Phase 1, Task 1:

Waste Generation Rates & Facility Sizing

An analysis of waste generation rates and the potential waste quantities and composition of waste available that could potentially be managed by an Energy-from-Waste (EFW) facility in Southern Alberta

IN SUPPORT OF:

Southern Alberta Energy-From-Waste Alliance
Vulcan Innovation Project
Vulcan County
102 Center Street, Box 180
Vulcan, Alberta T0L 2B0

PREPARED BY:

HDR
4838 Richard Road SW, Suite 140
WestMount Corporate Campus
Calgary, AB T3E 6L1

IN PARTNERSHIP WITH…

AECOM
Fourth Floor, 3292 Production Way
Burnaby, BC, Canada V5A 4R4

February 17, 2011

Contents

List of Figures

List of Tables

1.0 Introduction

The Southern Alberta Energy-from-Waste Alliance (SAEWA) is a coalition of waste management jurisdictions committed to researching and recommending for implementation, technological applications for recovering energy from waste materials, and reducing reliance on landfills.

The membership of SAEWA consists of 16 waste authorities listed below and included in Figure 1:

- Bow Valley Waste Management Commission
- Foothills Regional Services Commission
- MD of Ranchlands No. 66
- Crowsnest/Pincher Creek Landfill Association
- Willow Creek Regional Waste Management Services Commission
- Wheatland County
- Vulcan District Waste Commission
- Lethbridge Regional Waste Mgmt Services Commission
- Town of Coalhurst
- Town of Coaldale
- Chief Mountain Regional Solid Waste Authority
- Newell Regional Solid Waste Mgmt Authority
- Taber & district Regional Waste Management Authority
- North Forty Mile Regional Waste Mgmt Commission
- South Forty Waste Services Commission
- Special Areas Board (Big Country)

In July 2010, with the assistance of a grant from Rural Alberta Development Fund, the team of HDR and AECOM were retained to assist SAEWA in further exploring the opportunities to develop an Energy-from-Waste (EFW) facility in Southern Alberta. This research project consists of four (4) phases, each with a series of tasks as follows:

Phase 1 (Current Phase)

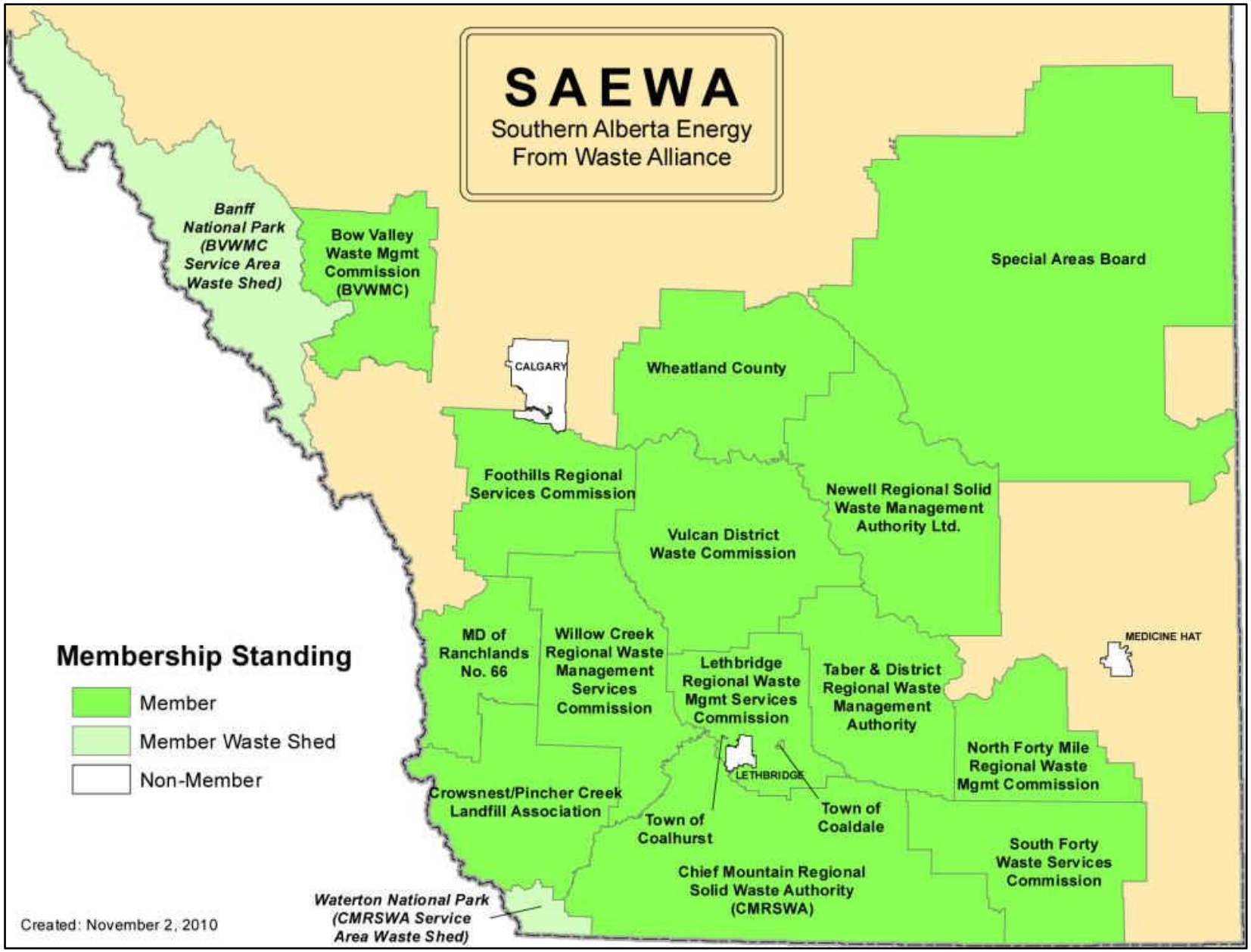
- Project Initiation
- TASK 1: WASTE GENERATION RATES AND FACILITY SIZING
- TASK 2: COMBUSTION TECHNOLOGIES

The completion of Phase 1 activities will result in the identification of waste quantities potentially available to be managed, the size of the facility required to manage these materials; and the applicable technologies capable of managing the quantity and composition of available waste streams.

Phase 2

The completion of Phase 2 activities will result in the identification of waste collection, transportation and handling implications with associated siting opportunities; heat recovery and cogeneration options, including potential market/siting opportunities; an additional level of detail with respect to the environmental implications (now including transportation impacts from Task 3), and the facility permitting and siting requirements. This phase also includes the development of a

Figure 1: SAEWA Membership



future project development schedule. Each of the tasks completed in this phase will then be utilized in Phase 3 to assess the economic and financial implications.

Phase 3

The completion of Phase 3 activities will result in the identification of the economic and financial implications of moving forward with the development of a facility and required supporting infrastructure.

Phase 4

The completion of Phase 4 activities will include a visit to, and review of, operational facilities by SAEWA members. This phase will be concluded with the development of a summary report documenting the results of all study tasks and recommendations for next steps.

The following report documents the results of Phase 1, Task 1 Waste Generation Rates and Facility Sizing.

2.0 Waste Generation Overview

The first step in completing the EFW Research Project is to establish a baseline for potential quantities and composition of waste materials that could be available to be managed at a future Southern Alberta EFW facility.

The baseline quantities identified in this report have been categorized as follows:

- Municipal Solid Waste (MSW) from SAEWA members;
- MSW from non-SAEWA members; and
- Other waste sources within, or within close proximity to, Southern Alberta.

