



Water and Waste Department
Environmental Standards Division

Brady Road Resource Management Facility Annual Report - 2018



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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 over 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 2018.

Major construction in 2018 included: completion of Phase 1 of the centralized leachate collection system, continuation of work on the lime mud berm, repaving of Charette Road, and drainage improvements.

Three incidents occurred at the site in 2018; all events were reported to an Environment Officer as required. In 2018, the BRRMF received 20 odour complaints; in all cases the customer was contacted for follow-up and corrective actions were taken as necessary.

In 2018, approximately 52% of the 682,779 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, 23,486 kL of leachate was hauled to the North End Sewage Treatment Plant for treatment.

Monitoring programs for ground water, surface water, leachate, and subsurface gas migration followed the sampling and analysis plans in 2018. No contingency plans were activated in 2018.

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 9 million metric tonnes of waste, with approximately 350,000 metric tonnes of waste materials landfilled on an annual basis. The site has capacity for over 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 licence 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 2018. The report also provides information on the BRRMF proposed activities for 2019.

The layouts of the primary components of the BRRMF are shown on Figure 3. 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 consists of 38 non-pumping manholes, 8 pumping manholes, and one leachate riser; construction of a centralized leachate collection system began in 2017 and is expected to be completed in 2019. The landfill gas (LFG) management system includes extraction wells, LFG collection piping, and a blower/enclosed flare station.

2.0 CONSTRUCTION

Major construction activities undertaken in 2018 included:

- Construction of a new Administration Building
- Began the rough cut of a new waste cell (Cell 32)
- Completed Phase 1 of the centralized leachate collection system: incorporated pumping manholes 13, 24, and 46
- Continued work on the lime mud berm.
- Repaved Charrette Road from Brady Road to the compost facility.
- Improved drainage in the ditch along the North side of Charrette Road.

Major construction activities planned for 2019 include:

- Complete construction of waste cell (Cell 32) and manhole (MH47).
- Complete Phase 2 of the centralized leachate collection system: incorporate Riser 1 and pumping manholes 3, 8, 31, and 33.
- Complete the northeast section of the lime mud berm.

3.0 MAJOR INCIDENTS

In 2018, there were no disruptions or failures of waste management practices due to equipment breakdown, no major spills occurred, and no alarms were activated.

Three incidents occurred at the BRRMF in 2018. The first incident involved a smoldering fire in a compost turner. The second incident involved downed hydro lines which blocked a road and trapped an employee in a grader until the power was turned off; the downed wires also resulted in a small grass fire and an oil leak from the fallen transformer. The third incident involved the accidental cutting of a pipe for a landfill gas well. All incidents were reported to Manitoba Sustainable Development and follow-up or corrective actions were taken.

Incident reports are provided in Appendix A.

4.0 WASTE DIVERSION OPERATIONS

In 2018, 682,779 metric tonnes of material were received at the BRRMF: 341,489 metric tonnes were composted or re-used on-site, 14,348 metric tonnes were removed from BRRMF for further processing or beneficial re-use, and 326,942 metric tonnes were landfilled. This translates to a diversion rate of 52%, which is an increase from the 2017 diversion rate of 47%.

The amount of materials composted or reused on site in 2018 increased due to improved tracking of clean fill loads. The amount of material removed from the site increased due to an overall increase in materials received at the BRRMF 4R depot, and an increase in the amount of compost sold. The amount of material landfilled decreased in 2018 because biosolids were required for a soil fabrication pilot project and a land application pilot project, which resulted in less biosolids being landfilled. There was also a decrease in the amount of wastes received from other municipalities.

A summary of the BRRMF Waste Diversion Operations is provided in Table 1.



Table 1. 2018 BRRMF
Waste Diversion Summary

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

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

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 1.

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 2018, a total of 53 ground water samples were analyzed – 5 samples from wells upgradient of the site (background water quality), and 48 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 2018 ground water results are provided in Table 2.1-2.3.

Based on the Piper diagrams (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.

Time versus concentration graphs (Appendix D) show the historical relationship of the analytical parameters at each monitoring location. In general, the analytical results for ground water obtained in 2018 were found to be similar to those obtained in 2015, 2016, and 2017, and are consistent with background levels.

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A comparison of the average values obtained in 2015, 2016, 2017, and 2018 are provided in Table 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. The Contingency Action Plan identified under Clause 125 was not implemented in 2018.

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



Table 2.1 2018 Ground Water Monitoring - Clay Wells

	Units	Criteria*	Downgradient and Crossgradient							
			Upgradient							
			GWQ25-6N60DR	GWQ25-5N62D	GWQ25-6N63E	GWQ25-6N57DR	GWQ25-6N67E	GWQ25-4N34B	GWQ25-4N34C	GWQ25-6N59DR
			Spring	Spring	Spring	Spring	Spring	Spring	Spring	Spring
Inorganic Parameters										
Alkalinity - Bicarbonate	mg/L		539	493	543	499	474	654	934	495
Alkalinity - Carbonate	mg/L		<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
Alkalinity - Total	mg/L		539	493	543	499	474	654	934	495
Dissolved Hardness (CaCO ₃)	mg/L		2,325	3,936	3,301	3,022	2,487	3,437	2,577	2,697
pH	units		6.81	6.76	6.84	6.70	6.89	6.97	6.75	6.67
Specific Conductivity	(µS/cm)		4,820	8,870	6,750	6,370	4,900	6,290	5,740	6,320
Turbidity	(ntu)		116	80.0	15.8	13.7	41.4	294	3,260	43.2
Total Dissolved Solids	mg/L		3,890	6,530	5,480	5,150	3,830	5,330	4,440	4,770
Total Suspended Solids	mg/L		280	1,080	800	110	240	730	5,960	580
Total Solids	mg/L		4,170	7,610	6,280	5,260	4,070	6,060	10,400	5,350
Dissolved Chloride (Cl)	mg/L	2,300	474	1,870	887	813	614	694	799	962
Dissolved Sulphate (SO ₄)	mg/L		1,750	1,980	1,770	2,110	1,510	2,380	1,760	1,870
Nutrients										
Ammonia - Dissolved	mg/L N		0.129	0.820	0.348	0.168	0.669	0.059	0.735	1.72
Nitrate - Dissolved	mg/L N		0.635	0.050	0.279	0.591	0.030	0.370	0.030	1.01
Total Kjeldahl Nitrogen	mg/L N		0.4	1.4	0.8	0.5	0.9	0.7	1.5	0.5
Phosphorus - Dissolved	mg/L P		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Other										
Cyanide - Total (CN)	mg/L	0.066	NR**							
Organic Indicators										
Carbonaceous Oxygen Demand	mg/L		40	90	40	40	30	60	170	50
Total Organic Carbon	mg/L		29.1	18.9	11.0	11.6	7.8	19.4	22.8	32.4
Metals										
Arsenic (As)- Dissolved	ug/L	1,900	0.53	1.73	0.59	0.57	0.56	0.69	0.91	0.52
Barium (Ba)- Dissolved	ug/L	29,000	8.70	17.1	17.3	11.3	10.6	14.2	11.1	11.2
Beryllium (Be)- Dissolved	ug/L	67.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	2.70	0.215	0.090	0.232	0.121	0.092	0.160	0.267	0.512
Calcium (Ca)- Dissolved	mg/L		575	930	758	727	582	697	610	686
Chromium (Cr)- Dissolved	ug/L	810	0.13	1.28	<0.10	0.24	0.14	0.65	<0.10	0.62
Copper (Cu)- Dissolved	ug/L	87.0	2.07	13.3	1.54	5.80	2.08	16.1	2.06	19.3
Iron (Fe)- Dissolved	ug/L		<10	696	20	<10	<10	48	29	<10
Lead (Pb)- Dissolved	ug/L	25.0	<0.050	0.616	<0.050	0.186	<0.050	0.711	<0.050	0.815
Magnesium (Mg)- Dissolved	mg/L		216	392	342	293	251	412	256	239
Manganese (Mn)- Dissolved	ug/L		1,860	2,480	2,330	2,390	1,050	1,720	1,780	2,440
Mercury (Hg)- Total	ug/L	2.8	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.223	0.193	<0.0050
Nickel (Ni)- Dissolved	ug/L	490	7.24	13.9	11.7	11.2	7.80	26.7	8.90	9.20
Potassium (K)- Dissolved	mg/L		10.9	18.9	15.3	15.2	12.3	12.9	11.3	11.9
Selenium (Se)- Dissolved	ug/L	63.0	0.133	0.172	0.237	0.256	0.190	0.248	0.257	0.229
Silver (Ag)- Dissolved	ug/L	1.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Sodium (Na)- Dissolved	mg/L	2,300	345	934	676	622	388	470	474	513
Zinc (Zn)- Dissolved	ug/L	1,100	6.2	20.7	12.9	13.4	10.0	20.4	10.1	20.7
Field Parameters										
pH	units		7.02	6.88	7.04	8.40	7.10	7.00	6.92	6.96
Specific Conductivity	(µS/cm)		4,330	8,620	5,400	5,840	4,710	6,090	5,400	5,840
Polycyclic Aromatic Hydrocarbons										
Naphthalene	ug/L	6,400	<0.050	<0.050						
Benzo(a)pyrene	ug/L	0.81	<0.0050	<0.0050						
Anthracene	ug/L	2.40	<0.010	<0.010						
Petroleum Hydrocarbons										
F1 (C6-C10 Hydrocarbons)	ug/L	750	<100	<100						
F2 (C10-C16 Hydrocarbons)	ug/L	150	<100	<100						
F3 (C16-C34 Hydrocarbons)	ug/L	500	<250	<250						
F4 (C34-C50 Hydrocarbons)	ug/L	500	<250	<250						
Benzene	µg/L	430	<0.50	<0.50						
EthylBenzene	µg/L	2,300	<0.50	<0.50						
Toluene	µg/L	18,000	<0.50	<0.50						
Xylene (Total)	µg/L	4,200	<0.50	<0.50						
Volatile Organic Carbons										
Vinyl chloride	µg/L	1.7	<0.50	<0.50						
Pesticides										
Diazinon	µg/L		<0.10	<0.10						
Herbicides										
2,4-D	ug/L		<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

Note: Criteria exceedences are highlighted in red.

* Criteria for total chloride and total metals

**NR - No result due to lab error.



Table 2.2 2018 Ground Water Monitoring - Till Wells

			Downgradient and Crossgradient											
			Upgradient											
			GWQ25-6N60ER	GWQ25-5N62E	GWQ25-W13A		GWQ25-W14A		GWQ25-W15A		GWQ25-W16A			
	Units	Criteria*	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn
Inorganic Parameters														
Alkalinity - Bicarbonate	mg/L		780	586	300	335	247	260	1,730	167	424	439	358	385
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		780	586	300	335	247	260	1,730	167	424	439	358	385
Dissolved Hardness (CaCO3)	mg/L		1,821	1,886	1,838	1,634	2,137	2,075	3,071	1,716	2,961	2,851	2,103	2,048
pH	units		6.83	7.08	7.26	7.40	6.98	7.20	7.31	7.61	7.75	6.87	7.12	7.18
Specific Conductivity	(µS/cm)		4,290	4,270	8,470	8,440	8,110	8,010	8,230	8,120	6,940	6,820	5,310	5,300
Turbidity	(ntu)		277	152	210	467	19,800	6,060	4,360	11,080	13,500	16,800	4,040	3,530
Total Dissolved Solids	mg/L		3,290	3,400	5,130	5,230	5,070	5,210	5,040	5,130	5,060	5,250	3,710	3,610
Total Suspended Solids	mg/L		740	491	930	1,360	27,730	7,190	15,760	18,100	17,840	15,800	830	4,870
Total Solids	mg/L		4,030	3,886	6,060	6,592	32,800	12,400	20,800	23,270	22,900	21,040	4,540	8,484
Dissolved Chloride (Cl)	mg/L	2,300	393	403	2,250	2,480	2,160	2,250	2,140	2,390	1,330	1,400	1,030	1,120
Dissolved Sulphate (SO4)	mg/L		1,460	1,470	803	869	857	886	845	883	1,720	1,750	1,130	1,150
Nutrients														
Ammonia - Dissolved	mg/L N		0.501	0.491	1.04	0.907	1.060	0.972	1.130	1.08	0.84	0.922	0.717	0.797
Nitrate - Dissolved	mg/L N		0.285	0.177	0.050	0.126	0.030	0.029	0.008	0.007	0.123	0.008	0.288	0.097
Total Kjeldahl Nitrogen	mg/L N		0.7	1.0	0.9	1.1	1.4	1.9	0.9	2.2	1.6	3.3	0.7	2.7
Phosphorus - Dissolved	mg/L P		<0.010	0.019	<0.010	<0.013	<0.010	0.023	<0.010	0.157	<0.010	0.022	0.020	0.019
Other														
Cyanide - Total (CN)	ug/L	66	<1.0			NR**	<1.0		<1.0		<1.0		<1.0	
Organic Indicators														
Carbonaceous Oxygen Demand	mg/L		40	<20	80	75	1,540	520	490	805	1,870	1,300	530	330
Total Organic Carbon	mg/L		31.6	8.2	6.5	3.0	78.4	16.0	43.9	18.9	59.5	57.8	55.4	25.2
Metals														
Arsenic (As)- Dissolved	ug/L	1,900	1.12	1.26	4.06	3.83	1.50	1.72	3.98	5.11	0.89	1.40	1.09	2.05
Barium (Ba)- Dissolved	ug/L	29,000	8.14	8.40	13.1	13.6	14.3	15.0	29.9	14.9	14.4	15.9	11.4	12.1
Beryllium (Be)- Dissolved	ug/L	67.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.28	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	2.70	0.0583	0.015	0.0274	0.018	0.071	0.103	0.178	0.055	0.050	0.269	0.0464	0.0554
Calcium (Ca)- Dissolved	mg/L		429	493	408	369	493	465	750	402	752	708	514	497
Chromium (Cr)- Dissolved	ug/L	810	<0.10	<0.10	0.19	0.12	<0.10	0.20	4.33	0.26	<0.10	1.83	<0.10	0.12
Copper (Cu)- Dissolved	ug/L	87.0	2.54	1.27	1.97	3.43	0.50	0.30	6.18	0.45	0.42	0.78	0.33	0.91
Iron (Fe)- Dissolved	ug/L	<10	<10	<10	454	453	99.0	179	3,640	569	359	1,190	33.0	179
Lead (Pb)- Dissolved	ug/L	25.0	<0.050	<0.050	0.10	0.29	0.054	0.055	9.16	0.106	<0.050	0.192	<0.050	<0.050
Magnesium (Mg)- Dissolved	mg/L		182	159	199	173	220	222	291	173	263	263	199	196
Manganese (Mn)- Dissolved	ug/L		1,110	1,070	66.7	62.0	489	515	1,140	310	1,730	1,560	782	997
Mercury (Hg)- Total	ug/L	2.8	<0.0050	<0.0050	<0.025	<0.0050	0.196	0.156	0.178	0.16	0.43	2.90	0.061	0.013
Nickel (Ni)- Dissolved	ug/L	490	7.83	6.78	1.52	1.27	3.24	3.25	5.46	2.22	7.44	8.96	5.13	6.83
Potassium (K)- Dissolved	mg/L		8.56	9.51	43.1	38.9	19.8	24.0	29.2	26.7	13.8	15.3	10.5	12.0
Selenium (Se)- Dissolved	ug/L	63.0	0.096	0.112	<0.050	<0.050	0.061	<0.050	<0.050	<0.050	0.083	0.104	<0.050	0.075
Silver (Ag)- Dissolved	ug/L	1.50	<0.010	<0.010	<0.010	0.020	<0.010	<0.010	<0.010	0.011	<0.010	<0.010	<0.010	<0.010
Sodium (Na)- Dissolved	mg/L	2,300	409	383	1,410	1,250	1,060	966	1,230	1,190	626	584	466	496
Zinc (Zn)- Dissolved	ug/L	1,100	9.6	3.0	6.3	12.4	2.5	4.5	9.0	1.7	4.0	6.2	3.0	3.9
Field Parameters														
pH	units		6.83	7.68	7.52	7.71	6.96	7.35	7.62	8.03	7.10	7.43	7.10	7.92
Specific Conductivity	(µS/cm)		4,110	3,150	8,100	7,350	7,490	7,100	7,750	6,510	6,990	5,770	5,350	4,600
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		0.006	
Anthracene	ug/L	2.40	<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		610		400		<250		<250	
F4 (C34-C50 Hydrocarbons)	ug/L	500	<250		<250		350		<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		NR**		NR**		NR**		<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: Criteria exceedences are highlighted in red.

* Criteria for total chloride and total metals

**NR - No result due to lab error.



Table 2.2 2018 Ground Water Monitoring - Till Wells

			Downgradient and Crossgradient						
			GWQ25-6N63F	GWQ25-6N57F	GWQ25-6N67F	GWQ25-4N34DR	GWQ25-6N58DR	GWQ25-6N58F	GWQ25-6N59F
	Units	Criteria*	Spring	Spring	Spring	Spring	Spring	Spring	Spring
Inorganic Parameters									
Alkalinity - Bicarbonate	mg/L		618	1,120	580	759	503	264	621
Alkalinity - Carbonate	mg/L		<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
Alkalinity - Total	mg/L		618	1,120	580	759	503	264	621
Dissolved Hardness (CaCO3)	mg/L		2,860	2,364	2,193	3,087	3,076	2,635	2,402
pH	units		6.85	6.92	6.90	6.98	6.69	7.10	6.72
Specific Conductivity	(µS/cm)		6,870	6,280	4,610	6,200	6,740	6,250	6,400
Turbidity	(ntu)		113	285	187	379	33.5	6,180	114
Total Dissolved Solids	mg/L		4,580	4,320	3,320	5,460	5,190	4,150	4,690
Total Suspended Solids	mg/L		960	3,230	660	1,160	740	10,150	670
Total Solids	mg/L		5,540	7,550	3,980	6,620	5,930	14,300	5,360
Dissolved Chloride (Cl)	mg/L	2,300	1,460	1,120	694	533	1,050	1,360	1,040
Dissolved Sulphate (SO4)	mg/L		1,180	1,460	1,140	2,790	1,920	1,140	1,720
Nutrients									
Ammonia - Dissolved	mg/L N		0.840	0.952	0.653	0.668	0.491	1.34	0.754
Nitrate - Dissolved	mg/L N		0.010	0.010	0.040	0.239	0.250	0.008	0.143
Total Kjeldahl Nitrogen	mg/L N		1.0	1.2	0.8	1.0	0.9	1.3	1.0
Phosphorus - Dissolved	mg/L P		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Other									
Cyanide - Total (CN)	ug/L	66							NR**
Organic Indicators									
Carbonaceous Oxygen Demand	mg/L		100	170	50	80	60	NR***	60
Total Organic Carbon	mg/L		8.4	16.3	7.6	12.4	14.8	95.7	30.1
Metals									
Arsenic (As)- Dissolved	ug/L	1,900	3.57	9.51	1.58	1.06	0.62	1.30	0.56
Barium (Ba)- Dissolved	ug/L	29,000	11.2	9.7	10.5	12.0	11.4	13.9	11.3
Beryllium (Be)- Dissolved	ug/L	67.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	2.70	0.0266	0.0279	0.0375	0.0183	0.117	0.0113	0.1800
Calcium (Ca)- Dissolved	mg/L		573	551	489	476	747	455	596
Chromium (Cr)- Dissolved	ug/L	810	0.55	<0.10	0.11	0.55	<0.10	<0.10	<0.10
Copper (Cu)- Dissolved	ug/L	87.0	10.0	<0.20	1.76	4.86	4.06	0.33	2.17
Iron (Fe)- Dissolved	ug/L	1,430	1,430	1,570	30.0	33.0	<10	353	18.0
Lead (Pb)- Dissolved	ug/L	25.0	0.562	<0.050	0.115	0.19	<0.050	<0.050	<0.050
Magnesium (Mg)- Dissolved	mg/L		347	240	236	461	294	364	222
Manganese (Mn)- Dissolved	ug/L		262	606	182	108	4,500	100	1,590
Mercury (Hg)- Total	ug/L	2.8	0.029	0.061	0.009	0.055	0.008	0.242	0.006
Nickel (Ni)- Dissolved	ug/L	490	4.38	5.68	3.73	6.48	13.6	4.97	8.57
Potassium (K)- Dissolved	mg/L		14.4	15.8	10.4	17.3	14.3	16.4	11.5
Selenium (Se)- Dissolved	ug/L	63.0	<0.050	<0.050	<0.050	0.058	0.391	<0.050	0.149
Silver (Ag)- Dissolved	ug/L	1.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Sodium (Na)- Dissolved	mg/L	2,300	603	675	320	578	605	611	655
Zinc (Zn)- Dissolved	ug/L	1,100	23.4	19.4	17.5	5.5	8.1	2.7	5.0
Field Parameters									
pH	units		6.99	7.33	7.50	7.22	6.81	7.48	7.14
Specific Conductivity	(µS/cm)		6,410	5,250	4,330	5,790	6,140	6,070	6,020
Polycyclic Aromatic Hydrocarbons									
Naphthalene	ug/L	6,400							
Benzo(a)pyrene	ug/L	0.81							
Anthracene	ug/L	2.40							
Petroleum Hydrocarbons									
F1 (C6-C10 Hydrocarbons)	ug/L	750							
F2 (C10-C16 Hydrocarbons)	ug/L	150							
F3 (C16-C34 Hydrocarbons)	ug/L	500							
F4 (C34-C50 Hydrocarbons)	ug/L	500							
Benzene	µg/L	430							
EthylBenzene	µg/L	2,300							
Toluene	µg/L	18,000							
Xylene (Total)	µg/L	4,200							
Volatile Organic Carbons									
Vinyl chloride	µg/L	1.7							
Pesticides									
Diazinon	µg/L								
Herbicides									
2,4-D	ug/L								

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: Criteria exceedences are highlighted in red.
 * Criteria for total chloride and total metals
 **NR - No result due to lab error.
 ***NR - No result due to interference.



Table 2.3 2018 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	Spring	Autumn
Inorganic Parameters																		
Alkalinity - Bicarbonate	mg/L		147	2,760	144	<3.0	133	137	215	212	145	133	142	142	139	154		
Alkalinity - Carbonate	mg/L		<3.0	<3.0	<3.0	91	<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	367	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0		
Alkalinity - Total	mg/L		147	2,760	144	459	133	137	215	212	145	133	142	142	139	154		
Dissolved Hardness (CaCO3)	mg/L		1,515	1,572	1,514	5,650	1,355	1,199	1,828	1,397	1,387	1,207	1,382	871	1,461	1,294		
pH	units		7.39	7.68	7.31	12.05	7.53	7.63	7.17	7.35	7.41	7.78	7.45	7.48	7.43	7.47		
Specific Conductivity	(µS/cm)		9,970	10,100	8,590	7,140	8,610	8,750	8,190	8,390	8,830	8,110	8,030	7,960	8,270	7,980		
Turbidity	(ntu)		1.89	13.4	10.4	9.22	21.8	13.0	0.35	0.75	2.27	7.56	0.801	3.20	3.56	83.5		
Total Dissolved Solids	mg/L		6,490	6,150	5,210	3,890	5,400	5,030	5,140	4,980	5,260	4,810	4,860	5,140	4,900	5,130		
Total Suspended Solids	mg/L		370	396	460	115	370	463	670	710	490	295	480	202	540	527		
Total Solids	mg/L		6,860	6,546	5,670	4,002	5,770	5,488	5,810	5,692	5,750	5,102	5,340	5,340	5,440	5,654		
Dissolved Chloride (Cl)	mg/L	2,300	2,780	2,790	2,310	1,460	2,280	2,420	2,170	2,310	2,330	2,200	2,090	144	2,120	2,130		
Dissolved Sulphate (SO4)	mg/L		944	938	811	459	706	748	761	802	792	658	755	587	765	818		
Nutrients																		
Ammonia - Dissolved	mg/L N		1.37	<0.003	1.10	0.528	1.06	1.13	1.05	1.13	1.07	0.324	0.978	1.01	0.956	1.02		
Nitrate - Dissolved	mg/L N		<0.003	1.260	0.006	0.089	0.005	0.015	<0.003	<0.003	0.005	0.870	<0.003	0.021	<0.003	0.042		
Total Kjeldahl Nitrogen	mg/L N		1.4	0.7	1.1	1.6	1.0	1.1	1.2	1.3	1.1	0.9	0.9	1.3	0.9	1.3		
Phosphorus - Dissolved	mg/L P		<0.010	0.024	<0.010	<0.013	<0.010	<0.013	<0.010	<0.013	<0.010	0.046	<0.010	<0.013	<0.010	0.020		
Other																		
Cyanide - Total (CN)	ug/L	66	<1.0	<1.0	<1.0	5.9	<1.0	<1.0	<1.0	<5.0	<1.0	<5.0	<1.0	1.5	<1.0	<5.0		
Organic Indicators																		
Carbonaceous Oxygen Demand	mg/L		100	60	80	60	80	50	70	50	80	35	70	<20	70	<20		
Total Organic Carbon	mg/L		3.8	3.0	4.4	9.9	2.5	1.3	3.8	1.6	2.5	1.9	2.9	1.7	3.3	1.9		
Metals																		
Arsenic (As)- Dissolved	ug/L	1,900	5.39	0.89	6.59	0.71	6.06	5.49	6.14	0.78	5.84	1.57	6.53	1.68	5.74	1.18		
Barium (Ba)- Dissolved	ug/L	29,000	11.5	13.8	12.5	65.5	16.0	14.7	12.6	23.7	13.4	18.3	12.6	32.3	11.7	15.4		
Beryllium (Be)- Dissolved	ug/L	67.0	<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	2.70	0.0066	0.173	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.115	<0.0050	0.030	<0.0050	0.0276	0.007	0.0567		
Calcium (Ca)- Dissolved	mg/L		338	341	326	701	292	261	412	307	303	259	296	84.9	313	261		
Chromium (Cr)- Dissolved	ug/L	810	<0.10	1.23	<0.10	56.2	<0.10	0.11	0.29	1.80	0.16	0.25	<0.10	0.43	0.12	0.58		
Copper (Cu)- Dissolved	ug/L	87.0	<0.20	3.22	<0.20	3.63	<0.20	3.69	<0.20	8.63	<0.20	3.24	<0.20	9.45	<0.20	3.18		
Iron (Fe)- Dissolved	ug/L		1,340	<10	806	<10	520	503	466	54.0	663	24.0	615	18.0	634	<10		
Lead (Pb)- Dissolved	ug/L	25.0	0.187	<0.050	<0.050	0.194	<0.050	0.257	<0.050	0.16	<0.050	<0.050	0.074	0.133	<0.050	<0.050		
Magnesium (Mg)- Dissolved	mg/L		163	175	170	947	152	133	194	153	153	136	156	160	165	156		
Manganese (Mn)- Dissolved	ug/L		31.9	37.6	32.5	<0.10	34.5	30.6	63.4	68.8	27.1	15.3	35.5	71.6	37.5	36.4		
Mercury (Hg)- Total	ug/L	0.29	<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	1.25	2.81	1.53	0.59	0.63	0.69	2.23	3.91	1.33	0.92	1.37	6.60	1.38	2.44		
Potassium (K)- Dissolved	mg/L		43.5	47.3	36.9	22.3	44.3	38.3	26.5	23.0	37.2	38.7	33.0	12.1	34.1	28.3		
Selenium (Se)- Dissolved	ug/L	63.0	<0.050	<0.050	<0.050	0.76	<0.050	<0.050	<0.050	0.085	<0.050	<0.050	<0.050	0.814	<0.050	0.158		
Silver (Ag)- Dissolved	ug/L	1.50	0.021	0.018	<0.010	0.010	0.011	0.010	0.0160	0.012	0.012	<0.010	<0.010	<0.010	<0.010	0.010		
Sodium (na)- Dissolved	mg/L	2,300	1,730	1,770	1,430	614	1,530	1,410	1,190	923	1,470	1,420	1,250	122	1,270	1,060		
Zinc (Zn)- Dissolved	ug/L	1,100	3.9	25.1	1.8	0.5	<1.0	4.7	2.1	108	1.1	9.0	<1.0	11.7	1.2	21.6		
Bacteria																		
Total Coliforms (MTF)	MPN/100mL		<1	<1	<10	<1	4	<1	<1	<1	<1	<1	<1	488	<1	<1		
Fecal Coliforms (MTF)	MPN/100mL		<1	<1	<10	<1	<1	<1	<1	<1	<1	<1	<1	13	<1	<1		
E. coli (MTF)	MPN/100mL		<1	<1	<10	<1	<1	<1	<1	<1	<1	<1	<1	6	<1	<1		
Field Parameters																		
pH	units		7.10	7.50	7.46	7.40	8.15	8.35	7.66	7.60	7.95	7.70	8.01	8.80	7.68	7.60		
Specific Conductivity	(µS/cm)		8,870	9,410	8,160	7,980	7,080	7,290	7,850	7,340	8,100	3,690	2,150	5,840	7,700	7,340		
Polycyclic Aromatic Hydrocarbons																		
Naphthalene	ug/L	1,400	<0.050	<0.050	<0.050	0.127	<0.050	<0.050	<0.050	<0.050	<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	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		
Anthracene	ug/L	2.40	<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	<300	<100	<100	<100	<100	<100	<100	<100	<100	<100		
F2 (C10-C16 Hydrocarbons)	ug/L	150	<100	<100	<100	110	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100		
F3 (C16-C34 Hydrocarbons)	ug/L	500	<250	250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	260		
F4 (C34-C50 Hydrocarbons)	ug/L	500	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250		
Benzene	µg/L	44	<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	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50		
Volatile Organic Carbons																		
Vinyl chloride	µg/L	0.5	<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	NR**	<0.10	<0.10	<0.10	<0.10	<0.10	NR**	<0.10	NR**	<0.10	NR**	<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: Criteria exceedences are highlighted in red.
 * Criteria for total chloride and total metals
 **NR - No result due to lab error.

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Table 2.3 2018 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		141	144	136	139	150	134	147	156	72	75	139	139
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		141	144	136	139	150	134	147	156	72	75	139	139
Dissolved Hardness (CaCO3)	mg/L		1,649	1,518	1,487	1,407	988	1,083	1,550	1,385	960	944	1,581	1,452
pH	units		7.39	7.22	7.42	7.53	7.48	7.58	7.40	7.54	7.78	7.78	7.40	7.58
Specific Conductivity	(µS/cm)		9,480	9,840	8,960	8,960	6,920	7,050	8,580	8,530	7,210	7,220	8,320	8,200
Turbidity	(ntu)		13.3	4.71	13.2	9.28	6.15	23.2	12.4	4.02	29.5	31.2	12.6	4.11
Total Dissolved Solids	mg/L		6,290	5,870	5,790	5,410	4,320	3,970	5,700	5,070	4,310	4,160	5,370	5,030
Total Suspended Solids	mg/L		340	486	350	469	330	441	280	484	240	394	410	444
Total Solids	mg/L		6,630	6,354	6,140	5,874	4,650	4,408	5,980	5,558	4,550	4,558	5,780	5,470
Dissolved Chloride (Cl)	mg/L	2,300	2,600	2,830	2,400	2,680	1,820	1,820	2,280	2,340	1,930	2,050	2,150	2,290
Dissolved Sulphate (SO4)	mg/L		890	981	794	908	619	617	815	863	538	573	808	867
Nutrients														
Ammonia - Dissolved	mg/L N		1.37	1.35	1.37	1.26	1.87	1.91	1.04	1.10	0.798	0.792	1.01	1.02
Nitrate - Dissolved	mg/L N		0.005	0.010	0.005	<0.003	<0.003	0.007	<0.003	<0.003	<0.003	0.006	<0.003	0.008
Total Kjeldahl Nitrogen	mg/L N		1.3	1.6	1.1	1.4	1.9	2.0	1.0	1.2	0.9	0.4	0.9	1.2
Phosphorus - Dissolved	mg/L P		<0.010	<0.013	<0.010	<0.013	<0.010	<0.013	<0.010	0.021	<0.010	<0.013	<0.010	0.023
Other														
Cyanide - Total (CN)	ug/L	66	<1.0	<5.0	<1.0		<1.0		<1.0		<1.0	<5.0	<1.0	
Organic Indicators														
Carbonaceous Oxygen Demand	mg/L		100	55	80	40	60	65	80	<20	60	25	80	55
Total Organic Carbon	mg/L		1.9	2.0	1.4	1.7	2.3	1.8	1.9	1.8	1.1	4.7	2.9	2.1
Metals														
Arsenic (As)- Dissolved	ug/L	1,900	7.35	7.18	5.54	5.29	0.28	2.7	4.75	4.42	0.34	0.77	5.74	4.48
Barium (Ba)- Dissolved	ug/L	29,000	12.6	13.0	13.5	14.9	47.5	12.3	12.6	12.9	11.5	26.5	14.6	15.5
Beryllium (Be)- Dissolved	ug/L	67.0	<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	2.70	<0.0050	0.0092	<0.0050	0.0509	0.0288	0.0141	<0.0050	0.0065	0.010	0.858	0.007	<0.0050
Calcium (Ca)- Dissolved	mg/L		362	339	330	326	365	254	332	317	208	210	338	321
Chromium (Cr)- Dissolved	ug/L	810	<0.10	0.18	<0.10	0.10	27.9	0.20	<0.10	<0.10	<0.10	1.16	<0.10	<0.10
Copper (Cu)- Dissolved	ug/L	87.0	<0.20	0.50	0.31	1.25	1.25	1.95	<0.20	<0.20	<0.20	2.19	0.84	<0.20
Iron (Fe)- Dissolved	ug/L		962	967	957	916	13.0	783	592	530	3,070	3,590	781	612
Lead (Pb)- Dissolved	ug/L	25.0	<0.050	0.0730	<0.050	0.136	<0.050	0.139	<0.050	<0.050	<0.050	2.29	0.109	<0.050
Magnesium (Mg)- Dissolved	mg/L		181	163	161	144	18.5	109	175	144	107	102	179	158
Manganese (Mn)- Dissolved	ug/L		23.8	22.3	16.7	16.0	0.41	9.78	38.1	41.7	31.3	94.8	37.7	23.1
Mercury (Hg)- Total	ug/L	0.29	<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	1.52	1.58	1.47	1.67	0.66	<0.50	1.45	1.45	<0.50	2.75	1.39	1.20
Potassium (K)- Dissolved	mg/L		44.8	42.1	44.1	42.3	21.0	30.9	41.9	37.1	32.5	31.8	37.9	36.5
Selenium (Se)- Dissolved	ug/L	63.0	<0.050	<0.050	<0.050	<0.050	0.098	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.357
Silver (Ag)- Dissolved	ug/L	1.50	0.013	0.012	0.012	0.012	0.016	<0.010	0.012	<0.010	<0.010	0.015	0.012	0.013
Sodium (Na)- Dissolved	mg/L	2,300	1,740	1,560	1,610	1,500	670	975	1,490	1,280	1,320	1,200	1,380	1,290
Zinc (Zn)- Dissolved	ug/L	1,100	1.3	1.5	1.2	2.3	1.4	3.30	8.2	1.6	<1.0	5.7	36.5	38.5
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		8.09	7.48	8.18	8.01	7.40	8.25	8.36	7.91	8.33	8.80	8.03	7.79
Specific Conductivity	(µS/cm)		6,740	8,670	7,300	7,950	5,540	5,950	7,220	7,580	6,200	6,550	6,450	7,400
Polycyclic Aromatic Hydrocarbons														
Naphthalene	ug/L	1,400	<0.050	<0.050	<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	<0.0050	<0.0050	
Anthracene	ug/L	2.40	<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	<200	<100	<200		<100		<200		<200	<100	<200	
F2 (C10-C16 Hydrocarbons)	ug/L	150	<100	<100	<100		<100		<100		<100	<100	<100	
F3 (C16-C34 Hydrocarbons)	ug/L	500	<250	<250	<250		<250		<250		<250	<250	<250	
F4 (C34-C50 Hydrocarbons)	ug/L	500	<250	<250	<250		<250		<250		<250	<250	<250	
Benzene	µg/L	44	<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	
Toluene	µg/L	18,000	<0.50	<0.50	<0.50		<0.50		<0.50		<0.50	<0.50	<0.50	
Xylene (Total)	µg/L	4,200	<0.50	<0.50	<0.50		<0.50		<0.50		<0.50	<0.50	<0.50	
Volatile Organic Carbons														
Vinyl chloride	µg/L	0.5	<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	
Herbicides														
2,4-D	ug/L		<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
 Note: Criteria exceedences are highlighted in red.
 * Criteria for total chloride and total metals


		Criteria*	2015		2016		2017		2018	
			Average	Average	Average	Average	Average	Average		
			Upgradient	Downgradient	Upgradient	Downgradient	Upgradient	Downgradient	Upgradient	Downgradient
Inorganic Parameters										
Alkalinity - Bicarbonate	mg/L		548	574	625	642	621	603	539	585
Alkalinity - Carbonate	mg/L		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<3.0	<3.0
Alkalinity - Hydroxide	mg/L		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<3.0	<3.0
Alkalinity - Total	mg/L		449	471	512	526	509	495	539	585
Dissolved Hardness (CaCO3)	mg/L		2,640	3,012	2,260	2,666	2,120	2,558	2,325	3,065
pH	units		6.96	7.07	6.96	6.97	7.04	6.97	6.81	6.80
Specific Conductivity	(µS/cm)		4,390	5,830	4,560	5,996	4,780	6,386	4,820	6,463
Turbidity	(ntu)		23.8	37.9	40.4	50.4	91.8	6,463	116	535
Total Dissolved Solids	mg/L		4,060	4,918	3,960	4,967	3,840	4,720	3,890	5,076
Total Suspended Solids	mg/L		160	325	310	1,247	500	8,842	280	1,357
Total Solids	mg/L		4,220	5,243	4,270	6,214	4,340	13,562	4,170	6,433
Dissolved Chloride (Cl)	mg/L	2,300	440	918	450	918	990	474	948	948
Dissolved Sulphate (SO4)	mg/L		1,710	1,845	2,000	1,959	1,670	1,738	1,750	1,911
Nutrients										
Ammonia - Dissolved	mg/L N		<0.003	0.268	<0.003	0.156	0.175	0.584	0.129	0.646
Nitrate - Dissolved	mg/L N		1.35	0.653	13.0	0.680	0.630	0.426	0.635	0.337
Total Kjeldahl Nitrogen	mg/L N		0.5	1.2	2.0	1.6	0.7	1.2	0.4	0.9
Phosphorus - Dissolved	mg/L P		0.020	0.026	0.180	0.012	<0.010	0.020	<0.010	<0.010
Other										
Cyanide - Total (CN)	ug/L	66	0.52	NR**	NR**	NR**	NR**	NR**	NR**	NR**
Organic Indicators										
Carbonaceous Oxygen Demand	mg/L		32	70	44	122	50	792	40	69
Total Organic Carbon	mg/L		12.0	16.5	10.6	22.0	10.8	19.6	29.1	17.7
Metals										
Arsenic (As)- Dissolved	ug/L	1,900	0.42	0.73	0.39	0.73	0.36	0.72	0.53	0.80
Barium (Ba)- Dissolved	ug/L	29,000	12.8	13.9	9.1	12.5	8.7	11.8	8.7	13.3
Beryllium (Be)- Dissolved	ug/L	67.0	<0.010	<0.010	0.015	0.008	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	2.70	0.143	0.125	0.068	0.181	0.052	0.216	0.215	0.211
Calcium (Ca)- Dissolved	mg/L		700	717	572	646	540	637	575	713
Chromium (Cr)- Dissolved	ug/L	810	<0.10	<0.10	<0.10	0.08	<1.0	<1.0	0.13	0.43
Copper (Cu)- Dissolved	ug/L	87.0	3.19	3.06	1.98	2.74	1.63	2.26	2.07	8.60
Iron (Fe)- Dissolved	ug/L		2.8	7.8	3.8	14	23	91	<10	115
Lead (Pb)- Dissolved	ug/L	25.0	0.037	0.058	0.037	0.053	0.103	0.098	<0.050	0.343
Magnesium (Mg)- Dissolved	mg/L		216	297	201	256	187	235	216	312
Manganese (Mn)- Dissolved	ug/L		1,680	1,577	1,720	1,412	1,590	1,866	1,860	2,027
Mercury (Hg)- Total	ug/L	2.80	<0.010	<0.010	<0.010	<0.010	<0.002	<0.002	<0.005	0.061
Nickel (Ni)- Dissolved	ug/L	490	7.0	10.3	7.0	9.5	6.4	9.9	7.2	12.8
Potassium (K)- Dissolved	mg/L		11.0	11.4	9.7	10.9	9.2	10.1	10.9	14.0
Selenium (Se)- Dissolved	ug/L	63.0	0.16	0.32	0.18	0.27	<0.40	<0.40	0.13	0.23
Silver (Ag)- Dissolved	ug/L	1.50	<0.005	0.006	<0.005	<0.005	<0.050	<0.050	<0.010	<0.010
Sodium (Na)- Dissolved	mg/L	2,300	362	555	336	485	534	534	345	582
Zinc (Zn)- Dissolved	ug/L	1,100	7.9	8.1	3.6	5.7	3.5	7.7	6.2	15.5
Field Parameters										
pH	units		7.42	6.66	7.36	7.38	7.84	7.78	7.02	7.19
Specific Conductivity	(µS/cm)		4,230	6,793	2,330	3,271	4,010	5,248	4,330	5,986
Polycyclic Aromatic Hydrocarbons										
Naphthalene	µg/L	6,400	NR**	<0.050	<0.050	NR**	NR**	NR**	<0.050	<0.050
Benzo(a)pyrene	µg/L	0.81	NR**	<0.010	<0.010	NR**	NR**	NR**	<0.0050	<0.0050
Anthracene	µg/L	2.40	NR**	<0.050	<0.050	NR**	NR**	NR**	<0.010	<0.010
Petroleum Hydrocarbons										
F1 (C6-C10 Hydrocarbons)	µg/L	750	NR**	NR**	<25	NR**	<25	NR**	<100	<100
F2 (C10-C16 Hydrocarbons)	µg/L	150	NR**	NR**	<100	NR**	<100	NR**	<100	<100
F3 (C16-C34 Hydrocarbons)	µg/L	500	NR**	NR**	<200	NR**	<200	NR**	<250	<250
F4 (C34-C50 Hydrocarbons)	µg/L	500	NR**	NR**	<200	NR**	<200	NR**	<250	<250
Benzene	µg/L	430	NR**	NR**	<0.10	NR**	<0.10	NR**	<0.50	<0.50
EthylBenzene	µg/L	2,300	NR**	NR**	<0.10	NR**	<0.10	NR**	<0.50	<0.50
Toluene	µg/L	18,000	NR**	NR**	<0.20	NR**	<0.20	NR**	<0.50	<0.50
Xylene (Total)	µg/L	4,200	NR**	NR**	<0.10	NR**	<0.10	NR**	<0.50	<0.50
Volatile Organic Carbons										
Vinyl chloride	µg/L	1.7	NR**	NR**	<0.2	NR**	<0.2	NR**	<0.50	<0.50
Pesticides										
Diazinon	µg/L		NR**	NR**	<2.0	NR**	<2.0	NR**	<0.10	<0.10
Herbicides										
2,4-D	µg/L		NR**	NR**	<1.0	NR**	<1.0	NR**	<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.
 Note: Bracketed criteria are for till and clay.
 Note: Criteria exceedences are highlighted in red.
 * Criteria for total chloride and total metals
 **NR - No result due to lab error.

			Table 3.2 2018 Ground Water Quality Comparison - Till Wells							
	Units	Criteria*	2015		2016		2017		2018	
			Average		Average		Average		Average	
Inorganic Parameters			Upgradient	Downgradient	Upgradient	Downgradient	Upgradient	Downgradient	Upgradient	Downgradient
Alkalinity - Bicarbonate	mg/L		570	333	667	399	663	366	683	536
Alkalinity - Carbonate	mg/L		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<3.0	<3.0
Alkalinity - Hydroxide	mg/L		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<3.0	<3.0
Alkalinity - Total	mg/L		467	273	547	327	544	300	683	536
Dissolved Hardness (CaCO3)	mg/L		1,625	2,305	1,580	1,977	1,550	2,001	1,853	2,415
pH	units		7.12	7.22	6.97	7.21	6.92	7.11	6.96	7.11
Specific Conductivity	(µS/cm)		4,030	6,212	4,380	6,814	4,300	7,027	4,280	6,888
Turbidity	(ntu)		952	5,051	209	3,110	183	4,259	215	5,126
Total Dissolved Solids	mg/L		3,620	5,056	3,470	4,703	3,260	4,774	3,345	4,715
Total Suspended Solids	mg/L		2,050	13,039	610	11,186	640	9,840	616	7,528
Total Solids	mg/L		5,670	18,095	4,080	15,889	3,900	14,614	3,958	12,245
Dissolved Chloride (Cl)	mg/L	2,300	425	1,421	380	1,465	390	1,562	398	1,518
Dissolved Sulphate (SO4)	mg/L		1,410	1,256	1,450	1,343	1,430	1,258	1,465	1,308
Nutrients										
Ammonia - Dissolved	mg/L N		0.552	0.855	0.161	0.709	0.304	0.845	0.496	0.892
Nitrate - Dissolved	mg/L N		0.112	0.048	0.445	0.257	0.371	0.086	0.231	0.086
Total Kjeldahl Nitrogen	mg/L N		1.4	4.0	1.0	3.0	0.8	1.6	0.9	1.4
Phosphorus - Dissolved	mg/L P		0.025	0.036	0.030	0.036	<0.010	0.022	0.012	0.018
Other										
Cyanide - Total (CN)	ug/L	66	0.83	0.72	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0
Organic Indicators										
Carbonaceous Oxygen Demand	mg/L		54	262	45	259	40	286	25	504
Total Organic Carbon	mg/L		56.5	71.0	9.2	39.6	10.0	31.1	19.9	32.3
Metals										
Arsenic (As)- Dissolved	ug/L	1,900	2.25	3.30	2.48	1.98	1.21	2.62	1.19	2.58
Barium (Ba)- Dissolved	ug/L	29,000	12.3	15.6	9.2	11.5	8.1	15.0	8.3	13.8
Beryllium (Be)- Dissolved	ug/L	67.0	<0.010	<0.010	0.01	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	2.70	0.052	0.180	0.058	0.076	<0.050	0.070	0.037	0.076
Calcium (Ca)- Dissolved	mg/L		386	527	376	475	367	457	461	544
Chromium (Cr)- Dissolved	ug/L	810	<0.10	<0.10	0.30	<1.0	<1.0	1.3	<0.10	0.51
Copper (Cu)- Dissolved	ug/L	87.0	2.00	1.24	2.82	1.89	1.85	3.69	1.91	2.27
Iron (Fe)- Dissolved	ug/L		15.0	413	6.3	166	194	884	<10.0	662
Lead (Pb)- Dissolved	ug/L	25.0	0.027	0.039	0.059	<0.050	0.067	0.530	<0.050	0.650
Magnesium (Mg)- Dissolved	mg/L		161	240	155	201	154	210	171	257
Manganese (Mn)- Dissolved	ug/L		516	651	774	549	868	486	1090	882
Mercury (Hg)- Total	ug/L	2.8	<0.010	<0.010	<0.010	<0.010	<0.002	0.028	<0.005	0.266
Nickel (Ni)- Dissolved	ug/L	490	7.3	4.8	7.4	4.0	7.6	4.6	7.3	5.5
Potassium (K)- Dissolved	mg/L		9.7	16.3	8.2	14.8	7.5	17.6	9.0	19.6
Selenium (Se)- Dissolved	ug/L	63.0	0.24	0.16	0.12	<0.40	<0.40	<0.40	0.10	0.07
Silver (Ag)- Dissolved	ug/L	1.50	<0.005	<0.005	<0.005	<0.050	<0.050	<0.050	<0.010	<0.010
Sodium (Na)- Dissolved	mg/L	2,300	581	745	521	651	422	772	396	784
Zinc (Zn)- Dissolved	ug/L	1,100	5.5	6.0	3.9	7.2	5.5	6.0	6.3	7.9
Field Parameters										
pH	units		7.53	6.98	7.35	7.50	7.85	7.93	7.26	7.37
Specific Conductivity	(µS/cm)		3,028	4,642	3,190	3,147	3,790	6,481	3,630	6,295
Polycyclic Aromatic Hydrocarbons										
Naphthalene	ug/L	6,400	<0.050	<0.050	<0.050	<0.050	NR**	NR**	<0.050	<0.050
Benzo(a)pyrene	ug/L	0.81	<0.010	<0.010	<0.010	<0.010	NR**	NR**	<0.0050	<0.0050
Anthracene	ug/L	2.40	<0.050	<0.050	<0.050	<0.050	NR**	NR**	<0.010	<0.010
Petroleum Hydrocarbons										
F1 (C6-C10 Hydrocarbons)	ug/L	750	<25	<25	<25	<25	<25	<25	<100	<100
F2 (C10-C16 Hydrocarbons)	ug/L	150	<100	<100	<100	<100	<100	<100	<100	<100
F3 (C16-C34 Hydrocarbons)	ug/L	500	<200	<200	<200	<200	<200	<200	<250	277
F4 (C34-C50 Hydrocarbons)	ug/L	500	<200	<200	<200	<200	<200	<200	<250	<250
Benzene	ug/L	430	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.50	<0.50
EthylBenzene	ug/L	2,300	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.50	<0.50
Toluene	ug/L	18,000	<0.20	<0.20	<0.20	<0.20	<0.20	0.41	<0.50	<0.50
Xylene (Total)	ug/L	4,200	<0.10	<0.10	<0.10	<0.10	<0.10	0.37	<0.50	<0.50
Volatile Organic Carbons										
Vinyl chloride	ug/L	1.7	<0.20	<0.20	<0.2	<0.2	<0.2	<0.2	<0.50	<0.50
Pesticides										
Diazinon	ug/L		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<0.10	<0.10
Herbicides										
2,4-D	ug/L		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<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.
 Note: Bracketed criteria are for till and clay.
 Note: Criteria exceedences are highlighted in red.
 * Criteria for total chloride and total metals
 **NR - No result due to lab error.

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			Table 3.3 2018 Ground Water Quality Comparison - Bedrock Wells							
			2015 Average		2016 Average		2017 Average		2018 Average	
	Units	Criteria*	Upgradient	Downgradient	Upgradient	Downgradient	Upgradient	Downgradient	Upgradient	Downgradient
Inorganic Parameters										
Alkalinity - Bicarbonate	mg/L		153	153	164	166	164	162	1,454	136
Alkalinity - Carbonate	mg/L		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<3.0	5.0
Alkalinity - Hydroxide	mg/L		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<3.0	17.0
Alkalinity - Total	mg/L		126	125	134	136	134	133	1,454	155
Dissolved Hardness (CaCO3)	mg/L		1,630	1,356	1,065	1,237	1,390	1,200	1,544	1,523
pH	units		7.46	7.64	7.56	7.67	7.42	7.49	7.54	7.67
Specific Conductivity	(µS/cm)		9,980	8,206	10,350	8,484	9,965	8,373	10,035	8,255
Turbidity	(ntu)		13.5	75.5	15.4	38.9	10.0	26.1	7.6	13.3
Total Dissolved Solids	mg/L		6,740	5,503	6,265	5,033	6,145	5,020	6,320	5,043
Total Suspended Solids	mg/L		40	300	320	426	640	590	383	416
Total Solids	mg/L		6,780	5,802	6,585	5,458	6,785	5,611	6,703	5,459
Dissolved Chloride (Cl)	mg/L	2,300	2,950	2,292	3,000	2,413	2,850	2,208	2,785	2,131
Dissolved Sulphate (SO4)	mg/L		942	748	974	759	943	765	941	747
Nutrients										
Ammonia - Dissolved	mg/L N		1.30	0.95	1.31	1.06	1.36	1.10	0.686	1.09
Nitrate - Dissolved	mg/L N		0.007	0.009	0.012	0.025	<0.003	0.011	0.631	0.046
Total Kjeldahl Nitrogen	mg/L N		2.9	2.9	2.0	1.6	1.6	1.3	1.1	1.2
Phosphorus - Dissolved	mg/L P		0.03	0.02	0.018	<0.010	<0.010	<0.010	0.015	<0.010
Other										
Cyanide - Total (CN)	ug/L	66	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<5.0
Organic Indicators										
Carbonaceous Oxygen Demand	mg/L		218	108	111	102	90	75	80	59
Total Organic Carbon	mg/L		2.5	7.1	3.5	2.1	3.7	3.2	3.4	2.6
Metals										
Arsenic (As)- Dissolved	ug/L	1,900	6.25	3.65	1.51	2.83	2.92	3.75	3.14	4.05
Barium (Ba)- Dissolved	ug/L	29,000	15.3	22.6	10.2	17.3	14.0	18.7	12.7	19.0
Beryllium (Be)- Dissolved	ug/L	67	<0.010	<0.010	<0.050	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	2.7	0.017	0.022	0.050	0.014	0.214	0.058	0.090	0.052
Calcium (Ca)- Dissolved	mg/L		379	333	245	303	312	282	340	313
Chromium (Cr)- Dissolved	ug/L	810	<0.10	4.66	0.21	4.54	<1.0	3.60	0.64	3.75
Copper (Cu)- Dissolved	ug/L	87	1.18	0.72	0.38	2.93	3.17	1.34	1.66	1.72
Iron (Fe)- Dissolved	ug/L		1,400	569	84.1	338	633	648	673	786
Lead (Pb)- Dissolved	ug/L	25	0.216	0.050	0.016	0.034	0.161	0.079	0.106	0.163
Magnesium (Mg)- Dissolved	mg/L		167	127	110	128	149	120	169	180
Manganese (Mn)- Dissolved	ug/L		32.1	29.0	20.1	27.2	24.1	29.3	34.8	33.7
Mercury (Hg)- Total	ug/L	0.29	<0.010	<0.010	<0.010	<0.010	<0.002	<0.002	<0.005	<0.005
Nickel (Ni)- Dissolved	ug/L	490	1.6	1.2	1.3	1.3	2.0	1.5	2.0	1.8
Potassium (K)- Dissolved	mg/L		44.8	32.0	30.1	28.7	41.0	29.6	45.4	34.1
Selenium (Se)- Dissolved	ug/L	63	<0.04	0.09	<0.20	<0.40	<0.40	<0.40	<0.05	0.11
Silver (Ag)- Dissolved	ug/L	1.5	<0.005	<0.005	<0.025	<0.050	<0.050	<0.050	0.0195	<0.010
Sodium (Na)- Dissolved	mg/L	2,300	1,755	1,195	1,140	1,074	1,590	1,126	1,750	1,238
Zinc (Zn)- Dissolved	ug/L	1,100	22.6	12.5	13.1	9.1	39.8	9.8	14.5	11.0
Bacteria										
Total Coliforms (MTF)	MPN/100mL		<3	128	12	23	<3	<3	<1	21
Fecal Coliforms (MTF)	MPN/100mL		<3	16	<3	<3	<3	<3	<1	1
E. coli (MTF)	MPN/100mL		<3	16	<3	<3	<3	<3	<1	<1
Field Parameters										
pH	units		7.09	7.61	7.87	7.73	8.34	8.31	7.30	7.96
Specific Conductivity	(µS/cm)		6,754	5,534	5,017	5,073	8,015	7,812	9,140	6,836
Polycyclic Aromatic Hydrocarbons										
Naphthalene	µg/L	1400	<0.050	0.136	<0.050	0.083	<0.050	<0.050	<0.050	<0.050
Benzo(a)pyrene	µg/L	0.81	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0050	<0.0050
Anthracene	µg/L	2.4	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.010	<0.010
Petroleum Hydrocarbons										
F1 (C6-C10 Hydrocarbons)	µg/L	750	<25	217	<25	107	<25	<25	<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	<200	<200	<250	<250
F4 (C34-C50 Hydrocarbons)	µg/L	500	<200	<200	<200	<200	<200	<200	<250	<250
Benzene	µg/L	44	<0.10	<10	<0.10	<5.0	<0.10	<0.10	<0.50	<0.50
EthylBenzene	µg/L	2,300	<0.10	<10	<0.10	<5.0	<0.10	0.17	<0.50	<0.50
Toluene	µg/L	18,000	<0.20	<20	<0.20	0.46	<0.20	0.48	<0.50	<0.50
Xylene (Total)	µg/L	4,200	<0.10	<10	<0.10	0.29	<0.10	0.95	<0.50	<0.50
Volatile Organic Carbons										
Vinyl chloride	µg/L	0.5	<0.20	<10	<0.20	<10	<0.20	<0.20	<0.50	<0.50
Pesticides										
Diazinon	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<0.10	<0.10
Herbicides										
2,4-D	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<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.
 Note: Bracketed criteria are for till and clay.
 Note: Criteria exceedences are highlighted in red.
 * Criteria for total chloride and total metals

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 2.

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), and 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 2018, a total of 30 surface water samples were analyzed – 5 upstream samples, 3 downstream samples, 9 samples intermediate to the site, and 13 pond samples. Because 2018 was an extremely dry year, water was retained in the retention ponds instead of being hauled for treatment. 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 2018 surface water results are provided in Table 5.1-5.2.

Time versus concentration graphs (Appendix D) show the historical relationship of the analytical parameters at each monitoring location. In general, the analytical results for surface water obtained in 2018 were found to be similar to those obtained in 2015, 2016, and 2017, with similar results for upstream and downstream locations.

Some analytical results for surface water obtained in 2018 were found to be highly variable compared to those obtained in 2015, 2016, and 2017. Copper and iron sometimes exceed the guidelines, although upstream and downstream results are similar. A comparison of the average values for upstream and downstream locations obtained in 2015, 2016, 2017, and 2018 are provided in Table 6. The data collected in 2018 will be used to enhance the existing surface water quality data to better evaluate trends. The Contingency Action Plan identified under Clause 125 was not implemented in 2018.

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




Table 4. 2018 Weekly Weir Data

Date	Flow (m/s)	pH (units)	Conductivity (m/s)	DO (mg/L)	Temp (°C)
20-Apr-18	0.0	10.42	1.80	*na	12.0
23-Apr-18	0.1	8.53	0.81	*na	8.6
4-May-18	0.1	9.77	1.09	12.4	13.4
11-May-18	0.0	8.87	1.15	12.5	10.2
18-May-18	0.0	8.30	1.26	12.3	11.5
25-May-18	0.0	9.36	1.51	6.4	21.6
1-Jun-18	0.0	9.25	1.66	15.2	18.1
8-Jun-18	0.0	10.18	1.71	12.9	21.2
15-Jun-18	0.0	10.16	1.55	10.4	26.9
22-Jun-18	0.0	9.30	1.70	21.2	27.4
29-Jun-18	0.0	9.00	1.70	19.2	23.3
6-Jul-18	0.0	9.50	1.62	26.9	27.5
13-Jul-18	0.0	9.00	1.72	14.6	23.6
20-Jul-18	0.0	8.70	1.88	8.0	24.1
27-Jul-18	0.0	9.00	1.97	18.2	26.6
3-Aug-18	0.0	9.63	2.02	*na	25.3
10-Aug-18	0.0	9.41	2.21	9.0	21.4
17-Aug-18	0.0	8.20	2.74	5.8	28.7
23-Aug-18	0.0	**ns	**ns	**ns	**ns
31-Aug-18	0.0	**ns	**ns	**ns	**ns
6-Sep-18	0.0	**ns	**ns	**ns	**ns
14-Sep-18	0.0	8.20	2.08	9.1	17.5
21-Sep-18	0.0	9.00	2.56	19.5	13.3
28-Sep-18	0.0	8.50	1.25	11.6	6.3
5-Oct-18	0.0	8.61	1.76	10.7	5.5
12-Oct-18	0.0	8.50	2.17	*na	4.6
18-Oct-18	0.2	9.00	2.43	12.4	5.7
26-Oct-18	0.0	9.10	2.32	*na	7.8
9-Nov-18	0.0	**ns	**ns	**ns	**ns

*na - not analysed due to equipment malfunction

**ns - no sample because weir was completely dry and/or frozen

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		Table 5.1 2018 Surface Water Monitoring - Ponds													
		Ponds													
Sampling date	Units	Criteria*	SW25-6		SW25-7		SW25-8		SW25-9A		SW25-9B		SW25-11A	SW25-11B	SW25-11C
			18-Jul-18	23-Apr-18	17-Jul-18	23-Apr-18	17-Jul-18	23-Apr-18	17-Jul-18	23-Apr-18	17-Jul-18	23-Apr-18	17-Jul-18	17-Jul-18	17-Jul-18
Inorganic Parameters															
Alkalinity - Bicarbonate	mg/L		1,660	65	54	129	722	204	204	159	126	1,010	895	709	468
Alkalinity - Carbonate	mg/L		132.0	9.0	139	16.0	96.2	+3.0	59.3	13.0	112	141	159	319	41.0
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
Alkalinity - Total	mg/L		1,790	74	192	145	818	204	263	172	238	1150	1050	1030	509
Dissolved Hardness (CaCO3)	mg/L		1,259	234	946	220	1,042	277	358	278	266	1,482	1,270	1,273	789
pH	units	6.5-9.0	8.37	9.30	9.55	9.19	8.50	8.01	9.07	9.18	9.32	8.56	8.65	9.10	8.68
Specific Conductivity	(µS/cm)		6,320	633	2,360	799	3,590	733	789	526	674	5,180	4,780	4,960	2,490
Turbidity	(ntu)		42.8	13.0	16.3	20.1	17.6	50.8	149.2	90.0	127.0	115.5	95.4	52.5	107.6
Total Dissolved Solids	mg/L		4,140	396	1,890	538	2,570	437	557	315	437	3,640	3,220	3,250	1,570
Total Suspended Solids	mg/L		545	84	353	70	226	127	455	295	455	382	345	320	248
Total Solids	mg/L		4,686	480	2,242	608	2,800	564	1,012	610	892	4,018	3,562	3,570	1,816
Dissolved Chloride (Cl)	mg/L	640	1,050	52.0	307	90.0	483	76.0	86.7	47.0	70.6	1,040	941	1,000	393
Dissolved Sulphate (SO4)	mg/L		158	144	698	96.8	356	69.5	63.1	38.4	33.9	202	174	157	211
Nutrients															
Ammonia - Dissolved	mg/L N		47.80	0.009	0.013	0.297	2.200	1.500	-0.003	0.588	0.028	4.330	2.240	0.011	2.220
Nitrate - Dissolved	mg/L N	13	3.79	0.060	<0.003	0.231	0.711	0.060	<0.003	0.050	0.049	<0.003	0.198	<0.003	0.710
Total Kjeldahl Nitrogen	mg/L N		NA**	3.4	5.9	5.1	18.0	3.0	3.7	4.6	2.7	19.0	17.0	16.0	13.0
Phosphorus - Dissolved	mg/L P		0.719	0.040	0.036	0.600	3.290	0.060	<0.013	<0.01	0.078	1.640	1.630	1.540	0.531
Other															
Cyanide - Total (CN)	mg/L	5000	14.4	1.5	1.4	3.8	8.2	1.3	<1.0	1.3	<1.0	4.3	3.9	3.8	4.1
Organic Indicators															
Carbonaceous Oxygen Demand	mg/L		805	60	140	130	405	70	120	170	120	425	360	415	255
Biochemical Oxygen Demand	mg/L		7	16	5	11	9	20	11	14	12	6	10	9	16
Metals															
Arsenic (As)- Dissolved	ug/L	5.0	30.8	1.81	12.5	3.77	29.7	2.59	13.4	4.58	13.3	69.0	63.4	55.8	14.5
Barium (Ba)- Dissolved	ug/L		187	9.59	37.5	20.6	92.3	42.9	110	186	78.5	414	288	138	96.8
Beryllium (Be)- Dissolved	ug/L		<0.10	<0.010	<0.010	0.010	<0.10	<0.010	0.330	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	0.090	0.151	0.0096	0.0375	0.0181	0.0190	0.0169	<0.0050	0.327	<0.0050	0.0106	0.0077	0.0252	0.0121
Calcium (Ca)- Dissolved	mg/L		63.9	30.2	83.5	31.7	142	45.1	47.6	49.8	28.3	90.7	74.9	79.3	66.8
Chromium (Cr)- Dissolved	ug/L		39.3	<0.10	0.22	0.29	0.64	0.16	0.12	2.46	<0.10	0.99	0.94	0.88	0.66
Copper (Cu)- Dissolved	ug/L	4.0	21.2	2.87	1.91	6.21	8.56	1.71	1.19	13.0	1.03	2.42	2.51	8.45	5.95
Iron (Fe)- Dissolved	ug/L	300	141	64.2	42.0	147	43.0	154	<10	2,190	17.0	19.0	28.0	11.0	12.0
Lead (Pb)- Dissolved	ug/L	7.0	0.817	0.060	0.090	0.297	0.160	0.110	<0.050	6.970	0.050	0.128	0.121	0.211	<0.050
Magnesium (Mg)- Dissolved	mg/L		267	38.5	179	34.3	167	39.8	58.1	37.4	47.5	305	263	261	151
Manganese (Mn)- Dissolved	ug/L		109	209	30.5	46.4	465	277	16.5	327	46.5	109	74.5	23.4	30.7
Mercury (Hg)- Dissolved	ug/L	0.0260	<0.050	<0.0020	<0.0050	<0.0020	<0.0250	<0.0020	<0.0050	<0.0020	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nickel (Ni)- Dissolved	ug/L	150	184	3.46	9.80	11.2	43.7	4.26	7.55	22.4	5.34	69.3	58.6	55.1	37.1
Potassium (K)- Dissolved	mg/L		174	10.9	47.0	97.0	469	11.9	19.2	10.6	16.1	154	152	131	134
Selenium (Se)- Dissolved	ug/L	1.0	2.03	0.214	0.440	0.376	1.60	0.168	0.245	0.134	0.161	0.864	0.665	0.628	0.534
Sodium (Na)- Dissolved	mg/L		846	34.1	166	23.0	116	39.9	56.5	27.9	42.8	515	492	532	200
Zinc (Zn)- Dissolved	ug/L	30.0	39.8	1.07	12.9	9.76	2.50	3.69	1.50	22.2	1.30	1.10	1.90	1.40	2.30
Bacteria															
Total Coliforms (MTF)	MPN/100mL		>24,200	150	>2,420	2,400	>24,200	930	>2,420	2,100	>2,420	>2,420	>2,420	>2,420	>2,420
Fecal Coliforms (MTF)	MPN/100mL		1,550	43	56	75	1,300	23	770	93	210	980	687	816	1,200
E. coli (MTF)	MPN/100mL		4,610	23	51	43	1,110	23	154	15	124	416	345	249	816
Field Parameters															
pH	units	6.5-9.0	8.80	9.76	9.00	9.41	8.75	8.03	8.60	9.48	9.00	8.80	8.92	9.54	8.88
Specific Conductivity	(µS/cm)		4,710	644	2,100	870	3,230	760	730	558	620	4,710	4,330	4,100	930
Temperature			23.7	3.9	25.9	4.5	23.6	4.9	27.3	4.7	26.3	23.7	19.5	20.9	3.6

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

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Table 5.2 2018 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*	23-Apr-18	10-Oct-18	23-Apr-18	17-Jul-18	10-Oct-18	23-Apr-18	10-Oct-18	23-Apr-18	23-Apr-18	17-Jul-18	23-Apr-18	17-Jul-18	23-Apr-18	17-Jul-18	23-Apr-18	23-Apr-18	23-Apr-18	
Inorganic Parameters																				
Alkalinity - Bicarbonate	mg/L		138	210	146	399	226	119	481	236	135	362	135	244	131	215	161	152	158	
Alkalinity - Carbonate	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	7.0	29.4	6.0	<3.0	<3.0	<3.0	<3.0	2.0	46.8	8.0	<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	<3.0	<3.0	<3.0	
Alkalinity - Total	mg/L		138	210	146	399	226	126	511	242	135	362	135	244	133	262	169	152	158	
Dissolved Hardness (CaCO3)	mg/L		148	348	152	724	363	238	761	257	155	1,198	152	1,174	194	326	230	204	232	
pH	units	6.5-9.0	7.57	7.54	7.54	7.48	7.67	9.02	8.65	8.56	7.55	8.13	7.57	8.32	8.47	8.83	9.19	8.32	8.43	
Specific Conductivity	(µS/cm)		326	903	412	1,790	911	689	2,490	846	342	3,170	347	3,240	474	818	528	518	617	
Turbidity	(ntu)		30.3	44.0	69.6	38.4	29.8	39.4	26.2	25.1	24.9	145.6	22.8	211.8	25.8	133.2	83.2	25.8	32.2	
Total Dissolved Solids	mg/L		203	537	252	1,170	536	422	1,570	517	211	2,190	215	2,250	275	552	320	316	373	
Total Suspended Solids	mg/L		59	173	180	1,800	126	136	198	335	43	1,580	49	1,250	75	682	136	62	67	
Total Solids	mg/L		262	710	432	2,968	662	558	1,770	852	254	3,776	264	3,492	350	1,234	456	378	440	
Dissolved Chloride (Cl)	mg/L	640	12.0	108	13.0	254	103	17.0	422	130	15.0	573	20.0	678	37.0	85.2	47.0	42.0	69.0	
Dissolved Sulphate (SO4)	mg/L		17.9	97.3	15.2	221	93.2	116	224	107	21.8	544	23.2	559	56.7	59.6	36.8	49.6	63.5	
Nutrients																				
Ammonia - Dissolved	mg/L N		0.080	<0.003	<0.003	0.148	<0.003	<0.003	0.850	<0.003	0.020	<0.003	0.010	0.005	<0.003	<0.003	0.599	0.222	0.161	
Nitrate - Dissolved	mg/L N	13	0.460	0.007	0.255	0.003	<0.003	0.080	0.919	0.004	0.234	<0.003	0.226	0.005	0.004	0.006	0.050	0.070	0.116	
Total Kjeldahl Nitrogen	mg/L N		4.0	1.1	1.1	12.0	1.3	2.7	11.0	3.3	0.9	3.4	0.9	2.6	2.5	2.7	1.9	2.1		
Phosphorus - Dissolved	mg/L P		0.130	0.039	0.080	0.205	0.037	0.030	0.473	<0.01	0.080	<0.013	0.070	<0.013	<0.010	0.063	<0.010	0.030	0.050	
Other																				
Cyanide - Total (CN)	mg/L	5000	0.9	<1.0	1.4	<1.0	<1.0	1.7	3.3	2.3	1.3	<1.0	1.2	<1.0	1.2	<1.0	1.4	1.3	1.5	
Organic Indicators																				
Carbonaceous Oxygen Demand	mg/L		40	60	70	370	95	60	1,000	190	30	160	40	120	30	140	90	50	60	
Biochemical Oxygen Demand	mg/L		5	8	15	14	7	7	19	20	3	<4	<3	4	11	19	13	33	17	
Metals																				
Arsenic (As)- Dissolved	ug/L	5.0	3.43	2.17	2.90	3.89	1.75	3.79	13.9	2.99	2.64	2.06	2.68	2.11	1.50	11.0	3.29	3.03	3.62	
Barium (Ba)- Dissolved	ug/L		33.7	73.6	31.3	139	65.5	33.3	107	44.0	33.1	119	32.3	144	31.1	83.1	62.4	32.5	33.5	
Beryllium (Be)- Dissolved	ug/L		<0.010	<0.10	<0.010	<0.10	<0.10	<0.010	<0.10	<0.010	<0.010	<0.10	<0.010	<0.10	<0.010	<0.10	0.075	<0.010	<0.010	
Cadmium (Cd)- Dissolved	ug/L	0.090	0.0525	0.0200	0.0169	0.0254	0.0452	0.0983	0.0166	0.0700	0.0108	0.0203	0.0093	0.0111	0.0094	<0.0050	0.197	0.0059	0.0072	
Calcium (Ca)- Dissolved	mg/L		33.4	61.9	33.1	115	63.3	32.8	67.1	42.4	33.5	145	32.9	124	36.9	47.4	37.5	36.5	36.9	
Chromium (Cr)- Dissolved	ug/L		0.15	0.21	0.16	1.83	0.18	0.20	0.64	0.79	0.12	0.15	0.19	0.66	<0.10	<0.10	1.28	0.21	0.11	
Copper (Cu)- Dissolved	ug/L	4.0	2.53	2.05	5.39	1.98	2.12	4.47	6.07	3.54	2.07	4.36	1.92	14.1	1.88	0.63	5.15	1.48	1.89	
Iron (Fe)- Dissolved	ug/L	300	74.9	43.0	83.0	1,410	68.0	21.0	18.0	55.0	108	19.0	139	<10	32.4	13.0	803	32.4	20.0	
Lead (Pb)- Dissolved	ug/L	7.0	0.190	0.379	0.537	1.400	0.081	0.070	0.051	0.101	0.113	<0.050	0.118	0.440	0.775	<0.050	1.740	0.054	0.047	
Magnesium (Mg)- Dissolved	mg/L		15.6	46.9	16.8	106	49.8	38.0	144	36.8	17.3	203	16.9	210	24.8	50.5	33.2	27.4	34.0	
Manganese (Mn)- Dissolved	ug/L		13.9	6.35	26.6	437	13.9	54.7	9.72	2.68	35.9	24.9	36.1	24.3	4.25	36.4	124	47.4	33.0	
Mercury (Hg)- Dissolved	ug/L	0.0260	<0.0020	<0.0050	<0.0020	0.0052	<0.0050	<0.0020	<0.0050	0.0020	<0.0020	<0.0050	<0.0020	<0.0050	<0.0020	<0.0050	<0.0020	<0.0020	<0.0020	
Nickel (Ni)- Dissolved	ug/L	150	2.67	2.57	2.35	3.90	2.59	6.72	33.5	7.25	2.33	7.69	2.37	6.67	2.30	6.10	6.53	3.73	5.60	
Potassium (K)- Dissolved	mg/L		8.49	12.0	7.92	14.8	12.5	18.8	118	16.1	7.75	21.9	7.93	22.2	7.66	16.5	10.4	8.75	11.8	
Selenium (Se)- Dissolved	ug/L	1.0	0.145	0.164	0.132	0.308	0.144	0.358	0.500	0.195	0.156	0.326	0.143	0.398	0.095	0.208	0.161	0.199	0.227	
Sodium (Na)- Dissolved	mg/L		8.53	50.2	10.1	127	59.1	44.9	203	82.6	10.5	205	10.2	209	18.4	47.0	28.2	24.7	38.0	
Zinc (Zn)- Dissolved	ug/L	30.0	2.90	2.20	7.51	16.5	9.50	2.39	7.00	4.83	3.60	3.10	2.90	13.1	3.67	1.00	15.7	0.51	0.71	
Bacteria																				
Total Coliforms (MTF)	MPN/100mL		11,000	>2,420	11,000	>2,420	>2,420	4,600	>2,420	4,600	930	>2,420	4,600	>2,420	4,600	>2,420	11,000	11,000	11,000	
Fecal Coliforms (MTF)	MPN/100mL		38	8	9	>2,420	26	230	830	<3	21	50	75	>2,420	4,600	479	43	23	23	
E. coli (MTF)	MPN/100mL		9	3	9	1,050	44	230	1,300	<3	21	31	75	>2,420	1,500	205	43	23	23	
Field Parameters																				
pH	units	6.5-9.0	7.98	7.60	7.82	7.70	8.07	8.53	9.00	8.43	7.95	8.50	7.81	8.10	8.26	8.10	9.32	8.30	8.82	
Specific Conductivity	(µS/cm)		401	918	351	1,620	930	808	2,430	952	370	2,690	392	2,830	520	830	540	517	645	
Temperature			7.4	32.0	5.9	20.8	3.4	8.6	5.7	8.9	6.0	19.2	5.9	21.2	6.9	3.2	4.7	3.6	4.1	

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



Table 6. 2018 Surface Water Monitoring - Perimeter Ditch Comparison

	Units	Criteria*	2015		2016		2017		2018	
			Average		Average		Average		Average	
			Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
Inorganic Parameters										
Alkalinity - Bicarbonate	mg/L		222	207	254	349	359	433	174	300
Alkalinity - Carbonate	mg/L		<0.50	15.5	<0.50	<0.50	<0.50	<0.50	<3.0	18
Alkalinity - Hydroxide	mg/L		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<3.0	<3.0
Alkalinity - Total	mg/L		271	221	208	287	294	355	174	319
Dissolved Hardness (CaCO3)	mg/L		286	383	515	523	316	448	248	499
pH	units	6.5-9.0	7.55	9.11	7.40	8.15	7.68	8.80	7.56	8.84
Specific Conductivity	(µS/cm)		689	1,056	1,029	1,588	774	1,154	615	1,590
Turbidity	(ntu)		636	72.3	151	135	118	87.2	37.2	32.8
Total Dissolved Solids	mg/L		516	795	721	1,025	496	810	370	996
Total Suspended Solids	mg/L		693	112	483	531	379	169	116	167
Total Solids	mg/L		1,209	907	1,204	1,557	875	978	486	1,164
Dissolved Chloride (Cl)	mg/L	640	54.0	116	61.3	209	62.0	151	60.0	220
Dissolved Sulphate (SO4)	mg/L		35.7	138	205	227	32.5	33.2	57.6	170
Nutrients										
Ammonia - Dissolved	mg/L N		<0.003	0.009	0.295	0.730	0.009	0.560	0.041	0.426
Nitrate - Dissolved	mg/L N	13	0.005	<0.003	3.96	2.98	<0.003	0.184	0.234	0.500
Total Kjeldahl Nitrogen	mg/L N		4.32	2.30	5.40	13.1	1.95	3.35	2.55	6.85
Phosphorus - Dissolved	mg/L P		135	35.9	0.060	0.060	382	195	0.085	0.252
Other										
Cyanide - Total (CN)	ug/L	5,000	1.36	2.09	1.55	2.69	1.96	2.29	0.70	2.50
Organic Indicators										
Carbonaceous Oxygen Demand	mg/L		154	78	131	249	255	135	50	530
Biochemical Oxygen Demand	mg/L		10	10	12	51	<3	23	7	13
Metals										
Arsenic (As)- Dissolved	ug/L	5	3.00	6.31	2.92	5.91	5.25	8.64	2.80	8.85
Barium (Ba)- Dissolved	ug/L		57.5	50.0	47.9	87.2	54.0	68.9	53.7	70.2
Beryllium (Be)- Dissolved	ug/L		0.021	<0.010	<0.010	<0.010	<0.010	<0.010	<0.10	<0.10
Cadmium (Cd)- Dissolved	ug/L	0.09	0.0274	0.0252	0.0620	0.0093	<0.0050	0.0071	0.036	0.057
Calcium (Ca)- Dissolved	mg/L		54.9	46.0	126.2	60.4	55.0	42.9	47.7	50.0
Chromium (Cr)- Dissolved	ug/L		0.13	0.29	0.20	0.49	0.23	0.26	0.18	0.42
Copper (Cu)- Dissolved	ug/L	4	1.64	2.57	3.48	5.02	2.20	2.67	2.29	5.27
Iron (Fe)- Dissolved	ug/L	300	100	29.7	172	32.2	156	33.5	59.0	19.5
Lead (Pb)- Dissolved	ug/L	7	0.058	0.070	0.041	0.105	0.157	0.150	0.285	0.060
Magnesium (Mg)- Dissolved	mg/L		36.2	64.9	48.7	90.7	43.5	55.4	31.3	91.0
Manganese (Mn)- Dissolved	ug/L		51.9	31.7	161.4	172.5	301	37.8	10.1	32.2
Mercury (Hg)- Dissolved	ug/L	0.026	<0.010	<0.010	0.0032	0.0030	0.0022	<0.0020	<0.0050	<0.0050
Nickel (Ni)- Dissolved	ug/L	150	2.69	11.1	2.77	18.9	2.45	10.9	2.62	20.1
Potassium (K)- Dissolved	mg/L		11.4	20.6	12.3	37.9	9.0	27.0	10.2	68.4
Selenium (Se)- Dissolved	ug/L	1	0.118	0.308	0.233	0.475	0.166	0.258	0.155	0.429
Sodium (Na)- Dissolved	mg/L		26.7	74.7	31.3	100	36.4	89.2	29.4	124
Zinc (Zn)- Dissolved	ug/L	30	5.19	5.09	4.31	5.28	2.91	3.31	2.55	4.70
Bacteria										
Total Coliforms (MTF)	MPN/100mL		6,000	5,267	11,000	>11,000	5,965	5,715	6,710	3,510
Fecal Coliforms (MTF)	MPN/100mL		225	93	336	4,008	2,301	33	23	530
E. coli (MTF)	MPN/100mL		235	76	336	3,979	2,301	19	6	765
Field Parameters										
pH	units	6.5-9.0	7.36	8.88	7.79	8.31	8.90	9.52	7.79	8.77
Specific Conductivity	(µS/cm)		702	1,000	947	1,380	720	450	660	1,619

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

5.3 LEACHATE

The leachate management system is a passive collection system which includes a network of drains, sumps, and pumping stations. There are 38 non-pumping manholes which feed into eight collection manholes and one collection riser (R1) around the perimeter of the landfill cells. Leachate is currently pumped from the collection manholes and riser, and hauled for treatment at the North End Sewage Treatment Plant; these sites also serve as the sampling points. The locations of the manholes and riser are shown on Figure 3.

In 2017, construction began on a centralized leachate collection system – manholes 13, 24, and 46 were incorporated in 2018; R1, manholes 3, 8, 31, 33, and some non-pumping manholes with substandard drainage will be incorporated in 2019. The manholes/sumps will pump into a header pipe which will feed by gravity and lift stations to a 300,000 L storage tank located at the intersection of Charette Road and the access road. The system will be designed as a truck-fill station to haul to the North End Sewage Treatment Plant.

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 2018 was 23,486 kL. There were no occurrences of leachate breakout from the development in 2018, and the maximum leachate head in Cell 30 or Cell 31 was not exceeded for more than seven days as per the Leachate Management Plan.

In 2018, ten 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 2018 leachate results are provided in Table 8. The majority of parameters were found to be highly variable between manholes. The annual average concentrations of cyanide, ammonia, chemical oxygen demand, and several metals were highly variable between 2015 and 2018. The average alkalinity, hardness, and conductivity have been increasing yearly since 2015 because of improved landfill cover which allows less water infiltration, which aids the biological breakdown of organic compounds.

A comparison of the average values obtained in 2015, 2016, 2017, and 2018 are provided in Table 9. Piper diagrams for leachate data are attached in Appendix C. The Contingency Action Plan identified under Clause 125 was not implemented in 2018

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



Table 7. 2018 Leachate Levels

	Date	11-Jan-18	14-Feb-18	7-Mar-18	16-Apr-18	7-May-18	6-Jun-18	10-Jul-18	13-Aug-18	11-Sep-18	3-Oct-18	28-Nov-18	10-Dec-18
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)	1.98	4.04	2.32	1.48	1.57	3.32	2.23	1.70	1.95	1.36	1.83	1.90
	Manhole Leachate Elevation (m)	231.68	229.62	231.34	232.18	232.09	230.34	231.43	231.96	231.71	232.30	231.83	231.76
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)	8.08	9.04	10.76	8.55	6.87	8.77	5.61	7.43	4.50	4.17	3.85	3.91
	Manhole Leachate Elevation (m)	228.53	227.57	225.85	228.06	229.74	227.84	231.00	229.18	232.11	232.44	232.76	232.70
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)	4.10	4.40	4.06	2.73	2.04	2.46	3.43	4.37	4.28	2.85	3.15	4.31
	Manhole Leachate Elevation (m)	230.79	230.49	230.83	232.16	232.85	232.43	231.46	230.52	230.61	232.04	231.74	230.58
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)	4.07	2.00	2.01	2.28	1.62	1.60	2.45	1.89	2.08	1.90	3.03	4.92
	Manhole Leachate Elevation (m)	230.93	233.00	232.99	232.72	233.38	233.40	232.55	233.11	232.92	233.10	231.97	230.08
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)	1.98	2.00	2.61	2.02	2.02	2.12	2.14	2.07	2.21	2.10	2.08	2.46
	Manhole Leachate Elevation (m)	233.73	233.71	233.10	233.69	233.69	233.59	233.57	233.64	233.50	233.61	233.63	233.25
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)	3.68	2.08	2.12	1.44	2.13	1.72	2.06	2.06	1.40	0.27	1.82	8.78
	Manhole Leachate Elevation (m)	231.06	232.66	232.62	233.30	232.61	233.02	232.68	232.68	233.34	234.47	232.92	225.96
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)	3.17	2.88	3.42	3.42	3.13	2.88	2.97	2.90	2.89	2.65	3.77	2.97
	Manhole Leachate Elevation (m)	232.25	232.54	232.00	232.00	232.29	232.54	232.45	232.52	232.53	232.77	231.65	232.45
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)	7.03	7.03	7.03	6.24	6.77	5.89	5.36	4.36	4.06	3.77	5.22	5.06
	Manhole Leachate Elevation (m)	228.01	228.01	228.01	228.80	228.27	229.15	229.68	230.68	230.98	231.27	229.82	229.98
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)	7.44	7.95	7.31	7.45	7.81	7.90	6.75	7.07	7.00	7.17	7.05	7.04
	Riser Leachate Elevation (m)	227.53	227.02	227.66	227.52	227.16	227.07	228.22	227.90	227.97	227.80	227.92	227.93



Table 8. 2018 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*	Jul-18	Jul-18	Jul-18	Jul-18	Jul-18	Jul-18	Jul-18	Jul-18	Jul-18	Jul-18
Petroleum Hydrocarbons												
CCME Petroleum Hydrocarbon Fraction F1	mg/L	0.75	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.51	0.11	
CCME Petroleum Hydrocarbon Fraction F2	mg/L	0.15	1.01	1.67	46.4	3.01	<0.10	123	<0.10	3.63	2.49	
CCME Petroleum Hydrocarbon Fraction F3	mg/L	0.50	1.55	1.55	474	12.2	<0.25	2,840	<0.25	3.53	7.75	
CCME Petroleum Hydrocarbon Fraction F4	mg/L	0.50	<0.25	<0.25	47.8	1.44	<0.25	455	<0.25	<0.25	1.90	
Volatile Organic Carbons												
Vinyl Chloride	mg/L	0.0017	<0.00050	0.00073	0.00087	0.00079	<0.00050	<0.00050	<0.00050	<0.00050	0.00087	
1,4 Dichlorobenzene	mg/L	0.067	0.00347	0.00511	0.00283	0.00568	<0.00050	0.00099	<0.00050	<0.00050	0.00118	
Chloroform	mg/L	0.022	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Trichloroethene	mg/L	0.017	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00062	
Tetrachloroethene	mg/L	0.017	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00153	<0.00050	
Dioxins and Furans												
2378 TeCDD	pg/L	14,000										<1.4
12378 PeCDD	pg/L	14,000										<0.94
123478 HxCDD	pg/L	14,000										<1.3
123678 HxCDD	pg/L	14,000										10.0
123789 HxCDD	pg/L	14,000										2.9
1234678 HpCDD	pg/L	14,000										579
OCDD	pg/L	14,000										4,590
Total TCDDs	pg/L	14,000										15.9
Total PeCDD	pg/L	14,000										<0.94
Total HxCDD	pg/L	14,000										151
Total HpCDD	pg/L	14,000										1,160
2378 TeCDF	pg/L	14,000										<1.1
12378 PeCDF	pg/L	14,000										<0.55
23478 PeCDF	pg/L	14,000										<0.66
123478 HxCDF	pg/L	14,000										1.8
123678 HxCDF	pg/L	14,000										1.1
123789 HxCDF	pg/L	14,000										2.8
234678 HxCDF	pg/L	14,000										<1.3
1234678 HpCDF	pg/L	14,000										51
1234789 HpCDF	pg/L	14,000										3.2
OCDF	pg/L	14,000										193
Total TCDF	pg/L	14,000										<1.1
Total PeCDF	pg/L	14,000										<0.66
Total HxCDF	pg/L	14,000										47.3
Total HpCDF	pg/L	14,000										193
Polychlorinated Biphenyls												
Aroclor 1016	ug/L		<0.20	<0.40	<2.0	<0.20	<0.020	<2.0	<0.020	<0.020	<0.40	
Aroclor 1221	ug/L		<0.20	<0.40	<2.0	<0.20	<0.020	<2.0	<0.020	<0.020	<0.40	
Aroclor 1232	ug/L		<0.20	<0.40	<2.0	<0.20	<0.020	<2.0	<0.020	<0.020	<0.40	
Aroclor 1242	ug/L		<0.20	<1.50	<4.5	<1.50	<0.020	<8.0	<0.020	<0.020	<0.550	
Aroclor 1248	ug/L		<0.20	<0.40	<2.0	<0.20	<0.020	<2.0	<0.020	<0.020	<0.40	
Aroclor 1254	ug/L		<0.20	<0.40	<2.0	<0.50	<0.020	<7.0	<0.020	<0.020	<0.40	
Aroclor 1260	ug/L		<0.20	<0.40	<2.0	<2.50	<0.020	<4.0	<0.020	<0.020	<0.40	
Total PCBs	ug/L	15	<0.60	<2.0	<7.50	<3.0	<0.060	<13.0	<0.060	<0.060	<1.30	
Pesticides and Herbicides												
Diazinon	ug/L		<0.10	<0.10	<172	<0.10	<0.10	<5.0	<0.10	<0.10	<0.40	
2, 4-D	mg/L		<0.0050	<0.0050	0.0030	<0.0050	<0.0010	0.0027	<0.0010	0.0053	<0.0050	
Aldrin	ug/L	8.5	<5.0	<5.0	<5.0	<5.0	<0.10	<5.0	<0.10	<0.10	<2.25	
Hexachlorocyclohexane (Lindane)	ug/L	1.2	<5.0	<5.0	<91.0	<5.0	<0.10	<10.0	<0.10	<0.10	<0.50	
MCPA	mg/L		<0.0050	<0.0050	<0.0010	<0.0050	<0.00010	<0.0010	<0.00010	<0.0010	<0.0050	
Mirex	ug/L		<5.0	<5.0	<5.0	<5.0	<0.10	<5.0	<0.10	<0.10	<0.50	
Methoxychlor	ug/L	6.5	<5.0	<5.0	<5.0	<5.0	<0.10	<5.0	<0.10	<0.10	<0.50	
Bacteria												
Total Coliforms	MPN/100mL		>24,200	>24,200	>24,200	12,000	>2,420	>24,200	166	>24,200	3,450	
Fecal Coliforms	MPN/100mL		2,760	400	610	100	32	790	1	>24,200	10	
E. coli	MPN/100mL		2,480	370	12,000	30	31	930	1	>24,200	31	

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



Table 9. 2018 Leachate Quality Comparison

			2015	2016	2017	2018
Sampling Date	Units	Criteria*	Average	Average	Average	Average
Field Parameters						
pH	units		6.98	7.41	7.63	7.28
Turbidity - NTU	ntu		21.4	37.9	119	298
Specific Conductivity	uS/cm		6,493	4,278	9,046	10,580
Inorganic Parameters						
Alkalinity - Bicarbonate	mg/L		2,937	4,276	4,479	4,270
Alkalinity - Carbonate	mg/L		<5.0	130	<5.0	<3.0
Alkalinity - Hydroxide	mg/L		<5.0	<5.0	<5.0	<3.0
Alkalinity - Total	mg/L		2,406	3,720	3,672	4,270
Hardness (as CaCO3)	mg/L		1,575	1,708	1,966	2,106
pH - units	units		7.57	7.24	7.35	7.06
Specific Conductivity	uS/cm		6,776	10,604	10,494	11,131
Turbidity - NTU	ntu		108	193	128	136
Total Dissolved Solids	mg/L		4,584	6,057	5,864	6,140
Total Suspended Solids	mg/L		245	13,543	579	789
Chloride (dissolved)	mg/L	2,300	744	1,060	1,222	1,163
Sulphate (dissolved)	mg/L		128	115	273	164
Other						
Cyanide (CN)	ug/L	66.0	10.3	10.4	8.0	21.4
Nutrients						
Dissolved Ammonia	mg/L		250	570	504	243
Nitrate Nitrite Nitrogen	mg/L		0.159	0.310	1.35	8.48
Total Kjeldhal Nitrogen	mg/L		304	276	621	342
Phosphorus (Total)	mg/L		1.87	3.32	3.29	2.12
Organic Indicators						
Biological Oxygen Demand	mg/L		64	583	726	1,347
Chemical Oxygen Demand	mg/L		902	1,140	2,540	2,367
Metals						
Total Arsenic (As)	mg/L	1.9	0.0115	0.0139	0.0248	0.0321
Total Barium (Ba)	mg/L	29	0.401	0.372	0.376	0.382
Total Beryllium (Be)	mg/L	0.067	0.03126	0.00014	0.00012	0.00113
Total Cadmium (Cd)	mg/L	0.0027	0.000195	0.000307	0.000308	0.000452
Total Calcium (Ca)	mg/L		129	147	212	236
Total Chromium (Cr)	mg/L	0.81	0.0315	0.0635	0.0724	0.0756
Total Chromium (Hexavalent)	mg/L		<0.0010	0.0050	0.0135	<0.010
Total Copper (Cu)	mg/L	0.087	0.0080	0.0084	0.0128	0.0291
Total Iron (Fe)	mg/L		10.7	6.8	18.8	20.1
Total Lead (Pb)	mg/L	0.025	0.00718	0.01072	0.01008	0.01057
Total Magnesium (Mg)	mg/L		248	279	329	368
Total Manganese (Mn)	mg/L		1.018	0.437	0.832	1.129
Total Mercury (Hg)	mg/L	0.0028	0.000004	0.000002	0.000021	0.000273
Total Nickel (Ni)	mg/L	0.49	0.1222	0.1546	0.1541	0.2522
Total Potassium (K)	mg/L		254	314	292	364
Dissolved Selenium (Se)	mg/L	0.063	0.1733	0.0009	0.0012	0.0019
Total Silver (Ag)	mg/L	0.0015	0.000095	0.000150	0.00009	0.00034
Total Sodium (Na)	mg/L	2,300	598	824	835	1,115
Total Zinc (Zn)	mg/L	1.1	0.0545	1.18	0.453	0.206

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.



