SNC·LAVALIN

EASTVIEW LANDFILL

ENVIRONMENTAL ACT PROPOSAL

Prepared on behalf of The City of Brandon

ENVIRONMENT & WATER

15 | 12 | 2014

REPORT
Internal ref. 620684

Environment Act Proposal Form

Manitoba
Conservation and Water Stewardship

Name of the development:
Brandon Eastview Landfill

Type of development per Classes of Development Regulation (Manitoba Regulation 164/88):
Class 2

Legal name of the applicant:
City of Brandon

Mailing address of the applicant: 410 - 9th Street

Contact Person: Ian Broome

City: Brandon Province: Manitoba Postal Code: R7A 6A2

Phone Number: 204-729-2292 Fax: 204-729-2485 email: i.broome@brandon.

Location of the development: City of Brandon

Contact Person: Ian Broome

Street Address: 3610 Victoria Avenue East

Legal Description: NW ¼ Section 17, Township 10, Range 18 W

City/Town: Brandon Province: Manitoba Postal Code: R7A 6A2

Phone Number: 204-729-2292 Fax: 204-729-2485 email: i.broome@brandon.

Name of proponent contact person for purposes of the environmental assessment:
Lyndsey MacBride, SNC-Lavalin Inc.

Phone: 204-786-8080
Fax: 204-786-7934

Mailing address: 148 Nature Park Way
Winnipeg, Manitoba R3P 0X7

Email address: lyndsey.macbride@snclavalin.com

Webpage address: www.snclavalin.com

Date: December 9, 2014

Signature of proponent, or corporate principal of corporate proponent:

Printed name: Ian Broome

EXECUTIVE SUMMARY

The City of Brandon's Eastview Landfill accepts residential and commercial wastes at a rate of approximately 45,000 tonnes/year. It is considered a Class 1 Waste Disposal Ground under Manitoba Regulation 150/91 because it services a population greater than 5,000 people. The site is approximately 60 ha in size and is currently composed of 14 landfill cells with one additional cell under development.

The Eastview Landfill currently operates under a Waste Disposal Grounds Regulation 150/91 Operating Permit under Manitoba's *Environment Act*. The landfill began operation prior to the enactment of the Manitoba *Environment Act* licensing requirements, however, Manitoba Conservation and Water Stewardship have since required the City of Brandon obtain a Class 2 *Environment Act* Licence.

The landfill was commissioned in 1977 and is expected to reach capacity in 2042. In 2010 the landfill held an estimated 1,917,500 tonnes of waste and is expected to hold an additional 1,646,632 tonnes of waste at closure for a total of 3,564,132 tonnes (AECOM 2010).

The Eastview Landfill provides the City of Brandon with an environmentally safe method of disposing household and commercial wastes. The City offers curbside collection of garbage, recyclables, and compost as well as a depot program. Depots are located throughout the City for use by residents of Brandon as well as surrounding communities. The landfill accepts excess or oversized recyclable materials that do not fit in the provided collection carts, including grass and other yard waste, branches, wood, metal, Freon depleting devices, glass, tires, and manure and waste water treatment sludge. The landfill provides customers with a location for the safe handling of Household Hazardous Waste (HHW), asbestos, and hydrocarbon impacted soil (PCS) and operates an Eco Centre for used oil, filters and containers. The landfill also operates a gas collection and flaring system designed to recover over 70 % of produced gas.

The landfill is located in the Aspen Parkland Ecoregion of the Prairies Ecozone of southwestern Manitoba. The landfill was used as farmland prior to construction of the landfill and cleared of all native vegetation and habitat. Site drainage is controlled by three on-site retention ponds, a properly graded land surface and a perimeter ditch and weeping tile. All leachate is directed to the wastewater treatment plant located northeast of the landfill. The landfill has evolved over the years as new technologies have become available and the City of Brandon Sanitation Section will continue to employ the latest waste diversion strategies and tools in an effort to extend the life of the landfill beyond 2042.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1 INTRODUCTION

1.1 PROJECT OVERVIEW

The City of Brandon's Eastview Landfill is located at 3610 Victoria Avenue East on the east side of the City of Brandon (**Figures 1.1 and 1.2**). The landfill has been in operation since 1977 and accepts residential and commercial wastes at a rate of approximately 45,000 tonnes/year. The Landfill is considered a Class 1 Waste Disposal Ground under Manitoba Regulation 150/91 because it services a population greater than 5,000 people, including the City of Brandon as well as the Rural Municipality of Cornwallis. The site is approximately 60 ha in size and is currently composed of 14 landfill cells with one additional cell under development.

The Eastview Landfill provides the City of Brandon with an environmentally safe method of disposing household and commercial wastes. The City offers curbside collection of garbage, recyclables, and compost as well as a depot program. Depots are located throughout the City for use by residents of Brandon as well as surrounding communities. The landfill also services a number of rural municipalities, including the RM of Cornwallis, within close proximity to the site along with commercial and industrial businesses. The landfill accepts excess or oversized recyclable materials that do not fit in the provided collection carts, including grass and other yard waste, branches, wood, metal, Freon depleting devices, glass, tires, and manure and waste water treatment sludge. The landfill provides customers with a location for the safe handling of Household Hazardous Waste (HHW), asbestos, and hydrocarbon impacted soil (PCS) and operates an Eco Centre for used oil, filters and containers. The landfill also operates a gas collection and flaring system.

The City of Brandon has received funding for a number of projects at the landfill including the Landfill Gas Collection and Flaring System; funding sources including the Green Manitoba in the form of the Waste Reduction and Pollution Program (WRAPP) and Resource Conservation Manitoba. The City will continue to look at partnering with Provincial, Federal and other potential funding sources for future projects.

1.2 PROPONENT

Project Name: Eastview Landfill

Proponent: City of Brandon

Contact: Ian Broome, Director of Public Works
900 Richmond Ave East
Brandon MB R7A 7M1
Phone: 204-729-2292
E-mail: i.broome@brandon.ca

1.3 STATEMENT OF NEED AND ALTERNATIVES

The landfill provides a critical public service by allowing the City of Brandon to properly dispose of its refuse. The site was selected from seven potential sites in 1977 based on proximity to the City and clay subsurface (**Appendix A**).

1.4 REGULATORY FRAMEWORK

1.4.1 Provincial

The Eastview Landfill currently operates under a Waste Disposal Grounds Regulation 150/91 Operating Permit under Manitoba's *Environment Act*. The landfill began operation prior to the enactment of the Manitoba *Environment Act* licensing requirements, however, Manitoba Conservation and Water Stewardship have since required the City of Brandon obtain a Class 2 *Environment Act* Licence. The landfill also operates in accordance with the following permits and licences (**Appendix B**):

- Eastview Landfill Waste Disposal Ground Operating Permit No. 3011.17 (2008)
- Eco Centre *Dangerous Goods and Handling Transportation Act* Licence No. 91HW (1999)
- Household Hazardous Waste Product Care Agreement
- Landfill Gas Collection and Flaring System *Environment Act* Licence No. 2932 (2010)

1.4.2 Federal

The landfill is not subject to federal permitting under the *Canadian Environmental Assessment Act*.

1.5 SCOPE OF THE ASSESSMENT

1.5.1 Geographic Boundaries

The scope of the assessment is limited to the property boundaries of the landfill.

1.5.2 Temporal Boundaries

The landfill is expected to operate until 2042 followed by a closure/post closure period of 25 years.

1.6 DOCUMENT ORGANIZATION

This document has been organized under the following headings:

Executive Summary

Section 1: Introduction

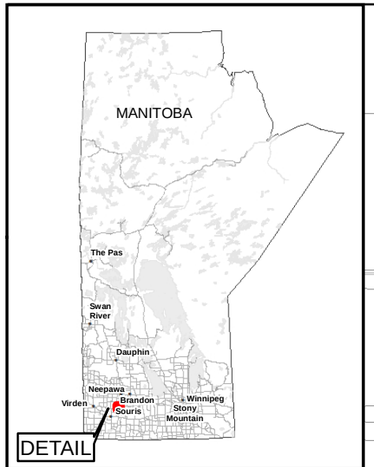
Section 2: Project Description

Section 3: Existing Environment

Section 4: Effects Assessment and Mitigation

Section 5: Public Engagement

Section 6: Monitoring



CITY OF BRANDON

DETAIL

SCALE: 1:60,000

0 0.225 0.45 0.9 1.35 1.8 Kilometres

SCALE: 1:10,000

0 80 160 320 Metres

LEGEND

LEGEND

NOTES

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 14N.
2. AIRPHOTO
3. BASE CADASTRAL DATA ADAPTED FROM HER MAJESTY IN RIGHT OF SASKATCHEWAN OR INFORMATION SERVICES CORPORATION OF SASKATCHEWAN, SASKADMIN2013, SASKGRID2013.
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5. TOPOGRAPHIC FEATURES OBTAINED FROM CANVEC V12.0 DATASET, NATURAL RESOURCES CANADA EARTH AND SCIENCES SECTOR CENTRE FOR TOPOGRAPHIC INFORMATION, 2013-09-30.
6. HIGHWAYS AND ROADS OBTAINED FROM THE NATIONAL ROAD NETWORK SASKATCHEWAN EDITION 6.0 DATASET, 2012-09-28.

REVISIONS

REV	DATE	DESCRIPTION	DRN	CHK

REFERENCE DRAWINGS

DWG No.	DATE	DESCRIPTION

SNC·LAVALIN

CLIENT: CITY OF BRANDON

PROJECT LOCATION: EASTVIEW LANDFILL

TITLE: LOCATION PLAN

DES BY	LM	DRN BY	JSB	DATE	2014 11 28	FIG No.	1.1	REV	0
CHK BY		APP BY		DWG No.	620684-E-02-E-001			11x17	

Path: J:\LOB\EIAM-PR\Current Projects\City of Brandon\620684 - Eastview Landfill EAL\4.0 Execution-Field Data\GIS\Drawings\620684-E-02-E-001 (Location Plan).mxd

LEGEND

1 - Materials Recovery Facility	7 - Soil Remediation	13 - Tree Pile	19 - Compactor
2 - Scale	8 - Manure Compost	14 - Yard/Graden Compost	20 - Eco Center
3 - Residential Drop Off	9 - Finished Compost	15 - Lechate Tanks	21 - HHW Trailer
4 - Tires	10 - Winter Cover	16 - Snow Dump/Concrete	22 - Flare
5 - Glass	11 - Wood Chip Stockpile	17 - Truck Storage	
6 - Lime Sludge	12 - Tree Chip Stockpile	18 - Compost Collection Pond	

Meathane Probes
Manholes
Ditches
Storm Sewer
Probes
Extraction Wells
Asbestos

NOTES

1. SITE PLAN PROVIDED BY CITY OF BRANDON

REVISIONS

REV.	DATE	DESCRIPTION	DRN	CHK

REFERENCE DRAWINGS

DWG. No.	DATE	DESCRIPTION

0 50 100 200 Meters

SCALE: 1:4,000

SNC·LAVALIN

CLIENT: CITY OF BRANDON

PROJECT LOCATION: EASTVIEW LANDFILL

SITE PLAN

DES BY	DRN BY	DATE	FIG No.	REV
LM	JSB	2014 12 02	1.2	0

CHK BY | APP BY | DWG No. 620684-E-02-E-002 | 11x17

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2 PROJECT DESCRIPTION

2.1 PROJECT LOCATION

The Eastview Landfill is located 3610 Victoria Avenue East in Brandon, Manitoba (**Figure 1.1**). The legal description is NW ¼ Section 17, Township 10, Range 18 W.

2.2 PROJECT LIFE

The Eastview Landfill was commissioned in 1977 and is expected to reach capacity in 2042 followed by a closure/post closure period of 25 years (AECOM 2010). The landfill has evolved over the years as new technologies have become available and the City of Brandon Sanitation Section will continue to employ the latest waste diversion strategies and tools in an effort to extend the life of the landfill beyond 2042.

2.3 OWNERSHIP OF LAND AND MINERAL RIGHTS

The registered owner of the property is the City of Brandon. The Certificate of Title is included in **Appendix C**. The mineral rights corresponding to the lands described above are owned by the City of Brandon.

2.4 MATERIAL ENTERING LANDFILL

2.4.1 Hours of Operation

The landfill is open to the public as outlined in **Table 2.1**.

Table 2.1 Hours of operation.

Summer (April 1 – Oct 31)	From	To
Monday to Friday	8:00	19:45
Saturday	8:00	16:45
Sunday & Statutory Holidays	11:00	18:45
Winter (November 1 – March 31)	**From**	**To**
Monday to Friday	8:00	17:45
Saturday	8:00	16:45
Sunday & Statutory Holidays	closed	

*hours subject to change

2.4.2 Waste Screening

All waste entering the facility is screened to ensure no prohibited wastes are allowed to enter the landfill. It is the responsibility of all staff to prevent prohibited wastes from entering the landfill and take the necessary precautions should any prohibited waste enter the site unknowingly. Landfill staff are trained to ensure materials entering the landfill are allowed in accordance with our operating permit and other regulatory requirements.

The first stage of control begins with the scale operator who visually inspects loads as they enter the landfill to determine acceptance. The next stage of this control mechanism is with the equipment operators within the tipping face and the areas where certain materials are segregated to ensure prohibited wastes do not enter the site. Materials delivered to the tipping face are inspected by the trash compactor operator. Any prohibited materials found within the active cell or other areas where materials are dropped are identified and removed using the proper handling procedures. When the material is not easily identified or no policy exists for its disposal, the material is isolated until a plan is developed for the proper handling and removal of material. The local Manitoba Conservation and Water Stewardship representative may be contacted to determine the best course of action for disposing of this material. Further details on waste screening and other procedures are outline in the facility's Operations Manual (**Appendix D**).

