



**Water and Waste
Eaux et déchets**

Environmental Standards Division

BRADY ROAD RESOURCE MANAGEMENT FACILITY ANNUAL REPORT - 2019



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BRADY ROAD RESOURCE MANAGEMENT FACILITY ANNUAL REPORT – 2019

EXECUTIVE SUMMARY

The Brady Road Resource Management Facility (BRRMF) is the City of Winnipeg's only active landfill. The site is bordered by the Perimeter Highway on the North, Waverley Street on the East, Brady Road and the R.M. of Macdonald on the West, and Rue des Trappistes on the South. The landfill has been in operation since 1973 and is estimated to have sufficient capacity for approximately 100 years, assuming current waste diversion practices are continued.

Environment Act Licence No. 3081 R, issued on April 23, 2014, requires the City of Winnipeg to submit an annual report on or before April 15th, detailing activities conducted at BRRMF in the previous year. This report provides a summary of major expenditures and construction, major incidents, waste diversion operations, ground water management, surface water management, leachate management, landfill gas management, and nuisance management for 2019.

Major construction in 2019 included: completion of the centralized leachate collection system, completion of the lime mud berm, and construction of a new waste cell.

One incident occurred at the site in 2019; the event was reported to an Environment Officer as required. In 2019, the BRRMF received 38 odour complaints; in all cases the customer was contacted for follow-up and corrective actions were taken as necessary.

In 2019, approximately 50% of the 637,422 metric tonnes of material received at the BRRMF were beneficially re-used, composted, or removed from the site for further processing or beneficial re-use. In addition, 36,763 kL of leachate was hauled to the North End Sewage Treatment Plant for treatment.

Monitoring programs for leachate, ground water, surface water, and subsurface gas migration followed the sampling and analysis plans in 2019 and contingency plans were not activated. Following a malfunction in the centralized leachate collection system, the leachate in Cell 31 exceeded the maximum head level for about 30 days until we were able to implement a contingency mitigation plan, which was not part of our original licence submittal.

Statistical analyses of analytical results obtained for leachate, ground water, and surface water indicate that the BRRMF has not had a negative impact on the ground water and surface water downstream of the site.

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1.0 INTRODUCTION

The Brady Road Resource Management Facility (BRRMF) site is located south of the Perimeter Highway, between Brady Road and Waverley Street. Residential land use is present within 500 m of the site to the east and within 120 m north of the site (Waverly West development), other surrounding land use is agricultural. Opened in 1973, the 790-hectare, Class 1 Solid Waste Disposal facility currently holds approximately 10 million metric tonnes of waste, with over 300,000 metric tonnes of waste materials landfilled on an annual basis. The site has capacity for approximately 100 additional years of waste disposal.

The BRRMF operates in accordance with Environment Act Licence No. 3081 R, which was issued on April 23, 2014. Clause 127 of the license requires the City of Winnipeg to prepare and submit an Annual Report on the activities undertaken at the site during the previous year on or before April 15th of each year. This report contains results and/or comments for each of the clauses of Licence No. 3081 R under which the BRRMF has generated pertinent information during 2019. The report also provides information on the BRRMF proposed activities for 2020.

The layouts of the primary components of the BRRMF are shown on Figure 1. Surface water flows are managed by perimeter ditching and retention ponds. The ground water monitoring well network includes 13 bedrock wells, 13 till wells, and 8 clay wells. The leachate collection system is a network of manholes/risers, drains, and sumps around the perimeter of the landfill cells, which feed into a centralized collection tank/truck fill station. The landfill gas (LFG) management system includes extraction wells, LFG collection piping, and a blower/enclosed flare station.

BRADY ROAD RESOURCE MANAGEMENT FACILITY ANNUAL REPORT – 2019**2.0 MAJOR ACTIVITIES AND CONSTRUCTION**

Major activities and construction undertaken in 2019 included:

- Construction of a new waste cell (Cell 32)
- Completion of the centralized leachate collection system: incorporated pumping manholes into the centralized above ground leachate tank
- Completion of the lime mud berm

Major activities and construction planned for 2020 include:

- Expanding the landfill gas collection system for Cell 30
- Accepting organic waste from a curb side collection pilot program from approximately 4000 homes across five collection routes

3.0 MAJOR INCIDENTS

In 2019, there were no disruptions or failures of waste management practices due to equipment breakdown, no major spills occurred, and no alarms were activated.

In April 2019, the main pump in the centralized leachate collection system failed, causing the main discharge line into the collection tank to be severed. While the centralized system was shut down for repairs, leachate was manually pumped out of the eight pumping manholes. Cell 31 is not connected to a pumping manhole, as a result, leachate rose above the crown of the collection system piping for approximately 30 days until a new pump and an interim pipe made of composite steel could be installed. Once stainless steel pipe can be procured and installed, the composite steel pipe will be kept on hand as a backup should a failure occur again in the future. Going forward, the leachate collection system for new waste cells will be built to accommodate a large hydraulic pump to be used for emergency pumping directly into a tanker truck if needed.

The incident was reported to Manitoba Sustainable Development; the Incident report is provided in Appendix A.

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4.0 WASTE DIVERSION OPERATIONS

In 2019, 637,422 metric tonnes of material were received at the BRRMF: 308,999 metric tonnes were composted or re-used on-site, 8,181 metric tonnes were removed from the BRRMF for further processing or beneficial re-use, and 320,242 metric tonnes were landfilled. This translates to a diversion rate of 50%, which is a decrease from the 2018 diversion rate of 52%.

The amount of material landfilled decreased in 2019 because biosolids continued to be diverted from the landfill to a soil fabrication pilot project and a land application pilot project. There was a decrease in the amount of clean fill received in 2019, and there was a decrease in the amount of City compost removed from the site. In 2020, the BRRMF will compost organic materials as part of the curbside collection pilot program.

A summary of the BRRMF Waste Diversion Operations is provided in Table 1, the 2019 BRRMF Tonnage Spreadsheet is provided in Appendix B.



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**Table 1. 2019 BRRMF
Waste Diversion Summary**

	2015	2016	2017	2018	2019
Total Materials Received (a) = (b) + (c) + (d)	460,506	434,403	658,871	682,779	637,422
Materials Landfilled					
Biosolids	44,717	44,652	42,397	33,030	20,365
Residential Waste Collection	177,846	174,280	172,209	172,041	174,050
Miscellaneous Wastes (dead animals, asbestos, hospital waste, construction/demolition waste, etc...)	144,205	96,834	93,851	88,813	93,621
Wastes from 4R Depots	n/a	15,872	12,806	12,175	12,883
Wastes from City Operations (street cleaning refuse, grit, non-recyclables from recycling facility, etc...)	19,611	20,878	23,595	20,864	19,323
Wastes from Other Municipalities	3,594	4,729	3,505	20	0
Total Landfilled (b)	389,974	357,246	348,364	326,942	320,242
Materials Composted or Reused On Site					
Biosolids	3,939	1,899	4,942	1,541	1,916
Ceramic	n/a	164	245	296	331
Clean Fill	4,957	6,198	247,852	281,546	252,113
Compostable Materials (retention pond dredgings, street leaves, leaf and yard waste)	33,475	34,726	28,532	33,041	31,525
Concrete	362	1,338	2,801	5,187	6,565
Glass	9,339	11,534	11,181	12,338	10,965
Lumber	n/a	187	185	202	192
Sweepings (sand)	10,814	11,620	398	259	223
Trees and Wood Chips	6,442	7,521	8,860	7,080	5,168
Total Composted or Reused (c)	69,328	75,187	304,998	341,489	308,999
Materials Removed from Site*					
Batteries	0	24	33	49	74
Bicycles	n/a	13	11	6	9
City Compost	343	403	3,287	11,483	5,166
Dutch Elm	19	3	102	111	0
Electronics	n/a	375	530	570	665
Household Hazardous Waste	n/a	303	341	594	686
Mattresses	n/a	n/a	n/a	n/a	233
Oil	n/a	22	32	60	90
Oversized Plastics	n/a	15	22	52	43
Ozone-Containing Appliances	78	66	111	180	166
Recyclables	n/a	156	274	471	278
Scrap Metal	543	532	619	607	635
Tires	222	57	146	165	134
Total Removed from Site (d)	1,205	1,970	5,510	14,348	8,181
Diversion Rate = (c) + (d) / (a)	15%	18%	47%	52%	50%

* Materials removed from site are stockpiled until sufficient quantities are collected

BRADY ROAD RESOURCE MANAGEMENT FACILITY ANNUAL REPORT – 2019**5.0 GROUND WATER, SURFACE WATER, LEACHATE, AND LANDFILL GAS MONITORING**

5.1 GROUND WATER

The land beneath the BRRMF consists of three layers: the uppermost layer is clay (averaging 12 m in thickness), the second layer is till (averaging 6 m in thickness), and the lowest layer is bedrock. Ground water flows downwards through the clay and till layers into the bedrock aquifer, which flows in a north-east direction. The ground water in all three layers is saline and non-potable. The ground water monitoring system includes 34 nested wells: 13 bedrock wells, 13 till wells, and 8 clay wells. The locations of the ground water monitoring wells are shown on Figure 2.

As per the BRRMF Operating Plan, ground water is monitored in accordance with the Ground Water Sampling and Analysis Plan (SAP), as specified under Clause 123. Sampling frequency is twice per year for bedrock wells and downgradient till wells, and once per year for clay wells and other till wells distant from the waste areas. As neither Federal nor Manitoba Provincial Governments regulate non-potable ground water quality, the Ontario Ministry of Environment (MOE) guidelines for non-potable groundwater quality are used as the regulatory guideline (MOE, 2011).

In 2019, a total of 49 ground water samples were analyzed – 5 samples from wells upgradient of the site (background water quality), and 44 samples from wells crossgradient and downgradient of the site. There were no deviations from the Ground Water SAP or from normal sample collection and preservation practices. The majority of results met the guidelines with the exception of chloride in some till and bedrock wells, and hydrocarbons in two of the bedrock wells. The 2019 ground water results are provided in Tables 2.1-2.3.

The 2015-2019 average values are provided in Tables 3.1-3.3. Some variability from historical data was observed in some of the samples, this may be a statistical anomaly; we will continue to monitor these parameters to better evaluate trends.

Based on the Piper diagrams provided in Appendix C, the major ions in the ground water from the clay layer are calcium, magnesium, sulfate and bicarbonate. Sodium and chloride are the major ions in the bedrock aquifer. Ground water in the till layer is generally intermediate in brackishness and shows a gradual change with depth. The Piper diagrams display tight groupings of ground water sampling data, which is indicative of no significant ground water chemical changes.


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Time versus concentration graphs provided in Appendix D show the historical relationship of the analytical parameters at each monitoring location. In general, the analytical results for ground water obtained in 2019 were found to be similar to those obtained in 2015-2018, and are consistent with background levels.

The Contingency Action Plan identified under Clause 125 was not implemented in 2019.

At this time we have no recommendations for changes in the ground water monitoring program.

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			Table 2.1 2019 Ground Water Monitoring - Clay Wells								
					Upgradient	Downgradient and Crossgradient					
					GWQ25-6N60DR	GWQ25-5N62D	GWQ25-6N63E	GWQ25-6N57DR	GWQ25-6N67E	GWQ25-4N34B	GWQ25-4N34C
	Units	Criteria	Spring	Spring	Spring	Spring	Spring	Spring	Spring	Spring	
Inorganic Parameters											
Alkalinity - Bicarbonate	mg/L		530	464	493	481	464	566	808	NS	
Alkalinity - Carbonate	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	NS	
Alkalinity - Hydroxide	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	NS	
Alkalinity - Total	mg/L		530	464	493	481	464	566	808	NS	
Dissolved Hardness (CaCO3)	mg/L		1,720	2,720	2,620	2,170	1,810	1,840	2,050	NS	
pH	units		6.89	6.74	6.77	7.42	6.86	7.19	6.89	NS	
Specific Conductivity	(µS/cm)		4,800	8,750	7,200	6,230	4,880	7,140	5,530	NS	
Turbidity	(ntu)		24.3	8.1	25.6	17.6	14.3	24	164	NS	
Total Dissolved Solids	mg/L		3,880	6,610	5,620	5,050	3,750	6,270	13,400	NS	
Total Suspended Solids	mg/L		268	715	635	308	409	353	3,400	NS	
Total Solids	mg/L		4,150	7,320	6,260	5,350	4,160	6,630	16,800	NS	
Dissolved Chloride (Cl)	mg/L	2,300 *	570	1,550	1,120	780	620	1,280	1,050	NS	
Dissolved Sulphate (SO4)	mg/L		1,730	3,030	1,920	2,080	1,380	2,790	1,760	NS	
Nutrients											
Ammonia - Dissolved	mg/L N		0.005	0.397	0.388	0.050	0.617	<0.003	0.685	NS	
Nitrate - Dissolved	mg/L N		0.855	0.855	0.288	0.870	0.037	0.055	0.032	NS	
Total Kjeldahl Nitrogen	mg/L N		0.2	1.0	0.8	0.5	0.9	0.8	1.5	NS	
Phosphorus - Dissolved	mg/L P		<0.013	<0.013	<0.013	0.025	0.025	0.018	0.020	NS	
Other											
Cyanide - Total (CN)	ug/L	66	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	NS	
Organic Indicators											
Chemical Oxygen Demand	mg/L		32	101	66	50	33	54	630	NS	
Total Organic Carbon	mg/L		10.0	19.8	14.8	16.4	10.9	18.5	57.3	NS	
Metals											
Arsenic (As)- Dissolved	ug/L	1,900 *	0.48	0.87	0.66	0.52	0.44	0.76	1.30	NS	
Barium (Ba)- Dissolved	ug/L	29,000 *	8.10	14.3	12.8	9.29	9.36	8.91	10.3	NS	
Beryllium (Be)- Dissolved	ug/L	67 *	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	NS	
Cadmium (Cd)- Dissolved	ug/L	2.7 *	0.0465	0.118	0.101	0.116	0.328	0.110	0.158	NS	
Calcium (Ca)- Dissolved	mg/L		579	914	757	676	521	774	542	NS	
Chromium (Cr)- Dissolved	ug/L	810 *	<0.10	0.11	<0.10	<0.10	0.14	0.21	0.10	NS	
Copper (Cu)- Dissolved	ug/L	87 *	1.40	2.04	1.51	2.18	2.19	3.34	1.12	NS	
Iron (Fe)- Dissolved	ug/L		<10	<10	<10	<10	<10	13	317	NS	
Lead (Pb)- Dissolved	ug/L	25 *	<0.050	<0.050	<0.050	0.059	0.060	0.051	<0.050	NS	
Magnesium (Mg)- Dissolved	mg/L		212	341	309	253	222	629	249	NS	
Manganese (Mn)- Dissolved	ug/L		860	2,300	2,290	2,210	711	135	1,620	NS	
Mercury (Hg)- Total	ug/L	2.8 *	<0.0050	<0.0050	0.0060	<0.0050	<0.50	0.0070	0.38	NS	
Nickel (Ni)- Dissolved	ug/L	490 *	6.67	10.8	11.5	9.98	6.83	11.3	7.91	NS	
Potassium (K)- Dissolved	mg/L		10.2	14.7	12.1	11.5	9.65	10.7	9.93	NS	
Selenium (Se)- Dissolved	ug/L	63 *	0.135	0.155	0.188	0.305	0.188	66.9	3.58	NS	
Silver (Ag)- Dissolved	ug/L	1.5 *	0.010	0.017	0.015	0.019	0.022	0.035	0.011	NS	
Sodium (Na)- Dissolved	mg/L	2,300 *	332	831	654	593	323	461	435	NS	
Zinc (Zn)- Dissolved	ug/L	1,100 *	4.5	7.3	5.7	6.1	6.1	2.5	5.1	NS	
Field Parameters											
pH	units		7.44	7.55	7.04	7.85	8.05	7.65	7.86	NS	
Specific Conductivity	(µS/cm)		4,050	7,410	6,300	5,140	4,330	4,860	3,730	NS	
Polycyclic Aromatic Hydrocarbons											
Naphthalene	ug/L	6,400	<0.050								
Benzo(a)pyrene	ug/L	0.81	<0.0050								
Anthracene	ug/L	2.4	<0.010								
Petroleum Hydrocarbons											
F1 (C6-C10 Hydrocarbons)	ug/L	750	<100								
F2 (C10-C16 Hydrocarbons)	ug/L	150	<100								
F3 (C16-C34 Hydrocarbons)	ug/L	500	<250								
F4 (C34-C50 Hydrocarbons)	ug/L	500	<250								
Benzene	µg/L	430	<0.50								
EthylBenzene	µg/L	2,300	<0.50								
Toluene	µg/L	18,000	<0.50								
Xylene (Total)	µg/L	4,200 *	<0.50								
Volatile Organic Carbons											
Vinyl chloride	µg/L	1.7	<0.50								
Pesticides											
Diazinon	µg/L		<0.10								
Herbicides											
2,4-D	ug/L		<0.10								

Note: Criteria from Ontario Ministry of the Environment. (2011, July 1). Soil, Ground Water and Sediment Standards for Use Under Part XV.I of the *Environmental Protection Act* Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition
 * Criteria for total chloride, total metals and xylene mixture
 NS - Sampled every other year

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Table 2.2 2019 Ground Water Monitoring - Till Wells

