Memorandum

To:	James Betke, P.Eng.	**Date:**	July 28, 2021
		Project No.:	18-0300-005.1208
From:	Jason Mann, M.Sc., P.Geo. Marci Friedman Hamm, M.Sc., P.Geo.		
Re:	**Lake St. Martin Outlet Channel Groundwater Quality Assessment - Final**		

1.0 INTRODUCTION

Groundwater quality and geochemistry along the Lake St. Martin Outlet Channel (LSMOC) channel was assessed using regional background data, and data more recently available from the 2019 to 2020 LSMOC groundwater monitoring program.

The methodology applied for the assessment of water quality data is given in Section 2. Section 3 contains a list of references used in the preparation of the report. The analysis of the regional background data is described in Section 4.0 and in Appendix A, including location maps, while the analysis of the 2019 to 2020 monitoring program is described in Section 5 and in Appendix B. Conclusions are presented in Section 6.0.

A set of existing figures are provided as "reference sketches" including:

- The location plan for the LSMOC including all groundwater and surface water sampling sites visited and sampled during 2019 and 2020.
- A copy of the draft stratigraphic profile along the Channel Centreline (September 2019 Figure 3 Rev A) as submitted in the draft Geotechnical Data Report is included as a reference for the monitoring well zone locations and general piezometric pressures along the channel alignment.
- The drawing showing preliminary bedrock aquifer piezometric pressures in the region of the LSMOC, and the location of artesian spring sites

A separate memo on the groundwater flow system (e.g. water levels and related analyses) is being prepared. The groundwater flow system was assessed during the analysis of regional geochemical background data and can be summarized as follows:

Groundwater flow system boundaries: The groundwater flow system in the region of the LSMOC is interpreted to be bound by discharge to naturally occurring spring sites, to Lake St. Martin, and to Lake Winnipeg. Groundwater discharge is also likely to the Dauphin River to the northwest, and to the Mantagao River to the east.

Recharge Areas: Groundwater recharge areas local to the LSMOC are located on topographically high ground areas with thin sediment cover south of Lake St. Martin, and somewhat to the southwest at the Lake St. Martin Narrows where there are bedrock outcrops at ground surface as well.

Examining the geochemical signature of water samples provides insight into the groundwater flow system. The geochemistry of the groundwater is influenced by the type of bedrock and surficial sediments, and the length of the flow paths from the recharge areas to the discharge areas (i.e., the aquifer residence time). The geochemistry of surface water is controlled by precipitation in contact with surficial materials in the drainage basin, and in some cases surface water is mixed with a baseflow groundwater discharge, specifically in topographically low areas comprised of streams, lakes, and wetlands.

Where groundwater and surface water are relatively isolated, groundwater geochemistry is typically more mineralized, and geochemical signatures are distinct. Given similar geology along a groundwater flow path, greater mineralization would be expected with a greater residence time in the flow system (or aquifer) and less mineralization would be expected for samples discharging much closer to their recharge source (e.g. low aquifer residence time).

Where surface water sources are groundwater fed, a geochemical signature intermediate between end member geochemical signatures of the groundwater system and surface water system can be present. Artesian springs are a point source of direct groundwater discharge to surface, and may have a geochemical signature that plots along the blended groundwater-surface water spectrum, depending on their size (e.g. discharge flow rate), and the subsequent dilution from precipitation and other surface water runoff into a spring pool.

The geochemical signatures of groundwater, surface water, and groundwater springs in the region have been analyzed based on historic and more recent information to:

- Characterize the geochemical signature of each water system;
- Find patterns in the distribution of the water types;
- Look for evidence of groundwater discharge to surface, or lack of it;
- Infer relative groundwater flow path length/residence times; and
- Examine the influence of the Lake St. Martin Impact Structure and associated Gypsumville evaporite deposit on the groundwater geochemistry in the vicinity of the LSMOC (if any).

This baseline information can be used to assess how construction and operation of the Lake St. Martin Outlet Channel may affect groundwater/surface water interactions in the region, and help with Adaptive Management planning.

2.0 METHODOLOGY

2.1 Data selection

Data was extracted from available project references including:

- 2013 surface water analyses for the LSMOC studies (KGS Group and North South Consultants 2016);
- 2019 to 2020 surface water groundwater analyses (KGS Group 2020) from the LSMOC studies.

In addition, data from a previous study of water supply wells at the Dauphin River First Nation (for Manitoba Infrastructure) was used since it includes the area monitored by the LSMOC project Sentinel wells (KGS Group 2011). Regional data from groundwater fed springs discussed in research papers was also included (Leybourne, 2009). This spring data was also referred to in earlier studies, which were also reviewed (McRitchie 1996, McRitchie and Kaszycki 1997). Data used for the assessment herein is given in the appendices of each report section.

2.2 Isotope Analyses

2.2.1 OXYGEN 18 AND DEUTERIUM

The stable isotopes delta-Oxygen 18 ($\delta\,^{18}O$) and delta-deuterium ($\delta\,^{2}H$) are used as surface water tracers in water quality studies. These isotopes are conservative tracers, reflecting the origin of the water. Recent precipitation and relatively young groundwater generally have less negative values of $\delta\,^{18}O$, while older saline water or old glacial waters generally have more negative values. Surface water containing fresh snowmelt during spring runoff or river flood stages would typically have more negative $\delta\,^{18}O$ values, than the flow during other parts of the year, so seasonal interpretation is also required. Values are presented as $\delta\,^{18}O$ VSMOW ‰ (Vienna Standard Mean Ocean Water). Studies on surface water such as the Red River have measured spring flood $\delta\,^{18}O$ values as low as -20 ‰, while fresh precipitation and relatively recent-age groundwater was in the range of -13 to -15 ‰ (Fritz et. al. 1975). The more saline, older groundwater (such as that found west of the Red River in southern Manitoba) has a different isotopic composition, with $\delta\,^{18}O$ values as low as -20 ‰.

2.2.2 TRITIUM

Tritium analyses are used to determine the age of a water sample. Tritium is a radioactive isotope of hydrogen that is a by-product of atmospheric testing of nuclear weapons beginning in 1953. Atmospheric concentrations of tritium rose and decreased rapidly in response to this testing with values leveling out since 2008. Water samples can be classified as receiving atmospheric recharge before 1953 (pre-modern) or 1953 and after (modern) (Lindsay and others 2019). Samples can also be a mixture of pre-modern water and modern water. Tritium values can correlate well to other indicators of relative groundwater age such as stable isotopes ($\delta\,^{18}O$ and deuterium), along with geochemical parameters, enabling a description of the recharge regime of the area. Values are reported in tritium units (TU).

2.3 Geochemical Analysis

2.3.1 SAMPLE SUMMARY REPORTS

The software tool AquaChem by Waterloo Hydrogeologic was used to characterize the geochemistry of the samples and create water quality plots. Sample summary sheets generated by AquaChem are given for each sample in each data set showing ion balances, major ion percentages, water type and several ion ratios which are characteristic of natural waters.

2.3.2 DUROV PLOTS

Multiple water types can be compared using a Durov plot. First the milliequivalents per litre (meq) of each cation and ion is calculated from the laboratory water quality data. The total cations and the total anions are set equal to 100%. Cations and anions are plotted on adjacent ternary plots. The intersection of the data is shown on a central rectangular plot. Side plots show the actual pH and conductivity values for each point. Durov plots can be used to differentiate between different water types, which plot in different sections of the central rectangular plot. Similar water types tend to cluster within the same region of the central rectangular plot. The plot can also be used to infer the origin of the water or mixing processes between water types. Mixed water types tend to plot between "end members" in the central rectangular plot. Seasonal changes or changes through time can also be investigated.

For ease of discussion, the 25 boxes on the Durov plot are numbered beginning in the left-hand corner from top to bottom and left to right.

2.3.3 STIFF DIAGRAMS

Individual water types can be compared using Stiff diagrams that display the relative concentrations of major ions expressed in milliequivalents per litre (meq). The lengths of the polygon sides illustrate the major ion concentrations, and plots of different shapes indicate different "fingerprints" of water qualities. Similar water types have a similar plot shape and would be generally expected to originate from the same source. Stiff diagrams prepared for different years can be used to determine water quality changes over time. Stiff diagrams for the site and historic and regional data are shown in each section.

2.3.4 ION RATIOS

The ratios of certain common ions can be used to group water types. These ratios are shown on the Sample Summary Reports for each section. Scatter plots of magnesium (Mg) to calcium (Ca) ratios and sulphate (SO_4) to chloride (Cl) concentrations were also prepared. A line showing a 1:1 ratio was added to provide a reference on some plots.

2.3.5 INDICATOR IONS

Concentrations of fluoride, boron and strontium have been noted to be elevated in some parts of the Lake St. Martin basin and are discussed in regional references (Desbarats 2003, Desbarats and Pyne 2004, Simpson and Desbarats 2003). Concentrations of these ions were examined for the data sets. Average concentrations were calculated for each sample and plotted for comparison with similar source waters.

2.4 Lines of Evidence for Water Quality Associations

Lines of evidence for water quality associations were summarized in tables for each data set. This analysis seeks to integrate the various methods used to support an interpretation of water quality. A data package has been produced for each study area as presented in the appendices including the data, sample summary report and supporting graphs, plots, and tables. A table is included for each data set summarizing the interpretations. Each text section presents an overview of the assessment.

3.0 BACKGROUND REFERENCES

The references below were identified as pertinent to the study area and were reviewed and used in the interpretation.

1. Baldwin, J. 2017. Lake St. Martin Channel. Lake St. Martin and Lake Winnipeg Test Hole Logs and Laboratory Testing Results. Internal Manitoba Infrastructure Memo. July 18, 2017.

2. Bourbonniere, R.A. (2009) Review of Water Chemistry Research in Natural and Disturbed Peatlands, Canadian Water Resources Journal, 34:4, 393-414, DOI:10.4296/cwrj3404393

3. Desbarats, A.J. 2003. Hydrogeology of the Lake Saint-Martin Impact Structure, Manitoba Canada. In *Proceedings of the 56th Canadian Geotechnical Conference, 4th Joint IAHCNC/CGC Conference, 2003 NAGS Conference*.

4. Desbarats, A.J and M. Pyne. 2004. Groundwater Resources of the Lake Saint-Martin Area, Manitoba, Geological Survey of Canada Open File 4624, 6 sheets, Scale 1:100,000.

5. ECOSTEM Ltd. 2017. Potential Wetland Responses to lake St. Martin Outlet Channel Operation if Option 1 is Adopted for Reach 2. Prepared for KGS Group by ECOSTEM Ltd. May 2017.

6. Fritz, P., Drimmie, R.J., Render, F.W., 1974. Stable Isotope Contents of a Major Prairie Aquifer in Central Manitoba, Canada. in Isotope Techniques in Groundwater Hydrology, Proceedings of a Symposium organised by the International Atomic Energy Agency, v.1, p. 379-398.

7. KGS Group. 2011. Internal Memorandum Project Number 11-0300-18. Re: Dauphin River Artesian Well Inventory and Well Protection Assessment. Dauphin River First Nation, Manitoba.

8. KGS Group. 2016. Assiniboine River and Lake Manitoba Basins Flood Mitigation Study; Lake Manitoba and Lake St. Martin Outlet Channels Conceptual Design Stage 2- Final Report. January 2016.

9. KGS Group and North South Consultants. 2016. Lake St. Martin Emergency Relief Channel Monitoring and Development of Habitat Compensation. Volume 3 - Water Quality. Prepared for Manitoba Infrastructure and Transportation- November 2016. Draft Report.

10. KGS Group. 2019. Lake St. Martin Outlet Channel Preliminary Design Geotechnical Data Report. Draft Rev. A, October 2019.

11. KGS Group. 2020. Lake St. Martin Outlet Channel Preliminary Design Report Rev.0_V.06.01 July, 2020.

12. KGS Group. 2021. LSMOC Groundwater and Surface Water Data 2019 to 2020. Data transmittal to Manitoba Infrastructure.

13. Leybourne, M.I., Betcher, R.N., McRitchie, W.D, Kaszycki, C.A., and D.R. Boyle. 2009. Geochemistry and stable isotopic composition of tufa waters and precipitates from the Interlake Region, Manitoba

Canada: Constraints on groundwater origin, calcitization and tufa formation. *Chemical Geology 260 (2009) 221-233*.

14. Lindsey, B.D., Jurgens, B.C., and Belitz, K., 2019, Tritium as an indicator of modern, mixed, and premodern ground-water age: U.S. Geological Survey Scientific Investigations Report 2019–5090, 18 p., https://doi.org/10.3133/sir20195090.

15. Manitoba Energy and Mines Geological Services, Manitoba Land Related Information System (MLRIS), University of Alberta. The Wetlands of Manitoba: A 1:1,000,000 Summary Map (1997).

16. McRitchie, W.D. 1996. GS-25: Groundwater Geochemistry and structural investigations of Paleozoic carbonates in Manitoba's Interlake region. In *Manitoba Energy and Mines, Minerals Division, Report of Activities, 1996, p.143-152.*

17. McRitchie, W.D. and C. Kaszycki. 1997. GS-22: Tufa Mounds, upwellings and gravity springs in the central and northern Interlake region, Manitoba (parts of NTS areas 62O,62P,63B and 63G). In *Manitoba Energy and Mines, Minerals Division, Report of Activities, 1997, p.133-146*.

18. Simpson, S.L., A.J. Desbarats. 2003. Isotopic Characterization of Groundwaters in the Vicinity of the Lake Saint-Martin Impact Structure, Manitoba Canada. In *Proceedings of the 56th Canadian Geotechnical Conference, 4th Joint IAHCNC/CGC Conference, 2003 NAGS Conference*.

19. WSP. Lake Manitoba and Lake St. Martin Outlet Channel Project – Preconstruction Environmental Field Work – Wetlands (CONS 15843). Project No. 20M-00910-00. November, 2020.

4.0 ASSESSMENT OF BACKGROUND STUDIES

4.1 Lake St. Martin Outlet Channel Area - Springs Sites (Leybourne and others)

4.1.1 STABLE ISOTOPE TESTING

Appendix A-1, Table A-1-1 contains Lines of Evidence for water quality associations for the spring sites. Appendix A-2 contains materials for the spring sites. Spring locations are shown in Appendix A-2-1 and A-2-2. Water quality tables are shown in A-2-3. A sample summary report is included in A-2-4. Stable isotope testing was reported in Leybourne (2009). The $\delta^{18}O$ values from the pool in the Mantagao River drainage was least depleted (-10.2‰), likely from evaporation in the pool. Fens and pools south of Lake St. Martin were slightly less depleted than other spring areas, with $\delta^{18}O$ values between -13‰ to -14‰, either from more recent recharge, or evaporative influences. The fens north of Dauphin River (1070, 1087), the fen in the upland of the lower Buffalo Creek drainage (1083), and the fens in the Mantagao River drainage and springs near lake Winnipeg (1026, 1027, 1028, 1029, 1020 and 1096) had $\delta^{18}O$ values ranging rom -14.5 to -15.5‰.

4.1.2 DUROV PLOT

The water type table and the Durov plot for the spring sites is shown in Appendix A-2-5 and A-2-6. Fourteen spring sites were sampled in April 1997 (Leybourne 2009). These sites lie in 5 sub areas east of Lake St. Martin as described in Appendix Table A-1-1.

- Fens north of Dauphin River;
- Fen in upland of lower Buffalo Creek drainage;
- Pool in upper Mantagao River (drainage east of channel alignment);
- Fens in Mantagao River drainage and springs near Lake Winnipeg; and
- Fens and pool south of Lake St. Martin, within and outside the footprint of the Lake St. Martin impact structure.

All but two of the locations plot in the upper left-hand side of the graph in rectangle 2, with the remainder just below in rectangle 3 (1022- pool in Mantagao River drainage) and rectangle 8 (1083- fen in upland of lower Buffalo Creek drainage). Conductivity is also highest at site 1083 - the fen in upland of lower Buffalo Creek drainage at (1086 µS/cm). Conductivity is lowest in the fens and pool south of Lake St. Martin (lowest reading 590 µS/cm).

The water type is magnesium-calcium-bicarbonate or calcium-magnesium bicarbonate for all locations except two as follows:

- magnesium-calcium-bicarbonate-sulphate (1022- pool in upper Mantagao River Drainage)
- magnesium-sodium-calcium-bicarbonate-sulphate (1083 - fen in upland of lower Buffalo Creek drainage)

4.1.3 STIFF DIAGRAMS

Stiff diagrams (Appendix A-2-7) for the remainder of the spring sites follow the water types grouped by letter. The water type groups have been kept constant throughout this report for evaluation across the sites and not all water types may be represented in a particular dataset.

- Group A- magnesium- calcium-bicarbonate for most of the springs
- Group B - magnesium-calcium-sodium-bicarbonate (none)
- Group C- magnesium-calcium-bicarbonate-sulphate (spring 1022)
- Group D- Magnesium-calcium-sodium-bicarbonate-sulphate (none)
- Group E-magnesium-sodium-calcium-bicarbonate-sulphate (spring 1083)

4.1.4 ION RATIOS

Ion ratios are shown in the Sample summary report Appendix A-2-4 and in the plots in Appendix A-2-8.

- ***Magnesium/Calcium –*** Fens and pool south of Lake St. Martin are most enriched in magnesium.
- ***Sulphate/Chloride –*** Fens and pools on the south side of LSM had close to a 1:1 sulphate to chloride ratio, while the pool in the upper Mantagao River drainage and the fens in the Mantagao River drainage and springs near Lake Winnipeg had the highest sulphate to chloride ratios.

4.1.5 INDICATOR METALS (BORON, STRONTIUM AND FLUORIDE)

Indicator metals are shown on the water quality tables in Appendix A-2-3. The highest boron concentrations were in the pool in the upper Mantagao River drainage (spring 1022). The highest fluoride and strontium concentrations were found north of the Dauphin River (springs 1070, 1087). Strontium was also most elevated in the fen in the upland of the lower Buffalo Creek Drainage (spring 1083) and the pool in the upper Mantagao River drainage (spring 1022).

4.2 Lake St. Martin Outlet Channel Area - Surface Water Monitoring (2013)

4.2.1 DUROV PLOT

Appendix A-1, Table A-1-2 contains Lines of Evidence for water quality associations for the 2013 surface water sampling. Appendix A-3 contains materials for the surface water. Surface water locations are shown in Appendix A-3-1. Water quality tables are shown in A-3-2. A sample summary report is included in A-3-3.

Surface water locations include:

- LSM1 – Lake St. Martin near Reach 1 Emergency Channel inlet site
- DR1- Dauphin River at discharge of Buffalo Creek
- DR2C - Dauphin River at discharge to Lake Winnipeg
- EC1 and EC2 –Reach 1 Emergency Channel Upstream Buffalo Creek before Big Buffalo Lake (BBL)
- BBL- Big Buffalo Lake
- BC1 and BC3 – Downstream of Big Buffalo Lake – BC3 is close to Dauphin River and gets a large groundwater discharge from springs along the west end of Buffalo Creek. BC1 will get input from any groundwater discharge to Big Buffalo Lake.

The water type table is shown in Appendix A-3-4. The Durov plot for the surface water sites is shown in Appendix A-3-5. Eight surface water sites were sampled in 2013.

The surface water plot is distinct from the plot of spring samples (Section 4.1) and groundwater samples (Section 5.2.5). Samples from Big Buffalo Creek BC1 and BC3 lie in rectangle 3 and show the most groundwater influence (since most of the groundwater and spring samples in other areas plot in quadrant 2). Reach 1 Emergency channel samples EC1 and EC2 and the May 2013 sample from Big Buffalo Lake plot in rectangle 8, slightly further from the groundwater type along reach 2 and 3 (Section 5.2.5). The sample from March 2013 from Big Buffalo Lake plots even further at the edge of rectangle 8 than the May sample, showing seasonal influence. The higher chloride in the Big Buffalo Lake and EC1 and 2 samples may be related to higher chloride in the local bedrock groundwater; however, bedrock groundwater was not sampled in this area. If so, the higher chloride in March 2013 could be from groundwater discharge prior to spring precipitation.

The water quality for Lake St. Martin Inlet and the two Dauphin River Samples plot together, in rectangle 14 as they are one source, due to the higher sodium and chloride content of the water. These samples are elevated in electrical conductivity, hardness, alkalinity, chloride, sulphate, sodium, and strontium; while the samples from EC1 and EC1 on Reach 1 are elevated in sulphate.

Conductivity is highest in Lake St. Martin and the Dauphin River (1300 µS/cm), lowest at BC1 and BC3 on Buffalo Creek (300 to 400 µS/cm) and slightly higher than that on Reach 1 and Big Buffalo Lake (520 µS/cm).

The water types are as follows:

- magnesium-calcium-sodium-bicarbonate (BC1 and BC3)
- magnesium-calcium-sodium-bicarbonate-sulphate (EC1 and EC2)
- sodium-magnesium-chloride bicarbonate (LSM1, DR1, DR2C)
- magnesium-calcium-sodium-bicarbonate-chloride (BBL)

4.2.2 STIFF DIAGRAMS

Stiff diagrams (A-3-6) follow the water types grouped by letter. The water type groups have been kept constant for evaluation across the sites and not all water types have samples from this location.

- Group A- magnesium- calcium-bicarbonate (none)
- Group B - magnesium-calcium-sodium-bicarbonate (BC1 and BC3)
- Group C- magnesium-calcium-bicarbonate-sulphate (none)
- Group D- magnesium-calcium-sodium-bicarbonate-sulphate (EC1 and EC2)
- Group E-magnesium-sodium-calcium-bicarbonate-sulphate (none)
- Group F- sodium-magnesium-chloride bicarbonate (LSM1, DR1, DR2C)
- Group G- magnesium-calcium-sodium-bicarbonate-chloride (BBL)

4.2.3 ION RATIOS

Ion ratios are shown in Appendix A-3-7.

- ***Magnesium/Calcium –*** Lake St. Martin and the Dauphin River samples and EC1 and EC2 are enriched in magnesium, while BBL, BC1 and BC3 plot closer to a 1:1 ratio.
- ***Sulphate/Chloride –*** All samples are enriched in chloride except EC2 (close to 1:1 ratio), and EC1 (enriched in sulphate). Lake St. Martin and Dauphin River samples are most enriched in sulphate.

4.2.4 INDICATOR METALS (BORON, STRONTIUM AND FLUORIDE)

Indicator metals are shown in the water quality tables in Appendix A-3-2. Boron, and strontium were higher in the Lake St. Martin and Dauphin River than the other locations. No difference in boron or fluoride were found across the drainage from Reach 1 through BC3. Strontium decreases across the drainage from BBL through BC3.

4.3 Dauphin River First Nation Domestic Well Study (KGS Group 2011)

4.3.1 DUROV PLOT

Appendix A-1, Table A-1-3 contains Lines of Evidence for water quality associations for the 2011 domestic well sampling at Dauphin River First Nation (DRFN). Appendix A-4 contains materials for the DRFN sampling. Locations are described generally in Table A-1-3 and are all north of the Dauphin River in the community. Water quality tables are shown in A-4-1. A sample summary report is included in A-4-2.

Domestic well locations were all on the north side of the Dauphin River. Wells 80,98,104/105 were furthest upriver, while well 5 was closest to Lake Winnipeg and wells 67 and 32/33, 34 and 35/36 were intermediate location.

The water type table and Durov plot for the domestic wells are shown in Appendix A-4-3 and A-4-4. Eight domestic wells were sampled in 2013. The domestic wells furthest up-stream on the Dauphin River (104, 105, 98 and 80) group together in rectangle 8 along with well 5 and well 67. Wells 32/33, 34, and 35/36 plot in rectangle 3.

Conductivity is highest in the wells furthest upstream (80, 98, 104, 105) (950-1000 µS/cm), moderate at wells 5 and 67 (800 to 825 µS/cm) and slightly lower (775 µS /cm) at the other wells.

The water types are as follows:

- Magnesium- calcium-bicarbonate (32/33, 34, 35/36)
- magnesium-calcium-sodium-bicarbonate (67)
- magnesium-calcium-sodium-bicarbonate-sulphate (5)
- magnesium-sodium-calcium-bicarbonate-sulphate (80, 98, 104/105)

4.3.2 STIFF DIAGRAMS

Stiff diagrams (Appendix A-4-5) follow the water types grouped by letter. The water type groups have been kept constant for evaluation across the sites and not all water types have samples from this location.

- Group A- magnesium- calcium-bicarbonate (32/33, 34, 35/36);
- Group B - magnesium-calcium-sodium-bicarbonate (67);
- Group C- magnesium-calcium-bicarbonate-sulphate (none);
- Group D- magnesium-calcium-sodium-bicarbonate-sulphate (5);
- Group E-magnesium-sodium-calcium-bicarbonate-sulphate (80, 98, 104/105);
- Group F- sodium-magnesium-chloride bicarbonate (none); and
- Group G- magnesium-calcium-sodium-bicarbonate-chloride (none).

4.3.3 ION RATIOS

Ion ratios are shown in Appendix A-4-6.

- ***Magnesium/Calcium –*** All samples were enriched in magnesium.
- ***Sulphate/Chloride –*** all samples were enriched in sulphate.

4.3.4 INDICATOR METALS (FLUORIDE)

Indicator metals are shown in the water quality table inn Appendix A-4-1. No differences in fluoride were noted in the samples. Boron and strontium were not analysed for these samples.

5.0 LSMOC MONITORING 2019 TO 2020

Monitoring locations are shown on reference sketch, Figure 1. Lines of evidence for water quality associations are shown in Appendix B-1. Groundwater and surface water tables (Appendix B-2) were submitted separately and have not been reproduced here. Groundwater and surface water types are shown in Appendix B-3.

5.1 Stable Isotopes

5.1.1 SURFACE WATER

Stable isotope results and plot are shown in Appendix B-4. The stable isotopes delta-Oxygen 18 ($\delta^{18}O$ VSMOW ‰) and delta-deuterium ($\delta^{2}H$) are used as surface water tracers in water quality studies. These isotopes are conservative tracers, reflecting the origin of the water. Surface water containing fresh snowmelt during a spring runoff would typically have more negative $\delta^{18}O$ values, in comparison to other times of the year. Less negative $\delta^{18}O$ values would be expected later in the season, particularly in lakes where evaporation occurs. Groundwater generally has more negative $\delta^{18}O$ values than surface water. Within the range of groundwater values samples in areas of recent recharge has less negative δ ^{18}O values, while more negative values can indicate older water.

A plot of $\delta^{18}O$ values and deuterium values is presented in Appendix B-4-2. Values are given in Appendix B-4-1. The discussion below rounds off these values to whole numbers for a general comparison.

Lake St. Martin (LSMOC Inlet) and Lake Winnipeg (LSMOC Outlet) isotopes plot as typical large body surface water with Lake St. Martin the least negative $\delta^{18}O$ at -7 to -8 ‰ (likely because of its smaller size) and Lake Winnipeg at -8 to -9‰. Both plot to the right of the meteoric water line indicating evaporative conditions of a surface water body.

Surface water along Buffalo Creek also plots as a typical surface water, but with slightly more negative $\delta^{18}O$ than the large lakes, likely because of groundwater contribution to the surface water drainage in Buffalo Creek. This includes (BC-02, west of channel Station 13+000 and BC-05 further downstream in the westward reach of the creek), which plots at -10 to -11‰. The $\delta^{18}O$ values at BC-05, further downstream, are slightly more negative than BC-02 at -11 to -12‰, likely due to an increasing groundwater flow component from spring discharges in the Buffalo Creek drainage basin. Both have a slight evaporative component, less than the large lakes, but comparable to some of the groundwater samples.

The upstream tributaries of Buffalo Creek on either side of the LSMOC alignment CR3-1 and CR3-2 have more negative $\delta^{18}O$ than either of the other Buffalo Creek samples at -12 to -13‰, but with no evaporative component. The isotopic signature is typical of a groundwater fed surface water source. These points are upstream of BC-05 and provide some of the groundwater component to that location.

Surface water collected in the Reach 3 channel near PW19-KGS-03, varies from spring $\delta^{18}O$ values of -11‰, like surface water at BC-05 (and in one case with a more evaporative signature) to fall values of -13 to -14‰ that plot like groundwater, including the groundwater at the adjacent bedrock well PW19-KGS-03 (-13 to -15‰). Groundwater discharge makes up the bulk of the flow in the fall, while surface water dominates in the spring.

5.1.2 PEAT

Only one monitoring well installed in peat was sampled for isotopes (TH19-KGS-100) located near channel Station 9 + 000. This well shows an $\delta^{18}O$ signature like groundwater of -14.8 ‰ and plots like groundwater well TH19-KGS-18. The peat is separated from the bedrock by an extensive thickness of till.

Wetlands mapping in this area (Manitoba Energy and Mines Geological Services and others, 1997) shows the alignment to pass through an extensive bog and fen complex as well as shrubby fen to wooded fen. A discussion of these northern Canadian fens developed in carbonate bedrock regions, describes their groundwater source and associated chemistry (Bourbonniere, 2009). The isotopic groundwater signature of the peat water sample collected combined with the major ion analysis discussed below indicates that the peat wetland system is part of a fen, largely fed by surface water and also by groundwater discharge (springs), rather than only the precipitation dominated (lower flow) bog systems common in other regions.

Wetland mapping in the Buffalo Lake wetland complex west of the LSMOC channel present Reach 2 and Reach 3 alignment in 2011 (pre- operation for Reach 1) showed fen covered approximately 62% of total wetland complex area with bog covering approximately 33% of the area (ECOSTEM Ltd. 2017). Wetland mapping along the channel alignment was also conducted, and indicated areas of fen wetland types (WSP, 2020).

5.1.3 TILL

Only one monitoring well installed in till was sampled for isotopes, TH19-KGS-20, located at the end of Reach 1. This well shows an $\delta^{18}O$ signature like groundwater of -14.8 ‰.

5.1.4 BEDROCK MONITORING WELLS AND SENTINEL WELLS

Groundwater Recharge - Stable Isotope testing

The $\delta^{18}O$ values from the bedrock monitoring wells and Sentinel wells range from -13.6‰ to -16.3‰. The only wells with values more negative than -15.5‰ are TH19 KGS-12 (most negative -16.3‰) located mid-way along the channel, Sentinel Well 3 (-15.6‰) and Sentinel Well 2 (-15.8‰), both located on the north side of the Dauphin River. Although all these values are typical of active recharge as opposed to very old water, the more depleted values at these locations may indicate a lower rate of recharge.

All the points lie either on the meteoric water line, or slightly to the right of the line except TH19-KGS17 and TH19-KGS 13, which lie furthest to the right of the line.

Groundwater Age- Tritium Sampling

Tritium values are shown on Table B-4-1. Tritium values were sampled for 7 monitoring wells and 1 surface water location in October 2019 and two sentinel wells in September 2019. Two wells and one surface location had higher tritium values from 8.2 to 10.7 TU (+/- 0.8 TU). The remainder of the monitoring wells had tritium values less than detection (0.8 TU +/- 0.2 TU).

A recent study by the USGS (Lindsay and others 2019) summarizes practice in setting thresholds for tritium concentrations to classify groundwaters as pre-modern, mixed, or modern.

Since tritium has a half life of 12.32 years, the tritium concentration in groundwater receiving precipitation 1953 and after would decrease as the tritium decayed. The study gives an example for a latitude/longitude within the northern plains comparable to Sioux Falls South Dakota. An estimate of average background precipitation from 2008 to 2012 of 9.53 TU was used. For this region, threshold values of 2.89 TU were calculated for modern groundwater (e.g. very recent recharge), and 0.28 TU for premodern (old, long residence time) groundwater. Values in between would represent mixed groundwater ages. This example provides a reasonable approximation for a general interpretation of study data.

For the LSMOC sampling, although detection limits below 0.8 TU are available (to 0.1 TU), this ultra-low level testing was not warranted for this project scope. Therefore, tritium values found below detection (<0.8 TU) are assumed to be in the pre-modern (before 1953) to mixed pre-modern and modern age (1953 and after) groundwater. These below detection limit (e.g. old, long residence time groundwaters) are listed in order of decreasing evidence of recent recharge, as shown by $\delta^{18}O$ and deuterium measurements for the same date.

- TH19-KGS 12 (most evidence of recent recharge)
- TH19-KGS17 - Reach 3
- SW19-KGS-02 - Sentinel well north of Dauphin River
- SW19-KGS-03- Sentinel well north Dauphin River
- TH19-KGS-19- Reach 3 near outlet
- PW19-KGS-02
- PW19 – KGS-01 Proposed Water Control Structure (least evidence of recent recharge)

Conductivity for this group of wells range from 591 to 841 µS/cm.

Modern age groundwaters (i.e. recharge to the aquifer occurring 1953, or thereafter) were found at:

- PW19-KGS-03 (Reach 3)
- SW-R3 surface water/groundwater discharge in channel
- TH19-KGS 18 Reach 3

Conductivity at KGS 03 and SW R3 ranges from 456 to 550 µS/cm and conductivity at KGS 18 is higher at 908 µS/cm.

5.2 Water Quality

5.2.1 OVERVIEW

Data from the 2019 to 2020 surface water and groundwater analysis was transmitted to MI in 2021 and included a summary statistical table of water quality parameters for the data set as a whole. Statistical analysis of subsets of this data is recommended as the project background monitoring proceeds, particularly where parameters have shown wide ranges that may be due to well completion in different zones (peat, till or bedrock) or in different geographic areas of the project. This work has not been completed for the current scope of work.

5.2.2 SURFACE WATER

5.2.2.1 Durov Plot

Durov plots could not be done for surface water points except for SWR-3 since other locations were not sampled for major ions. The sample summary report is shown in Appendix B-5-1 and the Durov plot is shown in Appendix B-5-2. This sample plots in the upper left of the central portion of the graph in rectangle 2. Conductivity values varied widely from spring 2019 (approx. 450 µS/cm) to Fall 2019 (approx. 175 µS/cm) during a period of extreme high precipitation; however, the water type remains similar at magnesium-calcium-bicarbonate as shown in Appendix B-3. The stiff diagram is included with the bedrock wells in Appendix B-8-3.

Expanded chemical analysis is proposed for surface water sites in 2021 to better define groundwater geochemistry.

5.2.3 PEAT WELLS

5.2.3.1 Durov Plot

The sample summary report for the peat wells is shown in Appendix B-6-1. The Durov plot for the peat wells is shown in Appendix B-6-2. Nine peat wells were sampled once in March 2019. Eight of these wells plot closer in the top left of the Durov plot in rectangle 2, while one sample (TH-19-18A) is found in the lower left in rectangle 4. Conductivity varies widely from approximately 460 µS/cm at TH-10-KGS-13, to 846 µS/cm at TH19-KGS-19A. The water type is magnesium-calcium-bicarbonate or calcium-magnesium bicarbonate except for TH19-KGS18A, which was sodium-calcium-magnesium-bicarbonate as shown in Appendix B-3.

5.2.3.2 Stiff Diagrams

Stiff diagrams are shown in Appendix B-6-3. Shapes are similar except for TH19-KGS-18A, which has a higher percentage of sodium.

5.2.3.3 Ion Ratios

Ion ratios are shown in the sample summary report (Appendix B-6-1) and in the plots in Appendix B-6-4.

- ***Magnesium/Calcium*** **-**The magnesium/calcium plot generally follows the 1:1 ratio trend line with samples plotting both on the line and to either side of the line.
- ***Sulphate/Chloride -*** The sulphate/chloride plot shows four wells (TH19-KGS-11A, TH19-KGS-13A, TH19-KGS-14A, and TH19-KGS17A) that plot close to the 1:1 ratio, with the other wells more scattered.

5.2.3.4 Indicator Metals Histograms (Boron, Strontium and Fluoride)

The indicator metals histograms are shown in Appendix B-6-5. Two wells have higher boron and strontium (TH19-KGS-100, TH19-KGS-19A); two wells have higher fluoride and strontium (TH19-KGS-03A, TH19-KGS -07A); one well has higher fluoride only (TH19-KGS-14A) and one well higher boron only (TH19-KGS 11A).

5.2.4 TILL WELLS

5.2.4.1 Durov Plot

The sample summary report for the till wells is shown in Appendix B-7-1. The Durov plot for the peat wells is shown in Appendix B-7-2. Seven till wells were sampled once in March 2019. One of these wells plots closer in the top left of the Durov plot in rectangle 2 (TH19-KGS16B), while four samples plot below in rectangle 3

(TH19-KGS-07, TH19-KGS-12B, TH19-KGS-17 B). One well plot to the right in rectangle 13 (TH19-KGS-02B) located at the proposed Water Control Structure and another well plots in the lower left in rectangle 4 (TH19-KGS20) at the inland end of Reach 1. Conductivity is highest at TH19-KGS-02B at the proposed Water Control Structure (1970 µS/cm), and is very high compared to other bedrock, till or peat measurements found. Most of the conductivity values fall between 790 and 945 µS/cm, with two lower values between 470 and 654 µS/cm. The water type is magnesium-calcium-bicarbonate or calcium-magnesium bicarbonate except for TH19-KGS17B (magnesium bicarbonate), TH19-KGS-02B (magnesium-sodium-calcium-sulphate-bicarbonate), and TH19-KGS-20 (sodium-magnesium-bicarbonate-sulphate).

5.2.4.2 Stiff Diagrams

Stiff diagrams are shown in Appendix B-7-3. Shapes are similar for TH19-KGS-07, TH19-KGS-12B and TH19-KGS-17 B, with unique shapes for the remaining wells.

5.2.4.3 Ion Ratios

Ion ratios are shown in the sample summary report (Appendix B-7-1) and in the plots in Appendix B-7-4.

- ***Magnesium/Calcium –*** All but one sample (TH19-KGS16B) plots left of the 1:1 ratio line indicating enrichment with magnesium.
- ***Sulphate/Chloride –*** The samples do not follow the sulphate/chloride plot 1:1 ratio line. The wells have varying concentrations of sulphate. Four wells (TH19-KGS-11A, TH19-KGS-13A, TH19-KGS-14A, and TH19-KGS17A) plot close to the 1:1 ratio, while the other wells are more scattered.

5.2.4.4 Indicator Metals Histograms (Boron, Strontium and Fluoride)

The indicator metals histograms are shown in Appendix B-7-5. The highest boron values were found at TH19-KGS-02B and TH19-KGS12B, the highest fluoride values were found at TH19-KGS20, TH19-KGS-07, TH19-KGS-12B, TH19-KGS17B; the highest strontium numbers were found at TH19-KGS02-B and TH19-KGS-17B.

5.2.5 BEDROCKMONITORING WELLS AND SENTINEL WELLS

5.2.5.1 Durov Plot

The sample summary report for the bedrock wells and sentinel is shown in Appendix B-8-1. The Durov plot is shown in Appendix B-8-2. Nineteen bedrock monitoring wells and 3 bedrock Sentinel wells were sampled from one to five times between March 2019 and October 2020. All the bedrock monitoring wells lie along the channel alignment channel. The Sentinel wells are located to the west in the Dauphin River First Nation; two on the north side of the Dauphin River (Sentinel well 2 and 3) and one on the south side (Sentinel well 1).

About half of the wells plot in the upper left-hand side of the graph in rectangle 2, with the remainder just below in rectangle 3, except for Sentinel well 2 and 3 on the north side of the Dauphin River and TH19-KGS-04 in reach 2 of the channel alignment (which plots further to the right in rectangle 8). Conductivity is also highest at Sentinel well 2 and 3 and TH19-KGS-04 (913 µS/cm to 1240 µS/cm). Conductivity at TH19-KGS 18 varies widely from 566 µS/cm in June 2020 to 1040 µS/cm in March 2019. This variability is not characteristic of the rest of the wells. Conductivity at the other wells ranges from 535 to 900 µS/cm. The water type is magnesium-calcium-bicarbonate or calcium-magnesium bicarbonate for most of the wells except as follows:

- Magnesium-calcium-bicarbonate-sulphate (PW19-KGS-02, TH19-KGS-01B, TH19-KGS-19 March 2019 only)

- Magnesium-calcium-sodium-bicarbonate-sulphate (TH19-KGS-04, TH19-KGS-11)
- Magnesium-sodium-calcium-bicarbonate-sulphate (Sentinel wells 2 and 3)
- Magnesium-calcium-sodium-bicarbonate (Sentinel well 1)

5.2.5.2 Stiff Diagrams

Stiff diagrams are shown in Appendix B-8-3. Stiff diagrams for the remainder of the wells follows the water types grouped by letter as follows:

- Group A- magnesium-calcium-bicarbonate or calcium-magnesium bicarbonate for most of the wells
- Group B - magnesium-calcium-sodium-bicarbonate (Sentinel well 1 March 2019 only)
- Group C- magnesium-calcium-bicarbonate-sulphate (PW19-KGS-02, TH19-KGS-01B, TH19-KGS-19 March 2019 only
- Group D- Magnesium-calcium-sodium-bicarbonate-sulphate (TH19-KGS-04, TH19-KGS-11)
- Group E-magnesium-sodium-calcium-bicarbonate-sulphate (Sentinel wells 2 and 3)

Stiff diagrams for sentinel wells are plotted together on the first page of the plots. Water type with increasing sodium and sulphate can be seen from the south side of the Dauphin River (Sentinel well 1) to the north side of the Dauphin River (Sentinel well 2 and 3). The Dauphin River forms a geochemical boundary in this area based on the observed differences in geochemistry, forming a discharge boundary condition of the aquifer. Water quality at Sentinel well 1 located closest to lake Winnipeg also becomes fresher in the spring changing to the magnesium-calcium-bicarbonate water, which is typical of the water quality within most of the bedrock wells along the LSMOC channel.

5.2.5.3 Ion Ratios

Ion ratios are shown in the sample summary report (Appendix B-8-1) and in the plots in Appendix B-8-4.

- ***Magnesium/Calcium –*** All but two samples (TH19-KGS18 and one date for PW19-KGS-03) plot left of the 1:1 ratio line indicating enrichment with magnesium. For TH19-KGS18, the June sample, which differs from the others, plots to the right.
- ***Sulphate/Chloride –*** The samples do not follow the sulphate/chloride plot 1:1 ratio line. The wells have varying concentrations of sulphate.

5.2.5.4 Indicator Metals Histograms (Boron, Strontium and Fluoride)

The indicator metals histograms are shown in Appendix B-8-5. Boron, fluoride, and strontium are all elevated at TH19-KGS-11. Strontium is elevated at TH19-KGS-19.

5.3 Conclusions

1. The groundwater system around the Lake St. Martin Outlet Channel (LSMOC) is characterized by local groundwater recharge in high elevation ground areas surrounding Lake St. Martin (in particular to the south-southeast of the north basin of Lake St. Martin), and a discharge groundwater system with boundary conditions including Lake St. Martin and Lake Winnipeg. Regional groundwater discharge occurs to Lake St. Martin, and to Lake Winnipeg. Dauphin River, and the artesian spring sites throughout the region (including to the east along the Mantagao River), also are a significant part of the aquifer discharge system.

2. Strong upward gradients between the piezometric surface of the bedrock aquifer and the overlying till aquitard indicate groundwater discharge conditions (to flowing artesian conditions) for the bedrock aquifer throughout most of the channel alignment. In the downstream areas of the existing Reach 3 channel, upward gradients are not as strong, and there are locally downward gradients between the till aquitard and bedrock aquifer beyond approximately Sta. 18+500 of the LSMOC. These downstream areas of the LSMOC are within an area of pressure relief for the regional bedrock aquifer groundwater discharge system, a natural result of the many groundwater artesian spring discharge sites near Lake Winnipeg. Including within areas of artesian spring site discharge, the bedrock aquifer remains confined by the till aquitard (i.e. the bedrock aquifer piezometric pressure rises above the bedrock-till stratigraphic contact), and throughout the region of the LSMOC.

3. The bedrock aquifer is covered by a thick deposit of till, forming a low permeability aquitard, except along Reach 3 where bedrock is shallower and is exposed within the existing Reach 3 emergency channel. Despite the bedrock exposure and the upward gradients from the bedrock aquifer to the channel in this area, baseflows of bedrock aquifer groundwater to the channel measured by KGS Group were low, indicating very low bedrock transmissivity in this area.

4. An extensive system of artesian groundwater springs is present in the region and has been documented by previous researchers, including southwest of Buffalo Creek between the channel alignment and the Dauphin River, east of the channel alignment draining to Mantagao River, along the shores of Lake Winnipeg, and on the southeast side of the north basin of Lake St. Martin. These spring sites are direct discharges of the bedrock aquifer system to the surface water system. The Big Buffalo Lake wetland system is also thought to be groundwater fed, though there has been limited water quality sampling available for geochemical analyses in this area to confirm this conclusively, to date.

5. Analysis of the geochemistry of the artesian spring discharge groundwater data (collected by others) shows that it is typical of bedrock groundwater geochemistry found in project wells along the LSMOC channel alignment.

6. Groundwater quality and geochemistry in the Lake St. Martin impact zone near Gypsumville has been documented by researchers and has a characteristically higher concentration of total dissolved solids including sulphate and sodium as well as boron, fluoride, and strontium. This type of water was not found either in the artesian spring studies (by others) or the current studies of groundwater quality in the LSMOC project area. The LSMOC project area does not appear to be part of the groundwater flow system originating from the Lake St. Martin impact crater zone. There was no evidence found in the current groundwater data in the vicinity of the LSMOC, of any long-distance groundwater flow paths from the impact crater region, surfacing in the groundwater flow system within the LSMOC project area.

7. Surface water samples, collected just downstream of Big Buffalo Lake and further downstream on Buffalo Creek (just prior to the discharge at Dauphin River) are geochemically similar, and are representative of bedrock groundwater quality. The lower reaches of Buffalo Creek receive a heavy groundwater discharge contribution from artesian spring sites draining to the west reach of Buffalo

Creek. The groundwater signature in the upper reaches of Buffalo Creek is expected to be a result of groundwater discharge from the upgradient Big Buffalo Lake wetland system area, and other artesian groundwater springs in the region. Samples from Big Buffalo Lake show a geochemistry more like the waters within the Reach 1 emergency channel, than those that are distinctly groundwater related in the downstream drainage of Buffalo Creek. Further sampling and water quality assessment at Big Buffalo Lake may clarify the geochemical signature of any groundwater discharge to the Big Buffalo wetland system.

8. Currently available surface water samples were analyzed for limited parameters, except for a single location in the Reach 3 emergency channel, where fall and summer samples were taken. Although both samples show a groundwater type water quality, the groundwater signature is more pronounced in the fall when surface runoff and associated precipitation is lower. This sample shows the transition from bedrock groundwater type water in the fall to a more typical surface water type in the spring, when runoff and precipitation to the Reach 3 emergency channel is generally greater.

9. The surficial deposits in the region of the LSMOC are dominated by wetlands, including bog and fen complexes, open to shrubby fen and wooded to forested fen.

10. The geochemistry of surface water samples collected from the perched peat deposits show a similar chemistry to the bedrock groundwater, including a more neutral pH and a carbonate geochemical signature. These samples were collected prior to the spring melt in 2019 when surface water contribution would be lowest and groundwater contribution would be highest. Groundwater discharge to artesian springs at numerous locations in the LSMOC watershed appears to control the surface water chemistry in the perched peat and fen surface water system overall, as well as the chemistry of the wetlands and fens themselves. Even in areas where the thick low permeability till aquitard prevents direct discharge of bedrock groundwater to the surface, the water quality in the peat and fens has a bedrock groundwater signature, presumably due to artesian spring discharge in other locations in the region of the LSMOC.

11. The till groundwater geochemistry is unique from the bedrock aquifer groundwater geochemistry, and surface water geochemistry, and shows generally higher dissolved solids and more frequent elevated percentages of sulphate and chloride than in the bedrock groundwater or surface water system. One well at the proposed location of the Water Control Structure is atypically high in dissolved solids and sulphate. The low permeability of the till limits any water influx into the till, either from discharge from fresher groundwater below, or recharge from fresher surface water and wetland sources perched above the till. The integrity and functioning of the till aquitard is demonstrated by its thickness and low permeability characteristics, combined with its unique groundwater geochemistry, and with the observation of upward gradients (to flowing artesian conditions) and because it demonstrates a confining condition for the underlying bedrock aquifer throughout the region of the LSMOC.

12. Bedrock groundwater geochemistry north of the Dauphin River in Dauphin River First Nation (including domestic wells and project sentinel wells) is distinct from groundwater found south of the river (including a sentinel well and bedrock wells along the channel alignment). A higher proportion

of sulphate and chloride is found in the wells north of the Dauphin River. This would indicate that the Dauphin River is a discharge boundary condition of the regional aquifer.

13. Bedrock groundwater geochemistry along the channel alignment is generally similar and consistent, with a few wells showing more mineralized conditions, with higher dissolved solids and sulphate. One well near the end of the channel towards Lake Winnipeg shows significant fluctuations in water type seasonally, which could indicate connection with surface water sources, or seasonal changes in groundwater flow paths.

14. Stable isotope results for $\delta^{18}O$ indicate a generally recent recharge source for the groundwater system, and relatively short aquifer residence times, which is also consistent with the overall geochemical results. Tritium results also indicate that groundwater at two locations is representative of very recent, modern recharge (i.e. post 1950), and that the groundwater in the vicinity of the WCS has had the longest residence time in the region of the LSMOC (which is furthest away from the observed artesian spring sites in the region of the LSMOC).

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List of Reference Sketches

List of Appendices

APPENDIX B: LAKE ST. MARTIN OUTLET CHANNEL 2019 TO 2020

Appendix B-1: Lines of Evidence for Water Quality Associations
- Table B-1-1 Surface Water
- Table B-1-2 Peat Wells
- Table B-1-3 Till Wells
- Table B-1-4 Bedrock Wells

Appendix B-2: Groundwater and Surface Water Tables (submitted as EIS deliverable in February 2021)

Appendix B-3: Water Quality Types

Appendix B-4: Stable Isotopes
- B-4-1 Table Isotope Results
  - Table B-4-1 Stable Isotope Results
- B-4-2 Stable Isotope Plot

Appendix B-5: Surface Water
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Appendix B-6: Peat Wells
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- B-6-2 Durov Plot
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- B-6-4 Ion Ratios
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- B-6-5 Indicator Metals Histograms (Boron, Strontium and Fluoride)

Appendix B-7: Till Wells
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- B-7-3 Stiff Diagrams
- B-7-4 Ion Ratios
  - Magnesium/Calcium
  - Sulphate/Chloride
- B-7-5 Indicator Metals Histograms (Boron, Strontium and Fluoride)

Appendix B-8: Bedrock and Sentinel Wells
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- B-8-2 Durov Plot
- B-8-3 Stiff Diagrams
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  - Bedrock Wells
- B-8-4 Ion Ratios
  - Magnesium/Calcium
  - Sulphate/Chloride
- B-8-5 Indicator Metals Histograms (Boron, Strontium and Fluoride)

STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

This report has been prepared for Manitoba Infrastructure (MI) in accordance with the agreement between KGS Group and MI (the “Agreement”). This report represents KGS Group’s professional judgment and exercising due care consistent with the preparation of similar reports. The information, data, recommendations, and conclusions in this report are subject to the constraints and limitations in the Agreement and the qualifications in this report. This report must be read as a whole, and sections or parts should not be read out of context.

This report is based on information made available to KGS Group by MI. Unless stated otherwise, KGS Group has not verified the accuracy, completeness, or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith. KGS Group shall not be responsible for conditions/issues it was not authorized or able to investigate or which were beyond the scope of its work. The information and conclusions provided in this report apply only as they existed at the time of KGS Group’s work.

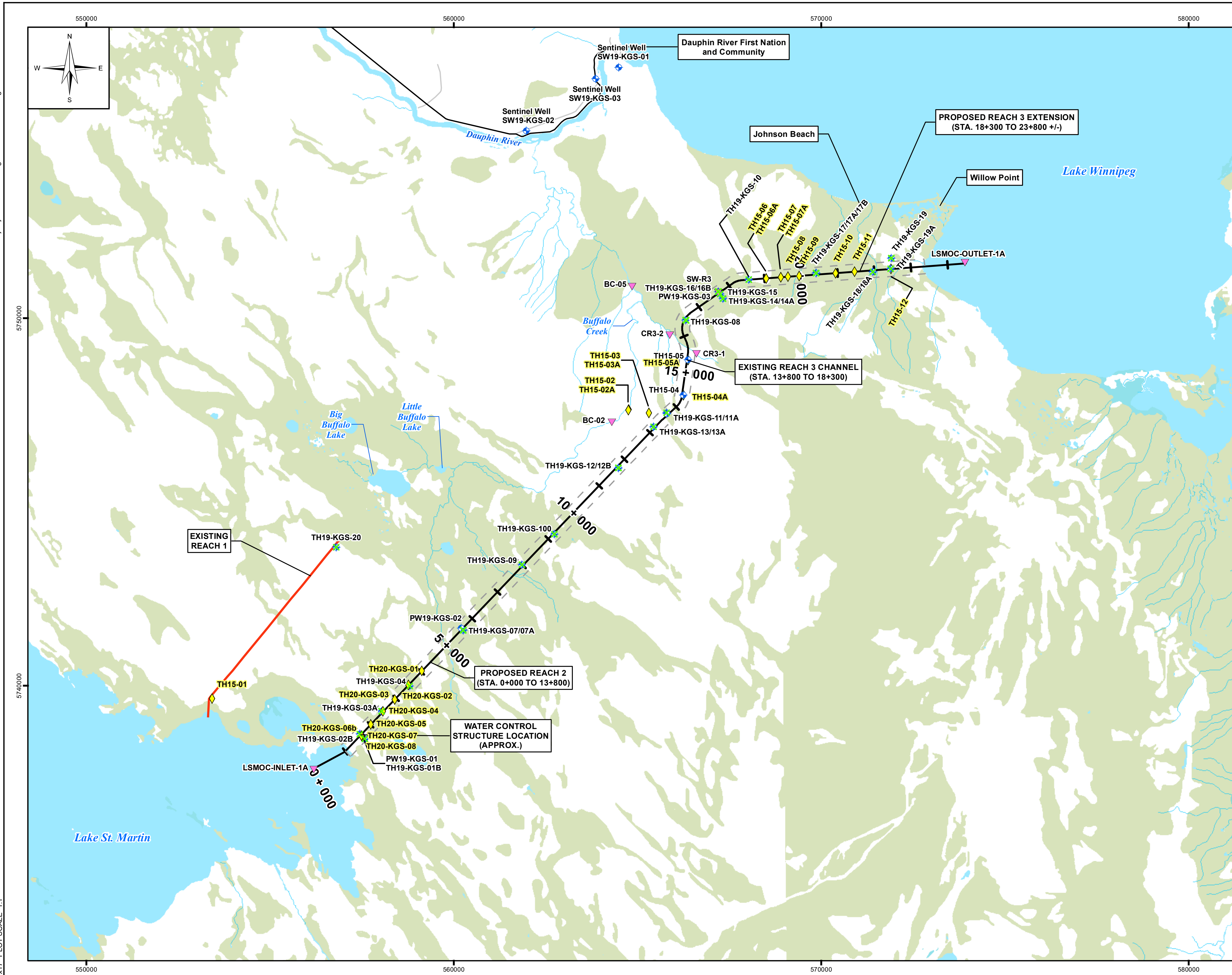
Third Party Use of Report

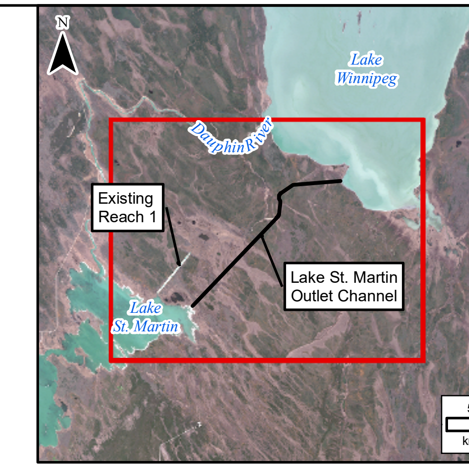
Any use a third party makes of this report or any reliance on or decisions made based on it, are the responsibility of such third parties. KGS Group accepts no responsibility for damages, if any, suffered by any third party because of decisions made or actions undertaken based on this report.

Geo-Environmental Statement of Limitations

KGS Group prepared the geo-environmental conclusions and recommendations for this report in a professional manner using the degree of skill and care exercised for similar projects under similar conditions by reputable and competent environmental consultants. The information contained in this report is based on the information that was made available to KGS Group during the investigation and upon the services described, which were performed within the time and budgetary requirements of [Insert client’s short name]. As this report is based on the available information, some of its conclusions could be different if the information upon which it is based is determined to be false, inaccurate, or contradicted by additional information. KGS Group makes no representation concerning the legal significance of its findings or the value of the property investigated.

REFERENCE SKETCHES





LEGEND:

- Surface Water Sampling Location
- Groundwater Sampling Location
- Standpipe with Vibrating Wire
- Standpipe
- LSMOC Alignment
- 400m Right Of Way

NOTES:
1. Locations with water quality samples have been labelled. For all other locations see the Geotechnical Data Report (KGS Group, October 2019).
2. Wetland, watercourse, and waterbody layers shown were obtained from NRCAN 1:50,000 data.
3. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 14. Elevations are in metres above sea level (MSL).

1 0 1 2 3 4
Kilometres
SCALE: 1:100,000 METRIC 11"x17"

NO.	YY/MM/DD	DESCRIPTION	ISSUED BY	CHECK BY
0	21/07/28	ISSUED FOR INFORMATION	PJL	JDM

REVISIONS / ISSUE

KGS GROUP

Manitoba Infrastructure

LAKE ST. MARTIN OUTLET CHANNEL GROUNDWATER AND SURFACE WATER SAMPLING SITES OF THE LSMOC PDA

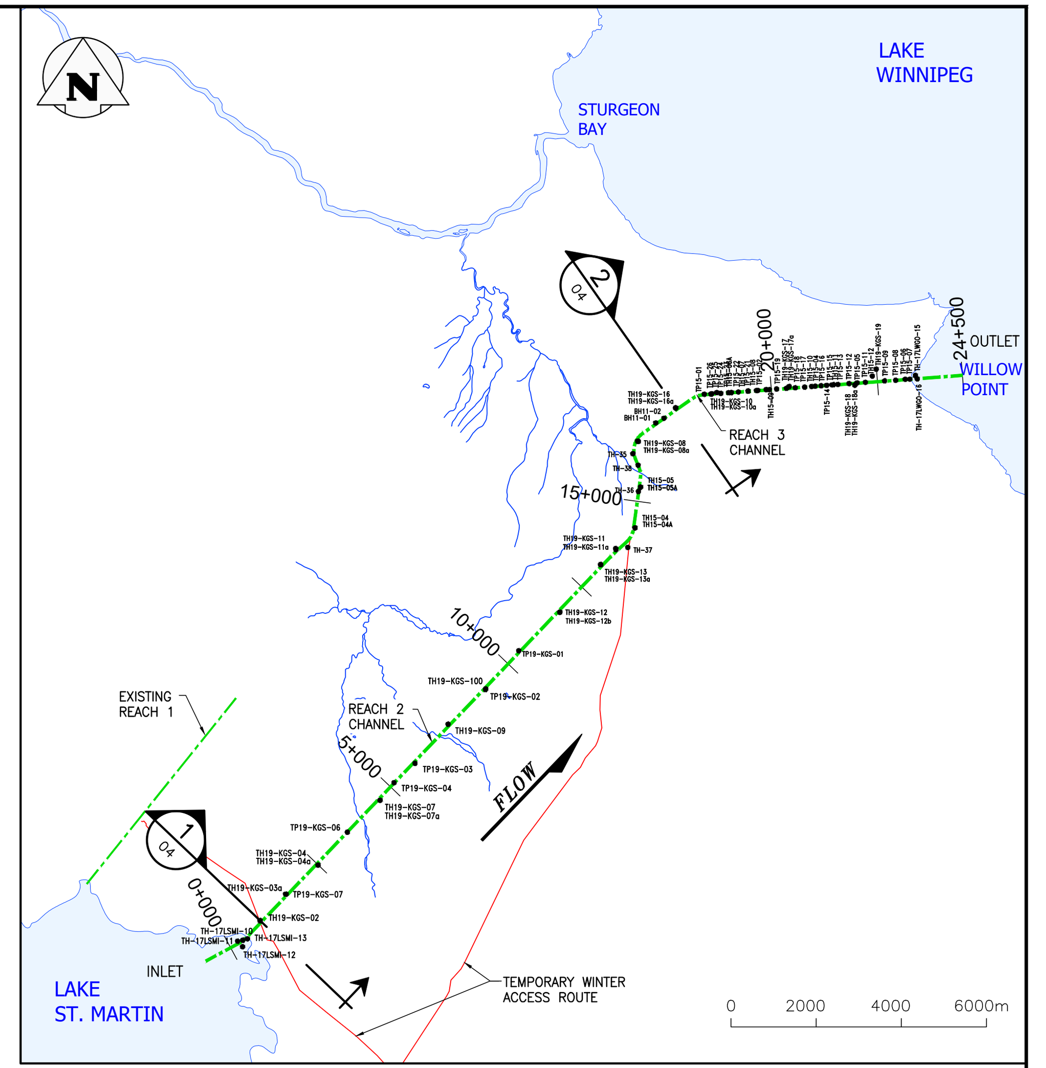
GROUNDWATER AND SURFACE WATER SAMPLING SITE LOCATION PLAN

JULY 2021 | FIGURE 1 | REV: 0

FileName: P:\Projects\2018\18-0300-005\Dwg\GIS\MXD\Detailed Design\Conceptual_Groundwater_Model_for_EIS\18-0300-005_Fig01.mxd
11"x17" PLOT SCALE 1:1

NOTES:

1. THE EXISTING GROUND SURFACE AT THE CHANNEL CENTRELINE WAS DERIVED FROM NUMEROUS DATA SOURCES INCLUDING:
   - JULY 2017 LIDAR DATA PROVIDED BY MI
   - MARCH 2019 TOPOGRAPHIC SURVEY INFILL BY KGS GROUP
   - 2017 BATHYMETRIC SURVEY PROVIDED BY MI (INLET)
   - 2013 AND 2018 BATHYMETRIC SURVEY PROVIDED BY NORTH/SOUTH CONSULTANTS INC. (INLET AND OUTLET)
2. THE ORIGINAL GROUND SURFACE AT THE CHANNEL CENTERLINE IN THE VICINITY OF THE EXISTING EMERGENCY REACH 3 CHANNEL WAS DERIVED FROM LIDAR DATA CAPTURED IN 2011.
3. THE PEAT SURFACE SHOWN IS BASED ON AVAILABLE PEAT PROBES, HAND AUGER TEST HOLES, TEST HOLES AND TEST PITS IN THE VICINITY OF THE CHANNEL. PEAT PROBES AND HAND AUGER TEST HOLES ARE NOT SHOWN ON THE PROFILE FOR CLARITY.
4. THE PIEZOMETRIC ELEVATIONS SHOWN ARE BASED ON READINGS COLLECTED IN MARCH 2019.
5. THE PIEZOMETRIC ELEVATION SHOWN FOR PW19-KGS-02 IS BASED ON A STATIC MEASUREMENT COLLECTED ON JUNE 11, 2019.
6. THE SEISMIC VELOCITY LAYERS SHOWN ARE BASED ON THE FOLLOWING GEOPHYSICAL SURVEYS:
   - 2011 – GEOPHYSICS GPR INTERNATIONAL INC.
   - FEBRUARY/MARCH 2019 – FRONTIER GEOSCIENCES INC.



KEY MAP

LEGEND:

- NO RECOVERY
- ICE
- WATER
- PEAT
- ORGANICS
- FILL
- CLAY
- SILTY CLAY
- CLAYEY SILT
- SILTY CLAY TO SILTY CLAY TILL
- SILTY CLAY TILL
- SAND
- SILTY SAND
- SAND AND GRAVEL
- COBBLE AND GRAVEL
- SILT
- SILT TILL
- BEDROCK (UNDIFFERENTIATED LIMESTONE

SL-8 SEISMIC LINE No. 8

BOTTOM OF PEAT (SEE NOTE 3)

SEISMIC REFRACTION SURVEY VELOCITY LAYERS (2011 AND 2019)

DRILL HOLE
VIBRATING WIRE PIEZOMETER
PIEZOMETRIC GROUNDWATER LEVEL (MARCH 2019)
GROUNDWATER MONITORING ZONE

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

2.5 0 2.5 5 7.5 10m
SCALE: 1:125 (24"x100") VERTICAL

250 0 250 500 750 1000m
SCALE: 1:12500 (24"x100") HORIZONTAL

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	DESIGN CHECK
A	19/09/30	ISSUED WITH DRAFT REPORT	SGB	RKe

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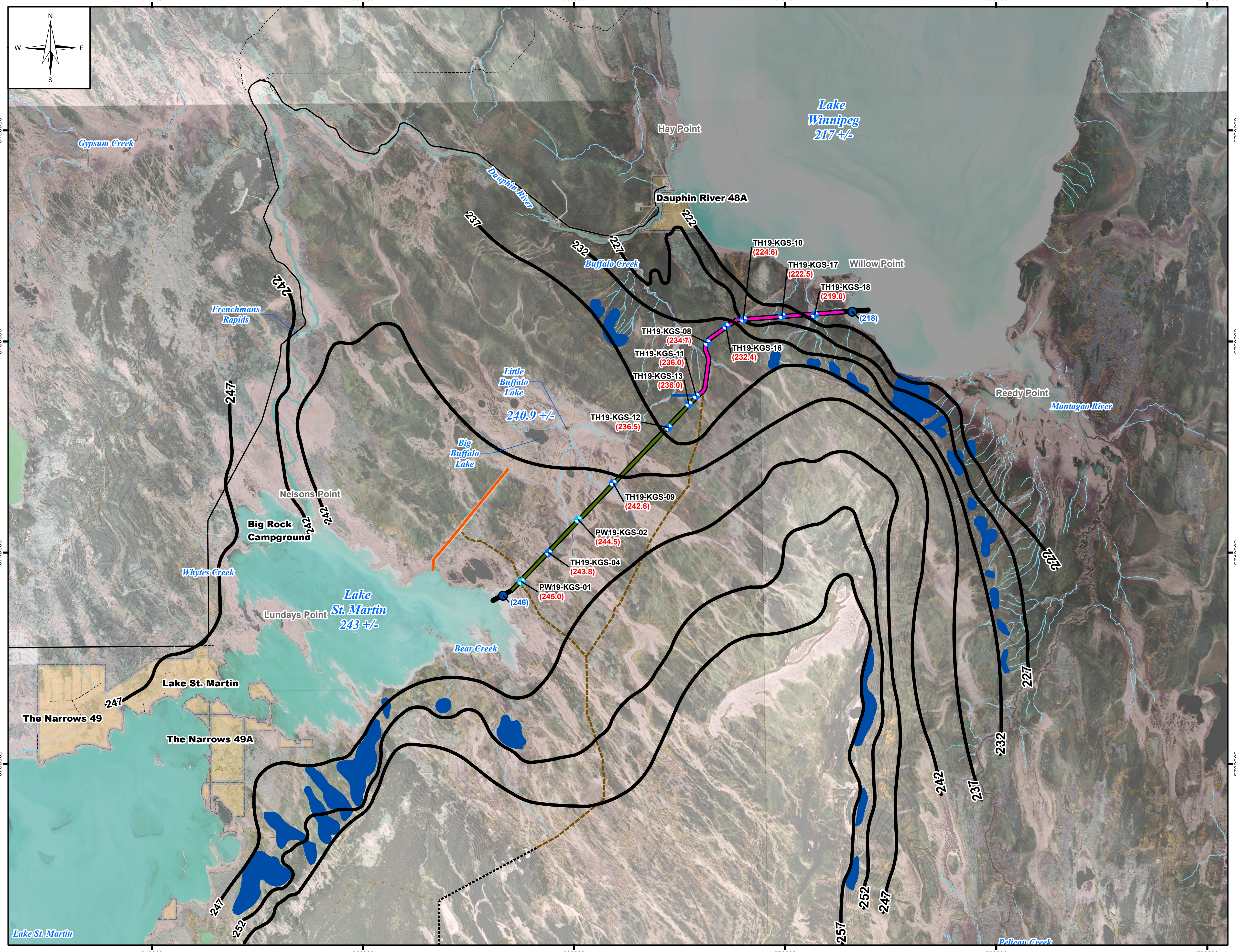
KGS GROUP CONSULTING ENGINEERS

Manitoba Infrastructure

LAKE ST. MARTIN OUTLET CHANNEL
PRELIMINARY DESIGN
GEOTECHNICAL DATA REPORT

STRATIGRAPHIC PROFILE ALONG CHANNEL CENTRELINE

SEPTEMBER 2019 | FIGURE 03 | REV: A



LEGEND:

- LSMOC Alignment
- Reach 1 Channel – Existing
- Proposed Reach 2 Alignment
- Reach 3 – Existing
- Reach 3 – Proposed
- Existing Transmission Line
- Existing Winter Access Road Alignment
- Forestry Road
- Highway
- Municipal Road
- Limited Use Road
- Trail
- Watercourse
- First Nation
- Artesian Groundwater Spring Sites
- (218) Bedrock Piezometric Pressure estimated during Inlet and Outlet Drilling Programs (by MI)
- (222.5) Bedrock Piezometric Pressure (June, 2019)

NOTE:
1. Instrumented Testholes include standpipes or standpipes and vibrating wire piezometers. See Geotechnical Data report for Details.
2. Wetland, Watercourse and Waterbody layers shown were obtained from NRCAN 1:50000 data.
3. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983 CSRS, Zone 14. Elevations are in metres above sea level (MSL) and are referencing Canadian Geodetic Vertical Datum 1928 (CGVD28).

DRAFT

2 0 2 4 6 8
Kilometres

SCALE: 1:175,000 METRIC 11"x17"

NO.	YY/MM/DD	DESCRIPTION	ISSUED BY	CHECK BY
A	19/10/23	ISSUED WITH DRAFT REPORT	AED	JDM

REVISIONS / ISSUE

KGS GROUP CONSULTING ENGINEERS

Manitoba Infrastructure

LAKE ST. MARTIN OUTLET CHANNEL PRELIMINARY DESIGN

REGIONAL ARTESIAN SPRING SITES AND BEDROCK AQUIFER PIEZOMETRIC PRESSURES

OCTOBER 2019 | FIGURE 05 | REV. A

FileName: P:\Projects\2018\18-0300-005\Dwg\GIS\MXD\Groundwater_Management_Plan\18-0300-005_Fig05.mxd
11"x17" PLOT SCALE 1:1

APPENDIX A

Background Studies

APPENDIX A-1

Lines of Evidence for Water Quality Associations

TABLE A-1-1
LINES OF EVIDENCE FOR WATER QUALITY ASSOCIATIONS - SPRINGS SITES

DATA SET	CHARACTERISTICS OF LOCATION	WATER QUALITY TABLES	WATER TYPES	BORON	FLUORIDE	STRONTIUM	DUROV PLOTS	STIFF DIAGRAMS	MAGNESIUM/ CALCIUM RATIO	SULPHATE/ CHLORIDE RATIO	STABLE ISOTOPES	ASSOCIATION WITHIN THE DATA SET
Springs East of Lake St. Martin (Leybourne et. al 1997)												
1070, 1087	Fens North of Dauphin River at Lake Wpg.		Mg-Ca-HCO_3	2nd highest including 1070 and 1083 0.131 - 0.146 mg/L	Highest group 0.742 - 0.715 mg/L	Highest group 0.260, 0.254 mg/L	Plots similar to Mantago Drainage	Plots similar to Mantago drainage	Most enriched group with 1094, 1029, rest of Mantago and 1083		-14.5 to -14.7 ^{18}O	Similar as shown by Durov, Stiff, Mg/Ca ratio Highest Sr and F; 2nd highest B
1083	Fen in upland of lower Buffalo Creek drainage	EC 1086 µS/cm highest	Mg-Na-Ca-HCO_3-SO_4- similar to 1022, but 1083 has greater sulphate proportion both are upland in discharge system.		High medium group 1022, 1029 and 1083 0.201 - 0.261 mg/L	Highest group 0.299 mg/L	Plots furthest southeast on plot due to higher SO_4, Cl and Na	Unique		Intermediate SO_4 to Cl ratio	-15.5 ^{18}O	Unique WQ Highest Sr and 2nd highest B
1022	Pool in upper Mantago River Drainage	EC similar to rest of Mantago Drainage Samples	Mg-Ca-HCO_3-SO_4	Highest 0.257 mg/L	1022,1029 and 1083 0.201 - 0.261 mg/L	Highest group 0.243 mg/L	Plots intermediate between Mantago drainage and 1083	Unique	Enriched in Mg, but less so than other samples	High SO_4 to Cl ratio	-10.2 ^{18}O indicates evaporative influence in the pool, which may explain the different water quality	Unique WQ may be due to evaporative influence in pool as shown by ^{18}O isotopes
1026, 1027, 1028, 1029, 1020,1096	Fens in Mantago River Drainage springs near Lake Wpg.		Mg-Ca-HCO_3	Third highest 1096, 1087, and 1022 0.104 mg/L and 0.107 mg/L	Low medium group except 1029 and 1022	Middle group: 0.152 - 0.178 mg/L	Plots similar to North of Dauphin River and Mantago Drainage	Plots similar to north of DRFN	Second most enriched group	High SO_4 to Cl ratio	-15 ^{18}O	Similar WQ
1090, 1091, 1092 pool, 1094	Fens and pool south of LSM. 1090, 1091 and 1092 within footprint of LSM impact structure, 1094 outside footprint	EC approx. 590 µS/cm lowest	Mg-Ca-HCO_3	Lowest 0.02 - 0.016 mg/L	1092 lowest 0.05 mg/L; rest are medium 0.128-0.174 mg/L including Mantago River springs (except 1029 and 1022)	Lowest group 0.049, 0.038, 0.092, and 0.045 mg/L	Plots furthest left, due to high bicarbonate and low chloride	Except for 1094 which has less sulphate and more Mg	1090, 1091, 1092 most enriched in Mg; 1094 next less enriched in Mg	1090, 1091, 1092 1:1 SO_4 to Cl	Slightly less depleted than in other areas. Could be from more recent recharge from high upland areas to south, or evaporative influence -13, -14 ^{18}O. Plot needed to examine.	Similar WQ; notably lowest conductivity B, Sr, F may be from more recent recharge from closeby upland areas

TABLE A-1-2
LINES OF EVIDENCE FOR WATER QUALITY ASSOCIATIONS - SURFACE WATER MONITORING

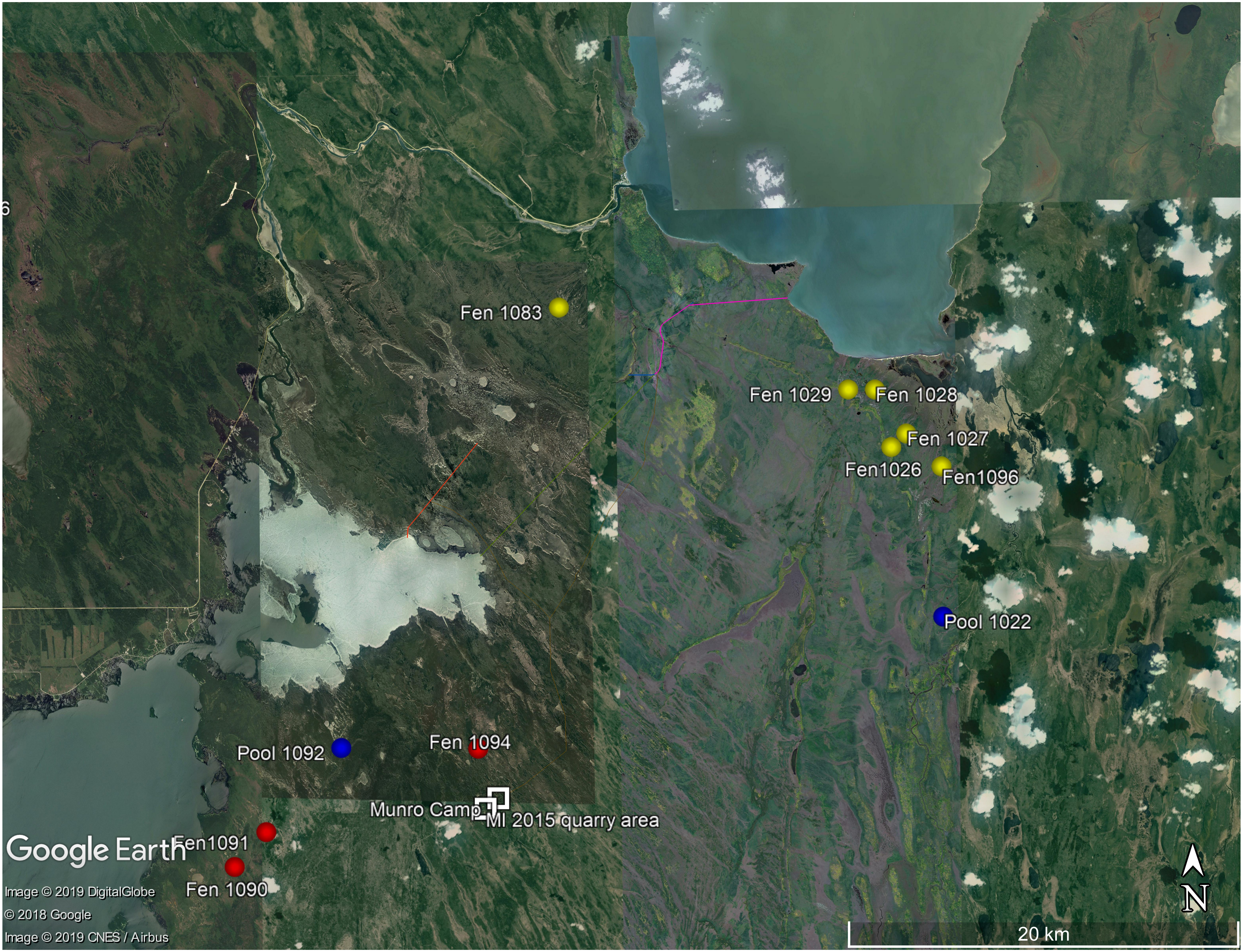
DATA SET	CHARACTERISTICS OF LOCATION	WATER QUALITY TABLES	WATER TYPES	BORON	FLUORIDE	STRONTIUM	DUROV PLOTS	STIFF DIAGRAMS	MAGNESIUM/ CALCIUM RATIO	SULPHATE/ CHLORIDE RATIO	STABLE ISOTOPES	ASSOCIATION WITHIN THE DATA SET
Lake St. Martin Surface Water Sampling May 2013												
LSM1, DR1, DR2C Lake St. Martin and Dauphin River	LSM near Reach 1 inlet side, DR1 Dauphin River at discharge of Buffalo Creek, DR2C Dauphin River at discharge to LWPG.	Elevated EC, hardness, alkalinity, chloride, sulphate, sodium and strontium	LSM 1, DR1, DR2C (Na-Mg-Cl-HCO_3)	LSM 0.101 mg/L	LSM 0.155 mg/L, DR1 0.177 mg/L, DR2C 0.140 mg/L	LSM1 0.337 mg/L, DR1 0.357 mg/L, DR2 0.326 mg/L	LSM, DR1, DR2	LSM, DR1, DR2	LSM, DR1, DR2 enriched in Mg	LSM DR1, DR2 strongly enriched in chloride	Not sampled	Lake St. Martin and Dauphin River are one water type
EC1, EC2 Upstream Buffalo Creek before Big Buffalo Lake (BBL)	Reach 1 Channel Sample	Elevated sulphate	EC1, EC2 (Mg-Ca-Na-HCO_3-SO_4)	No differences in B concentrations over the drainage. EC1 0.069 mg/L, EC2 0.059 mg/L	No differences in F concentrations over the drainage EC1, EC2, 0.18, 0.15 mg/L	EC1 0.148 mg/L, EC2 0.139 mg/L		EC1, EC2	EC1, EC2 enriched in Mg	EC2 1:1, EC1 enriched in sulphate	Not sampled	
BBL Big Buffalo Lake- May	Lake in bog discharge area. (note March sample was taken through the ice prior to spring melt and has residual channel discharge frozen from November 2012 operation and is not representative)		BBL (Mg-Ca-Na-HCO_3-Cl)	BBL 0.06 mg/L	BBL 0.11 mg/L	Strontium decreases along drainage from BBL 0.153 mg/L, BC1 0.117 mg/L	BBL plots with BC1 and BC3 for Ca-Mg-Na triangle, but with EC1 and EC2 on overall plot.	BBL plots with BC1 and BC3 for Stiff Diagrams			Not sampled	
BC1, BC3 Downstream of Big Buffalo Lake	BC3 is close to Dauphin River and gets a large GW discharge from springs along west end of Buffalo Creek. BC1 will get input from any GW discharge to BBL.		BC1, BC3 (Mg-Ca-Na-HCO_3) - Similar to BBL, but with less Cl	BC1 0.05 mg/L, BC3 0.04 mg/L	BC1 <0.1 mg/L, BC3 < 0.10 mg/L	BC3 0.0988 mg/L			BBL, BC1 and BC3 plot closer to 1:1	BBL, BC3 and BC1 enriched in Cl. BBL more than BC1 and BC3, as seen by greater Cl percentage in ion balance leading to water type having Cl in name.	Not sampled	BBL, BC3 and BC1 correspond based on 1 of 2 contributing plots in Durov, stiff diagram, magnesium/calcium ratio and sulphate to chloride ratio. BC3 receives a heavy groundwater discharge contribution from springs draining to the west part of Buffalo Creek, but does not look much different than BC1. This is evidence that BC1 receives groundwater discharge from upgradient BBL.

