Edmonton Metropolitan Region Board

Solid Waste Data Strategy

February, 2023

PURPOSE

A plan for how the Region will use data to advance shared regional solid waste goals.

Solid Waste Collaborative

With Tetra Tech Canada Inc.

1.0 Contents

Executive Summary

All modern organizations rely on data to help keep pace with accelerating change and to aid in decision-making. This is true for governments as well as industries and is evidenced within every type of service, including the management of solid waste. The way waste is managed today is expensive, poses risks to human health and the environment, and misses opportunities to recover value from discarded materials[1]. Across the Edmonton Metropolitan Region (Region), there are a range of engaged stakeholders committed to achieving the economic, social, and environmental benefits that can be gained through improvements to solid waste management.

Even with clear and compelling reasons to collaborate at the regional level, efforts can be hampered by the inability to share and use data. Poor data quality, unclear roles and responsibilities, lack of dedicated resources, and reluctance or inability to share information beyond organizational boundaries all represent significant challenges to success. Recognizing the fundamental importance that data will play in achieving shared solid waste goals, the Solid Waste Collaborative (collaborative) identified the need for a Solid Waste Data Strategy (data strategy) within their Solid Waste Action Plan.

This data strategy represents a set of choices and decisions that chart a course of action to achieve shared solid waste goals. It provides a formal mechanism to assess, prioritize, plan for, and implement the data and supporting tools that offer the highest value to the Region. The data strategy is the first of many steps required to develop data maturity and to foster the data-driven culture needed to optimize solid waste outcomes for the Region.

Regional Solid Waste Management

The Region has a complex system for managing solid waste with many actors playing a diverse set of roles. Municipalities establish waste programs, policies, and strategies for their communities. Government-regulated stewardship programs help create and maintain sustainable recycling for post-consumer products. Waste commissions work to minimize the costs of waste services to their residents. Public and private haulers, processors, and landfill operators directly measure volumes and costs and track emerging trends and innovation.

Each stakeholder involved in solid waste management creates and manages unique data that is important to developing a comprehensive understanding of the entire system. While there is no shortage of solid waste data available across the Region, it currently exists in disparate systems, in incompatible formats, held within discrete silos, providing little or no visibility or value at the regional level.

There are compelling reasons to work together as a Region to manage solid waste. Legislative and regulatory changes, the movement of waste across borders, the scale of waste solutions, emerging technologies, and limited expertise all contribute to the case for regional collaboration. Today, all municipalities are asked to do more with less, a regional data strategy provides the opportunity to optimize the value of data.

Solid Waste Data Strategy

The regional vision is that solid waste data is managed as a critical asset that provides insights and empowers the Region to make evidence-based decisions to accelerate the circular economy and design a future without waste. A set of guiding principles establishes a framework for expected behavior that will endure regardless of how the work

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[1] Canadian Council of Ministers of the Environment, 2019. Guide for Identifying, Evaluating and Selecting Policies for Influencing Construction, Renovation and Demolition Waste Management.

of the collaborative may change over time. This solid foundation will ground the work needed to build strategic capabilities and achieve the goals of the data strategy, including:

- Establish the data standards and methods needed to improve data access, data integrity, and data security for solid waste data.
- Define supporting roles and responsibilities to effectively coordinate data management between all stakeholders.
- Initiate a service delivery model for regional data that provides value to all stakeholders, is cost-effective, and makes effective use of limited time and resources.
- Recommend the data-sharing agreements needed to empower stakeholders to effectively collaborate to advance shared solid waste goals.
- Describe the tools currently enabling collection and analysis of solid waste data and the expected next steps to enhance the value of solid waste data to the Region.
- Achieve agreement on the specific and actionable milestones needed to achieve data strategy goals.

Data Management

Like all assets, data has a lifecycle and good practices must be applied at each stage from creation to destruction to maximize the accessibility, integrity, and security of solid waste data. A Data Standard for solid waste has been developed to operationalize these practices and to demonstrate and maintain this discipline over time. The Data Standard is maintained within the collaborative's SharePoint Workspace (collaboration site) and will continue to evolve as the complexity of solid waste data increases.

Methods that describe the step-by-step procedures required to answer questions or evaluate outcomes are needed. A summary of the consistent and repeatable processes for annual data planning, data requests (annual and ad hoc), and deriving solid waste measures is provided. The detailed process flows are also maintained in the collaboration site.

Key actions to support good data management practices include:

- Validate data classifications for each data type.
- Apply the 3-2-1 backup rule.
- Conduct a data risk assessment.
- Manage user permissions.
- Implement data quality controls.
- Establish responsibilities for quality assurance.
- Align with EMRB's Data Retention Policy and Schedule and with Data Destruction Procedures.
- Establish the project archival process.
- Develop methodologies for the outstanding solid waste KPI's.

Data Governance

Effective governance is needed to ensure that people, processes and technology can all work together to achieve the data vision. The supporting roles and responsibilities needed to reliably and responsibly manage solid waste data are recommended. Defined roles and responsibilities across the data governance structure are outlined to drive clarity regarding who is responsible for supplying and monitoring the use of each type of data. Responsibility for managing solid waste data must be shared between all parties and continuously managed over time.

Key actions to improve data governance include:

- Develop a change management strategy and communication plan for the data strategy.
- Establish Memorandums of Understanding with the regional waste commissions.

Service Delivery Model

The goal of the service delivery model is to connect existing silos of solid waste data to surface insights for users to leverage in operations and decision-making. A service delivery model is outlined and describes how all stakeholders will work together to create, update, and continuously improve solid waste data for the Region. The specific commitments needed to enable a service delivery model that provides value to all stakeholders, is cost-effective, and makes effective use of limited time and resources are defined.

Protocols

Even when stakeholders are committed to achieving shared goals and believe in the value of regional collaboration, protocols are needed to empower people to share data beyond traditional organizational boundaries. Existing protocols supporting regional data-sharing as well as those that will be needed to enhance future collaboration efforts are identified. For example, the EMRB is pursuing protocols with the regional waste commissions in the form of Memorandums of Understanding (MOUs). An MOU is a written record of understanding between parties that outlines the terms and conditions under which data can be shared. The goal of each MOU is to create a sense of shared benefits and accountabilities between the waste commission and the EMRB.

Enabling Tools and Technologies

An important contribution to effective management of collaboration is careful investment in the tools and technologies that will help facilitate sharing of information, learnings, best practices, and adoption of new ideas. The EMRB has invested in development of four key tools to help the collaborative build strategic capabilities, including the collaboration site, a solid waste data model, Tableau (a data analytics and visualization tool), and a geographic information system (GIS) platform. Key next steps outlined for these tools include:

- Utilize the collaboration space to provide increased access to regional solid waste data.
- Provide training.
- Add additional solid waste datasets.
- Initiate a relational database pilot project using a solid waste dataset.
- Develop a Tableau dashboard and self-serve workspace for analysis.
- Create dynamic maps and additional data layers needed to support a material flow analysis for the Region.

In addition, the EMRB has invested in the development of a synthetic region. There may be future opportunities for synthetic modelling to assist the collaborative in answering important but complex questions for solid waste management. Additional work is needed to understand how synthetic modelling could be used to support solid waste management.

Roadmap

The roadmap is the culmination of the analysis completed during development of the data strategy translated into specific, actionable milestones to improve data governance, data integrity, and data maturity. With agreement on the milestones, the work can be further broken down into the specific actions and projects needed through the annual action planning process.

Integrating the data strategy into annual action planning also provides a regular mechanism to test that planned data-related activities remain tied to regional priorities for solid waste over time. The Solid Waste Action Plan

(action) plan also represents an opportunity to obtain guidance from the MRSP Standing Committee and an established mechanism to secure required project resources.

Evaluation and Continuous Improvement

Developing the data strategy is only the first step in improving data integrity and maturity. It should be viewed as the starting point to be built upon and continuously improved over time. An evaluation process that assesses key indicators within the annual action planning process will be used to measure the success of the data strategy in supporting regional collaboration efforts. In addition, each year the collaborative will be asked to reexamine important success factors, spanning people, processes, and technology to ensure data requirements align with regional priorities.

Collectively, these actions will improve data maturity and instill a culture that enables the Region to make strategic and tactical evidence-based decisions more easily.

1.0 Introduction

On April 14, 2022, the Edmonton Metropolitan Region Board (Board) approved development of a Solid Waste Data Strategy (data strategy). Through a formal Request for Proposal process, EMRB Administration (EMRB) engaged Tetra Tech Canada Inc. (Tetra Tech) for assistance to complete the project. The scope of work included the evolution of the existing Solid Waste Data Model (data model), development of a data strategy document, and coordination of mutually beneficial data sharing agreements with the regional waste commissions.

1.1 Data Strategy Purpose

A data strategy represents a set of choices and decisions that chart a course of action to achieve high-level goals. It is not enough to simply have data; a strategy is needed to ensure that the skills, processes, and technologies needed are in place and working together to realize the value of the data. As the complexity of the EMRB's Solid Waste Collaborative (collaborative) work grows, so too will the data needed to support this work. As the Edmonton Metropolitan Region (Region) expands its efforts into strategic planning (e.g., Regional Organics Strategy), there is a need for a comprehensive plan to ensure that decision-makers have the information needed to confirm regional priorities, support data-driven decisions, and to optimize the outcomes achieved through regional collaboration.

The collaborative can make better recommendations with trusted, high-quality data than it can without. A successfully executed data strategy will achieve the following benefits:

- **Improved Resource Efficiency** – Common requirements, methodologies, and data formats that enable comprehensive, accurate and timely data to be managed more efficiently and cost-effectively.
- **Improved Data Analysis** – High-quality data that supports improved analysis, trend identification, modelling, scenario planning, and business intelligence.
- **Enhanced Collaboration** – A common platform that enables members to share information, cooperate on work-in-progress, and manage critical workflow. A single and complete set of tools that improves access to information and makes better use of regional information and expertise.
- **Improved Communication** – Enhanced ability to communicate complex concepts or large datasets using easy-to-understand data visualizations.
- **Minimized Risks** – Strong data governance minimizes the inherent risks of sharing information beyond traditional organizational borders.
- **Increased Trust** – Effective and secure data management guidelines and rules that define how data can be used so that the interests and concerns of all stakeholders are considered.
- **Data-Driven Decision-Making** – Provides a framework for decisions substantiated with data rather than intuition or observation alone to achieve better outcomes.
- **Enabled Regional Planning** – Data is the foundation from which future programs, services, and strategies can be designed, adapted, or expanded.
- **Enhanced Regional Cohesion** - A shared framework that focuses and mobilizes limited resources to achieve a common set of goals in alignment with each other.
- **Improved Performance Management** – A baseline for system performance, a framework to measure return on investment in regional solid waste initiatives, and a mechanism to report outcomes achieved.

The data strategy envisions a series of steps that build iteratively on one another, with data maturity as the critical and overarching focus. The data strategy defines how key stakeholders can work together to ensure that regional solid waste data is trusted, reliable and secure. As many regional decision-makers will not be experts in solid waste

data or perceive themselves as digitally-savvy, the data strategy can also be used for building understanding of the value of data for solid waste management at the regional level.

1.2 Project Approach

The data strategy project was initiated on July 13, 2022, with a review of the existing data model. The initial model was limited to municipally managed residential waste volume. Where data was unavailable, assumptions or industry standards were applied to derive reasonable estimates of volume. The same methodology was applied to all municipalities to calculate measures and key performance indicators, such as diversion and recycled rates.

The model has now been expanded to include estimates of privately managed residential waste and all non-residential waste. The model was streamlined for consistency and restructured into a format more consumable by data visualization applications to support analysis. A standardized methodology allows like-for-like comparisons across municipalities and a clearer picture of municipally managed waste within the Region. Opportunities to further improve data integrity that were identified while updating the model are noted throughout this document and have been added to the data strategy roadmap. Additional work to add more years of data and the actions needed to enhance the integrity of the data model are already underway. The revised data model, along with the supporting Tableau Workspace are posted in the Solid Waste SharePoint Workspace (collaboration site).

Building on the learnings from the data model, Tetra Tech conducted a series of workshops with EMRB to better understand the goals of the collaborative and the important role data is expected to play in achieving them. Between September and November 2022, four sessions were conducted to explore a data vision, key stakeholders and roles and responsibilities, collaboration requirements, and opportunities for data visualization to align data with strategy. Findings from these sessions were used to inform key elements outlined in this document.

A first draft of the data strategy was shared with the Solid Waste Collaborative (collaborative) in December 2022 for initial feedback and direction. A revised draft was provided to the collaborative in January 2023 for review and edits. The collaborative provided their support to submit the data strategy to the MRSP Standing Committee (committee) on February 9, 2023.

Supplemental to the data strategy, EMRB engaged the Roseridge Regional Waste Services Commission (Roseridge) and the Leduc and District Regional Waste Management Commission (LDRWMC) to provide an overview of the work to develop the data strategy and to explore the feasibility of establishing partnerships through formal data-sharing agreements.

1.3 Document Structure

The data strategy document is organized into the following sections:

- **1.0 – Introduction**: The purpose of the project, the document structure, and outlines the supplemental material referenced throughout the data strategy document.
- **2.0 – Project Background**: A brief description of solid waste management in the Region, key stakeholders that manage solid waste data, and the need for a data strategy to make best use of limited resources to achieve shared goals.
- **3.0 - Solid Waste Data Strategy**: Describes the data vision, guiding principles that support decision-making, strategic capabilities needed at the regional level, and the goals of the data strategy.
- **4.0 - Solid Waste Data**: An introduction to solid waste data, the types of data generated, where this information can be found, and enabling tools and technologies to maximize the value of solid waste data.

- **5.0 - Data Management**: An overview of good practices to be applied at each stage of the data lifecycle and the standards and methods developed to promote effective data management over time.
- **6.0 – Solid Waste Data Governance**: Recommended data roles and responsibilities, a supporting service delivery model, and protocols necessary for effective solid waste data management.
- **7.0 - Solid Waste Tools and Technology**: An overview of the key tools and technology used to manage solid waste data within the EMRB technical environment and the expected next steps to enhance data integrity and maturity.
- **8.0 – Solid Waste Data Strategy Roadmap**: A high-level plan that outlines major milestones to increase regional capabilities, drive data maturity, and advance the data vision.
- **9.0 – Data Strategy Evaluation and Continuous Improvement**: A defined approach to evaluate the success of the data strategy and strategies to continuously build data maturity and promote a data-driven culture over time.

1.4 Supplemental Resources

The outputs of the supporting tools referenced throughout this document can be large and, by nature, are continuously evolving. As a result, they are better viewed in interactive digital format rather than within a static document. Where supplemental source material is referenced throughout this document, they are maintained within the collaboration site. This allows the material to evolve over time and ensures that collaborative members always have access to the most-up-to-date version.

Since its first regional project, the collaborative has been developing a shared vocabulary to support consistency and interoperability at the regional level. Agreement on language is key to building shared understanding. As this document relies on a common understanding of key solid waste and data management terms, a Solid Waste Glossary of Terms (glossary) has been included in Appendix A.

Following approval of this data strategy, the glossary will be moved to the collaboration site and managed online so that it can be continuously updated to drive greater consistency across the Region over time. By moving the glossary online, it can also be used as an onboarding tool for new collaborative members or external vendors as they are engaged to assist with specific solid waste management and/or data-related projects.

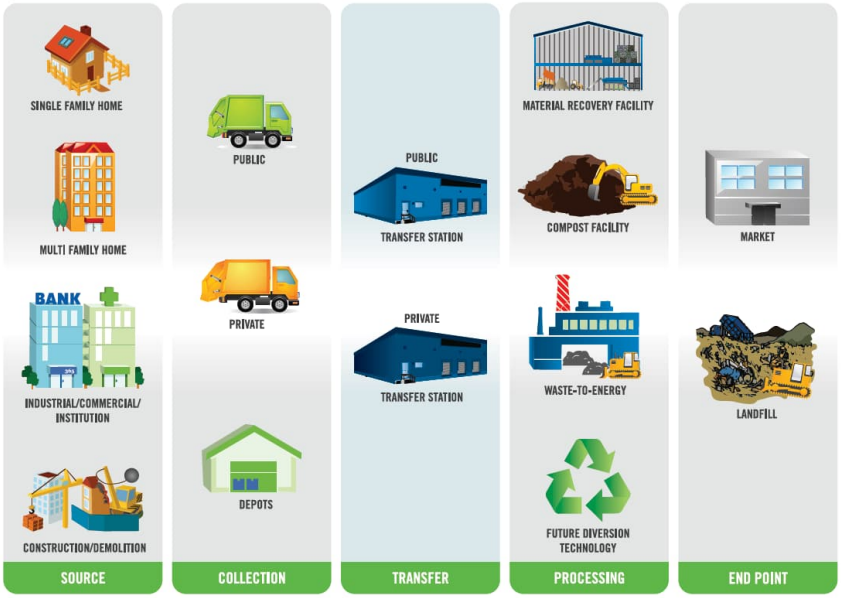
2.0 Project Background

The Region has a complex system for solid waste management with many actors playing a diverse set of roles. This section provides a definition of solid waste management and a high-level representation of how waste flows through a system from generation until it reaches its final destination. It also identifies the key stakeholders in the regional waste system, including the data they create and manage. This information provides important context for the need to develop a data strategy to enable stakeholders to share data to advance shared goals for solid waste management in the Region.

2.1 Solid Waste Management

The collaborative defines solid waste management as the collection, transfer, processing, and disposal of all solid waste material, including garbage, recyclables, hazardous waste, and organic material[2]. Figure 2-1 indicates the typical flow of solid waste material from collection to its end destination.

Figure 2-1: Solid Waste Flow Diagram.



Source: Tetra Tech Inc. 2022.

At the highest level, waste generated in the Region is collected by a hauler or is self-hauled to a drop off location. Collected waste is transported to a transfer station where it is sorted into recyclables, compostables, and garbage. Aggregated recyclables are sent to a materials recovery facility (MRF)[3], compostables go to compost or anerobic digestion facilities, and garbage goes directly to landfill. Recycled and composted materials are then sold to secondary markets to be transformed into end-products.

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[2] Metropolitan Region Servicing Plan.

[3] A Materials Recovery Facility (MRF) is a plant that processes recyclable materials to sell to manufacturers as raw materials for new products.

In practice, solid waste management in the Region is completed by many actors completing a wide range of activities. Each actor, at every step of the process introduces additional complexity in the data that must be tracked, collected, and analyzed to provide a holistic view of system operations at the regional level.

2.2 Municipal Waste Collection

Municipalities are responsible for establishing programs, policies, and strategies for waste management. Today, each municipality operates largely independently or through a sub-regional waste commission. As a result, there are significant differences across the Region in what, how, and when services are provided. In addition, there are important differences in the reporting requirements, management systems, and tools in use. This variation has led to significant differences in how each municipality collects, tracks, analyzes, and reports data. Lack of consistent data prevents a clear understanding of overall system capacity, performance, and opportunities at the regional level.

