoors, convenient (e.g. near laundry room or lobby), well lit and feels safe for residents (e.g. not in dark, remote corners of deserted parts of the building).*

By-Law and Building Codes

- Including garbage design specifications in the building codes for all subdivisions and new development (road sizing, garbage room design etc.)

MRF material flow study and key take-aways - RRS (2015)18

1) Packaging Designers
   a. Form, material and rigidity have a significant effect on a product's "sortability" in the MRF.
   b. Light-weighting of plastics can decrease recovery in a single stream MRF due to loss to the paper streams.

[20] *The Recycle BC overview is sourced from a Chapter of report entitled "Multi-Family Diversion Program Best Practices", which was delivered to the City of Calgary in 2012, The full report reference is: "Multi-Family Waste Diversion Stakeholder Engagement and Strategy, prepared for: Waste & Recycling Services, The City of Calgary, prepared by Stantec Consulting Ltd., December 6, 2013*
The City of Calgary report is no longer publicly posted but is available upon direct request for limited use. For a copy of the relevant
chapter contact Sharon Howland, Team Lead, Program Management, City of Calgary at sharon.howland@calgary.ca.

2) MRF Operators
   a. More equipment steps (disc screen decks or other separation equipment) can improve accuracy of splitting two-dimensional from three-dimensional materials.
   b. Properly maintaining the disc screens (cleaning and replacing discs) can significantly reduce loss of containers to the paper stream.
   c. Minimizing compaction to maintain the form/shape of incoming material improves separation.
   d. Continually training sorters to recognize a wide range of acceptable packaging is of growing importance
3) MRF Equipment Designers
   a. Further research and development is needed to improve consistency of behavior of non-bottle plastics in the MRF • Further testing and refining of optical sorter programming is needed to effectively optically sort a wider range of packaging.
4) Municipalities
   a. Regular communications with local MRFs is critical to understanding behavior of materials currently accepted and identifying additional materials that could be added.
   b. As the list of acceptable materials grows, continual education for residents is essential to keeping contamination to a minimum.
   c. For single stream programs, education to the consumer to not crush materials can improve their recovery.
5) Recycling Industry
   a. Continually evaluate and match MRF product quality and end market capabilities to ensure true recovery.

MRF – Optimization and Energy Efficiency[21]

- Compare cost of operating MRF with that of similar sized MRFs
- Access risks and benefits of public and private collection services
- Compare revenue generated from the MRF with that of other sample jurisdictions
- Ensuring that the MRF is appropriately sized and always has material to process

Multi-Material British Columbia (MMBC, 2016b) – Spreading the Word About Recycling Innovation & Contamination Reduction

MMBC agreements set a 3% threshold for contamination that collectors are striving to meet. High contamination rates can render the collected materials unsortable; it reduces the commodity value and MMBC's ability to meet local commodity market specifications; and it can present a significant health and safety issues. MMBC conducts routine composition audits and distributes contamination scorecard audits to those municipalities with high contamination rates in order to assist them in their plans to achieve the 3% rate. Effective consumer campaigns reminding them what they can and cannot recycle as well as active monitoring and enforcement will all help to reduce contamination rate.

sonnevera (2018) – Waste Transfer Stations Best Practices Across Canada

1) Signage: Clear signage is very important. Consider using large graphic signs if possible
2) Labelling: Ensure containers on site are properly labelled
3) Traffic management
   a. Train staff on traffic direction and safety
   b. Leave room for enough vehicles to queue on site

[21] *Sample reports can be obtained from thecif.ca. A recent study from the Niagara Region can be accessed here https://thecif.ca/projects/documents/456-Niagara_Summary_Report_000.pdf*

4) Hours of Operation
    a. Longer hours where necessary is advised to allow public drop before/after work hours
    b. Customer assessment to target when operations are required
5) Fencing/Security:
    a. Install camera to monitor activity on site and for liability reasons
    b. Fencing to reduce intrusion
6) There should be room for future expansion of the facility
7) Educational Programs and Surveys
    a. Conduct surveys to gather public opinion to shape existing/future programs
    b. Public education on the need to recycle and what goes where
8) Staff Training: Ensure staff are well trained, engaged and knowledgeable
9) Community Involvement: foster community involvement
10) Zoning: Necessary to have different zones for different waste types (e.g. hazardous material drop-off, recyclable, compost etc.)

Note: sonnervera best practices in Appendix 7

Cost-Effectiveness of Processing C&D Wastes and Markets For Recovered C&D Materials White Paper (SWANA, 2002)

Cost Effectiveness of Mixed C&D Waste Processing Facilities:

- C&D processing facilities can be as simple as mobile crushers and screens to enclosed fully-mechanized processing lines.
- Depending on the level of processing, processing costs can range from as little as $2.00 per ton up to $73 per ton for full scale, highly mechanized plants.
- Due to the heavy nature of C&D wastes, waste are typically not hauled more than 15 miles to either a processing or disposal site.
- Countries that have achieved high rates of C&D recycling rely on regulatory and other mechanisms, other than pure economics, to drive recovery**.**

Markets for Recovered C&D Materials

- Established markets exist for three of the six primary materials recovered from the C&D waste stream: concrete and asphalt aggregate, wood, and metals.
- The growing recognition of the high level of performance associated with recovered aggregate is likely to increase the demand for this material.
- Markets are continuing to develop for the other two major materials—namely gypsum wallboard and asphaltic shingles.
- Recovered gypsum wallboard is readily recycled into new wallboard. The major impediments to increased recycling of this material appear to be the lack of established recovery mechanisms. The growing recognition of the disposal problems that can be created by gypsum wallboard in landfills (i.e., the production of hydrogen sulfide gas) is likely to spur further recovery of this material in the future.
- A growing body of evidence indicates that asphalt shingle can be used in the production of hot mix asphalt at low mixture levels (3%-7%). A growing number of states are funding demonstration projects in this regard, and some are changing hot mix asphalt specifications for state-funded roadway projects to allow for the use of this material.

Note: SWANA document available for download at **https://swana.org/default.aspx** to members

2.4 Scan of Best Practices that Reduce Cost- Landfill

Cost savings can be realised at every stage of a landfill development. The best practices are provided below and detailed in Table 6.

- Planning
  - Limit the number of Regional solid waste facilities to optimize the amount of waste received – reduce staff and administration
  - For a municipality with multiple landfills, temporarily close a number of landfills and divert waste to a one facility to reduce operational costs
- Administrative
  - Set Staffing and operational hours to manage the waste (i.e. control hauler schedules and when waste placed in landfill)
  - Appropriate equipment selection (i.e. right size landfill equipment)
  - Implement a preventative maintenance program
  - Appropriate annual budgeting using full cost accounting
- Landfill Operations
  - Manage airspace utilization (i.e. monitor compaction, cover practices, grade control, have a fill plan)
  - Use of alternative daily cover
  - Use of synthetic covers to reduce leachate generation and associated management costs
- Landfill Engineering
  - alternative cap designs to reduce post-closure care costs (reduce leachate generation and obtain better landfill gas capture)
  - progressive capping to reduce leachate generation
  - Master Development Plans for capital and operational cost estimates
  - Design for feedstock and capacity

For landfill development for a greenfield landfill site or an expansion of an existing site a proper financial analysis should be completed using full cost accounting principles to develop a business plan. The plan is to include both revenue sources and expenses.

Revenue:

The typical sources for revenue include Municipal Solid Waste, Industrial/Commercial/Institutional waste, Construction and Demolition Waste, Special Waste, diverted waste (recyclables), and in some provinces where permitted, revenue generating cover (i.e. alternative daily cover in which a fee can be applied). A recently new revenue source is from landfill gas recovery where landfills that are large enough to be economically feasible for gas capture to obtain carbon credits (this must be quantifiable and verifiable).

Revenue can be obtained ranging from 100% tax requisition to 100% tipping fees, as established by the municipality/regional authority.

Municipalities typically plan their landfill based on population within a membership catchment area (i.e. municipal district, county, city, town, village, special area, etc.). The catchment area can be established based on historical practices, existing agreements, transportation distances, competing landfill availability, and partners financial capability. However, many municipalities do not reassess revenue until there is an issue.

For example:

1) With development of a private landfill or more economical neighboring municipality, landfill waste can be diverted which changes a landfills economics.
2) With population reduction or a change in recycling programs landfill tonnage, revenue can decrease.
3) With the closure of an adjacent municipalities landfill, disposal tonnage would increase and may require additional staffing and equipment.
4) With a large industrial development which may send waste that may require special handling.

A Landfill Manager must be aware of changes such as competing landfill development and population changes and assess revenue generation accordingly.

Expenses:

The following is one method to categorize landfill expenses and the typical range of cost.

Direct Labour Cost: Operators salaries, wages, insurance and benefits, vacation, taxes, contract labour, etc. – 25% to 35% total expenses.

Primary Equipment Cost: All primary equipment in fleet ownership and operating costs including equipment depreciation, technical labour and benefits, parts, supplies, third-party services, tire, equipment rental, fuel, etc. – 25% - 30% total expenses.

Secondary Equipment Costs: All supporting equipment fleet ownership and operating costs including equipment depreciation, technical labour and benefits, parts, supplies, third-party services, tire, equipment rental, fuel, etc. – 5% - 10% total expenses.

Operations Support Costs: Include depreciation of site buildings, maintenance and repairs to onsite structures, property taxes, administrative and management labour and benefits cost (landfill manager, public education, etc.), office supplies, and travel related expenses – 15% - 20% total expenses.

Landfill Operating Costs: All costs from site monitoring and testing to general operating supplies, licences, fees, permits, amortization (airspace expense – land acquisition, permitting, earthworks, landfill cells, surface water infrastructure, etc.), capping and closure/post-closure expense and royalties – 5% to 15% of total expenses.

General and Administrative Costs: Expenses for bad debt and other minor expenses 3% to 5% of total expenses.

The expenses can be further classified into fixed and variable costs, in which some of the costs are controllable costs. A controllable cost is expenses that fluctuate based on daily management efforts and most significantly include labour and equipment variable expenses.

To manage costs a Landfill Manager must focus on variable controllable costs throughout each component of the operation (i.e. scale house, waste transfer station, compaction, litter control, leachate management operation, landfill gas operation). This can include limiting operational hours, conducting landfill equipment efficiency audits, managing compaction density, using tarping systems to reduce leachate management costs, etc.

The following table summarizes approaches to manage revenue and expenses for landfills.

Table 6: Landfill Best Practices

Best Practice

Landfill
• **Planning**
  ○ Limit the number of Regional solid waste facilities to optimize the amount of waste received – reduce staff and administration
  ○ For a municipality with multiple landfills, temporarily close a number of landfills and divert waste to a one facility to reduce operational costs
• **Administrative**
  ○ Set Staffing and operational hours to manage the waste (i.e. control hauler schedules and when waste placed in landfill)
  ○ Appropriate equipment selection (i.e. right size landfill equipment)
  ○ Implement a preventative maintenance program
  ○ Appropriate annual budgeting using full cost accounting
• **Landfill Operations**
  ○ Manage airspace utilization (i.e. monitor compaction, cover practices, grade control, have a fill plan)
  ○ Use of alternative daily cover (e.g. tarps)
  ○ Use of synthetic covers to reduce leachate generation and associated management costs
• **Landfill Engineering**
  ○ Alternative cap designs to reduce post-closure care costs (reduce leachate generation and obtain better landfill gas capture)
  ○ Progressive capping to reduce leachate generation
  ○ Master Development Plans for capital and operational cost estimates
  ○ Design for feedstock and capacity

Landfill Revenue To maintain and/or increase landfill revenue methods include: 1) Analysis of airspace consumption by waste type and applying true costs for special and bulky waste disposal (i.e. mattresses, pipes, trailers, contaminated soil, etc.). This is traditionally applied through special handling charges 2) If regulatory permissible, obtain revenue generating cover such as contaminated soils, ash, auto fluff, shredded tires to offset the use of cover soil 3) Obtain waste disposal tonnage including flow control, closing nearby landfills, competing with private landfill operations 4) Flow control ordnances 5) Sale of landfill gas 6) Leasing of unused property 7) Selling of excess soil or aggregate 8) Sales of processed/scrap materials (e.g. asphalt shingles, concrete, asphalt, chipped wood) 9) Increase airspace by landfill expansion (vertical and/or lateral)

Landfill Master Plan

A best management practices for landfill managers is to develop a Landfill Master Plan. A Landfill Master Plan is an engineering design, planning, and financial document that is developed and updated throughout a landfill active life. The document should include:

1) Drawings and CAD models for full extent of landfill development (landfill cells grading and top of waste contour envelope) and supporting infrastructure
2) Summary of site geology and hydrogeology
3) Summary of site groundwater chemistry
4) Summary of potential regulatory changes that may impact the landfill development
5) Waste tonnage projections and diversion ranges for end of site capacity estimate
6) Landfill cell phasing based on disposal tonnage projections and associated timeline to fill phases
7) Landfill site soil balance for liner system, cap system (final barrier layer), and operational cover (i.e. daily and intermediate cover)
8) Conceptual engineering design(s) and options for the liner system, leachate collection system, landfill cap (final barrier layer), leachate conveyance system, stormwater management system, and landfill gas system
9) Capital financial estimates for the selected liner system, leachate collection system, landfill cap (final barrier layer), leachate conveyance system, stormwater management system, and landfill gas system based on recent local construction costs or contractor/supplier cost estimates
10) Financial security assessment for closure and post-closure care
11) Capital and closure financial estimates cost per cubic meter and/or by tonne

The document is used by landfill managers for capital budgeting and to reduce the level of effort required from a qualified professional for landfill cell design and tendering. A Landfill Master Plan should be updated between every five to ten years to coincide with the Landfill Approval Renewal period or as necessary for financial planning purposes.

Landfill Financial Modelling and Budgeting[22]

1) A best management practice for landfill manager is to develop a landfill budget and assess risk impacts from a financial model which evaluated changes to waste flows (i.e. organics diversion, waste bans, new recycle programs) to manage or reduce expenses.
2) Annual financial modelling and budgeting through Total Cost method is a method to verify landfill tipping fees and risks with changes to fixed and variable capital and operations costs.

Landfill Operations

Best management practices for landfill operations to manage or reduce expenses include:

1) Level of Service Assessment
   - Assess waste disposal customer hours and set landfill operations hours based on findings for winter and summer operations
   - Work with private waste haulers to schedule receipt of waste loads. This may assist with setting landfill operations hours and planning for staff compliment
2) Operator Training
   - Operator training (i.e. certified landfill operators, equipment specific training)

[22] http://nofnec.ca/PDF/2016/NAL/NAL-Module4-Landfill_OandM_Best_Practices.pdf. *Accessed April 3, 2019*

3) Airspace Utilization:
   - Layer thickness to limit to 60 cm maximum to achieve maximum waste density[2324]
   - Active face slope – keep as low (flat) as possible to achieve maximum waste density2324[25]
   - Waste compaction pattern efficiency to achieve maximum waste density. This includes verifying the number of passes (three to five) and cross knitting
   - A method to track waste compaction density including annual or more frequent survey, GPS mounted on landfill compaction equipment, and visual observation,
   - Use of survey technology such as drones, or GPS mounted on landfill compaction equipment. Survey equipment to monitor airspace consumption and to set design grades. GPS to set slopes to design grades, monitor lift thickness waste compaction pattern and equipment use with the data used to determine compaction density.
   - Leachate recirculation to reduce leachate treatment costs, increase waste compaction, and increase the rate of landfill gas generation.
   - Pancake versus traditional fill method to increase waste density[26]

4) Equipment Efficiency
   - Matching equipment to peak time (i.e. equipment capacity, quantity of equipment required to processed received tonnage, and staffing)
   - Sigma six evaluation of landfill equipment for efficiency
   - Appropriate equipment selection (i.e. select most economical equipment for the function intended)
   - Preventative maintenance program
   - Have back-up compaction equipment available

5) Cover Operations
   - Prepare final lift for daily cover application (compaction, finish grading) to limit loss of cover soil
   - Removal of daily soil cover for soil balance and leachate movement
   - Target of 5:1 or greater waste to cover ratio
   - Soil Cover usage tracking (calculate amount permitted to be use daily based on received tonnage, track volume taken to active face)
   - Use of alternative daily cover to reduce soil cover, realize additional airspace, and potentially reduce leachate generation

6) Fire Mitigation
   - Hot load inspection and management
   - Waste screening (check for lithium batteries and other fire risk waste)
   - Purchase a heat detector to check the active face routinely

7) Leachate Management:
   - Use of synthetic daily and intermediate covers to direct precipitation to the surface water management system and reduce leachate management and disposal costs
   - Leachate recirculation to the active face
   - Leachate evaporation systems on landfill slopes and/or within leachate ponds

[23] https://wasteadvantagemag.com/landfill-best-practices-benchmarking-for-improvement/. *Accessed April 3, 2019*
[24] http://www.nofnec.ca/PDF/2012/Waste-Management-and-Disposal.pdf. *Accessed April 3, 2019*
[25] https://www.concreteconstruction.net/projects/infrastructure/five-landfill-compaction-best-practices_o. *Accessed April 3, 2019*
[26] https://blueridgeservices.com/wp-content/uploads/2015/04/Alternative-Daily-Cover-Handouts.pdf. *Accessed April 3, 2019*

8) Litter Control

- Develop and implement a litter control strategy including litter control fencing, wind barriers, portable litter fencing around the active face, litter picking system (vacuum trucks, litter pickers), small active face, restrict disposal on windy days (bale operations, alternative active face), mandatory tarping policy.

Benchmarking the Performance and Costs of MSW Landfills (SWANA, 2008)

This document overviews results from benchmarking from 16 jurisdictions for parameters of airspace utilization density, cover soil usage, factors impacting waste density (landfill age, height, waste stream mix, annual rainfall, landfill surcharging with cover soil, stripping and reclamation of intermediate cover soil, leachate recirculation/moisture addition), and MSW landfill Costs (landfill capital costs, personnel costs, amortized equipment capital costs, equipment maintenance costs, other operating costs, indirect and overhead costs)

The cost per ton tends to decrease as the size of the landfill increases, confirming that there are economies of scale associated with personnel costs and operating costs.

Tracking and comparing information through a benchmarking initiative may assist in finding cost savings.

Note: SWANA document available for download at **https://swana.org/default.aspx** to members

2.5 Scan of Best Practices that Reduce Cost- Composting

The best practices that reduce cost are summarized below and detailed in Table 7.

