

Eastview Landfill 2022 Annual Report

Prepared by:  TETRA TECH





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Executive Summary

The City of Brandon (City) owns and operates the Eastview Landfill (Landfill) located at 765 33rd Street East in Brandon, Manitoba. The Landfill operates as a Class 1 Waste Disposal Ground (WDG) under Manitoba Environment Act License No. 3149 (License). The License was issued by Manitoba Conservation and Climate, now Manitoba Environment, Climate and Parks (MECP) on August 25, 2015.

Tetra Tech Canada Inc. (Tetra Tech) was retained by the City to prepare this Report.

The 2022 Annual Operations Report is provided to fulfill the City's License requirement to annually report on operations and monitoring at the Landfill. This Annual Operations Report covers the period from January 1, 2022 to December 31, 2022.

Site facilities include:

- Former and active disposal areas.
- Commercial and residential disposal areas.
- Scale and scale house.
- Snow removal dump site (City use only).
- Clean fill disposal.
- Concrete disposal area.
- Landfill Gas (LFG) collection system.
- Material Recovery Facility.
- Designated stockpiles for metals, propane tanks, tires, yard waste, and branches.
- Freon device removal depot.
- Eco-Centre for used oil, filters, and containers.
- Tree and wood chipping.
- Composting.
- E-waste depot.
- Household hazardous waste depot.

The areas of the Landfill are shown in Figure E-1.



Detailed environmental monitoring is provided in the 2022 Water Quality Monitoring Report by Kontzamanis Graumann Smith MacMillan Inc. (KGS Group) (2023) and Landfill Gas Annual Report by Integrated Gas Recovery Services (IGRS) (2023).

Historical records show a decreasing trend in customer visits and organic materials diverted over the past three years and a year over year decrease in total recyclable materials diverted. Total waste disposal increased over the past three years. Total materials managed at the site show a slight decreasing trend over the past ten years.

In 2022, the City focused on public education and awareness for waste diversion programs.

Environmental monitoring showed results consistent with historical data. Groundwater, surface water, and LFG are monitored throughout the year to assess potential impacts from the Landfill on the surrounding environment. The following findings were noted:

- The LFG Collection and Flaring System was mainly not operated during 2022 due to operational issues caused by weather and equipment failures. LFG Collection and Flaring and associated greenhouse gas emission reductions decreased substantially in 2022 compared to the previous years.
- Groundwater elevation and flow were toward the northeast, consistent with historical results.
- Groundwater quality analysis showed exceedances of the Maximum Acceptance Concentrations (MAC) or Aesthetic Objectives (AO) Health Canada – Canadian Drinking Water Quality Guidelines (HC-CDWQ) in the Landfill. Off-site monitoring wells showed exceedances of Total Dissolved Solids and Manganese. KGS Group concluded that the groundwater exceedances did not pose significant concerns.
- Surface water quality analysis showed exceedances of HC-CDWQ Guidelines MAC and AO in some samples. KGS Group concluded that exceedances are not considered a risk to the surrounding environment because surface water is managed through evaporation or treatment at the Wastewater Treatment Plant (WWTP).

The City logged no major (lost time) health and safety incidents or nuisance, noise, or odour complaints in 2022. There was one major incident noted 2022. A fire occurred in the wood pile in November 2022 connected to the Wood Burning project. The fire was reported to MECP on November 3, 2022, as required by the License.

As the City moves forward with annual operations reporting, a number of key metrics have been identified to assess overall landfill and solid waste system performance. Targets for key metrics will be developed by City staff. Table E-1 summarizes the metrics considered most relevant to the Landfill's ongoing operations.

The following were recommended in reports prepared by others:

- As per the recommendations by IGRS (2022) for the LFG Collection and Flaring System:
 - Continue to operate and monitor the LFG system full time according to the Operation and Maintenance Manual for the Landfill.
 - Implement the plan to address the reduced vacuum on Lateral 2 and complete necessary repairs (scheduled for 2023).
 - Replace the gas analyzer.
 - Investigate the repair issues with freezing at the flare base.
 - Budget to overhaul the LFG blower and motor.
 - Complete upgrades to the LFG system including expanding the LFG collection wellfield.
- As per the recommendations by KGS Group (2023) for groundwater and surface water monitoring:
 - Continue to follow the streamlined Monitoring, Sampling, and Analysis Plan, as approved by MECP on December 2, 2017. Complete sampling of the Primary Monitoring Network in 2023.
 - Complete a geodetic evaluation survey of the ground and top of well casing at each monitoring well in conjunction with the next sampling event.