Some member municipalities have already conducted, or regularly conduct, studies on the composition of residential waste. Unfortunately, differences between methodologies and data collection across these studies prevents the ability to easily compare results and to aggregate data at a regional level. Although the collaborative supports a common material classification system, the process for each municipality to adopt this standard is unclear.

Today, it is difficult to understand the full costs and benefits of waste services at the regional level. The costs to provide non-residential waste collection services in the Region are largely managed through confidential terms outlined in formal agreements with private haulers. As a result, municipalities are often unable to share provider rates and other related service costs. In addition, haulers may invoice the municipality using net costs rather than costs broken down by generator, source, or stream (i.e., garbage, recycling, and organics). This makes it more difficult to compare costs to identify efficiencies, economies of scale, or other opportunities at the system level.

Funding mechanisms for waste services are different across municipalities, with services funded through a variety of sources including property taxes, utility rates, or other subsidies. In addition, municipalities may not have the capacity to track the full costs associated with managing waste services, including corporate and administrative services. Alternatively, municipalities may not be actively monitoring the revenues or cost savings generated through waste services, such as depot fees, sales of recycled material, or the use of recycled aggregate in public works projects. As a result, the financial benefits of recycling and composting programs may not be fully reflected within municipal accounting.

There are significant opportunities for municipalities to enhance capabilities to share information at the regional level. Data has the potential to drive understanding of system performance, identifying outliers or gaps, and highlighting opportunities that cross municipal boundaries. The ability to access and learn from data is critical in achieving solid waste goals and improving the system at a regional level.

See Appendix C: Municipal Waste Programs for a more detailed overview of services.

2.3 Waste Stewardship Programs

There are five regulated waste stewardship programs in Alberta:

- Beverage Containers
- Electronics
- Paint and Paint Containers

- Tires
- Used oil materials (used oil, oil filters and oil containers)

Alberta's waste stewardship programs are managed by delegated administrative organizations (DAO) operating at arms-length from government and are accountable to the Minister of Environment and Protected Areas. There are two recycling DAOs, the Alberta Recycling Management Authority (ARMA) and the Beverage Container Management Board (BCMB), managing the five stewardship programs. Regulations give these organizations responsibility to manage these programs and they are required to submit annual reports and business plans including audited financial reports, yearly to the Minister. These reports are available to the public.

ARMA has managed regulated recycling programs for used oil, paint, tires, and electronics in Alberta for more than 30 years. The Designated Material Recycling and Management Regulation authorizes ARMA to levy and collect surcharges (environmental fees) on the sale or supply of designated material in or into Alberta. ARMA collects and processes designated materials from municipal drop-off facilities. With the recent announcement of ARMA as the designation organization to provide oversight over Alberta's Extended Producer Responsibility (EPR) framework to be implemented in 2025, ARMA will be a key source of recycling data for the Region in the future.

The BCMB is responsible for setting the deposit refund amount for all regulated beverage containers in Alberta. Alberta's beverage container recycling industry has long been viewed as a successful model for not just keeping beverage containers out of landfills, but for ensuring they are recycled and become part of the circular economy.

The Beverage Container Program is operated by the Alberta Beverage Container Recycling Corporation (ABCRC). ABCRC operates the largest deposit-based beverage container collection system in Canada with not-for-profit provisions as the appointed and approved agent for Alberta beverage manufacturers and distributors whose beverage containers are regulated. ABCRC is working to bring more transparency in the data they report, including analyzing how much material from a recycled beverage container is actually used to make other beverage containers and recycled products. This is intended to provide more insight into current recycling processes and enable exploration of innovative options that produce less waste[4].

Recycling material managed through waste stewardship programs represents a significant portion of total recycling in the Region. Obtaining data from the DAOs and/or product stewardship programs operating in the Region would expand the understanding of the total amount of recycling that is generated and collected. In addition, these organizations are in the best position to provide assumptions used in modeling (e.g., contamination, processing losses). This data would also enable a more accurate assessment of performance of the recycling programs as well as contribute to achievement of the Region's ambitious waste targets.

See Appendix D: Provincial Waste Stewardship Programs for a more detailed overview.

2.4 Regional Waste Commissions

Two solid waste commissions operate within the Region: the Roseridge Waste Management Services Commission (Roseridge) and the Leduc and District Regional Waste Management Commission (LDRWMC). Waste commissions operate programs and facilities to help minimize the costs of waste services for their residents.

[4] https://www.abcrc.com/assets/Uploads/2021-ABCRC-Sustainability-Report.pdf.

Although initially established with a focus on minimizing the costs of waste disposal for residents, activities have evolved over time to emphasize waste diversion, including expansion into recycling and composting facilities. Waste commissions hold high-quality data within weigh-scale applications, financial systems, audits, and studies (e.g., waste characterization). In addition, staff have knowledge and expertise that would help strengthen the assumptions underpinning waste estimates and enhance the value of regional solid waste data. In turn, the waste commissions would benefit from information regarding the strategy and operations of other stakeholders within the regional waste system.

The regional waste commissions operate as independent entities with governance structures separate from the municipalities they serve. There is currently no data sharing agreement in place between the EMRB and the waste commissions. As a result, solid waste data provided from the waste commissions must be requested through the EMRB member municipalities. Formal data-sharing agreements would reduce turnaround time, minimize staff workload, and provide access to additional front-line expertise.

2.5 Private Waste Collection

Across the Region, a significant amount of waste is managed privately through individual contracts managed directly between the hauler and the customer. As no municipality currently requires private haulers to report on waste collection and there is a reluctance to voluntarily share data for fear of disclosing information to competitors, a large gap exists in regional waste data. Consequently, privately managed waste volumes must be estimated for both residential and non-residential waste.

Private haulers represent an invaluable source of information regarding the assumptions used to estimate waste volumes and current performance of the solid waste system. There is an incentive for private haulers to engage with the Region to identify and address barriers and pursue opportunities that would improve the bottom line as well as improve services for residents or realize economic, environmental and social benefits for the Region.

2.6 Regional Waste Facilities

Waste facilities include public drop off centres and public and privately managed transfer stations, materials recovery facilities, composting facilities (aerobic and anaerobic), and landfills. Like haulers, waste facility operators represent important sources of knowledge and data.

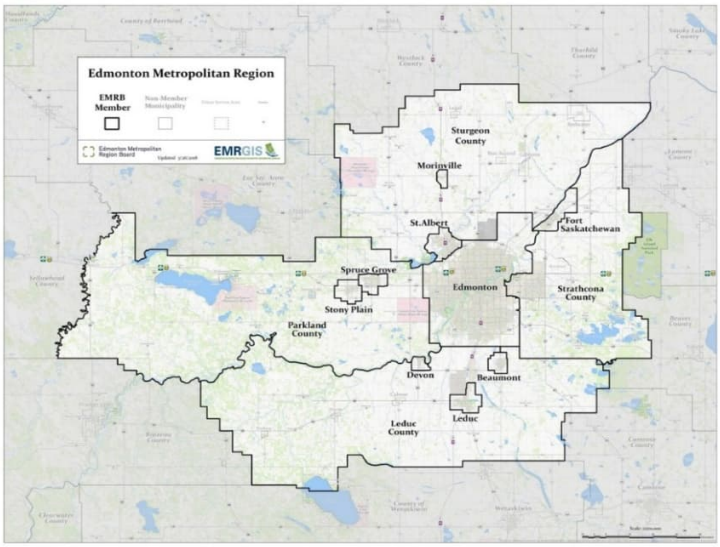
Although information from publicly managed facilities is accessible, not all facilities report the same way and there is a risk of double-counting or missing waste volumes if a material passes through multiple facilities before reaching its final destination. As much of the Region's privately collected waste volume is currently managed through privately owned transfer stations, private processors, or is transported out of the Region for final disposal, the Region does not have access to reliable information regarding how much of the recycling and organics streams are successfully processed and how much is still ending up in landfill. Additional engagement with waste facilities represents an opportunity to develop more reliable and accurate assumptions regarding contamination and processing losses at each facility.

See Appendix F: Regional Waste Facilities Map.

2.7 Solid Waste Collaborative

Figure 2 2: Boundaries of the Edmonton Metropolitan Region

The Edmonton Metropolitan Region Board (Board) is a regional growth management board comprised of elected officials from the 13 member municipalities (each with a population of over 5,000) that make up the Edmonton Metropolitan Region (Region). See Figure 2-2 for boundaries of the Region.



EMRB's main functions are to plan for the long-term sustainability of the Region through the development and implementation of a regional Growth Plan and the Metropolitan Region Servicing Plan (MRSP). Through the MRSP, the Region can coordinate to improve municipal services and save taxpayer dollars through efficiencies.

To support development of the inaugural MRSP, an environmental scan was completed for key servicing areas to build a shared understanding of the state of servicing in the Region. For solid waste management, an overview of each municipality's waste management system was documented, including all known public and private waste facilities serving the Region.

The environmental scan highlighted the need to identify fundamental solid waste goals for the Region as well as agreement on metrics to support long-term planning. The environmental scan also highlighted the lack of critical data and the difficulty in comparing data across the Region as a significant barrier to effective collaboration. Consequently, a key recommendation of the MRSP was to initiate regional collaboratives for high-priority municipal services, including solid waste management. The MRSP was approved by the Board on December 19, 2019.

In October of 2020, the EMRB initiated the collaborative to help achieve shared goals for regional solid waste. With representation from each of the 13 member municipalities, the collaborative was established to leverage regional expertise, provide a supportive forum to foster research, share best practices, and enable evidence-based decisions and actions.

In its first action plan, the collaborative confirmed the vision of a "Zero Waste" Region with a focus on accelerating the circular economy. To advance the regional vision, the action plan included a prioritized list of solid waste projects and initiatives with regional significance and a 5-year roadmap to guide project implementation. In alignment with this roadmap, the collaborative is currently undertaking foundational projects, including development of this data strategy. The action plan was formally approved by the Board on August 12, 2021.

Recognizing the mutual benefits of regional collaboration efforts, the EMRB invited the waste commissions to participate in the solid waste collaborative. Expanded membership has the potential to broaden access to data and expertise to benefit the waste commissions as well as the collaborative. A representative from each waste commission was added to the collaborative in January of 2023.

See Appendix B: Data Strategy Contributors for a full list of collaborative members.

2.8 The Need for a Data Strategy

Across the Region, there are a range of engaged stakeholders committed to achieving the economic, social, and environmental benefits that can be gained by reducing waste, optimizing processing, and minimizing the material

that ends up in the landfill. While each stakeholder must manage the information and data needed to guide local strategy and operations, there are a range of factors that necessitate collaboration across the Region, including:

- There is an increased urgency to reduce the impacts of waste management globally.
- The legislative and regulatory landscapes for waste are changing rapidly.
- Waste moves between municipalities and outside the Region's borders.
- Traditional and circular waste solutions require feedstock at scale.
- Waste solutions are becoming more sophisticated, and expertise is required to fully understand and compare options.
- Small waste volumes require municipalities to aggregate material to achieve economies of scale.
- The decisions made in one municipality's waste program will impact the others.
- Participation from private industry will be required to achieve regional waste targets.
- Regional cooperation can prevent leakage and other unintended consequences of local waste policies.

Despite the strong case for regional collaboration, success requires each stakeholder to develop new ways of working together. There is no shortage of solid waste data available across the Region. However, the data exists in disparate systems, in incompatible formats, held within discrete silos, providing little or no visibility or value at the regional level.

There is a need to align data with strategy and to optimize limited resources through technology. A data strategy provides a formal mechanism to assess, prioritize, plan for, and implement the data and tools that offer the highest value to the Region. Additionally, it represents the first of many steps required to develop the data maturity and foster the data-driven culture needed to optimize solid waste outcomes for the Region.

3.0 Solid Waste Data Strategy

A data strategy is a long-term, guiding plan that engages stakeholders in taking a deliberate and objective look, using a data lens, at what is needed to achieve stated objectives, including:

- The **technology** that will enable the storage, sharing, and analysis of the data.
- The **processes** required to ensure data is both accessible and of high quality.
- What **people** need so that they are empowered to effectively provide, use, and enhance the data.

This section outlines the data vision, guiding principles, strategic capabilities needed, and the goals of this data strategy.

3.1 Data Vision

A data vision defines a "North Star" for the data strategy and communicates why the Region should care about data. The solid waste data vision is:

> *Solid waste data is a critical asset that provides insights and empowers the Region to make evidence-based decisions to accelerate the circular economy and design a future without waste.*

Insights from the data can be used to chart the best course to advance the projects and initiatives outlined within the action plan and make progress towards the Region's shared goals for solid waste.

3.2 Guiding Principles

Guiding principles establish a framework for expected behavior and decision-making as the collaborative designs, implements, and manages solid waste data across the data management lifecycle. The following guiding principles have been adapted from the EMRGIS Strategy and Implementation Plan:

1. **Autonomy** – All stakeholders will respect the self-determination of municipalities and waste commissions to control their own data.
2. **Collaboration** – All stakeholders will work together to support the planning efforts of the Region including free sharing of relevant non-confidential datasets.
3. **Equity** – All stakeholders will be treated in a way that is equitable, consistent, and congruent to ensure the benefits of data are available to all.
4. **Flexibility** – All stakeholders will be expected to proactively identify options that work best for their organization while also considering the needs of all others, including available technology, required data standards, and supporting methods.
5. **Mutuality** – Working together in the Region will be the key to achieving a consistent level of data access needed to advance shared goals.
6. **Sustainability** – All stakeholders will look for opportunities to encourage data acquisition and management practices that are self-sustaining and continuously improving.
7. **Transparency** – The results of decision-making processes related to data and technology supporting implementation of the action plan and the MRSP will be transparent to stakeholders.

These principles are expected to establish universal and enduring guidance regardless of how the collaborative's mandate, goals, projects, or structure may change over time.

3.3 Strategic Capabilities

Strategic capabilities are those needed for the Region to achieve its data vision. Today, solid waste data can be characterized as isolated in silos. Data silos mean that each stakeholder has their own ways of working with data which may not be consistent or comparable with data managed by others. This makes regional collaboration more difficult, obscures insights, and prevents greater understanding of performance at the system level. To address the largest challenges first, the following strategic capabilities have been identified as having the greatest regional impact:

- Improving Accessibility
- Enhancing Data Integrity
- Measuring Performance
- Demonstrating Return on Investment.

Strategies to enhance each strategic capability have been identified. Supporting actions and projects are reflected in the data strategy roadmap and will be further explored through the annual action planning process.

3.3.1 Accessibility

Since its inception, the collaborative has identified data as a key enabler. Over the last two years, the collaborative has collected significant program, policy, and performance datapoints from across the Region. The data template has evolved into a model that contains a large amount of data that can support analysis at the municipal, sub-regional, and regional levels. However, this information is not easy to find, view, or analyze.

Making data easier to find (or discover) helps ensure that the necessary data is available when it is needed. Effective governance will enable the right people to access business intelligence and visualization tools that translate data into actionable information. These tools can be used to democratize data by condensing complex concepts or large datasets using easy to understand formats. By making data easier to consume, both technical and non-technical stakeholders can benefit and use it to make better decisions.

3.3.2 Integrity

There is risk in low-quality data or the inability to provide assurances regarding the integrity of the solid waste data used to develop recommendations and support decisions. Low quality data hinders value and creates cumulative issues for future analytics. Additionally, there is reputational risk when asking others to rely on data that cannot be substantiated.

Data can be considered to have integrity if users can trust the data to support key operational and decision-making processes. Wherever possible, the collaborative will take action to demonstrate that data is traceable and auditable. This will increase the confidence that the solid waste data used to support recommendations presented to the Board are data-driven.

Some of the key steps that will be taken to improve data integrity include:

- Implementing a repeatable process and/or tools to help identify, remove, and correct data discrepancies.
- Providing training so that data suppliers and users can comply with relevant standards, methods, and protocols governing solid waste data management.
- Establishing permissions to prevent data being damaged, misused, or lost.
- Implementing data validation rules and/or controls that minimize the sources of human error common during data collection and prevent accidental modification or loss of data during use.
- Establishing strong backup and recovery practices so that data is protected and secure and can be effectively recovered, if needed.

3.3.3 Performance Measurement

Performance measurement is the process used to assess the efficiency and effectiveness of projects, programs, or initiatives. It is a systematic approach to collecting, analyzing, and evaluating how successful the collaborative is in achieving stated outcomes and goals.

Performance measurement is typically used to demonstrate accountability, support decision making, and improve the processes needed to enhance success. Performance measurement is an integral part of any strategic or project planning process and must be considered from the outset.

As part of the annual action planning process, the collaborative assesses potential projects using a triple-bottom-line framework that considers three dimensions of benefits:

- Economic Effect Potential:
    - Increased efficiency.
    - Increased business performance and economic opportunities.
    - Financial sustainable.
    - External funding received.
- Environmental Effect Potential:
    - Reduction in solid waste generated.
    - Reduction of GHG emissions.
    - Reduction of toxins discharged into the environment.
- Social Effect Potential:
    - Improved diversion opportunities for residents and businesses.
    - New or enhanced partnerships.
    - Benefits transferred across municipalities.

Assessment results are used to prioritize projects as well as to outline the benefits and outcomes expected. To ensure this data is available at the completion of the project, the data needed to measure benefits will need to be specified in the project charter prior to submission for approval. This includes outlining specific data that will be used, created, modified, or purchased throughout the life of the project. A comprehensive plan to procure required data will enhance the collaborative's ability to measure outcomes at project completion, following implementation, and over time until desired goals have been achieved. This approach also ensures that all data requirements, including any additional time and funding necessary, have been fully considered prior to project initiation.

Enhancing the capability to measure performance will provide the information needed to make strategic decisions about where best to focus collaborative efforts, obtain required resources, and demonstrate achievements over time.

3.3.4 Return on Investment

The collaborative brings together skills and expertise from across the Region. To support continued investment in regional collaboration, the ability to demonstrate return is critical. The collaborative has committed to the following suite of key performance indicators (KPIs) within the action plan to help measure the success:

- Waste generated.
- Waste diverted.
- Waste processed (recycled and composted).
- Gross value added.
- Direct, indirect, and induced jobs.

- Access to a depot.
- Cost per tonne.
- GHG emissions.
- Toxins avoided.

The methodologies employed to derive these KPIs are essential for credibility. Each methodology must define the series of steps to achieve the result so that it can be consistently and reliably repeated. It is important that all solid waste data stakeholders understand and agree with the methodologies applied.