Table 9. 2018 Leachate Quality Comparison

			2015	2016	2017	2018
Sampling Date	Units	Criteria*	Average	Average	Average	Average
Extractables						
Benzo (a) Pyrene (PAH)	mg/L	0.00081	0.0137500	0.0007944	0.0002600	0.0007530
Anthracene	mg/L	0.0024	0.01375	0.00105	0.00089	0.00133
4'4' Methylenebis 2 Chloroaniline	ug/L		NA	NA	<50	<50
Benzo (a) anthracene (PAH)	mg/L	0.0047	0.01375	0.00123	0.00089	0.00113
Benzo (b) fluoroanthene (PAH)	mg/L		<0.050	0.00140	0.00049	0.00117
Benzo (g,h,i) Perylene (PAH)	mg/L	0.0002	0.01375	0.00073	0.00033	0.00103
Hexachlorobenzene	ug/L	3.1	<0.050	<0.050	<0.30	<5.0
Phenanthrene	mg/L	0.58	0.00062	0.00374	0.00205	0.00513
Phenol	mg/L	12	0.221	0.391	0.677	0.276
Petroleum Hydrocarbons						
CCME Petroleum Hydrocarbon Fraction F1	mg/L	0.75	0.19	0.11	0.45*	0.11
CCME Petroleum Hydrocarbon Fraction F2	mg/L	0.15	<0.10	0.17	0.23*	20.2
CCME Petroleum Hydrocarbon Fraction F3	mg/L	0.50	<0.20	<0.20	0.41*	371
CCME Petroleum Hydrocarbon Fraction F4	mg/L	0.50	<0.20	<0.20	<0.20*	56.3
Volatile Organic Carbons						
Vinyl Chloride	mg/L	0.0017	0.00184	<0.040	<0.040	0.00050
1,4 Dichlorobenzene	mg/L	0.067	0.00244	0.00510	0.00580	0.00222
Chloroform	mg/L	0.022	<0.0050	<0.020	<0.020	<0.00050
Trichloroethene	mg/L	0.017	<0.0050	<0.020	<0.020	0.00029
Tetrachloroethene	mg/L	0.017	<0.0050	<0.020	<0.020	0.00039
Polychlorinated Biphenyls						
Aroclor 1016	ug/L		<0.50	<0.50	<0.50	<2.0
Aroclor 1221	ug/L		<0.50	<0.50	<0.50	<2.0
Aroclor 1232	ug/L		<0.50	<0.50	<0.50	<2.0
Aroclor 1242	ug/L		<0.50	0.11	<0.50	<8.0
Aroclor 1248	ug/L		<0.50	<0.50	<0.50	<2.0
Aroclor 1254	ug/L		<0.50	0.09	<0.50	<7.0
Aroclor 1260	ug/L		<0.50	0.10	<0.50	<4.0
Total PCBs	ug/L	15	<0.50	0.10	<3.0	<13.0
Pesticides and Herbicides						
Diazinon	ug/L		<40	<10	<320	<172
2, 4-D	mg/L		<0.020	<2.0	<1.0	0.0024
Aldrin	ug/L	8.5	<0.05	<0.05	<0.30	<5.0
Hexachlorocyclohexane (Lindane)	ug/L	1.2	<0.03	<0.03	<0.20	<91.0
MCPA	mg/L		<0.040	<4.0	<2.0	<0.0050
Mirex	ug/L		<0.20	<0.05	<0.30	<5.0
Methoxychlor	ug/L	6.5	<0.10	<0.10	<0.70	<5.0
Bacteria						
Total Coliforms	MPN/100mL		141,751	4,859	6,158	15,448
Fecal Coliforms	MPN/100mL		144,943	323	243	3,211
E. coli	MPN/100mL		139,665	322	193	4,453

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

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 2018, the LFGCFS coverage was extended to the new centralized leachate collection system. The BRRMF LFGCFS operated as intended, although there are suspected blockages in two sections of the underground collection pipes. These sections should be inspected and repaired as required.

The 2018 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 2018, the maximum level of CH₄ measured was 0.5%. The Subsurface Landfill Gas Contingency Plan was not activated, indicating that the LFGCFS is operating effectively.

The 2018 subsurface gas migration probe data is provided in Table 10.



Table 10. 2018 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S
		% LEL	(%)	PPM	PPM
1	10-Jan-18	0.0	20.0	0.0	0.0
1	14-Feb-18	0.4	22.0	0.0	0.0
1	7-Mar-18	No Access			
1	4-Apr-18	0.0	22.5	0.0	0.0
1	2-May-18	0.0	21.7	0.0	0.0
1	5-Jun-18	0.0	16.7	0.0	0.0
1	17-Jul-18	0.0	18.7	0.0	0.0
1	22-Aug-18	0.0	19.4	0.0	0.0
1	7-Sep-18	0.0	18.9	1.0	0.0
1	22-Oct-18	0.0	19.1	0.0	0.0
1	19-Nov-18	0.0	12.1	0.0	0.0
1	13-Dec-18	0.0	21.1	0.0	0.0
2	10-Jan-18	0.0	21.2	0.0	0.0
2	14-Feb-18	0.4	22.0	0.0	0.0
2	7-Mar-18	No Access			
2	4-Apr-18	0.0	20.8	0.0	0.0
2	2-May-18	0.0	20.4	0.0	0.0
2	5-Jun-18	0.0	18.9	0.0	0.0
2	17-Jul-18	0.0	19.0	0.0	0.0
2	22-Aug-18	0.0	19.2	0.0	0.0
2	7-Sep-18	0.0	19.1	0.0	0.0
2	22-Oct-18	0.0	18.7	0.0	0.0
2	19-Nov-18	0.0	19.0	0.0	0.0
2	13-Dec-18	0.0	19.1	0.0	0.0
3	10-Jan-18	0.0	22.2	0.0	0.0
3	14-Feb-18	0.4	21.0	0.0	0.0
3	7-Mar-18	0.0	21.9	1.0	0.0
3	4-Apr-18	0.0	22.1	0.0	0.0
3	2-May-18	0.0	18.9	1.0	0.0
3	5-Jun-18	0.0	19.2	0.0	0.0
3	17-Jul-18	0.0	16.1	0.0	0.0
3	22-Aug-18	0.0	19.2	1.0	0.0
3	7-Sep-18	0.0	19.4	0.0	0.0
3	22-Oct-18	0.0	19.7	0.0	0.0
3	19-Nov-18	0.0	20.0	0.0	0.0
3	13-Dec-18	0.0	20.0	0.0	0.0



Table 10. 2018 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S
		% LEL	(%)	PPM	PPM
4	10-Jan-18	0.0	21.2	1.0	0.0
4	14-Feb-18	0.4	22.2	0.0	0.0
4	7-Mar-18	0.0	20.1	0.0	0.0
4	4-Apr-18	0.0	21.9	0.0	0.0
4	2-May-18	0.0	20.2	0.0	0.0
4	5-Jun-18	0.0	19.0	0.0	0.0
4	17-Jul-18	0.0	19.7	0.0	0.0
4	22-Aug-18	0.0	19.5	1.0	0.0
4	7-Sep-18	0.0	19.5	1.0	0.0
4	22-Oct-18	0.0	21.9	0.0	0.0
4	19-Nov-18	0.0	20.0	0.0	0.0
4	13-Dec-18	0.0	21.0	0.0	0.0
5	10-Jan-18	0.0	21.9	1.0	0.0
5	14-Feb-18	0.4	22.1	0.0	0.0
5	7-Mar-18	0.0	20.8	0.0	0.0
5	4-Apr-18	0.0	22.0	0.0	0.0
5	2-May-18	0.0	20.5	0.0	0.0
5	5-Jun-18	0.0	18.9	0.0	0.0
5	17-Jul-18	0.0	19.8	0.0	0.0
5	22-Aug-18	0.0	19.7	1.0	0.0
5	7-Sep-18	0.0	19.5	0.0	0.0
5	22-Oct-18	0.0	21.8	0.0	0.0
5	19-Nov-18	0.0	20.0	0.0	0.0
5	13-Dec-18	0.0	21.0	0.0	0.0
6	10-Jan-18	0.3	21.3	0.0	2.0
6	14-Feb-18	0.4	21.2	0.0	0.0
6	7-Mar-18	0.0	20.8	1.0	0.0
6	4-Apr-18	0.0	21.1	0.0	0.0
6	2-May-18	0.0	20.8	0.0	0.0
6	5-Jun-18	0.0	19.3	0.0	0.0
6	17-Jul-18	0.0	16.8	0.0	0.0
6	22-Aug-18	0.0	18.9	1.0	0.0
6	7-Sep-18	0.0	18.1	0.0	0.0
6	22-Oct-18	0.0	20.8	0.0	0.0
6	19-Nov-18	0.0	20.0	0.0	0.0
6	13-Dec-18	0.0	21.0	0.0	0.0



Table 10. 2018 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S
		% LEL	(%)	PPM	PPM
7	10-Jan-18	0.0	21.0	0.0	0.0
7	14-Feb-18	0.4	22.4	0.0	0.0
7	7-Mar-18	0.0	22.1	0.0	0.0
7	4-Apr-18	0.0	21.8	0.0	0.0
7	2-May-18	0.0	21.0	0.0	0.0
7	5-Jun-18	0.0	19.1	0.0	0.0
7	17-Jul-18	0.0	18.8	0.0	0.0
7	22-Aug-18	0.0	18.7	1.0	0.0
7	10-Sep-18	0.0	18.7	0.0	0.0
7	22-Oct-18	0.0	20.3	0.0	0.0
7	19-Nov-18	0.0	19.0	0.0	0.0
7	13-Dec-18	0.0	21.0	0.0	0.0
8	10-Jan-18	0.0	21.0	0.0	0.0
8	14-Feb-18	0.4	22.2	0.0	0.0
8	7-Mar-18	0.0	21.8	0.0	0.0
8	4-Apr-18	0.0	21.8	0.0	0.0
8	2-May-18	0.0	21.0	0.0	0.0
8	5-Jun-18	0.0	19.1	0.0	0.0
8	17-Jul-18	0.0	18.8	0.0	0.0
8	22-Aug-18	0.0	18.8	0.0	0.0
8	7-Sep-18	0.0	18.6	0.0	0.0
8	22-Oct-18	0.0	19.8	0.0	0.0
8	19-Nov-18	0.0	19.0	0.0	0.0
8	13-Dec-18	0.0	20.5	0.0	0.0
9	10-Jan-18	0.3	20.1	0.0	1.0
9	14-Feb-18	0.4	21.0	1.0	0.0
9	7-Mar-18	0.0	21.2	1.0	0.0
9	4-Apr-18	0.0	21.7	0.0	0.0
9	2-May-18	0.0	19.6	0.0	0.0
9	5-Jun-18	0.0	18.6	2.0	0.0
9	17-Jul-18	0.0	18.4	1.0	0.0
9	22-Aug-18	0.0	18.0	3.0	0.0
9	7-Sep-18	0.0	18.1	0.0	0.0
9	22-Oct-18	0.0	19.2	0.0	0.0
9	19-Nov-18	0.0	19.3	0.0	0.0
9	13-Dec-18	0.0	18.4	1.0	0.0



Table 10. 2018 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S
		% LEL	(%)	PPM	PPM
10	10-Jan-18	0.3	20.1	0.0	0.0
10	14-Feb-18	0.4	22.0	0.0	0.0
10	7-Mar-18	0.0	20.7	2.0	0.0
10	4-Apr-18	0.1	21.8	0.0	0.0
10	2-May-18	0.0	21.0	0.0	0.0
10	5-Jun-18	0.1	19.1	0.0	0.0
10	17-Jul-18	0.0	18.9	0.0	0.0
10	22-Aug-18	0.0	18.9	1.0	0.0
10	10-Sep-18	0.0	19.1	0.0	0.0
10	22-Oct-18	0.0	20.0	0.0	0.0
10	19-Nov-18	0.0	20.0	0.0	0.0
10	13-Dec-18	0.0	21.0	0.0	0.0
P28E	10-Jan-18	0.3	21.8	0.0	2.0
P28E	14-Feb-18	0.4	21.2	1.0	0.0
P28E	8-Mar-18	0.0	20.0	1.0	0.0
P28E	4-Apr-18	0.0	21.6	0.0	0.0
P28E	2-May-18	0.0	21.0	0.0	0.0
P28E	12-Jun-18	0.0	18.1	0.0	2.0
P28E	17-Jul-18	0.0	18.7	0.0	0.0
P28E	22-Aug-18	0.0	18.9	0.0	0.0
P28E	7-Sep-18	0.0	18.9	0.0	0.0
P28E	22-Oct-18	0.0	21.3	0.0	0.0
P28E	19-Nov-18	0.0	20.0	0.0	0.0
P28E	13-Dec-18	0.0	20.3	0.0	0.0
P30E	10-Jan-18	0.3	21.8	0.0	2.0
P30E	14-Feb-18	0.4	21.9	1.0	0.0
P30E	8-Mar-18	0.1	20.3	2.0	0.0
P30E	4-Apr-18	0.0	21.6	0.0	0.0
P30E	2-May-18	0.0	20.3	0.0	0.0
P30E	12-Jun-18	0.0	17.8	1.0	2.0
P30E	17-Jul-18	0.0	19.4	0.0	0.0
P30E	23-Aug-18	0.0	19.0	0.0	0.0
P30E	7-Sep-18	0.0	18.8	1.0	0.0
P30E	22-Oct-18	0.0	21.9	0.0	0.0
P30E	20-Nov-18	0.0	20.0	0.0	0.0
P30E	13-Dec-18	0.0	20.0	0.0	0.0



Table 10. 2018 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S
		% LEL	(%)	PPM	PPM
P34E	10-Jan-18	0.3	21.7	0.0	2.0
P34E	14-Feb-18	0.4	21.7	0.0	0.0
P34E	8-Mar-18	0.0	19.8	1.0	0.0
P34E	4-Apr-18	0.0	22.2	0.0	0.0
P34E	2-May-18	0.0	19.9	0.0	0.0
P34E	12-Jun-18	0.0	18.2	0.0	3.0
P34E	17-Jul-18	0.0	18.5	0.0	0.0
P34E	22-Aug-18	0.0	19.2	1.0	0.0
P34E	7-Sep-18	0.0	18.8	0.0	0.0
P34E	22-Oct-18	0.0	18.2	0.0	0.0
P34E	19-Nov-18	0.0	20.0	0.0	0.0
P34E	13-Dec-18	0.0	19.8	0.0	0.0
P106E	10-Jan-18	0.0	20.9	0.0	0.0
P106E	14-Feb-18	0.5	21.1	0.0	0.0
P106E	7-Mar-18	0.0	19.4	2.0	0.0
P106E	4-Apr-18	0.0	21.9	0.0	0.0
P106E	2-May-18	0.1	20.8	0.0	0.0
P106E	5-Jun-18	0.0	19.1	0.0	0.0
P106E	17-Jul-18	0.0	20.2	0.0	0.0
P106E	23-Aug-18	0.0	19.6	0.0	0.0
P106E	6-Sep-18	0.0	19.4	0.0	0.0
P106E	22-Oct-18	0.0	19.9	0.0	0.0
P106E	19-Nov-18	0.0	20.0	0.0	0.0
P106E	13-Dec-18	0.0	21.3	0.0	0.0
P107E	10-Jan-18	0.0	20.9	0.0	0.0
P107E	14-Feb-18	0.5	20.9	0.0	0.0
P107E	7-Mar-18	0.0	18.9	5.0	0.0
P107E	4-Apr-18	0.0	21.9	0.0	0.0
P107E	2-May-18	0.0	20.3	0.0	0.0
P107E	5-Jun-18	0.0	20.9	0.0	0.0
P107E	17-Jul-18	0.0	20.1	0.0	0.0
P107E	23-Aug-18	0.0	19.4	0.0	0.0
P107E	6-Sep-18	0.0	19.4	0.0	0.0
P107E	22-Oct-18	0.0	20.0	0.0	0.0
P107E	19-Nov-18	0.0	20.0	0.0	0.0
P107E	13-Dec-18	0.0	22.4	0.0	0.0



Table 10. 2018 External Gas Probe
Monitoring

Well No.	Date	CH4	O2	CO	H2S
		% LEL	(%)	PPM	PPM
P108E	10-Jan-18	0.0	21.6	0.0	0.0
P108E	14-Feb-18	0.5	21.8	0.0	0.0
P108E	7-Mar-18	0.0	20.8	4.0	0.0
P108E	4-Apr-18	0.0	21.9	0.0	0.0
P108E	2-May-18	0.0	20.6	0.0	0.0
P108E	5-Jun-18	0.0	19.1	0.0	0.0
P108E	17-Jul-18	0.0	20.0	0.0	0.0
P108E	23-Aug-18	0.0	19.1	0.0	0.0
P108E	6-Sep-18	0.0	19.1	0.0	0.0
P108E	22-Oct-18	0.0	20.2	0.0	0.0
P108E	19-Nov-18	0.0	20.0	0.0	0.0
P108E	13-Dec-18	0.0	22.4	0.0	0.0
P109E	10-Jan-18	0.0	21.0	0.0	0.0
P109E	14-Feb-18	0.5	22.2	0.0	0.0
P109E	7-Mar-18	0.0	20.9	2.0	0.0
P109E	4-Apr-18	0.0	21.9	0.0	0.0
P109E	2-May-18	0.0	18.5	0.0	0.0
P109E	5-Jun-18	0.0	17.3	0.0	0.0
P109E	17-Jul-18	0.0	17.7	0.0	0.0
P109E	23-Aug-18	0.0	18.0	0.0	0.0
P109E	6-Sep-18	0.0	17.9	0.0	0.0
P109E	22-Oct-18	No Access			
P109E	19-Nov-18	No Access			
P109E	13-Dec-18	No Access			
P110E	10-Jan-18	0.0	12.0	0.0	0.0
P110E	14-Feb-18	0.4	21.4	0.0	0.0
P110E	7-Mar-18	0.0	20.8	2.0	0.0
P110E	4-Apr-18	0.0	21.9	0.0	0.0
P110E	2-May-18	0.0	20.3	0.0	0.0
P110E	5-Jun-18	0.0	19.0	0.0	0.0
P110E	17-Jul-18	0.0	16.6	0.0	0.0
P110E	22-Aug-18	0.0	19.9	1.0	0.0
P110E	6-Sep-18	0.0	18.8	0.0	0.0
P110E	22-Oct-18	0.0	20.5	0.0	0.0
P110E	19-Nov-18	0.0	20.0	0.0	0.0
P110E	13-Dec-18	0.0	21.8	0.0	0.0



Table 10. 2018 External Gas Probe Monitoring

Well No.	Date	CH4	O2	CO	H2S
		% LEL	(%)	PPM	PPM
P111E	10-Jan-18	0.0	22.2	0.0	0.0
P111E	14-Feb-18	0.4	22.3	0.0	0.0
P111E	7-Mar-18	0.0	20.9	2.0	0.0
P111E	4-Apr-18	0.0	21.9	0.0	0.0
P111E	2-May-18	0.0	20.4	0.0	0.0
P111E	5-Jun-18	0.0	18.9	0.0	0.0
P111E	17-Jul-18	0.0	20.0	0.0	0.0
P111E	22-Aug-18	0.0	20.0	0.0	0.0
P111E	6-Sep-18	0.0	18.6	0.0	0.0
P111E	22-Oct-18	0.0	20.6	0.0	0.0
P111E	19-Nov-18	0.0	20.0	0.0	0.0
P111E	13-Dec-18	0.0	22.0	0.0	0.0
P112E	10-Jan-18	0.0	22.2	0.0	0.0
P112E	14-Feb-18	0.4	22.1	0.0	0.0
P112E	7-Mar-18	No Access			
P112E	4-Apr-18	0.0	21.9	0.0	0.0
P112E	2-May-18	0.0	22.1	0.0	0.0
P112E	5-Jun-18	0.0	19.0	0.0	0.0
P112E	17-Jul-18	0.0	20.0	0.0	0.0
P112E	22-Aug-18	0.0	20.0	0.0	0.0
P112E	6-Sep-18	0.0	18.6	0.0	0.0
P112E	22-Oct-18	0.0	20.7	0.0	0.0
P112E	19-Nov-18	0.0	20.0	0.0	0.0
P112E	13-Dec-18	0.0	21.0	0.0	0.0

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.

We anticipate a decrease in odour complaints because Cell 30, which was used for active disposals from December 2014 to November 2017, now has an intermediate cover. Cell 31 has been used for active disposals December 2017; it is located immediately South of Cell 30, which is further from the surrounding developments. (See Figure 3)

In 2018, there were 20 odour complaints from 11 customers; in all cases the source of the odour was investigated. 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, and used compost or wood chips to reduce the odour and prevent further occurrence.

Table 11 provides a summary of nuisance complaints received in 2018.

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 2018 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 blocked sections of LFG collection piping should be inspected and 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.

<https://www.ontario.ca/page/soil-ground-water-and-sediment-standards-use-under-part-xv1-environmental-protection-act>

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).

<http://cegg-rcqe.ccme.ca/download/en/221>

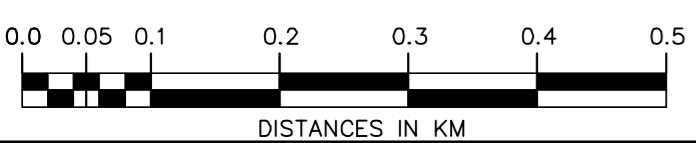
**FIGURE 1
GROUNDWATER SAMPLING
LOCATIONS**

BRADY ROAD LANDFILL



LEGEND

- ▲ OVERBURDEN PIEZOMETER NEST
- GROUNDWATER WELL



B.M. ELEV.	FIELD BOOK #:
POSTED TO LBIS	
1	11/11/25 KB
NO. REVISIONS	DATE BY

THE CITY OF WINNIPEG
 WATER AND WASTE DEPARTMENT

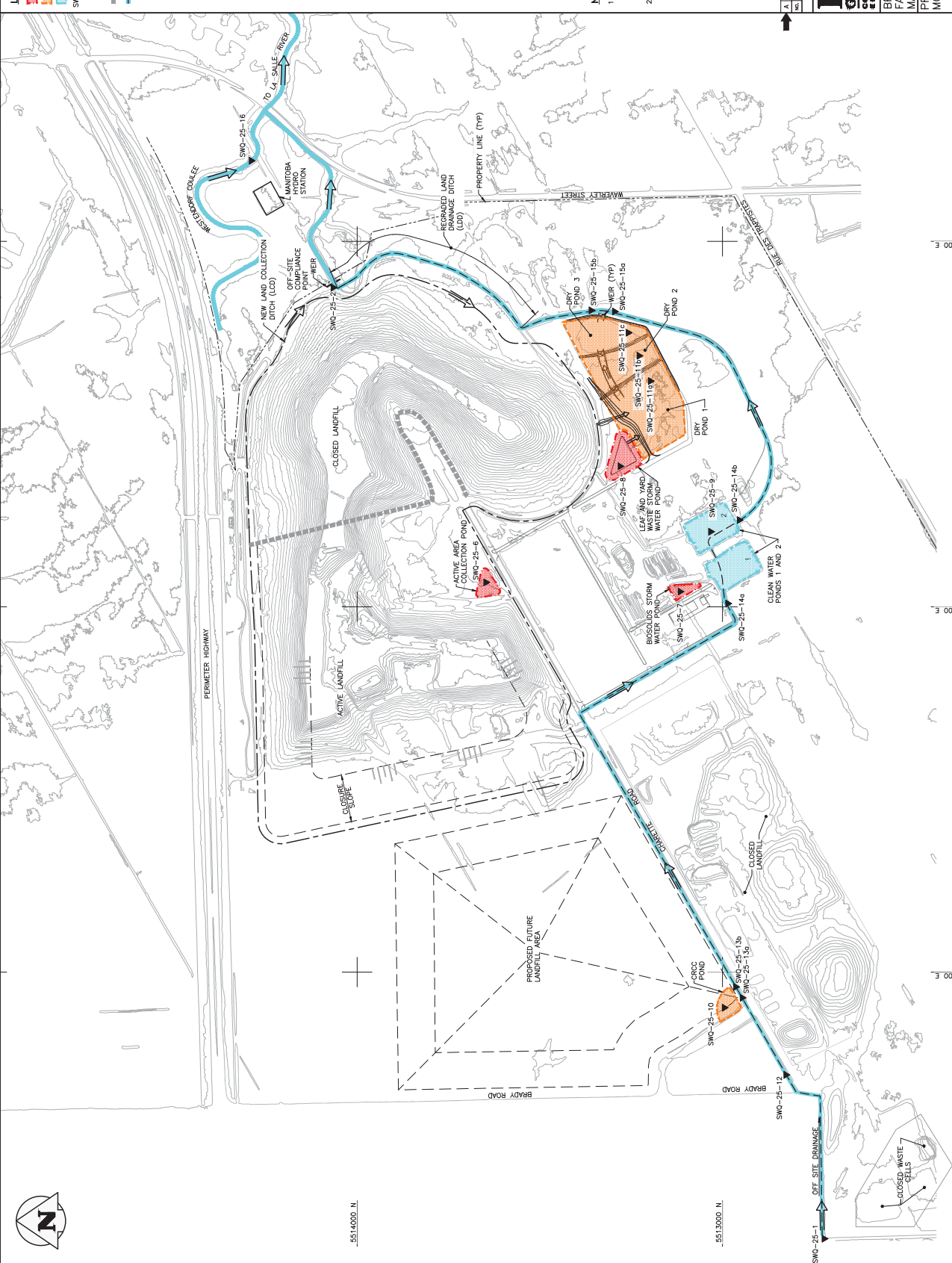
BRADY ROAD LANDFILL

WELL LOCATIONS

SHEET 1 OF 1

FIGURE 1_R1

FIGURE 2
SURFACE WATER SAMPLING
LOCATIONS



LEGEND:

- IMPACTED WATER POND
- DRY POND
- CLEAN WATER POND
- SWC-25-16
- SURFACE WATER SAMPLING LOCATION
- SURFACE WATER FLOW DIRECTION
- CLOSED LANDFILL BOUNDARY
- LAND DRAINAGE DITCH

NOTES:

1. GEOGRAPHY SOURCES ARE CITY OF WINNIPEG, KGS OPERATING AREA AND ADDITIONAL LANDFILL PERIMETER SURVEY BY KGS GROUP 2013.
2. EXACT SURFACE WATER SAMPLING LOCATION TO BE DETERMINED IN FIELD.

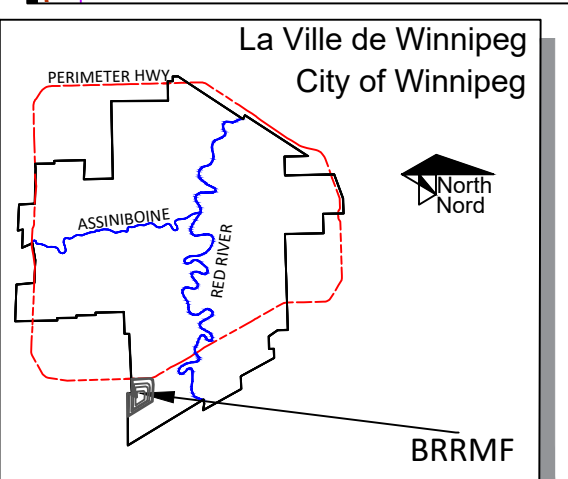
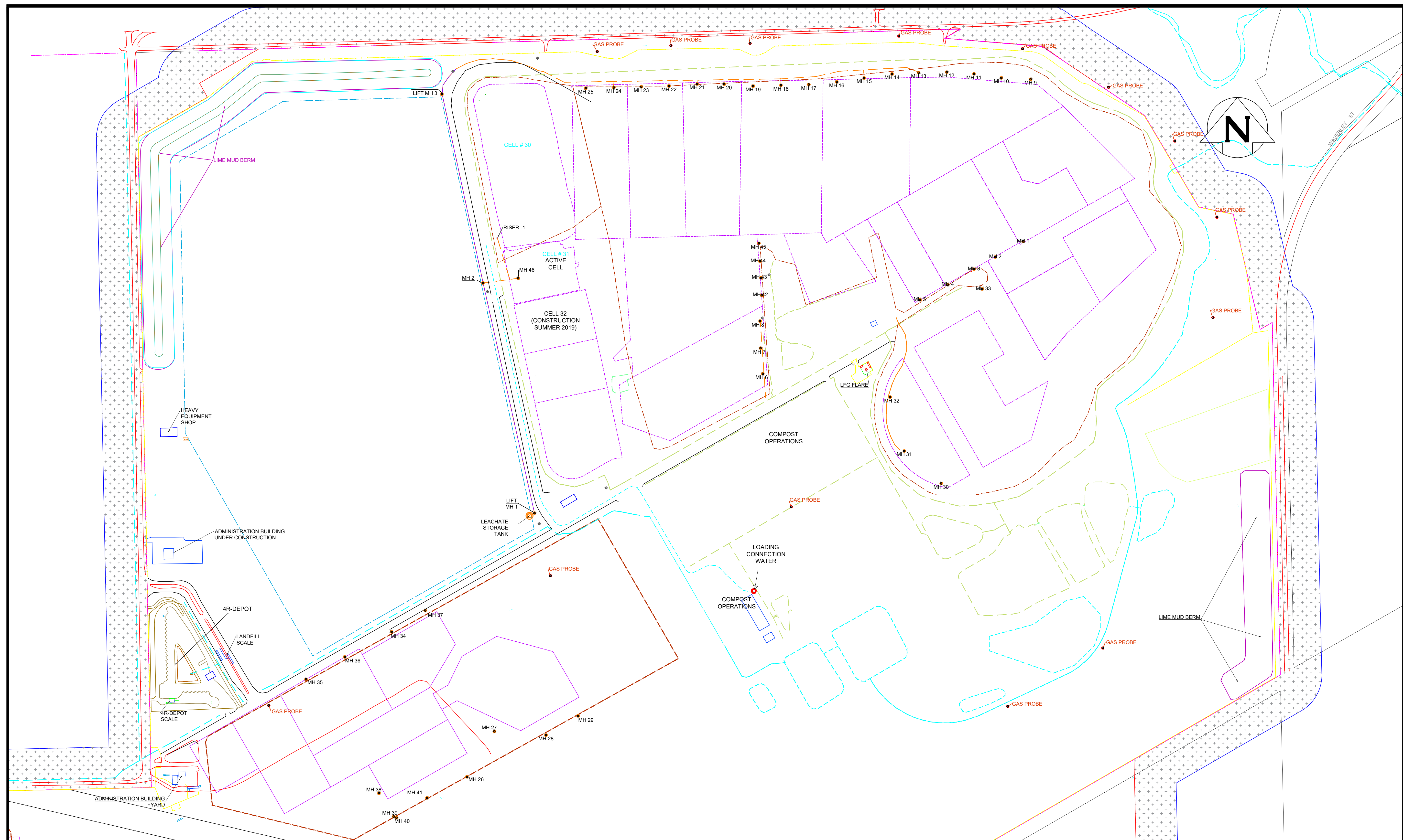


KGS GROUP
CONSULTING ENGINEERS

THE CITY OF WINNIPEG
WATER AND WASTEWATER

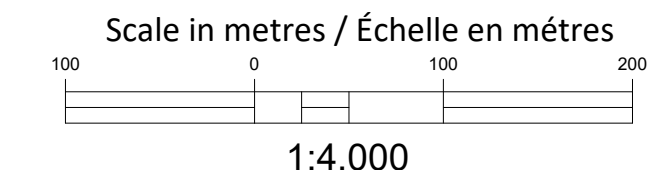
BRADY ROAD RESOURCE MANAGEMENT
FACILITY SURFACE WATER
MANAGEMENT PLAN
PROPOSED SURFACE WATER
MONITORING LOCATIONS

FIGURE 3
LEACHATE COLLECTION SYSTEM



LEGEND/LÉGENDE

	CONTROL ZONE / Zone de contrôle		MANHOLE
	LANDFILL SITE / Site d'enfouissement Area : 802.94 Ha.		GAS PROBE
	CLEAN WATER DRAINAGE		GW Well
	IMPACTED WATER DRAINAGE		RISER
	BRRMF ROADS		
	CLOSED LANDFILL		
	LEACHATE HEADER PIPES		



METRIC / MÉTRIQUE
 WHOLE NUMBERS INDICATE MILLIMETERS / LES NUMÉROS ENTIERS INDICENT LES MILLIMÈTRES
 DECIMALIZED NUMBERS INDICATE METRES / LES NUMÉROS DÉCIMALISÉS INDICENT LES MÈTRES

ORTHOPHOTO Date	2018	FIELD BOOK #:	
UPDATED FEATURES			
WINTER & SUMMER GW FLOW DIRECTION			
As per W.L. GIBBONS, HYDROLOGY Report	Aug. 2016	BWSW	
KGS Leachate Header Pipes - Update	April 2019	IS/MO	
WELLS FEATURES SURVEYED	2017	BMMN	
AIR PHOTO UPDATED TO	04.26.18	M.O.	
CONVERT TO AUTOCAD DRAWING	OCT. 2018	M.O.	
NO. REVISIONS	DATE	BY	DATE

LANDFILL ENVIRONMENTAL SECTION / SECTION ENVIRONNEMENTALE D'ENFOUISSEMENT	
SURVEY BY:	VALIDATED BY:
DRAWN BY: MO	APPROVED BY: MO
HOR. SCALE 1:4,000	PRINTED
VERTICAL	DATE: April, 05, 2019
DATE	April, 05, 2019

THE CITY OF WINNIPEG / LA VILLE DE WINNIPEG
 WATER AND WASTE DEPARTMENT
 SOLID WASTE DIVISION

Site No. 25
Brady Rd.

SHEET 1 OF 1
 CITY DRAWING NUMBER
 Leachate Collection System 2019

"WARNING"
 THE EXACT BOUNDARY OF REFUSE CAN BE CERTIFIED ONLY BY DETAILED INVESTIGATION. THE EXTENT AND EXACT LOCATION OF ALL UNDERGROUND SERVICES INCLUDING NEW CONNECTIONS MUST BE CHECKED WITH THE APPROPRIATE UTILITIES.

"ATTENTION"
 LA LIMITE EXACTE DU REFUS PEUT ÊTRE CERTIFIÉE UNIQUEMENT PAR UNE ENQUÊTE DÉTAILLÉE L'EXISTENCE ET LA SITUATION EXACTE DE TOUS LES SERVICES SOUTERRAINS, Y COMPRIS LES NOUVELLES CONNEXIONS DOIT ÊTRE VÉRIFIÉE AVEC LES UTILITAIRES APPROPRIÉS.

APPENDIX B
2018 BRRMF TONNAGE
SPREADSHEET

2017 Actuals for Forecast Purposes
2018 actuals
Manually entered as not tracked in wasteworks

CITY OF WINNIPEG : Brady Road Resource Management Facility Tonnage (metric tonnes) 2018

Material Type	WW Material	January	February	March	April	May	June	July	August	September	October	November	December	Total
Domestic Collection - AREA 1-MILLER	DOM REF CT	4,828.62	3,938.24	4,545.60	5,182.32	6,347.87	5,970.33	5,717.06	6,079.44	5,349.51	6,132.21	4,890.61	4,414.36	63,396.17
Domestic Collection - AREA 2-GFL	DOM REF CT	4,339.73	3,510.17	4,067.02	4,518.07	5,427.23	4,988.45	4,885.57	5,290.20	4,629.40	5,318.13	4,416.75	3,960.78	55,351.50
Domestic Collection - BULKY PU-WASTE C	DOM REF CT	45.69	56.23	56.99	79.50	130.13	114.33	121.04	105.03	155.37	108.58	62.95	53.83	1,089.67
Subtotal Single Family Collection	DOM REF CT	9,214.04	7,504.64	8,669.61	9,779.89	11,905.23	11,073.11	10,723.67	11,474.67	10,134.28	11,558.92	9,370.31	8,428.97	119,837.34
BFI Northwest Apartments	APT WT	1,782.71	1,475.45	1,758.76	1,824.47	2,125.40	2,014.67	2,045.56	2,028.92	1,884.57	2,116.60	1,781.18	1,655.91	22,494.20
BFI Southwest (432-2007)	APT WT	1,209.82	999.65	1,153.99	1,251.41	1,411.43	1,320.86	1,321.88	1,394.24	1,154.68	1,417.36	1,125.07	1,070.90	14,831.29
BFI East Apartments	APT WT	1,132.76	973.87	1,124.17	1,134.34	1,404.35	1,339.05	1,377.75	1,283.33	1,389.33	1,393.27	1,205.50	1,120.48	14,878.20
Subtotal Apt Collection	APT WT	4,125.29	3,448.97	4,036.92	4,210.22	4,941.18	4,674.58	4,745.19	4,706.49	4,428.58	4,927.23	4,111.75	3,847.29	52,203.69
Total Residential Collection		13,339.33	10,953.61	12,706.53	13,990.11	16,846.41	15,747.69	15,468.86	16,181.16	14,562.86	16,486.15	13,482.06	12,276.26	172,041.03
City Refuse - eg. Street Cleaning	CITY REFUS	415.96	391.64	416.33	763.09	883.20	759.88	1,301.14	1,562.65	1,561.23	1,728.69	1,730.49	446.27	11,960.57
Construction / Demolition Waste - City	CITY CNDEM	44.06	4.59	10.02	(4.55)	77.50	73.48	3.98	85.57	282.08	27.69	30.37	5.14	639.93
Landscaping - City - trees, etc., & (DE)	TREELFCITY													
	TREES CITY													
	TREES DE 1													
Grit	GRIT	594.04	907.35	816.56	529.62	400.52	338.14	281.73	198.52	156.31	214.99	450.01	461.85	5,349.64
Bio solids landfilled	SLUDGE	191.42	171.52	218.77	242.41	228.53	274.04	203.87	155.57	184.75	252.91	169.53	186.72	2,480.04
Residue from MRF	RESIDUE	4,054.57	3,772.19	4,557.12	4,678.66	3,620.95	1,192.16	1,908.03	0.00	0.00	4,794.52	273.85	4,177.83	33,029.88
Sweepings	SWEEP	658.91	373.37	663.69	440.99	442.47	445.00	377.73	300.21	499.57	642.03	457.58	407.55	5,709.10
Total City Depts - Charged		5,958.96	5,620.66	6,682.49	6,684.52	5,692.85	3,082.70	4,076.48	2,302.52	2,683.94	7,660.83	3,111.83	5,685.36	59,243.14
Total Residential + City Depts		19,298.29	16,574.27	19,389.02	20,674.63	22,539.26	18,830.39	19,545.34	18,483.68	17,246.80	24,146.98	16,593.89	17,961.62	231,284.17
Dead Animals-Charge	ANIMAL WAS	596.84	395.28	415.66	456.78	425.80	485.70	414.31	462.09	333.07	457.72	615.96	325.55	5,384.76
Asbestos	ANIMLS-CHG	23.55	20.48	8.55	21.61	26.24	39.91	41.10	28.74	33.37	60.43	28.57	9.86	342.41
Charitable Organization - C / special rate	SRM	112.31	78.36	111.64	174.37	207.71	153.56	194.98	386.05	170.17	184.02	146.00	102.42	2,021.59
Commercial / Industrial - all sources	ASBESTOS													
	C-CHARITY	5,100.71	4,234.77	5,365.26	5,725.92	7,272.92	6,780.32	7,990.09	8,011.99	6,843.57	7,286.90	6,168.34	4,226.38	75,007.17
Commercial Flat Fee	COMM/INDUS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Construction / Demolition Waste	COMM FF	627.42	190.87	201.62	630.76	476.89	302.77	793.19	637.95	374.53	319.20	260.82	177.51	4,993.53
Concrete - charged	CONST/DEM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Food waste	CONC - CHG	0.00	0.00	0.00	0.00	0.00	6.81	0.00	19.10	2.73	(4.46)	0.56	0.00	24.74
Hospital Waste	FOOD WASTE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	HOSP WASTE	0.53	0.72	0.44	0.54	0.88	0.88	0.60	0.63	0.84	0.85	1.06	0.37	8.34
Landscaping - Com. - trees, etc., & (DE)	LANDSCAPE													
Sawdust - Charged	TREELFCOMM	12.80	13.37	22.74	22.32	37.17	39.94	19.65	31.84	18.17	17.70	24.27	12.09	272.06
	TREES COMM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TREES DE 2													
	SAWDUST CH													
Special Waste	HYDRO POLE													
Sewer Grit	RECYC-REFU													
Manure	RES/OVER	0.00	0.00	0.00	0.00	4.11	2.45	1.55	11.06	0.48	0.00	3.89	0.00	23.54
	SANDBAG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TIRES	0.00	67.54	0.00	45.14	85.61	0.00	0.00	169.27	0.00	0.00	11.28	0.00	378.84
	TOILETS_\$5													
	TOILETS_CH													
	WEEDS													
	SEWER-GRIT													
	MANURE-P													
Total Non City Depts - Charged		6,474.16	5,001.39	6,125.91	7,077.44	8,537.33	7,812.34	9,455.47	9,758.72	7,776.93	8,322.36	7,260.75	4,854.18	88,456.98
Dead Animals - TFW	ANIMALS N/C	1.40	1.41	0.80	1.75	0.96	0.76	0.61	1.45	2.20	2.29	2.82	0.70	17.15
Brady Admin Building Construction Material	1777 BRADY	0.00	1.67	2.74	0.54	97.44	0.16	2.12	8.66	1.17	3.77	9.17	4.19	131.63
Charitable Organization - TFW	CHARITY	44.22	38.32	46.86	32.25	27.96	35.07	55.90	42.32	44.08	44.45	24.05	26.47	461.95
Neighbourhood clean ups	CLEAN-UP	0.00	0.00	0.00	0.00	9.24	0.16	0.00	4.60	3.28	0.00	0.00	0.00	17.28
Total Non City Depts - Not Charged		45.62	41.40	50.40	34.54	135.60	36.15	58.63	57.03	50.73	50.51	36.04	31.36	628.01
Total Non City Depts		6,519.78	5,042.79	6,176.31	7,111.98	8,672.93	7,848.49	9,514.10	9,815.75	7,827.66	8,372.87	7,296.79	4,885.54	89,084.99

Material Type	WW Material	January	February	March	April	May	June	July	August	September	October	November	December	Total
BRADY ROAD LANDFILL - VEHICLES / LOADS														
Vehicles - Domestic Refuse - City		0	0	0	0	0	0	0	0	0	0	0	0	0
Vehicles - Domestic Refuse - Contract	DOM REF CT	1,532	1,297	1,377	1,398	1,563	1,431	1,470	1,507	1,339	1,524	1,415	1,337	17,190
Vehicles - 4R Depot (Brady) - Garbage Area		2,663	2,329	3,367	5,873	8,893	7,568	7,559	7,184	6,736	6,054	3,705	2,668	64,599
Vehicles - 4R Depot (Pacific)		1,244	904	1,209	1,970	3,036	3,024	3,157	2,754	2,720	3,234	1,923	1,376	26,551
Vehicles - 4R Depot (Panet)			1,674	2,458	3,686	5,166	5,314	5,213	4,939	4,990	6,074	3,381	2,617	45,512
Vehicles - Commercial / Industrial	COMM/INDUS	3,291	2,889	3,424	4,334	5,588	5,176	5,790	5,836	4,828	5,292	4,153	2,776	53,377
Vehicles - Special Waste					0	4	3	1	1	1	0	2	0	12
Vehicles - Mud Trucks - Tandem (manually tracked)		1,034	796	408	1,054	961	647	700	705	365	593	869	1,661	9,793
Vehicles - Mud Trucks - Semi (manually tracked)		850	340	409	1,172	949	495	1,022	407	308	876	1,604	463	8,895
OTHER MUNICIPALITIES - VEHICLES / LOADS														
RM of Tache		0	0	0	0	0	0	0	0	0	0	0	0	0
Manitoba Conservation (Falcon Lake)		3	0	0	0	0	0	1	0	0	1	1	1	7
R. M. of Springfield / Emterra		0	0	1	0	0	0	0	0	0	0	0	0	1
R. M. of West St.Paul / Emterra		0	0	0	0	0	0	0	0	0	0	0	0	0
R.M. of MacDonald / Blackhawk Enterprises		0	0	0	4	8	5	1	0	0	0	0	0	18
														0
TOTAL VEHICLES - ALL PAYING CUSTOMERS		10,617	10,229	12,653	19,491	26,168	23,663	24,914	23,333	21,287	23,648	17,053	12,899	225,955

Blue font = formula = don't type in

Reconcile Monthly Tonnage to WasteWorks Material Analysis report														
Total Actual Weight per WW														
		31,781.74	27,337.75	30,077.98	34,810.95	45,893.72	40,704.82	41,572.64	42,484.56	35,304.68	53,833.28	36,879.50	27,212.23	447,893.85
														0.00
s: Removals X 2 (negative here but positive in WW)	(BATTERYRMV)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(5.24)	0.00	0.00	0.00	0.00	(5.24)
	(COMPOSTREM)	0.00	(15.94)	(25.08)	(100.68)	(121.60)	(1,971.54)	(5,288.12)	(6,048.22)	(128.30)	(406.02)	(8,860.90)	0.00	(22,966.40)
	(GLASS REMV)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(LEACH REMV)	(3,400.70)	(2,994.96)	(1,127.78)	(3,241.86)	(2,189.18)	(3,406.18)	(2,188.54)	(3,380.64)	(3,621.44)	(6,956.82)	(1,984.04)	(4,466.48)	(38,958.62)
	(ODS REMOVA)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(SCRAP REMV)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(TREESDE-WA)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(2.72)	(2.72)
	(TIRES REMV)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MUD TRUCKS MANULLY TRACKED	24,996.00	12,484.00	11,445.50	32,049.00	26,650.00	14,848.00	27,378.50	13,333.00	8,994.50	22,688.50	40,134.00	20,751.00	255,752.00
Less: Items not on tonnage report	RES/REFUSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	WEIGH ONLY	(1,020.58)	(1,211.02)	(128.28)	(28.53)	(142.65)	(30.47)	(219.92)	(10.24)	(45.73)	(29.80)	0.00	(38.52)	(2,905.74)
	4RDEPTFF WASTEWORCS REPORT	(53.39)	(96.46)	(168.63)	(490.30)	(33.22)	(43.10)	(27.90)	(8.04)	(4.63)	0.00	0.00	0.00	(925.67)
	4RDEPTFF WRARS LEVY REPORT	4.84	7.02	21.60	72.93	7.51	15.96	8.45	4.07	1.88	12.21	0.63	0.00	157.09
	4R MATERIALS	71.92	36.56	92.13	152.92	234.59	196.76	202.62	196.40	196.06	196.42	46.03	0.00	1,622.39
	ZRATE ADJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CASH CUSTOMER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	ACCT 472 ARSON PILOT ZONE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Net	52,379.83	35,546.94	40,187.44	63,224.43	70,299.17	50,314.25	61,437.73	46,565.65	40,697.02	69,337.76	66,215.21	43,455.51	639,660.94
	Total per Tonnage Report	52,379.83	35,546.94	40,187.44	63,224.43	70,299.17	50,314.25	61,437.73	46,565.65	40,697.02	69,337.76	66,215.21	43,455.51	639,660.94
	Difference should be zero	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

APPENDIX C
2018 PIPER DIAGRAMS

2018 Groundwater Piper Diagrams

Site: Brady Well #: W4

Dates:

- 13-Jun-13
- 23-Oct-13
- 11-Jun-14
- 23-Oct-14
- 2-Jun-15
- 26-Oct-15
- 24-May-16
- 26-Oct-16
- 23-May-17
- 19-Oct-17
- 24-May-18
- 16-Oct-18

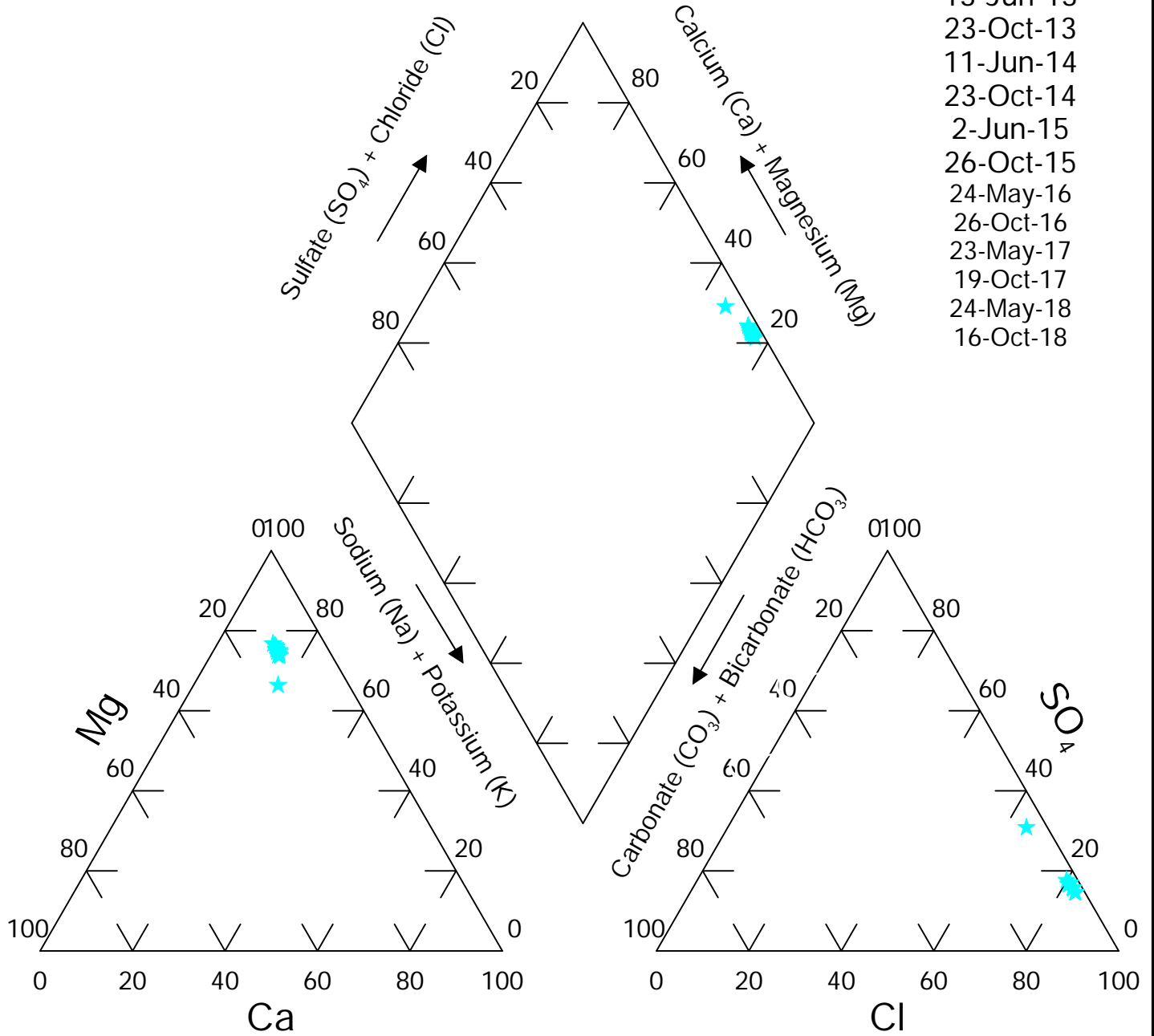


FIGURE: 1P

Site: Brady Well #: W5

- Dates:**
 24-Oct-12
 13-Jun-13
 23-Oct-13
 11-Jun-14
 23-Oct-14
 2-Jun-15
 26-Oct-15
 24-May-16
 26-Oct-16
 23-May-17
 19-Oct-17
 24-May-18
 18-Oct-18

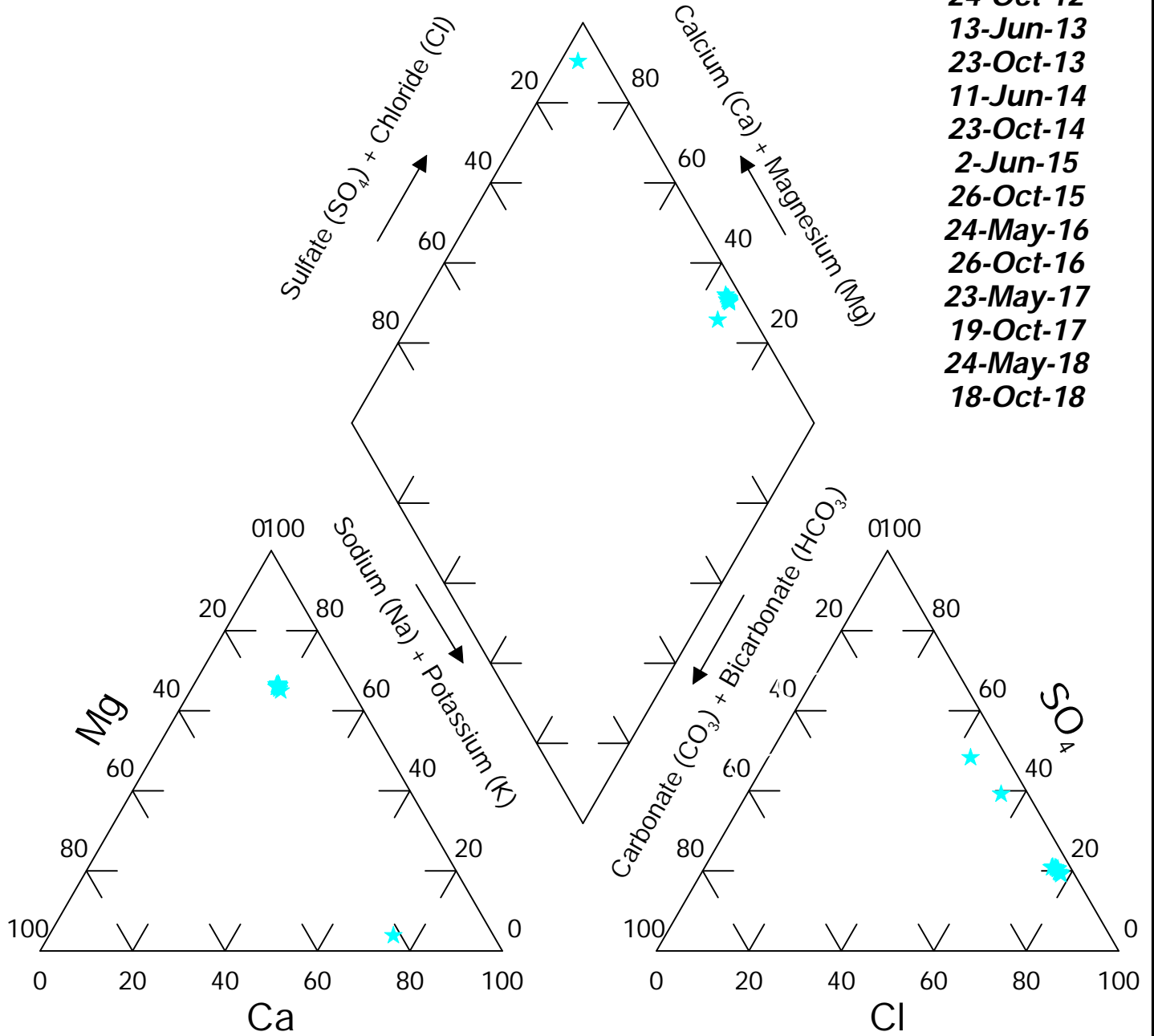


FIGURE: 2P

Site: Brady Well #: W6

Dates:

- 13-Jun-13
- 22-Oct-13
- 11-Jun-14
- 20-Oct-14
- 3-Jun-15
- 26-Oct-15
- 30-May-16
- 25-Oct-16
- 24-May-17
- 17-Oct-17
- 23-May-18
- 18-Oct-18

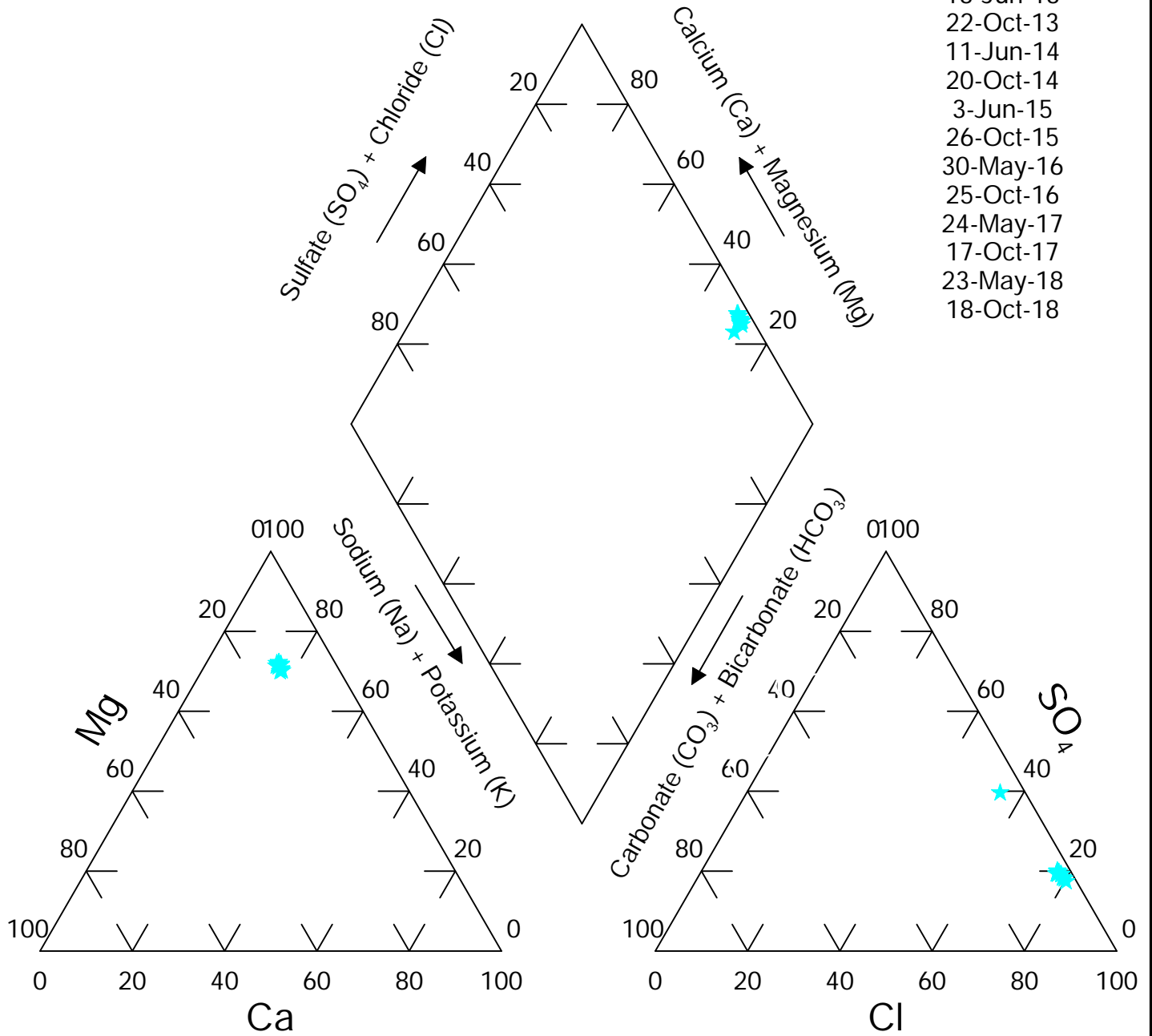


FIGURE: 3P

Site: Brady Well #: W7

- Dates:**
 12-Jun-13
 22-Oct-13
 11-Jun-14
 20-Oct-14
 2-Jun-15
 26-Oct-15
 24-May-16
 24-Oct-16
 24-May-17
 17-Oct-17
 23-May-18
 17-Oct-18

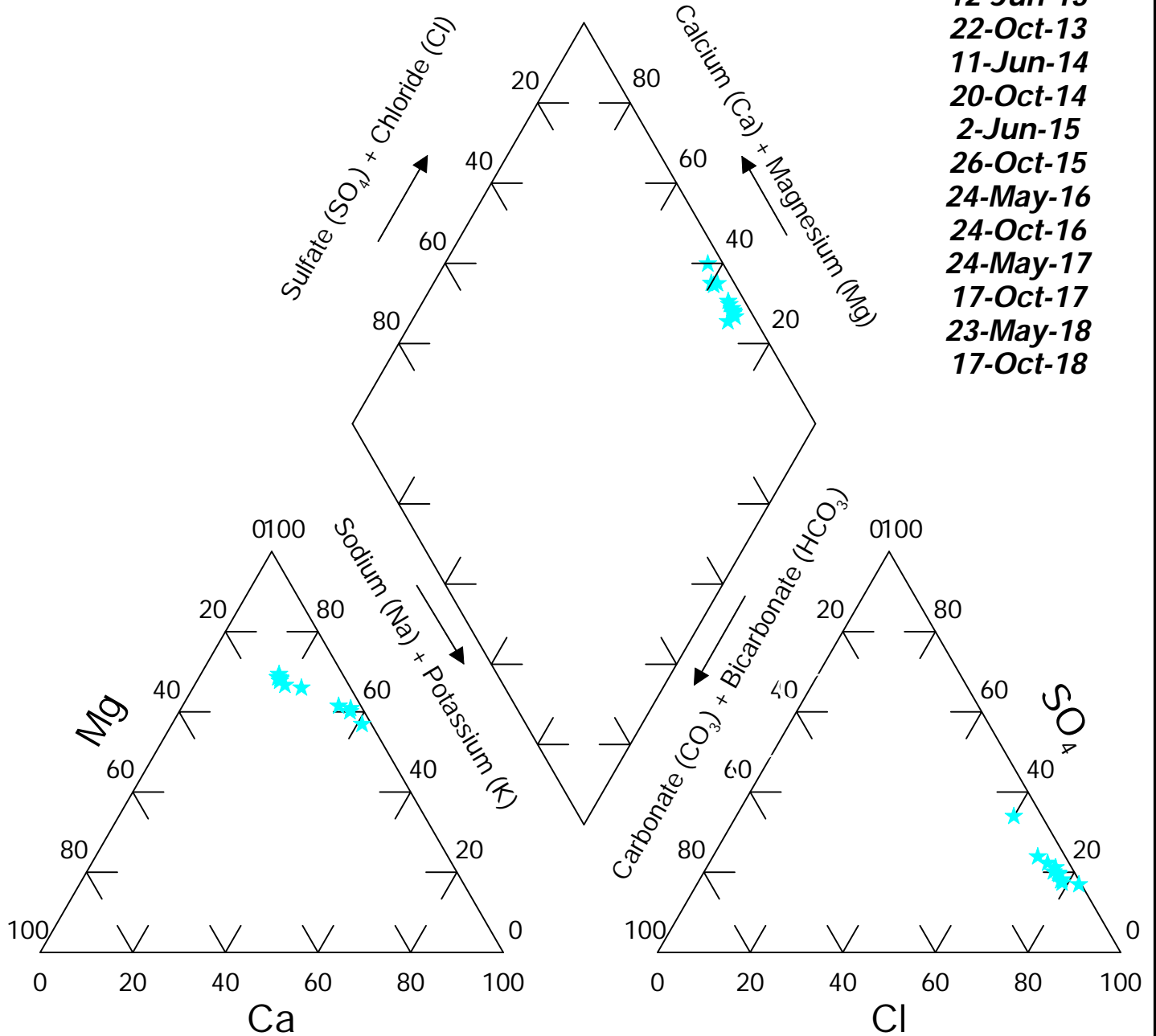


FIGURE: 4P

Site: Brady Well #: W8

Dates:
 12-Jun-13
 22-Oct-13
 11-Jun-14
 23-Oct-14
 3-Jun-15
 26-Oct-15
 25-May-16
 24-Oct-16
 24-May-17
 17-Oct-17
 29-May-18
 18-Oct-18

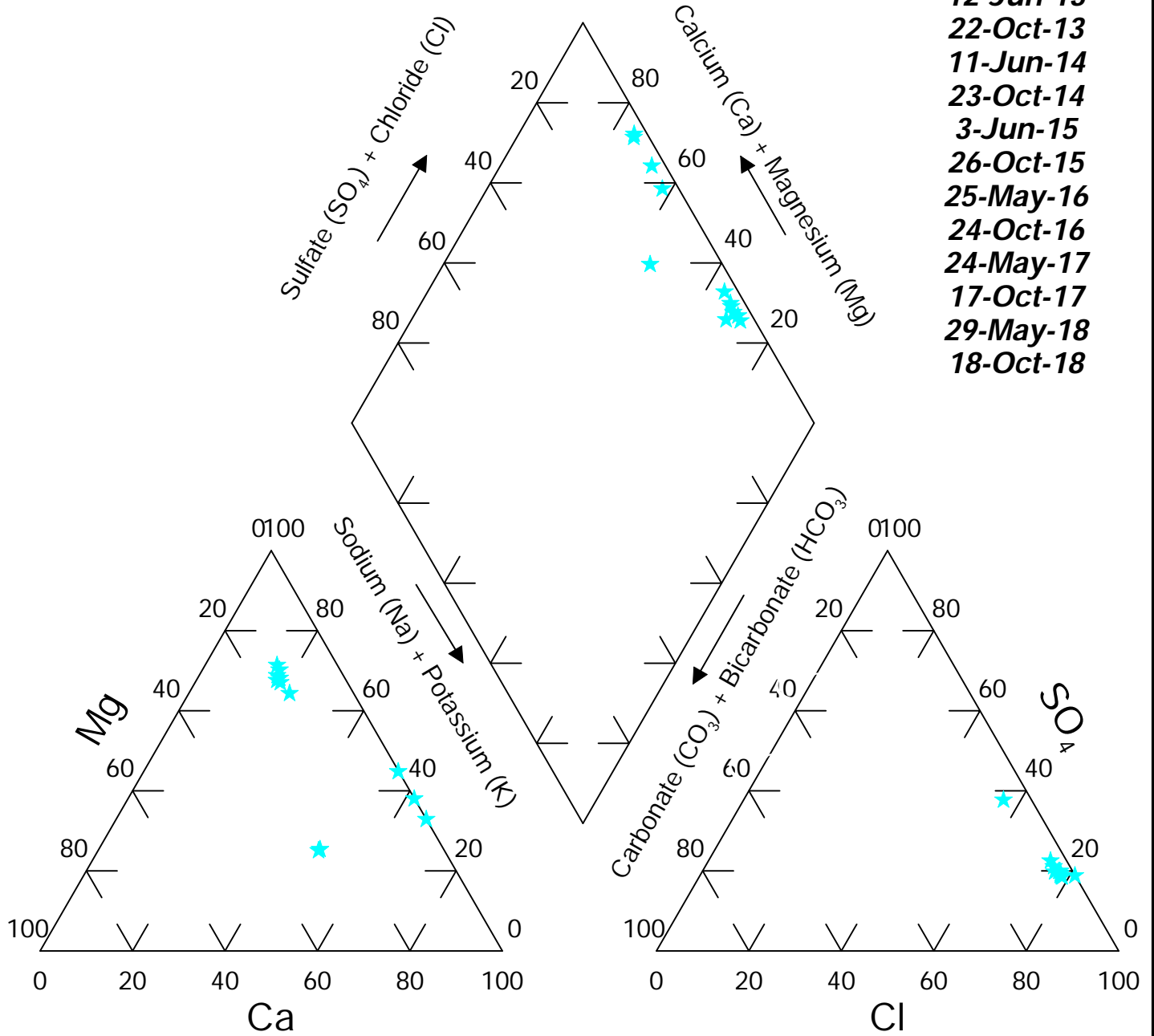


FIGURE: 5P

Site: Brady Well #: W9

- Dates:**
 11-Jun-13
 21-Oct-13
 1-Jun-14
 20-Oct-14
 3-Jun-15
 22-Oct-15
 24-May-16
 26-Oct-16
 23-May-17
 18-Oct-17
 24-May-18
 18-Oct-18

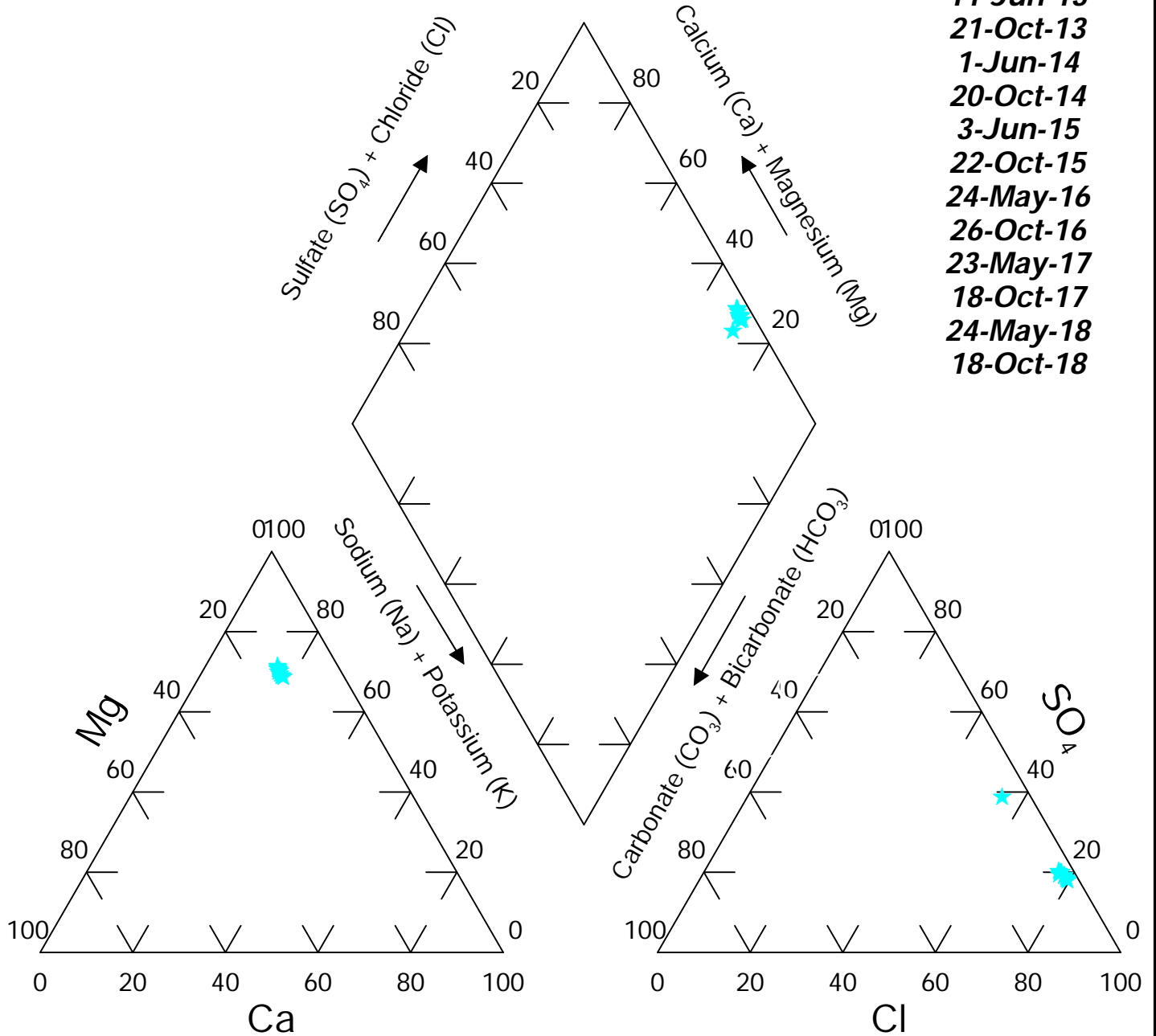


FIGURE: 6P

Site: Brady Well #: W10

Dates:

- 11-Jun-13
- 22-Oct-13
- 10-Jun-14
- 20-Oct-14
- 3-Jun-15
- 22-Oct-15
- 25-May-16
- 26-Oct-16
- 23-May-17
- 18-Oct-17
- 24-May-18
- 16-Oct-18

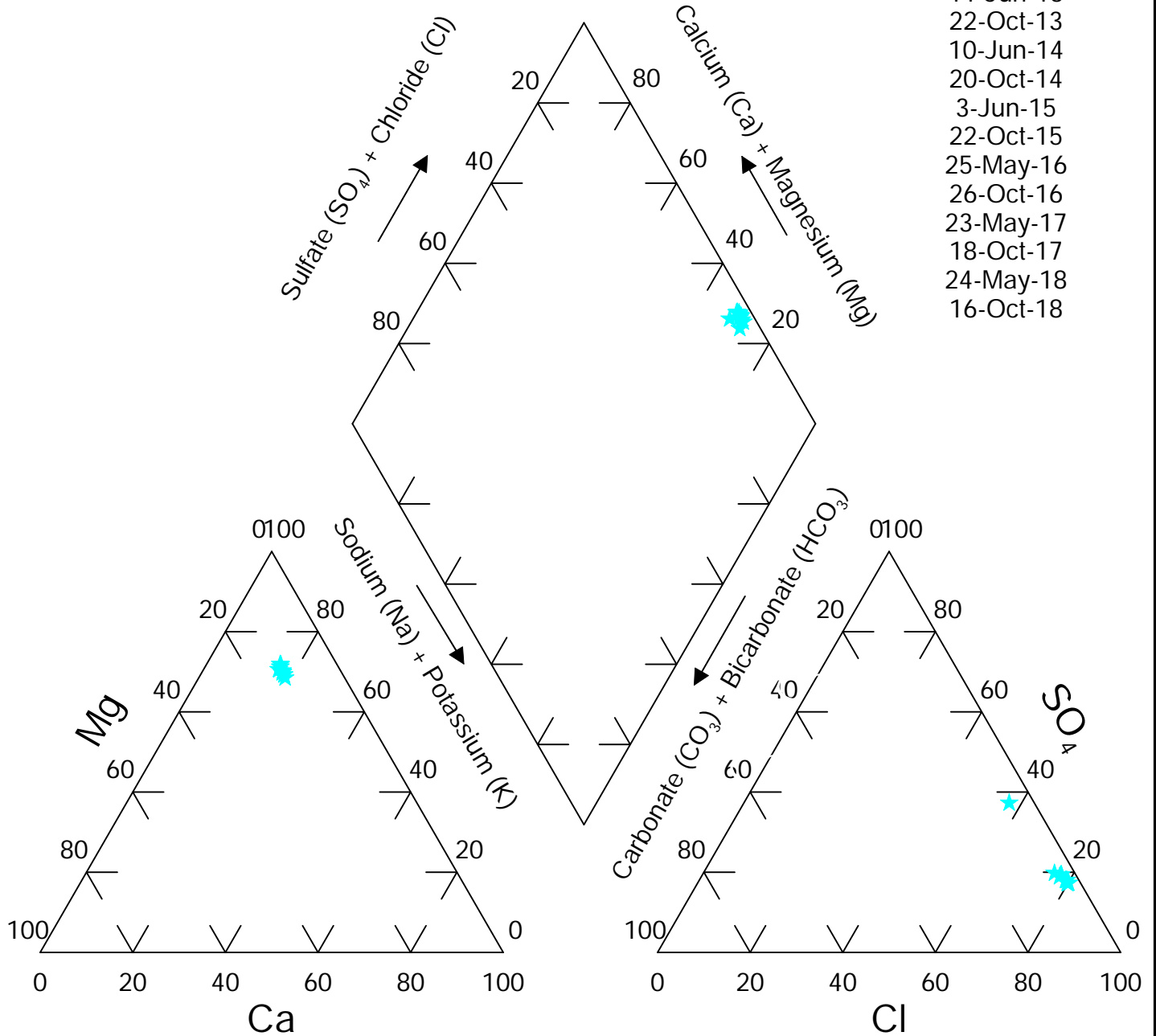


FIGURE: 7P

Site: Brady Well #: W11

Dates:

- 12-Jun-13
- 22-Oct-13
- 10-Jun-14
- 23-Oct-14
- 2-Jun-15
- 22-Oct-15
- 25-May-16
- 26-Oct-16
- 23-May-17
- 18-Oct-17
- 24-May-18
- 17-Oct-18

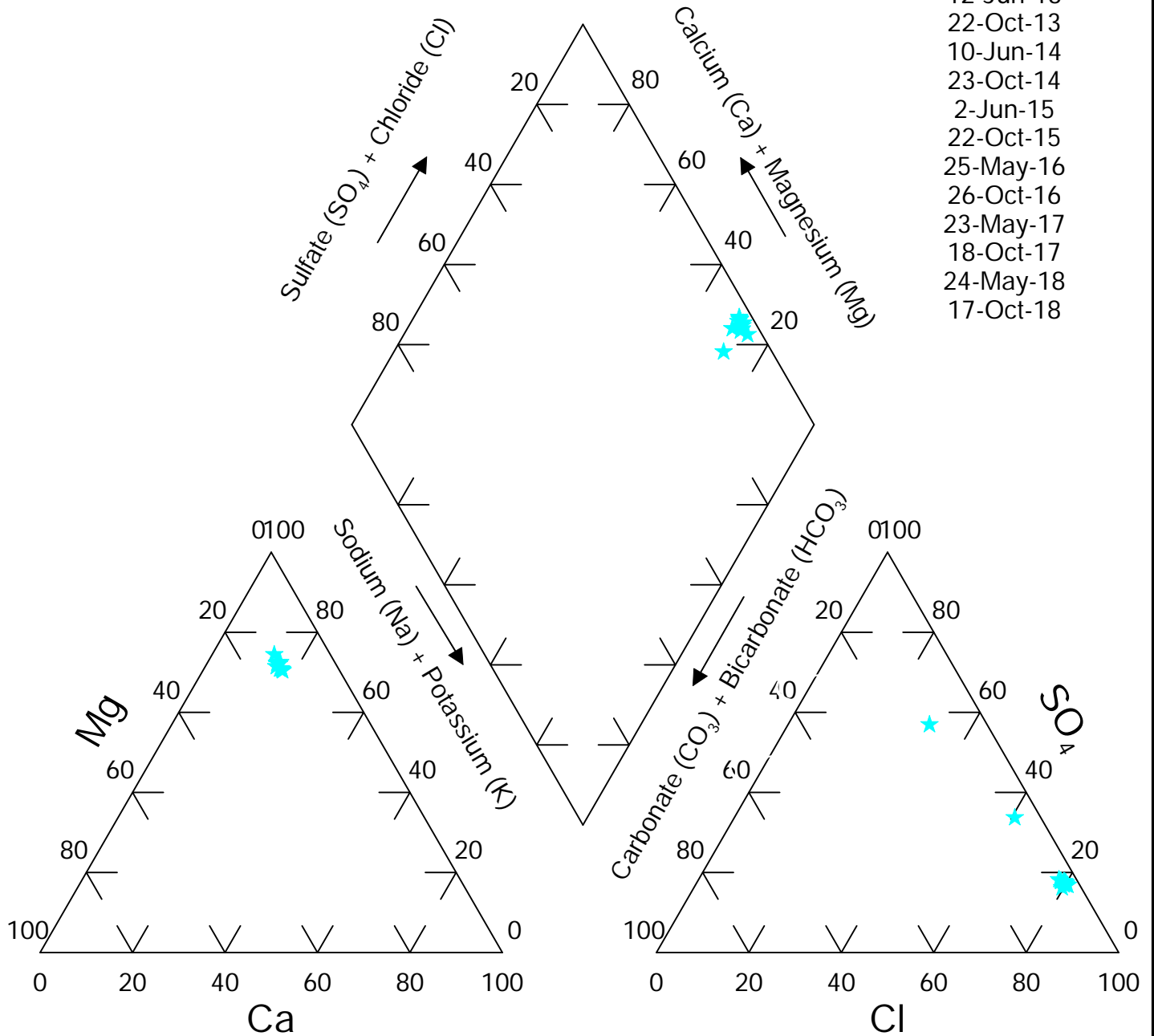


FIGURE: 8P

Site: Brady Well #: W12

Dates:

- 13-Jun-13
- 23-Oct-13
- 12-Jun-14
- 20-Oct-14
- 3-Jun-15
- 22-Oct-15
- 25-May-16
- 26-Oct-16
- 25-May-17
- 17-Oct-17
- 24-May-18
- 17-Oct-18

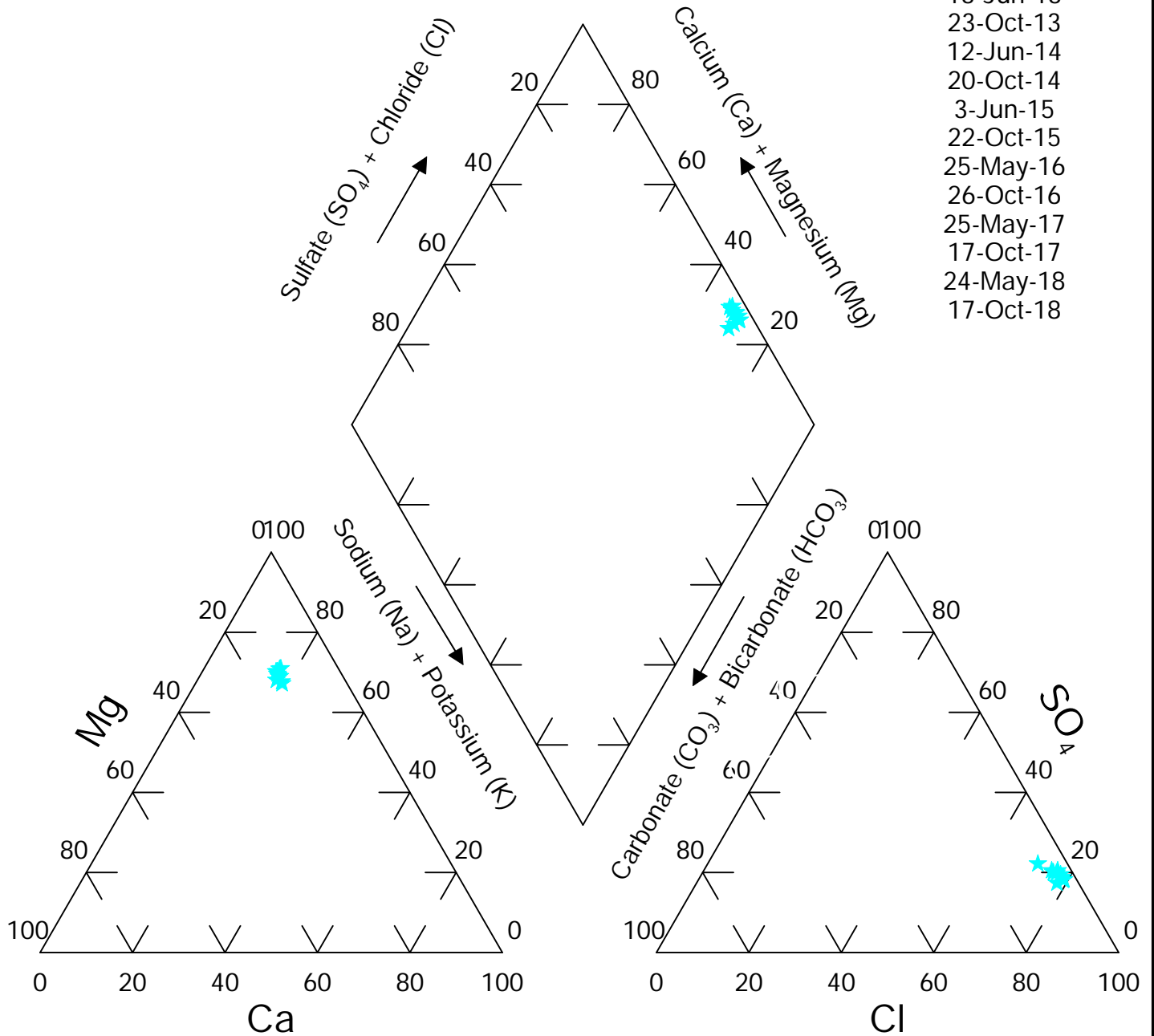


FIGURE: 9P

Site: Brady Location : W13

Dates:
 1-Jun-15
 21-Oct-15
 27-May-16
 24-Oct-16
 24-May-17
 16-Oct-17
 28-May-18
 17-Oct-18

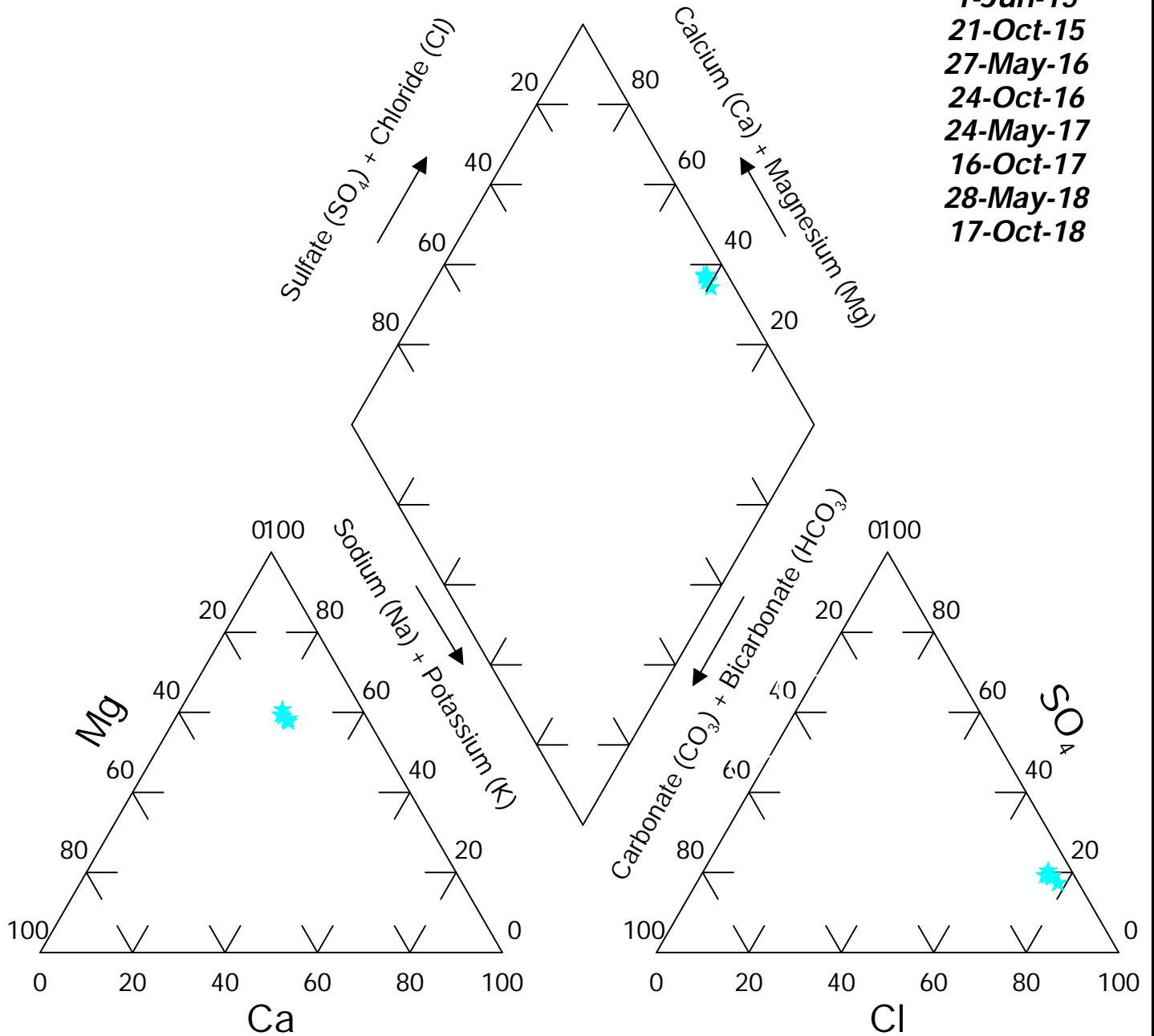


FIGURE: 1z

Site: Brady

Location : GWQ25-W14

Dates:
 3-Jun-15
 21-Oct-15
 25-May-16
 26-Oct-16
 25-May-17
 16-Oct-17
 28-May-18
 18-Oct-18

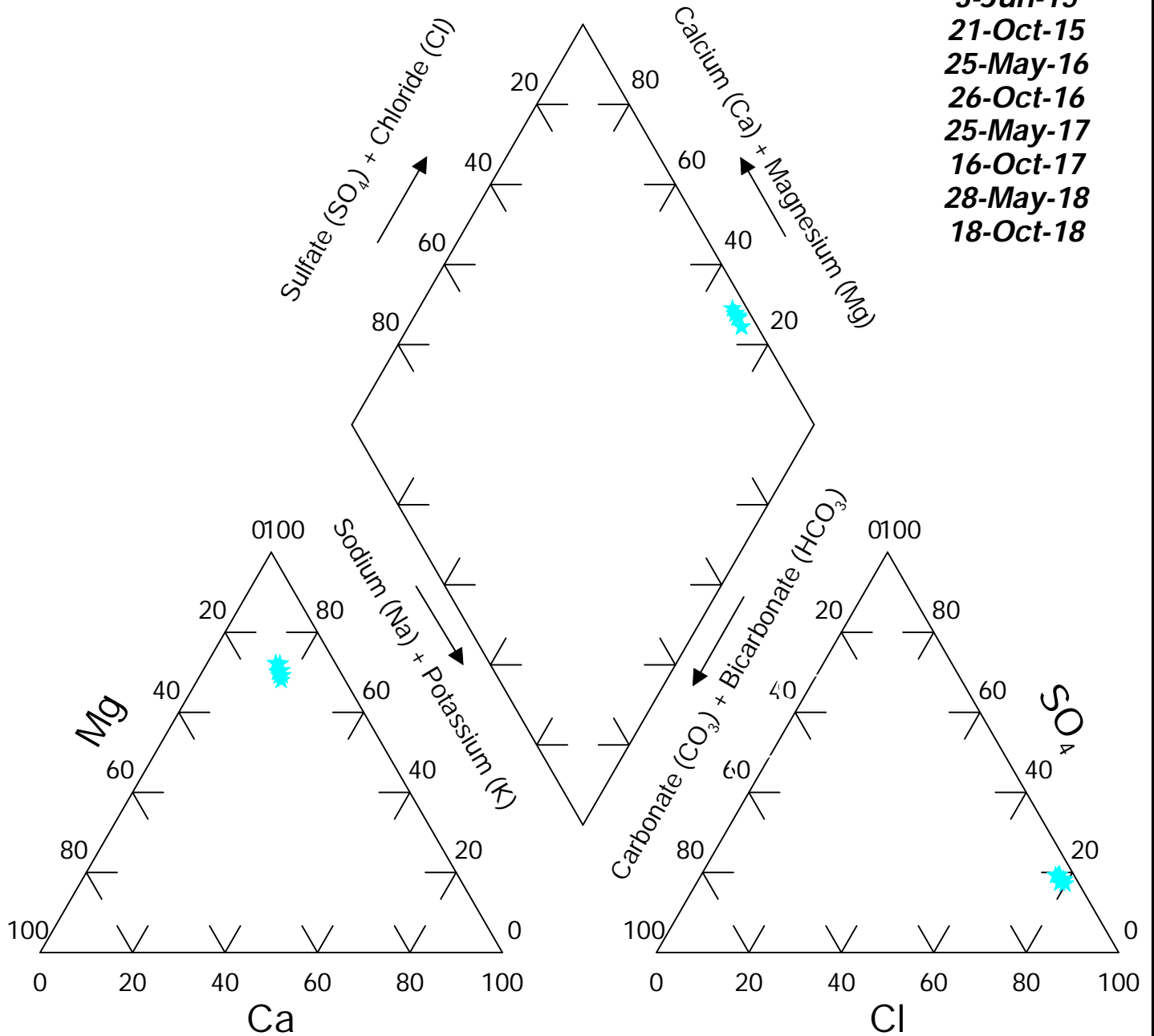


FIGURE: 2z

Site: Brady

Location : GWQ25-W15

Dates:
 3-Jun-15
 21-Oct-15
 30-May-16
 25-Oct-16
 25-May-17
 16-Oct-17
 28-May-18
 22-Oct-18