	Units	Criteria	Upgradient		Downgradient and Crossgradient									
			GWQ25-6N60ER		GWQ25-5N62E		GWQ25-W13A		GWQ25-W14A		GWQ25-W15A		GWQ25-W16A	
			Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn
Inorganic Parameters														
Alkalinity - Bicarbonate	mg/L		576	631	357	525	627	1,790	594	568	2,670	3,580	399	422
Alkalinity - Carbonate	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Alkalinity - Hydroxide	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Alkalinity - Total	mg/L		576	631	357	525	627	1,790	594	568	2,670	3,580	399	422
Dissolved Hardness (CaCO3)	mg/L		1,440	1,580	1,910	2,460	3,080	4,590	4,170	2,360	5,160	12,200	1,510	1,800
pH	units		6.93	6.92	7.37	7.40	7.15	7.25	7.45	7.41	6.78	6.84	7.03	6.92
Specific Conductivity	(µS/cm)		4,340	4,200	8,540	8,520	8,330	8,280	8,470	8,520	6,780	6,840	5,380	5,370
Turbidity	(ntu)		219	275	1410	3,025	1290	7,500	96.9	1,330	7600	335	178.4	21,950
Total Dissolved Solids	mg/L		3,360	3,240	5,560	5,180	8,060	5,070	3,540	5,100	2,160	370	4,270	3,700
Total Suspended Solids	mg/L		760	999	2,410	3,770	5,500	10,200	9,480	8,460	35,350	36,550	513	1,080
Total Solids	mg/L		4,120	4,240	7,970	8,950	13,600	15,300	13,000	3,360	37,500	36,900	4,790	4,780
Dissolved Chloride (Cl)	mg/L	2,300 *	520	351	1,720	2,430	3,060	2,220	3,010	2,370	1,360	1,890	990	1,080
Dissolved Sulphate (SO4)	mg/L		1,560	1,190	1,990	810	650	879	650	819	1,860	1,440	1,010	1,050
Nutrients														
Ammonia - Dissolved	mg/L N		0.348	0.424	1.01	0.970	0.922	0.951	1.05	1.06	0.845	0.945	0.737	0.759
Nitrate - Dissolved	mg/L N		0.222	0.189	0.003	0.061	0.122	0.035	<0.003	0.004	0.024	<0.003	0.067	0.105
Total Kjeldahl Nitrogen	mg/L N		0.5	0.9	1.2	1.5	1.2	1.5	1.4	1.7	2.5	3.0	1.1	1.5
Phosphorus - Dissolved	mg/L P		<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	0.053	<0.013	<0.013	0.013
Other														
Cyanide - Total (CN)	ug/L	66	<1.0		<1.0	1.2	<1.0		<1.0		<1.0		1.1	
Organic Indicators														
Chemical Oxygen Demand	mg/L		39	46	100	140	300	380	345	136	1,290	1,700	52	78
Total Organic Carbon	mg/L		9.6	9.2	3.5	4.7	27.3	7.0	32.7	5.0	61.3	46.1	7.2	9.7
Metals														
Arsenic (As)- Dissolved	ug/L	1,900 *	0.98	1.24	2.54	4.63	3.27	1.18	4.51	6.58	0.89	1.12	1.43	0.96
Barium (Ba)- Dissolved	ug/L	29,000 *	7.69	8.38	11.2	12.0	13.2	11.2	13.1	10.9	12.6	13.3	11.4	13.0
Beryllium (Be)- Dissolved	ug/L	67 *	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	2.7 *	0.0199	0.0941	0.0077	0.0124	0.0186	0.0236	0.0107	<0.0050	0.0317	0.0290	0.103	0.176
Calcium (Ca)- Dissolved	mg/L		430	434	338	319	442	532	337	388	782	843	530	536
Chromium (Cr)- Dissolved	ug/L	810 *	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Copper (Cu)- Dissolved	ug/L	87 *	1.42	1.29	<0.20	<0.20	<0.20	0.35	<0.20	0.21	0.28	<0.20	0.43	0.22
Iron (Fe)- Dissolved	ug/L		<10	38	445	502	387	169	<10	615	396	1,310	18.0	35
Lead (Pb)- Dissolved	ug/L	25 *	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium (Mg)- Dissolved	mg/L		184	206	173	182	206	202	175	153	270	241	209	190
Manganese (Mn)- Dissolved	ug/L		1,240	1,090	71.8	58.1	245	322	122	219	1,650	2,240	850	914
Mercury (Hg)- Total	ug/L	2.8 *	0.0230	0.0150	<0.025	<0.0050	0.130	<0.0050	0.130	0.140	0.36	<0.0050	<0.0050	0.0050
Nickel (Ni)- Dissolved	ug/L	490 *	7.93	7.88	1.17	1.23	2.39	3.12	1.54	1.89	7.43	9.61	5.61	6.61
Potassium (K)- Dissolved	mg/L		8.29	8.94	34.2	36.4	22.3	19.8	33.0	29.6	14.4	13.2	10.7	11.2
Selenium (Se)- Dissolved	ug/L	63 *	0.104	0.053	<0.050	<0.050	<0.050	2.70	<0.050	<0.050	0.104	0.174	0.064	0.130
Silver (Ag)- Dissolved	ug/L	1.5 *	<0.010	0.025	0.011	0.032	0.013	<0.010	0.038	<0.010	0.020	<0.010	0.012	<0.010
Sodium (Na)- Dissolved	mg/L	2,300 *	370	372	1,310	1,380	1,110	1,040	1,320	1,250	606	616	474	469
Zinc (Zn)- Dissolved	ug/L	1,100 *	3.4	3.8	2.3	1.8	2.0	1.9	<1.0	1.3	3.7	4.8	4.0	5.0
Field Parameters														
pH	units		7.65	7.52	7.92	8.18	7.76	7.88	8.03	8.23	7.22	7.78	7.70	7.78
Specific Conductivity	(µS/cm)		3,800	5,500	7,660	6,980	5,530	6,460	5,850	4,900	6,080	5,710	4,760	4,430
Polycyclic Aromatic Hydrocarbons														
Naphthalene	ug/L	6,400	<0.050		<0.050		<0.050		<0.050		<0.050		<0.050	
Benzo(a)pyrene	ug/L	0.81	<0.0050		<0.0050		<0.0050		<0.0050		<0.0050		<0.0050	
Anthracene	ug/L	2.4	<0.010		<0.010		<0.010		<0.010		<0.010		<0.010	
Petroleum Hydrocarbons														
F1 (C6-C10 Hydrocarbons)	ug/L	750	<100		<100		<100		<100		<100		<100	
F2 (C10-C16 Hydrocarbons)	ug/L	150	<100		<100		<100		<100		<100		<100	
F3 (C16-C34 Hydrocarbons)	ug/L	500	<250		<250		<250		<250		<250		<250	
F4 (C34-C50 Hydrocarbons)	ug/L	500	<250		<250		<250		<250		<250		<250	
Benzene	µg/L	430	<0.50		<0.50		<0.50		<0.50		<0.50		<0.50	
EthylBenzene	µg/L	2,300	<0.50		<0.50		<0.50		<0.50		<0.50		<0.50	
Toluene	µg/L	18,000	<0.50		<0.50		<0.50		<0.50		<0.50		<0.50	
Xylene (Total)	µg/L	4,200 *	<0.50		<0.50		<0.50		<0.50		<0.50		<0.50	
Volatile Organic Carbons														
Vinyl chloride	µg/L	1.7	<0.50		<0.50		<0.50		<0.50		<0.50		<0.50	
Pesticides														
Diazinon	µg/L		<0.10		<0.10		<0.10		<0.10		<0.10		<0.10	
Herbicides														
2,4-D	ug/L		<0.10		<0.10		<0.10		<0.10		<0.10		<0.10	

Note: Criteria from Ontario Ministry of the Environment. (2011, July 1). Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition
 * Criteria for total chloride, total metals and xylene mixture

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Table 2.2 2019 Ground Water Monitoring - Till Wells

			Downgradient and Crossgradient						
	Units	Criteria	GWQ25-6N63F	GWQ25-6N57F	GWQ25-6N67F	GWQ25-4N34DR	GWQ25-6N58DR	GWQ25-6N58F	GWQ25-6N59F
			Spring	Spring	Spring	Spring	Spring	Spring	Spring
Inorganic Parameters									
Alkalinity - Bicarbonate	mg/L		899	748	397	524	NS	NS	NS
Alkalinity - Carbonate	mg/L		<3.0	<3.0	<3.0	<3.0	NS	NS	NS
Alkalinity - Hydroxide	mg/L		<3.0	<3.0	<3.0	<3.0	NS	NS	NS
Alkalinity - Total	mg/L		899	748	397	524	NS	NS	NS
Dissolved Hardness (CaCO3)	mg/L		3,440	2,530	1,270	1,620	NS	NS	NS
pH	units		6.91	7.12	6.98	7.04	NS	NS	NS
Specific Conductivity	(µS/cm)		6,690	6,130	4,540	6,290	NS	NS	NS
Turbidity	(ntu)		1570	11.2	390	51.5	NS	NS	NS
Total Dissolved Solids	mg/L		4,480	3,820	3,320	5,530	NS	NS	NS
Total Suspended Solids	mg/L		5,940	6,040	548	2,940	NS	NS	NS
Total Solids	mg/L		10,400	9,860	3,870	8,470	NS	NS	NS
Dissolved Chloride (Cl)	mg/L	2,300 *	340	1,040	730	760	NS	NS	NS
Dissolved Sulphate (SO4)	mg/L		1,030	1,450	990	780	NS	NS	NS
Nutrients									
Ammonia - Dissolved	mg/L N		0.809	0.899	0.629	0.443	NS	NS	NS
Nitrate - Dissolved	mg/L N		<0.003	<0.003	0.054	0.192	NS	NS	NS
Total Kjeldahl Nitrogen	mg/L N		1.0	1.3	0.7	0.9	NS	NS	NS
Phosphorus - Dissolved	mg/L P		<0.013	0.023	0.022	<0.013	NS	NS	NS
Other									
Cyanide - Total (CN)	ug/L	66	<1.0	1.0	<1.0	<1.0			NS
Organic Indicators									
Chemical Oxygen Demand	mg/L		185	180	27	39	NS	NS	NS
Total Organic Carbon	mg/L		12.5	19.0	6.4	10.5	NS	NS	NS
Metals									
Arsenic (As)- Dissolved	ug/L	1,900 *	2.12	9.87	1.29	2.09	NS	NS	NS
Barium (Ba)- Dissolved	ug/L	29,000 *	10.3	9.50	10.2	10.7	NS	NS	NS
Beryllium (Be)- Dissolved	ug/L	67 *	<0.10	<0.10	<0.10	<0.10	NS	NS	NS
Cadmium (Cd)- Dissolved	ug/L	2.7 *	0.0062	0.0086	0.0155	0.0182	NS	NS	NS
Calcium (Ca)- Dissolved	mg/L		527	485	407	457	NS	NS	NS
Chromium (Cr)- Dissolved	ug/L	810 *	<0.10	<0.10	<0.10	<0.10	NS	NS	NS
Copper (Cu)- Dissolved	ug/L	87 *	0.23	<0.20	0.29	0.59	NS	NS	NS
Iron (Fe)- Dissolved	ug/L		1,450	1,430	12	125	NS	NS	NS
Lead (Pb)- Dissolved	ug/L	25 *	<0.050	<0.050	<0.050	<0.050	NS	NS	NS
Magnesium (Mg)- Dissolved	mg/L		314	219	231	468	NS	NS	NS
Manganese (Mn)- Dissolved	ug/L		221	505	191	62.4	NS	NS	NS
Mercury (Hg)- Total	ug/L	2.8 *	0.0050	0.070	<0.0050	0.0250	NS	NS	NS
Nickel (Ni)- Dissolved	ug/L	490 *	3.75	5.22	3.85	5.08	NS	NS	NS
Potassium (K)- Dissolved	mg/L		11.1	13.5	9.18	16.2	NS	NS	NS
Selenium (Se)- Dissolved	ug/L	63 *	<0.050	<0.050	<0.050	0.115	NS	NS	NS
Silver (Ag)- Dissolved	ug/L	1.5 *	0.032	0.024	0.077	0.013	NS	NS	NS
Sodium (Na)- Dissolved	mg/L	2,300 *	570	638	305	598	NS	NS	NS
Zinc (Zn)- Dissolved	ug/L	1,100 *	1.3	2.2	2.2	2.6	NS	NS	NS
Field Parameters									
pH	units		7.80	7.65	7.50	7.74	NS	NS	NS
Specific Conductivity	(µS/cm)		5,710	5,140	4,330	4,600	NS	NS	NS
Polycyclic Aromatic Hydrocarbons									
Naphthalene	ug/L	6,400				<0.050			
Benzo(a)pyrene	ug/L	0.81				<0.0050			
Anthracene	ug/L	2.4				<0.010			
Petroleum Hydrocarbons									
F1 (C6-C10 Hydrocarbons)	ug/L	750				<100			
F2 (C10-C16 Hydrocarbons)	ug/L	150				<100			
F3 (C16-C34 Hydrocarbons)	ug/L	500				<250			
F4 (C34-C50 Hydrocarbons)	ug/L	500				<250			
Benzene	µg/L	430				<0.50			
Ethylbenzene	µg/L	2,300				<0.50			
Toluene	µg/L	18,000				<0.50			
Xylene (Total)	µg/L	4,200 *				<0.50			
Volatile Organic Carbons									
Vinyl chloride	µg/L	1.7				<0.50			
Pesticides									
Diazinon	µg/L					<0.10			
Herbicides									
2,4-D	ug/L					<0.10			

Note: Criteria from Ontario Ministry of the Environment. (2011, July 1). Soil, Ground Water and Sediment Standards for Use Under Part XV.I of the Environmental Protection Act Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition
 * Criteria for total chloride, total metals and xylene mixture
 NS - Sampled every other year

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Table 2.3 2019 Ground Water Monitoring - Bedrock Wells

	Units	Criteria	Upgradient		Downgradient and Crossgradient											
			GWQ25-W6		GWQ25-W8		GWQ25-W11		GWQ25-W13		GWQ25-W14		GWQ25-W15		GWQ25-W16	
			Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn
Inorganic Parameters																
Alkalinity - Bicarbonate	mg/L		161	138	144	137	137	131	376	205	144	126	146	145	154	156
Alkalinity - Carbonate	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Alkalinity - Hydroxide	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Alkalinity - Total	mg/L		161	138	144	137	137	131	376	205	144	126	146	145	154	156
Dissolved Hardness (CaCO3)	mg/L		936	1,060	830	925	757	843	1,060	1,290	797	849	788	1,090	905	1,190
pH	units		7.51	7.64	7.39	7.59	7.54	7.58	7.22	7.25	7.38	7.55	7.48	7.48	7.51	7.49
Specific Conductivity	(µS/cm)		10,100	10,100	8,920	8,700	8,740	8,590	8,580	8,420	8,830	8,180	8,270	7,960	8,180	7,970
Turbidity	(ntu)		5.97	7.58	1.40	1.59	1.46	1.81	1.01	1.12	1.15	4.38	2.41	17.9	37.6	87.2
Total Dissolved Solids	mg/L		6,190	6,250	5,230	5,220	5,120	5,140	5,000	5,110	5,110	4,760	4,920	4,720	4,900	4,730
Total Suspended Solids	mg/L		529	272	544	244	329	348	656	663	445	219	350	570	563	822
Total Solids	mg/L		6,720	6,530	5,780	5,460	5,450	5,490	5,650	5,780	5,550	4,980	5,270	5,290	5,460	5,550
Dissolved Chloride (Cl)	mg/L	2,300 *	3,280	430	2,300	2,440	2,740	2,400	2,500	2,250	3,000	2,280	2,370	2,550	2,480	2,520
Dissolved Sulphate (SO4)	mg/L		770	895	688	634	788	865	673	835	651	703	570	790	590	791
Nutrients																
Ammonia - Dissolved	mg/L N		1.42	1.45	1.11	1.140	1.06	1.11	1.09	1.13	1.04	0.034	0.974	1.08	0.980	1.09
Nitrate - Dissolved	mg/L N		<0.003	<0.003	<0.003	<0.003	0.003	<0.003	<0.003	<0.003	0.008	0.683	<0.003	0.031	<0.003	0.080
Total Kjeldahl Nitrogen	mg/L N		1.8	2.1	1.4	1.7	1.3	1.3	1.5	1.5	1.4	0.4	1.2	1.5	1.2	1.9
Phosphorus - Dissolved	mg/L P		<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013
Other																
Cyanide - Total (CN)	ug/L	66	<1.0	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	<1.0
Organic Indicators																
Chemical Oxygen Demand	mg/L		113	122	77	88	72	89	74	85	70	87	75	82	75	92
Total Organic Carbon	mg/L		1.7	2.1	3.2	1.7	2.2	0.5	4.9	1.8	2.9	1.1	4.5	1.6	3.5	1.9
Metals																
Arsenic (As)- Dissolved	ug/L	1,900 *	0.82	0.91	3.61	0.45	5.43	5.99	3.54	0.72	2.88	0.75	1.87	1.94	1.29	1.42
Barium (Ba)- Dissolved	ug/L	29,000 *	14.6	15.2	65.0	61.7	13.2	14.8	24.4	25.1	18.5	19.0	30.2	28.9	17.1	17.6
Beryllium (Be)- Dissolved	ug/L	67 *	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	2.7 *	0.119	0.160	0.0051	0.0168	<0.0050	<0.0050	0.197	2.270	0.0183	0.0373	0.0342	0.0472	0.0704	0.107
Calcium (Ca)- Dissolved	mg/L		364	341	776	817	315	284	351	309	255	251	102	118.0	312	279
Chromium (Cr)- Dissolved	ug/L	810 *	0.52	0.51	50.4	54.9	<0.10	<0.10	1.32	0.85	0.13	<0.10	0.21	0.18	0.35	0.21
Copper (Cu)- Dissolved	ug/L	87 *	5.23	2.00	3.27	3.39	<0.20	<0.20	0.74	6.62	2.89	2.19	11.9	8.56	6.76	2.95
Iron (Fe)- Dissolved	ug/L		<10	<10	<10	<10	914	501	191	23.0	<10	<10	<10	11.0	<10	<10
Lead (Pb)- Dissolved	ug/L	25 *	0.163	<0.050	0.215	0.491	0.051	<0.50	<0.050	<0.50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium (Mg)- Dissolved	mg/L		150	182	0.888	0.446	152	120	148	125	108	140	169	236	174	173
Manganese (Mn)- Dissolved	ug/L		37.8	37.4	0.20	<0.10	15	30.9	81.7	61.9	14.5	14.8	10.4	9.06	50.1	50.8
Mercury (Hg)- Total	ug/L	2.8 *	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nickel (Ni)- Dissolved	ug/L	490 *	2.97	2.80	0.65	<0.50	1.37	0.60	1.98	3.97	0.83	0.55	7.18	8.22	2.77	2.75
Potassium (K)- Dissolved	mg/L		47.4	50.6	20.1	22.7	40.2	37.7	24.5	20.1	35.5	40.8	10.7	10.3	32.0	32.8
Selenium (Se)- Dissolved	ug/L	63 *	0.053	<0.050	0.747	0.657	<0.050	<0.050	0.568	<0.050	0.052	<0.050	1.10	1.71	0.174	0.505
Silver (Ag)- Dissolved	ug/L	1.5 *	0.016	0.012	0.016	0.011	0.011	<0.010	<0.010	<0.010	0.028	0.011	<0.010	<0.010	0.043	0.020
Sodium (Na)- Dissolved	mg/L	2,300 *	1,740	1,760	596	663	1,520	1,440	989	864	1,270	1,410	131	196	1,190	1,220
Zinc (Zn)- Dissolved	ug/L	1,100 *	38.3	65.3	1.5	4.1	<1.0	<1.0	1.6	161	9.6	20.7	14.6	21.2	28.9	35.0
Bacteria																
Total Coliforms (MTF)	MPN/100mL		<1	1	<1	<1	<1	<1	25	<1	<1	<1	4	<1	<1	<1
Fecal Coliforms (MTF)	MPN/100mL		<1	<1	<1	<1	<1	<1	1	<1	<1	<1	12	<1	2	<1
E. coli (MTF)	MPN/100mL		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Field Parameters																
pH	units		7.78	7.76	7.78	7.04	8.30	7.98	7.96	7.71	7.84	7.79	7.20	6.86	6.70	6.86
Specific Conductivity	(µS/cm)		8,690	7,740	7,730	6,810	7,530	7,370	7,180	7,050	7,460	6,740	5,480	6,440	5,850	6,510
Polycyclic Aromatic Hydrocarbons																
Naphthalene	ug/L	6,400	<0.050	<0.050	0.161	<0.050	<0.050	<0.050	0.062	<0.050	<0.050	<0.050	<0.050	0.07	<0.050	<0.050
Benzo(a)pyrene	ug/L	0.81	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	ug/L	2.4	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Petroleum Hydrocarbons																
F1 (C6-C10 Hydrocarbons)	ug/L	750	<100	<100	<100	<100	<100	<100	<100	120	<100	<100	<100	<100	<100	<100
F2 (C10-C16 Hydrocarbons)	ug/L	150	<100	<100	110	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
F3 (C16-C34 Hydrocarbons)	ug/L	500	<250	<250	<250	260	<250	<250	<250	<250	<250	<250	310	380	<250	<250
F4 (C34-C50 Hydrocarbons)	ug/L	500	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	280	620	<250	<250
Benzene	µg/L	430	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
EthylBenzene	µg/L	2,300	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Toluene	µg/L	18,000	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Xylene (Total)	µg/L	4,200 *	<0.50	<0.64	<0.50	<0.64	<0.50	<0.64	<0.50	<0.64	<0.50	<0.64	<0.50	<0.64	<0.50	<0.64
Volatile Organic Carbons																
Vinyl chloride	µg/L	1.7	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Pesticides																
Diazinon	µg/L		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Herbicides																
2,4-D	ug/L		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Note: Criteria from Ontario Ministry of the Environment. (2011, July 1). Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition
* Criteria for total chloride, total metals and xylene mixture

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Table 2.3 2019 Ground Water Monitoring - Bedrock Wells