2.4.2.1 Accepted Wastes

The landfill accepts:

- Residential waste;
- Household hazardous waste (HHW);
- Construction & demolition waste (C&D);
- Industrial, commercial & institutional Waste (I.C.&I); and
- Various types of segregated waste (**Table 2.2**).

The landfill and Material Recovery Facility (MRF) provide residents and commercial haulers with a location to take any excess or oversized recyclable materials that do not fit in the provided collection cart. These materials are segregated on site with special locations for grass and other yard waste, branches, wood, metal, Freon depleting devices, glass, tires, and manure and waste water treatment sludge. There are also depots located throughout the City itself for residents to take any excess recyclable and organic materials. Due to current safety practices, some of the materials such as grass, wood, and branches have multiple locations for drop off within close proximity to allow for the safe handling of such materials by City staff.

Table 2.2 Summary of segregated waste entering the landfill.

Waste	Location
Scrap metal	Scrap Metal Recycling Area
Freon devices	Freon Device Recycling Area
Used tires	Designated Tire Recycling Area
Clean fill	Stockpile Area or Active Tipping Area
Wood waste	Wood Waste Recycling Areas 1 & 2
Yard waste	Yard Waste Recycling Areas or Composting Pad
Branches	Tree Branch Stockpile Area
Waste water sludge	Active Cell Tipping Face
Asbestos (double bagged)	Asbestos Disposal Area within Active Cell
Petroleum contaminated soils	Contaminated Soil Remediation Site
Manure	Composting Pad
Used oil, filters and containers	Eco Centre
Anti-freeze	Eco Centre
Electronic waste	E-waste Recycling Area
Glass	Glass Recycling Area
Concrete	Concrete Recycling Area
Asphalt	Asphalt Recycling Area
Used fire extinguishers	Shed
Shingles	
Bicycles	

2.4.2.2 Prohibited Wastes

In general, the following materials are prohibited from entering the landfill:

- Any material entering the site without proper documentation/MSDS sheets, or in the case of contaminated soil or asbestos a permit allowing disposal, until the proper documentation is provided;
- Any waste in a sealed container in which the identity of material is unknown to the person(s) delivering;
- Liquid industrial wastes;
- Liquid wastes;
- Radioactive waste or material;
- Unbagged asbestos;
- Dead animals (with the exception of Maple Leaf sludge); and

- Soils or sediments containing contaminants at concentrations in excess of the criteria specified for industrial occupancy in the Canadian Council of Ministers of the Environment (CCME), Environmental Quality Guidelines and the CCME Canada Wide Standards.

2.4.3 Material Quantities

The City of Brandon installed a dual scale weigh system at the Eastview Landfill in 2000 that allows for effective measurement of all material entering the site along with the type of materials entering (**Tables 2.3 and 2.4**). The weigh scales utilizes a PC Scale software program which tracks and can generate reports on material entering landfill based on a variety of parameters.

Table 2.3 Material quantities entering the landfill, 2010.

Material	Units	Year
		2010
Regular Waste & Recyclables		
material entering active cell	tonnes	43,476
recyclables (residential & commercial)	tonnes	7,646
organics	tonnes	8,261
e-waste	tonnes	156
scrap metal	tonnes	1,173
tires	tonnes	232
Household Hazardous Waste (tonnes)		
liquids	litres	79,000
solids	tonnes	7.5
Eco Centre		
used oil	litres	10,007
filters	number	477

Table 2.4 Material quantities entering the landfill, 2011 to 2014. Refuse is considered all material not considered recyclable, compostable or requires special handling.

Material	2011	2012	2013
	Weight (tonnes)		
Material Entering Active Cell			
Mixed refuse	41,273	41,782	43,997
Mixed refuse city depots	162	100	41
Recyclables and Diverted Waste			
Asbestos	101	388	289
Asphalt	1,249	3,980	1,048
Cardboard	1,348	1,598	1,427
Compactor bin	3,847	3,477	3,256
Compost	242	161	845
Concrete	4,092	4,018	7,336
Contaminated soil	5,922	31	126
E-waste	71	115	158
Fill	6,771	9,107	16,117
Freon device	82	84	104
Glass	61	50	53
Hazardous material	--	--	0.02
Household hazardous waste	--	--	20
Large cardboard bales	636	557	326
Manure	3,395	4,112	4,560
Metal	331	402	453
Minum charge use of scale	115	393	501
Mixed recycling	5,779	5,855	5,755
Paper	13	13	9
Plastic bottles	--	--	0.03
Plastic garbage bales	1.68	0.09	0.14
Shingles	1,604	1,188	1,133
Shredded paper	233	170	184
Sludge	293	268	354
Small cardboard bales	--	--	1
Tires	418	572	866
Trees	2,034	1,985	1,826
Wood waste	1,285	1,667	1,851
Yard waste	1,264	1,227	1,057
TOTAL	**82,623**	**83,303**	**93,691**

2.5 LANDFILL COMPONENTS

The Landfill includes the following components (**Figure 1.2**). Photographs of the site are included in **Appendix E**:

- Materials Recovery Facility (MRF) and office building
- Scale
- Landfill cells:
  - 10 retired cells
  - Three active cells
  - One cell under development
  - One cell planned for development
- Household Hazardous Waste Depot
- Segregated waste piles (**Table 2.2**):
- Residential "tipping" (drop-off) area
- Hot spot
- Snow dump
- Lime sludge pile
- Landfill gas collection and flaring system
- Ponds
  - Snow dump pond
  - Center ditch
  - Compost pond
- Parking lot
- Site roads
- Drainage ditches and underground weeping tile pipe (6" or 8")
- Groundwater monitoring wells
- Concrete berms around working areas of the landfill
- Fence (high fence bordering south and east property lines)
- Yellow bins with fences to catch flying debris
- Shed with pump and flow gauge

2.5.1 Landfill General Waste Cells

The Eastview Landfill currently has 15 waste cells, including 10 completed cells, three cells currently being filled, one cell under construction, and one cell to be constructed (**Table 2.5**). Over time, the City has improved environmental protection measures used during cell construction and closure including: the use of increasingly more sophisticated liners, capping retired cells, and the addition of a leachate collection system in 1994 during the development of Cell 7. The active areas of the landfill are surrounded by a concrete berm.

Cell 14 is currently under construction. Excavated materials will be handled as follows:

- Topsoil will be stockpiled on-site to be mixed with finished compost for use in City parks and boulevards;
- Clay be stockpiled for a later use to be determined; and
- Gravel will be stockpiled for use as daily cover material in active cells.

Any current and future cell designs will be completed either internally by the City's Engineering Department or externally by consultants. Cell construction will go to tender. Garbage is compacted and covered on a daily basis as per the Waste Disposal Ground Operation Requirements.

Table 2.5 Landfill waste cells.

Cell No.	Year of Construction	Type of Construction		Approximate Area (feet)		Approximate Depth of Waste (feet)	Estimated Volume of Waste (cubic yards)	Quantity of Waste (tonnes)	Filling Period	
		Liner	Cap	X	Y				From	To
1	1977	no liner	capped with granular material	100	960	23	60,000	n/a	1977	
2	1978	no liner	5 feet of capping material	100	565	72	75,500	n/a	1978	
3	1979	no liner	partial 5 feet clay capping material	100	780	43	62,000	n/a	1979	
5	1979	no liner	partial 5 feet clay capping material	100	700	58	75,000	n/a	1979	
4	1980	in-situ clay liner	5 feet clay capping material	200	600	59	n/a	737,037[a]	mid-1980's	late-1980's
6	1982	in-situ clay liner	5 feet clay capping material	125	675	66	n/a		mid-1980's	late-1980's
7	1994	partial bentonite clay liner & partial 60 mill HDPE geomembrane liner	5 feet clay capping material	200	700	70	n/a		late-1990's[b]	early-2000's[b]
8	1996	60 mill HDPE geomembrane liner	5 feet clay capping material	160	700	44[c]	n/a		late-1990's[b]	early-2000's[b]

Cell No.	Year of Construction	Type of Construction		Approximate Area (feet)		Approximate Depth of Waste (feet)	Estimated Volume of Waste (cubic yards)	Quantity of Waste (tonnes)	Filling Period	
		Liner	Cap	X	Y				From	To
9	1998	60 mill HDPE geomembrane liner	5 feet clay capping material	200	700	17.5[c]	n/a	737,037[a]	late-1990's[b]	early-2000's[b]
10	1999	60 mill HDPE geomembrane liner	5 feet clay capping material	200	700	25[c]	n/a		late-1990's[b]	early-2000's[b]
11	2001	60 mill HDPE geomembrane liner	5 feet clay capping material	200	600	22[c]	n/a	481,800[d]	2001	currently being filled
12	2003	60 mill HDPE geomembrane liner	5 feet clay capping material	200	485	19[c]	n/a		2003	currently being filled
13	2009	60 mill HDPE geomembrane liner	n/a	225	900	20[e]	n/a	n/a	2009	currently being filled
14	2011	60 mill HDPE geomembrane liner	n/a	215	380	0	0	0	2011	currently being filled
15	future development	60 mill HDPE geomembrane liner	n/a	170	765	0	0	0	2015/2016	future development

[a]total volume for cells 4, 6, 7, 8, 9 & 10
[b]main period
[c]data from 2006
[d]total waste for cells 11 & 12
[e]estimated

2.5.2 Residential Tipping Area

There is a residential tipping area east of the landfill scale for residential drop-off. All waste in the residential tipping area is transferred to the appropriate section of the landfill by staff.

2.5.3 Household Hazardous Waste

The City of Brandon began collecting household hazardous waste (HHW) in 1999 on a twice annually basis (spring and fall). In May 2013, the City in partnership with Product Care Manitoba, began operating a permanent depot location at the landfill. The depot consists of a trailer with tubs for separating the various HHW; the City plans to replace the trailer with a permanent structure in future. The depot is operated in accordance with the Transportation and Handling of Dangerous Goods Regulation and accepts a variety of household hazardous waste, including: leftover paint, burnt-out fluorescent light bulbs, flammable liquids, pesticides and corrosives. If any unknown and potentially harmful products are delivered to the landfill, City staff are instructed to request Material Safety Data Sheets (MSDS) to ensure the proper handling and disposal of these materials takes place. These MSDSs are sent to Manitoba Conservation to review the acceptability of these potentially hazardous materials. The depot is open for drop-off from 9:00 to 12:00 and 13:00 to 16:00 Monday to Saturday (same hours as Eco-Centre). All HHW is picked up on an as needed basis by a hazardous waste management company – Miller Environmental Corporation. The HHW also accepts lead acid batteries; these are stored separately and picked up by a company that recycles them.

The HHW depot did not require a separate licence; an agreement between Manitoba Conservation and Product Care Manitoba requires the depot to be operated in accordance with the Product Care Depot Operations Manual (**Appendix B**).

2.5.4 Compost Program

Compost depots have been in place in the City of Brandon since the 1970s and residential curbside collection of compost began in 2010. The compost pad is separated into household waste and manure.

Household organic waste includes: fruits and vegetables, table scraps, breads, rice, pasta, coffee grounds, filters, tea bags, eggshells, paper fibres, paper egg cartons, fast food drink trays, soiled paper towels, tissues and serviettes. The following items are excluded from the household organic waste: meats, bones, fish, dairy products, fat, plastics, metal, wood, tin and other non-compostable materials.

Manure is accepted from the Keystone Centre, the Provincial Exhibition of Manitoba, Heartland Livestock, and various other Feedlots. The manure comes from the horse and cattle shows at the fairgrounds as well as the livestock auction yards. It is placed in windrows on site at the South

compost pad where it is turned in place until it is ready for curing. At that time, the material is placed in a stockpile until it is finished and ready for use. This finished product has been tested by A & L Canada Laboratories Inc. of London Ontario and meets the current (CCME, 2005) type A compost standards. Based on the texture properties, suggested uses include soil amendment, landscaping and light topdressing purposes with some precautions. The City currently uses the majority of finished product internally, either as final cover on a finished waste cell or through its Parks Department on recreation fields, parks, boulevards, flower beds, etc. The Environmental Initiatives Section of the Operational Services Division is also using some of this material as an incentive for attending some environmental days such as Earth Day.

2.5.4.1 Residential Green Cart Program

Residential compost is collected by City crews from approximately 5,000 households within the City along with five depots throughout the City. The material is delivered to the Eastview Landfill, placed in a windrow, and turned as required using a wildcat compost turner until it has been determined to be ready. City staff monitor temperature and moisture levels during the composting process. Once completed the finished product is then screened to remove any impurities and/or oversized materials. The material is then stored on site for maturing. A sample of the finished product is then sent to an accredited laboratory where it is tested. Once the results of testing come back the material is then used within City operations and if the testing shows the material is of a high quality (Class “A”) then the material is used during special events such as Earth Day, Compost Days and other environmental event.

The curbside organics collection program was implemented in 2010. With increased volumes of compost, the City began assessing the feasibility of expanding the market for this end product. In August 2011, four samples of compost underwent a Compost Quality Analysis at an accredited laboratory (Standard Council of Canada) and the finished compost meets all the requirements necessary to be considered a marketable product.

