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Hartland Landfill

Operating & Environmental Monitoring 2015 Annual Report

Operational Certificate 12659

Parks & Environmental Services | Environmental Protection

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HARTLAND LANDFILL
OPERATING & ENVIRONMENTAL MONITORING 2015 ANNUAL REPORT

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EXECUTIVE SUMMARY

Hartland landfill and recycling facility is owned and operated by the Capital Regional District and is located about 14 km northwest of Victoria. It is a multi-employer site and is the only sanitary landfill in the capital region, serving just over 378,000 people. The operation is a multi-purpose facility providing recycling; household hazardous waste collection; a salvage area; yard and garden waste collection and processing; controlled waste disposal; and landfill services to commercial and residential customers.

The facility operates under an approved Solid Waste Management Plan and Operational Certificate 12659 issued by the Ministry of Environment (MOE). An authorization is in place for the Hartland landfill to deposit waste asbestos. The site has a BC Generator number 15394 and is a registered Return Collection Facility. This report is intended for internal and external CRD stakeholders and regulators including the BC MOE. The report compiles data regarding total waste tonnages, landfill lifespan, closure funding, operational and construction related activities in 2015, and environmental monitoring program results.

In 2015, the Hartland landfill received a total of 123,381 tonnes of waste[1], including 112,442 tonnes of refuse and 10,939 tonnes of controlled waste. The controlled waste tonnage includes 3,432 tonnes of asbestos. Based upon comparison of surface elevation data and planned final contours in the *Hartland Landfill Phase 2 Long Term Leachate Management Plan* (Sperling Hansen Associates, June 2007) the estimated remaining capacity[2] is 5,115,000 cubic metres, compared to 5,246,000 cubic metres in 2014. It is estimated that there has been approximately 6,885,414 tonnes of garbage deposited at the site at the end of 2015. The estimated landfill capacity will be reached in 35 years.

Since 1985, over $40 million has been invested in capital works, environmental controls and general site improvements.

Summary of Capital Projects for 2015:

- Gas and Leachate Collection Pipe Extension at 175 m Lift
- Airspace/Aggregate Production
- Environmental Inventory–Hartland North Aggregate Storage
- Hartland Leachate Line Hydraulic Review and Assessment
- South Leachate Containment Upgrades
- Seismic Stability Assessment Update
- Cell Phone Tower
- Lagoon Embankment Stabilization

Summary of Operational Changes for 2015:

- Kitchen Scraps Ban
- Execution of Security, Bird Control and Landfill Operations Contract
- Water System Maintenance/Upgrade
- Waste Discharge Permit Revisions
- Design, Operations and Closure Plan Update

Summary of Capital and Operational Changes Planned for 2016:

- Airspace/Aggregate Production
- Interim Landfill Cover–Phase 2, Cell 2 (South East Face)
- Phase 2 East Toe Berm Upgrades
- Phase 2 Cell 3 Underdrain and Liner System
- Gas and Leachate Collection Pipe Extension at 183 m Lift
- Conceptual Landfill Capacity Study, Aggregate Management Plan and Stockpile Design

1 Reported tonnages and calculated volumes (cubic metres) are based upon landfill actual weigh scale data.
2 Estimated capacities for 2015 and 2014 are rounded values to thousandths

- Repair of Commercial Scale Decks
- Waste Composition Study
- Bylaw Amendments
- Landfill Gas Engine Rebuild
- Design, Operations and Closure Plan Update
- Hartland Open House
- Software Upgrades, Upgrade Services and Cameras
- Continuations of Security, Bird Control and Landfill Operations Contracts
- Water System Upgrades
- Mechanical Services Contract for the Generator
- Activation of New Landfill Gas Infrastructure
- Invasive Plant Species Control
- Landfill Criteria Conformance Assessment

Hartland landfill employs a number of control measures to prevent or reduce effects on groundwater, surface water and air. An environmental monitoring, assessment and management program is in place to assess the effectiveness of environmental controls and to assess regulatory compliance. Monitoring data is reported between April 1, 2015 and March 31, 2016. The Harland landfill monitoring program confirms that regulatory requirements are met and provide critical data that supports successful management of the landfill. Based upon the monitoring program, effective measures are in place to ensure environmental impacts are mitigated and leachate is effectively controlled and contained on site prior to discharge to the sanitary sewer.

HARTLAND LANDFILL
OPERATING & ENVIRONMENTAL MONITORING 2015 ANNUAL REPORT

1.0 INTRODUCTION

Hartland landfill and recycling facility is owned and operated by the Capital Regional District (CRD) and is located about 14 km northwest of Victoria. It is a multi-employer site and is the only sanitary landfill in the capital region, serving a population of over 378,000 people. The operation is a multi-purpose facility providing recycling; household hazardous waste collection; a salvage area; yard and garden waste collection and processing; controlled waste disposal; and landfill services to commercial and residential customers.

This report represents the amalgamation of 3 historically separate documents and is intended for a diverse audience including: BC Ministry of Environment (MOE); CRD internal staff, CRD Committee and Board members; and the public. The data compiled herein is required to meet internal requirements and BC regulatory requirements per Section 3.2 of the Operational Certificate. As required by the Operational Certificate, this report summarizes the following:

- waste tonnages
- remaining landfill lifespan
- post closure funding
- 2015 Operations activities
- 2015 Construction contract related activities, and
- 2015–2016 Environmental monitoring program results

2.0 REGULATORY SETTING

The Hartland landfill operates in accordance with an approved Solid Waste Management Plan (SWMP). The original SWMP was approved by the MOE in 1989 and has been amended as required. A revision to the plan commenced in 2012 and is in progress. In addition to the SWMP, the landfill operates in accordance with the following:

- Amended Operational Certificate (#12659) approved by the BC MOE, last amended on January 27, 2010.
- Authorization to Dispose of Hazardous Waste Asbestos at the Hartland Landfill approved by the BC MOE on July 23, 2012.
- Waste Discharge Permit SC97.001 issued by the CRD Regional Source Control Program (RSCP), last amended on March 1, 2011[3], and subject to the CRD Sewer Use Bylaw.
- Waste generation in accordance with the Hazardous Waste Regulation under BC Generator number 15394.
- Environmental monitoring programs are regulated by the British Columbia Contaminated Sites Regulation (BC CSR)[4].
- Landfill gas is regulated by the Landfill Gas Management Regulation and various provincial guidelines and criteria. In April 2012, CRD submitted the Hartland Landfill Gas Management Plan in accordance with the Landfill Gas Regulation requirements.

3 CRD RSCP Waste discharge permit amendments were negotiated in winter 2015/2016, however, the permit amendments were formalized in April 2016 after this reporting timeline.
4 BC Contaminated Sites Regulation (BC CSR), BC Reg. 375/96 including amendments up to BC Reg. 184/2016 July 19, 2016.

3.0 BACKGROUND

Hartland landfill is located in the Tod Creek watershed, in the bedrock highlands of the Gowland Range, northwest of Victoria. The terrain is moderately rugged with relief of up to 446 m in the area. Undeveloped CRD property (about 320 ha in total) lies to the west and south of the landfill site. Mount Work Regional Park also lies to the west. Willis Point Road borders the site to the north, and beyond that is a Department of National Defense rifle range. Private residential properties are located to the east and southeast of the landfill.