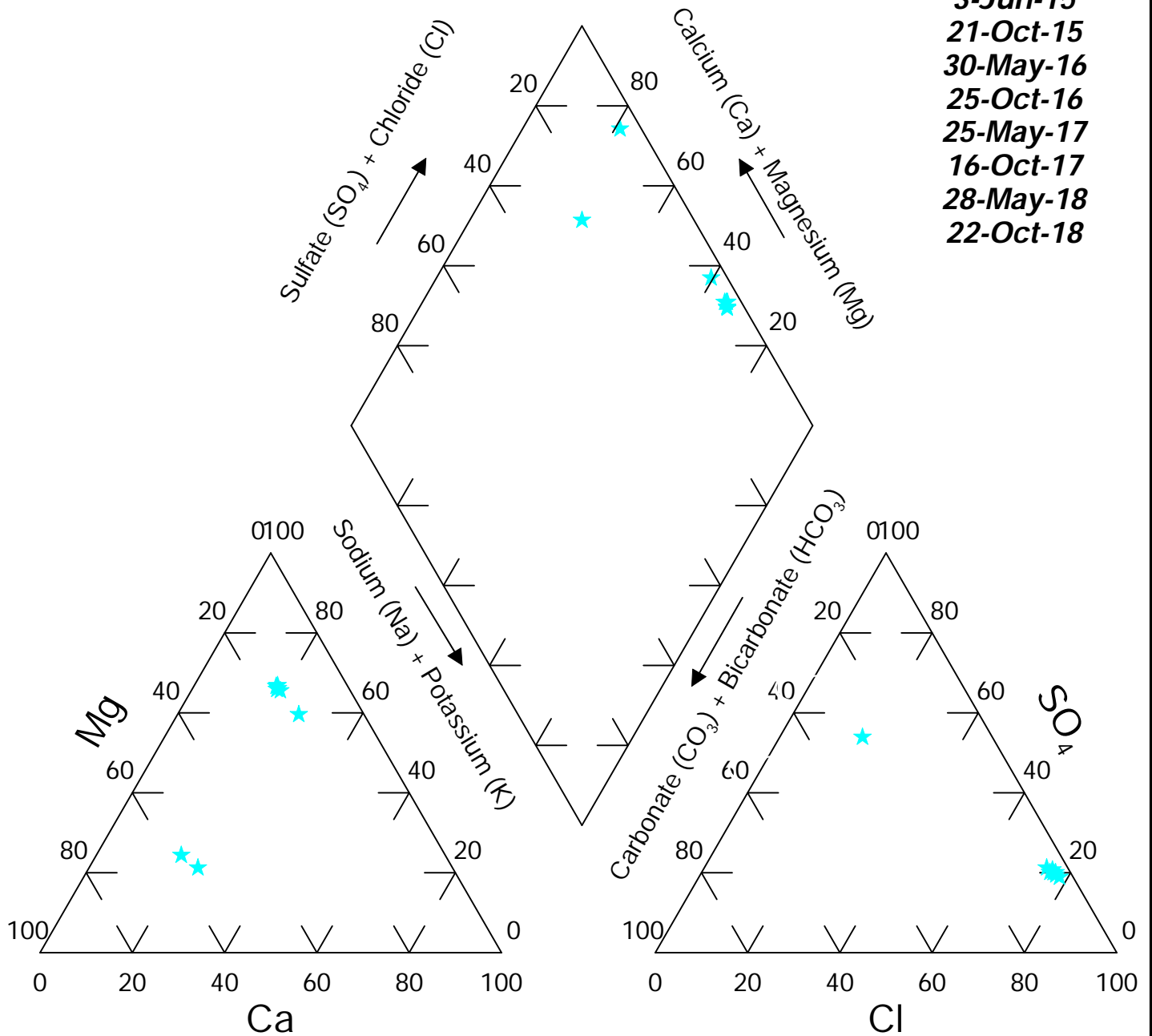


FIGURE: 3z

Site: Brady Location : GWQ25-W16

Dates:
 4-Jun-15
 21-Oct-15
 30-May-16
 25-Oct-16
 25-May-17
 16-Oct-17
 28-May-18
 22-Oct-18

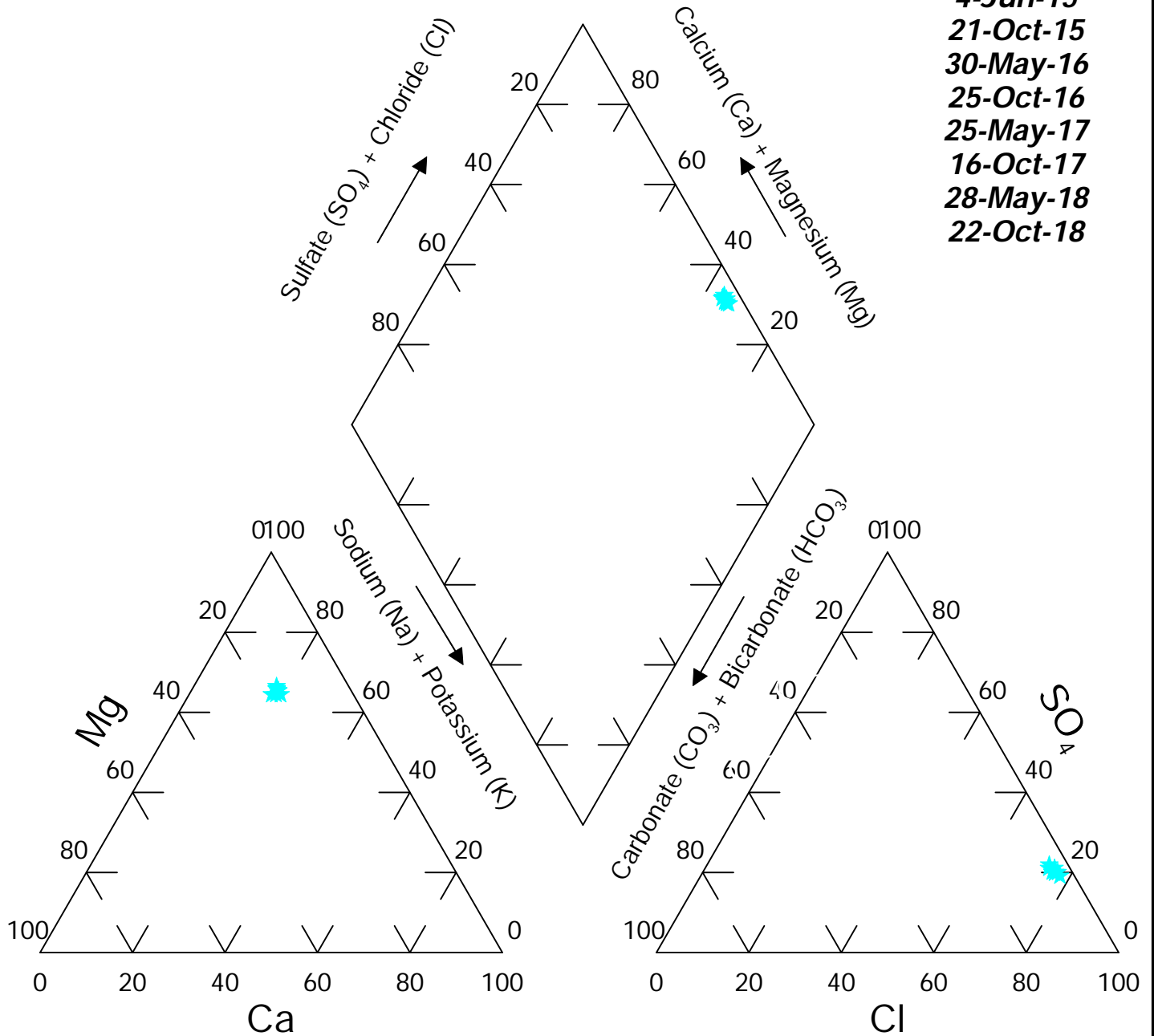
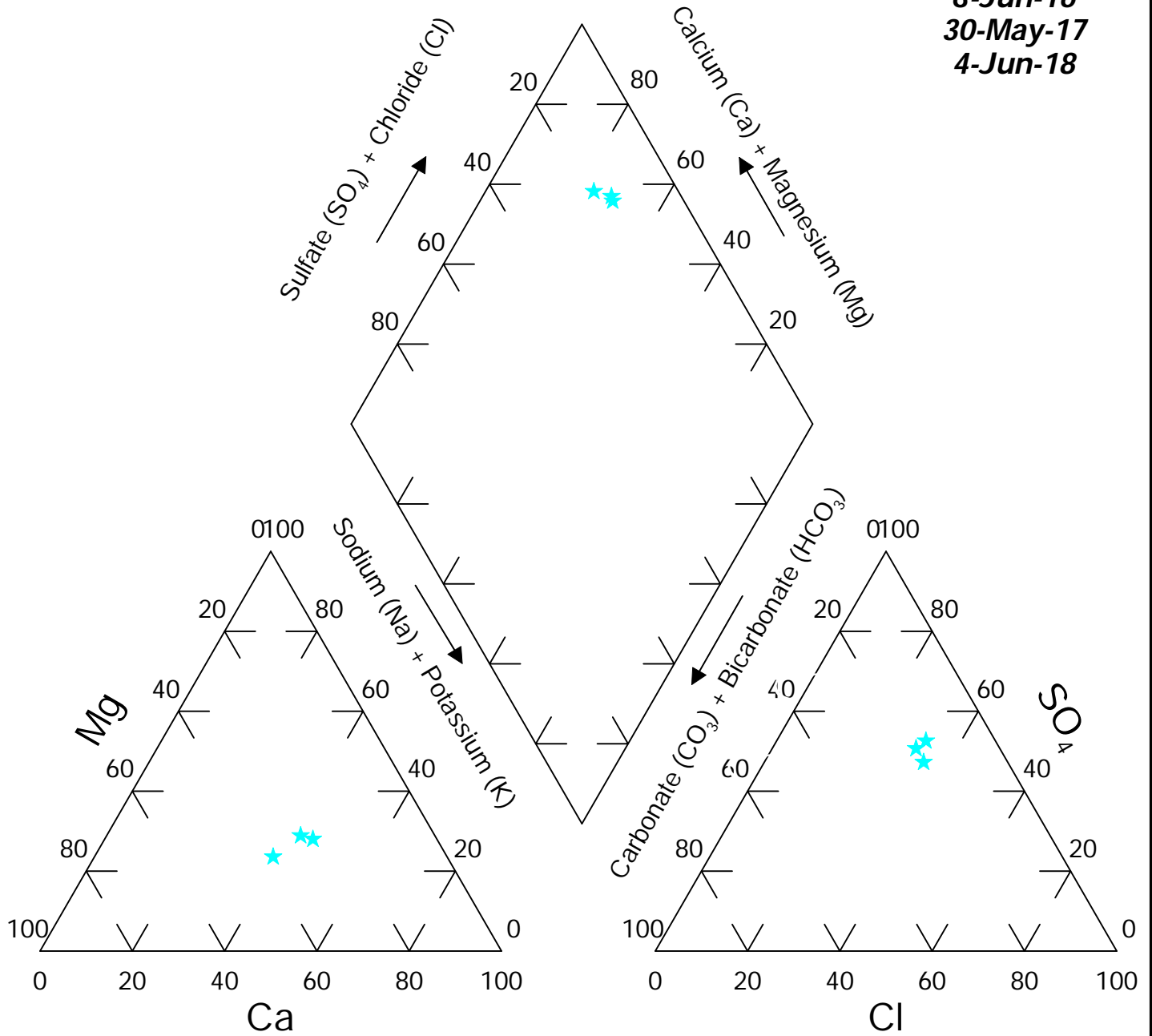


FIGURE: 4z

Site: Brady
Location : GWQ25-4N34-CR

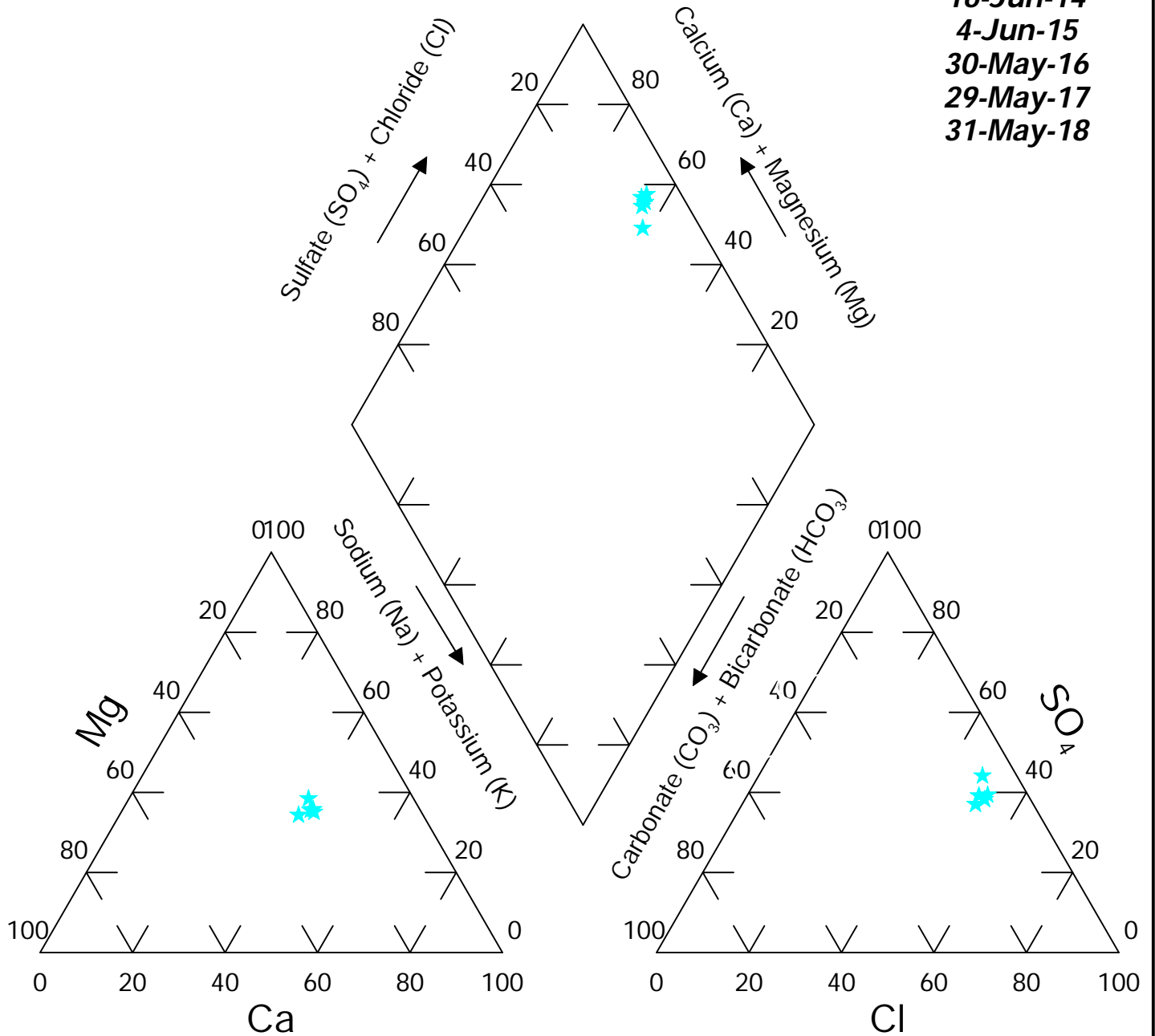
Dates:
8-Jun-16
30-May-17
4-Jun-18



Site: Brady

Location : GWQ25-5N62-D

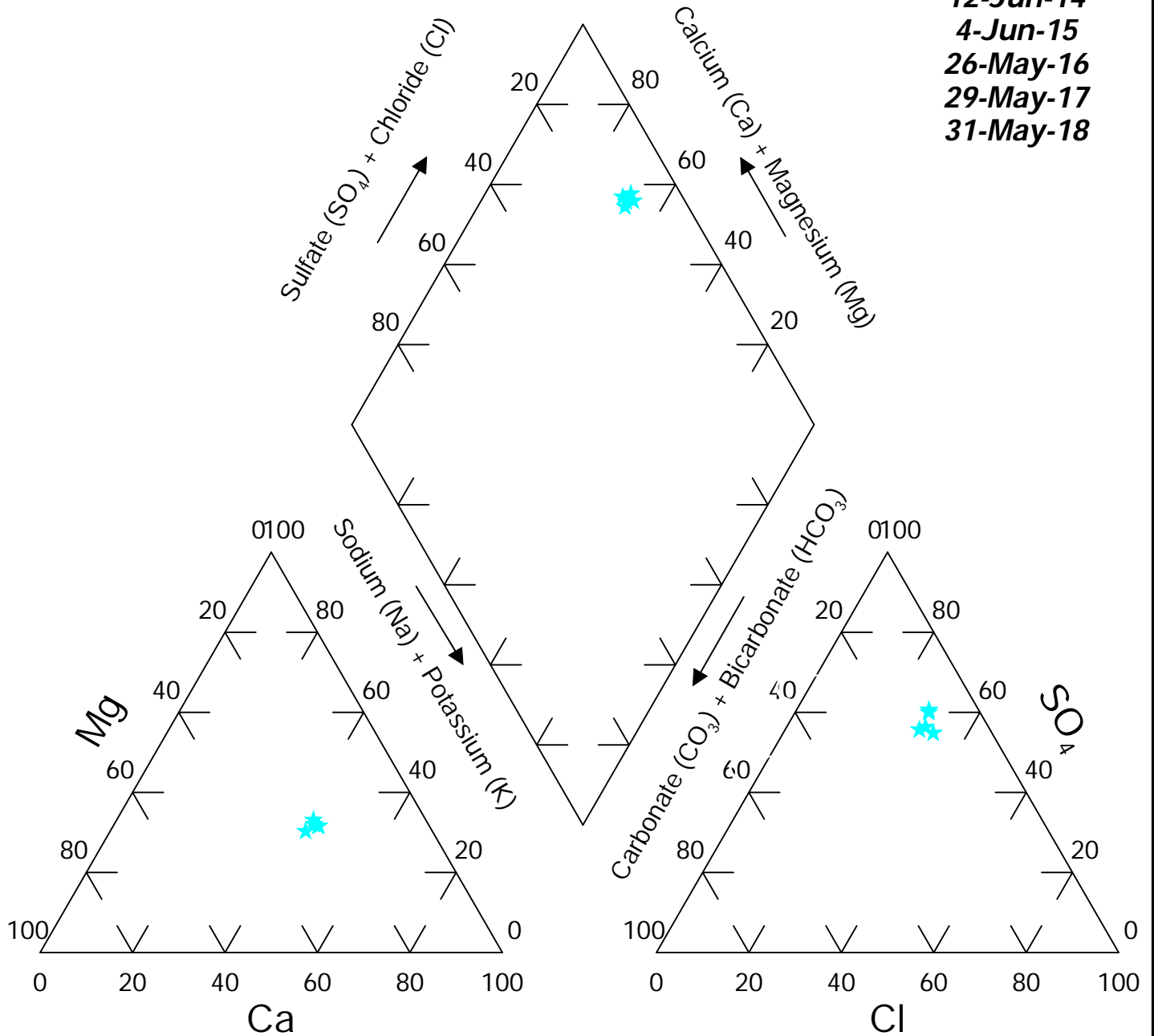
Dates:
16-Jun-14
4-Jun-15
30-May-16
29-May-17
31-May-18



Site: Brady

Location : GWQ25-6N57-DR

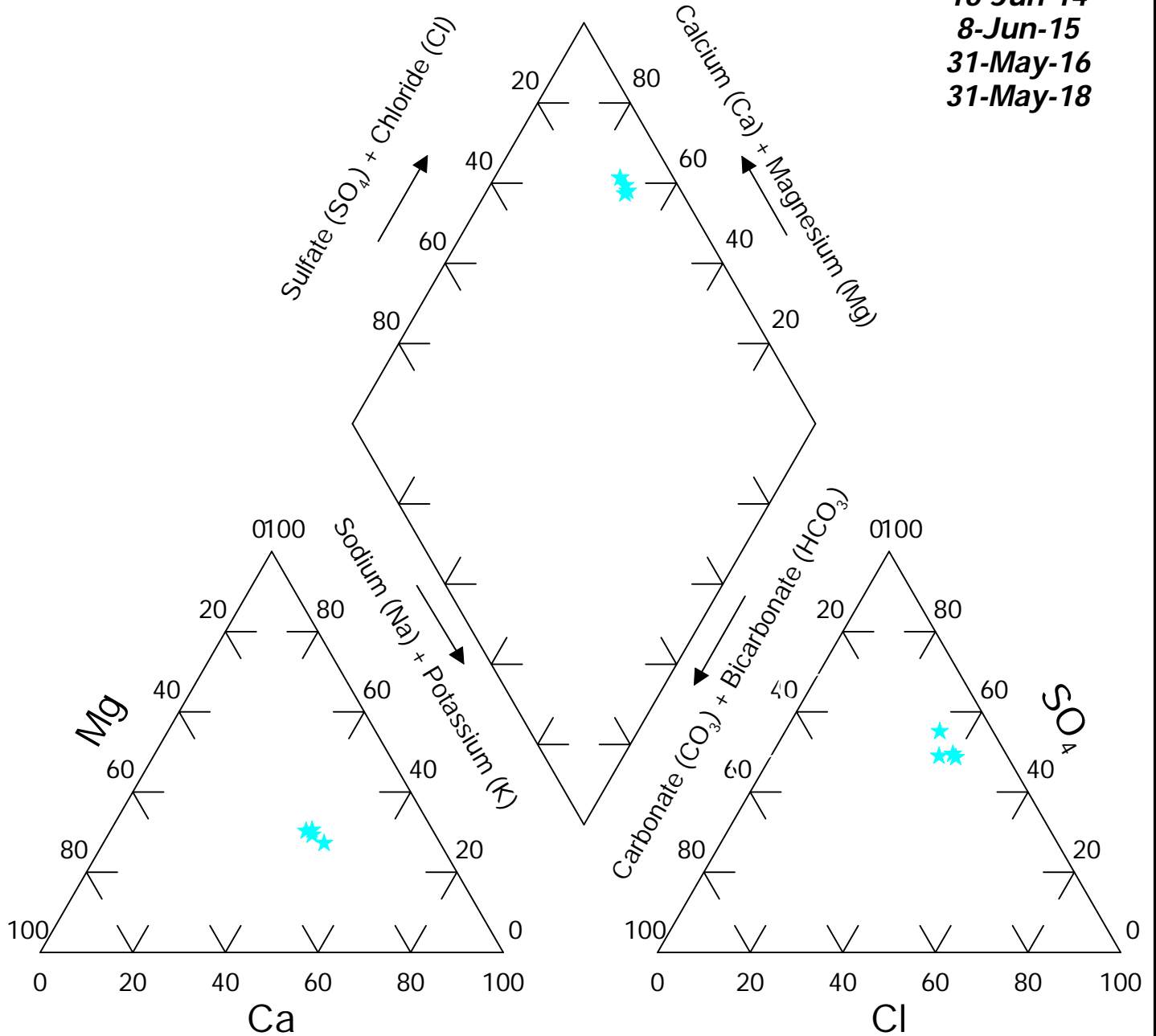
Dates:
12-Jun-14
4-Jun-15
26-May-16
29-May-17
31-May-18



Site: Brady

Location : GWQ25-6N58-DR

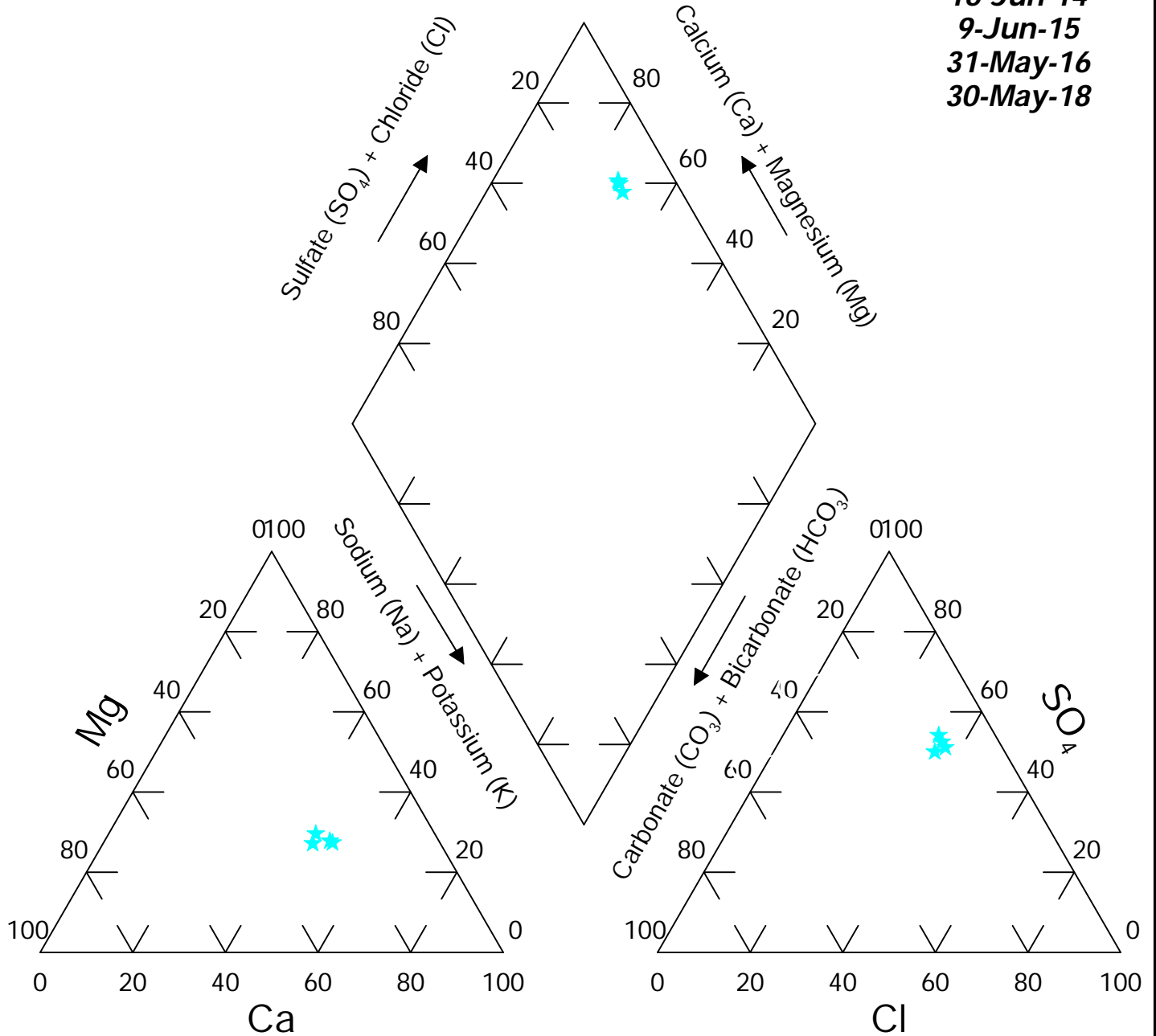
Dates:
16-Jun-14
8-Jun-15
31-May-16
31-May-18



Site: Brady

Location : GWQ25-6N59-DR

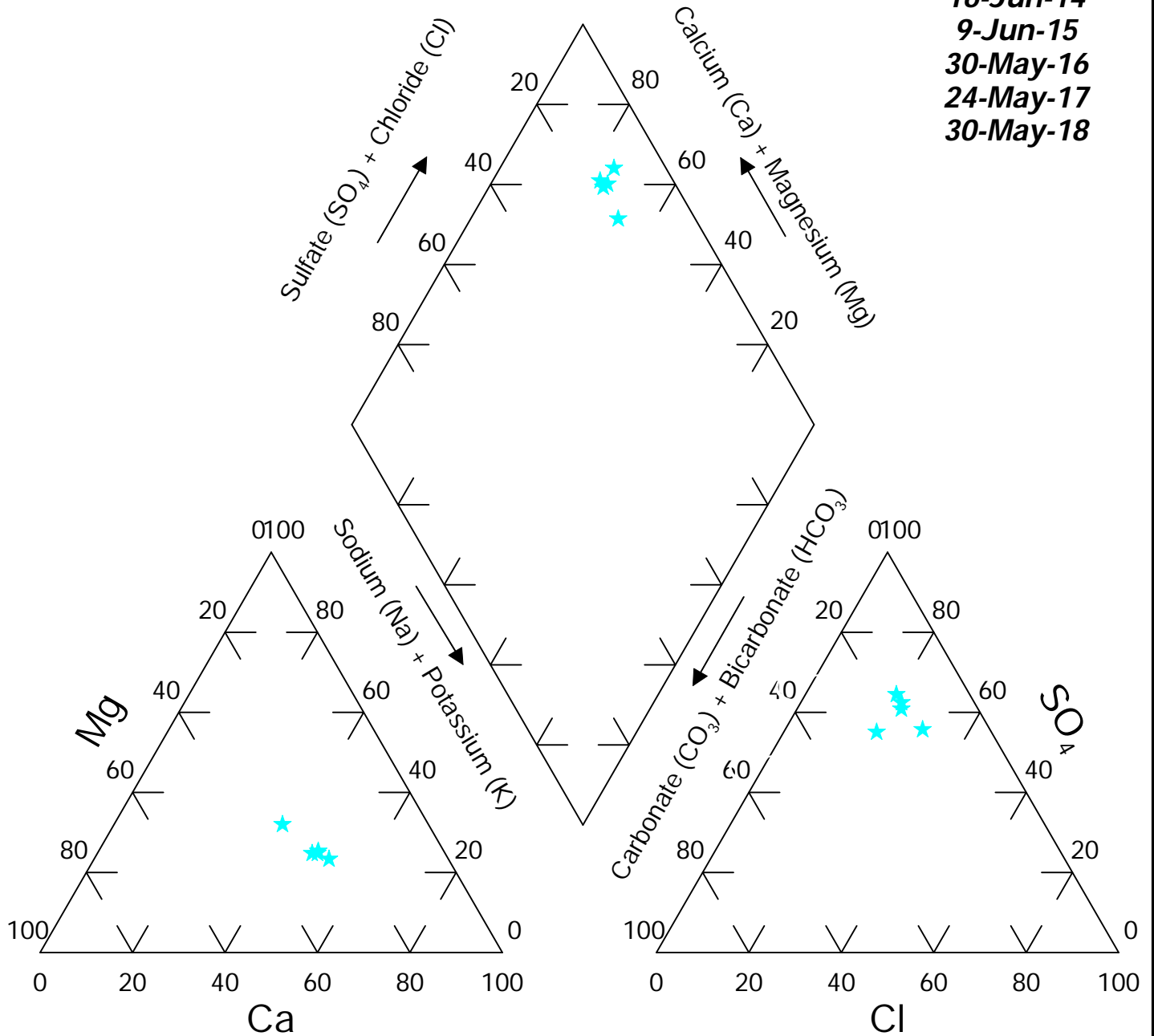
Dates:
16-Jun-14
9-Jun-15
31-May-16
30-May-18



Site: Brady

Location : GWQ25-6N60-DR

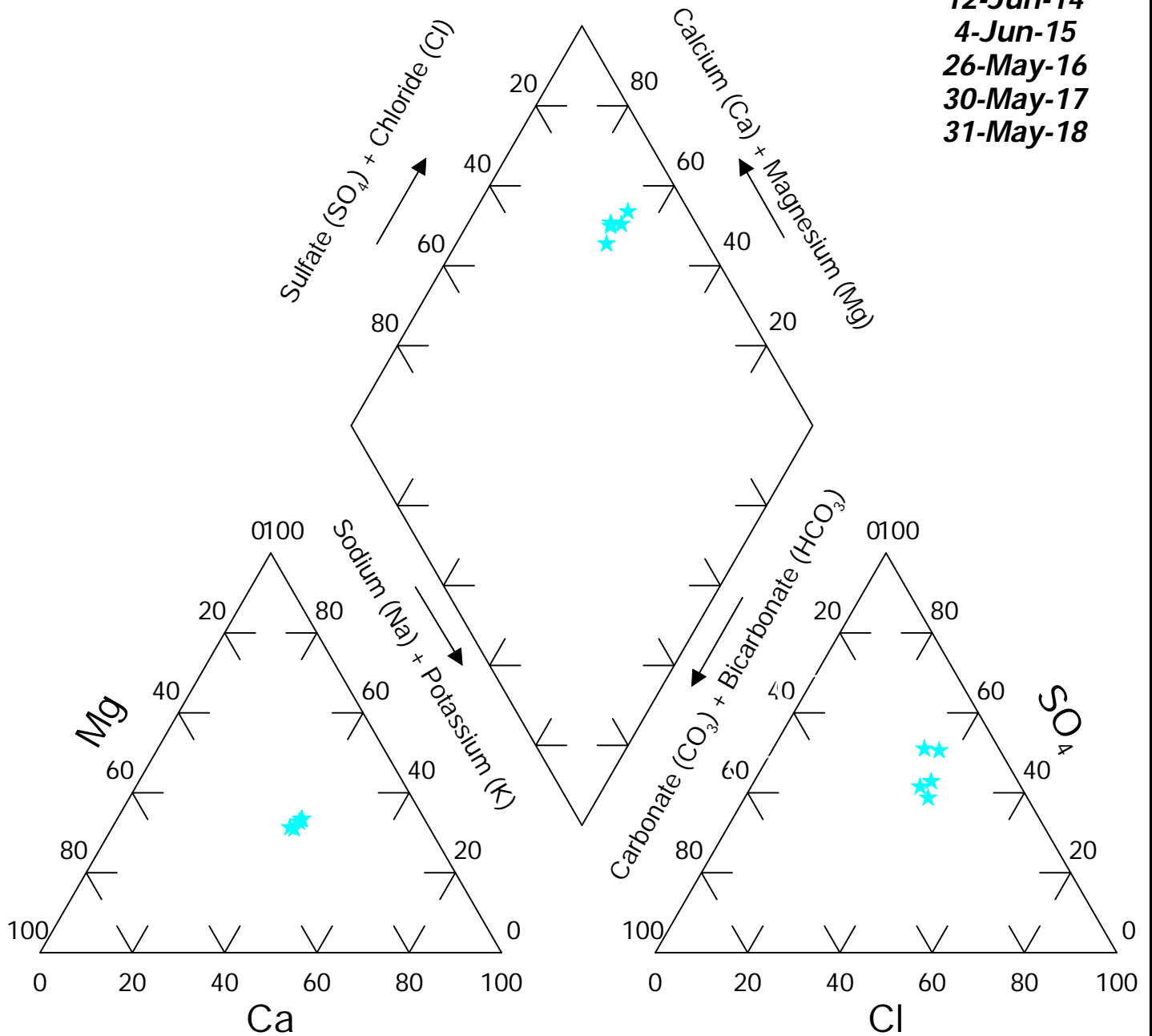
Dates:
16-Jun-14
9-Jun-15
30-May-16
24-May-17
30-May-18



Site: Brady

Location : GWQ25-6N63-E

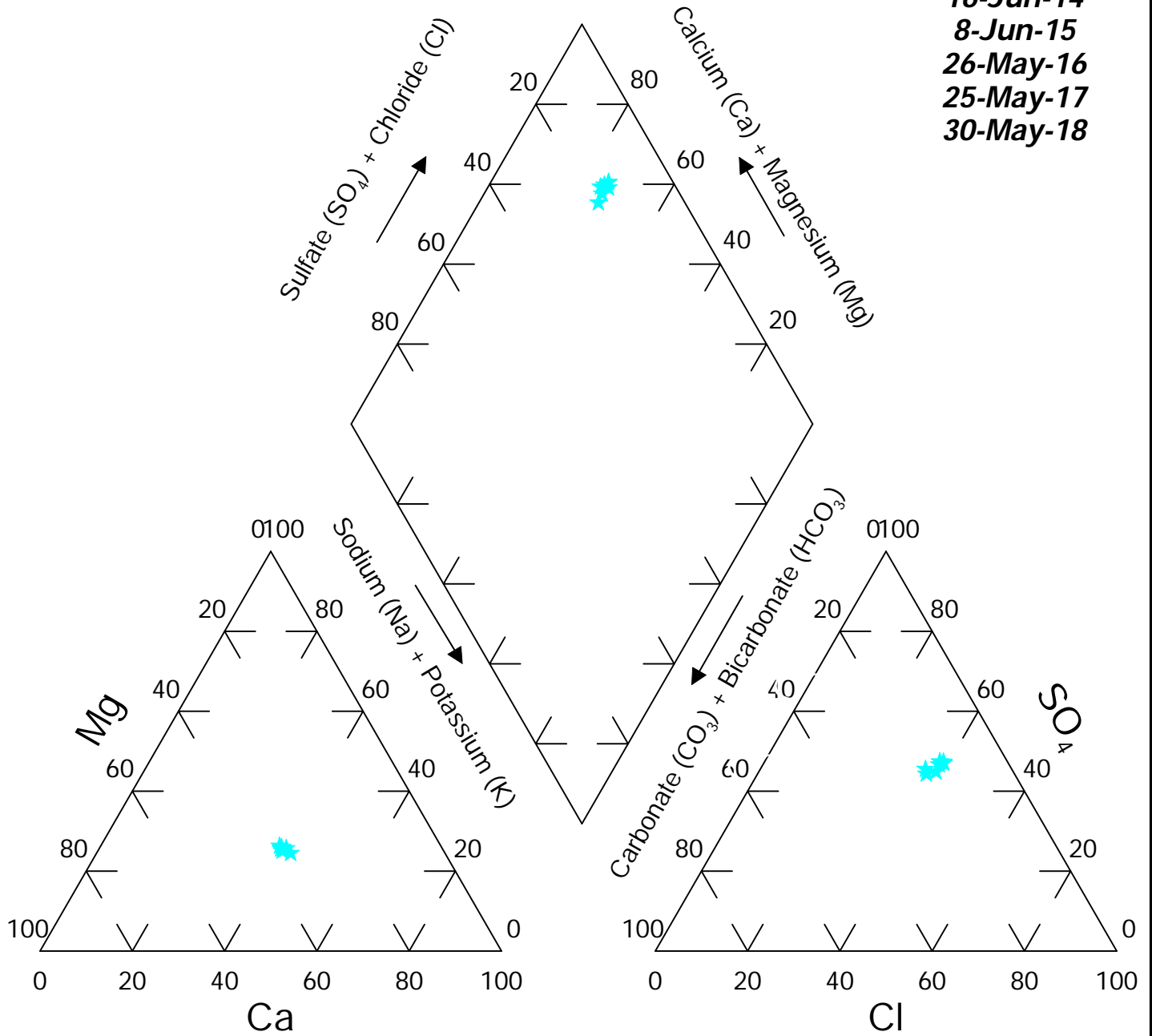
Dates:
 12-Jun-14
 4-Jun-15
 26-May-16
 30-May-17
 31-May-18



Site: Brady

Location : GWQ25-6N67-E

Dates:
 16-Jun-14
 8-Jun-15
 26-May-16
 25-May-17
 30-May-18



Site: Brady

Well #: 4N34-D/DR

Dates:
 29-Oct-12
 17-Jun-13
 24-Oct-13
 12-Jun-14
 8-Jun-15
 7-Jun-16
 25-May-17
 4-May-18

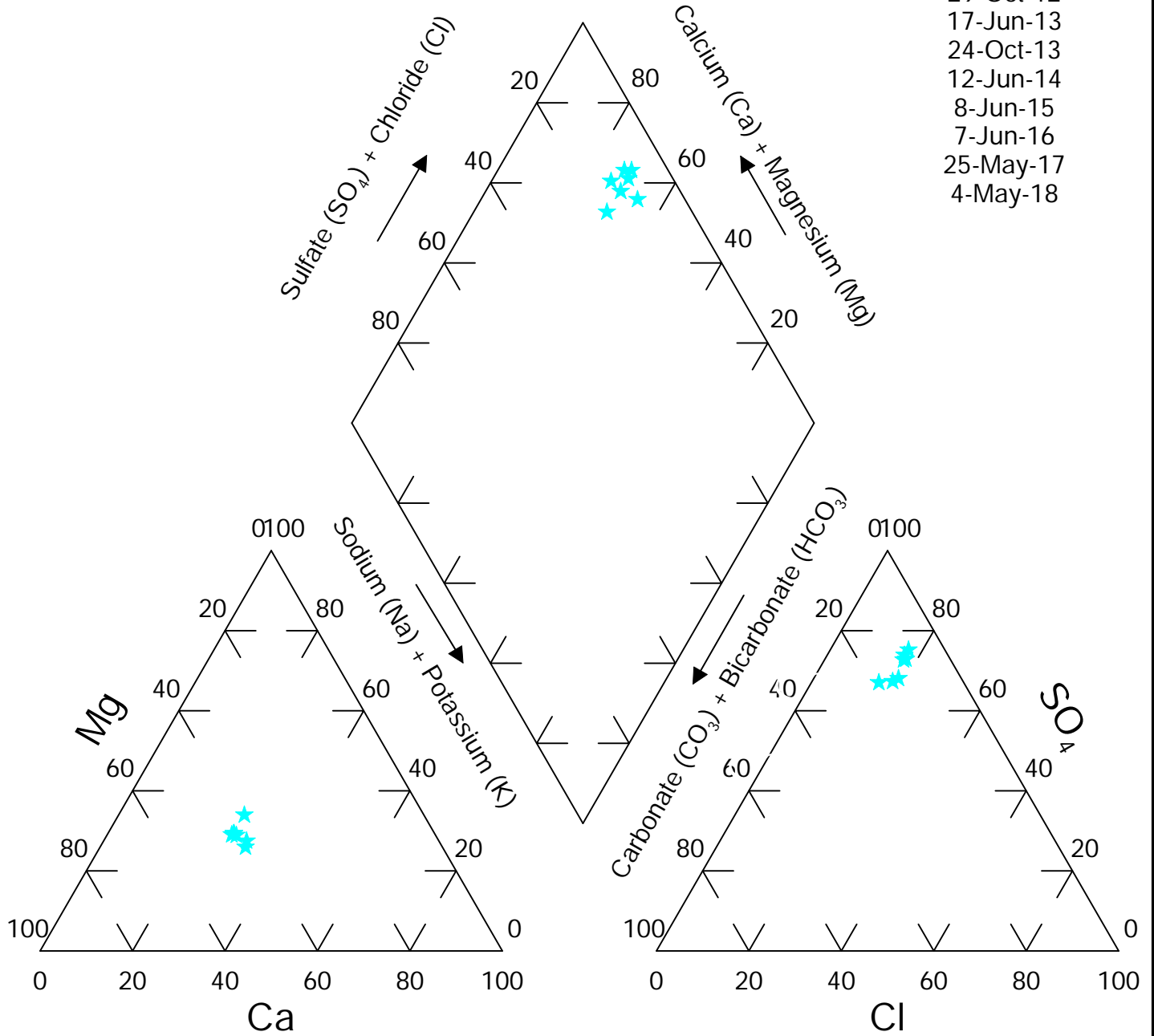


FIGURE: 10P

Site: Brady Well #: 5N62-E

Dates:

- 17-Jun-13
- 24-Oct-13
- 16-Jun-14
- 23-Oct-14
- 4-Jun-15
- 15-Oct-15
- 30-May-16
- 27-Oct-16
- 29-May-17
- 17-Oct-17
- 31-May-18
- 15-Oct-18

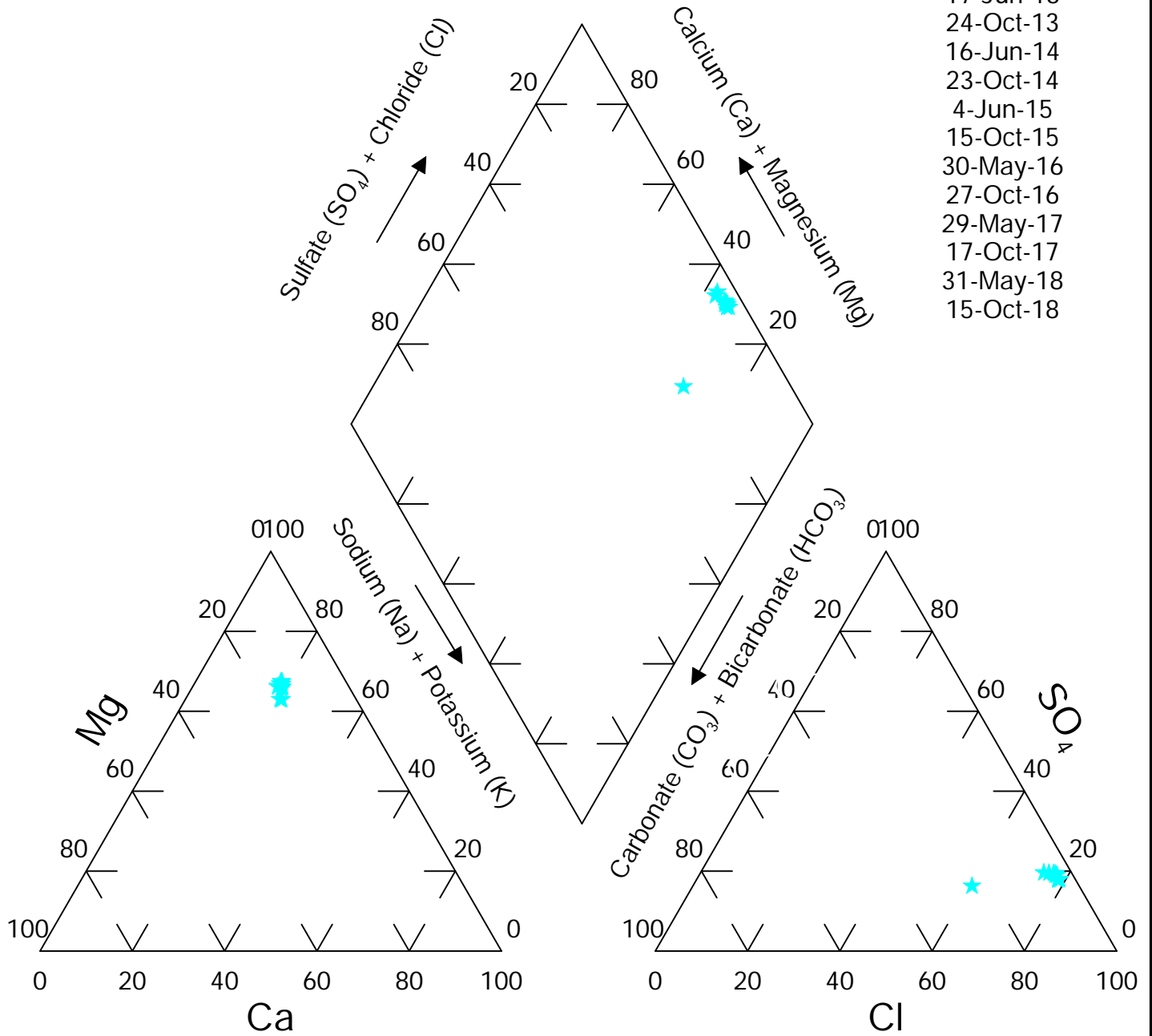


FIGURE: 11P

Site: Brady
Well #: 6N57-F/FR

Dates:
19-Jun-13
28-Oct-13
10-Jun-15
26-May-16
24-May-17
30-May-18

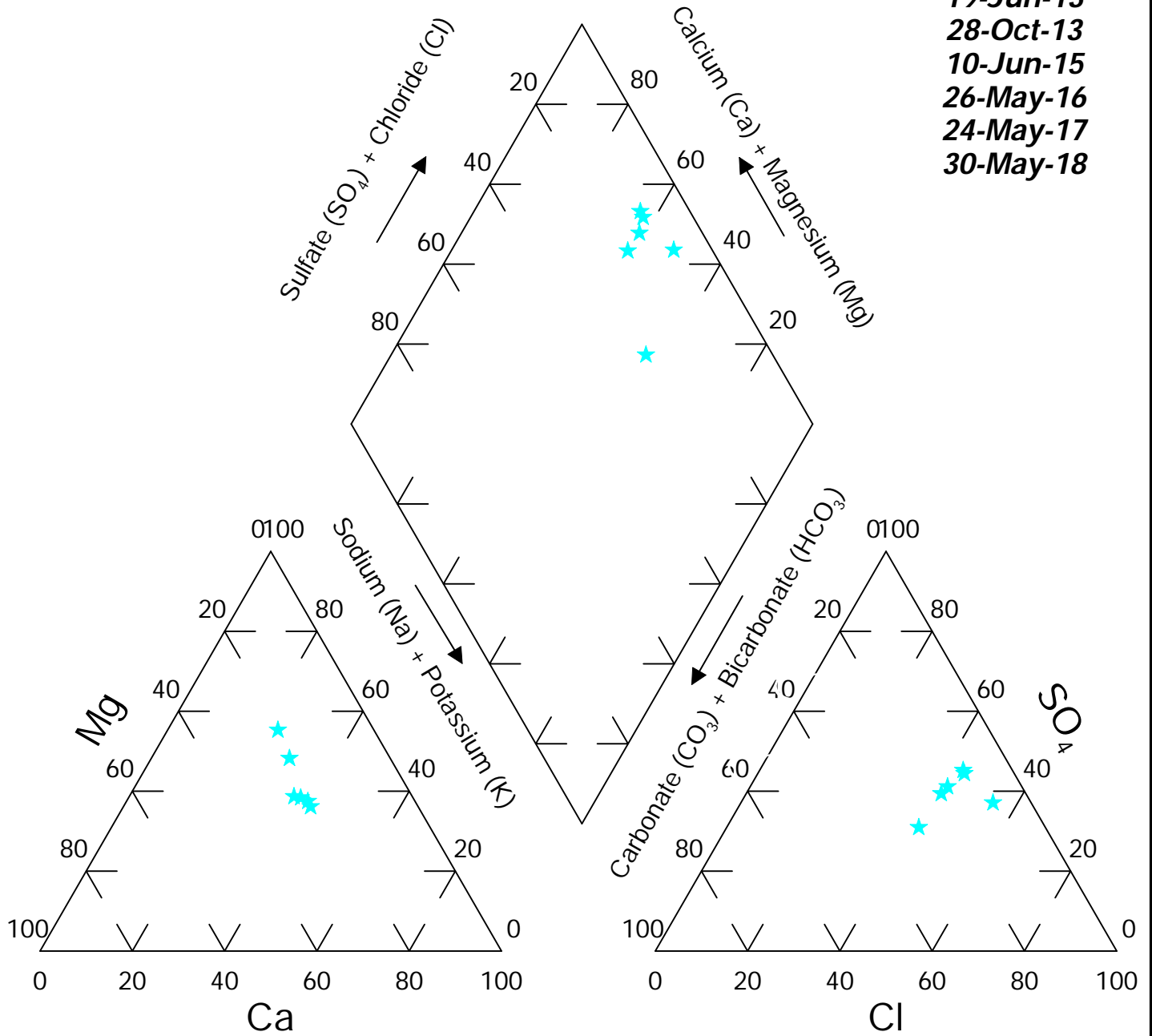
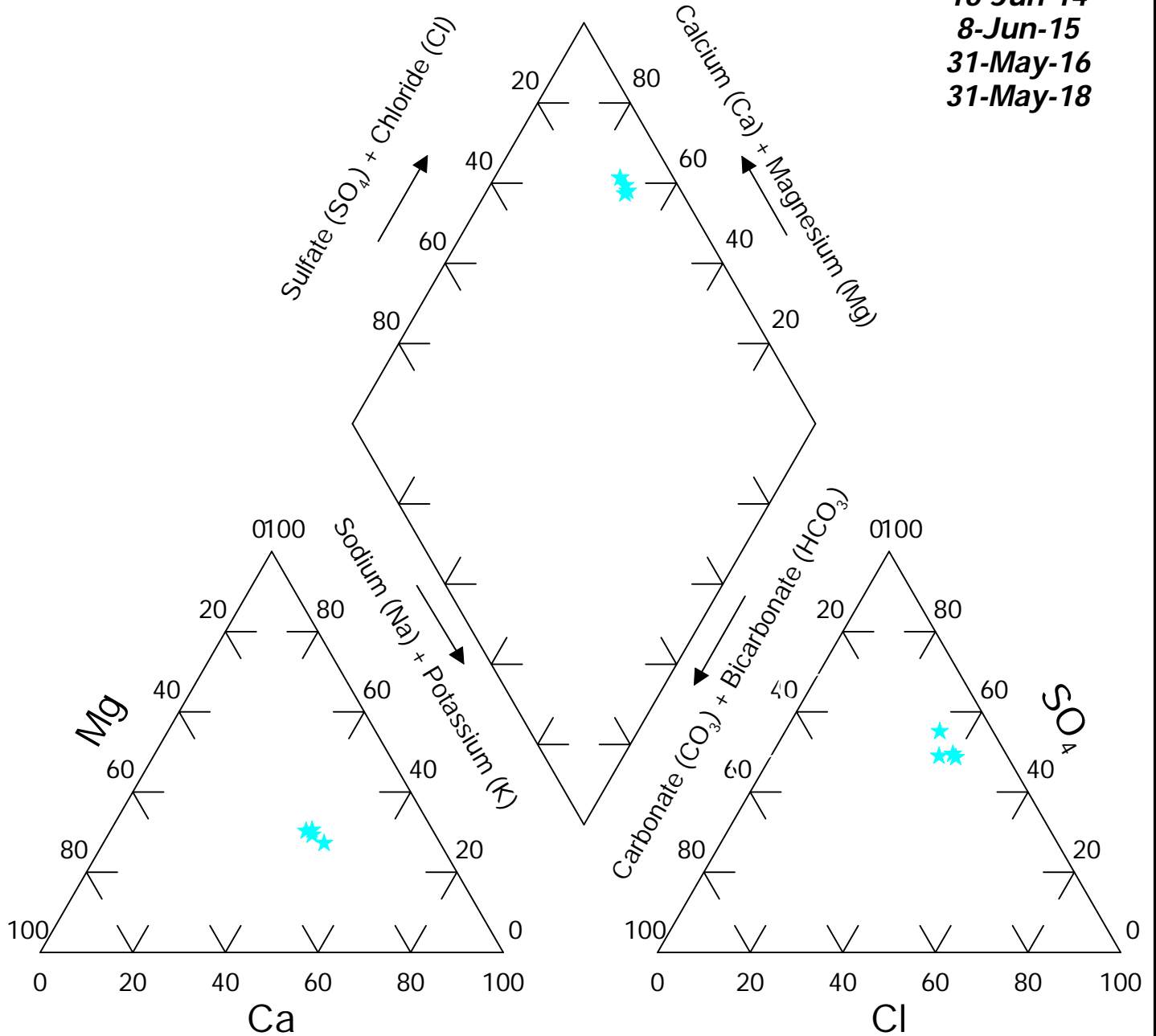


FIGURE: 12P

Site: Brady

Location : GWQ25-6N58-DR

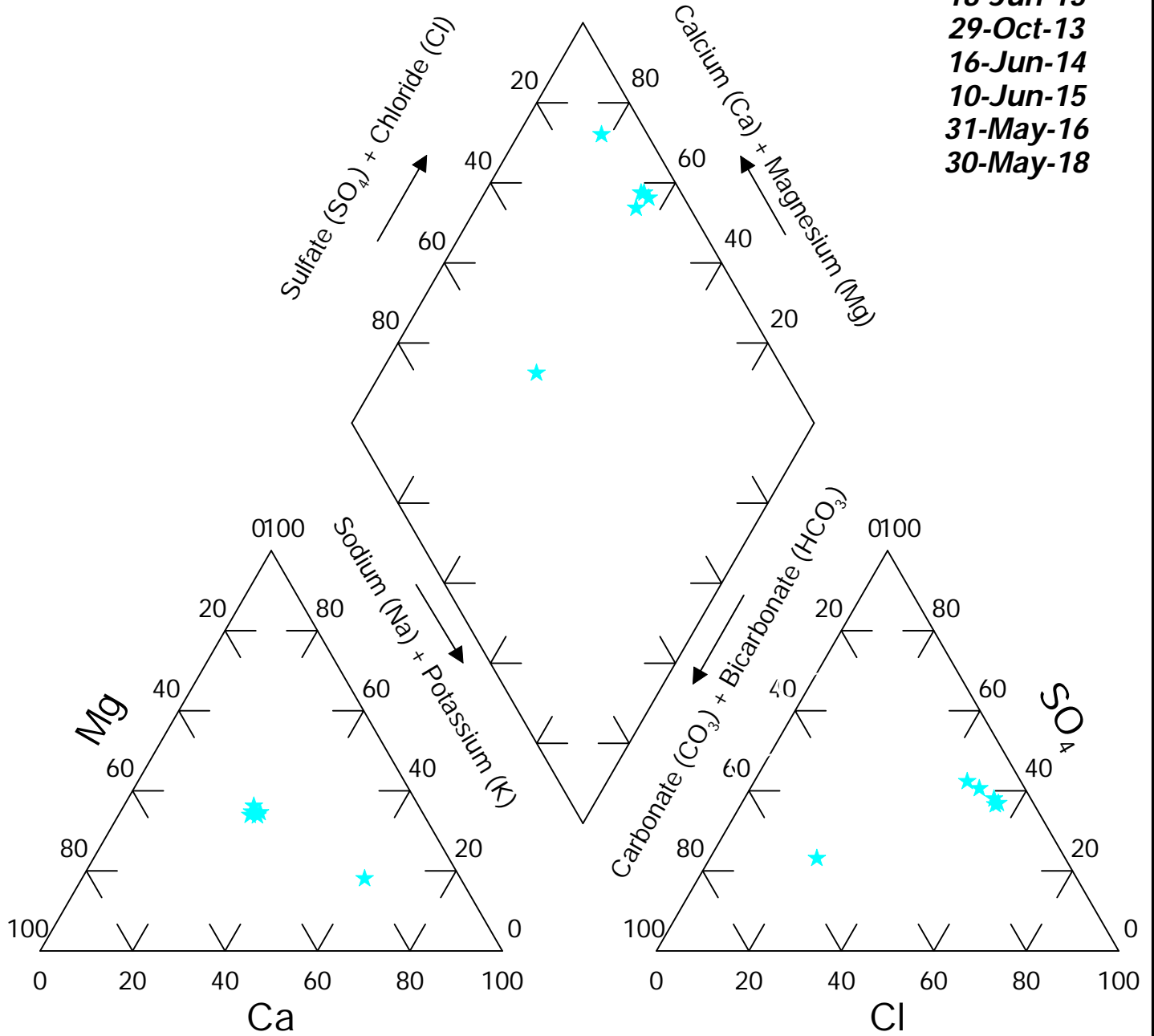
Dates:
16-Jun-14
8-Jun-15
31-May-16
31-May-18



Site: Brady

Well #: 6N58FR

Dates:
 18-Jun-13
 29-Oct-13
 16-Jun-14
 10-Jun-15
 31-May-16
 30-May-18



Site: Brady
Well #: 6N59-F/FR

Dates:
17-Jun-13
28-Oct-13
16-Jun-14
11-Jun-15
30-May-16
30-May-18

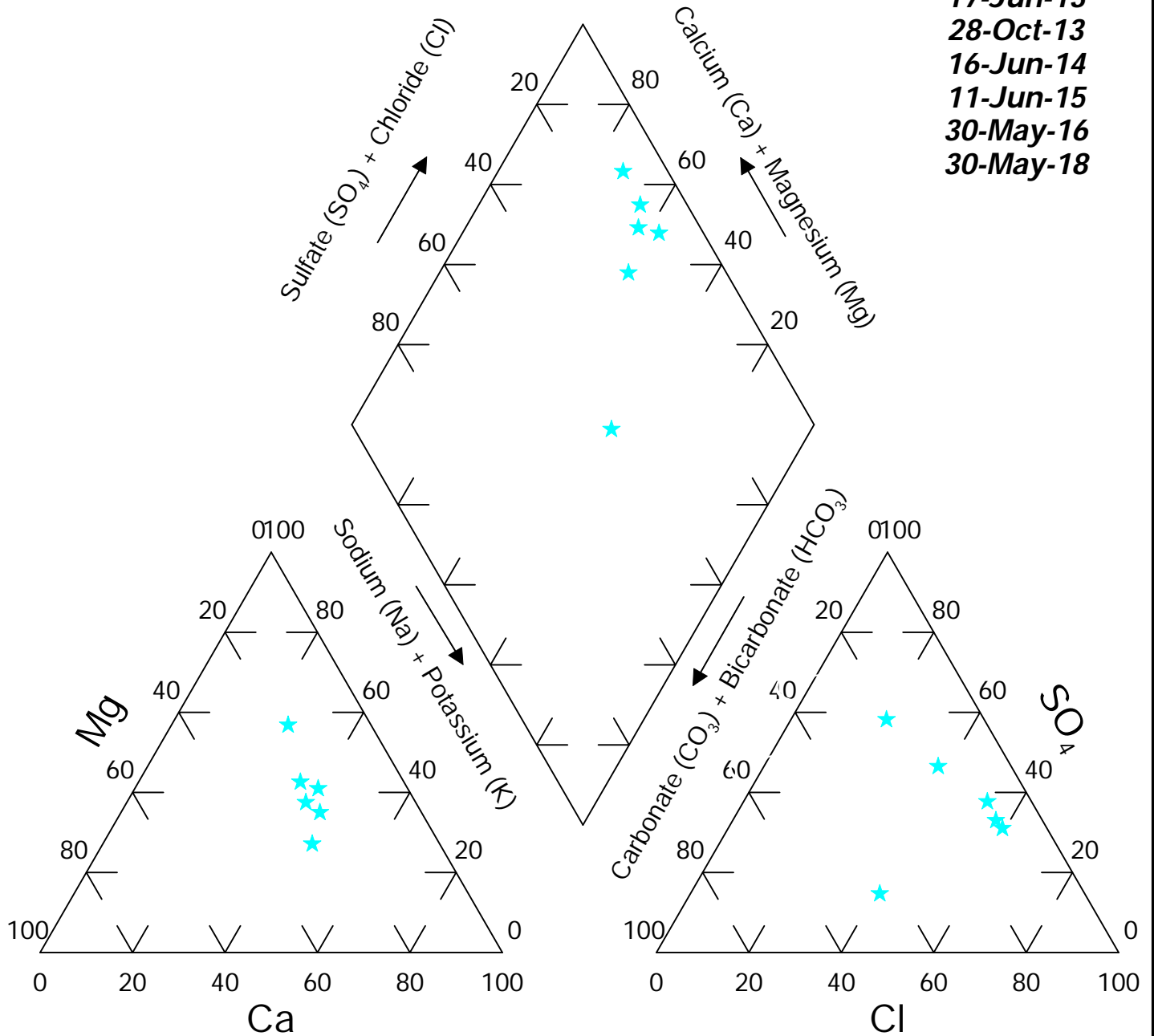


FIGURE: 14P

Site: Brady
Well #: 6N60-E/ER

Dates:
 19-Jun-13
 21-Oct-14
 8-Jun-15
 15-Oct-15
 30-May-16
 27-Oct-16
 24-May-17
 17-Oct-17
 30-May-18
 15-Oct-18

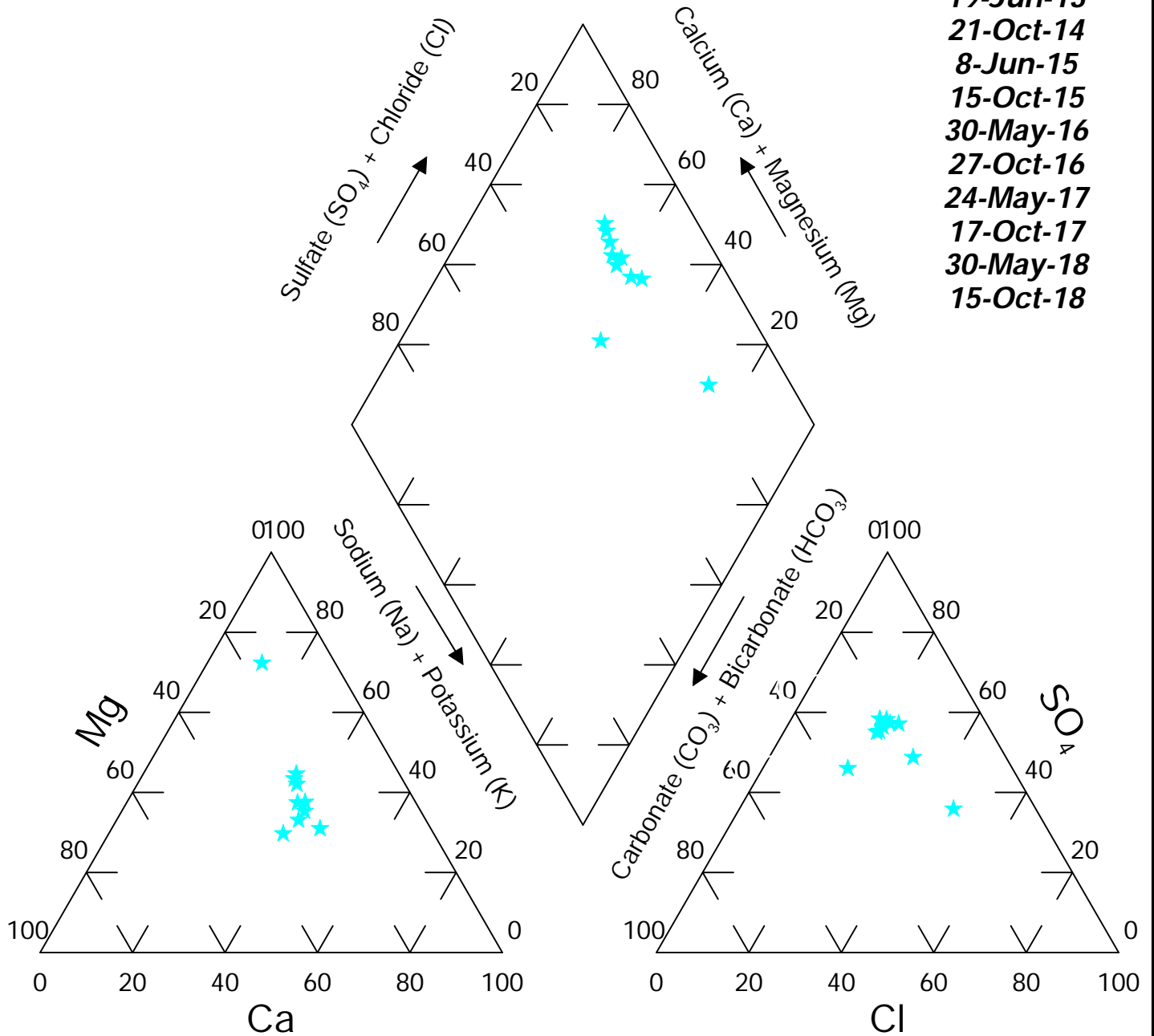


FIGURE: 15P

Site: Brady Well #: 6N63-F

Dates:
 17-Jun-13
 24-Oct-13
 24-Oct-13
 12-Jun-14
 4-Jun-15
 26-May-16
 29-May-17
 31-May-18

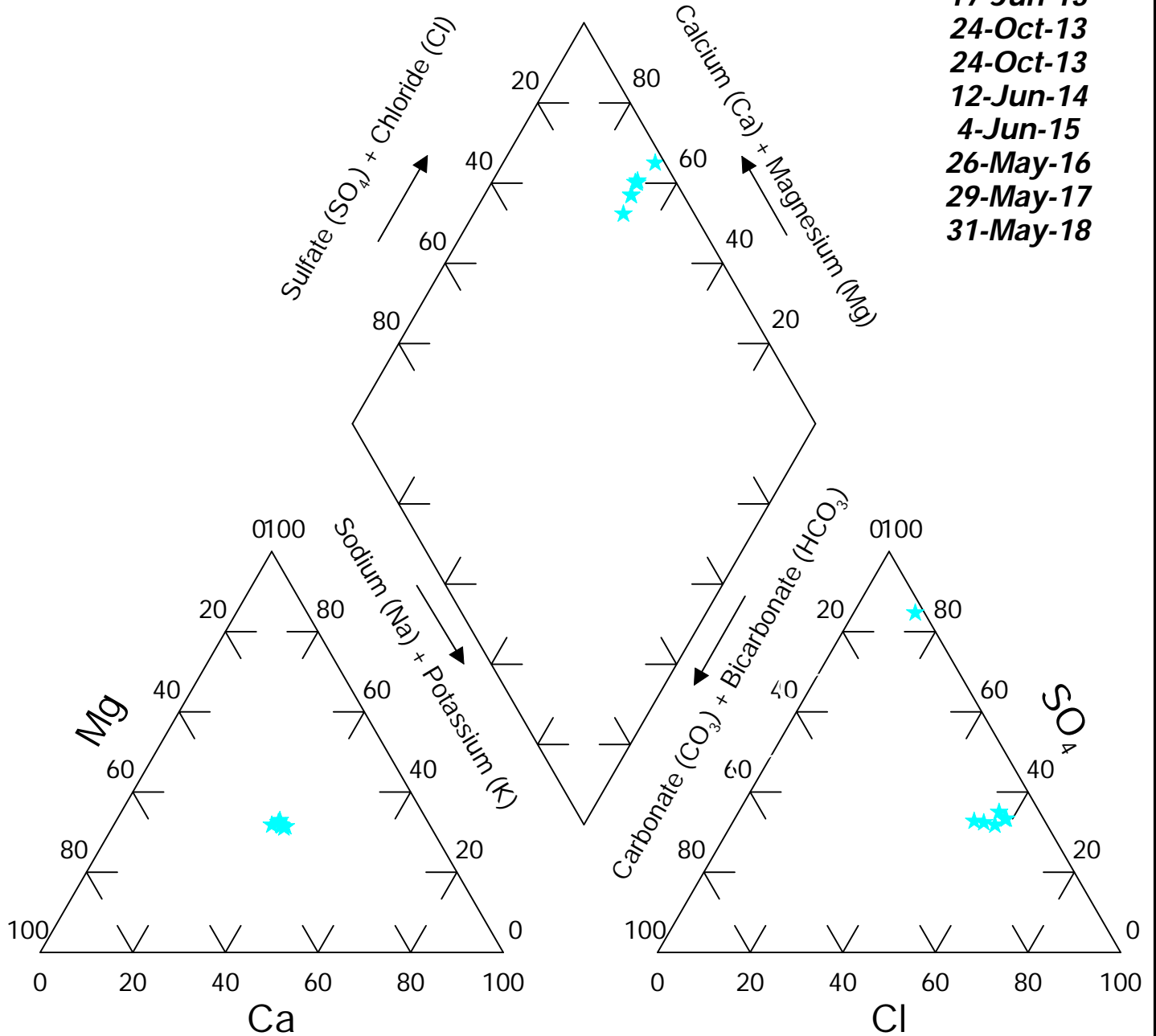


FIGURE: 16P

Site: Brady
Well #: 6N67-F

Dates:
17-Jun-13
23-Oct-13
12-Jun-14
8-Jun-15
26-May-16
25-May-17
30-May-18

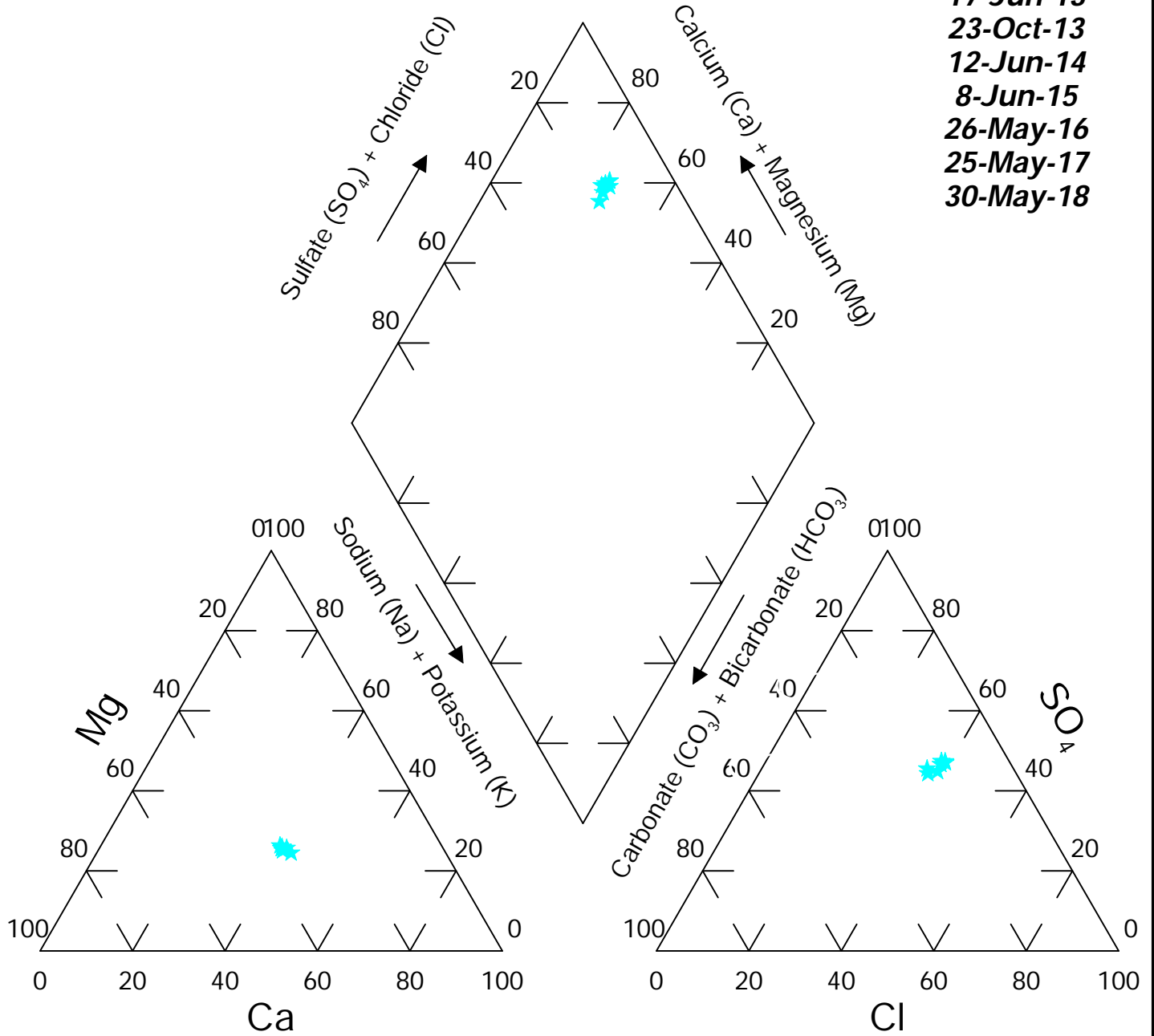
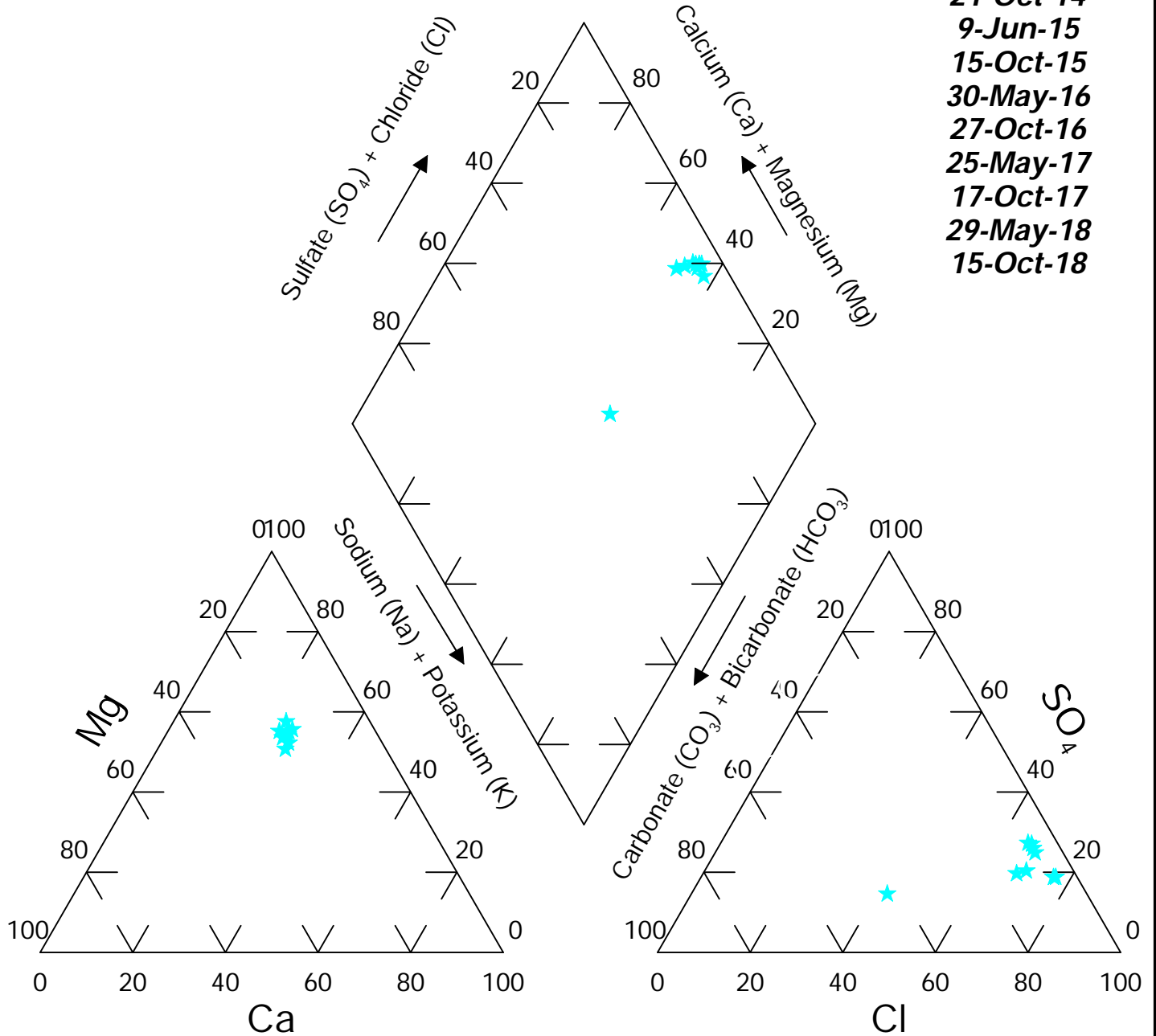


FIGURE: 17P

Site: Brady Well #: 13A

Dates:
 21-Oct-14
 9-Jun-15
 15-Oct-15
 30-May-16
 27-Oct-16
 25-May-17
 17-Oct-17
 29-May-18
 15-Oct-18



Site: Brady Well #: 14A

Dates:
 21-Oct-14
 4-Jun-15
 15-Oct-15
 30-May-16
 28-Oct-16
 25-May-17
 17-Oct-17
 29-May-18
 16-Oct-18

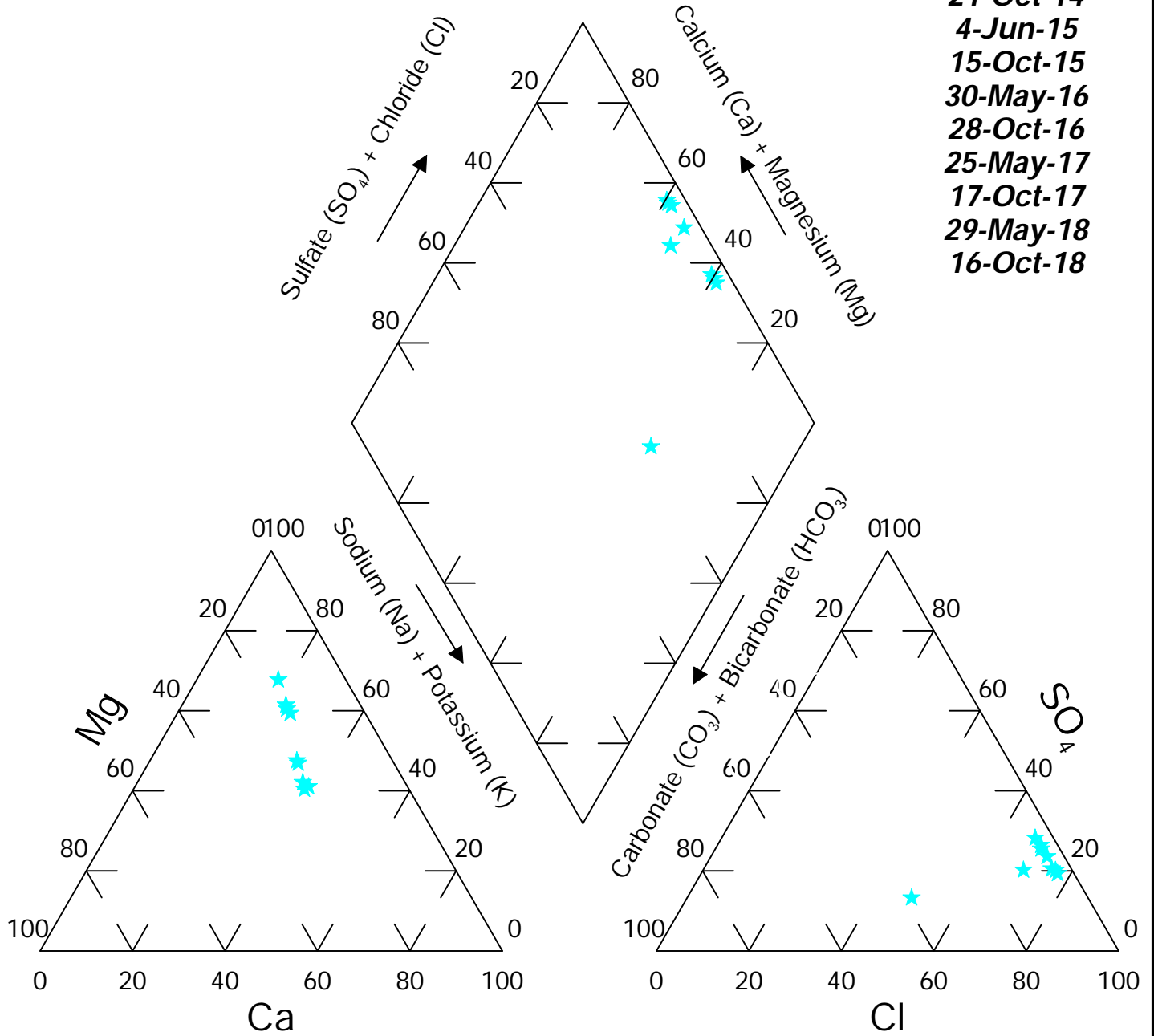
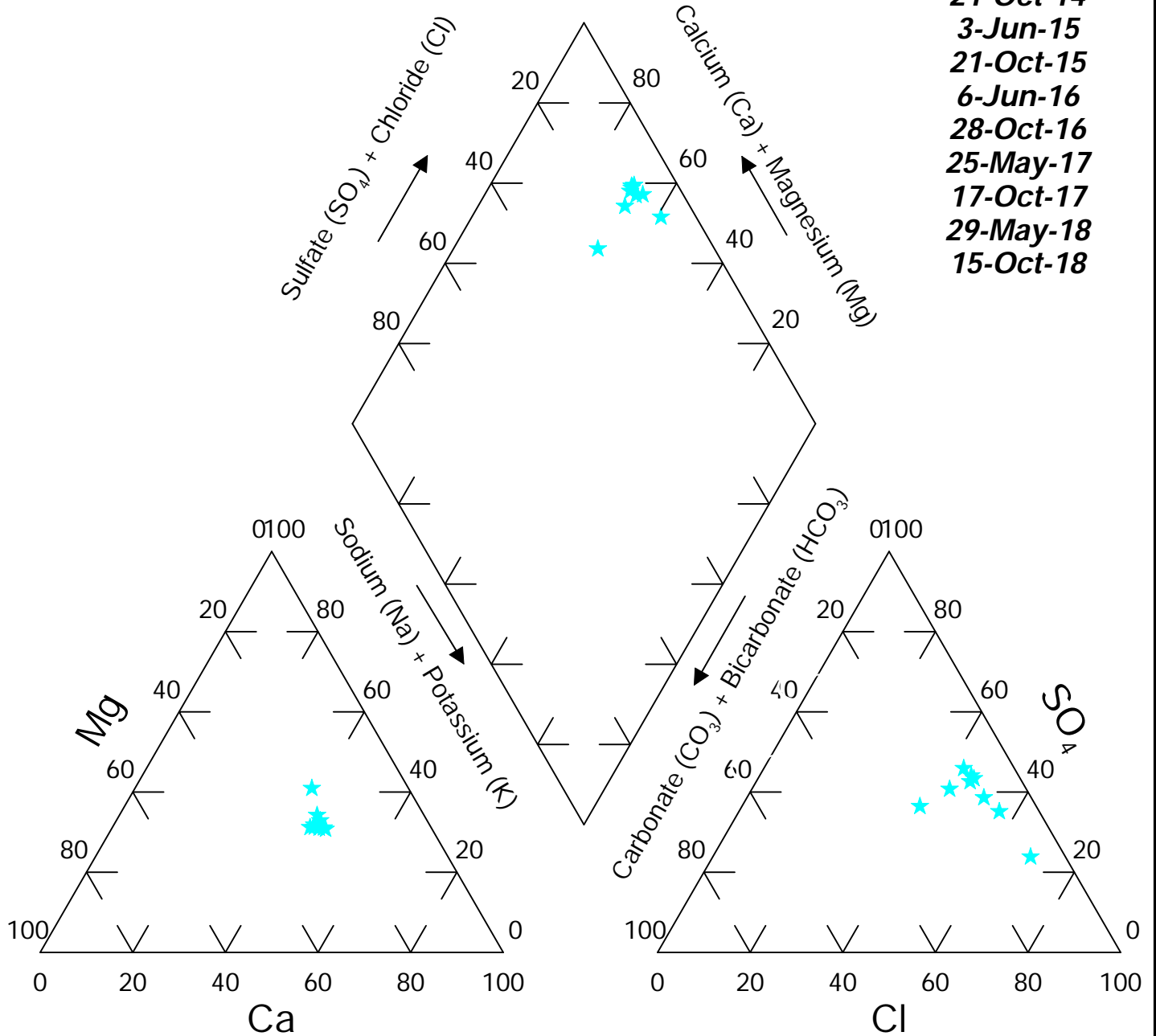


FIGURE: 13P

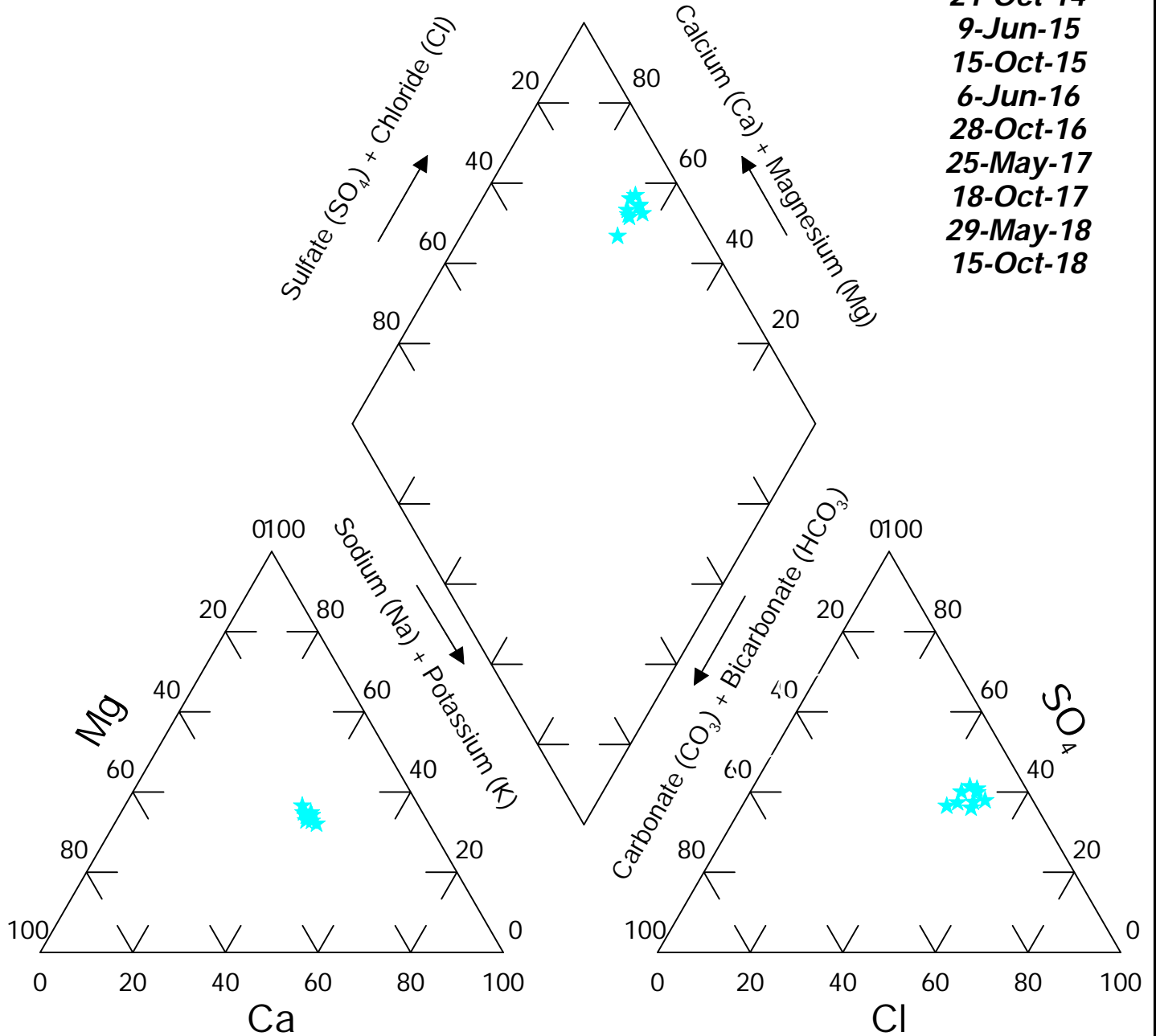
Site: Brady Well #: 15A

Dates:
 21-Oct-14
 3-Jun-15
 21-Oct-15
 6-Jun-16
 28-Oct-16
 25-May-17
 17-Oct-17
 29-May-18
 15-Oct-18



Site: Brady Well #: 16A

Dates:
 21-Oct-14
 9-Jun-15
 15-Oct-15
 6-Jun-16
 28-Oct-16
 25-May-17
 18-Oct-17
 29-May-18
 15-Oct-18