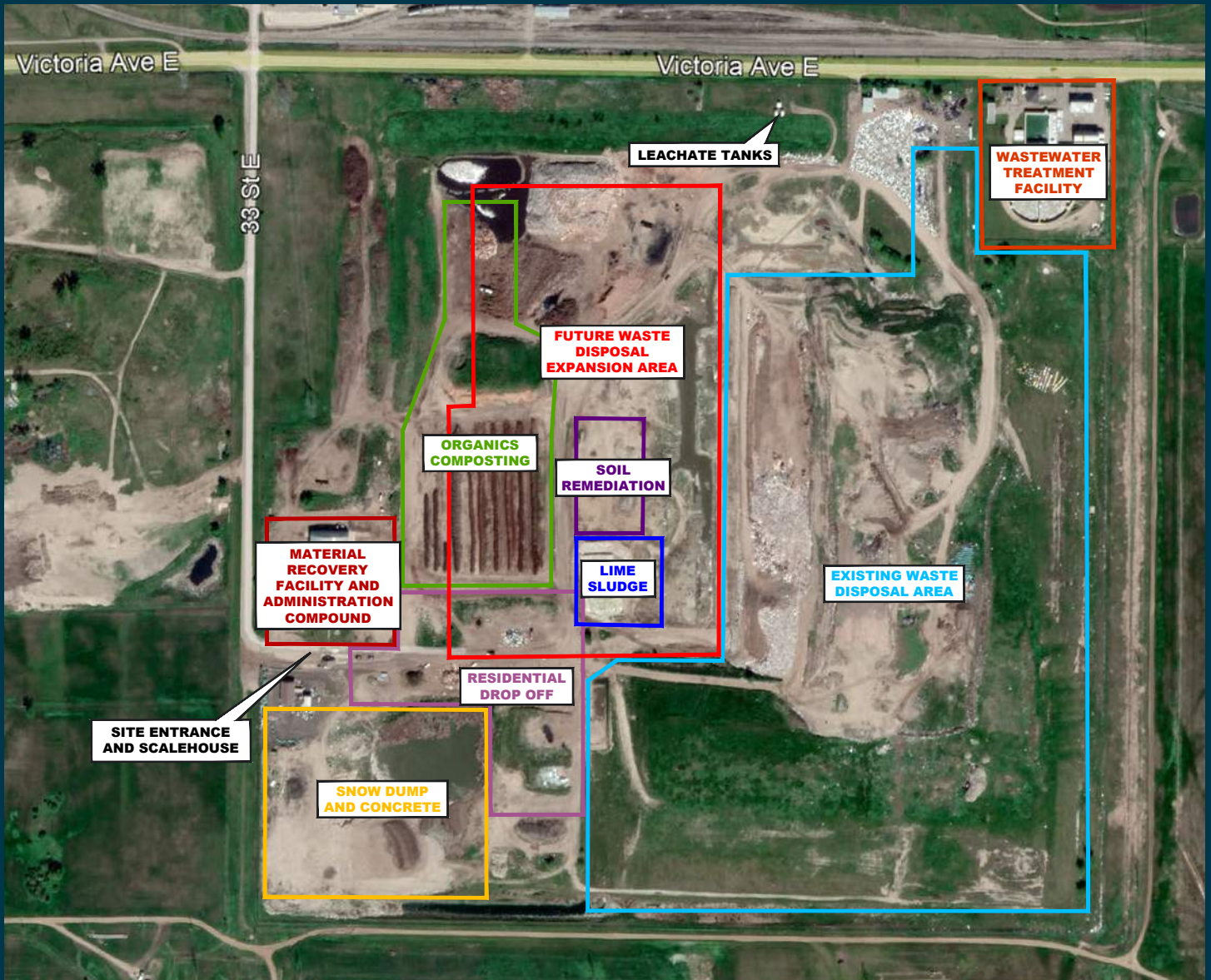


Figure E-1: Landfill Site Plan

Table E-1: Landfill Operational Summary

Item	2022 Value	Change from 2021
Captial and Special Projects	Wood Burning	Not Applicable
Waste Disposed	31,653.47 tonnes	+3.1%
(All) Materials Diverted	5,842.27 tonnes	-7.2%
Customer Visits	49,280	-8.1%
Landfill Airspace Consumed	Not Assessed	Not Assessed
Landfill Airspace Remaining	Not Assessed	Not Assessed
Changes to MECP Approved Plans	None	Not Assessed
Reportable Incidents	Wood Pile Fire (Nov. 3, 2022)	Not Assessed

Table E-2: Key Landfill Performance Metrics

Metric	2022 Value	Change from 2021
Waste Disposal Per Capita	0.62 tonnes/capita	+0.02 tonnes/capita
Apparent Waste Density	Not Assessed	Not Assessed
Groundwater Quality	No Significant Concerns	In Line with Historical Results
Surface Water Quality	No Significant Concerns	In Line with Historical Results
Greenhouse Gas Emission Reduction by LFG Collection and Flaring	2,624 tonnes CO ₂ e	-72%
Annual LFG Flow Volume	12,004,720 scf	-77%
Lost Time Incidents	None	Not Assessed
Non- Compliances	None	Not Assessed

Introduction

The City of Brandon (City) operates the Eastview Landfill (Landfill) located in Brandon, Manitoba. The Landfill operates as a Class 1 Waste Disposal Ground (WDG) under Manitoba Environment Act License No. 3149 (License). The License was issued by Manitoba Conservation and Climate, now Manitoba Environment, Climate and Parks (MECP) on August 25, 2015.

The 2022 Annual Operations Report is provided to fulfill the City's License requirement to annually report on operations and monitoring at the Landfill. This Annual Operations Report covers the operational period from January 1, 2022 to December 31, 2022.

Tetra Tech Canada Inc. (Tetra Tech) was retained by the City to prepare this Report.

Site Ownership

The Landfill is owned and operated by the City, and serves the City, the Rural Municipality (RM) of Cornwallis, and surrounding areas.

Registration and Reporting Requirements

Landfill design and operation in Manitoba is regulated by the Manitoba Environment Act, the Standards for Landfills in Manitoba, and the Landfill Gas (LFG) Management Regulation. Health Canada's Guidelines for Canadian Drinking Water Quality are also used in assessment of groundwater quality. The License details general operational terms and conditions for the Landfill.

The Landfill is classified as Class 1 WDG, which is defined as a landfill that:

- Receives more than 5,000 tonnes of solid waste in a year or 400 tonnes of solid waste in a 30-day period;
- Receives solid waste from outside the province; or
- Is operated by anyone other than a municipality or regional waste management authority, and:
- Disposes of solid waste generated by the operator; or
- Receives solid waste generated by others for commercial purposes.

The License details performance criteria for surface and groundwater quality, leachate management, LFG, and public health and safety. Clause 104 of the License identifies that an annual operations and monitoring report should be submitted to MECP. Table 1-1 summarizes the required information and location within the Annual Operations Report.

Table 1-1: Table of Concordance

License Requirement	Page
A summary of any construction activities which occurred at the Landfill	14
The mass of each type of waste received (solid waste to tipping face, compost feedstock, petroleum contaminated soils, special wastes, etc.)	16
The mass of each type of material that was removed from the Landfill (recyclables, treated soils, compost, etc)	19
A summary of the monitoring report results from air, groundwater, and surface water as per Clauses 86, 94, and 99 of the License, respectively	30
The volume of leachate which was removed from the Landfill for treatment	34
Summary reports and details of all incidents that required implementation of the contingency plan	36
Summary report of noise or odour complaints received	38
Summary report of any fires within the Landfill requiring notification as per Clause 11 of the License	37
Comparison of results of reports submitted in previous years to show trends and variances	38

The report contents are based on operational information provided to Tetra Tech by the City. Information regarding the Landfill groundwater and surface water monitoring program has been summarized from the 2022 Water Quality Monitoring Report by Kontzamanis Graumann Smith Mac-Millan Inc. (KGS Group) (2023). Information regarding the LFG reporting program has been summarized from the 2022 Annual Monitoring Report Eastview Landfill Gas Collection and Flaring system by Integrated Gas Recovery Services (IGRS) (2023).

Site Description

The Landfill is located at 765 33rd Street East in Brandon and is accessed via 33rd Street East from the west side of the site. The Landfill operates seven days per week from April 1 through September 30 and six days per week from October 1 through March 31 with varied hours of operation.

Site facilities include:

- Former and active disposal areas.
- Commercial and residential disposal areas.
- Scale and scale house.
- Snow removal dump site (City use only).
- Clean fill disposal.
- Concrete disposal area.
- LFG collection system.
- Material Recovery Facility (MRF).
- Designated stockpiles for metals, propane tanks, tires, yard waste, and branches.
- Freon device removal depot.
- Eco-Centre for used oil, filters, and containers.
- Tree and wood chipping.
- Composting.
- E-waste depot.
- Household hazardous waste (HHW) depot.