The landfill is situated in a north-south trending bedrock saddle with Mount Work to the west and an unnamed bedrock ridge to the east. The crest of the landfill forms a drainage divide between the Heal Creek drainage basin to the north and the Killarney Creek drainage basin to the south.

Filling with waste commenced at the site in the 1950s. The site was owned and operated by a private company until 1975 when the property was purchased by the CRD. The landfill is currently owned and operated by the CRD and is the primary solid waste disposal site for the 13 member municipalities of the capital region. Landfilling equipment and operation is conducted by private companies under contract and direction of CRD staff.

The Hartland landfill site is divided into 2 distinct areas referred to as Phase 1 and Phase 2. Initially, waste was deposited in Phase 1, which reached capacity in 1996 and was capped in 1997. Phase 2 is currently receiving waste. Filling of Phase 2, Cell 1 was completed in 2004. Subsequently, Cell 2 has been filled and Cell 3 construction will commence in 2016. Progressive and final closures have been completed throughout the filling as will be described in later sections of this report.

Leachate and surface runoff from the active landfill areas are directed to 2 leachate lagoons at the north end of the landfill. The leachate is then transported by a pipeline to the northwest trunk sewer system and ultimately, the Macaulay Point deep ocean outfall. Leachate discharge to sewer is authorized by RSCP Waste Discharge Permit SC97.001 (RSCP waste discharge permit) and is subject to the CRD Sewer Use Bylaw.

The CRD initiated a surface water and groundwater monitoring program for the landfill in 1983. Annual monitoring reports have been prepared and issued by Gartner Lee and AECOM since 1988. The present Hartland monitoring program is part of an Amended Operational Certificate #12659 last amended January 27, 2010 for the site that is required and approved by the BC MOE.

4.0 WASTE VOLUMES AND AIR SPACE CONSUMPTION

In 2015, the Hartland landfill received a total of 123,381 tonnes of waste, including 112,442 tonnes of refuse and 10,939 tonnes of controlled waste. The controlled waste tonnage includes 3,432 tonnes of asbestos. The following section reports annual statistics on waste management.

4.1 Monthly Waste Tonnage and Airspace Data

Monthly surveys are conducted by the CRD Environmental Engineering Division at the following key locations: active landfilling (waste), active asbestos (asbestos), and daily cover aggregate storage (daily cover). Elevation surveys document changes in airspace volume and support quality control, design conformance assessment, and ongoing landfilling optimization. The following Tables 1–3 summarize waste volumes and airspace consumption for each key location for 2015.

Table 1 Monthly Volume of Airspace Consumed at the Active Landfilling Location

Material	Date	Days	Weight Received[1] (Tonnes)	Weight/day (tonnes/day)	Airspace Consumed (m^3/day)	Total airspace consumed[2] (m^3)
Waste	Jan 3 – Feb 1	25	10,227	409	369	9,223
	Feb 2 – Feb 27	22	8,853	402	573	12,605
	Feb 28 – Apr 1	28	10,789	385	434	12,160
	Apr 2 – Apr 29	22	9,340	425	601	13,217
	Apr 30 – Jun 4	30	12,312	410	561	16,834
	Jun 5 – Jun 29	21	7,983	380	582	12,220
	Jun 30 – Jul 30	25	10,791	432	625	15,620
	Jul 31 – Sept 3	29	11,927	411	510	14,799
	Sept 4 – Oct 6	27	11,259	417	537	14,504
	Oct 7 – Nov 4	24	9,543	398	450	10,802
	Nov 5 – Dec 30	44	18,903	430	500	21,979
	Total	**297**	**121,927[1]**			**153,962**
	Average			**409**	**522**	

Notes:

[1] Tonnages include beneficial use material and controlled waste (except asbestos). In accordance with BC MOE requirements, beneficial use and controlled waste (except asbestos) are excluded from official tonnage reported by the CRD in Section 1 of this report. Additionally, survey reporting periods in this table (Table 1) varies somewhat from a calendar year.

[2] **I**ncludes daily cover volumes

Table 2 Monthly Volume of Airspace Consumed at the Asbestos Location

Material	Date	Days	Weight Received (Tonnes)	Weight/day (tonnes/day)	Airspace Consumed (m^3/day)	Total airspace consumed (m^3)[1]
Asbestos	Jan 3 – Feb 1	20	192	10	38	760
	Feb 2 – Feb 27	19	545	29	120	2,278
	Feb 28 – Apr 1	23	446	19	53	1,220
	Apr 2 – Apr 29	18	177	10	55	986
	Apr 30 – Jun 4	25	196	8	45	1,119
	Jun 5 – Jun 29	17	107	6	47	806
	Jun 30 – Jul 30	21	188	9	51	1,067
	Jul 31 – Sept 3	24	261	11	58	1,401
	Sept 4 – Oct 6	22	265	12	49	1,072
	Oct 7 – Nov 4	20	325	16	65	1,301
	Nov 5 – Dec 30	37	730	20	69	2,545
	Total	**246**	**3,432**			**14,554**
	Average			**14**	**59**	

Note:

[1] Includes daily cover volumes

Table 3 Monthly Volume of Airspace Consumed at the Aggregate Storage Location

Material	Date	Days	Volume/day (m^3/day)	Daily cover used (m^3)
Daily Cover	Jan 3 – Feb 1	25	88	2,209
	Feb 2 – Feb 27	22	169	3,724
	Feb 28 – Apr 1	28	123	3,438
	Apr 2 – Apr 29	22	88	1,935
	Apr 30 – Jun 4	30	83	2,479
	Jun 5 – Jun 29	21	201	4,229
	Jun 30 – Jul 30	25	76	1,907
	Jul 31 – Sept 3	29	121	3,516
	Sept 4 – Oct 6	27	109	2,943
	Oct 7 – Nov 4	24	114	2,746
	Nov 5 – Dec 30	44	126	5,544
	Total			**34,670**
	Average		**118**	

4.2 Daily Cover Aggregate Usage

Daily cover material is summarized separately for the active landfilling and active asbestos areas. The average daily cover usage of 118 m^3/day of daily cover is segregated to the 2 areas based upon the following:

- load capacity is 10 m^3, so on average 11.8 loads are used daily
- 9.4 loads (80%) were transported to the active landfilling location
- 2.4 loads (20%) were transported to the active asbestos location

Therefore, the volume of daily cover used in each location can be calculated, as shown in Table 4.

Table 4 Daily Cover Volumes

Aggregate used for daily cover		Volume (m^3)
Total daily cover used		34,670
Daily cover used for waste	(80%)	27,736
Daily cover used for asbestos	(20%)	6,934

4.3 Waste Volume/Density–Active Landfilling Area

Annual waste density for 2015 was calculated at 970 kg/m^3, while total waste volume was 126,226 m^3, as shown in Table 5.

