FINAL REPORT

FALL 2020
SEMI-ANNUAL MONITORING REPORT

WASTE MANAGEMENT OF CANADA
RICHMOND LANDFILL
TOWN OF GREATER NAPANEE, ON

Submitted to:

WASTE MANAGEMENT OF CANADA
1271 Beechwood Road
Napanee, ON K7R 3L1

Prepared by:

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4 Cataraqui Street
Kingston, ON K7K 1Z7

Project Number: 200172-03

14 January 2021

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1. INTRODUCTION

The purpose of this report is to present results and to provide an interpretation of the data that were collected during the summer and fall 2020 monitoring events at the Waste Management of Canada Corporation (WM) Richmond Landfill.

The WM Richmond Landfill is approved as a 16.2 hectare waste disposal (landfilling) facility within a total site area of 138 hectares, located on parts of Lots 1, 2 and 3, Concession IV of the former Township of Richmond, now in the Town of Greater Napanee, Ontario. The landfill has been closed to waste disposal since June 20, 2011.

2. METHODOLOGY

2.1 PROGRAM SUMMARY

The summer and fall 2020 monitoring events were conducted in accordance with the requirements outlined in the revised interim Environmental Monitoring Plan (EMP; Revision No. 05) dated April 15, 2016, as specified in the Amended Environmental Compliance Approval (ECA) number A371203, issued by MECP July 14, 2017 to reflect all amendments to the ECA that had been issued since the original ECA was issued in January 2012 and Environmental Review Tribunal (ERT) Order dated December 24, 2015.

The site layout and monitoring locations are shown on Figure 1. The monitoring programs for groundwater, surface water, leachate and landfill gas are summarized in Table 1.

The summer monitoring event was conducted between July 15 and August 18, 2020. The activities completed include the following:

- Groundwater monitoring wells installed in the shallow and intermediate bedrock flow zones (see Table 3) were monitored for water levels on July 15, 2020. No water level was measured at groundwater monitors M15, M18, M68-4 and M70-3 because they were dry, or from M19 because it is damaged;
- Water levels were not recorded at the staff gauges installed at the three ponds located on site between the landfill and Beechwood Road on July 15, 2020 because they were dry;
- Liquid levels were measured in landfill leachate wells on July 15, 2020; and,
- A rainfall of more than 25 mm was recorded by the site weather station on August 16, 2020; however, all surface water locations were dry so no samples were collected;

The fall monitoring event was conducted between October 26 and November 3, 2020. The activities completed include the following:

- Groundwater monitoring wells installed in the shallow and intermediate bedrock flow zones (see Table 3) were monitored for water levels on October 26, 2020. No water levels were measured at groundwater monitors M15, M18, M58-4, M68-4 and M70-3 because they were dry nor M19 because it is damaged;
- Water levels were recorded at the staff gauges installed at the three ponds located on site between the landfill and Beechwood Road on October 26, 2020;
- Liquid levels were measured in landfill leachate wells on October 26, 2020;
- Groundwater monitoring wells were sampled between October 27 – 29, 2020. No samples were collected from monitoring wells M53-4, M67-2 and M85 because they were dry and M58-4 because it was damaged. Samples were analyzed for the suite of groundwater inorganic and general parameters and Volatile Organic Compounds (VOCs) listed in Table 2;
- Surface water sampling was conducted on October 27, 2020 from locations S3, S18 and S19. No samples were collected from locations S2, S4R, S5, S6, S7, S8R and S20 because they were dry. Surface water samples were analyzed for surface water inorganic and general parameters and for 1,4-dioxane, as listed in Table 2;
- Landfill gas monitoring was conducted on November 3, 2020. Field measurements were made with a RKI Eagle probe calibrated to methane gas response at six gas monitors (GM1, GM3, GM4-1, GM4-2, GM5 and GM6); and,
- A total of eight Quality Assurance/Quality Control (QA/QC) samples were collected during the fall sampling event, including five field duplicate samples and three field blanks. De-ionised water for analysis of blank samples was supplied by the laboratory.

2.2 Water Sample Collection and Laboratory Analysis

Groundwater and surface water samples were collected in accordance with accepted industry protocols. Groundwater samples were collected using dedicated Waterra inertial lift pumps connected to dedicated polyethylene tubing. Three casing volumes of water were purged from each monitoring well prior to the collection of groundwater samples. During purging, readings for pH, temperature, conductivity and oxidation-reduction potential were recorded on a regular basis. The stabilization of the parameters was used to assess when well purging was complete. Low producing wells were purged dry and allowed to recover prior to sampling. If the monitoring well had not recovered sufficiently for sampling within 24 hours, the monitor was considered dry and a sample was not collected.

Surface water samples were collected using a clean bottle where water depth was sufficient; at sampling locations where water depth was an issue, a 50 cc syringe was used to carefully collect the surface water as not to disturb the bottom sediments. Surface water sampling locations were sampled from downstream to upstream to prevent any re-suspension of sediment impacting the downstream sampling locations. The pH, temperature, conductivity, dissolved oxygen and oxidation-reduction potential of the surface water were obtained in the field at all surface water sampling points while minimizing disturbance of the bottom sediment.

All water samples were placed in bottles supplied and prepared by the laboratory. The samples were packed in coolers with ice and shipped by courier to the laboratory. All samples were analysed by Maxxam Analytics Inc. of Mississauga, ON, which is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA). Table 2 presents a summary of groundwater and surface water analytical parameters.

2.3 Groundwater Elevations

Water levels were recorded to the nearest 0.005 m using an electronic water level meter for the groundwater monitoring wells listed in Table 3, grouped in relation to their location relative to the landfill footprint and groundwater flow zone monitored.

3. RESULTS AND DISCUSSION

Background information concerning the site geology and hydrogeology was described in detail in the Site Conceptual Model (SCM) report[1] and updated based on results from subsequent hydrogeological investigations[2,3,4,5,6,7], and is summarized here. The SCM report describes the groundwater flow conditions at the Richmond Landfill.

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[1] *Site Conceptual Model Report, WM Richmond Landfill*, prepared by Dr. B.H. Kueper and WESA Inc., October 2009

[2] *Supporting Document, Application to Amend Environmental Compliance Approval No. A371203, Waste Management Richmond Landfill Site*, prepared by BluMetric Environmental Inc., March 2015

[3] *Site Conceptual Model Update and Contaminant Attenuation Zone Delineation, Waste Management Richmond Landfill Site*, prepared by BluMetric Environmental Inc., January 2016

[4] *Addendum to Site Conceptual Model Update and Contaminant Attenuation Zone Delineation, Waste Management Richmond Landfill Site*, prepared by BluMetric Environmental Inc., April 2016

[5] *Site Conceptual Model Update and Contaminant Attenuation Zone Delineation, Waste Management Richmond Landfill Site*, prepared by BluMetric Environmental Inc., July 2017

[6] *Site Conceptual Model Update and Contaminant Attenuation Zone Delineation, Waste Management Richmond Landfill Site*, prepared by BluMetric Environmental Inc., October 2018

[7] *Addendum to Site Conceptual Model Update and Contaminant Attenuation Zone Delineation, Waste Management Richmond Landfill Site*, prepared by BluMetric Environmental Inc., May 2019

Based on the results from extensive studies conducted previously at the site, the basic hydrogeological framework for the facility has been defined as follows:

- The active groundwater flow zone at the site extends to a depth of approximately 30 m below the top of bedrock;
- The shallow groundwater flow zone is conceptualized as the overburden, the overburden-bedrock contact and the upper one to two metres of bedrock;
- The direction of groundwater flow in the shallow flow zone is strongly influenced by topography;
- The intermediate bedrock flow zone extends from one to two m below top of bedrock to a depth of approximately 30 m below top of bedrock;
- Groundwater flows through a network of fractures in the upper 30 m of bedrock;
- the dominant fracture orientation is horizontal to sub-horizontal; however, vertical to sub-vertical fractures are present providing hydraulic connection between horizontal fractures;
- Hydraulic connections of fractures exist in the intermediate bedrock flow zone to the west, south and east of the site (horizontal and vertical connections);
- Intermediate bedrock flownets show that groundwater flow directions are variable with season and generally flows to the west from the western edge of the landfill, to the southeast from the southern edge of the landfill, to the south along the eastern edge of the landfill, and north to northwest from the northern limit of the landfill;
- The hydraulic conductivity of the intermediate bedrock is lower to the north and east of the landfill compared to other areas of the site, implying that the rate of groundwater flow is lower than in areas immediately south, southeast and west of the landfill;
- South of the landfill, the intermediate bedrock flow zone has distinct areas of interacting hydrogeological zones which are not isolated from one another, but are distinct based on hydraulic conductivity, water level variations and the rate of response to recharge events; and,
- Groundwater monitoring wells in the southern portion of the proposed CAZ have static groundwater elevations that are much deeper than wells further north in the CAZ; these deep groundwater elevations appear to be controlled by karst systems confirmed to exist in the southern portion of the proposed CAZ, as discussed in the latest updates to the SCM[6,7].

3.1 LEACHATE RESULTS

3.1.1 Liquid Levels in Leachate Wells

Liquid levels were measured in the two landfill leachate wells on July 15 and October 26, 2020:

- The liquid level at LW-P1 was 146.64 and 146.48 metres above sea level (masl), respectively; and,
- The liquid level at LW-P2 was 149.36 and 149.23 masl, respectively.

3.1.2 Leachate Generation

An estimate of the amount of leachate generated at the site is provided by the site records of the volume of leachate hauled to the Town of Greater Napanee Waste Water Treatment Plant (WWTP) or Kingston's Ravensview WWTP, or pumped to the lined North Lagoon where leachate is stored temporarily on an as needed basis when volumes exceed the WWTP's ability to accept leachate.

The volume of leachate collected from the landfill and hauled to the Napanee and Ravensview WWTPs from January to December 2020 was approximately 29,546 m^3. A volume of approximately 308 m^3 of leachate[8] was also pumped from the North Chamber to the North Lagoon in January 2020 when the WWTPs were unable to accept it. WM started pumping this leachate back to the North Chamber in May once the WWTPs were able to accept higher volumes. A total volume of approximately 8,549 m^3 was pumped back to the North Chamber between May and October. Consequently, the total leachate volume generated by the landfill from January to December 2020 is estimated at 21,007 m^3 (see Table below).

[8] Note that this volume includes 13 m^3 of leachate that was released on January 14, 2020 as detailed in the MECP Provincial Officer's Report for Order Number 3623-BL33DW.

2020 Leachate Volumes (m^3)				
Month	Total Hauled for Treatment	From North Chamber to North Lagoon	From North Lagoon to North Chamber	Landfill-Generated Leachate
Jan	3487	308		3795
Feb	2380			2380
Mar	4501			4501
Apr	3436			3436
May	2043		298	1745
Jun	1927		1371	556
Jul	1869		1514	355
Aug	1789		1478	311
Sep	2307		1943	364
Oct	2440		1550	890
Nov	1416		692	725
Dec	1950			1950
TOTAL	**29,546**			**21,007**

3.2 GROUNDWATER RESULTS

3.2.1 Groundwater Elevations

Groundwater elevations were measured on July 15 and October 26, 2020 from monitoring wells listed in Table 3, and are presented in Tables 4a and 4b, respectively. An inventory of all monitoring well locations is provided in Appendix A. Groundwater elevation contours within the shallow groundwater flow zone are shown on Figure 2a (summer) and Figure 2b (fall), while Figure 3a (summer) and Figure 3b (fall) show groundwater elevation contours for the intermediate bedrock flow zone. Groundwater flow directions were inferred by interpolating the water elevations from wells screened within the corresponding groundwater flow zone, and are consistent with historical results.

The summer and fall 2020 shallow groundwater contours (Figures 2a and 2b, respectively) show that the Empey Hill drumlin southwest from the landfill creates a flow divide, with shallow groundwater being directed both to the north and the south towards areas of lower hydraulic heads. The water level from shallow bedrock monitors M85 and M86 was not used to prepare the summer or fall 2020 groundwater contours, as the water level at these locations, poor producers that recover slowly following purging, are believed to be unrepresentative of static groundwater conditions. North of the landfill, shallow groundwater converges towards Marysville Creek in the area immediately east of County Road 10 (Deseronto Road), while shallow groundwater flow in the southern portion of the site converges on Beechwood Ditch and the southern pond system.

Shallow groundwater east of the landfill is influenced by a local zone of higher water levels in the vicinity of monitoring well M96; shallow groundwater north of M96 flows to the north-northwest and ultimately Marysville Creek, while groundwater south of M96 flows to the south-southwest, towards Beechwood Ditch and the ponds.

The summer and fall 2020 intermediate bedrock zone contours are presented on Figures 3a and 3b, respectively. On the landfill property, groundwater in this hydrostratigraphic unit generally flows to the north, west, and south-southeast relative to the landfill. Monitoring wells M178R-1 (low permeability deeper screen) and M178R-4 (shallower screen with lower hydraulic head believed to be reflective of the shallow flow zone in this area) were not used to generate the interpolated groundwater contours for the Intermediate Bedrock flow zone. Additionally, intermediate bedrock zone monitoring wells located farther to the south (e.g., M173, M174, M181-1, M181-2, M182, M185-1, M187 and M189) were not considered in the groundwater contour interpolation because they exhibit much lower hydraulic heads, and appear to be part of a separate group of hydraulically responsive wells within the intermediate bedrock flow zone. This subset of wells appears to be influenced by karst systems that were identified in the southern part of the proposed CAZ. Additional details from the karst assessment in the area south and southeast of the Site have been provided under separate cover[6,7].

3.2.2 Groundwater Analytical Results

Groundwater monitoring results from the wells sampled in fall 2020 are presented in Table 5a. Groundwater quality data for the fall 2020 monitoring event are consistent with historical results.

Alkalinity, ammonia and 1,4-dioxane results are shown for the Shallow and Intermediate Bedrock Flow Zones on Figures 4 and 5, respectively.

3.2.2.1 Shallow Groundwater Flow Zone

As shown in Table 5a, slightly elevated concentrations of a number of water quality parameters (e.g., alkalinity, boron, chloride, conductivity, DOC, sodium and/or TDS) were observed in some shallow groundwater zone monitoring wells located in close proximity to the landfill footprint, north and northwest from the unlined portion of the landfill (e.g., M66-2, M86, M101, M103 and M104). 1,4-dioxane was detected at monitoring wells M101, M103 and M104, and 1,1-dichloroethane was detected at monitoring well M101. The approximate extents of leachate impacted shallow groundwater, consistent with those delineated from recent hydrogeological investigations[6,7], are shown on Figure 4.

Monitor M54-4, located approximately 200 m south of the landfill footprint, also exhibited slightly elevated alkalinity, conductivity and TDS, as well as low but detectable concentrations of chlorinated VOCs (e.g., 1,1,1-trichloroethane, 1,1-dichloroethane, cis-1,2-dichloroethylene, tetrachloroethylene and trichloroethylene). An assessment of the impacts at shallow monitoring well M54-4, attributed to surface contamination from historical local sources rather than from landfill leachate, was submitted under separate cover[9].

In other areas of the Site, there is no evidence of groundwater impacts away from the landfill footprint in the shallow groundwater flow zone. Isolated occurrences of elevated concentrations of water quality parameters (i.e., one or two parameters per sample) are seen elsewhere on the Site.

3.2.2.2 Intermediate Groundwater Flow Zone

Analytical results from intermediate bedrock groundwater monitors sampled in fall 2020 were generally consistent with historical results.

North of the landfill, elevated concentrations of water quality parameters and detectable 1,4-dioxane concentrations were observed at monitors M6-3 and OW4, which are located in close proximity to the landfill footprint. These results indicate the presence of leachate impacts at these locations. Despite the relatively higher concentrations of some parameters (e.g., alkalinity at OW1 and M5-3), the absence of 1,4-dioxane indicates no impacts from the landfill are apparent further north from the landfill footprint and near Marysville Creek (e.g., at OW1, M5-3, M75, M82-1 and M82-2).

South of the landfill, the presence of 1,4-dioxane and elevated concentrations of alkalinity (typically greater than 400 mg/L where 1,4-dioxane is present), DOC, chloride and TDS indicate groundwater impacts from the landfill at several monitoring well locations (e.g., M9-2, M9-3, M64-2, M108, M109-1, M110-1, M114-1, M121, M123, M167, M168, M170, M172, M178R-2, M178R-3, M178R-4 and M192). 1,4-dioxane was detected for the first time in spring 2020 at monitoring well M70-2, located on site near the southeastern property limit; this well is within the previously delineated area of leachate impacts as 1,4-dioxane has been detected at adjacent monitoring well M170 since 2013 (Figure 5). Monitoring well M70-2, as well as other locations south and southeast of the landfill with elevated concentrations of chloride, sodium, TDS, and/or BTEX compounds (e.g., M106, M185-1, M186, M70-2), are indicative of naturally poor quality connate (and often saline) groundwater.

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9 *Assessment of Chlorinated VOC Impacts at Shallow Groundwater Monitoring Well M54-4, Waste Management Richmond Landfill, Town of Greater Napanee*, BluMetric Environmental Inc., July 2017

These pockets of naturally poor quality groundwater are isolated and do not reflect any widespread or significant upwelling of saline groundwater. Monitoring well M70-2 was recently introduced in the EMP in May 2017, and it is believed that purging activities at this low permeability well may have drawn the nearby contaminant plume to the well screen.

Several monitoring wells downgradient of these impacted wells (e.g. M177, M179, M185-1, M185-2, M186, M187, M188-1 and M190) do not show impacts associated with landfill leachate (i.e. no 1,4-dioxane detected and alkalinity concentrations of 350 mg/L or lower) thus defining the limit of the groundwater plume. The approximate extents of leachate impacted groundwater in the intermediate bedrock flow zone, consistent with those delineated from recent hydrogeological investigations[6,7], are shown on Figure 5.

Wells sampled in the western part of the landfill site (e.g., M72, M74 and M82-1) exhibit concentrations of water quality parameters that are relatively low and continue to reflect background conditions.

3.2.3 Guideline B-7 Reasonable Use Limits (RULs)

Constituent concentrations from selected monitoring wells located within the low-head areas of the WM Richmond Landfill in both the Shallow and Intermediate Bedrock Groundwater Flow Zones are compared to the RULs derived from laboratory analytical results (Table 5b). The RULs reported in Table 5b for leachate indicator parameters and trigger wells were presented in the interim EMP (Revision No. 05) dated April 2016, including 1,4-dioxane for which the site-specific RUL of 0.001 mg/L was set as required by the ERT Order dated December 24, 2015.

All results for 1,4-dioxane at trigger wells in the shallow and intermediate bedrock flow zones were below the RUL of 0.001 mg/L, with the exception of M178R-2, M178R-3, and M178R-4 and M192 with detectable concentrations that are consistent with historical data.
In the shallow groundwater zone, slightly elevated concentrations of a number of inorganic or general water quality parameters above their respective RUL (e.g., alkalinity, DOC, iron, manganese, sodium, and/or TDS) were observed in monitoring wells M54-4, M66-2, M80-2 and OW37-s.

Slightly elevated concentrations of a number of water quality parameters above their respective RUL (e.g., alkalinity, chloride, DOC, iron, manganese, sodium, and/or TDS) were also observed in some intermediate groundwater flow zone monitoring wells (e.g., M82-1, M82-2, M106, M178R-2, M178R-3, M178R-4, M185-1, M186, M190 and M192).

3.2.4 Status of Monitoring Wells and Compliance with Ontario Regulation 903

During the fall 2020 monitoring event, the condition of groundwater monitoring wells included in the EMP was inspected. Any repairs, such as new locks, labels or well caps, were made as necessary. Watertight casings and seals remain in place at all monitors to ensure that surface water or foreign materials cannot enter groundwater monitoring wells. All groundwater monitoring wells are fitted with a vermin proof cap to meet the requirements of Ontario Regulation 903 and are locked to provide protection against vandalism as per Waste Management standard operating procedure and in line with industry best practices.

Shallow groundwater monitoring wells M19, M58-4 and M68-4 are damaged and it is recommended that they be decommissioned when a revised EMP is approved as they cannot be repaired. These wells are considered unnecessary because flow in the shallow groundwater flow zone can be adequately assessed across the site without them.

3.2.6 Groundwater Chemistry Quality Assurance / Quality Control (QA/QC)

An evaluation of QA/QC data (from duplicate and blank samples) is included in Appendix B. A standard margin of error of 20% relative percent difference (RPD) between regular and duplicate samples was deemed acceptable for field duplicates. In general, the comparison between samples and duplicates shows very good correlation for the majority of analyzed constituents. All parameters for groundwater duplicate QA/QC sampling were within the 20% margin of error. All parameters were near or below the RDL in the field blanks, with the exception of some inorganic parameters that showed concentrations greater than 5x the RDL, similar in all field blanks (alkalinity, calcium, chloride, conductivity, sodium and TDS). These results are likely associated with impurities that present in the deionized water supplied by the laboratory.

3.3 SURFACE WATER RESULTS

3.3.1 Pond Elevations

Staff gauges are installed in the three ponds on the south side of the landfill labeled SG1, SG2 and SG3 (Figure 1). Water levels were not recorded at the staff gauges on July 15, 2020 because they were dry. Staff gauge locations and pond water elevations measured on October 26, 2020 are shown on Figure 2b.

3.3.2 Surface Water Monitoring Locations

The two water courses that may receive surface water/storm water runoff from the Richmond Landfill site are Marysville Creek to the north of the waste mound and Beechwood Ditch to the south (Figure 1). Beechwood Ditch is a man-made surface water course that flows from the east onto WM property. It then flows west across a portion of the site before again crossing Beechwood Road and travelling southwest to cross County Road 10, and joins Marysville Creek east of Highway 49 and north of Highway 401. Both Beechwood Ditch and Marysville Creek flow intermittently in the vicinity of the landfill. Marysville Creek has some base flow locally, and flows on a continuous basis west of County Road 10 (Deseronto Road). Marysville Creek eventually discharges into the Bay of Quinte at Hungry Bay.

An ephemeral unnamed local surface water course is present in the central portion of the proposed CAZ boundary, originating from a small man made pond located directly east of Quarry Road (see Figure 1). Surface water flows west from this pond over a distance of approximately 600 m along a topographically low area, to a second pond located near monitoring well M187 and finally to a local topographic depression located approximately 75 m farther west, where water, when flowing, enters into the ground into a near-surface karst feature.

Surface water monitoring locations are shown on Figure 1. No samples were collected during the summer sampling round (August 18, 2020) because all sampling locations were dry. No samples were collected from sampling locations S2, S4R, S5, S6, S7, S8R and S20 in October 2020 because they were dry.

3.3.3 Surface Water Flow

No surface water flow measurements were recorded for the summer sampling event (August 18, 2020) because all sampling locations were dry. Visual observations of surface water flow and general water characteristics for the fall sampling event are summarized in Table 6. Surface water flow velocities were not measured at any location because of insufficient flow conditions.

3.3.4 Surface Water Analytical Results

The analytical results from surface water locations sampled during the fall 2020 sampling event are presented in Table 7.

Surface water quality results were compared to Provincial Water Quality Objectives (PWQO). Background surface water quality was monitored on site at upstream station S2 for Marysville Creek. Background surface water quality was monitored at upstream station S18 for the unnamed local water course located in the central portion of the CAZ. Storm water runoff from the existing landfill area flows to one of three storm water sedimentation retention ponds, located to the northeast, northwest and south of the landfill footprint. Sampling location S3 is located near the downstream property boundary along Marysville Creek.

Parameters analysed in surface water samples collected during the fall 2020 sampling event were all below PWQO, with the exception of total phosphorous at locations S3 and S19, chromium (VI) at location S3, and cobalt and iron at location S19.

Results from fall 2020 are consistent with historical results and indicate that the landfill is not causing adverse impacts to surface water quality.

3.3.5 Surface Water Quality Assurance / Quality Control (QA/QC)

An evaluation of QA/QC data (from duplicate and blank samples) is included in Appendix B. A standard margin of error of 20% was deemed acceptable for field duplicates. In general, the comparison between regular samples and duplicates shows very good correlation for the majority of analyzed constituents. All parameters for the fall sampling round surface water field duplicate sample (location S3) were within the 20% margin of error, with the exception of ammonia and total phosphorous. In both of these cases, the measured concentrations were less than five times the RDL and therefore within acceptable margin of error.

3.4 Subsurface Gas Sampling

On November 3, 2020, BluMetric inspected the subsurface gas monitoring probes and measured methane concentrations at all locations. The locations of the gas monitors are shown on Figure 1 and results are provided in Table 8. Measurements of gas wells were between 0 and 15 ppm, well below the LEL for methane of 5% by volume in air (or 50,000 ppm).