TABLE A-1-3
LINES OF EVIDENCE FOR WATER QUALITY ASSOCIATIONS - DAUPHIN RIVER FIRST NATION DOMESTIC WELL STUDY

DATA SET	CHARACTERISTICS OF LOCATION	WATER QUALITY TABLES	WATER TYPES	BORON	FLUORIDE	STRONTIUM	DUROV PLOTS	STIFF DIAGRAMS	MAGNESIUM/ CALCIUM RATIO	SULPHATE/ CHLORIDE RATIO	STABLE ISOTOPES	ASSOCIATION WITHIN THE DATA SET
Dauphin River First Nation 2011 Domestic Wells												
80, 98, 104/105	Furthest upriver - Artesian	Elevated EC approaches 100 µS/cm; Cl 64-72 mg/L; SO_4 146-159 mg/L, no nitrate, no elevated K. 80 has very high Fe: 2 mg/L. All wells have high Fe >0.3 mg/L. Na also elevated in 80, 98, 104/105 from 77 to 88 mg/L. Hardness (Ca/Mg) and alkalinity are uniform - not associated with the elevated EC, Cl, SO_4 parameters.	Mg-Na-Ca-HCO_3-SO_4	Not analyzed	0.22 to 0.51 mg/L	Not analyzed	Group together	Group together	All enriched in Mg	All enriched in sulphate vs chloride	Not sampled	Upriver wells
5	Closest to Lake Wpg	5 has more sodium and sulphate, but not other parameters	Mg-Ca- Na-HCO_3-SO_4 calcium dominant over sodium	Not analyzed		Not analyzed	Slightly different than 32/33, 34, and 35/6	Unique	All enriched in Mg	All enriched in sulphate vs chloride	Not sampled	Unique
67		67 has more sulphate, but not other parameters	Mg-Ca-Na-HCO_3 less sulphate	Not analyzed		Not analyzed	Slightly different than 32/33, 34, and 35/6	Unique	All enriched in Mg	All enriched in sulphate vs chloride	Not sampled	Unique
32/33, 34, 35/36			Mg-Ca-HCO_3	Not analyzed		Not analyzed	Group together	Group together	All enriched in Mg	All enriched in sulphate vs chloride	Not sampled	Group together

APPENDIX A-2

Lake St. Martin Outlet Channel Area – Springs Sites (Leybourne)



6
Fen 1083
Fen 1029
Fen 1028
Fen 1027
Fen1026
Fen1096
Pool 1022
Pool 1092
Fen 1094
Munro Camp
MI 2015 quarry area
Google Earth
Fen1091
Fen 1090
Image © 2019 DigitalGlobe
© 2018 Google
Image © 2019 CNES / Airbus
N
20 km

Fen 1066
Fen 1064
Fen 1060
Fen 1061
Fen1087
Fen1070
Fen 1076
Fen 1083
Fen 1029
Fen 1028
Fen 1027
30 km
N
Google Earth
© 2018 Google
Image Landsat / Copernicus

Table 1. Geochemical and stable isotopic data for representative tufa waters

Sample #	1002	1003	1005	1011	1014	1015	1016	1022	1026	1027	1028	1029	1031	1037	1042	1060	1061	1062	1064	1066	1070	1076	1083	1087	1090	1091	1092	1094	1096
Easting	505611	505791	507599	518117	511594	511594	516959	580719	578057	578830	577222	575854	480872	486137	481006	508005	508442	509967	508084	509015	559092	531287	561060	559991	544545	546161	549982	556971	580633
Northing	5857048	5857378	5847218	5832142	5832332	5832332	5822852	5735164	5743807	5744498	5745598	5746742	5943177	5923746	5906452	5798856	5800532	5801564	5803508	5810981	5773780	5755606	5750902	5773212	5722383	5724162	5728451	5728423	5742825
Class	C	C	P	P	Fs	P	Fs	P	Fs-EofG	Fs-EofG	Fs-EofG	Fs-EofG	Es	Es	Fs	Fs	Fs	Fs	Fs	Fs	Fs-EofG	Fs	Fs-EofG	Fs-EofG	Fs	Fs	P	Fs	Fs-EofG
T (°C)	15	16	17.3	16.9	5.8	20.7	5.4	19.4	6.3	6.3	5	15.4	7.4	4.9	4.9	4.5	4.4	4.8	4.8	4.8	4.3	4.9	3.7	4.7	13.9	5.4	20.4	5.3	4.9
EC (µS/cm)	261	280	430	371	660	425	614	662	670	684	666	610	497	521	556	552	578	577	600	524	788	672	1086	795	610	590	598	589	710
pH	7.88	7.7	8.71	7.75	7.97	8.15	7.82	8.26	7.39	7.54	7.4	7.64	7.56	7.62	7.61	7.74	7.44	7.3	7.52	7.56	7.23	7.56	7.47	7.4	7.69	7.65	7.8	7.7	7.42
mg/L																													
HCO3	185	195	307	260	464	325	425	325	409	414	409	379	326	349	364	366	382	379	397	338	530	449	396	540	424	418	434	381	424
SO4	0.21	2.14	3.39	2.34	5.47	3.57	10.1	119	38.4	51.6	40.7	36.3	6.58	9.62	8.23	7.82	8.33	9.56	6.02	4.93	20.40	10.60	209.00	21.60	7.95	5.81	0.62	16.90	63.10
Cl	0.94	2.3	1.32	1.38	2.53	1.73	2.31	3.19	2.06	2.45	2.13	2.05	1.56	1.39	3.71	2.19	1.88	1.86	1.73	1.80	4.68	2.41	46.60	4.15	1.97	1.82	2.25	2.06	2.80
µg/L																													
NO2	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
NO3	<50	216	184	<50	<50	165	<50	<50	<50	<50	<50	<50	395	449	<50	382	116	<50	454	<50	<50	<50	<50	<50	83	507	101	341	55
F	71	68	83	219	144	96	527	261	160	147	174	255	113	180	200	143	267	415	172	141	742	498	201	715	128	150	50	162	188
Br	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Ca	29300	33600	34400	40000	83600	55100	70000	64600	64000	66200	63400	59300	58100	57400	63800	53700	55700	58100	56800	57500	70500	54800	67400	72300	56100	53800	53800	58900	67900
Mg	20900	20100	41300	30500	47200	36000	46600	45000	51300	52200	51700	46400	34900	39500	38800	44500	47000	44300	47700	36600	63500	56500	62000	64400	54500	53300	56900	44300	52900
Na	2290	3790	3200	3030	3280	2800	4970	33200	8980	12100	9590	8890	740	910	4020	1940	1060	1850	2420	1530	15300	6230	86000	15200	1700	940	1700	4210	14700
K	990	570	1200	1060	1400	1160	2520	4510	3540	4180	3840	3570	500	730	1450	1070	1200	2450	1440	1030	5510	3910	5290	5230	1120	1120	1370	2060	4470
Si	6250	4570	5690	4650	5130	4810	4480	4790	4180	4090	4120	3680	2270	2320	3220	3690	3150	4490	3960	3630	4560	4430	4480	4590	3590	2880	4910	4080	4200
Al	12	21	1.5	4.6	<0.5	0.9	0.9	7.6	1.1	<0.5	22	1.2	<0.5	<0.5	3.2	0.8	6.7	1.1	<0.5	<0.5	1.5	<0.5	<0.5	0.8	0.5	<0.5	0.5	1.5	0.5
Fe	92	90	<3	25	<3	<3	<3	73	94	54	130	58	<3	<3	<3	<3	<3	71	<3	<3	259	<3	255	126	<3	<3	39	<3	98
Mn	26	26	0.2	2.7	<0.2	0.8	0.4	4.8	8.9	9.9	7	4.3	<0.2	<0.2	27	<0.2	<0.2	14	<0.2	0.2	16.0	0.2	6.4	21.0	7.7	<0.2	13.0	<0.2	24.0
As	1.1	1.3	<0.5	0.8	<0.5	<0.5	<0.5	1.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	1.6	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
B	19	44	<16	36	<16	32	48	257	75	107	54	44	<16	36	24	<16	<16	51	36	<16	131	76	146	104	<16	<16	26	25	105
Ba	12	14	35	42	90	61	150	14	50	35	43	49	94	100	190	33	62	110	50.0	33.0	96.0	92.0	12.0	84.0	32.0	62.0	32.0	42.0	31.0
Cd	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Co	0.07	0.06	<0.02	<0.02	<0.02	<0.02	<0.02	0.06	0.37	0.31	0.21	0.05	<0.02	<0.02	0.13	<0.02	<0.02	0.54	<0.02	<0.02	0.19	<0.02	0.12	0.12	<0.02	<0.02	0.05	<0.02	0.44
Cr	0.5	0.5	0.3	0.2	<0.2	<0.2	<0.2	0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	19.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cs	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cu	0.3	0.4	0.1	<0.1	<0.1	<0.1	3.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.4	<0.1	<0.1	0.2	0.2	<0.1	<0.1	<0.1	<0.1	2.5	<0.1	<0.1	0.1	0.2
Ga	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mo	0.04	0.09	0.35	0.37	1.38	0.85	1.38	<0.03	0.18	0.14	0.21	0.32	0.32	0.34	0.32	0.39	0.24	0.25	0.47	0.83	0.08	0.50	0.43	0.05	0.08	0.19	<0.03	0.22	0.09
Ni	0.6	0.9	<0.5	0.5	1.2	0.7	0.8	1	1.6	1.6	1.4	1.1	1.1	1.1	2.7	<0.5	<0.5	1.1	0.5	0.6	1.2	<0.5	0.9	0.9	<0.5	<0.5	<0.5	0.5	1.2
Pb	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.5	<0.2	<0.2	<0.2	<0.2	0.4	<0.2	<0.2	<0.2
Rb	1.4	1.7	1	1	0.9	0.9	1.5	3.1	2.4	2.5	2.4	2.3	0.9	1.1	1.4	1.5	1.4	1.6	1.2	1.2	3.5	4.0	3.3	3.3	2.0	2.6	1.8	2.2	2.8
Sb	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Sc	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.8	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2
Se	2	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	3	<2	<2	<2	<2
Sr	39	52	43	70	74	56	138	243	165	178	169	152	26	36	55	46	57	128	66	34	260	161	299	254	49	38	45	92	192
Th	0.017	0.013	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.016	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Ti	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	1.0	<.5	<.5	<.5	<.5	<.5	<.5	<.5
Tl	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
U	0.042	0.089	0.947	0.034	2.134	1.062	0.05	0.058	0.165	0.129	0.091	0.066	0.656	0.817	0.445	1.107	0.629	0.49	1.370	1.216	0.178	2.676	0.250	0.326	0.736	0.683	0.098	1.116	0.161
V	0.46	0.4	0.04	0.02	0.03	0.06	0.02	0.07	0.03	0.02	0.02	0.01	0.07	0.04	0.03	0.05	0.06	0.02	0.08	0.05	0.07	0.27	<0.01	<0.01	0.04	<0.01	0.03	0.02	<0.01
Y	0.073	0.061	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Zn	<2	<2	<2	<2	2	<2	2	<2	<2	<2	<2	<2	2	2	4	<2	<2	<2	<2	<2	2	<2	<2	<2	<2	2	<2	<2	<2
‰																													
$\delta18O_{VSMOW}$	-11.53	-13.21	-11.36	-14.88	-15.91	-15.08	-15.52	-10.77	-15.16	-15.12	-15.07	-14.73	-16.09	-16.37	-15.22	-16.19	-15.81	-15.95	-15.82	-15.35	-14.53	-14.66	-15.41	-14.71	-14.21	-14.67	-12.73	-14.22	-15.09
$\delta2H_{VSMOW}$	-92.4	-98.8	-104.7	-116.8	-123.9	-117.5	-110.4	-85.3	-115.6	-114.9	-115.4	-112.7	-125.1	-125	-118.9	-113.2	-117.5	-114.2	-120.2	-116.3	-109.3	-113.3	-117.8	-111.1	-99.8	-111.0	-91.9	-108.3	-111.3
$\delta13C_{DIC}$	-8.94	-11.68	-8.61	-10.79	-12.24	-11.22		-9.57	-10.28	-9.81	-10.13	-9.79	-12.44	-11.79	-12.32	-11.56	-11.67	-10.58	-11.93	-12.36	-10.74	-10.63	-10.11	-10.63	-10.96	-11.38	-10.71	-11.23	-9.67
$SI_{calcite}$	0.05	-0.04	1.09	0.2	0.76	0.85	0.5	0.94	0.02	0.18	0	0.35	0.11	0.14	0.19	0.24	-0.03	-0.14	0.08	0.07	-0.03	0.15	-0.01	0.16	0.4	0.21	0.59	0.26	0.06
$SI_{dolomite}$	0.16	-0.07	2.52	0.52	1.3	1.81	0.85	2.01	-0.01	0.31	-0.06	0.81	0.06	0.14	0.18	0.41	-0.12	-0.39	0.1	-0.04	-0.11	0.32	-0.05	0.28	0.98	0.45	1.51	0.43	0.02
P_{CO2}	-2.68	-2.47	-3.33	-2.4	-2.44	-2.7	-2.33	-2.83	-1.91	-2.05	-1.92	-2.14	-2.16	-2.21	-2.18	-2.31	-1.99	-1.85	-2.05	-2.16	-1.65	-2.04	-2.02	-1.81	-2.15	-2.16	-2.22	-2.25	-1.93

C, creek; P, pool; Es, Escarpment spring; Fs, fen spring; Fs-EofG, fen spring east of Gypsumville

Sample Summary Report Leybourne 1997

Sample ID	1022			
Sample Date	8/31/1997			
Station	1022			
Location				
Geology				
Watertype	Mg-Ca-HCO3-SO4			
Temperature (°C)	19.4			
pH	8.26			
Conductivity	662	uS/cm		
Sum of Anions	7.933835	meq/L		
Sum of Cations	8.492052	meq/L		
Balance	3.398398	%		
Total dissolved solids	595.3298	mg/L		
Total hardness		mg/l CaCO3		
Alkalinity	5.326372	mg/l CaCO3		
Major ion composition	mg/l	mmol/l	meq/l	
Na	33.2	1.444121	1.444121	
K	4.51	0.1153503	0.1153503	
Ca	64.6	1.611857	3.223714	
Mg	45	1.851471	3.702942	
Cl	3.19	8.997904E-02	8.997904E-02	
SO4	119	1.239583	2.479167	
NO3	<0.05	<8.064516E-04	<8.064516E-04	
HCO3	325	5.326372	5.326372	
Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.435556	0.8705819	0.319	0.194
Ca/SO4	0.5428571	1.300322	0.152	0.364
Na/Cl	10.40752	16.04952	0.556	0.858
Cl/Br			287	648

Sample Summary Report **Leybourne 1997**

Sample ID	1026	
Sample Date	8/31/1997	
Station	1026	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)	6.3	
pH	7.39	
Conductivity	670	uS/cm
Sum of Anions	7.577306	meq/L
Sum of Cations	7.901093	meq/L
Balance	2.091865	%
Total dissolved solids	577.7889	mg/L
Total hardness		mg/l CaCO3
Alkalinity	6.703034	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	8.98	0.3906085	0.3906085
K	3.54	9.054102E-02	9.054102E-02
Ca	64	1.596886	3.193772
Mg	51.3	2.110677	4.221354
Cl	2.06	5.810558E-02	5.810558E-02
SO4	38.4	0.4	0.8000001
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	409	6.703034	6.703034

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.247563	0.7565754	0.319	0.194
Ca/SO4	1.666667	3.992215	0.152	0.364
Na/Cl	4.359223	6.722392	0.556	0.858
Cl/Br			287	648

Sample Summary Report — Leybourne 1997

Sample ID	1027	
Sample Date	8/31/1997	
Station	1027	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)	6.3	
pH	7.54	
Conductivity	684	uS/cm
Sum of Anions	7.947526	meq/L
Sum of Cations	8.237134	meq/L
Balance	1.789398	%
Total dissolved solids	603.2568	mg/L
Total hardness		mg/l CaCO3
Alkalinity	6.784978	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	12.1	0.5263211	0.5263211
K	4.18	0.10691	0.10691
Ca	66.2	1.651779	3.303558
Mg	52.2	2.147706	4.295413
Cl	2.45	6.910615E-02	6.910615E-02
SO4	51.6	0.5375	1.075
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	414	6.784978	6.784978

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.268199	0.7690898	0.319	0.194
Ca/SO4	1.282946	3.073077	0.152	0.364
Na/Cl	4.938776	7.616124	0.556	0.858
Cl/Br			287	648

Sample Summary Report Leybourne 1997

Sample ID	1028	
Sample Date	8/31/1997	
Station	1028	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)	5	
pH	7.4	
Conductivity	666	uS/cm
Sum of Anions	7.625991	meq/L
Sum of Cations	7.938194	meq/L
Balance	2.005906	%
Total dissolved solids	580.8571	mg/L
Total hardness		mg/l CaCO3
Alkalinity	6.703034	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	9.59	0.4171421	0.4171421
K	3.84	9.821399E-02	9.821399E-02
Ca	63.4	1.581915	3.163831
Mg	51.7	2.127134	4.254269
Cl	2.13	6.008005E-02	6.008005E-02
SO4	40.7	0.4239584	0.8479167
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	409	6.703034	6.703034

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.226306	0.7436838	0.319	0.194
Ca/SO4	1.55774	3.731299	0.152	0.364
Na/Cl	4.502347	6.943105	0.556	0.858
Cl/Br			287	648

Sample Summary Report — Leybourne 1997

Sample ID	1029	
Sample Date	8/31/1997	
Station	1029	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)	15.4	
pH	7.64	
Conductivity	610	uS/cm
Sum of Anions	7.043741	meq/L
Sum of Cations	7.259716	meq/L
Balance	1.509948	%
Total dissolved solids	536.0643	mg/L
Total hardness		mg/l CaCO3
Alkalinity	6.21137	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	8.89	0.3866937	0.3866937
K	3.57	9.130832E-02	9.130832E-02
Ca	59.3	1.479615	2.95923
Mg	46.4	1.909072	3.818145
Cl	2.05	5.782352E-02	5.782352E-02
SO4	36.3	0.378125	0.75625
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	379	6.21137	6.21137

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.278017	0.7750439	0.319	0.194
Ca/SO4	1.633609	3.913031	0.152	0.364
Na/Cl	4.336586	6.687482	0.556	0.858
Cl/Br			287	648

Sample Summary Report Leybourne 1997

Sample ID	1070	
Sample Date	8/31/1997	
Station	1070	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)	4.3	
pH	7.23	
Conductivity	788	uS/cm
Sum of Anions	9.295071	meq/L
Sum of Cations	9.557758	meq/L
Balance	1.39336	%
Total dissolved solids	711.185	mg/L
Total hardness		mg/l CaCO3
Alkalinity	8.686084	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	15.3	0.6655134	0.6655134
K	5.51	0.1409269	0.1409269
Ca	70.5	1.75907	3.51814
Mg	63.5	2.612631	5.225262
Cl	4.68	0.1320069	0.1320069
SO4	20.4	0.2125	0.425
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	530	8.686084	8.686084

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.110236	0.6732944	0.319	0.194
Ca/SO4	3.455882	8.277976	0.152	0.364
Na/Cl	3.269231	5.041506	0.556	0.858
Cl/Br			287	648

Sample Summary Report   Leybourne 1997

Sample ID	1083	
Sample Date	8/31/1997	
Station	1083	
Location		
Geology		
Watertype	Mg-Na-Ca-HCO3-SO4	
Temperature (°C)	3.7	
pH	7.47	
Conductivity	1086	uS/cm
Sum of Anions	12.18347	meq/L
Sum of Cations	12.3486	meq/L
Balance	0.6731293	%
Total dissolved solids	873.0044	mg/L
Total hardness		mg/l CaCO3
Alkalinity	6.48998	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	86	3.740794	3.740794
K	5.29	0.1353	0.1353
Ca	67.4	1.681721	3.363441
Mg	62	2.550915	5.101831
Cl	46.6	1.314427	1.314427
SO4	209	2.177083	4.354167
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	396	6.48998	6.48998

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.087097	0.6592616	0.319	0.194
Ca/SO4	0.322488	0.772465	0.152	0.364
Na/Cl	1.845494	2.84595	0.556	0.858
Cl/Br			287	648

Sample Summary Report   Leybourne 1997

Sample ID	1087	
Sample Date	8/31/1997	
Station	1087	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)	4.7	
pH	7.4	
Conductivity	795	uS/cm
Sum of Anions	9.465091	meq/L
Sum of Cations	9.71	meq/L
Balance	1.277226	%
Total dissolved solids	724.108	mg/L
Total hardness		mg/l CaCO3
Alkalinity	8.849972	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	15.2	0.6611636	0.6611636
K	5.23	0.1337654	0.1337654
Ca	72.3	1.803982	3.607965
Mg	64.4	2.649661	5.299321
Cl	4.15	0.1170574	0.1170574
SO4	21.6	0.225	0.45
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	540	8.849972	8.849972

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.122671	0.6808352	0.319	0.194
Ca/SO4	3.347222	8.017699	0.152	0.364
Na/Cl	3.662651	5.648202	0.556	0.858
Cl/Br			287	648

Sample Summary Report Leybourne 1997

Sample ID	1090	
Sample Date	8/31/1997	
Station	1090	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)	13.9	
pH	7.69	
Conductivity	610	uS/cm
Sum of Anions	7.179615	meq/L
Sum of Cations	7.388671	meq/L
Balance	1.435013	%
Total dissolved solids	547.6557	mg/L
Total hardness		mg/l CaCO3
Alkalinity	6.948867	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	1.7	7.394593E-02	7.394593E-02
K	1.12	2.864575E-02	2.864575E-02
Ca	56.1	1.39977	2.799541
Mg	54.5	2.242337	4.484674
Cl	1.97	5.556699E-02	5.556699E-02
SO4	7.95	0.0828125	0.165625
NO3	0.083	1.33871E-03	1.33871E-03
HCO3	424	6.948867	6.948867

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.029358	0.6242462	0.319	0.194
Ca/SO4	7.056604	16.90289	0.152	0.364
Na/Cl	0.8629442	1.330753	0.556	0.858
Cl/Br			287	648

Sample Summary Report Leybourne 1997

Sample ID	1091	
Sample Date	8/31/1997	
Station	1091	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)	5.4	
pH	7.65	
Conductivity	590	uS/cm
Sum of Anions	7.040464	meq/L
Sum of Cations	7.142004	meq/L
Balance	0.715955	%
Total dissolved solids	535.5632	mg/L
Total hardness		mg/l CaCO3
Alkalinity	6.850534	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	0.94	4.088775E-02	4.088775E-02
K	1.12	2.864575E-02	2.864575E-02
Ca	53.8	1.342382	2.684765
Mg	53.3	2.192964	4.385929
Cl	1.82	0.051336	0.051336
SO4	5.81	6.052084E-02	0.1210417
NO3	0.507	8.177419E-03	8.177419E-03
HCO3	418	6.850534	6.850534

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.009381	0.6121315	0.319	0.194
Ca/SO4	9.259896	22.1805	0.152	0.364
Na/Cl	0.5164835	0.7964732	0.556	0.858
Cl/Br			287	648

Sample Summary Report — Leybourne 1997

Sample ID	1092	
Sample Date	8/31/1997	
Station	1092	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)	20.4	
pH	7.8	
Conductivity	598	uS/cm
Sum of Anions	7.195802	meq/L
Sum of Cations	7.477881	meq/L
Balance	1.922345	%
Total dissolved solids	550.907	mg/L
Total hardness		mg/l CaCO3
Alkalinity	7.112755	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	1.7	7.394593E-02	7.394593E-02
K	1.37	3.503989E-02	3.503989E-02
Ca	53.8	1.342382	2.684765
Mg	56.9	2.341082	4.682164
Cl	2.25	6.346484E-02	6.346484E-02
SO4	0.62	6.458334E-03	1.291667E-02
NO3	0.101	1.629032E-03	1.629032E-03
HCO3	434	7.112755	7.112755

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9455184	0.5734025	0.319	0.194
Ca/SO4	86.77419	207.8528	0.152	0.364
Na/Cl	0.7555556	1.165148	0.556	0.858
Cl/Br			287	648

Sample Summary Report　　Leybourne 1997

Sample ID	1094	
Sample Date	8/31/1997	
Station	1094	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)	5.3	
pH	7.7	
Conductivity	589	uS/cm
Sum of Anions	6.670675	meq/L
Sum of Cations	6.823141	meq/L
Balance	1.129894	%
Total dissolved solids	510.0922	mg/L
Total hardness		mg/l CaCO3
Alkalinity	6.244147	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	4.21	0.1831249	0.1831249
K	2.06	5.268771E-02	5.268771E-02
Ca	58.9	1.469634	2.939269
Mg	44.3	1.82267	3.64534
Cl	2.06	5.810558E-02	5.810558E-02
SO4	16.9	0.1760417	0.3520833
NO3	0.341	0.0055	0.0055
HCO3	381	6.244147	6.244147

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.329571	0.8063084	0.319	0.194
Ca/SO4	3.485207	8.348219	0.152	0.364
Na/Cl	2.043689	3.151589	0.556	0.858
Cl/Br			287	648

Sample Summary Report Leybourne 1997

Sample ID	1096	
Sample Date	8/31/1997	
Station	1096	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)	4.9	
pH	7.42	
Conductivity	710	uS/cm
Sum of Anions	8.362923	meq/L
Sum of Cations	8.500855	meq/L
Balance	0.8179234	%
Total dissolved solids	630.465	mg/L
Total hardness		mg/l CaCO3
Alkalinity	6.948867	mg/l CaCO3

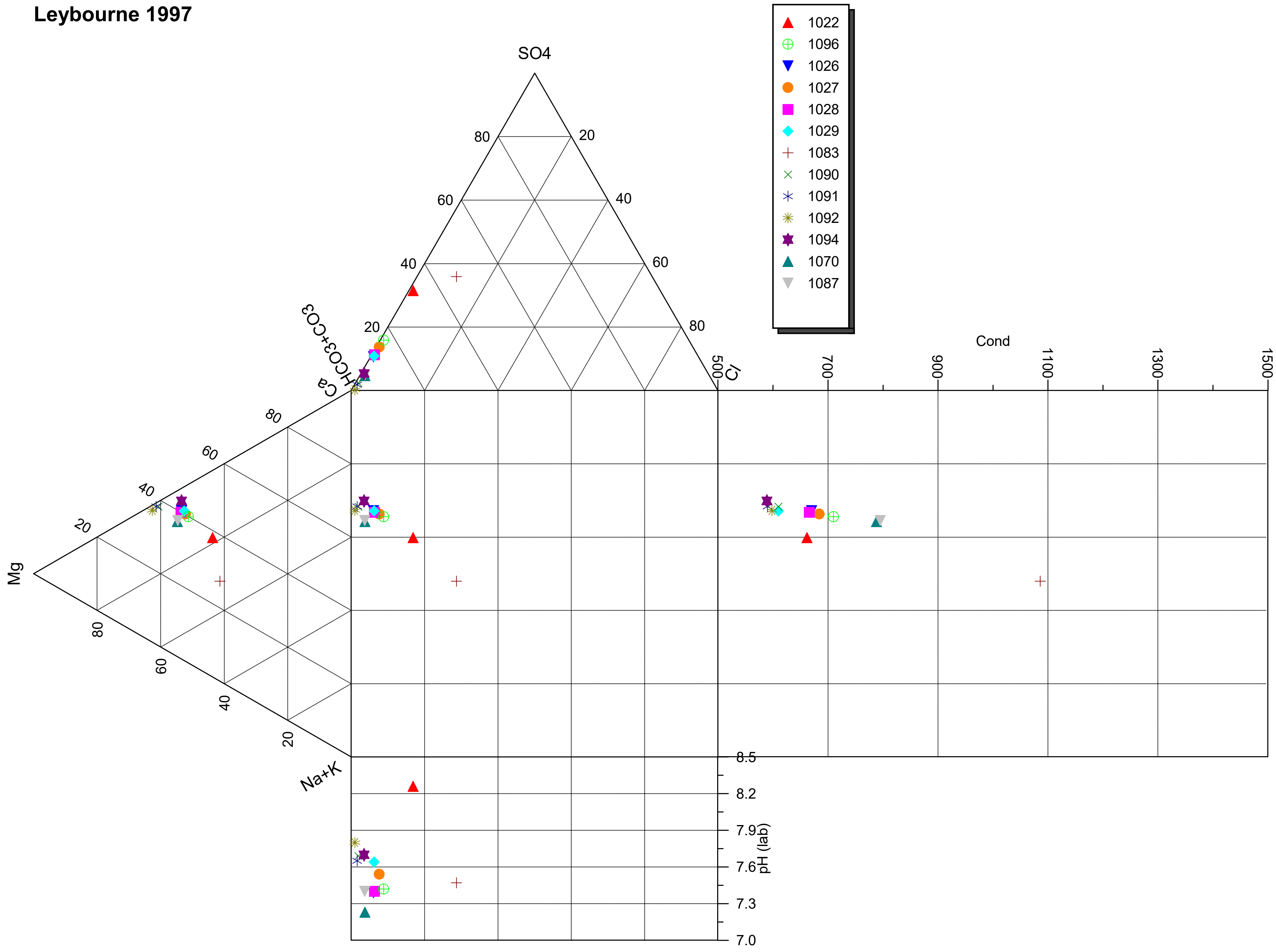
Major ion composition	mg/l	mmol/l	meq/l
Na	14.7	0.6394148	0.6394148
K	4.47	0.1143272	0.1143272
Ca	67.9	1.694196	3.388393
Mg	52.9	2.176507	4.353014
Cl	2.8	7.897846E-02	7.897846E-02
SO4	63.1	0.6572917	1.314583
NO3	0.055	8.870967E-04	8.870967E-04
HCO3	424	6.948867	6.948867

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.283554	0.7784016	0.319	0.194
Ca/SO4	1.07607	2.577541	0.152	0.364
Na/Cl	5.25	8.096066	0.556	0.858
Cl/Br			287	648

Leybourne Area 1997

Station	Date	Sample ID	Watertype			
1022	1997-08-31	1022	Mg-Ca-HCO3-SO4		45	FALSE
1026	1997-08-31	1026	Mg-Ca-HCO3		46	FALSE
1027	1997-08-31	1027	Mg-Ca-HCO3		47	FALSE
1028	1997-08-31	1028	Mg-Ca-HCO3		48	FALSE
1029	1997-08-31	1029	Mg-Ca-HCO3		49	FALSE
1070	1997-08-31	1070	Mg-Ca-HCO3		56	FALSE
1083	1997-08-31	1083	Mg-Na-Ca-HCO3-SO4		50	FALSE
1087	1997-08-31	1087	Mg-Ca-HCO3		57	FALSE
1090	1997-08-31	1090	Mg-Ca-HCO3		51	FALSE
1091	1997-08-31	1091	Mg-Ca-HCO3		52	FALSE
1092	1997-08-31	1092	Mg-Ca-HCO3		53	FALSE
1094	1997-08-31	1094	Mg-Ca-HCO3		54	FALSE
1096	1997-08-31	1096	Mg-Ca-HCO3		55	FALSE

Leybourne 1997



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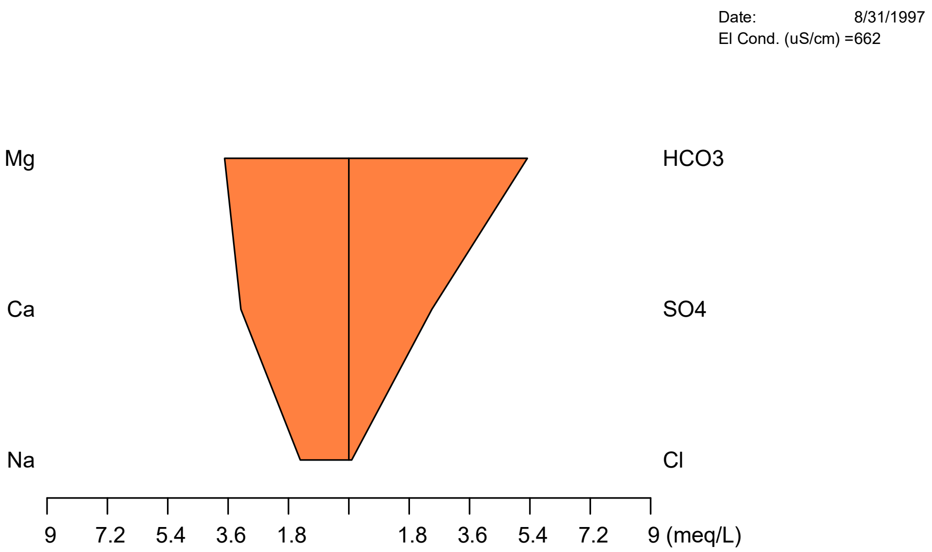

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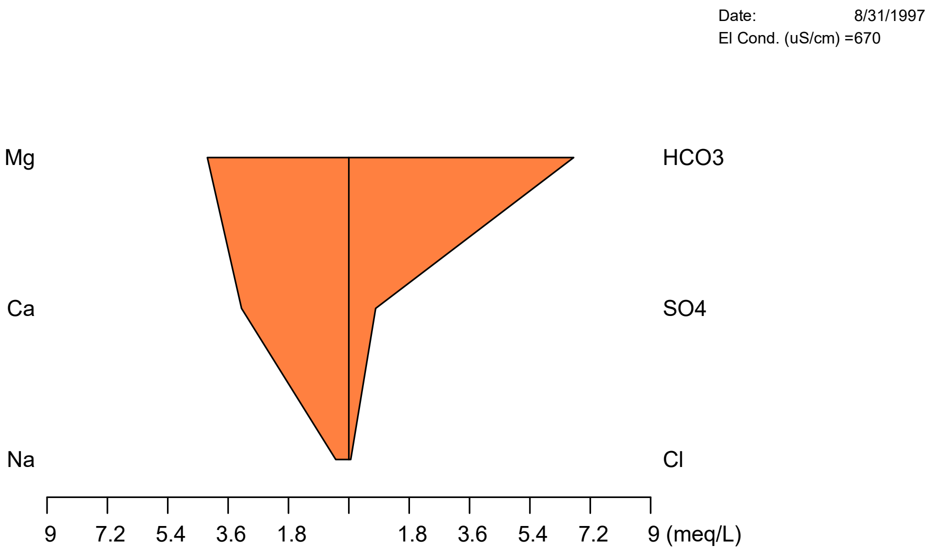
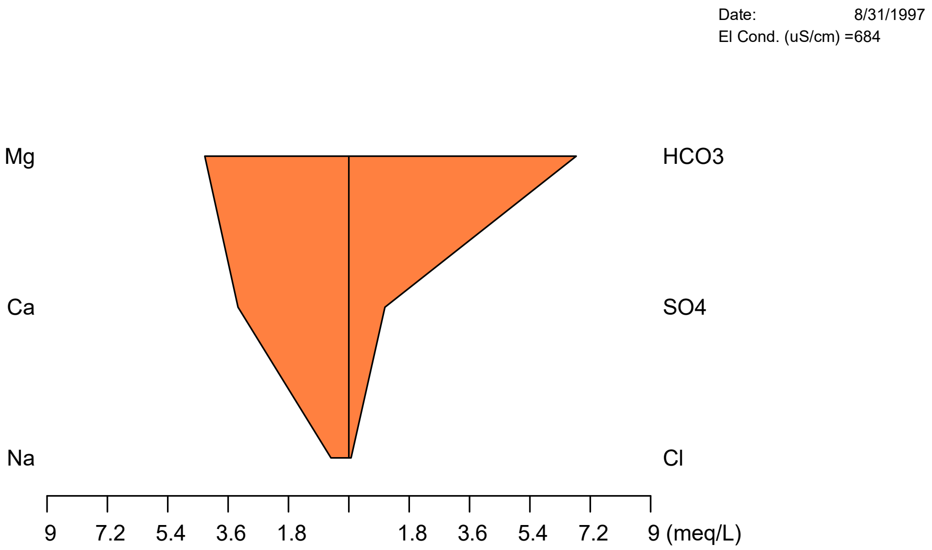
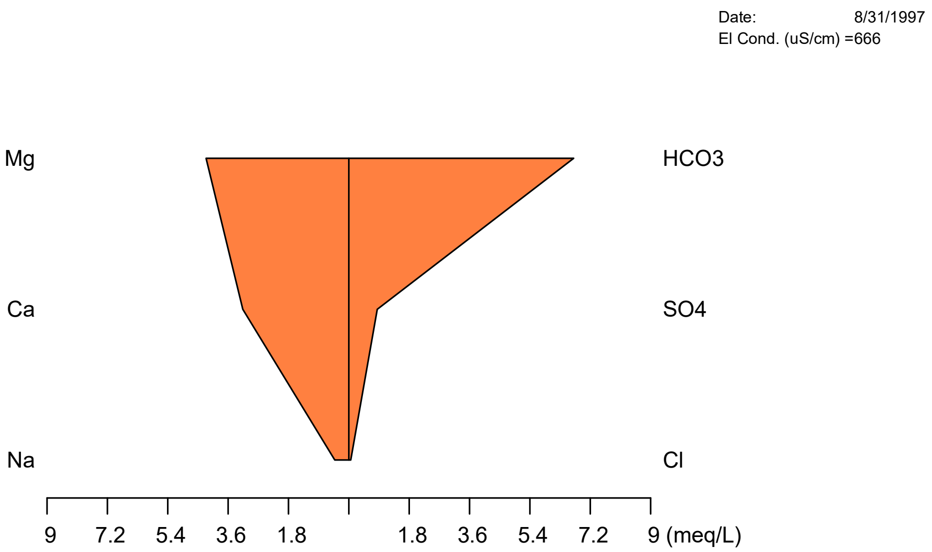


1027,8/31/1997



1028,8/31/1997



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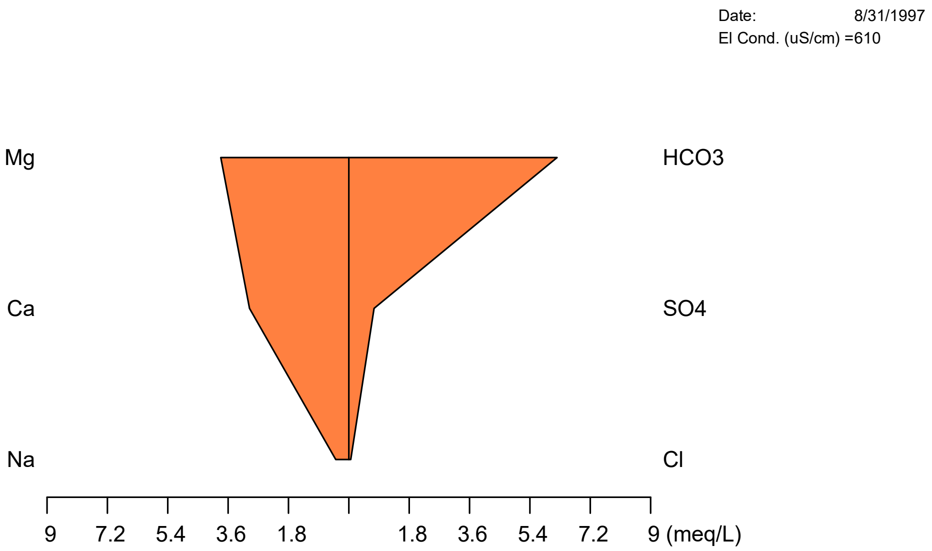
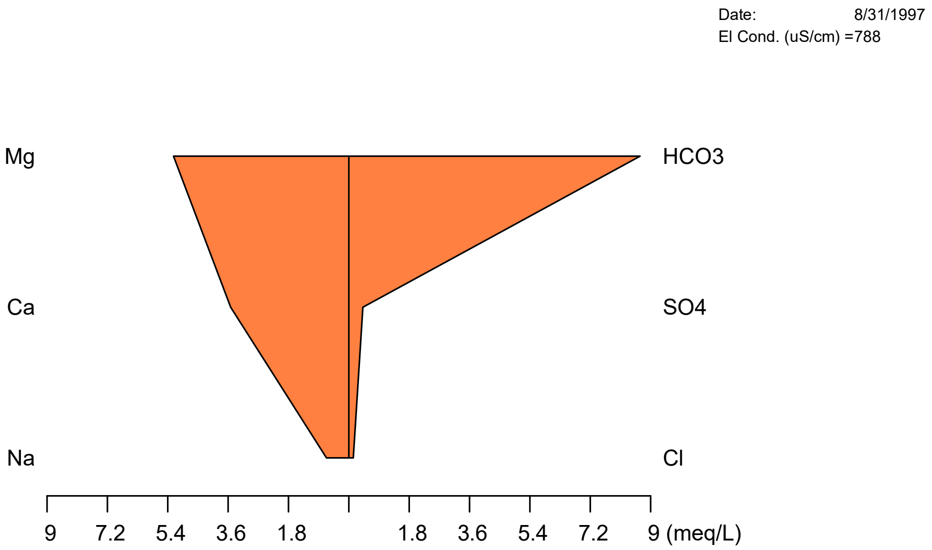


1070,8/31/1997



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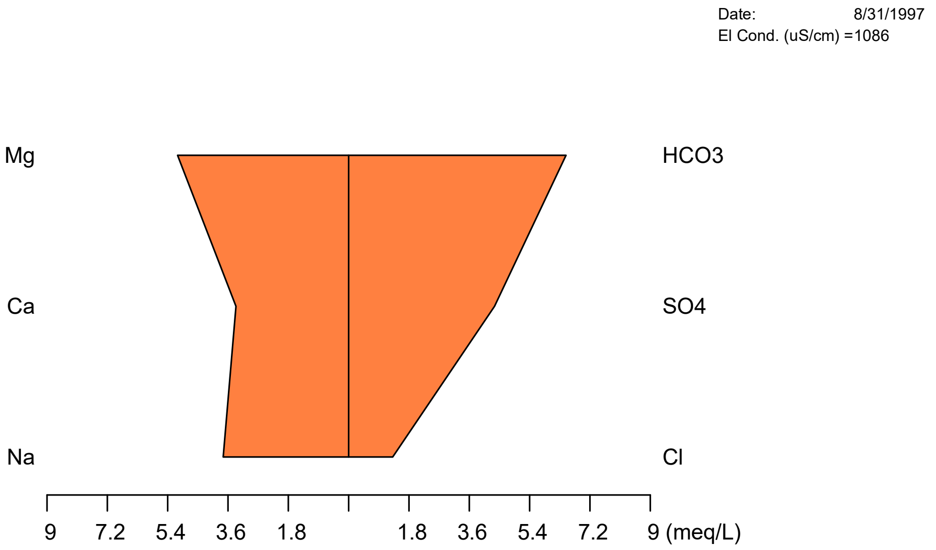
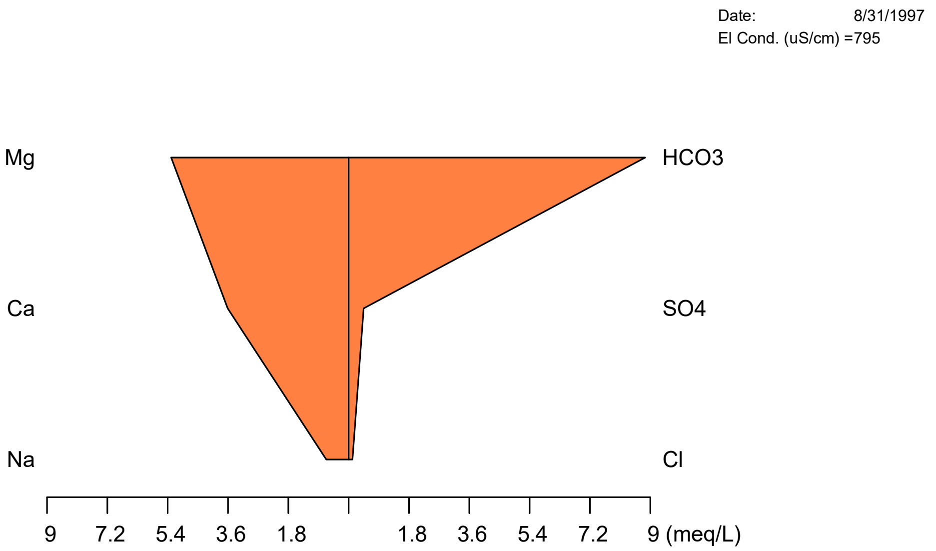


1087,8/31/1997



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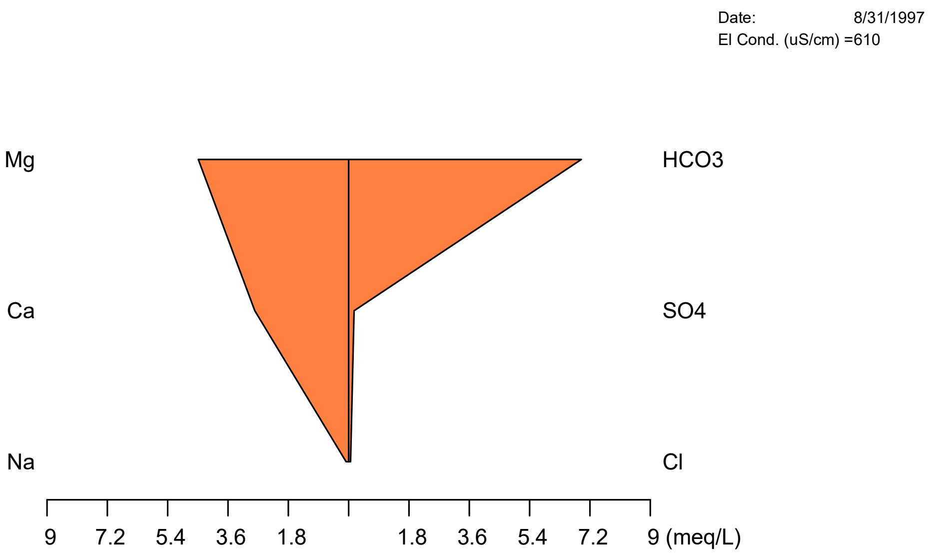

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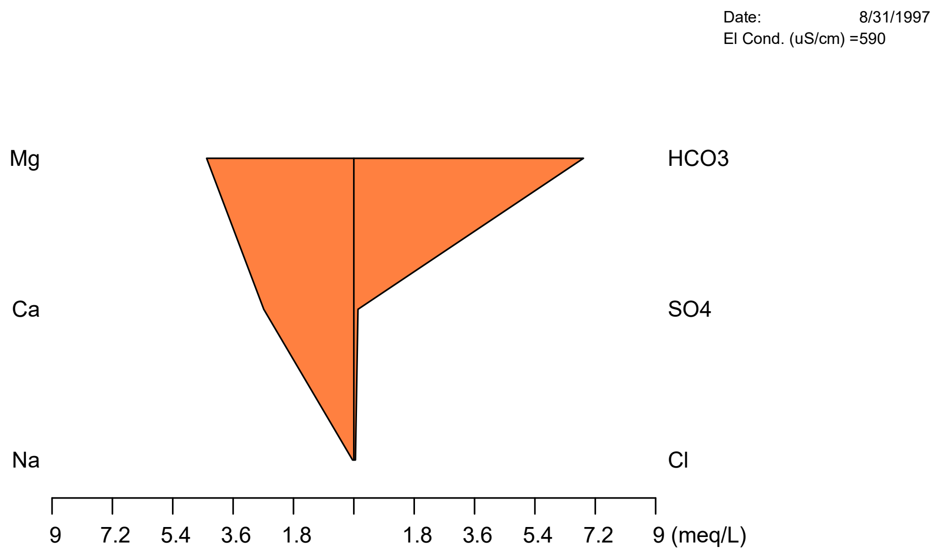

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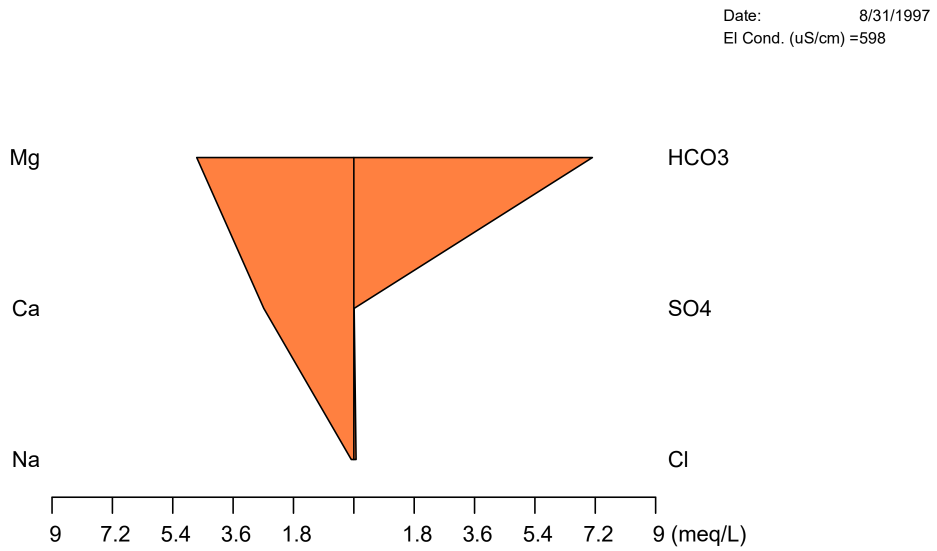
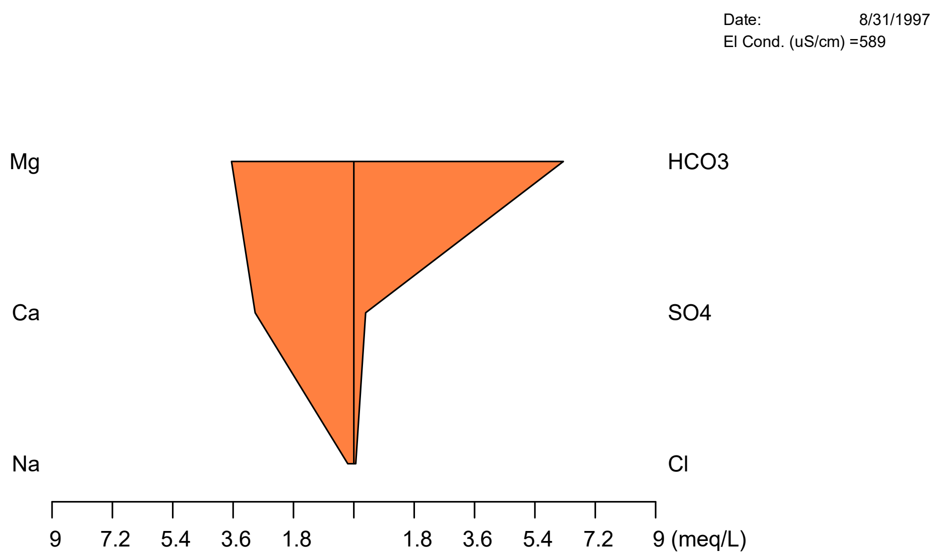
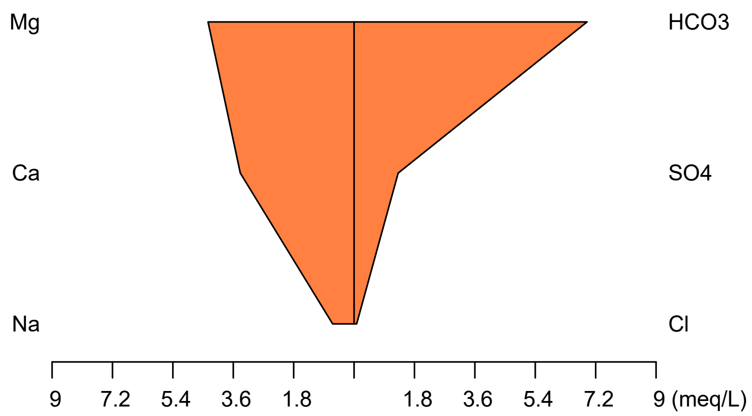


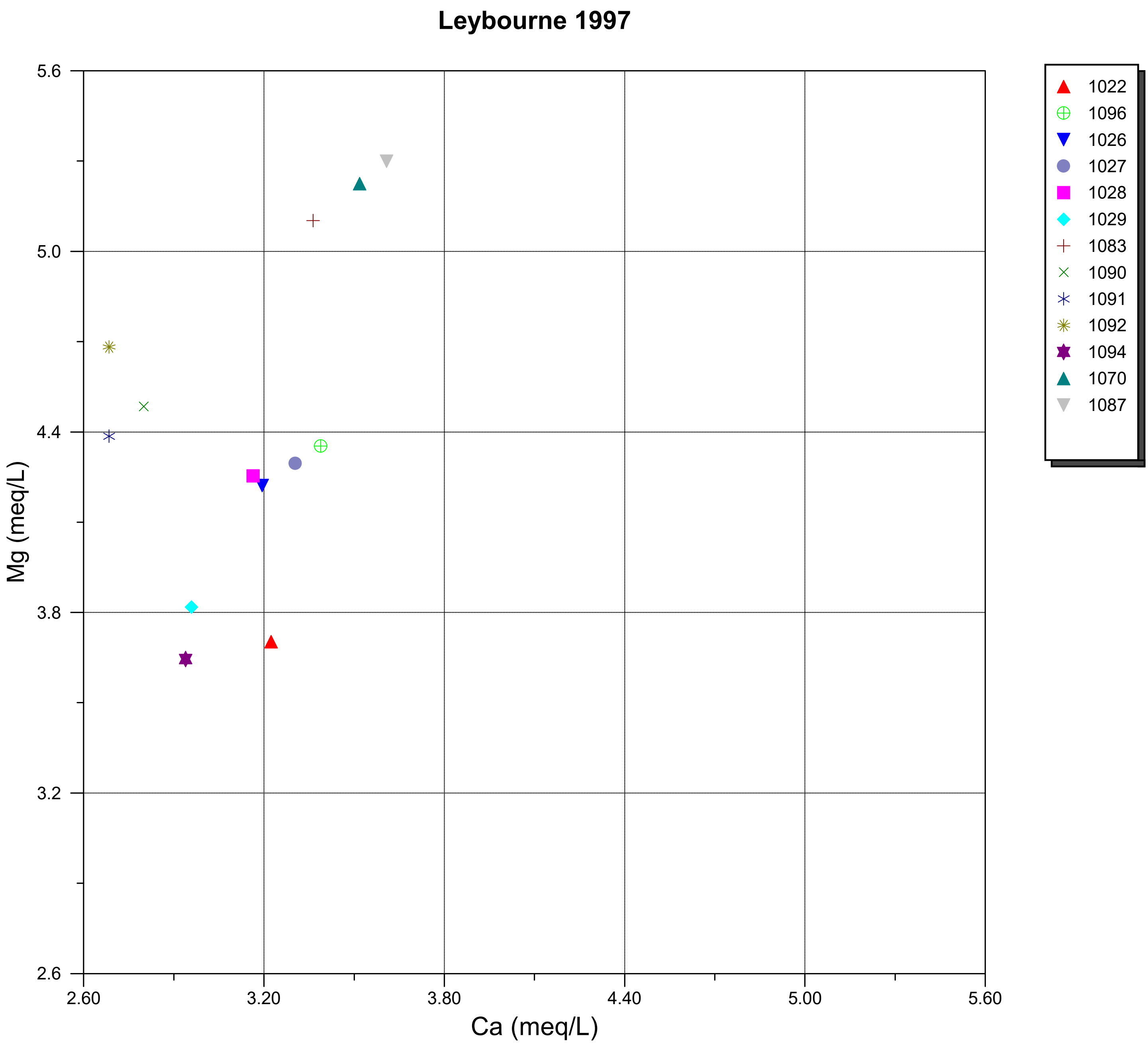
1094,8/31/1997



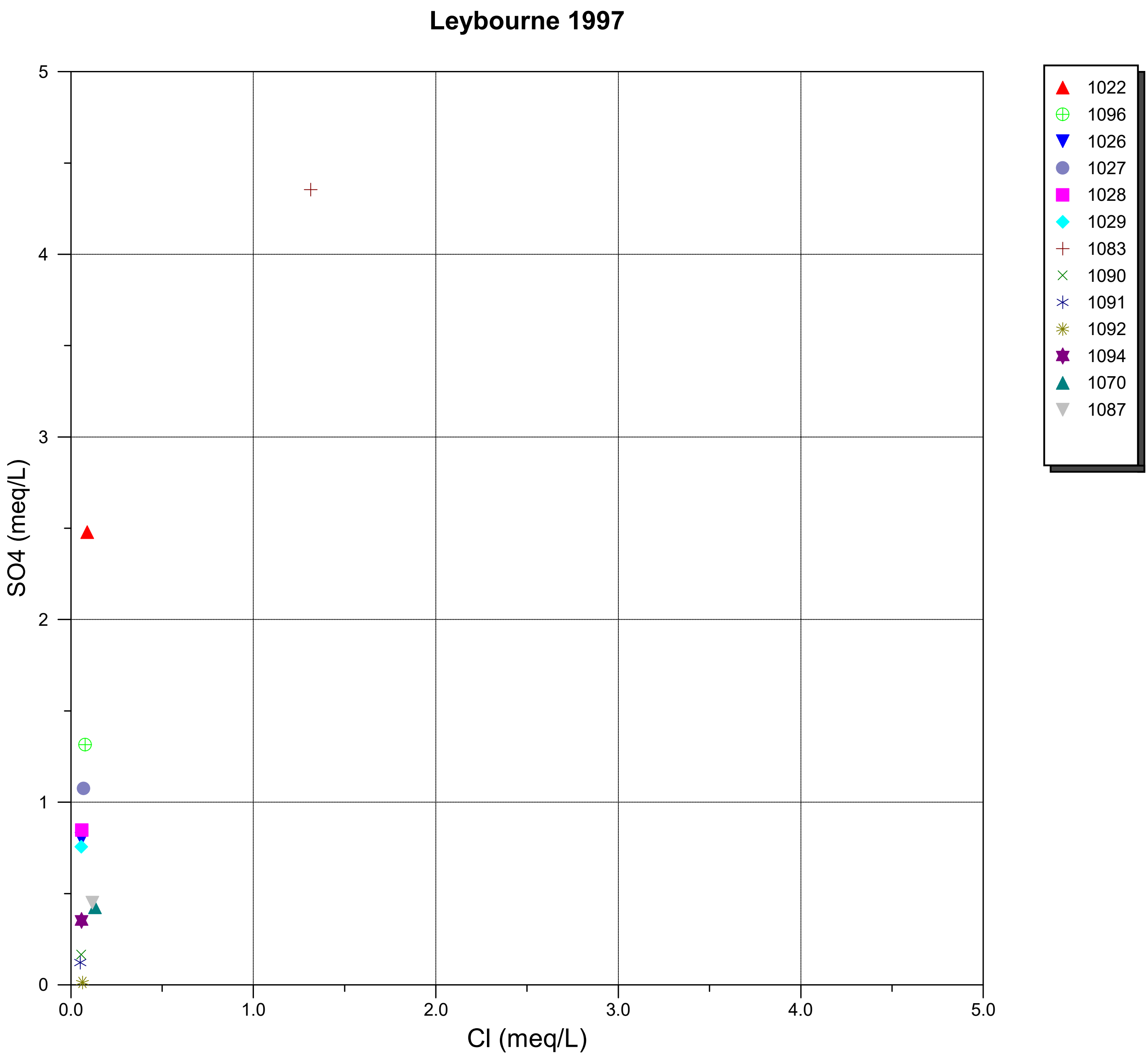
1096,8/31/1997

Date: 8/31/1997
El Cond. (uS/cm) =710





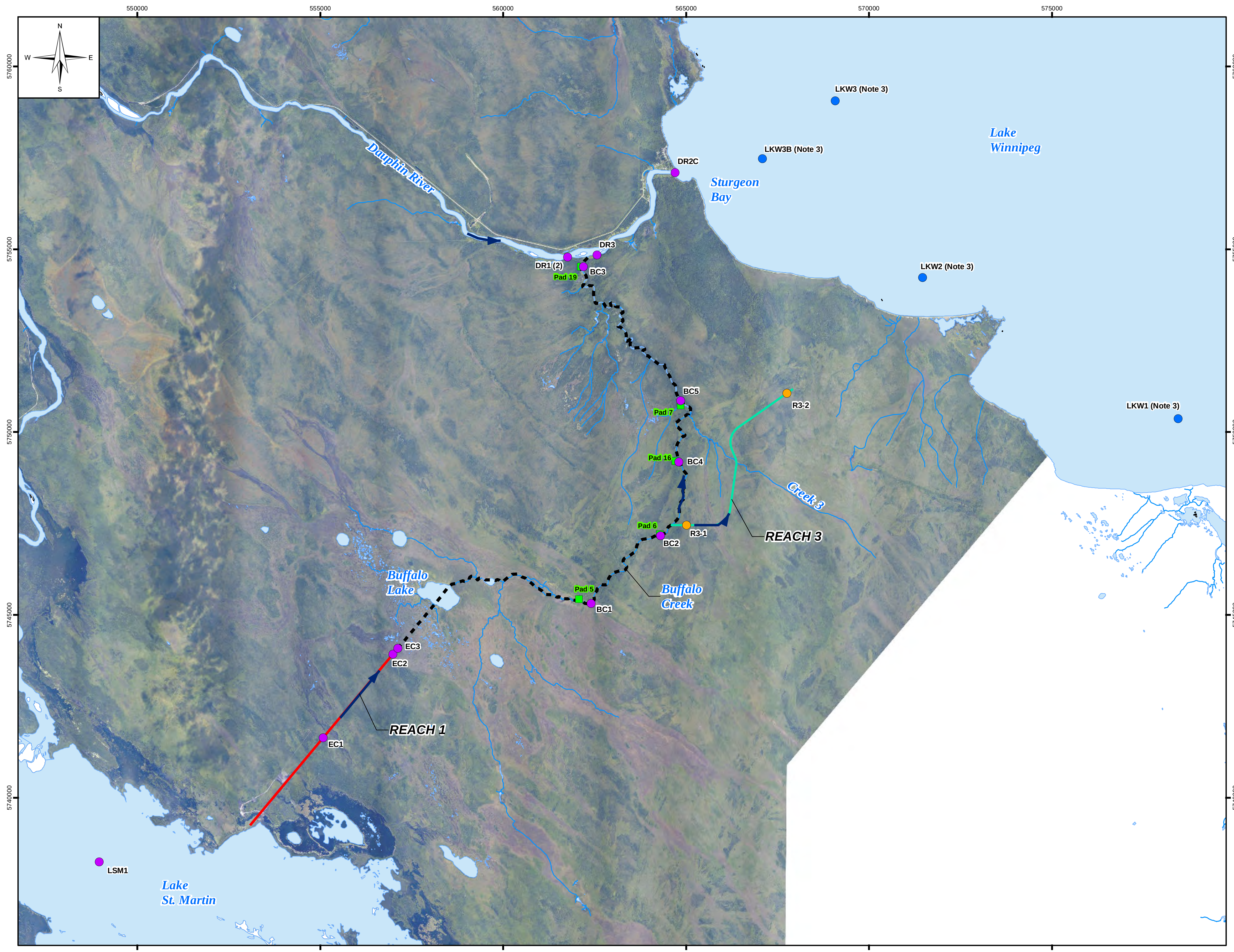
Leybourne 1997
Mg (meq/L)
Ca (meq/L)
5.6
5.0
4.4
3.8
3.2
2.6
2.60
3.20
3.80
4.40
5.00
5.60
1022
1096
1026
1027
1028
1029
1083
1090
1091
1092
1094
1070
1087

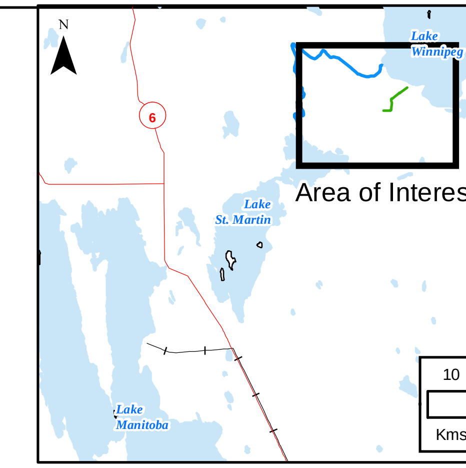


Leybourne 1997
SO4 (meq/L)
Cl (meq/L)
0
1
2
3
4
5
0.0
1.0
2.0
3.0
4.0
5.0
1022
1096
1026
1027
1028
1029
1083
1090
1091
1092
1094
1070
1087

APPENDIX A-3

Lake St. Martin Outlet Channel Area – Surface Water Monitoring





LEGEND:

Proposed Water Sampling Locations

- Construction & Operations Monitoring
- Proposed Reach 3 Operation Monitoring
- Regional Water Quality Monitoring
- Constructed Helicopter Landing Pad
- Direction of Surface Water Flow
- Water Feature
- Buffalo Creek Drainage System
- Reach 1 Emergency Outlet Channel
- Reach 3 Emergency Channel
- Water Feature
- Island

NOTES:

1. Aerial Imagery: July 2011.
2. This Station was continually relocated as ice staging changes on Dauphin River.
3. These Sample Stations were used as part of North/South Consultants delineation of Sturgeon Bay for the Regional Water Quality Program.
4. Due to safety concerns and/or ice cover, some Sample Stations had become inaccessible. Field crews attempted to choose appropriate surrogate Sample Stations when possible.

1 0 1 2 3 4

Kms

SCALE: 1:100,000 METRIC 11"x17"

All units are metric and in metres unless otherwise specified. Transverse Mercator Projection. NAD 1983. Zone 14 Elevations are in metres above sea level (MSL)

NO.	YY/MM/DD	DESCRIPTION	BY
0	13/11/08	ISSUED WITH FINAL REPORT	STO

REVISIONS / ISSUE

KGS GROUP CONSULTING ENGINEERS

Manitoba INFRASTRUCTURE AND TRANSPORTATION

EMERGENCY REDUCTION OF LAKE MANITOBA & LAKE ST. MARTIN WATER LEVELS

LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM – OVERVIEW OF WATER SAMPLING LOCATIONS

NOVEMBER 2013 | FIGURE 1 | REV: 0

FileName: P:\Projects\2011\11-0300-18\Dwg\GIS\MXD\REV0\Report_20120801\11-0300-18-F01-REV0.mxd
11"x17" PLOT SCALE 1:1

TABLE ECS-1
REACH 1 - 2011 CONSTRUCTION MONITORING PARAMETERS
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Parameter	Detection Limit (mg/L)	Guidelines (CCME PAL)[(2)]
Sediment		
Total suspended solids	5	25[(1)]
Nutrients		
Ammonia	0.05	0.055
Nitrate and nitrite	0.071	-
Nitrate-N	0.05	13
Nitrite-N	0.05	0.06
Total Kjeldahl Nitrogen	0.2	-
Total nitrogen	0.2	-
Total dissolved phosphorus	0.01	-
Total phosphorus	0.01	-
Petroleum Hydrocarbons		
Benzene	0.0005	0.37
Ethylbenzene	0.0005	0.9
Toluene	0.001	0.002
o-xylene	0.0005	-
m+p-Xylenes	0.0005	-
Xylenes	0.0015	-
Total hydrocarbons (C6-C50)	0.44	-
Fraction F1(C6-C10)	0.1	-
Fraction F2 (C10-C15)	0.25	-
Fraction F3 (C16-C34)	0.25	-
Fraction F4 (C35-C50)	0.25	-
Metals		
Total mercury	0.00006	0.000025
Dissolved mercury	0.00005	-

Notes:
1: Total Suspended Solids CCME guideline exceedance is 25 mg/L greater than baseline value
2: Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life

TABLE 4.2-1
IN-SITU DATA (SEPTEMBER 2011 - OCTOBER 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters				
		Turbidity (NTU)	Temperature (°C)	pH	DO (mg/L)	Specific Conductance (µS/cm)
LSM1	02-Sep-11	3.8	20.0	9.24	9.88	1740
	26-Sep-11	10.1	12.4	8.74	10.11	1250
	14-Oct-11	5.3	10.3	8.61	12.53	1180
	21-Oct-11	7.9	5.5	8.53	12.23	1200
	29-Oct-11	4.8	4.6	8.49	13.09	1190
	02-Nov-11	2.8	4.1	8.54	13.31	1200
	04-Nov-11	4.9	4.0	8.62	11.62	1180
	07-Nov-11	14.8	3.0	8.51	11.13	1200
	10-Nov-11	8.2	1.9	8.63	13.37	1200
	14-Nov-11	4.1	1.4	8.69	11.20	1230
	16-Mar-12	1.5	1.5	8.17	9.20	2360
	17-Apr-12 (1)	-	-	-	-	-
	16-May-12 (2)	-	-	-	-	-
	13-Jun-12 (3)	-	16.3	8.56	12.00	1170
	9-Aug-12 (3)	-	21.8	8.70	9.35	1101
	12-Sep-12 (4)	46.0	13.5	8.36	8.61	1054
	19-Oct-12	14.6	5.9	9.48 (6)	12.46	1053
	13-Nov-12	4.9	2.0	7.93	14.44	1356
	19-Nov-12	3.9	1.4	8.32	14.03	1213
	22-Nov-12	3.8	0.3	7.95	13.23	1153
	27-Nov-12 (5)	-	-	-	-	-
	24-Mar-13	8.9	0.1	7.82	9.46	1550
	2-May-13 (4)	1.1	1.3	7.78	9.15	1265
	14-May-13 (4)	8.0	8.4	7.84	9.91	340.2
	28-May-13 (4)	7.5	15.3	8.52	8.01	1023
	24-Jul-13 (4)	3.8	19.8	8.58	7.16	1022
	9-Oct-13 (4)	4.6	10.6	8.04	10.34	1069
	04-Nov-11	65.8	3.9	8.54	12.20	1190
	07-Nov-11	35.2	2.6	8.49	11.64	1030
	10-Nov-11	20.1	1.4	8.56	11.77	1210
	14-Nov-11	16.1	0.9	8.63	10.96	1220

TABLE 4.2-1
IN-SITU DATA (SEPTEMBER 2011 - OCTOBER 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters				
		Turbidity (NTU)	Temperature (°C)	pH	DO (mg/L)	Specific Conductance (µS/cm)
EC1	17-Nov-11	49.3	-0.3	8.62	10.79	1240
	25-Nov-11	14.4	0.4	8.41	11.60	1250
	16-Mar-12	2.6	2.2	8.26	9.93	3285
	17-Apr-12	3.9	3.4	7.61	14.90	1073
	16-May-12 (4)	75.9	13.8	8.18	8.83	1220
	13-Jun-12 (3)	-	15.9	9.10 (6)	10.36	1148
	9-Aug-12 (3)	-	21.5	8.33	8.83	1060
	12-Sep-12	44.1	13.1	6.73	8.34	1052
	19-Oct-12	9.8	5.9	9.58 (6)	9.17	1458
	13-Nov-12	4.4	0.2	8.42	14.93	1342
	19-Nov-12	3.5	1.2	8.50	13.84	1188
	22-Nov-12 (5)	-	-	-	-	-
	27-Nov-12 (5)	-	-	-	-	-
	2-May-13 (4)	9.0	1.2	7.61	8.51	667.0
	14-May-13	13.3	10.4	8.37	11.95	512.7
	28-May-13	4.1	15.1	8.37	8.16	583.1
	24-Jul-13	15.7	18.5	8.23	8.49	690.0
	09-Oct-13	4.4	10.0	8.11	10.41	776.0
EC2	16-Mar-12	4.0	2.0	8.19	9.54	2866
	17-Apr-12	3.6	3.1	7.63	13.09	1053
	16-May-12 (4)	84.1	13.8	8.10	8.78	1220
	13-Jun-12 (3)	-	16.0	8.60	10.55	1146
	9-Aug-12 (3)	-	21.1	8.61	8.42	1081
	12-Sep-12	44.5	12.9	7.35	8.76	1054
	19-Oct-12	10.6	5.9	8.46	9.13	1162
	13-Nov-12	5.5	0.0	8.50	14.88	1350
	19-Nov-12	3.8	1.0	8.50	13.72	1209
	22-Nov-12	7.4	0.2	8.30	13.09	1176
	27-Nov-12 (5)	-	-	-	-	-
	27-Mar-13	8.5	0.9	7.00	0.16	1120
	2-May-13 (5)	-	-	-	-	-

TABLE 4.2-1
IN-SITU DATA (SEPTEMBER 2011 - OCTOBER 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters				
		Turbidity (NTU)	Temperature (°C)	pH	DO (mg/L)	Specific Conductance (µS/cm)
	14-May-13	16.1	9.4	7.98	8.01	439.0
	28-May-13	4.1	15.6	8.55	8.20	500.1
	24-Jul-13	25.2	19.5	8.46	7.74	624.0
	09-Oct-13	10.4	10.2	8.40	9.79	724.0
EC3	16-Mar-12	12.4	1.6	8.18	10.80	2468
EC3	17-Apr-12	17.2	2.8	7.15	12.60	1061
EC3	16-May-12 (2)	-	-	-	-	-
EC3	13-Jun-12 (3)	-	16.0	8.59	10.68	1155
EC3	9-Aug-12 (3)	-	19.8	8.68	8.68	1068
EC3	12-Sep-12	58.8	12.8	7.81	8.77	1055
EC3	19-Oct-12	7.7	5.9	8.20	10.01	1146
EC3	13-Nov-12	5.8	-0.1	8.58	14.79	1375
EC3	19-Nov-12	4.8	1.0	8.50	13.73	1193
EC3	22-Nov-12	7.2	0.0	8.51	13.70	1186
EC3	27-Nov-12 (5)	-	-	-	-	-
EC3	2-May-13 (4)	4.2	3.3	7.40	8.78	722.3
EC3	14-May-13 (4)	7.7	12.6	8.42	10.45	430.5
EC3	28-May-13	2.3	15.3	8.13	6.96	434.2
EC3	24-Jul-13	23.2	20.0	8.57	7.61	621.0
EC3	09-Oct-13	10.6	10.8	8.50	9.87	729.0
BBL	27-Mar-13	9.3	2.8	7.20	0.02	1450
BBL	2-May-13 (1)	4.7	0.6	7.32	2.86	431.3
BBL	14-May-13	5.5	7.6	7.58	4.67	440.6
BBL	28-May-13	3.1	15.8	8.62	8.72	506.9
BBL	24-Jul-13	4.7	20.2	8.11	6.25	462.7
BBL	09-Oct-13	2.3	10.3	8.31	10.14	518.8
	02-Sep-11	0.0	20.2	8.31	6.42	361
	07-Sep-11	1.0	21.5	8.11	7.16	320
	26-Sep-11	2.3	12.5	7.84	10.94	231
	14-Oct-11	0.0	8.2	7.42	9.76	204
	21-Oct-11	1.5	6.0	7.80	11.69	196

TABLE 4.2-1
IN-SITU DATA (SEPTEMBER 2011 - OCTOBER 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters				
		Turbidity (NTU)	Temperature (°C)	pH	DO (mg/L)	Specific Conductance (µS/cm)
BC1	29-Oct-11	0.8	3.5	7.42	11.96	186
	02-Nov-11	3.5	4.5	7.55	11.74	180
	16-Mar-12	6.4	1.7	7.95	8.72	2168
	17-Apr-12	2.1	3.4	7.45	11.26	1082
	16-May-12 (2)	-	-	-	-	-
	13-Jun-12 (3)	-	16.5	8.16	7.76	1140
	9-Aug-12 (3)	-	20.7	8.28	6.16	1049
	12-Sep-12	5.8	12.4	7.73	7.66	1065
	19-Oct-12	3.0	5.9	7.83	10.13	965
	13-Nov-12	3.8	0.2	7.98	9.99	1285
	19-Nov-12	2.5	0.6	8.20	10.15	1111
	22-Nov-12	4.0	0.1	8.18	9.81	1095
	27-Nov-12	2.6	-0.1	7.52	2.94	1070
	27-Mar-13	161.0	0.0	7.55	2.11	1440
	02-May-13	7.0	0.3	7.29	11.82	488.7
	14-May-13	5.8	11.8	7.68	5.61	379.0
	28-May-13	8.6	15.0	7.78	6.48	401.7
	24-Jul-13	4.8	20.1	7.77	6.04	465.3
	09-Oct-13	2.1	9.6	7.86	7.64	545.6
	02-Sep-11	2.6	19.2	8.35	7.82	366
	07-Sep-11	0.1	21.9	8.52	8.92	325
	26-Sep-11	2.4	12.7	8.09	8.96	235
	14-Oct-11	1.2	8.4	7.62	9.31	204
	21-Oct-11	0.1	5.7	7.90	11.90	193
	29-Oct-11	3.0	3.1	7.84	11.56	194
	02-Nov-11	1.2	4.1	7.67	11.53	182
	04-Nov-11	41.4	3.2	7.82	10.12	1090
	07-Nov-11	-	-	-	-	-
	10-Nov-11	15.7	0.9	8.25	10.15	1210
	14-Nov-11	7.7	0.4	8.28	10.02	1220
	17-Nov-11	11.2	-0.3	8.19	10.25	1250

TABLE 4.2-1
IN-SITU DATA (SEPTEMBER 2011 - OCTOBER 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters				
		Turbidity (NTU)	Temperature (°C)	pH	DO (mg/L)	Specific Conductance (μS/cm)
BC2	16-Mar-12	4.8	0.8	7.90	9.65	2890
	17-Apr-12	4.3	3.7	7.67	11.80	1057
	16-May-12 (4)	52.7	14.5	7.78	6.86	1200
	13-Jun-12 (3)	-	15.4	8.00	9.01	-- (7)
	9-Aug-12 (3)	-	20.6	8.07	5.53	1002
	12-Sep-12	6.5	12.6	7.72	6.99	1051
	19-Oct-12	-	5.9	7.66	9.74	1048
	13-Nov-12	-	-	-	-	-
	19-Nov-12	9.8	0.2	8.14	10.80	1174
	22-Nov-12	5.0	0.1	8.10	10.90	1128
	27-Nov-12	2.4	-0.1	7.74	4.22	923
	27-Mar-13	86.4	-0.1	7.53	7.16	1430
	02-May-13	6.4	0.5	7.38	5.12	457.6
	14-May-13 (4)	5.4	11.9	7.75	6.76	356.2
	28-May-13	5.6	14.9	7.93	6.57	385.0
	24-Jul-13	8.9	20.2	7.83	7.47	453.7
	09-Oct-13	7.1	10.7	8.15	9.59	522.4
BC4	16-Mar-12	8.5	0.8	7.93	9.30	2134
	17-Apr-12	3.0	3.5	7.79	11.65	1062
	16-May-12 (4)	58.9	14.5	7.76	6.91	1200
	13-Jun-12 (3)	-	15.4	8.07	9.01	-- (7)
	9-Aug-12 (3)	-	20.5	8.08	5.86	997
	12-Sep-12	8.4	12.5	7.71	7.31	1051
	19-Oct-12	6.5	6.0	7.62	7.85	1061
	13-Nov-12	-	-	-	-	-
	19-Nov-12	7.4	0.2	8.17	10.95	1176
	22-Nov-12	4.5	0.0	8.08	11.27	1121
	27-Nov-12 (5)	-	-	-	-	-
	02-May-13	11.8	0.3	7.44	5.26	457.4
	14-May-13	6.8	12.0	7.81	7.07	556.7
	28-May-13	7.0	15.1	8.00	7.14	385.7
	24-Jul-13	7.3	20.2	7.94	7.32	453.6

TABLE 4.2-1
IN-SITU DATA (SEPTEMBER 2011 - OCTOBER 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters				
		Turbidity (NTU)	Temperature (°C)	pH	DO (mg/L)	Specific Conductance (µS/cm)
	09-Oct-13	8.2	10.5	8.17	9.32	521.9
BC5	16-Mar-12	7.1	0.8	9.38 (6)	9.10	1947
	17-Apr-12	19.6	3.2	7.77	12.12	1061
	16-May-12 (4)	42.1	14.0	8.03	7.20	1180
	13-Jun-12 (3)	-	16.2	8.00	7.44	1137
	9-Aug-12 (3)	-	20.4	8.05	5.94	993
	12-Sep-12	6.4	12.6	7.72	7.11	1049
	19-Oct-12	3.8	5.9	7.58	8.13	1045
	13-Nov-12	6.1	0.1	8.22	11.96	1359
	19-Nov-12	13.0	0.2	8.17	10.99	1175
	22-Nov-12	4.1	0.1	8.08	11.65	1124
	27-Nov-12	-	-	-	-	-
	02-May-13	5.4	0.4	7.54	6.64	436.4
	14-May-13	8.2	11.9	7.83	7.61	358.7
	28-May-13	8.4	15.1	8.01	6.88	384.9
	24-Jul-13	9.2	20.3	7.95	7.42	454.1
	09-Oct-13	11.8	10.4	8.10	9.37	527.3
	02-Sep-11	7.2	19.3	8.64	8.54	1090
	07-Sep-11	5.9	20.7	8.50	8.13	358
	26-Sep-11	13.1	13.0	7.39	8.83	373
	14-Oct-11	6.6	8.5	7.55	12.24	225
	21-Oct-11	6.7	5.5	8.18	11.81	474
	29-Oct-11	5.9	2.6	7.77	11.99	254
	02-Nov-11	6.7	3.5	7.63	10.85	236
	04-Nov-11	62.1	3.1	7.72	10.38	1140
	07-Nov-11	-	-	-	-	-
	10-Nov-11	24.5	0.8	8.19	11.08	1200
	14-Nov-11	16.1	0.5	8.18	11.56	1210
	17-Nov-11	17.9	-0.3	8.19	10.16	1240
	25-Nov-11	21.5	-0.2	7.94	9.72	1200
	16-Mar-12	11.8	0.8	8.12	9.24	1868
	17-Apr-12	6.6	2.8	7.78	11.70	1056

TABLE 4.2-1
IN-SITU DATA (SEPTEMBER 2011 - OCTOBER 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters				
		Turbidity (NTU)	Temperature (°C)	pH	DO (mg/L)	Specific Conductance (µS/cm)
BC3	16-May-12 (4)	93.1	14.3	7.70	7.12	1200
	13-Jun-12 (3)	-	16.1	8.02	7.53	1131
	9-Aug-12 (3)	-	20.8	8.03	6.25	984
	12-Sep-12	9.8	12.8	7.75	7.33	1049
	19-Oct-12	3.6	6.0	7.69	9.38	1025
	13-Nov-12	4.2	0.0	8.18	12.20	1347
	19-Nov-12	16.5	0.3	8.17	11.38	1167
	22-Nov-12	4.0	0.1	8.11	12.48	1101
	27-Nov-12 (5)	-	-	-	-	-
	2-May-13 (4)	8.8	1.0	7.92	8.56	427.9
	14-May-13	14.6	11.9	7.88	8.35	331.4
	28-May-13	14.3	15.1	8.62	7.30	348.1
	24-Jul-13	12.3	20.1	8.05	6.44	405.9
	09-Oct-13	21.7	10.6	8.15	9.83	486.8
DR1	02-Sep-11	5.2	19.8	8.93	8.70	1760
	07-Sep-11	3.1	20.2	9.00	8.98	1720
	26-Sep-11	9.2	12.7	8.41	10.35	1240
	14-Oct-11	5.6	10.1	8.32	10.16	1190
	21-Oct-11	7.6	6.3	8.58	11.34	1200
	29-Oct-11	5.9	4.8	8.38	14.10	1200
	02-Nov-11	5.1	4.4	8.45	10.80	1190
	04-Nov-11	6.7	3.9	8.41	11.54	1190
	07-Nov-11	-	-	-	-	-
	10-Nov-11	5.9	1.5	8.56	12.03	1220
	14-Nov-11	3.4	1.1	8.51	10.64	1340
	17-Nov-11	0.5	-0.2	8.57	11.02	1240
	25-Nov-11	0.0	-0.1	8.50	12.37	1060
	16-Mar-12	4.8	0.7	8.15	9.66	1338
	17-Apr-12	5.3	3.2	7.83	12.74	1055
	16-May-12 (4)	69.2	14.3	8.27	8.69	1290
	13-Jun-12 (3)	-	16.4	8.57	10.25	1159
	9-Aug-12 (3)	-	21.2	8.65	8.77	1056

TABLE 4.2-1
IN-SITU DATA (SEPTEMBER 2011 - OCTOBER 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters				
		Turbidity (NTU)	Temperature (°C)	pH	DO (mg/L)	Specific Conductance (µS/cm)
	12-Sep-12	8.5	13.6	8.08	8.30	1049
	19-Oct-12	8.3	6.2	7.79	9.81	1091
	13-Nov-12	5.0	-0.1	8.55	14.95	1385
	19-Nov-12	12.5	0.5	8.52	13.80	1211
	22-Nov-12	4.7	0.1	8.48	13.77	1184
	27-Nov-12	3.6	-0.1	8.37	12.68	867
	26-Mar-13	21.0	-0.1	8.01	9.4	1330
	02-May-13	5.7	1.0	8.07	12.61	1287
	14-May-13	7.2	8.9	8.34	10.94	1136
	28-May-13	6.9	14.6	8.50	8.58	1034
	24-Jul-13	6.2	20.4	8.44	7.89	1071
	09-Oct-13	5.0	10.9	8.45	10.05	1052
DR3	02-Sep-11	4.8	19.6	8.93	8.58	1740
	07-Sep-11	5.1	20.0	8.96	8.44	1630
	26-Sep-11	11.6	12.7	8.32	10.39	1210
	14-Oct-11	5.7	10.0	8.27	9.72	1150
	21-Oct-11	6.7	6.1	8.54	11.51	1160
	29-Oct-11	5.5	4.6	8.32	10.81	1140
	02-Nov-11	5.7	4.2	8.33	10.77	1150
	04-Nov-11	66.6	3.2	7.76	10.45	1140
	07-Nov-11	-	-	-	-	-
	10-Nov-11	30.8	0.8	8.20	10.31	1200
	14-Nov-11	18.2	0.5	8.24	10.18	1220
	17-Nov-11	19.5	-0.3	8.23	10.83	1240
	25-Nov-11	21.6	-0.3	7.95	9.68	1170
	16-Mar-12	8.2	0.7	8.08	9.03	1590
	17-Apr-12	5.4	3.4	7.89	13.30	1050
	16-May-12 [4]	64.3	14.0	7.90	7.40	1170
	13-Jun-12 [3]	-	16.2	8.01	7.81	1130
	9-Aug-12 [3]	-	22.0	8.66	8.64	1061
	12-Sep-12	16.2	13.6	8.24	8.58	1051
	19-Oct-12	9.4	6.0	7.73	9.40	1038

TABLE 4.2-1
IN-SITU DATA (SEPTEMBER 2011 - OCTOBER 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters				
		Turbidity (NTU)	Temperature (°C)	pH	DO (mg/L)	Specific Conductance (µS/cm)
	13-Nov-12 (5)	-	-	-	-	-
	19-Nov-12 (5)	-	-	-	-	-
	22-Nov-12 (5)	-	-	-	-	-
	27-Nov-12 (5)	-	-	-	-	-
	02-May-13	5.8	0.8	7.98	12.92	1269
	14-May-13	13.9	10.5	8.10	9.50	639.7
	28-May-13	6.3	14.4	8.51	8.06	1033
	24-Jul-13	7.3	20.4	8.45	7.81	1071
	09-Oct-13	4.7	10.9	8.50	10.29	1073
DR2C	02-Sep-11	4.0	20.1	8.79	7.92	1770
	07-Sep-11	4.4	20.5	8.82	8.64	1710
	26-Sep-11	9.9	12.7	8.48	8.87	1240
	14-Oct-11	5.6	10.1	8.33	10.13	1190
	21-Oct-11	7.2	6.2	8.55	11.24	1200
	29-Oct-11	7.1	4.8	8.38	11.17	1200
	02-Nov-11	5.2	4.3	8.50	11.44	1200
	04-Nov-11	5.8	3.8	8.43	13.34	1170
	10-Nov-11	23.2	0.9	8.23	11.93	1200
	14-Nov-11	17.4	0.8	8.34	11.52	1180
	17-Nov-11	16.1	0.0	8.29	10.81	1230
	16-Mar-12	8.6	0.9	8.02	8.08	1504
	17-Apr-12	12.2	3.2	7.88	12.50	1054
	16-May-12 (4)	62.5	14.2	8.06	8.80	1220
	13-Jun-12 (3)	-	16.2	8.06	8.10	1135
	9-Aug-12 (3)	-	21.5	8.28	7.18	1001
	12-Sep-12	12.3	13.5	8.28	8.70	1049
	19-Oct-12	4.4	6.0	7.63	10.23	1032
	13-Nov-12 (5)	-	-	-	-	-
	19-Nov-12 (5)	-	-	-	-	-
	22-Nov-12 (5)	-	-	-	-	-
	27-Nov-12 (5)	-	-	-	-	-
	25-Mar-13	20.4	-0.1	7.98	9.44	1500

TABLE 4.2-1
IN-SITU DATA (SEPTEMBER 2011 - OCTOBER 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters				
		Turbidity (NTU)	Temperature (°C)	pH	DO (mg/L)	Specific Conductance (µS/cm)
	02-May-13	4.7	1.6	7.44	12.72	1235
	14-May-13	12.0	9.4	8.30	10.22	1004
	28-May-13	5.8	14.5	8.50	7.97	1008
	24-Jul-13	7.5	20.4	8.52	7.48	1050
	09-Oct-13	5.0	10.9	8.52	10.90	1072

Notes:
"-" = No Data
1. Equipment malfunction while at sample station
2. Station was not sampled due to technical difficulties with the helicopter
3. Tubidity meter malfunctioned (could not recalibrate in field); no data
4. Sample site location moved due to various reasons including ice cover, water depth, wind effects on helicopter, weather:
   LSM1 to 14U 0546956 5740368 (near mouth of DR) on 12-09-2012; 14U 0547613 5741083 (near mouth of DR) on 2-May-2013; to 14U 0553400 5739379 (near R1) on 14-May-2013; to 14U 0549683 5734990 (b/w R1 and DR) on 28-May-2013 and 24-Jul-2013
   EC1 to 14U 0554932 5741600 (approx. 150 from original site) on 2-May-2013
   EC3 to 14U 0556924 5744039 (approx. 200 m from original site) on 2-May-2013; to 14U 0556973 5744197 on 14-May-2013
   BBL to 14U 0558555 5745814 (at lake outlet) on 2-May-2013
   BC2 to 14U 0564360 5747210 on 14-May-2013
   BC3 to 14U 0562131 5754406 on 2-May-2013
5. Sample not possible due to ice cover.
6. pH is outside of expected range - suspected to be equipment error.
7. Specific conductance meter malfunctioned at station BC2, re-calibrated after station BC4; no data

TABLE 4.2-2
GENERAL WATER QUALITY (2011 - 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters [1]											
		T.S.S.	Ammonia (as N)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	T.K.N.	Total Nitrogen	Total Phosphorus	Total Dissolved Phosphorus	Mercury (Total) (ug/L)	Dissolved Mercury (Methyl) (ug/L)	Total Mercury (Methyl) (ug/L)
EQL		*2.0*	*0.01*	*0.0051/ 0.005 [2] / 0.071 [3]*	*0.005 [2] / 0.05 [3]*	*0.001 [2] / 0.05 [3]*	*0.2*	*0.2*	*0.01*	*0.01*	*0.001*	*0.000001*	*0.000001*
LSM1	02-Sep-11	7.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.021	0.012	<0.050	-	-
	26-Sep-11	5.0	<0.050	<0.071	<0.050	<0.050	2.3	2.3	0.024	0.015	<0.050	-	-
	14-Oct-11	10.0	<0.050	<0.071	<0.050	<0.050	1.1	1.1	0.021	<0.010	<0.050	-	-
	29-Oct-11	5.8	0.044	0.009	0.009	<0.0010	1.1	-	0.016	<0.010	0.0015	-	-
	02-Nov-11	7.0	0.061	<0.071	<0.050	<0.050	1.0	1.0	0.019	0.014	<0.050	-	-
	04-Nov-11	7.0	0.074	<0.071	<0.050	<0.050	1.1	1.1	0.027	0.013	<0.050	-	-
	07-Nov-11	19.0	0.083	<0.071	<0.050	<0.050	1.2	1.2	0.027	0.011	<0.050	-	-
	10-Nov-11	10.0	0.067	<0.071	<0.050	<0.050	1.1	1.1	0.025	0.013	<0.050	-	-
	14-Nov-11	7.0	0.071	<0.071	<0.050	<0.050	1.1	1.1	0.022	0.014	<0.050	-	-
	18-Jan-12	<2.0	0.093	0.020	0.018	0.002	1.0	-	0.012	0.012	<0.001	<0.00005	<0.00005
	9-Feb-12 [4]	<2.0	0.129	<0.071	<0.050	<0.050	1.1	1.1	0.015	-	-	-	-
		<2.0	0.179	<0.071	<0.050	<0.050	1.2	1.2	0.017	0.010	-	-	-
	21-Feb-12 [4]	<2.0	0.219	<0.071	<0.050	<0.050	1.8	1.8	0.025	<0.010	-	-	-
		<2.0	0.202	<0.071	<0.050	<0.050	1.7	1.7	0.021	<0.010	-	-	-
	16-Mar-12 [4]	4.4	0.160	<0.071	<0.050	<0.050	1.1	1.1	0.014	<0.010	<0.001	<0.00005	<0.00005
		2.0	0.192	<0.071	<0.050	<0.050	1.1	1.1	<0.010	0.011	-	-	-
	17-Apr-12 [4]	14.0	0.028	<0.071	<0.050	<0.050	1.0	1.0	0.023	0.010	-	-	-
		7.6	0.026	<0.071	<0.050	<0.050	1.0	1.0	0.021	<0.010	-	-	-
	17-May-12	8.0	-	<0.071	<0.0050	0.001	1.0	1.0	0.019	<0.010	-	-	-
	13-Jun-12	7.6	0.013	<0.071	<0.050	<0.050	1.0	1.0	0.020	<0.010	-	-	-
	09-Aug-12	9.8	0.017	<0.071	<0.050	<0.050	0.4	0.4	0.017	-	-	-	-
	12-Sep-12	72.7	0.013	<0.071	<0.050	<0.050	1.6	1.6	**0.032**	<0.010	-	-	-
	19-Oct-12 [4]	19.2	0.022	<0.071	<0.050	<0.050	0.9	0.9	0.020	<0.010	-	-	-
		11.6	0.023	<0.071	<0.050	<0.050	1.2	1.2	0.020	<0.010	-	-	-
	13-Nov-12 [4]	7.0	0.058	<0.071	<0.050	<0.050	0.9	0.9	0.017	<0.010	-	-	-
		7.8	0.057	<0.071	<0.050	<0.050	0.9	0.9	0.015	<0.010	-	-	-
	19-Nov-12 [4]	4.0	0.074	<0.071	<0.050	<0.050	0.9	0.9	0.014	<0.010	-	-	-
		4.2	0.071	<0.071	<0.050	<0.050	0.9	0.9	0.012	<0.010	-	-	-
	22-Nov-12 [4]	3.8	0.083	<0.071	<0.050	<0.050	0.9	0.9	0.011	<0.010	-	-	-
		4.0	0.080	<0.071	<0.050	<0.050	0.9	0.9	0.011	<0.010	-	-	-
	27-Nov-12 [5]	-	-	-	-	-	-	-	-	-	-	-	-
	24-Mar-13	<2.0	0.247	<0.050	0.035	0.002	1.0	1.1	0.010	0.004	<0.0005	<0.000050	<0.000050
	02-May-13	3.2	0.273	<0.071	0.061	<0.050	1.0	1.0	0.019	<0.010	-	-	-
	14-May-13	9.8	0.070	<0.071	<0.050	<0.050	0.7	0.7	**0.043**	0.010	-	-	-
	28-May-13	11.0	<0.010	<0.071	<0.050	<0.050	0.7	0.7	0.021	<0.010	-	-	-
	24-Jul-13	6.5	0.233	<0.071	<0.050	<0.050	1.0	1.0	0.017	0.010	-	-	-
	09-Oct-13	8.0	0.032	<0.071	<0.050	<0.050	0.9	0.9	0.014	<0.010	-	-	-
	04-Nov-11	130.0	0.066	<0.071	<0.050	<0.050	1.3	1.3	0.065	0.015	<0.050	-	-
	07-Nov-11	51.0	0.060	<0.071	<0.050	<0.050	1.1	1.1	0.034	0.011	<0.050	-	-
	10-Nov-11	20.0	0.068	<0.071	<0.050	<0.050	1.1	1.1	0.032	0.014	<0.050	-	-
	14-Nov-11	20.0	0.078	<0.071	<0.050	<0.050	1.1	1.1	0.026	0.014	<0.050	-	-
	17-Nov-11	58.0	0.080	<0.071	<0.050	<0.050	1.2	1.2	0.027	0.010	<0.050	-	-
	25-Nov-11	17.0	0.088	<0.071	<0.050	<0.050	1.0	1.0	0.027	0.013	<0.050		
	17-Jan-12	3.6	0.078	0.023	0.021	0.001	1.0	-	0.013	0.013	<0.001	<0.00005	<0.00005
	07-Feb-12	3.6	-	-	-	-	-	-	-	-	-	-	-
	21-Feb-12	3.6	-	-	-	-	-	-	-	-	-	-	-
	16-Mar-12	2.4	0.149	<0.071	<0.050	<0.050	1.1	1.1	0.035	<0.010	-	-	-
	17-Apr-12 [6]	6.8	0.032	<0.071	<0.050	<0.050	0.9	0.9	0.018	0.011	-	-	-
		12.8	-	-	-	-	-	-	-	-	-	-	-
		17.8	-	-	-	-	-	-	-	-	-	-	-
	16-May-12 [7]	8.4	<0.010	<0.071	<0.050	<0.050	1.0	1.0	0.013	0.011	-	-	-
		7.6	-	-	-	-	-	-	-	-	-	-	-

TABLE 4.2-2
GENERAL WATER QUALITY (2011 - 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters [1]											
		T.S.S.	Ammonia (as N)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	T.K.N.	Total Nitrogen	Total Phosphorus	Total Dissolved Phosphorus	Mercury (Total) (ug/L)	Dissolved Mercury (Methyl) (ug/L)	Total Mercury (Methyl) (ug/L)
EQL		*2.0*	*0.01*	*0.0051/ 0.005 (2) / 0.071 (3)*	*0.005 (2) / 0.05 (3)*	*0.001 (2) / 0.05 (3)*	*0.2*	*0.2*	*0.01*	*0.01*	*0.001*	*0.000001*	*0.000001*
EC1	13-Jun-12 (7)	10.0	0.015	<0.071	<0.050	<0.050	1.1	1.1	0.028	<0.010	-	-	-
		13.6	-	-	-	-	-	-	-	-	-	-	-
	09-Aug-12	11.0	0.026	<0.071	<0.050	<0.050	0.3	0.3	0.020	-	-	-	-
		9.2	-	-	-	-	-	-	-	-	-	-	-
	12-Sep-12	**138.0**	0.012	<0.071	<0.050	<0.050	1.8	1.8	0.044	<0.010	-	-	-
		136.0	-	-	-	-	-	-	-	-	-	-	-
	19-Oct-12 (7)	18.2	0.037	<0.071	<0.050	<0.050	1.2	1.2	**0.145**	<0.010	-	-	-
		15.4	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12 (7)	4.0	0.080	<0.071	<0.050	<0.050	0.9	0.9	0.014	<0.010	-	-	-
		8.8	-	-	-	-	-	-	-	-	-	-	-
	19-Nov-12 (7)	4.8	0.072	<0.071	<0.050	<0.050	0.9	0.9	0.017	<0.010	-	-	-
		4.8	-	-	-	-	-	-	-	-	-	-	-
	22-Nov-12	-	-	-	-	-	-	-	-	-	-	-	-
	27-Nov-12 (5)	-	-	-	-	-	-	-	-	-	-	-	-
	02-May-13	7.3	0.212	0.103	0.103	<0.050	1.3	1.4	**0.115**	<0.010	-	-	-
	14-May-13	14.0	<0.010	<0.071	<0.050	<0.050	0.4	0.4	**0.056**	0.016	-	-	-
	28-May-13	5.7	0.020	<0.071	<0.050	<0.050	0.3	0.3	0.021	<0.010	-	-	-
	24-Jul-13	10.0	0.050	<0.071	<0.050	<0.050	<0.20	<0.20	0.011	<0.010	-	-	-
	09-Oct-13	2.4	0.015	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-
EC2	17-Jan-12	4.0		0.015	0.015	<0.0010	1.0	1.0	0.015	0.013	<0.001	<0.00005	<0.00005
	07-Feb-12	4.8	-	-	-	-	-	-	-	-	-	-	-
	21-Feb-12	2.8	-	-	-	-	-	-	-	-	-	-	-
	16-Mar-12	**26.8**	0.145	<0.071	<0.050	<0.050	1.1	1.1	0.022	<0.010	-	-	-
	17-Apr-12 (7)	5.6	0.031	<0.071	<0.050	<0.050	0.9	0.9	0.017	<0.010	-	-	-
		48.8	-	-	-	-	-	-	-	-	-	-	-
	16-May-12 (7)	6.8	<0.010	<0.071	<0.050	<0.050	1.0	1.0	0.013	0.011	-	-	-
		6.4	-	-	-	-	-	-	-	-	-	-	-
	13-Jun-12 (7)	12.8	0.014	<0.071	<0.050	<0.050	1.1	1.1	0.026	<0.010	-	-	-
		10.0	-	-	-	-	-	-	-	-	-	-	-
	09-Aug-12	10.4	0.035	<0.071	<0.050	<0.050	0.4	0.4	0.018	-	-	-	-
		11.4	-	-	-	-	-	-	-	-	-	-	-
	12-Sep-12	**93.3**	0.011	<0.071	<0.050	<0.050	1.8	1.8	0.031	0.035	-	-	-
	19-Oct-12 (7)	21.0	0.033	<0.071	<0.050	<0.050	1.0	1.0	0.028	<0.010	-	-	-
		15.4	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12 (7)	6.6	0.074	<0.071	<0.050	<0.050	0.9	0.9	0.014	<0.010	-	-	-
		6.4	-	-	-	-	-	-	-	-	-	-	-
	19-Nov-12 (7)	5.3	0.070	<0.071	<0.050	<0.050	0.9	0.9	0.014	<0.010	-	-	-
		4.6	-	-	-	-	-	-	-	-	-	-	-
	22-Nov-12	**10.4**	0.082	<0.071	<0.050	<0.050	1.0	1.0	0.013	<0.010	-	-	-
	27-Nov-12 (5)	-	-	-	-	-	-	-	-	-	-	-	-
	27-Mar-13	<2.0	0.284	<0.071	<0.050	<0.050	0.5	0.5	0.017	0.003	-	-	-
	2-May-13 (5)	-	-	-	-	-	-	-	-	-	-	-	-
	14-May-13	**15.2**	0.414	<0.071	<0.050	<0.050	1.4	1.4	**0.070**	0.014	-	-	-
	28-May-13	7.0	0.063	<0.071	<0.050	<0.050	0.6	0.6	0.034	<0.010	-	-	-
	24-Jul-13	**15.0**	0.019	<0.071	<0.050	<0.050	0.4	0.4	0.033	0.013	-	-	-
	09-Oct-13	6.8	0.024	<0.071	<0.050	<0.050	0.2	0.2	0.012	<0.010	-	-	-

