2019 ANNUAL REPORT FOR THE VANCOUVER LANDFILL

Prepared for:

BC MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE STRATEGY

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VANCOUVER LANDFILL OVERVIEW

The Vancouver Landfill opened in 1966 and is owned and operated by the City of Vancouver. It is located at 5400 72nd Street in Delta, in the southwest corner of Burns Bog, and is only accessible via Highway 99 Southbound.

The Landfill is responsible for the management of municipal solid waste (MSW) from commercial and residential sources within Metro Vancouver as part of Metro Vancouver's 2010 *Integrated Solid Waste and Resource Management Plan*. Most of the waste received at the Landfill is first delivered to either the Vancouver South Transfer Station (VSTS), also owned and operated by the City of Vancouver, or one of Metro Vancouver's transfer stations.

Landfill operations are regulated by Operational Certificate MR-01611 issued by the BC Ministry of Environment and Climate Change Strategy (MOE) and conducted according to engineered plans and legal agreements with Metro Vancouver and the City of Delta. These legal agreements expire in 2037 which coincide with current fill and closure plans and associated financing. The engineered plans, titled *Design Plan, Vancouver Landfill, Delta BC* and *Operating Plan, Vancouver Landfill, Delta BC*, were prepared by Golder Associates and submitted to the MOE in early spring 2019. They supersede the *Design, Operations and Progressive Closure Plan for Vancouver Landfill* prepared by Sperling Hansen Associates (2014).

The Landfill property is 320 hectares in size, which contains the footprint (area filled with garbage) at 225 hectares and a 16.7 hectare pond historically used for dredging cover material. Approximately 320 hectares of undeveloped land that were part of the original Landfill property were transferred back to Delta as shown in Figure 1. The site plan for the Landfill property is shown in Figure 2.

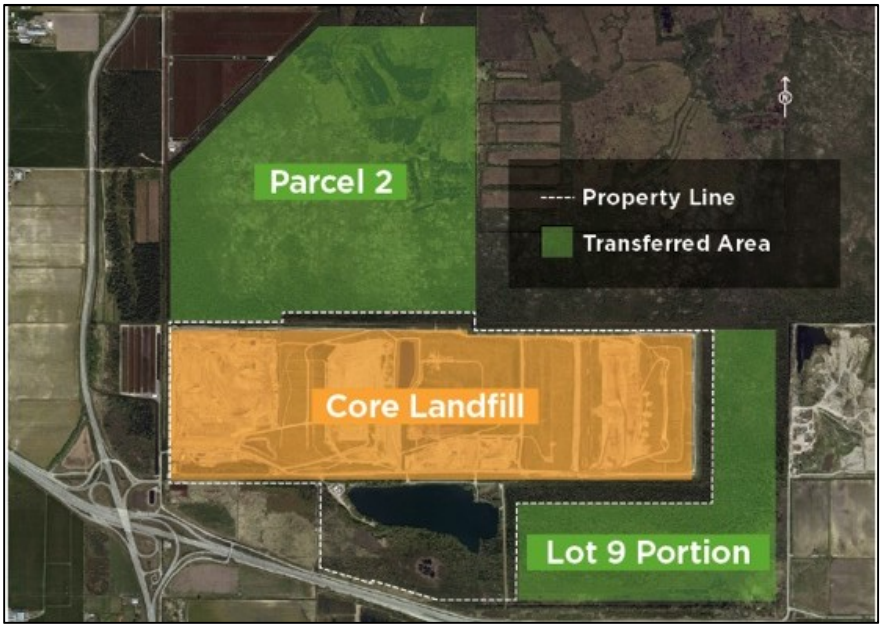

Figure 1: 2019 Vancouver Landfill Property and Footprint

The Landfill is authorized to accept up to 750,000 tonnes of municipal solid waste (MSW) for disposal each year. Materials used beneficially, such as for cover, road building and closure, are not counted towards this limit.

In 2019, 660,338 tonnes of MSW and 61,178 tonnes of demolition waste were accepted for a total of 721,516 tonnes. This reflects approximately 70% of the total MSW generated in Metro Vancouver, with the remaining 30% being delivered to the Burnaby Waste to Energy Facility and out of region landfills.

Leachate and surface runoff are collected in the inner ditch of a double ditch collection system, and then pumped to the Annacis Island Wastewater Treatment Plant under the Greater Vancouver Sewerage & Drainage District Waste Discharge Permit SC-100168-FSA. In 2019, 2.1 million m^3 of leachate, surface runoff and stormwater from closed areas were collected, pumped into the sewer and treated, at a cost of over $3 million. Fifty five (55) leachate, surface and groundwater monitoring stations were sampled quarterly as part of the Landfill's Water Quality Monitoring Program to confirm the effectiveness of the leachate collection system. Six (6) additional monitoring stations were sampled in December as part of the Landfill's Stormwater Monitoring Program to monitor the stormwater quality from closed areas and potential receiving water bodies. This program will support future discharge of stormwater outside of the leachate collection system.

In 2019, landfill gas (LFG) was extracted by 250 vertical wells, 97 horizontal collectors (monitoring points), and 32 Draintube collectors, and used off site to generate electricity for sale to BC Hydro and heat for Village Farms' greenhouses. A small portion is also used to heat the Landfill Operations and Engineering Buildings. Excess gas is burned in on-site flares at the Landfill Gas Flare Station to minimize greenhouse gas emissions. Approximately 62.5 million cubic metres of LFG (normalized to 50% methane) were collected and destroyed in 2019, which is equivalent to the emissions of approximately 86,000 vehicles. In October 2019, the BC Utilities Commission approved an agreement between the City and FortisBC to develop a facility to produce renewable natural gas (RNG) from LFG for distribution in the FortisBC natural gas system. Construction will begin in 2020 and allow the City to approach 100% utilization of landfill gas by Q2 2022.

As each phase of the Landfill is filled to design height, it is closed using an engineered cover system to minimize leachate generation and maximize landfill gas capture. Since 2010, Phases 1, 2 and 3, and all but 2.4 ha of the Western 40 Hectares (Ha), have been progressively closed. This equates to closure of a total of 105 hectares, or 47% of the landfill footprint. In 2020, closure construction for the remaining 2.4 ha of the Western 40 Hectares and Phase 4 South will completed.

The Zero Waste Centre, formerly known as the Residential Drop-Off Area, is located at the entrance to the site and provides a safe and convenient location for residential and small commercial customers to drop off waste and recyclables. Over 20 categories of materials were collected for reuse and recycling in 2019, including 6 categories of residential packaging and printed paper collected on behalf of RecycleBC. The majority of recyclables are collected free of charge.

The City also operates a composting facility to process the yard and garden trimmings dropped off at the VSTS and Landfill into finished compost for sale and donation. In 2019, approximately 26,400 tonnes of yard trimmings were composted and 7,700 m^3 of finished compost distributed.

The locations of the Landfill phases and operations areas are shown in the site plan in Figure 2.

Figure 2: 2019 Vancouver Landfill Site Plan

The purpose of this report is to fulfill the annual reporting requirements defined by the Landfill's Operational Certificate and BC *Landfill Criteria for Municipal Solid Waste, Second Edition* (BC Ministry of Environment, 2016). This report also includes the MOE Annual Status Form. Additional information on the Landfill including hours of operation, location and disposal rates is available online at vancouver.ca/landfill. Historical annual reports are also available online at vancouver.ca/landfill-annual-report.

CITY OF VANCOUVER

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1. Introduction

This annual report covers the period from January to December 2019, and has been prepared to fulfill the requirements of the Landfill's Operational Certificate MR-01611. This report is available online at vancouver.ca/landfill-annual-report.

Issued by the Ministry of Environment and Climate Change Strategy (MOE) on March 8, 2001, the Operational Certificate authorizes the discharge of MSW from within Metro Vancouver and other sources as authorized by the MOE and specifies the environmental protection requirements for the Landfill.

This report meets the reporting requirements in Section 3.5.2 of the Operational Certificate by providing the information listed in Table 1.

Table 1: Operational Certificate Reporting Requirements

Reporting Requirement	2019 Annual Report Section(s)
updates to the design and operating plan	2. Design and Operating Plans
revised closure/post closure costs	3. Closure and Post Closure Costs
planned improvements	4. Planned Improvements
records for waste, recyclable material and compost quantities	Table 2: Inbound Material Quantities for 2018 & 2019 Table 3: 2018 & 2019 Recycling Quantities Appendix 1: Annual Waste Quantities
an evaluation of recycling and composting programs, including waste diversion projections	5.2 Municipal Solid Waste Disposal 6.1 Residential Drop-Off Area 6.3 Yard Trimmings Collection and Composting
a review of receiving environmental monitoring data with interpretation, including leachate flow data and leachate/drainage ditch levels suitably tabulated	7.3 Water Quality Monitoring Program & Annual Review Appendix 6: 2019 Water Quality Monitoring Program Review Executive Summary Appendix 7: 2019 Weekly Leachate and Drainage Ditch Water Elevations
an evaluation of leachate generation control measures	7.2 Leachate Generation Control Measures
an evaluation of the efficiency of the landfill gas management systems, including an estimation of the landfill gas generation rate, percent recovery and the actual rates/volumes of gas collected, utilized and flared	7.5 Landfill Gas Collection Efficiency

Reporting Requirement	2019 Annual Report Section(s)
a list of operating problems and corrective actions taken	8.5 Operating Problems & Corrective Actions
a summary of the public complaint and resolution log	8.7 Public Complaint & Resolution Log

This report also meets the additional reporting requirements as per Section 10.6 of the BC *Landfill Criteria for Municipal Solid Waste, Second Edition* (BC Ministry of Environment, 2016) (Landfill Criteria) by providing the information listed in Table 2.

Table 2: Additional Reporting Requirements as per the Landfill Criteria

Reporting Requirement	2019 Annual Report Section(s)
total volume of waste discharged into the landfill for the year	Table 2: Inbound Material Quantities for 2018 & 2019 Appendix 1: Annual Waste Quantities
operational plan for the next 12 months	2. Design & Operating Plans
remaining site life and capacity	2.3 Remaining Capacity
closure works completed	2.1 Fill Plan & Progressive Closure Status
results of regular inspection for cover integrity, health of vegetation, undesirable plant species, burrowing animals, erosion, settlement, etc.	8.4 Site Inspections
any changes from approved reports, plans and specifications	2. Design & Operating Plans
compaction, waste to cover ratio, waste to road ratio and airspace utilization factor	2.2 Operational Efficiency
operational and maintenance expenditures	8.6 Operational and Maintenance Expenditures

As of January 1, 2016, annual reports for high priority authorizations must include an Annual Status Form. The Form for the Vancouver Landfill lists all OC conditions, all of which were met in 2019, and is included as Appendix 8.

On August 15, 2019, MOE Environmental Protection Officers conducted an inspection at the Landfill, and issued Inspection Report No. 136503 dated October 23, 2019. The report covered the period from January 1, 2018 to August 15, 2019, and found the City to be in compliance with all requirements.

2. Design and Operating Plans

The *Design, Operations and Progressive Closure Plan for Vancouver Landfill* prepared by Sperling Hansen Associates (Sperling Hansen) was superseded in 2019 by the *Design Plan, Vancouver Landfill, Delta BC* (Design Plan) and *Operating Plan, Vancouver Landfill, Delta BC* (Operating Plan) prepared by Golder Associates (Golder). The Design Plan and Operating Plan were submitted to the MOE in March and April, respectively, following consultation with the MOE, City of Delta and Metro Vancouver. The Design Plan is a reference for landfill design and progressive closure, while the Operating Plan is a guide for day-to-day operation of the Landfill. The 2019 Plans take the following into account:

- Closure of Cache Creek landfill in 2016 and redirection of an additional 110,000 tonnes or more of municipal solid waste to the Landfill annually until 2025;
- Issuance by the MOE in 2016 of the *Landfill Criteria for Municipal Solid Waste* Second Edition (Landfill Criteria), providing updated guidance for landfill design and operation;
- Approval by the MOE of a new closure plan for the Western 40 Hectares (W40Ha) in 2016;
- Completion of closure & gas works design for Phase 3 Southeast and W40Ha;
- Completion of two recent landfill gas capital projects adding horizontal collectors and vertical gas wells as well as extending the ring header;
- Upgrades to the pump station for leachate/impacted surface water as well as surface water management at the Landfill in 2014;
- Completion of the 2013 Hydrogeological Review and subsequent technical memorandums as well as the scope for the 2018 review; and
- A review of nuisance waste and asbestos management procedures at the Landfill.

The Operating Plan provides the lift by lift filling plans until Phase 5N is completely filled by about 2024, in the form of conceptual designs. The Design Plan provides the design and construction considerations to meet the OC, Landfill Criteria and City design criteria for progressive closure.

In order to manage leachate, runoff and stormwater as progressive closure continues, the Design Plan provides the concept design for a new lined pond, now known as the Phase 4 Pond.

In September 2019, the City notified the MOE by letter of the following changes to the Design Plan:

- Decreased the grade of the top of Phases 4 and 5 from 6% to 4% to have a more usable area post-closure;
- Changed the drainage orientation for Phases 4 and 5 from a crown in the middle, draining north-south, to two crowns, draining east-west;

- Filling Phase 5 South ahead of Phase 5 North to facilitate directing clean stormwater to the new pond planned for construction with Phase 4 closure in 2020.

A number of figures in the Design Plan that referenced the final contours of Phases 4 and 5 were or are in the process of being updated, along with the filling sequence figures. These will be forwarded to the MOE upon completion.

2.1. Fill Plan & Progressive Closure Status

Plan and profile views of the engineered fill plan, including projected phase closure dates, are shown in Figure 3.

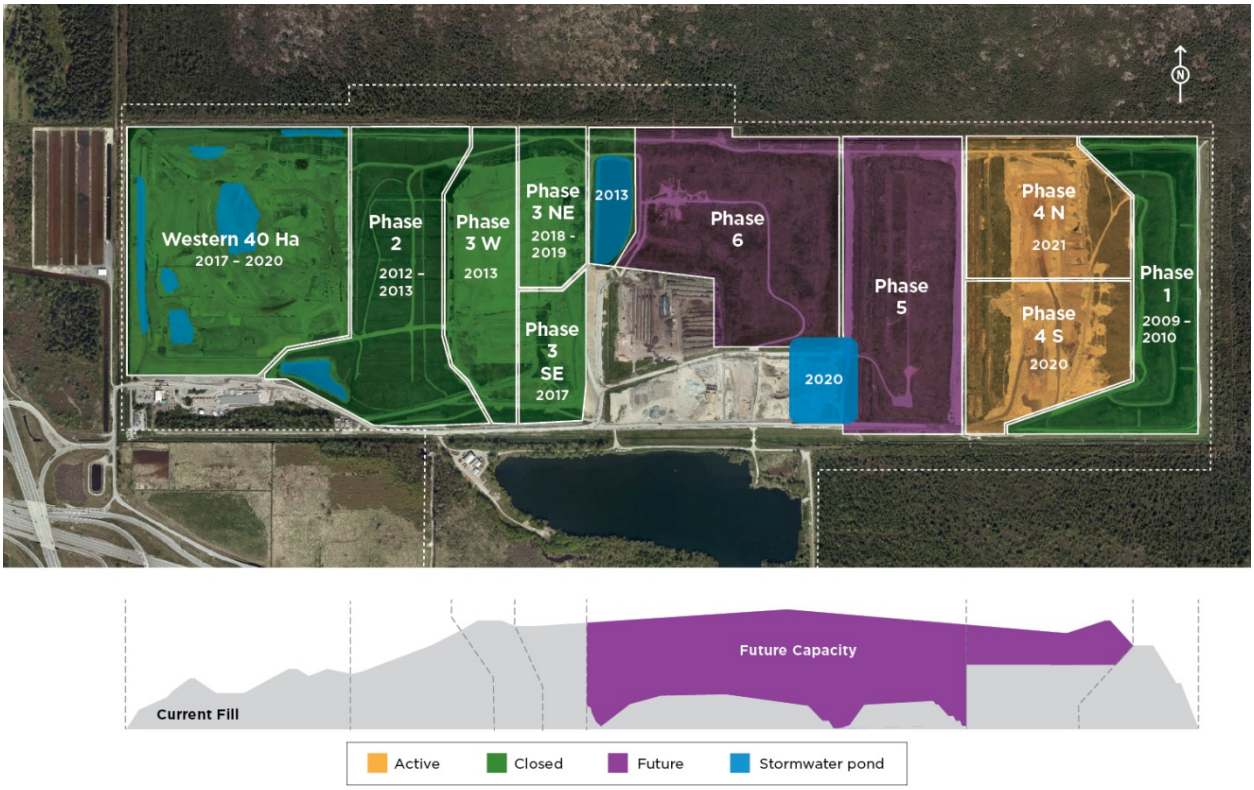

Figure 3: 2019 Landfill Fill and Progressive Closure Plan

A full time GPS Technician and one of the Landfill Engineers work closely with Superintendents and Operations staff in the active areas to ensure filling proceeds according to the intent of the engineered fill plan for each lift and phase.

In 2019, MSW filling continued in Phase 4 South, transitioned to Phase 4 North in July to allow for the construction of horizontal gas collectors, and then returned to the south in November. Some asbestos waste and demo garbage was disposed of in Phase 5 as well. Closure construction continued in Phase 3 Northeast (Phase 3NE) with substantial completion targeted in Q1 2020.

Fill areas are typically prepared with a base layer of demolition material (also known as a 'demo mat') to facilitate conveyance of leachate to the perimeter leachate ditch and the installation of gas works. The demo mat in Phase 4 North was constructed between April and May as well as in Phase 5 in May.

Contouring the Western 40 Hectares (W40Ha) with demolition material continued in 2019 until April, with closure construction of the final stage of the W40Ha (except for 2.4 ha) occurring from June through December.

A summary of the operational plan for the next 12 months is as follows:

- Disposal of demolition material in Phase 4 North and South for road building, and; in Phase 5 to complete preparation of the demo mat and facilitate drainage from Phase 4 to the new pond.
- Disposal of MSW in Phase 4 North and South.
- Planned improvements associated with MSW disposal, including installation of leachate collectors and landfill gas horizontal collectors in Phases 4 and 5, and installation of litter fencing on every lift.

As of the end of 2019, three phases have been closed with engineered cover systems (Phases 1, 2, and 3), in addition to all but 2.4 ha of the W40Ha, as detailed in Table 3.