3.5 Annual Summary

A comparative review of groundwater quality results between this and previous sampling events indicates that constituent concentrations vary over time but for the most part have remained relatively consistent over the current calendar year and over the past five years or more. Depending on which monitoring point and more importantly the time scale considered, conflicting trends in concentrations can occur sporadically. However since implementing the revised EMP dated June 29, 2010, the majority of the patterns have been observed to be seasonally variable but relatively similar.

Where sufficient historical data are available, alkalinity, chloride, dissolved organic carbon (DOC), iron, manganese, sodium and total dissolved solids (TDS) concentration data were reviewed for all groundwater trigger wells listed in Table 12 of the EMP. Time-concentration plots are provided in Appendix C. Over the past nine years (from the spring of 2012 to the fall of 2020), the vast majority of the analytical results show stabilized and/or variable/oscillating concentrations for almost all parameters. Exceptions to this generalization include:

- For the shallow groundwater monitors:
    - M54-4 for alkalinity, DOC, manganese and sodium (increasing trend) and chloride (increased to peak concentration of 130 mg/L in fall 2009 then decreasing trend since that time);
    - M66-2 for TDS (decreasing trend) and sodium (decreasing trend until spring 2018, then increasing trend);
    - M67-2 for sodium and TDS (decreasing trend);
    - M80-2 for alkalinity, sodium and TDS (increasing trend) and chloride (increased to peak of concentration of 85 mg/L in fall 2015 then decreasing trend since that time);
    - M86 for alkalinity (increasing trend) and chloride, DOC, iron, manganese, sodium and TDS (decreasing trend); and,
    - OW37-s for alkalinity, DOC, iron and manganese (increasing trend) and chloride (decreasing trend).
- For the intermediate bedrock groundwater monitors:
    - M56-2 for alkalinity (increasing);
    - M82-1 for DOC (decreasing trend);
    - M106 for chloride, sodium and TDS (increasing trend until 2015 then stable/slightly decreasing trend);
    - M179 for manganese (decreasing);
    - M188-1 for sodium (decreasing);

- M185-1 for alkalinity, DOC and manganese (decreasing) and chloride (increasing); and,
- M186 for alkalinity (increasing) and manganese and TDS (decreasing trend).

The observed trends in groundwater geochemistry outlined here are not necessarily indicative of landfill leachate impacts, and should be interpreted with caution.

1,4-dioxane was added since 2013 to the environmental monitoring program as a primary leachate indicator parameter. Time-concentration plots for 1,4-dioxane are included in Appendix D. Review of apparent temporal trends shows that:

- Plot A shows that concentrations are significantly higher at monitoring wells M6-3, OW4 and M104, located adjacent to the north of the landfill, compared to all other monitoring locations. Details for the areas to the north (blue series), southeast (green series) and south (red series) of the landfill are shown on Plots B, C and D, respectively;
- To the north of the landfill (Plot B), stable or declining (notably since 2018) trends are observed in the shallow groundwater flow zone (M101, M103 and M104) and intermediate bedrock flow zone (M6-3 and OW4);
- To the southeast of the landfill (Plot C), 1,4-dioxane was detected at M70-2 for the first time in 2020, increasing trends are observed at M170 and M192, and to a lesser degree at M168 located farther downgradient, while a generally decreasing trend is observed at M167; and,
- To the south of the landfill (Plot D), stable or declining trends are observed in the intermediate bedrock flow zone (M114-1, M121, M178R-2, M178R-3, M178R-4 and M64-2).

The stable and declining trends observed in 1,4-dioxane concentrations north and south of the landfill in both shallow and intermediate bedrock zones confirm that the plume is stable and naturally attenuating in these areas. With respect to the southeast portion of the property, WM has proposed to extend the eastern limit of the proposed Contaminant Attenuation Zone (CAZ) north of Beechwood Road by adding an area of approximately 20 acres east of the landfill property if an agreement can be reached with the property owner[6,7]. If such a negotiated agreement cannot be achieved, WM will implement an alternative solution consisting of a purge well system located along the eastern landfill property limit, designed to hydraulically control the off-site migration of landfill leachate impacted groundwater in the intermediate bedrock flow zone.

3.6 ADDITIONAL INVESTIGATIONS

Work outside of the scope of the EMP program was performed throughout the year at the Richmond Landfill Site. Table 9 summarizes the activities and reporting completed in 2020, as well as anticipated work planned for 2021.

Surface water and groundwater investigations were conducted in January 2020 as required by Provincial Officer's Order No. 3623-BL33DW (POO) dated January 23, 2020, following releases of leachate on January 14, 2020 in the area north of the landfill near the North Lagoon, as well as overflow in early January south of the landfill from the leachate collection system. Sampling results were submitted to MECP and public notices posted on the landfill website and distributed to interested parties. Additionally, an investigation was completed in 2020 to assess the integrity of the landfill's final cover system and evaluate groundwater infiltration into the leachate collection system. The results from this investigation were reported in December 2020[10].

As requested by the MECP, an investigation of the North Lagoon was initiated in fall 2019, including drilling and testing of additional groundwater monitoring wells and sampling of the lagoon. The results of the North Lagoon investigation were reported in March and April 2020[11,12] and updated water balance portion in May and July 2020. Monitoring wells M217 and M218, installed as part of the North Lagoon investigation, were sampled quarterly in 2020 as part of additional sampling events required by the EMP, as per amended ECA Condition No. 8.5(c)iv included in the ERT Order dated July 15, 2015. This condition requires that newly installed wells be tested a minimum of four times on a quarterly basis during the first year after being established. Quarterly sampling results from M217 and M18, as well as additional lagoon sampling results, were reported in December 2020[13].

Other activities conducted in 2020 were related to requirements from a separate ECA associated with the monitoring of on-site Ponds and Leachate, as well as from the Town of Napanee Waste Water Treatment Plant (WWTP) where landfill leachate is hauled and treated.

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[10] *Landfill Cover Integrity Study, Waste Management Richmond Landfill Site*, BluMetric Environmental Inc., December 2020

[11] *North Lagoon Investigation, Waste Management Richmond Landfill Site*, BluMetric Environmental Inc., March 2020

[12] *Expanded Timeframe for Water Balance for the North Lagoon, Waste Management Richmond Landfill*, BluMetric Environmental Inc., Memorandum dated April 22, 2020

[13] *North Lagoon and Groundwater Sampling Results, Waste Management Richmond Landfill, Town of Greater Napanee*, BluMetric Environmental Inc., Memorandum dated December 10, 2020

4. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The summer and fall 2020 monitoring programs included the collection of groundwater and surface water samples, as well as landfill gas monitoring, in accordance with the site monitoring requirements outlined in the revised interim EMP (Revision No. 05) dated April 15, 2016, as specified in the Amended Environmental Compliance Approval (ECA) number A371203, issued by MECP July 14, 2017 to reflect all amendments to the ECA that had been issued since the original ECA was issued in January 2012 and ERT Order dated December 24, 2015.

The following were completed as part of the summer and fall 2020 EMP monitoring events, between July 15 and August 18, 2020 and October 26 and November 3, 2020, respectively:

- Water levels were recorded from groundwater monitoring wells installed in the Shallow groundwater and Intermediate Bedrock Flow Zones, as well as leachate monitoring wells;
- Groundwater monitors completed in the Shallow and Intermediate Bedrock Flow Zones were sampled for analytical testing;
- Surface water locations were sampled for analytical testing;
- Landfill gas monitoring wells were monitored for methane concentrations; and,
- Quality Assurance/Quality Control (QA/QC) samples were collected, including field duplicate samples and field blank samples.

4.1 GROUNDWATER

- Groundwater flow directions interpreted from water elevations measured in monitors were consistent with historical flownets:
  - Shallow groundwater flow on site is influenced by local topographic highs in the southwestern (Empey Hill Drumlin) and eastern (groundwater monitor M96 area) portions of the site, and is characterized by a flow divide with shallow groundwater being directed both to the north (toward Marysville Creek) and the south (toward Beechwood Ditch). South of Beechwood Road shallow groundwater flow converges from local topographic highs to the north and south, and discharges to a local surface water course within a topographically low area running east-west in the central portion of the proposed CAZ;
  - Groundwater in the intermediate bedrock flow zone generally flows to the north, west, and south-southeast relative to the landfill;
- Groundwater quality data from fall 2020 are generally consistent with historical results;
- Slightly elevated groundwater concentrations of a number of water quality parameters are seen in the Shallow Flow Zone within the property in the immediate vicinity of the landfill footprint to the south, north and northwest of the landfill footprint;

- The geochemical results for the Intermediate Bedrock Flow Zone indicate higher concentrations of water quality parameters associated with landfill leachate impacts to the south-southeast and immediately north of the landfill relative to concentrations west and east of the landfill;
- Time-concentration plots of 1,4-dioxane results indicate that to the north of the landfill, stable or declining trends are observed in the shallow and intermediate bedrock flow zones; to the south of the landfill, generally stable or declining trends are observed in the intermediate bedrock flow zone; and, to the southeast of the landfill, increasing trends are observed at M170 and M192, and to a lesser degree at M168 located farther downgradient, while a generally decreasing trend is observed at M167;
- Continued groundwater monitoring within the Shallow and Intermediate Bedrock groundwater flow zones between the landfill footprint and the low-head areas is warranted in order to further examine groundwater quality and any trends over time;
- The proposed Contaminant Attenuation Zone (CAZ) should be extended onto the property adjacent to the southeast portion of the landfill property if an agreement can be reached with the owner; failing this, an engineered hydraulic control system should be implemented upgradient of this area to prevent further off-site migration of leachate impacted groundwater; and,
- Shallow groundwater monitoring wells M19, M58-4 and M68-4 are damaged and are considered unnecessary for the EMP monitoring program. Upon approval from MECP, these wells will be decommissioned.

4.2 SURFACE WATER

- The concentrations observed during the fall 2020 monitoring event are within the range of historical monitoring results and indicate that the landfill is not causing adverse impacts to surface water quality;
- The concentration of total phosphorous exceeded PWQO at locations S3 and S19; chromium exceeded PWQO at location S3; and cobalt and iron exceeded PWQO at location S19; and,
- All other measured parameters were consistent with natural surface water quality and below PWQO.

4.3 SUBSURFACE GAS

Measurements for methane gas were between 0 and 15 ppm for the six monitoring locations, well below the LEL for methane of 5% by volume in air (or 50,000 ppm).

5. LIMITING CONDITIONS

The summer and fall 2020 monitoring program involved the collection of groundwater (from on-site and off-site monitoring wells), surface water and off site domestic supply wells for analyses. The data collected during this investigation represent the conditions at the sampled locations only.

The conclusions presented in this report represent our professional opinion and are based on the conditions observed on the dates set out in the report, the information available at the time this report was prepared, the scope of work, and any limiting conditions noted herein.

BluMetric Environmental Inc. provides no assurances regarding changes to conditions subsequent to the time of the assessment. BluMetric Environmental Inc. makes no warranty as to the accuracy or completeness of the information provided by others or of the conclusions and recommendations predicated on the accuracy of that information.

This report has been prepared for Waste Management of Canada. Any use a third party makes of this report, any reliance on the report, or decisions based upon the report, are the responsibility of those third parties unless authorization is received from BluMetric Environmental Inc. in writing. BluMetric Environmental Inc. accepts no responsibility for any loss or damages suffered by any unauthorized third party as a result of decisions made or actions taken based on this report.

Respectfully submitted,
BluMetric Environmental Inc.

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TABLES

Table 1: Summary of Environmental Monitoring Program

Monitoring Locations		Parameter Suite	Monitoring Frequency
Shallow Groundwater Flow Zone Monitors			
M58-4, M68-4, M70-3, M96, M99-2		Groundwater Inorganic & General	Once each year, in spring
		VOCs	
M53-4, M54-4, M66-2, M67-2, M80-2, M81, M85, M86, M87-2, M101, M103, M104, M114-2, OW37-s		Groundwater Inorganic & General	Twice each year, in spring and fall
		VOCs	
Intermediate Bedrock Groundwater Flow Zone Monitors			
M56-2, M58-3, M59-2, M59-4, M91-1, M95-1		Groundwater Inorganic & General	Once each year, in spring
		VOCs	
M5-3, M6-3, M9-2, M9-3, M52-2, M64-2, M70-2, M72, M74, M75, M80-1, M82-1, M82-2, M106, M108, M109-1, M110-1, M114-1, M121, M123, M167, M168, M170, M172, M177, M178R-2, M178R-3, M178R-4, M179, M185-1, M185-2, M186, M187, M188, M190, M192, OW1, OW4		Groundwater Inorganic & General	Twice each year, in spring and fall
		VOCs	
Surface Water Sampling Locations			
Beechwood Ditch	S4R, S5 and S8R	Surface Water Inorganic and General	Three times each year, in spring, summer[1] and fall.
Marysville Creek	S2, S3, S6 and S7		
Unnamed water course in central portion of proposed CAZ	S18, S19 and S20		
Leachate Monitoring Locations			
North Chamber and South Chamber		Leachate Inorganic & General	Once each year, in spring
		VOCs	
Landfill Gas Monitoring Wells			
GM1, GM3, GM4-1, GM4-2, GM5, GM6		% methane by volume	Twice each year, in spring and fall
Off-site Domestic Water Supply Wells			
1441 County Road 1 West 1483 County Road 1 West 1494 County Road 1 West (UNKN)[2] 1499 County Road 1 West 1556 County Road 1 West (UNKN)[2] 1614 County Road 1 West 1654 County Road 1 West 1680 County Road 1 West 1695 County Road 1 West 1866 County Road 1 West 614 Belleville Road 696 Belleville Road		1,4 dioxane	Once every two years, starting in 2015

[1] The summer monitoring event shall be scheduled after a rainfall of more than 25 mm

[2] The final list of domestic well locations will depend on confirmation of which addresses have drilled wells (locations where well construction is unknown are denoted UNKN). A residential survey will be completed in order to determine which of these locations are to be sampled. Only those residences with drilled bedrock wells that supply water for domestic use will be sampled; residences that use shallow dug wells or cisterns for water supplies are not included in the program.

Table 2: Analytical Parameters for Water and Leachate Samples

Groundwater Inorganic and General Parameters		
Total dissolved solids	Magnesium	Manganese
Alkalinity	Sodium	Ammonia (total)
Conductivity	Potassium	Nitrate
Dissolved organic carbon	Boron	Nitrite
Calcium	Iron	Chloride
		Sulphate
Volatile Organic Compounds (VOCs)		
1,4-dioxane	1,2-Dichlorobenzene	1,1,2-Trichloroethane
Benzene	1,3-Dichlorobenzene	1,1-Dichloroethane
Toluene	1,4-Dichlorobenzene	1,2-Dichloroethane
Ethylbenzene	Methylene chloride	1,1-Dichloroethylene
m&p-Xylene	Chloromethane	Cis-1,2-Dichloroethylene
o-Xylene	Chloroethane	Trans-1,2-Dichloroethylene
Styrene	1,1,2,2-Tetrachloroethane	Trichloroethylene
1,3,5-Trimethylbenzene	1,1,1,2-Tetrachloroethane	Tetrachloroethylene
Chlorobenzene	1,1,1-Trichloroethane	Vinyl chloride
Surface Water Inorganic and General Parameters		
1,4-dioxane	Potassium	Nitrate
Total suspended solids	Boron	Nitrite
Total dissolved solids	Cadmium	Chloride
Biological oxygen demand	Chromium (Total, Cr6+, Cr3+)	Sulphate
Chemical oxygen demand	Cobalt	Phenols
Alkalinity	Copper	Total phosphorous
Conductivity	Iron	Naphthalene
Hardness	Lead	
Calcium	Nickel	*Field measurements:*
Magnesium	Zinc	*pH, temperature, conductivity, dissolved*
Sodium	Ammonia (total & un-ionized)	*oxygen, estimated flow rate*
Leachate Inorganic and General Parameters		
Total dissolved solids	Dissolved organic carbon	Ammonia (total)
Conductivity	Boron	Total Kjeldahl nitrogen
Alkalinity	Cadmium	Nitrate
pH	Chromium (total)	Nitrite
Hardness	Cobalt	Chloride
Calcium	Copper	Sulphate
Magnesium	Iron	Total phosphorous
Sodium	Lead	Phenols
Potassium	Manganese	Naphthalene
Biological oxygen demand	Nickel	N-nitrosodimethylamine (NDMA)
Chemical oxygen demand	Zinc	

Table 3: Groundwater Elevation Monitoring Locations

Location	Shallow Groundwater Flow Zone	Intermediate Groundwater Flow Zone
West of landfill footprint	M27, M58-4, M67-2, M84, M87-2, M88-2, M89-2, M97, M98, M99-2, M100, M101, M102, OW37-s	M3A-3, M56-2, M58-3, M59-2, M59-3, M59-4, M72, M73, M74, M82-1, M82-2, M91-1, M95-1
East of landfill footprint	M19, M23, M47-3, M68-4, M70-3, M77, M94-2, M96	M50-3, M52-2, M70-2, M108, M170
North of landfill footprint	M35, M60-4, M65-2, M66-2, M83, M85, M86, M103, M104	M46-2, M60-1, OW1
South of landfill footprint; north of Beechwood Road	M12, M14, M15, M18, M41, M53-4, M54-4, M80-2, M81	M9-2, M9-3, M10-1, M49-1, M53-2, M71, M80-1, M105, M106, M107, M109-1, M109-2, M110-1, M111-1, M112-1, M113-1, M192, M193
South of landfill footprint; south of Beechwood Road	M114-2, M115-2	M63-2, M64-2, M114-1, M116, M121, M122, M123, M125, M166, M167, M168, M173, M174, M176, M177, M178R-1, M178R-2, M178R-3, M178R-4, M179, M180, M181-1, M181-2, M182, M185-1, M185-2, M186, M187, M188, M189, M190, M191

Table 4a: Groundwater Elevations - July 15, 2020

Monitoring Well	Water Level (masl)	Monitoring Well	Water Level (masl)	Monitoring Well	Water Level (masl)	Monitoring Well	Water Level (masl)
Shallow Groundwater Flow Zone							
M12	124.59	M54-4	123.85	M83	123.35	M98	128.82
M14	125.50	M58-4	123.31	M84	121.95	M99-2	129.04
M15	dry	M60-4	123.90	M85	119.93	M100	124.06
M18	dry	M65-2	123.40	M86	120.98	M101	122.81
M19	damaged	M66-2	122.12	M87-2	123.37	M102	122.89
M23	125.82	M67-2	122.29	M88-2	127.03	M103	122.52
M27	124.83	M68-4	dry	M89-2	128.30	M104	122.51
M35	123.17	M70-3	dry	M94-2	123.87	M114-2	122.80
M41	124.88	M77	124.64	M96	127.33	M115-2	123.84
M47-3	123.80	M80-2	123.17	M97	124.31	OW37-s	121.78
M53-4	124.40	M81	124.16				
Intermediate Bedrock Groundwater Flow Zone							
M3A-3	124.49	M71	123.51	M113-1	122.57	M178R-4	116.24
M9-2	119.73	M72	122.40	M114-1	119.54	M179	108.72
M9-3	124.72	M73	122.43	M116	119.56	M180	110.93
M10-1	119.60	M74	123.09	M121	119.54	M181-1	95.87
M46-2	123.06	M80-1	122.66	M122	119.47	M181-2	104.91
M49-1	119.35	M82-1	122.53	M123	119.23	M182	89.05
M50-3	124.09	M82-2	122.09	M125	119.59	M185-1	107.77
M52-2	120.61	M91-1	122.58	M166	119.25	M185-2	114.09
M53-2	119.32	M95-1	122.47	M167	119.25	M186	114.12
M56-2	122.61	M105	119.69	M168	119.25	M187	89.63
M58-3	122.60	M106	122.52	M170	119.64	M188-1	114.78
M59-2	122.65	M107	119.66	M173	99.69	M189	104.72
M59-3	122.60	M108	119.27	M174	89.713	M190	113.39
M59-4	122.62	M109-1	119.67	M176	108.76	M191	114.95
M60-1	123.43	M109-2	119.68	M177	114.56	M192	119.25
M63-2	120.66	M110-1	119.67	M178R-1	115.36	M193	120.80
M64-2	118.63	M111-1	122.54	M178R-2	118.35	OW1	122.78
M70-2	119.81	M112-1	122.57	M178R-3	118.18		

Table 4b: Groundwater Elevations - October 26, 2020

Monitoring Well	Water Level (masl)	Monitoring Well	Water Level (masl)	Monitoring Well	Water Level (masl)	Monitoring Well	Water Level (masl)
Shallow Groundwater Flow Zone							
M12	124.54	M54-4	123.87	M83	123.36	M98	129.37
M14	125.00	M58-4	dry	M84	121.77	M99-2	129.06
M15	dry	M60-4	123.63	M85	120.18	M100	123.84
M18	dry	M65-2	122.42	M86	122.48	M101	122.68
M19	damaged	M66-2	122.08	M87-2	122.46	M102	124.10
M23	124.95	M67-2	121.92	M88-2	125.73	M103	122.94
M27	126.32	M68-4	dry	M89-2	127.64	M104	123.06
M35	123.44	M70-3	dry	M94-2	123.54	M114-2	123.10
M41	124.93	M77	123.37	M96	125.89	M115-2	124.13
M47-3	123.40	M80-2	123.01	M97	123.29	OW37-s	121.89
M53-4	124.35	M81	124.25				
Intermediate Bedrock Groundwater Flow Zone							
M3A-3	124.47	M71	123.56	M113-1	122.77	M178R-4	116.42
M9-2	119.01	M72	122.61	M114-1	118.92	M179	109.22
M9-3	123.87	M73	122.67	M116	118.94	M180	111.41
M10-1	118.96	M74	123.16	M121	118.93	M181-1	95.86
M46-2	123.47	M80-1	122.90	M122	118.91	M181-2	104.63
M49-1	118.35	M82-1	122.82	M123	118.72	M182	91.35
M50-3	124.16	M82-2	122.31	M125	118.96	M185-1	112.07
M52-2	119.55	M91-1	122.80	M166	118.74	M185-2	115.40
M53-2	118.69	M95-1	122.70	M167	118.74	M186	114.13
M56-2	122.81	M105	118.98	M168	118.75	M187	91.24
M58-3	122.83	M106	122.74	M170	118.95	M188-1	115.36
M59-2	122.93	M107	118.98	M173	99.56	M189	104.76
M59-3	122.92	M108	118.75	M174	91.09	M190	115.33
M59-4	122.86	M109-1	118.97	M176	108.96	M191	116.12
M60-1	122.07	M109-2	118.98	M177	115.15	M192	118.74
M63-2	120.54	M110-1	118.98	M178R-1	114.92	M193	120.20
M64-2	118.44	M111-1	122.75	M178R-2	119.26	OW1	122.54
M70-2	119.02	M112-1	122.80	M178R-3	119.31		