- **Size composting facility on the projected tonnage to prevent overdesigning**
- **Staff and operation hours – maintain staff and set operation hours when there is material to process.**
- **Obtain the required equipment. Equipment choices should be based on the condition and volume of incoming material. Rent or lease as needed.**
- **Zone facility such that distance between drop off and composting area is as short as possible**

Table 7: Compost Best Practices

Best Practice[27] [28] [29]
1) Sizing for peaking factors: a. Provided a compost facility, siting and design criteria checklist and an example of compost processing area detail b. Most sites cannot efficiently handle more than 9,500 cubic meter per hectare per year and generally, 15,100 cubic meter per hectare per year is the upper limit for intensely managed site. c. Locate the site entrance on or near major transportation routes; allow enough space for truck to adequately maneuver off the streets; and, ensure safe enter and egress for incoming and outgoing traffic; allow access to common utilities (e.g. electricity, water, telephone, internet, and sanitary sewage or septic tank and drain. d. Compost facility include the following operational functions that by area are: 1) staging/receiving (20-30%), Processing (55-65%) and Curing/Storage (10-20%). e. Recommended site selection criteria: Proximity to customers; Proximity to transportation corridors; Minimum travel and materials handling; Firm surface to support vehicles under varying weather conditions; Opportunity for expansion; Cost of space and utilities; Buffer from neighbors; Drainage, runoff control; Avoid sensitive receptors such as schools, hospitals, schools; FAA regulations prohibit the existence of compost facilities within 10,000 feet of any airport. 2) Staff and operation hours a. Operation and staffing is subject to the composting process monitoring data and material flows b. For composting facility utilizing source separated organics and yard waste, the best time of year to start composting is autumn, because leaves can be stockpiled and available to mix with succulent grass clippings the following spring. c. Staff will be required to operate and maintain equipment, monitor and sample compost piles, administration and gate management. Laborers will also be needed for debagging and other unskilled jobs. d. Hire mechanically talented individuals with the ability to reason systematically and demonstrate attention to detail. e. Train all staff in the basic principles of composting. f. Staff and operation hours – maintain staff and set operation hours when there is material to process. 3) Appropriate equipment. a. Equipment choices should be based on the condition and volume of the incoming materials. b. Lease or rent as-needed equipment such as grinders and screeners, if used infrequently. c. Appropriate equipment used in most composting facilities are: i. Turning equipment: 1. Front-end loaders: used for compost mixing, pile or windrow formation; often serves as the most important piece of equipment for small; mixing of material is difficult

[27] *Personal communication with Scott Gamble, Jacobs (2018)*
[28] *https://www2.gov.bc.ca/assets/gov/environment/waste-management/organic-waste/compost-best-practice-info-notice.pdf. Accessed April 3, 2019*
[29] *https://nerc.org/documents/compost_marketing/compost_quality_best_management_practices.pdf. Accessed April 3, 2019*

2. Specially designed turning equipment e.g. Windrow Turners: mixes the material more thoroughly but is less flexible than front-end loaders and cannot be used to move material.

ii. Grinding/chipping equipment such as grinders, hammer mills and chipper/shredders are used to reduce the size of brush and tree limbs before it is mixed with other materials.

iii. Mixing equipment: many small compost facilities use only front-end loaders to mix materials. Other mixing equipment includes pug mills and batch mixers.

iv. Screening equipment, such as Trommel (rotary) screens and shake or vibrate screens are used to remove large unwanted particles e.g. rocks, twigs, large wood from finished compost. Some composting facilities utilizing comingled waste use screening equipment to separate organic-rich fines from the rest of the feedstock for composting.

v. Other equipment includes debaggers, bagging equipment

d. Cost of equipment:

Equipment type	Cost Range	Capacity
Turning equipment		
Front-end loaders	$50,000 to $100,000	500 to 750 cy/hr
Tractor-driven turners	$10,000 to $90,000	2,000 to 4,000 cy/hr
Self-propelled turners	$40,000 to $200,000	2,000 to 4,000 cy/hr
Grinding/Chipping equipment		
Grinders	$20,000 to $700,000	10 to 500 cy/h
Hammer mills	$17,000 to $250,000	60 to 450 cy/hr
	$5,000 to $135,000	5 to 300 cy/hr
Mixing equipment		
Pug mills	$20,000 to $50,000	20 to 2000 cy/hr
Batch mixers	$10,000 to $150,000	10 to 500 cy/hr
Screens	$50,000 to $180,000	10 to 200 cy/hr

4) Material flow through site

a. Usually, rural agricultural areas or those zoned for industrial operations are best suited to outdoor composting technologies.

5) Receiving area

a. Pad types are Rigid Pavements, e.g. concrete and asphalt pads and Prepared Earth Surface, e.g. gravel slag and compacted earth pads. Compost facilities should not be sited on a ground surface area that has a clay base without surface improvements.

b. For drainage, Rigid and durable pavements should have a minimum slope of 1% in one direction. Gravel, slag or other non-rigid surfaces should have a Gradient of 2% in at least one dimension.

6) C:N ratio

a. A carbon to nitrogen (C: N) balance of 25:1 to 30:1 helps ensure rapid decomposition. C:N ratios below 20:1 tend to generate foul odors and C:N ratios above 40:1 increase composting times.

b.

7) PFRP

   a. Temperature must be monitored regularly since it is the primary indicator of the level of microbial activity and composting rate.

   b. Temperature around 110-140°F (43-60°C) indicate an active pile. Most weed seeds and pathogens are killed at 145°F (62.7°C). Temperatures above 160°F (71°C) effectively stop the composting process.

8) Generator check for contamination

   a. Diverting food waste to a composting program requires a separate collection and transportation system that maximizes the capture rate of food waste and eliminate non-organic contaminants such as plastic wraps, rubber bands, glass, and metal.

   b. Seasonality in waste composition: some municipal programs cease collection of residential and downtown yard waste during the winter months, so working with residents to give them home-based alternatives for food waste management during the winter months becomes important. For commercial and institutional establishments, finding a hauler that can continue collection year-round so that kitchen staff operations remain constant is key to a successful program.

   c. Educating residents and business Worker Training

Summary of General Composting Best Management Practices (Northeast Recycling Council Inc., 2016) [30] - British Columbia

This documented was generated in 2016 and summarizes the British Columbia composting best management practices in the Compost Facility Requirements Guideline: How to Comply with Part 5 of the Organic Matter Recycling Regulation (2004). The best management practices to consider when design a compost facility included: siting; leachate control; odour control; the composting process;

1) Siting a compost facility would require public participation and is the function of: Composting method; Topography; Proximity to land users; Buffer area; Vectors; fire; weather conditions; wetland % flood plains; site utilities; space requirement; vehicular traffic; travel distance; and local zoning and restrictions.

2) Leachate control (selected recommendation):

   a. A minimum of a 1 metre vertical buffer and 15 – 30 metre horizontal setbacks are recommended between the site and surface or groundwater resources.

   b. A 1% or 2-4% land slope is desirable to prevent run-off and leachate.

3) Feedstock: Raw materials should be kept dry and be composed as soon as possible to minimize odours.

4) A typically successful Carbon to Nitrogen Ratio is 25 to 30:1. Mixing wet nitrogen-rich materials with coarse, dry bulking agents provides an extra carbon source to increase the C:N ratio. It also increases porosity, enhances air circulation, and reduces moisture; thereby, reducing the potential for odour issues. If woodchips are added as a bulking agent, then the recommended ratio is 35 to 40:1.

5) Moisture content should be 45-65%. However, 50-60% is the most successful range. Excessive moisture content reduces porosity and increases compaction, thereby limiting air movement into the composting mass.

6) The cheapest mixing equipment is front-end-loader, but it is the most effective option. The most expensive and most effective option is to use a mechanical mixing equipment such as “mix box”.

Typical successful aeration equipment are: Front end loaders; windrow turners; aerated static piles; extended aerated static piles; bin-type composting systems; agitated bed or channel systems and aerated and turned extended bed system.

[30] *Northeast Recycling Council Inc., 2010. Summary of General Composting Best Management Practices Retrieved from: https://nerc.org/documents/compost_marketing/compost_quality_best_management_practices.pdf. Accessed on July 6, 2018*

Northeast Recycling Council, Inc. (2010) Best Management Practices Presentation[31]

Northeast Recycling Council, Inc. overviewed that the BMPs for composting are those leading towards the production of a desired quality compost in shortest time possible with the minimum odours; minimum environmental impacts and minimum process-related problems. In this regard, matching the feedstock with the compost product is the first major considerations when composting as the quality of compost varies depending on the characteristics of recipes, i.e. the primary ingredients. Knowing the quality requirement for the end market determines the type of primary ingredients to compost. This could also be a part of the quality assurance stage in composting.

The following technical information has been recommended for composting:

1) Aeration–Oxygen concentrations -10-14+%.
2) Carbon to Nitrogen (C: N) Ratio –20:1-60:1 (preferred 30:1-50:1)
3) Moisture--40 to 65 percent (preferred 50 –60%) —like a damp sponge.
4) Optimum pH range -5.5 to 8 (preferred 6.5 –8.0)
5) Temperature –120°and 160°F.131°F for 15 days to kill weed seeds & parasites.
6) Bulk density < 1000 lbs. per cubic yard
7) Particle size (diameter in mm) –3-13 (preferred depends on end market)
8) Porosity, structure, texture -particle size, shape & consistency influence aeration. Adjust with bulking agents –raw materials.
9) Compost recipe.
10) Grinding or mixing.

To control the odours, the following composting method were recommended:

1) Cover piles/windrows –layer of finished compost
2) Direct process air through a biofilter to remove odors.
3) Vessel containing mature compost.
4) Suction-type aeration system
5) In-vessel systems or an aerated static pile.

Technical Document on Municipal Solid Waste Organics Processing (Environment Canada, 2013)[32]

The Technical Document on Municipal Solid Waste Organics Processing was developed to provide science-based, objective and user-friendly information on the various aspects of organic waste management planning and operation for organics processing of different capacities and in different locations. The most applicable and relevant proven composting and anaerobic digestion treatment approaches for implementation in Canada and the considerations applicable to their implementation are also discussed. Treatment technologies still at the research level, that are not yet commercially available, or that have not fully demonstrated technical feasibility in the Canadian context are not covered in this Technical Document.

[31] *https://nerc.org/documents/compost_marketing/compost_quality_best_management_practices.pdf. Accessed on July 6, 2018.*
[32] *https://www.ec.gc.ca/gdd-mw/3E8CF6C7-F214-4BA2-A1A3-163978EE9D6E/13-047-ID-458-PDF_accessible_ANG_R2-reduced%20size.pdf*

The document draws on lessons learned and expert knowledge of professionals, practitioners and academics in the field of organics management across North America. The extensive and varied experience of all contributors and reviewers is brought together in 18 comprehensive chapters describing the technical aspects and key considerations involved in processing organic wastes. The document covers a wide range of topics from the science and principles of composting and anaerobic digestion, to the description of proven processing technologies, biogas utilization, facility design, odor control, and compost quality, as well as other related issues such as procurement approaches and system selection. It is hoped that readers will benefit from this compendium of knowledge and lessons learned to support further efforts to reduce greenhouse gas emissions and optimize the value of municipal solid waste organics under an integrated waste management approach.

2.6 Scan of Best Management Practices in Europe and Asia

Assessment of the Options to Improve the Management of Bio-Waste in the European Union (Final Report by Arcadis, 2010) – submitted to European Commission DG Environment[33]

This report was a comprehensive study focusing on ways of improving bio-waste management in European Union. The report also assessed environmental, economical and social impacts and prospective risks/opportunities on policy options. The focus of the study was mainly on the kitchen and green waste streams.

The study covered all Member States which may or may not have standards for waste management practices, such as landfilling, mechanical biological treatment (MBT), composting, etc. A baselines scenario was defined on the assumption that all Member States are managing with the targets from the Landfill Directive and with the policy targets they have imposed on themselves. Subsequently, we have divided Member States into three different classes upon which different scenarios can be applied.

1) A scenario 1 where in a first phase, due to quick economic growth and a catch-up operation in a context with less environmental awareness or pressure, waste generation grows more quickly than the economy. This first phase is followed by stabilization.
2) A scenario 2 where no decoupling takes place and the environmental impact evolves at the same speed as economic activity.
3) A scenario 3 where the waste generation is decoupled from the economic growth (relative decoupling) and tends to stabilize around a maximum value. The only factor influencing the waste quantity is the demographic growth.

Best Environmental Management Practice for the Waste Management Sector (EU)- JRC Science for Policy Report (2018)[34]

This report was developed in close collaboration with a broad range of waste management experts and presents information (environmental benefits, economics, case studies, references, etc.) and analysis of the actions that has been implemented by frontrunner organisations in the waste management sector. The report provides a set of environmental performance indicators that organisations can use to asses their waste management performance. A summary is provided below:

[33] *http://ec.europa.eu/environment/waste/compost/pdf/ia_biowaste%20-%20final%20report.pdf?_sm_au_=iVV2QH7RvHP621r7. Accessed on July 2018.*

[34] *http://publications.jrc.ec.europa.eu/repository/bitstream/JRC111059/jrc111059_bemp_waste_2018_final_04_2.pdf. Accessed on April 2, 2019*

Waste Strategy

- Pay as you throw – Encourages separation of waste. Increases recycling. As such, it should be accompanied by a very good collection program for the separated waste. It is also necessary that the waste is monitored over time on its composition and the collection methods
- Raising Awareness – to effectively encourage waste prevention, reuse and recycling, it is important that the messages are tailor made for well defined target audiences and delivered consistently over time through a range of complementary means. In the EU, at least EUR 5 per resident is invested in awareness-raising. An effective raining awareness strategy is the establishment of a network of waste advisors. These employees or volunteers are trained in waste prevention and management and support the residents in reducing and correctly separating at source.

Prevention and Reuse

- Assessment of the waste generation patterns in the territory, prioritizing the most relevant waste streams in terms of prevention potential and involvement of the relevant stakeholders. E.g. charges for plastic bags, material exchange centers etc.

Waste Collection

- Necessary to complement an effective curbside MSW collection system with material drop off sites (enviro-depots/transfer stations etc.). These sites should be well distributed and accessible to residents. Mobile collection points are also very useful

Extended Producer Responsibility Schemes

- Managing recycling streams (mostly packaging) under the extended producer responsibility (EPR). Producer responsibility organisations can increase waste separation, recycling and reuse by implementing competitions among territories, benchmarking of the environmental achievements of the different local authorities etc.

Waste Treatment

- Necessary to invest in state-of-the-art treatment operations. Ability to separate fibres, metals by type and plastics by polymer/colour etc. can help achieve a plant sorting rate of at least 88%.

Construction, Renovation and Demolition (CR&D)

- Local authorities can prioritize CRD prevention by fostering ambitious CRD waste plans
- Establish minimum CRD sorting requirements for large construction sites and set targets for CDW recycling that goes beyond the obligatory limits
- Processing of waste plasterboard and CRD for recycling
- Avoidance of PCB contamination of CDW and management of waste asbestos

Healthcare Waste

- Necessary to segregate waste at the point of generation to ensure hygiene and infection control
- Can improve waste segregation by preventing recyclable non-hazardous waste from being placed in the hazardous waste bins
- Carry out waste audits in healthcare facilities and define their waste management practices, clear categories of waste to be sorted and the precise guidelines.
- Optimisation of the treatment process/operations

Municipal Solid Waste

- Cost benchmarking – comparing costs with different countries/towns
- Advanced waste monitoring – web-based tools to track and report waste data, Composition analysis should be carried out at least 4 times a year
- Pay as you throw – charge based on the quantity of mixed waste collected, size of the waste collection bins, number of collection rounds. Can be adopted for a door to door collection.
- Performance based waste management contracting – share of the contract value depending on the achievement of the environmental objectives/performance levels or on customer satisfaction.
- Awareness raising – target different groups of people. Devote at least EUR 5 per resident. Keep track of the budget spent on awareness (amount/cap/year), share of the total MSW budget spent on awareness (%) and the share of the population in the catchment area that received the message over a given period (% of population per month)
- Establishment of a network of waste advisors – at least one waste advisor per 20,000 people
- Home and community composting – residents should have access to either separate collection of biowaste or home/community composting of biowaste. Keep track of population doing home composting (%), share of population doing it correctly (%), system in place for regular follow up (y/n), share of home composters visited annually (%)
- Local waste prevention programs – careful selection of waste prevention measures for both the short and long term, budget dedicated for waste prevention programs and the number of stakeholders involved in waste prevention.
- Schemes fostering the reuse of products and the preparation for reuse of waste – number of reuse/repair centers per 100,000 residents, quantity of end of life products collected for reuse, number of customers that use the reuse centers, availability of areas that foster material exchange and reuse
- Waste collection strategy- door to door waste collection. Monitor participation rate (%), share of population using a service (%), customer satisfaction, bulky items etc.
- Intermunicipal cooperation among small municipalities – benefits from the economies of scale
- Civic Amenity Sites (Waste Transfer Stations) – building several WTS per x number of residents, monitoring the fraction of waste collected at each facility, availability of product exchange areas aimed at fostering reuse. Sites should be easily accessible
- Logistics optimisation for waste collection – planning location of waste bins. Monitoring fuel consumption per tonne of waste collected, GHG emissions per tonne of waste and km travelled.
- Low emission vehicles – fuel with NG or biogas or hybrid-electric. Can monitor the average fuel consumption of the trucks, share of fleet that run of low emission fuel (%)

Cost Cutting Measures

- Insourcing of waste management services (ending contracts with private companies)
- Procuring LCA services from a consultant might be expensive but it helps avoid costs associated with licensing and staff time.
- Generally, these measures can help improve cost:
- Reducing the amount of waste generated;
- reducing the proportion of hazardous waste;
- Improving product design;
- Encouraging recovery, reuse and recycling of wastes;
- Decreasing incineration and landfilling;
- Minimizing adverse environmental impacts related to solid waste collection, transport, treatment and disposal systems;
- Encouraging the use of recyclables in products; and

- Generating revenues to cover costs.

The applied instruments include:

- Taxes, e.g.
  - Waste disposal tax;
  - Landfill tax;
  - Incineration tax;
  - Product levies (e.g. on plastic bags or aggregates).
- Waste pricing, such as
  - Unit-based pricing and pay-as-you-throw schemes;
  - Differential and variable rates;
  - Variable fee or charge systems.
- Deposit refund schemes.
- Extended producer responsibility systems.
- Others, such as:
  - Tradable permits;
  - Recycling subsidies;
  - VAT exemptions;
    - Extension of depreciation periods;
    - Positive incentives.