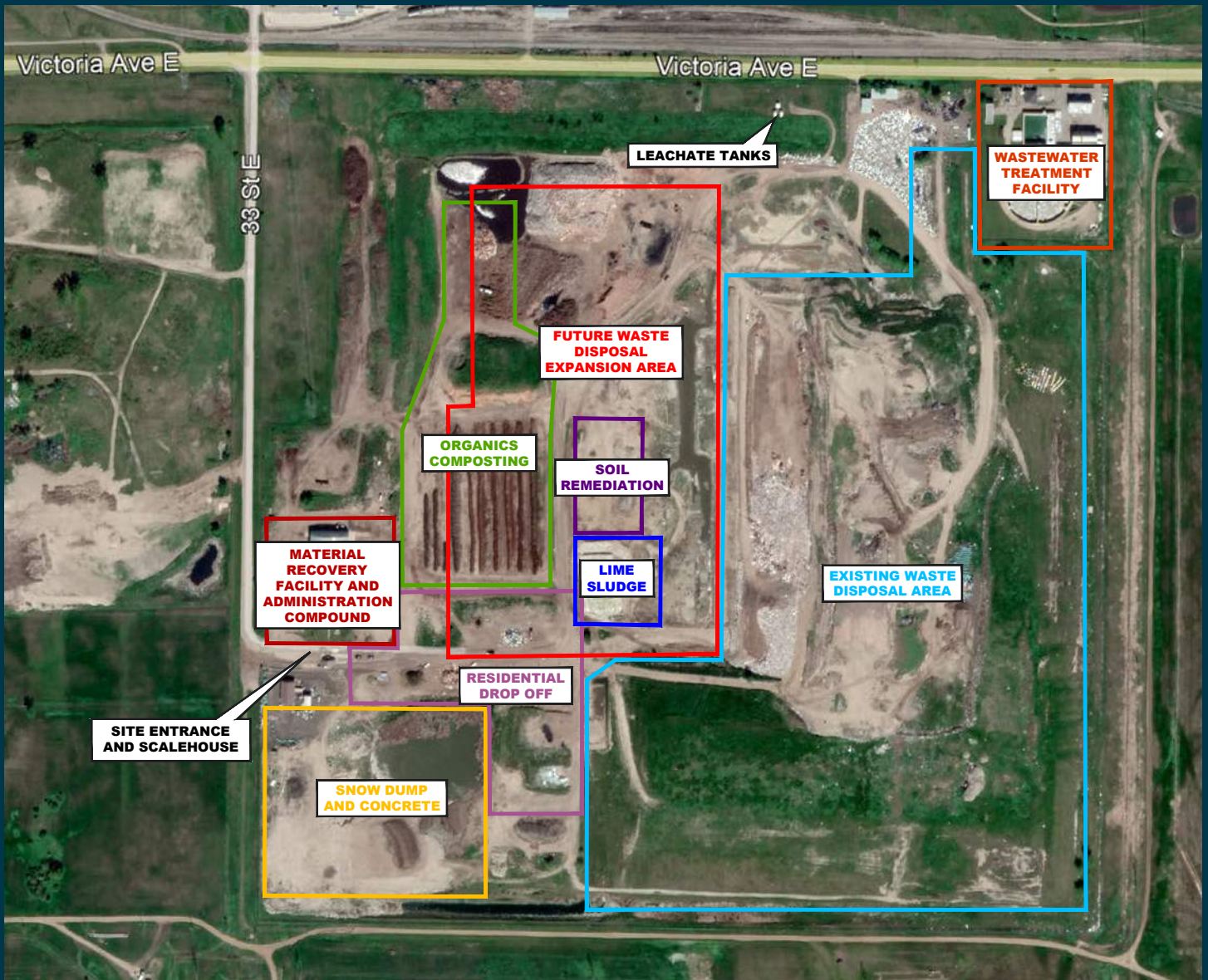


Figure 1: Landfill Site Plan

Site History and Development

The Landfill covers approximately 61.5 hectares in an eastern industrial area of the City. Previous site investigations conducted by Earth Tech identified distinct three stratigraphic units underlying the Landfill: sand and gravel fill (0 m to 4 m), brown to grey till (3 m to 14 m), and silty sand (14 m to end of logs) (Earth Tech 1999).

Landfilling is reported to have commenced in the 1970s and waste was historically placed in the southeast and east areas of the Landfill.

The following summarizes the developed and undeveloped areas within the Landfill design footprint, also shown on the KGS Group Landfill Cell Design Master Plan, shown as Figure 2.

- Cell 1 to Cell 6 – Developed along the eastern edge of the Landfill, unlined cells from the 1970s and 1980s that have been closed and capped.
- Cell 7 – Developed in 1994, a Geosynthetic Clay Liner that has been closed and capped.
- Cell 8 to Cell 12 – Developed between 1996 and 2003, High-Density Polyethylene (HDPE) lined cells that have been closed and capped.
- Cell 13 to Cell 16 – Developed between 2009 and 2017, HDPE lined cells that are currently in use.

The City has several proposed cells planned for the northwest portion of the Landfill.

Leachate is collected from lined disposal cells. There are eight manholes located around the perimeter of the waste disposal areas. These manholes collect leachate which is then pumped directly into leachate storage tanks located directly west of the old scale building. Figure 1 shows a map and utilization plan for the Landfill.

Asbestos is placed along the east side of Cell 13 and Cell 14 where it is covered and surveyed. Customers must purchase a permit to dispose asbestos in the Landfill. A separate permit is required for each day that asbestos is delivered to the Landfill.

In 2021, KGS Group developed an updated Closure and Post Closure Plan for the Landfill, which included final design contours based on a landfill lifespan that predicted closure in 2053. The City has a levy of \$5.00 per tonne to cover landfill closure and post closure costs.



Site Operations and Development

Waste is received from City municipal, commercial, and industrial sectors, the RM of Cornwallis, and drop-off loads from surrounding areas. To assist with traffic flow, waste is segregated into the following areas for disposal:

- Cell 13 and Cell 14 for large commercial traffic.
- Cell 15 for residential direct haul loads.
- Cell 16 for City collection vehicles.

A public recycling and yard waste drop off depot is located outside of the entrance gate to the Landfill. Inside the Landfill, incoming loads are scaled with scalehouse staff providing traffic to the appropriate drop off areas. There are segregated public drop off areas for grass, trees, wood, metal, tires, and glass along the south side of the main road.

2022 Projects

The City did not complete any capital improvement projects at the Landfill in 2022.

Special Projects

The City completed a wood incineration project in 2022, after submission of a Notice of Alteration to the Province of Manitoba. A fire related to the wood incineration project is further discussed in Landfill Fire Reporting.