In December of 2012 the City received funding from the Waste Reduction and Pollution Prevention fund in the amount of $300,000 to expand the green cart program to an additional 5,500 households on a voluntary basis. In 2013, the City expanded the program to 3,000 households and diverted approximately 825 tonnes of organic waste. As of 5 September 2014 the City had collected approximately 900 tonnes of organic waste in 2014 from 4,800 households. The City plans to expand the program even further to a final goal of 6,000 households and divert between 1,500 and 2,000 tonnes of green cart material on an annual basis.

2.5.4.2 Compost Pad Design

The compost pad was designed and constructed as follows:

- The topsoil was removed and stockpiled on site to be mixed with finished compost;

- The removed soil was replaced by an impervious layer of clay to prevent percolation of leachate and/or nutrients to the sub-soil and groundwater;
- The south pad was designed so all runoff drains to the east end of the compost pad where it is captured in a ditch that runs from the compost pad to the retention pond (no outside water can enter the site);
- The north compost pad (reserved for yard waste) was designed to slope from south to north and drain directly into the same retention pond as the south pad;
- Pad was designed with a two percent slope for continuous, slow drainage; faster drainage would potentially carry compost material into retention pond;
- Pond size was determined using estimated annual precipitation;
- Pad site was not be located in a flood plain and a minimum of 100 meters from creeks, streams, lakes, or any provincial surface water, public and private wells, and site boundaries;
- Adequate amount of space provided around perimeter of operation to ensure the equipment can easily maneuver in work area;
- A large buffer area on downwind side;
- The surface area can accommodate the maximum annual volume of feedstock received; and
- Up-gradient and down-gradient surface and ground water sampling and testing is conducted regularly.

2.5.4.3 Compost Commercialization Operational Study

The City of Brandon completed a study of the potential commercialization of its composting operation at the Eastview site in 2004. The main objective of the study was to produce 'Class A' compost, on a large scale, that could provide an ongoing production and revenue stream that are both environmentally and economically sustainable. The study determined the volume of compost produced at that time was sufficient to meet the needs of the City internally, but would require larger amounts of raw materials to make it commercially viable.

2.5.5 Material Recovery Facility (MRF)

A Material Recovery Facility (MRF) exists on site for the drop off and sorting of recyclable materials including paper and cardboard as well as aseptic, gable-top steel, aluminum, glass and plastic containers (**Figure 1.2**). All material from the MRF is sent to a processing facility where it is separated from other products. It is then baled, marketed and sold to an end user where it is converted into a new product. The City has a contract with BFI Canada who determines where the material is shipped.

2.5.6 Eco Centre

There is an Eco Centre for the collection and storage of used oil, filters and containers in accordance with the *Dangerous Goods Handling and Transportation Act*. These materials are picked up on an as needed basis by registered haulers of this material. The facility operates in accordance with *Dangerous Goods Handling and Transportation Act*. Licence No. 91HW (**Appendix B**); the proposal for this licence was filed on 25 June 1999 and issued on 9 August 1999.

2.5.7 Segregated Waste

The landfill operates numerous segregated waste piles in an effort to divert waste as well as for safety reasons.

Glass: Glass is ground to 3" minus and used for French drains on-site to filter leachate.

Tires: Tires Stewardship Manitoba was launched in April 2008. Tires are stored on-site and picked up by Reliable Tire Recycling.

Bicycles: The landfill operates a bicycle recycling program. The bicycles are refurbished by the local jail and donated.

Shingles: Some shingles are landfilled and some are diverted to be used in the City's asphalt reclaimer where they are mixed with old asphalt to create a hot mix used for pothole repair.

Freon devices: The landfill accepts refrigerators and air conditioners free of charge. A contractor is paid to degas the Freon and the devices then go to the scrap metal pile.

White goods: The landfill accepts white goods, such as stoves and other large metal items that can be sold as scrap metal.

Metal: Scrap metal is stored on-site and purchased and picked up by 2&10 Metal Recycling Ltd.

Trees/wood: There is a tree, tree chip and wood stockpiles on-site. Wood is chipped/ground and this process removes the majority of nails on-site. The ground wood is used in the composting process, as an absorbent in cells during wet periods, and for "carpet" on roads. The landfill is also working on a contract to sell the product as pellet fuel. The chipped wood is placed in windrows where it is processed into a reusable material using a compost turner attached to a front end loader

E-waste: The City of Brandon partnered with Green Manitoba in 2007 to implement a pilot project for the collection of e-waste, including: TVs, VCRs, stereos, microwaves, phones, computer

equipment, laptops, printers, scanners, fax machines and copiers. The pilot project moved to a year round program in 2009. Items are collected and delivered to Exner E-waste Processing Inc.

Fire extinguishers: Old fire extinguishers are stored in a shed and picked up by Miller Environmental for proper disposal.

Propane tanks: Propane tanks are accepted and picked up by companies that inspect them, refurbish them, and put them back into use.

Hot spot: There is a 'hot spot' on-site for hot materials to cool prior to being transferred to the applicable area on site. The procedure for acceptance of hot loads is outlined in the Operations Manual (**Appendix D**).

2.5.8 Snow Dump

There is a snow dump area and pond for use by the City of Brandon only (not private contractors). An engineering study was completed in 2008 to identify options to manage snow, including continuing to use the existing location as a snow dump and re-located the snow dump to an alternate site (**Appendix F**). The study recommended the snow dumping continue at the correct location as it already has management systems in place to monitor potential impacts to groundwater.

2.5.9 Asbestos

The landfill accepts double-bagged asbestos and buries it in a specific area on the east side of the landfill. Customers are required to adhere to the following procedure before delivering asbestos to the landfill to ensure the health and safety of all visitors to the landfill:

- Purchase a daily permit;
- Contact scale operator 24 hours prior to delivery and notify scale operator of the estimated amount and number of loads;
- Delivery from 8:00 to 12:00 and 13:00 to 17:00 Monday to Friday (no deviance from this unless approved by the Director);
- Asbestos entering landfill must be double bagged;
- Upon entrance to the landfill inform scale operator who will contact equipment operator;
- Person shall be directed to meet with equipment operator to determine the proper location for disposal;
- Delivery personnel are requested to dump bags of asbestos in a tight pile;
- If city staff determine that the person(s) delivering are doing so in an unsafe manner they have the right to stop the delivery until such time as safe work procedures are adhered to (including proper Personal Protective Equipment [PPE]); and

- Once the final load is delivered, the asbestos is buried with 1.5 to 2 feet of clean fill material and then surveyed.

2.5.10 Mold

Mold is a fungus that grows in the form of multi-cellular filaments called hyphae; in contrast, fungi that can adopt a single celled growth habit are called yeasts. Mold is accepted according to the following policies for expected and unexpected mold drop-offs.

When a contractor contacts the landfill regarding the mold policy, the landfill will inform the contractor the landfill accepts mold as long as Manitoba Environment has been notified by the Contractor. The Contractor is required to come to the Public Works Office (900 Richmond Avenue East) or to the Landfill (scale) and fill out the Work Authorization Form 24-hours prior to bringing the mold to the landfill. The form includes: location of mold, amount of mold, name of Contractor, and date. This time will allow personnel at the Landfill to prepare an area for the mold and to make sure that whatever type of vehicles that are being used, a roadway is suitable to accommodate them. The advance notice will also ensure that landfill personnel are available at the tipping area to supervise the drop-off.

If any mold arrives to the Landfill unexpected, the Contractor or driver still must sign the “Work Authorization Form” to track the mold. The Contractor may have to wait until an area is prepared or other Landfill personnel are available to show the Contractor where the tipping area for the mold will be.

Once the Contractor is done, and the mold is placed on the ground, then the Landfill employees will cover the mold pile with dirt or clay to prevent the spread of contaminations. Surveying is not required.

2.5.11 Wastewater Treatment Sludge and Lime Sludge

The Eastview Landfill has been accepting sludge from the Wastewater Treatment Facility for a number of years, and received a total of 354 tonnes of sludge in 2013. The sludge is delivered to the landfill from the wastewater treatment facility and landfilled.

Lime sludge, a by-product of water treatment clarification processes, was hauled to the landfill in the past, however, is no longer accepted. In 2002 the City of Brandon hired Eng-Tech Consulting Ltd. of Winnipeg to evaluate the potential usage of the lime sludge stockpiled at the landfill. The main objectives of that study were to:

- Evaluate the use of the lime sludge as an additive in granular fill (C-base) used in street construction. The lime sludge would either be added by itself or blended with lagoon ash from Manitoba Hydro’s Brandon Generating station;

- Determine the index properties of the lime sludge by itself and in conjunction with lagoon ash and Zenith Paving's granular C-base in varying proportions;
- Evaluate the use of the lime sludge or a lime sludge/lagoon ash blend as a potential supplement and/or liner material for lagoons and landfills;
- Determine the index properties of the lime sludge when combined with local (Brandon) clay as a binder additive in various ratios, to ascertain the optimum blend of sludge and binder; and
- Evaluate the use of the lime sludge and clay binder as an additive to granular C-base for use in road construction.

The study determined the addition of lime sludge could provide some benefits in some applications and would not provide benefit in others. It was also determined that more in depth testing should be considered to determine the permeability of the granular materials before and after the lime sludge/clay binder was added. After stockpiling this material on site at the landfill an alternative solution to treating this product as waste material was determined and is now utilized as a soil additive in some agricultural applications to neutralize the pH content of the soil.

2.5.12 Hydrocarbon Impacted Soils

The landfill is permitted to receive hydrocarbon impacted soils (≤ 4000 tonnes/year or 350 tonnes/month) under its Operating Permit. Customers are required to adhere to the following procedure before delivering hydrocarbon impacted soils to the landfill:

- Purchase of a daily permit;
- Contact scale operator 24 hours prior to delivery and notify scale operator of the estimated amount and number of loads;
- Delivery from 8:00 to 12:00 and 13:00 to 17:00 Monday to Friday (no deviance from this unless approved by the Director);
- Upon entrance to the landfill inform scale operator who will contact equipment operator(s);
- Person shall be directed to meet with an equipment operator to determine the proper location for disposal.

Upon receipt the soil is managed on site as described below.

2.5.12.1 Contaminated Soil Remediation Facility

All contaminated soil material entering the landfill is weighed and logged at the scale by the scale attendant. The attendant records and maintains records of where the material originated, the date the soils were received, the hauler that brought the material to the site, the quantity of soils, analytical data, and the final placement of the load. The weigh scale's PC Scale software program can generate reports on any contaminated soil entering the landfill based on a variety of parameters.

The contaminated soil remediation facility is located north of the lime sludge pile (**Figure 1.2**). The facility contains soil impacted with hydrocarbons from soil remediation projects or environmental incident sites. Soil is considered impacted when it is found to be above the criteria listed in Manitoba Conservation Guideline 2002-02E *Criteria for Acceptance of Contaminated Soil at Licenced Waste Disposal Grounds,* 2002. Soil that contains levels below the criteria presented in Manitoba Conservation Guideline 2002-02E can be used directly as landfill cover material upon receipt of approval by the Site Supervisor and the local regional office of Manitoba Conservation.

Hydrocarbon impacted soil is treated on site with the use of a rome plow attached to a track type dozer by employees trained in the standard operating procedure. All loads placed in the treatment area are spread in an even layer in a manner that avoids compaction and inter-mixing of different soil shipments. Occasionally (depending on placement area available) soil may be placed in windrows that do not exceed one metre in height. The windrows require periodic mixing in a similar fashion to a treatment layer. The final thickness of the treatment layers normally does not exceed 300 mm or the effective mixing depth of on-site equipment (rome plow), whichever is less. Boulders and other large debris are removed from each treatment layer to avoid potential damage to the tilling/aeration equipment, and to provide for optimum soil tillage. Depending on the stability of the soil, more than one pass may be required to turn and fully aerate the impacted soil.

The treatment layers are thoroughly aerated (mixed) on a regular basis. In most cases, a tillage frequency of one to two weeks provides optimum soil aeration. Periodic irrigation of the treatment layer is occasionally necessary to avoid desiccation or prevent excessive wind-blown dust. However, saturation of the soil is avoided to prevent runoff from occurring and potential migration of contaminants outside the treatment facility. After material has been aerated, the rome plow is placed in an area that will not interfere with ongoing work but must remain within the soil remediation facility. The dozer is cleaned so no contaminants leave the area.

Regular inspections are made by the operator at the time of aeration, who reports to the Site Supervisor any:

- Erosion, slope increase or damage to the berms surrounding the treatment area;
- Excessive “ponding” of surface water;
- Improper placement of contaminated loads; and/or
- Visible signs of migration or leaching of surface water and/or contaminants.

Once reported to the Supervisor, he/she will take corrective actions to ensure the proper maintenance of the treatment facility. Once the level of hydrocarbons meets the criteria stated in Manitoba Guideline 96-05, *Treatment and Disposal of Petroleum Contaminated Soil,* June 1996, revised April 2002, it is used as cover material in the cells.

2.5.13 Clean Fill

The landfill accepts and manages clean fill. Clean fill includes material from excavations, streets or driveway renovations, building and basement demolitions, or other similar activity, which is exclusively comprised of concrete smaller than 300 mm (11.8 inches) in any direction, cinder blocks, asphalt, gravel, dirt, or other similar biologically and chemically inert materials, and includes industrial fill material and residential fill material. Materials such as concrete, asphalt and cinder blocks are segregated within the landfill as follows:

- Asphalt is either stockpiled for future use or used as a base where applicable, such as the beneath the recyclable materials storage areas.
- Concrete is currently stockpiled south of the scale house and main entrance to the landfill. It acts as a pad for storage of snow during the winter months. In the past, it was used to develop berms along the north and west sides of the landfill to create a barrier to minimize noise pollution.