Cost Efficiency in Municipal Solid Waste Service Delivery (Spain) – Perez-Lopez et. al (2016)

Perez-Lopez et. al. (2016) studied the cost efficiencies achieved by using different MSW service deliveries in 771 Spanish Municipalities with a population of 1000-50,000 inhabitants, for the period 2007-2010. The service delivery forms analysed were municipal direct, municipal under contract, intermunicipal cooperation and private production under contract. The results obtained reveal significant differences between cost efficiency levels for the different forms of MSW service delivery.

In general, intermunicipal cooperation was found to be the most efficient service delivery form for the MSW management. However, the optimum service delivery was dependent on the size of the municipal population. Joint delivery was appropriate for populations of up to 20,000 but as you go over 20,000 (larger municipalities), it is more appropriate to contract out the service. At this population size, contractors achieve a higher level of service efficiency and offer greater cost savings to municipalities.

Does Recyclable Separation Reduce the Cost of Municipal Waste Management in Japan – Chifari et. al (2017)

Chifari et al (2017) analysed the cost elasticity with waste volumes at the collection, processing and disposal stages of waste management. Their findings are summarised below.

- Economies of scale exist at all 3 stages
- Collection cost is less elastic than disposal cost
- Source separation reduces processing cost but does not change the overall cost of waste management
- Cost of waste management systems decrease when the service is provided by private companies through a public tender
- Cost reduces even further when the service is performed under the coordination of adjacent municipalities

Feasibility of Composting Wood and Cardboard Waste with Green Garden or Household Kitchen Waste: Trials Research Report (WRAP 2007)[35]

- The cost of composting wood waste, and marketing the resultant compost, should not inherently be any greater than the cost of composting any other form of solid organic waste.
- Composting costs are very site specific and will vary according to several parameters, including:
  - Cost and purchase or lease the associated area required;
  - The composting technology (in-vessel systems tend to have a smaller footprint than windrow systems, but windrow composting is often used after in-vessel composting as a secondary composting stage);
  - The percentage of site capacity utilised (processing costs can spiral if the site has a low utilisation rate);
  - Efficiency of getting completed composting off site (failure to do this may restrict the intake of feedstock and increase unit processing costs);
  - Nature of final product (higher quality product requires higher processing costs than that required by the production of a restoration or agricultural product); and
    - The percentage of rejects that must be landfilled

Economic Analysis of Options for Managing Biodegradable Municipal Waste. Final Report to the European Commission. (Eunomia, undated)[36]

- Source separation/ separate collection increases the possibility for implementing variable charging schemes, which can influence waste generation, and act to sensitise citizens to waste as an environmental issue

Final Report Assessment of the Options to Improve the Management of Bio-Waste in the European Union (Acardis, 2010)[37]

- Optimisation of existing systems:
  - Collection frequency adjustments. Provision of a more frequent organic waste collection frequency, coupled with a reduced residual waste collection frequency, provides a more positive stimulus to use the service effectively.
  - Charging system adjustments. Altering the structure of charges in respect of segregated organics and disposal can generate price responses and influence overall diversion of material from disposal. There is merit in levying a charge on the organic waste collection as this maintains an incentive for waste prevention and home composting, as well as ensuring that contamination of the biowaste bin is not made problematic by having a zero-marginal cost;
  - Other promotion / incentivisation measures. Together with providing households with the information on service operation, further examples of promotional activity may include door knocking campaigns through to lottery style campaigns or school reward schemes etc. Such promotional campaigns can generate uplifts in performance, whilst poorly communicated collection systems may be expected to underperform.
- Adaptation of existing systems:
  - Changes in materials collected. Wheeled bin collections of biowaste are used across Europe for several different materials – principally garden waste, food waste and card. In many situations, only garden waste is collected
  - Increased scheme coverage. Providing collection services to additional households in an authority with an existing scheme will generally increase captures.

[35] http://www.wrap.org.uk/sites/files/wrap/Feasibility_of_Composting_Wood_and_Card_-_Trials_Research_Report.3947.pdf . *Accessed April 15, 2019*

[36] http://ec.europa.eu/environment/waste/compost/pdf/econanalysis_finalreport.pdf. *Accessed April 15, 2019*

[37] http://ec.europa.eu/environment/waste/compost/pdf/ia_biowaste%20-%20final%20report.pdf *Accessed April 15, 2019*

- Replacement of existing or introduction of new collection systems
  - New schemes. The introduction of new schemes typically involves the planning of new systems, their design, and possibly (depending upon who is to be tasked with the service) a new tender for a new collection service. This planning phase may incur upfront costs. These costs will, on a per household basis, generally depend upon the size of municipality / municipalities.

Innovative Finns Find Cash n Waste Management (European Commission, 2016)[38]

- Developed a sensor that detects the level of garbage in a bin and if its overflowing. Possible cost and fuel savings as the truck only has to go out when the bins are full.

Costs for Municipal Waste Management in the EU Final Report to Directorate General Environment, European Commission (Eunomia, 2001)[39]

- The influence of scale on the costs of certain facilities is known to be highly significant.
- Collection of dry recyclables reduces the quantity of residual waste collected
- PAYT schemes could be implemented to reduce the frequency at which waste is set out

[38] https://ec.europa.eu/environment/ecoap/about-eco-innovation/business-fundings/innovative-finns-find-cash-waste-management_en. *Accessed April 15, 2019*

[39] http://ec.europa.eu/environment/waste/studies/pdf/eucostwaste.pdf. *Accessed April 15, 2019*

3. Financial Analysis

3.1 System Modeling and Economics

3.1.1 Background

The objective of the financial analysis is to provide an analysis of the expected financial and environmental impact for recommended changes to Nova Scotia's waste-resource management by creating a financial model. The model developed is based on the major waste management infrastructure including transfer stations, landfills, MRFs, and composting facilities.

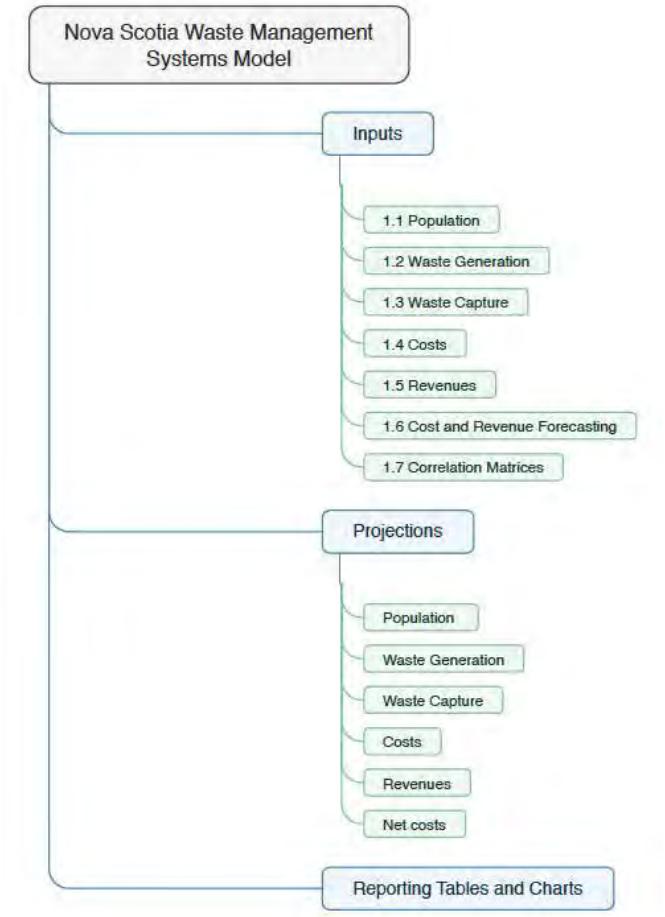
The steps to develop the model included:

- March 3, 2018 project initiation meeting with the Steering Committee. The Datacall system was discussed. It was determined that reports, such as Solid Waste Management Plans and Landfill Master Plans were not available. Solid Waste Management Plans would provide for waste projection, waste flows, infrastructure assessment and development plans, waste diversion goals, and associated financials. Landfill Master Plans would provide for the overall build out of the landfill site, cell sequencing, associated capital cots, and closure and post-closure care costs.
- March 8, 2018 Meeting with Nova Scotia Environment on background and type of information available in Datacall.
- Preliminary review of Datacall information online determined system was not easily understood to mine data for project. This was discussed at the May 7, 2018 Steering Committee meeting.
- May 29 and 31, 2018 regional coordinators meeting on community profiles and waste flows overview, on the forms provided for regional coordinators to complete and the verification process. The community profile information is to clarify waste flows and develop waste flow module for financial model as provided by regional coordinators. The submissions were requested to be completed by June 22, 2018
- February 20, 2019 – meeting to discuss completed community profiles and waste flows and move forward with financial model development. Based on Priority Group direction, to use Datacall financials from 2016 versus obtaining information directly from regions.
- March to July 2019, develop model with assistance from Nova Scotia Environment in supplying annualized costs per region including operating costs and amortized capital costs and waste flow quantities. As modules completed coordinated meetings and discussions with regional coordinators to overview modules for their region, verify information, and rationalize gaps or errors within the data. Regional Coordinators were provided access to the Model for online verification or given spreadsheets for regional coordinators to update and verify data. This included verifying data for:
    1. Waste generation by service area (waste shed) and population projection.
    2. Waste stream data to break out waste composition into recyclables, organics, garbage, and other.
    3. Map the waste flow to show the flow of materials through the waste shed (i.e., collection, drop-off, transfer, MRF, composting facilities, landfills).
    4. Verify annualized capital and operating costs.
    5. Verify revenues.

- July 25, 2019 Meeting with Steering Group which included direction to finalize the model and present current findings, develop recommendations for further analysis and changes to the Datacall system, and prepare a presentation.

3.1.2 Approach

In order to examine system costs a system model is required. To this end an integrated system model addressing waste flows and cash flows was architected and built using Quantrix Modeler. The overview model structure is depicted below (Figure 10).



Source: Keir Corp, 2019

Figure 10: Model Structure

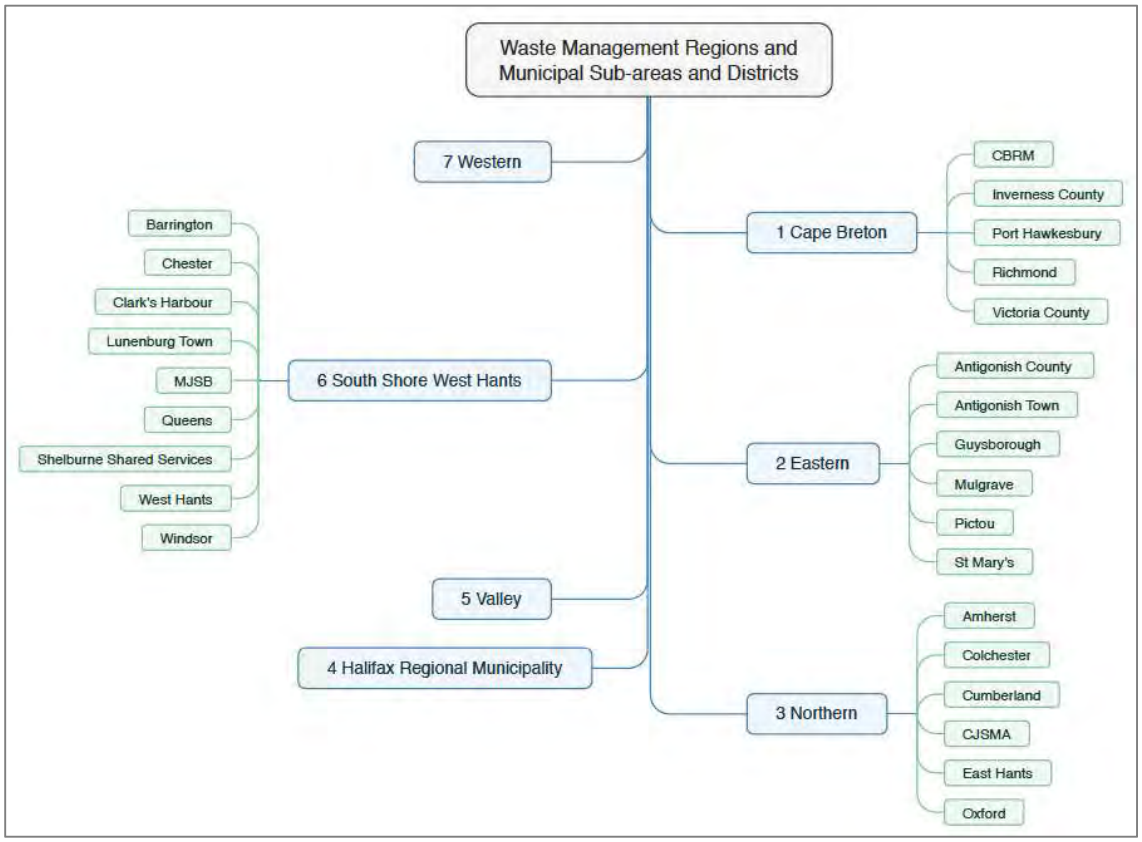
The input modules enable model calibration with existing data and assumptions. The projection modules use the input data to generate outputs over time for waste generation, waste capture, system flows and system costs and revenues. The reporting modules produce summary tables and graphs of the projections. Users enter data into the model in the input module. The other modules automatically calculate.

3.1.3 Model Overview

The completed model consists of 186 matrices with a total cell count of 35.1 million of which 25.6 million are calculated and 9.5 million are inputs. The model contains modules as per Figure 1 as further detailed in this section.

Population

Population was obtained for 99 census subdivisions (including First Nations) in the Province with the base year being 2016. These, were subsequently grouped into the 7 Regions and 28 constituent municipalities and service areas (Figure 11)

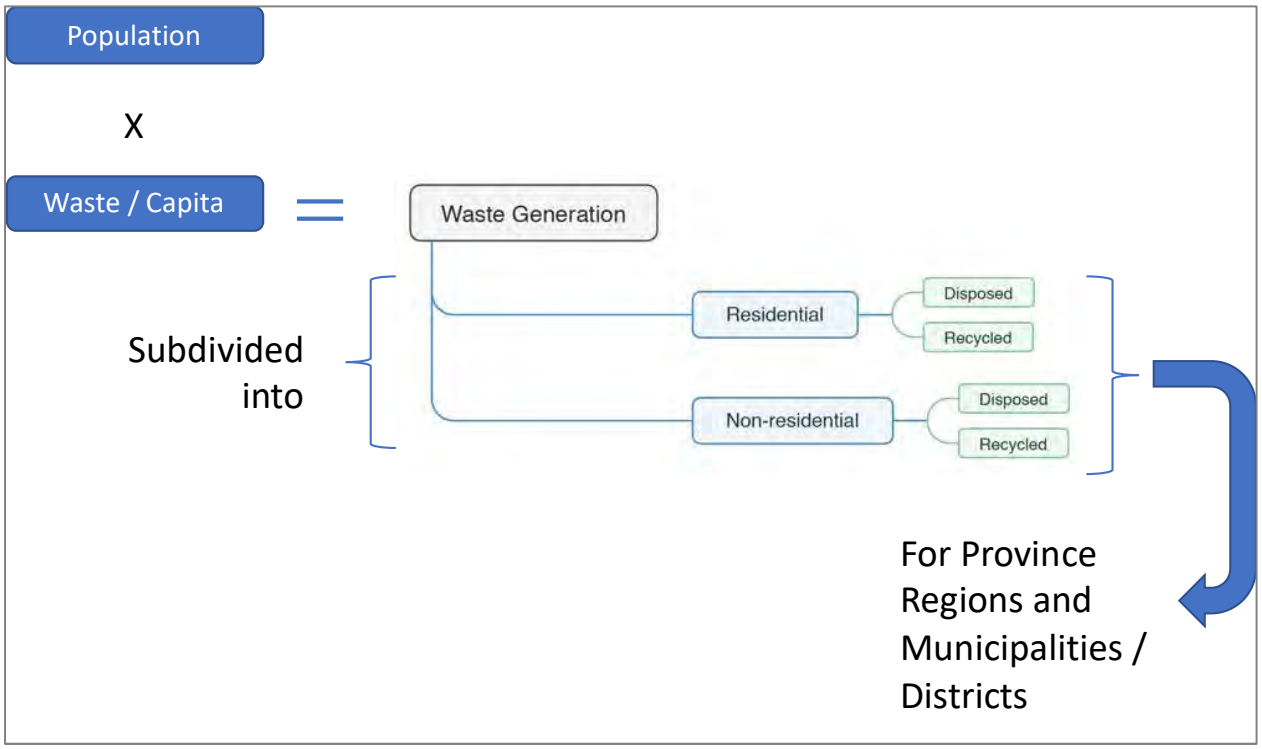


Source: Keir Corp, 2019

Figure 11: Waste Management Regions and Municipal Sub-areas

Waste Generation

Using per capita waste generation assumptions, waste generation in tonnes is calculated for the each of the Regions and sub-areas in terms of residential and non-residential waste and further subdivided into waste that is disposed and waste that is recycled (Figure 12). The population and waste projection period is 2016 to 2040.



Source: Keir Corp, 2019

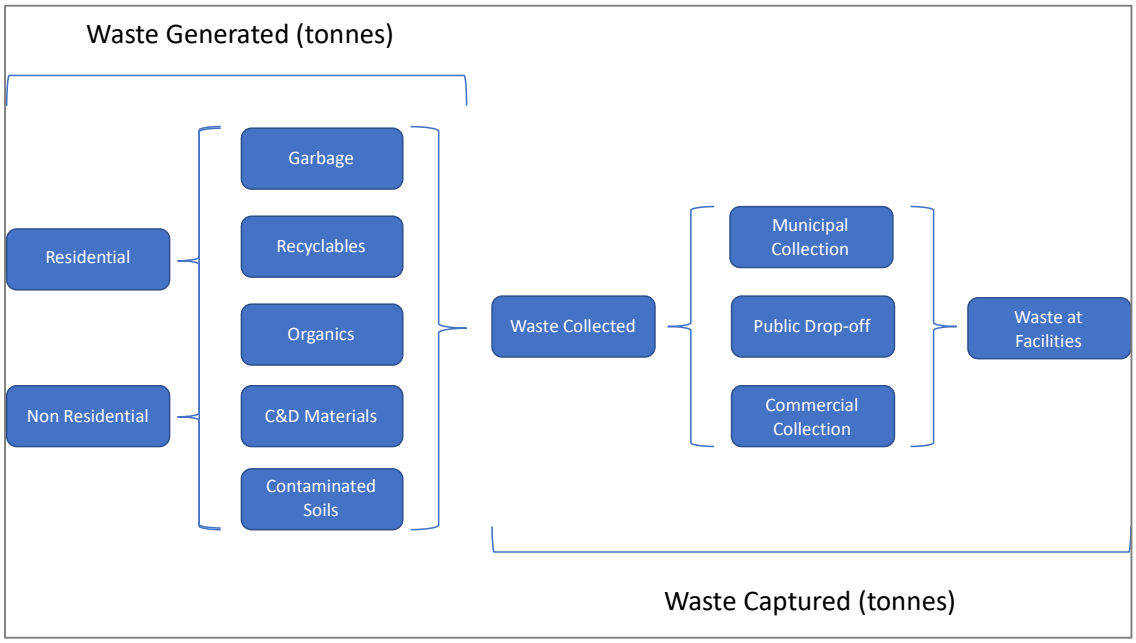
Figure 12: Waste Generation

Waste Capture

From waste generation, waste capture subdivides the residential and non-residential waste streams into garbage, construction and demolition materials, contaminated soils, recyclables, other recyclables and organics flows. In a two-step process the flows are first parsed by collection systems (including public drop-off) and generating sources (i.e. single family and multi-family residences).