Future Capital Projects

KGS Group was contracted by the City to complete a Long-Term Capital Plan in 2021 which laid out a timeline and vision for capital improvements at the Landfill. Projects identified include:

- Expansion of the LFG collection system.
- Recommendations for future options on alternative daily cover.
- Technologies for reducing landfilling.
- Vertical and horizontal expansion.
- Alternate composting solutions.
- Wood waste management.



Figure 2: Landfill Cell Design Master Plan (KGS Group 2017)

Waste Received, Recycled, and Discharged

All waste generated within the City is either hauled directly by City collection trucks, commercial haulers, or self hauled by small businesses and residents. In 2022, the total waste disposed in the active cells was 31,653 tonnes. The City tracks the following categories of waste:

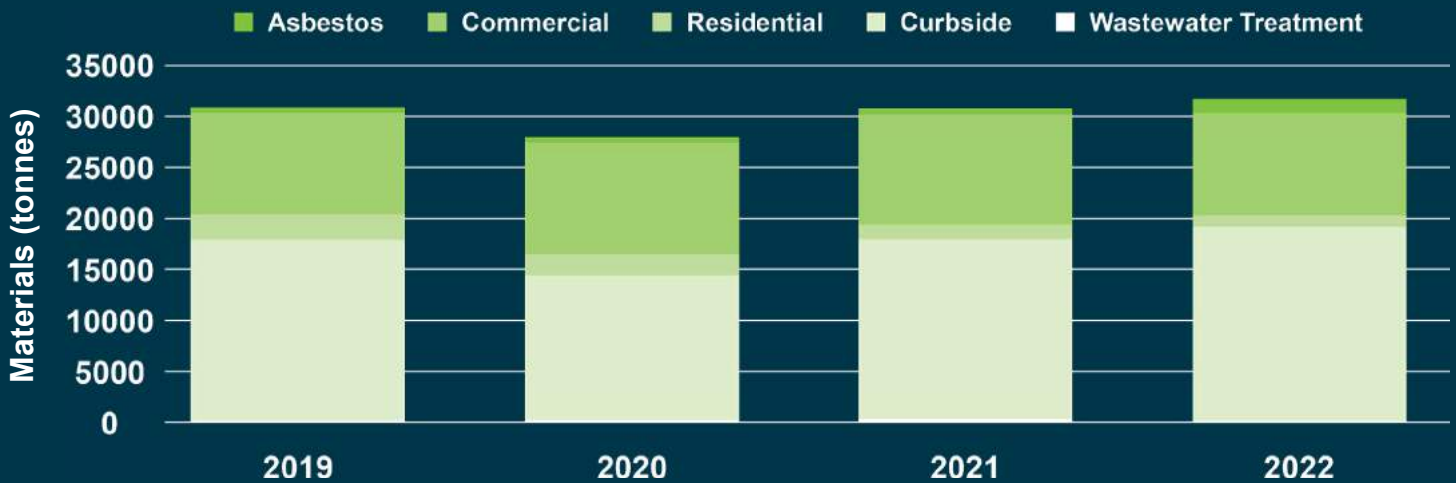
- Asbestos.
- Commercial mixed refuse.
- Residential mixed refuse.
- City curbside collection.
- WWTP sludge.

Table 3-2 shows materials disposed in the Landfill from 2019 to 2022.



Table 3-2: Waste Disposed in the Eastview Landfill Annually

Materials (Tonnes)	2019	2020	2021	2022
Asbestos	168.87	231.98	305.03	74.12
Commercial Mixed Refuse	17,675.40	14,161.82	17,573.40	19,065.29
Residential Mixed Refuse	2,554.44	2,075.56	1,465.76	1,149.81
City Curbside Collection	9,921.21	10,918.29	10,815.32	10,024.82
Wastewater Treatment Facility Sludge	506.55	499.67	528.38	1,339.43
Total	30,826.47	27,887.32	30,687.89	31,653.47

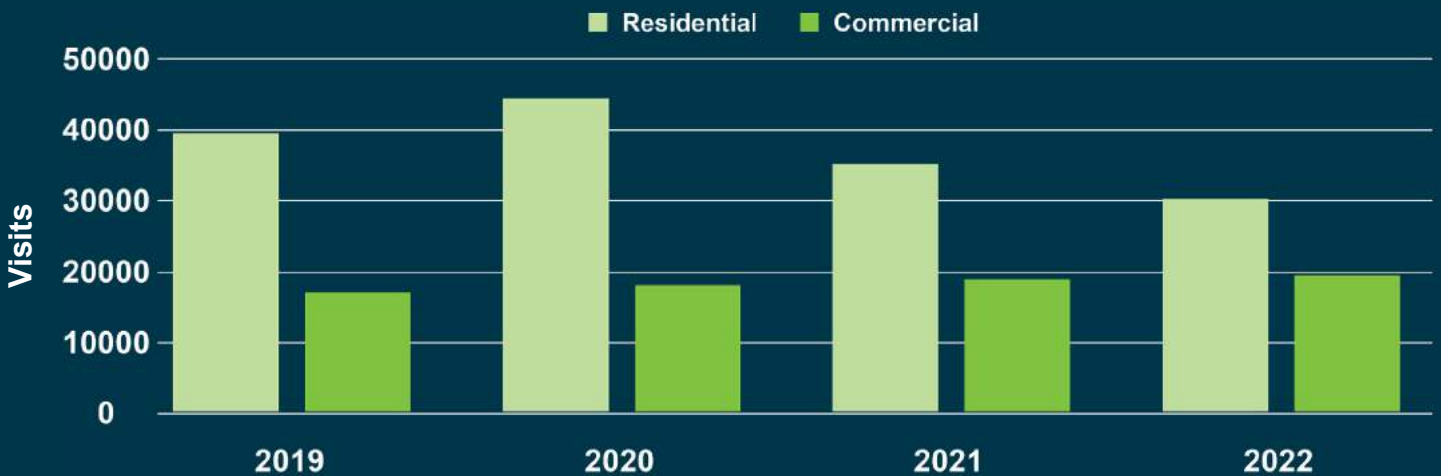


Visitors

The total number of visitors to the Landfill site in 2022 was 49,280, with 29,940 residential visits and 19,340 being commercial visits as summarized in Table 3-1.

Table 3-1: Annual Customer Visits

Visitors	2019	2020	2021	2022
Residential	39,336	44,240	34,951	29,940
Commerical	16,903	17,885	18,654	19,340
Total	56,239	62,125	53,605	49,280



Compost Feedstock

The City has operated a yard and tree trimming collection facility since the early 1990s, with material composted in turned windrows. In the subsequent years, the collection facility was upgraded to include a contact water pond collecting surface water from the composting area. Once windrowed materials have completed the active composting phase, they are placed in a curing pile. Following the curing process, the finished compost is mixed with soil, screened, and stored at the Landfill. The mixed compost and soil are used by the City for landscaping projects or sold as soil amendment to the public.