This initial categorization of waste streams is important as each waste stream has its own unique waste characteristics. In addition, the management responsibilities and therefore future availability considerations for each of these waste streams is different and therefore needs to be considered and evaluated separately.

The following sections of this report document the current waste streams identified as potentially available both within the Region and outside the Region and then examines the composition of this material and projects the long-term quantities that could require, and be available for, management in the future.

To conclude this task, an assessment of the calorific value (i.e. energy content of the waste) has been developed and the potential facility size is determined.

2.1 MSW from SAEWA Members

To develop waste disposal profiles for each of the SAEWA member municipalities, representatives from each SAEWA member were contacted individually to determine their annual solid waste disposal rates. Approximately half of these waste authorities own and operate their own landfill, and the rest transfer

and dispose of their waste in neighbouring waste authorities that operate their own landfill. Six SAEWA waste authorities send their waste to non-SAEWA member landfills.

For this purposes of this project, MSW includes waste from residential sources, construction and demolition (C&D) sites and institutional, commercial and light-Industrial (ICI) facilities. ICI waste includes waste from businesses, restaurants, food processing plants, schools, hotels and non-biomedical waste from hospitals. Generally, the waste from these three sources is comingled at transfer stations and disposal sites. Only a small number of waste authorities actually categorize the three waste streams separately.

Table 1 summarizes the waste disposal quantities from each of the SAEWA members. These figures represent an average disposal rate for the past three to four years, depending on the records that were submitted by the SAEWA waste authorities. These numbers have been presented as averages to minimize, to the extent possible, annual shifts in waste generation and disposal that can occur for a variety of reasons including, population growth, economic conditions, etc.

Table 1: Average Annual MSW Disposal Rates from SAEWA Members

SAEWA Waste Authorities	Residential MSW (tonnes/ year)	ICI Solid Waste[(1)] (tonnes/ year)	C&D Waste [(1)] (tonnes/ year)	Total tonnes/ year)	Current Method Of Management
Bow Valley Waste Management Commission	11,400		12,000	**23,400**	Transfer to Calgary Landfill for Residential MSW and local landfill disposal for C&D waste
Foothills Regional Services Commission	30,100		6,800	**36,900**	Local landfill disposal
MD of Ranchlands No. 66	20			**20**	Transfer to Foothills Landfill
Crowsnest/Pincher Creek Landfill Association	10,500	700	5,100	**16,300**	Local landfill disposal
Willow Creek Regional Waste Management Services Commission	3,700		2,900	**6,600**	Local landfill disposal
Wheatland County	1,410			**1,410**	Transfer to Drumheller Landfill
Vulcan District Waste Commission	5,700			**5,700**	Transfer to Lethbridge Landfill
Lethbridge Regional Waste Mgmt Services Commission	2,200		50,000	**52,200**	Transfer to Lethbridge Landfill
Town of Coalhurst	550			**550**	Transfer to Lethbridge Landfill
Town of Coaldale	3,000			**3,000**	Transfer to Lethbridge Landfill
Chief Mountain Regional Solid Waste Authority	10,300			**10,300**	Local landfill disposal plus transfer to Lethbridge Landfill
Newell Regional Solid Waste Mgmt Authority	12,700	6,500	2,950	**22,150**	Local landfill disposal

SAEWA Waste Authorities	Residential MSW (tonnes/ year)	ICI Solid Waste[(1)] (tonnes/ year)	C&D Waste [(1)] (tonnes/ year)	Total tonnes/ year)	Current Method Of Management
Taber & district Regional Waste Management Authority	6,300			**6,300**	Transfer to two neighbouring landfills
North Forty Mile Regional Waste Management Commission	1,500			**1,500**	Local landfill disposal
South Forty Waste Services Commission	1,480			**1,480**	Transfer to North Forty Mile Landfill
Special Areas Board (Big Country)	9,040			**9,040**	Local Landfill disposal
TOTAL	**109,900**	**7,200**	**79,750**	**196,850**	

Notes: (1) Where separate volumes are known. Where blank, these categories are included with the residential quantities.

The average annual MSW disposal rate for the past three years from SAEWA members is estimated to be 196,850 tonnes per year. This estimate takes into consideration fluctuations that were experienced during the downturn in the economy.

Waste disposal rates from the residential and ICI sectors are relatively consistent and generally do not fluctuate by more than 10% each year. These two waste streams are considered reliable and are primarily controlled by the respective SAEWA waste authorities. There are substantial additional quantities of waste that are collected by private haulers such as BFI and Waste Management within the Region. Private sector waste haulers were contacted and were not open to sharing their waste volumes with SAEWA. More information on private sector waste collection and disposal companies is provided in section 2.3.1.

Construction and Demolition waste represents a large portion of the materials disposed. C&D waste disposal quantities were observed to fluctuate by as much as 50% from year to year. This can be attributed to local economic conditions. The lack of reliability of this waste stream should be taken into consideration when sizing a future EFW facility.

***Conclusion** – On an average annual basis, the SAEWA members are responsible for the management of approximately 196,850 tonnes of residual waste requiring disposal. Therefore, 196,850 tonnes of MSW will be carried forward further in the study as waste available to be managed at a future Southern Alberta EFW facility.*

2.2 MSW from non-SAEWA Members

The largest cities in Southern Alberta are not SAEWA members. These cities include Calgary, Lethbridge and Medicine Hat. These cities operate their own landfills, and their average disposal rates are summarized in Table 2 below.

In addition to waste from these three cities, there are also a number of small municipalities within the boundaries of the SAEWA that are not members of SAEWA. The Town of Strathmore, for example, is within Wheatland County but is not part of SAEWA or any solid waste authority. This town has 12,000

residents and currently disposes an average of 5,300 tonnes per year of residual waste at Drumheller Landfill. In addition, a sub-region of the Regional District of East Kootenay (RDEK) in British Columbia also disposes of their waste to Southern Alberta landfills. Because of geographic and transportation issues, the RDEK will likely continue disposing of their waste in Southern Alberta. The amount of waste disposed from non-SAEWA members is listed in Table 2.

Table 2: Summary of MSW Disposed from Non-SAEWA Members

Non-SAEWA Members	MSW Disposed (tonnes/year)
City of Calgary	710,000*
City of Lethbridge	110,000*
City of Medicine Hat	56,000
Drumheller Regional Landfill	30,000
RDEK (Fernie, Sparwood and Elkford)	8,000
Town of Strathmore	5,300
TOTAL	**919,300**

** The waste quantities from SAEWA members managed at the above non-SAEWA facilities have been removed to prevent the potential for double-counting of waste quantities.*

The three cities above (Calgary, Lethbridge, and Medicine Hat) are unlikely to contribute their waste to a SAEWA EFW facility unless they become part of the SAEWA collective and have a vested interest in pursuing this initiative. The City of Lethbridge is centrally located and operates a regional landfill that also receives waste from five SAEWA members, including: Lethbridge County, Vulcan District, Town of Coalhurst, Town of Coaldale and Chief Mountain (overflow only). As per the note on Table 2, the quantity of material from the SAEWA members sending material to the Lethbridge Landfill are included in Table 1 according to the respective waste authority and have been excluded from Table 2 to prevent the double counting of waste quantities. The City of Calgary generates significant quantities of waste such that they could establish their own EFW facility, should they choose to do so.

The RDEK and Town of Strathmore are two sizable entities that are not part of SAEWA. These two organizations work with landfill owners in Southern Alberta to establish contracts for waste disposal capacity. These contracts are typically driven by economic considerations such as tipping fees and transportation costs.