TABLE 4.2-2
GENERAL WATER QUALITY (2011 - 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters [1]											
		T.S.S.	Ammonia (as N)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	T.K.N.	Total Nitrogen	Total Phosphorus	Total Dissolved Phosphorus	Mercury (Total) (ug/L)	Dissolved Mercury (Methyl) (ug/L)	Total Mercury (Methyl) (ug/L)
EQL		*2.0*	*0.01*	*0.0051/ 0.005 [2] / 0.071 [3]*	*0.005 [2] / 0.05 [3]*	*0.001 [2] / 0.05 [3]*	*0.2*	*0.2*	*0.01*	*0.01*	*0.001*	*0.000001*	*0.000001*
EC3	17-Jan-12	2.0	-	-	-	-	-	-	-	-	-	-	-
	07-Feb-12	6.0	-	-	-	-	-	-	-	-	-	-	-
	21-Feb-12	<2.0	-	-	-	-	-	-	-	-	-	-	-
	16-Mar-12	6.4	0.144	<0.071	<0.050	<0.050	1.0	1.0	0.018	<0.010	-	-	-
	17-Apr-12 [7]	6.8	0.031	<0.071	<0.050	<0.050	0.9	0.9	0.016	0.010	-	-	-
		4.8	-	-	-	-	-	-	-	-	-	-	-
	13-Jun-12 [7]	17.2	0.015	<0.071	<0.050	<0.050	1.0	1.0	0.027	<0.010	-	-	-
		7.6	-	-	-	-	-	-	-	-	-	-	-
	09-Aug-12	9.6	0.046	<0.071	<0.050	<0.050	0.5	0.5	0.018	-	-	-	-
		10.6	-	-	-	-	-	-	-	-	-	-	-
	12-Sep-12	**166.0**	0.012	<0.071	<0.050	<0.050	1.7	1.7	**0.075**	0.049	-	-	-
	19-Oct-12 [7]	236.0 [9]	0.035	<0.071	<0.050	<0.050	1.1	1.1	0.027	<0.010	-	-	-
		20.4	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12 [7]	12.0	0.058	<0.071	<0.050	<0.050	1.0	1.0	0.017	<0.010	-	-	-
		15.0	-	-	-	-	-	-	-	-	-	-	-
	19-Nov-12 [7]	6.4	0.069	<0.071	<0.050	<0.050	0.8	0.8	0.014	<0.010	-	-	-
		4.2	-	-	-	-	-	-	-	-	-	-	-
	22-Nov-12 [7]	8.8	0.085	<0.071	<0.050	<0.050	1.0	1.0	0.012	<0.010	-	-	-
		14.6	-	-	-	-	-	-	-	-	-	-	-
	27-Nov-12 [5]	-	-	-	-	-	-	-	-	-	-	-	-
	02-May-13	7.7	0.228	<0.071	<0.050	<0.050	1.7	1.7	**0.101**	<0.010	-	-	-
	14-May-13	**18.0**	0.148	<0.071	<0.050	<0.050	2.9	2.9	**0.052**	0.015	-	-	-
	28-May-13	5.0	0.040	<0.071	<0.050	<0.050	0.7	0.7	0.021	<0.010	-	-	-
	24-Jul-13	**12.0**	0.020	<0.071	<0.050	<0.050	0.4	0.4	**0.027**	<0.010	-	-	-
	09-Oct-13	4.4	<0.010	<0.071	<0.050	<0.050	0.3	0.3	0.014	<0.010	-	-	-
BBL	27-Mar-13	<2.0	1.910	<0.050	<0.0050	<0.0010	3.3	3.3	**0.044**	0.033	0.00065	0.000201	0.000311
	02-May-13	5.3	1.080	<0.071	<0.050	<0.050	2.3	2.3	**0.041**	<0.010	-	-	-
	14-May-13	25.7	1.100	<0.071	0.064	<0.050	1.8	1.8	**0.043**	0.014	-	-	-
	28-May-13	8.0	0.072	<0.071	<0.050	<0.050	1.0	1.0	**0.028**	0.011	-	-	-
	24-Jul-13	3.5	0.312	<0.071	<0.050	<0.050	1.6	1.6	0.020	0.014	-	-	-
	09-Oct-13	3.6	0.081	<0.071	<0.050	<0.050	1.0	1.0	0.010	<0.010	-	-	-
BC1	02-Sep-11	5.0	<0.050	<0.071	<0.050	<0.050	1.1	1.1	0.023	0.021	<0.050	-	-
	26-Sep-11	<5.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.019	0.016	<0.050	-	-
	14-Oct-11	6.0	<0.050	<0.071	<0.050	<0.050	0.9	0.9	<0.010	<0.010	<0.050	-	-
	29-Oct-11	<2.0	<0.010	0.031	0.031	<0.0010	0.8	-	0.024	0.020	0.0019	-	-
	02-Nov-11	<5.0	<0.050	<0.071	<0.050	<0.050	0.8	0.8	0.021	0.020	<0.050	-	-
	17-Jan-12	2.8	-	-	-	-	-			-	-	-	-
	07-Feb-12	<2.0	-	-	-	-	-	-	-	-	-	-	-
	21-Feb-12	<2.0	-	-	-	-	-	-	-	-	-	-	-
	16-Mar-12	4.0	0.134	<0.071	<0.050	<0.050	1.0	1.0	0.018	<0.010	-	-	-
	17-Apr-12 [7]	<2.0	0.022	<0.071	<0.050	<0.050	0.8	0.8	0.015	<0.010	-	-	-
		<2.0	-	-	-	-	-	-	-	-	-	-	-
	13-Jun-12	3.2	0.013	<0.071	<0.050	<0.050	0.8	0.8	0.013	<0.010	-	-	-
	09-Aug-12	4.0	0.044	<0.071	<0.050	<0.050	0.4	0.4	0.017	-	-	-	-
		<2.0	-	-	-	-	-	-	-	-	-	-	-
	12-Sep-12	6.4	0.034	<0.071	<0.050	<0.050	0.8	0.8	0.023	0.010	-	-	-
	19-Oct-12 [7]	4.8	0.041	0.114	0.114	<0.050	0.8	0.9	0.014	<0.010	-	-	-
		6.5	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12 [7]	5.4	0.075	<0.071	<0.050	<0.050	0.9	0.9	0.013	<0.010	-	-	-
		2.4	-	-	-	-	-	-	-	-	-	-	-
	19-Nov-12 [7]	5.2	0.075	<0.071	<0.050	<0.050	0.8	0.8	0.015	<0.010	-	-	-
		<2.0	-	-	-	-	-	-	-	-	-	-	-
	22-Nov-12 [7]	5.2	0.097	0.079	0.079	<0.050	0.9	1.0	<0.010	<0.010	-	-	-
		3.8	-	-	-	-	-	-	-	-	-	-	-

TABLE 4.2-2
GENERAL WATER QUALITY (2011 - 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters [1]											
		T.S.S.	Ammonia (as N)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	T.K.N.	Total Nitrogen	Total Phosphorus	Total Dissolved Phosphorus	Mercury (Total) (ug/L)	Dissolved Mercury (Methyl) (ug/L)	Total Mercury (Methyl) (ug/L)
EQL		*2.0*	*0.01*	*0.0051/ 0.005 [2] / 0.071 [3]*	*0.005 [2] / 0.05 [3]*	*0.001 [2] / 0.05 [3]*	*0.2*	*0.2*	*0.01*	*0.01*	*0.001*	*0.000001*	*0.000001*
	27-Nov-12 [4]	3.3	0.374	<0.071	<0.050	<0.050	1.2	1.2	0.015	<0.010	-	-	-
		4.4	0.368	<0.071	<0.050	<0.050	1.2	1.2	0.014	<0.010	-	-	-
	27-Mar-13	<2.0	1.440	<0.071	<0.050	<0.050	2.7	2.8	0.031	0.023	-	-	-
	2-May-13 [4]	**24.7**	1.530	<0.071	<0.050	<0.050	2.2	2.2	0.049	<0.010	-	-	-
		23.0	1.130	<0.071	<0.050	<0.050	2.6	2.6	**0.051**	<0.010	-	-	-
	14-May-13	**18.3**	0.432	<0.071	<0.050	<0.050	1.1	1.1	0.038	0.010	-	-	-
	28-May-13	**11.5**	0.085	<0.071	<0.050	<0.050	0.8	0.8	0.026	<0.010	-	-	-
	24-Jul-13	4.0	0.124	0.076	0.076	<0.050	1.2	1.2	0.021	0.014	-	-	-
	09-Oct-13	2.8	0.044	0.087	0.087	<0.050	0.9	1.0	0.011	<0.010	-	-	-
BC2	02-Sep-11	<5.0	<0.050	<0.071	<0.050	<0.050	1.1	1.1	0.018	0.018	<0.050	-	-
	26-Sep-11	6.0	<0.050	<0.071	<0.050	<0.050	0.9	0.9	0.020	0.017	<0.050	-	-
	14-Oct-11	<5.0	<0.050	<0.071	<0.050	<0.050	0.9	0.9	0.011	<0.010	<0.050	-	-
	29-Oct-11	<2.0	<0.010	0.006	0.006	<0.0010	0.8	-	0.025	0.022	0.0016	-	-
	02-Nov-11	<5.0	<0.050	<0.071	<0.050	<0.050	0.8	0.8	0.019	0.018	<0.050	-	-
	04-Nov-11	30.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.042	0.016	<0.050	-	-
	07-Nov-11	22.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.025	0.013	<0.050	-	-
	10-Nov-11	13.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.026	0.015	<0.050	-	-
	14-Nov-11	10.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.020	0.014	<0.050	-	-
	17-Nov-11	13.0	0.080	<0.071	<0.050	<0.050	1.0	1.0	0.011	<0.010	<0.050	-	-
	17-Jan-12	4.0	0.069	0.023	0.021	0.002	1.0	1.0	0.017	0.011	<0.001	<0.00005	<0.00005
	07-Feb-12	4.8	0.101	<0.071	<0.050	<0.050	1.1	1.1	0.014	-	-	-	-
	21-Feb-12	4.4	0.123	<0.071	<0.050	<0.050	1.0	1.0	0.016	0.014	-	-	-
	16-Mar-12	8.8	0.125	<0.071	<0.050	<0.050	1.0	1.0	0.020	<0.010	-	-	-
	17-Apr-12 [7]	2.0	0.020	<0.071	<0.050	<0.050	0.8	0.8	0.015	<0.010	-	-	-
		2.0	-	-	-	-	-	-	-	-	-	-	-
	16-May-12	2.4	<0.010	<0.071	<0.050	<0.050	0.9	0.9	0.010	<0.010	-	-	-
	13-Jun-12	4.8	0.019	<0.071	<0.050	<0.050	0.9	0.9	0.015	<0.010	-	-	-
	09-Aug-12	6.6	0.035	<0.071	<0.050	<0.050	0.4	0.4	0.019	.	-	-	-
	12-Sep-12	**10.6**	0.032	<0.071	<0.050	<0.050	0.9	0.9	0.019	<0.010	-	-	-
	19-Oct-12 [7]	7.2	0.052	0.075	0.075	<0.050	0.8	0.9	0.016	<0.010	-	-	-
		5.0	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12 [21]	-	-	-	-	-	-	-	-	-	-	-	-
	19-Nov-12 [7]	**21.4**	0.078	<0.071	<0.050	<0.050	0.8	0.8	0.016	<0.010	-	-	-
		8.0	-	-	-	-	-	-	-	-	-	-	-
	22-Nov-12	6.6	0.096	<0.071	0.069	<0.050	0.9	0.9	0.012	<0.010	-	-	-
	27-Nov-12	2.8	0.364	<0.071	<0.050	<0.050	1.2	1.2	0.013	<0.010			
	27-Mar-13	<2.0	1.550	<0.071	<0.050	<0.050	2.8	2.8	**0.054**	0.023	-	-	-
	02-May-13	**20.0**	1.51	<0.071	<0.050	<0.050	2.1	2.1	0.049	<0.010	-	-	-
	14-May-13	**16.0**	0.381	<0.071	<0.050	<0.050	1.0	1.0	0.034	0.011	-	-	-
	28-May-13	8.5	0.064	<0.071	<0.050	<0.050	1.1	1.1	0.022	<0.010	-	-	-
	24-Jul-13	5.0	0.087	0.102	0.102	<0.050	1.3	1.4	0.023	0.013	-	-	-
	09-Oct-13	5.6	<0.010	<0.071	0.052	<0.050	1.0	1.0	0.016	<0.010	-	-	-

TABLE 4.2-2
GENERAL WATER QUALITY (2011 - 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters [1]											
		T.S.S.	Ammonia (as N)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	T.K.N.	Total Nitrogen	Total Phosphorus	Total Dissolved Phosphorus	Mercury (Total) (ug/L)	Dissolved Mercury (Methyl) (ug/L)	Total Mercury (Methyl) (ug/L)
EQL		*2.0*	*0.01*	*0.0051/ 0.005 (2) / 0.071 (3)*	*0.005 (2) / 0.05 (3)*	*0.001 (2) / 0.05 (3)*	*0.2*	*0.2*	*0.01*	*0.01*	*0.001*	*0.000001*	*0.000001*
BC4	7-Feb-12	5.2	-	-	-	-	-	-	-	-	-	-	-
	21-Feb-12	4.8	-	-	-	-	-	-	-	-	-	-	-
	16-Mar-12	**16.0**	0.128	<0.071	<0.050	<0.050	1.0	1.0	0.024	<0.010	-	-	-
	17-Apr-12 (7)	2.4	0.018	<0.071	<0.050	<0.050	0.8	0.8	0.014	0.010	-	-	-
		<2.0	-	-	-	-	-	-	-	-	-	-	-
	16-May-12	<2.0	<0.010	<0.071	<0.050	<0.050	0.9	0.9	0.011	0.010	-	-	-
	13-Jun-12	4.4	0.021	<0.071	<0.050	<0.050	<0.20	<0.20	0.016	<0.010	-	-	-
	09-Aug-12	7.8	0.035	<0.071	<0.050	<0.050	0.3	0.3	0.021	-	-	-	-
		8.0	-	-	-	-	-	-	-	-	-	-	-
	12-Sep-12	**11.3**	0.032	<0.071	<0.050	<0.050	0.9	0.9	0.019	<0.010	-	-	-
	19-Oct-12 (7)	5.4	0.054	0.073	0.073	<0.050	0.9	0.9	0.019	<0.010	-	-	-
		6.8	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12 (21)	-	-	-	-	-	-	-	-	-	-	-	-
	19-Nov-12 (7)	**22.6**	0.081	<0.071	<0.050	<0.050	0.8	0.8	0.015	<0.010	-	-	-
		20.8	-	-	-	-	-	-	-	-	-	-	-
	22-Nov-12 (7)	7.2	0.098	0.074	0.074	<0.050	0.9	0.9	0.012	<0.010	-	-	-
		5.8	-	-	-	-	-	-	-	-	-	-	-
	27-Nov-12 (5)	-	-	-	-	-	-	-	-	-	-	-	-
	02-May-13	**16.3**	1.100	<0.071	<0.050	<0.050	1.8	1.8	0.040	<0.010	-	-	-
	14-May-13	**18.3**	0.375	<0.071	<0.050	<0.050	1.0	1.0	0.034	0.010	-	-	-
	28-May-13	7.6	0.064	<0.071	<0.050	<0.050	0.8	0.8	0.022	<0.010	-	-	-
	24-Jul-13	8.0	0.064	0.116	0.116	<0.050	1.1	1.2	0.024	0.012	-	-	-
	09-Oct-13	6.4	<0.010	<0.071	<0.050	<0.050	0.9	0.9	0.017	<0.010	-	-	-
BC5	7-Feb-12	3.6	-	-	-	-	-	-	-	-	-	-	-
	21-Feb-12	3.2	-	-	-	-	-	-	-	-	-	-	-
	16-Mar-12	**17.6**	0.130	<0.071	<0.050	<0.050	1.0	1.0	0.023	<0.010	-	-	-
	17-Apr-12	4.0	0.019	<0.071	<0.050	<0.050	0.8	0.8	0.015	0.010	-	-	-
	16-May-12	3.6	<0.010	<0.071	<0.050	<0.050	0.9	0.9	0.011	0.010	-	-	-
	13-Jun-12	5.2	0.022	<0.071	<0.050	<0.050	0.8	0.8	0.017	<0.010	-	-	-
	09-Aug-12	6.6	0.034	<0.071	<0.050	<0.050	0.4	0.4	0.018	-	-	-	-
		6.6	-	-	-	-	-	-	-	-	-	-	-
	12-Sep-12	**10.8**	0.035	<0.071	<0.050	<0.050	0.8	0.8	0.019	<0.010	-	-	-
	19-Oct-12 (7)	7.2	0.055	0.074	0.074	<0.050	1.0	1.0	0.015	<0.010	-	-	-
		10.8	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12 (7)	6.4	0.090	<0.071	<0.050	<0.050	0.9	0.9	0.016	<0.010	-	-	-
		6.2	-	-	-	-	-	-	-	-	-	-	-
	19-Nov-12 (7)	**21.0**	0.081	<0.071	<0.050	<0.050	0.9	0.9	0.015	<0.010	-	-	-
		32.2	-	-	-	-	-	-	-	-	-	-	-
	22-Nov-12	7.8	0.103	0.077	0.077	<0.050	0.9	1.0	0.011	<0.010	-	-	-
	27-Nov-12 (5)	-	-	-	-	-	-	-	-	-	-	-	-
	02-May-13	**13.0**	1.15	<0.071	0.063	<0.050	1.5	1.5	0.035	<0.010	-	-	-
	14-May-13	**16.7**	0.389	<0.071	<0.050	<0.050	1.5	1.5	0.037	0.015	-	-	-
	28-May-13	**11.5**	0.055	<0.071	<0.050	<0.050	0.8	0.8	0.024	<0.010	-	-	-
	24-Jul-13 (4)	9.0	0.049	0.098	0.098	<0.050	1.0	1.1	0.026	0.013	-	-	-
		9.5	0.074	0.100	0.100	<0.050	1.1	1.2	0.027	0.013	-	-	-
	9-Oct-13 (4)	8.4	<0.010	<0.071	<0.050	<0.050	1.0	1.0	0.021	<0.010	-	-	-
		8.4	<0.010	<0.071	<0.050	<0.050	0.9	0.9	0.020	<0.010	-	-	-
BC-TM	02-May-13	**21.6**	-	-	-	-	-	-	-	-	-	-	-
	14-May-13	**20.0**	-	-	-	-	-	-	-	-	-	-	-
	28-May-13	**11.5**	-	-	-	-	-	-	-	-	-	-	-
	24-Jul-13	**10.0**	-	-	-	-	-	-	-	-	-	-	-
	14-Aug-13 (23)	9.5	-	-	-	-	-	-	-	-	-	-	-
		10.5	-	-	-	-	-	-	-	-	-	-	-
	09-Oct-13	8.8	-	-	-	-	-	-	-	-	-	-	-
	16-Oct-13	6.8	-	-	-	-	-	-	-	-	-	-	-

TABLE 4.2-2
GENERAL WATER QUALITY (2011 - 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters [1]											
		T.S.S.	Ammonia (as N)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	T.K.N.	Total Nitrogen	Total Phosphorus	Total Dissolved Phosphorus	Mercury (Total) (ug/L)	Dissolved Mercury (Methyl) (ug/L)	Total Mercury (Methyl) (ug/L)
EQL		*2.0*	*0.01*	*0.0051/ 0.005 [2] / 0.071 [3]*	*0.005 [2] / 0.05 [3]*	*0.001 [2] / 0.05 [3]*	*0.2*	*0.2*	*0.01*	*0.01*	*0.001*	*0.000001*	*0.000001*
BC3	02-Sep-11	6.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.026	0.017	<0.050	-	-
	26-Sep-11	<5.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.020	0.018	<0.050	-	-
	14-Oct-11	<5.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.015	<0.010	<0.050	-	-
	29-Oct-11	4.4	<0.010	<0.0051	<0.0050	<0.0010	0.7	-	0.011	0.011	0.002	-	-
	02-Nov-11	<5.0	<0.050	<0.071	<0.050	<0.050	0.7	0.7	0.020	0.018	<0.050	-	-
	04-Nov-11	60.0	<0.050	<0.071	<0.050	<0.050	1.2	1.2	0.061	0.014	<0.050	-	-
	07-Nov-11	40.0	<0.050	<0.071	<0.050	<0.050	0.9	0.9	0.034	0.012	<0.050	-	-
	10-Nov-11	26.0	<0.050	<0.071	<0.050	<0.050	1.2	1.2	0.031	0.013	<0.050	-	-
	14-Nov-11	17.0	<0.050	<0.071	<0.050	<0.050	1.3	1.3	0.023	0.013	<0.050	-	-
	17-Nov-11	20.0	0.065	<0.071	<0.050	<0.050	1.0	1.0	0.012	<0.010	<0.050	-	-
	25-Nov-11	32.0	0.054	<0.071	<0.050	<0.050	1.0	1.0	0.035	0.011	<0.050	-	-
	17-Jan-12	4.8	0.065	0.025	0.024	0.001	1.0	1.0	0.014	0.012	<0.001	<0.00005	<0.00005
	07-Feb-12	6.8	-	-	-	-	-	-	-	-	-	-	-
	21-Feb-12	6.4	-	-	-	-	-	-	-	-	-	-	-
	16-Mar-12	**24.4**	0.125	<0.071	<0.050	<0.050	1.4	1.4	0.020	<0.010	-	-	-
	17-Apr-12	6.4	0.019	<0.071	<0.050	<0.050	0.8	0.8	0.015	0.011	-	-	-
	16-May-12 [8]	6.8	-	<0.050	<0.0050	<0.0010	0.9	0.9	0.012	0.011	0.0010	0.000076	0.000116
		8.4	-	<0.0051	<0.0050	<0.0010	0.9	0.9	0.012	0.010	-	-	-
		8.0	-	<0.050	<0.0050	<0.0010	1.0	1.0	<0.014	0.010	-	-	-
	13-Jun-12	5.6	0.026	<0.071	<0.050	<0.050	0.8	0.8	0.019	<0.010	-	-	-
	09-Aug-12	9.0	0.036	<0.071	<0.050	<0.050	0.4	0.4	0.020	-	-	-	-
		7.8	-	-	-	-	-	-	-	-	-	-	-
	12-Sep-12	**13.3**	0.035	<0.071	<0.050	<0.050	0.8	0.8	0.017	<0.010	-	-	-
	19-Oct-12 [7]	8.3	0.058	0.076	0.076	<0.050	0.8	0.9	0.015	<0.010	-	-	-
		6.8	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12 [7]	7.6	0.088	<0.071	<0.050	<0.050	0.9	0.9	0.015	<0.010	-	-	-
		6.4	-	-	-	-	-	-	-	-	-	-	-
	19-Nov-12 [7]	**19.7**	0.093	<0.071	<0.050	<0.050	0.9	0.9	0.017	<0.010	-	-	-
		16.4	-	-	-	-	-	-	-	-	-	-	-
	22-Nov-12	7.8	0.105	0.076	0.076	<0.050	0.9	1.0	0.012	<0.010	-	-	-
	27-Nov-12 [5]	-	-	-	-	-	-	-	-	-	-	-	-
	02-May-13	**16.0**	0.211	0.086	0.086	<0.050	1.4	1.5	0.035	<0.010	-	-	-
	14-May-13	**15.3**	0.355	<0.071	<0.050	<0.050	1.3	1.3	0.041	0.012	-	-	-
	28-May-13	**15.0**	0.029	<0.071	<0.050	<0.050	0.7	0.7	0.028	<0.010	-	-	-
	24-Jul-13	**10.5**	0.020	0.073	0.073	<0.050	1.0	1.0	0.029	0.014	-	-	-
	09-Oct-13	**15.2**	<0.010	<0.071	<0.050	<0.050	0.9	0.9	0.025	<0.010	-	-	-
	02-Sep-11	8.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.023	0.012	<0.050	-	-
	26-Sep-11	<5.0	0.057	<0.071	<0.050	<0.050	1.3	1.3	0.023	0.013	<0.050	-	-
	14-Oct-11	<5.0	<0.050	<0.071	<0.050	<0.050	1.5	1.5	0.022	<0.010	0.087	-	-
	29-Oct-11	8.0	0.069	0.017	0.015	0.0026	1.1	-	0.017	<0.010	<0.0010	-	-
	02-Nov-11	<5.0	0.075	<0.071	<0.050	<0.050	1.5	1.5	0.021	0.013	<0.050	-	-
	04-Nov-11	12.0	0.082	<0.071	<0.050	<0.050	1.1	1.1	0.025	0.015	<0.050	-	-
	07-Nov-11	8.0	0.091	<0.071	<0.050	<0.050	1.0	1.0	0.019	0.012	<0.050	-	-
	10-Nov-11	<5.0	0.089	<0.071	<0.050	<0.050	1.1	1.1	0.022	0.013	<0.050	-	-
	14-Nov-11	6.0	0.092	<0.071	<0.050	<0.050	1.0	1.0	0.019	0.013	<0.050	-	-
	17-Nov-11	9.0	0.090	<0.071	<0.050	<0.050	1.0	1.0	0.010	0.012	<0.050	-	-
	25-Nov-11	7.0	0.147	<0.071	<0.050	<0.050	0.9	0.9	0.021	0.015	<0.050	-	-

TABLE 4.2-2
GENERAL WATER QUALITY (2011 - 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters [1]											
		T.S.S.	Ammonia (as N)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	T.K.N.	Total Nitrogen	Total Phosphorus	Total Dissolved Phosphorus	Mercury (Total) (ug/L)	Dissolved Mercury (Methyl) (ug/L)	Total Mercury (Methyl) (ug/L)
EQL		*2.0*	*0.01*	*0.0051/ 0.005 [2] / 0.071 [3]*	*0.005 [2] / 0.05 [3]*	*0.001 [2] / 0.05 [3]*	*0.2*	*0.2*	*0.01*	*0.01*	*0.001*	*0.000001*	*0.000001*
DR1	18-Jan-12	<2.0	0.114	0.029	0.026	0.003	1.1	1.1	0.022	-	<0.001	<0.00005	<0.00005
	07-Feb-12	2.4	-	-	-	-	-	-	-	-	-	-	-
	09-Feb-12	<2.0	0.179	<0.071	<0.050	<0.050	1.2	1.2	0.017	-	-	-	-
	21-Feb-12	<2.0	0.216	<0.071	<0.050	<0.050	1.2	1.2	0.016	<0.010	-	-	-
	16-Mar-12	6.8	0.168	<0.071	<0.050	<0.050	1.1	1.1	0.029	<0.010	-	-	-
	17-Apr-12	6.4	0.042	<0.071	<0.050	<0.050	0.9	0.9	0.018	0.011	-	-	-
	16-May-12 [7]	12.8	-	<0.0051	<0.0050	<0.0010	1.0	1.0	0.013	<0.010	0.0011	<0.00005	0.000073
		11.6	-	-	-	-		-	-	-	-	-	-
	13-Jun-12 [7]	12.0	0.038	<0.071	<0.050	<0.050	1.0	1.0	0.026	<0.010	-	-	-
		8.4	-	-	-	-	-	-	-	-	-	-	-
	09-Aug-12	10.6	0.017	<0.071	<0.050	<0.050	0.3	0.3	0.019	-	-	-	-
		9.8	-	-	-	-	-	-	-	-	-	-	-
	12-Sep-12	25.6	<0.010	<0.071	<0.050	<0.050	0.9	0.9	0.013	<0.010	-	-	-
	19-Oct-12 [7]	21.2	0.049	<0.071	<0.050	<0.050	1.0	1.0	0.021	<0.010	-	-	-
		19.2	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12 [7]	6.6	0.057	<0.071	<0.050	<0.050	0.9	0.9	0.015	<0.010	-	-	-
		8.6	-	-	-	-	-	-	-	-	-	-	-
	19-Nov-12 [7]	10.0	0.074	<0.071	<0.050	<0.050	0.9	0.9	0.016	<0.010	-	-	-
		7.2	-	-	-	-	-	-	-	-	-	-	-
	22-Nov-12	6.6	0.077	<0.071	<0.050	<0.050	0.9	0.9	0.011	<0.010	-	-	-
	27-Nov-12 [7]	4.6	0.088	<0.071	<0.050	<0.050	1.0	1.0	0.010	<0.010	-	-	-
		4.8	-	-	-	-	-	-	-	-	-	-	-
	26-Mar-13	<2.0	0.263	0.046	0.044	0.002	1.2	1.2	0.011	0.004	0.00025	<0.000050	<0.000050
	2-May-13 [7]	11.7	0.83	<0.071	<0.050	<0.050	1.1	1.1	0.014	<0.010	-	-	-
		7.0	-	-	-	-	-	-	-	-	-	-	-
	14-May-13 [7]	10.8	0.082	<0.071	<0.050	<0.050	1.0	1.0	0.017	<0.010	-	-	-
		10.0	-	-	-	-	-	-	-	-	-	-	-
	28-May-13 [22]	11.5	<0.010	<0.071	<0.050	<0.050	0.7	0.7	0.020	<0.010	-	-	-
		11.0	0.013	<0.071	<0.050	<0.050	0.7	0.7	0.020	<0.010	-	-	-
		12.0	-	-	-	-	-	-	-	-	-	-	-
	24-Jul-13 [7]	8.5	<0.010	<0.071	<0.050	<0.050	0.9	0.9	0.019	0.010	-	-	-
		8.5	-	-	-	-	-	-	-	-	-	-	-
	9-Oct-13 [7]	7.6	<0.010	<0.071	<0.050	<0.050	0.9	0.9	0.015	<0.010	-	-	-
		7.6	-	-	-	-	-	-	-	-	-	-	-
DR-TM	14-Aug-13	6.0	-	-	-	-	-	-	-	-	-	-	-
	16-Oct-13 [23]	7.2	-	-	-	-	-	-	-	-	-	-	-
		8.0	-	-	-	-	-	-	-	-	-	-	-
	02-Sep-11	7.0	<0.050	<0.071	<0.050	<0.050	1.2	1.2	0.024	0.014	<0.050	-	-
	26-Sep-11	5.0	0.057	<0.071	<0.050	<0.050	1.2	1.2	0.025	0.013	<0.050	-	-
	14-Oct-11	7.0	<0.050	<0.071	<0.050	<0.050	1.1	1.1	0.020	<0.010	<0.050	-	-
	29-Oct-11	7.5	0.068	0.017	0.015	0.002	1.1	-	0.017	<0.010	<0.0010	-	-
	02-Nov-11	8.0	0.074	<0.071	<0.050	<0.050	1.0	1.0	0.020	0.014	<0.050	-	-
	04-Nov-11	69.0	<0.050	<0.071	<0.050	<0.050	1.1	1.1	0.070	0.019	<0.050	-	-
	07-Nov-11	64.0	<0.050	<0.071	<0.050	<0.050	1.1	1.1	0.052	0.031	<0.050	-	-
	10-Nov-11	26.0	<0.050	<0.071	<0.050	<0.050	1.1	1.1	0.033	0.014	<0.050	-	-
	14-Nov-11	27.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.025	0.014	<0.050	-	-
	17-Nov-11	16.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.016	0.014	<0.050	-	-
	25-Nov-11	22.0	0.057	<0.071	<0.050	<0.050	0.8	0.8	0.032	0.012	<0.050	-	-
	7-Feb-12	3.2	-	-	-	-	-	-	-	-	-	-	-
	21-Feb-12	2.8	-	-	-	-	-	-	-	-	-	-	-
	16-Mar-12	5.6	0.164	<0.071	<0.050	<0.050	1.1	1.1	0.018	<0.010	-	-	-
	17-Apr-12	4.0	0.039	<0.071	<0.050	<0.050	1.0	1.0	0.018	0.011	-	-	-
	16-May-12 [7]	3.6	<0.010	<0.071	<0.050	<0.050	0.8	0.8	0.010	0.010	-	-	-
		7.2	-	-	-	-		-	-	-	-	-	-

TABLE 4.2-2
GENERAL WATER QUALITY (2011 - 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters [1]											
		T.S.S.	Ammonia (as N)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	T.K.N.	Total Nitrogen	Total Phosphorus	Total Dissolved Phosphorus	Mercury (Total) (ug/L)	Dissolved Mercury (Methyl) (ug/L)	Total Mercury (Methyl) (ug/L)
EQL		*2.0*	*0.01*	*0.0051/ 0.005 [2] / 0.071 [3]*	*0.005 [2] / 0.05 [3]*	*0.001 [2] / 0.05 [3]*	*0.2*	*0.2*	*0.01*	*0.01*	*0.001*	*0.000001*	*0.000001*
DR3	13-Jun-12 [7]	2.3	0.026	<0.071	<0.050	<0.050	0.8	0.8	0.018	<0.010	-	-	-
		11.2	-	-	-	-	-	-	-	-	-	-	-
	09-Aug-12	8.0	0.023	<0.071	<0.050	<0.050	0.3	0.3	0.019	-	-	-	-
		8.2	-	-	-	-	-	-	-	-	-	-	-
	12-Sep-12	21.2	0.017	<0.071	<0.050	<0.050	1.0	1.0	0.024	<0.010	-	-	-
	19-Oct-12 [7]	**38.2**	0.059	0.075	0.075	<0.050	0.8	0.9	0.016	<0.010	-	-	-
		19.6	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12 [5]	-	-	-	-	-	-	-	-	-	-	-	-
	19-Nov-12 [5]	-	-	-	-	-	-	-	-	-	-	-	-
	22-Nov-12 [5]	-	-	-	-	-	-	-	-	-	-	-	-
	27-Nov-12 [5]	-	-	-	-	-	-	-	-	-	-	-	-
	2-May-13 [7]	13.7	0.181	<0.071	0.056	<0.050	1.1	1.1	0.016	<0.010	-	-	-
		7.0	-	-	-	-	-	-	-	-			
	14-May-13 [22]	**21.8**	0.230	<0.071	<0.050	<0.050	1.1	1.1	0.036	<0.010	-	-	-
		19.2	0.249	<0.071	<0.050	<0.050	1.2	1.2	0.035	<0.010	-	-	-
		10.0	-	-	-	-	-	-	-	-	-	-	-
	28-May-13 [7]	10.5	<0.010	<0.071	<0.050	<0.050	0.7	0.7	0.019	<0.010	-	-	-
		12.5	-	-	-	-	-	-	-	-	-	-	-
	24-Jul-13 [7]	9.0	<0.010	<0.071	<0.050	<0.050	0.9	0.9	0.016	0.011	-	-	-
		10.0	-	-	-	-	-	-	-	-	-	-	-
	9-Oct-13 [7]	8.8	<0.010	<0.071	<0.050	<0.050	0.9	0.9	0.015	<0.010	-	-	-
		6.4	-	-	-	-	-	-	-	-	-	-	-
	02-Sep-11	10.0	<0.050	<0.071	<0.050	<0.050	1.1	1.1	0.025	0.011	<0.050	-	-
	26-Sep-11	<5.0	0.055	<0.071	<0.050	<0.050	1.1	1.1	0.026	0.013	<0.050	-	-
	14-Oct-11	<5.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.024	0.018	0.09	-	-
	29-Oct-11	7.6	0.067	0.017	0.014	0.0025	1.1	-	0.018	<0.010	0.0011	-	-
	02-Nov-11	5.0	0.074	<0.071	<0.050	<0.050	1.0	1.0	0.020	0.014	<0.050	-	-
	04-Nov-11	11.0	0.085	<0.071	<0.050	<0.050	1.1	1.1	0.031	0.017	<0.050	-	-
	10-Nov-11	23.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.028	0.013	<0.050	-	-
	14-Nov-11	19.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.024	0.014	<0.050	-	-
	17-Nov-11	16.0	<0.050	<0.071	<0.050	<0.050	1.0	1.0	0.012	0.010	<0.050	-	-

TABLE 4.2-2
GENERAL WATER QUALITY (2011 - 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters (1)											
		T.S.S.	Ammonia (as N)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	T.K.N.	Total Nitrogen	Total Phosphorus	Total Dissolved Phosphorus	Mercury (Total) (ug/L)	Dissolved Mercury (Methyl) (ug/L)	Total Mercury (Methyl) (ug/L)
EQL		*2.0*	*0.01*	*0.0051/ 0.005 (2) / 0.071 (3)*	*0.005 (2) / 0.05 (3)*	*0.001 (2) / 0.05 (3)*	*0.2*	*0.2*	*0.01*	*0.01*	*0.001*	*0.000001*	*0.000001*
DR2C	17-Jan-12	4.0	-	-	-	-	-	-	-	-	-	-	-
	07-Feb-12	4.4	-	-	-	-	-	-	-	-	-	-	-
	21-Feb-12	4.8	0.180	<0.071	<0.050	<0.050	1.0	1.0	0.016	0.013	-	-	-
	16-Mar-12	9.2	0.154	<0.071	<0.050	<0.050	1.1	1.1	0.024	0.014	-	-	-
	17-Apr-12	5.6	0.026	<0.071	<0.050	<0.050	0.8	0.8	0.017	<0.010	-	-	-
	16-May-12 (7)	13.2	-	<0.010	<0.0050	<0.001	1.0	1.0	0.018	<0.010	0.0012	<0.00005	0.000061
		4.4	-	-	-	-		-	-	-	-	-	-
	13-Jun-12 (7)	5.2	0.028	<0.071	<0.050	<0.050	0.8	0.8	0.019	<0.010	-	-	-
		6.8	-	-	-	-	-	-	-	-	-	-	-
	09-Aug-12	6.6	0.028	<0.071	<0.050	<0.050	0.3	0.3	0.018	-	-	-	-
		10.2	-	-	-	-	-	-	-	-	-	-	-
	12-Sep-12	21.2	0.011	<0.071	<0.050	<0.050	0.9	0.9	0.015	<0.010	-	-	-
	19-Oct-12 (7)	9.8	0.054	<0.071	0.062	<0.050	0.9	0.9	0.018	<0.010	-	-	-
		17.7	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12 (5)	-	-	-	-	-	-	-	-	-	-	-	-
	19-Nov-12 (5)	-	-	-	-	-	-	-	-	-	-	-	-
	22-Nov-12 (5)	-	-	-	-	-	-	-	-	-	-	-	-
	27-Nov-12 (5)	-	-	-	-	-	-	-	-	-	-	-	-
	25-Mar-13	2.0	0.255	<0.050	0.026	<0.0010	1.2	1.2	0.008	0.004	0.00014	<0.000050	<0.000050
	2-May-13 (7)	9.7	0.205	<0.071	0.058	<0.050	1.1	1.1	0.017	<0.010	-	-	-
		10.7	-	-	-	-	-	-	-	-	-	-	-
	14-May-13 (7)	18.8	0.120	<0.071	<0.050	<0.050	1.2	1.2	0.024	<0.010	-	-	-
		9.3	-	-	-	-	-	-	-	-	-	-	-
	28-May-13 (7)	10.0	<0.010	<0.071	<0.050	<0.050	0.7	0.7	0.022	<0.010	-	-	-
		12.5	-	-	-	-	-	-	-	-	-	-	-
	24-Jul-13 (7)	9.0	<0.010	<0.071	<0.050	<0.050	0.9	0.9	0.020	<0.010	-	-	-
		9.5	-	-	-	-	-	-	-	-	-	-	-
	9-Oct-13 (7)	9.2	<0.010	<0.071	<0.050	<0.050	0.8	0.8	0.016	<0.010	-	-	-
		6.0	-	-	-	-	-	-	-	-	-	-	-
Water Quality Standards													
CCME - Protection of Aquatic Life (11)		(13)	(14)	(15)	3.0 (16)	0.06 (17)	-	-	(10)	-	0.026	-	0.004
MWQSOG Surface Water: Aquatic Life and Wildlife		Narrative-(19)	(20)	-	-	0.06	-	-	0.025 (lakes and streams entering lakes)/ 0.05 (other streams) (24)	-	0.026	-	0.004

Notes:
"-" = No Data

EQL = Estimated Quantitation Limit = The lowest level of the parameter that can be quantified with confidence

T.K.N. = Total Kjeldahl Nitrogen
T.S.S. = Total Suspended Solids

1. All values are expressed in milligrams per litre (mg/L) unless indicated otherwise.
2. Samples taken as part of the Regional Sampling Program (2012-2013) in conjunction with 2012-2013 Water Quality Monitoring Program on these dates: 17&18-Jan-12; 9-Feb-12; 16-May-12; and 24-26-Mar-13 (LSM1,DR1,DR2C).
3. Samples taken as part of the 2012-2013 Water Quality Monitoring Program on these dates: 7-Feb-12; 21-Feb-12; 16-Mar-12; 17-Apr-12; 13-June-12; 9-Aug-12; 12-Sept-12; 19-Oct-12; 13-Nov-12; 19-Nov-12; 22-Nov-12; 27-Nov-12; 27-Mar-13(EC2,BC1,BC2); 2-May-13; 14-May-13; 28-May-13; 24-Jul-13; and 9-Oct-13.
4. From top to bottom: sample; duplicate sample
5. Not able to sample due to ice cover
6. From top to bottom: sample; additional TSS sample; and duplicated TSS sample
7. From top to bottom: sample; additional TSS sample.
8. Triplicate sample for Regional program
9. TSS Sample was inundated with fine sediment due to rotor wash from the heliciopter during sampling; TSS2 represents more typical conditions during this sample event for this station
10. If trigger ranges for total phosphorous are exceeded, the potential exists for an environmental impact. If trigger range is not exceeded, but TP is more than 50% above baseline values, the potential exists for an environmental impact. Trigger Ranges for Total Phosphorus are as follow (mg/L):
    - ultra-oligotrophic <0.004
    - oligotrophic 0.004-0.010
    - mesotrophic 0.010-0.020
    - meso-eutrophic 0.020-0.035
    - eutrophic 0.035-0.10
    - hyper-eutrophic >0.10
11. CCME - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999. Updated January 2011.
    - Water Quality Guidelines for the Protection of Aquatic Life
12. Turbidity Guidelines (see fact sheet for complete details):

    Clear Flow:
    Maximum increase of 8 NTUs from background levels for a short-term exposure (e.g. 24 hr period).
    Maximum average increase of 2 NTUs from background levels for a longer term exposure (e.g. 30 day period).
    High Flow or Turbid Waters:
    Maximum increase of 8 NTUs from background levels at any one time when background levels are between 8 and 80 NTUs.
    Should not increase more than 10% of background levels when background is >80 NTUs.

TABLE 4.2-2
GENERAL WATER QUALITY (2011 - 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample	Date	Parameters [1]										
		T.S.S.	Ammonia (as N)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	T.K.N.	Total Nitrogen	Total Phosphorus	Total Dissolved Phosphorus	Mercury (Total) (ug/L)	Dissolved Mercury (Methyl) (ug/L)	Total Mercury (Methyl) (ug/L)
EQL		*2.0*	*0.01*	*0.0051/ 0.005 [2] / 0.071 [3]*	*0.005 [2] / 0.05 [3]*	*0.001 [2] / 0.05 [3]*	*0.2*	*0.2*	*0.01*	*0.01*	*0.001*	*0.000001*	*0.000001*

13. Suspended sediments

Clear Flow

Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g., 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d).

High flow

Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L. Should not increase more than 10% of background levels when background is ≥ 250 mg/L.

14. Total ammonia as N guideline is pH and Temperature dependant.

Water Quality Guidelines for Total Ammonia (as N) (mg/L) for the Protection of Aquatic Life

Temp (°C)	pH						
	6	**7**	**7.5**	**8**	**8.5**	**9**	**10**
0	190.0	19.00	6.02	1.92	0.616	0.206	0.035
5	125.8	12.58	3.98	1.27	0.413	0.141	0.028
10	83.9	8.47	2.68	0.86	0.282	0.100	0.024
15	49.1	5.74	1.83	0.59	0.197	0.073	0.021
20	39.5	3.96	1.27	0.41	0.141	0.055	0.020
25	27.6	2.77	0.89	0.29	0.103	0.044	0.018

15. Equivalent to 10 mg/L as nitrate-nitrogen. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg/L, which is equivalent to 1 mg/L nitrite-nitrogen.
16. Guidelines are expressed in nitrate-nitrogen per litre. These values are equivalent to 13 mg/L of nitrate.
17. Guidelines are expressed in nitrite-nitrogen per litre. These values are equivalent to 0.197 mg/L of nitrite.
18. Turbidity uses equivalent induced levels of change as calculated from site-specific or regional-specific correlation between TSS and Turbidity
19. Total Suspended Sediment Guidelines:
    5 mg/L Induced Change over 30 days from background TSS <= 25 mg/L
    25 mg/L Induced Change over 1 day from background TSS <= 250 mg/L
    10% Induced Change over 1 day from background TSS > 250 mg/L
20. MWQSOG Surface Water Ammonia Guideline for Aquatic Life, Cool Water, All Periods (Eq. 3). Manitoba Water Stewardship, November 2011.
21. No data was collected - helicopter was required for additional tasks; field crew chose to delete mid-stream sample stations to meet the available schedule for the helicopter
22. From top to bottom: sample, duplicate sample, additional TSS sample from other side of river
23. From top to botton: TSS sample, duplicate TSS sample
24. Unless it can be demonstrated that total phosphorus is not a limiting factor, considering the morphological, physical, chemical, or other characteristics of the water body, total phosphorus should not exceed 0.025 mg/L in any reservoir, lake, or pond, or in a tributary at the point where it enters such bodies of water. In other streams, total phosphorus should not exceed 0.05 mg/L.

	- Exceedance of CCME Guidelines
BOLD	- Exceedance of MWQSOG Guidelines

TABLE ECS-4
PETROLEUM HYDROCARBONS IN WATER (2012)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample No.	Date	Parameter [1]										
		Benzene	Toluene	Ethyl-benzene	Xylenes (-o,-m)	Xylenes (-p)	Xylenes (-o,-m,-p)	F1 (C6 - C10)	F2 (C10 - C16)	F3 (C16 - C34)	F4 (C34 - C50)	Total Hydrocarbons (C6 - C50)
LSM1	9-Feb-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
DUP (LSM1)	9-Feb-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
LSM1	13-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
DUP (LSM1)	13-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
LSM1	19-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
DUP (LSM1)	19-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
LSM1	22-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
DUP (LSM1)	22-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
EC-2	13-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
	19-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
	22-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
DR-1	13-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
	19-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
	22-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
	27-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
BC-1	13-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
	19-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
	22-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
	27-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
DUP (BC1)	27-Nov-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
BC2	9-Feb-12	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.0015	<0.10	<0.25	<0.25	<0.25	<0.44
EQL		*0.0005*	*0.001*	*0.0005*	*0.0005*	*0.0005*	*0.0015*	*0.1*	*0.25*	*0.25*	*0.25*	*0.44*
CCME [2]												
CCME [2] Freshwater Aquatic Life		370	2	90			-	-	-	-	-	-
MWQSOG Surface Water: Aquatic Life and Wildlife [3]		370	2	90			-	-	-	-	-	-

Notes:
EQL = Estimated Quantitation Limit = Lowest level of the parameter that can be quantified with confidence.
"-" = No Data

1. All concentrations in micrograms per litre (µg/L).
2. CCME - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines 1999. Updated January 2011.
   Chapter 4 - Aquatic Life
   MAC - Maximum Acceptable Concentration
   AO - Aesthetic Objective
3. Manitoba Water Stewardship - Manitoba Water Quality Standards, Objectives, and Guidelines. November 28th, 2011.

- Exceedance of CCME Criteria

TABLE ECS-5
QA/QC SAMPLES (2012 AND 2013)
LAKE ST. MARTIN EMERGENCY OUTLET CHANNEL SYSTEM

Sample No.	Date	Parameters																				
		Turbidity (NTU)	T.S.S.	Ammonia (as N)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	T.K.N.	Total Nitrogen	Total Phosphorus	Total Dissolved Phosphorus	Benzene	Toluene	Ethyl-benzene	Xylenes (-o)	Xylenes (-m,-p)	Xylenes (-o,-m,-p)	F1 (C6 - C10)	F2 (C10 - C16)	F3 (C16 - C34)	F4 (C34 - C50)	Total Hydrocarbons (C6 - C50)
EQL		*0.1*	*2.0*	*0.01*	*0.0051/ 0.005 (1) / 0.071 (2)*	*0.005 (1) / 0.05 (2)*	*0.001 (1) / 0.05 (2)*	*0.2*	*0.2*	*0.01/ 0.001*	*0.01/ 0.001*	*0.0005*	*0.001*	*0.0005*	*0.0005*	*0.0005*	*0.0015*	*0.1*	*0.25*	*0.25*	*0.25*	*0.44*
Trip Blank	17-Jan-12	<0.10	<2.0	<0.010	<0.0051	<0.005	<0.001	<0.2	<0.2	<0.001	<0.010	-	-	-	-	-	-	-	-	-	-	-
	07-Feb-12	<0.10	<2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09-Feb-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	<0.0005	<0.001	<0.005	<0.0005	<0.0005	<0.0015	<0.1	<0.25	<0.25	<0.25	<0.44
	21-Feb-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	16-Mar-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	17-Apr-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	16-May-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	13-Jun-12	<0.10	<2.0	0.015	<0.071	<0.005	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	12-Sep-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	19-Oct-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	<0.0005	<0.001	<0.005	<0.0005	<0.0005	<0.0015	<0.1	<0.25	<0.25	<0.25	<0.44
	19-Nov-12	0.20	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	<0.0005	<0.001	<0.005	<0.0005	<0.0005	<0.0015	<0.1	<0.25	<0.25	<0.25	<0.44
	22-Nov-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	<0.0005	<0.001	<0.005	<0.0005	<0.0005	<0.0015	<0.1	<0.25	<0.25	<0.25	<0.44
	27-Nov-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	<0.0005	<0.001	<0.0005	<0.0005	<0.0005	<0.0015	<0.1	<0.25	<0.25	<0.25	<0.44
	27-Mar-13	1.22	<2.0	<0.010	<0.0051	<0.005	<0.001	<0.20	<0.20	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-
	02-May-13	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	14-May-13	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	28-May-13	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	24-Jul-13	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	09-Oct-13	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
Field Blank	17-Jan-12	<0.10	<2.0	<0.010	<0.0051	<0.005	<0.001	<0.20	<0.2	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	07-Feb-12	<0.10	<2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	09-Feb-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	21-Feb-12	0.12	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	16-Mar-12	0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	17-Apr-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	16-May-12	<0.10	<2.0	-	<0.050	<0.005	<0.001	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	13-Jun-12	0.15	<2.0	<0.010	<0.071	<0.005	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	12-Sep-12	0.15	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	19-Oct-12	0.16	<2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13-Nov-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	<0.0005	<0.001	<0.005	<0.0005	<0.0005	<0.0015	<0.1	<0.25	<0.25	<0.25	<0.44
	19-Nov-12	0.16	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	<0.0005	<0.001	<0.005	<0.0005	<0.0005	<0.0015	<0.1	<0.25	<0.25	<0.25	<0.44
	22-Nov-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	<0.0005	<0.001	<0.005	<0.0005	<0.0005	<0.0015	<0.1	<0.25	<0.25	<0.25	<0.44
	27-Nov-12	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	<0.0005	<0.001	<0.0005	<0.0005	<0.0005	<0.0015	<0.1	<0.25	<0.25	<0.25	<0.44
	27-Mar-13	<0.10	<2.0	<0.010	<0.0051	<0.005	<0.001	<0.20	-	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-
	02-May-13	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	14-May-13	0.14	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	28-May-13	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	24-Jul-13	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-
	09-Oct-13	<0.10	<2.0	<0.010	<0.071	<0.050	<0.050	<0.20	<0.20	<0.010	<0.010	-	-	-	-	-	-	-	-	-	-	-

1. Samples taken as part of the Regional Sampling Program (2012-2013) in conjunction with 2012-2013 Water Quality Monitoring Program on these dates: 17&18-Jan-12; 9-Feb-12; 16-May-12; and 27-Mar-13.
2. Samples taken as part of the 2012-2013 Water Quality Monitoring Program on these dates: 7-Feb-12; 21-Feb-12; 16-Mar-12; 17-Apr-12; 13-June-12; 9-Aug-12; 12-Sept-12; 19-Oct-12; 13-Nov-12; 19-Nov-12; 22-Nov-12; 27-Nov-12; 2-May-13; 14-May-13; 28-May-13; 24-Jul-13; and 9-Oct-13.

Sample Summary Report

Sample ID	BBL	
Sample Date	3/27/2013	
Station	BBL (2013-03-27)	
Location		
Geology		
Watertype	Na-Mg-Ca-HCO3-Cl	
Temperature (°C)		
pH	7.49	
Conductivity	1080	uS/cm
Sum of Anions	11.57086	meq/L
Sum of Cations	11.1963	meq/L
Balance	-1.645157	%
Total dissolved solids	798.6072	mg/L
Total hardness		mg/l CaCO3
Alkalinity	7.6668	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	100	4.349761	4.349761
K	8.59	0.2197026	0.2197026
Ca	57.4	1.432207	2.864415
Mg	45.3	1.863814	3.727628
Cl	144	4.061749	4.061749
SO4	11.2	0.1166667	0.2333333
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	419	6.866923	6.866923

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.267108	0.7684283	0.319	0.194
Ca/SO4	5.125	12.27606	0.152	0.364
Na/Cl	0.6944444	1.070908	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	BBL			
Sample Date	5/28/2013			
Station	BBL (2013-05-28)			
Location				
Geology				
Watertype	Mg-Ca-Na-HCO3-Cl			
Temperature (°C)				
pH	8.54			
Conductivity	504	uS/cm		
Sum of Anions	5.420451	meq/L		
Sum of Cations	5.109641	meq/L		
Balance	-2.951637	%		
Total dissolved solids	372.0164	mg/L		
Total hardness		mg/l CaCO3		
Alkalinity	3.995701	mg/l CaCO3		
Major ion composition	mg/l	mmol/l	meq/l	
Na	36.6	1.592012	1.592012	
K	4.01	0.102562	0.102562	
Ca	32.7	0.815909	1.631818	
Mg	21.6	0.888706	1.777412	
Cl	48.9	1.379303	1.379303	
SO4	20.8	0.2166667	0.4333333	
NO3	<0.05	<8.064516E-04	<8.064516E-04	
HCO3	195	3.195823	3.195823	
Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.513889	0.9180865	0.319	0.194
Ca/SO4	1.572115	3.765734	0.152	0.364
Na/Cl	0.7484662	1.154216	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	BC1	
Sample Date	5/28/2013	
Station	BC1 (2013-05-28)	
Location		
Geology		
Watertype	Mg-Ca-Na-HCO3	
Temperature (°C)		
pH	8	
Conductivity	401	uS/cm
Sum of Anions	4.592157	meq/L
Sum of Cations	4.267093	meq/L
Balance	-3.669201	%
Total dissolved solids	321.0372	mg/L
Total hardness		mg/l CaCO3
Alkalinity	3.979312	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	23.9	1.039593	1.039593
K	2.73	6.982401E-02	6.982401E-02
Ca	30.2	0.7535307	1.507061
Mg	20	0.822876	1.645752
Cl	29	0.8179913	0.8179913
SO4	8.85	9.218751E-02	0.184375
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	194	3.179435	3.179435

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.51	0.9157282	0.319	0.194
Ca/SO4	3.412429	8.173891	0.152	0.364
Na/Cl	0.8241379	1.270909	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	BC3	
Sample Date	5/28/2013	
Station	BC3 (2013-05-28)	
Location		
Geology		
Watertype	Mg-Ca-Na-HCO3	
Temperature (°C)		
pH	8.15	
Conductivity	343	uS/cm
Sum of Anions	4.044163	meq/L
Sum of Cations	3.810629	meq/L
Balance	-2.973136	%
Total dissolved solids	283.9359	mg/L
Total hardness		mg/l CaCO3
Alkalinity	3.618757	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	20	0.8699521	0.8699521
K	2.33	5.959338E-02	5.959338E-02
Ca	28.3	0.7061231	1.412246
Mg	17.8	0.7323596	1.464719
Cl	22.5	0.6346484	0.6346484
SO4	8.68	9.041667E-02	0.1808333
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	172	2.81888	2.81888

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.589888	0.9641753	0.319	0.194
Ca/SO4	3.260368	7.809656	0.152	0.364
Na/Cl	0.8888889	1.370762	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	DR1			
Sample Date	3/26/2013			
Station	DR1 (2013-03-26)			
Location				
Geology				
Watertype	Na-Mg-Cl-HCO3			
Temperature (°C)				
pH	8.2			
Conductivity	1340	uS/cm		
Sum of Anions	13.75067	meq/L		
Sum of Cations	13.5873	meq/L		
Balance	-0.5975908	%		
Total dissolved solids	899.5618	mg/L		
Total hardness		mg/l CaCO3		
Alkalinity	5.306808	mg/l CaCO3		
Major ion composition	mg/l	mmol/l	meq/l	
Na	171	7.438091	7.438091	
K	10.7	0.2736692	0.2736692	
Ca	54.3	1.354858	2.709716	
Mg	38.3	1.575807	3.151615	
Cl	243	6.854202	6.854202	
SO4	94.5	0.984375	1.96875	
NO3	0.0439	7.080645E-04	7.080645E-04	
HCO3	275	4.50693	4.50693	
Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.417755	0.8597866	0.319	0.194
Ca/SO4	0.5746031	1.376364	0.152	0.364
Na/Cl	0.7037037	1.085187	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	DR2C			
Sample Date	3/25/2013			
Station	DR2C (2013-03-25)			
Location				
Geology				
Watertype	Na-Mg-Cl-HCO3			
Temperature (°C)				
pH	8.09			
Conductivity	1340	uS/cm		
Sum of Anions	13.77242	meq/L		
Sum of Cations	13.169	meq/L		
Balance	-2.23976	%		
Total dissolved solids	892.4976	mg/L		
Total hardness		mg/l CaCO3		
Alkalinity	5.339585	mg/l CaCO3		
Major ion composition	mg/l	mmol/l	meq/l	
Na	166	7.220603	7.220603	
K	10.5	0.2685539	0.2685539	
Ca	51.7	1.289985	2.579969	
Mg	37.5	1.542892	3.085785	
Cl	243	6.854202	6.854202	
SO4	94.1	0.9802083	1.960417	
NO3	0.0264	4.258064E-04	4.258064E-04	
HCO3	277	4.539708	4.539708	
Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.378667	0.836082	0.319	0.194
Ca/SO4	0.5494155	1.316031	0.152	0.364
Na/Cl	0.6831276	1.053456	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	EC1	
Sample Date	5/28/2013	
Station	EC1 (2013-05-28)	
Location		
Geology		
Watertype	Mg-Ca-Na-HCO3-SO4	
Temperature (°C)		
pH	8.37	
Conductivity	571	uS/cm
Sum of Anions	6.448105	meq/L
Sum of Cations	5.812791	meq/L
Balance	-5.181632	%
Total dissolved solids	433.059	mg/L
Total hardness		mg/l CaCO3
Alkalinity	4.061256	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	30.3	1.317977	1.317977
K	3.3	8.440264E-02	8.440264E-02
Ca	32.2	0.8034334	1.606867
Mg	34	1.398889	2.797778
Cl	31.6	0.8913284	0.8913284
SO4	90.2	0.9395833	1.879167
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	199	3.261379	3.261379

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9470589	0.5743367	0.319	0.194
Ca/SO4	0.3569845	0.8550954	0.152	0.364
Na/Cl	0.9588607	1.478667	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	EC2	
Sample Date	5/28/2013	
Station	EC2 (2013-05-28)	
Location		
Geology		
Watertype	Mg-Ca-Na-HCO3-SO4	
Temperature (°C)		
pH	8.43	
Conductivity	498	uS/cm
Sum of Anions	5.553706	meq/L
Sum of Cations	5.086246	meq/L
Balance	-4.393442	%
Total dissolved solids	376.6483	mg/L
Total hardness		mg/l CaCO3
Alkalinity	3.897368	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	27	1.174435	1.174435
K	3.53	9.028526E-02	9.028526E-02
Ca	30.3	0.7560258	1.512052
Mg	28	1.152026	2.304053
Cl	32.9	0.927997	0.927997
SO4	53.5	0.5572917	1.114583
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	189	3.09749	3.09749

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.082143	0.6562574	0.319	0.194
Ca/SO4	0.5663551	1.356607	0.152	0.364
Na/Cl	0.8206686	1.265559	0.556	0.858
Cl/Br			287	648

Sample Summary Report

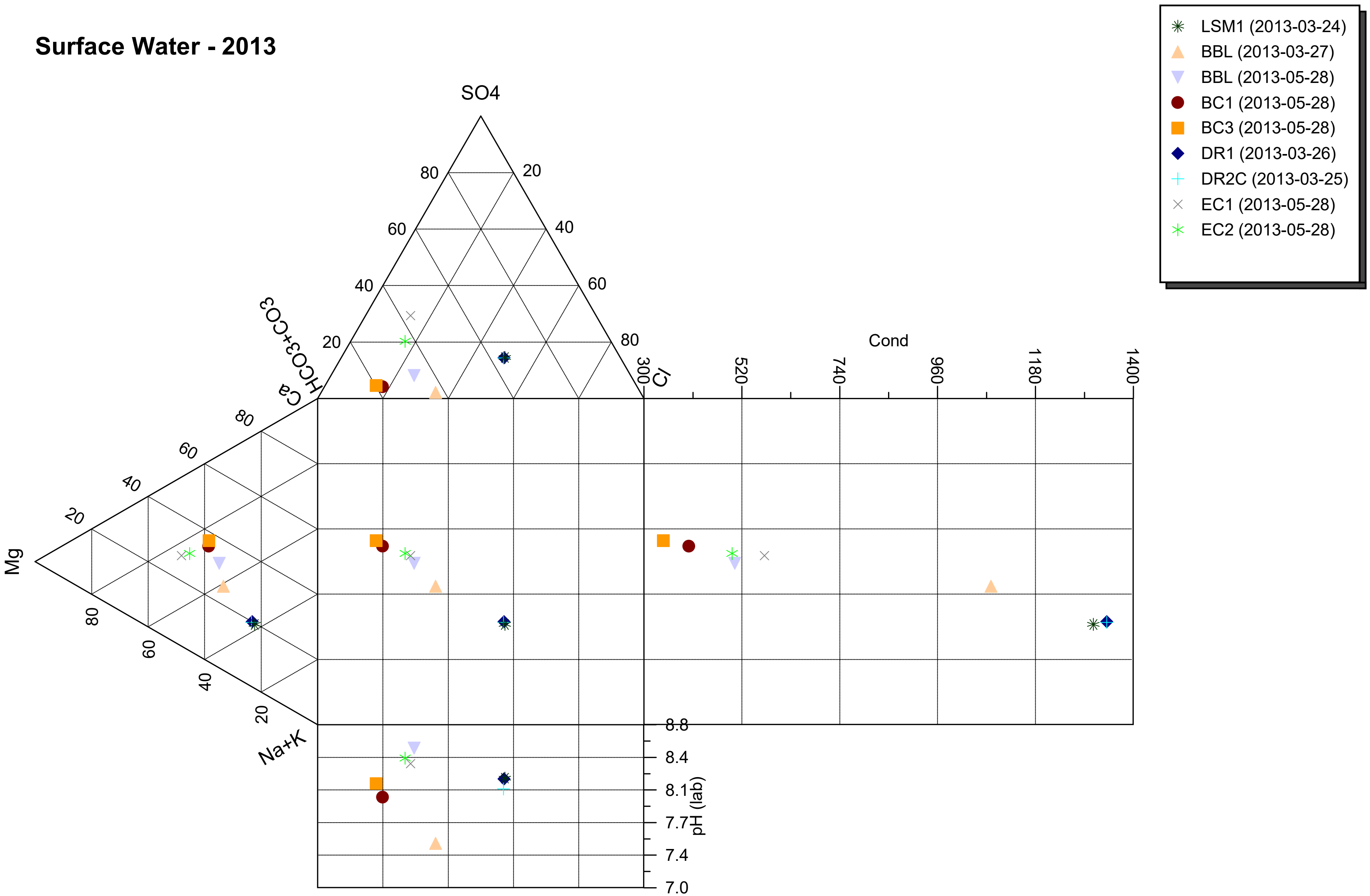
Sample ID	LSM1	
Sample Date	3/24/2013	
Station	LSM1 (2013-03-24)	
Location		
Geology		
Watertype	Na-Mg-Cl-HCO3	
Temperature (°C)		
pH	8.21	
Conductivity	1310	uS/cm
Sum of Anions	13.63051	meq/L
Sum of Cations	13.4169	meq/L
Balance	-0.7897565	%
Total dissolved solids	891.2137	mg/L
Total hardness		mg/l CaCO3
Alkalinity	5.224863	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	173	7.525086	7.525086
K	10.6	0.2711115	0.2711115
Ca	52.5	1.309946	2.619891
Mg	36.3	1.49352	2.98704
Cl	242	6.825996	6.825996
SO4	94.1	0.9802083	1.960417
NO3	0.035	5.645161E-04	5.645161E-04
HCO3	270	4.424986	4.424986

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.446281	0.8770863	0.319	0.194
Ca/SO4	0.5579171	1.336395	0.152	0.364
Na/Cl	0.7148761	1.102416	0.556	0.858
Cl/Br			287	648

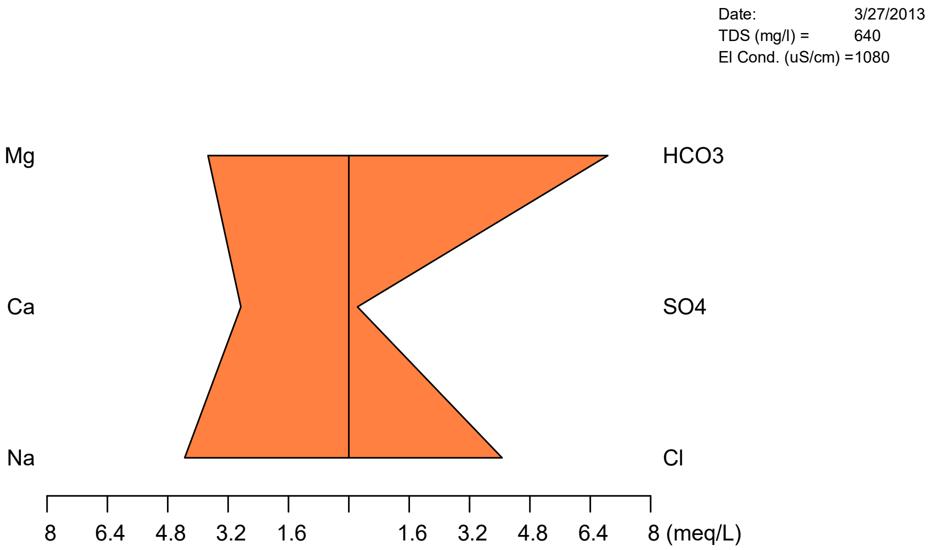
SW_LSM_2013

				Station	Date	Sample	Watertype			
FALSE	TRUE	52	102	BBL (2013-03-27)	3/27/2013	BBL	Na-Mg-Ca-HCO3-Cl		64	FALSE
FALSE	TRUE	53	103	BBL (2013-05-28)	5/28/2013	BBL	Mg-Ca-Na-HCO3-Cl		65	FALSE
FALSE	TRUE	54	104	BC1 (2013-05-28)	5/28/2013	BC1	Mg-Ca-Na-HCO3		66	FALSE
FALSE	TRUE	55	105	BC3 (2013-05-28)	5/28/2013	BC3	Mg-Ca-Na-HCO3		67	FALSE
FALSE	TRUE	56	106	DR1 (2013-03-26)	3/26/2013	DR1	Na-Mg-Cl-HCO3		68	FALSE
FALSE	TRUE	57	107	DR2C (2013-03-25)	3/25/2013	DR2C	Na-Mg-Cl-HCO3		69	FALSE
FALSE	TRUE	50	100	EC1 (2013-05-28)	5/28/2013	EC1	Mg-Ca-Na-HCO3-SO4		70	FALSE
FALSE	TRUE	51	101	EC2 (2013-05-28)	5/28/2013	EC2	Mg-Ca-Na-HCO3-SO4		71	FALSE
FALSE	TRUE	49	99	LSM1 (2013-03-24)	3/24/2013	LSM1	Na-Mg-Cl-HCO3		72	FALSE



Surface Water - 2013
SO4
Cl
Ca
HCO3+CO3
Mg
Na+K
Cond
pH (lab)
20
40
60
80
300
520
740
960
1180
1400
8.8
8.4
8.1
7.7
7.4
7.0
LSM1 (2013-03-24)
BBL (2013-03-27)
BBL (2013-05-28)
BC1 (2013-05-28)
BC3 (2013-05-28)
DR1 (2013-03-26)
DR2C (2013-03-25)
EC1 (2013-05-28)
EC2 (2013-05-28)

BBL (2013-03-27),3/27/2013



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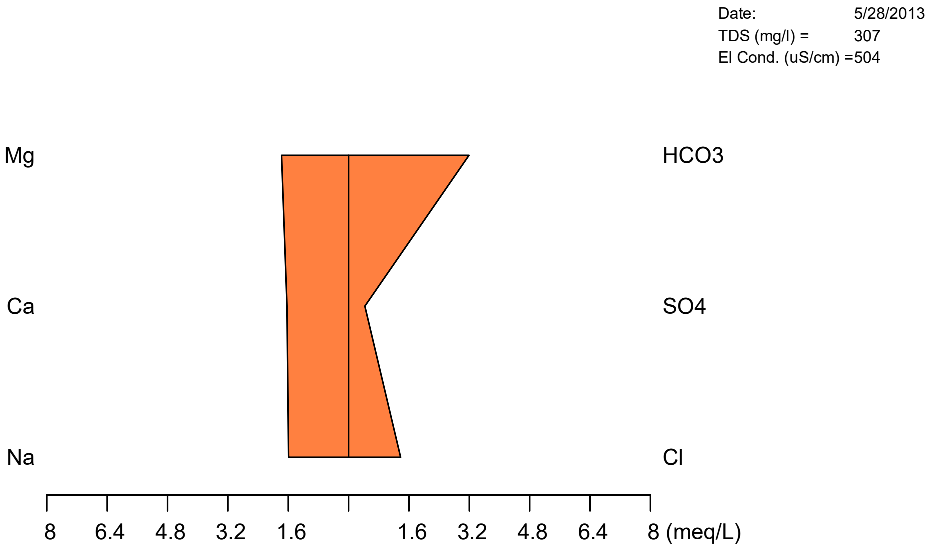
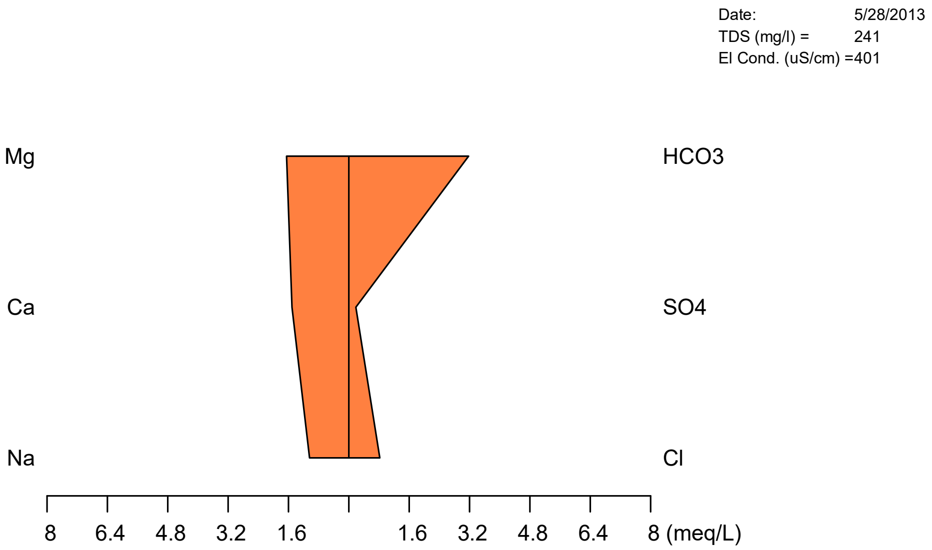


BC1 (2013-05-28),5/28/2013



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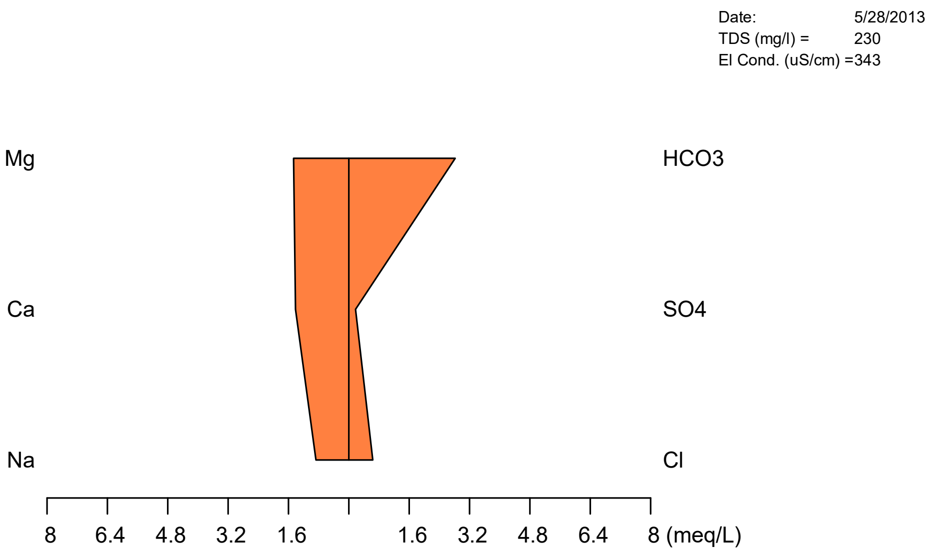

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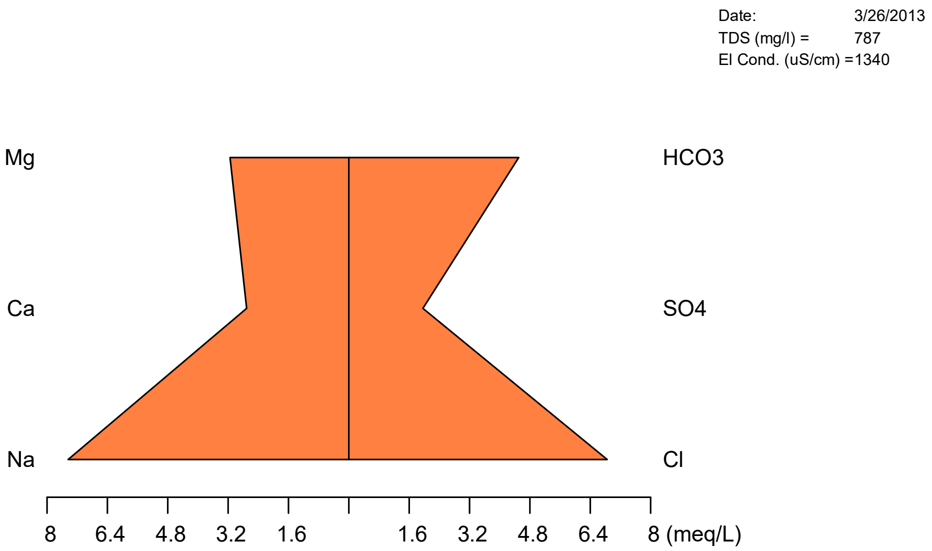
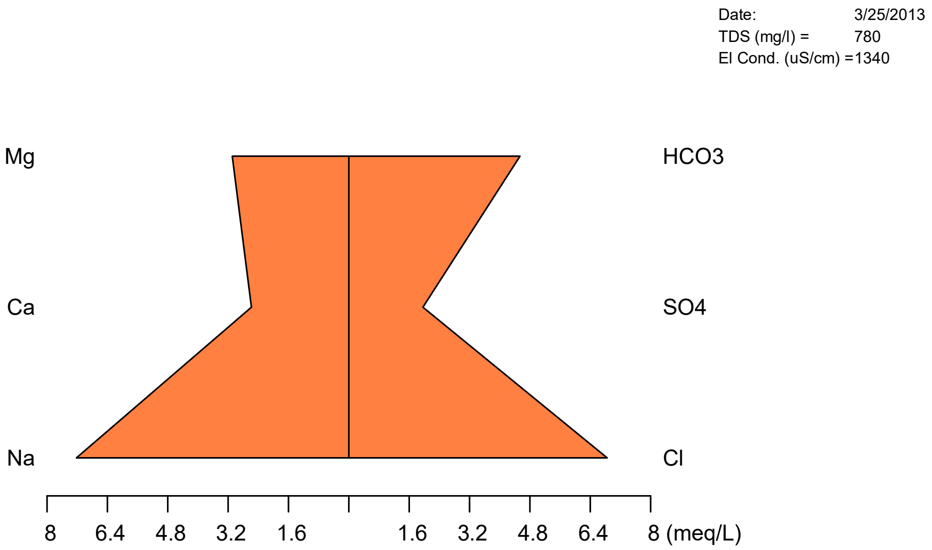


DR2C (2013-03-25),3/25/2013



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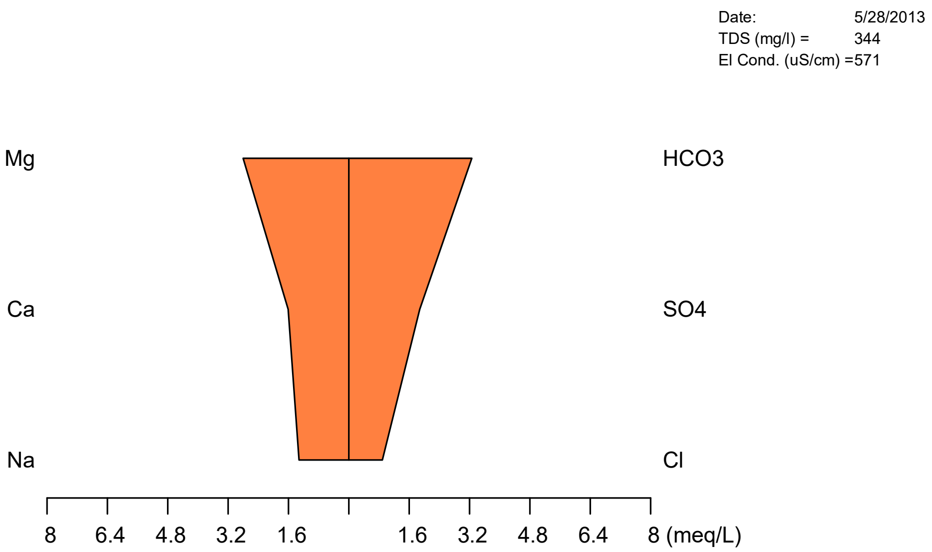
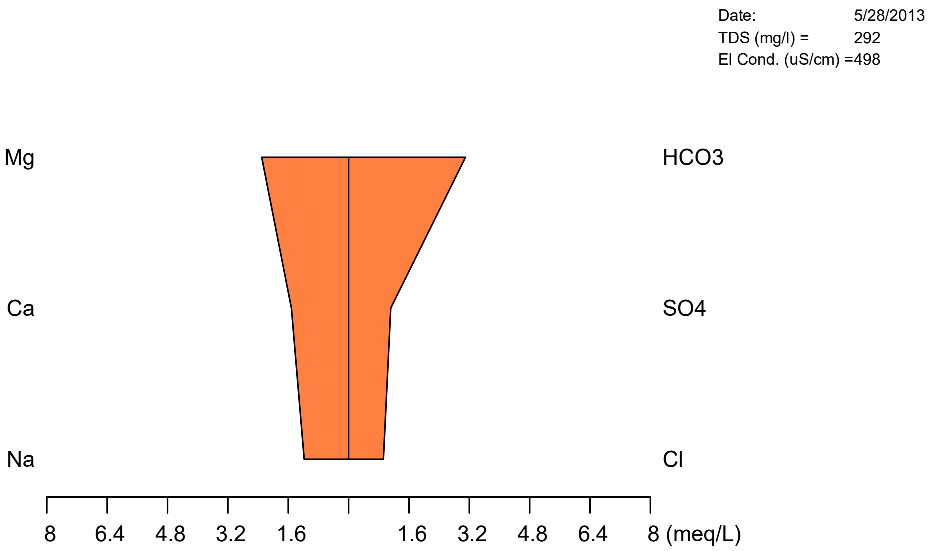
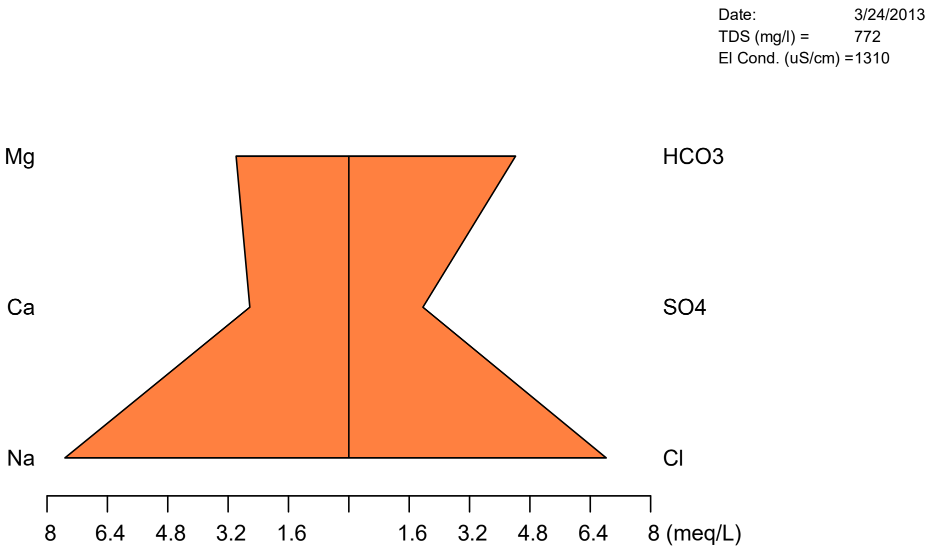
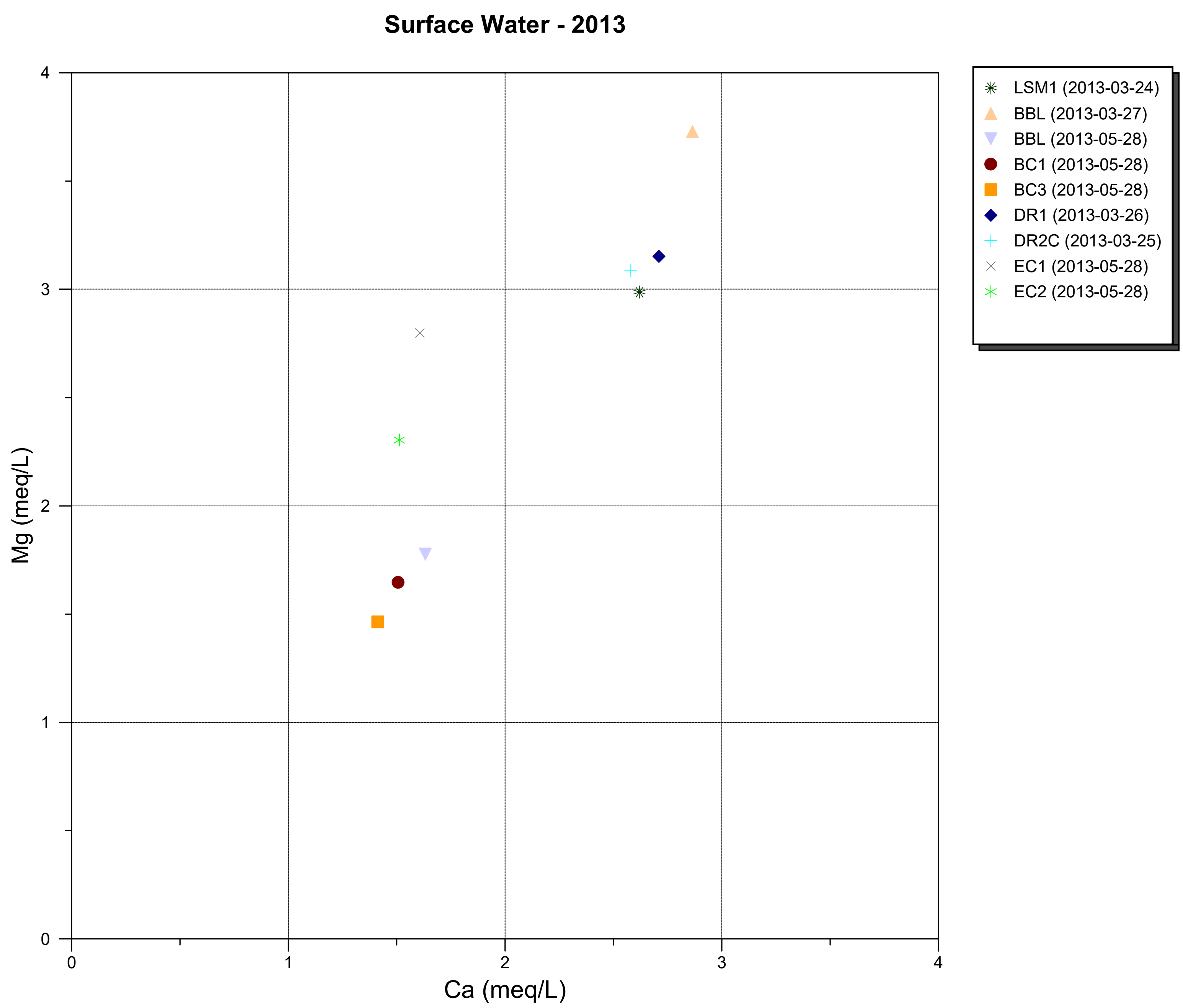


EC2 (2013-05-28),5/28/2013

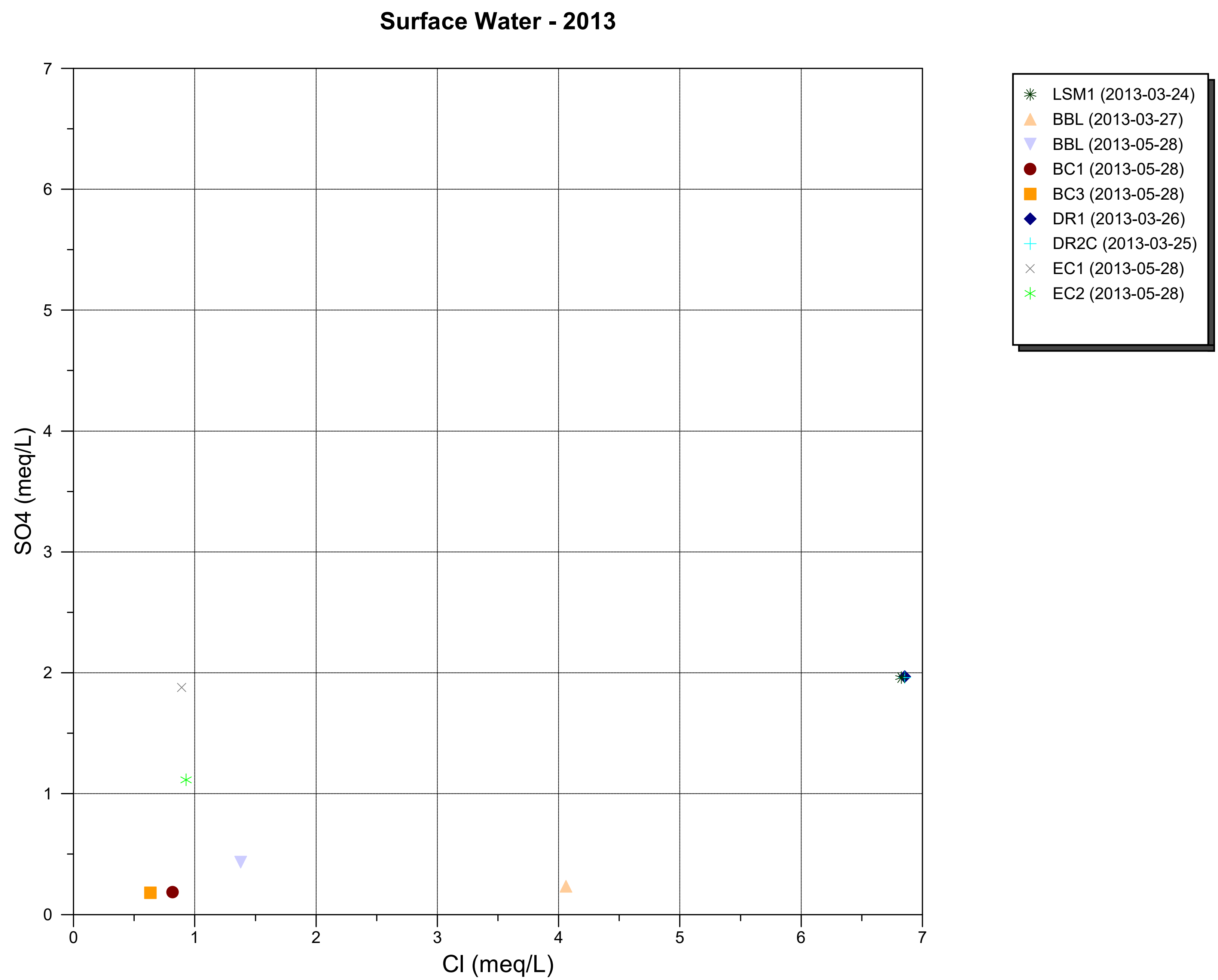


LSM1 (2013-03-24),3/24/2013





Surface Water - 2013
Mg (meq/L)
Ca (meq/L)
0
1
2
3
4
LSM1 (2013-03-24)
BBL (2013-03-27)
BBL (2013-05-28)
BC1 (2013-05-28)
BC3 (2013-05-28)
DR1 (2013-03-26)
DR2C (2013-03-25)
EC1 (2013-05-28)
EC2 (2013-05-28)


Surface Water - 2013
SO4 (meq/L)
Cl (meq/L)
0
1
2
3
4
5
6
7
LSM1 (2013-03-24)
BBL (2013-03-27)
BBL (2013-05-28)
BC1 (2013-05-28)
BC3 (2013-05-28)
DR1 (2013-03-26)
DR2C (2013-03-25)
EC1 (2013-05-28)
EC2 (2013-05-28)

APPENDIX A-4

Dauphin River First Nation Domestic Well

KGS GROUP

TABLE D3-3
GROUNDWATER GENERAL WATER QUALITY - ROUTE D
LAKE MANITOBA OUTLET CHANNELS

Sample No.	Date	Field / Lab Dup. Info	Parameter [1]															
			Turbidity (NTU)	pH (units)	E.C. (µS/cm)	T.D.S.	Alkalinity as $CaCO_3$	Bicarbonate (HCO_3)	Carbonate (CO_3)	Hydroxide (OH)	Hardness as $CaCO_3$	Chloride [5]	Fluoride	Sulphate	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	Ion Balance
EQL			*0.1*	*0.1*	*20*	*5*	*1*	*2*	*0.6*	*0.4*	*0.3*	*0.5*	*0.1*	*0.5*	*0.071*	*0.05*	*0.05*	*-*
5	16-Nov-11		15.5	7.82	827	544	368	449	<0.60	<0.40	406	28.2	0.22	105	<0.071	<0.050	<0.050	106
32/33	16-Nov-11		6.2	7.82	775	489	371	452	<0.60	<0.40	392	23.3	0.4	76.7	<0.071	<0.050	<0.050	101
34	16-Nov-11		9.1	7.84	768	487	371	453	<0.60	<0.40	400	21.7	0.41	74.9	<0.071	<0.050	<0.050	104
35/36	16-Nov-11		1.59	7.94	776	498	375	458	<0.60	<0.40	408	22.5	0.32	76.2	<0.071	<0.050	<0.050	106
67	16-Nov-11		4.6	7.97	796	511	372	454	<0.60	<0.40	406	28.1	0.46	82.7	<0.071	<0.050	<0.050	104
80	16-Nov-11		34	7.96	970	645	356	435	<0.60	<0.40	416	65.1	0.51	146	<0.071	<0.050	<0.050	102
98	16-Nov-11		1.89	8.07	974	626	361	440	<0.60	<0.40	379	64.3	0.3	146	<0.071	<0.050	<0.050	92.2
104/105	16-Nov-11		7.9	8.07	1000	656	351	428	<0.60	<0.40	393	72.3	0.47	159	<0.071	<0.050	<0.050	96
HC-CDWQ [2]																		
Drinking Water			0.3/1.0/0.1 (MAC)[8]	6.5 - 8.5 (AO)	-	500 (AO)	-	-	-	-	[9]	≤250 (AO)	1.5 (MAC)	500 (AO)	-	10 [4] (MAC)	1.0 [4] (MAC)	0.2 (MAC)
CCME[3] (Shown for Reference Only)																		
Freshwater Aquatic Life			Narrative [7]	6.5 - 9.0	-	-	-	-	-	-	-	120[5a]/640 [5b]	0.12	-	-	3[12]/ 124[11]	0.06	0.005

Notes:
EQL = Estimated Quantitation Limit = The lowest level of the parameter that can be quantified with confidence
"-" = No Data
E.C. = Electrical Conductivity
T.K.N. = Total Kjeldahl Nitrogen
T.D.S. = Total Dissolved Solids
RPD = Relative Percent Difference

1. All values are expressed in milligrams per litre (mg/L) unless otherwise specified.
2. Health Canada - Canadian Drinking Water Quality Guidelines (HC-CDWQ). Updated October 2014.
 MAC = Maximum Acceptable Concentration
 AO = Aesthetic Objectives
3. CCME - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999. Updated February 6, 2014.
 Canadian Water Quality Guidelines for the Protection of Aquatic Life
4. Equivalent to 10 mg/L as nitrate-nitrogen. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg/L, which is equivalent to 1 mg/L nitrite-nitrogen.
5. Chloride toxicity to freshwater organisms was evaluated using tests with both $CaCl_2$ and NaCl salts.
 a. Long-term exposure - May not be protective of certain species of endangered and special concern freshwater mussels. Refer to fact sheet for more explanation
 b. Short-term exposure - derived with severe-effect data (such as lethality) and are not intended to protect all components of aquatic ecosystem structure and function.
 but rather to protect most species against lethality during severe but transient events. Refer to fact sheet for more information
 c. Guideline is dependant on type of plant. See CCME summary table for details.
 Foliar damage
 = 100-178 mg/L for almond apricots and plums
 = 178-355 mg/L for grapes, peppers, potatoes and tomatoes
 = 355-710 mg/L for alfalfa, barley, corn, and cucumbers
 >710 mg/L for cauliflower, cotton, safflower, sesame, sorghum, sugar beets, and sunflowers
 Rootstocks
 = 180-600 mg/L for stone fruit (peaches, plums, etc.)
 = 710-900 mg/L for grapes
 Cultivars
 = 110-180 mg/L for strawberries
 = 230-460 mg/L for grapes
 = 250 mg/L for boysenberries, blackberries, and raspberries
6. Guideline for total ammonia is pH and Temperature dependent. See Factsheet for details.

