AECOM

Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program Annual Report

(April 2020 to March 2021)

Capital Regional District

Project number: 60631284

October 29 2021

Delivering a better world

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("AECOM") for the benefit of the Client ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time..

AECOM shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. AECOM accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

AECOM agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but AECOM makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

Without in any way limiting the generality of the foregoing, any estimates or opinions regarding probable construction costs or construction schedule provided by AECOM represent AECOM's professional judgement in light of its experience and the knowledge and information available to it at the time of preparation. Since AECOM has no control over market or economic conditions, prices for construction labour, equipment or materials or bidding procedures, AECOM, its directors, officers and employees are not able to, nor do they, make any representations, warranties or guarantees whatsoever, whether express or implied, with respect to such estimates or opinions, or their variance from actual construction costs or schedules, and accept no responsibility for any loss or damage arising therefrom or in any way related thereto. Persons relying on such estimates or opinions do so at their own risk.

Except (1) as agreed to in writing by AECOM and Client; (2) as required by-law; or (3) to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals, the Report and the Information may be used and relied upon only by Client.

AECOM accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of AECOM to use and rely upon the Report and the Information. Any injury, loss or damages arising from improper use of the Report shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

AECOM: 2015-04-13
© 2009-2015 AECOM Canada Ltd. All Rights Reserved.

Quality information

Report Prepared by	Report Prepared by
Signed in Hard Copy	Signed in Hard Copy
Kun Jia, M.Sc., P.Geo Hydrogeologist/Geochemist	Rebecca McGovern, M.Sc. G.I.T Hydrogeologist
Report Reviewed by	**Report Approved by**
Signed in Hard Copy	Signed in Hard Copy
Stephen Dickin, P.Geo Senior Hydrogeologist	Ryan D. Mills, M.Sc., P.Geo. Senior Hydrogeologist and Project Manager

AECOM Canada Ltd.
Permit to Practice
No. 1001307

Revision History

Revision	Revision date	Details	Authorized	Name	Position
0	August 30, 2021	Draft For Review	Yes	Ryan Mills	Project Manager
1	October 29, 2021	Final	Yes	Ryan Mills	Project Manager

Distribution List

# Hard Copies	PDF Required	Association / Company Name
4	1	Capital Regional District
2	1	AECOM

Prepared for:

Capital Regional District
Lukas Novy
Supervisor, Geo-Environmental Programs
Parks & Environmental Services
625 Fisgard St,
PO Box 1000
Victoria, BC V8W 2S6

Prepared by:

AECOM Canada Ltd.
3292 Production Way
Suite 330
Burnaby BC V5A 4R4
Canada

T: 604.444.6400
F: 604.294.8597
aecom.com

© 2020 AECOM Canada Ltd. All Rights Reserved.

This document has been prepared by AECOM Canada Ltd. (“AECOM”) for sole use of our client (the “Client”) in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM and the Client. Any information provided by third parties and referred to herein has not been checked or verified by AECOM, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM.

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("AECOM") for the benefit of the Capital Regional District ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

AECOM shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. AECOM accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

AECOM agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but AECOM makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

Without in any way limiting the generality of the foregoing, any estimates or opinions regarding probable construction costs or construction schedule provided by AECOM represent AECOM's professional judgement in light of its experience and the knowledge and information available to it at the time of preparation. Since AECOM has no control over market or economic conditions, prices for construction labour, equipment or materials or bidding procedures, AECOM, its directors, officers and employees are not able to, nor do they, make any representations, warranties or guarantees whatsoever, whether express or implied, with respect to such estimates or opinions, or their variance from actual construction costs or schedules, and accept no responsibility for any loss or damage arising therefrom or in any way related thereto. Persons relying on such estimates or opinions do so at their own risk.

Except (1) as agreed to in writing by AECOM and Client; (2) as required by-law; or (3) to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals, the Report and the Information may be used and relied upon only by Client.

AECOM accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of AECOM to use and rely upon the Report and the Information. Any injury, loss or damages arising from improper use of the Report shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

Executive Summary

Based on our review of historical data and interpretation of groundwater, surface water and leachate quality data collected between April 2020 and March 2021, the annual monitoring program provides an effective assessment of landfill performance and compliance related to groundwater, surface water and leachate flow and quality. The following conclusions are drawn based on our interpretation of the 2020/21 data.

Leachate Flow

The leachate level information collected in 2020/21 revealed that leachate mounding continues to be present in Phase 1 of the landfill. Leachate elevations in Phase 1 were generally stable and exhibited minor seasonal variations. The leachate mound in the upper portion of the refuse is interpreted as being 'perched' above the regional bedrock groundwater flow system, with relatively higher water levels and strong downward hydraulic gradients. In 2020/21, the localized leachate mound was only present in the northern Phase 2 area, and may be related to historical tarping or low permeability strata within the refuse. Overall, leachate elevations in Phase 2 are typically 1-2 m below the elevation of the unlined lower leachate lagoon, indicating that a significant leachate mound is not present in Phase 2.

Daily, monthly, and annual leachate discharge rates for 2020/21 were higher than those observed in 2019/20. The total volume of leachate discharged in 2020/21 was 407,153 m^3, which approximately 10% higher than that in 2019/20, likely due to higher precipitation. The highest monthly leachate flow recorded in 2020/21 was 101,810 m^3 (average monthly flow rate of 38.0 L/s) in January 2021, which was due to intense precipitation events and higher than normal operational levels in the upper leachate lagoon.

Groundwater Flow

Groundwater flow in 2020/21 generally followed previously established patterns. Regional groundwater flows from Mount Work northeast to the north-south trending valley that underlies the northern portions of the Phase 1 and Phase 2 landfill. Most of the northward bedrock groundwater flow below the landfill was captured by the Toutle Valley Underdrain, the Phase 2 basin leachate collection system, springs that discharge to the lower lagoon, and the north and south purge well systems. Groundwater monitors east of Phase 1 confirm flow from east to west toward the landfill, preventing off-site migration to the east. Groundwater elevations along the North Ridge exhibited strong seasonal fluctuations as the Highland Fault continued to function as a barrier to east-west groundwater flow.

In 2020/21, a total of 24,790 m^3 of leachate was removed by the north purge wells, which was consistent with that reported in 2019/20 (24,494 m^3) and slightly lower than that reported in 2018/19 (25,578 m^3). The highest leachate extraction rate was observed in January 2021, with the peak flow of 146 m^3/day. A total of 37,115 m^3 of leachate was removed by the south purge wells, which was approximately 14% higher than the volume removed in 2019/20. The average daily flow in 2020/21 was 101 m^3/day, which was approximately 10% higher than that in 2019/20. Water levels in north and south purge wells indicate that the leachate collection system is functioning effectively.

Groundwater Quality

The groundwater quality results for 2020/21 were similar to those measured in recent years and leachate-impacted groundwater was contained within the landfill property. At the north end of the landfill, leachate-impacted groundwater extends just north of the unlined lower leachate lagoon and through the middle of the lined upper leachate lagoon, but does not extend off-site. South of the landfill, leachate-affected groundwater does not extend off-site. Leachate related exceedances are confined to the landfill footprint on the east side of Phase 1 and are inferred to extend to the west side of Phase 2. Overall, this indicates the leachate collection system continued to function as intended and minimized impacts to groundwater and surface water.

Compliance monitoring wells and off-site monitoring wells met Contaminated Site Regulation (CSR) Aquatic Life Use (AW) and Drinking Water Use (DW) standards. CSR exceedances in groundwater were only observed in on-site monitoring wells that are located in close proximity to the waste footprint, known leachate sources, or leachate purge wells.

In 2020/21, most of groundwater wells exhibited slightly improved groundwater quality when compared to 2019/20 results. This is likely due to increased precipitation and associated increased dilution. Groundwater quality in Residual Treatment Facility (RTF) area was not impacted by the wastewater residuals spill release occurred on October 13, 2020. Approximately 130,000 L of residual solids were released from RTF through the stormwater system.

On October 18, 2020, approximately 25,000 L of residual wastewater solids were released from the valve chamber near Pump Station 4, which is located adjacent to Willis Point Road. Groundwater quality in compliance location 31 may have been impacted by the effluent, as elevated conductivity, sulphate, hardness, calcium and magnesium values were observed.

North of the Landfill

- In 2020/21, annual average conductivity values in the north purge wells were generally lower than those in 2019/20, indicating more diluted leachate quality. Improved water quality is attributed to the higher annual precipitation and associated increased dilution of leachate.
- Operation of the Phase 1 north purge well system continues to mitigate leachate impacts north of the landfill, as indicated by long-term stable or decreasing concentrations of leachate indicator parameters at locations 40, 20 and 21. In 2020/21, groundwater quality in well 20, 21 and 40 was slightly improved when compared to 2019/20 results.
- Water quality at locations 29 and 30 continued to be impacted by road salt application on Willis Point Road, but all parameters were below applicable CSR standards.
- Groundwater quality in close proximity to the Phase 2 basin confirms the hydraulic trap leachate collection system is effectively containing leachate north of Phase 2. Groundwater quality 100 m north of Phase 2 continued to show low concentrations of leachate indicator parameters, indicating water quality is not affected by landfill leachate. The slightly elevated sulphate concentrations are likely associated with runoff from aggregate stockpiles.
- Groundwater quality in the shallow well at location 27 continued to be affected by ongoing aggregate production and blasting activity close to the Toutle Valley. However, the deep well at this location is not impacted at this time.

Hartland North Pad

- Groundwater quality at the Hartland North Pad was consistent with background levels. Groundwater quality in close proximity to the October 13, 2020 wastewater residual spill event do not appear impacted.
- Groundwater quality in 91-1-1, 92-1-1, 93-1-1 and 94-1-1 were generally consistent with background conditions, except for slightly elevated sulphate concentrations in 92-1-1 and 94-1-1. Impacts in these newly installed wells may be associated with drilling and will likely dissipate with time.

South of the Landfill

- Water quality data from the south end of the landfill met the applicable CSR standards. Most of groundwater wells in this area continued to show decreasing trends in leachate indicator parameters (conductivity, chloride and ammonia) in 2020/21, as they have since the early 1990s.
- The application of road salt and herbicide continues to complicate interpretation of water quality data but impacts from these sources seasonal and are expected to diminish with time.
- Any long-term improvements in water quality south of the landfill are largely the result of leachate collection and containment measures instituted since 2001. Ongoing improvements to operational and maintenance protocols should continue improving water quality south of the landfill. Groundwater quality in this area is known to be sensitive to changes in the operation of the south purge wells and should continue to be monitored closely.

East of the Landfill

- Water quality along the east boundary of the Phase 1 landfill remained similar or slightly improved to previous years and concentrations of all parameters remained below applicable CSR standards.

Domestic Well Water Quality

As part of the CRD's groundwater quality monitoring program, nineteen (19) domestic wells were sampled in 2020, including 14 routine locations located within a two-kilometre radius of the landfill and five new wells located north of the Hartland North Pad. The water quality monitoring program indicated that groundwater quality in the domestic wells was consistent with previous results and water quality in all five new domestic wells met applicable Federal Water Quality guidelines (CDWQ and SDWQG) indicating that offsite domestic water wells are not impacted by landfill leachate.

Surface Water Quality

Surface water quality data collected in 2020/21 confirmed that nearby surface water bodies, Tod Creek, Durrance Lake and Durrance Creek and Killarney Lake are not impacted by landfill leachate.

Surface water in the vicinity of the landfill met the BCWQG-MAC criteria except for occasional exceedances for pH, iron, copper, zinc, and TSS. Elevated concentrations were largely related to seasonal flow variability (high and turbid flow) or construction activities. Of the 23 monitoring stations, total TSS and pH exceeded BCWQG-MAC at four (4) stations, total iron exceeded BCWQG MAC at six (6) stations, dissolved aluminum and iron concentrations exceeded BCWQG-MAC at three (3) stations, and total zinc only exceeded at one (1) station. The elevated metal concentrations were generally concurrent with high TSS, which may be related to construction and aggregate stockpiling activities. Water quality at background locations (SW-S-52 and CSs2) met BCWQG-MAC guidelines. Concentrations of leachate indicator parameters were consistent with previously reported background values.

Dissolved copper concentrations exceeded BCWQG-MAC values at nine (9) out of 23 stations. The dissolved copper BCWQG criteria varies with hardness, pH, dissolved organic carbon (DOC), and temperature, and is calculated using the Biotic Ligand Model (BLM). The exceedances of dissolved copper were typically associated with lower pH (<6.5), low hardness (<30 mg/L) and low DOC (<3 mg/L), which resulted in a stringent BCWQG. However, dissolved copper concentrations in surface water generally remained low (< 10 µg/L).

North of the Landfill

- The wastewater residual solids release on October 13, 2020 was contained in the wetland area upgradient of Durrance Lake. There is no evidence that surface water was impacted by the release.
- The spill from the CRL manhole and vent on February 9, 2021 was contained within a nearby dry depression and did not reach nearby surface water features. There is no evidence that surface water was impacted by the release.
- Surface water quality at Boundary Compliance stations along the northern property boundary met BCWQG-MAC in 2020/21, except for dissolved and total iron, dissolved copper at Sw-N-05 and Sw-N-16 during one or more sampling events. Similar to previous years, pH, dissolved and total iron at Sw-N-16 exceeded BCQWG-MAC during one or more sampling events. Surface water at these two locations was not impacted by leachate, but exhibited minor impacts from nearby construction activities involving blasting, aggregate placement, or excavation of organic soils. The iron exceedances are likely due to the disturbance of sediment during the sampling, as indicated by high TSS concentrations. Dissolved copper guidelines are dependent on pH, DOC and hardness values. Copper guidelines become more stringent under lower pH, hardness and DOC levels.
- At north of Hartland Landfill, dissolved copper concentrations at three (3) stations (not Boundary Compliance locations) exceeded BCWQC-MAC during one or more sampling events. Dissolved copper concentrations at these locations generally remained low (<10 µg/L). The dissolved copper exceedances at these locations are likely due to the lower pH and low DOC concentrations, which are reflective of the natural conditions.

Hartland North Pad

- In the Hartland North Pad area, surface water quality at Boundary Compliance stations (Sw-N-41s1 and Sw-N-42s1) met BCWQG-MAC in 2020/21, except for total iron and TSS. Leachate indicator parameters remained low in 2020/21, indicating surface water was not impacted by leachate. Water quality at Sw-N-42s1 station indicates slight impacts associated with aggregate stockpiling and construction activities at the RTF.
- Station Sw-N-41s3 (not a Boundary Compliance location) is located downstream of Sw-N-41s1 where the drainage from the northwest portion of the Hartland North Pad flows into Durrance Lake. In 2020/21, all parameters met BCWQG-MAC.

South of the Landfill

- Water quality at the Boundary Compliance location (Sw-S-04) met the BCWQG-MAC values for all analytes in all samples collected during 2020/21, except for total iron and pH during one sampling event. Surface water quality along the south boundary is not impacted by leachate.
- Water quality at station Sw-S-52 (not a compliance location) is representative of background water quality. In 2020/21, concentrations of all parameters were below the BCWQG-MAC. Concentrations of leachate indicator parameters were consistent with previously reported values.
- Surface water quality at south of Hartland Landfill were generally consistent with previous years, and is not impacted by leachate. Leachate indicator parameters remained below thresholds at all surface water locations, except for Sw-S-12 and Sw-S-03. The slightly higher elevated conductivity, sulphate and nitrate concentrations observed at Sw-S-12 and Sw-S-03 during drier months or early fall may be due to the runoff from paved areas surrounding the bin facility or dilute leachate. The elevated ammonia during the wet season may be derived from nitrate reduction via organic matter decomposing, and are not related to leachate.
- South of Hartland Landfill, dissolved copper concentrations at four (4) stations (not Boundary Compliance locations) exceeded BCWQC-MAC during one or more sampling events. Dissolved copper concentrations at these locations generally remained low (<10 µg/L), except for Sw-S-03 and Sw-S-12. The elevated copper concentrations at Sw-S-03 and Sw-S-12 may be related to the aggregate dust or surface water runoff from the truck wash and paved areas surrounding the bin facilities.

Leachate

The leachate quality data collected in 2020/21 remained in compliance with the requirements of the Waste Discharge Permit at the Hartland Valve Chamber. Overall, annual average leachate concentrations in 2020/21 were generally comparable with those measured in 2019/20.

Quality Assurance and Quality Control

Upon review of the quality assurance and quality control data collected in 2020/21, groundwater, surface water and leachate sampling and laboratory analysis have produced reliable results that are acceptable for the purposes of this monitoring report.

Compliance with Operating Certificate and Waste Discharge Permit

Groundwater quality, surface water quality and leachate quality data were used to assess compliance with the Amended Operational Certificate and Waste Discharge Permit and are discussed individually below.

Groundwater

A total of 36 groundwater monitoring wells were identified as Boundary Compliance monitoring locations including wells at locations. Water quality information collected from these wells were compared to the CSR standards for freshwater aquatic life and drinking water to assess compliance with the landfill Operating Certificate and protect both current and future uses of the groundwater resource. There were no exceedances reported in groundwater compliance wells in 2020/21.

Surface Water

A total of five surface water monitoring stations have been identified as Boundary Compliance stations surrounding Hartland Landfill These stations are concentrated along the southern and northern property boundaries and are located downgradient of areas that have the potential to be impacted by leachate or runoff from the site. Impacts were observed at select stations but are inferred to be caused by sources other than landfill leachate (e.g. low-flow sampling conditions, construction activities, spill events, blasting, aggregate stockpiling, etc.). Water quality data collected from these sites was compared to the BCWQG-MAC criteria and used to assess compliance with the landfill Operational Certificate.

With respect to surface water, the landfill was in compliance with the Operational Certificate in 2020/21, with the exception of the exceedances related to low-flow conditions or other non-leachate sources noted in Table 9-1.

Table ES-1. Surface Water Quality Compliance at Property Boundary Stations

Station	General Parameters	Metals	Recommended Corrective Action
North of the Landfill			
Sw-N-05	NA	Dissolved Copper (2)	• Dissolved copper guidelines are dependent on pH, DOC and hardness values. Copper guidelines become more stringent under lower pH, hardness and DOC levels.
Sw-N-16	Lab pH (2)	Total iron (2), Dissolved Copper (2)	• Exceedances are anticipated to be related to turbid flow conditions following a prolonged dry period. Continued monitoring to assess these anomalous results. • Dissolved copper guidelines are dependent on pH, DOC and hardness values. Copper guidelines become more stringent under lower pH, hardness and DOC levels. • pH values were occasionally below 6.5, but no statistically significant decrease in pH from background. No action needed.
Sw-N-41S1	TSS (1)	Total Iron (1)	• Exceedances are anticipated to be related to turbid flow conditions following a prolonged dry period. Continued monitoring to assess these anomalous results. Refinement of the Standard Operating Procedure for surface water sampling to minimize the potential for artificially elevated concentrations of metals associated with suspended sediments.
South of the Landfill			
Sw-S-04	Lab pH (1)	Total Iron (1)	• Total iron exceedances are anticipated to be related to turbid flow conditions following a prolonged dry period and/or upstream surface runoff from exposed rock. Continued monitoring to assess these anomalous results. • pH values were occasionally below 6.5, but no statistically significant decrease in pH from background. No action needed.

Leachate

The Hartland valve chamber is the compliance point for the Waste Discharge Permit. During the monitoring period, leachate discharges at the Hartland valve chamber were in compliance with the Waste Discharge Permit requirements.

Recommendations

Based on the findings of this report, our recommendations are summarized in Table ES-2:

Table ES-2. Summary of Recommendations

	Leachate Collection System	Status
1	Water levels and quality in the north purge wells should continue to be closely monitored to verify the effectiveness of the leachate collection system. Several pump failures were reported at North purge wells P7 and P8. Options for maintaining lower leachate levels in P9 should be further investigated to continue improving groundwater quality west of the lower leachate lagoon.	New
2	Pumping levels and the extent of the drawdown cones surrounding the north and south purge well systems should continue to be validated periodically (next assessment in 2024) to confirm the proper functioning of the wells. All procedures should follow the Standard Operating Procedure (SOP) – North Purge Well Drawdown Cone Verification (AECOM 2016), with interpretation of results by a qualified professional.	Ongoing
3	Pumping elevations in the south purge wells (P2, P3, P4 and P10) should be maintained at elevations below 140 m asl. Pumping elevations in P1 should be maintained near the bottom of the screened interval around 146 m asl.	Ongoing
4	Future quarry development plans (i.e. quarrying, blasting, etc.) for the north bedrock ridge should be evaluated from a hydrogeological perspective to ensure that the proposed development will not affect groundwater recharge or compromise leachate containment.	Ongoing
5	A detailed assessment of the effectiveness of the hydraulic trap and leachate collection systems including the north purge wells and south purge wells is required to evaluate effectiveness as the landfill extends further north and west, and as additional lifts are constructed. Additional leachate containment or groundwater management measures may need to be implemented at the north end of the Phase 2 landfill to mitigate the potential for off-site leachate migration during future landfill development.	Ongoing
Runoff and Infiltration Associated with Aggregate Stockpiles		

	Leachate Collection System	Status
6	The location and volume of aggregate stockpiles should continue to be minimized outside of the leachate collection system. Stockpiles should be covered where present to minimize sulphate, ammonia, nitrate and TSS impacts on surface water bodies and downgradient groundwater. Direct runoff from aggregate stockpiles should be diverted away from natural water courses as it is known to exceed BCWQ guidelines for sulphate.	Ongoing
7	Within the footprint of the leachate collection system, progressive closure and temporary tarps should continue to be implemented to minimize infiltration to the underlying leachate collection system and manage sulphide concentrations in leachate.	Ongoing
	Groundwater Monitoring Program	
8	A groundwater well survey should be conducted once every five years to obtain updated data on well elevations (i.e. next survey in 2025).	New
9	The elevation of the leachate mound in Phase 1 and 2 should be determined at least once every five years (i.e. next assessment in 2025). The existing protocols should be refined to ensure successive triplicate water level measurements produce the same result. Several inconsistencies have been recently identified, which are interpreted to be the result of highly conductive condensate in landfill gas wells.	Ongoing
10	Monitoring wells on the north ridge and at Hartland North should continue to be monitored to characterize daily groundwater level fluctuations, further define the groundwater divergence and monitor groundwater flow behavior over time after construction of the Residuals Treatment Facility is complete. These wells should be protected from site development activities and damage by heavy equipment. Monitoring of these wells will also be important as the extents of the quarry within Phase 2 migrate northward. Furthermore, any westward expansion of the quarry may be accompanied by an increase in groundwater flow reporting to the leachate collection system as the Highland Fault is inferred to behave as a barrier to eastward groundwater flow.	Ongoing
11	There should be a routine review of the landfill development plan and filling plan every two years to ensure the existing monitoring network and monitoring program remain sufficient. The next review should be conducted in 2023.	Ongoing
12	As required by the Amended Operational Certificate, the results of the annual monitoring program should continue to be reviewed and interpreted by a Qualified Professional experienced in assessing the impacts of landfill leachate at large municipal landfills similar to Hartland.	Ongoing
	Surface and Leachate Monitoring Program	
13	The chemistry of residual wastewater solids and stabilized biosolids (solids and leachate) should be characterized to allow for future evaluation of accidental releases, and impacts to leachate chemistry over time. This information may be available from operational monitoring programs.	New
14	Regular cleaning of the weirs and surface water stations should be conducted to minimize the potential for artificially elevated concentrations of metals associated with suspended sediments.	New
15	The source of ammonia, dissolved copper and nitrate observed at Sw-S-12 and Sw-S-03 should be investigated further. Additional waste has been placed on the western and southern portions of Phase 2 over recent years and occasional leachate seeps and runoff from the truck wash have been noted in the past. A multilevel monitoring well cluster could be established west of the bin facility and well 85-1-1 to resolve whether the source of impacts to surface water are due to runoff or discharge of leachate impacted groundwater.	Ongoing
16	In addition to the Sewer Use Criteria, leachate quality results for trace organic compounds should be compared to CSR standards for the protection of drinking water and aquatic life to allow for screening of data to identify parameters in leachate that exceed CSR standards, and guide any refinements to the monitoring program in future years.	Ongoing
	Construction Management	
17	Appropriate erosion control measures should continue to be implemented to minimize runoff from construction areas for all projects involving excavation, aggregate placement or soil relocation.	Ongoing
18	The placement of aggregate, road salt, dust suppressant and herbicides should be carefully considered and documented to help understand the causes of potential future concentrations of conductivity, ammonia, chloride, nitrate, sulphate and select metals at groundwater and surface water monitoring locations.	Ongoing
	Quality Assurance and Quality Control	
19	Field blanks and travel blanks should be collected and analyzed to ensure that environmental samples have not been contaminated during sample collection or transportation,	New
20	Quality assurance for laboratory analyses should continue to be evaluated quarterly, and any discrepancies should be resolved with the laboratory and CRD sampling personnel within one month of receiving the laboratory results. The appropriate notation should be added to the data files to explain the reason for the low precision and the steps taken, if any, to improve the sampling or laboratory procedures.	Ongoing
21	Field measurement probes should be calibrated daily in advance of monitoring activities. The calibration should be validated at least once in the middle of the day to confirm the readings are accurate. Both lab and field pH should also be recorded for QAQC purposes.	Ongoing

Table of Contents

1. Introduction 16
2. Site Description 18
2.1 Physiography 18
2.2 Geology 18
2.3 Climate 18
2.4 Significant Site Activities in 2020/21 19
2.5 Applicable Regulatory Criteria 20
2.5.1 Groundwater 20
2.5.2 Surface Water 21
2.5.3 Leachate 21
3. Methods and Quality Assurance 22
3.1 Field Techniques 22
3.2 Quality Assurance 23
3.2.1 Groundwater and Surface Water 23
3.2.2 Leachate 24
3.3 Statistical Assessment of Temporal Trends 24
3.4 Summary 42
4. Groundwater Flow 43
4.1 Data 43
4.2 Regional Groundwater Flow in the Bedrock 43
4.3 Leachate Elevations in Phase 1 and Phase 2 44
4.3.1 Phase 1 44
4.3.2 Phase 2 Basin 45
4.4 Groundwater Flow in Bedrock Aquifer 46
4.4.1 East of Phase 1 46
4.4.2 North of Phase 1 46
4.4.3 South of Phase 1 46
4.4.4 Phase 2 - North Ridge Area 47
4.5 Summary 48
4.5.1 Leachate Flow 48
4.5.2 Groundwater Flow 48
5. Groundwater Quality Monitoring Wells 59
5.1 Compliance Groundwater Monitoring Locations 59
5.2 Assessment of Groundwater Quality Impacts 59
5.3 Electrical Conductivity 60
5.4 Monitors North of the Phase 1 Landfill 61
5.4.1 Monitoring Site 58 61
5.4.2 Monitoring Sites 52 (P7), 80 (P8) and 81 (P9) 61
5.4.3 Monitoring Site 40 73
5.4.4 Monitoring Sites 20 and 21 73
5.4.5 Monitoring Site 31 73
5.4.6 Monitoring Sites 29 and 30 74
5.4.7 Monitoring Sites 28 and 39 74
5.5 Monitors West and North of the Phase 2 Landfill and Near the Hartland North Pad 77
5.5.1 Monitoring Site 63 77
5.5.2 Monitoring Sites 77, 78, 87 and 88 77

5.5.3 Wells North of Phase 2 Landfill 78
5.5.4 Wells near Hartland North Pad (Residual Treatment Facility) 81
5.6 Monitors South of the Phase 1 Landfill 84
5.6.1 South Purge Wells (P1, P2, P3, P4 and P10) 84
5.6.2 Monitoring Site 85 84
5.6.3 Monitoring Site 60 84
5.6.4 Monitoring Site 07 85
5.6.5 Monitoring Sites 71, 72, 73 85
5.6.6 Monitoring Site 04 88
5.6.7 Monitoring Site 19 88
5.7 Monitors East of the Phase 1 Landfill 88
5.7.1 Monitoring Sites 17 and 18 88
5.7.2 Monitoring Site 16 89
5.8 Summary 89
6. Groundwater Quality in Domestic Wells 92
6.1 Monitoring Locations 92
6.2 Domestic Well Quality 92
6.3 Summary 93
7. Surface Water Quality near the Landfill 95
7.1 Compliance Monitoring Locations 95
7.1.1 Regulatory Comments 95
7.2 Assessment of Surface Water Quality Impacts 99
7.3 Data 99
7.4 Surface Water Quality North of the Landfill 100
7.4.1 Surface Water Quality North of Phase 1 and Phase 2 100
7.4.2 Surface Water Quality near the Hartland North Pad 105
7.5 Surface Water Quality South of the Landfill 106
7.5.1 Upgradient Surface Water Quality 106
7.5.2 Surface Water Quality Near and South of the Recycling Area 106
7.6 Summary 111
8. Leachate 112
8.1 Compliance Monitoring Locations 112
8.2 Data 112
8.3 Leachate Generation and Discharge 112
8.4 Leachate Quality 113
8.4.1 Routine Monthly Leachate Analyses and Sewer Use Bylaw Comparison 113
8.4.2 Quarterly Trace Organic Analysis at Hartland Valve Chamber 118
8.5 Summary 118
9. Conclusions 120
9.1 Leachate Flow 120
9.2 Groundwater Flow 120
9.3 Groundwater Quality 120
9.4 Domestic Well Water Quality 121
9.5 Surface Water Quality 122
9.6 Leachate Quality 123
9.7 Quality Assurance and Quality Control 123
9.8 Compliance with Operating Certificate and Waste Discharge Permit 123
9.8.1 Groundwater 123

9.8.2 Surface Water 123
9.8.3 Leachate 124
10. Recommendations 125
11. Qualifications of the Authors 127
12. References 128

Figures

Figure 1-1. Site Location Map 17
Figure 4-1. Groundwater Elevations and Flow Directions in Bedrock 50
Figure 4-2. Groundwater Flow in Cross Section A-A' 51
Figure 4-3. Groundwater Flow in Cross Section B-B' 52
Figure 4-4. Groundwater Elevations East of Phase 1 53
Figure 4-5. Leachate and Groundwater Elevations within Phase 1 54
Figure 4-6. Groundwater Elevations Surrounding the North Purge Wells 55
Figure 4-7. Groundwater Elevations in South Purge Wells 56
Figure 4-8. Water Elevations within the Leachate Conveyance System and Surrounding the Phase 2 Basin 57
Figure 4-9. Groundwater Elevations in North Ridge Area 58
Figure 5-1. Electrical Conductivity Plan 69
Figure 5-2. Electrical Conductivity in Cross Section A-A' 70
Figure 5-3. Electrical Conductivity in Cross Section B-B' 71
Figure 5-4. Groundwater Quality North of Phase 1 72
Figure 5-5. Groundwater Quality North of Willis Point Road 76
Figure 5-6. Groundwater Quality North of Phase 2 79
Figure 5-7. Groundwater Quality North of Hartland North Pad 83
Figure 5-8. Groundwater Quality South of Landfill 86
Figure 5-9. Groundwater Quality Southeast of Landfill 87
Figure 5-10. Groundwater Quality East of Landfill 91
Figure 6-1. Domestic Well Locations 94
Figure 7-1. Surface Water Bodies and Sampling Locations 101
Figure 7-2. Surface Water Quality North of Phase 1 103
Figure 7-3. Surface Water Quality North of Phase 2 108
Figure 7-4. Surface Water Quality Downstream of the Hartland North Pad 109
Figure 7-5. Surface Water Quality South of Landfill 110
Figure 8-1. Hartland Valve Chamber Leachate Chemistry (Conductivity, Ammonia and Chloride) 116
Figure 8-2. Hartland Valve Chamber Leachate Chemistry (Sulphide, BOD and COD) 117

Tables

Table 3-1. Groundwater Quality QA/QC – Relative Percent Difference 26
Table 3-2. Surface Water Quality QA/QC – Relative Percent Difference 32
Table 3-3. Hartland Valve Chamber Leachate Chemistry QA/QC – Relative Percent Difference 40
Table 5-1. Groundwater Quality Exceedances 63
Table 7-1. Surface Water Quality Exceedances 96
Table 9-1. Surface Water Quality Compliance at Property Boundary Stations 124
Table 10-1. Summary of Recommendations 125

Appendices

Appendix A. Monitoring Station and Groundwater Level Data
- A1. Monitoring Well Co-ordinates
- A2. Monitoring Well Details
- A3. Groundwater Elevations
- A4. Surface Water Station Details

Appendix B. Water Quality Data
- B1. Groundwater Quality
- B2. Domestic Well Quality
- B3. Surface Water Quality
- B4. Monthly Leachate Quality Data – Hartland Valve Chamber
- B5. Quarterly Leachate Quality – Trace Organics
- B6. Monthly Leachate Quality – Phase 2 Cleanout
- B7. Monthly Leachate Quality – North Purge Wells
- B8. Monthly Leachate Quality – Controlled Waste Drainage
- B9. Monthly Leachate Quality – South Purge Wells
- B10. Monthly Leachate Quality – West Face Drainage
- B11. Monthly Leachate Quality - Cell 3 Pipe Outlet
- B12. Monthly Leachate Quality – Emerging Contaminant

Appendix C. Climate Data
- C1. Daily Rainfall Data – Hartland Landfill Weather Station
- C2. Monthly Rainfall Data – Hartland Landfill Weather Station

Appendix D. Leachate Pipeline Flow Data

Appendix E. Hartland Landfill Site Plan and Sampling Locations
- E1. Hartland Landfill Site Plan
- E2. Groundwater Level Monitoring Locations
- E3. Groundwater Quality Monitoring Locations
- E4. Surface Water Quality Monitoring Locations
- E5. Leachate Quality Monitoring Locations

Appendix F. Hartland Landfill Leachate Pipeline Plan

Appendix G. Results of Statistical Analysis
- G1. Groundwater
- G2. Surface Water
- G3. Leachate

1. Introduction

Hartland Landfill is located at the end of Hartland Avenue approximately 14 kilometres (km) north of Victoria (Figure 1-1). 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 Capital Regional District (CRD). The landfill is currently owned and operated by the CRD and is the primary solid waste disposal site for the 13 member municipalities and three electoral areas of the Capital Region.

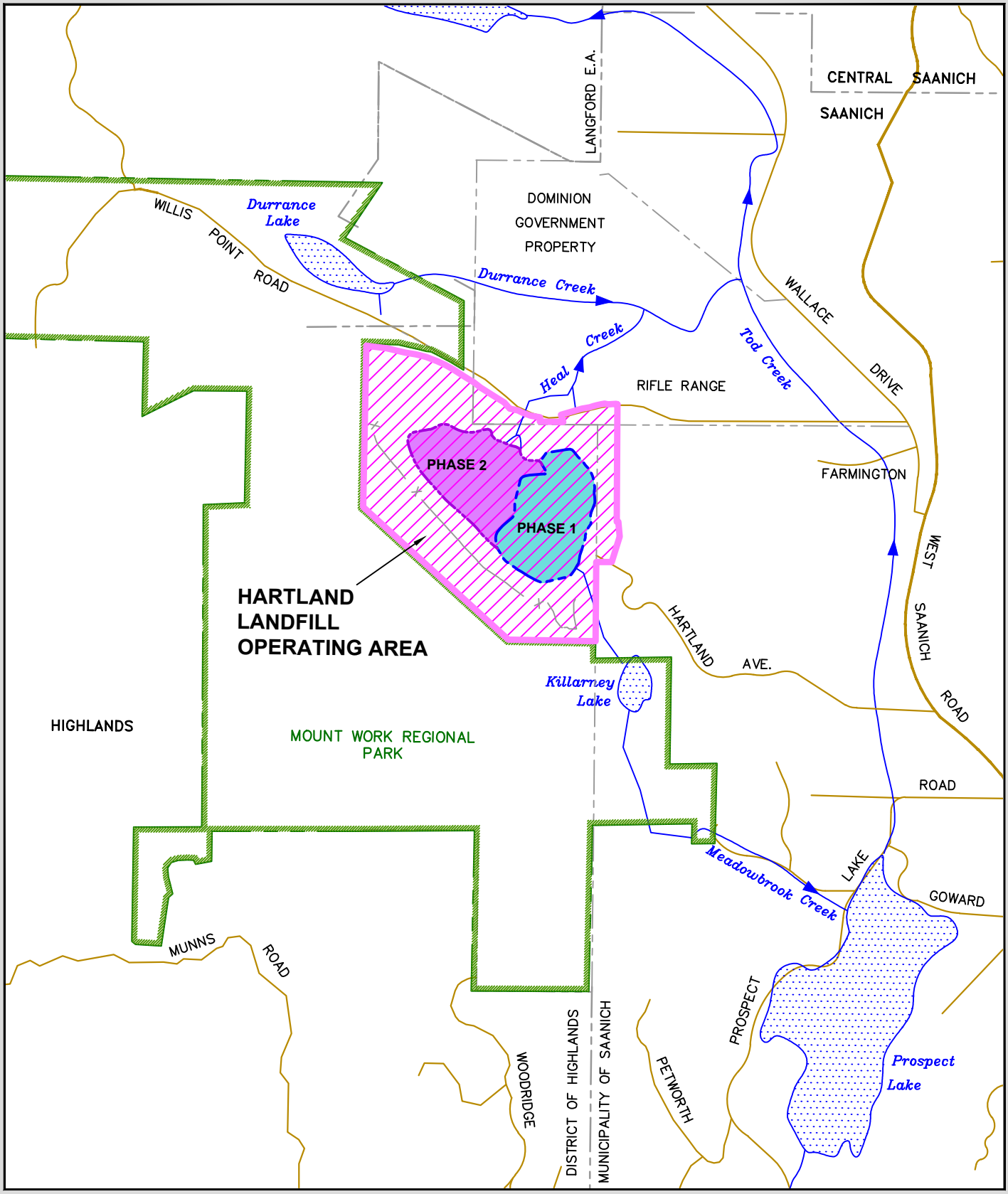
The CRD initiated a surface water and groundwater monitoring program for the landfill in 1983. Annual monitoring reports have been prepared and issued by Gartner Lee and AECOM since 1988. The present Hartland Monitoring Program is part of an Amended Operational Certificate # 12659, last amended January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

The Hartland Landfill is divided into two 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 engineered and operated as a ‘hydraulic trap” landfill with the maintenance of upward groundwater gradients below the base of the Phase 2 landfill providing leachate containment. Phase 2 is currently receiving waste. Filling of Phase 2 Cell 1 was completed in 2004 and was capped in 2011. During the summer of 2004, the west face of Phase 2 Cell 1 was capped with a geomembrane to reduce passive gas venting and provide an internal leachate collection system for future development of Phase 2 Cell 2. This area is referred to as the West Face closure. In 2016, Phase 2 Cell 3 was developed on the west side of Phase 2 along with new leachate collection infrastructure.

Leachate and surface runoff from the active landfill areas are directed to two leachate lagoons at the north end of the landfill. The leachate is then transported by a pipeline to the McLoughlin Point Wastewater Treatment plant and discharged via deep water outfall. . Leachate discharge to sewer is authorized by Waste Discharge Permit SC97.001 last amended on March 1, 2011. The permit is issued by the CRD Regional Source Control Program and is subject to the CRD Sewer Use Bylaw.

This 2020/21 monitoring report presents our interpretation of water quality results and groundwater flow conditions to:

1. Evaluate the effectiveness of the leachate containment and collection systems.
2. Assess the potential impact of landfill leachate and operational activities on groundwater and surface water quality.
3. Assess temporal trends in leachate, groundwater and surface water flow and quality.



Legend

- ROAD
- MUNICIPAL BOUNDARIES
- SURFACE DRAINAGE
- PHASE 1
- PHASE 2
- HARTLAND LANDFILL OPERATIONAL BOUNDARY

0 100 200 400 600 800 1000 m

1 : 25,000
UTM Zone 10N, NAD83

Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Site Location Map

Figure 1-1
Version 1

Reviewed by: KJ
Date Issued: MAY 2021
Prepared by: PCJ
Project Number: 60631284

AECOM

Date Plotted: 2016-08-24 File Location: \\cabny1fp001\prod\Projects\60631284\900-CAD_GIS\910-CAD\20-SHEETS\C432 - 2020-21 Annual Report\FIG1.1-Site Location-20210510-60631284-431.dwg

2. Site Description

2.1 Physiography

Hartland Landfill is located in the Tod Creek watershed, in the bedrock highlands of the Gowlland Range northwest of Victoria. The terrain is moderately rugged with relief of up to 446 metres (m) in the area. Undeveloped CRD property (about 320 hectares (ha) in total) lies to the west and south of the landfill site. Mount Work Regional Park lies to the west and the Department of National Defence rifle range is situated north of the landfill. Durrance Lake Regional Park is located northwest of the landfill, and Killarney Lake Regional Park is located to the southeast. Private residential properties are located to the east and southeast of the landfill.

Durrance Lake and Killarney Lake are two major surface water bodies located within one kilometre of the landfill footprint. A lined perimeter ditch collects and diverts natural runoff from upslope areas around the landfill footprint. The water is discharged into ephemeral surface water features that report to Durrance Lake to the northwest and Killarney Lake to the southeast.

A Residuals Treatment Facility (RTF) has recently been constructed at Hartland North to treat effluent from the McLoughlin Point Wastewater Treatment Plant. The RTF become operational in September 2020. Although the RTF is located within the Hartland Landfill Operating Area Boundary, it is managed by CRD as a separate site.

2.2 Geology

A thin veneer of glacial till composed of silty, gravelly sand, with interspersed cobbles and boulders mantles the bedrock in areas of gentle slopes and in valley bottoms. Fluvial deposits consisting of well-sorted sands and gravels are also present in localized bedrock depressions and channels.

The bedrock geology in the area surrounding the landfill mainly comprises Wark Diorite Gneiss with Colquitz Gneiss outcropping in the northern and eastern margins of the landfill site with thin overlying veneer of glacial till. The Wark Diorite Gneiss is dark green to black in colour. It is competent, except locally in shear zones, where it has been chloritized and weathered into soft, sand size grains and clay. Discontinuities, including joints, shear zones and altered veins have been observed on the bedrock outcrops and noted in borehole logs. Geologic mapping of an exposed bedrock outcrop north of the Phase 2 landfill (AECOM 2018) characterized the undulating bedrock surface and confirmed the presence a complex network of lithologic contacts, faults and fractures observed in exposed bedrock excavations (sub-vertical quarry walls) including the Highland Fault and other faults that were previously inferred based on lineaments identified on aerial photographs (Thurber 1987). Hydrogeologic investigations have confirmed the existence of several faults and shear zones. Permeability testing has determined that faults and shear zones behave as either conduits or barriers to groundwater flow.

2.3 Climate

The climate of this area is classified as "cool Mediterranean". Long-term (1981–2010) average climatic data is available for the Victoria International Airport Climatological Station (Victoria International Airport CS) located approximately 9 km from the landfill. Average annual temperature is 10.0ºC and mean monthly values range from a low of 4.0ºC in December to a high of 16.9ºC in July. Mean annual precipitation is 882.9 mm.

In 1994, the CRD established a climate station (Victoria Hartland CS) at the landfill office. The original Hartland climate station was replaced in 2009/10 with new equipment at a location on top of Phase 1. The new weather station records temperature, precipitation, wind direction, wind speed, barometric pressure and relative humidity directly to CRD's SCADA system.

Hartland daily precipitation measurements for 2020/21 are provided in Appendix C. The precipitation measured at Hartland Landfill from April 2020 to March 2021 was 1,133.5 mm, which was approximately 28% higher than the 30-year average reported for Victoria International Airport CS (882.9 mm/year), and 68% higher than the 2019/20 total precipitation recorded for Victoria Hartland CS (674 mm). These data indicate that 2020/21 was a wet year with respect to precipitation. Precipitation during wet season (i.e. October to February) was 843.4 mm, which contributed to over 74% of total annual precipitation. January 2021 was one of the wettest months of January on record for Victoria, with a total of 194 mm of precipitation recorded at the Victoria Hartland CS.

Climate change projections for the CRD were developed by the Pacific Climate Impacts Consortium to better understand the details of how climate may change in the Capital Region (CRD 2017). Overall, the results indicate that the region can expect warmer winter temperatures, fewer days below freezing, more extreme hot days in the summer, longer dry spells in summer months, more precipitation in fall, winter and spring, and more intense, extreme weather events. A water surplus occurs primarily in the cool, wet winter months (November, December and January) with water deficit conditions occurring in the warm, dry summer months (July, August, and September).

2.4 Significant Site Activities in 2020/21

CRD staff maintain a log of activities at the landfill that are relevant to landfill operations, leachate containment and compliance monitoring activities. Activities that are considered important from a compliance monitoring perspective are paraphrased below:

- Residuals Treatment Facility (RTF): Development in the vicinity of the RTF began in 2017 and the construction was completed in late 2020. RTF is now operational and permitted under Ministry of Environment and Climate Change Strategy Operational Certificate #109471. The treatment process at the RTF turns residual solids from the McLoughlin Point Wastewater Treatment Plant into Class A biosolids.
- Water Supply Main to RTF: A water main was installed along the East Perimeter Road with a water service installed between leachate lagoons in the northeast corner of the Hartland property. The new water main connects the RTF with Saanich's new water reservoir built on Hartland's eastern boundary (near the existing water reservoir which will be abandoned). The new water service also supplies water to the newly built Pump Station No. 4, which is part of the Wastewater Treatment Project's Residual Solids Conveyance Line (RSCL).
- Activation of Residual Solids Conveyance Line: The RSCL conveys processed wastewater from the McLoughlin Point Wastewater Treatment Plant to the RTF. Construction of the RSCL was completed in the summer of 2020.
- Activation of Centrate Return Line: The Centrate Return Line (CRL) is used to return centrate liquid from the RTF and leachate from the Hartland Landfill to the McLoughlin Point Wastewater Treatment Plant. The CRL was activated on December 30, 2020 to convey centrate liquid from the RTF and operated intermittently for leachate in January 2021 when leachate levels in upper lagoon were high. The formal switch from the leachate pipeline to the CRL commenced in March 2021, and flow rates ranged between 60 and 80 L/s.
- Preparation of Leachate Line Decommissioning: The leachate pipeline was deactivated in March 2021, and pigged in April 2021 to prepare for decommissioning. The leachate line has been filled with super-chlorinated water for planned storage of approximately one year (until March 2022).
- Deposition of Biosolids in Hartland Landfill: Since November 2020, as part of the commission of the RTF approximately 4,459 tonnes of dewatered lime stabilized biosolids and 793 tonnes of digested biosolids were received from RTF and deposited in controlled waste trenches.
- Aggregate Storage Development: Tree falling and clearing activities were completed in early March 2020 to develop the aggregate storage area located in the northeast corner of the landfill property (i.e. east of HB15). Development work continued in 2020/21.
- Spill of Dewatered Residual Solids from RTF: On October 13, 2020, an approximately 130,000 L of residual wastewater solids were released from the RTF through the stormwater system. Subsequent environmental investigations and monitoring was conducted by Corvidae Environmental Consulting (Corvidae), and the End-of-Spill Report (as per the BC Spill Reporting Regulation) is available on the CRD's website: https://www.crd.bc.ca/project/capital-projects/residuals-treatment-facility
- Pump Station 4 Effluent Release: On October 18, 2020, an approximately 25,000 L of residual wastewater solids were released from the valve chamber near Pump Station 4, which is located adjacent to Willis Point Rd. Approximately 21,000 L were retained within a manhole and the RSF line and the biosolids were removed from these structures to prevent additional release to ground at this location. Following the release, groundwater (well 31-1-1 and 31-1-2) and surface water downstream of the spill were collected on October 20th, 26th, 29th, November 6th, December 10th, 2020 and January 18th, 2021 to evaluate the potential impact. Analytical results indicated that surface water quality downstream of the

release was impacted during the October sampling events (McElhanney 2020a), and impacts were dissipated during the December 2020 and January 2020 sampling events (McElhanney 2020b). Samples collected from the groundwater wells (31-1-1 and 31-1-2) near the release have shown minimal impacts but impacts to downgradient groundwater could not be determined due to lack of monitoring wells (McElhanney 2020b).

- Spill from the CRL Manhole and Vent: On February 9, 2021, a spill, caused by an automatic valve failure at the Marigold Pump Station, occurred at the manhole located in the driveway to the RTF from Wills Point Road. The unintended closure of the valve resulted in liquid back-up throughout the pipeline and eventually spilled out of the manhole. The spill was contained within a nearby dry depression and did not reach surface water compliance station SW-N-41s1.
- Landfill Gas Fugitive Emission Survey: CRD contracted Sperling Hansen Associates to conduct full-scale methane fugitive emission survey to quantify greenhouse gas emissions. The survey was completed in June 2020.
- Groundwater Well Survey: Groundwater well survey was conducted by CRD and was completed in November 2020. The most recent survey data has been updated in CRD's database.
- Maintenance/Verification of North and South Purge Well Systems: Flow tests were regularly conducted at P1, P7 and P8 to monitor pump efficiency. Pumps and pressure transducers installed in several leachate collection wells (P1, P3, P4 and P8) were serviced or replaced in response to pump failure or routine maintenance procedures. In November 2020, pressure transducer elevations in P1 were recalibrated to the correct groundwater elevation.
- Herbicide Application: Herbicide was applied in June 2020 to invasive plant species (broom, thistle, blackberry) across the Hartland Landfill.
- Clearance/Maintenance of Surface Water Weir: Surface water weirs (SW-S-12, SW-S-20, SW-S-24) and recycling areas were cleaned out in June 2020 to remove sediment buildup.

2.5 Applicable Regulatory Criteria

The Hartland Landfill is required to operate in accordance with the monitoring requirements outlined in the following:

- Amended Operational Certificate (#12659) approved by ENV, last amended on January 27, 2010.
- Waste Discharge Permit SC97.001 issued by the CRD Regional Source Control Program, last amended on March 1, 2011, and subject to the CRD Sewer Use Bylaw.
- Legally enforceable standards defined by the British Columbia Contaminated Sites Regulation (CSR).

The Stage 10 (Omnibus) and Stage 11 (Housekeeping) amendments to the CSR are effective as of November 1, 2017. Stage 12 amendments to the CSR were issued January 24, 2019 and included clerical errors related to the Stage 10 and 11 amendments. The Stage 13 amendments (effective February 1, 2021) were developed to improve the process for identifying contaminated sites. The changes were considered in this report.

As part of the update of Stage 10 (Omnibus) and Stage 11 (Housekeeping) amendments, a number of emerging contaminants were added to the water and soil schedules due to their persistence in the environment, toxicity, and relevance to contaminated sites in BC. In April 2017, AECOM conducted a focused review on the applicability of emerging contaminants at the Hartland Landfill based on Schedule 2 activities in the CSR. In 2018, AECOM conducted a detailed emerging contaminant review, to confirm regulatory compliance and to recommend an approach for future monitoring (AECOM 2018). It was recommended to continue sampling and analyzing of emerging contaminants of concern (CECs) at the Hartland Valve Chamber on a quarterly basis in conjunction with the trace organics sampling program. In 2020/21, quarterly samples were collected and submitted for CECs at the Hartland Valve Chamber.

2.5.1 Groundwater

In February 2016, CSR Protocol 21 (P21), Water Use Determination, became legally enforceable. For the purposes of this report, Protocol 21 (Version 2.0, effective October 31, 2017) is considered when determining applicable water use standards at Hartland Landfill.

Groundwater quality data were compared to CSR Schedule 3.2 Generic Numerical Water Standards Column 3 Aquatic Life Use (AW) and Column 6 Drinking Water Use (DW), as required by P21.

Freshwater AW standards apply to groundwater because the landfill is “within 500 m of a surface water body containing aquatic life” (i.e. Heal Creek, Durrance Creek, Durrance Lake, Killarney Creek and Killarney Lake).

Future DW standards apply because the aquifer underlying the landfill has:

- A hydraulic conductivity greater than 10^{-6} m/s and a yield greater than 1.3 L/min.
- Groundwater with natural total dissolved solids (TDS) concentrations of less than 4,000 mg/L.
- An average confined aquifer saturated thickness greater than 1 m.
- An overlying silt or clay aquitard that is less than 5 m thick.

DW standards for iron and manganese do not apply to municipal landfills, based on the Stage 8 Amendments to the CSR that came into effect on January 24, 2013, and as presented on CSR Schedule 3.2.

As part of the Stage 13 amendments, Protocol 9, which includes the list of regional groundwater background concentrations, was updated. Regional background concentrations are provided in Table 1 of Protocol 9. Regional background concentrations for the Southern Vancouver Island have been considered when assessing groundwater quality data collected at the Hartland Landfill. In several instances, regional background concentrations are greater than the applicable CSR DW standard and/or the most stringent CSR freshwater AW standard. Groundwater that contains a substance concentration above the applicable CSR standard but below the regional background concentration is not considered contaminated under the CSR.

2.5.2 Surface Water

Surface water quality data are compared to the *British Columbia Approved and Working Water Quality Guidelines* (BCWQG) for the protection of AW and DW, because CSR Technical Guidance 15 (April 2013) indicates that groundwater in receiving environments (i.e. within 10 m of the high water mark of a surface water body) should be compared to the BCWQG. The approved and working BCWQGs were last updated in August 2019 and February 2021, respectively. Furthermore, there are two sets of BCWQG criteria for AW use:

- 30-day average (long-term)
- Maximum allowable concentration (short-term)

The purpose of the 30-day average guideline is to protect the most sensitive species and life stages against chronic exposure. To properly compare data against 30-day average guidelines, the 30-day average concentration is typically calculated by averaging the results of five or more samples collected within a 30-day period.

The maximum allowable concentration (MAC) guideline is established to protect the most sensitive species and life stages against short-term exposure (e.g. less than 96 hours). BCWQGs for MACs are typically used to assess risks associated with short-term exposures.

The dissolved copper data evaluation has been updated to reflect the revised BCWQG AW criteria (August 2019 version). The dissolved copper BCWQG varies with hardness, pH, dissolved organic carbon (DOC) and temperature, and is calculated using the Biotic Ligand Model (BLM). BLM is a series of linked equations that predict the toxicity of dissolved copper to aquatic life under specific conditions. In this report, only dissolved copper concentrations with paired DOC data were compared to BCWQG AW criteria.

The BCWQGs apply to surface water on site and on adjacent sites under provincial jurisdiction. The Federal Water Quality Guidelines (CCME) apply on the property owned by the federal government located north of the site. Both the BCWQG and CCME criteria are guidelines and do not have the same regulatory force as the CSR Omnibus standards.

2.5.3 Leachate

Discharges from the leachate pipeline are subject to the CRD Regional Source Control Program (RSCP) Waste Discharge Permit (Waste Discharge Permit Number SC97.001) authorizing the discharge of non-domestic waste to the sanitary sewer in accordance with the CRD’s Sewer Use Bylaw 2922. Sampling is conducted monthly.

The Hartland Landfill leachate compliance monitoring location is the Hartland Valve Chamber (flow detection chamber) located at the start of the leachate pipeline. Authorized discharge limits are identified within the permit.

In 2020/21, CRD collected 10 samples (including duplicates) from the Harland Valve Chamber for analysis of emerging contaminants.

3. Methods and Quality Assurance

3.1 Field Techniques

Sampling locations are shown on Figure 4-1. Boreholes and monitoring wells are identified using a standard system adopted by the CRD consisting of three numbers (e.g. 02-02-01). The first number refers to the monitoring site, the second to the borehole at that site (there may be more than one) and the third number refers to the monitoring well in that borehole (there may be two or three at different depths in older installations). If the third number is a zero, it indicates an open borehole where no PVC monitoring well has been installed. In addition, several leachate purge wells have been installed at the site. Purge wells are denoted with a “P” in front of the purge well number (e.g. P1).

Monitoring well construction details including location coordinates and elevations are summarized in Appendix A.1. Appendix A.1 also lists the status of all the groundwater monitoring wells at the site together with comments describing any problems associated with each monitoring well. Monitoring wells are categorized as active (fully functioning) or inactive (non-functioning or destroyed). In 2020/21, there were 129 active groundwater monitoring wells at 75 locations in the vicinity of Hartland Landfill, of which eight (8) are active purge wells and 13 are landfill gas wells that were regularly used to measure leachate levels in Phase 1. South purge well P1 was replaced and recommissioned in November 2018.

The methods used to develop and sample each monitoring well are indicated in Appendix A.2. The Standard Operating Practice (SOP) for groundwater sampling is periodically updated. A variety of techniques are used depending on the depth of the monitoring well, the groundwater level in the monitoring well, and the permeability of the surrounding geologic formation. A number of dedicated submersible pumps have been installed by CRD in the deeper monitoring wells and open boreholes at the landfill to facilitate more efficient sampling and have resulted in improved data quality. Sampling events were scheduled to avoid heavy rainfall events to prevent skewing data due to sample dilution.

In 2020/21, the monitoring program consisted of the following:

- Groundwater level measurements four times per year.
- Continuous water level monitoring with pressure transducers at north end of the Phase 2 landfill.
- Continuous water level monitoring with pressure transducers at the north and south purge well systems.
- Continuous water level monitoring with a pressure transducer east of Phase 1 landfill and Hartland North.
- Quarterly monitoring of wells near the property boundary and key locations to assess the effectiveness of leachate containment.
- Semi-annual monitoring stations with relatively stable long-term historical data.
- Annual sampling of 19 residential wells, including 14 wells within a 2 km radius of the landfill and five (5) domestic wells located north of the Hartland North Pad.
- Quarterly sampling of surface water stations at property boundary points and other selected monitoring locations.
- Quarterly testing of leachate discharge for trace organic compounds.
- Monthly testing of leachate for conventional parameters and metals at the point of discharge and select locations within the leachate collection system.
- Quarterly testing for select emerging contaminants at the Hartland Valve Chamber.

As in previous years, CRD staff carried out surface water, groundwater and leachate sampling and groundwater level measurements at the locations shown in tables in Appendix B and on figures in Appendix E. Further information on the monitoring program field procedures is contained in the CRD Monitoring Procedure Manual.

The CRD employs a continuous improvement and quality assurance program. As part of this work, field methods were updated, and written protocols were updated in 2017. Additionally, AECOM evaluated the sampling network and schedule (AECOM 2016b). The review recommended modifications to the groundwater, surface water and leachate monitoring program, which were implemented for the 2019/20 monitoring year.

3.2 Quality Assurance

In 2020/21, routine surface water, groundwater and domestic well water laboratory analyses were performed by Bureau Veritas Laboratory (BV) in Victoria and Burnaby, British Columbia. BV also analyzed leachate chemistry samples, which included analysis of trace organic compounds.

A quality assurance program is in place assess the validity of the chemical analysis results. This has involved the submission of randomly selected field replicate, trip blank and "reference" Victoria municipal water samples to the laboratory for analysis. Table 3-1 and Table 3-2 present quality assurance of groundwater and surface water, respectively. There were 20 surface water and 40 groundwater samples submitted in duplicate between April 2020 and March 2021. Table 3-3 presents quality assurance results for the Hartland Valve Chamber. In this report, each set of replicates were taken from the same source and/or site, and under the same conditions. In all cases, the field replicates were submitted 'blind' to the laboratory. This resulted in duplicate sampling frequencies of 13% (40/298 samples) for groundwater, 22% (20/88 samples) for surface water, 36% (4/11 samples) for the Hartland Valve Chamber compliance point, and 6.4% (4/62 samples) for the overall leachate sampling program. Overall, approximately 14% (64/448) of samples were duplicated, which exceeded the targeted duplicate sampling rate of 10%.

Submission of duplicate samples provides an estimate of total uncertainty associated with the data. Typically, one duplicate sample is collected for every ten samples (10%) as part of quality control measures. Total uncertainty is the variability (precision plus bias) associated with the sample collection and sample analyses. In addition, the Limit of Quantification (LOQ) should be considered because the precision of analytical results just above the Method of Detection Limit (MDL) are known to be poor. The LOQ is the range of concentrations between the MDL and five times the MDL for each parameter, as outlined in Part E of the 2013 British Columbia Field Sampling Manual.

The CRD has used several different statistical methods for checking the precision and accuracy of its monitoring program. The CRD uses the relative percent difference (RPD) method, as recommended by ENV, which uses duplicate analyses to determine precision of the analytical results. This method expresses percent of difference between two values as the ratio of their absolute difference to the average value of the sample and the duplicate, as shown in the equation below:

$$RPD = [(|x_1 - x_2|)/((x_1 + x_2)/2)]$$

Where:

x_1 is the initial sample concentration (mg/L)
x_2 is the duplicate sample concentration (mg/L)

Parameters with RPD values exceeded RPD criteria should be interpreted with caution. Alarm limits were set as per the BC Ministry of Environment Environmental Laboratory Manual. Duplicate samples with RPD values within 30% for general inorganics and metals and within 45% for organic compounds are considered to meet the Data Quality Objectives (DQOs).

3.2.1 Groundwater and Surface Water

Table 3-1 and Table 3-2 present calculated RPD values for replicate groundwater and surface water samples collected near the landfill. In both tables, RPD values were highlighted with an "a" if they were above 30% and it was noted with a "b" if one or more of the parameter concentrations were below the LOQ.

Table 3-1 indicates the following for groundwater samples collected at the landfill in 2020/21:

- A total of 40 duplicate samples were collected and analyzed for 45 parameters. Fourteen (14) samples had RPD values greater than 30% when all concentrations were above the LOQ.
- RPD values for ammonia (1 sample), dissolved aluminum (2 samples), barium (1 sample), cadmium (1 sample), copper (5 samples), iron (4 samples), lead (2 samples), nickel (3 samples) and zinc (8 samples) were greater than the 30% target when all concentrations were above the LOQ.
- Groundwater field replicates showed good precision for most parameters and the majority of RPD values for the 2020/21 monitoring year were within the acceptable range, except for dissolved zinc. Similar to 2019/20, 20% of the duplicate samples had dissolved zinc concentrations above the alarm limit of 30%, indicating potential contamination during the sample handling or filtration process. Dissolved copper also had RPD issue in 2019/20, but showed improved precision in 2020/21. It is suspected that the contamination may be introduced by the Waterra® 0.45-micron water filters or through

the sample handling process. Travel blanks and field blanks should be collected to confirm environmental samples have not been contaminated during the collection process.

- Overall, groundwater quality data is acceptably precise for the purpose of this report. However, dissolved zinc concentrations should be interpreted with caution. Field blanks should be collected to further investigate/evaluate if the filters are the source of metal contamination. It is recommended that in-line filters be flushed with sample water for at least 30 seconds (or 500 mL) to remove any trace metal particulate in advance of sampling.

Table 3-2 indicates the following for surface water samples collected at the landfill in 2020/21:

- A total of 20 duplicate samples were collected and analyzed for 40 parameters. Eleven (11) samples had parameters with RPD values greater than 30% when all concentrations were above the LOQ for a total of 41 out of 800 analyses.
- RPD values for TSS (2 samples), total aluminum (5 samples), total cobalt (4 samples), total copper (1 sample), total iron (6 samples), total lead (2 samples), total manganese (3 samples), total ammonia (2 samples), dissolved arsenic (1 sample), dissolved copper (4 samples), dissolved lead (5 samples) and dissolved zinc (3 samples) were greater than 30% on at least one occasion when all concentrations were above the LOQ.
- Overall, surface water field replicates showed good precision for most parameters and the majority of RPD values for the 2020/21 monitoring year were within the acceptable range. Some of the high RPD values (i.e. iron, aluminum, etc.) may be contributed by the disturbance of the sediments/low flow condition during the drier months. The majority of duplicate samples had RPD values for dissolved copper and zinc below the alarm limit (30%), indicating overall improved sampling handling procedures when compared to previous years.

3.2.2 Leachate

Four (4) duplicate leachate samples were collected during April 2020, September 2020, November 2020 and February 2021 events, and analyzed for various parameters. As shown in Table 3-3, two (2) samples and two (2) parameters had calculated RPD values that exceeded alarm limits when concentrations in both replicates were above the LOQ.

Given that landfill leachate is a complex analytical matrix, leachate field replicates showed good precision for most parameters and the majority of RPD values for the 2020/21 monitoring year were within the acceptable range. Leachate quality data is acceptably precise for the purposes of this report.

3.3 Statistical Assessment of Temporal Trends

Seasonal variability in water quality parameters can mask the overall trend of parameters in groundwater, surface water and leachate quality data. To better understand long-term trends in water quality, a non-parametric statistical analysis has been employed to evaluate trends in water quality data at Hartland Landfill since 2005. This test, known as the Mann-Kendall test, was used to evaluate temporal trends in contaminant concentrations. The analysis of trends is intended to promote early detection of statistically significant trends (at the 95% confidence level) in groundwater chemistry at each sampling location. This method does not require normally distributed data and allows for missing data (non-detects) and irregularly spaced measurement periods in the dataset. Non-detect measurements are assigned the value of the detection limit for the purposes of the statistical analysis. Water and leachate quality data at Hartland Landfill often includes concentrations below detection limits and samples are not always collected at regularly spaced intervals. The hypothesis of both increasing and decreasing trends are tested at the same time. The Mann-Kendall test can be used for virtually any water quality or leachate parameter and provides a quantitative means of determining if a given parameter is changing (increasing or decreasing) in a statistically significant manner over time.

A statistical analysis was conducted utilizing data collected between April 2016 and March 2021. A five-year time frame is consistent with the time interval over which most water quality data is plotted within this report and is anticipated to provide a good balance between seasonal variation and the detection of long-term trends in water quality. This analysis is used to identify areas of the landfill where water quality is degrading and/or improving. The time frame over which trend analysis is conducted should be carefully evaluated in conjunction with management and operational changes.

All field and lab replicates were removed from the data set prior to the analysis. Conductivity, ammonia and chloride concentrations were tested for trends using the Mann-Kendall test as they are considered indicators of leachate at Hartland Landfill. Trends in sulphate and nitrate concentrations were also evaluated because high concentrations have been observed in relation to aggregate generated and used at the site.

The analysis was conducted using data collected from a total of 79 groundwater monitoring wells (33 compliance and 46 routine), 8 leachate purge wells, 21 surface water monitoring stations (5 compliance and 16 routine), and the leachate compliance monitoring station (Hartland Valve Chamber). The rest of locations are either inactive or do not have sufficient data to run Mann-Kendall analysis. The results of the statistical trend analysis for groundwater, surface water and leachate are provided in Appendices G-1, G-2 and G-3, respectively, and are discussed in relevant sections of this report.

Table 3-1. Groundwater Quality QA/QC - Relative Percent Difference 2020-2021

| | | |

Table 3-1. Groundwater Quality QA/QC - Relative Percent Difference 2020-2021

| | | |

Table 3-1. Groundwater Quality QA/QC - Relative Percent Difference 2020-2021

AECOM

| | | |

Table 3-1. Groundwater Quality QA/QC - Relative Percent Difference 2020-2021

						Chromium		Cobalt		Copper		Hardness (As Caco3)		Iron		Lead		Lithium		Magnesium		Manganese		Molybdenum		Ammonia		Nitrite		Nitrate		Nitrite + Nitrate		Nickel		Phosphorus		Potassium	
				MAX Acceptable RPD		30%		30%		30%		30%		30%		30%		30%		30%		30%		30%		30%		30%		30%		30%		30%		30%		30%	
				Method Detection Limit (MDL)		0.1		0.01		0.05		0.5		1		0.005		0.5		0.05		0.05		0.05		0.015		0.005		0.02		0.02		0.02		2		0.05	
				Limit of Quantitation (5 x MDL)		0.5		0.05		0.25		2.5		5		0.025		2.5		0.25		0.25		0.25		0.075		0.025		0.1		0.1		0.1		10		0.25	
				Parameter		Chromium		Cobalt		Copper		Hardness (As Caco3)		Iron		Lead		Lithium		Magnesium		Manganese		Molybdenum		Ammonia		Nitrite		Nitrate		Nitrite + Nitrate		Nickel		Phosphorus		Potassium	
				Fraction		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS	
				Unit		µg/L		µg/L		µg/L		mg/L		µg/L		µg/L		µg/L		mg/L		µg/L		µg/L		mg/L		mg/L		mg/L		mg/L		µg/L		µg/L		mg/L	
Station	Sample Type	Compliance Well (Y/N)?	Date Sampled	Comments																																	
39-1-1	FR1	Y	21/05/2020	Clear, colourless	<	0.1		0.015		0.207		112.		< 1.		< 0.005		< 0.5		3.51		0.157		2.07		< 0.015		< 0.005		0.021		0.021		0.108		3.5		0.258	
39-1-1	FR2		21/05/2020		<	0.1		0.017		1.14		115.		2.		0.028 2		< 0.5		3.55		0.17		2.04		< 0.015		< 0.005		0.023		0.023		0.114		3.8		0.261	
39-1-1	FRM		21/05/2020	Mean of duplicates	<	0.1		0.016		0.673 5		113.5		1.5		0.016 6		< 0.5		3.53		0.163 5		2.055		< 0.015		< 0.005		0.022		0.022		0.111		3.65		0.259 5	
39-1-1	RPD		21/05/2020	RPD of duplicates	---	0.0%	---	12.5%	---	**138.5%**	b	2.6%	---	66.7%	b	139.8%	b	0.0%	---	1.1%	---	8.0%	---	1.5%	---	0.0%	---	0.0%	---	9.1%	---	9.1%	---	5.4%	---	8.2%	---	1.2%	---
39-1-1	FR1	Y	25/02/2021	Clear and colourless	<	0.1		0.019 3		0.168		111.		4.4		0.027 7		< 0.5		3.6		0.066		2.01		0.029		< 0.005		0.059		0.059		0.101		2.3		0.289	
39-1-1	FR2		25/02/2021		<	0.1		0.019 2		0.186		110.		3.2		< 0.005		< 0.5		3.58		< 0.05		2.08		0.031		< 0.005		0.056		0.056		0.092		3.		0.285	
39-1-1	FRM		25/02/2021	Mean of duplicates	<	0.1		0.019 25		0.177		110.5		3.8		0.016 35		< 0.5		3.59		0.058		2.045		0.03		< 0.005		0.057 5		0.057 5		0.096 5		2.65		0.287	
39-1-1	RPD		25/02/2021	RPD of duplicates	---	0.0%	---	0.5%	---	10.2%	---	0.9%	---	31.6%	b	138.8%	b	0.0%	---	0.6%	---	27.6%	---	3.4%	---	6.7%	---	0.0%	---	5.2%	---	5.2%	---	9.3%	---	26.4%	---	1.4%	---
39-1-1	FR1	Y	23/09/2020	Clear and colourless	<	0.1		0.017 3		0.236		115.		1.4		0.009 6		< 0.5		3.57		0.169		2.06		0.018		< 0.005		< 0.02		< 0.02		0.146		4.8		0.287	
39-1-1	FR2		23/09/2020		<	0.1		0.019 5		0.296		118.		2.1		0.014 7		< 0.5		3.59		0.153		2.07		< 0.015		< 0.005		< 0.02		< 0.02		0.145		5.4		0.289	
39-1-1	FRM		23/09/2020	Mean of duplicates	<	0.1		0.018 4		0.266		116.5		1.75		0.012 15		< 0.5		3.58		0.161		2.065		0.016 5		< 0.005		< 0.02		< 0.02		0.145 5		5.1		0.288	
39-1-1	RPD		23/09/2020	RPD of duplicates	---	0.0%	---	12.0%	---	22.6%	---	2.6%	---	40.0%	b	42.0%	b	0.0%	---	0.6%	---	9.9%	---	0.5%	---	18.2%	---	0.0%	---	0.0%	---	0.0%	---	0.7%	---	11.8%	---	0.7%	---
39-1-1	FR1	Y	18/11/2020	Clear and colourless	<	0.1		0.023 2		0.224		116.		2.4		0.008 7		< 0.5		3.57		< 0.05		1.75		0.023		< 0.005		0.065		0.065		0.144		2.6		0.251	
39-1-1	FR2		18/11/2020		<	0.1		0.023 8		0.258		116.		4.		0.008 7		< 0.5		3.58		< 0.05		1.76		< 0.015		< 0.005		0.063		0.063		0.143		2.2		0.249	
39-1-1	FRM		18/11/2020	Mean of duplicates	<	0.1		0.023 5		0.241		116.		3.2		0.008 7		< 0.5		3.575		< 0.05		1.755		0.019		< 0.005		0.064		0.064		0.143 5		2.4		0.25	
39-1-1	RPD		18/11/2020	RPD of duplicates	---	0.0%	---	2.6%	---	14.1%	---	0.0%	---	50.0%	b	0.0%	---	0.0%	---	0.3%	---	0.0%	---	0.6%	---	42.1%	---	b	0.0%	---	3.1%	---	3.1%	---	0.7%	---	16.7%	---	0.8%	---
41-1-1	FR1	Y	26/05/2020	Clear, colourless	<	0.1		0.051 6		0.72		222.		7.6		0.009 9		< 0.5		8.1		1.46		< 0.015		< 0.005		< 0.02		< 0.02		0.086		3.		1.16		0.261	
41-1-1	FR2		26/05/2020		<	0.1		0.053 1		0.258		217.		6.1		< 0.005		< 0.5		8.13		1.46		< 0.015		< 0.005		< 0.02		< 0.02		0.081		3.5		1.17		0.261	
41-1-1	FRM		26/05/2020	Mean of duplicates	<	0.1		0.052 35		0.489		219.5		6.85		0.007 45		< 0.5		8.115		1.46		< 0.015		< 0.005		< 0.02		< 0.02		0.083 5		3.25		1.165		0.261	
41-1-1	RPD		26/05/2020	RPD of duplicates	---	0.0%	---	2.9%	---	**94.5%**	a	2.3%	---	21.9%	---	65.8%	b	0.0%	---	0.4%	---	0.6%	---	0.0%	---	0.0%	---	0.0%	---	0.0%	---	0.0%	---	6.0%	---	15.4%	---	0.9%	---
41-1-1	FR1	Y	28/09/2020	Clear and colourless	<	0.1		0.143		0.326		201.		36.8		< 0.005		< 0.5		7.51		505.		2.03		0.027		< 0.005		< 0.02		0.188		< 2.		1.02		0.792	
41-1-1	FR2		28/09/2020		<	0.1		0.145		0.348		207.		38.		0.005 6		< 0.5		7.72		504.		2.01		0.028		< 0.005		< 0.02		< 0.02		0.198		2.1		1.02	
41-1-1	FRM		28/09/2020	Mean of duplicates	<	0.1		0.144		0.337		204.		37.4		0.005 3		< 0.5		7.615		504.5		2.02		0.027 5		< 0.005		< 0.02		< 0.02		0.193		2.05		1.02	
41-1-1	RPD		28/09/2020	RPD of duplicates	---	0.0%	---	1.4%	---	6.5%	---	2.9%	---	11.3%	---	0.0%	---	0.0%	---	2.8%	---	0.2%	---	1.0%	---	3.6%	---	0.0%	---	0.0%	---	0.0%	---	5.2%	---	4.9%	---	0.0%	---
41-1-1	FR1	Y	13/11/2020	Clear and colourless	<	0.1		0.175		0.184		200.		15.3		0.012 5		< 0.5		7.24		418.		2.45		0.039		< 0.005		< 0.02		< 0.02		0.117		2.4		0.812	
41-1-1	FR2		13/11/2020		<	0.1		0.166		0.208		201.		15.		0.006 7		< 0.5		7.26		425.		2.49		0.054		< 0.005		< 0.02		< 0.02		0.12		2.1		0.814	
41-1-1	FRM		13/11/2020	Mean of duplicates	<	0.1		0.170 5		0.196		200.5		15.15		0.009 6		< 0.5		7.25		421.5		2.47		0.046 5		< 0.005		< 0.02		< 0.02		0.118 5		2.25		0.813	
41-1-1	RPD		13/11/2020	RPD of duplicates	---	0.0%	---	5.3%	---	12.2%	---	0.5%	---	2.0%	---	60.4%	b	0.0%	---	0.3%	---	1.7%	---	1.6%	---	32.3%	---	b	0.0%	---	0.0%	---	0.0%	---	2.5%	---	13.3%	---	0.2%	---
41-1-1	FR1	Y	03/03/2021	Slightly silty and slightly brow	<	0.1		0.046		0.158		193.		8.5		< 0.005		< 0.5		7.09		66.5		1.5		0.055		< 0.005		0.026		0.026		0.059		< 2.		0.804	
41-1-1	FR2		03/03/2021		<	0.1		0.048 1		0.155		196.		9.6		< 0.005		< 0.5		6.95		69.1		1.5		0.045		< 0.005		0.026		0.026		0.094		< 2.		0.792	
41-1-1	FRM		03/03/2021	Mean of duplicates	<	0.1		0.047 05		0.156 5		194.5		9.05		< 0.005		< 0.5		7.02		67.8		1.5		0.05		< 0.005		0.026		0.026		0.076 5		< 2.		0.798	
41-1-1	RPD		03/03/2021	RPD of duplicates	---	0.0%	---	4.5%	---	1.9%	---	1.5%	---	12.2%	---	0.0%	---	0.0%	---	2.0%	---	3.8%	---	0.0%	---	20.0%	---	0.0%	---	0.0%	---	0.0%	---	45.8%	---	b	0.0%	---	1.5%	---
42-1-1	FR1	Y	26/05/2020	Clear, colourless	<	0.1		0.059 2		0.126		258.		702.		< 0.005		< 0.5		5.59		166.		0.198		0.02		< 0.005		< 0.02		< 0.02		0.101		7.5		0.924	
42-1-1	FR2		26/05/2020		<	0.18		0.063 7		0.347		258.		703.		< 0.005		< 0.5		5.48		164.		0.198		0.016		< 0.005		< 0.02		< 0.02		0.143		7.7		0.914	
42-1-1	FRM		26/05/2020	Mean of duplicates		0.175		0.061 45		0.236 5		258.		702.5		< 0.005		< 0.5		5.535		165.		0.198		0.018		< 0.005		< 0.02		< 0.02		0.122		7.6		0.919	
42-1-1	RPD		26/05/2020	RPD of duplicates	---	5.7%	---	7.3%	---	**93.4%**	b	0.0%	---	0.1%	---	0.0%	---	0.0%	---	2.0%	---	1.2%	---	0.0%	---	22.2%	---	0.0%	---	0.0%	---	0.0%	---	**34.4%**	a	2.6%	---	1.1%	---
42-1-1	FR1	Y	28/09/2020	Clear and colourless		0.18		0.046 8		0.102		266.		677.		< 0.005		< 0.5		6.06		162.		0.285		< 0.015		0.008		< 0.02		< 0.02		0.133		7.6		0.949	
42-1-1	FR2		28/09/2020			0.18		0.048 3		0.078		282.		694.		0.007 7		< 0.5		6.14		164.		0.292		0.078		0.008 1		< 0.02		< 0.02		0.129		6.4		0.96	
42-1-1	FRM		28/09/2020	Mean of duplicates		0.18		0.047 55		0.09		274.		685.5		0.006 35		< 0.5		6.1		163.		0.288 5		0.046 5		0.008 05		< 0.02		< 0.02		0.131		7.		0.954 5	
42-1-1	RPD		28/09/2020	RPD of duplicates	---	0.0%	---	3.2%	---	26.7%	---	5.8%	---	2.5%	---	42.5%	b	0.0%	---	1.3%	---	1.2%	---	2.4%	---	135.5%	---	b	1.2%	---	0.0%	---	0.0%	---	3.1%	---	17.1%	---	1.2%	---
42-1-1	FR1	Y	10/11/2020	Clear and colourless		0.26		0.104		0.283		280.		842.		0.080 7		< 0.5		6.25		169.		0.215		0.11		< 0.005		< 0.02		< 0.02		0.146		5.1		1.09	
42-1-1	FR2		10/11/2020			0.24		0.096 8		0.279		273.		838.		0.072 7		< 0.5		6.27		169.		0.246		0.1		< 0.005		< 0.02		< 0.02		0.146		5.1		1.09	
42-1-1	FRM		10/11/2020	Mean of duplicates		0.25		0.100 4		0.281		276.5		840.		0.076 7		< 0.5		6.26		169.		0.230 5		0.105		< 0.005		< 0.02		< 0.02		0.146		5.1		1.09	
42-1-1	RPD		10/11/2020	RPD of duplicates	---	8.0%	---	7.2%	---	1.4%	---	2.5%	---	0.5%	---	10.4%	---	0.0%	---	0.3%	---	0.0%	---	13.4%	---	9.5%	---	0.0%	---	0.0%	---	0.0%	---	0.0%	---	0.0%	---	0.0%	---
42-1-1	FR1	Y	11/02/2021	Clear and colourless		0.17		0.061 5		0.115		232.		711.		< 0.005 9		< 0.5		5.25		155.		0.159		0.097		< 0.005		< 0.02		< 0.02		0.136		8.2		0.928	
42-1-1	FR2		11/02/2021			0.17		0.069 2		0.085		236.		735.		0.005 2		< 0.5		5.26		154.		0.168		0.057		< 0.005		< 0.02		< 0.02		0.117		8.3		0.937	
42-1-1	FRM		11/02/2021	Mean of duplicates		0.17		0.065 35		0.1		234.		723.		0.005 55		< 0.5		5.255		154.5		0.163 5		0.077		< 0.005		< 0.02		< 0.02		0.126 5		8.25		0.932 5	
42-1-1	RPD		11/02/2021	RPD of duplicates	---	0.0%	---	11.8%	---	30.0%	---	1.7%	---	3.3%	---	12.6%	---	0.0%	---	0.2%	---	0.6%	---	5.5%	---	51.9%	---	b	0.0%	---	0.0%	---	0.0%	---	15.0%	---	1.2%	---	1.0%	---
71-1-1	FR1	Y	07/05/2020	Clear, colourless	<	0.1		0.069 3		4.44		147.		29.7		0.109		< 0.5		6.57		63.9		0.368		< 0.015		< 0.005		< 0.02		< 0.02		0.312		13.9		0.25	
71-1-1	FR2		07/05/2020		<	0.1		0.072 6		< 0.05		145.		16.4		< 0.005		< 0.5		6.42		63.1		0.344		< 0.015		< 0.005		< 0.02		< 0.02		0.243		12.		0.244	
71-1-1	FRM		07/05/2020	Mean of duplicates	<	0.1		0.070 95		2.245		146.		23.05		0.057		< 0.5		6.495		63.5		0.356		< 0.015		< 0.005		< 0.02		< 0.02		0.277 5		12.95		0.247	
71-1-1	RPD		07/05/2020	RPD of duplicates	---	0.0%	---	4.7%	---	195.5%	---	1.4%	---	**57.7%**	a	182.5%	b	0.0%	---	2.3%	---	1.3%	---	6.7%	---	0.0%	---	0.0%	---	0.0%	---	0.0%	---	24.9%	---	14.7%	---	2.4%	---
71-1-1	FR1	Y	04/09/2020	Clear and colourless	<	0.1		0.082 1		0.121		174.		16.2		< 0.005		< 0.5		7.68		78.6		0.358		0.018		< 0.005		0.026		0.026		0.308		7.4		0.247	
71-1-1	FR2		04/09/2020		<	0.1		0.083 9		0.087		173.		15.8		< 0.005		< 0.5		7.67		77.7		0.351		< 0.015		< 0.005		0.028		0.028		0.324		9.6		0.247	
71-1-1	FRM		04/09/2020	Mean of duplicates	<	0.1		0.083		0.104		173.5		16.		< 0.005		< 0.5		7.675		78.15		0.354 5		0.016 5		< 0.005		0.027		0.027		0.316		8.5		0.247	
71-1-1	RPD		04/09/2020	RPD of duplicates	---	0.0%	---	2.2%	---	**32.7%**	b	0.6%	---	2.5%	---	0.0%	---	0.0%	---	0.1%	---	1.2%	---	2.0%	---	18.2%	---	0.0%	---	7.4%	---	7.4%	---	5.1%	---	25.9%	---	0.0%	---
71-1-1	FR1	Y	05/11/2020	Clear and colourless	<	0.1		0.086 9		0.098		171.		25.9		< 0.005		< 0.5		7.69		101.		0.373		< 0.015		< 0.005		< 0.02		< 0.02		0.322		7.8		0.228	
71-1-1	FR2		05/11/2020		<	0.1		0.083 2		0.092		174.		25.7		< 0.005		< 0.5		7.59		103.		0.399		< 0.015		< 0.005		< 0.02		< 0.02		0.301		7.8		0.229	
71-1-1	FRM		05/11/2020	Mean of duplicates	<	0.1		0.085 05		0.095		172.5		25.8		< 0.005		< 0.5		7.64		102.		0.386		< 0.015		< 0.005		< 0.02		< 0.02		0.311 5		7.8		0.228 5	
71-1-1	RPD		05/11/2020	RPD of duplicates	---	0.0%	---	6.3%	---	4.4%	---	1.7%	---	0.8%	---	0.0%	---	0.0%	---	1.3%	---	2.0%	---	6.7%	---	0.0%	---	0.0%	---	0.0%	---	0.0%	---	6.7%	---	0.0%	---	0.4%	---
71-1-1	FR1	Y	25/02/2021	Clear and colourless	<	0.1		0.080 1		0.05		145.		16.6		< 0.005		< 0.5		6.64		87.1		0.395		0.018		< 0.005		< 0.02		< 0.02		0.303		11.4		0.258	
71-1-1	FR2		25/02/2021		<	0.1		0.075 7		0.051		146.		17.3		< 0.005		< 0.5		6.57		86.2		0.398		0.039		< 0.005		< 0.02		< 0.02		0.314		10.8		0.254	
71-1-1	FRM		25/02/2021	Mean of duplicates	<	0.1		0.077 9		0.050 5		145.5		16.95		< 0.005		< 0.5		6.605		86.65		0.396 5		0.028 5		< 0.005		< 0.02		< 0.02		0.308 5		11.1		0.256	
71-1-1	RPD		25/02/2021	RPD of duplicates	---	0.0%	---	5.6%	---	2.0%	---	0.7%	---	4.1%	---	0.0%	---	0.0%	---	1.1%	---	1.0%	---	0.8%	---	73.7%	---	b	0.0%	---	0.0%	---	0.0%	---	3.6%	---	5.4%	---	1.6%	---
72-1-1	FR1	Y	06/05/2020	Clear, colourless	<	0.1		0.050 1		< 0.05		266.		376.		< 0.005		0.52		13.8		124.		0.621		< 0.015		< 0.005		< 0.02		< 0.02		1.87		12.7		0.239	
72-1-1	FR2		06/05/2020		<	0.1		0.060 6		< 0.05		268.		384.		< 0.005		< 0.5		13.7		123.		0.614		< 0.015		< 0.005		< 0.02		< 0.02		1.73		12.8		0.236	
72-1-1	FRM		06/05/2020	Mean of duplicates	<	0.1		0.055 35		< 0.05		267.		380.		< 0.005		0.51		13.75		123.5		0.617 5		< 0.015		< 0.005		< 0.02		< 0.02		1.8		12.75		0.237 5	
72-1-1	RPD		06/05/2020	RPD of duplicates	---	0.0%	---	19.0%	---	0.0%	---	0.7%	---	2.1%	---	0.0%	---	3.9%	---	0.7%	---	0.8%	---	1.1%	---	0.0%	---	0.0%	---	0.0%	---	0.0%	---	7.8%	---	0.8%	---	1.3%	---
72-1-1	FR1	Y	04/09/2020	Clear and colourless	<	0.1		0.097 7		0.089		261.		379.		< 0.005		< 0.5		13.2		115.		0.62		0.073		< 0.005		< 0.02		< 0.02		1.74		7.		0.237	
72-1-1	FR2		04/09/2020		<	0.1		0.093 2		< 0.05		269.		389.		< 0.005		< 0.5		13.4		117.		0.657		0.06		< 0.005		< 0.02		< 0.02		1.82		5.5		0.235	
72-1-1	FRM		04/09/2020	Mean of duplicates	<	0.1		0.095 45		0.069 5		265.		384.		< 0.005		< 0.5		13.3		116.		0.638 5		0.066 5		< 0.005		< 0.02		< 0.02		1.78		6.25		0.236	
72-1-1	RPD		04/09/2020	RPD of duplicates	---	0.0%	---	4.7%	---	56.1%	---	3.0%	---	2.6%	---	0.0%	---	0.0%	---	1.5%	---	1.7%	---	5.8%	---	19.5%	---	0.0%	---	0.0%	---	0.0%	---	4.5%	---	24.0%	---	0.8%	---
72-1-1	FR1	Y	04/11/2020	Clear and colourless	<	0.1		0.044 7		< 0.05		269.		375.		< 0.005		< 0.5		13.7		128.		0.699		0.018		< 0.005		< 0.02		< 0.02		1.87		9.2		0.258	
72-1-1	FR2		04/11/2020		<	0.1		0.041 4		< 0.05		271.		381.		< 0.005		< 0.5		13.3		124.		0.691		< 0.015		< 0.005		< 0.02		< 0.02		1.76		9.1		0.251	
72-1-1	FRM		04/11/2020	Mean of duplicates	<	0.1		0.043 05		< 0.05		270.		378.		< 0.005		< 0.5		13.5		126.		0.695		0.016 5		< 0.005		< 0.02		< 0.02		1.815		9.15		0.254 5	
72-1-1	RPD		04/11/2020	RPD of duplicates	---	0.0%	---	7.7%	---	0.0%	---	0.7%	---	1.6%	---	0.0%	---	0.0%	---	3.0%	---	3.2%	---	1.2%	---	18.2%	---	0.0%	---	0.0%	---	0.0%	---	6.1%	---	1.1%	---	2.8%	---
72-1-1	FR1	Y	25/02/2021	Clear and colourless	<	0.2		0.07		< 0.1		276.		394.		< 0.01		< 1.		14.3		126.		0.69		0.024		< 0.005		< 0.02		< 0.02		1.76		8.1		0.28	
72-1-1	FR2		25/02/2021		<	0.2		0.044		< 0.1		272.		380.		< 0.01		< 1.		14.		122.		0.67		0.029		< 0.005		< 0.02		< 0.02		1.76		7.4		0.26	
72-1-1	FRM		25/02/2021	Mean of duplicates	<	0.2		0.057		< 0.1		274.		387.		< 0.01		< 1.		14.15		124.		0.68		0.026 5		< 0.005		< 0.02		< 0.02		1.76		7.75		0.27	
72-1-1	RPD		25/02/2021	RPD of duplicates	---	0.0%	---	45.6%	---	0.0%	---	1.5%	---	3.6%	---	0.0%	---	0.0%	---	2.1%	---	3.2%	---	2.9%	---	18.9%	---	0.0%	---	0.0%	---	0.0%	---	0.0%	---	9.0%	---	7.4%	---
73-1-1	FR1	COMPLIANCE	04/11/2020	Slightly silty and colourless	<	0.1		0.195		0.283		215.		< 1.		0.018 6		< 0.5		11.3		97.3		0.961		0.015		0.006 9		0.045		0.052		0.797		11.1		0.396	
73-1-1	FR2	COMPLIANCE	04/11/2020		<	0.1		0.19		0.326		213.		< 1.		0.018 9		< 0.5		11.2		97.4		0.974		0.015		0.013 2		0.043		0.056		0.792		10.6		0.391	
73-1-1	FRM	COMPLIANCE	04/11/2020	Mean of duplicates	<	0.1		0.192 5		0.304 5		214.		< 1.		0.018 75		< 0.5		11.25		97.35		0.967 5		0.015		0.010 05		0.044		0.054		0.794 5		10.85		0.393 5	
73-1-1	RPD	COMPLIANCE	04/11/2020	RPD of duplicates	---	0.0%	---	2.6%	---	14.1%	---	0.9%	---	0.0%	---	1.6%	---	50.0%	---	0.9%	---	0.1%	---	1.3%	---	0.0%	---	62.7%	---	4.5%	---	7.4%	---	0.6%	---	4.6%	---	1.3%	---
73-2-1	FR1	COMPLIANCE	04/09/2020	Clear and colourless	<	0.1		0.088 2		0.409		221.		20.6		< 0.005		< 0.5		11.5		56.		0.352		0.033		< 0.005		< 0.02		< 0.02		0.352		3.1		0.362	
73-2-1	FR2	COMPLIANCE	04/09/2020		<	0.1		0.099 2		0.484		222.		33.8		0.036 2		< 0.5		11.6		57.2		1.36		0.019		< 0.005		< 0.02		< 0.02		1.86		4.		0.369	
73-2-1	FRM	COMPLIANCE	04/09/2020	Mean of duplicates	<	0.1		0.093 7		0.446 5		221.5		27.2		0.020 6		< 0.5		11.55		56.6		1.355		0.026		< 0.005		< 0.02		< 0.02		1.106		3.55		0.365 5	
73-2-1	RPD	COMPLIANCE	04/09/2020	RPD of duplicates	---	0.0%	---	11.7%	---	16.8%	---	0.5%	---	**48.5%**	a	151.5%	b	50.0%	---	0.9%	---	2.1%	---	0.7%	---	53.8%	---	b	0.0%	---	0.0%	---	0.0%	---	**136.3%**	a	25.4%	---	1.9%	---

Notes:

SS Single sample
FR1 Field replicate 1
FR2 Field replicate 2
FRM Average of field replicates
RPD Relative percent difference of field replicates

na - Not applicable, some replicates less than the detection limit.

a *- Coefficient of variation greater than 30% and all replicates greater than the limit of quar*

b *- Coefficient of variation greater than 30% with some replicates less than the limit of qua*

Table 3-1. Groundwater Quality QA/QC - Relative Percent Difference 2020-2021

| | | |

Table 3-1. Groundwater Quality QA/QC - Relative Percent Difference 2020-2021

| | | |

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2020-2021

| | | |

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2020-2021

			MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%
			Method Detection Limit (MDL)	0.01	1	0.1	3	0.02	10	0.005	1	0.01	0.05
			Limit of Quantitation (5 x MDL)	0.05	5	0.5	15	0.1	50	0.025	5	0.05	0.25
			Parameter	pH	Specific Conductivity - 25°C.	Temperature	Aluminum	Arsenic	Boron	Cadmium	Chloride	Cobalt	Copper
			Fraction	TOT	TOT	TOT	TOT	TOT	TOT	TOT	DIS	TOT	TOT
			Unit	pH	µS/cm	°C	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Date Sampled										
SW-N-42S1	FR1	Y	02-Dec-2020	6.82	326.	6.	410.	0.211	62.	0.017 7	10.	0.63	1.9
SW-N-42S1	FR2		02-Dec-2020	6.82	326.	6.	21.4	0.093	63.	< 0.005	10.	0.084	1.54
SW-N-42S1	FRM		02-Dec-2020	6.82	326.	6.	215.7	0.152	62.5	< 0.011 35	10.	0.357	1.72
SW-N-42S1	RPD		02-Dec-2020	0.0%	0.0%	0.0%	180.2% a	77.6%	1.6%	111.9%	0.0%	152.9% a	20.9%
SW-N-16	FR1	Y	01-Dec-2020	6.44	331.	6.4	36.3	0.254	61.	0.006 8	6.8	0.263	8.18
SW-N-16	FR2		01-Dec-2020	6.44	331.	6.4	32.	0.244	60.	0.008 2	6.4	0.265	8.23
SW-N-16	FRM		01-Dec-2020	6.44	331.	6.4	34.15	0.249	60.5	0.007 5	6.6	0.264	8.205
SW-N-16	RPD		01-Dec-2020	0.0%	0.0%	0.0%	12.6%	4.0%	1.7%	18.7%	6.1%	0.8%	0.6%
SW-N-05	FR1	Y	02-Dec-2020	7.12	301.	8.8	65.8	0.129	52.	0.009 1	5.2	0.138	1.39
SW-N-05	FR2		02-Dec-2020	7.12	301.	8.8	86.1	0.142	48.	0.010 4	5.3	0.151	1.45
SW-N-05	FRM		02-Dec-2020	7.12	301.	8.8	75.95	0.135 5	50.	0.009 75	5.25	0.144 5	1.42
SW-N-05	RPD		02-Dec-2020	0.0%	0.0%	0.0%	26.7%	9.6%	8.0%	13.3%	1.9%	9.0%	4.2%
SW-S-04	FR1	Y	03-Feb-2021	7.02	137.7	6.8	118.	0.165	43.	0.007 3	15.	0.146	4.49
SW-S-04	FR2		03-Feb-2021	7.02	137.7	6.8	153.	0.168	46.	0.010 1	15.	0.176	4.78
SW-S-04	FRM		03-Feb-2021	7.02	137.7	6.8	135.5	0.166 5	44.5	0.008 7	15.	0.161	4.635
SW-S-04	RPD		03-Feb-2021	0.0%	0.0%	0.0%	25.8%	1.8%	6.7%	32.2%	0.0%	18.6%	6.3%
SW-N-41S1	FR1	Y	04-Feb-2021	7.59	235.	8.2	5.3	0.18	19.	< 0.005	8.1	0.064	0.27
SW-N-41S1	FR2		04-Feb-2021	7.59	235.	8.2	35.8	0.23	17.	< 0.005	7.7	0.094	0.25
SW-N-41S1	FRM		04-Feb-2021	7.59	235.	8.2	20.55	0.205	18.	< 0.005	7.9	0.079	0.26
SW-N-41S1	RPD		04-Feb-2021	0.0%	0.0%	0.0%	148.4% a	24.4%	11.1%	0.0%	5.1%	38.0% a	7.7%
SW-N-42S1	FR1	Y	04-Feb-2021	7.24	267.	7.2	23.4	0.082	56.	< 0.005	13.	0.058	0.55
SW-N-42S1	FR2		04-Feb-2021	7.24	267.	7.2	25.2	0.079	59.	< 0.005	12.	0.052	0.59
SW-N-42S1	FRM		04-Feb-2021	7.24	267.	7.2	24.3	0.080 5	57.5	< 0.005	12.5	0.055	0.57
SW-N-42S1	RPD		04-Feb-2021	0.0%	0.0%	0.0%	7.4%	3.7%	5.2%	0.0%	8.0%	10.9%	7.0%
SW-N-16	FR1	Y	04-Feb-2021	7.39	230.	6.7	68.2	0.24	42.	0.010 4	6.3	0.251	13.4
SW-N-16	FR2		04-Feb-2021	7.39	230.	6.7	71.	0.231	44.	0.012 5	5.9	0.258	13.3
SW-N-16	FRM		04-Feb-2021	7.39	230.	6.7	69.6	0.235 5	43.	0.011 45	6.1	0.254 5	13.35
SW-N-16	RPD		04-Feb-2021	0.0%	0.0%	0.0%	4.0%	3.8%	4.7%	18.3%	6.6%	2.8%	0.7%
SW-N-05	FR1	Y	03-Feb-2021	7.23	328.	8.3	138.	0.112	42.	0.007	5.1	0.167	1.39
SW-N-05	FR2		03-Feb-2021	7.23	328.	8.3	133.	0.131	41.	< 0.005	4.9	0.156	1.39
SW-N-05	FRM		03-Feb-2021	7.23	328.	8.3	135.5	0.121 5	41.5	< 0.006	5.	0.161 5	1.39
SW-N-05	RPD		03-Feb-2021	0.0%	0.0%	0.0%	3.7%	15.6%	2.4%	33.3%	4.0%	6.8%	0.0%

Notes:

SS *Single sample*
FR1 *Field replicate 1*
FR2 *Field replicate 2*
FRM *Average of field replicates*
RPD Relative percent difference of field replicates

na - Not applicable, some replicates less than the detection limit.

a *- Coefficient of variation greater than 30%*
and all replicates greater than the limit of quantitation.

b *- Coefficient of variation greater than 30%*
with some replicates less than the limit of quantitation.

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2020-2021

			MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%
			Method Detection Limit (MDL)	0.5	1	0.005	0.05	0.05	0.015	0.005	0.02	0.1	0.04
			Limit of Quantitation (5 x MDL)	2.5	5	0.025	0.25	0.25	0.075	0.025	0.1	0.5	0.2
			Parameter	Hardness (As Caco3)	Iron	Lead	Manganese	Molybdenum	N - Nh3 (As N)	N - No2 (As N)	N - No3 (As N)	Nickel	Selenium
			Fraction	TOT	TOT	TOT	TOT	TOT	TOT	DIS	DIS	TOT	TOT
			Unit	mg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	µg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Date Sampled										
SW-S-04	FR1	Y	22-Apr-2020	78.	1 300.	1.03	61.9	0.354	0.035	0.015 3	0.452	0.472	0.062
SW-S-04	FR2		22-Apr-2020	75.6	1 290.	1.04	71.9	0.362	0.061	0.016 4	0.449	0.524	0.06
SW-S-04	FRM		22-Apr-2020	76.8	1 295.	1.035	66.9	0.358	0.048	0.015 85	0.450 5	0.498	0.061
SW-S-04	RPD		22-Apr-2020	3.1%	0.8%	1.0%	14.9%	2.2%	--- 54.2%	6.9%	0.7%	10.4%	3.3%
SW-N-41S1	FR1	Y	22-Apr-2020	174.	1 790.	0.824	533.	0.404	0.027	< 0.005	0.163	0.092	0.074
SW-N-41S1	FR2		22-Apr-2020	176.	1 770.	0.826	570.	0.4	0.028	< 0.005	0.161	0.127	0.089
SW-N-41S1	FRM		22-Apr-2020	175.	1 780.	0.825	551.5	0.402	0.027 5	< 0.005	0.162	0.109 5	0.081 5
SW-N-41S1	RPD		22-Apr-2020	1.1%	1.1%	0.2%	6.7%	1.0%	--- 3.6%	0.0%	1.2%	32.0%	18.4%
SW-N-42S1	FR1	Y	22-Apr-2020	184.	958.	0.564	470.	0.464	0.029	< 0.005	0.049	0.226	0.051
SW-N-42S1	FR2		22-Apr-2020	192.	984.	0.641	461.	0.469	0.031	< 0.005	0.053	0.223	0.046
SW-N-42S1	FRM		22-Apr-2020	188.	971.	0.602 5	465.5	0.466 5	0.03	< 0.005	0.051	0.224 5	0.048 5
SW-N-42S1	RPD		22-Apr-2020	4.3%	2.7%	12.8%	1.9%	1.1%	--- 6.7%	0.0%	7.8%	1.3%	10.3%
SW-N-16	FR1	Y	21-Apr-2020	188.	1 880.	< 0.02	755.	0.705	0.12	< 0.005	< 0.02	1.59	0.091
SW-N-16	FR2		21-Apr-2020	189.	1 870.	0.022	730.	0.721	0.12	< 0.005	< 0.02	1.69	0.101
SW-N-16	FRM		21-Apr-2020	188.5	1 875.	< 0.021	742.5	0.713	0.12	< 0.005	< 0.02	1.64	0.096
SW-N-16	RPD		21-Apr-2020	0.5%	0.5%	9.5%	3.4%	2.2%	--- 0.0%	0.0%	0.0%	6.1%	10.4%
SW-N-05	FR1	Y	21-Apr-2020	188.	24.9	< 0.005	0.805	0.823	0.016	< 0.005	1.05	0.309	0.237
SW-N-05	FR2		21-Apr-2020	190.	68.5	0.036	2.76	0.844	< 0.015	< 0.005	1.06	0.365	0.252
SW-N-05	FRM		21-Apr-2020	189.	46.7	< 0.020 5	1.782 5	0.833 5	< 0.015 5	< 0.005	1.055	0.337	0.244 5
SW-N-05	RPD		21-Apr-2020	1.1%	**93.4%** a	151.2%	109.7%	2.5%	--- 6.5%	0.0%	0.9%	16.6%	6.1%
SW-S-04	FR1	Y	01-Oct-2020	135.	12.9	0.022 6	11.5	0.135	< 0.015	< 0.005	1.23	0.363	0.082
SW-S-04	FR2		01-Oct-2020	134.	29.3	0.038 1	5.28	0.12	< 0.015	< 0.005	1.2	0.328	0.083
SW-S-04	FRM		01-Oct-2020	134.5	21.1	0.030 35	8.39	0.127 5	< 0.015	< 0.005	1.215	0.345 5	0.082 5
SW-S-04	RPD		01-Oct-2020	0.7%	**77.7%** a	51.1%	74.1%	11.8%	--- 0.0%	0.0%	2.5%	10.1%	1.2%
SW-N-41S1	FR1	Y	30-Sep-2020	251.	114.	0.072 1	182.	0.489	< 0.015	< 0.005	0.339	0.148	0.168
SW-N-41S1	FR2		30-Sep-2020	252.	107.	0.019 4	175.	0.468	0.02	< 0.005	0.337	0.153	0.175
SW-N-41S1	FRM		30-Sep-2020	251.5	110.5	0.045 75	178.5	0.478 5	< 0.017 5	< 0.005	0.338	0.150 5	0.171 5
SW-N-41S1	RPD		30-Sep-2020	0.4%	6.3%	115.2%	3.9%	4.4%	--- 28.6%	0.0%	0.6%	3.3%	4.1%
SW-N-42S1	FR1	Y	30-Sep-2020	272.	300.	0.107	261.	0.57	0.032	< 0.005	0.041	0.215	0.061
SW-N-42S1	FR2		30-Sep-2020	257.	221.	0.085	203.	0.541	0.03	< 0.005	0.035	0.196	0.062
SW-N-42S1	FRM		30-Sep-2020	264.5	260.5	0.096	232.	0.555 5	0.031	< 0.005	0.038	0.205 5	0.061 5
SW-N-42S1	RPD		30-Sep-2020	5.7%	**30.3%** a	22.9%	25.0%	5.2%	--- 6.5%	0.0%	15.8%	9.2%	1.6%
SW-N-16	FR1	Y	29-Sep-2020	214.	284.	0.036	98.1	1.3	0.097	0.077 8	0.692	2.14	0.118
SW-N-16	FR2		29-Sep-2020	215.	283.	0.122	97.9	1.32	0.1	0.077 4	0.69	2.14	0.11
SW-N-16	FRM		29-Sep-2020	214.5	283.5	0.079	98.	1.31	0.098 5	0.077 6	0.691	2.14	0.114
SW-N-16	RPD		29-Sep-2020	0.5%	0.4%	**108.9%** a	0.2%	1.5%	--- 3.0%	0.5%	0.3%	0.0%	7.0%
SW-N-05	FR1	Y	29-Sep-2020	338.	165.	0.027 7	5.37	0.758	0.027	< 0.005	3.06	0.556	0.488
SW-N-05	FR2		29-Sep-2020	339.	170.	0.026 5	6.21	0.737	0.015	< 0.005	3.05	0.583	0.464
SW-N-05	FRM		29-Sep-2020	338.5	167.5	0.027 1	5.79	0.747 5	0.021	< 0.005	3.055	0.569 5	0.476
SW-N-05	RPD		29-Sep-2020	0.3%	3.0%	4.4%	14.5%	2.8%	--- 57.1%	0.0%	0.3%	4.7%	5.0%
SW-S-04	FR1	Y	03-Dec-2020	111.	259.	0.16	24.7	0.154	0.17	0.021	2.04	0.606	0.071
SW-S-04	FR2		03-Dec-2020	107.	189.	0.148	22.8	0.184	0.15	0.021 2	1.95	0.613	0.073
SW-S-04	FRM		03-Dec-2020	109.	224.	0.154	23.75	0.169	0.16	0.021 1	1.995	0.609 5	0.072
SW-S-04	RPD		03-Dec-2020	3.7%	31.3%	7.8%	8.0%	17.8%	--- 12.5%	0.9%	4.5%	1.1%	2.8%
SW-N-41S1	FR1		02-Dec-2020	230.	126.	0.017 3	115.	0.288	0.027	< 0.005	0.446	0.146	0.082
SW-N-41S1	FR2		02-Dec-2020	232.	128.	0.015 8	112.	0.273	0.022	< 0.005	0.449	0.148	0.073
SW-N-41S1	FRM		02-Dec-2020	231.	127.	0.016 55	113.5	0.280 5	0.024 5	< 0.005	0.447 5	0.147	0.077 5
SW-N-41S1	RPD		02-Dec-2020	0.9%	1.6%	9.1%	2.6%	5.3%	--- 20.4%	0.0%	0.7%	1.4%	11.6%

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2020-2021

			MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%
			Method Detection Limit (MDL)	0.5	1	0.005	0.05	0.05	0.015	0.005	0.02	0.1	0.04
			Limit of Quantitation (5 x MDL)	2.5	5	0.025	0.25	0.25	0.075	0.025	0.1	0.5	0.2
			Parameter	Hardness (As Caco3)	Iron	Lead	Manganese	Molybdenum	N - Nh3 (As N)	N - No2 (As N)	N - No3 (As N)	Nickel	Selenium
			Fraction	TOT	TOT	TOT	TOT	TOT	TOT	DIS	DIS	TOT	TOT
			Unit	mg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	µg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Date Sampled										
SW-N-42S1	FR1	Y	02-Dec-2020	221.	842.	0.568	307.	0.488	0.02	< 0.005	0.136	0.16	0.052
SW-N-42S1	FR2		02-Dec-2020	221.	60.2	0.031	28.6	0.412	0.026	< 0.005	0.137	0.148	0.055
SW-N-42S1	FRM		02-Dec-2020	221.	451.1	0.299 5	167.8	0.45	0.023	< 0.005	0.136 5	0.154	0.053 5
SW-N-42S1	RPD		02-Dec-2020	0.0%	173.3% a	179.3% a	165.9%	16.9%	--- 26.1%	0.0%	0.7%	7.8%	5.6%
SW-N-16	FR1	Y	01-Dec-2020	225.	198.	< 0.02	58.5	0.793	0.05	0.018 4	7.35	1.55	0.11
SW-N-16	FR2		01-Dec-2020	218.	209.	< 0.02	61.9	0.783	0.053	0.018 2	7.26	1.47	0.111
SW-N-16	FRM		01-Dec-2020	221.5	203.5	< 0.02	60.2	0.788	0.051 5	0.018 3	7.305	1.51	0.110 5
SW-N-16	RPD		01-Dec-2020	3.2%	5.4%	0.0%	5.6%	1.3%	--- 5.8%	1.1%	1.2%	5.3%	0.9%
SW-N-05	FR1	Y	02-Dec-2020	306.	81.4	< 0.02	2.08	1.56	0.021	< 0.005	6.19	0.469	0.467
SW-N-05	FR2		02-Dec-2020	314.	122.	0.016 6	2.81	1.6	0.023	< 0.005	6.27	0.472	0.449
SW-N-05	FRM		02-Dec-2020	310.	101.7	< 0.018 3	2.445	1.58	0.022	< 0.005	6.23	0.470 5	0.458
SW-N-05	RPD		02-Dec-2020	2.6%	39.9% a	18.6%	29.9%	2.5%	--- 9.1%	0.0%	1.3%	0.6%	3.9%
SW-S-04	FR1	Y	03-Feb-2021	71.2	185.	0.114	16.	0.1	0.053	< 0.005	1.29	0.68	0.065
SW-S-04	FR2		03-Feb-2021	72.3	220.	0.13	18.9	0.102	0.018	0.005 1	1.27	0.661	0.061
SW-S-04	FRM		03-Feb-2021	71.75	202.5	0.122	17.45	0.101	0.035 5	< 0.005 05	1.28	0.670 5	0.063
SW-S-04	RPD		03-Feb-2021	1.5%	17.3%	13.1%	16.6%	2.0%	--- 98.6% a	2.0%	1.6%	2.8%	6.3%
SW-N-41S1	FR1	Y	04-Feb-2021	175.	54.3	< 0.02	67.6	0.309	< 0.015	< 0.005	0.199	0.097	0.069
SW-N-41S1	FR2		04-Feb-2021	166.	118.	0.024	81.6	0.258	< 0.015	< 0.005	0.203	0.097	0.062
SW-N-41S1	FRM		04-Feb-2021	170.5	86.15	< 0.022	74.6	0.283 5	< 0.015	< 0.005	0.201	0.097	0.065 5
SW-N-41S1	RPD		04-Feb-2021	5.3%	73.9% a	18.2%	18.8%	18.0%	--- 0.0%	0.0%	2.0%	0.0%	10.7%
SW-N-42S1	FR1	Y	04-Feb-2021	172.	43.2	0.022	14.3	0.466	0.038	< 0.005	0.145	0.112	0.049
SW-N-42S1	FR2		04-Feb-2021	165.	40.8	0.027	14.4	0.506	< 0.015	< 0.005	0.146	0.127	0.049
SW-N-42S1	FRM		04-Feb-2021	168.5	42.	0.024 5	14.35	0.486	< 0.026 5	< 0.005	0.145 5	0.119 5	0.049
SW-N-42S1	RPD		04-Feb-2021	4.2%	5.7%	20.4%	0.7%	8.2%	--- 86.8%	0.0%	0.7%	12.6%	0.0%
SW-N-16	FR1	Y	04-Feb-2021	151.	245.	0.021 3	49.9	0.862	0.13	0.006 6	3.22	1.78	0.132
SW-N-16	FR2		04-Feb-2021	144.	245.	0.028	52.	0.872	1.	0.006 2	3.51	1.7	0.127
SW-N-16	FRM		04-Feb-2021	147.5	245.	0.024 65	50.95	0.867	0.565	0.006 4	3.365	1.74	0.129 5
SW-N-16	RPD		04-Feb-2021	4.7%	0.0%	27.2%	4.1%	1.2%	--- 154.0% a	6.3%	8.6%	4.6%	3.9%
SW-N-05	FR1	Y	03-Feb-2021	217.	190.	0.014 6	3.41	1.31	0.2	< 0.005	6.32	0.413	0.327
SW-N-05	FR2		03-Feb-2021	222.	182.	0.014 1	3.22	1.3	0.27	< 0.005	6.51	0.377	0.325
SW-N-05	FRM		03-Feb-2021	219.5	186.	0.014 35	3.315	1.305	0.235	< 0.005	6.415	0.395	0.326
SW-N-05	RPD		03-Feb-2021	2.3%	4.3%	3.5%	5.7%	0.8%	--- 29.8%	0.0%	3.0%	9.1%	0.6%

Notes:

SS *Single sample*
FR1 *Field replicate 1*
FR2 *Field replicate 2*
FRM *Average of field replicates*
RPD Relative percent difference of field replicates

na - Not applicable, some replicates less than the detection limit.

a *- Coefficient of variation greater than 30%*
and all replicates greater than the limit of quantitation.

b *- Coefficient of variation greater than 30%*
with some replicates less than the limit of quantitation.