2.6 Fuel Storage

There is one 4500 L diesel storage tank on site for use in heavy equipment. The tank is a steel aboveground tank surrounded by concrete pillars and sitting on an asphalt pad. There is also a propane storage system located at the compactor storage shed to be used to heat that building. Fuel is handled and stored in accordance with the Storage and Handling of Petroleum Products and Allied Products Regulation MR 188/2001 under the *Dangerous Goods Handling and Transportation Act*. All spills are reporting in accordance with the Environmental Accident Reporting Regulation MR 439/87.

2.7 Power and Water

Power is delivered to the site and metered by Manitoba Hydro. Water supply is provided and serviced by the City of Brandon.

2.8 Site Drainage, Ponds and Leachate

Site drainage is controlled by three on-site retention ponds (center ditch, compost collection pond and snow dump pond), a properly graded land surface and a perimeter ditch and weeping tile. Drainage is directed to the retention ponds, ditches, and underground weeping tile (8” or 12” perforated pipe). The weeping tile was installed along the east property line in 1994/1995. There are also eight manholes around the perimeter of the landfill to collect leachate before it can migrate into the groundwater offsite; the manholes drain runoff into the weeping tile. There is a 3.5 m to 4.5 m deep ditch along the south property line. Surface water is directed to the northeast corner of the landfill via the perimeter ditch and weeping tile where it exits the site via a flow gauge in a shed and

is discharged to the City's wastewater treatment plan. The flow gauge also has a control valve, installed in 2004, to determine if water is discharged to the Assiniboine River or the wastewater treatment plant, however, water has not been discharged to the river since its installation and all water is directed to the wastewater treatment plant. Prior to installation of the flow gauge, the leachate was stored in leachate tanks for measurement prior to discharge; these are no longer used.

A leachate collection and management system for each landfill cell was implemented beginning in 1994 with the development of Phase 7 of the cell development plan. In addition, monitoring wells were placed around the edges of the old cells to check for leachate migration onto adjoining properties and potential impacts to groundwater. Leachate from Cell 7 joins with the leachate generated from Cells 11, 12 and 13 and is collected by a common manhole. An electric pump moves the water to the sewage treatment plant via the trunk sewer pipe. Cells 8, 9 and 10 drain into manholes that are manually pumped out.

The City of Brandon commissioned a leachate study in 2008 to assess measures to ensure untreated leachate does not enter the environment and that snow melt can be managed in an environmentally sound manner (**Appendix F**). The specific objectives of the study were to:

- Undertake a sampling and analysis program of the leachate and snow melt;
- Review the experiences of other jurisdictions and review regional and local regulatory frameworks pertaining to leachate and snow melt management options;
- Evaluate leachate and snow melt management options for the City (including an alternate snow dump site at an abandoned landfill located southeast of the City of Brandon on 17th Street East and North of Provincial Highway 110);
- Discuss potential options with Manitoba Conservation and Water Stewardship; and
- Prepare a conceptual level cost estimate for the works and document in the form of a report.

Upon completion of the study, it was determined that handling and management of leachate would continue using the current method and further studies would be undertaken as new technologies were developed. It was also determined that the City can manage the volume of snow it currently handles on a yearly basis for its own use.

It has since been determined that technology exists for the treatment of leachate through the landfill gas collection and flaring system. Once that facility receives all necessary operational permits, a study will be undertaken to determine the feasibility of this and any other new methods of handling leachate.

2.8.1 Soil Remediation Facility Runoff

The Soil Remediation Facility is designed to contain internal storm runoff and seepage in order to prevent off site losses. Surface water is controlled by the use of ditches, along with a properly graded land surface. Prior to any discharge or removal of impounded surface water from the PCS treatment facility, thorough laboratory testing of the water for petroleum hydrocarbon compounds is conducted and the results reviewed by Manitoba Conservation and Water Stewardship.

2.8.2 Compost Pad Runoff and Pond

All drainage from the compost pad is directed to recycled asphalt pads, then to the compost retention pond via ditches. The pond water is used to re-water the compost as required. If the pond water gets too high, it is discharged to the water treatment plan via a manhole, however this is avoided as much as possible. Regular surface and ground water testing is conducted to ensure there are no negative environmental impacts resulting from the composting operation.

2.8.3 Segregated Waste Area Runoff

All surface water from the recycling area is captured in collection ponds and used to control moisture in the compost rows.

2.9 Gas Collection and Flaring System

The landfill operates a gas collection and flaring system to reduce landfill gas emissions and recover approximately 70 % of the produced gases (Comcor 2010b). Methane is combusted and the resultant products are carbon dioxide and water vapour; this reduces the global warming potential by approximately 95 %. An Environment Act Proposal for the landfill gas collection and flaring system was submitted in June 2010 (IGRS 2010) and the system was commissioned on 8 December 2010 under *Environment Act* Licence No. 2932. The system became operational full time in January of 2012 after approval to operate was received by the Office of the Fire Commissioner.

Prior to installation of the gas collection and flaring system, the landfill was producing gas (50 % methane, 50 % CO_2) at a rate of approximately 680 m^3/hr to 1,360 m^3/hr and upon closure is expected to produce 2,900 m^3/hr to 5,000 m^3/hr (Comcor 2010b). Based on a density of 1.3 kg/m^3, this is approximately 7,700 tonnes/year and 15,500 tonnes per year for 2010 and 33,000 tonnes/year to 57,000 tonnes/year at closure. Since the inception of the gas collection and faring system, greenhouse gas emissions were reduced by 4,700 tonnes of CO_2 e in 2011, 9,321 tonnes of CO_2 e in 2012, and 14,393 tonnes of CO_2 e in 2013 (IRGS 2011, 2012, and 2013).

The system design is detailed by IGRS (2010) and Comcor (2010a and 2010b). It consists of: (i) a landfill gas collection system; (ii) a landfill gas mechanical and flaring system; and (iii) a control system.

The gas collection system is the portion of the system that collects and transports the gas from the fill area to the mechanical and flaring system. It consists of a network of 18 vertical extraction wells connected by below ground piping that lead to an end location where gas is combusted in a candlestick flare.

The mechanical and flaring system is comprised of various components that ensure safe operation of the flare, while providing control of flare operation parameters and minimizing maintenance. The design details of the flare are:

- Operating temperature: minimum 500 °C
- Fuel flow rate: up to 0.330 m^3/s of landfill gas
- Gas composition: 50 % methane by volume
- Stack diameter: cowling diameter for 0.80 m
- Stack height: 5.0 m
- Exist velocity: 17.94 m/s

The mechanical system is controlled and monitored by a computer which records operational data including gas flows, gas concentrations, wellfield vacuum and other parameters that are important for proper operation of the system.

Phase two of the project will potentially see the product being sold to an end user, however, at this time the amount of gas produced does not make this an economic option.

2.10 CLOSURE PLAN

The City of Brandon implemented a waste disposal closure plan in 2010 (AECOM 2010). The volume of material estimated in the first 12 phases of the landfill from 1977 – 2010 was 2,396,875 m^3 (AECOM 2010). Based on an estimated compaction of 800 kg/m^3, the remaining capacity in 2010 was 1,637,379 tonnes (2,046,724 m^3 airspace). The closure costs are expected to be approximately $6.59 M and post-closure costs are expected to be approximately $2.38 M.

2.10.1 Closure Procedure

The majority of the grading and reshaping of the landfill will be done while the site is still operating by judicious placement of incoming waste over the site life (AECOM 2010). The final contours of the landfill will promote drainage away from the site to minimize infiltration and leachate production while also preventing erosion. A 4:1 slope is recommended for the side slopes with 2 % grade upwards to the landfill crown in order to direct drainage to the northeast. The final cover will be constructed as follows:

- 0.15 m of topsoil over subsoil;

- 0.35 m of subsoil over protection layer;
- Barrier layer that is constructed by compacting clay soils to a thickness of not less than 0.60 m measured perpendicular to the compacted waste surface to achieve a maximum permeability of 1 x 10^{-7} m/s;
- Contoured such that no water pools over the landfill cells; and
- Grade to achieve a minimum slope of 2 % and a maximum of 30 %.

2.10.2 Post-Closure

A post-closure care period should operate for a period of no less than 25 years to ensure the structural integrity and contamination management of the facility (AECOM 2010). The following should occur by the end of this period:

- Ground water quality standards are met at the points of compliance;
- Subsurface landfill gas concentrations are below explosive limits at subsurface gas monitoring locations;
- The leachate constituents are lower than the groundwater performance standard criteria concentrations; or
- The accumulated volume of leachate is equal to or less than the previous years accumulated volume of leachate for five consecutive years.

During the post-closure care period, the landfill is responsible for (AECOM 2010): protecting and maintaining the integrity of the final cover system; providing repairs to the final cover system as issues arise in order to correct settlement, subsidence, erosion, leachate break-out; and protecting, maintaining, and monitoring groundwater, surface water, landfill gas and leachate using the monitoring systems of the day.

The landfill should also inspect the final cover system at least two times per year during this period and complete an annual report that includes:

- Groundwater monitoring;
- Landfill gas monitoring;
- Leachate monitoring;
- Records of any maintenance and repairs completed; and
- Report of any remedial or corrective action taken.

2.10.3 Implementation Plan

In order to prepare for the closure of the landfill, the City of Brandon must complete the following (AECOM 2010):

- Develop a capital planning strategy that will ensure adequate funds are in reserve for this project;
- Conduct a geotechnical assessment of future development areas to assess the subsurface soil and groundwater conditions;
- Complete an updated Master Plan for the existing facilities and the future development;
- Complete an Operations Manual outlining a management plan for the future development that will be amended to meet current operational and environmental practices; and
- Conduct regular topographical surveys to assess the waste elevation and monitor remaining site capacity.

2.11 SECURITY

There are cameras located at the gate and scale for security purposes. The site is surrounded by a high security fence with barbed wire along the south and east property lines and a 10 ft high wire fence along the north and west property lines.

2.12 OPERATIONS MANUAL

The City has an Operations Manual to address the following:

- Cell developing and sequencing;
- Waste receiving, placement and covering;
- Nuisance control;
- Surface water management;
- Landfill gas management;
- Leachate management;
- Monitoring and reporting: and
- Inspections and maintenance

The operating manual also provides criteria for the acceptance, handling and disposal of special wastes such as hydrocarbon impacted soils, mold and asbestos. The manual provides information for dealing with hot loads within City Refuse trucks, commercial haulers, and commercial and residential self haulers.

2.13 EMERGENCY RESPONSE PLAN AND CONTINGENCY PLAN

The City has an Emergency Response Plan for the Material Recycling Facility to lay out procedures, actions, and lines of authority in the event of an emergency that may affect the building or its occupants. The City also completed a contingency plan for the landfill gas and flaring system in 2010.

2.14 HEALTH AND SAFETY

Monthly health and safety meetings are held with all staff to discuss safety concerns, learn new processes, and discuss better ways to be safe.

3 EXISTING ENVIRONMENT

3.1 PHYSICAL ENVIRONMENT

The landfill is located in the Aspen Parkland Ecoregion of the Prairies Ecozone of southwestern Manitoba. This Ecozone contains the majority of Canada's productive agricultural cropland, pasture, and rangeland (Environment Canada 1996). The landfill is located in the Stockton Ecodistrict which is a relatively long and narrow, level to hummocky pro-glacial lacustrine plain, lying between the Pembina Hills and Tiger Hills to the south and the Assiniboine River Valley on the north (Smith et al. 1998). The district has a mean elevation of 366 metres above sea level (masl).

3.1.1 Climate

The landfill lies in the Transitional Grassland Ecoclimatic Region, characterized by a semi-arid to humid continental climate marked by short, warm summers and long, cold winters with continuous snow cover (Environment Canada 1996). Precipitation varies greatly from year to year, ranging from 400 mm to 500 mm and peaks from late spring through summer. The region experiences variable winds, an abundance of sunshine and occurrences of severe weather incidences in all seasons (Smith et al. 1998).

Climate normals from 1981 to 2010 for the region were obtained from two Environment Canada meteorological stations: Brandon CDA located at 49° 52' 00" N and 99° 59' 00" W at an elevation of 362.7 masl, and Brandon A (wind data) located at 49° 54' 36'' N and 99° 57' 07'' W at an elevation of 409.4 masl (**Table 3.1**; Environment Canada 2014).

Table 3.1 Climate normals (1981-2010). Temperature and precipitation values are from the Brandon CDA station and wind speed and direction are from the Brandon A station (Environment Canada 2014).

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
temperature - mean (°C)	-16.5	-13.2	-5.9	4.5	11.4	16.6	19.2	18.2	12.2	4.6	-5.4	-13.6	2.7
daily maximum – mean (°C)	-10.5	-7.1	-0.3	11.2	18.7	23.3	26.0	25.6	19.3	10.9	-0.3	-8.1	9.1
daily minimum - mean (°C)	-22.4	-19.2	-11.4	-2.3	4.0	9.9	12.3	10.8	5.0	-1.8	-10.5	-19.1	-3.7
rainfall (mm)	0.1	1.2	8.0	16.3	52.1	79.6	68.2	65.5	41.6	23.6	3.8	1.0	360.8
snowfall (cm)	18	12	17	8	4	0	0	0	0	6	15	20	101
precipitation (mm) [a]	17.9	13.1	24.7	24.9	56.5	79.6	68.2	65.5	41.9	29.3	18.9	21.3	461.7
wind speed - mean (km/h)	15.3	15.0	15.1	15.9	16.8	14.9	12.3	13.2	14.7	15.4	14.8	15.0	14.9
wind direction	W	W	W	NE	NE	W	W	W	W	W	W	W	W

[a] The sum of the total rainfall and the water equivalent of the total snowfall observed during the day. In most cases a 10:1 ratio can be applied to the amount of snow to determine its water equivalent.