7. Turbidity Guidelines (see fact sheet for complete details):
 Clear Flow:
 Maximum increase of 8 NTUs from background levels for a short-t
 Maximum average increase of 2 NTUs from background levels for
 High Flow or Turbid Waters:
 Maximum increase of 8 NTUs from background levels at any one ti
 Should not increase more than 10% of background levels when ba
8. Waterworks systems that use a surface water source or a groundwa
 following health-based turbidity limits, as defined for specific treatn
 turbidity levels as low as possible, with a treated water turbidity tar
 from individual filters:
 a) For chemically assisted filtration, shall be less than or equal to 0
 and shall not exceed 1.0 NTU at any time.
 b) For slow sand or diatomaceous earth filtration, shall be less tha
 calendar month, and shall not exceed 3.0 NTU at any time.
 c) For membrane filtration, shall be less than or equal to 0.1 NTU i
 not exceed 0.3 NTU at any time. If membrane filtration is the sole
 Turbidity values greater than 1 NTU are shaded.
9. Public acceptance of hardness varies considerably. Generally, hardr
 between corrosion and incrustation; where a water softener is us
10. If trigger ranges for total phosphorous are exceeded, the potential
 but TP is more than 50% above baseline values, the potential exist
 Trigger r <4 meso-eutrophic
 4-10 eutrophic
 10-20 hyper-eutrophic
11. Short-term exposure (24 to 96 hours) concentrations which indicat
 (spill events to aquatic receiving environments and infrequent relea
 These are NOT protective guidelines.
12. Long-term exposure guideline that protects all forms of aquatic life

TABLE D3-4
GROUNDWATER METALS - ROUTE D
LAKE MANITOBA OUTLET CHANNELS

Well No.	Date	Parameter (1)					
		Calcium	Iron	Magnesium	Manganese	Potassium	Sodium
EQL		*0.2*	*0.1*	*0.05*	*0.001*	*0.1*	*0.05*
5	16-Nov-11	58.9	0.3	63	0.0104	7.32	61.3
32/33	16-Nov-11	57	0.46	60.6	0.0076	6.46	42
34	16-Nov-11	57.4	0.61	62.3	0.0062	6.67	41.7
35/36	16-Nov-11	59.3	0.17	63.2	0.0056	7	44.7
67	16-Nov-11	58.5	0.57	63.1	0.0111	6.82	48.4
80	16-Nov-11	60.1	2.12	64.5	0.025	7.71	87
98	16-Nov-11	57.5	0.29	57.3	0.0063	7.79	77
104/105	16-Nov-11	57.5	0.65	60.6	0.0103	7.95	88
HC-CDWQ (2)							
Drinking Water		-	0.3 (AO)	-	0.05 (AO)	-	200 (AO)
CCME(3) (Shown for Reference Only)							
Freshwater Aquatic Life		-	0.3	-	-	-	-

Notes:
EQL = Estimated Quantitation Limit = Lowest level of the parameter that can be quantified with confidence
"-" = No Data
RPD = Relative Percent Difference

1. All values are expressed in milligrams per litre (mg/L) unless otherwise specified.
2. Health Canada - Canadian Drinking Water Quality Guidelines (HC-CDWQ). Updated October 2014.
   MAC = Maximum Acceptable Concentration
   AO = Aesthetic Objectives
   OG = Operational Guideline
3. CCME - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999. Updated February 6,
   Guidelines for Canadian Drinking Water Quality.
   Community Water Supplies (Health Canada - Canadian Drinking Water Quality Guidelines)
   Canadian Water Quality Guidelines for the Protection of Aquatic Life
   Canadian Water Quality Guidelines for the Protection of Agriculture Water Uses
4. This is an operational guidance value, designed to apply only to drinking water treatment plants using aluminum-based coagulants.
The operational guidance value of 0.1 mg/L applies to conventional treatment plants, and 0.2 mg/L applies to other types of treatment s
5. Total aluminum should not exceed 0.005 mg/L in waters with a pH below 6.5.
   The concentration of total aluminum should not exceed 0.1 mg/L in waters with a pH greater or equal to 6.5.
6. Short-term exposure (24 to 96 hours) concentrations which indicate potential for severe effects during transient events
   (spill events to aquatic receiving environments and infrequent releases of short-lived/non-persistent substances).
   These are NOT protective guidelines.
7. Long-term exposure guideline that protects all forms of aquatic life for indefinite exposure periods (>7 day exposures for fish and inve
8. For the following equations, hardness is expressed as $CaCO_3$ in mg/L and the guideline is in µg/L. exposure);
   a. **Cadmium** Guideline: The long-term CWQG of 0.09 ug/L is for waters of 50 mg $CaCO_3$/L hardness. When water hardness is >0 to
   valid for hardness between 17 and 280 mg $CaCO_3$/L.
   b. **Cadmium** Guideline: The short-term benchmark concentration of 1.0 ug/L is for waters of 50 mg $CaCO_3$/L hardness. When water
   CWQG is 0.11 µg/L. At other hardness values, the benmark can be calculated with the equation Benchmark - 10^{1.016(log[hardnes
   valid for hardness between 5.3 and 360 mg CaCO3/L.

TABLE D3-4
GROUNDWATER METALS - ROUTE D
LAKE MANITOBA OUTLET CHANNELS

c. **Copper** Guideline = e^(0.8545[ln(hardness)]-1.465) * 0.2 µg/L;
d. **Lead** Guideline = e^(1.273[ln(hardness)]-4.705) µg/L;
e. **Nickel** Guideline = e^(0.76[ln(hardness)]+1.06) µg/L

Well No. (November 2016)	Hardness
TH-ED-01W TEST START	374
TH-ED-01W TEST STOP	375
TH-GD-08	384
TH-ED-01P	398
TH-ED-03	319
TH-GD-02	369
TH-GD-02 Dup	382
TH-GD-07	391
15-RD-PW1	388

9. If trigger ranges for total phosphorous are exceeded, the potential exists for an environmental impact. If trigger range is not exceedec but TP is more than 50% above baseline values, the potential exists for an environmental impact.
Trigger ranges (µg/L):

- Exceedance of HC-CDWQ Criteria

Sample Summary Report

Dauphin River First Nation_2011

Sample ID	104/105	
Sample Date	11/16/2011	
Station	104/105	
Location		
Geology		
Watertype	Mg-Na-Ca-HCO3-SO4	
Temperature (°C)		
pH	8.07	
Conductivity	1000	uS/cm
Sum of Anions	12.4118	meq/L
Sum of Cations	11.88753	meq/L
Balance	-2.157553	%
Total dissolved solids	874.4802	mg/L
Total hardness		mg/l CaCO3
Alkalinity	7.054416	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	88	3.827789	3.827789
K	7.95	0.2033336	0.2033336
Ca	57.5	1.434702	2.869405
Mg	60.6	2.493314	4.986628
Cl	72.3	2.039337	2.039337
SO4	159	1.65625	3.3125
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	428	7.014422	7.014422

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9488449	0.5754198	0.319	0.194
Ca/SO4	0.3616352	0.8662354	0.152	0.364
Na/Cl	1.217151	1.876977	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Dauphin River First Nation_2011

Sample ID	32/33	
Sample Date	11/16/2011	
Station	32/33	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.82	
Conductivity	775	uS/cm
Sum of Anions	9.704742	meq/L
Sum of Cations	9.823483	meq/L
Balance	0.6080434	%
Total dissolved solids	719.1176	mg/L
Total hardness		mg/l CaCO3
Alkalinity	7.447748	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	42	1.8269	1.8269
K	6.46	0.1652246	0.1652246
Ca	57	1.422227	2.844454
Mg	60.6	2.493314	4.986628
Cl	23.3	0.6572136	0.6572136
SO4	76.7	0.7989583	1.597917
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	452	7.407754	7.407754

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9405941	0.5704162	0.319	0.194
Ca/SO4	0.7431552	1.780101	0.152	0.364
Na/Cl	1.802575	2.779765	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Dauphin River First Nation_2011

Sample ID	34			
Sample Date	11/16/2011			
Station	34			
Location				
Geology				
Watertype	Mg-Ca-HCO3			
Temperature (°C)				
pH	7.84			
Conductivity	768	uS/cm		
Sum of Anions	9.639028	meq/L		
Sum of Cations	9.975604	meq/L		
Balance	1.715946	%		
Total dissolved solids	718.7362	mg/L		
Total hardness		mg/l CaCO3		
Alkalinity	7.464137	mg/l CaCO3		

Major ion composition	mg/l	mmol/l	meq/l
Na	41.7	1.81385	1.81385
K	6.67	0.1705957	0.1705957
Ca	57.4	1.432207	2.864415
Mg	62.3	2.563259	5.126517
Cl	21.7	0.6120831	0.6120831
SO4	74.9	0.7802083	1.560417
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	453	7.424143	7.424143

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9213483	0.5587448	0.319	0.194
Ca/SO4	0.7663552	1.835673	0.152	0.364
Na/Cl	1.921659	2.963405	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Dauphin River First Nation_2011

Sample ID	35/36	
Sample Date	11/16/2011	
Station	35/36	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.94	
Conductivity	776	uS/cm
Sum of Anions	9.765882	meq/L
Sum of Cations	10.28339	meq/L
Balance	2.581174	%
Total dissolved solids	731.8756	mg/L
Total hardness		mg/l CaCO3
Alkalinity	7.546081	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	44.7	1.944343	1.944343
K	7	0.1790359	0.1790359
Ca	59.3	1.479615	2.95923
Mg	63.2	2.600288	5.200576
Cl	22.5	0.6346484	0.6346484
SO4	76.2	0.79375	1.5875
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	458	7.506087	7.506087

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9382911	0.5690196	0.319	0.194
Ca/SO4	0.7782152	1.864082	0.152	0.364
Na/Cl	1.986667	3.063654	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Dauphin River First Nation_2011

Sample ID	5	
Sample Date	11/16/2011	
Station	5	
Location		
Geology		
Watertype	Mg-Ca-Na-HCO3-SO4	
Temperature (°C)		
pH	7.82	
Conductivity	827	uS/cm
Sum of Anions	10.3739	meq/L
Sum of Cations	10.97739	meq/L
Balance	2.826489	%
Total dissolved solids	773.6003	mg/L
Total hardness		mg/l CaCO3
Alkalinity	7.398582	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	61.3	2.666403	2.666403
K	7.32	0.1872204	0.1872204
Ca	58.9	1.469634	2.939269
Mg	63	2.592059	5.184118
Cl	28.2	0.795426	0.795426
SO4	105	1.09375	2.1875
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	449	7.358588	7.358588

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9349207	0.5669756	0.319	0.194
Ca/SO4	0.5609524	1.343666	0.152	0.364
Na/Cl	2.173759	3.35217	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Dauphin River First Nation_2011

Sample ID	67	
Sample Date	11/16/2011	
Station	67	
Location		
Geology		
Watertype	Mg-Ca-Na-HCO3	
Temperature (°C)		
pH	7.97	
Conductivity	796	uS/cm
Sum of Anions	10.00107	meq/L
Sum of Cations	10.39177	meq/L
Balance	1.915889	%
Total dissolved solids	742.7411	mg/L
Total hardness		mg/l CaCO3
Alkalinity	7.480526	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	48.4	2.105284	2.105284
K	6.82	0.1744321	0.1744321
Ca	58.5	1.459654	2.919307
Mg	63.1	2.596174	5.192347
Cl	28.1	0.7926053	0.7926053
SO4	82.7	0.8614583	1.722917
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	454	7.440532	7.440532

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9270999	0.5622327	0.319	0.194
Ca/SO4	0.7073761	1.694399	0.152	0.364
Na/Cl	1.72242	2.656157	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Dauphin River First Nation_2011

Sample ID	80	
Sample Date	11/16/2011	
Station	80	
Location		
Geology		
Watertype	Mg-Na-Ca-HCO3-SO4	
Temperature (°C)		
pH	7.96	
Conductivity	970	uS/cm
Sum of Anions	12.05471	meq/L
Sum of Cations	12.2891	meq/L
Balance	0.9628372	%
Total dissolved solids	866.595	mg/L
Total hardness		mg/l CaCO3
Alkalinity	7.169138	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	87	3.784292	3.784292
K	7.71	0.1971953	0.1971953
Ca	60.1	1.499576	2.999152
Mg	64.5	2.653775	5.30755
Cl	65.1	1.836249	1.836249
SO4	146	1.520833	3.041667
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	435	7.129144	7.129144

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9317829	0.5650727	0.319	0.194
Ca/SO4	0.4116438	0.9860225	0.152	0.364
Na/Cl	1.336406	2.060881	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Dauphin River First Nation_2011

Sample ID	98	
Sample Date	11/16/2011	
Station	98	
Location		
Geology		
Watertype	Mg-Na-Ca-HCO3-SO4	
Temperature (°C)		
pH	8.07	
Conductivity	974	uS/cm
Sum of Anions	12.10303	meq/L
Sum of Cations	11.13327	meq/L
Balance	-4.173485	%
Total dissolved solids	850.8463	mg/L
Total hardness		mg/l CaCO3
Alkalinity	7.251082	mg/l CaCO3

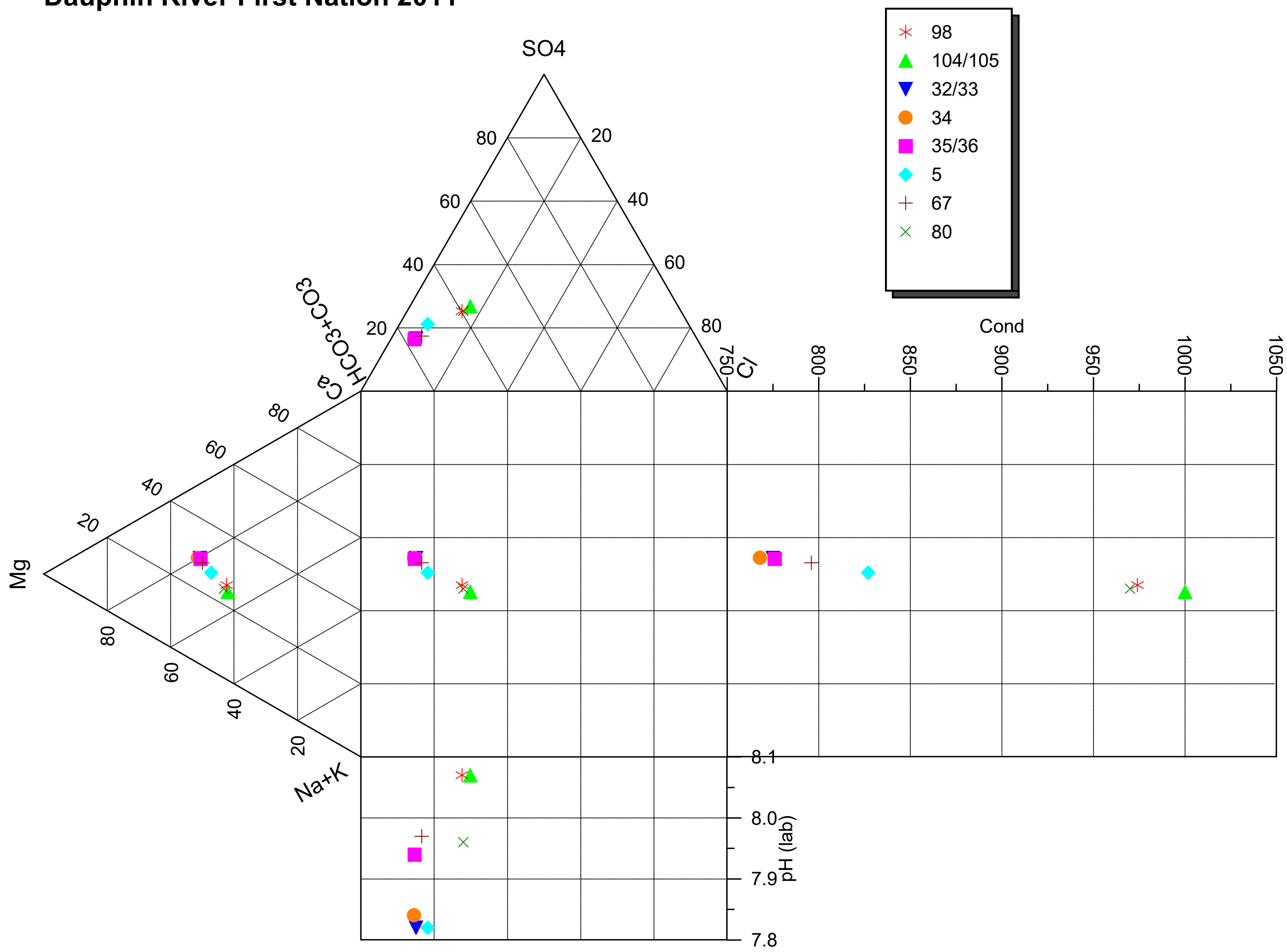
Major ion composition	mg/l	mmol/l	meq/l
Na	77	3.349316	3.349316
K	7.79	0.1992414	0.1992414
Ca	57.5	1.434702	2.869405
Mg	57.3	2.35754	4.715079
Cl	64.3	1.813684	1.813684
SO4	146	1.520833	3.041667
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	440	7.211088	7.211088

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.00349	0.6085592	0.319	0.194
Ca/SO4	0.3938356	0.9433659	0.152	0.364
Na/Cl	1.197512	1.846692	0.556	0.858
Cl/Br			287	648

DRFN_2011_Watertype

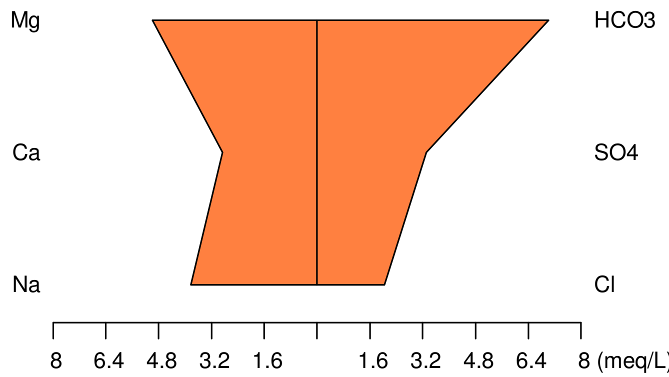
Station	Date	Sample ID	Watertype			
104/105	11/16/2011	104/105	Mg-Na-Ca-HCO3-SO4		1	FALSE
32/33	11/16/2011	32/33	Mg-Ca-HCO3		1	FALSE
34	11/16/2011	34	Mg-Ca-HCO3		1	FALSE
35/36	11/16/2011	35/36	Mg-Ca-HCO3		1	FALSE
5	11/16/2011	5	Mg-Ca-Na-HCO3-SO4		1	FALSE
67	11/16/2011	67	Mg-Ca-Na-HCO3		1	FALSE
80	11/16/2011	80	Mg-Na-Ca-HCO3-SO4		1	FALSE
98	11/16/2011	98	Mg-Na-Ca-HCO3-SO4		1	FALSE

Dauphin River First Nation 2011



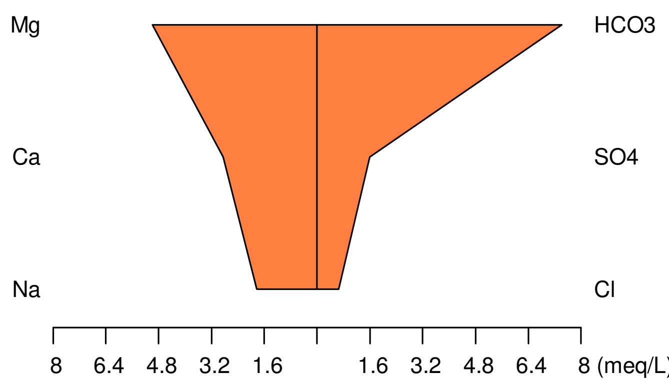
104/105,16/11/2011

Date: 16/11/2011
TDS (mg/l) = 656
El Cond. (uS/cm) =1000



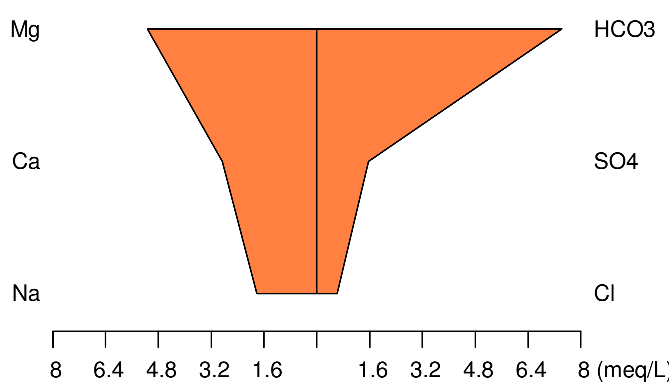
32/33,16/11/2011

Date: 16/11/2011
TDS (mg/l) = 489
El Cond. (uS/cm) =775



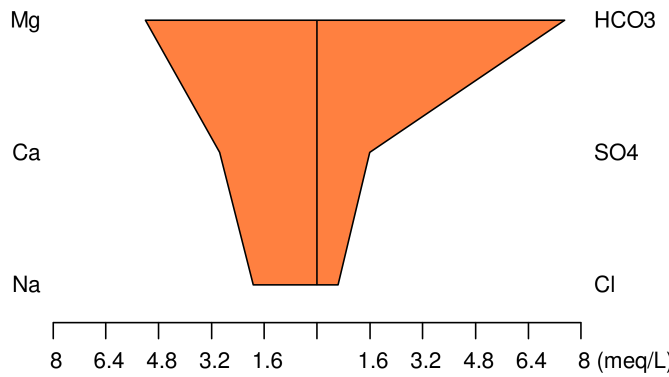
34,16/11/2011

Date: 16/11/2011
TDS (mg/l) = 487
El Cond. (uS/cm) =768



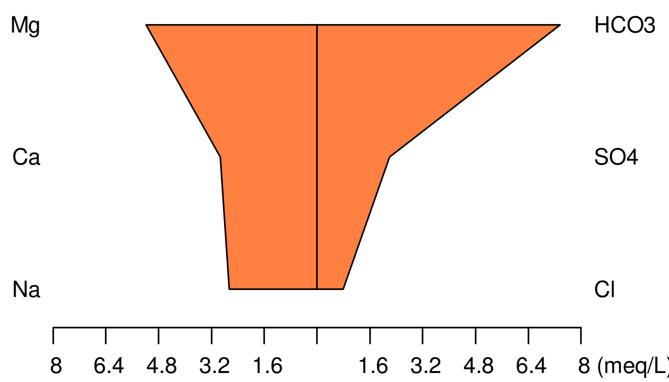
35/36,16/11/2011

Date: 16/11/2011
TDS (mg/l) = 498
El Cond. (uS/cm) =776



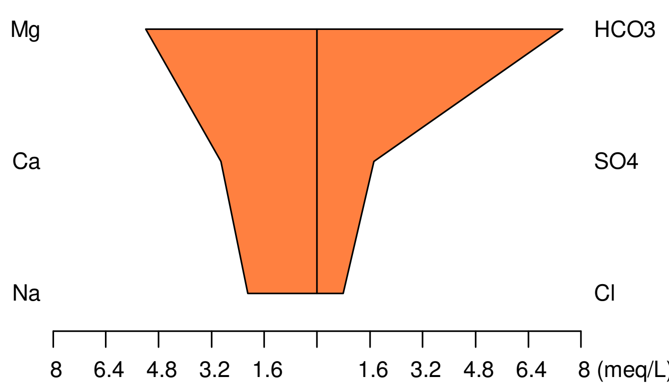
5,16/11/2011

Date: 16/11/2011
TDS (mg/l) = 544
El Cond. (uS/cm) =827

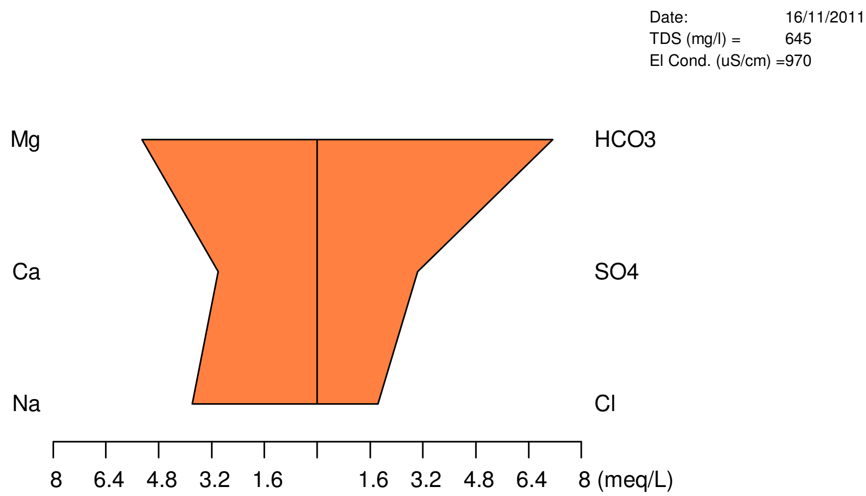


67,16/11/2011

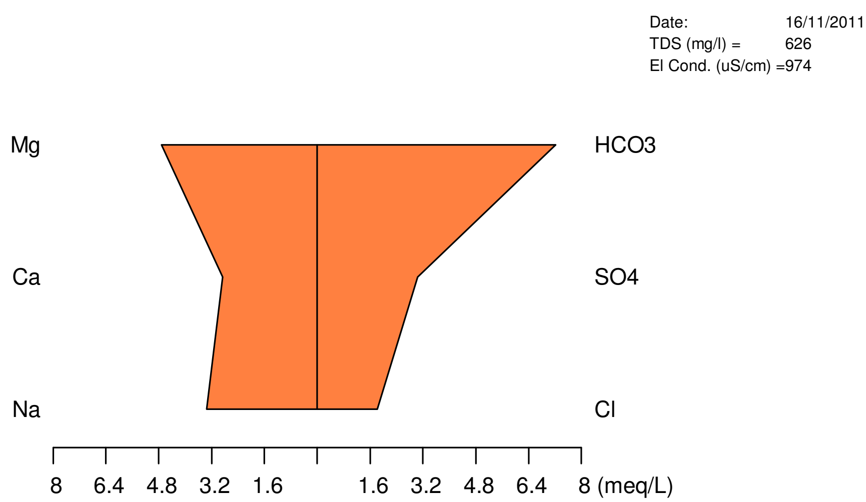
Date: 16/11/2011
TDS (mg/l) = 511
El Cond. (uS/cm) =796

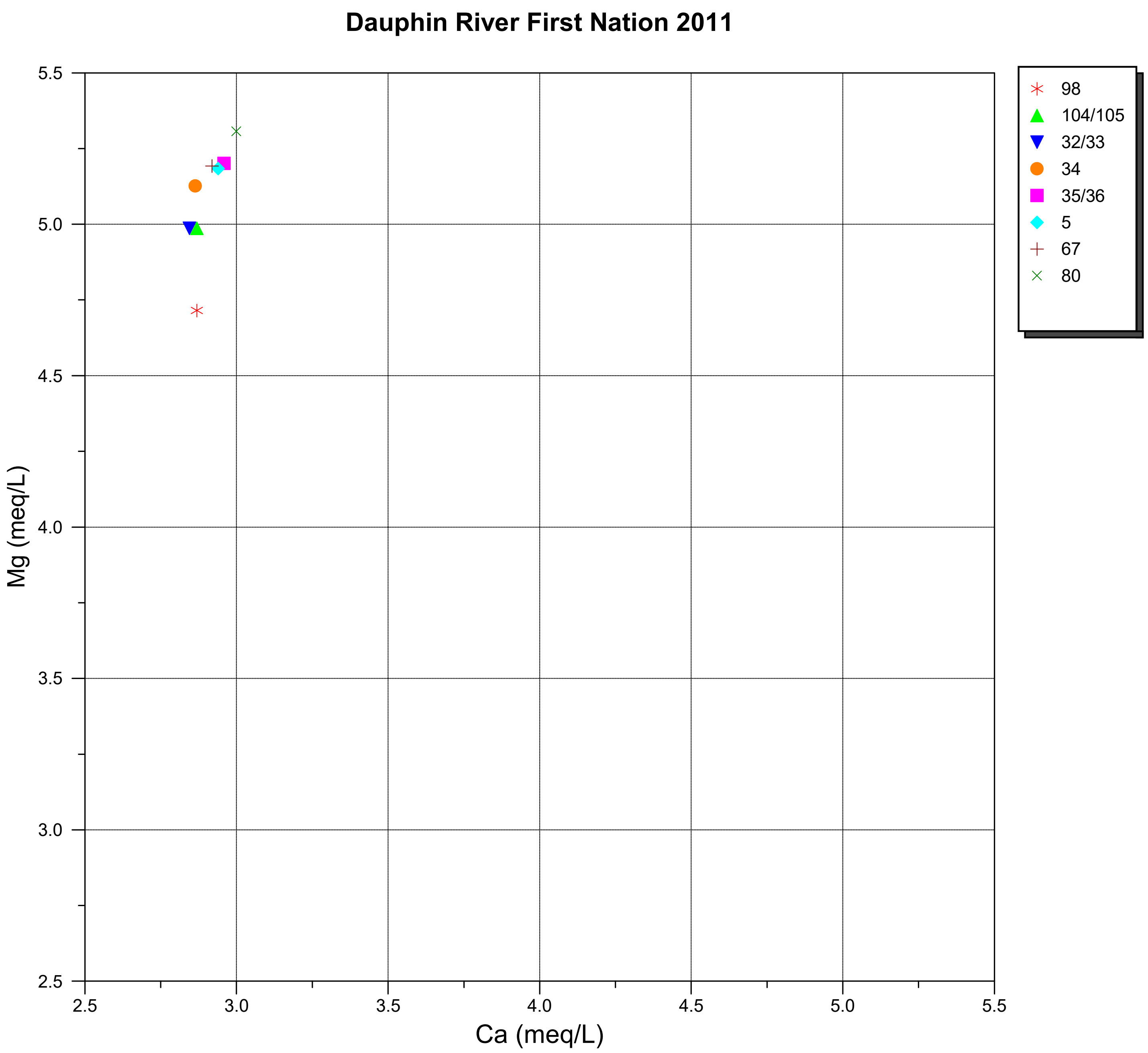


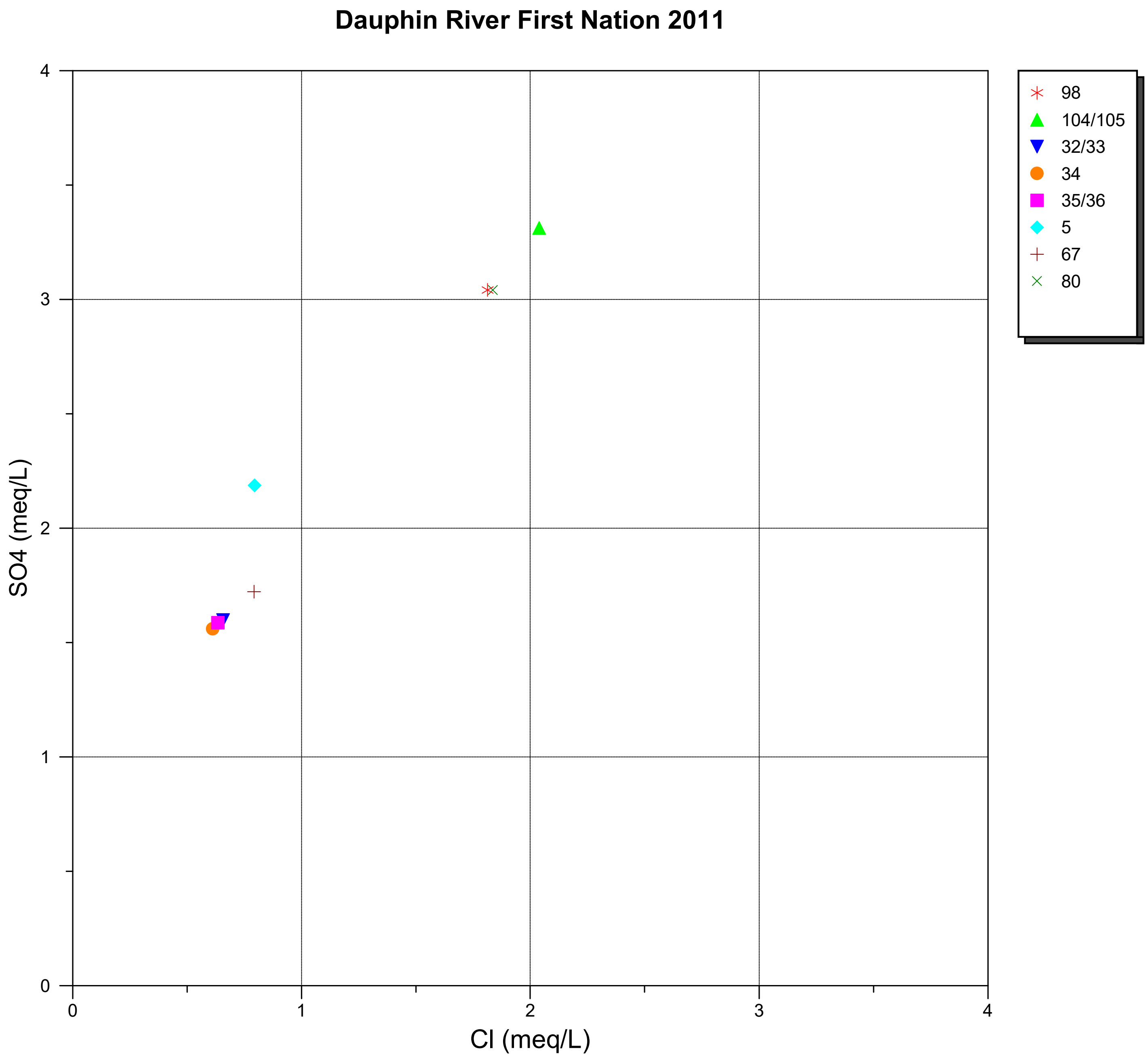
80,16/11/2011



98,16/11/2011




Dauphin River First Nation 2011
Mg (meq/L)
Ca (meq/L)
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.5
3.0
3.5
4.0
4.5
5.0
5.5
98
104/105
32/33
34
35/36
5
67
80



Dauphin River First Nation 2011
SO4 (meq/L)
Cl (meq/L)
0
1
2
3
4
98
104/105
32/33
34
35/36
5
67
80

APPENDIX B

Lake St. Martin Outlet Channel 2019 to 2020

APPENDIX B-1

Lines of Evidence for Water Quality Associations

TABLE B-1-1
LINES OF EVIDENCE FOR WATER QUALITY ASSOCIATIONS - SURFACE WATER

DATA SET	CHARACTERISTICS OF LOCATION (Note 1)	WATER QUALITY TABLES (Note 2)	WATER TYPES (Note 3)	BORON (Note 4)	FLUORIDE (Note 4)	STRONTIUM (Note 4)	DUROV PLOTS (Note 5)	STIFF DIAGRAMS (Note 6)	MAGNESIUM/ CALCIUM RATIO (Note 7)	SULPHATE/ CHLORIDE RATIO (Note 8)	STABLE ISOTOPES (Note 9)	ASSOCIATION WITHIN THE DATA SET
Surface Water												
LSMOC Inlet 1A	Lake St. Martin										Least negative O^{18} < -8, minor variation from summer, least negative to fall more negative. Plots furthest from the meteoric water line.	
LSMOC Outlet 1A	Lake Winnipeg										More negative than LSM (-9 to -10), more variability but also less negative in summer, more negative in winter. Plots to the right of meteoric water line, but less so than Lake St. Martin.	
BC-02	Upstream Buffalo Creek										More negative than Lake Wpg. (-10 to -11), little variation in O^{18} with season. Plots to the right of the meteoric water line, but less so than Lake Wpg.	
BC-05	Downstream Buffalo Creek	Nutrients, TSS, typical of background water quality	Insufficient Parameters	Insufficient Parameters	Insufficient Parameters	Insufficient Parameters	Insufficient Parameters	Insufficient Parameters	Insufficient Parameters	Insufficient Parameters	More negative than BC-02 (-11 to -12), less negative in summer, more negative in winter. Plots to the right of the meteoric water line at a similar distance as BC-02.	
CR3-1	Buffalo Creek west stem east side of alignment										More negative than BC-05 (-2 to -13), less negative in summer, more negative in winter. Plots on the meteoric water line indicating little evaporative process, and more groundwater contribution.	
CR3-2	Buffalo Creek west stem, west side of alignment											
SW-R3	Existing Reach 3 channel										Fall values more negative than other surface water (-13 to -15), summer values similar to BC-05 (-11). Fall values plot near or to the left of the meteoric water line, while spring values plot to the right of the meteoric water line at a distance similar to BC-05 and BC-02.	More negative fall values reflect increased proportion of groundwater discharge. Summer values have increased precipitation and surface water flow and so are less negative.

TABLE B-1-2
LINES OF EVIDENCE FOR WATER QUALITY ASSOCIATIONS - PEAT WELLS

DATA SET	CHARACTERISTICS OF LOCATION (Note 1)	WATER QUALITY TABLES (Note 2)	WATER TYPES (Note 3)	BORON (Note 4)	FLUORIDE (Note 4)	STRONTIUM (Note 4)	DUROV PLOTS (Note 5)	STIFF DIAGRAMS (Note 6)	MAGNESIUM/ CALCIUM RATIO (Note 7)	SULPHATE/ CHLORIDE RATIO (Note 8)	STABLE ISOTOPES (Note 9)	ASSOCIATION WITHIN THE DATA SET
Peat Wells (9 Locations)												
TH19-KGS-100, TH19-KGS 11A, TH19-KGS-19A	Reach 2 and 3	Higher conductivity 650 to 850 µS/cm		Higher boron 0.03 to 0.055 mg/L								
TH19-KGS03A, TH19-KGS 07A, TH19-KGS-14A	Reach 2 and 3	3A and 7A have higher conductivity 650 µS/cm to 700 µS/cm			Higher Fluoride 0.15 to 0.35 mg/L							
TH19-KGS-03A, TH19-KGS -07A, TH19-KGS-100, TH19-KGS-19A	Reach 2 and 3	Higher conductivity 650 to 850 µS/cm				Higher Strontium 0.1 to 0.2 mg/L		Similar shape				
TH19-KGS-03A	Star of Reach 2		Mg-Ca-HCO3 or Ca-Mg-HCO3				Plots slightly to right of most data due to higher Cl percentage					
TH19-KGS-3A, TH19-KGS-13A, TH19-KGS-17A, TH19KGS-18A	Reach 2 and 3								Approx 1:1 Mg/Ca ratio		Not Analyzed	
TH19-KGS 7A, TH19-KGS 14A, TH19-KGS 11A, TH19- KGS 19A	Reach 2 and 3								All enriched in Ca > 1:1 Mg/Ca ratio			
TH19-KGS-11A, TH19-KGS-13A, TH19-KGS-14A, TH19-KGS17A	End of Reach 2 beginning of Reach 3							Similar shape		Closest to 1:1 ratio		
TH19-KGS-18A	End of Reach 3		Na-Ca-Mg-HCO3				Plots below rest of data due to higher sodium percentage	Distinct shape				
TH19-KGS100	Reach 2								Enriched in Mg		Approximately -15.5 O^{18} similar to bedrock groundwater and slightly right of the meteoric water line.	

TABLE B-1-3
LINES OF EVIDENCE FOR WATER QUALITY ASSOCIATIONS - TILL WELLS

<table>
<tr><th>DATA SET</th><th>CHARACTERISTICS OF LOCATION (Note 1)</th><th>WATER QUALITY TABLES (Note 2)</th><th>WATER TYPES (Note 3)</th><th>BORON (Note 4)</th><th>FLUORIDE (Note 4)</th><th>STRONTIUM (Note 4)</th><th>DUROV PLOTS (Note 5)</th><th>STIFF DIAGRAMS (Note 6)</th><th>MAGNESIUM/ CALCIUM RATIO (Note 7)</th><th>SULPHATE/ CHLORIDE RATIO (Note 8)</th><th>STABLE ISOTOPES (Note 9)</th><th>ASSOCIATION WITHIN THE DATA SET</th></tr>
<tr><td colspan="13">Till Wells (7 Locations)</td></tr>
<tr><td>TH19-KGS-02B</td><td>Water Control Structure</td><td>Highest conductivity 1970 µS/cm</td><td>Mg-Na-Ca-SO_4-HCO_3</td><td rowspan="2">0.15 to 0.2 mg/L</td><td>0.2 to 0.3 mg/L</td><td>0.3 to 0.5 mg/L</td><td>Furthest right</td><td>Unique</td><td rowspan="5">All >1 enriched in magnesium</td><td rowspan="7">All enriched in sulphate in order from least to most enriched: 16B, 04, 07, 12B, 17B, 20</td><td rowspan="2">Not sampled</td><td></td></tr>
<tr><td>TH19-KGS-12B</td><td>Reach 2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>TH19-KGS-20</td><td>End of Reach 1</td><td>High conductivity 951 µS/cm</td><td>Na-Mg-HCO_3-SO_4</td><td rowspan="5">0.1 to 0.15 mg/L</td><td>0.5 to 0.6 mg/L</td><td>0.1 to 0.2 mg/L</td><td>Furthest lower</td><td>Unique</td><td>Approx -15 O^{18} similar to most of bedrock water quality in channel alignment.</td><td></td></tr>
<tr><td>TH19-KGS-07, TH19-KGS-12B, TH19-KGS-17B</td><td>Reach 2 and 3</td><td>Moderate conductivity 654 to 848 µS/cm</td><td>Mg-Ca-HCO_3 or Mg-HCO_3</td><td>0.5 to 0.6 mg/L</td><td></td><td>Cluster together</td><td>Similar</td><td rowspan="4">Not sampled</td><td></td></tr>
<tr><td>TH19-15-04</td><td>End of Reach 2</td><td>Lowest conductivity 470 µS/cm</td><td>Mg-Ca-HCO_3</td><td rowspan="2">0.2 to 0.3 mg/L</td><td>0.1 to 0.2 mg/L</td><td>Slightly above 07, 12B and 17B</td><td>Unique</td><td></td></tr>
<tr><td>TH19-KGS-16B</td><td>Reach 3</td><td>Low conductivity 521 µS/cm</td><td>Ca-Mg-HCO_3</td><td>0.1 to 0.2 mg/L</td><td>Furthest upper left</td><td>Unique</td><td>Slightly enriched in calcium</td><td></td></tr>
<tr><td>TH19-KGS-17B</td><td>Reach 3</td><td></td><td></td><td></td><td>0.3 to 0.5 mg/L</td><td></td><td></td><td></td><td></td></tr>
</table>

TABLE B-1-4
LINES OF EVIDENCE FOR WATER QUALITY ASSOCIATIONS - BEDROCK WELLS

DATA SET	CHARACTERISTICS OF LOCATION (Note 1)	WATER QUALITY TABLES (Note 2)	WATER TYPES (Note 3)	BORON (Note 4)	FLUORIDE (Note 4)	STRONTIUM (Note 4)	DUROV PLOTS (Note 5)	STIFF DIAGRAMS (Note 6)	MAGNESIUM/CALCIUM RATIO (Note 7)	SULPHATE/CHLORIDE RATIO (Note 8)	STABLE ISOTOPES (Note 9)	ASSOCIATION WITHIN THE DATA SET
Bedrock Wells												
TH-19-KGS-19 October 19 only	End of Reach 3 at Lake Winnipeg		$Mg-HCO_3$	0.4 mg/L, all other wells 0.1 to 0.2 mg/L, except TH19-KGS18 and TH19-KGS18 at 0.05 mg/L	1.2 mg/L, all other wells 0.2 to 0.4 mg/L	0.3 mg/L, all other wells 0.15 to 0.25 mg/L, except TH19-KGS-19 and TH19-KGS-19 at 0.65 mg/L	All plot in upper to mid left-hand side except TH19-04, which plots further to the right.	Group A: Magnesium-calcium-bicarbonate or calcium-magnesium bicarbonate for the majority of the wells. Group C: Magnesium-calcium-bicarbonate-sulphate (PW19-KGS-02, TH19-KGS-01B, TH19-KGS-19; March 2019 only). Group D: Magnesium-calcium-sodium-bicarbonate-sulphate (TH19-KGS-04, TH19-KGS-11).	All but two samples (TH19-KGS18 and one date for PW19-KGS-03) plot left of the 1:1 ratio line, indicating enrichment with magnesium. For TH19-KGS18 (June sample), which differs from the others, plots to the right.	The samples do not follow the sulphate/chloride plot 1:1 ratio line. The wells have varying concentrations of sulphate.		
TH-19-KGS-18	End of Reach 3 near Lake Winnipeg	Variable seasonal water quality 550 to 1050 µS/cm, lower conductivity in 2020	$Mg-Ca-HCO_3$ to Mg-HCO3								At TH19-KGS18, groundwater type water is at -14.5 O^{18}, but this is among the least negative of the samples, which range to -16 O^{18}. Also, TH19-13 and 17 are among the least negative of the groundwater samples near -14 O^{18}.	Sentinel well 1 water quality is closer to that of the LSMOC channel than Sentinel wells 2 and 3 across the river. The Dauphin River appears to be a boundary between fresher water to the south and water containing more sulphate and chloride to the north. The water quality in Sentinel wells 2 and 3 is similar to that found in a historic data set of wells at DRFN that were examined for water quality as part of regional background data. Sentinel well 1 shows more variability in sodium and chloride from March measurements before the spring melt to June measurement (early spring). This accounts for the change in water type between these two periods which is not seen in the Sentinel wells north of the Dauphin River. The potential for seasonal variations or the influence of Lake Winnipeg should be accounted for when evaluating water quality in these wells.
PW19-KGS-01, PW19-KGS-03, TH15-04, TH15-05, TH19-KGS-08, TH19-KGS-09, TH19-KGS-10,TH19-KGS-12, TH19-KGS-13,TH19-KGS-14, TH19-KGS15, TH19-KGS-16, TH19-KGS17, TH19-KGS-18, TH19-KGS-19 (except March 2019)	Reach 2 and 3	Conductivity of Other wells between 500 and 900 µS/cm	Mg-Ca- HCO3								TH19-KGS-12 is the most negative sample at -16 O^{18}	
PW19-KGS-03 (Oct 19 only), TH19-KGS 18 (June and October 2020)	Reach 2 and 3		Ca-Mg-HCO3									
PW19-KGS-02, TH19-KGS-01B, TH19-KGS-19 (March 2019 only)	Reach 2 and 3		Mg-Ca-HCO3-SO4									
TH19-KGS-04, TH19-KGS-11	Reach 2 and 3	TH19-KGS-04 1000 µS/cm	Mg-Ca-Na-HCO3-SO4									

APPENDIX B-2

Groundwater and Surface Water Tables
(submitted as EIS deliverables in February 2021)

TABLE 1
SUMMARY OF GROUNDWATER AND SURFACE WATER FIELD CHEMISTRY MEASUREMENTS AND COMPLETED LAB ANALYSES
LAKE ST. MARTIN OUTLET CHANNEL

Sample ID	Duplicate Sample ID	Date	Time	Temp. (^oC)	Field pH	Field E.C. (µS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Laboratory Analysis Parameter Sets						
										ROU-4W+Metals [1]		Bacteria [2]	Surface Water Sample Set [3]	Isotopes		
														Stable		Radioactive
										Dissolved Metals	Total Metals			Oxygen-18 (^{18}O)	Deuterium (^2H)	Tritium (^3H)
GROUNDWATER SAMPLES																
PW19-KGS-01		12-Mar-2019	18:00	5.2	8.1	782	-	-	-	x		x		x	x	x
		11-Jun-2019	9:40	5.3	7.32	688	0.37	32.2	-	x		x		x	x	x
		24-Oct-2019	13:45	5.4	7.42	717	0.47	135.8	-	x		x		x	x	x
	PW-200								-	x		x		x	x	x
		11-Mar-2020	9:50	5.2	6.68	748	0.93	354.6	-	x		x		x	x	x
		17-Jun-2020	16:30	5.3	7.2	684	0.59	-4.6	-	x		x		x	x	x
		27-Oct-2020	10:10	5.1	7.38	710	0.22	29.9	-	x		x		x	x	x
PW19-KGS-02		13-Mar-2019	16:40	6.4	7.9	796	-	-	-	x		x		x	x	x
	PW19-KGS-05								-	x		x		x	x	x
		11-Jun-2019	11:50	6.4	7.34	724	0.99	-29.3	-	x		x		x	x	x
		24-Oct-2019	16:10	6.1	7.32	751	1.86	161	-	x		x		x	x	x
		16-Jun-2020	17:20	8.2	6.98	810	1.36	-14.6	-	x		x		x	x	x
		28-Oct-2020	17:30	0.5	7.14	794	3.12	68.2	-	x		x		x	x	x
	PW-100								-	x		x		x	x	x
PW19-KGS-03		14-Mar-2019	17:40	6.7	7.8	663	-	-	-	x		x		x	x	x
	PW19-KGS-04								-	x				x	x	x
		11-Jun-2019	16:19	5.5	7.3	591	0.36	-3.3	-	x		x		x	x	x
	PW19-KGS-200								-	x		x		x	x	x
		24-Oct-2019	10:35	7.3	7.25	569	0.5	127.7	-	x		x		x	x	x
		16-Jun-2020	10:05	5.7	7.12	523	0.65	7.9	-	x		x		x	x	x
	PW19-KGS-300								-	x		x		x	x	x
		27-Oct-2020	17:10	7.5	7.24	592	0.44	10.6	-	x		x		x	x	x
TH15-04		08-Mar-2019	11:15	1.9	7.37	536	3.12	53.2	-	x				x	x	
TH15-05		08-Mar-2019	12:45	2.9	6.86	532	3.33	70.7	-	x				x	x	
TH19-KGS-01		09-Mar-2019	10:40	3.6	7.35	957	5.9	-45.9	-	x				x	x	
TH19-KGS-02B		11-Mar-2019	7:55	2	7.63	1888	9.42	19.3	-	x						
TH19-KGS-03A		08-Mar-2019	18:36	0	7.02	606	13.72	146.7	-	x						
TH19-KGS-04		09-Mar-2019	12:18	5.8	7.58	1018	1.17	-53.8	-	x				x	x	
TH19-KGS-05		08-Mar-2019	12:45	2.9	6.86	532	3.33	70.7	-	x				x	x	
TH19-KGS-07		07-Mar-2019	10:50	5.9	7.1	688	1.98	-46.8	-	x						
TH19-KGS-07A		07-Mar-2019	10:12	0.4	6.95	852	8	27.6	-	x						
TH19-KGS-08		08-Mar-2019	14:55	2.2	6.93	546	2.06	73.5	-	x				x	x	
TH19-KGS-09		12-Mar-2019	14:08	5.5	7.56	737	1.33	-74.5	-	x				x	x	
TH19-KGS-10		09-Mar-2019	17:35	3.6	7.57	707	2.19	-63.4	-	x				x	x	
	TH200								-	x				x	x	
TH19-KGS-100		07-Mar-2019	14:15	1.1	6.85	756	2.12	59.8	-	x				x	x	
TH19-KGS-11		08-Mar-2019	9:30	3.3	6.64	786	3.32	85.6	-	x				x	x	
TH19-KGS-11A		08-Mar-2019	9:10	1	6.51	648	7.5	87.2	-	x						

TABLE 1
SUMMARY OF GROUNDWATER AND SURFACE WATER FIELD CHEMISTRY MEASUREMENTS AND COMPLETED LAB ANALYSES
LAKE ST. MARTIN OUTLET CHANNEL

Sample ID	Duplicate Sample ID	Date	Time	Temp. (°C)	Field pH	Field E.C. (µS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Laboratory Analysis Parameter Sets						
										ROU-4W+Metals [1]		Bacteria [2]	Surface Water Sample Set [3]	Isotopes		
														Stable		Radioactive
										Dissolved Metals	Total Metals			Oxygen-18 (^{18}O)	Deuterium (^{2}H)	Tritium (^{3}H)
GROUNDWATER SAMPLES																
TH19-KGS-12		07-Mar-2019	15:30	1.9	6.79	904	5.21	59.2	-	x				x	x	
		12-Jun-2019	13:30	5.4	7.48	733	1.99	-9.2	-	x		x		x	x	x
		23-Oct-2019	16:15	4	7.36	748	2.55	145.3	-	x		x		x	x	x
		16-Jun-2020	14:45	8.5	6.99	810	0.19	20.1	-	x		x		x	x	x
		18-Oct-2020	12:50	3.7	7.47	759	3.67	75.3	-	x		x		x	x	x
TH19-KGS-12B		14-Mar-2019	13:00	2.4	7.82	918	8.38	76	-	x						
TH19-KGS-13		07-Mar-2019	16:40	2.6	7.08	786	1.86	75.5	-	x				x	x	
TH19-KGS-13A		07-Mar-2019	17:10	0.3	7	436	3.98	42.7	-	x						
TH19-KGS-14		08-Mar-2019	16:10	3	6.9	592	2.91	68.2	-	x				x	x	
TH19-KGS-14A		08-Mar-2019	16:15	1.7	6.84	446	11.29	49	-	x						
TH19-KGS-15		09-Mar-2019	16:25	4.3	7.15	769	3.13	-71.5	-	x				x	x	
TH19-KGS-16		15-Mar-2019	9:00	-	-	-	-	-	-	x				x	x	
	TH19-KGS-500								-	x				x	x	
TH19-KGS-16B		09-Mar-2019	16:00	3	6.89	889	9.29	-46.4	-	x						
TH19-KGS-17		10-Mar-2019	16:10	3.6	7.58	640	2.3	-23	-	x				x	x	x
		12-Jun-2019	18:25	7.7	7.54	626	1.63	-2.08	-	x		x		x	x	x
		23-Oct-2019	12:40	3.5	7.41	633	3	124	-	x		x		x	x	x
		16-Jun-2020	12:15	8.3	7.03	686	2.64	-29	-	x		x		x	x	x
		27-Oct-2020	15:10	3.7	6.68	641	1.49	16.4	-	x		x		x	x	x
TH19-KGS-17A		10-Mar-2019	16:00	3.2	7.2	544	12.02	-30.7	-	x						
TH19-KGS-17B		10-Mar-2019	16:20	0.3	7.12	904	12.13	-31.8	-	x						
TH19-KGS-18		11-Mar-2019	13:50	5.6	6.7	957	2.26	-81.5	-	x				x	x	x
		12-Jun-2019	10:20	6.7	7.03	972	2.51	-16.8	-	x		x		x	x	x
		23-Oct-2019	11:45	4.6	6.65	1023	3.5	122.3	-	x		x		x	x	x
		16-Jun-2020	11:00	9.5	6.56	567	3.84	8.4	-	x		x		x	x	x
		27-Oct-2020	13:40	5	6.51	910	2.51	27.2	-	x		x		x	x	x
TH19-KGS-18A		11-Mar-2019	14:43	2.1	6.97	497	8.84	88.5	-	x						
TH19-KGS-19		11-Mar-2019	17:44	2.3	8.76	770	6.18	-93.2	-	x				x	x	x
		12-Jun-2019	9:50	13.4	7.79	915	4.3	-8.6	-	x		x		x	x	x
		23-Oct-2019	16:40	5.7	8.17	783	8.47	131.9	-	x		x		x	x	x
		17-Jun-2020	13:12	16.3	7.83	813	6.59	-15.5	-	x		x		x	x	x
		27-Oct-2020	11:40	4.7	7.06	947	8.07	2.6	-	x		x		x	x	x
TH19-KGS-19A		11-Mar-2019	17:21	2.3	7.07	787	2.5	-81.6	-	x						
TH19-KGS-20		14-Mar-2019	14:25	3.8	7.28	1008	1.97	-38.1	-	x				x	x	
	TH300								-	x				x	x	

TABLE 1
SUMMARY OF GROUNDWATER AND SURFACE WATER FIELD CHEMISTRY MEASUREMENTS AND COMPLETED LAB ANALYSES
LAKE ST. MARTIN OUTLET CHANNEL

Sample ID	Duplicate Sample ID	Date	Time	Temp. (°C)	Field pH	Field E.C. (µS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Laboratory Analysis Parameter Sets						
										ROU-4W+Metals [1]		Bacteria [2]	Surface Water Sample Set [3]	Isotopes		
														Stable		Radioactive
										Dissolved Metals	Total Metals			Oxygen-18 (^{18}O)	Deuterium (^{2}H)	Tritium (^{3}H)
GROUNDWATER SAMPLES																
Sentinel Well 1 - (SW19-KGS-01)		08-Mar-2019	13:30	5.7	7.7	940	-	-	-	x		x		x	x	x
		18-Jun-2020	11:25	5.2	7.08	784	0.34	41.2	-	x		x		x	x	x
Sentinel Well 2 - (SW19-KGS-02)		27-Sep-2019	10:50	9.7	8.4	1202	-	-	-	x		x		x		x
		18-Jun-2020	15:15	5	7.01	1102	0.56	1.5	-	x		x		x	x	x
		Oct. 29, 2020	12:25	4.9	7.3	1163	0.71	75	-	x		x		x	x	x
Sentinel Well 3 - (SW19-KGS-03)		27-Sep-2019	14:45	6.4	8.15	961	-	-	-	x		x		x		x
		18-Jun-2020	13:50	5.4	6.93	874	0.63	3.1	-	x		x		x	x	x
		Oct. 29, 2020	11:02	5.4	6.91	921	1.13	82.2	-	x		x		x	x	x
SURFACE WATER SAMPLES																
SW-R3		11-Jun-2019	14:00	17.8	8.58	456	6.97	17.5	-	x	x	x		x	x	x
		24-Oct-2019	11:40	1.4	7.06	180	13.7	148.8	-	x	x	x		x	x	x
		17-Jun-2020	12:03	22.5	8.04	286	8.3	-9.8	21.8				x	x	x	x
		28-Oct-2020	10:08	0.6	7.29	389	12.89	64.6	-				x	x	x	x
	SW-100												x	x	x	x
LSMOC - Inlet-1A		17-Jun-2020	17:00	24.05	8.5	793	6.06	-16	7.13				x	x	x	x
		2020-Oct-28	15:25	1	6.48	1278	12.5	93.9	8.33				x	x	x	x
LSMOC - Outlet-1A		17-Jun-2020	13:30	19.5	8	625	7.16	-6.6	6.22				x	x	x	x
		28-Oct-2020	12:45	0.1	6	415	12.5	27.1	17.51				x	x	x	x
BC-02		17-Jun-2020	17:35	25.9	8.42	407	6.45	-13.5	34.6				x	x	x	x
		28-Oct-2020	12:15	0.6	8.09	573	12.86	68.1	-				x	x	x	x
BC-05		17-Jun-2020	17:25	26.3	8.35	434	5.3	-23.9	60.7				x	x	x	x
		28-Oct-2020	11:45	0.4	7.78	630	11.23	71.6	12.76				x	x	x	x
CR3-1		17-Jun-2020	13:58	22.3	7.27	229	0.06	-20.3	0.38				x	x	x	x
		28-Oct-2020	11:20	0.1	6.98	281	6.53	67.1	-				x	x	x	x
CR3-2		17-Jun-2020	14:14	25.5	7.75	258	4.38	-22.2	5.03				x	x	x	x
		28-Oct-2020	11:04	0.7	7.1	291	5.58	62.5	-				x	x	x	x

Notes:
1. ROU-4W plus metals includes: conductivity, hardness, pH, TDS (calculated), turbidity, alkalinity, bicarbonate, carbonate, chloride, fluoride, hydroxide, nitrate and nitrite, sulfate, aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, cesium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, molybdenum, nickel, phosphorus, potassium, rubidium, selenium, silicon, silver, sodium, strontium, sulfur, tellurium, thallium, thorium, tin, titanium, tungsten, uranium, vanadium, zinc, and zirconium
2. Bacteria test includes: escherichia Coli and total coliforms
3. Surface water sample set includes: BTEX, F1-F4, conductivity, total nitrogen, mercury (dissolved and total), ammonia by colour, total phosphorus, total dissolved phosphorus, total suspended solids, and turbidity.

TABLE 2
GROUNDWATER ELEVATION MEASUREMENTS
LAKE ST. MARTIN OUTLET CHANNEL

Sample ID	Date	Time	Ground Elevation (m)	Top of Casing Elevation (m)	Depth to Water from Top of Casing (m)	Groundwater Elevation (m)	Depth To Bottom from Top of Casing (m)	Stickup Height (m)	Comments
PW19-KGS-01	12-Mar-2019	15:40	245.485	246.125	1.908	244.217	-	-	
	11-Jun-2019	8:50			1.122	245.003	20.217	0.655	
	24-Oct-2019	13:00			0.43	245.695	-	-	
	17-Jun-2020	15:46			0.508	245.617	-	-	
	27-Oct-2020	9:03			0.883	245.242	-	-	
PWS19-KGS-02	11-Jun-2019	11:50	243.041	243.713	-0.837	244.55	-	0.88	Temporary 1.457 m casing added to measure flowing well; Measured 0.62 m below casing
	24-Oct-2019	-			Flowing	-	-	-	
	16-Jun-2020	17:20			Flowing	-	-	-	
	28-Oct-2020	17:20			Flowing	-	-	-	
PW19-KGS-03	14-Mar-2019	10:45	232.628	233.309	2.688	230.621	-	-	
	15-Mar-2019	13:28			2.677	230.632	-	-	
	11-Jun-2019	17:30			3.143	230.166	-	-	
	24-Oct-2019	8:54			2	231.309	-	-	
	17-Jun-2020	9:06			2.404	230.905	12.5	-	
	27-Oct-2020	16:30			2.903	230.406	-	-	
TH15-01A	26-Feb-2015	9:18	246.623	247.54	2.09	245.45	-	0.91	Final reading of multiple measurements taken in month
	1-May-2015	17:00			1.48	246.06	-	-	
	14-Sep-2015	-			2.395	245.145	-	-	
	15-Mar-2019	9:02			3.65	243.89	28.07	-	
	12-Jun-2019	14:05			2.865	244.675	28.07	0.897	
	24-Oct-2019	14:30			2.18	245.36	28.14	0.91	
	17-Jun-2020	-			2.335	245.205	28.075	-	Assumed static
	28-Oct-2020	16:00			2.927	244.613	28.02	-	
TH15-01B	26-Feb-2015	9:19	246.623	247.63	3.54	244.09	-	1.01	
	1-May-2015	17:00			3.805	243.825	-	-	
	14-Sep-2015	12:00			3.664	243.966	-	-	
	15-Mar-2019	9:08			4.705	242.925	9.734	-	Assumed static
	12-Jun-2019	14:05			4.314	243.316	9.734	1.01	
	24-Oct-2019	14:30			3.588	244.042	9.749	1.03	
	17-Jun-2020	-			4.208	243.422	9.733	-	Assumed static
	28-Oct-2020	16:00			4.354	243.276	9.681	-	
TH15-01C	26-Feb-2015	9:20	246.623	247.56	3.79	243.77	-	0.94	
	1-May-2015	17:00			3.965	243.595	-	-	
	14-Sep-2015	12:00			3.92	243.64	-	-	
	15-Mar-2019	9:08			4.57	242.99	5.28	-	
	12-Jun-2019	14:05			4.358	243.202	5.284	0.938	
	24-Oct-2019	14:30			3.531	244.029	5.27	0.93	
	17-Jun-2020	-			4.165	243.395	5.282	-	Assumed static
	28-Oct-2020	16:00			4.42	243.14	5.27	-	
TH15-02A	22-Feb-2015	11:23	235.763	236.664	1.7	234.964	-	0.88	
	1-May-2015	16:40			2.13	234.534	-	-	
	16-Sep-2015	12:00			2.409	234.255	-	-	
	15-Mar-2019	11:07			4.104	232.56	7.55	-	
	11-Jun-2019	-			2.666	233.998	7.557	0.88	
	23-Oct-2009	-			1.838	234.826	7.55	0.92	
	16-Jun-2020	15:42			2.520	234.144	7.555	-	
	28-Oct-2020	10:15			2.635	234.029	7.55	-	
TH15-03	23-Feb-2015	10:40	237.5096	238.297	2.830	235.467	-	0.79	
	1-May-2015	16:30			2.660	235.637	-	-	
	15-Mar-2019	10:54			3.798	234.499	-	-	Assumed static
	11-Jun-2019	-			3.531	234.766	7.508	-	
	23-Oct-2019	14:49			3.027	235.270	7.514	1.075	
	16-Jun-2020	15:48			3.260	235.037	7.508	-	Assumed static
	28-Oct-2020	10:30			3.374	234.923	7.5	-	
TH15-03A	23-Feb-2015	10:41	237.005	237.919	3.680	234.239	-	0.91	
	1-May-2015	16:30			3.000	234.919	-	-	Plugged at 2.09 m
	16-Sep-2015	12:00			3.600	234.319	-	-	
	15-Mar-2019	10:56			4.181	233.738	5.669	-	
	11-Jun-2019	-			3.683	234.236	5.667	-	
	23-Oct-2019	14:50			2.763	235.156	5.66	1.35	
	16-Jun-2020	15:48			3.486	234.433	5.667	-	
	28-Oct-2020	10:30			3.783	234.136	5.665	-	
TH15-04	24-Feb-2015	10:00	236.255	237.075	0.245	236.83	-	0.82	
	1-May-2015	16:20			0.27	236.805	-	-	
	16-Sep-2015	12:00			0.715	236.36	-	-	
	26-Feb-2019	-			2.22	234.855	-	-	
	14-Mar-2019	8:35			2.239	234.836	-	-	
	11-Jun-2019	13:15			1.19	235.885	12.923	0.883	
	19-Oct-2019	-			0	237.075	-	0.88	Installed packer
	16-Jun-2020	14:21			0.555	236.52	12.925	-	Removed packer and water still rising
	27-Oct-2020	17:30			0.695	236.38	-	-	Frozen

TABLE 2
GROUNDWATER ELEVATION MEASUREMENTS
LAKE ST. MARTIN OUTLET CHANNEL

Sample ID	Date	Time	Ground Elevation (m)	Top of Casing Elevation (m)	Depth to Water from Top of Casing (m)	Groundwater Elevation (m)	Depth To Bottom from Top of Casing (m)	Stickup Height (m)	Comments
TH15-04A	24-Feb-2015	8:01	236.027	236.927	3	233.927	-	0.9	
	1-May-2015	16:20			2.26	234.667	-	-	Plugged at 1.36 m below grade
	16-Sep-2015	12:00			3.055	233.872	-	-	
	26-Feb-2019	-			3.76	233.167	-	-	
	8-Mar-2019	10:15			3.77	233.157	6.914	-	
	12-Jun-2019	13:15			2.901	234.026	6.91	1.029	
	23-Oct-2019	-			2.255	234.672	6.91	1.02	
	16-Jun-2020	14:16			2.945	233.982	6.912	-	
	27-Oct-2020	17:30			3.065	233.862	6.91	-	
TH15-05	24-Feb-2015	8:05	234.347	235.277	2.84	232.437	-	0.93	
	1-May-2015	16:10			2.3	232.977	-	-	Plugged at 1.37 m below grade
	16-Sep-2015	12:00			2.793	232.484	-	-	
	27-Feb-2019	-			3.2	232.077	-	-	
	8-Mar-2019	12:19			3.16	232.117	9.922	-	
	12-Jun-2019	13:09			3.08	232.197	9.949	1.162	
	23-Oct-2019	14:06			2.336	232.941	9.958	1.185	
	16-Jun-2020	14:07			2.705	232.572	9.996	-	
	27-Oct-2020	17:33			2.9	232.377	10	-	
TH15-05A	24-Feb-2015	8:06	234.306	235.206	2.850	232.356	-	0.9	
	1-May-2015	16:10			2.400	232.806	-	-	Plugged at 1.5 m below grade
	16-Sep-2015	12:00			2.786	232.420	-	-	
	8-Mar-2019	12:02			3.16	232.046	6.416	-	
	12-Jun-2019	13:05			3.033	232.173	6.412	1.105	
	23-Oct-2019	14:16			2.275	232.931	6.45	1.13	
	16-Jun-2020	14:08			Dry	-	2.64	-	Frozen
	27-Oct-2020	17:33			2.854	232.352	6.415	-	
TH15-06	24-Feb-2015	9:00	228.857	229.367	4.270	225.097	-	0.51	
	1-May-2015	16:00			3.590	225.777	-	-	
	16-Sep-2015	12:00			4.376	224.991	-	-	
	10-Mar-2019	8:52			5.356	224.011	9.562	-	
	12-Jun-2019	-			4.271	225.096	9.554	0.85	
	23-Oct-2019	13:15			3.642	225.725	-	-	
	16-Jun-2020	13:39			3.854	225.513	9.563	-	
	27-Oct-2020	15:35			4.23	225.137	9.541	-	
TH15-06A	24-Feb-2015	9:01	228.187	229.11	3.050	226.060	-	0.92	
	1-May-2015	16:00			2.340	226.770	-	-	
	16-Sep-2015	12:00			2.984	226.126	-	-	
	27-Feb-2019	12:00			4.550	224.560	-	-	
	10-Mar-2019	8:50			4.644	224.466	-	-	
	12-Jun-2019	-			3.022	226.088	5.59	1.05	
	23-Oct-2019	13:15			2.365	226.745	-	-	
	16-Jun-2020	13:38			2.499	226.611	5.595	-	
	27-Oct-2020	15:35			2.699	226.411	5.59	-	
TH15-07	10-Mar-2019	8:17	227.5264	228.664	3.415	225.249	9.977	-	
	12-Jun-2019	11:20			2.423	226.241	9.978	1.18	
	23-Oct-2019	-			2.005	226.659	9.993	1.145	
	16-Jun-2020	13:46			2.118	226.546	9.98	-	
	27-Oct-2020	15:30			2.29	226.374	9.98	-	
TH15-07A	24-Feb-2015	9:05	228.1296	228.917	1.160	227.757	-	-	
	1-May-2015	15:50			0.970	227.947	-	-	
	16-Sep-2015	12:00			1.298	227.619	-	-	
	10-Mar-2019	8:19			4.456	224.461	5.36	-	
	12-Jun-2019	11:20			1.33	227.587	5.359	0.919	
	23-Oct-2019	-			0.999	227.918	5.363	0.865	
	16-Jun-2020	13:46			1.11	227.807	5.36	-	
	27-Oct-2020	15:30			1.205	227.712	5.38	-	
TH15-08A	1-May-2015	15:40	227.3449	228.279	3.330	224.949	-	-	
	16-Sep-2015	12:00			4.105	224.174	-	-	
	10-Mar-2019	9:39			4.828	223.451	10.255	-	
	12-Jun-2019	11:28			4.048	224.231	10.245	1.128	
	23-Oct-2019	12:28			3.462	224.817	-	-	
	16-Jun-2020	13:12			3.577	224.702	10.26	-	
	27-Oct-2020	15:20			4.043	224.236	10.241	-	
TH15-08B	24-Feb-2015	9:10	227.3449	228.265	1.320	226.945	-	-	
	1-May-2015	15:40			1.115	227.150	-	-	
	16-Sep-2015	12:00			1.415	226.850	-	-	
	10-Mar-2019	9:42			2.247	226.018	5.356	-	
	12-Jun-2019	11:28			1.471	226.794	5.358	1.13	
	23-Oct-2019	13:00			1.16	227.105	-	-	
	16-Jun-2020	13:13			1.223	227.042	5.315	-	
	27-Oct-2020	15:20			1.335	226.930	5.386	-	

TABLE 2
GROUNDWATER ELEVATION MEASUREMENTS
LAKE ST. MARTIN OUTLET CHANNEL

Sample ID	Date	Time	Ground Elevation (m)	Top of Casing Elevation (m)	Depth to Water from Top of Casing (m)	Groundwater Elevation (m)	Depth To Bottom from Top of Casing (m)	Stickup Height (m)	Comments
TH15-09A	1-May-2015	15:30	226.695	227.454	1.120	226.334	-	-	
	16-Sep-2015	12:00			1.305	226.149	-	-	
	10-Mar-2019	11:15			2.126	225.328	6.407	-	
	12-Jun-2019	11:37			1.36	226.094	6.363	0.904	
	23-Oct-2019	-			1.152	226.302	6.35	0.89	
	16-Jun-2020	13:07			1.195	226.259	6.332	-	
	27-Oct-2020	15:09			1.227	226.227	6.31	-	
TH15-09B	24-Feb-2015	9:25	226.695	227.42	1.425	225.995	-	-	
	1-May-2015	15:30			0.935	226.485	-	-	
	16-Sep-2015	12:00			1.169	226.251	-	-	
	26-Feb-2019	-			1.950	225.470	-	-	
	10-Mar-2019	11:20			1.985	225.435	3.779	-	
	12-Jun-2019	11:37			1.194	226.226	3.799	0.856	
	23-Oct-2019	-			1.004	226.416	3.78	0.84	
	16-Jun-2020	13:08			1.049	226.371	3.8	-	
	27-Oct-2020	15:09			1.078	226.342	3.78	-	
TH15-10A	1-May-2015	15:20	224.168	225.361	3.950	221.411	-	-	
	16-Sep-2015	12:00			2.386	222.975	-	-	
	25-Feb-2019	-			3.120	222.241	-	-	
	11-Mar-2019	13:36			3.158	222.203	10.44	-	
	12-Jun-2019	11:57			2.567	222.794	10.491	1.229	
	23-Oct-2019	-			1.993	223.368	10.495	-	
	16-Jun-2020	11:36			1.84	223.521	10.465	-	
	27-Oct-2020	14:15			2.086	223.275	10.41	-	
TH15-10B	1-May-2015	15:20	224.168	225.4	1.340	224.060	-	-	
	16-Sep-2015	12:00			1.715	223.685	-	-	
	25-Feb-2019	-			2.900	222.500	-	-	
	11-Mar-2019	13:39			2.901	222.499	6.029	-	
	12-Jun-2019	11:57			1.817	223.583	6.023	1.271	
	23-Oct-2019	-			1.38	224.020	6.02	-	
	16-Jun-2020	11:37			1.479	223.921	6.033	-	
	27-Oct-2020	14:15			1.579	223.821	6.003	-	
TH15-11A	1-May-2015	15:10	221.9015	222.62	1.460	221.160	-	-	
	16-Sep-2015	12:00			1.485	221.135	-	-	
	25-Feb-2019	-			1.970	220.650	-	-	
	13-Mar-2019	12:32			1.968	220.652	8.405	-	
	12-Jun-2019	11:00			1.44	221.180	8.405	0.91	
	23-Oct-2019	11:45			1.165	221.455	-	-	
	16-Jun-2020	11:30			1.093	221.527	8.41	-	
	27-Oct-2020	14:04			1.31	221.310	8.41	-	
TH15-11B	1-May-2015	15:10	221.9015	222.538	0.800	221.738	-	-	
	16-Sep-2015	12:00			1.095	221.443	-	-	
	25-Feb-2019	-			1.650	220.888	-	-	
	13-Mar-2019	12:34			1.653	220.885	4.706	-	
	12-Jun-2019	11:00			1.095	221.443	4.634	0.825	
	10/23/209	11:45			0.83	221.708	-	-	
	16-Jun-2020	11:30			0.902	221.636	4.64	-	
	27-Oct-2020	14:04			1.015	221.523	4.63	-	
TH15-12A	24-Feb-2015	14:01	221.082	222.052	1.580	220.472	-	-	
	1-May-2015	15:00			1.415	220.637	-	-	
	16-Sep-2015	12:00			1.690	220.362	-	-	
	25-Feb-2019	-			2.650	219.402	-	-	
	11-Mar-2019	17:01			2.67	219.382	7.581	-	
	12-Jun-2019	19:20			1.779	220.273	7.563	1.09	
	23-Oct-2019	10:27			1.16	220.892	-	-	
	16-Jun-2020	10:00			1.517	220.535	7.485	-	
	27-Oct-2020	10:30			1.63	220.422	7.43	-	
TH15-12B	24-Feb-2015	14:02	221.082	222.092	1.320	220.772	-	-	
	1-May-2015	15:00			1.185	220.907	-	-	
	16-Sep-2015	12:00			1.382	220.710	-	-	
	25-Feb-2019	-			2.070	220.022	-	-	
	11-Mar-2019	17:00			2.081	220.011	5.3	-	
	12-Jun-2019	19:20			1.421	220.671	5.312	1.14	
	23-Oct-2019	10:27			1.47	220.622	-	-	
	16-Jun-2020	10:02			1.558	220.534	5.273	-	
	27-Oct-2020	10:30			1.667	220.425	5.22	-	
TH19-KGS-01	9-Mar-2019	9:33	245.457	245.915	1.688	244.227	21.753	-	
	11-Jun-2019	9:28			0.993	244.922	21.79	0.525	
	24-Oct-2019	13:00			0.3	245.615	21.8	0.45	
	9-Mar-2020	17:15			1.14	244.775	-	0.33	
	17-Jun-2020	-			0.38	245.535	21.8	0.45	
	27-Oct-2020	10:00			0.75	245.165	21.78	-	

TABLE 2
GROUNDWATER ELEVATION MEASUREMENTS
LAKE ST. MARTIN OUTLET CHANNEL

Sample ID	Date	Time	Ground Elevation (m)	Top of Casing Elevation (m)	Depth to Water from Top of Casing (m)	Groundwater Elevation (m)	Depth To Bottom from Top of Casing (m)	Stickup Height (m)	Comments
TH19-KGS-02	13-Mar-2019	7:40	245.172	246.287	2.08	244.207	-	-	
	11-Jun-2019	9:15			2.017	244.27	-	1.035	
	24-Oct-2019	13:00			0.575	245.712	19.143	1.03	
	9-Mar-2020	15:37			1.33	244.957	19.14	0.912	
	17-Jun-2020	15:30			0.68	245.607	19.125	-	
	27-Oct-2020	9:06			0.54	245.747	-	-	Frozen
TH19-KGS-02b	9-Mar-2019	8:20	245.204	245.992	2.44	243.552	8.354	-	
	11-Jun-2019	9:20			1.729	244.263	-	0.943	Frozen
	24-Oct-2019	-			0.936	245.056	8.36	0.89	
	9-Mar-2020	16:07			0.863	245.129	-	0.8	Frozen
	17-Jun-2020	15:35			1.02	244.972	8.35	-	
	27-Oct-2020	9:06			1.276	244.716	-	-	
TH19-KGS-03a	8-Mar-2019	18:10	245.388	246.316	1.562	244.754	2.5	-	
	11-Jun-2019	10:28			1.264	245.052	1.634	0.965	
	24-Oct-2019	15:15			1.126	245.19	2.489	-	
	17-Jun-2020	18:25			1.24	245.076	2.44	-	
	28-Oct-2020	16:26			1.305	245.011	2.47	-	
TH19-KGS-04	9-Mar-2019	11:45	244.935	245.671	1.519	244.152	23.835	-	
	11-Jun-2019	11:07			0.81	244.861	23.829	-	
	24-Oct-2019	15:00			0.14	245.531	23.834	0.82	
	17-Jun-2020	17:45			0.26	245.411	23.91	-	
	10/28/20120	16:00			0.59	245.081	-	-	
TH19-KGS-04a	11-Jun-2019	11:07	245.011	245.802	0.18	245.622	-	-	Reading taken below ground surface due to damaged well
	24-Oct-2019	-			0.945	244.857	2.138	-	
	17-Jun-2020	17:45			1.055	244.747	2.01	-	
	28-Oct-2020	16:00			1.095	244.707	1.89	-	
TH19-KGS-07	7-Mar-2019	9:32	243.215	243.992	0.063	243.929	11.49	-	Frozen
	11-Jun-2019	9:30			Flowing	-	-	1.53	Added 0.48 m casing; still flowing with extension installed
	24-Oct-2019	-			Flowing	-	-	-	Added 1.575 m extension; still flowing. Installed packer
	17-Jun-2020	17:43			-	-	-	-	Damaged well
	28-Oct-2020	16:40			Flowing	-	-	-	Damaged well
TH19-KGS-07a	7-Mar-2019	7:30	243.193	244.042	1.045	242.997	2.642	-	Frozen
	11-Jun-2019	9:45			1.032	243.01	2.639	-	
	24-Oct-2019	-			0.83	243.212	-	-	
	28-Oct-2020	16:45			1.06	242.982	-	-	Soft bottom
TH19-KGS-08	8-Mar-2019	14:04	233.734	234.612	Flowing	-	19.188	-	Artesian conditions
	12-Jun-2019	12:50			Flowing	-	19.191	1.072	Artesian conditions remain after adding 1.55 m casing extension
	23-Oct-2019	-			Flowing	-	-	-	Artesian conditions remain after adding 1.53 m casing extension
	16-Jun-2020	14:00			Flowing	-	19.205	-	Artesian conditions remain after adding 1.83 m casing extension
	27-Oct-2020	17:30			0	234.612	-	-	Frozen at top of pipe
TH19-KGS-08a	8-Mar-2019	14:59	234.217	234.921	Dry	-	2.48	-	
	12-Jun-2019	12:50			2.428	232.493	2.48	0.73	
	23-Oct-2019	-			1.75	233.171	2.49	0.62	
	28-Oct-2020	10:50			2.435	232.486	2.48	-	
TH19-KGS-09	12-Mar-2019	13:54	241.489	242.617	0.047	242.57	18.898	-	
	11-Jun-2019	-			-0.643	243.26	-	-	Removed 0.544 m of casing and added 1.55 m of temporary casing (1.011 m) to measure flowing well; measured 0.363 m below added height
	23-Oct-2019	-			-1.25	243.867	-	-	Added casing
	16-Jun-2020	17:00			-0.63	243.247	18.765	1.17	Added casing; new stickup of 1.17m
	28-Oct-2020	14:30			0	242.617	-	-	Frozen at top of pipe
TH19-KGS-10	9-Mar-2019	16:50	228.82	229.858	5.28	224.578	14.575	-	
	12-Jun-2019	12:27			4.174	225.684	14.57	1.029	
	23-Oct-2019	15:27			3.441	226.417	14.574	1.025	
	16-Jun-2020	13:24			3.645	226.213	14.575	-	
	27-Oct-2020	15:43			4.033	225.825	14.59	-	
TH19-KGS-10a	9-Mar-2019	16:52	229.115	229.918	2.06	227.858	2.187	-	
	12-Jun-2019	12:27			1.362	228.556	2.188	0.893	
	23-Oct-2019	-			1.168	228.75	2.195	0.869	
	16-Jun-2020	13:22			1.31	228.608	2.19	-	
	27-Oct-2020	15:22			1.375	228.543	2.19	-	
TH19-KGS-100	7-Mar-2019	13:38	240.653	241.741	1.405	240.336	2.948	-	Frozen
	11-Jun-2019	13:40			1.253	240.488	2.939	1.16	
	23-Oct-2019	17:36			1.053	240.688	2.933	1.16	
	16-Jun-2020	16:16			1.161	240.58	2.936	-	
	28-Oct-2020	15:15			1.187	240.554	-	-	Frozen
TH19-KGS-11	8-Mar-2019	8:08	236.92	237.915	1.932	235.983	16.815	-	Frozen
	11-Jun-2019	14:55			0.76	237.155	17.808	1.03	
	23-Oct-2019	16:55			0	237.915	16.82	1.075	Installed packer
	16-Jun-2020	15:31			1.78	236.135	16.812	-	Removed packer
	28-Oct-2020	13:51			-	-	-	-	Frozen at 0.22 m
TH19-KGS-11a	8-Mar-2019	8:50	236.432	237.153	1.631	235.522	2.53	-	
	11-Jun-2019	14:58			1.142	236.011	2.532	0.82	
	23-Oct-2019	16:55			0.786	236.367	2.54	0.8	
	28-Oct-2020	13:51			1.111	236.042	2.528	-	

TABLE 2
GROUNDWATER ELEVATION MEASUREMENTS
LAKE ST. MARTIN OUTLET CHANNEL

Sample ID	Date	Time	Ground Elevation (m)	Top of Casing Elevation (m)	Depth to Water from Top of Casing (m)	Groundwater Elevation (m)	Depth To Bottom from Top of Casing (m)	Stickup Height (m)	Comments
TH19-KGS-12	7-Mar-2019	14:50	240.795	241.779	5.294	236.485	15.87	-	
	11-Jun-2019	14:00			4.1	237.679	-	-	
	23-Oct-2019	15:31			2.501	239.278	18.87	1.07	
	16-Jun-2020	14:39			3.142	238.637	15.92	-	
	28-Oct-2020	12:30			3.6	238.179	15.91	-	
TH19-KGS-12b	12-Mar-2019	-	240.834	241.897	0.18	241.717	9.659	-	GWL taken after removing frozen packer
	11-Jun-2019	-			2.751	239.146	9.655	1.17	
	23-Oct-2019	15:06			2.061	239.836	9.655	1.195	
	16-Jun-2020	14:35			2.62	239.277	9.652	-	
	28-Oct-2020	12:30			2.08	239.817	9.65	-	
TH19-KGS-13	7-Mar-2019	15:55	237.054	238.001	2.045	235.956	14.613	-	
	11-Jun-2019	14:25			0.891	237.11	14.615	0.964	
	23-Oct-2019	-			-0.87	238.871	-	-	Temporary 1.53 m casing added to measure flowing well; Measured 0.66 m below added casing height
	16-Jun-2020	15:55			-0.04	238.041	14.62	-	Temporary 1.83 m casing added to measure flowing well; Measured 1.790m below added casing height
	28-Oct-2020	13:41			-	-	-	-	Frozen at 0.28
TH19-KGS-13a	7-Mar-2019	16:29	237.025	237.81	1.37	236.44	2.172	-	
	11-Jun-2019	-			0.99	236.82	2.1	0.99	
	23-Oct-2019	-			0.745	237.065	2.16	0.73	
	16-Jun-2020	15:55			0.96	236.85	2.15	-	
	28-Oct-2020	13:43			1.02	236.79	2.14	-	
TH19-KGS-14	8-Mar-2019	15:40	232.921	233.994	1.65	232.344	11.794	-	
	11-Jun-2019	15:30			1.031	232.963	11.79	1.118	
	24-Oct-2019	11:07			-0.046	234.04	-	-	Temporary 1.596 m casing added to measure flowing well; Measured 1.55 m below casing height
	17-Jun-2020	9:17			-	-	-	-	Packer stuck in casing
	28-Oct-2020	9:24			-	-	-	-	Packer stuck in casing
TH19-KGS-14a	8-Mar-2019	15:50	233.008	233.894	1.82	232.074	2.485	-	
	11-Jun-2019	17:07			1.319	232.575	2.485	1.008	
	24-Oct-2019	11:00			1.068	232.826	-	-	
	17-Jun-2020	10:59			1.216	232.678	2.482	-	
	28-Oct-2020	9:13			1.34	232.554	-	-	
TH19-KGS-15	8-Mar-2019	17:11	232.609	233.818	3.258	230.56	11.453	-	
	11-Jun-2019	17:00			3.82	229.998	11.447	-	
	24-Oct-2019	11:43			2.958	230.86	11.457	1.235	
	17-Jun-2020	10:43			3.36	230.458	11.452	-	
	27-Oct-2020	16:10			3.664	230.154	-	-	
TH19-KGS-16	15-Mar-2019	11:52	233.038	233.807	1.411	232.396	-	-	
	11-Jun-2019	16:37			0.27	233.537	10.264	-	
	24-Oct-2019	10:00			-0.855	234.662	10.27	0.956	Temporary 1.575 m casing added to measure flowing well; Measured 0.72 m below added casing height
	17-Jun-2020	12:43			-0.1	233.907	-	-	Temporary 1.83 m casing added to measure flowing well; Measured 1.73 m below added casing height
	27-Oct-2020	16:30			0.024	233.783	-	-	Frozen; GWL taken after thawing and installation of 0.024 m of casing
TH19-KGS-16a	9-Mar-2019	15:27	232.602	233.694	Dry	-	2.612	-	
	11-Jun-2019	11:13			2.594	231.1	2.612	1.08	
	24-Oct-2019	10:00			2.565	231.129	2.615	1.072	
	17-Jun-2020	12:06			2.57	231.124	2.615	-	
	27-Oct-2020	16:30			2.57	231.124	2.615	-	
TH19-KGS-16b	9-Mar-2019	16:30	232.907	234.023	3.404	230.619	3.983	-	
	11-Jun-2019	16:37			3.601	230.422	3.981	-	
	24-Oct-2019	10:00			3.255	230.768	3.99	1.14	
	17-Jun-2020	12:03			3.533	230.49	3.982	-	
	28-Oct-2020	8:46			3.498	230.525	3.982	-	
TH19-KGS-17	10-Mar-2019	11:50	225.028	225.698	3.292	222.406	12.745	-	
	11-Jun-2019	17:59			2.475	223.223	-	-	
	24-Oct-2019	12:08			1.77	223.928	-	0.75	
	16-Jun-2020	11:58			2.014	223.684	12.755	-	
	27-Oct-2020	14:36			2.5	223.198	12.74	-	
TH19-KGS-17a	10-Mar-2019	11:48	225.238	225.829	1.866	223.963	2.14	-	
	11-Jun-2019	17:59			1.188	224.641	2.14	0.736	
	24-Oct-2019	12:04			0.828	225.001	-	0.695	
	16-Jun-2020	11:53			0.916	224.913	2.14	-	
	27-Oct-2020	14:40			1.039	224.79	2.15	-	
TH19-KGS-17b	10-Mar-2019	11:52	225.26	226.09	7.648	218.442	8.428	-	
	13-Mar-2019	13:26			1.884	224.206	-	-	Not static
	11-Jun-2019	17:57			1.731	224.359	8.414	0.998	
	24-Oct-2019	12:00			1.316	224.774	-	1.065	
	16-Jun-2020	11:55			1.34	224.75	8.415	-	
	27-Oct-2020	14:40			1.495	224.595	8.415	-	
TH19-KGS-18	11-Mar-2019	14:22	221.4033	222.447	3.46	218.987	13.123	-	
	11-Jun-2019	18:48			2.965	219.482	-	-	
	23-Oct-2019	12:00			2.667	219.78	-	1.18	
	16-Jun-2020	11:00			1.188	221.259	2.488	-	Pipe possibly broken or blocked
	27-Oct-2020	12:43			2.975	219.472	13.02	-	