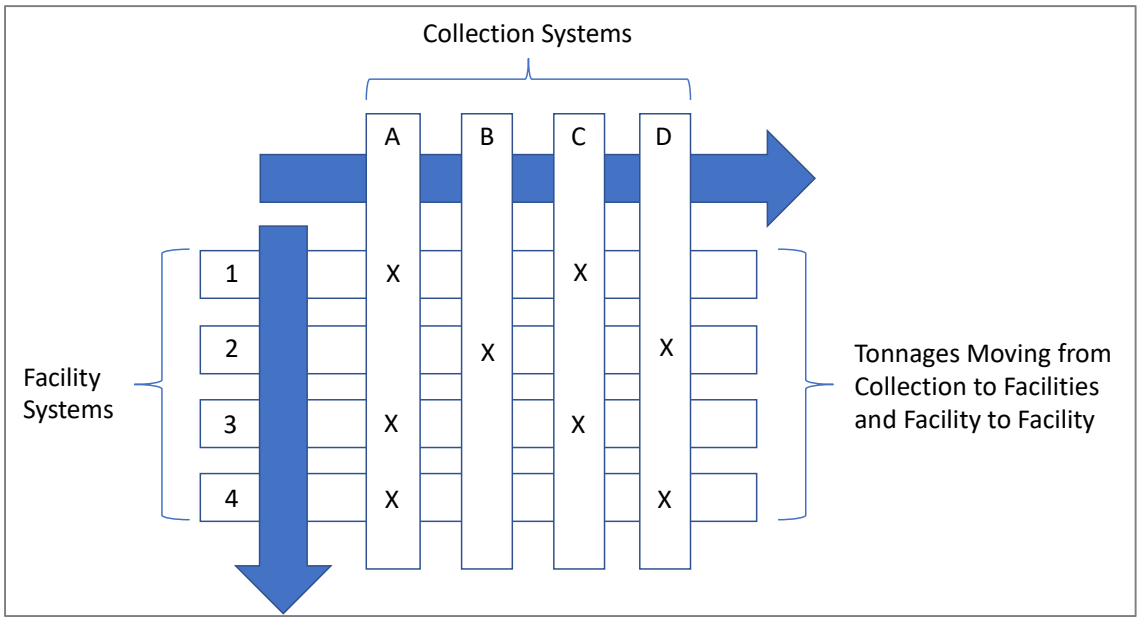
In the second step of the waste capture analysis the various streams of waste are channeled through the waste system facilities including transfer stations, MRFs, compost facilities and landfills

The diagrams that follow (Figures 13 and 14) set out schematics for the waste capture model structure.



Source: Keir Corp, 2019

Figure 13: Waste Capture

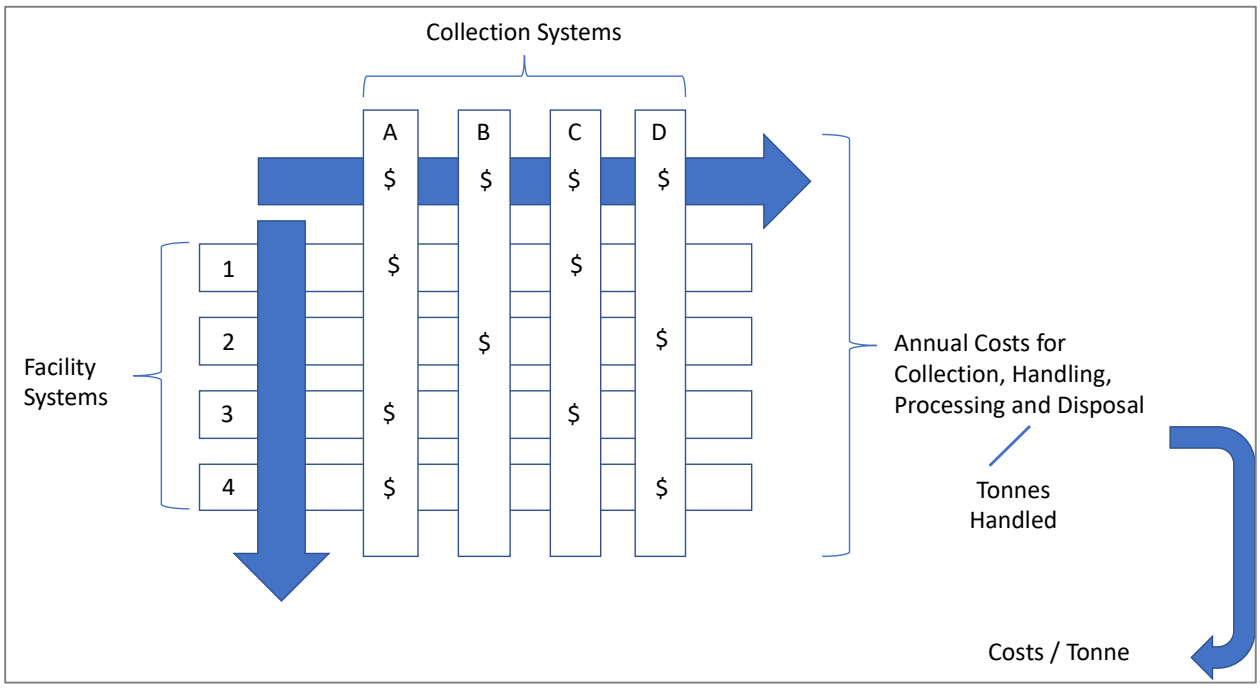


Source: Keir Corp, 2019

Figure 14: Waste Flows through System

Costs

The model is calibrated with annualized costs for the various activities and facilities in the system. These costs reflect capital and operating expenditures on a yearly basis. The aggregate costs for each activity and facility are then divided by tonnes handled to yield costs per tonne (Figure 15).



Source: Keir Corp, 2019

Figure 15: Costs per Tonne

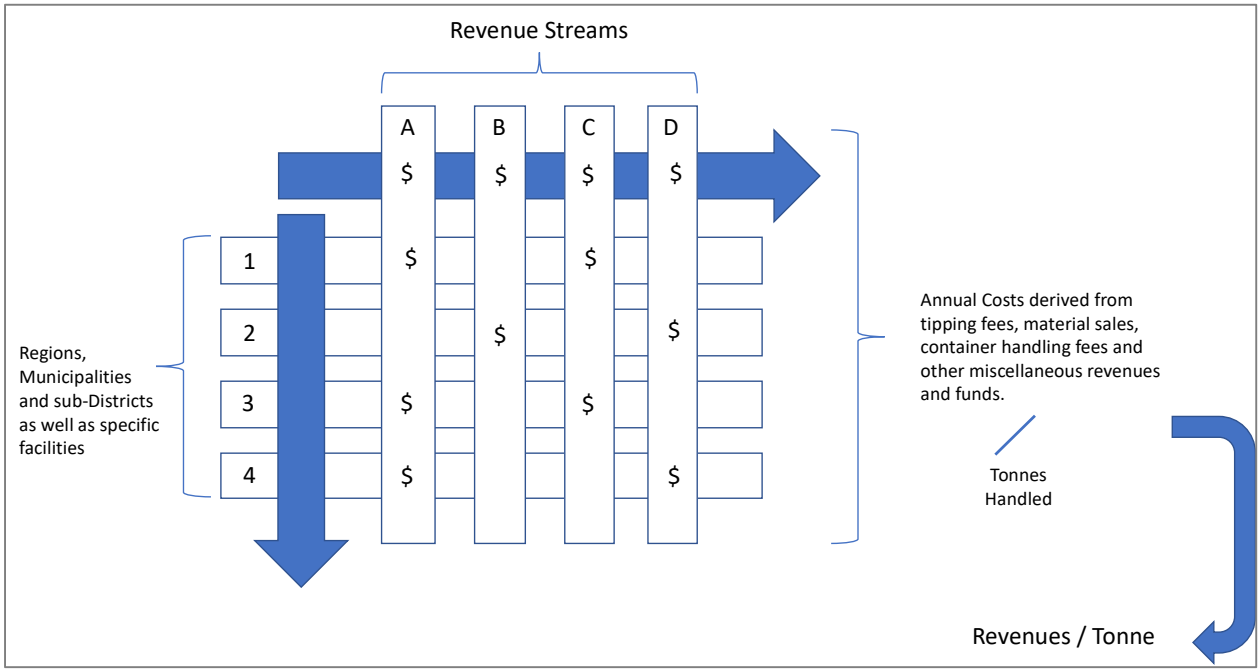
Revenues

The revenues reflect tipping fees at system facilities and also include recycled material sales, beverage container handling fees and other miscellaneous revenues and funds. These revenues are calculated for each of the regions and their associated municipalities and sub-districts as appropriate. Revenues are also calculated as appropriate for specific facilities (i.e. transfer stations and landfills).

To arrive at revenues per tonne the various revenue streams are divided by the tonnes handled on a per facility basis (Figure 16).

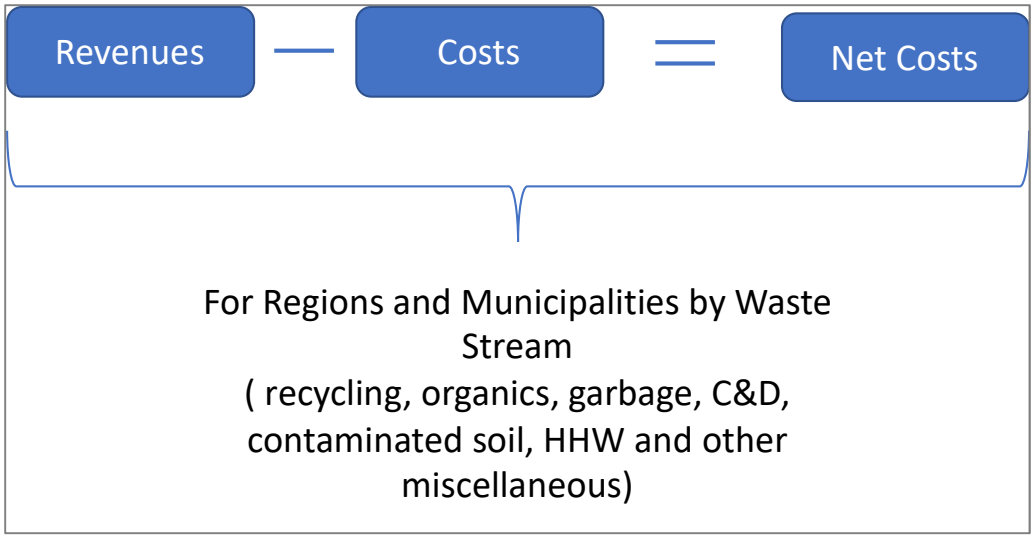
Net Costs

The net costs of the system and various system components and activities are calculated by subtracting costs from revenues (Figure 17).



Source: Keir Corp, 2019

Figure 16: Revenues per Tonne



Source: Keir Corp, 2019

Figure 17: Net Costs

Projections

The model is designed to enable projections for a 24-year period (2016 to 2040). For this model the 2016 baseline information was extracted from the Datacall.

Population projections are developed by applying average annual population growth rates to each of the municipalities in the model based on census trends over period 2006 to 2016.

Waste quantities are projected by using Statistics Canada data for Nova Scotia for per capita waste generation rates and then multiplying these rates by the population projections to yield forecasts of waste generation.

The waste capture rate and flow structures can be varied across the projection period by entering actual data in the current year or by entering data based on flow rechanneling and system restructuring.

Cost and revenue data can be varied across the projection period by using relevant inflation rates to reflect nominal dollar values.

3.1.4 Calibration

The intention was to calibrate the model using information from the Provincial data call. Unfortunately, this was more difficult than anticipated. On examination of the data provided as well as through discussions with various regional managers it was discovered that there were gaps in the data that the consistency of data among regions and municipalities is variable.

Based on these findings, model calibration involved substantial effort to assemble the required data and to subsequently review it internally and externally with each of the regional managers for accuracy and completeness.

To make the model calibration as efficient as possible data capture templates (in Excel) were provided to the regional managers to enable data entry. The model was also loaded to the Quantrix Qloud and regional managers were given access to the data input screens within the model to enable direct data entry and checking.

3.2 Outputs

Once the model is calibrated with actual data and assumptions it generates a series of outputs in tabular and graphical form. These outputs for the year 2019 are set out in the sections that follow.

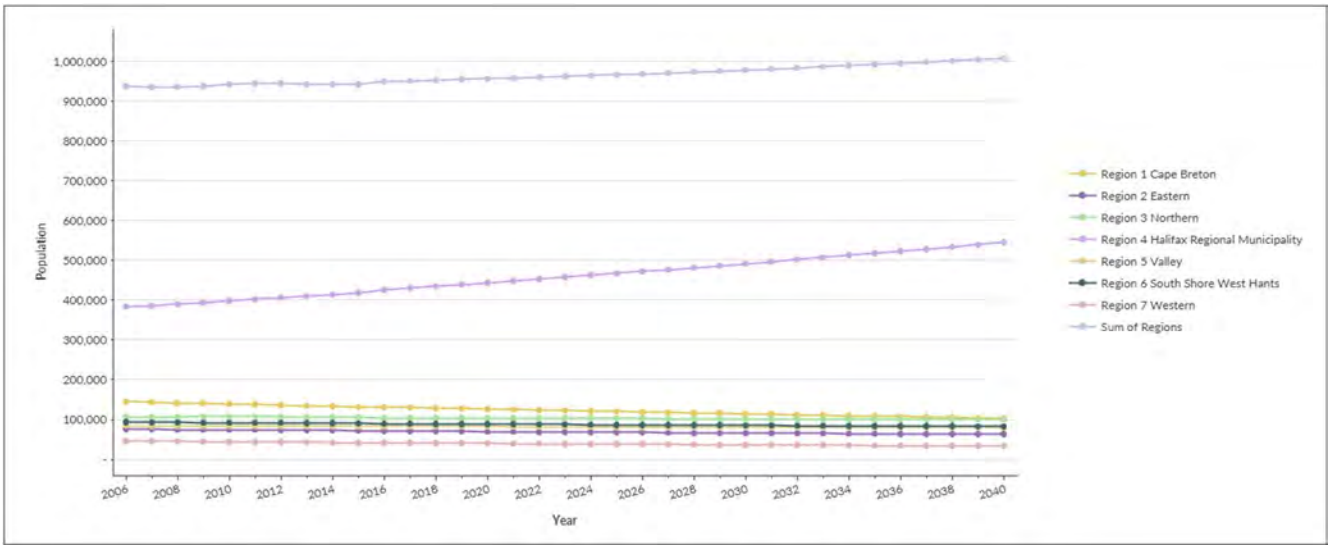
3.2.1 Population

Based on recent trends Nova Scotia is not expected to show dramatic population growth over the forecast period. All regions with the exception of Halifax Regional Municipality show stable or declining populations (Table 8). The average annual growth rate for Halifax Regional Municipality over the period 2006 to 2016 was approximately 0.9%. For the Province as a whole the corresponding average annual growth rate over the same period was approximately 0.1%. These growth rates have been utilized for the projection period 2016 to 2040.

Table 8: Population Growth (2016 – 2040)

		2019	2040
Region 1 Cape Breton	Sum of Region 1	127,726	103,627
Region 2 Eastern	Sum of Region 2	70,493	63,113
Region 3 Northern	Sum of Region 3	104,146	100,131
Region 4 Halifax Regional Municipality		439,393	544,964
Region 5 Valley		82,855	79,975
Region 6 South Shore West Hants	Sum of Region 6	88,982	82,769
Region 7 Western		40,848	33,364
Sum of Regions		954,444	1,007,945

Source: Keir Corp, 2019



Source: Keir Corp, 2019

Figure 18: Projected Population Growth (2016 – 2040)

3.2.2 Waste Generation

The average annual growth rate of per capita waste generation over the period 2006 to 2016 was -0.02% for residential disposal; 0.72% for non-residential disposal; 0.48% for residential diversion; and 0.64% for non-residential diversion. These growth rates have been utilized for the projection period 2016 to 2040.

The 2019 projected waste generation is set out in Table 10. It is based on a per capita waste generation rates of 179 kg for residential disposal; 221 kg for non-residential disposal; 157 kg for residential diversion and 157 kg for non-residential diversion. The total for waste generation amounts to approximately 681,000 tonnes, with 56% of this volume going to disposal and the balance (44%) being diverted. Please note that C&D is included as non-residential disposal and non-residential diversion waste generation.

For the Province the waste destined for disposal amounts to approximately 382,000 tonnes with approximately 45% of the volume being sourced from the residential waste stream and the remainder (55%) coming from the non-residential waste stream.

For diverted waste the total amount across the Province is approximately 300,000 tonnes with residential and non-residential sources each accounting for approximately 50%.

Table 9: Waste Generation (2019)

	Disposal			Diversion		
	Residential	Non-Residential	Sum of Sectors	Residential	Non-Residential	Sum of Sectors
Region 1	22,825	28,237	51,063	20,028	20,072	40,100
Region 2	12,598	15,584	28,182	11,053	11,078	22,132
Region 3	18,612	23,024	41,636	16,330	16,367	32,697
Region 4	78,522	97,140	175,662	68,898	69,051	137,949
Region 5	14,807	18,317	33,124	12,992	13,021	26,013
Region 6	15,902	19,672	35,574	13,953	13,984	27,936
Region 7	7,300	9,031	16,330	6,405	6,419	12,824
Sum of Regions	170,565	211,005	381,570	149,659	149,992	299,651
Percentage of Total Waste Generation	25%	31%	56%	22%	22%	44%

Source: Keir Corp, 2019; Statistics Canada, 2019

3.2.3 Waste Capture

The projected volume of waste captured by municipal curbside collection across the province totals approximately 238,000 tonnes. Of this sum 49% of the tonnage is garbage, 17% is recycling, and 34% is organics. The total amount of material captured through curbside collection is approximately 35% of the Provincial waste generated. Table 10 provides the summary of municipal curbside collection.