3.4 Data Strategy Goals

The overarching aim of the data strategy is to provide the structures and mechanisms needed to develop strategic capabilities for the Region. More specifically, the goals of this data strategy are to:

1. **Improve Data Management** – Establish the data standards and methods needed to improve data access, data integrity, and data security for solid waste data.
2. **Establish Governance** – Recommend a governance structure and supporting roles and responsibilities to effectively coordinate data management between all stakeholders.
3. **Implement a Service Delivery Model** – Initiate a service delivery model that provides value to all stakeholders, is cost-effective, and makes effective use of limited time and resources.
4. **Establish Protocols** – Formalize the agreements needed to empower people to effectively collaborate to advance shared solid waste goals.
5. **Optimize Tools and Technologies** – Describe the tools currently enabling collection and analysis of solid waste data and the expected next steps to enhance the value of solid waste data to the Region.
6. **Build a Roadmap** – Achieve agreement on the specific and actionable milestones needed to achieve data strategy goals.

Achievement of the data strategy goals will represent the first step towards building data maturity. However, completing the data strategy should be viewed as only the starting point for developing a data-driven culture. A data-driven culture looks for new ways to use data and analytics and proactively explores and operationalizes new datasets and ideas. This type of culture drives initiatives that invest in data assets, increase data literacy, remove data silos, and leverage technology in support of more effective analysis.

4.0 Solid Waste Data

Given the complexity of the regional solid waste system, there is a need to understand the different types of data used in solid waste management, the common sources of this data, and the enabling tools and technologies that are being used today to increase accessibility, utilization, and understanding to achieve greater value from the data.

4.1 Waste Data Types

While there are a wide variety of datasets that could prove helpful in improving performance of the solid waste system, foundational data that has been collected for the Region includes:

- **Generators** – who is responsible for generating the waste.
- **Sources** – where the waste is being generated.
- **Management** – who is responsible for collecting and sorting the waste.
- **Streams** – how the waste is being sorted at source prior to collection (1, 2, or 3 streams).
- **Categories** – what kinds of waste are collected (garbage, recycling, organics).
- **Material** – what specific materials make up the waste.
- **Stages** – how the waste gets handled.
- **Destinations** – where the waste ends up.
- **Service Cost** – how much it costs to manage waste.

To ensure that all stakeholders understand what is (and is not) included within each data type, definitions have been established. The definitions and data requirements for each data type have been outlined in the Glossary of Terms and within the Solid Waste Data Standard. Where opportunities to improve data integrity were identified, specific actions have been presented in the strategy and are reflected in the roadmap.

This foundational data will be used to monitor current system performance, highlight best practices, identify areas of concern, signal gaps in capacity, and measure the impacts of local and regional actions.

4.1.1 Waste Generators

Waste generators are defined as the unit by which waste generation is normalized for a population. For residential waste, the unit of generation is typically by household to align with typical invoicing for curbside services. The collaborative defines households as:

- **Single Family** – Households residing in dwellings with 1 or 2 units (i.e., single detached house, semi-detached house, or duplex).
- **Multi-Family** – Households that reside in dwellings with between 3 and 7 units (i.e., row-houses).
- **Communal** – Households residing in dwellings with 8 or more units (i.e., low-and high-rise buildings).

Each municipality specifies the number and types of households within the municipality as well the number that are currently served by a municipal waste collection program[5]. Average waste per household values for municipal services are used to estimate the volume of waste collected privately.

[5] Municipalities may define household types differently than the definition proposed by the collaborative. As these definitions are reflected in bylaws and standards, developing consistency in this definition across the Region may represent a significant undertaking.

For non-residential waste, the unit of generation is typically by person (per capita). Population figures for the population of each municipality are taken from Statistics Canada data and estimates are derived by applying average non-residential waste generated for all Albertans taken from the Statistics Canada's Waste Management Industry Survey results.

4.1.2 Waste Sources

The data model currently contains data from two waste sources, residential and non-residential.

Residential waste refers to waste from primary and seasonal dwellings[6] from all collection methods. Residential waste can be collected curbside for single-family households, multi-family households, or communal households. It may also be collected by municipalities through annual or seasonal special collection events. Residents may also self-haul their waste directly to a depot, transfer station, or landfill.

Non-residential waste is all non-hazardous material generated by a source other than residential. This includes Industrial, Commercial, and Institutional (ICI) wastes as well as non-residential Construction, Renovation, and Demolition (CRD) wastes.

Estimates for non-residential waste are currently derived by using Statistics Canada's Waste Management Industry Survey. The survey is conducted bi-annually and data releases take several years to be completed. Waste calculated using this method is likely to underrepresent the volume for the Region as a large urban centre surrounded by shoulder communities is more likely to generate more non-residential waste than smaller urban centres across Alberta. A waste characterization study would strengthen the assumptions used to estimate non-residential waste.

The data model cannot currently differentiate the volume generated from ICI and CRD sources within non-residential waste. Improving the understanding of waste from these sources has been identified as high priority for the collaborative.

In addition, the model does not currently contain data for waste generated by sources not typically included in the definition of municipal solid waste such as agricultural or "other" sources of waste.

Agricultural Waste is the waste produced from agricultural activities, such as from farms or slaughterhouses, and harvest material. This can include large amounts of organic material, including potentially hazardous materials such as fertilizer or pesticide waste as well as potentially recyclable material such as strapping and grain bags. This sector also generates a significant volume of CRD waste. As agriculture represents the largest land use in the Region and is the second highest contributing economic sector in the province, the collaborative agrees this there is a need to better understand management of this waste.

Other waste sources that are typically not included in municipal solid waste but contribute to the waste generated in the Region include, specified risk material[7], pet crematoria, wastewater treatment plants, and heavy industrial wastes. As these materials may provide additional sources of feedstock for waste processing facilities in the Region or opportunities for more circular solutions, the collaborative may wish to consider adding waste data from these sources in the future.

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[6] No seasonal dwellings have been reported by any municipality.

[7] Specified Risk Material includes biological waste from the cattle industry that must be removed and managed separately to prevent tissues that may contain BSE infectivity from entering the human food chain (Canadian Food Inspection Agency: Guidance on Specified Risk Material)

Waste characterization studies offer an opportunity to develop more information about the sources of waste not currently tracked within the data model. This data would provide a more comprehensive understanding of the total waste managed in the Region as well as the full range of opportunities to reduce, divert, and process these materials.

4.1.3 Waste Management

The data model currently collects reporting on **municipally managed waste**. This includes residential and non-residential waste collected through in-house or contracted haulers. Some municipalities also conduct special events that collect specific items curbside, such as large items or Christmas trees. Municipally managed waste also includes material that is self-hauled to a public depot, transfer station, or landfill.

Privately managed waste is all residential and non-residential waste collected curbside by a private hauler or self-hauled to a private depot, transfer station, processing facility, or landfill. As little information is publicly available for privately managed waste in the Region, residential and non-residential volumes are estimated in the model. Estimates for residential waste collected privately assume that households with private services generate similar volumes and types of waste as those with municipal services. Additional work is required to provide a better understanding of the streams available to residents with private services.

Estimates for privately managed non-residential waste are derived by removing the municipally managed waste volume reported from the total non-residential waste estimates provided in the Waste Management Industry Survey from Statistics Canada.

There is also a significant amount of waste managed through **provincial waste stewardship programs** within the Region. As ARMA material is collected through public waste facilities, this data is available and has been included in the data model as a portion of municipal waste. However, the integrity of this data could be improved by separating volumes managed by municipalities and ARMA and through more direct data reporting. This is likely to become even more important as EPR is implemented across Alberta.

There is currently no data from ABCRC contained within the data model. With more than 905,000 tonnes of material diverted from landfill across Alberta in 2021, data from ABCRC would expand the understanding of the total amount of recycling that is generated and collected within the Region.

4.1.4 Waste Streams

Solid waste, regardless of the source, is collected in up to three streams across the Region: **waste, recycling, and organics**. Each municipality defines which materials should be collected within each stream based on capability to pre-process or process the material. As different municipalities have different capabilities, the material in each stream varies across the Region. Services for all streams of waste may not be available in a municipality or be accepted by a facility.

Although municipalities have high-quality data for **household hazardous waste** volumes, material, and costs, this information has not yet been incorporated into the data model. Funding for the management of household hazardous waste from the province was recently reduced and municipalities will be expected to bridge the costs of managing these materials until they are incorporated into the EPR program. Incorporating data on household hazardous waste would improve the completeness of residential data for the Region.

4.1.5 Waste Categories

Solid waste can be classified into three broad categories: garbage, recyclables and compostables.

Garbage is defined as material that is not recyclable or compostable and is collected with the intention of being disposed.

Recyclables are defined as any dry waste that can be reprocessed into a material that has value as a feedstock in another production process that excludes energy recovery and is designated by the municipality. Today what is considered recyclable differs across municipalities. However, deployment of the EPR Framework is expected to align acceptable materials across Alberta.

Compostables refer to biodegradable or compostable waste, including food scraps, yard and garden trimmings (including grass clippings and leaves), and food-soiled paper products.

All three categories can be found in all three waste streams. For example, the recycling stream is expected to contain recyclables but will also contain garbage and compostables. The unintended material collected in the recycling and organics streams is considered contamination. This includes materials sorted into the wrong bin as well as hard-to-process materials, such as paper with food and beverage remnants, labels, caps, and glues. Contamination is removed prior to processing and is landfilled.

The data model currently uses assumptions to determine the relative percentages of garbage, recyclables and compostables within total waste volumes. Most municipalities are currently using an industry average to estimate these volumes. Where waste characterization data is available for residential waste, it could be used to replace industry averages with more accurate assumptions.

To align with the definition of solid waste management, a hazardous waste dataset can be added.

4.1.6 Waste Material

Each category of waste can be further broken down into specific materials. Greater detail regarding which materials are being recycled, composted, recovered, or disposed of can be helpful in developing diversion strategies to address the problematic materials (e.g., non-compostable liners for kitchen organics pails), estimating the impact of changes to waste programs or regulations to the Region (e.g., the new federal ban on certain single-use plastics), and measuring the success of regional interventions over time. This data can also be used to determine if there is enough of a particular material to create a new market or to be sold through an existing market.

Although most municipalities have conducted or regularly conduct the waste characterization studies needed to estimate specific materials, this information is not currently included in the data model. If the collaborative determines that there is value in this data, a common standard for classifying materials is needed to ensure that all municipalities are classifying materials in the same way.

In a previous collaborative project, the Cascadia Consulting Waste Classification System was recommended as a potential shared classification framework for the Region. The recommendation is based on its alignment with the Canadian Stewardship Services Alliance's National Stewards Guidebook that sets out a national material list and summarizes which materials are covered in each of the four existing Canadian provincial EPR programs. Alberta's future EPR program for packaging and paper products is likely to align with the materials that are legally designated in other provinces with the intention of creating a harmonized EPR system in Canada. These definitions also align with the wider material markets.

Although the collaborative supported the recommendation for a common classification system, the process for each municipality adopting this standard is unclear.

4.1.7 Waste Stages

Waste goes through many stages between generation and reaching its end destination. At each stage the volume of material may be impacted. For example, not all recycling collected is recycled. The contamination removed and the material that is lost during processing ends up in the landfill. However, the mass of all material collected must balance with the total material processed or landfilled.

- **Generated** – All waste, recycling, and organics or all garbage, recyclables or compostables collected[8].
- **Collected** – Material that is collected either manually or using automated equipment, depending on the stream. All material that is collected is either disposed, recovered, or processed.
- **Disposed** – All material collected in the waste stream that is not recovered.
- **Recovered** – Waste that is converted into usable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolization, anaerobic digestion, and landfill gas recovery. This process is often called waste-to-energy (WTE). Although there are currently no WTE facilities operating in the Region, this is expected to change in the near future.
- **Recycled** – Recyclable material collected that is converted back into a raw material. This is [9]material from the recycling stream that is not residue or lost during processing.
- **Composted** – Compostable material collected that undergoes a controlled biological degradation process and is converted back into a raw material.
- **Processed** - Material collected that is recycled or composted.
- **Diverted** – All material that is saved from landfill, including all material that is recovered or processed.
- **Contaminated** – Contamination is non-target material collected through the recycling or organics stream. This includes materials sorted incorrectly. Contamination is removed prior to processing and sent to disposal.
- **Residual** - Residuals are materials that are collected for recycling, but do not actually get recycled. This may include contaminants that are unable to be recycled as well as material that may be sorted incorrectly or missed during the sorting stage, sending potentially recyclable material to disposal.
- **Outbound** - Material that is sent to an MRF to be recycled.
- **Process loss** – Material that is sent to an MRF for recycling that does not get recycled. These losses can occur from inefficiencies in the actual recycling process as well as remaining residuals that need to be separated out. Losses in organics processing are much lower and are not considered material.
- **Landfilled** – All material collected that does not get processed, including material that is disposed, residual, or lost during processing.

Most contamination and process losses are currently estimated using industry averages rather than estimates or actual data provided by haulers or processors. Improved data regarding the rates of contamination and process losses from public and private processing facilities would improve the accuracy of current performance metrics for the regional waste system and highlight specific opportunities to improve diversion.

4.1.8 Waste Destinations

Waste destination information currently contained within the data model is limited to recovered, recycled, composted, or landfilled.

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[9] This definition does not account for the household hazardous waste that is collected in the Region and does not acknowledge that some waste generated is leaked into the environment.

Data regarding how much material is destined for each facility combined with the geographic location of the facility would support more effective analysis of how material flows within and beyond regional boundaries. In addition, processing capacity for each facility could be assessed against the volume of material currently being managed to estimate current and future processing gaps in the Region. Tracking at the facility level would also enable more precise rates of contamination and process losses from public and private processing facilities to be applied. This information could be used to provide more accurate measures of system performance.

Finally, for solid waste disposal to be economical, hauling distances are ideally in the range of 150 km or less to the end point location. These numbers will vary depending on the efficiency of hauling, but it is accepted that hauling contributes significantly to waste disposal costs, and the distance from drop off to a facility and from the facility to end markets should be considered an important part of solid waste data. Combining volume and geo-spatial data would provide additional insight into the total costs of managing waste for different scenarios (i.e., higher tipping fees versus transporting a longer distance) as well as assessing potential future markets for secondary material.

4.1.9 Service Costs

Cost data was requested during development of the initial solid waste data template. Much of data returned was incomplete and there continues to be sensitivities regarding sharing potentially sensitive or confidential information beyond municipal boundaries. However, a clear objective of the collaborative is to find efficiencies that will deliver savings to ratepayers or improve the quality of services to residents. To achieve this, greater visibility into funding mechanisms and service costs is needed.

Most municipalities currently have the ability to track the full costs associated with managing services. Full costs include all associated expenses including direct personnel, a portion of support functions, billing, customer services, accounts management, sundries, property costs, education and engagement programs, Information Technology, and enforcement.

Defining a shared methodology for determining the correct proportion of costs to attribute to waste management services would support standardization of service costs across the Region. Combining service cost information with waste volume and composition data would enable the Region to identify opportunities for efficiencies, estimate additional processing requirements, and to prioritize high-volume and high-cost portions of the waste stream in planning.

4.2 Data Sources

Across the Region, there are a wide array of sources for the creation and reporting of solid waste data. Publicly available sources may report data using different definitions, time periods, and levels of specificity. The key sources of solid waste data are summarized in Table 4-1.

Table 4-1: Sources of Solid Waste Data

Data Source	Description
Annual Reports	Most municipalities develop an annual report on waste services that is made publicly available. Product stewardship programs also provide annual reporting to the public. Waste management facilities are required to report annually to the Province, but this information is not publicly available. The revised Code of Practice for Compost Facilities Reporting for Alberta came into effect January of 2022 and outlines specific requirements for annual reporting but does not require that this information is made public or submitted to the GOA. Facilities may choose to make these reports available to the public.

Data Source	Description
Bylaws	A majority of municipalities in the Region have bylaws that outline their residential waste programs, set standards for what materials can be collected in each stream and establish how collection and/or drop off takes place. Some bylaws exist to restrict open burning of solid waste in urban areas; some open burning still exists in rural areas.
Contracts/ Invoices	Contracts are in place for hauling, and terms are clearly defined so adjustments can be made for continual improvement. Collection and processing costs are considered confidential. Product stewardship programs that reimburse municipalities for material collected report tonnages and cost per tonne data.
Invoice Tracking Tools	Municipalities generally maintain their own tracking tools for residential waste data. These tools often focus on financial data (invoice tracking) and high-level volumes reported by haulers; they may not provide detailed information such as material types, processor, and total tonnes processed.
Financial Systems	Several municipalities have adopted a user pay system to promote diversion as federal and provincial grant funding is available to support capital projects for solid waste.
GIS Systems	Most municipalities have internal GIS capabilities and maintain geospatial data for many municipal services, including waste services.
Performance Measures	Most municipalities collect and report information on waste volumes collected and diverted.
Tools and Calculators	Some organizations have compiled their waste characterization data into helpful tools to estimate materials coming from homes and businesses, or groups of businesses. Tools are built on the assumption that businesses of a certain type produce similar wastes at similar rates (per employee), regardless of the location or size of the business, and that residential generators are generally the same. For example, CalRecycle's Business Group Waste Stream Calculator uses statewide averages to estimate waste using employee counts. In the absence of local data, it is possible to apply waste per employee profiles for businesses to the Region. Since these tools provide estimates only, they should be used as planning tools, not measurement tools.
Studies	All municipalities invest in consulting and research services to address specific, urgent, or emerging issues and opportunities. These documents are typically not available to the public.
Waste Characterization Studies (Audits)	Waste characterization data is collected by taking samples of waste and sorting it into material types like newspaper and aluminum cans and weighing each type. Typically, samples are taken from trucks delivering waste to landfills and transfer stations from residential, commercial, and self-haul sources. In some cases, samples are taken from individual businesses to develop waste composition data for specific types of businesses. This data can then be extrapolated to estimate materials in the waste stream. It is important to understand the detailed methodologies applied in each study and how they differ across the Region.
Waste Survey	Statistics Canada conducts the Waste Management Industry Survey: Business and Government Sectors. This bi-annual survey results in the only publicly accessible dataset on private waste for Alberta. Due to the confidentiality provision of the Statistics Act, they do not release waste data below the provincial level. Statistics Canada is currently processing waste disposal data for the 2020 survey, which will be available in February 2023.
Weigh-Scale Applications	Waste facility operators require precise measurement for monitoring the waste volume and types transported by trucks to determine fees. Scales and weighing systems are essential for tracking and monitoring these loads. Custom software applications can be interfaced with the scale system to streamline and simplify data processing, complete faster transactions, and reduce the chances of human error.

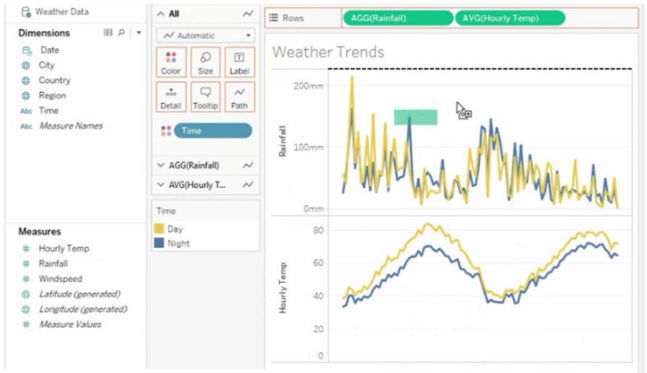
4.3 Enabling Tools and Techniques

While there are significant challenges in identifying and obtaining data, there are also existing and evolving tools and techniques that can assist the collaborative to maximize the value achieved from its data.