3.1.2 Air Quality

Environment Canada (2012) describes the air quality overall in Manitoba to be generally good with the exception of localized sources including proximity to transportation networks and industrial operations such as smelters and/or intensive livestock operations.

Air quality and greenhouse gas (GHG) emissions within the region are affected primarily by the agricultural, urban, rural, industrial and transportation activities as well as the gases arising from the landfill (City of Brandon 2014a). Landfill gas, generated during the natural process of bacterial decomposition of organic material, contains about 50 % methane and 50 % carbon dioxide, along with trace amounts of nitrogen, oxygen, hydrogen and non-methane organic compounds (NMOCs) (USEPA 2014). Methane gas is a potent greenhouse gas that has 21 times more global warming potential than carbon dioxide. Municipal solid waste landfills are the largest source of human-related methane emissions in the world and are responsible for almost 40 % of human-related methane emissions in North America (City of Brandon 2014a).

Other potential factors include: vehicle exhaust and road dust from traffic on city streets and rural roads surrounding the landfill; seasonal applications of fertilizers and manure as part of local agricultural practices; smoke from seasonal burning of cropped lands as part of agricultural practices; particulate matter from dust from windblown soils; and transportation of airborne pollutants from surrounding commercial/industrial/urban activities (e.g., manufacturing, transportation services). The effect of these activities on air quality will typically vary with seasonal weather patterns.

Air quality has been monitored by the Province of Manitoba at a number of locations throughout the province since 1968. Urban air quality monitoring is a joint effort of the Federal/Provincial National Air Pollution Surveillance (NAPS) program. The closest air quality monitoring station to the landfill is in Brandon in an urban/industrial development at 1430 Victoria Avenue East (49° 50' 21.012"N / 99° 55' 14.4834"W) (**Table 3.2**; Manitoba Conservation 2014a). Air quality at this station falls within the desirable guidelines, standards and objectives set out by the Manitoba government and the Canadian Council of Ministers of the Environment (CCME) (Manitoba Conservation 2014a).

Air dispersion modeling was conducted for the landfill gas collection and flaring system (Comcor 2010a). The emission rates and maximum calculated point of impingement (POI) concentrations for each of the landfill gas constituents and combustion by-products at the maximum ground level concentration were modeled. The POI concentrations were compared to the *Ontario Summary of Standards and Guidelines to Support Ontario Regulation 419* and the most stringent Manitoba standards from the *Manitoba Ambient Air Quality Criteria (***Table 3.3***)*. The maximum POI concentrations for all compounds modeled were well below the standards.

Table 3.2 Air quality values for Brandon, Manitoba (2004-2014)[1] compared to maximum acceptable concentration levels as per Manitoba Ambient Air Quality Criteria.

Air Quality Parameters	Ammonia (NH_3)	Nitrogen Oxides (NOx)	Nitrogen Dioxide (NO_2)	Nitric Oxide (NO)	Ground-level Ozone (O_3)	Particulate Matter < 2.5 µm diameter ($PM_{2.5}$)	Particulate Matter < 10 µm diameter (PM_{10})
	ppm	ppm	ppm	ppm	ppb	µg/m^3	µg/m^3
Manitoba Ambient Air Quality Criteria (2005)	2	n/a	0.053	n/a	65	30	50
Brandon[1]	0.014	0.0086	0.005	0.0035	25.2	19.8	5.3

[1]Manitoba Conservation. 2014. Manitoba Air Quality – Brandon Station Report (08/2004 – 08/2014).

Table 3.3 Emission rates and maximum calculated point of impingement (POI) concentrations for each of the landfill gas contaminants (Comcor 2010a).

Contaminant	Contaminant Code (CAS No.)	Facility Emission Rate (g/s)	Ontario Ministry of Environment Standards				Manitoba Conservation Standards			
			POI Criteria ($\mu g/m^3$)	Averaging Period (hr)	POI Concentrations ($\mu g/m^3$)	Percentage of Criteria	POI Criteria ($\mu g/m^3$)	Averaging Period (hr)	POI Concentrations ($\mu g/m^3$)	Percentage of Criteria
Landfill Gas Constituents										
1,1,1-Trichloroethane	71-55-6	2.99E-06	115,000	24	4.55E-05	0.0%				
1,1,2,2-Tetrachloroethane	79-34-5	0.00E+00	NA	0.5	0.00E+00	NA				
1,1-Dichloroethane (ethylidene dichloride)	75-34-3	3.92E-06	165	24	5.98E-05	0.0%				
1,1-Dichloroethane (vinylidene dichloride)	75-35-4	4.63E-07	10	24	7.05E-06	0.0%				
1,2-Dichloroethane (ethylene dichloride)	106-93-4	0.00E+00	3	24	0.00E+00	0.0%				
1,2-Dichloroethane (propylene dichloride)	78-87-5	0.00E+00	2,400	0.5	0.00E+00	0.0%				
2-Propanol	67-63-0	1.69E-05	7,300	24	2.57E-04	0.0%				
Acetone	67-64-1	8.06E-06	11,880	24	1.23E-04	0.0%				
Acrylonitrile	107-13-1	3.63E-05	1	24	5.53E-04	0.1%				
Bromodichloromethane	75-27-4	0.00E+00	NA	0.5	0.00E+00	NA				
Butane	106-97-8	4.01E-05	7,600	24	6.11E-04	0.0%				
Carbon disulfide	75-15-0	1.37E-06	330	0.5	6.19E-05	0.0%				
Carbon Tetrachoride	56-23-5	0.00E+00	24	24	0.00E+00	0.0%				
Carbonyl Sulfide	463-58-1	3.18E-06	3	24	4.85E-05	0.0%				
Chlorobenzene	108-90-7	2.78E-07	3,500	1	1.03E-05	0.0%				
Chlorodifluromethane	75-45-6	8.73E-05 ·	350,000	24	1.33E-03	0.0%				
Chloroethane (ethyl chloride)	75-00-3	2.20E-05	5,600	24	3.35E-04	0.0%				
Chloroform	67-66-3	*8.73E-05*	1	24	1.33E-05	0.0%				
Chloromethane	74-87-3	0.00E+00	320	24	0.00E+00	0.0%				
Dichlorobenzene	95-50-1	0.00E+00	30,500	1	0.00E+00	0.0%				
Dichlorodifluoromethane	75-71-8	1.24E-05	500,000	24	1.89E-04	0.0%				
Dichlorofluoromethane	75-43-4	3.90E-06	NA	0.5	1.78E-04	NA				
Dichloromethane (methylene chloride)	75-09-2	1.07E-05	220	24	1.63E-04	0.0%				
Dimethyl sulfide	75-18-3	5.25E--05	30	0.5	2.37E-03	0.0%				
Ethane	74-84-0	2.89E-03	4,800	24	4.40E-02	0.0%				
Ethanol	64-17-5	3.19E-05	19,000	1	1.18E-03	0.0%				

Contaminant	Contaminant Code (CAS No.)	Facility Emission Rate	Ontario Ministry of Environment Standards				Manitoba Conservation Standards			
Ethyl Mercaptan (ethanethiol)	75-08-1	1.53E-05	NA	0.5	6.90E-04	NA				
Ethylbenzene	100-41-4	2.52E-05	1,000	24	3.84E-04	0.0%				
Ethylene dibromide	106-93-4	0.00E+00	3	24	0.00E+00	0.0%				
Fluorotrichloromethane	75-69-4	2.52E-06	6,000	24	3.85E-05	0.0%				
Hexane	110-54-3	4.35E-05	2,500	24	6.63E-04	0.0%				
Hydrogen sulfide	7783-06-4	4.90E-05	7	24	7.47E-04	0.0%	1	1	1.82E-03	0.2%
Mercury	7439-97-6	7.91E-07	2	24	1.21E-05	0.0%				
Methyl ethyl ketone	78-93-3	3.36E-05	1,000	24	5.12E-04	0.0%				
Methyl isobutyl ketone	108-10-1	2.02E-05	1,200	0.5	9.12E-04	0.0%				
Methyl mercaptan	74-93-1	1.29E-05	20	0.5	5.83E-04	0.0%				
Pentane	109-66-0	1.34E-05	4,200	24	2.05E-04	0.0%				
Perchloroethylene (tetrachloroethylene)	127-18-4	5.11E-06	360	24	7.79E-05	0.0%				
Propane	74-98-6	2.66E-04	7,200	24	4.05E-03	0.0%				
1-1,2-dichloroethene	156-60-5	6.34E-07	105	24	9.67E-06	0.0%				
Trichlororethylene	79-01-6	S.31E-06	12	24	8.09E-05	0.0%				
Vinyl chloride	75-01-4	5.88E-06	1	24	8.97E-05	0.0%				
Xylenes	1330-20-7	7.94E-05	730	24	1.21E-03	0.0%				
Benzene	71-43-2	7.82E-06	NA	0.5	3.53E-04	NA				
Toluene	108-88-3	4.95E-05	2,000	0.5	2.23E-03	0.0%				
Combustion By-products										
Carbon Monoxide	630-08-0	1.24E+00	6,000	0.5	5.58E+01	0.9%	6000	8	2.57E+01	0.4%
Nitrogen Dioxide	10102-44-0	6.61E-01	200	24	1.0IE+01	5.0%	200	24	1.01E+01	5.0%
Particulate Matter	NA	1.27E-01	120	24	1.94E+00	1.6%	30	24	1.94E+00	6.5%
Sulphur Dioxide	7446-09-5	4.07E-02	275	24	6.20E-01	0.20%	150	24	6.20E-01	0.4%
Hydrogen Chloride	7647-01-0	2.03E-02	20	24	3.09E-01	1.5%	100	1	7.53E-01	0.8%

3.1.3 Surficial Geology and Soils

The landfill is located in the Stockton Ecodistrict, which is underlain by Cretaceous shale and covered by surficial deposits of undulating calcareous glacial till with areas of level lacustrine and hummocky glaciofluvial moraine (Smith et al. 1998). Due to the hummocky nature of the till plains with their many undrained depressions, numerous wetlands are present in the region (Environment Canada 1996). Well drained black chernozemic soils are dominant in the area, while low lying depressional areas are characterized by poorly drained saline humic gleysol soils with high seasonal water tables (Smith et al. 1998; Manitoba Land Resource Unit 1996). The majority of soils in the region have marginal capability for agriculture though there are areas of prime agricultural land on well-drained sites in level to gently undulating terrain. The main limiting factors are due to the risk of water erosion on well-drained sites and frequently flooding on poorly drained sites (Manitoba Land Resource Unit 1996).

3.1.4 Hydrogeology

The availability and quality of groundwater in the region is dependent upon the presence of shallow aquifers which are generally sand or sand and gravel lenses (Render 1987). The Assiniboine Delta aquifer is located east of the landfill, and is a thick unconfined deltaic sand and gravel water producing unit that averages 18 m in thickness varying from only a few feet along the extremities of the delta to over 30 m in the central portion of the system. This aquifer yields approximately 6,000,000 cubic metres per year for irrigation purposes.

The landfill is monitored by a system of groundwater monitoring wells and surface sampling points (Pinchin Environmental 2013; **Appendix H**). Twenty-seven monitoring wells were installed across the site at various times since 1999, with three off-site wells northeast of the landfill. Groundwater flows in a north to northeast direction towards the Assiniboine River. Groundwater samples collected in 2013 were analyzed for the following parameters and compared to the *Canadian Drinking Water Quality Guidelines* (CDWQG) published by Health Canada, 2012:

- General chemistry;
- Anions and cations;
- Metals including mercury;
- Polcyclic aromatic hydrocarbons (PAHs);
- Petroleum hydrocarbon (PHC) fractions F1-F4;
- Volatile organic compounds (VOCs);
- Diazinon (organophosphorous pesticide);
- 2,4-D (phenoxy acid herbicide);
- Fecal coliforms; and
- Total coliforms.

There are minor hydrogeochemical impacts on the groundwater system below the landfill (Pinchin Environmental 2013; **Appendix H**). Trends in the data are similar to the historical data with leachate impacts attenuating accordingly prior to the downgradient off-site monitoring wells. Total coliforms were present in every water sample collected from the site with the exception of monitoring wells BH-3-5W and BH-2. Fecal coliforms were also present in groundwater from several monitoring wells. Concentrations of diazinon, PAHs and PHC fractions F1-F4 were all below laboratory detection limits. Benzene was detected in monitoring well BH-3-5W but concentrations were below CDWQG criteria. Nitrate concentrations exceeded CDWQG criteria in groundwater from monitoring wells BH-3-5E, BH-3, BH-4, BH-16, BH-2 and BH-15. Arsenic concentrations exceeded the CDWQG criterion in groundwater from monitoring wells BH-5W and BH-3-5W. The groundwater monitoring data indicate the groundwater is typical of a landfill and there are no significant impacts on local groundwater quality.