Table 3: 2019 Progressive Closure Status

Area	Construction Timeframe	As of Dec 31, 2019			Completed by
		Area Closed	Additional Infrastructure Installed	Spend	
Phase 1	2009-2010	14 ha	22 vertical gas wells and 1 horizontal collectors; 9 stormwater discharge bridges	$ 12 M	CH2M Hill, Sperling Hansen Associates (SHA), Tyam Construction
	2012-2013	3.5 ha	Toe closure and ditch to divert stormwater to 2 southern discharge bridges only	included with Phase 2	RF Binnie Civil Engineering Consultants (Binnie), SHA, SCS Engineers (SCS), King Hoe Excavating (King Hoe)
Phase 2	2012-2013	19 ha	89 vertical gas wells and 12 horizontal collectors; 1 stormwater retention pond with 11,500 m^3 capacity	$ 17.4 M	Binnie, SHA, SCS, King Hoe
Phase 3W	2013	9.5 ha	13 vertical gas wells; 1 stormwater retention pond with 88,500 m^3 capacity (to serve all of Phase 3)	$ 15.3 M	Binnie, SHA, SCS, BD Hall Constructors (Hall)

Area	Construction Timeframe	As of Dec 31, 2019			Completed by
		Area Closed	Additional Infrastructure Installed	Spend	
Phase 3SE	2017 - 2018	9.7 ha	11 vertical gas wells	$ 10 M	Binnie, Golder, Hall
Phase 3NE	2018-2019	15.2 ha	33 vertical gas wells and 7 horizontal collectors	$ 19.9 M	Binnie, SHA, M2K
W40Ha – Stages 1-3*	2017-2019	34 ha	27 vertical gas wells, 32 Draintube collectors, and 6 stormwater retention ponds (87,700 m^3 capacity)	$ 23.5 M	Binnie, SHA, King Hoe
Total		**105 ha**		**$ 98.1 M**	
Note: * Closure of the remaining 2.4 ha of the Western 40 Hectares will occur in early 2020 ha = hectare (equal to 10,000 m^2 or 2.47 acres)					

2.2. *Operational Efficiency*

Aerial mapping and analysis has been completed at the Landfill on an annual basis since 2000. The annual flight to generate contour data is completed around the beginning of April when weather permits, and the data are typically available within three months. AECOM Canada Ltd. (AECOM) is under contract to the City to complete annual data analysis from 2017 to 2021.

The purpose of the aerial mapping and analysis is to utilize the contour data from the previous and current years coupled with the tonnages of materials disposed and beneficially used to assess the following parameters:

- Landfill settlement;
- Compaction density;
- Air space consumption;
- Waste to cover ratio and waste to other[1] materials ratio;
- Remaining capacity; and
- Lifespan analysis.

As per AECOM's *Vancouver Landfill Aerial Mapping Report April 2018 – April 2019* (2019 Aerial Mapping Report), the following operational efficiencies were achieved for the period from April 24th, 2018 to March 17th, 2019, for the Phase 4 active area:

- Compaction density of 1.04 tonne/m^3 for MSW. This value, also known as the effective density, is back calculated using assumed densities from various geotechnical sources and survey volumes after accounting for settlement.
- Airspace utilization factor of 0.96 m^3/tonne.

[1] Other refers to cover, road construction and other beneficial use materials.

- Waste to cover ratio by volume of 4.24 to 1, a waste to road materials ratio by volume of 2.91 to 1, and a waste to all other materials ratio of 1.39 to 1 in Phase 4.

2.3. Remaining Capacity

The 1999 Agreement between the City of Vancouver and the City of Delta defined the remaining capacity of the Landfill as of October 1, 1997 to be 20 million tonnes of MSW. The remaining capacity excludes any demolition waste disposed of in the Western 40 Hectares area. In 2018, City Staff reviewed and updated the historical demolition waste distribution between the Western 40 Hectares and other areas of the Landfill to more accurately align with filling records. The remaining capacity reported here as of December 31, 2019 is 7,852,948 tonnes.

The 2019 Aerial Mapping Report identified the remaining volumetric capacity for MSW as of March 17, 2019 and until the final contours are achieved to be 7.69 million cubic metres. This capacity is available in Phases 4 to 6. The volume is derived from the revised final contours prepared by Golder as part of the Design Plan.

3. Closure and Post Closure Costs

The Landfill's Operational Certificate requires the City to maintain a reserve sufficient to fund closure, post-closure and environmental contingencies related to the Landfill. The Solid Waste Capital Reserve (SWCR) was established to address these costs. In 2001, Council set the minimum balance of the SWCR at $30 million and directed that the requirements for the SWCR be reviewed every five years. At the end of 2019, the closing balance of the SWCR was approximately $63.2 million. This reflects a net decrease of $2.6 million from 2018 which is due to closure work undertaken and offset by planned operational surpluses, interest revenue and Metro Vancouver contributions.

Every year, closure and post-closure costs are reviewed and updated with current available information. For the 2019 Landfill Liability, the 2019 Design Plan was used as the primary resource. The Net Present Value for closure and post closure costs is $114.7 million, down from $116.5 million from 2018 due to 2019 closure expenditures.

As required by the 1989 Tripartite Agreement between the Greater Vancouver Sewerage and Drainage District (GVS&DD), the City of Delta and City of Vancouver, the GVS&DD is responsible for closure and post closure costs based on the proportion of regional waste in place at the Vancouver Landfill. The City of Vancouver is responsible to pay for closure and post-closure costs for Vancouver and Delta waste. At the end of 2019, 32.8% of the total waste in place at the Vancouver Landfill was regional waste, with the remaining 67.2% originating from Vancouver and Delta. This represents an increase of 4.1% in the proportion of regional waste since 2018, and corresponds to a current liability for the City of Vancouver of $63.1 million.

4. Planned Improvements

4.1. Leachate, Runoff and Stormwater Management

As filling progressed in Phase 4 North and South in 2019, leachate collectors were installed as follows:

- On the east side of lift 3 of Phase 4 North, between March and April;
- On the east side of lift 1 of Phase 5 North, between April and year end; and,
- On the east side of lift 5 Phase 4 South, between July and August.

In September 2017, the City kicked off the 2017-2021 Water Quality Consulting & Stormwater Management Planning Project following award to AECOM Canada Ltd. (AECOM). Major milestones achieved in 2019 are listed in the remainder of this section.

An action plan was developed and implemented to address the recommendations from the 2018 Hydrogeological Review. Action items completed in 2019 included:

- decommissioning and replacing select monitoring wells (see Appendix 3 for details);
- adding a pressure transducer to the piezometer transect extending south from the leachate collection system; and,
- updating salt storage requirements.

Two recommendations related to geotechnical modelling were put on hold due to limited value added at this time.

The remaining recommendations shall be either:

- completed in 2020 (geotechnical inspection, development of a database for monitoring data);
- included in the Stormwater Management Plan (water quality modelling, pilot test for discharge to the Dredge Pond, leachate collection system capacity evaluation, pump station assessment, berm upgrades); or,
- pursued as part of the 2023 Hydrogeological Review (verify conductivity of sand aquifer, review sampling manual, measure leachate levels in each phase, monitor piezometer transects).

Stormwater Management Planning continued and included stormwater modelling, feasibility studies (stormwater and surface water monitoring, and aquatic and terrestrial assessments), and stakeholder presentations and workshops. The Stormwater Management Plan (SMP) addresses the OC requirement that stormwater from above the engineered cover system in closed areas be directed outside of the leachate collection system (Section 2.8). The first draft of the SMP was delivered in November 2019 and will be revised and subject to stakeholder review in early 2020.

The design for the Remote Water Level Monitoring System was refined in 2019 and budget established which will allow for system procurement and installation in 2020.

Periodic consulting activities included a perimeter ditch overflow assessment as discussed further in the Operational Information section of this report.

4.2. Landfill Gas Collection

To maximize the collection of landfill gas during filling, 30 horizontal collectors were installed in Phase 4 North and South as follows:

- In lift 4 of Phase 4 South in January and February;
- In lift 2 of Phase 4 North in May and June; and,
- In lift 6 of Phase 4 South in October and November.

As part of the progressive landfill closure activities and detailed in section 4.3, 9 vertical wells were installed in Phase 3 North East, and 10 vertical wells were installed in the Western 40 Hectares.

The Landfill Gas Flare Station Upgrade Project continued to address long term settlement issues. Flare 2 was removed in 2018 and preloading for Flares 5 and 6 completed in April and May 2019. The new flares were installed in June with commissioning completed in October. The total flaring capacity of the five flares is 7,500 scfm.

In 2018, the City and FortisBC signed an agreement for the installation of a facility at the Landfill to produce renewable natural gas (RNG) from LFG for distribution in the FortisBC natural gas system. In October 2019, the BC Utilities Commission approved the Landfill Renewable Natural Gas Facility Project, which will be the largest in BC. Construction of the biogas facility will begin in 2020 and is expected to be completed by Q2 2022.

4.3. Progressive Landfill Closure

Construction for the Western 40 Hectares Closure & Gas System Upgrades Project was awarded to King Hoe King Hoe in May 2017, and planned to occur in three stages over a three-year period (2017-2019) due to the size of the area. Substantial completion of Stage 1 of construction (approximately 7.5 ha) was achieved in January 2018 and included the installation of 3 vertical gas wells and 3 horizontal collectors. Substantial completion of Stage 2 of construction (approximately 17.5 Ha) was achieved in December 2018 and included the installation of 13 vertical gas wells and 32 Draintube collectors. Six stormwater retention ponds with a combined capacity of 87,700 m^3 were also completed. Stage 3 work (approximately 11.2 ha) started in June and included the installation of 10 vertical gas wells. Approximately 2.4 hectares remain to be closed in 2020 due to King Hoe being requested by the City to install urgent gas works in Phase 4. As requested by the City of Delta, the Western 40 Hectares shall be returned to as natural a state as possible.

Construction of the Phase 3 Northeast (3NE) Closure & Phase 4 LFG System Expansion Project was awarded to M2K in May 2018 and started that July. Approximately 4.2 ha of liner construction was completed by November 2018 when works stopped due to weather, and 34 vertical gas wells installed by year end. The remainder of closure construction (11.8 ha) was completed in 2019 and included the installation of 9 vertical wells. Construction activities in

Phase 4 included the installation of leachate collectors and landfill gas wells as detailed in sections 4.1 and 4.2 above.

Design and construction supervision for the Phase 4 Closure and Gas Upgrades Project was awarded to Sperling Hansen and SCS in early 2019, with the ITT for construction awarded to King Hoe in early 2020. Construction includes closure of Phase 4 South (6 ha) in 2020 and closure of Phase 4 North (9 ha) in 2021. A total of 46 vertical gas wells will be installed, with 19 planned for Phase 4 South and 27 planned for Phase 4 North. A new stormwater pond will be also installed in 2020 in the former soil stockpile area to manage stormwater from the east side of the site. Stockpiling of soil for pond construction began in October 2019. Construction activities in 2020 will also include installation of an 800 mm discharge pipe to convey stormwater from Phase 1 to the Dredge Pond.

Progressive closure plans for 2020 to 2021 are summarized in Table 4.

Table 4: 2020-2021 Progressive Closure Plan

Area	Construction Timeframe	As of March 23, 2020			To be Completed by
		Area to be Closed	Additional Infrastructure Planned	Estimated Spend	
Phase 4 South	2020	6 ha	19 vertical gas wells; 2.5 ha stormwater retention pond	$ 16.1 M	Binnie, SHA, SCS, King Hoe
Phase 4 North	2021	9 ha	27 vertical gas wells	$ 13.2 M	

4.4. Landfill Facilities

Detailed design for improvements to the entrance and Zero Waste Centre (formerly known as the Residential Drop-Off area) was completed in early 2018 for the Landfill Entrance Improvement Project. The purpose of this project is to provide an expanded recycling facility with improved customer service and increase scale capacity to better separate commercial and residential traffic, reduce traffic congestion and improve safety. Construction activities were completed in 2019 and included:

- Construction of a new two-storey scalehouse for the main scales with office and meeting space;
- Replacement of the two existing weighscales and refurbishment of the scalehouse;
- Addition of two new weighscales north of the two-storey scalehouse, with a small kiosk between them;
- Expansion of the Zero Waste Centre with the installation of 6 additional drop-down bays for recycling, a cover with sprinklers for the used drywall and asbestos bin, a flex space to accept more recyclable materials and a kiosk for Staff.

4.5. Material Diversion

In 2017, a Construction & Demolition (C&D) Material Recovery Pilot Project was initiated to establish whether the material received at the landfill can be processed to recover wood waste suitable for use as an alternative fuel for local cement kilns. Processing equipment was leased to facilitate the removal of contaminants, upgrade the quality and reduce particle size to meet engineered specifications. Following the successful completion of the Pilot Project in 2018, an area of approximately 1.3 ha was identified for a future full scale facility. It was preloaded starting in November 2018 with rock that will be reused in Phase 4 closure. In 2019, the City prepared an RFP to complete the conceptual design including preliminary cost information for the full scale facility which will be issued in 2020.

4.6. Landfill End Use

As per the terms of the 1999 Agreement between the City of Vancouver and the City of Delta , the two parties shall work together to establish the end use of the site for the post-closure period. In December 2019, Delta Mayor Harvie wrote a letter to Vancouver Mayor Stewart requesting the development of a comprehensive End Use Plan for the Landfill. There is interest in investigating the possibility of the Landfill being used to support increased transit use along the Highway 99 corridor in future. It was also requested that the crest of the Landfill be designed to be as flat as possible to maximize potential end uses. Meetings will occur in early 2020 with City of Vancouver, City of Delta and Metro Vancouver Staff to continue discussions on end use planning for the Landfill.

5. Waste Disposal

In addition to Vancouver and Delta, the Vancouver Landfill directly serves the communities of Richmond, White Rock, the University Endowment Lands and portions of Surrey under the terms of the 1989 Tripartite Agreement and 2010 *Integrated Solid Waste and Resource Management Plan*. The remaining waste generated in the region was directed by Metro Vancouver to the Vancouver Landfill via the regional transfer stations, to the Waste-to-Energy Facility in Burnaby, and starting in 2017, to contingency disposal facilities outside of the region.

The Vancouver Landfill is authorized to accept up to 750,000 tonnes of waste each year, with disposal in the Western 40 Hectares restricted to demolition waste only. The annual totals for 2018 and 2019 municipal solid waste, demolition waste, cover, road construction and closure materials received are provided in Table 5. The historical quantities are shown in Figure 4.

Table 5: Inbound Material Quantities for 2018 & 2019

Material	*2019 Quantity* (tonnes)	*2018 Quantity* (tonnes)
Waste Discharge		
Municipal Solid Waste	643,574	631,243
Bottom Ash	16,755	0
Demolition Material	61,178	86,663
Cover Soil	516,712	558,856
Road Construction & Other Beneficial Use Materials		
Demolition hog	70,524	109,135
Wood waste	4,571	3,640
Crushed concrete	45,613	42,774
Purchased concrete & rock	58,615	97,000
Sand	838	
Closure Materials		
Aggregate	125,901	57,696
Sand & Soil	304,418	467,581
Total	1,848,698	2,054,588

Note:
Cover soil, road construction & other beneficial use materials, and closure materials are not included in waste discharge quantities.

In 2019, the total waste discharge was 721,508 tonnes, reflecting an increase of approximately 1% from 2018.

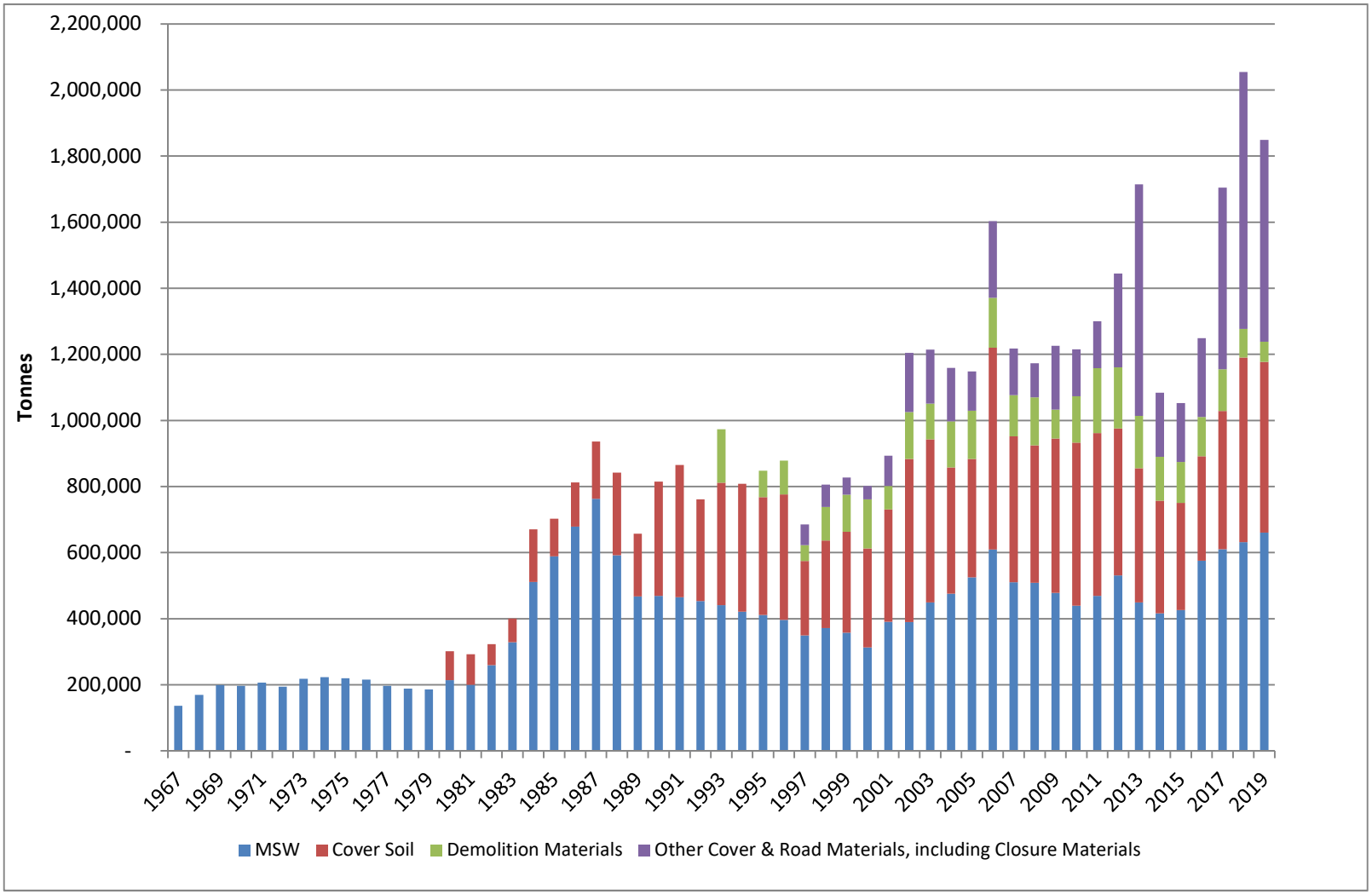

Figure 4: Historical Waste Quantities

5.1. *Waste Composition*

Metro Vancouver publishes waste composition study reports for the region, and the City of Vancouver contributes as a partner by coordinating waste audits at the Vancouver South Transfer Station. The data is combined with data gathered at the other regional facilities.

The results from the 2018 Waste Composition Monitoring Program completed by TRI Environmental Consulting (TRI) were published in June 2019 and provide current data on the composition of MSW for the following sectors:

- Single family residential waste;
- Multi-family residential waste;
- Commercial/Institutional waste;
- Drop-off or self-haul; and
- Streetscape waste.

During the 2018 Waste Composition Monitoring Program, TRI completed a single-use item (SUI) waste composition study to provide current data on the density, prevalence, composition and distribution of SUI in MSW in the region, and within the same sectors. The results were published in a dedicated report in July 2019.

TRI also completed a construction and demolition material composition study in 2018, at the Vancouver Landfill and Ecowaste Industries Landfill Ltd. in Richmond. The results of this study were published in October 2019.