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2020-2021

			MAX Acceptable RPD		30%		30%		30%		30%		30%		30%		30%		30%	
			Method Detection Limit (MDL)		0.005		1		1		1		0.5		0.02		10		0.005		0.005		0.05	
			Limit of Quantitation (5 x MDL)		0/025		5		5		5		2.5		0.1		50		0.025		0.025		0.25	
			Parameter		Silver		Sulphate		TSS		Zinc		Aluminum		Arsenic		Boron		Cadmium		Cobalt		Copper	
			Fraction		TOT		DIS		TOT		TOT		DIS		DIS		DIS		DIS		DIS		DIS	
			Unit		µg/L		mg/L		mg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Station	Sample Type	Compliance Well (Y/N)?	Date Sampled																					
SW-S-04	FR1	Y	22-Apr-2020	<	0.01		19.		11.		14.7		15.9		0.235		51.		0.011 2		0.089 8		3.79	
SW-S-04	FR2		22-Apr-2020	<	0.01		18.		8.4		15.3		15.3		0.216		51.		0.013		0.088 2		3.76	
SW-S-04	FRM		22-Apr-2020	<	0.01		18.5		9.7		15.		15.6		0.225 5		51.		0.012 1		0.089		3.775	
SW-S-04	RPD		22-Apr-2020	---	0.0%		5.4%		26.8%	---	4.0%		3.8%		8.4%		0.0%	---	14.9%	---	1.8%	---	0.8%	
SW-N-41S1	FR1	Y	22-Apr-2020		0.015		66.		52.		6.2		7.2		0.176		16.	<	0.005		0.052 6		0.614	
SW-N-41S1	FR2		22-Apr-2020		0.011		66.		57.		6.8		6.65		0.165		16.	<	0.005		0.059		0.664	
SW-N-41S1	FRM		22-Apr-2020		0.013		66.		54.5		6.5		6.925		0.170 5		16.	<	0.005		0.055 8		0.639	
SW-N-41S1	RPD		22-Apr-2020	---	30.8%		0.0%	---	9.2%	---	9.2%		7.9%		6.5%		0.0%	---	0.0%	---	11.5%	---	7.8%	
SW-N-42S1	FR1	Y	22-Apr-2020	<	0.01		91.		35.		5.6		9.1		0.166		40.	<	0.005		0.085 2		0.672	
SW-N-42S1	FR2		22-Apr-2020	<	0.01		90.		34.		6.		9.18		0.16		40.		0.012 4		0.090 5		0.743	
SW-N-42S1	FRM		22-Apr-2020	<	0.01		90.5		34.5		5.8		9.14		0.163		40.	<	0.008 7		0.087 85		0.707 5	
SW-N-42S1	RPD		22-Apr-2020	---	0.0%		1.1%	---	2.9%	---	6.9%		0.9%		3.7%		0.0%	---	85.1%	---	6.0%	---	10.0%	
SW-N-16	FR1	Y	21-Apr-2020	<	0.01		52.		15.		5.3		5.5		0.267		91.		0.006 7		0.697		3.12	
SW-N-16	FR2		21-Apr-2020	<	0.01		46.		16.		5.2		6.25		0.284		94.		0.006 9		0.727		6.92	
SW-N-16	FRM		21-Apr-2020	<	0.01		49.		15.5		5.25		5.875		0.275 5		92.5		0.006 8		0.712		5.02	
SW-N-16	RPD		21-Apr-2020	---	0.0%		12.2%	---	6.5%	---	1.9%		12.8%		6.2%		3.2%	---	2.9%	---	4.2%	---	**75.7%**	**a**
SW-N-05	FR1	Y	21-Apr-2020	<	0.005		110.		8.8		1.29		6.76		0.121		25.	<	0.005		0.044 8		1.89	
SW-N-05	FR2		21-Apr-2020	<	0.01		110.		6.4		1.6		5.87		0.202		26.		0.005 8		0.046 8		9.58	
SW-N-05	FRM		21-Apr-2020	<	0.007 5		110.		7.6		1.445		6.315		0.161 5		25.5	<	0.005 4		0.045 8		5.735	
SW-N-05	RPD		21-Apr-2020	---	66.7%		0.0%	---	31.6%	---	21.5%		14.1%		**50.2%**	**a**	3.9%	---	14.8%	---	4.4%	---	**134.1%**	**a**
SW-S-04	FR1	Y	01-Oct-2020	<	0.005		59.		2.		2.67		9.71		0.126		83.		0.012 7		0.068 2		1.51	
SW-S-04	FR2		01-Oct-2020	<	0.005		59.		2.		2.42		9.08		0.128		84.		0.012 3		0.069 6		1.49	
SW-S-04	FRM		01-Oct-2020	<	0.005		59.		2.		2.545		9.395		0.127		83.5		0.012 5		0.068 9		1.5	
SW-S-04	RPD		01-Oct-2020	---	0.0%		0.0%	---	0.0%	---	9.8%		6.7%		1.6%		1.2%	---	3.2%	---	2.0%	---	1.3%	
SW-N-41S1	FR1	Y	30-Sep-2020	<	0.005		130.		2.4		4.06		4.25		0.224		24.	<	0.005		0.14		0.265	
SW-N-41S1	FR2		30-Sep-2020	<	0.005		130.		2.		1.24		3.88		0.235		22.	<	0.005		0.137		0.318	
SW-N-41S1	FRM		30-Sep-2020	<	0.005		130.		2.2		2.65		4.065		0.229 5		23.	<	0.005		0.138 5		0.291 5	
SW-N-41S1	RPD		30-Sep-2020	---	0.0%		0.0%	---	18.2%	---	106.4%		9.1%		4.8%		8.7%	---	0.0%	---	2.2%	---	18.2%	
SW-N-42S1	FR1	Y	30-Sep-2020	<	0.01		130.		11.		1.2		7.57		0.221		55.	<	0.005		0.152		0.389	
SW-N-42S1	FR2		30-Sep-2020	<	0.01		120.		4.4		2.		7.48		0.223		54.	<	0.005		0.152		0.378	
SW-N-42S1	FRM		30-Sep-2020	<	0.01		125.		7.7		1.6		7.525		0.222		54.5	<	0.005		0.152		0.383 5	
SW-N-42S1	RPD		30-Sep-2020	---	0.0%		8.0%	---	85.7%	---	50.0%		1.2%		0.9%		1.8%	---	0.0%	---	0.0%	---	2.9%	
SW-N-16	FR1	Y	29-Sep-2020	<	0.005		95.		1.6		15.3		9.91		0.248		88.		0.019 9		0.416		5.57	
SW-N-16	FR2		29-Sep-2020		0.005 5		90.		2.8		15.3		9.98		0.277		88.		0.022 7		0.399		9.73	
SW-N-16	FRM		29-Sep-2020	<	0.005 25		92.5		2.2		15.3		9.945		0.262 5		88.		0.021 3		0.407 5		7.65	
SW-N-16	RPD		29-Sep-2020	---	9.5%		5.4%	---	54.5%	---	0.0%		0.7%		11.0%		0.0%	---	13.1%	---	4.2%	---	**54.4%**	**a**
SW-N-05	FR1	Y	29-Sep-2020	<	0.005		220.		2.8		2.69		3.97		0.115		34.		0.066 5		0.075 6		2.69	
SW-N-05	FR2		29-Sep-2020	<	0.005		240.		2.8		2.87		3.7		0.145		36.		0.067 2		0.079 3		8.52	
SW-N-05	FRM		29-Sep-2020	<	0.005		230.		2.8		2.78		3.835		0.13		35.		0.066 85		0.077 45		5.605	
SW-N-05	RPD		29-Sep-2020	---	0.0%		8.7%	---	0.0%	---	6.5%		7.0%		23.1%		5.7%	---	1.0%	---	4.8%	---	**104.0%**	**a**
SW-S-04	FR1	Y	03-Dec-2020	<	0.005		30.		2.		6.06		13.6		0.161		86.		0.008 6		0.082 4		3.98	
SW-S-04	FR2		03-Dec-2020	<	0.01		31.		2.8		5.8		14.1		0.167		82.		0.007 2		0.082 7		3.3	
SW-S-04	FRM		03-Dec-2020	<	0.007 5		30.5		2.4		5.93		13.85		0.164		84.		0.007 9		0.082 55		3.64	
SW-S-04	RPD		03-Dec-2020	---	66.7%		3.3%	---	33.3%	---	4.4%		3.6%		3.7%		4.8%	---	17.7%	---	0.4%	---	18.7%	
SW-N-41S1	FR1		02-Dec-2020	<	0.005		110.	<	1.		0.87		8.73		0.242		19.	<	0.005		0.13		0.227	
SW-N-41S1	FR2		02-Dec-2020	<	0.005		110.		4.		0.87		8.86		0.243		19.	<	0.005		0.12		0.241	
SW-N-41S1	FRM		02-Dec-2020	<	0.005		110.	<	2.5		0.87		8.795		0.242 5		19.	<	0.005		0.125		0.234	
SW-N-41S1	RPD		02-Dec-2020	---	0.0%		0.0%	---	120.0%	---	0.0%		1.5%		0.4%		0.0%	---	0.0%	---	8.0%	---	6.0%	

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2020-2021

| | | |

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2020-2021

| | | |

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2020-2021

| | | |

Table 3-3 Hartland Valve Chamber Leachate Chemistry QA/QC - Relative Percent Difference 2020 - 2021

AECOM

State	Parameter	MDL	LOQ	Lab Units	Maximum Acceptable RPD	Hartland Valve Chamber FR1 23-Apr-2020	Hartland Valve Chamber FR2 23-Apr-2020	RPD		COV	Hartland Valve Chamber FR1 22-Sep-2020	Hartland Valve Chamber FR2 22-Sep-2020	RPD		COV
CONVENTIONALS															
TOT	Total Sulphide	0.018	0.09	mg/L	30%	0.044	0.032	31.6%		15.79	0.097	0.097	0.0%		0.00
DISS	Dissolved Sulphide	0.001 8	0.009	mg/L	30%	0.021	0.039	**60.0%**	**a**	30.00	0.077	0.07	9.5%		4.76
TOT	TSS	1.	5.	mg/L	30%	37.	33.	11.4%		5.71	25.	26.	3.9%		1.96
TOT	BOD	30.	150.	mg/L	30%	28.	26.	7.4%		3.70	36.	35.	2.8%		1.41
TOT	COD	20.	100.	mg/L	30%	467.	516.	10.0%		4.98	656.	656.	0.0%		0.00
DISS	Chloride	10.	50.	mg/L	30%	430.	430.	0.0%		0.00	560.	560.	0.0%		0.00
DISS	Sulphate	10.	50.	mg/L	30%	39.	37.	5.3%		2.63	29.	29.	0.0%		0.00
TOT	Oil & Grease, Total	1.	5.	mg/L	30%	< 1.	< 1.	0.0%		0.00	< 1.	< 1.	0.0%		0.00
TOT	Oil & Grease, Mineral	2.	10.	mg/L	45%	< 2.	< 2.	0.0%		0.00	< 2.	< 2.	0.0%		0.00
TOT	Cyanide - SAD (total)	0.025	0.125	mg/L	30%	< 0.013	< 0.013	0.0%		0.00	0.035	0.029	18.8%		9.38
TOT	Cyanide - WAD	0.025	0.125	mg/L	30%	< 0.013	< 0.013	0.0%		0.00	< 0.013	< 0.013	0.0%		0.00
TOT	Phenols	0.03	0.15	mg/L	45%	0.25	0.27	7.7%		3.85	0.17	0.13	26.7%		13.33
TOT	Ammonia	18.	90.	mg/L	30%	310.	340.	9.2%		4.62	350.	380.	8.2%		4.11
TOT	Nitrite	0.5	2.5	mg/L	30%	1.61	1.58	1.9%		0.94	0.118	0.117	0.9%		0.43
TOT	Nitrate	2.	10.	mg/L	30%	11.9	11.6	2.6%		1.28	< 0.2	< 0.2	0.0%		0.00
TOT	pH	0.01	0.05	pH	30%	7.7	7.7	0.0%		0.00	7.77	7.77	0.0%		0.00
TOT	Conductivity	1.	5.	µS/cm	30%	4 109.	4 109.	0.0%		0.00	5 145.	5 145.	0.0%		0.00
TOT	Temperature	0.1	0.5	°C	30%	15.4	15.4	0.0%		0.00	17.8	17.8	0.0%		0.00
TOT	Dissolved Oxygen	0.01	0.05	mg/L	30%	2.06	2.06	0.0%		0.00	0.96	0.96	0.0%		0.00
TOT	ORP	0.1	0.5	mV	30%	39.	39.	0.0%		0.00	- 75.	- 75.	0.0%		0.00
METALS, TOTAL															
TOT	Arsenic	0.1	0.5	µg/L	30%	7.6	7.63	0.4%		0.20	10.5	10.4	1.0%		0.48
TOT	Cadmium	0.025	0.125	µg/L	30%	0.062	0.066	6.3%		3.13	0.053	0.058	9.0%		4.50
TOT	Chromium	0.5	2.5	µg/L	30%	51.9	51.6	0.6%		0.29	75.	73.8	1.6%		0.81
TOT	Cobalt	0.05	0.25	µg/L	30%	14.9	15.1	1.3%		0.67	22.5	21.8	3.2%		1.58
TOT	Copper	0.5	2.5	µg/L	30%	9.4	9.26	1.5%		0.75	16.7	18.7	11.3%		5.65
TOT	Iron	25.	125.	µg/L	30%	2 140.	2 160.	0.9%		0.47	3 210.	3 140.	2.2%		1.10
TOT	Lead	0.1	0.5	µg/L	30%	1.21	1.27	4.8%		2.42	1.04	0.98	5.9%		2.97
TOT	Manganese	0.5	2.5	µg/L	30%	641.	650.	1.4%		0.70	674.	648.	3.9%		1.97
TOT	Mercury	0.038	0.19	µg/L	30%	< 0.038	< 0.038	0.0%		0.00	< 0.038	< 0.038	0.0%		0.00
TOT	Molybdenum	0.25	1.25	µg/L	30%	3.05	2.79	8.9%		4.45	2.77	2.94	6.0%		2.98
TOT	Nickel	0.5	2.5	µg/L	30%	43.	43.7	1.6%		0.81	65.5	63.9	2.5%		1.24
TOT	Selenium	0.2	1.	µg/L	30%	0.408	0.408	0.0%		0.00	0.58	0.62	6.7%		3.33
TOT	Silver	0.05	0.25	µg/L	30%	0.032	0.027	16.9%		8.47	< 0.05	< 0.05	0.0%		0.00
TOT	Zinc	5.	25.	µg/L	30%	15.9	16.	0.6%		0.31	12.8	14.7	13.8%		6.91
BTEX															
DISS	Benzene	0.4	2.	µg/L	45%	0.42	< 0.4	4.9%		2.44	< 0.4	< 0.4	0.0%		0.00
DISS	Toluene	0.4	2.	µg/L	45%	0.52	0.52	0.0%		0.00	< 0.4	< 0.4	0.0%		0.00
DISS	Ethylbenzene	0.4	2.	µg/L	45%	0.49	0.53	7.8%		3.92	< 0.4	< 0.4	0.0%		0.00
DISS	Xylenes	0.4	2.	µg/L	45%	1.1	1.2	8.7%		4.35	< 0.4	< 0.4	0.0%		0.00
PAH															
TOT	Total PAH	0.02	0.1	µg/L	45%	4.	3.6	10.5%		5.26	5.1	4.8	6.1%		3.03
TOT	Acenaphthene	0.01	0.05	µg/L	45%	1.7	1.5	12.5%		6.25	1.4	1.3	7.4%		3.70
TOT	Acenaphthylene	0.01	0.05	µg/L	45%	0.058	0.057	1.7%		0.87	0.033	0.033	0.0%		0.00
TOT	Anthracene	0.01	0.05	µg/L	45%	0.31	0.31	0.0%		0.00	0.31	0.33	6.3%		3.13
TOT	Benzo(a)anthracene	0.01	0.05	µg/L	45%	0.079	0.073	7.9%		3.95	0.082	0.073	11.6%		5.81
TOT	Benzo(a)pyrene	0.005	0.025	µg/L	45%	0.021	0.021	0.0%		0.00	0.023	0.019	19.0%		9.52
TOT	Benzo(b,j)fluoranthene	0.01	0.05	µg/L	45%	0.028	0.028	0.0%		0.00	0.04	< 0.01	120.0%		60.00
TOT	Benzo(g,h,i)perylene	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	0.022	9.5%		4.76
TOT	Benzo(k)fluoranthene	0.01	0.05	µg/L	45%	0.01	0.01	0.0%		0.00	0.013	< 0.01	26.1%		13.04
TOT	Chrysene	0.01	0.05	µg/L	45%	0.08	0.072	10.5%		5.26	0.098	0.086	13.0%		6.52
TOT	Dibenzo(a,h)anthracene	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	Fluoranthene	0.01	0.05	µg/L	45%	0.6	0.52	14.3%		7.14	0.5	0.46	8.3%		4.17
TOT	Fluorene	0.01	0.05	µg/L	45%	0.59	0.49	18.5%		9.26	0.87	0.83	4.7%		2.35
TOT	Indeno(1,2,3-c,d)pyrene	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	Naphthalene	0.01	0.05	µg/L	45%	0.032	0.033	3.1%		1.54	0.22	0.21	4.7%		2.33
TOT	Phenanthrene	0.01	0.05	µg/L	45%	0.012	0.013	8.0%		4.00	0.55	0.51	7.5%		3.77
TOT	Pyrene	0.01	0.05	µg/L	45%	0.39	0.35	10.8%		5.41	0.36	0.33	8.7%		4.35
CHLORINATED PHENOLS															
TOT	Chlorinated phenols (total)	0.1	0.5	µg/L	45%	0.12	0.12	0.0%		0.00	< 0.41	< 0.41	0.0%		0.00
TOT	Total Dichlorophenols	0.1	0.5	µg/L	45%	0.12	0.12	0.0%		0.00	< 0.22	< 0.22	0.0%		0.00
TOT	Total Monochlorophenols	0.08	0.4	µg/L	45%	< 0.08	< 0.08	0.0%		0.00	< 0.09	< 0.09	0.0%		0.00
TOT	Total Nonchlorinated phenols	10.	50.	µg/L	45%	< 10.	< 10.	0.0%		0.00	2.8	2.6	7.4%		3.70
TOT	Total Tetrachlorophenols	0.1	0.5	µg/L	45%	< 0.1	< 0.1	0.0%		0.00	< 0.17	< 0.17	0.0%		0.00
TOT	Total Trichlorophenols	0.1	0.5	µg/L	45%	< 0.1	< 0.1	0.0%		0.00	< 0.24	< 0.24	0.0%		0.00
TOT	2-Chlorophenol	0.08	0.4	µg/L	45%	< 0.08	< 0.08	0.0%		0.00	< 0.05	< 0.05	0.0%		0.00
TOT	2,4 + 2,5 Dichlorophenol	0.1	0.5	µg/L	45%	0.12	0.12	0.0%		0.00	0.19	0.16	17.1%		8.57
TOT	2,4,6-Trichlorophenol	0.1	0.5	µg/L	45%	< 0.1	< 0.1	0.0%		0.00	< 0.1	< 0.1	0.0%		0.00
TOT	Pentachlorophenol	0.1	0.5	µg/L	45%	< 0.1	< 0.1	0.0%		0.00	< 0.1	< 0.1	0.0%		0.00
TOT	2,3,4,5-Tetrachlorophenol	0.1	0.5	µg/L	45%	< 0.1	< 0.1	0.0%		0.00	< 0.1	< 0.1	0.0%		0.00
TOT	2,3,4,6-Tetrachlorophenol	0.1	0.5	µg/L	45%	< 0.1	< 0.1	0.0%		0.00	< 0.1	< 0.1	0.0%		0.00
TOT	2,3,5,6-Tetrachlorophenol	0.1	0.5	µg/L	45%	< 0.1	< 0.1	0.0%		0.00	0.11	0.1	9.5%		4.76
EMERGING CONTAMINANTS															
TOT	Perfluorobutanesulfonic acid	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	0.69	0.67	2.9%		1.47
TOT	Perfluorodecanesulfonic acid (PFDS)	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	< 0.02	< 0.02	0.0%		0.00
TOT	Perfluoroheptanesulfonic acid	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	< 0.02	< 0.02	0.0%		0.00
TOT	Perfluorohexanesulfonic acid	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	0.85	0.81	4.8%		2.41
TOT	Perfluorononanesulfonic acid	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	< 0.02	< 0.02	0.0%		0.00
TOT	Perfluorooctanesulfonic acid	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	0.22	0.22	0.0%		0.00
TOT	Perfluorooctanoic acid (PFOA)	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	0.89	0.86	3.4%		1.71
TOT	Perfluoropentanesulfonic acid	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	0.035	0.033	5.9%		2.94
TOT	PF3A	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	< 0.02	< 0.02	0.0%		0.00
TOT	PF4A	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	< 0.02	< 0.02	0.0%		0.00
TOT	PFBoA	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	0.81	0.77	5.1%		2.53
TOT	PFDA	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	0.06	0.058	3.4%		1.69
TOT	PFDoA	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	< 0.02	< 0.02	0.0%		0.00
TOT	PFHpA	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	0.32	0.31	3.2%		1.59
TOT	PFHxA	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	1.5	1.5	0.0%		0.00
TOT	PFNA	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	0.044	0.044	0.0%		0.00
TOT	PFOSA	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	< 0.02	< 0.02	0.0%		0.00
TOT	PFPeA	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	0.65	0.61	6.3%		3.17
TOT	PFUA	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	< 0.02	< 0.02	0.0%		0.00
TOT	1,4-Dioxane	0.02	0.1	µg/L	45%	--- ---	--- ---	---	---	---	16.	17.	#REF!		3.03

Notes:

FR1, FR2 - Field replicates 1 and 2.

FRM - Mean of field replicates.

MDL - Method detection limit.

COV - Coefficient of Variation

LOQ - Limit of quantification.

RPD - Relative percent difference.

na - Not applicable, some replicates less than the detection limit.

a - Relative Standard Difference greater than 3% for general inorganic parameters/metals and 45% for organic parameters and all replicates greater than the limit of quantitation.

b - Relative Standard Difference greater than 3% for general inorganic parameters/metals and 45% for organic parameters, with some replicates less than the limit of quantitation.

Table 3-3 Hartland Valve Chamber Leachate Chemistry QA/QC - Relative Percent Difference 2020 - 2021

AECOM

State	Parameter	MDL	LOQ	Lab Units	Maximum Acceptable RPD	Hartland Valve Chamber FR1 18-Nov-2020	Hartland Valve Chamber FR2 18-Nov-2020	RPD		COV	Hartland Valve Chamber FR1 23-Feb-2021	Hartland Valve Chamber FR2 23-Feb-2021	RPD		COV
CONVENTIONALS															
TOT	Total Sulphide	0.018	0.09	mg/L	30%	0.048	0.047	2.1%		1.05	0.045	0.044	2.2%		1.12
DISS	Dissolved Sulphide	0.001 8	0.009	mg/L	30%	0.029	0.037	24.2%		12.12	0.038	0.036	5.4%		2.70
TOT	TSS	1.	5.	mg/L	30%	20.	20.	0.0%		0.00	19.	19.	0.0%		0.00
TOT	BOD	30.	150.	mg/L	30%	31.	32.	3.2%		1.59	27.	28.	3.6%		1.82
TOT	COD	20.	100.	mg/L	30%	334.	362.	8.0%		4.02	385.	398.	3.3%		1.66
DISS	Chloride	10.	50.	mg/L	30%	260.	260.	0.0%		0.00	250.	240.	4.1%		2.04
DISS	Sulphate	10.	50.	mg/L	30%	92.	90.	2.2%		1.10	86.	87.	1.2%		0.58
TOT	Oil & Grease, Total	1.	5.	mg/L	30%	< 1.	< 1.	0.0%		0.00	< 1.	< 1.	0.0%		0.00
TOT	Oil & Grease, Mineral	2.	10.	mg/L	45%	< 2.	< 2.	0.0%		0.00	< 2.	< 2.	0.0%		0.00
TOT	Cyanide - SAD (total)	0.025	0.125	mg/L	30%	0.005 7	0.005 5	3.6%		1.79	0.011 7	0.011 3	3.5%		1.74
TOT	Cyanide - WAD	0.025	0.125	mg/L	30%	0.005 8	0.004 4	27.5%		13.73	< 0.005	< 0.005	0.0%		0.00
TOT	Phenols	0.03	0.15	mg/L	45%	0.14	0.15	6.9%		3.45	0.16	0.16	0.0%		0.00
TOT	Ammonia	18.	90.	mg/L	30%	220.	200.	9.5%		4.76	200.	190.	5.1%		2.56
TOT	Nitrite	0.5	2.5	mg/L	30%	1.3	1.31	0.8%		0.38	1.81	1.78	1.7%		0.84
TOT	Nitrate	2.	10.	mg/L	30%	5.84	5.82	0.3%		0.17	9.51	8.8	7.8%		3.88
TOT	pH	0.01	0.05	pH	30%	7.73	7.73	0.0%		0.00	7.45	7.45	0.0%		0.00
TOT	Conductivity	1.	5.	µS/cm	30%	2 851.	2 851.	0.0%		0.00	2 591.	2 591.	0.0%		0.00
TOT	Temperature	0.1	0.5	°C	30%	14.2	14.2	0.0%		0.00	13.7	13.7	0.0%		0.00
TOT	Dissolved Oxygen	0.01	0.05	mg/L	30%	3.74	3.74	0.0%		0.00	2.25	2.25	0.0%		0.00
TOT	ORP	0.1	0.5	mV	30%	41.	41.	0.0%		0.00	42.	42.	0.0%		0.00
METALS, TOTAL															
TOT	Arsenic	0.1	0.5	µg/L	30%	8.15	7.76	4.9%		2.45	6.77	7.3	7.5%		3.77
TOT	Cadmium	0.025	0.125	µg/L	30%	0.071	0.066	7.3%		3.65	0.05	0.048	4.1%		2.04
TOT	Chromium	0.5	2.5	µg/L	30%	43.4	38.9	10.9%		5.47	35.1	35.5	1.1%		0.57
TOT	Cobalt	0.05	0.25	µg/L	30%	11.9	11.3	5.2%		2.59	8.94	9.39	4.9%		2.45
TOT	Copper	0.5	2.5	µg/L	30%	20.1	23.1	13.9%		6.94	12.3	12.7	3.2%		1.60
TOT	Iron	25.	125.	µg/L	30%	1 820.	1 660.	9.2%		4.60	1 370.	1 460.	6.4%		3.18
TOT	Lead	0.1	0.5	µg/L	30%	1.11	1.13	1.8%		0.89	0.838	0.885	5.5%		2.73
TOT	Manganese	0.5	2.5	µg/L	30%	565.	523.	7.7%		3.86	383.	409.	6.6%		3.28
TOT	Mercury	0.038	0.19	µg/L	30%	0.005 8	0.003 6	46.8%		23.40	< 0.038	< 0.038	0.0%		0.00
TOT	Molybdenum	0.25	1.25	µg/L	30%	3.81	3.2	17.4%		8.70	2.33	2.25	3.5%		1.75
TOT	Nickel	0.5	2.5	µg/L	30%	34.4	32.2	6.6%		3.30	24.8	27.1	8.9%		4.43
TOT	Selenium	0.2	1.	µg/L	30%	0.409	0.413	1.0%		0.49	0.328	0.402	20.3%		10.14
TOT	Silver	0.05	0.25	µg/L	30%	0.021	0.025	17.4%		8.70	< 0.02	< 0.02	0.0%		0.00
TOT	Zinc	5.	25.	µg/L	30%	17.1	16.4	4.2%		2.09	15.3	16.	4.5%		2.24
BTEX															
DISS	Benzene	0.4	2.	µg/L	45%	0.75	0.65	14.3%		7.14	0.46	0.46	0.0%		0.00
DISS	Toluene	0.4	2.	µg/L	45%	0.75	0.59	23.9%		11.94	0.89	0.96	7.6%		3.78
DISS	Ethylbenzene	0.4	2.	µg/L	45%	1.	0.87	13.9%		6.95	0.65	0.66	1.5%		0.76
DISS	Xylenes	0.4	2.	µg/L	45%	2.3	2.	14.0%		6.98	1.5	1.5	0.0%		0.00
PAH															
TOT	Total PAH	0.02	0.1	µg/L	45%	6.3	6.1	3.2%		1.61	14.	14.	0.0%		0.00
TOT	Acenaphthene	0.01	0.05	µg/L	45%	2.2	2.1	4.7%		2.33	4.5	4.5	0.0%		0.00
TOT	Acenaphthylene	0.01	0.05	µg/L	45%	0.035	0.03	15.4%		7.69	0.1	0.098	2.0%		1.01
TOT	Anthracene	0.01	0.05	µg/L	45%	0.16	0.15	6.5%		3.23	0.36	0.32	11.8%		5.88
TOT	Benzo(a)anthracene	0.01	0.05	µg/L	45%	0.062	0.051	19.5%		9.73	0.07	0.11	**44.4%**	**a**	22.22
TOT	Benzo(a)pyrene	0.005	0.025	µg/L	45%	0.014	0.01	33.3%		16.67	0.014	0.024	52.6%		26.32
TOT	Benzo(b,j)fluoranthene	0.01	0.05	µg/L	45%	0.017	0.014	19.4%		9.68	0.015	0.041	92.9%		46.43
TOT	Benzo(g,h,i)perylene	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	Benzo(k)fluoranthene	0.01	0.05	µg/L	45%	< 0.01	< 0.01	0.0%		0.00	< 0.01	0.014	33.3%		16.67
TOT	Chrysene	0.01	0.05	µg/L	45%	0.061	0.05	19.8%		9.91	0.068	0.1	38.1%		19.05
TOT	Dibenzo(a,h)anthracene	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	Fluoranthene	0.01	0.05	µg/L	45%	0.64	0.56	13.3%		6.67	0.98	1.2	20.2%		10.09
TOT	Fluorene	0.01	0.05	µg/L	45%	1.3	1.2	8.0%		4.00	2.7	2.7	0.0%		0.00
TOT	Indeno(1,2,3-c,d)pyrene	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	Naphthalene	0.01	0.05	µg/L	45%	0.67	0.71	5.8%		2.90	1.2	1.2	0.0%		0.00
TOT	Phenanthrene	0.01	0.05	µg/L	45%	0.38	0.39	2.6%		1.30	1.7	1.7	0.0%		0.00
TOT	Pyrene	0.01	0.05	µg/L	45%	0.42	0.36	15.4%		7.69	0.65	0.77	16.9%		8.45
CHLORINATED PHENOLS															
TOT	Chlorinated phenols (total)	0.1	0.5	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
TOT	Total Dichlorophenols	0.1	0.5	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
TOT	Total Monochlorophenols	0.08	0.4	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
TOT	Total Nonchlorinated phenols	10.	50.	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
TOT	Total Tetrachlorophenols	0.1	0.5	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
TOT	Total Trichlorophenols	0.1	0.5	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
TOT	2-Chlorophenol	0.08	0.4	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
TOT	2,4 + 2,5 Dichlorophenol	0.1	0.5	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
TOT	2,4,6-Trichlorophenol	0.1	0.5	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
TOT	Pentachlorophenol	0.1	0.5	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
TOT	2,3,4,5-Tetrachlorophenol	0.1	0.5	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
TOT	2,3,4,6-Tetrachlorophenol	0.1	0.5	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
TOT	2,3,5,6-Tetrachlorophenol	0.1	0.5	µg/L	45%	--- ---	--- ---	---	---	---	--- ---	--- ---	---	---	---
EMERGING CONTAMINANTS															
TOT	Perfluorobutanesulfonic acid	0.02	0.1	µg/L	45%	0.29	0.3	3.4%		1.69	0.35	0.35	0.0%		0.00
TOT	Perfluorodecanesulfonic acid (PFDS)	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	Perfluoroheptanesulfonic acid	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	Perfluorohexanesulfonic acid	0.02	0.1	µg/L	45%	0.34	0.34	0.0%		0.00	0.4	0.4	0.0%		0.00
TOT	Perfluorononanesulfonic acid	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	Perfluorooctanesulfonic acid	0.02	0.1	µg/L	45%	0.13	0.13	0.0%		0.00	0.15	0.15	0.0%		0.00
TOT	Perfluorooctanoic acid (PFOA)	0.02	0.1	µg/L	45%	0.54	0.53	1.9%		0.93	0.55	0.53	3.7%		1.85
TOT	Perfluoropentanesulfonic acid	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	PF3A	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	PF4A	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	PFBoA	0.02	0.1	µg/L	45%	0.34	0.34	0.0%		0.00	0.35	0.35	0.0%		0.00
TOT	PFDA	0.02	0.1	µg/L	45%	0.048	0.05	4.1%		2.04	0.047	0.047	0.0%		0.00
TOT	PFDoA	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	PFHpA	0.02	0.1	µg/L	45%	0.17	0.17	0.0%		0.00	0.17	0.17	0.0%		0.00
TOT	PFHxA	0.02	0.1	µg/L	45%	0.93	0.93	0.0%		0.00	0.95	0.97	2.1%		1.04
TOT	PFNA	0.02	0.1	µg/L	45%	0.033	0.031	6.3%		3.13	0.032	0.033	3.1%		1.54
TOT	PFOSA	0.02	0.1	µg/L	45%	< 0.02	< 0.02	0.0%		0.00	< 0.02	< 0.02	0.0%		0.00
TOT	PFPeA	0.02	0.1	µg/L	45%	0.39	0.4	2.5%		1.27	0.37	0.36	2.7%		1.37
TOT	PFUA	0.02	0.1	µg/L	45%	---	---	-		---	< 0.02	< 0.02	0.0%		0.00
TOT	1,4-Dioxane	0.02	0.1	µg/L	45%	11.	11.	0.0%		0.00	8.2	7.9	3.7%		1.86

Notes:

FR1, FR2 - Field replicates 1 and 2.

FRM - Mean of field replicates.

MDL - Method detection limit.

COV - Coefficient of Variation

LOQ - Limit of quantification.

RPD - Relative percent difference.

na - Not applicable, some replicates less than the detection limit.

a - Relative Standard Difference greater than 3% for general inorganic parameters/metals

b - Relative Standard Difference greater than 3% for general inorganic parameters/metals

3.4 Summary

In summary, the 2020/21 quality assurance (QA) analysis indicates the following:

- Duplicate sampling frequencies of 13% (40/298 samples) for groundwater, 22% (20/88 samples) for surface water, 36% (4/11 samples) for the Hartland Valve Chamber compliance point and 6.4% (4/62 samples) for the overall leachate sampling program. Overall, approximately 14% (64/448) of samples were duplicated, which met the targeted duplicate sampling rate of 10%.
- Groundwater sampling and laboratory analysis have produced reliable results. The QA results indicated a total of 14 samples and 27 analytical results exceeded the RPD alert limits where all parameter concentrations were above the LOQ. However, dissolved zinc concentrations should be interpreted with caution, as 20% of the duplicate samples had dissolved zinc concentrations above the alarm limit where all parameter concentrations were above the LOQ, indicating potential contamination during the sample handling or filtration process.
- Surface water sampling and laboratory analysis have produced reliable results. The QA results indicated a total of 11 samples and 41 analytical results exceeded the RPD alert limits where all parameter concentrations were above the LOQ.
- Leachate sampling and laboratory analysis have produced reliable results. A total of two (2) samples and two (2) parameters had calculated RPD values that exceeded RPD alert limits when concentrations in both replicates were above the LOQ.
- A Mann-Kendall statistical trend analyses was conducted on water quality data collected from 79 groundwater monitoring wells, 8 leachate purge wells, 21 surface water stations and 1 leachate monitoring point for parameters that are known indicators of leachate and aggregate influences to evaluate temporal trends in water quality at the landfill. The results of trend analyses are discussed in the groundwater and surface water quality sections of this report.

4. Groundwater Flow

4.1 Data

A review of the sampling program was undertaken in early 2016 (AECOM 2016), and recommendations for modifications to the number, location and sampling frequency of compliance monitoring locations were implemented throughout the 2020/21 monitoring year. The groundwater flow interpretation presented in this section is based on the following data:

- Groundwater elevations were measured four times per year in all groundwater monitoring wells.
- Continuous water level and leachate elevation monitoring using the SCADA system for the lower leachate lagoon, upper leachate lagoon, Phase 2 basin, wells 36-1-1 and 37-1-1, and one monitoring well located north of Phase 1 (40-1-1).
- Continuous water level monitoring in five purge wells south of Phase 1 (P1, P2, P3, P4 and P10).
- Continuous water level monitoring in six wells east of Phase 1 (17-1-1, 18-1-1, 54-1-1, 76-1-1, 89-1-1 and 89-2-1)
- Continuous water level and flow monitoring in or near three north purge wells (80-1-0-P8, 81-1-0-P9 and 52-4-0-P7) and two monitoring wells (52-3-0 and 52-1-1) located north of Phase 1.
- Continuous water level monitoring in ten wells north of Phase 2 (41-1-1, 43-1-1, 44-1-1, 62-1-1, 77-1-1, 78-1-1, 87-1-1, 87-2-1, 88-1-1 and 88-2-1).
- Continuous water level monitoring in four wells in Hartland North Ridge area (91-1-1, 92-1-1, 93-1-1 and 94-1-1).
- Presence and elevation of topography, refuse, engineered covers, temporary tarps, ditches, and surface water features.
- Daily precipitation data.

Groundwater elevations for 2020/21 are presented in Appendix A.3. The data indicate that there are two separate groundwater flow systems at the Landfill. One is a regional groundwater flow system in the bedrock surrounding and underlying the landfill. The second is a perched system contained within the Phase 1 waste itself. A similar perched system has not been observed within the Phase 2 landfill thus far. Although the two flow systems are separate, the presence of the leachate mound within the waste influences groundwater flow in the bedrock underlying the waste. Understanding these two flow systems is important for evaluating the effectiveness of leachate control and containment measures. The groundwater flow patterns are interpreted based on groundwater elevations measured in August 2020.

Monitoring wells 79-1-1, 79-2-1, 74-1-1 and 74-2-1 were decommissioned in June 2018 to accommodate blasting and site preparation for aggregate storage. The pressure transducer installed in 79-1-1 was removed from the well prior to decommissioning. Four new leachate monitoring wells (89-1-1, 89-2-1, 90-1-1 and 90-2-1) were installed in Phase 1 and Phase 2 in 2018 and 2019 to verify leachate capture and support management decisions.

In April 2020, four (4) pressure transducers were installed at locations 91-1-1, 92-1-1, 93-1-1 and 94-1-1 to continuously monitor water levels in the Hartland North Ridge area. Continuous water data were presented in Figure-4-9.

4.2 Regional Groundwater Flow in the Bedrock

Figure 4-1 presents regional groundwater flow based on groundwater elevations in bedrock wells and deep wells in refuse for August 2020. Within the landfill footprint, several wells (75-1-1, 82-1-1, VLGW-02-D, VLGW-03-D, VLGW-08-D, VLGW-15-D, VLGW-16-D and VLGW-17-D) are screened at or near the bottom of the waste and their water levels are interpreted as being representative of the regional groundwater flow system within bedrock underlying the landfill. Geological structures including the Highland Fault and another inferred fault near monitoring well 77-1-1 are shown in plan on Figure 4-1, and in cross section on Figure 4-2 and Figure 4-3. Measured groundwater levels and hydrogeologic testing indicates these structures influence local-scale groundwater flow patterns. Figure 4-2 is a cross-section that extends from north of the leachate lagoons to south of Phase 1 through the refuse and depicts groundwater flow in a north-south direction. Figure 4-3 depicts groundwater flow in an east-west cross-section extending from the bedrock ridge located north and west of Phase 2 eastward to the eastern property boundary.

Groundwater flow patterns were similar to those observed in previous years. Regional groundwater flow in the vicinity of Hartland Landfill is influenced by bedrock structures, topographic relief and the presence of surface water features. Regional groundwater flows from southwest to northeast from Mount Work and toward the north-south trending valley that underlies the northern portions of the Phase 1 and Phase 2 landfill.

Groundwater flow in the bedrock valley that holds the landfill is predominantly northward as shown in Figure 4-1. The majority of the leachate-impacted groundwater in the bedrock below the landfill flows northward to the lower leachate lagoon via the Phase 2 basin leachate collection system, microtunnel, leachate springs and purge wells (52-4-0-P7, 80-1-0-P8 and 81-1-0-P9) located north of Phase 1.

As shown on Figure 4-1, there is an inferred groundwater flow divide located near the southern end of the landfill and a small portion of groundwater below the southern portion of the Phase 1 landfill flows towards the southeast. This flow divide roughly corresponds to a bedrock high in the valley floor beneath the landfill. Southeastward groundwater flow below the landfill is constrained by a constructed clay berm/bedrock grout curtain installed at the south end of the landfill in the 1980s, and by five purge wells (P1, P2, P3, P4 and P10) which commenced pumping leachate in 2001. Leachate collected by the south purge well network is pumped from the south pumping station northward to the lower leachate lagoon.

In the vicinity of the North Ridge and Hartland North Pad (northwest of Phase 2), groundwater flow is divergent from the topographic high north of Phase 2, with flow both to the northeast (towards Heal Creek) and to the north (towards Durrance Lake). The groundwater divergence is more apparent during wet fall, winter and early spring months when precipitation inputs increase infiltration and raise groundwater levels. Groundwater levels are several metres higher west of the Highland Fault than they are immediately east of the fault, indicating that the Highland Fault is a barrier to west-east groundwater flow, especially during winter months. Geologic mapping of exposed bedrock on the North Ridge (AECOM 2018a) revealed an undulating bedrock surface with several closed depressions that allow for surface water pooling and enhanced recharge during wet weather, which is important for maintaining the Phase 2 hydraulic trap.

A bedrock ridge is located east of the landfill boundary, running roughly north-south between the Hartland Landfill and Kiowa Place road. Groundwater in the shallow bedrock along the landfill boundary flows inwards toward the northern portion of Phase 1. Further east of the landfill boundary, the topography begins to slope eastward towards Tod Creek valley and the groundwater flow direction is likely eastward towards Tod Creek.

4.3 Leachate Elevations in Phase 1 and Phase 2

4.3.1 Phase 1

Groundwater monitors installed at varying depths in Phase 1 provide water level data to confirm leachate levels and flow directions within the refuse. In addition to the monitors, water level data is collected from selected landfill gas wells in Phase 1.

The leachate mound in the Phase 1 landfill is depicted along a north-south cross section in Figure 4-2**,** based on groundwater level and leachate measurements taken in August 2020. During the operating years of the Phase 1 landfill, the leachate mound within Phase 1 reached elevations of approximately 160 m asl (above mean sea level). Final cover was installed on Phase 1 in 1997 to limit infiltration. As shown on Figure 4-2, the leachate mound in the refuse is above the regional bedrock groundwater flow system with downward gradients. The downward hydraulic gradients in the central portions of the landfill reverse to upward gradients due to pumping at the leachate collection purge wells at the north and south ends of the landfill. In 2020/21, leachate elevations within Phase 1 generally remained below 155 m asl, indicating an approximate 5 m decrease in the elevation of the leachate mound since Phase 1 landfill closure capping.

Figure 4-5 presents leachate levels in 14 gas monitors in the Phase 1 landfill. Although it is difficult to accurately measure leachate levels in gas wells, they do provide additional landfill leachate level information. Similar to previous years, leachate levels in the shallow landfill gas monitors typically show minor variations (<1m) in elevation, as the refuse has a relatively high porosity and a relatively consistent recharge and discharge. The higher perched leachate elevations in shallow gas wells screened in refuse (i.e. VLGW-21-D and VLGW-26-D) indicate downward vertical gradients from refuse to the underlying bedrock aquifer. A pressure transducer was installed in 89-2-1 in March 2019 to continuously record leachate levels. As shown on Figure 4-5, leachate elevations in the shallow well 89-2-1 were generally stable over time, ranging from 149.4 to 151.6 m asl.

Similar to previous years, leachate elevations in the deep gas monitors (VLGW-02-D, VLGW-03-D, VLGW-08-D, VLGW-15-D, VLGW-16-D and VLGW-17-D) continued to fluctuate in response to seasonal variability in groundwater recharge, indicating that the lower portions of the Phase 1 landfill are in hydraulic connection with the regional groundwater flow system. Leachate monitoring well 89-1-1 was installed in November 2018 to replace the decommissioned well 74-1-1. Well 89-1-1 was screened at the bottom of the refuse unit to facilitate measurement of leachate mound levels. In 2020/21, leachate elevations in 89-1-1

were generally stable and remained below 152 m asl. The relatively rapid increase in leachate levels between August 2019 and November 2019 may be related to leachate level recovery following well installation.

Well 75-1-1 is located downgradient of the other wells at the north end of Phase 1 and is connected with the deep regional water table. Similar to previous years, groundwater elevations in well 75-1-1 ranged from approximately 128 to 130 m asl in 2020/21 (Figure 4-5). The higher perched leachate elevations in shallow monitors VLGW-21-D (142 m asl) and VLGW-26-D (145 m asl), both located within 50 m of well 75-1-1 and screened in refuse, indicate that strong downward vertical gradients are present in this area of the landfill.

4.3.2 Phase 2 Basin

The Phase 2 landfill is located in a large bedrock basin situated immediately west of the north end of the Phase 1 landfill. The Phase 2 landfill is segregated into multiple cells. Cell 1 and Cell 2 are complete, and Cell 3 is currently active. Leachate from Cell 1 and Cell 2 is captured via the 350 mm diameter microtunnel via gravity and transmitted to the lower leachate lagoon. After reporting to the lower leachate lagoon, all leachate is discharged to the sanitary sewer via the leachate pipeline. A geomembrane liner separates Cell 2 and Cell 3, and leachate from Cell 3 is captured via the new Toutle drain which reports to the upper leachate lagoon prior to final discharge into the leachate pipeline and sanitary sewer.

Figure 4-8 presents hydrographs for the groundwater monitoring wells and leachate wells located north of the Phase 2 basin. For proper operation of the hydraulic trap leachate collection system, groundwater levels north of Phase 2 need to be higher than leachate levels inside the Phase 2 basin. During typical operations, leachate levels within the Phase 2 basin are typically around 113 m asl, 8 to 10 m lower than groundwater elevations outside the basin (AECOM 2020b). In 2020/21, groundwater elevations at surrounding locations 36, 37, 38, 39, 62, 77, and 78 remained higher than leachate levels in the Phase 2 basin, indicating the leachate collection system is functioning effectively.

Leachate monitoring wells (82, 83, 84, 86 and 90) were installed to investigate potential leachate mounding within the Phase 2 refuse. Wells 84 and 86 were damaged and subsequently decommissioned. New leachate monitoring wells (90-1-1 and 90-2-1) were installed in 2018-2019 to verify leachate capture and facilitate measurement of leachate mound levels. Drilling observations and subsequent monitoring indicated that the waste mass was moist, but largely unsaturated. Although higher leachate levels (i.e. >125 m asl) in 82-1-1, 83-1-1 were observed in the northern Phase 2 area (Figure 4-8), leachate levels were typically within their well screens. Higher leachate levels may be related to the presence of condensate, historical tarping or low permeability strata within the refuse, not the presence of leaching mounding. Well 90-1-1 and 90-2-1 remained dry in 2020/21. Overall, leachate elevations in Phase 2 are typically 1-2 m below the elevation of the unlined lower leachate lagoon, indicating that a significant leachate mound is not present in Phase 2.

Figure 4-8 also shows a hydrograph of the leachate levels in the lined upper leachate lagoon and the unlined lower leachate lagoon based on transducer readings recorded by the SCADA system. Between June and September 2020, the upper lagoon was allowed to remain approximately 50% full during the 2020 summer in preparation of testing the CRL. Due to the wet weather, water levels in upper leachate lagoon increased to approximately 51% full in December 2020 and continued to increase to a peak level of 128.2 m asl in mid-January 2021 (81% full). On December 30, 2020, the CRL became operational and leachate was discharged from the upper leachate lagoon at a rate of 65 to 85 L/s. The CRL operated intermittently in January 2021, and the CRL and leachate pipeline worked together to lower leachate levels in the upper lagoon. Since January 18, 2021, the volume of leachate in the upper lagoon gradually decreased and reached the normal operating level (123 m asl) on February 2nd, 2021. Water levels in the lower leachate lagoon remained around 114.5 m asl throughout the year, except for short period of time in June 2020 when conducting maintenance work at the micro tunnel. In January 2021, the set points in the lower lagoon were increased to 114.8 m asl in response to elevated leachate volume in the upper leachate lagoon. The available leachate storage capacity in both lower and upper lagoons were not exceeded in 2020/21.

As landfill development continues, it will be important to continue to confirm leachate levels within each phase of the landfill to verify seismic stability, confirm that the Toutle leachate underdrain and Phase 2 hydraulic trap are functioning, and to determine if additional leachate containment measures are necessary. It is recommended that the elevation of the leachate mound within Phase 2 be determined at least once every five years, with the next evaluation required before 2025.

4.4 Groundwater Flow in Bedrock Aquifer

4.4.1 East of Phase 1

Figure 4-4 shows groundwater elevations at locations 17, 18, 54 and 76, located on the bedrock ridge east of Phase 1. Dramatic change in water levels at location 18 have occurred occasionally since 2001. In 2016/17, groundwater elevations in the deepest wells at location 18 increased by approximately 8 m relative to years prior, and resulted in diminishing westward hydraulic gradients. As per 2018/19 annual monitoring recommendations (AECOM 2019a), pressure transducers were installed in wells 18-1-1, 76-1-1, 17-1-1 and 54-1-1 to continue monitor the groundwater elevations and confirm groundwater flow is toward the landfill.

As shown on Figure 4-4, groundwater levels in 18-1-1 returned to historical levels since 2018, indicating that stable westward hydraulic gradients were restored. In 2020/21, groundwater levels in 18-1-1 remained approximately 5-7 m lower than those in 76-1-1. Similarly, groundwater elevations at 54-1-1 are consistently higher than those in 17-1-1, indicating a westward component of groundwater flow at these locations. Similar to previous years, groundwater data at monitoring locations 18 and 76 indicated strong downward hydraulic gradients. Groundwater levels should continue to be monitored in these locations to verify groundwater gradients remain inward toward the landfill.

4.4.2 North of Phase 1

Groundwater quality data at wells downgradient of the north purge wells indicate that the purge well system operated since 1998 has had a mitigating effect on northward migration of leachate. In July 2016, monitoring well 81-1-0-P9 became operational in an ongoing effort to increase leachate collection capacity upgradient of well 40-1-1. The influence of pumping the north purge wells (80-1-0-P8, 52-4-0-P7 and 81-1-0-P9) on groundwater flow directions is illustrated in plan on Figure 4-1, with the 115 m, 120 m and 125 m water table contours deflected southward due to drawdown of the water table surrounding the north purge wells. In 2020/21, a total of 24,790 m^3 of leachate was removed by the north purge wells, which was consistent with that reported in 2019/20 (24,494 m^3) and slightly lower than that reported in 2018/19 (25,578 m^3). The highest leachate discharge rate was observed in January 2021, with the peak flow of 146 m^3/day.

Figure 4-6 presents precipitation and groundwater elevation data for monitoring wells located near the Phase 1 north purge well system (40-1-1, 52-1-1, 52-3-0, 52-4-0-P7, 80-1-0-P8 and 81-1-0-P9). Leachate discharge rates for the north purge wells (52-4-0-P7, 80-1-0-P8 and 81-1-0-P9) are also presented to illustrate the volume of leachate extracted and its relationship to precipitation events. Monitoring well 52-3-0 is the original purge well that operated between 1995 and 1998 and is located within 2 m of well 52-4-0-P7. Water levels in well 52-3-0 are affected by the pumping rate in 52-4-0-P7 and seasonal variations in groundwater recharge. Pressure transducers connected to SCADA are installed in wells 40-1-1, 52-3-0, 52-4-0-P7, 80-1-0-P8 and 81-1-0-P9 to provide long-term monitoring of purge well performance north of Phase 1.

As shown on Figure 4-6, leachate discharge rates in north purge wells increased significantly between October 2020 and January 2021, in response to intense precipitation. A total of 11,754 m^3 of leachate was discharged during that period, with the daily average leachate flows ranged from 97 to 146 m^3/day.

In 2020/21, groundwater levels in 40-1-1, 52-3-0 and 52-1-1 remained consistent with previous years. The average water levels in the north purge wells 80-1-0-P8 and 81-1-0-P9 were 113.5 and 118.9 m asl, which is generally consistent with those reported in 2019/20. The average water levels in 52-4-0-P7 was 112.1 m asl in 2020/21 and remained relatively stable, except for maintenance events.

Groundwater elevations in the wells surrounding the north purge well system should continue to be monitored to confirm that the north purge wells are functioning properly. Regular well maintenance is required to maintain leachate capture and therefore minimize potential future leachate impacts around the lower leachate lagoon at locations 40, 20 and 21.

4.4.3 South of Phase 1

The CRD installed six leachate collection purge wells at the south end of the Phase 1 landfill in August 2000 to intercept leachate migrating south of the Phase 1 groundwater divide. Pumps were installed in four of these wells (P1, P2, P3, and P4) and they have been in operation since September 2001 (continuously since May 2002). The remaining two wells (P5 and P6) were not outfitted with pumps due to low well yield.

Groundwater elevations measured using pressure transducers in each of the five operational south purge wells are plotted on Figure 4-7. The on/off cycling of the pumps is evident as water levels generally range from approximately 133 to 151 m ASL, which is consistent with previous years. These large and rapid changes in water levels imply the subsurface material has a low transmissivity, low bulk porosity and that the cone of depression associated with each purge well may be limited in lateral extent. Some fluctuations are related to pump maintenance events and short-term power disruptions.

Groundwater elevations in the south purge wells have fluctuated since 2007, and although elevations have remained somewhat greater than recommended, the installation of P10 in September 2010 and the pump upgrades to P1 between 2015 and 2017 resulted in significantly improved drawdown. Unfortunately, P1 required significant maintenance due to well fouling by leachate as a result of the existing design. In November 2018, P1 was re-installed and produces approximately of 1.01 L/s of leachate. The replacement well is screened in refuse only from 6.10 to 12.19 m below ground surface. Despite the shallower installation depth, the well removes a similar volume of leachate. In November 2020, pump in P1 was rebuilt and pressure transducer was re-installed. The lower set point was changed to 147.3 m asl, which is the lowest possible depth without burning out the pump. In 2020/21, the water levels in P1 generally remained stable, with average value of 147.7m asl.

In 2020/21, water levels all purge wells remained within their normal ranges, except for P3. Water levels in P3 gradually increased from 136.5 m to 139 m asl, indicating the diminishing of the pump performance. In March 2021, the pump in P3 was replaced. Water levels in adjacent purge well P2 remained below 136 m asl throughout the 2020/21, except for events of power failure and regular pump maintenance. The pressure transducer in P2 is installed above the pump, due to space limitations, but the constant water level readings (as shown on Figure 4-7) indicate that the P2 pump was functional throughout the year.

In 2020/21, a total of 37,115 m^3 leachate was removed by the south purge wells, which was approximately 14% higher than the volume removed in 2019/20. The average daily flow in 2020/21 was 101 m^3/day, which was approximately 10% higher than that in 2019/20. Overall, the increased leachate collection volume and stable water levels in south purge wells indicate proper function of the south purge well system throughout 2020/21. Water level monitoring should continue to confirm that the south purge wells are functioning properly.

4.4.4 Phase 2 - North Ridge Area

A detailed assessment of hydrogeologic conditions below the north ridge was conducted in 2016, culminating in a hydrogeological conceptual model of the ridge (AECOM 2016). The report indicated that subvertical strike-slip faults (e.g. Highland Fault near location 87/88 and inferred fault near location 77) behave as barriers to west-east groundwater flow, and create a compartmentalized groundwater flow system, while subhorizontal tensile fractures behave as preferential conduits for groundwater flow. It is likely that bedrock discontinuities contribute to the large fluctuations in groundwater elevations observed beneath the North Ridge in response to seasonal precipitation and infiltration events. Geologic mapping of exposed bedrock on the North Ridge (AECOM 2018a) revealed an undulating bedrock surface with several closed depressions that allow for surface water pooling and enhanced recharge during wet weather, which is important for maintaining the Phase 2 hydraulic trap.

Figure 4-9 presents the groundwater elevations in North Ridge area. The location of the groundwater divergence below the North Ridge has important implications for maintaining the hydraulic trap as the landfill expands northward in the future. Since 2006, ten new wells have been installed at five separate locations (77, 78, 79, 87 and 88) north of the High Level Road to better understand the groundwater divergence and direction of groundwater flow north of Phase 2. Continuous water levels have been recorded at monitoring locations 77-1-1, 78-1-1, 87-1-1, 87-2-1, 88-1-1 and 88-2-1 to better understand natural temporal and spatial variability in groundwater elevations over time. In November 2019, four new groundwater monitoring wells (91-1-1, 92-1-1, 93-1-1 and 94-1-1) were installed in the North Ridge area, to increase spatial coverage of groundwater monitoring and further define the groundwater divergence and overall groundwater flow regime at Hartland. Well 94-1-1 is located in the northwest corner of Hartland North and considered a background well. Continuous groundwater elevations recorded in these four locations were presented in Figure 4-9.

Similar to previous years, groundwater elevations in the North Ridge area exhibited strong seasonal fluctuations, and the groundwater divergence is more apparent during wet fall, winter and early spring months when precipitation inputs increase infiltration and raise groundwater levels. Groundwater levels are several metres higher west of the Highland Fault than they are immediately east of the fault, indicating that the Highland Fault is a barrier to west-east groundwater flow, especially during winter months. During the dry season, groundwater elevations beneath the North Ridge (62, 87 and 88) indicate a relatively broad and gently sloping piezometric surface near 168 m asl. Wells 93-1-1 and 94-1-1 are located along the inferred the

groundwater divergence. Groundwater elevations in these wells indicated strong eastward groundwater flow along the height of land, with hydraulic gradients of 0.09 and 0.14 during the dry and wet season, respectively.

Groundwater discharge to surface near the bottom of the Phase 2 Basin is indicated by upward groundwater gradients that are typically observed at locations 27, 77, 87, 88, and seeps along the western extent of the bedrock quarry extents and within the Toutle valley. Groundwater from this area and the west side of Phase 1 is captured by the Cell 3 Toutle Valley Leachate Underdrain and the Phase 2 hydraulic trap leachate collection system. Detailed groundwater discharge locations are presented in Hydrogeology and Hydrogeology Report (AECOM 2020b).

Given the importance of the groundwater divergence for leachate containment, the planned future quarrying in the Toutle Valley and the North Ridge should be conducted under the direction of a qualified blasting professional to minimize the potential for blast-enhanced fracturing, with possible negative impacts on hydraulic properties, groundwater elevations, groundwater flow rates and leachate containment north of the Phase 2 landfill. There are risks to the performance of the hydraulic trap if blasting is not properly designed and implemented.

4.5 Summary

4.5.1 Leachate Flow

Leachate mounding continues to be present in Phase 1 of the landfill. Leachate elevations in Phase 1 were generally stable and exhibited minor seasonal variations. The leachate mound in the upper portion of the refuse is interpreted as being 'perched' above the regional bedrock groundwater flow system, with relatively high water levels and strong downward hydraulic gradients. Between 2016 and 2021, leachate elevations in the upper portion of the refuse generally remained below 155 m, indicating an approximate 5 m decrease in the elevation of the leachate mound since closure of the Phase 1 landfill in 1997. The highest leachate elevations (155 – 157 m asl) were typically observed in the east/southeast area of the Phase 1 (i.e. 48-1-1, VLGW-004D and VLGW-011S), which corresponds with higher topography/refuse heights. Leachate levels in deeper parts of the refuse respond to seasonal recharge events, indicating that the lower portions of the Phase 1 landfill are in hydraulic connection with the regional groundwater flow system in bedrock. Leachate well 89-1-1 was screened at the bottom of the refuse, and leachate elevations in 2020/21 were generally stable and remained below 152 m asl. The rapidly increase in leachate levels between August 2019 and November 2019 may be related to leachate level recovery following well installation.

Leachate elevations in Phase 2 (Phase 2 Basin) are generally stable and typically around 113 m ASL. In 2020/21, 90-1-1 and 90-2-1 were either dry or contained only few centimeters of leachate above the well screen. However, the higher leachate levels (i.e. >125 m asl) in 82-1-1 and 83-1-1 suggests presence of the localized leachate mound in the northern Phase 2 area. The higher leachate elevations in this area may be related to historical tarping or low permeability strata within the refuse. Overall, leachate elevations in Phase 2 are typically 1-2 m below the elevation of the unlined lower leachate lagoon, indicating that a significant leachate mound is not present in Phase 2.

Due to the intense precipitation events, water levels in upper leachate lagoon reached the peak level of 128.2 m asl in mid-January 2021 (81% of capacity). The CRL was activated on December 30, 2020 and operated intermittently with leachate pipeline in January 2021 to lower the leachate volume in the upper lagoon. Since January 18, 2021, the volume of the upper lagoon gradually decreased and reached to normal level of 123 m asl on February 2nd, 2021. Leachate storage capacity in both lower and upper lagoon was not exceeded throughout 2020/21.

4.5.2 Groundwater Flow

Groundwater flow in 2020/21 generally followed previously established patterns. Regional groundwater flows from Mount Work northeast to the north-south trending valley that underlies the northern portions of the Phase 1 and Phase 2 landfill. Most of the northward groundwater flow in the bedrock below the landfill is captured by the Toutle Valley Underdrain, Phase 2 basin leachate collection system, springs discharging to the lower lagoon and the north and south purge well systems (wells P1, P2, P3, P4, P7, P8, P9 and P10).

Groundwater monitors east of Phase 1 (locations 54, 76, 17 and 18) confirm flow from east to west toward the landfill, preventing off-site migration to the east.

Pressure transducers installed in wells help delineate the size of the drawdown cone surrounding the north purge wells. In 2020/21, a total of 24,790 m^3 of leachate was removed by the north purge wells. The highest leachate extraction rate was

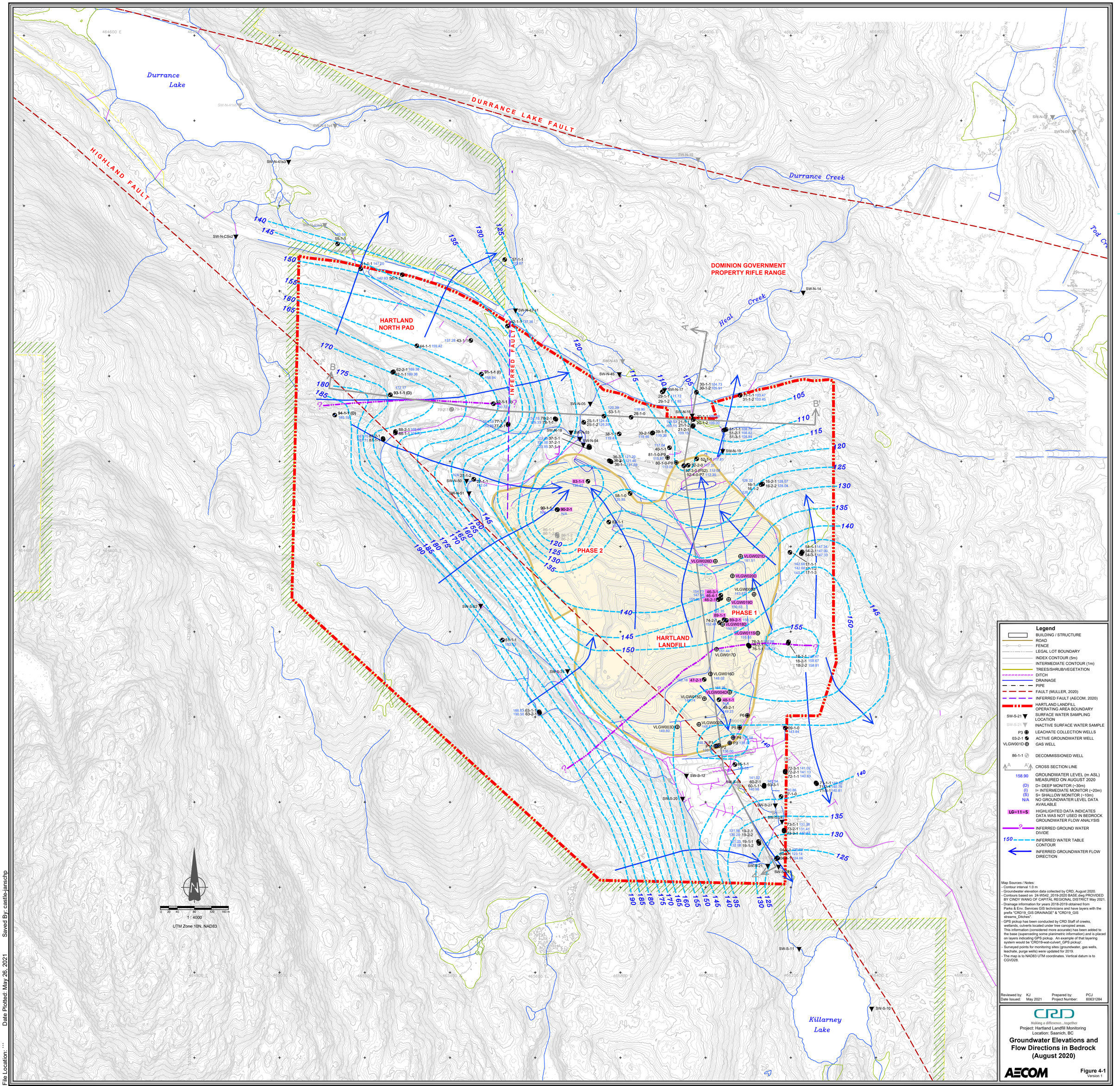
observed in January 2021, with the peak flow of 146 m^3/day. Water levels in 40-1-1, 52-3-0, 52-4-0-P7, 80-1-0-P8 and 81-1-0-P9 were generally consistent with historical ranges, indicating the leachate collection system is functioning effectively. Although leachate indicator concentrations in wells near 81-1-0-P9 have been slowly improving with the current pump settings, consideration should be given to either increasing the pumping rates or adjusting set points to achieve the groundwater elevations required to maintain pumping levels below the lower leachate lagoon and collect more leachate migrating from the area around the landfill gas plant. Closure of Phase 2 Cell 1 and the application of tarps to restrict infiltration and leachate generation appears to be slowly improving leachate containment north of the landfill.

A small amount of groundwater flows southeastward from the south end of Phase 1 in the direction of Killarney Lake. Southeastward groundwater flow below the landfill is constrained by a constructed clay berm and bedrock grout curtain installed at the south end of the landfill and by drawdown cones associated with the south purge wells. In 2020/21, water levels all purge wells remained within their normal ranges, except for P3. Water levels in P3 gradually increased from 136.5 m to 139 m asl, indicating the diminishing of the pump performance. In March 2021, the pump in P3 was replaced.

In 2020/21, a total of 37,115 m^3 leachate was removed by the south purge wells, which was approximately 14% higher than the volume removed in 2019/20. The average daily flow in 2020/21 was 101 m^3/day, which was approximately 10% higher than that in 2019/20. Overall, the increased leachate collection volume and stable water levels in south purge wells indicate proper function of the south purge well system throughout 2020/21. Water level monitoring should continue to confirm that the south purge wells are functioning properly.

Similar to previous years, groundwater elevations in the North Ridge area exhibited strong seasonal fluctuations and the Highland Fault continued to function as a barrier to east-west moving groundwater. During the wet fall, winter and early spring months, the horizontal hydraulic gradients between 87, 88 and 62 were steeper and exhibited a more prominent groundwater divergence than is apparent in the summer. Wells 93-1-1 and 94-1-1 are located along the inferred groundwater divergence. Groundwater elevations in these wells indicated strong eastward groundwater flow along the height of land, regardless of seasonality.

In 2018, geologic mapping of exposed bedrock revealed several closed depressions and geologic structures that enhance groundwater recharge below the North Ridge. A pattern of divergent groundwater flow beneath the North Ridge has been confirmed, with a component of flow migrating to the east, south and north. Although a weak groundwater divide is currently present, inward (southward) flow must be maintained to preserve the hydraulic trap leachate containment system. To ensure leachate containment, it is necessary to continue close monitoring of this hydraulic divide and conduct detailed planning (including hydrogeologic modelling) prior to landfill development in this area. Engineered solutions may be required following blasting, levelling and development of the North Ridge to maintain the current level of infiltration and the elevation of the groundwater divergence.



Legend

- BUILDING / STRUCTURE
- ROAD
- FENCE
- LEGAL LOT BOUNDARY
- INDEX CONTOUR (5m)
- INTERMEDIATE CONTOUR (1m)
- TREES/SHRUB/VEGETATION
- DITCH
- DRAINAGE
- PIPE
- FAULT (MULLER, 2020)
- INFERRED FAULT (AECOM, 2020)
- HARTLAND LANDFILL OPERATING AREA BOUNDARY
- SW-S-21 ▼ SURFACE WATER SAMPLING LOCATION
- SW-S-21 ▼ INACTIVE SURFACE WATER SAMPLE
- P3 ⊕ LEACHATE COLLECTION WELLS
- 03-2-1 ⊕ ACTIVE GROUNDWATER WELL
- VLGW001D ⊕ GAS WELL
- 86-1-1 DECOMMISSIONED WELL
- A A' CROSS SECTION LINE
- 158.90 GROUNDWATER LEVEL (m ASL) MEASURED ON AUGUST 2020
- (D) D= DEEP MONITOR (~30m)
- (I) I= INTERMEDIATE MONITOR (~20m)
- (S) S= SHALLOW MONITOR (~10m)
- N/A NO GROUNDWATER LEVEL DATA AVAILABLE
- LG-11-S HIGHLIGHTED DATA INDICATES DATA WAS NOT USED IN BEDROCK GROUNDWATER FLOW ANALYSIS
- INFERRED GROUND WATER DIVIDE
- 150 INFERRED WATER TABLE CONTOUR
- INFERRED GROUNDWATER FLOW DIRECTION

Map Sources / Notes:
- Contour interval 1.0 m
- Groundwater elevation data collected by CRD, August 2020.
- Contours based on 24-W542_2019-2020 BASE.dwg PROVIDED BY CINDY WANG OF CAPITAL REGIONAL DISTRICT May 2021.
- Drainage information for years 2018-2019 obtained from Parks & Env. Services GIS technicians and have layers with the prefix "CRD19_GIS DRAINAGE" & "CRD19_GIS streams_Ditches".
- GPS pickup has been conducted by CRD Staff of creeks, wetlands, culverts located under tree canopied areas. This information (considered more accurate) has been added to the base (superceding some planimetric information) and is placed on layers indicating GPS pickup. An example of that layering system would be 'CRD19-wat-culvert_GPS pickup'.
- Surveyed points for monitoring sites (groundwater, gas wells, leachate, purge wells) were updated for 2019.
- The map is to NAD83 UTM coordinates. Vertical datum is to CGVD28.

Reviewed by: KJ Prepared by: PCJ
Date Issued: May 2021 Project Number: 60631284

CRD
Making a difference...together

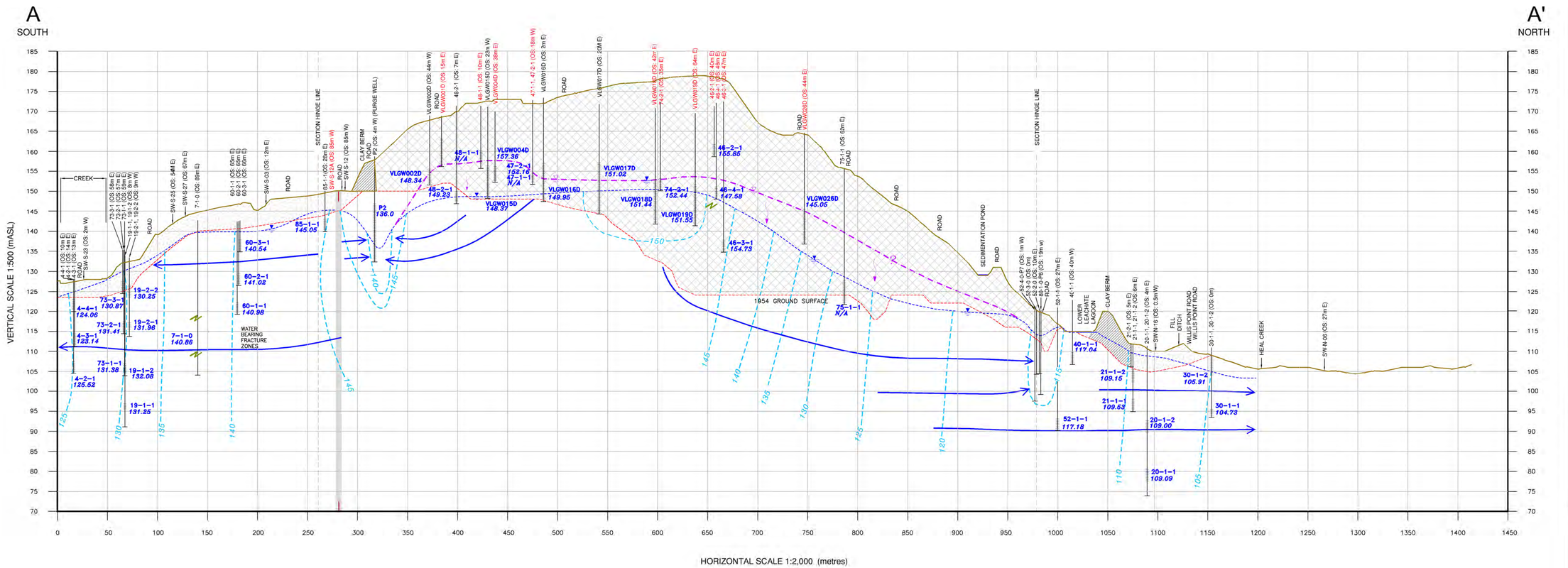
Project: Hartland Landfill Monitoring
Location: Saanich, BC

Groundwater Elevations and Flow Directions in Bedrock (August 2020)

AECOM

Figure 4-1
Version 1

File Location: \\\ Date Plotted: May 26, 2021 Saved By: castle-janschp



Legend

- 85-1-1 (6.5m) — MONITORING WELL (NUMBER) INDICATES DISTANCE WELL IS FROM PLANE OF SECTION. WHERE NOT INDICATED, DISTANCE IS LESS THAN 2 m.
- SCREENED INTERVAL
- 85-1-1 (6.5m) — MONITORING WELL WATER LEVEL WAS NOT USED IN THE BEDROCK GROUNDWATER FLOW ANALYSIS
- WATER BEARING FRACTURES
- GROUND SURFACE
- LOCATION OF BEDROCK DERIVED FROM 1954 GROUND CONTOUR OR BEDROCK INTERSECTIONS IN BOREHOLES
- REFUSE
- CLAY BERM
- UNCONSOLIDATED SOIL AND FILL
- INTERPRETED GROUNDWATER POTENTIOMETRIC SURFACE IN BEDROCK
- INFERRED VERTICAL LEACHATE FLOW
- INTERPRETED LEACHATE MOUND
- INFERRED GROUNDWATER POTENTIOMETRIC CONTOUR
- INFERRED GROUNDWATER FLOW DIRECTION IN BEDROCK
- 103.75 — GROUNDWATER ELEVATION (mASL) AUGUST 2020
- FAULT (MULLER, 1980)

Map Sources / Notes:
- Contours based on 24W542_2019-2020 base.dwg, provided by the Capital Regional District, May 2021.
- Stratigraphy between boreholes is inferred and may vary from that shown

0 10 20 40 60 80 m

1 : 2000

Section Looking West

Reviewed by: KJ
Date Issued: May 2021

Prepared by: PCJ
Project Number: 60631248

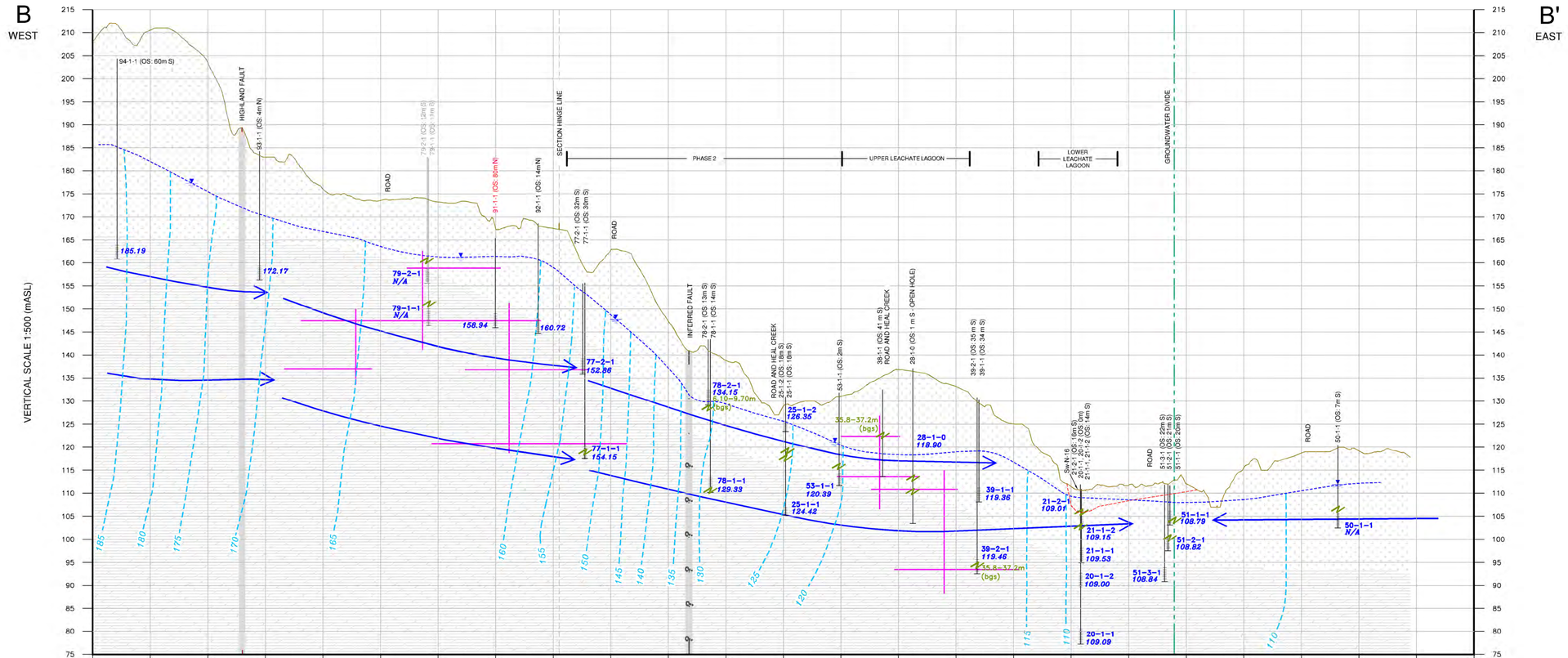
CRD
Working in Partnership

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Groundwater Flow in Cross Section A-A'
(August 2020)

AECOM

Figure 4-2
Version 2



Legend

- MONITORING WELL (NUMBER) INDICATES DISTANCE WELL IS FROM PLANE OF SECTION. WHERE NOT INDICATED, DISTANCE IS LESS THAN 2 m.
- SCREENED INTERVAL
- 85-1-1 (6.5m) — MONITORING WELL WATER LEVEL WAS NOT USED IN THE BEDROCK GROUNDWATER FLOW ANALYSIS
- OBSERVED FRACTURES ON DRILLED LOGS
- GROUND SURFACE
- LOCATION OF BEDROCK DERIVED FROM 1954 GROUND CONTOUR OR BEDROCK INTERSECTIONS IN BOREHOLES
- OVERBURDEN
- UNCONSOLIDATED SOIL AND FILL
- CLAY BERM
- SHALLOW WEATHERED AND BLAST ALTERED BEDROCK
- DEEP BEDROCK
- INTERPRETED GROUNDWATER POTENTIOMETRIC SURFACE IN BEDROCK
- INFERRED GROUNDWATER POTENTIOMETRIC CONTOUR
- INFERRED GROUNDWATER FLOW DIRECTION IN BEDROCK
- 112.50 — GROUNDWATER ELEVATION (mASL) AUGUST 2020
- INFERRED HYDRAULIC CONNECTIONS
- GROUNDWATER DIVIDE
- FAULT (MULLER, 1980)
- INFERRED FAULT (AECOM, 2017)

Map Sources / Notes:
- Contours based on 24W542_2019-2020 base.dwg, provided by the Capital Regional District, May 2021.
- Stratigraphy between boreholes is inferred and may vary from that shown.

0 10 20 40 60 80 m

1 : 2000
Section Looking North

Reviewed by: KJ
Date Issued: May 2021

Prepared by: PCJ
Project Number: 60631284

CRD
Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Groundwater Flow in Cross Section B-B'
(August 2020)

AECOM

Figure 4-3

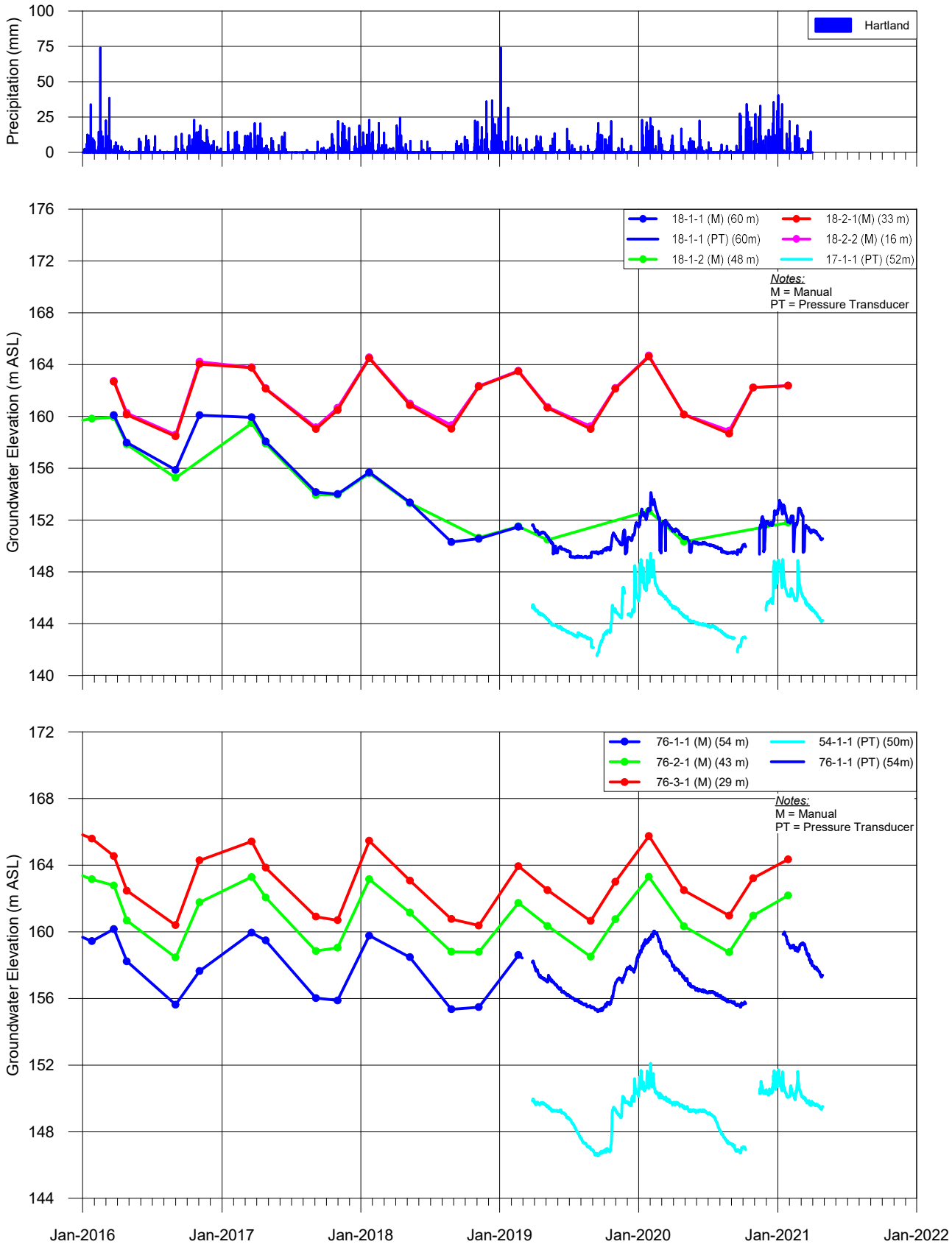


Figure 4-4. Groundwater Elevations East of Phase 1

AECOM

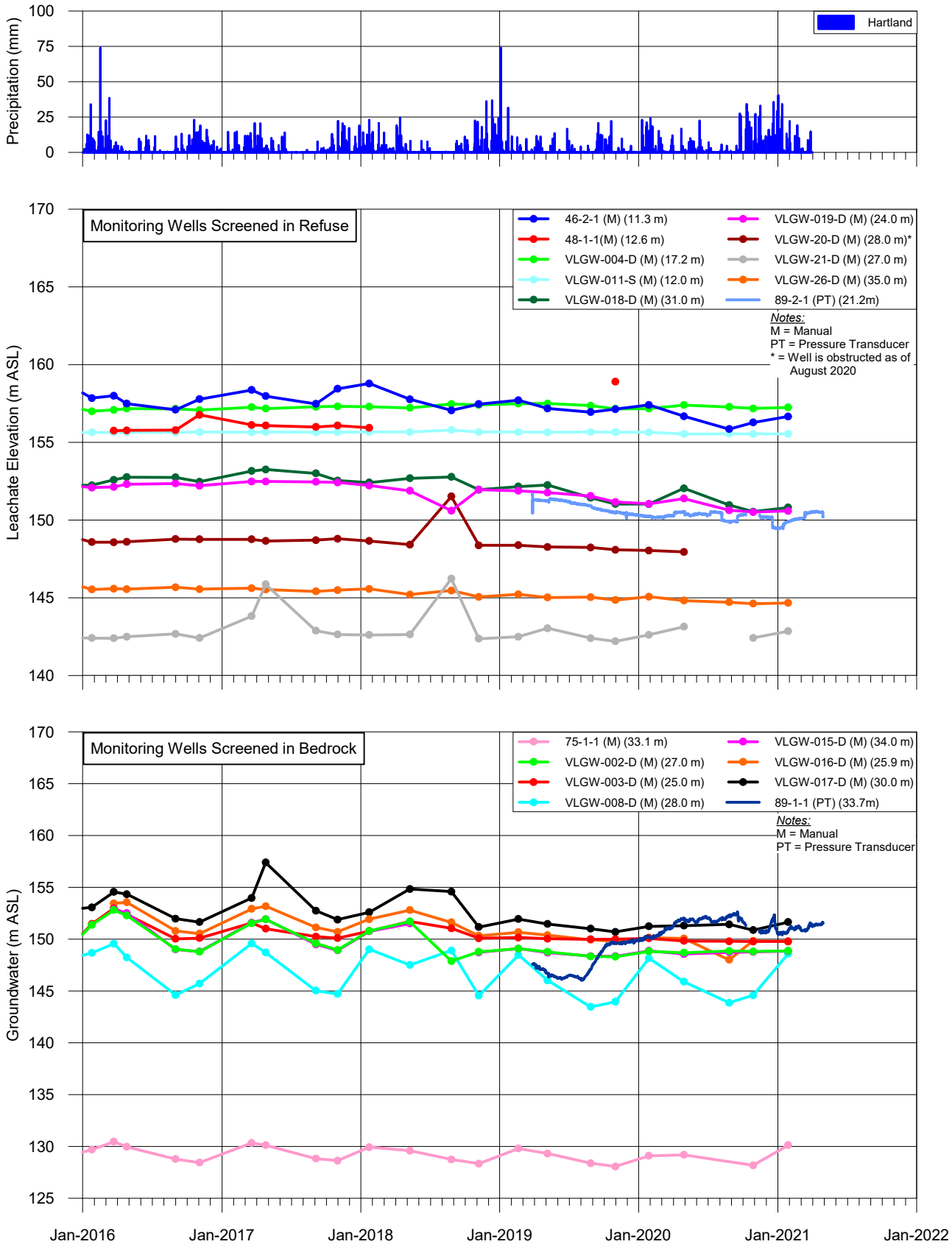


Figure 4-5. Leachate and Groundwater Elevations Within Phase 1

AECOM

Figure 4-6. Groundwater Elevations Surrounding the North Purge Wells

AECOM

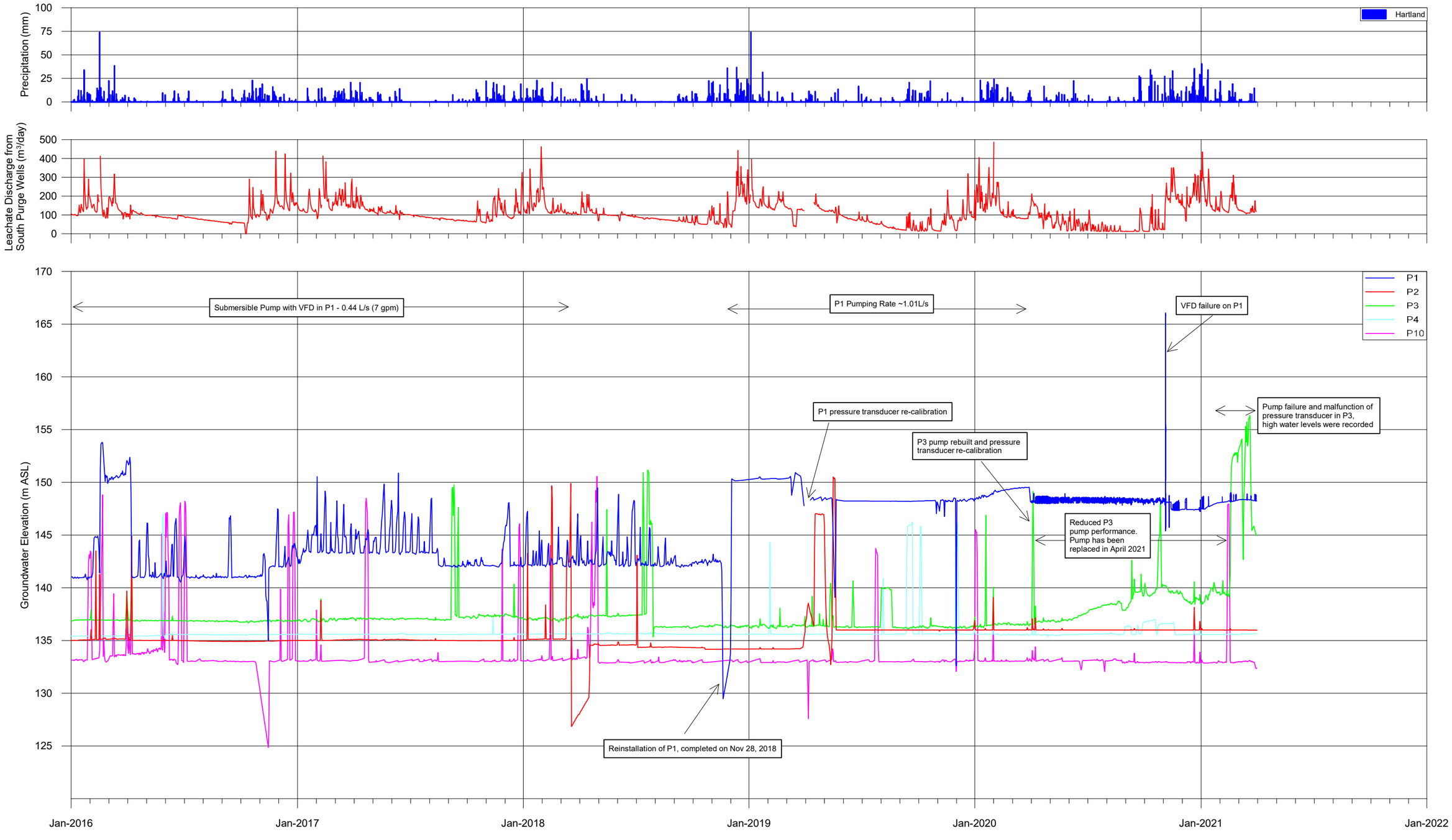


Figure 4-7. Groundwater Elevations in the South Purge Wells

AECOM

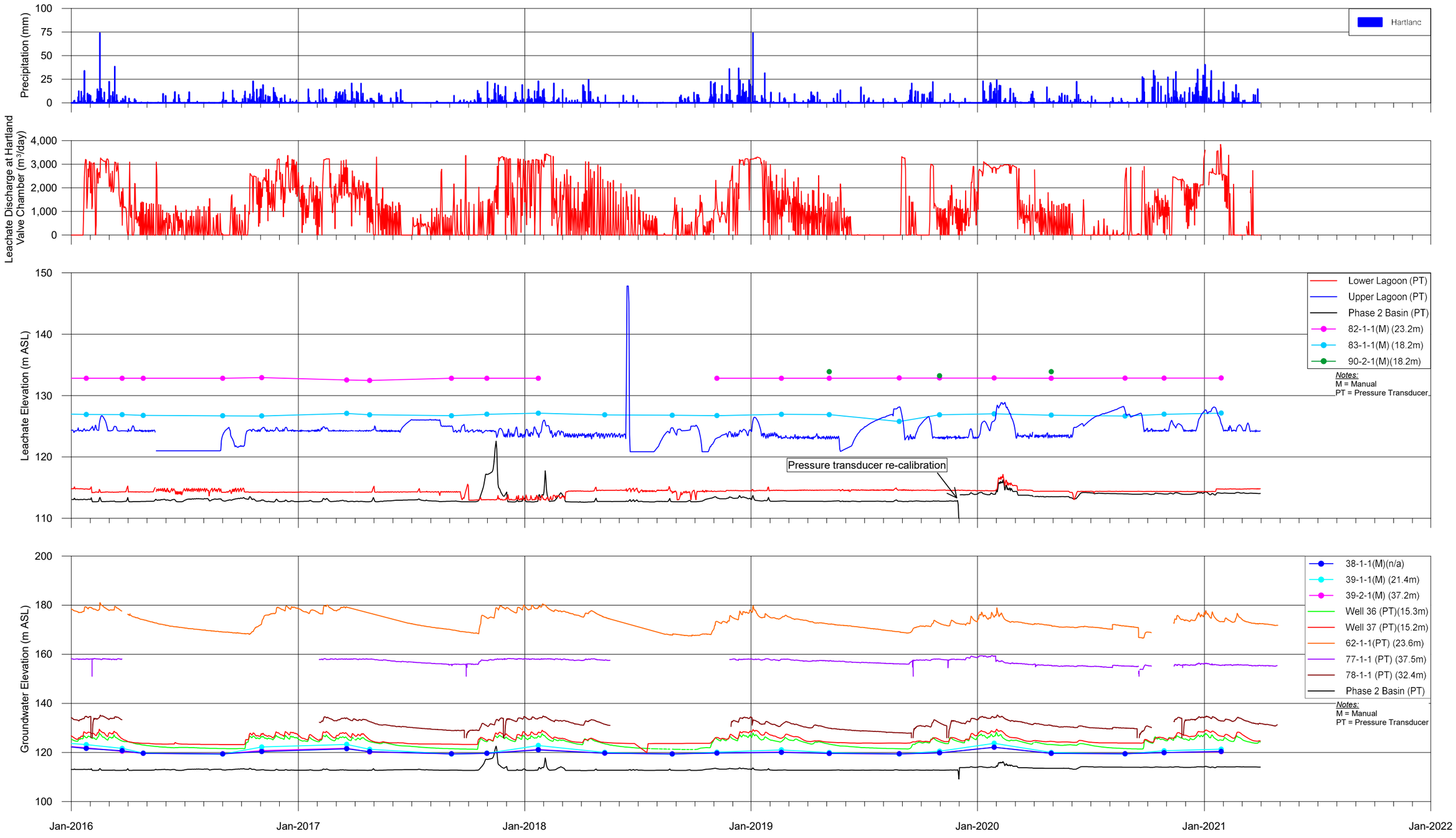


Figure 4-8. Water Elevations Within the Leachate Conveyance System and Surrounding the Phase 2 Basin

AECOM

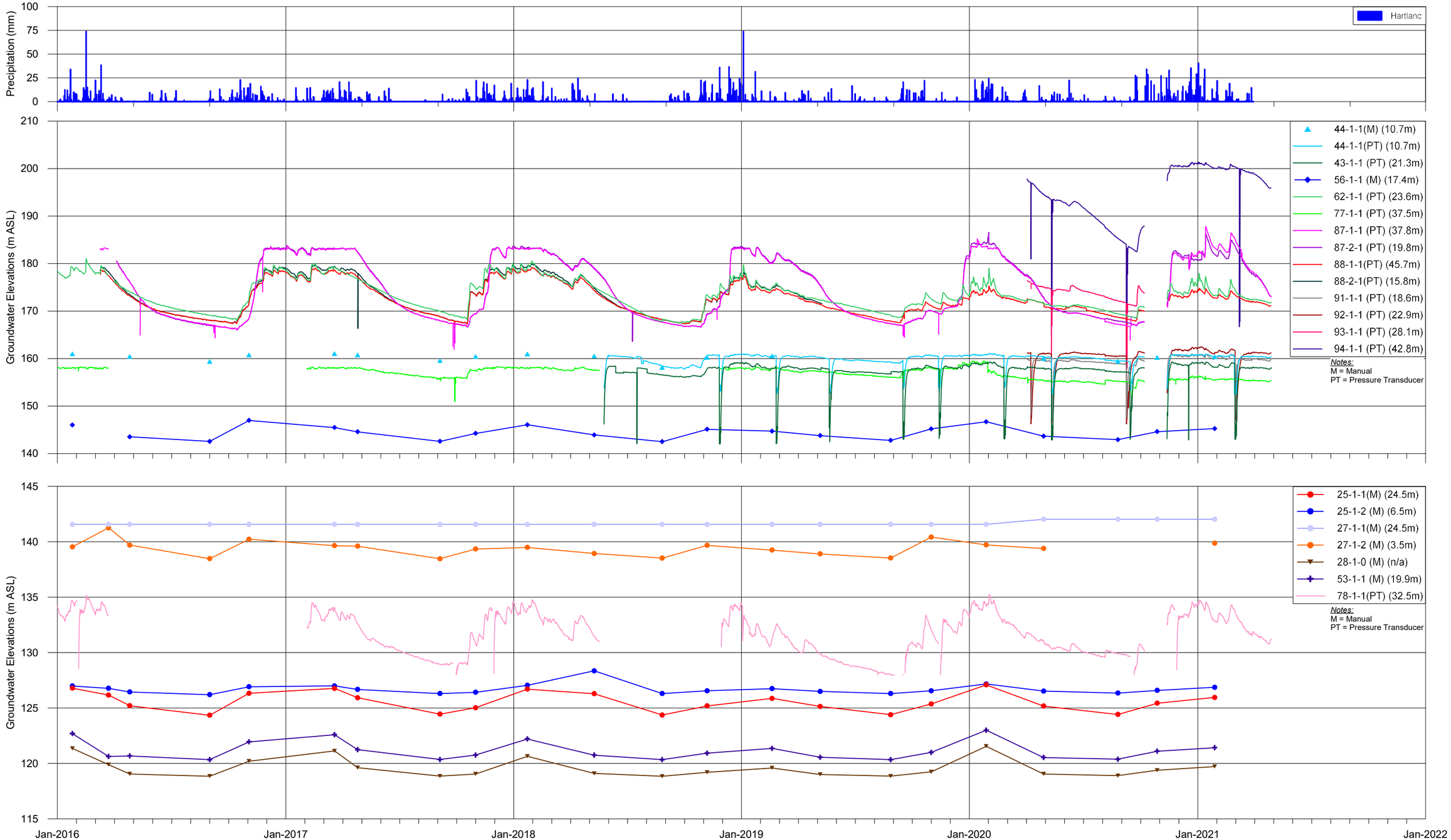


Figure 4-9. Groundwater Elevations in North Ridge Area

AECOM

5. Groundwater Quality Monitoring Wells

5.1 Compliance Groundwater Monitoring Locations

A total of 36 compliance monitoring wells have been identified at 19 different locations at the Hartland Landfill. These stations are concentrated along the south, east and northern property boundaries and are located downgradient of areas that have the potential to be impacted by leachate or runoff from the site. With respect to assessing landfill compliance with the landfill operating permit, the monitoring wells listed below are considered Boundary Compliance Wells.

South of the Landfill (10)

- 04-3-1, 04-4-1
- 71-1-1, 71-2-1, 71-3-1
- 72-1-1, 72-3-1
- 73-1-1, 73-2-1, 73-3-1

East of the Landfill (6)

- 17-1-1, 17-1-2, 17-1-3
- 18-1-1, 18-2-1, 18-2-2

North of the Landfill (15)

- 20-1-1, 20-1-2
- 21-1-1, 21-1-2, 21-2-1
- 28-1-0
- 29-1-1, 29-1-2
- 30-1-1, 30-1-2
- 31-1-1, 31-1-2
- 39-1-1, 39-2-1
- 53-1-1

North of the Hartland North Pad (5)

- 41-1-1
- 42-1-1
- 55-1-1
- 56-1-1
- 57-1-1

Compliance was assessed per Section 5.2. All data, including the applicable standards, are provided in Appendix B. Values that exceed CSR standards are noted with footnotes. Analytical results for groundwater samples collected from monitoring wells for the reporting period are presented in Appendix B.1. Table 5-1 presents a summary of the wells that exceeded CSR standards for one or more parameters in 2020/21. The majority of exceedances represent groundwater samples collected from leachate collection wells or in close proximity to leachate collection infrastructure.

A review of the sampling program was undertaken in early 2016, and recommendations for modifications to the number, location and sampling frequency of compliance monitoring locations were implemented beginning in the 2016/17 monitoring year. Groundwater quality data at compliance wells 04-2-1 and 72-2-1 has not been collected since 2016 due to the low recharge rate in the wells. These wells are no longer considered compliance locations.

Both DW and AW standards for iron and manganese are no longer applied to municipal landfills, based on the Stage 8 Amendments to the CSR.

Typical quarterly monitoring conducted by the CRD includes both compliance wells and other non-compliance locations that contribute to a fulsome understanding of landfill processes and potential for environmental risk.

5.2 Assessment of Groundwater Quality Impacts

The primary causes for any groundwater quality degradation at the site include leachate, road salt and aggregate production, stockpiling or use for construction purposes. Professional judgement is used to differentiate between different contaminant sources (leachate, road salt and aggregates) and to assess the nature and degree of any impacts. The authors are hydrogeologists and geochemists with considerable experience at other landfills in coastal regions of British Columbia. Groundwater quality may be judged to be impacted relative to background without exceeding regulatory criteria, and therefore compliant. If concentrations exceed CSR AW or DW standards for groundwater quality at the property boundary, standard protocols for notification of affected property owners should be followed.

Relative concentrations and patterns of conductivity, ammonia, chloride, sulphate and nitrate are compared to background concentrations to differentiate between the site's typical contaminant sources as outlined below:

- Background conductivity is typically below 500 µS/cm, but has been observed in some background wells at concentrations up to 1,000 µS/cm immediately after well installation, or following prolonged dry periods. Background ammonia concentrations are typically below 0.1 mg/L, but occasionally reach 0.5 mg/L downgradient of wetland areas. Background chloride concentrations are typically below 20 mg/L. Background sulphate concentrations are typically below 50 mg/L, but are regularly observed at concentrations up to 100 mg/L in wells screened within weathered bedrock and near geologic alteration zones.
- Groundwater is considered to be impacted by leachate when conductivity concentrations are above 1,000 µS/cm, ammonia concentrations are above 1 mg/L and chloride concentrations are above 20 mg/L. Peak concentrations in leachate impacted wells are typically observed during the dry summer and early fall months, when there is limited dilution by precipitation.
- Groundwater is considered impacted by aggregate (e.g. production, stockpiling or site construction works) when sulphate is present at concentrations above 75 mg/L and ammonia or nitrate are present at concentrations above background levels of 0.1 mg/L. Peak concentrations are typically observed during the first sampling event following the onset of wet weather in the fall months.
- Groundwater is considered impacted by road salt when both conductivity (>1,000 µS/cm) and chloride (>20 mg/L) are elevated above background levels, but ammonia and its degradation products (primarily nitrate) are not elevated. Road salt impacted sites must also be located downgradient (or downstream) of surfaces where road salt is known to be applied. Concentrations of conductivity and chloride typically exhibit peaks following cold weather periods when de-icing salt is often applied to roadways.

5.3 Electrical Conductivity

Figure 5-1 presents the electrical conductivity values in plan for samples collected at Hartland Landfill in September 2020. Figure 5-2 and Figure 5-3 present north-south and east-west cross-sections through the landfill and north of the landfill that show conductivity values in September 2020. Electrical conductivity is a good indicator of the presence of inorganic parameters and a good indicator of potential leachate contamination when elevated ammonia and chloride are also present. The highest conductivity values are typically observed during the dry season (i.e. August/ September), and were utilized to interpret the conductivity contours.

On Figure 5-1, the 1,000 µS/cm conductivity contour line is interpreted as indicating the presence of leachate in groundwater. Figure 5-1 shows that the 1,000 µS/cm contour closely resembles the outline of current refuse disposal and indicates that groundwater in these areas has been affected by leachate. Similar to previous years, conductivity values in north purge wells and south purge wells were generally above 1,000 µS/cm in 2020/21, except for 81-1-0-P9. As shown on Figure 5-1, conductivity values at north purge wells were highest in P7, which was close to 4000 µS/cm in September 2020. Conductivity values in the south purge wells ranged from 963 to 2,105 µS/cm, which were slightly lower than those measured in September 2019. Leachate was most concentrated in P4, with a highest conductivity value of 2,105 µS/cm. Similar to previous years, the 1,000 µS/cm contour runs north of the north purge well system and lower leachate lagoon, and extends south of P1, P2, P3, P4, P5, P6, and P10 of the south purge well system.

The 500 µS/cm conductivity contour is considered indicative of background groundwater quality. In September 2020, the 500 µS/cm conductivity contour along the north boundary shrunk slightly and did not extend to well 21-2-1 and 40-1-1. In 2020/21, the average conductivity in 21-2-1 and 40-1-1 ranged from 339 to 491 µS/cm and 310 to 456 µS/cm, respectively, which were approximately 20% lower than those measured in 2019/20. This indicates groundwater quality improvement in this area. Similar to previous years, the 500 µS/cm contour did not extend beyond location 25 at the north end of the landfill. Results from groundwater collected from location 36 showed that conductivity values during all four sampling events were above 500 µS/cm, indicating the 500 µS/cm contour extends beyond location 36. Along the east boundary of the landfill, the 500 µS/cm contour did not extend beyond location 18. At the west boundary, the location of the 500 µS/cm contour could not be determined, due to the absence of monitoring wells. However, the presence of conductivity data for location 27, coupled with eastward and upward groundwater flow in that area indicates the 500 µS/cm contour remains east of location 27. South of the landfill, the 500 µS/cm contour encompassed location 72-3-1 and 07-1-0, but did not extend to location 71.

Source control techniques should continue to be implemented throughout the landfill including minimizing the volume of aggregate stockpiles, application of covers and paving of traffic surfaces will be important to maintaining the quality of surface and groundwater in the future.

5.4 Monitors North of the Phase 1 Landfill

Long-term groundwater quality north of the Phase 1 landfill is shown on Figure 5-4.

5.4.1 Monitoring Site 58

Monitoring site 58 (not a Boundary Compliance Well) is located in the transition area between the Phase 1 and Phase 2 landfill 200 m from the property boundary. The well is 19 m deep and screened in bedrock below refuse. Well 58-1-0, has exhibited elevated concentrations of leachate indicator parameters since 2001, shortly after landfilling upslope of the well began. Although concentrations have generally decreased slightly since peak concentrations observed in 2001 to 2004, concentrations of key leachate indicator parameters (conductivity, ammonia, chloride and nitrate) remain highly elevated. Water quality is indicative of leachate-impacted groundwater flowing toward the lower leachate lagoon and the north purge wells.

In 2020/21, four groundwater sampling events were conducted at location 58. All four samples from well 58-1-0 exhibited concentrations of ammonia and cobalt concentrations that exceeded CSR AW standards. Further, concentrations of chloride, cobalt, nickel, strontium and vanadium exceeded CSR DW standards during one or more sampling events. Sodium concentrations were above the CSR DW of 200 mg/L but well below the regional background concentration of 1,700 mg/L, and therefore sodium concentrations were in compliance with the CSR at this location. In 2020/21, mean concentrations of ammonia and chloride were 100 mg/L and 925 mg/L, respectively, which were consistent with 2019/20 levels. Groundwater quality in 58-1-0 exhibited no trend in conductivity, sulphate and nitrate and an increasing trend in ammonia and chloride concentrations over the past five years.

Similar to 2019/20, dissolved cobalt concentrations ranged from 47.6 to 53.6 µg/L, which exceeded both CSR AW and regional background concentration of 14 µg/L. Continued water quality monitoring at this well over time is important as it provides an indication of the quality of leachate migrating toward the leachate lagoons and the Phase 1 north purge well system.

5.4.2 Monitoring Sites 52 (P7), 80 (P8) and 81 (P9)

Monitoring sites 52, 80 and 81 (not Boundary Compliance Wells) are located in the centre of the leachate plume between the toe of the Phase 1 landfill and the lower leachate lagoon, approximately 100 m from the property boundary. Leachate flows along the bedrock/refuse interface underlying Phase 1 toward the lower leachate lagoon and the north purge wells (52-4-0-P7, 80-1-0-P8 and 81-1-0-P9). Groundwater quality has been heavily impacted by leachate since monitoring began at these locations in the 1980's.

In 2020/21, groundwater samples were collected from well 52-1-1 (31 m deep) and leachate samples were collected from the north purge wells (80-1-0-P8, 52-4-0-P7 and 81-1-0-P9). Prior to 2016/17, leachate samples had only been collected from the combined discharge at 52-4-0-P7 and 80-1-0-P8.

Similar to previous years, concentrations of chloride in monitoring well 52-1-1 met the CSR DW standard of 250 mg/L during all sampling events in 2020/21. Ammonia concentrations were similar to previously reported values and exceeded CSR AW standards on three out of four sampling dates. In 2020/21, the mean annual conductivity concentration in 52-1-1 was 1,696 µS/cm, which was slightly lower than values observed in 2019/20 (1,725 µS/cm). A statistically significant decreasing trend in conductivity was observed over the past five years, indicating an improvement in water quality at this location.

In 2020/21, the mean conductivity in the P8 and P9 was 1,240 µS/cm and 847 µS/cm, respectively, which was slightly lower than those observed in 2019/20. Conductivity concentrations were most elevated in 52-4-0-P7, with an annual average of 3,269 µS/cm. Groundwater quality in 52-4-0-P7 exceeded CSR AW standards for ammonia in all four sampling events and exceeded the CSR DW standard for chloride during three out of four sampling events. Groundwater quality in 80-1-0-P8 exceeded the CSR AW standards for ammonia during all four sampling events. Statistically significant increasing trends in ammonia and chloride concentrations were observed in 52-4-0-P7, and an increasing trend in ammonia was observed in well 80-1-0-P8. Groundwater quality in 81-1-0-P9 met all CSR AW and DW standards in 2020/21. No statistically significant trends were observed in 81-1-0-P9. Although increasing trends in ammonia and chloride were detected, groundwater quality in the north purge wells showed slight improvement, supported by lower conductivity values and less CSR exceedances. The improved water quality in north purge wells was attributed to the higher annual precipitation and subsequent more dilution of leachate. Water quality at these wells should continue to be monitored to assess temporal changes in leachate quality and verify the effectiveness of the leachate collection system.

In 2020/21, water elevations in P9 were still elevated, so leachate collection volumes are likely to be relatively low over time. Despite the low well yield, the drawdown cone is likely to be relatively narrow and steep and may continue to help improve water quality at 40-1-1 over time. The relatively high leachate levels reported in P9 indicate there are opportunities for improved leachate collection by lowering pump set points, increasing pumping rates, or lowering the pump installed in the well.

Table 5-1. Groundwater Quality Exceedances 2020-2021

BC CSR				AW Maximum (1)	---	---		---		---				---		90		50		10000	
				DW Maximum (2)	---	---		---		---				9500		6		10		1000	
Station	**Sample Type**	**Compliance Well (Y/N?)**	**Date Sampled**	**Parameter**	**PH (Field)**	**Specific Conductivity - 25°C (Field)**		**Temperature (Field)**		**Alkalinity**		**Hardness as CaCO3**		**Aluminum**		**Antimony**		**Arsenic**		**Barium**	
				Fraction	TOT	TOT		TOT		TOT		DIS		DIS		DIS		DIS		DIS	
				Unit	pH	µS/cm		°C		mg/L		mg/L		µg/l		µg/l		µg/l		µg/l	
				Method Detection Limit	0.1	1		0.1		1		0.5		0.5		0.02		0.02		0.02	
Gw - 52-1-1	SS	N	14/05/2020	Clear, colourless	7.23	1683		14.2		810		499		2.4	<	0.04		0.254		111.	
	SS		29/09/2020	Clear and slightly yellow	7	1722		14.3		910		521		1.4	<	0.04		0.219		114.	
	SS		19/11/2020	Clear and slightly yellow	7.49	1692		13.7		900		494		4.7	<	0.04		0.29		108.	
	SS		19/02/2021	Clear and slightly green	6.95	1687		13.6		820		502		4.7		0.048		0.26		110.	
Gw - 58-1-0	SS	N	21/05/2020	Clear, moderately yellow-brown	6.99	5543		19.6		1800		1510		10.8		0.42		1.7		34.1	
	SS		23/09/2020	Clear and slightly yellow	7.07	4988		19.4		1800		1720		11.6		0.451		1.87		30.5	
	SS		27/11/2020	Clear and colourless	6.93	4875		19.3		1600		1450		13.3		0.431		1.38		31.5	
	SS		26/02/2021	Clear and moderately brown	6.62	4859		19.5		1600		1300		9.7		0.37		1.33		27.9	

Notes:

a *Above CSR Schedule 3.2 AW Standard.*

b *Above CSR Schedule 3.2 DW Standard.*

c *Detection limits above applicable BC CSR standards.*

d *Above CSR Schedule 3.2 DW Standard, but Below Regional Background Concentrations (South Vanouver Island Region).*

SS *Single sample*

FRM *Average of field replicates.*

(1) *Aquatic Life (AW) Freshwater, Column 3.*

(2) *Drinking Water (DW), Column 6.*

(3) *Standard varies with pH. Every ammonia result was compared to a standard based on the associated pH result for that sample.*

(4) *Standard varies with chloride. Every nitrite result was compared to a standard based on the associated chloride result for that sample.*

(5) *Standard varies with hardness. Every result was compared to a standard that was based on the associated hardness result for that sample.*

(6) *BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed by the Stage 8 CSR Amendments.*

(7) *Standard is based on the trivalent (Cr(III)) species. The Cr(III) is the most common form of chromium.*

(8) *Interim standard used for cobalt.*

(9) *CSR Stage 13 amendments, protocol 9, background concentration is higher than the applicable CSR DW and/or most stringent CSR AW standard. A concentration above the CSR DW or most strigent CSR AW stanadard but below the regional background concentration (South Vancouver Island Region). is not considered contaminated and is not highlighted as a CSR DW or AW exceedance*

Table 5-1. Groundwater Quality Exceedances 2020-2021

BC CSR			AW Maximum (1)		2 (9)			---		12000		0.5-4 (5)		---		1500		90 (7)		40		20-90 (5)	
			DW Maximum (2)		8			---		5000		5		---		250		6000		14 (9)		1500	
Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter		Beryllium			Bismuth			Boron			Cadmium			Calcium			Chloride			Chromium			Cobalt			Copper	
				Fraction		DIS			DIS			DIS			DIS			DIS			DIS			DIS			DIS			DIS	
				Unit		µg/l			µg/l			µg/l			µg/l			mg/L			mg/L			µg/l			µg/l			µg/l	
				Method Detection Limit		0.01			0.005			10			0.005			0.05			1			0.1			0.005			0.05	
Gw - 52-1-1	SS	N	14/05/2020	Clear, colourless	<	0.02		<	0.01			2 890.		<	0.01			132.			210.			1.11			2.42			1.19	
	SS		29/09/2020	Clear and slightly yellow	<	0.02		<	0.01			2 680.		<	0.01			140.			200.			1.21			2.56			0.1	
	SS		19/11/2020	Clear and slightly yellow	<	0.02		<	0.01			2 830.		<	0.01			132.			190.			1.08			2.11			0.27	
	SS		19/02/2021	Clear and slightly green	<	0.02		<	0.01			2 780.		<	0.01			134.			200.			1.07			1.93			0.13	
Gw - 58-1-0	SS	N	21/05/2020	Clear, moderately yellow-brown	<	0.05		<	0.025			3 350.			0.062			401.			**1 000.**	**b**		9.07			**51.2**	**a,b**		4.54	
	SS		23/09/2020	Clear and slightly yellow	<	0.02		<	0.01			3 330.			0.126			470.			**940.**	**b**		7.9			**53.6**	**a,b**		10.2	
	SS		27/11/2020	Clear and colourless	<	0.02		<	0.01			3 260.			0.104			390.			**930.**	**b**		8.06			**52.5**	**a,b**		10.1	
	SS		26/02/2021	Clear and moderately brown	<	0.02		<	0.01			3 580.			0.064			341.			**830.**	**b**		7.74			**47.6**	**a,b**		8.	

Notes:

a *Above CSR Schedule 3.2 AW Standard.*

b *Above CSR Schedule 3.2 DW Standard.*

c *Detection limits above applicable BC CSR standards.*

d *Above CSR Schedule 3.2 DW Standard, but Below Regional Background Concentratio*

SS *Single sample*

FRM *Average of field replicates.*

(1) *Aquatic Life (AW) Freshwater, Column 3.*

(2) *Drinking Water (DW), Column 6.*

(3) *Standard varies with pH. Every ammonia result was compared to a standard based on*

(4) *Standard varies with chloride. Every nitrite result was compared to a standard based o*

(5) *Standard varies with hardness. Every result was compared to a standard that was base*

(6) *BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed b*

(7) *Standard is based on the trivalent (Cr(III)) species. The Cr(III) is the most common forn*

(8) *Interim standard used for cobalt.*

(9) *CSR Stage 13 amendments, protocol 9, background concentration is higher than the ap*
A concentration above the CSR DW or most strigent CSR AW stanadard but below the
is not considered contaminated and is not highlighted as a CSR DW or AW exceedance

Table 5-1. Groundwater Quality Exceedances 2020-2021

BC CSR				AW Maximum (1)		---		---		40-160 (5)		---		---		---		---		10000
				DW Maximum (2)		---		--- (6)		10		33 (9)		---		---		250
Station	**Sample Type**	**Compliance Well (Y/N?)**	**Date Sampled**	**Parameter**		**Hardness (As Caco3)**		**Iron**		**Lead**		**Lithium**		**Magnesium**		**Manganese**		**Molybdenum**
				Fraction		DIS		DIS		DIS		DIS		DIS		DIS		DIS
				Unit		mg/L		µg/l		µg/l		µg/l		mg/l		µg/l		µg/l
				Method Detection Limit		0.5		1		0.005		0.5		0.05		0.05		0.05
Gw - 52-1-1	SS	N	14/05/2020	Clear, colourless		499.		533.		0.041		5.3		40.9		362.		0.21
	SS		29/09/2020	Clear and slightly yellow		521.		664.	<	0.01		5.2		41.7		397.		0.24
	SS		19/11/2020	Clear and slightly yellow		494.		592.	<	0.01		5.3		40.		390.		0.2
	SS		19/02/2021	Clear and slightly green		502.		536.	<	0.01		5.1		40.9		377.		0.24
Gw - 58-1-0	SS	N	21/05/2020	Clear, moderately yellow-brown		1 510.		2 410.		0.26	<	2.5		123.		6 230.		5.23
	SS		23/09/2020	Clear and slightly yellow		1 720.		572.		0.291	<	1.		132.		6 990.		9.35
	SS		27/11/2020	Clear and colourless		1 450.		789.		0.278	<	1.		116.		6 170.		7.64
	SS		26/02/2021	Clear and moderately brown		1 300.		1 300.		0.219	<	1.		108.		5 550.		6.72

Notes:

a *Above CSR Schedule 3.2 AW Standard.*

b *Above CSR Schedule 3.2 DW Standard.*

c *Detection limits above applicable BC CSR standards.*

d *Above CSR Schedule 3.2 DW Standard, but Below Regional Background Concentratio*

SS *Single sample*

FRM *Average of field replicates.*

(1) *Aquatic Life (AW) Freshwater, Column 3.*

(2) *Drinking Water (DW), Column 6.*

(3) *Standard varies with pH. Every ammonia result was compared to a standard based on*

(4) *Standard varies with chloride. Every nitrite result was compared to a standard based o*

(5) *Standard varies with hardness. Every result was compared to a standard that was base*

(6) *BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed b*

(7) *Standard is based on the trivalent (Cr(III)) species. The Cr(III) is the most common forn*

(8) *Interim standard used for cobalt.*

(9) *CSR Stage 13 amendments, protocol 9, background concentration is higher than the ap*
A concentration above the CSR DW or most strigent CSR AW stanadard but below the
is not considered contaminated and is not highlighted as a CSR DW or AW exceedance

Table 5-1. Groundwater Quality Exceedances 2020-2021

BC CSR				AW Maximum (1)				1.31-18.4 (3)				0.2-2 (4)				400				400				250-1500 (5)				---				---	
				DW Maximum (2)				---				1				10				10				80				---				---	
Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter		'Nitrogen - ammonia				Nitrogen - nitrite			Nitrogen - nitrate			Nitrogen - nitrate plus nitrite			Nickel			Phosphorus			Potassium		
				Fraction		DIS				DIS			DIS			DIS			DIS			DIS			DIS		
				Unit		mg/l				mg/l			mg/l			mg/l			µg/l			µg/l			µg/l		
				Method Detection Limit		0.015				0.005			0.02			0.02			0.02			2			0.05		
Gw - 52-1-1	SS	N	14/05/2020	Clear, colourless		**28.**	a		<	0.005		<	0.02		<	0.02			11.2			25.			13.5		
	SS		29/09/2020	Clear and slightly yellow		**25.**	a		<	0.005		<	0.02		<	0.02			11.4			30.4			13.7		
	SS		19/11/2020	Clear and slightly yellow		**25.**	a		<	0.005		<	0.02		<	0.02			10.7			13.			13.		
	SS		19/02/2021	Clear and slightly green		1.5			<	0.005		<	0.02		<	0.02			11.4			15.4			13.7		
Gw - 58-1-0	SS	N	21/05/2020	Clear, moderately yellow-brown		**130.**	a			0.097		<	0.2			0.097			**81.9**	b		89.			46.		
	SS		23/09/2020	Clear and slightly yellow		**75.**	a			0.639			0.116			0.755			77.8			74.7			35.1		
	SS		27/11/2020	Clear and colourless		**95.**	a			0.107		<	0.02			0.119			77.9			59.6			48.6		
	SS		26/02/2021	Clear and moderately brown		**100.**	a			0.050 5		<	0.02			0.069			74.7			53.1			51.5		

Notes:

a *Above CSR Schedule 3.2 AW Standard.*

b *Above CSR Schedule 3.2 DW Standard.*

c *Detection limits above applicable BC CSR standards.*

d *Above CSR Schedule 3.2 DW Standard, but Below Regional Background Concentratio*

SS *Single sample*

FRM *Average of field replicates.*

(1) *Aquatic Life (AW) Freshwater, Column 3.*

(2) *Drinking Water (DW), Column 6.*

(3) *Standard varies with pH. Every ammonia result was compared to a standard based on*

(4) *Standard varies with chloride. Every nitrite result was compared to a standard based o*

(5) *Standard varies with hardness. Every result was compared to a standard that was base*

(6) *BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed b*

(7) *Standard is based on the trivalent (Cr(III)) species. The Cr(III) is the most common forn*

(8) *Interim standard used for cobalt.*

(9) *CSR Stage 13 amendments, protocol 9, background concentration is higher than the ap*
A concentration above the CSR DW or most strigent CSR AW stanadard but below the
is not considered contaminated and is not highlighted as a CSR DW or AW exceedance

Table 5-1. Groundwater Quality Exceedances 2020-2021

BC CSR				AW Maximum (1)		20			---			0.5-15 (5)		---		---			128-429 (5)		---	
				DW Maximum (2)		10			---			20		1700 (9)		2500			500		---	
Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter		Selenium			Silicon			Silver		Sodium		Strontium			Sulphate		Sulphur	
				Fraction		DIS			DIS			DIS		DIS		DIS			DIS		DIS	
				Unit		µg/l			µg/l			µg/l		mg/L		µg/l			mg/L		µg/l	
				Method Detection Limit		0.04			50			0.005		0.05		0.05			1		3	
Gw - 52-1-1	SS	N	14/05/2020	Clear, colourless		0.1			37 100.		<	0.01		231.		**3 340.**	**b**	<	1.		<	6.
	SS		29/09/2020	Clear and slightly yellow		0.6			37 300.		<	0.01		236.		**3 400.**	**b**	<	1.		---	---
	SS		19/11/2020	Clear and slightly yellow		0.265			34 800.		<	0.01		225.		**3 270.**	**b**	<	1.		<	6.
	SS		19/02/2021	Clear and slightly green	<	0.08			34 600.		<	0.01		232.		**3 330.**	**b**	<	1.		<	6.
Gw - 58-1-0	SS	N	21/05/2020	Clear, moderately yellow-brown		0.42			19 400.		<	0.025		485.		**3 810.**	**b**		82.			29.
	SS		23/09/2020	Clear and slightly yellow		0.364			20 300.		<	0.01		453.		**3 960.**	**b**		81.		---	---
	SS		27/11/2020	Clear and colourless		0.352			21 000.		<	0.01		486.		**3 900.**	**b**		96.			36.6
	SS		26/02/2021	Clear and moderately brown		0.353			20 500.		<	0.01		493.		**3 780.**	**b**		96.			37.6

Notes:

a *Above CSR Schedule 3.2 AW Standard.*

b *Above CSR Schedule 3.2 DW Standard.*

c *Detection limits above applicable BC CSR standards.*

d *Above CSR Schedule 3.2 DW Standard, but Below Regional Background Concentratio*

SS *Single sample*

FRM *Average of field replicates.*

(1) *Aquatic Life (AW) Freshwater, Column 3.*

(2) *Drinking Water (DW), Column 6.*

(3) *Standard varies with pH. Every ammonia result was compared to a standard based on*

(4) *Standard varies with chloride. Every nitrite result was compared to a standard based o*

(5) *Standard varies with hardness. Every result was compared to a standard that was base*

(6) *BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed b*

(7) *Standard is based on the trivalent (Cr(III)) species. The Cr(III) is the most common forn*

(8) *Interim standard used for cobalt.*

(9) *CSR Stage 13 amendments, protocol 9, background concentration is higher than the ap*
A concentration above the CSR DW or most strigent CSR AW stanadard but below the
is not considered contaminated and is not highlighted as a CSR DW or AW exceedance

Table 5-1. Groundwater Quality Exceedances 2020-2021

BC CSR				AW Maximum (1)		3			---			1000			85			---			75-2400 (5)			---	
				DW Maximum (2)		---			2.5			---			20			20			3000			---	
Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter		Thallium			Tin			Titanium			Uranium			Vanadium			Zinc			Zirconium	
				Fraction		DIS			DIS			DIS			DIS			DIS			DIS			DIS	
				Unit		µg/l			µg/l			µg/l			µg/l			µg/l			µg/l			µg/l	
				Method Detection Limit		0.002			0.2			0.5			0.002			0.2			0.1			0.1	
Gw - 52-1-1	SS	N	14/05/2020	Clear, colourless	<	0.004		<	0.4		<	1.		<	0.004			0.9			1.28		<	0.2	
	SS		29/09/2020	Clear and slightly yellow		0.004 1		<	0.4		<	1.		<	0.004			0.6			1.01		<	0.2	
	SS		19/11/2020	Clear and slightly yellow	<	0.004		<	0.4		<	1.		<	0.004			0.68			0.3		<	0.2	
	SS		19/02/2021	Clear and slightly green		0.004 2		<	0.4		<	1.		<	0.004			1.02			1.91		<	0.2	
Gw - 58-1-0	SS	N	21/05/2020	Clear, moderately yellow-brown	<	0.01		<	1.			2.6			0.377			**23.7**	**b**		6.4			2.25	
	SS		23/09/2020	Clear and slightly yellow	<	0.004			0.63			1.7			0.423			18.			2.99			3.6	
	SS		27/11/2020	Clear and colourless	<	0.004			0.69			1.3			0.364			18.3			4.86			1.87	
	SS		26/02/2021	Clear and moderately brown	<	0.004			0.55			2.5			0.335			**21.2**	**b**		1.83			1.8	

Notes:

a *Above CSR Schedule 3.2 AW Standard.*

b *Above CSR Schedule 3.2 DW Standard.*

c *Detection limits above applicable BC CSR standards.*

d *Above CSR Schedule 3.2 DW Standard, but Below Regional Background Concentratio*

SS *Single sample*

FRM *Average of field replicates.*

(1) *Aquatic Life (AW) Freshwater, Column 3.*

(2) *Drinking Water (DW), Column 6.*

(3) *Standard varies with pH. Every ammonia result was compared to a standard based on*

(4) *Standard varies with chloride. Every nitrite result was compared to a standard based o*

(5) *Standard varies with hardness. Every result was compared to a standard that was base*

(6) *BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed b*

(7) *Standard is based on the trivalent (Cr(III)) species. The Cr(III) is the most common forn*

(8) *Interim standard used for cobalt.*

(9) *CSR Stage 13 amendments, protocol 9, background concentration is higher than the ap*
A concentration above the CSR DW or most strigent CSR AW stanadard but below the
is not considered contaminated and is not highlighted as a CSR DW or AW exceedance

DURRANCE LAKE

DURRANCE LAKE FAULT

HIGHLAND FAULT

DAM

DURRANCE CREEK

DOMINION GOVERNMENT PROPERTY RIFLE RANGE

HARTLAND NORTH PAD

INFERRED FAULT

TRAIL CR.