2018 Leachate Piper Diagrams

Site: Brady Location: MH3

Dates:
31-Jul-13
22-Jul-14
2-Sep-15
8-Sep-16
26-Sep-17
31-Jul-18

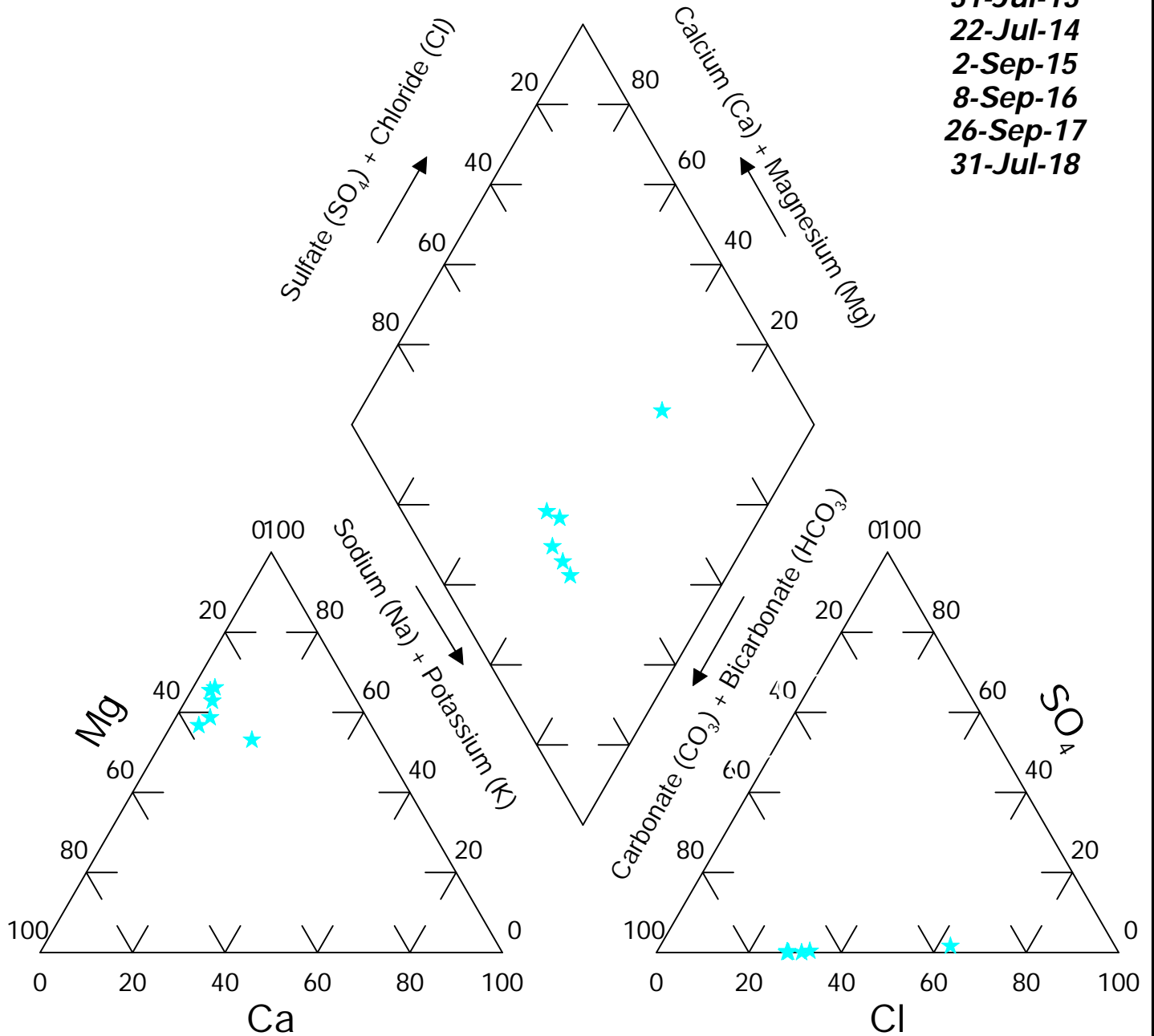


FIGURE: 18P

Site: Brady Location: MH8

Dates:
 1-Aug-13
 22-Jul-14
 2-Sep-15
 7-Sep-16
 26-Sep-17
 31-Jul-18

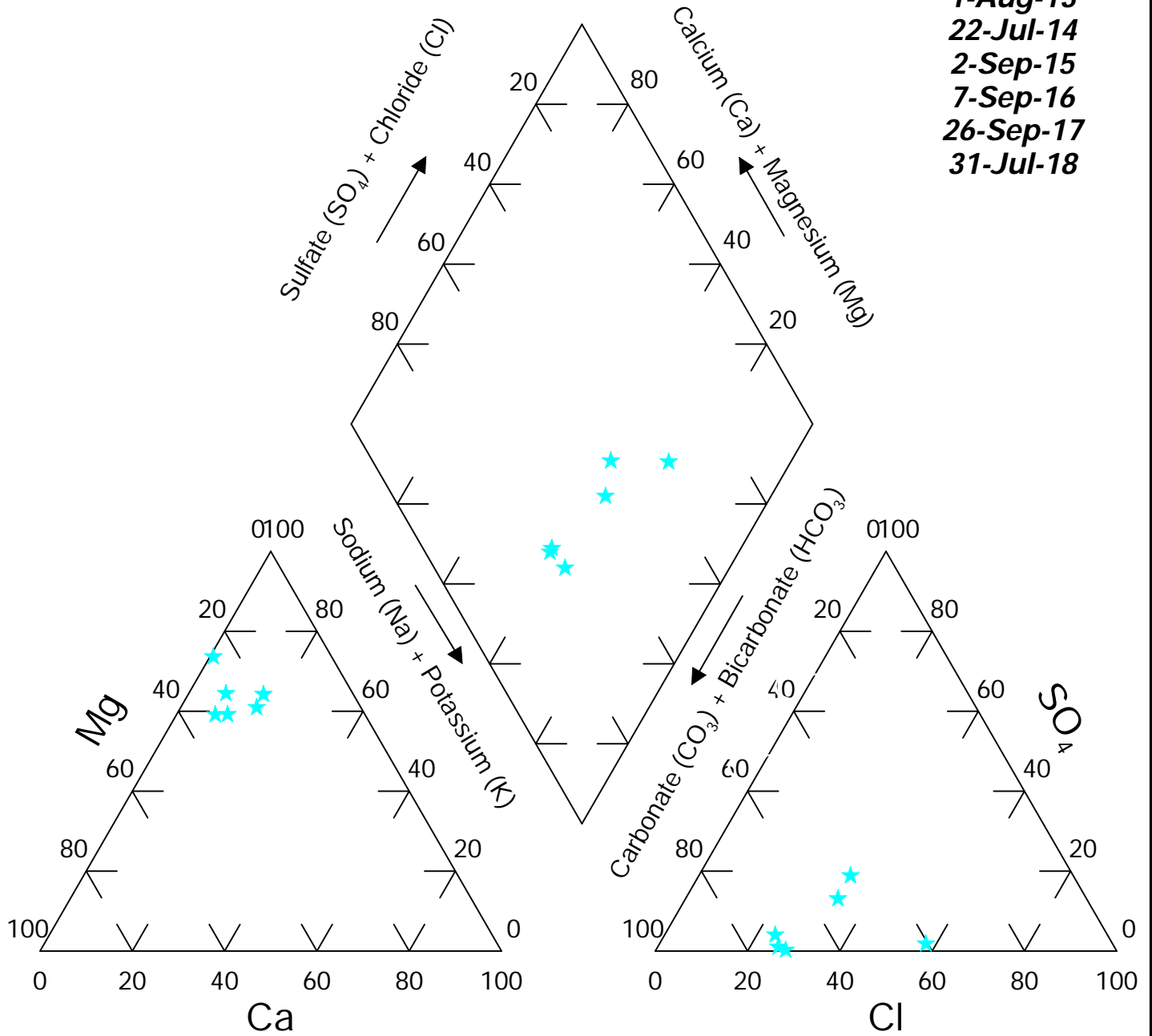


FIGURE: 19P

Site: Brady
Location: MH13

Dates:
1-Aug-13
22-Jul-14
2-Sep-15
9-Sep-16
26-Sep-17
31-Jul-18

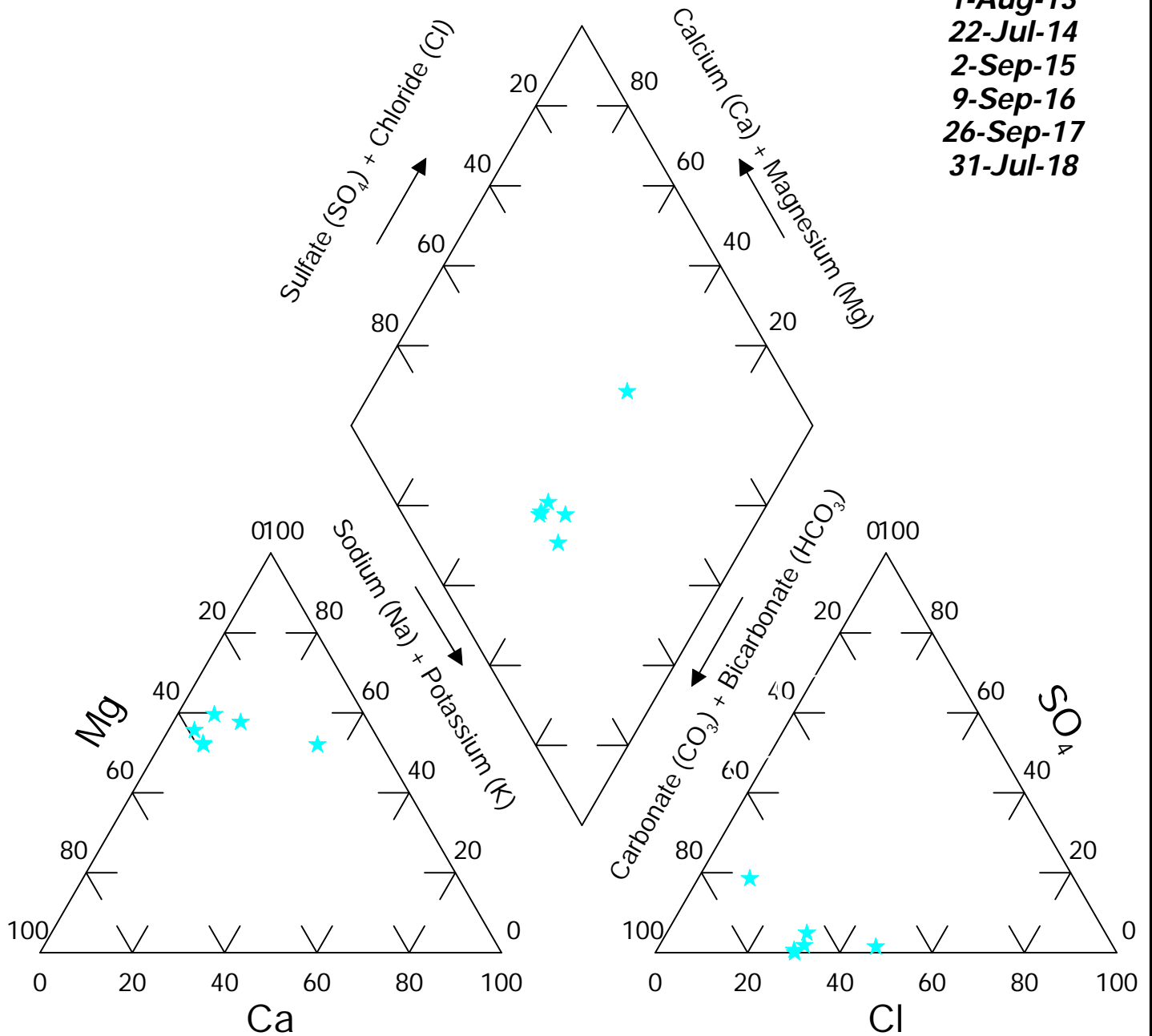


FIGURE: 20P

Site: Brady
Location: MH24

Dates:
1-Aug-13
22-Jul-14
2-Sep-15
7-Sep-16
26-Sep-17
31-Jul-18

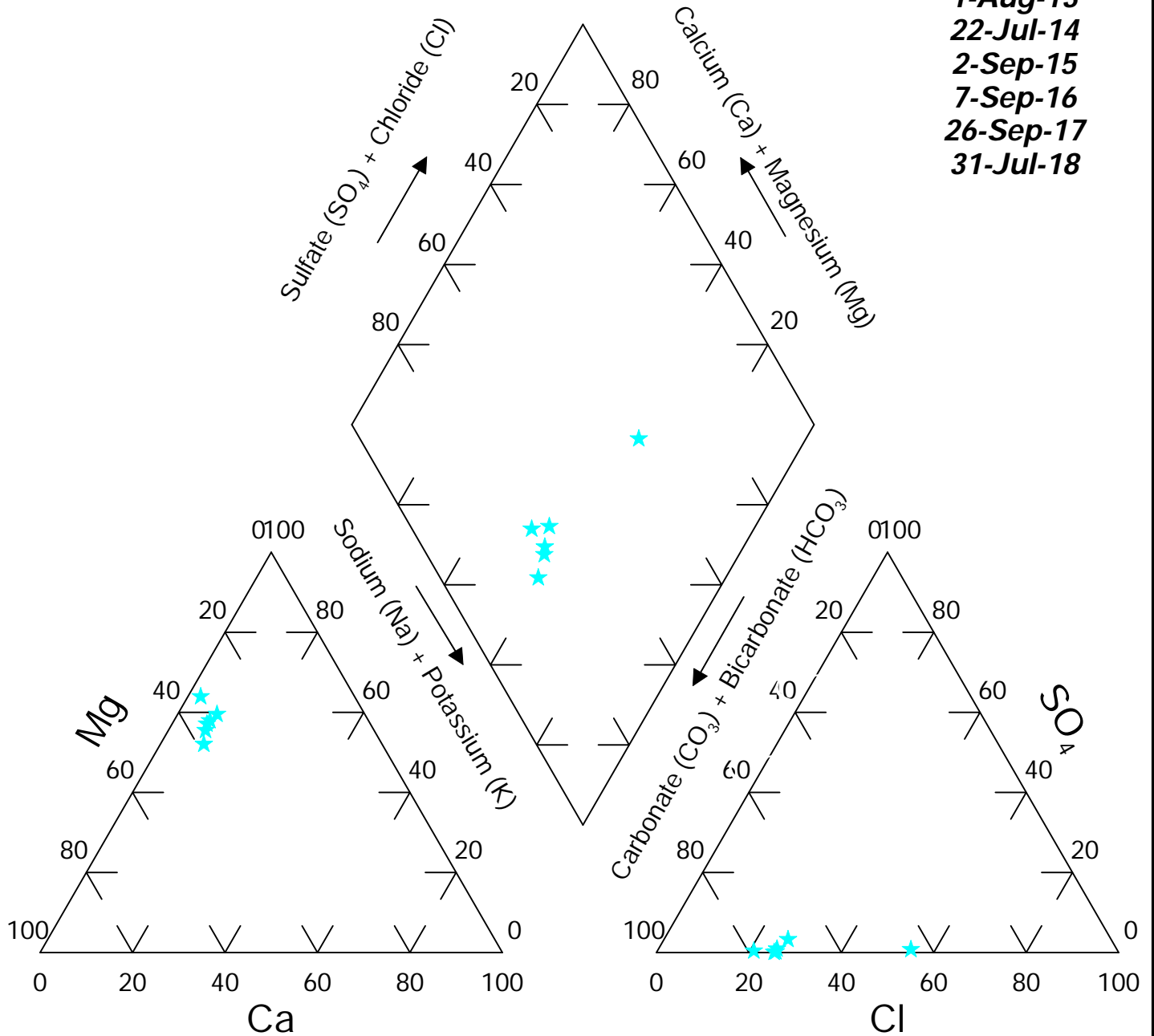


FIGURE: 21P

Site: Brady Location: MH27

Dates:
31-Jul-13
22-Jul-14
2-Sep-15
7-Sep-16
26-Sep-17
31-Jul-18

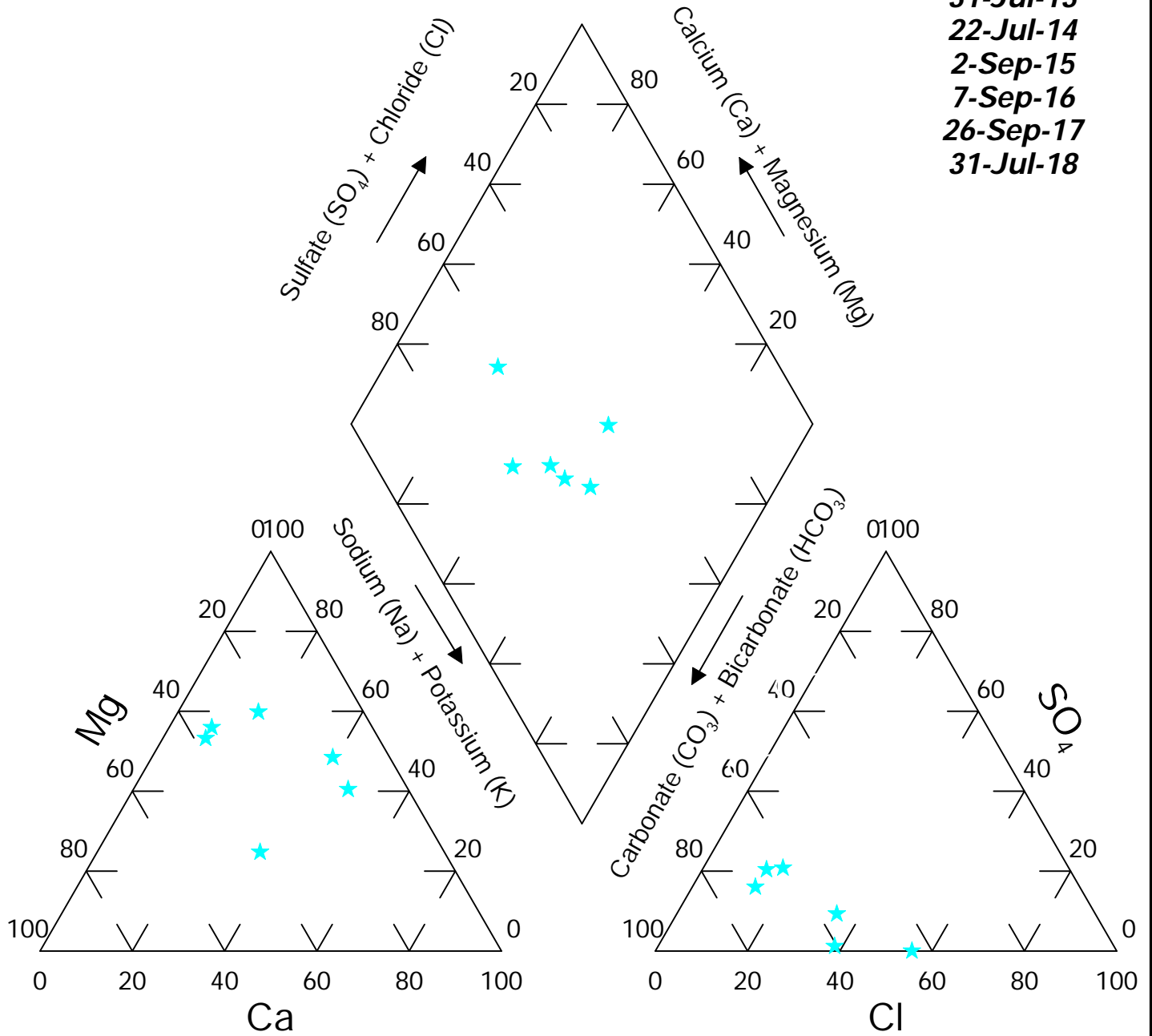


FIGURE: 22P

Site: Brady Location: MH31

Dates:
31-Jul-13
22-Jul-14
2-Sep-15
7-Sep-16
26-Sep-17
31-Jul-18

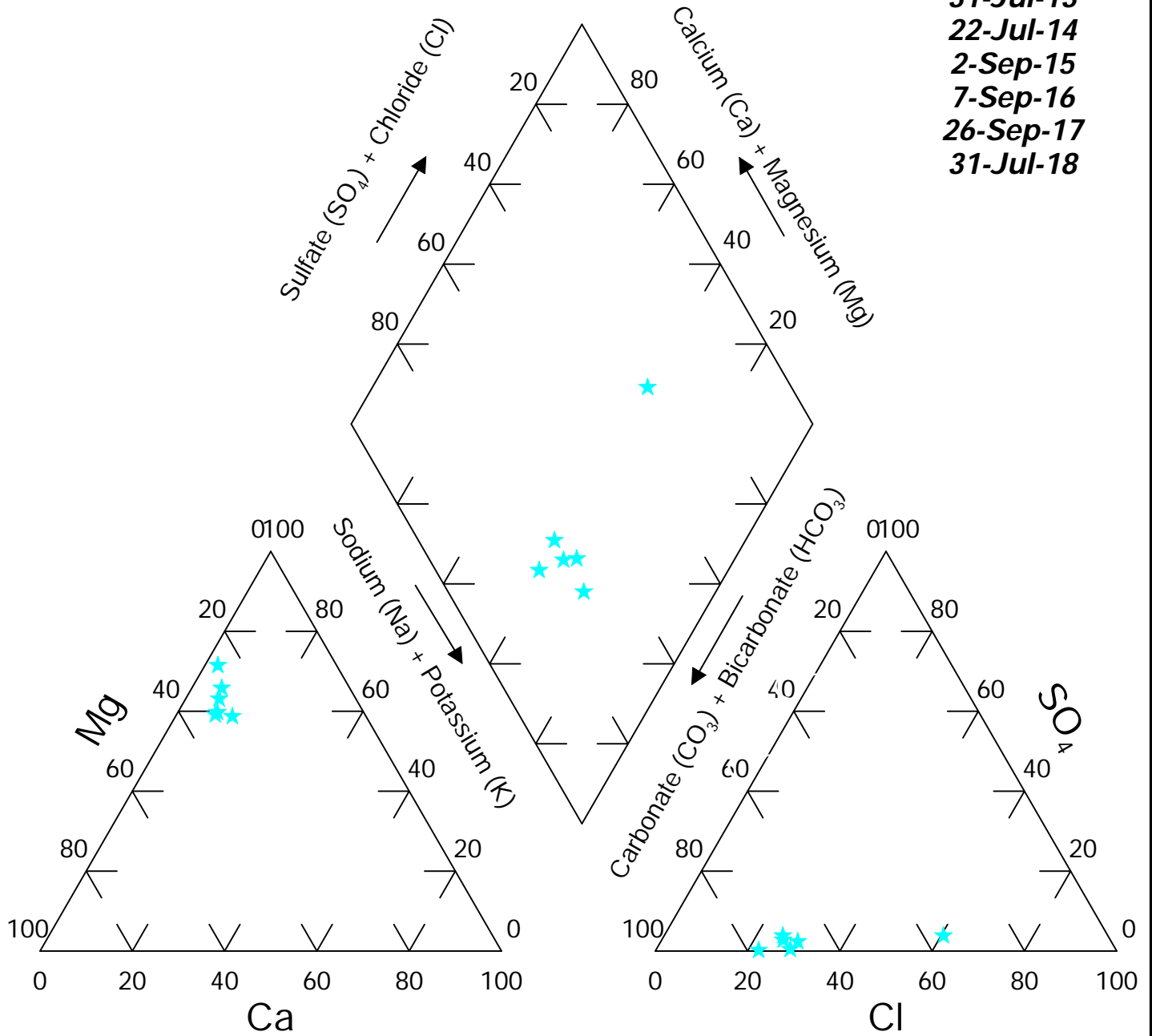


FIGURE: 23P

Site: Brady
Location: MH34

Dates:
31-Jul-13
22-Jul-14
2-Sep-15
8-Sep-16
26-Sep-17
31-Jul-18

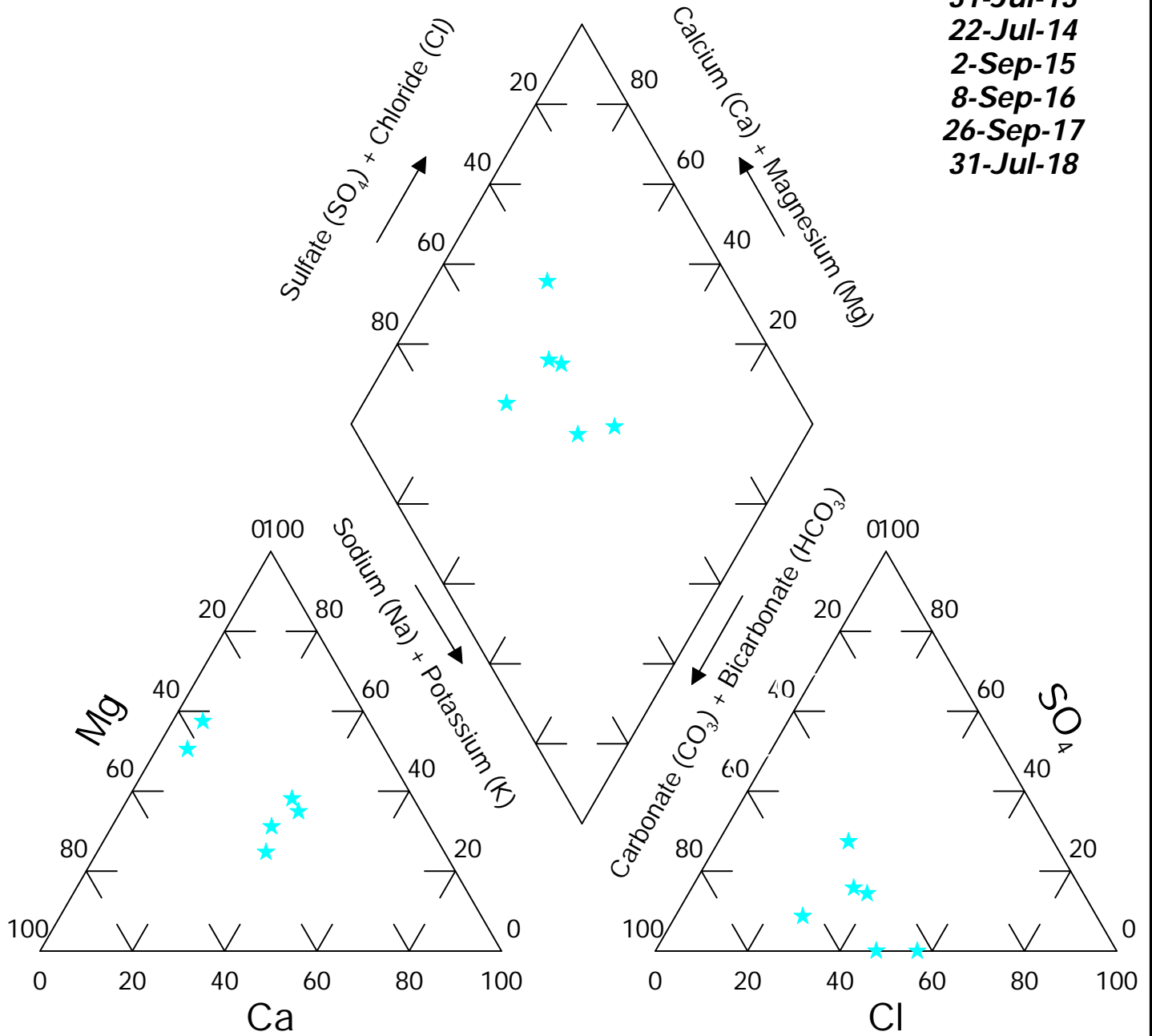


FIGURE: 24P

Site: Brady
Location: MH24

Date:
31-Jul-18

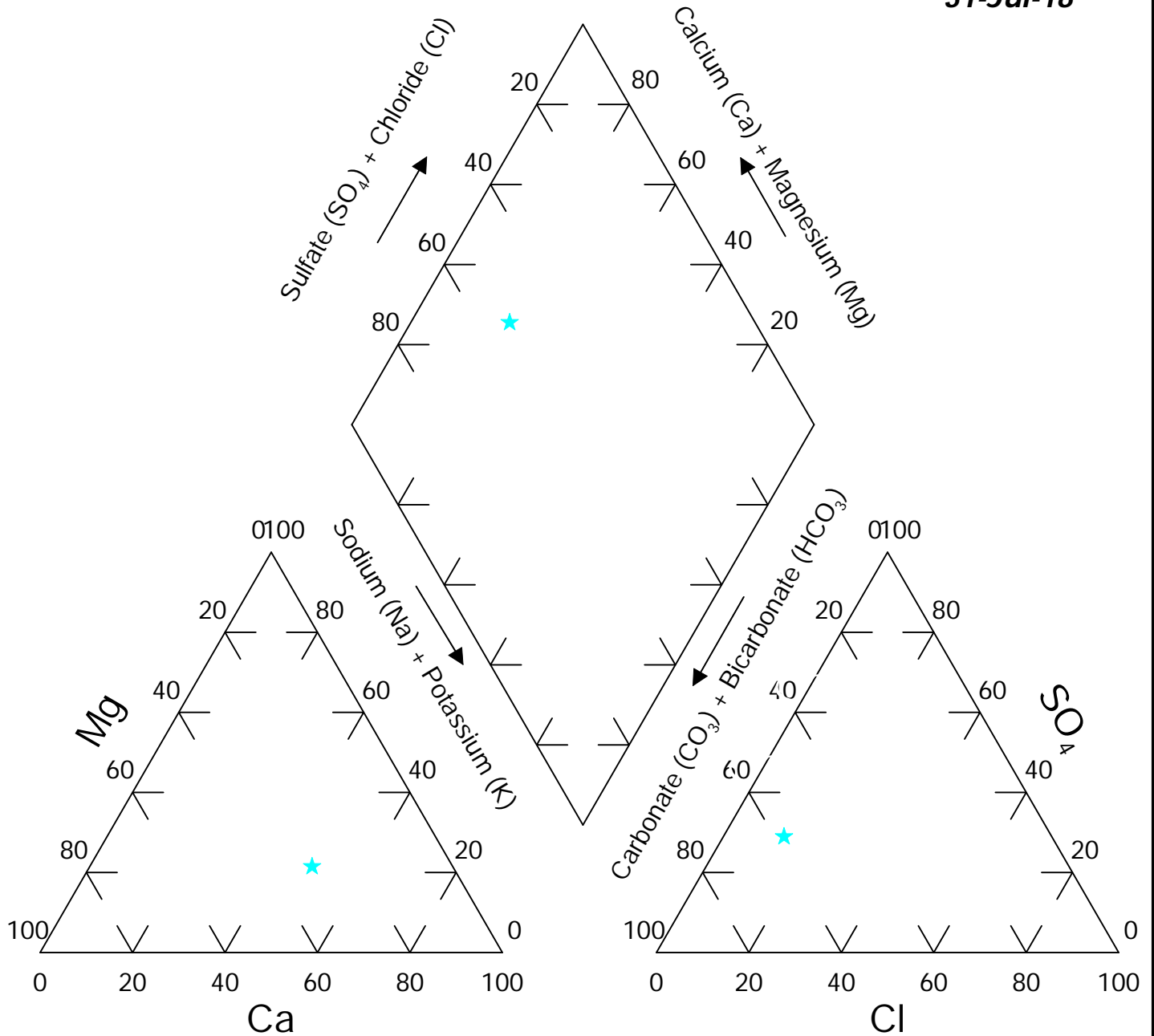


FIGURE: 21P

Site: Brady Location: *Riser 1*

Dates:

29-Oct-15
8-Sep-16
26-Sep-17
31-Jul-18

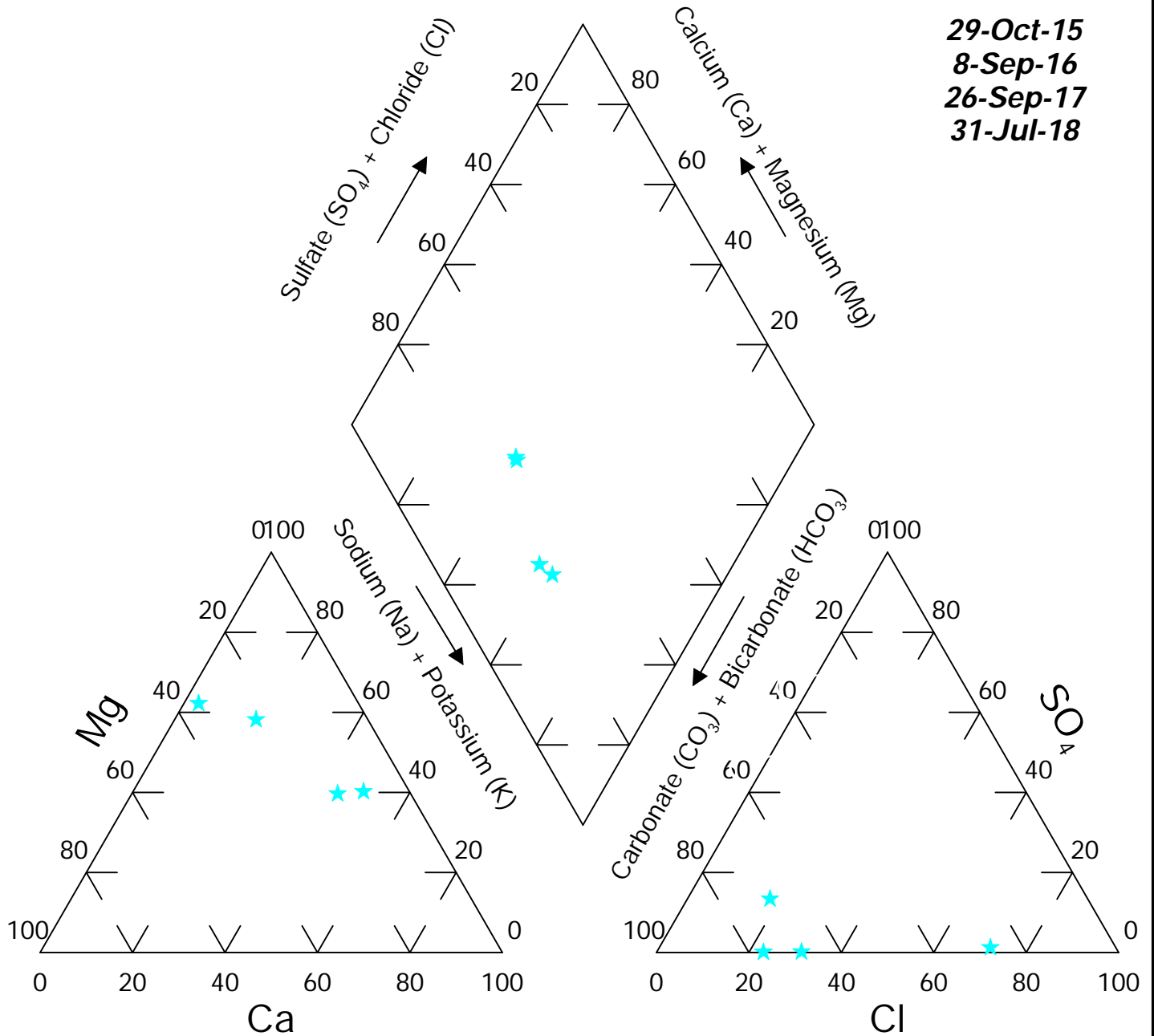
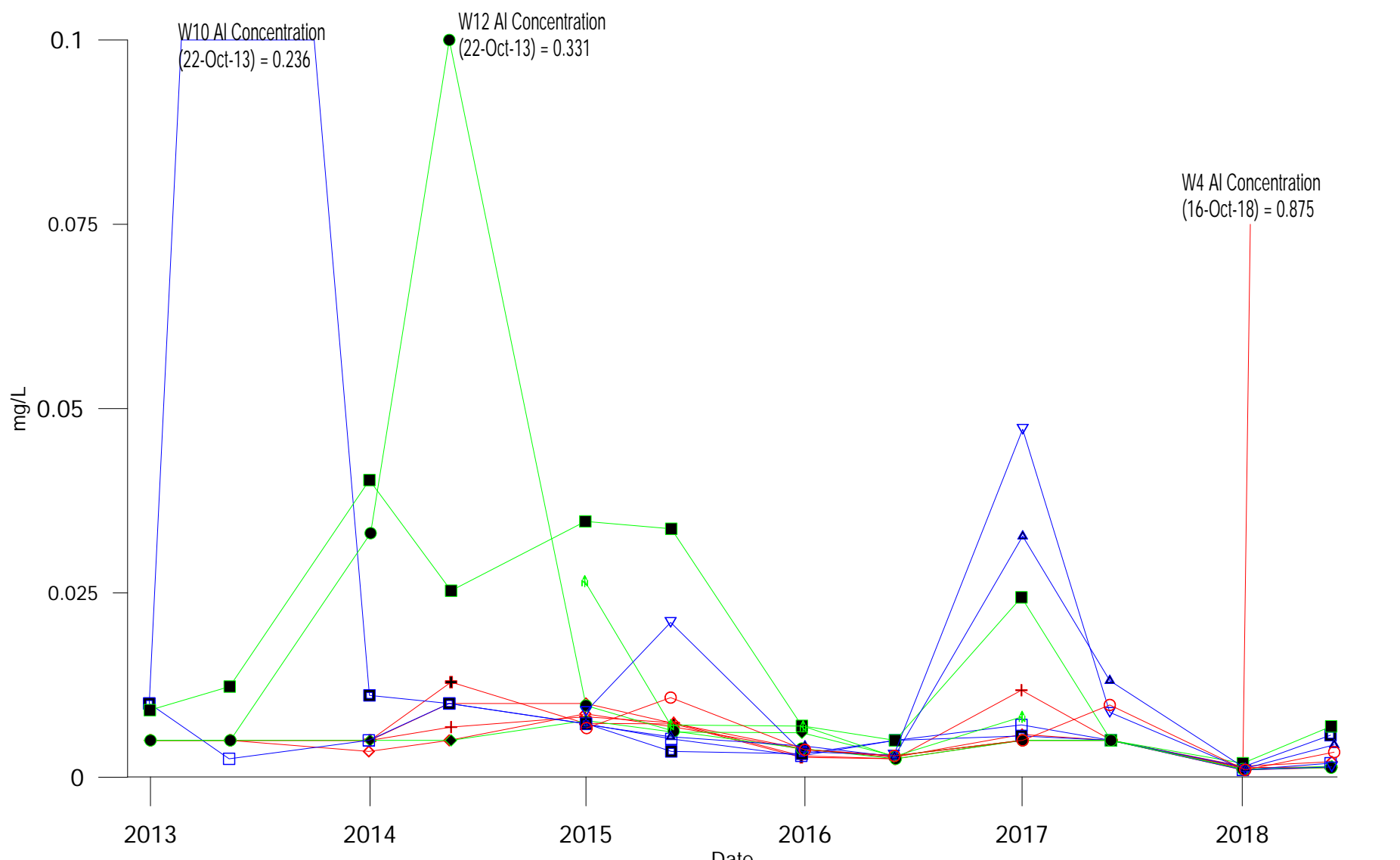


FIGURE: 18P

APPENDIX D
2018 TIME VS CONCENTRATION
GRAPHS

**2018 Groundwater
Time vs Concentration Graphs**



Cross gradient

□	□	□	W9
■	■	■	W10
▽	▽	▽	W14
△	△	△	W15

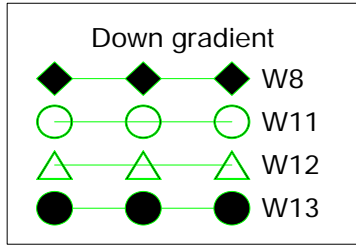
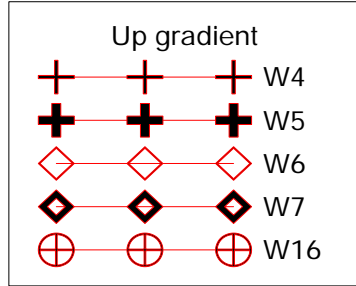
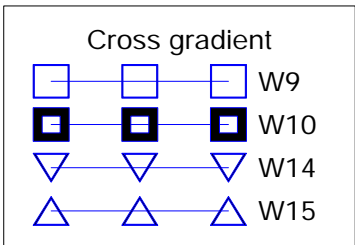
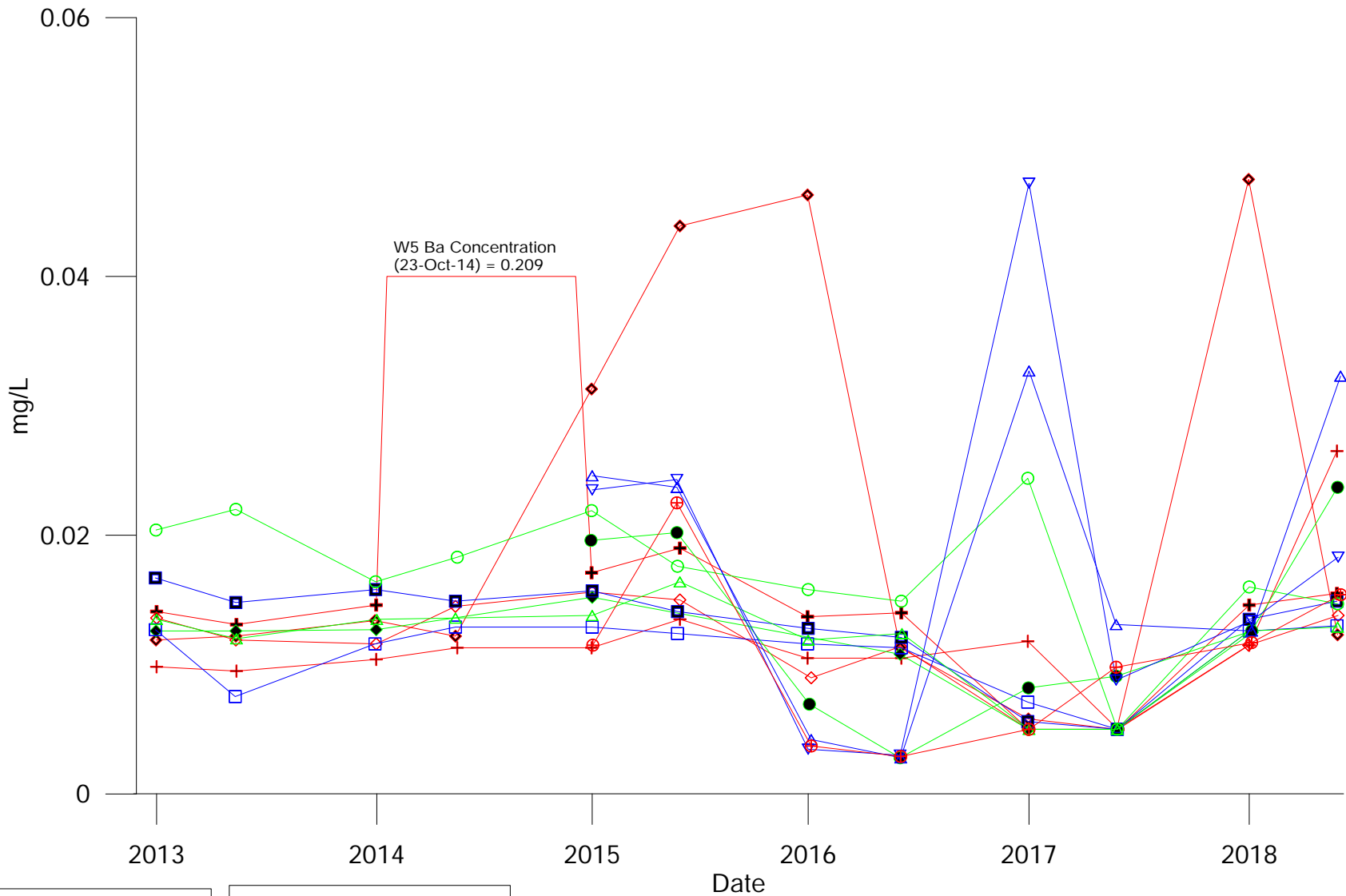
Up gradient

+	+	+	W4
+	+	+	W5
◇	◇	◇	W6
◇	◇	◇	W7
○	○	○	W16

Down gradient

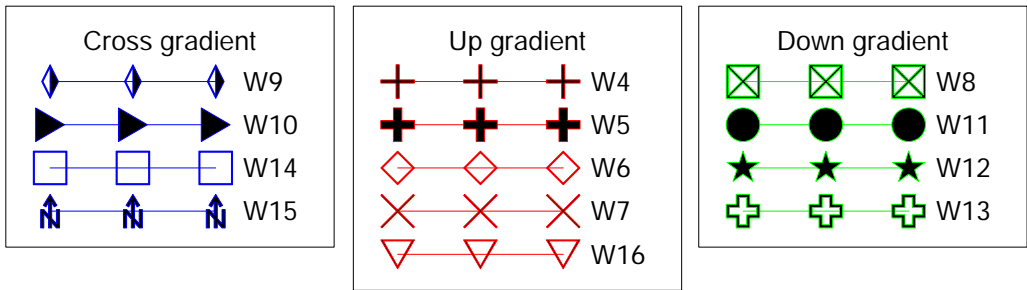
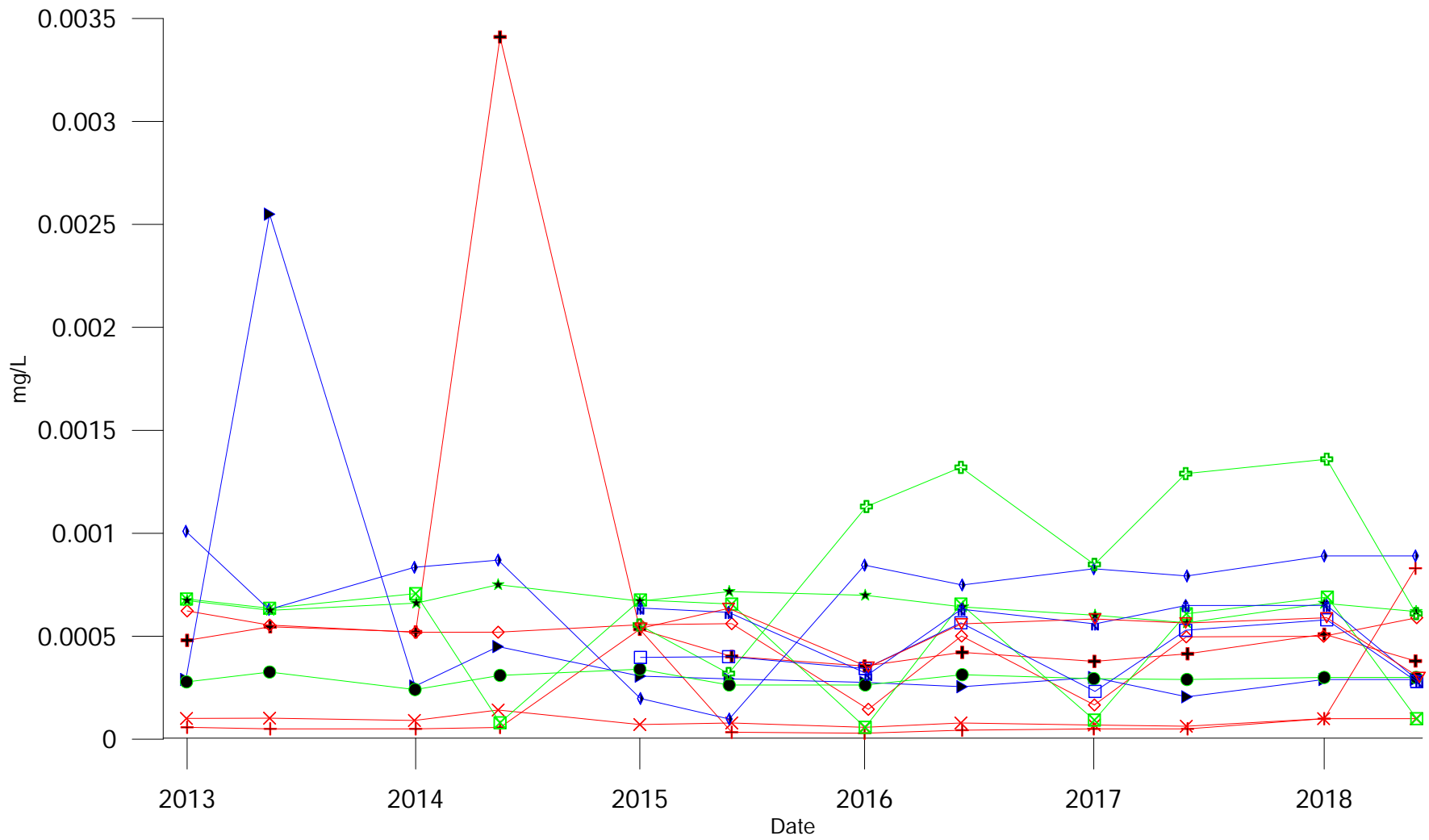
◆	◆	◆	W8
■	■	■	W11
●	●	●	W12
⬆	⬆	⬆	W13

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Aluminium Concentration Bedrock Wells		
APRIL 2019	FIGURE 1	REV 0



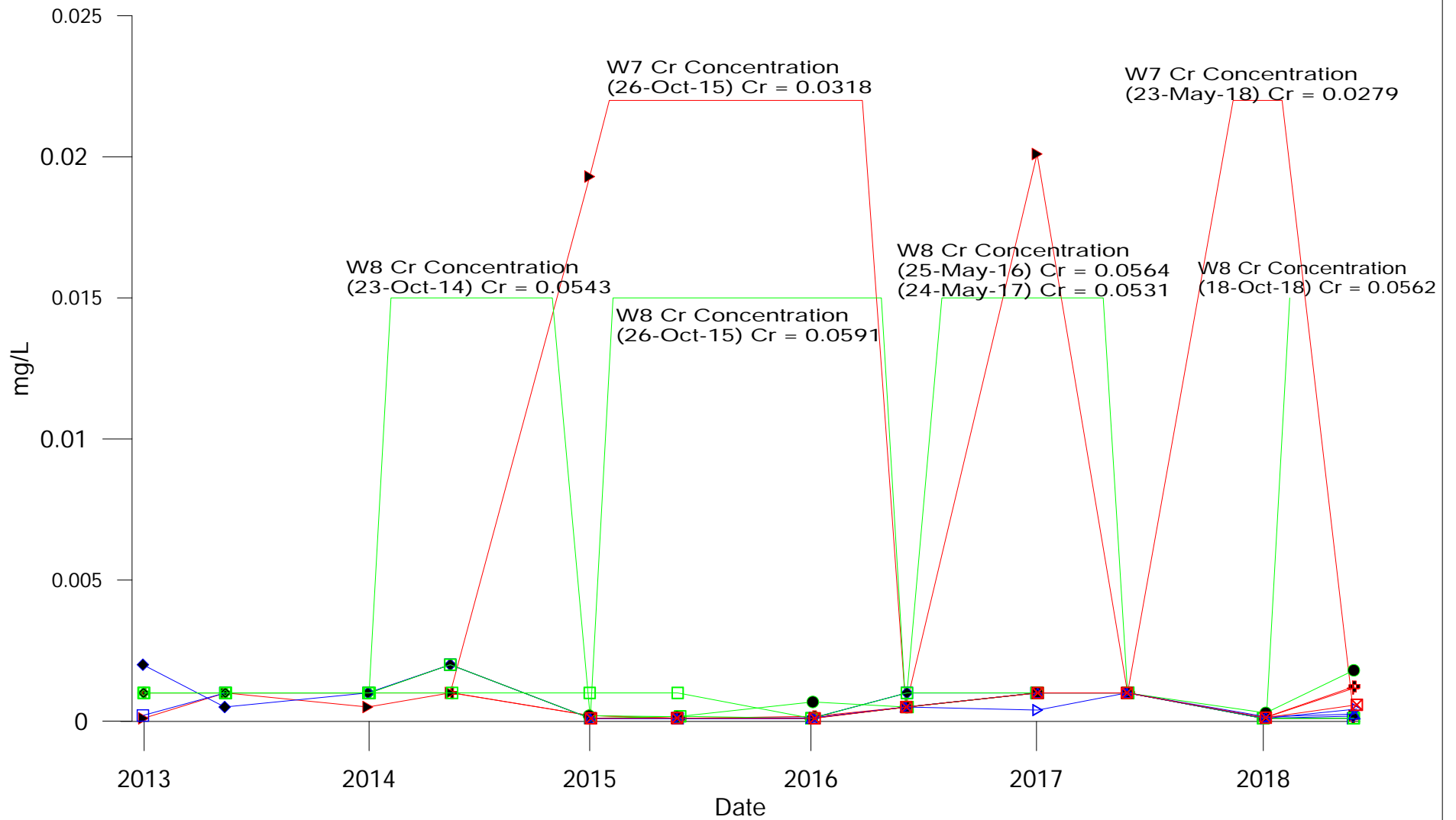
Barium MOE Criteria = 29 mg/L

	City of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Barium Concentration Bedrock Wells		
APRIL 2019	FIGURE 2	REV 0

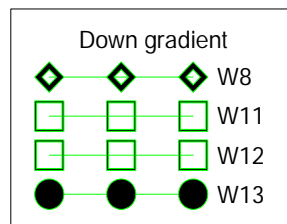
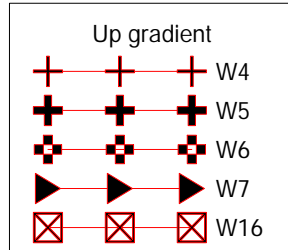
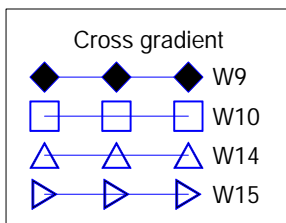


MOE Cobalt Criteria = 0.066 mg/L

	<p>City Of Winnipeg Solid Waste Services</p>	
	<p>BRADY ROAD RESOURCE MANAGEMENT FACILITY</p>	
<p>Dissolved Cobalt Concentration Bedrock Wells</p>		
<p>APRIL 2019</p>	<p>FIGURE 3</p>	<p>REV 0</p>



Chromium MOE Criteria = 0.81 mg/L



City Of Winnipeg
Solid Waste Services

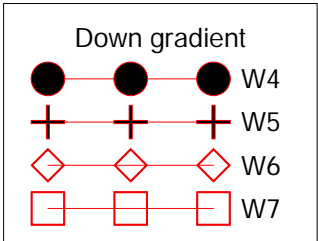
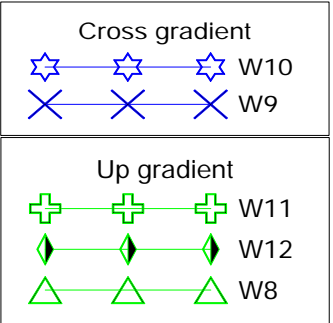
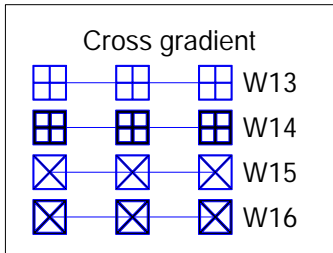
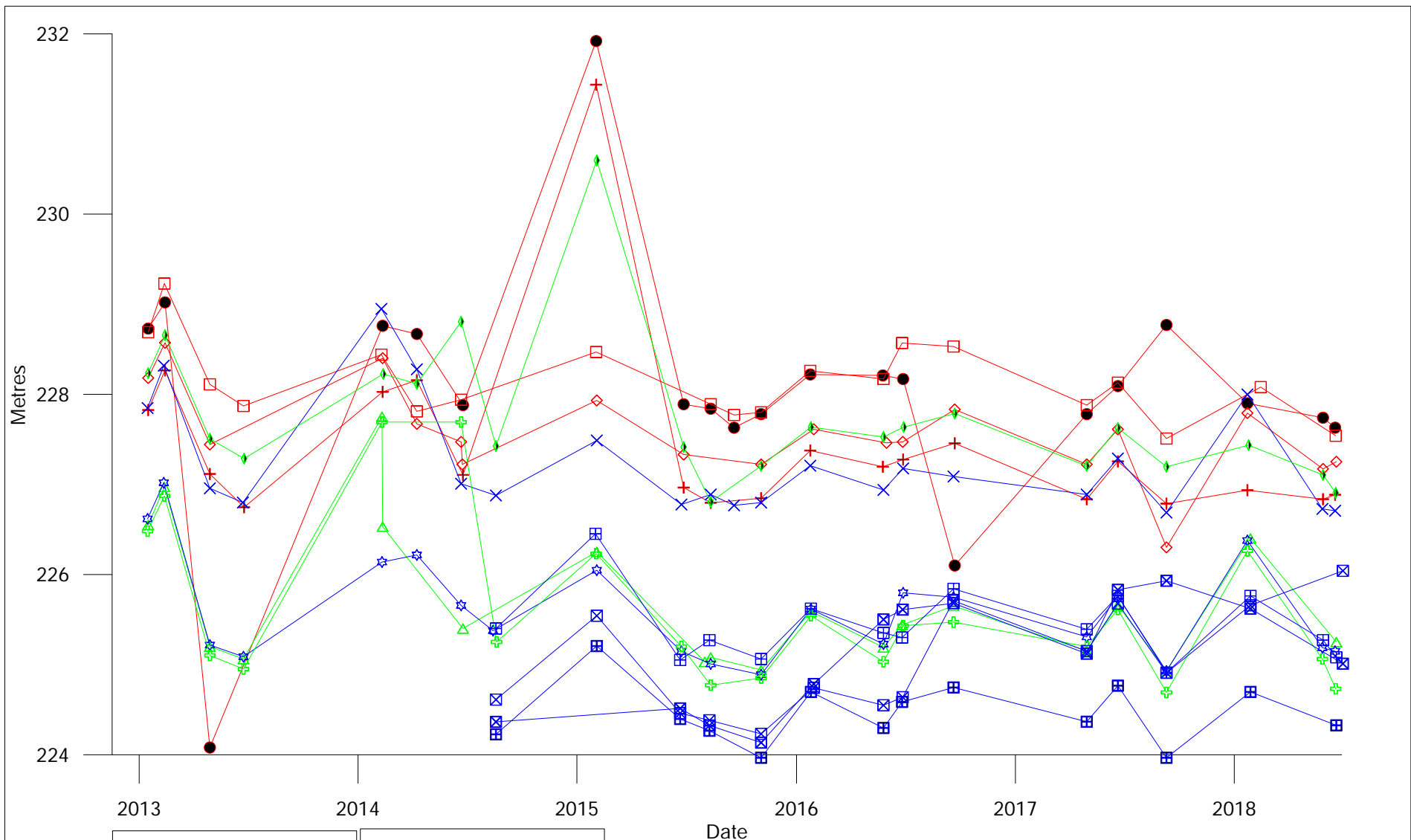
BRADY ROAD RESOURCE MANAGEMENT FACILITY

Dissolved Chromium Concentration
Bedrock Wells

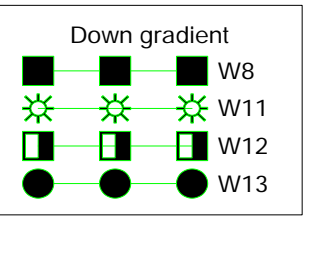
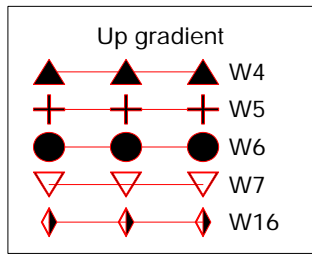
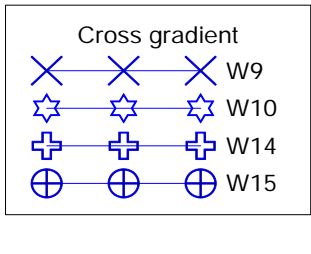
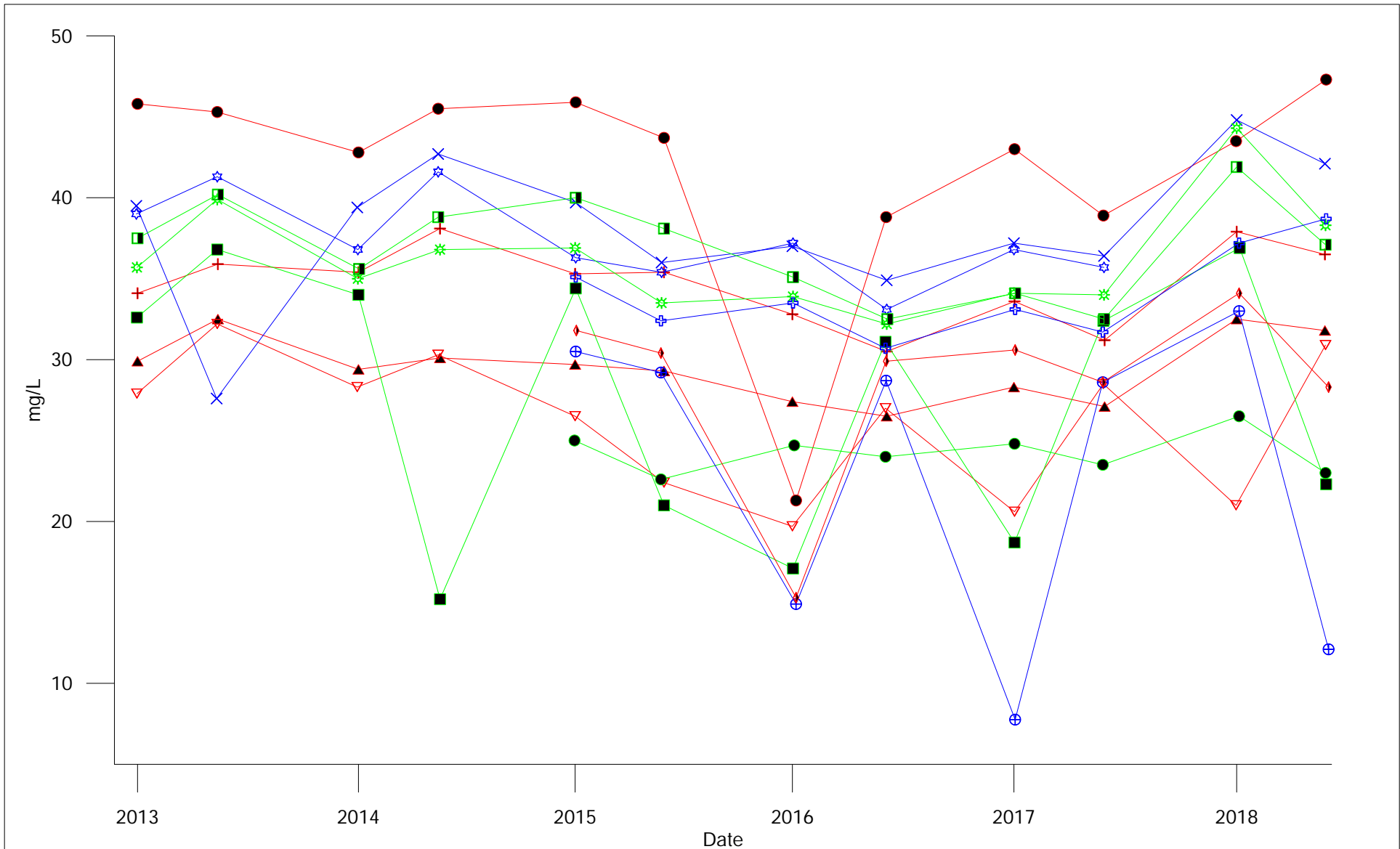
APRIL 2019

FIGURE 4

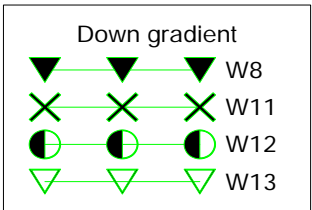
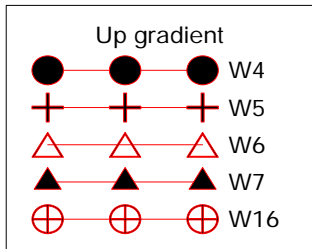
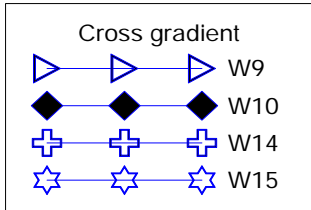
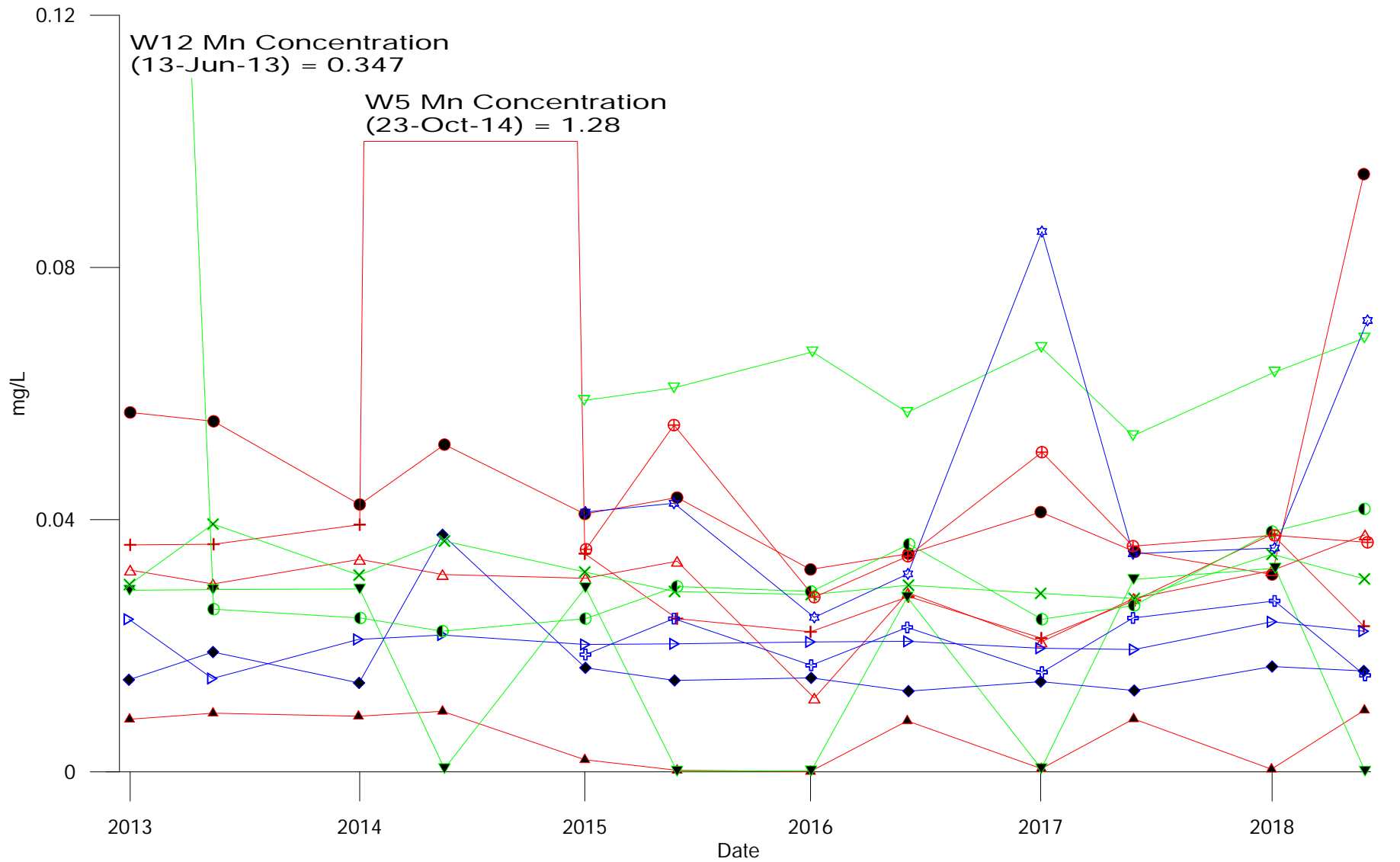
REV 0



	City of Winnipeg Solid Waste Services
	BRADY ROAD RESOURCE MANAGEMENT FACILITY GROUNDWATER ELEVATION Bedrock Wells
APRIL 2019	FIGURE GW-2 REV 0



	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Potassium Concentration Bedrock Wells		
APRIL 2019	FIGURE 5	REV 0



City Of Winnipeg
Solid Waste Services

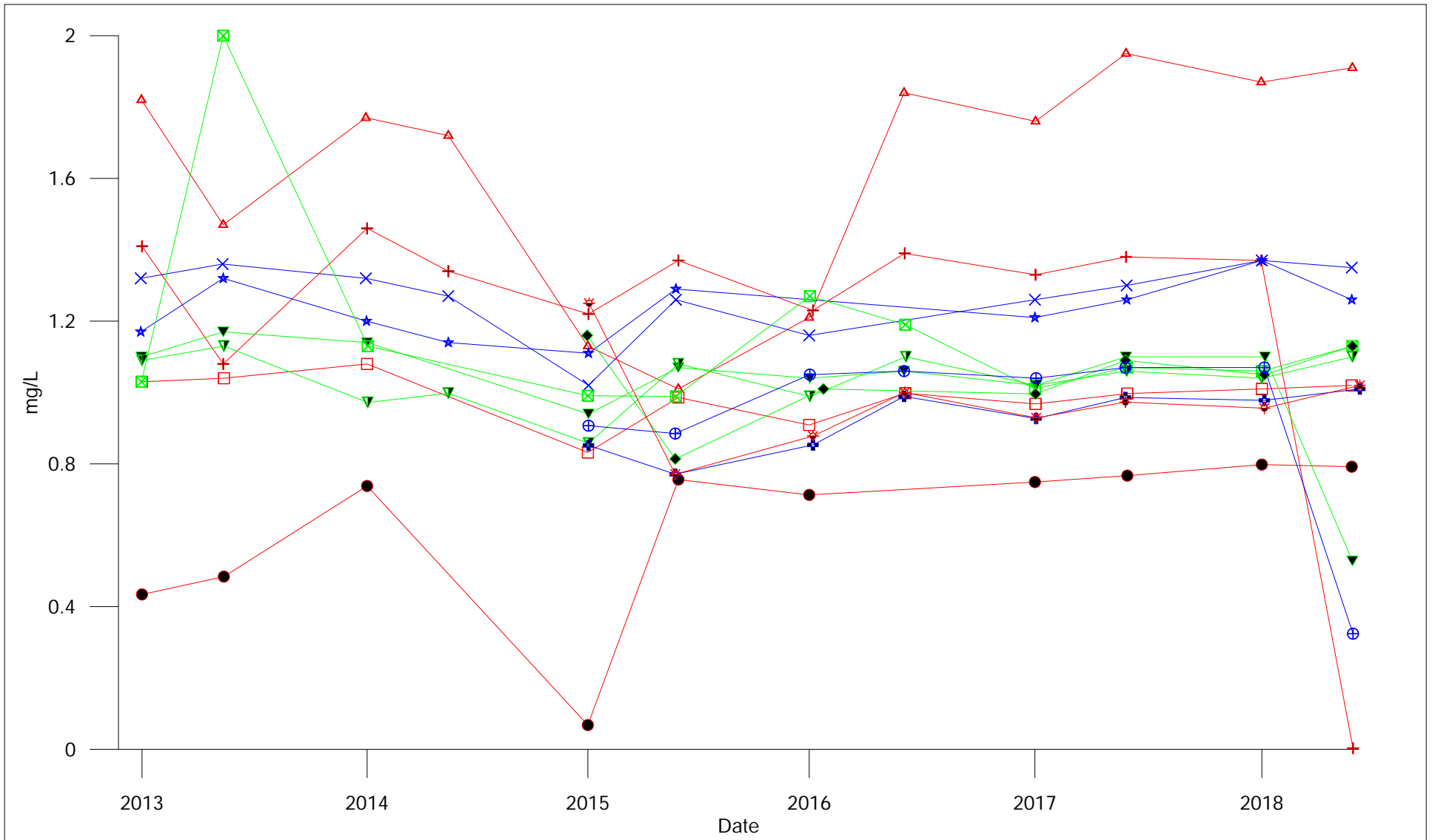
BRADY ROAD RESOURCE MANAGEMENT FACILITY

Dissolved Manganese Concentration
Bedrock Wells

APRIL 2019

FIGURE 7

REV 0



Cross gradient

- W9
- W10
- W14
- W15

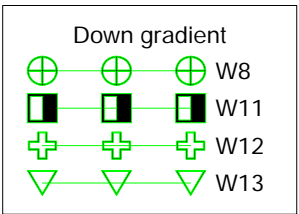
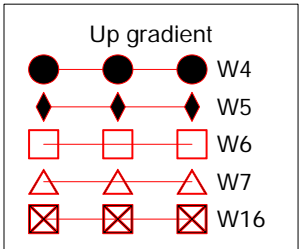
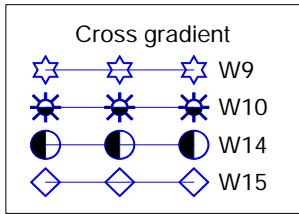
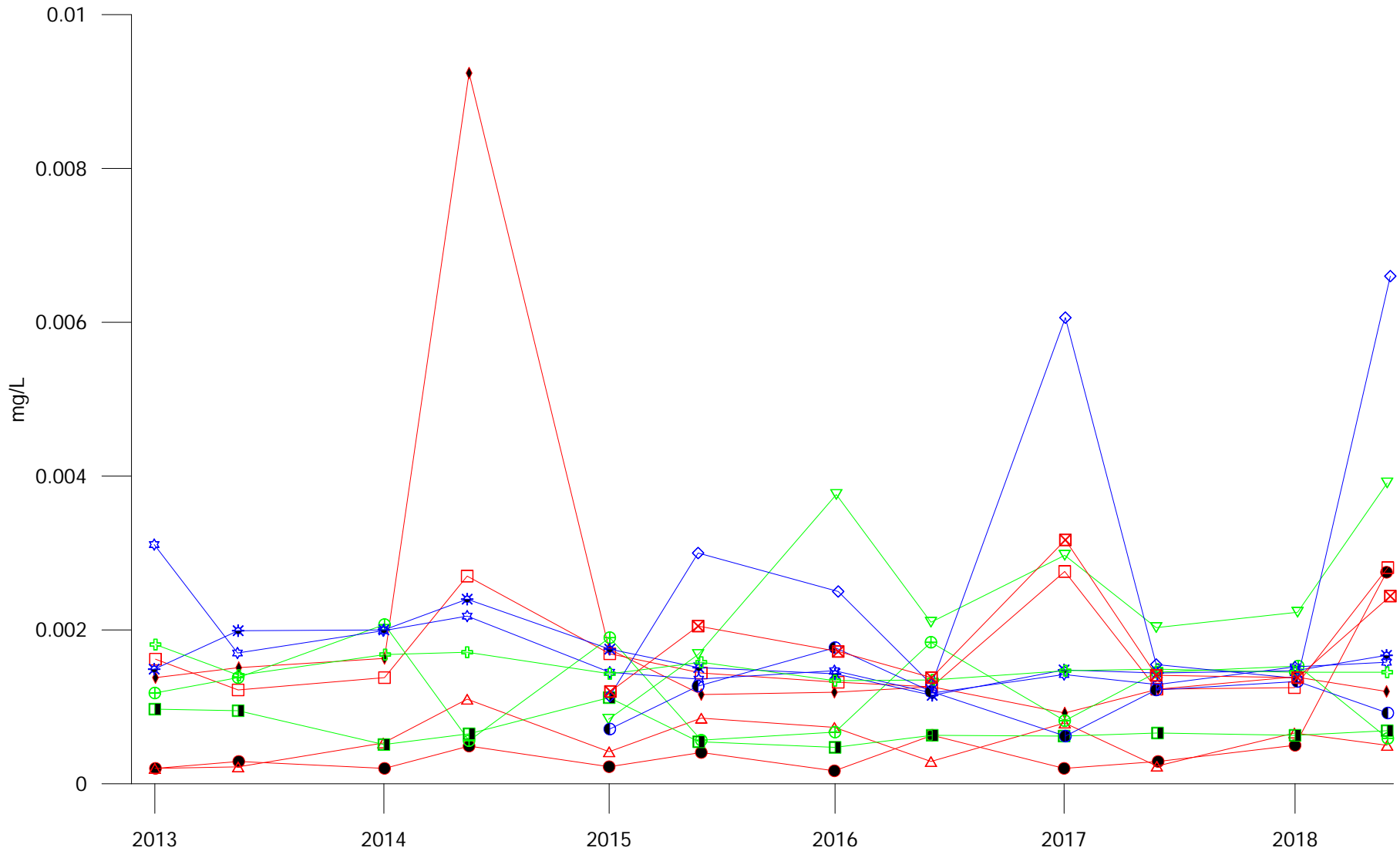
Up gradient

- W4
- W5
- W6
- W7
- W16

Down gradient

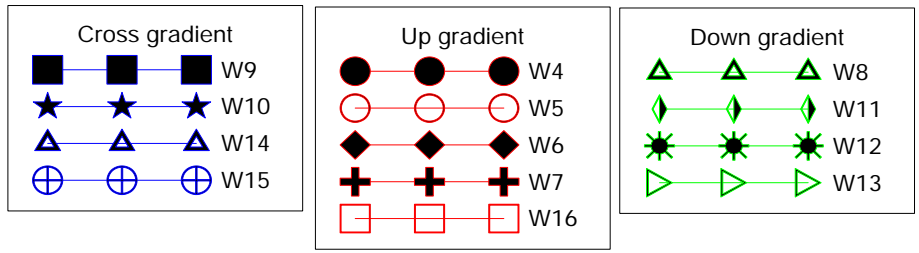
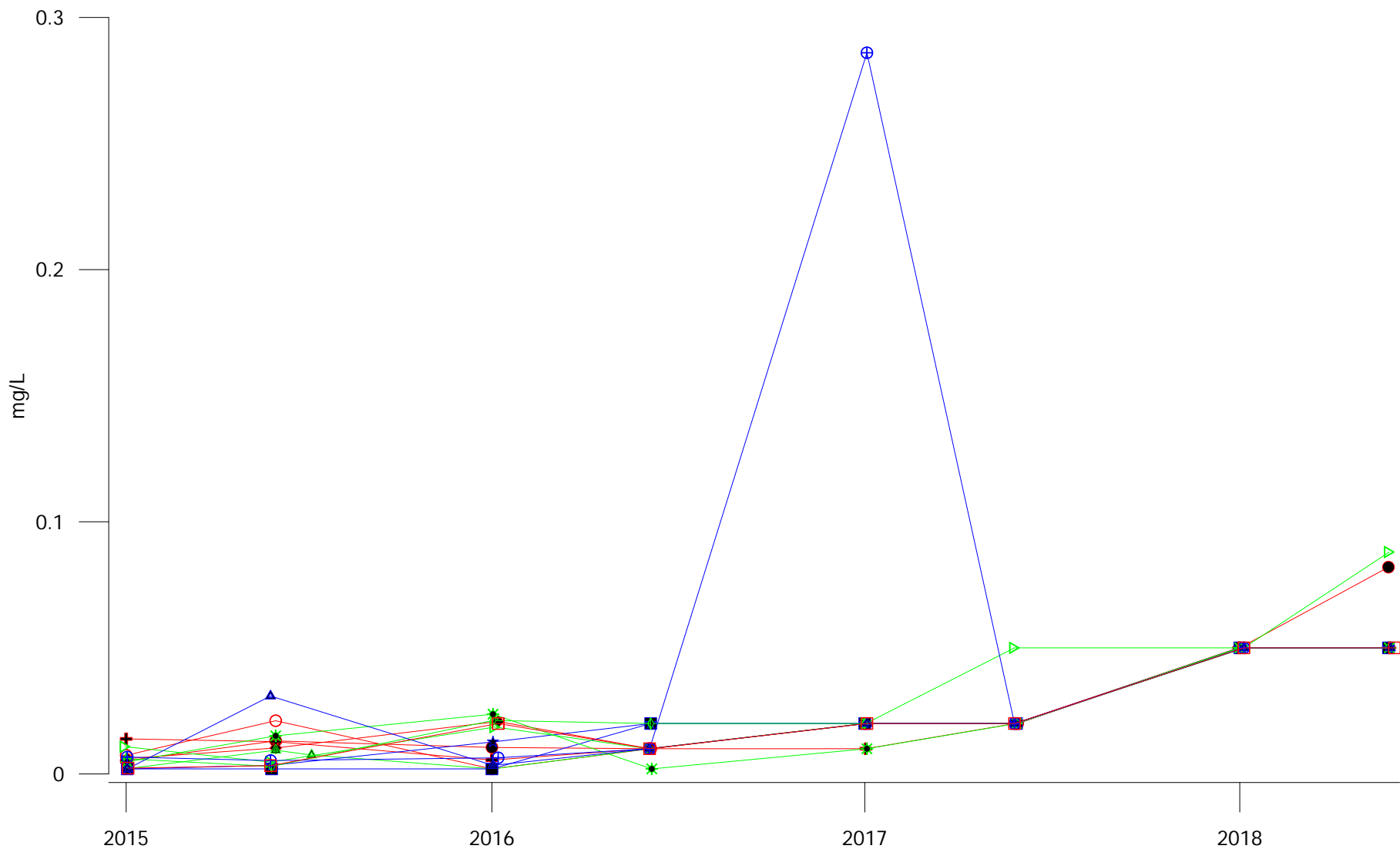
- W8
- W11
- W12
- W13

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Ammonia Concentration Bedrock Wells		
APRIL 2019	FIGURE 8	REV 0

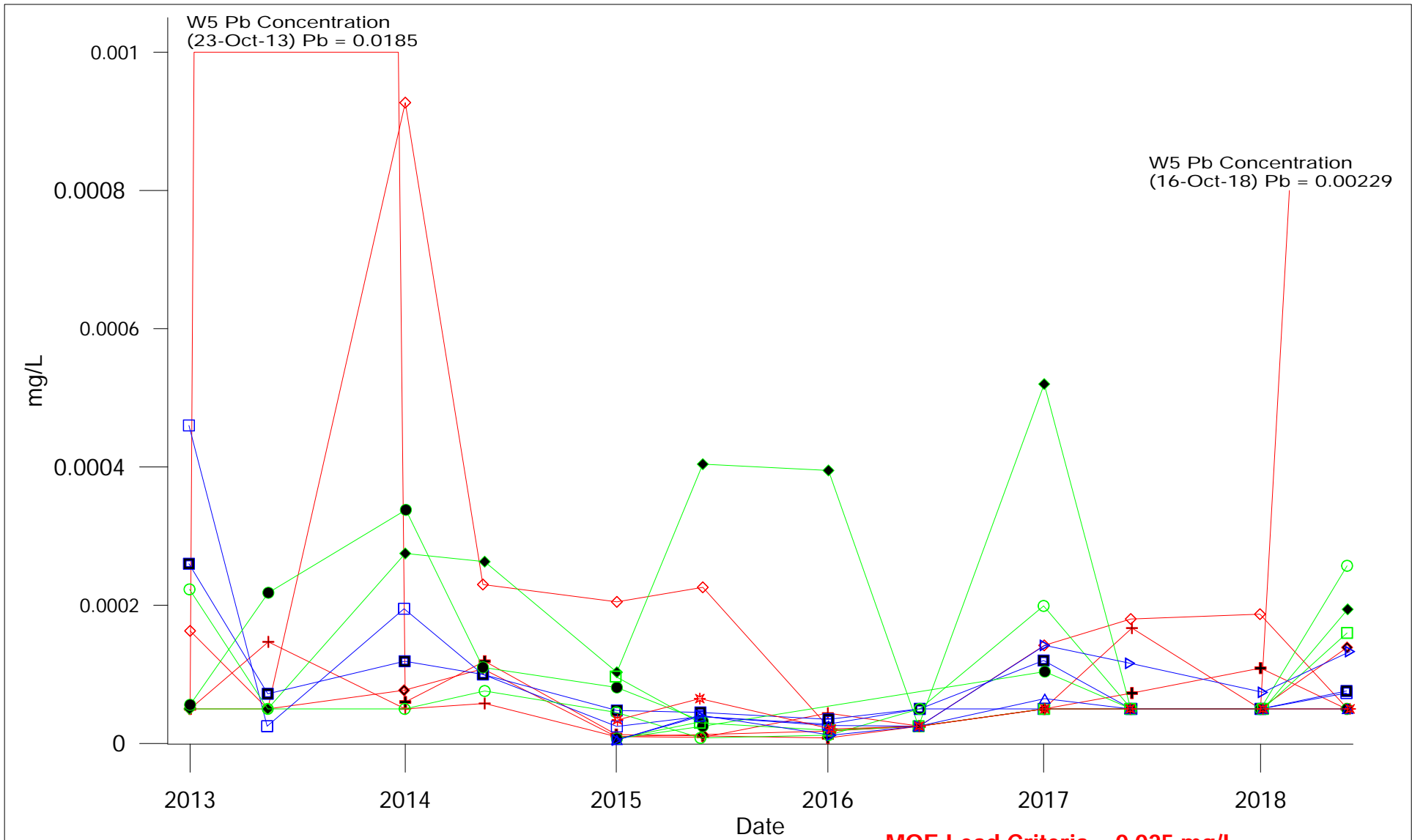


MOE Nickel Criteria = 0.49 mg/L

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Nickel Concentration Bedrock Wells		
APRIL 2019	FIGURE 9	REV 0



	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Phosphorus Concentration Bedrock Wells		
APRIL 2019	FIGURE 10	REV 0



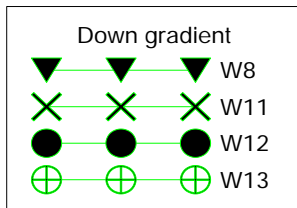
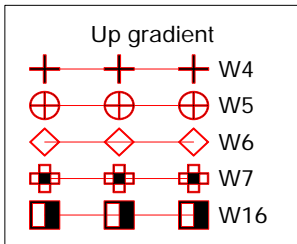
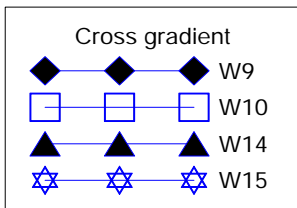
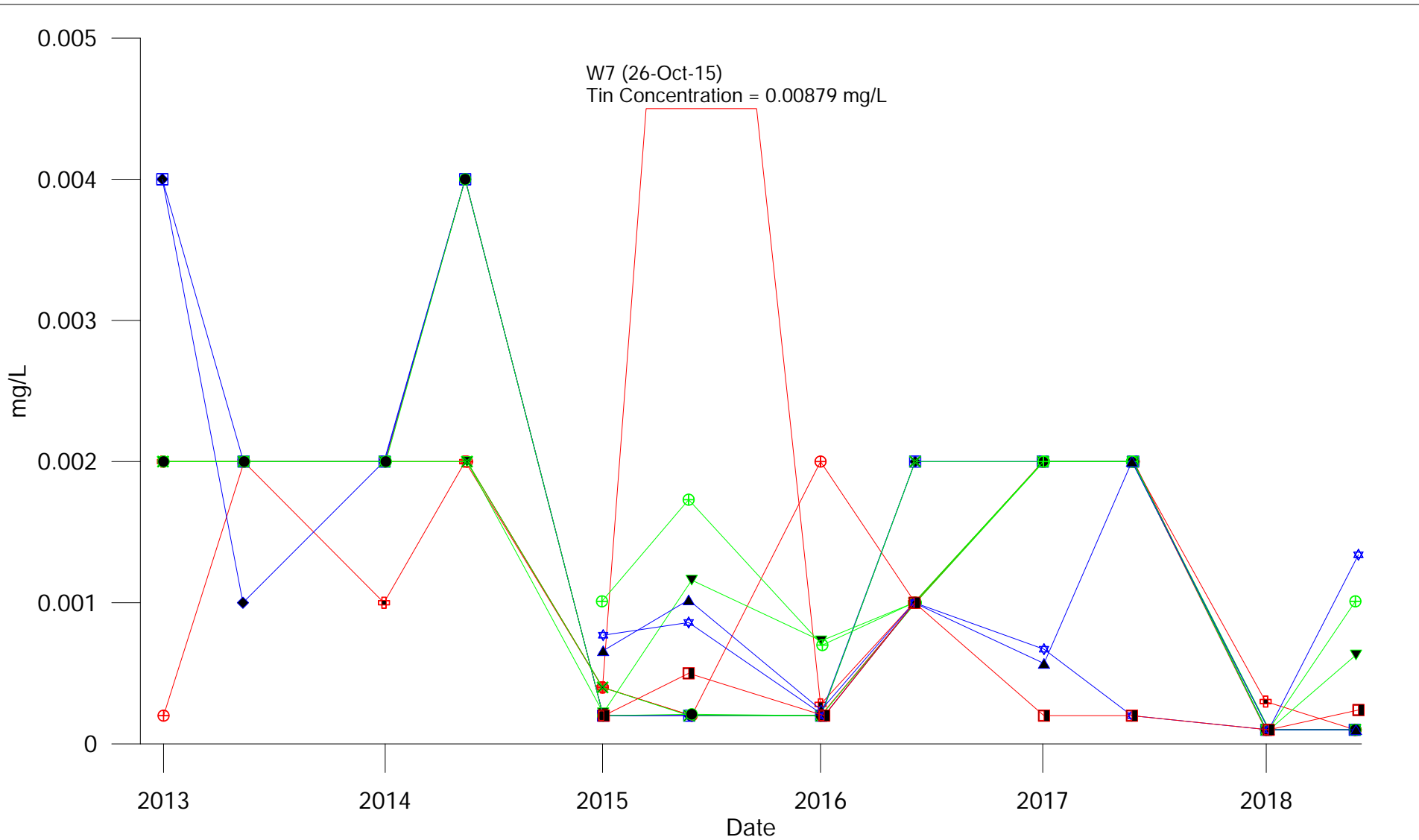
Cross Gradient	
□	W9
■	W10
△	W14
▷	W15

Up gradient	
+	W4
+	W5
◇	W6
◇	W7
*	W16

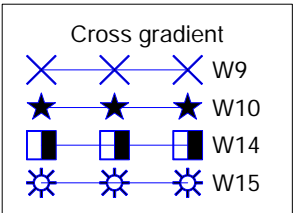
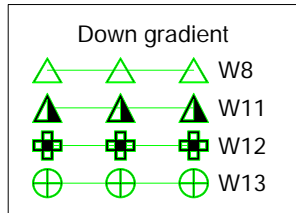
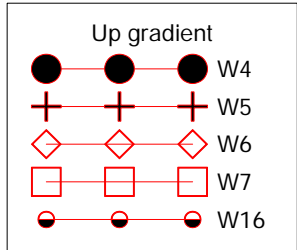
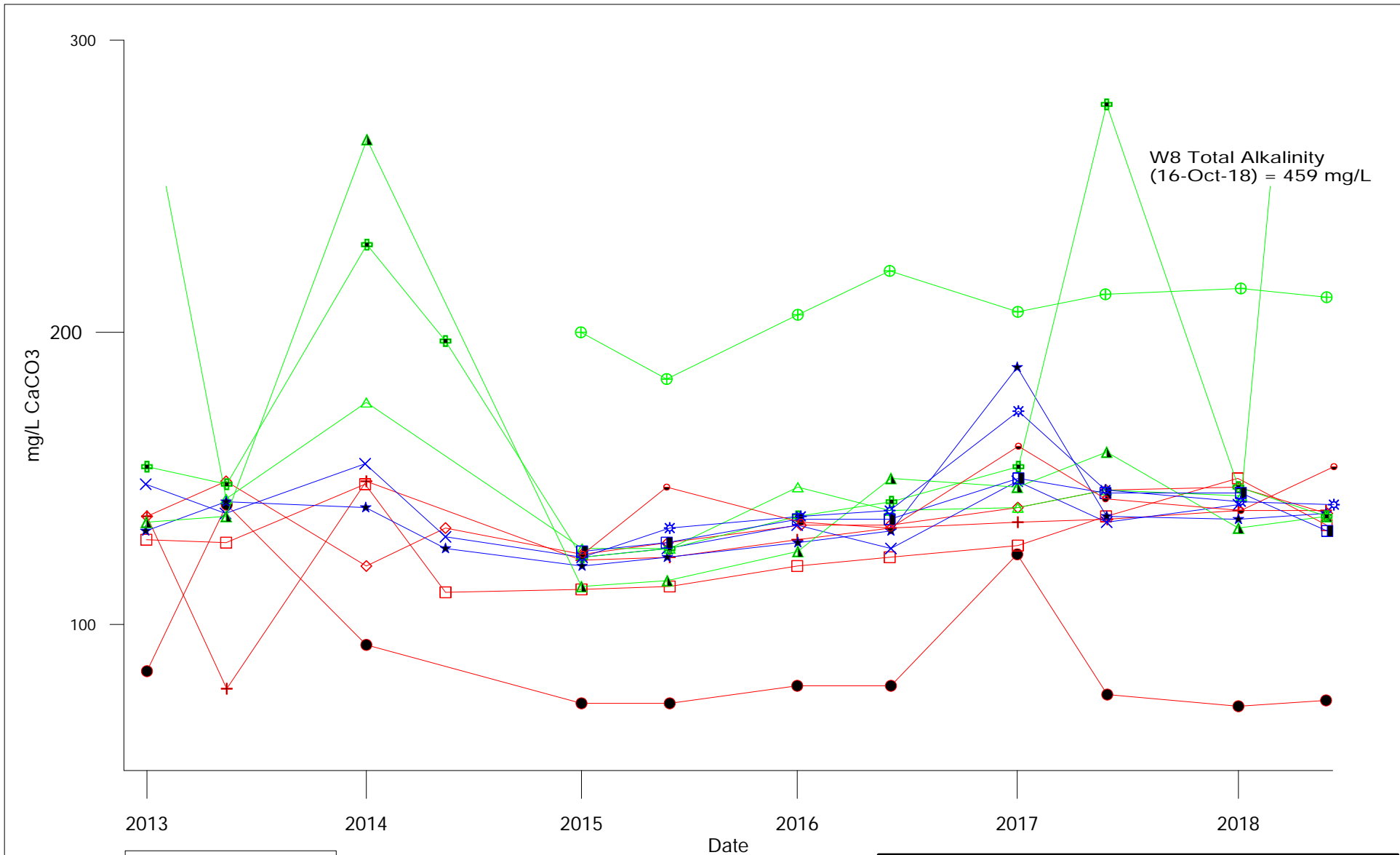
Down Gradient	
◆	W8
○	W11
●	W12
□	W13