***Conclusion** – On an average annual basis, the non-SAEWA members identified above are responsible for the management of approximately 919,300 tonnes of residual waste requiring disposal. Of this total material disposed, based on our assessment, we conservatively estimate that approximately 13,300 tonnes of material annually could be available to a Southern Alberta EFW facility.*

2.3 Other Waste Sources

There are other waste sources that could contribute significant quantities of waste to a future Southern Alberta EFW facility. The following waste sources were investigated to determine potential quantities that might be available and the likelihood of acquiring that waste stream for a potential SAEWA facility. The waste sources include a variety of waste material types, energy values, as well as collection and management implications. Some of the materials identified below will also need to be considered

carefully in Task 6 with respect to permitting implications given the composition of these waste streams and the definition of non-hazardous vs. hazardous waste.

2.3.1 Institutional, Commercial and Industrial (ICI) Sector Waste

Institutional, Commercial and Industrial (ICI) waste consists of materials from commercial sources such as businesses, restaurants, food processing plants, schools, hotels, shops, non-biomedical waste from hospitals. These materials are either:

1) Brought to local transfer stations and managed by SAEWA member systems (quantities included in Table 1 above); or,

2) These materials are collected by private sector haulers such as BFI and Waste Management. BFI owns and operates a landfill outside Calgary and operates the Lethbridge Regional Landfill on behalf of the City of Lethbridge. The landfill outside Calgary has been rumored to close in a few years although official information is not available as to the timing of this closure or any consideration for replacing this disposal capacity.

In addition to private sector landfills, publically owned landfills also receive waste from the ICI sector. The three City of Calgary owned landfills receive approximately 510,000 tonnes per year of waste from non-residential sources, of which 25% is C&D waste. The Lethbridge Landfill also receives approximately 79,000 tonnes of waste from the ICI sector.

A common practice in Southern Alberta is for ICI facilities and small subdivisions to rent containers and bins from waste haulers for disposing of waste from their premises. Table 3 lists non-SAEWA landfills that receive ICI sector waste and the quantity disposed from that sector.

Table 3: Summary of ICI Sector Waste Disposed at Non-SAEWA Landfills.

Commercial Sector Waste	MSW Disposed (t/yr)
City of Calgary Landfills (3 landfills)	510,000*
BFI Landfill (Calgary)	290,000**
Lethbridge Regional Landfill	79,000*
Drumheller Landfill – Wheatland County	7,400*

**Quantity accounted for in Table 2.*
***Average of report quantities from Alberta Environment.*

***Conclusion** – The management of private sector waste materials is largely driven by economic and financial considerations. The availability of these waste streams will be dependant on the proposed tipping fee that would be charged at a Southern Alberta EFW facility which will be estimated later in this study as part of Task 7: Capital and Operating Costs. To be conservative, and given the unwillingness of private sector operators to provide data, we have assumed that none of the materials will be available to a future Southern Alberta EFW facility. This assumption should be reconsidered once additional economic/financial information is prepared as part of the research project.*

2.3.2 Agricultural Waste

Southern Alberta has some of the largest confined animal feedlot operations in Canada. These facilities produce large quantities of organic residuals such as manure, straw and livestock processing waste. Common land use and waste management practices allow agricultural waste to be disposed through low cost land application. The likelihood of agricultural waste being a potential feedstock for a future EFW facility is low especially if the management of that waste stream has a cost to the farmer.

Waste that is not applied to land from agricultural operations is plastic wrap and garbage from the operation. This material is disposed in landfills along with residential and other ICI sector waste streams. These quantities have been accounted for in the disposal figures for landfills.

Conclusion *– Agricultural wastes that could be available to be managed at a Southern Alberta EFW facility include plastic wrap and other residuals from the agricultural operations. These quantities have been included in the ICI tonnages presented in the tables above.*

2.3.3 Municipal Wastewater Residuals (biosolids)

Wastewater residuals (or biosolids) are generated throughout Southern Alberta and these materials when dried have good heating value. For small communities such as those in Southern Alberta, the availability of biosolids for thermal processing is small. Wastewater treatment systems for small communities typically consist of lagoons. The biosolids normally accumulate in these lagoons and are usually cleaned out once every 20-30 years. Septic systems typically are cleaned out once or twice per year. This material is disposed at the regional landfills identified below.

Biosolids from larger wastewater treatment plants can be a reliable feedstock for EFW facilities. Reported biosolids disposal figures at Southern Alberta landfills are summarized in Table 4 below.

Table 4: Biosolids Disposal/Generation

	Biosolids Generation Rate	Disposal Method
City of Calgary	20,000 tonnes/year	Land applied (Calgro)
City of Lethbridge	1,000 tonnes/year	Disposed at Regional Landfill
Crowsnest/Pincher Creek Landfill	725 tonnes/year	Disposed at landfill
Foothills Regional Landfill	500 tonnes/year	Disposed at landfill
Drumheller Regional landfill	7 tonnes/year	Disposed at landfill
TOTAL	**22,232 tonnes/year**	

Conclusion *– On an average annual basis, we estimate that approximately 1,232 tonnes of material annually could be available to a Southern Alberta EFW facility.*

2.3.4 Hydrocarbon Contaminated Soil

Hydrocarbon contaminated soil is accepted at some Southern Alberta landfills. Based on the list of landfills below, there is more than 66,500 tonnes per year of hydrocarbon contaminated soil that is disposed.

City of Lethbridge Regional Landfill 17,800 t/yr

Crowsnest/Pincher Creek Landfill	28,700 t/yr
Drumheller Regional Landfill	20,000 t/yr

The heating value (dependant on the type of contamination) and the long term availability of these soils can vary significantly and therefore, these quantities should not be included as a consistent available feedstock for facility sizing, but rather as a potentially available feedstock that could be utilized on a case by case basis. In addition, the ability to manage these types of materials is very technology specific and the equipment maintenance implications can be a deterrent to processing this material.

Conclusion *– Contaminated soils should be considered on a case by case basis and should not be included as consistent available feedstock for facility sizing purposes.*

2.3.5 Oilfield Waste Residue

Oilfield waste residues include combustible waste such as filters, absorbents and rags. These materials are managed primarily by two companies, Hazco in Calgary and RB Williams in Edmonton, and are collected and processed into a non-hazardous material before they are shipped to a final destination for disposal. The following provides an overview of how these companies manage oilfield waste residues:

- Hazco currently trucks their processed materials to a facility in Buffalo, New York or to Lafarge in Kamloops, BC. Tipping fees are $440 per tonne and $100 per tonne, respectively. Hazco manages approximately 1,000 tonnes per year of oilfield waste residue.

- RB Williams sends their processed waste to the Wainwright, AB EFW facility. RBW has indicated interest in finding an alternative facility as the Wainwright facility is not always able to accommodate this waste stream. RBW manages approximately 1,500 tonnes/year of oilfield waste residue.

Conclusion *– On an average annual basis, we estimate that approximately 2,500 tonnes of material annually could be available to a Southern Alberta EFW facility.*

2.3.6 Railway Ties

Canadian Pacific Rail (CP Rail) and Canadian National Rail (CN Rail) were contacted with regard to spent/waste railway ties. Both companies indicated there are limited disposal options for railway ties in Western Canada and they would support an EFW facility that processes their waste in Western Canada.

The two railway companies estimate 800,000 railway ties per year require disposal in Western Canada (i.e., west of Manitoba). There are also large stockpiles of waste railway ties that are estimated to exceed 6.5 million railway ties. Considering railway ties typically weigh 0.09 tonnes per tie, the potential feedstock from railway ties are summarized in Table 5 below.