4.3.1 Visualization and Communication Tools

Information trapped in a series of spreadsheets or hidden in detailed reports can have limited value to users. To increase value and utility, data can be visualized. Data Visualization is a pictorial representation of a dataset or information using maps, graphs, charts, and other visual elements. Visualization helps identify and understand trends, insights, patterns, and other connections within the data.

Figure 4-1: Sample Tableau Workspace



Source: Tableau.com.

Visualization tools can also be used to share insights with stakeholders through self-serve analytics models, workspaces, and dashboards. Figure 4-1 shows how Tableau, an industry leading visualization tool, can be used to build workspaces where users can examine and explore data using different filters and views.

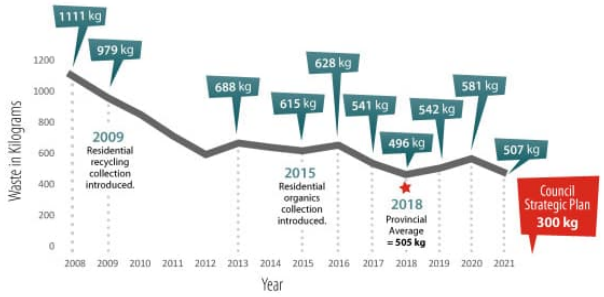
In addition to communicating data in more approachable and digestible ways, visualization tools can improve interpretation of large amounts of data and then illustrate the information in a way that tells a story or gives meaning to the data.

The collaborative can take advantage of visualization tools to report on performance, condense key messages, and demonstrate impact to the Region. Figure 4-2 is an example of how Cambridge University used a dashboard to breakdown waste data by School, Department, Faculty, and site. The data was used to help University staff benchmark the performance of their institution in comparison with other parts of the University, identify trends in waste generation, as well as examine rates of recycling over time.

Figure 4-2: Cambridge Waste and Recycling Dashboard

Source: University of Cambridge.

Figure 4-3: Squamish Waste Produced per Capita by Year (kgs)



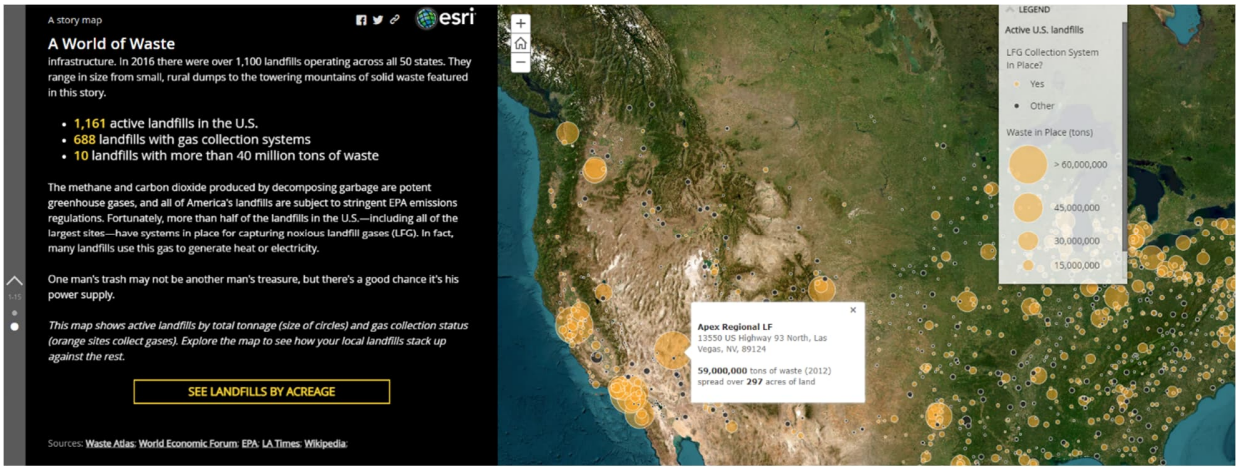
Source: District of Squamish

Infographic templates can be used to turn qualitative and quantitative data into compelling pictures or stories. Figure 4-3 is an example of how the District of Squamish used their waste volume data to set a goal of 300 kg per capita by 2021. The District then used annual data to track progress towards the goal and to communicate their Zero Waste Plan to the public. Although falling slightly short of their overall target, over the 12-year period they reduced per capita waste by more than 55%.

Story maps are web-based maps that are thoughtfully created to contextualize a subject, and provide supporting information so they become stand-alone resources. They can combine maps, diagrams, tables, text, photos, and videos and can use a range of functionality, including swipe, pop-ups, and time sliders, to help users explore content. Story maps can be built using Esri templates that enable users to quickly and easily build useful and attractive data stories tailored to the Region's needs.

Story maps could be an important tool to show how waste flows through the Region or to illustrate how the performance of the waste system has changed over time. They can also be used to communicate policy, demonstrate impact, increase engagement, and educate stakeholders. Figure 4-4 is an example of how a story map can be used to share information on waste.

Figure 4-4: Example Waste Story Map



Source: https://storymaps.esri.com/stories/2017/world-of-waste/

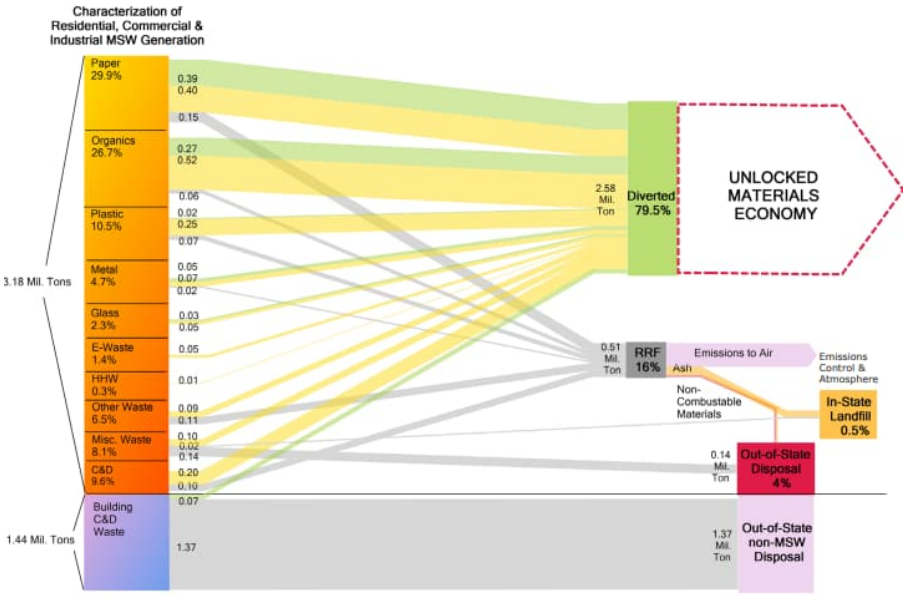
While story maps stories are linear in nature, their contents can also be viewed in a nonlinear fashion by interacting with the map. Depending on the tool or technology used, story maps can be created and published using low or no-code approaches.

4.3.2 Material Flow Analysis

Combining volume data with geo-spatial data could be used to assess current or anticipated hauling distances and the associated costs. By conducting geospatial analysis on waste flow data, a more compelling case may be made to enable policies for flow control, especially if evidence indicates significant leakage of waste outside the Region. Flow control consists of regulations or policies that restrict the movement of waste within regional boundaries. Any waste generated in the Region would need to go through a facility within the Region so that it can be quantified. This prevents leakage of waste that gets hauled outside the Region without being counted first.

By looking closely at the handling in the waste stream, particularly for organics and construction and demolition materials, there is an opportunity to identify the portions of the waste stream most suitable for transformation efforts. Transformation involves redirecting materials from end-of-life disposal scenarios to second-life products. These products can create commodities of substantial economic and environmental value. Figure 4-5 illustrates how the State of Connecticut combined economic data with waste stream data to model and quantify the economic and environmental potential of improved waste diversion.

Figure 4-5: "Unlocked" Waste Management System in Connecticut (FY 2010, millions of tons)



Source: Unlocking the Value: Transforming the Connecticut Materials Economy

Based on the estimates in a 2010 waste composition study, the State determined that almost 55% of the materials being sent to Recovery (RRF) facilities could be diverted. The Sankey diagram above represents the potential for "unlocking the materials economy" through increased redirection of materials towards recycling, composting, and material reuse rather than disposal.

By measuring the flow of materials through the Region, it is possible to identify and quantify the potential to transform what is currently seen as waste into drivers of new products, new markets, new businesses, and new jobs.

4.3.3 Synthetic Modelling

Synthetic data is information that is artificially generated to mimic real-world observations and is used to train machine learning models when actual data is difficult or expensive to obtain[10]. In general, synthetic data has several advantages over real world data:

- Once the synthetic environment is ready, it is fast and cheap to produce as much data as needed;
- Synthetic data can have perfectly accurate labels, including labeling that may be very expensive or impossible to obtain manually[11];
- The synthetic environment can be modified to improve the model and training; and
- Synthetic data can be used as a substitute for certain real data segments that contain, sensitive information (e.g., personal data).

Compared to real-world data, synthetic data generation can be faster, more flexible, and scalable over time. By adjusting parameters, it can also be an effective way to model and generate data that does not exist or is not available.

Synthetic models can be used to predict future values based on past values and are now commonly used in the field of economics and the natural environment[12].

4.3.4 Artificial Intelligence

One of the main benefits of using artificial intelligence (AI) in waste management is better understanding patterns of waste production and consumption. AI can develop more efficient plans for managing garbage. For example, 'intelligent' waste bins can be used to notify waste management companies when they are full, which means that collection routes can be optimized, labour reduced, and fuel saved.

New smart bins combining AI and robotics can be used to sort waste at the point of disposal in high-traffic areas such as public facilities. Machine learning classifies the item by type of waste and directs it to its respective bin - recycling, organics, or waste. Smart bins can also generate and report high-quality data for waste audits and generate dashboards that help monitor capacity, track diversion rates, identify trends, and assist in strategic planning. Finally, smart bins can also display content that helps raise awareness and educate the public.

The City of Regina leveraged AI to implement a Cart Smart program using camera GPS technology that detects contaminants in the blue cart (recycling) through imaging. After detection, residents with unacceptable items in their blue cart receive an "OOPS" mailer, to inform them that their recycling bin was contaminated. The information gathered from this program allowed for the creation of a "Recycle Right Plastic" education program. This innovative addition realized a 41% improvement in recycled contaminants over the three-month pilot.

At waste facilities, AI solutions scan waste and identify materials across many different classes to increase sorting efficiency and accuracy. For recycling facilities, this can mean enhanced outputs, increased productivity, and reduced costs, as well as a rise in the number of valuable materials that are sent for recycling. AI solutions are now being used differentiate between food-grade and non-food-grade plastics. This has the potential to increase the

[10] https://www.altexsoft.com/blog/synthetic-data-generation/

[11] if a picture of a park is generated, it's easy to automatically assign labels of trees, people, animals. We don't have to hire people to label these objects manually.

[12] https://www.altexsoft.com/blog/synthetic-data-generation/

purity of recycled material to generate higher value products that can potentially increase markets or create new ones[13].

Beyond the waste industry, all facilities that use raw materials or components to create a product must provide waste management. Patterns of waste may be hard to spot without enough data on facility processes. Waste management strategies may work in theory but fail in practice or require too much additional labor to be feasible. New AI-powered tools can help facility managers to effectively identify and manage sources of site waste. An optimized waste management process not only saves money, but it can also help organizations meet corporate ESG commitments.

4.3.5 Private Sector Engagement

The private sector has a stake in achieving regional waste targets and there is significant potential in engaging with this sector to share knowledge and provide non-confidential data. The collaborative can work with private waste haulers and facility operators to voluntarily share information about the tonnages, contamination rates, and processing losses to improve the accuracy of estimates for privately managed waste in the Region.

The Region could also request that all municipal buildings, including schools, require reporting from their haulers for both waste disposed and waste processed, again discounting contamination and residues. This information would help build a profile and provide insights into a significant source of waste in the Region. The Industrial Heartland is unique to the Region and there is an opportunity to partner to better understand the waste generated and identify opportunities for more circular solutions for the Region.

The Region could also explore a strategy successfully used in Ontario to apply private licensing rights to license the collection of materials. This enabled municipalities to obtain what might otherwise be considered commercially confidential information.

4.3.6 Social Return on Investment

In practice, social and environmental benefits can be very difficult to assess and measure. However, new methods are emerging that provide frameworks for organizations to evaluate the value of social and environmental benefits realized. Social return on investment (SROI) is a method for measuring values that are not traditionally reflected in financial statements, including social, economic, and environmental factors. They can identify how effectively an organization uses its capital and other resources to create value for the community. While a traditional cost-benefit analysis is used to compare different investments or projects, SROI is used more to evaluate the general progress of certain developments, showing both the financial and social impacts generated.

An SROI) framework is a method for formally measuring and accounting for this broader concept of value. These frameworks have the potential to help the Region better measure and communicate the benefits of regional collaboration.

[13] https://recycleye.com/ai-and-waste-recognition-why-it-works-so-well/

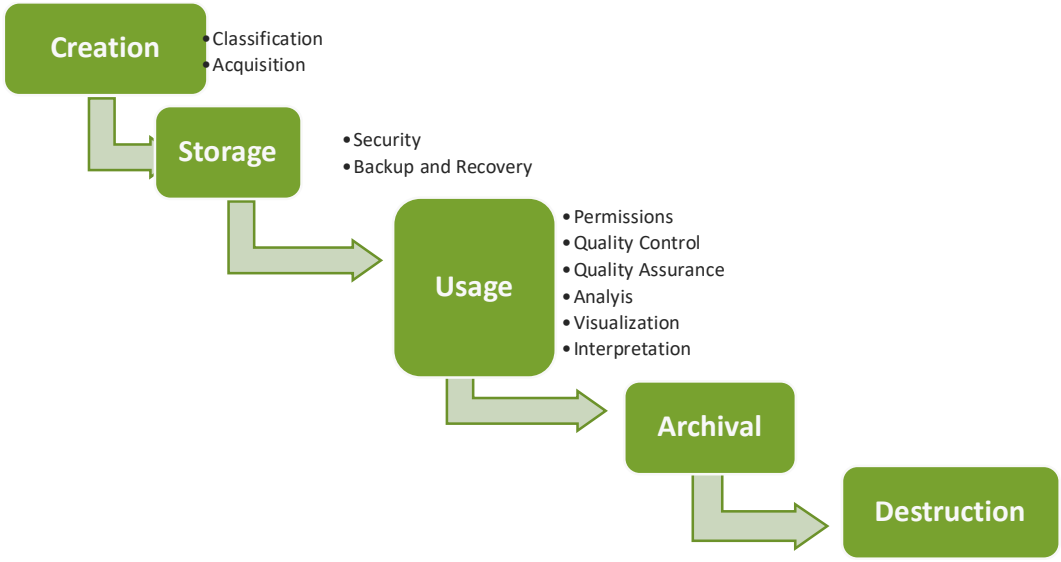
5.0 Data Management

If the data strategy is the house, data management is the foundation. Data management is the development, execution, and oversight of plans, policies, programs, and practices that deliver, control, protect, and enhance the value of data and information assets throughout its lifecycle[14]. This section outlines good data management practices to be applied at each stage, provides an overview of the Solid Waste Data Standard that operationalizes these practices, and summarizes the methods used to establish these practices into regular operations.

5.1 Data Lifecycle Management

Like all assets, data has a lifecycle. Data lifecycle management is a policy-based approach to managing the flow of an information system's data throughout its lifecycle, from creation to destruction. Good data practices must be applied at each stage. While there are many ways to depict the lifecycle of data, Figure 5-1 shows a traditional data lifecycle with five distinct stages as well as the typical activities completed within each stage.

Figure 5-1 Data Lifecycle by Stage



Source: Adapted from Dataworks.ie

5.1.1 Data Creation

Data creation is critical in data management. When managed correctly, the rigor applied while creating the data pays dividends in all later stages of the lifecycle. Data creation includes all the activities to acquire and to appropriately classify the acquired data.

[14] DAMA International. 2017. Data Management Book of Knowledge. 2nd Edition. Technics Publications

5.1.1.1 Acquisition

Once key data required is identified, the collaborative can identify the most appropriate approach to acquiring the data. As acquisition of solid waste data is still done manually, standardized forms will be used to minimize the effort to convert or cleanse the data after collection.

Requests for annual waste data reporting will include a standardized Excel form that provides key definitions of data, formatting controls, and conditional formatting to prevent data errors. The form will include all of the elements outlined within the Solid Waste Data Standard.

5.1.1.2 Classification

Solid waste data collected is classified by the level of access based on the risk as determined by the data supplier and/or validated by the data owner. In general, solid waste data must be classified as:

- **Open**: Few restrictions in place for who can access or use the data, including the general public. For example, residential waste volumes for previous years that have already been validated and reported publicly by each municipality.
- **Restricted**: Only data stewards, collaborative members, and other partners as defined by the data owner will have access to the data. Use of the data will be restricted to the conditions established by the data owner. For example, a municipality may provide an assumption for waste diversion but may wish to limit public reporting of this measure to the regional level.
- **Confidential**: Only accessible to the data supplier/owner and EMRB Administration. This may include sensitive cost information or studies that are not publicly available but may be helpful to inform strategic planning.

The classification level of each type of data will be specified within the Solid Waste Data Standard. Additional classifications of data may be required as the complexity of solid waste data increases and the number of data partners expands.

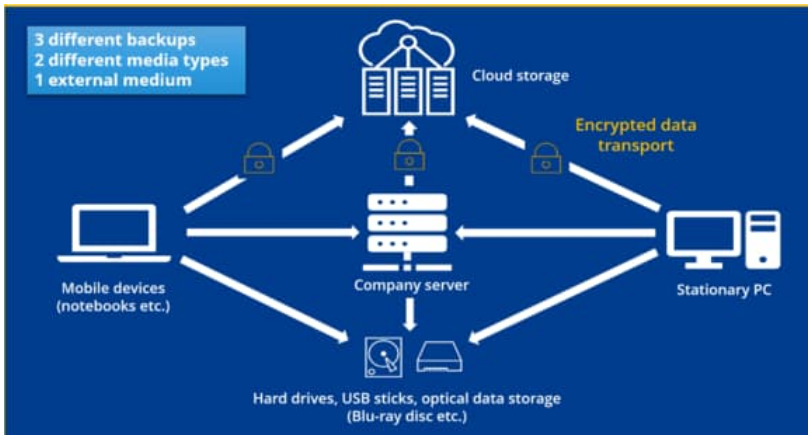
5.1.2 Data Storage

Data storage is defined as the recording of data onto storage media that preserves the information so it can be accessed again later. Data storage includes determining the appropriate approach to backup and disaster recovery as well as ensuring data security.