MOE Lead Criteria = 0.025 mg/L

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Lead Concentration Bedrock Wells		
APRIL 2019	FIGURE 6	REV 0



	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Tin Concentration Bedrock Wells		
APRIL 2019	FIGURE 11	REV 0



City Of Winnipeg
Solid Waste Services

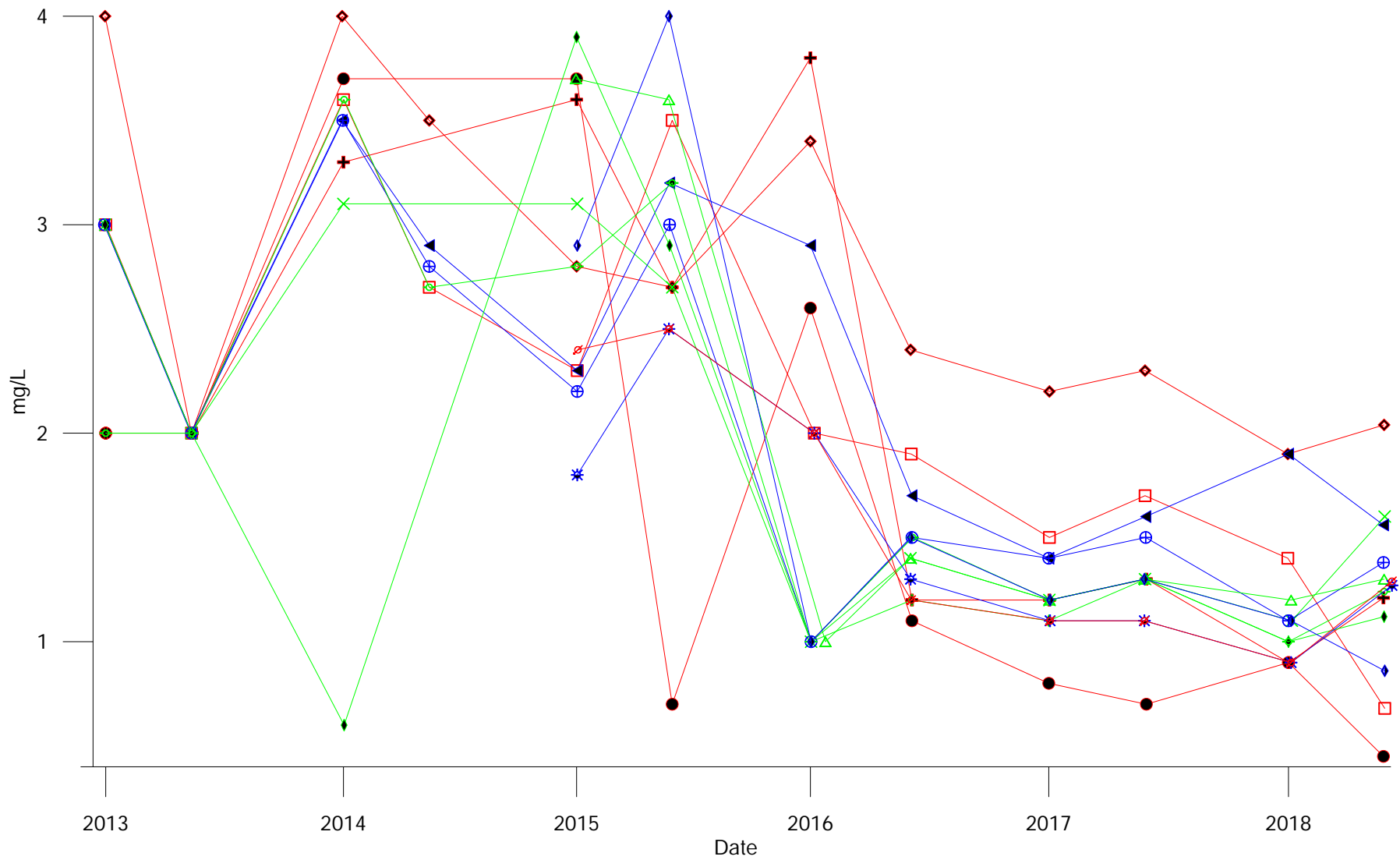
BRADY ROAD RESOURCE MANAGEMENT FACILITY

**Total Alkalinity
Bedrock Wells**

APRIL 2019

FIGURE 12

REV 0



Cross gradient

- ◀◀◀ W9
- ⊕⊕⊕ W10
- ◊◊◊ W14
- ⊛⊛⊛ W15

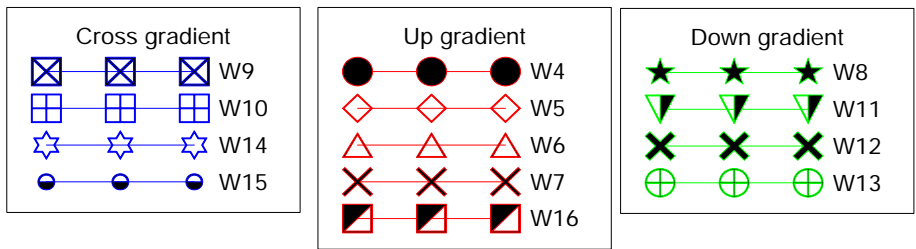
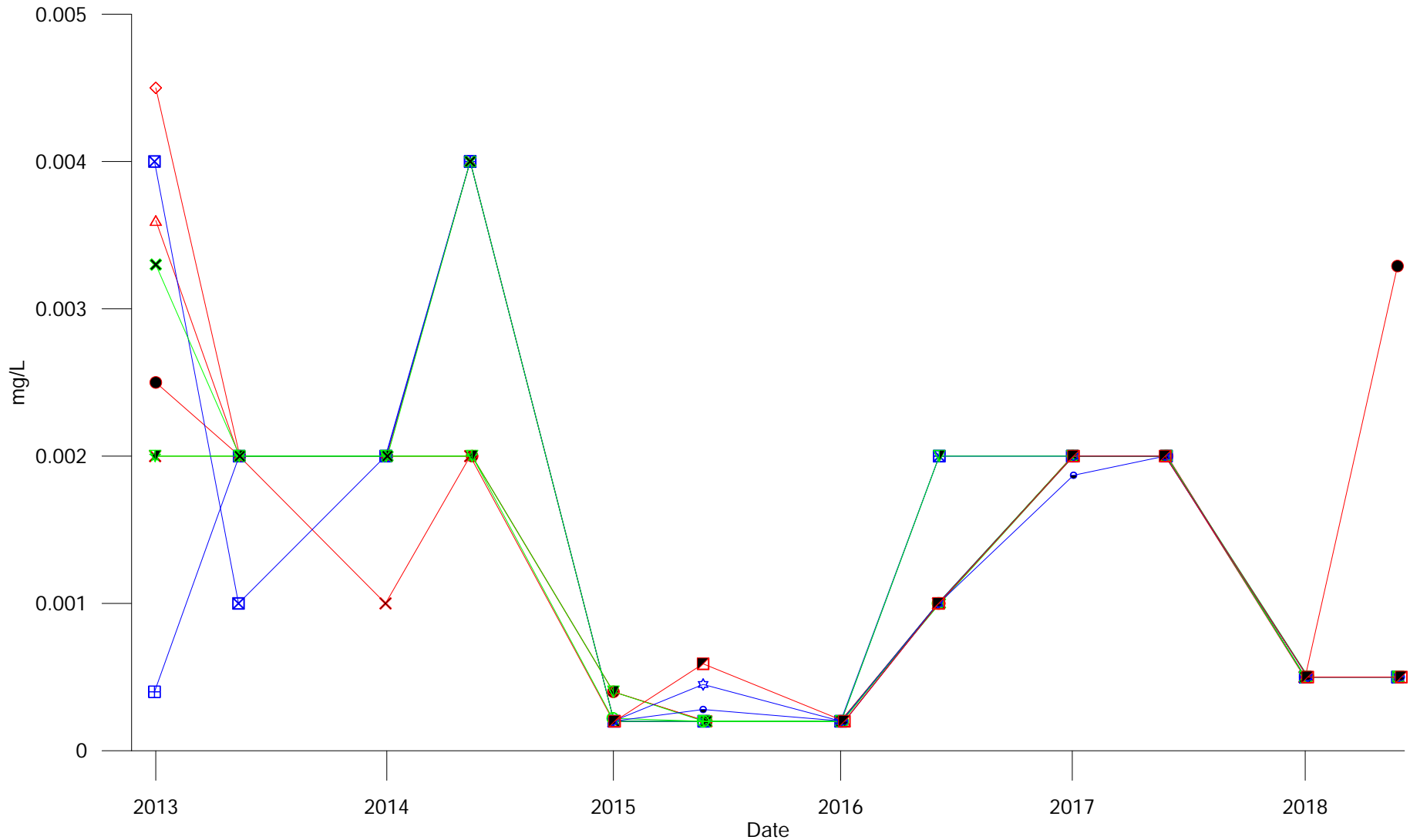
Up gradient

- W4
- ⊕⊕⊕ W5
- ◻◻◻ W6
- ◊◊◊ W7
- ⊘⊘⊘ W16

Down gradient

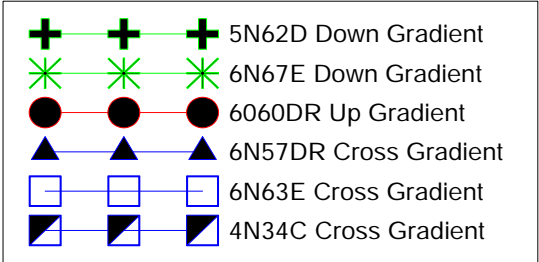
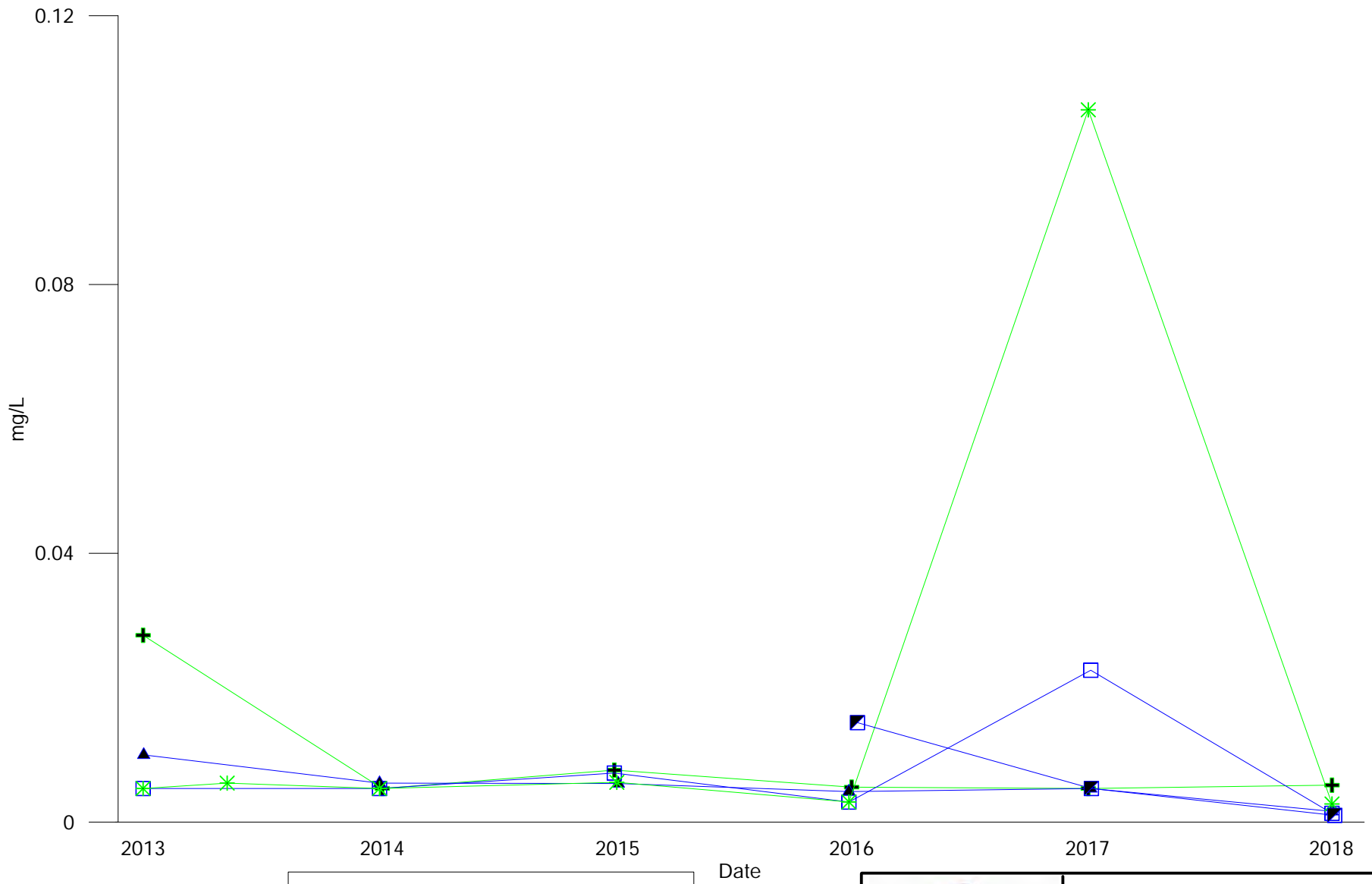
- ××× W8
- ◆◆◆ W11
- W12
- △△△ W13

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
TKN Concentration Bedrock Wells		
APRIL 2019	FIGURE 12	REV 0

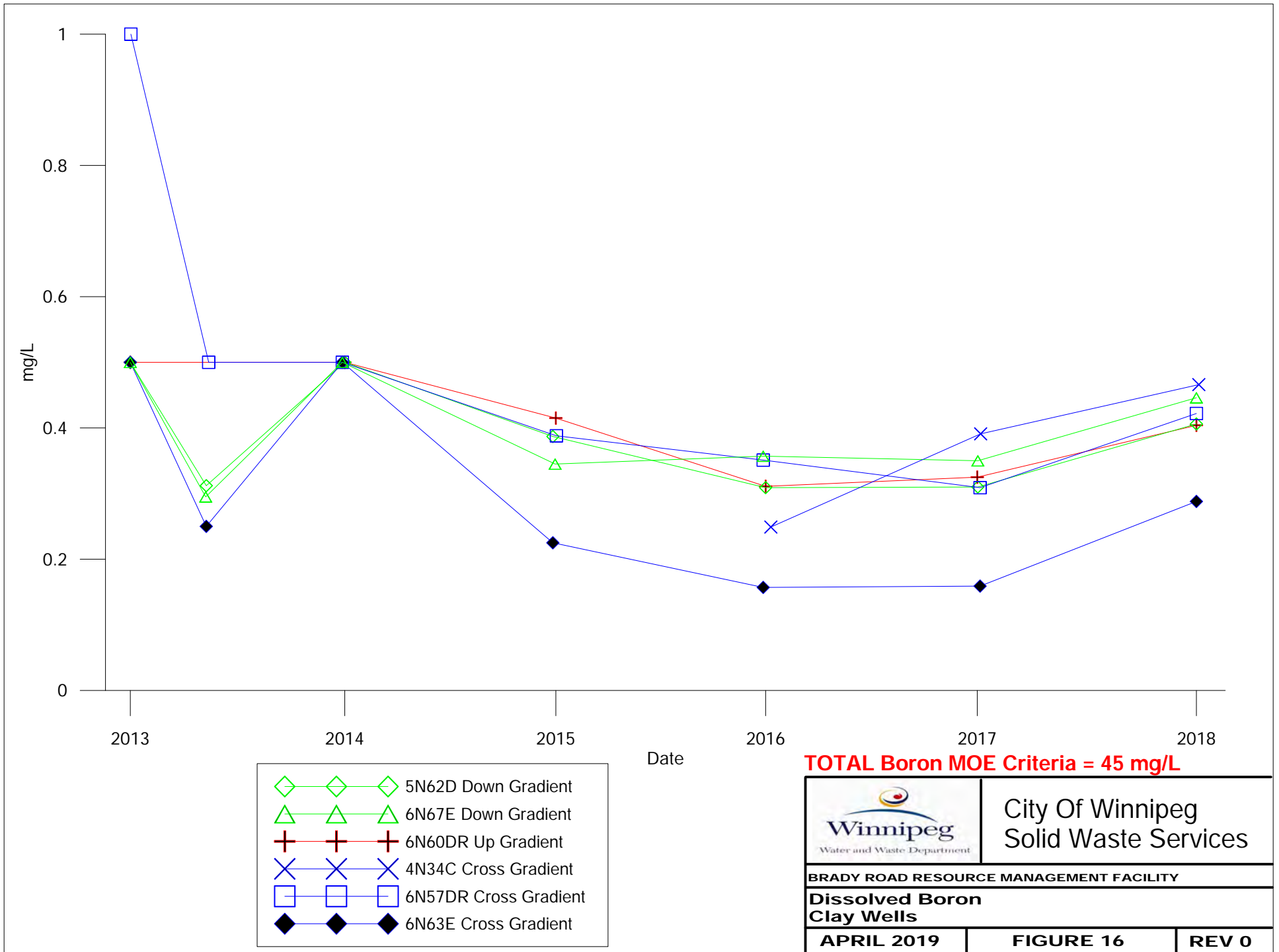


Vanadium MOE Criteria = 0.25 mg/L

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Vanadium Bedrock Wells		
APRIL 2019	FIGURE 13	REV 0



	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Aluminium Clay Wells		
APRIL 2019	FIGURE 15	REV 0



TOTAL Boron MOE Criteria = 45 mg/L



City Of Winnipeg
Solid Waste Services

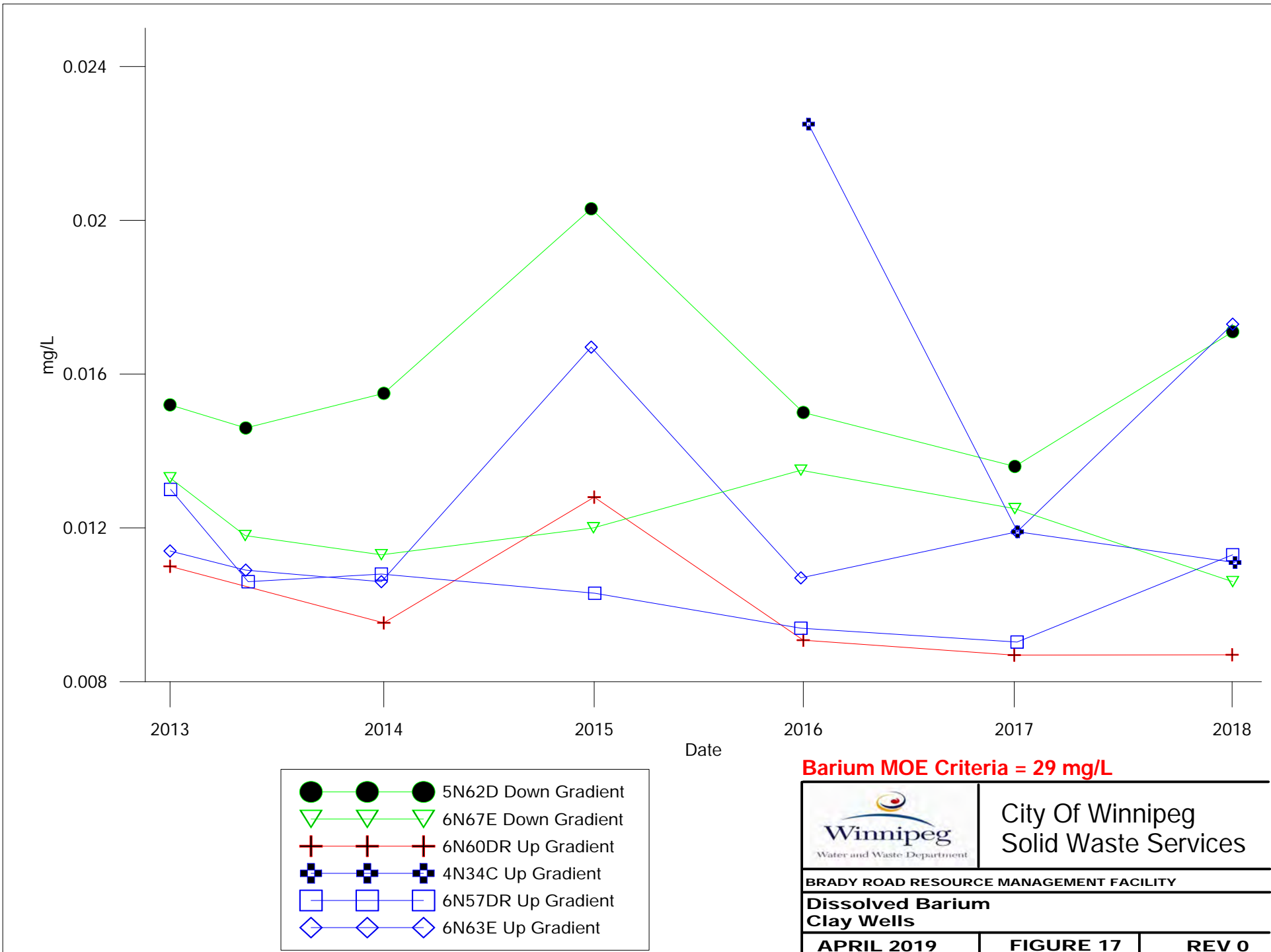
BRADY ROAD RESOURCE MANAGEMENT FACILITY

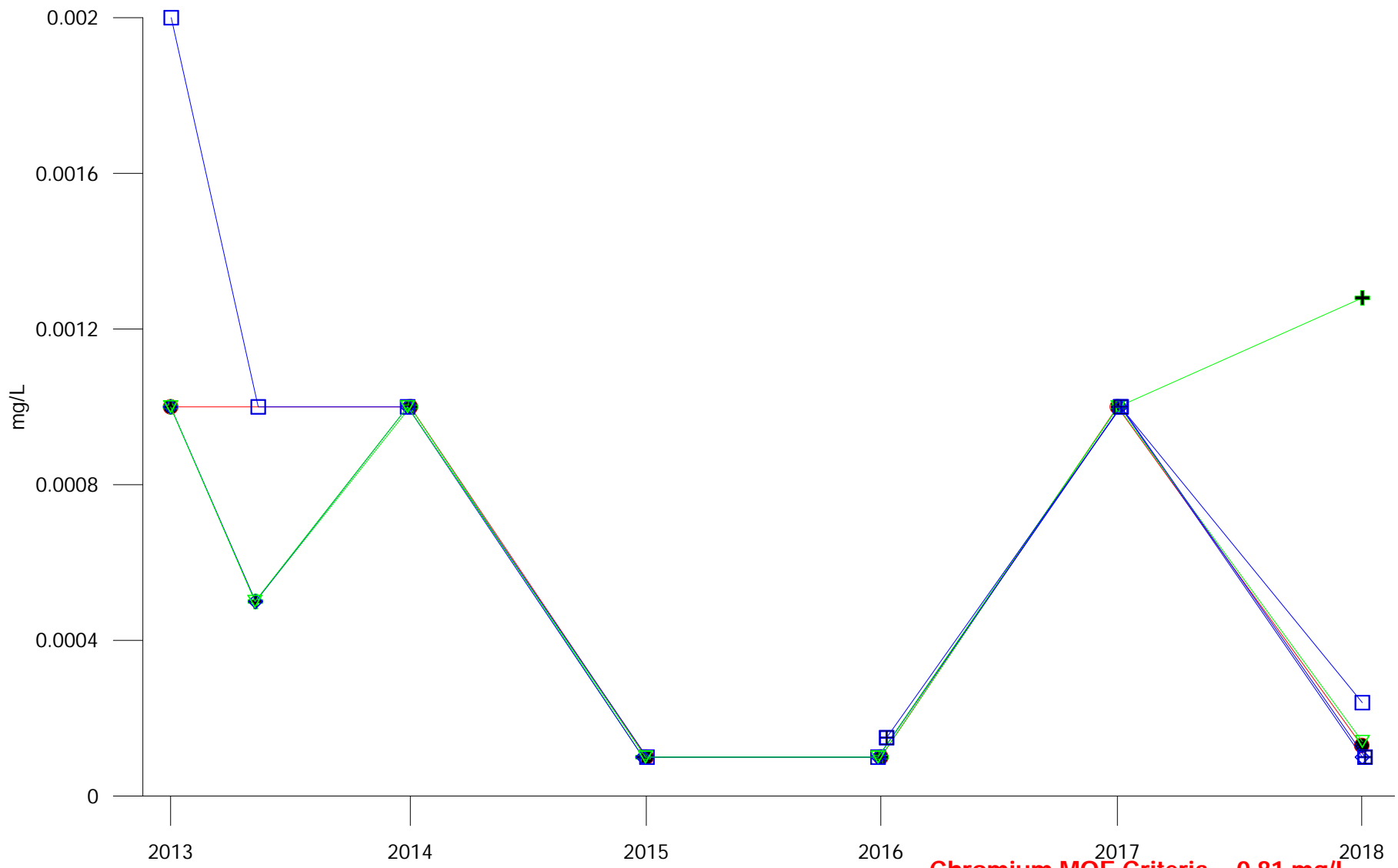
Dissolved Boron
Clay Wells

APRIL 2019

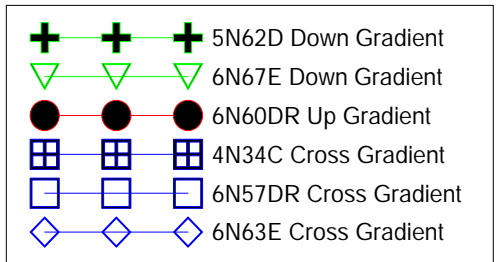
FIGURE 16

REV 0

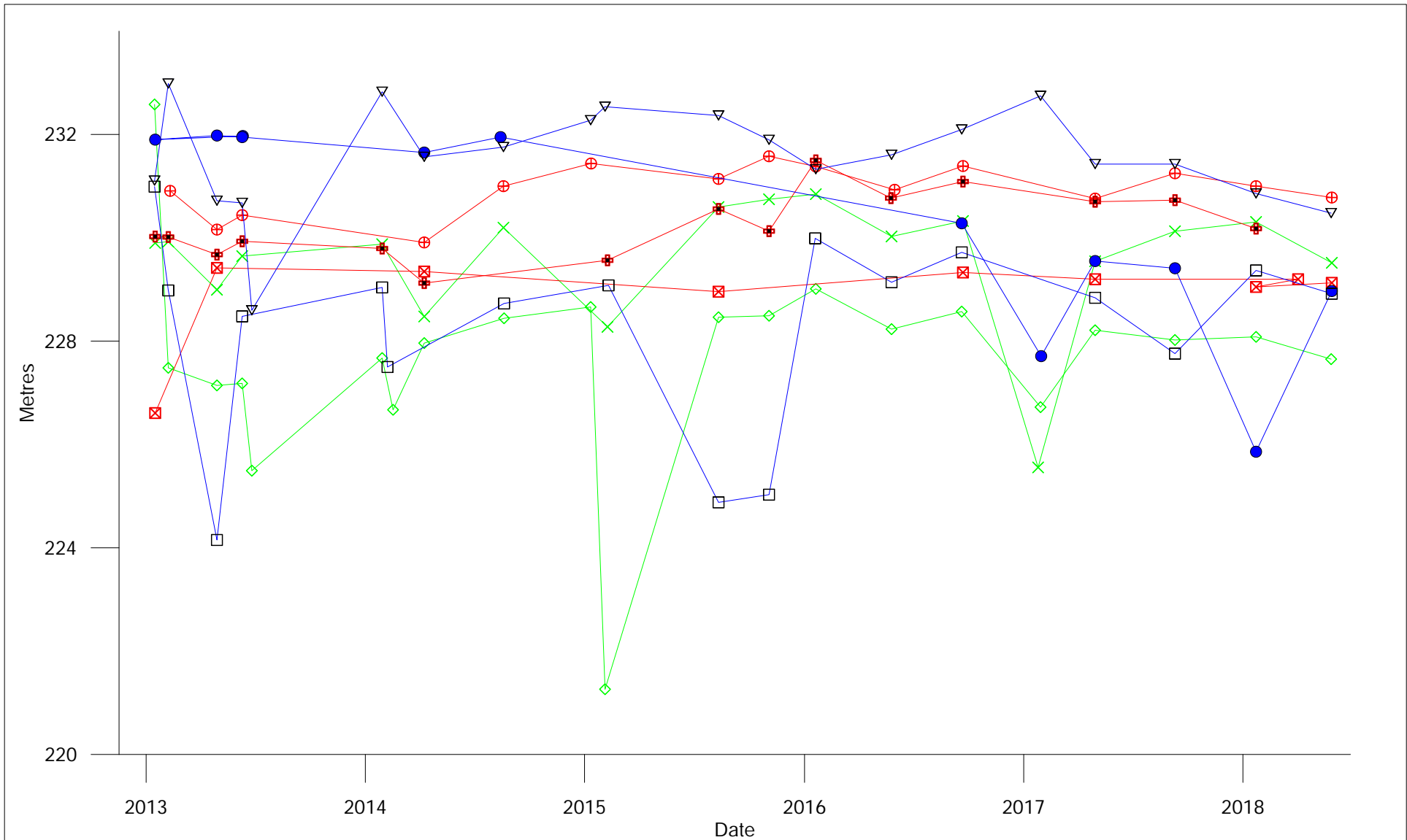




Chromium MOE Criteria = 0.81 mg/L



	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Chromium Clay Wells		
APRIL 2019	FIGURE 18	REV 0



Down gradient

- 5N62D
- 6N67E

Cross gradient

- 4N34CR
- 6N57DR
- 6N63E

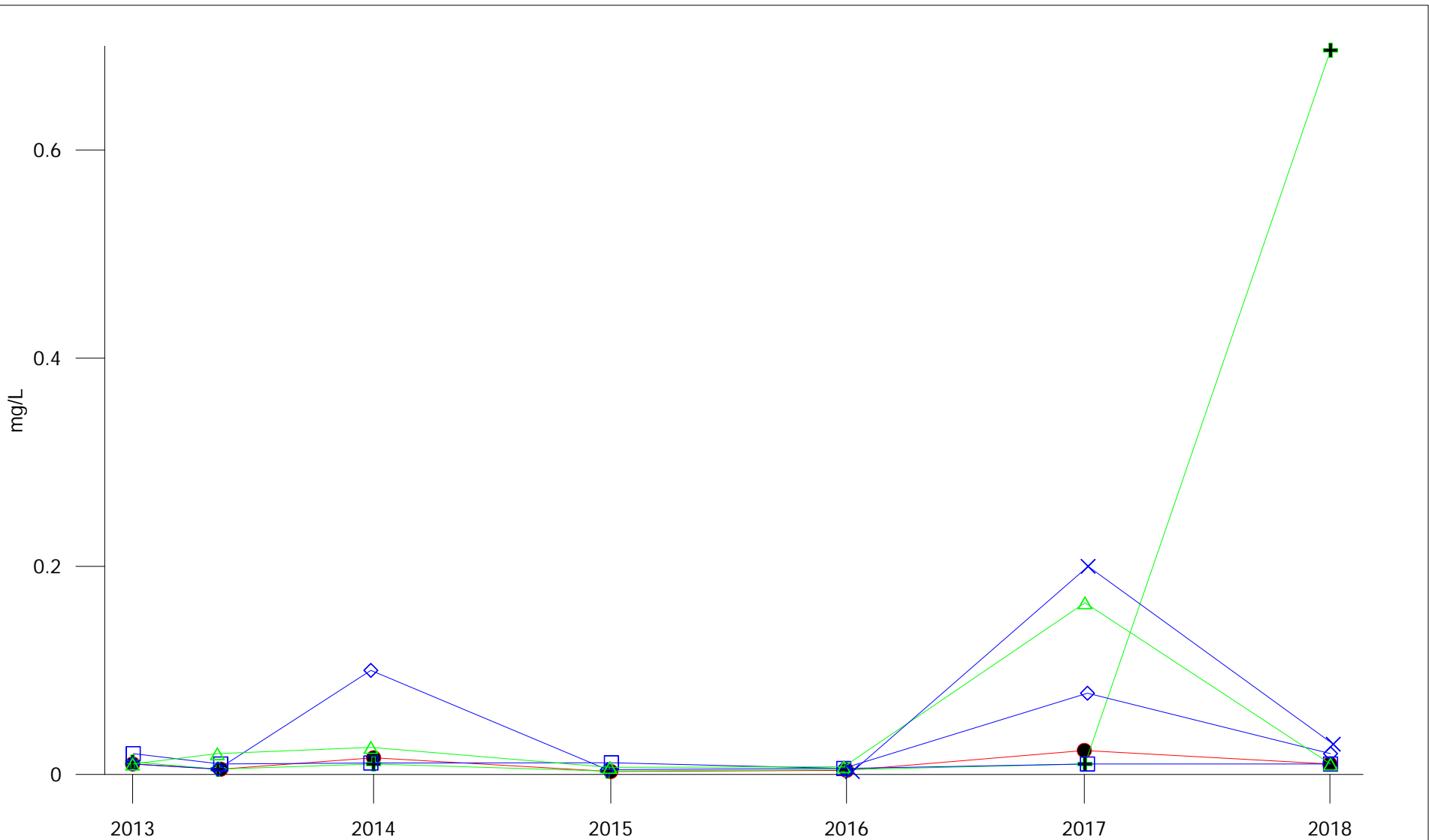
Up gradient

- 6N58DR
- 6N59DR
- 6N60DR




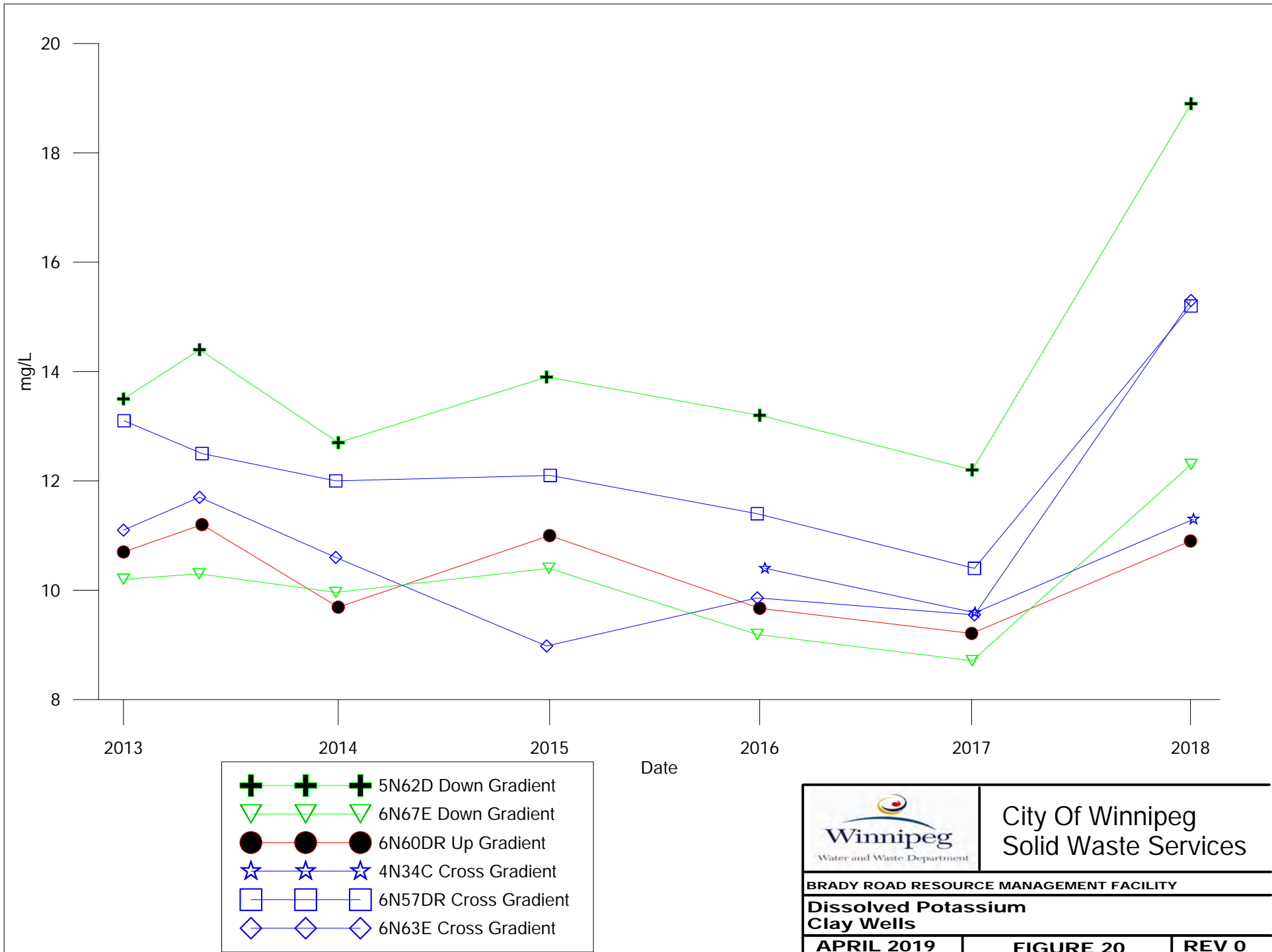
City Of Winnipeg
Solid Waste Services

BRADY ROAD RESOURCE MANAGEMENT FACILITY
**GROUNDWATER ELEVATIONS
 CLAY WELLS**
 APRIL 2019 | FIGURE GW-3-1 REV 0



- + + + 5N62D Down Gradient
- △ △ △ 6N67E Down Gradient
- ● ● 6N60DR Up Gradient
- × × × 4N34C Up Gradient
- □ □ 6N57DR Up Gradient
- ◇ ◇ ◇ 6N63E Up Gradient

	City Of Winnipeg Solid Waste Services
BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Iron Clay Wells	
APRIL 2019	FIGURE 19
REV 0	

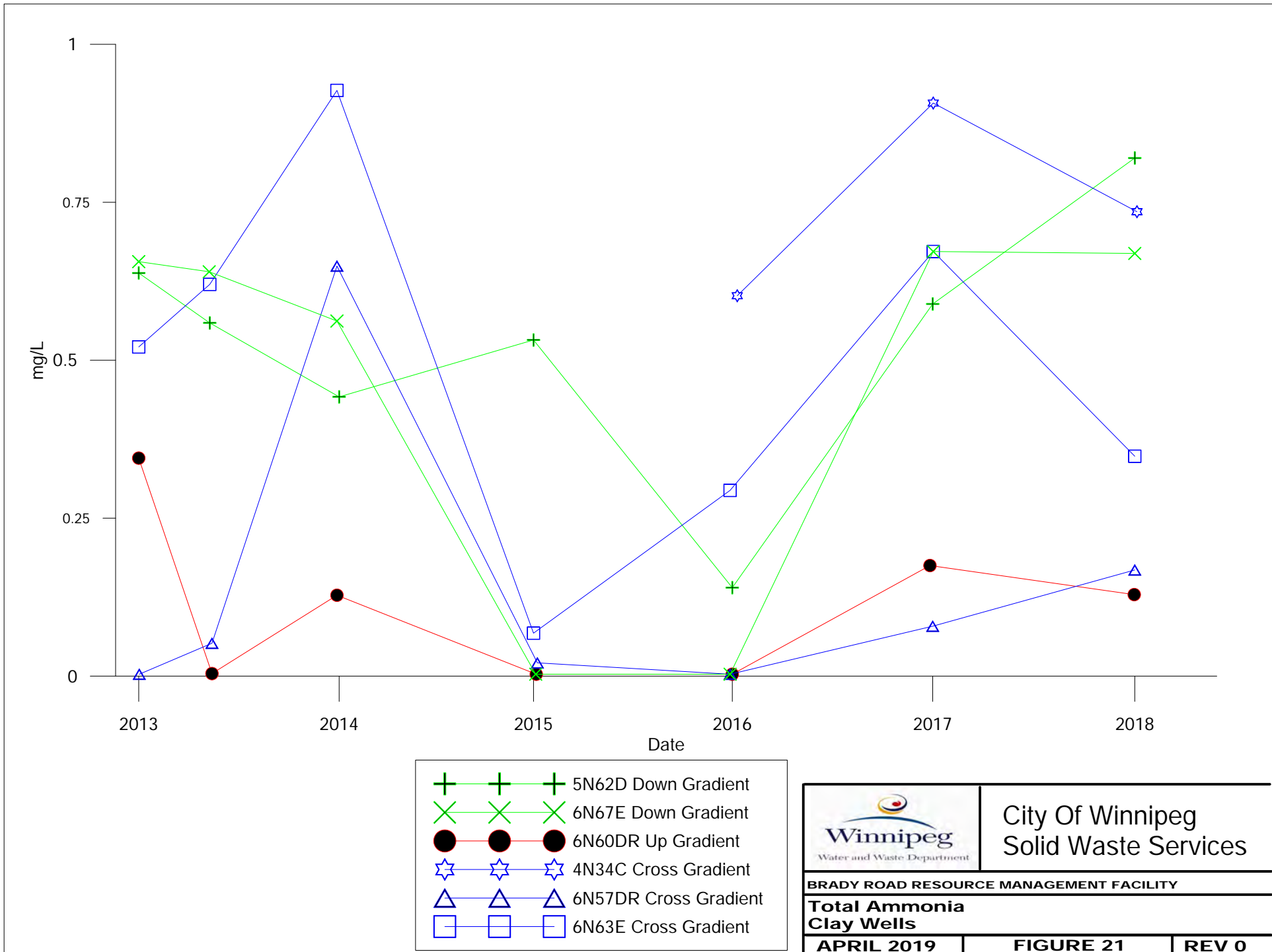


City Of Winnipeg
Solid Waste Services

BRADY ROAD RESOURCE MANAGEMENT FACILITY

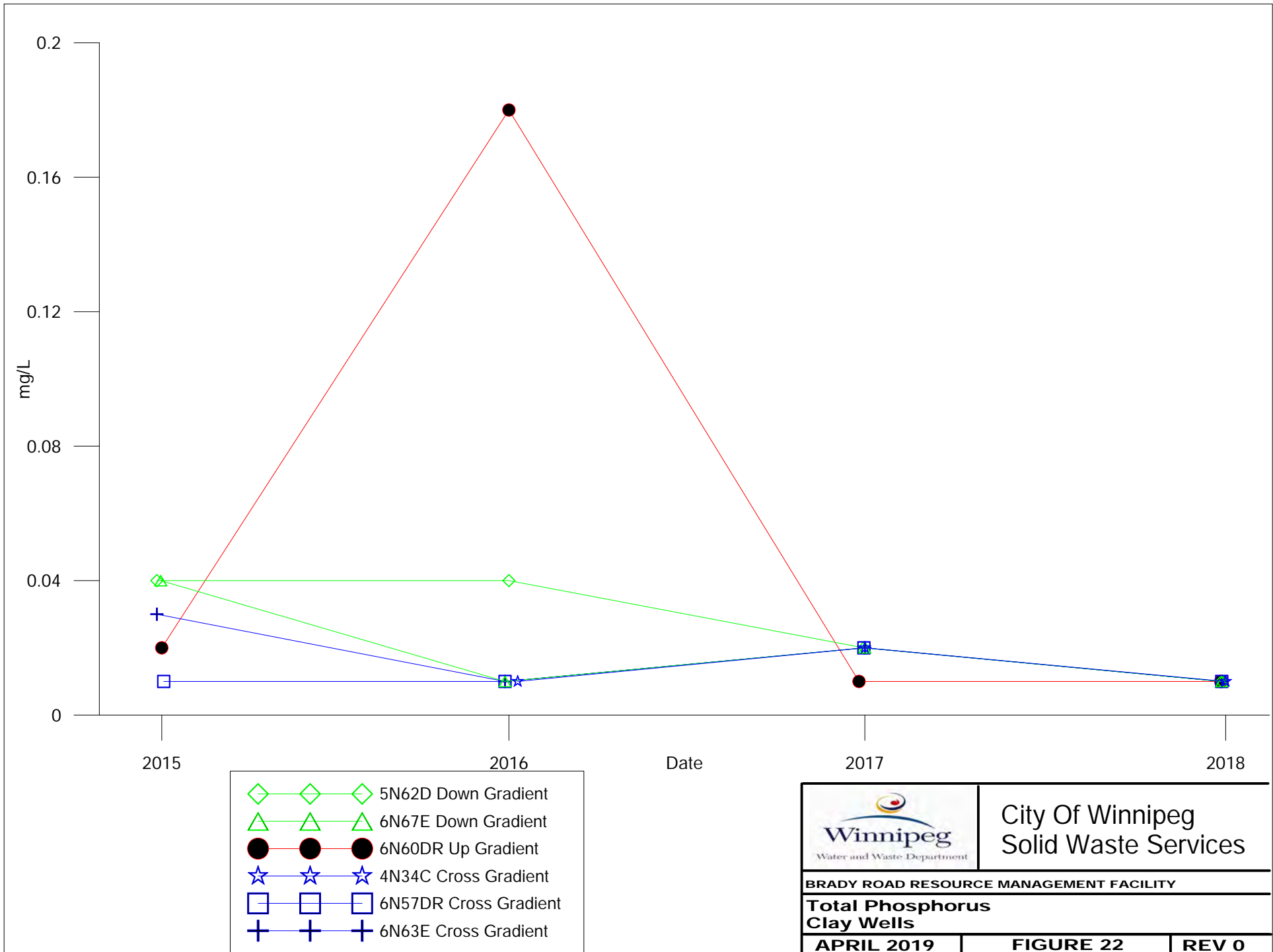
**Dissolved Potassium
Clay Wells**

APRIL 2019 FIGURE 20 REV 0



City Of Winnipeg
Solid Waste Services

BRADY ROAD RESOURCE MANAGEMENT FACILITY		
Total Ammonia Clay Wells		
APRIL 2019	FIGURE 21	REV 0

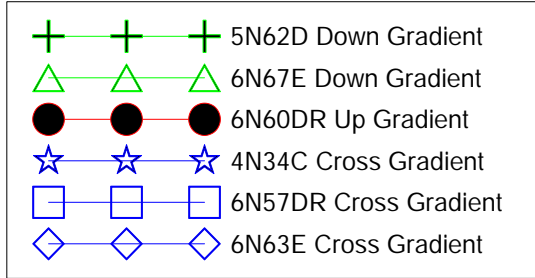
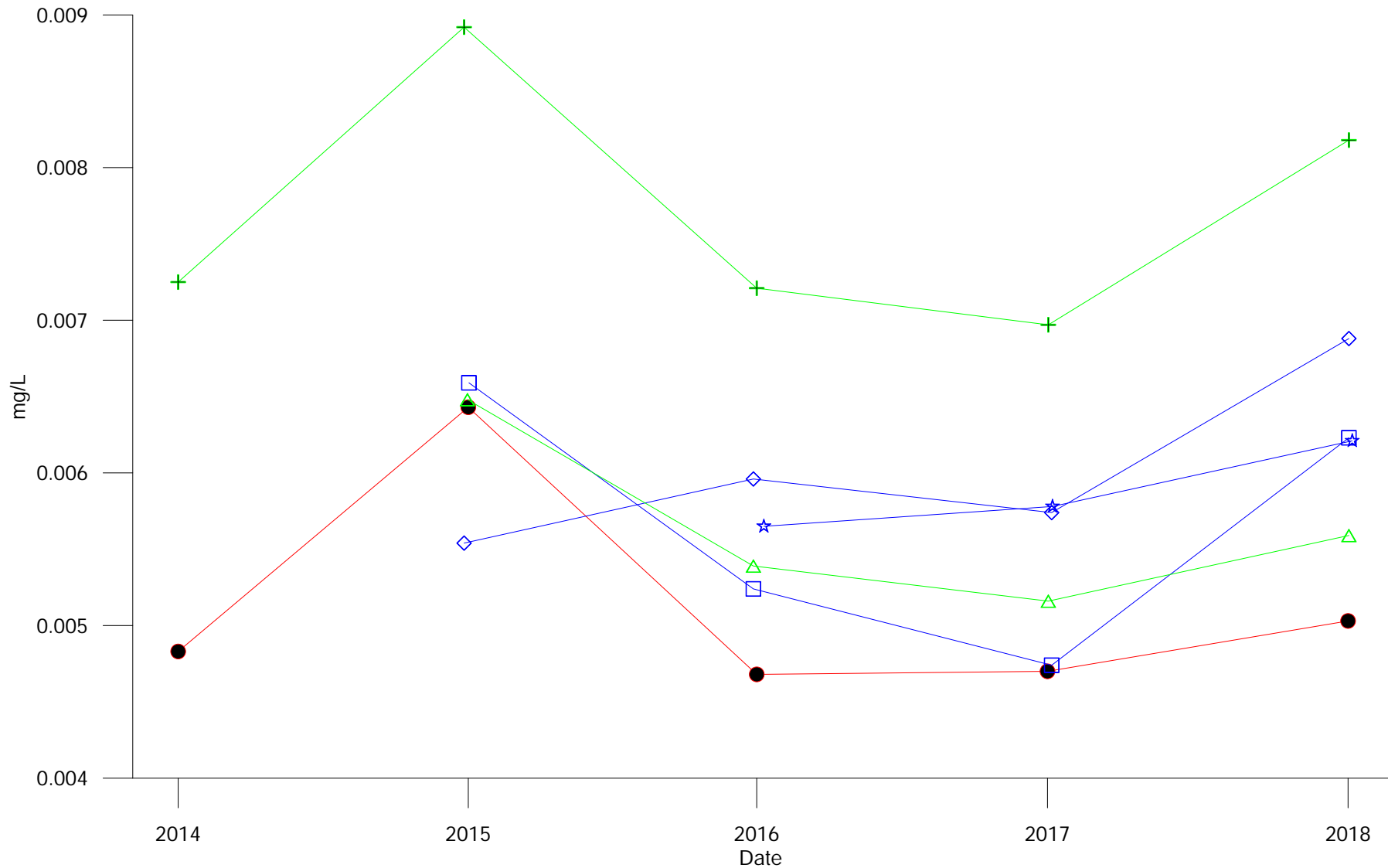


City Of Winnipeg
Solid Waste Services

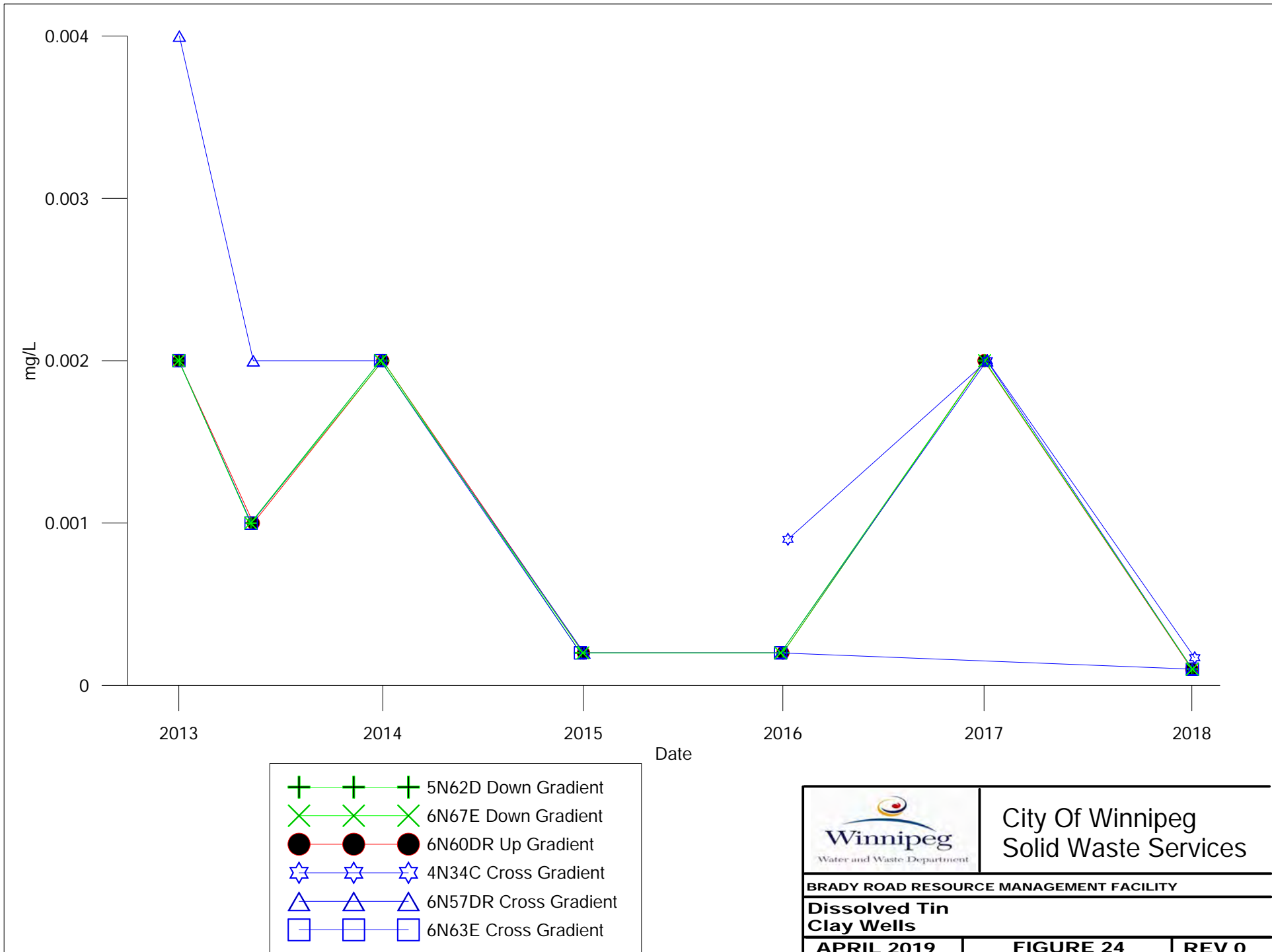
BRADY ROAD RESOURCE MANAGEMENT FACILITY

Total Phosphorus
Clay Wells

APRIL 2019 | FIGURE 22 | REV 0



City Of Winnipeg
Solid Waste Services



City Of Winnipeg
Solid Waste Services

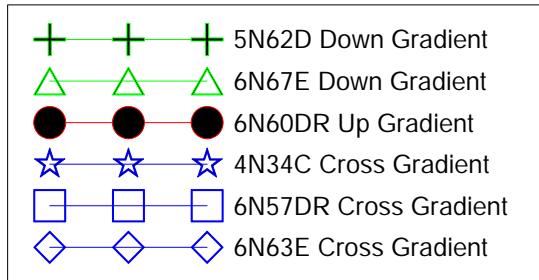
BRADY ROAD RESOURCE MANAGEMENT FACILITY

Dissolved Tin
Clay Wells

APRIL 2019

FIGURE 24

REV 0



City Of Winnipeg
Solid Waste Services

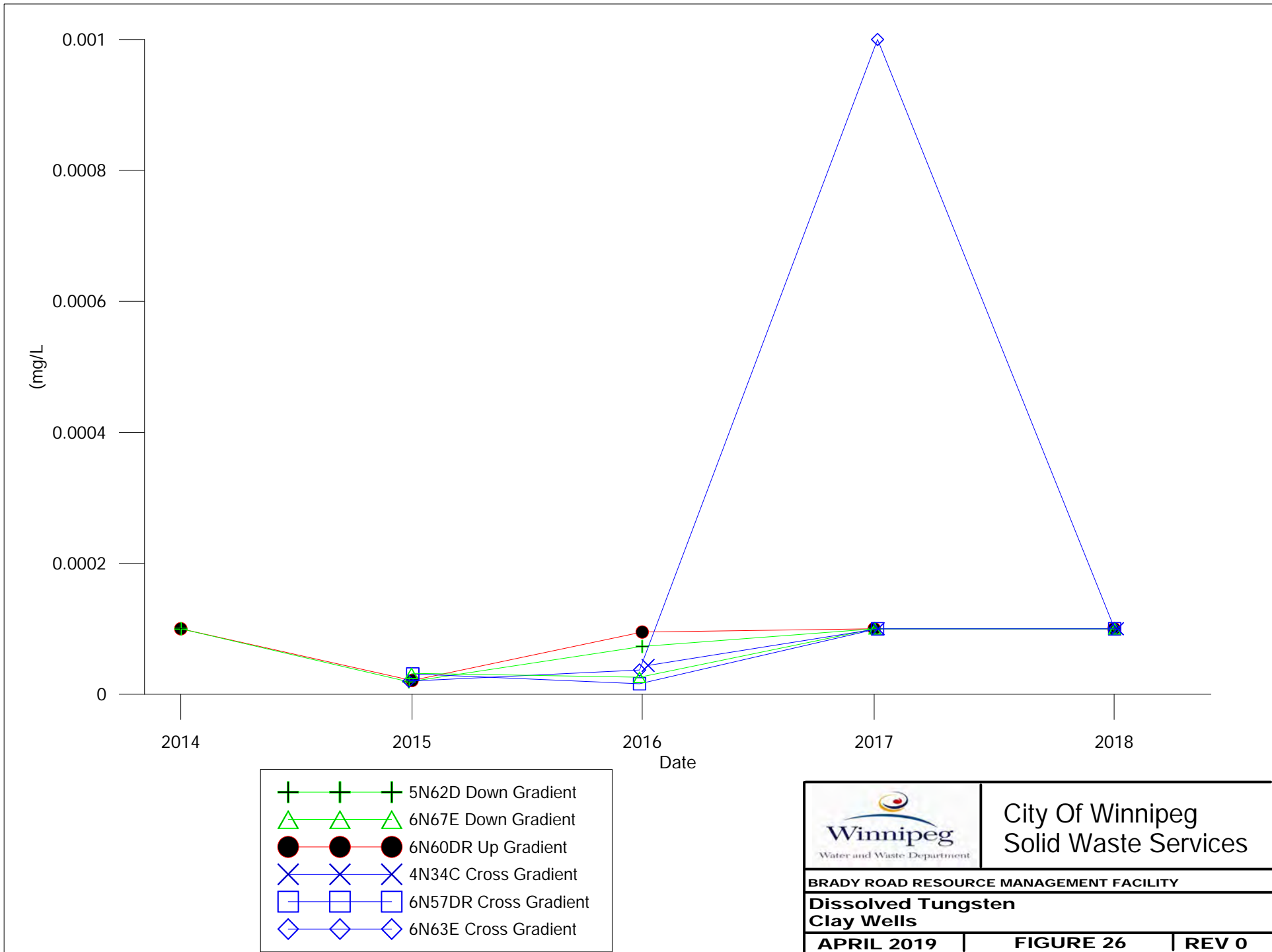
BRADY ROAD RESOURCE MANAGEMENT FACILITY

Total Kjeldahl Nitrogen
Clay Wells

APRIL 2019

FIGURE 25

REV 0



- + + + 5N62D Down Gradient
- △ △ △ 6N67E Down Gradient
- ● ● 6N60DR Up Gradient
- × × × 4N34C Cross Gradient
- □ □ 6N57DR Cross Gradient
- ◇ ◇ ◇ 6N63E Cross Gradient

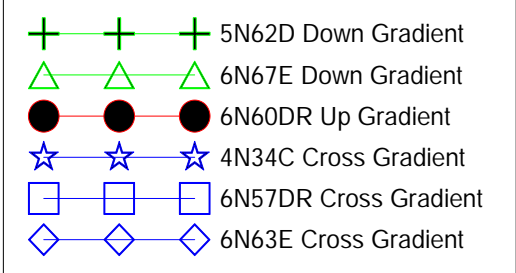
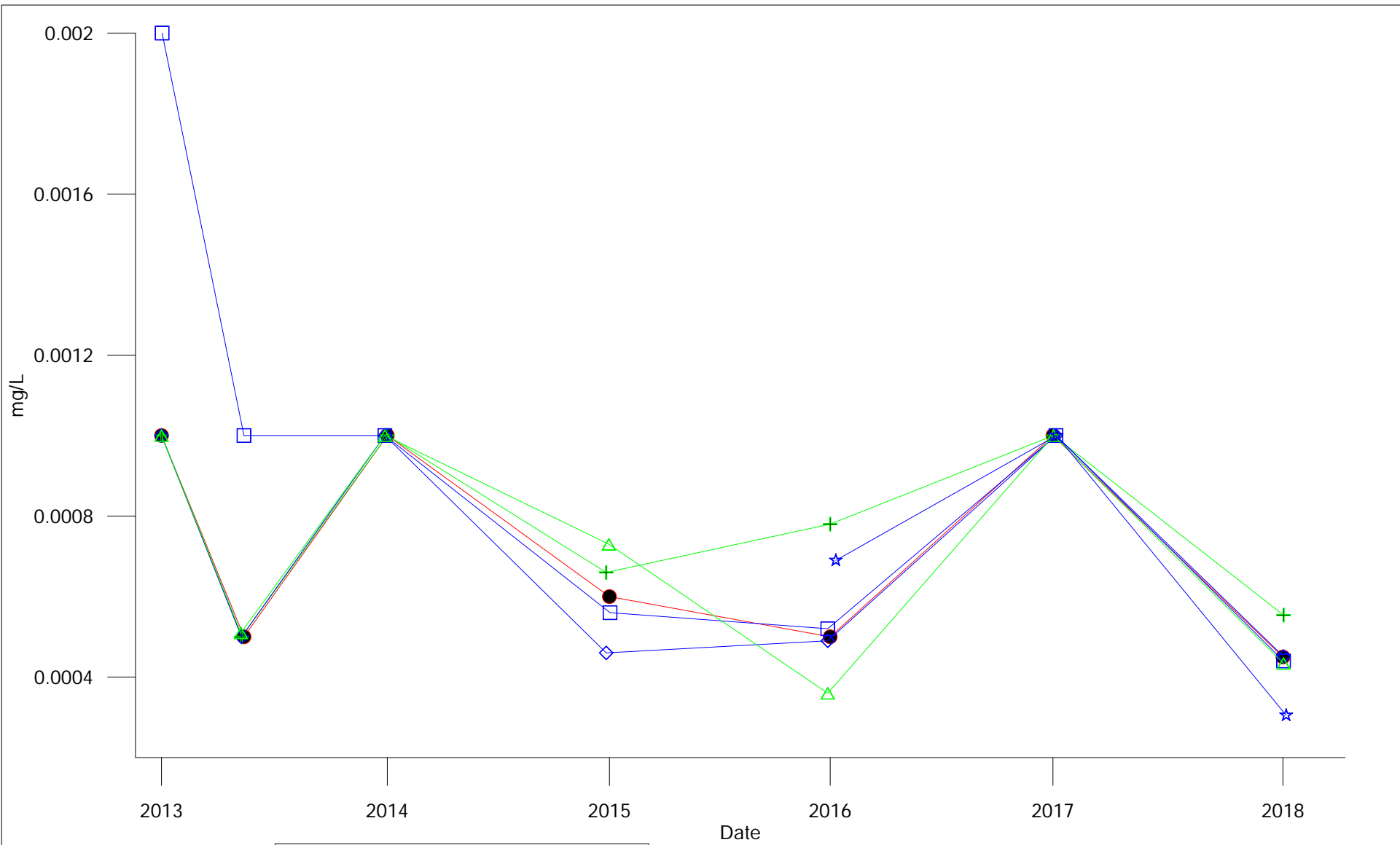


City Of Winnipeg
Solid Waste Services

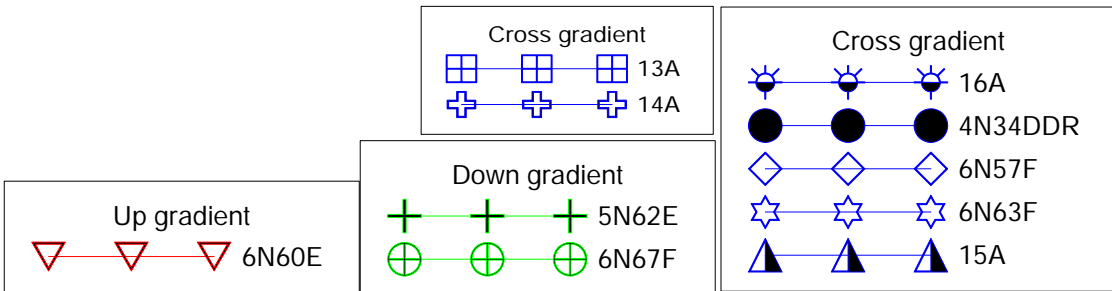
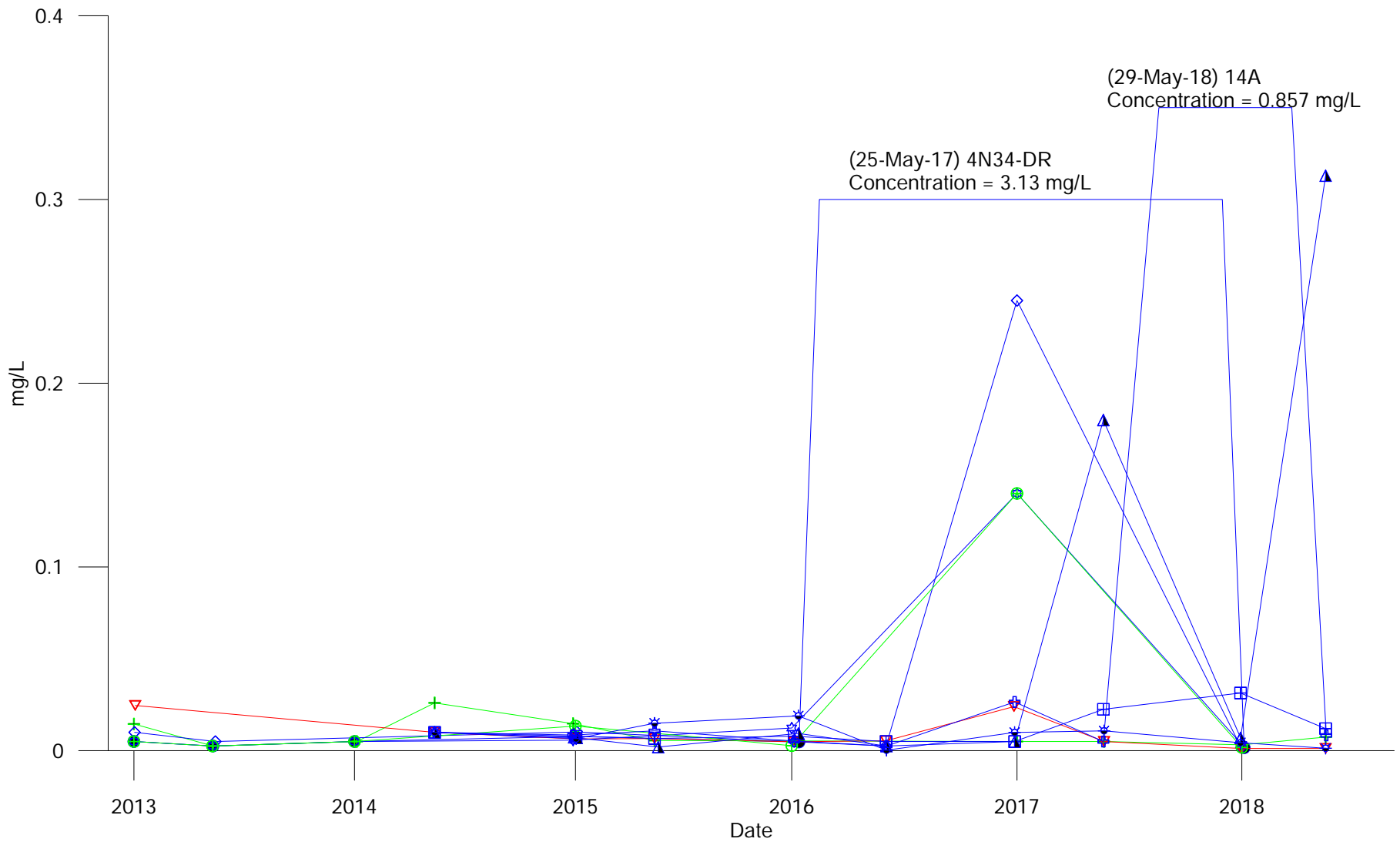
BRADY ROAD RESOURCE MANAGEMENT FACILITY

Dissolved Tungsten
Clay Wells

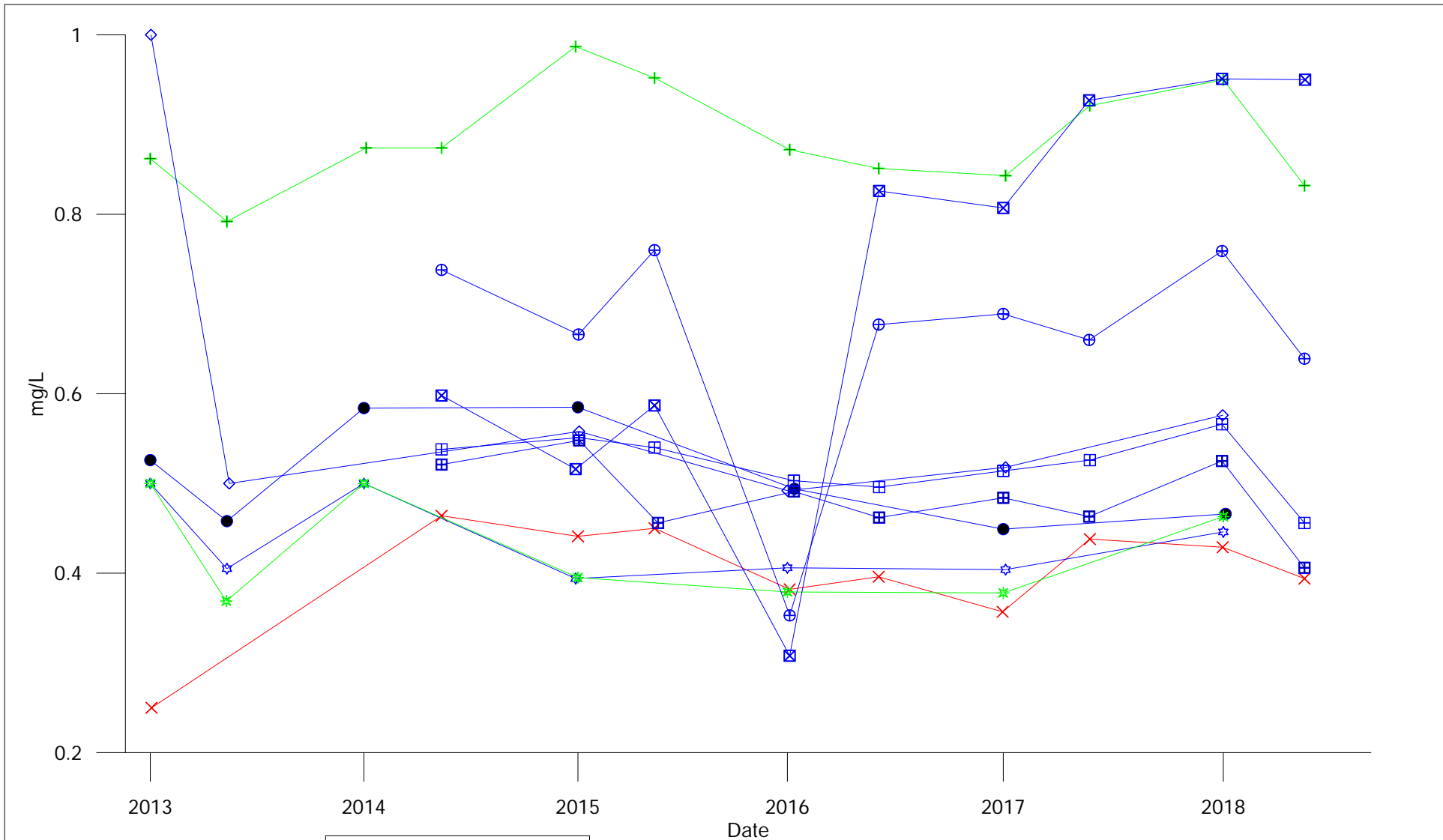
APRIL 2019 | FIGURE 26 | REV 0



City Of Winnipeg
Solid Waste Services



	<p>City Of Winnipeg Solid Waste Services</p>	
	<p>BRADY ROAD RESOURCE MANAGEMENT FACILITY</p>	
<p>Dissolved Aluminium Till Wells</p>		
<p>APRIL 2019</p>	<p>FIGURE 28</p>	<p>REV 0</p>



Up gradient
 X—X—X 6N60EER

Down gradient
 +—+—+ 5N62E
 ——* 6N67F

Cross gradient
 ⊕—⊕—⊕ 13A
 ⊠—⊠—⊠ 14A

Cross gradient
 ⊞—⊞—⊞ 15A
 ⊡—⊡—⊡ 16A
 ●—●—● 4N34DDR
 ◇—◇—◇ 6N57F
 ☆—☆—☆ 6N63F

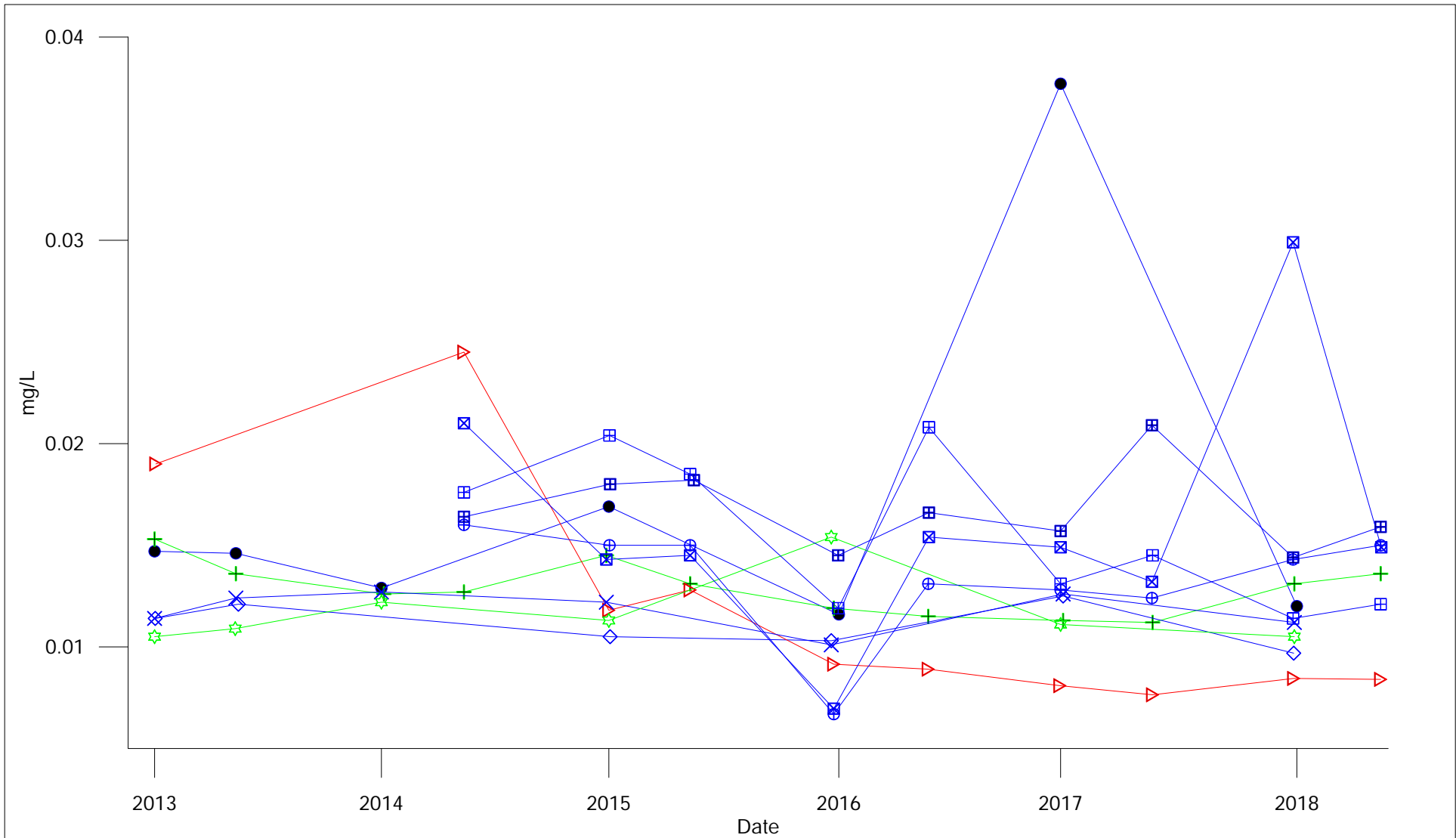
Boron MOE Criteria = 45 mg/L

City Of Winnipeg
 Solid Waste Services

BRADY ROAD RESOURCE MANAGEMENT FACILITY

**Dissolved Boron
 Till Wells**

APRIL 2019 | FIGURE 29 | REV 0



Up gradient
 6N60EER

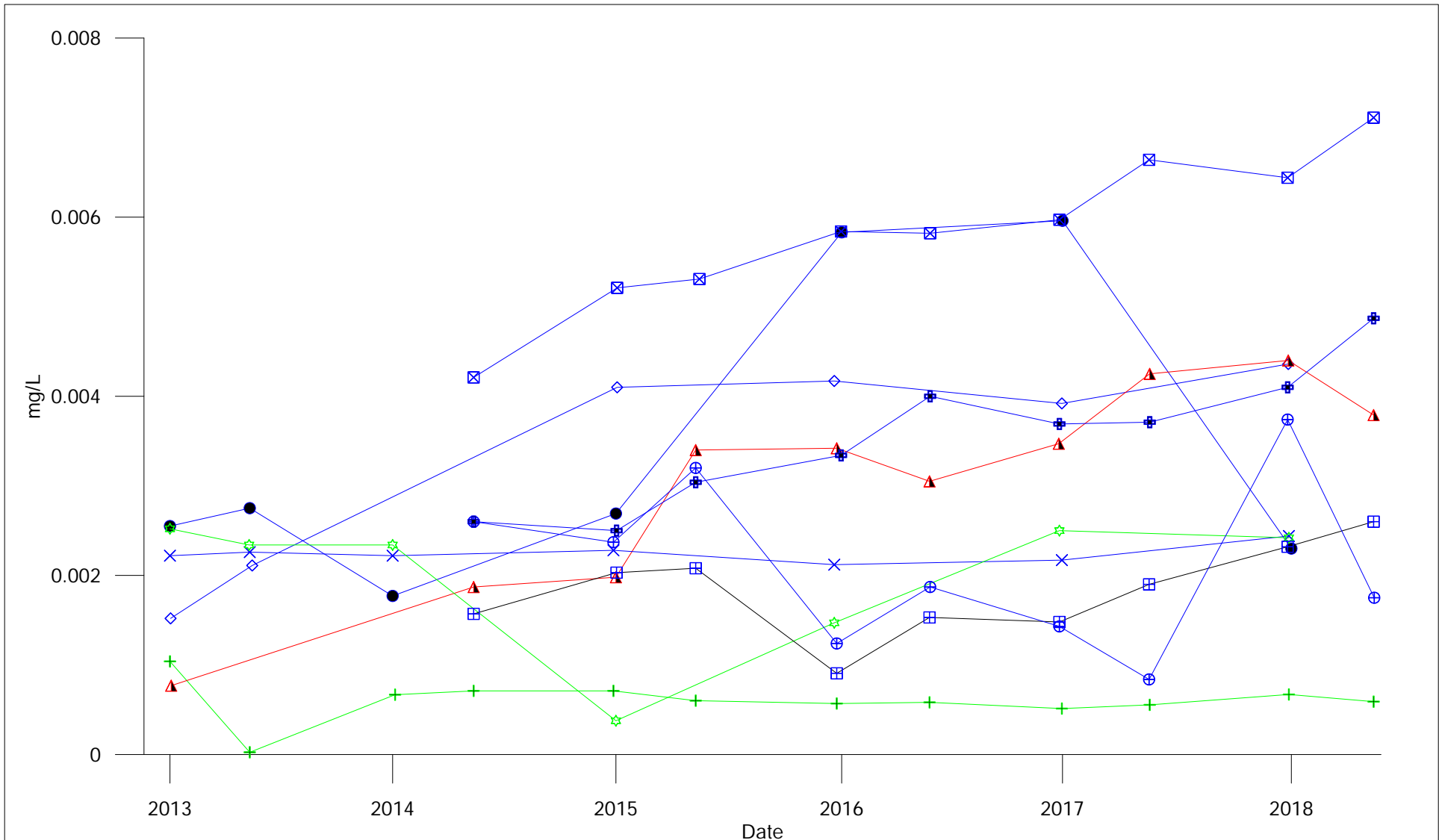
Down gradient
 5N62E
 6N67F

Cross gradient
 13A
 14A

Cross gradient
 15A
 16A
 4N34DDR
 6N57F
 6N63F

Barium MOE Criteria = 29 mg/L

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Barium Till Wells		
APRIL 2019	FIGURE 30	REV 0



Up gradient
 6N60EER

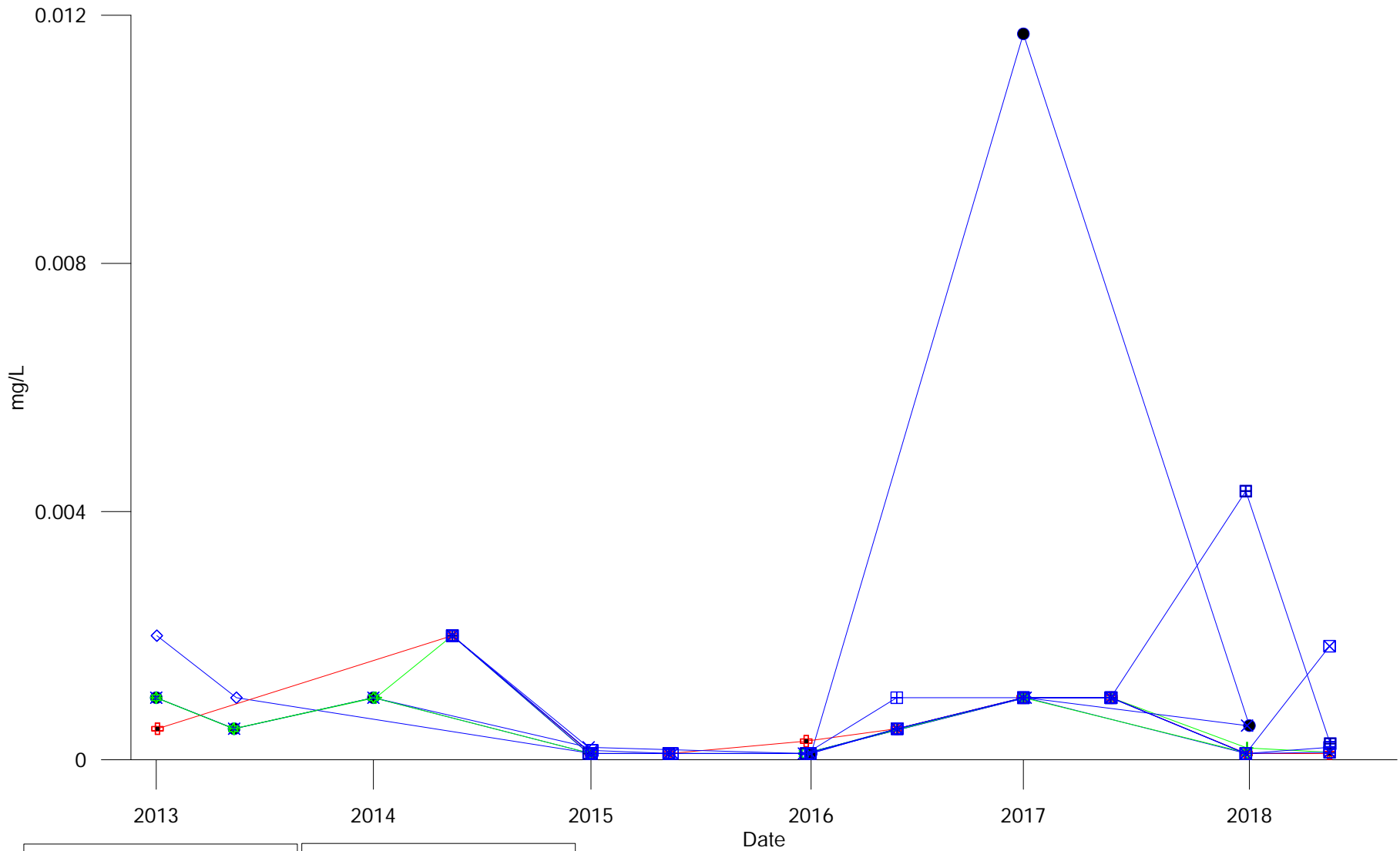
Down gradient
 5N62E
 6N67F

Cross gradient
 13A
 14A

Cross gradient
 15A
 16A
 4N34DDR
 6N57F
 6N63F

Cobalt MOE Criteria = 0.066 mg/L

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Cobalt Till Wells		
APRIL 2019	FIGURE 31	REV 0



Up gradient
 6N60E

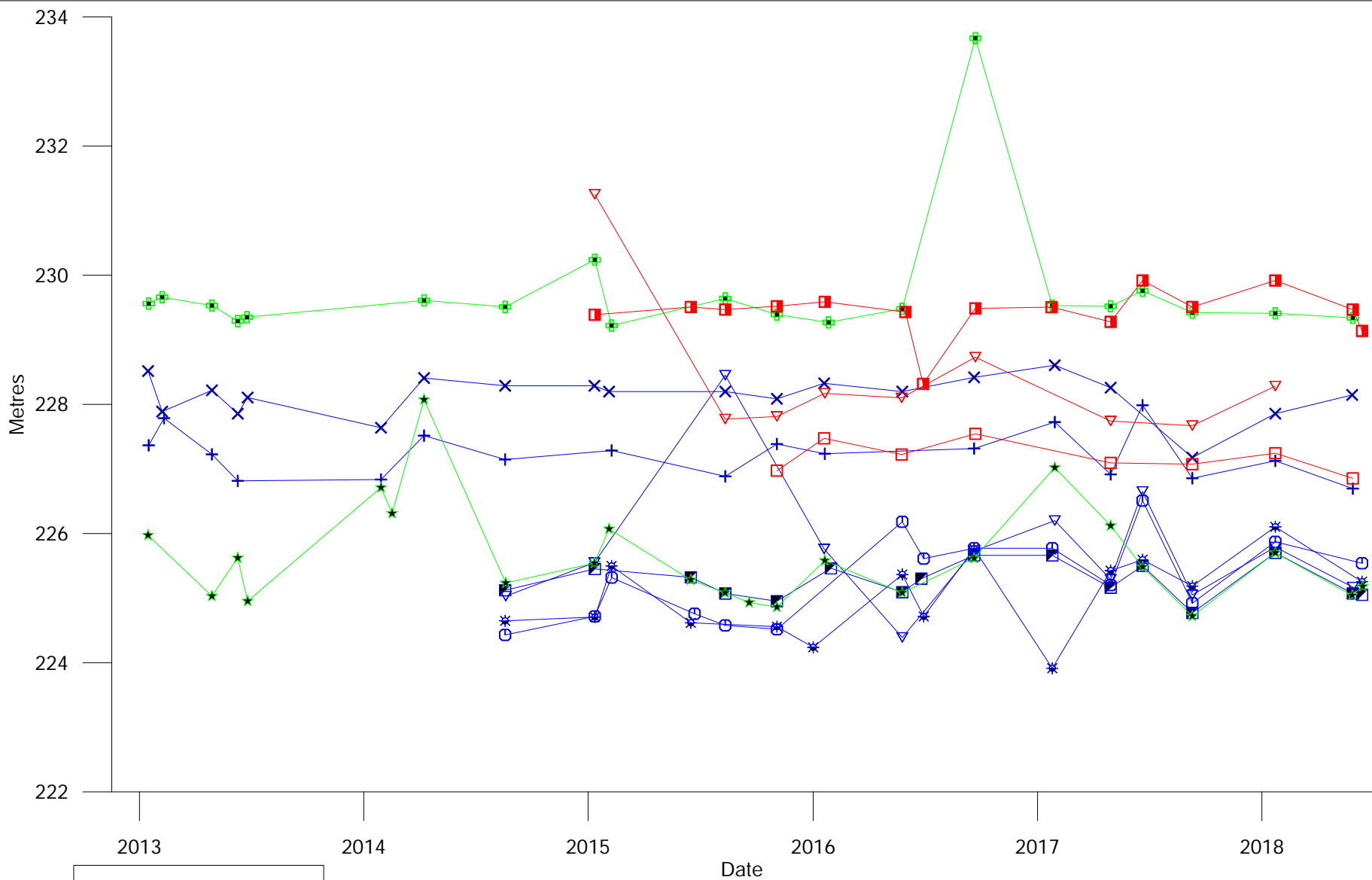
Down gradient
 5N62E
 6N67F

Cross gradient
 13A
 14A

Cross gradient
 15A
 16A
 4N34DDR
 6N57F
 6N63F

Chromium MOE Criteria = 0.81 mg/L

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Chromium Till Wells		
APRIL 2019	FIGURE 32	REV 0

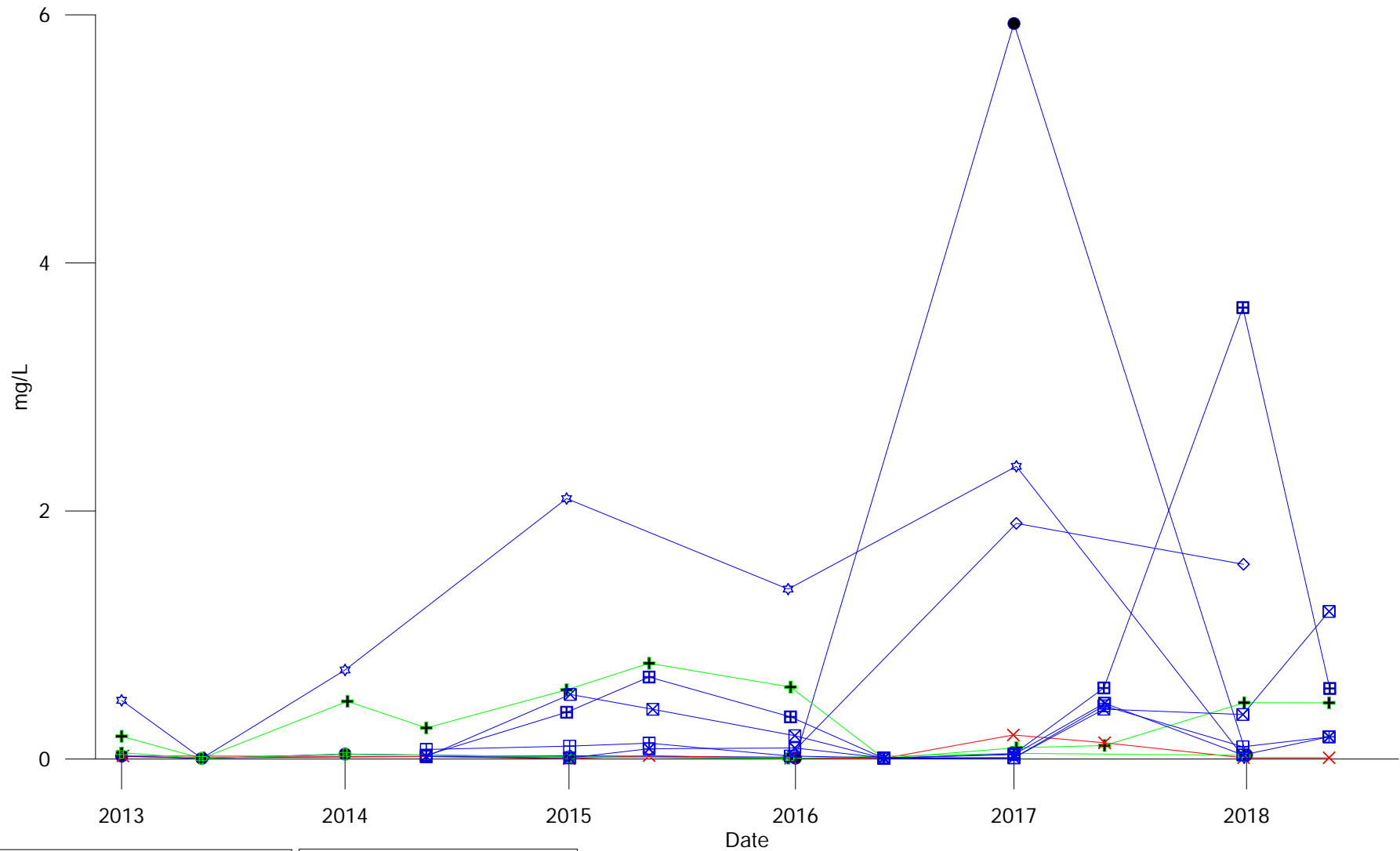


Cross gradient			
■	■	■	13A
⊕	⊕	⊕	15A
▽	▽	▽	6N57FR
⊛	⊛	⊛	16A
+	+	+	4N34DR
×	×	×	6N63F