Table 10: Municipal Curbside Collection (2019)

	Garbage	Recycling	Organics	Sum of Streams
Region 1	19,740	1,253	6,782	27,775
Region 2	7,328	3,766	5,599	16,692
Region 3	10,227	5,490	9,472	25,189
Region 4	45,333	19,611	39,081	104,025
Region 5	9,443	3,564	8,614	21,621
Region 6	17,917	5,425	7,896	31,237
Region 7	5,827	1,907	3,428	11,162
Sum of Regions	115,813	41,016	80,872	237,701
Percentage of Total Curbside Collection	49%	17%	34%	100%

Source: Keir Corp, 2019

Note: Garbage collection tonnages include recyclables that are subsequently diverted

Not all municipal collection is captured at public facilities. Some municipalities take their collection directly to private disposal and processing facilities.

The amount of waste captured via municipal curbside collection only accounts for a portion of the waste that enters the public waste management system. A substantial amount of waste enters the system through various facilities via drop-off by the public or tipping by commercial operators. The total amount of waste received at municipal disposal and processing facilities totals 434,000 tonnes. This quantity includes municipal curbside collection, transfer haul, residential self-haul, and private commercial haul. The total waste capture at public disposal and processing facilities is provided in Table 11.

Table 11: Waste Capture at Municipal Disposal and Processing Facilities (2019)

	Garbage	C&D Disposed	Contaminated Soil	C&D Diverted	Curbside Type Recyclables	Other Recyclables	Organics	HHW	Sum of Streams
Region 1		16,736			6,922	1,023	11,296	2	35,980
Region 2	65,949	4,972	3,700	326			8,934		83,882
Region 3	25,714	14,619	18,237	201	12,670	243	17,033		88,717
Region 4	44,143		711		28,478	1,082	52,736	524	127,674
Region 5									
Region 6	65,904	1,397	3,580	10,496	1,271		6,898		89,547
Region 7		1,179	922	2,284		663	3,428		8,476
Sum of Regions	201,710	38,904	27,151	13,308	49,342	3,010	100,325	527	434,276
Percentage of Total Capture	46%	9%	6%	3%	11%	1%	23%	0%	100%

Source: Keir Corp, 2019

Note some of the recyclables captured at Otter Landfill are also captured at Halifax recycling. These tonnages have only been included once in the above.

3.2.4 Waste Facility Infrastructure

There are 63 publicly owned waste management facilities in the Provincial system. These include:

Transfer Stations*	24
MSW Landfills**	6
C&D Landfills	13
MRFs	7
Compost Facilities	13
Total	**63**

*Total includes transfer station at Kaiser Meadow Landfill and public drop-off at Colchester Balefill Facility

**5 of the public MSW landfills include C&D landfills. These are not included in the C&D landfills count.

The facility locations are provided in the Community Profiles in Appendix 8.

The waste flows through Nova Scotia's system of public facilities are set out for the various regions in the following sequence of tables and graphs for transfer stations, landfills, material recycling facilities, and organic processing facilities**. Please note that not all waste captured through municipal collection or at the transfer station flows to public facilities for disposal or processing. The waste flow does not include materials captured at private facilities.**

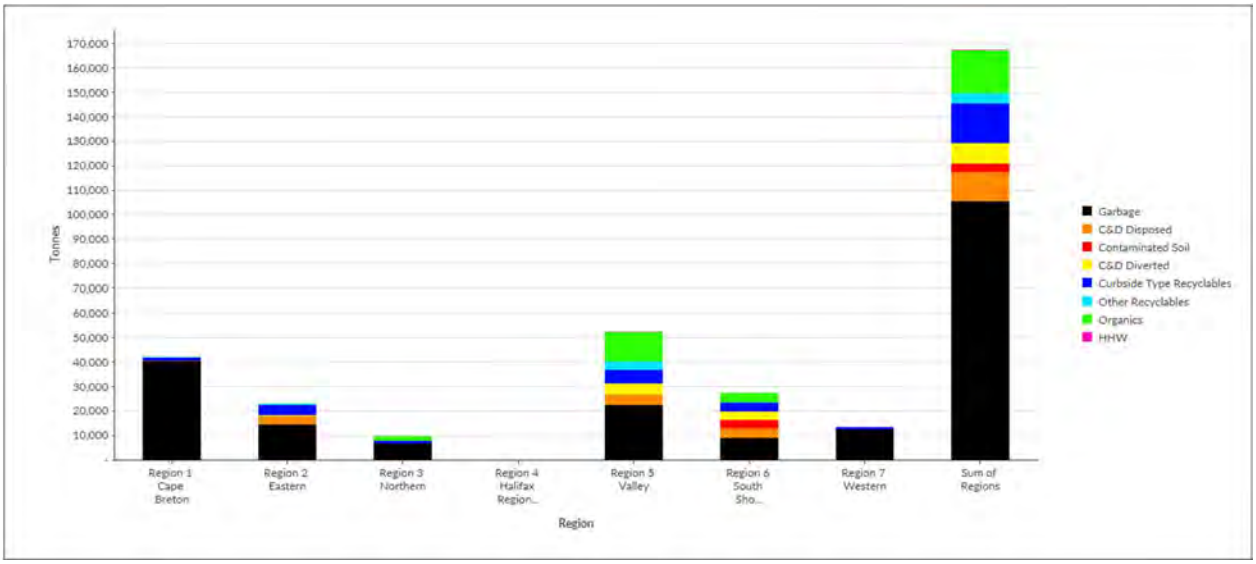
Transfer Stations

Public transfer stations receive approximately 167,000 tonnes of waste from across the Province, which equates to roughly 25% of the total waste generation of 681,000 tonnes. Table 12 and Figure 19 provide a summary by region.

Table 12: Public Transfer Station Waste Capture (2019)

	Garbage	C&D Disposed	Contaminated Soil	C&D Diverted	Curbside Type Recyclables	Other Recyclables	Organics	HHW	Sum of Streams
Region 1	40,445	121			1,204	207		2	41,980
Region 2	14,544	3,340		427	4,104	469	74	1	22,959
Region 3	6,743				1,050		1,696	10	9,499
Region 4									
Region 5	22,373	4,420		4,420	5,597	3,389	11,981	96	52,276
Region 6	8,894	3,950	3,450	3,551	3,560	160	3,711		27,276
Region 7	12,553	5			706				13,265
Sum of Regions	105,552	11,837	3,450	8,399	16,221	4,224	17,461	110	167,254
Percentage of Total Capture	63%	7%	2%	5%	10%	3%	10%	0%	100%

Source: Keir Corp, 2019



Source: Keir Corp, 2019

Figure 19: Public Transfer Station Waste Capture (2019)

Landfills

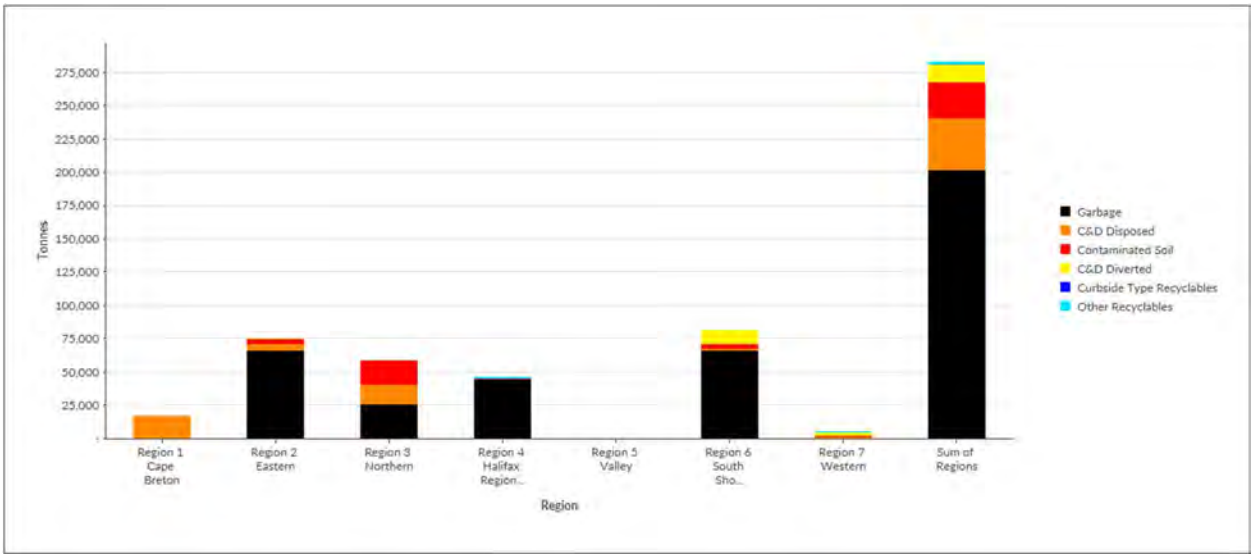
Public MSW landfills and C&D landfills receive approximately 283,000 tonnes from across the Province, which equates to approximately 42% of the total waste generation of 681,000 tonnes. Table 13 and Figure 20 provide a summary by region.

Table 13: Landfill Waste Capture (2019)

	Garbage	C&D Disposed	Contaminated Soil	C&D Diverted	Curbside Type Recyclables	Other Recyclables	Sum of Streams
Region 1		16,736					16,736
Region 2	65,949	4,972	3,700	326			74,948
Region 3	25,714	14,619	18,237	201		47	58,818
Region 4	44,143		711		109	1,082	46,044
Region 5							
Region 6	65,904	1,397	3,580	10,496			81,378
Region 7		1,179	922	2,284		663	5,048
Sum of Regions	201,710	38,904	27,151	13,308	109	1,791	282,972
Percentage of Total Capture	71%	14%	10%	5%	0%	1%	100%

Source: Keir Corp, 2019

Note curbside type recyclables and other recyclables captured by landfills are diverted



Source: Keir Corp, 2019

Note curbside type recyclables and other recyclables captured by landfills are diverted

Figure 20: Landfill Waste Capture (2019)

Material Recycling Facilities

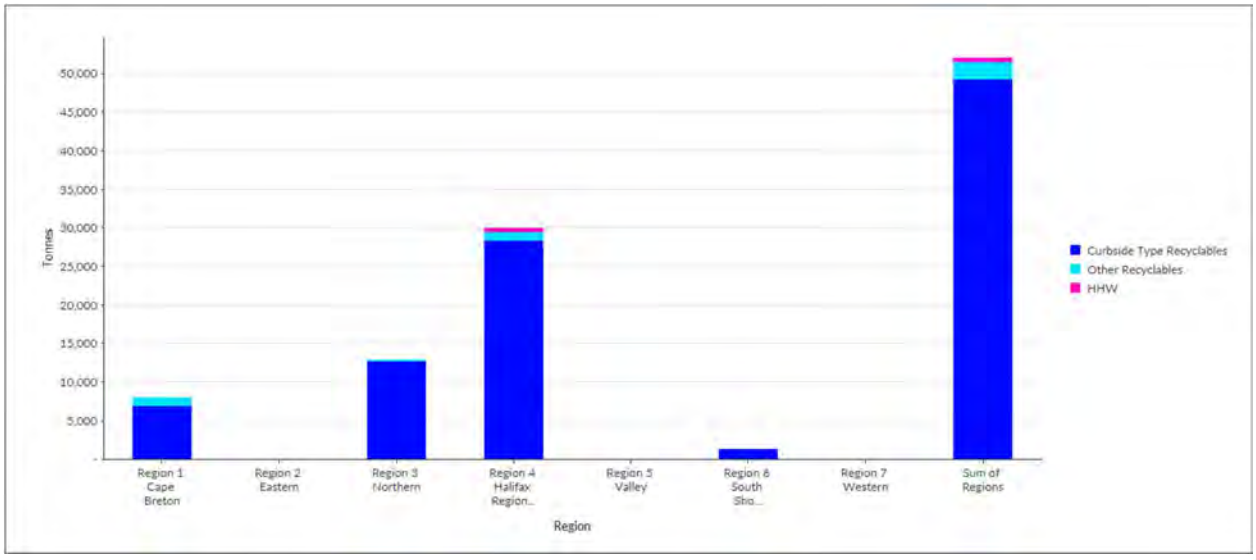
Public material recycling facilities receive approximately 52,000 tonnes from across the Province, which equates to approximately 8% of the total waste generation of 681,000 tonnes. Table 14 and Figure 21 provide a summary by region.

Table 14: MRF Waste Capture (2019)

		Curbside Type Recyclables	Other Recyclables	HHW	Sum of Streams
Region 1 Cape Breton	Sum of Region 1	6,922	1,023	2	7,948
Region 2 Eastern	Sum of Region 2				
Region 3 Northern	Sum of Region 3	12,670	196		12,866
Region 4 Halifax Regional Municipality		28,376	1,082	524	29,982
Region 5 Valley					
Region 6 South Shore West Hants	Sum of Region 6	1,271			1,271
Region 7 Western					
Sum of Regions		49,239	2,301	527	52,067
Percentage of Total Capture		95%	4%	1%	100%

Note: 6 tonnes of curbside type recyclables and 1,082 tonnes of other recyclables collected at Otter Lake Landfill are diverted to HRM Recycling

Source: Keir Corp, 2019



Note: 6 tonnes of curbside type recyclables and 1,082 tonnes of other recyclables collected at Otter Lake Landfill are diverted to HRM Recycling

Source: Keir Corp, 2019

Figure 21: MRF Waste Capture (2019)

Organics Processing Facilities

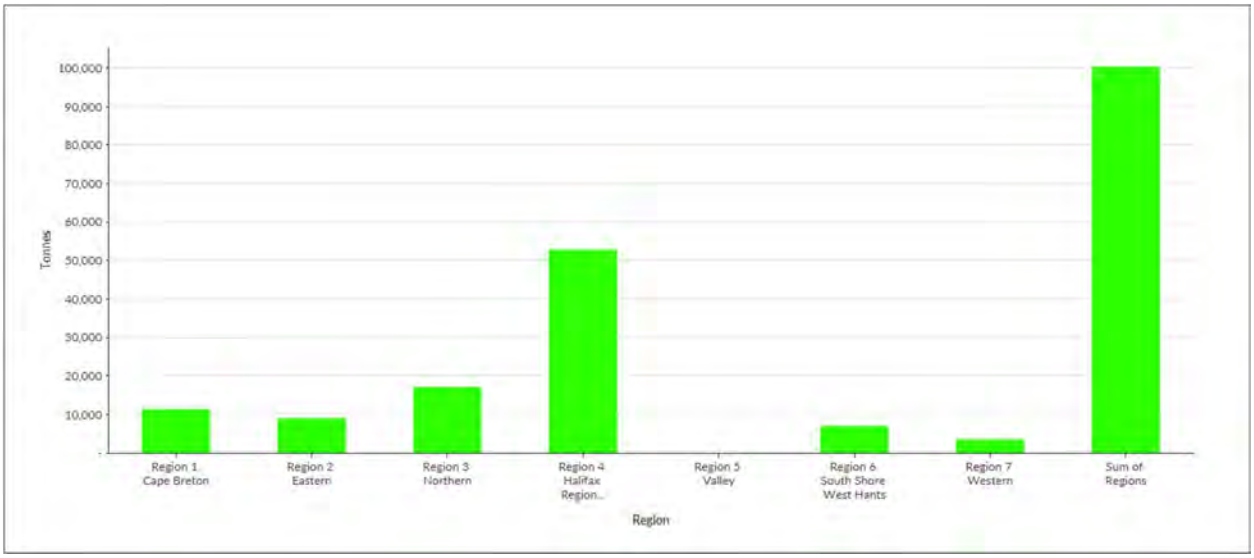
Organic processing facilities receive approximately 100,000 tonnes from across the Province, which equates to approximately 15% of the total waste generation of 681,000 tonnes. Table 15 and Figure 22 provide a summary by region.

Table 15: Public Organic Processing Facility Flows (2019)

	Organics
Region 1 Cape Breton	11,296
Region 2 Eastern	8,934
Region 3 Northern	17,033
Region 4 Halifax Regional Municipality	52,736
Region 5 Valley	
Region 6 South Shore West Hants	6,898
Region 7 Western	3,428
Sum of Regions	100,325

Source: Keir Corp, 2019

Note: Organics includes leaf and yard, food waste, and clean wood waste (C&D)



Source: Keir Corp, 2019

Note: Organics includes leaf and yard, food waste, and clean wood waste (C&D)

Figure 22: Public Organic Processing Facility Flows (2019)

3.3 System Costs

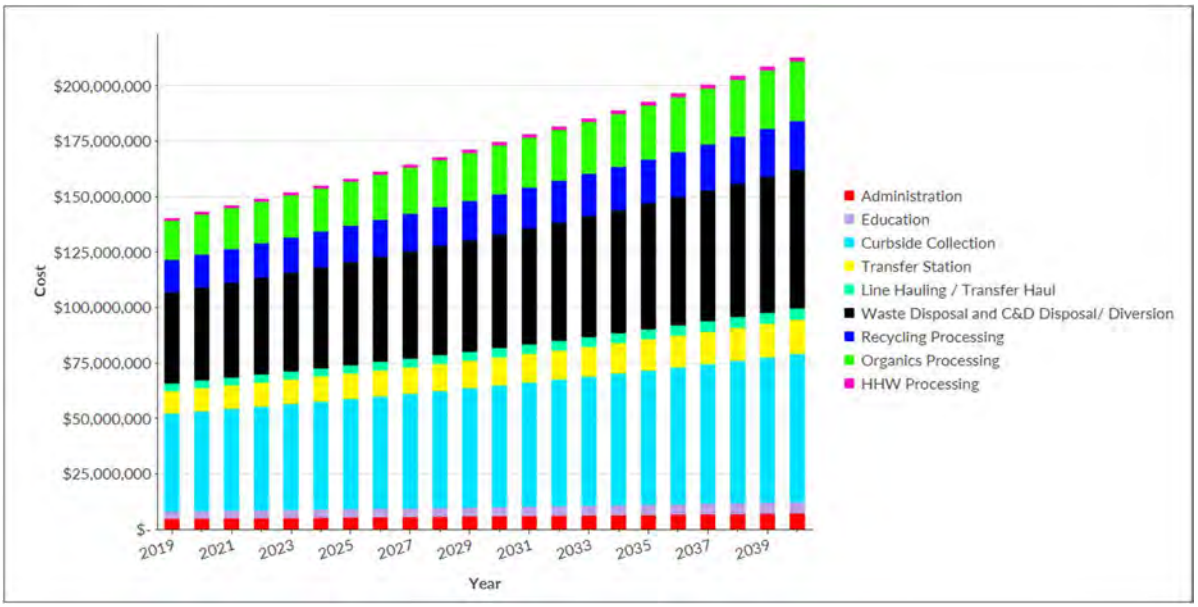
As waste is collected and flows through system facilities costs are incurred. In 2019 the estimated cost of Nova Scotia's public waste management system is approximately $140 million as set out in Table 16.