Table 5a: Groundwater Quality Results - October 27 - 29, 2020

		Alkalinity	Ammonia	Boron	Calcium	Chloride	Conductivity µS/cm	Dissolved Organic Carbon	Iron	Magnesium	Manganese	Nitrate	Nitrite	Potassium	Sodium	Sulphate	Total Dissolved Solids	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethylene	1,2-Dichlorobenzene (o)	1,2-Dichloroethane
Name	Date	mg/L	mg/L	mg/L	mg/L	mg/L	mS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Shallow Groundwater Flow Zone [1]																									
M54-4	2020-10-28	480	< 0.15	0.058	150	47	1100	2.9	< 0.1	31	0.034	< 0.1	< 0.01	1.8	76	59	650	< 0.0002	0.0012	< 0.0002	< 0.0002	0.0025	< 0.0001	< 0.0002	< 0.0002
M66-2	2020-10-27	390	0.33	1.4	65	130	1500	1.7	0.23	27	0.018	< 0.1	< 0.01	8.4	220	210	905	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M80-2	2020-10-27	350	< 0.15	0.042	83	45	840	1.8	< 0.1	44	0.007	< 0.1	< 0.01	3.6	26	37	510	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M81	2020-10-27	320	< 0.15	0.034	96	82	900	1.5	< 0.1	50	0.021	< 0.1	< 0.01	2.5	11	36	625	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M86	2020-10-28	350	< 0.15	1.1	65	36	960	2.2	< 0.1	33	0.01	0.43	< 0.01	17	100	110	540	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M87-2	2020-10-28	230	< 0.15	0.031	57	25	600	1.6	< 0.1	35	0.009	< 0.1	< 0.01	2.1	13	50	350	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M101	2020-10-27	470	< 0.15	0.077	150	49	1100	2.3	< 0.1	47	0.014	< 0.1	< 0.01	4.6	17	54	705	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00041	< 0.0001	< 0.0002	< 0.0002
M103	2020-10-27	650	< 0.15	0.27	140	160	1700	3.6	< 0.1	85	0.003	0.19	< 0.01	6.5	130	49	915	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M104	2020-10-27	900	1.91	2.3	190	1100	6200	51	< 0.1	190	0.8	231	0.105	16	900	64	3790	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001
M114-2	2020-10-28	320	< 0.15	0.028	120	130	1100	1.7	< 0.1	19	< 0.002	1.14	< 0.01	1.2	100	48	640	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
OW37-s	2020-10-29	190	< 0.15	0.087	44	29	460	4.5	0.45	16	0.22	< 0.1	< 0.01	7.2	21	5.6	180	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
Intermediate BedrockGroundwater Flow Zone																									
M5-3	2020-10-27	460	1.34	1.1	34	46	980	1.4	< 0.1	27	< 0.002	< 0.1	< 0.01	13	140	< 1	645	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M6-3	2020-10-27	1200	4.46	0.37	740	1400	9000	43	< 0.1	0.24	< 0.002	< 0.1	< 0.01	41	650	37	4120	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M9-2	2020-10-27	500	0.85	0.26	130	110	1200	6.4	11	36	0.33	< 0.1	< 0.01	6.3	98	< 1	695	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M9-3	2020-10-27	300	1.16	0.53	55	100	890	2.1	0.78	30	0.058	< 0.1	< 0.01	15	75	< 1	455	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00011	< 0.0001	< 0.0002	< 0.0002
M52-2	2020-10-29	300	1.84	1.1	33	440	2100	1.4	< 0.1	23	0.005	< 0.1	< 0.01	14	350	9.7	945	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M64-2	2020-10-29	310	0.98	0.96	55	140	990	1.2	< 0.1	31	0.007	< 0.1	< 0.01	9.8	92	1.7	485	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M70-2	2020-10-29	550	1.79	1.5	44	400	2300	2.7	0.89	31	0.013	< 0.1	< 0.01	13	410	2.4	1140	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M72	2020-10-27	290	0.54	0.42	57	27	640	1.5	< 0.1	34	0.004	< 0.1	< 0.01	7.6	19	26	435	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M74	2020-10-27	310	1.24	0.88	34	15	640	1.6	< 0.1	22	0.028	< 0.1	< 0.01	12	68	17	455	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M75	2020-10-27	310	1.16	0.93	38	45	950	1.8	< 0.1	24	0.026	< 0.1	< 0.01	13	130	110	590	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M80-1	2020-10-27	160	0.42	0.39	21	24	370	1.1	< 0.1	12	0.004	< 0.1	< 0.01	4.5	38	8	265	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M82-1	2020-10-29	340	0.96	0.93	51	40	870	2.4	< 0.1	28	0.003	< 0.1	< 0.01	10	90	50	350	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M82-2	2020-10-29	340	0.25	0.16	110	27	790	3	< 0.1	29	0.019	< 0.1	< 0.01	3.8	19	48	395	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M106	2020-10-28	390	2.69	2.1	120	1500	5500	1.4	< 0.1	78	0.002	< 0.1	< 0.01	24	850	1.8	2970	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.002	0.00049	< 0.0002	< 0.0002
M108	2020-10-27	430	0.69	0.19	100	58	940	4.8	2.3	30	0.12	< 0.1	< 0.01	6.4	59	< 1	560	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00035	< 0.0001	< 0.0002	< 0.0002
M109-1	2020-10-28	560	1.3	0.35	150	130	1400	7.5	13	44	0.3	< 0.1	< 0.01	7.2	110	< 1	735	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M110-1	2020-10-28	660	0.64	0.48	180	160	1700	8	< 0.1	59	0.015	< 0.1	< 0.01	8.3	130	< 1	955	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M114-1	2020-10-28	380	0.4	0.17	100	66	910	4.3	5.7	25	0.3	< 0.1	< 0.01	5.3	62	1.7	515	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	0.0002	< 0.0002	< 0.0002
M121	2020-10-29	590	1.9	1.5	72	940	4000	3	< 0.1	55	< 0.002	< 0.1	< 0.01	16	710	5.3	2140	< 0.01	< 0.005	< 0.01	< 0.01	< 0.005	< 0.005	< 0.01	< 0.01
M123	2020-10-29	350	0.24	0.14	89	29	730	3.4	< 0.1	19	0.011	< 0.1	< 0.01	3.6	41	7	450	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00019	< 0.0001	< 0.0002	< 0.0002
M167	2020-10-29	390	2.05	0.93	100	470	2300	3.1	< 0.1	64	0.003	< 0.1	< 0.01	20	250	3.5	1150	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M168	2020-10-29	490	1.36	0.7	140	290	1900	4.1	< 0.1	50	0.003	< 0.1	< 0.01	14	180	3.5	990	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M170	2020-10-29	770	1.72	2.1	38	480	2900	4	< 0.1	26	< 0.002	< 0.1	< 0.01	14	560	4.1	1590	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M172	2020-10-29	500	0.8	0.14	160	120	1200	5.8	20	34	0.64	< 0.1	< 0.01	4.6	62	< 1	620	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0012	0.00015	< 0.0002	< 0.0002
M177	2020-10-28	250	0.55	0.38	84	12	560	1.9	< 0.1	17	0.005	< 0.1	< 0.01	6.4	8.8	33	350	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M178R-2	2020-10-28	350	0.21	0.16	100	35	780	4.1	0.84	21	0.056	< 0.1	< 0.01	4.5	41	16	455	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00086	< 0.0001	< 0.0002	< 0.0002
M178R-3	2020-10-28	410	0.34	0.24	120	60	950	4.3	1.3	27	0.074	< 0.1	< 0.01	5.4	52	13	500	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00088	< 0.0001	< 0.0002	< 0.0002
M178R-4	2020-10-28	400	0.3	0.2	120	48	900	3.9	0.12	25	0.029	< 0.1	< 0.01	5.2	51	14	540	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00073	< 0.0001	< 0.0002	< 0.0002
M179	2020-10-28	240	0.32	0.31	100	67	770	2.6	0.16	17	0.029	< 0.1	< 0.01	4.7	56	19	375	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M185-1	2020-10-28	300	1.6	1.6	43	450	2200	1.3	< 0.1	17	0.007	< 0.1	< 0.01	11	410	35	1140	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M185-2	2020-10-28	280	< 0.15	0.1	110	2.9	560	2	< 0.1	6.5	0.013	< 0.1	< 0.01	1.9	4.8	25	330	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M186	2020-10-29	350	2.57	1.9	76	1200	4500	1.5	0.35	52	0.066	< 0.1	< 0.01	23	750	2.5	2310	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M187	2020-10-29	260	< 0.15	0.072	100	18	600	2.1	< 0.1	6.7	< 0.002	0.17	< 0.01	1.8	15	37	355	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M188-1	2020-10-28	280	0.53	0.4	57	30	630	1.6	< 0.1	18	0.009	< 0.1	< 0.01	5.4	54	14	340	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M190	2020-10-28	300	0.17	0.13	130	80	840	3.2	< 0.1	15	0.007	< 0.1	< 0.01	4	28	34	550	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M192	2020-10-29	610	2.31	2.1	83	480	2600	4.2	< 0.1	55	0.018	< 0.1	< 0.01	20	370	1.2	1400	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
OW1	2020-10-27	420	3.79	1	45	59	1100	2.6	< 0.1	32	0.042	< 0.1	< 0.01	13	140	64	685	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
OW4	2020-10-27	1100	1.11	1.1	160	430	3200	42	9.7	100	0.17	< 0.1	< 0.01	12	420	< 1	1840	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005

[1] M53-4, M67-2 and M85 Purged Dry - No Samples Collected

BluMetric™ Environmental

Table 5a: Groundwater Quality Results - October 27 - 29, 2020

Name	Date	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene (m)	1,4-Dichlorobenzene (p)	1,4-Dioxane	Benzene	Chlorobenzene	Chloroethane	Chloromethane	Cis-1,2-Dichloroethylene	Dichloromethane	Ethylbenzene	m+p-Xylene	o-Xylene	Styrene	Tetrachloroethylene	Toluene	Total Xylenes	Trans-1,2-dichloroethylene	Trichloroethylene	Vinyl Chloride
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Shallow Groundwater Flow Zone [1,2]																					
M54-4	2020-10-28	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	0.0012	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	0.0033	< 0.0002	< 0.0001	< 0.0001	0.001	< 0.0002
M66-2	2020-10-27	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M80-2	2020-10-27	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M81	2020-10-27	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M86	2020-10-28	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M87-2	2020-10-28	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M101	2020-10-27	< 0.0002	< 0.0002	< 0.0002	0.006	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M103	2020-10-27	< 0.0002	< 0.0002	< 0.0002	0.013	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M104	2020-10-27	< 0.001	< 0.001	< 0.001	0.1	< 0.0005	< 0.0005	< 0.001	< 0.0025	< 0.0005	< 0.0025	< 0.0005	< 0.0005	< 0.0005	< 0.001	< 0.0005	< 0.001	< 0.0005	< 0.0005	< 0.0005	< 0.001
M114-2	2020-10-28	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
OW37-s	2020-10-29	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
Intermediate BedrockGroundwater Flow Zone																					
M5-3	2020-10-27	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00016	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	0.00016	< 0.0002	< 0.0001	< 0.0002	0.00016	< 0.0001	< 0.0001	< 0.0002
M6-3	2020-10-27	< 0.0005	< 0.0005	< 0.0005	0.33	0.00089	< 0.00025	< 0.0005	< 0.0013	< 0.00025	< 0.0013	< 0.00025	0.0016	0.00045	< 0.0005	< 0.00025	0.0045	0.0021	< 0.00025	< 0.00025	< 0.0005
M9-2	2020-10-27	< 0.0002	< 0.0002	< 0.0002	0.019	0.0014	< 0.0001	0.017	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00015	< 0.0001	< 0.0002	< 0.0001	< 0.0002	0.00015	< 0.0001	< 0.0001	0.00025
M9-3	2020-10-27	< 0.0002	< 0.0002	< 0.0002	0.0026	< 0.0001	< 0.0001	0.0024	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M52-2	2020-10-29	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M64-2	2020-10-29	< 0.0002	< 0.0002	< 0.0002	0.0031	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M70-2	2020-10-29	< 0.0002	< 0.0002	< 0.0002	0.0047	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M72	2020-10-27	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M74	2020-10-27	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M75	2020-10-27	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M80-1	2020-10-27	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00055	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	0.00014	0.0018	0.00034	< 0.0002	< 0.0001	0.00038	0.0021	< 0.0001	< 0.0001	< 0.0002
M82-1	2020-10-29	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M82-2	2020-10-29	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M106	2020-10-28	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00058	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M108	2020-10-27	< 0.0002	< 0.0002	< 0.0002	0.0082	< 0.0001	< 0.0001	0.0035	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M109-1	2020-10-28	< 0.0002	< 0.0002	< 0.0002	0.022	0.00018	< 0.0001	0.0073	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M110-1	2020-10-28	< 0.0002	< 0.0002	< 0.0002	0.025	0.00035	< 0.0001	0.0084	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00034	< 0.0001	< 0.0002	< 0.0001	< 0.0002	0.00034	< 0.0001	< 0.0001	< 0.0002
M114-1	2020-10-28	< 0.0002	< 0.0002	< 0.0002	0.0041	0.00062	< 0.0001	0.0059	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M121	2020-10-29	< 0.01	< 0.01	< 0.01	0.0048	0.28	< 0.005	< 0.01	< 0.025	< 0.005	< 0.025	0.011	0.11	0.007	< 0.01	< 0.005	0.025	0.12	< 0.005	< 0.005	< 0.01
M123	2020-10-29	< 0.0002	< 0.0002	< 0.0002	0.0035	< 0.0001	< 0.0001	0.0033	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M167	2020-10-29	< 0.0002	< 0.0002	< 0.0002	0.0019	0.00073	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M168	2020-10-29	< 0.0002	< 0.0002	< 0.0002	0.0084	0.00014	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M170	2020-10-29	< 0.0002	< 0.0002	< 0.0002	0.014	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M172	2020-10-29	< 0.0002	< 0.0002	< 0.0002	0.0079	< 0.0001	< 0.0001	0.0043	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M177	2020-10-28	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M178R-2	2020-10-28	< 0.0002	< 0.0002	< 0.0002	0.0034	< 0.0001	< 0.0001	0.00089	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M178R-3	2020-10-28	< 0.0002	< 0.0002	< 0.0002	0.0048	< 0.0001	< 0.0001	0.0014	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M178R-4	2020-10-28	< 0.0002	< 0.0002	< 0.0002	0.0047	< 0.0001	< 0.0001	0.002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M179	2020-10-28	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M185-1	2020-10-28	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M185-2	2020-10-28	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.0002	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M186	2020-10-29	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00016	< 0.0001	< 0.0002	< 0.006	< 0.0001	< 0.0005	< 0.0001	< 0.0001	0.0002	< 0.0002	< 0.0001	< 0.0002	0.0002	< 0.0001	< 0.0001	< 0.0002
M187	2020-10-29	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M188-1	2020-10-28	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M190	2020-10-28	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M192	2020-10-29	< 0.0002	< 0.0002	< 0.0002	0.0069	0.00016	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0002
OW1	2020-10-27	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	0.0027	0.0001	0.00016	< 0.0002	< 0.0001	< 0.0002	0.00026	< 0.0001	< 0.0001	< 0.0002
OW4	2020-10-27	< 0.0005	< 0.0005	< 0.0005	0.08	0.0005	0.00047	< 0.0005	< 0.0013	< 0.00025	< 0.0013	0.0056	< 0.00025	< 0.00025	0.00077	< 0.00025	0.0035	< 0.00025	< 0.00025	< 0.00025	< 0.0005

[1] M53-4, M67-2 and M85 Purged Dry - No Samples Collected

Table 5b: Groundwater Quality Results and Reasonable Use Limits - October 27 - 29, 2020

Name	Date	1,4-dioxane	Alkalinity	Chloride	Dissolved Organic Carbon	Iron	Manganese	Sodium	Total Dissolved Solids	1,1-dichloroethylene	Benzene	Ethylbenzene	Toluene	Xylenes (Total)
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Shallow Groundwater Flow Zone														
RUL		*0.001**	*390*	*130*	*3.6*	*0.18*	*0.034*	*109*	*452*	*0.0035*	*0.0014*	*0.0013*	*0.0121*	*0.15*
M54-4	2020-10-28	< 0.001	*480*	47	2.9	< 0.1	0.034	76	*650*	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M66-2	2020-10-27	< 0.001	390	130	1.7	*0.23*	0.018	*220*	*905*	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M67-2	dry													
75% RUL †		*n/a*	*293*	*98*	*2.7*	*0.14*	*0.026*	*82*	*339*	*0.0026*	*0.0011*	*0.00098*	*0.0091*	*0.11*
M80-2	2020-10-27	< 0.001	*350*	45	1.8	< 0.1	0.007	26	*510*	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M87-2	2020-10-28	< 0.001	230	25	1.6	< 0.1	0.009	13	*350*	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
OW37-s	2020-10-29	< 0.001	190	29	*4.5*	*0.45*	*0.22*	21	180	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
Intermediate BedrockGroundwater Flow Zone														
RUL		*0.001**	*400*	*132*	*3.5*	*0.18*	*0.032*	*106*	*465*	*0.0035*	*0.0014*	*0.0013*	*0.0121*	*0.15*
M177	2020-10-28	< 0.001	250	12	1.9	< 0.1	0.005	8.8	350	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M178R-2	2020-10-28	*0.0034*	350	35	*4.1*	*0.84*	*0.056*	41	455	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M178R-3	2020-10-28	*0.0048*	*410*	60	*4.3*	*1.3*	*0.074*	52	*500*	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M178R-4	2020-10-28	*0.0047*	400	48	*3.9*	0.12	0.029	51	*540*	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M179	2020-10-28	< 0.001	240	67	2.6	0.16	0.029	56	375	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M185-1	2020-10-28	< 0.001	300	*450*	1.3	< 0.1	0.007	*410*	*1140*	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M185-2	2020-10-28	< 0.001	280	2.9	2	< 0.1	0.013	4.8	330	< 0.0001	0.0002	< 0.0001	< 0.0002	< 0.0001
M186	2020-10-29	< 0.001	350	*1200*	1.5	*0.35*	*0.066*	*750*	*2310*	< 0.0001	0.00016	< 0.0001	< 0.0002	0.0002
M187	2020-10-29	< 0.001	260	18	2.1	< 0.1	< 0.002	15	355	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M188-1	2020-10-28	< 0.001	280	30	1.6	< 0.1	0.009	54	340	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M190	2020-10-28	< 0.001	300	80	*3.2*	< 0.1	0.007	28	*550*	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M192	2020-10-29	*0.0069*	*610*	*480*	*4.2*	< 0.1	0.018	*370*	*1400*	< 0.0001	0.00016	< 0.0001	< 0.0002	< 0.0001
75% RUL †		*n/a*	*300*	*99*	*2.63*	*0.14*	*0.024*	*80*	*349*	*0.0026*	*0.0011*	*0.00098*	*0.0091*	*0.11*
M80-1	2020-10-27	< 0.001	160	24	1.1	< 0.1	0.004	38	265	< 0.0001	0.00055	0.00014	0.00038	0.0021
M82-1	2020-10-29	< 0.001	*340*	40	2.4	< 0.1	0.003	*90*	*350*	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M82-2	2020-10-29	< 0.001	*340*	27	*3.0*	< 0.1	0.019	19	*395*	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001
M106	2020-10-28	< 0.001	*390*	*1500*	1.4	< 0.1	0.002	*850*	*2970*	0.00049	0.00058	< 0.0001	< 0.0002	< 0.0001

* Site-specific RUL for 1,4 dioxane set by ERT Order dated December 24, 2015

† Wells located on the boundary of WM property, including the CAZ boundary, are compared to 75% of RUL concentrations

0.05 Groundwater results exceed Reasonable Use Limits (RUL)

Table 6: Surface Water Characteristics - October 27, 2020

Date	Parameter		Surface Water Station									
			S2	S3	S4R	S5	S6	S7	S8R	S18	S19	S20
2020-10-27	Velocity:	m/s	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
	Depth:	m	-	0.09	-	-	-	-	-	0.10	NM	-
	Width:	m	-	0.30	-	-	-	-	-	0.40	NM	-
	Estimated Flow Rate:	m^3/s	-	NM	-	-	-	-	-	NM	NM	-

NM: Not Measured (Flow was insufficient, water was ponded, or unable to measure due to vegetation)

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Table 7b: Surface Water Quality Results - October 27, 2020

			Marysville Creek				Beechwood Ditch			South of Beechwood Road		
			S2	S3	S6	S7	S5	S4R	S8R	S18	S19	S20
			(upstream)	(downstream)	(downstream)	(downstream)	(upstream)	(downstream)	(downstream)	(upstream)	(downstream)	(downstream)
		Date	2020-10-27	2020-10-27	2020-10-27	2020-10-27	2020-10-27	2020-10-27	2020-10-27	2020-10-27	2020-10-27	2020-10-27
Reading Name	Units	PWQO										
Inorganic and General Parameters												
Alkalinity	mg/L			130						250	330	
Ammonia	mg/L			0.17						< 0.15	0.56	
Ammonia (unionized)	mg/L	0.02		< 0.00061						< 0.00061	0.0011	
Biochemical Oxygen Demand	mg/L			< 2						< 2	< 2	
Chemical Oxygen Demand	mg/L			18						17	18	
Chloride	mg/L			11						40	120	
Conductivity	µS/cm			410						700	1100	
Hardness	mg/L		Dry	180	Dry	Dry	Dry	Dry	Dry	300	430	Dry
Nitrate	mg/L			< 0.1						< 0.1	< 0.1	
Nitrite	mg/L			< 0.01						< 0.01	< 0.01	
Phenols	mg/L	0.001		< 0.001						< 0.001	< 0.001	
Phosphorus (total)	mg/L	0.03		*0.034*						< 0.03	*0.052*	
Sulphate	mg/L			56						55	84	
Total Dissolved Solids	mg/L			285						515	690	
Total Suspended Solids	mg/L			< 10						< 10	15	
Metals												
Boron	mg/L	0.2		< 0.02						0.057	0.035	
Cadmium	mg/L			< 0.0001						< 0.0001	< 0.0001	
Calcium	mg/L			60						110	140	
Chromium (III)	mg/L	0.0089		< 0.005						< 0.005	< 0.005	
Chromium (VI)	mg/L	0.001		*0.0013*						< 0.0005	< 0.0005	
Chromium (Total)	mg/L			< 0.005						< 0.005	< 0.005	
Cobalt	mg/L	0.0009		< 0.0005						< 0.0005	*0.0011*	
Copper	mg/L	0.005	Dry	< 0.002	Dry	Dry	Dry	Dry	Dry	< 0.002	< 0.002	Dry
Iron	mg/L	0.3		< 0.1						< 0.1	*3.6*	
Lead	mg/L	0.005		< 0.0005						< 0.0005	< 0.0005	
Magnesium	mg/L			5.4						11	23	
Nickel	mg/L	0.025		< 0.001						< 0.001	0.001	
Potassium	mg/L			7						4.7	6.3	
Sodium	mg/L			8.1						24	58	
Zinc	mg/L	0.02		< 0.01						< 0.01	< 0.01	
Volatile Organic Compounds (VOCs)												
1,4-dioxane	mg/L	0.02	Dry	< 0.001	Dry	Dry	Dry	Dry	Dry	< 0.001	< 0.001	Dry
Naphthalene	mg/L	0.007		< 0.00005						< 0.00005	< 0.00005	
Field Measurements												
pH (Field)	unitless	6.5-8.5		7.1						7.04	7.04	
Conductivity (Field)	µS/cm		Dry	401.6	Dry	Dry	Dry	Dry	Dry	667	952	Dry
Dissoved Oxygen (Field)	mg/L			10.05						6.2	7.4	
Temperature (Field)	°C			7.0						7.1	7.0	

Exceeds PWQO

Table 8: Subsurface Gas Monitoring Results - November 3, 2020

Gas Monitor	Location	Reading (ppm)
GM1	North of garage area, south of waste mound	10
GM3	Northeast corner of waste mound	0
GM4-1	Southeast corner of waste mound	10
GM4-2		15
GM5	Northwest corner of waste mound	0
GM6	North of waste mound	0

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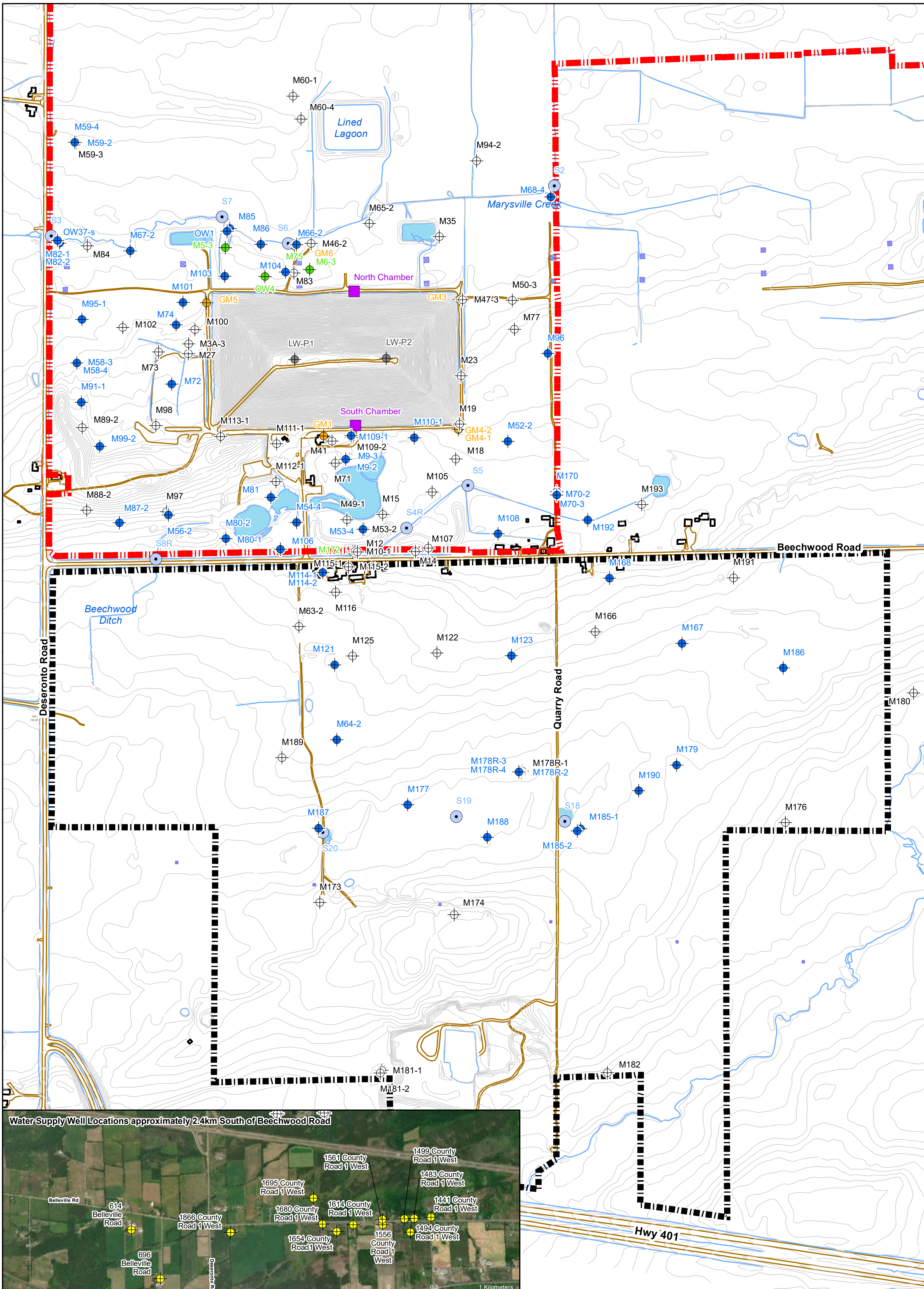
Table 9: Additional Investigations