Up gradient			
▽	▽	▽	6N58FR
□	□	□	6N59FR
■	■	■	6N60ER

Down gradient			
★	★	★	5N62E
⊕	⊕	⊕	6N67F

	<p>City Of Winnipeg Solid Waste Services</p>
	<p>BRADY ROAD RESOURCE MANAGEMENT FACILITY</p>
<p>GROUNDWATER ELEVATION TILL WELLS</p>	
<p>APRIL 2019</p>	<p>FIGURE GW-1-1 REV 0</p>



Up gradient
 X X X 6N60EER

Down gradient
 + + + 5N62E
 + + + 6N67F

Cross gradient
 □ □ □ 13A
 □ □ □ 14A

Cross gradient
 □ □ □ 15A
 □ □ □ 16A
 ● ● ● 4N34DDR
 ◇ ◇ ◇ 6N57F
 ☆ ☆ ☆ 6N63F

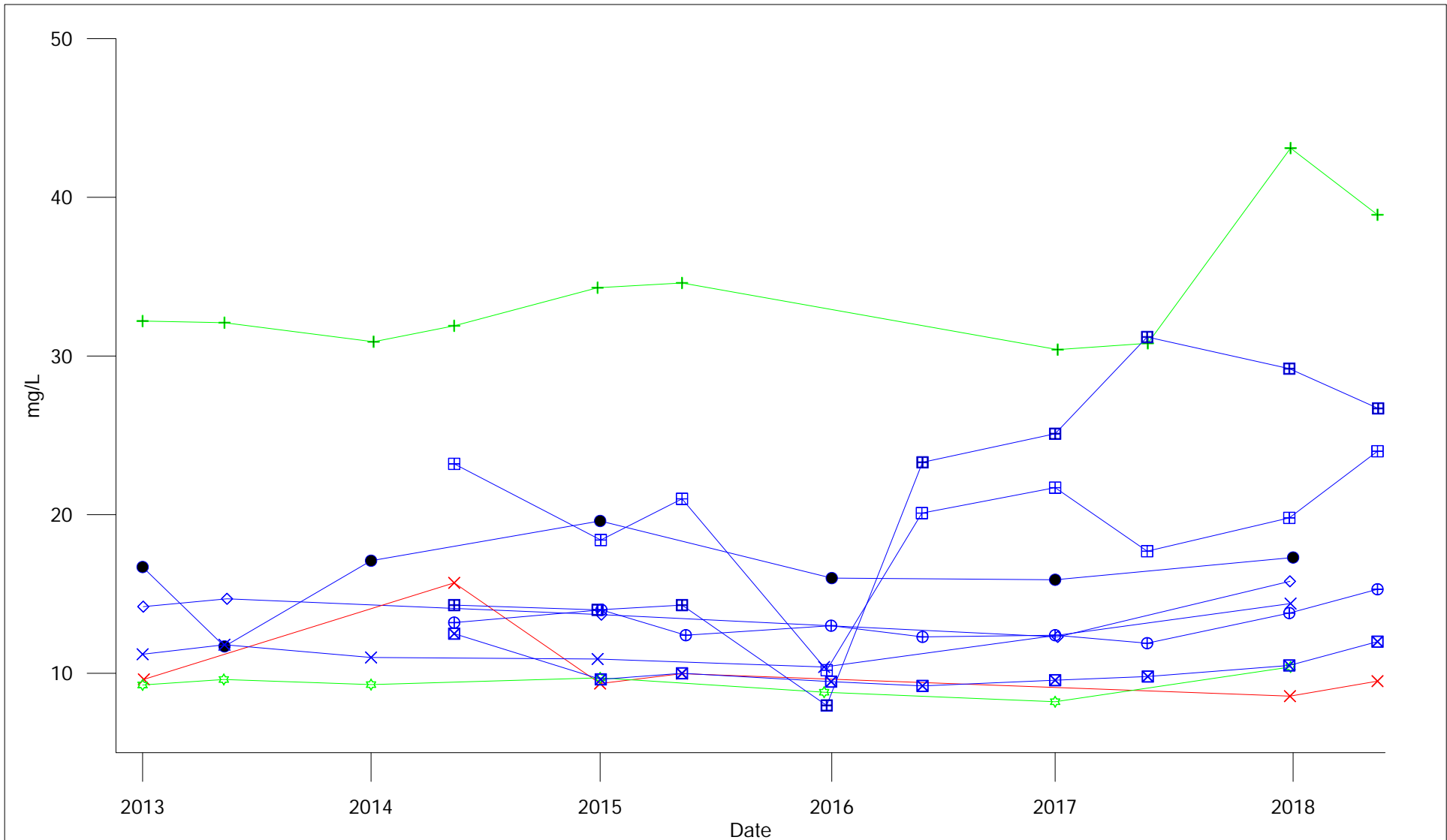


City Of Winnipeg
 Solid Waste Services

BRADY ROAD RESOURCE MANAGEMENT FACILITY

Dissolved Iron
 Till Wells

APRIL 2019 | FIGURE 33 | REV 0



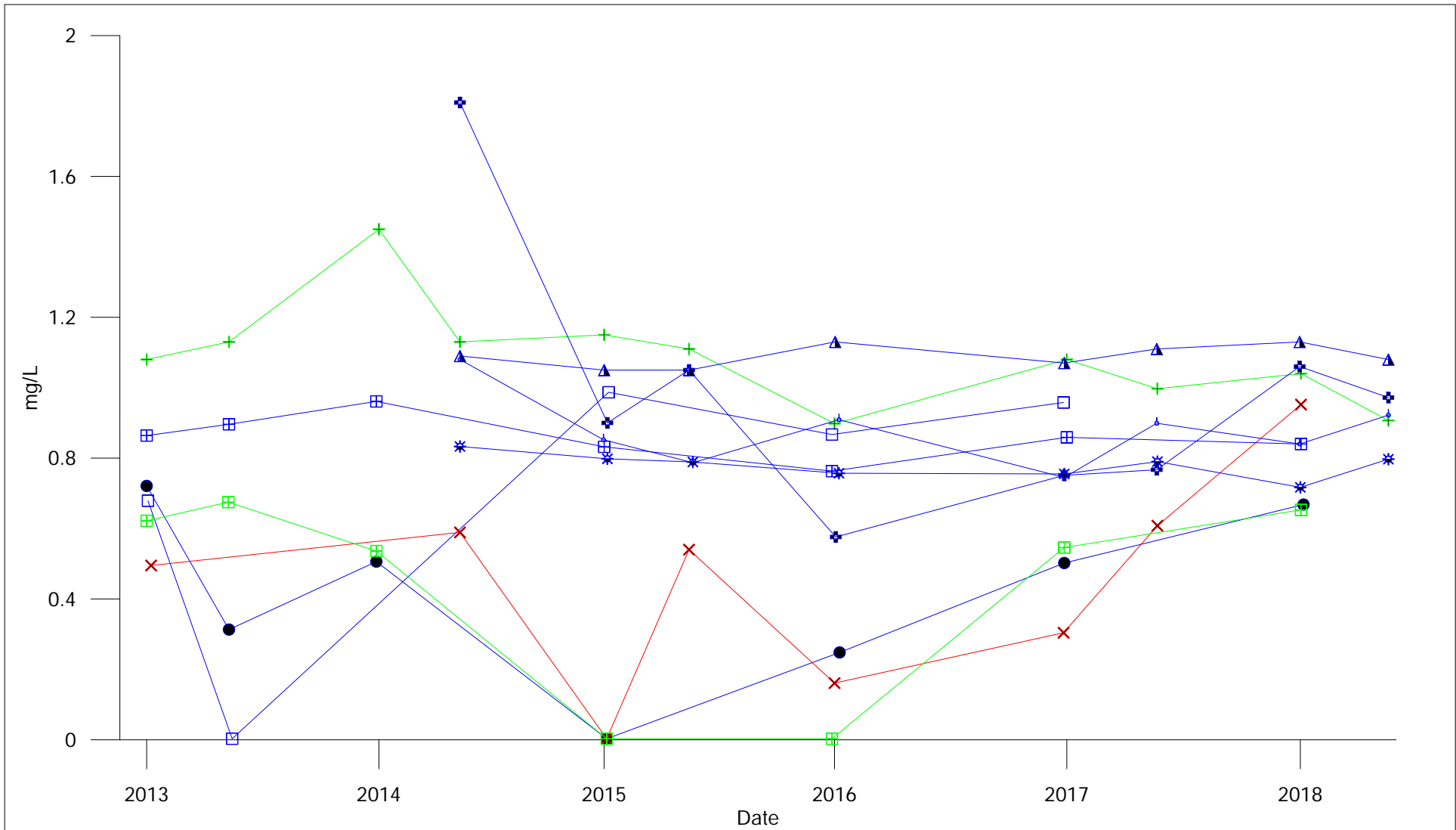
Up gradient
 X—X—X 6N60EER

Down gradient
 +—+—+ 5N62E
 ——* 6N67F

Cross gradient
 □—□—□ 13A
 ⊠—⊠—⊠ 14A

Cross gradient
 ⊕—⊕—⊕ 15A
 ⊠—⊠—⊠ 16A
 ●—●—● 4N34DDR
 ◇—◇—◇ 6N57F
 X—X—X 6N63F

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Potassium Till Wells		
APRIL 2019	FIGURE 34	REV 0



Up gradient
 X—X—X 6N60EER

Cross gradient
 +—+—+ 13A
 ▲—▲—▲ 14A

Down gradient
 +—+—+ 5N62E
 □—□—□ 6N67F

Cross gradient
 ○—○—○ 15A
 ☀—☀—☀ 16A
 ●—●—● 4N34DDR
 □—□—□ 6N57F
 □—□—□ 6N63F



City Of Winnipeg
 Solid Waste Services

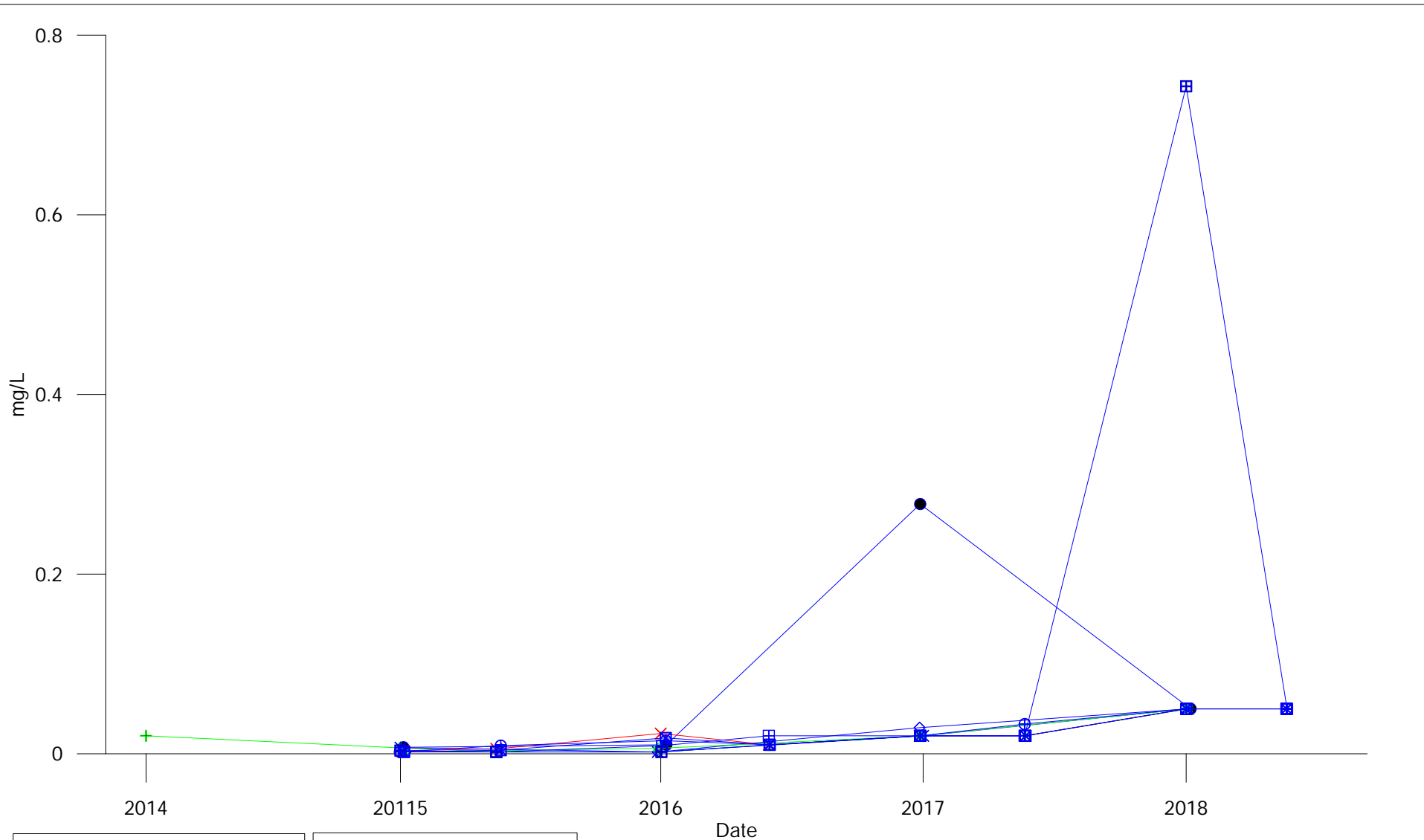
BRADY ROAD RESOURCE MANAGEMENT FACILITY

Total Ammonia
 Till Wells

APRIL 2019

FIGURE 37

REV 0



Up gradient
 X—X—X 6N60EER

Down gradient
 +—+—+ 5N62E
 ☆—☆—☆ 6N67F

Cross gradient
 □—□—□ 13A
 ⊞—⊞—⊞ 14A

Cross gradient
 ⊠—⊠—⊠ 16A
 ●—●—● 4N34DDR
 ◇—◇—◇ 6N57F
 ——* 6N63F
 ⊕—⊕—⊕ 15A



City Of Winnipeg
 Solid Waste Services

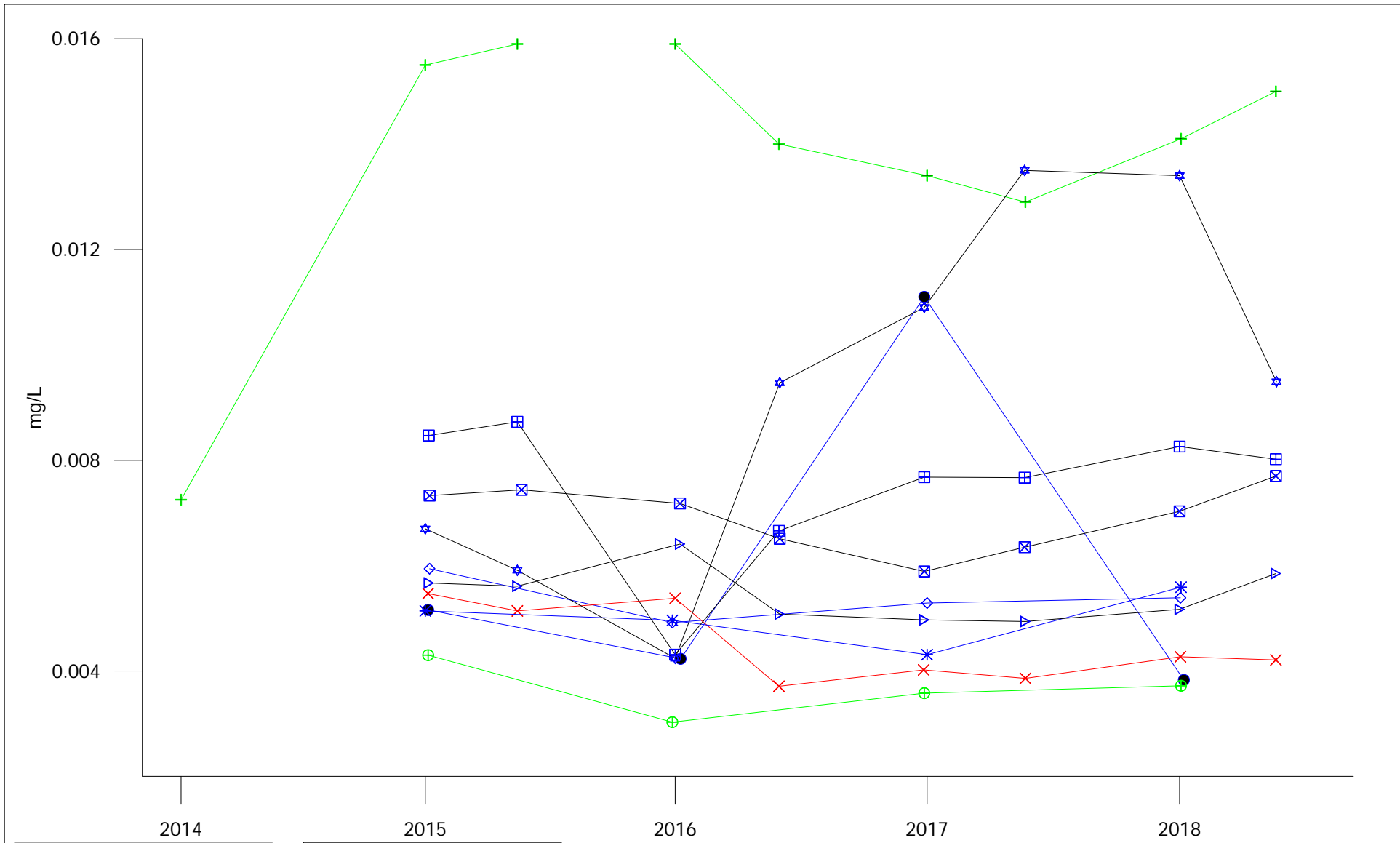
BRADY ROAD RESOURCE MANAGEMENT FACILITY

Phosphorus
 Till Wells

APRIL 2019

FIGURE 35

REV 0



Up gradient
 X—X—X 6N60E

Down gradient
 +—+—+ 5N62E
 ⊕—⊕—⊕ 6N67F

Cross gradient
 ⊠—⊠—⊠ 15A
 ▽—▽—▽ 16A

Cross gradient
 ●—●—● 4N34DDR
 ◇—◇—◇ 6N57F
 ——* 6N63F
 ⊠—⊠—⊠ 13A
 ☆—☆—☆ 14A

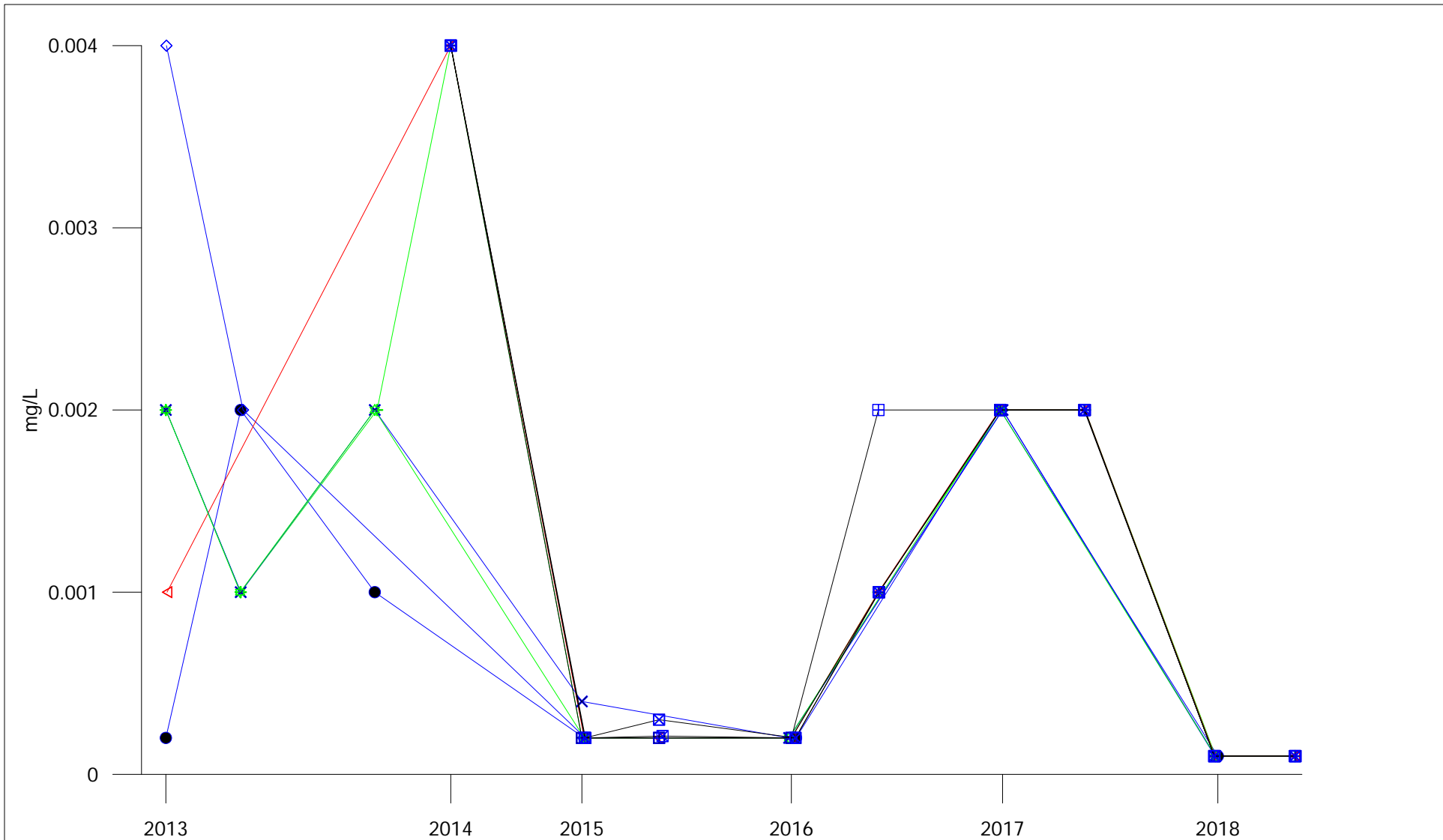


City Of Winnipeg
 Solid Waste Services

BRADY ROAD RESOURCE MANAGEMENT FACILITY

Dissolved Rubidium
 Till Wells

APRIL 2019 | FIGURE 36 | REV 0



Up gradient
 6N60EER

Cross gradient

- 4N34DDR
- 6N57F
- 6N63F
- 13A
- 14A

Down gradient

- 5N62E
- 6N67F

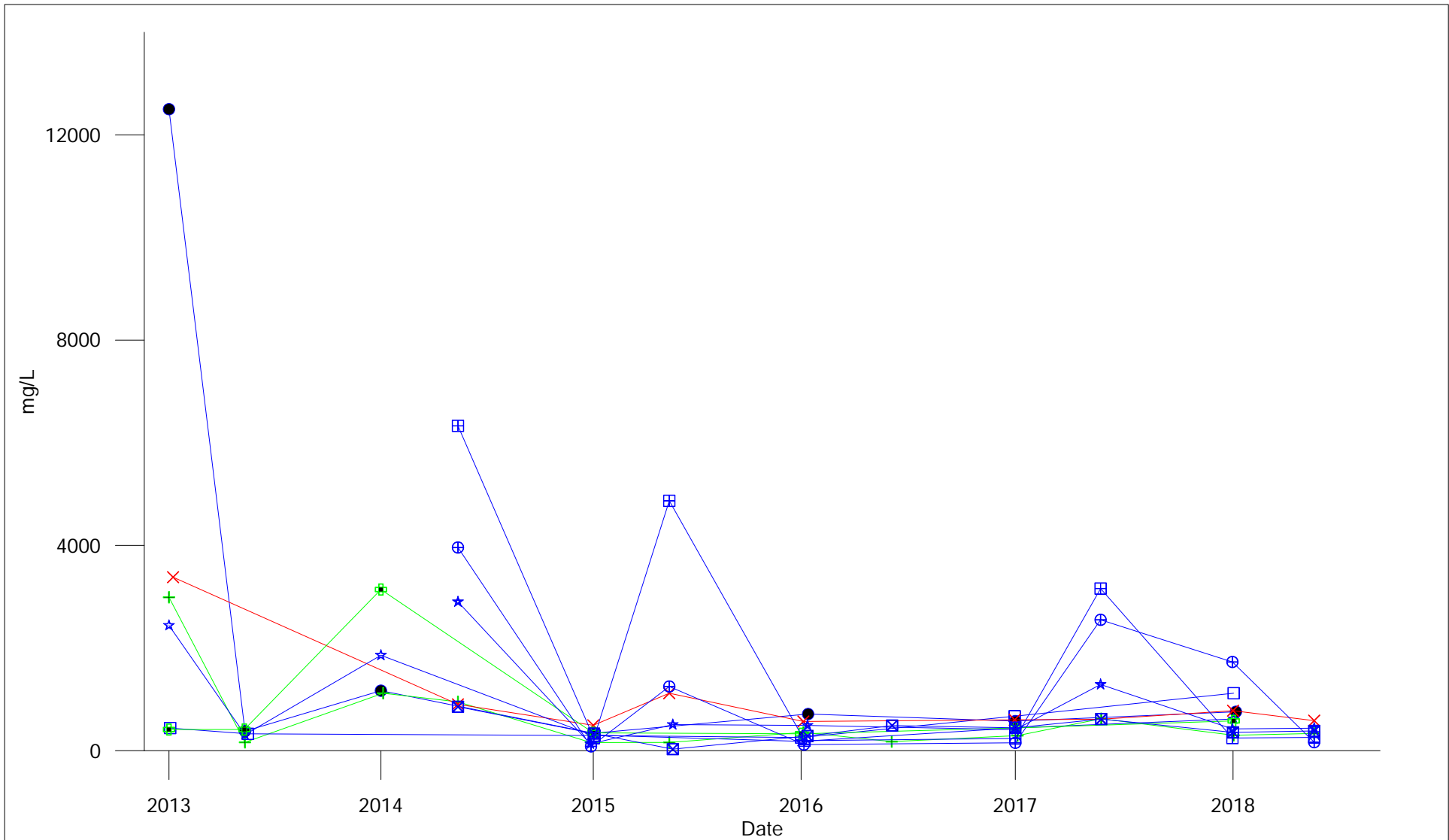
Cross gradient

- 15A
- 16A



City Of Winnipeg
 Solid Waste Services

BRADY ROAD RESOURCE MANAGEMENT FACILITY
**Dissolved Tin
 Till Wells**
 APRIL 2019 | FIGURE 38 | REV 0



Up gradient
 X—X—X 6N60E

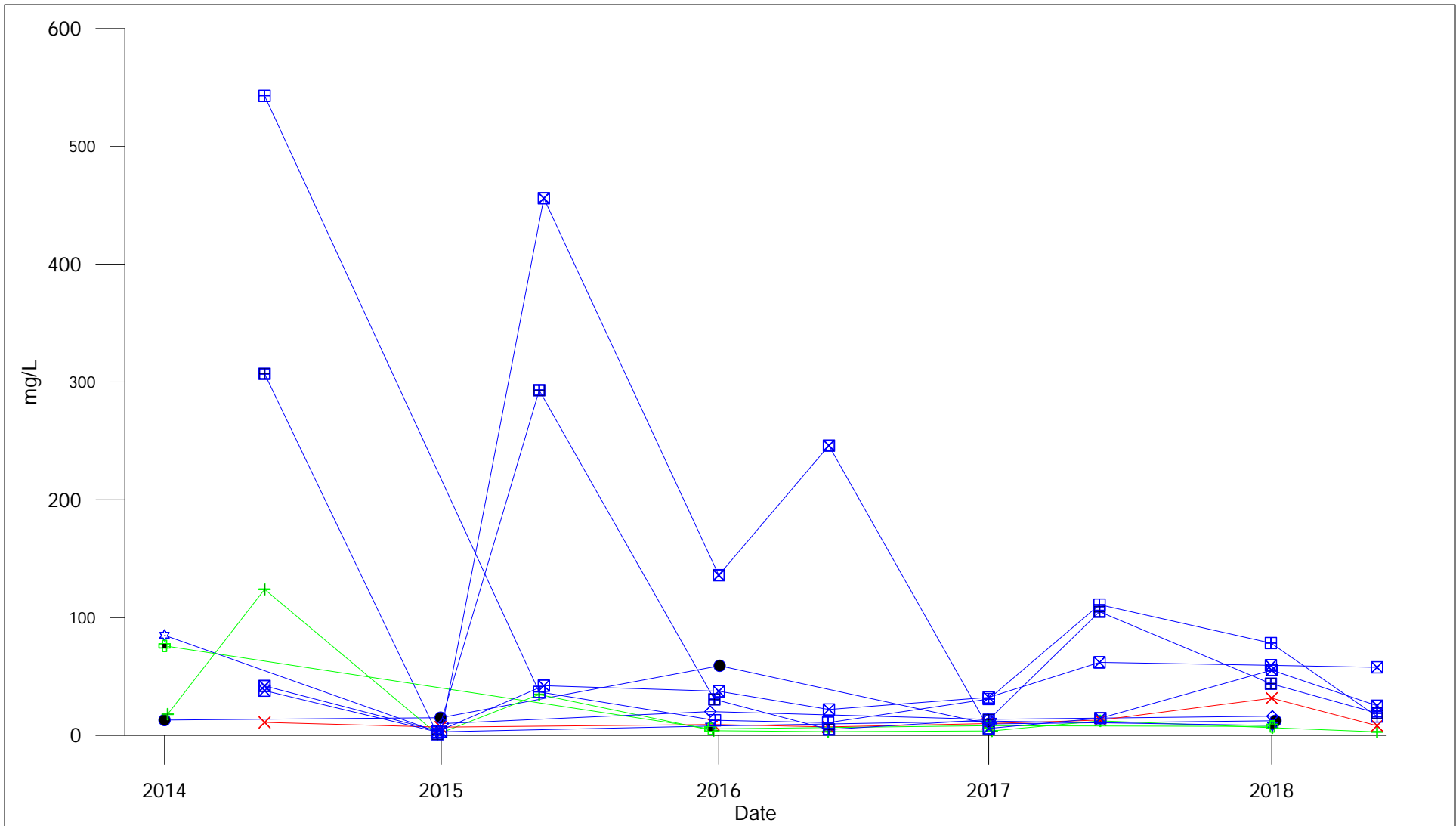
Down gradient
 +—+—+ 5N62E
 ⊕—⊕—⊕ 6N67F

Cross gradient
 ⊞—⊞—⊞ 13A
 ⊕—⊕—⊕ 14A

Cross gradient
 ☆—☆—☆ 15A
 ⊠—⊠—⊠ 16A
 ●—●—● 4N34DDR
 □—□—□ 6N57F
 ☆—☆—☆ 6N63F



City Of Winnipeg
 Solid Waste Services



Up gradient

× × × 6N60E

Down gradient

+ + + 5N62E

■ ■ ■ 6N67F

Cross gradient

□ □ □ 13A

▣ ▣ ▣ 14A

Cross gradient

⊠ ⊠ ⊠ 15A

⊞ ⊞ ⊞ 16A

● ● ● 4N34DDR

◇ ◇ ◇ 6N57F

☆ ☆ ☆ 6N63F

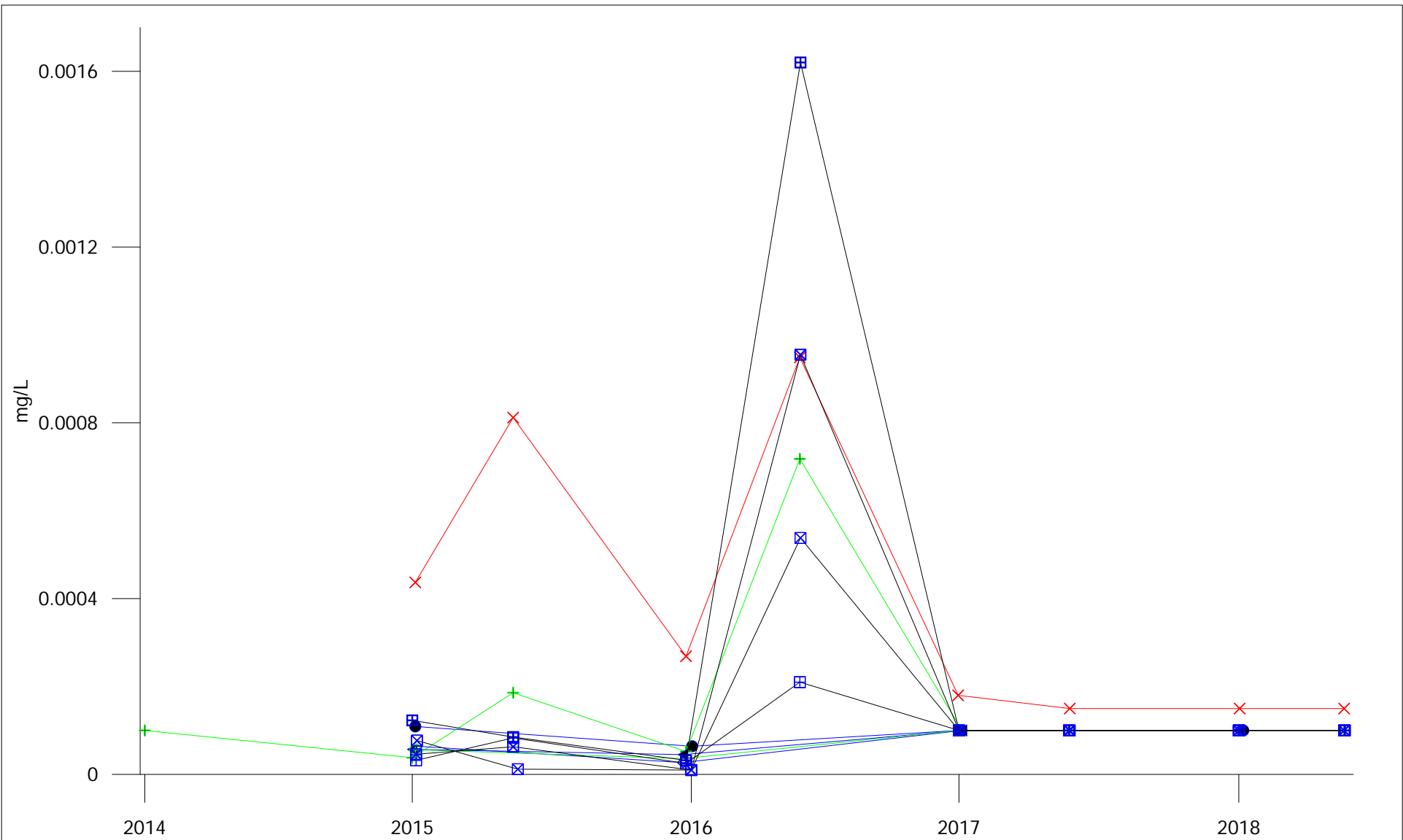



City Of Winnipeg
Solid Waste Services

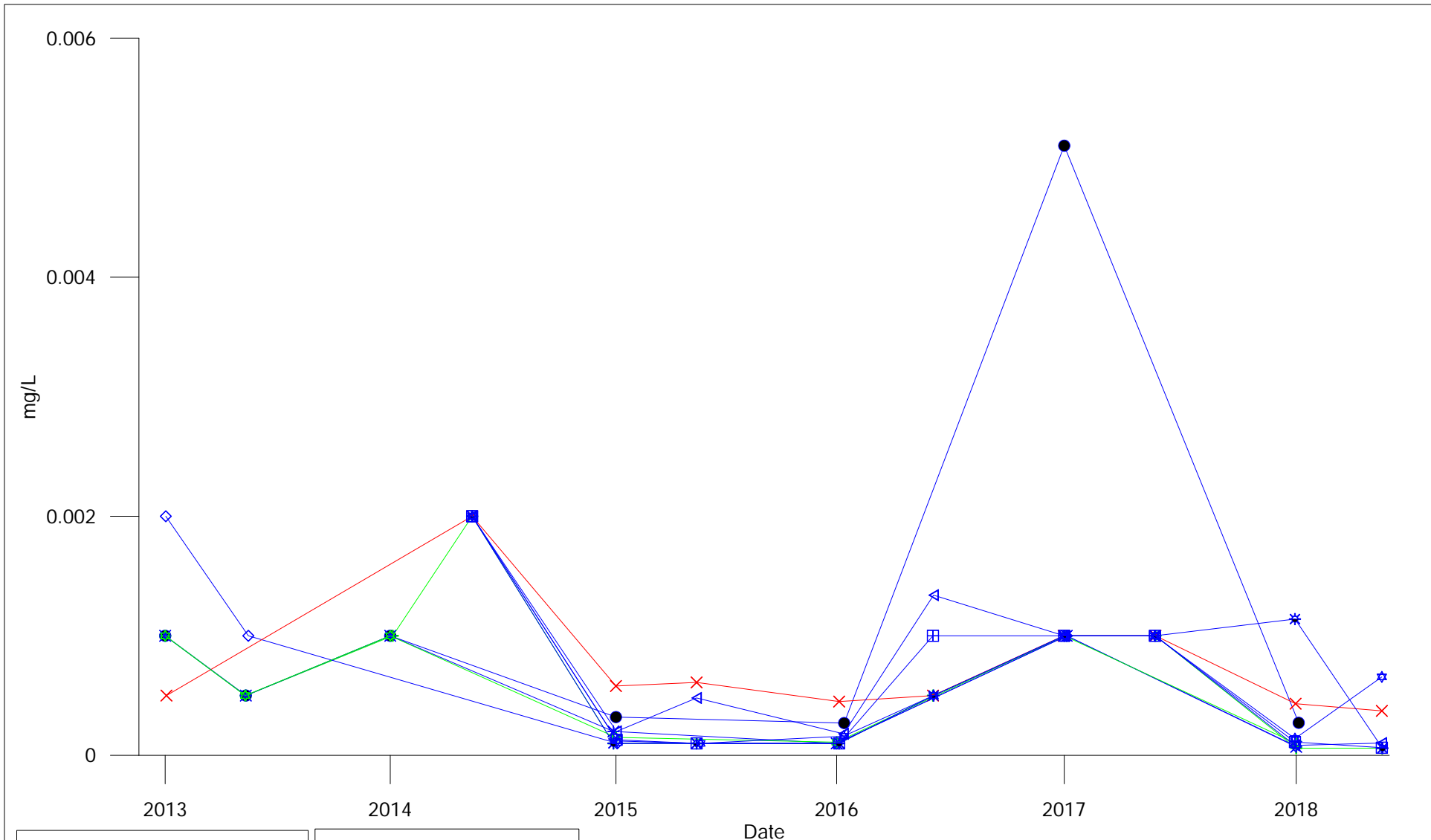
BRADY ROAD RESOURCE MANAGEMENT FACILITY

**Total Organic Carbon
Till Wells**

APRIL 2019 | FIGURE 39 | REV 0



<p style="text-align: center;">Up gradient</p> <p style="text-align: center;">X—X—X 6N60E</p>	<p style="text-align: center;">Down gradient</p> <p style="text-align: center;">+—+—+ 5N62E</p> <p style="text-align: center;">⊕—⊕—⊕ 6N67F</p>	<p style="text-align: center;">Cross gradient</p> <p style="text-align: center;">●—●—● 4N34DDR</p> <p style="text-align: center;">◇—◇—◇ 6N57F</p> <p style="text-align: center;">▲—▲—▲ 6N63F</p> <p style="text-align: center;">▣—▣—▣ 13A</p> <p style="text-align: center;">▤—▤—▤ 14A</p>	<p style="text-align: center;">Cross gradient</p> <p style="text-align: center;">⊠—⊠—⊠ 15A</p> <p style="text-align: center;">⊡—⊡—⊡ 16A</p>	 City Of Winnipeg Solid Waste Services
BRADY ROAD RESOURCE MANAGEMENT FACILITY				
Dissolved Tungsten Till Wells				
APRIL 2019	FIGURE 41	REV 0		



Up gradient
 X X X 6N60EER

Down gradient
 + + + 5N62E
 ☆ ☆ ☆ 6N67F

Cross gradient
 □ □ □ 13A
 ☆ ☆ ☆ 14A

Cross gradient
 ☆ ☆ ☆ 15A
 △ △ △ 16A
 ● ● ● 4N34DDR
 ◇ ◇ ◇ 6N57F
 ☆ ☆ ☆ 6N63F



City Of Winnipeg
 Solid Waste Services

BRADY ROAD RESOURCE MANAGEMENT FACILITY

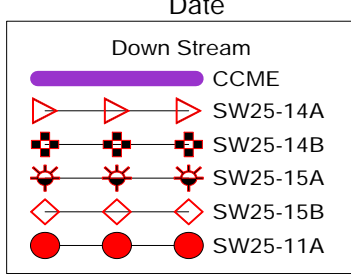
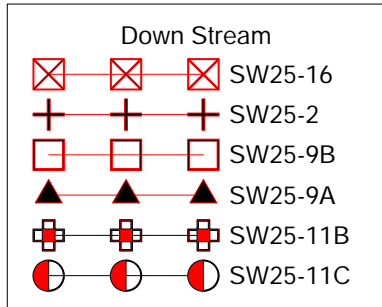
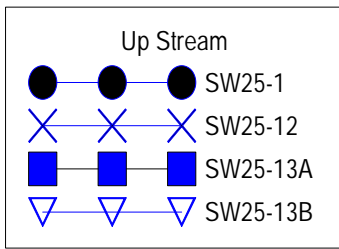
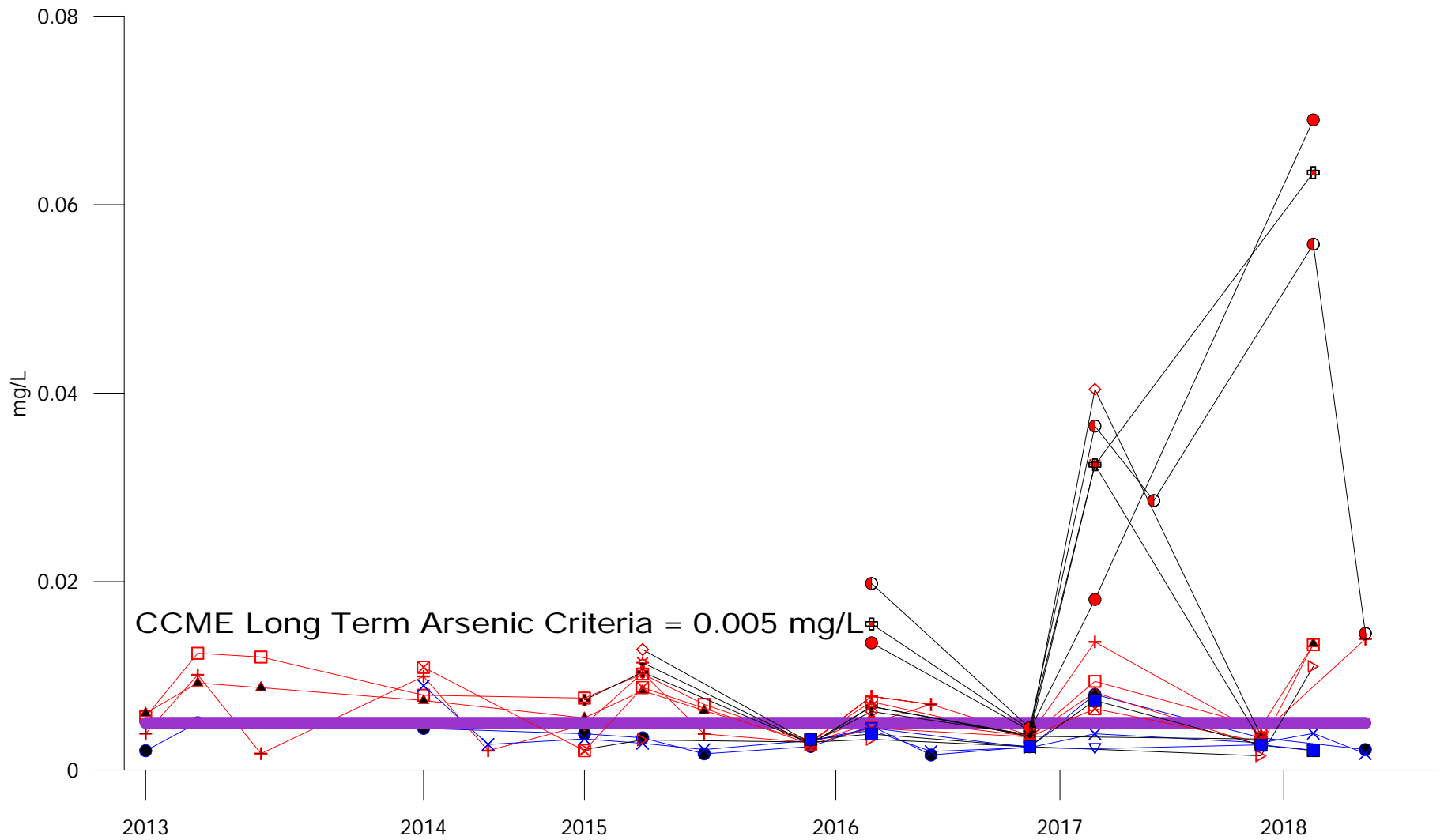
Dissolved Zirconium
 Till Wells

APRIL 2019

FIGURE 42

REV 0

**2018 Surface Water
Time vs Concentration Graphs**



City Of Winnipeg
Solid Waste Services

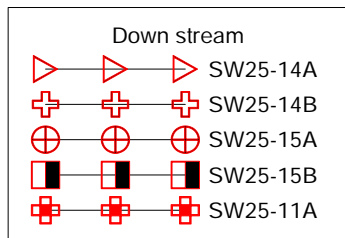
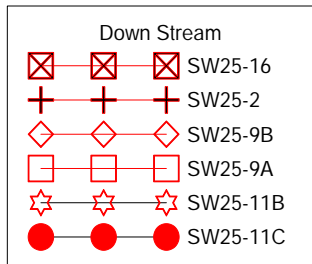
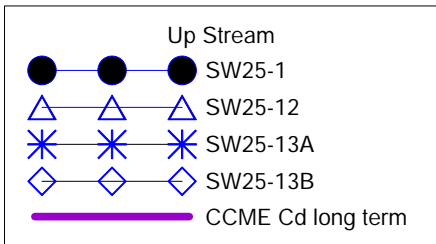
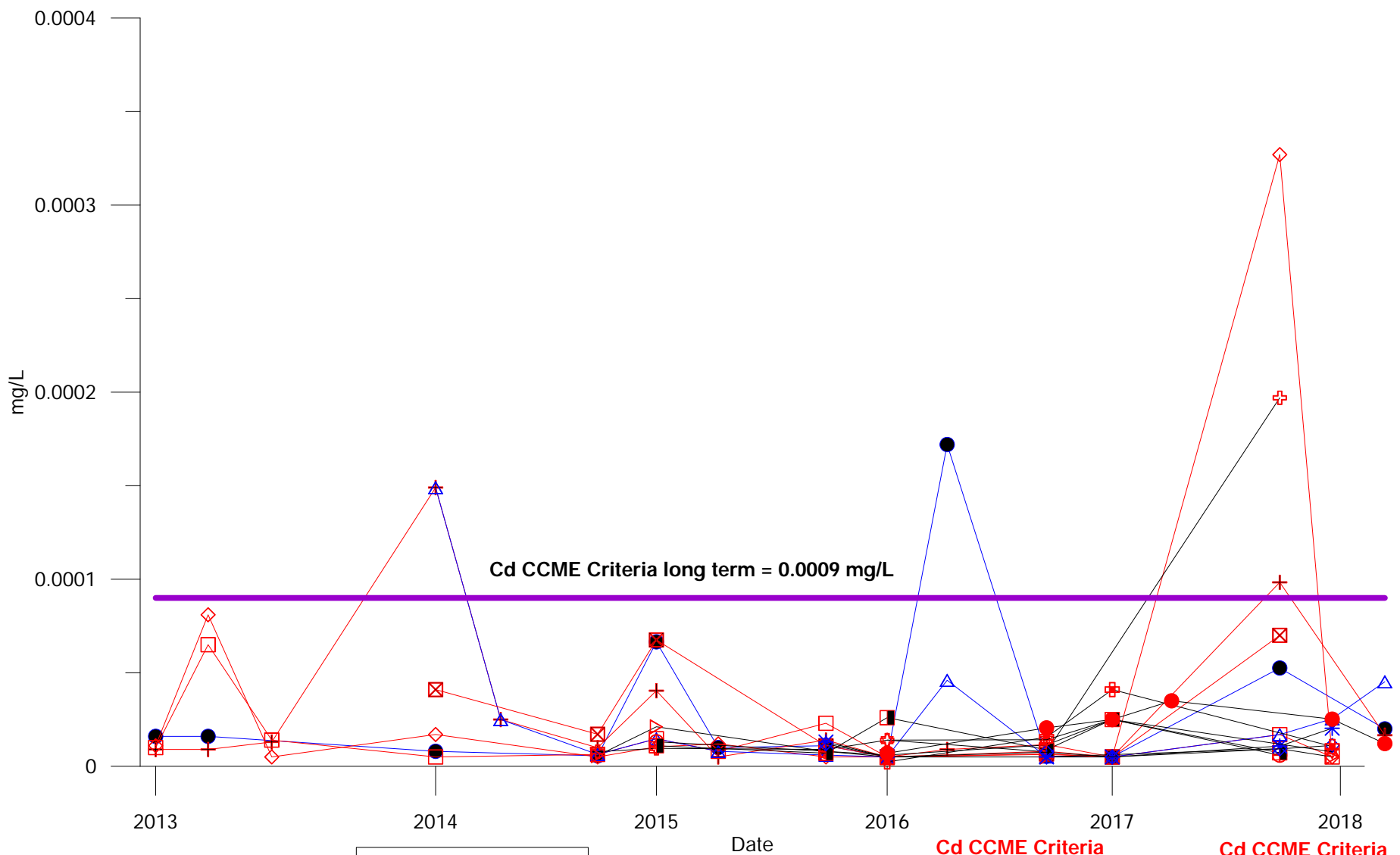
BRADY ROAD RESOURCE MANAGEMENT FACILITY

Dissolved Arsenic
Surface Water

APRIL 2019

FIGURE 43

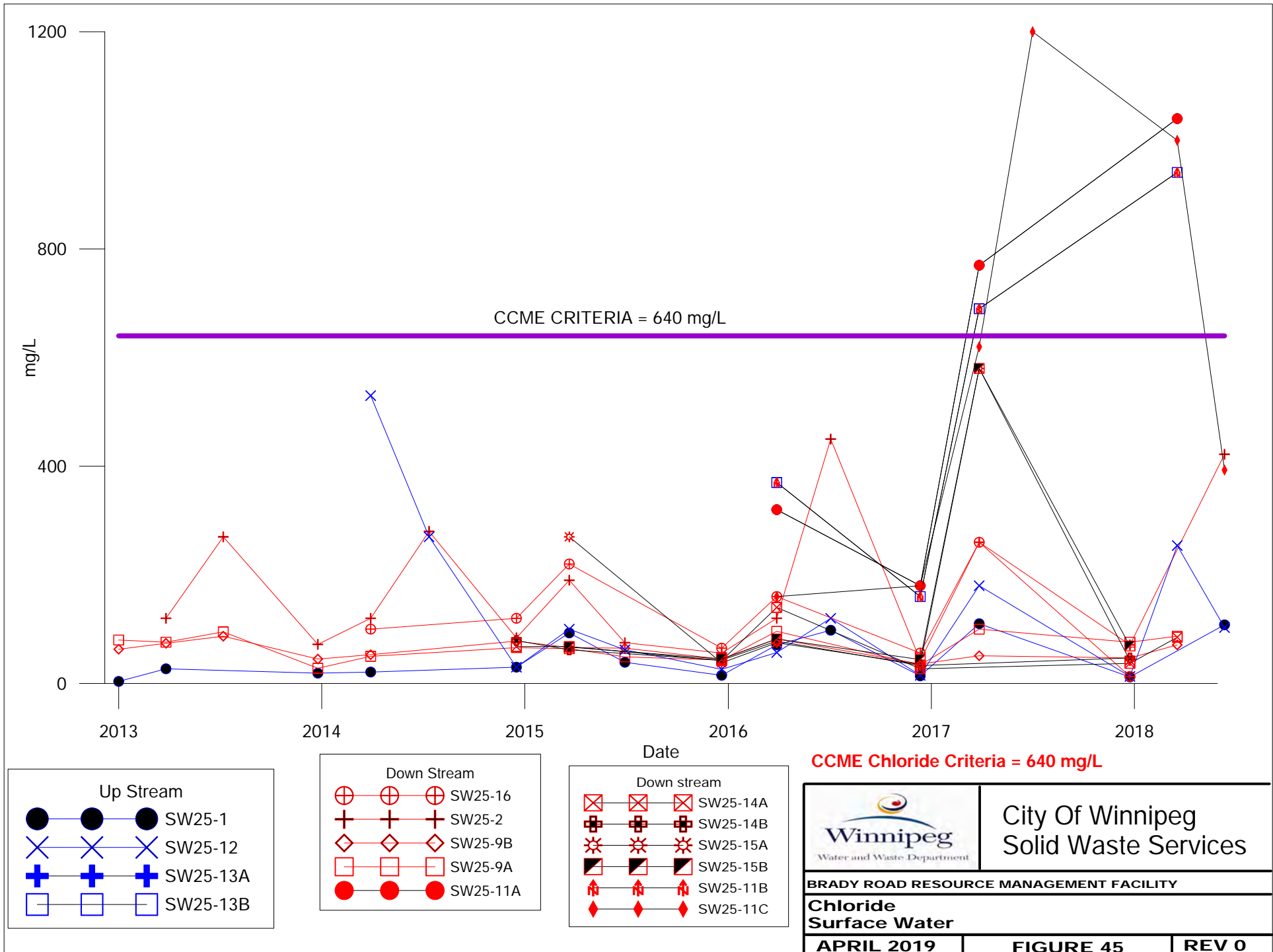
REV 0



**Cd CCME Criteria
0.001 mg/L short term**

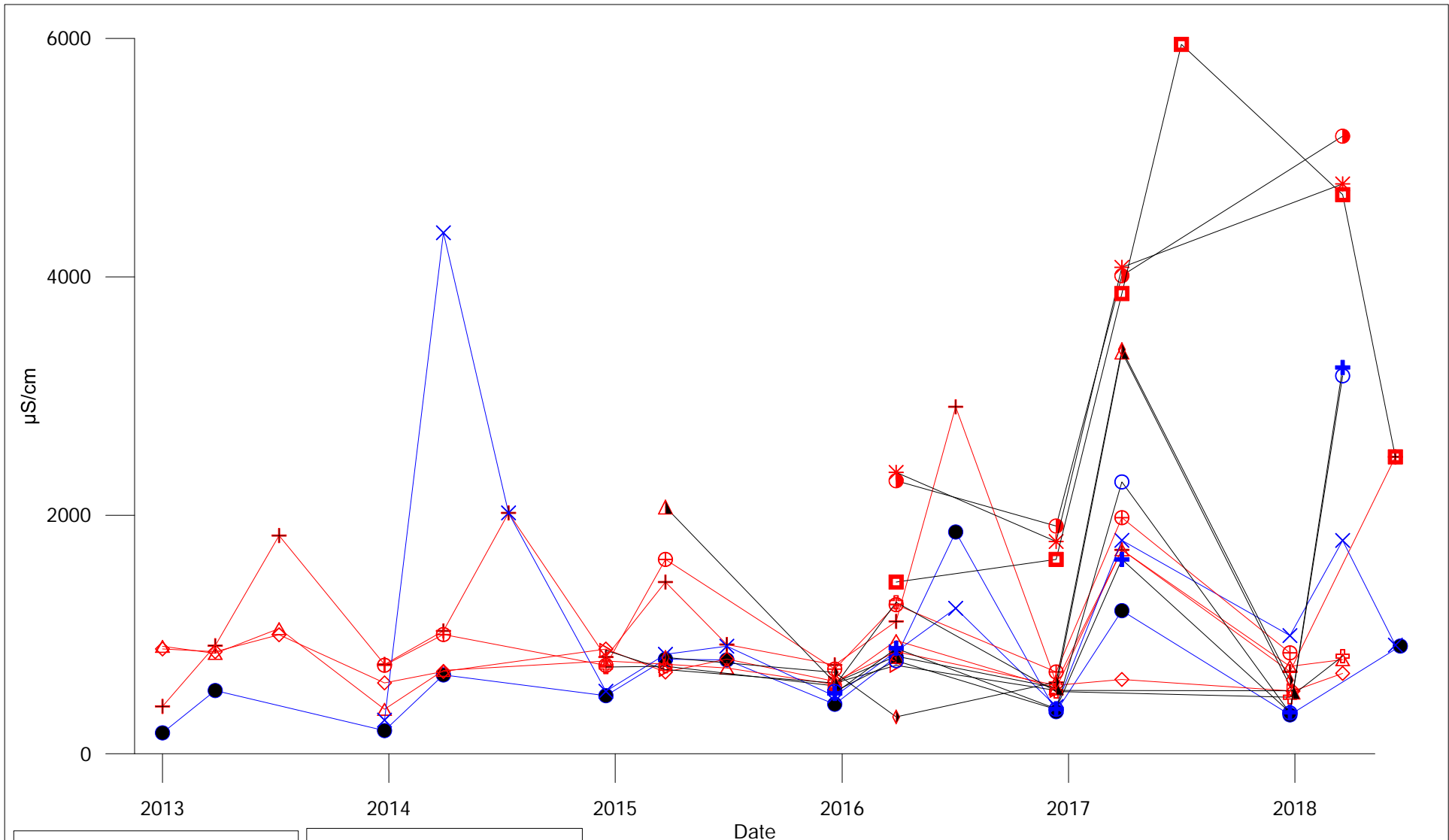
**Cd CCME Criteria
0.0009 Long Term**

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Cadmium Surface Water		
APRIL 2019	FIGURE 44	REV 0



CCME Chloride Criteria = 640 mg/L

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Chloride Surface Water		
APRIL 2019	FIGURE 45	REV 0



Up Stream

- SW25-1
- × SW25-12
- SW25-13A
- ⊕ SW25-13B

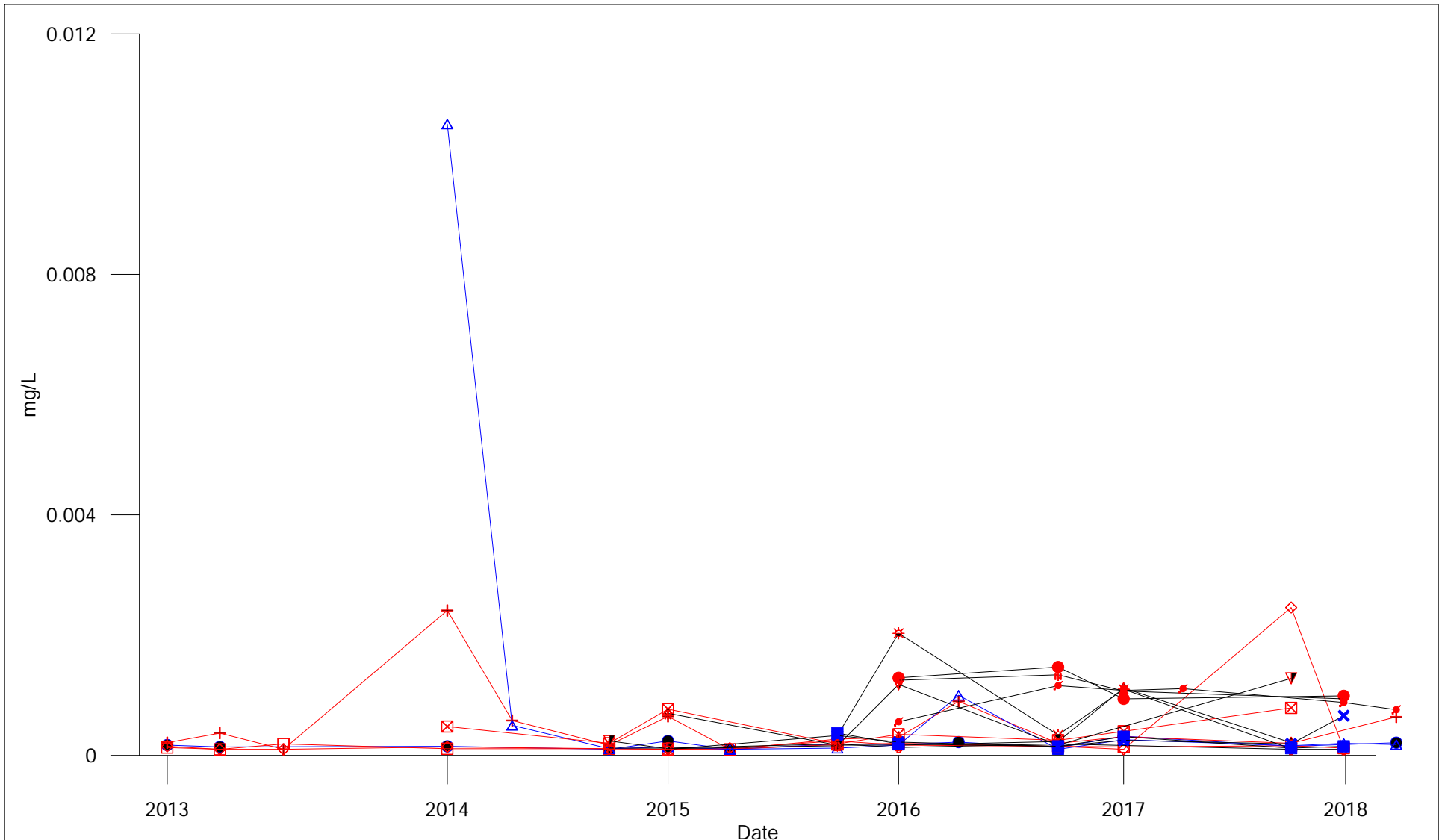
Down Stream

- ⊕ SW25-16
- ⊕ SW25-2
- ◇ SW25-9B
- △ SW25-9A
- ◐ SW25-11A
- ✱ SW25-11B

Down stream

- ⊕ SW25-14A
- ▷ SW25-14B
- ▲ SW25-15A
- ◆ SW25-15B
- SW25-11C

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Specific Conductance Surface Water		
APRIL 2019	FIGURE 51	REV 0



Up Stream

- SW25-1
- △ SW25-12
- SW25-13A
- × SW25-13B

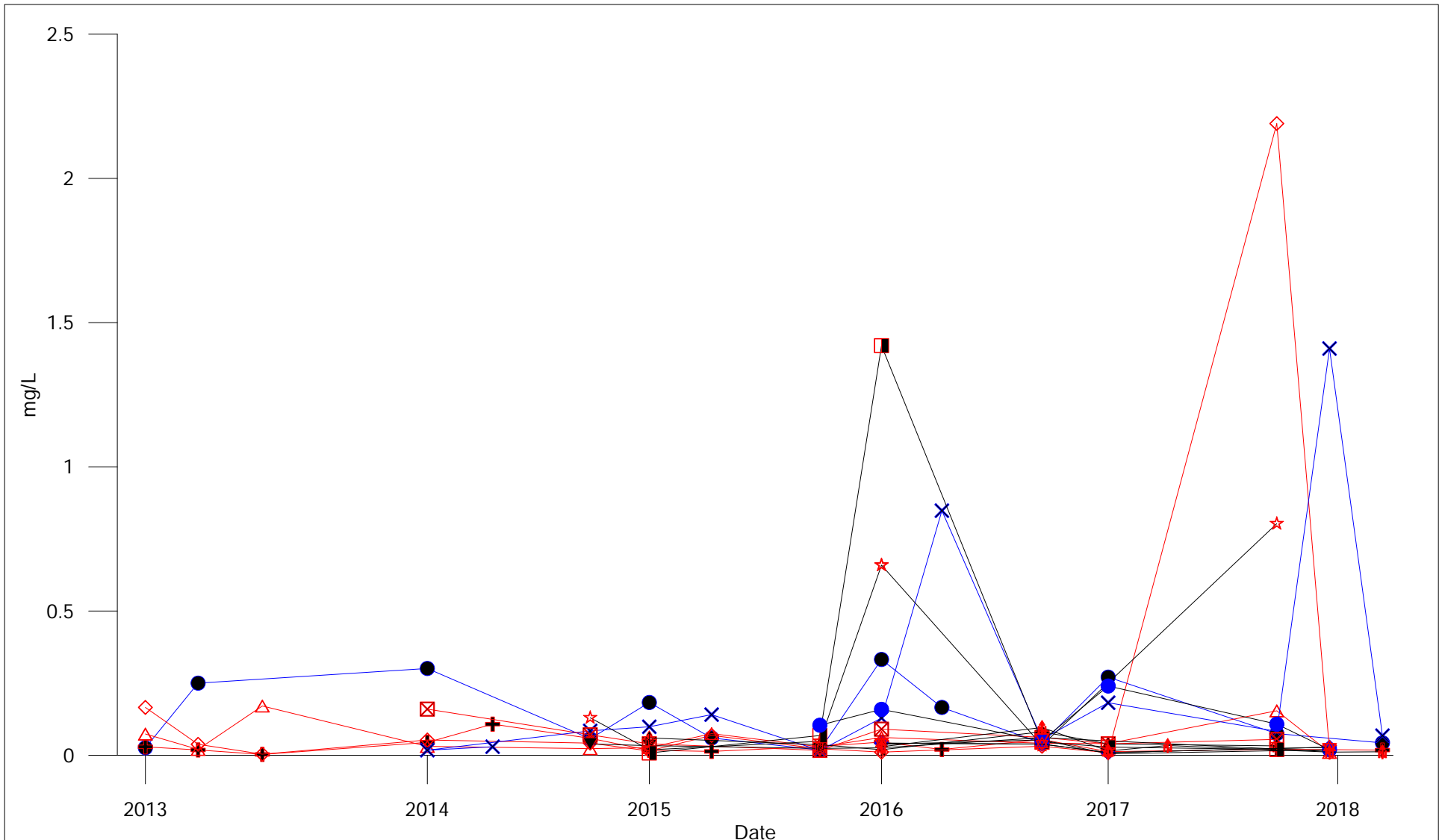
Down Stream

- ⊠ SW25-16
- ⊕ SW25-2
- ◇ SW25-9B
- SW25-9A
- SW25-11A

Down stream

- ⊕ SW25-14A
- ▽ SW25-14B
- ⬆ SW25-15A
- ☀ SW25-15B
- ⬆ SW25-11B
- SW25-11C

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Chromium Surface Water		
APRIL 2019	FIGURE 46	REV 0



Up Stream

- SW25-1
- × SW25-12
- SW25-13A
- ◇ SW25-13B

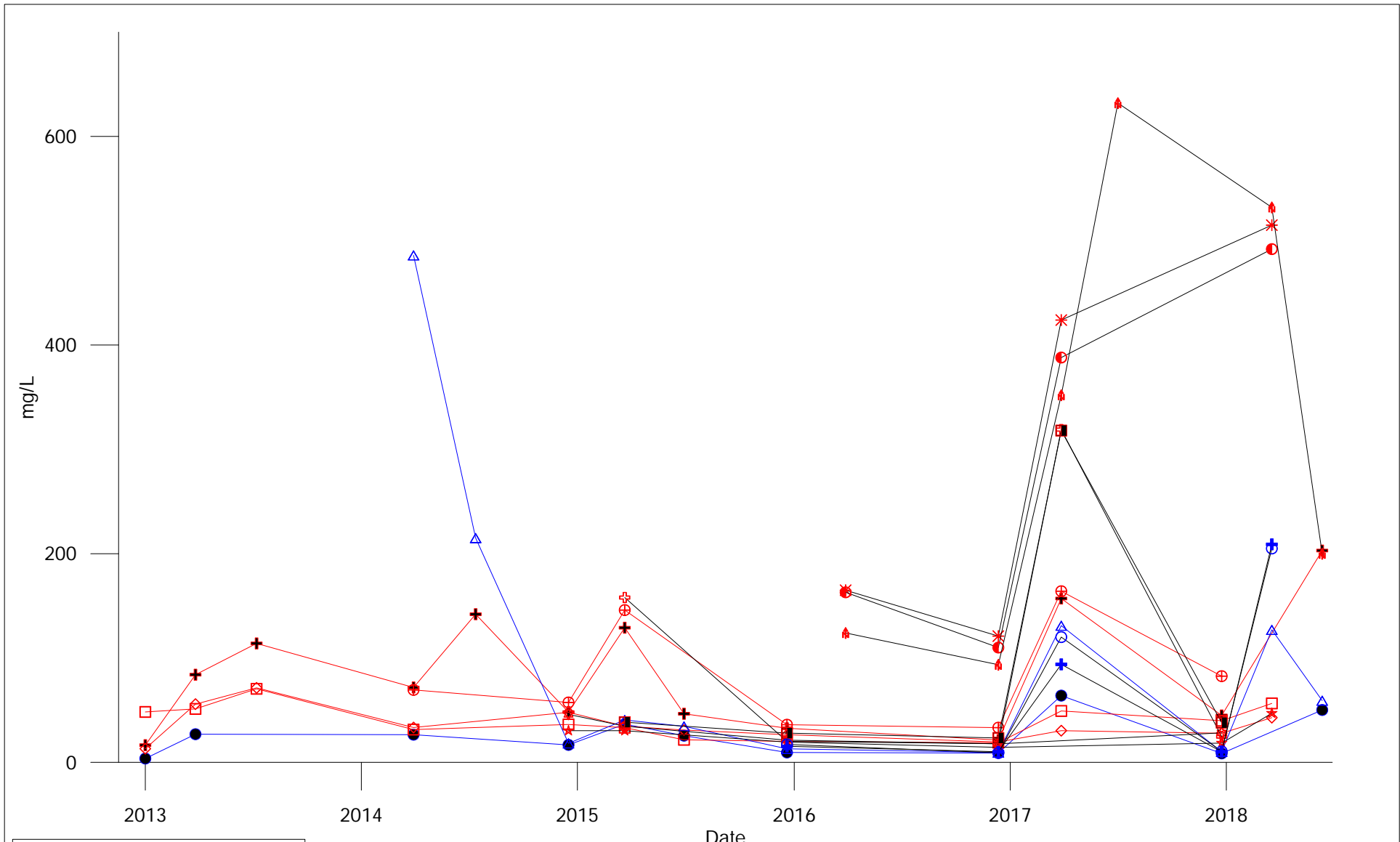
Down Stream

- ⊠ SW25-16
- ⊕ SW25-2
- ◇ SW25-9B
- △ SW25-9A
- ▽ SW25-11A

Down Stream

- ▼ SW25-14A
- ☆ SW25-14B
- ⬆ SW25-15A
- ◻ SW25-15B
- ☆ SW25-11B
- ⬆ SW25-11C

	City Of Winnipeg Solid Waste Services	
	BRADY ROAD RESOURCE MANAGEMENT FACILITY	
Dissolved Iron Surface Water		
APRIL 2019	FIGURE 47	REV 0



Up Stream	
●	SW25-1
△	SW25-12
○	SW25-13A
+	SW25-13B

Down Stream	
⊕	SW25-16
+	SW25-2
◇	SW25-9B
□	SW25-9A
*	SW25-11A
◐	SW25-11B

Down stream	
☆	SW25-14A
☆	SW25-14B
+	SW25-15A
■	SW25-15B
♠	SW25-11C

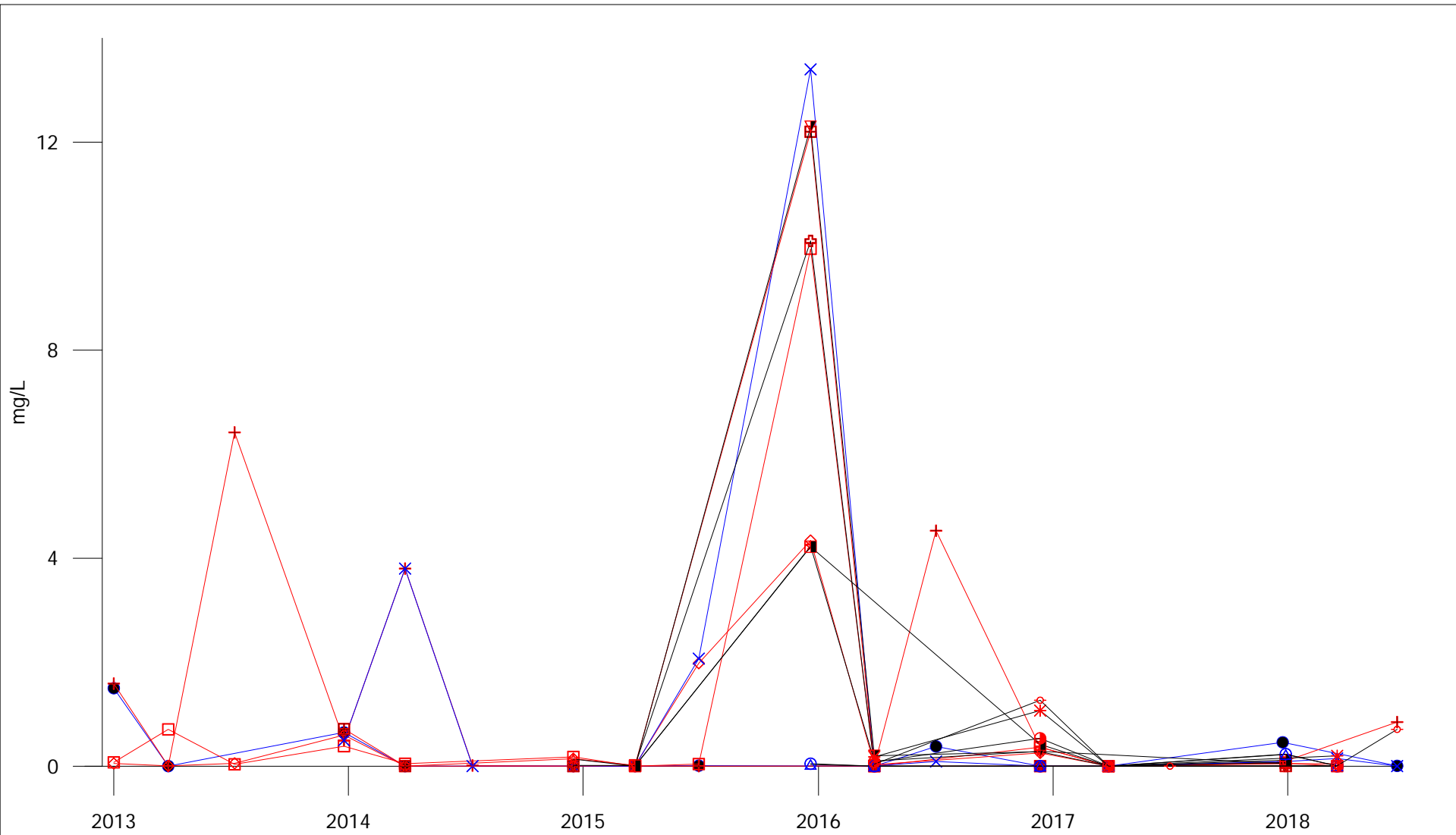



City Of Winnipeg
Solid Waste Services

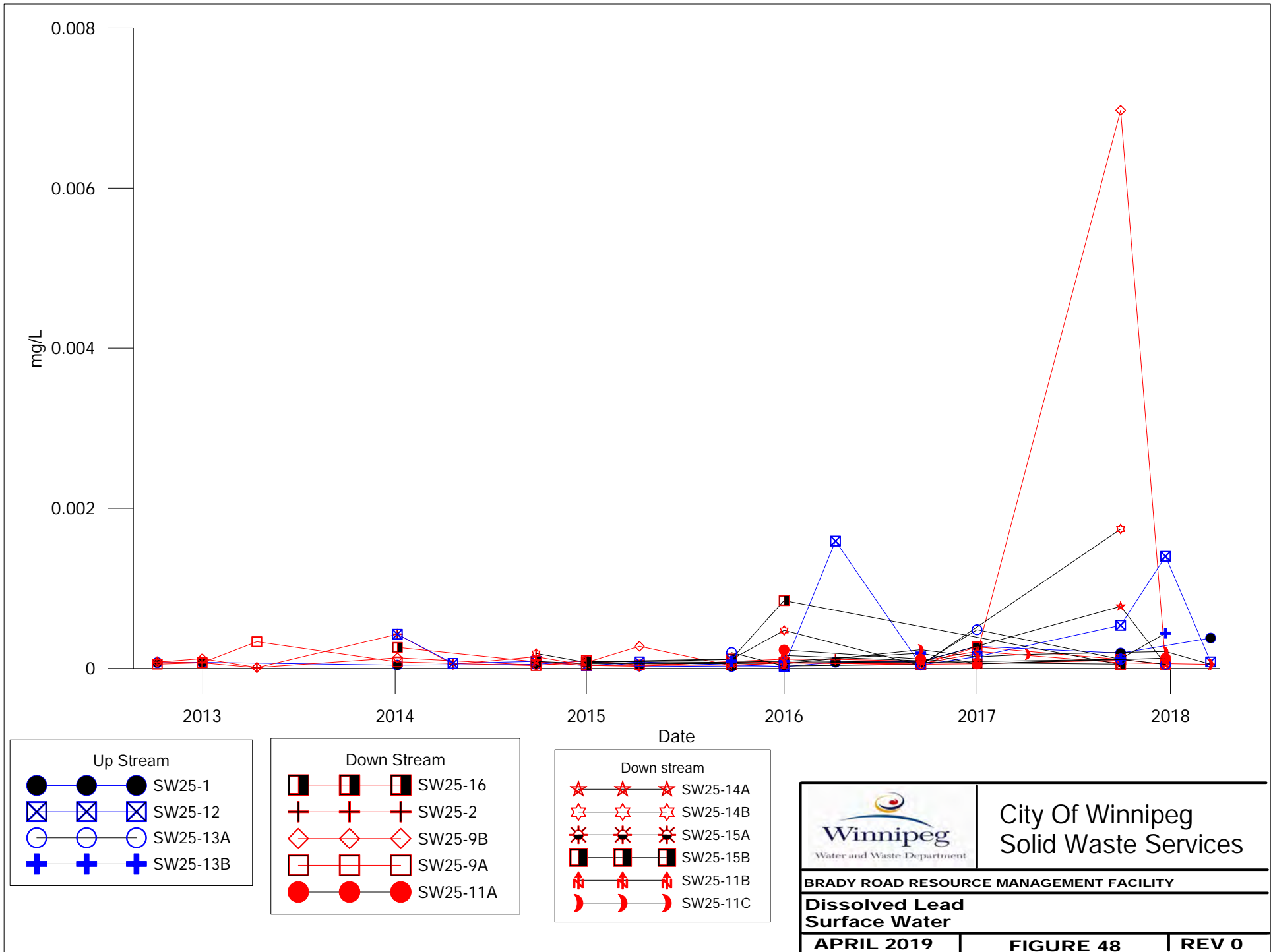
BRADY ROAD RESOURCE MANAGEMENT FACILITY

Dissolved Sodium
Surface Water

APRIL 2019 | FIGURE 50 | REV 0



<p>Up Stream</p> <ul style="list-style-type: none"> ● SW25-1 × SW25-12 ○ SW25-13A △ SW25-13B 	<p>Down Stream</p> <ul style="list-style-type: none"> ⊠ SW25-16 ⊕ SW25-2 ◇ SW25-9B □ SW25-9A ◐ SW25-11A ✱ SW25-11B 	<p>Down stream</p> <ul style="list-style-type: none"> ⊕ SW25-14A ☆ SW25-14B ▼ SW2-15A ◼ SW25-15B ○ SW25-11C 	<div style="text-align: center;">  <p>City Of Winnipeg Solid Waste Services</p> </div> <hr/> <p>BRADY ROAD RESOURCE MANAGEMENT FACILITY</p> <p>Nitrate Nitrite as Nitrogen Surface Water</p> <hr/> <p>APRIL 2019 FIGURE 49 REV 0</p>
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Up Stream

- SW25-1
- ⊠ SW25-12
- SW25-13A
- ⊕ SW25-13B

Down Stream

- ◻ SW25-16
- ⊕ SW25-2
- ◇ SW25-9B
- ◻ SW25-9A
- SW25-11A

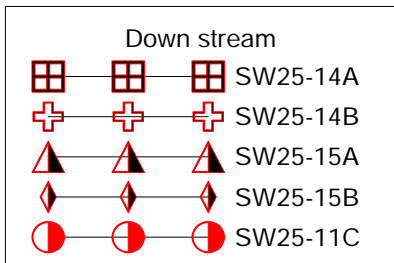
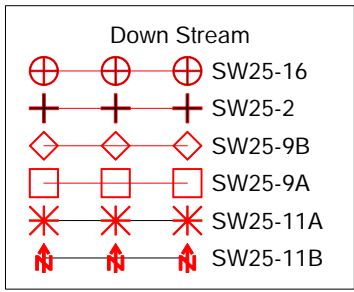
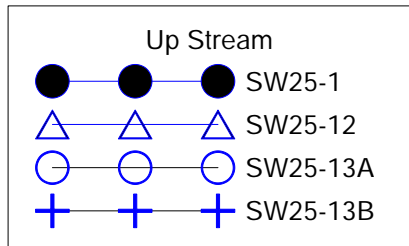
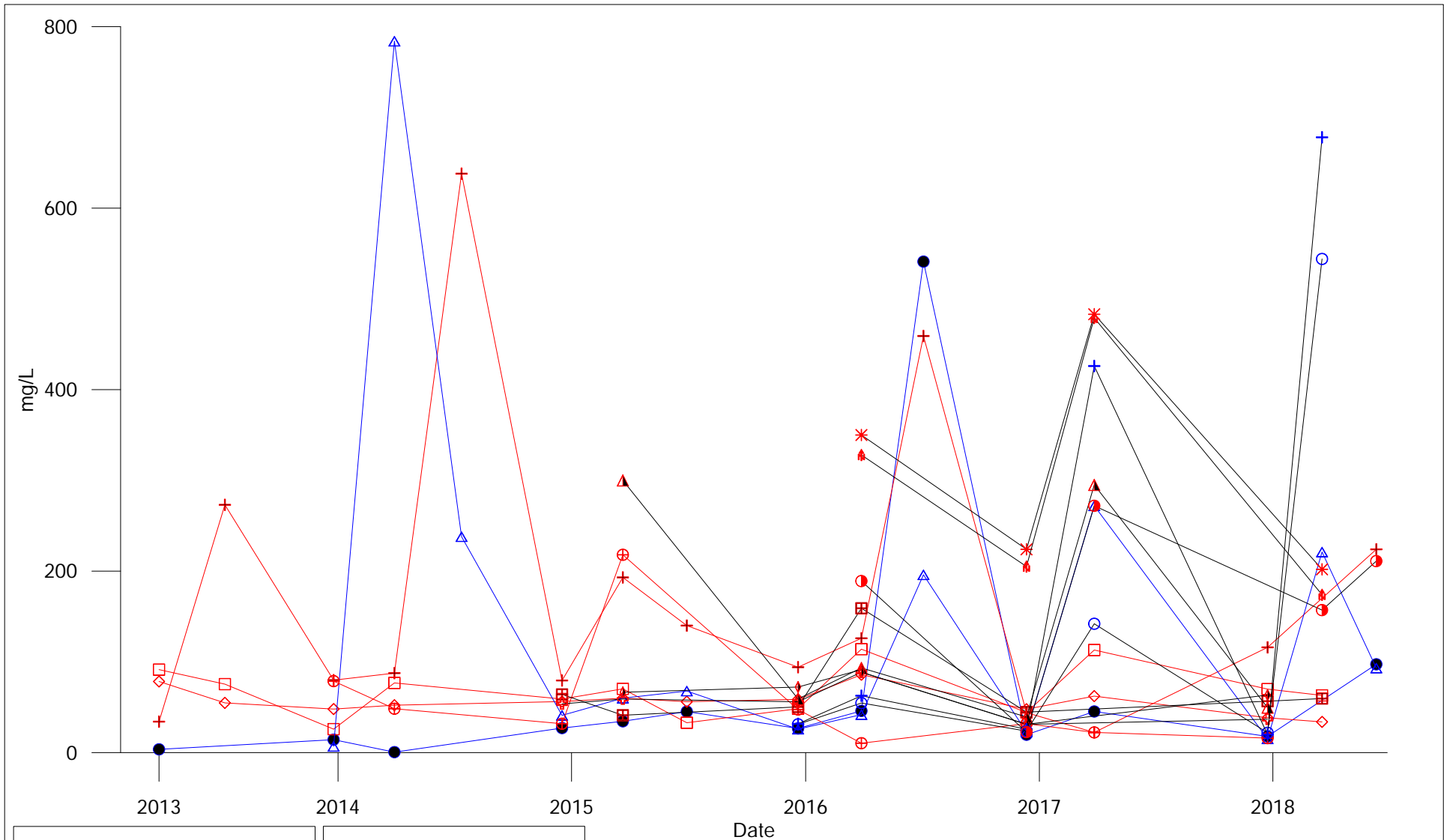
Down stream

- ☆ SW25-14A
- ☆ SW25-14B
- ⊗ SW25-15A
- ◻ SW25-15B
- ⬆ SW25-11B
- ☾ SW25-11C



City Of Winnipeg
Solid Waste Services

BRADY ROAD RESOURCE MANAGEMENT FACILITY		
Dissolved Lead Surface Water		
APRIL 2019	FIGURE 48	REV 0



City Of Winnipeg
Solid Waste Services

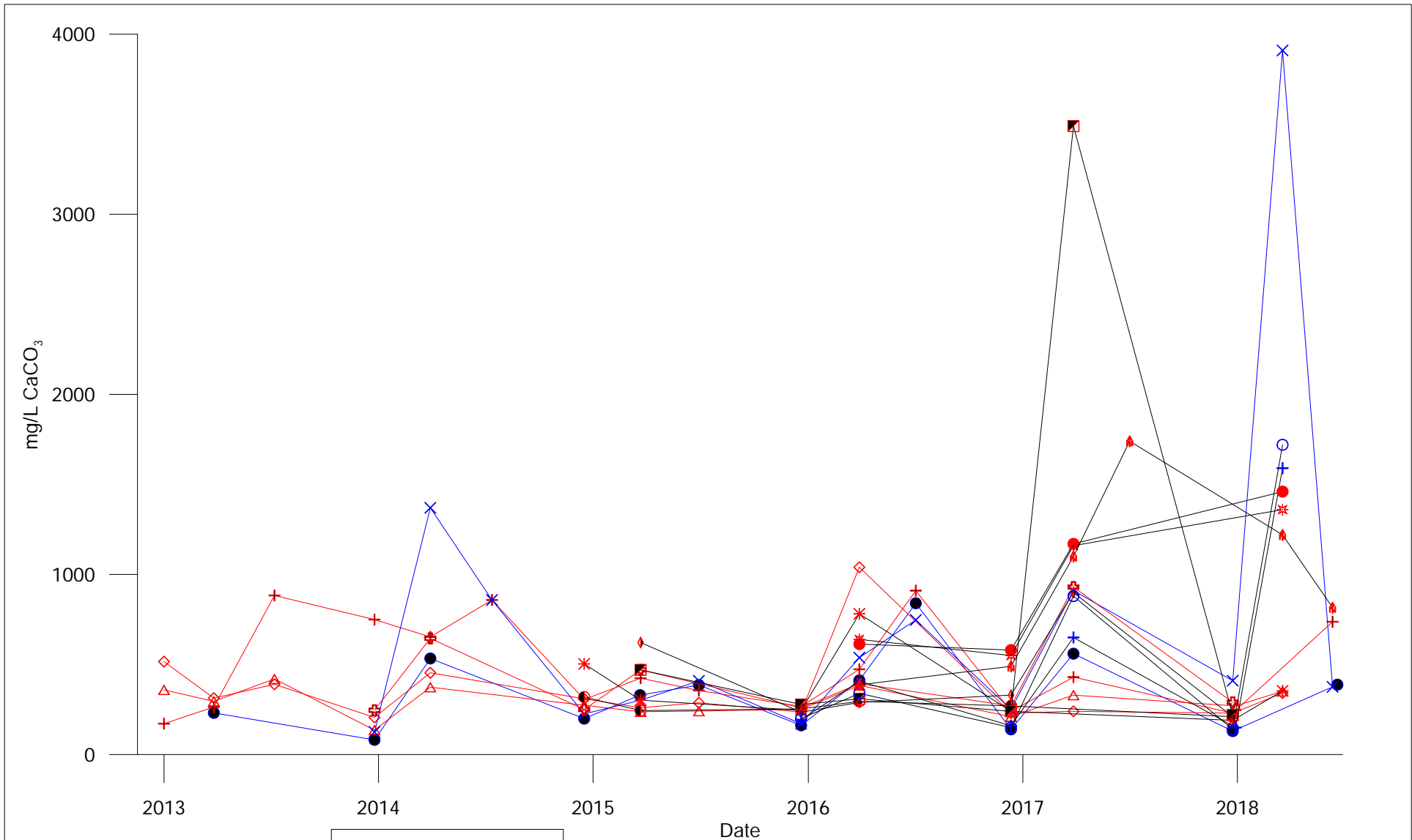
BRADY ROAD RESOURCE MANAGEMENT FACILITY

Sulfate
Surface Water

APRIL 2019

FIGURE 52

REV 0



Up Stream

- SW25-1
- × SW25-12
- SW25-13A
- + SW25-13B

Down Stream

- + SW25-16
- + SW25-2
- ◇ SW25-9B
- △ SW25-9A
- SW25-11A
- * SW25-11B

Down stream

- * SW25-14A
- ◐ SW25-14B
- ◑ SW25-15A
- ◒ SW25-15B
- ↑ SW25-11C



**City Of Winnipeg
Solid Waste Services**

BRADY ROAD RESOURCE MANAGEMENT FACILITY

**Total Hardness
Surface Water**

APRIL 2019 | FIGURE 53 | REV 0

APPENDIX E
2018 LANDFILL GAS COLLECTION
AND FLARING REPORT

**2018 ANNUAL MONITORING REPORT
CITY OF WINNIPEG**

**BRADY ROAD RESOURCE MANAGEMENT FACILITY
LANDFILL GAS COLLECTION AND FLARING SYSTEM**

Prepared for

THE CITY OF WINNIPEG

Prepared by

INTEGRATED GAS RECOVERY SERVICES INC.

March 4, 2019



2018 ANNUAL MONITORING REPORT CITY OF WINNIPEG

BRADY ROAD RESOURCE MANAGEMENT FACILITY LANDFILL GAS COLLECTION AND FLARING SYSTEM

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APPENDIX A Plant and Flare Data

1.0 INTRODUCTION

The City of Winnipeg operates the Landfill Gas Collection and Flaring System at the Brady Road Resource Management Facility in Winnipeg, Manitoba, which operates under Manitoba Conservation Licence 3081. After a short commissioning phase, the system became operational full time in August 2013 after approval to operate was received by the Office of the Fire Commissioner.

Operation of the system including maintenance and monitoring was completed by Comcor Environmental Limited (Comcor) on behalf of its partner Integrated Gas Recovery Services (IGRS).

This report outlines work performed and data collected during the operation of the Landfill Gas Collection and Flaring System during 2018.

2.0 LANDFILL GAS COLLECTION SYSTEM

There are two main components of the LGCFS that require monitoring. These include:

- Landfill Gas Collection Wellfield
- Mechanical System

The purpose and procedures associated with the monitoring of each of these components are discussed separately below. The recommended monitoring frequency is presented in Table 1.