In 2022 5,842 tonnes of organic material were diverted from disposal in the landfill to the compost area at the Landfill. Organic material included green waste (yard waste, tree brush, wood waste etc.) and household organic waste. As shown on Table 3-2, the amount of organic material composted decreased by approximately 451 tonnes from 2021 to 2022. Table 3-2 shows organic quantities collected at the landfill from the residential, commercial, and industrial sector annually over the past four years. Industrial organic materials include manure and bedding wastes from the agriculture sector. Table 3-3 summarizes the tonnage on organic material diverted since 2012.

Typical compost collection programs are composed of 80% green waste and 20% household organic waste. Based on this assumption, approximately 4,670 tonnes of incoming organic material was green waste and 1,170 tonnes of incoming organic material was household organic waste in 2022.

In 2022, approximately 137 tonnes of compost was removed from the Landfill as soil amendment and approximately 75 m³ of compost was given away. The City has a large stockpile of compost remaining at the Landfill and is investigating options for removal of the compost.

Table 3-3 depicts the collection of diverted organic materials between depot, self-haul, and curbside collection over the past four years. Curbside collection by the City remains the primary source of diverted organic materials.



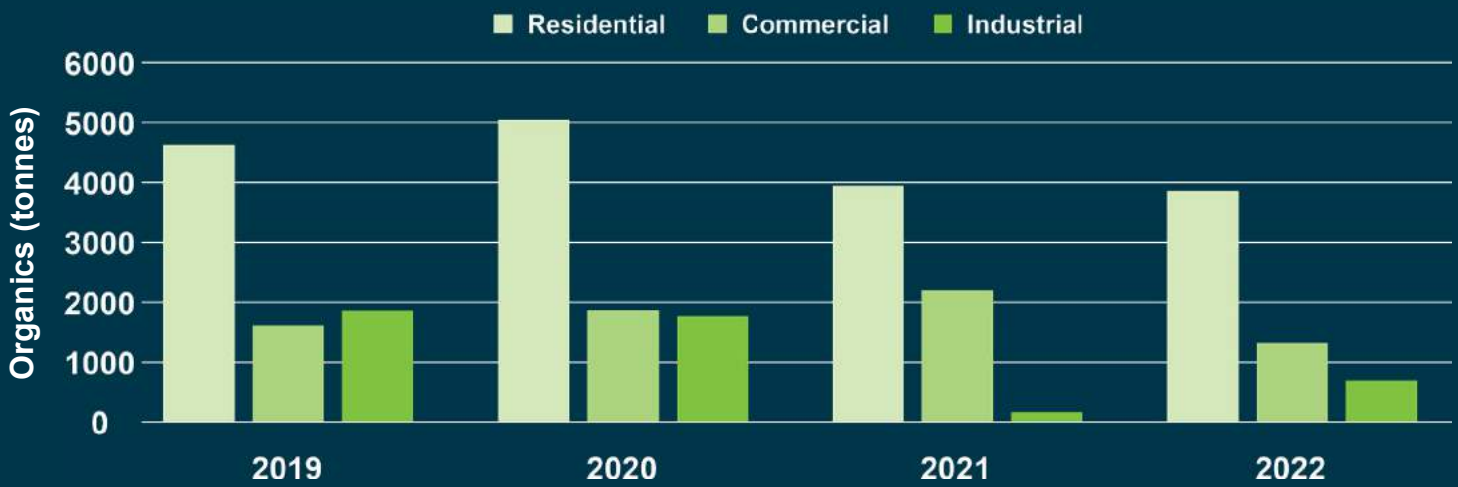
Table 3-2 Comparison of Collection Methods for Organic Materials

Material (tonnes)	2019	2020	2021	2022
Depots	400.79	423.74	381.53	313.76
Self-Haul	329.17	401.34	268.58	238.06
Curbside	2,119.34	2,231.47	1,988.94	2,219.42
Total	2,849.30	3,056.55	2,639.05	2,771.24



Table 3-3 Organic Quantities to the Landfill

Material (Tonnes)	2019	2020	2021	2022
Residential	4,261.00	5,044.42	3,940.42	3,850.70
Commercial	1,608.00	1,863.18	2,193.94	1,307.60
Industrial	1,855.00	1,763.18	159.62	683.97
Total	7,724.00	8,670.78	6,293.98	5,842.27





Household Hazardous Waste

The City has operated a HHW depot at the Landfill since 2012. The HHW depot is serviced by Product Care Manitoba in conjunction with Miller Environmental with Landfill staff receiving training on HHW handling and storage. The HHW depot at the landfill accepts items from residential sources including:

- Fluorescent lights.
- Flammables.
- Acids.
- Aerosols.
- Caustics.
- Corrosives.
- Oxidizers.
- Paint.
- Toxins.
- Physically hazardous materials such as non-refillable gas cylinders.

The Landfill received 57.9 tonnes of HHW in 2023, a slight decrease from the 58.2 tonnes received in 2021. Table 3-4 shows the total HHW received at the Landfill from 2019 to 2022.



Petroleum Contaminated Soils

The Contaminated Soil Remediation Facility accepts contaminated soils for treatment. Contaminated soils are treated with the use of a rotary plow attached to a tracked bulldozer. Once materials meet the guidelines stated in Guideline 96-05, Treatment Disposal of Petroleum Contaminated Soil (MECP 2010), they are stockpiled for use as cover material in the active waste disposal areas. The Landfill received 78.8 tonnes of contaminated soil in 2022, and none was removed in 2022.

Customers are required to obtain a permit to dispose Contaminated Soils at the Landfill. Permits are issued by the City and may require pre-disposal laboratory testing. No Contaminated Soil loads are accepted without a permit.

E-Waste

The City has been diverting electronic waste (E-Waste) from the Landfill since 2010. E-Waste accepted for diversion includes most types of household electronics (i.e., televisions, monitors, computers, printers, audio systems, etc.). A total of 93.2 tonnes of E-Waste was collected in 2022. Table 3-4 summarizes trends in E-Waste diverted since 2019. E-Waste diversion has increased since 2020.

Tires

Scrap tires are stockpiled at the Landfill and removed from the Landfill via Tire Stewardship Manitoba. In 2022, 159.9 tonnes of scrap tires were removed from the Landfill. Table 3-4 shows the annual tonnes of scrap tire removed from the Landfill for recycling.

Metals

Scrap metals and household appliances that do not contain refrigerant are stockpiled at the Landfill and periodically sent to a processor. In 2022, 525.2 tonnes of scrap metal were removed from the Landfill. Table 3-4 shows total scrap metal removed from the Landfill for recycling from 2019 to 2022.