The reports for the 3 waste composition studies completed in 2018, as well as those completed in previous years, are available on Metro Vancouver's website: http://www.metrovancouver.org/services/solid-waste/about/reports-resources/Pages/default.aspx

5.2. *Municipal Solid Waste Disposal*

Waste disposed of at the Vancouver Landfill is either hauled directly to the Landfill, or transferred through the Vancouver South Transfer Station (VSTS) or one of Metro Vancouver's Transfer Stations.

In 2019, a total of 660,329 tonnes of municipal solid waste was disposed of at the Landfill, primarily in Phase 4. Of this, 148,605 tonnes was transferred through the VSTS and 347,879 tonnes was transferred from the regional transfer stations. A total of 48,871 tonnes was also received as non-recyclable residuals from licensed transfer stations and material recovery facilities in the region (known as demo garbage).

Table A1 in Appendix 1 provides a breakdown of material type, origin and disposal location for 2019. Table A2 provides a breakdown of material type, origin and disposal location for 2018. Table A3 shows the breakdown by month of MSW, bottom ash, demolition material, cover material, road & other beneficial use materials, closure materials and yard trimmings for 2019. Details on some of these materials are included in the following sections.

The Landfill's Operational Certificate restricts the type of waste discharged at the Landfill to typical MSW and other materials specifically authorized by the MOE. Asbestos waste may also be discharged in accordance with the *Hazardous Waste Regulation*. All other Hazardous Waste is prohibited from disposal at the Landfill.

5.2.1. Asbestos Waste

A total of 10,250 tonnes of asbestos waste was disposed of in 2019 from commercial and residential customers, up from 9,299 tonnes in 2018.

Commercial asbestos waste is received Monday to Friday from 8:00am to 2:00pm for direct burial, while residential asbestos waste is received during regular operating hours in a dedicated bin in the Zero Waste Centre. Burials occur a minimum of 20 metres away from all other active areas, and include the placement of a minimum of 0.5 metres of material on the waste. An exposure control plan is in place that includes periodic exposure monitoring to minimize the risk of asbestos exposure to Staff. The definition of asbestos waste used in the Asbestos Policy follows the *Occupational Health & Safety Regulation*. Commercial loads of asbestos waste have to meet the *Transportation of Dangerous Goods Regulation*.

The used residential drywall pilot program at the Landfill started in September 2016 in alignment with the pilot program at two regional transfer stations, as a means of reducing illegal dumping and improper disposal of used drywall. It allows residents to deliver up to 10 bags of used drywall, up to 5 times per year. In late 2018, the pilot program expanded to the remaining three regional transfer stations as well; however it is not in place at the Vancouver South Transfer Station due to space constraints. A total of 589 tonnes of used residential drywall were received at the Vancouver Landfill in 2019, down from 699 tonnes in 2018. The decrease is likely due to program expansion to other facilities. Used drywall from commercial customers is not accepted due to capacity constraints and the availability of alternative disposal options within the commercial sector.

5.3. Other Authorized Waste

Ongoing discharges authorized by the MOE prior to 2019 are those for Non-Recyclable Wastewater Treatment Plant Residuals, Non-Recyclable Drinking Water Treatment Plant Residuals, and Bottom Ash, all of which are generated by regional facilities. In 2018, the City received temporary authorization to accept Iona Grit Dump Solids for disposal until November 30, 2024. In 2019, the City received temporary authorization to accept up to 2 tonnes of non-recyclable marine debris from the Salish Sea Nearshore Habitat Recovery Program.

5.3.1. Non-Recyclable Wastewater Treatment Plant (WWTP) Residuals

As of 1998, the Landfill has been accepting grit from the Annacis Island and Lions Gate Wastewater Treatment Plants (WWTPs), and since 2000 from Lulu Island and Iona WWTPs as well. Grit is primarily composed of materials that are denser than water and may include sand, pebbles, cinders, coffee grounds, seeds, cigarette filters and organic matter. Before grit was accepted at the Landfill, testing was conducted to confirm that it is not a Hazardous Waste. To minimize nuisance impacts, containers are tarped, drained and sealed at the WWTP to eliminate leakage during transportation to the Landfill.

In 2005, the Landfill began accepting wastewater treatment plant residuals consisting of sludge and scum screenings from Annacis Island WWTP on a trial basis. Sludge screenings are

solids composed of hair, plastic debris, paper fibers and other finer materials. Scum screenings are floating materials such as toilet paper, waste paper products, plastics and other buoyant materials, which are generally combined with fat and grease. In October 2008, the MOE authorized disposal of wastewater treatment plant residuals from the Annacis Island WWTP at the Landfill.

In 2012, the MOE consolidated the authorizations for the disposal of non-recyclable WWTP residuals from any of the five regional WWTPs. As part of the authorization, the City and Metro Vancouver were required to develop a sampling and reporting program that meets the City's needs for operating the Landfill in compliance with the OC. In fulfillment of this requirement, Metro Vancouver completes a Waste Assessment Form for the Landfill on an annual basis to confirm that the WWTP residuals are not Hazardous Waste. Further, Metro Vancouver completes characterization sampling and reporting on a biennial basis. The most recent characterization was completed by Opus International Consultants Ltd. and dated May 2018. All waste residuals continue to be classed as non-hazardous and suitable for disposal by landfill.

In 2019, 2,802 tonnes of grit were buried as nuisance waste in Phases 4. Only 5 tonnes of sludge and scum screenings were received and buried with the bulk processed at the Waste to Energy Facility as a means of energy recovery. The tonnage of grit, sludge and scum received is reported as a separate line item in Table A1 in Appendix A1.

5.3.2. Non-Recyclable Drinking Water Treatment Plant (WTP) Residuals

In November 2009, the Landfill began accepting drinking water treatment plant (WTP) residuals from the Seymour Capilano Filtration Plant on a trial basis. The residuals consist of silt and sediment from the raw water reservoir, and the coagulants added to bind that sediment together. In November 2011, the MOE authorized the ongoing disposal of WTP residuals at the Landfill with the municipal solid waste. In 2019, Metro Vancouver diverted all WTP residuals for beneficial use as a raw material in a local cement kiln.

5.3.3. Bottom Ash

The regional Waste-To-Energy Facility (WTEF) opened in 1988 in Burnaby, and the bottom ash was originally managed at the Coquitlam Landfill. In 2001, bottom ash was first accepted as subgrade material for an expansion of the Vancouver Landfill Composting Facility. As of late October 2017, bottom ash was redirected by Metro Vancouver to the Coquitlam Landfill for use in the construction of the new Coquitlam Transfer Station, in accordance with MOE approval. Deliveries of bottom ash resumed in August 2019, following completion of the work on the new transfer station. A total of 16,755 tonnes of bottom ash were disposed of in 2019.

5.3.4. Iona Grit Dump Solids

On August 9, 2018, the MOE authorized the temporary disposal of Grit Dump Solids from a closed landfill on the Iona WWTP site, until November 30, 2024. The landfill was operational from approximately 1963 to 2000 and was historically used to dispose of material from the grit collection tanks of both the Iona and Lulu Island WWTPs, and authorized under permit PE-00023 (now Operational Certificate 00023). During the last year of operation (1999 to 2000), the landfill also accepted material from an "oily sludge farm" which consisted of petroleum hydrocarbon contaminated waste from refinery storage tanks. Material removal is

required to allow for planned upgrades to the Iona WWTP and will occur during an eight to twelve week period in the summer and early fall each year until 2024. It is estimated there is between 40,000 and 65,000 tonnes of Grit Dump Solids that requires disposal. The 2018 characterization study completed by Opus International Consultants (Canada) Ltd. confirmed that the Grit Dump Solids are not hazardous waste as defined in the *Hazardous Waste Regulation* and can be managed as nuisance waste at the Landfill. The addendum to the Study as prepared by Metro Vancouver and dated June 2018 confirmed that the Grit Dump Solids were suitable for management as regular municipal solid waste given that biological contamination levels are comparable to native soil.

As stipulated in the authorization letter, the disposal counted towards the allowable annual tonnage, and is reported as a separate line item in Table A1 in the Appendix. In 2019, the Landfill received 18,047 tonnes of Grit Dump Solids, for a cumulative total as of 2018 of 33,219 tonnes.

5.3.5. Non-Recyclable Marine Debris

In October 2019, the City received a disposal request from the SeaChange Marine Conservation Society for the disposal of approximately 2 tonnes of non-recyclable marine debris to be recovered from the Salish Sea Nearshore Habitat Recovery Program in North Vancouver. The debris was to include crab traps, tires, chains, rope, bricks, blocks and old docks. The City received an authorization letter from the MOE to allow for disposal before year end. Due to program delays, disposal was deferred until 2020 and the City was granted an extension to the disposal authorization by the MOE in late January.

5.4. Demolition Material

Demolition material is mainly wood waste with small amounts of soft construction material, which has to meet the minimum criteria for wood content of 80%. Drywall, asbestos, putrescible material and Hazardous Wastes are prohibited. In 2019, a total of 61,178 tonnes of demolition material were received at the Landfill, down from 86,663 tonnes in 2018. Approximately 10% was used for contouring the Western 40 Hectares prior to closure activities, while the remainder was used for preparation of roads, and drainage and gas collection layers in Phases 4 & 5.

5.5. Cover Materials

Cover soil for Landfill operations is primarily excavation material generated by sewer, water and street construction activities in the City of Vancouver and City of Delta.

In 2019, the Landfill received a total of 516,712 tonnes of soil. The material was distributed on site as follows:

- 20% was direct hauled to Phase 4 for cover. In addition to soil, reusable tarps are used on a regular basis in lieu of daily cover, and are deployed using the bulldozer at the Active Face.
- 38% was direct hauled to Phase 5 to cover demo waste during drainage layer construction.

- 42% was delivered to the soil stockpile area, located southeast of the Compost Facility until September when it was moved north to the other side of the main access road.

The soil stockpile area is managed by the on-site contractor, Poschner Construction 88 Ltd. (Poschner), who must maintain a minimum of 30,000 m^3 of soil in the area at all times. 'Yuke' dump trucks are used to deliver soil to the active face on an as needed basis. Poschner installed a weighscale in the area in 2016. Soil usage data by fill location is considered for Annual Aerial Mapping. In September 2019, the area was relocated north as shown in Figure 2 (2019 Vancouver Landfill Site Plan) to allow for receiving and preparing materials for construction of the Phase 4 Closure Pond in 2020.

5.6. Road Construction & Other Beneficial Use Materials

Road construction materials for temporary access roads on the active areas at the Landfill include purchased and recycled concrete, demolition (demo) hog and wood waste.

In late 2014, the City issued an Expression of Interest for the supply of clean concrete and asphalt directly from construction sites, and has since periodically brought in a crushing contractor for processing the material at the Landfill. Crushed material is used in closure works and for landfill operations. Approximately 45,600 tonnes of concrete and asphalt were received and managed in 2019, in addition to 58,600 tonnes of purchased aggregate.

Demo hog is ground construction wood waste received at a reduced fee from local wood waste processors for use as top dressing on tipping pads. In 2015, the City issued a Letter of Interest and met with demo hog suppliers after revising the material specifications. The interested suppliers deliver demo hog on a rotating basis. Effective June 2019, a reduced rate was established for 'fine' demo hog, to reflect the additional processing costs required to reduce the size to meet the City Engineer's specifications. The rate for 'coarse' demo hog was not subject to change. Fine demo hog is used to surface tipping pads, while both coarse and fine demo hog are used for road building and as a road base before placing rock for tipping pads. Approximately 70,500 tonnes of coarse and fine demo hog was received in 2019.

Since January 1, 2011, residential quantities of clean wood waste have been accepted at the Landfill at a reduced fee to encourage diversion. Starting that September, the types of wood accepted were expanded to include all wood waste free from fixtures. Wood waste is ground onsite and then used as road base and topped with demo hog.

Residential quantities of clean wood waste have also been accepted at the Vancouver South Transfer Station (VSTS) since January 2011, and the material was comingled with food and green waste collected curbside for composting at private facilities. Due to challenges meeting demo hog needs at the Landfill in 2018, the types of wood waste accepted at the VSTS was expanded for 2019 and collected separately for transfer to the Landfill. Approximately 4,500 tonnes of wood waste was received in 2019, with over 900 tonnes coming from the Transfer Station.

5.7. Closure Materials

Materials used for the construction of engineered cover systems in completed areas of the Landfill include:

- soil to contour the areas to achieve design elevations;
- a geomembrane liner as an impermeable barrier;
- aggregate to convey landfill gas and stormwater to collection systems below and above the liner, respectively; and,
- topsoil to support the growth of grass and future vegetation.

In 2019, closure contractors for the City sourced approximately 125,900 tonnes of aggregate and 304,400 tonnes of soil and topsoil for the Phase 3 North East and Western 40 Hectares Closure Projects.

6. Waste Reduction & Recycling Initiatives

6.1. Zero Waste Centre

The Zero Waste Centre (ZWC) offers a recycling area for large items not typically included in curbside collection programs (mattresses, scrap metal, white goods) and a number of Product Stewardship Program Materials (cell phones, household batteries, lead acid batteries, smoke alarms, tires, thermostats, used oil, used oil filters). On May 19, 2014, the City expanded collection to include all forms of packaging and printed paper covered by the provincial Stewardship Program, and under contract to RecycleBC. New materials collected included plastic foam packaging, plastic bags and overwrap, and glass bottles and jars. In June 2018, the City began collecting Other Flexible Plastic Packaging on behalf of RecycleBC for their pilot project as detailed later in this section.

In 2019, as part of the Landfill Entrance Improvement Project, the City expanded the Zero Waste Centre. The expansion provides the opportunity to manage existing material streams more effectively and plan and implement the collection of additional materials for reuse and recycling such as carpet and paint.

Recycled quantities received are provided in Table 6. Starting in 2016, the quantities of those materials measured in litres and units have been converted to tonnes. The conversion factors used were provided by Metro Vancouver and Product Stewards.

The total amount of materials recycled in 2019, including the tonnes associated with materials measured in litres and units, was 1,719 tonnes, compared to 1,629 tonnes in 2018.

Table 6: Recycling Quantities for 2018 & 2019

Item	2019	2018	Units
Clothing	6.6	1.8	tonnes
Containers (Plastic, Metal, Paper)[1]	2.9	2.8	tonnes
Cooking Oil	0.6	0.4	tonnes
Drywall, new scraps only	123	136	tonnes
Electronics & Small Appliances[1]	117	113	tonnes
Fire Extinguishers	0	0.5	tonnes
	0	*214*	*units*
Glass Bottles & Jars[1]	5.4	3.8	tonnes

Item	2019	2018	Units
Household Batteries & Cell Phones[1]	0.7	0.0	tonnes
Items for Re-use	n/a	n/a	tonnes
Lead Acid Batteries[1]	11.3	10	tonnes
Light Bulbs[1,2]	1.1	0.5	tonnes
Mattresses	247	220	tonnes
	9,146	*8,809*	*pieces*
Mixed Paper & Cardboard, Commercial	18	19	tonnes
Mixed Paper & Cardboard, Residential[1]	209	214	tonnes
Other Flexible Plastic Packaging (new in 2018)	1.6	0.1	tonnes
Plastics Bags & Overwrap[1]	3.1	3.9	tonnes
Plastic Foam Packaging[1]	5.7	6.4	tonnes
Product Care Items (Paint, Aerosol, Solvent)[1,2]	3.8	6.1	tonnes
Propane Tanks	3,317	280	*units*
	4.3	2.3	tonnes
Refrigerators, Freezers & Air Conditioners	198	150	tonnes
	2,936	*1,160*	*units*
Scrap Metal (excluding Refrigerators, Freezers & Air Conditioners)	685	674	tonnes
Smoke Alarms[1]	*4*	*0*	*boxes*
Tires[1]	47	38	tonnes
	4498	*3,199*	*units*
Waste Antifreeze[1]	1.2	0.4	tonnes
	1,160	*455*	*litres*
Waste Oil[1]	24	27	tonnes
	27,049	*30,737*	*litres*
Waste Oil Filters[1]	1.7	1.5	tonnes
Total[3]	**1,719**	**1,629**	**tonnes**

Note:
n/a means not available
[1] product stewardship program material
[2] abandoned or recovered from waste stream
[3] includes tonnes calculated for those items measured in units, pieces, and litres. The conversion factors used were provided by Metro Vancouver and Product Stewards.

Additional details for select materials are as follows:

- Mattress quantities reported in Table 3 reflect those delivered directly to the Landfill by customers. In 2018 and part of 2019, mattresses received at the Transfer Station from customers and City Crews were transported to the processor via the Landfill. This included 7,627 mattresses in 2019 and 19,485 mattresses in 2018.
- Batteries and used oil related items (oil, filters and containers) are the only Household Hazardous Waste (HHW) items accepted at the ZWC. However, other types of HHW such as paint, pesticides, antifreeze, and flammables, are periodically abandoned or

recovered by staff from disposal. These items are sorted into a temporary storage facility in the ZWC for collection by Product Stewards and contracted professionals.

- In 2011, the City initiated a partnership with the Salvation Army for the diversion of items of value for reuse. Since the Salvation Army operates in partnership with the product stewards for Electronics (Encorp) and Small Appliances (Product Care), they also manage the end-of-life electronics collected at the Landfill. In February 2017, the program to divert items of value was suspended given the need to pre-load the area for facility expansion. The end-of-life electronics program continues and has diverted over 1,200 tonnes since 2011.
- Starting in June 2017, residential volumes of cooking oil (maximum 10 L per day) have been accepted free for recycling at the ZWC. Staff bulks the oil for periodic collection with a vacuum truck.
- As per RecycleBC's website[2], Other Flexible Plastic Packaging are types of film and flexible plastics that often include multiple layers of different types of plastic, making it more difficult to recycle. Collection of Other Flexible Plastic Packaging is part of a research and development project to determine how to best recycle this material. During this time, material that is unable to be recycled will be recovered and produced into engineered fuel.

6.2. Disposal Bans

Since 2008, the City of Vancouver has enforced disposal bans in alignment with Metro Vancouver to reduce the amount of material being landfilled that could instead be recycled, and to follow BC's *Recycling Regulation* (defines materials to be managed under provincial Product Stewardship Programs).

The materials banned from disposal as garbage at the Landfill are defined in the appendices of the City's Solid Waste Bylaw, and mirror those in Metro Vancouver's Tipping Fee Bylaw in most cases. Both Bylaws were updated for 2015 to more effectively categorize the banned materials as follows:

- Banned Hazardous & Operational Impact Materials
- Banned Recyclable Materials
- Banned Product Stewardship Program Materials

The category of Banned Recyclable Materials was also expanded to include food scraps and clean wood.

The Disposal Bans are enforced by Metro Vancouver's Inspection Officers that randomly visit the City's disposal facilities. Disposal Ban Violation Notices and surcharges are issued to those customers that dispose of banned materials in excess of the defined thresholds. Appendix 2 contains a complete list of materials that are accepted for recycling at the Vancouver Landfill and those that are banned from disposal as garbage.