Description of Activities in 2020	Reporting Completed in 2020	Anticipated / Planned Work in 2021
CAZ Investigation:		- Preparation of application to amend ECA to include proposed CAZ - Preparation of revised EMP to reflect new wells and proposed CAZ
Investigations Related to Provincial Officer's Order No. 3623-BL33DW: · Surface water sampling events Jan. 16, 17, 23, 27, 30 · Groundwater sampling events Jan. 27, 31 - Landfill cover integrity and groundater infiltration assessment	- Public Notices (Jan. 20, Feb. 3, Feb. 4, Feb. 28, Mar. 26) - Action Plan (Jan. 31) - Preliminary Sampling Results Memorandum (Feb. 4) - Response to Provincial Officer's Order (Feb. 17) - Leachate Release Groundwater Sampling Results (Feb. 21) - Landfill Cover Integrity Assessment Report (Dec. 2020)	- No additional work anticipated
North Lagoon Investigation: · Quarterly sampling of newly installed monitoring well M217 and M218 - Sampling of North Lagoon	- North Lagoon Investigation Report (March 2020) - Expanded Timeframe for Water Balance Memorandum (April 2020, updated May 2020 and July 2020) - North Lagoon and Groundwater Sampling Results (Dec. 2020)	- PFAS sampling of North Lagoon and monitoring wells M217 and M218
Town of Greater Napanee WWTP Requirements: · Monthly North/South Chambers combined leachate sampling (Jan-Dec)	- Monthly reports prepared for the Town of Greater Napanee	- Monitoring and reporting to continue in 2021
ECA Monitoring Requirements - Storm Water Ponds and Leachate: · Storm Water Ponds · Monthly sampling for inorganic and general chemistry parameter lists (March, April, May, October, November, December) · Quarterly Sampling of the ECA Storm water ponds for Toxicity (March, June, September, December) · Leachate (North Chamber) · Quarterly sampling list (March, August, October, December) · Annual sampling chemistry list (May)	- Monitoring results from the 2019 calendar year for the stormwater ponds and leachate locations were reported in the 2019 Annual Report, prepared by WSP Canada Inc. and dated March 2020	- Monitoring and reporting to continue in 2021

FIGURES



LEGEND

- Topographic Contour Lines
- Surface Water
- Property Boundary
- Proposed CAZ Boundary
- M35 — Monitoring Well Used to Measure Water Level (Not Sampled)
- M53-4 — Monitoring Well Used to Measure Water Level and Sampled for Chemistry
- M5-3 — Monitoring Well Sampled for Chemistry (Not used for Water Levels)
- GM1 — Gas Monitoring Well
- Leachate Chambers
- Lechate Monitoring Well
- S2 — Surface Water Monitoring Location
- 1097 Beechwood — Domestic Water Supply Well Sampled for Chemistry

REFERENCES

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WASTE MANAGEMENT

PROJECT

WASTE MANAGEMENT RICHMOND LANDFILL
FALL 2020 SEMI-ANNUAL REPORT

TITLE

SITE PLAN AND
MONITORING LOCATIONS

PROJECT #		DATE	
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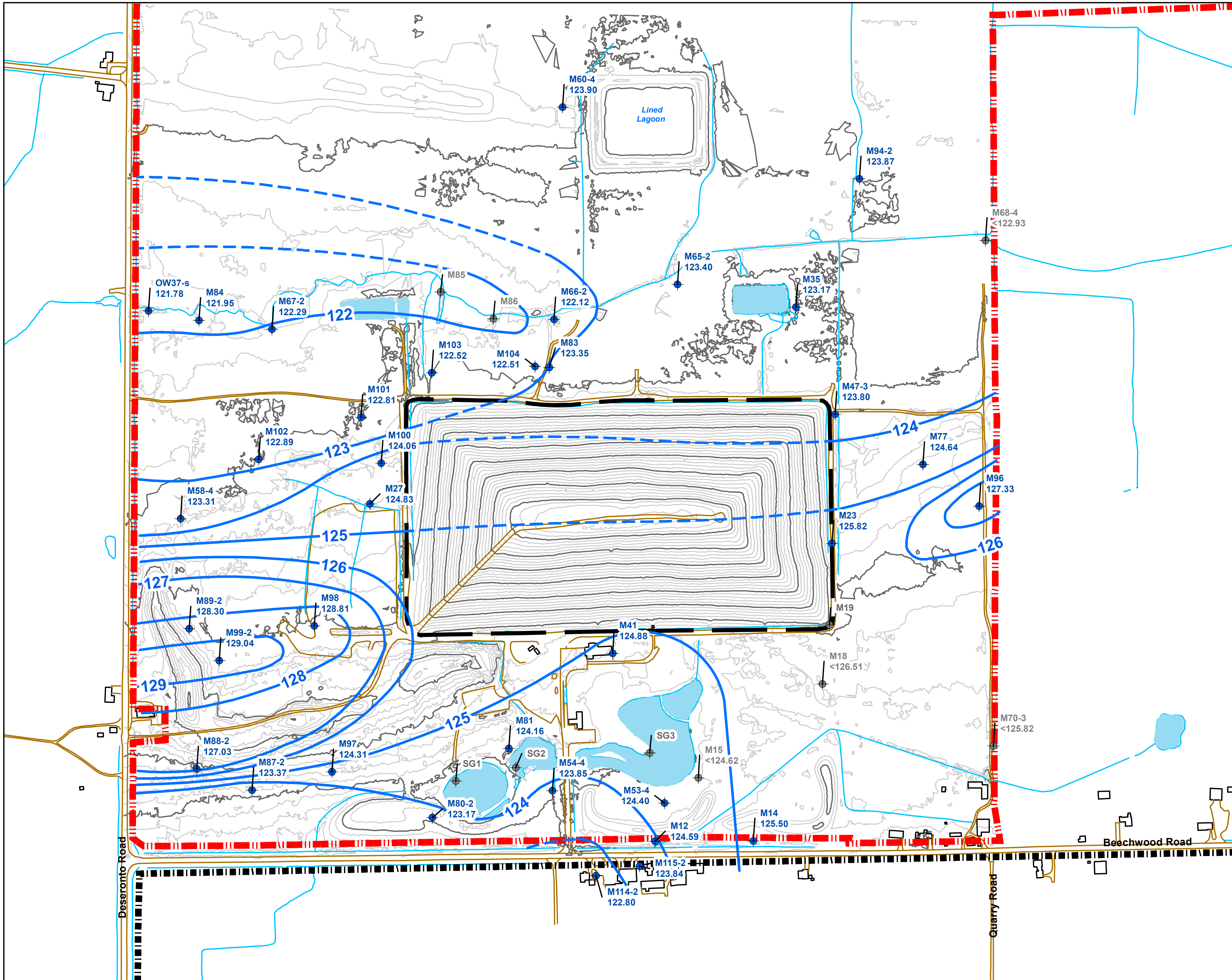

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LEGEND

- Potentiometric Surface (masl)
- Topographic Contour Lines (5 m)
- Topographic Contour Lines (1 m)
- Surface Water
- Property Boundary
- Proposed CAZ Boundary
- M53-4 Shallow Groundwater Zone Elevation Monitor
- M5-3 Monitor Not Used in Contouring
- M35 Staff Gauge Location

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

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PROJECT

WASTE MANAGEMENT RICHMOND LANDFILL FALL 2020 SEMI-ANNUAL REPORT

TITLE

SHALLOW GROUNDWATER FLOW ZONE POTENTIOMETRIC SURFACE – JULY 15, 2020

BluMetric™ Environmental

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Web: http://www.blumetric.ca

PROJECT #	DATE
200172-03	December, 2020

DRAWN	CHECKED	FIG NO.	REV
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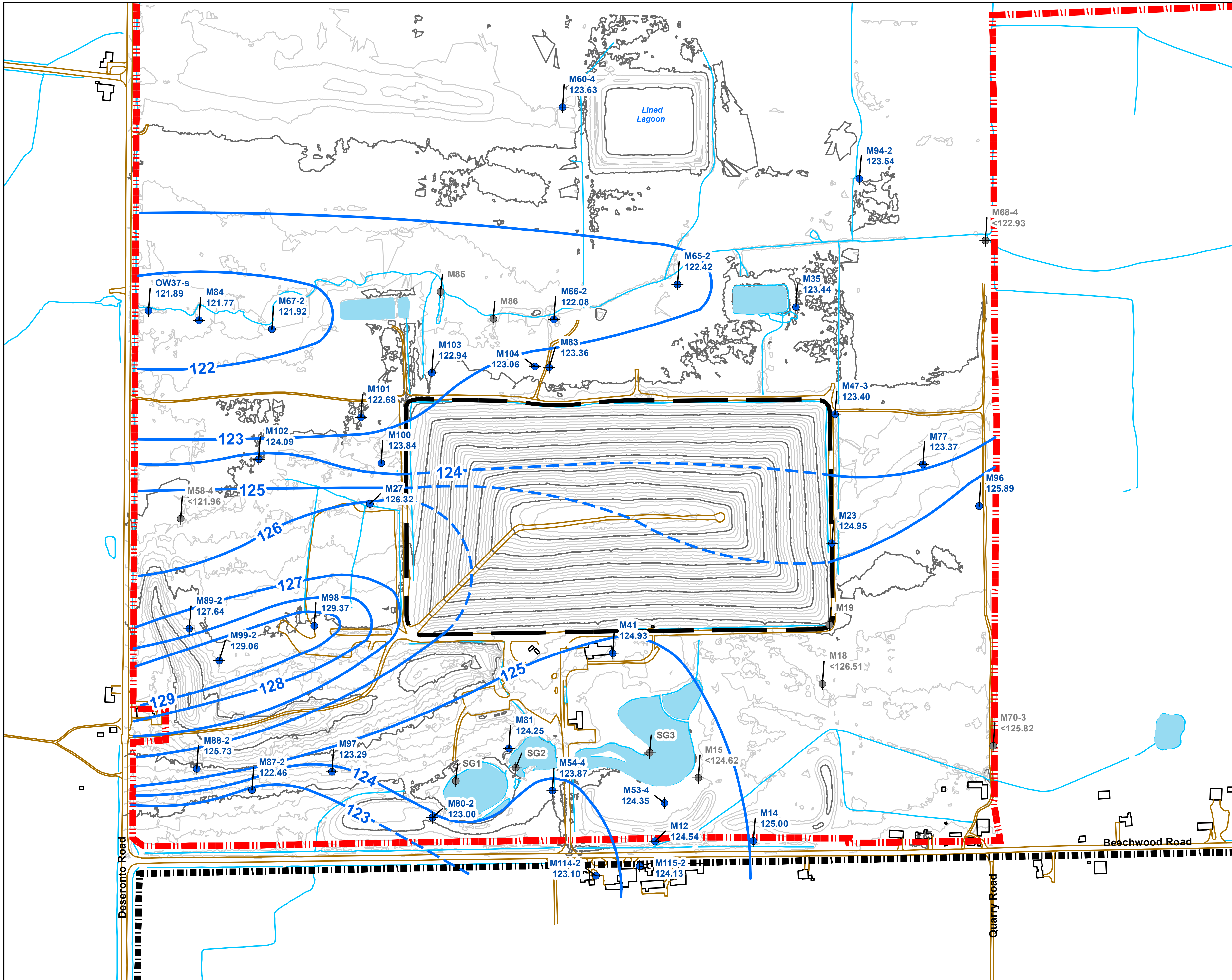

LEGEND

- Potentiometric Surface (masl)
- Topographic Contour Lines (5 m)
- Topographic Contour Lines (1 m)
- Surface Water
- Property Boundary
- Proposed CAZ Boundary
- M53-4 Shallow Groundwater Zone Elevation Monitor
- M5-3 Monitor Not Used in Contouring
- M35 Staff Gauge Location

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
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WASTE MANAGEMENT RICHMOND LANDFILL FALL 2020 SEMI-ANNUAL REPORT

TITLE

SHALLOW GROUNDWATER FLOW ZONE POTENTIOMETRIC SURFACE – OCTOBER 26, 2020

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PROJECT #	DATE
200172-03	December, 2020

DRAWN	CHECKED	FIG NO.	REV
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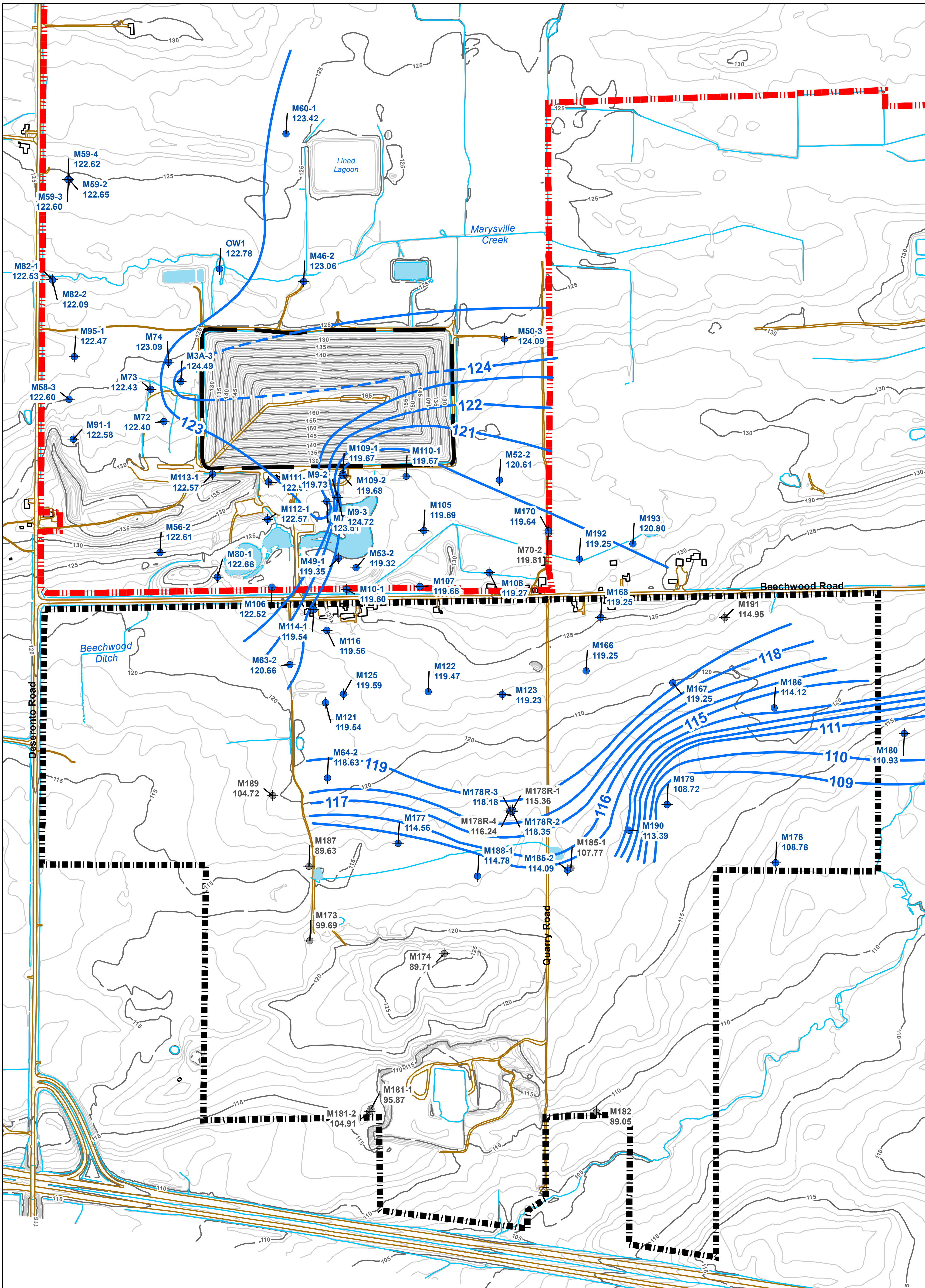

LEGEND

- Potentiometric Surface (masl)
- Topographic Contour Lines (5 m)
- Topographic Contour Lines (1 m)
- Surface Water
- Property Boundary
- Proposed CAZ Boundary
- M166 Intermediate Groundwater Zone Elevation Monitor
- M189 Monitor Not Used in Contouring

REFERENCES

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TITLE

INTERMEDIATE BEDROCK GROUNDWATER FLOW ZONE POTENTIOMETRIC SURFACE – JULY 15, 2020

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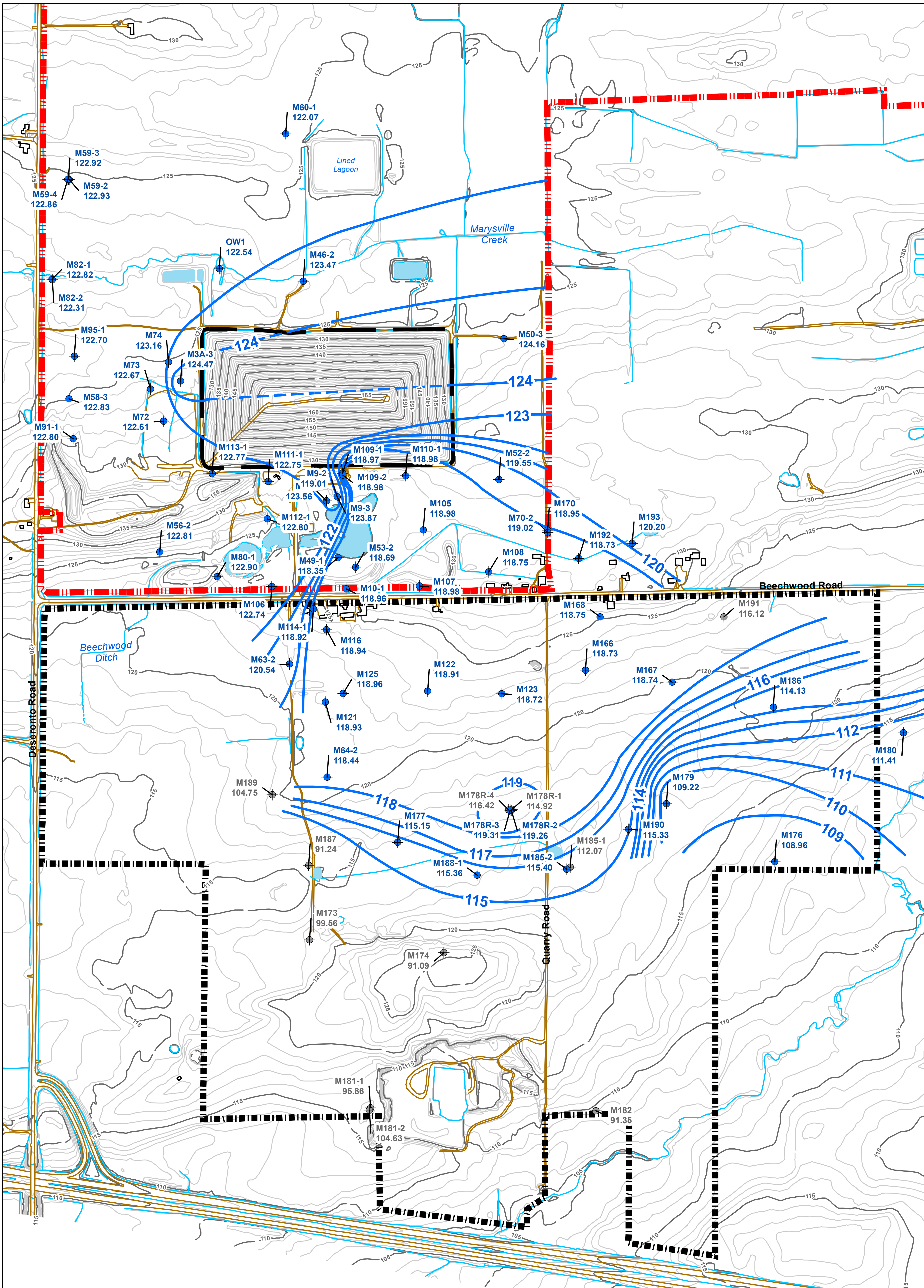

LEGEND

- Potentiometric Surface (masl)
- Topographic Contour Lines (5 m)
- Topographic Contour Lines (1 m)
- Surface Water
- Property Boundary
- Proposed CAZ Boundary
- M166 Intermediate Groundwater Zone Elevation Monitor
- M189 Monitor Not Used in Contouring

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FALL 2020 SEMI-ANNUAL REPORT

TITLE

INTERMEDIATE BEDROCK GROUNDWATER FLOW ZONE POTENTIOMETRIC SURFACE – OCTOBER 26, 2020

PROJECT #		DATE	
200172-03		December, 2020	
DRAWN	CHECKED	FIG NO.	REV
GM	FR	03b	0

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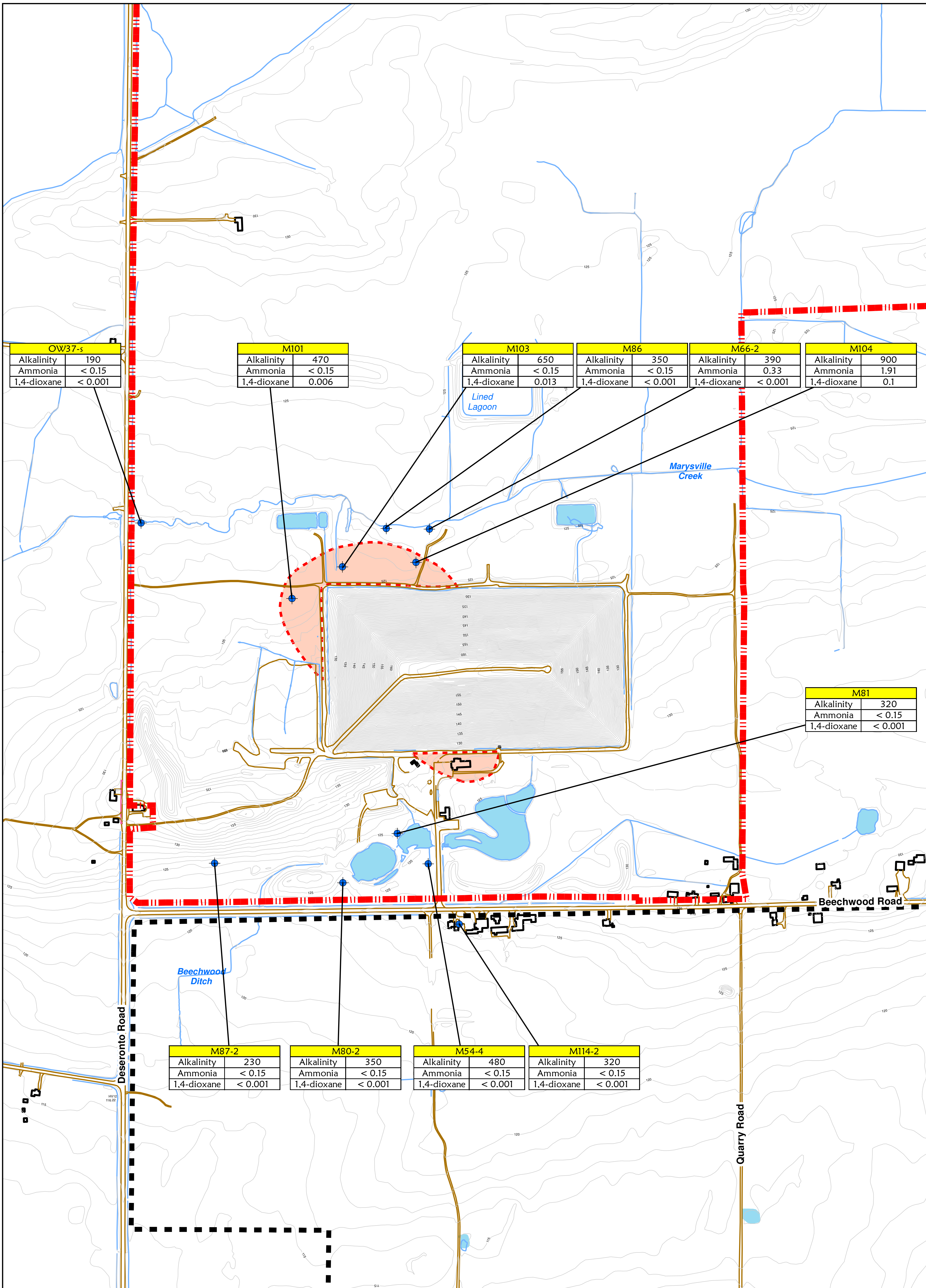

LEGEND

- Topographic Contour Lines
- Surface Water
- Property Boundary
- Proposed CAZ Boundary
- M99-2 Shallow Monitoring Well Sampled for Chemistry
- M99-2 Shallow Monitoring Well Not Sampled (see text for detailed)
- 1,4 Dioxane Impacted Area

NOTE:
M58-4 damaged - no sample collected.