LOWER LEACHATE LAGOON

L~200ø PVC (LEACHATE) PIPELINE

PHASE 2

PHASE 1

HARTLAND LANDFILL

KILLARNEY LAKE

SW-N-41s3
SW-N-CSs2
SW-N-41s1
SW-N-42-s1
SW-N-45
SW-N-17
SW-N-16
SW-N-05
SW-N-53
SW-N-18
SW-N-54
SW-N-19
SW-N-50
SW-N-51
SW-N-15
SW-N-14
SW-N-06
SW-N-09
SW-S-02
SW-S-03
SW-S-12
SW-S-20
SW-S-17
SW-S-24
SW-S-21
SW-S-04
SW-S-11
SW-S-10

55-1-1 (360.0)
41-1-1 (416.0)
57-1-1 (359.0)
43-1-1 (479.0)
44-1-1 (353.0)
62-1-1 (186.0)
62-2-1 (193.0)
91-1-1 (I) (315.0)
93-1-1 (D) (222.0)
92-1-1 (I) (390.0)
94-1-1 (D) (420.0)
79-2-1
79-1-1
77-1-1 (257.0)
77-2-1 (255.0)
78-2-1 (451.0)
78-1-1 (399.0)
88-2-1 (274.0)
88-1-1 (215.0)
87-2-1 (163.0)
87-1-1 (257.0)
25-1-1 (407.0)
25-1-2 (320.0)
55-1-1 (342.0)
28-1-0 (296.0)
29-1-1 (292.0)
29-1-2 (287.0)
30-1-1 (233.0)
30-1-2 (433.0)
31-1-1 (280.0)
31-1-2 (271.0)
20-1-1 (136.0)
20-1-2 (134.0)
21-1-1 (128.0)
21-1-2 (447.0)
21-2-1 (491.0)
39-2-1 (244.0)
39-1-1 (187.0)
38-1-1 (473.0)
37-3-1 (380.0)
37-2-1
37-1-1
40-1-1 (431.0)
81-1-0-P9 (973.0)
80-1-0-P8 (1640.0)
36-3-1 (434.0)
36-2-1
36-1-1
52-1-1 (722.0)
52-2-0
52-3-0
52-4-0-P7 (3909.0)
52-5-0 (4988.0)
83-1-1
27-1-1 (127.0)
27-1-2 (333.0)
90-2-1
90-1-1
82-1-1
86-1-1
86-1-2
86-2-1
86-2-2
50-1-1
51-1-1 (252.0)
51-2-1 (306.0)
51-3-1 (345.0)
16-1-1 (215.0)
16-1-2 (222.0)
16-2-1 (222.0)
16-2-2 (N/A)
75-1-1
VLGW021D
VLGW026D
VLGW020D
VLGW008D
VLGW019D
VLGW018D
VLGW011S
VLGW017D
VLGW016D
VLGW004D
VLGW015D
VLGW001D
VLGW002D
VLGW003D
46-3-1
46-4-1
46-2-1
89-1-1
89-2-1
47-2-1
47-1-1
48-1-1
48-2-1
P1 (963.0)
P2 (1840.0)
P3 (1624.0)
P4 (2106.0)
P5
P6
09-1-0
85-1-1 (575.0)
72-3-1 (484.0)
72-2-1 (N/A)
72-1-1 (441.0)
71-3-1 (320.0)
71-2-1 (355.0)
71-1-1 (279.0)
60-2-1 (477.9)
60-1-1 (582.0)
59-3-1 (568.0)
97-1-0 (568.0)
73-3-1 (256.0)
73-2-1 (350.0)
73-1-1 (332.0)
19-2-1 (315.0)
19-2-2 (284.0)
19-1-1 (314.0)
19-1-2 (354.0)
04-3-1 (455)
04-2-1 (N/A)
04-1-1 (311.0)
54-1-1
54-2-1
54-3-1
17-1-1 (355.0)
17-1-2 (315.0)
17-1-3 (415.0)
76-3-1
76-2-1
76-1-1
18-1-1 (265.0)
18-1-2 (N/A)
18-2-1 (252.0)
18-2-2 (281.0)
61-1-1
63-1-1 (224.0)
63-2-1 (232.0)

500
1000
1500
2000
2500

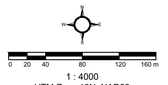
B
B'
A
A'

1 : 4000
UTM Zone 10N, NAD83

Legend

- BUILDING / STRUCTURE
- ROAD
- FENCE
- LEGAL LOT BOUNDARY
- INDEX CONTOUR (5m)
- INTERMEDIATE CONTOUR (1m)
- TREES/SHRUB/VEGETATION
- DITCH
- DRAINAGE
- PIPE
- EXISTING WASTE
- FAULT (MULLER, 2020)
- INFERRED FAULT (AECOM, 2020)
- HARTLAND LANDFILL OPERATING AREA BOUNDARY
- SURFACE WATER SAMPLING LOCATION
- SW-N-06 INACTIVE SURFACE WATER SAMPLE
- P3 SOUTH PURGE WELLS
- 03-2-1 ACTIVE GROUNDWATER WELL
- 86-1-1 DECOMMISSIONED WELL
- VLGW001D GAS WELL
- A A' CROSS SECTION LINE
- 43-1-1 (784) Well (conductivity) GROUNDWATER ELECTRICAL CONDUCTIVITY (µS/cm) IN SEPTEMBER 2020 READINGS IN A SINGLE MONITORING WELL
- (N/A) GROUNDWATER SAMPLE WAS NOT COLLECTED IN SEPTEMBER 2020
- 500 INFERRED GROUNDWATER ELECTRICAL CONDUCTIVITY CONTOUR (µS/cm)

Map Sources / Notes:
- Contour interval 1.0 m
- Groundwater electrical conductivity data collected by CRD, September 2020.
- Contours based on 24-W542_2019-2020 BASE.dwg PROVIDED BY CINDY WANG OF CAPITAL REGIONAL DISTRICT May 2021.
- Drainage information for years 2018-2019 obtained from Parks & Env. Services GIS technicians and have layers with the prefix "CRD19_GIS DRAINAGE" & "CRD19_GIS streams_Ditches".
- GPS pickup has been conducted by CRD Staff of creeks, wetlands, culverts located under tree canopied areas. This information (considered more accurate) has been added to the base (superceding some planimetric information) and is placed on layers indicating GPS pickup. An example of that layering system would be 'CRD19-wat-culvert_GPS pickup'.
- Surveyed points for monitoring sites (groundwater, gas wells, leachate, purge wells) were updated for 2019.
- The map is to NAD83 UTM coordinates. Vertical datum is to CGVD28.



1 : 4000
UTM Zone 10N, NAD83

Reviewed by: KJ Prepared by: PCJ
Date Issued: May 2021 Project Number: 60631284

Making a difference...together

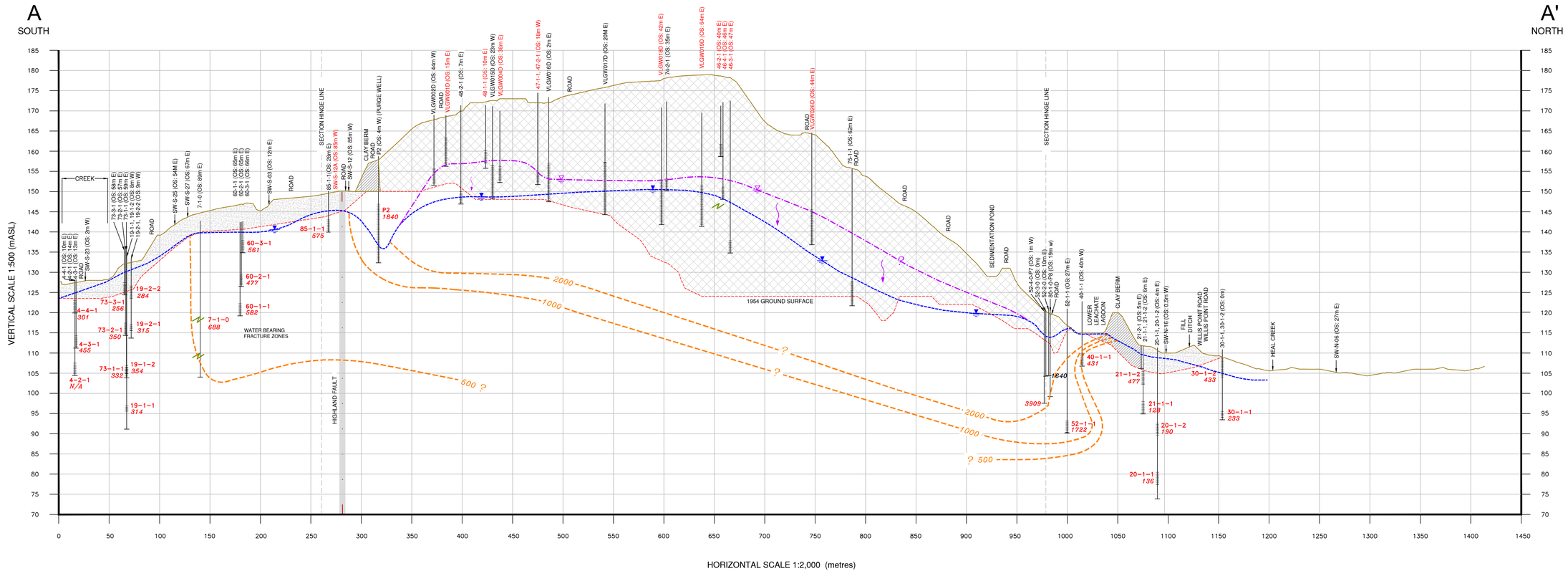
Project: Hartland Landfill Monitoring
Location: Saanich, BC

Electrical Conductivity Plan (September 2020)

AECOM

Figure 5-1
Version 2

File Location: \\CABNY1FP001\PROD\PROJECTS\60631284\900-CAD_GIS\910-CAD\20-SHEETS\C432 - 2020-21 ANNUAL REPORT\FIG5.1-ELECTRICAL CONDUCTIVITY PLAN-20210510-60631284-431.DWG Date Plotted: May 26, 2021 Saved By: castle-janschp



Legend

- 85-1-1 (6.5m) — MONITORING WELL (NUMBER) INDICATES DISTANCE WELL IS FROM PLANE OF SECTION. WHERE NOT INDICATED, DISTANCE IS LESS THAN 2 m.
- SCREENED INTERVAL
- WATER BEARING FRACTURES
- GROUND SURFACE
- LOCATION OF BEDROCK DERIVED FROM 1954 GROUND CONTOUR OR BEDROCK INTERSECTIONS IN BOREHOLES
- REFUSE
- CLAY BERM
- UNCONSOLIDATED SOIL AND FILL
- INTERPRETED GROUNDWATER POTENTIOMETRIC SURFACE IN BEDROCK (AUGUST 2020)
- INTERPRETED LEACHATE MOUND
- INFERRED VERTICAL LEACHATE FLOW
- FAULT (MULLER 1980)
- INFERRED ELECTRICAL CONDUCTIVITY CONTOUR (SEPTEMBER 2020).
- 834.0 — ELECTRICAL CONDUCTIVITY SEPTEMBER 2020 (µ S/cm)
- (N/A) — GROUNDWATER SAMPLE WAS NOT COLLECTED IN SEPTEMBER 2020
- 537.0 — ELECTRICAL CONDUCTIVITY DATA WAS NOT USED TO INTERPRET CONDUCTIVITY CONTOUR

Map Sources / Notes:
- Contours based on 24W542_2019-2020 base.dwg, provided by the Capital Regional District, May 2021.
- Stratigraphy between boreholes is inferred and may vary from that shown

0 10 20 40 60 80 m

1 : 2000

Section Looking West

Reviewed by: KJ
Date Issued: May 2021

Prepared by: PCJ
Project Number: 60631284

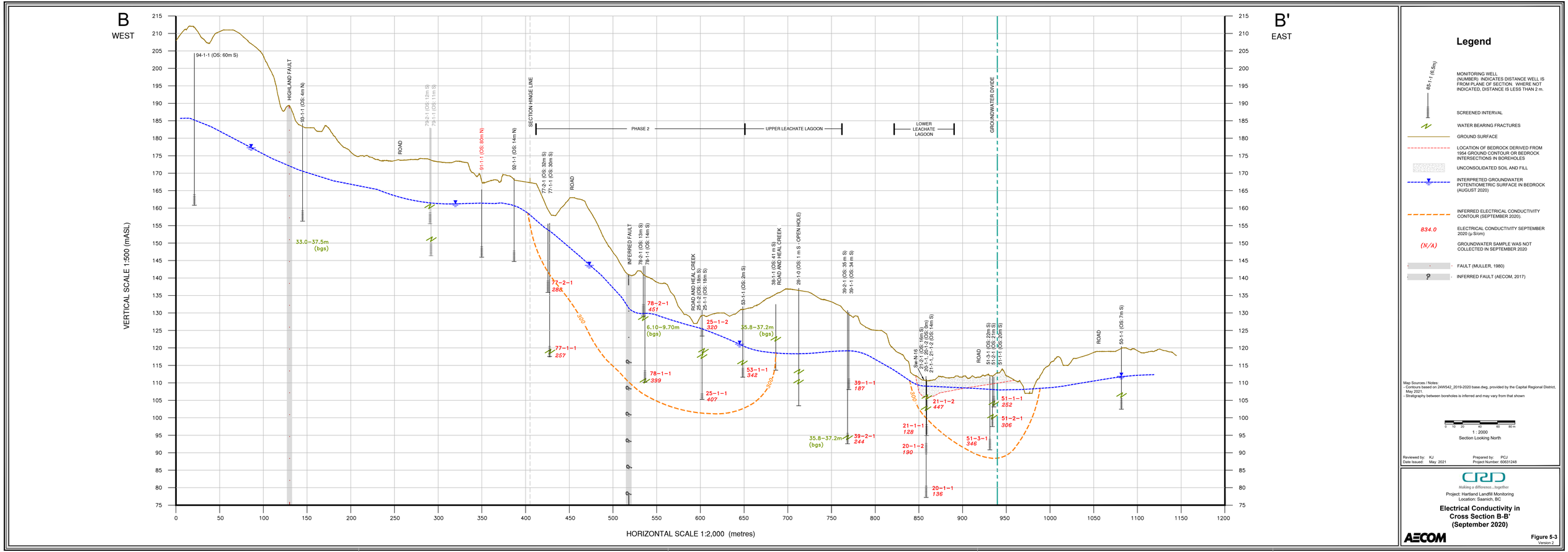
Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Electrical Conductivity in Cross Section A-A' (SEPTEMBER 2020)

AECOM

Figure 5-2
Version 1



Legend

- 85-1-1 (6.5m) — MONITORING WELL (NUMBER) INDICATES DISTANCE WELL IS FROM PLANE OF SECTION. WHERE NOT INDICATED, DISTANCE IS LESS THAN 2 m.
- SCREENED INTERVAL
- WATER BEARING FRACTURES
- GROUND SURFACE
- LOCATION OF BEDROCK DERIVED FROM 1954 GROUND CONTOUR OR BEDROCK INTERSECTIONS IN BOREHOLES
- UNCONSOLIDATED SOIL AND FILL
- INTERPRETED GROUNDWATER POTENTIOMETRIC SURFACE IN BEDROCK (AUGUST 2020)
- INFERRED ELECTRICAL CONDUCTIVITY CONTOUR (SEPTEMBER 2020).
- 834.0 — ELECTRICAL CONDUCTIVITY SEPTEMBER 2020 (µ S/cm)
- (N/A) — GROUNDWATER SAMPLE WAS NOT COLLECTED IN SEPTEMBER 2020
- FAULT (MULLER, 1980)
- ? — INFERRED FAULT (AECOM, 2017)

Map Sources / Notes:
- Contours based on 24W542_2019-2020 base.dwg, provided by the Capital Regional District, May 2021.
- Stratigraphy between boreholes is inferred and may vary from that shown

1 : 2000
Section Looking North

Reviewed by: KJ
Date Issued: May 2021
Prepared by: PCJ
Project Number: 60631248

Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Electrical Conductivity in Cross Section B-B'
(September 2020)

AECOM

Figure 5-3
Version 2

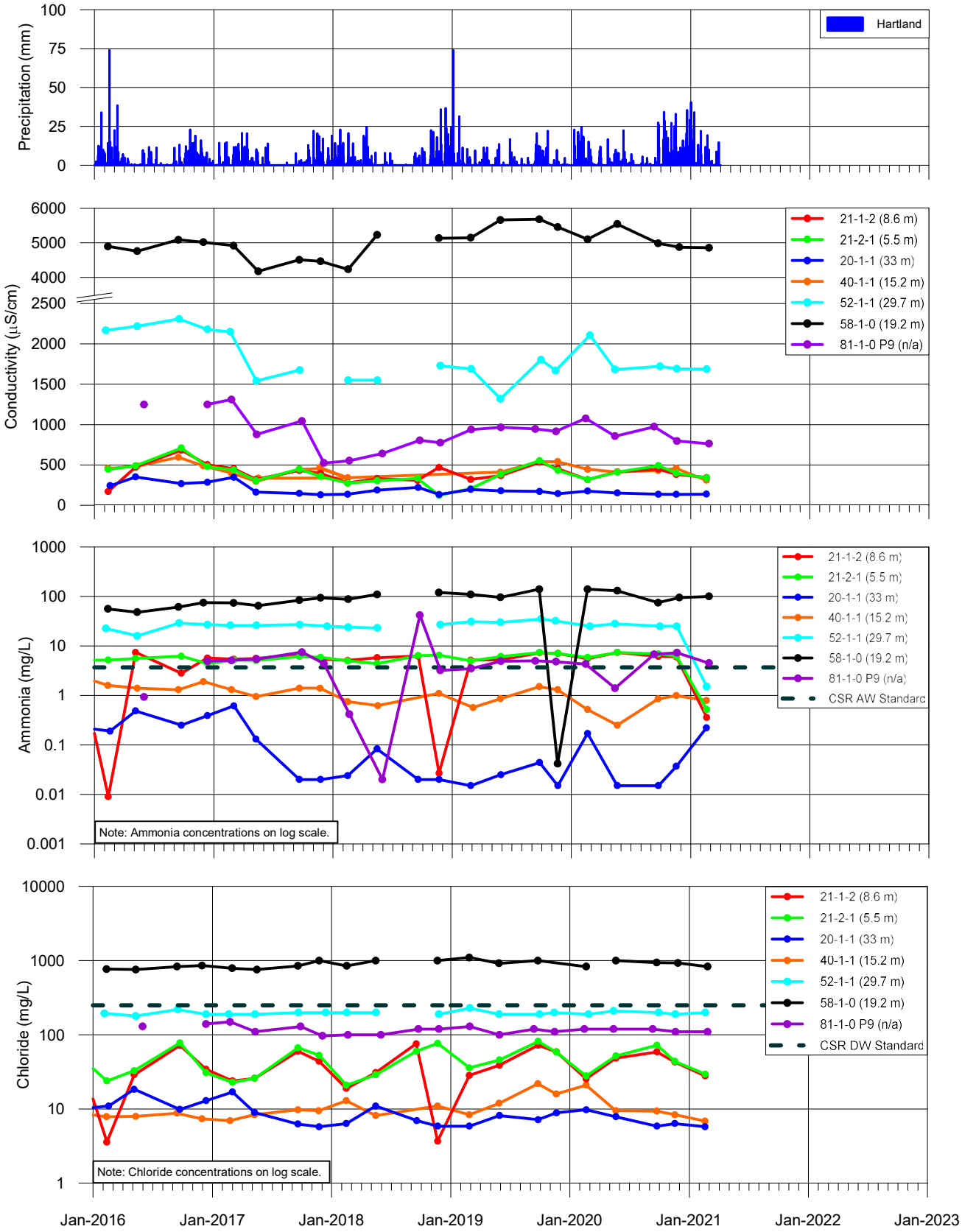


Figure 5-4. Groundwater Quality North of Phase 1

AECOM

5.4.3 Monitoring Site 40

Monitoring well 40-1-1 is not a Boundary Compliance Well and is installed between the upper and lower leachate lagoons, approximately 70 m from the property boundary. Groundwater quality at this location has been affected by leachate since 2002 and continued to be affected in 2020/21.

In 2020/21, all parameters met the CSR AW and DW standards in all four sampling events. Conductivity and ammonia values in all four sampling events were below 500 µS/cm and 1 mg/L, respectively, indicating slight groundwater quality improvement. The mean conductivity and ammonia concentrations decreased approximately 17-30% when compared to 2019/20. Chloride concentrations were slightly elevated in 2019/20 but returned to historical ranges in 2020/21. The recent improvement of water quality may be related to increased precipitation and dilution in 2020/21.

Although water quality at location 40 is still slightly impacted by leachate, the long-term concentrations of leachate indicator parameters suggest continuing improvement in groundwater quality. This is likely due to reduced leachate generation following closure of Phase 2 Cell 1 in 2011 and operation of 81-1-0-P9 as a purge well since 2016. Statistical trend analysis revealed decreasing trends in conductivity, ammonia and chloride concentrations over the past five years. Sulphate concentrations were slightly elevated during the September and November events, but remained much lower than they were prior to the observation of leachate impacts at this location in 2002. Water quality has been investigated at this location in the past and was the subject of a previous report (AECOM 2009a).

Water quality at location 40 should continue to be closely monitored to verify the effectiveness of leachate collection north of the Phase 1 landfill. The ongoing purge well performance evaluation program should be expanded to include P9, with the value of each well assessed based on the rate of contaminant mass removal.

5.4.4 Monitoring Sites 20 and 21

Monitoring locations 20 and 21 are considered Boundary Compliance Wells and are located directly north of the Phase 1 landfill and the lower leachate lagoon and between 5 and 15 m from the landfill property boundary. These monitors are located in the most probable path for any potential subsurface leachate migration below the unlined lower lagoon. The concentrations of leachate indicator parameters at locations 20, 21, 40, 52, and 58 are plotted against time in Figure 5-4.

In 2020/21, groundwater quality at location 20 and 21 met both CSR AW and DW standards. Groundwater quality in wells 21-1-2 and 21-2-1 generally have higher concentrations of conductivity, ammonia and chloride concentrations, because they were screened at shallower depths. In 2020/21, conductivity concentrations in wells 21-1-2 and 21-2-1 ranged from 339 to 491 µS/cm. Chloride concentrations at location 21 have remained well below the CSR DW standard (250 mg/L) since 1997 and below 120 mg/L since 2002. At location 20, conductivity values remained below 200 µS/cm in 2020/21, and ammonia and chloride concentrations were generally consistent with background ranges. Similar to 40-1-1, conductivity values at 20-1-1, 20-1-2, 21-1-2 and 21-2-1 were slightly lower in 2020/21, indicating improved water quality. Ammonia concentrations in all four wells remained within their historical ranges.

Over the past five years, groundwater quality data collected from wells at locations 20 and 21 revealed a statistically significant decreasing trend in conductivity in wells 20-1-1, 20-1-2, 21-1-1, 21-1-1 and 21-2-1. Decreasing trends in ammonia were observed in wells 20-1-1 and 20-1-2. Chloride concentrations exhibited a statistically significant decreasing trend in well 20-1-1. Statistically significant decreasing trends in leachate parameters indicate improved water quality at these locations.

Groundwater quality was impacted by construction activities during the fall and winter of 2019/20, but water quality at downgradient wells 40-1-1, 20 and 21 was improved in 2020/21.

These rapid improvements highlight the importance of progressive landfill closure, diversion of clean runoff, and operating and maintaining leachate collection infrastructure at the landfill.

5.4.5 Monitoring Site 31

Monitoring wells at location 31 are considered Boundary Compliance Wells and they are located along the landfill north property line, south of Willis Point Road and 160 m northeast of the lower leachate lagoon. They are downgradient of the landfill and have the lowest groundwater elevations measured at the site.

On October 18, 2020, an approximately 25,000 L of wastewater residuals were released from the residual solids force main valve chamber near Pump Station 4 , adjacent to Willis Point Rd. Approximately 21,000 L of biosolids were contained within a manhole and the RSF line and the biosolids were removed from these structures to prevent additional release to ground. Biosolids generally contain high concentrations of macronutrients including nitrogen, phosphorus, sulphur, calcium, and magnesium embedded in the organic matter (Pritchard 2006). Groundwater wells 31-1-1 and 31-1-2 are located approximately 20 m upgradient (south) of the spill location. Following the release, groundwater (wells 31-1-1 and 31-1-2) and downstream surface water samples were collected and submitted for analysis on October 20, October 26 and November 6, December 10, 2020 and January 18, 2021 to evaluate impacts from the spill. Detailed analytical data and results were included in the spill investigation memo (McElhanney 2020b). Analytical results indicated that that surface water quality downstream of the release was temporally impacted during the October sampling events (McElhanney 2020a), and impacts were dissipated during the December 2020 and January 2020 sampling events (McElhanney 2020b). Samples collected from the groundwater wells (31-1-1 and 31-1-2) near the release have shown minimal impacts. However, impacts to downgradient groundwater are unknown due to the absence of downgradient monitoring wells (McElhanney 2020b).

In 2020/21, routine groundwater sampling at location 31 was conducted on September 23 and November 9, 2020. Groundwater quality at location 31 met both CSR AW and DW standards. However, conductivity values in both 31-1-1 and 31-1-2 increased by approximately 40% to 60% following the spill. Sulphate concentrations in both wells also increased 3-4 times following the spill. Moreover, hardness, calcium, magnesium concentrations also exhibited higher concentrations following the spill. Chloride and ammonia concentrations remained low and consistent with historical ranges. The increased conductivity, sulphate, hardness, calcium and magnesium concentrations indicate that the groundwater quality was likely temporally impacted by the spill. Water quality at location 31 should continue to be monitored closely. Sulphate concentrations in 31-1-2 exhibited statistically significant increasing trend between 2016 and 2021, and the peak concentration of 230 mg/L was observed in November 2020.

5.4.6 Monitoring Sites 29 and 30

Monitoring locations 29 and 30 are located north of Willis Point Road and are Boundary Compliance Wells. Conductivity, ammonia and chloride plots for both locations over the past five years are included on Figure 5-5. At locations 29 and 30, all parameters met applicable CSR standards in 2020/21.

At monitoring locations 29 and 30, elevated conductivity and chloride concentrations observed since 2007 are considered related to intermittent road salt application on Willis Point Road. The District of Saanich has confirmed the use of de-icing salt (sodium chloride) on an as-needed basis on this road for several years and that no records of application dates are kept. As shown on Figure 5-5, conductivity and chloride concentrations measured in the shallow monitors at locations 29 and 30 have exhibited seasonal fluctuations for a very long time, with maximum concentrations typically occurring in winter and early spring months. In 2020/21, chloride concentrations were below 100 mg/L. Ammonia concentrations remain very low (<0.1 mg/L) at locations 29 and 30, suggesting that landfill leachate is not contributing to groundwater quality impacts north of Willis Point Road.

Groundwater quality data collected from wells at locations 29 and 30 over the past five years revealed a statistically significant decreasing trend in conductivity in 29-1-1 and 30-1-1, and a decreasing trend in chloride in 30-1-1. Although statistically significant increasing trends were observed in chloride and sulphate in well 29-1-1 and an increasing trend in sulphate and nitrate were observed in well 29-1-2, their concentrations remained within acceptable ranges. It is speculated that changes in road salt application result in variable water quality at these monitoring locations (i.e. conductivity, sodium and chloride concentrations).

5.4.7 Monitoring Sites 28 and 39

Groundwater monitoring wells 28 and 39 are located between the upper leachate lagoon and Willis Point Road and are considered Boundary Compliance Wells. In 2020/21, groundwater quality at locations 28 and 39 met CSR standards, did not report elevated concentrations of leachate indicator parameters, and were not impacted by landfill leachate. Similar to previous years, conductivity values in well 28-1-0 remained below 300 µS/cm in 2020/21, indicating the stable water quality. Since 2018/19, conductivity values at location 39 have been below 300 µS/cm, with the exception of 1,481 µS/cm in May 2019.

Statistical trend analysis of groundwater quality data collected from well 28-1-0 over the past five years revealed a statistically significant decreasing trend in conductivity and an increasing trend in nitrate. A statistical trend analysis of groundwater quality in 39-1-1 and 39-2-1 revealed a statistically significant decreasing trend in conductivity over the past five years. Sulphate

concentrations in 39-1-1 exhibited a statistically significant increasing trend, but concentrations remained far below CSR standards. Chloride concentrations decreased in a statistically significant manner in 39-1-1 over the past five years. Groundwater quality should continue to be monitored at locations north of the upper leachate lagoon.

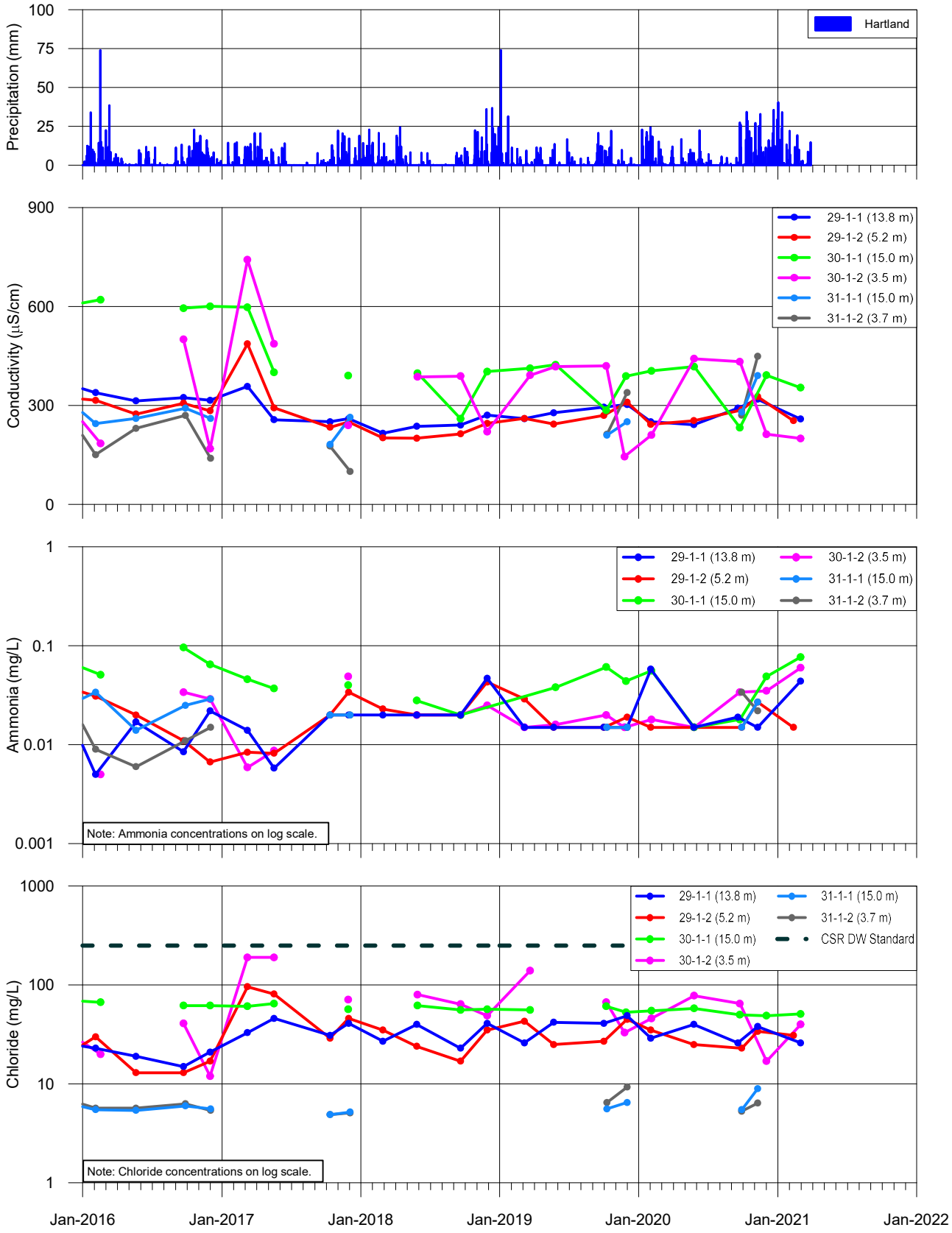


Figure 5-5. Groundwater Quality North of Willis Point Road

AECOM

5.5 Monitors West and North of the Phase 2 Landfill and Near the Hartland North Pad

Background water quality has historically been represented by monitoring location 63 on the west side of Phase 2, and five monitoring locations (77, 78, 79, 87 and 88) north of the Phase 2 landfill. Through the winter and spring of 2016/17, a portion of the slope between Phase 2 and the Hartland North Pad was cleared of vegetation to allow for construction of a future aggregate storage area. Since clearing, overburden soils have been stripped to expose the bedrock surface that consists of several closed depressions that may impact groundwater recharge. This work was conducted in the vicinity of monitoring locations 77, 78, 79, 87 and 88. Groundwater monitoring wells 79-1-1 and 79-2-1 were decommissioned in May 2018 to allow for construction of an aggregate stockpile in this area. In 2019/20, excavation and blasting were conducted at the North Pad area and east of the Toutle Valley Road. Given recent land clearing, excavation and quarrying activities, water quality data from locations 77, 78, 87 and 88 should no longer be considered representative of background groundwater quality, and groundwater at these wells should be closely monitored for landfill and construction related impacts.

In November 2019, four new monitoring wells (91-1-1, 92-1-1, 93-1-1, 94-1-1) were installed in Hartland North to characterize hydrogeological conditions near the RTF and monitor impacts from construction, quarrying and operations. Well 94-1-1 was installed as a new background well and is located upgradient of the landfill and the RTF. Quarterly groundwater sampling at these locations commenced in March 2020.

Six monitoring locations (25, 27, 36, 37, 38 and 53) north of the Phase 2 landfill near the upper leachate lagoon, and eight locations (41, 42, 43, 44, 55, 56, 57 and 62) near the Hartland North Pad were monitored for groundwater quality parameters in 2020/21.

5.5.1 Monitoring Site 63

Monitoring well 63 is located at the western edge of the property and is located upgradient of Hartland Landfill. Water quality at this location is considered representative of background groundwater chemistry. Similar to previous years, groundwater quality at location 63 in 2020/21 exhibited conductivity concentrations less than 240 µS/cm, ammonia concentrations below 0.1 mg/L, chloride concentrations below 6 mg/L, sulphate concentrations below 12 mg/L, and low or non-detectable concentrations of other parameters. Groundwater quality data revealed a statistically significant decreasing trend in conductivity and sulphate in well 63-1-1 and 63-2-1, indicating that groundwater quality was not impacted by recent excavation and quarrying activities.

5.5.2 Monitoring Sites 77, 78, 87 and 88

Concentrations of all parameters from samples collected in 2020/21 from wells at locations 77, 78, 87 and 88 (not Boundary Compliance Wells) were below applicable CSR standards. Ammonia, sulphate, chloride and conductivity concentrations were consistent with previous monitoring. In 2020/21, groundwater samples were collected during September 2020 and November 2020.

Groundwater quality in monitoring wells at location 77 were consistent with background conditions, with conductivity values below 300 µS/cm, low ammonia (<0.1 mg/L), low sulphate (<30 mg/L), and low chloride concentrations (< 6 mg/L). Low conductivity and sulphate concentrations suggest minimal or no impact from the natural flushing of mineral oxidation products from weathered bedrock and aggregate stockpiles. Conductivity values at wells 77-1-1 and 77-2-1 show statistically significant decreasing trends over the past five years. Groundwater quality at 77-1-1 has deteriorated slightly as indicated by statistically significant increasing trends in chloride and sulphate over the past five years.

Water quality at location 78 exhibited conductivity values ranging from 177 to 451 µS/cm, low or non-detectable ammonia concentrations, and chloride concentrations generally < 5 mg/L. Sulphate concentrations at deep well 78-1-1 were relatively stable and ranged between 48 and 60 mg/L. Sulphate concentrations at well 78-2-1 reached to 120 mg/L in September 2020, and then decreased to 20 mg/L in November 2020. Groundwater quality at 78-1-1 exhibited a statistically significant increasing trend in sulphate concentrations over the past five years. A statistically significant increasing trend in ammonia and sulphate concentrations was observed at well 78-2-1 over the past five years.

Groundwater nested wells 87 and 88 are located on either side of the Highland Fault. Similar to previous years, water quality at location 87 and 88 exhibited conductivity values generally below 400 µS/cm, low or non-detectable ammonia concentrations, and chloride concentrations < 10 mg/L. In 2020/21, sulphate concentrations at 87 and 88 were generally within the historical ranges (<20 mg/L), except for 88-2-1. Sulphate concentrations at 88-2-1 ranged from 66 mg/L and 120

mg/L during the September and November sampling. The elevated sulphate concentrations at 88-2-1 indicate that groundwater quality was impacted by the excavation and quarrying activities.

5.5.3 Wells North of Phase 2 Landfill

Wells north of Phase 2 include 25, 27, 36, 37, 38, and 53. Leachate indicator parameters in wells at locations 25, 36, 37 and 38 are plotted on Figure 5-6.

5.5.3.1 Monitoring Site 36

Monitoring location 36 is not a Boundary Compliance Well and is located 20 m northeast and downgradient of the Phase 2 basin. Well 36-3-1 was monitored and sampled on a quarterly basis in 2020/21. Well 36-2-1 has not been monitored since 2016/17 due to well construction related impacts.

Well 36-3-1 is well suited to assess whether leachate is migrating beneath the clay liner along the north side of Phase 2. The elevation of the bottom of the well screen in 36-3-1 is 112 m asl. The bottom of the Phase 2 basin is at 113 m asl. The bottom of the clay liner along the north side of the Phase 2 basin is at 114 m asl. In 2020/21, groundwater quality in 36-3-1 exhibited conductivity values below 1,000 µS/cm, which were consistent with values measured in 2019/20. However, sulphate concentrations ranged from 200 to 320 mg/L, which were approximately 20% to 60% higher than those measured in 2019/20. Ammonia and chloride concentrations remained low but were slightly elevated. Conductivity and ammonia concentrations at well 36-2-1 show statistically significant decreasing trends, while sulphate concentrations show a statistically increasing trend over the past five years. Statistically significant increasing trends in conductivity and nitrate were observed in well 36-3-1 over the past five years. Due to the low ammonia and chloride concentrations, it is unlikely that leachate migration is occurring beneath the clay liner at the north edge of Phase 2.

Elevated sulphate concentrations in 36-3-1 observed since 2008 may be related to infiltration of runoff from aggregate stockpiles and/or aggregate use in landfill infrastructure at the north end of Phase 2. Large volumes of aggregate that have been stored in unused parts of Phase 2 since 2012 have the potential to impact water quality in this area if not managed. Aggregate has also been used extensively in landfill infrastructure throughout Phase 2 (i.e. around leachate and landfill gas collectors, road building, landfill cover, and to construct the sedimentation pond near location 36). Although it is anticipated that elevated sulphate concentrations are the result of runoff from aggregate stockpiles, continued monitoring will help confirm cause(s) of groundwater quality change in this area.

5.5.3.2 Monitoring Site 37

Monitoring location 37 is not a Boundary Compliance Well and it is located 25 m north of the Phase 2 basin. Well 37-3-1 was routinely monitored in 2020/21. Well 37-1-1 has been excluded from the monitoring program due to the limited access. Sampling of 37-2-1 was deemed unwarranted due to its stable and low concentrations of leachate indicator parameters.

Similar to previous years, chloride, ammonia concentrations at shallow well 37-3-1 (14.8 m deep) remained low and consistent with background water quality. Conductivity and sulphate concentrations ranged from 380 to 464 µS/cm, and 120 to160 mg/L, respectively, which were slightly higher than those measured in 2019/20 and 2018/19. Elevated conductivity and sulphate concentrations may be related to the infiltration of runoff from aggregate stockpiles and areas where aggregate has been used to construct site infrastructure at the north end of Phase 2. Statistically significant increasing trends were detected at wells 37-2-1 and 37-3-1 for sulphate indicating a slight deterioration in groundwater quality at this location. Due to low ammonia and nitrate concentrations, water quality degradation is likely related to onsite aggregate stockpiling and not leachate.

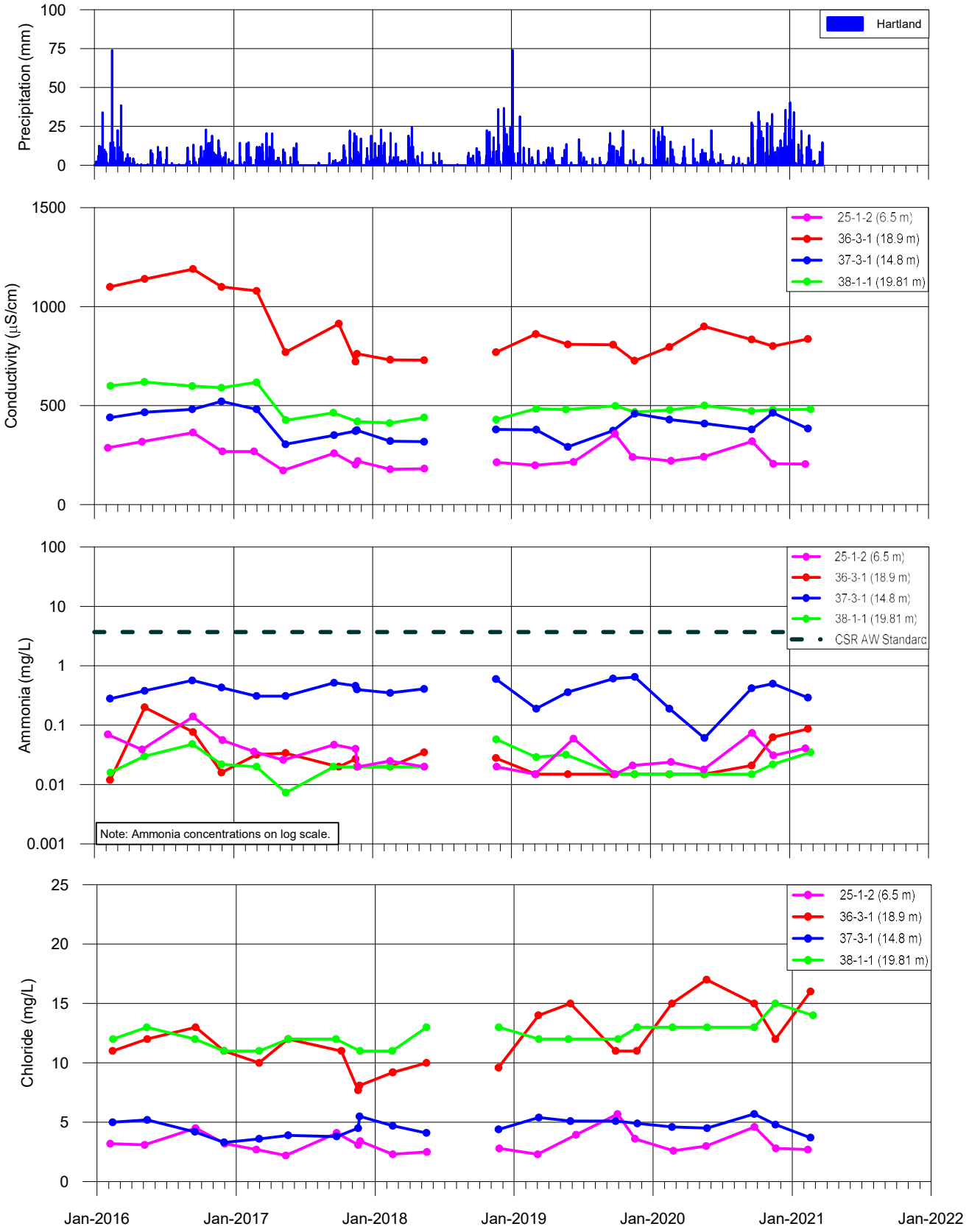


Figure 5-6. Groundwater Quality North of Phase 2

AECOM

5.5.3.3 Monitoring Site 38

Location 38 is not a Boundary Compliance Well and is located roughly 80 m north of the Phase 2 basin immediately north of the upper leachate lagoon. Water quality at this location met CSR standards in 2020/21. As presented on Figure 5-6, well 38-1-1 exhibited slightly elevated conductivity values (473 - 501 µS/cm), undetectable to low ammonia concentrations (<0.05 mg/L), and chloride concentrations less than 15 mg/L. Sulphate concentrations were slightly below 50 mg/L, which is consistent with 2019/20. Over the past five years a statistically significant decreasing trend in conductivity was observed at this location. Although statistically significant increasing trends in chloride were observed for the past five years, concentrations remained relatively low.

5.5.3.4 Monitoring Sites 25 and 53

Wells 25-1-1, 25-1-2 (not Boundary Compliance Wells) and 53-1-1 (Boundary Compliance Well) are located on an east-west trending ridge 100 m north of the Phase 2 basin near the property boundary. These wells have exhibited good water quality in the past and remain unaffected by landfill leachate. Since 2009, water quality at all three wells has been relatively stable and concentrations met CSR AW and DW standards in 2020/21. In 2020/21, these wells exhibited slightly elevated conductivity 118 – 437 µS/cm, low ammonia concentrations (< 0.1 mg/L), and low chloride concentrations (< 10 mg/L). Statistically significant decreasing trends in conductivity at wells 25-1-1, 25-2-1 and 53-1-1 were observed over the past five years, indicating slightly improved groundwater quality. However, sulphate concentrations in 25-1-1 remained elevated during all four sampling events and ranged between 160 and 180 mg/L. Since 2018, sulphate concentrations in 25-1-1 have gradually increased from 60 mg/L to 180 mg/L, indicating that groundwater may be impacted by blasting/aggregate placement for infrastructure projects. Due to the low ammonia and relatively stable conductivity concentrations, it is not likely that the groundwater is being impacted by leachate.

Previous groundwater quality changes in these wells (i.e. increased concentrations of leachate indicator parameters) following the 2008 leachate storage test indicate that a hydraulic trap reversal would potentially result in northward leachate migration in this area. As such, groundwater quality and water levels should be closely monitored in this area to verify that the hydraulic trap is effective at containing leachate.

5.5.3.5 Monitoring Site 27

Monitoring location 27 is located northwest of Phase 2 and adjacent to aggregate stockpiles, where shallow groundwater has been historically impacted by blasting residues. Similar to previous years, groundwater quality in wells 27-1-1 and 27-1-2 met all applicable CSR standards. However, water quality in shallow well 27-1-2 continued to be affected by ongoing aggregate production and blasting activity/excavation close to the Toutle Valley.

In 2020/21, nitrate and sulphate concentrations in shallow well 27-1-2 (3.5 m deep) ranged from 0.69 to 2.82 mg/L, and 80 to 180 mg/L, respectively, which were consistent or slightly lower than those observed in 2019/20. Because ammonia concentrations remained low, it is likely that the elevated nitrate and sulphate concentrations resulted from infiltration of runoff from blasting areas and aggregate stockpiles near the Toutle Valley (i.e. not representative of leachate impacts). Nitrate concentrations in deep well 27-1-1 (24.5 m deep) remained at detection limits. Nitrate is an oxidation product of ammonia, which is found in blasting residues and leachate. Similar to previous years, ammonia concentrations at both 27-1-1 and 27-1-2 were near detection limits and chloride concentrations were below 5.5 mg/L and within the historical range. Conductivity values in deep well 27-1-1 remained below 200 µS/cm, and sulphate concentrations in the deep bedrock monitor 27-1-1 were less than 15 mg/L. Sulphate concentrations were less than 20 mg/L in shallow well 27-1-2 prior to the commencement of quarrying and aggregate stockpiling in 2002. Nearby quarrying, stockpiling of aggregate and road building continues to affect shallow water quality at location 27.

Groundwater quality at location 27 revealed a statistically significant decreasing trend in conductivity over the past five years. Increasing trends in chloride at shallow well (27-1-2) and sulphate at the deep well (27-1-1) were observed over the past five years. These increasing trends indicate a slight degradation of the groundwater quality, primarily due to quarrying and aggregate stockpiling. Hydraulic conditions and contaminant concentrations should be carefully monitored at this location because groundwater in this area reports to the surface water collection and conveyance system. Although not immediately required, it is recommended that the CRD commence early planning for potential future shallow groundwater and surface water management in this area.

5.5.4 Wells near Hartland North Pad (Residual Treatment Facility)

The Hartland North Pad has had a variety of uses including yard waste composting (1994 – 2004) and aggregate stockpiling (2006 - 2017). Additionally, the area was a construction site for the RTF associated with CRD's McLoughlin Point Wastewater Treatment Plant project. The construction of the RTF buildings began in early 2019 and was completed in September 2020. The RTF is now operational and permitted under ENV Operational Certificate #109471.

Monitoring locations 41, 42, 55, 56 and 57 are considered Boundary Compliance Wells around the Hartland North Pad. Monitoring locations 43, 44 and 62 are adjacent to the Hartland North Pad and are not Boundary Compliance Wells. Monitoring locations 91, 92, 93 and 94 were established in November 2019 and located south of the RTF. In 2020/21, groundwater quality in all monitoring wells met all applicable CSR standards.

On October 13, 2020, approximately 130,000 L of untreated residual solids were released from the RTF through the stormwater system. Corvidae conducted the environmental investigation and post-spill monitoring. The End of-Spill report was preceded by an Update to the Minister Report, submitted December 3, 2020. Wells 41-1-1, 55-1-1, 56-1-1 and 57-1-1 are located in close to and downgradient of the spill location. Corvidae (2021) concluded that groundwater quality was within CSR standards or attributed to background, and only BCWQG exceedances were limited to microbiological parameters in some locations downgradient of the spill, with a limited effects pathway to potential receptors. The long-term risk to human health and the environment is considered low and no additional remediation efforts were recommended (Corvidae 2021).

5.5.4.1 Monitoring Sites 44 and 62

Groundwater sampling at well 44-1-1 commenced in 2016/17 to track potential construction related impacts at the Hartland North Pad area. Well 44-1-1 is located southwest of monitoring location 43, and groundwater quality is generally consistent with background conditions. In 2020/21, groundwater quality in 44-1-1 was consistent with the range of background values and exhibited low conductivity (< 400 µs/cm), low sulphate (< 50 mg/L) and low ammonia (< 0.1 mg/L). Well 44-1-1 is located upgradient of the wastewater residuals spill area, and water quality results indicated that groundwater was not impacted from the wastewater residuals spill or surrounding construction/blasting activities.

Monitoring location 62 is located southwest of monitoring location 44. Similar to previous years, 62-1-1 (23.7 m deep) and 62-2-1 (18.9 m deep) exhibited water quality that was similar to background values throughout 2019/20. Water quality at this location has not changed since clearing and site preparation activities associated with the RTF began, and all leachate indicator parameters were reflective of background groundwater quality.

5.5.4.2 Monitoring Sites 41, 42, 43, 55, 56 and 57

Figure 5-7 shows plots of leachate indicator parameters for monitoring locations 41, 42, 43, 55 and 56. In 2020/21, water quality in all these locations remained relatively stable, and were do not appear to have been impacted by the release of wastewater residuals in October 2020.

The 2020/21 monitoring results indicated that water quality at station 43 and 44 (not Boundary Compliance Wells) were consistent with background levels. Short duration impacts during May 2018 are inferred to be associated with RTF construction and/or blasting activities in the area. Groundwater quality at all stations downgradient of the Hartland North Pad should continue to be monitored to assess for changes in water quality.

In 2020/21, groundwater quality in wells 41-1-1, 42-1-1, 55-1-1, 56-1-1 were consistent with historical results and exhibited with low conductivity (< 400 µs/cm), low ammonia (< 0.1 mg/L), and slightly elevated sulphate concentrations (45-98 mg/L). Well 41-1-1 exhibited a decreasing trend in conductivity, sulphate and nitrate concentrations over the past five years with a marked reduction since stockpiles were removed from the Hartland North Pad in 2017. A statistically significant increasing trend was observed in chloride concentrations at 41-1-1. Concentrations of chloride have remained within background ranges since 2014. A statistically significant decreasing trend was detected for conductivity in well 42-1-1. Water quality in well 43-1-1 exhibited a statistically significant decreasing trend in conductivity and chloride concentrations and a statistically significant increasing trend in ammonia concentrations. Well 55-1-1 exhibited a decreasing trend in conductivity and nitrate concentrations. Water quality in well 56-1-1 exhibited statistically significant decreasing trends in conductivity and sulphate concentrations, and an increasing trend in chloride concentrations. A statistically significant decreasing trend was observed in conductivity values at well 57-1-1. Chloride concentrations at locations 41, 42, 56 and 57 were below background concentrations. Overall, the groundwater quality results indicated that the monitoring wells in close proximity to the RTF were not impacted by the release of wastewater residuals on October 13, 2020.

5.5.4.3 Monitoring Sites 91, 92, 93 and 94

Figure 5-7 shows plots of leachate indicator parameters for monitoring locations 91, 92, 93 and 94. Wells 91-1-1, 92-1-1, 93-1-1 and 94-1-1 (not Boundary Compliance Wells) located near the Hartland North Pad. Groundwater sampling at these locations commenced in March 2020. In 2020/21, water quality at all four locations remained below CSR AW and DW standards. Conductivity, chloride and ammonia concentrations at all four locations were below background groundwater concentrations. Slightly elevated sulphate concentrations were present in wells 92-1-1 and 94-1-1 with concentrations ranging from 31 to 110 mg/L. Newly installed monitoring wells often require several sampling events before the influence of drilling has dissipated and groundwater quality stabilizes.

Statistical trend analyzes were not completed for locations 91, 92, 93 or 94, as a minimum data set of five years is required. Groundwater quality at these locations should continue to be monitored for changes in water quality associated with construction and operation of the RTF.

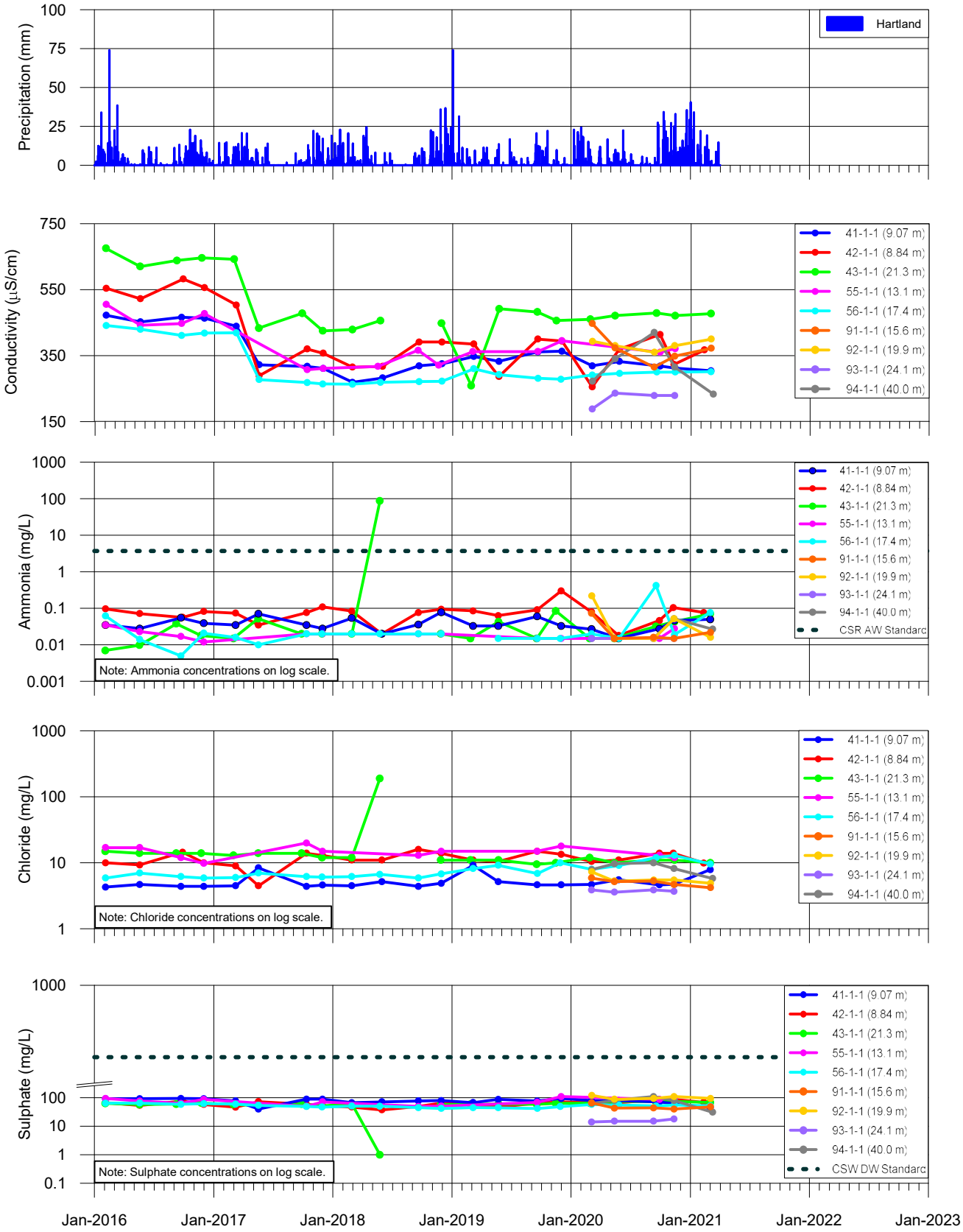


Figure 5-7. Groundwater Quality North of Hartland North Pad

AECOM

5.6 Monitors South of the Phase 1 Landfill

Monitoring well locations 4, 7, 19, 60, 71, 72, 73 and 85 are all located south of the Phase 1 landfill. Only wells at locations 4, 71, 72 and 73 are considered Boundary Compliance Wells. Well 71 is located off site along Hartland Avenue. Wells at locations 4, 19, 60, 71, 72 and 73 are multi-level nested monitoring wells, and the well at location 7 is a 37 m deep, drilled well (open borehole) that was used until 1989 for domestic water supply at the landfill. Wells at locations 71, 72 and 73 were installed in 2003. Well 85-1-1 was installed in 2009 to replace well 3-2-1, which was decommissioned to permit construction of the bin facility.

Similar to previous years, all analytes in all wells met the applicable CSR standards in 2020/21. Figure 5-8 shows plots of leachate indicator parameters in wells located south and downgradient of the landfill, and Figure 5-9 plots leachate indicator parameters for wells located southeast of the landfill.

Groundwater quality in these wells is sensitive to the performance of the south purge well system (see Section 4.4.3). When the purge well system is functioning properly, concentrations of leachate indicator parameters have been shown to decline and seasonal fluctuations in concentrations of leachate indicator parameters are dampened. The reported concentrations indicate that the south purge well system successfully mitigating southward migration of leachate in 2020/21.

5.6.1 South Purge Wells (P1, P2, P3, P4 and P10)

Groundwater quality data collected from the south purge wells (P1, P2, P3, P4 and P10) exhibited statistically significant increasing trends for multiple leachate indicator parameters between 2016 and 2021, indicating water quality degradation and therefore improved leachate capture. In 2020/21, average conductivity values in all south purge wells decreased to 1,625 µS/cm, from 1,976 µS/cm in 2019/20. This result is consistent with the higher precipitation and leachate flow (i.e. dilution) in 2020/21. A statically significant increasing trend in conductivity was observed in only south purge well P2.

Chloride concentrations in the south purge wells have been increasing in recent years and statistically significant increasing trends were detected in P3. Chloride concentrations in 2020/21 ranged from 65 mg/L (P10) to 270 mg/L (P3), which is similar to ranges previously seen in these south purge wells.

Ammonia concentrations in the south purge wells have continuously exceeded CSR standards and concentrations have been increasing in recent years. In 2020/21, nitrate concentrations in the south purge wells were mostly below or close to the detection limit. No statistically significant trend in ammonia and nitrate was observed at any of the south purge wells over the past five years.

5.6.2 Monitoring Site 85

In well 85-1-1 (not a Boundary Compliance Well), chloride concentrations were typically below 50 mg/L, but increased to peak value of 150 mg/L in February 2017, May 2019 and September 2019. In 2020/21, chloride concentrations were elevated in September (140 mg/L) but decreased to 83 mg/L in November 2020. Similar to previous years, sulphate concentrations were below 50 mg/L and ammonia concentrations were below 0.2 mg/L. Given the low sulphate and ammonia concentrations, groundwater at this location is unlikely to be impacted by aggregate runoff or dilute leachate. The elevated chloride concentrations may be related to the application of Garlon™ XRT herbicide, which contains chloride (i.e. Triclopyr).

A statistically significant decreasing trend in ammonia was observed in well 85-1-1 over the past five years, indicating the benefits of improved performance of the south purge well system in recent years. A statistically significant increasing trend in chloride and sulphate were exhibited in well 85-1-1 over the past five years. Groundwater quality should be closely monitored at location 85 to monitor the effectiveness of the south purge wells.

5.6.3 Monitoring Site 60

Three monitoring wells are present at location 60: 60-1-1 (23 m), 60-2-1 (16 m) and 60-3-1 (7 m). These wells are not considered Boundary Compliance Wells. Concentrations met the applicable CSR standards in all three wells at this location, but concentrations of leachate indicator parameters remained slightly elevated. In 2020/21, groundwater quality at location 60 was consistent with those measured in 2019/20, with slightly elevated conductivity (470 to 582 µS/cm), and low ammonia (<0.1 mg/L). Groundwater quality in 60-1-1 exhibited a statistically significant decreasing trend in conductivity and sulphate concentrations and an increasing trend in chloride concentrations over the past five years. In addition, statistically significant

decreasing conductivity values and an increasing trend in nitrate concentrations were detected in well 60-2-1, and decreasing trends in conductivity and nitrate concentrations were observed at 60-3-1, indicating continued improvement in groundwater quality at location 60. Although increasing trends in chloride and sulphate were observed at 60-3-1, concentrations were generally within historical ranges. Overall, groundwater quality at well 60 is generally stable or slightly improved. This indicates upgrades to the south purge well system and maintenance protocols since 2012 are continuing to improve shallow groundwater quality at this location.

Elevated concentrations of leachate indicator parameters and the sensitivity of water quality to performance of the south purge well system demonstrates the need for continued close monitoring of water quality at this location, review of pumping and water level data in the south purge wells, and active management of the south leachate collection system. Recent CRD projects have focused on improving leachate management at the south end of the landfill.

5.6.4 Monitoring Site 07

In 2020/21, all parameters at Boundary Compliance Well 07-1-0 were below applicable CSR standards. Sulphate and concentrations remained low and comparable to background conditions. However, ammonia, chloride and conductivity values were slightly higher than those measured in 2019/20. A statistically significant increasing trend in chloride concentrations was noted. The slight increase in chloride concentrations may be related to the application of Garlon™ XRT herbicide in June 2020. In 2020/21, ammonia concentrations increased to 0.089 mg/L, which was the highest measured concentration since 2014. Ammonia is often the first parameter detected at the leading edge of an advancing leachate plume. Although ammonia concentrations still remained low (<0.1 mg/L), the higher ammonia and conductivity concentrations indicate groundwater may be slightly impacted by dilute leachate. Water quality south of the landfill should be followed closely to ensure the south leachate collection system is effective.

5.6.5 Monitoring Sites 71, 72, 73

Wells 71, 72 and 73 are located at or near the eastern landfill property boundary south of Phase 1 and are considered Boundary Compliance Wells. Concentrations of leachate indicator parameters are shown on Figure 5-8 for wells at location 73 and on Figure 5-9 for wells at locations 71 and 72.

During 2020/21, all samples collected at location 71 met applicable CSR AW and CSR DW standards for all parameters. Similar to previous years, conductivity values ranged between 238 and 355 µS/cm, and chloride concentrations were below 10 mg/L. Ammonia concentrations were typically near or below detection limits, except for 71-2-1 during September 2020. A statistically significant decreasing trend was noted for conductivity in wells 71-1-1 and 71-2-1. Statistically significant increasing trends were observed in wells 71-1-1, 71-2-1 and 71-3-1 for sulphate concentrations as well as chloride concentrations in wells 71-2-1 and 71-3-1. Sulphate concentrations remained below 35 mg/L and chloride concentrations remained below 25 mg/ L during 2020/21. Although the ammonia concentration in 71-3-1 exhibited a statistically significant increasing trend, concentrations remained well below the CSR AW standard. Similar to previous years, groundwater quality at location 71 was not impacted by leachate.

All measured concentrations at 72-1-1 and 72-3-1 remained below applicable CSR standards in 2020/21. Similar to 2018/19, groundwater quality exhibited low conductivity values (<500 µS/cm), low ammonia (<0.1 mg/L) and non-detectable to low nitrate concentrations. Chloride and sulphate concentrations ranged from 43 mg/L to 76 mg/L, and 46 mg/L to 62 mg/L, respectively, which were comparable or slightly lower than those measured in 2019/20. Well 72-1-1 exhibited a statistically significant decreasing trend in conductivity and well 72-3-1 also exhibited decreasing trends in conductivity and chloride concentrations. A statistically significant increasing trend in chloride concentrations was noted in well 72-1-1. Close monitoring confirmed adequate leachate containment south of the landfill and indicates the previously elevated conductivity and chloride concentrations in 2018/19 were related to the use of road salt at the bin facility and not leachate.

At Boundary Compliance Well 73, located further south along the eastern property boundary, all parameters met applicable CSR standards in 2020/21. Conductivity, sulphate and chloride concentrations were relatively stable, and remained close to background levels. Nitrate and ammonia concentrations were near or below detection limits. Overall, concentrations of parameters at location 73 remained within background levels, and water quality continues to improve with distance from Phase 1. Statistical trend analysis revealed decreasing trends in conductivity values at all three wells, and chloride concentrations in 73-1-1. A statistically significant increasing trend was observed for nitrate in groundwater from well 73-3-1 and for sulphate in groundwater from 73-1-1. Based on the graphical and statistical analysis of groundwater chemistry data, it appears that groundwater quality at location 73 is relatively stable, is continuing to improve and not impacted by leachate.

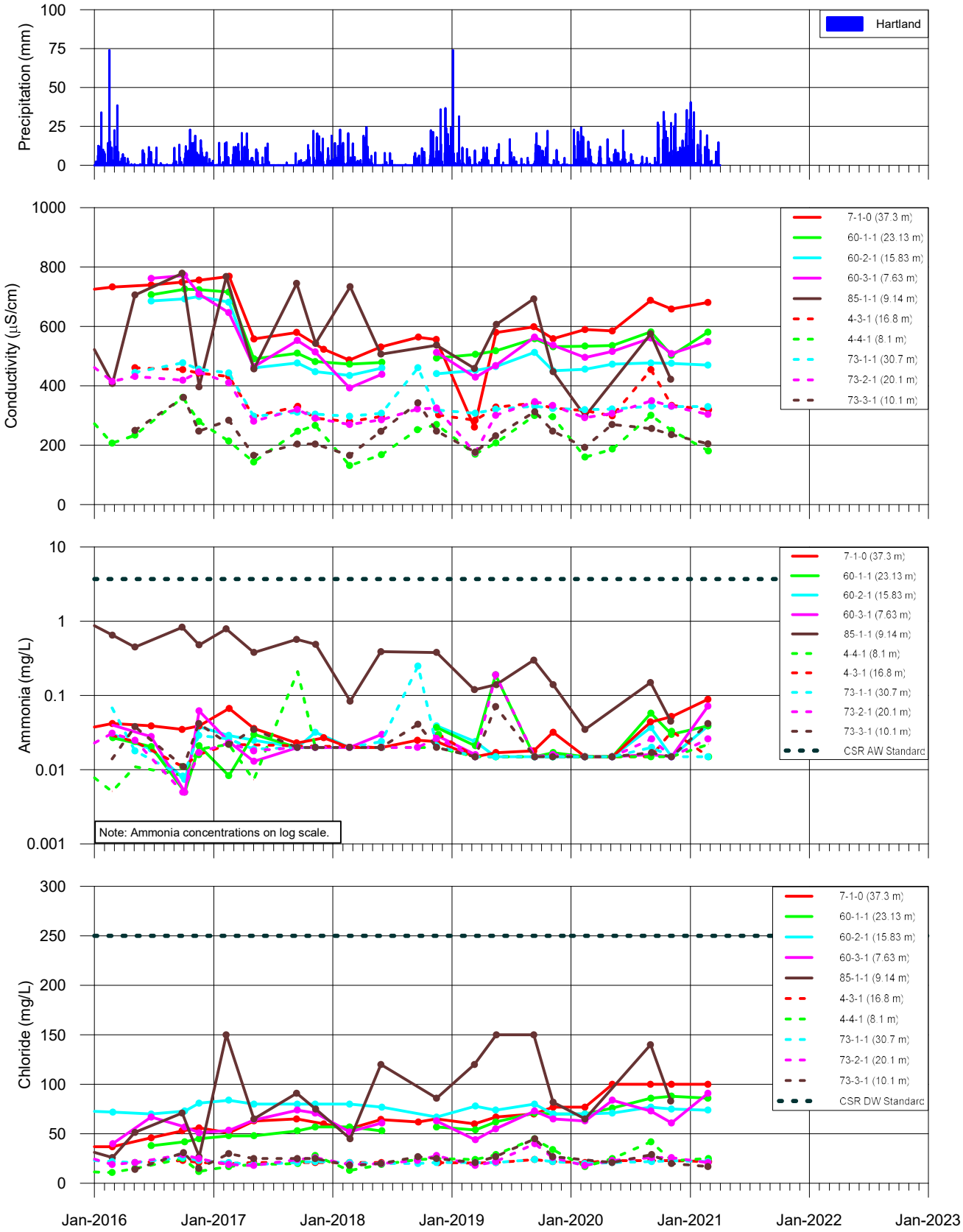


Figure 5-8. Groundwater Quality South of Landfill

AECOM

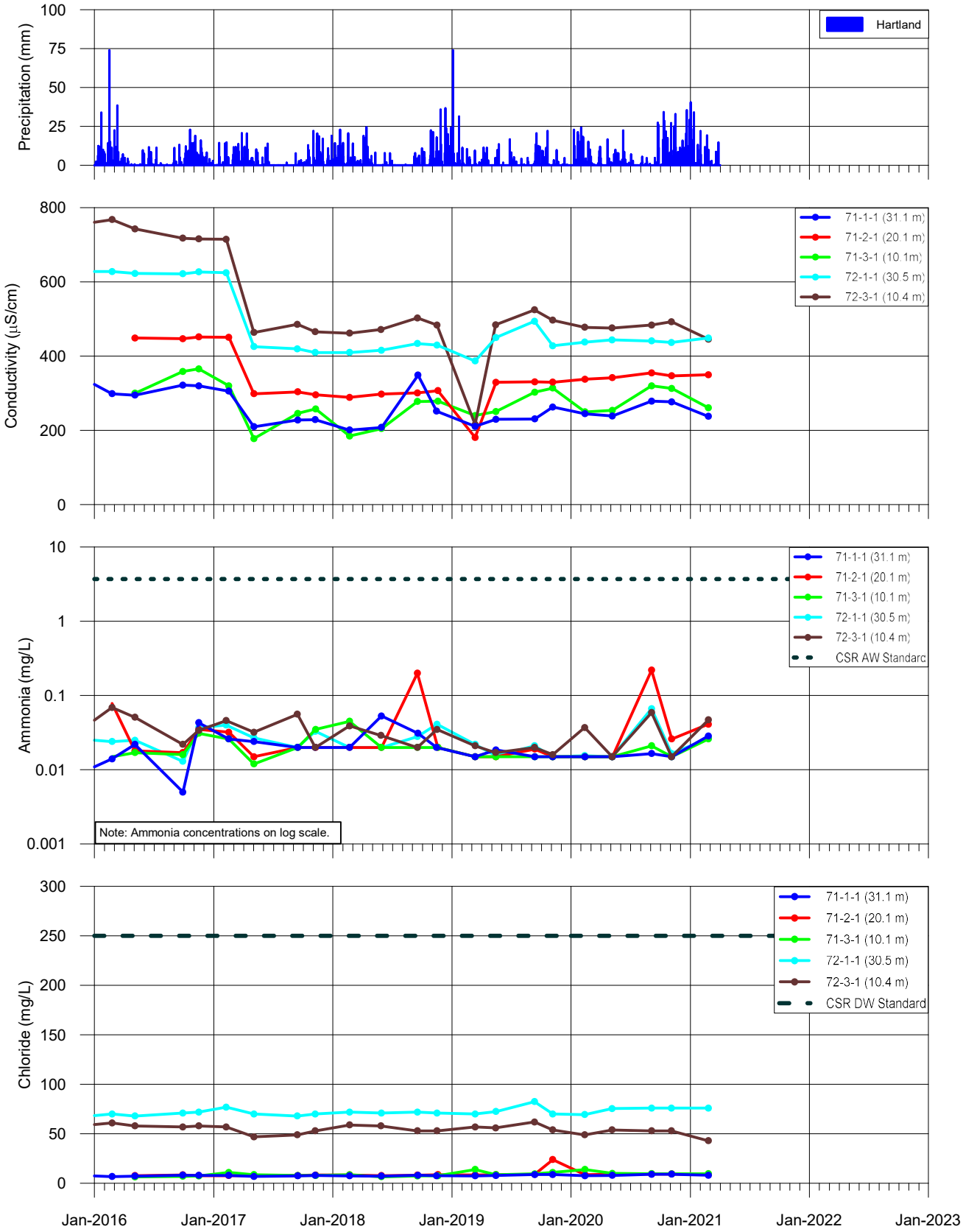


Figure 5-9. Groundwater Quality Southeast of Landfill

AECOM

5.6.6 Monitoring Site 04

Location 04 is the most southerly groundwater monitoring location at the landfill and is considered a Boundary Compliance Well. Groundwater sampling in the deepest monitoring well at location 04-2-1 was discontinued in 2016 due to extremely slow recharge and resultant challenges in collecting representative samples.

All concentrations observed in 04-3-1 and 04-4-1 met the applicable CSR standards in 2020/21. Groundwater quality in 04-4-1 continued to report slightly elevated concentrations of chloride in 2020/21, with a maximum concentration of 42 mg/L during September 2020 sampling event. Conductivity, sulphate and ammonia concentrations in both wells were generally consistent with background conditions, indicating improvement in groundwater quality at this location.

A statistical analysis of data collected at location 04 over the past five years indicated statistically significant decreasing trends in conductivity and ammonia in well 04-3-1 and increasing trends for chloride in well 04-4-1. Overall, water quality in wells at location 04 has improved slightly but should continue to be closely monitored for impacts due to leachate, road salt and aggregate placement.

5.6.7 Monitoring Site 19

Four monitoring wells are present at location 19: 19-1-1 (38 m), 19-1-2 (28 m), 19-2-1 (17 m) and 19-2-2 (9 m). These wells are not considered Boundary Compliance Wells. During 2020/21, all samples collected at location 19 met applicable CSR AW and DW standards. Similar to previous years, conductivity in all wells were below 500 µS/cm, ammonia and nitrate concentrations were generally close to detection limits, and sulphate concentrations were below 50 mg/L. Chloride concentrations in 19-1-1 were slightly elevated in 2019/20, but returned to the historical range of values in 2020/21. Statistically significant decreasing trends in sulphate were identified in wells 19-1-1, 19-2-1 and 19-2-2. Chloride concentrations in wells 19-1-1 and 19-2-2 exhibited statistically significant increasing trends, but remained low (<20 mg/L). Similar to previous years, groundwater quality at location 19 was not impacted by leachate or aggregate placement.

5.7 Monitors East of the Phase 1 Landfill

Monitoring well locations 16, 17, 18, 50, 54 and 76 are situated along the east boundary of the Phase 1 landfill north of Hartland Avenue. Groundwater quality is no longer monitored at locations 50, 54 and 76 due to continued demonstration of groundwater flow toward the landfill and the presence of water quality reflective of background conditions.

5.7.1 Monitoring Sites 17 and 18

Figure 5-10 presents concentrations of leachate indicator parameters in wells at locations 17 and 18. In 2020/21, concentrations in wells at compliance locations 17 and 18 met applicable CSR standards for all parameters analyzed.

Groundwater quality data at location 18 indicated statistically significant decreasing trends in conductivity and nitrate concentrations at well 18-1-1. Although an increasing trend for sulphate was observed at wells 18-1-1, 18-2-1 and 18-2-2, sulphate concentrations were generally below 50 mg/L, which were consistent with background values. The slightly elevated sulphate and nitrate concentrations were only observed in 18-2-1 and 18-2-2 during November 2020 sampling event, and may indicate dilute aggregate/runoff impacts. Groundwater samples have not been collected at 18-1-2 due to an obstruction in the well prior to 2010. Because the obstruction cannot be removed, the well should be decommissioned and replaced with a new well in accordance with the *Water Sustainability Act*.

In 2020/21, ammonia, chloride, sulphate and conductivity values at location 17 remained below background values, indicating groundwater quality was relatively stable. Similar to previous years, nitrate concentrations at 17-1-3 ranged from below detection limits to 0.37 mg/L. Slightly elevated nitrate concentrations may be derived from the oxidation of ammonia, which is associated with decaying organic matter. Based on field observations and experience at the landfill, the occasionally elevated ammonia and nitrate concentrations generally occurs during the winter, and has been attributed to decaying organic matter, including reptiles that have entered well. At location 17, statistically significant decreasing trends were found in nitrate (17-1-1) and sulphate (17-1-2), indicating improved groundwater quality. Similar to previous years, groundwater quality at location 17 and 18 was not impacted by leachate. Water quality at location 18 may be experiencing minor impacts from aggregate material.

5.7.2 Monitoring Site 16

At monitoring location 16 (not a Boundary Compliance Well) located northeast of Phase 1, concentrations of leachate indicator parameters were indicative of background conditions and applicable CSR standards were met for all parameters in 2020/21. Similar to previous years, nitrate concentrations in wells 16-1-2, 16-2-1 and 16-2-2 during the winter increased above background values and reached a maximum concentration of 0.98 mg/L. However, conductivity, sulphate, ammonia and chloride concentrations remained below background values, which suggests that nitrate impacts are not associated with leachate. Overall, groundwater quality at location 16 has improved, as shown by statistically significant decreasing trend in conductivity.

5.8 Summary

The groundwater quality results for 2020/21 were similar to those measured over recent years and leachate-impacted groundwater is contained within the landfill property. At the north end of the landfill, leachate-affected groundwater extends just north of the unlined lower leachate lagoon and through the middle of the lined upper leachate lagoon but does not extend off-site. South of the landfill, leachate-affected groundwater does not extend off-site. Leachate related exceedances are confined to the landfill footprint on the east side of Phase 1 and are inferred to extend to the west side of the Phase 2 landfill.

In 2020/21, most of groundwater wells exhibited slightly improved groundwater quality than that in 2019/20, primarily due to the higher precipitation and associated increased dilution. Groundwater quality in the RTF area was not impacted by the spill release occurred on October 13, 2020 and February 9, 2021. Groundwater quality in Boundary Compliance location 31 may be impacted by the pump #4 effluent release that occurred on October 18, 2020.

Our review of the 2020/21 groundwater quality data revealed the following:

- Boundary Compliance Wells and off-site monitoring wells met CSR AW and DW standards.
- CSR exceedances in groundwater were observed in on-site monitoring wells in close proximity to leachate purge wells and known leachate sources as follows:
    - Similar to previous years, water quality in well 58-1-0 (within the landfill footprint) exceeded CSR AW standards for ammonia and cobalt on all four sampling dates and CSR DW standards for chloride and cobalt on all four sampling dates. Nickel, strontium and vanadium concentrations exceeded CSR DW on one or more sampling events.
    - Groundwater quality in well 52-1-1 (near the north purge wells) exceeded CSR AW standards for ammonia on three of four sampling dates and CSR DW standards for strontium on all four sampling dates.
    - Groundwater quality in north purge wells (52-4-0-P7 and 80-1-0-P8) and south purge wells (P1, P2, P3, P4 and P10) exceeded CSR AW standards for ammonia on one or more sampling dates. Chloride, barium and nitrate concentrations in few locations occasionally exceeded CSR DW standards. Lithium and sodium concentrations in all wells were below regional background values, and therefore elevated concentrations were not considered CSR exceedances.
- Annual average conductivity in the north purge wells were generally lower than those in 2019/20, indicating more dilute leachate quality. Improved water quality in north purge wells is attributed to higher than average precipitation and subsequent increased leachate dilution.
- Operation of the Phase 1 north purge well system continues to mitigate leachate impacts north of the landfill, as indicated by long-term stable or decreasing concentrations of leachate indicator parameters at locations 40, 20 and 21. Groundwater quality in well 20, 21 and 40 showed slight improvement over 2019/20 results.
- Groundwater quality between the lower leachate lagoon and Willis Point Road continued to show no indications of leachate impacts. However, elevated conductivity, sulphate, hardness, calcium and magnesium concentrations indicate that groundwater quality at Boundary Compliance location 31 may be impacted by the pump #4 effluent release that occurred on October 18, 2020.
- Groundwater quality in close proximity to the Phase 2 basin confirms the hydraulic trap leachate collection system is effectively containing leachate north of Phase 2. Groundwater quality 100 m north of Phase 2 continued to show low concentrations of leachate indicator parameters, indicating water quality is not affected by landfill leachate. The slightly elevated sulphate concentrations are likely associated with runoff from aggregate stockpiles.

- Groundwater quality in the shallow well at location 27 continued to be affected by ongoing aggregate production and blasting activity close to the Toutle Valley. The deep well at this location does not appear impacted at this time.
- Groundwater quality at the Hartland North Pad were consistent with background levels. Groundwater quality in close proximity to the October 13, 2020 wastewater residual solids spill event do not appear impacted.
- Groundwater quality in 91-1-1, 92-1-1, 93-1-1 and 94-1-1 were generally consistent with background conditions, except for slightly elevated sulphate concentrations in 92-1-1 and 94-1-1. Impacts in these newly installed wells may be associated with drilling and will likely dissipate with time.
- Water quality along the south boundary of the Phase 1 landfill remained similar to previous years and is not impacted by leachate. Although ammonia concentrations in some of wells at south of landfill were slightly elevated during the winter months, they were within historical ranges, and well below the applicable CSR standards. Therefore the occasionally elevated ammonia concentrations were not considered a potential concern. Long-term improvements in water quality south of the landfill are largely the result of leachate collection and containment measures instituted since 2001.
- Water quality along the east boundary of the Phase 1 landfill remained similar to previous years and is not impacted by leachate. Although ammonia concentrations in wells 17 and 18 were slightly elevated during the winter months, they were generally below 0.1 mg/L, and well below the applicable CSR standards. Therefore the occasionally elevated ammonia concentrations were not considered a potential concern.

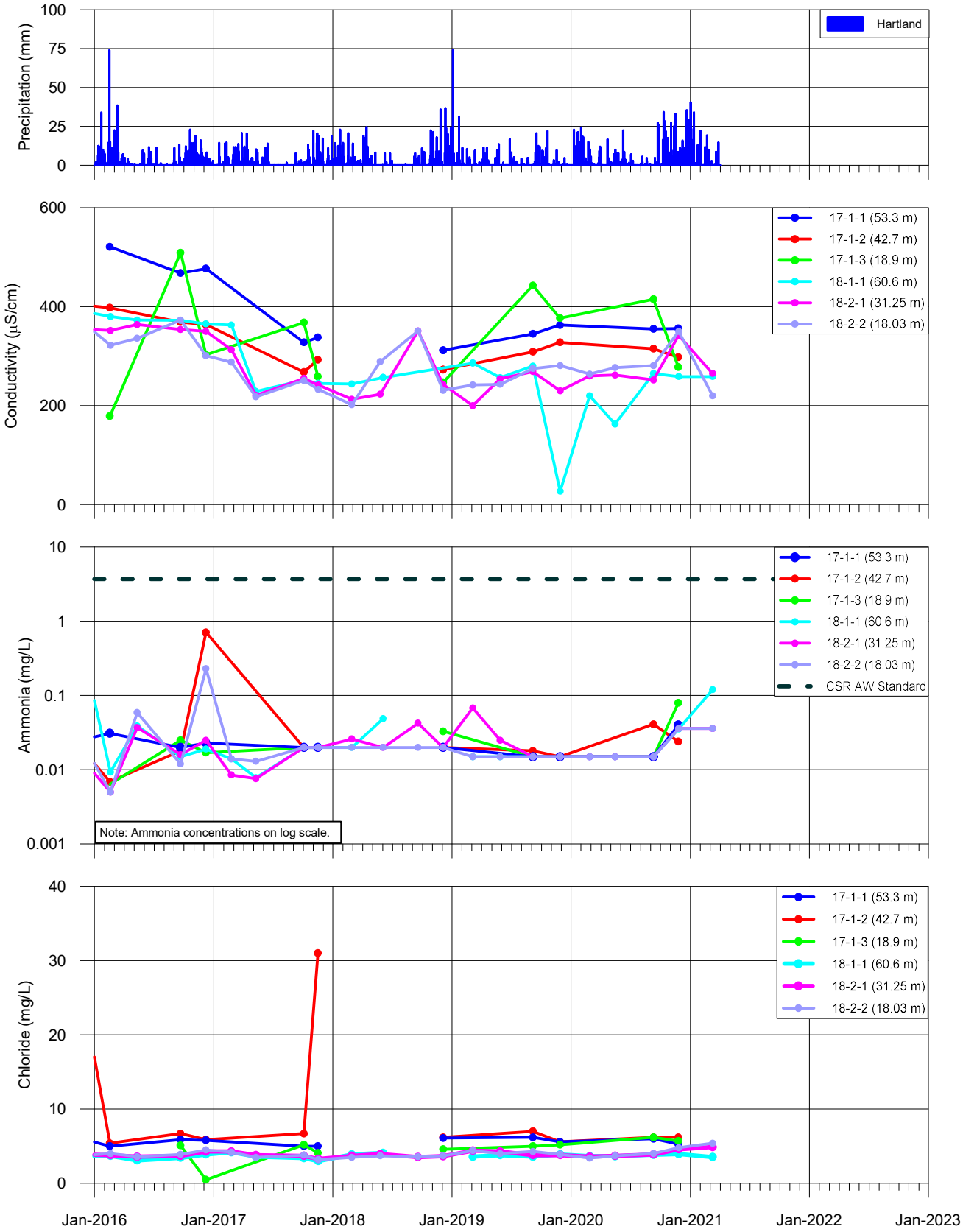


Figure 5-10. Groundwater Quality East of Landfill

AECOM

6. Groundwater Quality in Domestic Wells

6.1 Monitoring Locations

This section of the report is based on our interpretation of water quality data collected between July 22 and July 24, 2020 from domestic wells around Hartland Landfill. The sampling program included:

- Single samples were collected in July 2020 from fourteen (14) selected domestic wells located within a 2 km radius of the landfill. Well 30 (Hartland Ave) was added in 2019 to the routine sampling program.
- One replicate sample was collected from wells located on Hartland Avenue.
- Single samples and one replicate sample were collected from five (5) additional domestic wells located north of the Hartland North Pad and analyzed for selected parameters (sodium, chloride, ammonia, conductivity, and pH).

Since the 1980s, the CRD has performed routine sampling and analysis of domestic wells in the vicinity of the landfill that are used as a primary source of drinking water. The number of wells included in the program have 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 as shown on Figure 6-1. The wells are primarily 0.15 m diameter drilled wells that penetrate between 30 m and 120 m of bedrock. Three of the wells are shallow dug wells completed in overburden. Well yields are generally low and substantial drawdown occurs during pumping, particularly during the dry summer months.

The routine samples collected in 2020 were analyzed for general water quality parameters and total metals. Tabulated results are presented in Appendix B.2. Results were compared to the *British Columbia Approved Source Drinking Water Quality Guidelines (SDWQGs)* where available and *Guidelines for Canadian Drinking Water Quality* (CDWQ). SDWQGs and CDWQ were updated in September 2020 and June 2019, respectively, and a number of parameters (e.g. sulphate, antimony, lead, cobalt, chromium, copper, manganese, nickel, etc.) were added to the drinking water guidelines or updated.

6.2 Domestic Well Quality

Groundwater quality in the domestic wells was similar to the results that have been reported since 2000. Although concentrations of some parameters have varied since the sampling program began, they are considered representative of natural conditions or related to household water filtration/treatment equipment.

The current water quality met the applicable guidelines and standards in sampled wells, with a few exceptions. Exceedances of the CDWQ guideline (aesthetic objectives) were noted at select locations as described below:

- Field pH values were below the CDWQ guideline of 7.0 in wells 24, 25, 61 and 47.
- Groundwater quality in domestic wells 37 (at house and well head) and 38 marginally exceeded the total manganese SDWQG guideline (0.02 mg/L). The SDWQG for total manganese in drinking water is an aesthetic objective to protect against staining and unpleasant taste but is not considered to be toxic at these concentrations.
- Iron concentrations in well 53 have been reported at concentrations above the SDWQG guideline since 2013 and exceeded the CDWQ for aesthetic objectives and SDWQG for aesthetic objectives of 0.3 mg/L in 2020. The iron exceedances may be related to maintenance of household water filtration equipment. Iron is naturally present in the soils and the metamorphic rocks found in the vicinity of the landfill. Iron concentrations in groundwater samples collected from these domestic wells are interpreted as originating from natural sources.

The five domestic wells located northwest of the landfill near the end of Willis Point Road met CDWQ and SDWQG guidelines for leachate indicator parameters with the exception of pH, indicating these wells were not impacted by leachate from Hartland Landfill.

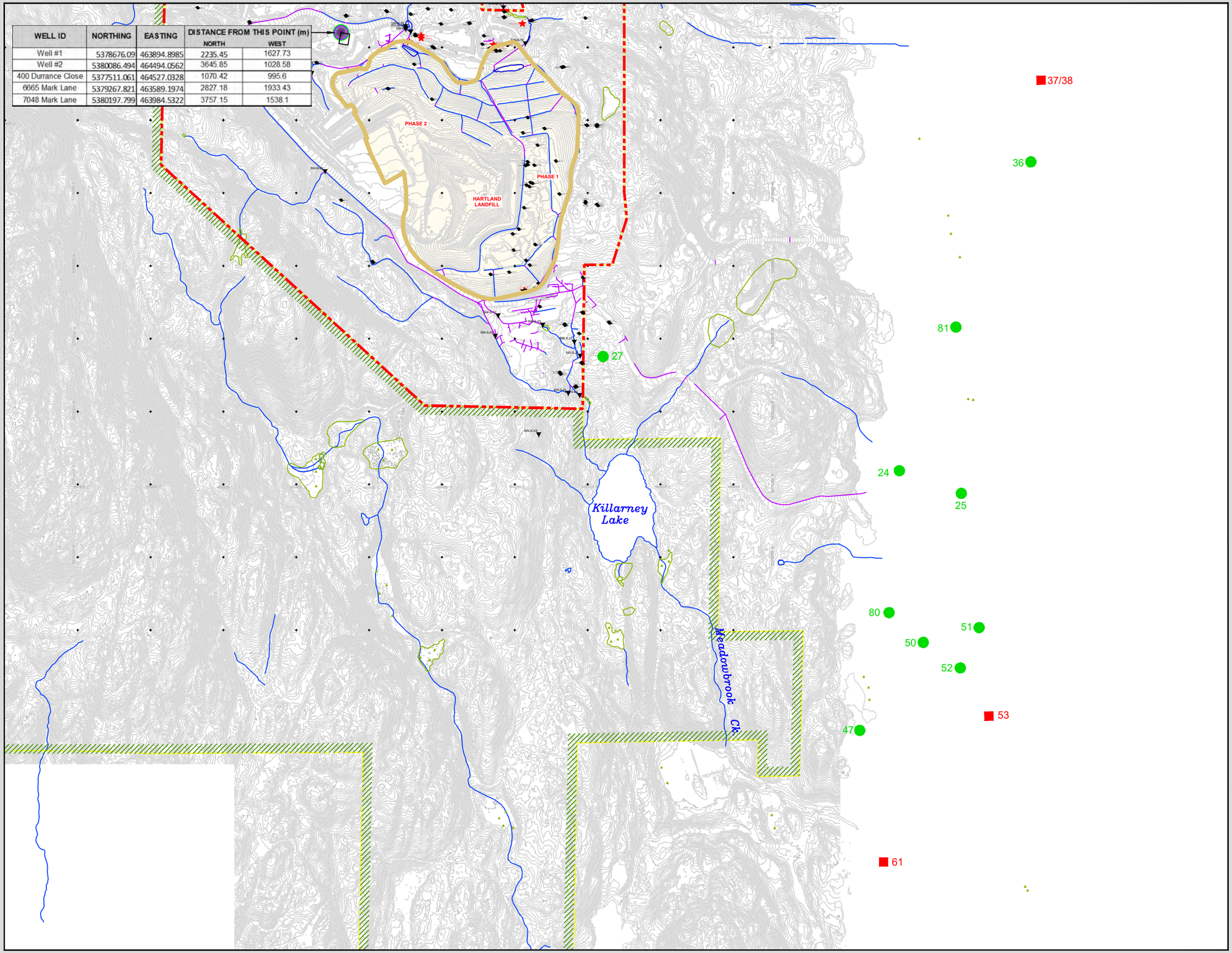
Overall, the 2020 domestic well water quality results are similar to historical data. The data indicates that the domestic wells have not been impacted by leachate from Hartland Landfill. Previously elevated concentrations of total lead in well 37 fell below the SDWQG and the CDWQ in 2020. The occasional exceedance in total lead concentration in well 37 may be due to leaching from plumbing or lead service lines.

6.3 Summary

As part of the CRD's groundwater quality monitoring program, nineteen (19) domestic wells were sampled in 2020, including 14 routine locations and 5 new wells. The water quality monitoring program indicated:

- Iron concentrations in domestic well 53 exceeded the CDWQ and SDWQG drinking water quality guidelines. Iron concentrations in this well have been reported above the guideline since 2013. However, iron guidelines are not human health objectives and may be naturally occurring or related to maintenance of water filtration equipment or household plumbing.
- Manganese concentrations in domestic wells 37 and 38 exceeded the SDWQG of 0.02 mg/L. The SDWQG for manganese in drinking water is an aesthetic objective to protect against staining (e.g., plumbing) but manganese is not deemed toxic at these concentrations.
- Overall, the groundwater quality in the domestic wells sampled in 2020 were consistent with previous results, and landfill leachate did not impact the water quality in the sampled wells. Water quality in all five new domestic wells located northwest of the landfill near the end of Willis Point Road met CDWQ and SDWQG guidelines, indicating these domestic wells were not impacted by leachate from Hartland Landfill.

WELL ID	NORTHING	EASTING	DISTANCE FROM THIS POINT (m)	
			NORTH	WEST
Well #1	5378676.09	463894.8985	2235.45	1627.73
Well #2	5380086.494	464494.0562	3645.85	1028.58
400 Durrance Close	5377511.061	464527.0328	1070.42	995.6
6665 Mark Lane	5379267.821	463589.1974	2827.18	1933.43
7048 Mark Lane	5380197.799	463984.5322	3757.15	1538.1



Legend

- BUILDING / STRUCTURE
- ROAD
- FENCE
- LEGAL LOT BOUNDARY
- INDEX CONTOUR (5m)
- INTERMEDIATE CONTOUR (1m)
- TREES/SHRUB/VEGETATION
- DITCH
- DRAINAGE
- PIPE
- EXISTING WASTE
- HARTLAND LANDFILL OPERATING AREA BOUNDARY
- 37 — DRILLED DOMESTIC WELL SAMPLED IN JULY, 2020
- 61 — DUG DOMESTIC WELL SAMPLED IN JULY, 2020.
- Well #1 — DRILLED DOMESTIC WELL SAMPLED IN JULY, 2020.

Map Sources / Notes:
- Contour interval 1.0 m
- Groundwater elevation data collected by CRD, September 2019.
- Contours based on 24-W542_2019-2020 BASE.dwg PROVIDED BY CINDY WANG OF CAPITAL REGIONAL DISTRICT May 2021.
- Drainage information for years 2018-2019 obtained from Parks & Env. Services GIS technicians and have layers with the prefix "CRD19_GIS DRAINAGE" & "CRD19_GIS streams_Ditches".
- GPS pickup has been conducted by CRD Staff of creeks, wetlands, culverts located under tree canopied areas. This information (considered more accurate) has been added to the base (superceding some planimetric information) and is placed on layers indicating GPS pickup. An example of that layering system would be 'CRD19-wat-culvert_GPS pickup'.
- Surveyed points for monitoring sites (groundwater, gas wells, leachate, purge wells) were updated for 2019.
- The map is to NAD83 UTM coordinates. Vertical datum is to CGVD28.

N / W / E / S

0 50 100 200 300 400 m

1 : 10,000

UTM Zone 10N, NAD83

Reviewed by: KJ | Prepared by: PCJ
Date Issued: May 2021 | Project Number: 60631284

Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Domestic Well Locations

AECOM

Figure 6-1
Version 1

File Location: \\NA.AECOMNET.COM\LFS\AMER\BURNABY-CABNY1\LEGACY\CABNY1FP001\PROD\PROJECTS\60631284\900-CAD_GIS\910-CAD\20-SHEETS\C432 - 2020-21 ANNUAL REPORT\FIG6.1-DOMESTIC WELL LOCATIONS-20200622-60631284-431.DWG Date Plotted: August 30, 2021 Saved By:castle-janschp

7. Surface Water Quality near the Landfill

7.1 Compliance Monitoring Locations

A total of five surface water compliance monitoring stations have been identified surrounding Hartland Landfill. These stations are concentrated along the southern and northern property boundaries and are located downgradient of areas that have the potential to be impacted by leachate or runoff from the site. With respect to assessing landfill compliance with the landfill operating permit, the following are considered Boundary Compliance stations:

South of the Landfill

- Sw-S-04

North of Phases 1 and 2

- Sw-N-05
- Sw-N-16

North of the Hartland North Pad

- Sw-N-41s1
- Sw-N-42s1

Laboratory analytical results are presented in Appendix B.3. A review of the sampling program was undertaken in early 2016 (AECOM 2016), and recommended adjustments to the number, location and sampling frequency of sampling at compliance monitoring locations were implemented in the 2016/17 monitoring year. In 2020/21, a total of 23 surface water stations were sampled.

7.1.1 Regulatory Comments

As discussed in Section 2.4.2, the results were compared to the BCWQG for the protection of freshwater AW. Exceedances of BCWQGs are noted in Table 7-1. Some parameters have variable guidelines, as noted below:

- For ammonia, there is no single value for the protection of freshwater AW. The toxicity of ammonia is related to the temperature and pH of the water and the BCWQG includes values for acute and chronic effects. The appropriateness of the chronic (allowable 30-day average) concentration for the assessment of ongoing operations is currently being evaluated. Based on surface water monitoring data collected, CRD staff calculated the allowable 30-day average concentration of ammonia for the protection of freshwater AW and the maximum allowable concentration (MAC) based on the pH and temperature of each sample as discussed in the footnotes of Table 7-1, with exceedances highlighted based on BCWQG-MAC‘s.
- The BCWQG-MAC for sulphate was calculated for each sample based on the hardness measured in each sample. A detailed description is presented in the footnotes of Appendix B.3.
- The BCWQG-MAC and 30-day average values for total suspended solids (TSS) reference a “change from background value” and the flow conditions (i.e. clear or turbid waters). Water quality at stations SW-N-CSs2 and SW-N-14 are taken to represent background surface water quality north of the landfill. Water quality at station SW-S-52 represents background surface water quality south of the landfill. In 2020/21, the background TSS values north and south of the landfill were both <2 mg/L, respectively.
- BCWQGs for cadmium, lead, nickel, manganese, silver and zinc are hardness dependent. Total metal concentrations were compared to guidelines based on the associated hardness results for each sample.
- The dissolved copper BCWQG varies with hardness, pH, dissolved organic carbon (DOC) and temperature, and is calculated using the Biotic Ligand Model (BLM).