Household appliances containing refrigerant are stockpiled at the Landfill and periodically delivered to Puresphera in Winnipeg for proper refrigerant removal and recycling of components.

Table 3-4 E-Waste, Tires, Metals, and Household Hazardous Waste

Material (Tonnes)	2019	2020	2021	2022
E-Waste	110.21	76.73	86.88	93.23
Tires	236.00	196.00	280.00	159.91
Metals	416.00	546.00	555.00	525.18
Household Hazardous Waste	30.78	47.25	58.19	57.90



Recyclables

The City owns and operates an MRF for the processing of residential and commercial recyclables, with shipping and marketing contracted. The incoming material is segregated into non-recyclables, old corrugated cardboard (OCC), shredded office paper (SOP), and mixed recyclable material. Mixed recyclable materials are baled and shipped to processing plants for further sorting, while OCC and SOP are baled separately and shipped to end markets.

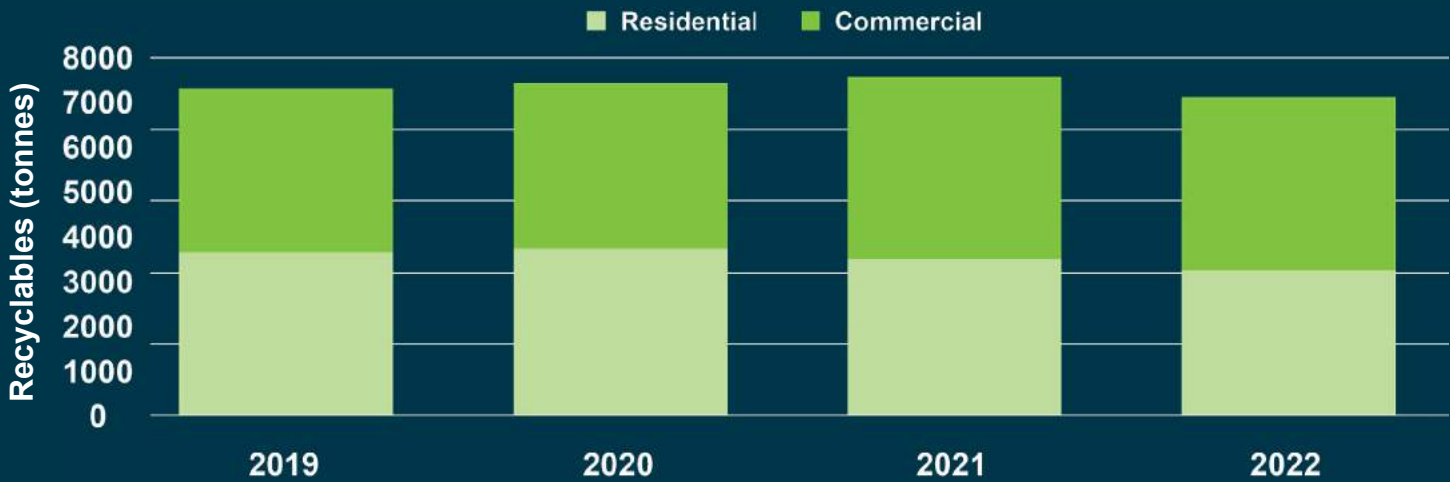
Recyclable materials are collected via curbside residential collection, commercial collections by private haulers, and from four recycling depots in the City. In 2022, a total of 7,094 tonnes of recyclables were collected, with 3,232 tonnes being residential recyclables and 3,863 tonnes being commercial recyclables. Table 3-5 shows the tonnage of material recycled annually from 2019 to 2022.

In 2022, approximately 1,785 tonnes of OCC, 3,863 tonnes of mixed recyclables, and 99 tonnes of SOP were shipped out from the MRF.