			Downgradient and Crossgradient											
			GWQ25-W9		GWQ25-W10		GWQ25-W7		GWQ25-W12		GWQ25-W4		GWQ25-W5	
	Units	Criteria	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn
Inorganic Parameters														
Alkalinity - Bicarbonate	mg/L		144	138	140	133	334	126	147	139	74.5	63.5	128	133
Alkalinity - Carbonate	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Alkalinity - Hydroxide	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Alkalinity - Total	mg/L		144	138	140	133	334	126	147	139	74.5	63.5	128	133
Dissolved Hardness (CaCO3)	mg/L		877	916	845	888	664	739	866	941	535	553	842	947
pH	units		7.41	7.42	7.50	7.43	7.69	7.82	7.47	7.52	7.62	7.88	7.56	7.44
Specific Conductivity	(µS/cm)		9,790	9,680	9,210	9,040	6,980	6,970	9,020	8,970	7,430	7,300	8,380	8,290
Turbidity	(ntu)		2.76	9.91	2.22	2.93	13.4	7.94	4.76	3.39	3.73	33.3	10.8	13.0
Total Dissolved Solids	mg/L		5,920	5,880	5,480	5,460	4,010	3,980	5,380	5,430	4,110	4,160	4,880	5,080
Total Suspended Solids	mg/L		364	416	396	396	512	282	349	300	1,400	271	522	439
Total Solids	mg/L		6,280	6,300	5,880	5,850	4,520	4,260	5,730	5,730	5,510	4,430	5,400	5,510
Dissolved Chloride (Cl)	mg/L	2,300 *	25.3	2,540	3,350	1,330	2,130	316	2,780	2,490	2,460	2,000	3,580	1,910
Dissolved Sulphate (SO4)	mg/L		790	68	750	833	649	634	710	873	546	901	990	6.6
Nutrients														
Ammonia - Dissolved	mg/L N		1.3	1.39	1.24	1.24	1.88	1.89	1.14	1.12	0.761	0.821	0.976	1.04
Nitrate - Dissolved	mg/L N		<0.003	<0.003	<0.003	<0.003	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Total Kjeldahl Nitrogen	mg/L N		1.5	1.8	1.5	1.7	2.4	2.7	1.2	1.7	0.9	0.9	1.2	1.3
Phosphorus - Dissolved	mg/L P		<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013
Other														
Cyanide - Total (CN)	ug/L	66	<1.0	<1.0	<1.0		<1.0		<1.0		<1.0	<1.0	<1.0	
Organic Indicators														
Chemical Oxygen Demand	mg/L		105	104	90	96	66	64	86	94	63	70	70	76
Total Organic Carbon	mg/L		2.9	1.3	2.4	1.7	3.2	1.1	4.6	1.7	1.6	1.4	2.7	1.6
Metals														
Arsenic (As)- Dissolved	ug/L	1,900 *	7.14	7.11	5.77	5.60	0.33	0.48	4.68	12	0.72	0.44	4.56	5.74
Barium (Ba)- Dissolved	ug/L	29,000 *	11.5	12.2	14.4	13.2	48.0	46.8	12.3	18	10.5	10.6	13.5	14.3
Beryllium (Be)- Dissolved	ug/L	67 *	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	2.7 *	<0.0050	<0.0050	0.0051	<0.0050	0.0167	0.0157	<0.0050	<0.50	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)- Dissolved	mg/L		325	329	281	338	384	348	322	325	187	181	317	311
Chromium (Cr)- Dissolved	ug/L	810 *	<0.10	<0.10	<0.10	<0.10	20.9	19.70	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Copper (Cu)- Dissolved	ug/L	87 *	<0.20	<0.20	<0.20	<0.20	2.14	1.16	<0.20	46	<0.20	<0.20	<0.20	0.21
Iron (Fe)- Dissolved	ug/L		884	899	484	904	<10	30	577	<1000	2,930	2,170	559	770
Lead (Pb)- Dissolved	ug/L	25 *	<0.050	<0.50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.063	<0.050	<0.050	<0.050
Magnesium (Mg)- Dissolved	mg/L		170	152	138	161	23.4	34.9	163	168	102	101	171	171
Manganese (Mn)- Dissolved	ug/L		21.7	22.0	29.9	14.7	0.43	0.85	32.0	63	34.2	26.3	22.4	35.6
Mercury (Hg)- Total	ug/L	2.8 *	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nickel (Ni)- Dissolved	ug/L	490 *	1.41	1.62	0.56	1.37	0.63	<0.50	1.34	<0.50	<0.50	<0.50	1.08	1.50
Potassium (K)- Dissolved	mg/L		39.9	39.2	37.0	41.1	23.8	25.8	37.4	36.9	30.2	28.8	35.8	34.7
Selenium (Se)- Dissolved	ug/L	63 *	<0.050	<0.050	<0.050	<0.050	0.092	0.061	<0.050	<0.050	<0.050	0.096	0.055	<0.050
Silver (Ag)- Dissolved	ug/L	1.5 *	0.012	<0.010	0.011	0.045	<0.010	<0.010	0.011	<1.0	0.075	0.011	<0.010	0.019
Sodium (Na)- Dissolved	mg/L	2,300 *	1,590	1,570	1,320	1,500	750	786	1,400	1,390	1,250	1,320	1,330	1,390
Zinc (Zn)- Dissolved	ug/L	1,100 *	1.2	<1.0	<1.0	<1.0	4.7	3.20	1.6	<100	1.8	<1.0	3.1	47.1
Bacteria														
Total Coliforms (MTF)	MPN/100mL		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Fecal Coliforms (MTF)	MPN/100mL		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
E. coli (MTF)	MPN/100mL		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Field Parameters														
pH	units		8.40	8.01	8.00	8.25	NR	8.05	8.20	6.82	8.61	8.43	8.15	8.01
Specific Conductivity	(µS/cm)		8,590	8,140	8,070	7,610	5,870	5,430	7,880	6,880	5,890	6,390	7,110	7,060
Polycyclic Aromatic Hydrocarbons														
Naphthalene	ug/L	6,400	<0.050	<0.050	<0.050		0.135		<0.050		0.068	<0.050	<0.050	
Benzo(a)pyrene	ug/L	0.81	<0.0050	<0.0050	<0.0050		<0.0050		<0.0050		<0.0050	<0.0050	<0.0050	
Anthracene	ug/L	2.4	<0.010	<0.010	<0.010		<0.010		<0.010		<0.010	<0.010	<0.010	
Petroleum Hydrocarbons														
F1 (C6-C10 Hydrocarbons)	ug/L	750	<100	<100	<100		<100		<100		<100	<100	290	
F2 (C10-C16 Hydrocarbons)	ug/L	150	<100	<100	<100		190		<100		<100	<100	<	

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Table 3.1 2019 Ground Water Quality Comparison - Clay Wells

	Units	Criteria	2016		2017		2018		2019	
			Average		Average		Average		Average	
			Upgradient	Downgradient	Upgradient	Downgradient	Upgradient	Downgradient	Upgradient	Downgradient
Inorganic Parameters										
Alkalinity - Bicarbonate	mg/L		625	642	621	603	539	585	530	546
Alkalinity - Carbonate	mg/L		<0.50	<0.50	<0.50	<0.50	<3.0	<3.0	<3.0	<3.0
Alkalinity - Hydroxide	mg/L		<0.50	<0.50	<0.50	<0.50	<3.0	<3.0	<3.0	<3.0
Alkalinity - Total	mg/L		512	526	509	495	539	585	530	546
Dissolved Hardness (CaCO ₃)	mg/L		2,260	2,666	2,120	2,558	2,325	3,065	1,720	2,202
pH	units		6.96	6.97	7.04	6.97	6.81	6.80	6.89	6.98
Specific Conductivity	(µS/cm)		4,560	5,996	4,780	6,386	4,820	6,463	4,800	6,622
Turbidity	(ntu)		40.4	504	91.8	6,463	116	535	24.3	42.2
Total Dissolved Solids	mg/L		3,960	4,967	3,840	4,720	3,890	5,076	3,880	6,783
Total Suspended Solids	mg/L		310	1,247	500	8,842	280	1,357	268	970
Total Solids	mg/L		4,270	6,214	4,340	13,562	4,170	6,433	4,150	7,753
Dissolved Chloride (Cl)	mg/L	2,300 *	450	927	470	990	474	948	570	1,067
Dissolved Sulphate (SO ₄)	mg/L		2,000	1,959	1,670	1,738	1,750	1,911	1,730	2,160
Nutrients										
Ammonia - Dissolved	mg/L N		<0.003	0.156	0.175	0.584	0.129	0.646	0.005	0.356
Nitrate - Dissolved	mg/L N		13.0	0.680	0.630	0.426	0.635	0.337	0.855	0.356
Total Kjeldahl Nitrogen	mg/L N		2.0	1.6	0.7	1.2	0.4	0.9	0.2	0.9
Phosphorus - Dissolved	mg/L P		0.180	0.012	<0.010	0.020	<0.010	<0.010	<0.013	0.017
Other										
Cyanide - Total (CN)	ug/L	66	NR	NR	NR	NR	NR	NR	<1.0	<1.0
Organic Indicators										
Chemical Oxygen Demand	mg/L		44	122	50	792	40	69	32	156
Total Organic Carbon	mg/L		10.6	22.0	10.8	19.6	29.1	17.7	10.0	23.0
Metals										
Arsenic (As)- Dissolved	ug/L	1,900 *	0.39	0.73	0.36	0.72	0.53	0.80	0.48	0.76
Barium (Ba)- Dissolved	ug/L	29,000 *	9.1	12.5	8.7	11.8	8.7	13.3	8.1	10.8
Beryllium (Be)- Dissolved	ug/L	67 *	0.015	0.008	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	2.7 *	0.068	0.181	0.052	0.216	0.215	0.211	0.047	0.155
Calcium (Ca)- Dissolved	mg/L		572	646	540	637	575	713	579	697
Chromium (Cr)- Dissolved	ug/L	810 *	<0.10	0.08	<1.0	<1.0	0.13	0.43	<0.10	0.11
Copper (Cu)- Dissolved	ug/L	87 *	1.98	2.74	1.63	2.26	2.07	8.60	1.40	2.06
Iron (Fe)- Dissolved	ug/L		3.8	14	23	91	<10	115	<10	58
Lead (Pb)- Dissolved	ug/L	25 *	0.037	0.053	0.103	0.098	<0.050	0.343	<0.050	<0.050
Magnesium (Mg)- Dissolved	mg/L		201	256	187	235	216	312	212	334
Manganese (Mn)- Dissolved	ug/L		1,720	1,412	1,590	1,866	1,860	2,027	860	1,544
Mercury (Hg)- Total	ug/L	2.8 *	<0.010	<0.010	<0.002	<0.002	<0.005	0.061	<0.0050	0.071
Nickel (Ni)- Dissolved	ug/L	490 *	7.0	9.5	6.4	9.9	7.2	12.8	6.7	9.7
Potassium (K)- Dissolved	mg/L		9.7	10.9	9.2	10.1	10.9	14.0	10.2	11.4
Selenium (Se)- Dissolved	ug/L	63 *	0.18	0.27	<0.40	<0.40	0.13	0.23	0.14	11.89
Silver (Ag)- Dissolved	ug/L	1.5 *	<0.005	<0.005	<0.050	<0.050	<0.010	<0.010	0.010	0.020
Sodium (Na)- Dissolved	mg/L	2,300 *	336	485	325	534	345	582	332	550
Zinc (Zn)- Dissolved	ug/L	1,100 *	3.6	5.7	5.5	7.7	6.2	15.5	4.5	5.5
Field Parameters										
pH	units		7.36	7.38	7.84	7.78	7.02	7.19	7.44	7.67
Specific Conductivity	(µS/cm)		2,330	3,271	4,010	5,248	4,330	5,986	4,050	5,295
Polycyclic Aromatic Hydrocarbons										
Naphthalene	µg/L	6,400	<0.050	NR	NR	NR	<0.050	<0.050	<0.050	
Benzo(a)pyrene	µg/L	0.81	<0.010	NR	NR	NR	<0.0050	<0.0050	<0.0050	
Anthracene	µg/L	2.4	<0.050	NR	NR	NR	<0.010	<0.010	<0.010	
Petroleum Hydrocarbons										
F1 (C6-C10 Hydrocarbons)	µg/L	750	<25	NR	<25	NR	<100	<100	<100	
F2 (C10-C16 Hydrocarbons)	µg/L	150	<100	NR	<100	NR	<100	<100	<100	
F3 (C16-C34 Hydrocarbons)	µg/L	500	<200	NR	<200	NR	<250	<250	<250	
F4 (C34-C50 Hydrocarbons)	µg/L	500	<200	NR	<200	NR	<250	<250	<250	
Benzene	µg/L	430	<0.10	NR	<0.10	NR	<0.50	<0.50	<0.50	
Ethylbenzene	µg/L	2,300	<0.10	NR	<0.10	NR	<0.50	<0.50	<0.50	
Toluene	µg/L	18,000	<0.20	NR	<0.20	NR	<0.50	<0.50	<0.50	
Xylene (Total)	µg/L	4,200 *	<0.10	NR	<0.10	NR	<0.50	<0.50	<0.50	
Volatile Organic Carbons										
Vinyl chloride	µg/L	1.7	<0.2	NR	<0.2	NR	<0.50	<0.50	<0.50	
Pesticides										
Diazinon	µg/L		<2.0	NR	<2.0	NR	<0.10	<0.10	<0.10	
Herbicides										
2,4-D	µg/L		<1.0	NR	<1.0	NR	<0.10	<0.10	<0.10	

Note: Criteria from Ontario Ministry of the Environment. (2011, July 1). Soil, Ground Water and Sediment Standards for Use Under Part XVI.I of the Environmental Protection Act Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition
 Note: Where value is expressed as less than (<), the value is halved and used in the calculations, where value is expressed as (-), the value is used in the calculations.
 * Criteria for total chloride, total metals and xylene mixture
 NR - No result due to lab error.

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Table 3.2 2019 Ground Water Quality Comparison - Till Wells

	Units	Criteria	2016		2017		2018		2019	
			Average		Average		Average		Average	
			Upgradient	Downgradient	Upgradient	Downgradient	Upgradient	Downgradient	Upgradient	Downgradient
Inorganic Parameters										
Alkalinity - Bicarbonate	mg/L		667	399	663	366	683	536	604	1,007
Alkalinity - Carbonate	mg/L		<0.50	<0.50	<0.50	<0.50	<3.0	<3.0	<3.0	<3.0
Alkalinity - Hydroxide	mg/L		<0.50	<0.50	<0.50	<0.50	<3.0	<3.0	<3.0	<3.0
Alkalinity - Total	mg/L		547	327	544	300	683	536	604	1,007
Dissolved Hardness (CaCO ₃)	mg/L		1,580	1,977	1,550	2,001	1,853	2,415	1,510	3,436
pH	units		6.97	7.21	6.92	7.11	6.96	7.11	6.93	7.12
Specific Conductivity	(µS/cm)		4,380	6,814	4,300	7,027	4,280	6,888	4,270	7,049
Turbidity	(ntu)		209	3,110	183	4,259	215	5,126	247	3,338
Total Dissolved Solids	mg/L		3,470	4,703	3,260	4,774	3,345	4,715	3,300	4,297
Total Suspended Solids	mg/L		610	11,186	640	9,840	616	7,528	880	9,199
Total Solids	mg/L		4,080	15,889	3,900	14,614	3,958	12,245	4,180	12,768
Dissolved Chloride (Cl)	mg/L	2,300 *	380	1,465	390	1,562	398	1,518	436	1,643
Dissolved Sulphate (SO ₄)	mg/L		1,450	1,343	1,430	1,258	1,465	1,308	1,375	1,101
Nutrients										
Ammonia - Dissolved	mg/L N		0.161	0.709	0.304	0.845	0.496	0.892	0.386	0.859
Nitrate - Dissolved	mg/L N		0.445	0.257	0.371	0.086	0.231	0.086	0.206	0.048
Total Kjeldahl Nitrogen	mg/L N		1.0	3.0	0.8	1.6	0.9	1.4	0.7	1.5
Phosphorus - Dissolved	mg/L P		0.030	0.036	<0.010	0.022	0.012	0.018	<0.013	0.013
Other										
Cyanide - Total (CN)	ug/L	66	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0	<1.0	<1.0
Organic Indicators										
Chemical Oxygen Demand	mg/L		45	259	40	286	25	504	43	354
Total Organic Carbon	mg/L		9.2	39.6	10.0	31.1	19.9	32.3	9.4	18.1
Metals										
Arsenic (As)- Dissolved	ug/L	1,900 *	2.48	1.98	1.21	2.62	1.19	2.58	1.11	3.03
Barium (Ba)- Dissolved	ug/L	29,000 *	9.2	11.5	8.1	15.0	8.3	13.8	8.0	11.6
Beryllium (Be)- Dissolved	ug/L	67 *	0.01	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	2.7 *	0.058	0.076	<0.050	0.070	0.037	0.076	0.057	0.033
Calcium (Ca)- Dissolved	mg/L		376	475	367	457	461	544	432	495
Chromium (Cr)- Dissolved	ug/L	810 *	0.30	<1.0	<1.0	1.3	<0.10	0.51	<0.10	<0.10
Copper (Cu)- Dissolved	ug/L	87 *	2.82	1.89	1.85	3.69	1.91	2.27	1.36	0.23
Iron (Fe)- Dissolved	ug/L		6.3	166	194	884	<10.0	662	22	530
Lead (Pb)- Dissolved	ug/L	25 *	0.059	<0.050	0.067	0.530	<0.050	0.650	<0.050	<0.050
Magnesium (Mg)- Dissolved	mg/L		155	201	154	210	171	257	195	231
Manganese (Mn)- Dissolved	ug/L		774	549	868	486	1090	882	1,165	548
Mercury (Hg)- Total	ug/L	2.8 *	<0.010	<0.010	<0.002	0.028	<0.005	0.266	0.019	0.065
Nickel (Ni)- Dissolved	ug/L	490 *	7.4	4.0	7.6	4.6	7.3	5.5	7.9	4.2
Potassium (K)- Dissolved	mg/L		8.2	14.8	7.5	17.6	9.0	19.6	8.6	19.6
Selenium (Se)- Dissolved	ug/L	63 *	0.12	<0.40	<0.40	<0.40	0.10	0.07	0.08	0.25
Silver (Ag)- Dissolved	ug/L	1.5 *	<0.005	<0.050	<0.050	<0.050	<0.010	<0.010	0.015	0.021
Sodium (Na)- Dissolved	mg/L	2,300 *	521	651	422	772	396	784	371	835
Zinc (Zn)- Dissolved	ug/L	1,100 *	3.9	7.2	5.5	6.0	6.3	7.9	3.6	2.5
Field Parameters										
pH	units		7.35	7.50	7.85	7.93	7.26	7.37	7.59	7.80
Specific Conductivity	(µS/cm)		3,190	3,147	3,790	6,481	3,630	6,295	4,650	5,581
Polycyclic Aromatic Hydrocarbons										
Naphthalene	µg/L	6,400	<0.050	<0.050	NR	NR	<0.050	<0.050	<0.050	<0.050
Benzo(a)pyrene	µg/L	0.81	<0.010	<0.010	NR	NR	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	µg/L	2.4	<0.050	<0.050	NR	NR	<0.010	<0.010	<0.010	<0.010
Petroleum Hydrocarbons										
F1 (C6-C10 Hydrocarbons)	µg/L	750	<25	<25	<25	<25	<100	<100	<100	<100
F2 (C10-C16 Hydrocarbons)	µg/L	150	<100	<100	<100	<100	<100	<100	<100	<100
F3 (C16-C34 Hydrocarbons)	µg/L	500	<200	<200	<200	<200	<250	277	<250	<250
F4 (C34-C50 Hydrocarbons)	µg/L	500	<200	<200	<200	<200	<250	<250	<250	<250
Benzene	µg/L	430	<0.10	<0.10	<0.10	<0.10	<0.50	<0.50	<0.50	<0.50
EthylBenzene	µg/L	2,300	<0.10	<0.10	<0.10	<0.10	<0.50	<0.50	<0.50	<0.50
Toluene	µg/L	18,000	<0.20	<0.20	<0.20	0.41	<0.50	<0.50	<0.50	<0.50
Xylene (Total)	µg/L	4,200 *	<0.10	<0.10	<0.10	0.37	<0.50	<0.50	<0.50	<0.50
Volatile Organic Carbons										
Vinyl chloride	µg/L	1.7	<0.2	<0.2	<0.2	<0.2	<0.50	<0.50	<0.50	<0.50
Pesticides										
Diazinon	µg/L		<2.0	<2.0	<2.0	<2.0	<0.10	<0.10	<0.10	<0.10
Herbicides										
2,4-D	µg/L		<1.0	<1.0	<1.0	<1.0	<0.10	<0.10	<0.10	<0.10

Note: Criteria from Ontario Ministry of the Environment. (2011, July 1). Soil, Ground Water and Sediment Standards for Use Under Part XVI of the Environmental Protection Act Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition
 Note: Where value is expressed as less than (<), the value is halved and used in the calculations, where value is expressed as (-), the value is used in the calculations.
 * Criteria for total chloride, total metals and xylene mixture
 NR - No result due to lab error.