Table 5: Summary of Waste Railway Ties for Disposal

Waste Railway Ties	Quantity
Annual Generation	72,000 tonnes/yr
Stockpiled/Legacy	585,000 tonnes

The stockpiled or legacy railway ties are estimated to be disposed at a rate of 10% per year. That equates to a supply of 58,500 tonnes per year for a 10 year period. Therefore, the two railway companies can potentially supply 130,500 tonnes per year of waste railway ties for disposal for up to 10 years.

The railway firms also noted the following considerations for a future EFW facility:

- The EFW facility should be located along the railway system so that waste railway ties could be delivered economically (this will be included in the Task 3 analysis)[1];
- A small proportion of the stockpiled railway ties are coated with penta-chloro-phenol (PCP). PCP coated railway ties make up 5-10% of existing waste inventory. The future EFW facility must be certified to be able to destroy creosote and PCP in an environmentally safe manner before any railway ties would be delivered.
- According to CP Rail, disposal costs for railway ties are under $50 per tonne when thermally treated in the United States.

PCP coated railway ties require additional pollution control works that will escalate the capital cost for an EFW facility. Due to the small quantity of this material, it is recommended that PCP ties not be included as available feedstock and that the available stockpiled railway ties be reduced by 10% and that the availability of railway ties is adjusted to 124,650 tonnes per year.

Conclusion *– On an average annual basis, we estimate that approximately 124,650 tonnes of material annually could be available to a Southern Alberta EFW facility for the first ten years of operation. Once the current stock piles of materials have been reduced, this annual quantity would be reduced to 72,000 tonnes/year.*

2.3.7 Specified Risk Materials

Specified Risk Materials (SRM) are regulated through the Canadian Food Inspection Agency (CFIA) because of concerns associated with Bovine Spongiform Encephalopathy (BSE) or Mad Cow Disease. SRM consist of the skull, brain, trigeminal ganglia (nerves attached to the brain), eyes, tonsils, spinal cord and dorsal root ganglia (nerves attached to the spinal cord) of cattle aged 30 months or older; and the distal ileum (portion of the small intestine) of cattle of all ages. It also includes carcasses of condemned cattle and cattle dead stock, of any age. Any inedible material that is mixed with SRM, such as floor waste or recovered solids from wastewater, must also be treated as SRM.

Disposal methods for SRM must be approved by the CFIA. Currently, SRM from Alberta and British Columbia are rendered by West Coast Reduction in Calgary before being disposed in a secure landfill in Alberta. The rendering process removes 60% of the moisture and produces two types of material, Tallow and Meat and Bone Meal (MBM). Tallow is fat extracts free of protein that has a high marketable value. MBM is the concentrated protein product that is free of fat and moisture. The MBM is disposed in a secure landfill. The secure landfill reports receiving between 25,000 and 30,000 tonnes/year of MBM.

[1] Note: Incorporating rail haul into the EFW facility could significantly expand the service area of the facility beyond what is currently assessed in this report. This will be investigated further as part of Task 3: Waste Collection, Transportation and Handling.

Conclusion *– On an average annual basis, we estimate that approximately 27,500 tonnes of material could be available to a Southern Alberta EFW facility.*

2.4 Summary of Total and Available Waste Quantities

The amount of waste that could potentially supply a Southern Alberta EFW facility is summarized in Table 6 below. The table identifies both total quantities and potentially available quantities for an EFW facility in Southern Alberta.

Table 6: Summary of Total and Available Waste Quantities

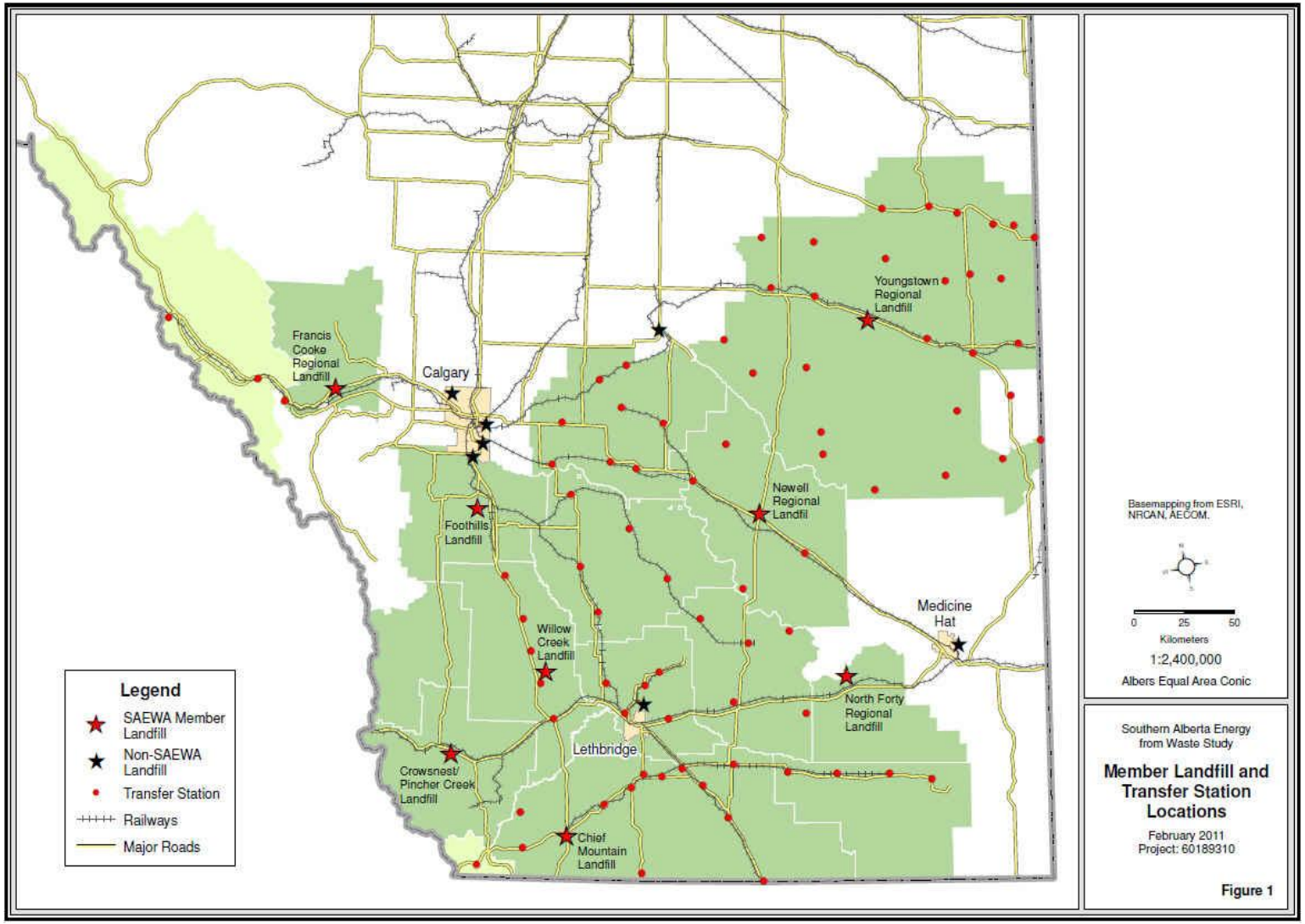
Waste Stream	Total Waste Quantities (Tonnes/year)	Potentially Available Waste for SAEWA (Tonnes/year)
MSW from SAEWA Members	196,850	196,850
MSW from Non-SAEWA Members	919,300	13,300
Other Waste Sources:		
ICI Sector Waste	290,000*	0**
Agricultural Waste	0***	0
Biosolids	22,232	1,232
Contaminated Soils	66,500	0
Combustible Oilfield Waste	2,500	2,500
Railway Ties	124,650	124,650
Specified Risk Materials - MBM	27,500	27,500
TOTAL	**1,649,532**	**366,032**

**Only includes quantities destined to the BFI landfill*
*** These cannot be defined at this time, and would likely only be available on the basis of lower tipping fees and transportation costs. This represents quantities that go to non-SAEWA member landfills or private landfills.*
****Included in "MSW from SAEWA" members category*

3.0 Disposal and Transfer Station Facilities

There are a number of waste disposal facilities and transfer stations throughout Southern Alberta, both within the jurisdiction of SAEWA members as well as in close proximity to the Region. Figure 2 below illustrates the locations of known facilities at this point in the study. As we continue the research project, this figure will be updated to reflect new facilities and the closure of old facilities.