Table 16: Waste Management System Costs (2019)

	Admin	Education	Curbside Collection	Transfer Station	Line Hauling / Transfer Haul	Waste Disposal and C&D Disposal/ Diversion	Recycling Processing	Organics Processing	HHW Processing	Sum of Cost Item
Region 1	$1,056,677	$388,709	$5,599,236	$1,845,134	$1,318,834	$5,655,972	$3,521,493	$3,950,443	$16,524	$23,353,023
Region 2	$255,612	$411,529	$4,363,395	$1,193,112	$358,259	$4,494,870	$431,160	$857,922	$62,689	$12,428,547
Region 3	$938,146	$523,747	$4,981,182	$758,329	$214,875	$4,294,829	$3,451,406	$1,177,968	$133,646	$16,474,128
Region 4	$1,114,021	$656,153	$16,856,312	$380,624		$17,629,077	$4,797,058	$8,853,222	$703,135	$50,989,602
Region 5	$533,877	$629,932	$2,935,271	$2,605,994	$627,776	$1,658,474	$875,965	$1,041,114	$71,223	$10,979,625
Region 6	$501,549	$429,540	$7,094,058	$2,424,337	$826,258	$5,715,090	$1,058,877	$1,133,290	$88,222	$19,271,221
Region 7	$275,866	$340,197	$2,247,302	$995,860		$1,864,643	$331,596	$688,881	$36,727	$6,781,072
Sum of Regions	$4,675,748	$3,379,807	$44,076,754	$10,203,391	$3,346,002	$41,312,954	$14,467,555	$17,702,840	$1,112,167	$140,277,218
Percentage	3%	2%	31%	7%	2%	29%	10%	13%	1%	100%

Source: Keir Corp, 2019

Figure 23 provides a cost projection across the forecast period (2019 to 2040) for handling the different material flows through the system including hazardous waste and other materials. This projection does not change the current system configuration and it is driven by the population projections, waste generation projections and dollar inflation. The inflation rate is assumed to be 2% for both costs and revenues.



Source: Keir Corp, 2019

Figure 23: System Cost Projections by Waste Flow (2019 – 2040)

Cost projections on a regional basis for 2019 and 2040 are provided in Table 17.

Table 17: System Cost Projection (2019 and 2040)

		2019	2040
Region 1 Cape Breton	Sum of Region 1	$23,353,023	$35,395,391
Region 2 Eastern	Sum of Region 2	$12,428,547	$18,837,530
Region 3 Northern	Sum of Region 3	$16,474,128	$24,969,282
Region 4 Halifax Regional Municipality		$50,989,602	$77,283,223
Region 5 Valley		$10,979,625	$16,641,448
Region 6 South Shore West Hants	Sum of Region 6	$19,271,221	$29,208,741
Region 7 Western		$6,781,072	$10,277,842

Source: Keir Corp, 2019

The model permits significant disaggregation of the overall system costs to individual municipalities, facility groups, specific facilities, and individual waste streams. In the sequence of tables and charts that follow the costs for transfer stations, MRFs, organic processing facilities and landfills are provided.

It should be noted that as not all regions have all waste infrastructure, there are waste flows that cross regional boundaries therefore there are a set of costs for the municipalities that own and operate (either directly or through contract) the facilities as well as costs (via tipping fees) that apply to municipalities that transfer their waste material to facilities beyond their borders or private facilities. The tables that follow identify tipping fees paid by municipalities to external transfer station, landfill, recycling and organics processing facilities. The tip fee costs presented are not intended to include hauling costs, however, due to differences in reporting some municipalities may be including hauling costs in addition to tip fee costs.

Transfer Stations

Table 18 provides the tonnage, costs, and cost per tonne for municipal transfer stations. The costs set out include facility operating costs and amortized capital costs.

Table 18: Costs for Municipalities that own Transfer Stations

		Tonnes	Cost	Cost per Tonne
Region 1 Cape Breton	CBRM	30,210	$620,078	$21
	Inverness County	5,682	$325,243	$57
	Port Hawkesbury			
	Richmond	3,021	$153,665	$51
	Victoria County	3,066	$746,148	$243
Region 2 Eastern	Antigonish County	8,033	$162,448	$20
	Antigonish Town			
	Guysborough	1,668	$108,102	$65
	Mulgrave			
	Pictou	12,838	$814,215	$63
	St. Mary's	419	$100,186	$239
Region 3 Northern	Amherst			
	Colchester	1,332		
	Cumberland			
	CJSMA	333		
	East Hants	7,834	$758,329	$97
	Oxford			
Region 4 Halifax Regional Municipality			$380,624	
Region 5 Valley		52,276	$2,605,994	$50
Region 6 South Shore West Hants	Barrington			
	Chester	2,725	$4,917	$2
	Clark's Harbour			
	Lunenburg Town			
	MJSB	19,317	$1,843,480	$95
	Queens	2,106	$255,930	$122
	Shelburne Shared Services	3,129	$207,389	$66
	West Hants			
	Windsor			
Region 7 Western		13,265	$995,860	$75
Sum of Regions		167,254	$10,082,608	$60

Source: Keir Corp, 2019

Note: St. Mary's transfer station operating cost includes line hauling

Table 18 indicates that the per tonne cost range for municipalities that own and operate (either directly or through contract) their own transfer stations ranges from $21 to $122. The outlier values are Chester ($2), St. Mary's ($239), and Victoria County ($243). St. Mary's transfer station operating cost includes line hauling.

Table 19: Tipping Costs for Municipalities that Export to Transfer Stations

		Recycling			Organics		
		Tonnes	Cost	Cost per Tonne	Tonnes	Cost	Cost per Tonne
Region 1 Cape Breton	CBRM						
	Inverness County						
	Port Hawkesbury						
	Richmond						
	Victoria County						
Region 2 Eastern	Antigonish County						
	Antigonish Town	11					
	Guysborough						
	Mulgrave	36	$8,163	$225			
	Pictou						
	St. Mary's						
Region 3 Northern	Amherst						
	Colchester						
	Cumberland						
	CJSMA						
	East Hants						
	Oxford						
Region 4 Halifax Regional Municipality							
Region 5 Valley							

Table 19: Tipping Costs for Municipalities that Export to Transfer Stations
(Continued)

		Recycling			Organics		
		Tonnes	Cost	Cost per Tonne	Tonnes	Cost	Cost per Tonne
Region 6 South Shore West Hants	Barrington				341	$45,065	$132
	Chester						
	Clark's Harbour				12	$1,520	$131
	Lunenburg Town	222			360		
	MJSB						
	Queens						
	Shelburne Shared Services				497	$66,036	$133
	West Hants						
	Windsor						
Region 7 Western							
Sum of Regions		269	$8,163	$30	1,210	$112,621	$93

Source: Keir Corp, 2019

Table 19 indicates the per tonne cost range for municipalities exporting waste to external transfer stations ranges from tipping fees of $131 per tonne for organics to $225 per tonne for recycling. These costs are based on reported tipping fees however due to differences in reporting some municipalities may be including hauling costs.

Table 20 provides a breakdown of transfer station costs by municipality for those that own and operate (either directly or through contract) their own facilities as well as those that export their waste materials to external transfer stations. The costs presented do not include line hauling costs. In total transfer station costs in the Province amount to approximately $10.2 million.

Table 20: Transfer Station Costs Summary

		Municipal Transfer Station Owner Costs	Municipal Customer Tipping Costs		Sum of Transfer Station Costs
			Recycling	Organics	
Region 1 Cape Breton	CBRM	$620,078			$620,078
	Inverness County	$325,243			$325,243
	Port Hawkesbury				$ -
	Richmond	$153,665			$153,665
	Victoria County	$746,148			$746,148
	Sum of Region 1	$1,845,134			$1,845,134
Region 2 Eastern	Antigonish County	$162,448			$162,448
	Antigonish Town				$ -
	Guysborough	$108,102			$108,102
	Mulgrave		$8,163		$8,163
	Pictou	$814,215			$814,215
	St. Mary's	$100,186			$100,186
	Sum of Region 2	$1,184,950	$8,163		$1,193,112
Region 3 Northern	Amherst				
	Colchester				
	Cumberland				
	CJSMA				
	East Hants	$758,329			$758,329
	Oxford				
	Sum of Region 3	$758,329			$758,329
Region 4 Halifax Regional Municipality		$380,624			$380,624
Region 5 Valley		$2,605,994			$2,605,994
Region 6 South Shore West Hants	Barrington			$45,065	$45,065
	Chester	$4,917			$4,917
	Clark's Harbour			$1,520	$1,520
	Lunenburg Town				
	MJSB	$1,843,480			$1,843,480
	Queens	$255,930			$255,930
	Shelburne Shared Services	$207,389		$66,036	$273,425
	West Hants				
	Windsor				
	Sum of Region 6	$2,311,716		$112,621	$2,424,337
Region 7 Western		$995,860			$995,860
Sum of Regions		$10,082,608	$8,163	$112,621	$10,203,391

Source: Keir Corp, 2019

3.3.1 Landfills

In the case of landfills there are two types of facilities. Those that accept both MSW and C&D waste and those that only accept C&D (Otter Lake is an exception accepting MSW but not C&D waste). C&D landfills also engage in diversion of C&D materials. Table 21 sets out the internal costs for municipalities that own landfill facilities. The costs set out include operating costs and amortized capital costs. The calculated landfill cost per tonne is based on total waste capture and includes tonnages subsequently diverted at the landfill. Table 22 provides landfill costs for municipalities that export their waste material to external facilities.

Table 21: Costs for Municipalities that Landfill their own Waste

		MSW Landfill (w/ C&D)			C&D Landfill Only		
		Tonnes	Cost	Cost per Tonne	Tonnes	Cost	Cost per Tonne
Region 1 Cape Breton	CBRM				16,736	$1,699,601	$102
	Inverness County						
	Port Hawkesbury						
	Richmond					$185,071	
	Victoria County					$137,606	
Region 2 Eastern	Antigonish County						
	Antigonish Town						
	Guysborough	72,281	$3,169,245	$44			
	Mulgrave						
	Pictou				2,414	$61,929	$26
	St. Mary's				253	$13,839	$55
Region 3 Northern	Amherst						
	Colchester	41,685	$2,570,329	$62			
	Cumberland						
	CJSMA	14,953	$1,189,178	$80			
	East Hants				2,180	$143,729	$66
	Oxford						
Region 4 Halifax Regional Municipality		46,044	$17,629,077	$383			
Region 5 Valley							
Region 6 South Shore West Hants	Barrington				3,248	$173,129	$53
	Chester	54,064	$3,136,154	$58			
	Clark's Harbour						
	Lunenburg Town						
	MJSB						
	Queens	24,065	$1,336,136	$56			
	Shelburne Shared Services						
	West Hants						
	Windsor						
Region 7 Western					5,048	$483,763	$96
Sum of Regions		253,092	$29,030,119	$115	29,880	$2,898,667	$97

Source: Keir Corp, 2019

Note C&D Disposal and diversion tonnages are required for Region 1

Note Otter Lake Landfill does not accept C&D waste

Table 21 indicates the cost range for municipalities handling their own waste at their own landfills generally ranges from $44 per tonne to $80 for garbage, contaminated soils, and C&D waste, and $26 per tonne to $102 for C&D material only. Halifax Regional Municipality is an extreme cost outlier for handling their own waste at their own landfill in part due to pre-treatment requirements.

Table 22 indicates that the cost range for municipalities exporting waste for disposal ranges from tipping fee costs of $31 per tonne to $111 for garbage. These costs are based on reported tipping fees, however, due to differences in reporting some municipalities may be including hauling costs. Antigonish County exports C&D waste for $10 per tonne and Valley Region diverts C&D for processing at $35 per tonne.

Table 22: Tipping Costs for Municipalities that Export Garbage, Contaminated Soil and C&D

		Garbage			Contaminated Soil			C&D		
		Tonnes	Cost	Cost per Tonne	Tonnes	Cost	Cost per Tonne	Tonnes	Cost	Cost per Tonne
Region 1 Cape Breton	CBRM	34,427	$2,720,539	$79						
	Inverness County	5,000	$454,582	$91				121		
	Port Hawkesbury	500	$42,110	$84						
	Richmond	2,169	$170,261	$78						
	Victoria County	3,066	$246,200	$80						
Region 2 Eastern	Antigonish County	3,863	$340,384	$88				2,847	$27,668	$10
	Antigonish Town	428	$32,085	$75						
	Guysborough									
	Mulgrave	99	$8,652	$87					$341	
	Pictou	9,749	$797,125	$82						
	St. Mary's	408	$43,602	$107						
Region 3 Northern	Amherst									
	Colchester									
	Cumberland									
	CJSMA									
	East Hants	5,158	$391,593	$76						
	Oxford									
Region 4 Halifax Regional Municipality										
Region 5 Valley		22,373	$1,505,055	$67				4,420	$153,419	$35

Table 22: Tipping Costs for Municipalities that Export Garbage, Contaminated Soil and C&D (Continued)

		Garbage			Contaminated Soil			C&D		
		Tonnes	Cost	Cost per Tonne	Tonnes	Cost	Cost per Tonne	Tonnes	Cost	Cost per Tonne
Region 6 South Shore West Hants	Barrington	1,964	$160,251	$82						
	Chester									
	Clark's Harbour	286	$26,134	$91						
	Lunenburg Town	375								
	MJSB	8,894	$683,324	$77	3,450			1,155		
	Queens									
	Shelburne Shared Services	828	$92,222	$111				1,760		
	West Hants	2,800	$86,230	$31						
	Windsor	560	$21,510	$38						
Region 7 Western		12,553	$1,380,880	$110				5		
Sum of Regions		115,499	$9,202,741	$80	3,450			10,308	$181,428	$18

Source: Keir Corp, 2019

Note: Region 5 shows the tipping cost for C&D diverted for processing

Region 7 tip fee costs include line hauling

C&D may require further investigation the numbers presented represent best available information at this time.

Table 23: Cost Summaries Garbage, Contaminated Soil and C&D

		Municipal Facility Owner Costs		Municipal Customer Tipping Costs			Sum of Waste Disposal and C&D Disposal/ Diversion Costs
		MSW Landfill (w/ C&D)	C&D Landfill	Garbage	Contaminated Soil	C&D	
Region 1 Cape Breton	CBRM		$1,699,601	$2,720,539			$4,420,141
	Inverness County			$454,582			$454,582
	Port Hawkesbury			$42,110			$42,110
	Richmond		$185,071	$170,261			$355,332
	Victoria County		$137,606	$246,200			$383,807
	Sum of Region 1		$2,022,278	$3,633,693			$5,655,972
Region 2 Eastern	Antigonish County			$340,384		$27,668	$368,051
	Antigonish Town			$32,085			$32,085
	Guysborough	$3,169,245					$3,169,245
	Mulgrave			$8,652		$341	$8,993
	Pictou		$61,929	$797,125			$859,054
	St. Mary's		$13,839	$43,602			$57,441
	Sum of Region 2	$3,169,245	$75,768	$1,221,848		$28,009	$4,494,870
Region 3 Northern	Amherst						
	Colchester	$2,570,329					$2,570,329
	Cumberland						
	CJSMA	$1,189,178					$1,189,178
	East Hants		$143,729	$391,593			
	Oxford						
	Sum of Region 3	$3,759,507	$143,729	$391,593			$4,294,829
Region 4 Halifax Regional Municipality		$17,629,077					$17,629,077

Table 23: Cost Summaries Garbage, Contaminated Soil and C&D (continued)

		Municipal Facility Owner Costs		Municipal Customer Tipping Costs			Sum of Waste Disposal and C&D Disposal/ Diversion Costs
		MSW Landfill (w/ C&D)	C&D Landfill	Garbage	Contaminated Soil	C&D	
Region 5 Valley				$1,505,055		$153,419	$1,658,474
Region 6 South Shore West Hants	Barrington		$173,129	$160,251			$333,380
	Chester	$3,136,154					$3,136,154
	Clark's Harbour			$26,134			$26,134
	Lunenburg Town						
	MJSB			$683,324			$683,324
	Queens	$1,336,136					$1,336,136
	Shelburne Shared Services			$92,222			$92,222
	West Hants			$86,230			$86,230
	Windsor			$21,510			$21,510
	Sum of Region 6	$4,472,290	$173,129	$1,069,671			$5,715,090
Region 7 Western			$483,763	$1,380,880			$1,864,643
Sum of Regions		$29,030,119	$2,898,667	$9,202,741		$181,428	$41,312,954

Source: Keir Corp, 2019

Landfill Financial Analysis

The landfill cost provided in Table 21 are lower than anticipated based on research and AECOM experience in developing and assessing landfill financials. From March 1, 2018 meetings with the Steering Committee it is understood that there is no information for Landfill Master Plans available through the regions. A landfill cost evaluation overview is provided in the following section.

3.3.2 Assessment of Canada and US Tipping Fees

Figure 24 provides tipping fees in some landfills across Canada from the National Solid Waste Benchmarking Initiative (NSWBI)[40]. It shows that the average landfill tipping fee is $99.85/Tonne for larger Canadian municipalities.