Table 7-1 Surface Water Quality Exceedances 2020-2021

B.C. Water Quality Guidelines				BC WQG MAXIMUM (1)	---			5			---			---			---			600			110			---			---			---			1000			3.28 - 416.7 (5)			815 - 3394 (5)			2000			1.9 - 24.9 (3)			0.06 - 0.6 (4)			32.8		
				BC WQG AVERAGE (1)	---			---			1200			---			---			150			4			---			---			---			---			3.43 - 19.57 (5)			767 - 2585 (5)			1000			0.135 - 1.77 (3)			0.02 - 0.2 (4)			3		
STATION	SAMPLE TYPE	COMPLIANCE WELL?	DATE	PARAMETER	Aluminum			Arsenic			Boron			Cadmium			Chloride			Cobalt			Copper			Hardness (As Caco3)			Iron			Lead			Manganese			Molybdenum			N - Nh3 (As N)			N - No2 (As N)			N - No3 (As N)					
				STATE	TOT			TOT			TOT			TOT			DIS			TOT			TOT			TOT			TOT			TOT			TOT			TOT			TOT			DIS			DIS					
				UNIT	µg/L			µg/L			µg/L			µg/L			mg/L			µg/L			µg/L			mg/L			µg/L			µg/L			µg/L			mg/L			mg/L			mg/L					
				Method Detection Limit (MDL)	0.5			0.02			10			0.005			1			0.01			0.1			0.5			1			0.005			0.1			0.05			0.015			0.005			0.02					
				Limit of Quantification (LOQ)	2.5			0.1			50			0.025			5			0.05			0.5			2.5			5			0.025			0.5			0.25			0.075			0.025			0.1					
					30%			30%			30%			30%			30%			30%			30%			30%			30%			30%			30%			30%			30%			30%			30%					
				COMMENTS	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG			
SW-N-05	FRM	COMPLIANCE	21/04/2020	Mean of duplicates	34.6	---	---	0.117 5		---	25.5	---		0.005 5	---	---	5.4			0.074 55			1.275	---	---	189.	---	---	46.7		---	< 0.020 5			1.782 5			0.833 5			< 0.015 5			< 0.005			1.055					
SW-N-05	FRM	COMPLIANCE	29/09/2020	Mean of duplicates	97.3	---	---	0.133 5		---	33.	---		0.009 65	---	---	6.05			0.194 5			2.05	---	---	338.5	---	---	167.5		---	0.027 1			5.79			0.747 5			0.021			< 0.005			3.055		b			
SW-N-05	FRM	COMPLIANCE	02/12/2020	Mean of duplicates	75.95	---	---	0.135 5		---	50.	---		0.009 75	---	---	5.25			0.144 5			1.42	---	---	310.	---	---	101.7		---	< 0.018 3			2.445			1.58			0.022			< 0.005			6.23		b			
SW-N-05	FRM	COMPLIANCE	03/02/2021	Mean of duplicates	135.5	---	---	0.121 5		---	41.5	---		< 0.006	---	---	5.			0.161 5			1.39	---	---	219.5	---	---	186.		---	0.014 35			3.315			1.305			0.235			< 0.005			6.415		b			
SW-N-16	FRM	COMPLIANCE	21/04/2020	Mean of duplicates	21.05	---	---	0.298		---	95.	---		0.012	---	---	8.4			0.774			2.985	---	---	188.5	---	---	**1 875.**	**a**	---	< 0.021			742.5			0.713			0.12			< 0.005			< 0.02					
SW-N-16	FRM	COMPLIANCE	29/09/2020	Mean of duplicates	17.8	---	---	0.296		---	87.5	---		0.030 05	---	---	13.			0.429 5			6.12	---	---	214.5	---	---	283.5		---	0.079			98.			1.31			0.098 5			0.077 6			0.691					
SW-N-16	FRM	COMPLIANCE	01/12/2020	Mean of duplicates	34.15	---	---	0.249		---	60.5	---		0.007 5	---	---	6.6			0.264			8.205	---	---	221.5	---	---	203.5		---	< 0.02			60.2			0.788			0.051 5			0.018 3			7.305		b			
SW-N-16	FRM	COMPLIANCE	04/02/2021	Mean of duplicates	69.6	---	---	0.235 5		---	43.	---		0.011 45	---	---	6.1			0.254 5			13.35	---	---	147.5	---	---	245.		---	0.024 65			50.95			0.867			0.565			0.006 4			3.365		b			
SW-N-41S1	FRM	COMPLIANCE	22/04/2020	Mean of duplicates	1 035.	---	---	1.04		---	17.	---		0.033 7	---	---	4.2			0.963			2.875	---	---	175.	---	---	**1 780.**	**a**	---	0.825			551.5			0.402			0.027 5			< 0.005			0.162					
SW-N-42S1	FRM	COMPLIANCE	22/04/2020	Mean of duplicates	528.5	---	---	0.329 5		---	40.	---		0.025 1	---	---	9.65			0.826			3.61	---	---	188.	---	---	971.		---	0.602 5			465.5			0.466 5			0.03			< 0.005			0.051					
SW-N-42S1	FRM	COMPLIANCE	30/09/2020	Mean of duplicates	83.3	---	---	0.241 5		---	52.5	---		< 0.005 2	---	---	11.			0.319 5			0.63	---	---	264.5	---	---	260.5		---	0.096			232.			0.555 5			0.031			< 0.005			0.038					
SW-N-42S1	FRM	COMPLIANCE	02/12/2020	Mean of duplicates	215.7	---	---	0.152		---	62.5	---		< 0.011 35	---	---	10.			0.357			1.72	---	---	221.	---	---	451.1		---	0.299 5			167.8			0.45			0.023			< 0.005			0.136 5					
SW-S-04	FRM	COMPLIANCE	22/04/2020	Mean of duplicates	748.5	---	---	0.374 5		---	51.	---		0.031 45	---	---	18.5			0.837 5			8.455	---	---	76.8	---	---	**1 295.**	**a**	---	1.035			66.9			0.358			0.048			0.015 85			0.450 5					
SW-S-04	FRM	COMPLIANCE	01/10/2020	Mean of duplicates	22.25	---	---	0.098		---	75.5	---		0.016 4	---	---	26.5			0.098 7			1.39	---	---	134.5	---	---	21.1		---	0.030 35			8.39			0.127 5			< 0.015			< 0.005			1.215					
SW-S-04	FRM	COMPLIANCE	03/12/2020	Mean of duplicates	127.5	---	---	0.162 5		---	80.5	---		0.011 7	---	---	15.			0.197 5			3.715	---	---	109.	---	---	224.		---	0.154			23.75			0.169			0.16			0.021 1			1.995					
SW-S-04	FRM	COMPLIANCE	03/02/2021	Mean of duplicates	135.5	---	---	0.166 5		---	44.5	---		0.008 7	---	---	15.			0.161			4.635	---	---	71.75	---	---	202.5		---	0.122			17.45			0.101			0.035 5			< 0.005 05			1.28					
SW-N-17	SS		24/04/2020		94.1	---	---	0.13		---	71.	---		< 0.005	---	---	9.3			0.192			1.04	---	---	152.	---	---	167.		---	0.056			24.5			0.694			0.016			< 0.005			0.785					
SW-N-17	SS		30/09/2020	Clear and colourless, moderate flow, abundance of decaying leaves	29.6	---	---	0.162		---	119.	---		0.020 2	---	---	10.			0.165			0.911	---	---	212.	---	---	55.3		---	0.020 1			28.4			0.823			0.016			< 0.005			0.883					
SW-N-17	SS		02/12/2020	Clear and colourless.	29.8	---	---	0.11		---	87.	---		0.005 5	---	---	9.5			0.089 6			0.785	---	---	245.	---	---	42.1		---	0.012 7			6.97			0.827			0.25			< 0.005			3.63		b			
SW-N-17	SS		04/02/2021	Moderately high flow,clear and colourless	36.5	---	---	0.114		---	84.	---		0.012 6	---	---	11.			0.07			0.83	---	---	174.	---	---	45.2		---	0.454			4.06			0.783			0.52			< 0.005			3.11		b			
SW-N-18	SS		21/04/2020		21.5	---	---	0.081		---	10.	---		< 0.005	---	---	5.1			0.055			0.323	---	---	182.	---	---	41.3		---	0.016 2			0.863			0.448			< 0.015			< 0.005			0.775					
SW-N-18	SS		29/09/2020	Clear and colourless, moderate flow	15.9	---	---	0.111		---	15.	---		< 0.005	---	---	6.8			0.095 4			0.607	---	---	379.	---	---	28.8		---	0.028 1			1.09			0.65			0.05			< 0.005			3.96		b			
SW-N-18	SS		03/02/2021	High flow, clear and colourless	187.	---	---	0.069		---	< 10.	---		< 0.005	---	---	6.3			0.21			0.741	---	---	173.	---	---	347.		---	0.032 1			6.5			0.42			0.018			< 0.005			0.801					
SW-N-19	SS		21/04/2020		26.5	---	---	0.35		---	35.	---		0.022 3	---	---	4.4			2.68			14.3	---	---	198.	---	---	122.		---	0.058			280.			1.1			0.051			0.005 7			0.132					
SW-N-19	SS		29/09/2020	Clear and colourless, moderate flow	13.7	---	---	0.354		---	60.	---		0.006 1	---	---	11.			1.16			3.69	---	---	220.	---	---	323.		---	0.028 6			175.			0.771			0.19			0.208		b	1.4					
SW-N-19	SS		01/12/2020	Clear and colourless.	18.	---	---	0.281		---	47.	---		0.010 1	---	---	5.8			0.356			11.8	---	---	236.	---	---	29.		---	< 0.02			15.6			0.902			0.11			0.045 2			8.23		b			
SW-N-19	SS		04/02/2021	Moderately high flow, clear and slightly yellow	61.3	---	---	0.271		---	33.	---		0.024 7	---	---	5.9			0.365			18.6	---	---	158.	---	---	86.7		---	0.05			12.6			0.973			0.61			0.008 1			3.3		b			
SW-N-41S3	SS		22/04/2020		163.	---	---	0.208		---	34.	---		0.016 4	---	---	13.			0.121			1.23	---	---	124.	---	---	170.		---	0.259			11.6			0.327			0.06			< 0.005			0.047					
SW-N-45	SS		24/04/2020		21.1	---	---	0.142		---	59.	---		0.005 7	---	---	7.6			0.135			1.79	---	---	165.	---	---	35.6		---	< 0.02			11.9			0.944			0.04			< 0.005			1.24					
SW-N-45	SS		30/09/2020	Clear and colourless, moderate flow	12.1	---	---	0.139		---	91.	---		0.007 7	---	---	7.2			0.107			1.14	---	---	244.	---	---	11.		---	0.007 3			5.46			1.01			0.033			< 0.005			1.9					
SW-N-45	SS		02/12/2020	Clear and colourless.	64.3	---	---	0.12		---	75.	---		0.007 3	---	---	7.2			0.15			1.23	---	---	293.	---	---	77.1		---	0.026			5.36			1.27			0.035			< 0.005			6.		b			
SW-N-45	SS		04/02/2021	High flow, clear and colourless	74.3	---	---	0.114		---	61.	---		0.005	---	---	8.			0.119			1.08	---	---	201.	---	---	102.		---	0.019 6			3.64			1.24			< 0.015			< 0.005			4.47		b			
SW-N-50	SS		21/04/2020		10.5	---	---	0.059		---	10.	---		< 0.005	---	---	5.1			0.042 1			0.28	---	---	182.	---	---	11.8		---	< 0.005			0.45			0.41			< 0.015			< 0.005			1.16					
SW-N-50	SS		29/09/2020	Slightly turbid and colourless, low flow	70.5	---	---	0.074		---	14.	---		< 0.005	---	---	6.5			0.162			0.876	---	---	383.	---	---	130.		---	0.028 4			3.13			0.652			< 0.015			< 0.005			3.92		b			
SW-N-50	SS		08/02/2021	High flow, clear and colourless, plastic garbage observed in culvert	129.	---	---	0.068		---	11.	---		< 0.005	---	---	5.1			0.171			0.671	---	---	131.	---	---	181.		---	0.034			4.01			0.304			0.38			< 0.005			0.526					
SW-N-54	SS		21/04/2020		36.8	---	---	0.434		---	55.	---		0.007 3	---	---	2.			0.253			13.7	---	---	193.	---	---	66.9		---	< 0.02			57.			0.878			0.031			< 0.005			0.309					
SW-N-54	SS		29/09/2020	Slightly turbid, slightly yellow, moderately low flow	7.26	---	---	0.662		---	53.	---		0.019 1	---	---	3.9			0.904			6.03	---	---	261.	---	---	128.		---	0.020 6			401.			0.683			0.17			0.012 1			0.182					
SW-N-54	SS		02/12/2020	Clear and colourless.	182.	---	---	0.357		---	70.	---		< 0.005	---	---	2.4			0.332			17.4	---	---	212.	---	---	317.		---	0.041			18.4			0.645			0.18			0.014 2			6.52		b			
SW-N-54	SS		03/02/2021	Moderately high flow, clear and slightly yellow	217.	---	---	0.338		---	52.	---		< 0.005	---	---	2.8			0.295			13.8	---	---	165.	---	---	411.		---	0.042 1			26.3			0.491			< 0.015			< 0.005			1.26					
SW-S-03	SS		22/04/2020		8 050.	---	---	2.5		---	29.	---		0.284	---	---	7.7			9.32		**b**	53.5	---	---	78.4	---	---	**15 400.**	**a**	---	14.7		**b**	570.			0.585			0.14			0.014 2			1.12					
SW-S-03	SS		01/10/2020	Clear and colourless, moderately low flow	617.	---	---	0.361		---	74.	---		0.032 2	---	---	25.			0.797			10.9	---	---	187.	---	---	**1 120.**	**a**	---	1.78			40.2			0.317			0.016			0.006 4			4.58		b			
SW-S-03	SS		03/12/2020	Clear and colourless.	1 140.	---	---	0.4		---	69.	---		0.066 7	---	---	12.			1.44			15.2	---	---	106.	---	---	**2 160.**	**a**	---	3.56			203.			0.196			0.18			0.111			2.61					
SW-S-12	SS		22/04/2020		10 600.	---	---	0.871		---	34.	---		0.058 6	---	---	8.9			11.9		**b**	45.4	---	---	149.	---	---	**19 600.**	**a**	---	2.11			364.			0.364			0.57			0.046 7			3.16		b			
SW-S-12	SS		01/10/2020	Clear and colourless, low flow	42.4	---	---	0.458		---	34.	---		0.030 9	---	---	6.4			0.346			21.2	---	---	297.	---	---	60.7		---	0.016 1			25.6			0.193			0.025			< 0.005			7.67		b			
SW-S-12	SS		03/12/2020	Clear and colourless.	57.1	---	---	0.203		---	90.	---		0.015 4	---	---	11.			0.364			9.87	---	---	123.	---	---	473.		---	0.023 4			368.			0.074			3.4		**b**	0.060 7			2.71					
SW-S-12	SS		03/02/2021	Moderately high flow,clear and colourless	113.	---	---	0.26		---	83.	---		0.018 1	---	---	14.			0.345			21.4	---	---	107.	---	---	399.		---	0.032			196.			0.103			2.5		**b**	0.020 4			2.35					
SW-S-20	SS		03/12/2020	Clear and colourless.	102.	---	---	0.116		---	22.	---		< 0.005	---	---	6.5			0.151			1.48	---	---	57.6	---	---	152.		---	0.037			44.2			0.052			0.17			< 0.005			0.074					
SW-S-20	SS		03/02/2021	High flow, clear and colourless	168.	---	---	0.123		---	10.	---		< 0.005	---	---	5.2			0.121			1.06	---	---	45.9	---	---	212.		---	0.051			5.85			0.059			0.087			< 0.005			0.06					
SW-S-21	SS		03/12/2020	Clear and colourless.	472.	---	---	0.14		---	15.	---		0.006 9	---	---	6.4			0.286			2.02	---	---	47.6	---	---	400.		---	0.24			20.9			0.07			0.21			< 0.005			0.277					
SW-S-21	SS		03/02/2021	Moderately high flow,clear and colourless	72.2	---	---	0.099		---	11.	---		0.005	---	---	4.6			0.054			1.	---	---	40.8	---	---	63.3		---	0.027			1.29			0.062			< 0.015			< 0.005			0.105					
SW-S-24	SS		22/04/2020		723.	---	---	0.391		---	55.	---		0.032 9	---	---	19.			0.87			7.53	---	---	80.2	---	---	**1 300.**	**a**	---	0.976			110.			0.359			0.037			0.011 5			0.544					
SW-S-24	SS		01/10/2020	Clear and colourless, moderately low flow	12.8	---	---	0.171		---	88.	---		0.017 5	---	---	27.			0.128			3.5	---	---	146.	---	---	9.3		---	0.013			19.8			0.123			0.022			< 0.005			0.035					
SW-S-24	SS		03/12/2020	Clear and colourless.	77.6	---	---	0.167		---	92.	---		0.013 4	---	---	27.			0.191			4.03	---	---	116.	---	---	152.		---	0.114			31.7			0.182			0.14			0.039 9			2.28					
SW-S-24	SS		03/02/2021	High flow, clear and colourless	118.	---	---	0.175		---	70.	---		0.013 9	---	---	27.			0.193			7.27	---	---	98.2	---	---	222.		---	0.128			32.2			0.163			0.049			0.016 2			2.15					
SW-S-27	SS		03/12/2020	Clear and colourless.	47.7	---	---	0.179		---	126.	---		0.057 7	---	---	14.			0.32			1.49	---	---	123.	---	---	94.7		---	0.187			125.			0.166			0.19			< 0.005			< 0.02					
SW-S-27	SS		03/02/2021	Moderately high flow,clear and colourless	168.	---	---	0.151		---	77.	---		0.082 3	---	---	20.			0.351			1.56	---	---	94.4	---	---	362.		---	0.32			68.6			0.126			0.017			< 0.005			0.091					

Notes:

na — *Not applicable.*

Null — *No sample collected.*

a — *Above Maximum allowable concentration (MAC) British Columbia Water Quality Guideline.*

b — *Above 30-day average British Columbia Water Quality Guideline.*

(1) — *British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for British Columbia, 1998 Edition,*

(2) — *Maximum acceptable concentration unless otherwise noted.*

(3) — *The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*

(4) — *The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*

(5) — *This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*

(6) — *This value is the short-term daily for streams with unknown fish distribution.*

(7) — *The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the North landfill are derived from stations SW-N-CSs2, SW-N-41s3 and SW-N-14.*

(8) — *Dissolved copper guideline varies with water hardness, temperature and dissolved organic carbon; Dissolved copper results were only compared with guidelines where DOC was analyzed.*

Table 7-1 Surface Water Quality Exceedances 2020-2021

B.C. Water Quality Guidelines				BC WQG MAXIMUM (1)	---			---			0.05 - 1.5 (5)			128 - 429 (5)			Variable (7)			33 - 340.5 (5)			6.5 to 9.0			---			---			---			100			---			---			0.038-2.8 (5)			---			Variable (8)			---		
				BC WQG AVERAGE (1)	---			---			0.1 - 3 (5)			---			Variable (7)			7.5 - 187.5 (5)			---			---			---			---			50			---			---			0.018-0.645 (5)			---			Variable (8)			---		
				PARAMETER	Nickel			Selenium			Silver			Sulphate			TSS			Zinc			pH			Conductivity			Temperature			Aluminum			Arsenic			Boron			Cadmium			Cobalt			Copper			Hardness (As Caco3)		
				STATE	TOT			TOT			TOT			DIS			TOT			TOT			TOT			TOT			TOT			DIS			DIS			DIS			DIS			DIS			DIS			DIS		
				UNIT	µg/L			µg/L			µg/L			mg/L			mg/L			µg/L			pH			µS/cm			°C			µg/L			µg/L			µg/L			µg/L			µg/L			µg/L			mg/L		
				Method Detection Limit (MDL)	0.02			0.04			0.005			1			1			1			0.1			1			0.1			0.5			0.02			10			0.005			0.005			0.05			0.5		
				Limit of Quantification (LOQ)	0.1			0.2			0.025			5			5			5			0.5			5			0.5			2.5			0.1			50			0.025			0.025			0.25			2.5		
					30%			30%			30%			30%			30%			30%			30%			30%			30%			30%			30%			30%			30%			30%			30%			30%		
STATION	SAMPLE TYPE	COMPLIANCE WELL?	DATE	COMMENTS	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG
SW-N-05	FRM	COMPLIANCE	21/04/2020	Mean of duplicates	0.353 5	---	---	0.223 5	---	---	< 0.007 5			110.	---		7.6		b	1.445			7.31	---	---	289.	---	---	9.7	---	---	6.315			0.161 5	---	---	25.5	---	---	< 0.005 4			0.045 8	---	---	**5.735**	a	b	188.	---	---
SW-N-05	FRM	COMPLIANCE	29/09/2020	Mean of duplicates	0.696 5	---	---	0.5	---	---	< 0.005			230.	---		2.8			2.78			6.67	---	---	535.	---	---	13.6	---	---	3.835			0.13	---	---	35.	---	---	0.066 85			0.077 45	---	---	**5.605**	a	b	333.5	---	---
SW-N-05	FRM	COMPLIANCE	02/12/2020	Mean of duplicates	0.532	---	---	0.485	---	---	< 0.007 5			180.	---		9.		b	2.175			7.12		---	301.	---	---	8.8	---	---	23.			0.153 5	---	---	47.	---	---	0.007 8			0.101 5	---	---	1.265		b	294.5	---	---
SW-N-05	FRM	COMPLIANCE	03/02/2021	Mean of duplicates	0.492 5	---	---	0.357	---	---	< 0.005			130.	---		< 1.			2.745			7.23	---	---	328.	---	---	8.3	---	---	18.65			0.119	---	---	41.5	---	---	0.026 9			0.076 6	---	---	1.2		b	222.5	---	---
SW-N-16	FRM	COMPLIANCE	21/04/2020	Mean of duplicates	1.685	---	---	0.107	---	---	< 0.01			49.	---		15.5		b	5.25			7.06	---	---	306.	---	---	10.1	---	---	5.875			0.275 5	---	---	92.5	---	---	0.006 8			0.712	---	---	5.02		b	182.	---	---
SW-N-16	FRM	COMPLIANCE	29/09/2020	Mean of duplicates	2.12	---	---	0.125 5	---	---	< 0.005 25			92.5	---		2.2			15.3			**6.43**	a	---	379.	---	---	14.	---	---	9.945			0.262 5	---	---	88.	---	---	0.021 3			0.407 5	---	---	**7.65**	a	b	211.5	---	---
SW-N-16	FRM	COMPLIANCE	01/12/2020	Mean of duplicates	1.51	---	---	0.116 5	---	---	< 0.01			120.	---		< 1.7			6.6			**6.44**	a	---	331.	---	---	6.4	---	---	12.1			0.271 5	---	---	52.	---	---	0.010 4			0.238 5	---	---	**9.005**	a	b	217.	---	---
SW-N-16	FRM	COMPLIANCE	04/02/2021	Mean of duplicates	1.81	---	---	0.129 5	---	---	< 0.005			43.5	---		< 1.			8.18			7.39	---	---	230.	---	---	6.7	---	---	22.25			0.241 5	---	---	45.5	---	---	0.009 95			0.253	---	---	9.855		b	146.5	---	---
SW-N-41S1	FRM	COMPLIANCE	22/04/2020	Mean of duplicates	1.345	---	---	0.159 5	---	---	0.013			66.	---		**54.5**	a	b	6.5			7.77	---	---	255.	---	---	8.9	---	---	6.925			0.170 5	---	---	16.	---	---	< 0.005			0.055 8	---	---	0.639			169.	---	---
SW-N-42S1	FRM	COMPLIANCE	22/04/2020	Mean of duplicates	0.705	---	---	0.103	---	---	< 0.01			90.5	---		**34.5**	a	b	5.8			7.3	---	---	309.	---	---	9.3	---	---	9.14			0.163	---	---	40.	---	---	< 0.008 7			0.087 85	---	---	0.707 5			188.5	---	---
SW-N-42S1	FRM	COMPLIANCE	30/09/2020	Mean of duplicates	0.295	---	---	0.064	---	---	< 0.01			125.	---		7.7		b	1.6			6.63	---	---	437.	---	---	12.9	---	---	7.525			0.222	---	---	54.5	---	---	< 0.005			0.152	---	---	0.383 5			277.5	---	---
SW-N-42S1	FRM	COMPLIANCE	02/12/2020	Mean of duplicates	0.38	---	---	0.1	---	---	< 0.01			125.	---		23.5		b	< 2.35			6.82		---	326.	---	---	6.	---	---	10.04			0.122	---	---	60.	---	---	< 0.005			0.073 85	---	---	0.460 5			214.5	---	---
SW-S-04	FRM	COMPLIANCE	22/04/2020	Mean of duplicates	1.585	---	---	0.067 5	---	---	< 0.01			18.5	---		9.7		b	15.		b	7.43	---	---	156.	---	---	9.9	---	---	15.6			0.225 5	---	---	51.	---	---	0.012 1			0.089	---	---	3.775		b	74.85	---	---
SW-S-04	FRM	COMPLIANCE	01/10/2020	Mean of duplicates	0.333 5	---	---	0.075	---	---	< 0.005			59.	---		2.			2.545			**6.28**	a	---	267.	---	---	11.9	---	---	9.395			0.127	---	---	83.5	---	---	0.012 5			0.068 9	---	---	1.5		b	143.5	---	---
SW-S-04	FRM	COMPLIANCE	03/12/2020	Mean of duplicates	0.810 5	---	---	0.081 5	---	---	< 0.007 5			30.5	---		2.4			5.93			7.07		---	197.	---	---	8.4	---	---	13.85			0.164	---	---	84.	---	---	0.007 9			0.082 55	---	---	3.64		b	106.5	---	---
SW-S-04	FRM	COMPLIANCE	03/02/2021	Mean of duplicates	0.83	---	---	0.066 5	---	---	< 0.01			18.5	---		< 1.			6.95			7.02	---	---	137.7	---	---	6.8	---	---	27.5			0.121	---	---	42.	---	---	0.006 4			0.064 75	---	---	4.165		b	74.25	---	---
SW-N-17	SS		24/04/2020		0.33	---	---	0.14	---	---	< 0.01			84.	---		1.6			1.7			6.98	---	---	367.	---	---	9.9	---	---	4.97			0.103	---	---	70.	---	---	< 0.005			0.077 9	---	---	0.942		b	159.	---	---
SW-N-17	SS		30/09/2020	Clear and colourless, moderate flow, abundance of decaying leaves	0.393	---	---	0.211	---	---	< 0.005			140.	---		1.2			4.06			**6.15**	a	---	367.	---	---	13.4	---	---	7.04			0.182	---	---	122.	---	---	< 0.005			0.143	---	---	0.965			217.	---	---
SW-N-17	SS		02/12/2020	Clear and colourless.	0.254	---	---	0.282	---	---	< 0.005			170.	---		2.4			1.71			**6.27**	a	---	365.	---	---	7.5	---	---	7.42			0.143	---	---	89.	---	---	0.006 5			0.071 9	---	---	0.734			237.	---	---
SW-N-17	SS		04/02/2021	Moderately high flow,clear and colourless	0.24	---	---	0.207	---	---	< 0.01			87.	---		< 1.			20.8			7.36	---	---	263.	---	---	7.3	---	---	10.5			0.101	---	---	82.	---	---	0.008 2			0.052 3	---	---	0.775			173.	---	---
SW-N-18	SS		21/04/2020		0.128	---	---	0.195	---	---	< 0.005			100.	---		< 1.			1.73			7.96	---	---	274.	---	---	9.6	---	---	3.29			0.071	---	---	12.	---	---	< 0.005			0.037 2	---	---	**5.84**	a	b	177.	---	---
SW-N-18	SS		29/09/2020	Clear and colourless, moderate flow	0.248	---	---	0.334	---	---	< 0.005			260.	---		< 1.			6.05			6.76	---	---	548.	---	---	13.5	---	---	3.01			0.142	---	---	18.	---	---	< 0.005 8			0.073 2	---	---	0.585			375.	---	---
SW-N-18	SS		03/02/2021	High flow, clear and colourless	0.309	---	---	0.142	---	---	< 0.005			100.	---		< 1.			4.43			7.35	---	---	237.	---	---	8.4	---	---	5.57			0.06	---	---	< 10.	---	---	< 0.005			0.035 7	---	---	0.489		b	179.	---	---
SW-N-19	SS		21/04/2020		3.3	---	---	0.195	---	---	0.016			85.	---		6.		b	1.9			8.4	---	---	315.	---	---	11.6	---	---	12.4			0.336	---	---	35.	---	---	0.019 3			2.5	---	---	9.24		b	196.	---	---
SW-N-19	SS		29/09/2020	Clear and colourless, moderate flow	2.31	---	---	0.145	---	---	0.006 9			99.	---		< 1.			1.33			7.76	---	---	391.	---	---	16.1	---	---	9.64			0.337	---	---	59.	---	---	< 0.005			1.07	---	---	1.99			218.	---	---
SW-N-19	SS		01/12/2020	Clear and colourless.	1.97	---	---	0.131	---	---	< 0.01			130.	---		2.4			4.1			6.71		---	345.	---	---	6.4	---	---	13.2			0.302	---	---	42.	---	---	0.007 6			0.354	---	---	**11.2**	a	b	228.	---	---
SW-N-19	SS		04/02/2021	Moderately high flow, clear and slightly yellow	2.42	---	---	0.153	---	---	< 0.005			50.	---		1.2			7.25			7.06	---	---	235.	---	---	6.9	---	---	26.5			0.261	---	---	36.	---	---	0.014 5			0.341	---	---	13.5		b	157.	---	---
SW-N-41S3	SS		22/04/2020		0.31	---	---	0.133	---	---	< 0.01			28.	---		9.2		b	2.1			7.43	---	---	191.	---	---	8.4	---	---	4.89			0.127	---	---	32.	---	---	0.008 8			0.023 5	---	---	2.11		b	121.	---	---
SW-N-45	SS		24/04/2020		0.34	---	---	0.199	---	---	< 0.01			97.	---		4.			1.3			7.27	---	---	333.	---	---	8.8	---	---	7.28			0.097	---	---	58.	---	---	< 0.005			0.103	---	---	1.52		b	169.	---	---
SW-N-45	SS		30/09/2020	Clear and colourless, moderate flow	0.288	---	---	0.395	---	---	< 0.005			170.	---		5.2		b	1.34			**6.25**	a	---	341.	---	---	12.7	---	---	4.74			0.125	---	---	102.	---	---	< 0.005			0.105	---	---	**1.36**	a	b	257.	---	---
SW-N-45	SS		02/12/2020	Clear and colourless.	0.42	---	---	0.481	---	---	< 0.01			200.	---		1.2		b	2.6			6.67		---	425.	---	---	8.4	---	---	14.7			0.131	---	---	73.	---	---	0.005 7			0.102	---	---	1.41		b	284.	---	---
SW-N-45	SS		04/02/2021	High flow, clear and colourless	0.37	---	---	0.302	---	---	< 0.005			120.	---		1.6			2.71			7.21	---	---	308.	---	---	8.1	---	---	12.9			0.118	---	---	65.	---	---	0.007 1			0.073 6	---	---	1.01		b	217.	---	---
SW-N-50	SS		21/04/2020		0.11	---	---	0.215	---	---	< 0.005			100.	---		< 1.			0.28			7.48	---	---	267.	---	---	8.7	---	---	3.33			0.08	---	---	12.	---	---	< 0.005			0.034 9	---	---	**5.06**	a	b	179.	---	---
SW-N-50	SS		29/09/2020	Slightly turbid and colourless, low flow	0.283	---	---	0.37	---	---	< 0.005			220.	---		4.			0.4			6.79	---	---	283.	---	---	12.9	---	---	4.3			0.141	---	---	21.	---	---	< 0.005			0.078 8	---	---	**5.79**	a	b	377.	---	---
SW-N-50	SS		08/02/2021	High flow, clear and colourless, plastic garbage observed in culvert	0.218	---	---	0.118	---	---	< 0.005			63.	---		< 1.			0.9			7.45	---	---	206.	---	---	8.3	---	---	4.55			0.083	---	---	< 10.	---	---	< 0.005			0.024 9	---	---	0.272		b	129.	---	---
SW-N-54	SS		21/04/2020		1.38	---	---	0.258	---	---	< 0.01			35.	---		< 1.		<	1.			8.26	---	---	285.	---	---	11.1	---	---	5.22			0.433	---	---	51.	---	---	< 0.005			0.132	---	---	13.		b	190.	---	---
SW-N-54	SS		29/09/2020	Slightly turbid, slightly yellow, moderately low flow	1.61	---	---	0.223	---	---	< 0.005			110.	---		2.8			0.64			6.99	---	---	285.	---	---	17.4	---	---	**121.**	a	b	0.781	---	---	55.	---	---	0.022 5			1.53	---	---	14.2		b	262.	---	---
SW-N-54	SS		02/12/2020	Clear and colourless.	1.48	---	---	0.268	---	---	< 0.01			65.	---		4.			1.4			7.19		---	301.	---	---	8.8	---	---	52.4		b	0.377	---	---	67.	---	---	0.007			0.221	---	---	17.4		b	211.	---	---
SW-N-54	SS		03/02/2021	Moderately high flow, clear and slightly yellow	1.38	---	---	0.187	---	---	< 0.005			42.	---		< 1.			5.6			7.53	---	---	237.	---	---	7.6	---	---	8.52			0.308	---	---	51.	---	---	< 0.005			0.101	---	---	12.5		b	158.	---	---
SW-S-03	SS		22/04/2020		13.2	---	---	0.16	---	---	**0.141**	a	b	16.	---		**130.**	a	b	**224.**	a	b	7.28	---	---	102.	---	---	11.7	---	---	**387.**	a	b	0.687	---	---	29.	---	---	0.020 3			0.603	---	---	**13.8**	a	b	49.7	---	---
SW-S-03	SS		01/10/2020	Clear and colourless, moderately low flow	1.86	---	---	0.156	---	---	0.012			110.	---		5.2		b	23.			6.73	---	---	404.	---	---	16.	---	---	5.94			0.214	---	---	74.	---	---	0.008 6			0.155	---	---	5.73		b	194.	---	---
SW-S-03	SS		03/12/2020	Clear and colourless.	3.57	---	---	0.126	---	---	0.011			27.	---		**45.**	a	b	33.5			7.12		---	209.	---	---	11.3	---	---	**146.**	a	b	0.227	---	---	69.	---	---	0.019 4			0.347	---	---	**8.25**	a	b	100.	---	---
SW-S-12	SS		22/04/2020		16.8	---	---	0.231	---	---	0.024			54.	---		**130.**	a	b	51.3			7.18	---	---	217.	---	---	11.6	---	---	**666.**	a	b	0.333	---	---	32.	---	---	0.020 7			1.47	---	---	**17.4**	a	b	112.	---	---
SW-S-12	SS		01/10/2020	Clear and colourless, low flow	5.1	---	---	0.271	---	---	< 0.005			200.	---		1.6			7.14			7.08	---	---	535.	---	---	16.7	---	---	29.2			0.494	---	---	39.	---	---	0.033 6			0.345	---	---	21.7		b	308.	---	---
SW-S-12	SS		03/12/2020	Clear and colourless.	1.94	---	---	0.101	---	---	< 0.005			30.	---		< 1.			3.77			6.8		---	253.	---	---	11.1	---	---	31.3			0.231	---	---	95.	---	---	0.014 5			0.342	---	---	**9.57**	a	b	118.	---	---
SW-S-12	SS		03/02/2021	Moderately high flow,clear and colourless	3.3	---	---	0.166	---	---	< 0.01			27.	---					4.			6.81	---	---	210.	---	---	9.3	---	---	64.4		b	0.222	---	---	75.	---	---	0.018 3			0.282	---	---	**19.4**	a	b	103.	---	---
SW-S-20	SS		03/12/2020	Clear and colourless.	0.28	---	---	0.063	---	---	< 0.01			5.2	---		2.8			13.4		b	7.2		---	94.	---	---	7.3	---	---	31.7			0.11	---	---	20.	---	---	< 0.005			0.077 4	---	---	1.42			54.8	---	---
SW-S-20	SS		03/02/2021	High flow, clear and colourless	0.26	---	---	< 0.04	---	---	< 0.01			< 1.	---		< 1.			11.2		b	7.04	---	---	112.	---	---	5.9	---	---	45.6			0.103	---	---	< 10.	---	---	< 0.005			0.038 5	---	---	0.85			44.5	---	---
SW-S-21	SS		03/12/2020	Clear and colourless.	0.54	---	---	0.075	---	---	< 0.01			5.8	---		1.6			15.8		b	7.54		---	78.	---	---	6.8	---	---	32.2			0.117	---	---	16.	---	---	< 0.005			0.034 5	---	---	1.04			44.7	---	---
SW-S-21	SS		03/02/2021	Moderately high flow,clear and colourless	0.19	---	---	< 0.04	---	---	< 0.01			< 1.	---		< 1.			9.5		b	6.96	---	---	65.3	---	---	5.9	---	---	36.9			0.082	---	---	< 10.	---	---	< 0.005			0.029 9	---	---	0.94			41.8	---	---
SW-S-24	SS		22/04/2020		1.68	---	---	0.07	---	---	< 0.01			20.	---		8.4		b	15.4		b	7.48	---	---	158.	---	---	10.8	---	---	16.			0.267	---	---	56.	---	---	0.016 6			0.123	---	---	4.32		b	79.1	---	---
SW-S-24	SS		01/10/2020	Clear and colourless, moderately low flow	0.655	---	---	0.086	---	---	< 0.005			90.	---		7.2		b	6.61			6.62	---	---	225.	---	---	13.8	---	---	8.76			0.213	---	---	100.	---	---	0.021 9			0.143	---	---	**9.88**	a	b	157.	---	---
SW-S-24	SS		03/12/2020	Clear and colourless.	0.85	---	---	0.09	---	---	< 0.01			33.	---		1.2			5.4			7.4		---	217.	---	---	9.1	---	---	23.7			0.162	---	---	93.	---	---	0.015 2			0.118	---	---	3.73		b	113.	---	---
SW-S-24	SS		03/02/2021	High flow, clear and colourless	1.19	---	---	0.105	---	---	< 0.01			27.	---		< 1.			5.4			6.66	---	---	190.	---	---	7.8	---	---	23.3			0.154	---	---	66.	---	---	0.012 6			0.108	---	---	**6.83**	a	b	96.6	---	---
SW-S-27	SS		03/12/2020	Clear and colourless.	0.72	---	---	0.066	---	---	< 0.01			40.	---		< 1.			6.9			7.1		---	207.	---	---	6.1	---	---	18.2			0.212	---	---	121.	---	---	0.032 8			0.252	---	---	1.08		b	121.	---	---
SW-S-27	SS		03/02/2021	Moderately high flow,clear and colourless	0.59	---	---	0.043	---	---	< 0.01			28.	---		< 1.			5.9			6.68	---	---	169.	---	---	5.7	---	---	15.			0.102	---	---	75.	---	---	0.025 9			0.156	---	---	0.829		b	96.7	---	---

Notes:

na — *Not applicable.*

Null — *No sample collected.*

a — *Above Maximum allowable concentration (MAC) British Columbia Water Quality Guideline.*

b — *Above 30-day average British Columbia Water Quality Guideline.*

(1) — *British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for British Columbia, 1998 Edition,*

(2) — *Maximum acceptable concentration unless otherwise noted.*

(3) — *The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*

(4) — *The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*

(5) — *This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*

(6) — *This value is the short-term daily for streams with unknown fish distribution.*

(7) — *The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the North landfill are derived from stations SW-N-CSs2, SW-N-41s3 and SW-N-14.*

(8) — *Dissolved copper guideline varies with water hardness, temperature and dissolved organic carbon; Dissolved copper results were only compared with guidelines where DOC was analyzed.*

Table 7-1 Surface Water Quality Exceedances 2020-2021

B.C. Water Quality Guidelines				BC WQG MAXIMUM (1)	350			---			---			---			---			---			---			---			---		
				BC WQG AVERAGE (1)	---			---			---			---			---			---			---			---			---		
				PARAMETER	Iron			Lead			Manganese			Molybdenum			Nickel			Selenium			Silver			Zinc			Dissolved Organic Carbon		
				STATE	DIS			DIS			DIS			DIS			DIS			DIS			DIS			DIS			Dissolved		
				UNIT	µg/L			µg/L			µg/L			µg/L			µg/L			µg/L			µg/L			µg/L			µg/L		
				Method Detection Limit (MDL)	1			0.005			0.05			0.05			0.02			0.04			0.005			0.1			0.5		
				Limit of Quantification (LOQ)	5			0.025			0.25			0.25			0.1			0.2			0.025			0.5			2.5		
					30%			30%			30%			30%			30%			30%			30%			30%			30%		
STATION	SAMPLE TYPE	COMPLIANCE WELL?	DATE	COMMENTS	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG
SW-N-05	FRM	COMPLIANCE	21/04/2020	Mean of duplicates	19.		---	0.085 15	---	---	0.489 5	---	---	0.856 5	---	---	0.337	---	---	0.244 5	---	---	< 0.005	---	---	2.71	---	---	0.91	---	---
SW-N-05	FRM	COMPLIANCE	29/09/2020	Mean of duplicates	4.05		---	0.096 8	---	---	0.624 5	---	---	0.693 5	---	---	0.569 5	---	---	0.476	---	---	< 0.005	---	---	4.1	---	---	2.	---	---
SW-N-05	FRM	COMPLIANCE	02/12/2020	Mean of duplicates	20.4		---	< 0.005	---	---	0.902 5	---	---	1.485	---	---	0.470 5	---	---	0.458	---	---	< 0.005	---	---	1.885	---	---	2.25	---	---
SW-N-05	FRM	COMPLIANCE	03/02/2021	Mean of duplicates	12.05		---	< 0.005 5	---	---	0.498	---	---	1.275	---	---	0.395	---	---	0.326	---	---	< 0.005	---	---	1.36	---	---	1.95	---	---
SW-N-16	FRM	COMPLIANCE	21/04/2020	Mean of duplicates	199.		---	0.083 3	---	---	714.	---	---	0.650 5	---	---	1.64	---	---	0.096	---	---	< 0.005	---	---	5.105	---	---	8.8	---	---
SW-N-16	FRM	COMPLIANCE	29/09/2020	Mean of duplicates	108.5		---	0.088 3	---	---	94.	---	---	1.29	---	---	2.14	---	---	0.114	---	---	< 0.005	---	---	15.3	---	---	10.	---	---
SW-N-16	FRM	COMPLIANCE	01/12/2020	Mean of duplicates	92.65		---	0.174 05	---	---	48.4	---	---	0.792 5	---	---	1.51	---	---	0.110 5	---	---	< 0.005	---	---	6.565	---	---	9.05	---	---
SW-N-16	FRM	COMPLIANCE	04/02/2021	Mean of duplicates	227.5		---	0.006 8	---	---	60.45	---	---	0.790 5	---	---	1.74	---	---	0.129 5	---	---	< 0.005	---	---	6.235	---	---	9.65	---	---
SW-N-41S1	FRM	COMPLIANCE	22/04/2020	Mean of duplicates	19.15		---	0.010 75	---	---	43.05	---	---	0.291	---	---	0.109 5	---	---	0.081 5	---	---	< 0.005	---	---	1.32	---	---	4.4	---	---
SW-N-42S1	FRM	COMPLIANCE	22/04/2020	Mean of duplicates	32.6		---	0.014	---	---	43.25	---	---	0.389	---	---	0.224 5	---	---	0.048 5	---	---	< 0.005	---	---	3.565	---	---	5.65	---	---
SW-N-42S1	FRM	COMPLIANCE	30/09/2020	Mean of duplicates	57.95		---	0.011 95	---	---	126.5	---	---	0.558	---	---	0.205 5	---	---	0.061 5	---	---	< 0.005	---	---	0.505	---	---	5.3	---	---
SW-N-42S1	FRM	COMPLIANCE	02/12/2020	Mean of duplicates	36.5		---	0.013 55	---	---	27.2	---	---	0.404	---	---	0.154	---	---	0.053 5	---	---	< 0.005	---	---	0.525	---	---	3.15	---	---
SW-S-04	FRM	COMPLIANCE	22/04/2020	Mean of duplicates	16.6		---	0.026 4	---	---	4.26	---	---	0.321	---	---	0.498	---	---	0.061	---	---	< 0.005	---	---	3.57	---	---	5.7	---	---
SW-S-04	FRM	COMPLIANCE	01/10/2020	Mean of duplicates	1.95		---	0.007 65	---	---	0.315	---	---	0.27	---	---	0.345 5	---	---	0.082 5	---	---	< 0.005	---	---	2.36	---	---	4.85	---	---
SW-S-04	FRM	COMPLIANCE	03/12/2020	Mean of duplicates	12.85		---	0.017	---	---	3.2	---	---	0.157	---	---	0.609 5	---	---	0.072	---	---	< 0.005	---	---	3.835	---	---	4.5	---	---
SW-S-04	FRM	COMPLIANCE	03/02/2021	Mean of duplicates	26.		---	0.010 8	---	---	4.055	---	---	0.114	---	---	0.670 5	---	---	0.063	---	---	< 0.005	---	---	5.755	---	---	5.1	---	---
SW-N-17	SS		24/04/2020		20.		---	0.015 2	---	---	13.6	---	---	0.683	---	---	0.177	---	---	0.132	---	---	0.006 8	---	---	1.1	---	---	3.	---	---
SW-N-17	SS		30/09/2020	Clear and colourless, moderate flow, abundance of decaying leaves	12.3		---	0.009 2	---	---	26.4	---	---	0.836	---	---	0.335	---	---	0.238	---	---	< 0.005	---	---	3.15	---	---	3.9	---	---
SW-N-17	SS		02/12/2020	Clear and colourless.	10.2		---	< 0.005	---	---	5.55	---	---	0.785	---	---	0.274	---	---	0.266	---	---	< 0.005	---	---	1.73	---	---	2.1	---	---
SW-N-17	SS		04/02/2021	Moderately high flow,clear and colourless	11.5		---	0.010 3	---	---	2.96	---	---	0.755	---	---	0.206	---	---	0.162	---	---	< 0.005	---	---	1.58	---	---	2.6	---	---
SW-N-18	SS		21/04/2020		12.2		---	0.155	---	---	0.372	---	---	0.485	---	---	0.189	---	---	0.205	---	---	< 0.005	---	---	4.73	---	---	1.4	---	---
SW-N-18	SS		29/09/2020	Clear and colourless, moderate flow	2.1		---	0.007 2	---	---	0.487	---	---	0.609	---	---	0.216	---	---	0.305	---	---	< 0.005	---	---	5.53	---	---	1.1	---	---
SW-N-18	SS		03/02/2021	High flow, clear and colourless	1.9		---	0.005 6	---	---	0.915	---	---	0.407	---	---	0.12	---	---	0.137	---	---	< 0.005	---	---	1.25	---	---	0.87	---	---
SW-N-19	SS		21/04/2020		47.1		---	0.027 7	---	---	258.	---	---	1.1	---	---	3.36	---	---	0.171	---	---	< 0.005	---	---	1.7	---	---	11.	---	---
SW-N-19	SS		29/09/2020	Clear and colourless, moderate flow	220.		---	0.020 8	---	---	173.	---	---	0.757	---	---	2.15	---	---	0.119	---	---	< 0.005	---	---	0.98	---	---	9.6	---	---
SW-N-19	SS		01/12/2020	Clear and colourless.	22.		---	0.036 2	---	---	15.2	---	---	0.848	---	---	2.04	---	---	0.139	---	---	< 0.005	---	---	3.16	---	---	10.	---	---
SW-N-19	SS		04/02/2021	Moderately high flow, clear and slightly yellow	32.6		---	0.026 9	---	---	11.4	---	---	0.952	---	---	2.43	---	---	0.162	---	---	< 0.005	---	---	4.04	---	---	11.	---	---
SW-N-41S3	SS		22/04/2020		31.8		---	0.036 8	---	---	3.39	---	---	0.327	---	---	0.125	---	---	0.088	---	---	< 0.005	---	---	2.03	---	---	4.	---	---
SW-N-45	SS		24/04/2020		15.2		---	0.014 7	---	---	10.5	---	---	0.883	---	---	0.234	---	---	0.214	---	---	< 0.005	---	---	1.04	---	---	3.1	---	---
SW-N-45	SS		30/09/2020	Clear and colourless, moderate flow	2.8		---	0.008 5	---	---	5.3	---	---	1.09	---	---	0.282	---	---	0.489	---	---	< 0.005	---	---	1.6	---	---	3.1	---	---
SW-N-45	SS		02/12/2020	Clear and colourless.	14.7		---	0.014 5	---	---	2.34	---	---	1.21	---	---	0.303	---	---	0.426	---	---	< 0.005	---	---	1.06	---	---	2.1	---	---
SW-N-45	SS		04/02/2021	High flow, clear and colourless	13.		---	0.005 8	---	---	1.7	---	---	1.14	---	---	0.27	---	---	0.319	---	---	< 0.005	---	---	1.24	---	---	2.	---	---
SW-N-50	SS		21/04/2020		6.2		---	0.128	---	---	0.373	---	---	0.45	---	---	0.158	---	---	0.229	---	---	< 0.005	---	---	2.86	---	---	1.1	---	---
SW-N-50	SS		29/09/2020	Slightly turbid and colourless, low flow	6.1		---	0.262	---	---	0.473	---	---	0.723	---	---	0.289	---	---	0.373	---	---	< 0.005	---	---	2.73	---	---	1.6	---	---
SW-N-50	SS		08/02/2021	High flow, clear and colourless, plastic garbage observed in culvert	1.		---	< 0.005	---	---	0.144	---	---	0.301	---	---	0.089	---	---	0.118	---	---	< 0.005	---	---	0.29	---	---	0.7	---	---
SW-N-54	SS		21/04/2020		8.6		---	0.027	---	---	13.4	---	---	0.887	---	---	1.28	---	---	0.24	---	---	< 0.005	---	---	0.74	---	---	9.2	---	---
SW-N-54	SS		29/09/2020	Slightly turbid, slightly yellow, moderately low flow	**498.**	a	---	0.034 3	---	---	586.	---	---	0.666	---	---	1.94	---	---	0.24	---	---	0.007 9	---	---	1.81	---	---	11.	---	---
SW-N-54	SS		02/12/2020	Clear and colourless.	102.		---	0.029 7	---	---	26.3	---	---	0.616	---	---	1.25	---	---	0.245	---	---	< 0.005	---	---	0.63	---	---	12.	---	---
SW-N-54	SS		03/02/2021	Moderately high flow, clear and slightly yellow	19.4		---	< 0.005	---	---	20.7	---	---	0.451	---	---	1.17	---	---	0.2	---	---	< 0.005	---	---	0.47	---	---	7.3	---	---
SW-S-03	SS		22/04/2020		**595.**	a	---	0.476	---	---	31.8	---	---	0.422	---	---	1.31	---	---	0.091	---	---	0.006 3	---	---	18.9	---	---	7.1	---	---
SW-S-03	SS		01/10/2020	Clear and colourless, moderately low flow	11.9		---	0.015 5	---	---	19.5	---	---	0.303	---	---	0.717	---	---	0.174	---	---	< 0.005	---	---	5.86	---	---	6.7	---	---
SW-S-03	SS		03/12/2020	Clear and colourless.	**374.**	a	---	0.539	---	---	155.	---	---	0.162	---	---	1.65	---	---	0.083	---	---	< 0.005	---	---	9.32	---	---	5.6	---	---
SW-S-12	SS		22/04/2020		**1 160.**	a	---	0.211	---	---	107.	---	---	0.295	---	---	3.12	---	---	0.175	---	---	< 0.005	---	---	11.5	---	---	9.5	---	---
SW-S-12	SS		01/10/2020	Clear and colourless, low flow	32.5		---	0.013 6	---	---	25.5	---	---	0.448	---	---	5.29	---	---	0.296	---	---	< 0.005	---	---	7.55	---	---	14.	---	---
SW-S-12	SS		03/12/2020	Clear and colourless.	342.		---	0.010 4	---	---	369.	---	---	0.091	---	---	1.99	---	---	0.097	---	---	< 0.005	---	---	3.62	---	---	7.3	---	---
SW-S-12	SS		03/02/2021	Moderately high flow,clear and colourless	259.		---	0.016 4	---	---	190.	---	---	0.118	---	---	2.99	---	---	0.131	---	---	< 0.005	---	---	3.82	---	---	9.7	---	---
SW-S-20	SS		03/12/2020	Clear and colourless.	33.1		---	0.015 7	---	---	41.3	---	---	< 0.05	---	---	0.232	---	---	< 0.04	---	---	< 0.005	---	---	11.5	---	---	3.8	---	---
SW-S-20	SS		03/02/2021	High flow, clear and colourless	51.5		---	0.035	---	---	3.4	---	---	0.058	---	---	0.152	---	---	0.042	---	---	< 0.005	---	---	11.	---	---	4.7	---	---
SW-S-21	SS		03/12/2020	Clear and colourless.	10.3		---	0.005 5	---	---	0.193	---	---	0.07	---	---	0.178	---	---	< 0.04	---	---	< 0.005	---	---	7.01	---	---	3.5	---	---
SW-S-21	SS		03/02/2021	Moderately high flow,clear and colourless	21.6		---	0.009 7	---	---	0.279	---	---	0.07	---	---	0.185	---	---	< 0.04	---	---	< 0.005	---	---	9.43	---	---	4.1	---	---
SW-S-24	SS		22/04/2020		24.8		---	0.031 2	---	---	24.4	---	---	0.359	---	---	0.607	---	---	0.068	---	---	< 0.005	---	---	4.81	---	---	6.5	---	---
SW-S-24	SS		01/10/2020	Clear and colourless, moderately low flow	7.		---	0.177	---	---	22.8	---	---	0.19	---	---	0.785	---	---	0.107	---	---	< 0.005	---	---	11.1	---	---	7.1	---	---
SW-S-24	SS		03/12/2020	Clear and colourless.	45.4		---	0.032 1	---	---	19.9	---	---	0.148	---	---	0.749	---	---	0.076	---	---	< 0.005	---	---	4.15	---	---	4.6	---	---
SW-S-24	SS		03/02/2021	High flow, clear and colourless	33.8		---	0.014 8	---	---	20.1	---	---	0.156	---	---	1.1	---	---	0.079	---	---	< 0.005	---	---	3.89	---	---	5.6	---	---
SW-S-27	SS		03/12/2020	Clear and colourless.	32.7		---	0.041 3	---	---	110.	---	---	0.145	---	---	0.6	---	---	0.051	---	---	< 0.005	---	---	6.1	---	---	3.8	---	---
SW-S-27	SS		03/02/2021	Moderately high flow,clear and colourless	52.1		---	0.034	---	---	52.	---	---	0.118	---	---	0.399	---	---	0.04	---	---	< 0.005	---	---	3.72	---	---	3.3	---	---

Notes:

na *Not applicable.*

Null *No sample collected.*

a *Above Maximum allowable concentration (MAC) British Columbia Water Quality Guideline.*

b *Above 30-day average British Columbia Water Quality Guideline.*

(1) *British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for British Columbia, 1998 Edition,*

(2) *Maximum acceptable concentration unless otherwise noted.*

(3) *The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*

(4) *The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*

(5) *This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*

(6) *This value is the short-term daily for streams with unknown fish distribution.*

(7) *The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the North landfill are derived from stations SW-N-CSs2, SW-N-41s3 and SW-N-14.*

(8) *Dissolved copper guideline varies with water hardness, temperature and dissolved organic carbon; Dissolved copper results were only compared with guidelines where DOC was analyzed.*

7.2 Assessment of Surface Water Quality Impacts

The primary causes of any surface water quality degradation at the site include leachate, road salt, and crushed aggregate production, stockpiling and use. Ammonium lignosulphonate has been used for dust suppression on gravel roads since 2014. Background conductivity in surface water is typically below 200 µS/cm, but has been observed at higher concentrations at some locations during periods of low flow, or after periods of prolonged dry weather. Background ammonia concentrations are typically below 0.01 mg/L, but occasionally reach 0.1 mg/L downgradient of wetland areas. Background chloride concentrations are typically below 10 mg/L. Background sulphate concentrations are typically below 10 mg/L, but often increase in the downstream direction as streams receive groundwater discharge from underlying groundwater aquifers.

Surface water is considered to be impacted by leachate when conductivity concentrations are above 500 µS/cm, ammonia concentrations are above 0.5 mg/L and chloride concentrations are above 20 mg/L. Peak concentrations at surface water monitoring stations are typically observed during the dry summer and early fall months, when flows are low and there is limited dilution by precipitation.

Surface water is considered impacted by aggregate (e.g. production, stockpiling or site construction works) when sulphate is present at concentrations above 75 mg/L and ammonia or nitrate (blasting residuals) are present at concentrations above background levels of 0.1 mg/L. Peak concentrations are typically observed during the first sampling event following the onset of wet weather in the fall months, and in areas of active quarry development or aggregate placement.

Surface water is considered impacted by road salt when both conductivity (>300 µS/cm) and chloride (>20 mg/L) are elevated above background levels, but ammonia and its degradation products (primarily nitrate) are not elevated (<0.1 mg/L) above background levels. Sites that are judged to be impacted by road salt must also be located downstream (or downgradient) of surfaces and roadways where road salt is known to be applied. Concentrations of conductivity and chloride typically exhibit peaks following cold weather periods when de-icing salt is often applied to roadways.

Surface water quality in natural and anthropogenically modified systems can be highly variable due to variations in flow and chemical inputs over time. Professional judgement is also used to determine the nature and degree of any impacts due to leachate, road salt and aggregate stockpiles. The authors are hydrogeologists and geochemists with considerable experience evaluating leachate and water quality at other landfills and mines in coastal regions of British Columbia. If any surface water concentrations exceed BCWQG for the protection of freshwater AW at the property boundary, standard CSR protocols for notification of affected property owners should be followed.

7.3 Data

Hartland Landfill is located within the Tod Creek watershed on a drainage divide between the Heal Creek drainage basin to the north and the Killarney Creek basin to the south. Surface water from both the Heal Creek drainage basin and Killarney Creek basin flow into Tod Creek and ultimately discharge to Tod Inlet. Surface water sampling stations are shown on Figure 7-1. Surface water sampling stations have been established on the landfill property to monitor compliance at the property boundary and identify changes in surface water quality that could be related to landfill operations. Surface water stations are also located at numerous off-site locations to routinely monitor water quality.

The surface water interpretation was based on water quality data collected at 8 locations south and west of the landfill, 11 locations north of Phase 1 and 2 landfill areas, and 4 locations northwest of the landfill (Hartland North Pad). Surface water quality samples are collected four times per year from property Boundary Compliance and other key stations, and two times per year from all other stations. When watercourses were dry, samples were not collected. Surface water sampling locations are shown on Figure 7-1. In 2020/21, pre-existing surface water locations continued to be monitored for potential impacts, if any, related to construction of the RTF in the Hartland North Area.

Sampling points utilized for the 2020/21 monitoring program are shown below:

South and West of the Landfill

- Sw-S-03
- Sw-S-04 - compliance
- Sw-S-12
- Sw-S-20
- Sw-S-21
- Sw-S-24
- Sw-S-27
- Sw-S-52

North of the Hartland North Pad

- Sw-N-41s1 - compliance
- Sw-N-41s3
- Sw-N-42s1 - compliance
- Sw-N-CS2

North of Phases 1 and 2

- Sw-N-05 - compliance
- Sw-N-14
- Sw-N-16 - compliance
- Sw-N-17
- Sw-N-18
- Sw-N-19
- Sw-N-45
- Sw-N-50
- Sw-N-51
- Sw-N-53
- Sw-N-54

7.4 Surface Water Quality North of the Landfill

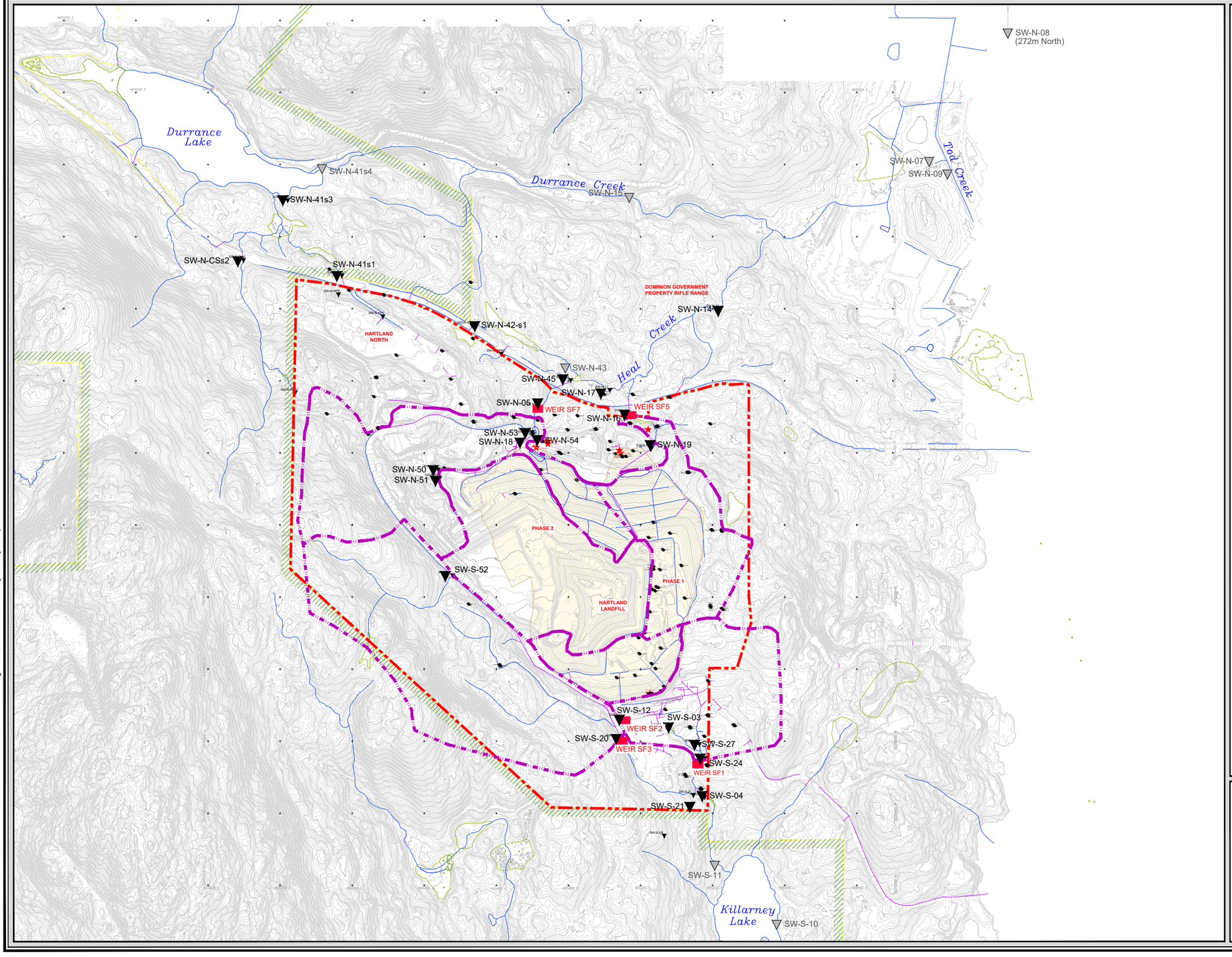
7.4.1 Surface Water Quality North of Phase 1 and Phase 2

Figure 7-2 presents conductivity, ammonia, chloride and sulphate concentrations in Heal Creek downstream of the landfill at stations Sw-N-05, Sw-N-14 and Sw-N-16. The distance of each station from the landfill boundary is shown in brackets in the legend. Sw-N-05 and Sw-N-16 are compliance stations. The plot shows that water quality continued to meet applicable BCWQG at stations downstream of the landfill on all sampling dates in 2020/21. Similar to previous years, these sampling locations were periodically dry in 2020/21 due to arid summer conditions.

Heal Creek flows north-easterly from the sedimentation pond at the north end of the Phase 2 basin to the confluence with Durrance Creek, as shown in Figure 4-1. Durrance Creek discharges to Tod Creek, which in turn discharges to Tod Inlet, about 3 km north of the landfill. Heal Creek is a small creek with a watershed area of 128 ha. Heal Creek is mainly steep and rocky although the creek passes through a few small wetlands near the upper end. The creek dries up during the summer months except in the lower reaches where groundwater discharge maintains flow year-round.

Clean runoff from the Phase 1 closure and the eastern perimeter of the landfill is directed to a lined sedimentation pond and then into the wetland located north of the lower leachate lagoon. The wetland, in turn, discharges northward to Heal Creek. Heal Creek also receives drainage from the area north of Phase 2 (High Level Road ditch), and from a small stream draining a small wetland below the east end of the Hartland North Pad. Aggregate and piping was added to select sections of the High Level Road ditch in June 2018 to protect the ditch from nearby construction and mitigate ponding, which may contribute to elevated concentrations of sulphate in surface drainage over time.

As discussed in Section 2.4, a spill occurred at the manhole located in the driveway to the RTF from Wills Point Road. The spill was contained within the nearby dry depression soon afterwards and did not reach to surface water compliance station SW-N-41s1. The spill was removed by vacuum truck within 4 hours of incident. Therefore, no surface water samples were collected.



Legend

- BUILDING / STRUCTURE
- ROAD
- FENCE
- LEGAL LOT BOUNDARY
- INDEX CONTOUR (5m)
- INTERMEDIATE CONTOUR (1m)
- TREES/SHRUB/VEGETATION
- DITCH
- DRAINAGE
- PIPE
- EXISTING WASTE
- HARTLAND LANDFILL OPERATING AREA BOUNDARY
- SW-S-52 — ACTIVE SURFACE WATER SAMPLING LOCATION
- SW-N-15 — INACTIVE SURFACE WATER SAMPLING LOCATION
- SURFACE WATER DIVIDE
- WEIR SF1 — WEIR LOCATION

Map Sources / Notes:
- Contour interval 1.0 m
- Groundwater elevation data collected by CRD, September 2019.
- Contours based on 24-W542_2019-2020 BASE.dwg PROVIDED BY CINDY WANG OF CAPITAL REGIONAL DISTRICT May 2021.
- Drainage information for years 2018-2019 obtained from Parks & Env. Services GIS technicians and have layers with the prefix "CRD19_GIS DRAINAGE" & "CRD19_GIS streams_Ditches".
- GPS pickup has been conducted by CRD Staff of creeks, wetlands, culverts located under tree canopied areas. This information (considered more accurate) has been added to the base (superceding some planimetric information) and is placed on layers indicating GPS pickup. An example of that layering system would be 'CRD19-wat-culvert_GPS pickup'.
- Surveyed points for monitoring sites (groundwater, gas wells, leachate, purge wells) were updated for 2019.
- The map is to NAD83 UTM coordinates. Vertical datum is to CGVD28.

N W E S

0 50 100 200 300 400 m

1 : 10,000

UTM Zone 10N, NAD83

Reviewed by:	KJ	Prepared by:	PCJ
Date Issued:	May 2021	Project Number:	60631284

CRD
Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Surface Water Bodies and Sampling Locations

AECOM

Figure 7-1
Version 1

File Location: \\NA.AECOMNET.COM\LFS\AMERIBURNABY-CABNY1\LEGACY\CABNY1FP001\PROD\PROJECTS\60631284\900-CAD_GIS\910-CAD\20-SHEETS\C432 - 2020-21 ANNUAL REPORT\FIG7.1-SURFACE WATER BODIES AND SAMPLING-20210510-60631284-431.DWG Date Plotted: August 30, 2021 Saved By:castle-janschp

7.4.1.1 Monitoring Site SW-N-16

A small wetland is located just north of the lower leachate lagoon. Water flows from this wetland northwards through a weir (Sw-N-16 – Boundary Compliance station) before discharging to a culvert under Willis Point Road and then to Heal Creek. Site Sw-N-16 is located on the landfill property and is the compliance point used to monitor the quality of the surface water leaving the landfill through this route.

In 2020/21, all parameters were measured at concentrations below BCWQG-MAC guidelines at Sw-N-16 except for pH, dissolved copper, dissolved and total iron during one or more sampling events. Similar to previous years, nitrate and sulphate concentrations were elevated during wet season, whereas ammonia concentrations remained relatively low. Given the low ammonia and chloride concentrations, it is unlikely the surface water was impacted by leachate. The elevated nitrate and sulphate concentrations during the winter season suggested that surface water may be impacted by the prolonged dry summer season (i.e. less dilution), as well as nearby construction activities involving blasting, aggregate placement, or excavation of organic soils.

The iron exceedance in April 2020 is likely due to the disturbance of sediment during sampling, as indicated by high TSS concentrations. Moreover, elevated iron concentrations may be derived from the wetland located upgradient of Sw-N-16 or related to sediment accumulation at sampling locations. Dissolved copper concentrations were above the BCWQG 30-Day average guideline during all four sampling events. Dissolved copper concentrations in September and December 2020 above the BCWQG-MAC coincided with lower pH (<6.5) and therefore lower BCWQG criteria.

Overall, water quality at Sw-N-16 is slightly improved, with lower conductivity and fewer exceedances. In June 2020, CRD staff removed sediment accumulations adjacent to sampling locations and cleaned catchment basins in an effort to reduce sediment interference at select sampling locations.

7.4.1.2 Monitoring Site Sw-N-05

The other route for surface water to leave the property to the north is through the main channel of Heal Creek located just north of Phase 2. In 2020/21, water quality samples were collected on all four sampling dates at Boundary Compliance station Sw-N-05.

Surface water quality measured at Sw-N-05 met BCWQG-MAC for all parameters on all dates sampled, except for dissolved copper during April and September 2020 sampling events. Nitrate concentrations exceeded BCWQG 30-Day average guidelines on three out of four sampling dates. Similar to previous years, sulphate and nitrate concentrations at this location were slightly elevated while ammonia concentrations remained low. Conductivity, sulphate and nitrate concentrations at Sw-N-05 exhibited increasing trends over past five years, indicating slight degradation of water quality due to aggregate production and usage.

7.4.1.3 Monitoring Site SW-N-19

Sw-N-19 is located within the landfill property below the northeast freshwater retention pond, and approximately 80 m east of the lower leachate lagoon. It is not a compliance monitoring station. It receives runoff primarily from the bedrock/refuse interface adjacent to Phase 1 and discharges to the wetland upstream of Sw-N-16. In 2019/20, water quality samples were collected on all four sampling dates.

In 2020/21, all parameters were below BCWQG-MAC guidelines on all sampling dates, except for dissolved copper in December. Similar to Sw-N-16, nitrate concentrations were elevated during the winter and were above BCWQG 30-day average. No statistically significant trends were detected in 2020/21, indicating water quality at this station remained stable over the last five years.

7.4.1.4 Monitoring Sites SW-N-45 and SW-N-17

Sw-N-45 is located north of Phase 2, and outside the landfill property boundary on the north side of Willis Point Road. During 2020/21, water quality met BCWQG-MAC, except for pH and dissolved copper. The copper exceedance was due to the low pH (<6.5) value and associated more stringent guideline. Nitrate concentrations in Sw-N-45 were marginally above BCWQG 30-Day average during wet seasons. Similar to previous years, conductivity, nitrate and sulphate concentrations were elevated, indicating that surface water may be impacted by construction activities/aggregate stockpiling or nearby road works.

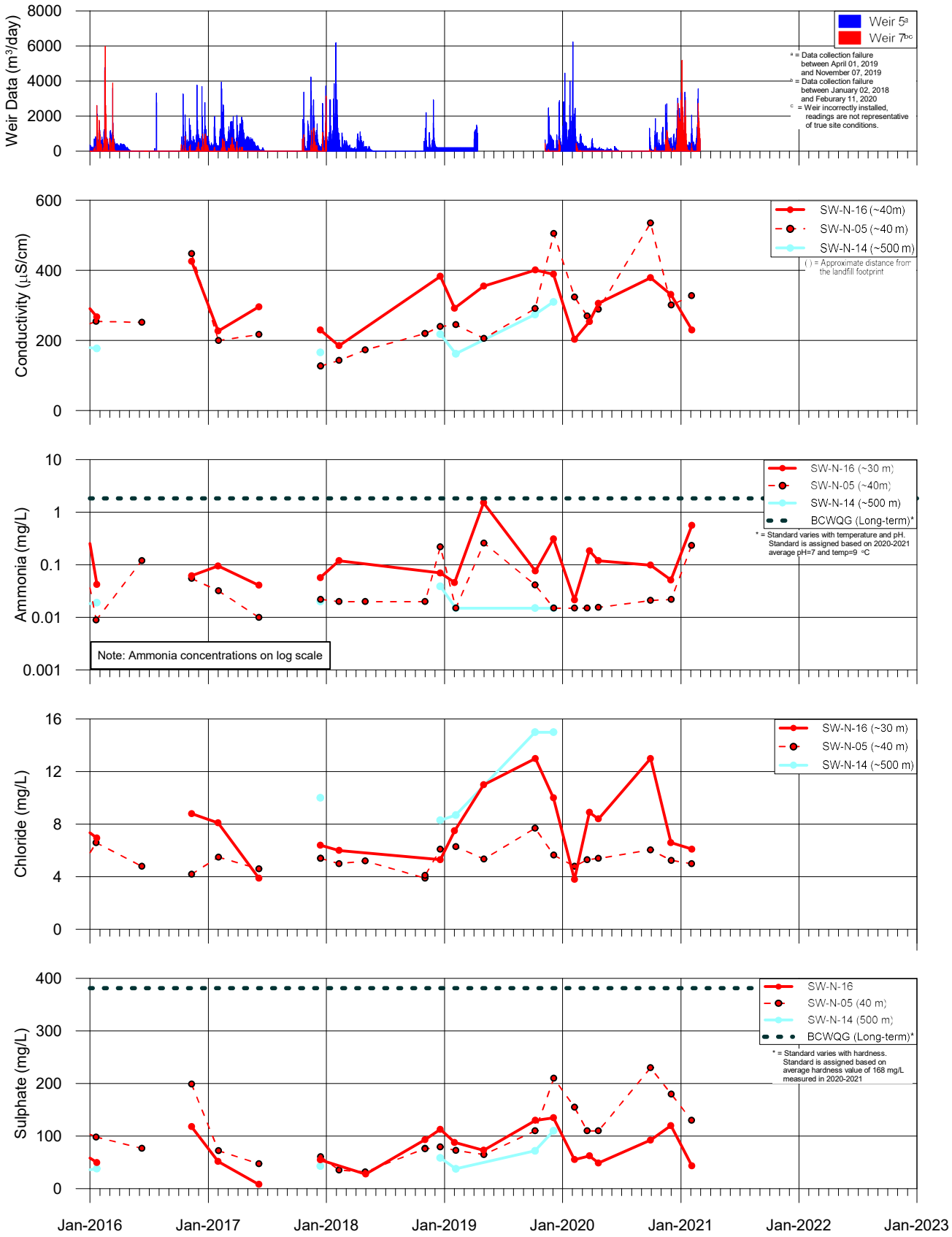


Figure 7-2. Surface Water Quality North of Phase 1

AECOM

Further downstream on the north side of Willis Point Road at station Sw-N-17, concentrations of all analytes were measured below BCWQG-MAC criteria on all sampling dates in 2020/21 except for pH. Similar to Sw-N-45, conductivity, nitrate and sulphate concentrations were elevated compared to those in 2018/19, especially during the winter months. However, low ammonia and chloride concentrations suggest that surface water is not likely impacted by leachate or road salt. Statistical results revealed increasing trends in sulphate, nitrate and conductivity at Sw-N-45 and Sw-N-17, indicating the slight water quality degradation due to aggregate production, blasting residue and usage.

7.4.1.5 Monitoring Sites SW-N-14

This sampling location is off site along Heal Creek north of Willis Point Road, and within the Heals Rifle Range. Sw-N-14 is located on Heal Creek upstream of the confluence with Durrance Creek. In 2020/21, surface water samples from Sw-N-14 were not collected due to inaccessibility.

7.4.1.6 Monitoring Sites SW-N-51 and SW-N-50

Stations Sw-N-50 and Sw-N-51 are located near the northern boundary of the newly constructed Phase 2 Cell 3 and near the northwest diversion ditch near the Toutle Valley rock quarry and aggregate processing area. They are not Boundary Compliance stations.

Figure 7-3 presents conductivity, chloride, sulphate, and ammonia concentrations at stations Sw-N-50, Sw-N-05, Sw-N-54 and Sw-N-18. In 2020/21, water quality at Sw-N-50 met BCWQG-MAC, except for dissolved copper during two sampling events. Concentrations of leachate parameters remained stable and low throughout 2020/21 indicating water was not impacted by leachate. Nitrate concentrations marginally exceeded BCWQG 30-Day average on one of four sampling dates. In 2019/20, conductivity and sulphate concentrations at Sw-N-50 were slightly elevated during the September and December 2020 sampling events and returned to normal values on February 2021 sampling date. A statistically significant trend was not observed for the past five years, indicating relatively stable water quality at this location.

Sw-N-51 is located immediately south of Sw-N-50. In 2020/21, water sample was not able to be collected at station Sw-N-51 due to dry conditions.

7.4.1.7 Monitoring Sites SW-N-54 and SW-N-18

Sw-N-18 and Sw-N-54 are located adjacent to the upper leachate lagoon. Station Sw-N-18 is located near the headwaters of Heal Creek and monitors the combined discharge from the Sw-N-50 and Sw-N-51 catchment areas. Sw-N-54 monitors discharge from the NW freshwater retention pond to Phase 2 Cell 1 sedimentation pond. They are not Compliance Boundary stations.

In 2020/21, water quality in Sw-N-54 was generally consistent with previous years. Conductivity, sulphate and nitrate concentrations were slightly elevated, but generally lower than 2019/20 results, primarily due to the wet condition. Given the low ammonia concentrations (<0.02 mg/L), surface water was not impacted by leachate. In 2020/21, all parameters in Sw-N-54 met BCWQG-MAC, except for dissolved aluminum and iron on the September 2020 sampling date. The exceedances were likely due to dry/low-flow conditions in the channel and turbid waters. Water quality at Sw-N-54 were generally consistent with that at Sw-N-54, with slightly elevated conductivity, sulphate and nitrate concentrations. Ammonia concentrations at Sw-N-18 were elevated in 2019/20 but remained low (<0.05 mg/L) in 2020/21. The elevated nitrate and sulphate concentrations at Sw-N-54 and Sw-N-18 indicated surface water quality was impacted by quarrying or aggregate stockpiling. Statistical analysis indicated decreasing trends in ammonia at Sw-N-18 station, while Sw-N-54 did not exhibit any significant trends. Water quality at locations 18 and 54 should continue to be monitored for impacts from the aggregate stockpiling and blasting activities.

Historically, conductivity, sulphate, and nitrate concentrations fluctuated at locations SW-N-18, SW-N-50 and SW-N-05 due to varying stream discharge, dilute leachate, and ongoing quarrying activities. Mitigation measures have been implemented to manage water quality in the Toutle Valley. Temporary tarps were installed on a large portion of the Phase 2 landfill, and aggregate storage in the Toutle Valley was carefully managed. In 2021, aggregate has been removed from Toutle Valley and placed in the cleared area on the Hartland North Pad. A blasting program will be initiated for Cell 4 preparation in October 2021. Given the sensitivity of surface water quality to blasting, quarrying and runoff from aggregate stockpiles at these locations, water quality at these locations should continue to be monitored closely. Careful surface water management planning is required for this area as the landfill develops. Additional sediment control measures and efforts to reduce the quantity of blasting products may help reduce impairment to water quality as quarry development becomes increasingly close to the northern boundary of the landfill and these water quality monitoring stations.

7.4.2 Surface Water Quality near the Hartland North Pad

The Hartland North Pad is located northwest of the landfill as shown on Figure 7-1. Recent geologic mapping of the area (AECOM 2018) revealed an undulating bedrock surface with extensive deformation, fracturing and mineralization. This area continued to undergo significant changes with the construction of the RTF. Development in the vicinity of the RTF began in 2017 and the construction was completed in late 2020. The treatment process at the RTF turns residual solids from the McLoughlin Point Wastewater Treatment Plant into Class A biosolids.

The west side of the Hartland North Pad drains northward through an ephemeral channel that originates at the northwest corner of the Hartland North Pad. The water is carried through a culvert under Willis Point Road and into a drainage channel that eventually discharges into Durrance Lake approximately 450 m to the north. Flow through the channel only occurs during wet weather periods. During dry periods, several wetlands persist along the drainage course, but they are not connected by surface flows. In the downstream portions of the creek, flows increase due to groundwater discharge to the stream. Further downstream, a second creek of similar size joins the original creek. The “combined” creek has a well-defined channel in the area where it discharges to Durrance Lake.

On October 13, 2020, an approximately 130,000 L of residual solids were released from the RTF through stormwater system. This surface water in this area is directed through a culvert under Willis Point Road where it enters the wetland, located approximately 400 m north of the spill site terminus (Corvidae 2021). The environmental emergency sampling results indicated the surface water quality met applicable BCWQG criteria, except for *E.coli* within the exposure area.

7.4.2.1 Monitoring Sites SW-N-41, SW-N-42, and SW-N-CSs2

Figure 7-4 presents conductivity, ammonia, chloride and sulphate concentrations at sampling locations located along the ephemeral channel at the northwest corner of the Hartland North Pad to the drainage channel discharging into Durrance Lake at stations Sw-N-41s1, Sw-N-41s3, Sw-N-42s1, and Sw-N-CSs2, which are off the landfill property. The sampling location Sw-N-CSs2 was periodically dry in 2020/21 and only two out of four samples were collected.

At surface water quality station Sw-N-41s1, located off the landfill property northwest of the Hartland North Pad, all parameters met the BCWQG-MAC, except for total iron and TSS during April 2020 sampling event. The iron and TSS exceedances were likely due to the turbid flow condition. Dissolved iron concentrations were well below the BCWQG guideline of 0.35 mg/L. As shown on Figure 7-4, chloride concentration was elevated to 19 mg/L during the December 2020 sampling event, indicating the temporary impact of road salt application. Statistical analysis did not indicate any trend over the last five years, indicating the overall stability of water quality since the application of the temporary tarps over the aggregate stockpiles in 2012, and removal of the Hartland North aggregate stockpiles in 2017.

Sw-N-41s1 is located in close proximity to the wastewater residuals exposure area. However, surface water quality collected in December 2020 (post-spill) did not show the sign of impact.

Station Sw-N-41s3 is located downstream of Sw-N-41s1, where the drainage from the northwest portion of the Hartland North Pad flows into Durrance Lake. In 2019/20, all parameters met BCWQG-MAC. Similar to previous years, concentrations of leachate parameters remained low. Conductivity and sulphate concentrations at Sw-N-41s3 remained lower than those observed upstream at Sw-N-41s1, which may be the result of dilution from other tributaries. Conductivity, chloride and sulphate concentrations did not exhibit statistical trends following the decreasing trends observed in 2018/19, indicating stable water quality since the installation of the tarp on aggregate stockpiles in 2013 and removal of the aggregate stockpiles from the Hartland North Pad in 2017.

Water quality at Sw-N-42s1, located northeast of the Hartland North Pad along Willis Point Road, reported concentrations of all parameters below applicable BCWQG-MAC in 2020/21. Similar to previous years, this site continued to report higher conductivity, ammonia and sulphate values than all other nearby stations except Sw-N-41s1. Chloride concentrations were higher than all other stations near the Hartland North Pad but remained below 15 mg/L. Chloride concentrations were highest at Sw-N-41s1 and Sw-N-41s3 during winter months and may indicate impacts from road salt applied to Willis Point Road. The Mann-Kendall analysis revealed a statistically significant increasing trend in sulphate and conductivity at Sw-N-42s1, indicating that water quality at this location has slightly been impacted by aggregate stockpiling or RTF construction activities over the past five years.

Water quality at background station Sw-N-CSs2 was relatively stable and concentrations were less than the applicable BCWQG-MAC. This sampling location was periodically dry in 2020/21 and was sampled two out of three attempted sampling

events. Water quality at this station remained similar to previous years. Statistical trend analysis revealed statistically significant decreasing trends in sulphate concentrations.

Overall, surface water in the Hartland North Pad and downstream area was generally consistent with historical results and exhibited minor impact from aggregate stockpiling or RTF construction activities. Corvidae (2021) concluded the wastewater residuals were contained in the wetland area, which is approximately 120 m upgradient of Durrance Lake. No clear evidence shows that surface water quality in close proximity to spill and along transport pathway (i.e. Sw-N-41s1 and Sw-N-41s3) was impacted by the biosolid spill that occurred on October 13, 2020.

7.5 Surface Water Quality South of the Landfill

An ephemeral stream drains the area to the south of the landfill and flows southward towards Killarney Lake, which subsequently drains to Prospect Lake. Surface water flow south of the landfill occurs mainly during periods of wet weather and groundwater seepage has been observed in the Killarney Creek channel during dry periods. Clean surface water runoff from the south slope of Phase 1 runs westward in a ditch to a culvert that discharges into a small wetland at Sw-S-03 and then into the ephemeral stream that flows south to Killarney Lake.

There are a number of surface water sampling stations located south of the landfill, listed from upstream to downstream, as follows:

- Sw-S-52 diversion ditch rerouted from north of the landfill, upstream of wheel wash facility
- Sw-S-20 flow monitoring weir along diversion ditch at south end of Phase 1
- Sw-S-12 flow monitoring weir upstream of the public weigh scale
- Sw-S-03 culvert emerging from southeast corner of recycling area immediately upstream of a small natural wetland
- Sw-S-27 Killarney Creek, north tributary
- Sw-S-24 Killarney Creek, downstream of confluence of north and west tributaries
- Sw-S-21 drainage ditch along road south of diversion ditch at south end of Phase 1
- Sw-S-04 Killarney Creek, on property boundary, 270 m south of the landfill

7.5.1 Upgradient Surface Water Quality

7.5.1.1 Monitoring Site Sw-S-52

Sw-S-52 is a background monitoring station. During 2020/21, two surface water samples were collected at station Sw-S-52 out of the three attempted sampling events. Concentrations of all parameters were below the BCWQG- MAC. Concentrations of leachate indicator parameters were consistent with previously reported background concentrations, indicating that seasonal fluctuations in precipitation did not likely influence surface water quality at Hartland Landfill in 2020/21. Similar to previous years, sulphate concentrations at Sw-S-52 were relatively stable and were below 10 mg/L throughout the monitoring year. No statistically significant trends were observed at this sampling location over the past five years.

7.5.1.2 Monitoring Site Sw-S-20

At station Sw-S-20, samples were collected on only one out of three attempted sampling dates. Concentrations of leachate indicator parameters were below applicable BCWQG-MAC values in 2020/21. Water quality exceeded BCWQG 30-day average for total zinc on two sampling dates. Slightly elevated metal concentrations during the wet season may be partially due to elevated TSS. A statistically significant decreasing trend in sulphate was observed over the last five years indicating improvement of water quality at this sampling location.

7.5.2 Surface Water Quality Near and South of the Recycling Area

Figure 7-5 graphically presents water quality data for stations located south of the landfill, including Sw-S-03, Sw-S-04, and Sw-S-12. The distance of each station from the landfill boundary is shown in brackets in the legend. Water quality at each station is colour coded according to its distance from the landfill footprint. CRD's recycling area went into operation in January 2001 and is located near Sw-S-12.

7.5.2.1 Monitoring Site Sw-S-12

In 2020/21, surface water samples were collected at station Sw-S-12 during four planned sampling events. All parameters met BCWQG-MAC during all sampling events, except for TSS, total iron, dissolved aluminum, iron, and copper. Most of exceedances were observed during April 2020 sampling event, which may be related to turbid flow conditions, associated with high TSS concentrations. Dissolved copper concentrations also exceeded BCWQG-MAC during December 2020 and February 2021 sampling events. Similar to previous years, ammonia concentrations generally remained low during the summer and fall but increased above 2 mg/L in December 2020 and February 2021. Conductivity, nitrate and sulphate concentrations were slightly elevated in October 2020 but returned to normal in December 2020. Overall, the increase in conductivity, nitrate and sulphate concentrations during the drier months and early fall (i.e. April and October) may be due to runoff from paved areas surrounding the bin facility or dilute leachate. The elevated ammonia during the wet season may be derived from nitrate reduction via organic matter decomposing. Dissolved organic carbon concentrations at this location ranged from 7.3 to 14 mg/L, which is 2-3 times higher than that at other stations.

Due to concurrent low ammonia and other leachate indicator parameter concentrations, it is unlikely that surface water was impacted by leachate. Surface water at this location should be closely monitored because ammonia is often the first parameter detected at the leading edge of an advancing leachate plume. High flows and a slightly orange/yellow color were previously reported/observed. The source of the elevated concentrations of ammonia and nutrients should be investigated.

7.5.2.2 Monitoring Site Sw-S-03

Sw-S-03 is located on the landfill property in the main channel of Killarney Creek where the culvert discharges into a small wetland area. Sw-S-03 is not a compliance location. Historically, water quality at Sw-S-03 was affected by contaminated runoff from the south face of the landfill and the former truck wash area until the truck wash facility was relocated in the fall of 1997. Due to the close proximity to the public drop-off and storage area, water quality in Sw-S-03 may be affected by runoff from the bin facility, heavy traffic and industrial actives.

Water quality at Sw-S-03 exhibited similar pattern with Sw-S-12. Conductivity, sulphate and nitrate concentrations were most elevated during October 2020 sampling dates and returned to normal ranges in wet season. Ammonia concentrations remained low (<0.2 mg/L) throughout 2020 and reached a peak value of 1.4 mg/L in February 2021. In 2020/21, TSS, total iron, zinc, silver, dissolved aluminum, iron, copper and TSS exceeded BCWQG-MAC during at least one sampling event. Most of exceedances were observed in April 2020, likely due to the drier condition and turbid flow. The elevated conductivity, sulphate and nitrate concentrations were likely due to upstream runoff from the area surrounding Sw-S-12 as discussed above. Statistical analysis indicated decreasing in nitrate concentrations over past five years. Water quality should continue to be closely monitored for quarry and leachate impacts in the area downgradient of the bin facility and the south purge wells.

7.5.2.3 Monitoring Site SW-S-04

Water quality at the property Boundary Compliance location (Sw-S-04) met the BCWQG-MAC values for all analytes in all samples collected during 2020/21, except for total iron and pH. The TSS, dissolved copper and total zinc concentrations were marginally above the 30-day average guidelines in one or more sampling events.

Similar to upstream stations, conductivity, nitrate and sulphate concentrations were slightly elevated in October 2020. Ammonia and chloride concentrations remained low during all sampling events. No statistically significant trend was observed over the past five years. Sw-S-04 should continue to be monitored closely for indicators of impacts from leachate and aggregate placement.

7.5.2.4 Monitoring Sites SW-S-24 and SW-S-27

Stations Sw-S-24 and Sw-S-27 are located on the landfill property downgradient of Phase 1 of the landfill, the landfill administration area, and mountain bike trails. These stations are not Compliance Boundary locations.

Water quality at Sw-S-24 remained below the BCWQG-MAC values in 2020/21, except for total iron and dissolved copper. At Sw-S-24, conductivity and sulphate concentrations were slightly elevated in October 2020 but other leachate indicator parameters remained low. At station Sw-S-27, samples were collected on two out of four attempted sampling dates. Water quality remained below the BCWQG-MAC values in 2020/21 in all sampling events. Concentrations of leachate indicator parameters were very low at this location, and water quality is not impacted by leachate.

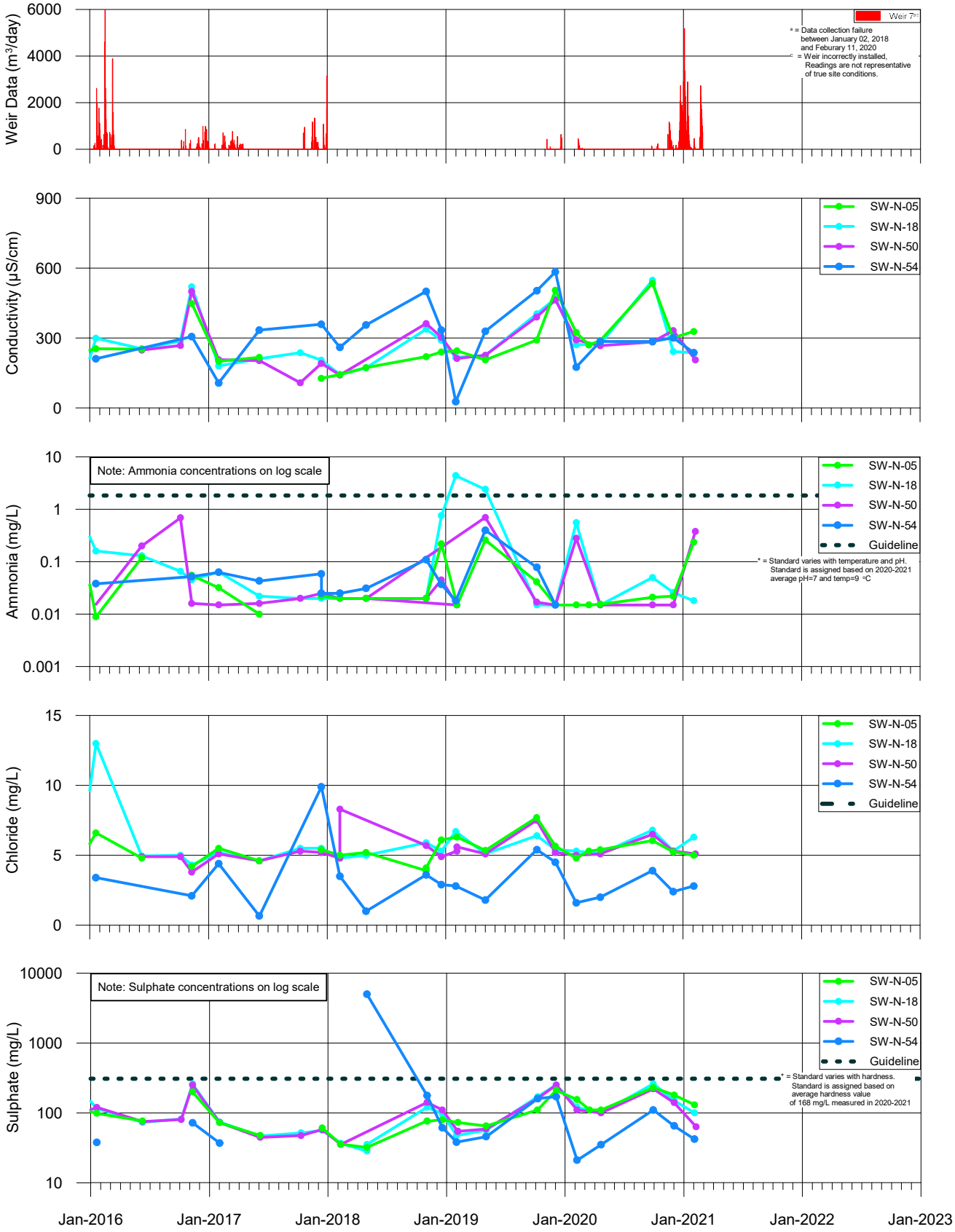


Figure 7-3. Surface Water Quality North of Phase 2

AECOM

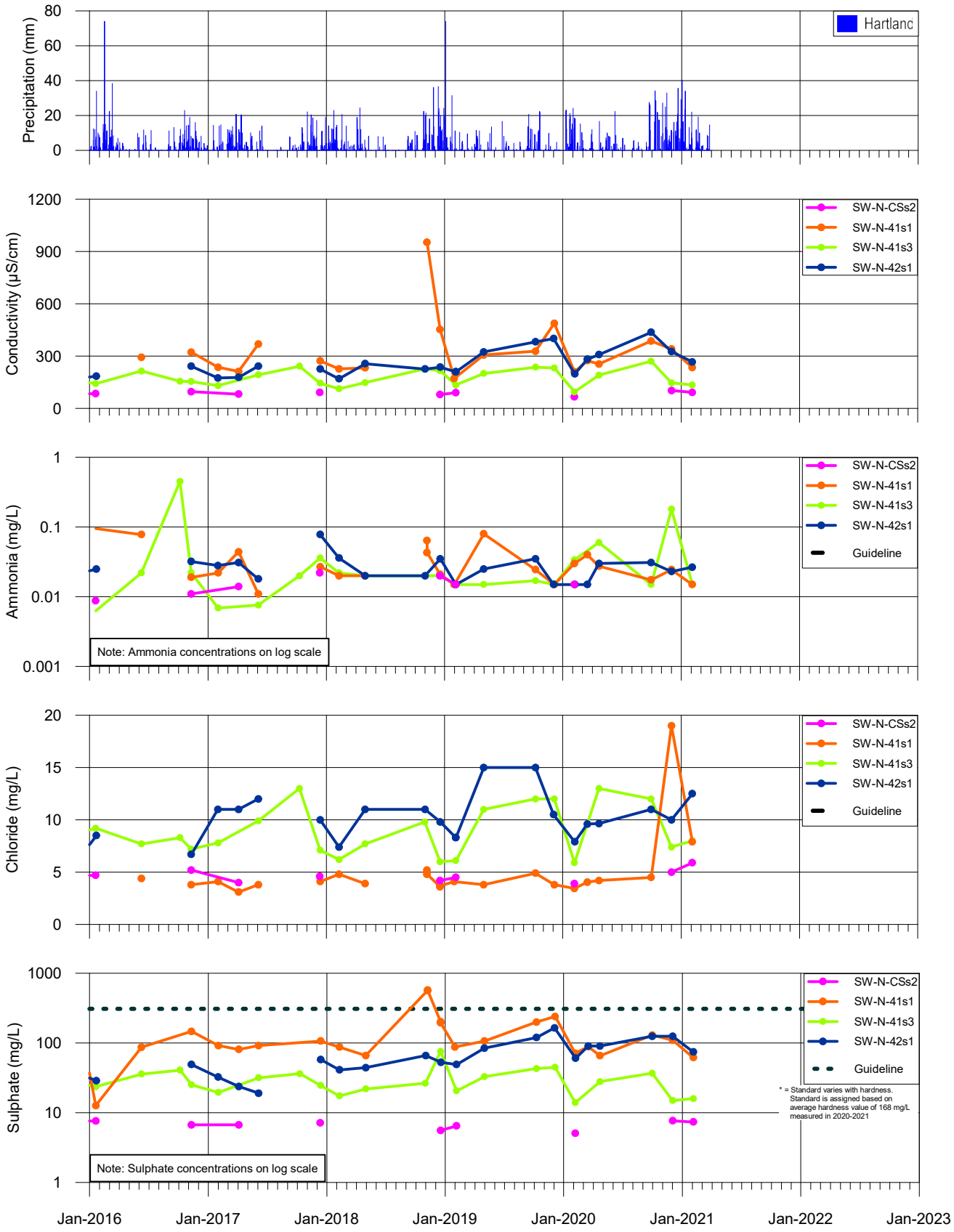


Figure 7-4. Surface Water Quality Downstream of the Hartland North Pad

AECOM

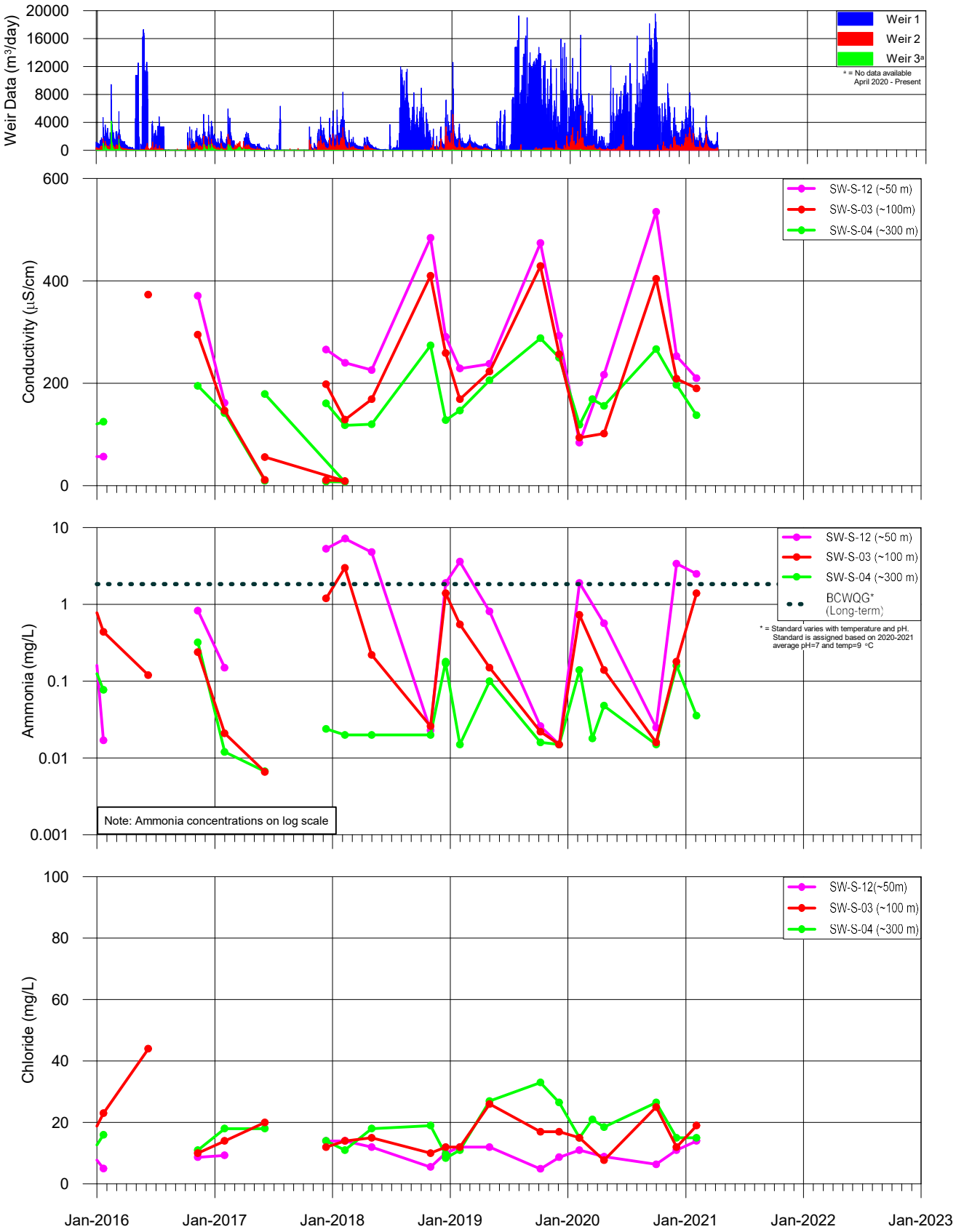


Figure 7-5. Surface Water Quality South of Landfill

AECOM

7.6 Summary

The surface water quality data collected in 2020/21 revealed that nearby surface water bodies, Tod Creek, Durrance Lake, Durrance Creek, and Killarney Lake are not impacted by leachate or other landfill activities.

- The release of wastewater residuals on October 13, 2020 was contained in the wetland area upgradient of Durrance Lake. No clear evidence shows impacts to surface water quality.
- The spill from the CRL manhole and vent on February 9, 2021 was contained within the nearby dry depression soon afterwards and did not reach nearby surface water features.
- Surface water quality at Boundary Compliance stations along the northern property boundary met BCWQG-MAC in 2020/21, except for dissolved and total iron and dissolved copper concentrations at Sw-N-05 and Sw-N-16 during one or more sampling events. Similar to previous years, pH and dissolved and total iron values at Sw-N-16 exceeded BCQWG-MAC criteria during one or more sampling events. Surface water at these two locations were not impacted by leachate, but exhibited minor influence from nearby construction activities involving blasting, aggregate placement, or excavation of organic soils. Iron exceedances are likely due to the disturbance of sediment during the sampling, as indicated by high TSS concentrations. Dissolved copper guidelines are dependent on pH, DOC and hardness values, and become more stringent under lower pH, hardness and DOC levels.
- North of Hartland Landfill, dissolved copper concentrations at three (3) stations (none of which are Boundary Compliance locations) exceeded BCWQC-MAC criteria during one or more sampling events. Dissolved copper concentrations at these locations generally remained low (<10 µg/L). Dissolved copper exceedances at these locations are likely due to low pH and DOC concentrations, which are reflective of the natural conditions.
- In the Hartland North Pad area, surface water quality at Boundary Compliance stations (Sw-N-41s1 and Sw-N-42s1) met BCWQG-MAC in 2020/21, except for total iron and TSS. Leachate indicator parameters remained low in 2020/21, indicating surface water was not impacted by construction activities. Water quality at Sw-N-42s1 station indicates slight impacts of aggregate stockpiling and construction activities at the RTF. Surface water along the Hartland North Pad boundary was not impacted by leachate. Occasionally elevated ammonia concentrations are likely the result of natural drainage from the construction area.
- Water quality at the Boundary Compliance location (Sw-S-04) met the BCWQG-MAC values for all analytes in all samples collected during 2020/21, except for total iron and pH during one sampling event. Surface water quality along the south boundary is not impacted by leachate.
- Water quality at station Sw-S-52 (not a compliance location) is representative of background water quality. In 2020/21, concentrations of all parameters were below the BCWQG-MAC. Concentrations of leachate indicator parameters were consistent with previously reported values.
- Surface water quality at south of Hartland Landfill were generally consistent with previous years, and was not impacted by leachate. Slightly elevated conductivity, sulphate and nitrate concentrations observed at Sw-S-12 and Sw-S-03 during drier months and early fall may be due to runoff from paved areas surrounding the bin facility or dilute leachate. The elevated ammonia during the wet season may be derived from nitrate reduction via organic matter decomposing.
- South of Hartland Landfill, dissolved copper concentrations at four (4) stations (none of which are Boundary Compliance locations) exceeded BCWQC-MAC criteria during one or more sampling events. Dissolved copper concentrations at these locations generally remained low (<10 µg/L), except for locations Sw-S-03 and Sw-S-12. Elevated copper concentrations at these stations may be related to aggregate dust or surface water runoff from the truck wash and paved areas surrounding the bin facilities.

8. Leachate

8.1 Compliance Monitoring Locations

Discharge from the leachate pipeline is subject to the CRD Regional Source Control Program (RSCP) Waste Discharge Permit (Waste Discharge Permit Number SC97.001). The compliance monitoring location for leachate at Hartland Landfill is the Hartland Valve Chamber (flow detection chamber) at the start of the leachate pipeline. Leachate compliance data is reported to the CRD RSCP on a quarterly basis.

8.2 Data

Our interpretation of the leachate chemistry data was based on samples collected at the following locations by CRD staff:

- Hartland Valve Chamber (leachate pipeline flow detection chamber and compliance point)
- Phase 1 North purge well system (combined discharge from 52-4-0-P7, 80-1-0-P8 and 81-1-0-P9)
- Phase 1 South purge well system (combined discharge from P1, P2, P3, P4 and P10)
- Phase 2 landfill leachate cleanout
- Controlled Waste drainage
- West Face drainage
- Cell 3 Pipe Outlet drainage

These locations were sampled and analyzed for conventional parameters, organic compounds and metals on a monthly basis in 2020/21. In addition, Hartland Valve Chamber samples were analyzed quarterly for trace organic compounds including polycyclic aromatic hydrocarbons (PAHs), phthalate esters, ketones, aromatics, phenols, ethers, nitrosamines, alkanes, alkenes and other select organic compounds.

Due to lack of flow, only ten (10) leachate samples were collected from the West Face Drainage in 2020/21. Samples in July and August could not be collected. Discharge from this toe drain has been intermittent since it was installed. Drainage patterns from the West Face Closure toe drain are attributed to precipitation, refuse settlement, and the increasing depth of waste cover over the toe drain. Similar to 2019/20, only ten (10) leachate samples were collected at Cell 3 Pipe Outlet in 2020/21 due to a lack of drainage. Fifteen (15) leachate samples were collected from the Hartland Valve Chamber on 2020/21. A total of five (5) leachate samples were taking at the Markham Valve Chamber throughout 2020/21. A sample from the Phase 1 north purge well system and the Controlled Waste Ditch could not be collected in July and August 2020 and so ten (10) in total were collected at both locations throughout 2020/21. A sample from the Phase 2 Cleanout well system could not be collected during July, August, November or December 2020 so only eight (8) samples were collected at this location during 2020/21.

8.3 Leachate Generation and Discharge

Leachate collected from the Phase 1 and Phase 2 landfill is discharged to the lower leachate lagoon. During wet winter months, leachate is pumped into a second, lined upper lagoon to minimize head build-up in the unlined lower lagoon. Leachate from the lagoons is discharged from the site through an 8.6 km long pipeline that discharges to the Saanich sanitary sewer and ultimately to the Macaulay Point deep water outfall. The CRL was activated on December 30, 2020 and operated intermittently in January 2021 when leachate levels in upper lagoon were high. The formal switch from the leachate pipeline to the CRL occurred in March 2021, with flow rates ranged between 60 and 80 L/s.

Total monthly leachate flows discharged to sewer are provided in Appendix D. Average daily leachate flow in 2020/21 was 12.91 L/s, which is in line with the 2019/20 average of 11.75 L/s. The highest monthly leachate flow recorded in 2020/21 was 101,810 m^3 (average monthly flow rate of 39.2 L/s) in January 2021, which was due to intense precipitation events and higher operational levels in the upper leachate lagoon. Changes in leachate discharge rates throughout the year may be related to variability in precipitation, biofouling within the line, or operational improvements aimed at minimizing leachate generation.

8.4 Leachate Quality

Sampling and testing of leachate quality have been carried out since the early 1970s. Since 2000, leachate samples have primarily been collected from the Hartland Valve Chamber, which represents the point of discharge for compliance with the RSCP Waste Discharge Permit.

The analytical results of the routine monthly leachate discharge samples are provided in Appendix B.4. Analysis of trace organics in the leachate discharge was conducted quarterly and is provided in Appendix B.5. The analytical results for samples collected from the leachate collection and conveyance network are presented in Appendices B.6., B.7., B.8., B.9., B.10., and B11. Analysis of emerging contaminants in Hartland Valve Chamber was conducted quarterly and is provided in Appendix B.12. In addition to the Sewer Use Bylaw Criteria, leachate quality results for trace organic compounds were screened against CSR standards for the protection of drinking water and aquatic life to support operational decisions regarding leachate containment.

8.4.1 Routine Monthly Leachate Analyses and Sewer Use Bylaw Comparison

The Hartland Valve Chamber is the compliance point for the Waste Discharge Permit. During 2020/21, all leachate quality samples from the compliance point met RSCP Waste Discharge Permit criteria.

Although the Waste Discharge Permit criteria only apply to the combined discharge at the Hartland Valve Chamber, comparison of other leachate monitoring station results to these criteria allows for evaluation of individual leachate contributions to the combined leachate discharge. Concentrations above RSCP criteria at locations other than the Hartland Valve Chamber are not considered to be non-compliant, and the criteria are used for reference purposes only.

Figure 8-1 and Figure 8-2 present time series plots for selected parameters in leachate at the compliance point (Hartland Valve Chamber) and in Phases 1 and 2 for the past five years. Evaluation of this data allows for comparison of leachate from each of the landfill areas. At all sampling locations, concentrations of inorganic parameters such as conductivity and chloride show the seasonal dilution effect whereby greater precipitation in the fall and winter months results in lower concentrations during the wet winter months. Higher concentrations occur during drier periods from May to October. Leachate discharge from the Phase 2 basin is significantly stronger than leachate generated in Phase 1, which was closed in 1996. The mixing of leachate from Phases 1 and 2 in the Hartland Valve Chamber results in a leachate that exhibits chemistry which is intermediate between the two primary sources.

Similar to previous years, leachate concentrations at the Hartland Valve Chamber throughout 2020/21 were well above background concentrations observed in surface water and groundwater, with conductivity concentrations ranging from 2,055 µS/cm to 7,451 µS/cm, ammonia concentrations ranging from 190 mg/L to 380 mg/L, and chloride concentrations ranging from 240 mg/L to 560 mg/L. Overall, annual average leachate concentrations in 2020/21 were slightly more concentrated, with average conductivity values at the Hartland Valve Chamber slightly higher than those measured in 2019/20.

The highest concentrations of leachate indicator parameters were observed in August and September 2020, when precipitation (and dilution) was near the annual minimum. As shown in Figure 8-2, BOD concentrations at the Hartland Valve Chamber exhibited a pattern that was consistent with conductivity, ammonia and chloride values. BOD concentrations at Hartland remain relatively low for a large landfill, and were typically below 100 mg/L. In August 2018, BOD concentration reached to peak value of 160 mg/L, which was consistent of elevated sulphide value (0.912 mg/L). The changes in quantity of biological organisms may be related to the elevated temperatures observed during summer months, or changes in leachate storage and management prior to sample collection. Since August 2018, BOD concentrations have fallen back below 100 mg/L.

Total sulphide, dissolved sulphide and PAH concentrations at Hartland Valve Chamber did not exceed the Waste Discharge Permit criteria during any of the 2020/21 sampling events. Total and dissolved sulphide concentrations exceeded the Waste Discharge Permit criteria in January 2019 and remained well below standard of 1 mg/L since then. Infiltration through aggregate placed in the Phase 2 landfill during the winter months is known to be an important source of sulphate to the Phase 2 Cleanout. Sulphate can be reduced to sulphide by bacteria under reducing conditions in the absence of other reducing agents such as oxygen and nitrate.

Average conductivity concentrations were higher in 2020/21 than in 2019/20. Waste Discharge Permit criteria were not exceeded during any of the sampling events during 2020/21 and the long-term conductivity and chloride concentrations at the Hartland Valve Chamber revealed a decreasing trend in conductivity and ammonia and an increasing trend in nitrate and

sulphate over the past five years. This indicates that leachate quality is relatively stable and slightly improving at this location. Concentrations of many parameters were several orders of magnitude below Waste Discharge Permit criteria.

8.4.1.1 Phase 2 Cleanout

In 2020/21, elevated sulphide concentrations within Phase 2 indicated reducing conditions in the leachate. Total sulphide concentrations fell below the Waste Discharge Permit criteria during all sampling events, except for three samples collected in May 2020, June 2020 and October 2020. Total sulphide concentrations peaked at 4.0 mg/L in October 2020, which was lower than the peak concentrations of 5.1 mg/L in 2019/20, 7.58 mg/L in 2018/19, and 8.88 mg/L in 2017/18. The average total sulphide concentration in 2020/21 was 0.86 mg/L, which was lower than the average value of 2.06 mg/L in 2019/20. Dissolved sulphate concentrations within the Phase 2 landfill generally below 250 mg/L. However, dissolved sulphate concentrations in one (1) sample taken in March 2021 reached to peak value of 20,000 mg/L, which was well above the Waste Discharge Permit criteria of 1,500 mg/L.

As waste deposition continues and the refuse matures, elevated sulphide concentrations may persist in Phase 2. There is significantly higher sulphur content in Phase 2 leachate relative to the Phase 1 landfill, which may be due to the use of locally sourced aggregate containing sulphur as landfill cover. Naturally occurring sulphide minerals appear to be oxidizing to sulphate, which subsequently infiltrates to the Phase 2 basin, and is converted to sulphate via oxidation-reduction reactions. Sulphate concentrations in the Phase 2 cleanout were generally lower than those measured in Phase 1 and the Controlled Waste drainage where leachate is anticipated to be more oxidized.

Similar to previous years, BOD and COD concentrations within Phase 2 were generally higher than concentrations observed in the Hartland Valve Chamber and Phase 1. In 2020/21, all BOD values met the Waste Discharge Permit criteria of 500 mg/L with the exception of one (1) sample collected in September 2020. COD exceeded the Waste Discharge Permit criteria of 1,000 mg/L in Phase 2 on total of four (4) of eight (8) sampling dates in 2020/21, with a peak of 2,710 mg/L in September 2020. Total phenols also exceeded Waste Discharge Permit criteria of 1 mg/L on three (3) sampling dates. All metal concentrations at the Phase 2 clean out met Waste Discharge Permit criteria.

8.4.1.2 North Purge Wells

In 2020/21, data collected from the Phase 1 north purge wells (52-4-0-P7, 80-1-0-P8 and 81-1-0-P9) indicates that all parameters met the Waste Discharge Permit criteria. Total sulphide concentrations in the Phase 1 leachate are quite low (≤ 0.11 mg/L). In 2020/21, sulphate concentrations in Phase 1 were stable, with a mean value of 32.15 mg/L, indicating that sulphate is the most stable form of sulphur in the Phase 1 landfill. Similar to previous years, the average BOD, COD and sulphide concentrations were lowest in Phase 1 when compared to other leachate sampling locations. In 2020/21, all metal concentrations in north purge wells met Waste Discharge Permit criteria.

8.4.1.3 South Purge Wells

Combined effluent collected from the Phase 1 south purge wells (P1, P2, P3, P4 and P10) is presented in Appendix B.9. Leachate sampling at the south purge Wells commenced in November 2020 and is part of the monthly leachate sampling program. Leachate samples from the south purge Wells met Waste Discharge Permit criteria on all sampling dates in 2020/21. In 2020/21, total sulphide concentrations in the south purge Wells ranged from 0.0012 to 0.0210 mg/L and were well below Waste Discharge Permit criteria. BOD and COD concentrations ranged from 3.2 to 14 mg/L, and 56 to 84 mg/L, respectively and were much lower than those in the north purge wells. Leachate quality in the south purge wells is characterized by moderately elevated conductivity (1,097 to 1,399 µS/cm), ammonia (3.8 to 60 mg/L), chloride (79-120 mg/L) and low sulphate (<10 mg/L). In 2020/21, all metal concentrations in the south purge wells met Waste Discharge Permit criteria, except for one (1) total iron result. In November 2020, the total iron concentration in the south purge wells was 317 mg/L and exceeded the Discharge Permit criteria of 50 mg/L. During the following sampling events, total iron concentrations remained below 20 mg/L.

8.4.1.4 Controlled Waste Drainage

Leachate collected by the Controlled Waste Drainage is not as concentrated as leachate collected from Phase 2 and the West Face Toe Drain. In 2020/21, all leachate parameters in the Controlled Waste Drainage leachate met the Waste Discharge Permit criteria with the exception of total sulphide, which exceeded the max Waste Discharge Permit criteria for one (1) sample collected in September 2020. All metal concentrations at Controlled Waste Drainage met Waste Discharge Permit criteria.

8.4.1.5 West Face Drainage

In 2020/21, leachate discharging from the West Face Closure Toe Drain was flowing and sampled in nine (9) of twelve months. The drainage was dry during the July 2020 and August 2020 sampling dates. Similar to previous years, the West Face Closure Toe Drain generally had the most concentrated leachate, with the highest BOD, COD, ammonia, conductivity, and chloride concentrations.

In 2020/21, the average concentrations of conductivity, chloride, BOD and COD were lower than those measured in 2019/20. The 2020/21 sulphide concentrations remained low and met Waste Discharge Permit criteria on all sampling dates. COD exceeded the Waste Discharge Permit criteria on all sampling dates. Chloride exceeded the Waste Discharge Permit criteria on one sampling date and total phenols exceeded the Waste Discharge Permit criteria on six (6) of nine (9) sampling events.

The leachate from the West Face Closure Toe Drain is strongly reduced with a high organic content. However, it only flows episodically and does not convey a large volume of leachate to the leachate collection system on an annual basis. Recent observations indicate flow has been increasing over time. A weir and flow monitor has been installed at the location to evaluate trends over time. Leachate monitoring indicates that it does not appear to materially affect the quality of leachate at the Hartland Valve Chamber.

8.4.1.6 Cell 3 Pipe Outlet

Cell 3 includes new leachate containment (i.e. the Toutle Drain) and gravity flow conveyance infrastructure, which discharges directly into the upper leachate lagoon. Starting in 2016, the Cell 3 Pipe Outlet began discharging leachate and leachate from this location is considered representative of newly deposited refuse. In 2020/21, samples were collected on ten (10) out of twelve attempted sampling dates. Sampling from this station is challenging due to the intermittent flows observed at this location. In 2020/21, all parameters met Waste Discharge Permit criteria, except for COD on nine (9) of ten sampling dates. In 2020/21, total sulphide exceeded Waste Discharge Permit criteria on one (1) of the ten sampling dates.

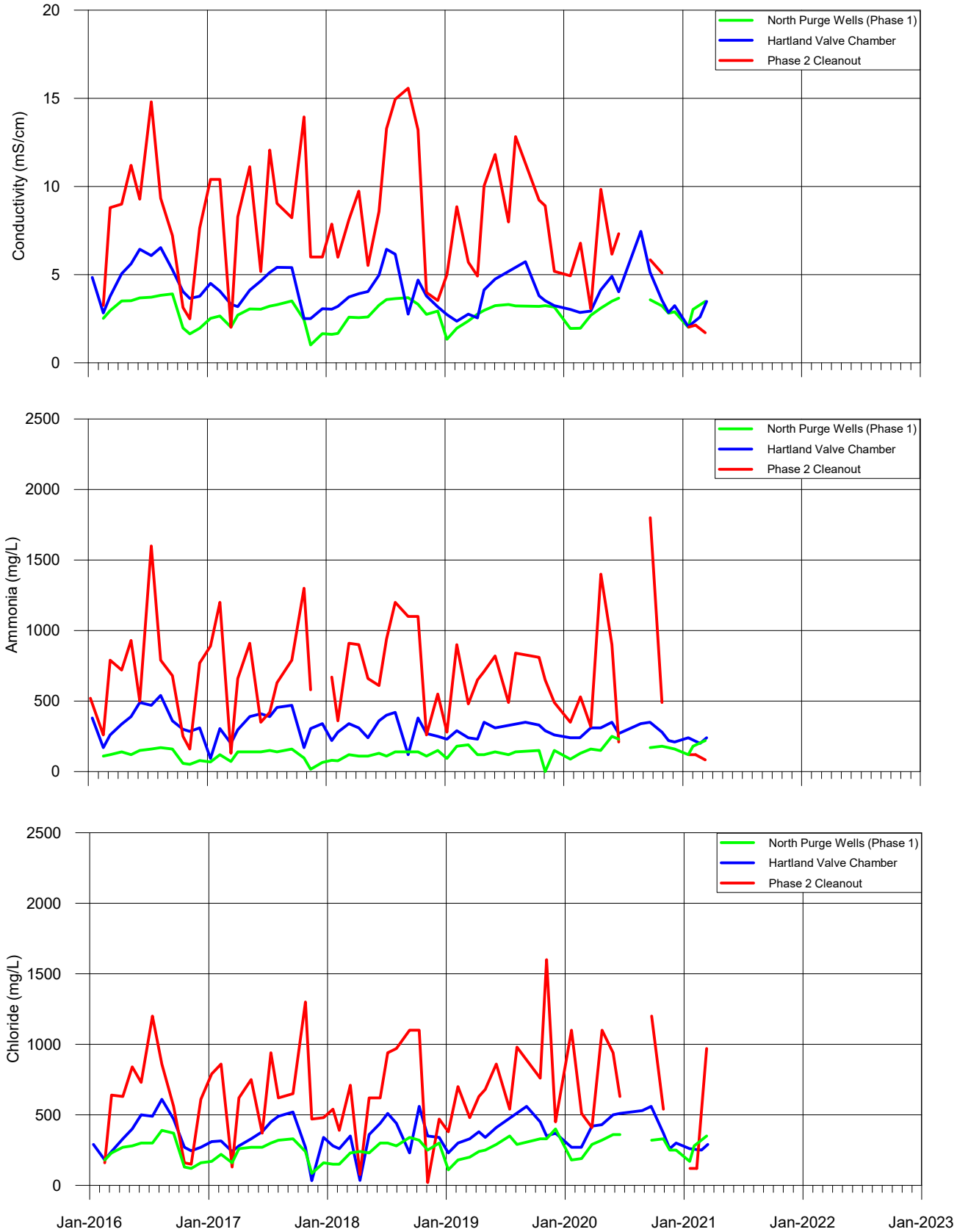


Figure 8-1. Hartland Valve Chamber Leachate Chemistry (Conductivity, Ammonia and Chloride)

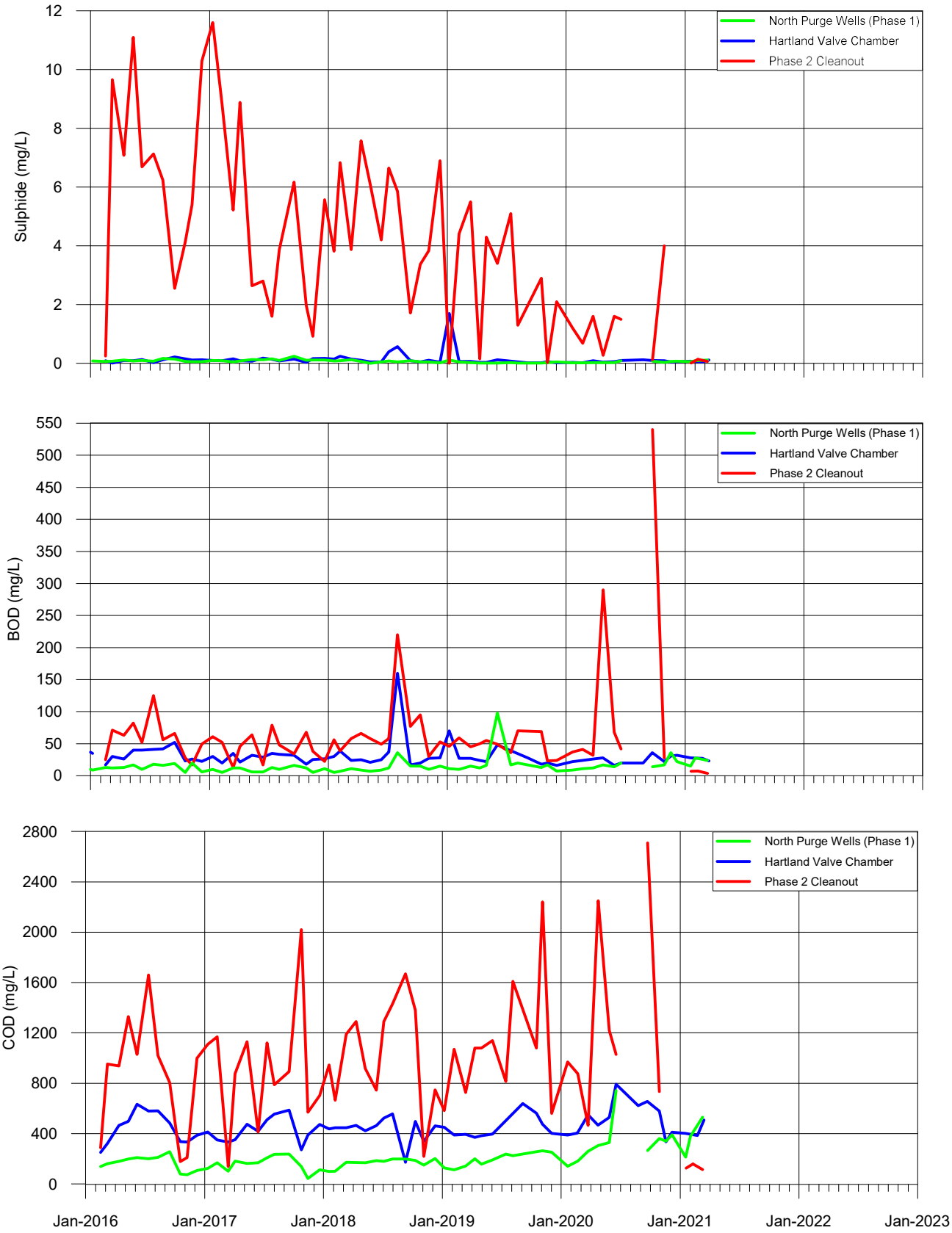


Figure 8-2. Hartland Valve Chamber Leachate Chemistry (Sulphide, BOD and COD)

AECOM

8.4.2 Quarterly Trace Organic Analysis at Hartland Valve Chamber

Trace volatile and semi-volatile organic analysis has been carried out quarterly since 1998 on leachate samples collected from the Hartland Valve Chamber. Trace organic compound analytical results for combined leachate in 2020/21 are presented in Appendix B.5.

A total of four (4) volatile and semi-volatile organic compounds were reported at detectable concentrations across all sampling dates. The detected compounds were found at concentrations that are low compared to those commonly found in leachate at municipal solid waste landfills of similar size. Of the trace organic compounds analyzed, none exceeded Waste Discharge Permit criteria. Similar to previous years, concentrations of volatile organic compounds in Phase 2 leachate (i.e. West Face Drainage and Phase 2 cleanout) are exceedingly low and typically at concentrations on the order of 1% to 20% of Waste Discharge Permit criteria. Regular sampling and analysis for VOC concentrations in leachate sources should continue, but it is not warranted in groundwater at compliance monitoring locations at this time.

In 2020/21, all trace organic parameters were present at concentrations below 0.1 µg/L with the exception of 2,3,5,6-tetrachlorophenol. Concentrations of 2,3,5,6-tetrachlorophenol were marginally above the detection limit for one sample in September 2020. The elevated 2,3,5,6-tetrachlorophenol concentration returned to below the detection limit in October 2020. Elevated concentrations (up to 100 µg/L) of methyl ethyl ketone and dimethyl ketone were reported in 2014/15, but concentrations were below detection limits in 2020/21.

Phthalate esters were detected during the October 2016, April 2017 and October 2018 sampling events, but were not detected in 2020/21. Dimethyl phthalate concentrations were slightly above the detection limit in 2017/18 but have been below detection limits since 2018/19.

In 2020/21, all phenolic compounds were present at or below detection limits. During 2017/18, two phenolic compounds (2,4-dimethylphenol, and 2,4 + 2,5 dichlorophenol) reported concentrations above detection limits. Phenol concentrations leachate are lower than or similar to those found at other larger landfills. Phenol is commonly used in a number of manufacturing processes and is present in many consumer products. It also occurs naturally at low concentrations due to sources in wood and other natural organic matter.

In 2020/21, all low weight PAH's were detected in Hartland Landfill leachate, with the exception of 2-chloronaphthalene and 2-methylnaphthalene (Appendix B.4). Total concentration of low weight PAHs ranged from 0.87 to 11.89 µg/L, which was consistent with historical concentrations. Acenaphthene exhibited a maximum concentration of 5.2 µg/L in January 2021, which was lower than the maximum value of 5.4 µg/L in 2019/20. In 2020/21, high molecular weight PAHs. including benzo(a)anthracene, fluoranthene, and pyrene, continued to be detected in leachate with maximum concentrations of 0.18 µg/L, 1.2 µg/L, and 0.84 µg/L, respectively. These high molecular weight PAHs generally had significantly lower concentrations than those measured in 2019/20. Chrysene and benzo(a)pyrene have been marginally above detection limits since 2016. Total concentrations of high molecular weight PAHs ranged from 0.19 to 5.98 µg/L, which were lower than those measured in 2019/20.

All volatile organic compounds were detected in 2020/21, except for methyl tertiary butyl ether, M & P xylenes, O-xylenes and styrene. The highest concentrations were generally observed in January 2021 and coincided with low ORP values.

The CRD's Environmental Protection division conducted high-resolution analyses of leachate between 2004 and 2007. The high-resolution analytes included polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), nonylphenols, and chlorobenzenes. Data collected revealed that nonylphenols and PBDEs are not present at levels of environmental concern, even in full strength leachate (Golder 2008). The aquatic risks of PCBs observed in leachate samples were also found to be negligible. In addition, concentrations of nonylphenols, PCBs, DDT and select PDBEs varied in comparison to CRD wastewater. Hartland leachate contributes only 2% of the total wastewater discharge from the Macaulay Point outfall. The evaluation concluded that despite differences in the chemical profile of leachate and Macaulay Point wastewater, leachate had no observable impact on the chemical profile at Macaulay Point. Based on these findings, the high-resolution analyses were discontinued, although co-ordination between the CRD's Marine Monitoring and Environmental programs is on-going.

8.5 Summary

The leachate flow and quality data collected in 2020/21 indicates the following:

- Average annual leachate flow was 12.91 L/s, with a maximum monthly flow of 101,810m^3 (38.0 L/s) in January 2021. This was slightly lower than the extreme flows of 39.6 L/s observed during 2006/07, and consistent with the long-term (1997 to 2020) average of 12.60 L/s.
- Leachate discharge remained in compliance with the requirements of the Waste Discharge Permit at the Hartland Valve Chamber. Statistical trend analysis indicates that leachate quality has been relatively stable to slightly improving over the past five years.
- The highest concentrations of leachate parameters at Hartland Valve Chamber were observed in August and September 2020, when precipitation (and dilution) was near the annual minimum.
- Phase 1 leachate exhibited the lowest average values of BOD, COD and sulphide concentrations, compared to other leachate sampling locations.
- Phase 2 leachate exhibited the most reducing conditions. Dissolved sulphate concentrations in March 2021 exceeded Waste Discharge Permit criteria with a peak dissolved sulphide concentration of 20,000 mg/L in March 2021.
- The West Face Closure Toe Drain exhibited the most concentrated leachate. COD exceeded the Waste Discharge Permit criteria on all sampling dates. Chloride exceeded the Waste Discharge Permit criteria on one sampling date. Total phenols exceeded the Waste Discharge Permit criteria on six sampling dates.

9. Conclusions

Based on our review of historical data and interpretation of groundwater, surface water and leachate quality data collected between April 2020 and March 2021, the annual monitoring program provides an effective assessment of landfill performance and compliance related to groundwater, surface water and leachate flow and quality. The following conclusions are drawn based on our interpretation of the 2020/21 data.

9.1 Leachate Flow

The leachate level information collected in 2020/21 revealed that leachate mounding continues to be present in Phase 1 of the landfill. Leachate elevations in Phase 1 were generally stable and exhibited minor seasonal variations. The leachate mound in the upper portion of the refuse is interpreted as being 'perched' above the regional bedrock groundwater flow system, with relatively higher water levels and strong downward hydraulic gradients. The localized leachate mound is present in the northern Phase 2 area and may be related to historical tarping or low permeability strata within the refuse. Overall, leachate elevations in Phase 2 are typically 1-2 m below the elevation of the unlined lower leachate lagoon, indicating that a significant leachate mound is not present in Phase 2.

Daily, monthly, and annual leachate discharge rates for 2020/21 were higher than those observed in 2019/20. The total volume of leachate discharged in 2020/21 was 407,153 m^3, which approximately 10% higher than that in 2019/20, likely due to higher precipitation. The highest monthly leachate flow recorded in 2020/21 was 101,810 m^3 (average monthly flow rate of 38.0 L/s) in January 2021, which is due to intense precipitation events and higher operational levels in the upper leachate lagoon.

9.2 Groundwater Flow

Groundwater flow in 2020/21 generally followed previously established patterns. Regional groundwater flows from Mount Work northeast to the north-south trending valley that underlies the northern portions of the Phase 1 and Phase 2 landfill. Most of the northward groundwater flow in the bedrock below the landfill is captured by the Toutle Valley Underdrain, Phase 2 basin leachate collection system, springs discharging to the lower lagoon, and the north and south purge well systems. Groundwater monitors east of Phase 1 confirm flow from east to west toward the landfill, preventing off-site migration to the east. Groundwater elevations in the North Ridge area exhibited strong seasonal fluctuations in 2020/21, and the Highland Fault continued to function as a barrier to east-west moving groundwater.

In 2020/21, a total of 24,790 m^3 of leachate was removed by the north purge wells, which was consistent with that reported in 2019/20 (24,494 m^3). The highest leachate extraction rate was observed in January 2021, with the peak flow of 146 m^3/day. A total of 37,115 m^3 leachate was removed by the south purge wells, which was approximately 14% higher than the volume removed in 2019/20. The average daily flow in 2020/21 was 101 m^3/day, which was approximately 10% higher than that in 2019/20. Water levels in north and south purge wells indicate that the leachate collection system is functioning effectively.

9.3 Groundwater Quality

The groundwater quality results for 2020/21 were similar to those measured over recent years and leachate-impacted groundwater is contained within the landfill property. At the north end of the landfill, leachate-affected groundwater extends just north of the unlined lower leachate lagoon and through the middle of the lined upper leachate lagoon but does not extend off-site. South of the landfill, leachate-affected groundwater does not extend off-site. Leachate related exceedances are confined to the landfill footprint on the east side of Phase 1 and are inferred to extend to the west side of the Phase 2 landfill. Overall, this indicates the leachate collection system continued to function as intended and minimized impacts to groundwater and surface water.

Compliance monitoring wells and off-site monitoring wells met CSR AW and DW standards. All CSR exceedances in groundwater were observed in on-site monitoring wells that are located in close proximity to the waste footprint, known leachate sources, or leachate purge wells.

In 2020/21, most of the groundwater wells exhibited improved groundwater quality when compared to 2019/20 results due to increased precipitation and associated groundwater dilution. Groundwater quality in the RTF area was not impacted by the releases of wastewater residuals that occurred on October 13, 2020 and February 9, 2021. Groundwater quality in compliance location 31 may be impacted by the pump #4 effluent release that occurred on October 18, 2020, as elevated values of

conductivity, sulphate, hardness, calcium and magnesium were noted. However, groundwater quality at location 31 met all applicable CSR AW and DW standards.