Table 5 Waste Volume Calculations

2015 Waste volumes	Volume (m^3)
Total airspace consumed by waste	153,962
Volume of daily cover (m^3)	27,736
Volume of waste (m^3)	126,226
Tonnage of waste landfilled (tonnes)	121,927
Waste/daily cover ratio[1]	4.55
Waste density (tonnes/m^3)[2]	0.97

Notes:

[1] Waste:cover ratio = waste landfilled (m^3)/total daily cover (m^3)

[2] Waste density = waste received (tonnes)/waste volume received (m^3)

4.4 Waste Volume/Density–Active Asbestos Location

The annual tonnage of asbestos received and proportionate daily cover used in the active asbestos location is shown in Table 6. Asbestos density is must lower than waste density due to lack of compaction.

Table 6 Asbestos Volume Calculations

2015 Asbestos volumes	Volume (m^3)
Total airspace consumed by asbestos	14,554
Volume of daily cover (m^3)	6,934
Volume of asbestos (m^3)	7,620
Tonnage of asbestos landfilled (tonnes)	3,432
Asbestos / daily cover ratio[1]	1.10
Asbestos density (tonnes/m^3)[2]	0.45

Notes:
[1] Asbestos:cover ratio = asbestos landfilled (m^3)/total daily cover (m^3)
[2] Asbestos density = asbestos received (tonnes)/asbestos volume received (m^3)

4.5 Uncertainties

Daily cover aggregate use for side-slopes is considerable because of daily cover requirements for exposed perimeters at the active landfilling and asbestos locations (daily cover thicknesses of at least 0.35 m required). As such, estimates may vary somewhat from actual ratios.

4.6 Quality Control

Hartland's target compaction density is at least 850 kg/m^3 (0.85 tonnes/m^3). Compaction test are performed to support the landfill operations and to verify compaction. Five different compaction tests were completed throughout 2015 at random locations throughout Hartland's recently landfilled areas. The results are shown in Table 7.

Table 7 2015 Compaction Tests

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LANDFILL COMPACTION TEST REPORT 2015
TESTS SUMMARY

Contract:	Operation of Hartland Landfill Jan 2014 to June 2016
Client:	CRD - Hartland Landfill
Project Manager:	Kyle Teschke
Contractor:	Chew Excavating
Superintendent:	Mike Flynn
Date:	Friday, February 12, 2016

	Date Completed	Density (T/m3)
Compaction Test No.1	May 15, 2015	1.02
Compaction Test No.2	May 7, 2015	1.17
Compaction Test No.3	July 21, 2015	1.03
Compaction Test No.4	August 14, 2015	1.16
Compaction Test No.5	February 1, 2016	1.29
	Average	**1.13**

4.7 Air Space Consumption

Comparison volumes of airspace consumed, weight received, and daily cover used in the active landfilling and active asbestos locations are shown in Table 8.

Table 8 Airspace Consumption

Material	Airspace Consumed (m^3)	% of Total	Weight Received (tonnes)	% of Total	Daily Cover Used (m^3)	% of Total
Waste	126,226	94.3	121,927	97.3	27,736	80
Asbestos	7,620	5.7	3,432	2.7	6,934	20
Total	**133,846**	**100**	**125,359**	**100**	**34,670**	**100**

It is shown that 94.3% of Hartland's total airspace was consumed for waste which required 80% of the daily cover used. Conversely, 5.7% of Hartland's total airspace was consumed for asbestos which required 20% of the daily cover used.

4.8 Design Conformance

Hartland landfill is designed to be constructed in a series of cells. Each cell is divided into a series of lifts which are progressively filled with waste. Throughout 2015, the Phase 2, Cell 2, 179 m lift was constructed from March 21, 2015 until the end of December 2015 at which time it was not complete. Filling within the 179 m lift was completed as designed.

5.0 REMAINING SITE LIFE

Annual planemetric surveys are conducted over the Hartland landfill site. Survey data is used to define surface elevation. Space use calculations are derived from the planemetric data and compared to the final contours associated with a filling plan prepared in the *Hartland Landfill Phase 2 Long Term Leachate Management Plan* (Sperling Hansen Associates, June 2007) to estimate remaining capacity. The 2015 survey was conducted in summer of 2015. The estimated remaining capacity is 5,114,817 cubic metres, compared to 5,246,416 cubic metres in 2014. It is estimated that there has been approximately 6,885,414 tonnes of garbage deposited at the site at the end of 2015. Based on the 2007 Sperling Hansen Associates plan and current tonnage the estimated landfill capacity will be reached in 35 years. A landfill capacity study commenced in late 2014 to assess remaining capacity and evaluate landfill expansion options.

6.0 CLOSURE AND POST-CLOSURE FUND

A requirement of the Operational Certificate is a closure and post-closure fund to meet or exceed the estimated closure and post-closure costs with a reasonable contingency. At the end of 2015 the closure/post-closure fund was $8,178,029.

7.0 2015 ACTIVITIES/2016 PLANS

7.1 2015 Capital Works

Since 1985, over $40 million has been invested in capital works, environmental controls and general site improvements. The annual budget is approximately $3 million and the following capital projects commenced/completed in 2015:

Gas and Leachate Collection Pipe Extension at 175 m lift – The gas wells and leachate drains in each lift of refuse have been connected to the existing landfill gas collection system that generates approximately 11 scfm annually. Well heads, valves, condensation traps, monitoring points and piping have been installed to each gas well and leachate drain. The gas is conveyed to the gas plant and the leachate conveyed to the storage lagoons and then discharged into the municipal sewer.

Airspace/Aggregate Production – The 2014–2015 contract created approximately 55,000 m^3 of airspace and produced 90,000 m^3 of aggregate that is used on site as cover material in accordance with SWMP. Aggregate is also used for other operational needs (i.e., road surfacing and construction projects).

Environmental Inventory–Hartland North Aggregate Storage – Landfill conceptual planning anticipates that approximately 280,000 m^3 of aggregate would be stored over the life of the landfill. In preparation for potential future aggregate storage in the Hartland north area, an environmental inventory was completed to present environmental and archeological features that may need to be incorporated into the project design.

Hartland Leachate Line Hydraulic Review and Assessment – Minor leachate pipeline leaks in 2011 and 2014 prompted an inspection of the pipeline fittings and manholes to support anticipated pipeline upgrades and included hydraulic modelling. The operating assessment will determine if hydraulic transients or other operating conditions contribute to the infrastructure failures and what upgrades, if any, are required.

South Leachate Containment Upgrades – In 2015, the south leachate contaminant system was upgraded through lift station upgrades, installation of a new forcemain (to transfer leachate to the storage lagoon), and a new pump in pumping well 1 to meet long term capacity requirements. The south leachate containment system receives leachate from the south face leachate collection system. Increased pumping capacity was implemented at the south leachate containment area.

Seismic Stability Assessment Update – Seismic assessments are conducted on an as-needed basis to ensure adequate slope safety at the landfill. In 2015, an updated assessment was conducted for Phase 2 to support build out of the 183 m lift. The seismic assessment scope of work included surveys and slope failure modelling. Based upon the assessment, modifications to the east-facing toe berm were recommended.