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**Water and Waste
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Table 3.3 2019 Ground Water Quality Comparison - Bedrock Wells

	Units	Criteria	2016		2017		2018		2019	
			Average		Average		Average		Average	
			Upgradient	Downgradient	Upgradient	Downgradient	Upgradient	Downgradient	Upgradient	Downgradient
Inorganic Parameters										
Alkalinity - Bicarbonate	mg/L		164	166	164	162	1,454	136	150	154
Alkalinity - Carbonate	mg/L		<0.50	<0.50	<0.50	<0.50	<3.0	5.0	<3.0	<3.0
Alkalinity - Hydroxide	mg/L		<0.50	<0.50	<0.50	<0.50	<3.0	17.0	<3.0	<3.0
Alkalinity - Total	mg/L		134	136	134	133	1,454	155	150	154
Dissolved Hardness (CaCO3)	mg/L		1,065	1,237	1,390	1,200	1,544	1,523	998	872
pH	units		7.56	7.67	7.42	7.49	7.54	7.67	7.58	7.51
Specific Conductivity	(µS/cm)		10,350	8,484	9,965	8,373	10,035	8,255	10,100	8,433
Turbidity	(ntu)		15.4	38.9	10.0	26.1	7.6	13.3	6.8	12.4
Total Dissolved Solids	mg/L		6,265	5,033	6,145	5,020	6,320	5,043	6,220	4,989
Total Suspended Solids	mg/L		320	426	640	590	383	416	401	475
Total Solids	mg/L		6,585	5,458	6,785	5,611	6,703	5,459	6,625	5,463
Dissolved Chloride (Cl)	mg/L	2,300 *	3,000	2,413	2,850	2,208	2,785	2,131	1,855	2,281
Dissolved Sulphate (SO4)	mg/L		974	759	943	765	941	747	833	680
Nutrients										
Ammonia - Dissolved	mg/L N		1.31	1.06	1.36	1.10	0.686	1.09	1.44	1.11
Nitrate - Dissolved	mg/L N		0.012	0.025	<0.003	0.011	0.631	0.046	<0.003	0.035
Total Kjeldahl Nitrogen	mg/L N		2.0	1.6	1.6	1.3	1.1	1.2	2.0	1.5
Phosphorus - Dissolved	mg/L P		0.018	<0.010	<0.010	<0.010	0.015	<0.010	<0.013	<0.013
Other										
Cyanide - Total (CN)	ug/L	66	<0.50	<0.50	<0.50	<0.50	<1.0	<5.0	<1.0	<1.0
Organic Indicators										
Chemical Oxygen Demand	mg/L		111	102	90	75	80	59	118	81
Total Organic Carbon	mg/L		3.5	2.1	3.7	3.2	3.4	2.6	1.9	2.3
Metals										
Arsenic (As)- Dissolved	ug/L	1,900 *	1.51	2.83	2.92	3.75	3.14	4.05	0.87	3.52
Barium (Ba)- Dissolved	ug/L	29,000 *	10.2	17.3	14.0	18.7	12.7	19.0	14.9	23.4
Beryllium (Be)- Dissolved	ug/L	67 *	<0.050	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	2.7 *	0.050	0.014	0.014	0.058	0.090	0.052	0.140	0.130
Calcium (Ca)- Dissolved	mg/L		245	303	312	282	340	313	353	326
Chromium (Cr)- Dissolved	ug/L	810 *	0.21	4.54	<1.0	3.60	0.64	3.75	0.52	6.45
Copper (Cu)- Dissolved	ug/L	87 *	0.38	2.93	3.17	1.34	1.66	1.72	3.62	4.16
Iron (Fe)- Dissolved	ug/L		84.1	338	633	648	673	786	<10	516
Lead (Pb)- Dissolved	ug/L	25 *	0.016	0.034	0.161	0.079	0.106	0.163	0.094	0.186
Magnesium (Mg)- Dissolved	mg/L		110	128	149	120	169	180	166	129
Manganese (Mn)- Dissolved	ug/L		20.1	27.2	24.1	29.3	34.8	33.7	37.6	26.8
Mercury (Hg)- Total	ug/L	2.8 *	<0.010	<0.010	<0.002	<0.002	<0.005	<0.005	<0.0050	<0.0050
Nickel (Ni)- Dissolved	ug/L	490 *	1.3	1.3	2.0	1.5	2.0	1.8	2.9	2.8
Potassium (K)- Dissolved	mg/L		30.1	28.7	41.0	29.6	45.4	34.1	49.0	30.8
Selenium (Se)- Dissolved	ug/L	63 *	<0.20	<0.40	<0.40	<0.40	<0.05	0.11	<0.050	0.36
Silver (Ag)- Dissolved	ug/L	1.5 *	<0.025	<0.050	<0.050	<0.050	0.0195	<0.010	0.014	0.036
Sodium (Na)- Dissolved	mg/L	2,300 *	1,140	1,074	1,590	1,126	1,750	1,238	1,750	1,129
Zinc (Zn)- Dissolved	ug/L	1,100 *	13.1	9.1	39.8	9.8	14.5	11.0	51.8	17.2
Bacteria										
Total Coliforms (MTF)	MPN/100mL		12	23	<3	<3	<1	21	<1	2
Fecal Coliforms (MTF)	MPN/100mL		<3	<3	<3	<3	<1	1	<1	1
E. coli (MTF)	MPN/100mL		<3	<3	<3	<3	<1	<1	<1	<1
Field Parameters										
pH	units		7.87	7.73	8.34	8.31	7.30	7.96	7.77	7.78
Specific Conductivity	(µS/cm)		5,017	5,073	8,015	7,812	9,140	6,836	8,215	6,961
Polycyclic Aromatic Hydrocarbons										
Naphthalene	µg/L	6,400	<0.050	0.083	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Benzo(a)pyrene	µg/L	0.81	<0.010	<0.010	<0.010	<0.010	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	µg/L	2.4	<0.050	<0.050	<0.050	<0.050	<0.010	<0.010	<0.010	<0.010
Petroleum Hydrocarbons										
F1 (C6-C10 Hydrocarbons)	µg/L	750	<25	107	<25	<25	<100	<100	<100	<100
F2 (C10-C16 Hydrocarbons)	µg/L	150	<100	<100	<100	<100	<100	<100	<100	<100
F3 (C16-C34 Hydrocarbons)	µg/L	500	<200	<200	<200	<200	<250	<250	<250	<250
F4 (C34-C50 Hydrocarbons)	µg/L	500	<200	<200	<200	<200	<250	<250	<250	<250
Benzene	µg/L	430	<0.10	<5.0	<0.10	<0.10	<0.50	<0.50	<0.50	<0.50
EthylBenzene	µg/L	2,300	<0.10	<5.0	<0.10	0.17	<0.50	<0.50	<0.50	<0.50
Toluene	µg/L	18,000	<0.20	0.46	<0.20	0.48	<0.50	<0.50	<0.50	<0.50
Xylene (Total)	µg/L	4,200 *	<0.10	0.29	<0.10	0.95	<0.50	<0.50	<0.50	<0.50
Volatile Organic Carbons										
Vinyl chloride	µg/L	1.7	<0.20	<10	<0.20	<0.20	<0.50	<0.50	<0.50	<0.50
Pesticides										
Diazinon	µg/L		<2.0	<2.0	<2.0	<2.0	<0.10	<0.10	<0.10	<0.10
Herbicides										
2,4-D	µg/L		<1.0	<1.0	<1.0	<1.0	<0.10	<0.10	<0.10	<0.10

Note: Criteria from Ontario Ministry of the Environment. (2011, July 1). Soil, Ground Water and Sediment Standards for Use Under Part XV.I of the Environmental Protection Act Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition
 Note: Where value is expressed as less than (<), the value is halved and used in the calculations, where value is expressed as (>), the value is used in the calculations.
 * Criteria for total chloride, total metals and xylene mixture

BRADY ROAD RESOURCE MANAGEMENT FACILITY ANNUAL REPORT – 2019**5.2 SURFACE WATER**

Surface water flows at the BRRMF are managed by perimeter ditching and the central access road, which creates a barrier between the impacted water ditches on the North and the clean water ditches on the South; there are also 8 surface water retention ponds. The system is designed to run dry for most of the year, as such, grab sampling is performed three times per year: spring run-off, summer run-off, and fall run-off. The surface water sampling points are shown in Figure 3.

As per the BRRMF Operating Plan, surface water is managed in accordance with the Surface Water Sampling and Analysis Plan (SAP), as specified under Clause 115. Compliance parameters are applied to the upstream and downstream sampling points, with modifications at other locations interior to the site. Sampling for the clean water ponds (SWQ-25-9a and b) is similar to sampling for perimeter ditching. Sampling for impacted water ponds Active Area Collection Pond (SWQ-25-6), Biosolids Storm Water Pond (SWQ-25-7), Leaf and Yard Waste Storm Water Pond (SWQ-25-8) and dry ponds (SWQ-25-11 a, b, and c) is performed only prior to discharge events. The Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Freshwater Aquatic Life are used as the regulatory guideline (CCME, 2003). Weekly field monitoring is performed at the weir from spring thaw to freeze-up.

In 2019, a total of 35 surface water samples were analyzed – 6 upstream samples, 5 downstream samples, 8 samples intermediate to the site, and 16 pond samples. There were no deviations from the Surface Water SAP or from normal sample collection and preservation practices. Weekly weir data is provided in Table 4 and the 2019 surface water results are provided in Tables 5.1 and 5.2.

The analytical results for some of the pond samples exceeded the guidelines for pH, chloride, arsenic, copper, iron, nickel, and selenium; the water was retained in the ponds or hauled for treatment as required. Many of the analytical results for perimeter ditching were highly variable between sampling events and between sample points. Dissolved chloride and pH sometimes exceeded the guidelines at the intermediate and downstream locations, and iron concentration sometimes exceeded the guideline at the upstream and downstream locations. Samples collected from the ponds and the perimeter ditching frequently contain elevated levels of arsenic, which is due to its natural occurrence in Manitoba soils.

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The 2015-2019 averages for upstream and downstream locations are provided in Table 6 and time versus concentration graphs showing the historical relationship of the analytical parameters at each monitoring location are provided in Appendix D. In general, the analytical results for surface water obtained in 2019 were found to be similar to those obtained in 2015-2018, with similar results for upstream and downstream locations.

The Contingency Action Plan identified under Clause 125 was not implemented in 2019.


At this time we have no recommendations for changes in the surface water monitoring program.



Table 4. 2019 Weekly Weir Data


Date	Flow (m/s)	pH (units)	Conductivity (m/s)	DO (mg/L)	Temp (°C)
18-Apr-19	0.2	7.50	0.64	6.0	10.8
26-Apr-19	0.0	9.33	4.20	16.5	8.5
3-May-19	0.2	9.12	0.93	11.9	13.5
10-May-19	0.2	8.91	1.14	11.6	10.8
17-May-19	0.0	8.52	1.33	11.6	12.5
24-May-19	0.0	8.44	1.46	10.7	14.3
31-May-19	0.0	8.39	1.55	11.1	16.6
7-Jun-19	0.0	8.91	1.60	10.9	22.7
14-Jun-19	0.0	9.22	1.61	11.8	20.4
21-Jun-19	0.0	9.42	1.65	12.1	21.2
28-Jun-19	0.0	9.96	1.62	14.3	23.1
5-Jul-19	0.0	10.32	1.68	13.8	28.3
13-Jul-19	0.0	9.84	1.70	18.0	26.4
19-Jul-19	0.0	8.40	3.20	7.4	24.1
25-Jul-19	0.0	8.81	3.57	9.0	28.7
2-Aug-19	0.0	8.50	3.62	5.2	27.6
9-Aug-19	0.0	8.81	3.78	10.3	24.7
16-Aug-19	0.0	8.62	3.33	9.0	23.3
23-Aug-19	0.0	8.66	3.71	6.7	19.4
30-Aug-19	0.0	8.36	2.35	7.9	21.5
6-Sep-19	0.0	8.42	2.20	6.9	18.8
13-Sep-19	0.0	8.83	1.97	9.3	18.5
27-Sep-19	0.3	8.43	0.78	4.9	13.0
4-Oct-19	0.1	8.21	0.87	5.2	8.3
11-Oct-19	*ns				
18-Oct-19	*ns				
25-Oct-19	0.1	8.40	0.61	7.3	10.4
1-Nov-19	**ns				
15-Nov-19	**ns				
*ns - no sample, staff reassigned to storm clean-up					
**ns - no sample because weir was completely dry and/or frozen					

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		Table 5.1 2019 Surface Water Monitoring - Ponds																
		Ponds																
				SW25-6		SW25-7		SW25-8		SW25-9A		SW25-9B		SW25-11A		SW25-11B		SW25-11C
Sampling date	Units	Criteria	30-Apr-19	31-Jul-19	30-Apr-19	31-Jul-19	30-Apr-19	31-Jul-19	Spring	31-Jul-19	30-Apr-19	Summer	30-Apr-19	31-Jul-19	30-Apr-19	31-Jul-19	30-Apr-19	31-Jul-19
Inorganic Parameters																		
Alkalinity - Bicarbonate	mg/L		3,220	2,910	136	266	662	660	239	205	253	207	522	677	525	585	407	622
Alkalinity - Carbonate	mg/L		<3.0	<3.0	69.3	46	<3.0	41.7	<3.0	30.0	6.2	35.1	114	108	89.0	178	123	276
Alkalinity - Hydroxide	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Alkalinity - Total	mg/L		3,220	2,910	205	312	662	701	239	235	260	242	635	784	614	763	530	898
Dissolved Hardness (CaCO ₃)	mg/L		1,130	553	189	299	401	360	152	162	142	115	147	286	158	242	127	240
pH	units	6.5-9.0	7.82	7.87	9.48	8.77	8.13	8.43	8.23	8.96	8.34	8.93	9.03	8.63	8.95	8.96	9.11	9.02
Specific Conductivity	(µS/cm)		1,550	8,940	3,410	2,470	834	3,300	940	926	772	761	2,950	4,020	2,650	3,950	2,350	4,140
Turbidity	(ntu)		286.4	820	27.1	6.79	39.68	14.6	22.84	63.8	134	89.6	45.3	63.5	45.7	12.5	43.9	8.35
Total Dissolved Solids	mg/L		6,660	6,180	1,070	1,830	2,330	2,420	504	578	431	497	1,800	2,720	1,720	2,600	1,550	2,890
Total Suspended Solids	mg/L		485	3,280	176	410	196	204	148	228	435	297	201	366	163	292	202	269
Total Solids	mg/L		7,150	9,450	1,250	2,240	2,530	2,630	652	806	866	794	2,000	3,090	1,880	2,890	1,750	3,160
Dissolved Chloride (Cl)	mg/L	640 *	730	1,490	148	298	438	500	79	100	74.4	82	246	680	510	660	489	970
Dissolved Sulphate (SO ₄)	mg/L		16.0	<0.4	382	582	342	412	94.9	73.0	42.9	42.2	254	443	256.0	423.0	226	349
Nutrients																		
Ammonia - Dissolved	mg/L N		264	NA	0.009	0.292	3.66	0.885	2.98	<0.003	4.34	0.028	9.67	1.10	7.65	0.208	2.13	0.090
Nitrate - Dissolved	mg/L N	13	0.081	NA	0.003	0.399	0.039	0.231	0.340	<0.003	0.541	<0.003	0.381	0.758	1.42	0.469	0.657	0.003
Total Kjeldahl Nitrogen	mg/L N		330	NA	3.9	56	17	16	4.4	1.7	6.7	1.8	22	12	20	10	14	11
Phosphorus - Dissolved	mg/L P		11.8	NA	0.066	0.507	2.72	2.75	0.076	0.986	0.275	0.181	0.030	1.41	0.020	1.16	<0.013	1.82
Other																		
Cyanide - Total (CN)	ug/L	5000	9.6	7.9	1.3	2.0	7.4	6.3	1.3	<1.0	1.2	<1.0	4.5	4.4	4.4	3.9	4.1	3.6
Organic Indicators																		
Chemical Oxygen Demand	mg/L		>5000	4790	206	179	402	428	62	82	95	103	384	359	372	311	347	337
Biochemical Oxygen Demand	mg/L		4390	2140	19	<4	8	9	<4	10	9	14	54	18	54	2	64	103.8
Metals																		
Arsenic (As)- Dissolved	ug/L	5 *	14.3	28.4	7.40	13.6	15.6	23.2	3.92	15.5	5.74	15.2	11.7	38.3	10.4	34.0	11.6	38.5
Barium (Ba)- Dissolved	ug/L		187	155	34.5	55.4	87.9	85.9	56.3	66.6	57.6	70.1	60.6	188	65.8	163	46.3	160
Beryllium (Be)- Dissolved	ug/L		0.15	0.51	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	0.09 *	0.0094	0.0190	0.0086	<0.0050	0.0175	0.0224	0.0055	0.0053	0.0088	<0.0050	0.0146	0.0152	0.0170	0.0130	0.0109	0.0153
Calcium (Ca)- Dissolved	mg/L		422	117	70.8	103	142	133	55.1	53.5	45.2	38.5	53.3	90.0	54.0	82.2	42.5	82.6
Chromium (Cr)- Dissolved	ug/L		97.9	75.9	0.19	0.20	1.01	0.97	0.11	<0.10	<0.10	0.12	4.32	1.23	3.80	1.28	2.68	1.36
Copper (Cu)- Dissolved	ug/L	4 *	0.58	0.71	1.15	1.60	6.67	7.16	1.83	1.87	1.14	0.74	5.82	6.37	5.57	4.27	5.38	5.85
Iron (Fe)- Dissolved	ug/L	300 *	192	448	17	37	267	157	24	<10	17	28	47	20	48	28	33	13
Lead (Pb)- Dissolved	ug/L	7 *	0.106	0.496	<0.050	0.091	0.183	0.414	<0.050	0.063	<0.050	0.063	0.090	0.130	0.085	0.089	0.082	0.156
Magnesium (Mg)- Dissolved	mg/L		321	392	104	188	163	165	47.0	51.4	41.8	44.7	164	235	159	228	149	258
Manganese (Mn)- Dissolved	ug/L		3,050	196	15.9	75.7	737	492	263	1.47	244	6.56	16.3	50.6	8.34	22.1	8.66	30.9
Mercury (Hg)- Dissolved	ug/L	0.026 *	<0.025	<0.025	<0.0050	<0.0050	0.0060	<0.025	0.0070	<0.0050	0.0050	<0.0050	0.0060	<0.0050	0.0050	<0.0050	0.0050	<0.0050
Nickel (Ni)- Dissolved	ug/L	150 *	191	225	7.43	10.2	42.7	38.8	5.74	5.07	5.45	4.30	61.9	55.8	55.2	52.0	46.4	57.4
Potassium (K)- Dissolved	mg/L		228	324	35.1	61.7	400	430	16.5	17.1	16.6	17.3	95.5	228	93.8	208	94.4	184
Selenium (Se)- Dissolved	ug/L	1 *	2.47	2.04	0.305	0.361	1.04	1.13	0.210	0.304	0.234	0.202	0.647	0.776	0.562	0.746	0.635	0.675
Sodium (Na)- Dissolved	mg/L		886	1260	103	169	116	111	38.4	45.9	35.4	39.5	269	322	251	318	227	391
Zinc (Zn)- Dissolved	ug/L	30 *	6.2	2.6	<1.0	1.3	5.5	5.30	3.8	<1.0	1.8	1.1	4.8	2.3	4.7	1.7	3.1	1.8
Bacteria																		
Total Coliforms (MTF)	MPN/100mL		3870	>24,200	890	>2,420	250	>24,200	60	>2,420	210	>2,420	1,550	>2,420	200	>2,420	480	>2,420
Fecal Coliforms (MTF)	MPN/100mL		1,790	6130	10	397	180	1,870	<10	225	10	816	550	240	100	613	170	308
E. coli (MTF)	MPN/100mL		650	5480	<10	488	80	1,470	<10	365	30	921	500	326	10	345	160	228
Field Parameters																		
pH	units	6.5-9.0	7.99	8.08	9.63	9.33	8.55	8.58	8.55	9.57	8.76	9.50	9.65	8.87	9.28	9.08	9.81	9.23
Specific Conductivity	(µS/cm)		7,270	7,270	14,790	2,320	3,040	2,940	8,310	867	7,400	755	2,590	3,410	2,490	3,170	2,230	3,520
Temperature	°C		8.8	24.5	5.8	22.5	7.1	24.6	8.0	23.7	8.5	25.0	6.2	22.2	6.8	23.5	6.6	22.4


Note: Criteria from Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines Summary Table. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. (CCME, 2003)
 * Criteria for total chloride and total metals
 NA - Not analysed due to laboratory error