[2] https://recyclebc.ca/flexiblepackaging accessed March 24, 2020

6.3. Yard Trimmings Collection and Composting

Since 1995, the Landfill has operated a composting facility for yard trimmings to divert organics from disposal. Major milestones in the history of organics diversion in the City are as follows:

- 2000 - City crews began collecting residential yard trimmings at the curbside for composting at the Landfill.
- 2006 - curbside collection was automated to reduce injuries to collection workers.
- April 2010 - the City added food scraps to the curbside collection program for single family residents. Since food scraps are not authorized for composting under the Landfill's Operational Certificate, commingled yard trimmings and food scraps from the curbside program are directed to a private composting facility in the region.
- January 2015 – the City bans food scraps from disposal as garbage

The yard trimmings delivered by customers to the Vancouver South Transfer Station and Landfill continue to be composted at the Landfill, in addition to the leaves collected from City Streets by City Crews. Starting in 2019, yard trimmings were also delivered from two of the regional transfer stations (Maple Ridge and Langley), due to the closure of one of the commercial composting facilities in the region. In 2019, a total of 26,400 tonnes of yard trimmings was received, up from approximately 20,000 tonnes in 2018.

The Composting Facility includes a 4.8 hectare paved surface, dual-shaft shredder, excavator and two front-end loaders. A rental star screener has been used since 2015 on an as needed basis. A windrow-turner was added one to the fleet in 2019 to replace a front end loader.

The static windrow composting method is used to process yard trimmings into finished compost. The feedstock is ground up and placed in windrows (piles) using front end loaders, then turned regularly to maintain optimal oxygen and temperature levels throughout. After a minimum of six months in windrows, the material is screened typically in the spring and stockpiled for curing and subsequent sale or donation.

Approximately 7,700 cubic metres of finished compost were distributed in 2019, compared to 9,200 in 2018. Compost sales totaled 6,200 cubic metres, of which approximately 300 was purchased at a reduced rate by Delta Farmers. The remaining 1,500 cubic metres was donated to City of Delta and City of Vancouver residents during free compost campaigns in April and May, respectively.

Compost quality is compared to standards set out in the MOE's *Organic Matter Recycling Regulation* based on the feedstock and composting method used. In 2018, the compost met the standards for unrestricted distribution for all parameters listed in the Regulation. A summary of the compost quality in 2018 and 2019, and the standards for unrestricted use, are provided in Table 7.

Table 7: Compost Quality for 2018 & 2019

Parameter	BC Standard mg/kg unless stated	2019 Mean Value mg/kg unless stated	2018 Mean Value mg/kg unless stated
Arsenic	13	4.8	6.9
Cadmium	3	0.6	0.5
Chromium	100	24.6	20.6
Cobalt	34	5.9	4.5
Copper	400	88.8	98.6
Lead	150	38.2	48.6
Mercury	2	0.1	0.1
Molybdenum	5	1.4	1.9
Nickel	62	16.5	16.9
Selenium	2	<0.50	<0.50
Zinc	500	201.6	207.1
Foreign Matter (%)	1	0.2	0.2

6.4. Diversion Projections

The 2010 *Integrated Solid Waste and Resource Management Plan* (ISWRMP) established future diversion targets, including an aspirational goal of 80% diversion by 2020. The Plan outlines initiatives for achieving these rates which include diverting demolition, landfill clearing and construction waste for recycling, as well as food waste to composting and energy recovery.

As per the *Draft 2019 ISWRMP Biennial Progress Report* produced by Metro Vancouver and dated January 2020, 64% of the materials generated in the region in 2018 were recycled or diverted from disposal. This reflects an increase of 2% from 2016 as reported in the *2017 ISWRMP Biennial/5 year progress report*.

7. Environmental Protection Programs

7.1. Leachate, Surface Runoff and Stormwater Management

Water management at the Vancouver Landfill is described using the following terminology:

- **Leachate** - produced by rainwater percolating through waste.
- **Surface Runoff** - rainwater that flows along the surface of areas of the Landfill (subject to the placement of daily or intermediate cover), and may be impacted by leachate.
- **Stormwater** - rainwater that is collected above the engineered cover system installed in closed areas of the Landfill. Stormwater is not impacted by leachate.

The Landfill site is underlain by compressed peat and a continuous layer of relatively impermeable clayey-silt, which is referred to as the natural soil barrier layer. Prior to the

placement of waste in each landfill cell, a layer of demolition materials was placed on top of the peat. This provides the conduit for leachate to flow laterally to the double ditch system surrounding the Landfill footprint as shown in Figure 5. The layer of demolition materials, natural soil barrier layer, and double ditch system are collectively referred to as the leachate collection system. The inner ditch collects leachate, while the outer ditch, more commonly known as the drainage ditch, collects clean water that runs off adjacent land. The drainage ditch is maintained at a higher level than the inner ditch to contain leachate in the inner ditch as shown in a cross-section of the leachate collection system in Figure 6. The leachate is then conveyed from the pump station located in the southwest corner of the Landfill through force mains to the Annacis Island WWTP under Waste Discharge Permit SC-100168-FSA (WDP) issued by the Greater Vancouver Sewerage & Drainage District.

In addition to leachate, surface runoff and stormwater from closed areas are routed to the inner ditch. To reduce peak discharge to the sewer system, approximately 103,000 m^3 of leachate and surface runoff retention capacity was created at the end of 2013 through the expansion of two internal storage ponds running south to north between the Compost Facility and Phase 1. The Phase 2 and Phase 3 closure areas each have a dedicated pond for stormwater retention, which had a combined capacity of 100,000 m^3 at the time of installation. Six ponds for clean stormwater were constructed in the Western 40 Hectares closure area in 2018 that have a combined storage capacity of approximately 87,700 m^3. An additional detention pond will be constructed in 2020 as part of the Phase 4 Closure and Landfill Gas Upgrades Project.

The annual fees associated with leachate, surface runoff and stormwater management include a conveyance fee paid to Delta for the use of the sewer system, and an industrial discharge fee made up of capacity and usage components for the treatment of the leachate at the WWTP. The capacity and usage charges account for biological oxygen demand (BOD), total suspended solids (TSS) and flow. In 2019, the cost associated with leachate conveyance and treatment totaled almost $3.20 million. Approximately 72% of this cost was associated with conveyance, similar to previous years.

Figure 5: Leachate, Surface Runoff and Stormwater Management

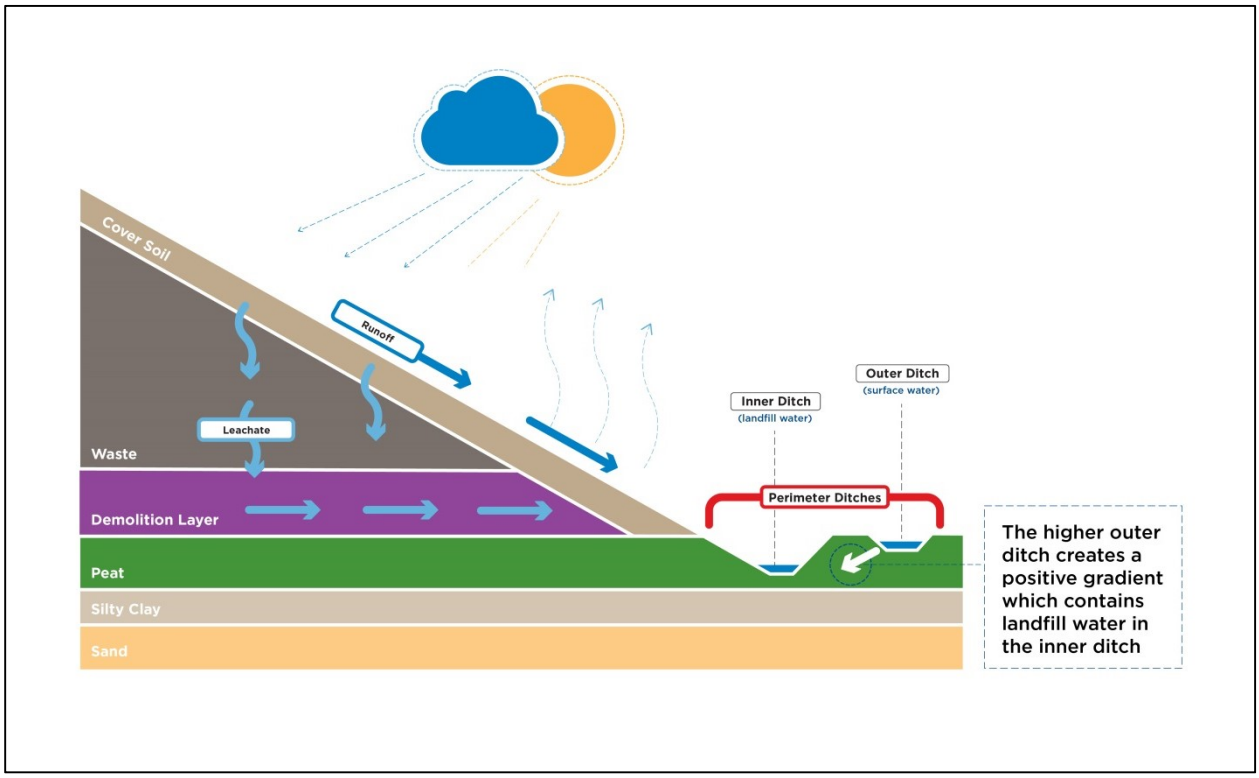

Figure 6: Leachate Collection System Cross-Section

Monthly leachate flow and precipitation data for 2019 are provided in Table 8.

Table 8: 2019 Leachate Flow Volumes and Precipitation

Month	Leachate Flow (m^3)	Precipitation[3] (mm)	Precipitation Volume (m^3)	Ratio of Leachate Flow to Precipitation Volume
January[1]	466,703	141	316,800	147%
February[1]	254,663	75	168,750	151%
March[1]	143,848	31	70,200	205%
April	193,829	111	249,300	78%
May[1]	76,305	30	68,400	112%
June	45,144	26	58,950	77%
July	39,953	31	69,300	58%
August	40,640	26	58,050	70%
September	90,891	122	274,950	33%
October	173,729	123	275,850	63%
November[1]	225,873	86	192,825	117%
December	357,947	164	369,450	97%
Total[2]	2,109,525	966	2,172,825	97%

Notes:

[1] The high ratio of leachate flow to precipitation volume reported in select months can be due to the release of stored water that occurs when the landfill becomes saturated, and to the controlled release of clean stormwater from storage ponds in the winter months.

[2] The high ratio of leachate flow to precipitation volume is attributed to an increase in landfill surface area that has been closed with an engineered cover system, and overland flow from the outer drainage ditch to the inner ditch during significant rainfall events in winter.

[3] Recorded at Vancouver Airport 1108395 since weather data at Delta Burns Bog Station 1102415 was not available as of May 2019.

A total of 2,109,525 m^3 of leachate, surface runoff and stormwater was pumped to Annacis Island in 2019. Leachate from the Vancouver Landfill is considered dilute compared to other municipal solid waste landfills because of the high volume of surface runoff and stormwater from the closed areas that are treated as leachate.

The average annual ratio of leachate discharge to precipitation volume is 86% since progressive closure started in 2009. The remaining volume of precipitation is lost from the landfill surface through evaporation. In 2018 and 2019, the total discharge represented over 95% of the precipitation volume. The increase is attributed to an increase in the surface area of the landfill that has been progressively closed (by over 40 ha or 19% of the landfill footprint since 2017), in addition to other water inputs that have yet to be characterized (berm overtopping from outer drainage ditch on north side of leachate collection system).

7.2. *Leachate Generation Control Measures*

Leachate generation at the Landfill is controlled through a number of mechanisms, which include the following:

- Progressive closure of completed phases, with an impermeable geomembrane cover system installed to minimize infiltration and leachate generation. Hydroseeding reduces erosion and increases evapotranspiration. See Figure 7 for the cross-section of a final cover system.
- Dedicated stormwater retention ponds for closed areas and linear ponds for surface runoff to control flows to the leachate pump station during significant precipitation events. See Figure 5 for pond locations.
- Use of daily and intermediate cover at the active face and keeping the active face as small as possible to minimize infiltration from precipitation.
- Erosion control measures on side slopes, such as swales and downchutes, to convey water to internal ditches.

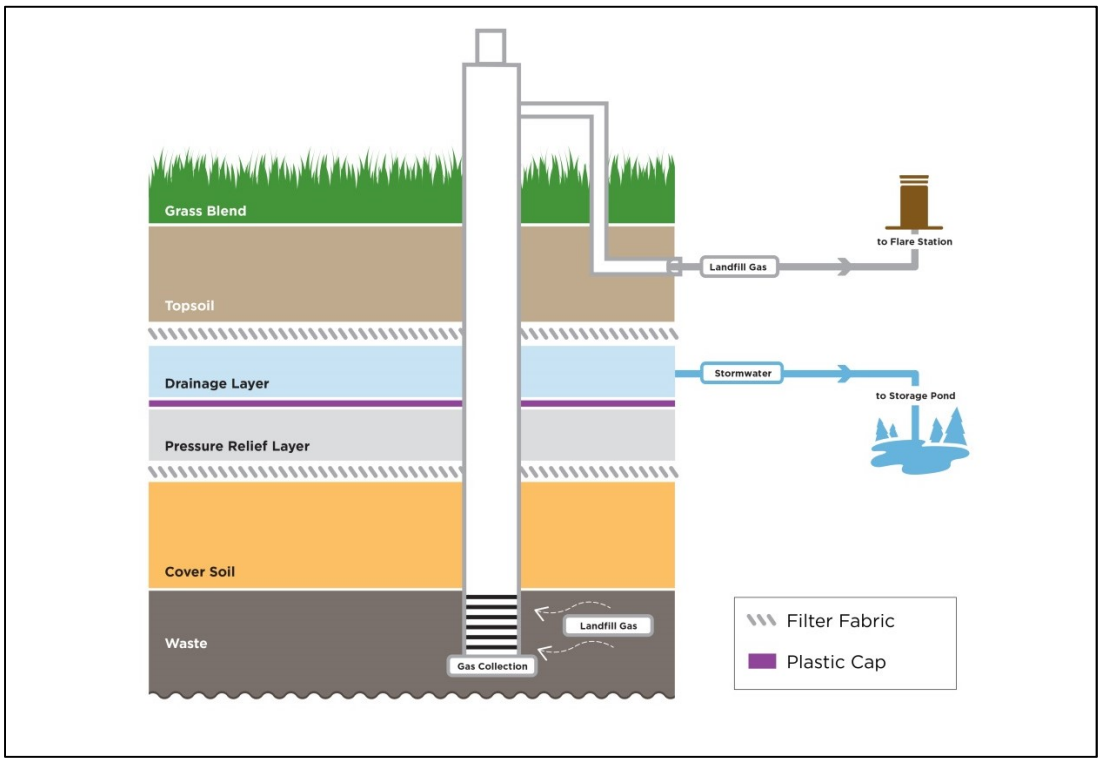

Figure 7: Final Cover System Cross-Section

7.3. *Water Quality Monitoring Program & Annual Review*

The OC requires regular sampling and analysis of leachate, and surface and ground waters in the vicinity of the Landfill, for the stations and parameters indicated. Leachate flow measurement and leachate/drainage ditch water level measurements are also required. The Landfill's WDP also requires regular sampling and analysis of leachate, in addition to leachate flow measurement. The Landfill Water Quality Monitoring Program (WQM Program) is in place

to meet the above requirements. Sampling and data collection is completed by City Staff, according to the 2017 Field Sampling and Quality Control Manual prepared by SNC-Lavalin Inc. (SNC-Lavalin).

In 2019, 1 leachate station, 13 surface water locations, 20 shallow groundwater wells, and 21 deep groundwater wells were grab-sampled quarterly by Landfill Staff. Shallow groundwater wells are screened in the peat aquifer and range in depth between 2.5 – 4 m, while deep groundwater wells are screened in the sand aquifer and range in depth between 6 – 9 m. Well and sampling locations are shown in Appendix 3. Additionally, a 24-hour composite sample representing the leachate pumped to Annacis Island WWTP was taken monthly. Samples were analyzed for the parameters listed in Appendix 4.

Consultants hired by the City have completed annual reviews of the WQM Program each year since 1999. As per the *City of Vancouver Landfill - 2019 Annual Water Quality Monitoring Report* (2019 Review) prepared by AECOM, the 2019 Landfill WQM Program meets or exceeds the requirements set out in the OC and WDP with respect to the number, type and locations of stations monitored, sampling frequency, water quality parameters, and detection limits with two exceptions:

- 2 surface water stations (Station 44 and 45) were not sampled during dry ditch conditions in the third quarter, similar to in previous years.
- Monitoring and sampling of OC well 27-2013 could not be conducted in the fourth quarter because the well was damaged during well casing maintenance activities. Replacement is planned for 2020.

As part of the the 2017-2021 Water Quality Consulting & Stormwater Management Planning Project described in Section 4.1, AECOM conducted stormwater and surface water monitoring at the Landfill and surrounding area between September 2018 and April 2019. The objective of the program was to assess the feasibility of discharging stormwater outside of the leachate collection system, as required by the OC and WDP. The final report issued in December 2019 and titled *City of Vancouver – 2018/18 Stormwater and Surface Water Monitoring Report* recommended that a regular monitoring program for stormwater be implemented, and include monthly sample collection from October to March each year. Sampling began in December 2019. Results from the sampling events are included in the 2019 Review.

The executive summary from the 2019 Review, including report recommendations, is included in Appendix 6. A tabulation of the leachate/drainage ditch levels is included in Appendix 7.

Section 8.6 includes details of the perimeter ditch overflow event and response that occurred in early January 2019 due to significant rainfall events, which prompted flow of water from the outer drainage ditch to the inner ditch.

7.4. Landfill Gas Management System

The City of Vancouver has operated an active landfill gas (LFG) collection and flare system since 1991. The system was initially installed to control odour and had the added benefit of reducing greenhouse gas emissions. In December 2002, the City entered into a 20-year agreement with Maxim Power (Maxim) for landfill gas utilization and the following year Maxim commissioned a gas conditioning facility at the Landfill. In 2014, Maxim sold their equipment for landfill gas conditioning (located at the Landfill Gas Flare Station) and co-generation

facility (located off site) to Village Farms International, owner and operator of the greenhouse site that hosts the co-generation facility. Village Farms also uses conditioned landfill gas as a natural gas replacement fuel in two of their six direct-fired boilers. A small portion of the gas is also directed to the Landfill Administration and Engineering Buildings (Ops Buildings) where it is used to provide space heat.

An overview of the landfill gas management system is shown in Figure 8, with the distribution of the vertical gas wells, horizontal collectors and Draintube[3]collectors across the Landfill footprint shown in Figure 9. As of the 2016 Annual Report, horizontal wells with extraction points and measuring devices at each end are counted as two wells.