Cell Phone Tower – A cell phone tower was constructed on the ridge west of the landfill to support Capital Region Emergency Services Telecommunication requirements. The cell phone tower was constructed and is operated under a license to occupy.

Lagoon Embankment Stabilization – As a result of slope stability assessments respecting the eastern embankment of the upper leachate lagoon, the CRD completed slope stabilization upgrades in 2015. A gabion basket retaining wall was designed and constructed under the supervision of a geotechnical engineer.

Landfill Gas Utilization Options and Technologies Review – Consultants were engaged to review existing landfill gas production, provide an overview of landfill gas utilization options, and present a high-level technical assessment of technologies suitable for Hartland. A final report is expected by late 2016.

7.2 2015 Operations

The following is a brief summary of 2015 operations activities at the landfill.

Kitchen Scraps Ban – Following a phased implementation and incentive period in 2013 and 2014, kitchen scraps were banned from disposal at the landfill in January 2015. Prior to 2015, the CRD upgraded the kitchen scraps transfer station located in the southern portion of the site. Throughout 2015–2016, segregated kitchen scraps from municipal and private haulers are to be transported and processed off site under a third-party contract. This waste stream is used to produce both green energy and compost.

Execution of Security, Bird Control and Landfill and Operations Contracts – Throughout 2015, staff executed and managed contracts for on-site security, seasonal bird control, and provided direction to landfill operations contractor.

Water System Maintenance/Upgrade – Site potable water infrastructure was upgraded in 2015, including storage tank cleaning and leak repairs.

Waste Discharge Permit Revisions – In winter 2015, Hartland and Environmental Protection staff coordinated to revise the RSCP waste discharge permit to reflect operational changes. In November 2015, the aged on-site septic system was abandoned and the waste from the organic receiving area and administrative building domestic wastes were redirected into the leachate collection system. These changes, as well as administrative and source description updates, and the exclusion of chlorinated phenols in discharge sampling, will be finalized in April 2016.

Design, Operations and Closure Plan Update (DOCP) – CRD staff commenced preparation of an update to the DOCP which was last submitted in 2005. Completion of the DOCP continued through 2016.

7.2.1 2015 Landfill Fire

On evening of July 23, 2015 an active face landfill fire occurred at the site. The fire covered approximately 5,000 m^2 and was restricted to the surface of the landfill's active face where large loads of garbage are disposed. The fire was responded to by CRD staff and fire staff from District of Saanich, Central Saanich, City of Victoria and District of Highlands. The response also included communication with Emergency Management BC staff and Island Health officials. The fire was declared extinguished by the Saanich Fire Department at 1 p.m. on July 24. No infrastructure was damaged in the fire and the site was gradually reopened on July 25 and to full operation on July 27.

The cause of the fire is unknown; however, prior incidents had been the result of disposal of battery containing electronics or chemical reactions. The fire response included the use of potable water, flame retardant, and leachate. Water used in fire-fighting was captured using the existing leachate storage system. Leachate discharge to the sanitary sewer resumed after laboratory data confirmed compliance with the CRD RSCP waste discharge permit criteria.

7.3 2016 Plans (Capital and Operations)

7.3.1 Planned 2016 Capital Projects

Airspace/Aggregate Production – To prepare for opening Phase 2 Cell 3, drilling, blasting and hauling aggregate and shot rock from the northwest side of the landfill will take place in summer 2016. It is estimated that about 47, 200 cubic metres will be removed and stored on site for operational use.

Interim Landfill Cover - Phase 2, Cell 2 (South East Face) – As landfill slopes rise and are completed, interim cover systems are constructed. Interim cover is required in the Landfill Criteria for Municipal Solid Waste and reduces leachate generation by shedding precipitation and improves landfill gas capture. Hartland interim closures include a gravel layer covered by synthetic cover.

Phase 2 East Toe Berm Upgrades – Modifications to the Phase 2 east toe berm recommended in the 2015 Seismic Stability Assessment Update commenced in 2015 and will continued through 2016.

Phase 2 Cell 3 Underdrain and Liner System – In accordance with Hartland filling plans, Phase 2 Cell 3 will be designed and constructed for use commencing in late 2016. Design includes new leachate containment and conveyance infrastructure.

Gas and Leachate Collection Pipe Extension at 183 m Lift – Landfill gas wells and leachate drains in each lift of refuse will be connected to the existing collection systems. Well heads, valves, condensation traps, monitoring points and piping will be installed and commissioned to convey landfill gas to the gas plant and leachate to the storage lagoons.

Conceptual Landfill Capacity Study, Aggregate Management Plan and Stockpile Design – The CRD commenced a conceptual landfill capacity study to planning review of current landfilling practices and to identify measures to extend the landfill capacity and make the landfill more efficient on a per tonne basis and look at the feasibility of expansion. An aggregate management plan and stockpile design will identify appropriate locations to store the rock, ensure that the stockpiles are accessible, stable, and that the run-off is contained.

Repair of Commercial Scale Decks – Repair of the aged automated commercial scale decks is planned for 2016 to address issues identified in a previous structural assessment.

7.3.2 Planned 2016 Operations Projects

Waste Composition Study – The CRD routinely conducts a waste composition studies to inform landfill operations and management.

Bylaw Amendments – In 2016, a bylaw amendment will be in effect to categorize vermiculite insulation as controlled waste. An increase in tipping fee for out-of-region asbestos and kitchen scraps will come into effect January 2017.

Landfill Gas Engine Rebuild – Following an August 2015 engine failure, the Landfill Gas Utilization plant power generating engine will undergo a major rebuild in 2016. In accordance with the regulations and to minimize environmental discharges during power plant downtime, landfill gas will be destroyed using the ground flare.

Design, Operations and Closure Plan Update (DOCP) – Completion of the DOCP Update is anticipated in early 2016. The report will be submitted to the BC MOE as required by the BC Landfill Criteria and the Hartland Operational Certificate.

Hartland Open House – Hartland will host an open house in June 2016 to promote public awareness about landfill operations and activities. The CRD event features site tours, access to landfill experts, and educational displays focusing on recycling, environmental monitoring, compost education and watershed management.

Software Upgrades, Upgrade Servers and Cameras – With the planned repair of the auto scale, other changes are planned to update software and ancillary equipment.

Continuation of Security, Bird Control and Landfill Operations Contracts – Ongoing management of CRD contractors, including security, bird control, operations and kitchen scraps management.

Water System Upgrades – A new water meter and line are planned to improve the flow of water to the site and replace the need for a water storage tank to allow supply of sufficient water volume. The tank will be used to store water for various site purposes, but not for potable water.

Mechanical Services Contract for the Generator – When the CRD purchased the power generator from Maxim, the contract for mechanical services was transferred. Procurement of mechanical services commenced following expiry of the previous agreement in late 2014 and are ongoing.

Activation of New Landfill Gas Infrastructure – Gas wells are being added as each lift is complete, following the landfill gas management plan approved by the MOE. The wells are activated as soon as possible based on methane content and the need to manage oxygen intake.

Invasive Plant Species Control – Invasive species control will continue with removal of some species and spraying of others with herbicide.

Landfill Criteria Conformance Assessment – A conformance assessment will be scheduled upon finalization of the upcoming BC MOE Draft Revised Landfill Criteria.