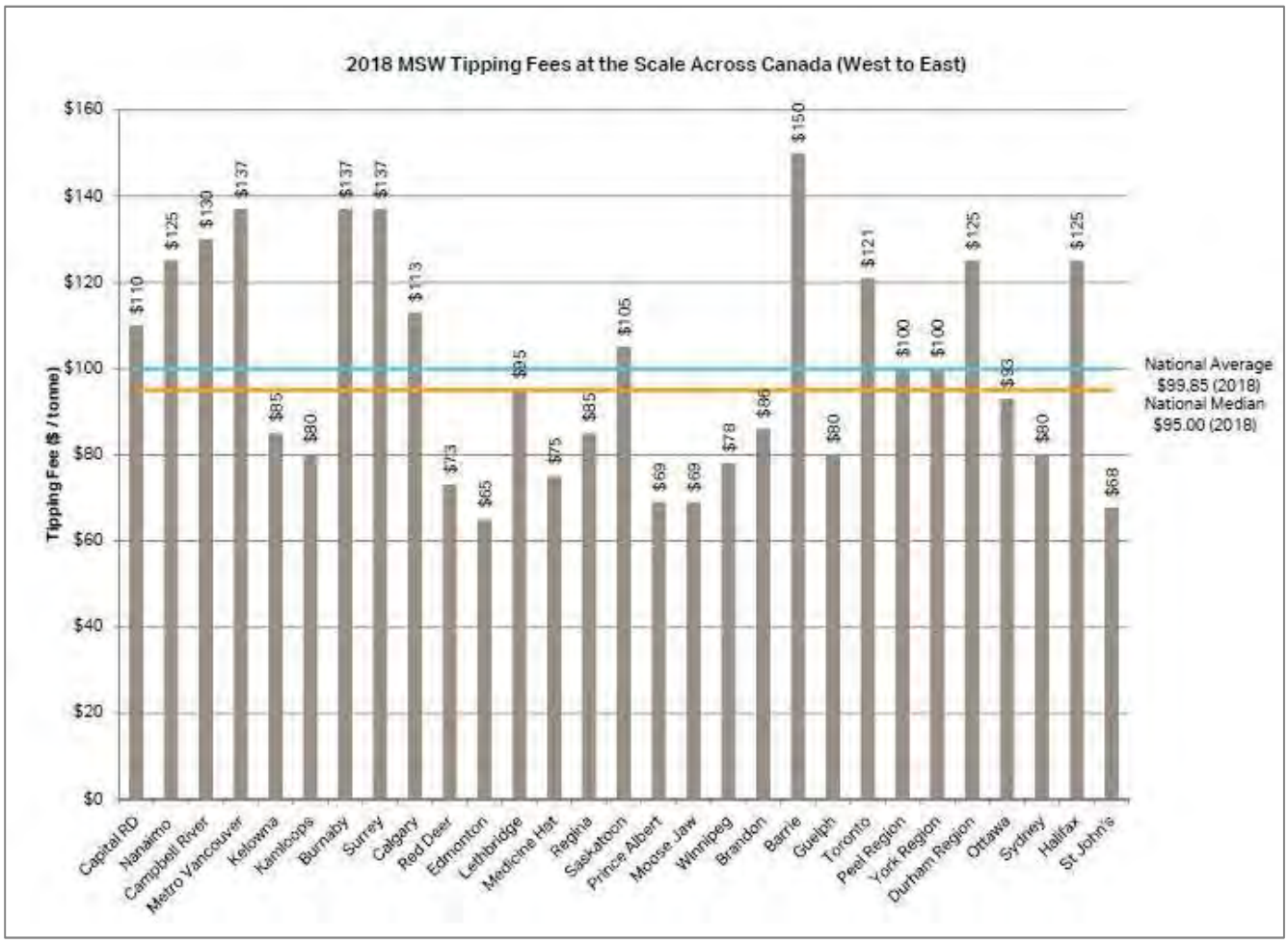


Figure 24: Tipping Fees across some Cities in Canada

The Environmental Research and Education Foundation (EREF)[41] compiled tipping fees for 397 landfills in the USA in 2018. The EREF report is included in Appendix 7. Based on the current exchange rate and converting for tonnage, the tipping fees range from $63 to $72 for small to large landfills. Figure 25 is a plot of tonnage against the tipping fee, which shows the tipping fees are higher for smaller landfills because of limited economies of scale.

[40] http://nswbi.nationalbenchmarking.ca/
[41] https://erefdn.org/product/analysis-msw-landfill-tipping-fees-2/

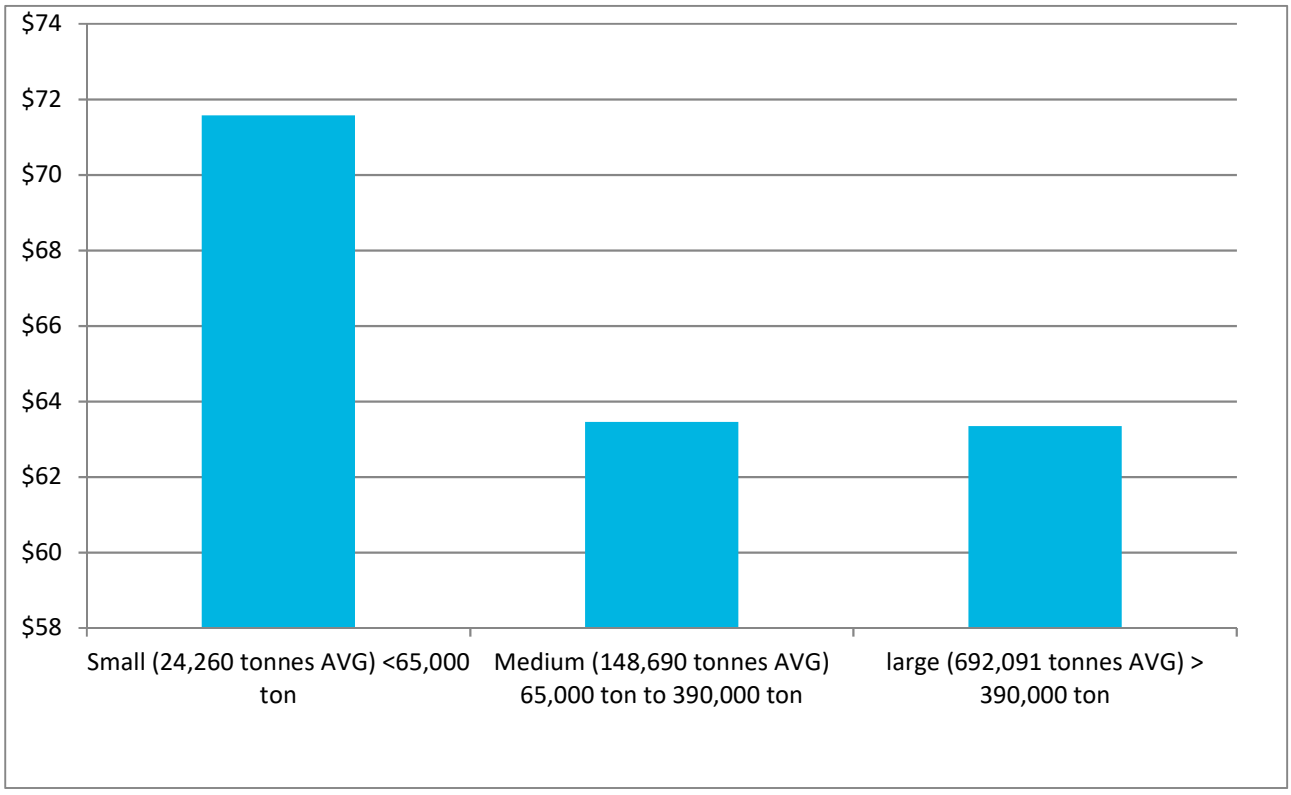


Figure 25: Tipping Fee vs. Tonnage for Landfills across the US

Please note that Landfills should be developed to maximize the amount of waste disposed within an economic haul distance. To be cost effective to reduce a municipal solid waste landfill tipping fee, a landfill should be larger than 20,000 tonnes/yr. The network of landfills should be assessed as part of a regional solid waste study. A landfill maybe able to be temporarily closed and waste diverted to another landfill to be cost effective, subject to an economical hauling distance.

From the NSWBI and EREF tipping fee assessments, we expect that low tonnage landfills will have higher tipping fees to cover capital, operational, and closure costs. However, this is not demonstrated in Table 22.

To understand landfill tipping fees full cost accounting principals must be completed by the Regions. This will include:

- Develop landfill master plans which provide capital costs for the full build out of the site and can provide an estimated cost per tonne
- Operations budget verification for all landfill operational cost items
- Financial liability assessment to develop a cost per tonne for the closure and the post-closure care required by regulations

3.3.3 MRFs and Organics Processing

The tables that follow provide throughput tonnages, total costs and per tonne costs for MRFs and organics processing facilities by Region and municipality according to processing of own wastes or exporting for external processing. Table 24 sets out the internal costs for municipalities that own MRFs and organics processing facilities. The costs provided include operating costs and amortized capital costs. Table 25 provides tipping costs for municipalities that export their recyclables and organics to external facilities.

Table 24: Costs for Municipalities that Process their own Recyclables and Organics

		Recycling Processing			Organics Processing		
		Tonnes	Cost	Cost per Tonne	Tonnes	Cost	Cost per Tonne
Region 1 Cape Breton	CBRM	7,057	$2,585,682	$366	9,980	$3,694,237	$370
	Inverness County	562	$614,337	$1,094	210	$14,809	$71
	Port Hawkesbury						
	Richmond				376	$201,261	$536
	Victoria County	326	$271,504	$832	731	$40,137	$55
Region 2 Eastern	Antigonish County				1,041	$56,416	$54
	Antigonish Town						
	Guysborough				1,920	$440,506	$229
	Mulgrave						
	Pictou				5,974	$338,096	$57
	St. Mary's						
Region 3 Northern	Amherst						
	Colchester	9,262	$2,370,275	$256	12,565	$752,412	$60
	Cumberland						
	CJSMA	3,604	$1,011,163	$281	4,468	$310,193	$69
	East Hants						
	Oxford						
Region 4 Halifax Regional Municipality		29,457	$4,797,058	$163	52,736	$8,853,222	$168

Table 24: Costs for Municipalities that Process their own Recyclables and Organics (continued)

		Recycling Processing			Organics Processing		
		Tonnes	Cost	Tonnes	Cost	Tonnes	Cost
Region 5 Valley							
Region 6 South Shore West Hants	Barrington						
	Chester						
	Clark's Harbour						
	Lunenburg Town						
	MJSB				6,749	$754,465	$112
	Queens	1,271	$392,194	$308	149		
	Shelburne Shared Services						
	West Hants						
	Windsor						
Region 7 Western					3,428	$688,881	$201
Sum of Regions		51,540	$12,042,212	$234	100,325	$16,144,634	$161

Source: Keir Corp, 2019

Recycling tonnes includes curbside type recyclables and other recyclables such as white goods and scrap metal

Organics tonnage includes food waste, leaf and yard, and clean wood

Based on Table 24 the cost range for municipalities handling their own recycling at their own MRFs generally ranges from $163 per tonne to $366. There are two significant outliers however in Region 1, namely Inverness County and Victoria County at $1,094 and $832 per tonne respectively.

The cost range for municipalities handling their own organics processing generally ranges between $54 and $229 per tonne. Outlier values that are beyond this range are found in the Cape Breton Region for CBRM and Richmond.

Table 25: Tipping Costs for Municipalities that Export their Recyclables and Organics

		Recycling Processing			Organics Processing		
		Tonnes	Cost	Cost per Tonne	Tonnes	Cost	Cost per Tonne
Region 1 Cape Breton	CBRM						
	Inverness County						
	Port Hawkesbury		$10,917				
	Richmond	849	$39,055	$46			
	Victoria County						
Region 2 Eastern	Antigonish County	970	$67,213	$69			
	Antigonish Town	323	$29,923	$93	381	$20,717	$54
	Guysborough	365	$28,053	$77			
	Mulgrave				12	$683	$59
	Pictou	3,089	$295,335	$96			
	St. Mary's	297	$10,636	$36	18	$1,504	$85
Region 3 Northern	Amherst						
	Colchester						
	Cumberland						
	CJSMA	47					
	East Hants	1,050	$69,968	$67	1,616	$115,363	$71
	Oxford						
Region 4 Halifax Regional Municipality					3,381		
Region 5 Valley		8,985	$875,965	$97	11,981	$1,041,114	$87
Region 6 South Shore West Hants	Barrington	247	$58,960	$239			
	Chester	1,119	$58,626	$52	1,605	$158,350	$99
	Clark's Harbour	31	$7,488	$240			
	Lunenburg Town						
	MJSB	2,600	$360,824	$139			
	Queens				2,106	$187,052	$89
	Shelburne Shared Services	419	$102,768	$245			
	West Hants	587	$67,827	$115			
	Windsor	154	$10,191	$66	429	$33,423	$78
Region 7 Western		2,602	$331,596	$127			
Sum of Regions		23,736	$2,425,343	$102	21,529	$1,558,206	$72

Source: Keir Corp, 2019

Note: Region 7 tip fee costs include line hauling

Based on Table 25, for municipalities that export their recyclables for processing the cost range is from a low tipping fee of $36 to a high of $245. This is intended to be the tipping costs for recycling and organics facilities only excluding line hauling costs however there may be differences in reporting.

The cost range for municipalities exporting organic materials for processing is $54 to $99 per tonne. There are no significant outliers.

Table 26 presents a Provincial cost summary for the processing of recycling and organics at facilities owned and operated (either directly or through contract) by the host municipality as well as the tipping fee costs for municipalities that export these materials for processing at external facilities. For the Province as a whole the cost of material processing is approximately $32.2 million.

Table 26: Costs Summary for Recycling and Organics Processing Costs

		Municipal Facility Owner Costs		Municipal Customer Tipping Costs		Sum of Organics and Recycling Processing
		Recycling Processing	Organics Processing	Recycling	Organics	
Region 1 Cape Breton	CBRM	$2,585,682	$3,694,237			$6,279,919
	Inverness County	$614,337	$14,809			$629,145
	Port Hawkesbury			$10,917		$10,917
	Richmond	-	$201,261	$39,055		$240,315
	Victoria County	$271,504	$40,137			$311,641
	Sum of Region 1	$3,471,522	$3,950,443	$49,971		$7,471,936
Region 2 Eastern	Antigonish County		$56,416	$67,213		$123,629
	Antigonish Town			$29,923	$20,717	$50,640
	Guysborough		$440,506	$28,053		$468,559
	Mulgrave				$683	$683
	Pictou		$338,096	$295,335		$633,432
	St. Mary's			$10,636	$1,504	$12,140
	Sum of Region 2		$835,018	$431,160	$22,904	$1,289,082
Region 3 Northern	Amherst					-
	Colchester	$2,370,275	$752,412			$3,122,687
	Cumberland	-				
	CJSMA	$1,011,163	$310,193			$1,321,356
	East Hants			$69,968	$115,363	$185,331
	Oxford					
	Sum of Region 3	$3,381,438	$1,062,605	$69,968	$115,363	$4,629,374

Table 26: Costs Summary for Recycling and Organics Processing Costs (continued)

		Municipal Customer Tipping Costs		Municipal Customer Tipping Costs		Sum of Organics and Recycling Processing
		Recycling Processing	Organics Processing	Recycling	Organics	
Region 4 Halifax Regional Municipality		$4,797,058	$8,853,222			$13,650,280
Region 5 Valley				$875,965	$1,041,114	$1,917,079
Region 6 South Shore West Hants	Barrington			$58,960		$58,960
	Chester			$58,626	$158,350	$216,976
	Clark's Harbour			$7,488		$7,488
	Lunenburg Town					
	MJSB		$754,465	$360,824		$1,115,289
	Queens	$392,194			$187,052	$579,246
	Shelburne Shared Services			$102,768		$102,768
	West Hants			$67,827		$67,827
	Windsor			$10,191	$33,423	$43,614
	Sum of Region 6	$392,194	$754,465	$666,684	$378,825	$2,192,168
Region 7 Western			$688,881	$331,596		$1,020,477
Sum of Regions		$12,042,212	$16,144,634	$2,425,343	$1,558,206	$32,170,395

Source: Keir Corp, 2019

Material Recycling Facility and Organics Processing Facility Financial Analysis

The operational cost of a MRF is dependent on items including the design of the facility (i.e. process capacity, capital equipment) and the staffing needed to maintain the facility and process the materials.

From the AECOM National Solid Waste Benchmarking Initiative 2018, the costs from 2017 range from $143 to $238, with an average of $140, processing cost per tonne of material. This cost is calculated as the MRF processing cost divided by the tonnes of material accepted at the MRF. The communities with the MRF's have population greater than 100,000.

The operational cost per tonne provided in Tables 24 and 25 show variability between each facility. The variability can be partially explained as lower tonnage processing facilities will have higher operating costs. However, to understand MRF processing fees per tonne full cost accounting principles must be completed by the Regions. Also MRFs should be evaluated for processing capacity, efficiency, and facility condition with the potential conversion to EPR. This assessment can be completed through a regional solid waste management study.

The operational cost of a compost is dependent on items including the design of the facility (i.e. in vessel, pad designs, biofilters, buildings), the operations equipment (i.e. loaders, turners, screening), and the staffing needed to operate the facility.

From the AECOM National Solid Waste Benchmarking Initiative 2018, the costs from 2017 range from $31 to $65 processing cost per tonne of yard waste. This cost is calculated as the compost processing cost divided by the tonnes of material accepted at the compost facility. The communities with the yard waste compost facilities have population greater than 100,000.

The operational cost per tonne provided in Tables 24 and 25 show variability between each facility. The variability can be partially explained from the tonnage processed. However, to understand organics processing the design and operations must be assessed and full cost accounting principles must be developed by the Regions.

Please note that organics facilities should be sited within an economic hauling distance of large generators and users of the final compost product to reduce hauling costs. Windrow and aerated static pile compost facilities have lower capital investment and operations costs as compared to landfills, hence, there could be more compost facilities developed to accommodate organics processing. This can be completed though a regional solid waste management study.

3.3.4 System Revenues

Whereas all activities and facilities generate costs only certain activities and facilities generate revenues. The system revenue estimate for 2019 is roughly $44 million. Of this sum approximately: 20% is derived from transfer stations; 38% from MSW landfills and C&D landfills; 18% from recycling processing facilities; 6% from organics processing facilities; and 20% from other revenue and funding. Table 27 provides the revenue profile by region and Table 28 shows revenue by municipality and with additional granularity. Revenues associated with each of the activities types includes tipping fee revenues, sale of the materials, and other revenue.