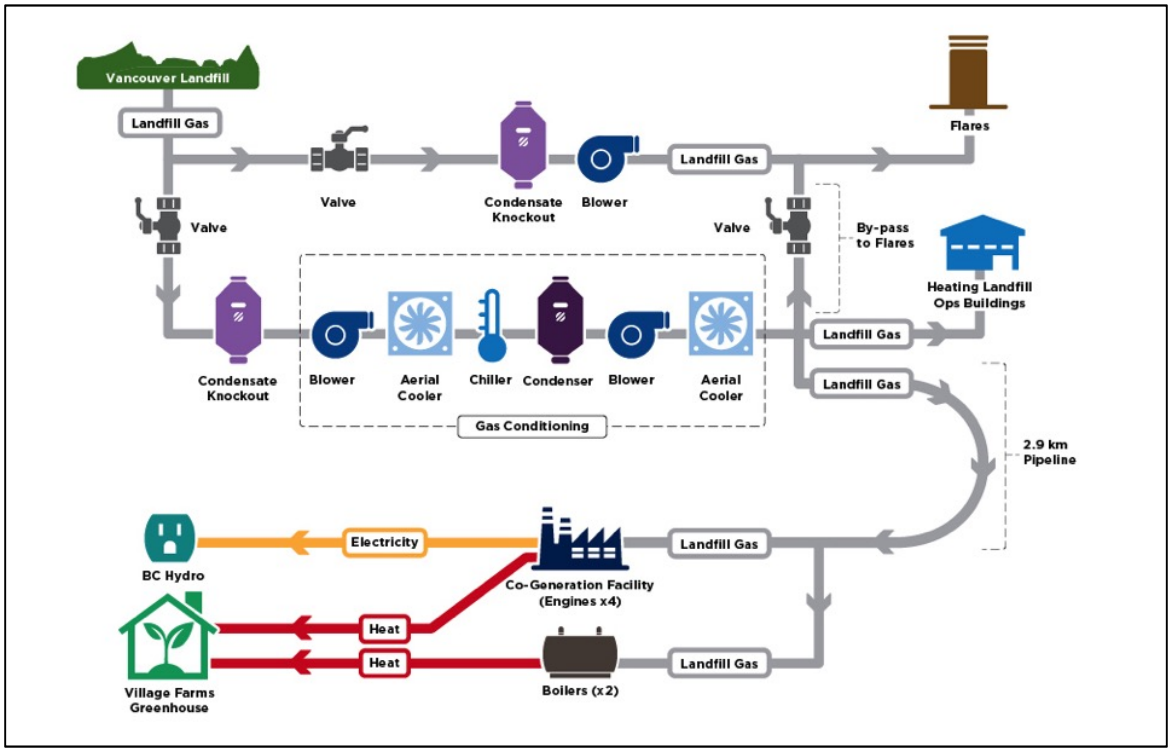

Figure 8: Landfill Gas Collection & Beneficial Use System

[3] Draintube is a geocomposite mat consisting of small diameter plastic pipes (<25mm in diameter) between layers of geocomposite material that is used for collecting landfill gas under the geomembrane cover.

Figure 9: 2019 Landfill Gas Collection System

The total volume of landfill gas (LFG) collected in 2019 is reported in two ways in this section and Table 9:

1. As measured by individual meters; and,
2. On a normalized basis (to 50% methane by volume) as per the methodology used by the MOE in Section 3.2 of the 2010 *Landfill Gas Management Facilities Design Guidelines*).

Table 9: 2019 Landfill Gas Collection and Beneficial Use

Date	Weighted Average Methane Content (% by vol)	LFG to Utilization Facility (m^3)	LFG to Flare (m^3)	LFG to Building Heat (m^3)	LFG Captured for Period (m^3)
2019 Total (Metered)	51.1	29,128,241	32,017,181	6,941	61,152,362
2019 Total (Normalized)	50.0	29,764,110	32,716,116	7,092	62,487,319
2019 Daily Average (Metered)	51.1	79,803	87,718	19	167,541
2019 Daily Average (Normalized)	50.0	81,546	89,633	19	171,198

The total metered volume of LFG collected in 2019 equates to approximately 20,500 tonnes of methane or 430,200 tonnes of carbon dioxide equivalents (CO_2e). It is equivalent to the emissions approximately of 86,000 vehicles over the period of a year.

In 2019, approximately 48% of the LFG collected was directed to beneficial use, and the remaining 52% was flared.

7.5. Landfill Gas Collection Efficiency

The average LFG collection efficiency for 2019, as calculated using a site-specific model developed by SCS Engineers in 2011, was 68.3%. This reflects a decrease of 6.9 percent compared to 2018, which is largely due to the impact of closure construction extending throughout the entire year in 2019.

Major milestones in 2019 for improving gas collection included the following:

- Nine (9) new vertical wells and six (6) new horizontal collectors were installed or commissioned in Phase 3 Northeast;
- Ten (10) new vertical wells were installed or commissioned in the Western 40 Hectares;
- Thirty (30) new horizontal collectors were installed or commissioned during the year in Phase 4; and,
- Nineteen (19) new pneumatic dewatering pumps were deployed throughout Phase 3.

Further details on landfill gas collection activities in 2019 can be found in the *2019 Annual Landfill Gas Report for the Vancouver Landfill* (City of Vancouver, 2019).

7.6. Landfill Gas Surface Emissions Monitoring Program

In 2015, the City hired Golder Associates Ltd. (Golder) to conduct surface emissions monitoring to determine the total emission or flux from the Landfill footprint, with identification of general areas of higher emissions. The Airborne Matter Mapping method is used and applies a mass balance approach by sampling the emission plume with a helicopter and using multiple sampling runs at different elevations.

In the first year of monitoring, the method identified the active area (Phase 3) to be the largest source of emissions, and a few other areas for intermediate soil cover repair. Measurements collected in 2016 and 2018 yielded similar results. Closure activities in the Western 40 Hectares and Phase 3 Northeast areas were in progress in summer 2019, so the next flights will occur in summer 2020.

7.7. Landfill Gas Migration & Emissions Monitoring Program

In October 2000, the City retained an independent consultant to develop the Landfill Gas Migration and Emission Monitoring Program. Since June 2001, ambient air has been routinely monitored in confined spaces, on-site buildings, at the Landfill Gas Flare Station and at property boundary monitoring stations. Sampling at all locations is conducted using portable gas analyzers at a frequency of once every month.

The Landfill Gas Flare Station and confined spaces are tested for combustible gases, oxygen and hydrogen sulphide. On-site buildings are also tested for carbon dioxide. Property boundary stations are tested for total organic carbon (as methane; TOC) and hydrogen sulphide.

Hydrogen sulphide is measured as a surrogate for the odorous compounds typically found in MSW landfills. The human nose can detect hydrogen sulphide at a concentration of less than 1

ppm with a Recognition Threshold of 0.0047 ppm or 4.7 ppb hydrogen sulphide. The Recognition Threshold is the concentration at which 50% of humans can identify the odourant.

In 2019, the perimeter test results were consistent with the historical pattern of generally low total organic carbon (TOC) readings and ranged from 0 to 32 ppm. No test locations had readings exceeding the City's 50 ppm guideline for TOC, and there were no detectable hydrogen sulphide readings at any locations in 2019.

There were also no odour complaints received at the Vancouver Landfill in 2019.

8. Operational Information

8.1. Nuisance Waste

In 1999, a database was created to track nuisance waste accepted at the Landfill. Nuisance waste is defined as material that requires special consideration, documentation, handling or disposal (such as direct burial). These materials typically originate from small businesses or light industry and are not classified as Hazardous Waste under the MOE's *Hazardous Waste Regulation*. The waste generator completes a Waste Assessment Form and submits it for review and approval by City staff. Waste Assessment Forms are entered into the database from which summary reports can be generated.

Nuisance waste also includes materials ordered for destruction by the Canadian Food Inspection Agency (CFIA). Deep burial is required to meet CFIA requirements, and is often witnessed by a CFIA Officer.

Table 10 lists the types of nuisance wastes and quantities received at the Landfill in 2019. The tonnage of CFIA burials in 2018 and 2019 were over 1,500 tonnes higher than in 2017. This occurred due to an order issued by CFIA restricting movement of plant and soil materials from the False Creek area of Vancouver where Japanese beetle was found.

Table 10: 2019 Nuisance Waste Quantities

Material	2019 Quantity (tonnes)
Street sweepings	5,786
CFIA burials	2,521
Shellfish scrapings and shells	654
Invasive species	553
Greenhouse waste	234
Fish nets	216
Non-compostable organics	70
Paper straps	62
Rope	43
Other*	50
Total	10,190

Note:

* Other includes expired cosmetics, grain sweepings, non-recyclable products (rubber, hose assemblies, pocket coil cores, stumps).

8.2. Bird Control & Counts

Birds, particularly gulls, are a nuisance at landfill sites. In large numbers, they create a negative image of landfills and scatter litter onto surrounding areas. Birds are also a potential aviation hazard. A formal program using birds of prey started in July 2001. The program includes the use of trained raptors (hawks and falcons) near the active face as a primary control method. The raptors discourage gulls and other birds from approaching the waste. Secondary control methods are used when trained raptors are not an option, such as when traffic is heavy or it is very windy or rainy. These methods include noise deterrents (stock or bull whips, pyrotechnics, whistles), visual deterrents (aerial projectiles, laser pointers, kites), and positioning the bird control vehicle close to the active area.

Pacific Northwest Raptors has been providing bird control service since January 2016, and is based on Vancouver Island.

Annual bald eagle counts are performed by the Hancock Wildlife Foundation (HWF). In early 2018, the City began supporting the HWF in collaboration with Simon Fraser University for the Bald Eagle Tracking Alliance Project. The Project aims to better understand the movements of bald eagles using tracking devices.

8.3. Household Hazardous Waste

Household hazardous wastes (HHW), such as paints, used oil, flammable liquids and pesticides, are banned from disposal at the Vancouver Landfill. However, residents periodically abandon or discard HHW in loads of refuse.

In 1993, a storage facility was set up at the Vancouver Landfill for abandoned HHW. The facility was upgraded in 1999 to provide a larger covered drop-off area and improved security. The facility consists of a fenced area where HHW waste is placed into boxes, drums, tub skids or a fireproof storage cabinet. Used oil is bulked by Staff into a steel double walled tank. Product stewards and a HHW contractor regularly remove and safely dispose of the waste. The facility was updated in 2019 as part of the Landfill Entrance Improvement Project.

In 2019, the total cost of contracted services for the removal and disposal of HHW not covered by stewardship programs was approximately $25,500 compared to $19,000 in 2018. Cost fluctuations from year to year are consistent with historical trends. Note that City staff time to segregate and pack the materials is not included in the costs above.

8.4. Site Inspections

Formal site inspection activities beyond those conducted as part of environmental monitoring programs, are summarized in

Table 11. In 2020, an inspection and maintenance program for closed areas of the Landfill is planned to be developed.

Table 11: 2019 Site Inspection Activities

Type of Inspection	Description	Findings & Action Taken (if applicable)
Site Tour	Conducted weekly by the Landfill Manager, Landfill Engineer, GPS Technician, and Superintendent to assess progress of filling, cover integrity, erosion, and settlement in active areas.	Any signs of erosion on side slopes are addressed promptly by Operations Staff at the direction of the Superintendent.
Workplace Inspections	Conducted monthly by representatives from the OH&S Committee and exempt Staff to verify compliance with the Landfill's Safety Management Program and *OH&S Regulation*.	Any deficiencies identified are logged and addressed as soon as practical with discussion following in the monthly OH&S Committee Meetings.
Vegetation Inspection	Site inspection conducted in early spring with landscaping services contractor to identify invasive species and prepare management plan. Periodic inspections completed by landscaping services contractor in habitat screening area for invasive plans.	Scotch Broom identified in various areas of the site. Landscaper provided mechanical control in late spring for these species, as well as for blackberries in the habitat screening area as needed.
Leachate Collection System Inspection	Conducted in advance of and during significant precipitation events by Environmental Technician to ensure ditches and culverts are not obstructed by debris, leachate flow is unobstructed, and freeboard exists between water levels in the leachate and drainage ditches and crest of the intermediate berm.	Any accumulation of debris is managed promptly by Operations Staff. Intermediate berm overtopped in 4 locations in early January. See section 8.5 for details of action taken.
Property Boundary Inspection	Conducted quarterly by Environmental Technician to monitor for litter so crews can be deployed for collection.	Contractor engaged to remove litter from trees bordering the active areas in the first, second and fourth quarters of the year.

8.5. Operating Problems and Corrective Actions

The operating problems and corrective actions taken in 2019 are detailed in

Table 12.

Table 12: 2019 Operating Problems and Corrective Actions

Problem	**Perimeter Ditch Overflow, January 2019**
Description	As a result of significant rainfall over two days in early January, the berm between the drainage and leachate ditches along the north boundary towards the western end of the Landfill was overtopped in four areas. Each area was two metres or less in length.
Corrective Action	The City notified the MOE of a potential malfunction of works, and retained AECOM to complete sampling in the areas and report on the findings. Visual observations and field data collected at the time of the events indicated that flow was either limited (no flow) or from the drainage ditch towards the leachate ditch. In their March 22, 2019 technical memo, AECOM confirmed that there was no impact to the environment as a result of the overtopping. Upgrades to the intermediate berm are planned for 2020.
Problem	**Leachate Pump Station Pump 4 Failure, November 2019**
Description	Pump 4 failed to re-start during a storm event, and it was identified that all fuses had blown and circuits had melted.
Corrective Action	New fuses were installed and non-functioning circuits bypassed after confirming there would no harm to the pump to operate without them. The cause of the failure was unknown, so the City's Electrical Engineer engaged the station designer (Stantec) and an electrical contractor to initiate testing. Several rounds of testing were required to simulate all operating conditions, and a summary report with conclusions will follow in early 2020.

8.6. Operational and Maintenance Expenditures

The total spent in 2019 for operations and maintenance at the Vancouver Landfill was approximately $19.6 million, as detailed in

Table 13. Total expenditures in 2019 were approximately 14% lower than in 2018 due to a different approach taken for capital project financing, and the fire that occurred in June 2018. The fire prompted the need for water inputs for firefighting (increase in sewer fees), contractor services (firefighting), additional soil for cover (soil deposit fees), and professional services (increase in consulting projects).

Table 13: Operational and Maintenance Expenditures for 2018 & 2019

Item*	2019	2018
Salaries, Administration, Wages & Fringe Benefits	$5,281,174	$5,003,977
Vehicle & Equipment Rental	$3,724,090	$4,834,650
Insurance, Taxes, Loan Payments, Utilities, Building Maintenance, Permits & Landscaping	$3,154,924	$2,808,297
Recycling	$242,748	$317,586
Roads and Cover	$1,974,885	$1,916,647
Water Quality, Gas Management, Ditch Maintenance, Bird Control, Household Hazardous Waste Disposal, etc.	$1,002,508	$2,399,271
Consulting Projects (Leachate Upgrades, Gas, etc.)	$133,939	$556,501
Sewer and Soil Deposit Fees	$3,376,175	$4,360,215
Weighscales	$679,720	$666,738
Total	$19,570,163	$22,863,882

Note:
* Items do not include capital loan repayments and other cost allocations.

8.7. Public Complaint and Resolution Log

In 2019, the Landfill logged 13 complaints, down from 17 received in 2018. The Public Complaint and Resolution Log for 2019 is available in Appendix 5.

More than one complaint was received on the following items:

- Used residential drywall bag limit. Residents can deliver up to 10 bags of used drywall that is double bagged and sealed in 6 mil bags up to 5 times per year, and it is managed as asbestos waste. Some customers complained about not being able to bring more bags per trip. It was explained to the customers that requests to deliver more than 10 bags per trip can be assessed on a case-by-case basis.
- Customer experience - Several customers raised concern regarding communications by Staff, such that messaging could have been communicated in a more friendly tone. When a customer experience complaint is received, a Supervisor is in contact with the customer to gather information, and with the Staff member to resolve it.

8.8. Landfill Tours

Tours of the Landfill are regularly provided by Landfill Staff for a variety of visitors, including school groups (kindergarten to university levels), special interest groups, industry associations & professionals, delegates from other countries, and members of the public. Visitors in groups

bring their own vehicles for tours since the Landfill doesn't have a dedicated vehicle for this purpose.

Tours provide the opportunity to showcase how waste is responsibly managed to minimize environmental impacts, and how much work we still have to do as a society to reduce the amount of waste sent for disposal.

In 2019, over 60 groups and 1,500 people participated in Landfill Tours. The Landfill hosted an open house in 2018 that included coach bus tours of the site, educational displays on the environment and sustainability, and free food. The next event will be held in June 2020.

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Appendix 1: Annual Waste Quantities

Table A1: 2019 Material Summary by Source

	Waste Discharge				Cover	Road Construction & Other Beneficial Use					Closure		VLF Composting	
Source	VSTS MSW tonnes	VLF MSW tonnes	Total MSW tonnes	Demo tonnes	Cover Soil tonnes	Sand tonnes	Demo hog tonnes	Wood Waste tonnes	Crushed Concrete & Asphalt Grindings tonnes	Purchased Aggregate tonnes	Aggregate tonnes	Sand & Soil tonnes	VSTS Yard Trimmings tonnes	VLF Yard Trimmings tonnes
By Municipality	**148,605**	**126,236**	**274,840**										**12,610**	**8,181**
Vancouver Residential Collection	34,306	0	34,306											
Vancouver Public Works	4,831	1,740	6,571		239,698	38		64	1,118	28,315	3,930		893	5,978
Vancouver Commercial & Residential Drop-Off	65,421	9,565	74,986	17,409	139			1,175	3,201		1,705	36,618	11,113	402
Delta Residential Contractor		14,211	14,211											
Delta Public Works		4,612	4,612		80,911			12	12,841					51
Delta Commercial	516	12,999	13,515	4,455	83,633			133	1,165	292	1,717	3,025	0	61
Delta Residential Drop-Off	25	4,286	4,311					1,892					3	1,299
Richmond	39,472	53,998	93,470	2,902	81,446	800	70,279	446	24,188	13,588	4,738	136,259	300	71
UEL	3,016	53	3,068					2					0	0
Surrey	330	18,830	19,160	14,091	13,140		220	564	359	16,421	5,994	68,356	18	229
White Rock	5	783	789					116	411					63
Other Municipalities*	684	5,157	5,841	22,321	17,745		24	167	2,330		107,816	60,161	282	27
Regional Waste Transfer		**347,879**	**347,879**											**5,609**
Coquitlam Resource Recovery Transfer		127,087	127,087											
North Shore Transfer Station Transfer		69,221	69,221											
Surrey Transfer Station Transfer		135,123	135,123											
Maple Ridge Transfer Station		9,306	9,306											3,170
Langley Transfer Station		7,141	7,141											2,439
Other Authorized Waste		**37,609**	**37,609**											
Bottom Ash		16,755	16,755											
Water Treatment Plant Residuals		0	0											
Sewage Treatment Plant Residuals		2,807	2,807											
Iona Grit Dump Residuals		18,047	18,047											
Non-Recyclable Marine Debris		0	0											
Totals	**148,605**	**511,724**	**660,329**	**61,178**	**516,712**	**838**	**70,524**	**4,571**	**45,613**	**58,615**	**125,901**	**304,418**	**12,610**	**13,790**
Total Materials to Vancouver Landfill												**1,848,698**		**26,400**

* Burnaby, City of Langley, City of North Vancouver, Coquitlam, District of North Vancouver, District of West Vancouver, Langley Township, Maple Ridge, New Westminster, Pitt Meadows, Port Coquitlam, Port Moody.