8.0 2015–2016 ENVIRONMENTAL MONITORING

CRD staff monitor landfill gas, groundwater, surface water and leachate quality to ensure the effectiveness of management activities and confirm regulatory compliance. Based on monitoring conducted in 2015[5], the program continues to provide data needed to:

- meet Operational Certificate requirements
- identify potential impacts of landfill operations, if any
- plan environmental mitigation, if required, and
- measure the effectiveness of control measures

The key findings of the landfill gas, groundwater, surface water and leachate monitoring program presented here are referenced from the following:

- Hartland Landfill Groundwater, Surface Water, Leachate Monitoring Program Annual Report (April 2015 to March 2016), AECOM Canada Ltd. (AECOM) – Appendix A
- Hartland Landfill – Landfill Gas Monitoring, Annual Report, 2015, Parks & Environmental Services, Environmental Protection, CRD, October 2016 – Appendix B

8.1 Landfill Gas Monitoring Program

Decomposition of refuse creates landfill gas; the composition and amount of gas generated varies based on factors such as amount, type and age of waste, as well as environmental conditions, such as moisture content. Peak gas generation occurs during the first 1 to 3 years after disposal. Landfill gas is primarily composed of methane and carbon dioxide with small amounts of water vapour, oxygen, nitrogen and trace gases. Trace gases include hydrogen sulphide, ammonia, nitrous oxide, volatile organic compounds and chlorofluorocarbons. Initially, decomposition of waste is an aerobic process and produces mainly carbon dioxide. As oxygen is depleted the decomposition occurs under anaerobic conditions.

Landfill gas management is dictated by a variety of BC regulations (including the BC Landfill Gas Management Regulation), design guidelines, criteria, Hartland-specific management plans, and WorkSafeBC. The BC Landfill Gas Management Regulation requires landfills generating more than 1,000 tonnes per year of methane to develop landfill gas management plans that targets 75% collection efficiency in 4 years. A plan was completed for Hartland landfill and submitted to the MOE in April 2012 with an implementation target of the end of 2016.

Since 2012, Hartland landfill has implemented a system to assess and control fugitive landfill gas emissions. The objective of these controls is ultimately to reduce emissions, ensure staff health and safety, and comply with regulations. The landfill gas collection and/or management program at Hartland includes gas generation modelling, gas collection infrastructure installation and maintenance, and operation of a landfill gas beneficial use facility. Additionally, the landfill gas program monitors the effectiveness of the collection infrastructure through a variety of monitoring programs.

5 Monitoring calendars vary such that the landfill gas 'year' is January to December but the groundwater, surface water and leachate 'year' is April to March.

Landfill gas generated in the landfill is drawn under vacuum to the gas plant where it is directed to a generator and/or to a flare. The gas is then conditioned (cleaned) and methane and oxygen content is measured. Excess gas is fed back to a candlestick flare, while the ground flare is only used during extended generator downtime. The landfill gas collection system is designed to reach 75% collection efficiency as per the Landfill Gas Management Facilities Design Guidelines. The CRD is in the process of implementing the plan.

To monitor the effectiveness of the landfill gas collection infrastructure, Hartland landfill has implemented a 4-component monitoring program. In 2015, the monitoring program confirmed that landfill gas was maintained within the landfill and results were within specified criteria or regulatory limits.

The main components of the landfill gas system at Hartland include collection infrastructure; gas generation modelling, and gas utilization. The effectiveness of the landfill gas system is monitored by the CRD GeoEnvironmental Program as follows:

1. **Collection and utilization system monitoring** – to evaluate changes in gas quality over time, and evaluate data for gas collection and gas utilization to assess collection efficiency and total emissions from the landfill.

2. **Subsurface perimeter and building foundation probe monitoring** – quarterly monitoring to assess the potential for subsurface landfill gas migration at the eastern landfill boundary and at on-site buildings for compliance with criteria, and for worker and public health and safety. Monitoring is required by the BC MOE Landfill Criteria for Municipal Solid Waste.

3. **Ambient grid and hot spot monitoring** – twice annual monitoring to verify the effectiveness of cover and landfill gas collection systems and identify areas of concern where landfill gas is being released to the atmosphere for protection of worker and public health and safety.

4. **Landfill Gas Speciation** – speciation is conducted biennially, and was conducted in 2015, to assess the composition of gas with regard to volatile organic compounds, sulphur gases and typical landfill gases in order to calculate ambient dilution concentrations for health and safety and infrastructure integrity purposes.

8.1.1 Gas Generation

In 2015, Hartland landfill generated 8,032 tonnes of methane, based on a model provided by MOE. This is the equivalent of 1,646 standard cubic feet per minute (scfm) of landfill gas at 50% methane. As required, the MOE gas generation model is updated annually with waste quantity and composition data to enable annual calculation of collection efficiency and greenhouse gas (GHG) emissions. Diversion of organics, which was initiated in 2013, is expected to a decrease in overall gas production.

8.1.2 Gas Collection and Utilization

In 2015, the gas collection system consisted of 74 vertical wells, 57 horizontal wells and 5 leachate gas trench wells, for a total of 131 wells. Six new horizontal wells were installed in completed lifts in Phase 2. The top 8 collecting wells accounted for close to 40% of the total volume of gas collected. The well field was balanced monthly in 2015, as recommended by the Landfill Gas Management Facilities Design Guidelines.

Total fugitive GHG emissions generated from the landfill for 2015 are estimated at 68,304 tonnes CO_2, an almost 9% decrease from 2014 quantities and a 35% decrease since the implementation of the Landfill Gas Management Plan (LFGMP) in 2012. It is expected that GHG emissions will continue to decline due to the implementation of the organics (kitchen scraps) diversion program in 2015, and continued success of the CRD's waste diversion initiatives.

The CRD has implemented the conceptual design in the plan with limited filling plan changes. In 2015, landfill gas collection efficiency was 65.9%. Modelled methane generation was 1,646 scfm and of that an average of 1,085 scfm was captured through the gas plant. Current landfill gas collection efficiencies are within estimated ranges according to the LFGMP.

8.1.3 Gas Monitoring and Compliance Summary

Numerous monitoring programs are in place to evaluate the performance of landfill gas system. Table 9 has been prepared to summarize the results of these monitoring programs, whether the results comply with requirements, actions taken to address non-compliance, and recommendations.