Parameter	Units
Alkalinity	mg/L $CaCO_3$
Ammonia	mg/L
1,4-dioxane	mg/L

Note:
Monitoring Wells M53-4, M67-2 and M85 were Purged Dry - No Samples Collected

REFERENCES

DO NOT SCALE DRAWING.
THIS DRAWING MAY HAVE BEEN REDUCED. ALL SCALE NOTATIONS INDICATED ARE BASED ON 11"x17" FORMAT DRAWINGS.
-UNITS: METERS
-PROJECTION: UTM NAD83 ZONE 18
-DATA SOURCE: WM CANADA, BLUMETRIC, MNRO, NRCAN

0 25 50 100 150 200
Metres
1:6,650

BluMetric Environmental
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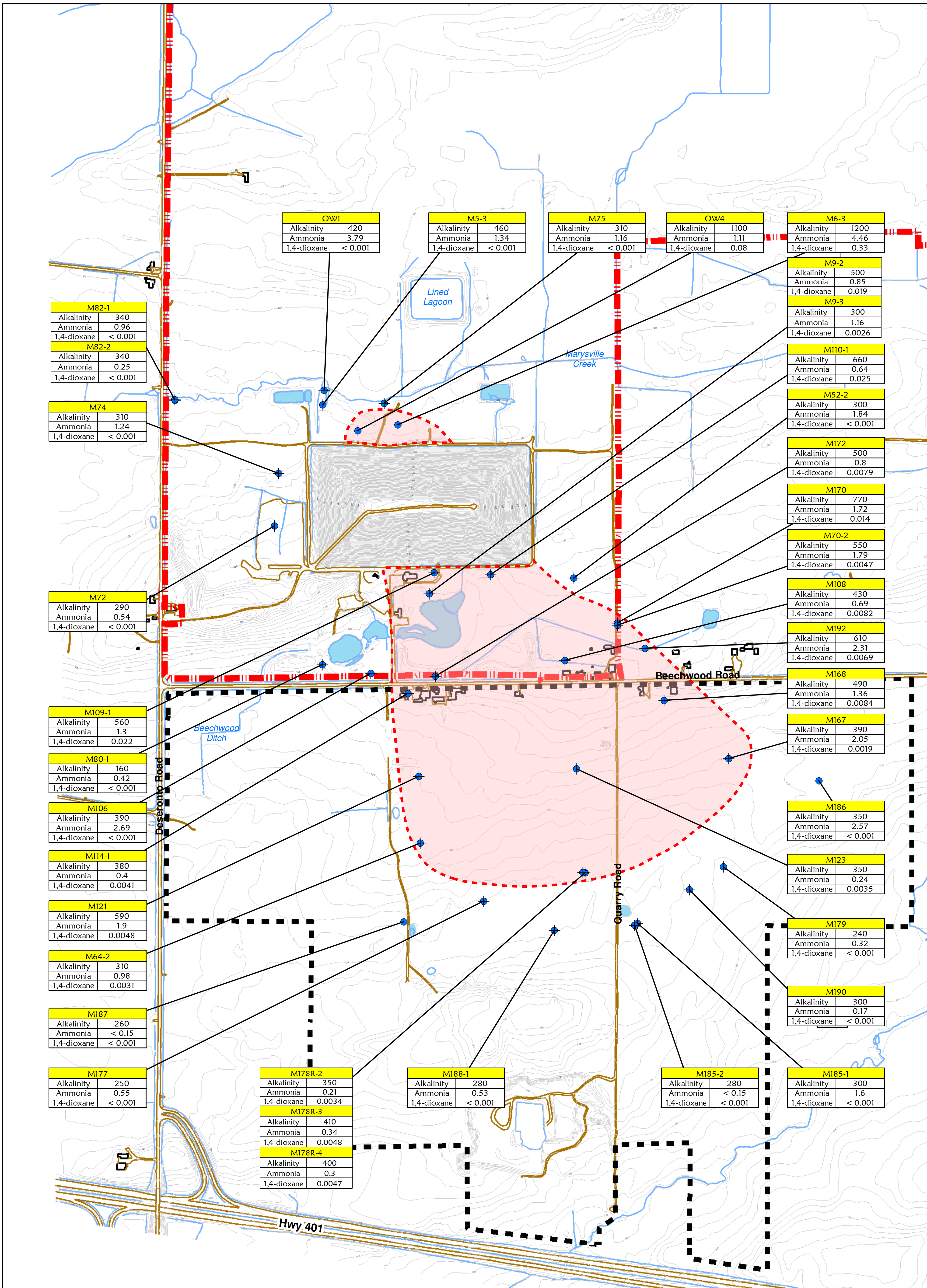
CLIENT
WASTE MANAGEMENT

PROJECT
WASTE MANAGEMENT RICHMOND LANDFILL
FALL 2020 SEMI-ANNUAL REPORT

TITLE
SHALLOW GROUNDWATER
FLOW ZONE CONCENTRATIONS

PROJECT #	DATE		
200172-03	December 2020		
DRAWN	CHECKED	FIG NO.	REV
GM	FR	04	0



LEGEND

- Topographic Contour Lines
- Surface Water
- Property Boundary
- Proposed CAZ Boundary
- M9-2 Intermediate Monitoring Well Sampled for Chemistry
- 1,4 Dioxane Impacted Area

Parameter	Units
Alkalinity	mg/L CaCO3
Ammonia	mg/L
1,4-dioxane	mg/L

REFERENCES

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC.
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-UNITS: METERS
-PROJECTION: UTM NAD83 ZONE 18
-DATA SOURCE: WM CANADA, BLUMETRIC, MNRO, NRCAN

0 25 50 100 150 200
Metres
1:9,000

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CLIENT
WM WASTE MANAGEMENT

PROJECT
WASTE MANAGEMENT RICHMOND LANDFILL FALL 2020 SEMI-ANNUAL REPORT

TITLE
INTERMEDIATE BEDROCK GROUNDWATER FLOW ZONE CONCENTRATIONS

PROJECT #		DATE	
200172-03		December 2020	
DRAWN	CHECKED	FIG NO.	REV
GM	FR	05	0

APPENDIX A

Monitoring Well Inventory

Appendix A: Monitoring Well Inventory

Monitoring Well	Easting	Northing
2054	335293	4902797
2055	335402	4902782
M3A-1	334990	4902928
M3A-2	334990	4902930
M3A-3	334990	4902930
M4-1	335006	4903036
M4-2	335006	4903038
M4-3	335006	4903038
M5-1	335003	4903162
M5-2	335003	4903163
M5-3	335003	4903163
M6-1	335200	4903172
M6-2	335201	4903174
M6-3	335201	4903174
M9-1	335410	4902787
M9-2	335410	4902789
M9-3	335410	4902789
M9R-1	335400	4902787
M10-1	335494	4902596
M10-2	335494	4902596
M10-3	335494	4902594
M12	335500	4902596
M14	335625	4902637
M15	335528	4902695
M16	335447	4902710
M18	335648	4902866
M19	335632	4902944
M23	335602	4903049
M27	334997	4902908
M28	334897	4902853
M29	334924	4902983
M30	334999	4903033
M31	334857	4902977
M35	335458	4903336
M38	335006	4902978
M39	335299	4903310
M41	335368	4902818
M42-1	335006	4903006
M42-2	335007	4903008
M42-3	335007	4903008
M43-1	335475	4902588
M43-2	335476	4902590
M43-3	335476	4902590
M45-1	334790	4904582
M45-2	334790	4904582
M45-3	334790	4904582
M46-1	335185	4903230
M46-2	335185	4903232
M47-1	335552	4903214
M47-2	335552	4903215
M47-3	335552	4903215
M48-1	334838	4902564
M48-2	334839	4902565
M48-3	334839	4902565

Appendix A: Monitoring Well Inventory

Monitoring Well	Easting	Northing
M49-1	335454	4902658
M49-2	335455	4902660
M49-3	335455	4902660
M50-1	335660	4903247
M50-2	335660	4903248
M50-3	335660	4903248
M51-1	335714	4903073
M51-2	335714	4903075
M51-3	335714	4903075
M52-1	335748	4902939
M52-2	335748	4902940
M52-3	335748	4902940
M53-1	335501	4902651
M53-2	335499	4902650
M53-3	335498	4902650
M53-4	335496	4902649
M54-1	335346	4902623
M54-2	335347	4902622
M54-3	335347	4902620
M54-4	335348	4902618
M55-1	334961	4903151
M55-2	334962	4903149
M55-3	334962	4903148
M55-4	334963	4903146
M56-1	335066	4902508
M56-2	335065	4902545
M57	335418	4902623
M58-1	334760	4902816
M58-2	334760	4902814
M58-3	334761	4902812
M58-4	334761	4902811
M59-1	334609	4903287
M59-2	334607	4903287
M59-3	334606	4903287
M59-4	334604	4903287
M60-1	335044	4903538
M60-3	335079	4903494
M60-4	335077	4903494
M61-1	334457	4903750
M61-2	334456	4903749
M61-3	334455	4903748
M61-4	334454	4903747
M62-1	335166	4904438
M62-2	335168	4904441
M62-3	335166	4904441
M62-4	335165	4904440
M63-1	335424	4902393
M63-2	335425	4902394
M64-1	335585	4902174
M64-2	335585	4902176
M65-1	335297	4903314
M65-2	335298	4903316

Appendix A: Monitoring Well Inventory

Monitoring Well	Easting	Northing
M66-1	335154	4903218
M66-2	335155	4903219
M67-1	334799	4903089
M67-2	334799	4903090
M68-1	335670	4903504
M68-2	335671	4903502
M68-3	335671	4903500
M68-4	335672	4903499
M69-1	335062	4904299
M69-2	335063	4904298
M69-3	335063	4904296
M69-4	335064	4904295
M70-1	335890	4902862
M70-2	335891	4902860
M70-3	335891	4902858
M71	335390	4902773
M72	334981	4902831
M73	334931	4902891
M74	334950	4902962
M75	335151	4903215
M76	335675	4903217
M77	335685	4903188
M78	335391	4902776
M79	335673	4903215
M80-1	335207	4902532
M80-2	335206	4902534
M81	335275	4902654
M82-1	334640	4903060
M82-2	334641	4903058
M83	335169	4903156
M84	334702	4903072
M85	334999	4903208
M86	335077	4903195
M87-1	334959	4902493
M87-2	334965	4902495
M88-1	334883	4902497
M88-2	334885	4902499
M89-1	334815	4902673
M89-2	334818	4902674
M90-1	334520	4903845
M90-2	334522	4903843
M91-1	334798	4902729
M91-2	334792	4902734
M93	335006	4903908
M94-1	335497	4903519
M94-2	335486	4903526
M95-1	334743	4902908
M95-2	334740	4902917
M96	335774	4903158
M97	335059	4902551
M98	334976	4902730
M99-1	334869	4902646

Appendix A: Monitoring Well Inventory

Monitoring Well	Easting	Northing
M99-2	334869	4902646
M100	334994	4902965
M101	334949	4903015
M102	334836	4902919
M103	335021	4903101
M104	335150	4903152
M105	335620	4902778
M106	335331	4902549
M107	335650	4902654
M108	335791	4902733
M109-1	335405	4902844
M109-2	335407	4902840
M110-1	335543	4902883
M110-2	335546	4902884
M111-1	335250	4902774
M111-2	335254	4902774
M112-1	335274	4902692
M112-2	335277	4902693
M113-1	335123	4902751
M113-2	335119	4902750
M114-1	335437	4902530
M114-2	335439	4902528
M115-1	335489	4902561
M115-2	335490	4902558
M116	335480	4902494
M117	335586	4902525
M121	335529	4902337
M122	335742	4902433
M123	335905	4902479
M125	335561	4902368
M166	336069	4902589
M167	336266	4902624
M168	336063	4902714
M170	335889	4902865
M171	335759	4903206
M172	335490	4902593
M173	335661	4901812
M174	335961	4901879
M176	336613	4902308
M177	335784	4902084
M178-1	336032	4902203
M178-2	336032	4902206
M178-3	336035	4902209
M178R-1	336008	4902236
M178R-2	336008	4902233
M178R-3	336005	4902233
M178R-4	336002	4902232
M178R-5	335997	4902232
M179	336338	4902357
M180	336801	4902677
M181-1	335912	4901492
M181-2	335912	4901492

Appendix A: Monitoring Well Inventory

Monitoring Well	Easting	Northing
M182	336402	4901643
M183	336953	4901770
M184	336176	4901998
M185-1	336170	4902151
M185-2	336170	4902151
M186	336509	4902627
M187	335607	4901972
M188-1	335979	4902069
M188-2	335978	4902068
M189	335479	4902099
M190	336274	4902275
M191	336332	4902802
M192	335976	4902826
M193	336082	4902896
M194-1	335564	4901886
M194-2	335568	4901889
M195	335592	4902084
M199	335717	4902027
M200	335793	4902059
M201	335829	4901991
M202	335932	4902013
M203	335709	4902128
M204	335910	4902186
M205	336077	4902128
M206	335938	4902329
M207	336131	4902261
OW1	334995	4903200
OW4	335108	4903128
OW5	335113	4903134
OW36	334799	4903100
OW37-d	334630	4903063
OW37-s	334634	4903062
OW54-d	335406	4902785
OW54-i	335406	4902785
OW54-s	335406	4902785
OW55-d	335376	4903186
OW55-i	335376	4903186
OW55-s	335376	4903184
OW56-d	335106	4903131
OW56-i	335106	4903131
OW56-s	335106	4903129
OW57	335117	4902762
PW1	335465	4902639
PW2	334988	4903095
PW3	335620	4902778
PW4	335626	4902775
PW5	335066	4902547

APPENDIX B

Results from Analytical Quality Assurance / Quality Control (QA/QC) Program

Appendix B

Summary of Results with Relative Percent Difference (RPD[1]) greater than 20%

Location	Parameter	Unit	Regular Sample	Field Duplicate	RPD (%)	RDL[2]	Comment
S3	Ammonia	mg/L	0.56	0.29	63.53	0.15	within 5x RDL
S3	Phosphorous (total)	mg/L	0.052	0.071	30.89	0.03	within 5x RDL

[1] RPD (%) = 100 * ABS (Regular Sample - Duplicate Sample) / ([Regular Sample + Duplicate Sample] / 2)
[2] RDL = Laboratory Reportable Detection Limit

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	M108 Regular Sample	M108 Field Duplicate	RPD (%)
General/Inorganic Parameters				
Alkalinity	mg/L	430	430	0.00
Ammonia	mg/L	0.69	0.71	2.86
Boron	mg/L	0.19	0.18	5.41
Calcium	mg/L	100	99	1.01
Chloride	mg/L	58	59	1.71
Conductivity	µS/cm	940	940	0.00
Dissolved Organic Carbon	mg/L	4.8	4.7	2.11
Iron	mg/L	2.3	2.2	4.44
Magnesium	mg/L	30	30	0.00
Manganese	mg/L	0.12	0.11	8.70
Nitrate	mg/L	< 0.1	< 0.1	0.00
Nitrite	mg/L	< 0.01	< 0.01	0.00
Potassium	mg/L	6.4	6.2	3.17
Sodium	mg/L	59	58	1.71
Sulphate	mg/L	< 1	< 1	0.00
Total Dissolved Solids	mg/L	560	530	5.50
Volatile Organic Compounds (VOCs)				
1,1,1,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,1-Trichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1,2,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,2-Trichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1-Dichloroethane	mg/L	0.00035	0.00037	5.56
1,1-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
1,2-Dichlorobenzene (o)	mg/L	< 0.0002	< 0.0002	0.00
1,2-Dichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,3,5-Trimethylbenzene	mg/L	< 0.0002	< 0.0002	0.00
1,3-Dichlorobenzene (m)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dichlorobenzene (p)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dioxane	mg/L	0.0082	0.0076	7.59
Benzene	mg/L	< 0.0001	< 0.0001	0.00
Chlorobenzene	mg/L	< 0.0001	< 0.0001	0.00
Chloroethane	mg/L	0.0035	0.0036	2.82
Chloromethane	mg/L	< 0.0005	< 0.0005	0.00
Cis-1,2-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Dichloromethane	mg/L	< 0.0005	< 0.0005	0.00
Ethylbenzene	mg/L	< 0.0001	< 0.0001	0.00
m+p-Xylene	mg/L	< 0.0001	< 0.0001	0.00
o-Xylene	mg/L	< 0.0001	< 0.0001	0.00
Styrene	mg/L	< 0.0002	< 0.0002	0.00
Tetrachloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Toluene	mg/L	< 0.0002	< 0.0002	0.00
Total Xylenes	mg/L	< 0.0001	< 0.0001	0.00
Trans-1,2-dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Trichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Vinyl Chloride	mg/L	< 0.0002	< 0.0002	0.00

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	M110-1 Regular Sample	M110-1 Field Duplicate	RPD (%)
General/Inorganic Parameters				
Alkalinity	mg/L	660	670	1.50
Ammonia	mg/L	0.64	0.63	1.57
Boron	mg/L	0.48	0.47	2.11
Calcium	mg/L	180	180	0.00
Chloride	mg/L	160	180	11.76
Conductivity	µS/cm	1700	1800	5.71
Dissolved Organic Carbon	mg/L	8	8.1	1.24
Iron	mg/L	< 0.1	< 0.1	0.00
Magnesium	mg/L	59	59	0.00
Manganese	mg/L	0.015	0.015	0.00
Nitrate	mg/L	< 0.1	< 0.1	0.00
Nitrite	mg/L	< 0.01	< 0.01	0.00
Potassium	mg/L	8.3	8.2	1.21
Sodium	mg/L	130	130	0.00
Sulphate	mg/L	< 1	< 1	0.00
Total Dissolved Solids	mg/L	955	975	2.07
Volatile Organic Compounds (VOCs)				
1,1,1,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,1-Trichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1,2,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,2-Trichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1-Dichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
1,2-Dichlorobenzene (o)	mg/L	< 0.0002	< 0.0002	0.00
1,2-Dichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,3,5-Trimethylbenzene	mg/L	< 0.0002	< 0.0002	0.00
1,3-Dichlorobenzene (m)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dichlorobenzene (p)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dioxane	mg/L	0.025	0.023	8.33
Benzene	mg/L	0.00035	0.00037	5.56
Chlorobenzene	mg/L	< 0.0001	< 0.0001	0.00
Chloroethane	mg/L	0.0084	0.0083	1.20
Chloromethane	mg/L	< 0.0005	< 0.0005	0.00
Cis-1,2-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Dichloromethane	mg/L	< 0.0005	< 0.0005	0.00
Ethylbenzene	mg/L	< 0.0001	< 0.0001	0.00
m+p-Xylene	mg/L	0.00034	0.00037	8.45
o-Xylene	mg/L	< 0.0001	< 0.0001	0.00
Styrene	mg/L	< 0.0002	< 0.0002	0.00
Tetrachloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Toluene	mg/L	< 0.0002	< 0.0002	0.00
Total Xylenes	mg/L	0.00034	0.00037	8.45
Trans-1,2-dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Trichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Vinyl Chloride	mg/L	< 0.0002	< 0.0002	0.00

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	M114-1 Regular Sample	M114-1 Field Duplicate	RPD (%)
General/Inorganic Parameters				
Alkalinity	mg/L	380	380	0.00
Ammonia	mg/L	0.4	0.37	7.79
Boron	mg/L	0.17	0.17	0.00
Calcium	mg/L	100	100	0.00
Chloride	mg/L	66	69	4.44
Conductivity	µS/cm	910	910	0.00
Dissolved Organic Carbon	mg/L	4.3	4.2	2.35
Iron	mg/L	5.7	5.7	0.00
Magnesium	mg/L	25	25	0.00
Manganese	mg/L	0.3	0.3	0.00
Nitrate	mg/L	< 0.1	< 0.1	0.00
Nitrite	mg/L	< 0.01	< 0.01	0.00
Potassium	mg/L	5.3	5.3	0.00
Sodium	mg/L	62	62	0.00
Sulphate	mg/L	1.7	1.7	0.00
Total Dissolved Solids	mg/L	515	510	0.98
Volatile Organic Compounds (VOCs)				
1,1,1,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,1-Trichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1,2,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,2-Trichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1-Dichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1-Dichloroethylene	mg/L	0.0002	0.00021	4.88
1,2-Dichlorobenzene (o)	mg/L	< 0.0002	< 0.0002	0.00
1,2-Dichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,3,5-Trimethylbenzene	mg/L	< 0.0002	< 0.0002	0.00
1,3-Dichlorobenzene (m)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dichlorobenzene (p)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dioxane	mg/L	0.0041	0.0041	0.00
Benzene	mg/L	0.00062	0.00063	1.60
Chlorobenzene	mg/L	< 0.0001	< 0.0001	0.00
Chloroethane	mg/L	0.0059	0.0058	1.71
Chloromethane	mg/L	< 0.0005	< 0.0005	0.00
Cis-1,2-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Dichloromethane	mg/L	< 0.0005	< 0.0005	0.00
Ethylbenzene	mg/L	< 0.0001	< 0.0001	0.00
m+p-Xylene	mg/L	< 0.0001	< 0.0001	0.00
o-Xylene	mg/L	< 0.0001	< 0.0001	0.00
Styrene	mg/L	< 0.0002	< 0.0002	0.00
Tetrachloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Toluene	mg/L	< 0.0002	< 0.0002	0.00
Total Xylenes	mg/L	< 0.0001	< 0.0001	0.00
Trans-1,2-dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Trichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Vinyl Chloride	mg/L	< 0.0002	< 0.0002	0.00

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	M192 Regular Sample	M192 Field Duplicate	RPD (%)
General/Inorganic Parameters				
Alkalinity	mg/L	610	610	0.00
Ammonia	mg/L	2.31	2.24	3.08
Boron	mg/L	2.1	2.2	4.65
Calcium	mg/L	83	85	2.38
Chloride	mg/L	480	490	2.06
Conductivity	µS/cm	2600	2600	0.00
Dissolved Organic Carbon	mg/L	4.2	4.3	2.35
Iron	mg/L	< 0.1	< 0.1	0.00
Magnesium	mg/L	55	56	1.80
Manganese	mg/L	0.018	0.019	5.41
Nitrate	mg/L	< 0.1	< 0.1	0.00
Nitrite	mg/L	< 0.01	< 0.01	0.00
Potassium	mg/L	20	21	4.88
Sodium	mg/L	370	380	2.67
Sulphate	mg/L	1.2	1.2	0.00
Total Dissolved Solids	mg/L	1400	1330	5.13
Volatile Organic Compounds (VOCs)				
1,1,1,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,1-Trichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1,2,2-Tetrachloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1,2-Trichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,1-Dichloroethane	mg/L	< 0.0001	< 0.0001	0.00
1,1-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
1,2-Dichlorobenzene (o)	mg/L	< 0.0002	< 0.0002	0.00
1,2-Dichloroethane	mg/L	< 0.0002	< 0.0002	0.00
1,3,5-Trimethylbenzene	mg/L	< 0.0002	< 0.0002	0.00
1,3-Dichlorobenzene (m)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dichlorobenzene (p)	mg/L	< 0.0002	< 0.0002	0.00
1,4-Dioxane	mg/L	0.0069	0.0068	1.46
Benzene	mg/L	0.00016	0.00017	6.06
Chlorobenzene	mg/L	< 0.0001	< 0.0001	0.00
Chloroethane	mg/L	< 0.0002	< 0.0002	0.00
Chloromethane	mg/L	< 0.0005	< 0.0005	0.00
Cis-1,2-Dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Dichloromethane	mg/L	< 0.0005	< 0.0005	0.00
Ethylbenzene	mg/L	< 0.0001	< 0.0001	0.00
m+p-Xylene	mg/L	< 0.0001	< 0.0001	0.00
o-Xylene	mg/L	< 0.0001	< 0.0001	0.00
Styrene	mg/L	< 0.0002	< 0.0002	0.00
Tetrachloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Toluene	mg/L	< 0.0002	< 0.0002	0.00
Total Xylenes	mg/L	< 0.0001	< 0.0001	0.00
Trans-1,2-dichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Trichloroethylene	mg/L	< 0.0001	< 0.0001	0.00
Vinyl Chloride	mg/L	< 0.0002	< 0.0002	0.00