Table 1: Summary of Monitoring Frequency

System Component	Monitoring Frequency
Wellfield Monitoring	Monthly
Remote Mechanical System Monitoring	Weekly
Mechanical System Monitoring	Weekly

2.1 Wellfield System Monitoring

The wellfield system monitoring consists of measuring vacuum/pressure in each well and lateral pipe, as well as the percentage of methane, oxygen and carbon dioxide in the landfill gas, and parts per million of carbon monoxide and hydrogen sulphide at each location. These measurements were taken using a proper gas meter/analyzer such as a Landtec GEM-5000, or equivalent. Vacuum fluctuations were noted, as it can be an indication of water within in the piping system.

Each wellhead was monitored for the velocity of gas using an anemometer. The measured velocities were used to calculate landfill gas flow rates by multiplying the velocity by the pipe cross-sectional area.

The monitoring data collected during the monthly round is beneficial to determine if the wellfield is operating as intended. Changes to the wellhead valve position were made to ensure maximum gas collection from the landfill. The system was monitored and field balanced by a technician experienced in the operation of this type of system.

In July 2018, a Change Work Order (CWO) was issued by the City of Winnipeg following recommendation of Lateral #4 repairs and an extension of the compressed air and forcemain piping as associated with the leachate pumping system (LPS), including an additional conduit for future electrical. Figure 1 presents the existing wellfield conditions at the site.

During 2018, elevated levels of Carbon Monoxide (CO) (>500 ppm) were occasionally found at GW 2-13, which is consistent with historical monitoring. In addition, GW1-7 had elevated levels of CO from January through December. From mid 2016 to October 2017, GW1-7 was closed due to low methane levels and high CO. The CO levels dropped in late 2017 and the temperature readings were within a more typical range so the well was cracked for gas collection. The highest CO levels at 1-7 tends to occur during spring and summer. Elevated carbon monoxide within landfill gas can be an indicator of a subsurface fire within the waste. There was no indication of a subsurface fire in 2018.

An assessment of the wellfield monitoring data in late 2018 and early 2019 indicated that there were a number of wells on Lateral 6 and Lateral 7 without vacuum. Figure 2 presents the wells that have vacuum on Lateral 6 and 7 with green circles. The red circles indicate wells without vacuum.

The cause of the lost vacuum is under investigation, but it is suspected that Lateral 7 may have a portion of pipe blocked by frozen leachate. The area with the red bubbling indicates the suspected area of blocked pipe. It is believed that this section of pipe may have been flooded through late 2018 due to flooding of the header. The flooding occurred as a result of high leachate levels in manholes that also acted as discharge points for gravity drain traps. Instead of condensate draining from the gas pipe into the manholes, the gravity drains were drawing in leachate into the gas pipe. Since then, upgrades to the leachate collection system have taken place and flooding of the gas pipe should not be an issue in the future. As such, it is recommended that a reassessment of Lateral 7 well vacuum be performed in spring or early summer. If the blockage is caused by frozen leachate in the pipe, it should melt and no longer an issue by mid-summer. Additional clay cap or insulation over this section of pipe is recommended if the blockage was caused by frozen leachate. If the vacuum loss continues through summer, the pipe should be excavated and repaired, as necessary

Lateral 6 has lost vacuum further away from the header and area where leachate was entering the gas pipes. It is suspected that the lateral pipe is pinched between wells 6-55 and 6-66, as indicated by a red circle. It is recommended that the pipe be excavated and inspected for pinching or breakage in the spring. Repairs should be performed as required.

The wellfield monitoring data and valve positions can be found in Table 2.

Pump counter measurements were recorded on a monthly basis at all dual purpose gas/leachate collection wells. However, due to Comcor staffing issues which have since been corrected, four months of pump counter data was not recorded, including March, October, November and December 2018. Due to the lack of a functioning pump counter, pump counter readings were not recorded at PDT4 and well 3-29 throughout the 2018 reporting year. Table 3 presents the pump counter measurements recorded at both the pump drain traps and dual purpose wells in 2018. The following wells were fitted with pneumatic pumps for leachate removal during 2018: H-4, 1-9, 1-10, H-11, 2-18, 3-27, 3-29 and 3-30. Dual purpose well locations were chosen based on the incidence of elevated leachate levels in the surrounding area. Additional well locations were



LEGEND

- ROADS
 - MANHOLES
 - BUILDINGS
 - PERIMETER DITCHES/POND EDGE
 - FENCE
-
- GRAVITY DRAIN TRAP
c/w 75# HDPE DRAIN LINE
TO LEACHATE MANHOLE
AND DESIGNATION.
 - EXISTING LEACHATE MANHOLE
c/w 100# HDPE SUB-LATERAL PIPE,
FLOW CONTROL ASSEMBLY
AND DESIGNATION.
 - DUAL-PURPOSE WELL - LANDFILL
GAS EXTRACTION & LEACHATE PUMP -
c/w 100# SUB-LATERAL PIPE
AND DESIGNATION.
 - FLOW CONTROL ASSEMBLY
AND DESIGNATION.
 - ABOVE-GROUND WELL HEAD
AT LEACHATE MANHOLE
c/w 100# HDPE SUB-LATERAL
PIPE AND DESIGNATION.
 - LANDFILL GAS EXTRACTION WELL
c/w 100# HDPE SUB-LATERAL PIPE,
COMPRESSED AIR AND FORCEMAIN
PIPING AND DESIGNATION.
 - 250# LANDFILL GAS LATERAL,
75# FORCEMAIN &
75# COMPRESSED AIR
IN SAME TRENCH.
 - LANDFILL GAS EXTRACTION WELL
c/w 100# HDPE SUB-LATERAL PIPE
AND DESIGNATION.
 - PIUMPED CONDENSATE
DRAIN TRAP
AND DESIGNATION.
 - 450# LANDFILL GAS HEADER,
75# CONDENSATE PUMP DISCHARGE
75# WELLFIELD FORCEMAIN &
75# COMPRESSED AIR
IN SAME TRENCH.

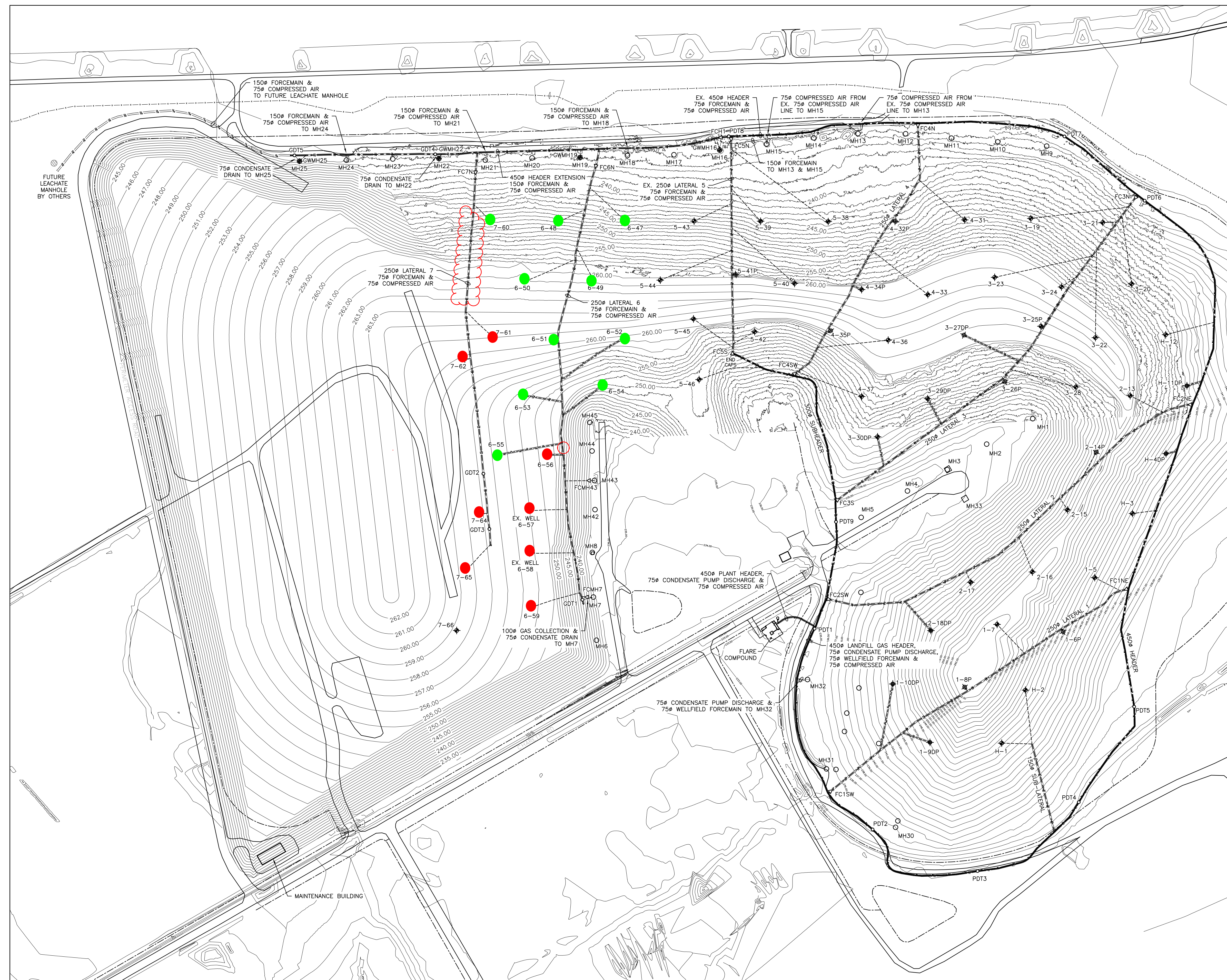


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INTEGRATED GAS RECOVERY SERVICES
 A Landfill Gas Utilization Company

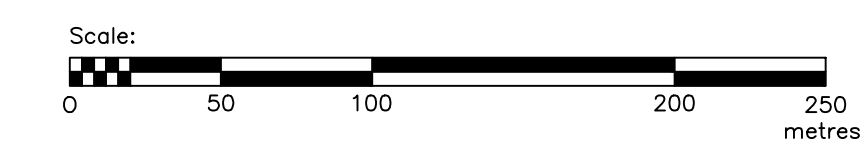
City of Winnipeg
 Brady Road
 Resource Management
 Facility

FIGURE 1
 EXISTING
 SITE CONDITIONS



LEGEND

- ROADS
 - MANHOLES
 - BUILDINGS
 - PERIMETER DITCHES/POND EDGE
 - FENCE
-
- GRAVITY DRAIN TRAP
c/w 75mm HDPE DRAIN LINE
TO LEACHATE MANHOLE
AND DESIGNATION.
 - EXISTING LEACHATE MANHOLE
c/w 100mm HDPE SUB-LATERAL PIPE,
FLOW CONTROL ASSEMBLY
AND DESIGNATION.
 - DUAL-PURPOSE WELL - LANDFILL
GAS EXTRACTION & LEACHATE PUMP -
c/w 100mm SUB-LATERAL PIPE
AND DESIGNATION.
 - FLOW CONTROL ASSEMBLY
AND DESIGNATION.
 - ABOVE-GROUND WELL HEAD
AT LEACHATE MANHOLE
c/w 100mm HDPE SUB-LATERAL
PIPE AND DESIGNATION.
 - LANDFILL GAS EXTRACTION WELL
c/w 100mm HDPE SUB-LATERAL PIPE,
COMPRESSED AIR AND FORCEMAIN
PIPING AND DESIGNATION.
 - 250mm LANDFILL GAS LATERAL,
75mm FORCEMAIN &
75mm COMPRESSED AIR
IN SAME TRENCH.
 - LANDFILL GAS EXTRACTION WELL
c/w 100mm HDPE SUB-LATERAL PIPE
AND DESIGNATION.
 - PIUMPED CONDENSATE
DRAIN TRAP
AND DESIGNATION.
 - 450mm LANDFILL GAS HEADER,
75mm CONDENSATE PUMP DISCHARGE
75mm WELLFIELD FORCEMAIN &
75mm COMPRESSED AIR
IN SAME TRENCH.



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INTEGRATED GAS RECOVERY SERVICES
 A Landfill Gas Utilization Company

City of Winnipeg
 Brady Road
 Resource Management
 Facility

FIGURE 2
 AREAS OF VACUUM LOSS

Table 2: Wellfield Monitoring Data

Units			26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18
Weather Conditions													
Ambient Temperature ° C			-3						30	24	8		
Control Panel													
Flow Rate	CFM		909						795	801	806		
CH ₄	%		34.9						48.2	48.4	48.1		
O ₂	%		7.1						2.6	2.10	2.1		
Wellfield Vac	"H ₂ O		-21.7						-44.4	-16.9	-19.3		
Outlet Press.	"H ₂ O		3.6						3.5	3.4	3.5		
LOCATIONS													
H-1													
Well	"H ₂ O		-10.36	-39.43	-31.68	-22.04	-7.94	-4.23	-3.77	-0.58	-1.42	-0.69	-0.47
well bore sea	"H ₂ O		-10.54	-47.32	-40.53	-45.88	-35.74	-40.02	-44.03	-15.39	-18.15	-8.06	-11.17
CH ₄	%		42.8	20.8	18.8	26.0	25.2	31.2	50.4	54.1	52.9	41.5	40.5
CO ₂	%		33	21.6	17.2	21.3	21.0	23.4	33.2	35.9	35.4	27.6	26.8
O ₂	%		0.9	4.7	7.5	7.8	7.7	6.4	2.9	1.9	2.1	6.4	6.8
BAL (N ₂)	%		23.4	52.9	56.6	44.8	46.2	39.0	13.5	8.1	9.6		23.8
CO	PPM		0	0	22	16	18	14	33	44	23		40
H ₂ S	PPM		24	2	0	0	13	10	1	16	11		
Vel Max	m/s		5.24	16.42	18.40	6.65	6.20	4.89	2.01	1.31	1.24		-
Vel Min	m/s		5.05	16.01	17.88	6.07	5.76	4.58	1.74	1.18	1.16		-
Flow	CFM		48.61735594	153.2226291	171.4127963	60.0984225	56.50763625	44.74308656	17.71769531	11.76454969	11.339325	0	#VALUE!
Temp	° C		15.9	16.3	15.8	24.7	24.7	25.0	-	-	-		-
Comments			2.5T -> no change	2.5T -> no change	2.5T -> 1T	1T -> 3/4T	3/4T -> 1/2T	1/2T -> 1/4T	1/4T -> no change	1/4T -> no change	1/4T -> no change	closed 1/4 T	clacked -> closed
H-2													
Well	"H ₂ O		-0.15	-0.73	0.30	0.36	-0.51	-0.89	-1.16	-0.14	-0.37	-1.25	-0.80
Lateral	"H ₂ O		-10.66	-48.95	-42.17	-44.42	-36.38	-40.63	-43.14	-15.20	-18.02	-7.73	-10.20
CH ₄	%		21.6	16.5	57.8	52.6	57.8	52.2	57.4	56.4	57.6	44.8	42.2
CO ₂	%		20.1	12.7	37.5	41.8	40.0	40.8	40.7	41.3	41.1	33.1	31.1
O ₂	%		12.2	14.0	1.7	0.4	0.6	0.2	0.4	0.4	0.5	4.1	5.1
BAL (N ₂)	%		46.3	56.2	8.2	0.0	8.5	6.8	1.4	0.6	2.0	18.0	21.5
CO	PPM		0	0	14	21	27	23	35	41	30	10	27
H ₂ S	PPM		0	0	4	3	27	24	7	21	18		
Vel Max	m/s		0.44	-	1.40	1.37	1.76	2.11	3.47	1.45	1.62		4.68
Vel Min	m/s		0.00	-	1.36	1.16	1.60	1.84	3.35	1.42	1.55		4.37
Flow	CFM		2.07887625	#VALUE!	13.04022375	11.95353844	15.875055	18.66263906	32.22258188	13.55994281	14.97735844	0	42.75870469
Temp	° C		15	-	19.1	32.8	31.3	31.0	-	-	-		-3.8
Comments			1/4T -> closed	closed -> no change	closed -> 1/4T	1/4T -> 1/2T	1/2T -> 3/4T	3/4T -> 1T	1T -> 1.25T	1.25T -> 1.5T	1.5T -> 1.75T	closed 1/4 T	closed
H-3													
Well	"H ₂ O		0.09	1.47	-9.82	-18.71	-20.05	-21.73	-25.98	-6.85	-9.32	-5.72	-7.98
Lateral	"H ₂ O		-11.30	-51.10	-44.73	-45.30	-36.72	-39.85	-43.36	-15.02	-18.00	-6.99	-9.35
CH ₄	%		36.9	55.0	47.1	41.4	42.6	40.9	56.2	56.4	55.7	56.3	54.5
CO ₂	%		31.1	44.7	38.0	35.6	36.3	35.5	43.4	43.0	42.9	41.9	41.8
O ₂	%		4.0	0.2	2.0	2.2	1.9	2.0	0.3	0.5	0.7	1.1	1.4
BAL (N ₂)	%		28.1	0.0	12.9	20.6	19.2	21.7	0.0	0.0	0.7	0.7	3.5
CO	PPM		92	103	126	20	51	39	80	248	174	57	70
H ₂ S	PPM		4	13	30	17	41	35	16	32	41		
Vel Max	m/s		-	5.15	3.91	5.74	6.22	6.36	4.51	1.45	1.62		4.06
Vel Min	m/s		-	4.95	3.75	5.55	6.00	6.19	3.81	1.30	1.54		3.87
Flow	CFM		#VALUE!	47.71965938	36.19134563	53.34207469	57.73606313	59.29522031	39.30966	12.99297656	14.93011125	0	37.46701969
Temp	° C		-	8.4	14.7	19.2	19.1	22.4	-	-	-		8.7
Comments			closed -> no change	closed -> 1/2T	1/2T -> 1T	1T -> no change	1T -> no change	1T -> no change	1T -> 1.25T	1.25T -> 1.5T	1.5T -> no change	1/4 T	1/2 T
H-4 DP													
Well	"H ₂ O		-0.03	0.37	-4.93	0.88	-0.64	-0.98	0.37	-2.51	-4.21	-4.23	-5.35
Lateral	"H ₂ O		-11.13	-48.47	-41.65	-45.12	-36.34	-39.59	-43.40	-15.11	-18.14	-7.05	-9.46
CH ₄	%		47.7	54.5	25.9	57.0	46.5	47.4	56.8	56.5	54.0	56.2	57.7
CO ₂	%		36.9	38.9	20.0	42.6	35.6	36.0	42.2	43.2	41.6	43.7	41.3
O ₂	%		3.9	2.5	10.5	0.3	3.2	2.8	0.8	0.2	0.5	0.1	1.0
BAL (N ₂)	%		11.4	3.9	43.6	0.0	14.7	13.8	0.0	0.0	4.0	0.0	0.0
CO	PPM		20	13	20	2	22	17	60	90	108	49	0
H ₂ S	PPM		14	21	13	81	38	44	31	52	46		
Vel Max	m/s		1.88	2.17	6.73	2.46	2.53	3.11	1.11	0.98	1.10		3.47
Vel Min	m/s		1.72	2.10	6.37	2.20	2.16	2.68	1.01	0.92	0.99		3.34
Flow	CFM		17.0089875	20.17454906	61.89381563	22.01718938	22.15893094	27.35612156	10.01640375	8.976965625	9.874662188	0	32.17533469
Temp	° C		8.2	7.1	13.3	30.3	26.5	28.1	-	-	-		6.1
Comments			1/4T -> no change	1/4T -> 3/4T	3/4T -> closed	closed -> 1/4T	1/4 -> no change	1/4T -> no change	1/4T -> 1/2T	1/2T -> 3/4T	3/4T -> no change	neck valve broken. No ch	1 T

Table 2: Wellfield Monitoring Data

	Units	26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18	
1-5 well bore sea	Well	"H ₂ O	-0.45	-1.05	-2.26	-0.76	0.26	0.11	1.83	1.13	0.76	-0.51	-0.82
	Lateral	"H ₂ O	-11.07	-51.49	-44.03	-45.33	-36.60	-40.02	-43.48	-15.27	-18.08	-7.18	-9.60
	CH ₄	%	49.0	41.0	31.1	31.1	34.1	33.0	34.1	57.7	54.8	56.6	52.2
	CO ₂	%	34.2	34.4	28.6	29.6	29.8	28.7	41.9	43.2	42.5	43.3	41.0
	O ₂	%	2.8	2.5	4.3	3.5	3.7	4.3	0.4	0.2	0.3	0.1	0.3
	BAL (N ₂)	%	14.0	22.1	36.0	35.8	32.5	34.0	0.0	0.0	2.5	0.0	6.0
	CO	PPM	30	22	2	17	7	0	17	32	20	0	0
	H ₂ S	PPM	0	1	4	0	15	21	76	92	68	0	0
	Vel Max	m/s	1.03	2.26	3.89	2.85	0.98	0.81	0.00	0.98	1.03		1.99
	Vel Min	m/s	0.98	1.95	3.65	2.54	0.42	0.00	0.00	0.85	0.94		1.37
	Flow	CFM	9.496684688	19.89106594	35.62437938	25.46623406	6.61460625	3.827022188	0	8.646235313	9.321870094	0	15.875055
	Temp	°C	12.0	15.7	24.5	32.8	32.1	32.0	-	-	-	-	-3.4
	Comments		1/4T -> no change	1/4T -> 1/2T	1/2T -> 1/4T	1/4T -> cracked	cracked -> no change	cracked -> no change	cracked -> 1/4T	1/4T -> 1/2T	1/2T -> 3/4T	no change	no change
1-6 DP	Well	"H ₂ O	-0.10	-0.31	0.01	-0.84	-0.62	-1.00	-1.12	0.00	0.04	-1.20	-1.45
	Lateral	"H ₂ O	-10.98	-51.23	-44.42	-45.10	-36.49	-39.91	-43.32	-15.31	-18.10	-7.46	-10.02
	CH ₄	%	33.2	35.5	48.5	33.1	36.0	35.4	59.0	58.8	56.9	45.5	39.8
	CO ₂	%	25.9	26.8	34.1	27.2	28.6	27.2	39.5	40.9	40.8	33.5	31.8
	O ₂	%	6.1	4.7	2.0	3.9	3.5	3.8	0.8	0.3	0.4	2.7	2.9
	BAL (N ₂)	%	35.0	33.5	15.3	36.0	32.1	33.0	0.7	0.0	2.3	18.5	25.5
	CO	PPM	15	14	13	11	14	9	20	23	14	0	15
	H ₂ S	PPM	43	29	113	28	97	112	67	130	102		
	Vel Max	m/s	1.48	1.56	1.10	2.76	2.54	3.01	1.51	1.02	0.88		3.10
	Vel Min	m/s	1.17	1.19	1.03	2.63	2.21	2.68	1.33	0.98	0.76		3.00
	Flow	CFM	12.52050469	12.99297656	10.06365094	25.46623406	22.44241406	26.88364969	13.41820125	9.4494375	7.74853875	0	28.82078438
	Temp	°C	13.1	14.9	21.1	31.0	30.9	31.4	-	-	-	-	-1.7
	Comments		1/2T -> 1/4T	1/4T -> no change	1/4T -> 1/2T	1/2T -> 1/4T	1/4T -> no change	1/4T -> no change	1/4T -> 1/2T	1/2T -> 3/4T	3/4T -> no change	no change	no change
1-7	Well	"H ₂ O	-0.57	0.15	-1.20	-0.43	-0.46	-0.05	0.21	0.50	0.33	0.10	0.14
	Lateral	"H ₂ O	-19.03	-49.09	-48.91	-46.47	-35.33	-40.11	-43.87	-15.64	-18.03	-6.34	-10.26
	CH ₄	%	0.0	48.1	27.7	35.3	33.6	29.8	53.6	53.0	52.9	52.4	52.9
	CO ₂	%	0.1	51.6	33.8	26.8	36.5	36.9	46.1	46.4	45.8	47.6	46.8
	O ₂	%	20.9	0.4	3.7	2.1	0.7	1.0	0.3	0.4	0.2	0.0	0.2
	BAL (N ₂)	%	79.0	0.0	34.8	25.9	29.0	32.3	0.0	0.0	1.0	0.0	0.0
	CO	PPM	<<<<	707	509	531	601	498	1257	1337	1271	572	555
	H ₂ S	PPM	210	78	60	96	220	247	121	183	218		
	Vel Max	m/s	-	8.63	8.49	5.65	4.33	3.41	-	-	-	-	1.01
	Vel Min	m/s	-	8.15	8.04	5.27	3.94	3.09	-	-	-	-	0.88
	Flow	CFM	#VALUE!	79.28078063	78.09960094	51.59392875	39.07342406	30.71067188	#VALUE!	#VALUE!	#VALUE!	0	8.929718438
	Temp	°C	-	18.4	18.9	21.9	26.6	27.2	-	-	-	-	0.1
	Comments		cracked -> closed	closed -> 1T	1T -> 3/4T	3/4T -> 1/2T	1/2T -> cracked	cracked -> closed	closed -> no change	closed -> no change	closed -> no change	no change	closed -> cracked
1-8	Well	"H ₂ O	-0.18	-0.75	0.07	0.48	-0.10	-0.12	0.05	0.15	0.02	-0.03	0.18
	Lateral	"H ₂ O	-19.10	-45.39	-50.87	-46.75	-35.54	-40.18	-17.98	-15.66	-17.98	-6.86	-10.94
	CH ₄	%	50.9	25.9	40.4	45.1	45.4	47.0	56.7	56.3	57.0	42.3	56.0
	CO ₂	%	45.2	24.8	37.3	33.9	38.1	39.8	42.1	43.4	43.3	32.4	43.8
	O ₂	%	0.3	9.5	2.2	4.5	2.7	2.4	0.8	0.2	0.1	6.0	0.2
	BAL (N ₂)	%	3.6	39.8	19.9	17.0	13.7	10.8	0.5	0.0	0.0	19.5	0.0
	CO	PPM	60	24	30	0	58	51	122	88	93	18	47
	H ₂ S	PPM	72	64	40	68	260	238	128	122	108		
	Vel Max	m/s	2.21	4.88	0.00	0.80	3.51	3.59	1.24	0.84	0.74		-
	Vel Min	m/s	2.10	4.59	0.00	0.00	3.42	3.50	1.19	0.76	0.56		-
	Flow	CFM	20.36353781	44.74308656	0	3.779775	32.74230094	33.49825594	11.48106656	7.55955	6.142134375	0	#VALUE!
	Temp	°C	20.1	20.3	14.9	21.8	30.1	31.0	-	-	-	-	-
	Comments		3/4T -> no change	3/4T -> closed	closed -> cracked	cracked -> 1/4T	1/4T -> no change	1/4T -> no change	1/4T -> no change	1/4T -> 1/2T	1/2T -> no change	cracked -> closed	closed, no change
1-9 DP	Well	"H ₂ O	-0.58	-0.96	-0.62	0.33	-0.22	-0.49	0.21	-0.20	-0.30	-0.17	-1.08
	Lateral	"H ₂ O	-11.03	-50.06	-51.71	-46.43	-37.41	-40.40	-43.70	-15.95	-18.64	-7.55	-10.29
	CH ₄	%	48.9	15.6	14.0	61.3	50.3	47.6	61.4	57.7	59.0	59.0	44.6
	CO ₂	%	36.3	18.1	18.9	38.3	37.5	37.0	38.2	39.8	38.8	39.7	33.8
	O ₂	%	0.7	4.8	3.6	0.3	0.5	0.7	0.4	0.6	0.4	0.8	2.6
	BAL (N ₂)	%	14.0	61.2	63.5	0.0	11.8	14.8	0.0	1.8	4.0		18.8
	CO	PPM	101	329	252	24	75	80	30	105	120		82
	H ₂ S	PPM	54	20	16	153	176	191	167	114	167		
	Vel Max	m/s	0.98	1.25	1.02	1.34	1.90	2.10	0.00	1.06	0.98	needs to be cut down lat port cracked	2.08
	Vel Min	m/s	0.91	1.16	0.89	1.24	1.05	1.32	0.00	1.01	0.91		2.01
	Flow	CFM	8.929718438	11.38657219	9.024212813	12.18977438	13.93792031	16.15853813	0	9.780167813	8.929718438	#VALUE!	19.32409969
	Temp	°C	21.0	22.9	19.7	26.5	33.1	32.7	-	-	-	-	-1.8
	Comments		1/4T -> no change	1/4T -> cracked	cracked -> closed	closed -> 1/4T	1/4T -> 1/2T	1/2T -> no change	1/2T -> 3/4T	3/4T -> no change	3/4T -> no change	1/2 T	very tall, no change

Table 2: Wellfield Monitoring Data

	Units	26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18	
1-10 DP	Well	"H ₂ O	0.00	-0.69	0.06	0.06	-1.22	-1.28	-0.56	-1.29	-1.14	-0.75	-0.87
	Lateral	"H ₂ O	-11.21	-49.35	-52.03	-45.78	-37.65	-40.73	-43.44	-15.97	-18.57	-7.76	-10.18
	CH ₄	%	56.2	19.5	64.8	64.8	40.5	39.9	64.5	61.8	62.1	17.9	17.2
	CO ₂	%	31.4	10.6	33.1	34.6	24.4	23.8	35.2	36.4	35.8	10.8	10.2
	O ₂	%	3.1	13.4	0.3	0.4	6.2	6.6	0.3	0.9	0.6	15.2	14.7
	BAL (N ₂)	%	9.3	56.3	0.0	0.0	28.6	29.7	0.0	0.9	1.5	0.0	57.7
	CO	PPM	<<<<	12	0	23	12	0	29	33	0		0
	H ₂ S	PPM	0	34	22	22	6	0	30	36	28		
	Vel Max	m/s	0.00	1.46	1.02	0.00	1.21	1.18	1.37	0.84	0.77		-
	Vel Min	m/s	0.00	1.38	0.82	0.00	0.93	1.00	1.28	0.76	0.70		-
	Flow	CFM	0	13.41820125	8.6934825	0	10.11089813	10.29988688	12.52050469	7.55955	6.945336563	0	#VALUE!
	Temp	°C	8.0	14.4	16.0	22.7	31.2	31.6	-	-	-	Very tall, needs to be	-
	Comments		1/4T -> no change	1/4T -> closed	closed -> cracked	cracked->1/4T->cracked	cracked-> no change	cracked-> no change	cracked-> 1/4T	1/4T -> 1/2T	1/2T -> no change	cut down	closed, no change
H-11 DP	Well	"H ₂ O	-4.18	-3.58	-26.27	10.15	-8.16	-10.22	-13.18	-7.26	-8.12	-3.88	-6.73
	Lateral	"H ₂ O	-11.78	-45.73	-40.11	-43.76	-36.85	-39.95	-43.03	-15.91	-18.42	-7.05	-9.10
	CH ₄	%	42.0	51.2	23.9	54.4	46.4	45.1	52.8	56.7	54.4	58.0	50.0
	CO ₂	%	30.1	39.5	21.2	43.9	38.8	37.8	38.7	40.6	39.8	41.1	35.8
	O ₂	%	2.9	2.1	8.1	0.5	1.7	2.1	2.1	1.1	1.9	0.8	3.1
	BAL (N ₂)	%	25.1	7.2	46.9	1.2	13.1	15.2	6.3	1.4	4.0	0.0	11.0
	CO	PPM	10	7	15	12	20	16	15	37	40	7	0
	H ₂ S	PPM	67	112	57	162	179	151	101	130	156		
	Vel Max	m/s	2.46	2.58	4.43	2.78	3.16	3.82	1.37	0.94	0.91		1.06
	Vel Min	m/s	2.20	2.22	4.05	2.28	3.06	3.50	1.21	0.89	0.85		0.99
	Flow	CFM	22.01718938	22.67865	40.065615	23.90707688	29.38775063	34.58494125	12.18977438	8.646235313	8.315505	0	9.685673438
	Temp	°C	14.8	16.5	24.0	32.5	30.3	31.0	-	-	-		7.4
	Comments		cracked-> no change	cracked-> 1/2T	1/2T -> cracked	cracked-> 1/2T	1/2T -> no change	1/2T -> no change	1/2T -> no change	1/2T -> no change	1/2T -> no change	1/4 T	no change
H-12 well bore sea	Well	"H ₂ O	-0.79	-1.37	-0.76	-1.71	-1.28	-1.53	-1.04	-0.15	-0.74	port broken	port broken
	Lateral	"H ₂ O	-11.90	-42.21	-40.13	-43.20	-36.69	-39.86	-43.02	-15.97	-18.49	5.90	10.50
	CH ₄	%	45.6	33.2	38.9	33.1	38.8	36.7	59.0	59.2	58.7	59.6	59.9
	CO ₂	%	44.0	22.8	26.5	24.6	28.6	27.4	40.3	40.4	41.0	40.3	39.4
	O ₂	%	4.3	8.9	6.3	6.6	4.9	5.2	0.3	0.4	0.3	0.0	0.3
	BAL (N ₂)	%	6.0	35.5	28.3	35.8	27.8	30.8	0.0	0.0	0.0	0.0	0.0
	CO	PPM	11	10	7	10	12	9	14	28	19	0	0
	H ₂ S	PPM	16	7	9	30	41	62	72	84	69		
	Vel Max	m/s	1.82	1.70	1.82	2.10	1.68	1.74	1.15	0.90	1.21		
	Vel Min	m/s	1.65	1.59	1.61	1.67	1.35	1.43	1.05	0.78	1.08		
	Flow	CFM	16.39477406	15.54432469	16.20578531	17.81218969	14.31589781	14.97735844	10.39438125	7.9375275	10.81960594	0	0
	Temp	°C	7.0	8.6	19.8	31.5	30.3	29.8	-	-	-		
	Comments		20T -> no change	20T -> 15T	15T -> 20T	20T -> 15T	15T -> no change	15T -> no change	15T -> 20T	20T -> 25T	25T -> 30T	no lat vac	no lat vac
2-13	Well	"H ₂ O	-0.07	-0.15	0.00	0.00	-0.23	-0.06	1.44	0.00	-0.02	cant reach	cant reach
	Lateral	"H ₂ O	-18.90	-63.32	-46.85	-47.50	-36.27	-40.80	-43.90	-18.41	-18.41	-6.56	-10.00
	CH ₄	%	45.9	13.7	56.1	55.4	39.9	42.3	55.8	55.7	55.6	55.0	55.7
	CO ₂	%	44.0	11.3	43.3	43.8	34.8	35.9	43.7	43.5	43.5	44.0	43.5
	O ₂	%	1.0	16.5	0.5	0.6	3.6	1.9	0.4	0.5	0.4	0.7	0.6
	BAL (N ₂)	%	9.1	58.5	0.0	0.0	21.9	20.0	0.0	0.0	0.0	0.0	0.0
	CO	PPM	241	109	337	584	341	423	327	579	481	259	330
	H ₂ S	PPM	70	34	>>>>	>>>>	377	>>>>	>>>>	>>>>	>>>>		
	Vel Max	m/s	1.40	3.84	1.61	0.84	4.20	3.73	0.00	1.04	1.00		1.22
	Vel Min	m/s	1.30	3.67	1.21	0.75	3.55	3.14	0.00	0.83	0.92		1.13
	Flow	CFM	12.75674063	35.48263781	13.32370688	7.512302813	36.61657031	32.45881781	0	8.835224063	9.07146	0	11.10308906
	Temp	°C	8.0	7.7	13.3	26.6	28.0	29.9	-	-	-	very tall, in a hole	5.5
	Comments		1/4T -> no change	1/4T -> cracked	cracked-> no change	cracked-> 1/4T	1/4T -> cracked	cracked-> no change	cracked-> 1/4T	1/4T -> no change	1/4T -> no change	talk to lrv	no change
2-14 well bore sea	Well	"H ₂ O	0.09	-0.01	0.07	0.10	-0.05	-0.07	0.01	0.02	-0.08	0.05	-0.02
	Lateral	"H ₂ O	-21.43	-42.62	-51.10	-49.41	-35.74	-41.02	-43.96	-16.03	-18.52	-6.25	-10.31
	CH ₄	%	45.2	43.4	49.7	43.4	47.0	56.4	47.9	56.4	54.8	54.8	45.3
	CO ₂	%	33.0	32.7	37.1	38.9	36.1	36.0	41.6	43.1	42.4	39.8	35.1
	O ₂	%	5.5	5.5	3.0	2.4	3.1	2.5	1.0	0.4	0.6	1.8	3.5
	BAL (N ₂)	%	16.3	18.5	10.1	7.0	13.9	13.5	1.0	0.0	1.9	3.7	13.2
	CO	PPM	23	25	0	44	21	20	44	54	68	18	23
	H ₂ S	PPM	24	21	29	48	57	63	42	75	93		
	Vel Max	m/s	1.82	3.98	2.38	3.24	3.61	3.84	4.65	1.17	1.32		4.08
	Vel Min	m/s	1.57	3.70	1.98	2.95	3.48	3.60	4.44	1.04	1.25		3.92
	Flow	CFM	16.01679656	36.28584	20.59977375	29.24600906	33.49825594	35.1519075	42.94769344	10.44162844	12.14252719	0	37.79775
	Temp	°C	10.1	17.8	19.7	24.1	30.4	30.0	25.3	-	-		16.3
	Comments		cracked-> no change	cracked-> no change	cracked-> no change	cracked-> 1/4T->cracked	cracked-> no change	cracked-> no change	cracked-> 1/4T	1/4T -> 1/2T	1/2T -> no change	no change	no change

Table 2: Wellfield Monitoring Data

	Units	26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18	
2-15	Well	"H ₂ O	0.04	-0.15	-0.10	-0.21	-1.46	-1.53	-0.90	-0.07	-0.37	0.24	-0.11
	Lateral	"H ₂ O	-18.98	-43.80	-51.22	-50.21	-35.73	-40.98	-44.07	-15.90	-18.46	-6.56	-10.36
	CH ₄	%	56.0	34.6	55.8	54.6	44.1	45.3	47.6	53.9	52.1	56.8	54.6
	CO ₂	%	43.4	27.6	41.9	42.1	37.9	36.9	36.6	40.2	40.0	43.2	39.7
	O ₂	%	0.3	7.7	0.5	0.7	1.0	1.4	2.8	1.2	1.5	0.0	1.7
	BAL (N ₂)	%	0.0	30.1	1.7	2.6	17.0	16.4	13.0	4.6	6.4	0.0	4.8
	CO	PPM	42	114	100	209	65	72	21	163	152	8	50
	H ₂ S	PPM	19	14	30	41	58	55	138	36	54		
	Vel Max	m/s	0.00	1.66	0.97	1.77	3.92	4.00	4.88	2.16	2.07		1.23
	Vel Min	m/s	0.00	1.16	0.62	1.48	3.63	3.88	4.62	2.10	1.98		1.03
	Flow	CFM	0	13.32370688	7.512302813	15.35533594	35.67162656	37.23078375	44.88482813	20.12730188	19.13511094	0	10.67786438
	Temp	°C	16.0	12.2	15.8	21.3	26.7	28.1	-	-	-	lat is tall	6.5
	Comments		1/4T -> no change	1/4T -> cracked	cracked -> 1/4T	1/4T -> 1/2T	1/2T -> no change	1/2T -> no change	1/2T -> no change	1/2T -> no change	1/2T -> no change	no change	no change
2-16	Well	"H ₂ O	0.43	-1.54	0.04	0.13	-0.19	-0.30	0.00	0.19	0.11	-0.09	-0.49
	Lateral	"H ₂ O	-19.05	-42.94	-49.72	-47.92	-36.27	-40.98	-43.51	-15.36	-18.24	-6.15	-10.37
	CH ₄	%	47.3	26.7	49.8	56.5	43.4	45.1	57.0	56.2	56.3	56.6	53.5
	CO ₂	%	37.0	22.0	37.0	43.2	33.6	34.2	42.4	43.1	42.8	41.4	39.5
	O ₂	%	2.5	10.1	2.8	0.3	3.8	3.5	0.4	0.5	0.3	0.8	1.7
	BAL (N ₂)	%	13.1	41.2	10.3	0.0	19.2	17.2	0.0	0.0	0.6	1.1	5.2
	CO	PPM	32	18	0	37	26	19	45	153	57	55	<<
	H ₂ S	PPM	47	10	35	65	56	62	138	69	112		
	Vel Max	m/s	5.22	14.66	4.98	5.09	6.56	7.01	4.88	1.84	1.75		6.50
	Vel Min	m/s	5.02	14.04	4.72	4.37	6.19	6.59	4.62	1.76	1.66		6.32
	Flow	CFM	48.38112	135.5994281	45.82977188	44.69583938	60.24016406	64.256175	44.88482813	17.0089875	16.11129094	0	60.57089438
	Temp	°C	15.3	16.2	20.4	-	23.0	29.7	-	-	-	-	17.9
	Comments		1T -> no change	1T -> 1/4T	1/4T -> no change	1/4T -> 1/2T	1/2T -> no change	1/2T -> no change	1/2T -> 3/4T	3/4T -> 1T	1T -> 1.25T	no change	no change
2-17	Well	"H ₂ O	0.07	-0.71	-1.19	-0.48	-0.97	-1.00	-0.20	0.05	0.00	-0.69	-1.05
	Lateral	"H ₂ O	-19.01	-48.26	-50.02	-47.02	-36.08	-40.64	-44.13	-15.94	-18.41	-6.88	-10.77
	CH ₄	%	53.0	44.4	42.9	47.5	49.1	50.3	57.4	57.1	57.0	57.0	55.5
	CO ₂	%	37.3	32.3	31.8	34.4	35.7	35.1	42.2	42.4	42.3	42.8	42.4
	O ₂	%	3.8	5.3	5.1	4.0	2.9	2.6	0.3	0.3	0.3	0.1	1.2
	BAL (N ₂)	%	5.7	17.9	20.1	14.1	12.2	12.0	0.0	0.0	0.4	0.0	0.0
	CO	PPM	89	0	4	4	10	0	35	37	48	14	24
	H ₂ S	PPM	39	1	9	27	13	10	9	19	25		
	Vel Max	m/s	3.91	3.33	5.30	3.72	3.46	3.54	1.82	2.72	3.10		3.11
	Vel Min	m/s	3.68	3.05	5.05	3.58	3.32	3.39	1.70	2.59	3.00		2.83
	Flow	CFM	35.86061531	30.14370563	48.90083906	34.49044688	32.03359313	32.74230094	16.63101	25.08825656	28.82078438	0	28.06482938
	Temp	°C	35.9	13.1	16.4	20.8	25.6	26.2	-	-	-	well and lat are both tall	4.1
	Comments		1/2T -> no change	1/2T -> no change	1/2T -> no change	1/2T -> no change	1/2T -> no change	1/2T -> no change	1/2T -> 3/4T	3/4T -> 1T	1T -> 1.25T	no change	no change
2-18	Well	"H ₂ O	-0.25	-1.18	-0.77	0.31	-0.51	-1.13	-1.37	-0.03	-0.15	-0.41	-0.25
	Lateral	"H ₂ O	-11.38	-46.34	-49.03	-47.22	-35.70	-40.27	-43.82	-18.23	-7.09	-9.92	-9.92
	CH ₄	%	51.4	28.5	31.3	56.1	45.1	42.1	50.3	57.5	56.3	48.6	47.2
	CO ₂	%	37.9	25.4	26.5	39.4	34.0	34.6	37.6	41.2	40.8	36.3	35.4
	O ₂	%	2.5	5.3	4.5	0.5	2.7	3.9	1.6	0.4	0.5	2.8	2.8
	BAL (N ₂)	%	8.1	40.9	37.8	4.0	18.2	19.4	10.4	0.7	2.5		14.6
	CO	PPM	191	78	87	49	31	33	80	73	65		4
	H ₂ S	PPM	54	24	30	80	66	74	34	67	69		
	Vel Max	m/s	2.43	6.90	5.66	2.68	4.43	4.50	4.15	3.29	3.22		3.96
	Vel Min	m/s	2.30	6.61	5.30	2.55	4.18	4.27	3.97	3.14	3.10		3.75
	Flow	CFM	22.34791969	63.83095031	51.7829175	24.71027906	40.67982844	41.43578344	38.36471625	30.37994156	29.8602225	0	36.42758156
	Temp	°C	12.4	38.1	39.1	35.6	28.9	30.1	-	-	-	Very tall, needs to be cut down	0.7
	Comments		1/2T -> no change	1/2T -> 1/4T	1/4T -> cracked	cracked -> 1/4T	1/4T -> 1/2T	1/2T -> no change	1/2T -> no change	1/2T -> 3/4T	3/4T -> 1T		very tall, no change
3-19	Well	"H ₂ O	0.18	-1.72	-0.23	-0.34	0.81	0.54	0.04	-4.14	0.41	0.85	-1.51
	Lateral	"H ₂ O	-10.87	-41.09	-37.90	-44.53	-37.02	-72.91	-42.12	-14.72	-17.58	-6.51	-8.32
	CH ₄	%	49.8	28.3	44.3	48.8	57.3	57.7	57.2	58.3	56.4	56.8	55.7
	CO ₂	%	37.9	20.4	33.7	33.1	42.3	41.9	42.4	34.7	41.6	43.2	38.9
	O ₂	%	1.1	11.6	4.2	4.7	0.4	0.6	0.3	4.4	0.1	0.2	1.9
	BAL (N ₂)	%	11.2	39.8	16.2	17.8	0.0	0.0	0.0	13.4	0.0	0.0	3.6
	CO	PPM	0	10	12	11	13	17	21	27	24		<<
	H ₂ S	PPM	33	7	62	52	84	95	38	28	31		
	Vel Max	m/s	5.15	9.48	5.25	5.73	4.08	4.98	9.55	6.74	5.21		5.70
	Vel Min	m/s	4.92	9.13	4.86	5.22	3.73	4.65	9.06	6.54	5.03		5.22
	Flow	CFM	47.57791781	87.92701594	47.76690656	51.73567031	36.90005344	45.49904156	87.92701594	62.744265	48.38112	0	51.59392875
	Temp	°C	9.0	8.1	16.2	14.0	20.2	22.4	-	-	-		6.2
	Comments		3/4T -> no change	3/4T -> 1/2T	1/2T -> no change	1/2T -> 1/4T	1/4T -> 3/4T	3/4T -> 1T	1T -> 1.5T	1.5T -> 3/4T	3/4T -> 1T	1T	no change

Table 2: Wellfield Monitoring Data

	Units	26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18	
3-20	Well	"H ₂ O	0.00	-1.06	-0.55	1.06	0.24	0.02	9.94	0.27	0.14	-0.70	-1.96
	Lateral	"H ₂ O	-11.11	-40.68	-36.50	-43.97	-37.41	-72.93	-42.15	-15.38	-18.05	-6.70	-8.74
	CH ₄	%	52.0	28.8	34.4	55.3	55.5	55.5	56.0	55.8	55.9	55.9	56.7
	CO ₂	%	43.8	21.4	27.4	44.1	44.2	44.0	43.8	43.9	44.0	43.8	42.4
	O ₂	%	1.0	11.3	7.9	0.4	0.3	0.1	0.3	0.4	0.2	0.4	0.9
	BAL (N ₂)	%	3.2	38.5	30.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0
	CO	PPM	69	41	57	42	32	33	144	152	149	45	27
	H ₂ S	PPM	7	3	18	18	27	20	12	16	17		
	Vel Max	m/s	2.10	9.70	6.59	2.77	4.47	4.74	4.20	1.80	1.97		5.50
	Vel Min	m/s	1.97	9.34	6.34	2.26	4.22	4.53	4.05	1.70	1.91		5.36
	Flow	CFM	19.22960531	89.958645	61.09061344	23.76533531	41.05780594	43.79814281	38.97892969	16.53651563	18.33190875	0	51.31044563
	Temp	°C	3.1	4.6	11.9	25.7	20.4	21.8	-	-	-		6.7
	Comments		3/4T -> no change	3/4T -> 1/2T	1/2T -> 1/4T	1/4T -> 1/2T	1/2T -> 3/4T	3/4T -> no change	3/4T -> 1T	1T -> 1.25T	1.25T -> 1.5T	no change	1/4 T
	3-21	Well	"H ₂ O	0.19	1.95	2.80	-2.49	4.24	-15.68	2.84	3.76	-5.33	-3.33
Lateral		"H ₂ O	-11.00	-42.39	-37.55	-43.11	-37.19	-72.82	-41.75	-15.73	-18.58	-7.02	-9.12
CH ₄		%	55.0	55.7	56.0	30.8	55.8	29.7	55.0	54.6	31.4	29.4	55.2
CO ₂		%	44.2	43.9	43.6	24.4	44.0	25.2	44.2	44.6	24.7	23.7	44.7
O ₂		%	0.2	0.3	0.4	10.0	0.3	11.1	0.6	0.5	12.0	10.0	0.0
BAL (N ₂)		%	0.0	0.0	0.0	34.6	0.0	34.0	0.0	0.0	31.9	36.5	0.0
CO		PPM	0	2	0	9	13	0	36	36	33	19	0
H ₂ S		PPM	22	10	45	0	14	24	18	23	21		
Vel Max		m/s	-	-	1.20	0.87	0.85	-	-	0.00	-		1.40
Vel Min		m/s	-	-	1.07	0.57	0.55	-	-	0.00	-		1.30
Flow		CFM	#VALUE!	#VALUE!	10.72511156	6.803595	6.61460625	#VALUE!	#VALUE!	0	#VALUE!	0	12.75674063
Temp		°C	-	-	20.9	33.4	25.7	-	-	-	-		-3.7
Comments			closed -> no change	closed->cracked->closed	closed -> 1/4T	1/4T -> closed	closed -> 1/4T	1/4T -> closed	closed -> no change	closed -> cracked	cracked -> closed	1T -> cracked	barely cracked
3-22		Well	"H ₂ O	-1.39	-2.07	-3.29	-0.78	-1.66	-2.23	-3.96	-2.31	-3.43	-3.12
	Lateral	"H ₂ O	-15.03	-63.38	-46.39	-42.44	-35.94	-40.97	-42.62	-14.28	-18.07	-5.85	-8.87
	CH ₄	%	41.2	43.4	42.0	46.3	46.1	47.0	56.8	56.7	55.9	56.0	56.1
	CO ₂	%	32.0	33.2	33.2	35.6	34.2	35.1	42.9	42.7	42.4	44.0	43.5
	O ₂	%	4.3	5.4	4.1	3.3	3.9	3.0	0.2	0.5	0.6	0.0	0.1
	BAL (N ₂)	%	22.4	18.1	20.5	14.7	15.8	14.9	0.0	0.0	1.0	0.0	0.0
	CO	PPM	44	102	105	28	13	0	229	200	240	13	112
	H ₂ S	PPM	>>>>	164	149	252	290	257	222	230	218		
	Vel Max	m/s	1.84	4.64	8.37	4.14	4.47	4.65	3.26	1.88	1.99		7.19
	Vel Min	m/s	1.69	4.32	8.01	3.84	4.27	4.33	3.07	1.73	1.90		6.94
	Flow	CFM	16.67825719	42.33348	77.39089313	37.70325563	41.29404188	42.42797438	29.90746969	17.05623469	18.37915594	0	66.76027594
	Temp	°C	12.0	17.3	23.1	30.9	28.7	29.0	-	-	-	in a hole	21.0
	Comments		1/2T -> no change	1/2T -> 3/4T	3/4T -> 1/2T	1/2T -> no change	1/2T -> no change	1/2T -> 3/4T	3/4T -> 1T	1T -> 1.25T	1.25T -> 1.5T	no change	1/2 T
	3-23	Well	"H ₂ O	0.00	0.19	0.02	0.00	0.03	0.00	-0.65	-4.19	-5.87	-3.22
Lateral		"H ₂ O	-14.81	-56.96	-47.67	-40.48	-35.43	-40.62	-42.27	-14.28	-18.15	-5.95	-8.82
CH ₄		%	57.1	58.7	43.9	53.4	53.3	51.8	58.7	49.1	50.3	55.4	52.7
CO ₂		%	41.5	41.0	29.7	37.0	36.7	35.9	41.0	39.7	40.1	43.3	41.6
O ₂		%	0.8	0.3	5.2	1.7	1.9	0.3	0.3	0.5	0.4	0.0	0.0
BAL (N ₂)		%	0.5	0.0	20.5	8.0	8.0	10.0	0.0	10.6	9.2	1.4	6.0
CO		PPM	0	6	0	18	14	11	18	19	24	0	10
H ₂ S		PPM	332	181	111	153	187	166	360	103	142		
Vel Max		m/s	-	1.77	1.44	1.02	1.15	1.00	3.41	2.43	3.04		4.63
Vel Min		m/s	-	1.45	1.30	0.98	1.03	0.85	3.24	2.26	2.89		4.41
Flow		CFM	#VALUE!	15.21359438	12.94572938	9.4494375	10.29988688	8.740729688	31.41937969	22.15893094	28.01758219	0	42.7114575
Temp		°C	-	6.9	24.0	33.4	31.4	31.7	-	-	-		18.7
Comments			closed -> no change	closed -> cracked	cracked -> no change	cracked -> no change	cracked -> no change	cracked -> no change	cracked -> 1/2T	1/2T -> 3/4T	3/4T -> no change	no change	1/4 T
3-24		Well	"H ₂ O	0.01	0.07	0.11	-0.03	-0.11	0.12	0.04	-0.17	-0.06	0.15
	Lateral	"H ₂ O	-14.98	-56.48	-37.37	-43.31	-37.23	-72.71	-42.56	-15.45	-18.31	-6.05	-9.51
	CH ₄	%	57.0	56.4	56.3	56.4	56.4	56.4	56.1	56.1	55.5	55.5	27.5
	CO ₂	%	41.9	0.1	43.5	43.1	19.0	38.9	43.6	27.4	26.4	44.4	20.6
	O ₂	%	0.3	21.8	0.2	0.3	10.6	0.5	0.3	7.6	8.1	0.2	10.5
	BAL (N ₂)	%	0.8	77.9	0.0	0.0	46.4	11.9	0.0	29.3	33.5	0.0	41.6
	CO	PPM	31	4	147	87	60	48	280	217	83	110	49
	H ₂ S	PPM	>>>>	7	>>>>	295	241	274	210	212	254		
	Vel Max	m/s	-	-	1.42	1.20	2.34	2.20	0.89	1.29	1.09		-
	Vel Min	m/s	-	-	1.31	1.09	2.10	2.06	0.66	1.21	1.01		-
	Flow	CFM	#VALUE!	#VALUE!	12.89848219	10.81960594	20.97775125	20.12730188	7.323314063	11.81179688	9.921909375	0	#VALUE!
	Temp	°C	-	-	21.7	33.2	28.2	29.9	-	-	-		-
	Comments		closed -> no change	closed -> no change	closed -> 1/4T	1/4T -> 1/2T	1/2T -> 1/4T	1/4T -> 1/2T	1/2T -> no change	1/2T -> 1/4T	1/4T -> closed	1/2 T	cracked -> closed

Table 2: Wellfield Monitoring Data

	Units	26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18	
3-25	Well	"H ₂ O	-14.80	-54.08	-5.33	-4.86	-12.64	-15.36	-17.26	-7.09	-10.57	-5.53	-8.82
	Lateral	"H ₂ O	-14.88	-56.21	-47.14	-42.26	-35.72	-41.00	-42.18	-15.31	-18.11	-7.00	-10.52
	CH ₄	%	53.0	24.4	40.2	48.7	43.8	42.9	52.9	54.7	53.6	57.0	56.0
	CO ₂	%	40.8	23.8	33.8	40.5	38.4	37.5	42.4	42.2	42.0	42.2	43.0
	O ₂	%	0.9	7.4	2.5	0.5	1.1	1.0	0.8	0.9	1.1	1.8	0.8
	BAL (N ₂)	%	5.2	44.3	23.5	10.2	16.7	18.6	3.8	2.2	3.3	0.0	0.2
	CO	PPM	0	8	5	18	9	0	18	23	12	>	<<
	H ₂ S	PPM	0	0	28	37	38	24	58	56	51		
	Vel Max	m/s	6.01	20.16	5.85	4.27	8.90	9.17	4.63	1.76	2.33		6.09
	Vel Min	m/s	5.79	19.26	5.70	4.00	8.70	9.01	3.54	1.59	2.25		5.50
	Flow	CFM	55.75168125	186.2484131	54.57050156	39.07342406	83.15505	85.89538688	38.60095219	15.82780781	21.63921188	0	54.75949031
	Temp	°C	25.0	31.4	32.7	34.4	30.8	31.1	-	-	-	in a hole	20.2
	Comments		full -> no change	full -> 1/2T	1/2T -> no change	1/2T -> no change	1/2T -> no change	1/2T -> no change	1/2T -> no change	1/2T -> 3/4T	3/4T -> no change	no change	1T
	3-26	Well	"H ₂ O	-20.96	-39.18	-51.88	-48.76	-34.90	-40.49	-43.90	-16.04	-18.23	-6.64
Lateral		"H ₂ O	-20.97	-39.19	-51.77	-48.79	-35.10	-40.56	-44.11	-16.01	-18.20	-6.54	-10.46
CH ₄		%	50.0	43.0	41.9	42.3	47.2	48.3	58.2	58.2	58.0	57.8	50.1
CO ₂		%	36.9	30.3	30.3	30.0	32.9	32.6	40.5	41.3	41.2	42.0	34.4
O ₂		%	2.5	5.4	5.7	5.4	3.8	3.1	0.8	0.5	0.4	0.1	3.8
BAL (N ₂)		%	10.6	21.5	22.6	22.1	16.1	16.0	0.5	0.0	0.4	0.0	9.8
CO		PPM	0	10	11	11	13	15	15	20	20	<	2
H ₂ S		PPM	80	33	25	69	77	91	64	107	98		
Vel Max		m/s	1.72	1.55	2.21	2.02	1.52	1.63	1.20	0.83	0.87		0.52
Vel Min		m/s	1.30	1.29	1.87	1.78	1.22	1.40	0.91	0.79	0.81		0.44
Flow		CFM	14.26865063	13.41820125	19.2768525	17.95393125	12.94572938	14.31589781	9.969156563	7.654044375	7.9375275	0	4.53573
Temp		°C	4.0	11.9	16.7	21.3	28.8	29.5	-	-	-		2.0
Comments			2T -> no change	2T -> no change	2T -> full	full -> 2T	2T -> 1T	1T -> no change	1T -> 3T	3T -> no change	3T -> no change	no change	no change
3-27 DP		Well	"H ₂ O	-0.02	0.09	0.11	0.19	0.18	0.12	0.00	7.88	9.42	8.64
	Lateral	"H ₂ O	-14.79	-57.56	-47.42	-41.46	-35.78	-41.09	-42.54	-15.62	-18.47	-6.17	-9.91
	CH ₄	%	40.2	57.4	57.4	56.5	57.6	57.4	55.2	45.4	43.0	57.6	56.5
	CO ₂	%	31.8	42.3	42.1	41.4	41.5	41.2	40.1	33.2	32.3	42.0	43.2
	O ₂	%	4.8	0.3	0.3	0.3	0.5	0.7	1.4	4.9	5.6	0.3	0.3
	BAL (N ₂)	%	23.2	0.0	0.0	1.8	0.0	0.8	3.4	16.4	19.0	0.0	0.0
	CO	PPM	0	14	0	20	18	6	17	15	5	223	0
	H ₂ S	PPM	38	160	164	153	173	148	252	122	148		
	Vel Max	m/s	-	-	-	-	-	-	-	-	-		1.52
	Vel Min	m/s	-	-	-	-	-	-	-	-	-		1.39
	Flow	CFM	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	0	13.74893156
	Temp	°C	-	-	-	-	-	-	-	-	-	in a hole	0.5
	Comments		closed -> no change	closed->cracked->closed	closed->1/4T->closed	closed->1/2T->closed	closed -> no change	closed -> no change	closed -> no change	closed -> no change	closed -> no change	closed -> cracked	1/2 T
	3-28	Well	"H ₂ O	0.08	-0.79	0.41	-0.16	-0.15	-0.21	-0.14	-0.36	-0.10	-0.07
Lateral		"H ₂ O	-21.00	-39.40	-51.72	-48.04	-35.38	-40.32	-44.10	-15.83	-18.34	-6.13	-10.37
CH ₄		%	52.3	34.5	56.9	47.0	51.5	52.0	57.0	55.2	54.9	57.1	49.3
CO ₂		%	40.1	25.3	42.6	34.7	37.0	37.3	42.1	39.8	39.9	42.5	35.3
O ₂		%	0.9	8.6	0.3	3.8	2.4	2.2	0.6	1.5	1.4	0.4	3.9
BAL (N ₂)		%	6.5	31.4	0.0	14.7	9.1	8.5	0.0	3.4	3.8	0.0	11.7
CO		PPM	0	20	0	30	22	18	35	38	22	>	16
H ₂ S		PPM	157	44	89	118	135	131	103	141	132		
Vel Max		m/s	2.32	5.67	1.23	4.71	3.62	4.01	5.29	1.55	1.60		3.61
Vel Min		m/s	2.10	5.36	1.00	4.38	3.55	3.89	4.93	1.46	1.50		3.40
Flow		CFM	20.88325688	52.11364781	10.53612281	42.94769344	33.87623344	37.32527813	48.28662563	14.22140344	14.64662813	0	33.12027844
Temp		°C	17.9	13.1	16.6	21.2	27.8	27.6	-	-	-	surging	12.5
Comments			1/2T -> no change	1/2T -> 1/4T	1/4T -> 1/2T	1/2T -> no change	1/2T -> no change	1/2T -> no change	1/2T -> 3/4T	3/4T -> no change	3/4T -> no change	no change	no change
3-29 DP		Well	"H ₂ O	-2.45	-1.96	-0.16	0.04	-0.96	-1.00	4.22	1.35	0.00	-0.70
	Lateral	"H ₂ O	-21.04	-38.69	-52.47	-49.84	-35.69	-40.48	-44.82	-15.94	-18.27	-6.38	-10.48
	CH ₄	%	32.1	31.3	49.8	57.6	51.5	52.3	58.6	57.9	58.6	58.1	58.1
	CO ₂	%	26.3	23.4	32.8	38.5	35.3	36.1	40.5	41.0	40.5	41.1	39.1
	O ₂	%	7.4	7.6	3.4	1.2	1.8	1.6	0.5	0.4	0.5	0.5	1.0
	BAL (N ₂)	%	34.2	37.6	14.2	2.4	11.4	10.0	0.0	0.0	1.0	0.0	1.6
	CO	PPM	0	10	0	12	15	11	16	19	17	0	6
	H ₂ S	PPM	84	14	25	94	104	104	152	242	256		
	Vel Max	m/s	0.91	2.66	1.22	1.09	1.79	1.83	1.80	1.60	1.85		3.42
	Vel Min	m/s	0.71	2.47	0.91	0.90	1.63	1.67	1.31	1.49	1.73		3.12
	Flow	CFM	7.654044375	24.23780719	10.06365094	9.402190313	16.15853813	16.53651563	14.69387531	14.59938094	16.91449313	0	30.89966063
	Temp	°C	3.2	17.7	18.0	21.7	29.8	30.1	-	-	-		-6.0
	Comments		1/4T -> cracked	1/4T -> cracked	cracked -> no change	cracked -> 1/4T	1/4T -> no change	1/4T -> no change	1/4T -> 1/2T	1/2T -> 3/4T	3/4T -> 1T	no change	1/4 T

Table 2: Wellfield Monitoring Data

	Units	26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18	
3-30 DP	Well	"H ₂ O	-0.14	-1.61	-2.01	-2.07	-0.98	-1.16	-0.65	-0.52	-1.46	-0.88	-1.13
	Lateral	"H ₂ O	-21.11	-39.43	-52.37	-48.60	-36.28	-40.73	-44.90	-16.00	-18.33	-6.39	-10.05
	CH ₄	%	53.7	35.9	33.1	34.4	52.6	51.9	56.8	57.5	56.8	49.7	42.7
	CO ₂	%	38.2	28.4	26.9	28.2	37.9	37.4	40.3	40.7	40.0	35.8	31.7
	O ₂	%	2.4	4.1	4.6	4.1	0.7	1.0	0.5	0.6	0.8	2.5	3.6
	BAL (N ₂)	%	5.7	31.6	35.6	33.3	8.9	9.7	2.4	1.2	2.8	12.7	22.4
	CO	PPM	12	0	0	0	14	20	19	21	14	0	6
	H ₂ S	PPM	118	4	2	24	65	89	48	97	101	0	0
	Vel Max	m/s	4.01	6.45	6.63	8.02	5.72	5.98	4.85	1.85	2.00	0	5.87
	Vel Min	m/s	3.91	6.34	6.48	7.36	5.40	5.74	4.65	1.82	1.93	0	5.63
	Flow	CFM	37.4197725	60.42915281	61.94106281	72.66617438	52.5388725	55.37370375	44.88482813	17.33971781	18.56814469	0	54.33426563
	Temp	°C	19.7	31.9	34.1	35.5	25.0	26.2	-	-	-	air leak, need kanalfex	-5.6
	Comments		1/4T -> no change	1/4T -> no change	1/4T -> no change	1/4T -> cracked	cracked -> 1/4T	1/4T -> no change	1/4T -> 1/2T	1/2 -> 3/4T	3/4T -> no change	no change	air leak, -1/4 T
4-31	Well	"H ₂ O	-0.88	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	8.13	3.45	7.80	4.93
	Lateral	"H ₂ O	-10.20	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	-15.91	-18.61	6.45	-9.13
	CH ₄	%	41.1							56.3	56.2	56.3	56.8
	CO ₂	%	34.2							43.3	43.3	43.8	42.9
	O ₂	%	6.1							0.3	0.2	0.0	0.0
	BAL (N ₂)	%	18.5							0.0	0.2	0.0	0.0
	CO	PPM	5							28	0	17	0
	H ₂ S	PPM	71							417	231		
	Vel Max	m/s	6.10							0.90	1.22		2.11
	Vel Min	m/s	5.79							0.79	1.10		1.98
	Flow	CFM	56.17690594	0	0	0	0	0	0	7.984774688	10.9613475	0	19.32409969
	Temp	°C	11.9							-	-		5.2
	Comments		1T -> 1/2T							closed -> 1/2T	1/2T -> 1T	no lat vac	1/4 T
4-32	Well	"H ₂ O	-5.25	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	92.30	21.34	4.58	-0.56
	Lateral	"H ₂ O	-12.72	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	-15.83	-18.49	-6.82	-8.98
	CH ₄	%	40.0							55.3	55.4	55.0	55.6
	CO ₂	%	33.9							44.4	44.2	45.0	44.1
	O ₂	%	5.2							0.3	0.1	0.0	0.2
	BAL (N ₂)	%	20.9							0.0	0.3	0.0	0.0
	CO	PPM	0							24	21	13	0
	H ₂ S	PPM	152							247	228		
	Vel Max	m/s	4.39							1.55	1.78		2.90
	Vel Min	m/s	4.17							1.46	1.71		2.78
	Flow	CFM	40.4435925	0	0	0	0	0	0	14.22140344	16.48926844	0	26.8364025
	Temp	°C	12.0							-	-		8.9
	Comments		2T -> 1T							closed -> 1/2T	1/2T -> 1T	1/2 T	1/4 T
4-33	Well	"H ₂ O	0.50	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	23.20	0.16	8.32	-2.12
	Lateral	"H ₂ O	-14.61	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	-16.95	-18.26	-6.42	-9.61
	CH ₄	%	55.5							57.9	56.8	57.1	57.7
	CO ₂	%	42.4							41.7	41.2	42.9	42.0
	O ₂	%	1.0							0.3	0.2	0.0	0.3
	BAL (N ₂)	%	1.0							0.0	1.9	0.0	0.0
	CO	PPM	14							15	9	0	13
	H ₂ S	PPM	212							366	268		
	Vel Max	m/s	4.62							1.39	1.51		3.80
	Vel Min	m/s	4.40							1.31	1.38		3.36
	Flow	CFM	42.61696313	0	0	0	0	0	0	12.75674063	13.65443719	0	33.82898625
	Temp	°C	20.0							-	-	needs new kanalflex	18.0
	Comments		cracked -> 1/4T							closed -> 1/4T	1/4T -> 1/2T	1T	1/4 T, kanalflex
4-34	Well	"H ₂ O	0.02	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	10.00	4.18	0.86	-3.69
	Lateral	"H ₂ O	-14.42	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	-14.73	-18.19	-6.47	-9.12
	CH ₄	%	29.8							56.0	55.7	56.1	50.8
	CO ₂	%	26.1							43.1	43.0	43.6	38.0
	O ₂	%	8.0							0.4	0.5	0.1	1.2
	BAL (N ₂)	%	36.0							0.0	0.8	0.0	10.2
	CO	PPM	0							18	10		9
	H ₂ S	PPM	>>>>							>>>>	>>>>		
	Vel Max	m/s	2.21							1.30	1.42		2.74
	Vel Min	m/s	2.03							1.20	1.33		2.62
	Flow	CFM	20.0328075	0	0	0	0	0	0	11.81179688	12.99297656	0	25.3244925
	Temp	°C	4.3							-	-		18.1
	Comments		1/2T -> 1/4T							closed -> 1/2T	1/2T -> 1T	1/2 T	no change

Table 2: Wellfield Monitoring Data

	Units	26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18	
4-35 well bore sea	Well	"H ₂ O	-2.13	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	0.99	-2.45	0.12	0.10
	Lateral	"H ₂ O	-14.93							-16.64	-18.43	-6.29	-10.57
	CH ₄	%	45.4							57.1	48.3	56.6	56.7
	CO ₂	%	36.3							42.6	35.6	43.4	42.0
	O ₂	%	2.4							0.3	1.8	0.0	0.9
	BAL (N ₂)	%	15.9							0.0	14.4	0.0	0.0
	CO	PPM	0							35	0	9	0
	H ₂ S	PPM	101							471	274		
	Vel Max	m/s	1.96							1.38	1.33		too much ice
	Vel Min	m/s	1.80							1.25	1.21		
	Flow	CFM	17.7649425	0	0	0	0	0	0	12.42601031	12.00078563	0	#VALUE!
Temp	°C	6.9							-	-			
Comments		1/4T -> no change							closed -> 1/4T	1/4T -> no change	no change	1/2 T	
4-36	Well	"H ₂ O	-1.15	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	35.99	34.27	34.42	16.67
	Lateral	"H ₂ O	-14.82							0.05	0.09	1.01 (surging, no lat vac)	no vac
	CH ₄	%	43.2							57.9	58.1	55.6	56.8
	CO ₂	%	32.8							41.8	41.9	43.5	43.1
	O ₂	%	4.9							0.3	0.2	0.4	0.1
	BAL (N ₂)	%	19.1							0.0	0.0	0.0	0.0
	CO	PPM	33							26	22	0	7
	H ₂ S	PPM	338							>>>>	>>>>		
	Vel Max	m/s	2.01							-	-		
	Vel Min	m/s	1.89							-	-		
	Flow	CFM	18.42640313	0	0	0	0	0	0	#VALUE!	#VALUE!	0	0
Temp	°C	14.9							-	-			
Comments		cracked -> no change							no lateral vacuum closed -> no change	no lateral vacuum closed -> no change	in a hole closed -> cracked	no lat vac, frozen?	
4-37	Well	"H ₂ O	-0.04	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	lateral closed	0.83	-0.01	0.09	-0.09
	Lateral	"H ₂ O	-14.78							-16.54	-18.25	-6.09	-10.46
	CH ₄	%	55.1							57.8	57.0	56.6	46.0
	CO ₂	%	42.3							41.7	41.5	42.6	33.0
	O ₂	%	1.0							0.4	0.3	0.4	4.8
	BAL (N ₂)	%	1.5							0.0	1.2	0.0	16.1
	CO	PPM	26							23	16	0	11
	H ₂ S	PPM	87							>>>>	>>>>		
	Vel Max	m/s	-							0.74	0.44		-
	Vel Min	m/s	-							0.66	0.00		-
	Flow	CFM	#VALUE!	0	0	0	0	0	0	6.61460625	2.07887625	0	#VALUE!
Temp	°C	-							-	-		-	
Comments		closed -> no change							closed -> 1/4T	1/4T -> no change	no change	cracked -> closed	
5-38	Well	"H ₂ O	0.32	0.14	2.70	0.00	-0.04	-0.01	0.12	-0.01	0.00	0.07	0.07
	Lateral	"H ₂ O	-13.45	-28.52	-40.17	-44.98	-36.15	-73.06	-42.21	-15.10	-18.02	-6.80	-8.67
	CH ₄	%	57.0	54.4	55.1	19.1	51.4	53.4	56.9	56.7	56.2	53.4	55.5
	CO ₂	%	42.8	44.4	44.6	15.2	39.7	38.7	42.3	42.8	42.6	39.2	40.2
	O ₂	%	0.1	0.8	0.3	13.2	1.6	1.9	0.6	0.5	0.7	2.2	1.5
	BAL (N ₂)	%	0.0	0.0	0.0	52.5	7.0	6.0	0.0	0.0	0.5	5.1	3.0
	CO	PPM	0	11	0	0	4	0	18	22	8	10	0
	H ₂ S	PPM	101	94	177	10	27	21	105	116	104		
	Vel Max	m/s	-	-	-	-	-	-	-	-	-	-	-
	Vel Min	m/s	-	-	-	-	-	-	-	-	-	-	-
	Flow	CFM	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	0	#VALUE!
Temp	°C	-	-	-	-	-	-	-	-	-	-	-	
Comments		closed -> no change	closed->cracked->closed	closed->cracked->closed	closed -> no change	closed -> no change	closed -> no change	closed -> no change	closed -> no change	closed -> no change	no change	closed -> no change	
5-39 well bore sea	Well	"H ₂ O	-12.99	-45.30	-38.69	-44.62	-35.36	-73.12	-41.80	-14.99	-18.08	-6.62	-8.7
	Lateral	"H ₂ O	-13.39	-45.05	-39.09	-44.35	-35.38	-73.14	-42.17	-15.15	-18.17	-6.57	-9.2
	CH ₄	%	55.9	56.3	56.7	56.3	56.1	56.8	56.9	56.8	56.9	56.1	56.4
	CO ₂	%	43.8	43.2	42.8	42.8	42.6	43.0	42.8	42.8	42.8	43.7	43.2
	O ₂	%	0.4	0.5	0.4	0.6	0.7	0.5	0.2	0.3	0.2	0.1	0.2
	BAL (N ₂)	%	0.0	0.0	0.0	0.0	0.4	0.7	0.0	0.0	0.1	0.0	0.0
	CO	PPM	104	102	93	76	51	62	92	113	100	59	14.0
	H ₂ S	PPM	77	95	176	141	161	184	119	151	171		
	Vel Max	m/s	2.18	3.02	1.79	3.05	2.42	3.04	2.28	1.21	1.41		2.4
	Vel Min	m/s	1.95	1.51	1.35	1.47	1.84	2.79	2.10	1.13	1.28		2.1
	Flow	CFM	19.51308844	21.40297594	14.83561688	21.35572875	20.12730188	27.54511031	20.69426813	11.05584188	12.70949344	0	21.21398719
Temp	°C	7.3	9.8	16.8	15.3	23.5	25.0	-	-	-		5.2	
Comments		full -> no change	full -> no change	full -> no change	full -> no change	full -> no change	full -> no change	full -> no change	full -> no change	full -> no change	no change	full open, no change	

Table 2: Wellfield Monitoring Data

	Units	26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18	
5-40	Well	"H ₂ O	-2.20	-4.67	-4.54	-4.86	-1.09	-1.63	1.95	-5.31	-5.99	-2.69	-4.60
	Lateral	"H ₂ O	-14.58	-44.76	-37.88	-43.33	-34.51	-73.09	-42.23	-15.09	-18.29	-6.69	-9.80
	CH ₄	%	51.3	41.0	43.7	42.4	42.4	42.4	57.6	53.1	52.2	53.4	50.5
	CO ₂	%	38.9	33.7	36.0	34.7	22.4	31.0	41.6	40.4	40.0	40.7	38.6
	O ₂	%	1.5	3.6	2.4	3.0	8.6	4.9	0.5	1.7	2.1	1.7	1.9
	BAL (N ₂)	%	8.4	21.9	17.9	19.9	41.2	24.2	0.0	4.7	5.8	3.9	8.6
	CO	PPM	7	11	12	12	11	14	17	21	15	>>	6
	H ₂ S	PPM	>>>>	28	64	53	219	189	>>>>	>>>>	>>>>		
	Vel Max	m/s	2.56	3.56	3.14	3.19	3.42	3.74	0.44	0.97	0.89		1.96
	Vel Min	m/s	2.21	3.46	3.05	2.99	3.18	3.44	0.00	0.84	0.80		1.82
	Flow	CFM	22.53690844	33.16752563	29.24600906	29.19876188	31.18314375	33.92348063	2.07887625	8.551740938	7.984774688	0	17.85943688
	Temp	°C	5.5	20.5	26.0	26.6	30.3	32.1	-	-	-		6.0
	Comments		1/2T -> 3/4T	3/4T -> no change	3/4T -> no change	3/4T -> no change	3/4T -> 1/4T	1/4T -> cracked	cracked -> 1/2T	1/2T -> no change	1/2T -> no change	down lat- change kana no change	no change
5-41 well bore sea	Well	"H ₂ O	-0.02	-9.29	-0.02	-0.59	-0.40	-0.88	5.89	-3.83	-6.05		-6.32
	Lateral	"H ₂ O	-14.80	-41.87	-38.52	-43.82	-34.70	-73.21	-41.75	-14.22	-17.86		-7.60
	CH ₄	%	55.0	33.1	53.5	49.1	48.4	47.6	58.8	59.0	57.9		42.1
	CO ₂	%	37.7	23.3	37.1	34.5	34.7	35.2	40.9	40.2	41.7		29.2
	O ₂	%	2.5	10.0	2.3	3.6	2.9	3.1	0.3	0.7	0.8		6.1
	BAL (N ₂)	%	4.7	33.6	7.3	12.6	14.0	14.0	0.0	0.0	0.0		22.7
	CO	PPM	10	11	13	10	12	5	22	22	25		0
	H ₂ S	PPM	300	236	486	402	497	378	450	>>>>	>>>>		
	Vel Max	m/s	6.41	11.30	5.96	6.96	6.99	7.42	2.98	1.96	4.35		3.36
	Vel Min	m/s	6.18	10.67	5.60	6.48	6.55	7.18	2.78	1.85	4.16		3.22
	Flow	CFM	59.48420906	103.8020709	54.61774875	63.50022	63.97269188	68.98089375	27.21438	18.00117844	40.20735656	0	31.08864938
	Temp	°C	17.2	16.2	25.5	23.0	29.0	30.2	-	-	-		-0.2
	Comments		3/4T -> 1T	1T -> 1/4T	1/4T -> no change	1/4T -> no change	1/4T -> no change	1/4T -> no change	1/4T -> 1T	1T -> 2T	2T -> 3T		closed -> cracked
5-42	Well	"H ₂ O	frozen	-11.06	-0.40	-1.04	-0.92	-1.02	-1.28	-0.50	-0.95	-0.08	-0.41
	Lateral	"H ₂ O	-14.91	-54.04	-38.28	-44.49	-36.47	-40.63	-42.28	-14.21	-18.29	-6.31	-10.18
	CH ₄	%	56.1	23.4	57.0	53.8	57.2	58.3	56.4	56.7	56.0	56.9	50.7
	CO ₂	%	40.5	17.9	42.2	39.2	42.3	42.0	42.7	42.7	43.2	41.5	37.1
	O ₂	%	0.4	12.4	0.6	2.5	0.4	0.2	0.7	0.5	0.6	1.1	2.8
	BAL (N ₂)	%	3.0	46.4	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.5	9.4
	CO	PPM	52	24	38	35	22	26	63	65	74	18	8
	H ₂ S	PPM	61	28	289	150	371	299	487	419	411		
	Vel Max	m/s	2.93	8.58	2.73	3.33	3.59	4.09	1.36	1.53	1.62		4.05
	Vel Min	m/s	2.65	8.40	2.61	3.24	3.40	3.91	1.28	1.42	1.55		3.86
	Flow	CFM	26.36393063	80.22572438	25.22999813	31.04140219	33.02578406	37.79775	12.4732575	13.93792031	14.97735844	0	37.37252531
	Temp	°C	12.8	10.2	17.8	20.7	26.9	27.3	-	-	-		17.7
	Comments		30T -> no change	30T -> 15T	15T -> 20T	20T -> no change	20T -> 25T	25T -> no change	25T -> 30T	30T -> no change	30T -> no change	no change	no change
5-43	Well	"H ₂ O	-1.12	-25.70	-31.36	-20.40	-18.70	-33.34	-13.23	-6.17	-7.42	-5.24	-7.73
	Lateral	"H ₂ O	-13.01	-45.61	-36.07	-44.66	-34.76	-73.55	-42.01	-14.99	-18.13	-6.38	-8.62
	CH ₄	%	54.2	52.7	34.4	44.1	49.7	47.3	58.4	58.6	58.0	57.5	58.7
	CO ₂	%	41.0	36.6	26.2	31.7	36.7	35.9	40.7	40.8	40.5	47.5	40.9
	O ₂	%	0.9	2.8	6.8	3.8	1.3	2.0	0.6	0.4	0.6	0.3	0.3
	BAL (N ₂)	%	4.0	7.9	32.6	20.6	12.2	14.8	0.0	0.0	1.0	0.0	0.0
	CO	PPM	<<<<	5	59	36	21	26	27	34	27	19	0
	H ₂ S	PPM	58	52	31	54	94	105	108	153	146		
	Vel Max	m/s	5.11	6.39	9.16	6.71	5.89	7.21	1.86	1.71	1.67		5.34
	Vel Min	m/s	4.83	6.25	7.38	6.31	5.66	6.98	1.76	1.60	1.56		4.79
	Flow	CFM	46.96370438	59.720445	78.14684813	61.51583813	54.57050156	67.04375906	17.10348188	15.63881906	15.26084156	0	47.86140094
	Temp	°C	5.0	10.7	13.8	14.5	21.7	23.8	-	-	-		9.6
	Comments		1/2T -> 3/4T	3/4T -> 1.5T	1.5T -> 1/2T	1/2T -> no change	1/2T -> 3/4T	3/4T -> 1T	1T -> 1.25T	1.25T -> 1.5T	1.5T -> 1.75T	no change	1T
5-44	Well	"H ₂ O	0.64	-0.66	-0.20	0.13	0.10	0.05	0.00	-0.02	0.05	0.03	-0.07
	Lateral	"H ₂ O	-12.77	-42.58	-36.32	-44.76	-35.82	-73.64	-42.86	-14.62	-17.95	-5.94	-8.78
	CH ₄	%	52.0	40.5	40.4	51.4	54.6	53.7	51.8	53.9	53.4	53.4	49.8
	CO ₂	%	40.3	31.5	31.5	38.6	41.9	40.8	42.8	41.9	41.0	39.0	38.9
	O ₂	%	2.1	6.6	6.0	2.6	0.5	0.4	0.5	0.6	0.5	0.8	1.5
	BAL (N ₂)	%	5.6	21.4	22.1	7.4	2.9	5.1	0.0	5.8	4.7	16.6	9.1
	CO	PPM	21	12	14	12	8	11	22	25	9	>>	0
	H ₂ S	PPM	>>>>	>>>>	>>>>	>>>>	>>>>	>>>>	>>>>	>>>>	>>>>		
	Vel Max	m/s	3.56	4.54	4.61	2.78	2.40	2.70	2.29	1.34	1.45		3.96
	Vel Min	m/s	3.40	4.33	4.54	2.67	2.26	2.58	2.19	1.17	1.32		3.69
	Flow	CFM	32.8840425	41.90825531	43.23117656	25.74971719	22.01718938	24.946515	21.16674	11.85904406	13.08747094	0	36.14409844
	Temp	°C	12.8	14.2	20.4	21.0	30.4	31.2	-	-	-		10.2
	Comments		1/2T -> 3/4T	3/4T -> 1/2T	1/2T -> 1/4T	1/4T -> no change	1/4T -> 1/2T	1/2T -> no change	1/2T -> 3/4T	3/4T -> no change	3/4T -> no change	no change	1/4 T

Table 2: Wellfield Monitoring Data

	Units	26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18	
5-45	Well	"H ₂ O	-0.03	0.00	0.08	0.09	0.03	0.01	0.04	0.01	0.00	0.07	0.05
	Lateral	"H ₂ O	-13.42	-54.22	-38.98	-44.93	-35.51	-73.62	-42.82	-14.71	-18.10	-6.02	-10.31
	CH ₄	%	47.1	13.2	40.6	40.9	35.7	36.1	49.3	49.3	49.0	51.0	51.5
	CO ₂	%	45.6	13.7	34.4	39.2	33.3	32.3	50.4	50.1	49.8	48.2	47.0
	O ₂	%	2.0	14.0	4.7	0.8	5.5	6.0	0.3	0.3	0.4	0.0	0.5
	BAL (N ₂)	%	5.3	59.2	20.4	18.9	25.5	25.7	0.0	0.0	0.8	0.0	0.0
	CO	PPM	23	17	11	10	0	0	19	28	17	1	3
	H ₂ S	PPM	201	0	32	0	94	101	463	387	316		
	Vel Max	m/s	0.00	0.83	-	-	-	-	-	-	-	-	0.50
	Vel Min	m/s	0.00	0.75	-	-	-	-	-	-	-	-	0.42
	Flow	CFM	0	7.465055625	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	0	4.34674125
	Temp	°C	-1.9	7.7	-	-	-	-	-	-	-	in a hole	-6.1
	Comments		cracked -> no change	cracked -> closed	closed -> no change	closed -> no change	closed -> no change	closed -> no change	closed -> no change	closed -> no change	closed -> no change	no change	closed -> cracked
5-46	Well	"H ₂ O	0.05	0.09	0.10	-1.56	-0.03	-0.07	-0.05	0.07	-0.01	-0.06	0.02
	Lateral	"H ₂ O	-13.61	-54.42	-40.07	-43.11	-36.68	-73.84	-42.77	-14.49	-18.32	-5.88	-1.32
	CH ₄	%	54.0	50.1	26.1	13.0	56.1	54.9	56.0	53.8	54.9	54.6	34.6
	CO ₂	%	43.9	38.3	20.2	10.7	42.9	41.1	43.3	42.4	43.0	40.0	28.6
	O ₂	%	0.1	3.3	11.3	15.5	0.8	0.6	0.4	0.4	0.5	1.8	6.1
	BAL (N ₂)	%	2.0	7.4	41.8	60.8	1.9	3.4	0.0	3.4	1.6	3.1	31..2
	CO	PPM	17	0	0	62	2	0	32	37	29	22	36
	H ₂ S	PPM	148	115	98	11	74	67	388	214	172		
	Vel Max	m/s	0.77	0.56	0.00	4.42	0.86	0.90	0.85	0.89	1.05		-
	Vel Min	m/s	0.61	0.53	0.00	4.28	0.74	0.81	0.74	0.81	0.96		-
	Flow	CFM	6.520111875	5.149943438	0	41.10505313	7.55955	8.079269063	7.512302813	8.032021875	9.496684688	0	#VALUE!
	Temp	°C	-3.0	10.6	18.6	11.5	29.0	32.0	-	-	-	-	-
	Comments		closed -> cracked	cracked -> no change	cracked -> 1/2T	1/2T -> cracked	cracked -> no change	cracked -> no change	cracked -> 1/4T	1/4T -> no change	1/4T -> no change	no change	cracked -> closed
6-47	Well	"H ₂ O	0.38	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	-15.12	-17.63	-6.40	-8.42
	Lateral	"H ₂ O	0.37							-15.31	-17.88	-6.56	-8.42
	CH ₄	%	56.9							60.1	61.2	59.3	60.0
	CO ₂	%	38.1							39.1	38.7	39.8	38.8
	O ₂	%	1.2							0.6	0.1	0.6	1.1
	BAL (N ₂)	%	2.8							0.0	0.0	0.0	0.0
	CO	PPM	16							23	12	15	0
	H ₂ S	PPM	100							44	53		
	Vel Max	m/s	no							0.00	0.00		1.11
	Vel Min	m/s	lat vac							0.00	0.00		0.96
	Flow	CFM	#VALUE!	0	0	0	0	0	0	0	0	0	9.780167813
	Temp	°C	-							-	-		-4.5
	Comments		full -> no change							full -> no change	full -> no change	no change	full open, no change
6-48	Well	"H ₂ O	0.41	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	-14.60	-17.39	-5.89	-7.73
	Lateral	"H ₂ O	0.44							-14.99	-17.81	-6.23	-8.15
	CH ₄	%	44.3							58.6	59.2	61.3	58.9
	CO ₂	%	28.5							36.2	37.4	37.1	35.4
	O ₂	%	4.1							1.5	1.3	1.1	1.6
	BAL (N ₂)	%	22.2							3.6	2.0	0.2	4.1
	CO	PPM	15							26	20	13	1
	H ₂ S	PPM	65							23	37		
	Vel Max	m/s	no							0.73	0.85		1.79
	Vel Min	m/s	lat vac							0.66	0.79		1.58
	Flow	CFM	#VALUE!	0	0	0	0	0	0	6.567359063	7.74853875	0	15.92230219
	Temp	°C	-							-	-		0.0
	Comments		1T -> no change							1T -> no change	1T -> no change	1/2 T	no change
6-49	Well	"H ₂ O	0.30	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	0.29	0.11	0.24	-0.15
	Lateral	"H ₂ O	0.36							-14.85	-17.70	-5.59	-7.59
	CH ₄	%	57.9							57.1	56.7	45.5	43.3
	CO ₂	%	41.3							42.1	41.8	35.9	33.3
	O ₂	%	0.4							0.5	0.5	4.4	5.0
	BAL (N ₂)	%	0.5							0.0	1.0	14.2	18.4
	CO	PPM	17							38	41	0	17
	H ₂ S	PPM	>>>>							>>>>	>>>>		
	Vel Max	m/s	no							0.95	0.98		5.62
	Vel Min	m/s	lat vac							0.90	0.91		5.41
	Flow	CFM	#VALUE!	0	0	0	0	0	0	8.740729688	8.929718438	0	52.11364781
	Temp	°C	-							-	-		-2.8
	Comments		1T -> no change							1T -> 1.5T	1.5T -> 1.75T	no change	-1 T

Table 2: Wellfield Monitoring Data

	Units	26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18
6-50	Well	"H ₂ O	0.03	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	0.22	0.41	0.11	0.16
	Lateral	"H ₂ O	0.32						-14.79	-17.76	-5.94	-7.73
	CH ₄	%	53.3						52.1	54.5	54.7	48.9
	CO ₂	%	46.3						46.6	44.4	46.0	47.5
	O ₂	%	0.3						1.0	1.1	0.0	1.1
	BAL (N ₂)	%	0.0						0.0	0.0	0.0	2.5
	CO	PPM	33						67	54	0	55
	H ₂ S	PPM	>>>>						469	>>>>		
	Vel Max	m/s	no						-	-		2.40
	Vel Min	m/s	lat vac						-	-		2.30
	Flow	CFM	#VALUE!	0	0	0	0	0	#VALUE!	#VALUE!	0	22.20617813
	Temp	°C	-						-	-		-0.3
	Comments		closed -> no change						closed -> no change	closed -> no change	cracked	
6-51	Well	"H ₂ O	0.13	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	0.24	0.22	0.20	0.24
	Lateral	"H ₂ O	0.16						-5.92	-6.46	-5.42	-8.58
	CH ₄	%	50.5						48.6	48.2	50.7	50.9
	CO ₂	%	48.9						50.7	50.4	49.3	48.3
	O ₂	%	0.4						0.4	0.5	0.0	0.3
	BAL (N ₂)	%	0.0						0.0	0.9	0.0	0.0
	CO	PPM	23						30	21	15	10
	H ₂ S	PPM	461						>>>>	>>>>		
	Vel Max	m/s	no						-	-		1.54
	Vel Min	m/s	lat vac						-	-		1.30
	Flow	CFM	#VALUE!	0	0	0	0	0	#VALUE!	#VALUE!	0	13.41820125
	Temp	°C	-						-	-		-3.8
	Comments		closed -> no change						closed -> no change	closed -> no change	closed -> cracked	
6-52	Well	"H ₂ O	0.39	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	-0.02	0.00	0.05	0.14
	Lateral	"H ₂ O	0.25						-5.86	-6.34	-5.11	-8.30
	CH ₄	%	0.4						4.9	5.8	20.5	25.9
	CO ₂	%	0.9						4.9	5.8	22.4	28.9
	O ₂	%	18.5						19.4	18.7	12.7	8.1
	BAL (N ₂)	%	80.2						70.8	69.8	44.0	37.2
	CO	PPM	13						17	11	8	0
	H ₂ S	PPM	26						27	23		
	Vel Max	m/s	no						-	-		-
	Vel Min	m/s	lat vac						-	-		-
	Flow	CFM	#VALUE!	0	0	0	0	0	#VALUE!	#VALUE!	0	#VALUE!
	Temp	°C	-						-	-		-
	Comments		closed -> no change						closed -> no change	closed -> no change	no change	
6-53	Well	"H ₂ O	0.17	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	-1.82	-2.13	-0.73	-2.51
	Lateral	"H ₂ O	0.15						-3.86	-5.27	-2.38	-4.75
	CH ₄	%	54.1						53.9	54.1	55.5	50.0
	CO ₂	%	38.7						38.4	39.1	41.4	36.9
	O ₂	%	0.5						0.5	0.3	0.1	0.1
	BAL (N ₂)	%	6.7						7.2	6.5	2.5	13.6
	CO	PPM	23						0	0	20	11
	H ₂ S	PPM	>>>>						>>>>	>>>>		
	Vel Max	m/s	no						4.45	4.67		18.98
	Vel Min	m/s	lat vac						3.86	4.09		16.64
	Flow	CFM	#VALUE!	0	0	0	0	0	39.26241281	41.38853625	0	168.2944819
	Temp	°C	-						-	-		-1.8
	Comments		full -> no change						full -> no change	full -> no change	no change	
6-54	Well	"H ₂ O	0.04	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	0.02	-0.29		-0.18
	Lateral	"H ₂ O	0.09						-5.61	-6.49		-7.36
	CH ₄	%	58.7						58.0	56.7		59.5
	CO ₂	%	40.6						41.5	40.8		39.4
	O ₂	%	0.5						0.4	0.5		0.8
	BAL (N ₂)	%	0.3						0.0	2.0		0.1
	CO	PPM	20						21	32		0
	H ₂ S	PPM	213						216	228		
	Vel Max	m/s	no						2.98	3.14		6.18
	Vel Min	m/s	lat vac						2.35	2.89		4.85
	Flow	CFM	#VALUE!	0	0	0	0	0	25.18275094	28.49005406	0	52.11364781
	Temp	°C	-						-	-		1.9
	Comments		3/4T -> no change						3/4T -> 1T	1T -> 1.25T		