3.2 AQUATIC ENVIRONMENT

3.2.1 Surface Hydrology

The aquatic environment within the region is primarily represented by the Assiniboine River and its tributaries. The Assiniboine River is located approximately 500 m north and 2,000 m east of the landfill. It serves as the raw water source for the city of Brandon and other municipalities in the area. Water drawn from the river is also used for irrigation and for facilities such as food processing industries (Armstrong 2005). The Assiniboine River originates near Kelvington, Saskatchewan, and flows southeast 1,070 km to the confluence with the Red River at Winnipeg. The Assiniboine River basin is approximately 41,500 km^2 in size (Armstrong 2005).

There is an unnamed tributary located east of the landfill that flows into the Assiniboine River; this tributary has been extensively modified into an agricultural drain to carry surface drainage away from the adjacent and upstream farmlands. On-site landfill drainage is controlled by the use of three retention ponds, a properly graded land surface, and a drainage ditch around the perimeter designed to contain internal storm runoff and seepage.

The surface water within the landfill is monitored annually at three different sampling points (Pinchin Environmental 2013; **Appendix H**) for the same parameters as the groundwater. Total and fecal coliforms were noted in every surface water sample collected. Concentrations of diazinon, PAHs and PHC fractions F1-F4 were all below laboratory detection limits. Toluene was detected in surface water sampling point SW-2, but concentrations were below CDWQG criteria. Arsenic concentrations exceeded the CDWQG criterion in surface water sampling point SW-2.

3.2.2 Aquatic Biota

The Assiniboine River in the vicinity of the landfill is a typical low-gradient, low-velocity, meandering prairie river (Stewart and Watkinson 2004). This reach of the Assiniboine River has been classified by DFO as a type A habitat – complex habitat with the presence of indicator (large-bodied) fish species (Milani 2013); the majority of the fish habitat in this reach consists of low-velocity runs with occasional snags of large woody debris. Channel substrate ranges from clay and silt to sand, gravel, cobble, boulders, and submerged large woody debris (Stewart and Watkinson 2004). Fifty species are known to occur in the Assiniboine River. This includes many large-bodied species such as walleye (*Sander vitreus*), sauger (*Sander canadensis*), yellow perch (*Perca flavescens*), burbot (*Lota lota*), northern pike (*Exos lucius*), white sucker (*Castostomus commersoni*) as well as a number of Cyprinid species and sticklebacks (Stewart and Watkinson 2004). Most of these fish species spawn in the spring or summer; the exception is Burbot which spawns in midwinter, broadcasting semipelagic, non-adhesive eggs over sand or gravel substrates (Stewart and Watkinson 2004).

The reach of the unnamed tributary situated east of the landfill and draining into the Assiniboine River has been classified by DFO as type C habitat – complex habitat with non-indicator (small-bodied or “forage”) fish species (Milani 2013).

The drainage ditch within the landfill is classified as a Type E habitat – indirect habitat with no fish presence (Milani 2013). A valve at the north end of the property controls the discharge from the landfill drainage ditch into a ditch that drains into the Assiniboine River. Even if fish were present in the lower reaches of the drainage ditch, the valve is kept closed, and no fish passage could occur into the landfill. Surface water quality samples are collected annually along the southern drainage ditch, the compost collection retention pond, and the snow dump retention pond in conjunction with the groundwater sampling program (Pinchin Environmental 2013; **Appendix H**).

3.3 TERRESTRIAL ENVIRONMENT

3.3.1 Vegetation

The landfill is located in a transitional region between the closed boreal forest cover to the north and the treeless grasslands to the south. Most of the area is now farmland but in its native state the landscape was characterized by trembling aspen (*Populus tremuloides*), bur oak (*Quercus macrocarpa*) groves, mixed tall shrubs, and intermittent fescue grasslands. Where the land has not been replaced by cultivated fields, open stands of trembling aspen and shrubs occur on most sites, with bur oak and grassland communities occupy increasingly drier sites. Poorly drained sites in the

region support willow (*Salix spp.*), alder (*Alnus spp.*) and red-osier dogwood (*Cornus sericea*) shrubs, with a grass and sedge (*Carex spp.*) groundcover (Smith et al. 1998).

The site was cleared of all native vegetation prior to construction of the landfill. Natural vegetative re-colonization has occurred in some areas around waste piles, ditches and the property boundary. The majority of re-colonization is from invasive species such as smooth brome (*Bromus inermis*), foxtail barely (*Hordeum jubatum*), sweet clover (*Melilotus officinalis*), wormseed mustard (*Erysimum cheiranthoides*) and leafy spurge (*Euphorbia esula*) that rapidly establish on disturbed soils. Leafy spruge was very abundant, especially along the roadways.

Along the drainage ditch that runs the length of the south and east boundary of the site, the vegetative community was composed primarily of cattail (*Typha latifolia*), soft-stem bulrush (*Scirpus validus*), and scouring rush (*Equisetum hyemale*). Smooth brome, sweet clover and leafy spruge dominated in more upland sites with some patches of stinging nettle (*Urtica dioica*) and a few Manitoba maples (*Acer negundo*) along the edges.

3.3.2 Wildlife

The native wildlife in the region has been greatly affected by agricultural development. Both grassland and wetland habitat loss has affected the distribution and abundance of species and wildlife populations. Once common, elk (*Cervus canadensis*) are now largely confined to the Spruce Woods area, while pronghorn (*Antilocarpa americana*) are currently rarely sighted. In contrast, white-tailed deer (*Odocoileus virginianus*), a recent addition to the fauna of the region, are now widespread, particularly in areas which provide both grazing and cover habitat. Other mammals common to the area include, coyote (*Canis latrans*), red fox (*Vulpes vulpes*), cottontail rabbit (*Sylvilagus floridanus*), striped skunk (*Mephitis mephitis*), American badger (*Taxidea taxus*), and Richardson (*Urocitellus richardsonii*) and Franklin's (*Poliocitellus franklinii*) ground squirrel (Smith et al. 1998).

Various bird species are still found throughout the area, including various raptors such as ferruginous hawk (*Buteo regalis*) and red-tailed hawk (*Buteo jamaicensis*). Even though a significant reduction in acreage and numbers of wetlands has occurred over the years, the region continues to provide major breeding, staging and nesting habitat for ducks, geese, other waterfowl and shorebirds. The region also provides major breeding habitat for sharp-tailed grouse (*Tympanuchus phasianellus*) and a number of songbirds (Environment Canada 1996).

The red-sided (*Thamnophis sirtalis parietalis*) and western plains garter snakes (*Thamnophis radix*) are common in the area and widespread. Other reptiles and amphibians present in the region include the endemic northern prairie skink (*Plestiodon spetentrionalis*) and plains hognose snake

(*Heterodon nasicus nasicus*) found around the Shilo and Spruce Woods area, the western painted turtle (*Chrysemys picta*), gray tiger salamander (*Ambystoma tigrinum*) and various toads and frogs (Environment Canada 1996; Preston 1982).

Due to the disturbed nature of the site and ongoing activities, there is a lack of wildlife habitat and occurrences at the Eastview Landfill. Bird species observed during the site visit included several Franklin's gulls (*Leucophaeus pipixcan*), American crows (*Corvus brachyrhynchos*), red-winged blackbirds (*Agelaius phoeniceus*), Canada geese (*Branta canadensis*) and one barn swallow (*Hirundo rustica*). Several white-tailed deer were observed along the boundaries of the landfill, within the Manitoba Hydro transmission line to the west of the property and near the drainage channel along the south boundary. A muskrat (*Ondatra zibethicus*) was observed within the drainage channel, near the north boundary. Although not observed, it was noted that skunks and ground squirrels are common on site.

3.4 SPECIES AT RISK

Manitoba's indigenous species of plants and animals at risk of extirpation or extinction receive protection under the *Manitoba Endangered Species Act* (MESA) and/or the Canadian *Species at Risk Act* (SARA). Wildlife species including birds, insects, amphibians, reptiles, mammals and vascular plants listed on Schedule 1 of the SARA and the MESA were identified as potentially being within the region (**Table 3.4**; Government of Canada 2012a, Manitoba Conservation 2014b).

Table 3.4 Species at risk with potential to occur in the region

Species	Scientific Name	Species Type	MB ESA Status[1]	SARA Status[2]
Baird's sparrow	*Ammodramus bairdii*	birds	endangered	n/a
Sprague's pipit	*Anthus spragueii*	birds	threatened	threatened
short-eared owl	*Asio flammeus*	birds	threatened	special concern
burrowing owl	*Athene cunicularia*	birds	endangered	endangered
ferruginous hawk	*Buteo regalis*	birds	endangered	threatened
chestnut-collared longspur	*Calcarius ornatus*	birds	endangered	threatened
chimney swift	*Chaetura pelagica*	birds	threatened	threatened
piping plover	*Charadrius melodus circumcinctus*	birds	endangered	endangered
common nighthawk	*Chordeiles minor*	birds	threatened	threatened
olive-sided flycatcher	*Contopus cooperi*	birds	n/a	threatened

Species	Scientific Name	Species Type	MB ESA Status[1]	SARA Status[2]
yellow rail	*Coturnicops noveboracensis*	birds	n/a	special concern
trumpeter swan	*Cygnus buccinator*	birds	endangered	n/a
peregrine falcon	*Falco peregrines anatum*	birds	endangered	n/a
loggerhead shrike	*Lanius ludovicianus excubitorides*	birds	endangered	threatened
red-headed woodpecker	*Melanerpes erythrocephalus*	birds	threatened	threatened
Eskimo curlew	*Numenius borealis*	birds	endangered	endangered
golden-winged warbler	*Vermivora chrysoptera*	birds	threatened	threatened
Canada warbler	*Wilsonia canadensis*	birds	endangered	threatened
pale yellow dune moth	*Copablepharon grande*	insects	endangered	special concern
dusky dune moth	*Copablepharon longipenne*	insects	endangered	endangered
Dakota skipper	*Hesperia dacotae*	insects	threatened	threatened
Ottoe skipper	*Hesperia ottoe*	insects	threatened	endangered
golden-edged gem	*Schinia avemensis*	insects	endangered	endangered
white flower moth	*Schinia bimatris*	insects	endangered	endangered
monarch	*Danaus plexippus*	insects	n/a	special concern
mapleleaf mussel	*Quadrula quadrula*	mollusc	endangered	N/A
great plains toad	*Bufo cognatus*	amphibians	threatened	N/A
northern leopard frog	*Lithobates pipiens*	amphibians	n/a	special concern
common snapping turtle	*Chelydra serpentina*	reptile	n/a	special concern
northern prairie skink	*Eumeces septentrionalis*	reptile	endangered	endangered
western hognose snake	*Heterdon nasicus*	reptile	threatened	n/a
mule deer	*Odocoileus hemionus*	mammal	threatened	n/a
rough agalinis	*Agalinis aspera*	vascular plant	endangered	endangered
buffalograss	*Buchloe dactyloides*	vascular plant	threatened	threatened
hackberry	*Celtis occidentalis*	vascular plant	threatened	n/a
smooth goosefoot	*Chenopodium subglabrum*	vascular plant	endangered	threatened
small white	*Cypripedium candidum*	vascular plant	endangered	endangered

Species	Scientific Name	Species Type	MB ESA Status[1]	SARA Status[2]
lady's-slipper				
hairy prairie-clover	*Dalea villosa*	vascular plant	threatened	threatened
western spiderwort	*Tradescantia occidentalis*	vascular plant	threatened	n/a

[1] Species listed under the *Manitoba Endangered Species Act*
[2] Species listed under the Federal *Species at Risk Act*

Manitoba's Conservation Data Centre (CDC) was contacted in July 2014 to screen the project area for rare species. The CDC found no occurrences of rare species within the site. During the July 2014 site visit, there were no observations of any species at risk. Due to the disturbed nature of the landfill, occurrences of any listed or rare species is not expected as the habitat requirements for any of these species is not available.

3.5 SOCIO-ECONOMIC ENVIRONMENT

3.5.1 Current Population Trends

Census information from Statistics Canada showed an annual increase of 0.6 % in Brandon's population from 1996 to 2006 and 11.0 % from 2006 to 2011. The population of Brandon was 39,145 in 1996, 41,511 in 2006, and 46,061 in 2011. The City is one of the fastest growing populations in the province (Statistics Canada 2014). According to Economic Development Brandon (City of Brandon 2014), the City is expected to grow at a rate of 1.25 % per annum over the next five-year period.

3.5.2 Stakeholders

Stakeholders within the region include:

- Private landowners and farmers;
- City of Brandon and a population of 4,378 within the RM of Cornwallis;
- Residents, business owners and town planners in the City of Brandon;
- Canadian Pacific Railway (CPR) and Canadian National Railway (CNR);
- Industrial businesses (Canexus sodium chlorate plant, Cumming & Dobbie Construction, Koch Industrial Fertilizer Plant, Maple Leaf);
- Utility companies (Manitoba Hydro, MTS, Shaw Cable); and
- Residential users of the landfill for personal disposal needs.

3.5.3 First Nations

The First Nations in the region include:

- Canupawakpa Dakota First Nation
- Sioux Valley Dakota Nation
- Swan Lake First Nation

The Canupawakpa Dakota First Nation Reserve is located 72 km southwest of Brandon and covers an area of 1,024 ha. It has a total registered population of 668 with 292 residing on-reserve and is governed by Chief Delbert Cruise and Councillors Darrell Brown and Sam Hapa (AANDC 2014).

The Sioux Valley Dakota Nation Reserve is located 43 km northwest of Brandon and covers an area of 4,136 ha. It has a total registered population of 2,502 with 1,382 residing on-reserve and is governed by Chief Vincent Tacan and Councillors Jennifer Bone, Eleanor Elk, Ivan Ironman, Franklin McKay and Anthony Tacan (AANDC 2014).