Figure 2: Map of Southern Alberta landfills and transfer station



4.0 Tipping Fees

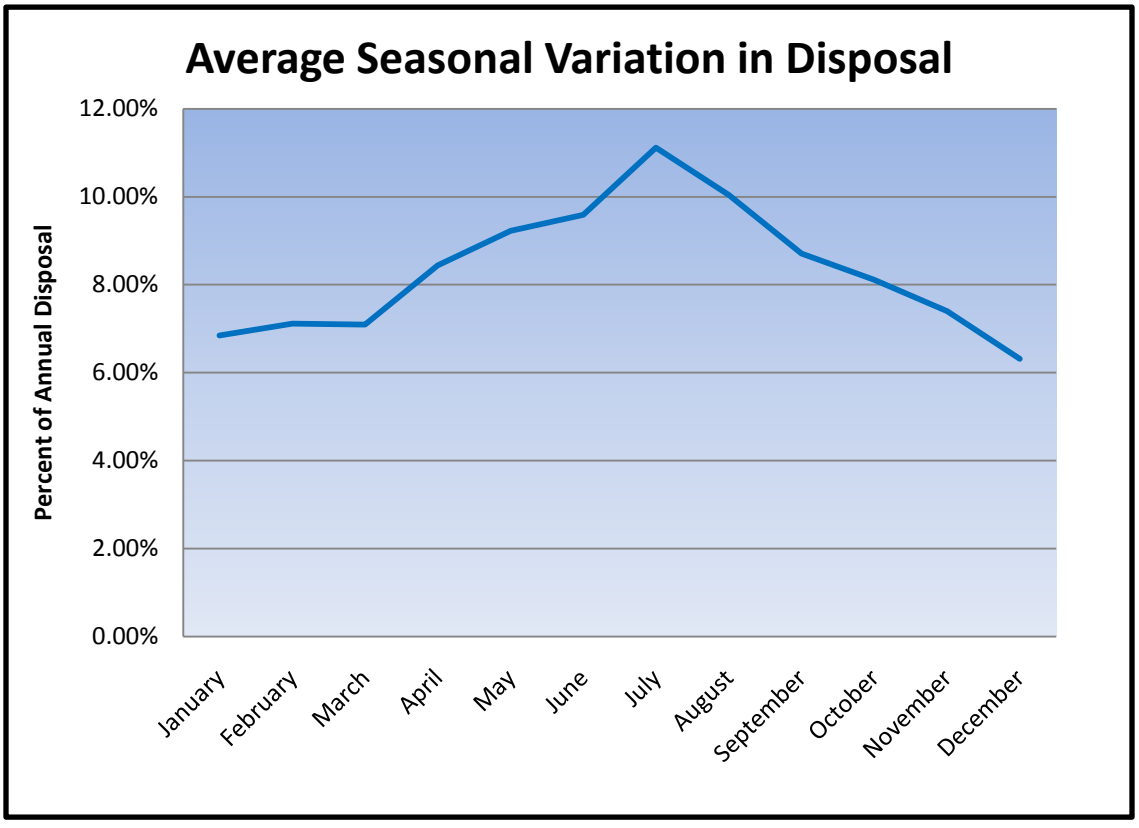
The tipping fees for disposal of waste in the SAEWA communities range from $30 per tonne to $95 per tonne, and have a median rate of $55 per tonne. These fees do not include transportation costs.

A detailed financial analysis will be conducted at a later date in Task 7 of this research project. Each waste commission applies its own rate structure that is not comparable between SAEWA members. The financial analysis will compare the costs and benefits of a future EFW facility when compared to the status quo.

5.0 Seasonal Variations

Municipal solid waste disposal quantities and composition vary throughout the year. These seasonal variations are typically associated with increased activity in yard work, gardening and home renovations. Three waste authorities, including Bow Valley, Big Country and LethbridgeLandfill, provided monthly disposal rates. This information was used to assess and project seasonal variations that will likely be experienced in the waste disposal system. Figure 3 illustrates the seasonal variations in disposal rates for the sample SAEWA communities.

Figure 3: Graph of Average Seasonal Variations in Disposal.



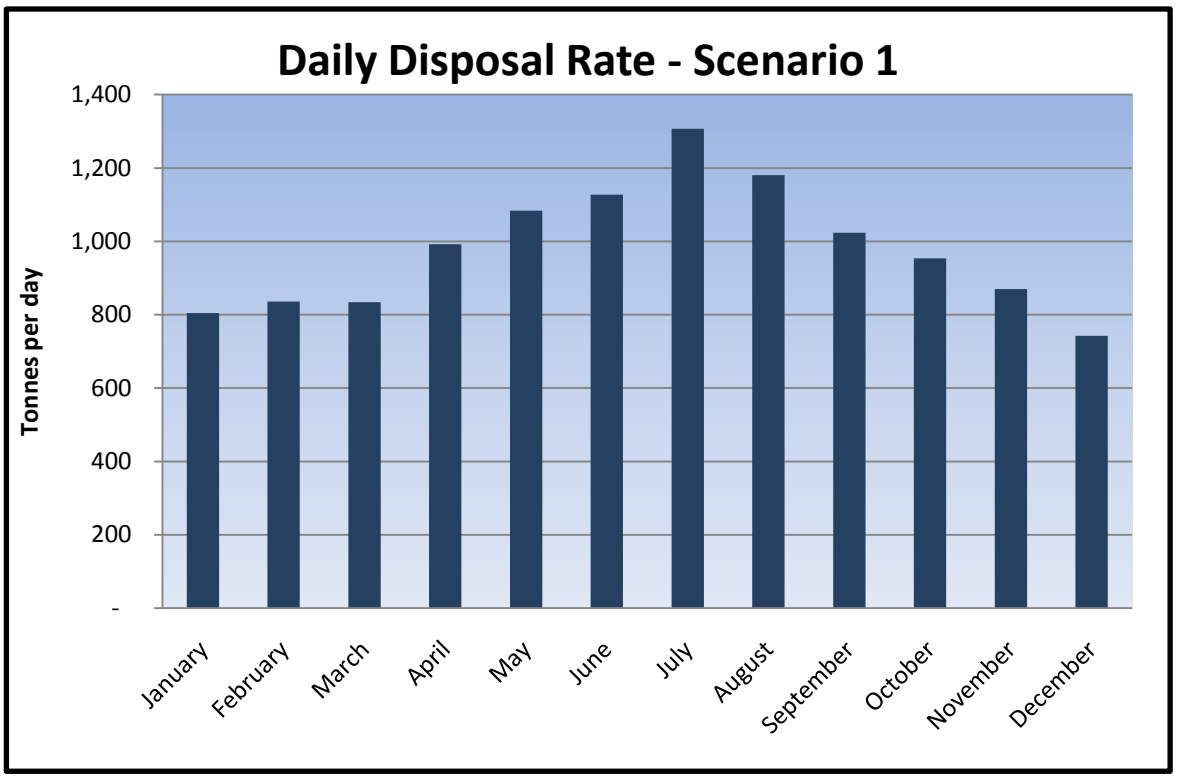
Seasonal variations can significantly affect the daily throughput for EFW facilities. To take into account seasonal variations, two scenarios were examined when considering facility size that assumed the following:

Scenario 1 – Daily MSW processing rates based on seasonal variations for MSW and a constant through put for non-MSW materials.