Table 2: Wellfield Monitoring Data

	Units	26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18
6-55	Well	"H ₂ O	0.18	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	-0.33	-0.88		-1.05
	Lateral	"H ₂ O	0.25						-4.32	-6.02		-3.72
	CH ₄	%	54.0						53.7	54.5		54.6
	CO ₂	%	40.0						41.3	41.9		40.7
	O ₂	%	1.1						0.3	0.1		0.0
	BAL (N ₂)	%	4.8						4.5	3.5		4.5
	CO	PPM	24						33	28		17
	H ₂ S	PPM	>>>>						>>>>	>>>>		
	Vel Max	m/s	no						2.86	2.74		16.64
	Vel Min	m/s	lat vac						2.77	2.61		15.89
	Flow	CFM	#VALUE!	0	0	0	0	0	26.60016656	25.27724531	0	153.6951009
	Temp	°C	-						-	-		-1.4
Comments		2T -> no change						2T -> 4T	4T -> 5T		1T	
6-56	Well	"H ₂ O	0.03	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	0.00	0.02		
	Lateral	"H ₂ O	0.21						0.01	0.05		
	CH ₄	%	56.6						60.5	60.9		
	CO ₂	%	37.7						38.4	38.8		
	O ₂	%	0.4						0.4	0.3		
	BAL (N ₂)	%	5.3						0.8	2.0		
	CO	PPM	21						23	19		
	H ₂ S	PPM	>>>>						>>>>	>>>>		
	Vel Max	m/s	no						no	no		
	Vel Min	m/s	lat vac						lateral vacuum	lateral vacuum		
	Flow	CFM	#VALUE!	0	0	0	0	0	#VALUE!	#VALUE!	0	0
	Temp	°C	-						-	-		
Comments		closed -> no change						closed -> no change	closed -> no change			
6-57	Well	"H ₂ O	0.16	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	0.21	0.14	0.16	0.25
	Lateral	"H ₂ O	0.17						0.05	0.04	0.20	no vac
	CH ₄	%	50.0						40.1	39.8	59.0	58.1
	CO ₂	%	36.0						28.4	27.9	37.9	37.1
	O ₂	%	2.5						7.5	8.0	0.0	0.1
	BAL (N ₂)	%	11.5						24.0	24.3	3.2	4.8
	CO	PPM	17						33	43	6	2
	H ₂ S	PPM	93						35	37		
	Vel Max	m/s	no						no	no		
	Vel Min	m/s	lat vac						lateral vacuum	lateral vacuum		
	Flow	CFM	#VALUE!	0	0	0	0	0	#VALUE!	#VALUE!	0	0
	Temp	°C	-						-	-		
Comments		full -> no change						full -> no change	full -> no change	no lat vac	no lat vac	
6-58	Well	"H ₂ O	0.07	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	0.03	0.01	0.10	0.17
	Lateral	"H ₂ O	0.03						0.00	0.00	0.07	no vac
	CH ₄	%	63.1						47.1	46.9	54.4	60.4
	CO ₂	%	36.0						34.1	34.0	39.0	39.5
	O ₂	%	0.5						5.4	5.2	0.4	0.0
	BAL (N ₂)	%	0.5						13.5	24.0	0.0	0.0
	CO	PPM	10						38	46	0	0
	H ₂ S	PPM	>>>>						76	63		
	Vel Max	m/s	no						no	no		
	Vel Min	m/s	lat vac						lateral vacuum	lateral vacuum		
	Flow	CFM	#VALUE!	0	0	0	0	0	#VALUE!	#VALUE!	0	0
	Temp	°C	-						-	-		
Comments		1/2T -> no change						1/2T -> no change	1/2T -> no change	no lat vac	no lat vac	
6-59	Well	"H ₂ O	0.09	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	0.05	0.02	0.05	0.22
	Lateral	"H ₂ O	0.43						0.04	0.12	0.07	no vac
	CH ₄	%	57.8						57.3	57.7	52.8	57.7
	CO ₂	%	41.6						42.3	42.1	38.1	42.3
	O ₂	%	0.5						0.3	0.2	1.7	0.1
	BAL (N ₂)	%	0.0						0.0	6.3	7.2	0.0
	CO	PPM	75						50	66	42	45
	H ₂ S	PPM	140						221	199		
	Vel Max	m/s	no						no	no		
	Vel Min	m/s	lat vac						lateral vacuum	lateral vacuum		
	Flow	CFM	#VALUE!	0	0	0	0	0	#VALUE!	#VALUE!	0	0
	Temp	°C	-						-	-		
Comments		1/2T -> no change						1/2T -> no change	1/2T -> no change	no lat vac	no lat vac	

Table 2: Wellfield Monitoring Data

	Units	26-Jan-18	1-Feb-18	1-Mar-18	25-Apr-18	22-May-18	23-Jun-18	30-Jul-18	31-Aug-18	26-Sep-18	29-Nov-18	3-Dec-18
7-60	Well	"H ₂ O	0.55	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	1.04	1.27	0.81	-6.16
	Lateral	"H ₂ O	0.27						0.49	0.37	0.52	-7.42
	CH ₄	%	64.0						63.9	64.1	63.0	63.5
	CO ₂	%	35.7						35.7	35.8	36.3	35.8
	O ₂	%	0.3						0.3	0.2	0.0	0.6
	BAL (N ₂)	%	0.0						0.0	0.0	0.0	0.0
	CO	PPM	11						21	16	0	6
	H ₂ S	PPM	198						82	109		
	Vel Max	m/s	no						no	no		1.52
	Vel Min	m/s	lat vac						lateral vacuum	lateral vacuum		1.01
	Flow	CFM	#VALUE!	0	0	0	0	0	#VALUE!	#VALUE!	0	11.95353844
Temp	°C	-						-	-		-1.6	
Comments		full -> no change						full -> no change	full -> no change	no lat vac	surging, full open	
7-61	Well	"H ₂ O	0.40	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	1.04	1.21		0.73
	Lateral	"H ₂ O	0.38						0.98	0.90		no vac
	CH ₄	%	51.3						52.7	53.2		53.4
	CO ₂	%	48.4						46.9	46.4		46.6
	O ₂	%	0.3						0.3	0.4		0.0
	BAL (N ₂)	%	0.0						0.0	0.0		0.0
	CO	PPM	86						176	155		52
	H ₂ S	PPM	>>>>						>>>>	>>>>		
	Vel Max	m/s	no						no	no		
	Vel Min	m/s	lat vac						lateral vacuum	lateral vacuum		0
	Flow	CFM	#VALUE!	0	0	0	0	0	#VALUE!	#VALUE!	0	0
Temp	°C	-						-	-			
Comments		full -> no change						full -> no change	full -> no change		no lat vac	
7-62	Well	"H ₂ O	0.27	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	0.84	0.90		0.76
	Lateral	"H ₂ O	0.19						0.97	0.93		no vac
	CH ₄	%	55.9						53.1	52.7		57.7
	CO ₂	%	43.4						46.4	46.6		42.1
	O ₂	%	0.4						0.4	0.5		0.1
	BAL (N ₂)	%	0.0						0.0	0.2		0.0
	CO	PPM	19						135	123		9
	H ₂ S	PPM	>>>>						>>>>	>>>>		
	Vel Max	m/s	no						no	no		
	Vel Min	m/s	lat vac						lateral vacuum	lateral vacuum		
	Flow	CFM	#VALUE!	0	0	0	0	0	#VALUE!	#VALUE!	0	0
Temp	°C	-						-	-			
Comments		1/4T -> no change						1/4T -> no change	1/4T -> no change		no lat vac	
7-64	Well	"H ₂ O	0.25	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	0.10	0.08	0.64	0.18
	Lateral	"H ₂ O	0.08						0.03	0.01	0.11	no vac
	CH ₄	%	51.6						52.2	52.5	49.4	48.5
	CO ₂	%	48.2						47.1	47.3	35.6	34.6
	O ₂	%	0.3						0.5	0.2	0.0	0.0
	BAL (N ₂)	%	0.0						0.0	0.0	15.2	16.9
	CO	PPM	82						80	76	8	6
	H ₂ S	PPM	>>>>						>>>>	>>>>		
	Vel Max	m/s	no						no	no		-
	Vel Min	m/s	lat vac						lateral vacuum	lateral vacuum		-
	Flow	CFM	#VALUE!	0	0	0	0	0	#VALUE!	#VALUE!	0	#VALUE!
Temp	°C	-						-	-		-	
Comments		1T -> no change						1T -> no change	1T -> no change	no lat vac	no vac	
7-65	Well	"H ₂ O	0.25	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	no lateral vacuum	CNM	CNM	cant monitor	port broken
	Lateral	"H ₂ O	0.12						Well	Well	0.13	
	CH ₄	%	57.0						Monitoring	Monitoring		
	CO ₂	%	38.8						Port	Port		
	O ₂	%	0.5						is	is		
	BAL (N ₂)	%	3.8						Broken	Broken		
	CO	PPM	10						-	-		
	H ₂ S	PPM	>>>>						-	-		
	Vel Max	m/s	no						no	no		
	Vel Min	m/s	lat vac						lateral vacuum	lateral vacuum		
	Flow	CFM	#VALUE!	0	0	0	0	0	#VALUE!	#VALUE!	0	0
Temp	°C	-						-	-			
Comments		1T -> no change						1T -> no change	1T -> no change	no lat vac well port broken	no lat vac	

Table 3: Pump Counters

Location	14-Dec-17			Jan. 2018			Feb. 2018			Apr. 2018			May. 2018		
	Counter	Counts / mo		Counter	Counts / mo	Litres / mo	Counter	Counts / mo	Litres / mo	Counter	Counts / mo	Litres / mo	Counter	Counts / mo	Litres / mo
PDT 1	4562	-		4562	0	0	4562	0	0	4591	29	75.4	4617	26	67.6
PDT 2	53779	-		53913	134	348.4	54374	461	1198.6	5527	1153	2997.8	56336	809	2103.4
PDT 3	12481	-		12487	6	15.6	12527	40	104	12589	62	161.2	12644	55	143
PDT 4	no counter	-		no counter	-	-	no counter	-	-	no counter	-	-	no counter	-	-
PDT 5	29188	-		29188	0	0	29198	10	26	30011	813	2113.8	30054	43	111.8
PDT 6	59032	-		59032	0	0	59044	12	31.2	81368	22324	58042.4	87505	6137	15956.2
PDT 7	7806	-		7806	0	0	7806	0	0	flooded	-	-	7806	0	0
PDT 8	2722	-		3312	590	1534	6973	3661	9518.6	17592	10619	27609.4	17592	0	0
PDT 9	173912	-		177669	3757	9768.2	183240	5571	14484.6	187248	4008	10420.8	189523	2275	5915
H-4	217585	-		220347	2762	7181.2	225506	5159	13413.4	229412	3906	10155.6	238551	9139	23761.4
1-9	659131	-		668421	9290	24154	675332	6911	17968.6	675332	0	0	675347	15	39
1-10	507089	-		510079	2990	7774	516029	5950	15470	516734	705	1833	518110	1376	3577.6
H-11	849881	-		859918	10037	26096.2	875423	15505	40313	893460	18037	46896.2	912299	18839	48981.4
2-18	928877	-		928877	0	0	928877	0	0	928877	0	0	928877	0	0
3-27	no pump	-		no pump	-	-	no pump	-	-	no pump	-	-	no pump	-	-
3-29	no counter	-		no counter	-	-	no counter	-	-	no counter	-	-	no counter	-	-
3-30	no pump	-		no pump	-	-	no pump	-	-	no pump	-	-	no pump	-	-

Location	June. 2018			July. 2018			Aug. 2018			Sept. 2018		
	Counter	Counts / mo	Litres / mo	Counter	Counts / mo	Litres / mo	Counter	Counts / mo	Litres / mo	Counter	Counts / mo	Litres / mo
PDT 1	4617	0	0	4617	0	0	4641	24	62.4	4647	6	15.6
PDT 2	56629	293	761.8	56629	0	0	57221	592	1539.2	57628	407	1058.2
PDT 3	12813	169	439.4	12995	182	473.2	13363	368	956.8	13407	44	114.4
PDT 4	no counter	-	-	no counter	-	-	no counter	-	-	no counter	-	-
PDT 5	30078	24	62.4	31528	1450	3770	31676	148	384.8	32274	598	1554.8
PDT 6	88462	957	2488.2	90427	1965	5109	91322	895	2327	94165	2843	7391.8
PDT 7	7806	0	0	7806	0	0	7806	0	0	8256	450	1170
PDT 8	17633	41	106.6	17633	0	0	17941	308	800.8	18063	122	317.2
PDT 9	190862	1339	3481.4	194574	3712	9651.2	195193	619	1609.4	197611	2418	6286.8
H-4	243274	4723	12279.8	249050	5776	15017.6	255838	6788	17648.8	264395	8557	22248.2
1-9	679090	3743	9731.8	682142	3052	7935.2	686229	4087	10626.2	694088	7859	20433.4
1-10	524403	6293	16361.8	525611	1208	3140.8	528974	3363	8743.8	531092	2118	5506.8
H-11	976219	63920	166192	998190	21971	57124.6	23055	24864	64646.4	49336	26281	68330.6
2-18	12669	83791	217856.6	57123	44454	115580.4	89941	32818	85326.8	109333	19392	50419.2
3-27	no pump	-	-	no pump	-	-	238279	0	0	238279	0	0
3-29	no counter	-	-	no counter	-	-	no counter	-	-	no counter	-	-
3-30	69250	0	0	69251	1	2.6	69251	0	0	69255	4	10.4

designed with compressed air and forcemain coming up to the well which allows for pumps to be relocated, as necessary.

Table 4 presents the water levels measured on a twice annual basis in 2018. However, as mentioned previously, due to Comcor staffing issues, only one of the semi-annual water level measurements was recorded in 2018. The percent of open screen available for gas collection at each well is estimated based on water levels.

Based on pump counters and water levels recorded throughout 2018, dual purpose well pumps continue to remove leachate consistently. Most of the monitored dual-purpose wells have open screen percentages on average 40%. Due to suspicion that the pumps at 3-27 and 3-30 may not be functioning as designed as a result of leachate and siltation residue making the pump inoperable, the pumps were pulled for maintenance in October 2017. The pumps were cleaned and in June 2018 the pump at 3-30 was reinstalled. The pump at 3-27 was reinstalled in August 2018. All pump replacements were coordinated when staff were available to perform the necessary confined space entry.

2.2 Surface Emission Monitoring

As required by the City, surface emission monitoring is requested to be carried out semi-annually, weather conditions permitting, by Comcor. This monitoring is performed using a portable flame ionization detector (FID) and a GPS, marking locations where concentrations of hydrocarbons were greater than 500 ppm. However, due to staffing issues and equipment complications, surface emission monitoring was not completed for the 2018 reporting year.

2.3 Mechanical System Monitoring

The main operational control of the mechanical system is carried out by the Programmable Logic Controller (PLC). The PLC also provides information on the operating status of the system, and records all data electronically which can be downloaded when required. Specific details on these items are included in the Flare Operation and Maintenance Manual. At a minimum the PLC records:

- Landfill gas composition and temperature
- Flare operating times
- Blower operating times
- Landfill gas flow rate
- Volume of landfill gas collected and flared
- Greenhouse Gas Emission Reduction in CO₂ equivalents.

These items were also monitored remotely and were reviewed at minimum on a weekly basis to ensure that all parameters outlined above are being recorded and that all system data indicates

Table 4: Water Levels

			Dec 4/6, 2018		
Units	meters	meters	meters	meters	%
Locations	Screen Length	Installed Well Depth	Depth to Water	Depth to Bottom	Open Screen
H-1	12	14.63	7.34	13.36	40.19
H-2	14	16.77	8.80	17.32	41.92
H-3	12	15.24	7.23	15.18	34.29
H-4*	11	14.02	7.39	9.18	39.55
1-5	11	13.72	7.99	13.65	46.31
1-6	12	15.55	10.90	15.53	61.88
1-7	18	21.34	15.00	19.53	65.33
1-8	21	24.39	15.97	22.43	60.55
1-9*	12	14.63	10.14	14.09	63.15
1-10*	9	12.20	9.25	10.89	67.80
H-11*	9	12.80	5.75	6.46	22.87
H-12	13	16.16	NM	No Port	-
2-13	21	25.00	NM	Too Tall	-
2-14	20	22.56	13.90	17.65	56.30
2-15	18	21.65	13.10	20.63	53.28
2-16	26	28.35	22.13	28.18	75.98
2-17	15	18.29	NM	-	-
2-18*	15	18.29	16.29	17.72	86.86
3-19	12	14.94	8.29	8.66	45.48
3-20	11	13.26	9.30	9.43	62.87
3-21	5	7.62	4.57	7.39	33.26
3-22	24	26.68	7.18	18.24	19.05
3-23	23	25.91	9.09	16.99	26.42
3-24	21	23.48	4.72	20.69	12.12
3-25	18	21.34	NM	-	-
3-26	9	12.20	NM	-	-
3-27*	21	24.09	NM	-	-
3-28	12	15.24	NM	-	-
3-29*	12	14.63	NM	-	-
3-30*	7	9.76	NM	-	-
4-31	16	18.75	8.73	17.10	37.99
4-32	10	12.50	7.02	9.99	43.83
4-33	24	26.68	9.15	28.51	28.14
4-34	20	22.56	5.96	7.65	16.23
4-35	15	17.38	NM	-	-
4-36	15	18.29	NM	-	-
4-37	12	14.94	NM	-	-
5-38	8	10.67	3.85	11.12	10.51
5-39	8	10.67	4.39	11.12	17.60
5-40	18	21.95	NM	-	-
5-41	17	18.90	7.70	15.49	33.19
5-42	12	16.16	NM	-	-
5-43	14	16.16	6.29	11.2	28.07
5-44	19	21.95	14.44	20.85	60.26
5-45	15	16.77	NM	-	-
5-46	16	18.90	NM	-	-
6-47	14	15.85	5.06	12.57	21.33
6-48	15	17.68	4.88	14.48	12.51
6-49	20	23.48	12.96	21.99	48.52
6-50	14	17.38	13.39	15.3	72.17
6-51	12	14.94	NM	-	-
6-52	6	9.15	NM	-	-
6-53	22	23.63	NM	-	-
6-54	13	15.85	NM	-	-
6-55	18	21.34	NM	-	-
6-56	10	12.80	NM	-	-
6-57	21	24.39	NM	-	-
6-58	17	22.50	NM	-	-
6-59	17	20.12	NM	-	-
7-60	13	15.55	5.1	12.82	16.41
7-61	13	15.24	NM	-	-
7-62	17	18.29	NM	-	-
7-64	22	24.09	NM	-	-
7-65	24	26.22	NM	-	-

* Dual Purpose Wells

* NM = Not Monitored

that the overall system is operating properly. The system review was carried out by a technician experienced in the operation of such systems.

Comcor staff also carried out the maintenance of the system as outlined by the Operations and Maintenance Manual. No other major repairs had to be made to the mechanical system during 2018.

Data for 2018 has been compiled, and is found in Appendix A.

2.3.1 System Pressure Measurements

Monitoring ports at the inlet and outlet to the blower were measured and recorded on a monthly frequency, using a suitably scaled pressure gauge. Gauge fluctuations were noted, as it can be an indication of water within the system.

Data for 2018 has been compiled, and is found in Table 2.

2.3.2 System Gas Measurements

The purpose of the main blower skid gas analyzer system is to monitor the oxygen and methane concentrations of the landfill gas being transferred by the LGFCS to the flare. As a safety precaution, if either the oxygen concentration gets too high, or the methane concentration gets too low, an alarm is sent to the main computer control panel PLC to shut the system down. Having records of the gas concentrations also allows for better analysis of the system and aids in troubleshooting when problems arise.

A pump, located within the gas analyzer system cabinet in the control room, is used to draw a continuous sample of process gas from the header pipe on the blower discharge side. After entering the analyzer, the sample is drawn through a de-mister and a series of filters to remove any particulate or moisture that may affect the monitoring equipment. The methane and oxygen concentrations of the sample are then measured by an infra-red methane analyzer and oxygen analyzer. The methane and oxygen concentrations are displayed on separate LED display screens mounted on the front face of the gas analyzer panel. The gas analyzer system will send signals to the PLC that will trigger a number of system alarms/warnings including low methane and high oxygen.

All system failures and/or alarms are displayed on the main control circuit panel. Any alarms that shut down the system are relayed by the auto messaging to the system operator.

During 2018, the system operated as intended with the analyzer data recorded at an interval of five minutes or better and any system alarms were sent to the operator. This data was recorded and summarized into a daily value and can be found in Appendix A.

In addition to the main system analyser, concentrations of methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) were measured manually, recorded monthly at the blower inlet and blower outlet, and compared to the insitu monitoring devices to ensure accuracy. These measurements were taken using a proper gas meter/analyzer such as a Landtec GEM-5000+, or equivalent.

2.3.3 System Flow Rate Measurements

Landfill gas velocities and temperatures at each landfill gas extraction well in the wellfield were measured and recorded on a monthly basis using an anemometer. These velocities were used to calculate landfill gas flow rates by multiplying by the pipe's cross sectional area.

A thermal mass flow meter continuously calculates flows to the flare and this data was recorded on an interval of 5 minutes or less.

The monitoring completed in 2018 is found in Table 2 and a summary of daily plant data can be found in Appendix A.

3.0 FLARE AND GREENHOUSE GAS EMISSIONS

3.1 Flare Emissions

The flare stack is equipped with four thermocouples that measure the temperature in the flare stack. These thermocouples are monitored by the system control panel PLC at intervals of 5 minutes or better. The control system is continuously monitoring the flame conditions and will shut down the LGCFS system immediately if flame is lost.

If the system shuts down for any reason, the fail safe valve will close and prevent any non-combusted landfill gas from being released to the atmosphere, thereby controlling the emissions from the flare.

3.2 Greenhouse Gas Emissions

The landfill gas comprises primarily methane and carbon dioxide in approximately equal amounts. In addition there are other trace amounts of a large number of compounds. Methane and carbon dioxide are greenhouse gases but methane has a global warming potential 25 times that of carbon dioxide. By combusting the methane in the flare the resultant products are carbon dioxide and water vapour which reduces its global warming potential by approximately 95 percent.

The control panel records both flow and methane gas concentration being collected from the system and sent to be combusted in the flare. These quantities are measured and recorded at intervals of 5 minutes or less. The data collected can be readily processed to calculate the greenhouse gas emission reduction expressed as carbon dioxide equivalents.

For the Brady Road Landfill, greenhouse gas emissions have been calculated based on operational data and can be found in Appendix A.

4.0 CONDENSATE COLLECTION SYSTEM

The purpose of the Condensate Collection System component of the LGCFSS is to remove moisture from the landfill gas and to collect condensate from the collection laterals/header pipes. Collection and removal of the condensate increases the efficiency of the landfill gas collection in the wellfield and minimizes the moisture being passed through the mechanical system.

Condensate and moisture are removed from the system at three main locations. First, relative low points have been provided in the gas collection header to allow any free moisture to drain by gravity out of the underground gas collection system. In the wellfield, this moisture drains into condensate gravity style and pump style drain traps which have pneumatic pumps installed inside the sump. Next, prior to the gas entering the blowers, a condensate moisture separator removes most of the residual water droplets remaining in the gas. At this stage the residual water drains by gravity into the condensate chamber.

The condensate chamber stores the water until the pump at the bottom of the chamber is activated either manually or automatically through a series of floats. The water is then pumped through a 75 mm diameter HDPE forcemain and is discharged into the leachate collection system.

In July 2018, the compressed air and forcemain piping as associated with the leachate pumping system (LPS) was extended, including an additional conduit for future electrical. Forcemain and compressed air was brought to cleanout #5, cleanout #6 and Cell 30 sump. Electrical conduit was brought to Cell 30 sump riser for future electrical connection.

The Condensate Collection System operated as intended during 2018.

5.0 CONCLUSIONS AND RECOMMENDATIONS

1. During operation in 2018, the Brady Road Resource Management Facility Gas Collection and Flaring System operated as was intended.
2. The system should continue to operate on a full-time basis and be monitored according to the Operation and Maintenance Manual for the site.
3. The cause of the loss of vacuum on Lateral 6 and 7 should be investigated in the spring. Lateral 6 should be excavated, inspected and repaired as required. Vacuum issues on Lateral 7 should be reassessed after an extended period of spring/summer weather.

All of which is Respectfully Submitted,

INTEGRATED GAS RECOVERY SERVICES

Diana Pepall, P.Eng.
Project Engineer

APPENDIX A
PLANT AND FLARE DATA

Date	CO2 Equivalents			Landfill Gas Flow							CH4	O2	Flare	Temperature			Blower 1		Blower 2																					
	Yearly	Monthly	Daily	Yearly	Monthly	Daily	Daily	Avg	Total	Avg				Avg	Run	Flare	Min.	Avg.	Max.	Daily	Cum.	Daily	Cum.																	
	Tonnes	Tonnes	Tonnes																					scf	scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C	°C	°C	Hours	Hours	Hours	Hours
	CO2	CO2	CO2																					scf	scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C	°C	°C	Hours	Hours	Hours	Hours
Jan 1 2018	199	199	199	1296277	1296277	1296277	36721	900	439	33.4	6.8	23:58	0	881	900	928	0	19218	23.9	17398.8																				
Jan 2 2018	402	402	203	2591436	2591436	1295159	36689	899	447	34.1	6.7	23:59	0	883	900	918	0	19218	23.9	17422.7																				
Jan 3 2018	593	593	191	3886214	3886214	1294778	36678	899	421	32.1	7.3	23:59	0	876	900	921	0	19218	23.9	17446.7																				
Jan 4 2018	782	782	189	5181794	5181794	1295580	36701	900	416	31.8	7.5	23:58	0	877	900	925	0	19218	23.9	17470.6																				
Jan 5 2018	971	971	189	6467099	6467099	1285305	36410	900	415	31.9	7.5	23:58	0	0	899	925	0	19218	24.6	17495.2																				
Jan 6 2018	1177	1177	206	7762357	7762357	1295258	36692	900	453	34.6	6.7	23:59	0	878	900	921	0	19218	23.9	17519.1																				
Jan 7 2018	1380	1380	203	9058154	9058154	1295797	36707	900	447	34.1	7	23:58	0	885	900	918	0	19218	23.9	17543																				
Jan 8 2018	1485	1485	105	9752086	9752086	693932	19658	900	230	32.8	7.4	12:51	0	876	900	926	0	19218	13.1	17556																				
Jan 9 2018	1622	1622	137	10565332	10565332	813246	23038	900	301	36.6	6.3	23:59	0	0	896	912	0	19218	34.3	17590.3																				
Jan 10 2018	1826	1826	204	11861652	11861652	1296320	36722	900	448	34.2	7.3	23:58	0	882	900	917	0	19218	23.9	17614.2																				
Jan 11 2018	2019	2019	193	13157456	13157456	1295804	36708	900	425	32.4	7.5	23:58	0	870	900	922	0	19218	23.9	17638.1																				
Jan 12 2018	2212	2212	193	14453340	14453340	1295884	36710	900	424	32.4	7.6	23:58	0	861	900	924	0	19218	23.9	17662																				
Jan 13 2018	2408	2408	196	15749999	15749999	1296659	36732	900	431	32.9	7.4	23:58	0	858	900	927	0	19218	23.9	17685.9																				
Jan 14 2018	2605	2605	197	17045638	17045638	1295639	36703	900	432	33	7.4	23:59	0	881	900	915	0	19218	24	17709.9																				
Jan 15 2018	2789	2789	184	18342794	18342794	1297156	36746	901	404	30.8	8	23:58	0	872	897	913	0	19218	23.9	17733.8																				
Jan 16 2018	2988	2988	199	19638387	19638387	1295593	36702	900	437	33.3	7.2	23:59	0	883	900	919	0	19218	23.9	17757.7																				
Jan 17 2018	3201	3201	213	20934476	20934476	1296089	36716	900	469	35.7	6.8	23:58	0	880	900	918	0	19218	23.9	17781.6																				
Jan 18 2018	3427	3427	226	22230826	22230826	1296350	36723	900	498	37.9	6.4	23:59	0	882	900	921	0	19218	23.9	17805.5																				
Jan 19 2018	3653	3653	226	23527170	23527170	1296344	36723	900	497	37.9	6.7	23:58	0	870	900	922	0	19218	23.9	17829.5																				
Jan 20 2018	3871	3871	218	24823236	24823236	1296066	36715	900	480	36.6	7.2	23:59	0	877	900	924	0	19218	23.9	17853.4																				
Jan 21 2018	4087	4087	216	26119506	26119506	1296270	36721	900	475	36.2	7.3	23:59	0	883	900	914	0	19218	23.9	17877.3																				
Jan 22 2018	4310	4310	223	27415607	27415607	1296101	36716	900	491	37.4	6.9	23:59	0	880	900	917	0	19218	23.9	17901.2																				
Jan 23 2018	4532	4532	222	28711179	28711179	1295572	36701	900	488	37.2	7.1	23:59	0	889	900	914	0	19218	23.9	17925.1																				
Jan 24 2018	4751	4751	219	30008054	30008054	1296875	36738	901	482	36.8	7.4	23:59	0	880	900	913	0	19218	23.9	17949																				
Jan 25 2018	4978	4978	227	31303877	31303877	1295823	36708	900	500	38.2	6.8	23:59	0	883	900	916	0	19218	23.9	17972.9																				
Jan 26 2018	5209	5209	231	32600396	32600396	1296519	36728	900	507	38.7	6.7	23:59	0	883	900	926	0	19218	23.9	17996.8																				
Jan 27 2018	5427	5427	218	33896059	33896059	1295663	36704	900	479	36.5	7.2	23:59	0	887	900	912	0	19218	23.9	18020.7																				
Jan 28 2018	5647	5647	220	35191718	35191718	1295659	36703	900	485	37	6.8	23:59	0	887	900	915	0	19218	23.9	18044.6																				
Jan 29 2018	5880	5880	233	36486476	36486476	1294758	36678	899	513	39.1	6	23:58	0	880	900	927	0	19218	23.9	18068.5																				
Jan 30 2018	6135	6135	255	37782237	37782237	1295761	36706	900	562	42.9	4.6	23:58	0	870	900	925	0	19218	23.9	18092.4																				
Jan 31 2018	6360	6360	225	39076667	39076667	1294430	36669	899	494	37.7	6.6	23:59	0	886	900	914	0	19218	23.9	18116.3																				
Feb 1 2018	6570	210	210	40373179	1296512	1296512	36728	900	462	35.2	7.2	23:59	0	878	900	922	0	19218	23.9	18140.2																				
Feb 2 2018	6783	423	213	41668379	2591712	1295200	36690	899	468	35.7	6.9	23:59	0	882	900	925	0	19218	23.9	18164.1																				
Feb 3 2018	6990	630	207	42964603	3887936	1296224	36719	900	455	34.7	7.3	23:59	0	886	900	915	0	19218	23.9	18188																				
Feb 4 2018	7204	844	214	44260831	5184164	1296228	36720	900	470	35.8	6.7	23:59	0	888	900	918	0	19218	23.9	18212																				
Feb 5 2018	7405	1045	201	45556724	6480057	1295893	36710	900	443	33.8	7.5	23:58	0	876	900	927	0	19218	23.9	18235.9																				
Feb 6 2018	7511	1151	106	46206480	7129813	649756	18406	899	234	35.6	7	12:03	1	-12	891	941	5.4	19223.4	6.7	18242.5																				
Feb 7 2018	7716	1356	205	47501977	8425310	1295497	36699	900	451	34.4	7.3	23:59	0	867	900	922	23.9	19247.3	0	18242.5																				
Feb 8 2018	7915	1555	199	48797726	9721059	1295749	36706	900	437	33.3	7.7	23:59	0	867	900	931	23.9	19271.2	0	18242.5																				

Date	CO2 Equivalents			Landfill Gas Flow							CH4	O2	Flare	Temperature			Blower 1		Blower 2	
	Yearly	Monthly	Daily	Yearly	Monthly	Daily	Daily	Avg	Total	Avg				Avg	Run	Flare	Min.	Avg.	Max.	Daily
	Tonnes	Tonnes	Tonnes	Yearly	Monthly	Daily	Daily	Avg	Total	Avg	Avg	Run	Flare	Min.	Avg.	Max.	Daily	Cumu.	Daily	Cumu.
	CO2	CO2	CO2	scf	scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C	°C	°C	Hours	Hours	Hours	Hours
Feb 9 2018	8119	1759	204	50093812	11017145	1296086	36716	900	449	34.2	7.3	23:59	0	870	900	919	23.9	19295.1	0	18242.5
Feb 10 2018	8325	1965	206	51389061	12312394	1295249	36692	899	453	34.6	7.3	23:58	0	858	900	928	23.9	19319	0	18242.5
Feb 11 2018	8516	2156	191	52685036	13608369	1295975	36712	900	421	32.1	8.2	23:59	0	874	895	916	23.9	19342.9	0	18242.5
Feb 12 2018	8705	2345	189	53981495	14904828	1296459	36726	900	416	31.7	8	23:58	0	879	899	917	23.9	19366.8	0	18242.5
Feb 13 2018	8912	2552	207	55277318	16200651	1295823	36708	900	456	34.8	7	23:59	0	886	900	915	23.9	19390.7	0	18242.5
Feb 14 2018	9121	2761	209	56564828	17488161	1287510	36473	900	460	35.3	7.2	23:58	0	0	899	928	23.7	19414.4	0	18242.5
Feb 15 2018	9329	2969	208	57859347	18782680	1294519	36671	899	457	34.9	7.5	23:58	0	877	900	922	23.9	19438.3	0	18242.5
Feb 16 2018	9533	3173	204	59019369	19942702	1160022	32861	899	449	38.3	6.2	21:28	0	885	900	917	22.3	19460.7	0	18242.5
Feb 17 2018	9533	3173	0	59019369	19942702	0	0	0	0	0	0	00:00	0	0	0	0	0	19460.7	0	18242.5
Feb 18 2018	9533	3173	0	59019369	19942702	0	0	0	0	0	0	00:00	0	0	0	0	0	19460.7	0	18242.5
Feb 19 2018	9533	3173	0	59019369	19942702	0	0	0	0	0	0	00:00	0	0	0	0	0	19460.7	0	18242.5
Feb 20 2018	9656	3296	123	59643163	20566496	623794	17671	899	270	42.8	5.7	11:34	1	-17	892	941	10.7	19471.3	0	18242.5
Feb 21 2018	9891	3531	235	60938805	21862138	1295642	36703	900	516	39.4	6.5	23:59	0	875	900	921	23.9	19495.2	0	18242.5
Feb 22 2018	10098	3738	207	62055634	22978967	1116829	31638	899	456	40.3	5.9	20:39	1	-4	895	951	20.6	19515.8	0	18242.5
Feb 23 2018	10333	3973	235	63351272	24274605	1295638	36703	900	516	39.4	6.2	23:59	0	877	900	918	23.9	19539.7	0	18242.5
Feb 24 2018	10572	4212	239	64647183	25570516	1295911	36711	900	526	40.1	5.8	23:59	0	885	900	919	23.9	19563.7	0	18242.5
Feb 25 2018	10803	4443	231	65943112	26866445	1295929	36711	900	509	38.8	6.4	23:59	0	886	900	920	23.9	19587.6	0	18242.5
Feb 26 2018	11035	4675	232	67237810	28161143	1294698	36676	899	510	39	6	23:59	0	856	900	959	23.9	19611.5	0	18242.5
Feb 27 2018	11276	4916	241	68532437	29455770	1294627	36674	899	531	40.5	5.1	23:58	0	878	900	924	23.9	19635.4	0	18242.5
Feb 28 2018	11521	5161	245	69827544	30750877	1295107	36688	899	539	41.1	5	23:59	0	888	900	925	23.9	19659.3	0	18242.5
Mar 1 2018	11757	236	236	71122833	1295289	1295289	36693	900	520	39.7	5.5	23:58	0	875	900	923	23.9	19683.2	0	18242.5
Mar 2 2018	11997	476	240	72418416	2590872	1295583	36701	900	527	40.2	5.3	23:58	0	883	900	926	23.9	19707.1	0	18242.5
Mar 3 2018	12247	726	250	73714056	3886512	1295640	36703	900	550	42	4.7	23:59	0	888	900	912	23.9	19731	0	18242.5
Mar 4 2018	12504	983	257	75009717	5182173	1295661	36703	900	566	43.2	4.3	23:58	0	881	900	920	23.9	19754.9	0	18242.5
Mar 5 2018	12592	1071	88	75429374	5601830	419657	11888	897	194	45.8	3.4	07:47	1	-2	886	942	7.8	19762.7	0	18242.5
Mar 6 2018	12835	1314	243	76725461	6897917	1296087	36716	900	534	40.7	5.2	23:59	0	886	900	914	23.9	19786.6	0	18242.5
Mar 7 2018	13024	1503	189	77809127	7981583	1083666	30698	899	417	38	6.8	20:04	1	-6	894	928	20	19806.6	0	18242.5
Mar 8 2018	13235	1714	211	79104969	9277425	1295842	36709	900	464	35.4	7.8	23:59	0	882	900	921	23.9	19830.5	0	18242.5
Mar 9 2018	13442	1921	207	80398500	10570956	1293531	36643	898	455	34.8	7.8	23:59	0	884	900	918	23.9	19854.4	0	18242.5
Mar 10 2018	13644	2123	202	81695364	11867820	1296864	36738	901	444	33.9	8.1	23:59	0	889	900	913	23.9	19878.3	0	18242.5
Mar 11 2018	13843	2322	199	82990494	13162950	1295130	36688	901	438	33.4	8.2	23:59	0	887	900	918	22.9	19901.2	0	18242.5
Mar 12 2018	14038	2517	195	84286290	14458746	1295796	36707	900	429	32.7	8.3	23:58	0	877	900	920	23.9	19925.1	0	18242.5
Mar 13 2018	14243	2722	205	85579717	15752173	1293427	36640	898	452	34.5	7.6	23:58	0	885	900	918	23.9	19949	0	18242.5
Mar 14 2018	14442	2921	199	86880133	17052589	1300416	36838	903	437	33.2	8.1	23:59	0	889	900	914	23.9	19972.9	0	18242.5
Mar 15 2018	14637	3116	195	88177790	18350246	1297657	36760	901	429	32.7	8.3	23:59	0	885	900	919	23.9	19996.9	0	18242.5
Mar 16 2018	14803	3282	166	89229074	19401530	1051284	29781	899	365	34.3	7.4	19:29	1	0	893	952	19.4	20016.3	0	18242.5
Mar 17 2018	15003	3482	200	90525660	20698116	1296586	36730	900	441	33.6	8	23:59	0	887	900	912	23.9	20040.2	0	18242.5
Mar 18 2018	15199	3678	196	91823459	21995915	1297799	36764	901	432	32.9	8.3	23:59	0	878	900	925	23.9	20064.1	0	18242.5
Mar 19 2018	15394	3873	195	93112081	23284537	1288622	36504	895	428	32.8	8.2	23:59	0	875	900	934	23.9	20088	0	18242.5

Date	CO2 Equivalents			Landfill Gas Flow						CH4	O2	Flare	Flare	Temperature			Blower 1		Blower 2																						
	Yearly	Monthly	Daily	Yearly	Monthly	Daily	Daily	Avg	Total					Avg	Avg	Run	Flare	Min.	Avg.	Max.	Daily	Cum.	Daily	Cum.																	
	Tonnes	Tonnes	Tonnes																						scf	scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C	°C	°C	Hours	Hours	Hours	Hours
	CO2	CO2	CO2																						scf	scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C	°C	°C	Hours	Hours	Hours	Hours
Mar 20 2018	15594	4073	200	94405773	24578229	1293692	36648	898	439	33.5	7.9	23:59	0	889	900	922	23.9	20111.9	0	18242.5																					
Mar 21 2018	15789	4268	195	95700890	25873346	1295117	36688	899	428	32.7	8.2	23:59	0	888	900	922	23.9	20135.8	0	18242.5																					
Mar 22 2018	15985	4464	196	96997713	27170169	1296823	36736	901	431	32.8	8.1	23:58	0	882	900	931	23.9	20159.7	0	18242.5																					
Mar 23 2018	16171	4650	186	98157724	28330180	1160011	32861	899	409	34.9	7.2	21:29	1	5	893	944	21.4	20181.1	0	18242.5																					
Mar 24 2018	16364	4843	193	99455129	29627585	1297405	36753	901	426	32.4	7.9	23:58	0	883	900	916	23.9	20205	0	18242.5																					
Mar 25 2018	16555	5034	191	100752049	30924505	1296920	36739	901	421	32.1	8	23:59	0	883	900	919	23.9	20228.9	0	18242.5																					
Mar 26 2018	16741	5220	186	102047754	32220210	1295705	36705	900	410	31.3	8.2	23:58	0	882	900	923	23.9	20252.8	0	18242.5																					
Mar 27 2018	16936	5415	195	103346683	33519139	1298929	36796	902	429	32.6	7.7	23:58	0	886	900	913	23.9	20276.8	0	18242.5																					
Mar 28 2018	17106	5585	170	104471730	34644186	1125047	31870	899	374	32.9	7.5	20:51	1	-7	888	922	20.8	20297.6	0	18242.5																					
Mar 29 2018	17293	5772	187	105768198	35940654	1296468	36726	900	411	31.3	8	23:59	0	871	894	919	23.9	20321.5	0	18242.5																					
Mar 30 2018	17484	5963	191	107066008	37238464	1297810	36764	901	419	31.9	7.7	23:59	0	868	898	928	23.9	20345.4	0	18242.5																					
Mar 31 2018	17673	6152	189	108365014	38537470	1299006	36798	902	415	31.6	7.8	23:59	0	882	900	919	23.9	20369.3	0	18242.5																					
Apr 1 2018	17863	190	190	109660264	1295250	1295250	36692	899	418	31.9	7.8	23:59	0	871	899	917	23.9	20393.2	0	18242.5																					
Apr 2 2018	18045	372	182	110957539	2592525	1297275	36749	901	401	30.5	8.3	23:58	0	871	898	922	23.9	20417.1	0	18242.5																					
Apr 3 2018	18229	556	184	112253822	3888808	1296283	36721	900	404	30.8	8.2	23:59	0	867	897	930	23.9	20441	0	18242.5																					
Apr 4 2018	18415	742	186	113551158	5186144	1297336	36751	901	408	31.1	8.1	23:59	0	873	900	923	23.9	20464.9	0	18242.5																					
Apr 5 2018	18600	927	185	114846216	6481202	1295058	36686	899	406	31	8	23:58	0	872	899	920	23.9	20488.8	0	18242.5																					
Apr 6 2018	18779	1106	179	116141138	7776124	1294922	36683	899	394	30.1	8.1	23:59	0	870	897	914	23.9	20512.7	0	18242.5																					
Apr 7 2018	18956	1283	177	117437603	9072589	1296465	36726	900	388	29.6	8.4	23:58	0	882	899	920	23.9	20536.6	0	18242.5																					
Apr 8 2018	19142	1469	186	118734551	10369537	1296948	36740	901	409	31.2	8	23:58	0	880	900	920	23.9	20560.5	0	18242.5																					
Apr 9 2018	19340	1667	198	120031368	11666354	1296817	36736	901	437	33.3	7.1	23:58	0	879	900	921	23.9	20584.4	0	18242.5																					
Apr 10 2018	19557	1884	217	121327338	12962324	1295970	36712	900	477	36.4	5.8	23:59	0	885	900	914	23.9	20608.4	0	18242.5																					
Apr 11 2018	19764	2091	207	122614136	14249122	1286798	36452	900	454	34.9	6.4	23:56	1	0	899	928	24.5	20632.9	0	18242.5																					
Apr 12 2018	19964	2291	200	123910861	15545847	1296725	36734	901	440	33.5	6.9	23:59	0	878	900	915	23.9	20656.8	0	18242.5																					
Apr 13 2018	20157	2484	193	125207238	16842224	1296377	36724	900	425	32.4	7.2	23:59	0	886	900	921	23.9	20680.7	0	18242.5																					
Apr 14 2018	20356	2683	199	126502949	18137935	1295711	36705	900	438	33.4	6.8	23:58	0	884	900	916	23.9	20704.6	0	18242.5																					
Apr 15 2018	20554	2881	198	127799665	19434651	1296716	36733	900	435	33.1	6.8	23:58	0	886	900	916	23.9	20728.5	0	18242.5																					
Apr 16 2018	20742	3069	188	129038801	20673787	1239136	35102	861	414	33	6.8	23:59	0	875	900	924	23.9	20752.4	0	18242.5																					
Apr 17 2018	20916	3243	174	130191434	21826420	1152633	32652	800	384	32.9	6.9	23:58	0	884	899	916	23.9	20776.3	0	18242.5																					
Apr 18 2018	21067	3394	151	131188404	22823390	996970	28242	800	332	32	7.3	18:06	0	860	898	921	17.9	20794.2	0	18242.5																					
Apr 19 2018	21169	3496	102	131754050	23389036	565646	16024	786	224	0	0	00:00	0	0	0	0	0	0	0	0																					
Apr 20 2018	21373	3700	204	132905772	24540758	1151722	32626	800	449	38.5	5.9	23:59	1	884	900	913	31.4	20825.6	0	18242.5																					
Apr 21 2018	21585	3912	212	134058096	25693082	1152324	32643	800	465	39.9	5.4	23:59	0	884	900	916	23.9	20849.5	0	18242.5																					
Apr 22 2018	21794	4121	209	135210612	26845598	1152516	32648	800	459	39.3	5.6	23:59	0	887	900	915	23.9	20873.4	0	18242.5																					
Apr 23 2018	21956	4283	162	136113508	27748494	902896	25577	799	357	39.1	5.6	18:49	1	42	895	978	18.7	20892.1	0	18242.5																					
Apr 24 2018	22165	4492	209	137266492	28901478	1152984	32662	801	460	39.4	5.1	23:58	0	883	900	918	23.9	20916	0	18242.5																					
Apr 25 2018	22382	4709	217	138418650	30053636	1152158	32638	800	477	40.9	5.3	23:59	0	863	900	921	23.9	20940	0	18242.5																					
Apr 26 2018	22583	4910	201	139480671	31115657	1062021	30085	799	441	41.1	4.9	22:09	2	14	890	951	22.1	20962.1	0	18242.5																					

Date	CO2 Equivalents			Landfill Gas Flow							CH4	O2	Flare	Temperature			Blower 1		Blower 2	
	Yearly	Monthly	Daily	Yearly	Monthly	Daily	Daily	Avg	Total	Avg				Avg	Run	Flare	Min.	Avg.	Max.	Daily
	Tonnes	Tonnes	Tonnes	Yearly	Monthly	Daily	Daily	Avg	Total	Avg	Avg	Run	Flare	Min.	Avg.	Max.	Daily	Cumu.	Daily	Cumu.
	CO2	CO2	CO2	scf	scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C	°C	°C	Hours	Hours	Hours	Hours
Apr 27 2018	22794	5121	211	140632891	32267877	1152220	32640	800	465	39.9	5.2	23:59	0	880	900	917	23.9	20986	0	18242.5
Apr 28 2018	23009	5336	215	141784712	33419698	1151821	32629	800	472	40.5	5.3	23:59	0	878	900	919	23.9	21009.9	0	18242.5
Apr 29 2018	23229	5556	220	142937235	34572221	1152523	32649	800	483	41.4	5	23:58	0	877	900	925	23.9	21033.8	0	18242.5
Apr 30 2018	23433	5760	204	144022974	35657960	1085739	30757	798	449	40.9	4.6	22:39	1	23	895	957	22.6	21056.4	0	18242.5
May 1 2018	23645	212	212	145174376	1151402	1151402	32617	800	465	39.9	5.2	23:58	0	886	900	916	23.9	21080.3	0	18242.5
May 2 2018	23858	425	213	146326755	2303781	1152379	32645	800	468	40.1	5.3	23:59	0	875	900	925	23.9	21104.2	0	18242.5
May 3 2018	24067	634	209	147477621	3454647	1150866	32602	799	460	39.5	5.5	23:58	0	874	900	927	23.9	21128.1	0	18242.5
May 4 2018	24249	816	182	148465680	4442706	988059	27990	800	401	40.1	5.4	20:40	2	0	893	962	20.5	21148.6	0	18242.5
May 5 2018	24459	1026	210	149617219	5594245	1151539	32621	800	463	39.7	5.5	23:58	0	875	900	926	23.9	21172.5	0	18242.5
May 6 2018	24669	1236	210	150769352	6746378	1152133	32638	800	463	39.7	5.5	23:58	0	882	900	921	23.9	21196.4	0	18242.5
May 7 2018	24880	1447	211	151921248	7898274	1151896	32631	800	464	39.8	5.5	23:59	0	870	900	934	23.9	21220.4	0	18242.5
May 8 2018	25086	1653	206	153074540	9051566	1153292	32670	801	454	38.9	5.8	23:58	0	874	900	921	23.9	21244.3	0	18242.5
May 9 2018	25289	1856	203	154226054	10203080	1151514	32620	800	446	38.3	5.9	23:58	0	870	899	924	23.9	21268.2	0	18242.5
May 10 2018	25484	2051	195	155370400	11347426	1144346	32417	799	429	37	6.3	23:58	1	0	899	925	23.8	21292	0	18242.5
May 11 2018	25645	2212	161	156268363	12245389	897963	25438	799	353	38.9	5.6	18:43	1	41	894	975	18.7	21310.7	0	18242.5
May 12 2018	25864	2431	219	157420553	13397579	1152190	32639	800	481	41.2	4.9	23:59	0	874	900	926	23.9	21334.6	0	18242.5
May 13 2018	26081	2648	217	158573001	14550027	1152448	32647	800	476	40.8	5.3	23:58	0	887	900	913	23.9	21358.5	0	18242.5
May 14 2018	26286	2853	205	159724192	15701218	1151191	32611	799	452	38.8	6.2	23:59	0	878	900	923	23.9	21382.4	0	18242.5
May 15 2018	26444	3011	158	160580254	16557280	856062	24251	799	348	40.1	5.3	17:50	0	875	900	919	18.5	21400.9	0	18242.5
May 16 2018	26495	3062	51	160824068	16801094	243814	6907	793	112	45.3	4.1	05:09	3	16	853	1004	4.4	21405.3	0	18242.5
May 17 2018	26715	3282	220	161976002	17953028	1151934	32632	800	485	41.6	5.3	23:59	0	878	900	946	23.9	21429.2	0	18242.5
May 18 2018	26933	3500	218	163128485	19105511	1152483	32648	800	480	41.1	5.1	23:58	0	883	900	919	23.9	21453.1	0	18242.5
May 19 2018	27151	3718	218	164280218	20257244	1151733	32626	800	479	41.1	5.1	23:58	0	887	900	915	23.9	21477	0	18242.5
May 20 2018	27369	3936	218	165432135	21409161	1151917	32632	800	480	41.2	5	23:58	0	881	900	917	23.9	21501	0	18242.5
May 21 2018	27553	4120	184	166584395	22561421	1152260	32641	800	405	34.7	8.8	23:59	0	840	900	922	23.9	21524.9	0	18242.5
May 22 2018	27672	4239	119	167336128	23313154	751733	21295	798	263	34.5	9.1	15:41	1	31	893	938	15.6	21540.5	0	18242.5
May 23 2018	27855	4422	183	168487930	24464956	1151802	32628	800	403	34.6	9.2	23:58	0	886	900	916	23.9	21564.4	0	18242.5
May 24 2018	28042	4609	187	169639683	25616709	1151753	32627	800	410	35.2	8.9	23:58	0	881	900	919	23.9	21588.3	0	18242.5
May 25 2018	28184	4751	142	170524872	26501898	885189	25076	800	312	34.8	9	18:24	0	883	900	921	19.1	21607.4	0	18242.5
May 26 2018	28184	4751	0	170524872	26501898	0	0	0	0	0	0	00:00	0	0	0	0	0	21607.4	0	18242.5
May 27 2018	28184	4751	0	170524872	26501898	0	0	0	0	0	0	00:00	0	0	0	0	0	21607.4	0	18242.5
May 28 2018	28249	4816	65	170882796	26859822	357924	10139	797	142	39.2	8.3	07:31	1	30	882	943	6.7	21614.1	0	18242.5
May 29 2018	28445	5012	196	172033746	28010772	1150950	32604	799	431	37	9	23:58	0	878	900	919	23.9	21638	0	18242.5
May 30 2018	28564	5131	119	172765303	28742329	731557	20724	799	262	35.4	8.9	15:14	1	19	892	997	15.2	21653.3	0	18242.5
May 31 2018	28720	5287	156	173918181	29895207	1152878	32659	801	344	29.5	10.9	23:59	0	881	900	917	23.9	21677.2	0	18242.5
Jun 1 2018	28759	39	39	174171767	253586	253586	7184	799	85	33.1	9.5	05:18	1	17	878	923	5.3	21682.4	0	18242.5
Jun 2 2018	28918	198	159	175323461	1405280	1151694	32625	800	350	30	10.7	23:59	0	871	899	923	23.9	21706.3	0	18242.5
Jun 3 2018	29071	351	153	176476642	2558461	1153181	32667	801	337	28.9	10.9	23:58	0	870	898	914	23.9	21730.3	0	18242.5
Jun 4 2018	29227	507	156	177627625	3709444	1150983	32605	799	342	29.4	10.6	23:59	0	884	900	916	23.9	21754.2	0	18242.5
Jun 5 2018	29392	672	165	178777184	4859003	1149559	32565	798	364	31.3	9.8	23:58	0	883	900	916	23.9	21778.1	0	18242.5
Jun 6 2018	29575	855	183	179930518	6012337	1153334	32672	801	402	34.4	8.1	23:58	0	869	900	933	23.9	21802	0	18242.5
Jun 7 2018	29769	1049	194	181080908	7162727	1150390	32588	799	427	36.6	6.7	23:59	0	878	900	955	23.9	21825.9	0	18242.5

Date	CO2 Equivalents			Landfill Gas Flow							CH4	O2	Flare	Flare	Temperature			Blower 1		Blower 2				
	Yearly	Monthly	Daily	Yearly	Monthly	Daily	Daily	Avg	Total	Avg					Avg	Run	Flare	Min.	Avg.	Max.	Daily	Cumu.	Daily	Cumu.
	Tonnes	Tonnes	Tonnes							Run					Starts	°C	°C	°C	Hours	Hours	Hours	Hours		
	CO2	CO2	CO2							scf					scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C
Jun 8 2018	30002	1282	233	182233717	8315536	1152809	32657	801	511	43.8	4	23:59	0	867	900	927	23.9	21849.8	0	18242.5				
Jun 9 2018	30250	1530	248	183385751	9467570	1152034	32635	800	545	46.8	3.1	23:59	0	886	900	914	23.9	21873.7	0	18242.5				
Jun 10 2018	30497	1777	247	184536172	10617991	1150421	32589	799	543	46.7	3.1	23:58	0	846	900	944	23.9	21897.6	0	18242.5				
Jun 11 2018	30739	2019	242	185687686	11769505	1151514	32620	800	532	45.6	3.5	23:58	0	876	900	915	23.9	21921.5	0	18242.5				
Jun 12 2018	30979	2259	240	186839925	12921744	1152239	32641	800	528	45.2	3.5	23:58	0	880	900	921	23.9	21945.4	0	18242.5				
Jun 13 2018	31217	2497	238	187992109	14073928	1152184	32639	800	524	44.9	3.7	23:59	0	882	900	915	23.9	21969.3	0	18242.5				
Jun 14 2018	31456	2736	239	189143926	15225745	1151817	32629	800	527	45.2	3.7	23:59	0	866	900	927	23.9	21993.2	0	18242.5				
Jun 15 2018	31698	2978	242	190295256	16377075	1151330	32615	800	532	45.7	3.4	23:59	0	879	900	928	23.9	22017.1	0	18242.5				
Jun 16 2018	31869	3149	171	191096041	17177860	800785	22685	799	377	46.5	3.1	16:48	2	0	890	992	17.3	22034.5	0	18242.5				
Jun 17 2018	32108	3388	239	192247621	18329440	1151580	32622	800	525	45.1	3.7	23:58	0	884	900	917	23.9	22058.4	0	18242.5				
Jun 18 2018	32343	3623	235	193399881	19481700	1152260	32641	800	517	44.3	3.9	23:58	0	882	900	923	23.9	22082.3	0	18242.5				
Jun 19 2018	32579	3859	236	194551714	20633533	1151833	32629	800	519	44.6	3.8	23:58	0	884	900	921	23.9	22106.2	0	18242.5				
Jun 20 2018	32814	4094	235	195703119	21784938	1151405	32617	800	516	44.3	3.8	23:59	0	885	900	915	23.9	22130.1	0	18242.5				
Jun 21 2018	33048	4328	234	196854168	22935987	1151049	32607	799	514	44.1	3.9	23:59	0	882	900	914	23.9	22154	0	18242.5				
Jun 22 2018	33282	4562	234	198006540	24088359	1152372	32644	800	515	44.1	3.9	23:58	0	875	900	916	23.9	22177.9	0	18242.5				
Jun 23 2018	33514	4794	232	199159638	25241457	1153098	32665	801	510	43.7	4	23:58	0	887	900	918	23.9	22201.8	0	18242.5				
Jun 24 2018	33737	5017	223	200311833	26393652	1152195	32639	800	491	42.1	4.5	23:59	0	882	900	918	23.9	22225.7	0	18242.5				
Jun 25 2018	33881	5161	144	201016526	27098345	704693	19963	799	316	44.3	3.7	14:40	1	24	892	950	14.6	22240.4	0	18242.5				
Jun 26 2018	34118	5398	237	202142303	28224122	1125777	31891	800	522	45.8	3.3	23:27	1	83	895	973	23.3	22263.7	0	18242.5				
Jun 27 2018	34331	5611	213	203174733	29256552	1032430	29247	801	469	44.9	3.6	21:27	0	877	900	923	21.6	22285.3	0	18242.5				
Jun 28 2018	34478	5758	147	203843572	29925391	668839	18947	800	324	47.8	2.9	13:57	1	109	894	986	0	22285.3	13.7	18256.3				
Jun 29 2018	34667	5947	189	204711262	30793081	867690	24580	799	416	47.3	2.7	18:03	1	27	894	969	0	22285.3	18	18274.3				
Jun 30 2018	34911	6191	244	205862448	31944267	1151186	32611	799	537	46.1	3.3	23:59	0	869	900	930	0	22285.3	23.9	18298.2				
Jul 1 2018	35155	244	244	207014429	1151981	1151981	32633	800	537	46.1	3.1	23:58	0	866	900	932	0	22285.3	23.9	18322.1				
Jul 2 2018	35394	483	239	208165532	2303084	1151103	32608	799	526	45.2	3.5	23:59	0	873	900	923	0	22285.3	23.9	18346				
Jul 3 2018	35630	719	236	209315272	3452824	1149740	32570	799	520	44.7	3.6	23:58	0	874	900	935	0	22285.3	23.9	18369.9				
Jul 4 2018	35782	871	152	210158876	4296428	843604	23898	799	334	39.1	2.6	17:34	2	41	890	932	0	22285.3	17.5	18387.5				
Jul 5 2018	36016	1105	234	211310056	5447608	1151180	32611	799	515	44.2	3.5	23:58	0	872	900	930	0	22285.3	23.9	18411.4				
Jul 6 2018	36258	1347	242	212460561	6598113	1150505	32592	799	531	45.6	3.2	23:59	0	876	900	930	0	22285.3	23.9	18435.3				
Jul 7 2018	36503	1592	245	213612613	7750165	1152052	32635	800	538	46.2	3.1	23:59	0	871	900	919	0	22285.3	23.9	18459.2				
Jul 8 2018	36570	1659	67	213936600	8074152	323987	9178	798	147	44.9	3.6	06:43	0	863	900	942	0	22285.3	6.9	18466.1				
Jul 9 2018	36689	1778	119	214454507	8592059	517907	14671	798	262	49.9	2.4	10:50	1	27	890	932	0	22285.3	10.7	18476.7				
Jul 10 2018	36939	2028	250	215607052	9744604	1152545	32649	800	551	47.2	3	23:58	0	880	900	917	0	22285.3	23.9	18500.6				
Jul 11 2018	37188	2277	249	216758621	10896173	1151569	32622	800	547	47	3	23:58	0	884	900	923	0	22285.3	23.9	18524.5				
Jul 12 2018	37429	2518	241	217909313	12046865	1150692	32597	799	530	45.5	3.5	23:58	0	889	900	913	0	22285.3	23.9	18548.4				
Jul 13 2018	37667	2756	238	219060465	13198017	1151152	32610	799	524	45	3.6	23:59	0	884	900	920	0	22285.3	23.9	18572.3				
Jul 14 2018	37908	2997	241	220212444	14349996	1151979	32633	800	530	45.5	3.3	23:58	0	884	900	916	0	22285.3	23.9	18596.2				
Jul 15 2018	38143	3232	235	221363976	15501528	1151532	32621	800	517	44.4	3.7	23:58	0	882	900	915	0	22285.3	23.9	18620.2				
Jul 16 2018	38373	3462	230	222515368	16652920	1151392	32617	800	505	43.4	4.1	23:59	0	884	900	918	0	22285.3	23.9	18644.1				

Date	CO2 Equivalents			Landfill Gas Flow							CH4	O2	Flare	Temperature			Blower 1		Blower 2																					
	Yearly	Monthly	Daily	Yearly	Monthly	Daily	Daily	Avg	Total	Avg				Avg	Run	Flare	Min.	Avg.	Max.	Daily	Cum.	Daily	Cum.																	
	Tonnes	Tonnes	Tonnes																					scf	scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C	°C	°C	Hours	Hours	Hours	Hours
	CO2	CO2	CO2																					scf	scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C	°C	°C	Hours	Hours	Hours	Hours
Jul 17 2018	38604	3693	231	223661657	17799209	1146289	32472	800	508	43.8	3.7	23:58	0	0	899	918	0	22285.3	23.9	18668																				
Jul 18 2018	38840	3929	236	224813611	18951163	1151954	32633	800	518	44.5	3.6	23:58	0	881	900	920	0	22285.3	23.9	18691.9																				
Jul 19 2018	39030	4119	190	225739854	19877406	926243	26239	801	417	44.5	3.7	19:14	0	855	900	958	0	22285.3	19.3	18711.2																				
Jul 20 2018	39180	4269	150	226377071	20514623	637217	18051	797	331	51.3	1.6	13:19	1	29	892	951	0	22285.3	13.2	18724.3																				
Jul 21 2018	39440	4529	260	227528826	21666378	1151755	32627	800	572	49.1	2.3	23:59	0	874	900	921	0	22285.3	23.9	18748.2																				
Jul 22 2018	39701	4790	261	228680137	22817689	1151311	32614	800	573	49.2	2.2	23:59	0	877	900	915	0	22285.3	23.9	18772.2																				
Jul 23 2018	39957	5046	256	229831870	23969422	1151733	32626	800	564	48.4	2.5	23:58	0	887	900	911	0	22285.3	23.9	18796.1																				
Jul 24 2018	40211	5300	254	230984152	25121704	1152282	32642	800	559	47.9	2.7	23:59	0	876	900	920	0	22285.3	23.9	18820																				
Jul 25 2018	40464	5553	253	232136104	26273656	1151952	32633	800	556	47.7	2.7	23:58	0	886	900	923	0	22285.3	23.9	18843.9																				
Jul 26 2018	40713	5802	249	233287912	27425464	1151808	32628	800	547	46.9	3	23:58	0	883	900	919	0	22285.3	23.9	18867.8																				
Jul 27 2018	40943	6032	230	234345008	28482560	1057096	29945	798	506	47.3	2.9	22:03	1	37	895	961	0	22285.3	22	18889.8																				
Jul 28 2018	41195	6284	252	235495891	29633443	1150883	32602	799	553	47.5	2.9	23:58	0	876	900	922	0	22285.3	23.9	18913.7																				
Jul 29 2018	41448	6537	253	236648266	30785818	1152375	32644	800	556	47.7	2.7	23:59	0	878	900	925	0	22285.3	23.9	18937.6																				
Jul 30 2018	41701	6790	253	237800959	31938511	1152693	32653	800	557	47.8	2.7	23:58	0	879	900	917	0	22285.3	23.9	18961.5																				
Jul 31 2018	41949	7038	248	238952732	33090284	1151773	32627	800	546	46.9	3.2	23:58	0	883	900	918	0	22285.3	23.9	18985.4																				
Aug 1 2018	42193	244	244	240103551	1150819	1150819	32600	799	537	46.1	3.3	23:59	0	885	900	926	0	22285.3	23.9	19009.3																				
Aug 2 2018	42439	490	246	241255231	2302499	1151680	32625	800	542	46.5	3.2	23:59	0	875	900	919	0	22285.3	23.9	19033.2																				
Aug 3 2018	42672	723	233	242339838	3387106	1084607	30725	799	513	46.7	3.2	22:36	1	55	895	944	0	22285.3	22.5	19055.7																				
Aug 4 2018	42882	933	210	243300630	4347898	960792	27217	799	461	47.4	2.9	20:00	0	866	900	949	0	22285.3	20	19075.8																				
Aug 5 2018	42882	933	0	243300630	4347898	0	0	0	0	0	0	00:00	0	0	0	0	0	22285.3	0	19075.8																				
Aug 6 2018	42882	933	0	243300630	4347898	0	0	0	0	0	0	00:00	0	0	0	0	0	22285.3	0	19075.8																				
Aug 7 2018	43015	1066	133	243847016	4894284	546386	15478	799	292	52.8	1.9	11:23	1	123	893	945	0	22285.3	11.4	19087.1																				
Aug 8 2018	43275	1326	260	244997089	6044357	1150073	32579	799	573	49.2	3	23:59	0	889	900	913	0	22285.3	23.9	19111																				
Aug 9 2018	43532	1583	257	246150026	7197294	1152937	32660	801	564	48.4	3	23:59	0	884	900	920	0	22285.3	23.9	19134.9																				
Aug 10 2018	43786	1837	254	247301619	8348887	1151593	32622	800	559	48	3	23:59	0	845	900	1006	0	22285.3	23.9	19158.8																				
Aug 11 2018	44039	2090	253	248454752	9502020	1153133	32666	801	557	47.8	3	23:59	0	884	900	920	0	22285.3	23.9	19182.7																				
Aug 12 2018	44293	2344	254	249606925	10654193	1152173	32639	800	558	47.8	2.9	23:59	0	879	900	922	0	22285.3	23.9	19206.7																				
Aug 13 2018	44534	2585	241	250736260	11783528	1129335	31992	800	530	46.4	3.5	23:30	1	89	894	987	0	22285.3	23.4	19230.1																				
Aug 14 2018	44771	2822	237	251886683	12933951	1150423	32589	799	521	44.7	3.7	23:59	0	865	900	925	0	22285.3	23.9	19254																				
Aug 15 2018	45005	3056	234	253038647	14085915	1151964	32633	800	515	44.1	3.8	23:59	0	867	900	936	0	22285.3	23.9	19277.9																				
Aug 16 2018	45231	3282	226	254188291	15235559	1149644	32567	798	497	42.7	4.3	23:59	0	880	900	916	0	22285.3	24	19301.9																				
Aug 17 2018	45456	3507	225	255336511	16383779	1148220	32527	797	495	42.6	4.1	23:59	0	881	900	921	0	22285.3	23.9	19325.8																				
Aug 18 2018	45679	3730	223	256450900	17498168	1114389	31568	774	491	43.6	3.6	23:59	0	876	900	919	0	22285.3	23.9	19349.7																				
Aug 19 2018	45890	3941	211	257539049	18586317	1088149	30825	756	464	42.2	4.3	23:59	0	881	900	924	0	22285.3	23.9	19373.6																				
Aug 20 2018	46099	4150	209	258601398	19648666	1062349	30094	774	460	42.7	4	22:51	1	34	894	970	0	22285.3	22.7	19396.3																				
Aug 21 2018	46335	4386	236	259753856	20801124	1152458	32647	800	520	44.6	3.6	23:59	0	802	900	945	0	22285.3	22.9	19419.2																				
Aug 22 2018	46572	4623	237	260904946	21952214	1151090	32608	799	520	44.7	3.8	23:58	0	826	900	961	0	22285.3	23.9	19443.1																				
Aug 23 2018	46812	4863	240	262056688	23103956	1151742	32627	800	527	45.2	3.3	23:58	0	863	900	940	0	22285.3	23.9	19467																				
Aug 24 2018	47046	5097	234	263209556	24256824	1152868	32658	801	516	44.2	3.8	23:58	0	876	900	916	0	22285.3	23.9	19490.9																				

Date	CO2 Equivalents			Landfill Gas Flow						CH4	O2	Flare	Flare	Temperature			Blower 1		Blower 2	
	Yearly	Monthly	Daily	Yearly	Monthly	Daily	Daily	Avg	Total					Avg	Avg	Run	Flare	Min.	Avg.	Max.
	Tonnes	Tonnes	Tonnes	Yearly	Monthly	Daily	Daily	Avg	Total	Avg	Avg	Run	Flare	Min.	Avg.	Max.	Daily	Cumu.	Daily	Cumu.
	CO2	CO2	CO2	scf	scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C	°C	°C	Hours	Hours	Hours	Hours
Aug 25 2018	47275	5326	229	264360744	25408012	1151188	32611	799	503	43.2	4.1	23:59	0	881	900	921	0	22285.3	23.9	19514.8
Aug 26 2018	47506	5557	231	265512587	26559855	1151843	32629	800	508	43.5	3.7	23:59	0	871	900	922	0	22285.3	23.9	19538.7
Aug 27 2018	47737	5788	231	266662572	27709840	1149985	32577	799	507	43.6	3.7	23:59	0	878	900	919	0	22285.3	23.9	19562.7
Aug 28 2018	47947	5998	210	267684165	28731433	1021593	28940	798	462	44.6	3.5	21:18	3	48	885	981	0	22285.3	21.3	19584
Aug 29 2018	48183	6234	236	268835268	29882536	1151103	32608	799	520	44.6	3.5	23:59	0	844	900	948	0	22285.3	23.9	19607.9
Aug 30 2018	48439	6490	256	269987312	31034580	1152044	32635	800	564	48.3	2.3	23:58	0	852	900	1003	0	22285.3	23.9	19631.8
Aug 31 2018	48694	6745	255	271138722	32185990	1151410	32617	800	561	48.2	2.2	23:58	0	887	900	918	0	22285.3	23.9	19655.7
Sep 1 2018	48943	249	249	272290817	1152095	1152095	32637	800	548	47	2.4	23:58	0	883	900	923	0	22285.3	23.9	19679.6
Sep 2 2018	49188	494	245	273443477	2304755	1152660	32653	800	538	46.2	2.7	23:59	0	887	900	911	0	22285.3	23.9	19703.5
Sep 3 2018	49436	742	248	274595166	3456444	1151689	32625	800	546	46.9	2.3	23:59	0	865	900	922	0	22285.3	23.9	19727.4
Sep 4 2018	49679	985	243	275747187	4608465	1152021	32634	800	535	45.9	2.6	23:59	0	884	900	918	0	22285.3	23.9	19751.3
Sep 5 2018	49917	1223	238	276899740	5761018	1152553	32650	800	523	44.9	2.9	23:58	0	882	900	920	0	22285.3	23.9	19775.2
Sep 6 2018	50158	1464	241	278051443	6912721	1151703	32625	800	529	45.4	2.7	23:59	0	875	900	918	0	22285.3	23.9	19799.1
Sep 7 2018	50397	1703	239	279201839	8063117	1150396	32588	799	526	45.2	2.8	23:58	0	879	900	920	0	22285.3	23.9	19823
Sep 8 2018	50640	1946	243	280352697	9213975	1150858	32602	799	534	45.8	2.6	23:58	0	885	900	923	0	22285.3	23.9	19846.9
Sep 9 2018	50881	2187	241	281503948	10365226	1151251	32613	799	530	45.5	2.9	23:58	0	882	900	920	0	22285.3	23.9	19870.8
Sep 10 2018	51115	2421	234	282656436	11517714	1152488	32648	800	515	44.2	3.6	23:59	0	886	900	915	0	22285.3	23.9	19894.8
Sep 11 2018	51349	2655	234	283808345	12669623	1151909	32631	800	515	44.2	3.7	23:58	0	883	900	922	0	22285.3	23.9	19918.7
Sep 12 2018	51577	2883	228	284960355	13821633	1152010	32634	800	502	43.1	4.1	23:59	0	876	900	931	0	22285.3	23.9	19942.6
Sep 13 2018	51830	3136	253	286111792	14973070	1151437	32618	800	556	47.8	1.5	23:59	0	869	900	916	0	22285.3	23.9	19966.5
Sep 14 2018	52080	3386	250	287263951	16125229	1152159	32638	800	550	47.2	1.6	23:58	0	885	900	920	0	22285.3	23.9	19990.4
Sep 15 2018	52250	3556	170	288038354	16899632	774403	21937	800	374	47.7	1.4	16:06	0	877	900	923	0	22285.3	17	20007.4
Sep 16 2018	52250	3556	0	288038354	16899632	0	0	0	0	0	0	00:00	0	0	0	0	0	22285.3	0	20007.4
Sep 17 2018	52372	3678	122	288538419	17399697	500065	14166	799	267	52.8	1.8	10:28	1	10	889	947	0	22285.3	9.5	20016.9
Sep 18 2018	52641	3947	269	289690531	18551809	1152112	32637	800	591	50.7	1.5	23:59	0	882	900	918	0	22285.3	23.9	20040.8
Sep 19 2018	52897	4203	256	290842626	19703904	1152095	32637	800	564	48.3	1.8	23:58	0	885	900	918	0	22285.3	23.9	20064.7
Sep 20 2018	53155	4461	258	291994316	20855594	1151690	32625	800	568	48.7	1.6	23:59	0	883	900	918	0	22285.3	23.9	20088.6
Sep 21 2018	53411	4717	256	293146672	22007950	1152356	32644	800	563	48.2	1.7	23:58	0	884	900	920	0	22285.3	23.9	20112.5
Sep 22 2018	53660	4966	249	294298252	23159530	1151580	32622	800	547	46.9	2.8	23:58	0	884	900	916	0	22285.3	23.9	20136.4
Sep 23 2018	53687	4993	27	295449762	24311040	1151510	32620	800	60	5.2	26.2	23:59	0	883	900	916	0	22285.3	23.9	20160.3
Sep 24 2018	53843	5149	156	296602087	25463365	1152325	32643	800	343	29.4	12.4	23:59	0	886	900	915	0	22285.3	23.9	20184.2
Sep 25 2018	54100	5406	257	297754298	26615576	1152211	32640	800	566	48.5	1.6	23:59	0	886	900	912	0	22285.3	23.9	20208.1
Sep 26 2018	54360	5666	260	298905839	27767117	1151541	32621	800	573	49.2	1.9	23:58	0	882	900	916	0	22285.3	23.9	20232
Sep 27 2018	54617	5923	257	300058377	28919655	1152538	32649	800	565	48.4	2	23:59	0	887	900	913	0	22285.3	23.9	20255.9
Sep 28 2018	54871	6177	254	301209459	30070737	1151082	32608	799	559	48	2	23:58	0	888	900	912	0	22285.3	23.9	20279.8
Sep 29 2018	55129	6435	258	302362170	31223448	1152711	32654	801	566	48.6	1.9	23:58	0	882	900	921	0	22285.3	23.9	20303.7
Sep 30 2018	55381	6687	252	303513772	32375050	1151602	32623	800	555	47.6	2.3	23:58	0	885	900	919	0	22285.3	23.9	20327.7
Oct 1 2018	55601	220	220	304481574	967802	967802	27416	799	485	49.5	1.8	20:11	1	10	895	971	0	22285.3	20.3	20348
Oct 2 2018	55872	491	271	305633878	2120106	1152304	32642	800	595	51	1.7	23:58	0	883	900	920	0	22285.3	23.9	20371.9

Date	CO2 Equivalents			Landfill Gas Flow							CH4	O2	Flare	Flare	Temperature			Blower 1		Blower 2	
	Yearly	Monthly	Daily	Yearly	Monthly	Daily	Daily	Avg	Total	Avg					Avg	Run	Flare	Min.	Avg.	Max.	Daily
	Tonnes	Tonnes	Tonnes	Yearly	Monthly	Daily	Daily	Avg	Total	Avg	Avg	Run	Flare	Min.	Avg.	Max.	Daily	Cumu.	Daily	Cumu.	
	CO2	CO2	CO2	scf	scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C	°C	°C	Hours	Hours	Hours	Hours	
Oct 3 2018	56098	717	226	306591026	3077254	957148	27114	799	498	51.4	1.8	19:56	1	-3	895	984	0	22285.3	19.8	20391.7	
Oct 4 2018	56367	986	269	307742978	4229206	1151952	32632	800	592	50.8	1.8	23:58	0	889	900	916	0	22285.3	23.9	20415.6	
Oct 5 2018	56646	1265	279	308893667	5379895	1150689	32597	799	613	52.6	1.1	23:59	0	877	900	924	0	22285.3	23.9	20439.5	
Oct 6 2018	56923	1542	277	310045167	6531395	1151500	32620	800	609	52.3	1.2	23:58	0	891	900	908	0	22285.3	24	20463.5	
Oct 7 2018	57202	1821	279	311196804	7683032	1151637	32624	800	613	52.6	1.2	23:59	0	881	900	915	0	22285.3	23.9	20487.4	
Oct 8 2018	57483	2102	281	312349310	8835538	1152506	32648	800	618	53	1.1	23:59	0	883	900	911	0	22285.3	23.9	20511.3	
Oct 9 2018	57762	2381	279	313500662	9986890	1151352	32616	800	613	52.6	1.3	23:59	0	888	900	912	0	22285.3	23.9	20535.2	
Oct 10 2018	58043	2662	281	314651988	11138216	1151326	32615	800	618	53	1.1	23:58	0	885	900	914	0	22285.3	23.9	20559.1	
Oct 11 2018	58322	2941	279	315804021	12290249	1152033	32635	800	613	52.6	1.2	23:58	0	889	900	911	0	22285.3	23.9	20583.1	
Oct 12 2018	58604	3223	282	316955741	13441969	1151720	32626	800	619	53.1	1.1	23:59	0	882	900	921	0	22285.3	23.9	20607	
Oct 13 2018	58882	3501	278	318106981	14593209	1151240	32612	799	611	52.4	1.4	23:58	0	884	900	920	0	22285.3	23.9	20630.9	
Oct 14 2018	59156	3775	274	319258195	15744423	1151214	32612	799	603	51.8	1.5	23:58	0	891	900	909	0	22285.3	23.9	20654.8	
Oct 15 2018	59435	4054	279	320410390	16896618	1152195	32639	800	614	52.7	1.2	23:58	0	888	900	911	0	22285.3	23.9	20678.7	
Oct 16 2018	59709	4328	274	321562031	18048259	1151641	32624	800	602	51.7	1.7	23:59	0	890	900	912	0	22285.3	23.9	20702.6	
Oct 17 2018	59982	4601	273	322713217	19199445	1151186	32611	799	600	51.5	1.6	23:58	0	884	900	917	0	22285.3	23.9	20726.5	
Oct 18 2018	60263	4882	281	323864187	20350415	1150970	32605	799	619	53.1	1.1	23:58	0	885	900	917	0	22285.3	23.9	20750.4	
Oct 19 2018	60539	5158	276	325016700	21502928	1152513	32648	800	607	52	1.6	23:59	0	884	900	917	0	22285.3	23.9	20774.3	
Oct 20 2018	60810	5429	271	326168672	22654900	1151972	32633	800	596	51.1	1.9	23:59	0	887	900	915	0	22285.3	23.9	20798.2	
Oct 21 2018	61089	5708	279	327319718	23805946	1151046	32607	799	614	52.7	1.3	23:58	0	887	900	911	0	22285.3	23.9	20822.1	
Oct 22 2018	61357	5976	268	328454107	24940335	1134389	32135	799	589	51.3	1.9	23:40	1	86	896	964	0	22285.3	23.5	20845.6	
Oct 23 2018	61631	6250	274	329605947	26092175	1151840	32629	800	602	51.6	1.6	23:58	0	874	900	922	0	22285.3	23.9	20869.5	
Oct 24 2018	61911	6530	280	330757977	27244205	1152030	32635	800	616	52.8	1.2	23:58	0	884	900	916	0	22285.3	23.9	20893.4	
Oct 25 2018	62190	6809	279	331909770	28395998	1151793	32628	800	614	52.7	1.4	23:59	0	882	900	922	0	22285.3	23.9	20917.3	
Oct 26 2018	62469	7088	279	333062816	29549044	1153046	32663	801	613	52.6	1.5	23:59	0	882	900	914	0	22285.3	23.9	20941.2	
Oct 27 2018	62745	7364	276	334214289	30700517	1151473	32619	800	607	52.1	1.8	23:58	0	884	900	920	0	22285.3	23.9	20965.2	
Oct 28 2018	63017	7636	272	335365636	31851864	1151347	32615	800	598	51.4	2.1	23:59	0	893	900	910	0	22285.3	23.9	20989.1	
Oct 29 2018	63142	7761	125	335891957	32378185	526321	14910	799	275	51.6	1.9	10:56	0	883	900	914	0	22285.3	11.7	21000.7	
Oct 30 2018	63219	7838	77	336197829	32684057	305872	8665	799	169	54.7	1.2	06:23	1	42	887	989	5.7	22291	0	21000.7	
Oct 31 2018	63501	8120	282	337349439	33835667	1151610	32623	800	620	53.2	1.6	23:59	0	889	900	910	23.9	22314.9	0	21000.7	
Nov 1 2018	63782	281	281	338501890	1152451	1152451	32647	800	617	52.9	1.6	23:58	0	876	900	923	23.9	22338.8	0	21000.7	
Nov 2 2018	64060	559	278	339654150	2304711	1152260	32641	800	612	52.5	1.8	23:59	0	884	900	919	23.9	22362.7	0	21000.7	
Nov 3 2018	64335	834	275	340806792	3457353	1152642	32652	800	606	51.9	2	23:58	0	883	900	916	23.9	22386.6	0	21000.7	
Nov 4 2018	64616	1115	281	341958911	4609472	1152119	32637	800	618	53	1.6	23:58	0	884	900	914	24.9	22411.5	0	21000.7	
Nov 5 2018	64896	1395	280	343110432	5760993	1151521	32620	800	615	52.8	1.6	23:58	0	882	900	920	23.9	22435.4	0	21000.7	
Nov 6 2018	65170	1669	274	344262045	6912606	1151613	32623	800	603	51.7	2.1	23:59	0	887	900	912	23.9	22459.3	0	21000.7	
Nov 7 2018	65440	1939	270	345414312	8064873	1152267	32641	800	593	50.9	2.3	23:59	0	889	900	915	23.9	22483.2	0	21000.7	
Nov 8 2018	65712	2211	272	346566592	9217153	1152280	32642	800	598	51.3	2.1	23:58	0	888	900	912	23.9	22507.1	0	21000.7	
Nov 9 2018	65986	2485	274	347718557	10369118	1151965	32633	800	602	51.7	1.9	23:58	0	876	900	915	23.9	22531	0	21000.7	
Nov 10 2018	66266	2765	280	348869823	11520384	1151266	32613	799	616	52.9	1.2	23:58	0	883	900	918	23.9	22554.9	0	21000.7	
Nov 11 2018	66540	3039	274	350021357	12671918	1151534	32621	800	603	51.7	1.9	23:58	0	888	900	913	23.9	22578.8	0	21000.7	

Date	CO2 Equivalents			Landfill Gas Flow						CH4	O2	Flare	Flare	Temperature			Blower 1		Blower 2																						
	Yearly	Monthly	Daily	Yearly	Monthly	Daily	Daily	Avg	Total					Avg	Avg	Run	Flare	Min.	Avg.	Max.	Daily	Cum.	Daily	Cum.																	
	Tonnes	Tonnes	Tonnes																						scf	scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C	°C	°C	Hours	Hours	Hours	Hours
	CO2	CO2	CO2																						scf	scf	scf	meter3	scfm	MMBTU	(%)	(%)	Hours	Starts	°C	°C	°C	Hours	Hours	Hours	Hours
Nov 12 2018	66814	3313	274	351172543	13823104	1151186	32611	799	603	51.8	1.6	23:58	0	888	900	913	23.9	22602.7	0	21000.7																					
Nov 13 2018	67093	3592	279	352323962	14974523	1151419	32617	800	614	52.7	1.2	23:59	0	879	900	922	23.9	22626.6	0	21000.7																					
Nov 14 2018	67377	3876	284	353475921	16126482	1151959	32633	800	624	53.5	0.9	23:58	0	883	900	916	23.9	22650.5	0	21000.7																					
Nov 15 2018	67647	4146	270	354628163	17278724	1152242	32641	800	594	51	1.8	23:58	0	888	900	914	23.9	22674.5	0	21000.7																					
Nov 16 2018	67910	4409	263	355779465	18430026	1151302	32614	800	578	49.7	1.6	23:58	0	883	900	920	23.9	22698.4	0	21000.7																					
Nov 17 2018	68181	4680	271	356930770	19581331	1151305	32614	800	596	51.2	1	23:58	0	886	900	911	23.9	22722.3	0	21000.7																					
Nov 18 2018	68453	4952	272	358081651	20732212	1150881	32602	799	598	51.4	1	23:58	0	882	900	916	23.9	22746.2	0	21000.7																					
Nov 19 2018	68721	5220	268	359232756	21883317	1151105	32608	799	589	50.6	1.1	23:58	0	882	900	917	23.9	22770.1	0	21000.7																					
Nov 20 2018	68992	5491	271	360384094	23034655	1151338	32615	800	595	51.1	1.1	23:58	0	884	900	923	23.9	22794	0	21000.7																					
Nov 21 2018	69258	5757	266	361527025	24177586	1142931	32377	800	584	50.5	1.1	23:56	1	0	899	914	22.9	22816.9	0	21000.7																					
Nov 22 2018	69532	6031	274	362680019	25330580	1152994	32662	801	603	51.7	0.8	23:59	0	883	900	918	24.6	22841.5	0	21000.7																					
Nov 23 2018	69802	6301	270	363832541	26483102	1152522	32649	800	594	50.9	1.1	23:59	0	882	900	920	23.9	22865.4	0	21000.7																					
Nov 24 2018	70060	6559	258	364985041	27635602	1152500	32648	800	567	48.7	1.8	23:59	0	887	900	918	23.9	22889.3	0	21000.7																					
Nov 25 2018	70316	6815	256	366131650	28782211	1146609	32481	800	562	48.5	1.7	23:56	1	0	899	910	24.4	22913.7	0	21000.7																					
Nov 26 2018	70495	6994	179	366918298	29568859	786648	22284	799	393	49.4	1.4	16:24	0	888	900	915	15.9	22929.7	0	21000.7																					
Nov 27 2018	70629	7128	134	367493055	30143616	574757	16282	800	295	50.7	1.2	23:59	0	0	898	912	24.1	22953.7	0	21000.7																					
Nov 28 2018	70898	7397	269	368644443	31295004	1151388	32617	800	592	50.8	1.2	23:59	0	0	899	912	25.3	22979	0	21000.7																					
Nov 29 2018	71173	7672	275	369834569	32485130	1190126	33714	830	606	50.3	1.3	23:58	1	0	899	930	25.2	23004.2	0	21000.7																					
Nov 30 2018	71462	7961	289	371131659	33782220	1297090	36744	901	635	48.4	1.8	23:59	0	880	900	915	24.1	23028.3	0	21000.7																					
Dec 1 2018	71750	288	288	372428507	1296848	1296848	36737	901	634	48.3	1.7	23:59	0	876	900	925	23.1	23051.4	0	21000.7																					
Dec 2 2018	72035	573	285	373725240	2593581	1296733	36734	901	626	47.7	1.9	23:59	0	886	900	913	24.1	23075.5	0	21000.7																					
Dec 3 2018	72339	877	304	375114864	3983205	1389624	39365	965	668	47.5	1.8	23:59	0	882	900	925	24.2	23099.7	0	21000.7																					
Dec 4 2018	72627	1165	288	376389227	5257568	1274363	36100	999	634	49.2	1.2	21:08	2	-7	894	960	20.9	23120.6	0	21000.7																					
Dec 5 2018	72941	1479	314	377830642	6698983	1441415	40832	1001	690	47.3	1.7	23:59	0	886	900	914	24.1	23144.7	0	21000.7																					
Dec 6 2018	73180	1718	239	378901530	7769871	1070888	30336	999	525	48.5	1.3	17:50	1	-12	894	953	18.1	23162.8	0	21000.7																					
Dec 7 2018	73489	2027	309	380341504	9209845	1439974	40792	1000	680	46.7	1.8	23:59	0	878	900	921	24.1	23186.9	0	21000.7																					
Dec 8 2018	73798	2336	309	381781400	10649741	1439896	40789	1000	679	46.6	1.8	23:59	0	880	900	928	23.2	23210.2	0	21000.7																					
Dec 9 2018	74105	2643	307	383221354	12089695	1439954	40791	1000	676	46.4	1.8	23:59	0	878	900	928	24.2	23234.4	0	21000.7																					
Dec 10 2018	74411	2949	306	384651247	13519588	1429893	40506	1000	673	46.5	1.8	23:48	1	246	897	982	24	23258.4	0	21000.7																					
Dec 11 2018	74720	3258	309	386091758	14960099	1440511	40807	1000	679	46.6	1.8	23:58	0	869	900	927	23.1	23281.5	0	21000.7																					
Dec 12 2018	75029	3567	309	387532448	16400789	1440690	40812	1000	680	46.6	1.8	23:58	0	878	900	920	24.2	23305.7	0	21000.7																					
Dec 13 2018	75333	3871	304	388973004	17841345	1440556	40808	1000	668	45.8	2	23:58	0	883	900	929	24.2	23329.9	0	21000.7																					
Dec 14 2018	75635	4173	302	390413869	19282210	1440865	40817	1001	665	45.6	2.1	23:58	0	880	900	922	24.2	23354.1	0	21000.7																					
Dec 15 2018	75944	4482	309	391854302	20722643	1440433	40805	1000	680	46.7	1.8	23:59	0	883	900	915	23.1	23377.2	0	21000.7																					
Dec 16 2018	76238	4776	294	393294562	22162903	1440260	40800	1000	647	44.4	2.5	23:58	0	875	900	920	24.2	23401.4	0	21000.7																					
Dec 17 2018	76541	5079	303	394736034	23604375	1441472	40834	1001	667	45.7	2	23:58	0	884	900	916	24.2	23425.6	0	21000.7																					