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			Table 5.2 2019 Surface Water Monitoring - Perimeter Ditch																			
			Upstream						Downstream						Intermediate							
			SW25-1		SW25-12		SW25-2		SW25-16		SW25-13A		SW25-13B		SW25-14A		SW25-14B		SW25-15A		SW25-15B	
Sampling date	Units	Criteria	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer			
Inorganic Parameters																						
Alkalinity - Bicarbonate	mg/L		200	336	193	206	515	194	206	865	271	271	743	214	229	213	206	159	837	209	788	
Alkalinity - Carbonate	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	45.3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	148	77.3	70.5	56.5	90.0	
Alkalinity - Hydroxide	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	
Alkalinity - Total	mg/L		200	336	193	206	515	194	251	865	271	271	743	214	229	213	221	237	907	265	878	
Dissolved Hardness (CaCO3)	mg/L		105	179	242	112	297	137	117	269	178	154	291	155	296	358	139	109	221	119	236	
pH	units	6.5-9.0	7.56	7.31	7.65	7.57	7.33	7.65	9.13	8.11	7.81	7.59	7.33	7.65	7.65	8.36	8.74	9.15	8.34	9.10	8.51	
Specific Conductivity	(µS/cm)		461	765	492	495	1,920	456	8,710	4,160	1,040	868	1,850	515	731	715	751	721	4,410	924	4,390	
Turbidity	(ntu)		19.6	29.6	790	6.52	148	59.5	8.07	2.78	55.4	6.26	74.7	104.8	172	343	62.5	52.0	55.3	36.1	214	
Total Dissolved Solids	mg/L		304	491	323	316	532	295	579	2,780	675	501	1,290	318	430	295	431	426	2,920	540	1,870	
Total Suspended Solids	mg/L		64	353	1,080	24	5,000	125	77	267	103	65	481	340	660	1,490	265	128	781	256	11,900	
Total Solids	mg/L		368	844	1,400	340	5,530	420	656	3,050	778	566	1,770	658	1,090	1,780	696	554	3,700	796	13,800	
Dissolved Chloride (Cl)	mg/L	640 *	29.7	45.0	15.8	38.7	222	23.6	111	900	117	49.2	249	35.3	89.6	79.2	81.8	76.6	890	117.0	960	
Dissolved Sulphate (SO4)	mg/L		13.4	32.0	3.0	25.9	317	<0.4	75.0	313	<0.4	274	380	24.6	74.8	59.4	40.3	44.9	425.0	78.1	402.0	
Nutrients																						
Ammonia - Dissolved	mg/L N		0.005	0.114	0.011	0.065	0.241	0.004	0.028	0.037	>2	0.006	<0.003	0.009	0.007	0.013	3.72	0.011	0.312	0.017	0.749	
Nitrate - Dissolved	mg/L N	13	<0.003	<0.003	0.022	0.007	<0.003	0.035	0.016	<0.003	0.829	<0.003	<0.003	<0.003	<0.003	0.009	0.528	0.173	0.082	0.302	0.045	
Total Kjeldahl Nitrogen	mg/L N		0.9	1.8	2.2	0.6	3.9	1.2	2.1	1.0	5.3	1.3	3.8	0.8	1.1	1.1	6.7	4.2	12	4.8	13	
Phosphorus - Dissolved	mg/L P		0.064	0.220	0.098	0.104	0.456	0.166	<0.013	1.35	0.344	0.020	0.243	0.100	0.079	0.024	0.255	<0.013	1.74	<0.013	1.66	
Other																						
Cyanide - Total (CN)	mg/L	5000	<1.0	<1.0	1.1	<1.0	<1.0	1.2	1.5	3.0	1.2	1.3	1.1	<1.0	<1.0	<1.0	1.1	1.1	2.8	1.4	2.3	
Organic Indicators																						
Chemical Oxygen Demand	mg/L		77	156	195	59	176	80	88	320	99	76	193	134	149	220	118	139	442	141	458	
Biochemical Oxygen Demand	mg/L		4	7	7	<4	61	<4	8	<4	8	13	15	6	6	9	15	33	29	14	19	
Metals																						
Arsenic (As) - Dissolved	ug/L	5 *	3.08	6.69	2.18	3.08	3.83	2.84	5.01	29.2	5.85	3.95	5.86	3.14	2.88	2.63	5.90	4.13	36.3	4.77	35.1	
Barium (Ba) - Dissolved	ug/L		32.7	61.5	56.1	36.0	95.4	34.3	50.2	168	65.6	61.0	141	36.7	48.6	56.7	56.0	42.3	155	44.1	151	
Beryllium (Be) - Dissolved	ug/L		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	
Cadmium (Cd) - Dissolved	ug/L	0.09 *	0.0157	<0.0050	0.0178	0.0114	<0.0050	0.0057	0.0116	0.0104	0.0163	0.0060	0.0247	0.0080	0.0054	<0.0050	0.0068	0.0122	0.0056	0.0098	0.0091	
Calcium (Ca) - Dissolved	ug/L		41.6	63.3	46.3	44.5	83.5	41.5	46.5	89.5	56.2	61.9	103	45.6	59.3	56.4	46.4	41.0	77.1	42.1	73.5	
Chromium (Cr) - Dissolved	ug/L		0.15	0.18	0.20	0.18	0.28	0.22	0.34	1.31	1.14	0.46	0.61	0.14	0.21	0.13	0.11	0.16	1.38	0.37	1.41	
Copper (Cu) - Dissolved	ug/L	4 *	1.40	0.20	2.43	1.37	<0.20	2.30	2.57	1.06	2.68	1.79	1.06	1.40	1.46	1.99	1.51	1.99	1.61	2.11	1.40	
Iron (Fe) - Dissolved	ug/L	300 *	93	353	44	132	303	207	19	89	77	113	327	124	185	53	30	20	34	16	44	
Lead (Pb) - Dissolved	ug/L	7 *	0.097	0.051	0.083	0.064	<0.050	0.067	0.052	<0.050	0.060	1.10	0.126	0.054	0.111	0.107	0.085	<0.050	<0.050	<0.050	0.069	
Magnesium (Mg) - Dissolved	mg/L		27.5	45.9	23.9	27.7	99.4	27.2	56.0	251	55.7	39.9	100	27.7	39.3	39.7	41.2	46.1	269.0	55.3	260.0	
Manganese (Mn) - Dissolved	ug/L		6.81	197	63.9	9.85	985	57.0	13.7	135	49.4	32.9	592	8.20	53.6	21.4	230	38.3	93.8	8.75	111	
Mercury (Hg) - Dissolved	ug/L	0.026 *	0.0070	<0.0050	<0.0050	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0060	<0.0050	0.0050	<0.0050	<0.0050	0.0110	0.0050	<0.0050	0.0050	<0.0050	
Nickel (Ni) - Dissolved	ug/L	150 *	2.47	2.76	4.98	2.70	1.80	2.83	9.48	56.2	12.8	4.72	10.8	2.76	3.23	4.05	5.35	5.09	57.6	8.73	54.2	
Potassium (K) - Dissolved	mg/L		13.9	12.6	9.51	12.2	12.6	10.3	27.6	153	38.4	17.4	22.5	11.6	11.5	11.6	16.7	17.0	24.0	187	24.0	
Selenium (Se) - Dissolved	ug/L	1 *	0.260	0.171	0.255	0.189	0.202	0.156	0.287	0.541	0.382	0.242	0.403	0.144	0.170	0.163	0.178	0.219	0.618	0.266	0.621	
Sodium (Na) - Dissolved	mg/L		16.4	32.5	12.5	17.9	116	24.9	60.3	389	64.0	55.2	148	18.1	32.6	28.0	35.3	40.1	415	56.9	400	
Zinc (Zn) - Dissolved	ug/L	30 *	1.7	<1.0	1.9	4.3	1.2	4.5	1.9	2.0	3.8	4.6	2.8	3.4	92.4	7.1	2.5	1.7	1.9	1.6	5.6	
Bacteria																						
Total Coliforms (MTF)	MPN/100mL		1,920	>2,420	>2,420	190	>24,200	>2,420	1,010	>2,420	>2,420	90	>24,200	160	1400	1,660	120	20	>2,420	240	>24,200	
Fecal Coliforms (MTF)	MPN/100mL		40	88	225	<10	260	1,730	1,090	1,410	727	<10	3,260	10	<10	670	40	<10	>2,420	<10	2,760	
E. coli (MTF)	MPN/100mL		80	46	133	30	170	1,050	750	1,300	866	<10	3,650	<10	10	720	<10	<10	>2,420	10	1,840	
Field Parameters																						
pH	units	6.5-9.0	7.98	7.85	8.71	8.18	8.00	8.77	9.11	8.20	8.64	8.40	7.91	8.13	8.31	8.46	8.84	9.41	8.89	9.46	8.68	
Specific Conductivity	(µS/cm)		4,760	806	522	4,950	1,549	560	942	3,530	1,078	815	1,765	6,580	6,210	6,960	7,220	715	3,640	783	3,610	
Temperature	°C		4.2	17.7	12.1	4.0	17.8	10.8	5.7	19.7	11.0	4.4	16.5	3.2	3.8	5.9	9.2	5.2	20.5	6.3	18.8	

Note: Criteria from Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines Summary Table. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. (CCME, 2003)
 * Criteria for total chloride and total metals

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		Table 6. 2019 Surface Water Monitoring - Perimeter Ditch Comparison								
		2016		2017		2018		2019		
	Units	Criteria	Average		Average		Average			
Inorganic Parameters			Upstream	Downstream	Upstream	Downstream	Upstream	Downstream		
Alkalinity- Bicarbonate	mg/L		254	349	359	433	174	300	243	447
Alkalinity- Carbonate	mg/L		<0.50	<0.50	<0.50	<0.50	<3.0	18	<3.0	16
Alkalinity- Hydroxide	mg/L		<0.50	<0.50	<0.50	<0.50	<3.0	<3.0	<3.0	<3.0
Alkalinity- Total	mg/L		208	287	294	355	174	319	243	462
Dissolved Hardness (CaCO3)	mg/L		515	523	316	448	248	499	175	188
pH	units	6.5-9.0	7.40	8.15	7.68	8.80	7.56	8.84	7.51	8.35
Specific Conductivity	(µS/cm)		1,029	1,588	774	1,154	615	1,590	573	4,637
Turbidity	(ntu)		151	135	118	87.2	37.2	32.8	279.7	22.1
Total Dissolved Solids	mg/L		721	1,025	496	810	370	996	373	1,345
Total Suspended Solids	mg/L		483	531	379	169	116	167	499	149
Total Solids	mg/L		1,204	1,557	875	978	486	1,164	871	1,495
Dissolved Chloride (Cl)	mg/L	640 *	61.3	209	62.0	151	60.0	220	30	376
Dissolved Sulphate (SO4)	mg/L		205	227	32.5	33.2	57.6	170	16	129
Nutrients										
Ammonia - Dissolved	mg/L N		0.295	0.730	0.009	0.560	0.041	0.426	0.043	0.688
Nitrate - Dissolved	mg/L N	13	3.96	2.98	<0.003	0.184	0.234	0.500	0.008	0.282
Total Kjeldahl Nitrogen	mg/L N		5.40	13.1	1.95	3.35	2.55	6.85	1.63	5.80
Phosphorus - Dissolved	mg/L P		0.060	0.060	382	195	0.085	0.252	0.127	0.567
Other										
Cyanide - Total (CN)	ug/L	5,000	1.55	2.69	1.96	2.29	0.70	2.50	<1.0	1.90
Organic Indicators										
Chemical Oxygen Demand	mg/L		131	249	255	135	50	530	143	169
Biochemical Oxygen Demand	mg/L		12	51	<3	23	7	13	6	8
Metals										
Arsenic (As)- Dissolved	ug/L	5 *	2.92	5.91	5.25	8.64	2.80	8.85	3.98	13.35
Barium (Ba)- Dissolved	ug/L		47.9	87.2	54.0	68.9	53.7	70.2	50.1	94.6
Beryllium (Be)- Dissolved	ug/L		<0.010	<0.010	<0.010	<0.010	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	0.09 *	0.0620	0.0093	<0.0050	0.0071	0.036	0.057	0.012	0.013
Calcium (Ca)- Dissolved	mg/L		126.2	60.4	55.0	42.9	47.7	50.0	50.4	64.1
Chromium (Cr)- Dissolved	ug/L		0.20	0.49	0.23	0.26	0.18	0.42	0.18	0.93
Copper (Cu)- Dissolved	ug/L	4 *	3.48	5.02	2.20	2.67	2.29	5.27	1.34	2.10
Iron (Fe)- Dissolved	ug/L	300 *	172	32	156	34	59	20	163	62
Lead (Pb)- Dissolved	ug/L	7 *	0.041	0.105	0.157	0.150	0.285	0.060	0.077	<0.050
Magnesium (Mg)- Dissolved	mg/L		48.7	90.7	43.5	55.4	31.3	91.0	32.4	120.9
Manganese (Mn)- Dissolved	ug/L		161.4	172.5	301	37.8	10.1	32.2	89.2	66.0
Mercury (Hg)- Dissolved	ug/L	0.026 *	0.003	0.003	0.002	<0.002	<0.005	<0.005	<0.0050	<0.0050
Nickel (Ni)- Dissolved	ug/L	150 *	2.77	18.9	2.45	10.9	2.62	20.1	3.4	26.2
Potassium (K)- Dissolved	mg/L		12.3	37.9	9.0	27.0	10.2	68.4	12.0	73.0
Selenium (Se)- Dissolved	ug/L	1 *	0.233	0.475	0.166	0.258	0.155	0.429	0.229	0.403
Sodium (Na)- Dissolved	mg/L		31.3	100	36.4	89.2	29.4	124	20	171
Zinc (Zn)- Dissolved	ug/L	30 *	4.3	5.3	2.9	3.3	2.6	4.7	1.4	2.6
Bacteria										
Total Coliforms (MTF)	MPN/100mL		11,000	>11,000	5,965	5,715	6,710	3,510	2,253	1,950
Fecal Coliforms (MTF)	MPN/100mL		336	4,008	2,301	33	23	530	118	1,076
E. coli (MTF)	MPN/100mL		336	3,979	2,301	19	6	765	86	972
Field Parameters										
pH	units	6.5-9.0	7.40	8.15	7.68	8.80	7.56	8.84	8.18	8.65
Specific Conductivity	(µS/cm)		947	1,380	720	450	660	1,619	2,029	1,850
Temperature	°C		NA	NA	NA	NA	19.7	7.2	11.3	12.1

Note: Criteria from Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines Summary Table, Water Quality Guidelines for the Protection of Freshwater Aquatic Life. (CCME, 2003)
 * Criteria for total chloride and total metals
 NA - not analyzed

BRADY ROAD RESOURCE MANAGEMENT FACILITY ANNUAL REPORT – 2019**5.3 LEACHATE**

The leachate management system is a network of manholes/risers, drains, and sumps around the perimeter of the landfill cells, which feed into a header pipe. The leachate flows via gravity and lift stations into a 300,000L storage tank located at the intersection of Charette Road and the access road, which acts as a truck fill station for hauling to the North End Sewage Treatment Plant for treatment. Leachate can also be pumped from eight collection manholes and one riser if needed; these sites also serve as sampling points. The locations of the manholes and riser are shown on Figure 3.

As per the BRRMF Operating Plan, leachate is managed in accordance with the Leachate Sampling and Analysis Plan (SAP), as specified under Clause 100. The MOE guidelines for non-potable groundwater quality are used as the regulatory guideline (MOE, 2011).

The total volume of leachate removed from the BRRMF in 2019 was 36,763 kL. There were no occurrences of leachate breakout from the development in 2019, however, the leachate head in Cell 31 exceeded the crown of the collection system piping for approximately 30 days due to a malfunction in the centralized leachate collection system. The Contingency Action Plan identified under Clause 125 was not implemented in 2019, however an interim mitigation plan was used to operate the centralized leachate collection system until stainless steel replacement components could be installed.

In 2019, 10 leachate samples were analyzed; there were no deviations from the Leachate SAP or from normal sample collection and preservation practices. Monthly leachate elevations are provided in Table 7, and the 2019 leachate results are provided in Table 8. The majority of parameters were found to be highly variable between manholes; several of the samples exceeded the guidelines for chloride and hydrocarbons. Leachate is highly variable due to waste composition, amount of precipitation, site hydrology, waste compaction, cover, and interaction of leachate with the environment.

The 2015-2019 average results are provided in Table 9, and Piper diagrams showing the historical relationship of cations and anions at each monitoring location are provided in Appendix C. Many of the other parameters measured vary significantly from year to year. The average alkalinity, hardness, and conductivity have been increasing yearly since 2015 because improved landfill cover allows less water infiltration, which aids the biological breakdown of inorganic compounds.

We have no recommendations for changes in the leachate monitoring program at this time.

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Table 7. 2019 Leachate Levels

	Date	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19
Manhole 3	Top of Manhole Elevation (m)	233.66	233.66	233.66	233.66	233.66	233.66	233.66	233.66	233.66	233.66	233.66	233.66
	Depth to Leachate (m)	1.69	1.62	1.68	3.64	1.69	3.84	1.60	5.33	2.16	0.94	1.29	2.84
	Manhole Leachate Elevation (m)	231.97	232.04	231.98	230.02	231.97	229.82	232.06	228.33	231.50	232.72	232.37	230.82
Manhole 8	Top of Manhole Elevation (m)	236.61	236.61	236.61	236.61	236.61	236.61	236.61	236.61	236.61	236.61	236.61	236.61
	Depth to Leachate (m)	3.38	3.00	3.04	1.94	3.02	4.68	5.49	4.31	1.94	4.52	6.73	7.92
	Manhole Leachate Elevation (m)	233.23	233.61	233.57	234.67	233.59	231.93	231.12	232.30	234.67	232.09	229.88	228.69
Manhole 13	Top of Manhole Elevation (m)	234.89	234.89	234.89	234.89	234.89	234.89	234.89	234.89	234.89	234.89	234.89	234.89
	Depth to Leachate (m)	7.90	8.89	10.05	8.31	5.26	4.58	8.49	9.69	9.61	3.44	5.21	5.58
	Manhole Leachate Elevation (m)	226.99	226.00	224.84	226.58	229.63	230.31	226.40	225.20	225.28	231.45	229.68	229.31
Manhole 24	Top of Manhole Elevation (m)	235.00	235.00	235.00	235.00	235.00	235.00	235.00	235.00	235.00	235.00	235.00	235.00
	Depth to Leachate (m)	6.47	5.38	7.67	7.97	1.89	1.27	7.77	7.67	7.97	1.20	5.80	7.90
	Manhole Leachate Elevation (m)	228.53	229.62	227.33	227.03	233.11	233.73	227.23	227.33	227.03	233.80	229.20	227.10
Manhole 27	Top of Manhole Elevation (m)	235.71	235.71	235.71	235.71	235.71	235.71	235.71	235.71	235.71	235.71	235.71	235.71
	Depth to Leachate (m)	2.02	1.95	1.97	1.94	2.30	2.42	2.48	2.08	2.33	2.10	2.38	1.86
	Manhole Leachate Elevation (m)	233.69	233.76	233.74	233.77	233.41	233.29	233.23	233.63	233.38	233.61	233.33	233.85
Manhole 31	Top of Manhole Elevation (m)	234.74	234.74	234.74	234.74	234.74	234.74	234.74	234.74	234.74	234.74	234.74	234.74
	Depth to Leachate (m)	2.55	1.90	1.74	3.31	1.54	2.21	1.77	3.07	3.52	0.60	7.90	2.44
	Manhole Leachate Elevation (m)	232.19	232.84	233.00	231.43	233.20	232.53	232.97	231.67	231.22	234.14	226.84	232.30
Manhole 34	Top of Manhole Elevation (m)	235.42	235.42	235.42	235.42	235.42	235.42	235.42	235.42	235.42	235.42	235.42	235.42
	Depth to Leachate (m)	2.64	3.31	3.42	2.76	2.97	2.80	2.70	2.61	2.70	2.17	2.41	2.40
	Manhole Leachate Elevation (m)	232.78	232.11	232.00	232.66	232.45	232.62	232.72	232.81	232.72	233.25	233.01	233.02
Manhole 46	Top of Manhole Elevation (m)	235.04	235.04	235.04	235.04	235.04	235.04	235.04	235.04	235.04	235.04	235.04	235.04
	Depth to Leachate (m)	4.20	4.10	3.05	3.77	3.76	4.00	4.83	4.62	5.16	4.51	4.86	4.95
	Manhole Leachate Elevation (m)	230.84	230.94	231.99	231.27	231.28	231.04	230.21	230.42	229.88	230.53	230.18	230.09
Riser 1	Top of Riser Elevation (m)	234.97	234.97	234.97	234.97	234.97	234.97	234.97	234.97	234.97	234.97	234.97	234.97
	Depth to Leachate (m)	7.21	7.26	7.22	7.25	7.13	7.19	7.06	7.04	7.18	7.36	7.41	7.35
	Riser Leachate Elevation (m)	227.76	227.71	227.75	227.72	227.84	227.78	227.91	227.93	227.79	227.61	227.56	227.62

Client File No. 5556.00

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Table 8. 2019 Leachate Monitoring