Appendix 1: Annual Waste Quantities

Table A2: 2018 Material Summary by Source

	Waste Discharge				Cover	Road Construction & Other Beneficial Use				Closure		VLF Composting	
Source	VSTS MSW tonnes	VLF MSW tonnes	Total MSW tonnes	Demo tonnes	Cover Sand & Soil tonnes	Demo hog tonnes	Wood Waste tonnes	Crushed Concrete & Asphalt Grindings tonnes	Purchased Aggregate tonnes	Aggregate tonnes	Sand & Soil tonnes	VSTS Yard Trimmings tonnes	VLF Yard Trimmings tonnes
Vancouver Residential Collection	35,714		35,714										
Vancouver Public Works	5,728	4,310	10,038		229,033		17	2,921	63,123			875	5,876
Vancouver Commercial & Residential Drop-Off	73,860	9,482	83,341	24,090	6,056	9,750	298	3,377			7,619	11,490	99
Delta Residential Contractor		14,353	14,353										
Delta Public Works		4,704	4,704		133,776		17	18,726					59
Delta Commercial	155	13,759	13,914	4,034	82,207	25	82	3,511	2,520		47,621	1	47
Delta Residential Drop-Off	21	4,733	4,754				2,007					6	1,268
Richmond	37,076	32,335	69,411	7,330	83,143	72,863	411	10,950		29,412	315,776	119	76
UEL	3,092	64	3,156									95	0
Surrey	245	12,425	12,669	24,030	6,092	171	531	2,019	27,509	19,963	76,815	13	248
White Rock	7	630	637	1,346			131	396					70
Other Municipalities*	1,010	4,715	5,725	25,832	18,550	26,326	147	873	3,848	8,321	19,751	91	108
Regional Waste Transfer		**353,380**	**353,380**										
Coquitlam Resource Recovery Transfer		106,155	106,155										
North Shore Transfer Station Transfer		75,199	75,199										
Surrey Transfer Station Transfer		154,276	154,276										
Maple Ridge Transfer Station		10,206	10,206										
Langley Transfer Station		7,544	7,544										
Other Authorized Waste		**19,447**	**19,447**										
Bottom Ash		0	0										
Water Treatment Plant Residuals		710	710										
Sewage Treatment Plant Residuals		3,533	3,533										
Sapperton Pump Station Grit		31	31										
Iona Grit Dump Residuals		15,173	15,173										
Totals	**156,907**	**474,336**	**631,243**	**86,663**	**558,856**	**109,135**	**3,640**	**42,774**	**97,000**	**57,696**	**467,581**	**12,691**	**7,851**
Total Materials to Vancouver Landfill											**2,054,588**		**20,541**

* Burnaby, City of Langley, City of North Vancouver, Coquitlam, District of North Vancouver, District of West Vancouver, Langley Township, Maple Ridge, New Westminster, Pitt Meadows, Port Coquitlam, Port Moody.

Appendix 1: Annual Waste Quantities

Table A3: 2019 Material Summary by Month

	Waste Discharge					Cover, Road & Closure Materials			VLF Composting		
	VSTS	VLF	Total	Bottom Ash	Demolition Material	Cover Material	Road & Other Beneficial Use Materials	Closure Materials	VSTS Yard Trimmings	VLF Yard Trimmings	Yard Trimmings Total
Month	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
January	13,997	38,295	52,292		4,445	19,017	13,683	6,802	709	1,009	1,718
February	10,968	27,469	38,437		4,062	17,213	17,406	14,483	261	220	481
March	12,451	38,730	51,181		6,172	90,060	26,478	52,868	1,068	764	1,832
April	13,278	42,644	55,922		5,916	26,717	18,571	20,370	1,019	908	1,927
May	14,143	41,987	56,130		6,539	41,911	15,009	14,348	1,082	927	2,009
June	12,716	45,082	57,798		5,333	36,903	8,007	2,302	969	902	1,871
July	14,232	53,543	67,775		6,629	53,660	10,519	22,120	933	773	1,706
August	12,747	50,674	63,421	3,238	4,822	51,619	9,166	2,041	822	735	1,557
September	11,674	49,760	61,434	2,698	4,102	39,476	12,428	1,890	811	707	1,517
October	11,824	43,478	55,303	3,117	4,799	39,992	13,473	1,409	1,683	939	2,622
November	10,097	33,887	43,984	3,689	4,782	32,522	10,514	0	2,280	2,736	5,016
December	10,478	29,419	39,896	4,015	3,578	67,624	24,906	291,687	973	3,172	4,144
Totals	148,605	494,968	643,573	16,755	61,178	516,712	180,161	430,318	12,610	13,790	26,400
Total Materials to Vancouver Landfill								1,848,697			

Appendix 2: 2019 Recyclable and Banned Materials

Recyclable Materials – Accepted for FREE (Residential Only)

- ✓ Antifreeze and empty antifreeze containers
- ✓ Batteries and cell phones
- ✓ Books
- ✓ Cardboard
- ✓ Cooking oil
- ✓ Clothing
- ✓ Electronics, small appliances and power tools (maximum 5 large items)
- ✓ Foam packaging
- ✓ Glass bottles and jars
- ✓ Lead acid car and truck batteries
- ✓ Metal containers (cans, tins, foil, empty aerosol cans excluding spray paint cans)
- ✓ Other flexible plastic packaging
- ✓ Paper containers (tetra-packs, coffee cups)
- ✓ Plastic bags and overwrap
- ✓ Plastic containers (jars, jugs, bottles)
- ✓ Printed paper and paper packaging (newspaper, magazines, catalogues, writing paper, paper bags)
- ✓ Propane tanks (maximum 4 disposable and 2 refillable)
- ✓ Scrap metal
- ✓ Smoke and carbon monoxide alarms
- ✓ Thermostats
- ✓ Tires (passenger or light truck with or without rims; maximum of 10)
- ✓ Used oil (maximum 15 litres), oil filters (maximum 3) and empty oil containers
- ✓ Large appliances (refrigerators, freezers, air conditioners)

Recyclable Materials – Accepted for a FEE

- ✓ Gypsum drywall, new scraps only (maximum level pick-up truck load)
- ✓ Food scraps (maximum 150kg)
- ✓ Mattresses and box springs (maximum 8 pieces)
- ✓ Wood waste (includes painted and treated wood, residential quantities)
- ✓ Yard & garden trimmings

Banned Materials

The lists of Banned Materials that follow are taken from City of Vancouver Solid Waste By-Law No. 8417 in effect as of January 1, 2019.

Banned Hazardous and Operational Impact Materials

The following wastes are prohibited from disposal at the Vancouver Landfill and Vancouver South Transfer Station:

1. Automobile bodies;
2. Refuse that is on fire, smoldering, flammable or explosive;
3. Hazardous Waste as defined in the Hazardous Waste Regulation (B.C. Reg. 63/88), with the exception of asbestos waste delivered to the Vancouver Landfill in accordance with the Asbestos Policy;
4. Propane tanks;
5. Liquids or sludge;

6. Coated or uncoated wire and cable that exceeds either 1% of the total weight of the load or 1% of the total volume of the load;
7. Dead animals from personal or business activities;
8. Inert fill material including soil, sod, gravel, concrete and asphalt exceeding 0.5 cubic metres per load.
9. Excrement, other than amounts of pet excrement that are double bagged and discarded with Municipal Solid Waste and that do not exceed either 5% of the total weight of the load or 5% of the total volume of the load;
10. Barrels, drums, pails or other large (205 litre or greater) liquid containers, whether full or empty;
11. New or used gypsum (drywall), with the exception of residential used gypsum (drywall) delivered to the Vancouver Landfill in accordance with the Drywall Policy.
12. Mattresses;
13. Railroad ties or creosote treated wood;
14. Toxic Plants, with the exception of Toxic Plants that are double bagged and delivered in dedicated loads to the Vancouver Landfill for management as special handle waste requiring burial.
15. Personal hygiene products where the personal hygiene products make up more than 10% of the total weight of the load unless the personal hygiene products are double bagged in sealed plastic bags that are sufficiently durable to resist leaking or breaking during collection and disposal.
16. Any material that would cause undue risk of injury or occupational disease to any person at the Vancouver Landfill and Transfer Station or that would otherwise contravene the Occupational Health and Safety Regulation (B.C. Reg. 296/97) enacted pursuant to the Workers Compensation Act, as amended or replaced from time to time;
17. Any other material deemed by the City Engineer as unacceptable for disposal at the Vancouver Landfill or Vancouver South Transfer Station.

Banned Recyclable Materials

1. Beverage containers identified in "Schedule 1 — Beverage Container Product Category" to the *Recycling Regulation* (B.C. Reg. 449/2004) of the *Environmental Management Act*.
2. Containers other than beverage containers made of:
    - Metal,
    - Glass, or
    - Plastic identified by the SPI Code #1 (Polyethylene Terephthalate or PET) or SPI Code #2 (High Density Polyethylene or HDPE) or SPI Code #4 (Low Density Polyethylene or LDPE) or SPI Code #5 (Polypropylene or PP).
3. Recyclable Paper.
4. Corrugated Cardboard.
5. Yard Waste.
6. Food Waste.
7. Clean Wood Waste.
8. Expanded Polystyrene Packaging.

Banned Product Stewardship Materials

The following materials included in the effective Product Stewardship Program product categories of the *Recycling Regulation* of the *Environmental Management Act*, are banned from garbage containers, and from disposal as garbage at the Vancouver South Transfer Station, and Vancouver Landfill:

1. The following materials pursuant to Schedule 2 – Residual Product Category to the Recycling Regulation:
    - Solvents and flammable liquids;
    - Pesticides;
    - Gasoline;
    - Pharmaceutical products and medications;
    - Oil, oil filters and oil containers;
    - Paint;
    - Lead-acid batteries;
    - Antifreeze and antifreeze containers;
2. Electronics and electrical products, including metal household and commercial appliance, as identified in Schedule 3 – Electronics and Electrical Products Category to the *Recycling Regulation*;
3. Tires pursuant to Schedule 4 – Tire Product Category to the *Recycling Regulation*.

Appendix 3: 2019 Water Quality Monitoring Location Plan

Note:

- Routine monitoring at Stations 101, 103, 105, 107 and 108 and 202 started in Q4 2019 as part of the stormwater monitoring program.
- Station 19 was removed from the monitoring program in Q4 2019 (replaced by station 126).
- Duplicate stations 24, 25, and 38 were installed in Q4 2019 and the originals decommissioned.
- Stations 56, 57, 61 and 62 were added to the monitoring program in Q4 2019.
- Required station 27-2013 was damaged in Q4 2019 and was not sampled. A replacement will be installed in early 2020.
- Station 71 is not an OC compliance location and was last sampled in 2014.

Appendix 4: 2019 Water Quality Monitoring Program Parameters

Surface Water

alkalinity as $CaCO_3$	copper, total	phenols
aluminium, total	dissolved oxygen*	potassium, total & dissolved
ammonia	hardness as $CaCO_3$	sodium, total & dissolved
arsenic, total	iron, total & dissolved	specific conductivity
cadmium, total	lead, total	sulphate
calcium, total & dissolved	magnesium, total & dissolved	temperature*
chloride	manganese, total & dissolved	zinc, total
chromium, total	nickel, total	TSS
cobalt, total	pH*	TOC
turbidity	true colour	VOCs

Groundwater

alkalinity as CaCO3	cobalt, dissolved	pH*
aluminium, dissolved	copper, dissolved	phenols
ammonia	hardness as $CaCO_3$	potassium, dissolved
arsenic, dissolved	iron, dissolved	sodium, dissolved
cadmium, dissolved	lead, dissolved	specific conductivity
calcium, dissolved	magnesium, dissolved	sulphate
chloride	manganese, dissolved	temperature*
chromium, dissolved	nickel, dissolved	zinc, dissolved
		VOCs

Leachate Grab Samples

alkalinity as $CaCO_3$	cyanide	potassium, total & dissolved
aluminium, total	dissolved oxygen*	sodium, total & dissolved
ammonia	hardness as $CaCO_3$	specific conductivity
cadmium, total	iron, total & dissolved	sulphate
calcium, total & dissolved	lead, total	sulphide, total & dissolved
chloride	magnesium, total & dissolved	temperature*
chromium, total	manganese, total & dissolved	toxicity
cobalt, total	pH*	volatile organic compounds
copper, total	phenols, total**	zinc, total

Leachate Composite Samples

aluminium, total	copper, total	nickel, total
cadmium, total	iron, total	pH
chemical oxygen demand	lead, total	total suspended solids
chromium, total	manganese, total	zinc, total
cobalt, total	molybdenum, total	

* Field Data

** Total of 2,3,4,5 and 2,3,4,6 tetrachlorophenols and pentachlorophenols

Appendix 5: 2019 Public Complaint and Resolution Log

No.	Issue	Resolution
1	Customer indicated he called 311 and was told that there is a limit of 10 bags of used drywall per trip to the Landfill, to a maximum of 50 bags per year. Upon arrival at the Landfill, customer says he was told he could have brought all 50 bags in one trip.	Policy explained to customer and that exceptions to limits may be made on a case-by-case basis.
2	Customer indicated that Staff lectured him about securing his load.	Followed up with Staff about how to deliver policy information while achieving good customer service.
3	Citizen complained about wait times to weigh in to drop off recyclable materials.	Called customer to inform that improvements are being made to the recycling area at the Landfill with better traffic flows in and out.
4	Citizen was looking at the webpage for the rates of the Vancouver Landfill; she states that the details should just give the actual fee instead of a breakdown. $30.	Called customer to explain that the transaction fee of $5 per load needs to be listed and charged separately, as per the Solid Waste Bylaw.
5	Caller went down to the Landfill to try to dispose of some garbage. Upon arriving he saw that the Landfill was closed early for maintenance, and was turned away. He feels that the Landfill should not be closed during regular operating hours, as it is quite a distance for people to travel, without being aware that the station is closed.	No callback requested. Early closure communications were posted on vancouver.ca and on reader boards.
6	Citizen had called frustrated with the construction in Delta preventing regular access to the Landfill.	Explained that Delta is not the same municipality as Vancouver, so we do not have access to their roads or projects. It was recommended he contact Delta.
7	Citizen feels the used drywall limit of 10 bags per visit is not practical. He is renovating a 6' x 6' bathroom. Each bag only holds 20 to 25 lbs., so he has 14 bags even with all the wood removed.	Policy explained to customer - that exceptions to limits may be made on a case-by-case basis.
8	Customer complained about limit of 10 bags of asbestos waste at residential tipping fee, given that he owns multiple properties in Metro Vancouver. Requested to speak to a supervisor.	Superintendents made arrangements with customer to bring his load of asbestos in.
9	You used to be able to back your vehicle right up to the bin to dump garbage, but now there is a gate there and you must stay back 6 to 8 feet which makes it more difficult. Is this a new WCB rule or something? He would like to know if this is a permanent change or is it just temporary.	Superintendent called customer to explain that this is a WSBC regulation for fall protection.
10	Citizen is upset with the charges at the Landfill for yard trimmings. He put all his leaves in plastic bags and wants to take them down to landfill and feels he should not be charged for it. He is cleaning up the City sidewalks and having to pay for it.	No response requested.

No.	Issue	Resolution
11	The citizen stated that the signs to the soil pick up area (compost) in the landfill needs better directional signage (the citizen stated he saw a few confused individuals). In that, the arrows were not accurate and were causing citizens to drive to the wrong location within the landfill.	Signs to be reviewed in 2020.
12	Customer recently completed their new home construction and has purchased a large container worth of brand new furniture. They have made 5 trips to the Landfill to dispose the packaging from the furniture in their personal vehicle (not a commercial vehicle). The employee has made comments every time her son has dropped off a load saying he can't drop off as much stuff as he is and that it's for residential drop off only etc. despite her son telling him that it's residential drop off every time. Yesterday afternoon he was given a pink notice with location information for commercial packaging & printed paper disposal and was told that he can't come back to the landfill.	Superintendent spoke to staff member involved regarding incident to get a better understanding of situation. Superintendent called resident back to apologize for experience and to clear up any misunderstandings.

Appendix 6: 2019 Water Quality Monitoring Program Review Executive Summary

AECOM Canada Ltd. (AECOM) reviewed historical data and interpreted leachate, groundwater, surface water and stormwater quality data collected by City of Vancouver (CoV) and AECOM staff between January 1, 2019 and December 31, 2019. This annual monitoring report presents the findings of the monitoring program review in accordance with the landfill Operational Certificate MR-01611 (OC). The requirements of the monitoring program and subsequent interpretation and reporting are specified within the OC and Waste Discharge Permit SC-100168-FSA (WDP). Section 3.5.2 of the OC requires that the annual report include a review and interpretation of the analytical data from receiving environment monitoring for the preceding year, and leachate flow data and leachate/drainage ditch levels. The WDP governs the discharge of leachate from the Vancouver Landfill. Leachate discharged from the landfill is conveyed through City of Delta (CoD) and Metro Vancouver forcemains to the Annacis Island Wastewater Treatment Plant.

The monitoring data included measurements of leachate flows and leachate quality at the leachate pump station near the southwest corner of the landfill. Groundwater elevations and groundwater quality were measured in the shallow and deep aquifers surrounding the footprint of the landfill and immediately outside the perimeter ditch leachate collection system. Surface water elevations and surface water quality were measured in the perimeter drainage ditch surrounding the landfill footprint, and in downstream drainage ditches and the Delta Irrigation Enhancement Project (DIEP) irrigation canal that is connected to the Fraser River.

A routine stormwater monitoring program commenced in December 2019. Stormwater monitoring is not a requirement of the OC or the WDP. The purpose of the program is to monitor the quality of the stormwater from closed areas of the landfill to support discharge of stormwater outside the leachate collection system in the future. Discharge of stormwater outside the leachate collection system did not occur in 2019.

The 2019 monitoring program met or exceeded the requirements of the OC and WDP with respect to the stations monitored, media monitored and parameters analyzed, with the following exceptions:

- Similar to previous years, surface water samples could not be collected from a few monitoring stations in late summer when surface water was not present.
- Monitoring and sampling of OC compliance well 27-2013 could not be conducted in the fourth quarter of 2019 because the well was damaged during well casing maintenance activities. Decommissioning and replacement of this well is slated for 2020.

The monitoring program contained a quality assurance and quality control component which confirmed the groundwater, surface water and leachate water quality data are acceptably precise and reliable. It also included a field sampling audit which confirmed the absence of any issues that would materially affect the quality of data collected.

Leachate Flow

The CoV maintained suitable flow measuring devices for the purpose of recording the volume of leachate discharged to the sanitary sewer each month as required under Section 3.2.2 of the OC. The total volume of leachate discharged in 2019 was 2,109,525 m^3, approximately 23% lower than that in 2018 due to a relatively dry year. The high leachate to precipitation ratio (i.e., 97%) indicates that stormwater comprises a large proportion of the total discharge, likely due to increased geomembrane placement associated with progressive closure. Progressive closure reduces infiltration rates and increases daily and monthly maxima when the clean stormwater is discharged as leachate. Evapo-transpiration rates will increase as vegetation matures on recently closed landfill phases.

The highest daily leachate flow rate (34,320 m^3/day) occurred during a winter storm on January 4, 2019, which is well below the maximum (under review) daily limit of 45,000 m^3/day.

Perimeter Ditch System

The perimeter ditch system consists of an inner leachate collection ditch and an outer surface water drainage ditch, which are separated by an intermediate soil berm. The outer drainage ditch diverts natural surface runoff and shallow groundwater flow from Burns Bog around the landfill footprint. The inner leachate ditch collects the following which are collectively referred to as 'leachate' once they reach the inner ditch:

- Leachate – Rainwater that is contaminated after the water percolates through waste.
- Surface Runoff – Rainwater that flows along other surfaces at the landfill such as intermediate cover areas (temporarily closed) and operational areas (i.e.. entrance area buildings and scales) that may be impacted by leachate.
- Stormwater – Rainwater that is collected above the impermeable geomembrane in closed areas of the Landfill. It is not impacted by leachate.