Scenario 2 – Daily MSW processing rate based on seasonal variations for MSW, constant through put for biosolids and SRM material, and top up quantities for railway ties to balance waste flows.

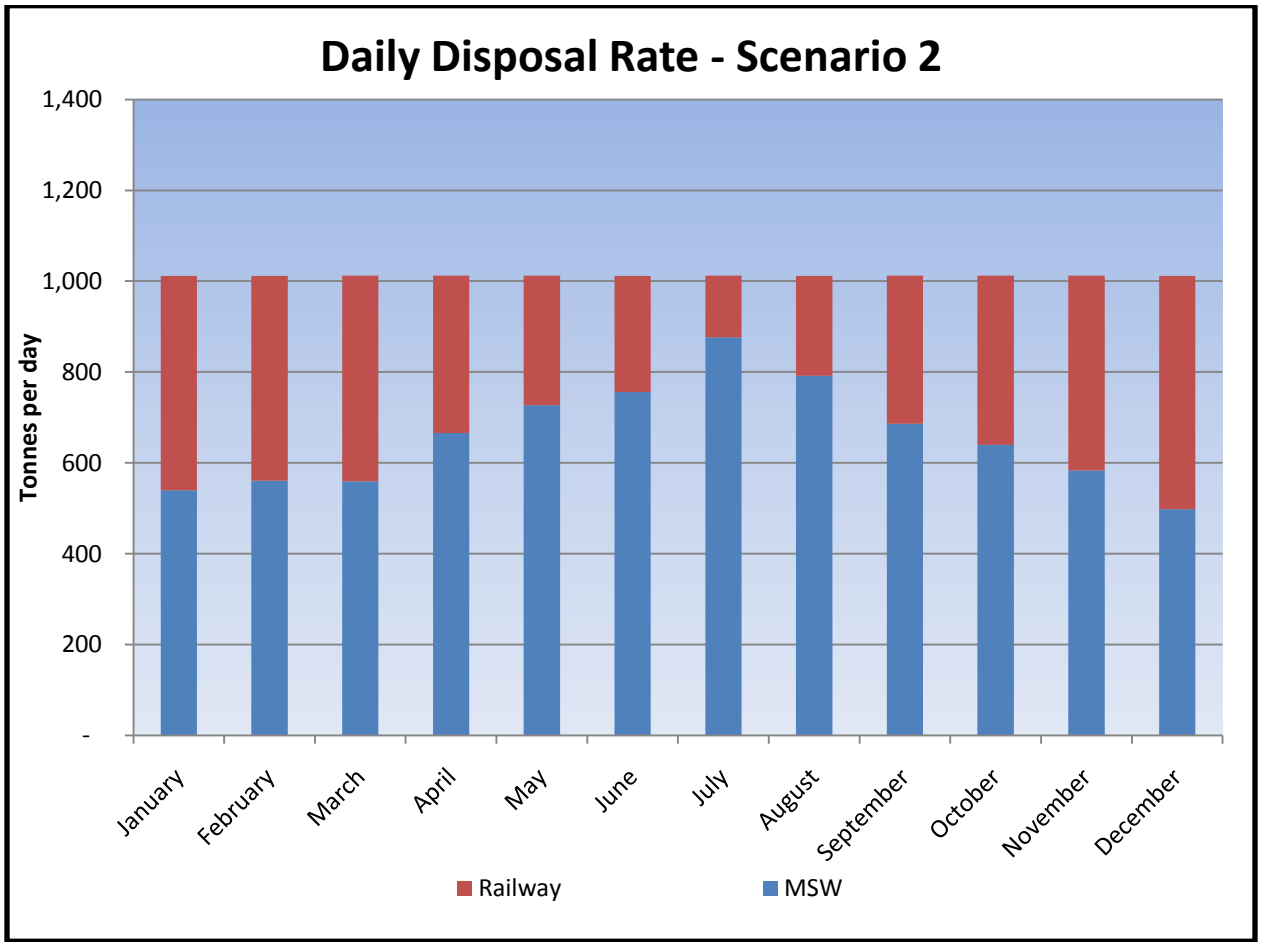
The daily disposal rates for Scenarios 1 and 2 are illustrated in Figures 4 and 5.

Figure 4: Daily Disposal Rate with a Constant Flow of non-MSW material.



The above figure illustrates how the disposal rate can fluctuate by as much as 500 tonnes per day depending on the season.

Figure 5: Daily Disposal Rate with a Top up of Railway Ties to Balance Waste Flows.



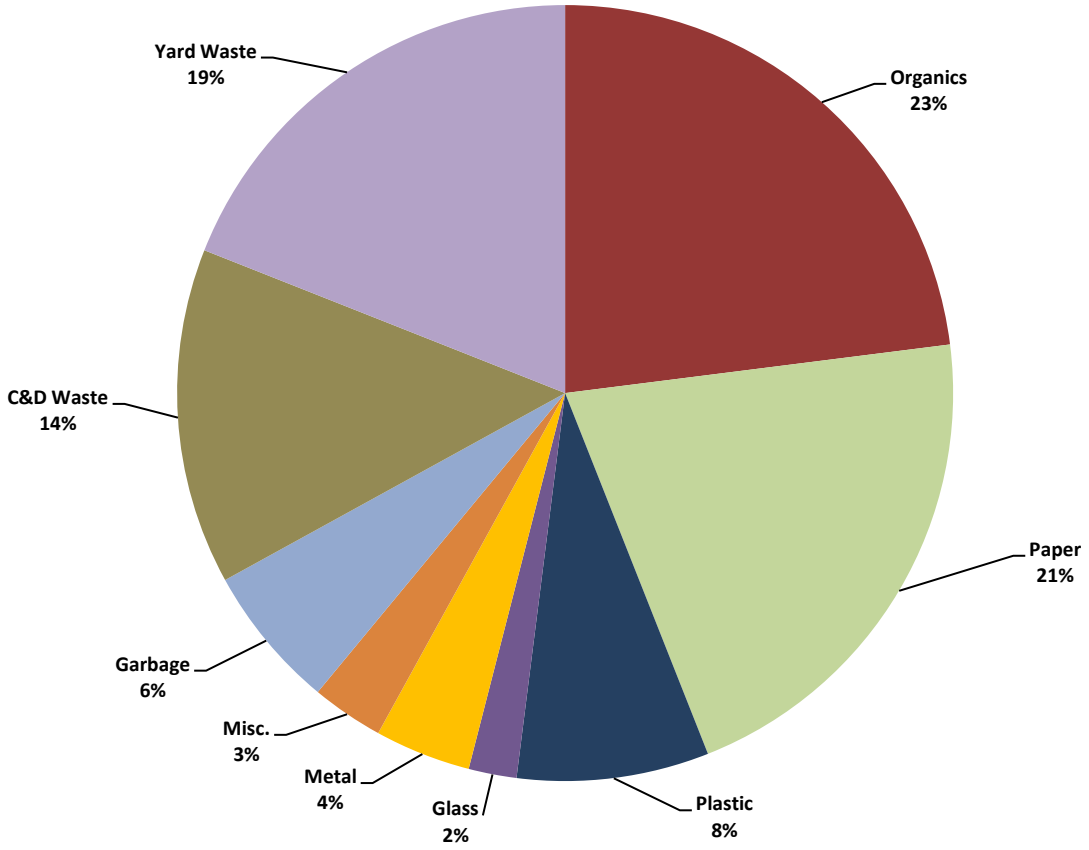
The above figure illustrates how railway ties could be used to supplement the feedstock to maintain a constant processing rate. Based on potentially available waste streams, the target EFW processing rate is approximately 1,000 tonnes/day.

$$\text{Target EFW Processing Rate} = \frac{366{,}032 \text{ tonnes/year}}{365 \text{ days/year}} = 1{,}003 \text{ tonnes/day}$$

6.0 Waste Composition

The communities in the SAEWA are generally less than 10,000 people. The waste composition[2] for small towns in Alberta is illustrated in Figure 6 below.