TABLE 2
GROUNDWATER ELEVATION MEASUREMENTS
LAKE ST. MARTIN OUTLET CHANNEL

Sample ID	Date	Time	Ground Elevation (m)	Top of Casing Elevation (m)	Depth to Water from Top of Casing (m)	Groundwater Elevation (m)	Depth To Bottom from Top of Casing (m)	Stickup Height (m)	Comments
TH19-KGS-18a	11-Mar-2019	14:43	221.427	222.157	0.801	221.356	2.123	-	
	11-Jun-2019	-			1.058	221.099	1.23	0.84	Frozen
	23-Oct-2019	10:45			0.78	221.377	-	0.862	
	16-Jun-2020	11:00			0.95	221.207	1.98	-	
	27-Oct-2020	12:43			0.93	221.227	1.45	-	
TH19-KGS-19	11-Mar-2019	16:00	220.585	221.487	2.623	218.864	12.362	-	
	11-Jun-2019	19:15			2.098	219.389	8.38	0.945	
	23-Oct-2019	10:00			2.692	218.795	-	1.08	
	16-Jun-2020	9:19			1.755	219.732	8.46	-	
	27-Oct-2020	11:34			2.125	219.362	-	-	
TH19-KGS-19a	11-Mar-2019	16:52	221.013	221.932	1.875	220.057	2.558	-	
	11-Jun-2019	18:45			1.2	220.732	2.55	1.04	
	23-Oct-2019	10:30			0.995	220.937	-	1.025	
	16-Jun-2020	10:04			1.065	220.867	2.55	-	
	27-Oct-2020	10:30			1.16	220.772	2.545	-	
TH19-KGS-20	14-Mar-2019	13:51	242.523	243.285	0.799	242.486	25.79	-	GWL measurement taken after removal of packer
	12-Jun-2019	-			1.525	241.76	25.69	0.905	Added casing
	24-Oct-2019	-			-0.795	244.08	25.83	0.95	Temporary 1.570 m casing added to measure flowing well; Measured 0.795 below added casing height
	17-Jun-2020	-			-0.71	243.995	-	-	Temporary 1.83 m casing added to measure flowing well; Measured 1.12 m below added casing height
	28-Oct-2020	-			-	-	-	-	Frozen plug
TH20-KGS-01	22-Feb-2020	12:00	245.143	246.142	0.9	245.242	-	-	Measurements taken one day after installation
	2-Mar-2020	11:33			0.89	245.252	-	-	Frozen
	17-Jun-2020	17:36			0.68	245.462	19.01	-	
	28-Oct-2020	14:30			-	-	-	-	Frozen at 1.012
TH20-KGS-02	2-Mar-2020	-	244.922	245.88	0.39	245.49	-	-	Frozen
	17-Jun-2020	17:59			0.485	245.395	2.38	-	Frozen
	28-Oct-2020	14:45			-	-	-	-	Frozen at 0.45 m
TH20-KGS-03	24-Feb-2020	7:40	245.021	246.07	1.42	244.65	-	-	GWL measurement taken 30 minutes after installation
	2-Mar-2020	-			0.88	245.19	-	-	Frozen
	17-Jun-2020	18:00			0.62	245.45	20.39	-	Soft bottom
	28-Oct-2020	14:45			0.926	245.144	-	-	Frozen
TH20-KGS-04	25-Feb-2020	7:40	245.172	246.136	1.25	244.886	-	-	GWL measurement taken on same day as installation
	2-Mar-2020	-			1.03	245.106	-	-	Frozen
	17-Jun-2020	18:13			0.69	245.446	16.32	-	Soft bottom
	28-Oct-2020	15:30			-	-	-	-	Frozen at 1.012
TH20-KGS-05	26-Feb-2020	7:40	245.202	246.105	1.09	245.015	-	-	GWL measurement taken 30 minutes after installation
	2-Mar-2020	-			0.92	245.185	-	-	Frozen
	9-Mar-2020	16:52			1.125	244.98	16.14	0.84	
	13-Mar-2020	-			1.05	245.055	-	-	
	17-Jun-2020	18:35			0.61	245.495	3.72	-	Frozen
	28-Oct-2020	15:00			-	-	-	-	Frozen at 0.865 m
TH20-KGS-06b	5-Mar-2020	9:30	245.399	246.611	1.525	245.086	-	-	
	9-Mar-2020	12:00			1.51	245.101	-	1.173	
	13-Mar-2020	12:57			-	-	-	-	
	17-Jun-2020	16:03			1.12	245.491	19.2	-	
	27-Oct-2020	10:00			1.45	245.161	20.01	-	
TH20-KGS-07	5-Mar-2020	12:00	245.404	246.37	0.44	245.93	-	-	
	9-Mar-2020	17:50			0.51	245.86	-	0.91	
	13-Mar-2020	-			1.293	245.077	-	-	
	17-Jun-2020	15:40			0.845	245.525	18.3	-	
	27-Oct-2020	9:30			1.205	245.165	18.29	-	
TH20-KGS-08	9-Mar-2020	18:05	245.357	246.298	1.18	245.118	-	0.908	
	13-Mar-2020	-			1.215	245.083	-	-	
	17-Jun-2020	-			0.785	245.513	17.75	-	
	27-Oct-2020	9:18			1.139	245.159	17.75	-	
Sentinel Well 1	8-Mar-2019	17:50	-	-	2.530	-	-	-	To be surveyed in winter/spring 2021
	18-Jun-2020	11:05			1.39	-	13.304	0.64	To be surveyed in winter/spring 2021
Sentinel Well 2	18-Jun-2020	-	-	-	Flowing	-	16.2	0.53	To be surveyed in winter/spring 2021
Sentinel Well 3	18-Jun-2020	13:23	-	-	0.273	-	14.05	0.74	To be surveyed in winter/spring 2021

Notes:
1. "-" = no value

TABLE 3
GENERAL WATER QUALITY
LAKE ST. MARTIN OUTLET CHANNEL

KGS Sample ID	Duplicate Sample ID	Date Sampled	ALS Sample ID	Parameter (1) pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride	Fluoride	Sulphate	Ammonia	Unionized Ammonia (2)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	Sodium	Total Phosphorus	Phosphorus - Total Dissolved	T.D.S.	T.S.S.	T.K.N.	Turbidity (NTU)	E. Coli	Total Coliform (MPN/100mL)
HC-CDWQ (3)																											
Drinking Water - MAC				-	-	-	-	-	-	-	-	1.5	-	-	-	-	10 (9)	1.0 (9)	-	-	-	-	-	-	0.1/0.3/1.0 (13)	None Detectable per 100 mL	None Detectable per 100 mL
Drinking Water - AO				7.0 - 10.5	-	-	-	-	-	80-100(5)	250	-	500	-	-	-	-	-	200	-	-	500	-	-	-	-	-
CCME (4) - Canadian Water Quality Guidelines for the Protection of Aquatic Life																											
Freshwater				6.5 - 9.0	-	-	-	-	-	-	120(6a) 640 (6b)	0.12(7)	-		0.019 (8)	-	3(10a) 124(10b)	0.06	-	(11)	-	-	(12)	-	Narrative (14)	-	-
GROUNDWATER SAMPLES																											
PW19-KGS-01		12-Mar-2019	L2245232-28	8.16	741	329	401	<0.60	<0.34	366	13.4	**0.249**	78.9	-	-	0.0093	0.0093	<0.0010	31.3	<0.030	-	437	-	-	1.04	0	0
		11-Jun-2019	L2290890-1	7.65	705	338	412	<0.60	<0.34	353	9.05	**0.263**	77.0	-	-	<0.0051	<0.0050	<0.0010	27.9	<0.030	-	428	-	-	1.12	0	0
		24-Oct-2019	L2371920-1	8.18	694	363	443	<0.60	<0.34	420	9.35	**0.305**	78.6	-	-	<0.0051	<0.0050	<0.0010	28.0	0.037	-	467	-	-	78.3	0	0
	PW-200		L2371920-4	8.21	697	357	436	<0.60	<0.34	431	9.87	**0.302**	79.3	-	-	<0.0051	<0.0050	<0.0010	29.0	<0.030	-	469	-	-	81.2	0	0
	RPD			0.4%	0.4%	1.7%	1.6%	NC	NC	2.6%	5.4%	1.0%	0.9%	-	-	NC	NC	NC	*3.5%*	*NC*	*NC*	*0.4%*	*NC*	*NC*	3.6%	*NC*	*NC*
		17-Jun-2020	L2463404-1	7.89	866	378	461	<0.60	<0.34	396	29.0	**0.339**	87.5	-	-	<0.0051	<0.0050	<0.0010	45.4	<0.030	-	515	-	-	3.20	0	0
		27-Oct-2020	L2523514-1	8.26	726	327	398	<0.60	<0.34	336	9.46	**0.251**	70.5	-	-	<0.0051	<0.0050	<0.0010	26.9	<0.030	-	409	-	-	1.91	0	0
PW19-KGS-02		13-Mar-2019	L2245232-26	8.14	744	336	410	<0.60	<0.34	372	12.6	**0.289**	88.2	-	-	<0.0051	<0.0050	<0.0010	33.9	<0.030	-	455	-	-	233	0	0
	PW19-KGS-05		L2245232-27	8.18	755	329	401	<0.60	<0.34	380	12.6	**0.280**	88.8	-	-	<0.010	<0.010	<0.0020	34.1	<0.030	-	454	-	-	180	0	0
	RPD			*0.5%*	*1.5%*	*2.1%*	*2.2%*	*NC*	*NC*	*2.1%*	*0.0%*	*3.2%*	*0.7%*	-	-	*NC*	*NC*	*NC*	*0.6%*	*NC*	*NC*	*0.2%*	*NC*	*NC*	*25.7%*	*NC*	*NC*
		11-Jun-2019	L2290890-2	7.79	735	327	399	<0.60	<0.34	362	14.1	**0.317**	89.0	-	-	<0.0051	<0.0050	<0.0010	35.7	<0.030	-	449	-	-	2.57	0	0
		24-Oct-2019	L2371920-2	8.22	729	366	446	<0.60	<0.34	371	8.52	**0.339**	93.1	-	-	0.0082	0.0082	<0.0010	31.9	<0.030	-	471	-	-	1.33	0	3
		16-Jun-2020	L2462330-4	8.32	736	334	399	3.96	<0.34	378	10.9	**0.310**	89.6	-	-	<0.0051	<0.0050	<0.0010	32.9	<0.030	-	453	-	-	1.13	0	0
		28-Oct-2020	L2523514-2	8.24	787	329	401	<0.60	<0.34	344	16.9	**0.330**	85.5	-	-	<0.0051	<0.0050	<0.0010	34.5	<0.030	-	444	-	-	2.96	0	0
	PW-100		L2523514-8	8.08	790	326	398	<0.60	<0.34	350	16.8	**0.344**	85.4	-	-	<0.0051	<0.0050	<0.0010	35.7	<0.030	-	445	-	-	2.47	0	0
	RPD			*2.0%*	*0.4%*	*0.9%*	*0.8%*	*NC*	*NC*	*1.7%*	*0.6%*	*4.2%*	*0.1%*	-	-	*NC*	*NC*	*NC*	*3.4%*	*NC*	*NC*	*0.2%*	*NC*	*NC*	*18.0%*	*NC*	*NC*
PW19-KGS-03		14-Mar-2019	L2245232-24	8.17	626	335	409	<0.60	<0.34	362	1.06	**0.197**	36.8	-	-	0.016	0.016	<0.0020	8.44	<0.030	-	364	-	-	2.75	0	5
	PW19-KGS-04		L2245232-25	8.22	622	333	406	<0.60	<0.34	361	1.01	**0.212**	37.2	-	-	0.0123	0.0123	<0.0010	8.45	<0.030	-	362	-	-	2.41	-	-
	RPD			*0.6%*	*0.6%*	*0.6%*	*0.7%*	*NC*	*NC*	*0.3%*	*4.8%*	*7.3%*	*1.1%*	-	-	*26.1%*	*26.1%*	*NC*	*0.1%*	*NC*	*NC*	*0.6%*	*NC*	*NC*	*13.2%*	*NC*	*NC*
		11-Jun-2019	L2290890-3	7.71	606	330	402	<0.60	<0.34	344	1.12	**0.175**	31.3	-	-	<0.0051	<0.0050	<0.0010	8.58	<0.030	-	349	-	-	2.16	0	0
	PW19-KGS-200		L2290890-4	7.71	609	333	406	<0.60	<0.34	348	1.15	**0.176**	31.8	-	-	<0.0051	<0.0050	<0.0010	8.60	<0.030	-	352	-	-	2.33	0	0
	RPD			*0.0%*	*0.5%*	*0.9%*	*1.0%*	*NC*	*NC*	*1.2%*	*2.6%*	*0.6%*	*1.6%*	-	-	*NC*	*NC*	*NC*	*0.2%*	*NC*	*NC*	*0.9%*	*NC*	*NC*	*7.6%*	*NC*	*NC*
		24-Oct-2019	L2371920-3	8.11	550	331	403	<0.60	<0.34	327	0.91	**0.181**	31.8	-	-	<0.0051	<0.0050	<0.0010	3.76	<0.030	-	344	-	-	1.06	0	130
		17-Jun-2020	L2462330-5	8.24	536	300	365	<0.60	<0.34	314	0.86	**0.199**	25.8	-	-	<0.0051	<0.0050	<0.0010	5.83	<0.030	-	313	-	-	2.10	0	200
	PW19-KGS-300		L2462330-6	8.23	535	298	363	<0.60	<0.34	315	0.87	**0.198**	25.9	-	-	<0.0051	<0.0050	<0.0010	5.72	<0.030	-	312	-	-	1.37	0	165
	RPD			*0.1%*	*0.2%*	*0.7%*	*0.5%*	*NC*	*NC*	*0.3%*	*1.2%*	*0.5%*	*0.4%*	-	-	*NC*	*NC*	*NC*	*1.9%*	*NC*	*NC*	*0.3%*	*NC*	*NC*	*42.1%*	*NC*	*19.2%*
		27-Oct-2020	L2523514-3	8.21	608	318	388	<0.60	<0.34	318	0.99	**0.202**	27.1	-	-	<0.0051	<0.0050	<0.0010	7.05	<0.030	-	329	-	-	0.82	0	0
Sentinel Well 1 (SW19-KGS-01)		18-Jun-2020	L2463404-2	8.29	700	330	400	1.08	<0.34	368	9.60	**0.273**	80.4	-	-	<0.0051	<0.0050	<0.0010	27.3	<0.030	-	432	-	-	0.52	0	0
		8-Mar-2019	L2242160-1	7.68	881	395	482	<0.60	<0.34	406	26.20	**0.324**	80.9	-	-	<0.0051	0.0051	<0.0010	48.0	<0.030	-	520	-	-	32.9	0	0
Sentinel Well 2 (SW19-KGS-02)		27-Sep-2019	L2356084-1	8.27	1170	349	426	<0.60	<0.34	432	91.4	**0.269**	198	-	-	<0.010	<0.010	<0.0020	111	<0.030	-	748	-	-	62.0	0	4
		18-Jun-2020	L2463404-3	8.26	1180	345	421	<0.60	<0.34	449	97.2	**0.284**	204	-	-	<0.010	<0.010	<0.0020	107	<0.030	-	759	-	-	0.91	0	0
		29-Oct-2020	L2523514-9	8.06	1240	340	415	<0.60	<0.34	424	89.0	**0.291**	187	-	-	<0.0051	<0.0050	<0.0010	106	<0.030	-	722	-	-	1.17	0	0
Sentinel Well 3 (SW19-KGS-03)		27-Sep-2019	L2356084-2	8.15	913	386	471	<0.60	<0.34	407	40.5	**0.287**	115	-	-	<0.010	<0.010	0.0049	61.9	<0.030	-	576	-	-	83.4	0	6
		18-Jun-2020	L2463404-4	8.33	930	373	447	3.96	<0.34	420	42.4	**0.308**	117	-	-	<0.010	<0.010	<0.0020	58.5	<0.030	-	576	-	-	1.29	0	0
		29-Oct-2020	L2523514-10	8.03	979	374	456	<0.60	<0.34	407	39.3	**0.319**	109	-	-	<0.0051	<0.0050	<0.0010	59.8	<0.030	-	562	-	-	1.44	0	2
TH15-04		8-Mar-2019	L2245232-4	7.90	470	237	289	<0.60	<0.34	241	1.93	**0.272**	35.4	-	-	0.0178	0.0159	0.0019	19.3	<0.030	-	275	-	-	1630	-	-
TH15-05		8-Mar-2019	L2245232-6	7.80	577	341	416	<0.60	<0.34	338	0.89	**0.231**	22.1	-	-	<0.0051	<0.0050	<0.0010	6.91	<0.030	-	342	-	-	>4000	-	-
TH19-KGS-01B		9-Mar-2019	L2245232-12	8.14	773	376	458	<0.60	<0.34	376	21.6	**0.287**	94.7	-	-	<0.010	<0.010	<0.0020	38.4	<0.030	-	497	-	-	>4000	-	-
TH19-KGS-02B		11-Mar-2019	L2245232-18	8.07	1970	269	328	<0.60	<0.34	834	93.9	**0.32**	737	-	-	<0.051	<0.050	0.014	178	<0.030	-	1430	-	-	1180	-	-
TH19-KGS-03A		8-Mar-2019	L2245232-40	8.05	650	360	439	<0.60	<0.34	367	13.6	**0.199**	11.1	-	-	0.0502	0.0442	0.0060	14.0	0.092	-	373	-	-	>4000	-	-
TH19-KGS-04		9-Mar-2019	L2245232-7	7.99	987	346	423	<0.60	<0.34	438	54.2	**0.281**	164	-	-	<0.010	<0.010	<0.0020	69.3	<0.030	-	632	-	-	347	-	-
TH19-KGS-07		7-Mar-2019	L2245232-11	8.16	654	303	369	<0.60	<0.34	331	14.9	**0.600**	64.8	-	-	<0.0051	<0.0050	<0.0010	28.2	<0.030	-	391	-	-	101	-	-
TH19-KGS-07A		7-Mar-2019	L2245232-10	7.74	689	434	530	<0.60	<0.34	393	4.31	**0.373**	12.2	-	-	0.018	0.0129	0.0051	10.2	0.053	-	419	-	-	>4000	-	-
TH19-KGS-08		8-Mar-2019	L2245232-36	8.19	600	341	416	<0.60	<0.34	352	1.07	**0.237**	22.1	-	-	0.006	0.0060	<0.0010	7.17	<0.030	-	347	-	-	267	-	-
TH19-KGS-09		12-Mar-2019	L2245232-2	7.98	737	377	460	<0.60	<0.34	417	3.81	**0.222**	77.7	-	-	<0.010	<0.010	<0.0020	21.6	<0.030	-	460	-	-	745	-	-
TH19-KGS-10		9-Mar-2019	L2245232-5	7.98	669	415	506	<0.60	<0.34	403	1.38	**0.329**	21.7	-	-	0.0052	0.0052	<0.0010	8.14	<0.030	-	404	-	-	>4000	-	-
	TH200		L2245232-30	8.11	691	414	505	<0.60	<0.34	412	1.36	**0.320**	21.6	-	-	<0.0051	<0.0050	<0.0010	8.22	<0.030	-	406	-	-	>4000	-	-
	RPD			*1.6%*	*3.2%*	*0.2%*	*0.2%*	*NC*	*NC*	*2.2%*	*1.5%*	*2.8%*	*0.5%*	-	-	*NC*	*NC*	*NC*	*1.0%*	*NC*	*NC*	*0.5%*	*NC*	*NC*	*NC*	*NC*	*NC*

TABLE 3
GENERAL WATER QUALITY
LAKE ST. MARTIN OUTLET CHANNEL

KGS Sample ID	Duplicate Sample ID	Date Sampled	ALS Sample ID	Parameter [1] pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride	Fluoride	Sulphate	Ammonia	Unionized Ammonia [2]	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	Sodium	Total Phosphorus	Phosphorus - Total Dissolved	T.D.S.	T.S.S.	T.K.N.	Turbidity (NTU)	E. Coli	Total Coliform (MPN/100mL)
HC-CDWQ [3]																											
Drinking Water - MAC				-	-	-	-	-	-	-	-	1.5	-	-	-	-	10 [9]	1.0 [9]	-	-	-	-	-	-	0.1/0.3/1.0 [13]	None Detectable per 100 mL	None Detectable per 100 mL
Drinking Water - AO				7.0 - 10.5	-	-	-	-	-	80-100[5]	250	-	500	-	-	-	-	-	200	-	-	500	-	-	-	-	-
CCME [4] - Canadian Water Quality Guidelines for the Protection of Aquatic Life																											
Freshwater				6.5 - 9.0	-	-	-	-	-	-	120[6a] 640[6b]	0.12[7]	-		0.019 [8]	-	3[10a] 124[10b]	0.06	-	[11]	-	-	[12]	-	Narrative [14]	-	-
TH19-KGS-100		7-Mar-2019	L2245232-41	7.62	767	461	562	<0.60	<0.34	*450*	6.32	**0.208**	1.71	-	-	<0.010	<0.010	0.0044	12.5	0.129	-	439	-	-	307	-	-
TH19-KGS-11		8-Mar-2019	L2245232-37	8.23	732	275	335	<0.60	<0.34	*316*	9.93	**1.15**	121	-	-	0.0317	0.0272	0.0045	39.4	<0.030	-	440	-	-	>4000	-	-
TH19-KGS-11A		8-Mar-2019	L2245232-20	7.12	669	397	484	<0.60	<0.34	*331*	0.13	0.086	0.37	-	-	0.0172	0.0156	0.0017	6.65	0.046	-	354	-	-	>4000	-	-
TH19-KGS-12		7-Mar-2019	L2245232-19	8.39	727	319	376	6.24	<0.34	*426*	17.9	**0.321**	81.0	-	-	<0.0051	<0.0050	<0.0010	27.4	<0.030	-	446	-	-	>4000	-	-
		12-Jun-2019	L2290890-5	7.85	777	414	505	<0.60	<0.34	*402*	4.20	**0.292**	71.5	-	-	<0.0051	<0.0050	<0.0010	30.1	<0.030	-	475	-	-	>4000	<10	<10
		23-Oct-2019	L2371438-4	8.37	715	475	567	6.36	<0.34	*332*	5.27	**0.356**	65.9	-	-	0.0183	0.0152	0.0031	51.2	<0.030	-	*508*	-	-	>4000	-	-
		16-Jun-2020	L2462330-3	8.24	717	380	463	<0.60	<0.34	*402*	4.39	**0.391**	46.9	-	-	0.0121	0.0121	<0.0010	29.3	<0.030	-	429	-	-	3020	<1	<1
		28-Oct-2020	L2523514-4	8.20	775	412	502	<0.60	<0.34	*377*	3.06	**0.319**	59.2	-	-	0.0101	0.0101	<0.0010	26.4	<0.030	-	450	-	-	3240	0	0
TH19-KGS-12B		14-Mar-2019	L2245232-34	8.29	791	371	452	<0.60	<0.34	*425*	13.6	**0.573**	81.8	-	-	<0.010	<0.010	<0.0020	31.1	0.049	-	481	-	-	676	-	-
TH19-KGS-13		7-Mar-2019	L2245232-1	7.80	724	361	440	<0.60	<0.34	*405*	2.82	**0.238**	82.3	-	-	0.018	0.016	0.0023	21.3	<0.030	-	449	-	-	3970	-	-
TH19-KGS-13A		7-Mar-2019	L2245232-17	7.54	460	276	337	<0.60	<0.34	*257*	2.14	**0.148**	1.79	-	-	<0.0051	<0.0050	0.0012	9.08	0.056	-	261	-	-	>4000	-	-
TH19-KGS-14		8-Mar-2019	L2245232-39	8.15	650	348	425	<0.60	<0.34	*363*	1.60	**0.266**	41.0	-	-	<0.0051	<0.0050	<0.0010	12.6	<0.030	-	380	-	-	2840	-	-
TH19-KGS-14A		8-Mar-2019	L2245232-9	7.58	483	330	403	<0.60	<0.34	*296*	1.08	**0.216**	3.44	-	-	0.0217	0.0189	0.0029	2.84	0.035	-	305	-	-	>4000	-	-
TH19-KGS-15		9-Mar-2019	L2245232-29	8.22	661	355	432	<0.60	<0.34	*383*	2.88	**0.249**	33.3	-	-	0.0175	0.0175	<0.0010	10.3	<0.030	-	383	-	-	599	-	-
TH19-KGS-16		15-Mar-2019	L2245232-14	8.07	632	336	410	<0.60	<0.34	*374*	2.78	**0.446**	44.5	-	-	0.107	0.101	0.0063	21.9	<0.030	-	390	-	-	>4000	-	-
	TH19-KGS-500		L2245232-13	7.96	674	353	431	<0.60	<0.34	*360*	5.52	**0.416**	54.0	-	-	0.141	0.134	0.0071	21.1	<0.030	-	408	-	-	896	-	-
	RPD			*1.4%*	*6.4%*	*4.9%*	*5.0%*	*NC*	*NC*	*3.8%*	*66.0%*	*7.0%*	*19.3%*	-	-	*27.4%*	*28.1%*	*11.9%*	*3.7%*	*NC*	*NC*	*4.5%*	*NC*	*NC*	*NC*	*NC*	*NC*
TH19-KGS-16B		9-Mar-2019	L2245232-35	7.95	809	472	575	<0.60	<0.34	*623*	2.31	**0.183**	22.9	-	-	0.052	0.047	0.0044	8.26	0.102	-	*521*	-	-	>4000	-	-
TH19-KGS-17		10-Mar-2019	L2245232-23	8.19	674	363	443	<0.60	<0.34	*384*	1.33	**0.272**	42.6	-	-	0.0094	0.0081	0.0013	9.43	<0.030	-	390	-	-	>4000	-	-
		12-Jun-2019	L2290890-6	7.71	622	332	405	<0.60	<0.34	*342*	0.96	**0.214**	42.2	-	-	0.0089	0.0089	<0.0010	16.0	<0.030	-	365	-	-	860	<10	<10
		23-Oct-2019	L2371438-3	8.23	591	365	446	<0.60	<0.34	*350*	0.92	**0.237**	40.6	-	-	0.008	0.0067	0.0013	9.11	<0.030	-	379	-	-	2000	-	-
		16-Jun-2020	L2462330-2	8.12	617	323	394	<0.60	<0.34	*365*	0.86	**0.275**	43.9	-	-	<0.0051	<0.0050	<0.0010	9.00	<0.030	-	361	-	-	>4000	<1	<1
		27-Oct-2020	L2523514-5	8.20	637	322	393	<0.60	<0.34	*418*	0.92	**0.245**	42.7	-	-	<0.0051	<0.0050	<0.0010	8.63	0.094	-	378	-	-	>4000	0	0
TH19-KGS-17A		10-Mar-2019	L2245232-21	7.93	578	348	425	<0.60	<0.34	*317*	2.54	**0.127**	2.91	-	-	0.0118	0.0104	0.0014	4.40	0.056	-	321	-	-	>4000	-	-
TH19-KGS-17B		10-Mar-2019	L2245232-15	8.29	846	481	587	<0.60	<0.34	*528*	3.39	**0.603**	106	-	-	0.051	0.039	0.0121	39.5	<0.030	-	*587*	-	-	>4000	-	-
TH19-KGS-18		11-Mar-2019	L2245232-38	7.77	1040	646	789	<0.60	<0.34	*637*	1.26	**0.181**	3.00	-	-	<0.010	<0.010	<0.0020	12.3	<0.030	-	*607*	-	-	>4000	-	-
		12-Jun-2019	L2290890-7	7.14	989	627	764	<0.60	<0.34	*620*	0.83	**0.135**	<0.60	-	-	<0.010	<0.010	<0.0020	11.3	<0.030	-	*587*	-	-	>4000	<10	<10
		23-Oct-2019	L2371438-2	7.86	913	675	823	<0.60	<0.34	*600*	0.22	**0.123**	<0.60	-	-	0.011	0.011	<0.0020	11.2	<0.030	-	*611*	-	-	2370	-	-
		16-Jun-2020	L2462330-1	7.41	566	331	404	<0.60	<0.34	*333*	0.38	**0.127**	5.69	-	-	<0.0051	<0.0050	<0.0010	6.56	<0.030	-	323	-	-	821	0	1
		27-Oct-2020	L2523514-6	7.81	908	537	655	<0.60	<0.34	*498*	0.17	**0.143**	1.20	-	-	<0.0051	<0.0050	<0.0010	9.36	<0.030	-	498	-	-	1880	0	0
TH19-KGS-18A		11-Mar-2019	L2245232-22	7.48	489	277	337	<0.60	<0.34	*129*	1.49	**0.125**	6.43	-	-	0.0202	0.0182	0.0019	70.2	<0.030	-	287	-	-	3110	-	-
TH19-KGS-19		11-Mar-2019	L2245232-31	8.47	785	348	403	10.4	<0.34	*431*	14.0	**0.376**	110	-	-	0.046	0.042	0.0034	37.1	0.041	-	497	-	-	468	-	-
		12-Jun-2019	L2290890-8	8.29	902	529	646	<0.60	<0.34	*489*	7.08	**0.288**	110	-	-	0.016	0.016	<0.0020	48.5	<0.030	-	*633*	-	-	>4000	<10	10
		23-Oct-2019	L2371438-1	8.30	841	514	620	3.48	<0.34	*400*	4.32	**0.325**	71.4	-	-	0.14	0.136	0.0042	43.1	<0.030	-	*541*	-	-	37.7	-	-
		17-Jun-2020	L2462330-7	8.34	860	476	566	7.2	<0.34	*487*	2.30	**0.275**	68.2	-	-	<0.010	<0.010	<0.0020	34.6	<0.030	-	*533*	-	-	36.3	0	1
		27-Oct-2020	L2523514-7	8.21	890	466	568	<0.60	<0.34	*491*	1.88	**0.242**	68.5	-	-	0.0166	0.0166	<0.0010	23.4	<0.030	-	*521*	-	-	32.4	0	1
TH19-KGS-19A		11-Mar-2019	L2245232-16	7.48	846	518	632	<0.60	<0.34	*523*	6.58	**0.148**	4.13	-	-	0.032	0.030	0.0022	8.37	<0.030	-	*506*	-	-	>4000	-	-
TH19-KGS-20		14-Mar-2019	L2245232-32	8.31	951	362	436	3	<0.34	*215*	21.3	**0.539**	147	-	-	0.029	0.024	0.0056	139	<0.030	-	*594*	-	-	>4000	-	-
	TH300		L2245232-33	8.30	945	353	426	2.28	<0.34	*215*	21.3	**0.535**	147	-	-	0.036	0.032	0.0048	141	<0.030	-	*591*	-	-	>4000	-	-
	RPD			*0.1%*	*0.6%*	*2.5%*	*2.3%*	*27.3%*	*NC*	*0.0%*	*0.0%*	*0.7%*	*0.0%*	-	-	*21.5%*	*28.6%*	*15.4%*	*1.4%*	*NC*	*NC*	*0.5%*	*NC*	*NC*	*NC*	*NC*	*NC*
TRIP BLANK		9-Mar-2019	L2245232-8	***5.92***	1.0	1.7	2.1	<0.60	<0.34	<0.20	<0.10	<0.020	<0.30	-	-	<0.0051	<0.0050	<0.0010	<0.050	<0.030	-	<5.0	-	-	<0.10	0	0
TRIP BLANK		11-Jun-2019	L2290890-9	***5.70***	<1.0	1.6	2	<0.60	<0.34	0.4	<0.10	<0.020	<0.30	-	-	<0.0051	<0.0050	<0.0010	<0.050	<0.030	-	<5.0	-	-	0.44	0	0
TRIP BLANK		26-Oct-2020	L2523514-11	***5.57***	<1.0	<1.0	<1.2	<0.60	<0.34	<0.20	<0.10	<0.020	<0.30	-	-	<0.0051	<0.0050	<0.0010	<0.050	<0.030	-	<5.0	-	-	<0.10	0	0
TRIP BLANK		17-Jun-2020	L2463404-8	***5.55***	<1.0	<1.0	<1.2	<0.60	<0.34	<0.20	<0.10	<0.020	<0.30	-	-	<0.0051	<0.0050	<0.0010	<0.050	<0.030	-	<5.0	-	-	<0.10	0	0
FIELD BLANK		7-Mar-2019	L2245232-3	***6.48***	1.2	2.0	2.4	<0.60	<0.34	<0.20	<0.10	<0.020	<0.30	-	-	<0.0051	<0.0050	<0.0010	<0.050	<0.030	-	<5.0	-	-	<0.10	-	-
FIELD BLANK		12-Jun-2019	L2290890-11	***6.12***	<1.0	1.7	2.1	<0.60	<0.34	0.4	<0.10	<0.020	<0.30	-	-	<0.0051	<0.0050	<0.0010	0.123	<0.030	-	<5.0	-	-	0.17	0	0

TABLE 3
GENERAL WATER QUALITY
LAKE ST. MARTIN OUTLET CHANNEL

KGS Sample ID	Duplicate Sample ID	Date Sampled	ALS Sample ID	Parameter (1) pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride	Fluoride	Sulphate	Ammonia	Unionized Ammonia (2)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	Sodium	Total Phosphorus	Phosphorus - Total Dissolved	T.D.S.	T.S.S.	T.K.N.	Turbidity (NTU)	E. Coli	Total Coliform (MPN/100mL)
HC-CDWQ (3)																											
Drinking Water - MAC				-	-	-	-	-	-	-	-	1.5	-	-	-	-	10 (9)	1.0 (9)	-	-	-	-	-	-	0.1/0.3/1.0 (13)	None Detectable per 100 mL	None Detectable per 100 mL
Drinking Water - AO				7.0 - 10.5	-	-	-	-	-	80-100(5)	250	-	500	-	-	-	-	-	200	-	-	500	-	-	-	-	-
CCME (4) - Canadian Water Quality Guidelines for the Protection of Aquatic Life																											
Freshwater				6.5 - 9.0	-	-	-	-	-	-	120(6a) 640 (6b)	0.12(7)	-		0.019 (8)	-	3(10a) 124(10b)	0.06	-	(11)	-	-	(12)	-	Narrative (14)	-	-
SURFACE WATER SAMPLES																											
BC-02		17-Jun-2020	L2463404-7	8.42	-	-	-	-	-	-	-	-	-	0.029	0.003977	<0.070	<0.020	<0.010	-	0.0551	0.0085	-	3.2	1.14	2.12	-	-
		28-Oct-2020	L2523516-3	8.09	-	-	-	-	-	-	-	-	-	0.026	0.000274	<0.070	0.020	<0.010	-	0.0162	-	-	8.6	1.28	5.25	-	-
BC-05		17-Jun-2020	L2463404-6	8.35	-	-	-	-	-	-	-	-	-	0.016	0.001954	<0.070	<0.020	<0.010	-	0.0486	0.0089	-	35.0	1.30	26.3	-	-
		28-Oct-2020	L2523516-4	7.78	-	-	-	-	-	-	-	-	-	0.016	0.000082	<0.070	<0.020	<0.010	-	0.0223	-	-	10.8	1.07	5.19	-	-
CR3-1		17-Jun-2020	L2462330-10	7.27	-	-	-	-	-	-	-	-	-	0.01	0.000086	<0.070	<0.020	<0.010	-	0.0073	0.0053	-	<3.0	0.64	0.16	-	-
		28-Oct-2020	L2523516-5	_6.98_	-	-	-	-	-	-	-	-	-	0.010	0.000008	<0.070	<0.020	<0.010	-	0.0051	-	-	<3.0	0.50	0.16	-	-
CR3-2		17-Jun-2020	L2462330-11	7.75	-	-	-	-	-	-	-	-	-	0.013	0.000416	<0.070	<0.020	<0.010	-	0.0093	0.0065	-	4.6	0.63	3.68	-	-
		28-Oct-2020	L2523516-6	7.1	-	-	-	-	-	-	-	-	-	0.017	0.000019	<0.070	0.064	<0.010	-	0.0104	-	-	<3.0	0.53	0.89	-	-
LSMOC-INLET-1A		17-Jun-2020	L2463404-5	8.5	-	-	-	-	-	-	-	-	-	0.025	0.003589	<0.070	<0.020	<0.010	-	0.0275	0.0055	-	8.4	0.84	4.85	-	-
		28-Oct-2020	L2523516-1	***6.48***	-	-	-	-	-	-	-	-	-	0.047	0.000013	<0.070	<0.020	<0.010	-	0.0204	-	-	5.8	1.21	4.46	-	-
LSMOC-OUTLET-1A		17-Jun-2020	L2462330-9	8	-	-	-	-	-	-	-	-	-	0.010	0.000368	<0.070	<0.020	<0.010	-	0.0207	0.0105	-	<3.0	0.52	4.38	-	-
		27-Oct-2020	L2523516-2	***6***	-	-	-	-	-	-	-	-	-	0.031	0.000003	<0.070	0.051	<0.010	-	0.0670	-	-	11.4	0.48	14.1	-	-
SW-R3		11-Jun-2019	L2290890-10	8.57	456	262	290	14	<0.34	269	0.970	0.159	17	-	-	<0.0051	<0.0050	<0.0010	6.84	<0.030	-	267	-	-	6.93	-	-
		24-Oct-2019	L2371920-5	8.02	176	107	131	<0.60	<0.34	106	0.66	0.044	1.52	-	-	<0.0051	<0.0050	<0.0010	0.92	<0.030	-	103	-	-	1.2	1	>200
		17-Jun-2020	L2462330-8	-	-	-	-	-	-	-	-	-	-	0.012	0.000593	<0.070	<0.020	<0.010	-	0.0171	0.0084	-	8.0	0.55	16.1	-	-
		28-Oct-2020	L2523516-7	-	-	-	-	-	-	-	-	-	-	0.010	0.000017	<0.070	<0.020	<0.010	-	0.0052	-	-	<3.0	0.49	1.58	-	-
	SW-100		L2523516-8	-	-	-	-	-	-	-	-	-	-	0.013	0.000022	<0.070	<0.020	<0.010	-	0.0045	-	-	<3.0	0.48	1.54	-	-
	RPD			*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*26.1%*	*26.1%*	*NC*	*NC*	*NC*	*NC*	*14.4%*	*NC*	*NC*	*NC*	*2.1%*	*2.6%*	*NC*	*NC*
Laboratory Detection Limits				0.10	1.0	1.0	1.2	0.60	0.34	0.20	0.10	0.020	0.30	0.010	-	0.0051	0.0050	0.0010	0.050	0.030		5.0			0.10		

E.C. = Electrical Conductivity
B.O.D. = Biochemical Oxygen Dema
C.O.D. = Chemical Oxygen Demand
D.O.C. = Dissolved Organic Carbon
TCU = True Colour Units
NTU = Nephelometric Turbidity Units

T.O.C. = Total Organic Carbon
T.K.N. = Total Kjeldahl Nitrogen
T.D.S. = Total Dissolved Solids
T.S.S. = Total Suspended Solids
S.A.R. = Sodium Absorption Ratio (no units)

Notes:
"-" = No Data

1. All values are expressed in milligrams per litre (mg/L) unless otherwise specified. Groundwater metals samples - dissolved (filtered and preserved in field). Surface water metals samples - Total (preserved in field)
2. Unionized ammonia calculated on Table 4 using pH, temperature, and laboratory analyzed ammonia values.
3. Health Canada - Canadian Drinking Water Quality Guidelines (HC-CDWQ). Updated Sept 2020.
   MAC = Maximum Acceptable Concentration = The maximum concentration of a parameter that is designed to protect those individuals most at risk, such as children and the elderly.
   AO = Aesthetic Objective = A guideline which addresses a parameter that may affect consumer acceptance of drinking water, such as taste, odour, and colour.
4. CCME - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999. Updated 2018
   Guidelines for Canadian Drinking Water Quality.
   Community Water Supplies (Health Canada - Canadian Drinking Water Quality Guidelines)
   Canadian Water Quality Guidelines for the Protection of Aquatic Life
   Canadian Water Quality Guidelines for the Protection of Agriculture
5. Public acceptance of hardness varies considerably. Generally, hardness levels between 80 and 100 mg/L (as CaCO3) provide acceptable balance between corrosion and incrustation.
   Where water is softened by sodium ion exchange, it is recommended that a separate, unsoftened supply be retained for culinary and drinking purposes.
6. Chloride toxicity to freshwater organisms was evaluated using tests with both $CaCl_2$ and NaCl salts.
   a. Long term concentration - Derived with mostly no- and some low-effect data and are intended to protect against negative effects to aquatic ecosystem structure and function during indefinite exposures (e.g. abide by the guiding principle as per CCME 2007). Refer to Factsheet for more explanation.
   b. Short term concentration - Derived with severe-effects data (such as lethality) and are not intended to protect all components of aquatic ecosystem structure and function but rather to protect most species against lethality during severe but transient events (e.g. inappropriate application or disposal of the substance of concern).
   c. Guideline is dependant on type of plant. See CCME summary table for details.
   Foliar damage
   = 100-178 mg/L for almond apricots and plums
   = 178-355 mg/L for grapes, peppers, potatoes and tomatoes
   = 355-710 mg/L for alfalfa, barley, corn, and cucumbers
   >710 mg/L for cauliflower, cotton, safflower, sesame, sorghum, sugar beets, and sunflowers
   Rootstocks
   = 180-600 mg/L for stone fruit (peaches, plums, etc.)
   = 710-900 mg/L for grapes
   Cultivars
   = 110-180 mg/L for strawberries
   = 230-460 mg/L for grapes
   = 250 mg/L for boysenberries, blackberries, and raspberries

TABLE 3

GENERAL WATER QUALITY

LAKE ST. MARTIN OUTLET CHANNEL

KGS Sample ID	Duplicate Sample ID	Date Sampled	ALS Sample ID	Parameter (1)																							
				pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride	Fluoride	Sulphate	Ammonia	Unionized Ammonia (2)	Nitrate & Nitrite (as N)	Nitrate (as N)	Nitrite (as N)	Sodium	Total Phosphorus	Phosphorus - Total Dissolved	T.D.S.	T.S.S.	T.K.N.	Turbidity (NTU)	E. Coli	Total Coliform (MPN/100mL)
HC-CDWQ (3)																											
Drinking Water - MAC				-	-	-	-	-	-	-	-	1.5	-	-	-	-	10 (9)	1.0 (9)	-	-	-	-	-	-	0.1/0.3/1.0 (13)	None Detectable per 100 mL	None Detectable per 100 mL
Drinking Water - AO				7.0 - 10.5	-	-	-	-	-	80-100(5)	250	-	500	-	-	-	-	-	200	-	-	500	-	-	-	-	-
CCME (4) - Canadian Water Quality Guidelines for the Protection of Aquatic Life																											
Freshwater				6.5 - 9.0	-	-	-	-	-	-	120(6a) 640 (6b)	0.12(7)	-		0.019 (8)	-	3(10a) 124(10b)	0.06	-	(11)	-	-	(12)	-	Narrative (14)	-	-

7. Interim Water Quality Guideline for the Protection of Aquatic Life.
8. Guideline for total ammonia is temperature and pH dependent. See Fact Sheet for details.
9. Systems using chloramine disinfection or that have naturally occurring ammonia should monitor the level of nitrate/nitrite in the distribution system.
   Homeowners with a well should test the concentration of nitrate/nitrite in their water supply.
10. All nitrate concentrations presented here will be for the ion only (i.e. as mg NO_3-/L). Conversion factors for some of the commonly reported units in the literature are provided in the Factsheet.
   For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrophication.
   Freshwater: Derived from toxicity tests utilizing $NaNO_3$.
   Marine: Derived from toxicity tests utilizing $NaNO_3$ and KNO_3.
   a. Long term concentration - Derived with mostly no- and some low-effect data and are intended to protect against negative effects to aquatic ecosystem structure and function during indefinite exposures (e.g. abide by the guiding principle as per CCME 2007).
   b. Short term concentration - Derived with severe-effects data (such as lethality) and are not intended to protect all components of aquatic ecosystem structure and function but rather to protect most species against lethality during severe but transient events (e.g. inappropriate application or disposal of the substance of concern).
11. If trigger ranges for total phosphorous are exceeded, the potential exists for an environmental impact. If trigger range is not exceeded, but TP is more than 50% above baseline values, the potential exists for an environmental impact.
   Trigger ranges (mg/L):

ultra-oligotrophic	<0.004	meso-eutrophic	0.020-0.035
oligotrophic	0.004-0.010	eutrophic	0.035-0.10
mesotrophic	0.010-0.020	hyper-eutrophic	>0.10

12. Suspended Sediments Guideline (see Total Particulate Matter fact sheet for complete details):
   Clear Flow:
   Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g. 24 hr period).
   Maximum average increase of 5 mg/L from background levels for longer term exposures (eg. inputs lasting between 24 hrs and 30 days).
   High Flow:
   Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L.
   Should not increase more than 10% of background levels when background is >250 mg/L.
13. Waterworks systems that use a surface water source or a groundwater source under the direct influence of surface water should filter the source water to meet the following health-based turbidity limits, as defined for specific treatment technologies. Where possible, filtration systems should be designed and operated to reduce turbidity levels as low as possible, with a treated water turbidity target of less than 0.1 NTU at all times. Where this is not achievable, the treated water turbidity levels from individual filters:
   a) For chemically assisted filtration, shall be less than or equal to 0.3 NTU in at least 95% of the measurements made, or at least 95% of the time each calendar month, and shall not exceed 1.0 NTU at any time.
   b) For slow sand or diatomaceous earth filtration, shall be less than or equal to 1.0 NTU in at least 95% of the measurements made, or at least 95% of the time each calendar month, and shall not exceed 3.0 NTU at any time.
   c) For membrane filtration, shall be less than or equal to 0.1 NTU in at least 99% of the measurements made, or at least 99% of the time each calendar month, and shall not exceed 0.3 NTU at any time.
   If membrane filtration is the sole treatment technology employed, some form of virus inactivation* should follow the filtration process. Turbidity values greater than 1 NTU are shaded.
14. Turbidity Guidelines (see fact sheet for complete details):
   Clear Flow:
   Maximum increase of 8 NTUs from background levels for a short-term exposure (e.g., 24 hr period).
   Maximum average increase of 2 NTUs from background levels for a longer term exposure (e.g., 30 day period).
   High Flow or Turbid Waters:
   Maximum increase of 8 NTUs from background levels at any one time when background levels are between 8 and 80 NTUs.
   Should not increase more than 10% of background levels when background is >80 NTUs.

	- Exceedance of HC-CDWQ Criteria MAC
Itallic	- Exceedance of HC-CDWQ Criteria AO
BOLD	- Exceedance of CCME Criteria for the Protection of Aquatic Life

TABLE 4
UNIONIZED AMMONIA
LAKE ST. MARTIN OUTLET CHANNEL

KGS Sample ID	Date	ALS Sample ID	pH (1)	Temp. (°C)	Temp. (1) (°K)	pKa (2)	f (3)	Ammonia (mg/L)	Unionized Ammonia (mg/L) (4)
BC-02	17-Jun-2020	L2463404-7	8.42	25.9	299.05	9.22	0.1371	0.029	0.003977
	28-Oct-2020	L2523516-3	8.09	0.6	273.75	10.06	0.0105	0.026	0.000274
BC-05	17-Jun-2020	L2463404-6	8.35	26.3	299.45	9.21	0.1221	0.016	0.001954
	28-Oct-2020	L2523516-4	7.78	0.4	273.55	10.07	0.0051	0.016	0.000082
CR3-1	17-Jun-2020	L2462330-10	7.27	22.3	295.45	9.33	0.0086	0.01	0.000086
	28-Oct-2020	L2523516-5	6.98	0.1	273.25	10.08	0.0008	0.010	0.000008
CR3-2	17-Jun-2020	L2462330-11	7.75	25.5	298.65	9.23	0.0320	0.013	0.000416
	28-Oct-2020	L2523516-6	7.1	0.7	273.85	10.06	0.0011	0.017	0.000019
LSMOC-INLET-1A	17-Jun-2020	L2463404-5	8.5	24.05	297.2	9.28	0.1436	0.025	0.003589
	28-Oct-2020	L2523516-1	6.48	1	274.15	10.05	0.0003	0.047	0.000013
LSMOC-OUTLET-1A	17-Jun-2020	L2462330-9	8	19.5	292.65	9.42	0.0368	0.010	0.000368
	27-Oct-2020	L2523516-2	6	0.1	273.25	10.08	0.0001	0.031	0.000003
SW-R3	17-Jun-2020	L2462330-8	8.04	22.5	295.65	9.32	0.0495	0.012	0.000593
	28-Oct-2020	L2523516-7	7.29	0.6	273.75	10.06	0.0017	0.010	0.000017
	28-Oct-2020	L2523516-8	7.29	0.6	273.75	10.06	0.0017	0.013	0.000022
PWQO									0.019

Notes:
1. pH and temperature values from field data.
2. pKa = 0.09018+2729.92/T, T = Temp. in Kelvins
3. f = $1/(10^{(pKa - pH)} + 1)$
4. Unionized Ammonia = f x (Ammonia)
5. PWQO - Provincial Water Quality Objectives, of the Ministry of Environment and Energy (MOEE), July 1994.

BOLD - Exceeds PWQO

TABLE 5
METALS IN WATER
LAKE ST. MARTIN OUTLET CHANNEL

KGS Sample ID	Duplicate Sample ID	Date Sampled	ALS Sample ID	Parameter (1)																		
				Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Cesium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury
HC-CDWQ (2)																						
Drinking Water - MAC				-	0.006	0.010	2.0	-	-	5.0	0.007	(9)	-	0.05	-	2.0	-	0.005	-	-	0.12	0.001
Drinking Water - AO				0.1- 0.2 (4) (OG)	-	-	-	-	-	-	-	-	-	-	-	1.0	0.3	-	-	-	0.02	-
CCME(3)																						
Freshwater Aquatic Life				0.005 - 0.1 (5)	-	0.005	-	-	-	29 (6) 1.5 (7)	0.00009(8a) 0.001(8b)	-	-	0.0089 (III)(10) 0.001 (VI)	-	(8c)	0.3	(8d)	-	-	0.430(11a)/ 3.600(11b)	0.000026 (inorganic) 0.000004 (methyl)(12)
GROUNDWATER SAMPLES																						
PW19-KGS-01		12-Mar-2019	L2245232-28	<0.0010	<0.00010	0.00038	0.0249	<0.00010	<0.000050	0.156	0.0000068	55.6	<0.000010	<0.00010	0.00025	**0.00452**	<0.010	0.000068	0.0245	55.2	0.00503	-
		11-Jun-2019	L2290890-1	<0.0010	<0.00010	0.00049	0.0254	<0.00010	<0.000050	0.133	<0.0000050	51.9	<0.000010	<0.00010	0.00024	<0.00020	0.051	<0.000050	0.0247	54.3	*0.051*	-
		24-Oct-2019	L2371920-1	**0.206**	<0.00010	0.00063	0.0290	<0.00010	<0.000050	0.142	<0.0000050	66.6	0.000054	0.00060	0.00049	0.00186	***0.390***	0.00122	0.0242	61.5	*0.0226*	-
	PW-200		L2371920-4	**0.212**	<0.00010	0.00064	0.0295	<0.00010	<0.000050	0.144	<0.0000050	68.0	0.000055	0.00063	0.00051	0.00153	***0.412***	0.00118	0.0243	63.4	*0.0228*	-
	RPD			*2.9%*	*NC*	*1.6%*	*1.7%*	*NC*	*NC*	*1.4%*	*NC*	*2.1%*	*1.8%*	*4.9%*	*4.0%*	*19.5%*	*5.5%*	*3.3%*	*0.4%*	*3.0%*	*0.9%*	*NC*
		17-Jun-2020	L2463404-1	<0.0010	<0.00010	0.00036	0.0282	<0.00010	<0.000050	0.180	<0.0000050	61.3	0.000010	<0.00010	0.00016	<0.00020	0.134	<0.000050	0.0312	59.1	0.0162	-
		27-Oct-2020	L2523514-1	<0.0010	<0.00010	0.00078	0.0243	<0.00010	<0.000050	0.145	<0.0000050	51.7	<0.000010	<0.00010	0.00019	<0.00020	0.152	<0.000050	0.0227	50.2	0.00596	-
PW19-KGS-02		13-Mar-2019	L2245232-26	<0.0010	<0.00010	0.00135	0.0242	<0.00010	<0.000050	0.145	<0.0000050	58.5	<0.000010	<0.00010	0.00015	0.00066	0.121	<0.000050	0.0252	55.0	0.00465	-
	PW19-KGS-05		L2245232-27	<0.0010	<0.00010	0.00136	0.0243	<0.00010	<0.000050	0.150	<0.0000050	60.3	0.000010	<0.00010	0.00014	<0.00020	0.128	<0.000050	0.0254	55.7	0.00462	-
	RPD			*NC*	*NC*	*0.7%*	*0.4%*	*NC*	*NC*	*3.4%*	*NC*	*3.0%*	*NC*	*NC*	*6.9%*	*NC*	*5.6%*	*NC*	*0.8%*	*1.3%*	*0.6%*	*NC*
		11-Jun-2019	L2290890-2	<0.0010	<0.00010	0.00161	0.0250	<0.00010	<0.000050	0.129	<0.0000050	55.1	0.000012	<0.00010	0.00016	0.00122	0.112	0.000057	0.0253	54.6	*0.112*	-
		24-Oct-2019	L2371920-2	<0.0010	<0.00010	0.00125	0.0258	<0.00010	<0.000050	0.137	<0.0000050	57.2	0.000016	<0.00010	0.00015	0.00079	0.116	0.000070	0.0245	55.5	0.00436	-
		16-Jun-2020	L2462330-4	<0.0010	<0.00010	0.00129	0.0246	<0.00010	<0.000050	0.144	<0.0000050	57.8	<0.000010	<0.00010	0.00015	0.00050	0.138	0.000055	0.0253	56.7	0.00495	-
		28-Oct-2020	L2523514-2	<0.0010	<0.00010	0.00185	0.0245	<0.00010	<0.000050	0.139	<0.0000050	54.2	0.000010	<0.00010	0.00015	<0.00020	0.191	<0.000050	0.0240	50.6	0.00685	-
	PW-100		L2523514-8	<0.0010	<0.00010	0.00182	0.0248	<0.00010	<0.000050	0.139	<0.0000050	55.4	0.000023	<0.00010	0.00016	<0.00020	0.202	<0.000050	0.0249	51.4	0.00694	-
	RPD			*NC*	*NC*	*1.6%*	*1.2%*	*NC*	*NC*	*0.0%*	*NC*	*2.2%*	*78.8%*	*NC*	*6.5%*	*NC*	*5.6%*	*NC*	*3.7%*	*1.6%*	*1.3%*	*NC*
PW19-KGS-03		14-Mar-2019	L2245232-24	0.0011	<0.00010	0.00069	0.0590	<0.00010	<0.000050	0.102	<0.0000050	62.9	<0.000010	<0.00010	0.00110	0.00020	***0.339***	<0.000050	0.0184	49.8	*0.151*	-
	PW19-KGS-04		L2245232-25	<0.0010	<0.00010	0.00071	0.0590	<0.00010	<0.000050	0.101	<0.0000050	62.4	<0.000010	<0.00010	0.00112	<0.00020	***0.337***	<0.000050	0.0184	49.7	*0.152*	-
	RPD			*NC*	*NC*	*2.9%*	*0.0%*	*NC*	*NC*	*1.0%*	*NC*	*0.8%*	*NC*	*NC*	*1.8%*	*NC*	*0.6%*	*NC*	*0.0%*	*0.2%*	*0.7%*	*NC*
		11-Jun-2019	L2290890-3	<0.0010	<0.00010	0.00037	0.0538	<0.00010	<0.000050	0.092	<0.0000050	56.4	<0.000010	<0.00010	0.00056	<0.00020	0.216	<0.000050	0.0194	49.4	*0.216*	-
	PW19-KGS-200		L2290890-4	<0.0010	<0.00010	0.00037	0.0527	<0.00010	<0.000050	0.091	<0.0000050	56.8	<0.000010	<0.00010	0.00058	<0.00020	0.202	<0.000050	0.0197	50.2	*0.202*	-
	RPD			*NC*	*NC*	*0.0%*	*2.1%*	*NC*	*NC*	*1.1%*	*NC*	*0.7%*	*NC*	*NC*	*3.5%*	*NC*	*6.7%*	*NC*	*1.5%*	*1.6%*	*6.7%*	*NC*
		24-Oct-2019	L2371920-3	0.0090	<0.00010	0.00110	0.0619	<0.00010	<0.000050	0.068	<0.0000050	68.3	<0.000010	0.00010	0.00198	0.00041	1.25	0.000065	0.0124	38.0	*0.276*	-
		17-Jun-2020	L2462330-5	0.0018	<0.00010	0.00072	0.0487	<0.00010	<0.000050	0.077	<0.0000050	55.6	<0.000010	<0.00010	0.00094	<0.00020	0.243	<0.000050	0.0139	42.4	*0.119*	-
	PW19-KGS-300		L2462330-6	0.0019	<0.00010	0.00067	0.0492	<0.00010	<0.000050	0.076	<0.0000050	55.2	0.000011	<0.00010	0.00090	<0.00020	0.248	0.000074	0.0139	42.9	*0.119*	-
	RPD			*5.4%*	*NC*	*7.2%*	*1.0%*	*NC*	*NC*	*1.3%*	*NC*	*0.7%*	*NC*	*NC*	*4.3%*	*NC*	*2.0%*	*NC*	*0.0%*	*1.2%*	*0.0%*	*NC*
		27-Oct-2020	L2523514-3	<0.0010	<0.00010	0.00091	0.0546	<0.00010	<0.000050	0.094	<0.0000050	56.2	<0.000010	<0.00010	0.00082	<0.00020	***0.362***	<0.000050	0.0160	43.1	*0.126*	-
Sentinel Well 1 - (SW19-KGS-01)		18-Jun-2020	L2463404-2	<0.0010	<0.00010	0.00050	0.0245	<0.00010	<0.000050	0.143	<0.0000050	58.6	0.000012	<0.00010	0.00022	<0.00020	0.072	<0.000050	0.0253	53.8	0.00547	-
		8-Mar-2019	L2242160-1	0.0010	<0.00010	0.00031	0.0450	<0.00010	<0.000050	0.186	<0.0000050	59.3	0.000036	<0.00010	0.000310	0.000230	<0.010	<0.000050	0.0326	62.5	0.0668	-
Sentinel Well 2 - (SW19-KGS-02)		27-Sep-2019	L2356084-1	<0.0010	<0.00010	<0.00010	0.0115	<0.00010	<0.000050	0.235	<0.0000050	61.6	0.000048	0.00013	0.00073	<0.00020	<0.010	<0.000050	0.0379	67.6	0.0114	-
		18-Jun-2020	L2463404-3	<0.0010	<0.00010	<0.00010	0.0124	<0.00010	<0.000050	0.190	<0.0000050	70.1	0.000020	<0.00010	0.00017	<0.00020	0.099	<0.000050	0.0381	66.6	0.00999	-
		29-Oct-2020	L2523514-9	<0.0010	<0.00010	<0.00010	0.0122	<0.00010	<0.000050	0.203	<0.0000050	65.0	0.000014	<0.00010	0.00017	<0.00020	0.102	<0.000050	0.0364	63.5	0.0103	-
Sentinel Well 3 - (SW19-KGS-03)		27-Sep-2019	L2356084-2	0.0019	<0.00010	0.00013	0.0187	<0.00010	<0.000050	0.247	<0.0000050	53.7	0.000023	0.00075	0.00020	0.00020	<0.010	<0.000050	0.0333	66.2	0.00319	-
		18-Jun-2020	L2463404-4	<0.0010	<0.00010	0.00019	0.0175	<0.00010	<0.000050	0.190	<0.0000050	64.8	0.000019	<0.00010	0.00023	<0.00020	0.110	<0.000050	0.0339	62.8	0.0146	-
		29-Oct-2020	L2523514-10	<0.0010	<0.00010	0.00022	0.0180	<0.00010	<0.000050	0.206	<0.0000050	60.2	0.000020	<0.00010	0.00024	<0.00020	0.116	<0.000050	0.0326	62.4	0.0152	-
TH15-04		8-Mar-2019	L2245232-4	0.0188	0.00018	0.00168	0.0269	<0.00010	<0.000050	0.117	<0.0000050	39.3	<0.000010	<0.00010	0.00017	0.00126	0.110	0.000073	0.0170	34.8	0.0156	-
TH15-05		8-Mar-2019	L2245232-6	<0.0010	<0.00010	0.00034	0.0716	<0.00010	<0.000050	0.091	<0.0000050	56.0	<0.000010	<0.00010	0.00021	<0.00020	0.132	<0.000050	0.0171	48.0	0.0134	-
TH19-KGS-01B		9-Mar-2019	L2245232-12	<0.0010	<0.00010	0.00012	0.0202	<0.00010	<0.000050	0.158	<0.0000050	51.3	<0.000010	<0.00010	0.00033	<0.00020	***0.921***	<0.000050	0.0286	60.1	*0.0241*	-
TH19-KGS-02B		11-Mar-2019	L2245232-18	0.0028	0.00018	0.00032	0.0279	<0.00010	<0.000050	0.202	0.0000081	123	<0.000010	<0.00010	0.00097	0.00292	<0.010	<0.000050	0.0568	128	*0.108*	-
TH19-KGS-03A		8-Mar-2019	L2245232-40	0.0143	<0.00010	0.00089	0.0364	<0.00010	<0.000050	0.028	0.0000055	73.0	<0.000010	0.00020	0.00049	0.00071	***0.756***	<0.000050	0.0129	44.9	*0.0770*	-
TH19-KGS-04		9-Mar-2019	L2245232-7	0.0026	0.00053	0.00196	0.0179	<0.00010	<0.000050	0.157	<0.0000050	61.5	<0.000010	0.00011	0.00037	<0.00020	0.023	<0.000050	0.0274	69.1	0.0190	-
TH19-KGS-07		7-Mar-2019	L2245232-11	0.0014	<0.00010	0.00025	0.0411	<0.00010	<0.000050	0.112	<0.0000050	41.9	<0.000010	<0.00010	0.00056	<0.00020	***0.778***	<0.000050	0.0223	55.0	0.00748	-

TABLE 5
METALS IN WATER
LAKE ST. MARTIN OUTLET CHANNEL

KGS Sample ID	Duplicate Sample ID	Date Sampled	ALS Sample ID	Parameter (1) Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Cesium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury
HC-CDWQ (2)																						
Drinking Water - MAC				-	0.006	0.010	2.0	-	-	5.0	0.007	(9)	-	0.05	-	2.0	-	0.005	-	-	0.12	0.001
Drinking Water - AO				0.1- 0.2 (4) (OG)	-	-	-	-	-	-	-	-	-	-	-	1.0	0.3	-	-	-	0.02	-
CCME(3)																						
Freshwater Aquatic Life				0.005 - 0.1 (5)	-	0.005	-	-	-	29 (6) 1.5 (7)	0.00009(8a) 0.001(8b)	-	-	0.0089 (III)(10) 0.001 (VI)	-	(8c)	0.3	(8d)	-	-	0.430(11a)/ 3.600(11b)	0.000026 (inorganic) 0.000004 (methyl)(12)
GROUNDWATER SAMPLES																						
TH19-KGS-07A		7-Mar-2019	L2245232-10	0.0161	0.00016	0.00217	0.0671	<0.00010	<0.000050	0.034	<0.0000050	88.1	<0.000010	<0.00010	<0.00010	<0.00020	0.010	<0.000050	0.0167	42.1	*0.113*	-
TH19-KGS-08		8-Mar-2019	L2245232-36	0.0047	<0.00010	0.00020	0.0602	<0.00010	<0.000050	0.102	<0.0000050	58.3	<0.000010	<0.00010	0.00019	<0.00020	0.062	<0.000050	0.0172	50.2	*0.0261*	-
TH19-KGS-09		12-Mar-2019	L2245232-2	0.0016	<0.00010	0.00062	0.0273	<0.00010	<0.000050	0.141	<0.0000050	62.9	<0.000010	<0.00010	0.00022	<0.00020	0.058	<0.000050	0.0233	63.0	0.0189	-
TH19-KGS-10		9-Mar-2019	L2245232-5	0.0029	<0.00010	0.00100	0.0585	<0.00010	<0.000050	0.091	<0.0000050	58.7	<0.000010	<0.00010	0.00020	<0.00020	<0.010	<0.000050	0.0207	62.2	0.0100	-
	TH200		L2245232-30	0.0029	<0.00010	0.00100	0.0601	<0.00010	<0.000050	0.091	<0.0000050	59.5	<0.000010	<0.00010	0.00021	<0.00020	<0.010	<0.000050	0.0207	64.0	0.0103	-
	RPD			*0.0%*	*NC*	*0.0%*	*2.7%*	*NC*	*NC*	*0.0%*	*NC*	*1.4%*	*NC*	*NC*	*4.9%*	*NC*	*NC*	*NC*	*0.0%*	*2.9%*	*3.0%*	*NC*
TH19-KGS-100		7-Mar-2019	L2245232-41	0.0101	<0.00010	0.00082	0.0507	<0.00010	<0.000050	0.056	<0.0000050	81.0	<0.000010	0.00019	0.00022	0.00128	***0.420***	0.000053	0.0181	60.3	*0.139*	-
TH19-KGS-11		8-Mar-2019	L2245232-37	0.0042	<0.00010	0.00206	0.0164	<0.00010	<0.000050	0.412	<0.0000050	56.2	0.000022	<0.00010	0.00014	<0.00020	0.044	<0.000050	0.0311	42.6	0.0163	-
TH19-KGS-11A		8-Mar-2019	L2245232-20	0.0134	<0.00010	0.00129	0.0386	<0.00010	<0.000050	0.044	<0.0000050	70.1	<0.000010	<0.00010	0.00153	0.00035	***1.09***	<0.000050	0.0059	38.0	***0.603***	-
TH19-KGS-12		7-Mar-2019	L2245232-19	0.0027	0.00017	0.00040	0.0416	<0.00010	<0.000050	0.138	<0.0000050	51.2	<0.000010	<0.00010	0.00085	0.00067	***1.64***	<0.000050	0.0350	72.3	*0.125*	-
		12-Jun-2019	L2290890-5	0.0011	0.00024	0.00041	0.0602	<0.00010	<0.000050	0.115	<0.0000050	48.5	<0.000010	<0.00010	0.00088	0.00022	***1.82***	<0.000050	0.0361	68.2	*1.82*	-
		23-Oct-2019	L2371438-4	0.0057	0.00063	0.00109	0.0919	<0.00010	<0.000050	0.109	<0.0000050	37.5	<0.000010	0.00017	0.00071	0.00058	***0.422***	<0.000050	0.0327	57.9	*0.0686*	-
		16-Jun-2020	L2462330-3	0.0010	0.00011	0.00121	0.0783	<0.00010	<0.000050	0.126	<0.0000050	45.5	<0.000010	<0.00010	0.00057	0.00041	***0.597***	<0.000050	0.0359	70.1	*0.209*	-
		28-Oct-2020	L2523514-4	0.0062	0.00025	0.00214	0.107	<0.00010	<0.000050	0.135	<0.0000050	45.3	<0.000010	0.00020	0.00168	0.00030	***0.423***	<0.000050	0.0353	64.1	*0.227*	-
TH19-KGS-12B		14-Mar-2019	L2245232-34	0.0048	0.00075	0.00071	0.0197	<0.00010	<0.000050	0.167	0.0000147	57.6	<0.000010	<0.00010	0.00267	0.00324	<0.010	<0.000050	0.0432	68.2	*0.0753*	-
TH19-KGS-13		7-Mar-2019	L2245232-1	<0.0010	0.00012	0.00093	0.0234	<0.00010	<0.000050	0.116	0.0000065	60.5	0.000014	<0.00010	0.00022	<0.00020	0.053	0.000247	0.0258	61.7	0.0145	-
TH19-KGS-13A		7-Mar-2019	L2245232-17	0.0268	<0.00010	0.00111	0.0240	<0.00010	<0.000050	0.026	0.0000227	49.5	<0.000010	0.00013	0.00072	0.00165	0.199	0.000119	0.0080	32.4	***0.506***	-
TH19-KGS-14		8-Mar-2019	L2245232-39	0.0017	<0.00010	0.00027	0.0371	<0.00010	<0.000050	0.136	<0.0000050	60.5	0.000010	<0.00010	0.00013	<0.00020	0.034	<0.000050	0.0233	51.4	*0.0209*	-
TH19-KGS-14A		8-Mar-2019	L2245232-9	0.0096	<0.00010	0.00137	0.0374	<0.00010	<0.000050	0.023	0.0000101	68.2	<0.000010	0.00011	0.00019	0.00096	***0.433***	<0.000050	0.0059	30.5	*0.142*	-
TH19-KGS-15		9-Mar-2019	L2245232-29	0.0041	0.00018	0.00065	0.0353	<0.00010	<0.000050	0.124	0.0000098	65.2	<0.000010	0.00021	0.00054	0.00044	<0.010	<0.000050	0.0253	53.4	*0.0825*	-
TH19-KGS-16		15-Mar-2019	L2245232-14	0.0339	0.00094	0.00185	0.0449	<0.00010	<0.000050	0.169	0.0000090	61.3	0.000020	0.00014	0.00036	0.00165	0.018	0.000084	0.0233	53.7	*0.0665*	-
	TH19-KGS-500		L2245232-13	0.0034	0.00086	0.00177	0.0428	<0.00010	<0.000050	0.158	0.0000090	58.8	0.000014	<0.00010	0.00034	0.00076	<0.010	0.000056	0.0227	51.7	*0.0638*	-
	RPD			*163.5%*	*8.9%*	*4.4%*	*4.8%*	*NC*	*NC*	*6.7%*	*0.0%*	*4.2%*	*35.3%*	*NC*	*5.7%*	*73.9%*	*NC*	*40.0%*	*2.6%*	*3.8%*	*4.1%*	*NC*
TH19-KGS-16B		9-Mar-2019	L2245232-35	0.838	<0.00010	0.00122	0.0816	<0.00010	<0.000050	0.103	0.0000301	129	0.000049	**0.00153**	0.00195	0.00353	***0.934***	0.00166	0.0186	73.1	*0.390*	-
TH19-KGS-17		10-Mar-2019	L2245232-23	0.0048	0.00100	0.00296	0.0417	<0.00010	<0.000050	0.094	<0.0000050	55.8	<0.000010	0.00014	0.00022	0.00020	0.016	<0.000050	0.0189	59.5	*0.0242*	-
		12-Jun-2019	L2290890-6	0.0045	0.00015	0.00270	0.0429	<0.00010	<0.000050	0.085	<0.0000050	49.8	<0.000010	<0.00010	0.00025	<0.00020	0.063	<0.000050	0.0170	53.0	*0.063*	-
		23-Oct-2019	L2371438-3	0.0015	<0.00010	0.00137	0.0428	<0.00010	<0.000050	0.082	<0.0000050	53.9	<0.000010	<0.00010	0.00011	0.00033	0.159	<0.000050	0.0174	52.2	*0.0405*	-
		16-Jun-2020	L2462330-2	0.0030	<0.00010	0.00120	0.0414	<0.00010	<0.000050	0.087	<0.0000050	55.5	<0.000010	<0.00010	<0.00010	<0.00020	0.140	<0.000050	0.0177	55.0	*0.0204*	-
		27-Oct-2020	L2523514-5	**1.25**	<0.00010	0.00134	0.0607	0.00012	<0.000050	0.094	0.0000064	67.7	0.000298	**0.00224**	0.00119	0.00168	***1.35***	0.00282	0.0192	60.5	*0.0417*	-
TH19-KGS-17A		10-Mar-2019	L2245232-21	0.0125	0.00018	0.00113	0.0319	<0.00010	<0.000050	0.027	0.0000079	61.6	<0.000010	0.00064	0.00029	**0.00459**	0.061	0.000102	0.0073	39.6	***0.454***	-
TH19-KGS-17B		10-Mar-2019	L2245232-15	0.0060	0.00033	0.00098	0.0365	<0.00010	<0.000050	0.130	0.0000078	41.1	<0.000010	**0.00104**	0.00022	0.00320	<0.010	0.000069	0.0599	103	0.0115	-
TH19-KGS-18		11-Mar-2019	L2245232-38	0.0023	0.00031	0.00101	0.0975	<0.00010	<0.000050	0.093	<0.0000050	114	<0.000010	<0.00010	0.00086	0.00048	0.213	<0.000050	0.0400	85.4	*0.0478*	-
		12-Jun-2019	L2290890-7	0.0018	0.00011	0.00190	0.154	<0.00010	<0.000050	0.052	<0.0000050	116	<0.000010	<0.00010	0.00154	<0.00020	***1.08***	<0.000050	0.0357	80.1	*1.08*	-
		23-Oct-2019	L2371438-2	0.0100	<0.00010	0.00099	0.154	<0.00010	<0.000050	0.060	<0.0000050	119	0.000010	<0.00010	0.00073	0.00035	***1.71***	0.000134	0.0323	73.3	*0.0643*	-
		16-Jun-2020	L2462330-1	0.0163	0.00014	0.00163	0.0434	<0.00010	<0.000050	0.028	<0.0000050	77.6	<0.000010	0.00047	0.00065	<0.00020	***1.78***	<0.000050	0.0089	33.9	*0.112*	-
		27-Oct-2020	L2523514-6	0.0030	<0.00010	0.00163	0.0871	<0.00010	<0.000050	0.063	<0.0000050	108	<0.000010	0.00020	0.00042	<0.00020	***1.53***	<0.000050	0.0227	55.2	*0.0492*	-
TH19-KGS-18A		11-Mar-2019	L2245232-22	0.0198	0.00038	0.00317	0.0104	<0.00010	<0.000050	0.027	<0.0000050	25.9	0.000018	0.00011	0.00043	0.00130	0.237	0.000081	0.0150	15.5	*0.123*	-
TH19-KGS-19		11-Mar-2019	L2245232-31	0.0292	0.00429	**0.0121**	0.0292	<0.00010	<0.000050	0.116	<0.0000050	44.9	0.000016	**0.00233**	0.00013	0.00200	<0.010	0.000052	0.0334	77.3	0.00082	-
		12-Jun-2019	L2290890-8	0.0128	0.00027	**0.0167**	0.0881	0.00014	<0.000050	0.097	0.0000097	66.7	0.000051	<0.00010	0.00035	0.00101	<0.010	0.000068	0.0351	78.2	<0.010	-
		23-Oct-2019	L2371438-1	0.0060	<0.00010	**0.00629**	0.0983	<0.00010	<0.000050	0.097	<0.0000050	34.4	<0.000010	<0.00010	0.00018	<0.00020	0.018	<0.000050	0.0331	76.2	*0.189*	-
		17-Jun-2020	L2462330-7	0.0025	<0.00010	**0.00520**	0.265	<0.00010	<0.000050	0.112	<0.0000050	50.3	<0.000010	0.00012	0.00108	0.00048	0.015	<0.000050	0.0335	87.7	*0.406*	-
		27-Oct-2020	L2523514-7	0.0094	<0.00010	0.00352	0.195	<0.00010	<0.000050	0.112	<0.0000050	62.7	<0.000010	0.00012	<0.00010	<0.00020	0.026	<0.000050	0.0341	81.2	***0.469***	-

TABLE 5
METALS IN WATER
LAKE ST. MARTIN OUTLET CHANNEL

KGS Sample ID	Duplicate Sample ID	Date Sampled	ALS Sample ID	Parameter (1) Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Cesium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury
HC-CDWQ (2)																						
Drinking Water - MAC				-	0.006	0.010	2.0	-	-	5.0	0.007	(9)	-	0.05	-	2.0	-	0.005	-	-	0.12	0.001
Drinking Water - AO				0.1- 0.2 (4) (OG)	-	-	-	-	-	-	-	-	-	-	-	1.0	0.3	-	-	-	0.02	-
CCME(3)																						
Freshwater Aquatic Life				0.005 - 0.1 (5)	-	0.005	-	-	-	29 (6) 1.5 (7)	0.00009(8a) 0.001(8b)	-	-	0.0089 (III)(10) 0.001 (VI)	-	(8c)	0.3	(8d)	-	-	0.430(11a)/ 3.600(11b)	0.000026 (inorganic) 0.000004 (methyl)(12)
GROUNDWATER SAMPLES																						
TH19-KGS-19A		11-Mar-2019	L2245232-16	0.0134	<0.00010	**0.00695**	0.0621	<0.00010	<0.000050	0.048	0.0000094	118	<0.000010	0.00043	0.00152	0.00165	2.44	0.000095	0.0100	55.4	***0.487***	-
TH19-KGS-20		14-Mar-2019	L2245232-32	0.0013	0.00021	0.00053	0.0152	<0.00010	<0.000050	0.142	<0.0000050	32.5	<0.000010	<0.00010	0.00085	0.00023	<0.010	<0.000050	0.0326	32.5	0.0197	-
	TH300		L2245232-33	0.0010	0.00020	0.00047	0.0151	<0.00010	<0.000050	0.150	<0.0000050	32.1	<0.000010	<0.00010	0.00075	0.00022	<0.010	<0.000050	0.0327	32.7	0.0199	-
	RPD			*26.1%*	*4.9%*	*12.0%*	*0.7%*	*NC*	*NC*	*5.5%*	*NC*	*1.2%*	*NC*	*NC*	*12.5%*	*4.4%*	*NC*	*NC*	*0.3%*	*0.6%*	*1.0%*	*NC*
TRIP BLANK		9-Mar-2019	L2245232-8	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.010	<0.0000050	<0.050	<0.000010	<0.00010	<0.00010	<0.00020	<0.010	<0.000050	<0.0010	<0.0050	<0.00010	-
TRIP BLANK		11-Jun-2019	L2290890-9	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.010	<0.0000050	0.141	<0.000010	<0.00010	<0.00010	<0.00020	<0.010	<0.000050	<0.0010	0.0120	<0.010	-
TRIP BLANK		26-Oct-2020	L2523514-11	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.010	<0.0000050	<0.050	<0.000010	<0.00010	<0.00010	<0.00020	<0.010	<0.000050	<0.0010	<0.0050	<0.00010	-
TRIP BLANK		17-Jun-2020	L2463404-8	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.010	<0.0000050	<0.050	<0.000010	<0.00010	<0.00010	<0.00020	<0.010	<0.000050	<0.0010	<0.0050	<0.00010	-
FIELD BLANK		7-Mar-2019	L2245232-3	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.010	<0.0000050	<0.050	<0.000010	<0.00010	<0.00010	<0.00020	<0.010	<0.000050	<0.0010	<0.0050	<0.00010	-
FIELD BLANK		12-Jun-2019	L2290890-11	0.0025	<0.00010	<0.00010	0.00018	<0.00010	<0.000050	<0.010	<0.0000050	0.106	<0.000010	<0.00010	<0.00010	0.00091	<0.010	<0.000050	<0.0010	0.0325	<0.010	-
SURFACE WATER SAMPLES																						
BC-02		17-Jun-2020	L2463404-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
		28-Oct-2020	L2523516-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
BC-05		17-Jun-2020	L2463404-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
		28-Oct-2020	L2523516-4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
CR3-1		17-Jun-2020	L2462330-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
		28-Oct-2020	L2523516-5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
CR3-2		17-Jun-2020	L2462330-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
		28-Oct-2020	L2523516-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
LSMOC-INLET-1A		17-Jun-2020	L2463404-5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
		28-Oct-2020	L2523516-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
LSMOC-OUTLET-1A		17-Jun-2020	L2462330-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
		27-Oct-2020	L2523516-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
SW-R3		11-Jun-2019	L2290890-10	**0.263**	<0.00010	0.00098	0.0396	<0.00010	<0.000050	0.040	<0.0000050	40.0	0.000032	0.00046	0.00019	0.00164	0.294	0.000149	0.0143	42.0	*0.0210*	-
		24-Oct-2019	L2371920-5	0.0342	<0.00010	0.00068	0.00697	<0.00010	<0.000050	<0.010	0.0000128	21.5	<0.000010	0.00016	<0.00010	<0.00050	0.035	<0.000050	0.0023	13.5	0.00204	-
		17-Jun-2020	L2462330-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
		28-Oct-2020	L2523516-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
	SW-100		L2523516-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0000050
	RPD			*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*
Laboratory Detection Limits				*0.0010*	*0.00010*	*0.00010*	*0.00010*	*0.00010*	*0.000050*	*0.010*	*0.0000050*	*0.050*	*0.000010*	*0.00010*	*0.00010*	*0.00020*	*0.010*	*0.000050*	*0.0010*	*0.0050*	*0.00010*	*0.0000050*

TABLE 5
METALS IN WATER
LAKE ST. MARTIN OUTLET CHANNEL

KGS Sample ID	Duplicate Sample ID	Date Sampled	ALS Sample ID	Parameter (1)																		
				Molybdenum	Nickel	Phosphorus	Potassium	Rubidium	Selenium	Silicon	Silver	Sodium	Strontium	Tellurium	Thallium	Tin	Titanium	Tungsten	Uranium	Vanadium	Zinc	Zirconium
HC-CDWQ [2]																						
Drinking Water - MAC				-	-	-	-	-	0.05	-	[14]	-	7.0	-	-	-	-	-	0.02	-	-	-
Drinking Water - AO				-	-	-	-	-	-	-	`	200	-	-	-	-	-	-	-	-	5	-
CCME[3]																						
Freshwater Aquatic Life				0.073[10]	[8e]	[13]	-	-	0.001	-	0.00025[15]	-	-	-	0.0008	-	-	-	0.033[7] 0.015[8]	-	0.037 [7a] 0.007 [8a]	-
GROUNDWATER SAMPLES																						
PW19-KGS-01		12-Mar-2019	L2245232-28	0.00113	0.00060	<0.030	4.93	0.00142	<0.000050	5.61	<0.000010	31.3	0.217	<0.00020	0.000011	<0.00010	<0.00030	<0.00010	0.00165	<0.00050	**0.0089**	<0.000060
		11-Jun-2019	L2290890-1	0.00106	0.00065	<0.030	4.91	0.00139	<0.000050	5.81	<0.000010	27.9	0.214	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.00184	<0.00050	0.0013	<0.000060
		24-Oct-2019	L2371920-1	0.000894	0.00141	0.037	4.93	0.00202	<0.000050	6.14	<0.000010	28.0	0.222	<0.00020	0.000014	<0.00010	0.0130	<0.00010	0.00211	0.00056	0.0042	0.00026
	PW-200		L2371920-4	0.000916	0.00143	<0.030	5.05	0.00210	<0.000050	6.14	<0.000010	29.0	0.228	<0.00020	0.000014	<0.00010	0.0128	<0.00010	0.00212	0.00055	0.0026	0.00028
	RPD			*2.4%*	*1.4%*	*NC*	*2.4%*	*3.9%*	*NC*	*0.0%*	*NC*	*3.5%*	*2.7%*	*NC*	*0.0%*	*NC*	*1.6%*	*NC*	*0.5%*	*1.8%*	*47.1%*	*7.4%*
		17-Jun-2020	L2463404-1	0.00149	<0.00050	<0.030	6.44	0.00338	<0.000050	4.50	0.000010	45.4	0.227	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000875	<0.00050	<0.0010	<0.00020
		27-Oct-2020	L2523514-1	0.00106	<0.00050	<0.030	4.40	0.00128	<0.000050	5.72	<0.000010	26.9	0.222	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.00162	<0.00050	<0.0010	<0.00020
PW19-KGS-02		13-Mar-2019	L2245232-26	0.000395	<0.00050	<0.030	4.81	0.00264	<0.000050	5.48	<0.000010	33.9	0.215	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000773	<0.00050	0.0025	<0.000060
	PW19-KGS-05		L2245232-27	0.000381	<0.00050	<0.030	4.99	0.00253	<0.000050	5.44	<0.000010	34.1	0.212	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000794	<0.00050	0.0014	<0.000060
	RPD			*3.6%*	*NC*	*NC*	*3.7%*	*4.3%*	*NC*	*0.7%*	*NC*	*0.6%*	*1.4%*	*NC*	*NC*	*NC*	*NC*	*NC*	*2.7%*	*NC*	*56.4%*	*NC*
		11-Jun-2019	L2290890-2	0.000424	<0.00050	<0.030	4.71	0.00241	<0.000050	5.80	<0.000010	35.7	0.202	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000996	<0.00050	0.0040	<0.000060
		24-Oct-2019	L2371920-2	0.000343	<0.00050	<0.030	5.06	0.00281	<0.000050	5.50	<0.000010	31.9	0.207	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000727	<0.00050	0.0019	<0.00020
		16-Jun-2020	L2462330-4	0.000406	<0.00050	<0.030	4.73	0.00266	<0.000050	5.39	<0.000010	32.9	0.205	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000739	<0.00050	<0.0010	<0.00020
		28-Oct-2020	L2523514-2	0.000503	<0.00050	<0.030	4.50	0.00253	<0.000050	5.69	<0.000010	34.5	0.218	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000935	<0.00050	<0.0010	<0.00020
	PW-100		L2523514-8	0.000502	<0.00050	<0.030	4.53	0.00244	**0.00151**	5.74	<0.000010	35.7	0.222	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000952	<0.00050	<0.0010	<0.00020
	RPD			*0.2%*	*NC*	*NC*	*0.7%*	*3.6%*	*NC*	*0.9%*	*NC*	*3.4%*	*1.8%*	*NC*	*NC*	*NC*	*NC*	*NC*	*1.8%*	*NC*	*NC*	*NC*
PW19-KGS-03		14-Mar-2019	L2245232-24	0.000434	0.00170	<0.030	3.39	0.00210	<0.000050	5.34	<0.000010	8.44	0.155	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.00114	<0.00050	0.0027	<0.000060
	PW19-KGS-04		L2245232-25	0.000433	0.00165	<0.030	3.45	0.00196	<0.000050	5.35	<0.000010	8.45	0.155	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.00116	<0.00050	0.0025	<0.000060
	RPD			*0.2%*	*3.0%*	*NC*	*1.8%*	*6.9%*	*NC*	*0.2%*	*NC*	*0.1%*	*0.0%*	*NC*	*NC*	*NC*	*NC*	*NC*	*1.7%*	*NC*	*7.7%*	*NC*
		11-Jun-2019	L2290890-3	0.000131	0.00097	<0.030	4.30	0.00257	<0.000050	5.46	<0.000010	8.58	0.149	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000491	<0.00050	0.0011	<0.000060
	PW19-KGS-200		L2290890-4	0.000118	0.00094	<0.030	4.28	0.00258	<0.000050	5.41	<0.000010	8.60	0.147	<0.00020	0.000010	<0.00010	<0.00030	<0.00010	0.000481	<0.00050	<0.0010	<0.000060
	RPD			*10.4%*	*3.1%*	*NC*	*0.5%*	*0.4%*	*NC*	*0.9%*	*NC*	*0.2%*	*1.4%*	*NC*	*NC*	*NC*	*NC*	*NC*	*2.1%*	*NC*	*NC*	*NC*
		24-Oct-2019	L2371920-3	0.000440	0.00505	<0.030	2.51	0.00179	0.000067	5.22	0.000011	3.76	0.123	<0.00020	<0.000010	0.00075	0.00035	<0.00010	0.00221	0.00117	0.0013	0.00060
		17-Jun-2020	L2462330-5	0.000318	0.00214	<0.030	2.83	0.00170	<0.000050	4.51	<0.000010	5.83	0.128	<0.00020	0.000015	<0.00010	<0.00030	<0.00010	0.00179	<0.00050	<0.0010	<0.00020
	PW19-KGS-300		L2462330-6	0.000335	0.00215	<0.030	2.83	0.00173	<0.000050	4.55	<0.000010	5.72	0.130	<0.00020	0.000015	<0.00010	<0.00030	<0.00010	0.00179	<0.00050	<0.0010	<0.00020
	RPD			*5.2%*	*0.5%*	*NC*	*0.0%*	*1.7%*	*NC*	*0.9%*	*NC*	*1.9%*	*1.6%*	*NC*	*0.0%*	*NC*	*NC*	*NC*	*0.0%*	*NC*	*NC*	*NC*
		27-Oct-2020	L2523514-3	0.000355	0.00140	<0.030	3.32	0.00210	<0.000050	5.10	<0.000010	7.05	0.148	<0.00020	0.000010	<0.00010	<0.00030	<0.00010	0.00145	<0.00050	<0.0010	<0.00020
Sentinel Well 1 - (SW19-KGS-01)		18-Jun-2020	L2463404-2	0.00117	0.00053	<0.030	4.52	0.00125	<0.000050	6.02	<0.000010	27.3	0.230	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.00195	<0.00050	<0.0010	<0.00020
		8-Mar-2019	L2242160-1	0.00105	0.00106	<0.030	6.34	0.00319	0.000051	5.55	<0.000010	48	0.236	<0.00020	0.000011	<0.00010	<0.00030	<0.00010	0.00218	<0.00050	<0.0010	0.000066
Sentinel Well 2 - (SW19-KGS-02)		27-Sep-2019	L2356084-1	0.00514	0.00171	<0.030	8.08	0.00483	0.000053	4.28	<0.000010	111	0.254	<0.00020	<0.000010	<0.00010	<0.00030	0.00016	0.000190	<0.00050	<0.0010	<0.00020
		18-Jun-2020	L2463404-3	0.000083	<0.00050	<0.030	7.43	0.00401	<0.000050	4.02	0.000023	107	0.248	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000200	<0.00050	<0.0010	<0.00020
		29-Oct-2020	L2523514-9	0.000102	<0.00050	<0.030	7.39	0.00408	0.000791	4.37	<0.000010	106	0.246	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000183	<0.00050	<0.0010	<0.00020
Sentinel Well 3 - (SW19-KGS-03)		27-Sep-2019	L2356084-2	0.00149	0.00070	<0.030	7.37	0.00380	<0.000050	5.11	<0.000010	61.9	0.238	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000179	<0.00050	<0.0010	<0.00020
		18-Jun-2020	L2463404-4	0.000182	<0.00050	<0.030	6.56	0.00342	<0.000050	4.75	<0.000010	58.5	0.241	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000175	<0.00050	<0.0010	<0.00020
		29-Oct-2020	L2523514-10	0.000188	<0.00050	<0.030	6.74	0.00356	0.000544	4.74	<0.000010	59.8	0.240	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000164	<0.00050	<0.0010	<0.00020
TH15-04		8-Mar-2019	L2245232-4	0.00196	0.00145	<0.030	2.39	0.00116	0.000081	4.70	<0.000010	19.3	0.161	<0.00020	<0.000010	0.00267	<0.00030	0.00026	0.000793	<0.00050	0.0014	0.000082
TH15-05		8-Mar-2019	L2245232-6	0.000417	0.00063	<0.030	3.48	0.00241	<0.000050	4.74	<0.000010	6.91	0.161	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000317	<0.00050	<0.0010	<0.000060
TH19-KGS-01B		9-Mar-2019	L2245232-12	0.00604	0.00121	<0.030	4.95	0.00252	<0.000050	5.01	<0.000010	38.4	0.216	<0.00020	0.000014	<0.00010	<0.00030	0.00015	0.000448	<0.00050	0.0020	<0.000060
TH19-KGS-02B		11-Mar-2019	L2245232-18	0.0161	0.00405	<0.030	6.93	0.00195	0.000719	5.33	<0.000010	178	0.520	<0.00020	0.000037	0.00028	<0.00030	0.0950	0.0103	<0.00050	0.0038	0.000106
TH19-KGS-03A		8-Mar-2019	L2245232-40	0.000905	0.00072	0.092	0.634	0.00116	0.000107	6.06	<0.000010	14.0	0.125	<0.00020	<0.000010	0.00023	<0.00030	<0.00010	0.00116	<0.00050	0.0048	0.000172
TH19-KGS-04		9-Mar-2019	L2245232-7	0.00208	0.00089	<0.030	5.35	0.00231	0.000112	5.88	<0.000010	69.3	0.259	<0.00020	0.000020	<0.00010	<0.00030	0.00063	0.00119	<0.00050	0.0024	<0.000060
TH19-KGS-07		7-Mar-2019	L2245232-11	0.00482	<0.00050	<0.030	4.29	0.00245	<0.000050	4.56	<0.000010	28.2	0.198	<0.00020	<0.000010	<0.00010	<0.00030	0.00406	0.000404	<0.00050	0.0017	<0.000060
TH19-KGS-07A		7-Mar-2019	L2245232-10	0.00102	<0.00050	0.053	2.04	0.00108	0.000123	13.0	<0.000010	10.2	0.173	<0.00020	<0.000010	<0.00010	<0.00030	0.00013	0.000994	0.00088	<0.0010	0.000144
TH19-KGS-08		8-Mar-2019	L2245232-36	0.000317	<0.00050	<0.030	4.13	0.00252	<0.000050	4.85	<0.000010	7.17	0.161	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000262	<0.00050	0.0036	<0.000060
TH19-KGS-09		12-Mar-2019	L2245232-2	0.000518	<0.00050	<0.030	4.94	0.00273	<0.000050	5.38	<0.000010	21.6	0.191	<0.00020	0.000014	<0.00010	<0.00030	0.00010	0.000432	<0.00050	<0.0010	<0.000060