Table 9 Landfill Gas Compliance Summary 2015

Program	Compliance Location	Criteria	Findings	Actions	Recommendations
Perimeter Probe Monitoring	Probes GP-1A, 1B, 2A, 2B, 3A, 3B, 11A, 11B, 12A and 12B	Maximum 1.25% methane in subsurface soil (MOE Landfill Criteria for Municipal Solid Waste)	No exceedances. Low risk of subsurface gas migration to adjacent properties.	None	Continue quarterly monitoring.
Building Foundation Probe Monitoring	Probes GP- 4A, 5A, 6A, 6B, 7A, 7B, 8A, 9A, 13A, 14A, 17A, 18A	Maximum 1.25% methane in any on-site facility (MOE Landfill Criteria for Municipal Solid Waste). Maximum 1% methane inside buildings (Landfill Gas Management Facility Design Guidelines).	No exceedances. Low risk of subsurface gas migration to adjacent building.	None	Continue quarterly monitoring.
Ambient Grid Monitoring	N/A	100 ppm THC[1] (CRD internal guideline)	6 grid locations >100 ppm No cover system failures suspected in the closed area of Phase 1.	Investigated hot spots, mitigated were possible.	Continue biannual monitoring.
Hot Spot Monitoring	N/A	1,000 ppm THC[1] (CRD internal guideline).	2 new hot spots >1,000 ppm, 2 hot spots removed. Currently 21 locations for hot spot investigation. Hotspots have decreased significantly since the implementation of the LFGMP in 2012.	Added new locations of hot spots to the monitoring program.	Continue biannual monitoring. Investigate remediation measures.
Well Field Monitoring and Balancing	N/A	Monitor monthly. Oxygen <3% - gas optimization and reduction of fire potential	Monitoring completed monthly; oxygen did not exceed 3%.	Well field monitoring has been scheduled monthly for 2016.	Continue monthly monitoring at minimum.
Gas Speciation (2015)	N/A	N/A	Undiluted landfill gas exceeded WorkSafeBC criteria for methane, carbon dioxide, hydrogen sulfide, vinyl chloride and benzene; however, ambient concentrations are likely well below WorkSafeBC limits due to dilution with ambient air.	None	Conduct speciation of landfill gas in 2017.
Gas Collection	N/A	75% gas collection efficiency target by the end of 2016 as per LFGMP.	Gas collection efficiency was estimated at 65.9%, based on the MOE gas generation model.	LFGMP submitted to MOE.	Continue to implement the gas management plan.

Note:
[1]THC – Total hydrocarbons

8.2 Groundwater Quality Monitoring Program

Engineered controls at Hartland landfill collect and contain leachate to reduce or eliminate potential effects to groundwater and surface water quality. Since 1990, the leachate has been captured and contained on site and discharged via pipeline to the sanitary sewer.

Groundwater and surface water monitoring stations on the Hartland landfill property and specific off-site locations have been monitored since 1983. The purpose of the groundwater and surface water monitoring program is to assess impacts of landfill processes and operations on water quality and to assess compliance with water quality standards at the property boundary. In addition to this, leachate, generated by the infiltration of precipitation through the garbage, is also monitored for flow and quality. Monitoring data is collected to assess the potential for effect of landfill processes on groundwater and surface water resources. The annual monitoring program has 3 main components:

1. Groundwater monitoring on site and at selected off-site domestic wells
2. Surface water monitoring at on-site and off-site locations
3. Leachate quality and flow monitoring

Hartland landfill has an extensive network of groundwater wells to monitor conditions immediately adjacent to the Phase 1 and Phase 2 areas, and at points adjacent to the landfill property boundary. Groundwater elevations are routinely monitored in approximately 120 well locations to understand the direction of groundwater flow within the landfill property. Groundwater quality is monitored at groundwater well locations to evaluate and identify changes in water chemistry that may be attributed to landfill processes and operations and, specifically, the effect of landfill leachate on groundwater resources. In addition, 12 privately-owned, domestic drinking water wells within a 2-km radius of Hartland landfill are monitored.

Groundwater quality is assessed against BC CSR numerical standards for the protection of drinking water and aquatic life in groundwater. This represents a change, as the data was previously compared against only the BC Water Quality Guidelines[6]. Water quality during the reporting period is generally similar to previous years, though when compared to the new standards, site conditions have improved.

8.2.1 Results

Of over 100 wells at Hartland, 42 are boundary compliance monitoring stations. These boundary compliance wells are clustered along the property boundary. Groundwater quality data collected between April 2014 and March 2016 indicated that the boundary stations were in compliance with BC CSR standards[7]. The results of the 2015–2016 program were similar to those measured in recent years and showed improvement in several areas. The results of groundwater monitoring for each of the landfill boundary areas are presented in the following sections.

8.2.1.1 Phase 1

Groundwater flow was consistent with historical trends. Groundwater flow directions in the Phase 1 area were primarily to the north, and most of the northward flowing groundwater was captured by the leachate containment and collection system. At the south end of Phase 1, a groundwater divide corresponding with a bedrock high influences the groundwater flow. North of this divide, groundwater flows to the north. South of the divide, groundwater flows south and is intercepted by the leachate containment and collection system.

The water quality data south of Phase 1 confirms that leachate containment has successfully controlled leachate impacts. Water level and quality monitoring in this area should continue to confirm ongoing effectiveness of leachate containment and identify any changes in the extent or magnitude of leachate impacts.

[6] BC Approved Water Quality Guidelines and the Compendium of Working Water Quality Guidelines

7 A single sample from well 31 had an exceedance of sulphate in September 2015, the result is considered anomalous and was not replicated in subsequent events in winter and spring 2016.

8.2.1.2 North of the Landfill

Groundwater quality in boundary compliance locations north of the Landfill met the applicable BC CSR groundwater standards. Groundwater quality in this area is stable or improving based upon statistical analysis. Improvements are considered related to the effective operation of the north purge well system.

Table 10 Groundwater Quality Compliance Summary North of the Landfill (2015–2016)

Well	Exceedances	Number of Exceedances	Trend
20-1-1	none	-	Decreasing sulphate
20-1-2	none	-	Decreasing conductivity, ammonia, sulphate
21-1-1	none	-	Decreasing sulphate
21-1-2	none	-	Decreasing sulphate
21-2-1	none	-	Stable
28-1-0	none	-	Stable
29-1-1	none	-	Decreasing conductivity chloride, increasing ammonia
29-1-2	none	-	Decreasing conductivity chloride, increasing ammonia
30-1-1	none	-	Decreasing conductivity chloride, increasing ammonia
30-1-2	none	-	Decreasing conductivity chloride, increasing ammonia
31-1-1	none[1]	-	Increasing ammonia
31-1-2	none[1]	-	Stable
39-1-1	none	-	Stable
39-2-1	none	-	Stable

Note:
[1] Reported sulphate concentrations in well 31-1-1 and 31-1-2 are considered anomalous and not representative of groundwater quality.

Concentrations of groundwater quality in other Phase 1 wells were consistent with previous years. Leachate impacts continued in areas immediately adjacent to the landfill (e.g., monitoring well 58-1-1). Impacted groundwater in this area is collected by the north purge well system. In fall 2015, the CRD and AECOM identified options for augmenting leachate collection in the area west of the lower leachate lagoon (e.g., monitoring well 40-1-1).

Continued operation of the north purge well system will reinforce leachate collection and containment and to contribute to water quality improvements. Augmentation of the north purge well system is recommended to further reduce the persistent presence of these leachate indicator parameters in groundwater in this area.

Wells along Willis Point Road met the BC CSR standards, but continued to show road salt-related impacts.

8.2.1.3 South of Phase 1

To the south of the Phase 1 groundwater divide, groundwater flows towards the south. A number of leachate containment measures have been installed in this area since the mid-1980s. The containment system in this area is composed of a grout curtain, a clay berm, a shallow toe drain and 5 purge wells which, in combination, obstruct and intercept southward-flowing leachate. The leachate is then directed to the leachate collection system.