Sampling Date	Units	Criteria	LQ25-MH3	LQ25-MH8	LQ25-MH13	LQ25-MH24	LQ25-MH27	LQ25-MH31	LQ25-MH34	RISER 1	LQ25-MH46	Composite
			11-Sep	11-Sep	11-Sep	11-Sep	11-Sep	11-Sep	11-Sep	11-Sep	10-Sep	10-Sep
Field Parameters												
pH	units		7.65	7.71	7.77	8.26	8.64	7.72	8.02	NR	6.52	
Turbidity	ntu		45.5	147	29.3	22.3	1.81	12.7	18.3	1,000	219	
Specific Conductivity	uS/cm		12,680	11,650	9,450	4,840	1,060	9,550	1,550	15,780	11,410	
Temperature	°C		12.1	14.8	9.9	13.3	13.2	14.1	12.1	18	17.8	
Inorganic Parameters												
Alkalinity - Bicarbonate	mg/L		3,640	5,510	5,150	2,950	442	3,390	419	9,420	5,610	
Alkalinity - Carbonate	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	
Alkalinity - Hydroxide	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	
Alkalinity - Total	mg/L		3,640	5,510	5,150	2,950	442	3,390	419	9,420	5,610	
Hardness (as CaCO ₃)	mg/L		516	516	716	713	261	358	368	373	3,140	
pH	units		7.24	7.23	7.08	7.43	7.45	7.54	7.39	7.48	6.32	
Specific Conductivity	uS/cm		15,900	14,900	12,400	8,650	1,150	11,300	1,730	20,600	13,900	
Turbidity	ntu		43.4	197.5	196.5	31.5	7.54	14.96	11.3	127	272	
Total Dissolved Solids	mg/L		7,990	6,920	7,030	4,550	812	5,550	1,180	10,300	12,800	
Total Suspended Solids	mg/L		691	737	569	403	12	362	209	862	1,870	
Total Solids	mg/L		8,680	7,660	7,600	4,960	824	5,910	1,390	11,100	14,700	
Chloride (dissolved)	mg/L	2300 *	3,960	2,470	2,850	1,960	120.0	1,740	190	4,560	1,800	
Sulphate (dissolved)	mg/L		201	519	43.0	46.0	<0.4	208	509	<0.4	321	
Other												
Cyanide (CN)	ug/L	66	13.6	14.5	7.9	16.4	2.2	44.2	3.5	16.3	9.0	
Nutrients												
Dissolved Ammonia	mg/L		793	725	422	364	1.18	464	4.30	1,450	679	
Nitrate Nitrogen	mg/L		2.70	1.15	0.009	<0.003	0.476	NA	3.71	0.024	0.019	
Total Kjeldhal Nitrogen	mg/L		1,100	1,200	600	430	1.8	NA	3.6	1,500	760	
Phosphorus (Total)	mg/L		4.0623	7.0160	3.8014	2.9273	<0.0012	0.8859	<0.0012	10.410	40.853	
Organic Indicators												
Biological Oxygen Demand	mg/L		125	752	88	69	<4	38	8	651	11,700	
Chemical Oxygen Demand	mg/L		1,890	>5,000	1,360	670	45	880	49	3,510	>5,000	
Metals												
Total Arsenic (As)	mg/L	1.9	0.009381	0.021305	0.002630	<0.000017	<0.000017	<0.000017	<0.000017	0.14818	0.016237	
Total Barium (Ba)	mg/L	29	0.794767	0.69706	0.83064	0.22505	0.10242	0.27728	0.13741	0.22320	0.22856	
Total Beryllium (Be)	mg/L	0.067	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	
Total Cadmium (Cd)	mg/L	0.0027	<0.000007	<0.000007	<0.000007	<0.000007	<0.000007	<0.000007	<0.000007	<0.000007	<0.000007	
Total Calcium (Ca)	mg/L		206.48	206.52	286.81	285.62	104.35	143.31	147.47	149.19	1,255.70	
Total Chromium (Cr)	mg/L	0.81	0.22424	0.18580	0.05984	0.02000	0.00332	0.02885	<0.00004	0.36729	0.19416	
Total Chromium (Hexavalent)	ug/L	140	<10	<10	<10	<10	<0.50	<10	<0.50	<10	<10	
Total Copper (Cu)	mg/L	0.087	0.017658	0.012241	0.059827	0.007284	0.003025	0.037759	0.013629	0.035131	0.009577	
Total Iron (Fe)	mg/L		12.761	6.2439	18.107	6.8711	0.33866	2.3165	0.57026	3.7702	20.568	
Total Lead (Pb)	mg/L	0.025	0.006801	0.002310	0.017148	<0.000065	<0.000065	0.005987	<0.000065	0.011731	<0.000065	
Total Magnesium (Mg)	mg/L		626.66	441.11	793.38	410.36	77.671	382.63	105.86	900.25	483.22	
Total Manganese (Mn)	mg/L		0.25812	0.72943	0.78991	0.59571	0.30266	0.24019	0.43188	0.21748	7.6511	
Total Mercury (Hg)	ug/L	2.8	0.0260	0.0140	<0.050	0.0060	<0.0050	0.0130	<0.0050	0.0370	0.0180	
Total Nickel (Ni)	mg/L	0.49	0.44968	0.35750	0.29358	0.11698	0.015250	0.25372	0.038765	0.81611	0.32406	
Total Potassium (K)	mg/L		785.97	603.91	554.62	286.26	19.491	386.69	63.757	961.08	550.01	
Dissolved Selenium (Se)	ug/L	63 *	1.91	1.69	1.01	1.07	<0.50	1.22	<0.50	<5.0	2.46	
Total Silver (Ag)	ug/L	1.5	0.218	0.122	<0.10	<0.10	<0.10	0.134	<0.010	0.22	<0.10	
Total Sodium (Na)	mg/L	2,300	1,979.8	1,832.5	1,678.6	880.4	76.460	1,165.2	113.76	3,163.9	1,390.3	
Total Zinc (Zn)	mg/L	1.1	0.18283	1.7838	0.38668	0.27311	0.29343	0.24964	0.04582	0.47484	1.0797	
Extractables												
Benzo (a) Pyrene (PAH)	ug/L	0.81	0.0196	0.640	9.76	0.0331	0.0519	0.0259	0.0160	0.0174	<0.0050	
Anthracene	ug/L	2.4	0.223	3.78	13.4	0.388	0.043	0.125	0.020	0.032	0.048	
4'4' Methylenebis 2 Chloroaniline	ug/L		<5.0	<5.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	
Benzo (a) anthracene (PAH)	ug/L	4.7	0.095	2.04	20.2	0.112	0.053	0.072	0.010	0.035	0.027	
Benzo (b,j) fluoroanthene (PAH)	ug/L		0.031	1.16	13.5	0.042	0.155	0.042	0.033	0.016	<0.010	
Benzo (g,h,i) Perylene (PAH)	ug/L	0.2	0.034	1.03	5.10	<0.020	0.032	0.035	<0.020	<0.020	<0.020	
Hexachlorobenzene	ug/L	3.1	<1.0	<5.0	<5.0	<1.0	<1.0	<1.0	<1.0	<0.080	<0.40	
Phenanthrene	ug/L	580	1.41	14.7	48.2	1.55	0.184	0.874	<0.050	0.172	0.235	
Phenols	ug/L	12,000	92	51	95	31.2	3.6	30	2.6	680	3,020	


Note: Criteria from Ontario Ministry of the Environment. (2011, July 1). Soil, Ground Water and Sediment Standards for Use Under Part XV.I of the Environmental Protection Act Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition

*Criteria for total chloride and total selenium.

NR - no result due to equipment malfunction

NA - not analyzed as sample matrix was incompatible with instrumentation

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			Table 8. 2019 Leachate Monitoring									
			LQ25-MH3	LQ25-MH8	LQ25-MH13	LQ25-MH24	LQ25-MH27	LQ25-MH31	LQ25-MH34	RISER 1	LQ25-MH46	Composite
Sampling Date	Units	Criteria	11-Sep	11-Sep	11-Sep	11-Sep	11-Sep	11-Sep	11-Sep	10-Sep	10-Sep	13-Sep
Petroleum Hydrocarbons												
CCME Petroleum Hydrocarbon Fraction F1	ug/L	750	730	<100	740	<100	<100	<100	<100	290	780	
CCME Petroleum Hydrocarbon Fraction F2	ug/L	150	1,830	3,940	2,470	720	<100	460	<100	1,870	6,740	
CCME Petroleum Hydrocarbon Fraction F3	ug/L	500	8,450	78,500	13,000	1,880	<250	4,500	<250	1,220	2,450	
CCME Petroleum Hydrocarbon Fraction F4	ug/L	500	1,540	13,900	1,480	<250	<250	790	<250	<250	<250	
Volatile Organic Carbons												
Vinyl Chloride	ug/L	1.7	0.94	0.84	2.02	<0.50	<0.50	<0.50	<0.50	0.95	0.62	
1,4 Dichlorobenzene	ug/L	67	8.7	4.0	9.2	<1.0	<1.0	1.3	<1.0	1.6	1.3	
Chloroform	ug/L	22	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	
Trichloroethene	ug/L	17	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	2.74	
Tetrachloroethene	ug/L	17	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.59	
Dioxins and Furans												
2,3,7,8-TCDD	pg/L	23,000										<2.0
1,2,3,7,8-PeCDD	pg/L	23,000										<0.80
1,2,3,4,7,8-HxCDD	pg/L	23,000										<0.83
1,2,3,6,7,8-HxCDD	pg/L	23,000										3.79
1,2,3,7,8,9-HxCDD	pg/L	23,000										1.86
1,2,3,4,6,7,8-HpCDD	pg/L	23,000										183
OCDD	pg/L	23,000										1,340
Total TCDD	pg/L	23,000										<2.0
Total PeCDD	pg/L	23,000										38.6
Total HxCDD	pg/L	23,000										324
Total HpCDD	pg/L	23,000										569
2,3,7,8-TCDF	pg/L	23,000										<0.89
1,2,3,7,8-PeCDF	pg/L	23,000										<0.56
2,3,4,7,8-PeCDF	pg/L	23,000										0.66
1,2,3,4,7,8-HxCDF	pg/L	23,000										1.06
1,2,3,6,7,8-HxCDF	pg/L	23,000										1.32
1,2,3,7,8,9-HxCDF	pg/L	23,000										1.10
2,3,4,6,7,8-HxCDF	pg/L	23,000										0.97
1,2,3,4,6,7,8-HpCDF	pg/L	23,000										9.46
1,2,3,4,7,8,9-HpCDF	pg/L	23,000										1.00
OCDF	pg/L	23,000										20.0
Total TCDF	pg/L	23,000										4.11
Total PeCDF	pg/L	23,000										<0.56
Total HxCDF	pg/L	23,000										11.4
Total HpCDF	pg/L	23,000										9.46
Polychlorinated Biphenyls												
Aroclor 1016	ug/L		<0.040	<8.0	<0.20	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	
Aroclor 1221	ug/L		<0.040	<8.0	<0.20	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	
Aroclor 1232	ug/L		<0.040	<8.0	<0.20	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	
Aroclor 1242	ug/L		<0.15	<46	<3.0	<0.40	<0.040	<0.16	<0.040	<0.15	<0.42	
Aroclor 1248	ug/L		<0.040	<8.0	<0.20	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	
Aroclor 1254	ug/L		<0.065	<8.0	<0.25	<0.060	<0.040	<0.040	<0.040	<0.040	<0.040	
Aroclor 1260	ug/L		<0.040	<8.0	<0.20	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	
Total PCBs	ug/L	15	<0.20	<52	3.1	<0.45	<0.12	<0.20	<0.12	<0.20	<0.44	
Pesticides and Herbicides												
Diazinon	ug/L		<0.10	<19	<3.5	<0.25	<0.10	<0.55	<0.25	0.21	0.30	
2,4-D	ug/L		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	6	
Aldrin	ug/L	8.5	<1.0	<50	<50	<1.0	<1.0	<1.0	<1.0	<0.080	<0.40	
gamma-Hexachlorocyclohexane (Lindane)	ug/L	1.2	<1.0	<50	<50	<1.0	<1.0	<1.0	<1.0	<0.080	<0.40	
MCPA	ug/L		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Mirex	ug/L		<1.0	<50	<50	<1.0	<1.0	<1.0	<1.0	<0.080	<0.40	
Methoxychlor	ug/L	6.5	<1.0	<50	<50	<1.0	<1.0	<1.0	<1.0	<0.080	<0.40	
Bacteria												
Total Coliforms	MPN/100mL		>24,200	>24,200	15,500	>24,200	>2,420	>24,200	770	>24,200	>24,200	
Fecal Coliforms	MPN/100mL		620	780	50	17,300	3	2,140	2	200	24,200	
E. coli	MPN/100mL		520	1,090	100	15,500	<1	1,900	5	110	6,130	

Note: Criteria from Ontario Ministry of the Environment. (2011, July 1). Soil, Ground Water and Sediment Standards for Use Under Part XVI.I of the Environmental Protection Act Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition

Client File No. 5556.00

Manitoba Environment Act Licence No. 3081 R

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**Water and Waste
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Table 9. 2019 Leachate Quality Comparison

			2015	2016	2017	2018	2019
			Average	Average	Average	Average	Average
Sampling Date	Units	Criteria					
Field Parameters							
pH	units		6.98	7.41	7.63	7.28	7.79
Turbidity - NTU	ntu		21.4	37.9	119	298	166
Specific Conductivity	uS/cm		6,493	4,278	9,046	10,580	8,663
Temperature	°C		NA	NA	NA	13.8	13.9
Inorganic Parameters							
Alkalinity - Bicarbonate	mg/L		2,937	4,276	4,479	4,270	4,059
Alkalinity - Carbonate	mg/L		<5.0	130	<5.0	<3.0	<3.0
Alkalinity - Hydroxide	mg/L		<5.0	<5.0	<5.0	<3.0	<3.0
Alkalinity - Total	mg/L		2,406	3,720	3,672	4,270	4,059
Hardness (as CaCO ₃)	mg/L		1,575	1,708	1,966	2,106	773
pH - units	units		7.57	7.24	7.35	7.06	7.24
Specific Conductivity	uS/cm		6,776	10,604	10,494	11,131	11,170
Turbidity - NTU	ntu		108	193	128	136	100
Total Dissolved Solids	mg/L		4,584	6,057	5,864	6,140	6,348
Total Suspended Solids	mg/L		245	13,543	579	789	635
Total Solids	mg/L		NA	NA	NA	6,924	6,980
Chloride (dissolved)	mg/L	2300 *	744	1,060	1,222	1,163	2,183
Sulphate (dissolved)	mg/L		128	115	273	164	205
Other							
Cyanide (CN)	ug/L	66	10.3	10.4	8.0	21.4	14.2
Nutrients							
Dissolved Ammonia	mg/L		250	570	504	243	545
Nitrate Nitrogen	mg/L		0.159	0.310	1.35	8.48	1.01
Total Kjeldhal Nitrogen	mg/L		304	276	621	342	699
Phosphorus (Total)	mg/L		1.87	3.32	3.29	2.12	7.77
Organic Indicators							
Biological Oxygen Demand	mg/L		64	583	726	1,347	1,493
Chemical Oxygen Demand	mg/L		902	1,140	2,540	2,367	2,045
Metals							
Total Arsenic (As)	mg/L	1.9	0.0115	0.0139	0.0248	0.0321	0.0220
Total Barium (Ba)	mg/L	29	0.401	0.372	0.376	0.382	0.391
Total Beryllium (Be)	mg/L	0.067	0.03126	0.00014	0.00012	0.00113	<0.00003
Total Cadmium (Cd)	mg/L	0.0027	0.000195	0.000307	0.000308	0.000452	<0.000007
Total Calcium (Ca)	mg/L		129	147	212	236	309
Total Chromium (Cr)	mg/L	0.81	0.0315	0.0635	0.0724	0.0756	0.1354
Total Chromium (Hexavalent)	mg/L		<0.0010	0.0050	0.0135	<0.010	<10
Total Copper (Cu)	mg/L	0.087	0.0080	0.0084	0.0128	0.0291	0.0218
Total Iron (Fe)	mg/L		10.7	6.8	18.8	20.1	7.9
Total Lead (Pb)	mg/L	0.025	0.00718	0.01072	0.01008	0.01057	0.00490
Total Magnesium (Mg)	mg/L		248	279	329	368	469
Total Manganese (Mn)	mg/L		1.018	0.437	0.832	1.129	1.246
Total Mercury (Hg)	ug/L	2.8	0.004	0.002	0.021	0.273	0.016
Total Nickel (Ni)	mg/L	0.49	0.1222	0.1546	0.1541	0.2522	0.2962
Total Potassium (K)	mg/L		254	314	292	364	468
Dissolved Selenium (Se)	ug/L	63 *	173.3	0.90	1.20	1.86	1.37
Total Silver (Ag)	ug/L	1.5	0.095	0.150	0.090	0.336	0.095
Total Sodium (Na)	mg/L	2,300	598	824	835	1,115	1,365
Total Zinc (Zn)	mg/L	1.1	0.0545	1.18	0.453	0.206	0.530

Note: Criteria from Ontario Ministry of the Environment. (2011, July 1). Soil, Ground Water and Sediment Standards for Use Under Part XV.I of the Environmental Protection Act Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition
*Criteria for total chloride and total selenium

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Table 9. 2019 Leachate Quality Comparison

			2015	2016	2017	2018	2019
Sampling Date	Units	Criteria	Average	Average	Average	Average	Average
Extractables							
Benzo (a) Pyrene (PAH)	ug/L	0.81	13.75	0.79	0.26	0.75	1.17
Anthracene	ug/L	2.4	13.75	1.05	0.89	1.33	2.01
4'4' Methylenebis 2 Chloroaniline	ug/L		NA	NA	<50	<50	<5.0
Benzo (a) anthracene (PAH)	ug/L	4.7	13.75	1.23	0.89	1.13	2.52
Benzo (b/j) fluoroanthene (PAH)	ug/L		<50	1.4	0.49	1.17	1.66
Benzo (g,h,i) Perylene (PAH)	ug/L	0.2	13.75	0.725	0.33	1.03	0.697
Hexachlorobenzene	ug/L	3.1	<0.050	<0.050	<0.30	<5.0	<5.0
Phenanthrene	ug/L	580	0.621	3.74	2.05	5.13	7.48
Phenol	ug/L	12,000	221	391	677	276	445
Petroleum Hydrocarbons							
CCME Petroleum Hydrocarbon Fraction F1	ug/L	750	186	111	450*	114	310
CCME Petroleum Hydrocarbon Fraction F2	ug/L	150	<100	171	230*	20,150	2,014
CCME Petroleum Hydrocarbon Fraction F3	ug/L	500	<200	<200	410*	371,200	12,250
CCME Petroleum Hydrocarbon Fraction F4	ug/L	500	<200	<200	<200*	56,300	2,037
Volatile Organic Carbons							
Vinyl Chloride	ug/L	1.7	1.84	<40	<40	0.50	0.71
1,4 Dichlorobenzene	ug/L	67	2.4	5.1	5.8	2.2	3.1
Chloroform	ug/L	22	<5.0	<20	<20	<0.50	<0.50
Trichloroethene	ug/L	17	<5.0	<20	<20	0.29	0.53
Tetrachloroethene	ug/L	17	<5.0	<20	<20	0.39	<0.50
Polychlorinated Biphenyls							
Aroclor 1016	ug/L		<0.50	<0.50	<0.50	<2.0	<8.0
Aroclor 1221	ug/L		<0.50	<0.50	<0.50	<2.0	<8.0
Aroclor 1232	ug/L		<0.50	<0.50	<0.50	<2.0	<8.0
Aroclor 1242	ug/L		<0.50	0.11	<0.50	<8.0	<3.0
Aroclor 1248	ug/L		<0.50	<0.50	<0.50	<2.0	<8.0
Aroclor 1254	ug/L		<0.50	0.09	<0.50	<7.0	<8.0
Aroclor 1260	ug/L		<0.50	0.10	<0.50	<4.0	<8.0
Total PCBs	ug/L	15	<0.50	0.10	<3.0	<13.0	3.3
Pesticides and Herbicides							
Diazinon	ug/L		<40	<10	<320	<172	<3.5
2, 4-D	mg/L		<0.020	<2.0	<1.0	0.0024	1.1
Aldrin	ug/L	8.5	<0.05	<0.05	<0.30	<5.0	<5.0
gamma-Hexachlorocyclohexane (Lindane)	ug/L	1.2	<0.03	<0.03	<0.20	<91.0	<5.0
MCPA	mg/L		<0.040	<4.0	<2.0	<0.0050	<1.0
Mirex	ug/L		<0.20	<0.05	<0.30	<5.0	<5.0
Methoxychlor	ug/L	6.5	<0.10	<0.10	<0.70	<5.0	<5.0
Bacteria							
Total Coliforms	MPN/100mL		141,751	4,859	6,158	15,448	18,210
Fecal Coliforms	MPN/100mL		144,943	323	243	3,211	5,033
E. coli	MPN/100mL		139,665	322	193	4,453	2,817

Note: Criteria from Ontario Ministry of the Environment. (2011, July 1). Soil, Ground Water and Sediment Standards for Use Under Part XV.I of the Environmental Protection Act Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition
* Manhole 31 results not included in average due to pump malfunction

BRADY ROAD RESOURCE MANAGEMENT FACILITY ANNUAL REPORT – 2019**5.4 LANDFILL GAS**

5.4.1 COLLECTION AND FLARING SYSTEM

Landfill gas (LFG) produced at the BRRMF is comprised primarily of methane (CH₄) and carbon dioxide (CO₂) in approximately equal amounts. These greenhouse gases contribute to global warming, but CH₄ has a global warming potential 25 times that of CO₂. To reduce emissions, the LFG is collected via a series of pipes beneath the BRRMF, and sent to a flare where the CH₄ is reduced to CO₂ and water vapour. The landfill gas collection and flaring system (LFGCFS) is run by Integrated Gas Recovery Systems Inc. on behalf of the City of Winnipeg.

As per the BRRMF Operating Plan, LFG operations and monitoring are managed through the Landfill Gas Operating Plan, submitted October 23, 2014, as per Clause 110.

In 2019, the BRRMF LFGCFS operated as intended, although surface emission monitoring identified some areas where gas was escaping due to weak surface cap and/or manholes with improper seals. Blockages in two sections of underground pipe identified in 2018 were repaired in 2019.