Detailed Results from Field Duplicate vs. Regular Samples

Reading Name	Units	S3 Regular Sample	S3 Field Duplicate	RPD (%)
1,4-Dioxane	mg/L	< 0.001	< 0.001	0.00
Alkalinity	mg/L	330	320	3.08
Ammonia	mg/L	0.56	0.29	63.53
Ammonia (unionized)	mg/L	0.0011	< 0.00061	0.00
Biochemical Oxygen Demand	mg/L	< 2	< 2	0.00
Chemical Oxygen Demand	mg/L	18	18	0.00
Chloride	mg/L	120	120	0.00
Conductivity	µS/cm	1100	1100	0.00
Dissolved Oxygen	mg/L	7.4	7.4	0.00
Hardness	mg/L	430	420	2.35
Naphthalene	mg/L	< 0.00005	< 0.00005	0.00
Nitrate	mg/L	< 0.1	< 0.1	0.00
Nitrite	mg/L	< 0.01	< 0.01	0.00
Phenols	mg/L	< 0.001	< 0.001	0.00
Phosphorus (total)	mg/L	0.052	0.071	30.89
Sulphate	mg/L	84	82	2.41
Total Dissolved Solids	mg/L	690	720	4.26
Total Suspended Solids	mg/L	15	18	18.18
Boron	mg/L	0.035	0.038	8.22
Cadmium	mg/L	< 0.0001	< 0.0001	0.00
Calcium	mg/L	140	140	0.00
Chromium (III)	mg/L	< 0.005	< 0.005	0.00
Chromium (Total)	mg/L	< 0.005	< 0.005	0.00
Chromium (VI)	mg/L	< 0.0005	< 0.0005	0.00
Cobalt	mg/L	0.0011	0.0011	0.00
Copper	mg/L	< 0.002	< 0.002	0.00
Iron	mg/L	3.6	3.7	2.74
Lead	mg/L	< 0.0005	< 0.0005	0.00
Magnesium	mg/L	23	23	0.00
Nickel	mg/L	0.001	0.001	0.00
Potassium	mg/L	6.3	6.4	1.57
Sodium	mg/L	58	58	0.00
Zinc	mg/L	< 0.01	< 0.01	0.00

Detailed Results from Field Blank Samples - Fall 2020

Reading Name	Units	2020-10-28 Groundwater Field Blank (1)
General/Inorganic Parameters		
Alkalinity	mg/L	17
Ammonia	mg/L	< 0.15
Boron	mg/L	0.038
Calcium	mg/L	4.6
Chloride	mg/L	8.4
Conductivity	µS/cm	68
Dissolved Organic Carbon	mg/L	0.6
Iron	mg/L	< 0.1
Magnesium	mg/L	1.2
Manganese	mg/L	< 0.002
Nitrate	mg/L	0.31
Nitrite	mg/L	< 0.01
Potassium	mg/L	0.58
Sodium	mg/L	6.4
Sulphate	mg/L	< 1
Total Dissolved Solids	mg/L	115
Volatile Organic Compounds (VOCs)		
1,1,1,2-Tetrachloroethane	mg/L	< 0.0002
1,1,1-Trichloroethane	mg/L	< 0.0001
1,1,2,2-Tetrachloroethane	mg/L	< 0.0002
1,1,2-Trichloroethane	mg/L	< 0.0002
1,1-Dichloroethane	mg/L	< 0.0001
1,1-Dichloroethylene	mg/L	< 0.0001
1,2-Dichlorobenzene (o)	mg/L	< 0.0002
1,2-Dichloroethane	mg/L	< 0.0002
1,3,5-Trimethylbenzene	mg/L	< 0.0002
1,3-Dichlorobenzene (m)	mg/L	< 0.0002
1,4-Dichlorobenzene (p)	mg/L	< 0.0002
1,4-Dioxane	mg/L	< 0.001
Benzene	mg/L	< 0.0001
Chlorobenzene	mg/L	< 0.0001
Chloroethane	mg/L	< 0.0002
Chloromethane	mg/L	< 0.0005
Cis-1,2-Dichloroethylene	mg/L	< 0.0001
Dichloromethane	mg/L	< 0.0005
Ethylbenzene	mg/L	< 0.0001
m+p-Xylene	mg/L	< 0.0001
o-Xylene	mg/L	< 0.0001
Styrene	mg/L	< 0.0002
Tetrachloroethylene	mg/L	< 0.0001
Toluene	mg/L	< 0.0002
Total Xylenes	mg/L	< 0.0001
Trans-1,2-dichloroethylene	mg/L	< 0.0001
Trichloroethylene	mg/L	< 0.0001
Vinyl Chloride	mg/L	< 0.0002

Reading Name	Units	2020-10-28 Groundwater Field Blank (2)
General/Inorganic Parameters		
Alkalinity	mg/L	20
Ammonia	mg/L	< 0.15
Boron	mg/L	0.023
Calcium	mg/L	4.7
Chloride	mg/L	8.9
Conductivity	µS/cm	69
Dissolved Organic Carbon	mg/L	0.5
Iron	mg/L	< 0.1
Magnesium	mg/L	1.3
Manganese	mg/L	< 0.002
Nitrate	mg/L	0.31
Nitrite	mg/L	< 0.01
Potassium	mg/L	0.58
Sodium	mg/L	6.3
Sulphate	mg/L	< 1
Total Dissolved Solids	mg/L	75
Volatile Organic Compounds (VOCs)		
1,1,1,2-Tetrachloroethane	mg/L	< 0.0002
1,1,1-Trichloroethane	mg/L	< 0.0001
1,1,2,2-Tetrachloroethane	mg/L	< 0.0002
1,1,2-Trichloroethane	mg/L	< 0.0002
1,1-Dichloroethane	mg/L	< 0.0001
1,1-Dichloroethylene	mg/L	< 0.0001
1,2-Dichlorobenzene (o)	mg/L	< 0.0002
1,2-Dichloroethane	mg/L	< 0.0002
1,3,5-Trimethylbenzene	mg/L	< 0.0002
1,3-Dichlorobenzene (m)	mg/L	< 0.0002
1,4-Dichlorobenzene (p)	mg/L	< 0.0002
1,4-Dioxane	mg/L	< 0.001
Benzene	mg/L	< 0.0001
Chlorobenzene	mg/L	< 0.0001
Chloroethane	mg/L	< 0.0002
Chloromethane	mg/L	< 0.0005
Cis-1,2-Dichloroethylene	mg/L	< 0.0001
Dichloromethane	mg/L	< 0.0005
Ethylbenzene	mg/L	< 0.0001
m+p-Xylene	mg/L	< 0.0001
o-Xylene	mg/L	< 0.0001
Styrene	mg/L	< 0.0002
Tetrachloroethylene	mg/L	< 0.0001
Toluene	mg/L	< 0.0002
Total Xylenes	mg/L	< 0.0001
Trans-1,2-dichloroethylene	mg/L	< 0.0001
Trichloroethylene	mg/L	< 0.0001
Vinyl Chloride	mg/L	< 0.0002

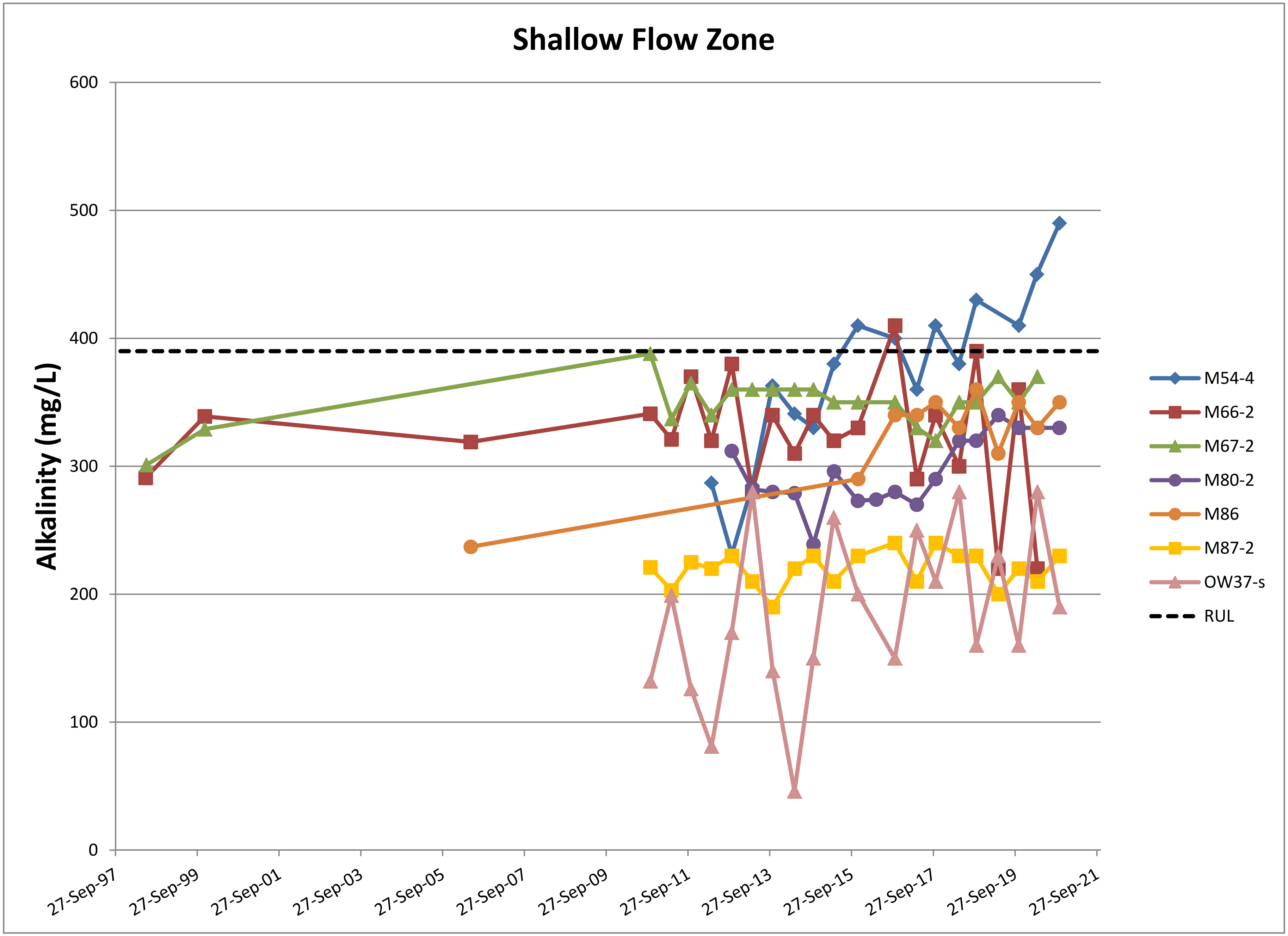
Reading Name	Units	2020-10-29 Groundwater Field Blank
General/Inorganic Parameters		
Alkalinity	mg/L	18
Ammonia	mg/L	< 0.15
Boron	mg/L	0.036
Calcium	mg/L	4.6
Chloride	mg/L	8.5
Conductivity	µS/cm	70
Dissolved Organic Carbon	mg/L	0.6
Iron	mg/L	< 0.1
Magnesium	mg/L	1.2
Manganese	mg/L	< 0.002
Nitrate	mg/L	0.29
Nitrite	mg/L	< 0.01
Potassium	mg/L	0.56
Sodium	mg/L	6.3
Sulphate	mg/L	< 1
Total Dissolved Solids	mg/L	30
Volatile Organic Compounds (VOCs)		
1,1,1,2-Tetrachloroethane	mg/L	< 0.0002
1,1,1-Trichloroethane	mg/L	< 0.0001
1,1,2,2-Tetrachloroethane	mg/L	< 0.0002
1,1,2-Trichloroethane	mg/L	< 0.0002
1,1-Dichloroethane	mg/L	< 0.0001
1,1-Dichloroethylene	mg/L	< 0.0001
1,2-Dichlorobenzene (o)	mg/L	< 0.0002
1,2-Dichloroethane	mg/L	< 0.0002
1,3,5-Trimethylbenzene	mg/L	< 0.0002
1,3-Dichlorobenzene (m)	mg/L	< 0.0002
1,4-Dichlorobenzene (p)	mg/L	< 0.0002
1,4-Dioxane	mg/L	< 0.001
Benzene	mg/L	< 0.0001
Chlorobenzene	mg/L	< 0.0001
Chloroethane	mg/L	< 0.0002
Chloromethane	mg/L	< 0.0005
Cis-1,2-Dichloroethylene	mg/L	< 0.0001
Dichloromethane	mg/L	< 0.0005
Ethylbenzene	mg/L	< 0.0001
m+p-Xylene	mg/L	< 0.0001
o-Xylene	mg/L	< 0.0001
Styrene	mg/L	< 0.0002
Tetrachloroethylene	mg/L	< 0.0001
Toluene	mg/L	< 0.0002
Total Xylenes	mg/L	< 0.0001
Trans-1,2-dichloroethylene	mg/L	< 0.0001
Trichloroethylene	mg/L	< 0.0001
Vinyl Chloride	mg/L	< 0.0002