Figure 6: Typical Waste Composition for Small Towns



With the inclusion of non MSW materials such as railway ties, SRM and biosolids, the composition of the waste that could fuel the EFW facility would significantly change. Below is a table that summarizes the waste composition for Scenarios 1 and 2. As you will note, the overall "mix" of materials will vary in the Scenario 2 examples due to seasonal variations in the MSW stream and the increase in tonnage of non-MSW materials to offset these changes.

[2] Provincial Waste Characterization Framework, A Joint Project of Alberta Environment, Government of Canada, Action Plan 2000 on Climate Change (Enhanced Recycling Program) and the Recycling Council of Alberta, dated October 2005.

Table 7: Waste Compositions of Waste Streams

	Scenario 1	Scenario 2 (Summer)	Scenario 2 (Winter)
Organics	13%	15%	11%
Paper	12%	14%	10%
Plastic	4%	5%	4%
Glass	1%	1%	1%
Metal	2%	3%	2%
Misc.	2%	2%	1%
Garbage	3%	4%	3%
C&D Waste	8%	9%	7%
Yard Waste	11%	12%	9%
Biosolids	1%	1%	1%
SRM - MBM	7%	7%	7%
Railway Ties	37%	27%	45%

As shown in Scenario 2, the waste composition changes between the summer and winter months.

7.0 Energy Content

Once the overall composition of the waste feedstock was determined, the energy content or "Higher Heating Value" (HHV) of individual materials, and the waste stream as a whole, was determined. These heating values were identified through various literature sources identified below[3] [4]. Table 8 below lists the identified waste categories and their respective higher heating values in kilojoules per kilogram.

Table 8: Estimated Higher Heating Value for Comingled Waste Stream

Materials	Higher Heating Value, kJ/kg		
	Low	High	Typical
Food Waste	3,489	6,978	4,652
Paper	11,630	18,608	16,747
Cardboard	13,956	17,445	16,282
Plastic	27,912	37,216	32,564
Textiles	15,119	18,608	17,445
Rubber	20,934	27,912	23,260
Leather	15,119	19,771	17,445
Yard Waste	2,326	18,608	6,513
Wood	17,445	19,771	18,608
Glass	116	233	140
Ferrous and non-ferrous metal	233	1,163	698
Dirt, Ash & Brick	2,326	11,630	6,978
MSW	9,304	15,119	10,467

3 Methodology for Allocating Municipal Solid Waste to Biogenic and Non-Biogenic Energy dated, May 2007 Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels, U.S. Department of Energy, Washington, DC 20585

4 Graham Kissack – Director, Environment, August 2003, Crofton Division, #4 Power Boiler – Alternative Fuels Trial Plan, Norske Canada.

Materials	Higher Heating Value, kJ/kg		
Railway Tie	15,119	19,073	17,445
Meat and Bone Meal			16,900
Biosolids (digested)			12,000

Definition: Higher Heating Value "The amount of heat produced by a specific material type when combusted under specific conditions. Higher Heating Value is usually expressed in Calories or Kilojoules per kilogram (i.e., Cal/Kg or KJ/Kg).

***Conclusion** – The energy content of the waste streams for the two scenarios were calculated using the waste compositions and the typical Higher Heating Values. The resulting average heating values are summarized below:*

- *Scenario 1: 14,447 KJ/Kg*
- *Scenario 2 (summer): 13,970 KJ/Kg*
- *Scenario 2 (winter): 14,954 KJ/Kg*

8.0 Future Waste Diversion

Most communities in SAEWA are relatively small, and waste diversion programs consist primarily of voluntary drop off depots rather than curbside recycling collection. For programs of this nature, maximum residential waste diversion rates experienced is likely to be in the 15 to 20% range. ICI and C&D waste diversion will depend more on the economics of recycling and on Federal and Provincial initiatives and legislation.

Alberta Environment's waste diversion goal is to reduce the disposal rate to 500 kg per capita per year. This is in stark contrast to the SAEWA disposal rate which is calculated to be over 1,000 kg per capita per year. The Alberta Environment goal and the SAEWA disposal rate both include residential, ICI and C&D waste. Currently, the average disposal rate for the Province of Alberta is 750 kg per capita per year and this is achieved through comprehensive waste diversion measures at urban communities.

Alberta Environment's waste diversion target of 500 kg per capita year requires comprehensive waste reduction measures such as curbside recycling, material disposal bans, organic waste (food and yard) collection and C&D waste diversion programs. These programs would target 85% of the waste stream.

Waste reduction, reuse and recycling initiatives, along with Extended Producer Responsibility (EPR) and more stringent packaging laws are important considerations when sizing a future EFW facility. The effectiveness of these programs will in part reduce the need for expansion of an EFW facility in the future, but will not in the foreseeable future result in a shortage of waste to be managed.

It is important to note, and will be discussed further in Task 2, that the types of EFW facilities being considered have the ability to increase waste diversion through the recovery of recyclable materials either through front-end processing and/or through the recovery of metals (ferrous and non-ferrous) from the ash/char produced by the facility. It is also a well documented fact that when sized properly, EFW facilities do not compete with waste diversion efforts, but rather provide another option for

additional materials recovery. When looking to other jurisdictions, it is well documented that municipalities with EFW facilities to manage residual waste, also have the highest waste diversion rates.

9.0 Long Range Projections

Municipal solid waste growth is linked to population growth. As a general rule of thumb, MSW increases in a linear path with population. That means even in the event that the per capita disposal rate of 500 kg per person per year were achieved, the absolute tonnage of MSW would increase as the population increases. In other words, each person may be producing less waste, but there are more people producing waste.

According to the Statistics Canada, medium growth scenario for Alberta, the population is expected to grow 5.4% between 2011 and 2015, the first year when a future EFW facility could begin operations. After 2015, population could grow an additional 12% by 2026, and a further 10% by 2036. This growth can be used to project the increase in MSW expected. It should be noted, however, that Statistics Canada only looked at the province as a whole, and the actual growth rate of rural areas could be lower. Furthermore, rural areas make up 19% of the population in Alberta. The Alberta Municipal Affairs profile of many towns, villages and municipal districts shows very little recent growth, but makes no projections into the future. Therefore, for planning purposes, it would be prudent to use a more conservative growth rate.

Waste disposal rates are expected to remain consistent throughout the planning period. Although there will be a slight population growth in Southern Alberta, it is expected that any increase in MSW generation will be offset by new waste diversion initiatives. Factors that can influence waste disposal rates, capacities and needs are listed below.