The 2019 Landfill Gas Collection and Flaring Report, prepared by Integrated Gas Recovery Services Inc., is attached in Appendix E.

5.4.2 SUBSURFACE LANDFILL GAS MONITORING PROGRAM

LFG that is not collected or that cannot escape into the atmosphere may migrate into neighbouring land below the ground surface. The purpose of LFG migration monitoring is to detect gas migration before it becomes a safety hazard to neighbouring properties.

As per the BRRMF Operating Plan, subsurface LFG migration is managed in accordance with the Subsurface Landfill Gas Monitoring Program, submitted on October 23, 2014, as specified under Clause 111. Probes are monitored monthly for methane (CH₄), oxygen (O₂), carbon monoxide (CO), and hydrogen sulphide (H₂S).

In 2019, the maximum level of CH₄ measured was 0.1%. The Subsurface Landfill Gas Contingency Plan was not activated, indicating that the LFGCFS is operating effectively.

The 2019 subsurface gas migration probe data is provided in Table 10.



Table 10. 2019 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S	
		% LEL	(%)	PPM	PPM	
1	10-Jan-19	0.0	22.5	0.0	0.0	
	11-Feb-19	0.0	20.0	0.0	0.0	
	15-Mar-19	0.0	16.7	0.0	0.0	
	18-Apr-19	0.0	16.8	0.0	0.0	
	27-May-19	0.1	17.9	0.0	0.0	
	6-Jun-19	0.0	16.7	1.0	0.0	
	10-Jul-19	0.0	18.5	1.0	0.0	
	8-Aug-19	No Access due to construction				
	17-Sep-19	No Access due to construction				
	8-Oct-19	0.0	19.1	0.0	0.0	
	15-Nov-19	0.0	18.7	1.0	0.0	
	10-Dec-19	0.0	23.8	0.0	0.0	
2	10-Jan-19	0.0	21.1	0.0	0.0	
	11-Feb-19	0.0	20.9	0.0	0.0	
	15-Mar-19	0.0	19.1	0.0	0.0	
	18-Apr-19	0.0	16.1	0.0	0.0	
	27-May-19	0.0	19.4	0.0	0.0	
	6-Jun-19	0.0	17.4	1.0	0.0	
	10-Jul-19	0.0	18.9	0.0	0.0	
	8-Aug-19	No Access due to construction				
	17-Sep-19	No Access due to construction				
	8-Oct-19	0.0	18.7	0.0	0.0	
	15-Nov-19	0.0	19.1	0.0	0.0	
	10-Dec-19	0.0	22.9	0.0	0.0	
3	10-Jan-19	0.0	21.0	0.0	0.0	
	12-Feb-19	0.0	20.8	0.0	0.0	
	15-Mar-19	0.0	20.1	0.0	0.0	
	18-Apr-19	0.0	21.3	0.0	0.0	
	27-May-19	0.0	19.6	0.0	0.0	
	7-Jun-19	0.0	18.3	0.0	0.0	
	10-Jul-19	0.0	18.5	0.0	0.0	
	9-Aug-19	0.0	19.8	0.0	0.0	
	17-Sep-19	0.0	14.4	0.0	0.0	
	8-Oct-19	0.0	19.7	0.0	0.0	
	15-Nov-19	0.0	19.6	0.0	0.0	
	10-Dec-19	0.0	23.8	0.0	0.0	

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Table 10. 2019 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S
		% LEL	(%)	PPM	PPM
4	10-Jan-19	0.0	21.2	1.0	0.0
	12-Feb-19	0.0	20.9	0.0	0.0
	15-Mar-19	0.0	20.2	0.0	0.0
	18-Apr-19	0.0	22.5	0.0	0.0
	27-May-19	0.0	20.2	0.0	0.0
	7-Jun-19	0.0	19.3	0.0	0.0
	10-Jul-19	0.0	19.1	0.0	0.0
	9-Aug-19	0.0	20.1	0.0	0.0
	17-Sep-19	0.0	18.2	0.0	0.0
	8-Oct-19	0.1	19.7	0.0	0.0
	15-Nov-19	0.0	19.5	0.0	0.0
	10-Dec-19	0.0	22.7	0.0	0.0
5	10-Jan-19	0.0	22.0	0.0	0.0
	12-Feb-19	0.0	21.8	0.0	0.0
	15-Mar-19	0.0	22.0	0.0	0.0
	18-Apr-19	0.0	21.8	0.0	0.0
	27-May-19	0.0	20.0	0.0	0.0
	7-Jun-19	0.0	18.5	0.0	0.0
	10-Jul-19	0.0	19.6	0.0	0.0
	9-Aug-19	0.0	20.5	0.0	0.0
	17-Sep-19	0.0	16.2	0.0	0.0
	8-Oct-19	0.1	20.5	0.0	0.0
	15-Nov-19	0.0	20.3	0.0	0.0
	10-Dec-19	0.0	22.7	0.0	0.0
6	10-Jan-19	0.0	21.5	0.0	0.0
	12-Feb-19	0.0	21.1	0.0	0.0
	15-Mar-19	0.0	19.4	0.0	0.0
	18-Apr-19	0.0	20.4	0.0	0.0
	27-May-19	0.0	20.7	0.0	0.0
	6-Jun-19	0.0	19.4	1.0	0.0
	10-Jul-19	0.0	19.2	0.0	0.0
	9-Aug-19	0.0	19.5	0.0	0.0
	18-Sep-19	0.0	19.2	0.0	0.0
	7-Oct-19	0.0	19.5	0.0	0.0
	15-Nov-19	0.0	19.3	0.0	0.0
	10-Dec-19	No Access			

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Table 10. 2019 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S
		% LEL	(%)	PPM	PPM
7	10-Jan-19	0.0	21.3	0.0	0.0
	14-Feb-19	0.0	20.3	0.0	0.0
	15-Mar-19	0.0	19.7	0.0	0.0
	18-Apr-19	0.0	17.4	0.0	0.0
	27-May-19	0.0	19.0	0.0	0.0
	6-Jun-19	0.0	18.2	1.0	0.0
	10-Jul-19	0.0	19.4	0.0	0.0
	9-Aug-19	0.0	20.3	0.0	0.0
	18-Sep-19	0.0	18.7	0.0	0.0
	7-Oct-19	0.0	20.1	0.0	0.0
	15-Nov-19	0.0	18.4	0.0	0.0
	10-Dec-19	0.0	20.9	0.0	0.0
8	10-Jan-19	0.0	21.8	0.0	0.0
	14-Feb-19	0.0	21.5	0.0	0.0
	15-Mar-19	0.0	20.2	1.0	0.0
	18-Apr-19	0.0	18.0	0.0	0.0
	27-May-19	0.0	20.0	0.0	0.0
	6-Jun-19	0.0	18.8	1.0	0.0
	10-Jul-19	0.0	19.0	0.0	0.0
	9-Aug-19	0.0	20.5	0.0	0.0
	18-Sep-19	0.0	18.6	0.0	0.0
	7-Oct-19	0.0	18.4	0.0	0.0
	15-Nov-19	0.0	18.0	0.0	0.0
	10-Dec-19	0.0	20.9	0.0	0.0
9	10-Jan-19	0.0	21.3	0.0	0.0
	14-Feb-19	0.0	21.0	1.0	0.0
	15-Mar-19	0.0	19.1	1.0	0.0
	18-Apr-19	0.0	18.9	0.0	0.0
	27-May-19	0.0	19.2	0.0	0.0
	6-Jun-19	0.0	17.5	1.0	0.0
	10-Jul-19	0.0	18.7	0.0	0.0
	9-Aug-19	0.0	20.7	0.0	0.0
	18-Sep-19	0.0	20.8	0.0	0.0
	7-Oct-19	0.0	19.6	0.0	0.0
	15-Nov-19	0.0	19.2	0.0	0.0
	10-Dec-19	0.0	20.8	0.0	72.0

Client File No. 5556.00

Manitoba Environment Act Licence No. 3081 R



Table 10. 2019 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S
		% LEL	(%)	PPM	PPM
10	10-Jan-19	0.0	21.8	0.0	0.0
	14-Feb-19	0.0	21.0	0.0	0.0
	15-Mar-19	0.0	19.7	1.0	0.0
	18-Apr-19	0.0	14.3	0.0	0.0
	27-May-19	0.0	21.0	0.0	0.0
	6-Jun-19	0.0	19.6	1.0	0.0
	10-Jul-19	0.0	19.3	0.0	0.0
	9-Aug-19	0.0	20.9	0.0	0.0
	18-Sep-19	0.0	20.9	0.0	0.0
	7-Oct-19	0.0	19.8	0.0	0.0
	15-Nov-19	0.0	20.2	0.0	0.0
	10-Dec-19	0.0	20.8	0.0	0.0
P28E	10-Jan-19	0.0	22.8	0.0	0.0
	14-Feb-19	0.0	21.6	0.0	0.0
	15-Mar-19	0.0	21.2	0.0	0.0
	18-Apr-19	0.0	20.9	0.0	0.0
	27-May-19	0.0	20.5	0.0	0.0
	6-Jun-19	0.0	20.0	0.0	0.0
	10-Jul-19	0.0	18.1	0.0	0.0
	9-Aug-19	0.0	18.4	0.0	0.0
	18-Sep-19	0.0	18.9	0.0	0.0
	7-Oct-19	0.0	18.5	0.0	0.0
	15-Nov-19	0.0	20.3	0.0	0.0
	10-Dec-19	0.0	20.3	0.0	0.0
P30ER	10-Jan-19	0.0	22.4	0.0	0.0
	14-Feb-19	0.0	21.6	0.0	0.0
	15-Mar-19	0.0	19.4	1.0	0.0
	18-Apr-19	0.0	19.0	0.0	0.0
	27-May-19	0.0	21.1	0.0	0.0
	6-Jun-19	0.0	20.1	0.0	0.0
	10-Jul-19	0.0	19.4	0.0	0.0
	9-Aug-19	0.0	20.1	0.0	0.0
	18-Sep-19	0.0	18.8	1.0	0.0
	7-Oct-19	0.0	19.3	0.0	0.0
	15-Nov-19	0.0	19.8	0.0	0.0
	10-Dec-19	0.0	21.8	0.0	0.0



Table 10. 2019 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S
		% LEL	(%)	PPM	PPM
P34ER	10-Jan-19	0.0	22.1	0.0	0.0
	14-Feb-19	0.0	18.2	0.0	0.0
	15-Mar-19	0.0	19.9	0.0	0.0
	18-Apr-19	0.0	20.5	0.0	0.0
	27-May-19	0.0	21.0	0.0	0.0
	6-Jun-19	0.0	20.0	0.0	0.0
	10-Jul-19	0.0	20.1	0.0	0.0
	9-Aug-19	0.0	20.0	0.0	0.0
	18-Sep-19	0.0	18.2	0.0	0.0
	8-Oct-19	0.0	18.2	0.0	0.0
	15-Nov-19	0.0	20.5	0.0	0.0
	10-Dec-19	0.0	20.9	0.0	0.0
P106E	10-Jan-19	0.0	21.2	0.0	0.0
	11-Feb-19	0.1	18.6	0.0	0.0
	15-Mar-19	0.1	18.6	0.0	0.0
	18-Apr-19	0.0	20.6	0.0	0.0
	27-May-19	0.1	20.5	0.0	0.0
	6-Jun-19	0.1	19.7	0.0	0.0
	10-Jul-19	0.0	18.4	0.0	0.0
	8-Aug-19	0.0	20.2	0.0	0.0
	17-Sep-19	0.0	17.4	0.0	0.0
	7-Oct-19	0.0	19.9	0.0	0.0
	15-Nov-19	0.1	19.9	0.0	0.0
	10-Dec-19	0.0	20.1	0.0	0.0
P107E	10-Jan-19	0.0	21.5	0.0	0.0
	11-Feb-19	0.0	16.6	0.0	0.0
	15-Mar-19	0.1	18.6	0.0	0.0
	18-Apr-19	0.0	17.4	0.0	0.0
	27-May-19	0.0	19.0	0.0	0.0
	6-Jun-19	0.0	18.9	0.0	0.0
	10-Jul-19	0.0	20.9	0.0	0.0
	8-Aug-19	0.0	19.5	0.0	0.0
	17-Sep-19	0.0	17.6	0.0	0.0
	7-Oct-19	0.1	19.1	0.0	0.0
	15-Nov-19	0.0	19.9	0.0	0.0
	10-Dec-19	0.0	20.6	0.0	0.0

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Table 10. 2019 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S	
		% LEL	(%)	PPM	PPM	
P108E	10-Jan-19	0.0	21.5	0.0	0.0	
	11-Feb-19	0.0	19.9	0.0	0.0	
	15-Mar-19	0.0	20.3	0.0	0.0	
	18-Apr-19	0.0	20.8	0.0	0.0	
	27-May-19	0.0	20.7	0.0	0.0	
	6-Jun-19	0.0	19.8	0.0	0.0	
	10-Jul-19	0.0	19.0	0.0	0.0	
	8-Aug-19	0.0	20.1	0.0	0.0	
	17-Sep-19	0.0	19.4	0.0	0.0	
	7-Oct-19	0.1	19.1	0.0	0.0	
	15-Nov-19	0.0	20.0	0.0	0.0	
	10-Dec-19	No Access				
P109E	10-Jan-19	No Access				
	11-Feb-19	No Access				
	15-Mar-19	No Access				
	18-Apr-19	No Access				
	27-May-19	0.0	17.7	0.0	0.0	
	6-Jun-19	0.0	17.1	0.0	0.0	
	10-Jul-19	0.0	16.5	0.0	0.0	
	8-Aug-19	0.0	17.3	0.0	0.0	
	17-Sep-19	0.0	14.7	0.0	0.0	
	7-Oct-19	0.0	19.9	0.0	0.0	
	15-Nov-19	0.0	20.0	0.0	0.0	
	10-Dec-19	0.0	21.9	0.0	0.0	
P110E	10-Jan-19	0.0	21.5	0.0	0.0	
	11-Feb-19	0.0	20.7	0.0	0.0	
	15-Mar-19	0.0	19.9	0.0	0.0	
	18-Apr-19	0.0	20.3	0.0	0.0	
	27-May-19	0.0	6.5	0.0	0.0	
	6-Jun-19	0.0	13.2	0.0	0.0	
	10-Jul-19	0.0	0.0	0.0	0.0	
	8-Aug-19	0.0	20.3	0.0	0.0	
	17-Sep-19	0.0	16.5	0.0	0.0	
	7-Oct-19	0.0	19.9	0.0	0.0	
	15-Nov-19	0.0	20.1	0.0	0.0	
	10-Dec-19	0.0	18.7	0.0	0.0	



Table 10. 2019 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S
		% LEL	(%)	PPM	PPM
P111E	10-Jan-19	0.0	21.5	0.0	0.0
	11-Feb-19	0.0	20.7	0.0	0.0
	15-Mar-19	0.0	18.6	0.0	0.0
	18-Apr-19	0.0	20.9	0.0	0.0
	27-May-19	0.0	20.6	0.0	0.0
	6-Jun-19	0.0	19.5	1.0	0.0
	10-Jul-19	0.0	20.1	0.0	0.0
	8-Aug-19	0.0	20.4	0.0	0.0
	17-Sep-19	0.0	20.1	0.0	0.0
	7-Oct-19	0.1	20.1	0.0	0.0
	15-Nov-19	0.0	20.1	0.0	0.0
	10-Dec-19	0.0	22.8	0.0	0.0
P112E	10-Jan-19	0.1	23.4	0.0	0.0
	11-Feb-19	0.0	21.7	0.0	0.0
	15-Mar-19	0.1	20.3	0.0	0.0
	18-Apr-19	0.0	21.2	0.0	0.0
	27-May-19	0.0	20.7	0.0	0.0
	6-Jun-19	0.0	19.5	1.0	0.0
	10-Jul-19	0.0	20.2	0.0	0.0
	8-Aug-19	0.0	20.2	0.0	0.0
	17-Sep-19	0.0	19.9	0.0	0.0
	7-Oct-19	0.0	19.9	0.0	0.0
	15-Nov-19	0.0	20.3	0.0	0.0
	10-Dec-19	0.0	21.7	0.0	0.0

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6.0 NUISANCE MANAGEMENT

In order to reduce odour, litter, and vector nuisances at the landfill, several best practices and operating procedures are used, such as placement of screens, minimizing the working face of each cell, application of appropriate cover material (daily, intermediate, or final), site landscaping, weekly litter control patrols, and odour monitoring. If necessary, a licensed professional will apply vector control products to ensure that proper chemicals are used and properly handled. Noise is not a significant issue due to the separation from surrounding homes. Fugitive dust emissions are minimized by spraying site roads with uncontaminated surface water.

In 2019, there were 38 odour complaints from 15 customers; in all cases the source of the odour was investigated. Several of the calls came from one customer; investigations revealed that the storm sewer adjacent to their property was the source of the odour in many instances. If the source of the odour could be located within the BRRMF, we immediately covered the odour causing material, moved the tipping face to a more favorable area if available, and used compost or wood chips to reduce the odour and prevent further occurrence. Table 11 provides a summary of nuisance complaints received in 2019.