greater than 5x RDL

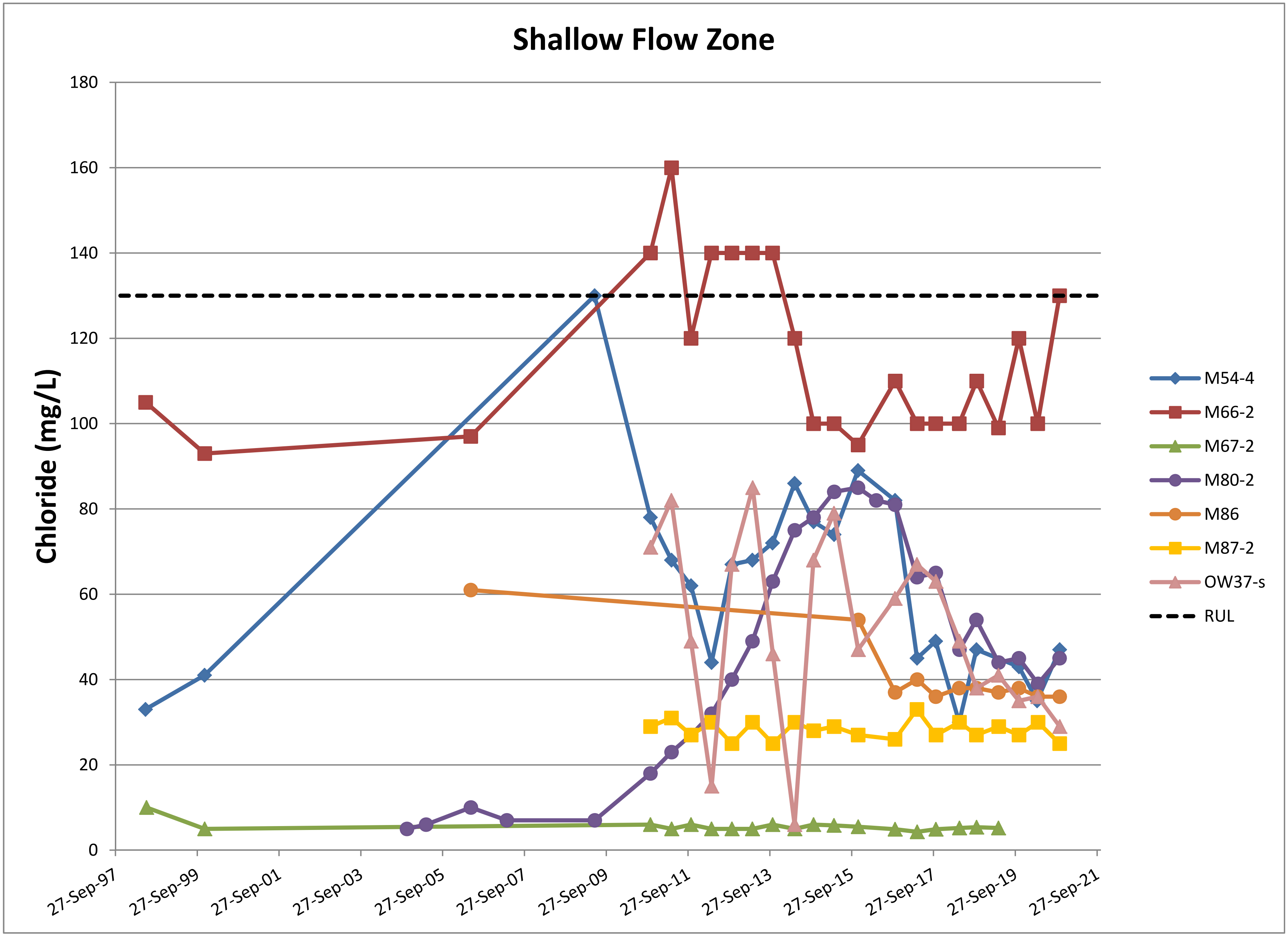
BluMetric™ Environmental

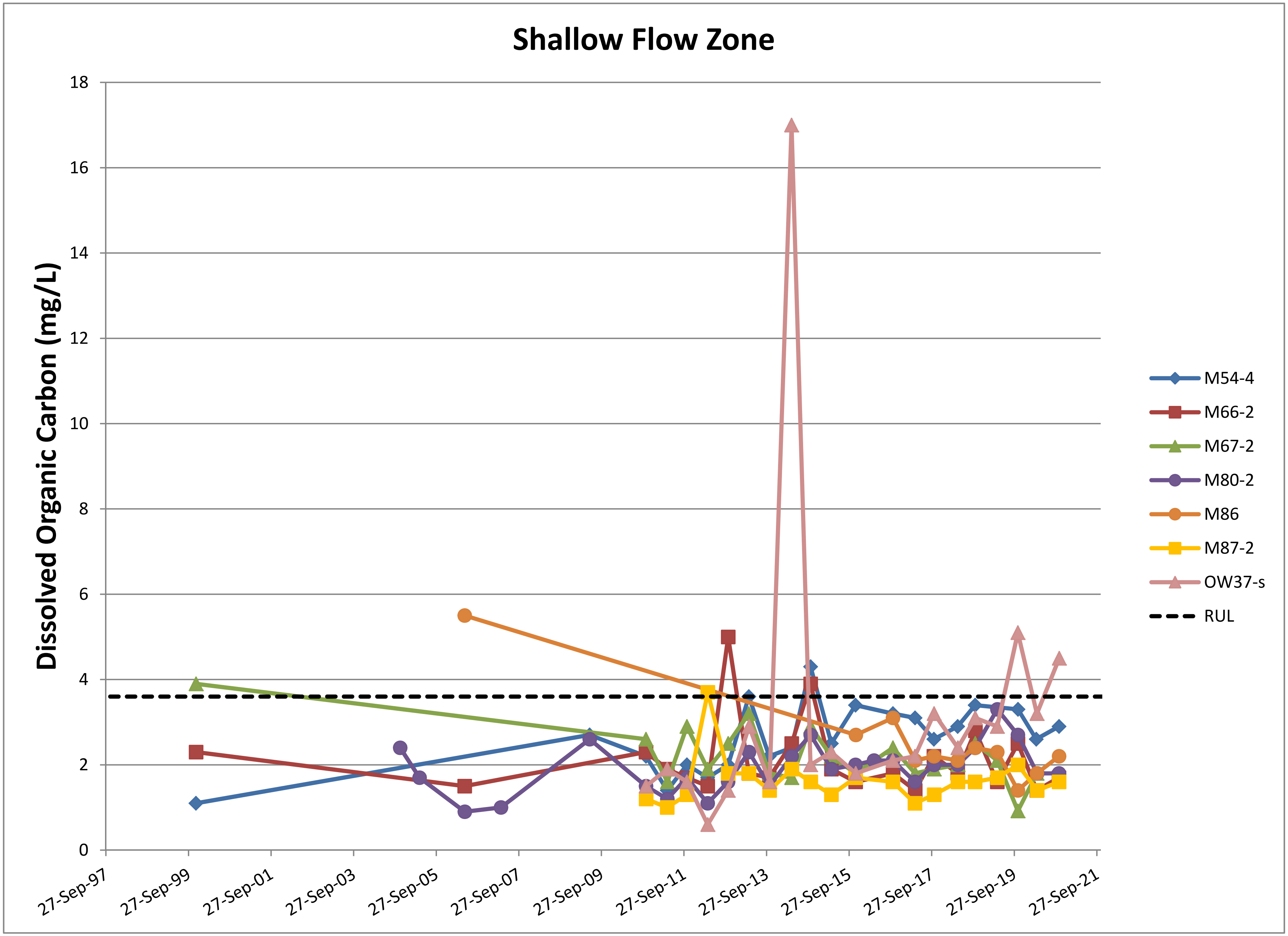
APPENDIX C

Time-Concentration Plots from Groundwater Trigger Wells

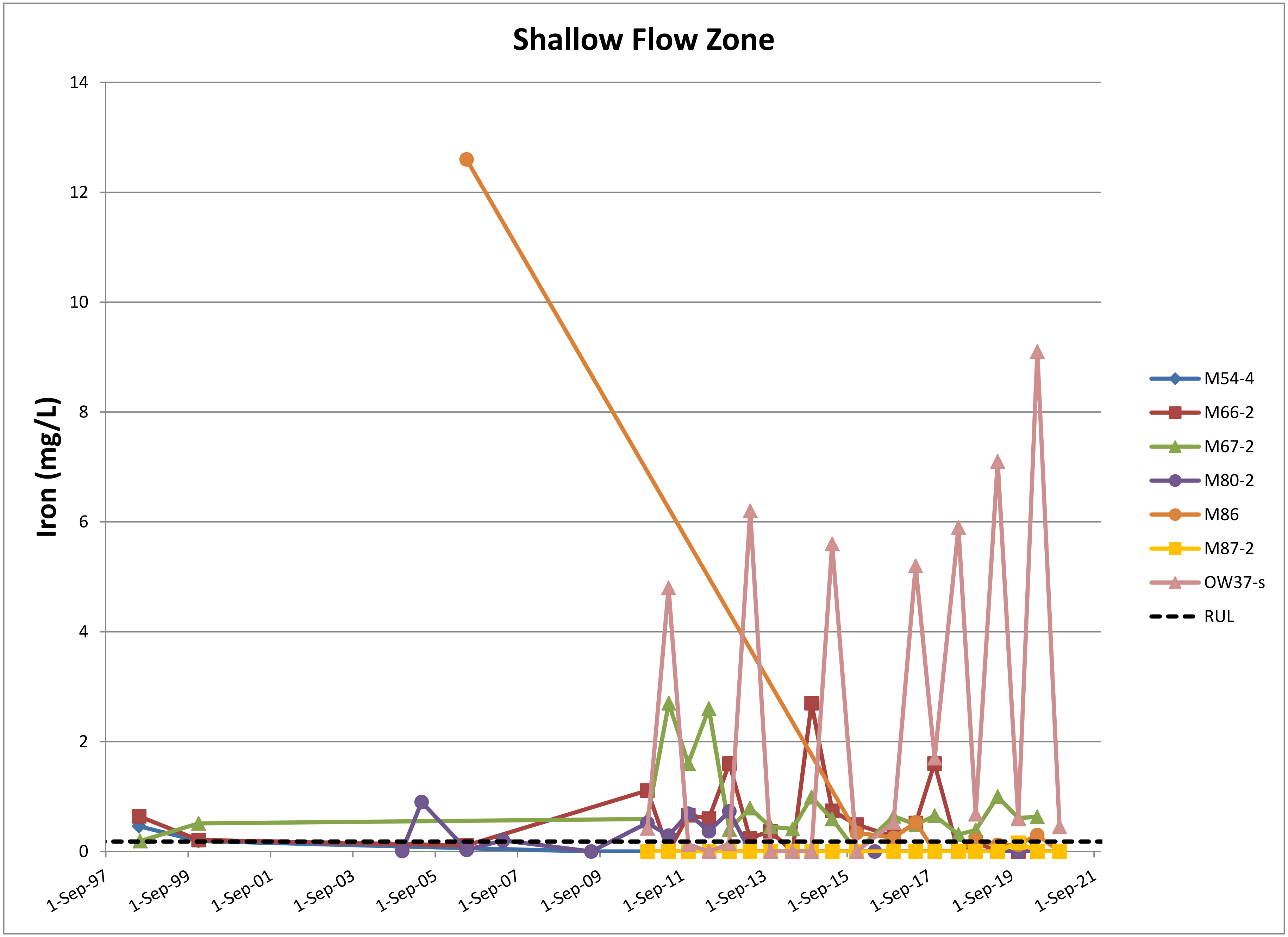


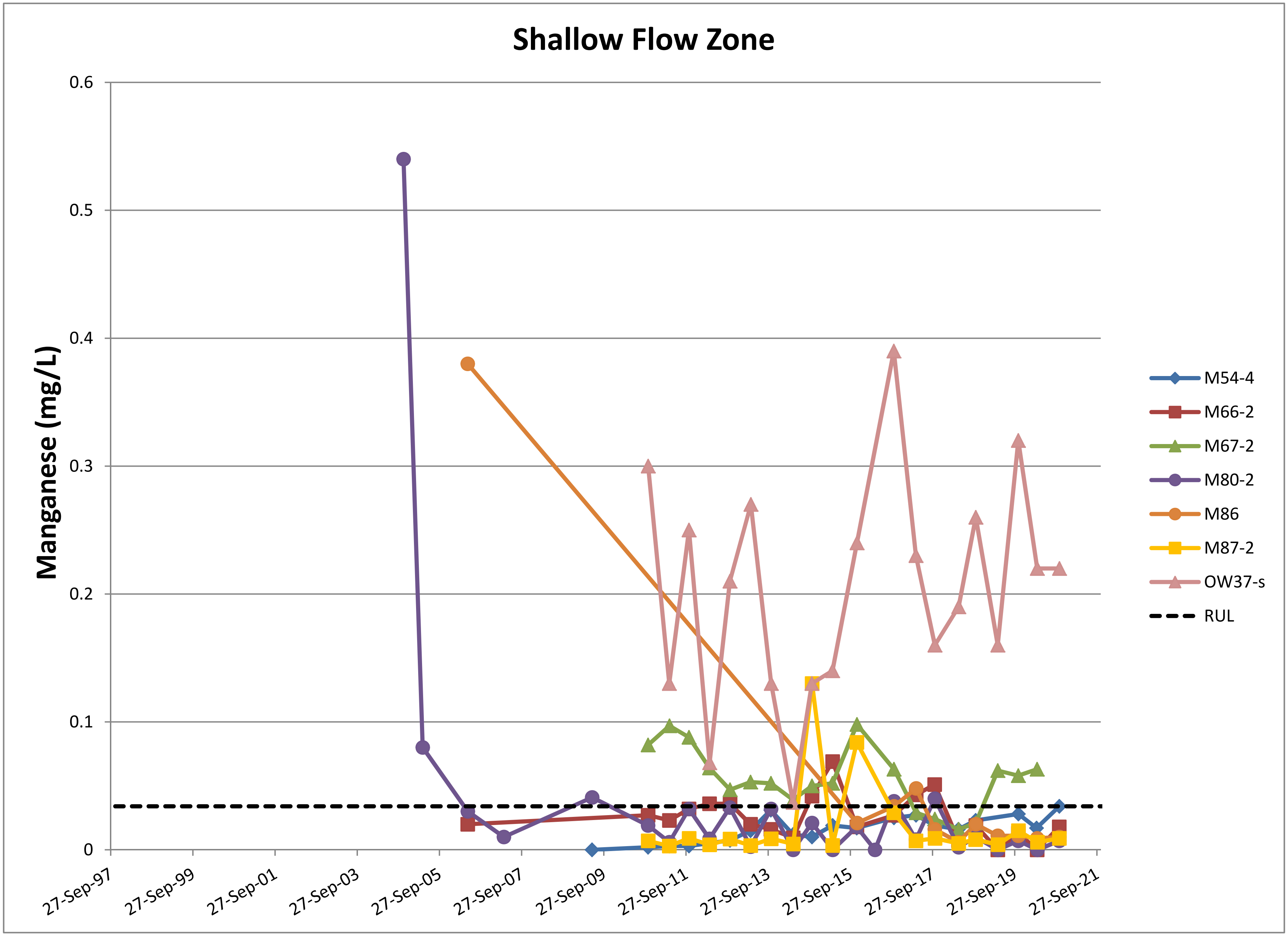
Shallow Flow Zone
Alkalinity (mg/L)
600
500
400
300
200
100
0
27-Sep-97
27-Sep-99
27-Sep-01
27-Sep-03
27-Sep-05
27-Sep-07
27-Sep-09
27-Sep-11
27-Sep-13
27-Sep-15
27-Sep-17
27-Sep-19
27-Sep-21
M54-4
M66-2
M67-2
M80-2
M86
M87-2
OW37-s
RUL

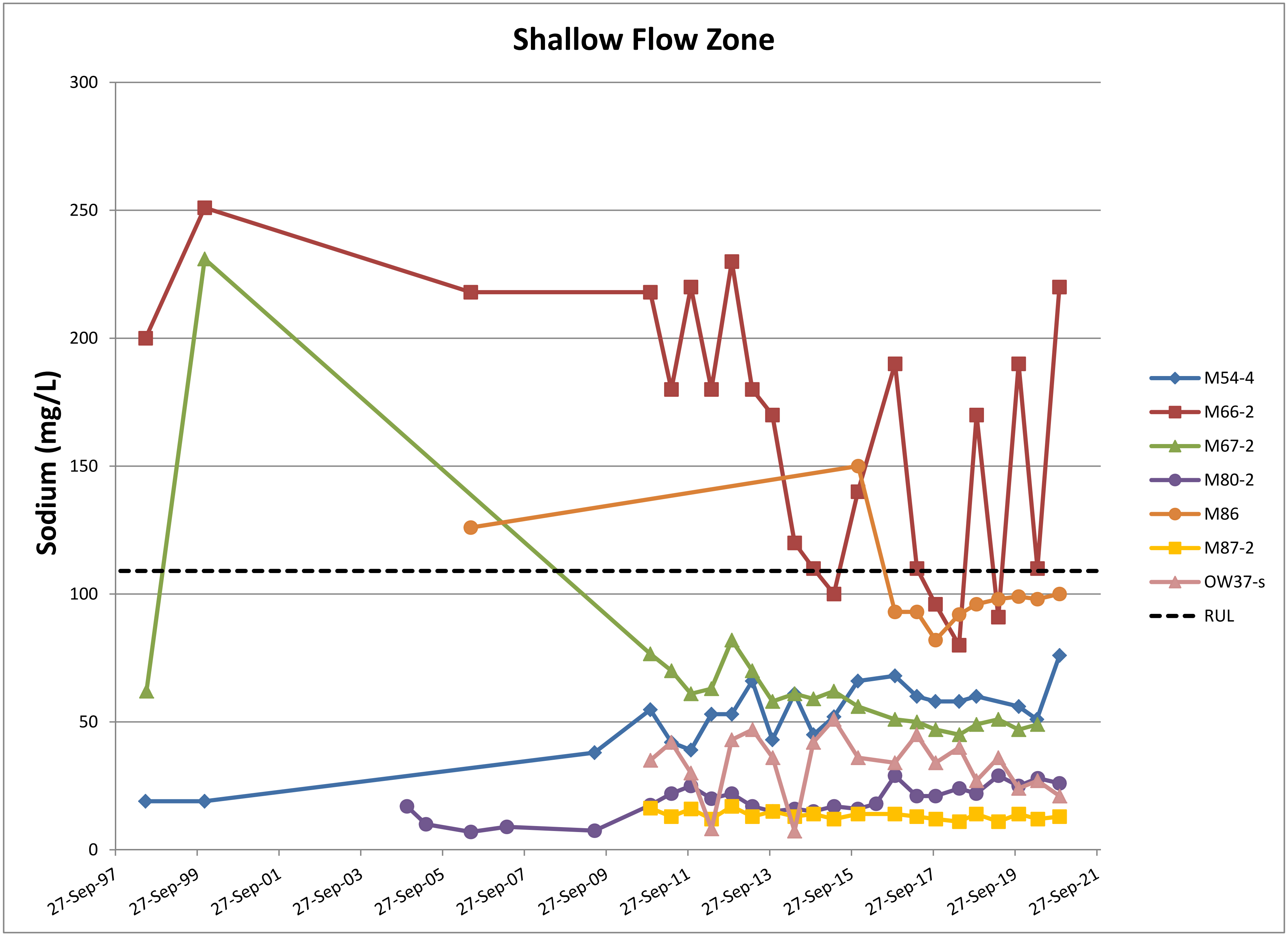

Shallow Flow Zone
Chloride (mg/L)
180
160
140
120
100
80
60
40
20
0
27-Sep-97
27-Sep-99
27-Sep-01
27-Sep-03
27-Sep-05
27-Sep-07
27-Sep-09
27-Sep-11
27-Sep-13
27-Sep-15
27-Sep-17
27-Sep-19
27-Sep-21
M54-4
M66-2
M67-2
M80-2
M86
M87-2
OW37-s
RUL



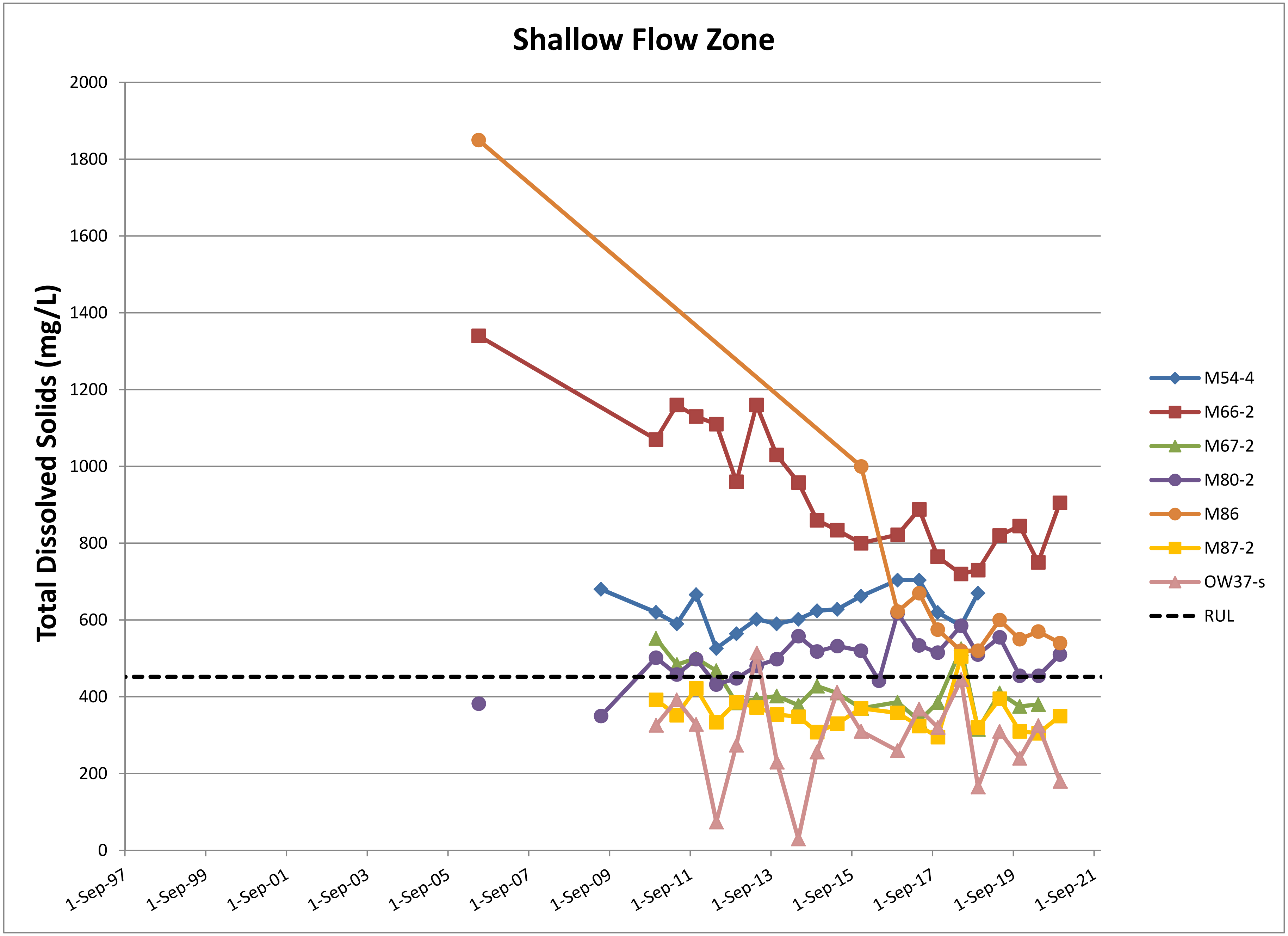
Shallow Flow Zone
Dissolved Organic Carbon (mg/L)
0
2
4
6
8
10
12
14
16
18
27-Sep-97
27-Sep-99
27-Sep-01
27-Sep-03
27-Sep-05
27-Sep-07
27-Sep-09
27-Sep-11
27-Sep-13
27-Sep-15
27-Sep-17
27-Sep-19
27-Sep-21
M54-4
M66-2
M67-2
M80-2
M86
M87-2
OW37-s
RUL


Shallow Flow Zone
Iron (mg/L)
14
12
10
8
6
4
2
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
1-Sep-19
1-Sep-21
M54-4
M66-2
M67-2
M80-2
M86
M87-2
OW37-s
RUL

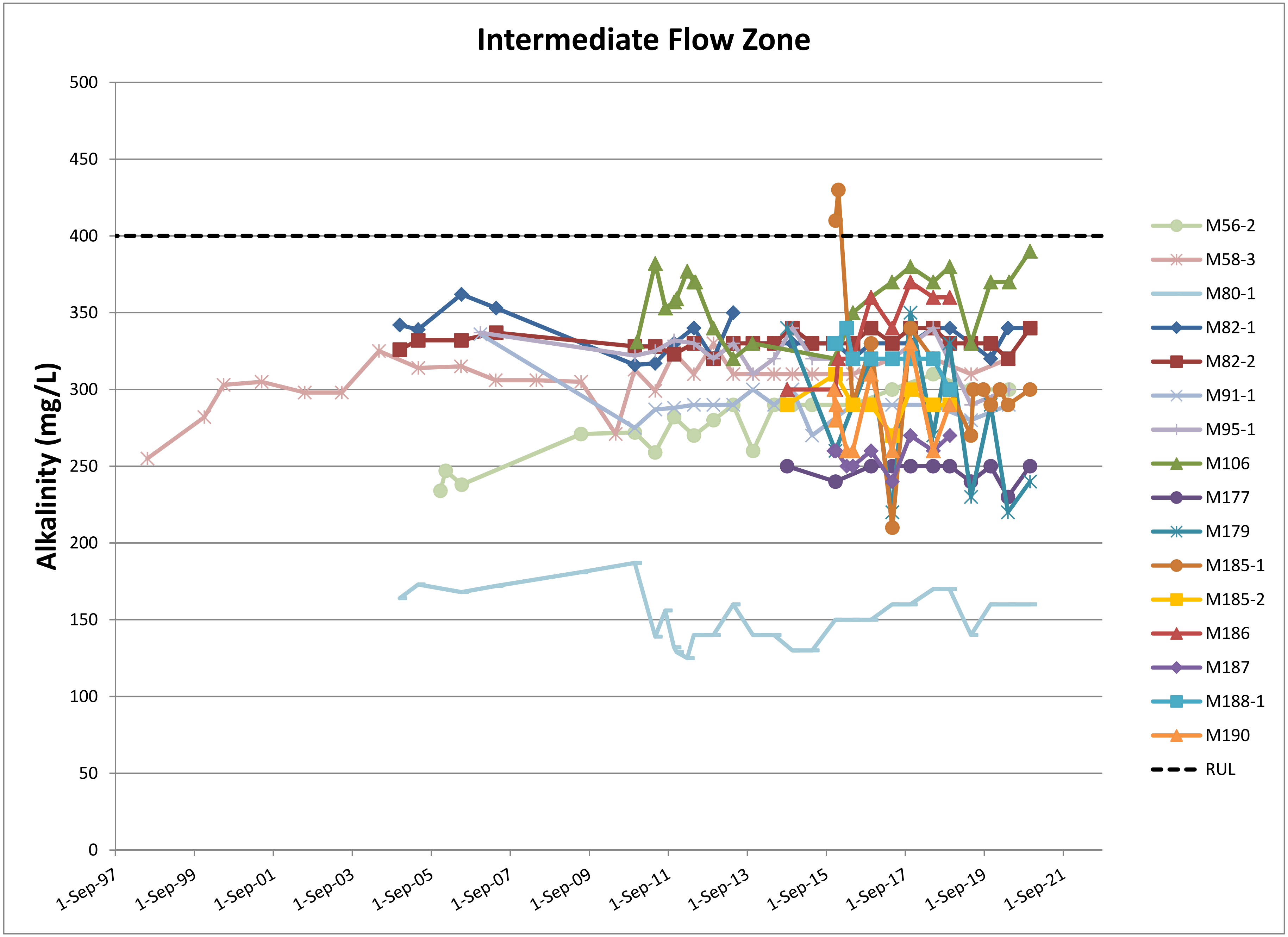

Shallow Flow Zone
Manganese (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
27-Sep-97
27-Sep-99
27-Sep-01
27-Sep-03
27-Sep-05
27-Sep-07
27-Sep-09
27-Sep-11
27-Sep-13
27-Sep-15
27-Sep-17
27-Sep-19
27-Sep-21
M54-4
M66-2
M67-2
M80-2
M86
M87-2
OW37-s
RUL

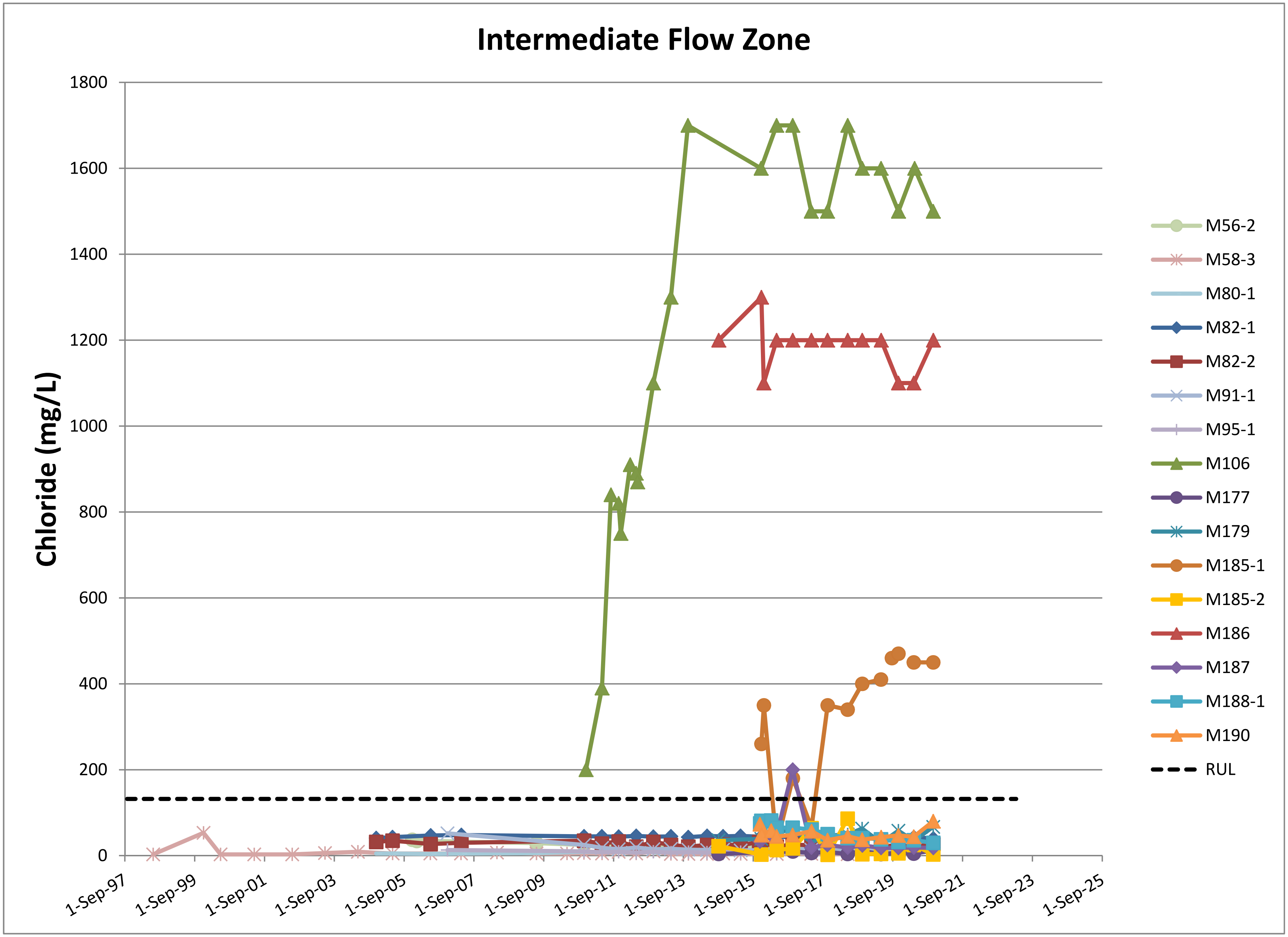


Shallow Flow Zone
Sodium (mg/L)
300
250
200
150
100
50
0
27-Sep-97
27-Sep-99
27-Sep-01
27-Sep-03
27-Sep-05
27-Sep-07
27-Sep-09
27-Sep-11
27-Sep-13
27-Sep-15
27-Sep-17
27-Sep-19
27-Sep-21
M54-4
M66-2
M67-2
M80-2
M86
M87-2
OW37-s
RUL

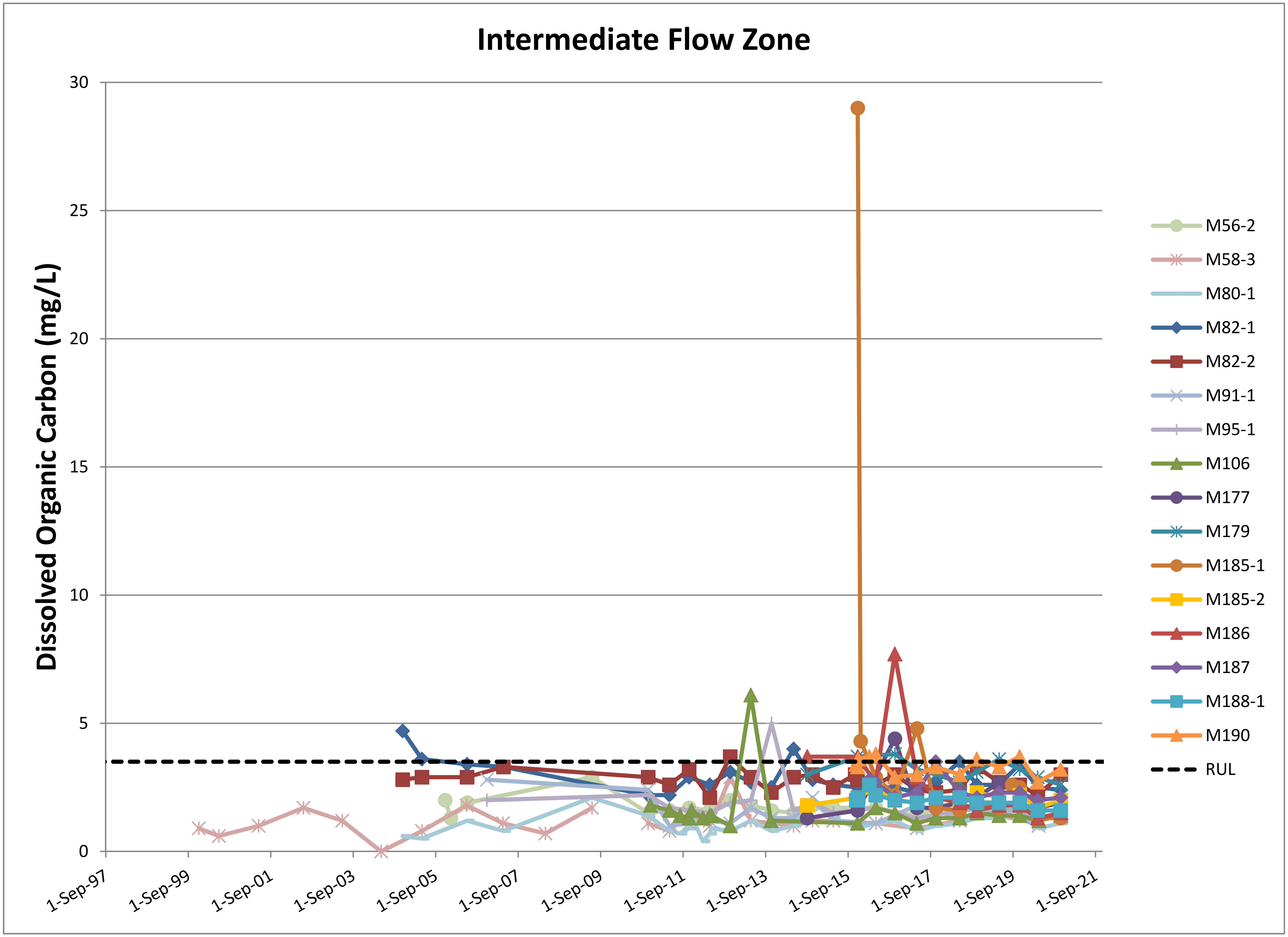


Shallow Flow Zone
Total Dissolved Solids (mg/L)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
1-Sep-19
1-Sep-21
M54-4
M66-2
M67-2
M80-2
M86
M87-2
OW37-s
RUL