The Swan Lake First Nation Reserve 7A is located approximately 45 km southeast of Brandon, on Highway 5 near Carberry, Manitoba, and covers an area of 2,636 ha. The Swan Lake First Nation has four reserves within the province and has a total registered population of 1,363 with 596 residing on-reserve. It is governed by Chief Francine Meeches and Councillors Angie Black, Don Daniels, Brian McKinney and Craig Soldier (AANDC 2014).

3.5.4 Regional Economy

The regional area was historically developed through the presence of fertile agriculture lands. Although agri-food products and related services still represent the area's largest industrial economic base, Brandon has experienced strong economic growth and diversification in recent years. The manufacture of metals, chemicals and pharmaceuticals are significant economic generators in the area, as with oil drilling and production, which employs thousands of people and supports substantial business growth. Oil production in the area is expected to sustain current drill rates for up to 20 years (City of Brandon 2014b).

Brandon's labour force is regional in nature with as many as 25 % of the labour force living in rural communities outside the city's boundaries (City of Brandon 2014b). Health care and social services make up the highest proportion of the workforce in the area (18 %) and is higher than the provincial average. Manufacturing industries (14 %) and retail trade (13 %) are the next largest contributors to the economy and also make up a higher proportion of the population compared to the provincial average (Statistics Canada 2012). The Prairie Mountain Health Authority is the region's largest employer, with 2,680 employees. Maple Leaf Consumer Foods is the second largest employer in the region with 2,250 employees. Some of the regions other significant employers include: Behlen

Industries LP, Koch Industries, Manitoba Hydro, Brandon School Division, and Canadian Forces Base (CFB) Shilo (City of Brandon 2014b). The unemployment rate in the region is 4.3 % (Statistics Canada 2012).

3.5.5 Land Use, Resource Use, and Protected Areas

The landfill is located in an area overseen by the Brandon and Area Planning District (BAPD) and in general under Zoning Bylaw 6642 adopted in 2001 and the BAPD Development Plan (MMM Group Ltd. 2013). The landfill is classified as Industrial Heavy Zone under Zoning Bylaw 6642. This designation provides for the highest range of uses, including those industrial operations that have the potential to generate significant levels of emissions, such as noise, odour, smoke, fumes or vibration, handle environmentally hazardous materials, generate considerable truck traffic, as well as those uses that incorporate extensive outdoor operations and storage as part of their normal operations. Wherever practical, Industrial Heavy Zone uses shall be separated from residential zones and other uses to reduce conflict. Heavy manufacturing, toxic waste disposal facilities and junk and salvage yards shall be limited to Industrial Heavy Zones.

The properties adjoining the waste disposal grounds include a Manitoba Hydro Right of Way on 20 acres at the northwest portion of the quarter section, Manitoba Hydro's Brandon Generating Station to the north; a City owned waste water treatment plant (WWTP) to the northeast, Cumming & Dobbie Construction to the west; and Koch Industries Fertilizer Plant to the east and south. All of these properties are zoned as Industrial Heavy Zones. The quarter sections to the south and south east of the waste disposal ground are zoned as either a Development Reserve Zone or Open Space Zone. All these properties are located within the City of Brandon Industrial Park.

There are no protected lands in the area. CFB Shilo contains the Douglas Marsh Protected Area and is located 20 km southeast of the landfill. The nearest provincial park is Sprucewoods Provincial Park located 55 km southeast.

3.5.6 Heritage Resources

Manitoba's Heritage Resource Branch (HRB) was contacted in July 2014 to screen the project area for heritage potential. The HRB determined the project had a low potential to impact significant heritage resources, and, therefore, has no concerns with the project.

3.5.7 Human Health and Safety

Most of the human health problems associated with landfills comes from landfill gas, its non-methanic volatile organic compounds, leachates and hazardous air pollutants. It is known that such releases contain a wide variety of potential carcinogens and toxic chemicals that represent a threat to public health. Although little quantitative data exists on the effect that landfill hazards have on those who live near landfills, exposure to these hazards may lead to an increase in birth defects, asthma, respiratory disease and cancer (Enviros Consulting Ltd and University of Birmingham

2004). Toxic chemicals from soil can be vaporized in areas such as basements, causing high concentrations of hazardous chemical gases in people's homes. If harmful chemicals are present in the soil surrounding a water supply, they can seep into the water and cause harmful effects. If waste is not properly contained, it has the potential to leak into the surrounding properties and contaminate the area (Enviros Consulting Ltd and University of Birmingham 2004).

Hazardous materials such as asbestos mold, and hydrocarbon impacted soils are permitted to be received by the landfill. Volatile toxins from these materials can become airborne and have the potential to pose significant adverse health risks. When inhaled in significant quantities, asbestos fibres can cause asbestosis (a scarring of the lungs), mesothelioma (a rare cancer of the lining of the chest or abdominal cavity) and lung cancer (Government of Canada 2012b). Inhaling excessive quantities of airborne mold particles may lead to allergic illness, asthma, respiratory infection or mycotoxin poisoning (NC Department of Health and Human Services 2014). Benzene, toluene, ethylbenzene and xylenes (BTEX) are known carcinogens found in petroleum and can be released through the soil, air and water (CCME 2008).

Since the potential for environmental and health effects of landfills and hazardous waste sites can be extensive, government regulations of such sites are stringent and have been put in place with public safety in mind. Some of these regulations (CCME 2006) include:

- Monitoring of groundwater, surface water and soil to ensure that chemical levels are within acceptable ranges;
- Use of liners (usually plastic sheets and layered clay) to prevent leakage of hazardous materials;
- Location restrictions to ensure that no potential leakage hazard could come from nearby geological attributes such as wetlands;
- Safe operating practices regarding the control of waste exposure;
- Closure regulations concerning the safe maintenance and monitoring of closed landfills and hazardous waste sites; and
- Corrective action for any potential leakages from waste sites

Although the overall health risk may be slightly increased by living close to a landfill, if properly maintained, the risk is very minimal. The development plan ensures that any Waste Disposal Ground (WDG) is located where impacts to human health or the environment are minimized. Development near the WDG will be restricted to agricultural uses and those types of industrial development that would not be adversely affected by being located adjacent to a WDG.

4 ENVIRONMENTAL EFFECTS ASSESSMENT & MITIGATION

The landfill continues to develop programs to increase diversion from the landfill and to efficiently manage products in the most environmentally friendly way possible. These efforts help to extend the life of the landfill. Waste handling is approached by the following methods from preferred to least favored: prevention, minimization, reuse, recycling, energy recovery and disposal. Many of these efforts are outlined in the 2013 Annual Report (**Appendix J**).

4.1 EFFECTS ASSESSMENT APPROACH

This environmental effects assessment details the interactions between the project and the natural and human environment, and in most cases describes how adverse effects have been avoided through design.

4.2 PHYSICAL ENVIRONMENT

4.2.1 Air Quality

Potential effects to air quality include:

- Production of landfill gas;
- Flaring of landfill gas; and,
- Release of particulate matter from exposed surfaces.

4.2.1.1 Landfill Gas Production and Flaring

In landfills, organic materials decompose without oxygen and create methane, a major contributor to climate change with 21 times more global warming potential than carbon dioxide. By preventing organic materials from reaching the landfill and recycling them instead, methane generation can be minimized or eliminated all together. Composting can significantly reduce greenhouse gas emissions by recycling organic material into fertilizers or other soil amendments as well as soil carbon sequestration benefits. The City of Brandon implemented a curbside organics collection program in 2010, As of September 2014 the City had collected approximately 900 tonnes of organic waste from 4,800 households; the City plans to expand the program to divert between 1,500 and 2,000 tonnes of green cart material annually.

The Eastview Landfill also developed a permanent landfill gas collection and flaring system to reduce emissions by collecting and destroying the landfill gas through combustion (flaring). Eventually the City would like to use the gas as an alternative fuel source to natural gas. The estimated reduction in greenhouse gases from the flaring operation was 4,700 tonnes CO_2 e in 2011, 9,321 tonnes CO_2 e in 2012, and 14,393 tonnes CO_2 e in 2013 (IRGS 2011, 2012 and 2013).

The flare emission modeling results show all parameters are well below standards and suggest the flare will not cause adverse effects to the landfill employees, public, or surrounding environment (Comcor 2010a).

The release of greenhouse gases to the atmosphere is considered a residual effect, however, the City of Brandon has implemented a composting program and a landfill gas collection and flaring system to significantly reduce GHG emissions. The gas collection and flaring system was designed to recover 70 % of the produced gas (Comcor 2010b).

4.2.1.2 Particulate Matter

Material deposited in the active cell by residential or commercial haulers is compacted in place and covered on a daily basis to reduce the release of airborne particulate matter. To ensure that waste is contained within the property, a fence surrounds the landfill and portable litter-control bins with fencing are located around the active areas to capture wind-blown debris and can be moved around the landfill as needed. Particulate emissions are minimal.

4.2.2 Noise

The use of heavy equipment at the facility is the chief noise-producing activity heard at the landfill. Other local sources of noise may include traffic to and from the site. Due to the distance of receptors, the incidence of nuisance noise generated at the site is considered infrequent and minimal.

4.2.3 Soils and Groundwater

Potential effects to soils and groundwater include leachate generated from precipitation that percolates through solid waste. Once in contact with decomposing solid waste, the percolating water becomes contaminated and is termed leachate when it flows out of the waste material. Management of leachate and mitigation of its harmful effects on the surrounding environment is controlled through the use of liners and the drainage management. The City of Brandon began using clay liners in 1980, and 60 mil high-density polyethylene (HDPE) liners in 1994 to protect the underlying soil and groundwater. Leachate is directed to the wastewater treatment plant located northeast of the landfill. The City of Brandon conducts annual groundwater monitoring to identify negative effects to groundwater where possible (Pinchin Environmental 2013; **Appendix H**).

The effect of leachate on groundwater is a residual effect, however, is considered minor (**Section 3.1.4**) and restricted to the landfill site.

4.3 AQUATIC ENVIRONMENT

4.3.1 Surface Hydrology

Surface water has the potential to be affected by migration of leachate from the landfill. The drainage plan for the landfill was designed to ensure all surface water is directed to the northeast corner of the site and discharged to the wastewater treatment plant. The City of Brandon conducts annual sampling and analysis of on-site surface water (Pinchin Environmental 2013; **Appendix H**). Residual effects to surface water quality resulting from the migration of leachate is restricted to the landfill site.

4.3.2 Aquatic Biota

There is no aquatic biota present within the landfill and the drainage channel adjacent to the landfill is considered to be of poor to nil habitat quality for fish. There are no anticipated effects on aquatic biota.

4.4 TERRESTRIAL ENVIRONMENT

4.4.1 Vegetation

The landfill was used as farmland prior to construction of the landfill and cleared of all native vegetation. Natural vegetative re-colonization has occurred in some areas around waste piles, ditches and the property boundary, though the majority of re-colonization is from invasive species. Permanent loss of native vegetation on the landfill property is a residual effect, however, the site will be re-vegetated in accordance with the closure plan.

4.4.2 Wildlife

The landfill was used as farmland prior to construction of the landfill and cleared of all native wildlife habitat, however, some wildlife still exists on-site. Some disturbance or mortality of small mammals (e.g., mice, voles) is expected due to standard facility operations such as soil removal, grading, excavation and other construction and equipment activities.

Permanent loss of wildlife habitat on the landfill property is a residual effect. Residual effects to wildlife are considered minor and localized due to standard operating procedures and site infrastructure (e.g., fencing) designed to limit the interaction of wildlife with the facility. Regular inspection of the integrity of perimeter fencing by landfill operations staff aids in continuing to limit interaction with large-bodied mammals such as white-tailed deer.

4.5 SPECIES AT RISK

There are no recorded occurrences of plant or animal species at risk within the landfill, hence, no measurable or residual effects are anticipated.

4.6 SOCIO-ECONOMIC ENVIRONMENT

The landfill is an existing development, hence, there are no anticipated effects on the socio-economic environment. All stakeholders in the region are aware of its existence and activities.

4.6.1 Land Use

The Eastview Landfill and adjacent properties are zoned as Industrial Heavy Zones (MH) and strategically separated from residential zones to reduce adverse effects on residents. The landfill collects approximately 45,000 tonnes of waste per year and is continuously evolving to improve its environmental stewardship as new technologies become available and will continue to employ the latest waste diversion strategies and tools. Since 2008, the first year of the City's new recycling collection program recycling rates increased from approximately 14 % to 38 %.

The landfill is an existing development hence there are no anticipated effects on the surrounding land use, however, residual waste will persist indefinitely post-closure and the land will become permanently unusable, unable to be reclaimed for another use.

4.6.2 Heritage Resources

The past and future operation of the Eastview Landfill facility is not anticipated to have any effect on heritage resources due to the absence of previously recorded sites on site.

4.6.3 Aesthetics

The physical presence of the site, visibility of operating areas and generation of litter are aspects of the development which contribute to negative visual impacts. The site is highly visible, particularly from the north by motorists travelling along Victoria Avenue East. A berm has been placed around the North and West perimeters of the facility to ensure that the visual impacts of the site are minimized. The active cells are covered daily.

The presence of the landfill has a residual effect on aesthetics; however, this is considered minor due to its location in an industrial area away from residential areas.

4.6.4 Human Health and Safety

Potential effects to human health and safety as a result of the Project were identified as follows:

- Use of heavy equipment and large machinery;
- Handling of special waste (e.g., asbestos, hydrocarbon impact soils, hazardous waste); and
- Exposure to respirable particulate matter and landfill gas emissions.