Water quality in the boundary compliance stations south of Phase 1 met the BC CSR standards. Consistent with the previous reporting periods, leachate indicator parameter concentrations indicate some leachate influence in this area, however, 5-year concentration trends are improving. Potential leachate migration is being addressed through continued optimization and maintenance of the south leachate purge well system. Significant upgrades to the south purge well system were completed in 2015.

As shown in Table 11, leachate indicator parameter trends indicate that concentrations are generally either stable or decreasing.

Table 11 Groundwater Quality Compliance Summary South of the Landfill (2015–2016)

Well	Exceedances	Number of Exceedances	Trend
04-2-1	none	-	Increasing chloride
04-3-1	none	-	Stable
04-4-1	none	-	Stable
07-1-0	none	-	Decreasing conductivity and sulphate
71-1-1	none	-	Increasing sulphate
71-2-1	none	-	Stable
71-3-1	none	-	Stable
72-1-1	none	-	Decreasing conductivity, increasing chloride
72-2-1	none	-	Stable
72-3-1	none	-	Increasing conductivity
73-1-1	none	-	Increasing conductivity
73-2-1	none	-	Increasing conductivity
73-3-1	none	-	Stable

8.2.1.4 East of Phase 1

Similar to previous years, water quality east of Phase 1 met BC CSR standards for the reporting period (as shown in Table 12). Although the concentrations met the BC CSR standards, some leachate indicator parameter concentrations rose to peak values since pre-2009. That said, other leachate indicator parameters, show statistically significant improving trends. The measured concentrations may be related to dilute leachate, aggregate or road salt. Water quality in this area should continue to be closely monitored. As groundwater movement in this area is directed from east to west, preventing off-site leachate migration to the east. The 2014–2015 data collected in wells east of Phase 1 confirmed that leachate is effectively contained on site in this area.

Table 12 Groundwater Quality Compliance Summary East of the Landfill (2015–2016)

Well	Exceedances	Number of Exceedances	Trend
18-1-1	none	-	Decreasing conductivity and chloride
18-2-1	none	-	Decreasing conductivity
18-2-2	none	-	Decreasing conductivity
54-1-1	none	-	Stable
54-2-1	none	-	Decreasing conductivity and chloride
54-3-1	none	-	Stable
76-1-1	none	-	Decreasing conductivity and sulphate
76-2-1	none	-	Decreasing ammonia, increasing conductivity
76-3-1	none	-	Decreasing sulphate

8.2.1.5 Phase 2

In the Phase 2 area, immediately west of Phase 1, groundwater flow is directed inward toward the base of the former Heal Lake, where leachate is collected by an underdrain system and discharged to the leachate lagoons. This area of the leachate collection and containment system is known as the Phase 2 basin. Because the groundwater flow is directed inward toward the basin, it is considered a hydraulic trap. Leachate and water levels are monitored in Phase 2 to ensure that the hydraulic trap is maintained. The 2015–2016 data indicate that the hydraulic trap functioned effectively throughout the year.

Automated leachate level monitoring has traditionally been conducted within the refuse in Phase 2. That monitoring equipment failed in 2014 and should be replaced by 2019 to ensure appropriate leachate and landfill operational activities.

8.2.1.6 North of Phase 2 and North of the Hartland North Pad

North of Phase 2 and north of the Hartland north pad, groundwater quality met BC CSR standards at all boundary compliance locations north of Phase 2, including locations north of the Hartland north pad.

In the vicinity of the Hartland north pad, northwest of Phase 2, groundwater results indicate that over the past 7 years, impacts from historical composting activities have been reduced and impacts from aggregate stockpiling on the Hartland north pad have stabilized or are decreasing. Improvements since 2012 are largely attributed to the cover system installed in January 2012. Continued monitoring is warranted to confirm ongoing improvements and efforts should be made to reduce infiltration by maintain temporary covers.

In 2014, 4 new monitoring wells were installed between Phase 2 and the north pad and added to the monitoring program. The wells are representative of background or bedrock groundwater quality.

In March 2016, a hydrogeological conceptual model was prepared for this area. The results are pending and will be included in the 2016–2017 annual report.

8.3 Domestic Well Monitoring Program

Since the 1980s, the CRD has performed routine sampling and analysis of domestic wells in the vicinity of the landfill that are used as the primary source of drinking water. In 2015, water quality data was collected from 12 domestic wells located within a 2-km radius of the landfill on June 15, 2015. The sampling program included single samples and 2 replicate samples which were analyzed for general water quality parameters and total metals.

The number of wells included in the program has gradually been reduced as municipal water became available and residents chose to connect to the municipal supply system. Most of the domestic wells near Hartland landfill are situated southeast of the landfill and are bedrock wells drilled to depths of 30 to 120 metres.

Laboratory analytical results were compared to the British Columbia Approved Water Quality Guidelines (2010 edition) where available and Guidelines for Canadian Drinking Water Quality (2008) where they are more stringent.

8.3.1 Results

The 2015 domestic well water quality met applicable drinking water quality guidelines, with a few exceptions. Similar to previous years, the iron concentration in well 53 exceeded the drinking water guidelines which are based upon aesthetic targets and are not human health objectives. Well 38, contained copper concentrations in excess of the drinking water guidelines. Copper is not a leachate indicator and the result is likely related to plumbing fixtures. The results indicate that landfill leachate is not affecting any of the 12 domestic wells sampled and water quality was consistent with background conditions.

8.4 Surface Water Monitoring Program

Hartland landfill is located within the Tod Creek watershed. Drainage south of the landfill is directed toward Killarney Lake and Prospect Lake, discharging to Tod Creek. Drainage north of the landfill flows northeasterly within Heal Creek to Durrance Creek, discharging to Tod Creek, and ultimately, to Tod Inlet. Surface water is monitored to ensure that it is not adversely affected by landfill operations.

The monitoring program includes approximately 32 sites within the landfill, at the property boundary and within each of the major off-site drainages. Five of these stations are considered boundary compliance monitoring stations. These stations are concentrated north and south of the landfill where creeks flow from the landfill property to off-site locations. Water quality results are compared to the BC Approved and Working Water Quality Guidelines (BC WQG) for Freshwater Aquatic Life.

8.4.1 Results

Surface water quality data collected in 2015–2016 confirmed that nearby surface water bodies, Tod Creek, Durrance Lake, Durrance Creek and Killarney Lake are not impacted by leachate and have not been for many years.

Surface water samples collected in this monitoring program typically met the BC WQG-MAC[8] and or BC WQG 30-day average values. Occasional exceedances for a few parameters (e.g., total suspended solids, iron, nitrates and copper) were reported at select compliance locations. Elevated concentrations are considered related to seasonal impacts (rain events or dry low-flow conditions). Some concentration trends (both increasing and/or decreasing) were identified across the site. Statistically, increasing trends have been noted at monitoring well SW-N-16 located north of the lower leachate lagoon. The CRD is revising sampling protocols to address sample variation during low flow stream conditions and implementing increased leachate containment near the lower lagoon which is expected to improve surface water quality.