Intermediate Flow Zone
Alkalinity (mg/L)
500
450
400
350
300
250
200
150
100
50
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
1-Sep-19
1-Sep-21
M56-2
M58-3
M80-1
M82-1
M82-2
M91-1
M95-1
M106
M177
M179
M185-1
M185-2
M186
M187
M188-1
M190
RUL



Intermediate Flow Zone
Chloride (mg/L)
0
200
400
600
800
1000
1200
1400
1600
1800
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
1-Sep-19
1-Sep-21
1-Sep-23
1-Sep-25
M56-2
M58-3
M80-1
M82-1
M82-2
M91-1
M95-1
M106
M177
M179
M185-1
M185-2
M186
M187
M188-1
M190
RUL



Intermediate Flow Zone
Dissolved Organic Carbon (mg/L)
30
25
20
15
10
5
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
1-Sep-19
1-Sep-21
M56-2
M58-3
M80-1
M82-1
M82-2
M91-1
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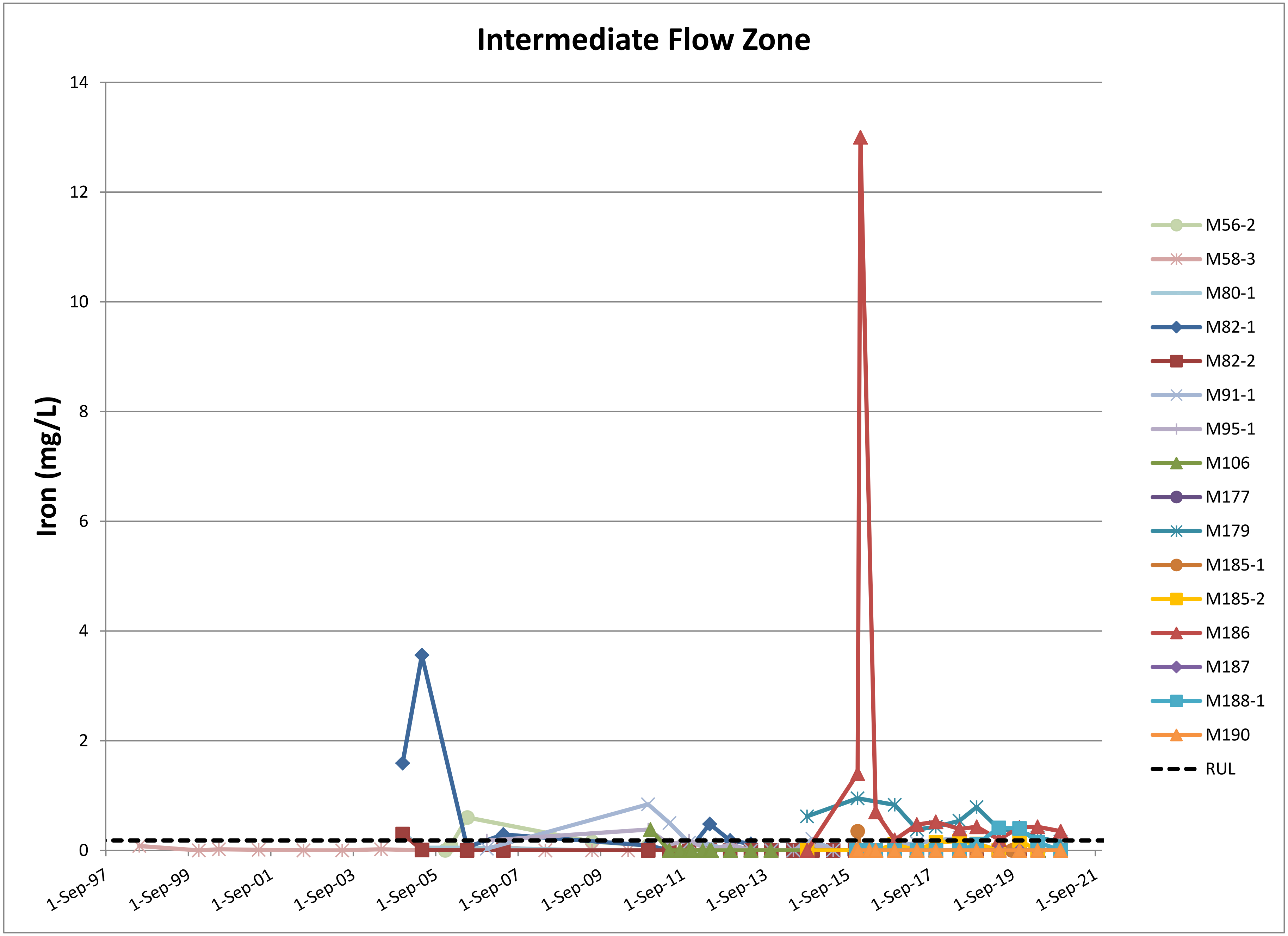
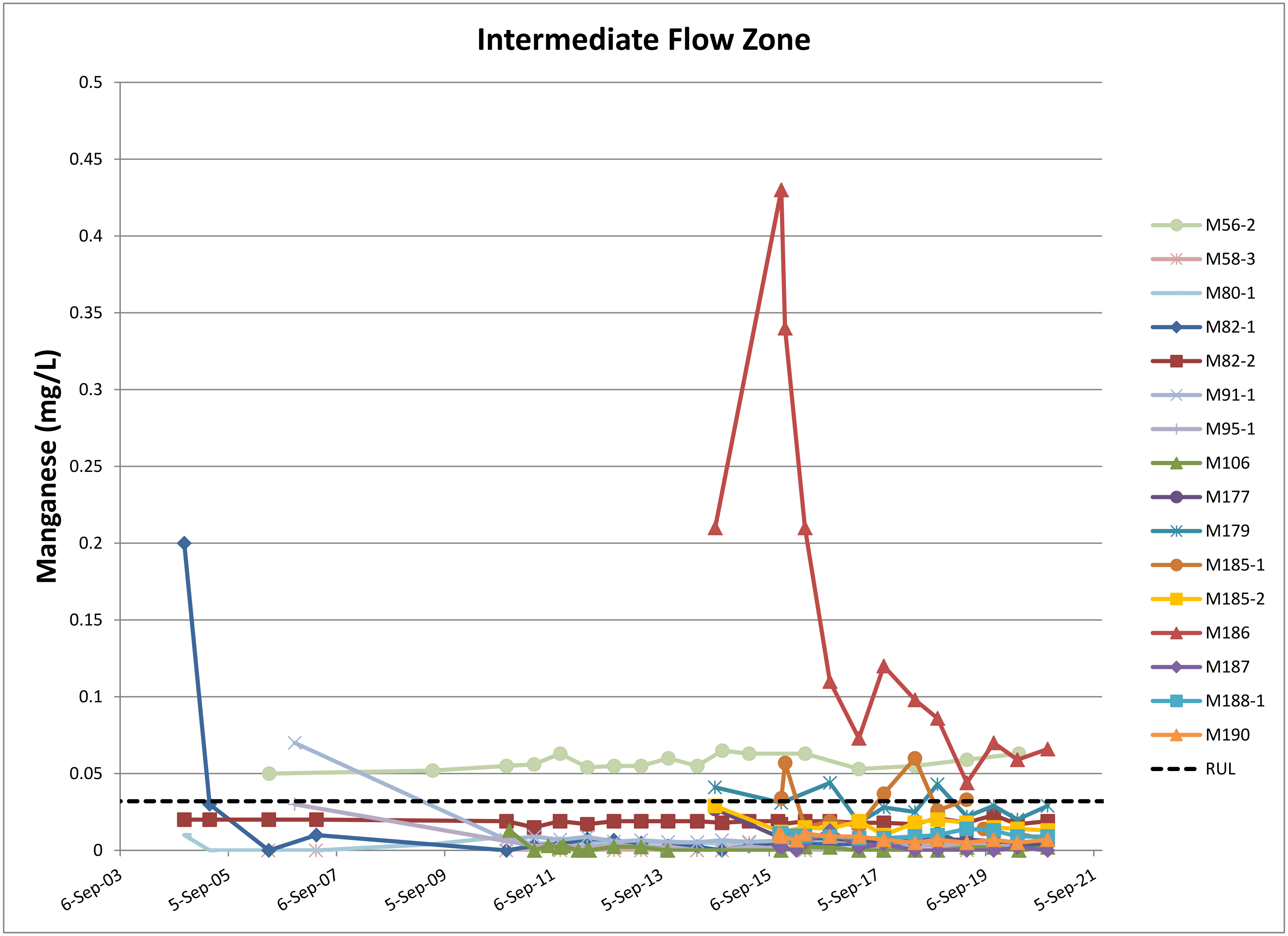
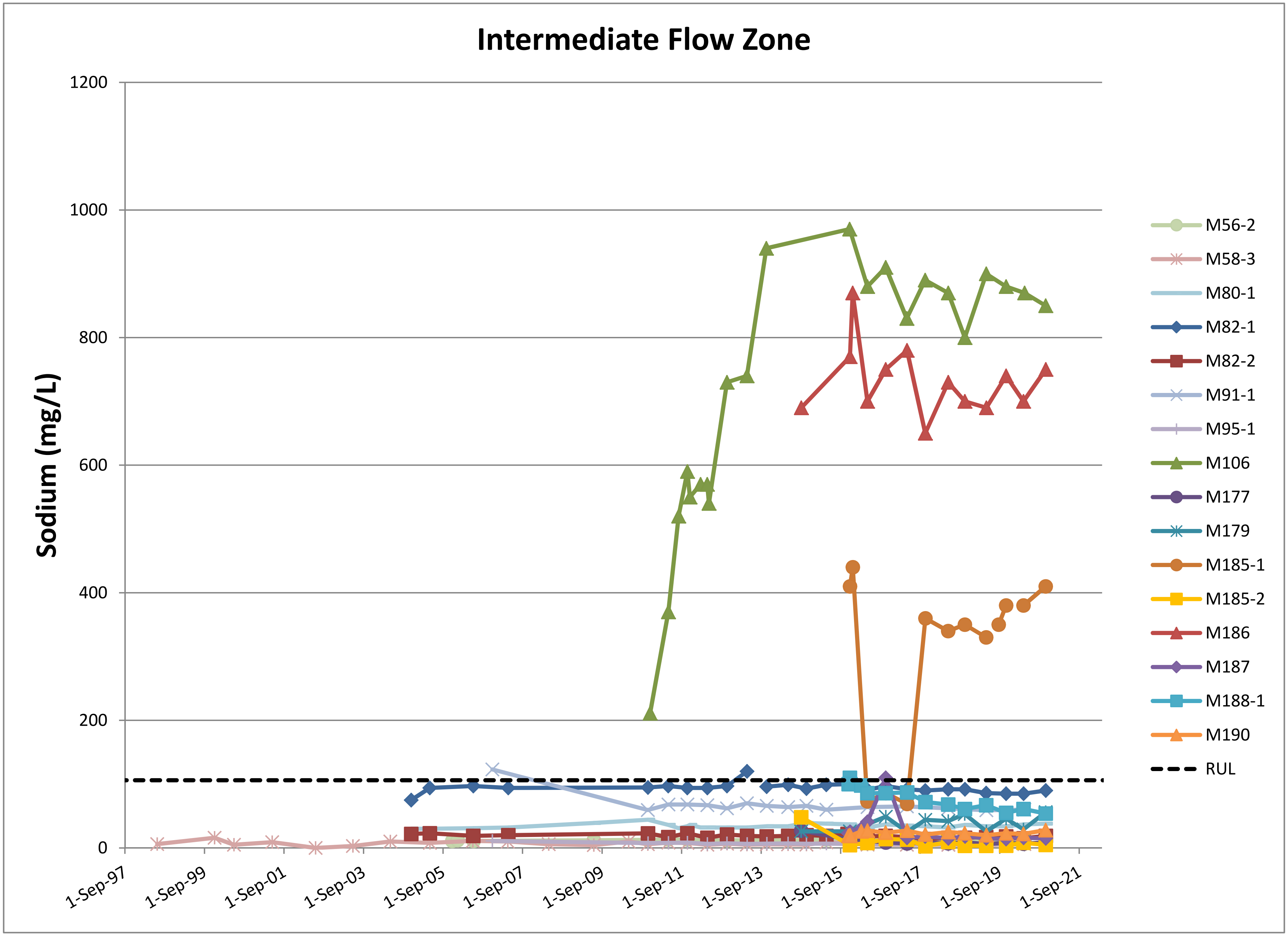
M106
M177
M179
M185-1
M185-2
M186
M187
M188-1
M190
RUL



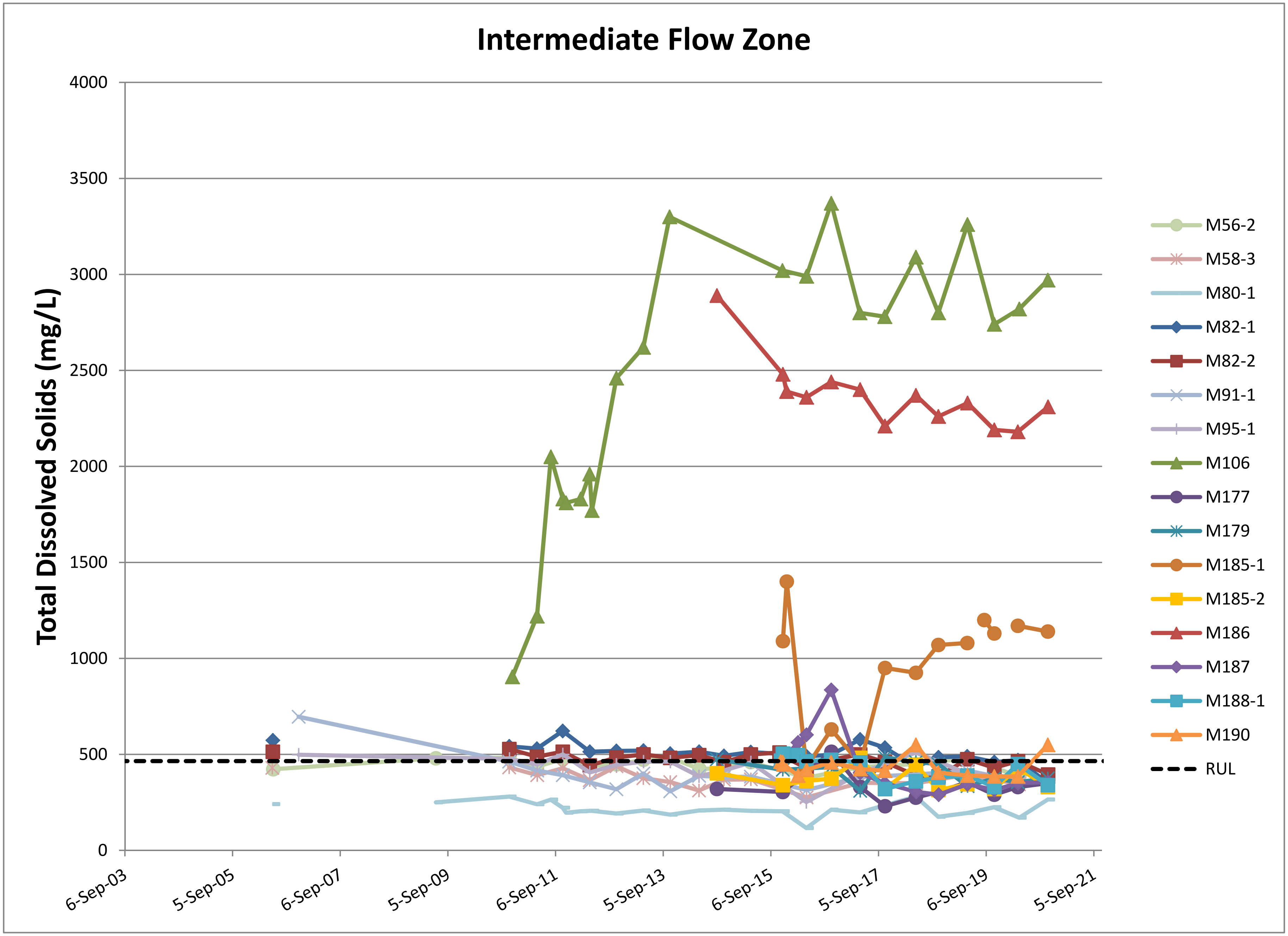
Intermediate Flow Zone
Iron (mg/L)
14
12
10
8
6
4
2
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
1-Sep-19
1-Sep-21
M56-2
M58-3
M80-1
M82-1
M82-2
M91-1
M95-1
M106
M177
M179
M185-1
M185-2
M186
M187
M188-1
M190
RUL



Intermediate Flow Zone
Manganese (mg/L)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
6-Sep-03
5-Sep-05
6-Sep-07
5-Sep-09
6-Sep-11
5-Sep-13
6-Sep-15
5-Sep-17
6-Sep-19
5-Sep-21
M56-2
M58-3
M80-1
M82-1
M82-2
M91-1
M95-1
M106
M177
M179
M185-1
M185-2
M186
M187
M188-1
M190
RUL

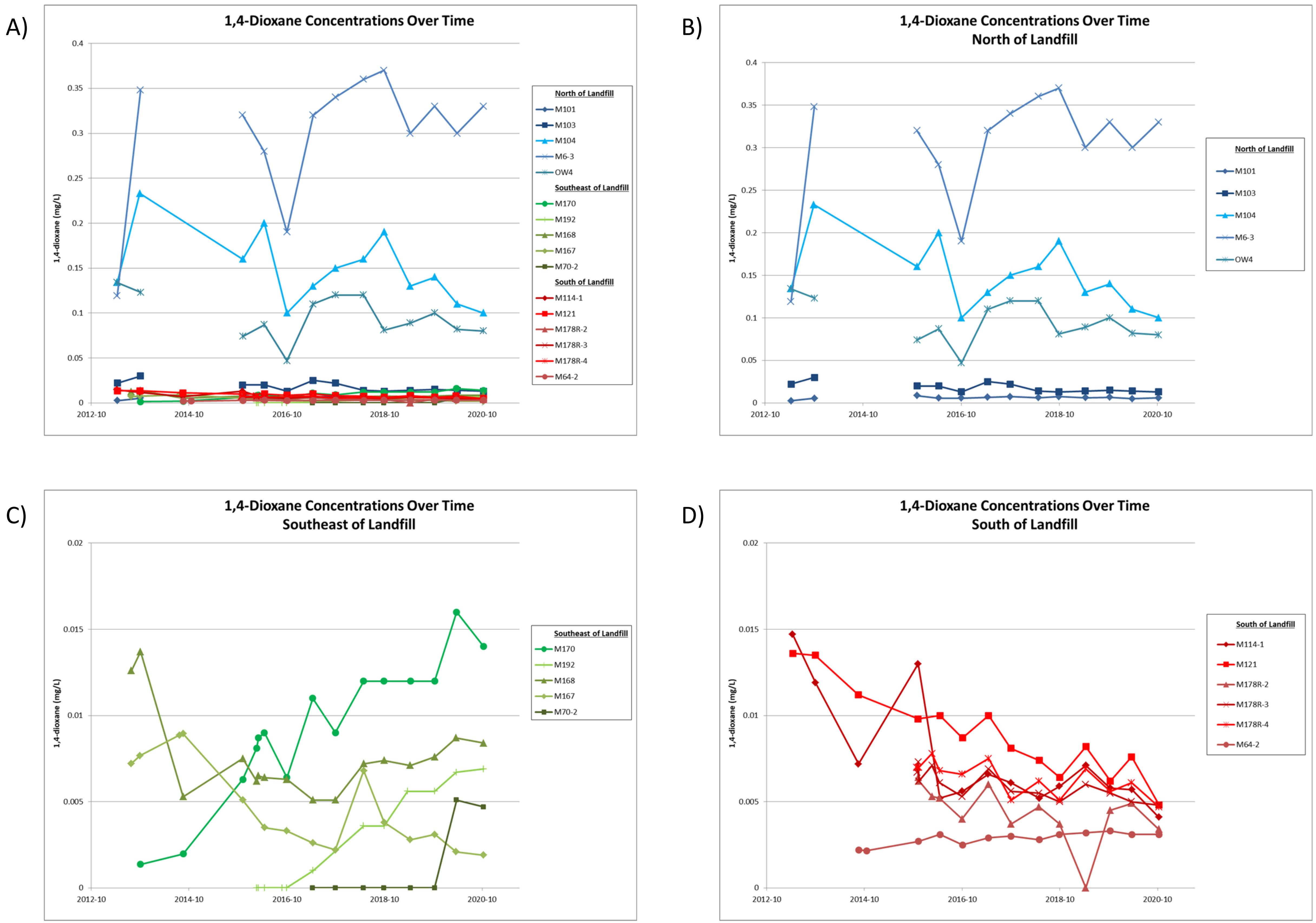


Intermediate Flow Zone
Sodium (mg/L)
1200
1000
800
600
400
200
0
1-Sep-97
1-Sep-99
1-Sep-01
1-Sep-03
1-Sep-05
1-Sep-07
1-Sep-09
1-Sep-11
1-Sep-13
1-Sep-15
1-Sep-17
1-Sep-19
1-Sep-21
M56-2
M58-3
M80-1
M82-1
M82-2
M91-1
M95-1
M106
M177
M179
M185-1
M185-2
M186
M187
M188-1
M190
RUL


Intermediate Flow Zone
Total Dissolved Solids (mg/L)
4000
3500
3000
2500
2000
1500
1000
500
0
6-Sep-03
5-Sep-05
6-Sep-07
5-Sep-09
6-Sep-11
5-Sep-13
6-Sep-15
5-Sep-17
6-Sep-19
5-Sep-21
M56-2
M58-3
M80-1
M82-1
M82-2
M91-1
M95-1
M106
M177
M179
M185-1
M185-2
M186
M187
M188-1
M190
RUL

APPENDIX D

Time-Concentration Plots for 1,4-Dioxane at Selected Wells



A)
1,4-Dioxane Concentrations Over Time
1,4-dioxane (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2012-10
2014-10
2016-10
2018-10
2020-10
North of Landfill
M101
M103
M104
M6-3
OW4
Southeast of Landfill
M170
M192
M168
M167
M70-2
South of Landfill
M114-1
M121
M178R-2
M178R-3
M178R-4
M64-2
B)
1,4-Dioxane Concentrations Over Time
North of Landfill
1,4-dioxane (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2012-10
2014-10
2016-10
2018-10
2020-10
North of Landfill
M101
M103
M104
M6-3
OW4
C)
1,4-Dioxane Concentrations Over Time
Southeast of Landfill
1,4-dioxane (mg/L)
0.02
0.015
0.01
0.005
0
2012-10
2014-10
2016-10
2018-10
2020-10
Southeast of Landfill
M170
M192
M168
M167
M70-2
D)
1,4-Dioxane Concentrations Over Time
South of Landfill
1,4-dioxane (mg/L)
0.02
0.015
0.01
0.005
0
2012-10
2014-10
2016-10
2018-10
2020-10
South of Landfill
M114-1
M121
M178R-2
M178R-3
M178R-4
M64-2

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