North of the Landfill

- In 2020/21, annual average conductivity values in the north purge wells were generally lower than those in 2019/20, indicating more diluted leachate quality. Improved water quality is attributed to the higher annual precipitation and associated increased dilution of leachate.
- Operation of the Phase 1 north purge well system continues to mitigate leachate impacts north of the landfill, as indicated by long-term stable or decreasing concentrations of leachate indicator parameters at locations 40, 20 and 21. In 2020/21, groundwater quality in well 20, 21 and 40 was slightly improved when compared to 2019/20 results.
- Groundwater quality in close proximity to the Phase 2 basin confirms the hydraulic trap leachate collection system is effectively containing leachate north of Phase 2. Groundwater quality 100 m north of Phase 2 continued to show low concentrations of leachate indicator parameters, indicating water quality is not affected by landfill leachate. Slightly elevated sulphate concentrations are likely associated with runoff from aggregate stockpiles.
- Groundwater quality in the shallow well at location 27 continued to be affected by ongoing aggregate production and blasting activity close to the Toutle Valley. However, the deep well at this location is not impacted at this time.

Hartland North Pad

- Groundwater quality at the Hartland North Pad were consistent with background levels. Groundwater quality in close proximity to the October 13, 2020 wastewater residual spill event does not appear impacted.
- Groundwater quality in 91-1-1, 92-1-1, 93-1-1 and 94-1-1 were generally consistent with background conditions, except for slightly elevated sulphate concentrations in 92-1-1 and 94-1-1. Impacts in these newly installed wells may be associated with drilling and will likely dissipate with time.

South of the Landfill

- Water quality data from the south end of the landfill met the applicable CSR standards. Most of groundwater wells in this area continued to show decreasing trends in leachate indicator parameters (conductivity, chloride and ammonia) in 2020/21, as they have since the early 1990s.
- The application of road salt and herbicide continues to complicate interpretation of water quality data but impacts from these sources seasonal and are expected to diminish with time.
- Any long-term improvements in water quality south of the landfill are largely the result of leachate collection and containment measures instituted since 2001. Ongoing improvements to operational and maintenance protocols should continue improving water quality south of the landfill. Groundwater quality in this area is known to be sensitive to changes in the operation of the south purge wells and should continue to be monitored closely.

East of the Landfill

- Water quality along the east boundary of the Phase 1 landfill remained similar or slightly improved to previous years and concentrations of all parameters remained below applicable CSR standards.

9.4 Domestic Well Water Quality

As part of the CRD's groundwater quality monitoring program, nineteen (19) domestic wells were sampled in 2020, including 14 routine locations located within a two-kilometre radius of the landfill and five new wells located north of the Hartland North Pad. The water quality monitoring program indicated that groundwater quality in the domestic wells was consistent with previous results and water quality in all five new domestic wells met applicable Federal Water Quality guidelines (CDWQ and SDWQG) indicating that offsite domestic water wells remain unimpacted by landfill leachate.

9.5 Surface Water Quality

Surface water quality data collected in 2020/21 confirmed that nearby surface water bodies, Tod Creek, Durrance Lake and Durrance Creek and Killarney Lake continued to be unimpacted by landfill leachate.

Surface water in the vicinity of the landfill met the BCWQG-MAC criteria except for occasional exceedances for pH, iron, copper, zinc, and TSS. Elevated concentrations were largely related to seasonal flow variability (high and turbid flow) or construction activities. Of the 23 monitoring stations, total TSS and pH exceeded BCWQG-MAC at four (4) stations, total iron exceeded BCWQG MAC at six (6) stations, dissolved aluminum and iron concentrations exceeded BCWQG-MAC at three (3) stations, and total zinc only exceeded at one (1) station. The elevated metal concentrations were generally concurrent with high TSS, which may be related to construction and aggregate stockpiling activities. Water quality at background locations (SW-S-52 and CSs2) met BCWQG-MAC guidelines. Concentrations of leachate indicator parameters were consistent with previously reported background values.

Dissolved copper concentrations exceeded BCWQG-MAC values at nine (9) out of 23 stations. The dissolved copper BCWQG criteria varies with hardness, pH, dissolved organic carbon (DOC), and temperature, and is calculated using the Biotic Ligand Model (BLM). The exceedances of dissolved copper were typically associated with lower pH (<6.5), low hardness (<30 mg/L) and low DOC (<3 mg/L), which resulted in a stringent BCWQG. However, dissolved copper concentrations in surface water generally remained low (< 10 µg/L).

North of the Landfill

- The wastewater residual solid release on October 13, 2020 was contained in the wetland area upgradient of Durrance Lake. No clear evidence shows impacts to surface water quality.
- The spill from the CRL manhole and vent on February 9, 2021 was contained within a nearby dry depression and did not reach nearby surface water features.
- Surface water quality at Boundary Compliance stations along the northern property boundary met BCWQG-MAC in 2020/21, except for dissolved and total iron, dissolved copper at Sw-N-05 and Sw-N-16 during one or more sampling events. Similar to previous years, pH, dissolved and total iron at Sw-N-16 exceeded BCQWG-MAC criteria during one or more sampling events. Surface water at these two locations was not impacted by leachate, but exhibited minor influenced from nearby construction activities involving blasting, aggregate placement, or excavation of organic soils. Iron exceedances are likely due to the disturbance of sediment during the sampling, as indicated by high TSS concentrations. Dissolved copper guidelines are dependent on pH, DOC and hardness values and become more stringent under low pH, hardness and DOC levels.
- North of Hartland Landfill, dissolved copper concentrations at three (3) stations (none of which are Boundary Compliance locations) exceeded BCWQC-MAC criteria during one or more sampling events. Dissolved copper concentrations at these locations generally remained low (<10 µg/L). The dissolved copper exceedances at these locations are likely due to low pH and low DOC concentrations, which are reflective of the natural conditions.

Hartland North Pad

- In the Hartland North Pad area, surface water quality at Boundary Compliance stations (Sw-N-41s1 and Sw-N-42s1) met BCWQG-MAC in 2020/21, except for total iron and TSS. Leachate indicator parameters remained low in 2020/21, indicating surface water was not impacted by leachate. Water quality at Sw-N-42s1 station indicates slight impacts associated with aggregate stockpiling and construction activities at the RTF.
- Station Sw-N-41s3 (not a Boundary Compliance location) is located downstream of Sw-N-41s1 where the drainage from the northwest portion of the Hartland North Pad flows into Durrance Lake. In 2020/21, all parameters met BCWQG-MAC.

South of the Landfill

- Water quality at Boundary Compliance location Sw-S-04 met BCWQG-MAC criteria for all analytes in all samples collected during 2020/21, except for total iron and pH during one sampling event. Surface water quality along the southern property boundary was not impacted by leachate.
- Water quality at station Sw-S-52 (not a Boundary Compliance location) was representative of background water quality. In 2020/21, concentrations of all parameters were below the BCWQG-MAC. Concentrations of leachate indicator parameters were consistent with previously reported values.

- Surface water quality south of Hartland Landfill was generally consistent with previous years, and was not impacted by leachate. Slightly elevated conductivity, sulphate and nitrate concentrations observed at Sw-S-12 and Sw-S-03 during drier months and early fall may be due to runoff from paved areas surrounding the bin facility or dilute leachate. Elevated ammonia concentrations during the wet season may be derived from nitrate reduction via organic matter decomposing.
- South of Hartland Landfill, dissolved copper concentrations at four (4) stations (none of which are Boundary Compliance locations) exceeded BCWQC-MAC criteria during one or more sampling events. Dissolved copper concentrations at these locations generally remained low (<10 µg/L), except for Sw-S-03 and Sw-S-12. Elevated copper concentrations at Sw-S-03 and Sw-S-12 may be related to the aggregate dust or surface water runoff from the truck wash and garbing bin areas.

9.6 Leachate Quality

The leachate quality data collected in 2020/21 remained in compliance with the requirements of the Waste Discharge Permit at the Hartland Valve Chamber. Overall, annual average leachate concentrations in 2020/21 were generally comparable with those measured in 2019/20.

9.7 Quality Assurance and Quality Control

Upon review of the quality assurance and quality control data collected in 2020/21, groundwater, surface water and leachate sampling and laboratory analysis have produced reliable results that are acceptable for the purposes of this monitoring report.

9.8 Compliance with Operating Certificate and Waste Discharge Permit

Groundwater quality, surface water quality and leachate quality data were used to assess compliance with the amended Operational Certificate and Waste Discharge Permit and are discussed individually below.

9.8.1 Groundwater

A total of 36 groundwater monitoring wells were identified as Boundary Compliance monitoring. Water quality information collected from these wells were compared to the CSR standards for freshwater aquatic life and drinking water to assess compliance with the landfill Operating Certificate and protect both current and future uses of the groundwater resource.

With respect to groundwater, Hartland Landfill remained in compliance with the Operational Certificate in 2020/21.

9.8.2 Surface Water

A total of five surface water monitoring stations have been identified as Boundary Compliance stations surrounding Hartland Landfill. These stations are concentrated along the southern and northern property boundaries and are located downgradient of areas that have the potential to be impacted by leachate or runoff from the site. Impacts were observed at select stations but are inferred to be caused by sources other than landfill leachate (e.g. low-flow sampling conditions, construction activities, spill events, blasting, aggregate stockpiling, etc.). Water quality data collected from these sites was compared to the BCWQG-MAC criteria and used to assess compliance with the landfill Operational Certificate.

With respect to surface water, the landfill was in compliance with the Operational Certificate in 2020/21, with the exception of the exceedances related to low-flow conditions or other non-leachate sources noted in Table 9-1.

Table 9-1. Surface Water Quality Compliance at Property Boundary Stations

Station	General Parameters	Metals	Comments
North of the Landfill			
Sw-N-05	NA	Dissolved Copper (2)	• Dissolved copper guidelines are dependent on pH, DOC and hardness values. Copper guidelines become more stringent under lower pH, hardness and DOC levels.
Sw-N-16	Lab pH (2)	Total iron (2), Dissolved Copper (2)	• Exceedances are anticipated to be related to turbid flow conditions following a prolonged dry period. Continued monitoring to assess these anomalous results. • Dissolved copper guidelines are dependent on pH, DOC and hardness values. Copper guidelines become more stringent under lower pH, hardness and DOC levels. • pH values were occasionally below 6.5, but no statistically significant decrease in pH from background.
Sw-N-41S1	TSS (1)	Total Iron (1)	• Exceedances are anticipated to be related to turbid flow conditions following a prolonged dry period. Continued monitoring to assess these anomalous results. Refinement of the Standard Operating Procedure for surface water sampling may decrease the potential for artificially elevated concentrations of metals associated with suspended sediments.
South of the Landfill			
Sw-S-04	Lab pH (1)	Total Iron (1)	• Total iron exceedances are anticipated to be related to turbid flow conditions following a prolonged dry period and/or surface runoff from exposed rock. Continued monitoring to assess these anomalous results. • pH values were occasionally below 6.5, but no statistically significant decrease in pH from background.

9.8.3 Leachate

The Hartland Valve Chamber is the compliance point for the Waste Discharge Permit. During the monitoring period, leachate discharges at the Hartland Valve Chamber were in compliance with the Waste Discharge Permit requirements.

10. Recommendations

Based on the findings of this report, our recommendations are summarized in Table 10-1:

Table 10-1. Summary of Recommendations

	Leachate Collection System	Status
1	Water levels and quality in the north purge wells should continue to be closely monitored to verify the effectiveness of the leachate collection system. Several pump failures were reported at North purge wells P7 and P8. Options for maintaining lower leachate levels in P9 should be further investigated to continue improving groundwater quality west of the lower leachate lagoon.	New
2	Pumping levels and the extent of the drawdown cones surrounding the north and south purge well systems should continue to be validated periodically (next assessment in 2024) to confirm the proper functioning of the wells. All procedures should follow the Standard Operating Procedure (SOP) – North Purge Well Drawdown Cone Verification (AECOM 2016), with interpretation of results by a qualified professional.	Ongoing
3	Pumping elevations in the south purge wells (P2, P3, P4 and P10) should be maintained at elevations below 140 m asl. Pumping elevations in P1 should be maintained near the bottom of the screened interval around 146 m asl.	Ongoing
4	Future quarry development plans (i.e. quarrying, blasting, etc.) for the north bedrock ridge should be evaluated from a hydrogeological perspective to ensure that the proposed development will not affect groundwater recharge or compromise leachate containment.	Ongoing
5	A detailed assessment of the effectiveness of the hydraulic trap and leachate collection systems including the north purge wells and south purge wells is required to evaluate effectiveness as the landfill extends further north and west, and as additional lifts are constructed. Additional leachate containment or groundwater management measures may need to be implemented at the north end of the Phase 2 landfill to mitigate the potential for off-site leachate migration during future landfill development.	Ongoing
	Runoff and Infiltration Associated with Aggregate Stockpiles	
6	The location and volume of aggregate stockpiles should continue to be minimized outside of the leachate collection system. Stockpiles should be covered where present to minimize sulphate, ammonia, nitrate and TSS impacts on surface water bodies and downgradient groundwater. Direct runoff from aggregate stockpiles should be diverted away from natural water courses as it is known to exceed BCWQ guidelines for sulphate.	Ongoing
7	Within the footprint of the leachate collection system, progressive closure and temporary tarps should continue to be implemented to minimize infiltration to the underlying leachate collection system and manage sulphide concentrations in leachate.	Ongoing
	Groundwater Monitoring Program	
8	The groundwater well survey should be conducted once every five years to obtain updated data on well elevations (i.e., next survey in 2025).	New
9	The elevation of the leachate mound in Phase 1 and 2 should be determined at least once every five years (i.e. next assessment in 2025). The existing protocols should be refined to ensure successive triplicate water level measurements produce the same result. Several inconsistencies have been recently identified, which are interpreted to be the result of highly conductive condensate in landfill gas wells.	Ongoing
10	Monitoring wells on the north ridge and at Hartland North should continue to be monitored to characterize daily groundwater level fluctuations, further define the groundwater divergence and monitor groundwater flow behavior over time after construction of the Residuals Treatment Facility is complete. These wells should be protected from site development activities and damage by heavy equipment. Monitoring of these wells will also be important as the extents of the quarry within Phase 2 migrate northward. Furthermore, any westward expansion of the quarry may be accompanied by an increase in groundwater flow reporting to the leachate collection system as the Highland Fault is inferred to behave as a barrier to eastward groundwater flow.	Ongoing
11	There should be a routine review of the landfill development plan and filling plan every two years to ensure the existing monitoring network and monitoring program remain sufficient. The next review should be conducted in 2023.	Ongoing
12	As required by the Amended Operational Certificate, the results of the annual monitoring program should continue to be reviewed and interpreted by a Qualified Professional experienced in assessing the impacts of landfill leachate at large municipal landfills similar to Hartland.	Ongoing
	Surface and Leachate Monitoring Program	
13	The chemistry of residual wastewater solids and stabilized biosolids (solids and leachate) should be characterized to allow for future evaluation of accidental releases, and impacts to leachate chemistry over time. This information may be available from operational monitoring programs.	New
14	Regular cleaning of the weirs and surface water stations should be conducted to minimize the potential for artificially elevated concentrations of metals associated with suspended sediments.	New

	Leachate Collection System	Status
15	The source of ammonia, dissolved copper and nitrate observed at Sw-S-12 and Sw-S-03 should be investigated further. Additional waste has been placed on the western and southern portions of Phase 2 over recent years and occasional leachate seeps and runoff from the truck wash have been noted in the past. A multilevel monitoring well cluster could be established west of the bin facility and well 85-1-1 to resolve whether the source of impacts to surface water are due to runoff or discharge of leachate impacted groundwater.	Ongoing
16	In addition to the Sewer Use Criteria, leachate quality results for trace organic compounds should be compared to CSR standards for the protection of drinking water and aquatic life to allow for screening of data to identify parameters in leachate that exceed CSR standards, and guide any refinements to the monitoring program in future years.	Ongoing
	Construction Management	
17	Appropriate erosion control measures should continue to be implemented to minimize runoff from construction areas for all projects involving excavation, aggregate placement or soil relocation.	Ongoing
18	The placement of aggregate, road salt, dust suppressant and herbicides should be carefully considered and documented to help understand the causes of potential future concentrations of conductivity, ammonia, chloride, nitrate, sulphate and select metals at groundwater and surface water monitoring locations.	Ongoing
	Quality Assurance and Quality Control	
19	Field blanks and travel blanks should be collected and analyzed to ensue that environmental samples have not been contaminated during the data collection process,	New
20	Quality assurance for laboratory analyses should continue to be evaluated quarterly, and any discrepancies should be resolved with the laboratory and CRD sampling personnel within one month of receiving the laboratory results. The appropriate notation should be added to the data files to explain the reason for the low precision and the steps taken, if any, to improve the sampling or laboratory procedures.	Ongoing
21	Field measurement probes should be calibrated daily in advance of monitoring activities. The calibration should be validated at least once in the middle of the day to confirm the readings are accurate. Both lab and field pH should also be recorded for QAQC purposes.	Ongoing

11. Qualifications of the Authors

Kun Jia, M.Sc., P.Geo. is a Hydrogeologist / Geochemist with over eight years of experience collecting, analyzing and interpreting hydrogeological and geochemistry data for waste management, mining and contaminated sites projects. Kun has contributed to and authored several monitoring reports at Hartland landfill since 2015 and has been the primary author of the annual monitoring report since 2015.

Rebecca McGovern, M.Sc.,G.I.T. is a Hydrogeologist with three years of experience collecting, analyzing and interpreting hydrogeological data for contaminated sites, landfills, mines, pharmaceutical sites and industrial facilities. Rebecca assisted with data compilation, preparation of graphical figures, data interpretation and report writing and co-authored this 2019/20 annual monitoring report.

Stephen Dickin, P.Geo. is a hydrogeologist with 13 years of experience interpreting and analyzing hydrogeological and water chemistry data for waste management and mining related projects. Stephen conducted the senior peer review of this report. Stephen has been involved with the annual groundwater monitoring report for the Hartland Landfill since 2008.

Ryan Mills, M.Sc., P.Geo. is a Senior Hydrogeologist with over 20 years of experience interpreting and analyzing hydrogeological and water chemistry data for waste management, water resources and mining related projects. Ryan has authored several groundwater monitoring reports and conducted numerous site investigations involving drilling and hydrogeologic testing at Hartland Landfill since 2004. He has also undertaken site investigations at numerous other municipal, industrial and small rural landfills throughout British Columbia. Ryan oversaw and reviewed key aspects of the report.

12. References

AECOM 2009a. *Investigation of Water Quality Changes in Well 40-1-1 at Hartland Landfill*. Report for CRD. GLL 61-134.

AECOM 2009b. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2008-March 2009)*. Report for CRD. Project No. 60117147.

AECOM 2010a. *Permeability Testing North of the Phase 2 Basin*. Report for CRD. Project No. 108244-90101.

AECOM 2010b. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2009-March 2010)*. Report for CRD. Project No. 60158830.

AECOM 2011. *South Purge Well (P10) and Phase 2 Pressure Transducer (Borehole 86) Installation*. Report for CRD. Project No. 60164161.

AECOM 2012a. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2010-March 2011)*. Report for CRD. Project No. 60216348.

AECOM 2012b. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2011-March 2012)*. Report for CRD. Project No. 60271648.

AECOM 2013. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2012-March 2013)*. Report for CRD. Project No. 60302549.

AECOM 2014. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2013-March 2014)*. Report for CRD. Project No. 60321035.

AECOM 2015. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2014-March 2015)*. Report for CRD. Project No. 60431039.

AECOM 2016a. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2015-March 2016)*. Report for CRD. Project No. 60431039.

AECOM 2016b. *Hartland Landfill- Sampling Program Confirmation Memo (February 15, 2016)*. Memo for CRD. Project No. 60431039.

AECOM 2016c. *Hydrogeological Conceptual Model of North Ridge.* Report for CRD. Project No. 60431039.

AECOM 2016d. *Standard Operating Procedure – North Purge Well Drawdown Cone Verification – DRAFT*. Report for CRD. Project No. 60431039.

AECOM 2017a. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2016-March 2017)*. Report for CRD. Project No. 60431039.

AECOM 2017b. *Hartland Landfill – BC MOE Stage 10 Omnibus Amendments to the CSR: Regulated and Potential Emerging Contaminants of Concern. Report for CRD. Project No. 60431039*

AECOM 2018a. *Geological Assessment of Hartland North*. Memo for CRD. Project No. 60431039.

AECOM 2018b. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2017-March 2018)*. Report for CRD. Project No. 60431039

AECOM 2018c. *Hartland Landfill – 2018 Drilling Investigations*. Report for CRD. Project No. 60431039

AECOM 2019a. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2018-March 2019)*. Report for CRD. Project No. 60431039

AECOM 2019b. *Hartland Landfill – 2019 Drilling Investigations*. Report for CRD. Project No. 60431039

AECOM 2020a. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2019-March 2020)*. Report for CRD. Project No. 60631284

AECOM 2020b. *Hartland Landfill – Hydrogeology and Hydrology Characterization Report.* Report for CRD. Project No. 60631389

BC MOE. (BC Ministry of Environment). 1998a. *British Columbia Water Quality Guidelines (Criteria); 1998 Edition* (updated January 17, 2001). Prepared by Water Quality Section Water Management Branch, Environment and Resource Protection Department, MOELP, August 1998.

BC MOE. 1998b. *A Compendium of Working Water Quality Guidelines for British Columbia 1998 Edition* (updated April 2001). Ministry of Environment, Lands and Parks.

Corvidae Environmental Consulting Inc. (Corvidae). 2021. CRD Residual Treatment Facility End of Spill Report. Report for the Capital Regional District. January 2021.

CRD. (Capital Regional District). 2000. *Capital Regional District Sewer Use Bylaw No. 4, 2000", (Bylaw 2830)* Prepared by CRD and Adopted November 22, 2000.

CRD. (Capital Regional District). 2017. *Climate Projections for the Capital Region. Report p*repared for CRD by Pinna Sustainability and Pacific Climate Impacts Consortium. July 2017.

CRD. (Capital Regional District). 2017. Hartland Landfill – *Operating and Environmental Monitoring - 2016 Annual Report . Draft report p*repared by CRD. September 2017.

Federal-Provincial Subcommittee on Drinking Water of the Federal-Provincial-Territorial Committee on Environmental and Occupational Health, 2008. Summary of Guidelines for Canadian Drinking Water Quality, 2008.

GLL. (Gartner Lee Limited).1987. *Hartland Landfill 1986 – 1987 Hydrogeological Monitoring Report*. GLL 87-126. Report for the Capital Regional District.

GLL. 1988. *Hartland Landfill 1988 Hydrogeological Monitoring Report*. GLL 88-108. Report for the Capital Regional District.

GLL. 1990. *Hartland Landfill 1989 Hydrogeological Monitoring Report*. GLL 89-703. Report for the Capital Regional District.

GLL. 1991a. *Hartland Landfill 1990 Hydrogeological Monitoring Report*. GLL 90-735. Report for the Capital Regional District.

GLL. 1991b. *Hartland Landfill Leachate Treatability Study*. GLL 90-730. Report prepared for the Capital Regional District.

GLL. 1992a. *Water Quality Impact Assessment – Southeast of the Hartland Landfill*. GLL 91-732. Report for the Capital Regional District.

GLL. 1992b. *Hydrogeological Investigation and Leachate Management Concepts – Hartland Landfill – Phase II*. GLL 91-722. Report for the Capital Regional District.

GLL. 1992c. *Hartland Landfill Monitoring Program – 1991 Annual Report for Capital Regional District*. GLL 92-719.

GLL. 1993a. *Hartland Landfill Monitoring Program – 1992 Annual Report for Capital Regional District*. GLL 93-715.

GLL. 1993b. *Heal Basin 1993 Inflow Monitoring Study. Report for the Capital Regional District*. GLL 92-718.

GLL. 1994a. *Installation of Groundwater Monitors at the North Site Stage 1 Compost Facility and Around the New Leachate Lagoon*. Report Letter for Capital Regional District. GLL 93-759.

GLL. 1994b. *Hartland Landfill Monitoring Program – 1993 Annual Report for Capital Regional District*. GLL 94-723.

GLL. 1994c. *South Toe Drain Design, Phase I, Hartland Landfill.* Report for Capital Regional District. GLL 94-707.

GLL. 1994d. *Groundwater Monitor Installations, Phase I Crest, Hartland Landfill*. Report for Capital Regional District. GLL 94-732.

GLL. 1994e. *Hartland Landfill – Phase II Underdrain Design*. Report for the Capital Regional District.GLL 94-702.

GLL. 1995a. *Heal Basin 1994 Inflow Monitoring Study, Hartland Landfill.* Report for Capital Regional District. GLL 94-706.

GLL. 1995b. *Hartland Landfill Monitoring Program – 1994 Annual Report for Capital Regional District*. GLL 95-708.

GLL. 1995c. *Hartland Landfill Northward Leachate Migration Study*. Report for Capital Regional District. GLL 95-717.

GLL. 1995d. *Installation of a Water Supply Well in the North Site Stage 1 Compost Facility*. Report for the Capital Regional District. GLL 94-704

GLL. 1996. *Hartland Landfill Monitoring Program – 1996 Annual Report for Capital Regional District*. GLL 96-734.

GLL. 1997a. *Hartland Landfill Purge Well Evaluation*. Report for Capital Regional District. GLL 95-798.

GLL. 1997b. *Hartland Landfill Yard Waste Composting Area Groundwater Study*. Report prepared for Capital Regional District. GLL 96-752.

GLL. 1997c. *Deep Fracture Flow Analysis Report, November 1997*. Report for Capital Regional District.

GLL. 1997. *Hartland Landfill Monitoring Program – 1996 Annual Report*. Report prepared for Capital Regional District.

GLL. 1998a. *Hartland Landfill – Geophysical Study*. Letter report for Capital Regional District.

GLL. 1998b. *Hartland Landfill Monitoring Program – 1997*. Annual Report. Prepared for Capital Regional District. GLL 98 753.

GLL. 1999a. *Hartland Landfill – Installation of Replacement Monitoring Wells (Draft Report)* GLL 98-788.

GLL. 1999b. *Hartland Landfill Monitoring Program – 1998. Annual Report*. Prepared for Capital Regional District. GLL 99 733.

GLL. 2000a .*Hartland Landfill – Conceptual Design of South Leachate Purge Well System.* Prepared for Capital Regional District. GLL 99-764.

GLL. 2000b. *Assessment of Potential Leachate Migration from Hartland Landfill Phase 2 – Winter 1998-1999.* Prepared for Capital Regional District. GLL 99-763.

GLL. 2000c. *Hartland Landfill Monitoring Program – 1999. Annual Report.* Prepared for Capital Regional District. GLL 20-721.

GLL. 2001. *Hartland Landfill Monitoring Program – 2000 Annual Report.* Prepared for Capital Regional District. GLL 22-419.

GLL. 2003a. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (January 2001 to March 2002*). Report for Capital Regional District. GLL 21-747.

GLL. 2003b. *Hartland Landfill – 2003 Groundwater Monitor Installations to the Southeast.* Report for Capital Regional District. GLL 23-035.

GLL. 2003c. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2002-March 2003)*. Report for CRD. GLL 23-304.

GLL. 2004a. *Hartland Landfill – Hydrogeological Review of Groundwater, Surface Water and Leachate Monitoring Programs*. Report for CRD. GLL 23-479.

GLL. 2004b. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2003-March 2004)*. Report for CRD. GLL 40-549.

GLL. 2005. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2004-March 2005)*. Report for CRD. GLL 50-569.

GLL. 2006. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2005-March 2006)*. Report for CRD. GLL 60-583.

GLL. 2007. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2006-March 2007)*. Report for CRD. GLL 70-405.

GLL. 2008. *Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program – Annual Report (April 2007-March 2008)*. Report for CRD. GLL 80-417.

Golder (Golder Associates Ltd.) 2007. *Phase 2 High Level Road Expansion Surface Water Quality Monitoring and Quarry and Aggregate Stockpile Inspections at the Hartland Landfill*. Project 06-1414-019. Report for the Capital Regional District.

Golder. 2008. 2007 *Assessment of Additional Chemical Analyses for Hartland Landfill*. Project 07-1421-0049. Report for the Capital Regional District.

McElhanney 2020a. Pump Station 4 Effluent Release and Result Memo. File Number 2243-18121-00 T9002. Report for CRD Pump and Bridge Project. November 27, 2020.

McElhanney 2020b. Pump Station 4 Effluent Release and Result Memo. File Number 2243-18121-00 T9002. Report for CRD Pump and Bridge Project. February 24, 2021.

Pritchard, D. & Collins, D. 2006 'The National Biosolids Research Program: Research Studies on the Impact of Heavy Metals on Sustainable Fertilisation and the Intensive Agricultural Applications of Biosolids', Final Report to the Water Corporation of Western Australia, December 2006.

Sperling Hansen. 2003. *2003 Update of Leachate Mounding Assessment at Hartland Landfill*. Final Report PPJ03002. Report prepared for Capital Regional District.

UMA Engineering. 1996. *Composting Site – Water Quality Management*. An Update Report to the CRD on the Status of Water Quality Monitoring and Management in the Vicinity of the Yard Waste Composting Site.

UMA Engineering. 1997. *Hartland Landfill Yard Waste Composting Site – Water Quality Management*. Report prepared for the Capital Regional District.

UMA Engineering and Gartner Lee Limited. 1992. *Todd Creek/Prospect Lake Rehabilitation Study*. GLL 91-707. Draft final report for the Capital Regional District.

Appendix A

Monitoring Station and Groundwater Level Data

- A1. Monitoring Well Co-ordinates
- A2. Groundwater Monitoring Plan
- A3. Groundwater Elevations
- A4. Surface Water Station Details

A1. Monitoring Well Co-ordinates

Appendix A-1. Monitoring Well Co-ordinates 2020-2021

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground Surface	Depth to Top of Screen Below Ground Surface	Depth to Bottom of Screen Below Ground Surface		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGS	m BGS	m BGS				
GW-04-3-1	Active	5375469.0	466167.8	127.11	128.20	128.09	114.26	111.21	1.05	15.90	12.85	15.90	2005 Mar	I	SP1	
GW-04-4-1	Active	5375466.8	466166.1	127.13	128.08	128.01	122.98	119.93	0.88	7.20	4.15	7.20	2005 Mar	S	SP1	
GW-07-1-0	Active	5375613.3	466177.0	140.60	142.69	142.29	N/A	N/A	1.69	No monitor	No monitor	No monitor	2005 Mar	D	SP1	
GW-09-1-0	Active	5375774.0	466187.0	148.96	150.14	150.14	N/A	N/A	1.18	No monitor	No monitor	No monitor	Historic	D	EP1	
GW-16-1-1	Active	5376345.6	466130.2	143.48	144.28	144.06	101.98	100.48	0.58	43.00	41.50	43.00	2005 Mar	D	EP1	
GW-16-1-2	Active	5376345.6	466130.1	143.48	144.28	144.00	110.98	109.48	0.52	34.00	32.50	34.00	2005 Mar	D	EP1	
GW-16-2-1	Active	5376347.1	466133.7	143.31	144.09	143.67	119.81	118.81	0.36	24.50	23.50	24.50	2005 Mar	I	EP1	
GW-16-2-2	Active	5376347.0	466133.7	143.31	144.09	143.72	129.81	126.81	0.41	16.50	13.50	16.50	2005 Mar	I	EP1	
GW-17-1-1	Active	5376186.4	466198.0	150.99	152.17	152.08	100.49	98.99	1.09	52.00	50.50	52.00	2005 Mar	D	EP1	
GW-17-1-2	Active	5376186.5	466198.0	150.99	152.17	152.11	110.99	109.49	1.12	41.50	40.00	41.50	2005 Mar	D	EP1	
GW-17-1-3	Active	5376186.5	466198.0	150.99	152.17	152.04	136.49	133.29	1.05	17.70	14.50	17.70	2005 Mar	I	EP1	
GW-18-1-1	Active	5375976.5	466194.8	168.81	169.48	168.82	110.64	109.14	0.19	59.67	58.17	59.67	2005 Mar	D	EP1	
GW-18-1-2	Active	5375976.5	466194.7	168.81	169.48	169.33	122.61	121.11	0.52	47.70	46.20	47.70	2005 Mar	D	EP1	
GW-18-2-1	Active	5375973.0	466193.8	168.92	169.68	169.16	138.42	136.92	0.24	32.00	30.50	32.00	2005 Mar	D	EP1	
GW-18-2-2	Active	5375973.0	466193.7	168.92	169.68	169.12	155.92	152.92	0.20	16.00	13.00	16.00	2005 Mar	I	EP1	
GW-19-1-1	Active	5375503.2	466125.3	132.89	133.86	133.85	96.89	95.39	0.96	37.50	36.00	37.50	2005 Mar	D	SP1	
GW-19-1-2	Active	5375503.2	466125.3	132.89	133.86	133.87	106.39	104.89	0.98	28.00	26.50	28.00	2005 Mar	I	SP1	
GW-19-2-1	Active	5375507.6	466124.1	132.60	133.37	133.26	117.10	115.60	0.66	17.00	15.50	17.00	2005 Mar	I	SP1	
GW-19-2-2	Active	5375507.6	466124.1	132.60	133.37	133.32	126.60	123.60	0.72	9.00	6.00	9.00	2005 Mar	S	SP1	
GW-20-1-1	Active	5376498.3	465971.1	110.46	111.32	111.17	80.46	77.46	1.20	33.00	30.00	33.00	2005 Mar	D	NP1	Deactivated in 2010.
GW-20-1-2	Active	5376498.4	465971.0	110.46	111.32	111.19	92.66	89.66	1.21	20.80	17.80	20.80	2005 Mar	I	NP1	
GW-21-1-1	Active	5376483.9	465970.8	110.92	111.79	111.69	98.02	94.92	1.25	16.00	12.90	16.00	2005 Mar	I	NP1	
GW-21-1-2	Active	5376483.9	465970.9	110.92	111.79	111.68	105.42	102.32	1.24	8.60	5.50	8.60	2005 Mar	S	NP1	
GW-21-2-1	Active	5376482.3	465970.0	111.10	111.87	111.80	No log	No log	0.70	NA	NA	NA	2005 Mar	S	NP1	
GW-25-1-1	Active	5376491.7	465713.9	129.91	130.89	130.77	106.91	105.41	0.86	24.50	23.00	24.50	2005 Mar	I	NP2	
GW-25-1-2	Active	5376491.7	465714.0	129.91	130.89	130.78	125.61	123.41	0.87	6.50	4.30	6.50	2005 Mar	S	NP2	
GW-27-1-1	Active	5376358.2	465455.8	141.09	141.91	141.57	118.09	116.59	0.48	24.50	23.00	24.50	2005 Mar	I	BKGND - WP2	
GW-27-1-2	Active	5376358.2	465455.7	141.09	141.91	141.56	140.59	137.59	0.47	3.50	0.50	3.50	2005 Mar	S	BKGND - WP2	
GW-28-1-0	Active	5376503.6	465825.1	136.25	137.07	136.52	N/A	N/A	0.27	NA	NA	NA	2005 Mar	D	NP1	

Notes:

Datum Description

m BGL	*metres below ground level*
m AGL	*metres above ground level*
m ASL	*metres above mean sea level*

Monitor Class

S	*Shallow well <15 m deep*
I	*Intermediate well between 15 and 30 m deep*
D	*Deep well >30 m deep*

Area of Landfill

SP1	*South of Phase 1 Landfill*
EP1	*East of Phase 1 Landfill*
NP1	*North of Phase 1 Landfill*
NP2	*North of Phase 2 Landfill*
BKGND - WP2	*Background Water Quality West of Phase 2*
HNP	*Hartland North Pad*
P1	*Phase 1*
P2	*Phase 2*

Appendix A-1. Monitoring Well Co-ordinates 2020-2021

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground Surface	Depth to Top of Screen Below Ground Surface	Depth to Bottom of Screen Below Ground Surface		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGS	m BGS	m BGS				
GW-29-1-1	Active	5376563.3	465898.2	113.39	114.41	114.38	100.28	98.87	0.99	14.52	13.11	14.52	2005 Mar	S	NP1	
GW-29-1-2	Active	5376563.3	465898.3	113.39	114.41	114.39	110.39	105.96	1.00	7.43	3.00	7.43	2005 Mar	S	NP1	
GW-30-1-1	Active	5376562.2	465978.4	109.84	110.89	110.79	95.51	94.10	0.95	15.74	14.33	15.74	2005 Mar	I	NP1	
GW-30-1-2	Active	5376562.3	465978.5	109.84	110.89	110.79	108.56	104.07	0.95	5.77	1.28	5.77	2005 Mar	S	NP1	
GW-31-1-1	Active	5376555.2	466080.9	105.28	106.34	106.26	90.92	89.50	0.98	15.78	14.36	15.78	2005 Mar	I	NP1	
GW-31-1-2	Active	5376555.2	466080.9	105.28	106.34	106.26	103.84	99.41	0.98	5.87	1.44	5.87	2005 Mar	S	NP1	
GW-36-1-1	Active	5376398.9	465778.3	130.21	130.21	131.51	117.87	114.87	1.30	15.34	12.34	15.34	2005 Mar	I	NP2	
GW-36-2-1	Active	5376400.6	465776.5	130.00	131.11	131.07	90.68	87.63	1.07	42.37	39.32	42.37	2005 Mar	D	NP2	
GW-36-3-1	Active	5376401.7	465773.6	130.01	131.01	130.96	115.01	112.01	0.95	18.00	15.00	18.00	2005 Mar	I	NP2	
GW-37-1-1	Active	5376432.6	465725.6	129.59	130.12	129.98	117.35	114.35	0.39	15.24	12.24	15.24	2005 Mar	I	NP2	
GW-37-2-1	Active	5376432.5	465727.8	129.92	130.64	130.60	89.47	86.42	0.68	43.50	40.45	43.50	2005 Mar	D	NP2	
GW-37-3-1	Active	5376435.6	465726.8	129.95	130.75	130.63	119.72	115.15	0.68	14.80	10.23	14.80	2005 Mar	S	NP2	
GW-38-1-1	Active	5376464.6	465797.2	131.90	132.46	132.31	N/A	N/A	0.41	18.29	No monitor	18.29	2005 Mar	I	NP2	
GW-39-1-1	Active	5376467.2	465876.1	129.54	130.24	130.11	111.10	108.10	0.57	21.44	18.44	21.44	2005 Mar	I	NP2	
GW-39-2-1	Active	5376466.3	465874.7	129.75	130.72	130.58	95.56	92.56	0.83	37.19	34.19	37.19	2005 Mar	D	NP2	
GW-40-1-1	Active	5376432.1	465915.2	122.00	122.78	122.68	109.76	106.76	0.68	15.24	12.24	15.24	2005 Mar	I	NP1	
GW-41-1-1	Active	5376852.1	465190.4	149.48	150.30	150.16	143.41	140.41	0.68	9.07	6.07	9.07	2005 Mar	S	HNP	
GW-42-1-1	Active	5376717.6	465534.9	138.81	139.45	139.33	133.02	129.97	0.52	8.84	5.79	8.84	2005 Mar	S	HNP	
GW-43-1-1	Active	5376683.8	465448.7	162.60	163.05	163.10	144.31	141.26	0.50	21.34	18.29	21.34	2007 Apr	I	HNP	
GW-44-1-1	Active	5376671.5	465322.3	161.46	162.02	161.89	153.84	150.79	0.43	10.67	7.62	10.67	2005 Mar	S	HNP	
GW-46-2-1	Active	5376075.5	466029.9	169.97	171.25	171.70	161.69	158.69	1.73	11.28	8.28	11.28	2006 Apr	S	P1	
GW-46-3-1	Active	5376085.7	466035.7	169.83	172.46	172.38	137.83	134.78	2.55	35.05	32.00	35.05	2006 Apr	D	P1	Installed during 2005
GW-46-4-1	Active	5376078.5	466035.9	169.71	172.10	172.03	151.12	148.07	2.32	21.64	18.59	21.64	2006 Apr	I	P1	Installed during 2005
GW-47-2-1	Active	5375888.1	465996.7	171.84	174.46	174.40	154.78	151.73	2.55	20.11	17.06	20.11	2006 Apr	I	P1	Installed during 2005
GW-48-1-1	Active	5375840.5	466031.3	169.78	171.34	171.63	160.14	157.14	1.85	12.64	9.64	12.64	2006 Apr	S	P1	
GW-48-2-1	Active	537815.8	466031.6	168.87	171.28	171.22	149.97	146.92	2.35	21.95	18.90	21.95	2006 Apr	I	P1	Installed during 2005
GW-51-1-1	Active	5376475.1	466048.2	110.90	111.68	111.76	106.13	103.13	0.86	7.77	4.77	7.77	2005 Mar	S	NP1	
GW-51-2-1	Active	5376474.1	466045.6	110.90	111.83	111.89	100.49	97.49	0.99	13.41	10.41	13.41	2005 Mar	S	NP1	
GW-51-3-1	Active	5376473.3	466042.7	110.97	111.84	111.89	93.85	90.85	0.92	20.12	17.12	20.12	2005 Mar	I	NP1	
GW-52-1-1	Active	5376406.0	465979.1	119.91	120.94	120.90	93.19	90.19	0.99	29.72	26.72	29.72	Historic	I	NP1	
GW-52-2-0	Active	5376391.0	465959.0	119.99	120.65	120.65	N/A	N/A	0.66	NA	NA	NA	Historic	I	NP1	

Notes:

Datum Description

m BGL	*metres below ground level*
m AGL	*metres above ground level*
m ASL	*metres above mean sea level*

Monitor Class

S	*Shallow well <15 m deep*
I	*Intermediate well between 15 and 30 m deep*
D	*Deep well >30 m deep*

Area of Landfill

SP1	*South of Phase 1 Landfill*
EP1	*East of Phase 1 Landfill*
NP1	*North of Phase 1 Landfill*
NP2	*North of Phase 2 Landfill*
BKGND - WP2	*Background Water Quality West of Phase 2*
HNP	*Hartland North Pad*
P1	*Phase 1*
P2	*Phase 2*

Appendix A-1. Monitoring Well Co-ordinates 2020-2021

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground Surface	Depth to Top of Screen Below Ground Surface	Depth to Bottom of Screen Below Ground Surface		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGS	m BGS	m BGS				
GW-52-3-0	Active	5376389.9	465948.8	119.8	120.4	120.4	N/A	N/A	0.57	No monitor	No monitor	No monitor	Historic	I	NP1	
GW-52-4-0-P7	Active	5376388.0	465947.0	119.80	120.60	120.60	N/A	N/A	0.80	22.25	No monitor	No monitor	Historic	I	NP1	Purge well
GW-53-1-1	Active	5376506.2	465761.3	130.84	131.81	131.92	114.15	110.88	1.08	19.96	16.69	19.96	2005 Mar	I	NP2	
GW-54-1-1	Active	5376187.7	466226.9	154.63	155.58	155.65	107.91	104.91	1.02	49.72	46.72	49.72	2005 Mar	D	EP1	
GW-54-2-1	Active	5376185.6	466225.5	154.69	155.62	155.66	118.55	115.55	0.97	39.14	36.14	39.14	2005 Mar	D	EP1	
GW-54-3-1	Active	5376183.4	466224.7	154.66	155.50	155.53	138.05	135.05	0.87	19.61	16.61	19.61	2005 Mar	I	EP1	
GW-55-1-1	Active	5376910.6	465136.1	147.67	147.68	148.52	139.06	134.56	0.85	13.11	8.61	13.11	2005 Mar	S	HNP	
GW-56-1-1	Active	5376838.5	465287.8	148.67	149.69	149.61	139.92	131.29	0.94	17.38	8.75	17.38	2005 Mar	I	HNP	
GW-57-1-1	Active	5376873.9	465528.4	132.37	132.99	132.90	122.77	118.81	0.53	13.56	9.60	13.56	2005 Mar	S	HNP	
GW-58-1-0	Active	5376324.8	465822.9	137.17	138.30	138.23	N/A	N/A	1.06	19.20	No monitor	No monitor	2009 May	I	NP2	
GW-60-1-1	Active	5375636.9	466137.2	141.63	142.40	142.32	122.23	119.23	0.69	22.40	19.40	22.40	2005 Mar	I	SP1	
GW-60-2-1	Active	5375638.4	466137.4	141.61	142.46	142.40	129.51	126.51	0.79	15.10	12.10	15.10	2005 Mar	I	SP1	
GW-60-3-1	Active	5375640.0	466137.5	141.74	142.60	142.49	137.84	134.84	0.75	6.90	3.90	6.90	2005 Mar	S	SP1	
GW-61-1-1	Active	5375980.6	465523.1	212.00	213.06	212.95	146.40	143.40	0.95	68.60	65.60	68.60	2005 Mar	D	BKGND - WP2	
GW-62-1-1	Active	5376609.3	465265.5	183.44	184.25	184.25	161.32	159.82	N/A	23.70	22.12	23.62	2008 May	I	HNP	Survey elevations suspect.
GW-62-2-1	Active	5376610.5	465267.3	183.06	183.96	183.96	168.70	165.70	N/A	18.90	14.36	17.36	2008 May	I	HNP	Survey elevations suspect.
GW-63-1-1	Active	5375812.3	465609.5	197.24	198.18	198.09	168.44	165.44	0.85	31.80	28.80	31.80	2005 Mar	I	BKGND - WP2	
GW-63-2-1	Active	5375809.7	465610.5	197.21	198.11	198.03	186.71	183.71	0.82	13.50	10.50	13.50	2005 Mar	S	BKGND - WP2	
GW-71-1-1	Active	5375643.3	466260.6	144.04	144.93	144.82	116.61	113.56	0.81	31.24	27.43	30.48	2005 Mar	D	SP1	
GW-71-2-1	Active	5375644.1	466259.9	144.04	144.92	144.81	127.04	123.98	0.80	20.10	17.00	20.06	2005 Mar	I	SP1	
GW-71-3-1	Active	5375645.3	466259.1	144.05	144.95	144.90	137.04	134.00	0.85	10.10	7.01	10.05	2005 Mar	S	SP1	
GW-72-1-1	Active	5375670.6	466186.6	143.29	144.13	144.03	115.86	112.81	0.79	30.48	27.43	30.48	2005 Mar	D	SP1	
GW-72-2-1	Active	5375671.7	466186.7	143.32	144.09	144.04	126.56	123.20	0.72	20.12	16.76	20.12	2005 Mar	I	SP1	
GW-72-3-1	Active	5375672.7	466186.8	143.38	144.17	144.12	136.06	133.02	0.74	10.36	7.32	10.36	2005 Mar	S	SP1	
GW-73-1-1	Active	5375532.1	466184.1	134.52	135.47	135.31	106.91	103.86	0.86	30.66	27.61	30.66	2005 Mar	D	SP1	
GW-73-2-1	Active	5375533.2	466184.1	134.50	135.40	135.36	117.40	114.38	0.86	20.12	17.10	20.12	2005 Mar	I	SP1	
GW-73-3-1	Active	5375534.3	466184.1	134.48	135.37	135.31	127.46	124.42	0.83	10.06	7.02	10.06	2005 Mar	S	SP1	
GW-75-1-1	Active	5376207.5	466035.3	154.82	155.62	155.97	127.72	121.72	1.15	33.10	27.10	33.10	2007 Apr	D	P1	
GW-76-1-1	Active	5375966.0	466228.4	171.08	171.79	171.69	123.23	117.13	0.61	61.90	47.85	53.95	2005 Mar	D	EP1	
GW-76-2-1	Active	5375967.5	466227.1	171.00	171.77	171.66	133.81	127.72	0.66	43.60	37.19	43.28	2005 Mar	D	EP1	

Notes:

Datum Description

m BGL	*metres below ground level*
m AGL	*metres above ground level*
m ASL	*metres above mean sea level*

Monitor Class

S	*Shallow well <15 m deep*
I	*Intermediate well between 15 and 30 m deep*
D	*Deep well >30 m deep*

Area of Landfill

SP1	*South of Phase 1 Landfill*
EP1	*East of Phase 1 Landfill*
NP1	*North of Phase 1 Landfill*
NP2	*North of Phase 2 Landfill*
BKGND - WP2	*Background Water Quality West of Phase 2*
HNP	*Hartland North Pad*
P1	*Phase 1*
P2	*Phase 2*

Appendix A-1. Monitoring Well Co-ordinates 2020-2021

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground Surface	Depth to Top of Screen Below Ground Surface	Depth to Bottom of Screen Below Ground Surface		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGS	m BGS	m BGS				
GW-76-3-1	Active	466226.0	5375968.8	171.0	171.8	171.7	145.1	142.0	0.72	29.00	25.91	28.96	2005 Mar	I	EP1	
GW-77-1-1	Active	5376487.8	465536.8	155.04	155.66	155.63	120.60	117.55	0.59	40.26	34.44	37.49	2006 Apr	D	NP2	Installed in 2006
GW-77-2-1	Active	5376485.8	465536.2	154.90	155.51	155.45	139.16	135.87	0.55	20.67	15.74	19.03	2006 Apr	I	NP2	Installed in 2006
GW-78-1-1	Active	5376498.8	465648.8	142.66	143.46	143.38	113.46	110.18	0.72	33.79	29.20	32.48	2006 Apr	D	NP2	Installed in 2006
GW-78-2-1	Active	5376500.3	465646.7	142.59	143.40	143.36	132.42	129.14	0.77	14.11	10.17	13.45	2006 Apr	S	NP2	Installed in 2006
GW-80-1-0-P8	Active	5376397.4	465931.0	119.61	120.29	N/A	N/A	N/A	N/A	20.42	No monitor	No monitor	2008 May	I	NP1	Purge well
GW-81-1-0-P9	Active	5376409.0	465910.8	122.17	122.85	N/A	N/A	N/A	N/A	26.82	No monitor	No monitor	2008 May	I	NP1	Installed in 2007
GW-82-1-1	Active	5376257.5	465772.7	154.67	155.89	155.86	135.17	131.50	1.18	23.77	19.50	23.17	2009 May	I	P2	Installed in 2007
GW-83-1-1	Active	5376353.3	465723.8	140.09	141.40	141.44	124.97	121.92	1.35	18.90	15.12	18.17	2009 May	I	P2	Installed in 2007
GW-85-1-1	Active	5375688.3	466068.7	149.09	150.09	150.07	142.99	139.95	0.98	9.14	6.1	9.14	2009 May	S	SP1	Installed in March 2009
GW-87-1-1	Active	5376451.7	465243.4	182.32	183.22	183.16	147.62	144.52	0.84	37.80	34.70	37.80	2015 Feb	D	NP2	Installed in 2014
GW-87-2-1	Active	5376453.8	465242.8	182.36	183.26	183.24	165.56	162.56	0.88	21.90	16.80	19.80	2015 Feb	I	NP2	Installed in 2014
GW-88-1-1	Active	5376467.2	465271.7	181.47	182.24	182.16	138.77	135.77	0.69	45.70	42.70	45.70	2015 Feb	D	NP2	Installed in 2014
GW-88-2-1	Active	5376470.1	465271.9	181.29	182.16	182.10	168.49	165.49	0.81	16.80	12.80	15.80	2015 Feb	I	NP2	Installed in 2014
GW-89-1-1	Active	5376028.4	466043.4	169.25	169.45	169.45	138.62	135.57	0.19	30.18	30.63	33.68	2018 Dec	D	P1	Installed in 208
GW-89-2-1	Active	5376026.8	466048.7	169.141	169.34	169.34	149.48	146.43	0.20	19.05	19.66	22.71	2018 Dec	I	P1	Installed in 2018
GW-90-1-1	Active	5376286.6	465651.3	151.876	152.69	152.69	118.34	115.30	0.81	38.40	33.54	36.58	2019 Oct	D	P2	leachate mound monitoring well
GW-90-2-1	Active	5376286.8	465652.3	152.00	152.75	152.75	136.84	133.79	0.75	14.94	15.16	18.21	2018 Dec	I	P2	leachate mound monitoring well
GW-91-1-1	Active	5376604.9	465473.7	164.61	165.33	165.33	149.01	145.97	0.72	18.64	15.60	18.64	2019 Nov	I	HNP	Installed in 2019
GW-92-1-1	Active	5376535.4	465501.9	167.68	168.57	168.57	147.76	144.72	0.88	22.96	19.92	22.96	2019 Nov	I	HNP	Installed in 2019
GW-93-1-1	Active	5376556.5	465260.0	183.42	184.24	184.24	159.34	156.29	0.83	28.04	24.08	27.13	2019 Nov	D	HNP	Installed in 2019
GW-94-1-1	Active	5376508.8	465129.5	203.65	204.32	204.32	163.87	160.83	0.67	42.82	39.78	42.82	2019 Dec	D	HNP	Installed in 2019
VLGW-02-D	Active	5375782.7	465984.2	168.58	168.93	168.79	155.58	151.58	0.21	22.00	13.00	17.00	2008 May	I	P1	Landfill gas well
VLGW-03-D	Active	5375776.6	465933.6	170.04	170.30	170.30	156.29	153.29	0.26	17.00	13.75	16.75	2014 Feb	I	P1	Landfill gas well
VLGW-04-D	Active	5375858.1	466056.5	169.24	169.95	169.90	156.24	152.24	0.65	19.00	13.00	17.00	2008 May	I	P1	Landfill gas well
VLGW-08-D	Active	5376088.1	466113.6	164.42	165.28	165.14	147.41	137.38	0.72	28.04	17.01	27.04	2008 May	I	P1	Landfill gas well
VLGW-11-S	Active	5375996.8	466122.6	166.06	166.53	166.48	160.42	155.78	0.42	11.28	5.64	10.28	2008 May	I	P1	Landfill gas well
VLGW-15-D	Active	5375842.9	465997.0	170.61	171.13	171.07	156.41	148.21	0.46	23.31	14.2	22.4	2008 May	D	P1	Landfill gas well
VLGW-16-D	Active	5375901.0	466011.3	172.47	173.38	173.31	157.02	147.48	0.84	25.90	15.45	24.99	2008 May	I	P1	Landfill gas well
VLGW-17-D	Active	5375959.1	466025.5	171.40	171.81	171.77	157.20	144.28	0.37	28.04	14.2	27.12	2008 May	D	P1	Landfill gas well

Notes:

Datum Description

m BGL	*metres below ground level*
m AGL	*metres above ground level*
m ASL	*metres above mean sea level*

Monitor Class

S	*Shallow well <15 m deep*
I	*Intermediate well between 15 and 30 m deep*
D	*Deep well >30 m deep*

Area of Landfill

SP1	*South of Phase 1 Landfill*
EP1	*East of Phase 1 Landfill*
NP1	*North of Phase 1 Landfill*
NP2	*North of Phase 2 Landfill*
BKGND - WP2	*Background Water Quality West of Phase 2*
HNP	*Hartland North Pad*
P1	*Phase 1*
P2	*Phase 2*

Appendix A-1. Monitoring Well Co-ordinates 2020-2021

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground Surface	Depth to Top of Screen Below Ground Surface	Depth to Bottom of Screen Below Ground Surface		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGS	m BGS	m BGS				
VLGW-18-D	Active	5376017.5	466039.7	170.14	170.78	170.61	152.94	141.80	0.47	29.25	17.2	28.34	2008 May	D	P1	Landfill gas well
VLGW-19-D	Active	5376076.2	466054.1	168.80	169.53	169.21	151.60	141.37	0.42	28.34	17.2	27.43	2008 May	I	P1	Landfill gas well
VLGW-20-D	Active	5376131.2	466062.8	167.88	169.05	168.93	148.03	140.76	1.05	28.04	19.85	27.12	2008 May	I	P1	Landfill gas well
VLGW-21-D	Active	5376177.2	466082.0	164.81	165.40	165.30	147.89	140.43	0.49	25.93	16.92	24.38	2008 May	I	P1	Landfill gas well
VLGW-26-D	Active	5376165.6	466022.9	163.94	164.57	164.45	145.50	136.82	0.51	28.04	18.44	27.12	2008 May	D	P1	Landfill gas well
P1	Active	5375732.0	466026.0	157.60	158.17	158.17	151.50	145.41	0.57	12.50	6.10	12.19	2018 Dec	S	P1	Purge well, to replace the old well installed in 2005
P2	Active	5375733.3	466030.9	157.37	158.72	158.62	146.87	132.37	1.25	25.00	10.5	25	2005 Mar	I	P1	Purge well
P3	Active	5375739.0	466056.7	157.25	158.51	158.41	143.18	132.25	1.16	25.00	14.07	25	2005 Mar	I	P1	Purge well
P4	Active	5375751.7	466064.7	157.73	158.88	158.78	146.21	132.73	1.05	25.00	11.52	25	2005 Mar	I	P1	Purge well
P10	Active	5375731.5	466023.5	157.89	N/A	158.01	144.79	129.89	0.12	28.00	13.1	28	2010 October	I	P1	Purge well
VLGW-01-D	Inactive	5375802.0	466040.8	168.25	168.86	168.79	163.25	156.25	0.54	14.00	5.00	12.00	2008 May	I	P1	Landfill gas well
GW-01-1-1	Inactive	5375781.9	465852.0			168.56	-42.00	-44.50	168.56	55.54	42	44.5				
GW-01-1-2	Inactive	5375781.9	465852.0			168.53	-24.40	-24.80	168.53	40.10	24.4	24.8				
GW-01-1-3	Inactive	5375781.9	465852.0			168.53	-13.00	-14.75	168.53	29.53	13	14.75				
GW-01-2-1	Inactive	5375787.9	465859.0			168.25	-4.70	-5.10	168.25	20.50	4.7	5.1				
GW-01-3-1	Inactive	5375791.9	465851.0			167.81	-5.11	-5.91	167.81	21.02	5.11	5.91				
GW-02-1-1	Inactive	5375813.9	465996.0			166.90	-33.00	-33.50	166.90	48.58	33	33.5				
GW-02-1-2	Inactive	5375813.9	465996.0			166.90	-23.00	-24.60	166.90	39.29	23	24.6				
GW-02-1-3	Inactive	5375813.9	465996.0			166.90	-12.20	-13.80	166.90	28.79	12.2	13.8				
GW-02-2-1	Inactive	5375812.9	465990.0			167.14	-6.25	-7.50	167.14	22.53	6.25	7.5				
GW-03-1-1	Inactive	5375684.9	466042.0	147.41	148.21	148.05	122.91	122.21	0.64	26.03	24.5	25.2				
GW-03-1-2	Inactive	5375684.9	466042.0	147.41	148.21	148.05	134.11	133.61	0.64	16.33	13.3	13.8				
GW-03-1-3	Inactive	5375684.9	466042.0	147.41	148.21	148.05	143.41	141.61	0.64	7.03	4	5.8				
GW-03-2-1	Inactive	5375685.5	466037.7	149.20	150.01	149.28	145.15	142.10	0.08	7.10	4.05	7.1	2005 Mar	S	SP1	
GW-04-1-1	Inactive	5375464.0	466171.0	126.67	128.12	128.07	96.47	95.77	1.40	32.00	30.2	30.9				
GW-04-1-2	Inactive	5375464.0	466171.0	126.67	128.12	128.07	104.27	103.67	1.40	24.10	22.4	23				
GW-04-1-3	Inactive	5375464.0	466171.0	126.67	128.12	128.07	116.67	115.07	1.40	11.60	10	11.6				
GW-04-1-4	Inactive	5375464.0	466171.0	126.67	128.12	128.07	122.97	121.27	1.40	6.10	3.7	5.4				
GW-04-2-1	Inactive	5375468.5	466169.3	127.14	127.95	127.86	107.49	104.44	0.75	22.70	19.65	22.70	2005 Mar	I	SP1	Deactivated in 2016.
GW-05-1-1	Inactive	5376444.9	465813.9	126.29	127.49	127.49	112.59	110.59	1.20	16.90	13.7	15.7				
GW-05-1-2	Inactive	5376444.9	465813.9	126.29	127.49	127.49	118.69	116.69	1.20	10.80	7.6	9.6				

Notes:

Datum Description

m BGL	*metres below ground level*
m AGL	*metres above ground level*
m ASL	*metres above mean sea level*

Monitor Class

S	*Shallow well <15 m deep*
I	*Intermediate well between 15 and 30 m deep*
D	*Deep well >30 m deep*

Area of Landfill

SP1	*South of Phase 1 Landfill*
EP1	*East of Phase 1 Landfill*
NP1	*North of Phase 1 Landfill*
NP2	*North of Phase 2 Landfill*
BKGND - WP2	*Background Water Quality West of Phase 2*
HNP	*Hartland North Pad*
P1	*Phase 1*
P2	*Phase 2*

Appendix A-1. Monitoring Well Co-ordinates 2020-2021

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground Surface	Depth to Top of Screen Below Ground Surface	Depth to Bottom of Screen Below Ground Surface		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGS	m BGS	m BGS				
GW-05-1-3	Inactive	5376444.9	465813.9	126.29	127.49	127.49	122.89	121.89	1.20	5.60	3.4	4.4				
GW-05-2-1	Inactive	5376426.9	465774.9	126.00	126.80	126.80	125.20	124.20	0.80	2.60	0.8	1.8				
GW-06-1-1	Inactive	5376148.9	465661.9	127.70	128.41	128.40	107.00	104.90	0.70	23.50	20.7	22.8				
GW-06-1-2	Inactive	5376148.9	465661.9	127.70	128.41	128.40	115.20	113.20	0.70	15.20	12.5	14.5				
GW-06-1-3	Inactive	5376148.9	465661.9	127.70	128.41	128.40	120.80	118.80	0.70	9.60	6.9	8.9				
GW-06-2-1	Inactive	5376151.9	465669.9	127.46	127.76	127.76	125.86	124.86	0.30	2.90	1.6	2.6				
GW-08-1-1	Inactive	5375867.9	465738.0	159.26	160.28	160.26	145.86	143.76	1.00	16.50	13.4	15.5				
GW-08-1-2	Inactive	5375867.9	465738.0	159.26	160.28	160.26	152.11	150.11	1.00	10.15	7.15	9.15				
GW-08-1-3	Inactive	5375867.9	465738.0	159.26	160.28	160.26	156.76	155.76	1.00	4.50	2.5	3.5				
GW-10-1-1	Inactive	5376108.9	465701.9	135.11	135.41	135.41	133.61	132.61	0.30	2.80	1.5	2.5				
GW-11-1-1	Inactive	5376254.9	465770.9	134.13	135.13	135.13	131.23	130.23	1.00	4.90	2.9	3.9				
GW-12-1-0	Inactive	5375701.0	466189.0	143.02	143.82	143.82	N/A	N/A	0.80	3.40	No monitor	No monitor	Historic	S	SP1	Dug well, deactivated in 2010
GW-13-1-1	Inactive	5376166.9	466031.9	150.43	152.73	152.73	121.93	118.93	2.30	33.80	28.5	31.5				
GW-13-1-2	Inactive	5376166.9	466031.9	150.43	152.73	152.73	126.83	125.33	2.30	27.40	23.6	25.1				
GW-14-1-1	Inactive	5375968.9	465969.9	158.73	160.22	160.22	138.53	135.53	1.49	24.69	20.2	23.2				
GW-15-1-1	Inactive	5375754.9	466007.0	159.78	160.82	160.82	145.68	143.38	1.04	17.44	14.1	16.4				
GW-22-1-1	Inactive	5376290.1	465751.7	138.54	138.81	139.86	111.22	109.69	1.32	28.09	27.32	28.85				
GW-23-1-1	Inactive	5376260.7	465718.7	128.37	129.52	129.50	111.51	110.09	1.13	17.57	16.86	18.28				
GW-23-1-2	Inactive	5376260.7	465718.7	128.37	129.52	129.49	124.67	121.80	1.12	5.14	3.7	6.57				
GW-24-1-1	Inactive	5376421.9	465753.0	127.77	128.88	128.88	109.91	108.51	1.11	18.56	17.86	19.26				
GW-24-1-2	Inactive	5376421.9	465753.0	127.77	128.88	128.87	124.10	121.26	1.10	5.09	3.67	6.51				
GW-26-1-1	Inactive	5376319.8	465596.6	128.22	129.16	129.12	109.79	111.20	0.90	17.73	18.43	17.02				
GW-26-1-2	Inactive	5376319.8	465596.6	128.22	129.16	129.12	124.36	121.52	0.90	5.28	3.86	6.7				
GW-32-1-1	Inactive	5376129.7	465569.9	165.41	166.44	166.34	123.85	122.44	0.93	42.27	41.56	42.97				
GW-32-1-2	Inactive	5376129.7	465569.9	165.41	166.44	166.37	157.93	152.04	0.96	10.43	7.48	13.37				
GW-33-1-1	Inactive	5376296.5	465627.4	124.55	123.43	124.54	111.11	109.69	-0.01	14.15	13.44	14.86				
GW-33-1-2	Inactive	5376296.5	465627.4	124.55	123.43		N/A	N/A	-124.55		no monitor	no monitor				
GW-34-1-1	Inactive	5376216.8	465668.4	119.47			104.64	101.64	-119.47		14.83	17.83				
GW-34-2-1	Inactive	5376214.9	465668.9	119.67			115.97	112.97	-119.67		3.7	6.7				
GW-35-1-1	Inactive	5376207.9	465677.3	120.19			108.29	105.29	-120.19		11.9	14.9				
GW-35-1-2	Inactive	5376207.0	465675.9	120.33			117.13	114.13	-120.33		3.2	6.2				

Notes:

Datum Description

m BGL	*metres below ground level*
m AGL	*metres above ground level*
m ASL	*metres above mean sea level*

Monitor Class

S	*Shallow well <15 m deep*
I	*Intermediate well between 15 and 30 m deep*
D	*Deep well >30 m deep*

Area of Landfill

SP1	*South of Phase 1 Landfill*
EP1	*East of Phase 1 Landfill*
NP1	*North of Phase 1 Landfill*
NP2	*North of Phase 2 Landfill*
BKGND - WP2	*Background Water Quality West of Phase 2*
HNP	*Hartland North Pad*
P1	*Phase 1*
P2	*Phase 2*

Appendix A-1. Monitoring Well Co-ordinates 2020-2021

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground Surface	Depth to Top of Screen Below Ground Surface	Depth to Bottom of Screen Below Ground Surface		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGS	m BGS	m BGS				
GW-45-1-1	Inactive	5376163.1	466106.3	162.37			143.71	140.71	-162.37		18.66	21.66				
GW-46-1-1	Inactive	5376078.3	466029.2	170.48	171.65	171.96	140.68	134.68	1.48		29.8	35.8				
GW-47-1-1	Inactive	5375918.3	465992.6	174.85	177.24	177.37	155.09	152.09	2.52	22.55	19.76	22.758	2008 May	I	P1	
GW-49-1-0	Inactive	5376759.5	465218.7	160.00	159.81	159.81	N/A	N/A	-0.19	62.20						
GW-50-1-1	Inactive	5376480.9	466193.4	119.37	120.41	120.43	105.47	102.47	1.06	16.90	13.9	16.9	2005 Mar	I	EP1	
GW-59-1-1	Inactive	5376254.5	465636.2	125.62	126.40	126.40	113.72	112.22	0.78	13.40	11.9	13.4				
GW-64-1-1	Inactive	5375855.0	465849.0	172.00		172.78	156.20	154.50	0.78	17.50	15.8	17.5				
GW-65-1-1	Inactive	5375831.0	465820.0	172.09		172.79	159.79	153.69	0.70	18.40	12.3	18.4				
GW-66-1-1	Inactive	5376088.0	465902.0	164.23		165.08	157.03	150.93	0.85	13.30	7.2	13.3				
GW-67-1-1	Inactive	5376256.2	465774.0	155.85	N/A	157.55	133.95	127.85	1.70	28.00	21.90	28.00	2005 Mar	I	P2	Destroyed. Replaced by GW-82-1-1
GW-67-2-1	Inactive	5376256.2	465774.0	155.85		157.55	133.95	127.85	1.70	28.00	21.9	28	2005 Mar	I	P2	
GW-68-1-1	Inactive	5376353.0	465718.0	141.56		142.74	130.36	124.26	1.18	17.30	11.2	17.3				
GW-68-2-1	Inactive	5376353.0	465718.0	141.56	N/A	142.29	123.76	120.76	0.73	20.80	17.80	20.80	Historic	I	P2	Destroyed. Replaced by GW-83-1-1
GW-69-1-1	Inactive	5376267.6	465665.8	140.64		142.50	127.64	121.54	1.86	19.10	13	19.1	2005 Mar	I	P2	
GW-69-2-1	Inactive	5376269.9	465667.0	140.67		142.11	121.67	115.67	1.44	25.20	19	25	2005 Mar	I	P2	
GW-70-1-1	Inactive	5376019.0	465891.0	167.00		167.59	149.50	143.40	0.59	23.60	17.5	23.6				
GW-74-1-1	Inactive	5376013.4	466018.4	170.94	171.56	171.60	138.04	132.04	0.66	38.90	32.90	38.90	2007 Apr	D	P1	
GW-74-2-1	Inactive	5 376 021.6	466 032.5	170.29	172.25	172.40	153.19	150.19	2.11	20.10	17.10	20.10	2006 Apr	I	P1	Installed during 2005
GW-79-1-1	Inactive	5376522.5	465404.3	182.87	183.63	183.59	147.82	144.77	0.72	39.62	35.05	38.10	2007 Apr	D	NP2	Installed during 2007, decommissioned in May 2018
GW-79-2-1	Inactive	5376521.9	465403.1	182.96	183.69	183.59	157.05	154.00	0.64	30.48	25.91	28.96	2007 Apr	I	NP2	Installed during 2007, decommissioned in May 2018
GW-84-1-1	Inactive	5376225.9	465646.9	158.20	158.86	158.79	120.63	117.58	0.59	27.74	37.565889	40.615889	2009 Feb	I	P2	Installed during 2007
GW-84-2-1	Inactive	5376224.8	465648.5	158.43	159.06	161.36	133.14	130.09	2.93	15.24	25.289839	28.339839	2009 Feb	S	P2	Installed during 2007
GW-86-1-1	Inactive	5376228.4	465651.4	160.55	N/A	N/A	N/A	N/A	N/A	42.98	N/A	N/A	2010 October	D	P2	SG piezo - 42.42 mBGS
GW-86-1-2	Inactive	5376228.4	465651.4	160.55	N/A	N/A	N/A	N/A	N/A	42.98	N/A	N/A	2010 October	I	P2	SG piezo - 20.85 mBGS
GW-86-2-1	Inactive	5376224.8	465651.8	160.55	N/A	N/A	N/A	N/A	N/A	30.78	N/A	N/A	2010 October	D	P2	SG piezo - 29.69 mBGS
GW-86-2-2	Inactive	5376224.8	465651.8	160.55	N/A	N/A	N/A	N/A	N/A	30.78	N/A	N/A	2010 October	I	P2	SG piezo - 8.67 mBGS
P5	Inactive	5375775.2	466079.9	158.35	159.46	159.36	144.43	133.35	1.01	25.00	13.92	25	2005 Mar	I	P1	Purge well
P6	Inactive	5375803.6	466098.0	159.88	161.65	161.55	147.74	134.88	1.67	25.00	12.14	25	2005 Mar	I	P1	Purge well

Notes:

Datum Description

m BGL	*metres below ground level*
m AGL	*metres above ground level*
m ASL	*metres above mean sea level*

Monitor Class

S	*Shallow well <15 m deep*
I	*Intermediate well between 15 and 30 m deep*
D	*Deep well >30 m deep*

Area of Landfill

SP1	*South of Phase 1 Landfill*
EP1	*East of Phase 1 Landfill*
NP1	*North of Phase 1 Landfill*
NP2	*North of Phase 2 Landfill*
BKGND - WP2	*Background Water Quality West of Phase 2*
HNP	*Hartland North Pad*
P1	*Phase 1*
P2	*Phase 2*

A2. Groundwater Monitoring Plan

Appendix A-2 - Groundwater Monitoring Plan 2020-2021

Station Name	Status	Pipe Diameter (mm)	Sampled in 2019/2020				Development Method	Sampling Method	Comments
			Chemistry		Water levels				
			Quarterly (4/yr)	Bi-annual (2/yr)	4/yr	Continuous			
GW-04-2-1	Active	50			Y		NA	NA	Dedicated submersible pump installed January 2012. Well recharges very slowly since 2014, so it is no longer sampled.
GW-04-3-1	Active	50	Y		Y		footvalve	footvalve	Submersile pump removed. Sampled using waterra in from May 2019 onwards.
GW-04-4-1	Active	50	Y		Y		footvalve	footvalve	
GW-07-1-0	Active	220	Y		Y		well pump	well pump	
GW-09-1-0	Active	150			Y		NA	NA	Sampling discontinued in 2010 due to outdated pump and redundancy. Water levels only.
GW-16-1-1	Active	50		Y	Y		footvalve	footvalve	
GW-16-1-2	Active	50		Y	Y		footvalve	footvalve	
GW-16-2-1	Active	50		Y	Y		footvalve	footvalve	
GW-16-2-2	Active	50		Y	Y		footvalve	footvalve	16-2-2 often dry; difficult to develop and sample. Sometimes use bailer.
GW-17-1-1	Active	50		Y	Y	Y	footvalve	footvalve	Pressure transducer installed in March 2019.
GW-17-1-2	Active	50		Y	Y		footvalve	footvalve	
GW-17-1-3	Active	50		Y	Y		footvalve	footvalve	
GW-18-1-1	Active	50	Y		Y	Y	sample pump	sample pump / footvalve	Dedicated submersible pump installed May 2009. Pump failed in September and November 2018. Waterra tubing from Feb/Mar 2019 onwards. Pressure transducer installed in March 2019.
GW-18-1-2	Active	50			Y		sample pump	sample pump	Pump damaged and stuck in well since 2004. Not sampled, only water levels.
GW-18-2-1	Active	50	Y		Y		footvalve	footvalve	
GW-18-2-2	Active	50	Y		Y		footvalve	footvalve	
GW-19-1-1	Active	50	Y		Y		footvalve	footvalve	19-1-1 sometimes flows artesian.
GW-19-1-2	Active	50	Y		Y		footvalve	footvalve	19-1-2 sometimes flows artesian.
GW-19-2-1	Active	50	Y		Y		footvalve	footvalve	19-2-1 sometimes flows artesian.
GW-19-2-2	Active	50	Y		Y		footvalve	footvalve	
GW-20-1-1	Active	50	Y		Y		sample pump	footvalve	Dedicated submersible pump installed January 2012. Pump ceased functioning in Nov 2019, was removed for repair and is currently sampled using waterra.
GW-20-1-2	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012.
GW-21-1-1	Active	50	Y		Y		sample pump	footvalve	Dedicated submersible pump installed January 2012. Pump replaced with waterra.
GW-21-1-2	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012.
GW-21-2-1	Active	50	Y		Y		footvalve	footvalve	
GW-25-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-25-1-2	Active	50	Y		Y		footvalve	footvalve	
GW-27-1-1	Active	50	Y		Y		not developed	footvalve	Artesian
GW-27-1-2	Active	50	Y		Y		footvalve	footvalve	27-1-2 almost dry in summer, bailer used occasionally.
GW-28-1-0	Active	150	Y		Y		sample pump	sample pump	Open borehole. Dedicated submersible pump installed January 2011.
GW-29-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-29-1-2	Active	50	Y		Y		footvalve	footvalve	
GW-30-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-30-1-2	Active	50	Y		Y		footvalve	footvalve	30-1-2 almost dry in summer, bailer used occasionally.
GW-31-1-1	Active	50		Y	Y		footvalve	footvalve	
GW-31-1-2	Active	50		Y	Y		footvalve	footvalve	
GW-36-1-1	Active	50				Y	NA	NA	Pressure transducer installed June 1997 records water levels continuously.
GW-36-2-1	Active	50			Y		footvalve	footvalve	
GW-36-3-1	Active	50	Y		Y		footvalve	footvalve	
GW-37-1-1	Active	50				Y	NA	NA	Pressure transducer installed June 1997 records water levels continuously.
GW-37-2-1	Active	50			Y		footvalve	footvalve	
GW-37-3-1	Active	50	Y		Y		footvalve	footvalve	
GW-38-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-39-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-39-2-1	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2011.
GW-40-1-1	Active	50	Y		Y	Y	footvalve	footvalve	Pressure transducer installed in September 2008 records water levels continuously. Can be removed as required for sampling.
GW-41-1-1	Active	50	Y		Y	Y	footvalve	footvalve	Pressure transducer installed in May 2018.
GW-42-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-43-1-1	Active	50	Y		Y	Y	footvalve	footvalve	Pressure transducer installed in May 2018.
GW-44-1-1	Active	50	Y		Y	Y	footvalve	footvalve	Pressure transducer installed in May 2018.
GW-46-2-1	Active	50			Y		NA	NA	
GW-46-3-1	Active	50			Y		NA	NA	
GW-46-4-1	Active	50			Y		NA	NA	
GW-47-2-1	Active	50			Y		NA	NA	
GW-48-2-1	Active	50			Y		NA	NA	
GW-50-1-1	Active	50			Y		footvalve	NA	Deactivated in from sampling program September 2012 due to poor recharge. Now only monitored for water level.
GW-51-1-1	Active	50		Y	Y		footvalve	footvalve	
GW-51-2-1	Active	50		Y	Y		footvalve	footvalve	
GW-51-3-1	Active	50		Y	Y		footvalve	footvalve	
GW-52-1-1	Active	50	Y		Y	Y	footvalve	footvalve	Pressure transducer installed in 2018
GW-52-2-0	Active	150			Y		NA	NA	
GW-52-3-0 (P52)	Active	150				Y	NA	NA	Pressure transducer records water levels continuously.
GW-52-4-0 (P7)	Active	250	Y			Y	NA	spigot	Pressure transducer installed. Purge well in conjunction with 80-1-0-P8. Pressure transducer records water levels continuously. Sampling spigot installed in 2016.
GW-53-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-54-1-1	Active	50			Y	Y	sample pump	sample pump	Dedicated submersible pump installed January 2012. Sampling discontinued in 2016. Water levels only. Pressure transducer installed in March 2019.
GW-54-2-1	Active	50			Y		footvalve	footvalve	Water levels only.
GW-54-3-1	Active	50			Y		footvalve	footvalve	Water levels only.
GW-55-1-1	Active	50		Y	Y		footvalve	footvalve	
GW-56-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-57-1-1	Active	50		Y	Y		footvalve	footvalve	
GW-58-1-0	Active	150	Y		Y		sample pump	sample pump	Dedicated submersible pump reinstalled after Phase 2 Cell one closure in October 2012. This well is an 8" diameter borehole.
GW-60-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-60-2-1	Active	50	Y		Y		footvalve	footvalve	
GW-60-3-1	Active	50	Y		Y		footvalve	footvalve	
GW-61-1-1	Active	150			Y		NA	NA	Borehole
GW-62-1-1	Active	50		Y	Y	Y	sample pump	sample pump	Portable pressure transducer installed January 2012 - records water levels every three hours. Dedicated submersible pump installed January 2012.
GW-62-2-1	Active	50		Y	Y		footvalve	footvalve	
GW-63-1-1	Active	50		Y	Y		sample pump	sample pump	Dedicated submersible pump installed January 2011.
GW-63-2-1	Active	50		Y	Y		footvalve	footvalve	
GW-71-1-1	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012 has malfunctioned.
GW-71-2-1	Active	50	Y		Y		sample pump	footvalve	Dedicated submersible pump installed January 2012.
GW-71-3-1	Active	50	Y		Y		footvalve	footvalve	
GW-72-1-1	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012.
GW-72-2-1	Active	50			Y		footvalve	footvalve	Well has been recharging very slowly since 2014, so it is no longer sampled. Water levels only.
GW-72-3-1	Active	50	Y		Y		footvalve	footvalve	

Notes:

Footvalves are 16 mm (5/8") unless otherwise noted.

NA - Not Available or Not Applicable.

Appendix A-2 - Groundwater Monitoring Plan 2020-2021

Station Name	Status	Pipe Diameter (mm)	Sampled in 2019/2020				Development Method	Sampling Method	Comments
			Chemistry		Water levels				
			Quarterly (4/yr)	Bi-annual (2/yr)	4/yr	Continuous			
GW-73-1-1	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012.
GW-73-2-1	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012.
GW-73-3-1	Active	50	Y		Y		footvalve	footvalve	
GW-74-2-1	Active	50			Y		NA	NA	
GW-75-1-1	Active	50			Y		NA	NA	
GW-76-1-1	Active	50			Y	Y	sample pump	sample pump	Dedicated submersible pump installed January 2010. Sampling discontinued in 2016. Water levels only. Pressure transducer installed in March 2019.
GW-76-2-1	Active	50			Y		sample pump	sample pump	Sampling discontinued in 2016. Water levels only. Dedicated submersible pump installed January 2012.
GW-76-3-1	Active	50			Y		footvalve	footvalve	Sampling discontinued in 2016. Water levels only.
GW-77-1-1	Active	50		Y	Y	Y	footvalve	footvalve	Portable pressure transducer installed January 2012 - records water levels every three hours. Dedicated submersible pump installed. Pump failed in 2020, replaced
GW-77-2-1	Active	50		Y	Y		footvalve	footvalve	
GW-78-1-1	Active	50		Y	Y	Y	footvalve	footvalve	Portable pressure transducer installed January 2012 - records water levels every three hours.
GW-78-2-1	Active	50		Y	Y		footvalve	footvalve	
GW-80-1-0 (P8)	Active	NA	Y		Y	Y	sample pump	spigot	Pressure transducer installed. Purge well in conjunction with 52-4-0-P7. Pressure transducer records water levels continuously. Sampling spigot installed in 2016.
GW-81-1-0 (P9)	Active	NA	Y		Y	Y	NA	bailer	Borehole. Pressure transducer installed in 2018.
GW-82-1-1	Active	50			Y		NA	NA	
GW-83-1-1	Active	50			Y		NA	NA	
GW-85-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-87-1-1	Active	50		Y	Y	Y	footvalve	sample pump	Well drilled in December 2014. Dedicated submersible pump (GeoTech) installed in February 2015. Pressure transducer installed March 2016.
GW-87-2-1	Active	50		Y	Y	Y	footvalve	waterra	Well drilled in December 2014. Pressure transducer installed in March 2016.
GW-88-1-1	Active	50		Y	Y	Y	footvalve	waterra	Well drilled in December 2014. Dedicated submersible pump (GeoTech) installed in February 2015 but replaced with waterra tubing after malfunctioning in 2016. Pressure transducer installed March 2016.
GW-88-2-1	Active	50		Y	Y	Y	footvalve	waterra	Well drilled in December 2014. Pressure transducer installed in March 2016.
GW-89-1-1	Active	50			Y	Y	NA	NA	Well drilled in Dec 2018. Pressure transducer installed in March 2019
GW-89-2-1	Active	50			Y	Y	NA	NA	Well drilled in Dec 2018. Pressure transducer installed in March 2019
GW-90-1-1	Active	50			Y		NA	NA	Well drilled in Oct 2019. No water levels taken in well due to high landfill gas concentrations in area. Dry condition in 2020
GW-90-2-1	Active	50			Y		NA	NA	Well drilled in Dec 2018. No water levels taken in well since Oct 2019 due to high landfill gas concentrations in area. Dry condition in 2020
GW-91-1-1	Active	50	Y		Y	Y	Waterra	Waterra	Well drilled in Dec 2019. Pressure transducer installed in March 2020
GW-92-1-1	Active	50	Y		Y	Y	Waterra	Waterra	Well drilled in Dec 2019. Pressure transducer installed in March 2020
GW-93-1-1	Active	50	Y		Y	Y	Waterra	Waterra	Well drilled in Dec 2019. Pressure transducer installed in March 2020
GW-94-1-1	Active	50	Y		Y	Y	Waterra	Waterra	Well drilled in Dec 2019. Pressure transducer installed in March 2020
P1	Active	NA	Y			Y	NA	spigot	Pressure transducer installed. QED bladder pumps installed and pressure transducer records water levels continuously. Second bladder pump installed April 2013. Electric submersible pump installed 14-May-2015.
P10	Active	NA	Y			Y	NA	spigot	Pressure transducer installed. QED bladder pumps installed and pressure transducer records water levels continuously.
P2	Active	NA	Y			Y	NA	spigot	Pressure transducer installed. QED bladder pumps installed and pressure transducer records water levels continuously.
P3	Active	NA	Y			Y	NA	spigot	Pressure transducer installed. QED bladder pumps installed and pressure transducer records water levels continuously.
P4	Active	NA	Y			Y	NA	spigot	Pressure transducer installed. QED bladder pumps installed and pressure transducer records water levels continuously.
VLGW002D	Active	NA			Y		NA	NA	
VLGW003D	Active	NA			Y		NA	NA	
VLGW004D	Active	NA			Y		NA	NA	
VLGW008D	Active	NA			Y		NA	NA	
VLGW011S	Active	NA			Y		NA	NA	
VLGW015D	Active	NA			Y		NA	NA	
VLGW016D	Active	NA			Y		NA	NA	
VLGW017D	Active	NA			Y		NA	NA	
VLGW018D	Active	NA			Y		NA	NA	
VLGW019D	Active	NA			Y		NA	NA	
VLGW020D	Active	NA			Y		NA	NA	
VLGW021D	Active	NA			Y		NA	NA	
VLGW026D	Active	NA			Y		NA	NA	
VLGW001D	Inactive	NA					NA	NA	Well is obstructed. No water level measurements were taken in 2018-2019
GW-01-1-1	Inactive	20							Site destroyed.
GW-01-1-2	Inactive	20							
GW-01-1-3	Inactive	20							
GW-01-2-1	Inactive	20							
GW-01-3-1	Inactive	20							
GW-02-1-1	Inactive	20							Site destroyed
GW-02-1-2	Inactive	20							
GW-02-1-3	Inactive	20							
GW-02-2-1	Inactive	20							
GW-03-1-1	Inactive	20							Deactivated at end of 1998, replaced by well 60-1-1.
GW-03-1-2	Inactive	20							Deactivated at end of 1998, replaced by well 60-2-1.
GW-03-1-3	Inactive	20							Deactivated at end of 1998, replaced by well 60-3-1.
GW-03-2-1	Inactive	50							Destroyed and replaced with 85-1-1 in March 2009.
GW-04-1-1	Inactive	20							Deactivated at end of 1998, replaced by new 04-2-1.
GW-04-1-2	Inactive	20							Deactivated at end of 1998, replaced by well 04-3-1.
GW-04-1-3	Inactive	20							Deactivated at end of 1998, replaced by well 04-4-1.
GW-04-1-4	Inactive	40							Deactivated during 1998, failed to recharge after purging.
GW-04-2-1	Inactive	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012. Sampling discontinued due to very slow recharge rate.
GW-05-1-1	Inactive	20							Site destroyed during construction of Phase 2 lagoon
GW-05-1-2	Inactive	20							
GW-05-1-3	Inactive	20							
GW-05-2-1	Inactive	20							
GW-06-1-1	Inactive	20							Site destroyed during dike construction in interim filling area.
GW-06-1-2	Inactive	20							
GW-06-1-3	Inactive	20							
GW-06-2-1	Inactive	20							
GW-08-1-1	Inactive	20							Site destroyed
GW-08-1-2	Inactive	20							
GW-08-1-3	Inactive	20							
GW-10-1-1	Inactive	20							Site destroyed
GW-11-1-1	Inactive	20							Site destroyed

Notes:

Footvalves are 16 mm (5/8") unless otherwise noted.

NA - Not Available or Not Applicable.

Appendix A-2 - Groundwater Monitoring Plan 2020-2021

Station Name	Status	Pipe Diameter (mm)	Sampled in 2019/2020				Development Method	Sampling Method	Comments
			Chemistry		Water levels				
			Quarterly (4/yr)	Bi-annual (2/yr)	4/yr	Continuous			
GW-12-1-0	Inactive	220							Deactivated in 2010.
GW-13-1-1	Inactive	50							Site destroyed
GW-13-1-2	Inactive	50							
GW-14-1-1	Inactive	50							Site destroyed
GW-15-1-1	Inactive	50							Site destroyed
GW-22-1-1	Inactive	50							Destroyed during expansion of interim composting area.
GW-23-1-1	Inactive	50							Site destroyed in November 1994
GW-23-1-2	Inactive	50							
GW-24-1-1	Inactive	50							Site destroyed during construction of Phase 2 lagoon
GW-24-1-2	Inactive	50							
GW-26-1-1	Inactive	50							Site destroyed in August 1994
GW-26-1-2	Inactive	50							
GW-32-1-1	Inactive	50							Site destroyed in October 1997
GW-32-1-2	Inactive	50							Site destroyed in October 1997
GW-33-1-1	Inactive	50							Deactivated in August 1992.
GW-33-1-2	Inactive	50							
GW-34-1-1	Inactive	50							Site destroyed in August 1994
GW-34-2-1	Inactive	50							
GW-35-1-1	Inactive	50							Site destroyed in August 1994
GW-35-1-2	Inactive	50							
GW-45-1-1	Inactive	50							Site destroyed.
GW-46-1-1	Inactive	50							Deactivated in June 1999.
GW-47-1-1	Inactive	50							Deactivated in December 2012.
GW-49-1-0	Inactive	50							Deactivated in June 2005.
GW-50-1-1	Inactive	50							Deactivated in September 2012 due to poor recharge.
GW-59-1-1	Inactive	50							Destroyed Feb 2005 by Phase 2 construction.
GW-64-1-1	Inactive	50							Destroyed by interim fill area construction in 2003.
GW-65-1-1	Inactive	50							Destroyed by interim fill area construction in 2003.
GW-66-1-1	Inactive	50							Destroyed by interim fill area construction in 2003.
GW-67-1-1	Inactive	50							Destroyed. Replaced by GW-82-1-1
GW-67-2-1	Inactive	50							Destroyed. Replaced by GW-82-1-1
GW-68-1-1	Inactive	50							Destroyed. Replaced by GW-83-1-1
GW-68-2-1	Inactive	50							Destroyed. Replaced by GW-83-1-1
GW-69-1-1	Inactive	50							Destroyed July 2006 during construction on active face
GW-69-2-1	Inactive	50							Destroyed July 2006 during construction on active face
GW-70-1-1	Inactive	50							Destroyed by interim fill area construction in 2003.
GW-74-1-1	Inactive	50			Y		NA	NA	Decommissioned
GW-84-1-1	Inactive	50							Destroyed spring 2009. Recorded continuous water levels until April 2012. No longer functioning. Cannot be repaired because it's buried in garbage.
GW-84-2-1	Inactive	50							Destroyed spring 2009. Recorded continuous water levels until April 2012. No longer functioning. Cannot be repaired because it's buried in garbage.
T-86-1-1	Inactive	NA							
T-86-1-2	Inactive	NA			Y	Y	NA	NA	Pressure transducer installed October 2010. Well replaces GW-84-1-1 & GW-84-2-1. Pressure transducer records water levels continuously. No longer functioning.
T-86-2-1	Inactive	NA			Y	Y	NA	NA	Pressure transducer installed October 2010. Well replaces GW-84-1-1 & GW-84-2-1. Pressure transducer records water levels continuously. No longer functioning.
T-86-2-2	Inactive	NA			Y	Y	NA	NA	Pressure transducer installed October 2010. Well replaces GW-84-1-1 & GW-84-2-1. Pressure transducer records water levels continuously. No longer functioning.

Notes:

Footvalves are 16 mm (5/8") unless otherwise noted.

NA - Not Available or Not Applicable.

A3. Groundwater Elevations

Appendix A-3 - Groundwater Elevations 2020-2021

Station	Groundwater Elevations (mASL)			
	Q2	Q3	Q4	Q1
	April 29 to May 1, 2020	August 26 to August 29, 2020	October 28 to October 30, 2020	January 28 to January 29, 2021
04-2-1	126.82	125.52	126.64	127.21
04-3-1	124.23	123.14	124.60	124.57
04-4-1	125.11	124.06	125.42	125.41
07-1-0	141.36	140.86	141.57	141.69
09-1-0	146.10	143.84	146.48	146.54
16-1-1	129.02	126.32	132.54	132.75
16-1-2	130.01	126.71	132.94	133.10
16-2-1	130.52	128.07	133.41	133.68
16-2-2	130.45	128.04	133.42	133.62
17-1-1	143.96	142.68	143.79	145.96
17-1-2	143.96	142.68	143.84	145.96
17-1-3	145.04	143.21	145.93	146.76
18-1-1	150.48	149.47	150.97	151.97
18-1-2	150.33	---	---	151.81
18-2-1	160.14	158.67	162.24	162.37
18-2-2	160.16	158.91	162.23	162.38
19-1-1	133.54	131.25	133.54	133.54
19-1-2	133.66	132.08	133.66	133.66
19-2-1	133.19	131.96	133.19	133.19
19-2-2	133.08	130.25	132.73	132.81
20-1-1	109.88	109.09	109.85	109.90
20-1-2	109.62	109.00	109.69	109.81
21-1-1	110.30	109.53	110.52	110.46
21-1-2	109.74	109.15	109.95	110.05
21-2-1	109.78	109.15	109.97	110.06
25-1-1	125.18	124.42	125.43	125.96
25-1-2	126.53	126.35	126.59	126.87
27-1-1	142.04	142.04	142.04	142.04
27-1-2	139.39	---	---	139.86
28-1-0	119.05	118.90	119.38	119.72
29-1-1	112.00	111.72	112.21	112.27
29-1-2	112.12	111.85	112.30	112.33
30-1-1	105.45	104.73	106.09	106.47
30-1-2	106.16	105.91	107.40	107.54
31-1-1	104.25	103.47	104.62	104.86
31-1-2	104.09	103.45	104.62	104.63
36-1-1	124.17	121.59	125.17	125.00
36-2-1	122.27	121.46	123.25	124.07
36-3-1	122.69	121.20	124.14	124.23
37-1-1	124.53	123.85	125.81	126.63
37-2-1	121.78	121.00	123.52	124.08
37-3-1	123.87	123.45	124.89	125.81
38-1-1	119.62	119.47	119.93	120.42
39-1-1	119.97	119.36	120.69	121.32
39-2-1	119.60	119.46	119.93	120.28
40-1-1	117.18	117.04	118.18	117.63
41-1-1	147.33	147.20	147.44	147.48
42-1-1	137.56	137.36	137.70	137.74
43-1-1	157.71	157.28	158.29	158.37
44-1-1	159.99	159.42	160.22	160.36
46-2-1	156.68	155.85	156.28	156.67
46-3-1	150.36	154.73	156.05	154.13
46-4-1	149.24	147.58	149.24	149.27
47-2-1	152.48	152.16	152.51	152.07
48-1-1	---	---	---	---
48-2-1	149.29	149.23	149.16	149.28
50-1-1	115.70	---	114.05	118.56
51-1-1	109.71	108.79	110.14	110.15
51-2-1	109.93	108.82	110.39	110.43
51-3-1	109.96	108.84	110.43	110.49

Notes:

Bracketed data on bottom of well.

--- - Not measured

Appendix A-3 - Groundwater Elevations 2020-2021

Station	Groundwater Elevations (mASL)			
	Q2	Q3	Q4	Q1
	April 29 to May 1, 2020	August 26 to August 29, 2020	October 28 to October 30, 2020	January 28 to January 29, 2021
52-1-1	117.46	117.18	117.23	117.69
52-2-0	117.55	117.37	117.55	118.03
52-3-0 (P52)	114.32	112.08	115.32	115.84
52-4-0 (P7)	111.0 to 113.0	111.0 to 113.0	111.0 to 113.0	111.0 to 113.0
53-1-1	120.54	120.39	121.11	121.42
54-1-1	149.50	147.34	149.63	150.32
54-2-1	149.12	147.00	149.18	149.98
54-3-1	149.11	147.33	149.32	149.96
55-1-1	142.13	140.59	141.80	143.22
56-1-1	143.65	142.93	144.60	145.25
57-1-1	128.82	125.87	129.57	129.83
58-1-0	127.37	125.85	128.38	128.74
60-1-1	141.48	140.98	141.66	141.76
60-2-1	141.53	141.02	141.72	141.80
60-3-1	141.10	140.54	141.37	141.33
61-1-1	183.87	183.13	184.83	185.16
62-1-1	171.80	169.38	172.42	173.46
62-2-1	171.79	169.38	172.42	173.44
63-1-1	190.66	188.83	191.80	192.24
63-2-1	191.53	190.50	193.75	193.76
71-1-1	141.43	140.62	141.55	141.91
71-2-1	141.54	140.79	141.75	142.07
71-3-1	141.57	140.81	141.78	142.09
72-1-1	141.34	140.83	141.78	141.67
72-2-1	141.61	141.13	141.57	141.90
72-3-1	141.50	141.02	141.75	141.89
73-1-1	133.08	131.38	134.19	134.05
73-2-1	133.10	131.41	133.53	134.10
73-3-1	132.67	130.87	132.79	133.04
74-2-1	152.48	152.44	152.25	152.33
75-1-1	129.20	---	128.19	130.13
76-1-1	157.24	155.73	156.97	159.30
76-2-1	160.34	158.77	160.97	162.19
76-3-1	162.49	160.98	163.22	164.35
77-1-1	155.05	154.15	155.66	155.66
77-2-1	153.98	152.86	154.45	154.47
78-1-1	131.04	129.33	132.18	133.01
78-2-1	134.84	134.15	134.98	136.01
80-1-0 (P8)	113.0 to 114.5	113.0 to 113.7	113.0 to 113.7	113.0 to 113.7
81-1-0 (P9)	116.33	115.97	116.43	116.52
82-1-1	132.82	132.85	132.85	132.86
83-1-1	126.82	126.67	126.97	127.15
85-1-1	145.28	145.05	145.49	145.49
87-1-1	174.89	167.71	170.26	183.19
87-2-1	175.03	167.70	170.28	182.15
88-1-1	171.40	168.75	171.35	173.05
88-2-1	171.60	168.66	171.29	173.91
89-1-1	147.60	152.35	151.15	---
89-2-1	152.17	150.32	149.59	---
90-1-1	152.69	---	---	---
90-2-1	133.90	---	---	---
91-1-1	159.63	158.94	159.98	160.24
92-1-1	161.05	160.72	161.53	161.53
93-1-1	174.98	172.17	176.52	---
94-1-1	194.47	185.19	195.49	200.27
LG-02-D	148.70	148.87	148.82	148.88
LG-03-D	149.84	149.80	149.78	149.80
LG-04-D	157.40	157.28	157.18	157.25
LG-08-D	145.90	143.87	144.60	148.60
LG-11-S	155.54	155.55	155.55	155.55
LG-15-D	148.57	148.74	148.78	148.86
LG-16-D	150.07	148.02	149.85	149.77
LG-17-D	151.31	151.44	150.88	151.65
LG-18-D	152.05	150.97	150.55	150.81
LG-19-D	151.39	150.63	150.51	150.59
LG-20-D	147.95	---	---	---
LG-21-D	175.89	181.51	175.17	175.60
LG-26-D	144.82	144.71	144.62	144.67

Notes:

Bracketed data on bottom of well.

--- - Not measured

A4. Surface Water Station Details

Appendix A-4. Surface Water Station Details 2020-2021

Station Name	Location		Status	Parameter List		Comments
	Northing	Easting		Routine		
	UTM (NAD83)	UTM (NAD83)		4/yr	2/yr	
Sw-N-05	5 376 534.511	465 729.384	Active	Y		Heal Creek - 40m from perimeter fence line
Sw-N-14	5 376 795.252	466 228.944	Active		Y	Heal Creek 2/3 of the way from the Northeast Diversion Ditch to Durrance Creek.
Sw-N-16	5 376 506.808	465 968.695	Active	Y		North Wetland at dischage of Weir SF5 into North Wetland Creek, just above confluence with Heal Creek.
Sw-N-17	5 376 566.303	465 903.628	Active	Y		Heal Creek below confluence with 42 Creek and above confluence with North Wetland Creek.
Sw-N-18	5 376 429.846	465 679.709	Active	Y		Northwest Diversion Ditch at discharge to Northwest Sedimentation Pond.
Sw-N-19	5 376 423.322	466 040.279	Active	Y		Northeast Diversion Ditch below Northeast Sedimentation Pond, just above discharge into North Wetland.
Sw-N-41s1	5 376 892.202	465 171.078	Active	Y		41 Creek at north side of Willis Point Road, near source.
Sw-N-41s3	5 377 102.438	465 021.226	Active	Y		41 Creek just above discharge to Durrance Lake.
Sw-N-42s1	5 376 753.436	465 553.804	Active	Y		42 Creek at discharge from 42 Wetland below southeast end of Yardwaste Pad. Across Willis Point Road from Well 42.
Sw-N-45	5 376 605.647	465 797.403	Active	Y		Heal Creek just above confluence with 42 Creek.
Sw-N-50	5 376 353.361	465 438.872	Active	Y		Toutle Valley break out.
Sw-N-51	5 376 323.976	465 444.733	Active	Y		NW diversion ditch just above confluence with Toutle Valley break out.
Sw-N-53	5 376 456.000	465 693.000	Active	Y		Drainage from High Level Road North Diversion Ditch to Northwest Sedimentation Pond.
Sw-N-54	5 376 438.000	465 713.000	Active	Y		Runoff from northeast face of Phase 2 and Phase 2 Cell 1 closure into Northwest Sedimentation Pond. Replaced Sw-N-47.
Sw-N-CSs2	5 376 933.072	464 896.583	Active		Y	Control station on south side of Willis Point Rd at ephemeral stream and culvert 300 m west of Yardwaste gate.
Sw-S-03	5 375 637.813	466 077.533	Active	Y		Kilarney Creek at culvert discharging from underneath Recycle Road.
Sw-S-04	5 375 447.329	466 171.246	Active	Y		Kilarney Creek below confluence with Southwest Diversion Ditch.
Sw-S-12	5 375 661.074	465 954.884	Active	Y		At the discharge of Weir SF2, upstream of Killarney Creek.
Sw-S-20	5 375 607.030	465 945.921	Active		Y	At the discharge of Weir SF3, in the Southwest Diversion Ditch where it converges with the South High Level Road.
Sw-S-21	5 375 419.559	466 150.441	Active	Y		Southwest Diversion Ditch just above confluence with Kilarney Creek.
Sw-S-24	5 375 553.049	466 179.487	Active	Y		Kilarney Creek just above confluence with Bike Trail Kiosk Creek and below confluence with Southeast Storm Drain.
Sw-S-27	5 375 591.468	466 163.597	Active	Y		Southeast Storm Drain just above confluence with Kilarney Creek.
Sw-S-52	5 376 059.905	465 472.066	Active		Y	Creek from Mt. Work before entering culvert draining to South Diversion Ditch.
Sw-N-06	5 376 669.740	466 024.406	Inactive	n/a		Heal Creek - East side of access road approximately 600m from entrace of rifle range. Discontinued: same channel morphology and water quality as SW-14 (no additional inputs between the two stations.
Sw-N-07	5 377 209.377	466 814.510	Inactive	n/a		Durrance Creek - on private property approximately 100m due west of Wallace Drive, 1km north of Willis Pt Road intersection. DISCONTINUED IN JUNE 2015 DUE TO SAFETY HAZARD (dilapidated bridge).
Sw-N-07A	5 377 096.940	466 527.760	Inactive	n/a		Intended to replace 07 but water quality differed significantly so station discontinued.
Sw-N-08	5 377 837.095	467 019.461	Inactive	n/a		Todd Creek on west side of road approximately 2km north of Willis Pt Road intersection
Sw-N-09	5 377 174.427	466 865.131	Inactive	n/a		Todd Creek below confluence with Durrance Creek. Just below Durrance Road bridge.
Sw-N-15	5 377 109.531	465 982.354	Inactive	n/a		Durrance Creek well above confluence with Heal Creek.
Sw-N-41s0	5 376 810.000	465 232.000	Inactive	n/a		41 Creek at source where pipe dischages from Yardwaste Pad. Near gate on access road of Willis Point Road.
Sw-N-41s2	5 376 955.866	465 105.992	Inactive	n/a		41 Creek at discharge from wetland located part way down creek.
Sw-N-41s4	5 377 189.115	465 130.141	Inactive	Y		Discharge from Durrance Lake.
Sw-N-41s5	5 377 478.219	464 471.090	Inactive	n/a		West end of Durrance Lake near where stream enters west end of lake.
Sw-N-41s6	5 377 236.090	464 906.330	Inactive	n/a		Creek / culvert entering Durrance Lake from north side 1/3 of the way from the west end (iinlet) to the east end (outlet). Discontinued due to high traffic area and liklihood of contamination from recreational activities.
Sw-N-41s7	5 377 416.510	464 790.110	Inactive	n/a		Creek / culvert entering Durrance Lake from north side near west end entrance of parking lot.
Sw-N-43	5 376 636.303	465 804.994	Inactive	n/a		42 Creek just above confluence with Heal Creek.
Sw-N-46	5 376 500.000	465 700.000	Inactive	n/a		Discharge channel from Northwest Sedimentation Pond.
SW-N-47	5 376 438.000	465 713.000	Inactive	n/a		Runoff from northeast face of Phase 2 into Northwest Sedimentation Pond. Replaced by Sw-N-54.
Sw-N-48	5 376 354.000	466 031.000	Inactive	n/a		Northeast Diversion Ditch at entry into Northeast Sedimentation Pond.
Sw-N-CSs1	5 377 280.000	464 570.000	Inactive	n/a		Control station at pond on north side of Willis Point Rd 800 m west of Yardwaste gate. Drains into southeast side of Durrrance Lake.
Sw-S-10	5 375 090.830	466 377.540	Inactive	n/a		Kilarney Lake, near outlet
Sw-S-11	5 375 258.558	466 213.279	Inactive	n/a		Kilarney Creek just above entrance into northwest end of Kilarney Lake.
Sw-S-13	5 375 660.000	466 060.000	Inactive	n/a		Old wash down area septic tank in current yardwaste drop off area.
Sw-S-22	5 375 307.180	466 327.650	Inactive	n/a		Stream entering northeast end of Kilarney Lake.
Sw-S-23	5 375 469.346	466 151.441	Inactive	n/a		Kilarney Creek just above confluence with Southwest Diversion Ditch. Discontinued due to water quality similarities to SW-S-25 and close proximity to SW-S-03
Sw-S-25	5 375 574.866	466 158.314	Inactive	n/a		Kilarney Creek just above confluence with Southeast Storm Drain. Discontinued due to proximity and simlarity to SW-S-23.
Sw-S-26	5 375 554.010	466 181.970	Inactive	n/a		Bike Trail Kiosk Creek just above confluence with Kilarney Creek.
Sw-S-28	5 375 626.640	466 172.100	Inactive	n/a		07 Creek just above confluence with Southeast Storm Drain.
Sw-S-29	5 375 645.480	466 159.040	Inactive	n/a		Southeast Storm Drain above confluence with 07 Creek, where culvert dischages after crossing under East Hydro Road near well site 60.
Sw-S-30	5 375 651.511	465 914.193	Inactive	n/a		Southwest Diversion Ditch just above confluence with High Level Road South Diversion Ditch.
Sw-S-31	5 375 887.490	465 662.951	Inactive	n/a		Base of High Level Road South Diversion Ditch, sampled at the grate.