8.5 Leachate Management and Monitoring Program

Leachate is produced from the percolation of precipitation and groundwater through the decomposing refuse in the landfill. At Hartland landfill, leachate is managed through landfill design, input monitoring, contaminant treatment, if required, and routine monitoring.

8.5.1 Leachate Management

Typically, leachate inputs do not vary; however during this reporting period, operational changes resulted in the redirection of organic receiving area and administrative building domestic wastes into the leachate collection system. The aged on-site septic system was abandoned in November 2015. As a result, the CRD RSCP waste discharge permit was amended to reflect the new inputs.

At Hartland, 2 leachate treatment options are available to mitigate sulphide concentrations which occasionally exceed the CRD RSCP waste discharge permit limits. Since 2014, leachate stored in the lower lagoon is continuously aerated. Additionally, bioxide amendment infrastructure is maintained to mitigate sulphide concentrations; however, bioxide amendment has not been required since aeration commenced in 2014.

8.5.2 Leachate Monitoring

A routine leachate monitoring program is conducted to:

- document leachate discharge volumes and flow rates to the sanitary sewer
- characterize the physical and chemical constituents in the leachate, and
- verify compliance with the CRD RSCP waste discharge permit at the point of discharge

Automated monitoring of the volume of leachate discharged is maintained on the CRD SCADA system and provides a basis for measuring flow rates to the sanitary sewer and leak detection. Monthly leachate samples are collected to verify compliance with the RSCP waste discharge permit. Routine and annual leachate testing includes analysis of a variety of chemical parameters (e.g., nutrients, mineral oil and grease, organic compounds, metals and chlorinated compounds).

8 BC WQG MAC are the maximum concentration of a parameter that should not be exceeded at any time.

8.5.2.1 Results

The total leachate discharged during the reporting period was 448,984 m^3. The average leachate flow over the period April 2015 to March 2016 was 11.23 L/s, which is similar to previous average flows of 11.48 L/s. Leachate generation rates vary with annual precipitation rates and the precipitation values for 2014–2015 and 2015–2016 were comparable.

Leachate quality at the point of discharge to the leachate pipeline was in compliance with the RSCP waste discharge permit throughout the reporting period.

Hartland landfill leachate continues to report low contaminant levels compared to other typical municipal waste landfills.

8.6 Summary of Environmental Monitoring Recommendations

The environmental monitoring program at Hartland landfill provides a valuable foundation to evaluate the effectiveness of the control measures, assess potential impacts of Hartland landfill and support landfill management and operations by providing information to staff, managers and committees.

- Overall, the monitoring programs conducted at Harland Landfill (landfill gas, groundwater, surface water, domestic wells and leachate) confirm that regulatory requirements are met and are critical to the successful management of Hartland landfill. Monitoring programs are routinely optimized through a continuous improvement program that evaluates data, sampling techniques and quality. As required to meet regulations, the annual monitoring program results will continue to be reviewed and interpreted by qualified professionals experienced in assessing the impacts of landfill leachate at large municipal landfills similar to Hartland landfill.
- Landfill gas monitoring programs should continue (i.e., quarterly perimeter probes, quarterly building foundation probes, bi-annual ambient grid, hot spot monitoring and speciation) to measure and ensure regulatory compliance. Landfill gas collection efficiency (utilization) for 2015 was 65.9%. Continued monthly well field balancing is necessary to optimize gas collection. Gas speciation is recommended for 2017, to enable tracking of gas composition changes.
- Operation of the north and south purge well systems effectively controls and contains leachate and should be continued, including planned optimization and maintenance activities. Water levels and the extent of the drawdown cone should be validated routinely. Additionally, option analysis for increased pumping capacity in the north purge well system should be completed.
- Recently malfunctioning monitoring equipment should be replaced by 2019 to allow for evaluation of leachate mounding in Phase 2.
- Aggregate stockpiles should be stored within the leachate containment area or covered to protect downgradient surface water quality. Water quality downgradient of aggregate stockpile areas should continue to be closely monitored to confirm the effectiveness of cover systems.
- Leachate flow and chemistry should continue to be monitored to inform landfill management and operational decisions and to comply with the RSCP waste discharge permit. Leachate treatment should be implemented on an as-needed basis to periodic sulphide concentration spikes, and monitoring should be conducted to demonstrate the effectiveness of the leachate treatment. Additionally, aeration system in the lower lagoon should continue to be operated as a cost-effective way to limit sulphide formation during storage of leachate.
- Future landfill planning should include a detailed hydrogeological evaluation to ensure that proposed works will not compromise the integrity of leachate containment.
- When the BC MOE Draft Revised Landfill Criteria is finalized, a conformance assessment will be required to confirm conformance with the new regulatory requirements.

9.0 CONCLUSIONS

The CRD Hartland landfill and recycling facility provides recycling; household hazardous waste collection; a salvage area; yard and garden waste collection and processing; controlled waste disposal; and landfill services to commercial and residential customers. The facility operates under an approved SWMP and BC MOE Operational Certificate 12659. This report is intended for internal and external CRD stakeholders and regulators including the BC MOE. The report compiles data regarding total waste tonnages, landfill lifespan, closure funding, operational and construction related activities in 2015 and environmental monitoring program results.

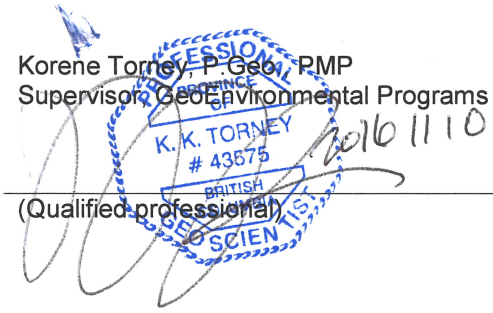
In 2015, the Hartland landfill received a total of 123,381 tonnes of waste[9], including 112,442 tonnes of refuse and 10,939 tonnes of controlled waste. The controlled waste tonnage includes 3,432 tonnes of asbestos. Throughout 2015, the Phase 2, Cell 2, 179 m lift received waste and was not yet complete as of the end of December 2015. Filling within the 179 m lift was completed as designed. It is estimated that there was approximately 6,885,414 tonnes of garbage deposited at the site at the end of 2015, and the estimated remaining capacity[10] is 5,115,000 cubic metres. Based on the 2007 Sperling Hansen Associates plan, and current tonnage, the estimated landfill capacity will be reached in 35 years.

The Harland landfill monitoring programs confirm that regulatory requirements are met and provide critical data that supports successful management of the landfill. Based upon the monitoring program, effective measures are in place to ensure environmental impacts are mitigated and leachate is effectively controlled and contained on site prior to discharge to the sanitary sewer.

9 Reported tonnages and calculated volumes (cubic metres) are based upon landfill actual weigh scale data.
10 Estimated capacity for 2015 is rounded to thousandths.

10.0 REPORT SIGNOFF

Certified/Approved by: Korene Torney, P.Geo., PMP
Supervisor, GeoEnvironmental Programs



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(Qualified professional)