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		<h3>Table 11. 2019 Nuisance Complaint Monitoring</h3>	
Date Created	Complaint	Odours	Response
1/4/2019	Citizen reached out via Twitter, concerned with the stronger smell of rotten garbage in Bridgewater Trails coming from Brady Rd today.		<p>Responded to the resident stating we investigated your concern and have found that the atmospheric conditions and landfill operations suggest that it would be unlikely the odour originated from Brady landfill. We continuously work to reduce the impact of the landfill on our community. To control odours in and around the landfill, we</p> <ul style="list-style-type: none"> • cover garbage on a daily basis, • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system, • use dedicated trenches for dead animals and cover all loads immediately, • monitor odours in and around the landfill on a regular basis, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south , and • reduce the amount of biosolids (the nutrient-rich by-product of sewage treatment) being buried through a biosolids composting trial program.
1/5/2019	Citizen who lives in Bridgewater area, sends an email reporting foul smell in their neighborhood. Citizen would like to know if there is anything going on with Brady dump causing this and if the situation is temporary.		<p>Responded to the resident stating we investigated your concern and have found that the atmospheric conditions and landfill operations suggest that it would be likely the odour originated from Brady landfill. We continuously work to reduce the impact of the landfill on our community. To control odours in and around the landfill, we</p> <ul style="list-style-type: none"> • cover garbage on a daily basis, • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system, • use dedicated trenches for dead animals and cover all loads immediately, • monitor odours in and around the landfill on a regular basis, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south , and • reduce the amount of biosolids (the nutrient-rich by-product of sewage treatment) being buried through a biosolids composting trial program.
1/19/2019	Citizen states that they are once again experiencing a strong odour in the air in their neighbourhood which they believe is coming from the Brady Rd landfill.		<p>Responded to the resident stating we have received your complaint and are going to continue to try to reduce odour issues at the landfill. At the moment, we are working on reducing the size of the tipping face and diverting some of our dominant odour causing waste streams. We are working to reduce the amount of biosolids (the nutrient-rich by-product of sewage treatment) being buried at Brady through a soil fabrication project. We are starting our second year of this on February 4th, 2019 and this should hopefully greatly reduce some of the odour in the coming months.</p>
1/24/2019	Caller states that he can smell garbage odour at his address which comes from the city dump. Caller states that it is much stronger than it has been in the past.		<p>Responded to the resident stating we have been continuing to monitor the odour coming from Brady and noticed that with the strong south wind over the weekend, there was a distinct odour being pushed northwards. We have checked the area around your residence and did not detect any Hydrogen Sulfide. As such, we are working to reduce the size of our tipping face and hope once the weather warms up we can improve our daily cover. Additionally, I am hoping once we remove biosolids from the site (starting Monday next week) we will also see an improvement in odour.</p>
1/26/2019	Citizen is following up. Citizen states the odour is significant again and smells like meat.		<p>Spoke with resident on the phone indicating that we are continuing to monitor the odour in that area. We also spoke about directing his concerns to Waste water services, to check and see if the odour is originating from the sewer.</p>
1/31/2019	Citizen states that for the past 3 days, the odour from the Brady has been medium/low but today (January 30th), it is substantially high to the point what it can also be smelled inside my house.		<p>Spoke with resident on the phone indicating that we are continuing to monitor the odour in that area. We also spoke about directing his concerns to Waste water services, to check and see if the odour is originating from the sewer.</p>
2/18/2019	Citizen reached out for contact information regarding a sewer investigation due to continuing odour issues.		<p>Responded to the resident stating a contact at Waste Water Services and the person I have spoken with regarding the odour issues at your residence. We will continue to monitor odour and H2S levels in and around your residence this week.</p>
2/19/2019	Citizen stated that the air smells like very rotten egg.		
2/27/2019	Citizen states, "There is a strong sewer like odour happening currently"... "I am not sure if it is coming from the Brady Landfill or not. All I know is it smells like sewer and is substantial."		Sent to Sewer Odour Outside Lagan
2/27/2019	Citizen reached out again via email stating, "there is a strong sewer like odour happening currently [Feb 27 1:36pm]"		<p>Responded to the resident stating staff are out as we speak doing an odour round and following up with operations if there was anything out of the ordinary this weekend that could have caused odour from Brady. We did receive an odour complaint on Saturday March 2nd and at that time the wind was from the west at around 9 km/h and the wind on March 1st and 2nd was predominantly from the west to north west and very frigid. Resident's house is approximately north east of the landfill. This in my opinion would not be atmospheric conditions that would be conducive for Brady to be the culprit of the odour complaint as any odour would travel directly east or south east from Brady. As discussed before I believe the resident has alluded that the odour is sewer like for the most part and we have contacted Staff Member from WW and informed her of the current situation and she thinks the odour could be coming from the land drainage sewer which is very close to the resident's property and is going to investigate further. Also another interesting note is that we have not received any other odour complaints from any other residents within at least 1 km from resident's property, I am not really sure why this is but I would have thought that we would receive a few more if the odour was as debilitating as described. This could further support that the odour is more specific to the land drainage sewer than related to the landfill. Councillor's question regarding odour related to the Provincial regulations is another matter and in our license it states in clause 15 that "The Licensee shall not cause or permit an odour nuisance to be created as a result of the construction, operation, or alteration of the Development, and shall take such steps as the Director may require to eliminate or mitigate an odour nuisance" and I believe we are doing our best to mitigate odours caused from the landfill to meet Provincial regulations. I do not know what else we could say on this matter as I think this would be a question that Manitoba Sustainable Development would be better suited to answer.</p>
3/3/2019	Unfortunately, we have actually seen an uptick in odour lately (I reported the vast majority of them to 311). I believe we are experiencing odours from multiple sources - some of which I believe are coming from the sewer system and others from the landfill. I believe your team also feels that way as odours come in situations where the wind is coming from the South or the North. When it comes to the landfill in particular, what I was trying ask in my last email is, based on Provincial Legislation should I expect not to experience odours based on where I live. In speaking to long term residences of Richmond West it seems like this odour issue is something new in past few years and wasn't an issue in years prior. That leads me to conclude that something has changed and that perhaps the odour is outside of what is expected based on the Provincial Legislation. Another way of looking at it is, it would seem surprising to me that residence should expect to have strong odour in residential areas as a norm and that the Provincial Legislation would be such that there wouldn't be odours in residential areas including schools, etc. On Saturday I was literally unable to be in my own yard for more than a few minutes as the smell was so strong.		
3/2/2019	Via email citizen stated There is a medium-low grade garbage like smell now - March 2 15:58 The wind has changed direction and now there is a very substantial sewer like odour - March 2 17:26		
4/15/2019	We are experiencing an odour issue currently. Citizen has previous similar reports		<p>Responded to the resident stating we are continuing to routinely check the area in and around your residence for hydrogen sulfide and odour. The wind on Monday was coming from the south, and could have pushed odour from the landfill northbound. However, when our technologist monitored the area at 1:00pm on Monday no odour or hydrogen sulfide was detected. By Tuesday the wind had changed direction and odour would not have been directed towards your neighborhood. We also checked the area just in case on Tuesday and did not detect any odour or hydrogen sulfide. Solid Waste Services is continuing to try and improve odour issues at Brady Landfill, and we will continue to monitor neighbouring communities for odour causing gases.</p>
4/21/2019	Citizen states on April 19th there was a medium level odour around the block.		
4/21/2019	Citizen states there is a medium grade odor around the block on April 19th. Citizen has submitted similar concerns previously		Continued to monitor concerned citizen residence by checking the level of H2S and odour daily in front of their house.
5/3/2019	Citizen states there is a medium grade odor around the block and at citizen's house. He states that the odor was present around 12:00 am on May 02 and the smell was so bad that it woke them up from their sleep.		
7/11/2019	Citizen states that the whole neighbourhood smells like garbage and they can't enjoy being outside.		<p>Responded to the resident stating we investigated your concern and have found that the atmospheric conditions and landfill operations suggest that it would be likely the odour originated from Brady landfill. We continuously work to reduce the impact of the landfill on our community. To control odours in and around the landfill, we</p> <ul style="list-style-type: none"> • cover garbage on a daily basis, • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system, • use dedicated trenches for dead animals and cover all loads immediately, • monitor odours in and around the landfill on a regular basis, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south , and • reduce the amount of biosolids (the nutrient-rich by-product of sewage treatment) being buried through a biosolids composting trial program.

Client File No. 5556.00

Manitoba Environment Act Licence No. 3081 R

Brady Road Resource Management Facility Annual Report – 2019

Date Created	Complaint	Response
		Odours
7/18/2019	VIA EMAIL: The citizen stated that they are wanting to be advised why there is a very bad odour coming from the Brady Road landfill. The citizen stated that they were outside on Thursday, July 18 at 8:30 p.m. and can't even sit outside on their back yard due to the smell.	Responded to the resident stating we investigated your concern and have found that the atmospheric conditions suggest that it would be unlikely the odour originated from Brady landfill. Although, we have been going through an adjustment period with the new contractors onsite which may lead to a temporary increase in odour when atmospheric conditions are right. We continuously work to reduce the impact of the landfill on our community. To control odours in and around the landfill, we <ul style="list-style-type: none"> • cover garbage on a daily basis, • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system, • use dedicated trenches for dead animals and cover all loads immediately, • monitor odours in and around the landfill on a regular basis, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south , and • reduce the amount of biosolids (the nutrient-rich by-product of sewage treatment) being buried through a biosolids composting trial program and land application pilot program.
7/24/2019	Via E-mail, citizen reported on July 25 from 17:30 until late night there was a bad compost and garbage smell. They believe this came from the landfill. Citizen stated they could not walk outside, they got headaches and had to close their windows. Citizen would like the City to be more vigilant about the landfill.	Responded to the resident stating we will review with our operators and foreman to see if something was done differently on the 25th of July that could be corrected. We continuously working to reduce the impact of the landfill on our community. In particular, to address odour issues we: <ul style="list-style-type: none"> • cover garbage on a daily basis, • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system, • use dedicated trenches for dead animals and cover all loads immediately, • monitor odours in and around the landfill on a regular basis, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south , and • reduce the amount of biosolids (the nutrient-rich by-product of sewage treatment) being buried through a biosolids composting trial program.
8/2/2019	Caller states the odour coming from the landfill tonight is unbearable and nauseating. Caller states they cannot even open the windows the odour is so bad. Caller would appreciate if this was investigated.	Staff spoke with citizen and they raised a number of concerns with the odour at Brady. Primarily they was concerned with their health being affected by the odour at the site. I informed her that we do regular checks in the area for Hydrogen Sulfide and have yet to detect any levels that could be harmful to human health. They also mentioned that they had been informed when they purchased the house that the landfill was going to be closed very soon. I informed them that this is incorrect and that the landfill will remain open for the foreseeable future. I also mentioned the various initiatives we are taking to reduce the odour. This includes improving our cap and increasing our landfill gas system. They remain weary of the site and states they get headaches from the odour. They ended the call mentioning that they wished they hadn't purchased in the area given the fact that the landfill is going to stay there.
8/14/2019	Resident states that the odor from the landfill is worse today. She had to go in the house as the smell is giving her a headache. This is an ongoing issue and she is worried about how this will affect her health in the long run.	Staff spoke with the concerned citizen . We will add their address to our odour round route. They are worried the odour will affect their health.
8/14/2019	The caller advised that since 19:00 today the caller can smell a garbage smell from Brady.	Staff spoke with concerned citizen and explained that we are doing work to expand our landfill gas system and this is causing a spike in odour coming from the landfill. Citizen was very appreciative of the work we are doing and understood the importance of expanding this system.
8/14/2019	Citizen is phoning in to complain about the smell coming from Brady road landfill. Citizen claims the smell coming from brady is so bad right now that she is unable to keep her windows open.	Staff left a message to call return call and explained what Brady was doing to mitigate odours and explained that we are doing work to expand our landfill gas system and this is causing a spike in odour coming from the landfill.
8/17/2019	Citizen emailed to report odour from the Brady Landfill.	Staff spoke with concerned citizen and explained that we are currently working to expand our landfill gas system, which has caused a spike in odour issues. They were understanding and seemed encouraged that we are working to try and mitigate the problem. They will continue to contact us with further odour concerns.
9/10/2019	Citizen emailed 'I would like to report a sulphur like odour in the area.	Responded to the resident stating that we continue to monitor odour in and around your residence. We have not detected any hydrogen sulfide in your neighbourhood , although we have noticed an garbage like odour in the last couple of days closer to the landfill. This issue has been mentioned to the foreman and supervisors at Brady. I believe it is partially attributed to the expansion of our landfill gas collection system, once this work is complete some of the odour issue should be mitigated. We will continue to monitor your neighbourhood and the surrounding area for the foreseeable future.
9/23/2019	Citizen states there the landfill smells really bad right now.	Responded to the resident stating we investigated your concern and have found that the atmospheric conditions and current landfill operations suggest that it would be likely the odour originated from Brady landfill. We apologize for any inconvenience this may have caused and we are working to address the issue to reduce the impact of the landfill on our community. To control odours in and around the landfill, we <ul style="list-style-type: none"> • cover garbage on a daily basis, • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system, • use dedicated trenches for dead animals and cover all loads immediately, • monitor odours in and around the landfill on a regular basis, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south , and • reduce the amount of biosolids (the nutrient-rich by-product of sewage treatment) being buried through a biosolids composting trial program.
10/4/2019	Citizen emailed 311 stating that she lives on Stan Baillie Drive, and that there has been a strong strong smell afrom the landfill on October 3rd around 10:30pm.	Responded to the resident stating we investigated your concern and have found that the atmospheric conditions (SSW) and landfill operations (having to re-work the tipping face due to the amount of precipitation we have received) suggest that it could be likely the odour originated from Brady landfill. I conducted an odour investigation today, as the winds were once again favourable of moving odour to your area, and am happy to report no (0ppm) H2S was detected, and no odour was detected. We do continuously work to reduce the impact of the landfill on our community. To control odours in and around the landfill, we: <ul style="list-style-type: none"> • cover garbage on a daily basis, • created a smaller, more controlled tipping face (area the garbage is dumped at), • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system, • cover all loads of dead animals immediately, • monitor odours in and around the landfill on a regular basis, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south (the new cell will be completed by the end of this year), and • currently have zero biosolids (nutrient-rich by-product of sewage treatment) being brought to Brady, as they are being used in the soil fabrication project.
10/7/2019	Via email citizen states that there is another sulfur like smell this morning.	Responded to the resident stating I investigated your concern and have found that the atmospheric conditions (SSE) and landfill operations (having to re-work the tipping face due to the amount of precipitation we have received) suggest that it could be likely the odour originated from Brady landfill. Although, when I was at Aintree investigating the odour, with my H2S reader at 10:30 am, there was no distinct sulfur smell or landfill odour detected. My reader was 0.000ppm H2S in the air, and I was unable to detect any odours outside. We do continuously work to reduce the impact of the landfill on our community. To control odours in and around the landfill, we: <ul style="list-style-type: none"> • cover garbage on a daily basis, • created a smaller, more controlled tipping face (area the garbage is dumped at), • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system, • cover all loads of dead animals immediately, • monitor odours in and around the landfill on a regular basis, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south (the new cell will be completed by the end of this year), and • currently have zero biosolids (nutrient-rich by-product of sewage treatment) being brought to Brady, as they are being used in the soil fabrication project.

Client File No. 5556.00

Manitoba Environment Act Licence No. 3081 R

Brady Road Resource Management Facility Annual Report – 2019

Date Created	Complaint	Response
		Odours
10/12/2019	Citizen emailed 311 stating that you can smell the foul odour from Brady Landfill on the South Perimeter.	<p>Responded to the resident stating we investigated your concern and have found that the atmospheric conditions suggest that it would be unlikely the odour originated from Brady landfill, but due to complications landfill operations, South perimeter proximity to the landfill and the state of emergency the city was in, it is possible the smell originated from Brady. We continuously work to reduce the impact of the landfill on our community. To control odours in and around the landfill, we</p> <ul style="list-style-type: none"> • cover garbage on a daily basis, • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system, • cover all loads of dead animals immediately, • monitor odours in and around the landfill on a regular basis, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south , and • are currently directing biosolids (the nutrient-rich by-product of sewage treatment) to a soil fabrication program at another location.
10/22/2019	Via email citizen is reporting that there is a terrible odor coming from the landfill. Citizen states they can smell it all the way up to Costco on Kenaston. Citizen is wondering what happened and when it will get better.	<p>Responded to the resident stating, I would like to share with you some of the work we are doing to reduce the impact of the landfill on our community. To control odours in and around the landfill, we</p> <ul style="list-style-type: none"> • cover garbage on a daily basis, • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system (further extensions are to be done in the new year), • use dedicated trenches for dead animals and cover all loads immediately, • monitor odours in and around the landfill on a regular basis and test for Hydrogen Sulfide, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south , and • reduce the amount of biosolids (the nutrient-rich by-product of sewage treatment) being buried through a biosolids composting trial program.
10/22/2019	Via email citizen states that they live in bridge water trails and they have been experiencing a horrible smell coming from the Brady Landfill.	<p>Responded to the resident stating we investigated your concern and have found that the atmospheric conditions (NNE Wind) and landfill operations suggest that it would be unlikely an odour yesterday originated from Brady landfill. However, we do recognize that given the right conditions, a strong odour can be produced and spread by the landfill. I would like to share with you some of the work we are doing to reduce the impact of the landfill on our community. To control odours in and around the landfill, we</p> <ul style="list-style-type: none"> • cover garbage on a daily basis, • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system (further extensions are to be done in the new year), • use dedicated trenches for dead animals and cover all loads immediately, • monitor odours in and around the landfill on a regular basis and test for Hydrogen Sulfide, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south , and • reduce the amount of biosolids (the nutrient-rich by-product of sewage treatment) being buried through a biosolids composting trial program.
11/1/2019	Citizen emailed us again complaining of trashy smell in Bridgewater Trails area coming from landfill.	<p>Responded to the resident stating we investigated your concern and have found that the atmospheric conditions and minor complications with landfill operations suggest that it would be likely the odour originated from Brady landfill. Most of the day there was a SSW wind, which would lead to odours migrating to bridgewater area. Operations were in the process of filling in a trench and working to cover the garbage received that day, which could explain the odour. We do continuously work to reduce the impact of the landfill on our community. To control odours in and around the landfill, we:</p> <ul style="list-style-type: none"> • cover garbage on a daily basis, • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system, • use dedicated trenches and/or folding-in-method for dead animals and cover all loads immediately, • monitor odours in and around the landfill on a regular basis, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south, and • have eliminated biosolids (the nutrient-rich by-product of sewage treatment) being buried through a biosolids soil amendment program at another location.
11/24/2019	Citizen emailed 311 stating that she lives in South Pointe and the Brady Landfill odour has been overwhelming.	<p>Responded to the resident stating we investigated your concern and have found that the atmospheric conditions over the weekend (predominantly South, West-Southwest winds) suggest that it would be likely the odour originated from Brady landfill. Operations is currently trying a new method of handling Specified Risk Material, which will no longer involve opening a trench up, but they have to stock pile garbage to fold the SRM into at the end of the day. Operations was experiencing some teaching and learning curves, but will hopefully be rectified soon. We continuously work to reduce the impact of the landfill on our community. To control odours in and around the landfill, we</p> <ul style="list-style-type: none"> • cover garbage on a daily basis, • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system, • use dedicated trenches for dead animals and cover all loads immediately, • monitor odours in and around the landfill on a regular basis, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south , and • eliminated the biosolids (the nutrient-rich by-product of sewage treatment) being buried through a biosolids composting trial program at another location.
12/5/2019	Citizen states there is an unbearable smell outside coming from the Brady Landfill. It's really hard to breath. Please do something about the smell. They worried that this will make my family sick.	<p>Spoke with resident about her concerns with the odour being produced at Brady Landfill. Resident recently purchased a new house in close proximity to the landfill and is concerned with how strong the odour is at this time of year. I went over some of the initiatives that we are undertaking to try to reduce some of the odour. I reassured the resident that we have checked H2S levels in and around her residents and have not detected any of the hazardous gas. Some of the initiatives I discussed with her include:</p> <ul style="list-style-type: none"> • cover garbage on a daily basis, • use natural bio filters (woodchips) on manholes to capture and biologically remove odours, • continue to expand the landfill gas capture system (further extensions are to be done in the new year), • use dedicated trenches for dead animals and cover all loads immediately, • monitor odours in and around the landfill on a regular basis and test for Hydrogen Sulfide, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • continue to move landfilling operations further south
12/14/2019	Citizen emailed 311 wanting to state that the odour coming from the landfill is horrible. She states that she would like this to be looked into as soon as possible. She states that it shouldn't be the atmosphere as it's -25 outside.	<p>Responded to citizen via voice mail asking them to please call back and discuss their concerns further. We have included the address in our odour monitoring rounds.</p>
12/19/2019	Citizen states, they moved in very recently and since their move, they have been getting strong foul odours from time to time on certain days. Just minutes ago, they went out their doors and got the same bad smell. Is there anything that can be done to prevent the smell? They would have never built this home here if they knew they would end up feeling like living in a dump. This is how strong the smell is when it smells. They are very worried about my sick elderly parents who live with me as the strong smell does not help them make it a pleasant place to live.	<p>Further to our discussion this morning, I would like to send you an outline of some of the activities we are doing to try and mitigate some of the odours originating from Brady Landfill. We are continuously working to reduce the impact of the landfill on our community. To control odours in and around the landfill, we</p> <ul style="list-style-type: none"> • improve daily coverage of garbage on a daily basis, • continue to expand the landfill gas capture system, • monitor odours and hydrogen sulfide in and around the landfill on a regular basis, • plant trees and shrubs on the berms along Brady Road and the Perimeter Highway, • improve the vegetative cover on the north slope, to reduce cracking in the clay cap. • continue to move landfilling operations further south , and • reduce the amount of biosolids (the nutrient-rich by-product of sewage treatment) being buried through a biosolids composting trial program. <p>Although all these initiatives will greatly reduce the amount and consistency of odour. We can never guarantee that there will not be odour coming from the site, given the nature of the material being buried.</p>

Client File No. 5556.00

Manitoba Environment Act Licence No. 3081 R

Brady Road Resource Management Facility Annual Report – 2019

Date Created	Complaint	Response
Odours		
12/19/2019	Citizen reports that there is a strong garbage like smell occurring in our neighborhood that has been happening for numerous hours.	We did investigate your odour concern on Friday December 20 (and a regular odour monitor on Monday December 23). The atmospheric conditions suggest it was unlikely originating from Brady, but there was an odour due to some operations complications that was getting to the perimeter, so there is a chance it may have made it to your neighborhood but unlikely. As we continue to move operations south and the biosolids soil fabrication program starts up again in February, the odour should start to be less impactful/noticeable.
12/26/2019	Via email citizen states that the smell was so bad tonight that they had to plug their nose when they were walking their dog at 8:15.	Responded to the resident stating we have investigated your concern, and have found that the atmospheric conditions suggest that it would be highly likely the odour originated from Brady Landfill. Operations was dealing with setbacks and complications of being closed the prior day, and receiving some waste that was not planned for. But it was dealt with to their best ability at the time. We are continuing to cover garbage on a daily basis, and find better locations in the landfill for handling more odorous waste (SRM containing material) as options arise with the cell operations moving further south. As well, the biosolids soil fabrication program will be starting up again end of January/beginning of February and that will also help to reduce odour and operation complications.

BRADY ROAD RESOURCE MANAGEMENT FACILITY ANNUAL REPORT – 2019

7.0 CONCLUSION

The diversion operations taking place at the BRRMF have been effective in diverting tens of thousands of metric tonnes of material from the landfill.

Leachate management was successful in 2019 as there were no breakouts of leachate.

The quality of the ground water beneath the site has not been negatively impacted, as demonstrated by the comparison of upstream to downstream ground water quality.

The quality of the surface water measured at the Weir is statistically similar to the quality of the surface water upstream of the BRRMF.

The areas where landfill gas is escaping should be repaired.

The BRRMF will continue to operate so as to ensure that the environment is maintained in such a manner as to sustain a high quality of life, including social and economic development, recreation and leisure for present and future Manitobans.

8.0 REFERENCES

1. Brady Road Resource Management Facility – Manitoba Environment Act Licence No. 3081 R

<https://www.winnipeg.ca/waterandwaste/pdfs/garbage/bradylicence.pdf>

2. Ontario Ministry of the Environment. (2011, July 1). Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act. Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition.

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3. Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines Summary Table. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. (CCME, 2003).

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