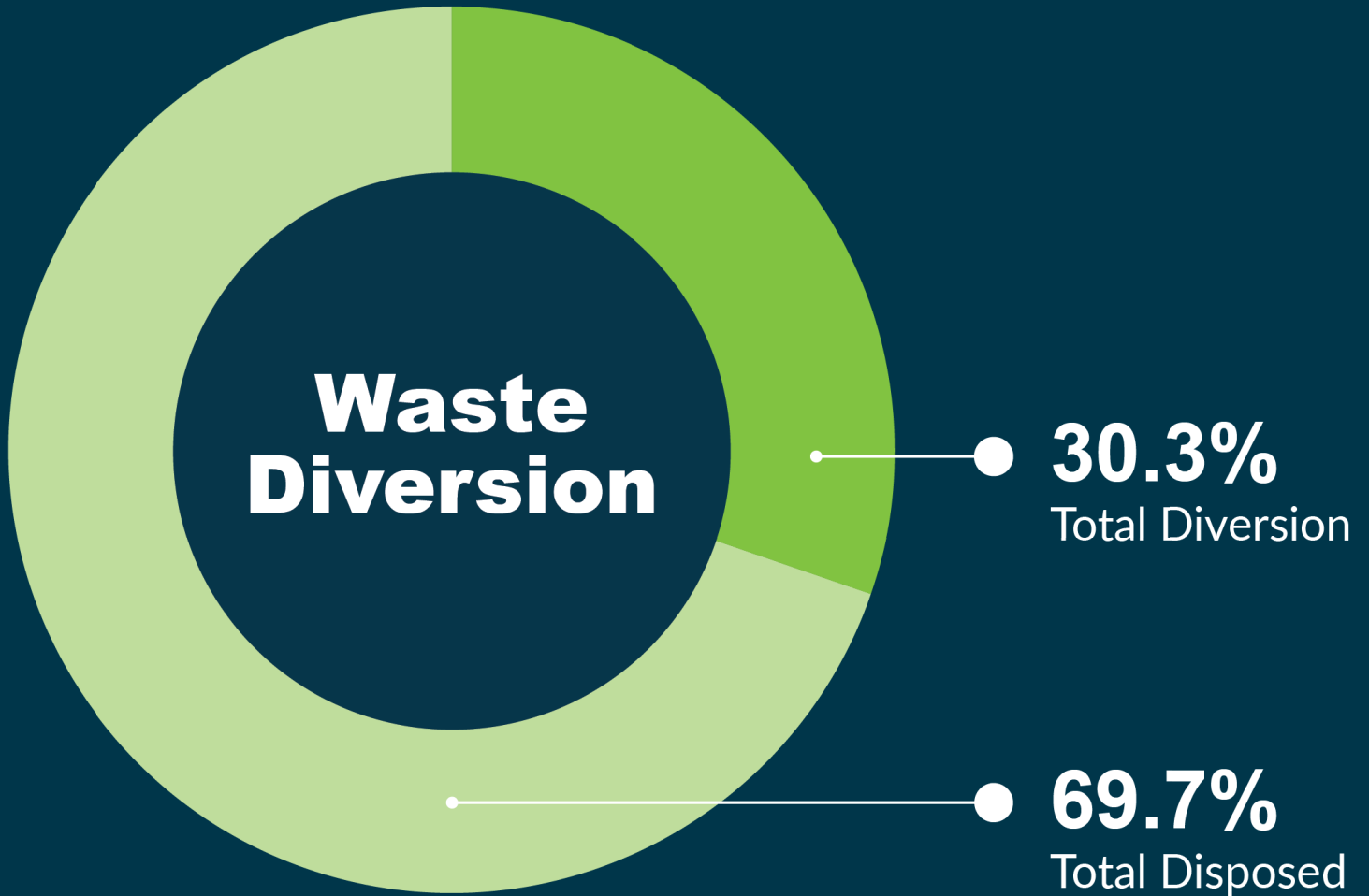


Table 3-5 Recyclables

Material (Tonnes)	2019	2020	2021	2022
Residential	3,635.00	3,703.63	3,483.96	3,231.55
Commercial	3,643.00	3,704.55	4,062.74	3,863.07
Total	7,278.18	7,408.18	7,546.70	7,094.62



Waste Diversion



Progress in Waste Diversion

The waste diversion rate has been generally consistent annually, with similar diversion noted between 2012 (30.3%) and 2022 (30.3%). 2020 had the highest rate observed to date of 37.8%. Table 3-6 provides a summary of waste diversion tracking from 2019 to 2022.

The City released a number of public advertisements on waste management best practices in 2022 in partnership with Multi-Material Stewardship Manitoba including curbside cart placement and filling information, HHW disposal locations, and E-Waste disposal information

Table 3-6 Annual Waste Diversion Rate

Material (%)	2019	2020	2021	2022
Total Diversion	33.9%	37.8%	32.6%	30.3%
Total Disposed	66.1%	62.2%	67.4%	69.7%

Environmental Monitoring Results

The City monitors and reports on four key sources of environmental impacts: LFG, groundwater, surface water, and leachate.

LFG Collection and Flaring System Monitoring

LFG monitoring was completed by IGRS and partner company Comcor Environmental Limited (Comcor) with the results of the 2022 monitoring program reported in 2023. The 2022 LFG Monitoring Report (IGRS 2023) provides a summary of monitoring and maintenance work and analysis of LFG emissions and greenhouse gas reductions. There are two main components of the LFG system that require monitoring:

- LFG collection wellfield including vertical and lateral wells; and
- Mechanical System including a blower and a flaring system.

Significant LFG system downtime occurred in 2022. Data from LFG operations was available from October 2022 and November 2022. LFG system downtime included:

- January 7, 2022 to September 9, 2022 the Programmable Logic Controllers (PLCs) monitoring the mechanical system lost connection due to internal issues with the PLC unit. The LFG monitoring system was down during this period.
- January 2022 the base of the flare froze and did not operate properly.
- December 2022 the LFG flaring system was down for unknown reasons. IGRS indicates that the cause was potentially insufficient LFG.

Minor maintenance activities were completed throughout 2022 including inspection of the condensate pump and pump drain trap, and preventative maintenance on the air compressor.

In 2022, the greenhouse gas emissions reduction due to flaring methane was 2,624 tonnes of carbon dioxide equivalent (CO₂e) and the total annual LFG flow was 12,004,720 standard cubic feet (scf). Table 4-1 provides a summary of total greenhouse gas emissions reduction and total LFG flow volume from 2019 to 2022. Due to the operational failures caused by weather and equipment failures, the recorded LFG collection and flaring decreased by over 70% year over year.

Table 4-1: Annual LFG Volumes

Year	2019	2020	2021	2022
Annual Greenhouse Gas Emission Reduction (Tonnes CO₂e)	12,404	8,338	8,953	2,464
LFG Flow (scf)	75,138,253	48,346,297	52,436,969	12,004,720

Water Quality Monitoring Results

Water quality monitoring was completed by KGS Group with results of the 2022 monitoring program reported in 2023. The 2022 Water Quality Monitoring Report (KGS 2022) provides detailed methodology and analysis of water quality. Based on the streamlined sampling and monitoring program approved by MECP in December 2017, the water quality monitoring program includes:

- Annual measurement of groundwater elevation in overburden (till and sand) materials as measured in 30 onsite groundwater monitoring wells.
- Establishment of a Primary Monitoring Network (PMN) consisting of ten onsite wells, two offsite wells, three surface water locations, and a leachate monitoring location sampled on an annual basis.
- Establishment of a Secondary Monitoring Network (SMN) consisting of 17 onsite wells and one offsite well sampled once every three years.
- Creation of set groundwater and surface water laboratory analytical packages, tailored to site conditions and current best practices.

Surface Water Monitoring Results

Three surface water locations are sampled on site on an annual basis. During the 2022 monitoring period, the surface water monitoring results identified exceedances of MAC for health-related HC-CDWQ Guidelines for manganese at two locations and nitrate at one location. AO Guidelines exceeded included chloride, sodium, TDS, iron, and manganese in at least one of the samples. The surface water monitoring results were consistent with historical data, with noted long-term improvements in alkalinity, bicarbonate, and TDS concentrations.

Exceedances in surface water are not considered a risk to the surrounding environment, as surface water from the site either evaporates or is transferred to the WTF rather than being discharged directly into the environment.

Groundwater Elevation and Flow

Groundwater elevations were highest along the southern Landfill boundary and southwest corner of the Landfill. Groundwater elevations were lowest towards the north property boundary. Groundwater flow is interpreted to be in a northeast direction at an approximate horizontal gradient of between 0.003 m/m and 0.040 m/m and an approximate downward vertical gradient of between 0.4 m/m and 0.6 m/m. This flow direction is consistent with regional groundwater flows toward the Assiniboine River.

Groundwater Quality

The PMN and SMN were sampled in the 2022 monitoring program. Results of laboratory analysis were compared to Health Canada – Canadian Drinking Water Quality Guidelines (HC-CDWQ).

The 2022 Water Quality Monitoring Report indicates that groundwater quality is generally stable at PMN monitoring wells. Laboratory results identified nitrate, benzene, xylene, arsenic, barium, chromium, and manganese exceeded applicable health related Maximum Acceptance Concentrations (MAC) of HC-CDWQ Guidelines at one or more location inside of the Landfill. The parameters exceeding MAC were consistent with historical results. There were two off-site sampling locations that exceeded MAC for arsenic and manganese.

Parameters exceeding non-health related HC-CDWQ Guidelines for Aesthetic Objectives (AO) observed at the onsite monitoring locations included chloride, sodium, Total Dissolved Solids (TDS), sulphate, ethylbenzene, xylenes, iron, and manganese. Off-site monitoring wells showed exceedances of TDS and manganese.