TABLE 5
METALS IN WATER
LAKE ST. MARTIN OUTLET CHANNEL

KGS Sample ID	Duplicate Sample ID	Date Sampled	ALS Sample ID	Parameter (1)																		
				Molybdenum	Nickel	Phosphorus	Potassium	Rubidium	Selenium	Silicon	Silver	Sodium	Strontium	Tellurium	Thallium	Tin	Titanium	Tungsten	Uranium	Vanadium	Zinc	Zirconium
HC-CDWQ [2]																						
Drinking Water - MAC				-	-	-	-	-	0.05	-	[14]	-	7.0	-	-	-	-	-	0.02	-	-	-
Drinking Water - AO				-	-	-	-	-	-	-	-	200	-	-	-	-	-	-	-	-	5	-
CCME[3]																						
Freshwater Aquatic Life				0.073[10]	[8e]	[13]	-	-	0.001	-	0.00025[15]	-	-	-	0.0008	-	-	-	0.033[7] 0.015[8]	-	0.037 [7a] 0.007 [8a]	-
GROUNDWATER SAMPLES																						
TH19-KGS-10		9-Mar-2019	L2245232-5	0.00102	0.00069	<0.030	3.32	0.00214	<0.000050	5.92	<0.000010	8.14	0.178	<0.00020	0.000014	<0.00010	<0.00030	0.00194	0.00259	<0.00050	<0.0010	<0.000060
	TH200		L2245232-30	0.00105	0.00069	<0.030	3.49	0.00229	<0.000050	5.88	<0.000010	8.22	0.184	<0.00020	0.000014	<0.00010	<0.00030	0.00200	0.00261	<0.00050	<0.0010	<0.000060
	RPD			*2.9%*	*0.0%*	*NC*	*5.0%*	*6.8%*	*NC*	*0.7%*	*NC*	*1.0%*	*3.3%*	*NC*	*0.0%*	*NC*	*NC*	*3.0%*	*0.8%*	*NC*	*NC*	*NC*
TH19-KGS-100		7-Mar-2019	L2245232-41	0.000134	<0.00050	0.129	0.532	0.00061	0.000159	9.96	<0.000010	12.5	0.203	<0.00020	<0.000010	<0.00010	0.00036	<0.00010	0.000316	<0.00050	<0.0010	0.000182
TH19-KGS-11		8-Mar-2019	L2245232-37	0.00464	0.00091	<0.030	5.88	0.00419	0.000142	4.29	<0.000010	39.4	0.291	<0.00020	<0.000010	0.00015	<0.00030	0.00197	0.000908	<0.00050	<0.0010	0.000061
TH19-KGS-11A		8-Mar-2019	L2245232-20	0.000394	0.00118	0.046	0.577	0.00084	0.000115	11.2	<0.000010	6.65	0.0968	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000357	<0.00050	0.0027	0.000113
TH19-KGS-12		7-Mar-2019	L2245232-19	0.0147	0.00303	<0.030	5.12	0.00238	<0.000050	5.47	<0.000010	27.4	0.260	<0.00020	0.000035	0.00012	<0.00030	0.00131	0.000077	<0.00050	0.0021	<0.000060
		12-Jun-2019	L2290890-5	0.0164	0.00373	<0.030	4.55	0.00208	<0.000050	5.81	<0.000010	30.1	0.234	<0.00020	<0.000010	<0.00010	<0.00030	0.00048	0.000106	<0.00050	0.0016	<0.000060
		23-Oct-2019	L2371438-4	0.0470	0.00573	<0.030	4.57	0.00213	0.000098	5.22	<0.000010	51.2	0.222	<0.00020	<0.000010	0.00019	<0.00030	0.00138	0.000043	<0.00050	0.0013	<0.00020
		16-Jun-2020	L2462330-3	0.00380	0.00167	<0.030	4.50	0.00203	<0.000050	6.17	<0.000010	29.3	0.244	<0.00020	<0.000010	0.00022	<0.00030	0.00018	0.000235	<0.00050	0.0034	<0.00020
		28-Oct-2020	L2523514-4	0.00605	0.00540	<0.030	4.55	0.00200	<0.000050	6.07	<0.000010	26.4	0.261	<0.00020	<0.000010	<0.00010	<0.00030	0.00024	0.000273	<0.00050	0.0013	<0.00020
TH19-KGS-12B		14-Mar-2019	L2245232-34	0.00812	0.00284	0.049	5.82	0.00151	0.000216	7.08	<0.000010	31.1	0.307	<0.00020	0.000033	0.00035	<0.00030	0.0573	0.00416	<0.00050	**0.0289**	0.000226
TH19-KGS-13		7-Mar-2019	L2245232-1	0.000721	0.00066	<0.030	4.37	0.00292	0.000088	5.18	<0.000010	21.3	0.202	<0.00020	<0.000010	<0.00010	<0.00030	0.00510	0.00120	<0.00050	0.0019	<0.000060
TH19-KGS-13A		7-Mar-2019	L2245232-17	0.00207	0.00110	0.056	0.981	0.00097	0.000382	6.02	<0.000010	9.08	0.117	<0.00020	<0.000010	0.00013	0.00158	<0.00010	0.000901	<0.00050	**0.0093**	0.000209
TH19-KGS-14		8-Mar-2019	L2245232-39	0.000275	<0.00050	<0.030	4.00	0.00281	<0.000050	4.72	<0.000010	12.6	0.162	<0.00020	<0.000010	<0.00010	<0.00030	0.00013	0.000199	<0.00050	0.0014	<0.000060
TH19-KGS-14A		8-Mar-2019	L2245232-9	0.000266	0.00052	0.035	0.791	0.00076	0.000088	5.06	<0.000010	2.84	0.0961	<0.00020	<0.000010	0.00026	0.00049	<0.00010	0.000417	<0.00050	**0.0142**	0.000145
TH19-KGS-15		9-Mar-2019	L2245232-29	0.00505	0.00267	<0.030	5.57	0.00319	0.000109	5.88	<0.000010	10.3	0.186	<0.00020	0.000027	0.00031	<0.00030	0.00704	0.00125	<0.00050	0.0027	0.000182
TH19-KGS-16		15-Mar-2019	L2245232-14	0.00749	0.00254	<0.030	4.57	0.00326	0.000113	4.87	<0.000010	21.9	0.162	<0.00020	<0.000010	<0.00010	0.00115	0.00208	0.00131	<0.00050	**0.0079**	0.000265
	TH19-KGS-500		L2245232-13	0.00483	0.00235	<0.030	4.50	0.00304	0.000106	4.59	<0.000010	21.1	0.160	<0.00020	<0.000010	<0.00010	<0.00030	0.00213	0.00123	<0.00050	0.0051	0.000103
	RPD			*43.2%*	*7.8%*	*NC*	*1.5%*	*7.0%*	*6.4%*	*5.9%*	*NC*	*3.7%*	*1.2%*	*NC*	*NC*	*NC*	*NC*	*2.4%*	*6.3%*	*NC*	*43.1%*	*88.0%*
TH19-KGS-16B		9-Mar-2019	L2245232-35	0.000866	0.00356	0.102	2.63	0.00265	<0.000050	8.20	<0.000010	8.26	0.177	<0.00020	0.000029	0.00024	0.0205	0.00041	0.0101	0.00259	**0.0103**	0.000878
TH19-KGS-17		10-Mar-2019	L2245232-23	0.00164	0.00148	<0.030	3.90	0.00217	0.000130	4.39	<0.000010	9.43	0.162	<0.00020	<0.000010	<0.00010	<0.00030	0.00186	0.000389	<0.00050	<0.0010	<0.000060
		12-Jun-2019	L2290890-6	0.0101	0.00087	<0.030	3.47	0.00227	0.000912	4.66	<0.000010	16.0	0.146	<0.00020	<0.000010	<0.00010	<0.00030	0.00038	0.000263	<0.00050	<0.0010	<0.000060
		23-Oct-2019	L2371438-3	0.000591	<0.00050	<0.030	3.18	0.00192	<0.000050	4.35	<0.000010	9.11	0.166	<0.00020	<0.000010	<0.00010	<0.00030	0.00012	0.000137	<0.00050	<0.0010	<0.00020
		16-Jun-2020	L2462330-2	0.000557	<0.00050	<0.030	3.34	0.00187	0.000140	4.29	<0.000010	9.00	0.163	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000116	<0.00050	<0.0010	<0.00020
		27-Oct-2020	L2523514-5	0.000300	0.00344	0.094	3.84	0.00528	<0.000050	6.22	<0.000010	8.63	0.169	<0.00020	0.000020	<0.00010	0.0471	<0.00010	0.000232	0.00216	**0.0071**	0.00189
TH19-KGS-17A		10-Mar-2019	L2245232-21	0.000599	0.00090	0.056	1.23	0.00087	0.000079	8.29	<0.000010	4.40	0.110	<0.00020	<0.000010	0.00036	0.00060	<0.00010	0.00149	0.00113	0.0060	0.000341
TH19-KGS-17B		10-Mar-2019	L2245232-15	0.0187	0.00089	<0.030	5.34	0.00146	**0.00304**	6.21	<0.000010	39.5	0.371	<0.00020	<0.000010	0.00039	0.00046	0.00011	**0.0297**	0.00134	0.0058	0.000481
TH19-KGS-18		11-Mar-2019	L2245232-38	0.00526	0.00259	<0.030	2.88	0.00226	0.000111	10.7	<0.000010	12.3	0.308	<0.00020	<0.000010	<0.00010	<0.00030	0.00101	0.000459	<0.00050	**0.0099**	0.000108
		12-Jun-2019	L2290890-7	0.00167	0.00461	<0.030	2.22	0.00167	<0.000050	10.6	<0.000010	11.3	0.290	<0.00020	<0.000010	<0.00010	<0.00030	0.00016	0.000586	<0.00050	0.0047	0.000193
		23-Oct-2019	L2371438-2	0.000785	0.00177	<0.030	1.98	0.00147	0.000095	9.86	0.000022	11.2	0.305	<0.00020	<0.000010	<0.00010	0.00047	<0.00010	0.000294	<0.00050	0.0014	<0.00020
		16-Jun-2020	L2462330-1	0.000534	0.00174	<0.030	0.616	0.00131	0.000918	6.99	<0.000010	6.56	0.108	<0.00020	<0.000010	<0.00010	0.00081	0.00013	0.000545	0.00102	<0.0010	0.00053
		27-Oct-2020	L2523514-6	0.000614	0.00136	<0.030	1.14	0.00157	0.000063	8.64	<0.000010	9.36	0.227	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	0.000475	<0.00050	<0.0010	0.00046
TH19-KGS-18A		11-Mar-2019	L2245232-22	0.000610	0.00060	<0.030	1.08	0.00154	0.000339	5.84	<0.000010	70.2	0.0751	<0.00020	0.000012	<0.00010	0.00068	<0.00010	0.000037	<0.00050	0.0045	0.000082
TH19-KGS-19		11-Mar-2019	L2245232-31	0.00887	0.00138	0.041	5.32	0.00379	**0.00134**	19.2	<0.000010	37.1	0.283	<0.00020	<0.000010	0.00015	0.00037	0.121	0.00218	0.00796	0.0051	0.000191
		12-Jun-2019	L2290890-8	0.00524	0.00216	<0.030	5.01	0.00370	0.000281	8.02	0.000021	48.5	0.921	<0.00020	0.000119	<0.00010	0.00061	0.0293	0.00203	0.00135	0.0026	0.000287
		23-Oct-2019	L2371438-1	0.00790	0.00089	<0.030	3.10	0.00167	0.000101	7.92	<0.000010	43.1	0.511	<0.00020	<0.000010	0.00092	<0.00030	0.0172	0.00186	<0.00050	0.0014	0.00023
		17-Jun-2020	L2462330-7	0.00415	0.00311	<0.030	4.20	0.00146	<0.000050	7.21	<0.000010	34.6	0.920	<0.00020	<0.000010	0.00019	<0.00030	0.00355	0.00146	<0.00050	0.0030	0.00021
		27-Oct-2020	L2523514-7	0.000099	<0.00050	<0.030	4.15	0.00144	0.000337	8.12	<0.000010	23.4	0.711	<0.00020	<0.000010	0.00016	0.00032	0.00189	0.000842	<0.00050	<0.0010	0.00031
TH19-KGS-19A		11-Mar-2019	L2245232-16	0.00213	0.00141	<0.030	2.28	0.00180	0.000081	8.56	<0.000010	8.37	0.184	<0.00020	<0.000010	0.00019	0.00059	<0.00010	0.000651	0.00094	0.0060	0.000931
TH19-KGS-20		14-Mar-2019	L2245232-32	0.00806	0.00129	<0.030	4.50	0.00202	0.000527	3.97	<0.000010	139	0.224	<0.00020	<0.000010	<0.00010	<0.00030	0.00603	0.00155	<0.00050	<0.0010	<0.000060
	TH300		L2245232-33	0.00774	0.00115	<0.030	4.41	0.00197	0.000450	3.99	<0.000010	141	0.219	<0.00020	<0.000010	<0.00010	<0.00030	0.00595	0.00145	<0.00050	<0.0010	<0.000060
	RPD			*4.1%*	*11.5%*	*NC*	*2.0%*	*2.5%*	*15.8%*	*0.5%*	*NC*	*1.4%*	*2.3%*	*NC*	*NC*	*NC*	*NC*	*1.3%*	*6.7%*	*NC*	*NC*	*NC*

TABLE 5
METALS IN WATER
LAKE ST. MARTIN OUTLET CHANNEL

KGS Sample ID	Duplicate Sample ID	Date Sampled	ALS Sample ID	Parameter (1)																		
				Molybdenum	Nickel	Phosphorus	Potassium	Rubidium	Selenium	Silicon	Silver	Sodium	Strontium	Tellurium	Thallium	Tin	Titanium	Tungsten	Uranium	Vanadium	Zinc	Zirconium
HC-CDWQ (2)																						
Drinking Water - MAC				-	-	-	-	-	0.05	-	(14)	-	7.0	-	-	-	-	-	0.02	-	-	-
Drinking Water - AO				-	-	-	-	-	-	-	-	200	-	-	-	-	-	-	-	-	5	-
CCME(3)																						
Freshwater Aquatic Life				0.073 (10)	(8e)	(13)	-	-	0.001	-	0.00025 (15)	-	-	-	0.0008	-	-	-	0.033 (7) 0.015 (8)	-	0.037 (7a) 0.007 (8a)	-
GROUNDWATER SAMPLES																						
TRIP BLANK		9-Mar-2019	L2245232-8	<0.000050	<0.00050	<0.030	<0.050	<0.00020	<0.000050	<0.050	<0.000010	<0.050	<0.00010	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	<0.000010	<0.00050	<0.0010	<0.000060
TRIP BLANK		11-Jun-2019	L2290890-9	<0.000050	<0.00050	<0.030	<0.050	<0.00020	<0.000050	<0.050	<0.000010	<0.050	<0.00010	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	<0.000010	<0.00050	<0.0010	<0.000060
TRIP BLANK		26-Oct-2020	L2523514-11	<0.000050	<0.00050	<0.030	<0.050	<0.00020	0.000090	<0.050	<0.000010	<0.050	<0.00010	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	<0.000010	<0.00050	<0.0010	<0.00020
TRIP BLANK		17-Jun-2020	L2463404-8	<0.000050	<0.00050	<0.030	<0.050	<0.00020	<0.000050	<0.050	<0.000010	<0.050	<0.00010	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	<0.000010	<0.00050	<0.0010	<0.00020
FIELD BLANK		7-Mar-2019	L2245232-3	<0.000050	<0.00050	<0.030	<0.050	<0.00020	<0.000050	<0.050	<0.000010	<0.050	0.00014	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	<0.000010	<0.00050	<0.0010	<0.000060
FIELD BLANK		12-Jun-2019	L2290890-11	<0.000050	<0.00050	<0.030	0.078	<0.00020	<0.000050	<0.050	<0.000010	0.123	0.00012	<0.00020	<0.000010	<0.00010	<0.00030	<0.00010	<0.000010	<0.00050	0.0033	<0.000060
SURFACE WATER SAMPLES																						
BC-02		17-Jun-2020	L2463404-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		28-Oct-2020	L2523516-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BC-05		17-Jun-2020	L2463404-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		28-Oct-2020	L2523516-4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CR3-1		17-Jun-2020	L2462330-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		28-Oct-2020	L2523516-5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CR3-2		17-Jun-2020	L2462330-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		28-Oct-2020	L2523516-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LSMOC-INLET-1A		17-Jun-2020	L2463404-5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		28-Oct-2020	L2523516-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LSMOC-OUTLET-1A		17-Jun-2020	L2462330-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		27-Oct-2020	L2523516-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW-R3		11-Jun-2019	L2290890-10	0.000566	0.00105	<0.030	3.48	0.00220	0.000066	1.33	<0.000010	6.85	0.117	<0.00020	0.000011	<0.00010	0.0106	<0.00010	0.00191	0.00120	<0.0030	0.00029
		24-Oct-2019	L2371920-5	0.000085	<0.00050	<0.030	2.00	0.00355	0.000108	4.17	<0.000010	1.03	0.0233	<0.00020	<0.000010	<0.00010	0.00117	<0.00010	0.000061	<0.00050	<0.0030	<0.00020
		17-Jun-2020	L2462330-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		28-Oct-2020	L2523516-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SW-100		L2523516-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	RPD			*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*
Laboratory Detection Limits				*0.000050*	*0.00050*	*0.030*	*0.050*	*0.00020*	*0.000050*	*0.050*	*0.000010*	*0.050*	*0.00010*	*0.00020*	*0.000010*	*0.00010*	*0.00030*	*0.00010*	*0.000010*	*0.00050*	*0.0010*	*0.00020*

Notes:
"-" = No Data

1. All values are expressed in milligrams per litre (mg/L) unless otherwise specified. Groundwater samples - dissolved (filtered and preserved in field). Surface water samples - Total (preserved in field)
2. Health Canada - Canadian Drinking Water Quality Guidelines (HC-CDWQ). Updated September 2020.
   MAC = Maximum Acceptable Concentration = The maximum concentration of a parameter that is designed to protect those individuals most at risk, such as children and the elderly.
   AO = Aesthetic Objective = A guideline which addresses a parameter that may affect consumer acceptance of drinking water, such as taste, odour, and colour.
   OG = Operational Guideline = Guideline meant for a parameter which may affect treatment plant processes or drinking water distribution systems.
3. CCME - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999. Updated December 2019.
   Guidelines for Canadian Drinking Water Quality.
   Community Water Supplies (Health Canada - Canadian Drinking Water Quality Guidelines)
   Canadian Water Quality Guidelines for the Protection of Aquatic Life
   Canadian Water Quality Guidelines for the Protection of Agriculture Water Uses
4. This is an operational guidance value, designed to apply only to drinking water treatment plants using aluminum-based coagulants.
   The operational guidance value of 0.1 mg/L applies to conventional treatment plants, and 0.2 mg/L applies to other types of treatment systems.
5. Total aluminum should not exceed 0.005 mg/L in waters with a pH below 6.5.
   The concentration of total aluminum should not exceed 0.1 mg/L in waters with a pH greater or equal to 6.5.

6. Short-term exposure (24 to 96 hours) concentrations which indicate potential for severe effects during transient events
(spill events to aquatic receiving environments and infrequent releases of short-lived/non-persistent substances).
These are NOT protective guidelines.
a. The short-term benchmark is for dissolved zinc and is calculated using the following equation: Benchmark = $\exp(0.833[\ln(\text{hardness mg}\cdot L^{-1})] + 0.240[\ln(\text{DOC mg}\cdot L^{-1})] + 0.526)$.
The value in the table is for surface water of 50 mg CaCO3·L−1 hardness and 0.5 mg·L−1 dissolved organic carbon (DOC). The benchmark equation is valid between hardness 13.8 and 250.5 mg CaCO3·L−1 and DOC 0.3 and 17.3 mg·L−1. (value is in µg/L)
7. Long-term exposure guideline that protects all forms of aquatic life for indefinite exposure periods (>7 day exposures for fish and invertebrates, 24 hour exposures for aquatic plants and algae).
a. The long-term CWQG is for dissolved zinc and is calculated using the following equation: CWQG = $\exp(0.947[\ln(\text{hardness mg}\cdot L^{-1})] - 0.815[\text{pH}] + 0.398[\ln(\text{DOC mg}\cdot L^{-1})] + 4.625)$.
The value in the table is for surface water of 50 mg CaCO3·L−1 hardness, pH of 7.5 and 0.5 mg·L−1 DOC. The CWQG equation is valid between hardness 23.4 and 399 mg CaCO3·L−1, pH 6.5 and 8.13 and DOC 0.3 to 22.9 mg·L−1. (value is in µg/L)
8. Guidelines for the following metals are specific to the hardness of the sample, expressed as CaCO3 in mg/L:

		Hardness Range (mg/L)	*Example Hardness (mg/L)	**Guideline (mg/L)
Cadmium	Long-Term [a]	50	-	0.00009
		0-16	-	0.00004
		17-280	100	0.00016
		>280	-	0.00037
	Short-Term [b]	50	-	0.00100
		0-5.2	-	0.00011
		5.3-360	100	0.00210
		>360	-	0.00770
Copper [c]		0-81	-	0.00200
		82-180	100	0.00236
		>180	-	0.00400
		Unknown	-	0.00200
Lead [d]		0-60	-	0.00100
		61-180	100	0.00318
		>180	-	0.00700
		Unknown	-	0.00100
Nickel [e]		0-60	-	0.02500
		61-180	100	0.09558
		>180	-	0.15000
		Unknown	-	0.02500

Sample ID	Date	Metal	Hardness (mg/L)	***Applicable Guideline (mg/L)
TH19-KGS-02B	11/Mar/2019	Copper	834	0.004
TH19-KGS-12B	14/Mar/2019	Copper	425	0.004
TH19-KGS-16B	9/Mar/2019	Copper	623	0.004
		Lead		0.007
TH19-KGS-17B	10/Mar/2019	Copper	528	0.004
TH19-KGS-19	11/Mar/2019	Copper	431	0.004
PW19-KGS-01	24/Oct/2019	Lead	420	0.007
PW-200 DUP	24/Oct/2019	Lead	431	0.007
TH19-KGS-17	27/Oct/2020	Lead	418	0.007

*The table on the left uses the equations defined by CCME to caclulate a guideline when hardness is within the defined Hardness Range. These equations are applicable only to the rows where an Example Hardness value of 100 is input

**This Guideline column lists the guidelines related to each Hardness Range for each metal. An example guideline value in the rows requiring use of the equation was calculated, using the example value of 100 mg/L

***The table above lists those samples and parameters of which the lab results exceeded the minimum guideline value, thus requring a comparison to the hardness of the samples to determine the applicable guideline. The Applicable Guidelines for these specific samples are listed in the right-most column

9. Guideline value not required, as there is no evidence of adverse health effects from calcium in drinking water. Calcium contributes to hardness.
10. Interim Water Quality Guideline.
11. These values are for a water hardness of 50 mg/L as CaCO3 and pH 7.5. The freshwater benchmark equation and the CWQG look-up table must be used in order to obtain a site-specific benchmark and CWQG, respectively,based on the hardness and pH of the water body of interest. Note that it is not appropriate to apply the manganese freshwater guidelines to marine or estuarine environments. Both the benchmark and guideline values were derived for dissolved manganese in order to represent the bioavailable form.
a. The CWQG for manganese (i.e. long-term guideline) is found using the CWQG calculator in Appendix B of the Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life: Manganese.
The long-term CWQG is for dissolved manganese and is found manually using the look-up table below or using the CWQG and benchmark calculator (Appendix B). The CWQG table is valid between hardness of 25 and 670 mg/L and pH 5.8 and 8.4, which are the ranges of data used to derive the hardness and pH slopes.
b. The short-term benchmark is calculated using the benchmark calculator in Appendix B of the Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life: Manganese or the following equation:
Benchmark = $\exp(^{0.878[\text{kb}(\text{hardness})]+4.76})$ where the benchmark is expressed in dissolved manganese concentration (µg/L), and hardness is measured as CaCO3 equivalents in mg/L.
The benchmark equation is valid between hardness of 25 and 250 mg/L, which is the range of data used to derive the hardness slope.
12. Interim Guideline - may not fully protect high trophic level fish.
13. If trigger ranges for total phosphorous are exceeded, the potential exists for an environmental impact. If trigger range is not exceeded, but TP is more than 50% above baseline values, the potential exists for an environmental impact.

Trigger ranges (mg/L):

ultra-oligotrophic	<0.004	meso-eutrophic	0.020-0.035
oligotrophic	0.004-0.010	eutrophic	0.035-0.10
mesotrophic	0.010-0.020	hyper-eutrophic	>0.10

14. Guideline value not required. Drinking water does not contribute significantly to an individual's intake of silver.
15. This guideline is not applicable to silver nanoparticles and was derived based on the total concentration of silver.

	- Exceedance of HC-CDWQ Criteria MAC
Itallic	- Exceedance of HC-CDWQ Criteria AO
BOLD	- Exceedance of CCME Criteria for the Protection of Aquatic Life

TABLE 6
PETROLEUM HYDROCARBONS IN SURFACE WATER
LAKE ST. MARTIN OUTLET CHANNEL

KGS Sample ID	Duplicate Sample ID	Date	ALS Sample ID	Parameter [1]								
				Benzene	Toluene [4a, 4b]	Ethyl-benzene [5a, 5b]	Xylenes (-o,-m,-p) [6a, 6b]	F1-BTEX (C6 - C10)	F2 (C10 - C16)	F3 (C16 - C34)	F4 (C34 - C50)	Total Hydrocarbons (C6 - C50)
SURFACE WATER SAMPLES												
BC-02		17-Jun-2020	L2463404-7	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
		28-Oct-2020	L2523516-3	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
BC-05		17-Jun-2020	L2463404-6	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
		28-Oct-2020	L2523516-4	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
CR3-1		17-Jun-2020	L2462330-10	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
		28-Oct-2020	L2523516-5	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
CR3-2		17-Jun-2020	L2462330-11	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
		28-Oct-2020	L2523516-6	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
LSMOC-INLET-1A		17-Jun-2020	L2463404-5	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
		28-Oct-2020	L2523516-1	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
LSMOC-OUTLET-1A		17-Jun-2020	L2462330-9	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
		27-Oct-2020	L2523516-2	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
SW-R3		17-Jun-2020	L2462330-8	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
		28-Oct-2020	L2523516-7	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
	SW-100		L2523516-8	<0.00050	<0.0010	<0.00050	<0.00064	<0.10	<0.10	<0.25	<0.25	<0.38
	RPD			*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*
Laboratory Detection Limits				*0.0005*	*0.001*	*0.0005*	*0.00064*	*0.1*	*0.1*	*0.25*	*0.25*	*0.38*
HC-CDWQ [2]												
Drinking Water Quality - MAC				0.005	0.060	0.140	0.090	-	-	-	-	-
Drinking Water Quality - AO				-	0.024	0.0016	0.020	-	-	-	-	-
CCME [3]												
Canadian Water Quality Guidelines for the Protection of Aquatic Life												
Freshwater Aquatic Life				0.37	0.002	0.090	-	-	-	-	-	-

Notes:
"-" = No Data

1. All concentrations in milligrams per litre (mg/L) unless otherwise specified.
2. Health Canada - Guidelines for Canadian Drinking Water Quality (HC-GCDWQ). Updated June 2019.
   MAC = Maximum Acceptable Concentration = The maximum concentration of a parameter that is designed to protect those individuals most at risk, such as children and the elderly.
   AO = Aesthetic Objective = A guideline which addresses a parameter that may affect consumer acceptance of drinking water, such as taste, odour, and colour.
3. CCME - Canadian Council of Ministers of the Environment. Canadian Water Quality Guidelines, 1999. Updated 2018.
   a. Community Water Supplies (Health Canada - Canadian Drinking Water Quality Guidelines)
   b. Canadian Water Quality Guidelines for the Protection of Aquatic Life
   c. Canadian Water Quality Guidelines for the Protection of Agriculture
4. Toluene
   a. Health basis of MAC: Adverse neurological effects, including vibration thresholds, colour discrimination, auditory thresholds, attention, memory and psychomotor functions.
   b. Other Health Considerations: Insufficient information to determine whether toluene is carcinogenic to humans.
5. Ethylbenzene
   a. Health basis of MAC: Effects on the liver and pituitary gland.
   b. Other Health Considerations: Tumour formation at various sites in animals, including kidney, lung, liver and testes.
6. Xylenes
   a. Health basis of MAC: Adverse neuromuscular effects.
   b. Other Health Considerations: Insufficient information to determine whether xylenes are carcinogenic to humans.

	- Exceedance of HC-CDWQ Criteria MAC
Itallic	- Exceedance of HC-CDWQ Criteria AO
BOLD	- Exceedance of CCME Criteria for the Protection of Aquatic Life

TABLE 7
HITORICAL GROUNDWATER QUALITY DATA FROM 2019-2020 OF THE LSMOC
LAKE ST. MARTIN OUTLET CHANNEL

Parameter[3]	HC-CDWQG[4]	CCME[5]	Statistics[6]						
			n[2]	Min	Max	Mean	Standard Deviation	5th Percentile	95th Percentile
PH (PH units)	7.0-10.5 (AO)	6.5-9.0	72	7.12	8.57	8.03	0.30	7.48	8.35
Hardness as Caco3	80-100 (AO)	-	72	106	834	392.50	107.01	249.8	609
Chloride	250 (AO)	120/640	72	0.13	97.2	13.06	22.38	0.53	69.86
Fluoride	1.5 (MAC)	0.12	72	0.044	1.15	0.28	0.15	0.13	0.55
Sulphate	500 (AO)	-	72	0.37	737	71.97	93.92	1.75	176.65
Nitrate(as N)	10 (MAC)	3/124	72	0.005	0.136	0.02	0.03	0.01	0.07
Nitrite(as N)	1.0 (MAC)	0.06	72	0.001	0.014	0.004	0.003	0.001	0.012
Calcium	-	-	72	20.8	129	62.20	21.81	36.11	116.90
Magnesium	-	-	72	13.1	128	57.58	17.79	32.46	83.09
Potassium	-	-	72	0.532	8.08	4.03	1.82	0.72	7.13
Sodium	200 (AO)	-	72	0.916	178	31.14	32.44	5.19	106.45
T.D.S.	500 (AO)	-	72	103	1430	462.39	164.86	281.60	673.05
TotalPhosphorus	-	-	72	0.035	0.129	0.07	0.03	0.04	0.11
E. Coli (MPL/100mL)	None Detectable per 100 mL	-	36	0	1	0.03	0.18	0	0
Total Coliform (MPL/100mL)	None Detectable per 100 mL	-	36	0	200	12.1	42.63	0	76
Conductivity (µS/cm)	-	-	72	176	1970	756	230	477	1099
Aluminum, Dissolved	0.1-0.2 (AO)	0.005-0.1	72	0.001	1.25	0.051	0.21	0.001	0.11
Antimony, Dissolved	0.006 (MAC)	-	72	0.00011	0.00429	0.00049	0.00085	0.00011	0.00099
Arsenic, Dissolved	0.01 (MAC)	0.005	72	0.00012	0.0167	0.00169	0.0026	0.00021	0.01
Barium, Dissolved	2.0 (MAC)	-	72	0.00618	0.265	0.0496	0.043	0.012	0.13
Beryllium, Dissolved	-	-	72	0.00012	0.00014	0.00013	0.000014	0.000121	0.00014
Bismuth, Dissolved	-	-	72	0.000025	0.000025	0.000025	0.000[7]	0.000025	0.000025
Boron, Dissolved	5.0 (MAC)	1.5-29	72	0.012	0.412	0.117	0.063	0.027	0.2
Cadmium, Dissolved	0.007 (MAC)	0.00009/0.001	72	0.0000055	0.00003	0.0000109	0.000007	0.000006	0.000025
Cesium, Dissolved	-	-	72	0.00001	0.000298	0.0000348	0.000059	0.00001	0.000054
Chromium, Dissolved	0.05 (MAC)	0.001(VI)/0.0089(III)	72	0.0001	0.00233	0.00048	0.00063	0.00011	0.0021
Cobalt, Dissolved	-	-	72	0.00011	0.00267	0.00056	0.00054	0.000143	0.0016
Copper, Dissolved	2.0 (MAC)/1.0 (AO)	-	72	0.0002	0.00459	0.00124	0.0012	0.0002	0.0035
Iron, Dissolved	0.3 (AO)	0.3	72	0.01	2.44	0.435	0.576	0.01495	1.71
Lead, Dissolved	0.005 (MAC)	-	72	0.000052	0.00282	0.00036	0.00072	0.000053	0.0017
Lithium, Dissolved	-	-	72	0.0021	0.0599	0.025	0.011	0.007685	0.04
Manganese, Dissolved	0.12 (MAC)/0.02 (AO)	0.43-3.6	72	0.00082	1.82	0.139	0.272	0.0045	0.497
Molybdenum, Dissolved	-	0.073	72	0.000081	0.047	0.00348	0.00667	0.00012	0.015
Nickel, Dissolved	-	-	72	0.00052	0.00573	0.00185	0.00135	0.0006	0.00483
Rubidium, Dissolved	-	-	72	0.00061	0.00528	0.0023	0.0010	0.000925	0.004
Selenium, Dissolved	0.05 (MAC)	0.001	72	0.000051	0.00304	0.0003	0.0005	0.0000547	0.00098
Silicon, Dissolved	-	-	72	0.707	19.2	6.19	2.51	4.17	10.65
Silver, Dissolved	-	0.00025	72	0.00001	0.000023	0.000017	0.000006	0.0000102	0.000023
Strontium, Dissolved	7	-	72	0.0223	0.92	0.23	0.15	0.10	0.52
Tellurium, Dissolved	-	-	72	0.0001	0.0001	0.0001	0.000[7]	0.0001	0.0001
Thallium, Dissolved	-	0.0008	72	0.00001	0.000119	0.0000255	0.000026	0.0000108	0.000053
Tin, Dissolved	-	-	72	0.00012	0.00267	0.000413	0.00057	0.00013	0.001
Titanium, Dissolved	-	-	72	0.00032	0.0471	0.005	0.012	0.000344	0.026
Tungsten, Dissolved	-	-	72	0.0001	0.121	0.011	0.027	0.00012	0.0704
Uranium, Dissolved	0.02 (MAC)	0	72	0.000037	0.0297	0.002	0.004	0.000093	0.0032
Vanadium, Dissolved		0.015/0.033	72	0.00056	0.00796	0.002	0.002	0.00057	0.005
Zinc, Dissolved	-	-	72	0.0011	0.0289	0.004	0.005	0.0013	0.01
Zirconium, Dissolved	-	-	72	0.000061	0.00189	0.0003	0.0004	0.0001	0.0009

Notes:
1. This table shows parameters with established guidelines.
2. "n" refers to number of samples.
3. Results are in mg/L unless otherwise specified in the parameter column.
4. Health Canada - Canadian Drinking Water Quality Guidelines (HC-CDWQ). Updated September 2020.
   MAC = Maximum Acceptable Concentration = The maximum concentration of a parameter that is designed to protect those individuals most at risk, such as children and the elderly.
   AO = Aesthetic Objective = A guideline which addresses a parameter that may affect consumer acceptance of drinking water, such as taste, odour, and colour.
   OG = Operational Guideline = Guideline meant for a parameter which may affect treatment plant processes or drinking water distribution systems.
5. CCME - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines for the protection of Freshwater Aquatic Life, 1999. Updated December 2019.
6. For statistical calculations, half detection limit values are used for the results of the laboratory analyses reported as less than the detection limit values.
7. Results of the laboratory analyses less than the detection limit values.

	- Exceedance of HC-CDWQ Criteria MAC
Itallic	- Exceedance of HC-CDWQ Criteria AO
BOLD	- Exceedance of CCME Criteria for the Protection of Aquatic Life

APPENDIX B-3

Water Quality Type

WATER TYPE

LAKE ST. MARTIN OUTLET CHANNEL

Sample ID	Date	Water Type
Bedrock Wells		
PW19-KGS-01	12-Mar-19	Mg-Ca-HCO3
	11-Jun-19	Mg-Ca-HCO3
	24-Oct-19	Mg-Ca-HCO3
	17-Jun-20	Mg-Ca-HCO3
	27-Oct-20	Mg-Ca-HCO3
PW19-KGS-02	13-Mar-19	Mg-Ca-HCO3-SO4
	11-Jun-19	Mg-Ca-HCO3-SO4
	24-Oct-19	Mg-Ca-HCO3-SO4
	16-Jun-20	Mg-Ca-HCO3-SO4
	28-Oct-20	Mg-Ca-HCO3-SO4
PW19-KGS-03	14-Mar-19	Mg-Ca-HCO3
	11-Jun-19	Mg-Ca-HCO3
	24-Oct-19	Ca-Mg-HCO3
	17-Jun-20	Mg-Ca-HCO3
	27-Oct-20	Mg-Ca-HCO3
Sentinel Well 1 (SW19-KGS-01)	8-Mar-19	Mg-Ca-Na-HCO3
	18-Jun-20	Mg-Ca-HCO3
Sentinel Well 2 (SW19-KGS-02)	29-Oct-20	Mg-Na-Ca-HCO3-SO4
	18-Jun-20	Mg-Na-Ca-HCO3-SO4
	27-Sep-19	Mg-Na-Ca-HCO3-SO4
Sentinel Well 3 (SW19-KGS-03)	29-Oct-20	Mg-Ca-Na-HCO3-SO4
	18-Jun-20	Mg-Ca-Na-HCO3-SO4
	27-Sep-19	Mg-Na-Ca-HCO3-SO4
TH15-04	8-Mar-19	Mg-Ca-HCO3
TH15-05	8-Mar-19	Mg-Ca-HCO3
TH19-KGS-01B	9-Mar-19	Mg-Ca-HCO3-SO4
TH19-KGS-04	9-Mar-19	Mg-Ca-Na-HCO3-SO4
TH19-KGS-08	8-Mar-19	Mg-Ca-HCO3
TH19-KGS-09	12-Mar-19	Mg-Ca-HCO3
TH19-KGS-10	9-Mar-19	Mg-Ca-HCO3
TH19-KGS-11	8-Mar-19	Mg-Ca-Na-HCO3-SO4
TH19-KGS-12	7-Mar-19	Mg-Ca-HCO3
	12-Jun-19	Mg-Ca-HCO3
	23-Oct-19	Mg-Na-HCO3
	16-Jun-20	Mg-Ca-HCO3
	28-Oct-20	Mg-Ca-HCO3
TH19-KGS-13	7-Mar-19	Mg-Ca-HCO3
TH19-KGS-14	8-Mar-19	Mg-Ca-HCO3
TH19-KGS-15	9-Mar-19	Mg-Ca-HCO3
TH19-KGS-16	15-Mar-19	Mg-Ca-HCO3

WATER TYPE

LAKE ST. MARTIN OUTLET CHANNEL

Sample ID	Date	Water Type
TH19-KGS-17	10-Mar-19	Mg-Ca-HCO3
	12-Jun-19	Mg-Ca-HCO3
	23-Oct-19	Mg-Ca-HCO3
	16-Jun-20	Mg-Ca-HCO3
	27-Oct-20	Mg-Ca-HCO3
TH19-KGS-18	11-Mar-19	Mg-Ca-HCO3
	12-Jun-19	Mg-Ca-HCO3
	23-Oct-19	Mg-Ca-HCO3
	16-Jun-20	Ca-Mg-HCO3
	27-Oct-20	Ca-Mg-HCO3
TH19-KGS-19	11-Mar-19	Mg-Ca-HCO3-SO4
	12-Jun-19	Mg-Ca-HCO3
	23-Oct-19	Mg-HCO3
	17-Jun-20	Mg-Ca-HCO3
	27-Oct-20	Mg-Ca-HCO3
Till Wells		
TH15-04	8-Mar-19	Mg-Ca-HCO3
TH19-KGS-02B	11-Mar-19	Mg-Na-Ca-SO4-HCO3
TH19-KGS-07	7-Mar-19	Mg-Ca-HCO3
TH19-KGS-12B	14-Mar-19	Mg-Ca-HCO3
TH19-KGS-16B	9-Mar-19	Ca-Mg-HCO3
TH19-KGS-17B	10-Mar-19	Mg-HCO3
TH19-KGS-20	14-Mar-19	Na-Mg-HCO3-SO4
Peat Wells		
TH19-KGS-03A	8-Mar-19	Mg-Ca-HCO3
TH19-KGS-07A	7-Mar-19	Ca-Mg-HCO3
TH19-KGS-100	7-Mar-19	Mg-Ca-HCO3
TH19-KGS-11A	8-Mar-19	Ca-Mg-HCO3
TH19-KGS-13A	7-Mar-19	Mg-Ca-HCO3
TH19-KGS-14A	8-Mar-19	Ca-Mg-HCO3
TH19-KGS-17A	10-Mar-19	Mg-Ca-HCO3
TH19-KGS-18A	11-Mar-19	Na-Ca-Mg-HCO3
TH19-KGS-19A	11-Mar-19	Ca-Mg-HCO3
Surface Water		
SW-R3	24-Oct-19	Mg-Ca-HCO3
SW-R3	11-Jun-19	Mg-Ca-HCO3

APPENDIX B-4

Stable Isotopes

ISOTOPE DATA - LSMOC 2019-2020
LAKE ST. MARTIN OUTLET CHANNEL

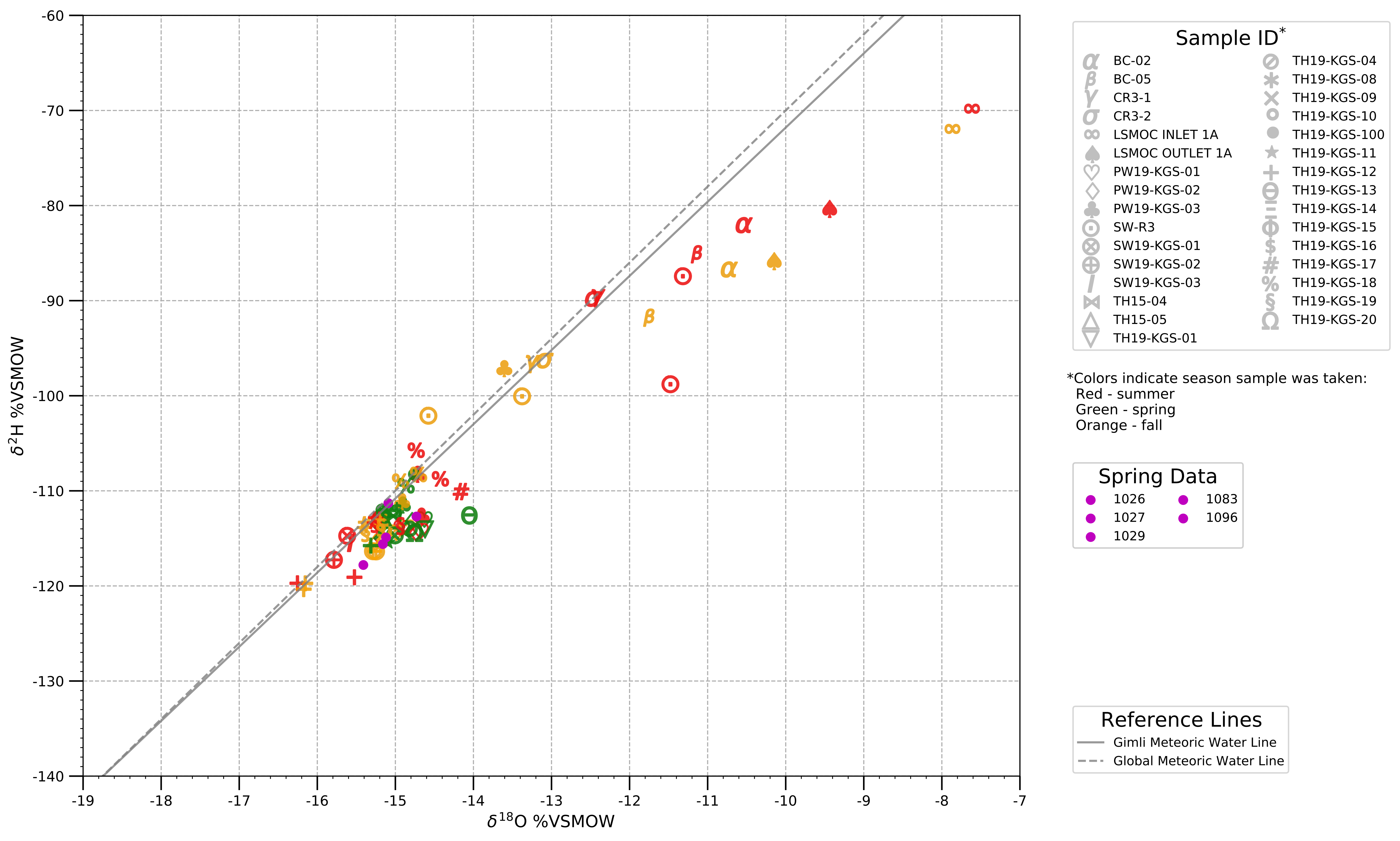
Sample ID	Duplicate Sample ID	Date	$\delta^{18}O$ Result	$\delta^{18}O$ Repeat	$\delta^{2}H$ Result	$\delta^{2}H$ Repeat	E3H Result	E3H ± 1σ	E3H Repeat	E3H ± 1σ
			VSMOW ± 0.2‰		VSMOW ± 0.8‰		± 0.8 T.U.		± 0.8 T.U.	
BC-02	-	17/Jun/20	-10.54	-	-82.06	-	-	-	-	-
		28/Oct/20	-10.73	-	-86.72	-	-	-	-	-
BC-05	-	17/Jun/20	-11.14	-11.07	-85.12	-85.06	-	-	-	-
		28/Oct/20	-11.75	-11.61	-91.79	-90.95	-	-	-	-
CR3-1	-	17/Jun/20	-12.41	-	-89.75	-	-	-	-	-
		28/Oct/20	-13.25	-	-96.67	-	-	-	-	-
CR3-2	-	17/Jun/20	-12.47	-	-89.83	-	-	-	-	-
		28/Oct/20	-13.09	-	-96.32	-	-	-	-	-
LSMOC INLET 1A	-	17/Jun/20	-7.63	-	-69.95	-	-	-	-	-
		28/Oct/20	-7.88	-7.81	-72.08	-72.06	-	-	-	-
LSMOC OUTLET 1A	-	17/Jun/20	-9.46	-9.36	-80.35	-80.11	-	-	-	-
		27/Oct/20	-10.17	-10.13	-85.85	-85.45	-	-	-	-
PW19-KGS-01	-	12/Mar/19	-14.64	-14.60	-113.02	-112.81	<0.8	0.3	-	-
		11/Jun/19	-14.69	-14.65	-114.25	-114.23	<0.8	0.8	-	-
		24/Oct/19	-14.87	-14.79	-113.88	-113.94	< 0.8	0.2	-	-
	DUP-PW-200	24/Oct/19	-15.09	-	-114.97	-	< 0.8	0.2	-	-
	-	17/Jun/20	-14.93	-14.92	-113.94	-114.16	-	-	-	-
		27/Oct/20	-15.00	-14.92	-114.41	-114.40	-	-	-	-
PW19-KGS-02	-	13/Mar/19	-14.81	-	-113.18	-	<0.8	0.3	-	-
	DUP-PW19-KGS-05	13/Mar/19	-15.19	-	-114.56	-	<0.8	0.3	-	-
	-	11/Jun/19	-14.76	-	-114.39	-	<0.8	0.8	-	-
		24/Oct/19	-15.11	-	-114.15	-	< 0.8	0.2	-	-
		16/Jun/20	-15.22	-	-114.90	-	-	-	-	-
		28/Oct/20	-15.28	-	-115.47	-	-	-	-	-
	DUP-PW-100	28/Oct/20	-15.23	-	-115.40	-	-	-	-	-
PW19-KGS-03	-	14/Mar/19	-14.92	-14.90	-111.49	-111.57	1.7	0.4	-	-
	DUP-PW19-KGS-04	14/Mar/19	-15.00	-	-111.60	-	1.9	0.4	-	-
	-	11/Jun/19	-14.68	-14.71	-112.66	-112.62	<0.8	0.8	-	-
	DUP-PW19-KGS-200	11/Jun/19	-14.73	-	-112.61	-	<0.8	0.8	-	-
	-	24/Oct/19	-13.62	-13.58	-97.15	-97.62	7.3	0.6	6.3	0.5
		17/Jun/20	-14.73	-	-108.26	-	-	-	-	-
	DUP-PW19-KGS-300	17/Jun/20	-14.83	-	-108.20	-	-	-	-	-
	-	27/Oct/20	-14.93	-	-111.13	-	-	-	-	-
Sentinel Well 1 (SW19-KGS-01)	-	8/Mar/19	-15.01	-15.03	-114.68	-113.97	<0.8	0.3	-	-
		18/Jun/20	-15.62	-	-114.73	-	-	-	-	-
Sentinel Well 2 (SW19-KGS-02)	-	27/Sep/19	-15.29	-15.35	-116.35	-115.60	< 0.8	0.3	-	-
		18/Jun/20	-15.79	-	-117.26	-	-	-	-	-
		29/Oct/20	-15.25	-	-116.37	-	-	-	-	-
Sentinel Well 3 (SW19-KGS-03)	-	27/Sep/19	-15.21	-15.22	-114.63	-114.84	< 0.8	0.3	-	-
		18/Jun/20	-15.58	-15.57	-115.47	-115.91	-	-	-	-
		29/Oct/20	-15.09	-	-114.86	-	-	-	-	-
SW-R3	-	11/Jun/19	-11.48	-11.52	-98.79	-98.59	7.3	0.8	-	-
		24/Oct/19	-14.58	-14.56	-102.10	-102.51	8.2	0.6	-	-
		17/Jun/20	-11.32	-	-87.43	-	-	-	-	-
		28/Oct/20	-13.38	-	-100.06	-	-	-	-	-
	DUP-SW-100	28/Oct/20	-13.35	-13.33	-99.46	-99.38	-	-	-	-
TH15-04	-	8/Mar/19	-15.04	-	-112.65	-	-	-	-	-
TH15-05	-	8/Mar/19	-15.16	-	-112.77	-	-	-	-	-
TH19-KGS-01	-	9/Mar/19	-14.62	-	-114.07	-	-	-	-	-
TH19-KGS-04	-	9/Mar/19	-14.83	-14.87	-113.99	-113.75	-	-	-	-
TH19-KGS-08	-	8/Mar/19	-15.14	-	-112.26	-	-	-	-	-
TH19-KGS-09	-	12/Mar/19	-15.21	-	-114.44	-	-	-	-	-
TH19-KGS-10	-	9/Mar/19	-15.21	-	-112.31	-	-	-	-	-
	DUP-TH200	9/Mar/19	-15.21	-	-112.80	-	-	-	-	-
TH19-KGS-100	-	7/Mar/19	-14.80	-	-108.59	-	-	-	-	-
TH19-KGS-11	-	8/Mar/19	-15.12	-15.16	-115.62	-115.73	-	-	-	-

ISOTOPE DATA - LSMOC 2019-2020
LAKE ST. MARTIN OUTLET CHANNEL

Sample ID	Duplicate Sample ID	Date	$\delta^{18}O$		$\delta^{2}H$		E3H			
			Result	Repeat	Result	Repeat	Result	± 1σ	Repeat	± 1σ
			VSMOW ± 0.2‰		VSMOW ± 0.8‰		± 0.8 T.U.		± 0.8 T.U.	
TH19-KGS-12	-	7/Mar/19	-15.33	-	-115.76	-	-	-	-	-
		12/Jun/19	-15.54	-	-119.09	-	<0.8	0.8	-	-
		23/Oct/19	-16.17	-	-119.73	-	< 0.8	0.2	-	-
		16/Jun/20	-16.27	-	-119.72	-	-	-	-	-
		28/Oct/20	-16.19	-	-120.34	-	-	-	-	-
TH19-KGS-13	-	7/Mar/19	-14.06	-14.10	-112.59	-112.80	-	-	-	-
TH19-KGS-14	-	8/Mar/19	-15.18	-	-113.03	-	-	-	-	-
TH19-KGS-15	-	9/Mar/19	-15.19	-15.17	-112.73	-112.66	-	-	-	-
TH19-KGS-16	-	15/Mar/19	-14.99	-15.01	-112.14	-112.18	-	-	-	-
	DUP-TH19-KGS-500	15/Mar/19	-15.19	-	-112.75	-	-	-	-	-
TH19-KGS-17	-	10/Mar/19	-15.11	-	-112.37	-	<0.8	0.3	-	-
		11/Jun/19	-14.17	-13.99	-110.08	-109.25	<0.8	0.8	-	-
		23/Oct/19	-15.40	-	-113.58	-	< 0.8	0.2	-	-
		16/Jun/20	-15.27	-15.23	-113.09	-112.77	-	-	-	-
		27/Oct/20	-15.19	-15.17	-113.33	-113.22	-	-	-	-
TH19-KGS-18	-	11/Mar/19	-14.87	-	-109.46	-	<0.8	0.3	-	-
		12/Jun/19	-14.43	-	-108.74	-	10.6	0.8	-	-
		23/Oct/19	-14.94	-	-108.99	-	10.7	0.8	-	-
		16/Jun/20	-14.74	-	-105.73	-	-	-	-	-
		27/Oct/20	-14.71	-	-108.28	-	-	-	-	-
TH19-KGS-19	-	11/Mar/19	-15.13	-	-112.49	-	<0.8	0.3	<0.8	0.5
		12/Jun/19	-14.94	-	-113.71	-	<0.8	0.8	-	-
		23/Oct/19	-15.39	-15.34	-114.44	-114.12	< 0.8	0.2	-	-
		17/Jun/20	-15.27	-	-113.47	-	-	-	-	-
		27/Oct/20	-15.19	-	-113.88	-	-	-	-	-
TH19-KGS-20	-	14/Mar/19	-14.76	-14.68	-114.41	-114.65	-	-	-	-
	DUP-TH300	14/Mar/19	-14.59	-	-114.05	-	-	-	-	-

Note:

Tritium is reported in Tritium Units.
1TU = 3.221 Picocurries/L per IAEA, 2000 Report.
1TU = 0.11919 Becquerels/L per IAEA, 2000 Report.



Sample ID*
BC-02
BC-05
CR3-1
CR3-2
LSMOC INLET 1A
LSMOC OUTLET 1A
PW19-KGS-01
PW19-KGS-02
PW19-KGS-03
SW-R3
SW19-KGS-01
SW19-KGS-02
SW19-KGS-03
TH15-04
TH15-05
TH19-KGS-01
TH19-KGS-04
TH19-KGS-08
TH19-KGS-09
TH19-KGS-10
TH19-KGS-100
TH19-KGS-11
TH19-KGS-12
TH19-KGS-13
TH19-KGS-14
TH19-KGS-15
TH19-KGS-16
TH19-KGS-17
TH19-KGS-18
TH19-KGS-19
TH19-KGS-20
*Colors indicate season sample was taken:
Red - summer
Green - spring
Orange - fall
Spring Data
1026
1027
1029
1083
1096
Reference Lines
Gimli Meteoric Water Line
Global Meteoric Water Line
δ^2H %VSMOW
δ^{18}O %VSMOW
-60
-70
-80
-90
-100
-110
-120
-130
-140
-19
-18
-17
-16
-15
-14
-13
-12
-11
-10
-9
-8
-7

APPENDIX B-5

Surface Water

Sample Summary Report

Sample ID	SW-R3	
Sample Date	10/24/2019	
Station	SW-R3 10/24/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.02	
Conductivity	176	uS/cm
Sum of Anions	2.220724	meq/L
Sum of Cations	2.20839	meq/L
Balance	-0.2784888	%
Total dissolved solids	170.7	mg/L
Total hardness	105.8	mg/l CaCO3
Alkalinity	109.5	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	0.916	3.984381E-02	3.984381E-02
K	2.02	5.166465E-02	5.166465E-02
Ca	20.8	0.518988	1.037976
Mg	13.1	0.5389838	1.077968
Cl	0.66	1.861635E-02	1.861635E-02
SO4	1.52	1.583333E-02	3.166667E-02
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	131	2.146938	2.146938

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.587786	0.9629009	0.319	0.194
Ca/SO4	13.68421	32.77819	0.152	0.364
Na/Cl	1.387879	2.140259	0.556	0.858
Cl/Br			287	648

Sample Summary Report

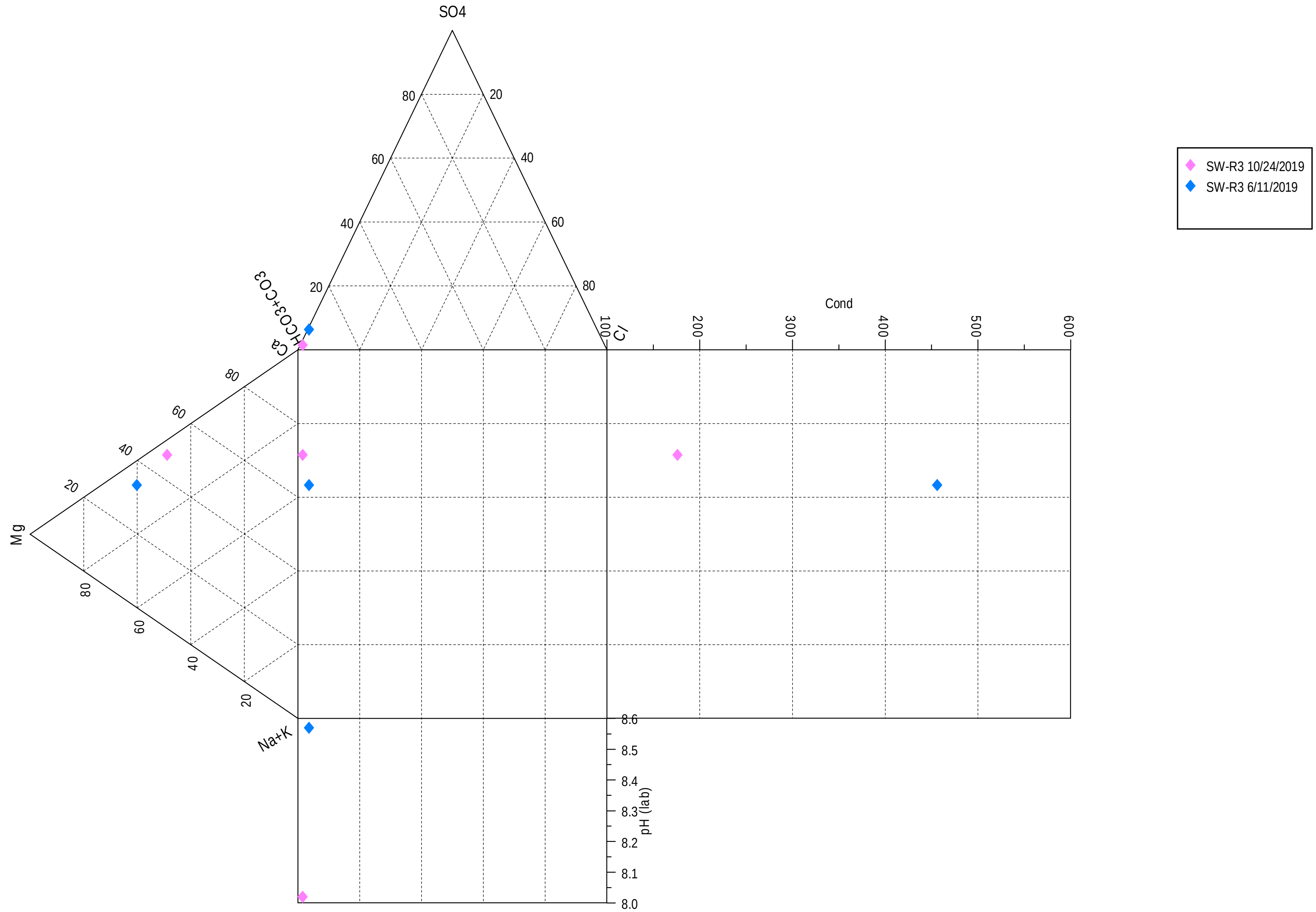
Sample ID	SW-R3	
Sample Date	6/11/2019	
Station	SW-R3 6/11/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.57	
Conductivity	456	uS/cm

Sum of Anions	5.609608	meq/L
Sum of Cations	5.764979	meq/L
Balance	1.36595	%

Total dissolved solids	412.8	mg/L
Total hardness	268.8	mg/l CaCO3
Alkalinity	284.6	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	6.84	0.2975236	0.2975236
K	3.38	8.644877E-02	8.644877E-02
Ca	38.3	0.9556366	1.911273
Mg	42.1	1.732154	3.464308
Cl	0.97	0.0273604	0.0273604
SO4	16.8	0.175	0.35
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	290	4.752763	4.752763

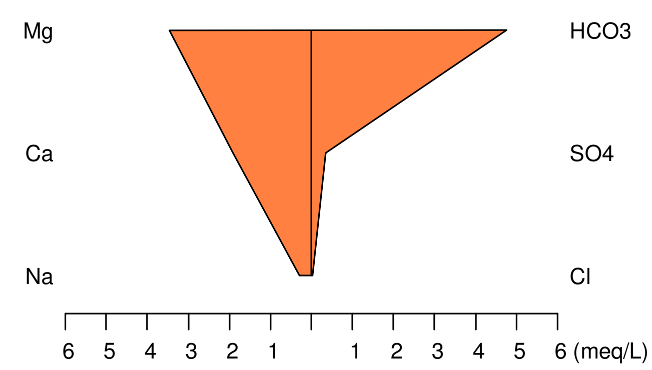
Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9097387	0.5517042	0.319	0.194
Ca/SO4	2.279762	5.460781	0.152	0.364
Na/Cl	7.051547	10.87424	0.556	0.858
Cl/Br			287	648



DESCRIPTION:		
PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO:	18-0300-005
CLIENT: Manitoba Infrastructure	DATE:	

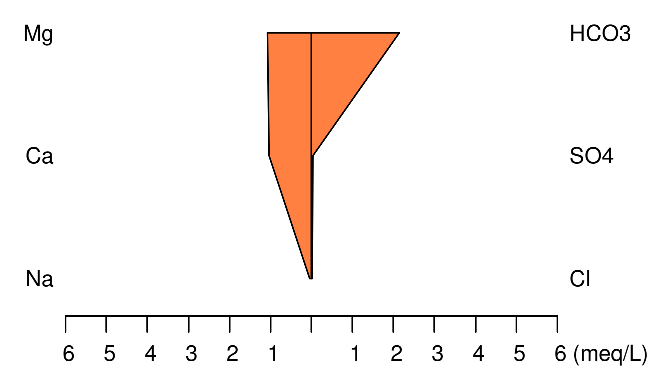
SW-R3

Date: 6/11/2019
TDS (mg/l) = 267
El Cond. (uS/cm) = 456
pH = 8.57

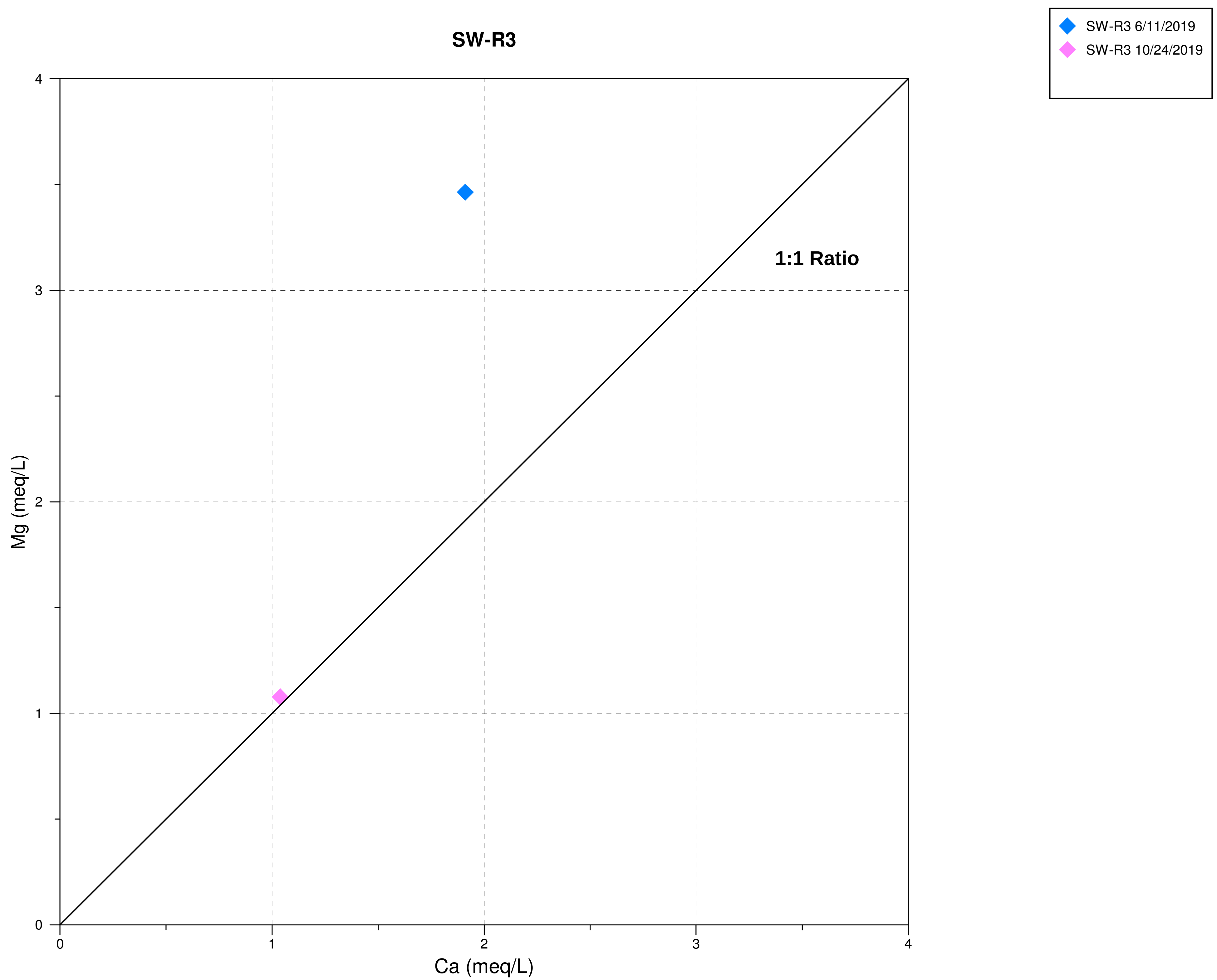


SW-R3

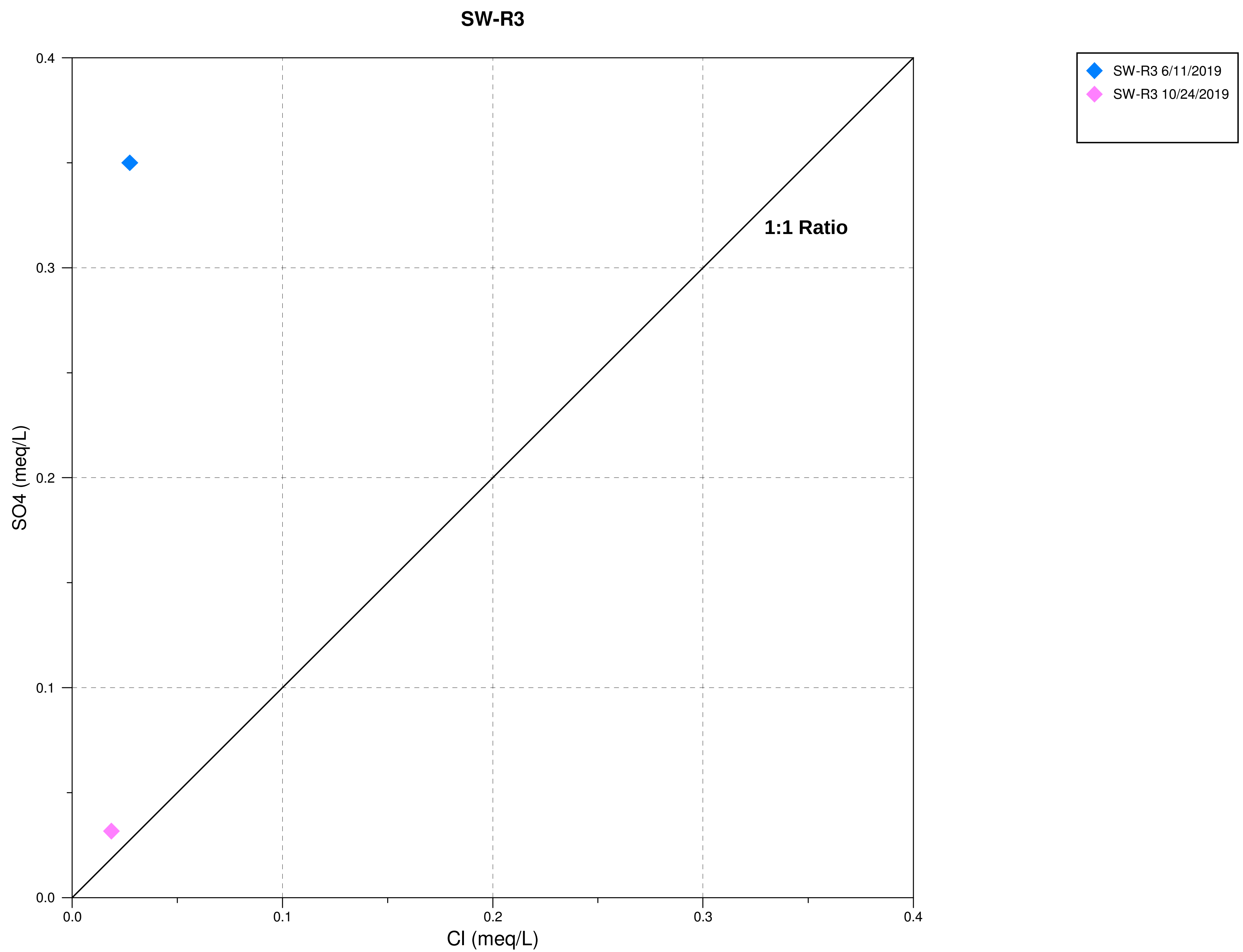
Date: 10/24/2019
TDS (mg/l) = 103
El Cond. (uS/cm) = 176
pH = 8.02



DESCRIPTION: SW-R3		
	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT:	DATE:



DESCRIPTION: SW-R3			
	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO:	18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:	



DESCRIPTION: SW-R3			
	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO:	18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:	

APPENDIX B-6

Peat Well

Sample Summary Report

Sample ID	TH19-KGS-03A	
Sample Date	3/8/2019	
Station	TH19-KGS-03A 3/8/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.05	
Conductivity	650	uS/cm
Sum of Anions	7.843334	meq/L
Sum of Cations	7.968256	meq/L
Balance	0.7900618	%
Total dissolved solids	597.3	mg/L
Total hardness	366.9	mg/l CaCO3
Alkalinity	362.1	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	14	0.6089665	0.6089665
K	0.634	1.621554E-02	1.621554E-02
Ca	73	1.821448	3.642897
Mg	44.9	1.847357	3.694713
Cl	13.6	0.3836097	0.3836097
SO4	11.1	0.115625	0.23125
NO3	0.0442	7.129032E-04	7.129032E-04
HCO3	439	7.1947	7.1947

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.625835	0.9859755	0.319	0.194
Ca/SO4	6.576576	15.75307	0.152	0.364
Na/Cl	1.029412	1.587464	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-07A	
Sample Date	3/7/2019	
Station	TH19-KGS-07A 3/7/2019	
Location		
Geology		
Watertype	Ca-Mg-HCO3	
Temperature (°C)		
pH	7.74	
Conductivity	689	uS/cm
Sum of Anions	9.104804	meq/L
Sum of Cations	8.364207	meq/L
Balance	-4.239489	%
Total dissolved solids	690.2	mg/L
Total hardness	393.0	mg/l CaCO3
Alkalinity	436.7	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	10.2	0.4436756	0.4436756
K	2.04	5.217618E-02	5.217618E-02
Ca	88.1	2.198214	4.396427
Mg	42.1	1.732154	3.464308
Cl	4.31	0.1215704	0.1215704
SO4	12.2	0.1270833	0.2541667
NO3	0.0129	2.080645E-04	2.080645E-04
HCO3	530	8.686084	8.686084

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	2.092637	1.269064	0.319	0.194
Ca/SO4	7.221312	17.29742	0.152	0.364
Na/Cl	2.366589	3.649535	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-100	
Sample Date	3/7/2019	
Station	TH19-KGS-100 3/7/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.62	
Conductivity	767	uS/cm

Sum of Anions	9.460704	meq/L
Sum of Cations	9.569678	meq/L
Balance	0.5726341	%

Total dissolved solids	725.5	mg/L
Total hardness	450.2	mg/l CaCO3
Alkalinity	463.0	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	12.5	0.5437201	0.5437201
K	0.532	1.360673E-02	1.360673E-02
Ca	81	2.021059	4.042118
Mg	60.3	2.480971	4.961942
Cl	6.32	0.1782657	0.1782657
SO4	1.71	0.0178125	0.035625
NO3	<0.01	<1.612903E-04	<1.612903E-04
HCO3	562	9.210526	9.210526

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.343284	0.8146242	0.319	0.194
Ca/SO4	47.36842	113.463	0.152	0.364
Na/Cl	1.977848	3.050055	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-11A	
Sample Date	3/8/2019	
Station	TH19-KGS-11A 3/8/2019	
Location		
Geology		
Watertype	Ca-Mg-HCO3	
Temperature (°C)		
pH	7.12	
Conductivity	669	uS/cm
Sum of Anions	7.972418	meq/L
Sum of Cations	6.932847	meq/L
Balance	-6.974517	%
Total dissolved solids	600.7	mg/L
Total hardness	331.3	mg/l CaCO3
Alkalinity	399.0	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	6.65	0.2892591	0.2892591
K	0.577	1.475768E-02	1.475768E-02
Ca	70.1	1.749089	3.498179
Mg	38	1.563464	3.126929
Cl	0.13	3.666857E-03	3.666857E-03
SO4	0.37	3.854167E-03	7.708333E-03
NO3	0.0156	2.516129E-04	2.516129E-04
HCO3	484	7.932197	7.932197

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.844737	1.118727	0.319	0.194
Ca/SO4	189.4595	453.8178	0.152	0.364
Na/Cl	51.15385	78.88475	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-13A	
Sample Date	3/7/2019	
Station	TH19-KGS-13A 3/7/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.54	
Conductivity	460	uS/cm
Sum of Anions	5.650965	meq/L
Sum of Cations	5.560661	meq/L
Balance	-0.8054529	%
Total dissolved solids	433.8	mg/L
Total hardness	256.8	mg/l CaCO3
Alkalinity	278.4	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	9.08	0.3949583	0.3949583
K	0.981	2.509061E-02	2.509061E-02
Ca	49.5	1.235092	2.470183
Mg	32.4	1.333059	2.666118
Cl	2.14	6.036212E-02	6.036212E-02
SO4	1.79	1.864583E-02	3.729167E-02
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	337	5.523038	5.523038

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.527778	0.9265093	0.319	0.194
Ca/SO4	27.65363	66.23955	0.152	0.364
Na/Cl	4.24299	6.543148	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-14A	
Sample Date	3/8/2019	
Station	TH19-KGS-14A 3/8/2019	
Location		
Geology		
Watertype	Ca-Mg-HCO3	
Temperature (°C)		
pH	7.58	
Conductivity	483	uS/cm
Sum of Anions	6.74063	meq/L
Sum of Cations	6.060589	meq/L
Balance	-5.312313	%
Total dissolved solids	510.8	mg/L
Total hardness	295.7	mg/l CaCO3
Alkalinity	332.6	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	2.84	0.1235332	0.1235332
K	0.791	2.023106E-02	2.023106E-02
Ca	68.2	1.701682	3.403363
Mg	30.5	1.254886	2.509772
Cl	1.08	3.046312E-02	3.046312E-02
SO4	3.44	3.583334E-02	7.166667E-02
NO3	0.0189	3.048387E-04	3.048387E-04
HCO3	403	6.604702	6.604702

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	2.236065	1.356045	0.319	0.194
Ca/SO4	19.82558	47.48879	0.152	0.364
Na/Cl	2.629629	4.055171	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-17A	
Sample Date	3/10/2019	
Station	TH19-KGS-17A 3/10/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.93	
Conductivity	578	uS/cm

Sum of Anions	7.126873	meq/L
Sum of Cations	6.559596	meq/L
Balance	-4.144801	%

Total dissolved solids	538.2	mg/L
Total hardness	316.6	mg/l CaCO3
Alkalinity	350.6	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	4.4	0.1913895	0.1913895
K	1.23	3.145917E-02	3.145917E-02
Ca	61.6	1.537003	3.074006
Mg	39.6	1.629294	3.258589
Cl	2.54	7.164475E-02	7.164475E-02
SO4	2.91	0.0303125	0.060625
NO3	0.0104	1.677419E-04	1.677419E-04
HCO3	425	6.965256	6.965256

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.555556	0.943355	0.319	0.194
Ca/SO4	21.16838	50.70525	0.152	0.364
Na/Cl	1.732283	2.671368	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-18A	
Sample Date	3/11/2019	
Station	TH19-KGS-18A 3/11/2019	
Location		
Geology		
Watertype	Na-Ca-Mg-HCO3	
Temperature (°C)		
pH	7.48	
Conductivity	489	uS/cm

Sum of Anions	5.728393	meq/L
Sum of Cations	5.653378	meq/L
Balance	-0.6590809	%

Total dissolved solids	458.5	mg/L
Total hardness	128.4	mg/l CaCO3
Alkalinity	278.4	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	70.2	3.053532	3.053532
K	1.08	2.762268E-02	2.762268E-02
Ca	25.9	0.6462399	1.29248
Mg	15.5	0.6377289	1.275458
Cl	1.49	4.202783E-02	4.202783E-02
SO4	6.43	6.697917E-02	0.1339583
NO3	0.0182	2.935484E-04	2.935484E-04
HCO3	337	5.523038	5.523038

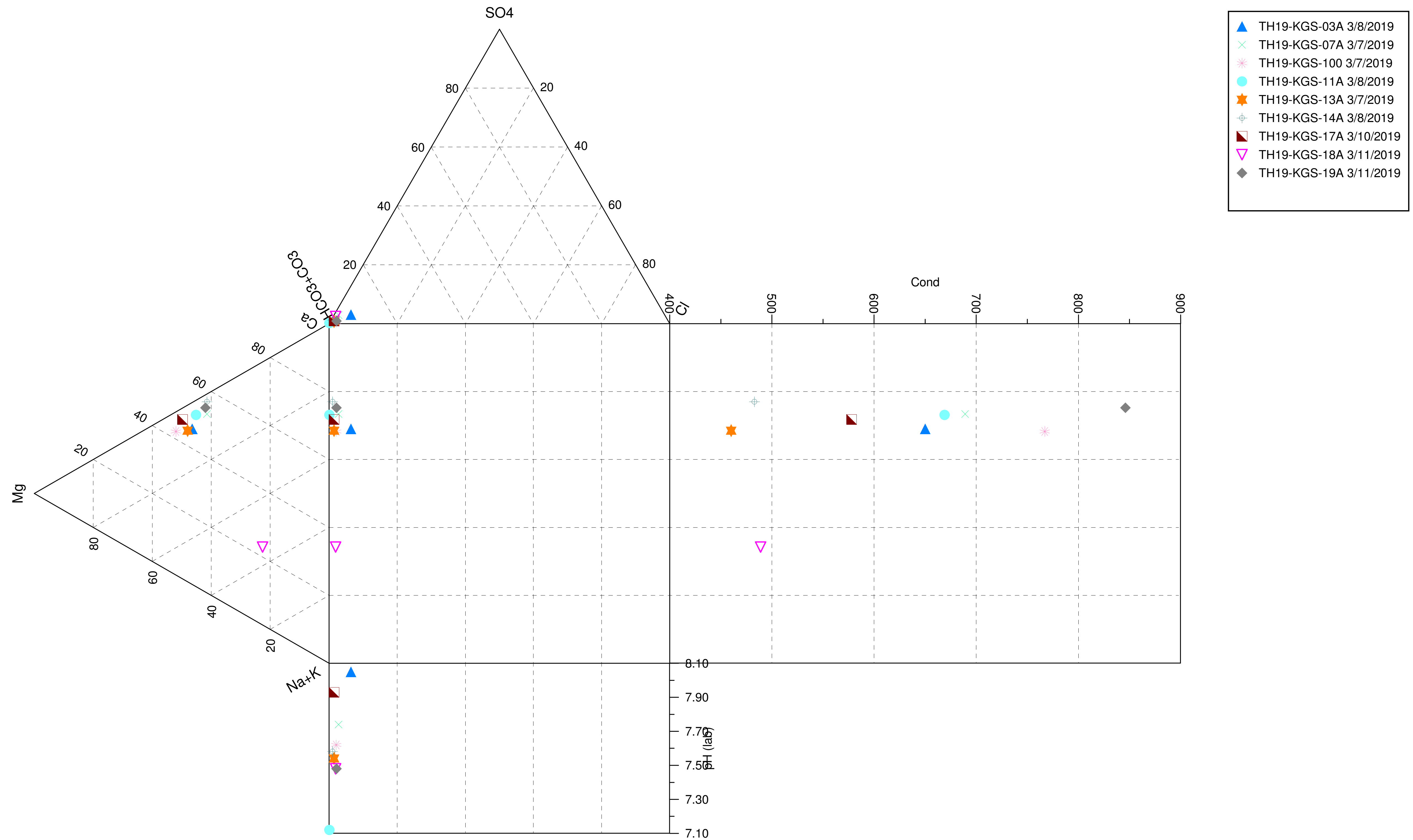
Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.670968	1.013346	0.319	0.194
Ca/SO4	4.027994	9.648371	0.152	0.364
Na/Cl	47.11409	72.655	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-19A	
Sample Date	3/11/2019	
Station	TH19-KGS-19A 3/11/2019	
Location		
Geology		
Watertype	Ca-Mg-HCO3	
Temperature (°C)		
pH	7.48	
Conductivity	846	uS/cm
Sum of Anions	10.6621	meq/L
Sum of Cations	10.87636	meq/L
Balance	0.994775	%
Total dissolved solids	827.8	mg/L
Total hardness	522.4	mg/l CaCO3
Alkalinity	520.4	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	8.37	0.364075	0.364075
K	2.28	5.831455E-02	5.831455E-02
Ca	118	2.944259	5.888518
Mg	55.4	2.279366	4.558733
Cl	6.58	0.1855994	0.1855994
SO4	4.13	4.302084E-02	8.604167E-02
NO3	0.03	4.838709E-04	4.838709E-04
HCO3	632	10.35775	10.35775

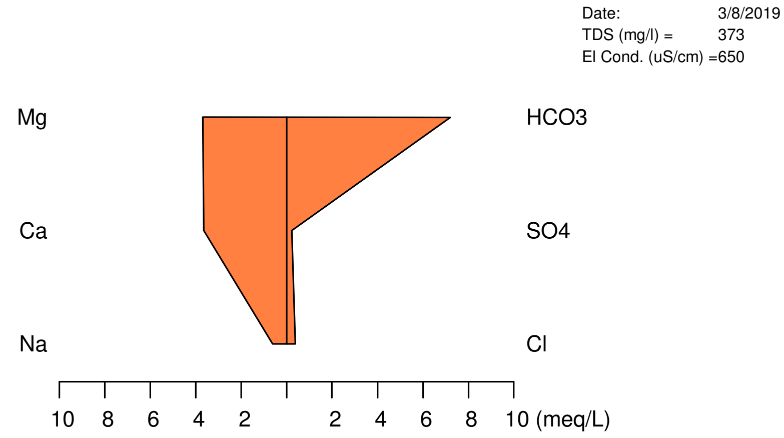
Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	2.129964	1.2917	0.319	0.194
Ca/SO4	28.57143	68.43797	0.152	0.364
Na/Cl	1.272036	1.961617	0.556	0.858
Cl/Br			287	648



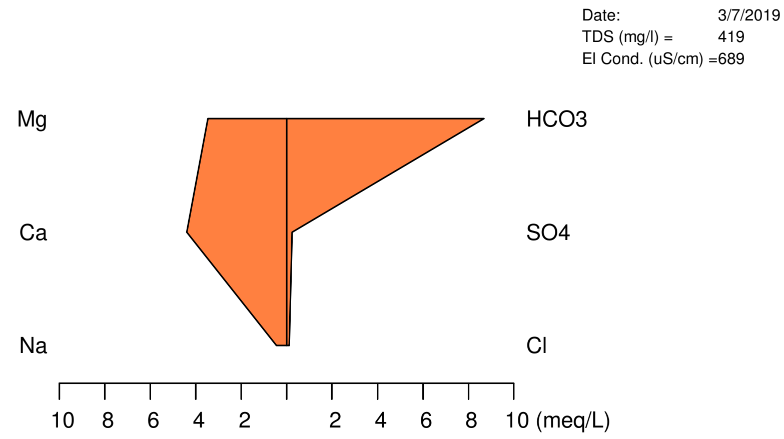
DESCRIPTION:	Peat Wells

PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO:	18-0300-005
CLIENT: Manitoba Infrastructure	DATE:	