5.1.2.1 Backup and Disaster Recovery

In alignment with security best practices, all solid waste data will apply the 3-2-1 backup rule as shown in Figure 5-2). This rule requires that three copies of the data are maintained, the original and at least two copies. It also requires the data is stored using two different media types for storage and that one copy is stored offsite. To comply with the Freedom of Information and Protection of Privacy Act (FOIP), the off-site storage location must be in Canada.

Figure 5-2: The 3-2-1 Data Backup Rule



Source: IONOS Inc.

A 3-2-1 backup strategy is useful for minimizing the chances of data loss and increasing the ability to recover data in multiple scenarios of system failure. For example, if there is a fire where data is physically stored, it can be recovered from cloud storage. Alternatively, if data in the cloud storage platform is compromised, local copies can be accessed or used in recovery efforts.

The EMRB will ensure that a 3-2-1 backup solution is implemented for solid waste data.

5.1.2.2 Data Security

Data security includes the planning, development and execution of security policies and procedures to provide proper authorization, access, and auditing of data. The goal of data security practices is to protect assets in alignment with privacy and confidentiality regulations, contractual agreements, and business requirements. This means balancing the aim of optimizing access and use of the data with the need to maintain adequate security.

The collaboration site is built in SharePoint Online, which has strong security features and administrative roles have been configured to provide the Site Owner(s) with the ability to easily add or remove permissions, as needed. There is currently no limit to the number of internal or external users that can be added so protocols must be established to regularly review permissions and to archive inactive project subsites.

As part of managing the security of all data, EMRB must be able to demonstrate that it is:

- Acting as a responsible trustee of shared data.
- Safeguarding proprietary information and non-disclosure agreements.
- Preventing unauthorized access or use of data.
- Minimizing the risks of security breaches and attacks
- Complying with FOIPP requirements for transparency.

EMRB will ensure the security of solid waste data by performing an annual data risk assessment, including the risks associated with solid waste data.

5.1.3 Data Usage

If data is to be used, it needs to be accessible and easy to understand. Solid waste data is stored in a shared location and organized in a simple and logical way to aid navigation within the Data section of the Collaboration Site.

Additionally, every user will need to understand what each piece of data means, how it's been collected or manipulated, and how they can (or can't) use it.

5.1.3.1 Data Permissions

Data permissions are access controls applied to one or more users. Solid waste data permissions will be assigned based on the type of user (supplier, owner, user, or steward) and the classification (open, restricted, confidential) assigned to the data. Different types of permissions include (but are not limited to) the following:

- **Contribute**: Ability to add new data.
- **View**: Ability to view data.
- **Edit**: Ability to edit or change data once it has been added.
- **Delete**: Ability to delete existing data.
- **Analyze**: Ability to analyze the data.
- **Report**: Ability to create reports based on data and analysis.
- **Share**: Ability to share data, analysis, and intelligence externally.

Table 5-1 indicates the permissions typically assigned to each role for different data classifications.

Table 5-1: Solid Waste Data Management Roles

Permission	Open	Restricted	Confidential
Contribute	• All	• Supplier/Owner • Steward	• Supplier/Owner • Steward
View	• All	• Supplier • User • Steward • Owner	• Supplier • Owner • Steward
Edit	• Supplier • Owner • Steward	• Owner • Steward	• Owner • Steward
Delete	• Steward	• Steward	• Steward
Analyze	• All	• User • Steward • Owner	• Steward
Report	• All	• Owner	• N/A
Share	• All	• Owner	• N/A

To maintain consistency in access to datasets, data owners should agree to consistent rules for determining the level of access to data that they provide. This may not always be possible as each data owner may have unique considerations for how data is managed within their domain. As a result, data permissions must be considered and assigned on a case-by-case basis and the data owner should always be consulted prior to reporting, sharing, or publishing the data.

5.1.3.2 Quality Control

Quality controls are the manual or automated techniques applied to improve data quality. Common dimensions used to assess and measure data quality include:

- Completeness to check for missing records.
- Timeliness to verify data is current.
- Uniqueness to avoid duplication.
- Consistency across multiple sources or storage locations.
- Relevance for the specific use case.
- Precision of location or decimal values.
- Accuracy to ensure data is correct.
- Integrity of data relationships and attributes.
- Validity of format, type, range, etc.

Low-quality data that is not addressed during collection must be identified and corrected prior to use. There are a limited number of options to clean data within Excel but the most common include, spell check, removing trailing spaces, and converting format (e.g., text to numbers, text to dates). Conditional formatting can also be applied to provide alerts when totals do not balance or when thresholds have been exceeded. However, the most effective methods for identifying data errors will be through visualization of the data which make it easy to spot abnormalities, outliers, broken trends, or unusual or unexpected results in the data.

5.1.3.3 Quality Assurance

Quality assurance is all the activities conducted to establish the level of confidence in the quality of the data. As with quality controls, quality assurance activities for solid waste data are largely manual. Data owners will be responsible for reviewing the data for quality and compliance with the Solid Waste Data Standard. Data owners will also be required to provide assurance of data quality before it can be used in analyses.

Quality assurance is a fundamental requirement for demonstrating traceability and auditability.

5.1.3.4 Data Analysis

Data analysis refers to processes that attempt to glean meaningful insights from raw data. There are many ways to analyze data including:

- **Pooling**: Data is compiled into a consistent format and shared according to the data access rules for the dataset.
- **Aggregation**: For quantifiable data, the values are aggregated to provide a regional value.
- **Business Intelligence**: Qualitative, numerical, and/or geospatial analysis to look for patterns or trends in data.
- **Modelling**: Using data as inputs or assumptions to create models of the solid waste system to better understand how it is performing and identify opportunities for improvement.
- **Scenario Planning**: Creating different scenarios based on changing key variables or decisions in a data model.

The level of confidence in the data will have a direct impact on the confidence that can be applied to the analysis and any resulting insights. As maturity grows, the collaborative can explore more sophisticated methods to analyze data including statistical modeling, algorithms, artificial intelligence, data mining, and machine learning.

5.1.3.5 Data Visualization

Data visualization refers to the process of creating graphical representations of information, typically through the use of one or more visualization tools. Visualizing data makes it easier to quickly communicate to a wider audience that may include technical and non-technical stakeholders[15].The collaborative will have access to Tableau and ArcGIS visualization tools to aid analysis of solid waste data.

5.1.3.6 Data Interpretation

The interpretation phase of the data life cycle provides the opportunity to make sense of analysis and visualization activities. Beyond simply presenting the data, this is when data can be used to create new knowledge through the lens of expertise and understanding. Interpretation may not only include a description or explanation of what the data shows but, more importantly, what the implication(s) may be for the Region.

Care must be taken to ensure that any interpretation of the data includes an assessment of the appropriate level of confidence in the interpretation. For example, greater confidence can be placed in interpretations based on reported data rather than derived data. For example, the collaborative can have greater confidence in providing recommendations based on residential waste volumes reported by haulers than recommendations based on estimates of non-residential waste volumes derived using the average waste generated per capita for Alberta.

5.1.4 Data Archival

Data archiving is the process of moving data that is no longer actively used to a separate storage device for long-term retention[16]. Archive data consists of older data that remains important to the collaborative or must be retained for future reference or regulatory compliance reasons (FOIPP). Data archives are indexed and have search capabilities, so that files can be located and retrieved.

All solid waste meeting and project materials must be archived in M-Files as they are completed. M-Files is EMRB's document management system and functions as the source of truth for internally managed work-in-progress as well as all final documents. Metadata is assigned to ensure the data can be easily located and retrieved, if necessary. This also allows for easier indexing and archival at project completion.

Work in progress or transitory files stored in the collaboration site will be deleted from the collaboration space following project closure. Only final deliverables will remain in PDF (non-editable) format on the associated SharePoint pages for projects once they have been completed. This will reduce primary storage consumption and ensure the inventory of solid waste data is being actively managed.

5.1.5 Data Destruction

Data destruction is the process of destroying stored data so that it is completely unreadable and cannot be accessed or used for unauthorized purposes[17]. This process goes further than deleting data (no longer readily accessible by the operating system or application that created it) to destroy the data using specialized software that overwrites the available space/blocks with random data until it is considered irretrievable.

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[15] https://online.hbs.edu/blog/post/data-life-cycle#generation

[16] https://www.techtarget.com/searchdatabackup/definition/data-archiving

[17] https://www.techtarget.com/searchstorage/definition/data-destruction

Solid waste data destruction practices will align with EMRB's Data Retention Policy and Schedule and with Data Destruction Procedures, following formal approval from the Board.

5.2 Solid Waste Data Standard

Data standards are documented agreements on representation, format, definition, structuring, tagging, transmission, manipulation, use, and management of solid waste data. An initial Solid Waste Data Standard has been developed to enable the collaborative to demonstrate that data is traceable (there is an ability to follow data all the way back to its original source), reliable (the same data would be found or recreated consistently when required) and auditable (the ability to assess the quality or utility of the data for its intended purpose). While implementing a standard requires significant work upfront, it saves time over the long-term as data becomes repeatable and the processes to comply with the standard become routine.

The data standard outlines the following for each type of solid waste data:

Data Supplier – The full name of the individual or group providing the data to the collaborative for use.

Date Accessed – The dd/mm/yyyy the information was created/accessed by the data supplier (not the date the data was provided).

Source – The full name and location of the source of the data provided, such as the system, document, or subject matter expert so that the data can be duplicated or reproduced in the future, if needed.

Relevant Period – The time period during which the data was collected (i.e., calendar year, fiscal year, point-in-time, etc.).

Data Definition – Definition of the data if it differs from the shared regional definition (e.g., the volume of waste from single-family households with curbside collection services also includes volumes collected from multi-family households.).

Relevant Data Dictionary of Codes – The data codes that allow translation from native systems and regional data (e.g., single-family recycling is tracked through code 1121 and multi-family recycling is tracked through code 1122).

Unit of Measure – The actual unit in which the associated values are measured (e.g., metric tonne or kilogram).

Spatial Data - Data must be provided in an industry standard digital format. The format should be in a shape file or another open standard format as defined by the EMRB Data Management Committee. Open-source GIS data will use NAD 1983 3TM114-83 as a coordinate system.

Known Limitations / Disclaimers – Identify where the data may have a limited sample size or lack of reliable data such as self-reported data, missing data, and deficiencies in data measurements that may impact the confidence when using the data.

Classification – The level of risk associated with the data so that the appropriate permissions can be assigned.

Changes – A detailed explanation of any changes to the methodology for reporting the data from the previous reporting period (e.g., contamination rate taken from a waste characterization study rather than applying an industry average, etc.).

Data Owner – The individual or group that has verified the data submission and has responsibility for determining how the data can (or can't) be used at the regional level.

The Solid Waste Data Standard will be applied at every stage of the data lifecycle. It will also be reviewed during the annual action planning process and updated to ensure alignment and continuous improvement over time. Having a

data standard in place helps facilitate collaboration, making it easier for people to find and consume the information and ultimately deliver value from the data.

The Solid Waste Data Standard is maintained in the collaboration site.

5.3 Solid Waste Data Methods

Data methods describe the processes used to identify, gather, and analyze data to answer questions or evaluate outcomes. The processes that have been established for annual data planning, data requests (annual and ad hoc), and calculating solid waste measures are summarized below. All solid waste data methods are maintained on the collaboration site.

5.3.1 Data Planning

Regional collaboratives are required to develop an action plan to guide strategy and operations. Action plans are updated each year to reflect progress, update or confirm priorities, and adjust the 5-year roadmap. To ensure that data continues to be a key focus of the collaborative, data planning has been integrated into the into the annual action planning process.

To ensure the collaborative is focused on data that will provide the most value to the Region, the action will identify the key questions the collaborative intends to answer, and the data and tools needed for the analysis. This will include identifying gaps in existing data, the confidence level needed for use in decision-making, and the human and financial resources required to acquire the data and/or the systems required to manage the data. All supporting data activities will be added to the 5-year roadmap.

The action plan will be developed in alignment with the annual EMRB budget process. Following budget confirmation, the action plan will be reviewed and endorsed by the committee and approved by the Board.

5.3.2 Data Requests

Processes have been documented to provide clarify the required steps for annual and ad hoc data requests. Regardless of the type of request, the following high-level steps are required:

- The data steward works with the collaborative to develop the data request.
- The data steward submits the request to each relevant data supplier.
- The data supplier collects and reviews the requested data for accuracy and completeness.
- The data supplier notifies the data owner that the data is ready for validation.
- The data owner reviews the data, resolves any issues or concerns, and defines or updates data classifications, as required.
- The data supplier/owner submits data to the EMRB.
- The data steward works with the data supplier and data owner to resolve any outstanding data integrity issues.
- The data owner approves the data.
- The data steward saves a copy of the completed data submission and all supporting communications (e.g., emails, instructions, resources).
- The data steward adds the data to solid waste tools or applications.
- The data steward notifies users when all data has been approved and can be used.
- The data steward updates the standards and/or methods, if required.
- The data steward publishes the data and makes it accessible to all users.

5.3.3 Data Methodologies

The action plan outlined a series of metrics commonly used to assess performance of waste management strategies, programs, and initiatives. Methodologies have been established to track the following measures:

- Waste generated.
- Waste diverted.
- Waste processed (recycled and composted).

The remaining KPIs outlined in the action plan are more complex and will require additional work to develop and implement the methodologies used to calculate them. These KPIs include:

- Gross Value Added.
- Direct, indirect, and induced jobs.
- Access to a depot.
- Cost per tonne.
- GHG emissions.
- Toxins avoided.

These metrics may require access to additional datasets (e.g., service costing) and may need to align with established methodologies for related measures (e.g., GHG emissions may need to align with EMRB or provincial calculations).

6.0 Solid Waste Data Governance

Data governance is "the exercise of authority and control (planning, monitoring, and enforcement) over the management of data assets". Broadly speaking, effective data governance requires organizations to carefully design how technology, people, and processes will all work together to achieve the data vision. Data governance is particularly important for the management of regional solid waste data as there are many stakeholders involved with potentially overlapping and/or missing roles and responsibilities. The following section proposes roles and responsibilities, a service delivery model, and protocols necessary to effectively govern solid waste data management at the regional level.

6.1 Roles and Responsibilities

Collaborative members will be responsible for developing, maintaining, and executing the solid waste data strategy. The collaborative must obtain data from municipalities, waste commissions, and regional stakeholders. At the same time, collaborative members are the conduit for information to and from their organizations and each will operate in a data ecosystem of their own.

Member municipalities have an obligation to share relevant information with the EMRB when it is requested. However, their primary responsibility is to manage and report solid waste data on behalf of their municipality. This means that the solid waste data from each municipality is managed to align with the data requirements and governance established for that municipality and data may need to be transformed to meet regional requirements.

Today there are no formal data-sharing agreements between the EMRB and the waste commissions. The waste commissions report data on behalf of the municipalities and can supplement the data with the data tracked within their facilities.

The municipalities and the waste commissions will also have established data collection and reporting relationships with regional stakeholders such as haulers and processors, and non-profit organizations (e.g., Alberta Recycling Management Authority) defined through individual contracts and/or Provincial Regulation. These stakeholders do not have an obligation to share information directly with the EMRB and any data provided would be on a voluntary basis or through permission from the municipalities.

With the many stakeholders, it is important that the sources of data, who supplies and who owns each type of data, who can use the data for which purposes, and what measures are in place to make sure data is secure, are all defined and continuously managed. Responsibility for managing solid waste data must be shared between all parties that contribute to it and/or use it. Collaboration between all roles is required to create and enable access to the high-quality data required to meet strategic needs.

6.1.1 Solid Waste

Effective data governance defines the shared responsibility for data-related decisions. This requires both technical and non-technical resources to contribute skills and expertise to the exchange and management of data. The roles for governing solid waste data are defined as follows:

Data Sponsor – Executive sponsor(s) responsible for oversight, support and funding of data management and governance activities.

Data Owner – Any individual or entity with authority to make decisions about the data within their domain and is responsible for determining who can have access to the data and how that data can be used when shared outside their domain.

Data User – Any individual, group, or service that consumes the data. Users can view, analyze, or create new data depending on the permissions and classifications governing the data.

Data Supplier – An individual or entity accountable for managing a subset of data. The data supplier may (or may not) be the same as the data owner and may also be a data user.

Data Steward – A business or technical resource that works with solid waste data stakeholders and data governance groups to define and control data.

An individual or entity may play more than one or may be responsible for all roles in solid waste data management for the Region. The detailed responsibilities associated with each role, as well as the individuals or entities most likely to undertake these roles, are outlined within Table 7-2.

Table 7-2: Solid Waste Data Management Roles

Role	Responsibilities	Participants
Solid Waste Data Sponsor	• Champions the Solid Waste Data Strategy. • Approves guiding principles for data management. • Provides guidance on the evidence needed to make decisions in the best interest of the Region/members. • Authorizes the resources needed to implement the Solid Waste Data Strategy. • Resolves data management issues.	MRSP Standing Committee Waste Commission Boards Regional Data Governance Committee
Solid Waste Data Owner	• Follows guiding principles for solid waste data management. • Provides strategic direction for solid waste data management. • Reviews, approves, and confirms adherence to local solid waste standards and policies. • Reviews data analysis and reports generated for regional solid waste initiatives. • Identifies potential issues, risks or conflicts in data presented at the local and regional levels.	Member Municipality Waste Commission Regional Stakeholder EMRB Administration
Solid Waste Data User	• Complies with EMRB and local data standards and policies. • Identifies any potential errors or issues with the solid waste data.	Collaborative
Solid Waste Data Steward(s)	• Manages solid waste data strategy implementation. • Ensures compliance with EMRB data standards and policies. • Empowers data suppliers and users with appropriate tools and training. • Coordinates annual data reporting processes and conducts ad hoc analyses, as required. • Resolves and/or escalates data management issues. • Recommends solid waste data standards and definitions • Works with data suppliers to clean and confirm data and with data owners to validate data.	EMRB Administration

	• Provides targeted support to resolve data issues. • Reports on solid waste data management and performance	
Solid Waste Data Supplier	• Provides solid waste data to the EMRB in compliance with standards and methods. • Collaborates with data owners and users to improve reporting, analysis, and data integrity, as required. • Communicates any material changes to data methodology or integrity.	Member Municipality Waste Commission Regional Stakeholder Data Steward

The roles defined for governing solid waste data must align with the data governance roles defined for the EMRB. The responsibilities outlined above must align with the broader EMRB Regional Data Strategy and adhere to all approved EMRB data-related policies.