Appendix B

Water Quality Data

- B1. Groundwater Quality
- B2. Domestic Well Quality
- B3. Surface Water Quality
- B4. Monthly Leachate Quality Data – Hartland Valve Chamber
- B5. Quarterly Leachate Quality – Trace Organics
- B6. Monthly Leachate Quality – Phase 2 Cleanout
- B7. Monthly Leachate Quality – North Purge Wells
- B8. Monthly Leachate Quality – Controlled Waste Drainage
- B9. Monthly Leachate Quality – South Purge Wells
- B10. Monthly Leachate Quality – West Face Drainage
- B11. Monthly Leachate Quality - Cell 3 Pipe Outlet
- B12. Monthly Leachate Quality Emerging Contaminant

B1. Groundwater Quality

BC CSR				AW Maximum (1)	---	---	---	---	---		---		90		50		10000		2 (9)		---		12000		0.5-4 (5)		---		1500		90 (7)		40		20-90 (5)		---		---		40-160 (5)	
				DW Maximum (2)	---	---	---	---	---		9500		6		10		1000		8		---		5000		5		---		250		6000		14 (9)		1500		---		--- (6)		10	
Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter	PH (Field)	Specific Conductivity - 25°C (Field)	Temperature (Field)	Alkalinity	Hardness as CaCO3		Aluminum		Antimony		Arsenic		Barium		Beryllium		Bismuth		Boron		Cadmium		Calcium		Chloride		Chromium		Cobalt		Copper		Hardness (As Caco3)		Iron		Lead	
				Fraction	TOT	TOT	TOT	TOT	DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS	
				Unit	pH	µS/cm	°C	mg/L	mg/L		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		mg/L		mg/L		µg/l		µg/l		µg/l		mg/L		µg/l		µg/l	
				Method Detection Limit	0.1	1	0.1	1	0.5		0.5		0.02		0.02		0.02		0.01		0.005		10		0.005		0.05		1		0.1		0.005		0.05		0.5		1		0.005	
Gw - 04-3-1	SS	Y	5/7/2020	Clear, colourless	7.51	299	9.4	160	195		1.61		0.053		0.234		38.9	<	0.01	<	0.005		68.		0.035 6		64.9		23.	<	0.1		**0.041**		0.388		195.		1.8		0.042 5	
	SS		9/2/2020	Clear and colourless	7.61	455	11.2	170	197		1.36		0.056		0.219		37.5	<	0.01	<	0.005		75.		0.029 5		65.5		23.	<	0.1		0.038 4		0.561		197.		1.6		0.051 7	
	SS		11/5/2020	Clear and colourless	7.13	334	10.2	170	194		1.34		0.053		0.212		29.5	<	0.01	<	0.005		74.		0.015 1		65.2		23.	<	0.1		0.039 1		0.319		194.	<	1.		0.047 9	
	SS		2/26/2021	Clear and colourless	6.78	320	9.6	190	185		3.9		0.043		0.162		24.	<	0.01	<	0.005		87.		0.011 6		62.		22.	<	0.1		0.039 3		0.283		185.		3.1		0.030 3	
Gw - 04-4-1	SS	Y	5/7/2020	Clear, colourless	6.52	187	8.2	70	93.3		10.9		0.042		0.097		8.78	<	0.01	<	0.005		58.		0.013 3		29.		25.		0.11		0.080 2		1.65		93.3		13.8		0.011 5	
	SS		9/2/2020	Clear and colourless	6.74	301	11.6	110	154		5.17		0.037		0.085		12.9	<	0.01	<	0.005		79.		0.018		49.2		42.	<	0.1		0.057		1.32		154.		1.9	<	0.005	
	SS		11/5/2020	Clear and colourless	6.17	250	11.6	66	115		7.81		0.05		0.102		10.1	<	0.01	<	0.005		66.		0.009 5		36.3		23.		0.38		0.081		2.27		115.		4.1	<	0.005	
	SS		2/25/2021	Clear and colourless	6.04	181	8.4	74	83.7		9.59		0.047		0.085		7.06	<	0.01	<	0.005		53.		0.006 7		26.2		25.	<	0.1		0.049 7		1.38		83.7		2.3	<	0.005	
Gw - 07-1-0	SS		5/7/2020	Clear, colourless	6.97	585	13.1	250	371	<	0.5		0.058		0.444		14.2	<	0.01	<	0.005		148.		0.036 7		127.		100.	<	0.1		2.98		0.551		371.		237.		0.014 3	
	SS		9/1/2020	Clear and colourless	6.78	688	14.6	260	353		0.73		0.063		0.664		12.6	<	0.01	<	0.005		174.		0.012 7		120.		100.	<	0.1		2.58		0.282		353.		352.		0.010 3	
	SS		11/4/2020	Clear and colourless	6.8	659	13.6	260	352		2.08		0.098		0.325		13.1	<	0.01	<	0.005		200.		0.136		121.		100.	<	0.1		2.82		0.837		352.		153.		0.34	
	SS		2/24/2021	Clear and colourless	6.78	681	13.2	320	359		0.85		0.066		0.454		13.3	<	0.01	<	0.005		150.		0.042 2		124.		100.	<	0.1		2.66		0.513		359.		322.		0.028 6	
Gw - 16-1-1	SS		9/28/2020	Clear and colourless	6.39	215	13.4	130	140		1.32	<	0.02		0.072		9.11	<	0.01	<	0.005		18.		0.005 4		46.5		3.	<	0.1		0.011 7		0.563		140.	<	1.	<	0.005	
	SS		11/25/2020	Clear and colourless	7.06	233	10.5	150	162		2.35		0.048		0.07		6.5	<	0.01	<	0.005		28.	<	0.005		53.		3.6	<	0.1		0.014 8		0.439		162.		3.3		0.007 4	
Gw - 16-1-2	SS		8/28/2020	Slightly silty and slightly grey	6.47	222	12	130	142		114.		0.06		0.196		25.8		0.032		0.012 4		17.		0.021 2		47.2		3.2		0.11		0.642		1.02		142.		159.		0.556	
	SS		11/25/2020	Very turbid, moderately grey	6.77	185	10.8	99	117		355.		0.109		0.347		31.4		0.085		0.038 9		14.		0.040 7		38.4		3.7		0.2		0.367		1.67		117.		466.		1.37	
Gw - 16-2-1	SS		8/28/2020	Clear and colourless	6.95	222	13	140	148		2.54		0.127		0.295		11.7	<	0.01	<	0.005		17.		0.037 2		49.1		3.4		0.13		0.222		3.09		148.		7.7		0.153	
	SS		11/25/2020	Clear and colourless	6.77	178	10.5	99	114		3.01		0.06		0.144		9.22	<	0.01	<	0.005		13.		0.018 5		37.6		3.2		0.16		0.038		0.896		114.		2.4		0.010 2	
Gw - 16-2-2	NS		8/28/2020	Dry. No sample collected.	---	---	---	---	---		---		---		---		---		---		---		---		---		---		---		---		---		---		---		---		---		---	---
	SS		11/25/2020	Clear and colourless	6.84	176	10.6	89	102		3.54		0.025		0.049		6.14	<	0.01	<	0.005		13.		0.014		33.5		3.3		0.13		0.032 2		1.2		102.		2.6		0.011 3	
Gw - 17-1-1	SS		9/10/2020	Slightly silty and moderately brown	7.1	355	12	230	238		32.7		0.204		0.646		18.1	<	0.01	<	0.005		22.		0.013		75.		6.	<	0.1		0.054 3		1.25		238.		29.6		0.087 3	
	SS		11/25/2020	Slightly turbid, slighlty grey	7.62	356	10.4	230	255		144.		0.21		0.523		23.9		0.07		0.020 5		32.		0.033 9		81.5		5.3		0.11		0.261		3.01		255.		224.		0.87	
Gw - 17-1-2	SS		9/10/2020	Slighlty silty and slighlty brown	7.13	315	11.7	190	190		12.4		0.374		0.766		32.6	<	0.01	<	0.005		24.		0.008 3		58.2		6.2	<	0.1		0.013 7		1.37		190.		12.4		0.036 6	
	SS		11/25/2020	Clear and colourless	7.75	298	10.6	180	187		32.2		0.179		0.778		35.	<	0.01	<	0.005		29.		0.010 6		57.3		6.2	<	0.1		0.021 3		1.28		187.		27.5		0.052 2	
Gw - 17-1-3	SS		9/10/2020	Clear and colourless	7.27	415	11.8	250	290		0.68		0.028		0.249		16.2	<	0.01	<	0.005		14.		0.010 3		87.5		6.2	<	0.1		0.021 1		0.598		290.		1.2		0.008 2	
	SS		11/25/2020	Clear and colourless	7.48	278	11	100	128		8.99		0.025		0.128		5.91	<	0.01	<	0.005		14.		0.009 7		40.4		5.7	<	0.1		0.075 4		2.23		128.		2.4		0.010 6	
Gw - 18-1-1	FRM	Y	5/15/2020	Mean of duplicates	7.32	163	10.6	160	178.5		3.955		0.728 5		1.755		12.25	<	0.01	<	0.005		23.5		0.031 45		60.1		3.65		0.105		0.11		0.9		178.5		18.5		0.033 5	
	FRM		9/10/2020	Mean of duplicates	7.46	265	12	165	179.5		2.645		0.501		1.92		10.45	<	0.01	<	0.005		22.		0.044 6		59.8		3.85	<	0.1		0.055 3		2.589 5		179.5		4.4		0.093 5	
	FRM		11/26/2020	Mean of duplicates	7.86	259	10.3	160	172		2.435		0.617 5		1.835		10.95	<	0.01	<	0.005		24.		0.063 45		57.15		3.95	<	0.1		0.006 2		0.373 5		172.		1.1		0.005 8	
	FRM		3/10/2021	Mean of duplicates	6.89	259	9.9	160	169.5		2.705		0.549		1.47		10.125	<	0.01	<	0.005		25.		0.034 35		55.75		3.55	<	0.1		0.058 8		0.187 5		169.5		3.	<	0.005	
Gw - 18-2-1	SS	Y	5/15/2020	Clear, colourless	7.17	262	10.6	150	180		1.28		0.027		0.057		1.66	<	0.01	<	0.005		12.		0.029		62.1		3.7	<	0.1		0.021 8		0.812		180.		1.7		0.012 5	
	SS		9/10/2020	Clear and colourless	6.94	252	11.2	170	193		2.9		0.031		0.04		1.71	<	0.01	<	0.005	<	10.		0.056 6		66.5		3.9	<	0.1		0.013		1.11		193.		1.4		0.010 4	
	SS		11/26/2020	Clear and colourless	7.74	342	10.2	150	238		1.13		0.028		0.059		1.8	<	0.01	<	0.005		11.		0.030 3		81.1		4.6	<	0.1		0.02		1.17		238.	<	1.		0.006 6	
	SS		3/10/2021	Clear and colourless	6.75	265	9.9	140	188		30.6		0.026		0.07		2.05	<	0.01	<	0.005	<	10.		0.048		64.1		4.9	<	0.1		0.027 2		2.46		188.		8.2		0.034 5	
Gw - 18-2-2	SS	Y	5/15/2020	Clear, colourless	7.29	277	10.6	160	188		0.61		0.035		0.075		6.32	<	0.01	<	0.005		12.		0.017 5		65.2		3.7	<	0.1		0.021 8		1.08		188.		1.2		0.011 5	
	SS		9/10/2020	Clear and colourless	7.25	281	11.2	160	195		1.72		0.027		0.06		6.47	<	0.01	<	0.005	<	10.		0.019 7		67.6		4.	<	0.1		0.017 1		0.928		195.		6.9		0.009 8	
	SS		11/26/2020	Clear and colourless	7.41	350	10.5	150	239		2.56		0.025		0.067		6.92	<	0.01	<	0.005		11.		0.038 2		81.9		4.8	<	0.1		0.026 8		1.18		239.		1.2		0.007 7	
	SS		3/10/2021	Clear and colourless	6.51	220	8.9	110	180		1.9		0.026		0.054		6.08	<	0.01	<	0.005	<	10.		0.014 7		62.		5.4	<	0.1		0.028 8		1.1		180.		8.6		0.005 9	
Gw - 19-1-1	SS		5/6/2020	Clear, moderately orange	7.11	357	10	180	225		1.99		0.079		0.277		8.23	<	0.01	<	0.005		21.		0.025 6		73.4		20.	<	0.1		0.632		2.41		225.		53.6		0.064 6	
	SS		9/2/2020	Clear and slighlty orange	7.25	314	11.5	170	192		1.81		0.024		0.391		11.4	<	0.01	<	0.005		30.		0.009 3		60.4		20.	<	0.1		0.426		0.073		192.		427.		0.005 2	
	SS		11/5/2020	Clear and slighlty orange	6.49	375	10.3	200	234		2.25	<	0.02		0.436		6.64	<	0.01	<	0.005		20.	<	0.005		76.3		29.	<	0.1		1.01		0.107		234.		1 910.	<	0.005	
	SS		2/24/2021	Clear and slighlty orange	6.81	264	8.8	180	164		0.55		0.033		0.578		9.	<	0.01	<	0.005		34.		0.006		49.6		14.	<	0.1		0.374		0.058		164.	<	220.	<	0.005	
Gw - 19-1-2	SS		5/6/2020	Clear, colourless	6.82	308	10.1	180	211		1.45		0.026		1.9		5.06	<	0.01	<	0.005		16.	<	0.005		69.2		18.	<	0.1		0.969		1.09		211.		4 870.		0.032 3	
	SS		9/2/2020	Clear and slighlty orange	6.99	354	11.4	190	220		0.61	<	0.02		1.55		3.17	<	0.01	<	0.005		16.	<	0.005		72.3		24.	<	0.1		0.941		0.05		220.		4 560.	<	0.005	
	SS		11/5/2020	Clear and slighlty orange	6.33	320	10.4	160	186		1.42	<	0.02		1.51		2.39	<	0.01	<	0.005		17.	<	0.005		60.1		17.	<	0.1		0.62		0.05		186.		2 950.	<	0.005	
	SS		2/24/2021	Clear and colourless	6.95	259	9.1	180	167		4.93	<	0.02		0.417		5.4	<	0.01	<	0.005		46.	<	0.005		50.3		12.	<	0.1		0.115		0.05		167.		369.		0.007 1	
Gw - 19-2-1	SS		5/6/2020	Clear, colourless	7.49	302	10.4	150	195		0.79	<	0.02		0.256		42.4	<	0.01	<	0.005		58.		0.005 6		60.		16.		0.38		0.062 3		0.246		195.		50.2		0.008 6	
	SS		9/2/2020	Clear and colourless	7.75	315	11.7	160	197		1.58	<	0.02		0.228		43.1	<	0.01	<	0.005		59.	<	0.005		60.2		16.	<	0.1		0.062 3		0.052		197.		72.1	<	0.005	
	SS		11/5/2020	Clear and colourless	7.22	304	10.5	160	196		1.19	<	0.02		0.235		39.5	<	0.01	<	0.005		55.	<	0.005		60.3		15.	<	0.1		0.059 2		0.05		196.		81.6	<	0.005	
	SS		2/24/2021	Clear and colourless	7.24	300	9.7	200	193		0.92	<	0.02		0.244		40.6	<	0.01	<	0.005		60.	<	0.005		59.5		16.	<	0.1		0.064 8		0.05		193.		81.9	<	0.005	
Gw - 19-2-2	SS		5/6/2020	Slighlty silty, slighlty grey	6.66	246	10.4	85	125		146.		0.081		0.743		79.5		0.019		0.012 6		57.		0.298		34.2		16.		0.25		0.773		5.28		125.		3 050.		0.73	
	SS		9/3/2020	Moderately silty and moderately brown	7.49	284	12.3	120	138		84.	<	0.02		0.101		7.87	<	0.01	<	0.005		40.8		0.203		51.4		22.	<	0.1		0.015 2		0.063		138.		21.4	<	0.005	
	SS		11/5/2020	Slighlty silty and slighlty brown	6.65	234	11.2	98	128	<	0.5	<	0.02		0.054		14.5	<	0.01	<	0.005		46.	<	0.005		38.3		16.	<	0.1		0.005 7		0.164		128.	<	1.	<	0.005	
	SS		2/24/2021	Slighlty silty and moderately brown	6.52	245	8.7	130	150		1.74	<	0.02		0.068		15.8	<	0.01	<	0.005		51.		0.043 1		44.1		17.	<	0.1		0.021 1		0.167		150.		18.1		0.008 3	
Gw - 20-1-1	SS	Y	5/21/2020	Clear, colourless	8.09	152	10.8	85	84.5	<	2.5	<	0.1	<	0.1		2.82	<	0.05	<	0.025		3 520.	<	0.025		26.		7.9	<	0.5		0.059		0.25		84.5		13.	<	0.025	
	SS		9/24/2020	Clear and colourless	8.18	136	10.9	75	71.9		4.8	<	0.04		0.093		2.27	<	0.02	<	0.01		4 230.				23.		5.9	<	0.2		0.024		0.12		71.9	<	2.	<	0.01	
	SS		11/18/2020	Clear and colourless	8.1	135	10.7	80	75.1		123.	<	0.1	<	0.1		2.49	<	0.05	<	0.025		4 280.	<	0.025		24.3		6.4	<	0.5		0.045		0.26		75.1		39.9		0.076	
	SS		2/18/2021	Clear and colourless	8.29	138	10.3	100	68		10.4	<	0.04		0.14		1.82	<	0.02	<	0.01		4 210.	<	0.01		23.1		5.8	<	0.2		0.025		0.23		68.		3.2		0.014	
Gw - 20-1-2	SS	Y	5/21/2020	Clear, colourless	7.8	189	11.1	94	68.5	<	2.5	<	0.1	<	0.1		2.95		1.72	<	0.05	<	0.025		4 480.	<	0.025		21.		10.	<	0.5	<	0.025		0.25		68.5	<	5.	<	0.025	
	SS		9/24/2020	Clear and colourless	7.94	190	11	100	95.9		2.	<	0.04	<	0.04		3.01	<	0.02	<	0.01		3 360.	<	0.01		29.7		11.	<	0.2		0.073		0.1		95.9		11.5	<	0.01	
	SS		11/18/2020	Clear and colourless	8.02	174	11	96	92.6		4.2	<	0.1	<	0.1		3.06	<	0.05	<	0.025		3 890.	<	0.025		28.8		9.4	<	0.5		0.315		0.25		92.6		9.5	<	0.025	
	SS		2/18/2021	Clear and colourless	8.1	187	10.1	130	86.4		3.8	<	0.04		0.138		3.16	<	0.02	<	0.01		3 810.	<	0.01		26.6		11.	<	0.2		0.153		2.84		86.4		7.8	<	0.01	
Gw - 21-1-1	FRM	Y	5/21/2020	Mean of duplicates	7.94	135	11.7	69	65.3	<	2.5	<	0.1		2.69		1.61	<	0.05	<	0.025		4 070.	<	0.025		20.05		3.7	<	0.5	<	0.025		0.25		65.3	<	5.	<	0.025	
	FRM		9/24/2020	Mean of duplicates	8.22	128	11.5	73	65.7		2.6	<	0.04		3.415		1.69	<	0.02	<	0.01		3 675.	<	0.01		20.05		3.55	<	0.2	<	0.01		0.12		65.7		2.15	<	0.01	
	FRM		11/18/2020	Mean of duplicates	7.69	135	10.9	73.5	69.35		8.5	<	0.1		1.1		2.465	<	0.05	<	0.025		3 805.	<	0.025		21.3		3.95	<	0.5		0.031		0.26		69.35		9.25	<	0.025	
	FRM		2/18/2021	Mean of duplicates	8.16	118	9.2	97.5	62.2		4.75	<	0.04		1.81		1.505	<	0.02	<	0.01		3 940.	<	0.01		19.1		3.35	<	0.2	<	0.01		0.1		62.2		3.95	<	0.01	

| | | |

BC CSR				AW Maximum (1)	---	---	---	---	---		---	90	50	10000	2 (9)	---	12000	0.5-4 (5)	---	1500	90 (7)	40	20-90 (5)	---	---	40-160 (5)
				DW Maximum (2)	---	---	---	---	---		9500	6	10	1000	8	---	5000	5	---	250	6000	14 (9)	1500	---	--- (6)	10
Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter	PH (Field)	Specific Conductivity - 25°C (Field)	Temperature (Field)	Alkalinity	Hardness as CaCO3		Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chloride	Chromium	Cobalt	Copper	Hardness (As Caco3)	Iron	Lead
				Fraction	TOT	TOT	TOT	TOT	DIS		DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	pH	µS/cm	°C	mg/L	mg/L		µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/L	mg/L	µg/l	µg/l	µg/l	mg/L	µg/l	µg/l
				Method Detection Limit	0.1	1	0.1	1	0.5		0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	1	0.1	0.005	0.05	0.5	1	0.005
Gw - 41-1-1	FRM	Y	5/26/2020	Mean of duplicates	6.86	332	10	150	219.5		0.515	0.052 5	1.705	2.375	< 0.01	< 0.005	26.5	0.005 4	74.55	5.55	< 0.1	0.052 35	0.489	219.5	6.85	0.007 45
	FRM		9/28/2020	Mean of duplicates	6.7	318	11.4	160	204		1.015	0.040 5	3.37	2.24	< 0.01	< 0.005	24.	0.007 3	69.25	4.65	< 0.1	0.144	0.337	204.	37.4	0.005 3
	FRM		11/13/2020	Mean of duplicates	7.18	312	10.5	160	200.5		3.38	0.041 5	5.595	1.69	< 0.01	< 0.005	27.	0.006 85	68.4	4.75	< 0.1	0.170 5	0.196	200.5	15.15	0.009 6
	FRM		3/3/2021	Mean of duplicates	6.8	304	9.4	205	194.5		0.985	0.045	3.355	1.565	< 0.01	< 0.005	32.5	< 0.005	66.25	7.9	< 0.1	0.047 05	0.156 5	194.5	9.05	< 0.005
Gw - 42-1-1	FRM	Y	5/26/2020	Mean of duplicates	6.52	369	9	195	258		4.52	< 0.02	0.219	13.45	0.011	< 0.005	80.	< 0.005	94.15	11.	0.175	0.061 45	0.236 5	258.	702.5	< 0.005
	FRM		9/28/2020	Mean of duplicates	6.41	414	10.4	210	274		3.5	< 0.02	0.199	14.9	0.010 5	< 0.005	77.5	< 0.005	99.7	14.	0.18	0.047 55	0.09	274.	685.5	0.006 35
	FRM		11/10/2020	Mean of duplicates	6.88	323	10	205	276.5		32.1	< 0.02	0.215	15.75	0.013 5	< 0.005	89.5	< 0.005	100.55	14.	0.25	0.100 4	0.281	276.5	840.	0.076 7
	FRM		2/11/2021	Mean of duplicates	6.69	367	7.9	230	234		6.26	< 0.02	0.151	12.5	0.013 5	< 0.005	75.5	< 0.005	85.1	9.95	0.17	0.065 35	0.1	234.	723.	0.005 55
Gw - 43-1-1	SS		5/13/2020	Clear, colourless	7.3	471	11.4	250	332		2.27	< 0.159	0.28	7.61	< 0.01	< 0.005	707.	0.018 9	116.	10.	< 0.1	0.054 5	3.27	332.	4.3	0.013 2
	SS		9/17/2020	Clear and colourless	7.77	479	12.6	260	322		7.95	0.133	0.267	7.22	< 0.01	< 0.005	604.	0.030 6	113.	11.	< 0.1	0.058 6	2.91	322.	15.5	< 0.005
	SS		11/13/2020	Clear and colourless	7.31	471	12.1	240	319		11.9	0.203	0.305	7.61	< 0.01	< 0.005	555.	0.029 9	112.	11.	< 0.1	0.082 9	3.19	319.	26.1	0.007 5
	SS		3/3/2021	Clear and colourless	7.08	477	10.6	300	318		2.06	0.165	0.26	7.93	< 0.01	< 0.005	609.	0.023	111.	10.	< 0.1	0.066 9	2.92	318.	1.7	< 0.005
Gw - 44-1-1	SS		5/13/2020	Clear, colourless	7.19	320	10.7	190	225		1.34	0.162	0.088	16.2	< 0.01	< 0.005	105.	0.021 6	81.6	6.1	< 0.1	0.032 7	3.41	225.	3.9	0.086 7
	SS		9/17/2020	Clear and colourless	7.63	353	12.2	200	231		1.73	0.193	0.057	10.6	< 0.01	< 0.005	88.	0.046 7	83.7	6.1	< 0.1	0.143	0.636	231.	9.9	< 0.005
	SS		11/13/2020	Clear and colourless	7.3	314	10.4	200	207		2.16	0.155	0.075	9.9	< 0.01	< 0.005	90.	0.042	75.2	5.6	< 0.1	0.089 5	0.539	207.	12.2	0.032 2
	SS		3/3/2021	Clear and colourless	7.25	318	9.8	220	208		1.14	0.206	0.096	11.5	< 0.01	< 0.005	82.	0.017 9	75.2	5.7	< 0.1	0.033 2	0.453	208.	2.1	< 0.005
Gw - 51-1-1	SS		9/23/2020	Clear and colourless	7.28	252	12	120	168		1.82	0.048	0.559	5.45	< 0.01	< 0.005	58.	0.015 8	57.3	6.4	< 0.1	0.090 1	4.84	168.	10.	0.006 1
	SS		11/18/2020	Clear and colourless	6.84	239	11.5	120	145		2.39	0.057	0.491	6.2	< 0.01	< 0.005	66.	0.008	50.	5.4	< 0.1	0.049	1.79	145.	4.9	0.010 4
Gw - 51-2-1	SS		9/23/2020	Clear and colourless	7.6	306	10.7	140	189		2.3	0.209	0.804	36.6	< 0.01	< 0.005	170.	0.017 6	52.8	25.	< 0.1	0.050 8	2.22	189.	7.1	0.115
	SS		11/18/2020	Clear and colourless	7.35	320	10.5	140	195		3.25	0.21	0.793	34.5	< 0.01	< 0.005	167.	0.009 5	55.4	24.	< 0.1	0.077 5	0.449	195.	1.9	0.023 5
Gw - 51-3-1	SS		9/23/2020	Slightly silty, slightly grey	7.69	346	10.7	130	212		2.67	0.121	0.427	27.	< 0.01	< 0.005	229.	0.008 2	59.	63.	< 0.1	0.041 9	0.761	212.	1.5	0.070 1
	SS		11/18/2020	Slightly silty and colourless	7.43	333	10.2	140	220		13.4	0.141	0.311	21.5	< 0.01	< 0.005	186.	0.008 5	62.2	34.	< 0.1	0.064 7	1.42	220.	7.7	0.050 9
Gw - 52-1-1	SS		5/14/2020	Clear, colourless	7.23	1683	14.2	810	499		2.4	< 0.04	0.254	111.	< 0.02	< 0.01	2 890.	< 0.01	132.	210.	1.11	2.42	1.19	499.	533.	0.041
	SS		9/29/2020	Clear and slightly yellow	7	1722	14.3	910	521		1.4	< 0.04	0.219	114.	< 0.02	< 0.01	2 680.	< 0.01	140.	200.	1.21	2.56	0.1	521.	664.	< 0.01
	SS		11/19/2020	Clear and slightly yellow	7.49	1692	13.7	900	494		4.7	< 0.04	0.29	108.	< 0.02	< 0.01	2 830.	< 0.01	132.	190.	1.08	2.11	0.27	494.	592.	< 0.01
	SS		2/19/2021	Clear and slightly green	6.95	1687	13.6	820	502		4.7	0.048	0.26	110.	< 0.02	< 0.01	2 780.	< 0.01	134.	200.	1.07	1.93	0.13	502.	536.	< 0.01
Gw - 52-4-0 (P7)	SS		5/14/2020	Clear, moderately yellow	7.14	3502	17.4	1500	532		28.7	1.11	8.81	350.	< 0.02	< 0.01	3 320.	< 0.01	121.	350. b	13.9	8.95	4.03	532.	13 100.	0.254
	SS		9/11/2020	Clear and slightly yellow	7.3	3909	19.2	1600	582		21.9	0.363	9.77	501.	< 0.01	< 0.005	2 810.	0.008 4	132.	390. b	5.92	7.65	1.79	582.	22 100.	0.153
	SS		11/20/2020	Clear and moderately brown	7.25	2436	16.6	1100	394		44.	0.854	7.54	215.	< 0.01	< 0.01	2 210.	0.018	101.	210.	15.7	6.76	1.58	394.	7 400.	0.298
	SS		2/19/2021	Clear and very brown	7	3228	15.1	1600	424		63.7	1.32	9.25	260.	< 0.02	< 0.01	2 950.	< 0.01	99.8	450. b	28.9	8.84	2.39	424.	9 430.	0.237
Gw - 53-1-1	SS	Y	5/20/2020	Clear, colourless	6.82	352	10.5	190	231		1.73	< 0.02	0.16	21.3	< 0.01	< 0.005	464.	0.012	80.6	7.3	< 0.1	0.443	0.114	231.	277.	0.007
	SS		9/24/2020	Clear and colourless	6.68	342	10.6	200	250		0.73	0.022	0.155	21.	< 0.01	< 0.005	473.	0.014 4	87.	7.3	< 0.1	0.486	0.2	250.	299.	0.007 4
	SS		11/19/2020	Clear and colourless	7.16	353	10.2	210	251		2.83	0.021	0.176	22.4	< 0.01	< 0.005	530.	0.015	87.6	7.6	< 0.1	0.447	0.051	251.	296.	0.005 8
	SS		2/11/2021	Clear and colourless	7.44	338	7.9	250	232		1.85	< 0.02	0.071	17.3	< 0.01	< 0.005	445.	0.006 8	81.2	1.6	< 0.1	0.337	0.529	232.	356.	0.005 3
Gw - 55-1-1	SS	Y	9/28/2020	Clear and colourless	6.58	360	9.9	160	220		1.31	0.089	0.167	4.58	< 0.01	< 0.005	16.	< 0.005	76.1	13.	< 0.1	0.016 1	0.421	220.	1.3	0.007
	SS		11/13/2020	Clear and colourless	7.13	371	9.7	170	235		3.91	0.128	0.187	4.85	< 0.01	< 0.005	17.	0.006 6	81.8	12.	0.1	0.043 2	0.313	235.	8.4	0.016 1
Gw - 56-1-1	SS	Y	5/27/2020	Clear, colourless	7.37	296	10	140	192		1.17	0.029	0.198	22.9	< 0.01	< 0.005	18.	0.016 2	68.1	9.1	< 0.1	0.005 2	1.09	192.	4.2	0.054 5
	SS		9/18/2020	Clear and colourless	7.9	300	11.6	150	202		11.	0.029	0.155	23.	< 0.01	< 0.005	14.	0.012 1	71.6	12.	< 0.1	0.007 7	0.102	202.	9.8	< 0.005
	SS		11/13/2020	Clear and colourless	7.65	300	9.7	150	196		2.76	0.066	0.159	23.1	< 0.01	< 0.005	16.	0.007 6	69.5	13.	< 0.1	0.021 6	0.09	196.	4.9	< 0.005
	SS		3/3/2021	Clear and colourless	7.21	301	9.3	190	198		2.46	0.025	0.139	20.1	< 0.01	< 0.005	21.	0.024 4	70.5	9.6	< 0.1	0.019 8	0.07	198.	4.6	< 0.005
Gw - 57-1-1	SS	Y	9/28/2020	Clear and colourless	6.84	358	9.5	170	229		1.72	0.065	0.09	10.4	< 0.01	< 0.005	35.	0.029 1	82.1	14.	< 0.1	0.053 2	0.206	229.	10.6	0.007 6
	SS		11/18/2020	Clear and colourless	7.46	387	9.6	180	258		11.8	0.026	0.081	11.6	< 0.01	< 0.005	35.	0.017 2	93.	14.	< 0.1	0.070 3	0.83	258.	26.9	0.016 5
Gw - 58-1-0	SS		5/21/2020	Clear, moderately yellow-brown	6.99	5543	19.6	1800	1510		10.8	0.42	1.7	34.1	< 0.01	< 0.025	3 350.	0.062	401.	1 000. b	9.07	51.2 a,b	4.54	1 510.	2 410.	0.26
	SS		9/23/2020	Clear and slightly yellow	7.07	4988	19.4	1800	1720		11.6	0.451	1.87	30.5	< 0.02	< 0.01	3 330.	0.126	470.	940. b	7.9	53.6 a,b	10.2	1 720.	572.	0.291
	SS		11/27/2020	Clear and colourless	6.93	4875	19.3	1600	1450		13.3	0.431	1.38	31.5	< 0.02	< 0.01	3 260.	0.104	390.	930. b	8.06	52.5 a,b	10.1	1 450.	789.	0.278
	SS		2/26/2021	Clear and moderately brown	6.62	4859	19.5	1600	1300		9.7	0.37	1.33	27.9	< 0.02	< 0.01	3 580.	0.064	341.	830. b	7.74	47.6 a,b	8.	1 300.	1 300.	0.219
Gw - 60-1-1	SS		5/7/2020	Clear, colourless	7.34	536	10.5	240	339		0.72	< 0.02	0.354	24.2	< 0.01	< 0.005	171.	0.008 3	107.	76.	< 0.1	0.050 8	0.7	339.	128.	0.019 9
	SS		9/2/2020	Clear and colourless	7.25	582	11.6	250	352		1.7	< 0.02	0.325	24.5	< 0.01	< 0.005	206.	0.008 7	112.	86.	< 0.1	0.052 4	0.228	352.	84.9	< 0.005
	SS		11/4/2020	Clear and colourless	6.76	503	10.5	260	361		2.04	< 0.02	0.303	24.	< 0.01	< 0.005	199.	0.008 3	116.	88.	< 0.1	0.043 5	0.239	361.	99.6	0.007 1
	SS		2/24/2021	Clear and colourless	6.97	581	9.8	290	350		0.68	< 0.02	0.341	23.8	< 0.01	< 0.005	186.	0.010 1	112.	86.	< 0.1	0.054 9	0.141	350.	119.	< 0.005
Gw - 60-2-1	SS		5/7/2020	Clear, colourless	7.47	473	10.8	150	272	< 0.5	0.054	0.373	42.6	< 0.01	< 0.005	258.	0.011	85.1	71.	< 0.1	0.136	0.383	272.	19.7	0.008 8
	SS		9/2/2020	Clear and colourless	7.42	477	11.7	160	275		0.81	0.041	0.367	41.2	< 0.01	< 0.005	289.	0.009 9	85.7	77.	< 0.1	0.13	0.252	275.	16.2	< 0.005
	SS		11/4/2020	Clear and colourless	6.94	476	10.8	170	283		2.02	0.049	0.316	39.	< 0.01	< 0.005	304.	0.013 5	88.6	75.	< 0.1	0.212	0.359	283.	40.5	0.011
	SS		2/24/2021	Clear and colourless	7.17	470	10	210	280		0.72	0.057	0.31	39.	< 0.01	< 0.005	304.	0.012 6	88.7	74.	< 0.1	0.175	0.255	280.	23.1	0.010 7
Gw - 60-3-1	SS		5/7/2020	Slightly silty, slightly grey	7.16	516	10.3	180	285		2.77	0.039	0.18	15.4	< 0.01	< 0.005	187.	0.255	97.4	84.	< 0.1	0.293	2.05	285.	3.4	0.009 5
	SS		9/2/2020	Clear and colourless	7.1	561	12.8	210	278		2.68	0.033	0.177	13.4	< 0.01	< 0.005	354.	0.327	94.7	73.	< 0.1	0.332	2.26	278.	2.	0.005 3
	SS		11/4/2020	Clear and colourless	6.64	509	11.3	210	291		1.97	0.055	0.156	14.6	< 0.01	< 0.005	277.	0.344	101.	61.	< 0.1	0.433	2.88	291.	1.	< 0.005
	SS		2/24/2021	Slightly silty and slightly black	6.78	549	9.7	180	294		4.4	0.061	0.162	14.6	< 0.01	< 0.005	209.	0.152	101.	91.	0.1	0.199	1.67	294.	2.2	< 0.005
Gw - 62-1-1	SS		9/17/2020	Clear and colourless	7.18	186	10.3	120	129		0.57	0.106	0.098	1.32	< 0.01	< 0.005	29.	0.011 5	44.7	2.9	0.19	0.013 2	0.09	129.	1.	< 0.005
	SS		11/12/2020	Clear and colourless	6.98	190	9.7	120	125		1.57	0.034	0.109	1.2	< 0.01	< 0.005	30.	0.005 1	43.6	3.	0.12	0.015	0.177	125.	5.5	0.025 5
	SS		9/17/2020	Clear and colourless	7.01	193	10.9	120	125		2.99	0.123	0.732	19.	< 0.01	< 0.005	316.	0.005 5	43.4	3.2	< 0.1	0.153	0.12	125.	1 960.	0.024 9
	SS		11/12/2020	Moderately silty and very grey	6.99	183	9.4	120	121		12.7	0.061	0.116	6.99	< 0.01	< 0.005	123.	0.039 9	41.9	3.5	0.17	0.022	0.634	121.	23.2	0.071 8
Gw - 63-1-1	SS		8/31/2020	Clear and colourless	7.61	224	10.5	150	148		2.45	< 0.02	< 0.02	9.89	< 0.01	< 0.005	< 10.	< 0.005	47.2	5.5	< 0.1	0.069 4	0.064	148.	24.4	< 0.005
	SS		11/2/2020	Clear and colourless	7.18	225	10.2	150	154		1.75	< 0.02	0.074	9.01	< 0.01	< 0.005	< 10.	< 0.005	48.3	5.6	< 0.1	0.061 9	0.064	154.	24.9	< 0.005
Gw - 63-2-1	SS		8/31/2020	Clear and colourless	7.35	232	10.5	150	165		6.99	< 0.02	0.073	15.6	< 0.01	< 0.005	< 10.	0.006 6	57.6	5.1	< 0.1	0.013 3	0.361	165.	4.9	< 0.005
	SS		11/2/2020	Clear and colourless	6.96	220	10.2	160	166		2.79	0.031	0.199	19.4	< 0.01	< 0.005	< 10.	0.008 3	57.1	5.9	< 0.1	0.007 3	0.235	166.	1.4	0.006
Gw - 71-1-1	FRM	Y	5/7/2020	Mean of duplicates	7.37	239	10.2	140	146		1.175	0.03	0.337 5	9.28	< 0.01	< 0.005	425.5	< 0.005	47.6	8.05	< 0.1	0.070 95	2.245	146.	23.05	0.057
	FRM		9/4/2020	Mean of duplicates	7.66	279	11.1	170	173.5		1.3	0.072	0.271	6.36	< 0.01	< 0.005	386.5	< 0.005	56.75	9.05	< 0.1	0.083	0.104	173.5	16.	< 0.005
	FRM		11/5/2020	Mean of duplicates	7.04	277	10.2	170	172.5		1.465	0.040 5	0.283 5	6.63	< 0.01	< 0.005	392.5	0.005 95	56.35	9.25	< 0.1	0.085 05	0.095	172.5	25.8	< 0.005
	FRM		2/25/2021	Mean of duplicates	7.4	238	9.7	175	145.5		0.915	0.035	0.352	5.835	< 0.01	< 0.005	552.5	< 0.005	47.25	8.1	< 0.1	0.077 9	0.050 5	145.5	16.95	< 0.005
Gw - 71-2-1	SS	Y	5/7/2020	Clear, colourless	7.35	342	10.2	210	224		25.7	0.025	0.315	18.8	< 0.01	< 0.005	243.	0.012 5	76.5	9.5	< 0.1	0.177	0.989	224.	292.	0.096 6
	SS		9/4/2020	Clear and colourless	7.67	355	11.3	220	229		5.18	< 0.02	0.238	17.9	< 0.01	< 0.005	277.	0.014	78.4	9.5	< 0.1	0.134	0.143	229.	36.4	0.035 7
	SS		11/5/2020	Clear and colourless	7.12	347	10.1	220	224		1.47	0.03	2.06	47.5	< 0.01	< 0.005	274.	0.006 8	76.2	9.5	< 0.1	0.647	0.09	224.	1 650.	0.021 9
	SS		2/25/2021	Clear and colourless	7.23	350	9.8	250	236		1.17	0.024	0.288	15.8	< 0.01	< 0.005	310.	0.016 9	80.8	9.	< 0.1	0.125	0.121	236.	189.	0.029 9
Gw - 71-3-1	SS	Y	5/7/2020	Clear, colourless	6.51	254	10.2	130	157		2.67	< 0.02	0.091	8.19	< 0.01	< 0.005	217.	0.017 1	55.7	10.	< 0.1	0.036 1	0.589	157.	2.9	0.005 2
	SS		9/4/2020	Slightly silty and slightly grey	6.8	320	11.1	180	201		0.92	0.021	0.098	14.	< 0.01	< 0.005	361.	0.018 7	71.2	9.7	< 0.1	0.036 5	0.606	201.	1.9	< 0.005
	SS		11/5/2020	Clear and colourless	6.53	313	11	180	203		3.75	< 0.02	0.121	11.5	< 0.01	< 0.005	442.	0.029 2	71.8	9.6	< 0.1	0.062 9	0.71	203.	12.6	0.010 8
	SS		2/25/2021	Clear and colourless	6.55	261	10.3	170	171		1.65	0.021	0.067	5.42	< 0.01	< 0.005	284.	0.033 2	60.8	9.7	< 0.1	0.053	0.745	171.	2.7	< 0.005

BC CSR				AW Maximum (1)	---	---	---	---	---		---		90		50		10000		2 (9)		---		12000		0.5-4 (5)		---		1500		90 (7)		40		20-90 (5)		---		---		40-160 (5)	
				DW Maximum (2)	---	---	---	---	---		9500		6		10		1000		8		---		5000		5		---		250		6000		14 (9)		1500		---		--- (6)		10	
Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter	PH (Field)	Specific Conductivity - 25°C (Field)	Temperature (Field)	Alkalinity	Hardness as CaCO3		Aluminum		Antimony		Arsenic		Barium		Beryllium		Bismuth		Boron		Cadmium		Calcium		Chloride		Chromium		Cobalt		Copper		Hardness (As Caco3)		Iron		Lead	
				Fraction	TOT	TOT	TOT	TOT	DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS	
				Unit	pH	µS/cm	°C	mg/L	mg/L		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		mg/L		mg/L		µg/l		µg/l		µg/l		mg/L		µg/l		µg/l	
				Method Detection Limit	0.1	1	0.1	1	0.5		0.5		0.02		0.02		0.02		0.01		0.005		10		0.005		0.05		1		0.1		0.005		0.05		0.5		1		0.005	
Gw - 72-1-1	FRM	Y	5/6/2020	Mean of duplicates	7.58	444	10.5	150	267		0.83	<	0.02		0.156		12.3	<	0.01	<	0.005		1 560.	<	0.005		84.3		75.5	<	0.1		0.055 35		0.05		267.		380.	<	0.005	
	FRM		9/4/2020	Mean of duplicates	7.86	441	11	160	265		1.945	<	0.02		0.122		12.5	<	0.01	<	0.005		1 450.		0.022 05		84.		76.	<	0.1		0.095 45		0.069 5		265.		384.	<	0.005	
	FRM		11/4/2020	Mean of duplicates	7.19	437	10.6	160	270		2.185	<	0.02		0.146 5		13.35	<	0.01	<	0.005		1 585.	<	0.005		85.75		76.	<	0.1		0.043 05		0.05		270.		378.	<	0.005	
	FRM		2/25/2021	Mean of duplicates	7.56	449	10.4	200	274		1.95	<	0.04		0.160 5		13.	<	0.02	<	0.01		1 815.		0.01		86.35		76.	<	0.2		0.057		0.1		274.		387.	<	0.01	
Gw - 72-3-1	SS	Y	5/6/2020	Clear, colourless	7.22	476	10.7	200	255		0.69		0.032		0.257		17.6	<	0.01	<	0.005		489.		0.017 7		89.3		54.	<	0.1		0.095 1		0.485		255.		3.3		0.008 5	
	SS		9/4/2020	Clear and colourless	7.56	484	11.7	210	260		1.56		0.024		0.264		16.3	<	0.01	<	0.005		537.		0.023 4		91.5		53.	<	0.1		0.090 6		0.33		260.		8.5		0.009 2	
	SS		11/4/2020	Clear and colourless	6.82	493	11.3	210	268		2.19		0.032		0.264		18.3	<	0.01	<	0.005		555.		0.021 7		94.2		53.	<	0.1		0.087 8		0.353		268.		6.1		0.006 4	
	SS		2/25/2021	Slighlty silty and colourless	7.18	446	10.1	190	244		0.99		0.023		0.27		14.9	<	0.01	<	0.005		484.		0.020 2		85.6		43.	<	0.1		0.083 1		0.358		244.		7.3		0.014 6	
Gw - 73-1-1	SS	Y	5/6/2020	Slighlty silty, slighlty grey	7.12	322	10	160	204		1.64		0.025		0.218		18.6	<	0.01	<	0.005		106.		0.030 1		63.4		21.		0.11		0.169		5.1		204.		8.2		0.153	
	SS		9/4/2020	Clear and colourless	7.65	332	10.9	160	208		9.5		0.03		0.185		13.	<	0.01	<	0.005		109.		0.017 9		64.3		22.		0.1		0.675		0.632		208.		3.5		0.031 5	
	FRM		11/4/2020	Mean of duplicates	6.74	331	10.2	170	214		1.445		0.021		0.178 5		12.85	<	0.01	<	0.005		112.		0.016 3		67.25		23.	<	0.1		0.192 5		0.304 5		214.	<	1.		0.018 75	
	SS		2/24/2021	Clear and colourless	6.97	330	9.7	200	206	<	0.5	<	0.02		0.207		12.2	<	0.01	<	0.005		107.		0.013 8		64.3		22.	<	0.1		0.215		0.209		206.	<	1.		0.014 1	
Gw - 73-2-1	SS	Y	5/6/2020	Clear, colourless	6.98	307	10.2	150	193	<	0.5	<	0.02		0.116		9.11	<	0.01	<	0.005		84.		0.009 2		60.4		23.	<	0.1		0.079 6		0.386		193.		17.4		0.006 6	
	FRM		9/4/2020	Mean of duplicates	7.28	350	10.8	160	221.5		3.56		0.116		0.113		10.55	<	0.01	<	0.005		92.5		0.052		69.5		26.	<	0.1		0.093 7		0.446 5		221.5		27.2		0.020 6	
	SS		11/4/2020	Clear and colourless	6.5	332	10.3	160	209		1.38	<	0.02		0.122		10.5	<	0.01	<	0.005		90.		0.005 9		65.8		26.	<	0.1		0.094 8		0.363		209.		19.9	<	0.005	
	SS		2/24/2021	Clear and colourless	6.6	304	10.1	190	191		0.55	<	0.02		0.093		8.74	<	0.01	<	0.005		66.		0.007 1		60.3		21.	<	0.1		0.064 7		0.267		191.		12.5	<	0.005	
Gw - 73-3-1	SS	Y	5/6/2020	Clear, colourless	6.99	270	10	84	116		2.15		0.043		0.184		22.7	<	0.01	<	0.005		60.		0.021 9		35.9		21.	<	0.1		0.028 2		4.7		116.		5.8		0.14	
	SS		9/4/2020	Clear and colourless	6.7	256	11	110	114		2.23		0.034		0.138		19.7	<	0.01	<	0.005		91.		0.022 6		35.7		29.	<	0.1		0.039 3		0.49		114.		1.8		0.005 7	
	SS		11/4/2020	Slighlty silty and colourless	5.96	236	10.7	84	89.7		10.9		0.033		0.17		17.5	<	0.01	<	0.005		56.		0.029 6		28.		20.	<	0.1		0.032 4		0.43		89.7		5.3		0.020 7	
	SS		2/24/2021	Slighlty silty and colourless (milky)	6.18	205	9.9	84	77.7		24.9		0.037		0.157		14.4	<	0.01	<	0.005		34.		0.020 7		24.3		17.	<	0.1		0.027 2		0.308		77.7		13.7		0.020 7	
Gw - 77-1-1	SS		9/18/2020	Moderately silty, moderately grey	8.12	257	11.5	160	173		3.68		0.07		0.15		11.4	<	0.01	<	0.005		212.		0.006 2		53.2		5.7	<	0.1		0.129		0.089		173.		11.5		0.008 6	
	SS		11/26/2020	Clear and colourless	8.2	257	10.1	160	182		2.51		0.027		0.11		7.98	<	0.01	<	0.005		215.		0.006 4		56.2		6.	<	0.1		0.068 5		0.051		182.		75.5		0.007 2	
Gw - 77-2-1	SS		9/16/2020	Clear and colourless	7.88	288	14	170	188		2.3		0.026		0.763		18.1	<	0.01	<	0.005		171.		0.008 8		51.7		6.4	<	0.1		0.011		0.106		188.		8.5		0.007 3	
	SS		11/27/2020	Clear and colourless	8.21	280	11.2	170	184		3.86		0.024		0.751		17.7	<	0.01	<	0.005		189.		0.008 2		50.1		6.7	<	0.1		0.011 6		0.141		184.		7.4		0.005	
Gw - 78-1-1	SS		9/16/2020	Clear and colourless	7.66	399	15.4	200	215		3.82		0.725		0.519		30.3	<	0.01	<	0.005		334.		0.020 6		60.9		3.6	<	0.1		0.021 1		0.269		215.		6.		0.005	
	SS		11/27/2020	Clear and colourless	7.96	347	10.9	190	222		1.8		0.647		0.512		29.3	<	0.01	<	0.005		330.		0.025 9		62.8		4.2	<	0.1		0.009 2		0.257		222.		1.9	<	0.005	
Gw - 78-2-1	SS		9/17/2020	Clear and colourless	7.49	451	15.2	170	279		23.5		0.188		0.469		21.9	<	0.01	<	0.005		250.		0.406		90.6		3.4		0.16		0.086 8		0.587		279.		52.7		0.013 9	
	SS		11/27/2020	Clear and colourless	7.06	177	11.9	84	103		1.85		0.057		0.179		6.58	<	0.01	<	0.005		191.		0.335		32.8		2.5		0.37		0.025 7		0.397		103.		1.4	<	0.005	
Gw - 80-1-0 (P8)	SS		5/14/2020	Clear, slighlty yellow	7	1491	13.8	630	416		11.2		0.598		2.25		67.	<	0.01	<	0.005		1 080.		0.024		123.		150.		6.71		7.01		10.7		416.		5 070.		0.22	
	SS		9/11/2020	Clear and slighlty yellow	7.09	1640	16.2	650	519		4.67		0.209		0.899		66.1	<	0.01	<	0.005		949.		0.048 6		155.		170.		1.23		6.52		16.2		519.		2 860.		0.177	
	SS		11/20/2020	Clear and moderately yellow	6.99	1261	14.6	390	337		19.4		0.593		1.94		29.1	<	0.01	<	0.005		645.		0.039 8		108.		56.		8.27		4.98		15.3		337.		930.		0.122	
	SS		2/19/2021	Clear and slighlty yellow	6.98	570	11.8	350	272		10.5		0.426		0.877		23.2	<	0.01	<	0.005		531.		0.022 5		84.3		70.		5.35		3.08		6.4		272.		612.		0.088 6	
Gw - 81-1-0 (P9)	SS		5/14/2020	Clear, slighlty yellow	7.38	857	13.7	280	434		1.56		0.162		0.135		64.8	<	0.01	<	0.005		1 030.		0.009		104.		120.		0.67		1.33		0.684		434.		28.4		0.168	
	SS		9/11/2020	Moderately silty and slighlty brownish grey	7.55	973	17.5	310	436		3.6		0.062		0.124		57.1	<	0.02	<	0.01		903.	<	0.01		107.		120.		0.74		0.995		0.62		436.		346.		0.044	
	SS		11/20/2020	Slighlty silty and slighlty yellow	8.02	797	13.6	310	307		25.7		0.159		0.202		42.	<	0.01	<	0.005		707.		0.009 5		76.5		110.		0.69		0.843		1.06		307.		382.		0.064 7	
	SS		2/26/2021	Slighlty silty and clear	7.59	763	12.5	320	384		4.74		0.06		0.174		50.8	<	0.01	<	0.005		901.	<	0.005		92.8		110.		0.67		0.903		0.096		384.		215.		0.005 2	
Gw - 85-1-1	SS		9/1/2020	Clear and colourless	6.75	575	15.1	91	177		1.35		0.046		0.198		4.05	<	0.01	<	0.005		168.		0.101		52.2		140.	<	0.1		0.594		6.04		177.		1.9		0.016 1	
	SS		11/2/2020	Clear and colourless	6.64	422	14.9	67	131		1.71		0.073		0.194		3.08	<	0.01	<	0.005		153.		0.022 3		39.2		83.	<	0.1		0.263		6.19		131.		1.		0.012 9	
Gw - 87-1-1	SS		9/16/2020	Clear and colourless	7.88	257	12.2	150	175		2.27		0.302		0.466		13.9	<	0.01	<	0.005		12.		0.044 8		54.8		5.	<	0.1		0.129		0.275		175.	<	1.		0.053 7	
	SS		11/13/2020	Clear and colourless	7.71	244	9.4	160	159		11.6		0.113		0.412		9.81	<	0.01	<	0.005		15.		0.014 3		49.8		5.1	<	0.1		0.112		0.121		159.		9.8		0.025 2	
Gw - 87-2-1	SS		9/16/2020	Clear and colourless	6.78	163	11.3	89	102		1.6	<	0.02		0.047		0.8	<	0.01	<	0.005	<	10.	<	0.005		32.9		3.9	<	0.1		0.006 7		0.125		102.		1.7	<	0.005	
	SS		11/10/2020	Clear and colourless	6.99	163	9	94	106		2.06	<	0.02		0.048		0.818	<	0.01	<	0.005		12.	<	0.005		34.		3.4	<	0.1		0.007 1		0.179		106.	<	1.		0.005 4	
Gw - 88-1-1	SS		9/18/2020	Clear and colourless	7.47	215	10.4	130	147		3.47		0.021		0.08		3.19	<	0.01	<	0.005		11.	<	0.005		49.2		4.3	<	0.1		0.021		0.137		147.		13.6	<	0.005	
	SS		11/10/2020	Clear and colourless	7.14	219	9.9	140	151		2.25		0.044		0.09		4.06	<	0.01	<	0.005		14.	<	0.005		50.5		4.2	<	0.1		0.019 7		1.45		151.		2.		0.034 1	
Gw - 88-2-1	SS		9/18/2020	Moderately silty, very brown	6.9	274	11.8	72	181		5.15		0.039		0.117		7.03	<	0.01	<	0.005		20.		0.024 9		61.1		4.7	<	0.1		0.047 3		0.45		181.		8.6	<	0.005	
	SS		11/10/2020	Clear and slighlty brown	6.52	231	10	83	138		4.83		0.054		0.129		5.81	<	0.01	<	0.005		27.		0.055 8		46.9		4.5	<	0.1		0.207		0.71		138.		17.2		0.014 7	
91-1-1	SS		5/13/2020		7.48	373	11.1	210	245		3.91		0.521		0.647		45.1	<	0.01	<	0.005		90.		0.009 2		80.7		5.2	<	0.1		0.051 1		0.374		245.		2.3		0.010 2	
	SS		9/10/2020		7.44	315	12.4	220	237		3.71		0.332		0.565		42.5	<	0.01	<	0.005		73.		0.031 5		78.		5.3	<	0.1		0.039 9		0.533		237.		1.3		0.012 9	
	SS		11/12/2020		7.58	348	10.3	210	233		2.93		0.322		0.478		42.1	<	0.01	<	0.005		75.		0.008 4		76.8		4.7	<	0.1		0.014 1		0.249		233.		1.1		0.007 8	
	SS		3/4/2021		7.09	372	9.9	220	250		2.51		0.289		0.568		45.2	<	0.01	<	0.005		75.		0.008 4		82.1		4.2	<	0.1		0.018 9		0.204		250.		1.5		0.006 1	
92-1-1	SS		5/13/2020		7.41	380	10.6	180	255		8.03		0.148		0.761		38.8	<	0.01	<	0.005		443.		0.022		80.5		5.3	<	0.1		0.080 2		0.432		255.		11.		0.016 6	
	SS		9/11/2020		7.42	360	11.8	190	243		13.8		0.145		0.834		32.2	<	0.01	<	0.005		391.		0.035 4		76.9		5.5	<	0.1		0.078 4		2.83		243.		19.4		0.119	
	SS		11/12/2020		7.63	380	10	200	268		2.73		0.076		0.776		35.4	<	0.01	<	0.005		423.		0.027 1		86.1		5.5	<	0.1		0.049 8		0.182		268.		1.1		0.005 4	
	SS		3/4/2021		6.99	400	10.3	180	247		32.		0.093		0.678		34.2	<	0.01	<	0.005		412.		0.019 8		77.7		4.9	<	0.1		0.077 8		0.197		247.		45.7		0.031 8	
93-1-1	SS		5/13/2020		7.33	236	10.6	140	160		2.87		0.275		0.428		14.1	<	0.01	<	0.005	<	10.		0.005 8		54.6		3.6	<	0.1		0.028 4		4.53		160.		9.8		0.114	
	SS		9/10/2020		7.5	229	11.2	150	157		3.38		0.247		0.392		8.12	<	0.01	<	0.005		14.		0.011 6		54.		3.9	<	0.1		0.017 9		0.737		157.		2.4		0.023 5	
	SS		11/12/2020		7.72	229	10.4	140	155		569.		0.284		0.596		18.6		0.044		0.009 8		19.		0.022 5		53.		3.7		0.82		2.17		1.44		155.		1 010.		0.304	
	NS		3/10/2021	Well inaccessible due to construction. N	---	---	---	---	---		---		---		---		---		---		---		---		---		---		---		---		---		---		---		---		---	
94-1-1	SS		5/13/2020		7.49	340	8.3	140	160		2.57		0.184		0.541		30.4	<	0.01	<	0.005		23.		0.02		47.8		9.7	<	0.1		0.335		0.217		160.	<	1.	<	0.005	
	SS		9/10/2020		7.28	420	9.2	150	183		2.59		0.124		0.317		37.	<	0.01	<	0.005		25.		0.021 5		57.3		10.	<	0.1		0.188		0.226		183.		1.3	<	0.005	
	SS		11/12/2020		7.61	315	8.4	150	176		2.77		0.199		0.28		33.4	<	0.01	<	0.005		27.		0.017		54.5		8.2	<	0.1		0.103		0.219		176.		2.3		0.007	
	SS		3/10/2021		7.34	233	7.5	150	150		10.2		0.152		0.334		35.2	<	0.01	<	0.005		16.		0.018 4		48.		5.8	<	0.1		0.131		0.275		150.		7.4		0.006 2	
Gw - P1	SS		5/13/2020	Clear, slighlty yellow	7.23	1269	16.1	590	284		5.8		0.082		7.73		1 620.	<	0.02	<	0.01		1 710.	<	0.01		82.6		110.		0.72		1.87		7.94		284.		15 900.		0.12	
	SS		9/3/2020	Pump not working. No sample collected.	---	---	---	---	---		---		---		---		---		---		---		---		---		---		---		---		---		---		---		---		---	
	SS		11/5/2020	Clear and colourless	6.95	1107	15.9	540	258		10.2	<	0.1		6.64		1 510.	<	0.05	<	0.025		1 340.	<	0.025		75.5		84.	<	0.5		1.19		0.86		258.		15 700.		0.075	
	SS		2/26/2021	Clear and colourless	6.96	1286	16.5	630	280		4.4		0.077		8.68		1 430.	<	0.02	<	0.01		1 610.	<	0.01		82.2		90.		0.66		1.59		0.33		280.		17 300.		0.068	
Gw - P2	SS		5/8/2020	Clear, slighlty orange	7.43	2041	17.8	880	271		4.1		0.044		1.03		611.	<	0.02	<	0.01		2 480.	<	0.01		70.6		190.		1.27		4.7		7.78		271.		754.		0.222	
	SS		9/3/2020	Clear and very orange	7.46	1840	20.3	830	252		5.7	<	0.04		0.992		490.	<	0.02	<	0.01		2 860.	<	0.01		65.2		160.		1.02		3.91		0.55		252.		813.		0.025	
	SS		11/5/2020	Clear and slighlty yellow	7.33	1379	15.5	770	233		6.3	<	0.04		0.966		472.	<	0.02	<	0.01		2 500.	<	0.01		62.5		130.		1.18		3.38		0.94		233.		926.		0.031	
	SS		2/26/2021	Clear and slighlty yellow	6.97	2043	16.4	930	289		5.2		0.043		1.11		602.	<	0.02	<	0.01		3 200.	<	0.01		74.		190.		1.08		4.14		0.44		289.		529.		0.028	
Gw - P3	SS		5/8/2020	Clear, slighlty orange	7.42	2469	16.7	1100	271		4.6	<	0.1		2.34		928.	<	0.05	<	0.025		3 570.	<	0.025		61.6		270.		1.41		5.54		6.31		271.		867.		0.191	
	SS		9/3/2020	Clear and moderately orange	7.63	1524	20.4	1100	231		5.8	<	0.04		2.57		725.	<	0.02	<	0.01		4 040.	<	0.01		51.3		220.		1.31		5.19		0.41		231.		1 160.		0.048	
	SS		11/5/2020	Clear and slighlty yellow	7.39	1558	15.1	970	215		7.7	<	0.04		2.43		638.	<	0.02	<	0.01		3 460.	<	0.01		49.5		180.		1.16		4.57		0.8		215.		1 010.		0.033	
	SS		3/10/2021	Clear and moderately yellow	8.31	2303	14.5	1100	283		5.1		0.051		2.06		872.	<	0.02	<	0.01		3 610.	<	0.01		64.7		260.		1.11		4.19		0.25		283.		1 640.		0.14	
Gw - P4	SS		5/8/2020	Clear, slighlty yellow	7.6	2042	16.3	920	310		2.9	<	0.04		1.52		152.	<	0.02	<	0.01		2 240.	<	0.01		77.6		190.		1.		3.69		8.32		310.		430.		0.145	
	SS		9/3/2020	Clear and slighlty orange	8.13	2105	18.4	920	325		3.3	<	0.04		1.6		139.	<	0.02	<	0.01		2 850.		0.014		80.5		220.		0.99		3.57		5.1		325.		141.		0.032	
	SS		11/5/2020	Clear and moderately yellow	7.79	1894	14.4	910	305		6.4	<	0.04		1.33		140.	<	0.02	<	0.01		2 600.	<	0.01		77.5		210.		1.05		3.33		11.9		305.		111.		0.17	
	SS		2/26/2021	Clear and slighlty yellow	6.93	2008	15.4	970	308		3.9		0.068		1.65		153.	<	0.02	<	0.01		2 700.	<	0.01		76.5		190.		0.9		3.05		1.06		308.		2 250.		0.041	
Gw - P10	SS		5/8/2020	Clear, slighlty yellow	7.03	1080	16.5	520	289		2.2	<	0.04		1.18		845.	<	0.02	<	0.01		903.	<	0.01		86.4		75.		0.47		1.34		4.46		289.		892.		0.1	
	SS		9/3/2020	Moderately silty and very orange	6.93	963	17.1	490	270		4.1	<	0.04		1.22		795.	<	0.02	<	0.01		961.	<	0.01		80.5		70.		0.41		0.939		0.34		270.		1 870.		0.044	
	SS		11/5/2020	Clear and moderately orange	6.91	891	14.8	480	269		4.3	<	0.04		1.18		780.	<	0.02	<	0.01		872.	<	0.01		81.8		65.		0.34		0.883		0.81		269.		882.		0.023	
	SS		2/26/2021	Slighlty silty and moderately orange	6.71	1081	16.1	560	286		2.9	<	0.04		1.07		843.	<	0.02	<	0.01		1 250.	<	0.01		85.5		68.		0.43		1.28		0.65		286.		606.		0.025	

Notes:

a	*Above CSR Schedule 3.2 AW Standard.*
b	*Above CSR Schedule 3.2 DW Standard.*
c	*Detection Limits above Applicable Standards.*
SS	*Single sample.*
FR1, FR2	*Field replicates.*
BC CSR	*CSR-Sch3.2: BC Contaminated Site Regulation - Schedule 3.2 - Generic Numerical Water Standards, be in effective on November 1, 2017.*
(1)	*Aquatic Life (AW) Freshwater, Column 3.*
(2)	*Drinking Water (DW), Column 6.*
(3)	*Standard varies with pH. Every ammonia result was compared to a standard based on the associated pH result for that sample.*
(4)	*Standard varies with chloride. Every nitrite result was compared to a standard based on the associated chloride result for that sample.*
(5)	*Standard varies with hardness. Every result was compared to a standard that was based on the associated hardness result for that sample.*
(6)	*BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed by the Stage 8 CSR Amendments.*
(7)	*Standard is based on the trivalent (Cr(III)) species.*
(8)	*Interim standard used.*
(9)	*CSR Stage 13 amendments, protocol 9, background concentration is higher than the applicable CSR DW and/or most stringent CSR AW standard. A concentration above the CSR DW or most stringent CSR AW stanadard but below the regional background concentration (South Vancouver Island Region). Is not considered contaminated and is not highlighted as a CSR DW or AW exceedance*

BC CSR				AW Maximum (1)		---		---		---		10000		1.31-18.4 (3)		0.2-2 (4)		400		400		250-1500 (5)		---		---		20		---		0.5-15 (5)		---		---		128-429 (5)		---		3		---		1000		85		---		75-2400 (5)		---
				DW Maximum (2)		33 (9)		---		--- (6)		250				1		10		80		---		---		10		20		---		20		1700 (9)		2500		500		---		---		2.5		---		20		20		3000		---
Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter		Lithium		Magnesium		Manganese		Molybdenum		Nitrogen - ammonia		Nitrogen - nitrite		Nitrogen - nitrate		Nitrogen - nitrate plus nitrite		Nickel		Phosphorus		Potassium		Selenium		Silicon		Silver		Sodium		Strontium		Sulphate		Sulphur		Thallium		Tin		Titanium		Uranium		Vanadium		Zinc		Zirconium
				Fraction		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS		DIS
				Unit		µg/l		mg/l		µg/l		µg/l		mg/l		mg/l		mg/l		mg/l		µg/l		µg/l		µg/l		µg/l		µg/l		mg/L		µg/l		mg/L		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l		µg/l
				Method Detection Limit		0.5		0.05		0.05		0.05		0.015		0.005		0.02		0.02		0.02		2		0.05		0.04		50		0.005		0.05		0.05		1		3		0.002		0.2		0.5		0.002		0.2		0.1
Gw - 04-3-1	SS	Y	5/7/2020	Clear, colourless		0.51		8.06		0.252		2.46	<	0.015	<	0.005		0.025		0.025		0.366		9.5		0.592		0.1		8 500.	<	0.005		11.9		176.		36.		11.2		0.002 4	<	0.2	<	0.5		0.623	<	0.2		0.97	<	0.1
	SS		9/2/2020	Clear and colourless		0.53		8.02		0.303		2.5	<	0.015	<	0.005		0.03		0.035		0.367		9.		0.57		0.118		8 490.	<	0.005		12.1		176.		38.		---		0.003	<	0.2	<	0.5		0.655		0.2		1.26	<	0.1
	SS		11/5/2020	Clear and colourless	<	0.5		7.63	<	0.05		2.07		0.033	<	0.005		0.023		0.023		0.345		4.5		0.497		0.08		7 460.	<	0.005		11.7		156.		34.		9.	<	0.002	<	0.2	<	0.5		0.536	<	0.2		0.46	<	0.1
	SS		2/26/2021	Clear and colourless	<	0.5		7.3		0.092		1.83	<	0.015	<	0.005	<	0.02	<	0.02		0.299		6.8		0.486		0.076		9 030.	<	0.005		11.5		158.		33.		10.5		0.002 6	<	0.2	<	0.5		0.403	<	0.2		0.78	<	0.1
Gw - 04-4-1	SS	Y	5/7/2020	Clear, colourless	<	0.5		5.07		5.16		0.134	<	0.015	<	0.005		0.146		0.146		0.36		5.1		1.3		0.043		5 240.	<	0.005		12.4		87.1		23.		6.5		0.002 2	<	0.2	<	0.5		0.016 1		0.55		0.55	<	0.1
	SS		9/2/2020	Clear and colourless	<	0.5		7.64		12.		0.14	<	0.015	<	0.005		0.13		0.135		0.43		5.6		1.63		0.041		6 070.	<	0.005		14.6		139.		32.		---		0.002 9	<	0.2	<	0.5		0.031 5		0.5		0.21	<	0.1
	SS		11/5/2020	Clear and colourless	<	0.5		6.03		7.03		0.181	<	0.015	<	0.005		0.665		0.665		0.709	<	2.		1.43		0.054		4 930.	<	0.005		13.7		104.		56.		16.1	<	0.002	<	0.2	<	0.5		0.013 1		0.43	<	0.1	<	0.1
	SS		2/25/2021	Clear and colourless	<	0.5		4.43		5.59		0.118		0.022	<	0.005		1.15		1.15		0.29		4.2		1.18		0.042		5 450.	<	0.005		12.		77.7		20.		5.9	<	0.002 8	<	0.2	<	0.5		0.010 8		0.45		0.43	<	0.1
Gw - 07-1-0	SS		5/7/2020	Clear, colourless	<	0.5		13.1		1 950.		0.287	<	0.015	<	0.005	<	0.02	<	0.02		3.82		4.2		1.38		0.074		7 800.	<	0.005		22.7		304.		46.		14.2	<	0.002	<	0.2	<	0.5		0.334	<	0.2		9.05	<	0.1
	SS		9/1/2020	Clear and colourless	<	0.5		12.6		1 780.		0.27		0.044	<	0.005	<	0.02		0.025		3.39		5.7		1.34		0.055		6 510.		0.008 6		24.1		263.		46.		---		0.003 1	<	0.2	<	0.5		0.316	<	0.2		8.29	<	0.1
	SS		11/4/2020	Clear and colourless	<	0.5		12.4		1 810.		0.313		0.052	<	0.005	<	0.02	<	0.02		4.01		2.4		1.39		0.128		7 300.	<	0.005		24.5		288.		42.		14.6	<	0.002	<	0.2	<	0.5		0.343	<	0.2		7.77	<	0.1
	SS		2/24/2021	Clear and colourless	<	0.5		12.1		1 890.		0.236		0.089	<	0.005	<	0.02	<	0.02		3.49		3.2		1.2		0.073		7 730.	<	0.005		22.9		292.		42.		12.5	<	0.002	<	0.2	<	0.5		0.278	<	0.2		11.9	<	0.1
Gw - 16-1-1	SS		8/28/2020	Clear and colourless	<	0.5		5.93		0.135		0.478	<	0.015	<	0.005		0.1	<	0.105		0.159	<	2.8		0.202		0.061		6 150.	<	0.005		4.77		158.		16.		---	<	0.002	<	0.2	<	0.5		0.141		0.73		0.76	<	0.1
	SS		11/25/2020	Clear and colourless	<	0.5		7.19		0.158		0.645		0.039	<	0.005		0.062		0.062		0.195	<	2.		0.183	<	0.04		7 830.	<	0.005		4.15		184.		20.		6.	<	0.002	<	0.2	<	0.5		0.191		0.64		0.37	<	0.1
Gw - 16-1-2	SS		8/28/2020	Slightly silty and slightly grey		0.88		5.86		51.2		0.526		0.027	<	0.005		0.158		0.163		0.625		10.3		0.289		0.048		6 220.	<	0.005		5.77		168.		16.		---		0.003 4	<	0.2		4.87		0.374		0.51		3.89		0.14
	SS		11/25/2020	Very turbid, moderately grey		0.71		5.16		28.1		0.253		0.046	<	0.005		0.98		0.98		0.72		10.6		0.239		0.053		6 450.	<	0.005		4.69		143.		17.		5.4		0.009 6	<	0.2		16.7		0.558		0.82		5.32		0.3
Gw - 16-2-1	SS		8/28/2020	Clear and colourless		1.45		6.18		1.5		1.16	<	0.015		0.015 9		0.995		1.010 9		2.94		6.1		0.385		0.168		6 750.	<	0.005		9.55		203.		24.		---	<	0.002	<	0.2	<	0.5		0.326		1.08		3.19	<	0.1
	SS		11/25/2020	Clear and colourless	<	0.5		4.81		0.146		0.325		0.03		0.005 7		0.538		0.544		0.572	<	2.		0.239		0.07		5 500.	<	0.005		4.47		138.		19.		5.7	<	0.002	<	0.2	<	0.5		0.076 9		0.42		0.99	<	0.1
Gw - 16-2-2	NS		8/28/2020	Dry. No sample collected.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	SS		11/25/2020	Clear and colourless	<	0.5		4.33		0.235		0.249		0.049	<	0.005		0.523		0.523		0.621	<	2.		0.19		0.051		5 190.	<	0.005		3.53		99.3		16.		4.6	<	0.002	<	0.2	<	0.5		0.068 6		0.26		0.82	<	0.1
Gw - 17-1-1	SS		9/10/2020	Slightly silty and moderately brown		1.47		12.2		3.17		0.562	<	0.015	<	0.005		0.022		0.022		0.849		4.6		0.684		0.073		13 600.	<	0.005		15.		449.		42.		---		0.002 6	<	0.2		0.87		0.547		1.99		1.79	<	0.1
	SS		11/25/2020	Slightly turbid, slighty grey		1.35		12.6		17.9		0.53		0.04	<	0.005	<	0.02		0.02		1.21		5.7		0.744		0.064		16 400.	<	0.005		12.5		501.		42.		12.7		0.005 7	<	0.2		4.96		0.568		2.35		4.03		0.42
Gw - 17-1-2	SS		9/10/2020	Slightly silty and slightly brown		2.02		10.8		0.839		0.629		0.041	<	0.005		0.052		0.052		0.156		4.6		0.813		0.059		17 500.	<	0.005		13.3		516.		29.		---		0.004 3	<	0.2	<	0.5		0.588		2.01		1.17	<	0.1
	SS		11/25/2020	Clear and colourless		2.01		10.7		0.959		0.541		0.024	<	0.005		0.025		0.025		0.152		3.		0.896	<	0.04		19 500.	<	0.005		11.5		543.		29.		8.4		0.005 4	<	0.2		0.61		0.442		2.63		0.94	<	0.1
Gw - 17-1-3	SS		9/10/2020	Clear and colourless	<	0.5		17.3		0.1		0.198	<	0.015	<	0.005		0.033		0.033		1.58		2.		0.361		0.042		9 000.	<	0.005		4.24		472.		28.		---	<	0.002	<	0.2	<	0.5		0.099 8		2.28		0.79	<	0.1
	SS		11/25/2020	Clear and colourless	<	0.5		6.63		0.262		0.091		0.08		0.006		0.374		0.38		1.07	<	2.		0.401		0.087		7 630.	<	0.005		3.43		143.		27.		8.	<	0.002	<	0.2	<	0.5		0.010 9		0.82		0.54	<	0.1
Gw - 18-1-1	FRM	Y	5/15/2020	Mean of duplicates		0.645		6.91		32.		0.4	<	0.015	<	0.005	<	0.02	<	0.02		0.323		10.5		0.204 5		0.050 5		7 650.	<	0.005		4.045		90.4		21.		6.7	<	0.002	<	0.2	<	0.5		0.137		1.065		3.375	<	0.1
	FRM		9/10/2020	Mean of duplicates	<	0.5		7.315		17.55		0.373 5	<	0.015	<	0.005	<	0.02	<	0.02		0.295		4.85		0.174		17.55		0.041		7 655.	<	0.005		4.125		87.8		20.5		---	<	0.002 4	<	0.2	<	0.5		0.126 5		0.855		2.92	<	0.1
	FRM		11/26/2020	Mean of duplicates		0.805		7.13		0.619		0.386		0.035 5	<	0.005	<	0.02	<	0.02		0.227		**5.6**		0.202	<	0.04		7 785.	<	0.005		4.415		85.5		22.		7.2	<	0.002	<	0.2	<	0.5		0.133 5		0.78		0.855	<	0.1
	FRM		3/10/2021	Mean of duplicates		0.535		7.33		15.5		0.362		0.12	<	0.005	<	0.02	<	0.02		0.273 5		6.2		0.168 5	<	0.04		7 835.	<	0.005		3.935		88.7		25.5		6.95		0.002	<	0.2	<	0.5		0.123 5		0.465		1.145	<	0.1
Gw - 18-2-1	SS	Y	5/15/2020	Clear, colourless	<	0.5		6.09		0.22		0.059	<	0.015		0.013 3		0.127		0.140 3		0.106		4.8		0.1		0.382		7 020.	<	0.005		3.23		70.9		27.		8.4	<	0.002	<	0.2	<	0.5		0.042 2		0.78		1.01	<	0.1
	SS		9/10/2020	Clear and colourless	<	0.5		6.51		0.929	<	0.05	<	0.015		0.007 5		0.25		0.257		0.196	<	2.		0.106		0.601		6 710.	<	0.005		3.41		68.1		26.		---	<	0.002	<	0.2	<	0.5		0.039 7		0.61		1.31	<	0.1
	SS		11/26/2020	Clear and colourless	<	0.5		8.58	<	0.05	<	0.05		0.036	<	0.005		0.595		0.595		0.069		4.1		0.111		0.756		7 130.	<	0.005		3.78		90.8		97.		29.6	<	0.002	<	0.2	<	0.5		0.031 5		0.61		0.57	<	0.1
	SS		3/10/2021	Clear and colourless	<	0.5		6.7		0.433		0.065		0.036		0.009		0.261		0.27		0.233		4.5		0.134		0.631		7 200.	<	0.005		3.62		75.4		52.		13.3	<	0.002	<	0.2	<	0.5		0.052 9		0.28		1.	<	0.1
Gw - 18-2-2	SS	Y	5/15/2020	Clear, colourless	<	0.5		6.11		0.106		0.079	<	0.015	<	0.005		0.056		0.056		0.061		4.6		0.137		0.279		6 760.	<	0.005		3.21		74.9		27.		9.3	<	0.002	<	0.2	<	0.5		0.068 5		0.76		0.59	<	0.1
	SS		9/10/2020	Clear and colourless	<	0.5		6.28		0.109	<	0.05	<	0.015	<	0.005		0.364		0.364		0.09		5.4		0.147		0.789		6 790.	<	0.005		3.47		70.1		33.		---	<	0.002	<	0.2	<	0.5		0.066 1		0.71		0.47	<	0.1
	SS		11/26/2020	Clear and colourless	<	0.5		8.45		0.145	<	0.05		0.036	<	0.005		0.682		0.682		0.137		**2.7**		0.143		0.754		7 260.	<	0.005		3.86		91.6		100.		30.6	<	0.002	<	0.2	<	0.5		0.046 1		0.57		0.54	<	0.1
	SS		3/10/2021	Clear and colourless	<	0.5		6.		0.121		0.059		0.036	<	0.005		0.226		0.226		0.105		3.7		0.12		0.59		7 000.	<	0.005		3.37		72.6		40.		12.7	<	0.002	<	0.2	<	0.5		0.037 7		0.25		0.35	<	0.1
Gw - 19-1-1	SS		5/6/2020	Clear, moderately orange		0.67		10.2		2 120.		1.04		0.017	<	0.005		0.039		0.039		0.956		6.1		0.224	<	0.04		11 000.	<	0.005		7.9		180.		30.		9.9		0.003 1	<	0.2	<	0.5		0.156	<	0.2		2.08	<	0.1
	SS		9/2/2020	Clear and slightly orange	<	0.5		10.1		1 520.		2.	<	0.015	<	0.005	<	0.02	<	0.02		0.524		3.2		0.179	<	0.04		12 200.	<	0.005		6.85		162.		35.		---	<	0.002	<	0.2	<	0.5		0.151	<	0.2		0.46	<	0.1
	SS		11/5/2020	Clear and slightly orange		0.54		10.5		2 350.		0.661		0.13		0.015 4	<	0.02	<	0.02		0.604	<	2.		0.205	<	0.04		10 800.	<	0.005		7.7		186.		31.		9.2	<	0.002	<	0.2	<	0.5		0.098 5	<	0.2		0.59	<	0.1
	SS		2/24/2021	Clear and slightly orange		0.59		9.7		902.		2.96		0.032	<	0.005	<	0.02	<	0.02		0.391		2.9		0.191	<	0.04		12 400.	<	0.005		8.22		141.		38.		11.3	<	0.002	<	0.2	<	0.5		0.184	<	0.2		0.29	<	0.1
Gw - 19-1-2	SS		5/6/2020	Clear, colourless	<	0.5		9.27		2 460.		0.351		0.043	<	0.005	<	0.02	<	0.02		0.421		6.9		0.178	<	0.04		10 700.	<	0.005		5.28		171.		29.		9.1		0.003 2	<	0.2	<	0.5		0.013		0.35		1.58	<	0.1
	SS		9/2/2020	Clear and slightly orange	<	0.5		9.47		2 400.		0.346		0.063	<	0.005	<	0.02	<	0.02		0.42		4.2		0.179		0.043		11 500.	<	0.005		5.57		185.		25.		---	<	0.002	<	0.2	<	0.5		0.006 3		0.3		0.15	<	0.1
	SS		11/5/2020	Clear and slightly orange	<	0.5		8.82		1 200.		0.245		0.032		0.005 5	<	0.02	<	0.02		0.211		2.2		0.133	<	0.04		8 840.	<	0.005		4.48		149.		25.		6.7	<	0.002	<	0.2	<	0.5		0.013 2	<	0.2		0.43	<	0.1
	SS		2/24/2021	Clear and colourless	<	0.5		10.1		269.		0.452		0.026		0.006 3	<	0.02	<	0.02		0.202		2.9		0.121	<	0.04		11 600.	<	0.005		4.89		145.		42.		12.2	<	0.002	<	0.2	<	0.5		0.061 5	<	0.2		0.18	<	0.1
Gw - 19-2-1	SS		5/6/2020	Clear, colourless	<	0.5		10.9		85.1		0.535	<	0.015	<	0.005	<	0.02	<	0.02		0.291		5.5		0.138	<	0.04		12 100.	<	0.005		4.74		167.		43.		13.4	<	0.002	<	0.2	<	0.5		0.102	<	0.2		0.79	<	0.1
	SS		9/2/2020	Clear and colourless	<	0.5		11.4		85.7		0.482		0.12	<	0.005	<	0.02	<	0.02		0.184		3.5		0.135	<	0.04		12 100.	<	0.005		4.79		177.		37.		---	<	0.002	<	0.2	<	0.5		0.109	<	0.2		0.18	<	0.1
	SS		11/5/2020	Clear and colourless	<	0.5		11.1		81.6		0.471	<	0.015	<	0.005	<	0.02	<	0.02		0.149	<	2.		0.126	<	0.04		11 100.	<	0.005		4.74		158.		41.		11.9	<	0.002	<	0.2	<	0.5		0.101	<	0.2		0.13	<	0.1
	SS		2/24/2021	Clear and colourless	<	0.5		10.7		82.2		0.525		0.04	<	0.005	<	0.02	<	0.02		0.182		3.5		0.147	<	0.04		12 100.	<	0.005		4.89		172.		47.		13.9	<	0.002	<	0.2	<	0.5		0.093 9	<	0.2		0.26	<	0.1
Gw - 19-2-2	SS		5/6/2020	Slightly silty, slightly grey		1.89		9.5		4 760.		0.219		0.025	<	0.005	<	0.02	<	0.02		8.88		19.		0.353	<	0.04		6 800.		0.005 1		7.76		154.		44.		13.3		0.010 8	<	0.2		5.31		0.062 7		0.37		15.8		0.15
	SS		9/3/2020	Moderately silty and moderately brown		1.47		8.75		579.		0.913		0.033	<	0.005	<	0.02	<	0.02		1.57		4.3		0.232	<	0.04		7 640.	<	0.005		7.66		139.		35.		---	<	0.002	<	0.2	<	0.5		0.030 7		0.5		1.44	<	0.1
	SS		11/5/2020	Slightly silty and slightly brown		1.		7.81		2.12		0.205		0.034		0.008 7	<	0.02	<	0.02		0.167	<	2.		0.247	<	0.04		6 810.	<	0.005		6.92		122.		37.		10.6	<	0.002	<	0.2	<	0.5		0.059 8	<	0.2		0.71	<	0.1
	SS		2/24/2021	Slightly silty and moderately brown		0.97		9.8		239.		0.269		0.043	<	0.005	<	0.02	<	0.02		2.01		3.		0.288	<	0.04		6 500.	<	0.005		6.11		156.		45.		12.7	<	0.002	<	0.2	<	0.5		0.040 8	<	0.2		0.42	<	0.1
Gw - 20-1-1	SS	Y	5/21/2020	Clear, colourless	<	2.5		4.73		23.7		0.26	<	0.015		0.008 9	<	0.02	<	0.02		0.24		12.		0.38	<	0.2		18 900.	<	0.025		13.6		529.		12.	<	15.	<	0.01	<	1.	<	2.5	<	0.01	<	1.	<	0.5	<	0.5
	SS		9/24/2020	Clear and colourless		1.1		3.53		7.09		0.4	<	0.015		0.005 7	<	0.02	<	0.02		0.331		15.4		0.27	<	0.08		19 200.	<	0.01		11.2		447.		13.		---	<	0.004	<	0.4	<	1.		0.020 3	<	0.4	<	0.2	<	0.2
	SS		11/18/2020	Clear and colourless	<	2.5		3.51		6.17		0.43		0.037	<	0.005	<	0.02	<	0.02		1.65	<	10.		0.28	<	0.2		19 500.	<	0.025		11.		461.		13.	<	15.	<	0.01	<	1.	<	2.5		0.071	<	1.		1.25	<	0.5
	SS		2/18/2021	Clear and colourless		1.4		2.51		2.15		0.44		0.22	<	0.005	<	0.02	<	0.02		0.135	<	4.		0.25	<	0.08		18 600.	<	0.01		10.2		450.		15.	<	6.	<	0.004	<	0.4	<	1.		0.021 3	<	0.4		1.57	<	0.2
Gw - 20-1-2	SS	Y	5/21/2020	Clear, colourless	<	2.5		3.89		5.16		0.36		0.025	<	0.005	<	0.02	<	0.02		0.11	<	10.	<	0.25	<	0.2		20 600.	<	0.025		8.85		465.		13.	<	15.	<	0.01	<	1.	<	2.5		0.026	<	1.	<	0.5	<	0.5
	SS		9/24/2020	Clear and colourless		1.		5.27		25.9		0.49		0.092	<	0.005	<	0.02	<	0.02		0.242		16.		0.36	<	0.08		19 400.	<	0.01		13.7		584.		14.		---	<	0.004	<	0.4	<	1.		0.021 2	<	0.4	<	0.2	<	0.2
	SS		11/18/2020	Clear and colourless	<	2.5		5.04		21.5		0.61		0.087	<	0.005	<	0.02	<	0.02		0.37	<	10.		0.38	<	0.2		20 500.	<	0.025		13.6		572.		13.	<	15.	<	0.01	<	1.	<	2.5		0.02	<	1.		1.	<	0.5
	SS		2/18/2021	Clear and colourless		1.3		4.85		24.2		0.49		0.17	<	0.005	<	0.02	<	0.02		0.671		5.		0.43	<	0.08		19 200.	<	0.01		13.7		558.		14.	<	6.	<	0.004	<	0.4	<	1.		0.019 5	<	0.4		1.96	<	0.2
Gw - 21-1-1	FRM	Y	5/21/2020	Mean of duplicates	<	2.5		3.705		4.785		0.37	<	0.015	<	0.005	<	0.02	<	0.02	<	0.1		11.5	<	0.25	<	0.2		19 600.	<	0.025		8.43		440.		11.	<	15.	<	0.01	<	1.	<	2.5		0.029 5	<	1.	<	0.5	<	0.5
	FRM		9/24/2020	Mean of duplicates	<	1.		3.79		5.83		0.49	<	0.015	<	0.005	<	0.02	<	0.02		0.054		12.55		0.195	<	0.08		18 300.	<	0.01		8.74		450.5		12.		---	<	0.004	<	0.4	<	1.		0.042 95	<	0.4	<	0.2	<	0.2
	FRM		11/18/2020	Mean of duplicates	<	2.5		3.94		8.495		0.565		0.027	<	0.005	<	0.02	<	0.02	<	0.1	<	10.	<	0.25	<	0.2		19 050.	<	0.025		8.605		475.5		11.	<	15.	<	0.01	<	1.	<	2.5		0.069	<	1.		1.13	<	0.5
	FRM		2/18/2021	Mean of duplicates		1.		3.495		7.055		0.44		0.127 5	<	0.005	<	0.02	<	0.02		0.040 5		4.05		0.205	<	0.08		18 300.	<	0.01		8.52		456.		11.5	<	6.	<	0.004	<	0.4	<	1.		0.020 7	<	0.4		2.01	<	0.2

| | | |

| | | |

| | | |

B2. Domestic Well Quality

Appendix B-2. Domestic Well Quality 2020 - 2021

Parameters	Criteria		Well Number	Site #2	Site #3	Site #11	Site # 12	Site #13	Site #10	Site #9
				Kiowa Ave	Spotts Close	Farmington Rd	Wallace Dr	Wallace Dr	Meadowbrook	Wildview Cres
	Canadian	British Columbia		24	25	36	37 (at House)	38 (at Well Head)	61	47
	DWQ Guidelines [1]	SDWQ Guidelines [2]	Sample Date	22-Jul-2020	22-Jul-2020	23-Jul-2020	23-Jul-2020	23-Jul-2020	22-Jul-2020	22-Jul-2020
Metals										
Aluminum, total	0.1 ‡	9.5	mg/L	0.0015	0.0012	0.00173	0.00147	0.00394	0.00349	0.01700
Antimony, total	0.006	0.006	mg/L	< 0.00002	0.000024	< 0.00002	0.000054	0.000056	< 0.00002	< 0.00002
Arsenic, total	0.010	0.010	mg/L	0.00007	0.000073	0.000061	0.00197	0.00193	0.000074	0.000078
Barium, total	1	n/a	mg/L	0.000595	0.00223	0.000065	0.00661	0.00721	0.00104	0.00475
Beryllium, total	n/a	n/a	mg/L	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	0.000012
Bismuth, total	n/a	n/a	mg/L	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005
Boron, total	5	5	mg/L	0.182	0.212	0.752	0.184	0.18	< 0.01	< 0.01
Cadmium, total	0.005	0.005	mg/L	0.000033	0.0000053	< 0.000005	< 0.000005	< 0.000	0.000015	0.0000201
Calcium, total	n/a	n/a	mg/L	75.6	62.1	6.88	32.9	32.9	21.5	15.3
Chromium, total	0.05	0.05	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.00012	< 0.0001
Cobalt, total	n/a	0.001	mg/L	0.0000134	0.0000233	< 0.000005	0.0000215	0.0000636	0.0000127	0.0000223
Copper, total	2 [1] and 1 †	2 [2] and 1 †	mg/L	0.00732	0.0238	0.000334	0.00425	0.0017	0.0444	0.118
Iron, total	0.3 †	0.3 †	mg/L	0.0035	0.006	0.0283	0.0028	0.0	0.0035	0.0354
Lead, total	0.005	0.005	mg/L	0.000141	0.00066	0.0000192	0.000239	0.000194	0.00135	0.00106
Lithium, total	n/a	n/a	mg/L	< 0.0005	< 0.0005	0.00106	0.0009	0.00089	< 0.0005	< 0.0005
Magnesium, total	n/a	n/a	mg/L	5.68	6.84	1.79	7.28	7.17	6.07	2.71
Manganese, total	0.12[1] and 0.02 †	0.12[2] and 0.02 †	mg/L	0.000447	0.000229	0.00284	**0.0272**	**0.0917**	0.000286	0.0157
Mercury, total	0.001	0.001	mg/L	< 0.0000019	< 0.0000019	< 0.0000019	< 0.0000019	< 0.0000019	< 0.0000019	0.0000021
Molybdenum, total	n/a	0.088	mg/L	0.000089	0.000136	0.00088	0.000838	0.000922	0.000055	< 0.00005
Nickel, total	n/a	0.08	mg/L	0.000195	0.000238	< 0.00002	0.00019	0.000231	0.000182	0.000082
Phosphorus, total	n/a	n/a	mg/L	0.0059	0.0074	0.0092	0.0453	0.04	0.011	0.0116
Potassium, total	n/a	n/a	mg/L	0.696	1.84	0.349	1.16	1.16	0.261	0.362
Selenium, total	0.05	0.01	mg/L	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004	0.000065	< 0.00004
Silicon, total	n/a	n/a	mg/L	9.21	8.95	8.25	8.29	8.28	9.4	8.05
Silver, total	n/a	n/a	mg/L	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005
Sodium, total	200 †	n/a	mg/L	13.9	10.6	41	15.9	15.5	7.13	9.43
Strontium, total	7.0	7.0	mg/L	0.077	0.087	0.0154	0.127	0.129	0.0456	0.0414
Sulphur, total	n/a	n/a	mg/L	4.4	6.6	4.7	8.2	7.9	< 3	< 3
Thallium, total	n/a	n/a	mg/L	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002
Tin, total	n/a	n/a	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Titanium, total	n/a	n/a	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Uranium, total	0.02	0.02	mg/L	0.000146	0.000303	< 0.000002	0.000204	0.000198	0.0000071	0.0000697
Vanadium, total	n/a	n/a	mg/L	0.00062	0.00097	0.00021	0.0006	0.00061	0.00065	< 0.0002
Zinc, total	5 †	3[2] and 5 †	mg/L	0.00361	0.0122	0.00045	0.00235	0.00206	0.00447	0.00335
Zirconium, total	n/a	n/a	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Conventionals										
Hardness (as CaCO3)	n/a	n/a	mg/L	212	183	24.6	112	112	79	49
Chloride, dissolved	250 †	250 †	mg/L	26	30	9.7	14	14	15	8
Total dissolved solids	500 †	n/a	mg/L	280	280	160	190	190	130	90
Specific Conductivity (Lab)	n/a	n/a	µS/cm	470	440	240	300	300	200	150
Conductivity (Field)	n/a	n/a	µS/cm	395	357	180	243	234	150	110
pH (lab)	7.0 to 10.5 †	n/a	pH	7.76	7.37	8.31	8.23	8.25	7.22	7.12
pH (field)	7.0 to 10.5 †	n/a	pH	**6.7**	**6.22**	8.25	7.42	7.42	**5.6**	**5.67**
Temperature (field)	15 †	15 †	°C	**15.8**	**15.8**	11.9	14.2	12.7	11.7	11
Ammonia	n/a	n/a	mg/L							

Notes:

1) Health Canada (updated in June 2019 version). Guidelines for Canadian Drinking Water Quality—Summary Table.

(2) British Columbia Approved Source Drinking Water Quality Guideline (SDWQGs) (2020 edition).

‡ *Limit for this parameter is an operational guideline (OG) only.*

† *Limit for this parameter is an aesthetic objective (AO), not a human health objective.*

ǂ *Limit for this guideline is an iterim value.*

BOLD *Sample concentrations expressed in bold exceed AO drinking water quality guidelines.*

Sample concentrations highlighted in yellow exceed drinking water quality guidelines.

n/a - no drinking water quality guideline is available for this parameter.

Appendix B-2. Domestic Well Quality 2020 - 2021

Parameters	Criteria			Site #4 Lohr Road	Site #6 Lohr Road	Site #7 Lohr Road	Site #8 Lohr Road	Site #16 Spotts Close	Site #5 Lohr Road	Site #14 Hartland Ave	BFD of Site #14 Hartland Ave
	Canadian DWQ Guidelines (1)	British Columbia SDWQ Guidelines (2)	Well Number Sample Date	50 22-Jul-2020	52 22-Jul-2020	53 22-Jul-2020	80 22-Jul-2020	81 22-Jul-2020	51 22-Jul-2020	n/a 23-Jul-2020	n/a 23-Jul-2020
Metals											
Aluminum, total	0.1 ‡	9.5	mg/L	0.00575	0.00401	0.10900	0.00091	0.00171	0.00184	0.00821	0.00801
Antimony, total	0.006	0.006	mg/L	0.000021	< 0.00002	0.000058	0.000023	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Arsenic, total	0.010	0.010	mg/L	0.000044	0.000086	0.000382	0.000077	0.000026	0.000098	0.000067	0.000064
Barium, total	1	n/a	mg/L	0.00915	0.0092	0.00268	0.0033	0.00124	0.0168	0.00187	0.00185
Beryllium, total	n/a	n/a	mg/L	< 0.00001	< 0.00001	0.000016	< 0.00001	< 0.00001	< 0.00001	0.000011	0.000013
Bismuth, total	n/a	n/a	mg/L	< 0.000005	< 0.000005	< 0.00001	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005
Boron, total	5	5	mg/L	0.127	0.048	0.014	< 0.01	0.848	0.038	0.014	0.014
Cadmium, total	0.005	0.005	mg/L	0.0000139	< 0.000005	0.0000122	< 0.000005	< 0.000005	< 0.000005	0.000014	0.000016
Calcium, total	n/a	n/a	mg/L	21.8	47.3	18.6	20.4	5.03	50.6	15.5	15.6
Chromium, total	0.05	0.05	mg/L	< 0.0001	< 0.0001	0.00142	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Cobalt, total	n/a	0.001	mg/L	0.0000715	0.0000129	0.000171	0.0000058	0.0000128	0.0000078	0.0000237	0.0000306
Copper, total	2 (1) and 1 †	2 (2) and 1 †	mg/L	0.0664	0.00384	0.0378	0.00771	0.00021	0.00625	0.00435	0.00385
Iron, total	0.3 †	0.3 †	mg/L	0.0063	0.0041	**2.6**	0.0076	0.0120	0.0064	0.0368	0.0324
Lead, total	0.005	0.005	mg/L	0.00258	0.000339	0.00159	0.000141	0.0000961	0.000534	0.000479	0.000486
Lithium, total	n/a	n/a	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0013	< 0.0005	< 0.0005	< 0.0005
Magnesium, total	n/a	n/a	mg/L	3.89	6.29	2.77	1.6	0.52	6.23	3.51	3.53
Manganese, total	0.12(1) and 0.02 †	0.12(2) and 0.02 †	mg/L	0.000814	0.000144	0.00899	0.000328	0.0009	0.0002	0.0017	0.0017
Mercury, total	0.001	0.001	mg/L	< 0.0000019	< 0.0000019	< 0.0000019	< 0.0000019	< 0.000002	< 0.0000019	< 0.0000019	< 0.0000019
Molybdenum, total	n/a	0.088	mg/L	0.000353	0.000839	0.000756	0.000375	0.002	0.00101	0.000338	0.000321
Nickel, total	n/a	0.08	mg/L	0.000206	0.000109	0.00082	0.000052	0.000062	0.00031	0.000062	0.00006
Phosphorus, total	n/a	n/a	mg/L	0.0075	0.0088	0.0304	0.0088	0.0058	0.0061	0.0088	0.0083
Potassium, total	n/a	n/a	mg/L	0.402	0.515	0.29	0.255	0.229	0.386	0.325	0.326
Selenium, total	0.05	0.01	mg/L	< 0.00004	0.000089	< 0.00004	0.000055	< 0.00004	0.000168	< 0.00004	< 0.00004
Silicon, total	n/a	n/a	mg/L	6.27	6.85	7.2	7.29	11.2	7.21	6.55	6.62
Silver, total	n/a	n/a	mg/L	< 0.000005	< 0.000005	0.000011	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005
Sodium, total	200 †	n/a	mg/L	9.13	5.79	4.87	34.1	43.6	6.22	15.7	15.7
Strontium, total	7.0	7.0	mg/L	0.0599	0.109	0.0381	0.0392	0.0446	0.137	0.0371	0.0379
Sulphur, total	n/a	n/a	mg/L	< 3	3.1	< 3	< 3	4.8	< 3	5.9	5.9
Thallium, total	n/a	n/a	mg/L	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002
Tin, total	n/a	n/a	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Titanium, total	n/a	n/a	mg/L	< 0.0005	< 0.0005	0.0043	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Uranium, total	0.02	0.02	mg/L	0.0000182	0.000744	0.000184	0.000468	0.000002	0.000614	0.0000154	0.0000152
Vanadium, total	n/a	n/a	mg/L	0.00055	0.00061	0.00194	0.00023	< 0.0002	0.00058	0.00069	0.00067
Zinc, total	5 †	3(2) and 5 †	mg/L	0.0149	0.00153	0.0212	0.00304	0.00712	0.00108	0.0209	0.0196
Zirconium, total	n/a	n/a	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Conventionals											
Hardness (as CaCO3)	n/a	n/a	mg/L	70.5	144	57.8	57.5	15	152	53	53
Chloride, dissolved	250 †	250 †	mg/L	14	14	6.9	11	16	16	24	24
Total dissolved solids	500 †	n/a	mg/L	140	170	100	160	150	200	130	130
Specific Conductivity (Lab)	n/a	n/a	µS/cm	200	320	150	270	230	340	210	210
Conductivity (Field)	n/a	n/a	µS/cm	162	240	122	199	172	250	150	150
pH (lab)	7.0 to 10.5 †	n/a	pH	**6.79**	7.91	**6.99**	7.5	8.57	7.76	7.42	**6.91**
pH (field)	7.0 to 10.5 †	n/a	pH	**5.54**	**6.6**	**5.8**	**6.05**	8.82	**6.67**	**5.51**	**5.51**
Temperature (field)	15 †	15 †	°C	13.4	11.5	15.3	12	11	11.4	10.8	10.8
Ammonia	n/a	n/a	mg/L								

Notes:

1) Health Canada (updated in June 2019 version). Guidelines for Canadian Drinking Water Quality—Summary Table.

(2) British Columbia Approved Source Drinking Water Quality Guideline (SDWQGs) (2020 edition).

‡ *Limit for this parameter is an operational guideline (OG) only.*

† *Limit for this parameter is an aesthetic objective (AO), not a human health objective.*

≠ *Limit for this guideline is an iterim value.*

BOLD *Sample concentrations expressed in bold exceed AO drinking water quality guidelines.*

Sample concentrations highlighted in yellow exceed drinking water quality guidelines.

n/a - no drinking water quality guideline is available for this parameter.

Appendix B-2. Domestic Well Quality 2020 - 2021

Parameters	Criteria			Site #18 Willis Pt Rd	Site #19 Willis Pt Rd	Site #20 Mark Lane	BFD of Site #20 Mark Lane	Site #21 Mark Lane	Site #17 Durrance Close
	Canadian DWQ Guidelines (1)	British Columbia SDWQ Guidelines (2)	Well Number Sample Date	n/a 24-Jul-2020	n/a 23-Jul-2020	n/a 23-Jul-2020	n/a 23-Jul-2020	n/a 23-Jul-2020	n/a 24-Jul-2020
Metals									
Aluminum, total	0.1 ‡	9.5	mg/L	-	-	-	-	-	-
Antimony, total	0.006	0.006	mg/L	-	-	-	-	-	-
Arsenic, total	0.010	0.010	mg/L	-	-	-	-	-	-
Barium, total	1	n/a	mg/L	-	-	-	-	-	-
Beryllium, total	n/a	n/a	mg/L	-	-	-	-	-	-
Bismuth, total	n/a	n/a	mg/L	-	-	-	-	-	-
Boron, total	5	5	mg/L	-	-	-	-	-	-
Cadmium, total	0.005	0.005	mg/L	-	-	-	-	-	-
Calcium, total	n/a	n/a	mg/L	-	-	-	-	-	-
Chromium, total	0.05	0.05	mg/L	-	-	-	-	-	-
Cobalt, total	n/a	0.001	mg/L	-	-	-	-	-	-
Copper, total	2 (1) and 1 †	2 (2) and 1 †	mg/L	-	-	-	-	-	-
Iron, total	0.3 †	0.3 †	mg/L	-	-	-	-	-	-
Lead, total	0.005	0.005	mg/L	-	-	-	-	-	-
Lithium, total	n/a	n/a	mg/L	-	-	-	-	-	-
Magnesium, total	n/a	n/a	mg/L	-	-	-	-	-	-
Manganese, total	0.12(1) and 0.02 †	0.12(2) and 0.02 †	mg/L	-	-	-	-	-	-
Mercury, total	0.001	0.001	mg/L	-	-	-	-	-	-
Molybdenum, total	n/a	0.088	mg/L	-	-	-	-	-	-
Nickel, total	n/a	0.08	mg/L	-	-	-	-	-	-
Phosphorus, total	n/a	n/a	mg/L	-	-	-	-	-	-
Potassium, total	n/a	n/a	mg/L	-	-	-	-	-	-
Selenium, total	0.05	0.01	mg/L	-	-	-	-	-	-
Silicon, total	n/a	n/a	mg/L	-	-	-	-	-	-
Silver, total	n/a	n/a	mg/L	-	-	-	-	-	-
Sodium, total	200 †	n/a	mg/L	13.3	24.1	20.9	20.8	11.7	6.14
Strontium, total	7.0	7.0	mg/L	-	-	-	-	-	-
Sulphur, total	n/a	n/a	mg/L	-	-	-	-	-	-
Thallium, total	n/a	n/a	mg/L	-	-	-	-	-	-
Tin, total	n/a	n/a	mg/L	-	-	-	-	-	-
Titanium, total	n/a	n/a	mg/L	-	-	-	-	-	-
Uranium, total	0.02	0.02	mg/L	-	-	-	-	-	-
Vanadium, total	n/a	n/a	mg/L	-	-	-	-	-	-
Zinc, total	5 †	3(2) and 5 †	mg/L	-	-	-	-	-	-
Zirconium, total	n/a	n/a	mg/L	-	-	-	-	-	-
Conventionals				-	-	-	-	-	-
Hardness (as CaCO3)	n/a	n/a	mg/L	-	-	-	-	-	-
Chloride, dissolved	250 †	250 †	mg/L	3.4	92	44	44	24	5.3
Total dissolved solids	500 †	n/a	mg/L	-	-	-	-	-	-
Specific Conductivity (Lab)	n/a	n/a	µS/cm	200	710	450	450	520	400
Conductivity (Field)	n/a	n/a	µS/cm	143	523	340	340	383	297.0
pH (lab)	7.0 to 10.5 †	n/a	pH	8.16	7.87	8.16	8.21	8.18	8.13
pH (field)	7.0 to 10.5 †	n/a	pH	7.89	**6.74**	7.12	7.12	**6.69**	**6.76**
Temperature (field)	15 †	15 †	°C	9.50	11.7	12	12	12.4	11.7
Ammonia	n/a	n/a	mg/L	0.019	< 0.015	0.023	< 0.015	< 0.015	< 0.015

Notes:

1) Health Canada (updated in June 2019 version). Guidelines for Canadian Drinking Water Quality—Summary Table.

(2) British Columbia Approved Source Drinking Water Quality Guideline (SDWQGs) (2020 edition).

‡ *Limit for this parameter is an operational guideline (OG) only.*

† *Limit for this parameter is an aesthetic objective (AO), not a human health objective.*

≠ *Limit for this guideline is an iterim value.*

BOLD *Sample concentrations expressed in bold exceed AO drinking water quality guidelines.*

Sample concentrations highlighted in yellow exceed drinking water quality guidelines.

n/a - no drinking water quality guideline is available for this parameter.

B3. Surface Water Quality

B.C. Water Quality Guidelines				BC WQG MAXIMUM (1)	---			5			---			---			600			110			---			---		
				BC WQG AVERAGE (1)	---			---			1200			---			150			4			---			---		
				PARAMETER	Aluminum			Arsenic			Boron			Cadmium			Chloride			Cobalt			Copper			Hardness (As Caco3)		
				STATE	TOT			TOT			TOT			TOT			DIS			TOT			TOT			TOT		
				UNIT	µg/L			µg/L			µg/L			µg/L			mg/L			µg/L			µg/L			mg/L		
				Method Detection Limit (MDL)	0.5			0.02			10			0.005			1			0.01			0.1			0.5		
				Limit of Quantification (LOQ)	2.5			0.1			50			0.025			5			0.05			0.5			2.5		
					30%			30%			30%			30%			30%			30%			30%			30%		
STATION	SAMPLE TYPE	COMPLIANCE WELL?	DATE	COMMENTS	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG
SW-N-05	FRM	COMPLIANCE	4/21/2020	Mean of duplicates	34.6	---	---	0.117 5		---	25.5	---		0.005 5	---	---	5.4			0.074 55			1.275	---	---	189.	---	---
SW-N-05	FRM	COMPLIANCE	9/29/2020	Mean of duplicates	97.3	---	---	0.133 5		---	33.	---		0.009 65	---	---	6.05			0.194 5			2.05	---	---	338.5	---	---
SW-N-05	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	75.95	---	---	0.135 5		---	50.	---		0.009 75	---	---	5.25			0.144 5			1.42	---	---	310.	---	---
SW-N-05	FRM	COMPLIANCE	2/3/2021	Mean of duplicates	135.5	---	---	0.121 5		---	41.5	---		< 0.006	---	---	5.			0.161 5			1.39	---	---	219.5	---	---
SW-N-14	NS		10/1/2020	Inaccessible due to active shooting.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-N-14	NS		12/2/2020	Inaccessible due to active shooting.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-N-14	NS		2/4/2021	Inaccessible due to active shooting.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-N-16	FRM	COMPLIANCE	4/21/2020	Mean of duplicates	21.05	---	---	0.298		---	95.	---		0.012	---	---	8.4			0.774			2.985	---	---	188.5	---	---
SW-N-16	FRM	COMPLIANCE	9/29/2020	Mean of duplicates	17.8	---	---	0.296		---	87.5	---		0.030 05	---	---	13.			0.429 5			6.12	---	---	214.5	---	---
SW-N-16	FRM	COMPLIANCE	12/1/2020	Mean of duplicates	34.15	---	---	0.249		---	60.5	---		0.007 5	---	---	6.6			0.264			8.205	---	---	221.5	---	---
SW-N-16	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	69.6	---	---	0.235 5		---	43.	---		0.011 45	---	---	6.1			0.254 5			13.35	---	---	147.5	---	---
SW-N-17	SS		4/24/2020		94.1	---	---	0.13		---	71.	---		< 0.005	---	---	9.3			0.192			1.04	---	---	152.	---	---
SW-N-17	SS		9/30/2020	Clear and colourless, moderate flow, abundance of decaying leaves	29.6	---	---	0.162		---	119.	---		0.020 2	---	---	10.			0.165			0.911	---	---	212.	---	---
SW-N-17	SS		12/2/2020	Clear and colourless.	29.8	---	---	0.11		---	87.	---		0.005 5	---	---	9.5			0.089 6			0.785	---	---	245.	---	---
SW-N-17	SS		2/4/2021	Moderately high flow,clear and colourless	36.5	---	---	0.114		---	84.	---		0.012 6	---	---	11.			0.07			0.83	---	---	174.	---	---
SW-N-18	SS		4/21/2020		21.5	---	---	0.081		---	10.	---		< 0.005	---	---	5.1			0.055			0.323	---	---	182.	---	---
SW-N-18	SS		9/29/2020	Clear and colourless, moderate flow	15.9	---	---	0.111		---	15.	---		< 0.005	---	---	6.8			0.095 4			0.607	---	---	379.	---	---
SW-N-18	SS		12/2/2020	Clear and colourless.	34.1	---	---	0.078		---	12.	---		< 0.005	---	---	5.3			0.059			0.34	---	---	229.	---	---
SW-N-18	SS		2/3/2021	High flow, clear and colourless	187.	---	---	0.069		---	< 10.	---		< 0.005	---	---	6.3			0.21			0.741	---	---	173.	---	---
SW-N-19	SS		4/21/2020		26.5	---	---	0.35		---	35.	---		0.022 3	---	---	4.4			2.68			14.3	---	---	198.	---	---
SW-N-19	SS		9/29/2020	Clear and colourless, moderate flow	13.7	---	---	0.354		---	60.	---		0.006 1	---	---	11.			1.16			3.69	---	---	220.	---	---
SW-N-19	SS		12/1/2020	Clear and colourless.	18.	---	---	0.281		---	47.	---		0.010 1	---	---	5.8			0.356			11.8	---	---	236.	---	---
SW-N-19	SS		2/4/2021	Moderately high flow, clear and slightly yellow	61.3	---	---	0.271		---	33.	---		0.024 7	---	---	5.9			0.365			18.6	---	---	158.	---	---
SW-N-41S1	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	1 035.	---	---	1.04		---	17.	---		0.033 7	---	---	4.2			0.963			2.875	---	---	175.	---	---
SW-N-41S1	FRM	COMPLIANCE	9/30/2020	Mean of duplicates	22.4	---	---	0.255 5		---	18.	---		< 0.005	---	---	4.5			0.167			2.463 5	---	---	251.5	---	---
SW-N-41S1	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	26.85	---	---	0.222		---	18.5	---		< 0.005	---	---	19.			0.142			0.284	---	---	231.	---	---
SW-N-41S1	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	20.55	---	---	0.205		---	18.	---		< 0.005	---	---	7.9			0.079			0.26	---	---	170.5	---	---
SW-N-41S3	SS		4/22/2020		163.	---	---	0.208		---	34.	---		0.016 4	---	---	13.			0.121			1.23	---	---	124.	---	---
SW-N-41S3	SS		9/30/2020	Clear and colourless, moderate flow	9.43	---	---	0.195		---	52.	---		< 0.005	---	---	12.			0.017 1			0.209	---	---	160.	---	---
SW-N-41S3	SS		12/2/2020	Clear and colourless.	15.5	---	---	0.079		---	21.	---		< 0.005	---	---	7.4			0.024 7			0.406	---	---	89.9	---	---
SW-N-41S3	SS		2/4/2021	High flow, clear and colourless	21.8	---	---	0.088		---	16.	---		< 0.005	---	---	8.			0.022 7			0.354	---	---	84.7	---	---
SW-N-42S1	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	528.5	---	---	0.329 5		---	40.	---		0.025 1	---	---	9.65			0.826			3.61	---	---	188.	---	---
SW-N-42S1	FRM	COMPLIANCE	9/30/2020	Mean of duplicates	83.3	---	---	0.241 5		---	52.5	---		< 0.005 2	---	---	11.			0.319 5			0.63	---	---	264.5	---	---
SW-N-42S1	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	215.7	---	---	0.152		---	62.5	---		< 0.011 35	---	---	10.			0.357			1.72	---	---	221.	---	---
SW-N-42S1	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	24.3	---	---	0.080 5		---	57.5	---		< 0.005	---	---	12.5			0.055			0.57	---	---	168.5	---	---
SW-N-45	SS		4/24/2020		21.1	---	---	0.142		---	59.	---		0.005 7	---	---	7.6			0.135			1.79	---	---	165.	---	---
SW-N-45	SS		9/30/2020	Clear and colourless, moderate flow	12.1	---	---	0.139		---	91.	---		0.007 7	---	---	7.2			0.107			1.14	---	---	244.	---	---
SW-N-45	SS		12/2/2020	Clear and colourless.	64.3	---	---	0.12		---	75.	---		0.007 3	---	---	7.2			0.15			1.23	---	---	293.	---	---
SW-N-45	SS		2/4/2021	High flow, clear and colourless	74.3	---	---	0.114		---	61.	---		0.005	---	---	8.			0.119			1.08	---	---	201.	---	---
SW-N-50	SS		4/21/2020		10.5	---	---	0.059		---	10.	---		< 0.005	---	---	5.1			0.042 1			0.28	---	---	182.	---	---
SW-N-50	SS		9/29/2020	Slightly turbid and colourless, low flow	70.5	---	---	0.074		---	14.	---		< 0.005	---	---	6.5			0.162			0.876	---	---	383.	---	---
SW-N-50	SS		12/2/2020	Clear and colourless.	67.4	---	---	0.072		---	11.	---		< 0.005	---	---	5.3			0.084 9			0.649	---	---	210.	---	---
SW-N-50	SS		2/8/2021	High flow, clear and colourless, plastic garbage observed in culvert	129.	---	---	0.068		---	11.	---		< 0.005	---	---	5.1			0.171			0.671	---	---	131.	---	---
SW-N-51	NS		4/21/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-N-51	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-N-51	NS		12/2/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-N-51	NS		2/8/2021	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-N-53	NS		4/21/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-N-53	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-N-53	NS		12/2/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-N-53	NS		2/3/2021	Dry, no sample collected	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-N-54	SS		4/21/2020		36.8	---	---	0.434		---	55.	---		0.007 3	---	---	2.			0.253			13.7	---	---	193.	---	---
SW-N-54	SS		9/29/2020	Slightly turbid, slightly yellow, moderately low flow	7.26	---	---	0.662		---	53.	---		0.019 1	---	---	3.9			0.904			6.03	---	---	261.	---	---
SW-N-54	SS		12/2/2020	Clear and colourless.	182.	---	---	0.357		---	70.	---		< 0.005	---	---	2.4			0.332			17.4	---	---	212.	---	---
SW-N-54	SS		2/3/2021	Moderately high flow, clear and slightly yellow	217.	---	---	0.338		---	52.	---		< 0.005	---	---	2.8			0.295			13.8	---	---	165.	---	---
SW-N-CS2	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-N-CS2	SS		12/2/2020	Clear and colourless.	9.89	---	---	0.037		---	< 10.	---		< 0.005	---	---	5.			0.018 4			0.305	---	---	66.1	---	---
SW-N-CS2	SS		2/4/2021	High flow, clear and colourless	6.61	---	---	0.03		---	< 10.	---		< 0.005	---	---	5.9			0.014 2			0.254	---	---	57.8	---	---
SW-S-03	SS		4/22/2020		8 050.	---	---	2.5		---	29.	---		0.284	---	---	7.7			9.32		**b**	53.5	---	---	78.4	---	---
SW-S-03	SS		10/1/2020	Clear and colourless, moderately low flow	617.	---	---	0.361		---	74.	---		0.032 2	---	---	25.			0.797			10.9	---	---	187.	---	---
SW-S-03	SS		12/3/2020	Clear and colourless.	1 140.	---	---	0.4		---	69.	---		0.066 7	---	---	12.			1.44			15.2	---	---	106.	---	---
SW-S-03	SS		2/3/2021	Moderately high flow,clear and colourless	120.	---	---	0.177		---	55.	---		0.011 4	---	---	19.			0.249			14.1	---	---	91.7	---	---
SW-S-04	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	748.5	---	---	0.374 5		---	51.	---		0.031 45	---	---	18.5			0.837 5			8.455	---	---	76.8	---	---
SW-S-04	FRM	COMPLIANCE	10/1/2020	Mean of duplicates	22.25	---	---	0.098		---	75.5	---		0.016 4	---	---	26.5			0.098 7			1.39	---	---	134.5	---	---
SW-S-04	FRM	COMPLIANCE	12/3/2020	Mean of duplicates	127.5	---	---	0.162 5		---	80.5	---		0.011 7	---	---	15.			0.197 5			3.715	---	---	109.	---	---
SW-S-04	FRM	COMPLIANCE	2/3/2021	Mean of duplicates	135.5	---	---	0.166 5		---	44.5	---		0.008 7	---	---	15.			0.161			4.635	---	---	71.75	---	---
SW-S-12	SS		4/22/2020		10 600.	---	---	0.871		---	34.	---		0.058 6	---	---	8.9			11.9		**b**	45.4	---	---	149.	---	---
SW-S-12	SS		10/1/2020	Clear and colourless, low flow	42.4	---	---	0.458		---	34.	---		0.030 9	---	---	6.4			0.346			21.2	---	---	297.	---	---
SW-S-12	SS		12/3/2020	Clear and colourless.	57.1	---	---	0.203		---	90.	---		0.015 4	---	---	11.			0.364			9.87	---	---	123.	---	---
SW-S-12	SS		2/3/2021	Moderately high flow,clear and colourless	113.	---	---	0.26		---	83.	---		0.018 1	---	---	14.			0.345			21.4	---	---	107.	---	---
SW-S-20	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-S-20	SS		12/3/2020	Clear and colourless.	102.	---	---	0.116		---	22.	---		< 0.005	---	---	6.5			0.151			1.48	---	---	57.6	---	---
SW-S-20	SS		2/3/2021	High flow, clear and colourless	168.	---	---	0.123		---	10.	---		< 0.005	---	---	5.2			0.121			1.06	---	---	45.9	---	---
SW-S-21	NS		4/22/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-S-21	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-S-21	SS		12/3/2020	Clear and colourless.	472.	---	---	0.14		---	15.	---		0.006 9	---	---	6.4			0.286			2.02	---	---	47.6	---	---
SW-S-21	SS		2/3/2021	Moderately high flow,clear and colourless	72.2	---	---	0.099		---	11.	---		0.005	---	---	4.6			0.054			1.	---	---	40.8	---	---
SW-S-24	SS		4/22/2020		723.	---	---	0.391		---	55.	---		0.032 9	---	---	19.			0.87			7.53	---	---	80.2	---	---
SW-S-24	SS		10/1/2020	Clear and colourless, moderately low flow	12.8	---	---	0.171		---	88.	---		0.017 5	---	---	27.			0.128			3.5	---	---	146.	---	---
SW-S-24	SS		12/3/2020	Clear and colourless.	77.6	---	---	0.167		---	92.	---		0.013 4	---	---	27.			0.191			4.03	---	---	116.	---	---
SW-S-24	SS		2/3/2021	High flow, clear and colourless	118.	---	---	0.175		---	70.	---		0.013 9	---	---	27.			0.193			7.27	---	---	98.2	---	---
SW-S-27	NS		4/22/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-S-27	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-S-27	SS		12/3/2020	Clear and colourless.	47.7	---	---	0.179		---	126.	---		0.057 7	---	---	14.			0.32			1.49	---	---	123.	---	---
SW-S-27	SS		2/3/2021	Moderately high flow,clear and colourless	168.	---	---	0.151		---	77.	---		0.082 3	---	---	20.			0.351			1.56	---	---	94.4	---	---
SW-S-52	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null		---	Null	---		Null	---	---	Null			Null			Null	---	---	Null	---	---
SW-S-52	SS		12/3/2020	Clear and colourless.	12.5	---	---	0.046		---	19.	---		< 0.005	---	---	5.4			0.026			0.51	---	---	60.	---	---
SW-S-52	SS		2/3/2021	High flow, clear and colourless	11.8	---	---	0.038		---	12.	---		< 0.005	---	---	5.1			0.019 1			0.292	---	---	53.5	---	---

Notes:

na — *Not applicable.*

Null — *No sample collected.*

a — *Above Maximum allowable concentration (MAC) British Columbia Water Ouality Guideline.*

b — *Above 30-day average British Columbia Water Quality Guideline.*

(1) — *British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for*

(2) — *Maximum acceptable concentration unless otherwise noted.*

(3) — *The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*

(4) — *The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*

(5) — *This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*

(6) — *This value is the short-term daily for streams with unknown fish distribution.*

(7) — *The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the North landfill are derived from stations SW-N-CSs2, SW-N-41s3 and SW-N-14.*

(8) — *Dissolved copper guideline varies with water hardness, temperature and dissolved organic carbon; Dissolved copper results were only compared with guidelines where DOC was analyzed.*

B.C. Water Quality Guidelines				BC WQG MAXIMUM (1)	1000			3.28 - 416.7 (5)			815 - 3394 (5)			2000			1.9 - 24.9 (3)			0.06 - 0.6 (4)			32.8			---		
				BC WQG AVERAGE (1)	---			3.43 - 19.57 (5)			767 - 2585 (5)			1000			0.135 - 1.77 (3)			0.02 - 0.2 (4)			3			---		
				PARAMETER	Iron			Lead			Manganese			Molybdenum			N - Nh3 (As N)			N - No2 (As N)			N - No3 (As N)			Nickel		
				STATE	TOT			TOT			TOT			TOT			TOT			DIS			DIS			TOT		
				UNIT	µg/L			µg/L			µg/L			µg/L			mg/L			mg/L			mg/L			µg/L		
STATION	SAMPLE TYPE	COMPLIANCE WELL?	DATE	Method Detection Limit (MDL)	1			0.005			0.1			0.05			0.015			0.005			0.02			0.02		
				Limit of Quantification (LOQ)	5			0.025			0.5			0.25			0.075			0.025			0.1			0.1		
					30%			30%			30%			30%			30%			30%			30%			30%		
				COMMENTS	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG
SW-N-05	FRM	COMPLIANCE	4/21/2020	Mean of duplicates	46.7		---	< 0.020 5			1.782 5			0.833 5			< 0.015 5			< 0.005			1.055			0.353 5	---	---
SW-N-05	FRM	COMPLIANCE	9/29/2020	Mean of duplicates	167.5		---	0.027 1			5.79			0.747 5			0.021			< 0.005			3.055		b	0.696 5	---	---
SW-N-05	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	101.7		---	< 0.018 3			2.445			1.58			0.022			< 0.005			6.23		b	0.532	---	---
SW-N-05	FRM	COMPLIANCE	2/3/2021	Mean of duplicates	186.		---	0.014 35			3.315			1.305			0.235			< 0.005			6.415		b	0.492 5	---	---
SW-N-14	NS		10/1/2020	Inaccessible due to active shooting.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-N-14	NS		12/2/2020	Inaccessible due to active shooting.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-N-14	NS		2/4/2021	Inaccessible due to active shooting.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-N-16	FRM	COMPLIANCE	4/21/2020	Mean of duplicates	**1 875.**	**a**	---	< 0.021			742.5			0.713			0.12			< 0.005			< 0.02			1.685	---	---
SW-N-16	FRM	COMPLIANCE	9/29/2020	Mean of duplicates	283.5		---	0.079			98.			1.31			0.098 5			0.077 6			0.691			2.12	---	---
SW-N-16	FRM	COMPLIANCE	12/1/2020	Mean of duplicates	203.5		---	< 0.02			60.2			0.788			0.051 5			0.018 3			7.305		b	1.51	---	---
SW-N-16	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	245.		---	0.024 65			50.95			0.867			0.565			0.006 4			3.365		b	1.81	---	---
SW-N-17	SS		4/24/2020		167.		---	0.056			24.5			0.694			0.016			< 0.005			0.785			0.33	---	---
SW-N-17	SS		9/30/2020	Clear and colourless, moderate flow, abundance of decaying leaves	55.3		---	0.020 1			28.4			0.823			0.016			< 0.005			0.883			0.393	---	---
SW-N-17	SS		12/2/2020	Clear and colourless.	42.1		---	0.012 7			6.97			0.827			0.25			< 0.005			3.63		b	0.254	---	---
SW-N-17	SS		2/4/2021	Moderately high flow,clear and colourless	45.2		---	0.454			4.06			0.783			0.52			< 0.005			3.11		b	0.24	---	---
SW-N-18	SS		4/21/2020		41.3		---	0.016 2			0.863			0.448			< 0.015			< 0.005			0.775			0.128	---	---
SW-N-18	SS		9/29/2020	Clear and colourless, moderate flow	28.8		---	0.028 1			1.09			0.65			0.05			< 0.005			3.96		b	0.248	---	---
SW-N-18	SS		12/2/2020	Clear and colourless.	47.6		---	0.018 1			1.09			0.33			0.026			< 0.005			0.97			0.138	---	---
SW-N-18	SS		2/3/2021	High flow, clear and colourless	347.		---	0.032 1			6.5			0.42			0.018			< 0.005			0.801			0.309	---	---
SW-N-19	SS		4/21/2020		122.		---	0.058			280.			1.1			0.051			0.005 7			0.132			3.3	---	---
SW-N-19	SS		9/29/2020	Clear and colourless, moderate flow	323.		---	0.028 6			175.			0.771			0.19			0.208		b	1.4			2.31	---	---
SW-N-19	SS		12/1/2020	Clear and colourless.	29.		---	< 0.02			15.6			0.902			0.11			0.045 2			8.23		b	1.97	---	---
SW-N-19	SS		2/4/2021	Moderately high flow, clear and slightly yellow	86.7		---	0.05			12.6			0.973			0.61			0.008 1			3.3		b	2.42	---	---
SW-N-41S1	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	**1 780.**	**a**	---	0.825			551.5			0.402			0.027 5			< 0.005			0.162			1.345	---	---
SW-N-41S1	FRM	COMPLIANCE	9/30/2020	Mean of duplicates	110.5		---	0.045 75			178.5			0.478 5			< 0.017 5			< 0.005			0.338			0.209 5	---	---
SW-N-41S1	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	127.		---	0.016 55			113.5			0.280 5			0.024 5			< 0.005			0.447 5			0.140 5	---	---
SW-N-41S1	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	86.15		---	< 0.022			74.6			0.283 5			< 0.015			< 0.005			0.201			0.135	---	---
SW-N-41S3	SS		4/22/2020		170.		---	0.259			11.6			0.327			0.06			< 0.005			0.047			0.31	---	---
SW-N-41S3	SS		9/30/2020	Clear and colourless, moderate flow	11.5		---	0.005 8			2.63			0.432			0.015			< 0.005			0.072			0.075	---	---
SW-N-41S3	SS		12/2/2020	Clear and colourless.	13.2		---	0.009 1			2.09			0.311			0.18			< 0.005			0.024			0.084	---	---
SW-N-41S3	SS		2/4/2021	High flow, clear and colourless	18.9		---	0.020 3			2.39			0.281			< 0.015			< 0.005			< 0.02			0.065	---	---
SW-N-42S1	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	971.		---	0.602 5			465.5			0.466 5			0.03			< 0.005			0.051			0.705	---	---
SW-N-42S1	FRM	COMPLIANCE	9/30/2020	Mean of duplicates	260.5		---	0.096			232.			0.555 5			0.031			< 0.005			0.038			0.295	---	---
SW-N-42S1	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	451.1		---	0.299 5			167.8			0.45			0.023			< 0.005			0.136 5			0.38	---	---
SW-N-42S1	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	42.		---	0.024 5			14.35			0.486			< 0.026 5			< 0.005			0.145 5			0.105	---	---
SW-N-45	SS		4/24/2020		35.6		---	< 0.02			11.9			0.944			0.04			< 0.005			1.24			0.34	---	---
SW-N-45	SS		9/30/2020	Clear and colourless, moderate flow	11.		---	0.007 3			5.46			1.01			0.033			< 0.005			1.9			0.288	---	---
SW-N-45	SS		12/2/2020	Clear and colourless.	77.1		---	0.026			5.36			1.27			0.035			< 0.005			6.		b	0.42	---	---
SW-N-45	SS		2/4/2021	High flow, clear and colourless	102.		---	0.019 6			3.64			1.24			< 0.015			< 0.005			4.47		b	0.37	---	---
SW-N-50	SS		4/21/2020		11.8		---	< 0.005			0.45			0.41			< 0.015			< 0.005			1.16			0.11	---	---
SW-N-50	SS		9/29/2020	Slightly turbid and colourless, low flow	130.		---	0.028 4			3.13			0.652			< 0.015			< 0.005			3.92		b	0.283	---	---
SW-N-50	SS		12/2/2020	Clear and colourless.	109.		---	0.009 2			1.93			0.392			< 0.015			< 0.005			0.904			0.2	---	---
SW-N-50	SS		2/8/2021	High flow, clear and colourless, plastic garbage observed in culvert	181.		---	0.034			4.01			0.304			0.38			< 0.005			0.526			0.218	---	---
SW-N-51	NS		4/21/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-N-51	NS		10/1/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-N-51	NS		12/2/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-N-51	NS		2/8/2021	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-N-53	NS		4/21/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-N-53	NS		10/1/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-N-53	NS		12/2/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-N-53	NS		2/3/2021	Dry, no sample collected	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-N-54	SS		4/21/2020		66.9		---	< 0.02			57.			0.878			0.031			< 0.005			0.309			1.38	---	---
SW-N-54	SS		9/29/2020	Slightly turbid, slightly yellow, moderately low flow	128.		---	0.020 6			401.			0.683			0.17			0.012 1			0.182			1.61	---	---
SW-N-54	SS		12/2/2020	Clear and colourless.	317.		---	0.041			18.4			0.645			0.18			0.014 2			6.52		b	1.48	---	---
SW-N-54	SS		2/3/2021	Moderately high flow, clear and slightly yellow	411.		---	0.042 1			26.3			0.491			< 0.015			< 0.005			1.26			1.38	---	---
SW-N-CS2	NS		10/1/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-N-CS2	SS		12/2/2020	Clear and colourless.	4.		---	< 0.005			0.127			0.074			0.12			< 0.005			< 0.02			0.037	---	---
SW-N-CS2	SS		2/4/2021	High flow, clear and colourless	2.5		---	0.009 5			0.149			0.077			< 0.015			< 0.005			< 0.02			< 0.02	---	---
SW-S-03	SS		4/22/2020		**15 400.**	**a**	---	14.7		**b**	570.			0.585			0.14			0.014 2			1.12			13.2	---	---
SW-S-03	SS		10/1/2020	Clear and colourless, moderately low flow	**1 120.**	**a**	---	1.78			40.2			0.317			0.016			0.006 4			4.58		b	1.86	---	---
SW-S-03	SS		12/3/2020	Clear and colourless.	**2 160.**	**a**	---	3.56			203.			0.196			0.18			0.111			2.61			3.57	---	---
SW-S-03	SS		2/3/2021	Moderately high flow,clear and colourless	286.		---	0.045 7			111.			0.137			1.4			0.030 6			0.999			2.22	---	---
SW-S-04	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	**1 295.**	**a**	---	1.035			66.9			0.358			0.048			0.015 85			0.450 5			1.585	---	---
SW-S-04	FRM	COMPLIANCE	10/1/2020	Mean of duplicates	21.1		---	0.030 35			8.39			0.127 5			< 0.015			< 0.005			1.215			0.333 5	---	---
SW-S-04	FRM	COMPLIANCE	12/3/2020	Mean of duplicates	224.		---	0.154			23.75			0.169			0.16			0.021 1			1.995			0.810 5	---	---
SW-S-04	FRM	COMPLIANCE	2/3/2021	Mean of duplicates	202.5		---	0.122			17.45			0.101			0.035 5			< 0.005 05			1.28			0.83	---	---
SW-S-12	SS		4/22/2020		**19 600.**	**a**	---	2.11			364.			0.364			0.57			0.046 7			3.16		b	16.8	---	---
SW-S-12	SS		10/1/2020	Clear and colourless, low flow	60.7		---	0.016 1			25.6			0.193			0.025			< 0.005			7.67		b	5.1	---	---
SW-S-12	SS		12/3/2020	Clear and colourless.	473.		---	0.023 4			368.			0.074			3.4	**b**		0.060 7			2.71			1.94	---	---
SW-S-12	SS		2/3/2021	Moderately high flow,clear and colourless	399.		---	0.032			196.			0.103			2.5	**b**		0.020 4			2.35			3.3	---	---
SW-S-20	NS		10/1/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-S-20	SS		12/3/2020	Clear and colourless.	152.		---	0.037			44.2			0.052			0.17			< 0.005			0.074			0.28	---	---
SW-S-20	SS		2/3/2021	High flow, clear and colourless	212.		---	0.051			5.85			0.059			0.087			< 0.005			0.06			0.26	---	---
SW-S-21	NS		4/22/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-S-21	NS		10/1/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-S-21	SS		12/3/2020	Clear and colourless.	400.		---	0.24			20.9			0.07			0.21			< 0.005			0.277			0.54	---	---
SW-S-21	SS		2/3/2021	Moderately high flow,clear and colourless	63.3		---	0.027			1.29			0.062			< 0.015			< 0.005			0.105			0.19	---	---
SW-S-24	SS		4/22/2020		**1 300.**	**a**	---	0.976			110.			0.359			0.037			0.011 5			0.544			1.68	---	---
SW-S-24	SS		10/1/2020	Clear and colourless, moderately low flow	9.3		---	0.013			19.8			0.123			0.022			< 0.005			0.035			0.655	---	---
SW-S-24	SS		12/3/2020	Clear and colourless.	152.		---	0.114			31.7			0.182			0.14			0.039 9			2.28			0.85	---	---
SW-S-24	SS		2/3/2021	High flow, clear and colourless	222.		---	0.128			32.2			0.163			0.049			0.016 2			2.15			1.19	---	---
SW-S-27	NS		4/22/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-S-27	NS		10/1/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-S-27	SS		12/3/2020	Clear and colourless.	94.7		---	0.187			125.			0.166			0.19			< 0.005			< 0.02			0.72	---	---
SW-S-27	SS		2/3/2021	Moderately high flow,clear and colourless	362.		---	0.32			68.6			0.126			0.017			< 0.005			0.091			0.59	---	---
SW-S-52	NS		10/1/2020	Dry. No sample collected.	Null		---	Null			Null			Null			Null			Null			Null			Null	---	---
SW-S-52	SS		12/3/2020	Clear and colourless.	6.5		---	< 0.02			0.27			< 0.05			0.18			< 0.005			< 0.02			< 0.1	---	---
SW-S-52	SS		2/3/2021	High flow, clear and colourless	7.3		---	0.005 1			0.303			< 0.05			0.018			< 0.005			< 0.02			< 0.02	---	---