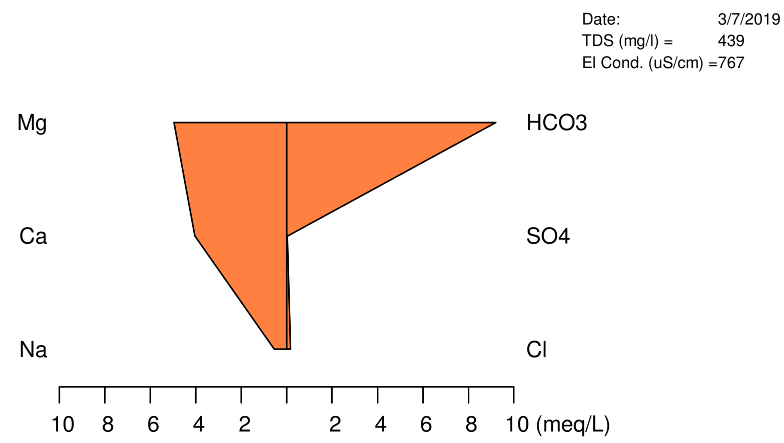
TH19-KGS-03A



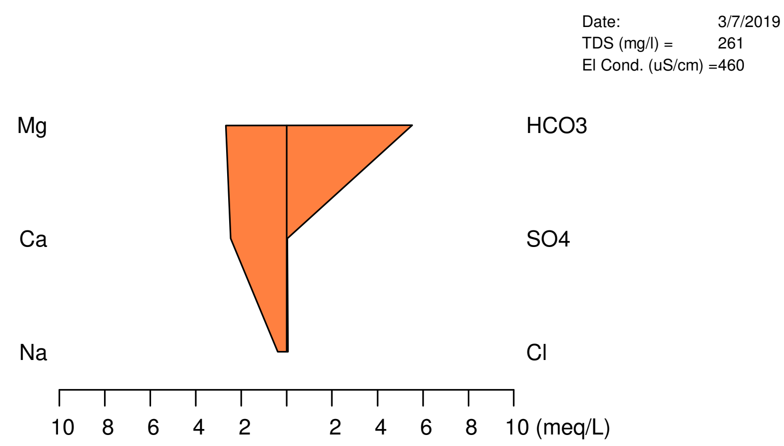
TH19-KGS-07A



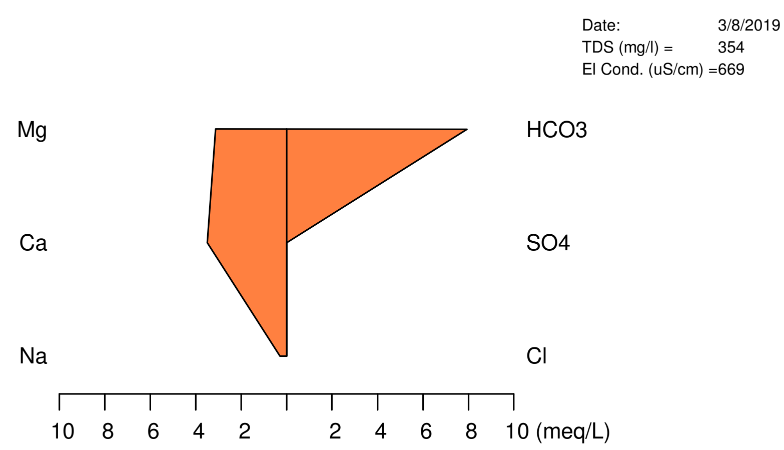
TH19-KGS-100



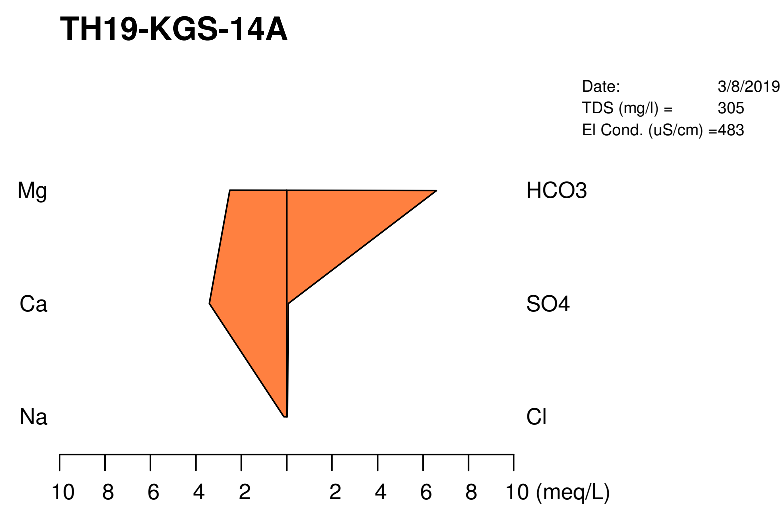
TH19-KGS-13A

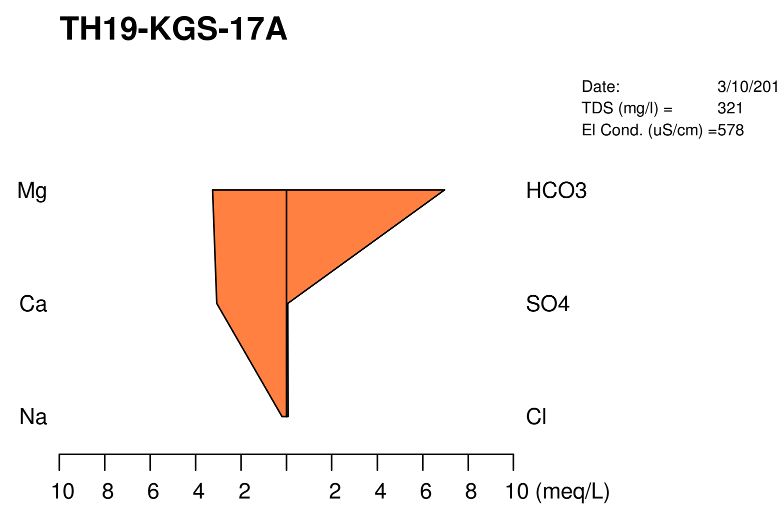


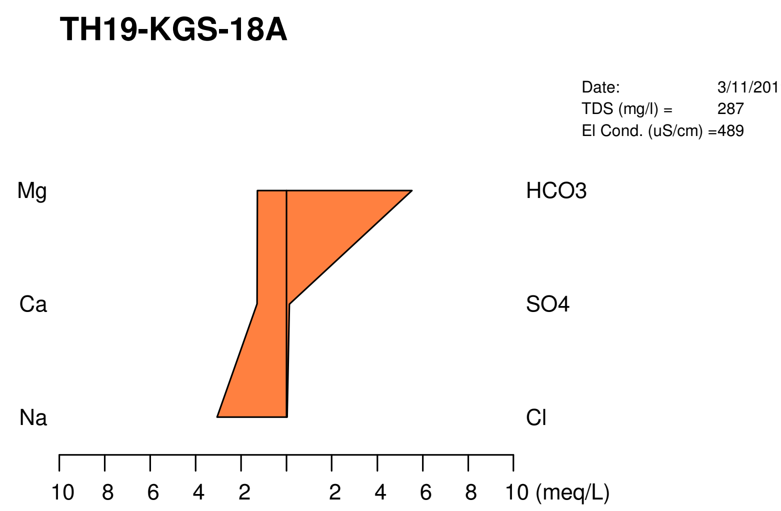
TH19-KGS-11A

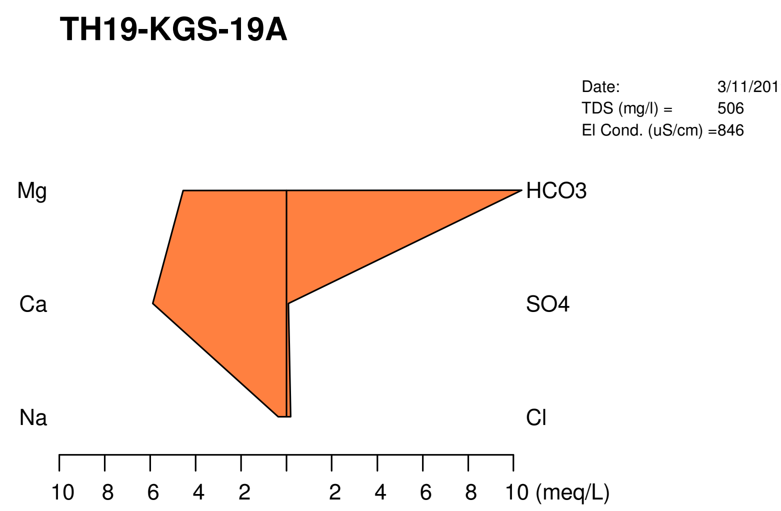


DESCRIPTION: Peat Wells		
	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:

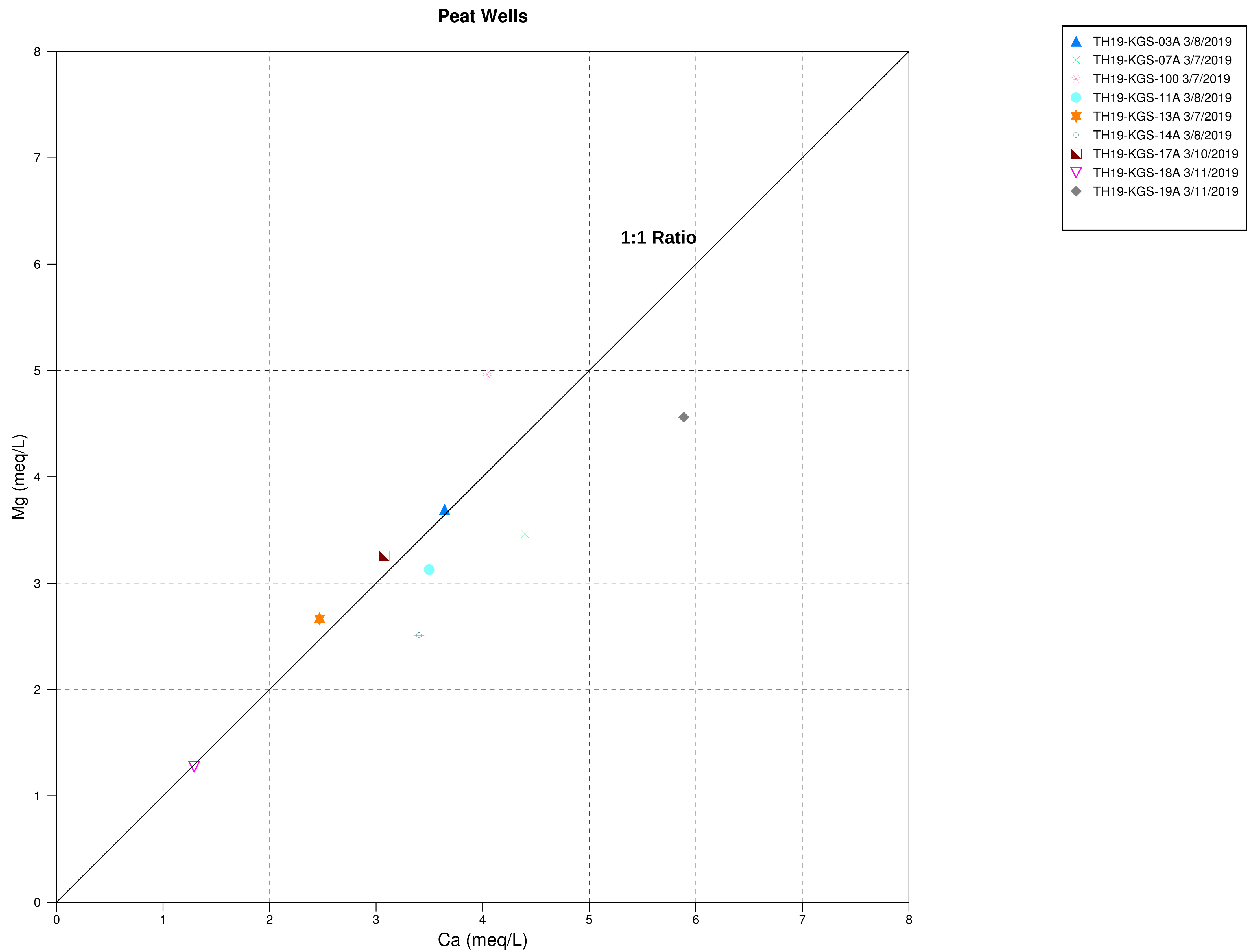






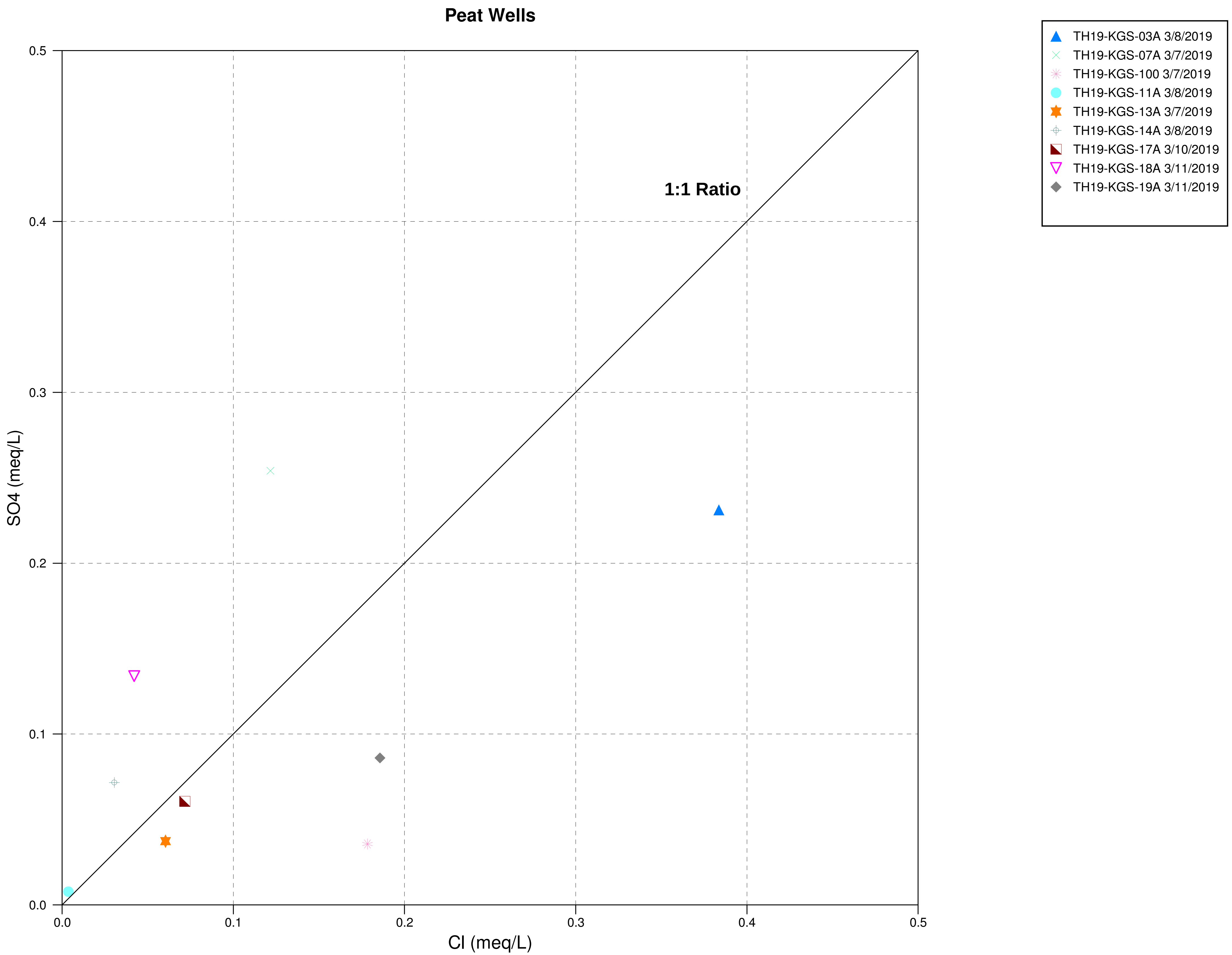


DESCRIPTION: Peat Wells		
	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:



DESCRIPTION: Peat Wells

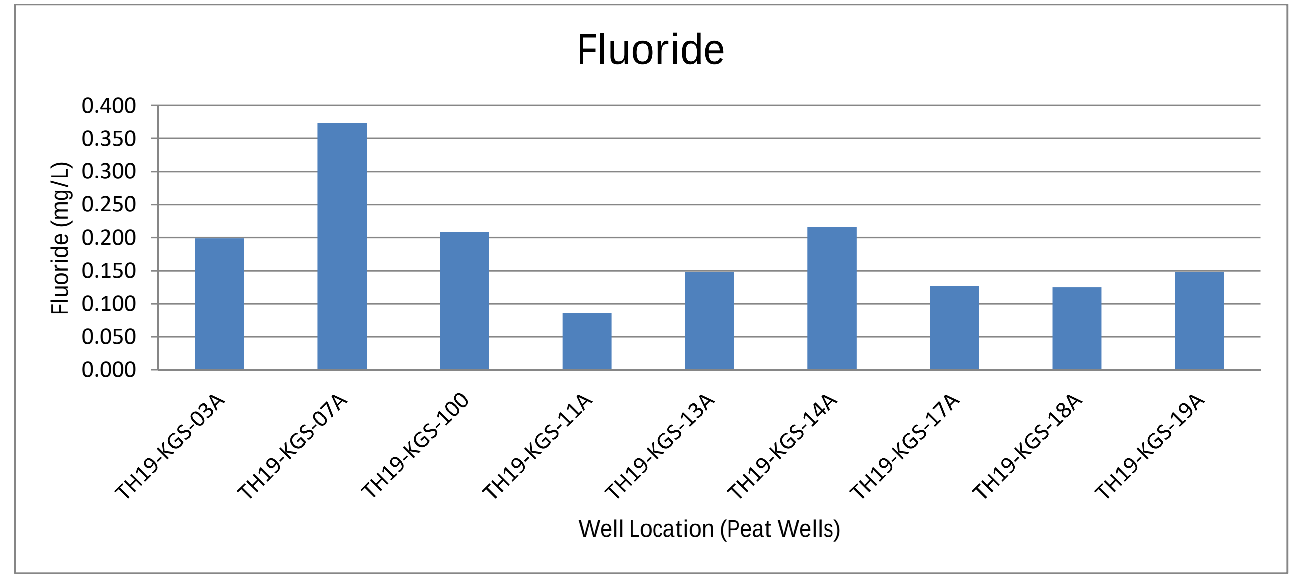
PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO:	18-0300-005
CLIENT: Manitoba Infrastructure	DATE:	

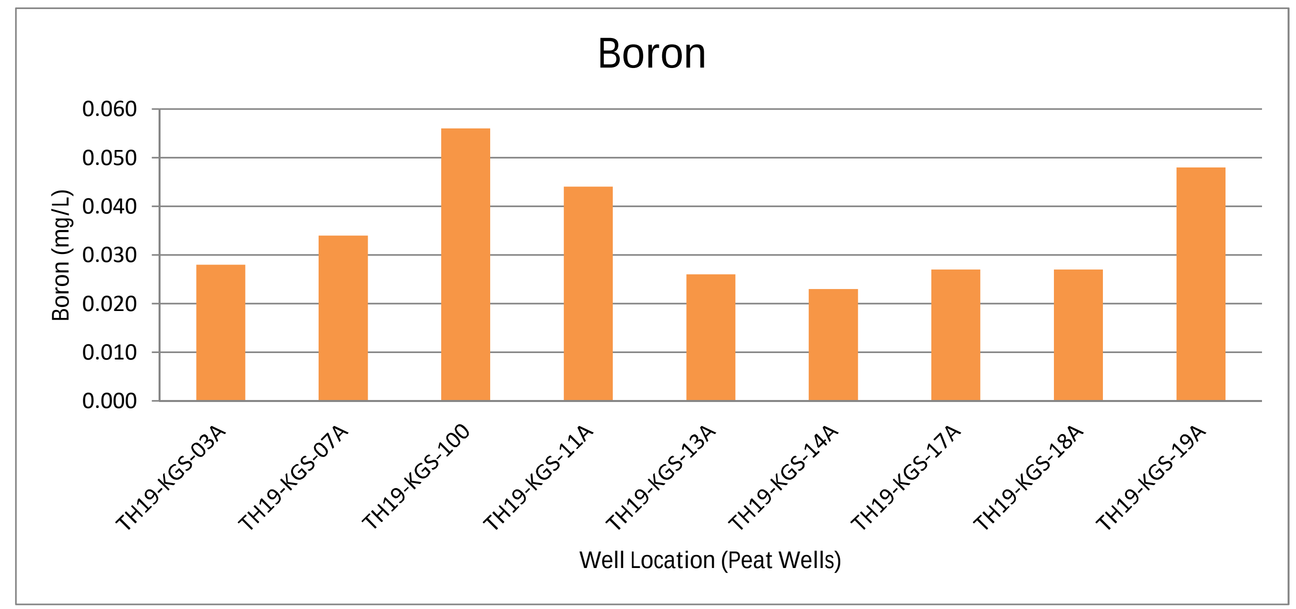


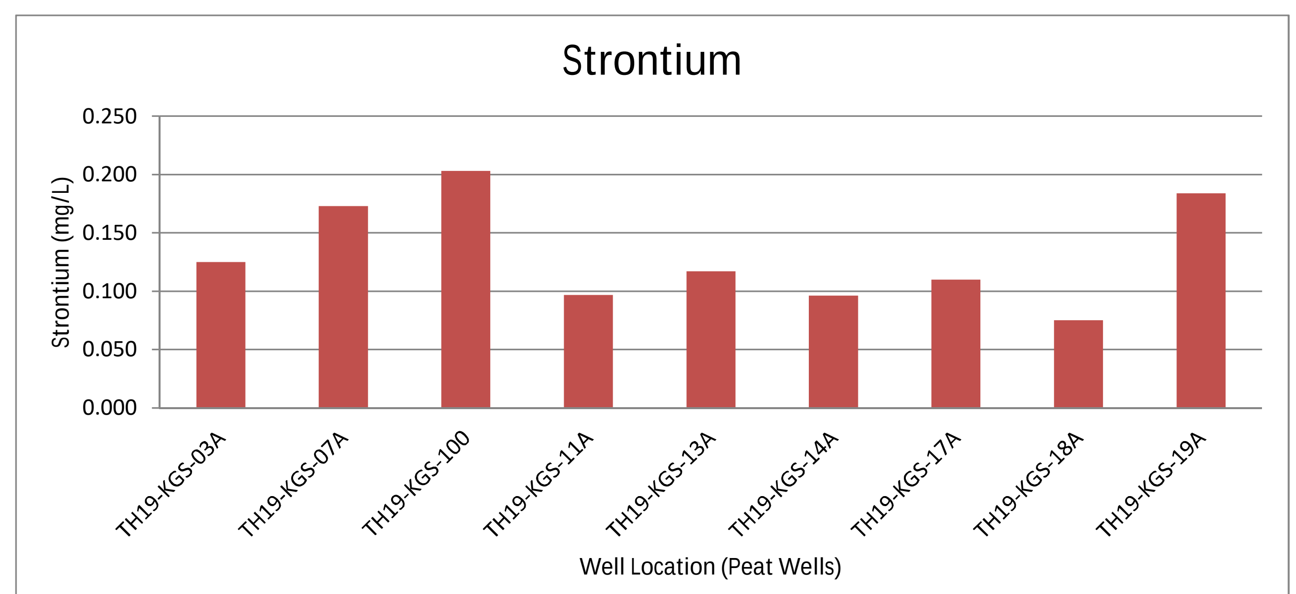
DESCRIPTION:	Peat Wells

PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO:	18-0300-005
CLIENT: Manitoba Infrastructure	DATE:	

Sample ID	Fluoride	Boron	Strontium
PEAT WELLS			
TH19-KGS-03A	0.199	0.028	0.125
TH19-KGS-07A	0.373	0.034	0.173
TH19-KGS-100	0.208	0.056	0.203
TH19-KGS-11A	0.086	0.044	0.097
TH19-KGS-13A	0.148	0.026	0.117
TH19-KGS-14A	0.216	0.023	0.096
TH19-KGS-17A	0.127	0.027	0.110
TH19-KGS-18A	0.125	0.027	0.075
TH19-KGS-19A	0.148	0.048	0.184







APPENDIX B-7

Till Wells

Sample Summary Report

Sample ID	TH15-04	
Sample Date	3/8/2019	
Station	TH15-04 3/8/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.9	
Conductivity	470	uS/cm

Sum of Anions	5.573706	meq/L
Sum of Cations	5.732224	meq/L
Balance	1.402085	%

Total dissolved solids	423.3	mg/L
Total hardness	241.2	mg/l CaCO3
Alkalinity	239.1	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	19.3	0.8395038	0.8395038
K	2.39	6.112798E-02	6.112798E-02
Ca	39.3	0.9805879	1.961176
Mg	34.8	1.431804	2.863608
Cl	1.93	5.443873E-02	5.443873E-02
SO4	35.4	0.36875	0.7375001
NO3	0.0159	2.564516E-04	2.564516E-04
HCO3	289	4.736374	4.736374

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.12931	0.6848618	0.319	0.194
Ca/SO4	1.110169	2.659221	0.152	0.364
Na/Cl	10	15.42108	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-02B	
Sample Date	3/11/2019	
Station	TH19-KGS-02B 3/11/2019	
Location		
Geology		
Watertype	Mg-Na-Ca-SO4-HCO3	
Temperature (°C)		
pH	8.07	
Conductivity	1970	uS/cm
Sum of Anions	23.43464	meq/L
Sum of Cations	24.6121	meq/L
Balance	2.450667	%
Total dissolved solids	1596.6	mg/L
Total hardness	833.5	mg/l CaCO3
Alkalinity	271.0	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	178	7.742574	7.742574
K	6.93	0.1772456	0.1772456
Ca	123	3.069016	6.138031
Mg	128	5.266406	10.53281
Cl	93.9	2.648599	2.648599
SO4	737	7.677083	15.35417
NO3	<0.05	<8.064516E-04	<8.064516E-04
HCO3	328	5.375539	5.375539

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9609375	0.5827533	0.319	0.194
Ca/SO4	0.1668928	0.3997632	0.152	0.364
Na/Cl	1.895634	2.923271	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-07	
Sample Date	3/7/2019	
Station	TH19-KGS-07 3/7/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.16	
Conductivity	654	uS/cm
Sum of Anions	7.879778	meq/L
Sum of Cations	7.961812	meq/L
Balance	0.5178372	%
Total dissolved solids	579.7	mg/L
Total hardness	330.8	mg/l CaCO3
Alkalinity	304.7	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	28.2	1.226633	1.226633
K	4.29	0.1097234	0.1097234
Ca	41.9	1.045461	2.090923
Mg	55	2.262909	4.525818
Cl	14.9	0.4202783	0.4202783
SO4	64.8	0.6750001	1.35
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	369	6.047481	6.047481

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.7618182	0.4619989	0.319	0.194
Ca/SO4	0.646605	1.548832	0.152	0.364
Na/Cl	1.892618	2.91862	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-12B	
Sample Date	3/14/2019	
Station	TH19-KGS-12B 3/14/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.29	
Conductivity	791	uS/cm
Sum of Anions	9.561297	meq/L
Sum of Cations	10.0023	meq/L
Balance	2.254206	%
Total dissolved solids	711.8	mg/L
Total hardness	424.3	mg/l CaCO3
Alkalinity	372.8	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	31.1	1.352776	1.352776
K	5.82	0.1488556	0.1488556
Ca	57.6	1.437197	2.874395
Mg	68.2	2.806007	5.612014
Cl	13.6	0.3836097	0.3836097
SO4	81.8	0.8520834	1.704167
NO3	<0.01	<1.612903E-04	<1.612903E-04
HCO3	452	7.407754	7.407754

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.8445748	0.512186	0.319	0.194
Ca/SO4	0.7041565	1.686686	0.152	0.364
Na/Cl	2.286765	3.526438	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-16B	
Sample Date	3/9/2019	
Station	TH19-KGS-16B 3/9/2019	
Location		
Geology		
Watertype	Ca-Mg-HCO3	
Temperature (°C)		
pH	7.95	
Conductivity	809	uS/cm
Sum of Anions	10.00574	meq/L
Sum of Cations	12.88746	meq/L
Balance	12.58768	%
Total dissolved solids	814.4	mg/L
Total hardness	622.6	mg/l CaCO3
Alkalinity	473.7	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	8.26	0.3592902	0.3592902
K	2.63	6.726635E-02	6.726635E-02
Ca	129	3.218724	6.437448
Mg	73.1	3.007612	6.015223
Cl	2.31	6.515723E-02	6.515723E-02
SO4	22.9	0.2385417	0.4770833
NO3	0.047	7.580644E-04	7.580644E-04
HCO3	575	9.423581	9.423581

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.764706	1.070193	0.319	0.194
Ca/SO4	5.633188	13.49334	0.152	0.364
Na/Cl	3.575758	5.514204	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-17B	
Sample Date	3/10/2019	
Station	TH19-KGS-17B 3/10/2019	
Location		
Geology		
Watertype	Mg-HCO3	
Temperature (°C)		
pH	8.29	
Conductivity	846	uS/cm

Sum of Anions	11.98859	meq/L
Sum of Cations	12.40002	meq/L
Balance	1.686962	%

Total dissolved solids	887.2	mg/L
Total hardness	526.3	mg/l CaCO3
Alkalinity	483.5	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	39.5	1.718156	1.718156
K	5.34	0.1365788	0.1365788
Ca	41.1	1.0255	2.051001
Mg	103	4.237811	8.475622
Cl	3.39	9.562036E-02	9.562036E-02
SO4	106	1.104167	2.208333
NO3	0.039	6.290323E-04	6.290323E-04
HCO3	587	9.620248	9.620248

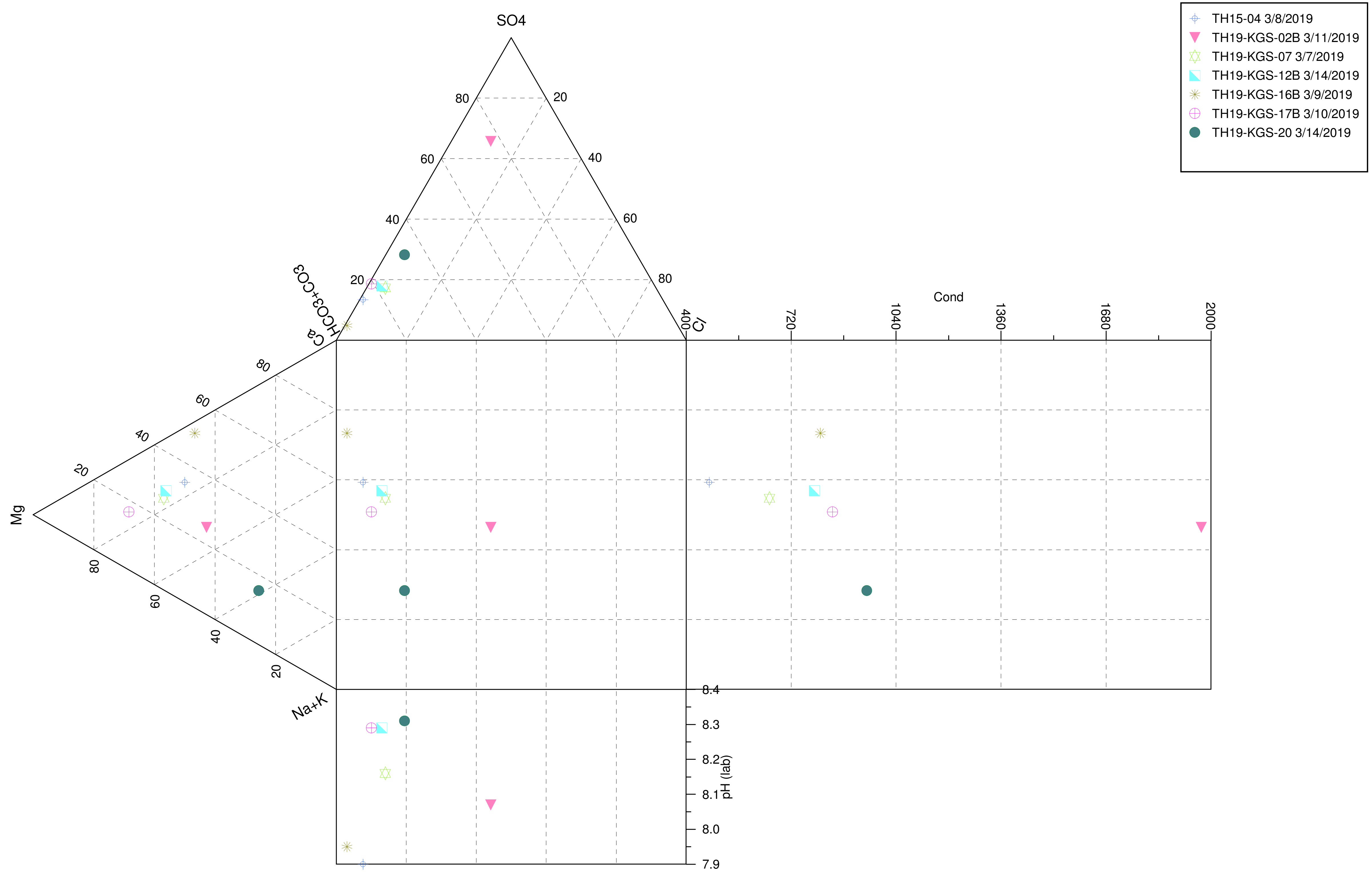
Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.3990291	0.2419882	0.319	0.194
Ca/SO4	0.3877358	0.9287549	0.152	0.364
Na/Cl	11.65192	17.96851	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-20	
Sample Date	3/14/2019	
Station	TH19-KGS-20 3/14/2019	
Location		
Geology		
Watertype	Na-Mg-HCO3-SO4	
Temperature (°C)		
pH	8.31	
Conductivity	951	uS/cm
Sum of Anions	10.95071	meq/L
Sum of Cations	10.46804	meq/L
Balance	-2.25351	%
Total dissolved solids	816.8	mg/L
Total hardness	214.8	mg/l CaCO3
Alkalinity	367.6	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	139	6.046167	6.046167
K	4.5	0.1150945	0.1150945
Ca	32.5	0.8109187	1.621837
Mg	32.5	1.337173	2.674347
Cl	21.3	0.6008005	0.6008005
SO4	147	1.53125	3.0625
NO3	0.024	3.870968E-04	3.870968E-04
HCO3	436	7.145533	7.145533

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1	0.6064425	0.319	0.194
Ca/SO4	0.2210884	0.5295796	0.152	0.364
Na/Cl	6.525822	10.06352	0.556	0.858
Cl/Br			287	648



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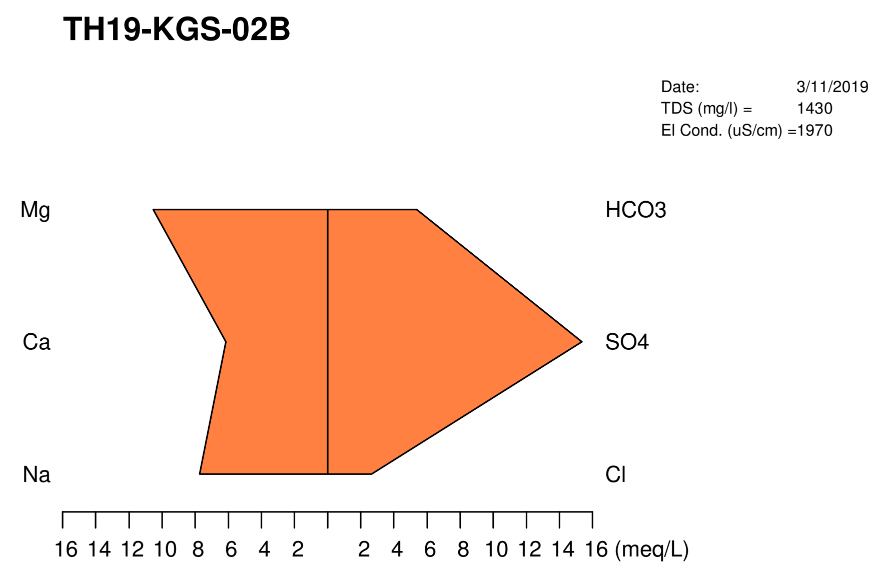
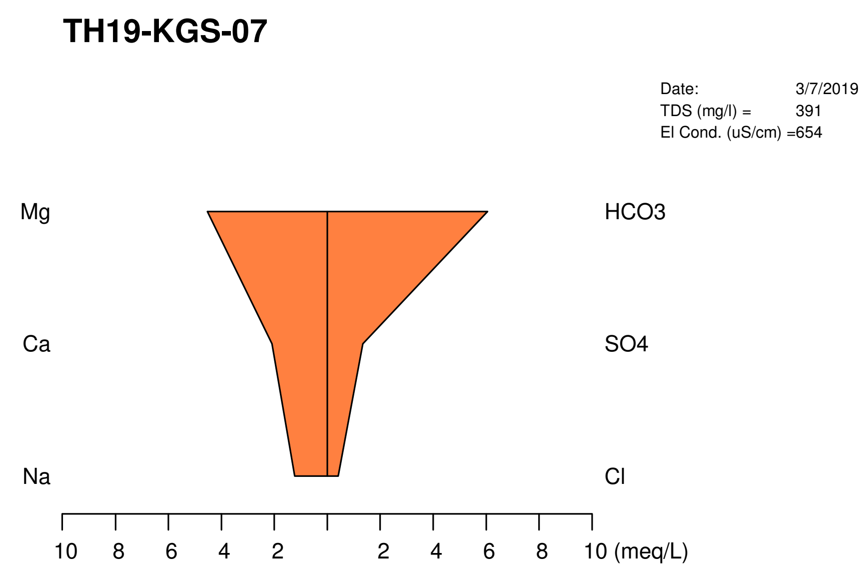
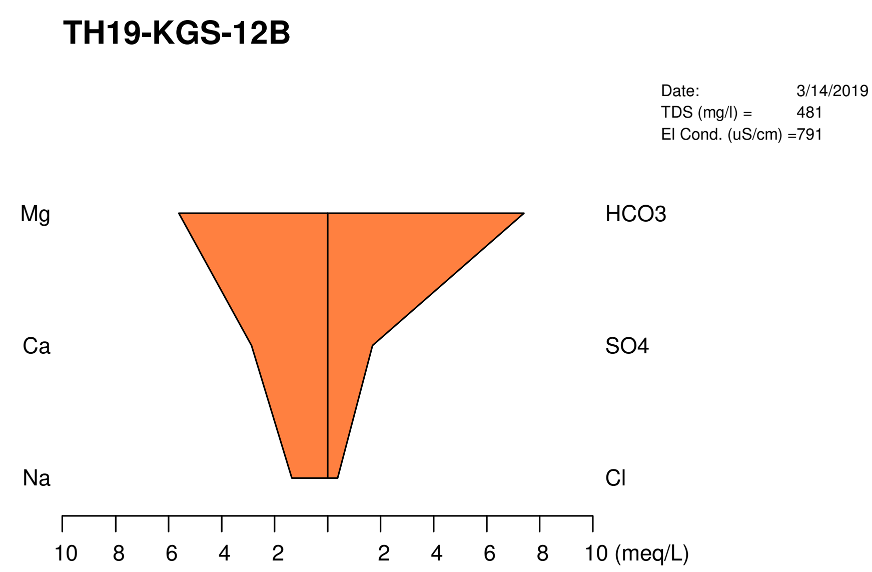
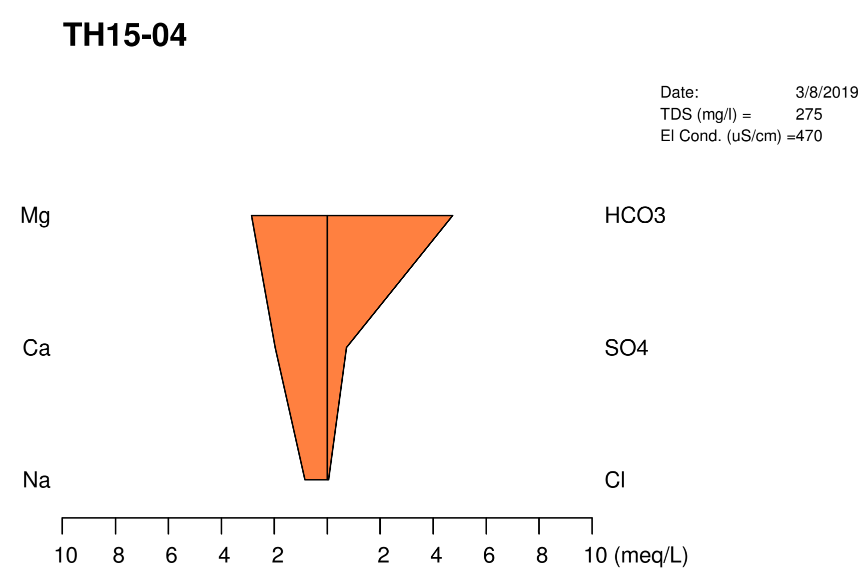
	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:







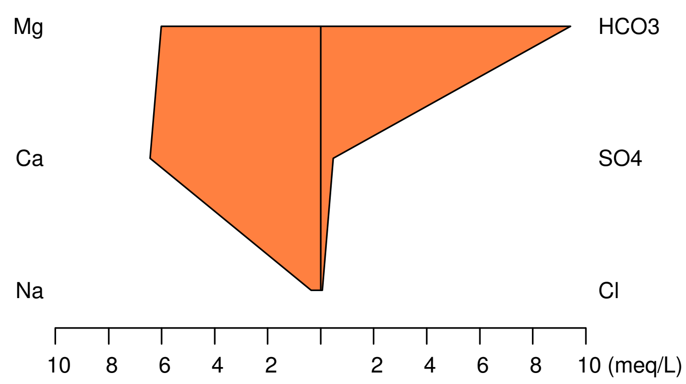


DESCRIPTION: Till Wells

PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
CLIENT: Manitoba Infrastructure	DATE:

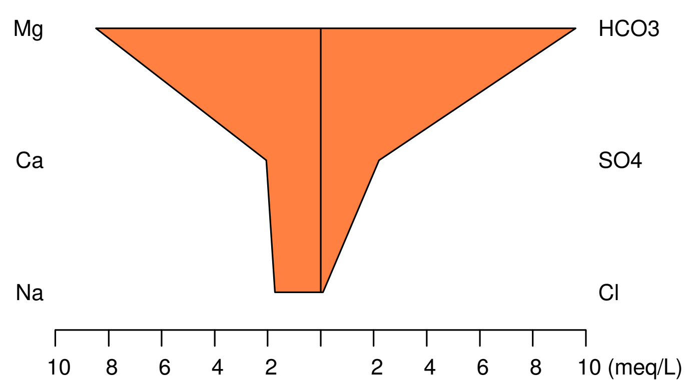
TH19-KGS-16B

Date: 3/9/2019
TDS (mg/l) = 521
El Cond. (uS/cm) =809



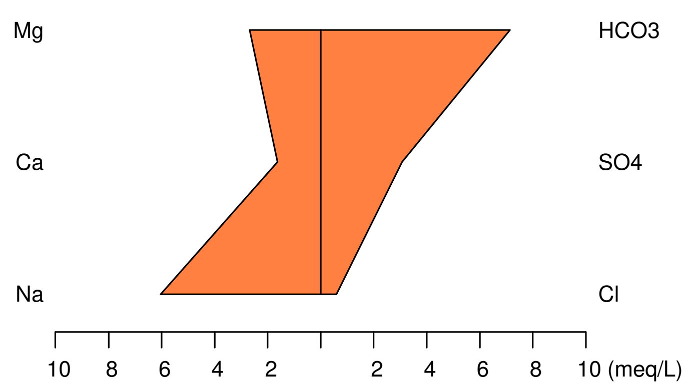
TH19-KGS-17B

Date: 3/10/2019
TDS (mg/l) = 587
El Cond. (uS/cm) =846

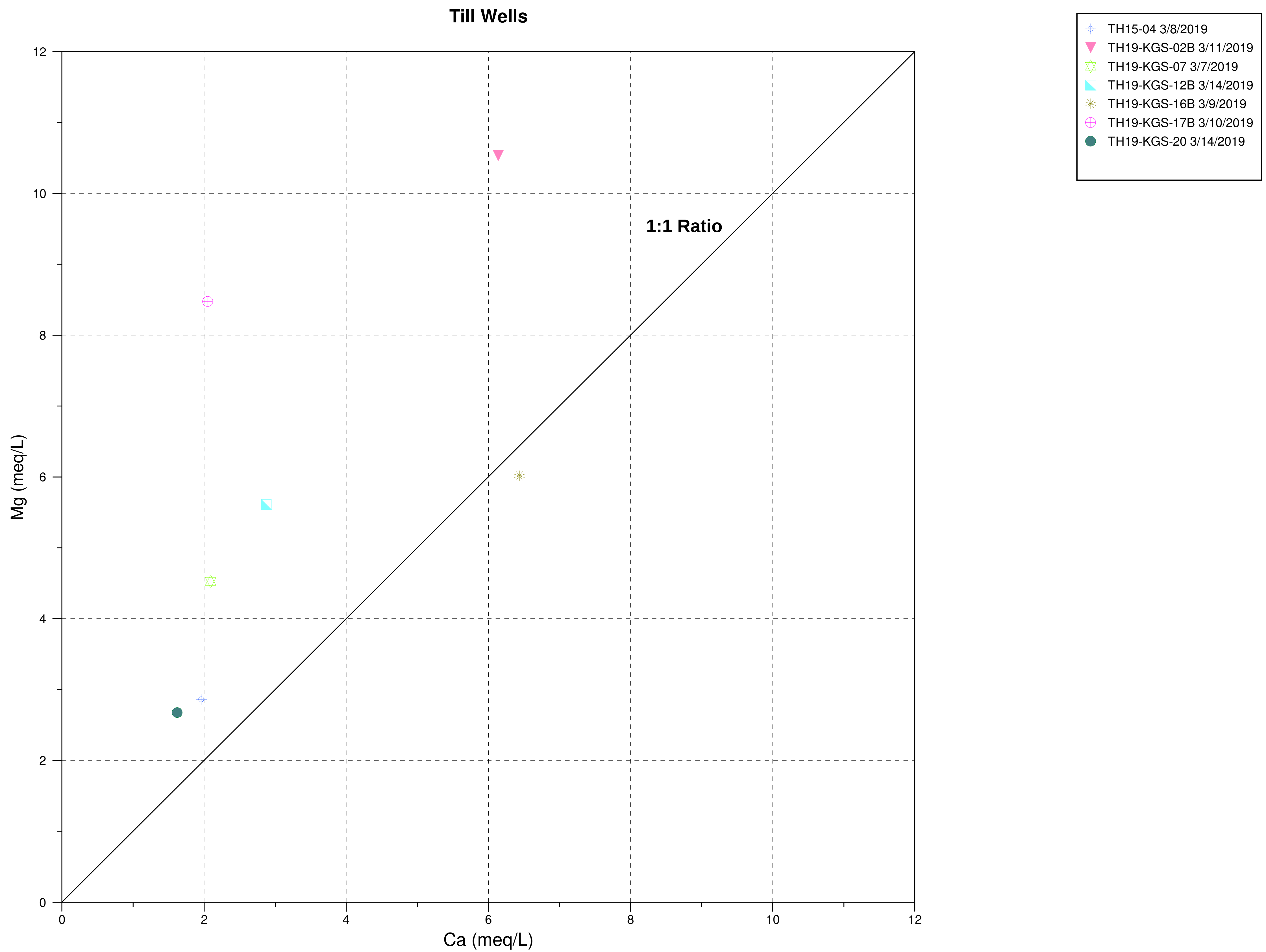


TH19-KGS-20

Date: 3/14/2019
TDS (mg/l) = 594
El Cond. (uS/cm) =951

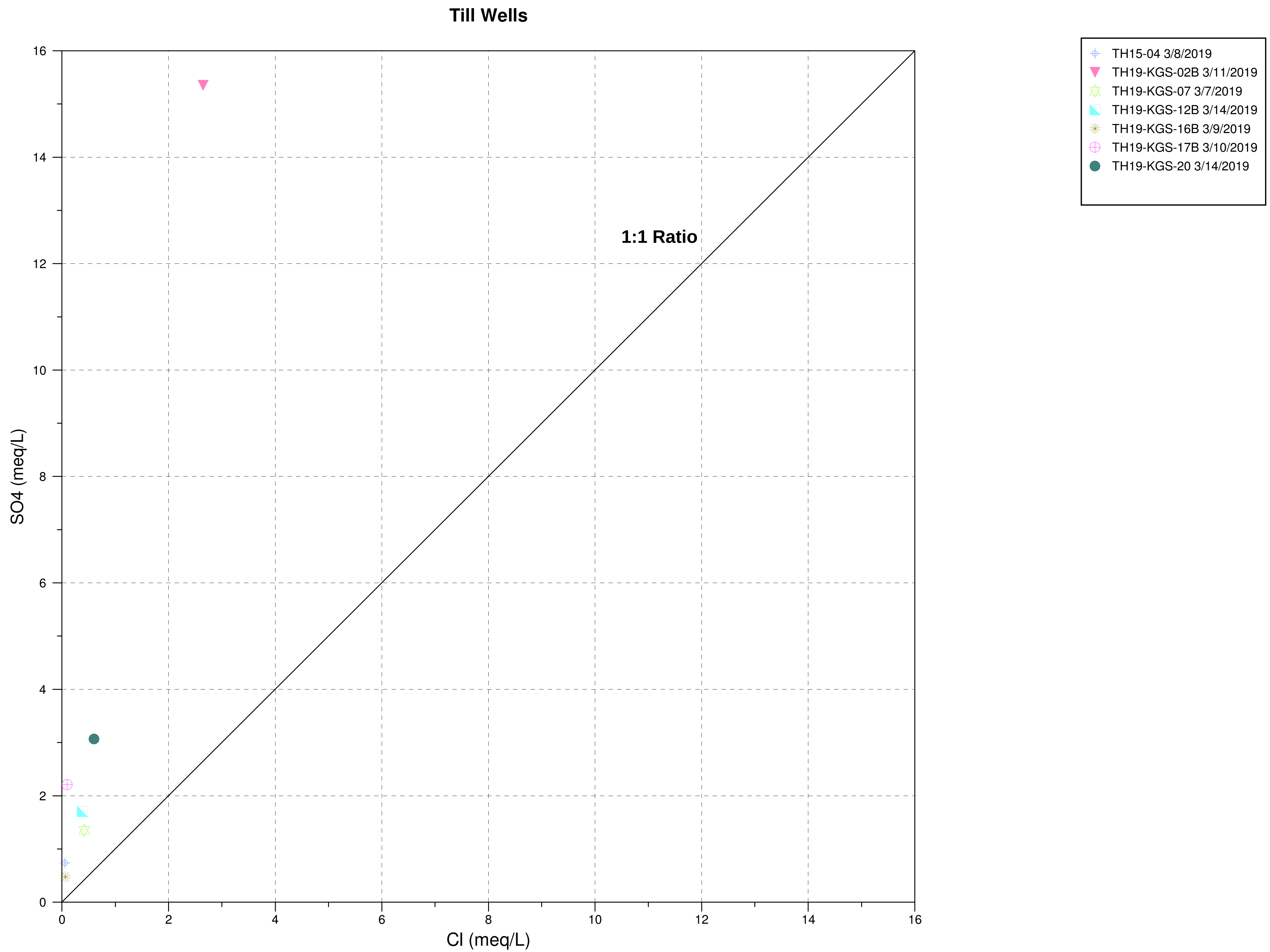


DESCRIPTION: Till Wells		
	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:



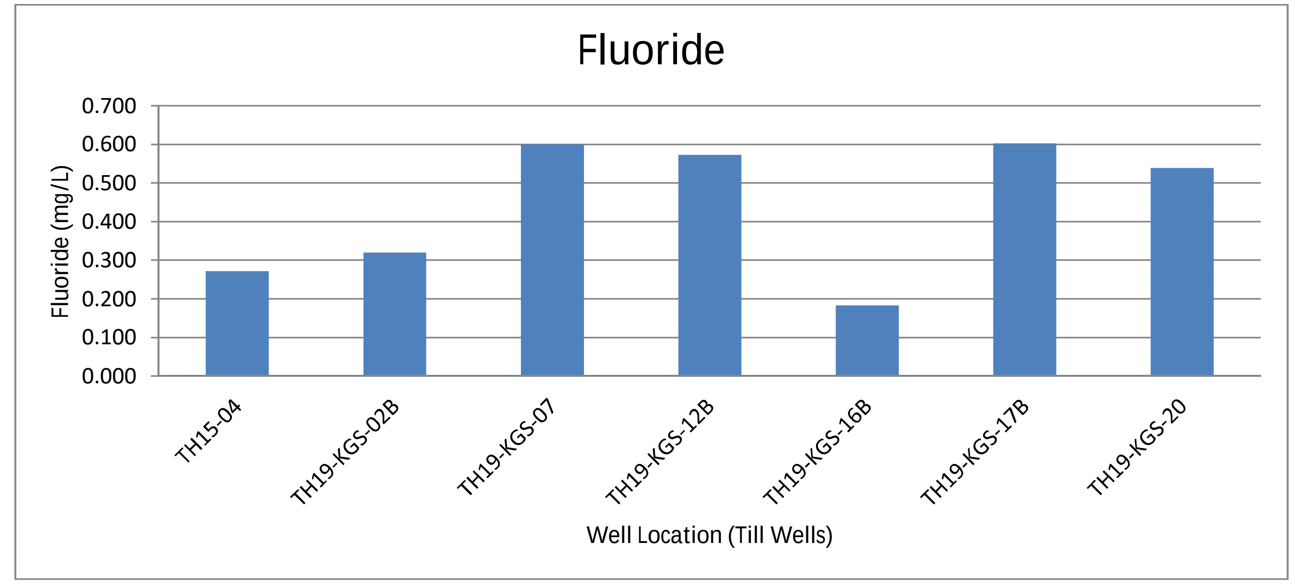
DESCRIPTION: Till Wells

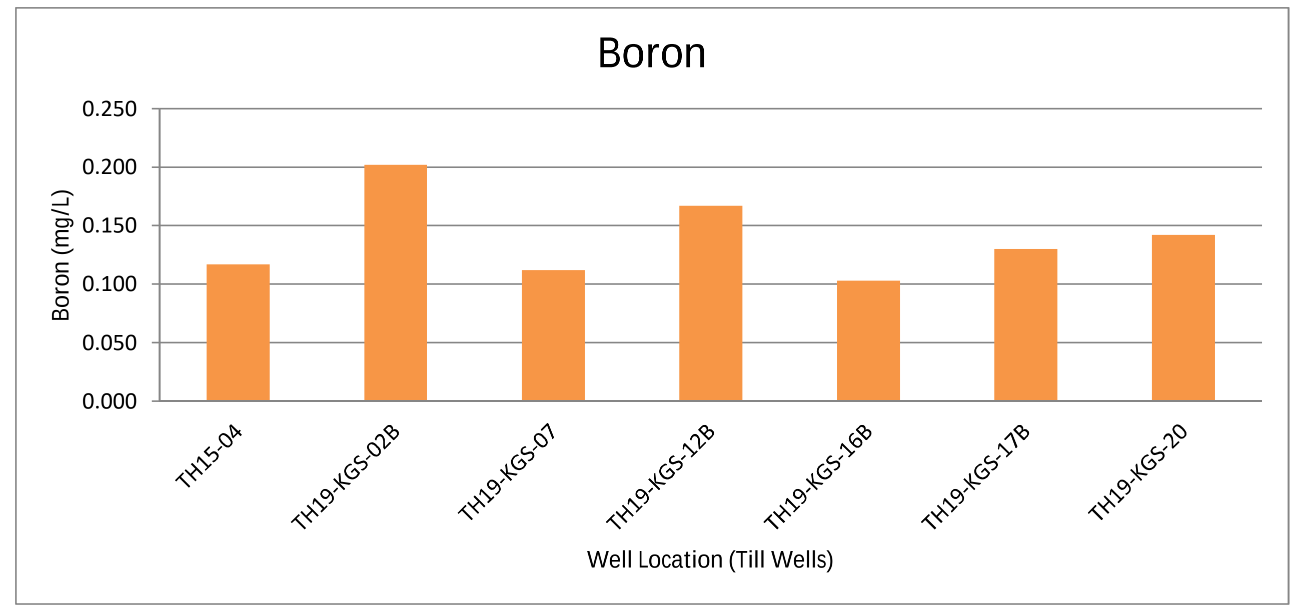
	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:

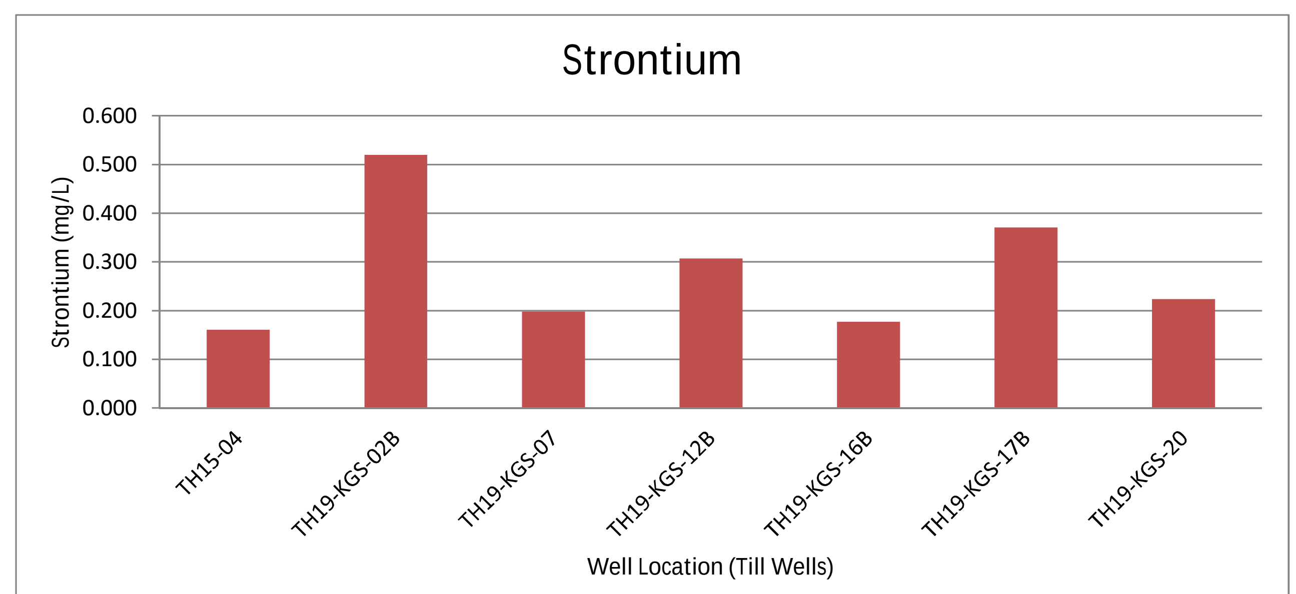


DESCRIPTION: Till Wells			
	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO:	18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:	

Sample ID	Fluoride	Boron	Strontium
TILL WELLS			
TH15-04	0.272	0.117	0.161
TH19-KGS-02B	0.32	0.20	0.52
TH19-KGS-07	0.600	0.112	0.198
TH19-KGS-12B	0.573	0.167	0.307
TH19-KGS-16B	0.183	0.103	0.177
TH19-KGS-17B	0.603	0.130	0.371
TH19-KGS-20	0.539	0.142	0.224







APPENDIX B-8

Bedrock and Sentinel Wells

Sample Summary Report

Sample ID	PW19-KGS-01	
Sample Date	10/24/2019	
Station	PW19-KGS-01 10/24/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.18	
Conductivity	694	uS/cm
Sum of Anions	9.210753	meq/L
Sum of Cations	9.737624	meq/L
Balance	2.780559	%
Total dissolved solids	693.3	mg/L
Total hardness	419.2	mg/l CaCO3
Alkalinity	365.4	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	28	1.217933	1.217933
K	4.93	0.1260924	0.1260924
Ca	66.6	1.66176	3.323519
Mg	61.5	2.530344	5.060687
Cl	9.35	0.2637317	0.2637317
SO4	78.6	0.81875	1.6375
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	443	7.260255	7.260255

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.082927	0.6567328	0.319	0.194
Ca/SO4	0.8473282	2.02963	0.152	0.364
Na/Cl	2.994652	4.618076	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-01	
Sample Date	10/27/2020	
Station	PW19-KGS-01 10/27/2020	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.26	
Conductivity	726	uS/cm
Sum of Anions	8.305043	meq/L
Sum of Cations	8.002512	meq/L
Balance	-1.85516	%
Total dissolved solids	612.4	mg/L
Total hardness	335.5	mg/l CaCO3
Alkalinity	328.5	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	26.9	1.170086	1.170086
K	4.4	0.1125369	0.1125369
Ca	51.7	1.289985	2.579969
Mg	50.2	2.065419	4.130837
Cl	9.46	0.2668344	0.2668344
SO4	70.5	0.734375	1.46875
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	398	6.522757	6.522757

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.029881	0.6245632	0.319	0.194
Ca/SO4	0.7333333	1.756575	0.152	0.364
Na/Cl	2.843552	4.385064	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-01	
Sample Date	3/12/2019	
Station	PW19-KGS-01 3/12/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.16	
Conductivity	741	uS/cm
Sum of Anions	8.641325	meq/L
Sum of Cations	8.8137	meq/L
Balance	0.9875364	%
Total dissolved solids	641.6	mg/L
Total hardness	365.8	mg/l CaCO3
Alkalinity	330.9	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	31.3	1.361475	1.361475
K	4.93	0.1260924	0.1260924
Ca	55.6	1.387295	2.77459
Mg	55.2	2.271138	4.542275
Cl	13.4	0.3779683	0.3779683
SO4	78.9	0.821875	1.64375
NO3	0.0093	0.00015	0.00015
HCO3	401	6.571924	6.571924

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.007246	0.6108369	0.319	0.194
Ca/SO4	0.7046894	1.687963	0.152	0.364
Na/Cl	2.335821	3.602088	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-01	
Sample Date	6/11/2019	
Station	PW19-KGS-01 6/11/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.65	
Conductivity	705	uS/cm
Sum of Anions	8.657862	meq/L
Sum of Cations	8.406569	meq/L
Balance	-1.472614	%
Total dissolved solids	638.3	mg/L
Total hardness	352.9	mg/l CaCO3
Alkalinity	339.9	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	27.9	1.213583	1.213583
K	4.91	0.1255809	0.1255809
Ca	51.9	1.294975	2.58995
Mg	54.3	2.234108	4.468216
Cl	9.05	0.2552697	0.2552697
SO4	77	0.8020834	1.604167
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	412	6.752201	6.752201

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9558011	0.5796384	0.319	0.194
Ca/SO4	0.674026	1.614514	0.152	0.364
Na/Cl	3.082873	4.754122	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-01	
Sample Date	6/17/2020	
Station	PW19-KGS-01 6/17/2020	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.89	
Conductivity	866	uS/cm
Sum of Anions	10.25073	meq/L
Sum of Cations	10.07236	meq/L
Balance	-0.8776785	%
Total dissolved solids	751.2	mg/L
Total hardness	396.1	mg/l CaCO3
Alkalinity	380.1	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	45.4	1.974791	1.974791
K	6.44	0.164713	0.164713
Ca	61.3	1.529518	3.059035
Mg	59.1	2.431598	4.863197
Cl	29	0.8179913	0.8179913
SO4	87.5	0.9114584	1.822917
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	461	7.555254	7.555254

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.037225	0.6290173	0.319	0.194
Ca/SO4	0.7005714	1.678099	0.152	0.364
Na/Cl	1.565517	2.414196	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-02	
Sample Date	10/24/2019	
Station	PW19-KGS-02 10/24/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3-SO4	
Temperature (°C)		
pH	8.22	
Conductivity	729	uS/cm
Sum of Anions	9.53997	meq/L
Sum of Cations	8.947438	meq/L
Balance	-3.205058	%
Total dissolved solids	698.6	mg/L
Total hardness	371.1	mg/l CaCO3
Alkalinity	367.8	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	31.9	1.387574	1.387574
K	5.06	0.1294174	0.1294174
Ca	57.2	1.427217	2.854434
Mg	55.5	2.283481	4.566961
Cl	8.52	0.2403202	0.2403202
SO4	93.1	0.9697917	1.939583
NO3	0.0082	1.322581E-04	1.322581E-04
HCO3	446	7.309422	7.309422

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.030631	0.6250182	0.319	0.194
Ca/SO4	0.6143931	1.471674	0.152	0.364
Na/Cl	3.744131	5.773854	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-02	
Sample Date	10/28/2020	
Station	PW19-KGS-02 10/28/2020	
Location		
Geology		
Watertype	Mg-Ca-HCO3-SO4	
Temperature (°C)		
pH	8.24	
Conductivity	787	uS/cm

Sum of Anions	8.880171	meq/L
Sum of Cations	8.493443	meq/L
Balance	-2.225946	%

Total dissolved solids	648.5	mg/L
Total hardness	343.4	mg/l CaCO3
Alkalinity	330.9	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	34.5	1.500667	1.500667
K	4.5	0.1150945	0.1150945
Ca	54.2	1.352363	2.704726
Mg	50.6	2.081876	4.163752
Cl	16.9	0.4766914	0.4766914
SO4	85.5	0.890625	1.78125
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	401	6.571924	6.571924

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.071146	0.6495886	0.319	0.194
Ca/SO4	0.6339182	1.518443	0.152	0.364
Na/Cl	2.04142	3.14809	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-02	
Sample Date	3/13/2019	
Station	PW19-KGS-02 3/13/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3-SO4	
Temperature (°C)		
pH	8.14	
Conductivity	744	uS/cm
Sum of Anions	8.961029	meq/L
Sum of Cations	9.052043	meq/L
Balance	0.5052659	%
Total dissolved solids	664.3	mg/L
Total hardness	372.3	mg/l CaCO3
Alkalinity	338.3	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	33.9	1.474569	1.474569
K	4.81	0.1230232	0.1230232
Ca	58.5	1.459654	2.919307
Mg	55	2.262909	4.525818
Cl	12.6	0.3554031	0.3554031
SO4	88.2	0.91875	1.8375
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	410	6.719423	6.719423

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.063636	0.6450343	0.319	0.194
Ca/SO4	0.6632653	1.588739	0.152	0.364
Na/Cl	2.690476	4.149004	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-02	
Sample Date	6/11/2019	
Station	PW19-KGS-02 6/11/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3-SO4	
Temperature (°C)		
pH	7.79	
Conductivity	735	uS/cm

Sum of Anions	8.839722	meq/L
Sum of Cations	8.924928	meq/L
Balance	0.4796381	%

Total dissolved solids	653.5	mg/L
Total hardness	362.1	mg/l CaCO3
Alkalinity	329.3	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	35.7	1.552865	1.552865
K	4.71	0.1204656	0.1204656
Ca	55.1	1.374819	2.749638
Mg	54.6	2.246451	4.492903
Cl	14.1	0.397713	0.397713
SO4	89	0.9270834	1.854167
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	399	6.539146	6.539146

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.009158	0.6119959	0.319	0.194
Ca/SO4	0.6191011	1.482951	0.152	0.364
Na/Cl	2.531915	3.904485	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-02	
Sample Date	6/16/2020	
Station	PW19-KGS-02 6/16/2020	
Location		
Geology		
Watertype	Mg-Ca-HCO3-SO4	
Temperature (°C)		
pH	8.32	
Conductivity	736	uS/cm
Sum of Anions	8.874963	meq/L
Sum of Cations	9.11125	meq/L
Balance	1.313712	%
Total dissolved solids	656.3	mg/L
Total hardness	377.5	mg/l CaCO3
Alkalinity	340.5	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	32.9	1.431071	1.431071
K	4.73	0.1209771	0.1209771
Ca	57.8	1.442188	2.884376
Mg	56.7	2.332853	4.665707
Cl	10.9	0.3074519	0.3074519
SO4	89.6	0.9333333	1.866667
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	399	6.539146	6.539146

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.0194	0.6182076	0.319	0.194
Ca/SO4	0.6450893	1.545201	0.152	0.364
Na/Cl	3.018349	4.654619	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-03	
Sample Date	10/24/2019	
Station	PW19-KGS-03 10/24/2019	
Location		
Geology		
Watertype	Ca-Mg-HCO3	
Temperature (°C)		
pH	8.11	
Conductivity	550	uS/cm
Sum of Anions	7.328764	meq/L
Sum of Cations	6.76874	meq/L
Balance	-3.97251	%
Total dissolved solids	549.3	mg/L
Total hardness	326.8	mg/l CaCO3
Alkalinity	332.6	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	3.76	0.163551	0.163551
K	2.51	6.419717E-02	6.419717E-02
Ca	68.3	1.704177	3.408354
Mg	38	1.563464	3.126929
Cl	0.91	0.025668	0.025668
SO4	31.8	0.33125	0.6625
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	403	6.604702	6.604702

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.797369	1.090001	0.319	0.194
Ca/SO4	2.147799	5.144685	0.152	0.364
Na/Cl	4.131868	6.371786	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-03	
Sample Date	10/27/2020	
Station	PW19-KGS-03 10/27/2020	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.21	
Conductivity	608	uS/cm
Sum of Anions	6.990782	meq/L
Sum of Cations	6.749454	meq/L
Balance	-1.756362	%
Total dissolved solids	526.9	mg/L
Total hardness	317.6	mg/l CaCO3
Alkalinity	320.3	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	7.05	0.3066581	0.3066581
K	3.32	8.491418E-02	8.491418E-02
Ca	56.2	1.402266	2.804531
Mg	43.1	1.773298	3.546595
Cl	0.99	2.792453E-02	2.792453E-02
SO4	27.1	0.2822917	0.5645834
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	388	6.358869	6.358869

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.303944	0.7907673	0.319	0.194
Ca/SO4	2.073801	4.967435	0.152	0.364
Na/Cl	7.121212	10.98168	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-03	
Sample Date	3/14/2019	
Station	PW19-KGS-03 3/14/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.17	
Conductivity	626	uS/cm

Sum of Anions	7.539659	meq/L
Sum of Cations	7.697992	meq/L
Balance	1.039089	%

Total dissolved solids	572.5	mg/L
Total hardness	361.8	mg/l CaCO3
Alkalinity	337.5	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	8.44	0.3671198	0.3671198
K	3.39	8.670454E-02	8.670454E-02
Ca	62.9	1.56944	3.13888
Mg	49.8	2.048961	4.097922
Cl	1.06	2.989899E-02	2.989899E-02
SO4	36.8	0.3833333	0.7666667
NO3	0.016	2.580645E-04	2.580645E-04
HCO3	409	6.703034	6.703034

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.263052	0.7659685	0.319	0.194
Ca/SO4	1.709239	4.094191	0.152	0.364
Na/Cl	7.962264	12.27867	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-03	
Sample Date	6/11/2019	
Station	PW19-KGS-03 6/11/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.71	
Conductivity	606	uS/cm
Sum of Anions	7.309786	meq/L
Sum of Cations	7.370022	meq/L
Balance	0.4103289	%
Total dissolved solids	554.2	mg/L
Total hardness	344.0	mg/l CaCO3
Alkalinity	331.7	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	8.58	0.3732095	0.3732095
K	4.3	0.1099792	0.1099792
Ca	56.4	1.407256	2.814512
Mg	49.4	2.032504	4.065007
Cl	1.12	3.159139E-02	3.159139E-02
SO4	31.3	0.3260417	0.6520833
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	402	6.588313	6.588313

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.1417	0.6923757	0.319	0.194
Ca/SO4	1.801917	4.316185	0.152	0.364
Na/Cl	7.660714	11.81365	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	PW19-KGS-03	
Sample Date	6/17/2020	
Station	PW19-KGS-03 6/17/2020	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.24	
Conductivity	536	uS/cm
Sum of Anions	6.581358	meq/L
Sum of Cations	6.595429	meq/L
Balance	0.1067862	%
Total dissolved solids	499.4	mg/L
Total hardness	313.2	mg/l CaCO3
Alkalinity	301.4	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	5.83	0.2535911	0.2535911
K	2.83	7.238166E-02	7.238166E-02
Ca	55.6	1.387295	2.77459
Mg	42.4	1.744497	3.488994
Cl	0.86	2.425767E-02	2.425767E-02
SO4	25.8	0.26875	0.5375
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	365	5.981925	5.981925

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.311321	0.7952405	0.319	0.194
Ca/SO4	2.155039	5.162027	0.152	0.364
Na/Cl	6.779069	10.45406	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	Sentinel Well 1 - (SW19-KGS-01)	
Sample Date	3/8/2019	
Station	Sentinel Well 1 - (SW19-KGS-01) 3/8/2019	
Location		
Geology		
Watertype	Mg-Ca-Na-HCO3	
Temperature (°C)		
pH	7.68	
Conductivity	881	uS/cm

Sum of Anions	10.37819	meq/L
Sum of Cations	10.36354	meq/L
Balance	-7.058624E-02	%

Total dissolved solids	766.7	mg/L
Total hardness	405.1	mg/l CaCO3
Alkalinity	397.4	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	48	2.087885	2.087885
K	6.34	0.1621554	0.1621554
Ca	59.3	1.479615	2.95923
Mg	62.5	2.571487	5.142975
Cl	26.2	0.7390128	0.7390128
SO4	80.9	0.8427083	1.685417
NO3	0.0051	8.225806E-05	8.225806E-05
HCO3	482	7.89942	7.89942

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9488	0.5753926	0.319	0.194
Ca/SO4	0.7330037	1.755785	0.152	0.364
Na/Cl	1.832061	2.825236	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	Sentinel Well 1 - (SW19-KGS-01)	
Sample Date	6/18/2020	
Station	Sentinel Well 1 - (SW19-KGS-01) 6/18/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.29	
Conductivity	700	uS/cm

Sum of Anions	8.564991	meq/L
Sum of Cations	8.664148	meq/L
Balance	0.5755211	%

Total dissolved solids	636.0	mg/L
Total hardness	367.6	mg/l CaCO3
Alkalinity	331.7	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	27.3	1.187485	1.187485
K	4.52	0.115606	0.115606
Ca	58.6	1.462149	2.924298
Mg	53.8	2.213536	4.427073
Cl	9.6	0.2707833	0.2707833
SO4	80.4	0.8375	1.675
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	400	6.555535	6.555535

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.089219	0.6605489	0.319	0.194
Ca/SO4	0.7288557	1.745849	0.152	0.364
Na/Cl	2.84375	4.385369	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	Sentinel Well 2 - (SW19-KGS-02)	
Sample Date	10/29/2020	
Station	Sentinel Well 2 - (SW19-KGS-02) 10/29/2020	
Location		
Geology		
Watertype	Mg-Na-Ca-HCO3-SO4	
Temperature (°C)		
pH	8.06	
Conductivity	1240	uS/cm
Sum of Anions	13.26176	meq/L
Sum of Cations	13.28036	meq/L
Balance	7.006827E-02	%
Total dissolved solids	934.3	mg/L
Total hardness	423.4	mg/l CaCO3
Alkalinity	342.4	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	106	4.610746	4.610746
K	7.39	0.1890108	0.1890108
Ca	65	1.621837	3.243675
Mg	63.5	2.612631	5.225262
Cl	89	2.510387	2.510387
SO4	187	1.947917	3.895833
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	415	6.801367	6.801367

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.023622	0.6207679	0.319	0.194
Ca/SO4	0.3475936	0.832601	0.152	0.364
Na/Cl	1.191011	1.836668	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	Sentinel Well 2 - (SW19-KGS-02)	
Sample Date	6/18/2020	
Station	Sentinel Well 2 - (SW19-KGS-02) 6/18/2020	
Location		
Geology		
Watertype	Mg-Na-Ca-HCO3-SO4	
Temperature (°C)		
pH	8.26	
Conductivity	1180	uS/cm

Sum of Anions	13.94406	meq/L
Sum of Cations	13.8348	meq/L
Balance	-0.3933399	%

Total dissolved solids	974.7	mg/L
Total hardness	448.9	mg/l CaCO3
Alkalinity	347.3	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	107	4.654244	4.654244
K	7.43	0.1900338	0.1900338
Ca	70.1	1.749089	3.498179
Mg	66.6	2.740177	5.480354
Cl	97.2	2.741681	2.741681
SO4	204	2.125	4.25
NO3	<0.01	<1.612903E-04	<1.612903E-04
HCO3	421	6.899701	6.899701

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.052553	0.6383126	0.319	0.194
Ca/SO4	0.3436275	0.8231009	0.152	0.364
Na/Cl	1.100823	1.697588	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	Sentinel Well 2 - (SW19-KGS-02)	
Sample Date	9/27/2019	
Station	Sentinel Well 2 - (SW19-KGS-02) 9/27/2019	
Location		
Geology		
Watertype	Mg-Na-Ca-HCO3-SO4	
Temperature (°C)		
pH	8.27	
Conductivity	1170	uS/cm
Sum of Anions	13.74078	meq/L
Sum of Cations	13.68362	meq/L
Balance	-0.2084393	%
Total dissolved solids	965.1	mg/L
Total hardness	431.8	mg/l CaCO3
Alkalinity	351.4	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	111	4.828234	4.828234
K	8.08	0.2066586	0.2066586
Ca	61.6	1.537003	3.074006
Mg	67.6	2.781321	5.562641
Cl	91.4	2.578083	2.578083
SO4	198	2.0625	4.125
NO3	<0.01	<1.612903E-04	<1.612903E-04
HCO3	426	6.981645	6.981645

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9112426	0.5526162	0.319	0.194
Ca/SO4	0.3111111	0.7452135	0.152	0.364
Na/Cl	1.214442	1.8728	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	Sentinel Well 3 - (SW19-KGS-03)	
Sample Date	10/29/2020	
Station	Sentinel Well 3 - (SW19-KGS-03) 10/29/2020	
Location		
Geology		
Watertype	Mg-Ca-Na-HCO3-SO4	
Temperature (°C)		
pH	8.03	
Conductivity	979	uS/cm
Sum of Anions	10.90859	meq/L
Sum of Cations	10.92343	meq/L
Balance	6.798725E-02	%
Total dissolved solids	794.9	mg/L
Total hardness	406.9	mg/l CaCO3
Alkalinity	376.0	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	59.8	2.601157	2.601157
K	6.74	0.172386	0.172386
Ca	60.2	1.502071	3.004142
Mg	62.4	2.567373	5.134746
Cl	39.3	1.108519	1.108519
SO4	109	1.135417	2.270833
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	456	7.47331	7.47331

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9647436	0.5850615	0.319	0.194
Ca/SO4	0.5522936	1.322925	0.152	0.364
Na/Cl	1.521628	2.346515	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	Sentinel Well 3 - (SW19-KGS-03)	
Sample Date	6/18/2020	
Station	Sentinel Well 3 - (SW19-KGS-03) 6/18/2020	
Location		
Geology		
Watertype	Mg-Ca-Na-HCO3-SO4	
Temperature (°C)		
pH	8.33	
Conductivity	930	uS/cm
Sum of Anions	11.1252	meq/L
Sum of Cations	11.12497	meq/L
Balance	-1.020102E-03	%
Total dissolved solids	803.8	mg/L
Total hardness	420.1	mg/l CaCO3
Alkalinity	379.9	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	58.5	2.54461	2.54461
K	6.56	0.1677822	0.1677822
Ca	64.8	1.616847	3.233695
Mg	62.8	2.58383	5.167661
Cl	42.4	1.19596	1.19596
SO4	117	1.21875	2.4375
NO3	<0.01	<1.612903E-04	<1.612903E-04
HCO3	447	7.32581	7.32581

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.031847	0.625756	0.319	0.194
Ca/SO4	0.5538462	1.326644	0.152	0.364
Na/Cl	1.379717	2.127672	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	Sentinel Well 3 - (SW19-KGS-03)	
Sample Date	9/27/2019	
Station	Sentinel Well 3 - (SW19-KGS-03) 9/27/2019	
Location		
Geology		
Watertype	Mg-Na-Ca-HCO3-SO4	
Temperature (°C)		
pH	8.15	
Conductivity	913	uS/cm
Sum of Anions	11.31545	meq/L
Sum of Cations	11.01929	meq/L
Balance	-1.326022	%
Total dissolved solids	817.1	mg/L
Total hardness	406.4	mg/l CaCO3
Alkalinity	388.3	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	61.9	2.692502	2.692502
K	7.37	0.1884992	0.1884992
Ca	53.7	1.339887	2.679775
Mg	66.2	2.723719	5.447439
Cl	40.5	1.142367	1.142367
SO4	115	1.197917	2.395833
NO3	<0.01	<1.612903E-04	<1.612903E-04
HCO3	471	7.719142	7.719142

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.8111783	0.4919329	0.319	0.194
Ca/SO4	0.4669565	1.118515	0.152	0.364
Na/Cl	1.528395	2.35695	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH15-04	
Sample Date	3/8/2019	
Station	TH15-04 3/8/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.9	
Conductivity	470	uS/cm

Sum of Anions	5.573706	meq/L
Sum of Cations	5.732224	meq/L
Balance	1.402085	%

Total dissolved solids	423.3	mg/L
Total hardness	241.2	mg/l CaCO3
Alkalinity	239.1	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	19.3	0.8395038	0.8395038
K	2.39	6.112798E-02	6.112798E-02
Ca	39.3	0.9805879	1.961176
Mg	34.8	1.431804	2.863608
Cl	1.93	5.443873E-02	5.443873E-02
SO4	35.4	0.36875	0.7375001
NO3	0.0159	2.564516E-04	2.564516E-04
HCO3	289	4.736374	4.736374

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.12931	0.6848618	0.319	0.194
Ca/SO4	1.110169	2.659221	0.152	0.364
Na/Cl	10	15.42108	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH15-05	
Sample Date	3/8/2019	
Station	TH15-05 3/8/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.8	
Conductivity	577	uS/cm
Sum of Anions	7.343931	meq/L
Sum of Cations	7.141406	meq/L
Balance	-1.398136	%
Total dissolved solids	554.6	mg/L
Total hardness	337.2	mg/l CaCO3
Alkalinity	343.2	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	6.91	0.3005685	0.3005685
K	3.48	8.900643E-02	8.900643E-02
Ca	56	1.397275	2.794551
Mg	48	1.974902	3.949805
Cl	0.89	2.510387E-02	2.510387E-02
SO4	22.1	0.2302083	0.4604167
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	416	6.817756	6.817756

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.166667	0.7075163	0.319	0.194
Ca/SO4	2.533937	6.069613	0.152	0.364
Na/Cl	7.764045	11.97299	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-01B	
Sample Date	3/9/2019	
Station	TH19-KGS-01B 3/9/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3-SO4	
Temperature (°C)		
pH	8.14	
Conductivity	773	uS/cm
Sum of Anions	10.13815	meq/L
Sum of Cations	9.312242	meq/L
Balance	-4.246208	%
Total dissolved solids	730.4	mg/L
Total hardness	375.3	mg/l CaCO3
Alkalinity	377.7	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	38.4	1.670308	1.670308
K	4.95	0.126604	0.126604
Ca	51.3	1.280004	2.560008
Mg	60.1	2.472742	4.945484
Cl	21.6	0.6092625	0.6092625
SO4	94.7	0.9864583	1.972917
NO3	<0.01	<1.612903E-04	<1.612903E-04
HCO3	458	7.506087	7.506087

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.8535774	0.5176456	0.319	0.194
Ca/SO4	0.5417107	1.297575	0.152	0.364
Na/Cl	1.777778	2.741525	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-04	
Sample Date	3/9/2019	
Station	TH19-KGS-04 3/9/2019	
Location		
Geology		
Watertype	Mg-Ca-Na-HCO3-SO4	
Temperature (°C)		
pH	7.99	
Conductivity	987	uS/cm
Sum of Anions	11.92741	meq/L
Sum of Cations	11.9169	meq/L
Balance	-4.409546E-02	%
Total dissolved solids	847.8	mg/L
Total hardness	437.8	mg/l CaCO3
Alkalinity	349.0	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	69.3	3.014384	3.014384
K	5.35	0.1368346	0.1368346
Ca	61.5	1.534508	3.069016
Mg	69.1	2.843036	5.686073
Cl	54.2	1.528797	1.528797
SO4	164	1.708333	3.416667
NO3	<0.01	<1.612903E-04	<1.612903E-04
HCO3	423	6.932478	6.932478

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.8900145	0.5397426	0.319	0.194
Ca/SO4	0.375	0.8982484	0.152	0.364
Na/Cl	1.278598	1.971736	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-08	
Sample Date	3/8/2019	
Station	TH19-KGS-08 3/8/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.19	
Conductivity	600	uS/cm
Sum of Anions	7.350357	meq/L
Sum of Cations	7.465	meq/L
Balance	0.7738094	%
Total dissolved solids	560.2	mg/L
Total hardness	352.0	mg/l CaCO3
Alkalinity	343.2	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	7.17	0.3118778	0.3118778
K	4.13	0.1056312	0.1056312
Ca	58.3	1.454664	2.909327
Mg	50.2	2.065419	4.130837
Cl	1.07	3.018106E-02	3.018106E-02
SO4	22.1	0.2302083	0.4604167
NO3	0.006	9.677419E-05	9.677419E-05
HCO3	416	6.817756	6.817756

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.161355	0.7042947	0.319	0.194
Ca/SO4	2.638009	6.3189	0.152	0.364
Na/Cl	6.700934	10.33356	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-09	
Sample Date	3/12/2019	
Station	TH19-KGS-09 3/12/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.98	
Conductivity	737	uS/cm
Sum of Anions	9.309968	meq/L
Sum of Cations	9.397411	meq/L
Balance	0.467427	%
Total dissolved solids	695.2	mg/L
Total hardness	416.1	mg/l CaCO3
Alkalinity	379.3	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	21.6	0.9395483	0.9395483
K	4.94	0.1263482	0.1263482
Ca	62.9	1.56944	3.13888
Mg	63	2.592059	5.184118
Cl	3.81	0.1074671	0.1074671
SO4	77.7	0.809375	1.61875
NO3	<0.01	<1.612903E-04	<1.612903E-04
HCO3	460	7.538865	7.538865

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9984127	0.6054799	0.319	0.194
Ca/SO4	0.8095239	1.939076	0.152	0.364
Na/Cl	5.669291	8.742659	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-10	
Sample Date	3/9/2019	
Station	TH19-KGS-10 3/9/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.98	
Conductivity	669	uS/cm
Sum of Anions	8.829575	meq/L
Sum of Cations	8.494815	meq/L
Balance	-1.932303	%
Total dissolved solids	662.7	mg/L
Total hardness	402.4	mg/l CaCO3
Alkalinity	417.1	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	8.14	0.3540705	0.3540705
K	3.32	8.491418E-02	8.491418E-02
Ca	58.7	1.464644	2.929288
Mg	62.2	2.559144	5.118289
Cl	1.38	0.0389251	0.0389251
SO4	21.7	0.2260417	0.4520833
NO3	0.0052	8.387097E-05	8.387097E-05
HCO3	506	8.292751	8.292751

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9437299	0.5723179	0.319	0.194
Ca/SO4	2.705069	6.479531	0.152	0.364
Na/Cl	5.898551	9.096201	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-11	
Sample Date	3/8/2019	
Station	TH19-KGS-11 3/8/2019	
Location		
Geology		
Watertype	Mg-Ca-Na-HCO3-SO4	
Temperature (°C)		
pH	8.23	
Conductivity	732	uS/cm
Sum of Anions	8.410262	meq/L
Sum of Cations	8.186076	meq/L
Balance	-1.350816	%
Total dissolved solids	612.5	mg/L
Total hardness	315.5	mg/l CaCO3
Alkalinity	276.8	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	39.4	1.713806	1.713806
K	5.88	0.1503902	0.1503902
Ca	56.2	1.402266	2.804531
Mg	42.6	1.752726	3.505451
Cl	9.93	0.2800915	0.2800915
SO4	121	1.260417	2.520833
NO3	0.0272	4.387097E-04	4.387097E-04
HCO3	335	5.490261	5.490261

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.319249	0.8000485	0.319	0.194
Ca/SO4	0.4644628	1.112541	0.152	0.364
Na/Cl	3.967774	6.118736	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-12	
Sample Date	10/23/2019	
Station	TH19-KGS-12 10/23/2019	
Location		
Geology		
Watertype	Mg-Na-HCO3	
Temperature (°C)		
pH	8.37	
Conductivity	715	uS/cm

Sum of Anions	11.05507	meq/L
Sum of Cations	8.991445	meq/L
Balance	-10.29419	%

Total dissolved solids	796.5	mg/L
Total hardness	331.8	mg/l CaCO3
Alkalinity	486.3	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	51.2	2.227077	2.227077
K	4.57	0.1168849	0.1168849
Ca	37.5	0.9356755	1.871351
Mg	57.9	2.382226	4.764452
Cl	5.27	0.1486488	0.1486488
SO4	65.9	0.6864583	1.372917
NO3	0.0152	2.451613E-04	2.451613E-04
HCO3	567	9.292471	9.292471

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.6476684	0.3927736	0.319	0.194
Ca/SO4	0.569044	1.363048	0.152	0.364
Na/Cl	9.71537	14.98215	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-12	
Sample Date	10/28/2020	
Station	TH19-KGS-12 10/28/2020	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.2	
Conductivity	775	uS/cm
Sum of Anions	9.596281	meq/L
Sum of Cations	8.813146	meq/L
Balance	-4.253991	%
Total dissolved solids	706.1	mg/L
Total hardness	376.8	mg/l CaCO3
Alkalinity	413.8	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	26.4	1.148337	1.148337
K	4.55	0.1163734	0.1163734
Ca	45.3	1.130296	2.260592
Mg	64.1	2.637317	5.274635
Cl	3.06	8.631217E-02	8.631217E-02
SO4	59.2	0.6166667	1.233333
NO3	0.0101	1.629032E-04	1.629032E-04
HCO3	502	8.227197	8.227197

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.7067083	0.4285779	0.319	0.194
Ca/SO4	0.7652027	1.832912	0.152	0.364
Na/Cl	8.627451	13.30446	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-12	
Sample Date	3/7/2019	
Station	TH19-KGS-12 3/7/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.39	
Conductivity	727	uS/cm
Sum of Anions	8.592311	meq/L
Sum of Cations	9.839383	meq/L
Balance	6.765912	%
Total dissolved solids	638.0	mg/L
Total hardness	425.2	mg/l CaCO3
Alkalinity	329.2	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	27.4	1.191834	1.191834
K	5.12	0.130952	0.130952
Ca	51.2	1.277509	2.555018
Mg	72.3	2.974697	5.949393
Cl	17.9	0.504898	0.504898
SO4	81	0.84375	1.6875
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	376	6.162203	6.162203

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.7081604	0.4294586	0.319	0.194
Ca/SO4	0.6320988	1.514085	0.152	0.364
Na/Cl	1.530726	2.360545	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-12	
Sample Date	6/12/2019	
Station	TH19-KGS-12 6/12/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.85	
Conductivity	777	uS/cm
Sum of Anions	9.930497	meq/L
Sum of Cations	9.469985	meq/L
Balance	-2.373715	%
Total dissolved solids	733.4	mg/L
Total hardness	401.6	mg/l CaCO3
Alkalinity	416.2	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	30.1	1.309278	1.309278
K	4.55	0.1163734	0.1163734
Ca	48.5	1.21014	2.420281
Mg	68.2	2.806007	5.612014
Cl	4.2	0.1184677	0.1184677
SO4	71.5	0.7447917	1.489583
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	505	8.276362	8.276362

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.7111437	0.4312678	0.319	0.194
Ca/SO4	0.6783217	1.624804	0.152	0.364
Na/Cl	7.166667	11.05177	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-12	
Sample Date	6/16/2020	
Station	TH19-KGS-12 6/16/2020	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.24	
Conductivity	717	uS/cm
Sum of Anions	8.74137	meq/L
Sum of Cations	9.441008	meq/L
Balance	3.847887	%
Total dissolved solids	665.2	mg/L
Total hardness	401.9	mg/l CaCO3
Alkalinity	381.8	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	29.3	1.27448	1.27448
K	4.5	0.1150945	0.1150945
Ca	45.5	1.135286	2.270572
Mg	70.1	2.88418	5.76836
Cl	4.39	0.1238269	0.1238269
SO4	46.9	0.4885417	0.9770834
NO3	0.0121	1.951613E-04	1.951613E-04
HCO3	463	7.588032	7.588032

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.6490728	0.3936253	0.319	0.194
Ca/SO4	0.9701492	2.323827	0.152	0.364
Na/Cl	6.67426	10.29243	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-13	
Sample Date	3/7/2019	
Station	TH19-KGS-13 3/7/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.8	
Conductivity	724	uS/cm

Sum of Anions	9.048727	meq/L
Sum of Cations	9.143639	meq/L
Balance	0.521711	%

Total dissolved solids	674.2	mg/L
Total hardness	404.8	mg/l CaCO3
Alkalinity	362.9	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	21.3	0.926499	0.926499
K	4.37	0.1117696	0.1117696
Ca	60.5	1.509556	3.019113
Mg	61.7	2.538572	5.077145
Cl	2.82	7.954259E-02	7.954259E-02
SO4	82.3	0.8572917	1.714583
NO3	0.016	2.580645E-04	2.580645E-04
HCO3	440	7.211088	7.211088

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9805511	0.5946478	0.319	0.194
Ca/SO4	0.7351154	1.760843	0.152	0.364
Na/Cl	7.553191	11.64783	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-14	
Sample Date	3/8/2019	
Station	TH19-KGS-14 3/8/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.15	
Conductivity	650	uS/cm
Sum of Anions	7.911212	meq/L
Sum of Cations	7.907068	meq/L
Balance	-2.619875E-02	%
Total dissolved solids	597.3	mg/L
Total hardness	362.4	mg/l CaCO3
Alkalinity	350.6	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	12.6	0.5480699	0.5480699
K	4	0.1023062	0.1023062
Ca	60.5	1.509556	3.019113
Mg	51.4	2.114791	4.229582
Cl	1.6	4.513055E-02	4.513055E-02
SO4	41	0.4270833	0.8541667
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	425	6.965256	6.965256

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.177043	0.7138087	0.319	0.194
Ca/SO4	1.47561	3.534571	0.152	0.364
Na/Cl	7.875	12.1441	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-15	
Sample Date	3/9/2019	
Station	TH19-KGS-15 3/9/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.22	
Conductivity	661	uS/cm
Sum of Anions	7.899818	meq/L
Sum of Cations	8.247141	meq/L
Balance	2.151011	%
Total dissolved solids	603.9	mg/L
Total hardness	382.4	mg/l CaCO3
Alkalinity	356.4	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	10.3	0.4480254	0.4480254
K	5.57	0.1424614	0.1424614
Ca	65.2	1.626828	3.253655
Mg	53.4	2.197079	4.394158
Cl	2.88	8.123499E-02	8.123499E-02
SO4	33.3	0.346875	0.69375
NO3	0.0175	2.822581E-04	2.822581E-04
HCO3	432	7.079978	7.079978