Table 27: Waste Management System Revenues by Region (2019)

	Transfer Station	MSW Landfill and C&D Landfill	Recycling Processing	Organics Processing	Other Revenue and Funding	Sum of Revenue Item
Region 1 Cape Breton	$1,235,503	$331,271	$576,333	$190,408	$566,431	$2,899,946
Region 2 Eastern	$560,649	$6,414,745		$289,365	$713,128	$7,977,887
Region 3 Northern	$230,600	$3,893,159	$2,814,101	$515,603	$846,405	$8,299,867
Region 4 Halifax Regional Municipality		$20,795	$3,962,658		$3,790,362	$7,773,816
Region 5 Valley	$2,511,203				$1,008,338	$3,519,541
Region 6 South Shore West Hants	$2,714,850	$5,519,997	$391,889	$807,888	$738,055	$10,172,680
Region 7 Western	$1,500,142	$372,616		$630,156	$935,562	$3,438,475
Sum of Regions	$8,752,947	$16,552,583	$7,744,981	$2,433,419	$8,598,281	$44,082,211
Percentage	20%	38%	18%	6%	20%	100%

Source: Keir Corp, 2019

Table 28: Waste Management System Revenues by Municipality (2019)

		Transfer Station			MSW Landfill and C&D Landfill			Recycling Processing				Organics Processing			Other Revenue and Funding	Sum of Revenue
		Tip Fees	Sale of Materials	Other	Tip Fees	Sale of Materials	Other	Tip Fees	Sale of Materials	Beverage Container Returns & Handling Fees	Other	Tip Fees	Sale of Compost	Other		
Region 1 Cape Breton	CBRM	$1,099,946			$110,408	$8,840		$40,658	$281,394	$156,399		$166,296				$2,340,477
	Inverness County	$37,675	$97,882						$97,882						$57,636	$291,074
	Port Hawkesbury														$32,259	$32,259
	Richmond				$158,356	$53,667						$18,311	$5,801			$236,136
	Victoria County															
	Sum of Region 1	$1,137,621	$97,882		$268,764	$62,507		$40,658	$379,275	$156,399		$184,607	$5,801		$566,431	$2,899,946
Region 2 Eastern	Antigonish County	$339,573	$58,126									$15,124			$78,185	$491,008
	Antigonish Town														$68,071	$68,071
	Guysborough	$74,163			$6,092,529	$105,282	$15,304					$94,934	$9,805		$39,890	$6,431,906
	Mulgrave														$29,966	$29,966
	Pictou		$64,909		$201,630							$144,803	$24,700		$465,566	$901,607
	St. Mary's		$14,112	$9,767											$31,450	$55,330
	Sum of Region 2	$413,735	$137,146	$9,767	$6,294,159	$105,282	$15,304					$254,861	$34,504		$713,128	$7,977,887
Region 3 Northern	Amherst															
	Colchester				$1,895,375	$42		$598,695	$1,130,945	$371,211	$253,783	$160,865	$2,873	$1,356	$468,189	$4,883,333
	Cumberland															
	CJSMA				$1,800,226	$15,367	$1,507		$339,156	$120,311		$342,530	$7,978		$187,188	$2,814,263
	East Hants	$177,321	$53,279		$180,642										$191,028	$602,270
	Oxford															
	Sum of Region 3	$177,321	$53,279		$3,876,243	$15,409	$1,507	$598,695	$1,470,101	$491,522	$253,783	$503,396	$10,851	$1,356	$846,405	$8,299,867
Region 4 Halifax Regional Municipality							$20,795		$3,064,998	$850,021	$47,639				$3,790,362	$7,773,816
Region 5 Valley		$2,379,204	$131,999												$1,008,338	$3,519,541

Table28: Waste Management System Revenues by Municipality (2019)
(continued)

		Transfer Station			MSW Landfill and C&D Landfill			Recycling Processing				Organics Processing			Other Revenue and Funding	Sum of Revenue
		Tip Fees	Sale of Materials	Other	Tip Fees	Sale of Materials	Other	Tip Fees	Sale of Materials	Beverage Container Returns & Handling Fees	Other	Tip Fees	Sale of Compost	Other		
Region 6 South Shore West Hants	Barrington				$111,661										$45,662	$157,323
	Chester				$3,111,422										$114,157	$3,225,579
	Clark's Harbour														$944	$944
	Lunenburg Town														$6,446	$6,446
	MJSB	$2,556,951										$791,771	$16,117		$281,474	$3,646,312
	Queens	$85,156			$2,296,914			$285,196		$106,693					$80,802	$2,854,762
	Shelburne Shared Services	$72,744													$72,882	$145,625
	West Hants														$98,249	$98,249
	Windsor														$37,439	$37,439
	Sum of Region 6	$2,714,850			$5,519,997			$285,196		$106,693		$791,771	$16,117		$738,055	$10,172,680
Region 7 Western		$1,500,142			$360,296	$12,320						$630,156			$935,562	$3,438,475
Sum of Regions		$8,322,873	$420,306	$9,767	$16,319,459	$195,518	$37,606	$924,550	$4,914,374	$1,604,635	$301,421	$2,364,790	$67,273	$1,356	$8,598,281	$44,082,211

Source: Keir Corp, 2019

3.3.5 Net Costs

The net costs are simply costs minus revenues. Table 29 provides a net cost summary by Region while Table 30 provides a more granular profile by municipality. Overall the ratio of costs to revenues for the entire system is 3.18 to 1. Costs total $140 million, revenues amount to $44 million and the resulting net cost is in the order of $96 million. Revenue includes the funding provided by Divert NS. This shows that much of the costs for solid waste management is being supported through municipal taxes.

Table 29: Net Costs by Region (2019)

	Sum of Costs	Sum of Revenues	Net Cost
Region 1 Cape Breton	($23,353,023)	$2,899,946	($20,453,077)
Region 2 Eastern	($12,428,547)	$7,977,887	($4,450,660)
Region 3 Northern	($16,474,128)	$8,299,867	($8,174,262)
Region 4 Halifax Regional Municipality	($50,989,602)	$7,773,816	($43,215,786)
Region 5 Valley	($10,979,625)	$3,519,541	($7,460,084)
Region 6 South Shore West Hants	($19,271,221)	$10,172,680	($9,098,542)
Region 7 Western	($6,781,072)	$3,438,475	($3,342,597)
Sum of Regions	($140,277,218)	$44,082,211	($96,195,008)

Source: Keir Corp, 2019

Table 30: Net Costs by Municipality (2019)

		Sum of Costs	Sum of Revenues	Net Cost
Region 1 Cape Breton	CBRM	($17,545,315)	$2,340,477	($15,204,838)
	Inverness County	($2,303,354)	$291,074	($2,012,280)
	Port Hawkesbury	($234,096)	$32,259	($201,837)
	Richmond	($1,176,220)	$236,136	($940,085)
	Victoria County	($2,094,038)	$ -	($2,094,038)
	Sum of Region 1	($23,353,023)	$2,899,946	($20,453,077)
Region 2 Eastern	Antigonish County	($1,637,151)	$491,008	($1,146,143)
	Antigonish Town	($547,260)	$68,071	($479,189)
	Guysborough	($4,368,983)	$6,431,906	$2,062,923
	Mulgrave	($85,855)	$29,966	($55,889)
	Pictou	($5,277,907)	$901,607	($4,376,301)
	St. Mary's	($511,391)	$55,330	($456,061)
	Sum of Region 2	($12,428,547)	$7,977,887	($4,450,660)
Region 3 Northern	Amherst	($299,424)	$ -	($299,424)
	Colchester	($8,557,327)	$4,883,333	($3,673,994)
	Cumberland	($1,521,302)	$ -	($1,521,302)
	CJSMA	($3,112,689)	$2,814,263	($298,426)
	East Hants	($2,983,385)	$602,270	($2,381,115)
	Oxford	$ -	$ -	$ -
	Sum of Region 3	($16,474,128)	$8,299,867	($8,174,262)
Region 4 Halifax Regional Municipality		($50,989,602)	$7,773,816	($43,215,786)
Region 5 Valley		($10,979,625)	$3,519,541	($7,460,084)
Region 6 South Shore West Hants	Barrington	($918,516)	$157,323	($761,193)
	Chester	($4,500,337)	$3,225,579	($1,274,758)
	Clark's Harbour	($83,383)	$944	($82,438)
	Lunenburg Town	($2,826)	$6,446	$3,620
	MJSB	($8,603,531)	$3,646,312	($4,957,219)
	Queens	($2,961,649)	$2,854,762	($106,887)
	Shelburne Shared Services	($1,023,292)	$145,625	($877,666)
	West Hants	($863,282)	$98,249	($765,034)
	Windsor	($314,405)	$37,439	($276,965)
	Sum of Region 6	($19,271,221)	$10,172,680	($9,098,542)
Region 7 Western		($6,781,072)	$3,438,475	($3,342,597)
Sum of Regions		($140,277,218)	$44,082,211	($96,195,008)

Source: Keir Corp, 2019

3.4 Summary

3.4.1 System Model

In order to examine system costs a system model is required. To this end an integrated system model addressing waste flows and cash flows was architected and built using Quantrix Modeler.

The completed model consists of 186 matrices with a total cell count of 35.1 million of which 25.6 million are calculated and 9.5 million are inputs. The model is framed in 2 modules. The first module accepts inputs and the second module generates outputs including report graphics and tables. Users calibrate the model in the input module. The outputs module utilizes the input data to self-calculate.

The projection period incorporated in the model is 2016 to 2040.

The model takes input and generates output for Nova Scotia's 7 waste management regions and their 28 constituent municipalities and service areas.

3.4.2 Inputs

Input Data Review

Although data confirmation and model calibration reviews were accomplished with most regional managers circumstances did not permit this for Region 1 – Cape Breton. The inputs and outputs of the model for this region need to be viewed with this in mind. The numbers generated by the model reflect best available information for Region 1 but the inputs used in the system modeling lack oversight and review.

The data input into the model is a mixture of 2016 Stats Canada information; data provided from AECOM waste benchmarking initiative workbooks; information derived from the 2016/17 data call and 2018/19 data derived from manager reviews.

3.4.3 Outputs

Population

Based on recent trends Nova Scotia is not expected to show dramatic population growth over the forecast period. All regions with the exception of Halifax Regional Municipality show stable or declining populations. The current Provincial population is estimated to be 954,000 climbing to 1,008,000 by 2040.

Waste Generation

At present total waste generated in the Province is estimated to be 681,000 tonnes. Of this amount approximately 56% is destined for disposal and the balance (44%) being diverted.

Waste Capture

The projected volume of waste captured by municipal curbside collection across the province totals approximately 238,000 tonnes. Of this sum 49% of the tonnage is garbage, 17% is recycling, and 34% is organics. The total amount of material captured through curbside collection is approximately 35% of the Provincial waste generated.

The total amount of waste received at municipal disposal and processing facilities totals 434,000 tonnes. This quantity includes municipal curbside collection, transfer haul, residential self-haul, and private commercial haul.

Waste System Infrastructure

There are 63 publicly owned waste management facilities in the Provincial system. These include:

Transfer Stations*	24
MSW Landfills**	6
C&D Landfills	13
MRFs	7
Compost Facilities	13
Total	**63**

*Total includes transfer station at Kaiser Meadow Landfill and public drop-off at Colchester Balefill Facility
**5 of the public MSW landfills include C&D landfills. These are not included in the C&D landfills count.

Overall System Costs

As waste is collected and flows through system facilities costs are incurred. In 2019 the estimated cost of Nova Scotia's public waste management system is approximately $140 million.

Administration and Education Costs

Administration and education costs for the Nova Scotia waste management system are estimated to be in the order of $8.1 million combined. This figure represents 6% of the overall system cost.

Collection and Haul Costs

Public collection and haul costs in the provincial waste management system amount to $47.5 million In combination these costs represent 34% of the overall system cost.

Transfer Station Costs

There are 24 public transfer stations in Nova Scotia. Costs for municipalities that own their own facilities are generally within a range $20 to $100 per tonne but there are some significant outliers on both the low side (Chester) and high side (Queens and Victoria County). The Chester costs are associated with a very minimal facility (essentially a concrete pad at their landfill). The Queens and Victoria costs need to be examined to determine if there are options involving flow and system reconfigurations that could bring costs down.

For municipalities that export their waste to outside transfer stations tipping fees for organics are clustered in the $130 range. The tipping fee for recyclables is higher at $225 per tonne. There are no obvious suggestions to try and drive better cost efficiencies other than vendor/client discussions to see if there are any potential flexibilities for rate restructuring.

For the Province overall transfer station costs sum to $10.2 million which is roughly 7% of the overall system cost.

Landfill Costs

There are 6 public MSW landfills and 13 C&D Landfills in Nova Scotia. Five of the six MSW landfills handle mixed waste (i.e. garbage, contaminated soils and C&D waste) with the exception of Otter Lake Landfill which does not accept C&D waste. The 13 C&D landfills handle C&D waste only.

Landfill costs for municipalities that own their own mixed waste landfills generally fall in a range of $40 to $80 per tonne. The extreme outlier is Halifax Regional Municipality with a cost per tonne over $380. The latter is in part explained by extensive pre-treatment of waste before it is interred at the landfill nevertheless in comparison with typical landfill costs across Canada this is a very high cost figure (refer to Stantec, 2013).

The cost spread for municipalities that have their own dedicated C&D landfills roughly range within a $25 to $100 per tonne cost band with clustering in the $50 to $70 stratum.

Tipping fees for municipalities that export waste material to mixed waste landfills are predominately with in the $70 to $110 with a few exceptions in Region 6 where West Hants and Windsor have export costs in the $30 to $40 range.

Few municipalities export C&D waste to dedicated C&D landfills. Antigonish County exports C&D waste at a tipping fee of $10 per tonne and Valley Region diverts C&D for processing at a tipping fee of $35 per tonne.

Overall landfill costs in the Province of Nova Scotia sum to approximately $41.3 million. This represents about 29% of the overall cost of the provincial waste management system.

MRFs and Organic Processing Costs

There are 7 public MRFs and 13 compost facilities in the Province of Nova Scotia. Per tonne processing costs for municipalities that use their own MRFs span a big range from $150 to $1,100. There is a 5 facility cluster in the $150 to $370 range but then costs climb quickly for the remaining 2 facilities both of which are in Region 1. For the latter facilities the tonnages are very small and therefore economies of scale are not achievable.

For municipalities that export their recyclables the per tonne tipping cost ranges are in the order of $30 to $250 with general clustering around in the $60 to $125 band. The high end of the range (i.e. greater than $200 are found in Region 6).

For organics processing the costs per tonne for municipalities with their own facilities ranges from roughly $50 to $200 with a couple of exceptions in Region 1, namely CBRM at $370 and Richmond at $536. For municipalities that export their organics to neighbouring processing facilities the tipping fees are all clustered in the $50 to $100 range.

Overall MRF costs total about $14.5 million and Organics processing costs about $17.7 million in the Province of Nova Scotia. Combined processing accounts for roughly 23% of the Provincial waste management system cost.

System Revenues

Whereas all activities and facilities generate costs only certain activities and facilities generate revenues. The system revenue estimate for 2019 is roughly $44 million. Of this sum approximately: 20% is derived from transfer stations; 38% from MSW landfills and C&D landfills; 18% from recycling processing facilities; 6% from organics processing facilities; and 20% from other revenue and funding.

Net Costs

The net costs are simply costs minus revenues. Table 18 provides a net cost summary by Region while Table 19 provides a more granular profile by municipality. Overall the ratio of costs to revenues for the entire system is 3.18 to 1. Costs total $140 million, revenues amount to $44 million and the resulting net cost is in the order of $96 million.

3.4.4 Conclusions

Background Data

As previously mentioned, the data needed to calibrate the system model was not readily available.

An extensive amount of data is collected through the Provincial waste management data call, but, it was found that there are gaps in the data and that the consistency of data among regions and municipalities is variable.

Although considerable effort is expended in the data call to collect a prodigious amount of data, the question looms - Is it all useful? A large portion of the data assembled had to be aggregated to make it usable for system modelling.

It became apparent during the model build that there is misalignment in how people record their waste flow data and cost information. Consistency across the seven regions and constituent municipalities is required.

Recommendation:

a) It is recommended that Nova Scotia review its approach to data management with particular attention to what is needed, how it is assembled, how it will be used.

b) It is recommended that Nova Scotia get alignment among the various providers of information about the data needed and when it is required.

Data Analysis

The data collected in the provincial data call is assembled in Excel spread sheets, but these are static. They are not interconnected and do not permit interactive analysis, forecasting or what-if analysis. Essentially the Excel Data Call workbook as it currently stands is a data base. In order to make use of the data it needs to be activated.

This study has produced a system model that is fully linked top to bottom. A change in input data or assumptions ripples through the entire model. The model is designed to enable what-if analysis.

Recommendation

c) Data is an asset. It needs to be analyzed to create value

d) The model is a tool for data analysis. It needs to be annually calibrated to be useful for planning.

e) As considerable effort was involved in developing the Quantrix model, Nova Scotia should consider replacing the Datacall system with the information needed to calibrate the Quantrix Model. If the Quantrix model is used, then the following should be implemented:

- **Develop forms and common definitions for data input based on what information to be tracked for facility user and government programs**
- **Develop similar accounting practices for facilities for standardized data entry**
- **Training of regional coordinators and applicable government staff in Quantrix**
- **Set up the Quantrix model for multiple user access in the Quantrix Qloud**
- **Regional coordinators or other trained staff to update model with full cost accounting data from standardized forms from (a)**

The Waste Management System

The model reveals that there are cost inefficiencies in the system. This may require system reconfiguration and consolidation to take advantage of economies of scale.

The spread of per tonne costs in many instances for activities and facilities appears to be fairly broad across the Regions and constituent municipalities. Attention needs to be given as to whether these costs are accounted for in the same way. Have some municipalities accounted for costs one way and other municipalities another?

Nova Scotia needs to look at its waste system and decision adjustments if it feels they are needed.

Recommendation:

f) Carefully look at the waste flow and cost information generated by the model to assess commonality of results.

g) Look at the cost outputs to determine if per tonne dollar costs spreads across regions and municipalities can be tightened either through negotiation or system reconfiguration.

h) Nova Scotia should develop a Provincial Solid Waste Management Plan, or have the seven Regions prepare their own plans which would include:

- **An assessment of system facilities using full cost accounting with respect to potential expansion, capacity thresholds, and financial viability.**
- **Determine potential facility expansions and closures taking into account associated transportation costs**
- **Determine EPR implementation scheduling and changes to the waste facility network with associated costs.**
- **Update the Quantrix model to assess facility network modification(s) and impacts to the Provincial system.**

Please note that for EPR implementation, producers will decide what infrastructure is needed as they design their system. Producers may choose an 'all Atlantic system' plan. It's is likely that producers will consolidate processing into a single MRF, as they have in BC, and use transfer stations to move materials through the province. The timeframe to transition to EPR can range from 2 years, as being proposed in Alberta, to up to 5 year as proposed in Ontario, taking into account the management of stranded assets. Producers will want to assess the status of the waste transfer station and MRF assets.

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