The purpose of the perimeter ditch system is to maintain an inward hydraulic gradient around the landfill footprint to ensure leachate is collected and conveyed to the leachate pump station. To achieve this, water levels in the leachate ditch are actively maintained at a lower elevation than the drainage ditch through pump station control. Water levels in the drainage ditch are reflective of natural inputs from the surrounding lands; however, a system of weirs is in place to increase retention of natural runoff and maintain higher water elevations.

Based on regular monitoring of five staff gauges installed in the perimeter ditch system, the overall efficiency of the system was 93.6% in 2019. This is comparable to the average containment efficiency from 1995 to present (93.1%). Short-lived outward gradients may occur during intense storm events when water levels in the leachate ditch rise more rapidly than in the outer drainage ditch. It is highly unlikely that leachate migrates through the berm during these events given the short duration and inferred groundwater velocities (Enterprise, 2009). Further, hydraulic containment is achieved because inward groundwater gradients are

maintained around the perimeter of the landfill, even during the dry season (SNC, 2013 and AECOM, 2018c).

Short-lived outward gradients were recorded at three staff gauge locations following the intense rainfall events January 3 and 4, 2019. Despite the outward gradients at these locations, runoff from the Bog into the northwest section of the northern ditch prompted flow over the berm and into the leachate ditch in four locations. CoV staff notified the MoE, collected four water samples from both ditches for assessment, and conducted ditch inspections until the hydraulic separation between the ditches was restored. AECOM's March 22, 2019 technical memo *Perimeter Ditch Overflow Assessment* confirmed that the temporary ditch overflow event did not result in offsite leachate migration or discharge to the downstream receiving surface water body (i.e., Crescent Slough).

Groundwater Flow

Two groundwater flow systems are present beneath the site. The shallow aquifer consists primarily of organic peat that extends from ground surface to approximately six metres depth and is underlain by a thick permeable deep sand aquifer (known as the deep aquifer). The shallow and deep aquifers are separated by a low permeability silt/clay aquitard that varies in thickness from 1 to 7 metres. Water levels are monitored in both aquifers on a quarterly basis using a series of monitoring wells located around the perimeter of the landfill. The perimeter ditch system and Dredge Pond are important hydrologic features that influence groundwater levels and flow directions in both aquifers. Groundwater elevations fluctuated on the order of one metre seasonally, and groundwater flow directions were predominantly from northeast to southwest which is consistent with previous years. Because topography is relatively flat, horizontal groundwater gradients and flow velocities in both the shallow and deep aquifers are relatively low.

Surface Water Flow

Regional surface water flows southwest from Burns Bog toward the perimeter ditch system. Surface water and shallow groundwater that enter the perimeter ditch system are carried around the landfill footprint and discharge into Crescent Slough from two connection points at the northwestern and southwestern corners of the landfill. Crescent Slough ultimately discharges to the Fraser River. The CoD intermittently opens a floodgate to allow river water to flow into the DIEP canal for irrigation purposes on nearby agricultural lands. As a result, periodic surface water flow reversals have been observed under certain tidal, river discharge and operational scenarios. Portions of the perimeter ditch system on the north, east and southeast sides of the landfill cease to flow however following prolonged periods of dry weather (i.e., late summer).

Leachate Quality Summary

Monthly leachate quality samples were collected from the approved sampling point at the leachate pump station in accordance with OC and WDP requirements. All samples were analyzed for the parameters stipulated in the OC and WDP. All leachate quality samples met applicable discharge criteria in 2019, with the following exceptions:

- Toxicity (96 hour LC50 Rainbow Trout) exceeded the HWR standard in one of four sampling events. The anomalous toxicity result may be due to sample container contamination.
- Dissolved manganese concentrations were marginally above the HWR criteria (1 mg/L) in three (3) of 12 samples. Mean concentrations of dissolved manganese from 2019 leachate samples remained below 0.75 mg/L were comparable with historical results.

The feasibility of discharging stormwater outside the leachate collection system is currently being assessed. It should be noted that diverting stormwater outside the leachate collection system will decrease the amount of leachate dilution and therefore decrease leachate quality.

Groundwater Quality

As per the OC, quarterly monitoring must be conducted on five shallow monitoring wells and seven deep monitoring wells. In 2019, three new non-OC shallow wells and two new non-OC deep wells were installed to replace comprised wells. Additionally, monitoring of six historically inactive wells was resumed to better characterize groundwater quality on the east side of the Landfill.

In 2019, the monitoring program included 20 shallow monitoring wells and 21 deep monitoring wells. Quarterly groundwater quality samples were collected from the monitoring stations required by the OC. All samples were analyzed for the parameters stipulated in the OC. Groundwater quality in the shallow aquifer is strongly influence by bog water chemistry. Upgradient groundwater flowing from Burns Bog toward the landfill is naturally acidic and contains elevated concentrations of several constituents that are readily mobilized under acidic conditions. Deep groundwater chemistry appears to have minimal influence from Burns Bog and represents a compilation of upgradient sources. Water chemistry in both shallow and deep aquifers naturally evolves along the flow path, particularity in the shallow aquifer, as groundwater travels away from the bog hydrologic system. Professional judgment was used to assess the nature and degree of any water quality impacts that may have occurred due to leachate, road salt, runoff from neighbouring lands and brackish waters from tidal fluctuations and municipal floodgate operations.

Groundwater quality results were tabulated and compared against applicable *Contaminated Sites Regulation* (CSR) standards. The shallow aquifer is not considered to be a drinking water aquifer due to the presence of organic soils. Primary leachate indicator parameters are considered to be ammonia, conductivity and chloride. Secondary leachate indicator parameters include alkalinity and hardness. All of these parameters were used to assess any leachate impacts in consideration of background concentrations of leachate indicator parameters and the results of statistical trend analysis.

Groundwater concentrations of leachate indicator parameters were generally lower in the shallow aquifer than in the deep aquifer because shallow groundwater is more dilute and influenced by natural runoff from Burns Bog. The groundwater quality results for 2019 were

similar to those measured over recent years and leachate-impacted groundwater was contained within the landfill property.

Shallow Groundwater Quality

In 2019, shallow groundwater quality at all monitoring stations does not appear to be impacted by leachate, with one exception (54-2013).

Shallow groundwater quality at monitoring station 54-2013 exhibited dilute leachate impacts. Based on the results of the 2018 Hydrogeology Review, groundwater quality at this location, immediately south and up to 40 metres outside of the perimeter ditch system, is impacted by dilute leachate. The impacts are relatively minor, decreasing with time, and contained within the landfill property boundary due to net-inward hydraulic gradients from the bog towards the perimeter ditch system. Further monitoring is planned during the next hydrogeologic review (2023) to verify that the extent of the impacts.

Background water quality in the shallow aquifer was similar to previous years and reflected natural water chemistry in Burns Bog. Shallow groundwater quality met applicable CSR standards, with the exception of a single beryllium exceedance in a well located in Burns Bog cross-gradient to the Landfill. This well is not considered to be impacted by leachate.

Deep Groundwater Quality

In 2019, deep groundwater quality at all monitoring stations does not appear to be impacted by leachate.

Background water quality in the deep aquifer was similar to previous years and reflected natural water chemistry. Concentrations of leachate indicator parameters and other dissolved minerals are higher than those observed in the overlying shallow aquifer. Concentrations of select leachate indicator parameters at downgradient monitoring wells are slightly higher than upgradient of the landfill, which may be the result of off-site sources (i.e., road salt and tidal influences).

Deep groundwater quality data met the applicable CSR Aquatic Life (AW) standards. It also met applicable CSR Drinking Water (DW) standards, with the exception of dissolved lithium, chloride, arsenic and vanadium at select monitoring wells. Elevated concentrations are either naturally occurring or attributed to road salt or off-site sources.

Surface Water Quality

As per the OC, quarterly monitoring and sampling must be conducted at eight surface water monitoring stations. In 2018, the number of stations monitored was increased from 11 to 13. Station 95 was added to characterize background surface water concentrations from the Crescent Slough. Station 96 was added to characterize drainage ditch water quality in the northwest corner of the Landfill.

In 2019, the surface water monitoring program met if not exceeded the requirements stipulated in the OC based on the number of stations and parameters monitored. The only

exceptions were associated with locations that could not be sampled in the summer when the ditch was dry or stagnant, which is consistent with previous years.

Surface water quality at monitoring stations located northwest, northeast, and south of the landfill does not appear to be impacted by leachate. Aside from the Crescent Slough background station, water chemistry at these locations is strongly influenced by naturally acidic surface water runoff and groundwater seepage from Burns Bog. Similar to previous years, pH and metals concentrations exceeded BCWQG AW and IW criteria at several locations. Exceedances at these stations are consistent with background water quality in the bog and are attributed to the naturally acidic water quality associated with Burns Bog. Winter conductivity and chloride values at the Crescent Slough background monitoring station also exceeded BCWQG IW criteria, likely due to seasonal runoff from nearby roadways.

Surface water quality at monitoring stations located southwest and west of the landfill does not appear to be impacted by leachate. Similar to previous years, pH, turbidity and metals concentrations exceeded BCWQG AW and IW criteria. Water quality impacts at these locations are attributed seasonal runoff from nearby agricultural fields and roadways and influences from the Fraser River.

Stormwater Quality

Following recommendations in the *2018/19 Vancouver Landfill Stormwater and Surface Water Monitoring Report*, a routine stormwater monitoring program was initiated in December 2019. The purpose of this program is to characterize the quality of stormwater discharging from closed phases of the landfill to determine the suitability of discharging stormwater outside the leachate collection system. Based on the December 2019 results, stormwater discharge from Phases 1, 2 and 3 met all applicable BCWQGs and is considered to be suitable for discharge outside the leachate collection system. Overall stormwater quality from these three stations was similar to or better than water quality in the proposed receiving environments (e.g. Dredge Pond, Centre Ditch and Crescent Slough). Stormwater discharge from Western 40 Pond 4 was poor and is not suitable for discharge outside the leachate collection system. No stormwater was discharging from Western 40 Pond 6 at the time of sampling so water quality could not be assessed.

Based on the findings of the 2019 Water Quality Monitoring Program Review, the below recommendations are provided along with ongoing recommendations from 2018 and 2017.

2019 Recommendations		
Monitoring Network		**Status**
2019-1	Well 27-2013 is compromised and should be decommissioned in accordance with the BC Groundwater Protection Regulation. This OC well should be replaced and reintroduced to the routine monitoring program in 2020.	New
2019-2	Inactive monitoring Wells 19 and 20 should be decommissioned once access to the property south of the landfill is granted.	New
Water Quality Monitoring Program		
2019-3	The leachate sampling containers utilized to collect samples for toxicity testing should be cleaned prior to leachate sample collection.	New
2019-4	Surface water and stormwater samples should be analyzed for dissolved organic carbon (DOC) to assess compliance against the new Aquatic Life BC Water Quality Guideline for copper. The guideline value varies with hardness, pH, dissolved organic matter and temperature, and is calculated using the Biotic Ligand Model (BLM).	New
2019-5	Well 70 should continue to be sampled as part of the routine monitoring program until sufficient data is collected from the 2019 replacement well (Well 125) to determine if they exhibit similar water quality. It is anticipated that one year of quarterly data is sufficient for the water quality comparison and therefore a water quality comparison should be conducted as part of the 2020 Annual Water Quality Monitoring Report. If it is concluded that Well 125 is a suitable replacement for OC Well 70, then CoV should request the change to the OC. Once MoE approves the change, the well should be decommissioned in accordance with the BC Groundwater Protection Regulation.	New
2019-6	Similar to well 35, only water level and field parameter data should be collected from wells 112 and 113 as part of the routine monitoring program. Water quality samples are not required.	New
2018 Recommendations		
Water Quality Monitoring Program		**Status**
2018-2	Update the *Field Sampling and Quality Control Manual* to include the sampling protocols as recommended in the 2018 field sampling audit (included in Appendix E5).	Ongoing
2018-3	Complete quarterly sampling of the wells in the vicinity of the leachate pump station for two years to allow for statistical trend analysis, as recommended in the Leachate Pump Station Investigation Memo (Appendix G of the 2018 Water Quality Monitoring Report).	Ongoing

2017 Recommendations		
Monitoring Network		**Status**
2017-2	Permanent station markers should be installed to identify the exact location of each surface water monitoring station to ensure the integrity of the surface water quality dataset is maintained.	Ongoing
Water Quality Monitoring Program		
2017-7	Each round of quarterly surface water sampling should be completed as rapidly as possible (ideally the same day) to ensure all surface water quality data is representative of the same meteoric conditions. Surface water quality is known to change rapidly at the landfill in response to precipitation events and flooding from downstream sources.	Ongoing
2017-8	Each round of quarterly groundwater sampling should be completed within a one week timeframe to ensure all groundwater quality data reflects similar meteoric conditions. Shallow groundwater quality is known to change rapidly at the landfill in response to precipitation events.	Ongoing

Appendix 7: 2019 Weekly Leachate and Drainage Ditch Water Elevations

Table 6-3. Vancouver Landfill Weekly Leachate and Drainage Ditch Water Elevations

Date	SG1		Flow Direction	SG2		Flow Direction	SG3		Flow Direction	SG4		Flow Direction	SG5		Flow Direction
	L1	D1		L2	D2		L3	D3		L4	D4		L5	D5	
	m	m		m	m		m	m		m	m		m	m	
Invert Elevation	**0.02**	**0.01**		**-0.01**	**-0.05**		**0**	**0.01**		**NA**	**0**		**-0.02**	**0.01**	
2019/01/04	0.27	0.53	inward	0.33	0.47	inward	0.63	1.03	inward	0.88	1.27	inward	0.82	0.58	outward
2019/01/07	0.15	0.07	outward	0.36	0.36	outward	0.6	1	inward	0.59	1.2	inward	0.28	0.38	inward
2019/01/11	-0.45	-0.11	inward	0.25	0.31	inward	0.67	1.06	inward	0.41	1.04	inward	0.08	0.38	inward
2019/01/16	-0.49	-0.13	inward	-0.24	-0.1	inward	0.24	0.92	inward	0.48	1.05	inward	-0.14	0.03	inward
2019/01/23	-0.36	0.09	inward	-0.16	0.12	inward	0.3	1	inward	0.53	1.2	inward	-0.04	0.33	inward
2019/01/31	-0.51	-0.14	inward	-0.25	-0.13	inward	0.22	0.94	inward	0.44	1	inward	-0.18	0.02	inward
2019/02/05	-0.49	-0.15	inward	-0.24	-0.09	inward	0.22	0.96	inward	0.45	1.1	inward	-0.15	0.09	inward
2019/02/11	-0.42	-0.16	inward	-0.26	-0.1	inward	0.21	0.9	inward	0.41	0.94	inward	-0.2	0.01	inward
2019/02/21	-0.28	-0.14	inward	-0.1	-0.07	inward	0.22	0.97	inward	0.46	1.15	inward	-0.17	0.12	inward
2019/03/01	-0.52	-0.15	inward	-0.26	-0.12	inward	0.19	0.95	inward	0.42	1	inward	-0.22	0	inward
2019/03/08	-0.49	-0.16	inward	-0.26	-0.15	inward	0.18	0.89	inward	0.4	0.88	inward	-0.24	-0.03	inward
2019/03/13	-0.52	-0.14	inward	-0.26	-0.11	inward	0.19	0.97	inward	0.44	1.1	inward	-0.21	0.11	inward
2019/03/18	-0.5	-0.16	inward	-0.29	-0.13	inward	0.17	0.95	inward	0.42	1.03	inward	-0.23	0.03	inward
2019/03/27	-0.56	-0.16	inward	-0.27	-0.15	inward	0.15	0.91	inward	0.4	0.89	inward	-0.28	0.02	inward
2019/04/02	-0.52	-0.16	inward	-0.28	-0.16	inward	0.16	0.83	inward	0.39	0.8	inward	-0.28	-0.03	inward
2019/04/09	-0.46	-0.15	inward	-0.26	-0.13	inward	0.16	0.91	inward	0.4	1	inward	-0.23	-0.01	inward
2019/04/16	-0.42	-0.14	inward	-0.25	-0.11	inward	0.14	0.97	inward	0.42	1.09	inward	-0.23	0.1	inward
2019/04/24	-0.54	-0.15	inward	-0.25	-0.07	inward	0.16	0.97	inward	0.43	0.14	outward	-0.22	0.21	inward
2019/05/03	-0.56	-0.16	inward	-0.28	-0.15	inward	0.16	0.88	inward	0.39	0.84	inward	-0.27	-0.01	inward
2019/05/15	-0.6	-0.15	inward	-0.3	-0.15	inward	0.15	0.8	inward	0.42	0.77	inward	-0.27	0	inward
2019/05/23	-0.6	-0.01	inward	-0.3	-0.17	inward	0.15	0.76	inward	0.4	0.61	inward	-0.3	0	inward
2019/05/31	-0.6	-0.12	inward	-0.3	-0.19	inward	0.13	0.75	inward	0.4	0.66	inward	-0.31	-0.05	inward
2019/06/07	-0.6	0.09	inward	-0.31	-0.2	inward	0.11	0.68	inward	0.4	0.56	inward	-0.28	0.13	inward
2019/06/13	-0.6	0	inward	-0.31	-0.22	inward	0.1	0.6	inward	0.39	0.51	inward	-0.31	0.07	inward
2019/06/21	-0.55	0.06	inward	-0.3	-0.21	inward	0.15	0.54	inward	0.41	0.5	inward	-0.29	0.04	inward
2019/06/28	-0.54	0.1	inward	-0.39	-0.22	inward	0.19	0.45	inward	0.43	0.48	inward	-0.27	0.12	inward
2019/07/11	-0.57	0.11	inward	-0.26	-0.24	inward	0.2	0.47	inward	0.43	0.47	inward	-0.27	0.14	inward
2019/07/19	-0.57	0.13	inward	-0.3	-0.24	inward	0.37	0.45	inward	0.43	0.45	inward	-0.28	0.15	inward
2019/07/25	-0.56	0.12	inward	-0.3	-0.26	inward	0.18	0.45	inward	0.43	0.45	inward	-0.28	0.16	inward
2019/08/02	-0.56	0.15	inward	-0.28	-0.26	inward	0.18	0.45	inward	0.45	0.45	outward	-0.3	0.15	inward
2019/08/09	-0.56	0.14	inward	-0.28	-0.26	inward	0.18	0.45	inward	0.42	0.45	inward	-0.3	0.15	inward
2019/08/16	-0.5	0.09	inward	-0.23	-0.26	outward	0.2	0.45	inward	0.42	0.45	inward	-0.28	0.11	inward
2019/08/28	-0.5	-0.03	inward	-0.28	-0.26	inward	0.2	0.45	inward	0.41	0.45	inward	-0.27	-0.02	inward
2019/09/06	-0.5	-0.12	inward	-0.28	-0.27	inward	0.25	0.44	inward	0.43	0.45	inward	-0.29	-0.08	inward
2019/09/18	-0.31	-0.15	inward	-0.08	-0.16	outward	0.45	0.44	outward	0.49	0.44	outward	0	-0.04	outward
2019/09/25	-0.36	-0.11	inward	-0.14	-0.22	outward	0.46	0.44	outward	0.47	0.48	inward	-0.15	-0.16	outward
2019/10/04	-0.42	-0.18	inward	-0.28	-0.26	inward	0.31	0.45	inward	0.45	0.48	inward	-0.2	-0.08	inward
2019/10/10	-0.56	-0.18	inward	-0.3	-0.27	inward	0.35	0.47	inward	0.46	0.5	inward	-0.21	-0.07	inward
2019/10/18	-0.47	-0.1	inward	-0.21	-0.24	outward	0.41	0.5	inward	0.51	0.6	inward	-0.05	-0.05	outward
2019/10/22	-0.21	0.34	inward	0.02	0.06	inward	0.59	0.76	inward	0.69	1.05	inward	0.24	0.43	inward
2019/10/25	-0.36	0.09	inward	-0.2	-0.12	inward	0.42	0.94	inward	0.57	0.95	inward	0	0.3	inward
2019/10/28	-0.46	-0.16	inward	-0.26	-0.17	inward	0.36	0.9	inward	0.55	0.9	inward	-0.06	0.08	inward
2019/11/01	-0.44	-0.16	inward	-0.19	-0.2	outward	0.34	0.85	inward	0.5	0.85	inward	-0.08	0.03	inward
2019/11/08	-0.48	-0.16	inward	-0.2	-0.23	outward	0.33	0.76	inward	0.49	0.79	inward	-0.13	-0.01	inward
2019/11/13	-0.52	-0.07	inward	-0.25	-0.21	inward	0.35	0.8	inward	0.5	0.84	inward	-0.21	0.03	inward
2019/11/19	-0.28	0.23	inward	-0.1	0.22	inward	0.44	1	inward	0.65	1.05	inward	-0.04	0.4	inward
2019/12/01	-0.55	-0.14	inward	-0.25	-0.18	inward	0.29	1.02	inward	0.53	0.85	inward	-0.31	0.04	inward
2019/12/13	-0.36	0.19	inward	-0.1	0.24	inward	0.37	1	inward	0.65	1.02	inward	-0.2	0.39	inward
2019/12/19	-0.45	-0.08	inward	-0.19	-0.07	inward	0.35	0.93	inward	0.62	0.94	inward	-0.26	0.15	inward
2019/12/27	-0.43	-0.08	inward	-0.15	-0.09	inward	0.3	0.9	inward	0.65	0.92	inward	-0.27	0.13	inward
2019/12/30	-0.43	-0.08	inward	-0.24	-0.1	inward	0.3	0.87	inward	0.67	0.89	inward	-0.27	0.06	inward
Summary Statistics															
Mean	-0.476	-0.056		-0.206	-0.116		0.277	0.769		0.480	0.784		-0.169	0.099	
Standard Deviation	0.117	0.129		0.150	0.168		0.140	0.220		0.100	0.274		0.193	0.154	
Number of Measurements			368			51			51			51			51
Outward or No Flow			3			7			2			3			4
Outward Flow Percentage			0.8%			13.7%			3.9%			5.9%			7.8%
Average Outward Flow			**6.44%**												