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.220974	0.7404503	0.319	0.194
Ca/SO4	1.957958	4.689954	0.152	0.364
Na/Cl	3.576389	5.515177	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-16	
Sample Date	3/15/2019	
Station	TH19-KGS-16 3/15/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.07	
Conductivity	632	uS/cm
Sum of Anions	7.785655	meq/L
Sum of Cations	8.555471	meq/L
Balance	4.710914	%
Total dissolved solids	600.3	mg/L
Total hardness	373.9	mg/l CaCO3
Alkalinity	338.3	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	21.9	0.9525976	0.9525976
K	4.57	0.1168849	0.1168849
Ca	61.3	1.529518	3.059035
Mg	53.7	2.209422	4.418844
Cl	2.78	7.841433E-02	7.841433E-02
SO4	44.5	0.4635417	0.9270834
NO3	0.101	1.629032E-03	1.629032E-03
HCO3	410	6.719423	6.719423

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.141527	0.6922705	0.319	0.194
Ca/SO4	1.377528	3.299633	0.152	0.364
Na/Cl	7.877698	12.14826	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-17	
Sample Date	10/23/2019	
Station	TH19-KGS-17 10/23/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.23	
Conductivity	591	uS/cm
Sum of Anions	8.22137	meq/L
Sum of Cations	7.469983	meq/L
Balance	-4.788539	%
Total dissolved solids	607.1	mg/L
Total hardness	349.3	mg/l CaCO3
Alkalinity	367.8	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	9.11	0.3962632	0.3962632
K	3.18	8.133346E-02	8.133346E-02
Ca	53.9	1.344878	2.689755
Mg	52.2	2.147706	4.295413
Cl	0.92	2.595007E-02	2.595007E-02
SO4	40.6	0.4229167	0.8458333
NO3	0.0067	1.080645E-04	1.080645E-04
HCO3	446	7.309422	7.309422

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.032567	0.6261925	0.319	0.194
Ca/SO4	1.327586	3.180006	0.152	0.364
Na/Cl	9.902173	15.27022	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-17	
Sample Date	10/27/2020	
Station	TH19-KGS-17 10/27/2020	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.2	
Conductivity	637	uS/cm
Sum of Anions	7.398015	meq/L
Sum of Cations	8.838248	meq/L
Balance	8.870472	%
Total dissolved solids	578.5	mg/L
Total hardness	417.8	mg/l CaCO3
Alkalinity	324.4	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	8.63	0.3753844	0.3753844
K	3.84	9.821399E-02	9.821399E-02
Ca	67.7	1.689206	3.378412
Mg	60.5	2.4892	4.978399
Cl	0.92	2.595007E-02	2.595007E-02
SO4	42.7	0.4447917	0.8895833
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	393	6.440813	6.440813

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.119008	0.6786141	0.319	0.194
Ca/SO4	1.58548	3.797746	0.152	0.364
Na/Cl	9.380435	14.46564	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-17	
Sample Date	3/10/2019	
Station	TH19-KGS-17 3/10/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.19	
Conductivity	674	uS/cm

Sum of Anions	8.228409	meq/L
Sum of Cations	8.197966	meq/L
Balance	-0.1853312	%

Total dissolved solids	616.8	mg/L
Total hardness	384.0	mg/l CaCO3
Alkalinity	365.4	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	9.43	0.4101824	0.4101824
K	3.9	9.974859E-02	9.974859E-02
Ca	55.8	1.392285	2.78457
Mg	59.5	2.448056	4.896112
Cl	1.33	3.751477E-02	3.751477E-02
SO4	42.6	0.44375	0.8875
NO3	0.0081	1.306452E-04	1.306452E-04
HCO3	443	7.260255	7.260255

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9378151	0.5687309	0.319	0.194
Ca/SO4	1.309859	3.137544	0.152	0.364
Na/Cl	7.090226	10.93389	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-17	
Sample Date	6/12/2019	
Station	TH19-KGS-17 6/12/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.71	
Conductivity	622	uS/cm
Sum of Anions	7.582992	meq/L
Sum of Cations	7.637808	meq/L
Balance	0.3601435	%
Total dissolved solids	571.5	mg/L
Total hardness	342.3	mg/l CaCO3
Alkalinity	334.2	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	16	0.6959617	0.6959617
K	3.47	8.875066E-02	8.875066E-02
Ca	49.8	1.242577	2.485154
Mg	53	2.180621	4.361242
Cl	0.96	2.707833E-02	2.707833E-02
SO4	42.2	0.4395834	0.8791667
NO3	0.0089	1.435484E-04	1.435484E-04
HCO3	405	6.637479	6.637479

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.9396226	0.5698271	0.319	0.194
Ca/SO4	1.180095	2.826715	0.152	0.364
Na/Cl	16.66667	25.7018	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-17	
Sample Date	6/16/2020	
Station	TH19-KGS-17 6/16/2020	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.12	
Conductivity	617	uS/cm
Sum of Anions	7.438643	meq/L
Sum of Cations	7.7795	meq/L
Balance	2.239807	%
Total dissolved solids	562.8	mg/L
Total hardness	364.8	mg/l CaCO3
Alkalinity	325.2	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	9	0.3914785	0.3914785
K	3.34	0.0854257	0.0854257
Ca	55.5	1.3848	2.769599
Mg	55	2.262909	4.525818
Cl	0.86	2.425767E-02	2.425767E-02
SO4	43.9	0.4572917	0.9145834
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	394	6.457202	6.457202

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.009091	0.6119556	0.319	0.194
Ca/SO4	1.264237	3.028264	0.152	0.364
Na/Cl	10.46512	16.13834	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-18	
Sample Date	10/23/2019	
Station	TH19-KGS-18 10/23/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.86	
Conductivity	913	uS/cm

Sum of Anions	13.53892	meq/L
Sum of Cations	12.52233	meq/L
Balance	-3.900755	%

Total dissolved solids	1030.6	mg/L
Total hardness	598.5	mg/l CaCO3
Alkalinity	677.1	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	11.2	0.4871732	0.4871732
K	1.98	5.064159E-02	5.064159E-02
Ca	119	2.96921	5.93842
Mg	73.3	3.015841	6.031681
Cl	0.22	6.205451E-03	6.205451E-03
SO4	<0.6	<6.250001E-03	<0.0125
NO3	0.011	1.774194E-04	1.774194E-04
HCO3	823	13.48801	13.48801

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.623465	0.9845382	0.319	0.194
Ca/SO4	198.3333	475.0736	0.152	0.364
Na/Cl	50.90909	78.5073	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-18	
Sample Date	10/27/2020	
Station	TH19-KGS-18 10/27/2020	
Location		
Geology		
Watertype	Ca-Mg-HCO3	
Temperature (°C)		
pH	7.81	
Conductivity	908	uS/cm
Sum of Anions	10.79792	meq/L
Sum of Cations	10.37817	meq/L
Balance	-1.982154	%
Total dissolved solids	831.2	mg/L
Total hardness	496.6	mg/l CaCO3
Alkalinity	539.3	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	9.36	0.4071376	0.4071376
K	1.14	2.915728E-02	2.915728E-02
Ca	108	2.694745	5.389491
Mg	55.2	2.271138	4.542275
Cl	0.17	4.795121E-03	4.795121E-03
SO4	1.2	0.0125	0.025
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	655	10.73469	10.73469

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.956522	1.186518	0.319	0.194
Ca/SO4	90	215.5796	0.152	0.364
Na/Cl	55.05882	84.90663	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-18	
Sample Date	3/11/2019	
Station	TH19-KGS-18 3/11/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.77	
Conductivity	1040	uS/cm

Sum of Anions	13.06712	meq/L
Sum of Cations	13.33985	meq/L
Balance	1.032802	%

Total dissolved solids	1009.2	mg/L
Total hardness	635.8	mg/l CaCO3
Alkalinity	649.2	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	12.3	0.5350206	0.5350206
K	2.88	7.366049E-02	7.366049E-02
Ca	114	2.844454	5.688907
Mg	85.4	3.51368	7.027361
Cl	1.26	3.554031E-02	3.554031E-02
SO4	3	0.03125	0.0625
NO3	<0.01	<1.612903E-04	<1.612903E-04
HCO3	789	12.93079	12.93079

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.334895	0.8095368	0.319	0.194
Ca/SO4	38	91.02251	0.152	0.364
Na/Cl	9.761905	15.05391	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-18	
Sample Date	6/12/2019	
Station	TH19-KGS-18 6/12/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	7.14	
Conductivity	989	uS/cm
Sum of Anions	12.58906	meq/L
Sum of Cations	12.94287	meq/L
Balance	1.385775	%
Total dissolved solids	976.3	mg/L
Total hardness	619.0	mg/l CaCO3
Alkalinity	628.7	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	11.3	0.491523	0.491523
K	2.22	5.677996E-02	5.677996E-02
Ca	116	2.894356	5.788713
Mg	80.1	3.295618	6.591236
Cl	0.83	2.341147E-02	2.341147E-02
SO4	<0.6	<6.250001E-03	<0.0125
NO3	<0.01	<1.612903E-04	<1.612903E-04
HCO3	764	12.52107	12.52107

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	1.44819	0.8782439	0.319	0.194
Ca/SO4	193.3333	463.097	0.152	0.364
Na/Cl	13.61446	20.99496	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-18	
Sample Date	6/16/2020	
Station	TH19-KGS-18 6/16/2020	
Location		
Geology		
Watertype	Ca-Mg-HCO3	
Temperature (°C)		
pH	7.41	
Conductivity	566	uS/cm
Sum of Anions	6.779703	meq/L
Sum of Cations	6.967631	meq/L
Balance	1.367012	%
Total dissolved solids	529.7	mg/L
Total hardness	333.1	mg/l CaCO3
Alkalinity	333.4	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	6.56	0.2853443	0.2853443
K	0.616	1.575516E-02	1.575516E-02
Ca	77.6	1.936224	3.872449
Mg	33.9	1.394775	2.78955
Cl	0.38	1.071851E-02	1.071851E-02
SO4	5.69	5.927084E-02	0.1185417
NO3	<0.005	<8.064516E-05	<8.064516E-05
HCO3	404	6.62109	6.62109

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	2.289085	1.388199	0.319	0.194
Ca/SO4	13.63796	32.6674	0.152	0.364
Na/Cl	17.26316	26.62165	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-19	
Sample Date	10/23/2019	
Station	TH19-KGS-19 10/23/2019	
Location		
Geology		
Watertype	Mg-HCO3	
Temperature (°C)		
pH	8.3	
Conductivity	841	uS/cm
Sum of Anions	11.91469	meq/L
Sum of Cations	9.959436	meq/L
Balance	-8.938647	%
Total dissolved solids	857.2	mg/L
Total hardness	399.3	mg/l CaCO3
Alkalinity	520.2	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	43.1	1.874747	1.874747
K	3.1	7.928734E-02	7.928734E-02
Ca	34.4	0.8583264	1.716653
Mg	76.2	3.135157	6.270315
Cl	4.32	0.1218525	0.1218525
SO4	71.4	0.74375	1.4875
NO3	0.136	2.193548E-03	2.193548E-03
HCO3	620	10.16108	10.16108

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.4514436	0.2737746	0.319	0.194
Ca/SO4	0.4817927	1.154052	0.152	0.364
Na/Cl	9.976851	15.38538	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-19	
Sample Date	10/27/2020	
Station	TH19-KGS-19 10/27/2020	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.21	
Conductivity	890	uS/cm
Sum of Anions	10.83233	meq/L
Sum of Cations	10.95921	meq/L
Balance	0.5822166	%
Total dissolved solids	811.7	mg/L
Total hardness	490.5	mg/l CaCO3
Alkalinity	467.9	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	23.4	1.017844	1.017844
K	4.15	0.1061427	0.1061427
Ca	62.7	1.564449	3.128899
Mg	81.2	3.340876	6.681752
Cl	1.88	0.0530284	0.0530284
SO4	68.5	0.7135417	1.427083
NO3	0.0166	2.677419E-04	2.677419E-04
HCO3	568	9.30886	9.30886

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.7721675	0.4682752	0.319	0.194
Ca/SO4	0.9153285	2.192513	0.152	0.364
Na/Cl	12.44681	19.19432	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-19	
Sample Date	3/11/2019	
Station	TH19-KGS-19 3/11/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3-SO4	
Temperature (°C)		
pH	8.47	
Conductivity	785	uS/cm
Sum of Anions	9.669072	meq/L
Sum of Cations	10.36356	meq/L
Balance	3.466795	%
Total dissolved solids	702.9	mg/L
Total hardness	430.1	mg/l CaCO3
Alkalinity	365.3	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	37.1	1.613761	1.613761
K	5.32	0.1360673	0.1360673
Ca	44.9	1.120315	2.240631
Mg	77.3	3.180416	6.360831
Cl	14	0.3948923	0.3948923
SO4	110	1.145833	2.291667
NO3	0.042	6.774193E-04	6.774193E-04
HCO3	403	6.604702	6.604702

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.5808538	0.3522544	0.319	0.194
Ca/SO4	0.4081818	0.9777298	0.152	0.364
Na/Cl	2.65	4.086585	0.556	0.858
Cl/Br			287	648

Sample Summary Report

Sample ID	TH19-KGS-19	
Sample Date	6/12/2019	
Station	TH19-KGS-19 6/12/2019	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.29	
Conductivity	902	uS/cm
Sum of Anions	13.12294	meq/L
Sum of Cations	12.02914	meq/L
Balance	-4.34877	%
Total dissolved solids	963.5	mg/L
Total hardness	488.2	mg/l CaCO3
Alkalinity	531.9	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	48.5	2.109634	2.109634
K	5.01	0.1281386	0.1281386
Ca	66.7	1.664255	3.328509
Mg	78.2	3.217445	6.43489
Cl	7.08	0.1997027	0.1997027
SO4	110	1.145833	2.291667
NO3	0.016	2.580645E-04	2.580645E-04
HCO3	646	10.58719	10.58719

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.8529412	0.5172597	0.319	0.194
Ca/SO4	0.6063636	1.45244	0.152	0.364
Na/Cl	6.850283	10.56387	0.556	0.858
Cl/Br			287	648

Sample Summary Report

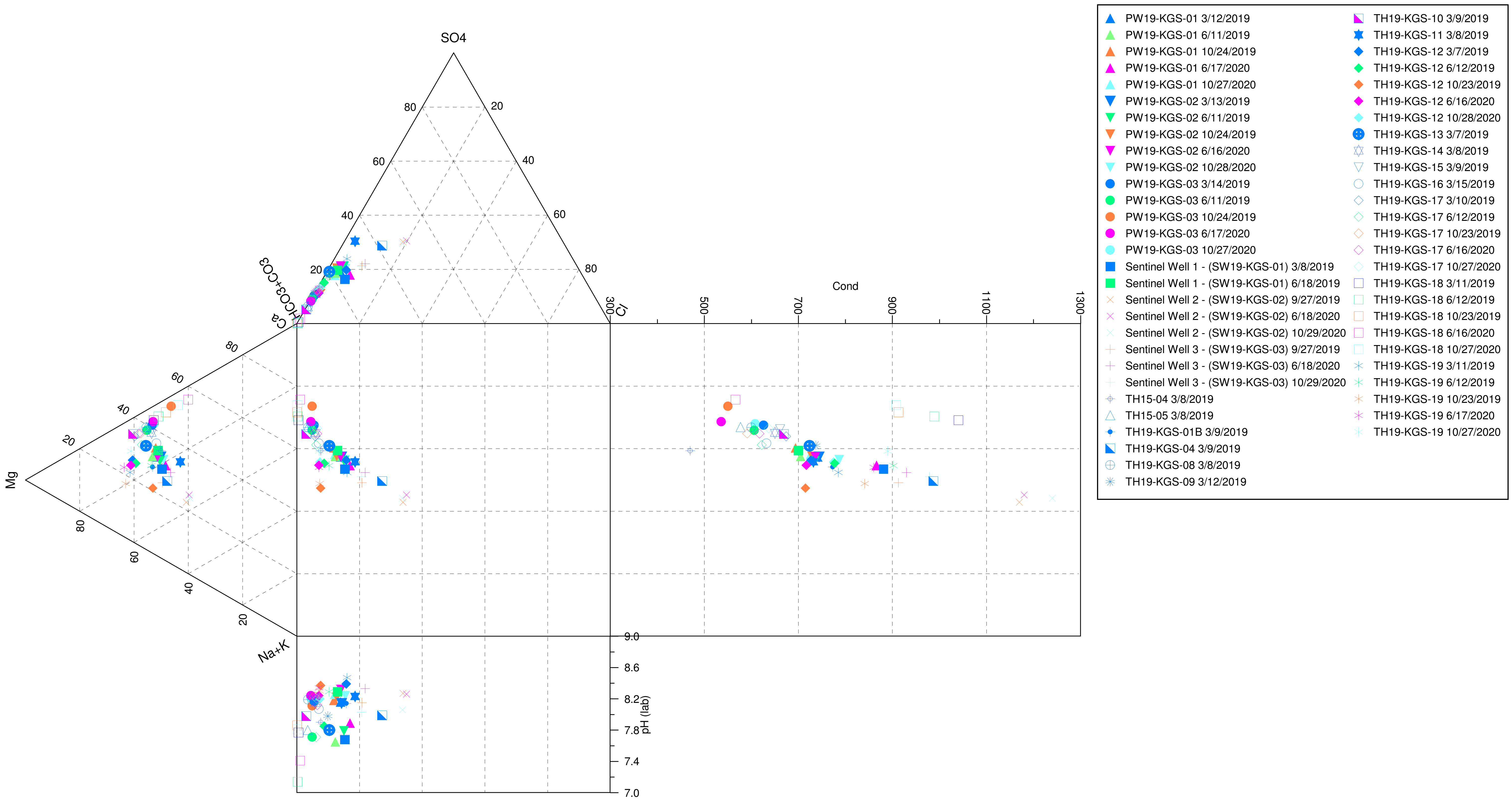
Sample ID	TH19-KGS-19	
Sample Date	6/17/2020	
Station	TH19-KGS-19 6/17/2020	
Location		
Geology		
Watertype	Mg-Ca-HCO3	
Temperature (°C)		
pH	8.34	
Conductivity	860	uS/cm

Sum of Anions	11.02675	meq/L
Sum of Cations	11.36943	meq/L
Balance	1.530078	%

Total dissolved solids	822.1	mg/L
Total hardness	486.3	mg/l CaCO3
Alkalinity	488.3	mg/l CaCO3

Major ion composition	mg/l	mmol/l	meq/l
Na	34.6	1.505017	1.505017
K	4.2	0.1074215	0.1074215
Ca	50.3	1.255053	2.510105
Mg	87.7	3.608311	7.216622
Cl	2.3	6.487516E-02	6.487516E-02
SO4	68.2	0.7104167	1.420833
NO3	<0.01	<1.612903E-04	<1.612903E-04
HCO3	566	9.276082	9.276082

Ratios	Sample		Standard Seawater	
	mg/l	mmol/l	mg/l	mmol/l
Ca/Mg	0.5735462	0.3478228	0.319	0.194
Ca/SO4	0.7375367	1.766643	0.152	0.364
Na/Cl	15.04348	23.19867	0.556	0.858
Cl/Br			287	648

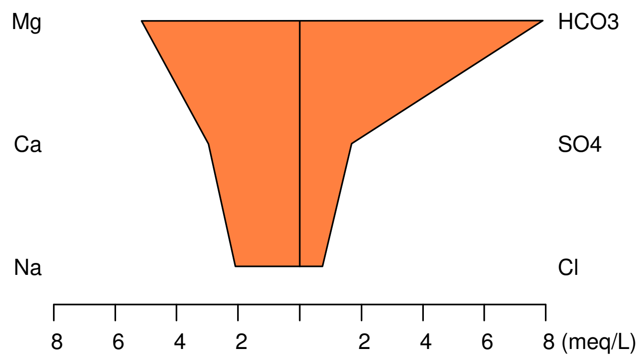


DESCRIPTION: Bedrock Wells

	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:

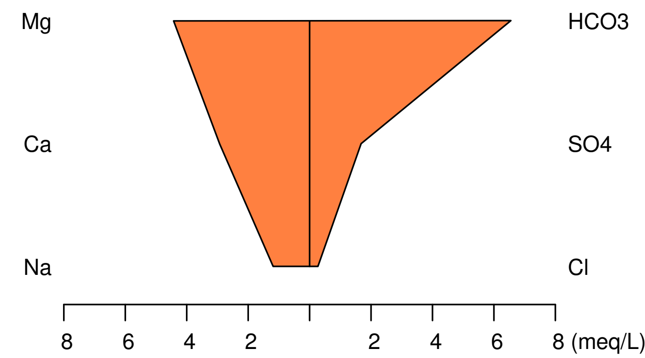
Sentinel Well 1

Date: 3/8/2019
TDS (mg/l) = 520
El Cond. (uS/cm) =881



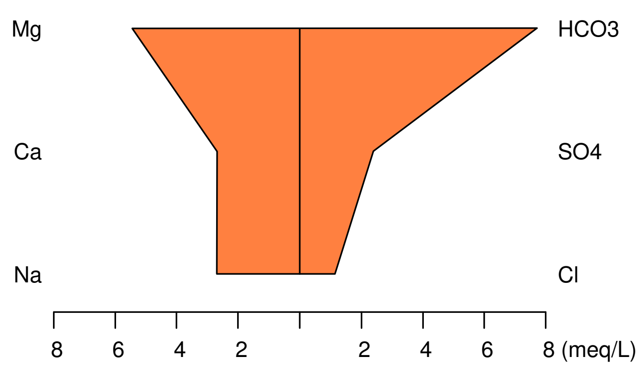
Sentinel Well 1

Date: 6/18/2020
TDS (mg/l) = 432
El Cond. (uS/cm) =700



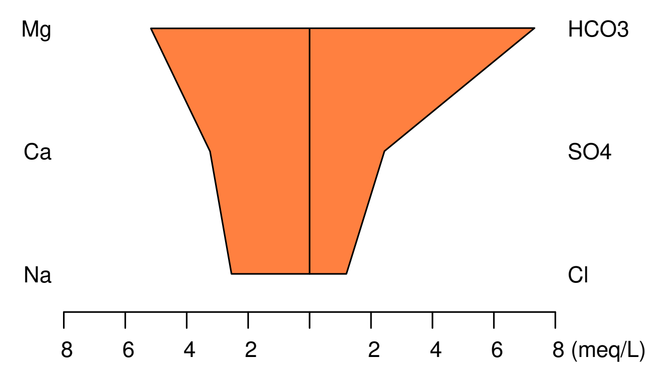
Sentinel Well 3

Date: 9/27/2019
TDS (mg/l) = 576
El Cond. (uS/cm) =913



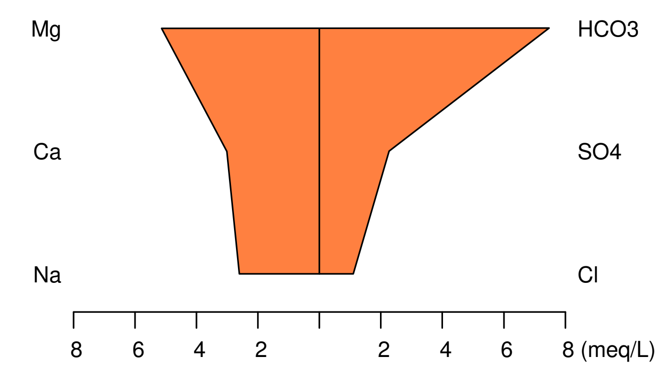
Sentinel Well 3

Date: 6/18/2020
TDS (mg/l) = 576
El Cond. (uS/cm) =930



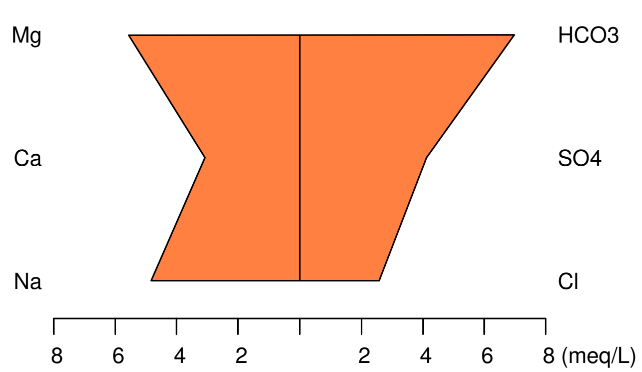
Sentinel Well 3

Date: 10/29/2020
TDS (mg/l) = 562
El Cond. (uS/cm) =979



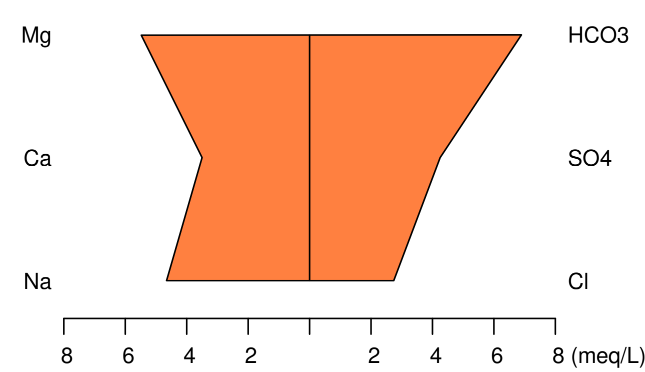
Sentinel Well 2

Date: 9/27/2019
TDS (mg/l) = 748
El Cond. (uS/cm) =1170



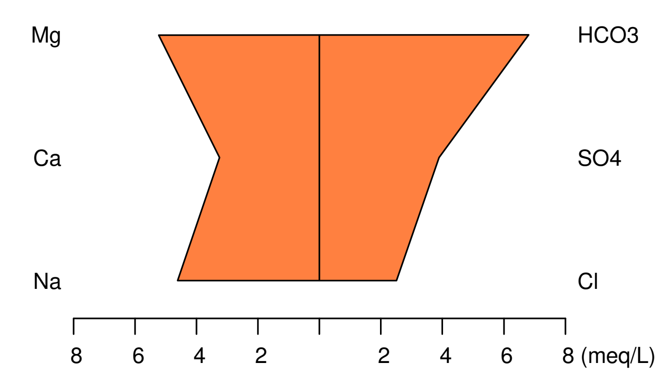
Sentinel Well 2

Date: 6/18/2020
TDS (mg/l) = 759
El Cond. (uS/cm) =1180



Sentinel Well 2

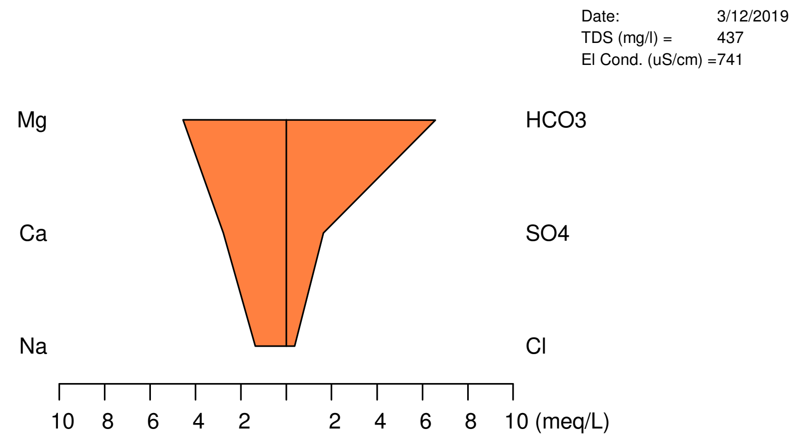
Date: 10/29/2020
TDS (mg/l) = 722
El Cond. (uS/cm) =1240



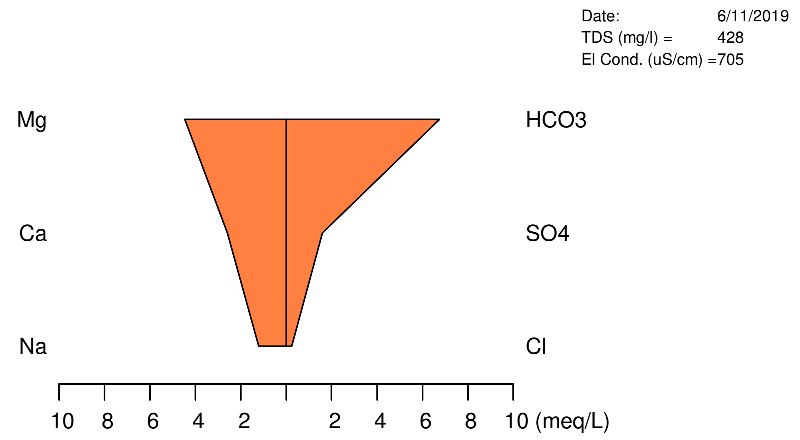
DESCRIPTION: Sentinel Wells

KGS GROUP	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:

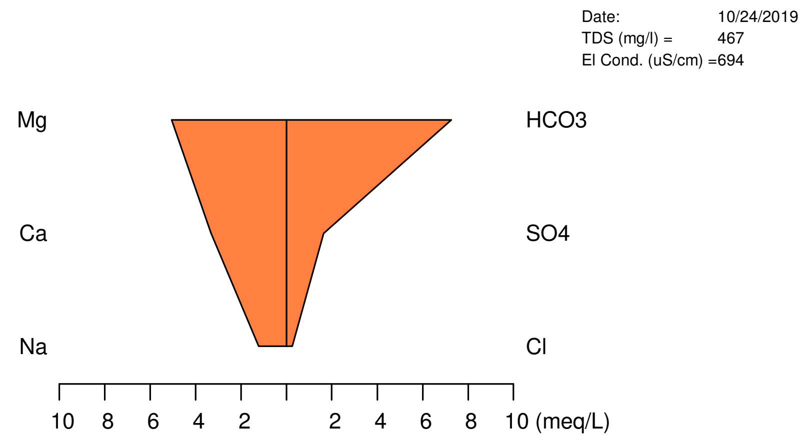
PW19-KGS-01



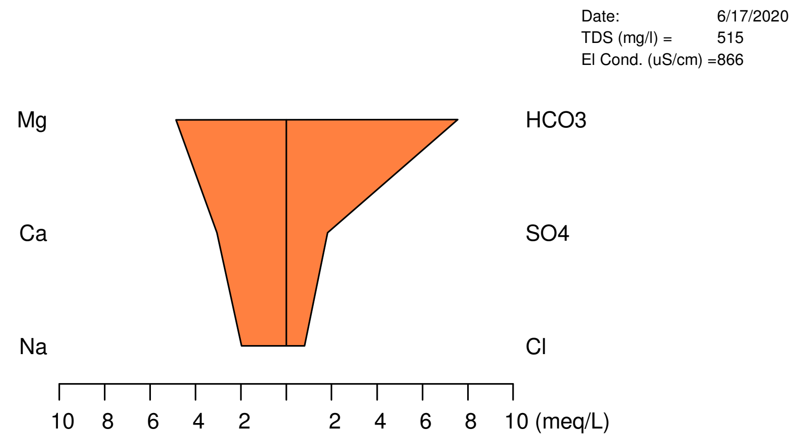
PW19-KGS-01



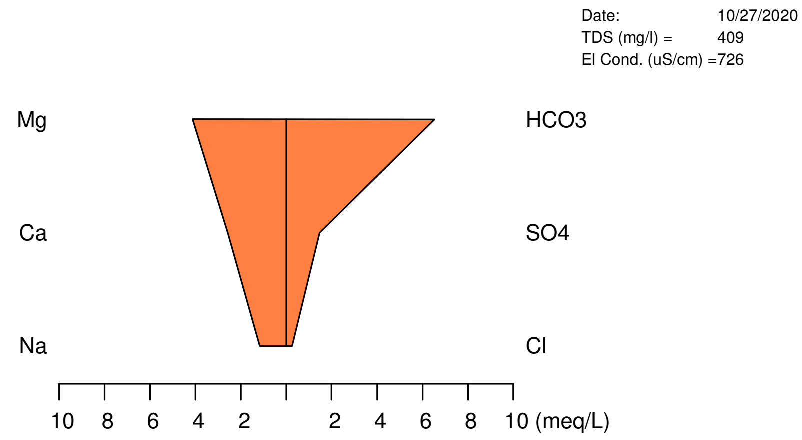
PW19-KGS-01



PW19-KGS-01



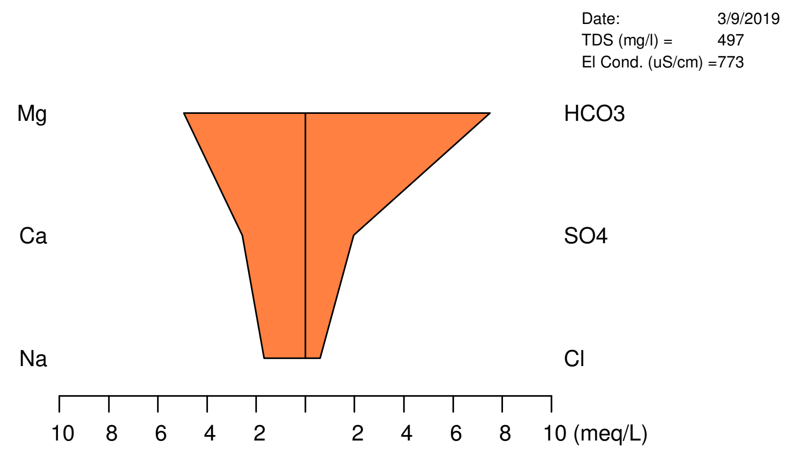
PW19-KGS-01



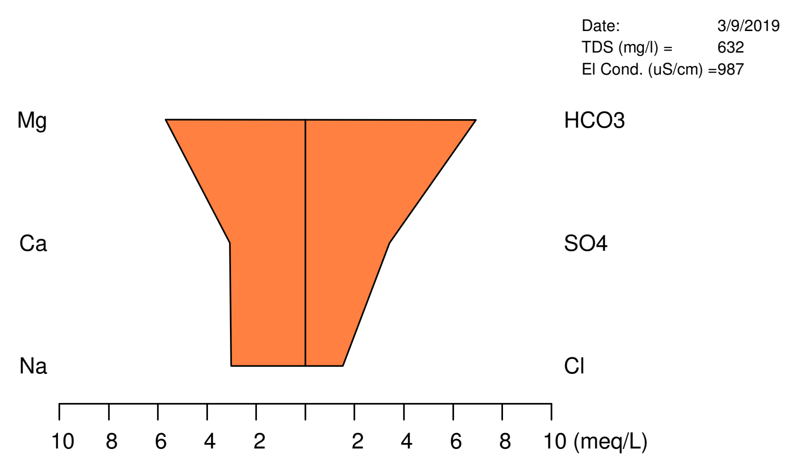
DESCRIPTION: Bedrock Wells

	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:

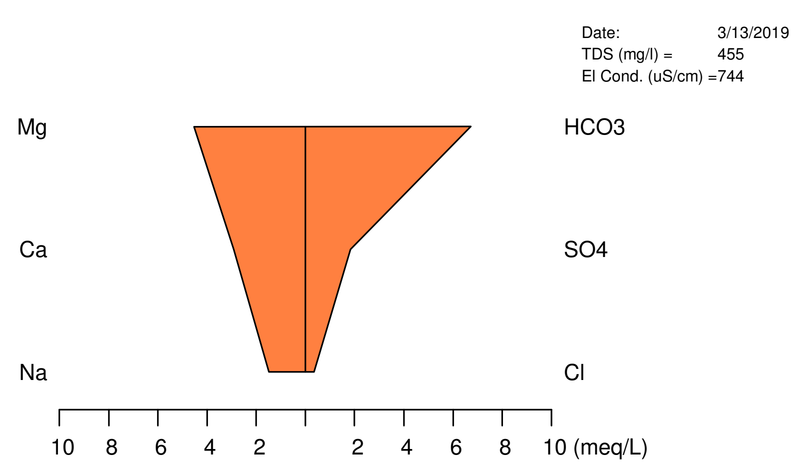
TH19-KGS-01B



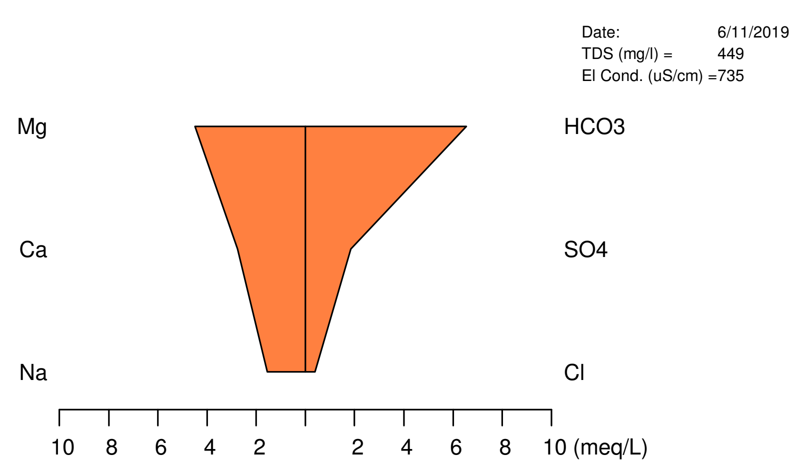
TH19-KGS-04



PW19-KGS-02



PW19-KGS-02



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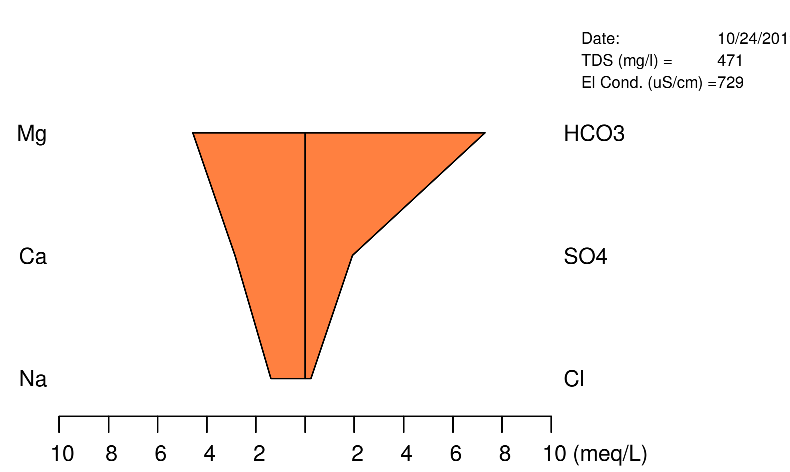
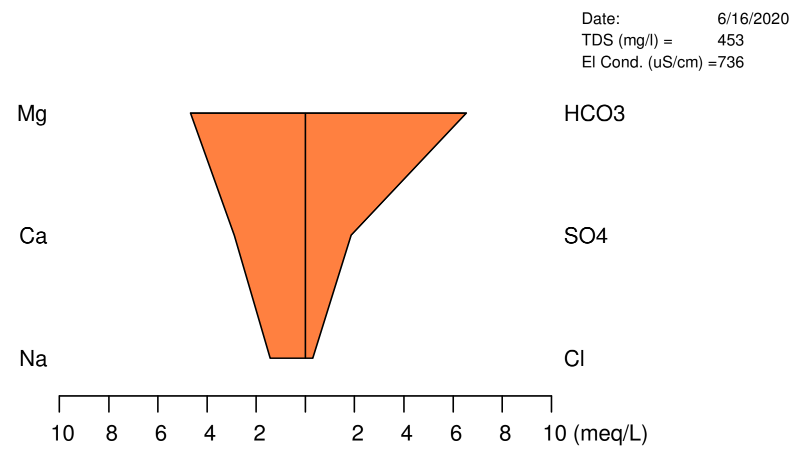


DESCRIPTION: Bedrock Wells		
	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:

PW19-KGS-02



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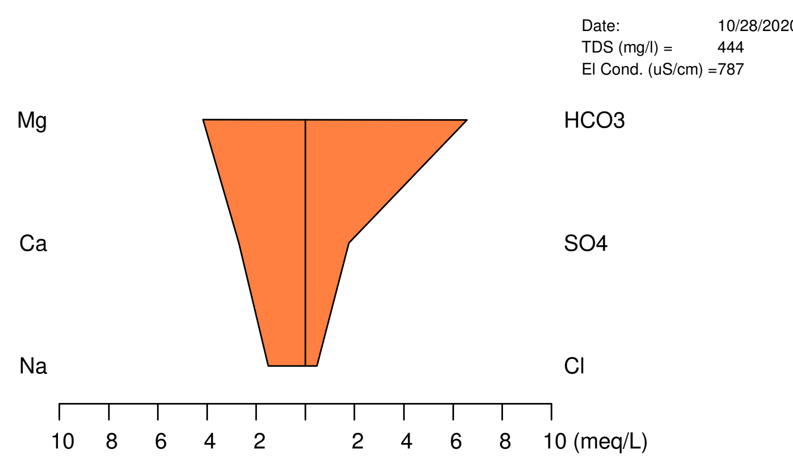
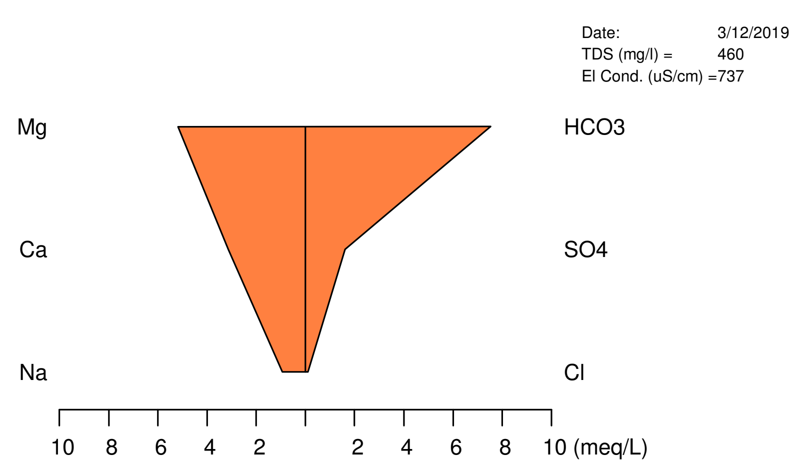
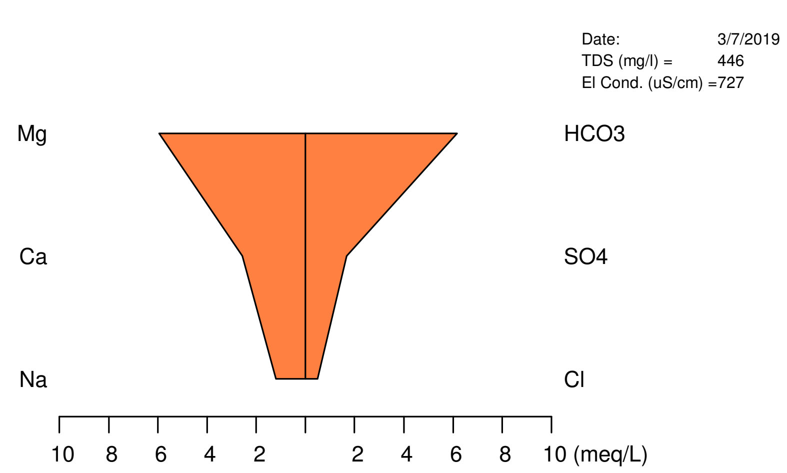


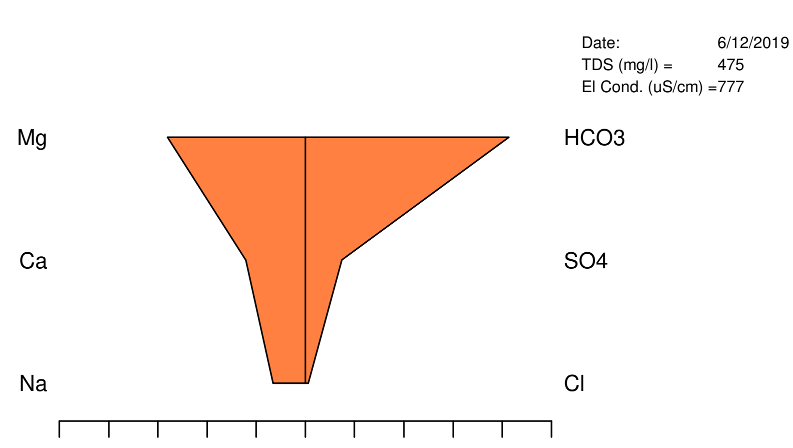
TH19-KGS-09



TH19-KGS-12

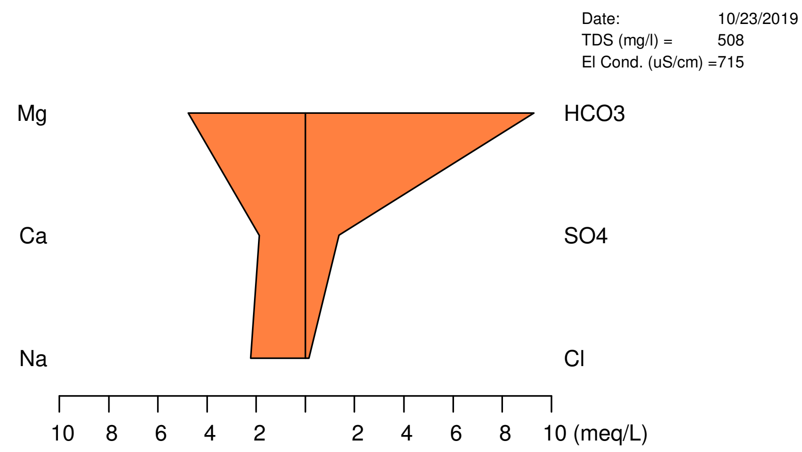


TH19-KGS-12



DESCRIPTION: Bedrock Wells		
	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:

TH19-KGS-12



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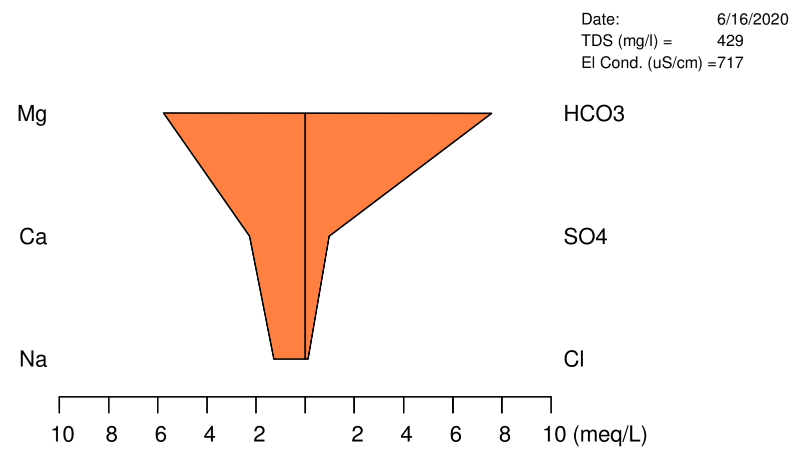

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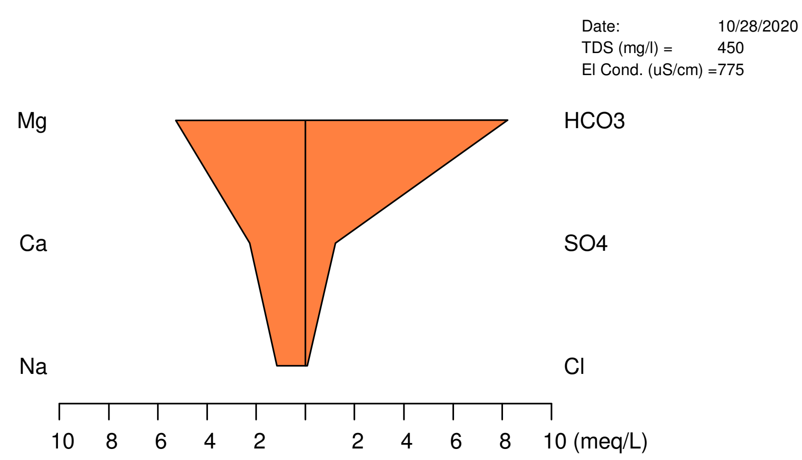
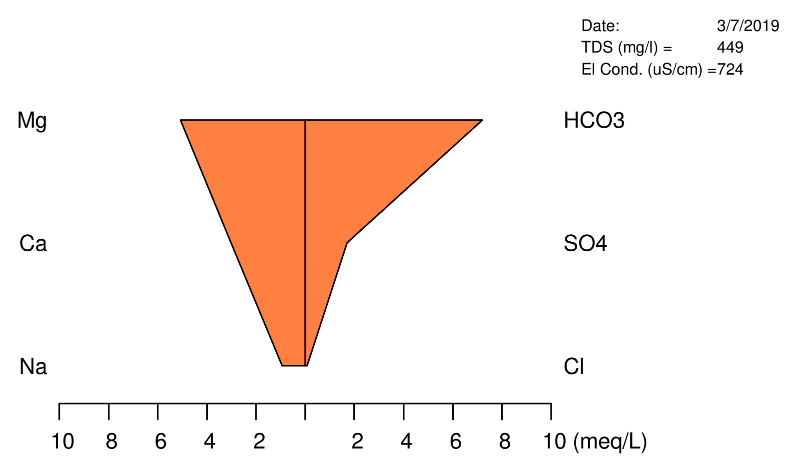
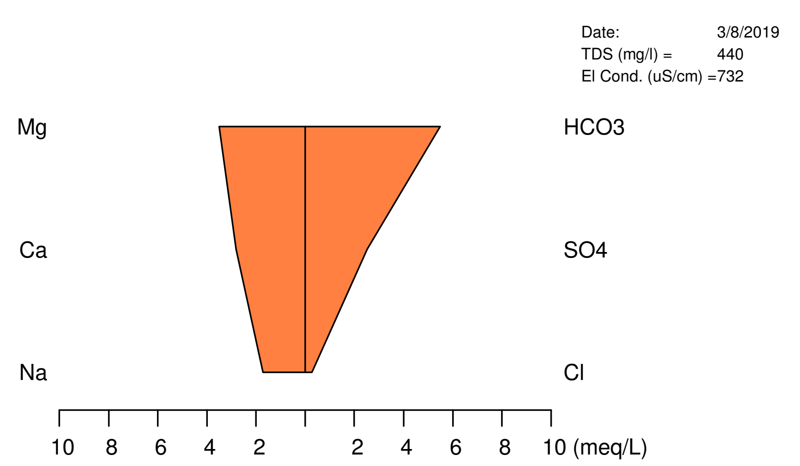


TH19-KGS-13



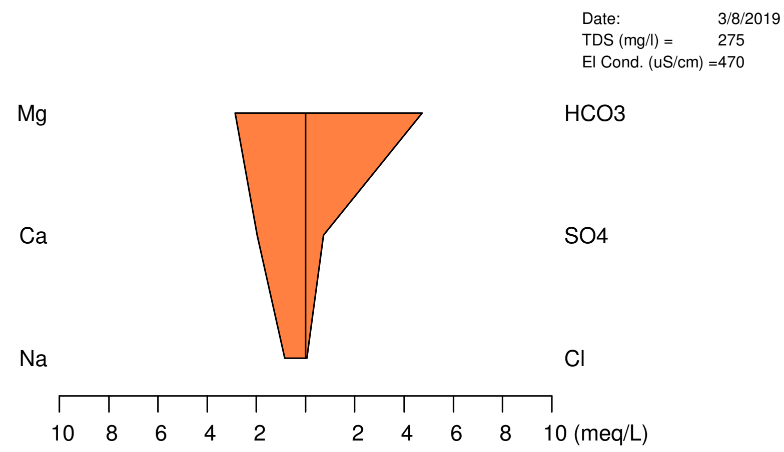
TH19-KGS-11



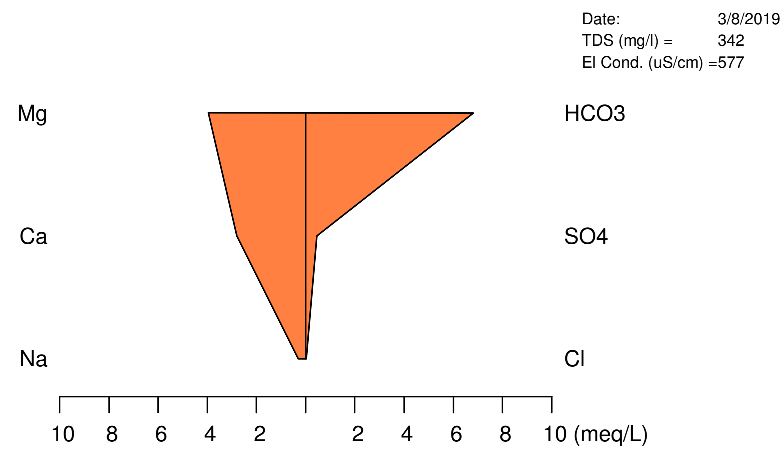
DESCRIPTION: Bedrock Wells

	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:

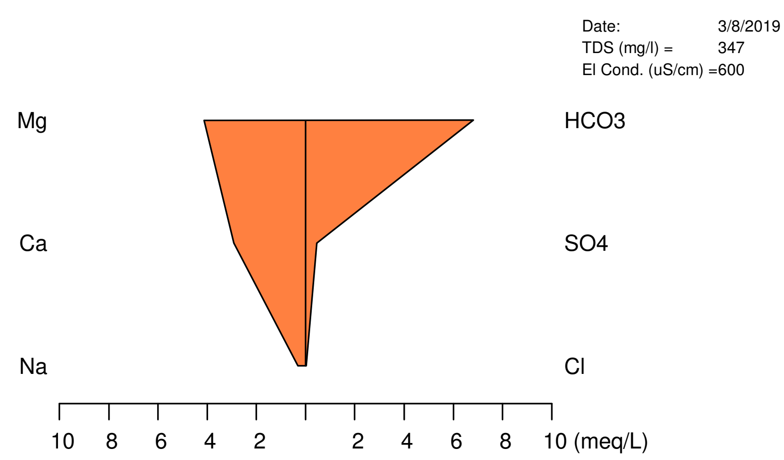
TH15-04



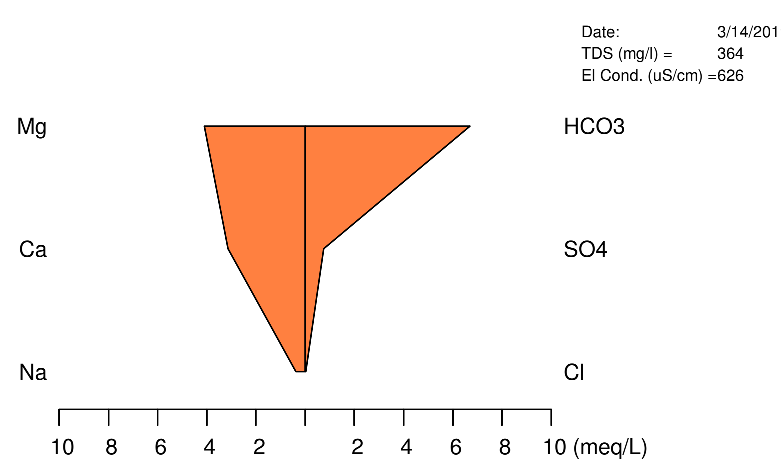
TH15-05



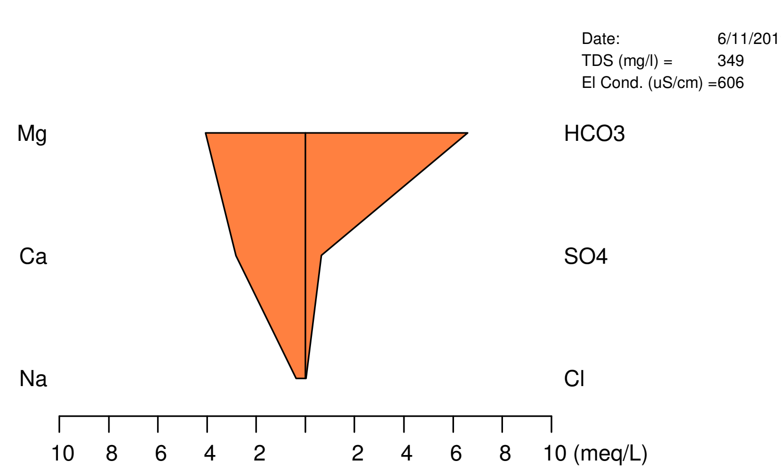
TH19-KGS-08



PW19-KGS-03



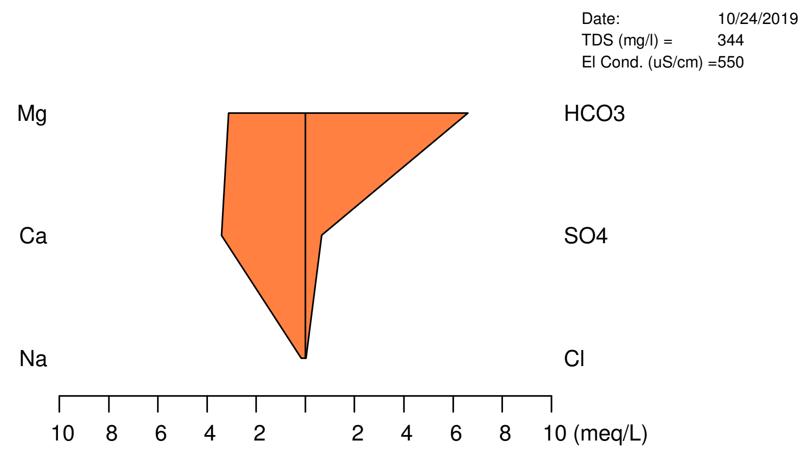
PW19-KGS-03



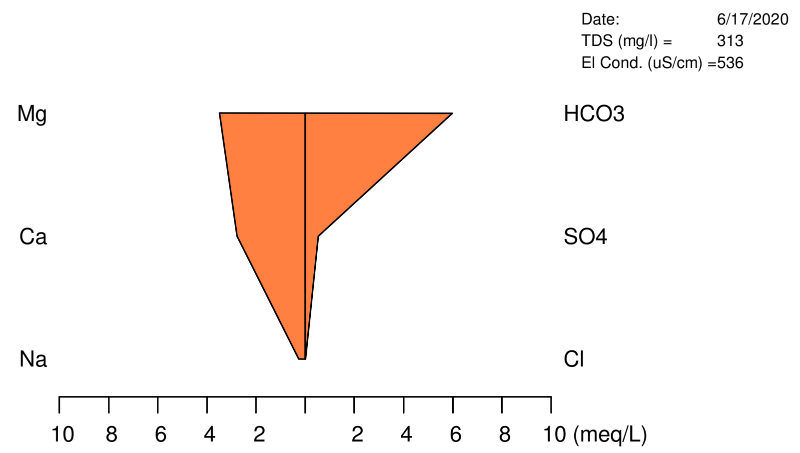
DESCRIPTION: Bedrock Wells

PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
CLIENT: Manitoba Infrastructure	DATE:

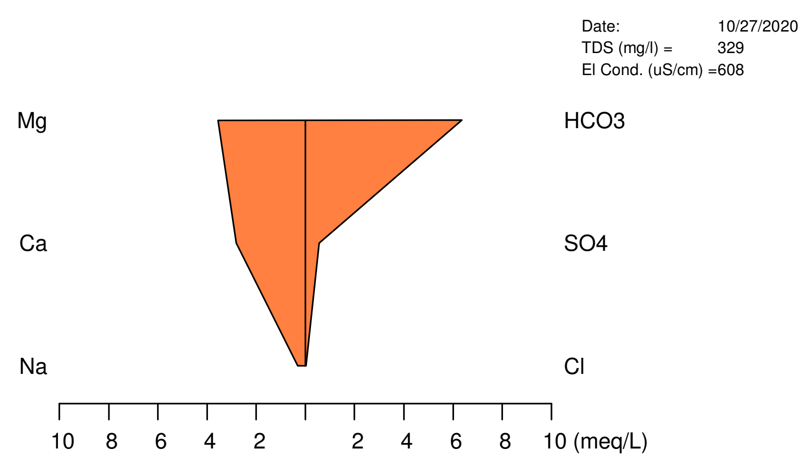
PW19-KGS-03



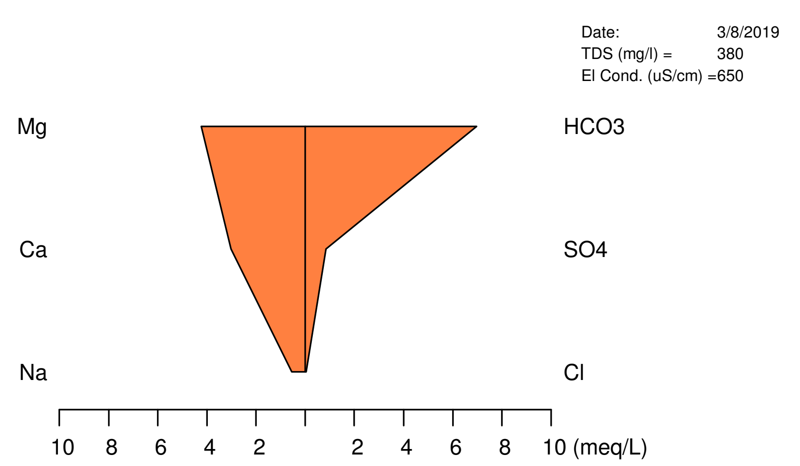
PW19-KGS-03



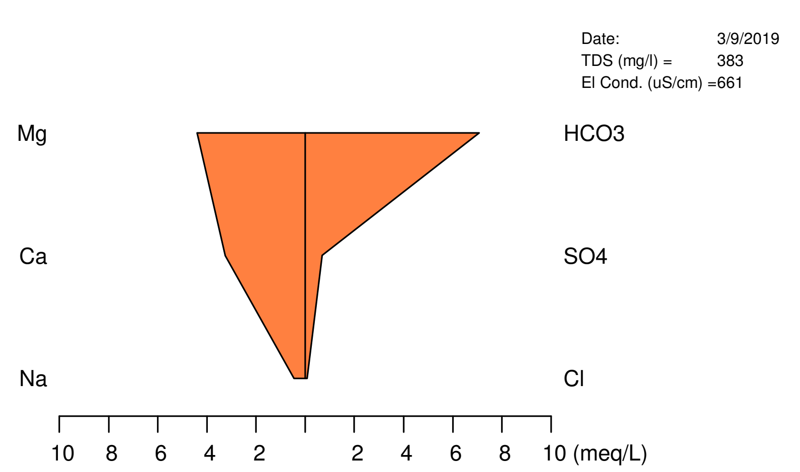
PW19-KGS-03



TH19-KGS-14



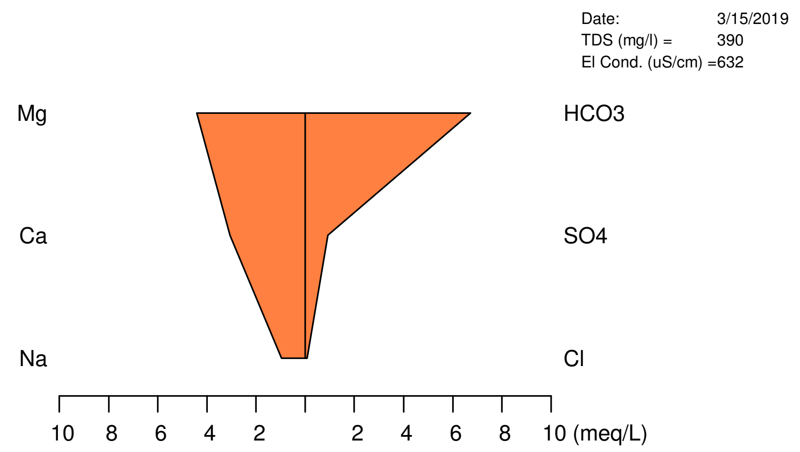
TH19-KGS-15



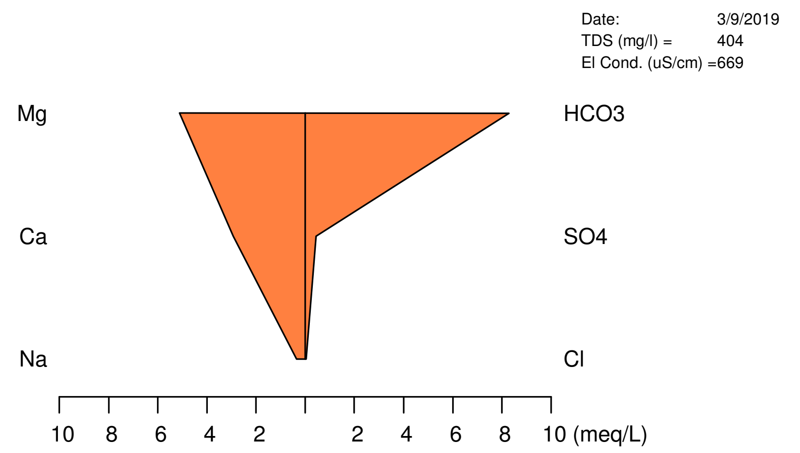
DESCRIPTION: Bedrock Wells

	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:

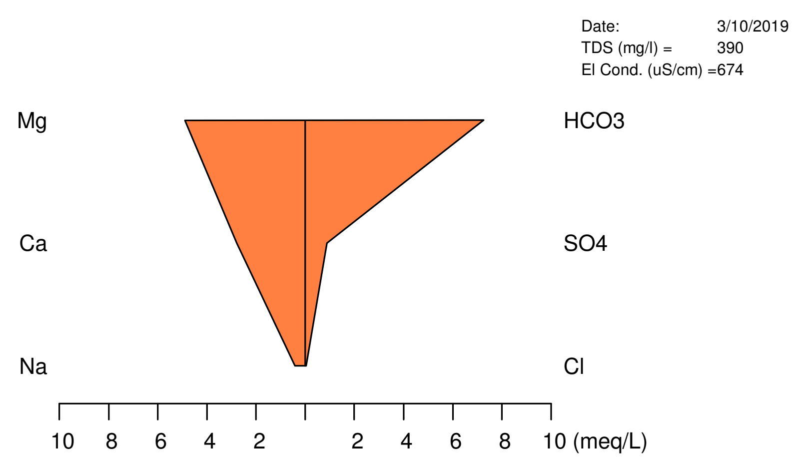
TH19-KGS-16



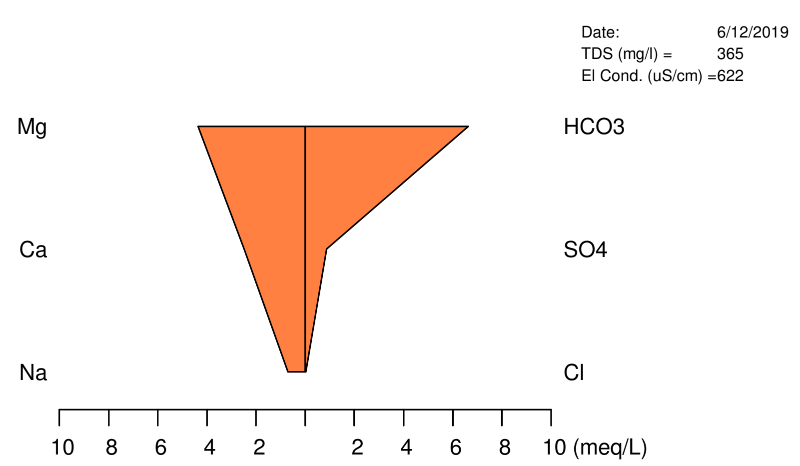
TH19-KGS-10



TH19-KGS-17



TH19-KGS-17



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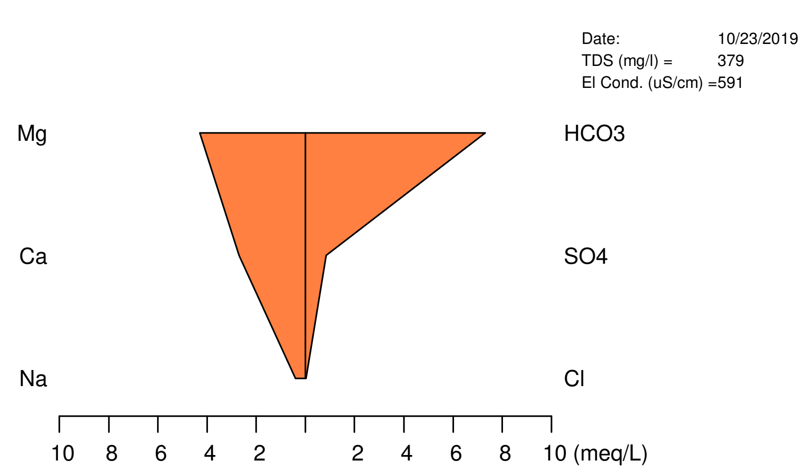
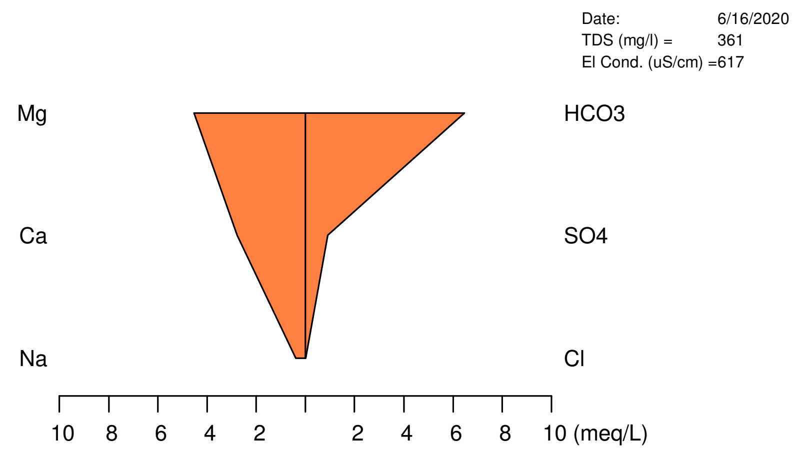


DESCRIPTION: Bedrock Wells

	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:

TH19-KGS-17



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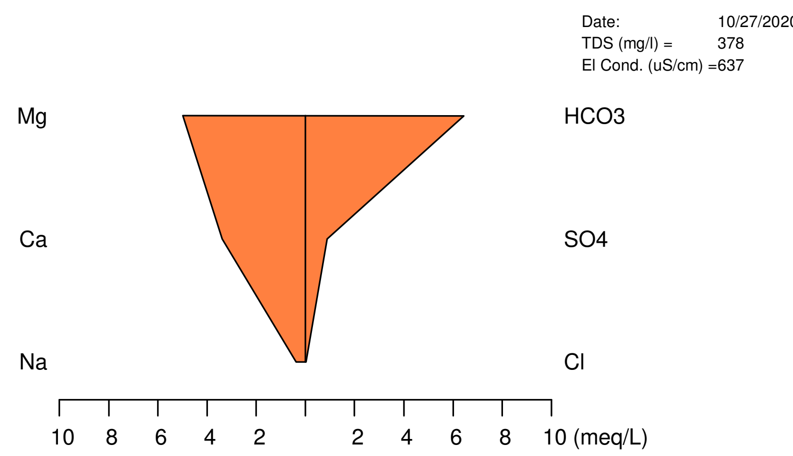
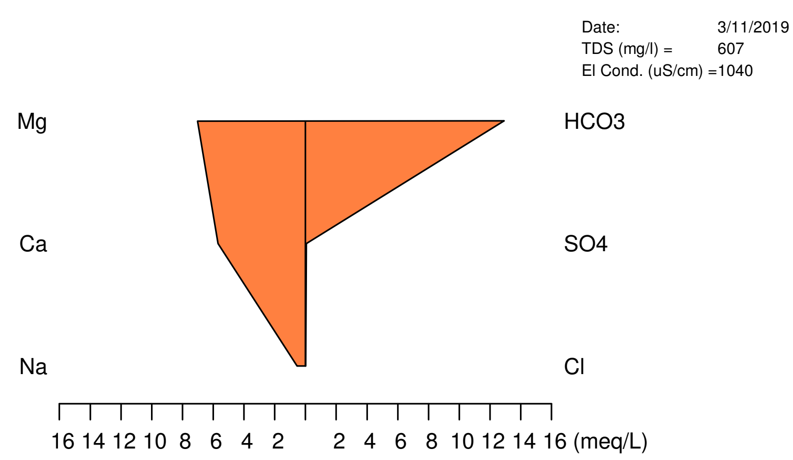
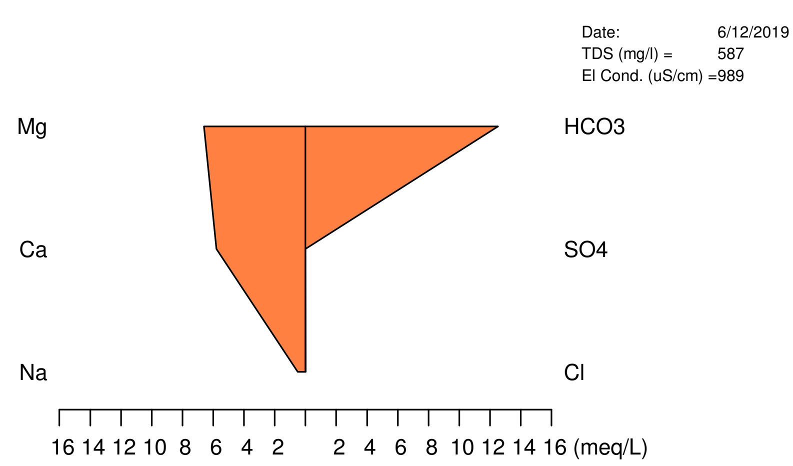


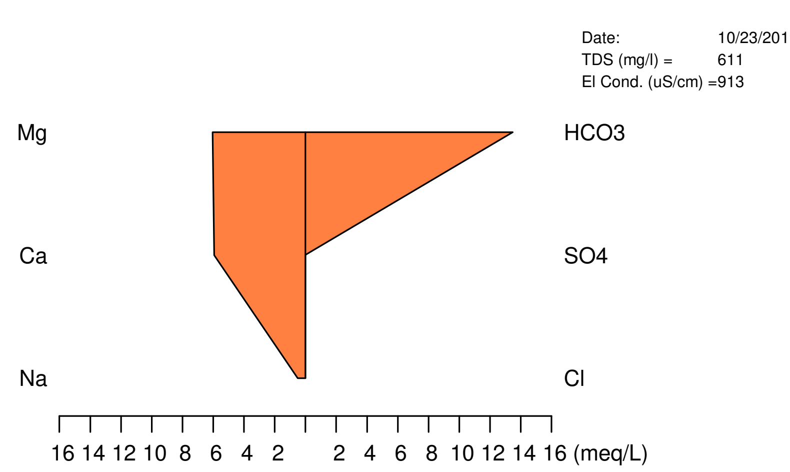
TH19-KGS-18



TH19-KGS-18



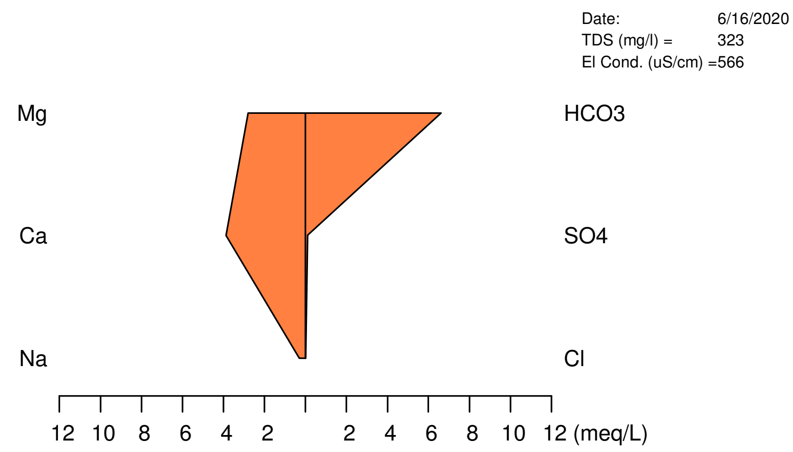
TH19-KGS-18



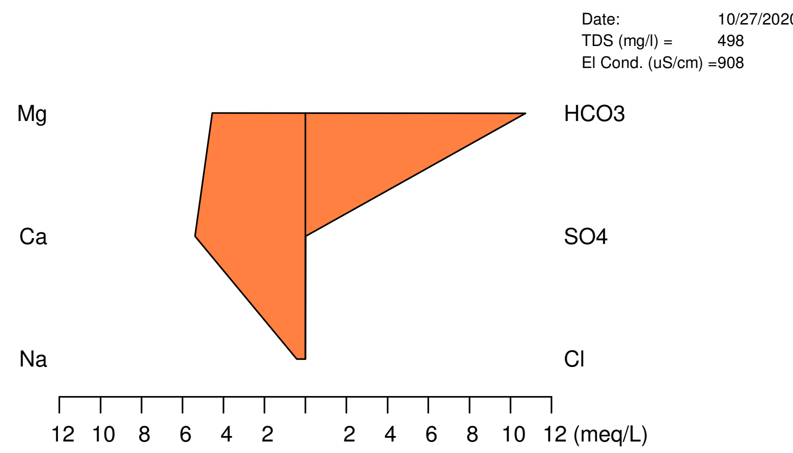
DESCRIPTION: Bedrock Wells

	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:

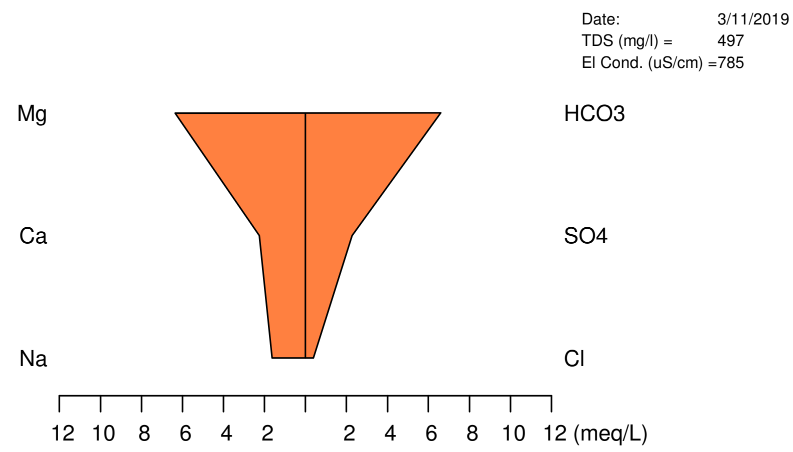
TH19-KGS-18



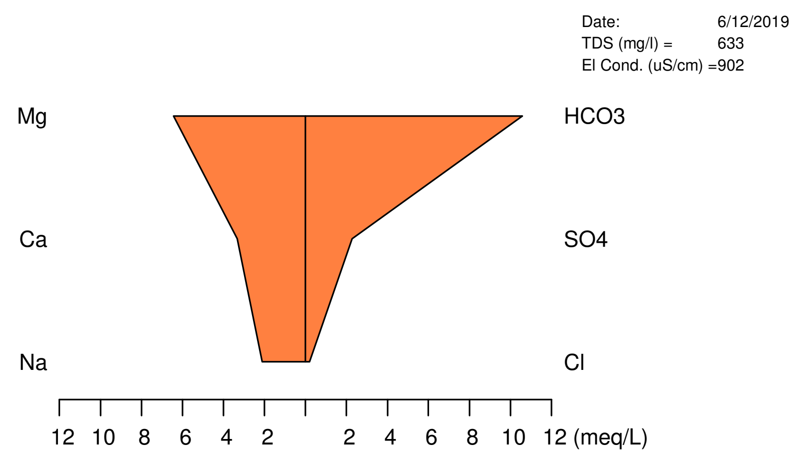
TH19-KGS-18



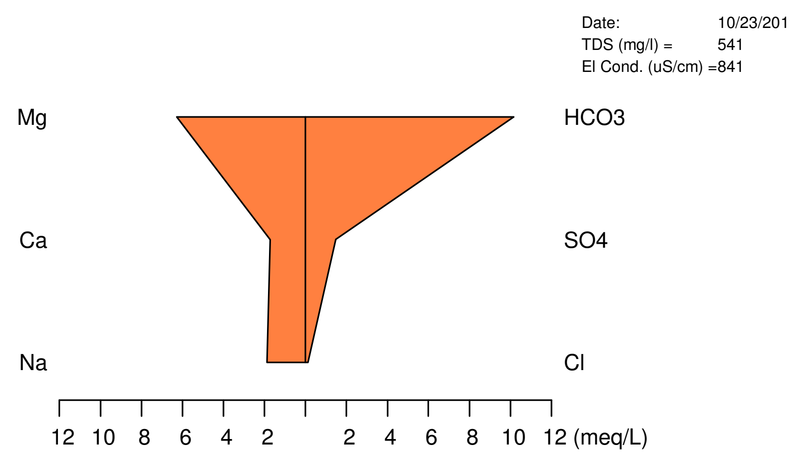
TH19-KGS-19



TH19-KGS-19



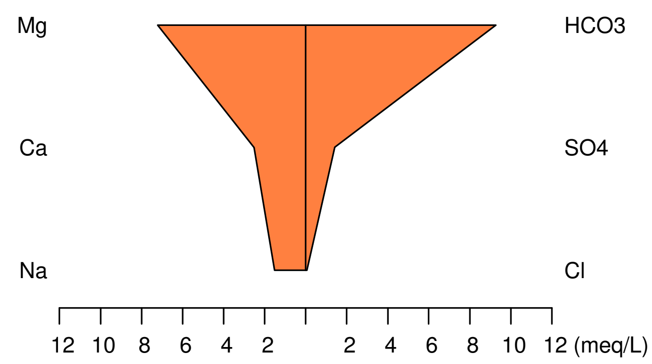
TH19-KGS-19



DESCRIPTION: Bedrock Wells	
PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
CLIENT: Manitoba Infrastructure	DATE:

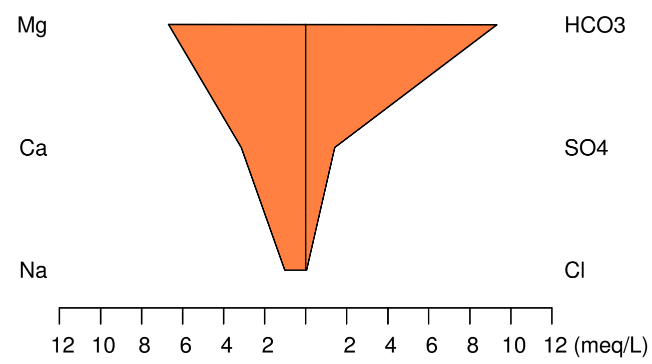
TH19-KGS-19

Date: 6/17/2020
TDS (mg/l) = 533
El Cond. (uS/cm) =860



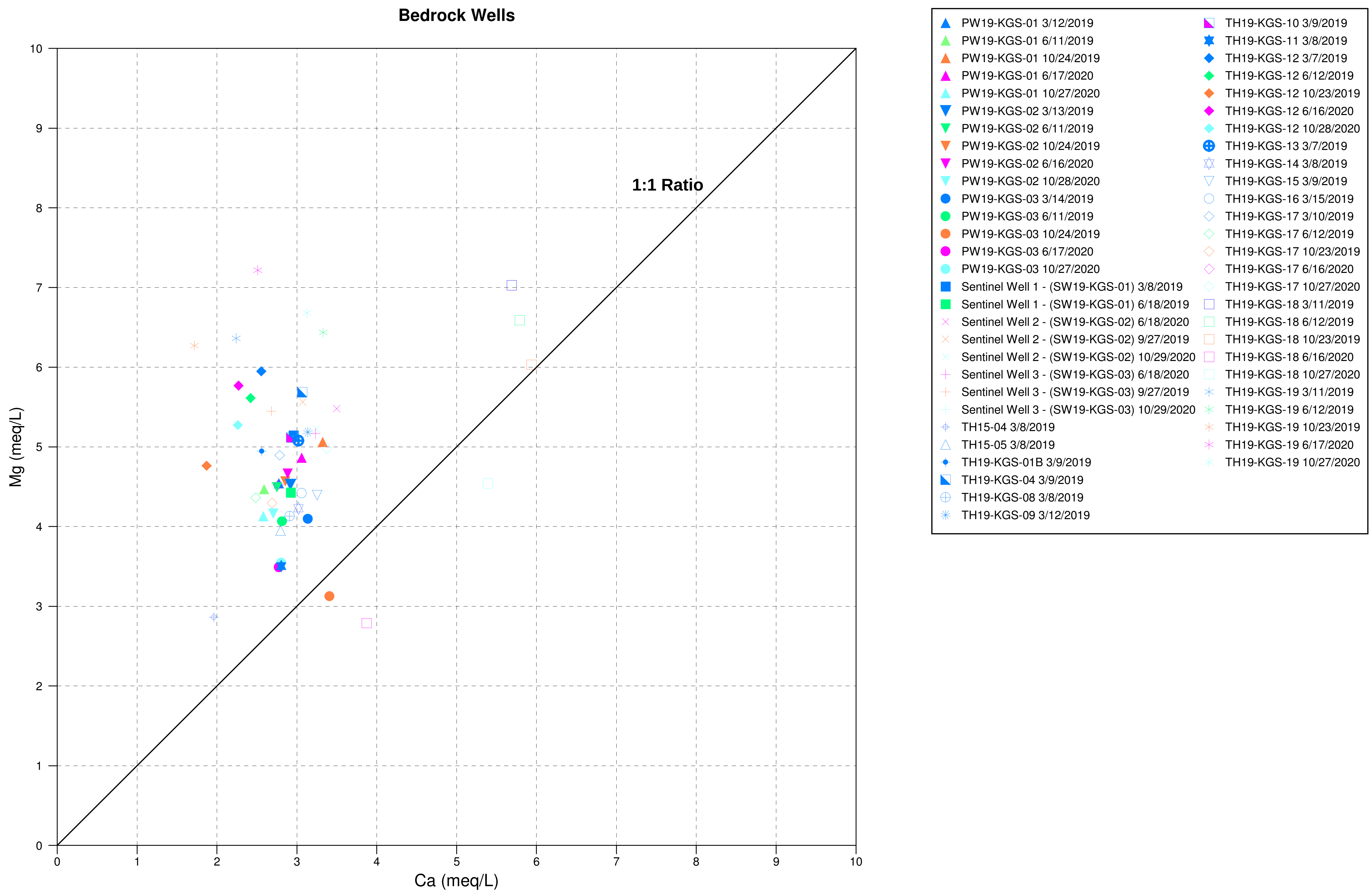
TH19-KGS-19

Date: 10/27/2020
TDS (mg/l) = 521
El Cond. (uS/cm) =890



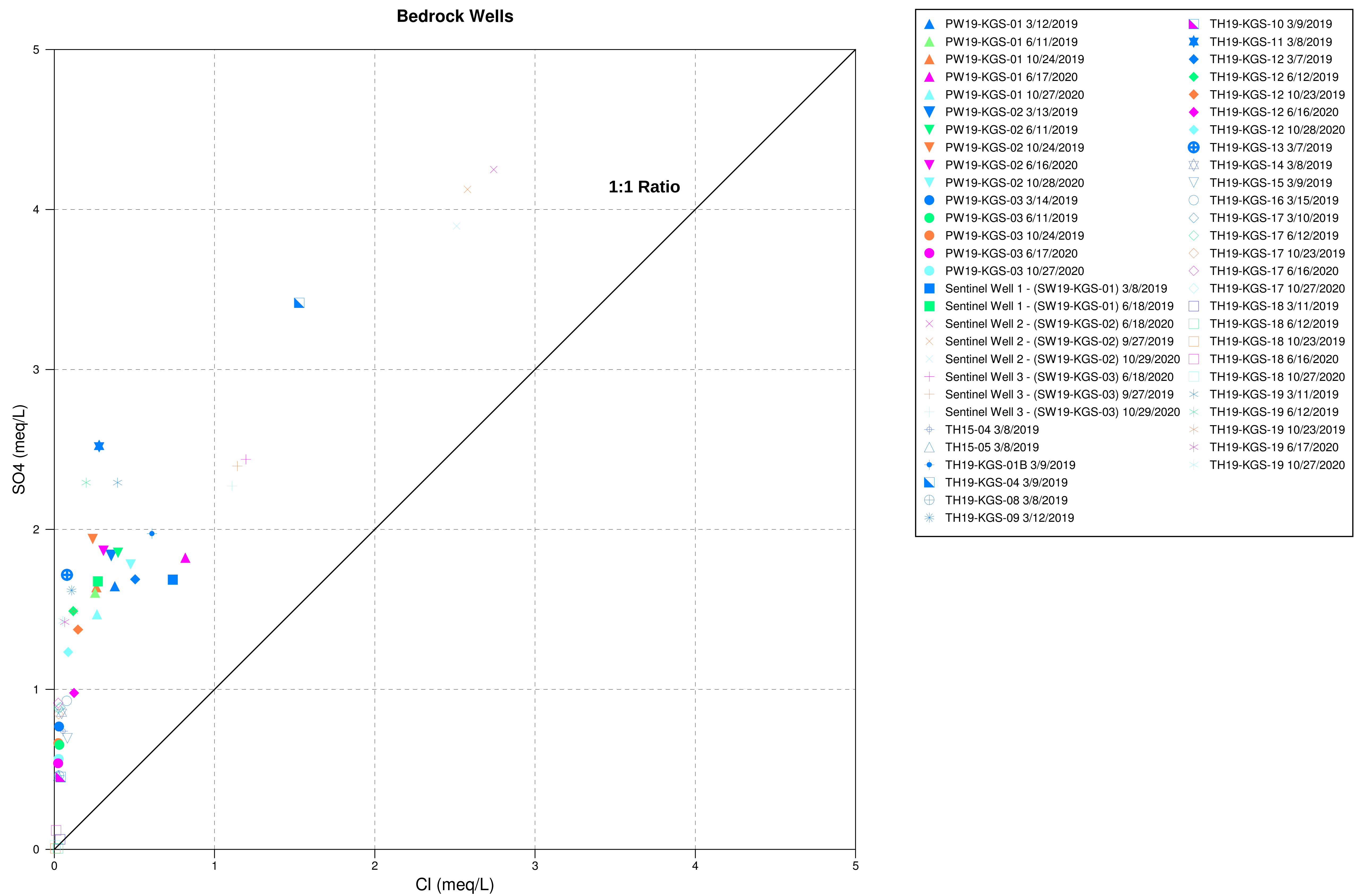
DESCRIPTION: Bedrock Wells

	PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
	CLIENT: Manitoba Infrastructure	DATE:



DESCRIPTION:

PROJECT: LSMOC Design, Tender & Contract Admin	PROJECT NO: 18-0300-005
CLIENT: Manitoba Infrastructure	DATE:



DESCRIPTION:

PROJECT:	LSMOC Design, Tender & Contract Admin	PROJECT NO:	18-0300-005
CLIENT:	Manitoba Infrastructure	DATE:	

Sample ID	Fluoride	Boron	Strontium
BEDROCK WELLS			
PW19-KGS-01	0.281	0.151	0.220
PW19-KGS-02	0.317	0.139	0.209
PW19-KGS-03	0.191	0.087	0.141
Sentinel Well 1	0.299	0.165	0.233
Sentinel Well 2	0.281	0.209	0.249
Sentinel Well 3	0.305	0.214	0.240
TH15-04	0.272	0.117	0.161
TH15-05	0.231	0.091	0.161
TH19-KGS-01B	0.287	0.158	0.216
TH19-KGS-04	0.281	0.157	0.259
TH19-KGS-08	0.237	0.102	0.161
TH19-KGS-09	0.222	0.141	0.191
TH19-KGS-10	0.329	0.091	0.178
TH19-KGS-11	1.15	0.412	0.291
TH19-KGS-12	0.336	0.125	0.244
TH19-KGS-13	0.238	0.116	0.202
TH19-KGS-14	0.266	0.136	0.162
TH19-KGS-15	0.249	0.124	0.186
TH19-KGS-16	0.446	0.169	0.162
TH19-KGS-17	0.249	0.088	0.161
TH19-KGS-18	0.142	0.059	0.248
TH19-KGS-19	0.301	0.107	0.669