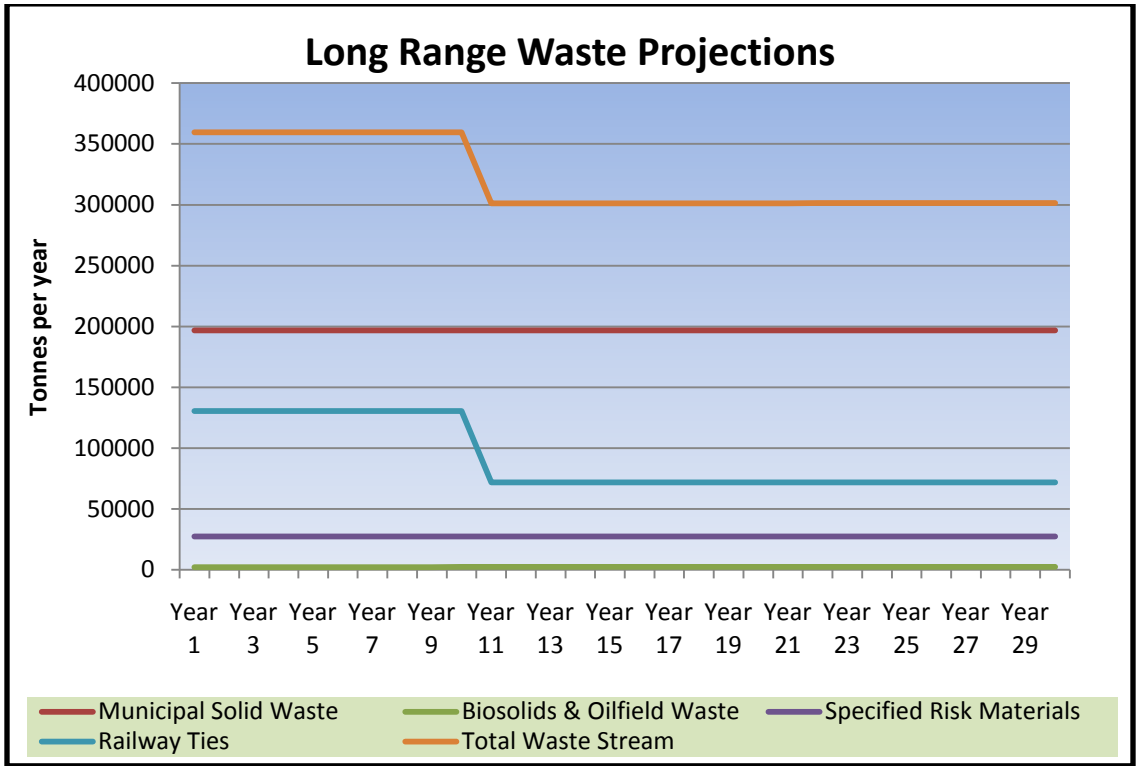
- Incentives for each waste organization and ICI suppliers to meet their planned waste diversion targets;
- Implementation of packaging legislation and extended producer responsibility;
- Identification of additional waste streams, not currently known today that could be managed by the SAEWA facility;
- Shifts in the current disposal marketplace (i.e. landfill closures, limited access to current disposal markets, etc.); and
- Economic growth factors as shown from new research shows waste generation is directly related to economic prosperity.

Railroad tie supply will be generous until the existing stockpile is used which is estimated to be 10 to 12 years. After that, only the stated replacement amount from the railway companies will be available.

SRM material is dependent on economic activity in the food industry. For study purposes, supply has been assumed to remain consistent year over year.

Each of these factors has the ability to impact the quantity and composition of waste being generated and therefore the quantity of waste potentially available to be managed at the facility. Figure 7 illustrates the long range waste projections for a SAEWA facility.

Figure 7: Long Range Waste Projections for SAEWA.



10.0 Task 1 Conclusion

The data collected to date indicates that there are large quantities of feedstock with adequate heating value which are suitable for, and available to, a future Southern Alberta EFW facility. The challenge is the control of the waste stream, so that the minimum amount required for the financing, building and operation of an EFW facility can be secured for the long term (30 plus years). This is generally possible for the residential waste that the municipalities are responsible for and control. It is usually possible for select industrial wastes coming from a single source, where contracts can be signed with the originator of the waste. It becomes very challenging with the private haulers collecting ICI and C&D waste, which will usually take it to the facility offering the lowest tipping fee. A second challenge lies in the variability of the waste stream. Some of the waste will be subject to seasonal variations, and much of it to economic fluctuations. This must be accounted for during facility sizing. The third challenge lies in predicting how much waste will be diverted through recycling and organics management programs in the future. For this study it has been assumed that this affects the larger urban municipalities more than the smaller rural communities.

Since EFW plants need to be operated at near 100% capacity all the time, initial sizing must take into consideration the waste streams that can be considered reasonably secure. Other, more difficult to secure waste materials collected by the private sector can be considered for facility sizing if initial calculations show that the EFW facility's tipping fee is competitive with landfilling. Should this not be the case, these materials may become available in the future if landfill costs rise above those for EFW.

In Table 9, the waste as feedstock is presented, along with a summary of what is realistically available, what carries a risk, and what might be available for future expansion.

Table 9: Summary of Available Waste for Energy Recovery

Waste Sector/ Category	Total Waste Tonnage	Waste tonnage realistically available	Responsibility/ source	Confidence in volumes and Data Gaps	Risks	Comments
MSW from SAEWA members	196,850	196,850	Municipality / Waste Authorities	High	Increased diversion, seasonal fluctuations	Only SAEWA member waste is firm
MSW from non-SAEWA members	919,300	13,300	Municipalities	High	Larger cities have own facilities	Waste from BC and Strathmore reasonably available
Institutional Commercial and Industrial waste	290,000	0 Some local ICI waste included in above totals	Private haulers	Moderate, based on population estimates and data from landfills. Private haulers will not provide ICI data	Waste can be obtained based on price only. Need to compete with landfill	Landfill tipping fees are rising, but not actual disposal costs, so competing on price is risky
C&D waste	127,500* Not part of total below	0 Some local C&D waste included in above totals	Private haulers	Moderate, dependent on economic activity and population. Private haulers will not provide data	Province may impose C&D recycling targets	Volumes and types of waste highly dependent on economic activity
Biosolids	22,232	1,232	Wastewater facilities and septic haulers	Moderate. Will need to work with septic hauling firms to confirm numbers and interest	Tipping fee and Provincial direction for biosolids	Could be managed by SAEWA waste commissions
Contaminated Soil	66,500		Oil Fields	Moderate. Quantities dependent on oil and gas industry and fluctuate annually	Competitive pricing	Can have special requirements for disposal
Oilfield Waste	2,500	2,500	Hazco and RB Williams	High	Competitive pricing	Generators welcome a local option
SRM	27,500	27,500	West Coast Reduction	High	Competitive pricing	Must make financial sense
Railway ties	124,650	124,650 (year 1) 72,000 (year 12)	CN and CP Rail	High	Competitive pricing	Generators welcome a local option
TOTAL	**1,649,532**	**366,032**				

**25% of non-residential waste from City of Calgary landfills which is accounted for in non-SAEWA members MSW.*

The waste tonnage realistically available is approximately 365,000 tonnes per year. This is an adequate amount for mass burn combustion, which is the most common technology for EFW facilities. This

volume of waste is also adequate for many of the alternate or emerging technologies for energy recovery from waste. The type(s) of technologies best suited for the subject waste streams, quantities and compositions are further explored in Task 2 Combustion Technologies. This includes a look at initial sizing and future expansion potential.