Notes:

na — *Not applicable.*

Null — *No sample collected.*

a — *Above Maximum allowable concentration (MAC) British Columbia Water Ouality Guideline.*

b — *Above 30-day average British Columbia Water Quality Guideline.*

(1) — *British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for*

(2) — *Maximum acceptable concentration unless otherwise noted.*

(3) — *The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*

(4) — *The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*

(5) — *This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*

(6) — *This value is the short-term daily for streams with unknown fish distribution.*

(7) — *The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the North landfill are derived from stations SW-N-CSs2, SW-N-41s3 and SW-N-14.*

(8) — *Dissolved copper guideline varies with water hardness, temperature and dissolved organic carbon; Dissolved copper results were only compared with guidelines where DOC was analyzed.*

B.C. Water Quality Guidelines				BC WQG MAXIMUM (1)	---			0.05 - 1.5 (5)			128 - 429 (5)			Variable (7)			33 - 340.5 (5)			6.5 to 9.0			---			---			100		
				BC WQG AVERAGE (1)	---			0.1 - 3 (5)			---			Variable (7)			7.5 - 187.5 (5)			---			---			---			50		
				PARAMETER	Selenium			Silver			Sulphate			TSS			Zinc			pH			Conductivity			Temperature			Aluminum		
				STATE	TOT			TOT			DIS			TOT			TOT			TOT			TOT			TOT			DIS		
				UNIT	µg/L			µg/L			mg/L			mg/L			µg/L			pH			µS/cm			°C			µg/L		
STATION	SAMPLE TYPE	COMPLIANCE WELL?	DATE	Method Detection Limit (MDL)	0.04			0.005			1			1			1			0.1			1			0.1			0.5		
				Limit of Quantification (LOQ)	0.2			0.025			5			5			5			0.5			5			0.5			2.5		
					30%			30%			30%			30%			30%			30%			30%			30%			30%		
				COMMENTS	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG
SW-N-05	FRM	COMPLIANCE	4/21/2020	Mean of duplicates	0.223 5	---	---	< 0.007 5			110.	---		7.6		b	1.445			7.31	---	---	289.	---	---	9.7	---	---	6.315		
SW-N-05	FRM	COMPLIANCE	9/29/2020	Mean of duplicates	0.5	---	---	< 0.005			230.	---		2.8			2.78			6.67	---	---	535.	---	---	13.6	---	---	3.835		
SW-N-05	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	0.485	---	---	< 0.007 5			180.	---		9.		b	2.175			7.12		---	301.	---	---	8.8	---	---	23.		
SW-N-05	FRM	COMPLIANCE	2/3/2021	Mean of duplicates	0.357	---	---	< 0.005			130.	---		< 1.			2.745			7.23	---	---	328.	---	---	8.3	---	---	18.65		
SW-N-14	NS		10/1/2020	Inaccessible due to active shooting.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-N-14	NS		12/2/2020	Inaccessible due to active shooting.	Null	---	---	Null			Null	---		Null			Null			Null		---	Null	---	---	Null	---	---	Null		
SW-N-14	NS		2/4/2021	Inaccessible due to active shooting.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-N-16	FRM	COMPLIANCE	4/21/2020	Mean of duplicates	0.107	---	---	< 0.01			49.	---		15.5		b	5.25			7.06	---	---	306.	---	---	10.1	---	---	5.875		
SW-N-16	FRM	COMPLIANCE	9/29/2020	Mean of duplicates	0.125 5	---	---	< 0.005 25			92.5	---		2.2			15.3			**6.43**	**a**	---	379.	---	---	14.	---	---	9.945		
SW-N-16	FRM	COMPLIANCE	12/1/2020	Mean of duplicates	0.116 5	---	---	< 0.01			120.	---		< 1.7			6.6			**6.44**	**a**	---	331.	---	---	6.4	---	---	12.1		
SW-N-16	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	0.129 5	---	---	< 0.005			43.5	---		< 1.			8.18			7.39	---	---	230.	---	---	6.7	---	---	22.25		
SW-N-17	SS		4/24/2020		0.14	---	---	< 0.01			84.	---		1.6			1.7			6.98	---	---	367.	---	---	9.9	---	---	4.97		
SW-N-17	SS		9/30/2020	Clear and colourless, moderate flow, abundance of decaying leaves	0.211	---	---	< 0.005			140.	---		1.2			4.06			**6.15**	**a**	---	367.	---	---	13.4	---	---	7.04		
SW-N-17	SS		12/2/2020	Clear and colourless.	0.282	---	---	< 0.005			170.	---		2.4			1.71			**6.27**	**a**	---	365.	---	---	7.5	---	---	7.42		
SW-N-17	SS		2/4/2021	Moderately high flow,clear and colourless	0.207	---	---	< 0.01			87.	---		< 1.			20.8			7.36	---	---	263.	---	---	7.3	---	---	10.5		
SW-N-18	SS		4/21/2020		0.195	---	---	< 0.005			100.	---		< 1.			1.73			7.96	---	---	274.	---	---	9.6	---	---	3.29		
SW-N-18	SS		9/29/2020	Clear and colourless, moderate flow	0.334	---	---	< 0.005			260.	---		< 1.			6.05			6.76	---	---	548.	---	---	13.5	---	---	3.01		
SW-N-18	SS		12/2/2020	Clear and colourless.	0.218	---	---	< 0.005			150.	---		< 1.			1.25			7.39		---	242.	---	---	8.8	---	---	8.45		
SW-N-18	SS		2/3/2021	High flow, clear and colourless	0.142	---	---	< 0.005			100.	---		< 1.			4.43			7.35	---	---	237.	---	---	8.4	---	---	5.57		
SW-N-19	SS		4/21/2020		0.195	---	---	0.016			85.	---		6.		b	1.9			8.4	---	---	315.	---	---	11.6	---	---	12.4		
SW-N-19	SS		9/29/2020	Clear and colourless, moderate flow	0.145	---	---	0.006 9			99.	---		< 1.			1.33			7.76	---	---	391.	---	---	16.1	---	---	9.64		
SW-N-19	SS		12/1/2020	Clear and colourless.	0.131	---	---	< 0.01			130.	---		2.4			4.1			6.71		---	345.	---	---	6.4	---	---	13.2		
SW-N-19	SS		2/4/2021	Moderately high flow, clear and slightly yellow	0.153	---	---	< 0.005			50.	---		1.2			7.25			7.06	---	---	235.	---	---	6.9	---	---	26.5		
SW-N-41S1	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	0.159 5	---	---	0.013			66.	---		54.5	**a**	**b**	6.5			7.77	---	---	255.	---	---	8.9	---	---	6.925		
SW-N-41S1	FRM	COMPLIANCE	9/30/2020	Mean of duplicates	0.145 5	---	---	< 0.005			130.	---		2.2			2.65			7.33	---	---	387.	---	---	12.7	---	---	4.065		
SW-N-41S1	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	0.083 5	---	---	< 0.005			110.	---		< 2.5			0.87			7.41		---	341.	---	---	8.4	---	---	8.795		
SW-N-41S1	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	0.066	---	---	< 0.01			62.	---		< 1.			< 1.			7.59	---	---	235.	---	---	8.2	---	---	4.915		
SW-N-41S3	SS		4/22/2020		0.133	---	---	< 0.01			28.	---		9.2		b	2.1			7.43	---	---	191.	---	---	8.4	---	---	4.89		
SW-N-41S3	SS		9/30/2020	Clear and colourless, moderate flow	0.081	---	---	< 0.005			37.	---		3.2			0.12			7.15	---	---	271.	---	---	12.5	---	---	5.		
SW-N-41S3	SS		12/2/2020	Clear and colourless.	0.068	---	---	< 0.005			15.	---		1.6			0.61			7.66		---	147.	---	---	8.2	---	---	4.56		
SW-N-41S3	SS		2/4/2021	High flow, clear and colourless	0.067	---	---	< 0.005			16.	---		< 1.			0.86			7.46	---	---	135.	---	---	7.6	---	---	3.57		
SW-N-42S1	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	0.103	---	---	< 0.01			90.5	---		**34.5**	**a**	**b**	5.8			7.3	---	---	309.	---	---	9.3	---	---	9.14		
SW-N-42S1	FRM	COMPLIANCE	9/30/2020	Mean of duplicates	0.064	---	---	< 0.01			125.	---		7.7		b	1.6			6.63	---	---	437.	---	---	12.9	---	---	7.525		
SW-N-42S1	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	0.1	---	---	< 0.01			125.	---		23.5		b	< 2.35			6.82		---	326.	---	---	6.	---	---	10.04		
SW-N-42S1	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	0.054	---	---	< 0.01			74.5	---		< 1.			< 1.			7.24	---	---	267.	---	---	7.2	---	---	6.65		
SW-N-45	SS		4/24/2020		0.199	---	---	< 0.01			97.	---		4.			1.3			7.27	---	---	333.	---	---	8.8	---	---	7.28		
SW-N-45	SS		9/30/2020	Clear and colourless, moderate flow	0.395	---	---	< 0.005			170.	---		5.2		b	1.34			**6.25**	**a**	---	341.	---	---	12.7	---	---	4.74		
SW-N-45	SS		12/2/2020	Clear and colourless.	0.481	---	---	< 0.01			200.	---		1.2			2.6			6.67		---	425.	---	---	8.4	---	---	14.7		
SW-N-45	SS		2/4/2021	High flow, clear and colourless	0.302	---	---	< 0.005			120.	---		1.6			2.71			7.21	---	---	308.	---	---	8.1	---	---	12.9		
SW-N-50	SS		4/21/2020		0.215	---	---	< 0.005			100.	---		< 1.			0.28			7.48	---	---	267.	---	---	8.7	---	---	3.33		
SW-N-50	SS		9/29/2020	Slightly turbid and colourless, low flow	0.37	---	---	< 0.005			220.	---		4.			0.4			6.79	---	---	283.	---	---	12.9	---	---	4.3		
SW-N-50	SS		12/2/2020	Clear and colourless.	0.214	---	---	< 0.005			140.	---		1.2			0.9			7.87		---	332.	---	---	8.8	---	---	6.78		
SW-N-50	SS		2/8/2021	High flow, clear and colourless, plastic garbage observed in culvert	0.118	---	---	< 0.005			63.	---		< 1.			0.9			7.45	---	---	206.	---	---	8.3	---	---	4.55		
SW-N-51	NS		4/21/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-N-51	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-N-51	NS		12/2/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null		---	Null	---	---	Null	---	---	Null		
SW-N-51	NS		2/8/2021	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-N-53	NS		4/21/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-N-53	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-N-53	NS		12/2/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null		---	Null	---	---	Null	---	---	Null		
SW-N-53	NS		2/3/2021	Dry, no sample collected	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-N-54	SS		4/21/2020		0.258	---	---	< 0.01			35.	---		< 1.			< 1.			8.26	---	---	285.	---	---	11.1	---	---	5.22		
SW-N-54	SS		9/29/2020	Slightly turbid, slightly yellow, moderately low flow	0.223	---	---	< 0.005			110.	---		2.8			0.64			6.99	---	---	285.	---	---	17.4	---	---	**121.**	**a**	**b**
SW-N-54	SS		12/2/2020	Clear and colourless.	0.268	---	---	< 0.01			65.	---		4.			1.4			7.19		---	301.	---	---	8.8	---	---	52.4		**b**
SW-N-54	SS		2/3/2021	Moderately high flow, clear and slightly yellow	0.187	---	---	< 0.005			42.	---		< 1.			5.6			7.53	---	---	237.	---	---	7.6	---	---	8.52		
SW-N-CS2	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-N-CS2	SS		12/2/2020	Clear and colourless.	0.051	---	---	< 0.005			7.7	---		< 1.			0.37			7.44		---	103.	---	---	8.5	---	---	4.86		
SW-N-CS2	SS		2/4/2021	High flow, clear and colourless	0.04	---	---	< 0.005			7.4	---		1.2			0.65			7.44	---	---	92.	---	---	7.6	---	---	4.21		
SW-S-03	SS		4/22/2020		0.16	---	---	**0.141**	**a**	**b**	16.	---		**130.**	**a**	**b**	**224.**	**a**	**b**	7.28	---	---	102.	---	---	11.7	---	---	**387.**	**a**	**b**
SW-S-03	SS		10/1/2020	Clear and colourless, moderately low flow	0.156	---	---	0.012			110.	---		5.2		b	23.			6.73	---	---	404.	---	---	16.	---	---	5.94		
SW-S-03	SS		12/3/2020	Clear and colourless.	0.126	---	---	0.011			27.	---		**45.**	**a**	**b**	33.5			7.12		---	209.	---	---	11.3	---	---	**146.**	**a**	**b**
SW-S-03	SS		2/3/2021	Moderately high flow,clear and colourless	0.11	---	---	< 0.005			23.	---		< 1.			4.34			6.85	---	---	190.	---	---	9.	---	---	45.		
SW-S-04	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	0.067 5	---	---	< 0.01			18.5	---		9.7		b	15.		b	7.43	---	---	156.	---	---	9.9	---	---	15.6		
SW-S-04	FRM	COMPLIANCE	10/1/2020	Mean of duplicates	0.075	---	---	< 0.005			59.	---		2.			2.545			**6.28**	**a**	---	267.	---	---	11.9	---	---	9.395		
SW-S-04	FRM	COMPLIANCE	12/3/2020	Mean of duplicates	0.081 5	---	---	< 0.007 5			30.5	---		2.4			5.93			7.07		---	197.	---	---	8.4	---	---	13.85		
SW-S-04	FRM	COMPLIANCE	2/3/2021	Mean of duplicates	0.066 5	---	---	< 0.01			18.5	---		< 1.			6.95			7.02	---	---	137.7	---	---	6.8	---	---	27.5		
SW-S-12	SS		4/22/2020		0.231	---	---	0.024			54.	---		**130.**	**a**	**b**	51.3			7.18	---	---	217.	---	---	11.6	---	---	**666.**	**a**	**b**
SW-S-12	SS		10/1/2020	Clear and colourless, low flow	0.271	---	---	< 0.005			200.	---		1.6			7.14			7.08	---	---	535.	---	---	16.7	---	---	29.2		
SW-S-12	SS		12/3/2020	Clear and colourless.	0.101	---	---	< 0.005			30.	---		< 1.			3.77			6.8		---	253.	---	---	11.1	---	---	31.3		
SW-S-12	SS		2/3/2021	Moderately high flow,clear and colourless	0.166	---	---	< 0.01			27.	---					4.			6.81	---	---	210.	---	---	9.3	---	---	64.4		**b**
SW-S-20	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-S-20	SS		12/3/2020	Clear and colourless.	0.063	---	---	< 0.01			5.2	---		2.8			13.4		b	7.2		---	94.	---	---	7.3	---	---	31.7		
SW-S-20	SS		2/3/2021	High flow, clear and colourless	< 0.04	---	---	< 0.01			< 1.	---		< 1.			11.2		b	7.04	---	---	112.	---	---	5.9	---	---	45.6		
SW-S-21	NS		4/22/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-S-21	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-S-21	SS		12/3/2020	Clear and colourless.	0.075	---	---	< 0.01			5.8	---		1.6			15.8		b	7.54		---	78.	---	---	6.8	---	---	32.2		
SW-S-21	SS		2/3/2021	Moderately high flow,clear and colourless	< 0.04	---	---	< 0.01			< 1.	---		< 1.			9.5		b	6.96	---	---	65.3	---	---	5.9	---	---	36.9		
SW-S-24	SS		4/22/2020		0.07	---	---	< 0.01			20.	---		8.4		b	15.4		b	7.48	---	---	158.	---	---	10.8	---	---	16.		
SW-S-24	SS		10/1/2020	Clear and colourless, moderately low flow	0.086	---	---	< 0.005			90.	---		7.2		b	6.61			6.62	---	---	225.	---	---	13.8	---	---	8.76		
SW-S-24	SS		12/3/2020	Clear and colourless.	0.09	---	---	< 0.01			33.	---		1.2			5.4			7.4		---	217.	---	---	9.1	---	---	23.7		
SW-S-24	SS		2/3/2021	High flow, clear and colourless	0.105	---	---	< 0.01			27.	---		< 1.			5.4			6.66	---	---	190.	---	---	7.8	---	---	23.3		
SW-S-27	NS		4/22/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-S-27	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-S-27	SS		12/3/2020	Clear and colourless.	0.066	---	---	< 0.01			40.	---		< 1.			6.9			7.1		---	207.	---	---	6.1	---	---	18.2		
SW-S-27	SS		2/3/2021	Moderately high flow,clear and colourless	0.043	---	---	< 0.01			28.	---		< 1.			5.9			6.68	---	---	169.	---	---	5.7	---	---	15.		
SW-S-52	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null			Null	---		Null			Null			Null	---	---	Null	---	---	Null	---	---	Null		
SW-S-52	SS		12/3/2020	Clear and colourless.	0.062	---	---	< 0.01			6.6	---		< 1.			1.6			7.52		---	94.	---	---	8.1	---	---	6.5		
SW-S-52	SS		2/3/2021	High flow, clear and colourless	< 0.04	---	---	< 0.005			6.7	---		< 1.			1.15			7.27	---	---	168.	---	---	7.6	---	---	9.73		

Notes:

na — *Not applicable.*

Null — *No sample collected.*

a — *Above Maximum allowable concentration (MAC) British Columbia Water Ouality Guideline.*

b — *Above 30-day average British Columbia Water Quality Guideline.*

(1) — *British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for*

(2) — *Maximum acceptable concentration unless otherwise noted.*

(3) — *The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*

(4) — *The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*

(5) — *This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*

(6) — *This value is the short-term daily for streams with unknown fish distribution.*

(7) — *The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the North landfill are derived from stations SW-N-CSs2, SW-N-41s3 and SW-N-14.*

(8) — *Dissolved copper guideline varies with water hardness, temperature and dissolved organic carbon; Dissolved copper results were only compared with guidelines where DOC was analyzed.*

AECOM

B.C. Water Quality Guidelines				BC WQG MAXIMUM (1)	---			---			0.038-2.8 (5)			---			Variable (8)			---			350			---			---		
				BC WQG AVERAGE (1)	---			---			0.018-0.645 (5)			---			Variable (8)			---			---			---			---		
STATION	SAMPLE TYPE	COMPLIANCE WELL?	DATE	PARAMETER	Arsenic			Boron			Cadmium			Cobalt			Copper			Hardness (As Caco3)			Iron			Lead			Manganese		
				STATE	DIS			DIS			DIS			DIS			DIS			DIS			DIS			DIS			DIS		
				UNIT	µg/L			µg/L			µg/L			µg/L			µg/L			mg/L			µg/L			µg/L			µg/L		
				Method Detection Limit (MDL)	0.02			10			0.005			0.005			0.05			0.5			1			0.005			0.05		
				Limit of Quantification (LOQ)	0.1			50			0.025			0.025			0.25			2.5			5			0.025			0.25		
					30%			30%			30%			30%			30%			30%			30%			30%			30%		
				COMMENTS	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG
SW-N-05	FRM	COMPLIANCE	4/21/2020	Mean of duplicates	0.161 5	---	---	25.5	---	---	< 0.005 4			0.045 8	---	---	**5.735**	**a**	**b**	188.	---	---	19.		---	0.085 15	---	---	0.489 5	---	---
SW-N-05	FRM	COMPLIANCE	9/29/2020	Mean of duplicates	0.13	---	---	35.	---	---	0.066 85			0.077 45	---	---	**5.605**	**a**	**b**	333.5	---	---	4.05		---	0.096 8	---	---	0.624 5	---	---
SW-N-05	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	0.153 5	---	---	47.	---	---	0.007 8			0.101 5	---	---	1.265		**b**	294.5	---	---	20.4		---	< 0.005	---	---	0.902 5	---	---
SW-N-05	FRM	COMPLIANCE	2/3/2021	Mean of duplicates	0.119	---	---	41.5	---	---	0.026 9			0.076 6	---	---	1.2		**b**	222.5	---	---	12.05		---	< 0.005 5	---	---	0.498	---	---
SW-N-14	NS		10/1/2020	Inaccessible due to active shooting.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-N-14	NS		12/2/2020	Inaccessible due to active shooting.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-N-14	NS		2/4/2021	Inaccessible due to active shooting.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-N-16	FRM	COMPLIANCE	4/21/2020	Mean of duplicates	0.275 5	---	---	92.5	---	---	0.006 8			0.712	---	---	5.02		**b**	182.	---	---	199.		---	0.083 3	---	---	714.	---	---
SW-N-16	FRM	COMPLIANCE	9/29/2020	Mean of duplicates	0.262 5	---	---	88.	---	---	0.021 3			0.407 5	---	---	**7.65**	**a**	**b**	211.5	---	---	108.5		---	0.088 3	---	---	94.	---	---
SW-N-16	FRM	COMPLIANCE	12/1/2020	Mean of duplicates	0.271 5	---	---	52.	---	---	0.010 4			0.238 5	---	---	**9.005**	**a**	**b**	217.	---	---	92.65		---	0.174 05	---	---	48.4	---	---
SW-N-16	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	0.241 5	---	---	45.5	---	---	0.009 95			0.253	---	---	9.855		**b**	146.5	---	---	227.5		---	0.006 8	---	---	60.45	---	---
SW-N-17	SS		4/24/2020		0.103	---	---	70.	---	---	< 0.005			0.077 9	---	---	0.942		**b**	159.	---	---	20.		---	0.015 2	---	---	13.6	---	---
SW-N-17	SS		9/30/2020	Clear and colourless, moderate flow, abundance of decaying leaves	0.182	---	---	122.	---	---	< 0.005			0.143	---	---	0.965			217.	---	---	12.3		---	0.009 2	---	---	26.4	---	---
SW-N-17	SS		12/2/2020	Clear and colourless.	0.143	---	---	89.	---	---	0.006 5			0.071 9	---	---	0.734			237.	---	---	10.2		---	< 0.005	---	---	5.55	---	---
SW-N-17	SS		2/4/2021	Moderately high flow,clear and colourless	0.101	---	---	82.	---	---	0.008 2			0.052 3	---	---	0.775			173.	---	---	11.5		---	0.010 3	---	---	2.96	---	---
SW-N-18	SS		4/21/2020		0.071	---	---	12.	---	---	< 0.005			0.037 2	---	---	**5.84**	**a**	**b**	177.	---	---	12.2		---	0.155	---	---	0.372	---	---
SW-N-18	SS		9/29/2020	Clear and colourless, moderate flow	0.142	---	---	18.	---	---	0.005 8			0.073 2	---	---	0.585			375.	---	---	2.1		---	0.007 2	---	---	0.487	---	---
SW-N-18	SS		12/2/2020	Clear and colourless.	0.092	---	---	13.	---	---	< 0.005			0.035 3	---	---	0.365			207.	---	---	7.		---	< 0.005	---	---	0.303	---	---
SW-N-18	SS		2/3/2021	High flow, clear and colourless	0.06	---	---	< 10.	---	---	< 0.005			0.035 7	---	---	0.489		**b**	179.	---	---	1.9		---	0.005 6	---	---	0.915	---	---
SW-N-19	SS		4/21/2020		0.336	---	---	35.	---	---	0.019 3			2.5	---	---	9.24		**b**	196.	---	---	47.1		---	0.027 7	---	---	258.	---	---
SW-N-19	SS		9/29/2020	Clear and colourless, moderate flow	0.337	---	---	59.	---	---	< 0.005			1.07	---	---	1.99			218.	---	---	220.		---	0.020 8	---	---	173.	---	---
SW-N-19	SS		12/1/2020	Clear and colourless.	0.302	---	---	42.	---	---	0.007 6			0.354	---	---	**11.2**	**a**	**b**	228.	---	---	22.		---	0.036 2	---	---	15.2	---	---
SW-N-19	SS		2/4/2021	Moderately high flow, clear and slightly yellow	0.261	---	---	36.	---	---	0.014 5			0.341	---	---	13.5		**b**	157.	---	---	32.6		---	0.026 9	---	---	11.4	---	---
SW-N-41S1	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	0.170 5	---	---	16.	---	---	< 0.005			0.055 8	---	---	0.639			169.	---	---	19.15		---	0.010 75	---	---	43.05	---	---
SW-N-41S1	FRM	COMPLIANCE	9/30/2020	Mean of duplicates	0.229 5	---	---	23.	---	---	< 0.005			0.138 5	---	---	0.291 5			263.5	---	---	29.55		---	< 0.005	---	---	160.	---	---
SW-N-41S1	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	0.242 5	---	---	19.	---	---	< 0.005			0.125	---	---	0.234			225.5	---	---	85.95		---	< 0.005 7	---	---	105.	---	---
SW-N-41S1	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	0.186 5	---	---	18.	---	---	< 0.005			0.069 7	---	---	0.268			171.5	---	---	49.15		---	0.005 25	---	---	68.15	---	---
SW-N-41S3	SS		4/22/2020		0.127	---	---	32.	---	---	0.008 8			0.023 5	---	---	2.11		**b**	121.	---	---	31.8		---	0.036 8	---	---	3.39	---	---
SW-N-41S3	SS		9/30/2020	Clear and colourless, moderate flow	0.214	---	---	59.	---	---	< 0.005			0.014 6	---	---	0.443			167.	---	---	5.9		---	0.013 1	---	---	2.36	---	---
SW-N-41S3	SS		12/2/2020	Clear and colourless.	0.107	---	---	23.	---	---	< 0.005			0.019 1	---	---	0.358			88.2	---	---	2.9		---	< 0.005	---	---	1.31	---	---
SW-N-41S3	SS		2/4/2021	High flow, clear and colourless	0.074	---	---	19.	---	---	< 0.005			0.014 5	---	---	0.294			86.4	---	---	3.1		---	< 0.005	---	---	0.98	---	---
SW-N-42S1	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	0.163	---	---	40.	---	---	< 0.008 7			0.087 85	---	---	0.707 5			188.5	---	---	32.6		---	0.014	---	---	43.25	---	---
SW-N-42S1	FRM	COMPLIANCE	9/30/2020	Mean of duplicates	0.222	---	---	54.5	---	---	< 0.005			0.152	---	---	0.383 5			277.5	---	---	57.95		---	0.011 95	---	---	126.5	---	---
SW-N-42S1	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	0.122	---	---	60.	---	---	< 0.005			0.073 85	---	---	0.460 5			214.5	---	---	36.5		---	0.013 55	---	---	27.2	---	---
SW-N-42S1	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	0.090 5	---	---	56.5	---	---	< 0.005			0.042 85	---	---	0.481			171.	---	---	18.35		---	0.008 3	---	---	10.7	---	---
SW-N-45	SS		4/24/2020		0.097	---	---	58.	---	---	< 0.005			0.103	---	---	1.52		**b**	169.	---	---	15.2		---	0.014 7	---	---	10.5	---	---
SW-N-45	SS		9/30/2020	Clear and colourless, moderate flow	0.125	---	---	102.	---	---	< 0.005			0.105	---	---	**1.36**	**a**	**b**	257.	---	---	2.8		---	0.008 5	---	---	5.3	---	---
SW-N-45	SS		12/2/2020	Clear and colourless.	0.131	---	---	73.	---	---	0.005 7			0.102	---	---	1.41		**b**	284.	---	---	14.7		---	0.014 5	---	---	2.34	---	---
SW-N-45	SS		2/4/2021	High flow, clear and colourless	0.118	---	---	65.	---	---	0.007 1			0.073 6	---	---	1.01		**b**	217.	---	---	13.		---	0.005 8	---	---	1.7	---	---
SW-N-50	SS		4/21/2020		0.08	---	---	12.	---	---	< 0.005			0.034 9	---	---	**5.06**	**a**	**b**	179.	---	---	6.2		---	0.128	---	---	0.373	---	---
SW-N-50	SS		9/29/2020	Slightly turbid and colourless, low flow	0.141	---	---	21.	---	---	< 0.005			0.078 8	---	---	**5.79**	**a**	**b**	377.	---	---	6.1		---	0.262	---	---	0.473	---	---
SW-N-50	SS		12/2/2020	Clear and colourless.	0.092	---	---	12.	---	---	< 0.005			0.034 9	---	---	0.355			202.	---	---	3.3		---	< 0.005	---	---	0.236	---	---
SW-N-50	SS		2/8/2021	High flow, clear and colourless, plastic garbage observed in culvert	0.083	---	---	< 10.	---	---	< 0.005			0.024 9	---	---	0.272		**b**	129.	---	---	1.		---	< 0.005	---	---	0.144	---	---
SW-N-51	NS		4/21/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-N-51	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-N-51	NS		12/2/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-N-51	NS		2/8/2021	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-N-53	NS		4/21/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-N-53	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-N-53	NS		12/2/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-N-53	NS		2/3/2021	Dry, no sample collected	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-N-54	SS		4/21/2020		0.433	---	---	51.	---	---	< 0.005			0.132	---	---	13.		**b**	190.	---	---	8.6		---	0.027	---	---	13.4	---	---
SW-N-54	SS		9/29/2020	Slightly turbid, slightly yellow, moderately low flow	0.781	---	---	55.	---	---	0.022 5			1.53	---	---	14.2		**b**	262.	---	---	**498.**	**a**	---	0.034 3	---	---	586.	---	---
SW-N-54	SS		12/2/2020	Clear and colourless.	0.377	---	---	67.	---	---	0.007			0.221	---	---	17.4		**b**	211.	---	---	102.		---	0.029 7	---	---	26.3	---	---
SW-N-54	SS		2/3/2021	Moderately high flow, clear and slightly yellow	0.308	---	---	51.	---	---	< 0.005			0.101	---	---	12.5		**b**	158.	---	---	19.4		---	< 0.005	---	---	20.7	---	---
SW-N-CS2	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-N-CS2	SS		12/2/2020	Clear and colourless.	0.068	---	---	< 10.	---	---	< 0.005			0.014 5	---	---	0.342			61.8	---	---	1.7		---	< 0.005	---	---	0.089	---	---
SW-N-CS2	SS		2/4/2021	High flow, clear and colourless	0.036	---	---	< 10.	---	---	< 0.005			0.014 5	---	---	0.284			57.4	---	---	1.		---	< 0.005	---	---	< 0.05	---	---
SW-S-03	SS		4/22/2020		0.687	---	---	29.	---	---	0.020 3			0.603	---	---	**13.8**	**a**	**b**	49.7	---	---	**595.**	**a**	---	0.476	---	---	31.8	---	---
SW-S-03	SS		10/1/2020	Clear and colourless, moderately low flow	0.214	---	---	74.	---	---	0.008 6			0.155	---	---	5.73		**b**	194.	---	---	11.9		---	0.015 5	---	---	19.5	---	---
SW-S-03	SS		12/3/2020	Clear and colourless.	0.227	---	---	69.	---	---	0.019 4			0.347	---	---	**8.25**	**a**	**b**	100.	---	---	**374.**	**a**	---	0.539	---	---	155.	---	---
SW-S-03	SS		2/3/2021	Moderately high flow,clear and colourless	0.175	---	---	58.	---	---	0.013 7			0.192	---	---	**13.4**	**a**	**b**	91.	---	---	120.		---	0.011 2	---	---	104.	---	---
SW-S-04	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	0.225 5	---	---	51.	---	---	0.012 1			0.089	---	---	3.775		**b**	74.85	---	---	16.6		---	0.026 4	---	---	4.26	---	---
SW-S-04	FRM	COMPLIANCE	10/1/2020	Mean of duplicates	0.127	---	---	83.5	---	---	0.012 5			0.068 9	---	---	1.5		**b**	143.5	---	---	1.95		---	0.007 65	---	---	0.315	---	---
SW-S-04	FRM	COMPLIANCE	12/3/2020	Mean of duplicates	0.164	---	---	84.	---	---	0.007 9			0.082 55	---	---	3.64		**b**	106.5	---	---	12.85		---	0.017	---	---	3.2	---	---
SW-S-04	FRM	COMPLIANCE	2/3/2021	Mean of duplicates	0.121	---	---	42.	---	---	0.006 4			0.064 75	---	---	4.165		**b**	74.25	---	---	26.		---	0.010 8	---	---	4.055	---	---
SW-S-12	SS		4/22/2020		0.333	---	---	32.	---	---	0.020 7			1.47	---	---	**17.4**	**a**	**b**	112.	---	---	**1 160.**	**a**	---	0.211	---	---	107.	---	---
SW-S-12	SS		10/1/2020	Clear and colourless, low flow	0.494	---	---	39.	---	---	0.033 6			0.345	---	---	21.7		**b**	308.	---	---	32.5		---	0.013 6	---	---	25.5	---	---
SW-S-12	SS		12/3/2020	Clear and colourless.	0.231	---	---	95.	---	---	0.014 5			0.342	---	---	**9.57**	**a**	**b**	118.	---	---	342.		---	0.010 4	---	---	369.	---	---
SW-S-12	SS		2/3/2021	Moderately high flow,clear and colourless	0.222	---	---	75.	---	---	0.018 3			0.282	---	---	**19.4**	**a**	**b**	103.	---	---	259.		---	0.016 4	---	---	190.	---	---
SW-S-20	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-S-20	SS		12/3/2020	Clear and colourless.	0.11	---	---	20.	---	---	< 0.005			0.077 4	---	---	1.42			54.8	---	---	33.1		---	0.015 7	---	---	41.3	---	---
SW-S-20	SS		2/3/2021	High flow, clear and colourless	0.103	---	---	< 10.	---	---	< 0.005			0.038 5	---	---	0.85			44.5	---	---	51.5		---	0.035	---	---	3.4	---	---
SW-S-21	NS		4/22/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-S-21	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-S-21	SS		12/3/2020	Clear and colourless.	0.117	---	---	16.	---	---	< 0.005			0.034 5	---	---	1.04			44.7	---	---	10.3		---	0.005 5	---	---	0.193	---	---
SW-S-21	SS		2/3/2021	Moderately high flow,clear and colourless	0.082	---	---	< 10.	---	---	< 0.005			0.029 9	---	---	0.94			41.8	---	---	21.6		---	0.009 7	---	---	0.279	---	---
SW-S-24	SS		4/22/2020		0.267	---	---	56.	---	---	0.016 6			0.123	---	---	4.32		**b**	79.1	---	---	24.8		---	0.031 2	---	---	24.4	---	---
SW-S-24	SS		10/1/2020	Clear and colourless, moderately low flow	0.213	---	---	100.	---	---	0.021 9			0.143	---	---	**9.88**	**a**	**b**	157.	---	---	7.		---	0.177	---	---	22.8	---	---
SW-S-24	SS		12/3/2020	Clear and colourless.	0.162	---	---	93.	---	---	0.015 2			0.118	---	---	3.73		**b**	113.	---	---	45.4		---	0.032 1	---	---	19.9	---	---
SW-S-24	SS		2/3/2021	High flow, clear and colourless	0.154	---	---	66.	---	---	0.012 6			0.108	---	---	**6.83**	**a**	**b**	96.6	---	---	33.8		---	0.014 8	---	---	20.1	---	---
SW-S-27	NS		4/22/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-S-27	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-S-27	SS		12/3/2020	Clear and colourless.	0.212	---	---	121.	---	---	0.032 8			0.252	---	---	1.08		**b**	121.	---	---	32.7		---	0.041 3	---	---	110.	---	---
SW-S-27	SS		2/3/2021	Moderately high flow,clear and colourless	0.102	---	---	75.	---	---	0.025 9			0.156	---	---	0.829		**b**	96.7	---	---	52.1		---	0.034	---	---	52.	---	---
SW-S-52	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null			Null	---	---	Null			Null	---	---	Null		---	Null	---	---	Null	---	---
SW-S-52	SS		12/3/2020	Clear and colourless.	0.06	---	---	16.	---	---	< 0.005			0.021 8	---	---	0.441			56.	---	---	5.1		---	< 0.005	---	---	0.323	---	---
SW-S-52	SS		2/3/2021	High flow, clear and colourless	0.05	---	---	12.	---	---	< 0.005			0.023 6	---	---	0.363			55.1	---	---	5.7		---	0.006 6	---	---	0.242	---	---

Notes:

na — *Not applicable.*

Null — *No sample collected.*

a — *Above Maximum allowable concentration (MAC) British Columbia Water Ouality Guideline.*

b — *Above 30-day average British Columbia Water Quality Guideline.*

(1) — *British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for*

(2) — *Maximum acceptable concentration unless otherwise noted.*

(3) — *The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*

(4) — *The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*

(5) — *This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*

(6) — *This value is the short-term daily for streams with unknown fish distribution.*

(7) — *The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the North landfill are derived from stations SW-N-CSs2, SW-N-41s3 and SW-N-14.*

(8) — *Dissolved copper guideline varies with water hardness, temperature and dissolved organic carbon; Dissolved copper results were only compared with guidelines where DOC was analyzed.*

B.C. Water Quality Guidelines				BC WQG MAXIMUM (1)	---			---			---			---			---			---		
				BC WQG AVERAGE (1)	---			---			---			---			---			---		
				PARAMETER	Molybdenum			Nickel			Selenium			Silver			Zinc			Dissolved Organic Carbon		
				STATE	DIS			DIS			DIS			DIS			DIS			Dissolved		
				UNIT	µg/L			µg/L			µg/L			µg/L			µg/L			µg/L		
STATION	SAMPLE TYPE	COMPLIANCE WELL?	DATE	Method Detection Limit (MDL)	0.005			0.02			0.04			0.005			0.1			0.5		
				Limit of Quantification (LOQ)	0.25			0.1			0.2			0.025			0.5			2.5		
					30%			30%			30%			30%			30%			30%		
				COMMENTS	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG	RESULT	MAX	AVG
SW-N-05	FRM	COMPLIANCE	4/21/2020	Mean of duplicates	0.856 5	---	---	0.337	---	---	0.244 5	---	---	< 0.005	---	---	2.71	---	---	0.91	---	---
SW-N-05	FRM	COMPLIANCE	9/29/2020	Mean of duplicates	0.693 5	---	---	0.569 5	---	---	0.476	---	---	< 0.005	---	---	4.1	---	---	2.	---	---
SW-N-05	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	1.485	---	---	0.470 5	---	---	0.458	---	---	< 0.005	---	---	1.885	---	---	2.25	---	---
SW-N-05	FRM	COMPLIANCE	2/3/2021	Mean of duplicates	1.275	---	---	0.395	---	---	0.326	---	---	< 0.005	---	---	1.36	---	---	1.95	---	---
SW-N-14	NS		10/1/2020	Inaccessible due to active shooting.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-N-14	NS		12/2/2020	Inaccessible due to active shooting.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-N-14	NS		2/4/2021	Inaccessible due to active shooting.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-N-16	FRM	COMPLIANCE	4/21/2020	Mean of duplicates	0.650 5	---	---	1.64	---	---	0.096	---	---	< 0.005	---	---	5.105	---	---	8.8	---	---
SW-N-16	FRM	COMPLIANCE	9/29/2020	Mean of duplicates	1.29	---	---	2.14	---	---	0.114	---	---	< 0.005	---	---	15.3	---	---	10.	---	---
SW-N-16	FRM	COMPLIANCE	12/1/2020	Mean of duplicates	0.792 5	---	---	1.51	---	---	0.110 5	---	---	< 0.005	---	---	6.565	---	---	9.05	---	---
SW-N-16	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	0.790 5	---	---	1.74	---	---	0.129 5	---	---	< 0.005	---	---	6.235	---	---	9.65	---	---
SW-N-17	SS		4/24/2020		0.683	---	---	0.177	---	---	0.132	---	---	0.006 8	---	---	1.1	---	---	3.	---	---
SW-N-17	SS		9/30/2020	Clear and colourless, moderate flow, abundance of decaying leaves	0.836	---	---	0.335	---	---	0.238	---	---	< 0.005	---	---	3.15	---	---	3.9	---	---
SW-N-17	SS		12/2/2020	Clear and colourless.	0.785	---	---	0.274	---	---	0.266	---	---	< 0.005	---	---	1.73	---	---	2.1	---	---
SW-N-17	SS		2/4/2021	Moderately high flow,clear and colourless	0.755	---	---	0.206	---	---	0.162	---	---	< 0.005	---	---	1.58	---	---	2.6	---	---
SW-N-18	SS		4/21/2020		0.485	---	---	0.189	---	---	0.205	---	---	< 0.005	---	---	4.73	---	---	1.4	---	---
SW-N-18	SS		9/29/2020	Clear and colourless, moderate flow	0.609	---	---	0.216	---	---	0.305	---	---	< 0.005	---	---	5.53	---	---	1.1	---	---
SW-N-18	SS		12/2/2020	Clear and colourless.	0.331	---	---	0.133	---	---	0.201	---	---	< 0.005	---	---	1.1	---	---	< 0.5	---	---
SW-N-18	SS		2/3/2021	High flow, clear and colourless	0.407	---	---	0.12	---	---	0.137	---	---	< 0.005	---	---	1.25	---	---	0.87	---	---
SW-N-19	SS		4/21/2020		1.1	---	---	3.36	---	---	0.171	---	---	< 0.005	---	---	1.7	---	---	11.	---	---
SW-N-19	SS		9/29/2020	Clear and colourless, moderate flow	0.757	---	---	2.15	---	---	0.119	---	---	< 0.005	---	---	0.98	---	---	9.6	---	---
SW-N-19	SS		12/1/2020	Clear and colourless.	0.848	---	---	2.04	---	---	0.139	---	---	< 0.005	---	---	3.16	---	---	10.	---	---
SW-N-19	SS		2/4/2021	Moderately high flow, clear and slightly yellow	0.952	---	---	2.43	---	---	0.162	---	---	< 0.005	---	---	4.04	---	---	11.	---	---
SW-N-41S1	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	0.291	---	---	0.109 5	---	---	0.081 5	---	---	< 0.005	---	---	1.32	---	---	4.4	---	---
SW-N-41S1	FRM	COMPLIANCE	9/30/2020	Mean of duplicates	0.559 5	---	---	0.150 5	---	---	0.171 5	---	---	< 0.005	---	---	1.32	---	---	2.35	---	---
SW-N-41S1	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	0.272	---	---	0.147	---	---	0.077 5	---	---	< 0.005	---	---	0.555	---	---	1.8	---	---
SW-N-41S1	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	0.291	---	---	0.097	---	---	0.065 5	---	---	< 0.005	---	---	0.57	---	---	2.	---	---
SW-N-41S3	SS		4/22/2020		0.327	---	---	0.125	---	---	0.088	---	---	< 0.005	---	---	2.03	---	---	4.	---	---
SW-N-41S3	SS		9/30/2020	Clear and colourless, moderate flow	0.429	---	---	0.084	---	---	0.103	---	---	< 0.005	---	---	0.28	---	---	2.6	---	---
SW-N-41S3	SS		12/2/2020	Clear and colourless.	0.292	---	---	0.101	---	---	0.072	---	---	< 0.005	---	---	1.3	---	---	1.5	---	---
SW-N-41S3	SS		2/4/2021	High flow, clear and colourless	0.266	---	---	0.137	---	---	0.058	---	---	< 0.005	---	---	0.45	---	---	1.5	---	---
SW-N-42S1	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	0.389	---	---	0.224 5	---	---	0.048 5	---	---	< 0.005	---	---	3.565	---	---	5.65	---	---
SW-N-42S1	FRM	COMPLIANCE	9/30/2020	Mean of duplicates	0.558	---	---	0.205 5	---	---	0.061 5	---	---	< 0.005	---	---	0.505	---	---	5.3	---	---
SW-N-42S1	FRM	COMPLIANCE	12/2/2020	Mean of duplicates	0.404	---	---	0.154	---	---	0.053 5	---	---	< 0.005	---	---	0.525	---	---	3.15	---	---
SW-N-42S1	FRM	COMPLIANCE	2/4/2021	Mean of duplicates	0.461	---	---	0.119 5	---	---	0.049	---	---	< 0.005	---	---	0.89	---	---	2.95	---	---
SW-N-45	SS		4/24/2020		0.883	---	---	0.234	---	---	0.214	---	---	< 0.005	---	---	1.04	---	---	3.1	---	---
SW-N-45	SS		9/30/2020	Clear and colourless, moderate flow	1.09	---	---	0.282	---	---	0.489	---	---	< 0.005	---	---	1.6	---	---	3.1	---	---
SW-N-45	SS		12/2/2020	Clear and colourless.	1.21	---	---	0.303	---	---	0.426	---	---	< 0.005	---	---	1.06	---	---	2.1	---	---
SW-N-45	SS		2/4/2021	High flow, clear and colourless	1.14	---	---	0.27	---	---	0.319	---	---	< 0.005	---	---	1.24	---	---	2.	---	---
SW-N-50	SS		4/21/2020		0.45	---	---	0.158	---	---	0.229	---	---	< 0.005	---	---	2.86	---	---	1.1	---	---
SW-N-50	SS		9/29/2020	Slightly turbid and colourless, low flow	0.723	---	---	0.289	---	---	0.373	---	---	< 0.005	---	---	2.73	---	---	1.6	---	---
SW-N-50	SS		12/2/2020	Clear and colourless.	0.377	---	---	0.139	---	---	0.221	---	---	< 0.005	---	---	0.38	---	---	0.62	---	---
SW-N-50	SS		2/8/2021	High flow, clear and colourless, plastic garbage observed in culvert	0.301	---	---	0.089	---	---	0.118	---	---	< 0.005	---	---	0.29	---	---	0.7	---	---
SW-N-51	NS		4/21/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-N-51	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-N-51	NS		12/2/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-N-51	NS		2/8/2021	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-N-53	NS		4/21/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-N-53	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-N-53	NS		12/2/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-N-53	NS		2/3/2021	Dry, no sample collected	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-N-54	SS		4/21/2020		0.887	---	---	1.28	---	---	0.24	---	---	< 0.005	---	---	0.74	---	---	9.2	---	---
SW-N-54	SS		9/29/2020	Slightly turbid, slightly yellow, moderately low flow	0.666	---	---	1.94	---	---	0.24	---	---	0.007 9	---	---	1.81	---	---	11.	---	---
SW-N-54	SS		12/2/2020	Clear and colourless.	0.616	---	---	1.25	---	---	0.245	---	---	< 0.005	---	---	0.63	---	---	12.	---	---
SW-N-54	SS		2/3/2021	Moderately high flow, clear and slightly yellow	0.451	---	---	1.17	---	---	0.2	---	---	< 0.005	---	---	0.47	---	---	7.3	---	---
SW-N-CS2	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-N-CS2	SS		12/2/2020	Clear and colourless.	0.078	---	---	0.047	---	---	0.048	---	---	< 0.005	---	---	0.52	---	---	1.4	---	---
SW-N-CS2	SS		2/4/2021	High flow, clear and colourless	0.066	---	---	< 0.02	---	---	< 0.04	---	---	< 0.005	---	---	0.16	---	---	1.4	---	---
SW-S-03	SS		4/22/2020		0.422	---	---	1.31	---	---	0.091	---	---	0.006 3	---	---	18.9	---	---	7.1	---	---
SW-S-03	SS		10/1/2020	Clear and colourless, moderately low flow	0.303	---	---	0.717	---	---	0.174	---	---	< 0.005	---	---	5.86	---	---	6.7	---	---
SW-S-03	SS		12/3/2020	Clear and colourless.	0.162	---	---	1.65	---	---	0.083	---	---	< 0.005	---	---	9.32	---	---	5.6	---	---
SW-S-03	SS		2/3/2021	Moderately high flow,clear and colourless	0.128	---	---	2.06	---	---	0.116	---	---	< 0.005	---	---	4.04	---	---	7.3	---	---
SW-S-04	FRM	COMPLIANCE	4/22/2020	Mean of duplicates	0.321	---	---	0.498	---	---	0.061	---	---	< 0.005	---	---	3.57	---	---	5.7	---	---
SW-S-04	FRM	COMPLIANCE	10/1/2020	Mean of duplicates	0.27	---	---	0.345 5	---	---	0.082 5	---	---	< 0.005	---	---	2.36	---	---	4.85	---	---
SW-S-04	FRM	COMPLIANCE	12/3/2020	Mean of duplicates	0.157	---	---	0.609 5	---	---	0.072	---	---	< 0.005	---	---	3.835	---	---	4.5	---	---
SW-S-04	FRM	COMPLIANCE	2/3/2021	Mean of duplicates	0.114	---	---	0.670 5	---	---	0.063	---	---	< 0.005	---	---	5.755	---	---	5.1	---	---
SW-S-12	SS		4/22/2020		0.295	---	---	3.12	---	---	0.175	---	---	< 0.005	---	---	11.5	---	---	9.5	---	---
SW-S-12	SS		10/1/2020	Clear and colourless, low flow	0.448	---	---	5.29	---	---	0.296	---	---	< 0.005	---	---	7.55	---	---	14.	---	---
SW-S-12	SS		12/3/2020	Clear and colourless.	0.091	---	---	1.99	---	---	0.097	---	---	< 0.005	---	---	3.62	---	---	7.3	---	---
SW-S-12	SS		2/3/2021	Moderately high flow,clear and colourless	0.118	---	---	2.99	---	---	0.131	---	---	< 0.005	---	---	3.82	---	---	9.7	---	---
SW-S-20	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-S-20	SS		12/3/2020	Clear and colourless.	< 0.05	---	---	0.232	---	---	< 0.04	---	---	< 0.005	---	---	11.5	---	---	3.8	---	---
SW-S-20	SS		2/3/2021	High flow, clear and colourless	0.058	---	---	0.152	---	---	0.042	---	---	< 0.005	---	---	11.	---	---	4.7	---	---
SW-S-21	NS		4/22/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-S-21	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-S-21	SS		12/3/2020	Clear and colourless.	0.07	---	---	0.178	---	---	< 0.04	---	---	< 0.005	---	---	7.01	---	---	3.5	---	---
SW-S-21	SS		2/3/2021	Moderately high flow,clear and colourless	0.07	---	---	0.185	---	---	< 0.04	---	---	< 0.005	---	---	9.43	---	---	4.1	---	---
SW-S-24	SS		4/22/2020		0.359	---	---	0.607	---	---	0.068	---	---	< 0.005	---	---	4.81	---	---	6.5	---	---
SW-S-24	SS		10/1/2020	Clear and colourless, moderately low flow	0.19	---	---	0.785	---	---	0.107	---	---	< 0.005	---	---	11.1	---	---	7.1	---	---
SW-S-24	SS		12/3/2020	Clear and colourless.	0.148	---	---	0.749	---	---	0.076	---	---	< 0.005	---	---	4.15	---	---	4.6	---	---
SW-S-24	SS		2/3/2021	High flow, clear and colourless	0.156	---	---	1.1	---	---	0.079	---	---	< 0.005	---	---	3.89	---	---	5.6	---	---
SW-S-27	NS		4/22/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-S-27	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-S-27	SS		12/3/2020	Clear and colourless.	0.145	---	---	0.6	---	---	0.051	---	---	< 0.005	---	---	6.1	---	---	3.8	---	---
SW-S-27	SS		2/3/2021	Moderately high flow,clear and colourless	0.118	---	---	0.399	---	---	0.04	---	---	< 0.005	---	---	3.72	---	---	3.3	---	---
SW-S-52	NS		10/1/2020	Dry. No sample collected.	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---	Null	---	---
SW-S-52	SS		12/3/2020	Clear and colourless.	< 0.05	---	---	0.086	---	---	0.044	---	---	< 0.005	---	---	1.	---	---	1.8	---	---
SW-S-52	SS		2/3/2021	High flow, clear and colourless	< 0.05	---	---	0.034	---	---	< 0.04	---	---	< 0.005	---	---	0.51	---	---	2.	---	---

Notes:

na — *Not applicable.*

Null — *No sample collected.*

a — *Above Maximum allowable concentration (MAC) British Columbia Water Ouality Guideline.*

b — *Above 30-day average British Columbia Water Quality Guideline.*

(1) — *British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for*

(2) — *Maximum acceptable concentration unless otherwise noted.*

(3) — *The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*

(4) — *The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*

(5) — *This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*

(6) — *This value is the short-term daily for streams with unknown fish distribution.*

(7) — *The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the North landfill are derived from stations SW-N-CSs2, SW-N-41s3 and SW-N-14.*

(8) — *Dissolved copper guideline varies with water hardness, temperature and dissolved organic carbon; Dissolved copper results were only compared with guidelines where DOC was analyzed.*

B4. Monthly Leachate Quality Data – Hartland Valve Chamber

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2020-2021

State	Parameter	Unit	Sewer Use Criteria			Hartland Valve Chamber FR1 23-Apr-2020		Hartland Valve Chamber FR2 23-Apr-2020		Hartland Valve Chamber FRM 23-Apr-2020		Hartland Valve Chamber SS 28-May-2020		Hartland Valve Chamber SS 18-Jun-2020		Hartland Valve Chamber NS 1-Jul-2020		Hartland Valve Chamber SS 25-Aug-2020		Hartland Valve Chamber FR1 22-Sep-2020		Hartland Valve Chamber FR2 22-Sep-2020
			min	max																		
CONVENTIONALS																						
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---		---		---		---		---		---		---		---		---		---
Total	BOD	mg/L	---	500		28		26		27		16.		20.		---		20.		36.		35.
Total	CBOD	mg/L	---	---		---		---		---		---		---		---		---		---		---
Total	Chloride	mg/L	---	1500		430		430		430		500.		510.		---		530.		560.		560.
Total	COD	mg/L	---	1000		467		516		492		528.		793.		---		622.		656.		656.
Total	Conductivity	µS/cm	---	---		4109		4109		4109		4 901.		4 018.		---		7 451.		5 145.		5 145.
Total	Cyanide SAD	mg/L	---	1	<	0.013		0.013	<	0.013		0.024		0.017		---		0.015		0.035		0.029
Total	Cyanide WAD	mg/L	---	1	<	0.013		0.013	<	0.013	<	0.01	<	0.01		---	<	0.01	<	0.013	<	0.013
Total	Dissolved Oxygen	mg/L	---	---		2.06		2.06		2.06		1.53		2.56		---		3.34		0.96		0.96
Total	Fecal Coliforms	CFU/100 mL	---	---		---		---		---		---		---		---		---		---		---
Total	N - Ammonia (As N)	mg/L	---	---		310		340		325		350.		270.		---		340.		350.		380.
Total	N - Nitrite (As N)	mg/L	---	---		1.61		1.58		1.595		2.02		2.29		---		0.112		0.118		0.117
Total	N - Nitrate (As N)	mg/L	---	---		12		12		12		16.4		19.70		---	<	0.20	<	0.20	<	0.2
Total	N - Nitrite+Nitrite (As N)	mg/L	---	---		---		---		---		---		---		---		---		---		---
Total	N - TKN (As N)	mg/L	---	---		---		---		---		---		---		---		---		---		---
Total	N - Total (As N)	mg/L	---	---		---		---		---		---		---		---		---		---		---
Total	Oil & Grease, Mineral	mg/L	---	15	<	2	<	2	<	2.	<	2.	<	2.		---	<	2.	<	2.	<	2.
Total	Oil & grease, total	mg/L	---	100	<	1	<	1	<	1.		1.	<	1.		---	<	1.	<	1.	<	1.
Total	ORP	mV	---	---		39.0		39.0		39		15.		- 41.		---		- 93.7		- 75.		- 75.
Total	pH	pH	5.5	11		7.7		7.7		7.70		7.74		7.78		---		7.84		7.77		7.77
Dissolved	Sulphide	mg/L	---	1		0.021		0.039		0.0300		0.039		0.064		---		0.099		0.077		0.07
Total	Sulphide	mg/L	---	1		0.044		0.032		0.0380		0.057		0.1		---		0.12		0.097		0.097
Dissolved	Sulphate	mg/L	---	1500		39		37		38		32.		44.		---		35.		29.		29.
	Temperature	°C	---	---		15.4		15.4		15.4		19.4		17.		---		20.2		17.8		17.8
Total	TOC	mg/L	---	---		---		---		---		---		---		---		---		---		---
Total	Total Phenols	mg/L	---	1		0.25		0.27		0.26		0.32		0.049		---		0.12		0.17		0.13
Total	TSS	mg/L	---	350		37		33		35		45.		15.		---		25.		25.		26.

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2020-2021

State	Parameter	Unit	Sewer Use Criteria		Hartland Valve Chamber FR1 23-Apr-2020	Hartland Valve Chamber FR2 23-Apr-2020	Hartland Valve Chamber FRM 23-Apr-2020	Hartland Valve Chamber SS 28-May-2020	Hartland Valve Chamber SS 18-Jun-2020	Hartland Valve Chamber NS 1-Jul-2020	Hartland Valve Chamber SS 25-Aug-2020	Hartland Valve Chamber FR1 22-Sep-2020	Hartland Valve Chamber FR2 22-Sep-2020
			min	max									
METALS													
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	0.4	7.6	7.63	7.615	8.23	7.15	---	9.33	10.5	10.4
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	0.3	0.062	0.066	0.0640	0.076	0.084	---	0.068	0.053	0.058
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4	51.9	51.6	51.75	61.3	53.2	---	70.9	75	73.8
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5	14.9	15.1	15	17.2	16.9	---	21.9	22.5	21.8
Total	Copper	µg/L	---	1	9.4	9.26	9.33	10.1	19.8	---	19.6	16.7	18.7
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50	2140	2160	2150	2410	2340	---	3050	3210	3140
Total	Lead	µg/L	---	1	1.21	1.27	1.24	1.14	1.05	---	1.09	1.04	0.98
Total	Lithium	µg/L	---	---	641	650	645.5	676	681	---	651	674	648
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5	< 0.038	< 0.038	< 0	< 0.038	0.05	---	0.049	< 0.038	< 0.038
Total	Mercury	µg/L	---	0.02	3.05	2.79	2.92	3.31	2.63	---	3.33	2.77	2.94
Total	Molybdenum	µg/L	---	5	43	43.7	43.35	50.1	48.9	---	61.2	65.5	63.9
Total	Nickel	µg/L	---	3	---	---	---	---	---	---	---	---	---
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	0.408	0.408	0.408	0.53	0.44	---	0.54	0.58	0.62
Total	Selenium	µg/L	---	0.3	---	---	---	---	---	---	---	---	---
Total	Silicon	µg/L	---	---	0.032	0.027	0.0295	< 0.05	< 0.05	---	< 0.05	< 0.05	< 0.05
Total	Silver	µg/L	---	0.5	---	---	---	---	---	---	---	---	---
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3	15.9	16	15.95	19.1	23.5	---	12	12.8	14.7
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2020-2021

State	Parameter	Unit	Sewer Use Criteria		Hartland Valve Chamber FR1 23-Apr-2020	Hartland Valve Chamber FR2 23-Apr-2020	Hartland Valve Chamber FRM 23-Apr-2020	Hartland Valve Chamber SS 28-May-2020	Hartland Valve Chamber SS 18-Jun-2020	Hartland Valve Chamber NS 1-Jul-2020	Hartland Valve Chamber SS 25-Aug-2020	Hartland Valve Chamber FR1 22-Sep-2020	Hartland Valve Chamber FR2 22-Sep-2020
			min	max									
POLYCYCLIC AROMATIC HYDROCARBONS													
Total	Total PAHs	µg/L	---	0.05	4.00	3.60	3.80	8.30	2.10	---	8.00	5.10	4.80
LOW WEIGHT													
Total	2-Chloronaphthalene	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	2-Methylnaphthalene	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Acenaphthene	µg/L	---	---	1.7	1.5	1.600	2.6	0.46	---	1.4	1.4	1.3
Total	Acenaphthylene	µg/L	---	---	0.058	0.057	0.058	0.041	0.02	---	0.042	0.033	0.033
Total	Anthracene	µg/L	---	---	0.31	0.31	0.310	0.26	0.11	---	0.2	0.31	0.33
Total	Fluorene	µg/L	---	---	0.59	0.49	0.540	1.5	0.32	---	0.94	0.87	0.83
Total	Naphthalene	µg/L	---	---	0.032	0.033	0.033	0.74	0.18	---	2.6	0.22	0.21
Total	Phenanthrene	µg/L	---	---	0.012	0.013	0.013	0.84	0.13	---	0.57	0.55	0.51
Total	Total Lmw-Pah'S	µg/L	---	---	2.70	0.87	1.78	5.98	1.22	---	---	3.38	3.21
HIGH WEIGHT													
Total	Benzo(A)Anthracene	µg/L	---	---	0.079	0.073	0.076	0.11	0.039	---	0.1	0.082	0.073
Total	Benzo(A)Pyrene	µg/L	---	---	0.021	0.021	0.021	0.023	0.021	---	0.026	0.023	0.019
Total	Benzo(B)Fluoranthene + Benzo(J)Fluoranthene	µg/L	---	---	0.028	0.028	0.028	0.04	0.041	---	0.058	0.04	< 0.01
Total	Benzo(G,H,I)Perylene	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	0.021	---	< 0.02	< 0.02	0.022
Total	Benzo(K)Fluoranthene	µg/L	---	---	0.01	0.01	0.01	0.015	0.019	---	0.021	0.013	< 0.01
Total	Chrysene	µg/L	---	---	0.08	0.072	0.076	0.11	0.047	---	0.14	0.098	0.086
Total	Dibenzo(A,H)Anthracene	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	0.022	---	< 0.02	< 0.02	< 0.02
Total	Fluoranthene	µg/L	---	---	0.6	0.52	0.56	0.71	0.32	---	0.64	0.5	0.46
Total	Indeno(1,2,3-C,D)Pyrene	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	0.021	---	< 0.02	< 0.02	< 0.02
Total	Pyrene	µg/L	---	---	0.39	0.35	0.37	0.47	0.21	---	0.43	0.36	0.33
Total	Total Hmw-Pah'S	µg/L	---	---	1.268	1.134	1.201	1.538	0.761	---	1.475	1.176	1.05
VOLATILE ORGANICS													
Dissolved	Benzene	µg/L	---	100.	0.42	< 0.4	0.41	0.48	< 0.4	---	< 0.4	< 0.4	< 0.4
Dissolved	Ethylbenzene	µg/L	---	200.	0.49	0.53	0.51	0.7	< 0.4	---	< 0.4	< 0.4	< 0.4
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200.	0.52	0.52	0.52	0.68	0.55	---	< 0.4	< 0.4	< 0.4
Dissolved	Xylenes	µg/L	---	200	1.1	1.2	1.15	1.5	< 0.4	---	< 0.4	< 0.4	< 0.4

Notes:

a *- Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.*

b *- Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.*

--- = Not available.

FR1 - Field replicate 1.

FR2 - Field replicate 2.

FR3 - Field replicate 3.

FRM - Mean of field replicates.

SS - Single Sample

NS- Not sampled

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2020-2021

State	Parameter	Unit	Sewer Use Criteria		Hartland Valve Chamber FRM 22-Sep-2020	Hartland Valve Chamber BLF 22-Sep-2020	Hartland Valve Chamber BTL 23-Sep-2020	Hartland Valve Chamber SS 29-Oct-2020	Hartland Valve Chamber FR1 18-Nov-2020	Hartland Valve Chamber FR2 18-Nov-2020	Hartland Valve Chamber FRM 18-Nov-2020	Hartland Valve Chamber BLF 18-Nov-2020	Hartland Valve Chamber BTL 18-Nov-2020
			min	max									
CONVENTIONALS													
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	35.5	---	---	22.	31.	32.	31.5	---	---
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Chloride	mg/L	---	1500	560.	---	---	370.	260.	260.	260.	---	---
Total	COD	mg/L	---	1000	656.	---	---	579.	334.	362.	348.	---	---
Total	Conductivity	µS/cm	---	---	5 145.	---	---	3 538.	2 851.	2 851.	2 851.	---	---
Total	Cyanide SAD	mg/L	---	1	0.032	---	---	0.015	0.005 7	0.005 5	0.005 6	---	---
Total	Cyanide WAD	mg/L	---	1	< 0.013	---	---	< 0.01	0.005 8	0.004 4	0.005 1	---	---
Total	Dissolved Oxygen	mg/L	---	---	0.96	---	---	2.96	3.74	3.74	3.74	---	---
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---
Total	N - Ammonia (As N)	mg/L	---	---	365.	---	---	280.	220.	200.	210.	---	---
Total	N - Nitrite (As N)	mg/L	---	---	0.117 5	---	---	3.99	1.3	1.31	1.305	---	---
Total	N - Nitrate (As N)	mg/L	---	---	< 0.2	---	---	7.83	5.84	5.82	5.83	---	---
Total	N - Nitrite+Nitrite (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---
Total	N - TKN (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 2.	---	---	< 2.	< 2.	< 2.	< 2.	---	---
Total	Oil & grease, total	mg/L	---	100	< 1.	---	---	< 1.	< 1.	< 1.	< 1.	---	---
Total	ORP	mV	---	---	- 75.	---	---	33.	41.	41.	41.	---	---
Total	pH	pH	5.5	11	7.77	---	---	7.53	7.73	7.73	7.73	---	---
Dissolved	Sulphide	mg/L	---	1	0.073 5	---	---	0.019	0.029	0.037	0.033	---	---
Total	Sulphide	mg/L	---	1	0.097	---	---	0.089	0.048	0.047	0.047 5	---	---
Dissolved	Sulphate	mg/L	---	1500	29.	---	---	150.	92.	90.	91.	---	---
	Temperature	°C	---	---	17.8	---	---	14.	14.2	14.2	14.2	---	---
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.15	---	---	0.19	0.14	0.15	0.145	---	---
Total	TSS	mg/L	---	350	25.5	---	---	30.	20.	20.	20.	---	---

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2020-2021

State	Parameter	Unit	Sewer Use Criteria		Hartland Valve Chamber FRM 22-Sep-2020	Hartland Valve Chamber BLF 22-Sep-2020	Hartland Valve Chamber BTL 23-Sep-2020	Hartland Valve Chamber SS 29-Oct-2020	Hartland Valve Chamber FR1 18-Nov-2020	Hartland Valve Chamber FR2 18-Nov-2020	Hartland Valve Chamber FRM 18-Nov-2020	Hartland Valve Chamber BLF 18-Nov-2020	Hartland Valve Chamber BTL 18-Nov-2020
			min	max									
METALS													
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	0.4	10.45	---	---	10.8	8.15	7.76	7.955	---	---
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	0.3	0.0555	---	---	0.072	0.071	0.066	0.0685	---	---
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4	74.4	---	---	50.8	43.4	38.9	41.15	---	---
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5	22.15	---	---	14.4	11.9	11.3	11.6	---	---
Total	Copper	µg/L	---	1	17.7	---	---	15	20.1	23.1	21.6	---	---
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50	3175	---	---	1800	1820	1660	1740	---	---
Total	Lead	µg/L	---	1	1.01	---	---	1.26	1.11	1.13	1.12	---	---
Total	Lithium	µg/L	---	---	661	---	---	685	565	523	544	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5	< 0.038	---	---	< 0.019	0.0058	0.0036	0.0047	---	---
Total	Mercury	µg/L	---	0.02	2.855	---	---	2.02	3.81	3.2	3.505	---	---
Total	Molybdenum	µg/L	---	5	64.7	---	---	41.5	34.4	32.2	33.3	---	---
Total	Nickel	µg/L	---	3	---	---	---	---	---	---	---	---	---
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	0.6	---	---	0.499	0.409	0.413	0.411	---	---
Total	Selenium	µg/L	---	0.3	---	---	---	---	---	---	---	---	---
Total	Silicon	µg/L	---	---	< 0.05	---	---	< 0.02	0.021	0.025	0.023	---	---
Total	Silver	µg/L	---	0.5	---	---	---	---	---	---	---	---	---
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3	13.75	---	---	18.7	17.1	16.4	16.75	---	---
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2020-2021

State	Parameter	Unit	Sewer Use Criteria		Hartland Valve Chamber FRM 22-Sep-2020	Hartland Valve Chamber BLF 22-Sep-2020	Hartland Valve Chamber BTL 23-Sep-2020	Hartland Valve Chamber SS 29-Oct-2020	Hartland Valve Chamber FR1 18-Nov-2020	Hartland Valve Chamber FR2 18-Nov-2020	Hartland Valve Chamber FRM 18-Nov-2020	Hartland Valve Chamber BLF 18-Nov-2020	Hartland Valve Chamber BTL 18-Nov-2020
			min	max									
POLYCYCLIC AROMATIC HYDROCARBONS													
Total	Total PAHs	µg/L	---	0.05	4.95	---	---	6.80	6.30	6.10	6.20	---	---
LOW WEIGHT													
Total	2-Chloronaphthalene	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	2-Methylnaphthalene	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Acenaphthene	µg/L	---	---	1.35	---	---	2.1	2.2	2.1	2.15	---	---
Total	Acenaphthylene	µg/L	---	---	0.033	---	---	0.1	0.035	0.03	0.0325	---	---
Total	Anthracene	µg/L	---	---	0.32	---	---	0.28	0.16	0.15	0.155	---	---
Total	Fluorene	µg/L	---	---	0.85	---	---	1.5	1.3	1.2	1.25	---	---
Total	Naphthalene	µg/L	---	---	0.215	---	---	0.12	0.67	0.71	0.69	---	---
Total	Phenanthrene	µg/L	---	---	0.53	---	---	0.45	0.38	0.39	0.385	---	---
Total	Total Lmw-Pah'S	µg/L	---	---	3.30	---	---	4.55	4.75	4.58	4.66	---	---
HIGH WEIGHT													
Total	Benzo(A)Anthracene	µg/L	---	---	0.0775	---	---	0.085	0.062	0.051	0.0565	---	---
Total	Benzo(A)Pyrene	µg/L	---	---	0.021	---	---	0.02	0.014	0.01	0.012	---	---
Total	Benzo(B)Fluoranthene + Benzo(J)Fluoranthene	µg/L	---	---	0.025	---	---	0.022	0.017	0.014	0.0155	---	---
Total	Benzo(G,H,I)Perylene	µg/L	---	---	0.021	---	---	< 0.02	< 0.02	< 0.02	< 0.02	---	---
Total	Benzo(K)Fluoranthene	µg/L	---	---	0.0115	---	---	< 0.01	< 0.01	< 0.01	< 0.01	---	---
Total	Chrysene	µg/L	---	---	0.092	---	---	0.071	0.061	0.05	0.0555	---	---
Total	Dibenzo(A,H)Anthracene	µg/L	---	---	< 0.02	---	---	< 0.02	< 0.02	< 0.02	< 0.02	---	---
Total	Fluoranthene	µg/L	---	---	0.48	---	---	0.86	0.64	0.56	0.6	---	---
Total	Indeno(1,2,3-C,D)Pyrene	µg/L	---	---	< 0.02	---	---	< 0.02	< 0.02	< 0.02	< 0.02	---	---
Total	Pyrene	µg/L	---	---	0.345	---	---	0.58	0.42	0.36	0.39	---	---
Total	Total Hmw-Pah'S	µg/L	---	---	1.113	---	---	1.708	1.284	2.992	5.984	---	---
VOLATILE ORGANICS													
Dissolved	Benzene	µg/L	---	100.	< 0.4	---	---	0.58	0.75	0.65	0.7	---	---
Dissolved	Ethylbenzene	µg/L	---	200.	< 0.4	---	---	< 0.4	1	0.87	0.935	---	---
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200.	< 0.4	---	---	< 0.4	0.75	0.59	0.67	---	---
Dissolved	Xylenes	µg/L	---	200	< 0.4	---	---	< 0.4	2.3	2	2.15	---	---

Notes:

a *- Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.*

b *- Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.*

--- = Not available.

FR1 - Field replicate 1.

FR2 - Field replicate 2.

FR3 - Field replicate 3.

FRM - Mean of field replicates.

SS - Single Sample

NS- Not sampled

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2020-2021

State	Parameter	Unit	Sewer Use Criteria		Hartland Valve Chamber SS 7-Dec-2020	Hartland Valve Chamber SS 18-Jan-2021	Hartland Valve Chamber FR1 23-Feb-2021	Hartland Valve Chamber FR2 23-Feb-2021	Hartland Valve Chamber FRM 23-Feb-2021	Hartland Valve Chamber SS 15-Mar-2021
			min	max						
CONVENTIONALS										
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	32.	28.	27.	28.	27.5	23.
Total	CBOD	mg/L	---	---	---	---	---	---	---	---
Total	Chloride	mg/L	---	1500	300.	260.	250.	240.	245.	290.
Total	COD	mg/L	---	1000	411.	402.	385.	398.	391.5	509.
Total	Conductivity	µS/cm	---	---	3 235.	2 055.	2 591.	2 591.	2 591.	3 474.
Total	Cyanide SAD	mg/L	---	1	0.007 6	0.008 1	0.011 7	0.011 3	0.011 5	< 0.013
Total	Cyanide WAD	mg/L	---	1	< 0.005	0.002 8	< 0.005	< 0.005	< 0.005	< 0.013
Total	Dissolved Oxygen	mg/L	---	---	2.53	2.86	2.25	2.25	2.25	3.47
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---
Total	N - Ammonia (As N)	mg/L	---	---	210.	240.	200.	190.	195.	240.
Total	N - Nitrite (As N)	mg/L	---	---	2.2	0.064	1.81	1.78	1.795	2.51
Total	N - Nitrate (As N)	mg/L	---	---	5.24	< 0.1	9.51	8.8	9.155	5.46
Total	N - Nitrite+Nitrite (As N)	mg/L	---	---	---	---	---	---	---	---
Total	N - TKN (As N)	mg/L	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 2.	< 2.	< 2.	< 2.	< 2.	< 2.
Total	Oil & grease, total	mg/L	---	100	< 1.	< 1.	< 1.	< 1.	< 1.	3.1
Total	ORP	mV	---	---	37.	11.	42.	42.	42.	75.
Total	pH	pH	5.5	11	7.53	7.74	7.45	7.45	7.45	7.66
Dissolved	Sulphide	mg/L	---	1	0.045	0.057	0.038	0.036	0.037	0.051
Total	Sulphide	mg/L	---	1	0.055	0.074	0.045	0.044	0.044 5	0.11
Dissolved	Sulphate	mg/L	---	1500	120.	57.	86.	87.	86.5	47.
	Temperature	°C	---	---	13.5	13.2	13.7	13.7	13.7	12.5
Total	TOC	mg/L	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.19	0.18	0.16	0.16	0.16	0.18
Total	TSS	mg/L	---	350	36.	14.	19.	19.	19.	18.

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2020-2021

State	Parameter	Unit	Sewer Use Criteria		Hartland Valve Chamber SS 7-Dec-2020	Hartland Valve Chamber SS 18-Jan-2021	Hartland Valve Chamber FR1 23-Feb-2021	Hartland Valve Chamber FR2 23-Feb-2021	Hartland Valve Chamber FRM 23-Feb-2021	Hartland Valve Chamber SS 15-Mar-2021
			min	max						
METALS										
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	0.4	7.21	8.08	6.77	7.3	7.035	8.08
Total	Barium	µg/L	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	0.3	0.058	0.046	0.05	0.048	0.049	0.077
Total	Calcium	µg/L	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4	44.8	40.2	35.1	35.5	35.3	49.2
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5	12.8	10.1	8.94	9.39	9.165	13.9
Total	Copper	µg/L	---	1	8.98	13.2	12.3	12.7	12.5	11.8
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50	1470	1520	1370	1460	1415	1990
Total	Lead	µg/L	---	1	0.967	1.03	0.838	0.885	0.8615	1.24
Total	Lithium	µg/L	---	---	625	464	383	409	396	657
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5	< 0.019	< 0.019	< 0.038	< 0.038	< 0.038	< 0.019
Total	Mercury	µg/L	---	0.02	3.25	2.26	2.33	2.25	2.29	2.68
Total	Molybdenum	µg/L	---	5	36.4	28.7	24.8	27.1	25.95	40.5
Total	Nickel	µg/L	---	3	---	---	---	---	---	---
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	0.387	0.365	0.328	0.402	0.365	0.409
Total	Selenium	µg/L	---	0.3	---	---	---	---	---	---
Total	Silicon	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	Silver	µg/L	---	0.5	---	---	---	---	---	---
Total	Sodium	µg/L	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3	15	13.9	15.3	16	15.65	23
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2020-2021

State	Parameter	Unit	Sewer Use Criteria		Hartland Valve Chamber SS 7-Dec-2020	Hartland Valve Chamber SS 18-Jan-2021	Hartland Valve Chamber FR1 23-Feb-2021	Hartland Valve Chamber FR2 23-Feb-2021	Hartland Valve Chamber FRM 23-Feb-2021	Hartland Valve Chamber SS 15-Mar-2021
			min	max						
POLYCYCLIC AROMATIC HYDROCARBONS										
Total	Total PAHs	µg/L	---	0.05	2.70	16.00	14.00	14.00	14.00	3.30
LOW WEIGHT										
Total	2-Chloronaphthalene	µg/L	---	---	---	---	---	---	---	---
Total	2-Methylnaphthalene	µg/L	---	---	---	---	---	---	---	---
Total	Acenaphthene	µg/L	---	---	0.96	5.2	4.5	4.5	4.5	1.4
Total	Acenaphthylene	µg/L	---	---	0.017	0.12	0.1	0.098	0.099	0.046
Total	Anthracene	µg/L	---	---	0.067	0.67	0.36	0.32	0.34	0.1
Total	Fluorene	µg/L	---	---	0.5	2.8	2.7	2.7	2.7	0.74
Total	Naphthalene	µg/L	---	---	0.44	1.3	1.2	1.2	1.2	0.18
Total	Phenanthrene	µg/L	---	---	0.1	1.8	1.7	1.7	1.7	0.095
Total	Total Lmw-Pah'S	µg/L	---	---	2.08	11.89	10.56	10.52	10.54	2.56
HIGH WEIGHT										
Total	Benzo(A)Anthracene	µg/L	---	---	< 0.01	0.18	0.07	0.11	0.09	0.034
Total	Benzo(A)Pyrene	µg/L	---	---	< 0.005	0.06	0.014	0.024	0.019	< 0.005
Total	Benzo(B)Fluoranthene + Benzo(J)Fluoranthene	µg/L	---	---	< 0.01	0.089	0.015	0.041	0.028	< 0.01
Total	Benzo(G,H,I)Perylene	µg/L	---	---	< 0.02	0.023	< 0.02	< 0.02	< 0.02	< 0.02
Total	Benzo(K)Fluoranthene	µg/L	---	---	< 0.01	0.03	< 0.01	0.014	0.012	< 0.01
Total	Chrysene	µg/L	---	---	< 0.01	0.17	0.068	0.1	0.084	0.034
Total	Dibenzo(A,H)Anthracene	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	Fluoranthene	µg/L	---	---	0.053	1.2	0.98	1.2	1.09	0.36
Total	Indeno(1,2,3-C,D)Pyrene	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	Pyrene	µg/L	---	---	0.033	0.84	0.65	0.77	0.71	0.24
Total	Total Hmw-Pah'S	µg/L	---	---	0.191	2.632	1.867	2.319	2.093	0.753
VOLATILE ORGANICS										
Dissolved	Benzene	µg/L	---	100.	0.68	0.62	0.46	0.46	0.46	0.52
Dissolved	Ethylbenzene	µg/L	---	200.	0.65	0.64	0.65	0.66	0.655	0.74
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200.	0.7	0.97	0.89	0.96	0.925	0.75
Dissolved	Xylenes	µg/L	---	200	2.1	3.8	1.5	1.5	1.5	1.9

Notes:

a *- Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.*

b *- Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.*

--- = Not available.

FR1 - Field replicate 1.

FR2 - Field replicate 2.

FR3 - Field replicate 3.

FRM - Mean of field replicates.

SS - Single Sample

NS- Not sampled

B5. Quarterly Leachate Quality – Trace Organics

Appendix B-5. Quarterly Leachate Quality - Trace Organics - 2020-2021

Sate	Parameters	Unit	Sewer Use Criteria			Hartland Valve Chamber FR1 23-Apr-2020		Hartland Valve Chamber FR2 23-Apr-2020		Hartland Valve Chamber FRM 23-Apr-2020		Hartland Valve Chamber SS 25-Aug-2020		Hartland Valve Chamber FR1 22-Sep-2020		Hartland Valve Chamber FR2 22-Sep-2020		Hartland Valve Chamber FRM 22-Sep-2020		Hartland Valve Chamber BLF 22-Sep-2020
			min	max																
PHTHALATE ESTERS																				
TOT	Bis(2-Ethylhexyl)Phthalate	µg/L	---	---		---		---		---		---		---		---		---		---
NA	N-Butylbenzyl Phthalate	µg/L	---	---		---		---		---		---		---		---		---		---
PHENOLS - HALOGENATED																				
TOT	2,4 + 2,5 Dichlorophenol	µg/L	---	---		0.12		0.12		0.12		0.13		0.19		0.16		0.175		---
TOT	2,4,6-trichlorophenol	µg/L	---	---	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1		---
TOT	2-Chlorophenol	µg/L	---	---	<	0.08	<	0.08	<	0.08	<	0.05	<	0.05	<	0.05	<	0.05		---
NA	Pentachlorophenol	µg/L	---	---	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1		---
PHENOLS - NON-HALOGENATED																				
TOT	2-Methyl-4,6-Dinitrophenol	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Phenol	µg/L	---	---		---		---		---		---		---		---		---		---
TOTAL CHLORINATED PHENOLIC COMPOUNDS																				
TOT	Chlorinated phenols (total)	µg/L	---	---		0.12		0.12		0.12	<	0.41	<	0.41	<	0.41	<	0.41		---
TOT	Total Dichlorophenols	µg/L	---	---		0.12		0.12		0.12	<	0.22	<	0.22	<	0.22	<	0.22		---
TOT	Total Monochlorophenols	µg/L	---	---	<	0.08	<	0.08	<	0.08	<	0.09	<	0.09	<	0.09	<	0.09		---
TOT	Total Nonchlorinated phenols	µg/L	---	---	<	10	<	10	<	10	<	1.6		2.8		2.6		2.7		---
TOT	Total Tetrachlorophenols	µg/L	---	---	<	0.1	<	0.1	<	0.1	<	0.17	<	0.17	<	0.17	<	0.17		---
TOT	Total Trichlorophenols	µg/L	---	---	<	0.1	<	0.1	<	0.1	<	0.24	<	0.24	<	0.24	<	0.24		---
TOT	Total Phenolic Compounds	µg/L	---	---		---		---		---		---		---		---		---		---
ETHERS - HALOGENATED																				
TOT	4-Bromophenyl Phenyl Ether	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Bis(2-Chloroethoxy)Methane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Bis(2-Chloroethyl)Ether	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Bis(2-Chloroisopropyl)Ether	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	N-Nitrosodimethylamine	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	N-Nitrosodi-N-Propylamine	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	N-Nitrosodiphenylamine	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,2-diphenylhydrazine	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	3,3-dichlorobenzidine	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Alpha-Terpineol	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Hexachlorobutadiene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Hexachlorocyclopentadiene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Isophorone	µg/L	---	---		---		---		---		---		---		---		---		---
ALKANES - HALOGENATED																				
TOT	Hexachloroethane	µg/L	---	---		---		---		---		---		---		---		---		---
OTHER ORGANICS																				
TOT	1,1,1,2-Tetrachloroethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,1,1-trichloroethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,1,2,2-tetrachloroethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,1,2Trichloro-1,2,2Trifluoroethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,1,2-trichloroethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,1-dichloroethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,1-dichloroethene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,2,3-Trichlorobenzene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,2,4-trichlorobenzene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,2-dichlorobenzene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,2-dichloroethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,2-dichloropropane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,3,5-trimethylbenzene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,3-Butadiene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,3-dichlorobenzene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,3-dichloropropane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1,4-dichlorobenzene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	1-Methylnaphthalene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	2,3,4,5-tetrachlorophenol	µg/L	---	---	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1		---
TOT	2,3,4,6-tetrachlorophenol	µg/L	---	---	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1		---
TOT	2,3,5,6-tetrachlorophenol	µg/L	---	---	<	0.1	<	0.1	<	0.1	<	0.1		0.11		0.1		0.105		---
TOT	2,4-dimethylphenol	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	2,4-dinitrophenol	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	2,4-dinitrotoluene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	2,6-dinitrotoluene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	2-Nitrophenol	µg/L	---	---		---		---		---		---		---		---		---		---
NA	4,6-dinitro-2-methylphenol	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	4-Chloro-3-Methylphenol	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	4-Chlorophenyl Phenyl Ether	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	4-Methyl-2-Pentanone	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	4-Nitrophenol	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Acridine	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Acrolein	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Acrylonitrile	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Benzidine	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Bromobenzene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Bromodichloromethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Bromomethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Butylbenzyl Phthalate	µg/L	---	---		---		---		---		---		---		---		---		---
NA	Carbon Tetrachloride	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Chlorobenzene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Chlorodibromomethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Chloroethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Chloroethene	µg/L	---	---		---		---		---		---		---		---		---		---
NA	Chloroform	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Chloromethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Cis-1,2-Dichloroethene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	cis-1,3-dichloropropene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Csr Vph C6-C10 (Vh Minus Btex)	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Dibromoethane	µg/L	---	---		---		---		---		---		---		---		---		---
NA	Dibromomethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Dichlorodifluoromethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Dichloromethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Diethyl Phthalate	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Dimethyl Ketone	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Dimethyl Phthalate	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Di-N-Butyl Phthalate	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Di-N-Octyl Phthalate	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Isopropylbenzene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Methyl Ethyl Ketone	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Nitrobenzene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	PCP	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Quinoline	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Sulfolane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Tetrabromomethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Tetrachloroethene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Tetrachloromethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Trans-1,2-Dichloroethene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	trans-1,3-dichloropropene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Tribromomethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Trichloroethene	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Trichlorofluoromethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	Trichloromethane	µg/L	---	---		---		---		---		---		---		---		---		---
TOT	VH C6-C10	µg/L	---	---		---		---		---		---		---		---		---		---
NA	Vinyl Chloride	µg/L	---	---		---		---		---		---		---		---		---		---

Notes:

a *- Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922*

b *- Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.*

--- = Not available.

FR1 - Field replicate 1.

FR2 - Field replicate 2.

FRM - Mean of field replicates.

NS- Not sampled

SS- Single sample

Appendix B-5. Quarterly Leachate Quality - Trace Organics - 2020-2021

Sate	Parameters	Unit	Sewer Use Criteria				Hartland Valve Chamber BLT 23-Sep-2020		Hartland Valve Chamber SS 29-Oct-2020		Hartland Valve Chamber SS 18-Jan-2021
			min	max							
PHTHALATE ESTERS											
TOT	Bis(2-Ethylhexyl)Phthalate	µg/L	---	---			---		---		---
NA	N-Butylbenzyl Phthalate	µg/L	---	---			---		---		---
PHENOLS - HALOGENATED											
TOT	2,4 + 2,5 Dichlorophenol	µg/L	---	---			---		0.2		0.2
TOT	2,4,6-trichlorophenol	µg/L	---	---	<		---	<	0.1	<	0.1
TOT	2-Chlorophenol	µg/L	---	---	<		---	<	0.05	<	0.05
NA	Pentachlorophenol	µg/L	---	---	<		---	<	0.1	<	0.1
PHENOLS - NON-HALOGENATED											
TOT	2-Methyl-4,6-Dinitrophenol	µg/L	---	---			---		---		---
TOT	Phenol	µg/L	---	---			---		---		---
TOTAL CHLORINATED PHENOLIC COMPOUNDS											
TOT	Chlorinated phenols (total)	µg/L	---	---			---	<	0.41	<	0.41
TOT	Total Dichlorophenols	µg/L	---	---			---	<	0.22	<	0.22
TOT	Total Monochlorophenols	µg/L	---	---	<		---	<	0.09	<	0.09
TOT	Total Nonchlorinated phenols	µg/L	---	---	<		---		10		3.5
TOT	Total Tetrachlorophenols	µg/L	---	---	<		---	<	0.17	<	0.17
TOT	Total Trichlorophenols	µg/L	---	---	<		---	<	0.24	<	0.24
TOT	Total Phenolic Compounds	µg/L	---	---			---		---		---
ETHERS - HALOGENATED											
TOT	4-Bromophenyl Phenyl Ether	µg/L	---	---			---		---		---
TOT	Bis(2-Chloroethoxy)Methane	µg/L	---	---			---		---		---
TOT	Bis(2-Chloroethyl)Ether	µg/L	---	---			---		---		---
TOT	Bis(2-Chloroisopropyl)Ether	µg/L	---	---			---		---		---
TOT	N-Nitrosodimethylamine	µg/L	---	---			---		---		---
TOT	N-Nitrosodi-N-Propylamine	µg/L	---	---			---		---		---
TOT	N-Nitrosodiphenylamine	µg/L	---	---			---		---		---
TOT	1,2-diphenylhydrazine	µg/L	---	---			---		---		---
TOT	3,3-dichlorobenzidine	µg/L	---	---			---		---		---
TOT	Alpha-Terpineol	µg/L	---	---			---		---		---
TOT	Hexachlorobutadiene	µg/L	---	---			---		---		---
TOT	Hexachlorocyclopentadiene	µg/L	---	---			---		---		---
TOT	Isophorone	µg/L	---	---			---		---		---
ALKANES - HALOGENATED											
TOT	Hexachloroethane	µg/L	---	---			---		---		---
OTHER ORGANICS											
TOT	1,1,1,2-Tetrachloroethane	µg/L	---	---			---		---		---
TOT	1,1,1-trichloroethane	µg/L	---	---			---		---		---
TOT	1,1,2,2-tetrachloroethane	µg/L	---	---			---		---		---
TOT	1,1,2Trichloro-1,2,2Trifluoroethane	µg/L	---	---			---		---		---
TOT	1,1,2-trichloroethane	µg/L	---	---			---		---		---
TOT	1,1-dichloroethane	µg/L	---	---			---		---		---
TOT	1,1-dichloroethene	µg/L	---	---			---		---		---
TOT	1,2,3-Trichlorobenzene	µg/L	---	---			---		---		---
TOT	1,2,4-trichlorobenzene	µg/L	---	---			---		---		---
TOT	1,2-dichlorobenzene	µg/L	---	---			---		---		---
TOT	1,2-dichloroethane	µg/L	---	---			---		---		---
TOT	1,2-dichloropropane	µg/L	---	---			---		---		---
TOT	1,3,5-trimethylbenzene	µg/L	---	---			---		---		---
TOT	1,3-Butadiene	µg/L	---	---			---		---		---
TOT	1,3-dichlorobenzene	µg/L	---	---			---		---		---
TOT	1,3-dichloropropane	µg/L	---	---			---		---		---
TOT	1,4-dichlorobenzene	µg/L	---	---			---		---		---
TOT	1-Methylnaphthalene	µg/L	---	---			---		---		---
TOT	2,3,4,5-tetrachlorophenol	µg/L	---	---	<		---	<	0.1	<	0.1
TOT	2,3,4,6-tetrachlorophenol	µg/L	---	---	<		---	<	0.1	<	0.1
TOT	2,3,5,6-tetrachlorophenol	µg/L	---	---	<		---	<	0.1	<	0.1
TOT	2,4-dimethylphenol	µg/L	---	---			---		---		---
TOT	2,4-dinitrophenol	µg/L	---	---			---		---		---
TOT	2,4-dinitrotoluene	µg/L	---	---			---		---		---
TOT	2,6-dinitrotoluene	µg/L	---	---			---		---		---
TOT	2-Nitrophenol	µg/L	---	---			---		---		---
NA	4,6-dinitro-2-methylphenol	µg/L	---	---			---		---		---
TOT	4-Chloro-3-Methylphenol	µg/L	---	---			---		---		---
TOT	4-Chlorophenyl Phenyl Ether	µg/L	---	---			---		---		---
TOT	4-Methyl-2-Pentanone	µg/L	---	---			---		---		---
TOT	4-Nitrophenol	µg/L	---	---			---		---		---
TOT	Acridine	µg/L	---	---			---		---		---
TOT	Acrolein	µg/L	---	---			---		---		---
TOT	Acrylonitrile	µg/L	---	---			---		---		---
TOT	Benzidine	µg/L	---	---			---		---		---
TOT	Bromobenzene	µg/L	---	---			---		---		---
TOT	Bromodichloromethane	µg/L	---	---			---		---		---
TOT	Bromomethane	µg/L	---	---			---		---		---
TOT	Butylbenzyl Phthalate	µg/L	---	---			---		---		---
NA	Carbon Tetrachloride	µg/L	---	---			---		---		---
TOT	Chlorobenzene	µg/L	---	---			---		---		---
TOT	Chlorodibromomethane	µg/L	---	---			---		---		---
TOT	Chloroethane	µg/L	---	---			---		---		---
TOT	Chloroethene	µg/L	---	---			---		---		---
NA	Chloroform	µg/L	---	---			---		---		---
TOT	Chloromethane	µg/L	---	---			---		---		---
TOT	Cis-1,2-Dichloroethene	µg/L	---	---			---		---		---
TOT	cis-1,3-dichloropropene	µg/L	---	---			---		---		---
TOT	Csr Vph C6-C10 (Vh Minus Btex)	µg/L	---	---			---		---		---
TOT	Dibromoethane	µg/L	---	---			---		---		---
NA	Dibromomethane	µg/L	---	---			---		---		---
TOT	Dichlorodifluoromethane	µg/L	---	---			---		---		---
TOT	Dichloromethane	µg/L	---	---			---		---		---
TOT	Diethyl Phthalate	µg/L	---	---			---		---		---
TOT	Dimethyl Ketone	µg/L	---	---			---		---		---
TOT	Dimethyl Phthalate	µg/L	---	---			---		---		---
TOT	Di-N-Butyl Phthalate	µg/L	---	---			---		---		---
TOT	Di-N-Octyl Phthalate	µg/L	---	---			---		---		---
TOT	Isopropylbenzene	µg/L	---	---			---		---		---
TOT	Methyl Ethyl Ketone	µg/L	---	---			---		---		---
TOT	Nitrobenzene	µg/L	---	---			---		---		---
TOT	PCP	µg/L	---	---			---		---		---
TOT	Quinoline	µg/L	---	---			---		---		---
TOT	Sulfolane	µg/L	---	---			---		---		---
TOT	Tetrabromomethane	µg/L	---	---			---		---		---
TOT	Tetrachloroethene	µg/L	---	---			---		---		---
TOT	Tetrachloromethane	µg/L	---	---			---		---		---
TOT	Trans-1,2-Dichloroethene	µg/L	---	---			---		---		---
TOT	trans-1,3-dichloropropene	µg/L	---	---			---		---		---
TOT	Tribromomethane	µg/L	---	---			---		---		---
TOT	Trichloroethene	µg/L	---	---			---		---		---
TOT	Trichlorofluoromethane	µg/L	---	---			---		---		---
TOT	Trichloromethane	µg/L	---	---			---		---		---
TOT	VH C6-C10	µg/L	---	---			---		---		---
NA	Vinyl Chloride	µg/L	---	---			---		---		---

Notes:

a *- Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922*

b *- Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.*

--- = Not available.

FR1 - Field replicate 1.

FR2 - Field replicate 2.

FRM - Mean of field replicates.

NS- Not sampled

SS- Single sample

B6. Monthly Leachate Quality – Phase 2 Cleanout

Appendix B6. Monthly Leachate Quality - Phase 2 Cleanout - 2020-2021

State	Parameter	Units	Sewer Use Criteria		Phase 2 Cleanout SS	Phase 2 Cleanout SS	Phase 2 Cleanout SS	Phase 2 Cleanout NS	Phase 2 Cleanout NS	Phase 2 Cleanout SS	Phase 2 Cleanout SS	Phase 2 Cleanout NS	Phase 2 Cleanout NS	Phase 2 Cleanout SS	Phase 2 Cleanout SS	Phase 2 Cleanout SS
			min	max	24-Apr-2020	28-May-2020	18-Jun-2020	1-Jul-2020	1-Aug-2020	23-Sep-2020	29-Oct-2020	18-Nov-2020	7-Dec-2020	19-Jan-2021	9-Feb-2021	11-Mar-2021
CONVENTIONALS																
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	290	68.	42.	---	---	**540** a	28.	---	---	7.	7.5	3.6
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
DIS	Chloride	mg/L	---	1500	1100	940.	630.	---	---	1200	540.	---	---	120.	120.	970.
Total	COD	mg/L	---	1000	**2250** a	**1220** a	**1030** a	---	---	**2710** a	735	---	---	125.	159.	114.
Total	Conductivity	µS/cm	---	---	9835	6 161.	7 311.	---	---	5842	5 093.	---	---	2 026.	2 127.	1 703.
Total	Cyanide SAD	mg/L	---	1	< 0.025	< 0.025	< 0.025	---	---	< 0.05	0.021	---	---	0.004 13	0.004 04	0.003 75
Total	Cyanide WAD	mg/L	---	1	< 0.025	< 0.025	< 0.025	---	---	< 0.05	< 0.013	---	---	0.001 65	0.000 62	< 0.000 5
Total	Dissolved Oxygen	mg/L	---	---	1.14	0.5	0.19	---	---	0.15	0.1	---	---	0.37	0.28	0.88
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - NH3 (As N)	mg/L	---	---	1400	900.	210.	---	---	1800	490.	---	---	120.	120.	84.
Total	N - NO2 (As N)	mg/L	---	---	0.55	< 0.5	0.181	---	---	< 0.5	0.101	---	---	0.005 5	0.011 5	0.026 9
Total	N - NO3 (As N)	mg/L	---	---	< 2	< 2.	< 0.2	---	---	< 2	< 0.2	---	---	< 0.02	< 0.02	0.021
Total	N - NO3 + NO2 (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Tkn (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 2	< 2.	< 2.	---	---	< 2	< 2.	---	---	< 2.	< 2.	< 2.
Total	Oil & grease, total	mg/L	---	100	< 1	1.5	4.2	---	---	1	1.1	---	---	< 1.	< 1.	< 1.
Total	ORP	mV	---	---	-335	-367	-344	---	---	-218	-260	---	---	-138	- 110.	- 44.
Total	pH	pH	5.5	11	**7.78** b	7.82	7.52	---	---	6.99	7.36	---	---	7.15	7.	7.11
Dissolved	Sulphide	mg/L	---	1	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphide	mg/L	---	1	0.27	**1.6** a	**1.5** a	---	---	0.12	**4** a	---	---	0.0091	0.14	0.064
Dissolved	Sulphate	mg/L	---	1500	< 10	< 10.	51.	---	---	41	130.	---	---	220.	230.	**20 000.** a
Total	Temperature	°C	---	---	24.2	27.7	22.9	---	---	24.3	23.7	---	---	21.9	22.2	19.9
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	**1.2** a	**1.2** a	0.66	---	---	**3.2** a	0.46	---	---	0.034	0.12	0.072
Total	TSS	mg/L	---	350	57	4.	6.	---	---	340	6.	---	---	< 1.	4.8	2.
METALS																
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	400	75.	15.7	8.78	---	---	121	9.28	---	---	2.32	3.08	1.99
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	300	0.445	0.098	0.056	---	---	0.329	0.042	---	---	0.008 5	0.021 5	0.014 3
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4000	335.	128.	74.6	---	---	368	64.5	---	---	11.2	13.1	9.01
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5000	43.5	33.5	19.7	---	---	46.4	20.3	---	---	3.69	4.58	3.45
Total	Copper	µg/L	---	1000	37.4	4.23	5.21	---	---	14.7	3.13	---	---	3.11	2.09	2.59
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50000	3 260.	753.	2 080.	---	---	2780	777.	---	---	1 970.	2 790.	2 010.
Total	Lead	µg/L	---	1000	8.31	1.91	1.01	---	---	7.12	0.96	---	---	0.21	0.275	0.16
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5000	325	330	917	---	---	302	543	---	---	222	205.	217.
Total	Mercury	µg/L	---	20	< 0.038	< 0.038	< 0.038	---	---	< 0.19	< 0.019	---	---	< 0.019	< 0.001 9	< 0.019
Total	Molybdenum	µg/L	---	5000	2.96	1.81	1.31	---	---	2.28	0.93	---	---	3.21	4.74	4.46
Total	Nickel	µg/L	---	3000	124.	107.	66.9	---	---	129	63.5	---	---	10.8	14.1	9.87
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	300	1.02	0.68	0.47	---	---	1.25	0.45	---	---	0.169	0.183	0.176
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	500	0.121	< 0.05	< 0.05	---	---	< 0.05	< 0.05	---	---	< 0.01	< 0.01	< 0.01
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3000	144.	23.7	13.5	---	---	145	12.5	---	---	3.8	10.	6.1
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
VOLATILE ORGANICS																
Dissolved	Benzene	µg/L	---	100	1.3	1.3	---	---	---	< 0.4	1.1	---	---	0.5	0.57	0.49
Dissolved	Ethylbenzene	µg/L	---	200	5.4	3.9	---	---	---	< 0.4	2.4	---	---	< 0.4	0.79	< 0.4
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200	18	1.8	---	---	---	0.62	0.86	---	---	0.54	0.5	< 0.4
Dissolved	Xylenes	µg/L	---	200	28	7.5	---	---	---	4.9	4.6	---	---	< 0.4	1.6	< 0.4

Notes:

a *- Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.*

b *- Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.*

--- = Not available.

SS - Single Sample

NS - Not sampled

B7. Monthly Leachate Quality – North Purge Wells

Appendix B-7. Monthly Leachate Quality - North Purge Well 2020-2021

State	Parameters	Unit	Sewer Use Criteria		North Purge Well System	North Purge Well System	North Purge Well System	North Purge Well System	North Purge Well System	North Purge Well System	North Purge Well System	North Purge Well System	North Purge Well System	North Purge Well System	North Purge Well System
					SS	SS	SS	NS	NS	SS	SS	SS	SS	SS	SS
			min	max	23-Apr-2020	28-May-2020	18-Jun-2020	1-Jul-2020	1-Aug-2020	23-Sep-2020	29-Oct-2020	18-Nov-2020	7-Dec-2020	18-Jan-2021	1-Feb-2021	11-Mar-2021
CONVENTIONALS																
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	17	14	20	---	---	14	17	36	22	15	28	24
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chloride	mg/L	---	1500	305	330	741	---	---	266	361	341	390	213	378	531
Total	COD	mg/L	---	1000	320	360	360	---	---	320	330	250	250	170	280	350
Total	Conductivity	µS/cm	---	---	3093	3495	3666	---	---	3569	3216	2804	2886	2006	3019	3472
Total	Cyanide SAD	mg/L	---	1	0.0044	0.0037	< 0.005	---	---	0.0029	0.0078	< 0.0025	0.003	0.00156	0.0066	0.0063
Total	Cyanide WAD	mg/L	---	1	< 0.0025	< 0.0025	< 0.005	---	---	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.0005	< 0.0025	< 0.005
Total	Dissolved Oxygen	mg/L	---	---	0.38	0.14	0.25	---	---	0.28	0.31	0.17	0.05	0.08	0.15	0.07
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Nh3 (As N)	mg/L	---	---	150	250	230	---	---	170	180	170	160	120	180	220
Total	N - No2 (As N)	mg/L	---	---	0.0581	< 0.05	0.079	---	---	0.0155	0.082	0.232	< 0.05	0.028	0.065	0.06
Total	N - No3 (As N)	mg/L	---	---	0.335	< 0.2	< 0.2	---	---	0.03	1.75	1.13	1.14	0.39	0.86	< 0.2
Total	N - No3 + No2 (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Tkn (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 2	< 2	< 2	---	---	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Total	Oil & grease, total	mg/L	---	100	< 1	< 1	< 1	---	---	< 1	< 1	< 1	< 1	< 1	< 1	1.8
Total	ORP	mV	---	---	-71	-161	-141	---	---	-116	-73	-143	-208	-148	-112	-149
Total	pH	pH	5.5	11	7.02	6.95	7	---	---	6.56	7.15	7.2	7.26	7.36	7.12	7.2
Dissolved	Sulphide	mg/L	---	1	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphide	mg/L	---	1	0.022	0.026	0.089	---	---	0.074	0.036	0.067	0.075	0.055	0.086	0.11
Dissolved	Sulphate	mg/L	---	1500	26	27	29	---	---	15	45	58	49	38	1.5	33
Total	Temperature	°C	---	---	16.6	17.6	18	---	---	18.5	17.6	15.8	15.4	14.1	15.3	15.2
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.048	0.079	0.036	---	---	0.028	0.039	0.047	0.036	0.041	< 0.015	0.06
Total	TSS	mg/L	---	350	19	63	46	---	---	60	6	9.6	6.8	2	5.2	9.6
METALS																
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	400	4.91	9.58	9.98	---	---	8.98	8.19	9.69	8.84	6.83	9.96	11.5
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	300	0.029	< 0.025	0.028	---	---	0.011	0.071	0.088	0.047	0.0223	0.031	0.044
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4 000.	12.1	15.9	18.9	---	---	6.27	25.3	30.5	27.5	19	30.4	46.7
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5000	8.19	9.35	9.81	---	---	7.67	10.5	10.1	9.06	5.13	7.29	10.6
Total	Copper	µg/L	---	1000	5.98	3.03	3.97	---	---	1.22	11.8	30.5	6.36	5.08	4.82	4.81
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50 000.	8120	18600	17800	---	---	19200	8240	8080	10600	5890	8210	11300
Total	Lead	µg/L	---	1 000.	0.285	0.27	0.35	---	---	0.08	0.731	0.928	0.648	0.386	0.579	0.815
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5000	888	1100	1210	---	---	1210	894	669	652	413	591	766
Total	Mercury	µg/L	---	20	< 0.038	< 0.038	0.044	---	---	< 0.038	< 0.019	0.0053	< 0.019	< 0.019	< 0.038	< 0.019
Total	Molybdenum	µg/L	---	5000	1.77	2.01	1.47	---	---	1.33	1.82	1.99	1.77	1.51	2.04	2.18
Total	Nickel	µg/L	---	3000	21.2	25	25.8	---	---	18.5	25.6	24.5	23.4	12.9	20	28.5
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	300	0.247	0.3	0.3	---	---	0.197	0.344	0.436	0.319	0.245	0.3	0.338
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	500	< 0.02	< 0.05	< 0.05	---	---	< 0.02	< 0.02	0.023	< 0.02	< 0.01	< 0.02	< 0.02
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3000	4.3	< 5	7.6	---	---	3.4	9.3	12	13.4	9.1	11.5	14.5
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
VOLATILE ORGANICS																
Dissolved	Benzene	µg/L	---	100	< 0.4	< 0.4	< 0.4	---	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	0.4	< 0.4
Dissolved	Ethylbenzene	µg/L	---	200	< 0.4	< 0.4	< 0.4	---	---	< 0.4	< 0.4	0.53	< 0.4	0.61	0.8	1.1
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200	< 0.4	< 0.4	< 0.4	---	---	< 0.4	< 0.4	< 0.4	0.55	1.1	1.6	2.1
Dissolved	Xylenes	µg/L	---	200	< 0.4	< 0.4	< 0.4	---	---	< 0.4	< 0.4	1.7	0.97	1.8	2.7	3.2

Notes:

a *- Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.*

b *- Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.*

--- = Not available.

SS - Single Sample

NS - Not Sampled

B8. Monthly Leachate Quality – Controlled Waste Drainage

Appendix B-8. Monthly Leachate Quality - Controlled Waste Drainage 2020-2021

States	Parameter	Units	Sewer Use Criteria		Controlled Waste Ditch SS 23-Apr-2020	Controlled Waste Ditch SS 28-May-2020	Controlled Waste Ditch SS 18-Jun-2020	Controlled Waste Ditch NS 1-Jul-2020	Controlled Waste Ditch NS 1-Aug-2020	Controlled Waste Ditch SS 23-Sep-2020	Controlled Waste Ditch SS 29-Oct-2020	Controlled Waste Ditch SS 18-Nov-2020	Controlled Waste Ditch SS 7-Dec-2020	Controlled Waste Ditch SS 18-Jan-2021	Controlled Waste Ditch SS 2-Feb-2021	Controlled Waste Ditch SS 11-Mar-2021
			min	max												
CONVENTIONALS																
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	72	17	59	---	---	26	85	44	130	73	64	58
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Chloride	mg/L	---	1500	580	630	640	---	---	510	580	200	350	360	160	440
Total	COD	mg/L	---	1000	588	559	662	---	---	630	602	248	430	431	204	512
Total	Conductivity	µS/cm	---	---	5625	6007	6239	---	---	6247	5567	2707	3651	3939	1493	4131
Total	Cyanide SAD	mg/L	---	1	< 0.013	< 0.01	0.011	---	---	< 0.01	0.018	0.00722	0.0102	0.0094	0.00798	0.0118
Total	Cyanide WAD	mg/L	---	1	< 0.013	< 0.01	< 0.01	---	---	< 0.01	< 0.01	0.00284	0.005	< 0.0025	0.00443	< 0.005
Total	Dissolved Oxygen	mg/L	---	---	6.5	4.97	3.14	---	---	0.03	4.16	6.04	4.13	6.4	10.33	4.63
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - NH3 (As N)	mg/L	---	---	420	460	460	---	---	380	440	140	190	270	110	280
Total	N - NO2 (As N)	mg/L	---	---	1.98	5.5	11.3	---	---	< 0.05	6.75	2.4	5.25	1.98	1.87	6.54
Total	N - NO3 (As N)	mg/L	---	---	14.8	1.89	1.1	---	---	< 0.2	2.33	12	46.3	12.5	22.4	16.4
Total	N - NO3 + NO2 (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Tkn (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 2	< 2	< 2	---	---	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Total	Oil & grease, total	mg/L	---	100	< 1	< 1	1.4	---	---	1.1	< 1	< 1	< 1	< 1	< 1	1.1
Total	ORP	mV	---	---	87.0	8.0	23.0	---	---	-75.0	-20.0	22.0	-13.0	63.0	-2.0	4.0
Total	pH	pH	5.5	11	8.52	8.49	8.5	---	---	8.35	8.52	8.2	8.3	8.04	7.89	6.57
Dissolved	Sulphide	mg/L	---	1	---	---	---	---	---	--- ---	---	---	---	---	---	---
Total	Sulphide	mg/L	---	1	0.032	0.0087	0.11	---	---	**1.7 a**	0.067	0.018	0.043	0.035	0.027	0.023
Dissolved	Sulphate	mg/L	---	1500	< 10	< 10	< 10	---	---	18	< 10	33	29	< 1	< 1	< 10
Total	Temperature	°C	---	---	18	19.8	21.1	---	---	18.6	18.5	16.6	15.5	17.1	11.5	15.6
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.046	0.047	< 0.03	---	---	0.22	0.051	0.017	0.019	< 0.03	< 0.038	0.024
Total	TSS	mg/L	---	350	18	17	10	---	---	17	110	8	58	12	10	12
METALS																
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	400	5.6	6.16	6.13	---	---	7.01	5.68	3.7	4.58	5.95	3.19	4.62
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	300	0.05	< 0.025	< 0.025	---	---	0.038	0.013	0.077	0.143	0.091	0.0961	0.08
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4000	44.2	45.4	43	---	---	66	36.8	20.4	36.5	34.1	20.8	34.1
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5000	23	22.8	21.4	---	---	19.9	21.4	11.5	17.3	15.5	7.53	17.2
Total	Copper	µg/L	---	1000	7.73	4.33	2.56	---	---	2.04	1.82	17.8	24	13.3	18.2	9.35
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50000	3260	2830	2730	---	---	1310	2810	1140	3180	4040	1750	2010
Total	Lead	µg/L	---	1000	0.34	0.17	0.13	---	---	0.659	0.159	0.297	0.766	0.521	0.786	0.248
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5000	1040	427	399	---	---	989	266	1380	1890	2240	853	1890
Total	Mercury	µg/L	---	20	< 0.038	< 0.038	0.04	---	---	< 0.038	< 0.019	0.0068	< 0.019	< 0.019	0.008	< 0.019
Total	Molybdenum	µg/L	---	5000	1.49	1.8	1.42	---	---	2.2	1.53	1.47	1.8	1.58	1.4	1.43
Total	Nickel	µg/L	---	3000	50.3	48.3	45.7	---	---	55.5	43.8	29	47.3	37	21.5	38.6
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	300	0.61	0.68	0.57	---	---	0.451	0.691	0.375	0.447	0.424	0.236	0.462
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	500	< 0.05	< 0.05	< 0.05	---	---	< 0.02	< 0.02	0.023	0.026	< 0.02	0.022	< 0.02
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3000	42.6	41.3	32.8	---	---	9	22.9	27.1	50.4	48.1	61.1	38.5
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
VOLATILE ORGANICS																
Dissolved	Benzene	µg/L	---	100	< 0.4	< 0.4	< 0.4	---	---	1	< 0.4	< 0.4	< 0.4	< 0.4	0.43	< 0.4
Dissolved	Ethylbenzene	µg/L	---	200	< 0.4	< 0.4	< 0.4	---	---	1	< 0.4	< 0.4	< 0.4	< 0.4	0.68	< 0.4
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200	< 0.4	< 0.4	< 0.4	---	---	0.55	< 0.4	< 0.4	0.51	< 0.4	1.3	< 0.4
Dissolved	Xylenes	µg/L	---	200	< 0.4	< 0.4	< 0.4	---	---	2.3	< 0.4	< 0.4	< 0.4	< 0.4	2.6	< 0.4

Notes:

a *- Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.*

b *- Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.*

SS - Single Sample

NS - Not Sampled

--- = Not available

B9. Monthly Leachate Quality – South Purge Wells

Appendix B-9. Leachate Quality - South Purge Wells - 2020-2021

State	Parameter	Units	Sewer Use Criteria		South Purge Wells NS 1-Apr-2020	South Purge Wells NS 1-May-2020	South Purge Wells NS 1-Jun-2020	South Purge Wells NS 1-Jul-2020	South Purge Wells NS 1-Aug-2020	South Purge Wells NS 1-Sep-2020	South Purge Wells NS 1-Oct-2020	South Purge Wells SS 1-Nov-2020	South Purge Wells SS 1-Dec-2020	South Purge Wells SS 1-Jan-2021	South Purge Wells SS 2-Feb-2021	South Purge Wells SS 10-Mar-2021
			min	max												
CONVENTIONALS																
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	---	---	---	---	---	---	---	14	14	3.2	10	5.7
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chloride	mg/L	---	1500	---	---	---	---	---	---	---	110	99	79	94	120
Total	COD	mg/L	---	1000	---	---	---	---	---	---	---	69	74	56	64	84
Total	Conductivity	µS/cm	---	---	---	---	---	---	---	---	---	1399	1358	1097	1190	1265
Total	Cyanide SAD	mg/L	---	1	---	---	---	---	---	---	---	0.00071	0	0.00133	0.00128	0.00131
Total	Cyanide WAD	mg/L	---	1	---	---	---	---	---	---	---	< 0.0005	< 0.0005	< 0.0005	0.00509	< 0.0005
Total	Dissolved Oxygen	mg/L	---	---	---	---	---	---	---	---	---	6.8	4.89	3.51	3.12	4.02
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - NH3 (As N)	mg/L	---	---	---	---	---	---	---	---	---	60	54	38	3.4	3.8
Total	N - NO2 (As N)	mg/L	---	---	---	---	---	---	---	---	---	0.0202	0.0628	0.0085	0.0061	< 0.005
Total	N - NO3 (As N)	mg/L	---	---	---	---	---	---	---	---	---	0.398	0.253	0.022	< 0.02	< 0.02
Total	N - NO3 + NO2 (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Tkn (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	---	---	---	---	---	---	---	< 1	< 1	< 1	< 1	< 1
Total	Oil & grease, total	mg/L	---	100	---	---	---	---	---	---	---	< 2	< 2	< 2	< 2	< 2
Total	ORP	mV	---	---	---	---	---	---	---	---	---	-82.0	-93.0	-87	-119	-117
Total	pH	pH	5.5	11	---	---	---	---	---	---	---	7.42	7.44	7.52	7.57	7.48
Dissolved	Sulphide	mg/L	---	1	---	---	---	---	---	---	---	0	0	0	0	0
Total	Sulphide	mg/L	---	1	---	---	---	---	---	---	---	0.02	0.012	0.02	0.014	0.021
Dissolved	Sulphate	mg/L	---	1500	---	---	---	---	---	---	---	8.6	6.5	3.6	< 1	2
Total	Temperature	°C	---	---	---	---	---	---	---	---	---	16.1	16.2	14.4	14.6	16.1
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	---	---	---	---	---	---	---	0.0048	0.006	0.0036	< 0.0015	0.0036
Total	TSS	mg/L	---	350	---	---	---	---	---	---	---	110	30	36	13	33
METALS																
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	400	---	---	---	---	---	---	---	97.9	8.71	6.95	8.42	7.76
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	300	---	---	---	---	---	---	---	0.153	< 0.01	0.01	0.011	< 0.01
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4000	---	---	---	---	---	---	---	5.3	0.78	0.58	0.75	0.66
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5000	---	---	---	---	---	---	---	4.91	2.73	1.62	1.55	1.97
Total	Copper	µg/L	---	1000	---	---	---	---	---	---	---	45.4	0.31	0.74	0.46	0.22
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50000	---	---	---	---	---	---	---	317000 Max	12200	20000	19500	15400
Total	Lead	µg/L	---	1000	---	---	---	---	---	---	---	24.1	0.83	0.189	0.173	0.176
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5000	---	---	---	---	---	---	---	1120	119	173	185	185
Total	Mercury	µg/L	---	20	---	---	---	---	---	---	---	< 0.0019	< 0.0019	< 0.0019	< 0.0019	< 0.0019
Total	Molybdenum	µg/L	---	5000	---	---	---	---	---	---	---	14.2	14.8	10.1	13.5	14.3
Total	Nickel	µg/L	---	3000	---	---	---	---	---	---	---	10.2	16.3	5.64	5.72	5.91
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	300	---	---	---	---	---	---	---	< 0.4	0.086	< 0.08	< 0.08	< 0.08
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	500	---	---	---	---	---	---	---	0.17	< 0.02	< 0.02	< 0.02	< 0.02
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3000	---	---	---	---	---	---	---	85	20.2	11.1	7.9	5
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
VOLATILE ORGANICS																
Total	Benzene	µg/L	---	100	---	---	---	---	---	---	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total	Ethylbenzene	µg/L	---	200	---	---	---	---	---	---	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Toluene	µg/L	---	200	---	---	---	---	---	---	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total	Xylenes	µg/L	---	200	---	---	---	---	---	---	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4

Notes:

a *- Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.*

b *- Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.*

--- = Not available.