To ensure the health and safety of all visitors to the landfill an attendant is on site at all times during regular working hours. When the site is not in operation all entrance gates are locked. Emergency contact information is located at the main gate in the case of an emergency.

The City of Brandon has developed an Operations Manual (**Appendix D**) as well as an emergency response plan for the landfill and MRF. These documents provide long-term planning, guidance and prescriptions for operations, safety and emergency response.

Currently the Eastview Landfill is permitted to receive hazardous materials including Household Hazardous Waste (HHW), asbestos, mold, and hydrocarbon contaminated soils. There are strict procedures in place for handling these materials to ensure safety of the landfill employees and public (**Sections 2.5.3, 2.5.9, 2.5.10, 2.5.12**).

Concerns about health risks from long-term exposure to carcinogenetic gases emitted from landfills have long been discussed. During the Environmental Impact Assessment of Brady Road Landfill and Future Resources Management Facility (Stantec 2011), there was no evidence of any significant health risk to the nearest neighbours to the landfill for reportable respiratory diseases after almost four decades of landfill operations. In addition, the landfill is located a mile from any residential subdivision which further reduced the exposure to potential carcinogens.

With the implementation of hazardous material collection and disposal guidelines, a landfill gas collection and flaring system, solid waste management protocols, operations, safety, and emergency response plans, and the setting of the landfill located away from residential areas, the Project is not anticipated to have a residual effect on human health and safety.

4.6.5 Accidents and Malfunctions

Potential accidents and malfunctions can be severe and must be considered. The most probable accidents and malfunctions for the Eastview Landfill include:

- A major landfill fire;
- A major spill on- or off-site; and
- Flooding of the landfill.

4.6.5.1 *Landfill Fires*

The risk of a major landfill fire has been reduced by a combination of design and operational features, and the City's commitment to the development of improved emergency-response procedures. A small, short-lived and easily managed fire occurred at the landfill in June 2014 which was routinely contained, smothered and extinguished within a couple of hours. Landfill fires, if not extinguished quickly, can become dangerous because they can emit clouds of chemical-containing smoke and because they can be hard to fully extinguish (Sperling 2001). Landfill fire risk is typically managed through a multiple lines of defence including prevention, early detection and rapid response. A rapid response is critical to effectively manage landfill fires and can include several subsurface landfill fire control techniques such as excavation, smothering and extinguishing with injections of water or inert gas (Stearns and Petoyan 1984). As a result of appropriate planning and timely response, the consequence of landfill fires is not anticipated to result in residual effects.

4.6.5.2 *Spills*

The risk of a spill of hazardous material within the landfill has the potential to impact the surrounding environment. Several mitigation measures are in place to reduce the risk of spills and in the unlikely event that one will occur, will limit the extent of disturbance. Vehicle and equipment access is limited to the existing roads and paths. All mobile and stationary equipment on site is kept in good condition, properly maintained, free of leaks and spill kits are available. Storage and handling of dangerous goods is conducted in accordance with the *Dangerous Goods Handling and Transportation Act* and associated regulations. Any reportable spills of a hazardous substance will be immediately cleaned up and reported to Manitoba Conservation Emergency Spill line at (204) 944-4888. In the event that a release did occur, it would have the potential to have lasting effects, however, the probability of a large release is low and there are no anticipated residual effects due to an accidental release.

4.7 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Potential effects of the environment on the landfill include flooding. Brandon has withstood several major flood events, most notably in 1997, 2011 and 2014. The City of Brandon has employed several flood protection measures over the year to protect against flooding, which includes a linear dike system on the north and south side of the Assiniboine River. Currently the city is implementing the "Brandon Flood Protection System Enhancement Project" which will enhance the linear dike system, including both improvements to the dikes and dike drainage systems (Manitoba Conservation 2014c). The dikes will be long and high enough that potential at-risk areas will be protected to a 1:300 year flood protection level (Manitoba Conservation 2014c). Other components to the enhancement project include upgrades to the lift station along the Assiniboine River corridor and the construction of a dike system along PTH 110 to protect this important transportation and

access route. With the flood protection measures, the potential for flooding of the landfill is low and there are no anticipated residual effects.

4.8 SIGNIFICANCE OF RESIDUAL EFFECTS

4.8.1 Residual Effects Assessment Criteria

Residual effects are effects remaining after application of mitigation measures. Residual effects were assessed for significance using the following criteria:

Direction - the direction of the effect may be positive, neutral, or negative with respect to beneficial or adverse effects from the Project on the existing environment.

Magnitude - a measure of the degree or intensity of change that can occur as the Project proceeds, which can be: low (above background conditions, but within established criteria or scientific threshold and the range of natural variability); medium (substantially above background conditions, but within established criteria or scientific threshold and the range of natural variability); or high (predicted to exceed established criteria or scientific threshold and will likely cause detectable change beyond the range of natural variability).

Geographic extent - refers to the area potentially affected by the effect, whether it is on-site, or some area beyond the landfill property.

Duration - refers to the length of time the environmental effect occurs and whether the effect is reversible once the disturbance has been completed (i.e., reclamation of disturbed areas). Duration can be: short-term (less than one year); medium-term (throughout operation); or long-term (continues beyond site closure and reclamation).

Frequency - refers to the frequency at which the effect occurs over the specified duration and is described as: infrequent (occurs once over the duration of the disturbance); frequent (occurs periodically over the duration of disturbance); or continuous (occurs continuously over the duration of disturbance).

Likelihood - refers to the probability of occurrence (i.e., the risk of an event occurring) and is described as very unlikely, unlikely, likely and very likely.

The activities associated with the Project were first assessed according to the above criteria, and then evaluated together to predict the overall environmental consequence. Environmental consequence was determined as:

Minimal - effects with a low magnitude, short- to medium-term duration, infrequent to continuous occurrence, and restricted to the landfill in geographic extent. The potential effect may result in a slight decline in the resource of the landfill during the life of the Project, but the resource should return to pre-construction levels.

Low - effects with a low magnitude, short- to long-term duration, infrequent to continuous occurrence, and restricted to the landfill in geographic extent. The potential effect may result in a slight decline in the resource in the landfill during the life of the Project. Research, monitoring, and/or recovery initiatives would not normally be required.

Moderate - effects with a medium magnitude, short- to long-term duration, frequent to continuous occurrence, and extend off-site to adjacent areas. Potential effect could result in a decline in resource to lower-than-baseline but stable levels in the region after Project closure and into the foreseeable future. Regional management actions such as research, monitoring, and/or recovery initiatives may be required.

High - refers to major effects that are long-term in duration, continuous in occurrence, and extend off-site to adjacent areas. Potential effect could threaten sustainability of the resource and should be considered a management concern. Research, monitoring, and/or recover initiatives should be considered.

The effect is considered to be significant if the environmental consequence is determined to be moderate or high, and is considered to be not significant if the environmental consequence is determined to be minimal or low.

4.8.2 Summary of Residual Effects

Residual effects, i.e., effects that remain after application of mitigation measures, are expected to occur to air quality, ground water and soil, surface water, vegetation, wildlife, aesthetics, and land use. The residual effects were assessed in terms of their direction, magnitude, geographic extent, duration, frequency and likelihood**. Table 4.1** provides a summary of the residual effects and significance for each of the environmental components.

Table 4.1 Residual effects and significance

Project Component	Predicted Residual Effect	Direction	Magnitude	Geographic Extent	Duration	Frequency	Likelihood	Significance
Air quality	Production of landfill gas, dust, and particulate matter	negative	medium	region	medium-term	continuous	very likely	low
Groundwater and soils	Leachate migration into subsurface	negative	low	project site	long-term	frequent	likely	low
Surface water	Leachate migration to surface water	negative	low	project site	long-term	frequent	likely	low
Vegetation	Loss of native vegetation	negative	low	project site	medium-term	infrequent	very likely	minimal
Wildlife	Loss of wildlife habitat	negative	low	project site	long-term	infrequent	very likely	minimal
	Disturbance or mortality to small mammals	negative	low	project site	medium-term	frequent	unlikely	minimal
Aesthetics	Visual appearance of the landfill	negative	low	project site	long-term	continuous	very likely	minimal
Land use	Persistence of thousands of tonnes of garbage and waste on site	negative	medium	project site	long-term	continuous	very likely	moderate

5 PUBLIC ENGAGEMENT

No formal public engagement process has taken place regarding the application for an Environment Act Licence for the landfill. It is an existing facility and well known to the City of Brandon residents. The public is made aware of any ongoing developments at the landfill, such as new cells or the development of the landfill gas collection and flaring system in 2010 by way of media, website, councillor's ward meetings, and weekly council updates.

The public has also been made aware of the need to increase the useful life of the landfill by diverting more solid waste from the tipping face. This was a major focus of the City's 2007 Solid Waste Management Plan that was approved by council in October of 2007. The public had numerous opportunities to be involved in this process, through mall displays, ward meetings, City Hall open houses and by contacting our information line set up for that purpose. In 2010 the City of Brandon implemented an organics collection pilot project where we held numerous events prior to the start of and during the project that have kept people informed of the project scope and its goals and objectives.

6 ENVIRONMENTAL MONITORING

The City of Brandon will continue its existing monitoring programs and report any findings of such programs to the Director when issues arise.

6.1.1 Contaminated Soil Remediation Facility

The contaminated soil remediation facility is inspected on a regular basis during aeration (**section 2.8.5.1**) for:

- Erosion, slope increase or damage to the berms surrounding the treatment area;
- Excessive “ponding” of surface water;
- Improper placement of contaminated loads; and/or
- Visible signs of migration or leaching of surface water and/or contaminates;

Any issues are dealt with to ensure the proper maintenance of the treatment facility.

6.1.2 Air Emissions

The landfill gas collection and flaring system requires regular monitoring and an annual report to satisfy condition 9 of Environment Act Licence No. 2932. The wellfield is monitored monthly and the mechanical system undergoes weekly and monthly monitoring (**Appendix G**).

The wellfield system monitoring consists of measuring vacuum/pressure in each well and lateral pipe, as well as the percentage of methane, oxygen and carbon dioxide in the landfill gas.

The following items are monitored remotely and reviewed on a weekly basis at a minimum to ensure all parameters are being recorded and the system is operating properly:

- Landfill gas composition and temperature;
- Flare operating times;
- Blower operating times;
- Landfill gas flow rate; and
- Volume of landfill gas collected and flared.

Monitoring ports at the inlet and the outlet to the blower are measured and recorded on a monthly frequency, using a suitably scaled pressure gauge.

The main blower skid gas analyzer system monitors the oxygen and methane concentrations of the landfill gas being transferred to the flare and if either oxygen concentrations get too high, or

methane concentration gets too low, an alarm is sent to the main computer panel to shut the system down.

Landfill gas velocities and temperatures at each landfill gas extraction well are measured and recorded on a monthly basis using an anemometer. These velocities were used to calculate landfill gas flow rates by multiplying by the pipe's cross sectional area.

The flare stack is equipped with a thermocouple that measures the temperature in the flare stack. This thermocouple is monitored by the system control panel at intervals of five minutes or better. The control system is continuously monitoring the flame conditions and will shut down the system immediately if flame is lost. The main control panel records both flow and methane gas concentration being collected from the system and sent to be combusted in the flare. These quantities are measured and recorded at intervals of five minutes or less. The data collected can be readily processed to calculate the greenhouse gas emission reduction expressed as carbon dioxide equivalents.

6.1.3 Ground Water and Surface Water Monitoring and Analysis

The City of Brandon conducts annual monitoring and analysis of ground and surface water, including 30 groundwater monitoring wells and the three on-site retention ponds (Pinchin Environmental 2013; **Appendix H**). Groundwater monitoring consists of measuring static water levels and collecting field parameters with a multi-parameter meter including: dissolved oxygen, conductivity, salinity, specific conductivity, pH, temperature, total dissolved solids and oxidation-reduction potential. Samples are sent to an accredited laboratory for analysis of the parameters listed in **Table 6.1**. All monitoring wells have been designed and constructed in accordance with the guidelines for the siting of a Class 1 Waste Disposal Ground in the Province of Manitoba (Manitoba Environment 1994). As future development of the site occurs, the need to relocate existing monitoring wells will arise with the intent of decommissioning the old monitoring wells such that impact to local groundwater is minimized.

Table 6.1 Parameters examined during groundwater and surface water monitoring.

Parameter		
Bicarbonate	Total Kjeldhal Nitrogen	Selenium, dissolved
Carbonate	Phosphorous, dissolved	Silver, dissolved
Hydroxide	Arsenic, dissolved	Sodium, dissolved
Alkalinity, total	Barium, dissolved	Zinc, dissolved
Hardness, dissolved	Beryllium, dissolved	Benzene
pH	Cadmium, dissolved	Ethylbenzene
Specific Conductivity	Calcium, dissolved	Toluene
Turbidity	Chromium, dissolved	Xylenes
Residue, filterable	Copper, dissolved	Vinyl Chloride
Residue, non filterable	Iron, dissolved	Diazinon
Residue, total	Lead, dissolved	2, 4-D
Chloride, dissolved	Magnesium, dissolved	Total and Fecal Coliforms
Sulphate, dissolved	Manganese, dissolved	Naphthalene
Cyanide, total	Mercury, extractable	Benzo(a)pyrene
Ammonia	Nickel, dissolved	Anthracene
Nitrate_Nitrite	Potassium, dissolved	

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