6.1.2 Edmonton Metropolitan Region Board

EMRB plays an overarching role in ensuring the Board has the information needed to make decisions in the best interests of the Region. Solid waste data will need to align with the requirements for all regional data established through the EMRB data governance bodies. In turn, EMRB data governance will need to consider the requirements for solid waste data in the regional data ecosystem.

To support this, the roles required to govern all regional data are defined as follows:

Data Sponsor – Executive sponsor(s) responsible for oversight, support and funding of data management and governance activities.

Data Governance Committee – Manages data governance initiatives (e.g., development of policies and metrics), issues and escalations.

Data Governance Office – Provides an ongoing focus on regional data definitions and data management standards across functional areas.

The detailed responsibilities associated with each regional data governance role, as well as individuals or entities that are most likely to be assigned these roles, are outlined in Table 6-1.

Table 6-1: Regional Data Governance Responsibilities by Role

Role	Responsibilities	Participants
Regional Data Governance Sponsor	• Provides administrative leadership of data management for the EMRB and its members. • Reports to the EMRB CEO on regional data management and governance activities.	EMRB Director
Regional Data Governance Committee (DGC)	• Provides strategic direction for regional data management. • Champions EMRB data strategy at the local member level • Establishes guiding principles for data management. • Reviews, approves, and confirms adherence to regional and local standards and policies. • Reviews progress on relevant projects and initiatives. • Reviews reports generated by the EMRB Data Management Office. • Resolves and/or escalates data management issues.	EMRB Director (Chair) EMRB Member Municipalities Data Partners
Data Governance Office (DGO)	• Designs policies and standards, including data definitions. • Links data governance efforts to technology and other related functions. • Empowers users with appropriate data management tools and training. • Administers data repositories and manages data archiving, recovery, maintenance, and security. • Reviews data for quality and works with data suppliers and owners to clean and validate data. • Ensures coordination and consistency across key roles in the data life cycle. • Provides targeted support for issues. • Reports on EMRB Data Management performance.	EMRB Administration

The roles and/or responsibilities defined above may change or evolve as the EMRB Data Strategy is implemented.

6.2 Service Delivery Model

The goal of the service delivery model is to connect existing silos of solid waste data to surface insights for users to leverage in operations and decision-making. The service delivery model outlined below describes how all stakeholders commit to working together to create, update, and continuously improve solid waste data for the Region. To be successful, each role must understand and carry out the commitments described below:

- Data steward(s) will work with the collaborative and the DMO to identify and structure data requests in a simple and convenient format with a reasonable turn-around time for data suppliers.
- Data steward(s) will provide a simple, accessible, and secure method for collecting and aggregating annual data (e.g., standardized templates or forms).

- Data suppliers agree to provide data in compliance with approved standards, methods, and protocols.
- Data suppliers agree to provide data within established timelines. If it is not possible to meet the established timelines, the data supplier will contact the data owner and/or steward(s) for assistance or to explore alternative options.
- Data suppliers and/or owners will work with data steward(s) to review, clean, and correct errors in the data, as they are identified to reduce errors and minimize rework.
- Data owners will proactively validate data, including verifying classification, confirming limitations, and identifying material changes to methodology from previous reporting.
- Data steward(s) will ensure solid waste data provided is accessible to users within two business days of receiving the data to support data review, analysis, and cleansing.
- The collaborative will work with data suppliers and steward(s) to identify more accurate sources of data, improved assumptions, or to replace estimates with actual data, whenever possible.
- The data steward(s) will coordinate with the collaborative to identify solid waste data priorities in alignment with the annual action planning process.
- Data steward(s) will coordinate procurement and installation requests for hardware and software with the EMRB.
- The collaborative will document progress against data strategy initiatives and report performance each year through the action plan.
- The collaborative will be responsible for identifying and supporting ad hoc data requirements, as required.

The need to make enhancements to the service delivery model is inevitable and all stakeholders will play an important role in identifying and supporting opportunities to evolve.

6.3 Data Protocols

All stakeholders share an interest in advancing regional goals for solid waste management. At the same time collaboration is hard work and takes sincere and sustained commitment. Sharing information outside of an organization can run counter to traditional ways of working. Protocols are needed to empower people to extend beyond the default mode of working in silos. The protocols that are in place, or needed, to enable collaboration on shared solid waste goals are outlined below.

All activities to enhance or establish new data-sharing protocols with stakeholders should be supported by a change management strategy and a comprehensive communication plan.

6.3.1 Municipal Members

There are formal mechanisms already in place to support effective data sharing between the EMRB and its member municipalities. Authority for EMRB to request data from its members is specified within the EMRB Regulation. In addition, Policy G018 was adopted to aid in the development and maintenance of a shared regional GIS system and related services, including solid waste geo-spatial data. If additional clarity is required with member municipalities, the EMRB can specify data sharing obligations through policy approved by the Board.

The Edmonton Metropolitan Region Board Regulation and EMRB Governance and Finance Policies and Bylaws can both be found online.

6.3.2 Waste Commissions

As the regional waste commissions operate as independent entities separate from the municipalities they serve, there are currently no formal mechanisms in place to enable data-sharing directly with the EMRB. To streamline

access to waste information and data and to leverage the considerable knowledge and expertise of the waste commissions, the EMRB would like to establish a formal data-sharing agreement in the form of a Memorandum of Understanding (MOU).

An MOU is a written record of understanding between parties that outlines the terms and conditions under which data can be shared. The MOU describes the benefits of the agreement for both parties and affirms the spirit in which each intends to work with the other. It also outlines the EMRB's obligations to ensure the integrity, safety, and security of waste commission data. Through the MOU process, EMRB will develop a better understanding of each commission's interests, preferences, and concerns regarding information sharing. This provides an opportunity to adjust the service delivery model to ensure all needs are met. The goal of each MOU is to create a sense of shared ownership and accountability between the waste commission and the EMRB.

6.3.3 Other Stakeholders

There are other stakeholders across the Region that may have an interest in regional waste data. For example, not all municipalities represented by the waste commissions are members of the EMRB[18]. Although waste from non-member municipalities adds to the total waste generated in the Region, these volumes are currently being excluded from regional waste estimates and are not considered in regional analysis or planning. These municipalities may wish to be informed about, or participate in, regional projects. More work is required to determine the best way to engage these communities.

Additionally, EMRB boundaries are within Treaty 6 Territory and within the Métis Nation of Alberta Region 2 and 4 and consideration should be given to meaningful engagement with Indigenous communities on regional waste management.

As data maturity grows and the complexity of the work increases there may also be opportunities to partner with other orders of government, post-secondary institutions, or industry to improve regional solid waste data. Where new partners are identified, additional protocols may be required to enable data-sharing.

6.3.4 External Data Support

EMRB may not always be best suited to manage the data or host the service. In cases where other organizations or outside expertise or services are required, the options and mechanisms needed to effectively partner must be better understood. Increased literacy with data partnerships will make it faster and easier to engage partners as well as helping to enhance data maturity, even when the data is managed externally.

[18] The Towns of Calmar, Redwater, Legal, Gibbons, and Bon Accord are not members of the EMRB.

7.0 Solid Waste Tools and Technologies

Regional work, by nature, is collaborative. Effectively managed collaborations have the potential to foster innovation, creativity, and productivity. An important contribution to effective management of collaboration is careful investment in the tools and technologies that will help facilitate sharing of information, learnings, best practices, and adopting new ideas. This section provides an overview of these tools and technologies as well as outlines expected next steps needed to develop strategic capabilities and build data maturity.

7.1 Solid Waste Collaboration Site

A well-managed collaboration space is designed to provide value and to reinforce a culture where all members contribute as well as benefit from the collaboration.

The EMRB uses the Microsoft's O365 productivity suite. Cloud-based SharePoint is as part of this toolset. Branching from the main EMRB SharePoint site, the Solid Waste Collaboration Site (collaboration site) is an out of the box team site with controlled access. SharePoint allows secure collaboration beyond the EMRB network without additional costs to install, manage, and update over time. As an industry standard tool, most collaborative members are familiar working with SharePoint and with related tools.

The collaborative currently accesses all shared documents and data through the site, including meeting materials. New pages or sub-sites are created when new projects are initiated to assist in communication and editing directly with vendors and to ensure EMRB maintains ownership of all working materials throughout the project lifecycle.

As the work outlined in the data strategy is executed, the collaboration site will be an important tool to provide a single point of access to solid waste data at the regional level as well as the data management and governance documentation.

Expected next steps for the collaboration site include:

- Move the Glossary of Terms online through a managed list to increase access and drive consistency over time.
- Create single-sign-on access through a data connection to Tableau for self-serve data analysis.
- Promote and create direct links from the Solid Waste Collaborative SharePoint site to EMRGIS to access solid waste-specific products, and solid waste geospatial data.
- Create a data connection to ArcGIS to access spatial data that should not be made available publicly.

7.2 Solid Waste Data Model

The solid waste data model is the primary tool for collecting and analyzing waste data at the regional level. The data from each member municipality is aggregated within a mass balance model built using Microsoft Excel. The spreadsheet contains demographic, waste program, and volume data for residential and non-residential data. Standardized formats and consistent methodologies are applied to data integrity and provide a more comprehensive picture of regional waste.

As the collaborative builds larger and more complex datasets, a more robust tool such as a relational data base may be required to optimize the value of the data. A relational database would require up-front development and ongoing maintenance costs. However, administrative savings achieved through reduced time and effort required to manually transcribe and analyze data as well as the increase in capability may offset these costs.

A relational database would also enable future automation through an Application Programming Interface (API). An API is a software intermediary that allows two applications to talk to each other within or across organizations. API's would make it easier and cheaper to connect larger datasets together or to increase the frequency of reporting to allow greater sensitivity in monitoring and measuring the impacts and outcomes of regional collaboration efforts. For example, the Region may want to measure the change in behaviors related to a bylaw change, directly after implementation as well as over time.

Expected next steps for the data model include:

- Enhance data completeness and quality using the data standard and improved controls.
- Strengthen model assumptions through improved data sources or subject matter experts.
- Set baselines for KPI's and establish regional targets.
- Complete a project charter for an ICI waste characterization study.
- Add service costing to the dataset.
- Define methodologies for outstanding KPI's.
- Develop an SROI framework, including data requirements.
- Build a business case for a relational database pilot at EMRB using the waste dataset.

7.3 Tableau

EMRB entered into a licensing agreement for Tableau in November, 2022. Tableau is a visual analytics platform with a stated mission to help people see and understand their data. Tableau is an interactive data visualization software that focused on business intelligence. Tableau enables users to visually express data by translating drag-and-drop actions into data queries through an intuitive interface. Visualizing data enables users to get to answers faster and spot unanticipated insights that may be hidden within large or complex datasets. Views that anticipate the highest value data can be set to increase the accessibility and utility of the data. Canned reports and dashboards can be configured to reduce the effort of providing routinely requested information and track and report on performance. A workspace can enable members to explore the data on their own and to ask new questions using a self-service model.

- Provide access to the self-service Tableau workspace through the collaboration site.
- Provide a Tableau 101 training session for collaborative members to build proficiency in working directly with the data.
- Include a dashboard wish list exercise to the annual action planning process.
- Develop canned reports for the action plan.
- Explore a spatial data Add-In to pull geo-spatial data into Tableau.

7.4 EMRGIS

Since EMRB's inception, developing regional geographic information services (GIS) capabilities has been identified as a key priority to aid in regional initiatives and to support decision-making. In 2015, the EMRB launched a GIS portal - EMRGIS. The EMRGIS site uses Esri technology, the industry leader in GIS software. The site leverages two important products, ArcGIS Online and ArcGIS Hub. ArcGIS Online is a complete cloud GIS solution allowing for the creation and hosting of interactive maps, apps, and tools. ArcGIS Hub is a fully customizable website that seamlessly leverages all GIS functionality into a user-friendly interface.

EMRGIS provides a publicly accessible platform that hosts dynamic and interactive maps and tools. This open data tool allows member municipalities, regional stakeholders, and the public to access regional GIS data. This site can

also be leveraged as a basic, but fully functioning, GIS platform for teams that may not have (or easily access) these capabilities in-house.

The collaborative has geospatial data for known public and privately managed waste facilities across the Region. Combined with the data model, the GIS platform can be used to understand the movement of waste between municipalities as well as leakage outside of the Region to support strategic planning efforts. A transportation layer could be added to assess the full costs-benefit or to assess the proximity of facilities to end markets.

Expected next steps for EMRGIS include:

- Create dynamic maps for regional waste facilities.
- Upload dynamic maps to the ArcGIS Hub so that they can be easily accessed when needed.
- Add and update the EMRGIS Open Data Catalog metadata tables to ensure that solid waste maps and tools are discoverable to users.
- Develop regional solid waste data stories.
- Create material flow data layers.

7.5 Synthetic Region

In spring of 2022 the EMRB, along with 15 other organizations, provided regional data to RUNWITHIT Synthetics (RWI) to create the Synthetic Edmonton Metropolitan Region Environment Intelligent Advanced Lab (SEEITAL). SEEITAL provides a geospatially accurate model that reflects the people, policy, technology, and infrastructure of the Region. Example attributes include household types and composition, waste generation, and recycling behaviors. Through pattern recognition and scenario modelling, the Collaborative could test the impacts of different regulatory, policy, program, and infrastructure investments to assess and optimize regional outcomes.

While synthetic modelling is a relatively new technique, it may assist the collaborative in answering important but complex questions, such as:

- What are the financial, environmental, and social benefits of diverting an additional tonne or organics from landfill?
- Which variables have the largest impact on waste generation?
- What is the most effective way to reduce contamination?
- Will our solid waste system be able to keep pace with expected population and job growth?
- What are the cumulative impacts of proposed program and regulatory changes in the Region?
- How do we forecast the waste generated, diverted, processed, and landfilled in the future?
- What parts of the solid waste system are underutilized or underperforming? How can we better utilize existing resources, improve efficiency, and save costs?

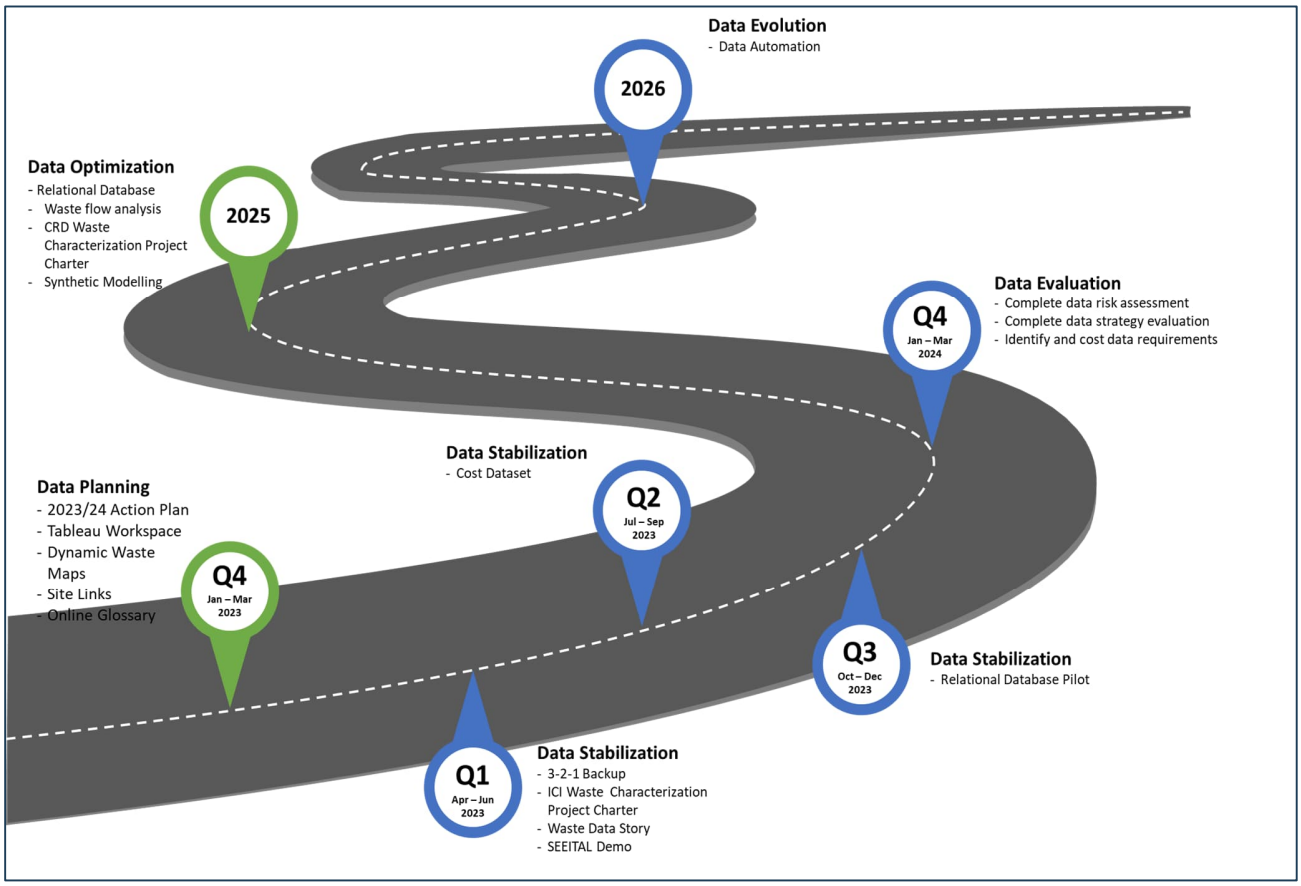
Expected next steps for SEEITAL include:

- Meeting with the collaborative and the RUNWITHIT team to explore applications of the synthetic Region for waste management.
- Identifying required data inputs.
- Developing a research plan and identify potential partners (e.g., post-secondary institutions, Alberta Innovates).

8.0 Solid Waste Data Strategy Roadmap

The data strategy roadmap is the culmination of the analysis translated into specific, actionable milestones to improve data governance, data integrity, and data maturity. The data strategy is intended to set attainable goals and take realistic, incremental steps to become more data driven over time. The roadmap is intended to achieve high-level endorsement for the priorities, key milestones, and relative timelines anticipated for data-related activities.

Figure 80-1: Solid Waste Data Strategy Roadmap



With agreement on the destination, the work can be further broken down into the specific actions and projects needed. By integrating data-related activities into the annual action planning process, they can be viewed within the entire scope of work planned and constraints and dependencies can be identified.

Through the annual action planning process, the collaborative can consider the following requirements in more detail:

- Additional time that may be needed to identify, procure, clean, analyze, and approve the data.
- Budget considerations for procuring additional datasets, tools, or services needed to obtain new information.
- The resources needed to complete the work, including skillsets or expertise that may not be available in-house.
- Data-sharing agreements that may be needed to access data or information.

- Any training or education that may be needed to find, access, or use data more effectively.

Integrating data strategy into annual action planning also provides a regular mechanism to test that planned data-related activities remain tied to regional priorities for solid waste over time. The action plan also represents an established mechanism to obtain guidance from decision-makers and an approval process to secure project resources.