Note

1) All measured data are converted to geodetic elevations.

2) Stations L1 and D1 are measured on daily basis (week days).

Indicates outward gradient flow direction

Appendix 8: 2019 Annual Status Form

Annual Status Form

AUTHORIZATION NUMBER: 1611
AUTHORIZATION TYPE: Municipal Waste
LEGAL AUTHORIZATION HOLDER NAME: City of Vancouver

AUTHORIZED PERSON NAME: Nicole Steglich
AUTHORIZED PERSON SIGNATURE: N Steglich
SIGNATURE DATE: Mar 31, 2020

I understand that it is an offense to mislead a government official, and I declare that all of the information presented is accurate and true.

CONDITION NUMBER	CONDITION DESCRIPTION	COMPLIANT (Yes/No/ND)	ACTION TAKEN	ANNUAL REPORT SECTION(S)
1.1.1	The discharge [of refuse to a sanitary landfill from sources within the Greater Vancouver Regional District and other sources specifically authorized by the Regional Waste Manager] is authorized for the full term of the Greater Vancouver Regional Solid Waste Management Plan, dated July 1995. The solid waste management plan must be amended to authorize the discharge beyond this term.	Yes	N/A	Vancouver Landfill Overview
1.1.2	Maximum authorized rate of discharge is 750,000 tonnes per year	Yes	N/A	5. Waste Disposal
1.1.3	The characteristics of the discharge shall be typical municipal solid waste and other materials as specifically authorized by the Regional Waste Manager. Asbestos waste may be discharged in accordance with the *Special Waste Regulations* .	Yes	N/A	5. Waste Disposal
1.1.4	Waste shall not be discharged within a buffer zone as identified in Section 2.9. Putrescible and household waste shall not be discharged into water. The burning of waste is prohibited.	Yes	N/A	5. Waste Disposal
1.1.5	The authorized works common to this section and Sections 1.2, 1.3 and 1.4 are a locking gate to control access by the public, a weigh scale and fire protection equipment, approximately located as shown on attached Site Plan A.	Yes	N/A	
1.1.6	The authorized works specific to this section are those associated with a landfill operation and include berms, covering material, surface water diversionary works, environmental monitoring systems, leachate collection/pumping works and a landfill gas management system consisting of existing and future collection works, a blower/flare station and gas utilization works, approximately located as shown on attached Site Plan B.	Yes	N/A	7. Environmental Protection Programs; 8. Operational Information

Authorized Person Initial: NS

Date: Mar 31, 2020

CONDITION NUMBER	CONDITION DESCRIPTION	COMPLIANT (Yes/No/ND)	ACTION TAKEN	ANNUAL REPORT SECTION(S)
1.1.7	The location of the point of discharge is Lot 9, Section 5 and 6, New Westminster District, Plan 38013. Discharge within the area identified as the "100 Acre Reserve", approximately as shown on Site Plan B, is restricted to construction and demolition waste in accordance with the approved closure plan required in Section 2.8	Yes	N/A	5. Waste Disposal
1.2.1	The characteristics of waste [at the landfill transfer station facility] are the same as set out in Section 1.1.3	Yes	N/A	6. Waste Reduction and Recycling Initiatives
1.2.2	The authorized works are those associated with a transfer station and include a paved access area and roll off bins, approximately located as shown on attached Site Plan C.	Yes	N/A	6. Waste Reduction and Recycling Initiatives
1.2.3	The location of the facilities is Lot 9, Section 5 and 6, New Westminster District, Plan 38013.	Yes	N/A	Vancouver Landfill Overview
1.3.1	The type of materials which may be managed at this facility [recycling depot and household hazardous waste storage facility] are typical recyclable materials and household hazardous waste.	Yes	N/A	6. Waste Reduction and Recycling Initiatives
1.3.2	The authorized works are those associated with a recycling depot and household hazardous waste storage facility and include roll off bins, recycling containers, a secure (fenced) storage area and storage shed for household hazardous waste, approximately located as shown on attached Site Plan C.	Yes	N/A	8. Operational Information; 6. Waste Reduction and Recycling Initiatives
1.3.3	The location of the facility is the same location as set out in Section 1.2.3.	Yes	N/A	Vancouver Landfill Overview
1.4.1	The type of waste that may be composted [at the composting facility for organic wastes from sources within the Greater Vancouver Regional District and other sources as specifically authorized by the Regional Waste Manager] is restricted to fruit and vegetable waste, typical yardwaste and Christmas trees.	Yes	N/A	6. Waste Reduction and Recycling Initiatives
1.4.2	The authorized works are those associated with a composting facility and include an impermeable pad, a stationary grinding plant, and windrow turning equipment, approximately located as shown on attached Site Plan A.	Yes	N/A	6. Waste Reduction and Recycling Initiatives
1.4.3	The location of the facilities is the same location as set out in Section 1.2.3.	Yes	N/A	Vancouver Landfill Overview
2.1	In the event of an emergency which prevents compliance with a requirement of this operational certificate, that requirement will be suspended for such time as the emergency continues or until otherwise directed by the Regional Waste Manager.	Yes	N/A	
2.2	Inspect the authorized works regularly and maintain them in good working order. Notify the Regional Waste Manager of any malfunction of these works.	Yes	N/A	8. Operational Information
2.3	Inspect the property boundaries regularly and notify the Regional Waste Manager of any visual evidence of environmental impacts on adjacent properties	Yes	N/A	8. Operational Information
2.4	Provision of fencing, site access, vehicle safety barriers, surface water diversionary works, firebreaks and on site restoration as required, shall be carried out to the satisfaction of the Regional Waste Manager.	Yes	N/A	

Authorized Person Initial: NS

Date: Mar 31, 2020

CONDITION NUMBER	CONDITION DESCRIPTION	COMPLIANT (Yes/No/ND)	ACTION TAKEN	ANNUAL REPORT SECTION(S)
2.5	In preparation for the placement of putrescible waste, construct a base cell consisting of an approximate 3 metre lift of demolition and construction waste covered with a minimum 0.15 metre layer of suitable cover material. Firebreaks shall be incorporated into each cell in such quantity and manner as to prevent fires from becoming an environmental or safety hazard. Putrescible and household waste shall not be discharged in the base cell. Fort the purpose of this section, suitable cover consists of soil, utilized in accordance with Section 2.7 or other material as deemed acceptable by the Regional Waste Manager.	Yes	N/A	5. Waste Disposal
2.6	All waste shall be placed in cells of a size acceptable to the Regional Waste Manager. The working face shall be confined to the smallest practical area. Waste shall be discharged in layers of 0.6 metres or less and compacted to the smallest practical volume. Intermediate cover, consisting of a minimum 0.30 metre of suitable cover material shall be applied as the filling proceeds. Side slopes shall be a maximum of 1:3 (vertical: horizontal). During non-discharge hours, the working f ace shall be covered with a tarp or other measures to the satisfaction of the manager to provide vector and litter control. The working face shall be covered with a minimum of 0.15 metres of suitable cover material once a week. The manager may vary the frequency of covering when freezing conditions adversely affect normal operation.	Yes	N/A	5. Waste Disposal
2.7	Urban park quality soil may be utilized for berm construction, intermediate and final cover, top dressing and landscaping. Soil with any substance with a concentration exceeding the lowest applicable numerical standard for urban park land may only be used for internal berms or intermediate cover. The utilization or discharge of special waste soil is prohibited.	Yes	N/A	5. Waste Disposal
2.8	Submit a closure plan for the area identified as the "100 acre reserve", ..., to the Regional Waste Manager by December 31, 2001 for approval. For the remainder of the landfill, the operational certificate holder shall apply final cover to any area of the landfill, which will not receive any further waste, Final cover shall be applied within one (1) year of completing the subject area. Final cover shall consist of a minimum of 1.0 metre of low permeability (<1 x 10(-5) cm/s) compacted soil (or equivalent) cap plus a minimum of 0.15 metre of topsoil and suitable vegetative cover. Final cover shall be slowed to promote surface water runoff. Surface water runoff shall be directed outside of the leachate collection system.	Yes	N/A	2. Design, Operations and Progressive Closure Plan; 4. Planned Improvements
2.9	Maintain a buffer zone along the north, east and south perimeters of the site, approximately as shown on Site Plan B and as follows: a minimum of 50 metres wide along the west half of the northern boundary and 30 metres wide along the balance of the northern boundary; and a minimum of 50 metres wide along all remaining boundaries. The buffer zone along the southern boundary of the site shall include a minimum fifteen (15) metre wide natural or landscaped screen.	Yes	N/A	Vancouver Landfill Overview

Authorized Person Initial: NS

Date: Mar 31, 2020

CONDITION NUMBER	CONDITION DESCRIPTION	COMPLIANT (Yes/No/ND)	ACTION TAKEN	ANNUAL REPORT SECTION(S)
2.10	Post a sign, to the satisfaction of the Regional Waste Manager, at the entrance of the landfill site with the following current information: site name, owner and operator, contact telephone number and address for the owner and operator, telephone number in case of emergency, hours of operation, materials and wastes accepted for recycling and landfilling, prohibited materials and wastes, and tipping fees.	Yes	N/A	
2.11	Take all reasonable measures necessary to prevent fires from occurring at the site. Provide and maintain fire fighting equipment and materials to the satisfaction of the Regional Waste Manager. The operational certificate holder is responsible for complying with all municipal fire safety requirements. In the event of a landfill fire, immediately notify the local fire department, the Provincial Emergency Program and the manager.	Yes	N/A	8. Operational Information
2.12	Take measures to minimize leachate generation, including but not limited to, providing effective covering and surface water runoff. Measures taken, their effectiveness and any proposed measures shall be detailed in the annual report. The leachate collection works shall be maintained in accordance with sound engineering principles as supported by qualified personnel.	Yes	N/A	7. Environmental Protection Programs
2.13	Submit a report to the Regional Waste Manager by April 30, 2001 detailing measures taken to minimize odours and greenhouse gas emissions and their effectiveness. The annual report shall include a description of measures taken and the beneficial results accomplished by these measures, any revisions to the implementation schedule and any new measures planned for the coming year.	Yes	N/A	7. Environmental Protection Programs
2.14	The amount of compostable materials and finished compost accumulated at the facility shall be limited to the maximum which can be properly managed at the site.	Yes	N/A	6. Waste Reduction and Recycling Initiatives
2.15	The amount of recyclable materials and household hazardous waste accumulated at the facility shall be limited to the maximum which can be properly managed at the site	Yes	N/A	6. Waste Reduction and Recycling Initiatives
2.16	Conduct a hydrogeological assessment to determine the following: hydrogeological impact of continuing extraction of sand and water from the dredge pond and its effect on leachate management; the natural attenuation properties of the peat and silt layers in the long term; the effect of additional height of waste on the horizontal hydraulic conductivity of the demolition layer (base cell); and they hydrogeological impact of current operating practices. Take into consideration recommendations of the hydrogeological study completed in September 1995. Review and update the hydrogeological assessment every five years with the first review prior to December 31, 2005. Incorporate actions recommended in this review and subsequent reviews into the revised design and operating plan. Hydrogeological assessments and reviews shall be conducted by a qualified professional licensed to practice in the province of BC.	Yes	N/A	4. Planned Improvements
2.17	Register a covenant or other legal notification not later than 6 months following the subdivision of the property described in Section 1.1.7, that the property was used for the purpose of waste disposal as a charge against the title to the property.	Yes	N/A	

Authorized Person Initial: NS

Date: Mar 31, 2020

CONDITION NUMBER	CONDITION DESCRIPTION	COMPLIANT (Yes/No/ND)	ACTION TAKEN	ANNUAL REPORT SECTION(S)
2.18	Operate the authorized facilities in accordance with a design and operating plan certified by a qualified professional. Review the plan on an annual basis. Any revisions to the plan shall be submitted as part of the annual report.	Yes	N/A	2. Design, Operations and Progressive Closure Plan
2.19	Accrue, during the lifetime of the landfill, a dedicated reserve fund sufficient to finance closure, post-closure and environmental contingencies related to the landfill. Include a minimum post closure period of twenty (25) years and how the fund will be accrued in the design and operations plan. Update estimated costs of closure and post-closure activities annually and incorporate into the annual report. Should estimated costs increase, increase the rate of the accrual accordingly.	Yes	N/A	3. Closure and Post Closure Costs
2.20	Submit a closure plan for the sanitary landfill and landfill transfer station facility at least six (6) months prior to the closure of the landfill for approval. Incorporate the required information.	Yes	N/A	
2.21	Submit a site profile to the Regional Waste Manger not less than 10 days prior to decommissioning the authorized facilities.	Yes	N/A	
3.1	Record the quantity, in tonnes, of waste received at the landfill, recycling and composting facilities. Record the quantity and destination of recyclable materials and mature compost removed from these facilities.	Yes	N/A	5. Waste Disposal; 6. Waste Reduction and Recycling Initiatives
3.2.1	Maintain leachate, surface water and groundwater monitoring stations, approximately located as shown on the attached Site Plan D, and as outlined in Table 1. Obtain grab samples at each station and analyze for each parameter at a frequency as indicated in Table 2. Take care in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.	Yes	N/A	7. Environmental Protection Programs
3.2.2	Provide and maintain a suitable flow measuring device and record the volume of leachate discharge to sanitary sewer each month.	Yes	N/A	7. Environmental Protection Programs
3.2.3	Establish and maintain a minimum of four (4) water level monitoring stations and record once per month the water level elevation in the leachate and drainage ditches at each station.	Yes	N/A	7. Environmental Protection Programs
3.3.1	Sampling and flow measurement shall be carried out in accordance with the procedures described in "British Columbia Field Sampling Manual for Continuous Monitoring plus the Collection of Air, Air-Emission, water, Wastewater, Soil, Sediment and Biological Samples", 1996 Edition, or by suitable alternative.	Yes	N/A	7. Environmental Protection Programs
3.3.2	Analyses are to be carried out in accordance with procedures descried in the latest version of "British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials, (March 1994 Permittee Edition)", or by suitable alternative.	Yes	N/A	7. Environmental Protection Programs
3.3.3	All data analysis required to be submitted by the permit shall be conducted by a laboratory acceptable to the Regional Waste Manager. Provide the laboratory quality assurance data, associated field blanks, and duplicate analysis results along with the submission of data required under section 3.2.	Yes	N/A	7. Environmental Protection Programs

Authorized Person Initial: NS

Date: Mar 31, 2020

CONDITION NUMBER	CONDITION DESCRIPTION	COMPLIANT (Yes/No/ND)	ACTION TAKEN	ANNUAL REPORT SECTION(S)
3.4	Maintain the following information and records, current and suitably tabulated, at the landfill office for inspection: copy of Operational Certificate MR-01611; training procedures and personnel training records; contingency plans and notification procedures; current design and operating plan; inspection records from staff and regulatory agencies; hydrogeological, geotechnical and landfill gas assessments; incoming waste, and soil records; records of recyclable materials shipped off site; environmental monitoring results and interpretations; and annual operating and monitoring reports for the previous year.	Yes	N/A	
3.5.1	Maintain data of analyses and records of waste and recyclable material quantities for inspection. Submit data of analysis suitably tabulated, to the Regional Waste Manager for the previous three months. The reporting period ends Mar 31, Jun 30, Sept 30 and Dec 31. All reports shall be received by the manager within 31 days of the end of the reporting period.	Yes	N/A	
3.5.2	Prepare an annual report which shall include a compendium of data submitted under Section 3.5.1, in addition to: a review and interpretation of the analytical data from receiving environment monitoring for the preceding year; waste, recyclable material and compost records; leachate flow data and leachate/drainage ditch levels suitably tabulated; an evaluation of leachate generation control measures; an evaluation of the efficiency of the landfill gas generation rate, percent recovery and the actual rates/volumes of gas collection, utilized and flared; revised closure/post closure costs and amount of funds currently available; revised design and operating plan and planned improvements; identification of operating problems and corrective actions taken; an evaluation of the recycling and composting programs including waste diversion projections; and public complaint/resolution log for the landfill. Submit report to the Regional Waste Manager on or before Mar 31 of the following year.	Yes	N/A	

Authorized Person Initial: NS

Date: Mar 31, 2020