It was noted that arsenic exceedances may be due to naturally occurring arsenic as it is present in 15 of 30 monitoring wells and benzene concentrations have slightly increased in recent sampling programs. Groundwater quality was generally stable at monitoring wells in the PMN; however, total phosphorus, nitrate, nitrite, and ammonia concentrations have shown some variability.

KGS Group concludes that the current groundwater exceedances did not pose significant concerns.

Leachate Removal and Treatment

As part of the water quality monitoring program, one leachate sample is collected from the central leachate collection system on an annual basis. Leachate analysis identified elevated levels of most parameters tested, consistent with historical results.

There are eight manholes located around the perimeter of the Landfill that have been collecting leachate from waste cells since 1994. Leachate from Phase 7, Phase 11, Phase 12, and Phase 13 drains into a manhole at the north end of Cell 11 via perforated leachate collection pipes installed within previous granular fill and is pumped to the leachate storage tanks located west of the old scale building. Leachate extraction is weather-dependent and typically occurs between May and October. Once leachate is contained in the storage tanks, the City WWTP controls the flow of the leachate into the WWTP.

Phase 8, Phase 9, and Phase 10 have been closed and capped with approximately 1 m to 1.5 m of clay. The volume of leachate produced in these cells has decreased from their active use. This has reduced the need to have the manholes pumped on a regular basis. The manholes are periodically checked and only pumped as needed.

In 2022, approximately 4,805 m³ of leachate was pumped to the WWTP for treatment.



Incident Reporting

Health and Safety

In 2021, the City adopted a new Landfill Contingency/Emergency Response Plan in order to meet the requirements of the new operating Permit. In 2022, there were no reportable health and safety incidents at the Landfill site.



November 3, 2022

Landfill Fire Reporting

On November 3, 2022 there was an unplanned fire within the burnable wood pile. The fire was likely the result of the 2022 wood incineration project. The fire was assumed to be started by embers from the wood incinerator that were not completely extinguished before the contractors' staff left the Landfill for the evening. The City Sanitation Department administration was notified by 911 at approximately 7:30 p.m. that a fire was happening on site and that fire fighters were requesting assistance of Landfill operators and equipment. The Brandon Fire and Emergency Services (BFES) determined that the fire would be a controlled burn and requested that the wood and yard waste located nearby be moved and that a fire break be constructed on the west berm to mitigate the spread of any further fire along a nearby grassy area. After the material was moved to a safer location, BFES left two units and staff to monitor the area. One operator from the City Sanitation Department remained on site to operate equipment if needed.

The fire was reported to MECP.



November 3, 2022

Complaints Received

The City did not receive any nuisance, noise, or odour complaints regarding Landfill operations in 2022.

All nuisance complaints reported to Landfill staff are investigated by the Manager of Solid Waste. The Landfill does not typically have issues with noise complaints due to the location of the facility being approximately 0.8 km from the nearest residential dwelling. The use of daily cover has proven successful in mitigating odours.

Key Performance Metrics

Table 8-1 summarizes key metrics used to assess Landfill and solid waste management system performance. These metrics will be tracked in future years to assist City Administration in assessing and managing performance.

Table 8-1: Key Landfill Performance Metrics

Metric	2022 Value	Change from 2021
Waste Disposal Per Capita	0.62 tonnes/capita	+0.02 tonnes/capita
Apparent Waste Density	Not Assessed	Not Assessed
Groundwater Quality	No Significant Concerns	In Line with Historical Results
Surface Water Quality	No Significant Concerns	In Line with Historical Results
Greenhouse Gas Emissions Reduction by LFG Collection and Flaring	2,624 tonnes CO ₂ e	-72%
Annual LFG Flow Volume	12,004,720 scf	-77%
Lost Time Incidents	None	Not Assessed
Non- Compliances	None	Not Assessed

Summary

The following summarizes the key aspects of Landfill operations in 2022:

- The City did not complete any capital improvement projects at the Landfill in 2022.
- During 2022, 31,653 tonnes of material were received at the Landfill for disposal at the active face.
- A total of 13,773 tonnes of materials were diverted from the waste stream as recycling, compost, scrap metal, scrap tires, and HHW. This represents a diversion rate of 30.3%.
- Following MECP recommendations in 2017, groundwater and surface water monitoring events were conducted once during 2022 for the PMN by KGS Group. The groundwater analytical results identified that nitrate, benzene, xylene, arsenic, barium, chromium, and manganese exceeded applicable health related MAC of HC CDWQ Guidelines at one or more onsite locations. The parameters exceeding MAC were consistent with historical results. KGS Group concluded that the current groundwater exceedances did not pose significant concerns.
- The surface water monitoring program identified exceedances for the health-related MAC for manganese and nitrate. Exceedances above AO criteria were observed for chloride, sodium, TDS, iron, and manganese in at least one of the samples, which is consistent with past results.
- In 2022, approximately 4,805 m³ of leachate was removed from site for treatment at the WTF.
- In 2022, there were no reportable health and safety incidents at the Landfill site.
- The City did not receive any nuisance, noise, or odour complaints regarding Landfill operations in 2022.
- One fire occurred in November 2022 in the wood stockpile related to the wood burning project.

Recommendations

Based on the 2022 operational results, Tetra Tech makes the following recommendations for consideration by the City:

- Update data review and tracking systems to reflect information requested by the Environment Act License.
- Calculate landfill airspace consumption annually.
- Begin tracking and reporting on key Landfill performance metrics including apparent waste density and per capita waste disposal.

The following were recommended in reports prepared by others:

- As per the recommendations by IGRS (2022) for the LFG Collection and Flaring System:
 - Continue to operate and monitor the LFG system full time according to the Operation and Maintenance Manual for the Landfill.
 - Implement the plan to address the reduced vacuum on Lateral 2 and complete necessary repairs (scheduled for 2023)
 - Replace the gas analyzer.
 - Investigate the repair issues with freezing at the flare base.
 - Budget to overhaul the LFG blower and motor.
 - Complete upgrades to the LFG system including expanding the LFG collection wellfield.
- As per the recommendations by KGS Group (2023) for groundwater and surface water monitoring:
 - Continue to follow the streamlined Monitoring, Sampling, and Analysis Plan, as approved by MECP in December 2, 2017. Sampling of the Primary Monitoring Network is recommended to occur in 2023.
 - Complete a geodetic evaluation survey of the ground and top of well casing is recommended at each monitoring well in conjunction with the next sampling event.

Closure

We trust this document meets your present requirements. If you have any questions or comments, please contact the undersigned.

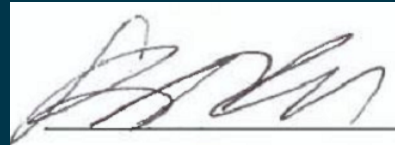
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