9.0 Data Strategy Evaluation and Continuous Improvement

Developing the data strategy is only the first step in improving data maturity. It should be viewed as the starting point to be built upon and continuously improved over time.

9.1 Evaluation

The data actions outlined in the strategy must address specific regional needs to generate value. Following implementation of the strategy, a defined evaluation process will help confirm the value achieved by directly measuring the impacts to:

- **Data Quality** - Users indicate trust in the data used to support key operations and decision-making processes has increased.
- **Data Maturity** – Users indicate improved capabilities and improved ability to access, utilize, and gain insights from solid waste data.
- **Decisions Impacted** – Stakeholders agree that they have the evidence and information needed to support actions, recommendations and decisions.
- **Improved Collaboration** – Stakeholders report greater ability to collaborate.

These indicators can be assessed both formally and informally within the annual action planning process.

In addition, solid waste data will be assessed as a subset of the entire EMRB data ecosystem and will benefit and grow from development of the broader EMRB data strategy. This integration also ensures that solid waste data continues to comply with all policies and standards approved at the enterprise level and provides an opportunity to leverage learnings and tools to build data maturity faster.

9.2 Continuous Improvement

Each year, there should be a reexamination of important success factors, spanning people, process, and technology. Questions that should be asked to continuously build on the initial data strategy include:

- Does the data vision still resonate?
- Do new strategic capabilities need to be explored?
- What questions are the most important or impactful to answer next?
- What data, tools, or technologies are we missing?
- What are the risks of not knowing?
- Do we need new, or more formal, partnerships to access data or information?
- Are we using our resources in the smartest way?

This will enable the Region to continuously identify and organize data assets, increase data literacy, remove data silos, and leverage technology in support of more effective analysis. This can help instill a culture that enables the Region to make strategic and tactical data-driven decisions more easily.

Over time, data integrity can be further enhanced through automation of frequent and repeatable steps in data processes, such as data collection.

10.0 APPENDIX A: Glossary of Terms

Term	Definition	Source
Agricultural Waste	Waste produced from agricultural activities, such as from farms slaughterhouses, and harvest material. This can include large amounts of organic material, including potentially hazardous materials such as manure, fertilizer, or pesticide waste as well as potentially recyclable material such as strapping and grain bags.	
Cadastral Base Map	A map defining land ownership information. Generally used for taxation, planning, zoning and infrastructure management. Often serve as the base map.	Growing Forward: The Capital Region Growth Plan
Composted	Compostable material collected that undergoes a controlled biological degradation process and is converted back into a raw material.	
Construction, Renovation, and Demolition (CRD) Waste	There is not enough known about the CRD waste collected to apply accurate assumptions. A waste characterization study of CRD waste will help to increase the information needed to develop a clearer understanding of this waste within the Region	DAMA International. 2017. Data Management Book of Knowledge
Contamination	Non-target material collected through the recycling or organics stream that is removed prior to processing and sent to disposal.	Solid Waste Data Model
Data Archival	The process of moving data that is no longer actively used to a separate storage device for long-term retention.	https://www.techtarget.com/searchdatabackup/definition/data-archiving
Data Classification	The level of access based on the risk as determined by the data supplier and/or validated by the data owner. Data is classified as open, restricted, or confidential.	Solid Waste Data Strategy
Data Destruction	The process of destroying stored data so that it is completely unreadable and cannot be accessed or used for unauthorized purposes.	https://www.techtarget.com/searchstorage/definition/data-destruction
Data Lifecycle Management	Data lifecycle management is a policy-based approach to managing the flow of an information system's data throughout its lifecycle, from creation to destruction.	
Data Management	The development, execution, and supervision of plans, policies, programs, and practices that deliver, control, protect, and enhance the value of data and information assets throughout their lifecycles.	DAMA International
Data Management	The development, execution, and oversight of plans, policies, programs, and practices that deliver, control, protect, and enhance the value of data and information assets throughout its lifecycle	DAMA International. 2017. Data Management Book of Knowledge
Data Owner	An entity that has approval authority for decisions about data within their domain.	DAMA International
Data Permissions	Access controls applied to one or more users and are assigned based on user type (supplier, owner, user, or steward) and the classification level (open, restricted, confidential) of the data.	Solid Waste Data Strategy
Data Quality Assurance	The activities conducted to establish the level of confidence in the quality of the data.	Solid Waste Data Strategy

Term	Definition	Source
Data Quality Controls	"The manual or automated techniques applied to data to improve: - Completeness to check for missing records. - Timeliness to verify data is current. - Uniqueness to avoid duplication. - Consistency across multiple sources or storage locations. - Relevance for the specific use case. - Precision of location or decimal values. - Accuracy to ensure data is correct. - Integrity of data relationships and attributes. - Validity of format, type, range, etc.	
Data Sharing Agreement	Formal contract that details what data are being shared and the appropriate use for the data.	U.S. Geological Survey
Data Strategy	A long-term, guiding plan that engages stakeholders in taking a deliberate and objective look, using a data lens, at what is needed to achieve stated objectives.	
Data Supplier	The people responsible for providing or enabling access to inputs for data management activities	Adapted from DAMA International. 2017. Data Management Book of Knowledge
Data User	Any individual, group, or service that consumes the data. Users can view, analyze, or create new data depending on the permissions and classifications governing the data.	Solid Waste Data Strategy
Data Visualization	The process of creating graphical representations of information, typically through the use of one or more visualization tools.	Solid Waste Data Strategy
Disposed	All material collected in the waste stream that is not recovered.	
Diverted	Waste that is saved from landfill, including all material that is recovered or processed.	Solid Waste Data Model
Edmonton Region Waste Advisory Committee (ERWAC)	A voluntary ad hoc committee focused on providing a forum for municipalities wishing to cooperate on matters of solid waste management, in particular, on waste minimization. It includes representatives from urban and rural municipalities in the ACR as well as non-voting members from Alberta Environment and Protected Areas (AEPA), the Recycling Council of Alberta.	Alberta Capital Region
Garbage	Any waste that cannot be reprocessed into a material that has value as a feedstock in another production process, and which is designated by the municipality. The individual items that may be considered garbage may differ between municipalities.	regional Monitoring and Measurement Program.
Geographic Information System (GIS)	A set of tools for collecting, storing retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes.	Growing Forward: The Capital Region Growth Plan
Geospatial	Fusion of geography and information technology collection, management, analysis and integration of geo/location-based data to enable improved decisions and policy making	Federal Inter-Agency Committee on Geomatics
Geospatial Data	Data pertaining to the geographic location and characteristics of natural/constructed features and boundaries on, above, or below the Earth's surface	Webster's New Millennium TM Dictionary of English

Term	Definition	Source
Household Hazardous Waste (HHW)	"Toxic, flammable, corrosive, and reactive products generated from households. HHW has at least one of the following properties: - Toxic e.g., fabric softeners, household pesticides and herbicides - Flammable e.g., nail polish remover, acetone, gasoline - Reactive e.g., foam insulation - Corrosive e.g., oven cleaners, toilet bowl cleaners, bleach"	ARMA: https://www.albertarecycling.ca/programs/household-hazardous-waste/
Landfilled	All material collected that does not get recovered or processed, including material that is disposed, residual, or lost during processing.	
Materials Recovery Facility	A Materials Recovery Facility (MRF) is a plant that processes recyclable materials to sell to manufacturers as raw materials for new products.	
Metadata	Metadata describes other data. It provides information about a certain item's content. For example, an image may include metadata that describes how large the picture is, the color depth, the image resolution, when the image was created and other data.	Wikipedia
Methods	Methods are formal agreements between organizations that are sharing people, technology, process or data and explain how the item is being shared and sets out the means and the systems adopted to collect, store, access, compile and analyze information.	Wikipedia
Municipal Solid Waste	All recyclables and compostable materials (wet and dry) materials, as well as garbage from residential and non-residential sources.	
Municipally Managed Waste	Residential and non-residential waste collected curbside or through special collection events, and waste that is self-hauled to a public depot, transfer station, or landfill.	
Non-residential Waste	All non-hazardous material generated by a source other than residential. This includes Industrial, Commercial, and Institutional (ICI) wastes as well as non-residential Construction, Renovation, and Demolition (CRD) wastes.	
Organics	Organic waste generally refers to biodegradable or compostable waste that includes food scraps, yard and garden trimmings (including glass clippings and leaves) and food-soiled paper products. In the Region, most municipalities collect organics from the residential sector as a separate stream along with garbage and household recyclables.	Regional Monitoring and Measurement Program.
Other Waste Sources	Waste sources not typically not included in municipal solid waste but contribute to the waste generated in the Region include, specified risk material , pet crematoria, wastewater treatment plants, and heavy industrial wastes.	
Privately Managed Waste	Residential and non-residential waste collected curbside by a private hauler or self-hauled to a private depot, transfer station, processing facility, or landfill.	
Process Loss	Process loss refers to the losses that occur between material that is sent for recycling from a MRF and material that is actually recycled. The losses that occur along the process may include inefficiencies in the actual recycling process as well as residuals remaining that need to be separated from material. For organics, these are the processing losses at an organics processing facility, either through contamination or general yield loss.	
Process Loss	Recycling that is sent from a MRF that does not get recycled. These losses can occur from inefficiencies in the actual recycling process as well as remaining residuals that need to be separated out. Losses in organics processing are much lower and are not considered material.	

Term	Definition	Source
Processed	Material collected that is recycled or composted.	Solid Waste Data Model
Protocols	Formal agreements between organizations that are sharing people, technology, process or data and explain why the item is being shared and sets out the principles and commitments adopted when collecting, storing, accessing, compiling, and analyzing information.	Wikipedia
Recovered	Waste that is converted into usable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolization, anaerobic digestion and landfill gas recovery.	
Recycled	Recyclable material collected that is converted back into a raw material. This is material from the recycling stream that is not residue or lost during processing.	
Residential Waste	Waste from primary and seasonal dwellings from all collection methods.	
Residual	Residuals are materials that are collected for recycling, but do not actually get recycled. This may include contaminants that are unable to be recycled as well as material that may be sorted incorrectly or missed during the sorting stage, sending potentially recyclable material to disposal.	
Solid Waste Management	The collection, transfer, processing, and disposal of all solid waste material, including garbage, recyclables, hazardous waste, and organic material.	Metropolitan Region Servicing Plan
Specified Risk Material	Includes biological waste from the cattle industry that must be removed and managed separately to prevent tissues that may contain BSE infectivity from entering the human food chain	Canadian Food Inspection Agency: Guidance on Specified Risk Material
Waste		
Waste Collected	Material that is collected either manually or using automated equipment that is either disposed, recovered, or processed.	
Waste Generated	All material collected: the total of waste, recycling, and organics OR the total garbage, recyclables and compostables.	
Waste Generator	The unit by which waste generation is normalized for a population. For residential waste, the unit of generation is typically by household (single-family, multi-family or communal). For non-residential waste, the unit of generation is typically by person (per capita).	

This Glossary of Terms has been copied to the Solid Waste SharePoint Collaboration site online so that it can be accessed by all members, integrated with other EMRB glossaries to ensure consistency with the Growth Plan, and to ensure it stays current and evolves over time.

11.0 APPENDIX B: Data Strategy Contributors

- Beaumont - **Lenore Turner**, Environmental Lead
- Devon - **Torrie Santucci**, Environment and Sustainability Manager
- Edmonton - **Neil Kjelland**, Director, Sustainable Waste Processing, Waste Services
- Fort Saskatchewan - **Sadie Miller**, Waste Programs Supervisor
- Leduc - **Michael Hancharyk**, Manager, Environment
- Leduc County - **Des Mryglod** - Director of Engineering and Utilities
- Spruce Grove - **Kevin Stener**, Director, Public Works
- St. Albert - **Katie Burd**, Waste & Diversion Operations Supervisor
- Strathcona County - **Leah Seabrook** (Chair), Manager of Waste Management and Community Energy Services
- Sturgeon County - **Scott MacDougall**, Chief Operating Officer
- Leduc and District Regional Waste Management Commission - **Mike Pieters**, General Manager, Infrastructure and Planning
- Roseridge Waste Management Services Commission - **Susan Berry**, Executive Director

12.0 APPENDIX C: Municipal Waste Programs

12.1 City of Beaumont

The City of Beaumont has a three-container system for residential wastes. Two 240 L carts are provided to each single-family dwelling, a grey one for garbage and a green one for organics. Beaumont uses blue bags for the collection of recyclables. When the organics program first began residents were provided with “kitchen catchers” for storing food wastes prior to transferring to the green cart. New residents are not provided with “kitchen catcher” pails but there is a potential to reinitiate this. Blue bag recyclables are collected manually, while the two organic and garbage carts are collected using automated equipment.

Beaumont does not provide waste collection services for multi-family or communal residences. These household coordinate private waste pick up handled by the property management. All three streams of curbside collection are provided by E360, bi-weekly for garbage, weekly for recyclables, and weekly for organics during the summer months and bi-weekly for organics during the winter months.

Beaumont has an annual large-item pick-up event for acceptable large items that do not fit within the existing curbside programs. Beaumont also has an annual round-up event where residents can drop off household hazardous, electronic waste, used tires, and a variety of other items. Beaumont residents can also self-haul recyclables directly to the LDRWMC facility, which has a Materials Recovery Facility.

Residents can also use the Leduc Ecostation and the Public-Drop off area at LDRWMC facility to dispose of a variety of waste items including household hazardous waste, electronic waste, and tires.

Waste and organics are taken to the LDRWMC facility. Waste is landfilled and organics are loaded onto GFL Environmental trucks and transported to a composting facility (currently Roseridge). Recyclables are transported directly to Capital Paper in Edmonton.

12.2 Town of Devon

The Town of Devon has three stream residential curbside collection. Two carts are provided to each single-family dwelling, 1 black 240L cart for garbage and 1 green 120L cart for organics. Garbage and organics are collected using automated equipment. Garbage is collected weekly throughout the year. Green carts are collected weekly from May through October and biweekly from November to April. Blue bags are used for recyclables and are collected weekly throughout the year by hand. All materials are collected by GFL Environmental.

There are no multi-family or communal residences in Devon.

There are two large item pickup events per year – one in the spring and one in the fall (limit of 4 large items per household). Items must be less than 6 ft. x 3 ft. and under 200 lbs. All items not accepted for pickup can be dropped off at the Devon Recycle Depot for free during Large Item Pickup Week. Curbside brown bag yard waste collection occurs after Large Item Pickup Week, once in the spring and once in fall.

In addition to curbside collection, Devon also operates a recycling depot. Any material that can be collected at the curb can also be dropped off at the depot. Blue bag and green cart materials are accepted free of charge, but there is a fee for garbage and hazardous items. The fee depends on the volume of waste. The depot also accepts electronics, household hazardous waste, scrap metal, tires, used clothing, paint, batteries, propane, bulky items, and white goods. Fees are charged for some items such as vehicle batteries, white goods, and bulky objects.

Residential curbside organics, and waste are disposed of at the LDRWMC Landfill (hauled away by GFL Environmental). In cases where waste items cannot be brought to the LDRWMC facility, GFL Environmental will transport the waste to their own Transfer Station and MRF in Winterburn at an additional tipping cost to the Town. Recyclables are also transported to GFL Environmental's MRF.

12.3 City of Edmonton

The City of Edmonton manages waste from single-family homes and multi-residential units and other sources. Waste is collected by city-owned vehicles and by private haulers such as GFL Environmental, Waste Connections Canada, Waste Management, and Appleton under fixed-term contracts. Single-family homes currently have three streams, while multi-family residences only have garbage and recyclables.

Single-family units are provided with two carts, black (either 120 L or 240 L for an extra charge) for garbage and 120 L green carts for organics, along with a kitchen catcher for storing food wastes prior to transferring to the green cart. Organics are collected weekly throughout the spring through fall months and bi-weekly in the winter. Garbage is collected bi-weekly year-round. All collection for these streams is completed using automated equipment. Recyclables are collected through a blue bag program and are collected manually each week throughout the year. Recyclables consists primarily of conventional recyclables such as clean paper, cardboard, plastics, glass jars and bottles, and metal containers.

Materials from multi-family units are gathered through a bin system (e.g., blue bin for recycling and black bin for garbage) that are collected using front-end loader trucks. Although there is currently no organics collection from multi-family, a source separated organics program is expected to be rolled out starting in late 2023 and finishing within a few years after.

The City started a retreat from providing direct collection services to commercial customers in 2019.

Depending on the condition and type of waste, residents may drop off materials at three facility types that the City operates. Edmonton operates four Eco Stations that accept household hazardous waste, electronics, and large bulky objects that cannot be collected at the curbside. The City also operates a Reuse Centre, a facility that accepts various items such as arts and crafts supplies, office and school supplies, and paper and plastics products that could be used by others. The Eco Stations and Reuse Centre are attended by City staff.

There are also 21 Community Recycling Depots located throughout Edmonton where residents and small businesses can drop off their recyclables. The recyclable materials accepted at the depots are similar to that accepted in the blue bag program. These depots are typically unattended.

The waste managed by Edmonton is processed at the Edmonton Waste Management Centre (EWMC) located on the east side of the City. The primary elements of the EWMC are a materials recovery facility (MRF) for recyclables, the integrated processing and transfer facility (IPTF), and a co-compost facility, as well as a biofuel conversion plant and a high solids anaerobic digestion facility that are both commissioned (see below).

Materials collected through the blue bag/bin program are taken directly to the MRF for sorting, consolidation, and processed, then sold to end-markets. The IPTF is the induction point for the mixed waste (for multi-unit collections) and black cart streams. At the IPTF, waste can be sorted and separated, manually and mechanically, for a variety of destinations.

Food waste collected in green carts, as well as other biodegradable materials separated from mixed waste, are delivered to the Organics Tipping Floor. At this location, they are pre-processed to remove plastics and other

contaminants, then are either delivered to the anaerobic digestion facility, the City's own composting cure site, or to a composting facility operated by a private contractor in the Edmonton Region.

A third-party operates a plant for processing construction and demolition (C&D) waste at the Edmonton Waste Management Centre. This plant processes clean wood and drywall, metals, trees and shrubs, concrete and asphalt shingles. These materials are processed into materials for a variety of other uses.

Since closure of the West Edmonton Landfill, Edmonton has not had an operating landfill within the city limits. Consequently, any waste that cannot be processed through EWMC's system must be consolidated and transported outside the Region for disposal. Approximately 230,000 tonnes of waste per year (2022 data) is being transported to Beaver Municipal Solutions Landfill, a privately operated facility located at Ryley approximately 80 kms east of Edmonton.

The City of Edmonton previously operated the Clover Bar landfill at the Edmonton Waste Management Facility. This landfill has not received waste since approximately 2010, and is in the process of being capped.