B10. Monthly Leachate Quality – West Face Drainage

Appendix B-10. Monthly Leachate Quality - West Face Drainage 2020-2021

State	Parameter	Units	Sewer Use Criteria		West Face Drainage SS 23-Apr-2020	West Face Drainage SS 28-May-2020	West Face Drainage SS 18-Jun-2020	West Face Drainage NS 1-Jul-2020	West Face Drainage NS 1-Aug-2020	West Face Drainage SS 23-Sep-2020	West Face Drainage SS 29-Oct-2020	West Face Drainage SS 18-Nov-2020	West Face Drainage SS 7-Dec-2020	West Face Drainage SS 18-Jan-2021	West Face Drainage SS 1-Feb-2021	West Face Drainage SS 11-Mar-2021
			min	max												
CONVENTIONALS																
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	53	---	290	---	---	55	260	350	210	110	81	99
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Chloride	mg/L	---	1500	1100	---	1200	---	---	**1800** a	1100	760	950	650	750	1300
Total	COD	mg/L	---	1000	**1510** a	---	**2560** a	---	---	**2800** a	**2820** a	**1480** a	**1740** a	**1500** a	**1330** a	788
Total	Conductivity	µS/cm	---	---	13668	14361	15352	---	---	15259	16147	13080	13769	11519	11920	12031
Total	Cyanide SAD	mg/L	---	1	0.114	---	0.032	---	---	0.572	0.051	< 0.013	0.02	0.019	0.023	0.025
Total	Cyanide WAD	mg/L	---	1	< 0.025	---	< 0.025	---	---	< 0.05	< 0.05	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013
Total	Dissolved Oxygen	mg/L	---	---	1.53	1.17	0.99	---	---	0.52	1.18	0.73	0.39	0.08	0.04	0.09
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Nh3 (As N)	mg/L	---	---	680	---	1600	---	---	780	1400	1000	920	870	730	800
Total	N - No2 (As N)	mg/L	---	---	84.4	---	0.52	---	---	204	0.54	1.28	0.775	0.485	0.419	< 0.5
Total	N - No3 (As N)	mg/L	---	---	77.4	---	< 2	---	---	162	< 2	7.6	11.2	1.55	18.6	4.1
Total	N - No3 + No2 (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Tkn (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 1	---	3.5	---	---	< 1	17	2.2	1.5	3.9	< 1	7.8
Total	Oil & grease, total	mg/L	---	100	< 2	---	< 2	---	---	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Total	ORP	mV	---	---	-8	-64	-65	---	---	-69	-56	-33	-29	-78	-47.0	-18.0
Total	pH	pH	5.5	11	7.95	7.9	7.92	---	---	7.87	7.82	7.71	7.82	7.82	7.93	7.87
Dissolved	Sulphide	mg/L	---	1	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphide	mg/L	---	1	< 0.018	---	0.12	---	---	0.1	0.11	0.048	0.1	0.053	0.055	0.092
Dissolved	Sulphate	mg/L	---	1500	84	---	< 10	---	---	310	< 10	18	57	< 100	< 10	28
Total	Temperature	°C	---	---	18.7	20.1	21.5	---	---	18.8	27	35.2	29	34.1	34.8	27.7
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.085	---	**1.6** a	---	---	0.2	**1.6** a	**1.2** a	**1.5** a	**1.2** a	0.16	**1.2** a
Total	TSS	mg/L	---	350	21	---	89	---	---	25	8.4	18	21	12	15	17
METALS																
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	400	40.4	---	80.1	---	---	80	89.6	56.1	56.6	40.7	39.4	42
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	300	0.34	---	0.325	---	---	0.537	0.337	0.202	0.251	0.25	0.252	0.318
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4000	248	---	351	---	---	429	319	183	176	150	120	153
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5000	49.6	---	42.2	---	---	94.3	41.9	28.2	39.1	27.5	30.3	33.7
Total	Copper	µg/L	---	1000	87.2	---	11.3	---	---	116	11.2	21.4	41.6	45.2	59.9	44.8
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50000	3530	---	2970	---	---	5500	3350	2750	2560	2130	1930	2450
Total	Lead	µg/L	---	1000	3.95	---	6.14	---	---	6.35	6.02	3.72	3.79	3.58	3.01	3.7
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5000	331	---	317	---	---	582	337	317	310	286	214	307
Total	Mercury	µg/L	---	20	0.045	---	< 0.038	---	---	< 0.19	0.026	< 0.019	< 0.019	< 0.019	< 0.038	< 0.019
Total	Molybdenum	µg/L	---	5000	5.79	---	2.08	---	---	9.24	1.93	1.65	1.89	1.6	2.7	1.7
Total	Nickel	µg/L	---	3000	136	---	125	---	---	263	115	77.1	109	77.1	84.5	93.4
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	300	2.03	---	0.97	---	---	4.87	1.17	0.73	0.92	0.71	0.7	0.81
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	500	0.096	---	< 0.1	---	---	< 0.1	< 0.1	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3000	84.1	---	130	---	---	122	128	71.5	68.7	63.3	52.9	68.4
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
VOLATILE ORGANICS																
Total	Benzene	µg/L	---	100	< 0.4	---	---	---	---	< 0.4	4.2	3.2	3	2.4	1.6	1.3
Total	Ethylbenzene	µg/L	---	200	< 0.4	---	---	---	---	< 0.4	15	12	7.7	8.3	6.2	4.6
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ethe	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Toluene	µg/L	---	200	0.42	---	---	---	---	< 0.4	47	41	30	29	14	9.2
Total	Xylenes	µg/L	---	200	< 0.4	---	---	---	---	< 0.4	44	37	35	31	21	18

Notes:

a *- Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922*

b *- Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922*

SS - Single Sample

NS - Not Sampled

--- = Not available.

B11. Monthly Leachate Quality - Cell 3 Pipe Outlet

Appendix B-11. Monthly Leachate Quality - Cell 3 Pipe Outlet 2020-2021

State	Parameter	Units	Sewer Use Criteria		Cell 3 Pipe Outlet	Cell 3 Pipe Outlet	Cell 3 Pipe Outlet	Cell 3 Pipe Outlet	Cell 3 Pipe Outlet	Cell 3 Pipe Outlet	Cell 3 Pipe Outlet	Cell 3 Pipe Outlet	Cell 3 Pipe Outlet	Cell 3 Pipe Outlet	Cell 3 Pipe Outlet	Cell 3 Pipe Outlet
			min	max	SS 23-Apr-2020	SS 28-May-2020	SS 18-Jun-2020	NS 1-Jul-2020	NS 1-Aug-2020	SS 23-Sep-2020	SS 29-Oct-2020	SS 18-Nov-2020	SS 7-Dec-2020	SS 18-Jan-2021	SS 1-Feb-2021	SS 11-Mar-2021
CONVENTIONALS																
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	41	48	130	---	---	74	< 30	310	< 30	65	41	15
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Chloride	mg/L	---	1500	830	1300	1300	---	---	700	1100	710	890	730	640	1100
Total	COD	mg/L	---	1000	**1270 a**	**1620 a**	**1530 a**	---	---	936	**1780 a**	**1180 a**	**1730 a**	**1410 a**	**1080 a**	**1350 a**
Total	Conductivity	µS/cm	---	---	8220	9104	9062	---	---	12425	9250	7759	8362	7790	6170	6640
Total	Cyanide SAD	mg/L	---	1	< 0.025	0.23	0.392	---	---	0.0172	0.135	< 0.013	0.144	0.037	0.055	0.053
Total	Cyanide WAD	mg/L	---	1	< 0.025	< 0.025	< 0.025	---	---	< 0.005	< 0.05	< 0.013	0.015	< 0.013	< 0.013	< 0.013
Total	Dissolved Oxygen	mg/L	---	---	1.05	1.24	1.47	---	---	0.25	0.4	0.08	0.4	0.73	0.7	1.48
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - NH3 (As N)	mg/L	---	---	850	640	620	---	---	460	700	540	530	600	460	540
Total	N - NO2 (As N)	mg/L	---	---	0.136	137	174	---	---	6.27	69.7	< 0.5	65.1	11.2	26.1	25.2
Total	N - NO3 (As N)	mg/L	---	---	< 0.2	92	111	---	---	2.78	63.8	< 2	56.1	16.4	47.2	38.5
Total	N - No3 + No2 (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Tkn (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 1	1.5	< 1	---	---	< 1	< 1	< 1	< 1	< 1	< 1	1
Total	Oil & grease, total	mg/L	---	100	< 2	< 2	< 2	---	---	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Total	ORP	mV	---	---	-22	-33	-33	---	---	-72	-52	-223	-157	-81	-8.6	6
Total	pH	pH	5.5	11	9.06	8.93	8.81	---	---	8.41	8.97	8.53	8.91	8.8	8.79	9.01
Dissolved	Sulphide	mg/L	---	1	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphide	mg/L	---	1	**1.4 a**	< 0.018	0.044	---	---	0.14	0.066	0.078	< 0.036	0.07	0.068	0.042
Dissolved	Sulphate	mg/L	---	1500	< 10	100	150	---	---	< 10	160	83	10	< 100	< 100	28
Total	Temperature	°C	---	---	17.3	17.6	18.1	---	---	18.6	21.4	27.4	21.5	20.9	18.2	15.9
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.97	0.11	< 0.075	---	---	0.054	< 0.075	0.25	0.062	0.18	< 0.03	0.13
Total	TSS	mg/L	---	350	3.3	20	28	---	---	54	17	30	10	12	18	11
METALS																
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	400	13.6	41.5	51	---	---	10.3	67.8	45.5	52.2	43.5	32.9	34.9
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	300	0.104	0.312	0.444	---	---	0.047	0.41	0.308	0.325	0.178	0.185	0.229
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4000	121	215	231	---	---	75.2	251	165	226	159	131	189
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5000	30.6	44.5	53.4	---	---	26.5	63.8	43.1	49.9	34	27.5	36
Total	Copper	µg/L	---	1000	3.8	64	82	---	---	4.92	108	109	88.1	60.3	50.2	53.9
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50000	794	2800	3390	---	---	33300	4450	3270	3750	3570	2820	2870
Total	Lead	µg/L	---	1000	1.91	3.69	4.08	---	---	1.54	4.38	6.24	3.98	4.18	3.18	3.65
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5000	450	286	408	---	---	2780	415	449	475	515	357	391
Total	Mercury	µg/L	---	20	0.052	0.092	0.041	---	---	< 0.19	0.041	0.0024	0.024	0.028	< 0.038	0.026
Total	Molybdenum	µg/L	---	5000	1.68	5.34	3.98	---	---	1.55	4.52	4	6.47	3.48	3.74	4.21
Total	Nickel	µg/L	---	3000	97.8	131	157	---	---	56.5	165	105	131	129	74.9	101
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	300	0.51	2.27	2.32	---	---	0.84	2.91	1.58	1.97	1.3	1.29	1.31
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	500	0.084	< 0.1	< 0.1	---	---	< 0.05	< 0.1	0.054	0.072	< 0.05	< 0.05	0.058
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3000	23.6	77	92	---	---	286	88	94.2	77.3	82.3	59.5	65
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
VOLATILE ORGANICS																
Dissolved	Benzene	µg/L	---	100	1.4	< 0.4	---	---	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Dissolved	Ethylbenzene	µg/L	---	200	4.3	< 0.4	---	---	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200	2.1	0.42	---	---	---	< 0.4	< 0.4	< 0.4	0.43	< 0.4	< 0.4	< 0.4
Dissolved	Xylenes	µg/L	---	200	8.5	< 0.4	---	---	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4

Notes:

a *- Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922*

b *- Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922*

SS - Single sample

NS - Not sampled

--- = Not available.

B12. Monthly Leachate Quality Emerging Contaminant

Appendix B-12. Monthly Leachate Quality - Emerging Contaminant 2020-2021

State	Parameter	Units	Sewer Use Criteria		Hartland Valve Chamber SS 28-May-2020	Hartland Valve Chamber FR1 22-Sep-2020	Hartland Valve Chamber FR2 22-Sep-2020	Hartland Valve Chamber FRM 22-Sep-2020	Hartland Valve Chamber BLT 23-Sep-2020	Hartland Valve Chamber FR1 18-Nov-2020	Hartland Valve Chamber FR2 18-Nov-2020	Hartland Valve Chamber FRM 18-Nov-2020	Hartland Valve Chamber BLF 18-Nov-2020	Hartland Valve Chamber BLT 18-Nov-2020	Hartland Valve Chamber FR1 23-Feb-2021
			min	max											
EMERGING CONTAMINANTS															
Total	Perfluorobutanesulfonic acid	µg/L	---	---	0.63	0.69	0.67	0.68	< 0.02	0.29	0.3	0.295	< 0.02	< 0.02	0.35
Total	Perfluorodecanesulfonic acid (PFDS)	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	Perfluoroheptanesulfonic acid	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	Perfluorohexanesulfonic acid	µg/L	---	---	0.75	0.85	0.81	0.83	< 0.02	0.34	0.34	0.34	< 0.02	< 0.02	0.4
Total	Perfluorononanesulfonic acid	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	Perfluorooctanesulfonic acid	µg/L	---	---	0.2	0.22	0.22	0.22	< 0.02	0.13	0.13	0.13	< 0.02	< 0.02	0.15
Total	Perfluorooctanoic acid (PFOA)	µg/L	---	---	0.79	0.89	0.86	0.88	< 0.02	0.54	0.53	0.535	< 0.02	< 0.02	0.55
Total	Perfluoropentanesulfonic acid	µg/L	---	---	0.025	0.035	0.03	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	PF3A	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	PF4A	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	PFBoA	µg/L	---	---	0.87	0.81	0.77	0.79	< 0.02	0.34	0.34	0.34	< 0.02	< 0.02	0.35
Total	PFDA	µg/L	---	---	0.049	0.06	0.06	0.06	< 0.02	0.048	0.05	0.049	< 0.02	< 0.02	0.047
Total	PFDoA	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	PFHpA	µg/L	---	---	0.28	0.32	0.31	0.32	< 0.02	0.17	0.17	0.17	< 0.02	< 0.02	0.17
Total	PFHxA	µg/L	---	---	1.3	1.5	1.50	1.50	< 0.02	0.93	0.93	0.93	< 0.02	< 0.02	0.95
Total	PFNA	µg/L	---	---	0.039	0.044	0.04	0.04	< 0.02	0.033	0.031	0.032	< 0.02	< 0.02	0.032
Total	PFOSA	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	PFPeA	µg/L	---	---	0.52	0.65	0.61	0.63	< 0.02	0.39	0.4	0.395	< 0.02	< 0.02	0.37
Total	PFUA	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	---	---	---	< 0.02	< 0.02	< 0.02
Total	1,4-Dioxane	µg/L	---	---	20.	16.	17.00	16.50	---	11.	11.	11.	---	---	8.2

Notes:

a *- Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.*

b *- Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.*

--- = Not available.

Appendix C

Climate Data

- C1. Daily Rainfall Data – Hartland Landfill Weather Station
- C2. Monthly Rainfall Data – Hartland Landfill Weather Station

C1. Daily Rainfall Data – Hartland Landfill Weather Station

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																								
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
January	1	2.4	11.6	0	7.6	0	8	5.4	0	11	5	35	0	22.2	22	0	0	3	2	0	0	0	0	0	0	10.5
January	2	0	0	0	0	0	2.6	32.6	0	0	0.8	64.4	11.2	0	1.3	0.0	0.8	0.0	1.5	0.0	0.0	0.0	0.0	0	0	40.5
January	3	0	0.2	0	16.8	4.6	2.6	6.8	5.8	0	1.6	7.8	1.6	0.2	0.0	0.0	5.5	0.0	10.5	4.3	0.0	0.0	0.0	17.75	0	7.5
January	4	0	16.2	0	11.2	13	0.2	15	0	0	1.4	9.6	0.4	20.4	40.0	4.3	8.3	5.3	0.0	3.5	0.5	0.0	0.8	74	0	13.75
January	5	0	20.8	0	0	30.2	0	0	0	0	23.8	57.4	11	2.8	5.8	21.8	22.8	1.8	0.0	31.5	2.0	0.0	4.0	1.5	0	16.5
January	6	0	20.4	0.4	6.4	0	10.2	0	9.8	3	11.4	2.6	0	21	0.0	23.8	8.5	3.8	0.0	26.0	2.5	0.0	0.0	0.5	0	0.75
January	7	0	1	0	1.8	0	44.4	0	16.4	14.2	6	55.8	0	28.6	0	11	1	9	0	0	0	0	14	7.5	0	0.25
January	8	0	0	0	7.6	0.2	21.8	0	2.2	12.8	1.8	4.2	8.2	2.2	15.0	0.0	1.8	6.0	9.0	0.3	0.0	0.0	6.5	0	0	5
January	9	0	0	19.6	19.8	0	0	0	2	0	16.4	10.8	0.6	0.2	2.0	0.3	0.5	6.8	7.5	0.3	0.0	0.3	1.5	1.5	0	1.5
January	10	0	0	21	3	0	0.4	0	1.2	0	42.4	12	36.6	17.2	1.5	0.0	0.3	2.3	5.0	2.3	0.0	0.0	2.5	1.5	23	3.25
January	11	0	0	1	1.2	0	0.4	0	1.6	0.6	14.2	0.6	3.4	0.8	27.8	0.0	0.0	0.0	2.5	3.0	0.0	0.0	4.0	1.5	2	23.5
January	12	0	0	0.2	4.2	0	7.8	7	0	0	17	0	1.8	0	4	3	0	1	4	1	6	0	5	0	12.5	34
January	13	0	17.2	0	0.6	3.2	0	0.4	2.2	0	8.4	0	0	0	2.5	16.3	0.0	0.0	2.3	0.3	12.5	0.0	3.8	0	0	0.75
January	14	0	20.4	65.6	6	0	n/a	2.2	2.2	0	0	0	12	0	22	14	1	0	0	0	2	0	0	0	0	0
January	15	0	22.8	0.2	10.8	0	0	0	2	3.6	0	0	0	0	21	15	6	1	0	0	0	0	0	0	3.75	0
January	16	0	13.4	10.2	6.4	0	0.8	0	0	8.6	36	5.6	0	0	0	11	0	0	0	3	2	1	0	0	0	0.75
January	17	0	16.4	8.6	2.2	0.4	0.8	0	0	54.4	1.4	0	0	0	1.3	0.3	0.5	0.0	0.0	0.0	12.0	14.5	12.5	0	0	1.5
January	18	0	0.2	20.6	0	10.2	1.8	0	5.4	18.4	0	12.4	0.4	0	2	0	0	0	0	21	6	6	4	7.75	1.75	0.25
January	19	0	0.4	3.2	0	2.6	8.6	0	2.6	15.4	3.6	5.4	2.8	0	0.0	0.0	0.0	0.3	0.3	37.0	0.5	2.3	4.0	5.25	1.5	0
January	20	0	0	2.8	5.4	0.4	11.6	0.6	0	10	6	0	0	0	0	8	0	0	0	1	0	0	3	4.5	1.75	0
January	21	0	0.4	1	10	21.4	10.8	9.4	0	0.4	2.2	2	0	0	0.0	8.8	19.5	0.0	0.0	0.0	7.8	0.5	12.0	0.25	18	0.75
January	22	0	1	1.6	0	0	4	27.6	0	42.2	0	18.2	0	0	0	0	5	0	0	1	34	0	12	0	21.25	0
January	23	0	16	0.4	0.4	0	4.4	10	8.6	0.2	0.2	8.8	0	0	0.0	5.0	4.3	0.0	0.0	8.8	2.5	0.0	23.0	31.5	19.5	0.75
January	24	0	6.2	0	0	1.2	22.8	9.4	0.6	0	0	0	0	0	4	10	1	4	0	14	0	0	1	3.5	3.25	13.25
January	25	0	0.4	0.4	0.8	1	20.4	0.6	0	0	0	0.2	0	0	1	0	20	6	0	4	0	0	4	0.25	3.75	3.5
January	26	0	6.6	2	0	0	3	24.4	3.6	0	18.6	0	1	0	0.0	0.0	21.5	0.3	0.0	0.0	0.0	0.0	6.5	0	3	0.5
January	27	0	4	7.4	0	0	6.2	6.2	4.4	0	3	0	0.2	6	0	0	0	3	0	0	10	0	6	0	12	2
January	28	0	1.2	19.2	0	0	0	0	16.8	0.2	11.2	0	0.4	0	0.0	5.0	0.0	0.0	1.5	0.3	0.5	0.0	3.0	0	8.5	3.25
January	29	0	0	88.2	0	5.8	0	7.4	13.4	0	33.2	0	8.2	0	0.5	6.0	1.5	0.0	1.3	0.0	1.3	2.0	2.8	0	15.25	0
January	30	0	3.2	2.2	0	5.2	16	2.8	18.6	11.4	10.8	0	4.2	0	6.5	0.0	21.8	0.5	21.3	0.0	8.8	0.0	13.0	0	9.5	0
January	31	0	0	5	1	0	3.6	38	0.4	3.8	1	0	2.8	0	0	0	1	1	2	0	4	0	5	0	6.25	10.25
Total Monthly Rainfall		***2.4***	***200***	***280.8***	***123.2***	***99.4***	***213.2***	***205.8***	***119.8***	***210.2***	***277.4***	***312.8***	***106.8***	***121.6***	***180.5***	***161.75***	***150.75***	***53.75***	***70.25***	***162.6***	***114.9***	***26.6***	***153.5***	***158.75***	***166.5***	***194.5***
Maximum Daily Rainfall		***2.4***	***22.8***	***88.2***	***19.8***	***30.2***	***44.4***	***38***	***18.6***	***54.4***	***42.4***	***64.4***	***36.6***	***28.6***	***40***	***23.75***	***22.75***	***8.5***	***21.25***	***37***	***34***	***14.5***	***23***	***74***	***23***	***40.5***

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
February	1	0	0	28.8	26.4	0	0.8	0.2	6	0	10.2	0	0	1.4	3.0	0.0	4.8	0.5	0.0	1.0	7.5	0.0	14.50	1.0	24.25	22
February	2	0	0	45.4	0.4	9.4	0	0.2	8	0	11	0	0.2	4.6	2	0	5	0	0	3	1	0	5.50	11.3	0.25	7
February	3	0	0.4	3.2	0	3.2	0.4	0	1.2	1.6	5.6	1.6	0	0	1.0	2.0	0.0	0.0	0.0	3.5	0.3	0.0	1.50	0.0	0	0
February	4	0	0	6.2	0	9.2	0	0	2.2	10.6	32.6	6.6	0.2	0	0.5	9.8	0.0	1.8	0.0	1.0	1.8	14.0	1.3	0.3	13	0.75
February	5	0	0	0.6	0	4	2.6	0	0	0	0	0	12.8	0	1	0	0	0	0	4	0	3	0.0	0.0	18.5	0.25
February	6	0	0	17.6	0.4	0.4	11.8	0	6.4	25.4	0	0	14	4.4	0	9	0	10	0	28	0	0	0.8	1.3	17.75	0
February	7	0	0	5.4	0.4	0	8.2	0	0	0	0.2	4	13	0	2.8	0.3	0.0	6.8	0.0	17.3	0.0	0.3	0.3	0.3	18.25	0
February	8	0	1	11.4	5.4	13.4	0.2	0	0	0	0.4	1	1.8	0	0.5	0.0	0.0	0.0	0.0	10.8	0.0	0.0	0.3	0.0	0.25	0
February	9	0	1.6	1.6	1.8	0	0	0	0	0	0	1.4	3.4	0	0	0	6	0	0	5	0	15	0.0	0.0	0	0
February	10	0	0.8	2.2	0	0	0.6	0	0	0	0	0.4	5.8	12.2	0	0	15	0	0	11	0	4	0.0	0.0	0	0
February	11	0	0	0	0	0	4	0	0	0	0	1.2	3.4	1.4	3	1	2	0	17	2	4	1	0.0	0.0	0	0
February	12	0	13.8	0	0	0	0	0	0	0.6	0	0.8	0	0	4	23	1	0	7	0	15	0	0.0	0.0	0	0
February	13	0	11.8	2.4	0	0	0	0	0	0	5.8	1	0	0	2.0	1.8	4.0	1.0	5.8	5.8	10.5	0.0	1.3	0.0	2.5	0
February	14	0	0.2	0	0	0	0	0	1	0	0	14.6	0	0	4	12	1	0	2	4	12	5	1.0	0.0	0.25	1.5
February	15	0	0.6	0	0.6	0.6	0	1.2	3.8	0	0	10.8	3.4	0	1	0	0	9	10	0	8	5	1.0	0.0	4.5	11.75
February	16	0	0	4.8	0.2	10.8	7.8	2.4	2.8	0	0	0.8	0	0	5	7	0	1	18	0	74	0	6.0	10.5	0	11.25
February	17	0	0	12.8	0	0.4	0.6	5.4	3	0	0	2.8	0	0	0	0	7	0	3	0	0	0	20.8	0.5	0	0
February	18	0	0.6	10.6	0	3.4	0	1.6	8	0	0	1.6	0	0	0	0	9	0	13	0	15	0	0.5	0.0	0	5.25
February	19	0	3.2	9.6	0	0	4.8	2.4	0	0	0	22.2	0	0	0	0	28	6	18	0	6	0	0.0	0.0	0	3.25
February	20	0	0	0	0	0	0.4	10.2	0	0	0	16	2.2	0	0	0	0	0	11	2	1	0	0.0	0.8	0	4
February	21	0	3.2	3.8	1.4	0	65.8	2.4	0	0	0	1.2	0	0	0	1	3	1	3	0	3	0	0.0	0.3	0	19.25
February	22	0	3	24.4	1.4	4.4	38.2	0.8	0	0	0	0.6	0	2.4	0	0	2	1	0	0	1	0	2.8	0.0	2.5	1.25
February	23	0	2.6	10.6	4	0	14.4	0.2	0	0	1.2	0	0	1.6	2.3	0.0	0.0	21.3	4.0	0	11	0	3.3	4.5	15.25	5
February	24	0	0	54.2	0	0	0	0	0	0	0	5.4	0	1.8	10	0	1	0	0	0	0	0	3.5	5.3	0	0
February	25	0	1.8	1.6	0	0	0	0	4.2	0	0	0	0	13.4	1	0	28	2	4	0	0	0	5.0	3.5	0.25	10
February	26	0	0	0.2	5.8	0	0	0	3.8	0	12	0	0	0	5	0	6	6	16	1	0	0	0.0	0.0	0.25	1
February	27	0	1	21.6	16.8	0	0	0	1.8	0	0.2	0	1.2	0	3.0	2.5	0.0	1.3	0.0	15.0	0.3	0.0	0.8	0.0	0	0.75
February	28	0	13	7.4	1	0	0	2	0	1	0	0	0	0.6	0	4	2	0	0	20	1	4	0.3	0.0	10.25	0.5
February	29	n/a	n/a	n/a	13.6	n/a	n/a	n/a	0.8	n/a	n/a	n/a	1.6	n/a	n/a	n/a	0	n/a	n/a	n/a	3.25	n/a	n/a	n/a	1	
Total Monthly Rainfall		***0***	***58.6***	***286.4***	***79.6***	***59.2***	***160.6***	***29***	***53***	***39.2***	***79.2***	***94***	***63***	***43.8***	***50.25***	***72.5***	***122.5***	***67.3***	***130.0***	***133.0***	***176.0***	***51.3***	***70.0***	***39.3***	***129.0***	***104.8***
Maximum Daily Rainfall		***0***	***13.8***	***54.2***	***26.4***	***13.4***	***65.8***	***10.2***	***8***	***25.4***	***32.6***	***22.2***	***14***	***13.4***	***9.75***	***22.5***	***27.5***	***21.25***	***18.25***	***27.75***	***74***	***15***	***20.75***	***11.25***	***24.25***	***22***

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
March	1	0	11.8	9.8	0.4	6.6	0	0	0	6.6	0	0	2.8	0	0	4.25	5.00	18.00	0.00	0.00	3.00	1.75	0.25	0.00	0.75	0.25
March	2	0	1	3.6	2.6	11.2	0	1.2	0	0.2	0	5.4	1.6	0.2	2	6.5	0.0	3.3	0.0	4.0	22.5	7.0	14.0	0.0	5.75	0
March	3	0	2	32	6.2	2.2	0	1.4	2.2	0	0	2.4	4.6	0	0	1.75	5.75	6.25	13.00	0.25	5.50	11.75	0.75	0.00	0	0
March	4	2.2	0	9	5.8	0	0	0	0.2	0	0	0.2	0.2	0	0	7.25	0.00	0.00	4.00	0.00	7.50	0.00	0.00	0.00	0.75	2.5
March	5	0.8	0	0	0	0	0	0.4	11	0	0	1.2	0	0	0	5.5	4.8	0.0	14.0	0.0	0.0	4.0	0.0	0.0	1.25	0
March	6	0	0	0	0	0	0	0.4	0	0	2.2	0	0	0	0	0.25	12.25	3.75	2.5	0	0	1.75	0	0	0	0.75
March	7	0.2	0	0	0	0	0.2	4.8	43.8	0.6	0.4	2.8	2.2	0	1.5	0	0	6.5	14.75	0	7.75	10.25	0	0	0	2.75
March	8	0	2.6	0	0	5.2	2.8	0.8	0	1.6	15.8	8.8	0	1	0	0	0	1.5	0	0	11.75	7.75	5.25	0.25	0	0
March	9	8.8	8.2	0	1	2.8	1.2	20.4	0.2	3.4	5.4	1.6	4.4	0	0.25	7	0	0	2.5	0	1.75	11.75	0.25	0	0	0
March	10	0	5.8	0.6	0.2	0	3.4	3	0	0	0.8	12	0	0	2.25	15.75	15.5	0	0	0	6.25	0.25	0	0	0.75	0
March	11	0	0.4	0	4.6	0	44.8	13.6	0	0	3.8	65.8	0	0	11	2.75	5.5	0.25	2.75	0.25	38.5	7.5	0	0	0	0
March	12	0	1.2	2	0.6	0	18	17.4	0	0	0	3.4	0	0	13.25	1	0.75	6.25	0	3	1.5	2.25	0	9.5	0.5	0
March	13	0	2.8	3.6	1.8	3	16.6	17.6	0	0	0	1.2	0	0	1	1	7.25	2.5	0	0.75	0.25	9	2	1.25	0.25	0
March	14	0.6	0	7	14.4	0.2	0	6.8	0	0	0.4	3.2	10	0	5.75	2.75	0.75	13.25	3	1	8.5	11.25	0.25	0	0	0.25
March	15	0	0.6	0.4	0	4.6	1.6	0	0	0	0	6.4	24	0	2.5	19.25	3.5	9.5	6.25	16	2.5	1.75	0	1	0	0
March	16	0	0	8	3	0.6	15	0	0	4.6	1	6	15	0	1.5	8	19	2.5	22.25	36.25	0	2.5	0	0.25	0	0
March	17	0	0	0	5.8	0	0	1.2	0	1	0.8	9.8	3.8	2.2	0.25	4	1.75	0	0.75	0	0	13.75	2.75	0	0	0
March	18	1	0	0	4	5.4	8.6	0.8	6.6	0	0	0	2	0	0	0.25	1.25	0	0	0.75	0	9	0	0	0	0
March	19	0	0	0.6	5.2	7.2	2.2	3	15.8	11	0	6	4.6	0	0	1.25	0.25	8.5	0.75	0	0	0	0	0	0	1
March	20	0	0	0	1	0.8	13.4	0	0	4	0	1.4	2.2	0	0	0.5	0	3.25	1.25	17.25	0	0.25	0	0	0	0.5
March	21	0.2	2.2	4.6	0	0	1.6	8.6	0	0.4	0	0.4	0	0	0.75	0	15	5.75	0	7.25	2.25	2.75	0.5	0	0	8.75
March	22	0	7	0	7.6	0	0	27.4	0	0	1.4	4.4	0	0	0	4.75	0.25	0	0	13	1.25	0.75	2.5	0	0	0.75
March	23	0	8.8	1	0	0	0	6.2	0.2	0	0	9.6	0.8	0	0	0.25	0	0	1	0.5	0	1.5	0	0	0	0
March	24	0.8	3.4	0	0	0	0	1	7.8	0	2.6	8.4	0	0	0	0	0	0	0	1.5	4.5	2	0.25	0	1.25	8.25
March	25	0	1.4	0	0	8.4	0	0.4	2.4	0	0	0	0.2	0	5.25	0.5	0	0	0	0.5	1.5	1.25	0	0	0	0.75
March	26	1.6	0.4	15.2	0	5	2.2	6.4	1.6	34.8	1	0	0	0	0.5	1.5	0	0	8	6.75	0	2	3.25	2	0.75	0
March	27	7.6	0	0	0.2	5.6	0.6	3.6	0.2	4	0	0	0.6	0	0	0	1.75	0	2.75	0	3.25	1.75	0.25	0.5	5	0
March	28	0	4	0.4	0	7.6	3.6	0.4	0	4.4	0.6	0	4.6	0	2.75	0	0	0	0.5	1.25	7	20.75	0	0	9.25	14.75
March	29	0.2	0	5.4	0	1.8	0	0	0	3.8	0	0	0	0.2	40	0	2	0	7	0.25	0	11.75	0.75	0	1.25	0
March	30	0	3	6.8	0	0.8	0	0.6	2.2	0	0.4	0.4	0.6	0	1	2	16.5	0	5	11.75	0	0	0	0	12	0
March	31	0.6	6.2	0	0	2	0	2.2	2.8	5.6	0	1.4	15	0	0	10.25	10.75	0	0.5	0.25	0	0	0	0	0.25	0
Total Monthly Rainfall		***24.6***	***72.8***	***110***	***64.4***	***81***	***135.8***	***149.6***	***97***	***86***	***36.6***	***162.2***	***99.2***	***3.6***	***92***	***108***	***130***	***91***	***113***	***123***	***137***	***158***	***33***	***15***	***40***	***41***
Maximum Daily Rainfall		***8.8***	***11.8***	***32***	***14.4***	***11.2***	***44.8***	***27.4***	***43.8***	***34.8***	***15.8***	***65.8***	***24***	***2.2***	***40***	***19.25***	***19***	***18***	***22.25***	***36.25***	***38.5***	***20.75***	***14***	***9.5***	***12***	***14.75***

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																						
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
April	1	9	0	0	0	1.2	0	0	0	7.6	13.4	0.4	0	18.6	0	4.25	2.25	0.00	0.00	0.25	0.00	4.50	0.0	0	4.75	
April	2	0	0	1.4	0	0	0	0	0	0.6	0	0	0	18.2	16	16	3	0	0	1	0	0	0.0	0.5	0	
April	3	0	0	1.2	0	0	0	0.4	0	2.2	5.6	0	0	0	3.5	16.5	0.0	0.0	0.0	1.0	4.8	0.0	0.0	3.5	0.8	
April	4	0	0	0	0	0	0	4.6	0	0	0	0	5	0	0	0.25	1.00	0.00	0.50	0.00	0.25	4.00	0.0	0	0.00	
April	5	0	0	0	0	3	0	0	0	9.2	0	0.2	0	0	0	15	0	11	0	0	1	12	19.0	1	0	
April	6	0	0	0	3.4	2.4	0	1.8	0	1.6	0	0	0.4	0	0.5	10.75	0.75	2.50	3.50	0.00	0.00	3.00	17.8	2	0.00	
April	7	0	0	2.2	0	6.4	2	3.8	0	4.6	0	4.6	4.6	0	8	2.75	6.75	3.75	0.00	0.00	0.00	10.50	1.3	0	0.00	
April	8	0	0.6	0.6	0	0	0	2.6	0	0	3.6	6	1.4	0	5.75	0	0	12	0	0	0	3	12.0	11.5	0	
April	9	0	0	0.2	0	0	2.4	1.8	0	0	5.6	2	0	n/a	0.5	0	0	0	12	0	0	0	3.0	3.5	0	
April	10	0	1.6	0	0	4	1	0	0	0.4	4.2	1.2	0	0	0	0	0	1	0	0	0	1	0.0	2	0	
April	11	0	1	0	0	0	0	0	0	1	0	0	0	0	0	4.5	0.0	14.8	0.0	4.5	0.0	0.0	0.5	8	0.0	
April	12	0	0.8	0.4	0	1.2	0.2	1	0	0.4	0.2	0	0	17.4	0	0.75	4.50	0.25	0.00	8.50	4.25	20.50	1.0	0.25	0.00	
April	13	0	0	0	1.6	0.6	11.2	13.6	0	0.6	4.8	1.4	0.2	3.6	0	1.75	2.25	5.50	0.00	0.25	0.00	6.25	0.5	6.75	0.00	
April	14	0	0	0	0.8	0	32	0.2	0	0	8.6	0.4	10.8	31.4	0	1.25	0.00	6.50	0.00	1.00	2.50	0.00	24.5	0	0.00	
April	15	0	0	0	0.4	0	9	0.8	2.2	8	0.4	0	0	n/a	0.5	7.5	0.0	0.8	0.0	1.5	0.0	10.0	3.5	0	0.0	
April	16	0.8	0	0	0	0	3.2	0.8	0	5	0	3.4	0	0	0	1.25	0.00	3.00	4.25	0.00	0.00	0.00	1.3	0	0.00	
April	17	1.2	0	0	0	12.2	0.6	0.6	0	0.2	2.4	0.8	0	4.4	3.25	0	9	1	7	0	0	1	12.0	0	0	
April	18	3.2	0.6	0	0	2.2	0	0.2	0	1.6	0.2	1	6.6	0	0	0	1	0	11	0	0	1	1.0	11.25	0	
April	19	2.8	0	4.4	0	0	0	2.8	0	0	0	0	22.6	0	3	0	1	1	0	0	0	0	0.0	0.75	0	
April	20	21.8	0	2.4	0	0	0	0	0	0	0.4	0	0	0	11.25	1.25	12.25	6.50	2.00	0.00	0.00	0.50	0.0	0	0.00	
April	21	0	1	0	0	0	0.2	1.4	0	0	1.2	0	8	0	0.5	1.5	0.3	0.8	1.0	0.0	0.0	0.0	3.8	0	0.0	
April	22	0	0	4.4	4.4	3	0	0	0	0	0	0.8	0	1	0	0	0	0	3	0	0	3	2.0	3.25	17	
April	23	4	0	0	1	3.6	0	1	0	0	0	0	1.4	0	7.25	0	0	0	2	0	1	1	0.0	0	0	
April	24	1.6	0.2	0	0	0	0	7.6	0	0.6	0	3.8	0	0	3.75	0	0	0	7	2	0	0	0.0	0	0	
April	25	0.8	0	0	0	0	0	0	0	0	0	0.8	0	0	0	2	5	0	11	12	0	0	0.0	0	3	
April	26	0.6	0	1.2	0	0	9.4	0	0	0	0	2.6	0	0	0	8.25	3.25	0.00	0.25	0.75	0.00	0.25	0.0	0	4.50	
April	27	1	0	0	0.4	0	0.6	1.2	2.2	0	0	11.4	3	0	1	0	0	0	1	0	0	5	0.0	0	1	
April	28	4.2	0	0	0	2	0	0	0.4	0	0	0	6.4	0	2.25	10.75	0.00	0.00	2.25	2.25	0.00	0.00	0.0	0	1.25	
April	29	1.8	0	0	0.2	1.4	0	0	0	0	5	0	0	0	0	3.5	0.0	0.8	0.0	0.5	0.0	4.8	6.0	0	0.8	
April	30	2	0	0	0.2	4.4	0	0	0	0	0	0	0	0	0.75	0	2	1	0	0	0	0	0.0	0	0	
Total Monthly Rainfall		***54.8***	***5.8***	***18.4***	***12.4***	***47.6***	***71.8***	***46.2***	***4.8***	***43.6***	***55.6***	***40.8***	***70.4***	***94.6***	***67.75***	***109.75***	***53.5***	***70.5***	***66***	***35.5***	***13.8***	***90.75***	***109.05***	***54.25***	***32.75***	
Maximum Daily Rainfall		***21.8***	***1.6***	***4.4***	***4.4***	***12.2***	***32***	***13.6***	***2.2***	***9.2***	***13.4***	***11.4***	***22.6***	***31.4***	***16***	***16.5***	***12.25***	***14.75***	***11.75***	***12.00***	***4.80***	***20.50***	***24.50***	***11.50***	***16.75***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
May	1	0.8	0	0.4	2.2	3.6	0	0	0	0	0	0	0	0	0.75	0	4.25	0	0	0	0	2.5	1.5	0	0	
May	2	0	0	5.2	0	0	0	0	0.2	2	0	2.8	0.4	4	15.75	0	0.75	0	0	0	0	2	0	0	1.75	
May	3	0	0	0.2	2	0	0	1.4	1	0	0	2.2	2.8	0	8.25	9.75	0	0	0	0	0.75	2	0	0	2	
May	4	0.6	0	2	3	2.2	0	11.4	0.6	0.4	0	0.2	0	3.2	6.75	0	10.75	0	1.75	0	0.25	0	0	0	0	
May	5	15.8	0	0	2	4	1	4.4	0.6	0	0	0.2	0	8.6	0	0	0	0	15	0	0	0	0	0	0	
May	6	3.6	0	0	1.6	1	0	0	0	0	0.8	1	0	11.8	2.75	2	0	0	5	3.5	0	0.25	0	0	0	
May	7	0	0	0.4	0	0	0	0	1	0	3.6	0	0	0	0	4.75	0	0	0	0	0	0	0	0	0	
May	8	0	0	3.4	1.6	0	0	0	0.2	0.8	0	0	0	0	0	1.5	0	0	0	0	0	0	0	0	0	
May	9	0	0	1.4	0	0	0	0	0	0.8	0	0	0	0	0	0	0	0	9.5	0	0	0	0	0	0	
May	10	0	0	0.4	11	0	0	0	1	0	0	0	0.2	3.6	2.25	0	0	0	0	0	0	0	0.75	0	0	
May	11	0	0.2	1.4	0.4	0	0	0	0.6	0	0	0	0.2	2.8	0	0.5	0	0	0	0	0	10.25	8.25	0	1.75	
May	12	0	0.8	0	0	0	0	0	0	0	0	0	0	0.4	0	5.75	0	2.5	0	0	0	1.25	0	0	7.25	
May	13	0	0	0.4	0	0	1	0	0	0.2	0	0	5.2	10.2	0	0	0	5.5	0	0	0	6.75	0	0	5.75	
May	14	0	3.6	0.2	0	6	0.2	1.4	0	0.2	0	0	0.2	9	0	0	0	3.25	0	0	0	0	0	4.75	0	
May	15	0	1	0	0	1	0	0.2	0	0.8	0	0	0	0	0	9.75	0	0	0	0.5	0	8.25	0	1.75	0	
May	16	0	0	0.2	0	5.2	0	0	0	0.2	0	0	0	0	0	20.75	0	1.75	0	0	0	2.75	0	0	10	
May	17	0	0	9.4	0	0	6.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.75	
May	18	0	0	1.8	0	0	0	0	0	0.4	0	0	0	7.8	4.5	0	0	3	0	0	0	0	0	0	0	
May	19	0	0	0	7.2	0	0	2.4	0	1.6	0	1.6	1.8	0	1.5	0	0	1	0	0	0	0	0	0	0	
May	20	0	0	0	0	0	1.8	0.6	0	0	0	10.4	0.2	0	7.25	0	0	0	0	0	0.75	0	0	9.75	0	
May	21	3	0.6	0	4.4	0	0.4	0.4	0	0.4	2.6	0	4.6	n/a	0	0	0.5	4.75	0	0	0	0	0	1.25	8	
May	22	1	0	0	0	0	0	2	9.4	0.4	17.4	0	0	0	1	1.5	5.75	6.75	0	0	0	0	0	0	0	
May	23	3.6	0	0	0	0	0	1	1.2	0.4	0	0	0	0	0	0.25	0	8	0	0	0.25	0	0	0	0	
May	24	0	0.4	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	1.25	3.25	0	0	0	0	0	0	
May	25	0	6.8	0	0	0	2.6	0	1.2	0	3	0	0	0	1.5	0	1.25	0	0	0	0	0	0	13.5	7.75	
May	26	0	1.8	0	9.6	0	2.4	0	0.6	0	6.2	0	0.2	1.2	7	2.25	0	0.25	2	0	0	0	0	0.25	0	
May	27	0.4	22.8	0	7.2	0	0	0.2	9	0	0.4	0	0	0	0	0	0	3.5	0.75	0	0	0	0	0	0	
May	28	4.8	2.4	0	0.8	3.2	2.4	0	3.2	0	0	0	0	n/a	6.25	2.5	0	5.25	3	0	9.75	0	0	0	0	
May	29	6	0	0	0	0	1.4	0	7.6	0	0	0	0	0	0.75	0.5	0.25	1.5	0	0	0	0	0	0	0	
May	30	5.2	0	0	6.2	1.2	0	0	1	0	0	0	0	0	3.75	0	0	4.25	0	0	0	5	0	0	2.5	
May	31	14	0	0	0.8	0	0	0	0	0.4	0	0	0	0	6.5	0	8.5	1	0	0	0	0.25	0	0	0	
Total Monthly Rainfall		***58.8***	***40.4***	***26.8***	***60***	***27.4***	***19.4***	***25.4***	***38.4***	***9.2***	***34.2***	***18.4***	***15.8***	***62.6***	***76.5***	***61.75***	***32***	***53.5***	***40.25***	***4***	***11.75***	***41.25***	***10.5***	***31.25***	***47.5***	
Maximum Daily Rainfall		***15.8***	***22.8***	***9.4***	***11***	***6***	***6.2***	***11.4***	***9.4***	***2***	***17.4***	***10.4***	***5.2***	***11.8***	***15.75***	***20.75***	***10.75***	***8***	***15***	***3.5***	***9.75***	***10.25***	***8.25***	***13.5***	***10***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
June	1	0.2	0	0.6	0	8.4	0	0	0	0.4	5.4	0	0	0	0	0	1.75	0.5	0	0	7.5	0	0	0	0	
June	2	0.4	0	0	0	2.8	0	0	0	0	0.6	0	0.4	0	0	0	5.25	0.25	0	0.25	0.25	0.75	0.25	0	0.75	
June	3	8.2	0	0	0	0.8	0	0	0	0	0	1.4	4.4	0	0	1	0	0	0	0.25	0	0	0.25	0	0	
June	4	0.4	0	0	0	0	0	0	0	0	0	1.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0.75	
June	5	0	0	4	1.6	0	2.4	0	4.8	0	0	0.8	2.8	0	0	0	0	0	0	0	0	0	0	0.25	0	
June	6	0	0	0.4	3.6	0.6	0	0	1	0	0	0.8	5.8	0	0	0	0	0	0	0	0	0	0	0.25	3.75	
June	7	0.6	0	1.6	0.4	0	0	0	0.2	0	6.2	0	0	0	0	0	0	0	0	0	0	0	0	1.75	0.25	
June	8	0	0	0.6	0	0	0	0	0	0.4	16.8	0	0	0	0	0	15	0.25	0	0	0	11.25	0	0	0	
June	9	0	0	0	0	10	0	0	5	0	0	9	10.2	0	0	0	0.25	0	0	0	0	0	8	0	22.5	
June	10	0	10.8	0	2.4	1.4	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	5.5	0.5	0	0.75	
June	11	3	0	0	2.6	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	
June	12	0.2	0	0	15.8	1.2	0	0	0.4	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	8.75	
June	13	0	0	0.2	0	0	0	0.6	8.4	0.2	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0.25	
June	14	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	1.5	1	0	3	0	2	0	0	
June	15	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4.25	14	0	0	3.75	
June	16	1.2	3.6	2.4	0	0	0	0	0	0.2	0.8	0	0	0	0	1	0	0	0	0	11.75	0	0	0	0.25	
June	17	13.4	0	0	0	0.4	2.6	0	0	0	0.6	0	0	1.4	0.35	0	1	0	6.25	0	0	0.25	0	0	0	
June	18	0	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	1	0	0	0.25	2.25	0	0	0	
June	19	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	2.25	1.75	0.25	0	2.75	0	0	0	0	0.5	
June	20	0.4	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	3.25	0	0.25	0	0	0	0	1	
June	21	11.8	0	1.6	0	0	0	0	0	0.4	0	5.8	0	1.4	0.35	0	0	2.5	0	0	0	0	0	0	0	
June	22	0	0	0.2	0	0	0	0	0	0	0	1.4	0	0	0	0	0	0	0	0	8.5	0	0	0	0	
June	23	2.2	0	6.2	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	4.75	0	0	0	0	
June	24	0	7.8	7.6	0	0	0	0	0	0	0	3.2	0	2.8	0.7	0	4.25	1.25	0.75	0	1.25	0	0	0	0	
June	25	0.8	0	0.4	0	0	0	0	0.4	0	0	0	0	0.2	0.05	3	0	2	0	0	0	0	7.75	0	0	
June	26	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
June	27	0.6	0	0	0	0.8	1	0	0	0	0	0	0	1.4	0.35	0	0	1.5	0	0	0	0	0	16.75	1.75	
June	28	0	0	7.4	0	0.2	6.6	0	0	0	0	4	0	0	0	0.25	0	3	2	0	0	0	0	0	0.25	
June	29	27.4	0	0	0	0	5	0	0	0	0	4.4	0	0	0	0	2.5	0	1.75	0	0	0	0	0	0	
June	30	0	0	3.6	0.8	0	0	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	
Total Monthly Rainfall		***73.8***	***23.2***	***37***	***27.6***	***28***	***18***	***2***	***20.2***	***1.6***	***30.4***	***34.4***	***24.2***	***7.2***	***1.8***	***7.5***	***44.75***	***30.25***	***12***	***3.5***	***41.5***	***34***	***19.25***	***19***	***45.25***	
Maximum Daily Rainfall		***27.4***	***10.8***	***7.6***	***15.8***	***10***	***6.6***	***1.4***	***8.4***	***0.4***	***16.8***	***9***	***10.2***	***2.8***	***0.7***	***3***	***15***	***12***	***6.25***	***2.75***	***11.75***	***14***	***8***	***16.75***	***22.5***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
July	1	0	0	0	0	0	0	1.2	0	0	0	0	0	0	0	0	3	0	0	0	0.5	0	3	0	0	
July	2	0	0	3.2	0.2	0	0	0	3.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.25	0	
July	3	0	20.6	3.2	1.8	0	0	0	0	0	0	0	2.2	0	0	0.25	5.5	0	0	0	0	0	0	0	7	
July	4	0	1.8	0	0	0	0	0	0	0	0	0	0	0	0	0	4.25	0	0	0	0	0	0	0	0	
July	5	2.4	0	0	1	0	0	0	0	0	0	0	0.4	0	0	0	0	0	0.25	0	0.25	0	0	0	0	
July	6	4.8	0	0	0	0	0	0	3.4	0.4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
July	7	0	0	0	0	0	0	0	0	0	0	0	0	1.6	0.4	0	0	0	1	0	3.5	0	0	1.75	0	
July	8	23	0	0	0	0	7.4	0	0	0.6	0	0	0	6	1.5	0	0	0	0	0	0.75	0	0	0	0.25	
July	9	2.4	0	0	0	0	0	0	21	0	0	0	0	0	0	0	0	0	0	0	11.5	0	0	4	3	
July	10	0	0	0	0	0	0	0	0.8	0	1.8	0	0	0	0	0	0	0	0	0	0	0	0.25	5.25	0	
July	11	0	0	0	0	0	0	0	2.6	0.2	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0.5	0	
July	12	0	0.2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	
July	13	0	0	0	0	n/a	0	3	0	0	0	0	0	0	0	2.25	0	0	0	0	0	0	0	0	0	
July	14	0	1.8	0.6	0	n/a	0	4.2	0	0	0	0	0	0	0	0.25	1.25	0	0	0	0	0	0	0	0	
July	15	0	9.2	0	0	n/a	0	0	0	0	0	0	0	0	0	9.75	0	0	0	0	0	0	0	0	0	
July	16	0	0	0.8	0	n/a	0	0	0	0	0	0	0	0	0	0.75	3	0	0	0	0	0	0	0	0	
July	17	0	0	0.6	0	n/a	0	0	0	0	0	5.6	0	0	0	12.75	0	0	0	0	0	0	0	2.5	0	
July	18	0	0	0	0	0	0	0	0	0	0	14.45	0	0	0	0.25	0	0	0	0	0	0	0	0	0	
July	19	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
July	20	0	0	0	0	0	0	0.4	0	0	0	3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	
July	21	2.4	0	0	0	0	0	0	0	0	0	9.2	0	0	0	0	4	0	0	0	0	0	0	0	0	
July	22	0	0	0	0	0	0	0	0	0	0	7.8	0	0	0	0	0	0	0	0	1.5	0	0	0	0	
July	23	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	
July	24	0	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.25	0	0	0	0	0	0	
July	25	0	0	0	0	0	0	0	0	0	0	0	0	3	0.75	0	0	0	3	7.75	0	0	0	0	0	
July	26	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	
July	27	0	0	0	3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.5	0	0	0	0	0	
July	28	0	0	0	10.2	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	
July	29	0	0	0.4	0	0	0	0	0	0	0	0	3.8	0	0	0	0	0	0	0	0	0	0	0	0	
July	30	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
July	31	0	0.8	0	0	0	0	0	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	
Total Monthly Rainfall		***35***	***34.4***	***9.6***	***16.6***	***10***	***7.4***	***11.8***	***31***	***1.2***	***2***	***41.65***	***7***	***10.6***	***2.65***	***26.25***	***21***	***0***	***6.5***	***17.5***	***18.5***	***0***	***3.25***	***22.25***	***10.25***	
Maximum Daily Rainfall		***23***	***20.6***	***3.2***	***10.2***	***10***	***7.4***	***4.2***	***21***	***0.6***	***1.8***	***14.45***	***3.8***	***6***	***1.5***	***12.75***	***5.5***	***0***	***3***	***9.5***	***11.5***	***0***	***3***	***8.25***	***7***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
August	1	0	0	0	0	0	0	0	0	0	0	0	1.6	0	0	0	0	0	0	0	0	0	0	0.5	0	
August	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.25	0	
August	3	0	0	0.2	0	13.6	0	0	0.4	0	0	0	0	0	0	0	0	2.75	0	0	0	0	0	0	1.25	
August	4	0	0	0.2	0	5.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
August	5	0	0	7.8	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
August	6	5.4	0	0	0	2.4	0	0	25.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.5	
August	7	0	0	0	0	0	0	0	0.2	0	0	0	0	0	12.25	0	0	0	0	0	0	0	0	0	2.25	
August	8	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0.25	0	2	0	0	0	0	0	0	0	0.25	
August	9	0	0	0	0	0	0	0	0	0	0	0	4.4	2	1.25	0	0.25	0	0	1	0	0	0	0	0	
August	10	0	0	0	0	0	0	0	0	0	0.8	0	0	12	0	0	0	0	0	0	0.5	0	0	0.75	0	
August	11	0	0	0	0	0	0	0	0	0	0.2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
August	12	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	1.75	0.5	0	0	
August	13	0	0	0.2	0	0	0	0	0	0	0	0	0	7.2	0	0	0	0	0	0	0	1.5	0	0	0	
August	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.75	0	0	0	0	0	0	
August	15	0	0	8.2	0	0	0	0	0	0	0	1.4	0	0	0	0	0	0	1.75	0	0	0	0	0	0	
August	16	0	5.4	3.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	1	
August	17	0	0	0	0	0	0.8	0	0	2.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
August	18	0	0.2	0	3.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
August	19	0	0	0	0	0	0	0	0	0	0	12.2	5.8	0	0	0	0	0	0	0	0	0	0	0	0	
August	20	0.2	0	0	0	0	0	0	0	0	0	0.8	4.8	0	0	0	0	0	0	0	0	0	0	0	4.75	
August	21	5.4	0	0	0	2.2	0	0	11.2	0	0	7.6	0.4	0	0	0	0	0	0	0	0	0	0	4.75	2.5	
August	22	0	0	0	0	11.2	0	0	3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
August	23	0.2	0	0	0	6.4	0	0	0	0	0	0	0	0	0	16.5	0	0	0	0	0	0	0	2.25	0	
August	24	0.2	0	0	0	1.8	0	0	30	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0.25	0.25	
August	25	3.4	0	0	0	0	0	0	31.6	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	
August	26	5	0	0	0	0	0	0	0.8	0	0	0	4.6	0	0	0	0	0	0	0	0	0	0	0	0	
August	27	7.2	0	0	0	0	0	0	2.6	0	0	0	5.2	0	0.5	0	0	0	0	0	0	0	0	0	0	
August	28	0	0	0	0	0	0	0	0	0	2.4	0	1.2	0	0	0	0	0	0	0.25	0.5	0	0	0	0	
August	29	0	0	3.8	4.8	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	6.25	0	0	0	0	0	
August	30	0	0	0	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.75	0	0	0	0	1	
August	31	0	0	0	0	0	0	0	0	0	0	1.2	0	0	12	0	0	0	0	1.25	1.75	0	0	0	0	
Total Monthly Rainfall		***27***	***5.6***	***24.4***	***9.6***	***43.2***	***0.8***	***0.6***	***106.2***	***2.8***	***3.4***	***23.2***	***43.6***	***22.2***	***26.25***	***16.5***	***2.25***	***3***	***12.75***	***15.5***	***2.75***	***3.25***	***0.5***	***12.75***	***18.75***	
Maximum Daily Rainfall		***27***	***5.4***	***8.2***	***4.8***	***13.6***	***0.8***	***0.6***	***31.6***	***2.4***	***2.4***	***12.2***	***15***	***12***	***12.25***	***16.5***	***2***	***2.75***	***10.75***	***6.75***	***1.75***	***1.75***	***0.5***	***4.75***	***5.5***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
September	1	0	0	0	0	5.2	0	0	2	0	0	0	0	0	0	0	0	0	0	8.5	3.5	0	0	0	0	
September	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	11.25	0	0	0	0	
September	3	0	0	0	0	1.6	0	0	0	0	0	5.6	0	1.6	0	0	0	0	19	12.25	0	0	0	0	0	
September	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.5	0	0	0	0	0	
September	5	0.4	0	2	0.2	0	0	0	0	0	0	0	0	1.4	0	0	0	0	0	0	2.5	0	0	0	0	
September	6	0	0	0.4	0	0	0	1.2	0	0	0	0	0	13.8	10.25	0	0	0	0	4.5	2	0	0	0	0	
September	7	0	0	0	0.4	0	0	7.6	0	0	0	0	0	5.4	7	0	0	0	0	15.25	2.5	0	0	0	0	
September	8	0	1.2	0	6	0	0	0	2.2	0	0	0	0	0	2.5	0	0	0	0	0	0	0.5	6	0	0	
September	9	0	0	0	0	0	0	0	0	0	11.6	0	0	12.2	0.25	0	0	0	0	0	0	7.75	1.5	1	0	
September	10	0	0	0	0	0	0	1.6	0	0	0	0	0	0	0.25	0	0.5	0	1	0	0	0	8	0	0	
September	11	0	0	0	0	0	0	0.8	21.4	0	0	0	0	0	1.25	0	0	0	0	0	0	0	0	0	0	
September	12	0.2	0	0	0	0	0	0	0.2	0	0	0	0	0	14.25	0	0	3.75	0	0	0	0	2.5	2.5	0	
September	13	0	0	0	0	0	0	0	11.4	0	0.6	0	0	0	8	0	0	0	0	0	0	0	0.5	0	0	
September	14	6.4	0	0	0	0	0	0.8	0.8	0	0.6	0	0	0	0.25	0	0	0	0	0	0	0	0	8.25	4.75	
September	15	3	0	0	0	0	0	0	17.2	0	0.2	0	0	0	1.25	0	0	0	0	3	0	0	0	13.5	2	
September	16	9.6	0	0	0	0	0	10	2.2	0	0	5.2	0	5.4	2.75	0	0	3	0	0	0	0	4.5	0.75	0.25	
September	17	9.6	0	0	0	0	0	0	6.8	0	3.2	0	0	0	13.25	0	0	0	0	1.25	13.25	1	4	20.75	0	
September	18	5.4	0.2	0	0	0	n/a	8	5.8	0	4.4	2.4	0	0	18	0.25	0	0	0.25	1.25	0	1.25	0	1.25	0	
September	19	0	0	0	0	0	n/a	4.6	7.6	0	1.2	0	0	6.2	10.75	2.25	0	0	0.75	0.25	5	2.75	0	0.5	0	
September	20	0	0	0	3.2	0	n/a	0	0	0	10	1	0.2	0	0.5	0	0	0	0	0.75	0	0.25	0	0	0	
September	21	0	0	0	0	5.8	n/a	0	0	0	0	0.6	0	0	0	0	0	8.75	0	4.5	0	0	5.25	0	2.25	
September	22	0	0	0	0	0	n/a	0	1.4	0	0	0.6	0	0	0	1.75	0	0.25	0	0	0	0	6.25	6.25	0	
September	23	0	0	0.4	0	0	n/a	0	4.2	0	0	0	0	0	10.5	11.5	0	12.5	0	0	2	0	2	12.5	27.5	
September	24	0	0	0	0	0	n/a	0	0	0	0	1	11.6	0	1.5	0	0	3.5	12.5	0	0.5	0	0	0.25	20	
September	25	0	2.2	6.2	0	0	n/a	0	0	0	0	0.4	8.4	0	7.75	0	0	9.25	3	4.5	0.25	3.25	0	0	26	
September	26	23	0	0.8	0	14.6	n/a	0	0	0	0	0	1.2	0	17.5	3	0	4.75	1.25	2.75	0	0	0	0.5	11.5	
September	27	12.4	0	0	0	0	n/a	0	0	0	0	0	0	0	6	24	0	0	12	0.25	0	0	0	12	0	
September	28	8.6	0	0	0	0.6	n/a	0	0	0	0	0.6	0	0.8	0	1	0	6.5	0	0	0	0	0	0.25	0	
September	29	0	0	0	15.6	0.8	n/a	0	0	0.4	0	1	0	8	0	0	0	4.75	0	0	0	1	0	0	0	
September	30	11	0	0	1.4	0	n/a	0	0	0	0	8.8	0	0	0	0	0	3.25	1.5	0	0	1.5	0	0	0	
Total Monthly Rainfall		***89.6***	***3.6***	***9.8***	***26.8***	***28.6***	***0***	***34.6***	***83.2***	***0.4***	***31.8***	***27.2***	***21.4***	***54.8***	***133.75***	***43.75***	***0.5***	***60.25***	***51.25***	***76.5***	***42.75***	***19.25***	***40.5***	***80.25***	***94.25***	
Maximum Daily Rainfall		***23***	***2.2***	***6.2***	***15.6***	***14.6***	***0***	***10***	***21.4***	***0.4***	***11.6***	***8.8***	***11.6***	***13.8***	***18***	***24***	***0.5***	***12.5***	***19***	***15.25***	***13.25***	***7.75***	***8***	***20.75***	***27.5***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
October	1	3	0	0	0	0	n/a	0	0	0	0	0	0	3.4	0	0	0	9.25	0	0	0.5	0	11	0	0	
October	2	0.4	9.6	0	0	0	n/a	0	0	0	0	10.2	2	0	0	0	0	7	0	0	0.5	0	3	0.75	0	
October	3	12	2.6	0	0	0	n/a	0	0	0	0	1	13.4	0	0	0.5	0	5.75	0	2.25	4.25	0	0.5	0.25	0.25	
October	4	15	0.4	0	0	0	n/a	0	0	0	0	1	6.4	0	0	0.25	0	0	0	0	1	0	0	9.25	0.25	
October	5	1	0	21	0	0	0	0	4.8	0.4	0	0	1.8	0	0	0	0	0	0	0	0.25	0	0	2.5	0.5	
October	6	0	0	0	0	0	0	4.6	5.2	0	1.6	9	1.8	0	0	2	0	0	0	0	8	2	8.75	0	0	
October	7	8	0	9.2	0	0	0	8.2	3.6	0.4	0	10.4	2.4	0	0	0	0	0	0	0	12.25	0	0	9	0.25	
October	8	13.6	3.4	23.6	1.4	2	0	7.4	19.2	0	5.2	0	0	0	2.75	0.5	0	1.75	0	11.75	5	0	8.5	0.75	0.25	
October	9	0.2	1.8	1	5.2	0	0	7.6	3.4	0	0	0.4	0.6	0	23	0.5	0	0	0	0	0.25	0	5.25	0	16.5	
October	10	12.2	0	0	3	16.2	0	2.8	0	0.4	0	0	0	0	3.5	0.5	0	0	0	0	0	0	0.25	0	6.5	
October	11	0.8	0	0	0	0	0	1.6	0	0	0	0	0	0	2.25	8	0.25	0.25	1.25	12.75	0	0.25	0	0	34.25	
October	12	2.2	13.2	3.2	0	7	0	24	0	0	0	0	0	0	0.5	15.75	0	0	4.25	0	4.5	3.25	0	5	2	
October	13	2.4	3	7.8	0	0	0	0	0	0	0	n/a	8.2	0.8	0	2.5	3.5	4	1	6.75	3.25	1.75	0	0	28.5	
October	14	6.6	14.2	0	0	7.4	0	0	0	0	5	0	0	3.2	0	0	17.75	0	7	0	2.5	0	0	0	0	
October	15	2	0	0	0	0	0	8	0	0	10	0	7.6	3.2	0	0	3	0	0	0.25	9.25	0	0	3.25	0	
October	16	0	0	0	8	0.4	0	100	0	0	1.6	0.2	7	14.2	0	0	14.25	0	3	0	2.75	0.5	0	10.5	0	
October	17	0.8	7.6	0	24.8	0	0	104.4	27.2	0	0	1.2	0	48.6	0	0	0	0	0.75	0	2.25	13	0	11.25	0.75	
October	18	0	0	0	5.8	1.2	0	0.6	5.2	0	11.8	22.6	0	0	0	0	0	0	4.5	0	3.75	5.75	0	11.5	21.75	
October	19	0	0	0	0.2	3.2	1.6	12.8	10.2	0	8.2	27.4	0	0	0	0	19.75	0.5	0.25	0	6.5	9.75	0	2.5	0	
October	20	0	0	0	19.2	0	1.2	85.4	3.2	0	0	9.8	1.8	0	0	0.25	1	0.5	6.25	0.25	23	2	0	4.5	0	
October	21	0	0	0	0	14.4	0	13.6	0	0	0	1.6	0	4.4	0	0	0.75	0	4.5	0.25	11.5	2.5	0	22.25	0	
October	22	0.2	0	0	0	10.4	0	1.6	1.6	0	0	5.6	0	1.4	0.25	5.25	0	0.25	2	0.25	0.25	5	0	0	0	
October	23	0	0	0	0	9.6	0	1.8	0	0	0	0	0	34.8	2.25	16.25	5.75	0.5	25.75	0.25	1.5	0	0	0	17.5	
October	24	0	0	3.2	0	0.4	0	0	0	0	3	0	0	0	17.75	0	3	0	8.75	0	0	0	0.25	0	0	
October	25	0	0	0.4	0	21.4	0	0	7.2	3	0.4	0	0	10	22.75	0	3.75	0	1.5	0.5	0.25	0	1	0.5	0	
October	26	6.8	0	0	0	9.2	0	0	0	0	0.2	0	0	7.6	3.25	0	0	0.25	22.75	14.5	14.25	0	4	0	0.75	
October	27	0	0	1.2	0	1.6	1.8	0	0	0	0	0	0	0	0	1.75	9.75	0	9.75	2.25	4.75	0	6.25	0	0	
October	28	4.2	0	20	4.6	0	0	0	1.6	11	0	0	0	8.4	2.75	4.25	21.25	0	5.25	0	0.25	0	22.5	0	0.75	
October	29	21	0	8	0	0	0	0	0.2	3.2	1	0	0	13.4	0.5	15	1.25	0	14.75	12.5	0.5	0	8.75	0	0	
October	30	47.2	0	44.4	0	6.4	0	0	12.6	12	0	0	0.6	14.4	0.5	0	22.5	0	2.75	0.75	6	0	3.5	0	8.25	
October	31	7.8	1.8	27.4	1.8	13.6	0	0	0	17.8	0	0	2.4	3	4.25	7	3.75	0.25	11.25	15.75	6	0	6	0	0	
Total Monthly Rainfall		***167.4***	***57.6***	***170.4***	***74***	***124.4***	***4.6***	***384.4***	***105.2***	***48.2***	***48***	***100.4***	***56***	***170.8***	***86.25***	***80.25***	***131.25***	***30.25***	***137.25***	***81***	***135***	***45.75***	***89.5***	***93.75***	***139***	
Maximum Daily Rainfall		***47.2***	***14.2***	***44.4***	***24.8***	***21.4***	***1.8***	***104.4***	***27.2***	***17.8***	***11.8***	***27.4***	***13.4***	***48.6***	***23***	***16.25***	***22.5***	***9.25***	***25.75***	***15.75***	***23***	***13***	***22.5***	***22.25***	***34.25***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																						
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
November	1	0.8	1	0	0	0.6	0	0	15.4	5.6	0	0	0	0	2.75	0	10	1.5	3	48.5	14.5	0	2.25	0	0	
November	2	0	19.4	0	0	0	0	0.6	36.4	12.6	16.6	0	1.4	0.8	0.25	0	1.25	4	0	16	14.5	22.25	20	0	0	
November	3	9.4	0	0.8	0	0	0	0	0	2.2	15.6	4	3.4	0	0	7.75	3	3	1.75	0	0.25	3.5	7	0	27.25	
November	4	0	7.4	1.2	9.8	5	0	0	n/a	10.2	21.4	0.2	6.4	0	0	1	5.75	0	21.25	0	2.25	4.75	21.5	0	9.75	
November	5	0.4	13	0	1.4	0.8	0	0	n/a	21.2	26.2	0	0	19.4	9	0	11	2.25	5	0.25	19	0.5	9.25	0	5	
November	6	3.2	0	14	7.8	0	4.2	0	n/a	2.2	88	2.6	66	17	2.75	0	0	5.75	8.25	0.5	0.5	0	0	0	0	
November	7	3.6	0	0	0	0	2.8	0	n/a	0	4.2	2	36.6	18.6	0.25	0	3.75	3.25	10.25	4.25	2.75	0	0	0	0	
November	8	0	0	2.8	11.8	0	4	0	n/a	2.4	17.6	7.4	2.2	0.8	0	0.75	0.25	11.75	0	15	1.75	3	0	0.75	0	
November	9	0	0	1.4	4	0	7	0	n/a	0.8	1	2	3	6.4	1	2.75	0	0	0	0.5	8.25	1.75	0	3.25	6	
November	10	0	0.2	6.2	0	0	4	0	n/a	3.4	18.2	4.2	2.2	8.2	0	0	0	0	3.25	2.5	0	0	4.25	0	0	
November	11	0	0	18.8	0	0	7.6	0	n/a	27.8	1.2	1.6	12	0.6	3.25	0	0	0	0	6.25	0	3.25	0.25	0	0	
November	12	0	22.2	14.6	0	4.8	11.6	0	n/a	0	42.2	22.6	22	0	0	9.5	24.5	0	0	0.5	0.75	2.5	0	0	25	
November	13	0	53.6	7.8	1.4	4.6	5.6	0	n/a	14	18	1.8	0	6.4	6.25	8.25	4	3.75	0	44.5	7	14.5	0	0	13	
November	14	0	22.2	4.4	0	25.8	4	0	n/a	0	0.6	2	0.8	0	2.25	0.25	3	0.5	0	23.25	0	20.5	9	0	2.5	
November	15	0	33.6	2.6	0	18.4	0	2.2	n/a	0	39.8	14.2	0.2	17	1.5	0	0.25	0	0	13	5.25	10.5	18	0	6.75	
November	16	0	27	10.6	0	6.4	11	22.6	n/a	0.6	0	4.6	0	58.4	0	0	0	3	0	3.75	6.5	2.5	0	0.75	33	
November	17	2.4	0	3.8	0	0	0	1.2	n/a	0	12.8	5.4	0	15	12.75	11.75	0.5	0	0	7	0	0.25	0.25	0.25	11.75	
November	18	0	0	0	0	0	15.2	68	14.4	0	6.8	1	0	16.4	2	6.5	4.5	5	0	49	0	0.25	0	9.75	5.5	
November	19	1.2	3.6	1	0	15.2	21.8	27.4	0	0	7.8	1.6	0	42.2	0.75	0	7	24	0	0	0	18.75	0	0.25	3.5	
November	20	8.4	35.2	9.4	0	6.8	1	0	0	0	14.4	0	3.4	7.2	0	0.25	3.75	0	0	0	1.25	7.75	0	0	1.25	
November	21	0.2	28.8	4	0	7.6	0	0	0	0	35.2	0	7.2	1	0	0	10.75	0	2.25	0	0	2.75	0	0	0.25	
November	22	1.4	19.6	3.4	0	7.2	0	0	1.2	0	1.8	0	0	17.6	0	5.75	14	0	17.75	0	16	7.75	9	0	2.5	
November	23	0.8	3.8	4.8	6.6	0.8	0	10.6	5.6	0	10.2	0	0	10.2	0	58	0.25	0	1.5	0	0.5	8.5	6.5	2.25	6	
November	24	3.2	28.2	18.4	0	0	0	5	13.4	0.8	1.4	0	0	2.6	0	15	10.25	0	18	8	11	2	8.75	0.5	8.5	
November	25	2.2	43.2	7.2	9	0.6	0	8	2.8	20.4	14.4	0	0	17.2	4.5	9.75	0.25	0	9.75	0.75	8.25	5.25	0	0	0.25	
November	26	0	10.8	0	25.6	2	0	0	1.6	0	32	10.6	0	9.4	14.25	0	0	0	27.75	0	6.5	6.5	3	0	1	
November	27	8	0.8	0.4	3.8	6.8	0	0.2	0.8	0	17.8	0	0	0	0.25	1.25	0	0	5.75	0	5.75	0.75	36	0	5	
November	28	16.8	0	0.4	0	33	0	66.8	0	5.2	0.8	10.4	2.2	8.2	0	24.25	0	0	7.25	0	0	2.25	13.5	0	0	
November	29	1.8	0.6	0	2	8.8	0	2.6	1.2	12	17.4	0.2	6	7	8	0	5.5	0	3.25	0	1.5	0.5	2	0	0	
November	30	9.4	1.2	2.8	4.4	2.4	0	0	5.6	0.2	2	0	0.6	1	17.75	7	0.5	7.75	0.25	0.25	0.25	7.5	0.25	0	11.5	
Total Monthly Rainfall		***73.2***	***375.4***	***140.8***	***87.6***	***157.6***	***99.8***	***215.2***	***98.4***	***141.6***	***485.4***	***98.4***	***175.6***	***308.6***	***89.5***	***169.75***	***124***	***75.5***	***146.25***	***243.75***	***134.25***	***160.25***	***170.75***	***17.75***	***185.25***	
Maximum Daily Rainfall		***16.8***	***53.6***	***18.8***	***25.6***	***33***	***21.8***	***68***	***36.4***	***27.8***	***88***	***22.6***	***66***	***58.4***	***17.75***	***58***	***24.5***	***24***	***27.75***	***49***	***19***	***22.25***	***36***	***9.75***	***33***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
December	1	0	5.2	9.4	0	8.2	0	0	0	2.6	0	15.2	1.8	0	0.25	0.25	16	6.75	0.25	0.25	1	17.25	2.5	0	0	
December	2	0	19.4	16.4	12.4	12.8	0	1.4	0.2	0	0	46.4	0	0	0.25	0	23.25	5.75	0	9.5	0	2.5	1	0	0	
December	3	0	3.6	0	0	0	0	9	0.2	0	0	100.4	0	0	0.25	0	10.25	0	0.25	2.25	4.5	0	0	0	0	
December	4	0	0	0	0	6	3.2	0	16.6	0	3.6	18	0	0	0	0	13	0	0	7.75	0	0	0	0	0	
December	5	0	2.4	4.8	0	4.6	0	6.6	1.4	0	0.4	0.2	0	0	0	0	10.75	0	2	2.25	5	0	0	0	0.75	
December	6	0	0.4	16.2	0	5.2	0	9.8	12.4	0	0	0	4.2	0	0	0	8.5	0	1	17.5	0.25	0	0	0.25	0	
December	7	0.4	3	0	0	0	0	10.8	6	0	0.2	0	0.4	0	7	0	11	0	5.25	9.75	0	0	0	0.75	10.5	
December	8	1	2.8	1	0	12.4	0	0	16.2	0	0.2	0	0	0	4.25	1.75	7	0	0	5.75	0	0	0	0	16	
December	9	2.6	2.8	2.6	1.6	0	0	0	22	0	0.6	3.4	9.6	0	18.25	0	0	0	19.75	43	0	0.25	0	0	0	
December	10	1.8	8.4	3.2	0.8	5.4	4.4	9.2	38.4	0	1.4	0.2	3.8	0	0	0	9.25	0	13.75	15.25	8.25	0	8	0	0	
December	11	0	2.8	2.2	0	2.8	6.2	2	0	0	19.2	0.4	0	0	3.75	0	0.25	0	38.25	8	1.5	0	4.25	0	0.5	
December	12	0	11.4	28.8	0	8.4	20	4.4	0	0.2	17	0	22.2	0	5	0	6	0	6	0	0.25	0	36.75	4.75	0.25	
December	13	0	33.2	7.2	0	32.4	0.4	3.4	3	0	29.4	2.2	4.2	0	0.5	0	0	2	1.25	19	0	0	22.25	0.5	11.25	
December	14	1.6	0	22.6	1.2	15	21.4	18.6	14.4	0	31.8	9	1.6	10.4	3.25	0	7.75	2	0	10.25	0	0	24	0	2	
December	15	2.8	10	63	4.2	3.6	5	0	0.8	0	6.4	16.2	0	25.75	2	2.25	1.5	2.5	0	0	0	3	2.25	0	8.25	
December	16	47.6	7	0	49.2	61.8	5.8	8.4	0.6	0	0	0	0	14.25	0	1.25	0.75	4.5	0	0.25	0	4.5	0.75	0	8.5	
December	17	24.6	1	9.8	5.6	29.8	0.2	1.6	3.8	0	0	1.8	5.8	9.5	0	0.75	24.75	0	0.25	0	0	11	7	0.25	6.5	
December	18	2.2	0	3.8	0	1.6	0.2	0	1.8	0	1.8	6.2	3.4	4	0.75	0.75	10.75	0	2	25.75	1	6.5	13.5	0	16.5	
December	19	9.8	0	2.4	1.2	6	0.2	0	0	2	10	15.2	0	4.75	0.75	0.5	1.75	0	3.25	15.25	4	3	20	0	20.75	
December	20	7.8	0	1	3.8	0	0	0.6	0	15.2	6.2	0	0	11	1.5	0	22.75	0	3.75	0	1.25	0.75	5.5	0.5	0	
December	21	0.6	6.6	0	1.2	0	0	0.4	0	6.4	15.8	0	27.4	4.75	0	0	7.25	10.75	23.5	9	0	2.25	11.25	0.25	35.5	
December	22	0	0	0	4.8	0	0.4	0	0	10.6	1	19.4	13.2	0	0	0	0	2.5	3	9.25	0.25	0.75	0	0	12.5	
December	23	7	0.6	0	3.2	0	0	0	0	11.8	17.2	12.6	0.4	0	7	0.25	2.5	7.25	0	2.5	1.5	0	10.75	0	0.25	
December	24	0.2	18.2	0	4.6	0	1.2	4.8	0.8	15.4	23	0.2	21.8	0	5.25	1.25	4.25	6.75	11.75	8.25	0.25	0	12.25	0	0	
December	25	0	17.6	0	7.6	0	14.6	5.2	9.4	12.8	3.4	0	1.8	0	1	5.75	2	0	0.75	0	0	2.75	0	0	7	
December	26	7.4	21.8	0	2.4	0	12.2	0	4.4	0.4	4.8	0	7.8	0	8	3.5	22.25	0	0	0	0	0	0.5	0	4.75	
December	27	4.6	17	0	4.8	0	22.4	3.6	0	6.2	0	4.2	5	0	10.75	5.25	10	0	1.5	1	1	0.25	5.5	0	6.5	
December	28	10.6	15.4	0	0	2	1	1.8	0	13.8	0	7.6	0.6	0.25	0.5	30.75	0.75	2.5	6.25	12.25	0.25	19	1	0	0	
December	29	0.2	46.4	0.2	0	0	0	0	5.6	0.2	0.6	4.2	12.6	0	0	19.75	3	0	0.25	0	2.75	2.75	24.25	0	12.5	
December	30	0	0	0.2	3	0	4.2	0.2	0.6	5.6	0	1.8	1.6	3.5	0	5.25	3	0	0	0	0	4	19.5	0	29.25	
December	31	0	0.8	11.6	3.6	6.4	0	4.6	3.2	16.2	0	0	3	16.25	0	3.75	0	0.25	0	0	0.25	0	0	0	9.75	
Total Monthly Rainfall		***132.8***	***257.8***	***206.4***	***115.2***	***224.4***	***123***	***106.4***	***161.8***	***119.4***	***194***	***284.8***	***152.2***	***104.4***	***80.25***	***83***	***240.25***	***53.5***	***144***	***234***	***33.25***	***80.5***	***232.75***	***7.25***	***219.75***	
Maximum Daily Rainfall		***47.6***	***46.4***	***63***	***49.2***	***61.8***	***22.4***	***18.6***	***38.4***	***16.2***	***31.8***	***100.4***	***27.4***	***25.75***	***18.25***	***30.75***	***24.75***	***10.75***	***38.25***	***43***	***8.25***	***19***	***36.75***	***4.75***	***35.5***	

C2. Monthly Rainfall Data – Hartland Landfill Weather Station

Appendix C-2. Monthly Rainfall Data: Hartland Landfill Weather Station

Month	Monthly Rainfall (mm)																				
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Avg
January	213.2	205.8	119.8	210.2	277.4	312.4	106.8	121.6	180.5	161.8	150.75	53.75	70.25	160.8	114.5	26	153.5	158.8	166.5	194.5	154.6
February	160.6	29	53	39.2	79.2	94	63	43.8	50.25	72.5	122.5	67.3	130	133	172.8	50	70	39.3	129.0	104.8	87.5
March	135.8	149.6	97	86	36.6	162.2	71.4	99.2	92	108	129.5	91	113	123	137	158	132	15.0	40.0	41.3	94.8
April	71.8	46.2	4.8	43.6	55.6	40.8	70.4	94.6	67.75	109.75	53.5	70.5	66	35	14	90.75	108	54.3	32.8		52.9
May	19.4	25.4	38.4	9.2	34.2	18.4	15.8	62.6	76.5	61.75	32	53.5	40.25	4	11.8	41.25	10.5	31.3	47.5		35.3
June	18	2	20.2	1.6	30.4	34.4	24.2	7.2	1.8	7.5	44.75	30.25	12	3.5	41.5	34	19.3	19.0	45.3		24.4
July	7.4	11.8	31	1.2	2	41.7	7	10.6	2.65	26.25	21	0	6.5	17.5	18.5	0	3.3	22.3	10.3		14.4
August	0.8	0.6	106.2	2.8	3.4	23.2	43.6	22.2	26.25	16.5	2.25	3	12.75	15.5	2.8	3.25	0.5	12.8	18.8		17.8
September	0	34.6	83.2	0.4	31.8	27.2	21.4	54.8	133.75	43.75	0.5	60.25	51.25	76.5	42.8	19.25	40.5	80.3	94.3		44.0
October	4.6	384.4	105.2	48.2	48	100.4	56	170.8	86.25	80.25	131.25	30.25	137.25	81	135	45.75	89.5	93.8	139.0		106.7
November	99.8	215.2	98.4	141.6	485	98.4	175.6	308.6	89.5	169.75	124	75.5	146.25	243.8	134.3	160.25	170.8	17.8	185.3		165.6
December	123	106.4	161.8	119.4	194	284.8	152.2	104.4	80.25	83	240.25	53.5	144	234	33.3	80.5	232.8	7.3	219.8		149.6
Total Yearly Rainfall	***854.4***	***1211***	***919***	***703.4***	***1277.6***	***1237.9***	***807.4***	***1100.4***	***887.45***	***940.8***	***1052.25***	***588.8***	***929***	***1127.1***	***858.3***	***709***	***1030.7***	***551.6***	***1128.4***		***947.6***

Note:

No weather data was collected from Nov 4 - 17, 2004

Weather data collected in 2009 is unreliable due to equipment failure

Appendix D

Leachate Pipeline Flow Data

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-1997	13	2148	0	2148	40816
Feb-1997	0	2700	732	2226	62334
Mar-1997	0	2759	2412	2696	83557
Apr-1997	0	2655	214	2545	78899
May-1997	4	2654	0	956	29561
Jun-1997	11	1563	0	546	17503
Jul-1997	17	2452	0	525	16090
Aug-1997	15	1608	0	386	11606
Sep-1997	21	2662	0	456	14159
Oct-1997	6	2782	0	1233	36996
Nov-1997	4	2533	0	1437	44565
Dec-1997	2	2408	0	1695	52547
TOTAL	93	2782	0	1404	488633

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-1998	0	2603	879	2187	65977
Feb-1998	3	2603	0	1624	43531
Mar-1998	3	2419	0	n/a	35275
Apr-1998	10	1542	0	542	16675
May-1998	13	1890	0	423	12574
Jun-1998	17	1241	0	239	7239
Jul-1998	21	1919	0	240	7645
Aug-1998	31	0	0	0	0
Sep-1998	27	1020	0	58	1821
Oct-1998	19	2379	0	511	14962
Nov-1998	7	2462	0	1538	45248
Dec-1998	0	2619	n/a	n/a	76518
TOTAL	151	2619	0	736	327465

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-1999	0	n/a	n/a	n/a	69000
Feb-1999	0	2970	1966	2681	74930
Mar-1999	0	2970	2539	2875	92028
Apr-1999	5	2894	0	1812	57986
May-1999	11	2889	0	660	20656
Jun-1999	18	1215	0	257	7480
Jul-1999	18	2772	0	365	11687
Aug-1999	30	n/a	n/a	n/a	1000
Sep-1999	4	1193	0	148	4597
Oct-1999	19	1473	0	163	4719
Nov-1999	4	2840	0	1497	43972
Dec-1999	4	3480		n/a	67907
TOTAL	113	3480	0	1162	455962

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2000	3	2791	0	n/a	55088
Feb-2000	7	2235	0	n/a	29318
Mar-2000	7	2211	0	n/a	37258
Apr-2000	8	1737	0	n/a	21289
May-2000	19	2772	0	501	15547
Jun-2000	19	2685	0	396	11902
Jul-2000	22	1086	0	155	4831
Aug-2000	26	907	0	116	3619
Sep-2000	21	2640	0	354	10623
Oct-2000	n/a	n/a	n/a	n/a	8572
Nov-2000	n/a	n/a	n/a	n/a	11737
Dec-2000	12	2926	0	943	29235
TOTAL	144	2926	0	411	239019

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2001					38089
Feb-2001					30154
Mar-2001					24565
Apr-2001	15	2622	0	646	18746
May-2001	16	1647	0	400	12407
Jun-2001	22	2026	0	295	8862
Jul-2001	22	1521	0	244	7576
Aug-2001	24	2873	0	291	9047
Sep-2001	23	1633	0	157	4723
Oct-2001	15	2631	0	552	17112
Nov-2001	7	2899	0	993	29819
Dec-2001	0	3397	58	2241	69492
TOTAL	144	3397	0	647	270592

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2002	1	2892	0	1946	60342
Feb-2002	1	3395	0	1946	54497
Mar-2002	2	3412	0	2200	68224
Apr-2002	6	2444	0	1022	29651
May-2002	13	2118	0	578	17928
Jun-2002	16	1683	0	381	11435
Jul-2002	20	2330	0	330	10231
Aug-2002	23	1521	0	253	7848
Sep-2002	28	1154	0	72	2160
Oct-2002	26	1356	0	143	4450
Nov-2002	14	2477	0	618	18555
Dec-2002	9	2896	0	987	30615
TOTAL	159	3412	0	873	315936

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2003	5	4880	0	1569	48664
Feb-2003	4	2819	0	1354	37921
Mar-2003	3	2849	0	1533	47546
Apr-2003	6	2185	0	846	24562
May-2003	18	1892	0	514	15962
Jun-2003	15	1397	0	340	10224
Jul-2003	20	1126	0	282	8768
Aug-2003	21	1140	0	214	6658
Sep-2003	23	1147	0	222	6671
Oct-2003	15	3869	0	1621	50260
Nov-2003	4	3681	0	2546	76397
Dec-2003	0	3587	96	2218	68773
TOTAL	134	4880	0	1105	402406

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2004	0	2859	99	1597	49509
Feb-2004	0	2833	2	1536	44551
Mar-2004	2	2792	0	1170	36288
Apr-2004	22	1675	0	319	9272
May-2004	31	0	0	0	0
Jun-2004	13	3565	0	1104	33135
Jul-2004	30	63	0	2	63
Aug-2004	23	3007	0	601	18636
Sep-2004	24	2998	0	454	13640
Oct-2004	14	3668	0	1138	35284
Nov-2004	2	2889	0	1631	48938
Dec-2004	4	3659	0	2191	67947
TOTAL	165	3668	0	979	357263

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2005	7	3671	0	2247	69680
Feb-2005	2	3662	0	2571	72002
Mar-2005	11	2484	0	824	25551
Apr-2005	4	2800	0	1041	30206
May-2005	18	2840	0	691	21437
Jun-2005	16	1800	0	431	12946
Jul-2005	18	1301	0	274	8512
Aug-2005	22	2771	0	417	12927
Sep-2005	19	1301	0	274	8512
Oct-2005	24	3025	0	432	13393
Nov-2005	5	2999	0	1347	40421
Dec-2005	5	2916	0	1180	36601
TOTAL	151	3671	0	977	352188

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2006	0	3415	1123	3075	95329
Feb-2006	2	3435	0	2206	61795
Mar-2006	8	2926	0	846	26247
Apr-2006	14	2141	0	558	16762
May-2006	19	2058	0	464	14402
Jun-2006	21	2175	0	359	10795
Jul-2006	28	1996	0	105	3277
Aug-2006	23	1991	0	327	10148
Sep-2006	22	1770	0	255	7654
Oct-2006	23	2043	0	304	9427
Nov-2006	2	3677	0	2872	86167
Dec-2006	0	3563	3130	3425	106180
TOTAL	162	3677	0	1233	448183

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2007	0	3657	3272	3464	107411
Feb-2007	0	3619	815	2398	67168
Mar-2007	0	3442	38	2130	66034
Apr-2007	6	1929	0	872	26177
May-2007	14	2120	0	572	17740
Jun-2007	18	2127	0	477	14331
Jul-2007	22	2157	0	387	12019
Aug-2007	28	1730	0	92	2859
Sep-2007	29	76	0	2	76
Oct-2007	14	3288	0	945	29316
Nov-2007	11	2306	0	793	23813
Dec-2007	1	3715	0	2549	79041
TOTAL	143	3715	0	1223	445985

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2008	0	2949	260	1644	50970
Feb-2008	2	2927	0	1322	38343
Mar-2008	0	1874	0	901	27953
Apr-2008	7	1849	0	845	25364
May-2008	18	2946	0	537	16670
Jun-2008	25	2695	0	286	8594
Jul-2008					0
Aug-2008					0
Sep-2008					28892
Oct-2008					29892
Nov-2008					17433
Dec-2008					37620
TOTAL	52	2949	0	923	281731

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2009	0	3522	799	2400.13	74404
Feb-2009	2	1551	0	866.54	24263
Mar-2009	0	2388	42	1040.23	32247
Apr-2009	5	2838	0	1056.40	31692
May-2009	11	2292	0	760.94	23589
Jun-2009	18	1839	0	426.58	13224
Jul-2009	9	2880	0	804.66	25749
Aug-2009	0	2871	402	942.19	29208
Sep-2009	18	2847	0	313.20	9396
Oct-2009	7	2838	0	814.52	25250
Nov-2009	0	3345	210	2426.10	72783
Dec-2009	0	3246	1125	2169.39	67251
TOTAL	70	3522	0	1168	429056

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2010	0	3438	1080	2460.58	76278
Feb-2010	0	1824	387	1013.46	28377
Mar-2010	10	1617	0	629.32	19509
Apr-2010	10	2853	0	1280.63	38419
May-2010	11	1989	0	704.32	21834
Jun-2010	16	1776	0	498.70	14961
Jul-2010	17	1815	0	399.87	12396
Aug-2010	18	2481	0	391.84	12147
Sep-2010	13	1752	0	647.50	19425
Oct-2010	7	1719	0	791.61	24540
Nov-2010	1	2034	0	1107.90	33237
Dec-2010	1	3462	0	2673.97	82893
TOTAL	104	3462	0	1050	384016

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2011	1	3324	0	2521.00	75630
Feb-2011	5	2823	0	1544.10	46323
Mar-2011	2	2832	0	1762.00	52860
Apr-2011	5	2715	0	1429.70	42891
May-2011	7	2847	0	894.68	27735
Jun-2011	13	1563	0	534.80	16044
Jul-2011	15	1428	0	441.19	13677
Aug-2011	13	1434	0	338.06	10818
Sep-2011	8	2604	0	454.94	14103
Oct-2011	20	1932	0	359.61	11148
Nov-2011	8	3288	0	1020.30	30609
Dec-2011	6	2589	0	1011.77	31365
TOTAL	103	3324	0	1026	373203

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2012	0	2556	156	1693.94	52512
Feb-2012	1	2742	0	1634.28	47394
Mar-2012	1	2472	0	1518.68	47079
Apr-2012	3	2121	0	914.60	27438
May-2012	11	1671	0	563.16	17458
Jun-2012	16	1848	0	449.77	13493
Jul-2012	10	2979	0	606.97	18816
Aug-2012	20	1266	0	205.55	6372
Sep-2012	9	1410	0	460.90	13827
Oct-2012	15	2688	0	641.03	19872
Nov-2012	3	2847	0	1601.70	48051
Dec-2012	0	2610	779	2346.68	72747
TOTAL	89	2979	0	1053	385059

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2013	0	2526	43	1615.94	50094
Feb-2013	2	1986	0	1017.00	28476
Mar-2013	3	2694	0	1750.26	54258
Apr-2013	5	2136	0	997.30	29919
May-2013	10	1840	0	627.00	19437
Jun-2013	12	2515	0	594.30	17829
Jul-2013	14	1390	0	379.26	11757
Aug-2013	16	1590	0	355.55	11022
Sep-2013	9	2199	0	523.50	15705
Oct-2013	6	2448	0	772.81	23957
Nov-2013	6	2418	0	844.87	25346
Dec-2013	7	1848	0	708.74	21971
TOTAL	90	2694	0	849	309771

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2014	1	2316	0	1348.52	41804
Feb-2014	2	3366	0	1951.21	54634
Mar-2014	0	3387	150	2252.39	69824
Apr-2014	2	2535	0	1004.27	30128
May-2014	7	2562	0	796.90	24704
Jun-2014	5	1677	0	473.77	14213
Jul-2014	18	2517	0	485.68	15056
Aug-2014	14	911	0	302.55	9379
Sep-2014	16	959	0	305.43	9163
Oct-2014	16	2163	0	447.48	13872
Nov-2014	8	2808	0	1420.00	42601
Dec-2014	0	2589	600	1814.42	56247
TOTAL	89	3387	0	1050	381625

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2015	0	2472	460	1976.13	61260
Feb-2015	0	2508	312	1750.36	49008
Mar-2015	0	2481	45	1493.71	46305
Apr-2015	1	2763	0	1118.30	33549
May-2015	15	2078	0	519.23	16096
Jun-2015	17	1744	0	449.57	13487
Jul-2015	23	1758	0	267.19	8283
Aug-2015	19	2595	0	376.71	11678
Sep-2015	15	1679	0	454.97	13649
Oct-2015	15	2251	0	460.35	14271
Nov-2015	3	3186	0	2154.30	64629
Dec-2015	0	3350	386	2693.29	83492
TOTAL	108	3350	0	1143	415707

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2016	1	3240	0	1836.23	56923
Feb-2016	1	3267	0	2639.38	76542
Mar-2016	1	3099	0	1818.87	56385
Apr-2016	8	3096	0	784.40	23532
May-2016	16	3098	0	540.00	16740
Jun-2016	10	1251	0	454.73	13642
Jul-2016	16	1222	0	340.00	10540
Aug-2016	16	1553	0	330.42	10243
Sep-2016	19	1707	0	324.00	9720
Oct-2016	7	2610	0	1328.81	41193
Nov-2016	0	3228	603	2038.40	61152
Dec-2016	0	3378	774	2344.35	72675
TOTAL	95	3378	0	1232	449287

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2017	1	2436	0	1390.29	43099
Feb-2017	2	3234	0	2049.18	57377
Mar-2017	0	3192	384	2050.16	63555
Apr-2017	0	2328	111	1547.40	46422
May-2017	11	3312	0	758.90	23526
Jun-2017	21	1410	0	291.60	8748
Jul-2017	7	882	0	356.03	11037
Aug-2017	15	2790	0	494.32	15324
Sep-2017	17	3375	0	494.00	14820
Oct-2017	23	2028	0	290.32	9000
Nov-2017	3	3324	0	1850.90	55527
Dec-2017	5	3276	0	1763.90	54681
TOTAL	105	3375	0	1111	403116

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2018	2	3213	0	2401.16	74436
Feb-2018	1	3438	0	2097.71	58736
Mar-2018	9	27775	0	1048.97	32518
Apr-2018	11	3111	0	1023.00	30690
May-2018	17	2892	0	629.00	19497
Jun-2018	17	2184	0	482.00	14473
Jul-2018	11	1608	0	385.00	11942
Aug-2018	21	1593	0	158.00	4908
Sep-2018	18	1286	0	234.00	7026
Oct-2018	8	1692	0	520.00	16127
Nov-2018	1	2676	0	1157.00	35865
Dec-2018	1	3234	0	2428.00	75255
TOTAL	117	27775	0	1047	381473

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2019	2	3300	0	2607.00	80823
Feb-2019	3	2787	0	1302.00	36442
Mar-2019	5	2439	0	1013.00	31393
Apr-2019	8	2526	0	769.00	23078
May-2019	11	2172	0	595.00	18437
Jun-2019	21	802	0	152.00	4546
Jul-2019	29	14	0	1.00	19
Aug-2019	25	3320	0	158.00	4888
Sep-2019	12	3298	0	858.00	25725
Oct-2019	14	3010	0	897.00	27803
Nov-2019	7	2114	0	785.00	23560
Dec-2019	2	2196	0	1196.00	37091
TOTAL	139	3320	0	861	313805

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2020	0	3108	1092	2793.00	86573
Feb-2020	0	2990	2608	2910.00	84399
Mar-2020	3	2892	0	1117.00	34616
Apr-2020	6	2772	0	711.00	21319
May-2020	13	1342	0	483.00	14962
Jun-2020	26	1502	0	126.00	3791
Jul-2020	21	692	0	68.00	2107
Aug-2020	15	2840	0	356.00	11031
Sep-2020	17	4804	0	710.00	21298
Oct-2020	4	1956	0	976.00	30254
Nov-2020	4	2474	0	1749.00	52828
Dec-2020	0	3396	274	1767.00	54774
TOTAL	109	4804	0	1147	417952

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2021	0	6558	2122	3284.00	101810
Feb-2021	15	18835	0	1722.00	48208
Mar-2021	20	12720	0	1444.00	44771
Apr-2021					
May-2021					
Jun-2021					
Jul-2021					
Aug-2021					
Sep-2021					
Oct-2021					
Nov-2021					
Dec-2021					
TOTAL	35	18835	0	2150	194789

Appendix E

Hartland Landfill Site Plan and Sampling Locations

- E1. Hartland Landfill Site Plan
- E2. Groundwater Level Monitoring Locations
- E3. Groundwater Quality Monitoring Locations
- E4. Surface Water Quality Monitoring Locations
- E5. Leachate Quality Monitoring Locations

E1. Hartland Landfill Site Plan

CRD - Facilities Management & Engineering Services - Jun 07, 2021 - Technologist: jpbezeau - Map Document: HartlandSiteFacilitiesPhases2021.mxd

HARTLAND LANDFILL SITE PLAN

Mount Work Regional Park
Juan de Fuca Electoral Area
District of Saanich
Hartland North Site
Compost Access Road
Leachate Pipeline
Hartland Valve Chamber (compliance point)
Northwest Sedimentation Pond (fresh water)
West Face Leachate
Upper Leachate Lagoon
C3PO
Lower Leachate Lagoon
PS
Microtunnel
Aggregate Stockpile
Quarry Access Road
Future Landfill Extent
Gas Utilization Facility
Sedimentation Pond (fresh water)
Phase 2, Cell 1 North Face Closure (2011)
Perimeter East Road
Toutle Leachate Underdrain
Phase 2, Cell 3 (Active)
Phase 1 Closure (1997)
Phase 2, Cell 2 (2016)
Phase 1 Cost Road
South West Progressive Closure (2008)
South Leachate Pump Station
Main Access Road
Entrance
Hartland Ave
Bin Drop-off
Parking
Recycling Area
Mount Work Regional Park

Making a difference...together

Metres
0 50 100 200
Projection: UTM ZONE 10N NAD 83

Observation Chamber
Pump Station
Residual Solids & Centrate Return Line
Hartland Leachate Line
Contours (5m interval)
Index
Index-Depression
Cell Phases
Lot Lines
Regional Park

Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

E2. Groundwater Level Monitoring Locations

HARTLAND LANDFILL
GROUNDWATER LEVEL MONITORING LOCATIONS

Making a difference...together

Metres

0 25 50 100 150

Projection: UTM ZONE 10N NAD 83

Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

Groundwater Level Monitoring Locations

Monitoring Frequency (# times per year)

- 4
- Continuous

Roads

Contours (5m interval)

E3. Groundwater Quality Monitoring Locations

CRD - Parks & Environmental Services - Facilities Management & Engineering Services - Apr 28, 2021 - Technologist: sruljancich - Map Document: HartlandGroundwaterQuality2021Seasonal.mxd

HARTLAND LANDFILL
GROUNDWATER QUALITY MONITORING LOCATIONS

GW-55-1-1
GW-41-1-1
GW-56-1-1
GW-57-1-1
GW-42-1-1
GW-43-1-1
GW-44-1-1
GW-62-1-1
GW-62-2-1
GW 91-1-1
GW 93-1-1
GW 92-1-1
GW 94-1-1
GW-78-1-1
GW-78-2-1
GW-25-1-1
GW-25-1-2
GW-53-1-1
GW-28-1-0
GW-29-1-1
GW-29-1-2
GW-30-1-1
GW-30-1-2
GW-31-1-1
GW-31-1-2
GW-21-1-1
GW-21-1-2
GW-21-2-1
GW-20-1-1
GW-20-1-2
GW-51-1-1
GW-51-2-1
GW-51-3-1
GW-38-1-1
GW-39-1-1
GW-39-2-1
GW-37-3-1
GW-40-1-1
GW-81-1-0-P9
GW-52-1-1
GW-36-3-1
GW-80-1-0-P8
GW-52-4-0-P7
GW-88-1-1
GW-88-2-1
GW-77-1-1
GW-77-2-1
GW-87-1-1
GW-87-2-1
GW-27-1-1
GW-27-1-2
GW-58-1-0
GW-16-1-1
GW-16-1-2
GW-16-2-1
GW-16-2-2
GW-17-1-1
GW-17-1-2
GW-17-1-3
GW-18-1-1
GW-18-2-1
GW-18-2-2
GW-63-1-1
GW-63-2-1
P4
P2
P10
P3
P1
GW-85-1-1
GW-72-1-1
GW-72-3-1
GW-71-1-1
GW-71-2-1
GW-71-3-1
GW-07-1-0
GW-60-1-1
GW-60-2-1
GW-60-3-1
GW-19-1-1
GW-19-1-2
GW-19-2-1
GW-19-2-2
GW-73-1-1
GW-73-2-1
GW-73-3-1
GW-04-3-1
GW-04-4-1

Willis Point Rd
Willis Point Entrance Road
North Park Road
High Level Road
Northwest Slope Road
Perimeter Road North
Turtle Valley Road
140 Road
150 Road
160 Road
160 Road
160 Road
High Level Road
North Main Haul Road
170 Road
South Diversion Road
East Perimeter Road
Berm Road
East Hydro Road
Main Access Road
Main Access Road
Recycle & Public Road
South Diversion Road
South Park Road
Potential Scale Access Road
Hartland Ave
Hartland Ave

N
W
E
S

Making a difference...together

Metres
0 25 50 100 150

Projection: UTM ZONE 10N NAD 83

Groundwater Monitoring Location – Non-Compliance Well
Groundwater Monitoring Location – Compliance Well
Roads
Contours (5m interval)

Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

E4. Surface Water Quality Monitoring Locations

HARTLAND LANDFILL
SURFACE WATER QUALITY MONITORING LOCATIONS

Metres
0 50 100 200

Projection: UTM ZONE 10N NAD 83

Making a difference...together

- Surface Water Monitoring Location – Compliance Station
- Surface Water Monitoring Location – Non-compliance Station
- Road
- Contours (10m interval)

Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

E5. Leachate Quality Monitoring Locations

HARTLAND LANDFILL
LEACHATE QUALITY MONITORING LOCATIONS

Making a difference...together

Metres

0 25 50 100 150

Projection: UTM ZONE 10N NAD 83

★ Leachate Quality Monitoring Locations

Contours (5m interval)

Roads

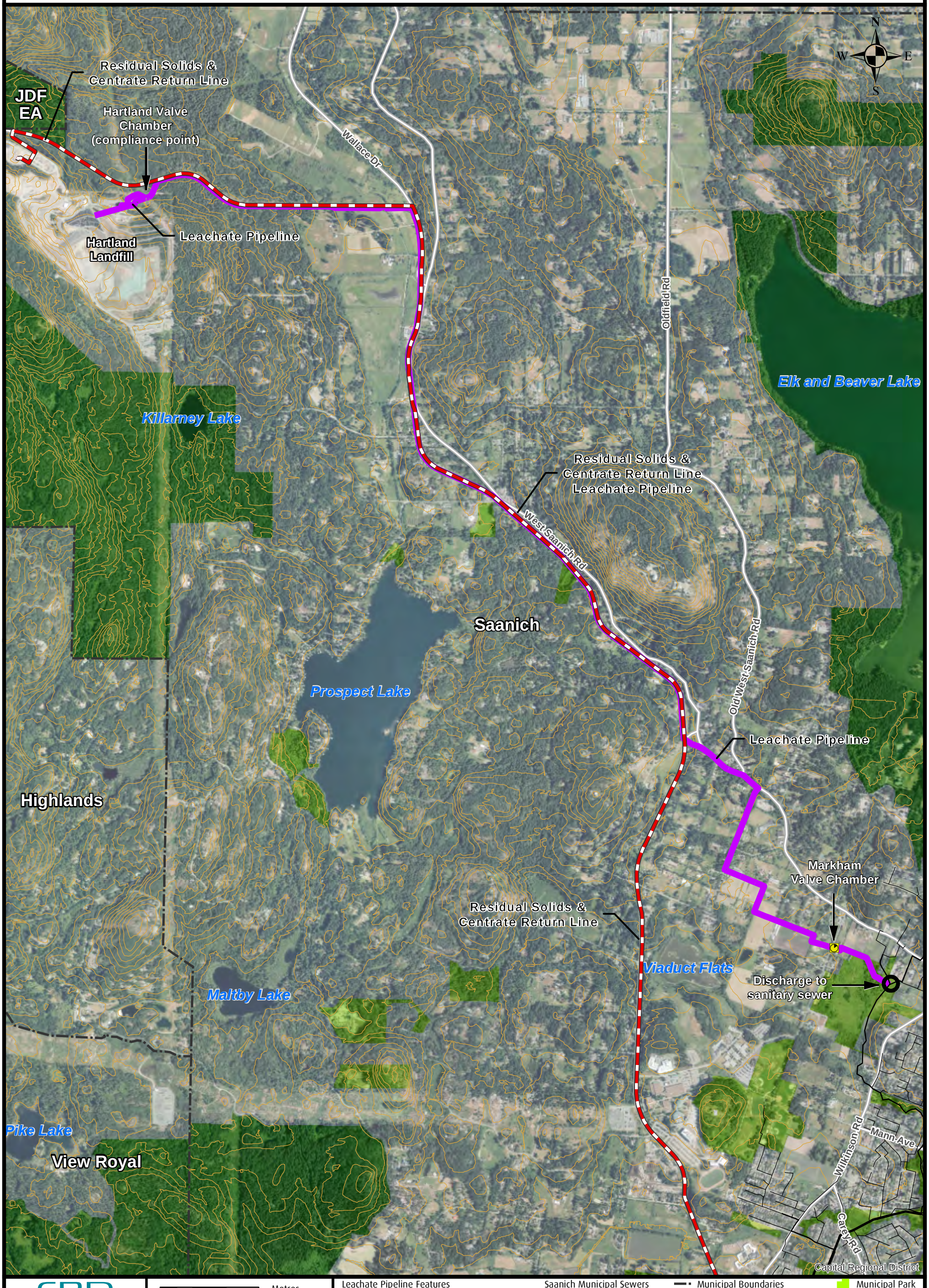
Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

Appendix F

Hartland Landfill Leachate Pipeline Plan

CRD - Facilities Management & Engineering Services - Jun 08, 2021 - Technologist: jpbezeau - Map Document: Hartland_Leachate_Line.mxd

HARTLAND LANDFILL - LEACHATE PIPELINE PLAN



Making a difference...together

Metres

0 100 200 400 600

Projection: UTM ZONE 10N NAD 83

Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

Leachate Pipeline Features
- Metering Chamber
- Observation Chamber
- Pump Station
- Residual Solids & Centrate Return Line
- Leachate Pipeline

Saanich Municipal Sewers
- 0 - 200 mm
- 201 - 599 mm
- 600 - 899 mm
- > 900 mm

- Municipal Boundaries
- Major Roads

Contours (10m Interval)
- Major Contour
- Major Contour - Depression

- Municipal Park
- Regional Park

Orthophoto flown in 2019

Appendix G

Results of Statistical Analysis

- G1. Groundwater
- G2. Surface Water
- G3. Leachate

G1. Groundwater

Appendix G-1. Results of Statistical Analysis - Groundwater

Station	Parameter									
	Conductivity		Ammonia		Chloride		Sulphate		Nitrate	
	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing
	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
Boundary Compliance Monitoring Wells										
Gw-04-3-1	N	Y	N	Y	N	N	N	N	N	N
Gw-04-4-1	N	N	N	N	Y	N	N	N	N	N
Gw-18-1-1	N	Y	N	N	N	N	Y	N	N	Y
Gw-18-1-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-18-2-1	N	N	N	N	N	N	Y	N	N	N
Gw-18-2-2	N	N	N	N	N	N	Y	N	N	N
Gw-20-1-1	N	Y	N	Y	N	Y	N	N	N	N
Gw-20-1-2	N	Y	N	Y	N	N	N	N	N	N
Gw-21-1-1	N	Y	N	N	N	N	N	N	N	N
Gw-21-1-2	N	Y	N	N	N	N	N	N	N	N
Gw-21-2-1	N	Y	N	N	N	N	N	N	N	N
Gw-28-1-0	N	Y	N	N	N	N	N	N	Y	N
Gw-29-1-1	N	Y	N	N	Y	N	Y	N	N	N
Gw-29-1-2	N	N	N	N	N	N	Y	N	Y	N
Gw-30-1-1	N	Y	N	N	N	Y	N	N	N	N
Gw-30-1-2	N	N	N	N	N	N	Y	N	N	N
Gw-31-1-1	N	N	N	N	N	N	N	N	N	N
Gw-31-1-2	N	N	N	N	N	N	Y	N	N	N
Gw-39-1-1	N	Y	N	N	N	N	Y	N	N	N
Gw-39-2-1	N	Y	N	N	N	Y	N	N	N	N
Gw-41-1-1	N	Y	N	N	Y	N	N	Y	N	Y
Gw-42-1-1	N	Y	N	N	N	N	N	N	N	N
Gw-53-1-1	N	Y	N	N	N	Y	N	N	N	N
Gw-54-1-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-54-2-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-54-3-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-55-1-1	N	Y	N	N	N	N	N	N	N	Y
Gw-56-1-1	N	Y	N	N	Y	N	N	Y	N	N
Gw-57-1-1	N	Y	N	N	N	N	N	N	N	N
Gw-71-1-1	N	Y	N	N	N	N	Y	N	N	N
Gw-71-2-1	N	Y	N	N	Y	N	Y	N	N	N
Gw-71-3-1	N	N	N	N	Y	N	Y	N	Y	N
Gw-72-1-1	N	Y	N	N	Y	N	N	N	N	N
Gw-72-2-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-72-3-1	N	Y	N	N	N	Y	N	N	N	N
Gw-73-1-1	N	Y	N	N	N	Y	Y	N	N	N
Gw-73-2-1	N	Y	N	N	N	N	N	N	N	N
Gw-73-3-1	N	Y	N	N	N	N	N	N	Y	N
Gw-76-1-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-76-2-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-76-3-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

NA - Not Applicable

N - No Trend

Green highlights indicate decreasing trends

Red highlights indicate increasing trends

Appendix G-1. Results of Statistical Analysis - Groundwater

Station	Parameter									
	Conductivity		Ammonia		Chloride		Sulphate		Nitrate	
	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing
	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
Additional Monitoring Wells										
Gw-07-1-0	N	N	N	N	Y	N	N	N	N	N
Gw-16-1-1	N	N	N	N	N	N	N	N	N	N
Gw-16-1-2	N	Y	Y	N	N	N	N	N	N	N
Gw-16-2-1	N	N	N	N	N	N	N	N	N	N
Gw-16-2-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-17-1-1	N	N	N	N	N	N	N	N	N	Y
Gw-17-1-2	N	N	N	N	N	N	N	Y	N	N
Gw-17-1-3	N	N	N	N	Y	N	N	N	N	N
Gw-19-1-1	N	N	N	N	Y	N	N	Y	N	N
Gw-19-1-2	N	N	N	N	N	Y	N	N	N	N
Gw-19-2-1	N	N	N	N	N	N	N	Y	N	N
Gw-19-2-2	N	Y	Y	N	Y	N	N	Y	N	N
Gw-25-1-1	N	Y	Y	N	N	N	Y	N	Y	N
Gw-25-1-2	N	Y	N	N	N	N	N	N	N	N
Gw-27-1-1	N	Y	N	N	N	N	Y	N	N	N
Gw-27-1-2	N	Y	N	N	Y	N	N	N	N	N
Gw-36-2-1	N	Y	N	Y	N	N	Y	N	N	N
Gw-36-3-1	N	Y	N	N	N	N	N	Y	N	N
Gw-37-2-1	N	N	N	N	N	N	Y	N	N	N
Gw-37-3-1	N	N	N	N	N	N	Y	N	N	N
Gw-38-1-1	N	Y	N	N	Y	N	N	N	N	N
Gw-40-1-1	N	Y	N	Y	N	Y	N	N	N	N
Gw-43-1-1	N	Y	Y	N	N	Y	N	N	N	N
Gw-44-1-1	N	N	N	Y	N	N	N	N	N	Y
Gw-51-1-1	N	N	N	N	N	N	N	N	N	N
Gw-51-2-1	N	Y	N	N	N	N	Y	N	N	N
Gw-51-3-1	N	N	N	N	N	N	Y	N	N	N
Gw-52-1-1	N	Y	N	N	N	N	N	N	N	N
Gw-52-4-0 (P7)	N	N	Y	N	Y	N	N	N	N	N
Gw-58-1-0	N	N	Y	N	Y	N	N	N	N	N
Gw-60-1-1	N	Y	N	N	Y	N	N	Y	N	N
Gw-60-2-1	N	Y	N	N	N	N	N	N	Y	N
Gw-60-3-1	N	Y	N	N	Y	N	Y	N	N	Y
Gw-62-1-1	N	Y	N	N	N	Y	Y	N	Y	N
Gw-62-2-1	N	Y	N	N	N	N	N	N	N	Y
Gw-63-1-1	N	Y	N	N	N	N	N	N	N	N
Gw-63-2-1	N	Y	N	N	N	N	N	N	N	N
Gw-77-1-1	N	Y	N	N	Y	N	Y	N	N	N
Gw-77-2-1	N	Y	N	N	N	N	N	N	N	N
Gw-78-1-1	N	N	N	N	N	N	Y	N	N	N
Gw-78-2-1	N	N	Y	N	N	N	Y	N	N	N
Gw-79-1-1	N	N	Y	N	N	Y	N	N	N	N
Gw-79-2-1	N	N	N	N	N	Y	N	N	N	N
Gw-85-1-1	N	N	N	Y	Y	N	Y	N	N	N
Gw-87-1-1	N	Y	N	N	N	Y	N	N	N	N
Gw-87-2-1	N	Y	N	N	N	Y	N	N	N	N
Gw-88-1-1	N	Y	N	N	N	Y	Y	N	Y	N
Gw-88-2-1	N	Y	N	N	N	Y	N	N	N	N
GW-91-1-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GW-92-1-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GW-93-1-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GW-94-1-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-P1	N	N	N	N	N	N	Y	N	N	N
Gw-P2	Y	N	N	N	N	N	Y	N	N	N
Gw-P3	N	N	N	N	Y	N	N	N	N	N
Gw-P4	N	N	N	N	N	N	N	N	N	N
Gw-80-1-0 (P8)	N	N	Y	N	N	N	N	N	N	N
Gw-81-1-0 (P9)	N	N	N	N	N	N	N	N	N	N
Gw-P10	N	N	N	N	Y	N	N	Y	N	N

Notes:

NA - Not Applicable

N - No Trend

Green highlights indicate decreasing trends

Red highlights indicate increasing trends

G2. Surface Water

Appendix G-2. Results of Statistical Analysis - Surface Water

Station	Parameter									
	Conductivity		Ammonia		Chloride		Sulphate		Nitrate	
	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N
Boundary Surface Water Quality Location										
SW-S-04	N	N	N	N	N	N	N	N	N	N
SW-N-05	Y	N	N	N	N	N	Y	N	Y	N
SW-N-16	N	N	N	N	N	N	N	N	N	N
SW-N-41s1	N	N	N	N	N	N	N	N	N	N
SW-N-42s1	Y	N	N	N	N	N	Y	N	N	N
Routine Surface Water Quality Location										
SW-S-03	N	N	N	N	N	N	N	N	N	Y
SW-N-CSs2	N	N	N	N	N	N	N	Y	N	N
SW-N-06*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-07*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-08*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-09*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-S-10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-S-11*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-S-12	N	N	N	N	N	N	N	N	N	N
SW-N-14	N	N	N	N	N	N	N	N	N	N
SW-N-15*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-17	Y	N	N	N	N	N	Y	N	Y	N
SW-N-18	N	N	N	Y	Y	N	N	N	N	N
SW-N-19	N	N	N	N	N	N	N	N	N	N
SW-S-20	N	N	N	N	N	N	N	Y	N	N
SW-S-21	N	N	N	N	N	N	N	N	N	N
SW-S-23*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-S-24	N	N	N	N	N	N	N	N	N	N
SW-S-25*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-S-27	N	N	N	N	N	N	N	N	N	Y
SW-S-31*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-S-52	N	N	N	N	N	N	N	N	N	N
SW-N-41s3	N	N	N	N	N	N	N	N	N	N
SW-N-41s4*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-41s6*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-43*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-45	Y	N	N	N	N	N	Y	N	Y	N
SW-N-47*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-50	N	N	N	N	N	N	N	N	N	N
SW-N-51	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-53	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-54	N	N	N	N	N	N	N	N	N	N

Notes:

NA - location does not have sufficient data to run statistical analysis

** Inactive well*

Green highlights indicate decreasing trends

Red highlights indicate increasing trends

G3. Leachate

Appendix G-3. Results of Statistical Analysis - Leachate

Station	Parameter									
	Conductivity		Ammonia		Chloride		Sulphate		Nitrate	
	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N
Hartland Valve Chamber	N	Y	N	Y	N	N	Y	N	Y	N

Notes:

Green highlights indicate decreasing trends

Red highlights indicate increasing trends