12.4 City of Fort Saskatchewan

The City of Fort Saskatchewan has three-stream curbside collection. Each single-family residence is provided with two 240 L carts, black for garbage and green for organics. The garbage carts are typically collected weekly throughout the year. Organics carts are collected weekly from May through October and biweekly from November through April. Residents can request an extra black cart for a minimum of 6 months for an additional $12 per month. Residents are allowed unlimited blue bags of recyclables that are manually collected every week. Single-family curbside collection services are contracted to Collective Waste Solutions.

Multi-family units are provided with two-stream collection services. Garbage and single-stream recycling is collected through front-loaded bins with automated collection. Garbage is typically collected weekly while recycling varies. Curbside collection for multi-family is contracted to GFL Environmental.

Fort Saskatchewan operates a transfer station that accepts household hazardous waste, electronics, and bulky objects. Residential garbage is also accepted at a nominal cost.

The blue bags from recycling are sent to GFL Environmental's MRF in Winterburn (Edmonton) where the bags are debagged, sorted, and processed for end-markets.

Once collected, the organic stream is sent directly to a composting facility (which one(s)?).

Garbage is taken to either the Laurin or Winterburn transfer station (both in Edmonton, owned and operated by GFL ENVIRONMENTAL Environmental) for consolidation and transported to one of two landfills – the Waste Management landfill facility in Thorhild or Beaver Municipal Solutions landfill in Ryley.

12.5 City of Leduc

The City of Leduc has a three-stream curbside waste management program for residential units.

Single-family homes are provided with two 240 L carts, black for garbage and green for organics. Carts are emptied using automated collection equipment. Garbage is collected bi-weekly. Green cart material is collected weekly from late April to mid-November, then bi-weekly between November and April. Recyclables are collected in blue bags manually each week throughout the year.

Residents are limited in the amount of garbage and organics that can be placed at the curb; however, an extra black cart can be obtained for a minimum of six months for an additional $12.75 per month. Curbside collection services are provided by GFL Environmental.

Residents also have the option of taking material directly to the LDRWMC landfill free of charge with an access card. Each household gets up to 1 tonne of free household waste per year. Multi-unit homes have private pick up handled by the property management. The City of Leduc has an Eco Station (formerly the Recycling Depot) where residents can drop off various materials: blue bag recyclables, cardboard, organic waste, household waste, household hazardous waste, and electronics. The City also has a Yard Waste Transfer Station that accepts various organic materials such as garden waste, leaves, plant material, tree branches, trimmings, twigs, and weeds.

Recyclables end up at a sort station in Winterburn. Our organics are currently going to Roseridge, however we have had some pilot material go to Altroot. Garbage is transported to the LDRWMC Landfill

12.6 Leduc County

Curbside collection of garbage and dual stream recyclables is provided to single-family homes in select parts of the County, including New Sarepta and East Vistas (Diamond Estates, Lukas Estates, and the Royal Oaks subdivisions) as well as residential portion of Nisku. Residents are provided with a 65-gallon cart for waste, Residents are supplied a cart by the contracted service provider. All waste pickup occurs weekly throughout the year. Garbage is collected using automated equipment by and recycling is collected manually, and both activities are done by GFL Environmental.

There are no multi-family units in the County.

Leduc County operates eight waste transfer stations at various locations across the County. Cards are supplied annually to County residents to access the transfer stations. All transfer stations are attended during hours of operations and accept: residential household waste, blue bag recyclables, household furniture, compost, and yard waste (seasonally from May 15 to October 15), and wood (except Looma transfer station). The transfer stations at Sunnybrook and New Sarepta also accept household hazardous materials, oil product waste, antifreeze, paint, batteries, white goods, metals, construction and demolition waste, tires, and electronics. Residents can also drop garbage, recycling and organics off directly at the LDRWMC facility free of charge. Leduc Country residents can dispose of up to 3 tonnes at no charge, The County's blue bag recycling program accepts plastics, glass jars and bottles, metal cans, and paper and cardboard.

Leduc County also has an agreement with the City of Leduc to allow County residents to access the City of Leduc Eco-station. Additionally, Leduc County also has agreements with the Town of Thorsby and a number of summer village on the north shore of Pigeon Lake to allow their residents to access the Sunnybrook or Mission Beach transfer stations,

12.7 Town of Morinville

The Town of Morinville has a three-stream curbside collection program for all residences. Single-family homes are provided with two carts, black for garbage and green for organics. Cart collection is automated. Garbage and organics are collected weekly throughout the year. Blue bags are used for recyclables, which are collected manually. Recyclables are also collected weekly. All materials are collected by GFL Environmental under contract to the Town.

Residents may also take material, particularly large objects, directly to the Roseridge Landfill. Morinville residents are billed through the Town for material taken directly to the landfill. Waste, recyclables, and organics are taken to the Roseridge Landfill.

12.8 Parkland County

Parkland County provides curbside waste collection in Entwistle and Wabamun. In the hamlet of Entwistle, waste is collected weekly and residents provide their own containers. Wabamun has 3 stream curbside collection services. The contractor supplies residents with 65-gallon carts for waste and organics. Recycling is collected in blue bags.

For multi-family dwellings may receive curbside collection services through the County for a fee or can contract with private waste haulers. Parkland County is considering expanding curbside waste collection services to more densely populated areas.

Residents of Parkland County can self-haul and drop off their waste at designated facilities. Parkland County operates six waste transfer stations, three recycling centres, and one household waste and recyclable drop off site that provide waste management services to County residents. The waste transfer stations are attended and offer a broad range of services to residents. In addition to the typical materials, most transfer stations are equipped to accept: paint, motor oil and containers, household hazardous waste, electronic wastes, batteries, appliances, propane tanks, tires, small furniture, CR&D waste, and commercial waste. County residents with access cards can drop off most of their wastes at transfer stations free of charge. There are some exceptions such as a surcharge for fridges and freezers containing food waste. Non-residents can also use the facilities for a fee.

All Transfer Stations accept non-residential waste for a fee, although there are some restrictions in place. The acceptable material determination is made by the operator on-site. There are also fees for construction wastes and accepted commercial wastes.

Waste collected in Parkland County is landfilled in either Ryley and Thorhild. The contractor transports the recycling and organics to their facilities in Edmonton for processing. The Kapasiwin Transfer Station and Seba Beach Transfer Stations have on-site compost operation areas.

12.9 City of Spruce Grove

The City of Spruce Grove operates a two-cart system in conjunction with a blue bag program for recyclables. Each residential premises defined as a lot with a house, duplex or street-oriented row housing, is provided with a black 120 L or 240 L cart for garbage and a green 240 L cart for organics. The green organic carts are collected weekly from April to November and monthly from December to March. Curbside recyclables in the blue bag program are picked up weekly and there is no bag limit. The garbage stream is collected weekly on a year-round basis. The carts are collected using automated equipment, but the recyclables are collected manually. Residents are only allowed to put out one black cart full of garbage each week and beginning in the spring of 2023 residents will no longer be permitted to place any additional organics outside of their green cart. Currently, all three waste streams are collected by GFL Environmental.

The materials collected through Spruce Grove's organics and blue bag programs are similar to those collected by other municipalities with similar source separation programs.

There are no "multi-unit developments" within Spruce Grove.

Each year the City conducts a large item pick up event for residential waste customers and hosts a shred-4-free and an E-Roundup event for all residents.

Spruce Grove's solid waste utility operates an Eco Centre that accepts the same items as the curbside programs, as well as household hazardous wastes, electronic waste, tires and scrap metal (including white goods and propane tanks). The site also operates as a waste transfer site for household garbage and construction waste. Fees are charged at the Eco Centre for landfill waste.

Recyclables go to various facilities owned and operated by GFL Environmental. Organics are transported to Roseridge and waste is transported to Thorhild and/or Claystone.

12.10 City of St. Albert

The City of St. Albert is responsible for the collection and disposal of wastes from single-family units and multi-residential units. The City has a three-stream waste stream program. The City operates a Pay-As-You-Throw system, whereby the size of a household's garbage cart corresponds to their monthly waste fee. Residents can choose between an 80 L, 120 L, or 240 L Brown Garbage Cart, and a 120 L or 240 L Green Organics Cart, for which there is no fee difference among sizes. Carts systems are collected using automated equipment.

The City collects garbage bi-weekly. GFL Environmental collects organics and recyclables. Organics are collected every week from April to the end of October and every other week from November to the end of March. Recyclables are manually collected each week.

The City of St. Albert provides modified curbside collection to 30 multi-family complexes (1,201 households), which receive garbage and recycling collection only. Twelve multi-family complexes (474 households) receive three-stream curbside collection. The remaining 95 complexes (5,769 households, primarily apartments and condominiums) coordinate their waste collection privately.

The City offers seasonal waste programs throughout the year to encourage waste diversion: Curbside Large Item Pick Up, Large Item Drop Off, Compost Giveaway, Curbside Leaf Pick Up, and Christmas Tree Pick Up and Drop Off.

In addition to its curbside and seasonal diversion programs, St. Albert also operates two transfer stations: a Recycling Depot and a Compost Depot. The Recycling Depot, open to residents of St. Albert only, accepts paper and cardboard, scrap metal, Styrofoam, tires, oil, household hazardous waste, and electronics. The Compost Depot accepts yard wastes and larger items such as tree branches and stumps for residents of St. Albert, but does not accept vegetable and fruit scraps, bones, or dairy products.

Garbage and organics are taken to Roseridge, where they are landfilled and composted, respectively. Recycling is processed at one of GFL Environmental's Materials Recovery Facilities and then shipped elsewhere to be recycled into end products.

12.11 Town of Stony Plain

The Town of Stony Plain has a three-stream program for its residential waste management. It consists of a black cart for garbage, a green cart for organics (called "Organicart"), and blue bags for recyclables. The cart collection is automated, while blue bags are collected manually. Garbage is collected every other week, while. Organics are collected every week from mid-April to mid-October and every other week from mid-October to mid-April. recyclables are collected weekly. All residential waste is collected under contract by GFL Environmental.

Stony Plain also operates the Rotary Recycling Centre which accepts the same materials collected through the curbside program, as well as electronics, paint products, and batteries. Residents are directed to take household hazardous waste and metal scraps to the local Parkland County Transfer Station and Recycle Centre.

12.12 Strathcona County

Strathcona County is unique in that it includes Sherwood Park, the largest hamlet in Alberta with a population over 70,600, as well as large rural area with eight smaller hamlets. The County provides single-family homes with two carts, black for garbage and green for organics. Residents are also provided with a smaller "green catcher" bin for collecting food waste in the kitchen. Garbage is collected every other week. For all hamlet households, organics are collected weekly from May through October and bi-weekly from November through April. Rural households have bi-weekly organics collection year round.

Recyclables are collected in blue bags on a weekly basis. The program changed in September of 2018 to reflect changes to recycling markets. Clean items (e.g., non-food soiled items) accepted in blue bag include: hard plastics containers, tubs, and bottles; aluminum and tin food cans and containers; office paper, envelops, and craft paper; wrapping paper (no foil); magazines, newspaper, and flyers; cardboard; boxboard; and books (with front and back covers removed).

The County has contracted out all single-family curbside collection (currently GFL Environmental for all three streams). In addition to curbside services, Strathcona County provides community services through recycle stations. The Broadview Enviroservice Station is a one stop depot where residents can drop off household hazardous waste, electronics, appliances that are not collected at the curbside. The Enviroservice Station also accepts recyclables, yard waste, tires, and reusable clothing, in addition, there is a reuse program, called the HodgePodge Lodge. There are also two rural recycling stations: a permanent site in Ardrossan and a recycling outpost is located at South Cooking Lake.

Strathcona County contracts out all processing and disposal needs for waste, recycling and organics. Currently they work with a variety of service providers to ensure that materials are diverted and disposed of properly.

12.13 Sturgeon County

Sturgeon County is the largest member of the Roseridge Regional Waste Services Commission. A significant portion of the County's residents live in 11 hamlets and 74 rural subdivisions. Residents in the hamlets and rural subdivisions are responsible for hiring their own waste management service provider. Residents may also take waste directly to the Roseridge Regional Landfill. Residents are billed through the County for material hauled directly to the landfill. The County also operates a waste transfer station at Redwater.

13.0 APPENDIX D: Provincial Waste Stewardship Programs

Stewardship programs are important to Alberta's efforts to minimize, divert, and properly manage our waste and residual materials. Government-regulated stewardship programs help create and maintain sustainable recycling for post-consumer products which cost more to recycle than what the material may be worth at market, or to dispose of in landfills[19].

There are five regulated waste stewardship programs in Alberta:

- Beverage Containers
- Electronics
- Paint and Paint Containers
- Tires
- Used oil materials (used oil, oil filters and oil containers)

Alberta's waste stewardship programs are managed by delegated administrative organizations (DAO) operating at arms-length from government and are accountable to the Minister of Environment and Protected Areas. There are 2 recycling DAOs, the Alberta Recycling Management Authority (ARMA) and the Beverage Container Management Board (BCMB).

Obtaining data from the DAOs and/or product stewardship programs operating in the Region would expand the understanding of the total amount of recycling that is generated and collected. In addition, these organizations are in the best position to provide assumptions used in modeling (e.g., contamination, processing losses).

13.1.1 The Alberta Recycling Management Authority

ARMA is a not-for-profit organization incorporated under the Societies act and operates as a DAO accountable to the Alberta Minister of Environment and Parks through its Budget, Business Plan, and Annual Report. The Designated Material Recycling and Management Regulation (the Regulation) authorizes ARMA to levy and collect Surcharges (environmental fees) on the sale or supply of designated material in or into Alberta. These funds are to be used to provide or pay for any or all of the following components regarding designated material:

- Waste minimization and recycling programs;
- Public information programs for the promotion of waste minimization and recycling programs;
- Expenditures on collection, transportation, storage, processing and disposal;
- Research and development activities; and
- Promote the uses of recycled materials and products.

ARMA is authorized to manage four Designated Materials—electronics, paint, tires, and used oil materials—through a process called multi-material stewardship. Fundamental to this process is ensuring that the financial resources, including environmental fee revenue for each designated material program, are managed independently, while at the same time realizing the synergies and cost-effectiveness of operating under a single organization.

In addition to its environmental stewardship mandate, ARMA meets its obligations under the Societies Act through its bylaws and governance framework. ARMA formally reports to its membership through an Annual Report and Annual General Meeting.

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[19] Government of Alberta: Regulated stewardship programs.

ARMA outlines six areas of strategic focus in their 2021-2022 Annual Report:

- Evolve and be innovative in developing Alberta made solutions to address local challenges that could make a global impact.
- Work with the province's recycling champions including municipalities, Indigenous communities, industry, thought leaders, post-secondary institutions, and government to generate ideas, systems and services to enhance and expand existing programs as well as explore new ones.
- Fulfill our recycling mandate but also discover waste minimization opportunities that incorporate rethinking, refusing, reducing, reusing, repairing, repurposing and recovering.
- Continue to explore and support different stewardship models (e.g., extended producer responsibility to evolve with the needs of Alberta).
- Develop synergies and harmonization with other industry-related environmental organizations across Canada.
- Gain and maintain public support for recycling initiatives in Alberta through effective stakeholder and industry awareness efforts across all programs and at the corporate level.

The Province recently announced that ARMA would be the designation organization to provide oversight over Alberta's Extended Producer Responsibility (EPR) framework to be implemented in 2025.

13.1.2 Beverage Container Management Board

The BCMB was created through legislation to aid the Ministry of Environment and Parks in achieving its goals and objectives. The following information is taken from the BCMB 2021 Annual Report. BCMB are responsible for regulating and delivering Alberta's beverage container recycling system in collaboration with industry stakeholders including:

- The Collection System Agent (Alberta Beverage Container Recycling Corporation);
- The main Collection Service Provider (Alberta Beer Container Corporation/BDL);
- The Alberta Bottle Depot Association (ABDA); and
- Beverage manufacturers.

As the Collection System Agent (CSA) for all non-refillable beverage containers, the Alberta Beverage Container Recycling Corporation (ABCRC) is responsible, on behalf of manufacturers, for the collection, processing and shipping of containers from all Alberta depots to recycling companies.

Non-refillable containers account for about 98% of all beverage containers returned to depots. ABCRC's role includes setting and administering Container Recycling Fees, the recycling and verification of containers, and marketing.

The BCMB has an agreement with the CSA to operate the common collection system which is required under regulation. The agreement establishes performance standards by which the BCMB evaluates the CSA.

The Alberta Bottle Depot Association (ABDA) is the member organization that represents most of the 221 depots in the province. The association has a governance role as a nominating entity for the BCMB's Board of Directors. It represents depots in relation to service agreements with the CSAs and Collection Service Providers (CSP) through important roles related to handling commissions (setting of fees paid to depots).

The Alberta Beer Container Corporation (ABCC), a nominating entity for the BCMB's Board of Directors, is the main CSP for refillable beverage containers. It is responsible, on behalf of manufacturers, for the recovery and recycling of empty refillable beer containers from depots. The BCMB has an agreement with the CSP to operate the collection service. The agreement establishes performance standards by which the BCMB evaluates the CSP.

There are more than 500 manufacturers register products with the BCMB. While the BCMB manages container registration for non-alcoholic and cannabis beverages, Alberta Gaming, Liquor and Cannabis (AGLC) is the deemed manufacturer for all liquor products in Alberta. It manages the registration of liquor containers for the BCMB, making it the largest registrant in the beverage container recycling system. AGLC is also a nominating entity for the BCMB's Board of Directors.

**Beverage containers were not included in Alberta's initial EPR framework.*

14.0 APPENDIX E: Regional Waste Commissions

Two solid waste commissions operate within the Region, the Roseridge Waste Management Services Commission (Roseridge) and the Leduc and District Regional Waste Management Commission (LDRWMC).

14.1.1 Roseridge Regional Waste Management Services Commission

Roseridge was established in 2001 by an Order-in-Council under Part 15 of the Municipal Government Act (MGA). It was preceded by a waste management authority representing the same municipalities. Its members are Sturgeon County, Town of Redwater, Town of Morinville, Town of Legal, Town of Gibbons and Town of Bon Accord. Each municipality appoints an elected official to be member to the Board of Directors. The Directors are responsible for managing Roseridge.

14.1.2 Leduc and District Regional Waste Management Commission

The Leduc and District Regional Waste Management Commission (LDRWMC) is available to its member municipalities including Leduc County, City of Leduc, Town of Beaumont, Town of Devon, and the Town of Calmar. The municipalities signed an agreement in the 1970s to establish a waste management authority to provide waste services for the member municipalities. In 2021, the authority transitioned to a commission.

Each municipality appoints a member to the Board that oversees the LDRWMC's business. The members elect a member of the Board to be Chair, typically for the term of one year. Operation of the LDRWMC landfill and associated waste management activities are contracted to GFL Environmental. Commission management and administration is contracted to one of the member municipalities (currently the City of Leduc).

15.0 APPENDIX F: Regional Waste Facilities Map